WATER PROJECT GRANTS AND LOANS

GRANT APPLICATION

I. Project Information

Project Name: Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities Project

Project Type: ☐ Conservation ☒ Reuse ☐ Flow Restoration and Protection
☐ Above-Ground Storage ☐ Below-Ground Storage
☒ Water Infrastructure ☒ Other: Existing In-Ground Storage Modification

Grant Funding Requested (must be no more than 75% of Total Cost of Project): $ 583,925

Match Funding (must be no less than 25% of Total Project Cost): $ 6,026,211

Total Cost of Project: $ 6,610,136

II. Applicant Information

Applicant Name: Metropolitan Wastewater Management Commission	**Co-Applicant Name:**
Address: 225 Fifth Street	Address:
Springfield, OR 97477	
Phone: 541-726-3694	Phone:
Fax: 541-726-2309	Fax:
Email: mwmcpartners@springfield-or.gov	Email:

Principle Contact: Todd Miller, City of Springfield Environmental Services Supervisor	**Fiscal Officer: Valerie Warner, City of Springfield**
Address: 225 Fifth Street	Address: 225 Fifth Street
Springfield, OR 97477	Springfield, OR 97477
Phone: 541-736-7137	Phone: 541-726-3740
Fax: 541-726-2309	Fax: 541-726-2309
Email: tmiller@springfield-or.gov	Email: vwarner@springfield-or.gov

Certification: I certify that this application is a true and accurate representation of the proposed work and that I am authorized to sign as the Applicant or Co-Applicant. By the following signature, the Applicant and Co-Applicant (if applicable) certify that they are aware of the requirements of an Oregon Water Resources Department funding award, have read and are aware of conditions within the example grant agreement on the Department's website and are prepared to implement the project, if awarded.

Signature of Applicant/Authorized Person: Matt Stouder Date: 4/28/2021

Print Name: Matt Stouder Title: Environmental Services Director & MWMC Executive Officer

Signature of Co-Applicant/Authorized Person: N/A Date: _____

III. Eligibility

Select applicant entity type for both applicant and co-applicant (if applicable).

☐	City		☐	Oregon County
☐	Port		☐	Irrigation District
☐	Drainage District		☐	Water Improvement District
☐	Water Control District		☐	Non-Profit Organization
☐	Soil and Water Conservation District		☐	Corporation
☐	Partnership		☐	Sole Proprietorship
☐	Cooperative		☐	Indian tribe
☐	State of Oregon Agency		☐	Individual
☐	Federal Agency		☒	Other: Intergovernmental Agency

To be eligible for funding a project must address an instream and/or out-of-stream water supply need and result in project implementation. Does the project address an instream and/or out-of-stream water supply need and result in project implementation? ☒Yes ☐No

Provide a brief, one to two paragraph description of the water supply need that the project intends to address. Please reference (and attach) supporting data or reports that document the need.

This project will provide Delta Sand & Gravel, a water rights holder junior to instream flow rights on the Willamette River, with fully substitutable Class A recycled water which will reduce demand on Willamette River flows, especially during drought conditions, and maintain more freshwater in the river (See attached water rights certificates). The project will also alleviate demands on finished McKenzie River drinking water for irrigation by supplying recycled water for urban parks and street tree watering and for public landscaping irrigation at the wastewater treatment facility. The project will initially provide 0.65 to 1.3 million gallons per day (1.0 to 2.0 cfs) of total use. This project will launch community recycled water for expansion over the next decade of up to 7-10 million gallons per day to provide resiliency against drought and provide economic growth opportunities.

Is either the Applicant or Co-Applicant required to have a Water Management and Conservation Plan?
☐Yes ☒No
(Note: EWEB's WMCP, Attachment #8, references the project; MWMC is not required to have a WMCP)

If yes, has the plan been submitted to the Water Resources Department and received approval?
☐Yes ☐No (NOTE: EWEB's WMCP is approved)

Note: Pursuant to ORS 541.659 if an applicant is required to have a water management and conservation plan, the plan must be submitted to the Water Resources Department and receive approval prior to department acceptance of an application for a loan or grant from the account.

IV. Project Summary

Provide a brief, 4-5 sentence summary of the proposed project. This summary should include a brief description of the goal and scope of the project as well as summarize project implementation (i.e., planned infrastructure or activity). Please refer to the Water Project Grants and Loans Application Instructions for additional information on what to include in your project summary.

The project will launch public recycled water use in the Eugene/Springfield community. New Class A recycled water distribution facilities at the MWMC's wastewater treatment plant will include 1.3 million gallon per day (mgd) total pumping capacity, 1 million gallons of seasonal storage capacity, and connection to a 3.5 mgd capacity pipeline to construction aggregate partners (Delta Sand & Gravel and Knife River) who currently rely on river water withdrawals. Onsite services at the MWMC's treatment plant will include new connections to irrigation systems for 100% recycled water irrigation across 28 acres and a self-service tanker truck fill station for authorized users to fill irrigation trucks to water street trees throughout Eugene. Initial summertime recycled water uses of 0.65 mgd will divert treated wastewater from river discharge to beneficial use and reduce temperature impacts on the Willamette River's salmon rearing and spawning habitat and retain more instream flows in the Willamette and McKenzie Rivers through reduction on water withdrawals.

V. Project Location

Instructions: Please answer the following questions about the location of the proposed project.

1. Please provide the following information about the project location.
    a. Latitude/Longitude (in decimal degrees): 44.09527778 / 123.11194444
    b. County: Lane
    c. Watershed/Basin: Upper Willamette Basin (HUC 17090003)

2. Please attach and label, Attachment #1, a site plan map showing the following (✓ when complete):
    a. ☒ Project area boundaries
    b. ☒ True north arrow
    c. ☒ Map title and legend
    d. ☒ Latitude and longitude of project location
    e. ☒ Property boundaries
    f. ☒ Tax Map and Lot numbers of each property in project area boundary and listed in Question #3. Use the same Tax Lot No. on the map as is used in Question #3.
    g. ☒ Surface water bodies
    h. ☒ Location of involved structures (existing or proposed)
    i. ☒ Point of Diversion and Place of Use associated with the project (if applicable)
    j. ☐ Proposed measurement locations (if applicable)

3. In the table below, identify any properties which project implementation impacts, indicate the types of activities that would occur on that site, and include a landowner agreement form and map for each property. *Add rows as needed.*

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type (✓ One)**	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation? (✓ all that apply)**	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Landowner Agreement Form Attached (✓ when complete)**
17041300	203, 300, 301, 302, 400, 500, 600, 800, 801, 900, 901	☒Public ☐Private	MWMC	☒ Access site ☒ Project work ☒Ground disturbing activity (301/302 only) ☐Other impact: _____	Excavation, trenching, and construction, and piping/conduits.	☐
17041313	100, 200, 300	☒Public ☐Private	MWMC	☒ Access site ☒ Project work ☐Ground disturbing activity ☐Other impact: _____	Construction and water user access; irrigation	☐
17041321	1100, 1200, 1300, 1400	☒Public ☐Private	MWMC	☒ Access site ☒ Project work ☐Ground disturbing activity ☐Other impact: _____	Construction and water user access; irrigation	☐
17041324	100	☒Public ☐Private	MWMC	☒ Access site ☒ Project work ☐Ground disturbing activity ☐Other impact: _____	Construction and water user access; irrigation	☐
17031800	602	☒Public ☐Private	EWEB	☒ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: _____	Excavation and piping	☐
17031800	600	☐Public ☒Private	Delta Sand & Gravel	☒ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: _____	Excavation and piping	☐

4. For **each** property listed in Question #3, attach a Landowner Agreement Form. Attach Landowner Agreement form(s) and label Attachment #2.
    a. Where a single landowner entity is the owner of record for multiple properties, one form may list the multiple properties owned by that entity.
    b. For *public* lands attach the landowner form or other documented authorization from the federal or state government property owner allowing project implementation **or** documentation that demonstrates such authorization is being pursued.

VI. Project Specifics

Instructions: Please answer the following questions.

Project Description, Needs, and Goals

5. Provide additional information (building on the project summary) to further describe the proposed project and the project goal.

The primary purpose of this project is to launch long-term, reliable, Class A recycled water use in the Eugene/Springfield community. Class A recycled water is the highest quality of recycled water under Oregon rules and is suitable for virtually any non-drinking water use, and is therefore a valuable water supply resource. The project relies on upgrades to the MWMC's facilities to produce Class A quality water; after treatment this project provides new storage, pumping, and distribution infrastructure for use at construction aggregate facilities and public greenspace. This new water source will achieve multiple water resource benefits, including (1) reduction of thermal load and nutrients from discharges to the Willamette River, (2) securing of an industrial water source during times of drought to ensure local aggregate and construction needs are met, (3) conserving drinking water resources by irrigating public greenspaces with recycled water, and (4) maintaining freshwater flows in the Willamette and McKenzie Rivers by reducing withdrawals for needs met by recycled water.

6. Provide a summary of evidence to demonstrate project feasibility. This summary may include the results of a feasibility study. Attach the results of the study or other evidence, as necessary to support the summary.

Recycled water use feasibility for construction aggregate has been determined in the MWMC's *Industrial Aggregate Recycled Water Use Feasibility Study* (June 2013; Attachment # 11) supported OWRD grant funding. That study identified the need to produce Class A recycled water at a demonstration scale (this project) to prove adoptability to more large-scale use. The feasibility of Class A recycled water production was studied, and recommendations for design needs were made, under the MWMC's *Conceptual Design Report – Class A Recycled Water Facilities* (Kennedy Jenks Consultants, February 2021; Attachment #6).

7. Describe partnerships and collaborative efforts associated with the planning or implementation of this project. Include a description of how parties of diverse interests worked, or will work together to achieve a common goal.

This project is made possible by over a decade of discussion and collaboration between the MWMC (itself a partnership of the Cities of Eugene and Springfield and Lane County) and our construction aggregate partners at Delta Sand & Gravel and Knife River, as well as Eugene's Parks & Open Space Division and Eugene Water & Electric Board (EWEB). The seeds of this partnership started prior to all of the current personnel engaged from every organization in seeing this vision through to reality. Multiple stakeholders have been interviewed over the past years and involved in steering the direction of developing community recycled water use that provides the best overall benefits to the community, the environment, and the partners. Stakeholder interviews were documented in internal and consultant reports and guided the identification of these initial Class A recycled water uses for the community.

8. List letters of support (name and/or affiliation of sender is sufficient). Attach copies of the letters to your application.

The MWMC has letters of intent (Attachment #5) to use the MWMC's Class A recycled water from Delta Sand & Gravel, Knife River, and Eugene Parks & Open Space. Additional letters of support for this project from City of Springfield Environmental Services Division, Lane County Public Works Department, and EWEB are included in Attachment #5.

Project Tasks

9. Identify tasks necessary for the proposed project using the following format and including as many tasks as necessary to implement the project. In the event that your proposed project receives grant funding, the tasks identified will be incorporated into your grant agreement as the "Project Description."

   Note: Project management and administration are common functions within specified project tasks and not a separate project task. All cost match and grant budget funds must apply to the tasks identified below. See the Budget Procedures and Allowable Costs document for more.

   For each Task address the following:

   Task number. Key Task Title
   - Task schedule: The approximate dates during which the key task will be completed.
   - Description of key task activities: Include specific details of the task such as task purpose, planned approach, and proposed methods.
   - Permits/Regulatory Approvals Required: List any permits or regulatory approvals required to conduct the task. All permits/regulatory approvals identified must also be listed in question 15 of this application.

Task 1. Engineering Design

- Task schedule: 2/12/21-3/1/22 (12 months)
- Description of key task activities: The consulting engineer (Kennedy Jenks) will iteratively develop of 30%, 60%, 90% and 100% design for all infrastructure; this process will include permit and regulatory compliance review and consultations as necessary for Conditional Use Plan alignment, City of Eugene building permitting, and NEPA analysis.
- Permits/Regulatory Approvals Required: Conditional Use Plan alignment review/concurrence before 100% design.

Task 2. Contracting and Permitting

- Task schedule: 3/2/22-8/11/22 (5 months)
- Description of key task activities: Preparation and solicitation of bid documents, award of construction contract, and securing of City of Eugene building permit and NEPA assessments.
- Permits/Regulatory Approvals Required: None

Task 3. Disinfection Facilities Construction

- Task schedule: 8/12/22-6/24/23 (10 months)
- Description of key task activities: Construction of filter pumps, ultraviolet (UV) light disinfection channel, and associated electrical and instrumentation.
- Permits/Regulatory Approvals Required: City of Eugene building permit; NEPA analysis.

Task 4. Storage & Pumping Facilities Construction

- Task schedule: 8/12/22-6/24/23 (10 months)
- Description of key task activities: Retrofitting of high-rate chlorine contact basin for seasonal recycled water storage use, construction of concrete pads, vertical pump stations, pneumatic tanks.
- Permits/Regulatory Approvals Required: City of Eugene building permit; NEPA analysis.

Task 5. Distribution Systems Facilities Construction

- Task schedule: 8/12/22-6/24/23 (10 months)
- Description of key task activities: Construction of piping to MWMC irrigation networks, West Bank Trail pipeline connection, metered connection to Delta Sand & Gravel at end of West Bank Trail pipeline, and piping to and installation of bulk fill water station (tanker truck fill).
- Permits/Regulatory Approvals Required: City of Eugene building permit; NEPA analysis.

Task 6. Facilities Commissioning

- Task schedule: 6/25/23-9/25/23 (3 months)
- Description of key task activities: Startup and testing of Class A disinfection facilities and all recycled water storage, pumping, and distribution lines. Final completion of construction upon successful startup and testing adjustments.
- Permits/Regulatory Approvals Required: DEQ inspections/approvals for Class A recycled water system use

Task 7. Partner Implementation and Demonstration

- Task schedule: 9/1/23- 10/31/24 (14 months)
- Description of key task activities: First full-year (October through October) implementation of recycled water production, delivery, and use, including associated ongoing performance monitoring, measurement and adjustments, public education and outreach, and site tours.
- Permits/Regulatory Approvals Required: DEQ Recycled Water Use Plan and OWRD registration of recycled water uses.

Copy and paste additional tasks as needed.

10. Project Task Scheduling – Estimated total project duration: 3 years, 8 months (months/years)

    Place an "X" in the appropriate column to indicate when each Project Task would take place. Note that successful projects generally do not receive their first reimbursement until late Q1 or early Q2 of the year after application submission. Project tasks listed must match the tasks identified in Question 9.

Key Tasks (Add additional rows as needed)	**Grant year** 2022				**Grant year** 2023				**Grant year** 2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Engineering Design	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Contracting and Permitting	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Disinfection Facilities Construction	☐	☐	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐
4. Storage & Pumping Facilities Construction	☐	☐	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐
5. Distribution Systems Construction	☐	☐	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐
6. Facilities Commissioning	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐
7. Partner Implementation and Demonstration	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒

11. Describe how you propose to measure and report the water diverted and used from the proposed project. Include a proposed method, timing, frequency, and location of measurement in your proposal. If you have questions please contact the Department for more information. Consider that many forms of measurement will incur additional costs.

    Note: Funded projects are required by statute to "regularly measure and report the water diverted and used from the project" [ORS 541.692(3)]." Common approaches for measuring water diverted and used include totalizing flow meters, stream gages, reservoir staff plates and water level sensors paired with volume-depth curves, and flumes. The Department makes the final determination on the method, timing, frequency, and location of measurement. This requirement applies if there is any diversion of water. Grant/loan funds can be used to pay for measurement and reporting expenses during the life of the grant.

Daily flows will be metered and recorded for total Class A recycled water produced and used. Additional metering will record daily, weekly, and/or monthly uses at the bulk fill station, MWMC irrigation, and Delta Sand & Gravel facilities.

12. Provide suggestions for interim and long-term project performance benchmarks and how those benchmarks would be measured.

Water quality and quantity will be continuously monitored and recorded. Interim benchmarks: maintaining Class A recycled water standards at the quantities needed without interruption at least 90% of the time during first year of use, achieving peak delivery of at least 0.65 mgd during at least one day in the first year of use and an average of 0.5 mgd during peak summer months. Long-term benchmarks will be 100% reliability for Class A recycled water delivery with a maximum day use of 1.3 mgd.

13. Describe any issues, unknowns, or conditions that may affect the completion of the key tasks or project. If applicable, describe any measures planned to mitigate them.

The MWMC is committed to this bring this project to the community with grant funding assistance. This project will not result in direct regulatory benefit to the MWMC at inception. Therefore, the MWMC's final approval for construction is pending securing of funding support. Several sources of funding and partnerships are being sought to help ensure this project moves forward. The user partners are implementing their own facility upgrades to allow for recycled water use to demonstrate the use. The direct benefits to the partners will come after full adoption and reliability is proven – the short-term interest is in establishing the water resource benefits outlined in this application. No issues are identified that would otherwise impact the completion of key project tasks.

Permits and Regulatory Approvals

14. Identify any water rights needed to <u>implement the proposed project</u> below. Check all of the following that apply and provide the information requested:
    a. ☐ The proposed project requires a new water right or other water right transactions. If checked, list transaction(s) required (e.g., new right, transfer, etc.): _____
    b. ☐ The applicants holds the water right(s) required for the project. If checked, list all such water rights required for the project in the table below, adding rows as needed. See the Application Instructions for further instruction, including how to find water right information.
    c. ☐ The applicant has legal access to a water right that will required for the project and has been given permission to utilize the water right(s). If checked, list all such water rights required for the project in the table below, adding rows as needed. See the Application Instructions for further guidance, including how to find water right information.

NOTE: No additional water rights are needed to implement this project. Registration of water reuse will be required with OWRD. However, important water rights considerations under this project are Delta Sand & Gravel's water right and instream rights on this reach of the Willamette River (see Attachment #10)

Water Right Number (Include prefixes, if applicable, e.g., G 00010)	Is this an application, permit, certificate, limited license, special or final order, transfer, decree, lease, or claim?	Water Right Amount			Tax Map/Lot IDs within the Place of Use where water will be used to implement the proposed project
		Max Volume (ac-ft)	Max Rate (cfs)	Duty (ac-ft/ac)	

15. In the table below, provide a list of any permits and regulatory approvals needed to implement the project and indicate the status of each in the table below. Please submit copies of any secured permits/approvals or describe efforts in securing necessary permits/approvals, including current status. If no permits or regulatory approvals are required, please provide an explanation. *Add rows as needed.*

The MWMC has conducted thorough review of potential applicable regulatory approvals needed associated with any aspect of the project, including federal cross-cutting requirements for funding eligibility. Many of these are not applicable or will be documented as "no impact," such as wetland protection, cultural resource protection, air quality attainment, endangered species and eagle protection, land use compatibility (LUCS), and floodplain management. See MWMC's Environmental Review Checklist, Attachment #13. Others requiring minor documentation may be fish habitat protection and environmental justice review. Identified approval needs are listed below.

Permit/ Regulatory Approval	Status and Efforts To Date
Conditional Use Plan alignment (City of Eugene)	Preliminary consultation with City of Eugene on building heights; no anticipated other issues, pending 30% design.
Building permit (City of Eugene)	Pending completion of 100% design
NEPA analysis (multiple agencies)	Previous written consultation with NOAA Fisheries; DEQ approval of water reuse as a river temperature mitigation strategy.
Recycled Water Use Plan (DEQ)	The MWMC has an approved RWUP with DEQ for Class B and C that is being updated. The RWUP will be amended for Class A use upon 100% design.
Reclaimed Water Registration (OWRD)	Pending project commissioning.
Recycled Water User Agreements (DEQ)	Pending project commissioning.

VII. Public Benefits

Instructions: Describe how the project would provide public benefits in each of the three public benefit categories identified below. In your responses, describe current conditions and anticipated project outcomes and benefits and provide evidence to support your claims. Describe how the project outcomes will contribute to each anticipated public benefit. Descriptions should be quantitative when possible. Applications will be scored and ranked solely based on the descriptions of the economic, environmental, and social/cultural public benefits and the likelihood of the project achieving the claimed benefits. More specifically, the evaluation will be based on the change in conditions expected to result from the project as demonstrated in the application.

Please see the Scoring Criteria document available on the Applications, Forms and Guidance webpage, for definitions of each public benefit and a description of how the public benefits will be evaluated. Applications that do not demonstrate public benefit in each of the three categories (economic, environmental, social/cultural) will be deemed incomplete.

Leave blank any public benefits that are not applicable to the proposed project.

16. Economic Benefits – ORS 541.673(2)

    a. Does the project create or retain jobs? If so, explain.

According to the MWMC's Triple Bottom Line Assessment of Thermal Load Mitigation Alternatives ("TBL", Good Company, May 2014 – Attachment 12), the construction aggregate recycled water use project creates 30 employee-years of construction jobs (equivalent to employing 30 workers full time for a period of 1 year). This project requires over 3 years of design, construction, and commissioning to see through to implementation. This does not take into account jobs retained during times of drought in which recycled water use can help keep aggregate operations and local construction projects up and running. Water rights at risk during drought can result in curtailment or shut down of business operations.

    b. Does the project increase economic activity? If so, explain.

The TBL report (Attachment 12) estimates a business savings of $55,000 per year in avoided pumping costs (electrical usage) for Delta Sand & Gravel. As described in (a), this project can maintain or increase economic activity during drought periods by providing this alternative water source to river water. Reduction in demand on drinking water supplies for irrigation uses can make the conserved potable water available for community growth, and high-quality recycled water distribution capability can feed new commercial growth opportunities. The initial project will deliver 0.65 million gallons per day (MGD, equal to 1 cfs) and be able to increase uses immediate upon demand to 1.3 MGD/2 cfs.

c. Does the project result in increases in efficiency or innovation? If so, explain.

Yes – this project launches the first-ever Class A recycled water program for community use in Eugene. The need for the project scale, design elements, and uses was identified through decades-long partnerships and planning studies to develop the best, most effective, uses of this new water resource in the community. The initial use partners were identified based on unique characteristics to demonstrate recycled water use for commercial, single campus, and multi-site uses. Based on stakeholder input in launching this project, we expect these innovations in water use will result in rapid expansion of recycled water use and water use efficiency in the coming decade. Recycled water use is required by state guidelines to be used efficiently and effectively without waste. By adopting recycled water use, we will also be implementing efficiency measures.

d. Does the project result in enhancement of infrastructure, farmland, public resource lands, industrial lands, commercial lands or lands having other key uses? If so, explain.

Yes. The project adds significant new recycled water infrastructure to the MWMC's regional treatment plant, including 1.3 mgd (2 cfs) of pumping capacity and 1.0 million gallons of storage. New distribution lines and a truck fill station connect this infrastructure directly to the construction aggregate facilities via an existing 3.5 mgd capacity buried pipeline and to multiple public (and commercial, in the future) uses at the tanker truck fill station.

This important infrastructure increases the community's water resources reliability (in times of drought), effectiveness (through prudent use of alternative water sources), and availability (both by reducing demand on freshwater supplies and by providing a new source of recycled water).

e. Does the project enhance economic value associated with tourism or recreational or commercial fishing, with fisheries involving native fish of cultural significance to Indian tribes, or with other economic values resulting from restoring or protecting water instream? If so, explain.

N/A

f. Does the project result in increases in irrigated land for agriculture? (which may include increasing irrigated acres, agricultural economic value, or productivity of irrigated land) If so, explain.

N/A

17. Environmental Benefits – ORS 541.673(3)

    a. Describe any measurable improvements in protected streamflows that are likely to result from the project. First, fill in the table below by, 1) listing the existing water right information of the source water right to be moved, protected, or transferred instream, and 2) naming the legal means proposed to permanently dedicate and protect water instream by the Oregon Water Resources Department. After filling in the table, complete your answer to this question by describing how protected streamflows will result in the environmental public benefits in the box below the table. *Note: The legal protection of water instream MUST be included to receive a score for this public benefit. Projects which permanently dedicate water instream will receive a scoring bump in the environmental public benefit category.*

Note: this project will not immediately result in legal protection of instream flows. However, this initial project is an important step toward potentially securing instream flow leases from the construction aggregate partners. After initial test period (of two or more years) proving the reliability of recycled water for business operations, the need for the partners' water right will be reevaluated for protection of instream flows. See Attachment #10.

Legal Protection of Water Instream *(add rows to table as needed)*

Water right permit or certificate number to be used in transaction for instream protection (e.g., irrigation, reservoir, or AR/ASR; S-####)	**Rate(s) (cfs)/duty (ac-ft/ac) or volume (ac-ft) of the contributing water right**	**Estimated rate (cfs)/duty (ac-ft/ac) or volume (ac-ft) of water to be legally protected instream**	**Percent (%) of right to be legally protected instream****	**Transaction for Legal Means of Instream Protection (chose one)**
				☐ Instream transfer ☐ Allocation of Conserved Water ☐ Above ground storage release ☐ Below ground storage release
				☐ Instream transfer ☐ Allocation of Conserved Water ☐ Above ground storage release ☐ Below ground storage release
				☐ Instream transfer ☐ Allocation of Conserved Water ☐ Above ground storage release ☐ Below ground storage release

Attention: If awarded funding, the legal protection of water instream, described in the table above, will be a condition of funding. The grant agreement will specifically cite the percent identified above, not the estimated rate.*

Describe how the protected streamflows accomplish one or more of the following:

(A) Supports the natural hydrograph;
(B) Improves floodplain function;
(C) Supports state- or federally-listed sensitive, threatened or endangered fish species;
(D) Supports native fish species of cultural importance to Indian tribes; or
(E) Supports riparian habitat important for wildlife:

The project reduces demand from an existing water right resulting in more retained instream flow. The Willamette River's instream flow water right is periodically unmet during low river flow conditions. Recycled water is being used primarily to replace river water on lossy/evaporative applications, while maintained river water use will be returned to settling ponds for infiltration back to the river. (Willamette River instream flow right, Nov. 3, 1983, RM 187 to 173.7, Nov-May 2,500 cfs, June-Oct 2,000 cfs). The 10-year low flow conditions on this reach are 1,310 cfs (May-Oct) and 1,340 cfs (Nov-Apr). See Attachment #10.

b. Does the project result in water conservation? If so, explain.

Some conservation outcomes are expected from efficiency in water management. Under state guidelines for approved recycled water use, no excessive use or runoff is allowed (e.g. must water no greater than the irrigation demand of the site). Therefore, adoption of recycled water use necessitates implementation of efficiency measures.

c. Describe the anticipated measurable improvement in groundwater levels that enhances environmental conditions in groundwater restricted areas or other areas.

N/A

d. Describe if and how the project would create a measurable improvement in the quality of surface water or groundwater.

Diversion of treated wastewater effluent from the Willamette River for recycled water uses will reduce the total loading of temperature, nutrients, and solids discharged into the river as well as associated oxygen demand. All parameters are quantified in the MWMC's daily discharge reports. Temperature benefit will be quantified as reduced thermal load on the

Willamette River measured in kilocalories per day.

The Willamette River is identified as water-quality limited for temperature (based on fish use needs) year-round. Temperature increases come from the loading of heat from multiple sources on the river basin, including over 80% from sunlight on exposed sections lacking full vegetation cover. Regardless of the MWMC's permit temperature limits, any reduction in treated wastewater discharge to the river works to reduce the total heat loading on the river system. In this way, recycled water use provides not only a water supply benefit, but a critical water quality benefit.

e. Does the project increase ecosystem resiliency to climate change impacts? If so, explain.

A key driver for implementing this project is to ensure more retained freshwater flow in the McKenzie and Willamette Rivers and provide a sustainable irrigation water resource to establish and maintain natural infrastructure/greenscape in the urban environment. These assets combine to enhance regional climate change resiliency. This project complements the drought-period benefit of providing a water supply to construction aggregate partners with the non-drought benefit of voluntarily reducing or curtailing the withdrawal of cooler, freshwater from the river, thereby providing an ongoing ecosystem benefit. Projects like this will serve as examples for more adoption in the Willamette Valley and in Oregon to improve resiliency of our rivers.

f. Does the project result in improvements that address one or more limiting ecological factors in the project watershed? If so, explain.

Yes. This project improves Willamette River temperature loading as described in (d) and (e). The Willamette River is listed as water quality impaired year-round for temperature based on criteria for endangered salmon rearing and spawning (Willamette Basin Temperature Total Maximum Daily Load (TMDL), DEQ, 2006). The DEQ's fish use maps identify salmon, steelhead, and trout migration, rearing, and spawning areas that require varying temperature protections. This project helps to reduce temperature in the mainstem Willamette River, which is identified for salmon rearing and spawning at the point of the MWMC's discharge. The MWMC is also a partner in watershed restoration efforts to increase riparian shade through native tree plantings and reduce overall heat input on the river, as well as to improve habitat functions and overall water quality. Recycled water use may be important for establishing and maintaining such restoration projects during summer periods and drought.

18. Social/Cultural Benefits – ORS 541.673(4)

a. Does the project promote public health and safety and of local food systems? If so, explain.

This project is an important development in reducing the periodic tapping and withdrawal of potable water from fire hydrants at multiple locations in Eugene. By providing the recycled water fill station at the Eugene/Springfield wastewater treatment plant, tree watering crews will reduce or curtail hydrant tapping and recycled water instead. All equipment will have specialty fittings that prevent any cross connection of recycled water equipment with potable water sources. Repeated accessing of fire hydrants presents a risk of water supply depressurization and/or contaminant introduction. This project will reduce that risk.

b. Does the project result in measurable improvements in conditions for members of minority or low-income communities, economically distressed rural communities, tribal communities or other communities traditionally underrepresented in public processes? If so, explain.

The decision to demonstrate recycled water use via the City of Eugene's street tree program was largely based on the asset that this is a city-wide program that will engage all communities and demographics. Oftentimes, public infrastructure projects are perceived as inequitably impacting or benefitting a localized community. This project is key to engaging a wide spectrum of community members, and is highly tailorable to demands for more recycled water use (which can benefit local parks, streetscapes, environment, and property values) or for restricted use (if communities need more time to evaluate and accept recycled water use in their neighborhood).

Under Task 7 of this project, $250,000 is dedicated to partner implementation and demonstration, which will include public information and outreach, interpretative displays, and other opportunities for community engagement.

c. Does the project promote recreation and scenic values? If so, explain.

The MWMC intends to install interpretative signage and features along the multi-use path adjacent to the wastewater treatment plant and Willamette River, where landscape will be newly irrigated with recycled water.

Potentially indirect recreational/scenic values are also identified. The project's benefits include water quality protection for the Willamette River (a key recreational and scenic asset to the community) and enhancement of urban greenspace (primarily street tree establishment). Recycled water carries nutrients from the wastewater treatment process to trees – resulting in better growth and vitality. This additional water source may help establish urban trees and park space more quickly.

d. Does this project contribute to the body of scientific data publicly available in this state? If so, explain.

N/A

e. Does this project promote state or local priorities, including but not limited to the restoration and protection of native fish species of cultural significance to Indian tribes? If so, explain.

Yes. This project is a priority under multiple plans and strategy documents. Development of Class A recycled water use is identified in EWEB's Water Conservation Management Plan (Attachment #8) and the Eugene-Springfield Natural Hazard Mitigation Plan (Attachment #9). Recycled water use development is also identified as Oregon priorities under the Oregon Integrated Water Resources Strategy, Governor's Executive Order 05-04 (March 2005), and SB 212 (2001), as well as part of Oregon's 100-Year Water Vision.

Recycled water use helps improve temperature and streamflow in the Willamette River, which are critical to native fish species survival.

f. Does this project promote collaborative basin planning efforts, including but not limited to efforts under Oregon's Integrated Water Resources Strategy? If so, explain.

Yes. The Oregon Association of Clean Water Agencies (ACWA) and DEQ have been in decades-long collaboration on addressing Willamette River temperature needs primarily through partnerships to restore watershed processes and adopt recycled water use strategies. Collaborations include input and integration with the IWRS and other statewide plans and initiatives. The MWMC and EWEB are in collaboration to develop Class A recycled water as a complement to drinking water conservation and source protection programs.

This project itself is the result of 10+ years of collaboration with local partners and stakeholders.

VIII. Project Budget

Instructions: Please answer the following questions about the proposed project budget using the tables provided. All Grant and Other Funds must be allowable costs as described in the Department's Grant Budget Procedures and Allowable Costs document.

19. Please provide an estimated line item budget for the proposed project. Examples include: direct project specific costs, such as in-house staff salary, contractual services, travel and administrative costs. See the Budget Procedures and Allowable Costs on the OWRD Applications, Forms, and Guidance webpage for further guidance.

OVERALL PROJECT BUDGET Line Items	**Number of Units*** *(e.g. # of Hours)*	**Unit Cost** *(e.g. hourly rate)*	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
Materials						
Contractual/Consulting				$6,026,211	$583,925	$6,610,136
Staff Salary/Benefits						
Equipment (must be approved)						
Supplies						
Other:						
Administrative Costs**						
		Total		**$6,026,211**	**$583,925**	**$6,610,136**

** The "Unit" should be per "hour" or "day" – not per "project" or "contract." Units x Unit Costs = Total Cost*
*** Administrative Costs may not exceed 10% of the total funding requested from the Department*

20. Identify the budget for each key task below. Key tasks identified below should be the same as the key tasks identified in Questions 9 and 10.

Key Tasks	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
1. Engineering Design		*$1,043,589*	*N/A*	*$1,043,589*
2. Contracting and Permitting		*$143,078*	*N/A*	*$143,078*
3. Disinfection Facilities Construction		*$3,087,768*	*N/A*	*$3087768*
4. Pumping & Storage Facilities Construction		*$79,039*	*$26,346*	*$105,385*
5. Distribution Systems Construction		*$187,500*	*$62,500*	*$250,000*
6. Facilities Commissioning		*$464,446*	*$154,815*	*$619,261*
7. Partner Implementation and Demonstration		*$1,020,792*	*$340,264*	*$1,361,055*
Total		**$6,026,211**	**$583,925**	**$6,610,136**

IX. Match Funding

Instructions: Fill out the table below and attach the appropriate documentation for both secured and pending match (add rows as needed). Label the documentation as Attachment #3. Applications requesting grant funds must demonstrate match that at a minimum equals 25% of total project cost.

For secured funding, you must *attach a letter of support* from the match funding source that:

- Specifies the dollar amount identified for this project,
- Equals the dollar amount shown in the "Amount/Dollar Value" column in the table below, and
- Describes the work to be accomplished through the match.

For pending resources, you must attach *other written documentation showing a request* for the matching funds. Documentation must:

- Include the project name,
- Note the date on which a future funding application will be submitted,
- Identify the funding program from which funds are pending, and
- Provide evidence that the project is eligible for the funding program identified.

Match Funding Source (if in-kind, briefly describe the nature of the contribution)	**Type (✓ only One)**	**Status (✓ only One)**	**Amount/ Dollar Value**	**Date Match Funds Available** *(Month/Year)*
Hazard Mitigation Grant Program (OEM)	☒cash ☐in-kind	☐secured ☒pending	$1,652,534	9/2021
WaterSMART grant (BOR)	☒cash ☐in-kind	☐secured ☒pending	$1,652,534	4/2022
MWMC capital program	☒cash ☐in-kind	☐secured ☒pending	$2,721,143	7/2021
	☐cash ☐in-kind	☐secured ☐pending		
Total of Match Funds			= $6,026,211	

X. Storage-Specific Project Requirements (if not a storage project skip this section)

Instructions: If your proposal is for a storage project that will divert water under an existing or new storage water right or limited license, answer questions 21 through 23 in this section. If your proposal is for above-ground storage, also answer question 24 through 26. All other projects can skip this section.

21. Identify Storage Project Type: ☐ Above-Ground ☐ Below-Ground

22. Indicate the capacity of the storage project and any new-developed water below:
    a. What will be the *total* capacity of the storage project in acre-feet after completion? _____
    b. What will be the volume of the *newly-developed* water in acre-feet? _____

23. Answer the following "Yes/No" questions about the storage project.

a. Will the project divert more than 500 acre-feet of surface water annually? Yes ☐ No ☐

b. Will the project impound surface water on a perennial stream? Yes ☐ No ☐

c. Will the project divert water from a stream that supports sensitive, threatened or endangered species? Yes ☐ No ☐

If you answered "yes" to **any** of the questions above, (a), (b), or (c), the project will need a *Seasonally Varying Flow (SVF) Prescription,* determining the duration, timing, frequency and volume of flows (including ecological base flow), necessary for protection and maintenance of biological, ecological, and physical functions outside of the irrigation season. The Department will establish the SVF prescription after funding is awarded, for more information about this requirement, please contact Technical Coordinator, Rachel LovellFord at 503-986-0941.

24. **Above-Ground Storage Only:** If you answered "yes" to Question 23 (a), (b), or (c) above, your proposed project is above-ground storage, **and** you are requesting **grant** funding then a **minimum of 25%** of the newly developed water must be dedicated to instream use. This is separate from the SVF Prescription. ***If awarded funding, the percentage identified below will be a condition of funding.*** *Note: Any storage project which permanently dedicates water instream will receive a scoring bump in the environmental public benefit category.*

    Please identify the percentage of stored water to be dedicated to instream use. _____%

25. **Above-Ground Storage Only:** Into which stream(s) will the project release water? _____

26. **Above-Ground Storage Only:** How does the project control the outflow from the reservoir? Describe:
    a. What infrastructure governs changes to reservoir outflow rates?
    b. Whether changes to the outflow rate are made automatically or by hand.
    c. If water is released into more than one stream, what controls the rate of release and how much water goes to which stream?
    d. What are minimum and maximum release rates to each water source?
    e. Any other factors that limit the rate at which water is released from the reservoir.

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Attachment 5 - Letters of support

Attachment 6 - Plans, designs, and/or engineering specifications

Attachment 7 - Secured permits and regulatory approvals needed to implement the project

Attachment 8 - Other: EWEB Water Management and Conservation Plan

Attachment 9 - Other: Eugene-Springfield Natural Hazards Mitigation Plan

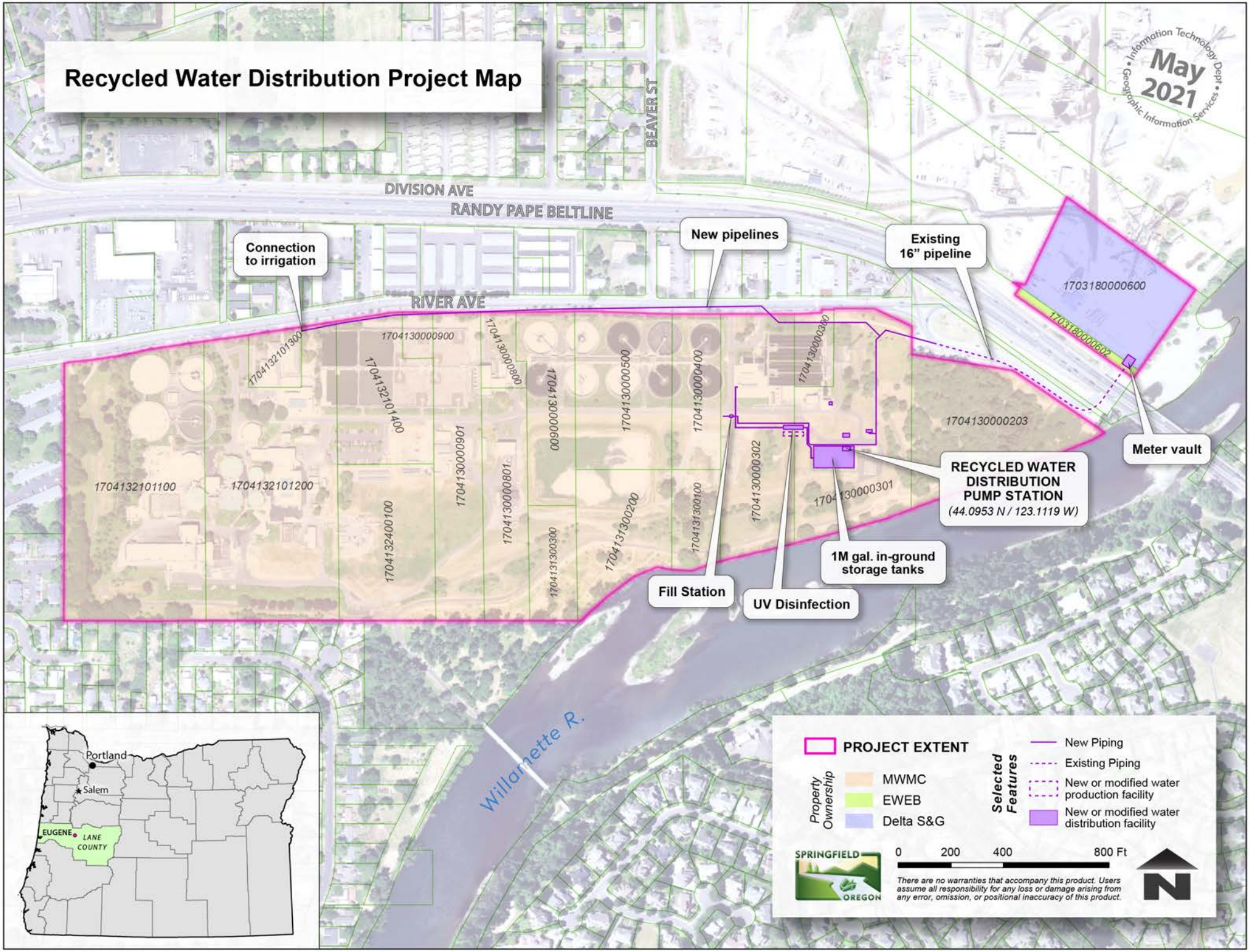
Attachment 10 - Other: Water Rights Certificates

Attachment 11 - Other: Industrial Aggregate Recycled Water Use Planning Study

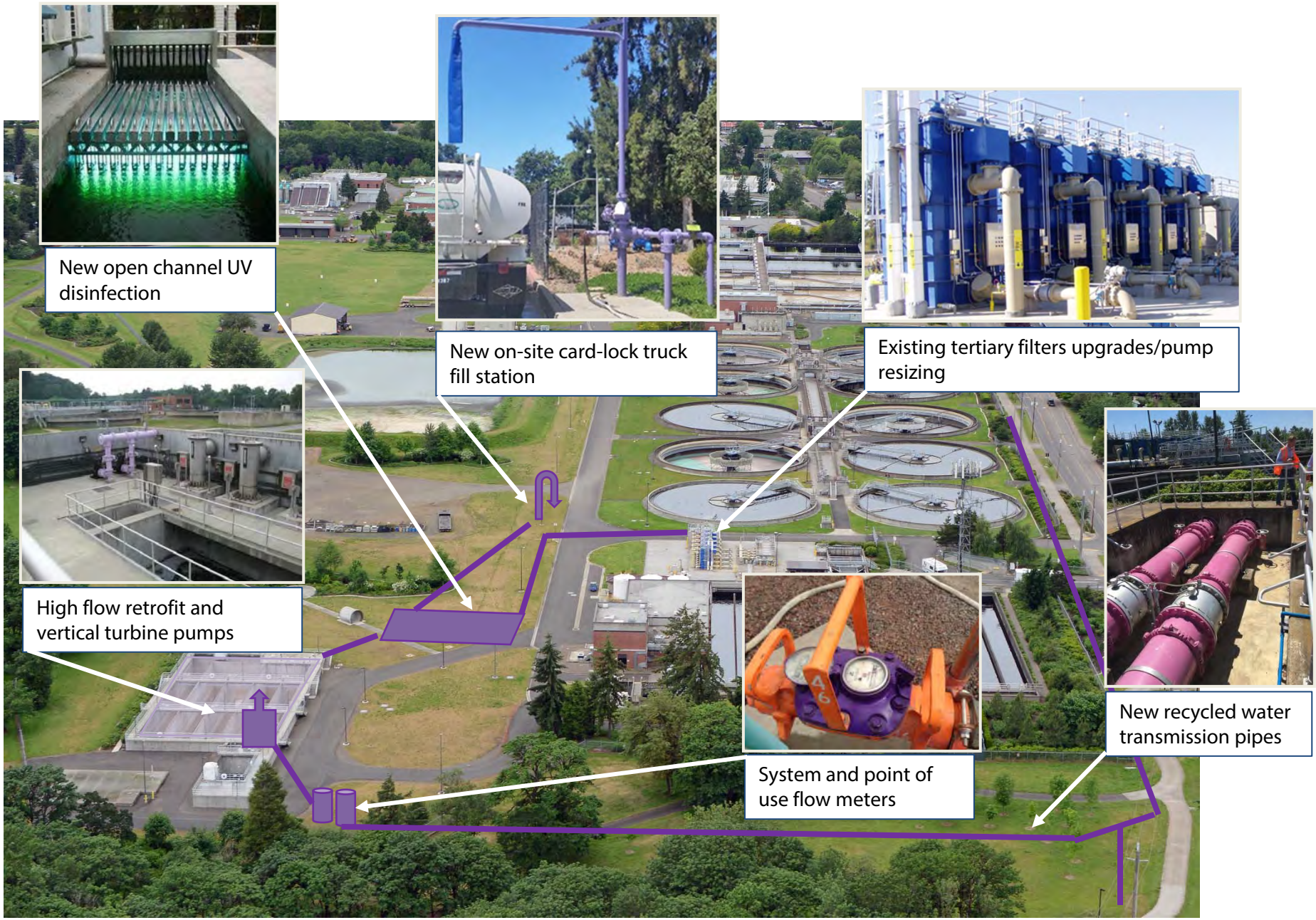
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Attachment 13 - Other: MWMC Environmental Review Checklist

Attachment 1 - Site Map

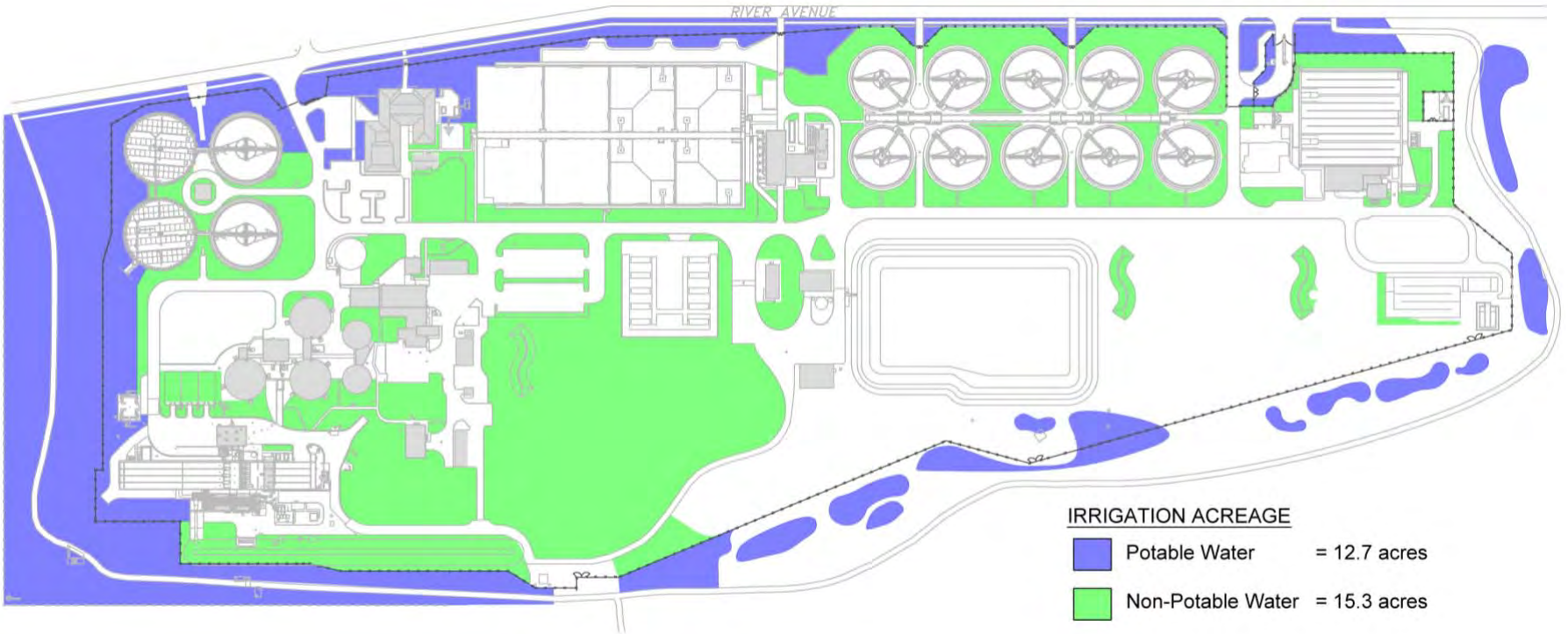

Recycled Water Distribution Project Map
May 2021
Information Technology Dept • Geographic Information Services •
DIVISION AVE
RANDY PAPE BELTLINE
BEAVER ST
RIVER AVE
Connection to irrigation
New pipelines
Existing 16" pipeline
Meter vault
RECYCLED WATER DISTRIBUTION PUMP STATION
(44.0953 N / 123.1119 W)
1M gal. in-ground storage tanks
Fill Station
UV Disinfection
1703180000600
1703180000602
1704130000203
1704132101300
1704130000900
1704132101400
1704130000800
1704130000600
1704130000500
1704130000400
1704130000300
1704130000901
1704130000801
1704130000302
1704130000301
1704132101100
1704132101200
1704132400100
1704131300300
1704131300200
1704131300100
Willamette R.
Portland
Salem
EUGENE
LANE COUNTY
PROJECT EXTENT
Property Ownership
MWMC
EWEB
Delta S&G
Selected Features
New Piping
Existing Piping
New or modified water production facility
New or modified water distribution facility
SPRINGFIELD OREGON
0 200 400 800 Ft
There are no warranties that accompany this product. Users assume all responsibility for any loss or damage arising from any error, omission, or positional inaccuracy of this product.
N

MWMC Proposed Class A Recycled Water Facilities



WPCF Treatment Plant Landscape Irrigation

- 45% of site currently irrigated with potable water
- Project will upgrade to 100% recycled water use
- Approximate total use in peak irrigation = 500,000 gallons per day

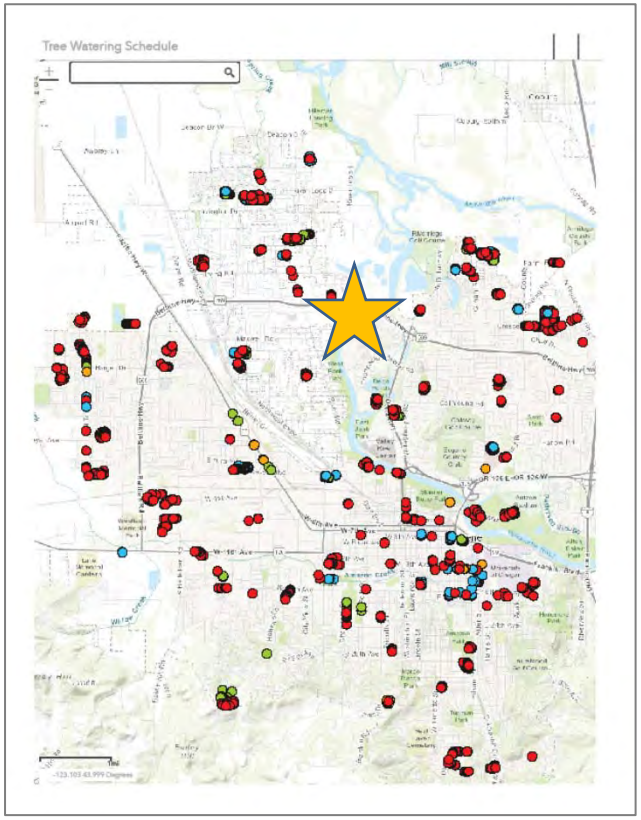


City of Eugene Street Tree Watering

- Tanker truck fill at WPCF
- Tankers retrofitted for recycled water use
- Total use approximately 2,500+ gallons per day at locations throughout Eugene



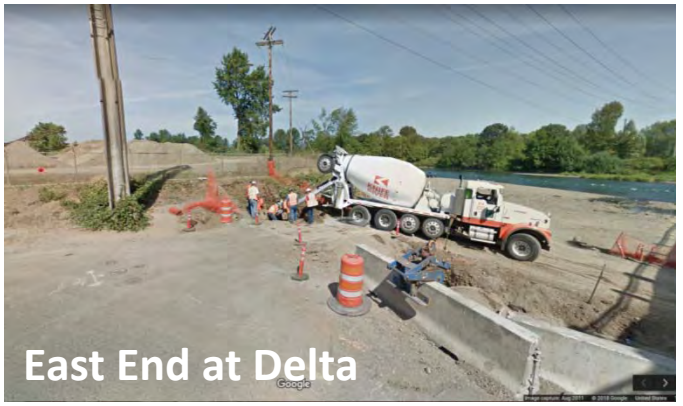




Industrial Aggregate Site Use







- Project connection to existing West Bank Trail pipeline
- Gravel yard new piping to dust control and wash stations
- Initial use 100,000 - 500,000 gallons per day, year-round
- Future full process expansion to 3 million gallons per day







Attachment 2 - Property Access Authorization

Water Project Grants and Loans

Landowner Agreement

Instructions to Applicants: Work with landowners to complete this form for all properties on which the proposed project would occur. Submit this completed form as part of your grant/loan application. For questions contact WRD_DL_waterprojects@oregon.gov.

Project and Applicant Information

Project Name: Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities

Funding Applicant: Metropolitan Wastewater Management Commission
Co-Applicant (if applicable): _____

Funding Applicant Contact Information:
Name: Todd Miller
Phone Number: 541-736-7137
Email Address: tmiller@springfield-or.gov

Co-Applicant Contact Information:
Name:_____
Phone Number: _____
Email Address: _____

Landowner Information

Landowner(s) Name: Eugene Water & Electric Board

Landowner Authorized Representative: Wally McCullough

Landowner Contact Information (or Authorized Representative)
Address: 4200 Roosevelt Blvd
(required) Eugene OR 97402
(optional) Phone Number: 541-685-7435
(optional) Email Address: Wallace.McCullough@EWEB.ORG

Property Information

List each property owned by the above-mentioned Landowner on which the project would occur:

County	Tax map	Lot number
Lane	17031800	602

Landowner Acknowledgement

1. EWEB is/are the legal owner(s) (the Landowner) of the above described property (the Property).
2. I am authorized to act on behalf of the Landowner.
3. I am aware of and agree to the above-mentioned proposed project and grant permission for the Applicant, and the Applicant's agents, to conduct the following activities on the Property. (List activities below)

a. Obtain entry permit and access site for utility marking and staging
b.
c.
d.

4. I am aware that monitoring information related to the Project is a matter of public record.
5. I certify that the above-mentioned information is true and accurate, I am aware of and agree to the proposed work, and I am authorized to sign as the Landowner or Authorized Representative.

Signature of Landowner or Authorized Representative: Wally McCullough Digitally signed by Wally McCullough Date: 2021.04.27 16:48:05 -07'00'
Date: _____ Print Name: _____

DocuSign Envelope ID: B6E2F14F-5CE8-4A7D-B9CE-061F237B5E72

Water Project Grants and Loans

Landowner Agreement

Instructions to Applicants: Work with landowners to complete this form for all properties on which the proposed project would occur. Submit this completed form as part of your grant/loan application. For questions contact WRD_DL_waterprojects@oregon.gov.

Project and Applicant Information

Project Name: Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities

Funding Applicant: Metropolitan Wastewater Management Commission
Co-Applicant (if applicable): _____

Funding Applicant Contact Information:
Name: Todd Miller
Phone Number: 541-736-7137
Email Address: tmiller@springfield-or.gov

Co-Applicant Contact Information:
Name: _____
Phone Number: _____
Email Address: _____

Landowner Information

Landowner(s) Name: Delta Sand & Gravel

Landowner Authorized Representative: Stan Pickett

Landowner Contact Information (or Authorized Representative)
Address: 999 Division ~~Street~~ correction: Avenue
(required) Eugene OR ~~97401~~ correction: 97404
(optional) Phone Number: (541) 688-2233
(optional) Email Address: spickett@deltasg.com

Property Information

List each property owned by the above-mentioned Landowner on which the project would occur:

County	Tax map	Lot number
Lane	17031800	600

Landowner Acknowledgement

1. Delta Sand & Gravel is/are the legal owner(s) (the Landowner) of the above described property (the Property).
2. I am authorized to act on behalf of the Landowner.
3. I am aware of and agree to the above-mentioned proposed project and grant permission for the Applicant, and the Applicant's agents, to conduct the following activities on the Property. (List activities below)

a. Access site for utility marking and staging
b. Perform earthwork as needed to install recycled water meter tie-in to Delta Sand & Gravel
c.
d.

4. I am aware that monitoring information related to the Project is a matter of public record.
5. I certify that the above-mentioned information is true and accurate, I am aware of and agree to the proposed work, and I am authorized to sign as the Landowner or Authorized Representative.

Signature of Landowner or Authorized Representative: _____ DocuSigned by: Stanley Pickett 8BE7E13EC5B3459... _____
Date: 4/26/2021 Print Name: Stanley Pickett

Attachment 3 - Documentation of Matching Funds

We Clean Water

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MANAGEMENT COMMISSION

partners in wastewater management

MWMC Commission

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Eugene City Councilor
MWMC President

Joe Pishioneri
Springfield City Councilor
MWMC Vice President

Pat Farr
Lane County Commissioner

Bill Inge
Lane County Citizen

Doug Keeler
Springfield Citizen

Walt Meyer
Eugene Citizen

Peter Ruffier
Eugene Citizen

Administration

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Springfield, Oregon 97477
(541) 726-3694
FAX (541) 726-2309

Operations

Dave Breitenstein
Wastewater Director
City of Eugene
410 River Avenue
Eugene, Oregon 97404
(541) 682-8600
FAX (541) 682-8601

April 28, 2021

Grant Program Coordinator
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

OWRD Grant Program Coordinator,

I am writing to document the Metropolitan Wastewater Management Commission's (MWMC's) pending funding match associated with the MWMC's grant application for the "Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities Project" under the Oregon Department of Water Resources' Water Project Grants and Loans (WPGL) program.

This project comprises seven tasks; the first three tasks are necessary for project implementation but are ineligible for funding under the WPGL program. However, those tasks are eligible for funding under the federal programs listed below. Of the remaining four tasks, the MWMC is seeking 25% of WPGL funds. The MWMC is seeking federal funding through two programs for 50% of the total costs of Tasks 1-7.

The project budget presented below does not include other MWMC funds budgeted toward project implementation, including staff time, legal and administrative costs, and pending other project costs that are not yet confirmed. For Task 7, "Partner Implementation and Demonstration," the MWMC has identified a minimum of $250,000 for community engagement, interpretative displays and education, and assistance with partner startup needs; however, the MWMC has budgeted over $1,000,000 for potential future costs associated with successful implementation and community demonstration efforts.

The budget table below indicates the project as represented in the MWMC's WPGL grant application and the portion of funding being requested from OWRD and federal programs. The status of the federal program funding is as follows (next page):

Hazard Mitigation Grant Program

- Federal Emergency Management Agency (FEMA) funds being administered through the Oregon Office of Emergency Management (OEM)
- Amount of request: $1,652,534
- More funding may be requested pending determination of program details
- Status: Pre-Application Form/Letter of Intent submitted via City of Eugene program partners, April 15, 2021
- Timeline: Formal application pending summer 2021; funding available fall 2021 – fall 2024

WaterSMART Title XVI Program

- Administered by federal Bureau of Reclamation
- Amount of request: $1,652,534
- Funding available up to 25% of total project cost
- Status: annual announcement for grant application expected in August 2021
- Timeline: applications are anticipated to be due in September 2021 with funding available April 2022

Project Funding Table

Task No.	Task	Total Cost	OWRD Funds	Federal Funds	MWMC Funds
1	Engineering Design	$ 1,043,589	ineligible	$ 521,795	$ 521,795
2	Construction Contracting and Permitting	$ 143,078	ineligible	$ 71,539	$ 71,539
3	Disinfection Facilities Construction	$ 3,087,768	ineligible	$ 1,543,884	$ 1,543,884
4	Storage and Pumping Faciliites Construction	$ 619,261	$ 154,815	$ 309,631	$ 154,815
5	Distribution Systems Construction	$ 1,361,055	$ 340,264	$ 680,528	$ 340,264
6	Facilities Commissioning	$ 105,385	$ 26,346	$ 52,693	$ 26,346
7	Partner Implementation and Demonstration	$ 250,000	$ 62,500	$ 125,000	$ 62,500
	TOTAL	$ 6,610,136	$ 583,925	$ 3,305,068	$ 2,721,143

The MWMC looks forward to securing this critical funding from OWRD and federal partners to ensure timely development of this valuable water resources for our community.

Sincerely

Matt Stouder
MWMC Executive Officer

Attachment 4 - Project Feasibility Documentation

Industrial Aggregate Recycled Water Use Planning Study

Eugene-Springfield, Oregon

Final Report



This planning study conducted by the Metropolitan Wastewater Management Commission was funded in part by a grant from the Oregon Water Resource Department's Water Conservation, Reuse, and Storage program.

Metropolitan Wastewater Management Commission

partners in wastewater management

Metropolitan Wastewater Management Commission
225 Fifth Street, Springfield, OR 97477
(541) 726-3694
www.mwmcpartners.org

June 28, 2013

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1 INTRODUCTION AND BACKGROUND

1.1 STUDY DESCRIPTION

The Eugene/Springfield Metropolitan Wastewater Management Commission (MWMC) will study the feasibility of expanding recycled water use to neighboring industrial aggregate partners in lieu of river and groundwater sources. The potential demand is over 3 million gallons per day (MGD) and could be the first recycled water use in Eugene/Springfield outside of MWMC's facilities. This use could potentially provide more efficient use of water resources, benefits to river temperature and habitat, and enhance green business practices. The proposed study includes analytical water balance modeling, engineering design scoping, water quality evaluations, water rights issues assessment, stakeholder acceptability, and triple bottom line (TBL) cost/benefit analysis. Potential industrial applications for recycled water include gravel washing, concrete and asphalt production, equipment rinsing, and dust control. These applications could demonstrate safe and effective recycled water use to the greater community, potentially expanding interest in regional use of recycled water for resource sustainability and water quality benefits.

The Industrial Aggregate Recycled Water Use Study employs several key, inter-related studies:

(1) Water Quality Needs Assessment. The water quality demands, capabilities, and management requirements for higher classes of recycled water production need to be assessed to ensure project feasibility and to inform design requirements. Questions to be answered via this assessment include: What are the water quality requirements for industrial uses? How do recycled water classes compare with user needs? What treatment modifications, monitoring, and testing are needed to ensure quality control? What are the recycled water handling requirements, including systems modifications and site control needs?

(2) Water Rights Management Assessment. Understanding the fate of water rights held by the industrial properties is essential to assessing the TBL project benefits and stakeholder acceptability of the project. Industrial partners will need to consider whether water rights remain available to them as a secondary source of water, and how any project impact on water rights could affect property values. Water rights retained as instream flow would add to the environmental benefits of the project and the goals of maintaining river flows and temperatures for habitat benefits.

(3) Water Balance Modeling. A carefully designed and executed computer model to simulate water mass balance and thermal loading will be developed under this study. The model will answer key questions regarding water flows and peak capacity between the treatment plant and the industrial operations, offsets to treatment plant discharge and industrial withdrawals from surface- and well-water, fate and transport of used process water to industrial site settling ponds, and thermal loading changes on the Willamette River.

(4) Engineering Feasibility Study. The most critical aspect of the overall study is an understanding of the engineering requirements to consistently produce the required class of recycled water at the treatment plant, pumping and delivering recycled water at required flows and pressures, connecting to one or more of the three 12-inch diameter recycled-water-ready pipelines via new piping on public and private property, ensuring appropriate utility clearances along the pipe route, energy

demand and pump station requirements, and site use distribution system requirements. The MWMC regional staff and consultant team will address all of these issues through critical engineering analyses and problem solving, providing findings and recommendations via technical memoranda that will be used to inform other study aspects (such as cost-benefit analysis) as well as future project design.

(5) Stakeholder Acceptability Evaluation. The political feasibility of the project is as important as the technical feasibility of construction for project implementation. The overall study includes a user and community Stakeholder Acceptability Evaluation to consider how both recycled water use requirements and stakeholder needs are drivers to project recommendations and design issues. Industrial operators and site personnel will be queried to determine operational and informational project needs. Local officials, agency partners, and community stakeholders will be engaged to ensure potential political hurdles are addressed and community support has been gained.

(6) Triple Bottom Line Cost-Benefit Analysis. The project addresses multiple potential benefits and involves multiple stakeholders; the study includes a cost/benefit analysis that evaluates the environmental, socio-cultural, and economic assets and impacts associated with the proposed recycled water use. Consultants with expertise in TBL economics will identify energy and life cycle costs, environmental impacts, value-added benefits, and financial requirements, among other factors, in assessing the overall project benefit for the local community.

1.2 STUDY GOALS

This planning study is part of a broader, longer-term study conducted by the MWMC. The MWMC has completed an initial recycled water implementation scoping phase of work followed by a first phase of implementation planning. Phase 1 study provided a conceptual alternative assessment of potential recycled water uses in the Eugene-Springfield area that could help the MWMC achieve regulatory compliance goals. Phase 1 recommended four conceptual uses for Phase 2 study of project feasibilities. Those four conceptual uses were (1) Delta Sand & Gravel uses for aggregate production, (2) Knife River Corporation use for concrete and asphalt production, (3) MWMC storage and irrigation use at its Beneficial Reuse Site, and (4) MWMC expanded use at its Biocycle Farm poplar plantation.

The Delta Sand & Gravel and Knife River projects are collocated. This study provides an initial feasibility assessment of both of those collocated projects. Given the context of this study as both a feasibility assessment of industrial aggregate recycled water use as well as component study informing a longer-term recycled water implementation planning study, its goals are both near-term and short-term.

Near-Term Goal: Determine the feasibility of a project to (1) provide reliable, cost-effective, and environmentally beneficial recycled water use of approximately 3 MGD for industrial aggregate and construction products, and (2) serve as a demonstration site for fostering community interest in future recycled water use.

Long-Term Goals: (1)Maintain thermal load compliance to meet Willamette River water quality and habitat needs; (2) make more efficient use of water resources through recycled water use in lieu of

freshwater sources; (3) contribute to local energy efficiency and recycled material content goals; and (4) gain visibility, recognition, and community support for recycled water use.

This study helps achieve the near-term and long-term goals by providing answers to (1) thermal load and water use benefits through water balance modeling, (2) operational benefits through engineering and water quality management studies, (3) constructability through engineering assessments and cost-benefit analyses, and (4) community acceptability through stakeholder engagement and demonstrations.

1.3 STUDY PARTNERS AND STAKEHOLDERS

1.3.1 CONCEPTUAL PROJECT PARTNERS

The direct stakeholders in this study are the MWMC, Delta Sand & Gravel, and Knife River Corporation.

MWMC - The MWMC is the sponsoring agency funding and managing the study. The MWMC has been pursuing recommendations prescribed in its *2004 Facilities Plan* for implementing and expanding recycled water use. The MWMC has implemented recycled water use at its own agricultural management operations, but has not yet expanded use to non-MWMC partners. The MWMC needs to consider its regulatory compliance costs, long-term recycled water production and use strategy, and factors favorable to increasing sustainable resource recovery from the wastewater treatment plant.

Delta Sand & Gravel - As one of the industrial users under study, Delta Sand & Gravel could benefit or be impacted by operating costs, water reliability, health and safety requirements, community sustainability, and water rights impacts. Delta proudly touts its involvement in projects of significance in the local community. On its website (*www.deltasg.com*), Delta cites the following community projects in which Delta played a role:

- Springfield's MLK Parkway Roundabout and the Jasper Trunk sewer upgrade
- Willamalane Park & Recreation's Clearwater Park Boat Landing
- University of Oregon's PK Park baseball stadium and Matthew Knight Arena basketball and entertainment venue.
- Eugene Water & Electric Board's Roosevelt Operations Center
- Sacred Heart's RiverBend regional medical center in Springfield
- The Justice Department's Wayne Morse federal courthouse in Eugene

Delta management has expressed support and enthusiasm for potentially being a partner in a project that helps the community meet regulatory goals in a cost-effective way and in protecting the Willamette River. Delta's long-term vision is reclamation of gravel pits for recreational and habitat value.

Knife River - As one of the potential industrial users participating in the study, Knife River could benefit or be impacted by operating costs, water quality and reliability, product performance, health and safety requirements, customer satisfaction, green product assets, and water rights impacts. Knife River cites its potential partnership with the MWMC in its *2012 Corporate Responsibility Report*, stating:

We have just started testing the use of wastewater from the joint Eugene/Springfield wastewater treatment plant. That plant puts millions of gallons of treated water in the Willamette River each day, some of which could be a potential source for making concrete. We also may be able to use the water for dust control in our yard.

1.3.2 WATER RESOURCE AGENCIES

Eugene Water & Electric Board (EWEB) - EWEB is the local drinking water utility in Eugene providing service to urban water users around the wastewater treatment plant and recycled water pipelines. EWEB is interested in recycled water as a complementary water source, has a stake in local water quality and reliability, and considerations for future water conservation/supply strategy.

EWEB's *Water Management Conservation Plan* (December 2011) references the MWMC's recycled water planning as follows:

> *Reuse, Recycling, and Non-Potable Water Opportunities. For residential and commercial/industrial customers, EWEB provides technical assistance to customers interested in rainwater harvesting. EWEB also coordinated design and installation of a rainwater harvesting system in mid-2010 at the Water Wise Demonstration Garden. EWEB and the Metropolitan Wastewater Management Commission (MWMC) currently are involved in the implementation planning phase of a recycled water program; the initial phase of work will include community involvement, demonstrations, and alternatives evaluation. For commercial and industrial customers, EWEB provides technical assistance for graywater reuse projects upon request.*
>
> *Five-Year Benchmark: Within the next 5 years, EWEB will continue to explore opportunities for water reuse and recycling, such as on playing fields and golf courses*.

Oregon Association of Clean Water Agencies (ACWA) - As the statewide organization of stormwater management and wastewater treatment facilities, ACWA promotes advances in community integration in wastewater management and sharing of information and models that help other wastewater treatment facilities cost-effectively and efficiently meet their compliance and operating goals. ACWA is supportive of recycled water project advances in Oregon and was supportive of this study effort to further the understanding of recycled water use and feasibility.

Oregon Department of Environmental Quality (ODEQ) - The ODEQ is the agency responsible for administering many aspects of the Clean Water Act, including the issuance of National Pollutant Discharge Elimination System (NPDES) and Water Pollution Control Facility (WPCF) discharge permits to wastewater producers, development of water quality standards including the total maximum daily loads (TMDLs) for the Willamette basin, and for ensuring recycled water use compliance with state rules. The DEQ will ultimately approve the MWMC's NPDES permit, including a recycled water use plan, which will address the Willamette TMDL for temperature.

Oregon Water Resources Department (OWRD) - The OWRD administers water rights including instream flow requirements; registers uses of recycled water; and promotes water conservation, reuse, and storage to meet Oregon's water resource needs.

1.3.3 WATERSHED CONSERVATION ORGANIZATIONS

The Freshwater Trust (TFT) - As the organization promoting water rights leasing incentives to maintain instream flows for habitat benefits, TFT supports the concept of recycling water for uses that currently require water withdrawals. TFT could play a role in the outcome and management of water rights under the proposed project. TFT is currently actively engaged with the MWMC's riparian restoration projects to mitigate river temperature loading.

McKenzie Watershed Council (MWC) - The McKenzie Watershed Council is the parent host to the McKenzie Confluence Group, an advisory panel of stakeholders concerned about water quality, restoration, and land management issues in and around the confluence of the McKenzie and Willamette Rivers. The Eugene-Springfield wastewater treatment plant and the industrial aggregate operations considered for conceptual recycled water use are part of the confluence area.

Long Tom Watershed Council (LTWC) - The Long Tom Watershed Council includes stewardship of the Willamette/Flat Creek drainage, in which all of the MWMC's facilities are located. The Council was engaged as a Phase 1 stakeholder and has been involved for the past several years in exploring the potential interest and concerns for recycled water use, including potential for stream flow augmentation to benefit local habitat and water quality. There is interest in the environmental benefits of water recycling from the Council. There may also be additional outreach benefits for the MWMC in building a stronger awareness of the MWMC and wastewater management in the Amazon Creek and Flat Creek basins of the watershed.

This section summarizes the key findings and important details comprising the Industrial Aggregate Recycled Water Use Planning Study. The sub-sections below present each of the six main study elements completed in fulfillment of the Water Conservation, Reuse, and Storage grant agreement:

- Water Quality Needs Assessment
- Water Rights Management Assessment
- Water Balance Modeling
- Engineering Feasibility Study
- Stakeholder Acceptability Evaluation
- Triple Bottom Line Cost-Benefit Analysis

Various technical memoranda (tech memos), reports, and other documents were developed during each study element. Each of the documents as referenced in the sections below are included as appendices to this report.

2 CONCEPTUAL PROJECT PLANNING STUDIES

2.1 WATER QUALITY NEEDS ASSESSMENT

Purpose: The purpose of this study element was to assess the water quality and quantity requirements of the industrial aggregate operations to match recycled water production needs.

Finding: Based on this assessment, the study team recommends Class A recycled water (the highest class of recycled water) produced and delivered at rates of up to at least 6 MGD to the industrial facilities. Additionally, better understanding of the comparative water quality of Willamette River water at the point of use and the MWMC's recycled water is needed to better communicate the safety of recycled water use.

Studies: The following reports were developed in documenting the findings of this study element:

- Internal Tech Memo 08: Industrial Aggregate Water Quantity, Quality, and Handling Requirements

The results of these studies are described below in the following sub-sections:

- Industrial Water Quantity Need
- Industrial Water Quality Need
- Recycled Water Quality Comparison
- Recycled Water Use and Handling Requirements

2.1.1 INDUSTRIAL WATER QUANTITY NEED

The combined pumping capacities of Delta Sand & Gravel and Knife River for river and groundwater, equals 5,150 gpm, equivalent to 7.41 MGD. However, based on a 10-hour operational day of maximum pumping, the demand is 3.09 MGD (over 24 hours). This distinction between instantaneous flow rate and average flow rate over a 24-hour day is important for the MWMC's recycled water production considerations and the net daily thermal load benefits from diverting effluent for water recycling. The 3.09 MGD use is a maximum. Due to seasonal reductions in construction demands during winter months and other operational constraints, demand could be significantly reduced.

2.1.2 INDUSTRIAL WATER QUALITY NEED

For most of the industrial aggregate operations, water quality demands are fairly basic in that water must be of quality to adequately clean gravel, rinse equipment, and provide dust control. The exceptions are concrete and asphalt batching, which have specific water quality limitations. Concrete batching is understood to be the most critical as water chemistry plays a role in how concrete cures. Knife River's groundwater well (assumed to be the 200-foot deep well in OWRD records) may supply higher quality water for concrete batching than can be supplied by the Willamette River. The basic

water chemistry of well water, as tested for critical concrete parameters by Knife River, appears identical to that of river water.

Temperature is important to the production of aggregate. In winter, the Delta Sand & Gravel operation typically slows considerably due to low demand for construction materials as well as cold weather conditions, which may cause icing of equipment (per discussions with Delta personnel). Knife River reportedly uses the warmer water provided by the groundwater well in the winter and also heats water for use – including washing of aggregate to warm materials up to more optimal temperatures for production.

2.1.3 RECYCLED WATER QUALITY COMPARISON

The Oregon recycled water use rules approve the use of Class C recycled water for all of the industrial aggregate processes in use at the Delta Sand & Gravel and Knife River sites. The MWMC's recycled water is similar in water quality to the Willamette River source currently used for aggregate product production with the exception of total dissolved solids, which are an order of magnitude higher in recycled water. However, the total solids count in recycled water is well below the 50,000 parts per million total solids limit for concrete batching. The MWMC's median Class D recycled water analysis for bacteria as *E. coli* (at 3 colonies/100 mL) is also below that of the Willamette River (at 55 colonies/100 mL) as reported by the ODEQ (2006 *Willamette Basin TMDL*)..

Furthermore, recycled water meets the critical water quality parameters for concrete batching (ASTM 1602) by orders of magnitude (for each chloride, sulfate, total solids, and alkalinity). The MWMC partnered with Knife River in 2011 to pour a test batch of concrete mixed with the MWMC's Class C recycled water (produced on a trial basis). The results of that trial were positive, with concrete water quality needs and cured concrete strength testing thresholds having been met. Further understanding of Willamette River water quality would be helpful to provide a better comparison of recycled water and river water characteristics

The thermal load of treatment plant effluent could be a water quality benefit for industrial aggregate use. The average daily temperature of treatment plant effluent is approximately 5°C (3°F) greater than that of the Willamette River. That temperature difference could play a valuable role for reducing energy requirements to meet winter temperature needs for concrete and aggregate production.

2.1.4 RECYCLED WATER USE AND HANDLING REQUIREMENTS

The industrial aggregate facilities currently use non-potable river water for their operations. Therefore, substituting recycled water for industrial processes would not face the typical concerns of moving from a potable to a non-potable water supply in terms of historical use practices. The Oregon recycled water use rules approve the use of Class C recycled water for all of the industrial aggregate processes at the Delta Sand & Gravel and Knife River sites. However, the amount of worker exposure to water at the Delta facility, in particular, generated discussion between the project study team and

the industrial operation managers (April 30, 2013 meeting) about worker safety, permissible exposure levels, and overall risks. Class C recycled water use carries the following requirements:

- Controlled site access through fencing, etc.
- Setbacks of water use from fenced perimeters
- Signage notifying visitors and personnel of recycled water use
- Informing of site personnel of recycled water impotability and safety precautions

The ODEQ's Recycled Water Use Plan Internal Management Directive (IMD) requires additional notification to site workers, the public, and other potentially affected parties. The IMD's suggested notification practices include a facilities health and safety training program. Consultant recommendations call for a Site Supervisor Training program as part of the project implementation.

The facilities are already fenced and isolated from public use. However, modifications to practices or equipment, or use of a non-recycled water source for some applications, may be necessary. The EPA *Guidelines for Recycled Water Use* recommends that for industrial sites with high potential for worker exposure, disinfection of recycled water should reduce total coliform levels to a median of less than 14 colonies per 100 milliliter (mL) – a value between that specified for Oregon's Class C and Class A and B waters. Quality control assurances are required under an approved recycled water use plan. These assurances include a formal monitoring, testing, and reporting program (responsibility of the MWMC as recycled water producer).

These considerations suggest that a minimum of Class B water would be needed for the industrial aggregate uses. Given that the disinfection requirements are identical for Class B and Class A, and that the MWMC has tertiary filtration capacity capable of 10 MGD, the study team recommends designing for Class A recycled water (filtered, highly disinfected) production, thereby ensuring ease of permitting and operator acceptance, as well as demonstration of highest quality recycled water for the MWMC's first outside-the-fence application. Furthermore, better understanding of the comparative water quality of Willamette River water at the point of use and the MWMC's recycled water is needed to better communicate the safety of recycled water use.

2.2 WATER RIGHTS MANAGEMENT ASSESSMENT

Purpose: The purpose of this study element is to understand the implications of using recycled water for industrial use in lieu of river water; specifically, what impact does this use have on the operators' water rights, what obligations are required of the MWMC and the users in complying with water rights, and what impact does the conceptual project have on managing instream flow in the Willamette River?

Finding: Based on this assessment, the use of recycled water in place of river or groundwater by the industrial aggregate operators neither conflicts with nor necessarily provides a benefit to their existing water rights. The industrial operators are not at risk of forfeiting unused water rights when substituted with recycled water. Given a theoretical design recycled-water flow of 6 MGD, the equivalent flow limit is 9.3 cubic feet per second (cfs), less than the 12 cfs maximum total site combined water rights. Should infrastructure capacities limit maximum recycled water flow,

additional water needs could be supplemented with existing river water supply. An instream flow lease is not practical given need for backup water supply; however, any unused water right capacity would be an instream flow benefit to the Willamette River.

Studies: The following tech memo was developed in documenting the findings of this study element:

- Internal Tech Memo 07: Industrial Aggregate Water Rights Management Assessment

The results of these studies are described below in the following sub-sections:

- Existing Water Rights Conditions
- Water Rights Under Recycled Water Use
- Instream Flow Management

2.2.1 EXISTING WATER RIGHTS CONDITIONS

The water rights associated with the industrial aggregate properties are represented in Table 2-1, below. Water rights are maximum flow rates in cfs. These water rights are presented as total daily flows converted to MGD based on instantaneous flow rate and daily total flow based on a 10-hour period of operation (the assumed average operational condition).

Table 3-1: Summary of Industrial Aggregate Water Rights

Water Right User	Water Right (cfs)	Equivalent pumping rate (gpm)	Instantaneous Flow Rate (MGD)	Typical Daily Flow (10-hour day; MGD)
Delta (river)	7.14	3,204	4.6	1.9
Knife River (river)	4.5	2,019	2.9	1.2
Knife River (well)	0.33	150	0.22	0.1
Total Industrial Rate	12	5,385	7.75	3.2

The industrial users have water rights adequate to meet their current and forecasted demands for water use. Any use of recycled water would be in lieu of either river water or groundwater. That unused river or groundwater would therefore, remain instream (or in the aquifer). The typical daily water use for industrial aggregate, 3.2 MGD, is virtually equal to the amount of recycled water diversion required for the MWMC's thermal load mitigation (3.1 MGD, under historical conditions).

2.2.2 WATER RIGHTS UNDER RECYCLED WATER USE

The users would not be at risk of forfeiting unused water rights under a recycled water use scenario. Oregon water law specifically protects the water rights of users adopting recycled water use (OAR 540.610(2)(h)). The users would register the use of recycled water with the OWRD, but no water right for recycled water use is applicable. Oregon law allows water rights holders to sell, lease, or donate water rights to be converted to instream water rights. Section 2.2.3 provides further discussion of instream flow management.

Downstream water rights holders are not expected to be impacted by the conceptual recycled water project. The MWMC's discharge constituents under 5% of the Willamette River flow at the site, well under the 50% flow threshold for consideration of injury to downstream water rights users. Furthermore, the site is within two miles upstream of the confluence of the McKenzie River with the Willamette River. Downstream of the McKenzie River, the Willamette is under-allocated, with no risk to junior use curtailment.

2.2.3 INSTREAM FLOW MANAGEMENT

Recycled water use has the potential to both benefit and detract from total stream flow. The Willamette River at the project location has an instream flow water right of 2000 cfs (summer) and 2500 cfs (winter) to support aquatic life and minimize pollution impacts. Given a review of Willamette River flow data, it appears river flows may not be at or below these flows 25-50% of the time in early February and early July. Managing instream flow to prevent further reductions could be important in project considerations.

One method of preserving instream flow is through an instream flow lease on conserved water right withdrawals (as replaced by recycled water). Such leases require defined periods of time that the water lease is in effect, typically on a seasonal basis or longer. Leases can be renegotiated on that periodic basis, but any water right leased for instream use is not available to the certified water right holder during the lease period. Given that the industrial operators view the ongoing availability of river water for industrial use as a critical backup supply to recycled water it appears that an instream lease is not an option, at least for initial project implementation. However, non-withdrawn water would, in effect, remain as instream flow and balance any effluent diverted for recycled water use at the aggregate facilities.

2.3 WATER BALANCE MODELING

Purpose: The purpose of this study element is to provide calculations to ensure a conceptual design balances recycled water supply and demand, determine the net downstream river flow impacts, account for terrestrial pathways of recycled water applied to industrial use, and estimate thermal load discharge benefits.

Finding: Based on this assessment, recycled water supply can meet demand. Thermal load can be significantly reduced through this application of recycled water, despite lower water use need proportionate to operational slow down in late fall through early spring. However, better information is needed to fully evaluate thermal load benefits that may or may not be realized given dynamics of silt settling pond discharge and infiltration.

Studies: The following reports were developed in documenting the findings of this study element:

- Internal Tech Memo 05: Water Balance Model Boundaries, Inputs, and Outputs Definition
- Internal Tech Memo 09: Industrial Aggregate Water Fate Assessment
- UO Student Project Report

- Water Balance Model (alpha, Excel workbooks)

The results of these studies are described below in the following sub-sections:

- Modeling Framework
- Water Flows and Capacities
- Industrial Water Demands
- Recycled Water Use and Fate
- Modeled Water Balances
- Thermal Load Benefits

2.3.1 MODELING FRAMEWORK

The Industrial Aggregate Recycled Water Use Study resulted in the initial development of a water balance model specifically to understand the flow demands for industrial aggregate use and impacts to WPCF effluent and river flows. The model is considered the "alpha" model as it is the initial construct for building in more model sophistication to help the MWMC understand its overall recycled water production needs. The next step "beta" model will include expanded MWMC facilities use and operational demands for multiple recycled water applications, all of which are conceptual or theoretical at this point.

The basic formula of water balance is:

$$\Delta S = \Sigma I - \Sigma O,$$

where:

ΔS = change in water storage,
ΣI = sum of all water inflows, and
ΣO = sum of all water outflows.

The alpha model assumes zero water in storage, so water balance requires that all water inputs equal all water outputs. The model is based on steps of single, 24-hour days for a theoretical 365-day year. That theoretical year is overlaid with the 20-year historical effluent and river flow data set within the Waste Load Allocation Tool (described more fully in 2.3.6 below).

Figure 2-1 presents the basic schematic of water flow paths involved in the model. Four primary areas of flow are recognized: (1) treatment plant effluent is filtered and disinfected in a channel of the chlorine contact basin (CCB) to produce Class A recycled water, and unfiltered effluent is disinfected in the CCB and discharged to the river (the MWMC also produces recycled water for its own facilities, but that use is ignored in the alpha model to gain specific understanding of the flow path for industrial aggregate use); (2) recycled water is distributed to industrial aggregate facilities where it is put to use, potentially with river and groundwater sources; (3) runoff water from the operations travels through settling ponds and recharges the river via hyporheic flow; and, (4) treatment plant effluent enters the river mixing zone, and downstream the river flow may be withdrawn for industrial aggregate use and be recharged via settling pond hyporheic flow.

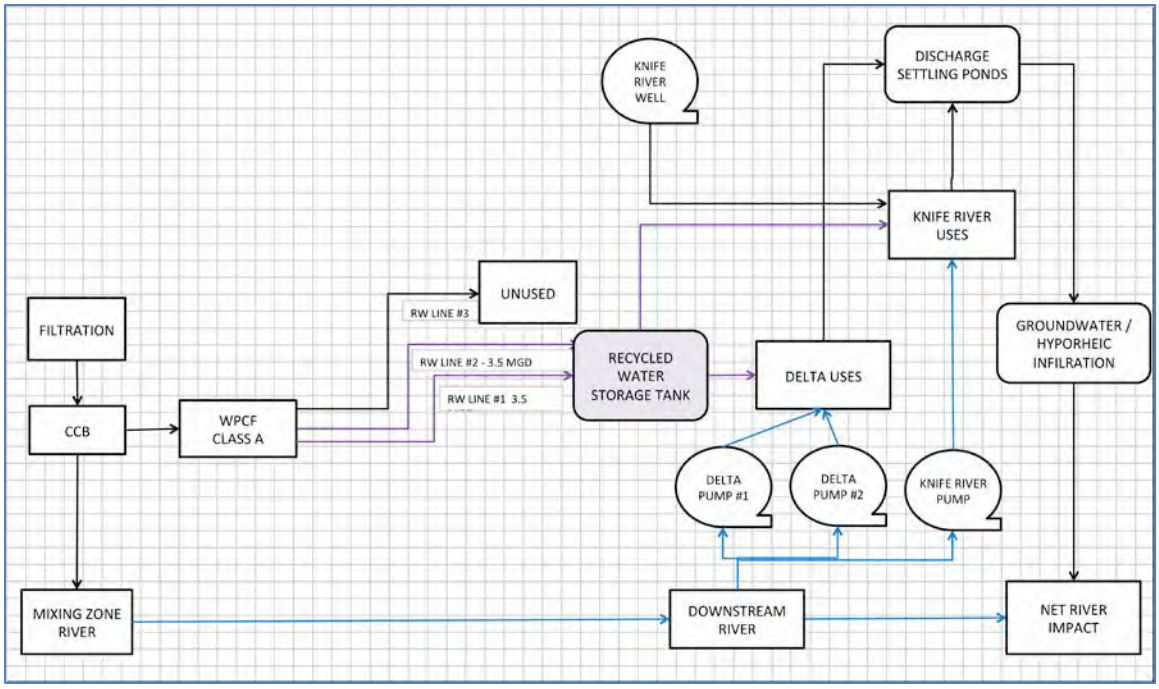


Figure 3-1: System Schematic of Industrial Aggregate Water Throughput

The model constructed for the study is based in Microsoft Excel. Five workbooks compose the model:

1) WBM_Regions.xlsx
2) IndustrialBalance.xlsx
3) EffluentBalance.xlsx
4) RiverBalance.xlsx
5) WLA_Tool.xlsm

TM05 presents the initial basis for development of the model, defining model purpose, boundaries, inputs, and outputs. The subsequent alpha model Excel workbooks developed for the study are presented as a separate file to this report. The base model layout is based on the simple block diagram illustrated in Figure 2-2. Each of the sub-model tools (Industrial Balance, Effluent Balance, and River Balance) provides additional block diagram schematics of all flows accounted for in each sub-region.

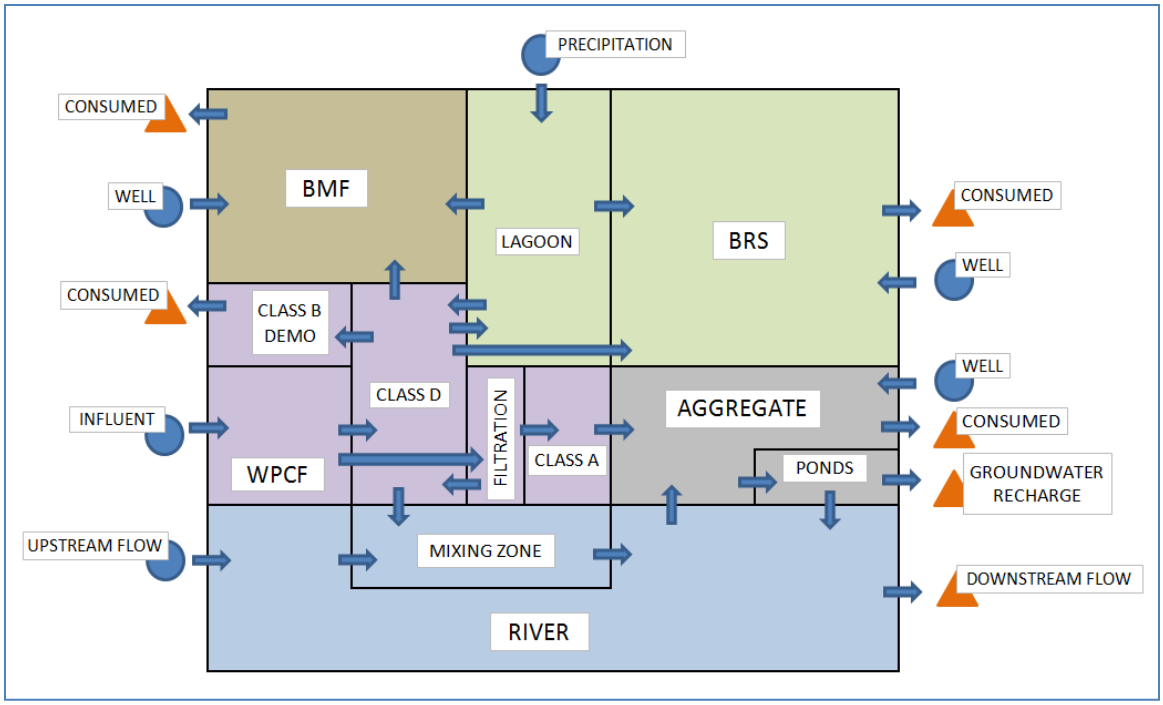


Figure 3-2: Block Diagram of Water Balance Model Boundaries, Inputs, Flowpaths, and Outputs

2.3.2 WATER FLOWS AND CAPACITIES

Recycled water supply for industrial aggregate use is limited by several factors:

- Maximum WPCF filtration capacity for Class A recycled water is 10 MGD (equivalent to 5 million gallons per 12 hour period of use, or a net 5 MGD).
- The existing conveyance lines (West Bank Trail pipeline; three 12-inch diameter pipes) between the WPCF and the aggregate facilities are designed for 3.5 MGD per line (theoretically higher flows are possible).

2.3.3 INDUSTRIAL WATER DEMANDS

Recycled water demand for industrial use is based on the total daily demand for industrial processes up to the limits of recycled water production. Table 2-2 presents monthly variations in the estimated daily total water demand, in MGD, for industrial use. Water demand estimates are based on the following assumptions:

- Concrete mixing will use colder groundwater sources for summer batching
- All other applications will use recycled water as a first source
- Operations are 12 hours per day of continuous use

- Seasonal variations in production ramp down from 100% capacity in summer to 10% capacity in winter.

Table 3-2: Approximation of Industrial Processes Water Demands on a Seasonal (Monthly) Basis

VOLUME OF WATER USE (DEMAND)													
Period: (MM format for lookup)		1	2	3	4	5	6	7	8	9	10	11	12
Application	Baseline*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% Operational	50%	10%	15%	40%	75%	80%	100%	100%	100%	90%	70%	40%	10%
Total Water Use (mgd)	7.75	0.39	0.58	1.55	2.91	3.10	3.88	3.88	3.88	3.49	2.71	1.55	0.39
Rock & Gravel Processing	40%	0.16	0.23	0.62	1.16	1.24	1.55	1.55	1.55	1.40	1.09	0.62	0.16
Dust Control and Washing	40%	0.16	0.23	0.62	1.16	1.24	1.55	1.55	1.55	1.40	1.09	0.62	0.16
Asphalt	15%	0.06	0.09	0.23	0.44	0.47	0.58	0.58	0.58	0.52	0.41	0.23	0.06
Concrete	5%	0.02	0.03	0.08	0.15	0.16	0.19	0.19	0.19	0.17	0.14	0.08	0.02
Total Non-Concrete (Qi8)	**95%**	**0.37**	**0.55**	**1.47**	**2.76**	**2.95**	**3.68**	**3.68**	**3.68**	**3.31**	**2.58**	**1.47**	**0.37**
Concrete demand for recycled water (Qi4C)		**0.02**	**0.03**	**0.08**	**0.15**	**0.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.14**	**0.08**	**0.02**
Concrete demand for well water (Qi5)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.19**	**0.19**	**0.19**	**0.17**	**0.00**	**0.00**	**0.00**
* Baseline operation is 12 hrs/day (i.e. 50% of full day) and water demand equivalent to peak water right capacity.													
Monthly operations is percent of baseline.													

The total daily water demand under these assumptions ranges from 0.39 MGD in winter to 3.88 MGD in summer. No water metering is in place to verify the assumptions. A study involving water metering over long-term use of the facilities would be helpful for developing a better accounting of water use.

2.3.4 RECYCLED WATER USE AND FATE

Definitions of how recycled water will be used and the subsequent fate of the water after use are important for environmental, health and safety, and regulatory compliance considerations. For water balance modeling, the important aspect of water use and fate is an understanding of where water flow is distributed and how it is consumed, evaporated, discharged, or otherwise accounted for after applied use.

Water is recycled to supply demand for beneficial uses. For most recycled water uses, water balance models ensure that recycled water is produced at a rate in balance with water storage and beneficial use consumption. Non-beneficial discharge to groundwater or surface water is not allowed without a discharge permit (separate from registration of recycled water use). The current industrial aggregate practices result in used wash water running into a series of channels, pits, and settling ponds to remove silt. The clean water then seeps out of the settling ponds into subsurface gravels. Ultimately, this water becomes part of the hyporheic flow of the river system.

A University of Oregon master's student project team interested in this topic of water balance accounting for industrial use of recycled water provided additional study research. The team researched the conceptual project water demands to determine values of water use, water losses, water consumption, and water runoff, infiltration, and discharge. Given the lack of site monitoring,

field investigation studies, or representative case study examples, the team provided best estimates of water use. The team's report, presented in Appendix C, also offers evaluation of potential project benefits.

Better understanding of the regulatory requirements for this handling of recycled water as well as the ultimate understanding of thermal load balance from point of effluent diversion for recycled water use to point of return to the river will be important. Given the industrial water demand assumptions of the study and very high level approximations of water runoff from each application, the study team developed a preliminary estimate of recycled water fate associated with industrial aggregate process application, which is summarized in Table 2-3.

Table 3-3: Estimation of Industrial Processes Water Demands and Proportionate Site Runoff

Water Use Application	Environmental Fate	Assumed Overall Site Water Usage	Assumed Runoff Discharge	Net Water Discharge to Settling Ponds
Gravel washing	Evaporation, adhesion, soil infiltration, discharge runoff (settling ponds)	25%	90%	22.5%
Rock crushing	Adhesion, discharge runoff (settling ponds)	15%	90%	13.5%
Concrete batching	Incorporated in product, minimal other losses	5%	10%	0.5%
Asphalt production	Primarily steam/evaporation	15%	10%	1.5%
Equipment wash rack	Mostly runoff (settling ponds), some equipment adhesion/evaporation	19%	60%	11.4%
Wheel wash	Virtually all evaporation, vehicle adhesion, and soil infiltration	1%	10%	0.1%
Dust control	Virtually all evaporation, vehicle adhesion, and soil infiltration	20%	0%	0%
All processes	**All of the above**	**100%**	→	**49.5%**

2.3.5 MODELED WATER BALANCES

Two key objectives of water balance modeling are: (1) assurance that all water flows are accounted for, and (2) determination of final output of flow rates.

Water Balance Accounting

Three key areas of water balance checks exist within the model: (1) industrial use balance, (2) effluent balance, and (3) river flow balance. A fourth area of the model, facilities use balance, is not included in the alpha model but will account for the MWMC's internal site use of recycled water in the beta model development. The following expressions define these balances. The symbol Q represents water flow rate.

Industrial Balance:

$$(Q_{wr} + Q_{gw} + Q_{rw}) = (Q_c + Q_{ro})$$

where:

Q_{wr} = input from river water rights sources
Q_{gw} = input from groundwater sources
Q_{rw} = input from recycled water sources
Q_c = output of water consumed in use (incorporated in product, evaporated, etc.)
Q_{ro}= output of water runoff to settling ponds

Effluent Balance:

$$(Q_e) = (Q_{rw} + Q_d)$$

where:

Q_e = input of treatment plant effluent into final filtration and disinfection
Q_{rw} = output of final treated effluent for recycled water use
Q_d = output of final treated effluent for discharge to the Willamette River

River Balance:

$$(Q_{us} + Q_d + Q_{sp}) = (Q_{wr} + Q_{ds})$$

where:

Q_{us} = input to river as flow upstream of the treatment plant
Q_d = input to river from discharged treatment plant effluent
Q_{sp} = input to river from settling pond infiltration
Q_{wr} = output from river as water right withdrawals
Q_{ds} = output of river as final downstream flow

Flow Rate Output

The key flow rates calculated are the industrial water demands as described in Section 2.3.3. The net daily (24 hour) water demand ranges from 0.39 to 3.88 MGD. For the alpha water balance model, recycled water production is assumed able to meet all industrial demand. The model user can adjust the maximum recycled water flow rate to limit the total demand that can be met by recycled water supply; in that case, the model accounts for river and/or groundwater sources to make up the difference.

In the alpha model, the total recycled water demand for industrial use dictates the flow of effluent diverted for Class A recycled water production. If demand exceeds the limit of Class A production, the total diverted effluent for recycled water use is set equal to the limit; the remainder of industrial water demand is made up through river or groundwater withdrawals. The diverted effluent flow for recycled water production is subtracted from total effluent flow to model the reduced effluent

discharge to the river that would occur. Effluent and river flows are modeled based on a 20-year historical period of record from 1991 – 2011.

2.3.6 THERMAL LOAD BENEFITS

The precursor to the water balance model was the Waste Load Allocation Tool (WLA Tool) developed by the ODEQ for calculating point-source excess thermal load. The MWMC study team modified the WLA Tool to test theoretical conditions and the tool's sensitivity to changes in flows, temperatures, and recycled water diversion. The MWMC is interested in meeting its currently understood near-term regulatory requirement to offset 3.1 MGDof effluent as well as meeting potentially more stringent, future regulatory scenarios. For this reason, the study team developed a "Base Case" scenario, which results in more frequent and widespread days of theoretical excess thermal load. The scenario, based on increasing stresses to river temperature from climate change, federal dam management changes, and population growth, projected to the year 2035, is represented as a calendar showing days of excess.

The alpha model output for recycled water demand and resulting effluent river discharge was plugged into the WLA Tool base case scenario. The thermal load benefits of the conceptual recycled water use are significant. The 2035 Base Case indicates high recurrence intervals of thermal load excess from mid-July through end of October. The modeled recycled water diversion for industrial aggregate use indicates complete temperature mitigation for all occurrences except for one extreme situation in late October. Should that situation continue to be a model result as better information and project design progresses, it may be possible to engineer mitigation through temporary recycled water storage at the WPCF on critical dates. Appendix C presents both the *2035 Base Case* thermal risk calendar and the resulting *Industrial Aggregate Use under 2035 Base Case Conditions* risk calendar.

A critical note is that the model assumes 100% of recycled water's thermal load is diverted from the Willamette River to realize a temperature benefit. Without full understanding of thermal balance involved in water use and discharge at the aggregate facilities, it is unknown whether the silt settling ponds provide additional thermal load reduction benefit, a neutral impact, or a complete pass through of recycled water thermal load back to the river. If the latter is the case, the thermal load mitigation capacity of the project is reduced by approximately 50% (the estimated amount of total water used on site that results in runoff to the settling ponds).

2.4 ENGINEERING FEASIBILITY STUDY

Purpose: The purpose of this study element is to identify all the project infrastructure components, constructability issues, equipment specification, and costs to build, operate, and maintain the conceptual recycled water use project.

Finding: Based on this assessment, the design recommendation is to utilize existing tertiary filtration, CCB, and West Bank Trail pipeline infrastructure to produce and convey Class A recycled

water to the industrial aggregate facilities. Water stored in a hydropneumatic pressure tank would be distributed directly to points of use through a dedicated recycled water service loop. Total 20-year life cycle cost is estimated to be $7,698,000, and approximate thermal load mitigation value is $0.08/kilo-calories per day(kcal/day).

Studies: The following reports were developed in documenting the findings of this study element:

Engineering Reviews

- Internal Tech Memo 10: Industrial Aggregate Use Operating Assumptions
- Kennedy/Jenks Consultants Technical Memorandum: Delta Sand/Knife River Industrial Aggregate Site Recycled Water Conceptual Design

Permitting Reviews

- Internal Tech Memo 11: Environmental Compliances Review Checklist
- Internal Tech Memo 12: Industrial Aggregate Environmental Issues Review
- Kennedy/Jenks Consultants Technical Memorandum: Environmental Regulatory Feasibility Review – Industrial Aggregate Site

The results of these studies are described below in the following sub-sections:

- Conceptual Design Assumptions
- Conceptual Design Specifications
- Costing and Energy Demands
- Permitting and Construction Issues

2.4.1 CONCEPTUAL DESIGN ASSUMPTIONS

The following design assumptions are the basis for the engineering design produced during the study. More detailed design assumptions are presented in TM10: Industrial Aggregate Use Operating Assumptions.

The concept for Industrial Aggregate Recycled Water Use, as updated during the study, assumes Class A recycled water production and delivery directly to each point of use. A tank reservoir system is added to buffer instantaneous peak demands on the supply to economize recycled water system sizing, production, and pumping rates. Pumps for each distribution system needed at the facilities would provide the instantaneous flow rates and pressures as needed. Only one of the West Bank Trail pipelines is deemed to be necessary to accommodate flow demands, but redundant pump systems would provide system reliability.

The primary operating principles are:

1. The MWMC will produce Class A recycled water by adding additional disinfection and pumping capabilities to the tertiary effluent train. The existing tertiary filtration system is capable of producing up to 10 MGD to blend into effluent at the CCB. A segregated disinfection area within the CCB will provide additional chemical disinfection to reach Class A standards.

2. A new recycled water pump station is added to distribute Class A recycled water to service lines feeding away from the WPCF.
3. Class A recycled water service pipelines consist of new piping connected to the existing West Bank Trail pipeline system – the three parallel 12-inch diameter pipes connecting MWMC property with the public easement immediately south of the industrial aggregate property line. Only one or two of the pipes is needed to deliver the required flow.
4. Recycled water delivered to the aggregate site is stored in a buffer tank and distributed via a dedicated recycled water plumbing system to each point of use throughout the facilities.

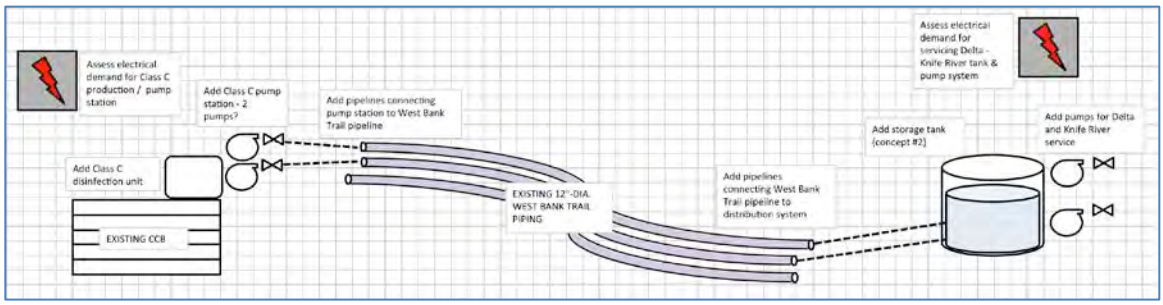


Figure 3-3: Preliminary Conceptual Design Assumption

2.4.2 CONCEPTUAL DESIGN SPECIFICATIONS

Kennedy/Jenks Consultants developed a conceptual design drawing and system specification based on refined assumptions and technical analysis of the required project. The conceptual design is presented in the draft Technical Memorandum - Delta Sand/Knife River Industrial Aggregate Site Recycled Water Conceptual Design (Appendix B).

The produced design specifies the following elements:

- Peak recycled water flow of 7.2 MGD (5,000 gpm)
- Operating pressures ranging 65 to 95 psig (average 80 psig)
- 10 points of use, each with equal distribution flow at 450 gpm, except for asphalt batching, which has the highest peak demand requirement, and was allocated twice the flow rate of other points of use (900 gpm).
- Three cyclical variable speed drive pumps delivering water to a 12,500 gallon hydropneumatic tank
- Ductile iron above-grade and HDPE below-grade 12-inch diameter piping (conveyance line and service loop)
- 6- and 10-inch diameter service lines with buried isolation valves to each location of use
- Reduced pressure principle backflow preventer in non-recycled water service lines to prevent cross-connection of recycled water with river water or groundwater.

The resulting design is presented as Figure 2-4. A larger scale design figure is presented with the consultant Technical Memorandum.

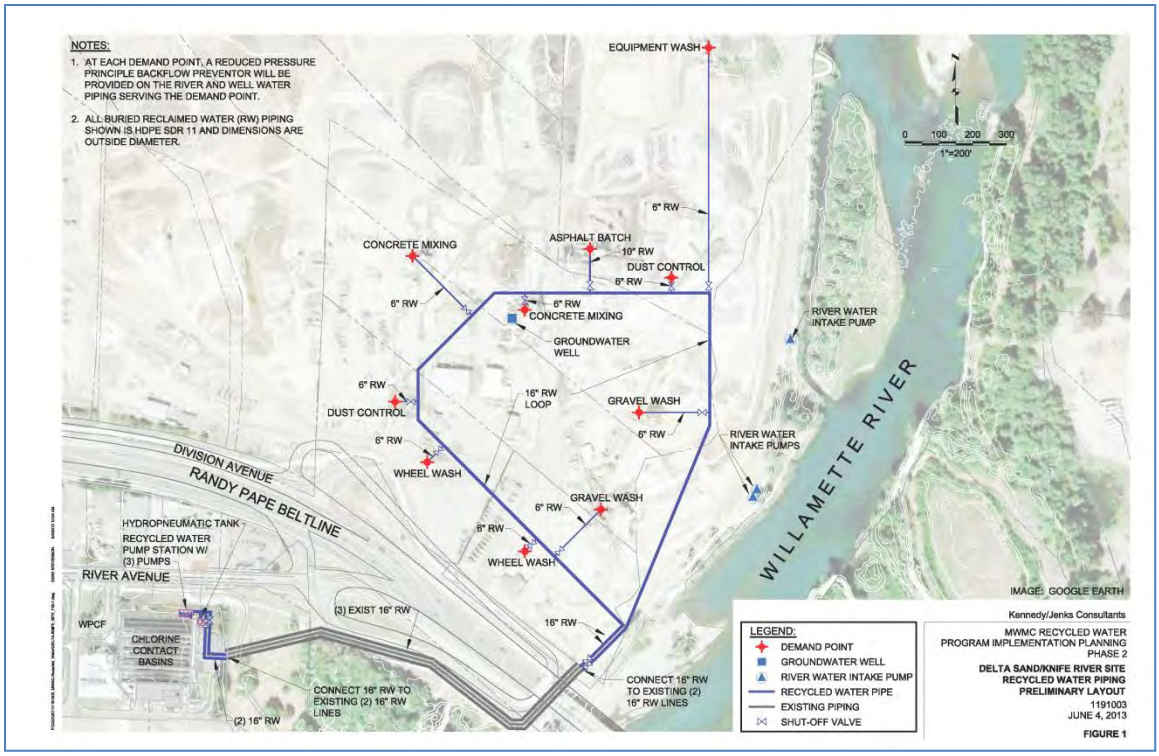


Figure 3-4: Final Conceptual Design Layout

2.4.3 COSTING AND ENERGY DEMANDS

The Phase 1 conceptual project assessment study completed previous to the current study resulted in an engineering cost estimate of $3,074,000, with a total 20-year life cycle cost of $4,701,000 (including $797,000 of consulting and administrative costs). However, the scope of work assumptions underlying the Phase 1 estimate were revised substantially in Phase 2 to address revised aggregate industrial process needs. The Phase 2 design update produced for the current study adds several cost items, bringing the total capital cost to $4,299,000, with a 20-year life cycle cost of $6,801,000. With consulting and administrative costs, the total project value is estimated to be $7,698,000 (approximately 60% increase in estimated cost over Phase 1 assumptions). A complete cost breakdown is presented in the conceptual design technical memorandum (Appendix B).

The primary drivers for increased costs are:

- Production of Class A in place of Class C recycled water
- Additional 3.6 MGDpump
- Increase pump motor sizes from 150 to 200 horsepower
- Addition of hydropneumatic tank
- Addition of site distribution loop, service lines, and backflow preventers

The total energy requirement for the distribution pumps, assumed to be running two at a time for 10 hours per day at 173 horsepower is estimated to be 2,580 kwh/day, resulting in an annual energy cost of $55,563. Additional pumping costs would be associated with pumping effluent through the tertiary filtration unit specifically for Class A water production. Treatment plant staff estimates total cost to run filters is $100/day at 10 MGD. Further analysis will be needed to determine cost of tertiary filtration dedicated to recycled water production.

2.4.4 PERMITTING AND COMPLIANCE ISSUES

An environmental compliance review was conducted as part of the study to understand potential land use, water quality, and other environmental regulatory compliances the project may need to document. Permits for construction and use of recycled water may be contingent on several of these compliance issues. Understanding the permitting complexities, compliance triggers, and overall environmental impacts of the conceptual industrial aggregate recycled water use project is key to evaluating overall cost, TBL benefits, and feasibility of the project. Furthermore, a thorough evaluation of environmental impacts is important for addressing issues most important to various community stakeholders.

The Environmental Compliances Review Checklist (TM11) and Industrial Aggregate Conceptual Project Environmental and Permitting Compliances Review (TM12) provide detailed background, review, and evaluation of potential permitting and construction issues to be considered in evaluating the project feasibility. The primary findings include:

- Industrial aggregate processes are an approved use of Class C recycled water in Oregon
- Federal recycled water use guidance suggest treatment to Class A or B disinfection levels is appropriate for the operational conditions specific to Delta Sand & Gravel
- Plumbing codes and guidelines indicate installation of dedicated, labeled, recycled water piping (“purple pipe”) to each point of use is required
- Discharge of used recycled water to silt settling ponds could prompt an NPDES discharge permit requirement – or generate increased third-party scrutiny or watershed interest-group objections over continued discharge under a WPCF permit.
- Most or all construction would be within existing construction/disturbed ground footprint, largely reducing further documentation or action for many sensitive resources.
- The thermal load mitigation benefits of the project provide overall positive habitat impacts to the project
- No water rights would be interfered with or prevent project feasibility
- No particular land use or constructability issues are noted as potential barriers to project feasibility.

Many of the environmental review processes identified in the checklist are driven by requirements of the National Environmental Policy Act (NEPA). NEPA is only required on projects having a federal nexus (either implemented, permitted, or funded by a federal agency). The NEPA consideration is useful in understanding the potential documentation required for securing potential project funding, particularly for grant opportunities that could enhance the project feasibility.

2.5 STAKEHOLDER ACCEPTABILITY EVALUATION

Purpose: The purpose of this study element is to evaluate how well the proposed project would be received by various stakeholder interests and what project modifications or mitigations could be made to better meet stakeholder objectives.

Finding: Based on this assessment, the premise of conceptual use of recycled water for industrial aggregate use and thermal load mitigation is strongly supported by regulatory agencies and is well-received by water resource interests and conservation groups. However, the key stakeholders – the potential recycled water users at the industrial aggregate site, have expressed doubt and lack of interest in pursuing the project, given perceived business risks without benefits.

Studies: The following reports were developed in documenting the findings of this study element:

- Briefing Sheet for Elected Officials
- MIG Memo: Stakeholder Questionnaire Results and Next Steps

The results of these studies are described below in the following sub-sections:

- Industrial Operator Considerations
- Water Resources Stakeholders Input
- Community Acceptability Assessment

Local elected officials were not directly surveyed for the Industrial Aggregate Feasibility Study, but continue to be apprised of the MWMC's study efforts. Elected officials were engaged and provided input to the MWMC's Phase 1 study considerations. For this study, project managers distributed a briefing sheet to keep elected officials informed (Appendix D).

2.5.1 INDUSTRIAL OPERATOR CONSIDERATIONS

Management personnel from Delta Sand & Gravel and Knife River have been regularly engaged in the MWMC's exploration into a potential recycled water use partnership. Both companies expressed support for the OWRD's funding of this study. In April 2013, the MWMC project team, including consultants and student research team, toured the facilities and interviewed the site managers to better understand water use, needs, and concerns. The key aggregate operator considerations are:

- River water supplies would be relied upon to ensure critical water supply is always met, and need to be available at the flip of a switch.
- Would not be able to convert existing plumbing to recycled water use; would require separate service lines directly to points of use.
- Proven recycled water quality and concrete product performance is absolutely critical for production considerations.
- Customer satisfaction and perception of product is critical to business.
- Need to understand relative risks of recycled water use (particularly compared to current practice of river water use).

- Worker safety and acceptance of recycled water is key.
- Overall concern about cost of implementing, worker health and safety, and regulatory compliance.

Given the lack of identified business benefits (particularly cost savings), and the mounting overall concerns about unproven recycled water reliability, both Delta and Knife River opted late in the study to withdraw from further participation. Should the MWMC identify project benefits and risk reduction, the project could be feasible for further consideration.

2.5.2 WATER RESOURCE AGENCY AND ORGANIZATION INPUT

The study project manager delivered presentations and hosted roundtable discussions with water resource stakeholders in April and May 2013 to gather input on project feasibility and community acceptability. Given the preliminary stage of the MWMC's overall recycled water conceptual alternatives assessment and the focus on the industrial aggregate alternative for this study in particular, stakeholder engagement was targeted to three specific audiences:

1. Water resource and aquatic habitat agencies (Eugene Water & Electric Board (EWEB), ODEQ, OWRD, and Oregon Department of Fish & Wildlife (ODFW))
2. Watershed conservation interests (local watershed councils)
3. Sustainable water resource interests (University of Oregon urban water planning students)

2.5.3 COMMUNITY ACCEPTABILITY ASSESSMENT

Communications consultant MIG reviewed the stakeholder survey results and input received from various stakeholder meetings. The summary of survey results is presented in MIG's memo report *Stakeholder Questionnaire Results and Next Steps* (Appendix D). The key findings of the assessment are:

- All respondents felt somewhat to very well informed about recycled water use and the MWMC's interest in water recycling.
- Most respondents were very supportive (92%) of the concept of water recycling. All agency staff is very supportive (100%).
- All respondents were supportive of the potential use of recycled water by industrial aggregate operations adjacent to the Eugene-Springfield wastewater treatment plant (91% were supportive or very supportive; 9% were somewhat supportive). Of agency staff, 100% were very supportive.
- Major concerns about recycled water use are avoiding human health and safety risks and protecting groundwater.
- Based on the questionnaire results, the presentations by program staff appear to be effective in informing stakeholders about recycled water and obtaining support for potential directions. In addition, this effort has helped identify areas where more information should be provided or messaging refined in the future to increase stakeholder support.

Key consultant recommendation: The MWMC should continue emphasizing recycled water objectives that have strong stakeholder agreement to gain support, and should further research and emphasize where recycled water is an asset to:

- Protect the Willamette River
- Conserve water resources
- Meet regulatory requirements
- Increase community sustainability
- Provide flexibility to adapt to future water resource needs
- Restore watershed health
- Diversify water resource practices

2.6 TRIPLE BOTTOM LINE COST-BENEFIT ANALYSIS

Purpose: The purpose of this study element is to evaluate the full costs of the project as well as potential project benefits, both internal and external to the MWMC, particularly in the interest of the Eugene-Springfield community. The TBL assessment of economic, environmental, and social impacts of the project can be used to make an informed decision on project value based on organizational mission and community values.

Finding: Based on this assessment, the Industrial Aggregate Recycled Water Use alternative presents potentially higher cost of thermal load compliance than riparian shade credits would, but also presents the potential for significant energy costs and greenhouse gas emission reduction, lower pollutant loading in general, reduced pressure on river water withdrawal, and investment in sustainable water resource infrastructure for the future. Riparian shade projects would provide more aesthetic value and a broader range of ecosystem benefits, but a dispersed thermal load reduction in the watershed, as opposed to reduction at the point source.

Studies: The following reports were developed in documenting the findings of this study element:

- SWOT Assessment Matrix
- Good Company Report: Triple Bottom Line Assessment: Recycled Water Use at Industrial Aggregate Facilities

The results of this study are described below in the following sub-sections:

- Strategic Goals and SWOT Analysis
- Triple Bottom Line Methods and Reporting
- Project Cost-Benefit Overview

2.6.1 STRATEGIC GOALS AND SWOT ANALYSIS

The MWMC has strategic goals associated with recycled water use and implementation planning. These goals continue to serve as a basis for steering and evaluating conceptual recycled water uses. The seven primary goals are:

- **Goal 1: COMMUNITY VALUES** Develop a recycled water program that reflects community values, responds to community needs and provides opportunities to obtain community input.
- **Goal 2: REGULATORY COMPLIANCE** Help meet environmental regulatory discharge requirements of the WPCF through reduction of thermal load, nutrients, suspended solids and/or other constituents to the Willamette River by diverting high-quality, treated effluent (recycled water) to beneficial reuse applications.
- **Goal 3: COST EFFECTIVENESS** Meet recycled water usage goals through applications that are cost effective to the MWMC.
- **Goal 4: COST BENEFITS** Maximize cost offsets through fee-based recycled water delivery by developing recycled water applications that meet water supply interests and demands.
- **Goal 5: ENVIRONMENTAL BENEFITS** The recycled water program and applications will enhance surface water quality and protect water resources.
- **Goal 6: REGIONAL WATER SUPPLY BENEFITS** Develop recycled water applications that reduce stresses on local surface water and groundwater supplies.
- **Goal 7: SUSTAINABILITY** Develop a recycled water program that enhances future regulatory compliance, offsets needs for future treatment system infrastructure, is economically balanced, and is flexible to meet challenges of triple bottom line methods and reporting.

Given the study's strategic goals, a TBL cost-benefit evaluation was proposed for the Phase 2 study. The Industrial Aggregate Recycled Water Use conceptual alternative was selected to pilot a TBL methodology and assessment. To initiate the TBL process, program staff developed a SWOT matrix (SWOT stands for Strengths, Weaknesses, Opportunities, and Threats). SWOT analysis is a common element of organizational strategic planning. The SWOT matrix, presented in Appendix B, identifies in quick reference of initially recognized potential project pros and cons for further consideration through TBL assessment.

2.6.2 TRIPLE BOTTOM LINE METHODS AND REPORTING

Kennedy/Jenks Consultants teamed with Good Company, a local sustainable business consultant, to lead the TBL evaluation for the study. The TBL process for this study included the following steps:

1. Use study strategic planning goals and SWOT matrix as starting point of evaluation.
2. Identify project metrics to evaluate under Economic, Environmental, and Social aspects of benefit analysis.

3. Gather existing data and study results to assess metric values.
4. Identify data gaps and seek new information as available.
5. Recommend mitigation for potential project impacts.
6. Present findings report.

The next step of the TBL analysis will be to review the findings with project decision-makers and determine how to appropriately weight metrics and rank alternatives to best reflect the over project TBL benefit based on the MWMC's objectives and its stakeholders' values.

The key TBL aspects for the recycled water study identified by Good Company are as follows.

Economic Aspects

- Capital Costs and 20-Year Net Present Value
- Operational Change and Risk

Environmental Aspects

- Habitat and Biodiversity
- Water Quality and Regulatory Compliance
- Greenhouse Gas Emissions

Social Aspects

- Human Health and Safety
- Community Development

For this study, the Industrial Aggregate Recycled Water Use Conceptual Alternative was evaluated in comparison with "existing conditions" (the without-project alternative), and "riparian shade credits" (the most likely thermal load mitigation alternative to recycled water use).

2.6.3 PROJECT COST-BENEFIT OVERVIEW

The TBL assessment resulted in the following statement of findings.

> The Industrial Aggregate site and operations provide a unique opportunity for development of recycled water infrastructure in our community as the site is close to the WPCF and that Industrial Aggregate's water demand matches the WPCF's compliance needs and ODEQ's approved uses for recycled water. For Industrial Aggregate specifically, the project offers installation of recycled water infrastructure potentially at no cost and reduced energy costs (associated with pumping water). Recycled water offers a revenue/cost recovery opportunity for the MWMC through the sale of recycled water and it offers the community a means for adapting to the possibility of increased frequency of low-flow river conditions due to climate change. By developing infrastructure and experience within the Industrial Aggregate project, the MWMC is better positioned to produce recycled water in the future.
>
> However, there are numerous, significant and potentially insurmountable financial and operational barriers to overcome. These include: an additional 20-year cost of $2.3 million

to MWMC (compared to the 20-year net present value of purchasing riparian shade credits); neither Delta nor Knife River are water limited for production; the likelihood of new permits being needed by Industrial Aggregate or the WPCF; production concerns about product quality, liability and supply disruptions; insuring the health and safety of Industrial Aggregate employees who would be routinely and significantly exposed to the recycled water; and a limited lifetime of Delta's production at the site (estimated between 10 -12 years).

The findings presented in the TBL Assessment are summarized in Table 2.4..

Table 3-4: Summary of TBL Findings of Thermal Load Mitigation Alternatives

	Industrial Aggregate Recycled Water Use Alternative	**Riparian Shading Credit Alternative**
Economic Aspects	• 20-year NPV: $6.8 million • $0.08/kcal/day • Annual energy cost reduction of $66,000/year	• 20-year NPV: $4.5 million • $0.05/kcal/day
Environmental Aspects	• Reduces thermal load at point source location • Reduces discharge of additional pollutants • Net greenhouse gas (GHG) emission reduction of roughly 25% of the MWMC's current emissions • Requires use of additional materials (filter media and chlorine) • Reduces withdrawal of water from river and groundwater sources	• Reduces thermal load elsewhere in watershed (non-local) • Provides temperature benefit directly on salmon habitat stream channel • Newly planted trees provide carbon sequestration (no net GHG impact yet determined) • Provides multiple habitat/ecosystem benefits • May require use of herbicides
Social Aspects	• Increases human exposure to recycled water • Class A recycled water is highest quality; likely exceeds quality of river water in many ways • Invests in development of recycled water infrastructure to meet future community water resource needs and adaptability	• Improved landscape aesthetics

3 STUDY CONCLUSIONS AND RECOMMENDATIONS

Recommendations are based on evaluation of study findings and the near-term and long-term goals of the planning study. Goals are described in Section 1. The capacities of the project to meet those goals are summarized in Table 3-1 below.

Near-Term Goals	Project Capacity
Provide reliable, cost-effective, and environmentally beneficial recycled water use of approximately 3 MGD for industrial aggregate and construction products.	The project appears to be feasible from a constructability standpoint for the target use and flow rate. Further confirmation of energy savings and securing of funding partnerships could make the project cost effective. The project would have water resource, habitat, and greenhouse gas benefits.
Serve as a demonstration site for fostering community interest in future recycled water use.	The site provides excellent potential to demonstrate Class A recycled water safety and benefits to the community. However, smaller demonstrations of "outside the fence" recycled water applications may be necessary to achieve critical stakeholder support for the conceptual project prior to implementation.
Long-Term Goals	**Project Capacity**
Maintain thermal load compliance to meet Willamette River water quality and habitat needs.	The project exhibits high capacity to meet the MWMC's full thermal load mitigation needs for theoretically amplified temperature conditions through the year 2035. However, Delta Sand & Gravel's projected gravel supply will be depleted by 2025, greatly reducing recycled water demand and therefore thermal load mitigation capacity. However, recycled water use for habitat or water quality treatment through reclaimed gravel pits could offer future thermal mitigation benefits. Better understanding of the fate and thermal balance of water discharged to silt settling ponds needs to be evaluated.
Make more efficient use of water resources through recycled water use in lieu of freshwater sources.	The project is supported by water resource agencies as a step toward providing freshwater resource alternatives. The project would result in reduced withdrawal of river water and groundwater. However, the project does not offset potable water use, which would exhibit a greater community benefit.
Contribute to local energy efficiency and recycled material content goals.	The project potentially could reduce energy demands for pumping and water heating costs. However, there is not a LEED or other sustainable building material recognition given for recycled water content in concrete. Despite that, some community interests may value the practice.
Gain visibility, recognition, and community support for recycled water use.	The project garners strong initial stakeholder support. Given the endorsement of diverse water resource agency and conservation groups, the project appears well poised to continue gaining support from the larger community, and could be a good initial demonstration of recycled water use beyond the MWMC's fenceline.

3.1 OVERALL FEASIBILITY OF INDUSTRIAL RECYCLED WATER USE

From a construction and project implementation standpoint, the conceptual project is highly feasible. The project makes use of key existing infrastructure (tertiary filtration, CCB, and West Bank Trail recycled water pipeline). Almost all new construction would occur either on MWMC or Delta Sand & Gravel property. A short segment of pipeline would go through a public easement right-of-way. Although a large diameter potable water line exists in the right of way, the recycled water piping would cross beneath and perpendicular to the potable water line in full compliance with required regulations.

With the key exception of further understanding of how used recycled water discharged to settling ponds would be regulated, all other environmental compliance and permitting of the conceptual project does not appear to present any feasibility challenges . The situation is unique in that no single recycled water use rule or water discharge regulation appears to directly address the concept of beneficial recycled water use and subsequent discharge. Negotiation with the site owner, regulatory agencies, and affected stakeholders may need to occur. Permitting complexity could impact the project feasibility.

There is good initial stakeholder acceptance and support for the project concept, with the key exception of the industrial aggregate operators. Based on discussions of project issues, but not conclusions, operators have identified only business risks in adopting recycled water use and no actual benefits. Given positive energy cost projections from the project, strong regulatory agency support, and potential for Class A recycled water to exceed Willamette River water quality, there is potential to better identify operational benefits and mitigate risk to the industrial aggregate operators.

3.2 POTENTIAL ASSETS/DRAWBACKS

The project study identified the following key assets and potential drawbacks.

<u>Assets</u>

- Industrial partners supportive of sustainable product practices and community improvement
- Trial concrete mixing with Class C recycled water was positive
- Good utilization of existing infrastructure
- Demonstration of high quality Class A recycled water use
- Reduction of river and groundwater withdrawals
- Thermal load reduction capacity to meet most projected, exacerbated temperature conditions
- Additional discharge pollutant load reductions
- Reduced greenhouse gas emission and energy footprint
- Reduced pumping and heating costs can be achieved
- Step toward future expansion of recycled water infrastructure
- Cost for thermal load reduction may be competitive with riparian shade, depending on further verification of riparian shade credit costs.

Drawbacks

- No track record with Class A recycled water quality or known potential impacts to concrete or other products
- Recycled water use rules and protections imply recycled water presents risks to worker health and safety
- Potential regulatory umbrella of an NPDES discharge permit requirement for recycled water runoff to silt settling ponds
- Lack of thermal balance data on settling pond infiltration and river recharge. Discounting 100% of settling pond discharge from recycled water diversion of thermal load could reduce the thermal load benefit of the project by approximately 50%.
- Lack of direct business or water supply benefit to operators presents no incentive for industrial partners to cost share in construction or to pay for recycled water service
- Insufficient water use data to fully estimate water use with the accuracy needed to determine the precise thermal load benefits of project
- Recycled water demand in late October may drop during the period when thermal load compliance is at greatest risk
- Potentially costlier than riparian shade credits

3.3 FURTHER CONSIDERATIONS TO BE MADE

The following key assessments need follow-up to address the project assets and drawbacks listed above.

- Comparison of Class A recycled water with Willamette River water quality at point of use.
- Assessment of settling pond discharge fate and compliance with recycled water use rules and Clean Water Act (NPDES) discharge requirements.
- Consideration of supplying only high-volume, low-exposure, and low-runoff applications with recycled water to control for worker exposure and settling pond discharge concerns. This could include sole supply to Knife River operations for concrete and asphalt production.
- Case study examples of concrete production with recycled water having similar qualities to the MWMC's potential Class A recycled water quality to demonstrate product integrity, operational safety, and customer satisfaction.
- Exploration of agreements that would retain as much instream water flow as practical in the Willamette River (among the MWMC, industrial aggregate operators, water resource agencies, and water trust organizations).
- More detailed energy and material demand analysis to determine potential energy and cost savings and how the bottom line could result in a win-win opportunity for a public-private partnership.
- Continued engagement with community stakeholders to ensure project acceptability and support.

Attachment 5 - Letters of Support

KNIFE RIVER CORPORATION
AN MDU RESOURCES COMPANY

September 15, 2020

Mr. Matt Stouder, General Manager
Metropolitan Wastewater Management Commission
225 Fifth Street
Springfield, OR 97477

RE: INTEREST AND INTENTION IN PURSUING RECYCLED WATER PROJECTS

Mr. Stouder,

Knife River wishes to express its interest and support for the Metropolitan Wastewater Management Commission's (MWMC's) development of Class A recycled water for community uses. Knife River expresses its intention to be an initial partner in water reuse as a demonstration user of Class A recycled water for equipment washing, wheel washing, and dust control.

Knife River appreciates the level of effort and planning the MWMC has put in over the past decade to wisely invest in the safe and beneficial use of recycled water in our community. Our participation in the 2013 *Industrial Aggregate Recycled Water Use Planning Study,* completed by the MWMC for the Oregon Water Resources Department, demonstrates our early support for the concept. The MWMC's commitment to develop Class A recycled water, the highest quality recycled water class in Oregon, addresses the findings of the study related to project feasibility and opportunities.

As partners in natural resource management, Knife River strives to be good stewards of our water resources and protection of the Willamette River. Demonstrating safe and reliable recycled water use at our facility will open the opportunity to expand our use of recycled water in the future, setting us up to be partners in reducing the stresses on the Willamette River in times of drought and warm temperatures. We are pleased to be an early partner in this important community asset.

Sincerely,

Tami Canaday
Eugene/Florence Division Manager

Eugene Public Works
Parks & Open Space

11/10/2020

Mr. Matt Stouder, General Manager

Metropolitan Wastewater Management Commission

225 Fifth Street

Springfield, OR 97477

RE: INTEREST AND INTENTION IN PURSUING RECYCLED WATER PROJECTS

Mr. Stouder,

The City of Eugene Parks & Open Space Division's Park Operations Section is responsible for irrigation in City parks. As such, we wish to express our interest and support for the Metropolitan Wastewater Management Commission's (MWMC's) development of Class A recycled water for community uses. Our intention is to be a partner in water reuse through turf and landscape irrigation.

The Parks and Open Space Division appreciates the level of effort and planning the MWMC has put in over the past decade to wisely invest in the safe and beneficial use of recycled water in our community. The MWMC's commitment to develop Class A recycled water, the highest quality recycled water class in Oregon, is key to our ability to significantly reduce our use of potable water for irrigation purposes.

Having a safe and reliable recycled water source for parks irrigation aligns with our sustainability goals and will expand our use of recycled water in the future. Since 2017, Eugene Parks and Open Space has been certified Salmon-Safe. This certification brings with it some conditions focusing on ways to continue to improve our natural resource stewardship. One of those is around water conservation. This project provides exciting potential to improve our ability to conserve the valuable water resources of our community and region. We are pleased to be a partner in this important community asset.

Sincerely,

Chris Girard

Chris Girard
City of Eugene
Park Maintenance Manager
541-682-4824

DELTA SAND & GRAVEL CO.
999 DIVISION AVENUE | EUGENE, OREGON 97404 | PHONE (541) 688-2233 | FAX (541) 688-8610

September 2, 2020

Mr. Matt Stouder, General Manager
Metropolitan Wastewater Management Commission
225 Fifth Street
Springfield, OR 97477

RE: INTEREST AND INTENTION IN PURSUING RECYCLED WATER PROJECTS

Mr. Stouder,

Delta Sand & Gravel (Delta) wishes to express its interest and support for the Metropolitan Wastewater Management Commission's (MWMC's) development of Class A recycled water for community uses. Delta expresses its intention to be an initial partner in water reuse as a demonstration user of Class A recycled water for equipment washing, wheel washing, and dust control.

Delta appreciates the level of effort and planning the MWMC has put in over the past decade to wisely invest in the safe and beneficial use of recycled water in our community. Our participation in the 2013 *Industrial Aggregate Recycled Water Use Planning Study,* completed by the MWMC for the Oregon Water Resources Department, demonstrates our early support for the concept. The MWMC's commitment to develop Class A recycled water, the highest quality recycled water class in Oregon, addresses the findings of the study related to project feasibility and opportunities.

As partners in natural resource management, Delta strives to be good stewards of our water resources and protection of the Willamette River. Demonstrating safe and reliable recycled water use at our facility will open the opportunity to expand our use of recycled water in the future, setting us up to be partners in reducing the stresses on the Willamette River in times of drought and warm temperatures. We are pleased to be an early partner in this important community asset.

Sincerely,

Stan Pickett, President
Delta Sand & Gravel Co.

Lane County Public Works Department

April 26, 2021

Grant Program Coordinator
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

OWRD Grant Program Coordinator,

I am writing to support the Metropolitan Wastewater Management Commission's (MWMC) grant application for the "Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities Project." This project was developed through a decades-long scoping and planning process that involved multiple stakeholders and regulatory considerations.

Development of Class A recycled water facilities to produce, store, and distribute this alternative water resource is identified as a priority in the 2021 Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan and Eugene Water & Electric Board's (EWEB) 2018 Water Conservation and Management Plan. Community recycled water use was also identified for long-term development under the MWMC's 2004 Facilities Plan.

Implementation of Class A recycled water use with the MWMC's demonstration partners is critical to expanding the use of recycled water in our community in the decade ahead. The project partners were identified through feasibility studies and stakeholder interviews. These initial uses will provide community engagement throughout Eugene neighborhoods via the street tree watering program, offer interpretative and recreational opportunities at the MWMC's treatment plant facility landscaping along the City of Eugene's West Bank Path system, and demonstrate industrial-scale usage at nearby construction aggregate (sand and gravel) facilities.

My organization fully supports this project and we urge the OWRD to help fund this important step forward in water resource development for our community.

Sincerely,

Daniel M. Hurley
Director, Department of Public Works
Lane County

Eugene Water & Electric Board
500 East 4th Avenue/Post Office Box 10148
Eugene, Oregon 97440-2148
541-685-7000
www.eweb.org

April 27, 2021

Grant Program Coordinator
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

OWRD Grant Program Coordinator,

I am writing to support the Metropolitan Wastewater Management Commission's (MWMC) grant application for the "Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities Project." This project was developed through a decades-long scoping and planning process that involved multiple stakeholders and regulatory considerations.

Development of Class A recycled water facilities to produce, store, and distribute this alternative water resource is identified as a priority in the 2021 Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan and Eugene Water & Electric Board's (EWEB) 2018 Water Conservation and Management Plan. Community recycled water use was also identified for long-term development under the MWMC's 2004 Facilities Plan.

Implementation of Class A recycled water use with the MWMC's demonstration partners is critical to expanding the use of recycled water in our community in the decade ahead. The project partners were identified through feasibility studies and stakeholder interviews. These initial uses will provide community engagement throughout Eugene neighborhoods via the street tree watering program, offer interpretative and recreational opportunities at the MWMC's treatment plant facility landscaping along the City of Eugene's West Bank Path system, and demonstrate industrial-scale usage at nearby construction aggregate (sand and gravel) facilities.

EWEB fully supports this project, and we urge the OWRD to help fund this important step forward in water resource development for our community.

Sincerely,

Wally McCullough
Digitally signed by Wally McCullough
Date: 2021.04.27 07:25:30 -07'00'

Wally McCullough
Water Engineering Supervisor

Rely on us.

CITY OF SPRINGFIELD, OREGON

DEVELOPMENT AND PUBLIC WORKS DEPARTMENT
ENVIRONMENTAL SERVICES DIVISION

225 FIFTH STREET
SPRINGFIELD, OR 97477
(541) 726-3694
FAX (541) 726-2309
www.springfield-or.gov

April 26, 2021

Grant Program Coordinator
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

OWRD Grant Program Coordinator,

I am writing to support the Metropolitan Wastewater Management Commission's (MWMC) grant application for the "Eugene Construction Aggregate and Public Greenspace Class A Recycled Water Facilities Project." This project was developed through a decades-long scoping and planning process that involved multiple stakeholders and regulatory considerations. Initial uses of recycled water in Eugene will provide water resource benefits valuable to the entire community.

Development of Class A recycled water facilities to produce, store, and distribute this alternative water resource is identified as a priority in the 2021 Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan and Eugene Water & Electric Board's (EWEB) 2018 Water Conservation and Management Plan. Community recycled water use was also identified for long-term development under the MWMC's 2004 Facilities Plan.

Implementation of Class A recycled water use with the MWMC's demonstration partners is critical to expanding the use of recycled water in our community in the decade ahead. The project partners were identified through feasibility studies and stakeholder interviews. These initial uses will provide community engagement throughout Eugene neighborhoods via the street tree watering program, offer interpretative and recreational opportunities at the MWMC's treatment plant facility landscaping along the City of Eugene's West Bank Path system, and demonstrate industrial-scale usage at nearby construction aggregate (sand and gravel) facilities.

The City of Springfield's Environmental Services Division fully supports this project and we urge the OWRD to help fund this important step forward in water resource development for our community.

Sincerely,



Matt Stouder
Environmental Services Director

Attachment 6 - Plans, Designs, and/or Engineering Specifications

Kennedy Jenks

240 Country Club Road, Suite A
Eugene, Oregon 97401
541-338-8135
FAX: 541-338-8180

Class A Recycled Water Facilities
Conceptual Design Report

26 February 2021



EXPIRES: 6/30/22

Prepared for

Metropolitan Wastewater Management Commission
225 Fifth Street
Springfield, Oregon 97477

KJ Project No. 1776023*00

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G Bulk Water Fill Station Technical Memorandum
H Construction Costs Technical Memorandum

List of Abbreviations

%	percent
BMF	Biosolid Management Facility
CCB	chlorine contact basin
CMU	concrete masonry unit
gpm	gallons per minute
gpm/sf	gallons per minute per square foot
hp	horsepower
HRCCB	high rate chlorine contact basin
MG	million gallons
mgd	million gallons per day

mJ/cm^2	millijoules per square centimeter
mL	milliliter
MWMC	Metropolitan Wastewater Management Commission
NTU	nephelometric turbidity unit
NWRI	National Water Research Institute
OAR	Oregon Administrative Rule
psi	pounds per square inch
sf	square foot
TM	Technical Memorandum
UV	ultraviolet
VFD	variable frequency drive
WPCF	Water Pollution Control Facility

Section 1: Introduction

This Conceptual Design Report (Report) has been developed in accordance with the Metropolitan Wastewater Management Commission's (MWMC) contract authorization to Kennedy Jenks for professional engineering services regarding their recycled water program. The contract is titled, *"Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project P80062 and P80098, Amendment 9"*.

This Report summarizes evaluations done to select a recommended project alternative for the MWMC's implementation of an initial demonstration sized Class A recycled water program. The program is intended to initially provide Class A recycled water for three users. These users include Delta Sand & Gravel Co. (Delta S&G) for equipment washing and dust control; the MWMC for landscape irrigation at the water pollution control facility (WPCF); and the City of Eugene Parks & Open Space for use in their urban tree watering program. As the recycled water program demonstrates that it is a safe and reliable source of water, the MWMC will seek to identify additional users to increase the demand for recycled water. Facilities constructed for the initial demonstration of Class A recycled water will be designed to facilitate future expansion.

Work completed as part of the conceptual design process for the Class A Recycled Water Facilities included developing design criteria and an initial fatal flaw analysis of alternatives. The design criteria will be used to guide the design of the recycled water facilities. The fatal flaw analysis was conducted as a means of efficiently narrowing the number of alternatives for further consideration while still documenting the wide range of potential options.

Project alternatives remaining after completion of the fatal flaw analysis were evaluated in more detail. Alternatives associated with the following project elements were included in this additional evaluation: tertiary filtration, Class A disinfection, recycled water storage, recycled water pumping, and bulk water fill station. In each case, alternatives associated with the project element were compared and a recommended alternative was selected. Technical memoranda (TM) were developed to document each evaluation and are included as appendices to this Report. The TMs listed below were developed to document each evaluation and are included as appendices to this Report. A summary of these evaluations is presented within the body of this Report.

- Basis of Design TM
- Fatal Flaw Analysis TM
- Tertiary Filter Evaluation TM
- Class A Disinfection Alternatives Analysis TM
- Recycled Water Storage Alternatives TM
- Recycled Water Pumping Station Alternatives TM
- Bulk Water Fill Station TM
- Construction Costs TM

Based on the evaluations of the individual project elements, a preferred overall project alternative was identified that includes improvements to the tertiary filters, use of ultraviolet light for disinfection, use of the WPCF's existing High Rate Chlorine Contact Basin (HRCCB) for recycled water storage, a vertical turbine type recycled water pumping station and associated site and infrastructure improvements. A more detailed project description, opinion of probable construction cost, and estimated project schedule are presented in the final section of this Report.

Section 2: Basis of Design

This section summarizes design criteria contained in the Basis of Design Technical Memorandum (TM) dated August 2020 and other alternatives analysis TMs prepared by Kennedy Jenks for the Project. Copies of these TMs are included in appendices A through H of this Report. Design criteria summarized below will be used to guide design of the Class A Recycled Water Facilities.

Design criteria are presented below in Table 1 below and are organized into seven categories. Assumptions and clarifying information regarding criteria from these categories are discussed under the appropriate subsections below.

Table 1: Class A Recycled Water Facilities Design Criteria

Item	Value
Water Quality	
Recycled Water Class	A
Turbidity, NTU	
24-hour mean	≤ 2
5% of time during a 24-hour period	≤ 5
Maximum	≤ 10
Total Coliforms (organisms per 100 mL)	
7-day median	≤ 2.2
Maximum	23
Water Demand and Pressure	
Water Demand	
Average Annual, mgd	0.19
Max Day, mgd	0.65
Peak, gpm	1,460
Pressure, point of use, psi[(a)]	30 – 60
Tertiary Filtration	
Tertiary Filter Feed Pumps	
Type	Submersible, Variable speed
Number[(b)]	5
Capacity, each, mgd	0.65 / 5.5
Motor Power, hp	3 / 60
Tertiary filters	
Type	Compressible media
Number	5
Filtration Area per Filter, sf	49
Filtration Rate, gpm/sf	5 - 40
Capacity, total, mgd[(c)]	0.35 – 11.0

Item	Value
Disinfection[d]	
Type	Ultraviolet Light (UV), Low Pressure, Open Channel
Capacity, mgd	1.3
Design UV Dose, mJ/cm2	100
UV Transmittance, %	55
UV Lamp Output, %	50
Quartz Sleeve Transmittance, %	80
Number of Channels	1
Number of UV Banks, minimum[e]	3
Recycled Water Storage	
Minimum Design Capacity, days[f]	1
Recycled Water Pumping Station	
Type	Vertical Turbine, Variable Speed
Number of pumps[g]	3
Capacity, each, gpm	730
Discharge pressure, psi	80
Bulk Water Fill Station	
Type	Metered, Side Fill
Capacity, gpm	200

Notes:

(a) Point of use pressure requirement depends on use. For example, the system will be designed to provide Delta Sand & Gravel (Delta S&G) with water at a pressure between 30 and 50 psi.
(b) Tertiary filter feed pumps include two new 0.65 mgd, 3 hp pumps and three existing 5.5 mgd, 60 hp pumps.
(c) Maximum capacity with one filter out of service or in backwash.
(d) UV system will be designed in accordance with National Water Research Institute (NWRI) guidelines.
(e) A minimum of two duty and one redundant UV bank is required to meet NWRI guidelines.
(f) Days of storage at maximum day demand which is equivalent to 0.65 million gallons (MG). Usable volume of the High Rate Chlorine Contact Basin (HRCCB) which will be used for recycled water storage is equal to about 0.98 MG.
(g) Includes one standby pump.

2.1 Water Quality

In Oregon, recycled water is classified as Class A, B, C, or D according to the level of disinfection and filtration applied to treated wastewater. Design of this project will be based on production of Class A recycled water as defined by Oregon Administrative Rule (OAR) 340-055. Class A recycled water has the fewest restrictions on beneficial reuse.

2.2 Water Demand and Pressure Requirements

Three potential users of Class A recycled water have been identified by the MWMC for the initial demonstration phase of the recycled water program. These are Delta S&G for equipment washing and dust control; the MWMC for landscape irrigation at the WPCF; and the City of

Eugene Parks & Open Space staff for tree watering. Total water demand and pressure needed for these users are presented in Table 1 above. Assumptions used to calculate average, maximum, and peak values are presented in the Basis of Design TM, as well as a per-customer breakdown of maximum day and peak usage values.

The MWMC staff have identified other potential uses that may be added after the facility is operating and established. Demand projections for other potential uses are presented in the Basis of Design TM.

2.3 Tertiary Filtration

Two new, smaller capacity submersible pumps will be added to the existing three filter feed pumps to lower the minimum throughput of the tertiary filters to 0.35 mgd. Current minimum capacity is approximately 3 mgd.

2.4 Class A UV Disinfection

Design of the Class A Recycled Water Facilities will be based on the use of UV disinfection. Design criteria for UV disinfection will be in accordance with Oregon Department of Environmental Quality requirements and guidelines published by the National Water Research Institute (NWRI).

2.5 Recycled Water Storage Criteria

To provide system reliability and uninterrupted supply of recycled water to users, storage facilities will provide volume equivalent to at least 1 day of consumption at a maximum day demand. Design of the Class A Recycled Water Facilities will be based on use of the existing HRCCB. Total useable volume of the HRCCB is approximately 0.98 MG. Initial maximum day demand is projected to be 0.65 mgd.

2.6 Recycled Water Pumping Station

The Recycled Water Pumping Station will be designed to provide a firm capacity of 1,460 gallons per minute (gpm) which is equivalent to the projected maximum instantaneous demand for recycled water. One standby pump will be provided for system redundancy.

2.7 Bulk Water Fill Station

A bulk water fill station will initially provide water for the City of Eugene Parks & Open Space's tree watering program. The station will include flexibility for future modifications to supply water to a variety of truck types and sizes.

Section 3: Alternatives Considered

This section summarizes alternatives evaluations done to select the recommended project.

3.1 Fatal Flaw Analysis

A fatal flaw analysis was completed that considered a wide range of potential project alternatives. This was done to make the conceptual design process more efficient while still providing documentation of the breadth of alternatives considered. Alternatives included in the fatal flaw analysis are listed below, along with a summary of results and rationales for retaining or eliminating those alternatives from further analysis. Additional detail is provided in the Fatal Flaw Analysis TM included as Appendix B.

3.1.1 Disinfection Technologies

Disinfection process alternatives were divided into three categories: 1) chlorination (i.e., using sodium hypochlorite); 2) ultraviolet light (UV) disinfection; and 3) non-standard technologies (e.g., ozone, chlorine dioxide, peracetic acid, etc.). Of these technologies, chlorination and UV were retained for further evaluation. Non-standard technologies were eliminated from further consideration because they would be significantly more costly, would be technologies with which plant staff were unfamiliar, could involve dangerous chemicals, and potentially be difficult to achieve regulatory approval.

3.1.2 Chlorine Contact Time

A minimum contact time of 90 minutes would be needed if chlorination were to be selected as the preferred disinfection alternative. Five alternatives to provide the needed contact time were considered: 1) the existing chlorine contact basin (CCB), 2) the existing HRCCB, 3) a new CCB, 4) the West Bank Trail pipeline; and 5) the recycled water storage tank.

Alternatives retained for further evaluation included the use of the existing HRCCB and construction of a new dedicated CCB. Using the existing CCB was eliminated from further consideration because of concerns that it would make it less available for its intended use in disinfecting secondary effluent, operational complexities, and excessive detention time. The West Bank Trail pipeline was eliminated from further consideration because it would not provide sufficient contact time. Use of a recycled water storage tank was eliminated because of the potential difficulty in ensuring adequate contact time and potential regulatory challenges.

3.1.3 Recycled Water Storage

Alternatives for recycled water storage were divided into four categories including: 1) whether to provide storage, 2) use of an existing or new tank, 3) potential tank locations and 4) construction alternatives.

The tertiary filters could run continuously to meet recycled water demand and thus eliminate the cost associated with providing recycled water storage (e.g., converting existing tankage or constructing a new tank). However, because providing storage would increase system reliability

and reduce the size of disinfection facilities, storage was deemed to be a necessary project element.

Three alternatives for the use of existing facilities for storage were considered and included the existing CCB, existing HRCCB, or West Bank Trail pipeline. Construction of a new storage tank was also considered. Use of the existing HRCCB and construction of a new storage tank were retained for further evaluation. Use of the existing CCB was eliminated from further consideration because it would reduce its availability for normal use in disinfecting secondary effluent. The West Bank Trail pipeline was eliminated because it is a pressure vessel and cannot be filled and drained to provide needed storage volume.

The fatal flaw analysis considered locating the storage tank either onsite at the WPCF or offsite at a remote location. Offsite storage was eliminated from further consideration because of increased costs, safety concerns, permitting challenges, and public impact.

Alternatives associated with the type of tank for construction included above-ground steel tanks, above-ground concrete tanks, and below-ground concrete tanks. Below-ground concrete tanks were retained for further evaluation. Above-ground steel tanks were recommended for further consideration only if a below-ground concrete tank proved to be too costly. Above-ground concrete tanks were eliminated because of a combination of cost, large footprint, and potential visual impacts.

3.1.4 Recycled Water Pumping

Pumping facilities will be needed to meet flow and pressure demands of recycled water users. The fatal flaw analysis considered three aspects related to pumping: 1) use of new or existing structures, 2) pump type and 3) number of pumping stations.

Existing structures that were considered for installation of new recycled water pumps included the existing CCB, the HRCCB, and the tertiary filter flow distribution structure. A new pump station structure was also considered. The use of the HRCCB was retained for further evaluation assuming that it would be ultimately selected for recycled water storage. Because of cost and footprint, construction of a new separate pumping station was recommended for further consideration only if the HRCCB was not used for storage. The existing CCB was eliminated from further consideration for the same reasons it was eliminated as a storage alternative. The tertiary flow distribution structure was eliminated because of its unfavorable location, size, and limited wet well volume.

Pump types considered included submersible centrifugal pumps, centrifugal pumps (other than submersible) including use of the existing spare irrigation pumps originally installed at the Biosolids Management Facility (BMF), and vertical turbine pumps. Centrifugal pumps and vertical turbine pumps were retained as potential alternatives. Submersible pumps were eliminated because they cannot operate at the pressure needed for the recycled water distribution system.

Multiple pump stations were compared against using a single pump station to deliver recycled water to all three identified users at the required flow and pressures. Based on the fatal flaw

analysis, multiple pump stations were eliminated from further consideration due to increased operational complexity associated with multiple pumps.

3.2 Alternatives Evaluation

After completing the initial fatal flaw analysis, the remaining recycled water facility alternatives were evaluated in more detail. Results of these evaluations were documented in a series of TMs that are included as appendices to this Report. A summary is provided below.

3.2.1 Tertiary Filtration

The existing tertiary filters have a capacity range of 3 to 11 mgd. The current minimum rate of 3 mgd exceeds the projected maximum day demand value of 0.65 mgd being used for design of the Class A recycled water facilities. Alternatives to reduce the minimum capacity of the filters included returning excess water to the filter feed pump wet well and installing new smaller capacity feed pumps. These alternatives were compared with simply maintaining the filters current minimum capacity.

The existing filters are designed to operate at filtration rates ranging from 5 to 40 gpm per square foot (sf) of filter area. Because each filter has a surface area of 49 sf, the minimum theoretical filter flow rate is 245 gpm (0.35 mgd). The filters, however, cannot operate at this low flow rate because the existing filter feed pumps were designed for higher flows and MWMC staff report that they cannot operate at less than about 3 mgd. Alternatives considered for reducing the capacity of the filters were based on a flow range of 0.35 mgd to 0.65 mgd (projected maximum day demand).

Reducing the minimum capacity of the tertiary filters was recommended in lieu of maintaining the current minimum value of 3 mgd for the following reasons: 1) doing so will allow the filters to operate at a lower more continuous basis which is conducive to better filter performance and 2) it reduces the size and cost of downstream disinfection facilities.

Providing new, smaller capacity filter feed pumps was selected as the preferred alternative for reducing the minimum filter capacity. Although more costly than simply returning excess flow to the filter feed pump wet well, providing smaller capacity pumps is operationally less complex. It would also eliminate potential difficulties in balancing pump speed, filter control valve throttling, and pressure reducing valve settings that would be needed to return excess flow.

3.2.2 Class A Disinfection

Three disinfection alternatives passed the fatal flaw analysis and were evaluated in further detail. These included the following: 1) use of the existing HRCCB, 2) construction of a new CCB and 3) construction of a UV disinfection system.

UV disinfection was selected as the recommended disinfection alternative. Reasons for its selection included eliminating performance challenges associated with low summertime ammonia levels in the WPCF effluent and breakpoint chlorination, smaller area requirements, lower carbon footprint, and being better suited to intermittent operation. A 20-year net present

worth comparison of the UV disinfection and construction of a new CCB showed little difference between the two alternatives.

Although initially considered, use of the existing HRCCB was not recommended nor did it receive the same level of detailed evaluation as the other disinfection alternatives. Factors leading to this conclusion included the large size of the HRCCB and the need for major structural modifications to create an appropriately sized basin within the existing structure that would also reduce the HRCCB's capacity to treat primary effluent during peak flow events.

3.2.3 Recycled Water Storage

Three storage alternatives were evaluated that included the following: 1) use of the existing HRCCB, 2) construction of a new below-ground concrete tank, and 3) construction of a new above-ground steel tank.

Use of the existing HRCCB was selected as the recommended storage alternative. Although the HRCCB would not be available to store recycled water during winter months when it must be ready for use during peak flow events to disinfect primary effluent, this should not negatively impact the recycled water program because recycled water demand should be primarily limited to low flow summer and fall months of the year. Advantages of the existing HRCCB for recycled water storage include reducing construction costs for the project by approximately $1.9 million. The HRCCB would also provide approximately 50 percent more storage than would be provided with construction of a new dedicated storage tank which would make expansion of the recycled program easier.

Disadvantages of a new below-ground concrete storage tank include increased construction cost, additional space requirements, and less initial flexibility to expand the recycled water program without construction of additional storage. Disadvantages of a new above-ground steel tank include the same disadvantages of a new below-ground concrete tank. In addition, an above-ground steel tank would not match other structures on the WPCF site, it would be less amenable to future expansion, and would require additional pumping facilities.

3.2.4 Recycled Water Pumping

Recycled water pump types that were evaluated included horizontal centrifugal pumps and vertical turbine pumps. Evaluation of the vertical turbine pumps considered locating them in the HRCCB or in a separate dedicated wet well.

Constructing a vertical turbine type pumping station in the HRCCB was selected as the recommended alternative. Although the MWMC's spare horizontal centrifugal pumps originally installed at the BMF could potentially meet flow and pressure requirements for the project, they are not suitable for use with the HRCCB because the water surface in the HRCCB would be below the elevation of the pumps. The existing irrigation pumps and most horizontal centrifugal pumps in general are not designed to draw water from an elevation below that of the pump. The pumping end of vertical turbine type pumps are located below the water surface and are specifically designed for pumping from structures like the HRCCB. Locating the recycled water station within the HRCCB was recommended over construction of a separate dedicated

pumping station because it would lower overall project costs by approximately $0.5 million while making better use of existing infrastructure at the WPCF.

3.3 Bulk Water Fill Station

Alternatives considered for construction of a bulk water fill station included comparing locating the bulk water fill station inside the fence line of the WPCF with locating it outside of the fence line. Locating the station inside the fence line was recommended to reduce project costs, provide better security, and decrease the potential for vandalism.

Section 4: Recommended Project

This section describes the recommended Class A Recycled Water Facilities Project for advancement to final design. This section also presents the opinion of probable construction cost (OPCC) and schedule for the project.

4.1 Project Description

The recommended Class A Recycled Water Facilities Project will be based on the use of UV disinfection and utilizing the existing HRCCB for recycled water storage. Project evaluations were based on facility capacity of either 0.65 mgd (equal to the projected initial maximum day demand) or 3 mgd (the current minimum capacity of the tertiary filters). The 0.65 mgd UV disinfection system evaluated by Kennedy Jenks included provisions for future expansion to 1.3 mgd. When presented with the project at their October 9, 2020 commission meeting, the MWMC decided the project should include the full 1.3 mgd to increase long term cost efficiency of the recycled water program.

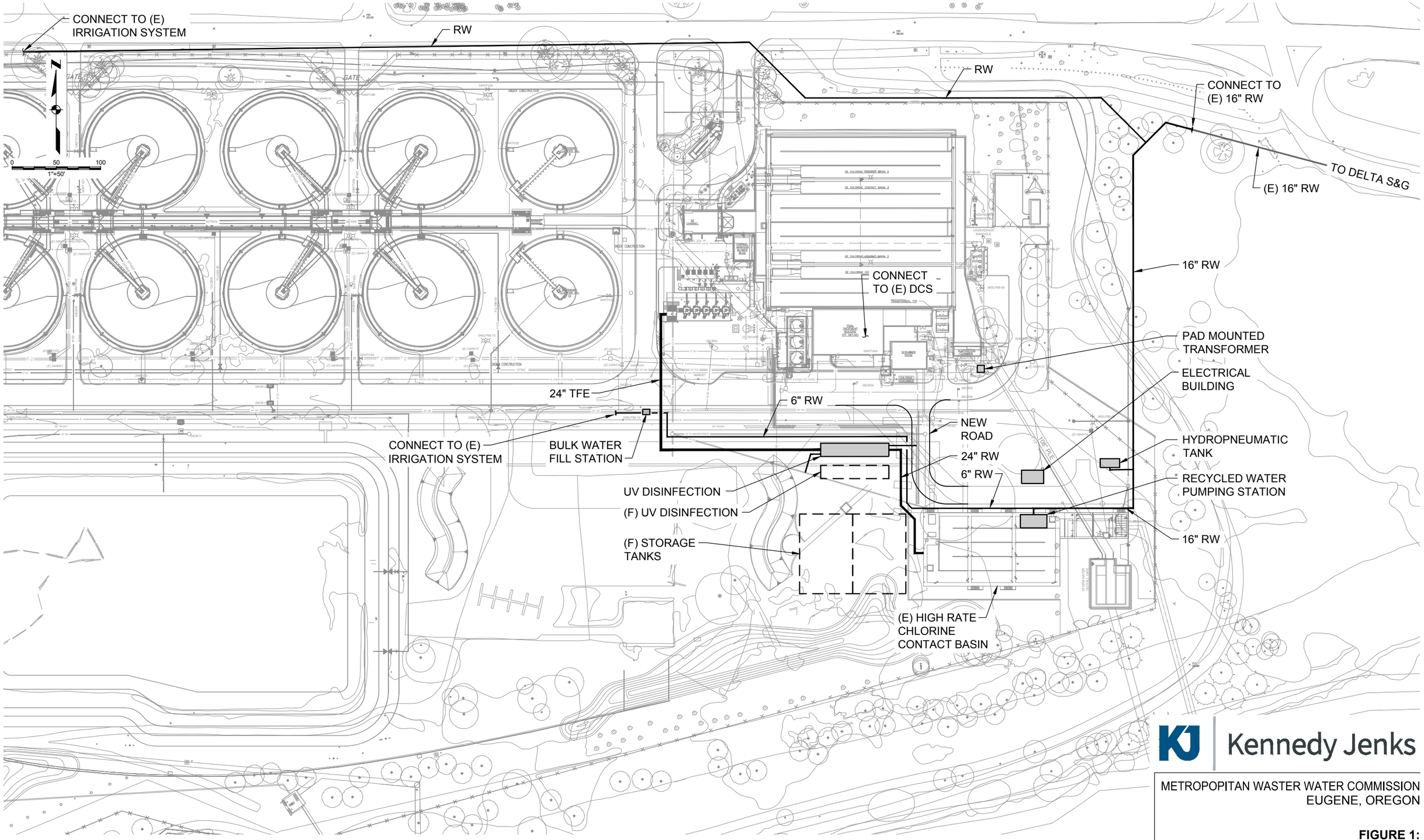
A conceptual layout for the recommended improvements is shown below on Figure 1. Brief descriptions for the main project elements are provided below.

4.1.1 Filter Feed Pumps

Two new, lower capacity submersible pumps will be installed to allow the tertiary filters to operate at a lower rate (0.35 to 1.3 mgd). The pumps will be variable speed and able to pump at rates between 0.35 and 0.65 mgd. The pumps will be installed in the existing filter feed pump wet well in spaces specifically meant for the future installation of additional filter feed pumps. Electrical service and controls for the new pumps will come from the existing Final Treatment Building in similar fashion to the existing filter feed pumps.

4.1.2 UV Disinfection

An open channel type UV system will be provided with an operating deck about 3 feet above the surrounding ground elevation. A minimum of three UV banks will be provided, two duty and one standby. The total number of UV banks may be greater and will depend on the UV system manufacturer. The channel will be approximately 80 feet long, 3 feet wide, and 8 feet deep. An open sided structure with metal roof will be provided over the operating deck and portion of the channel containing the UV modules. The structure will have a concrete masonry unit (CMU) back wall to provide additional protection from the weather and an area to mount electrical/control equipment. A combination of aluminum grating and solid decking will cover the UV channels. Aluminum railing will surround the elevated perimeter of the structure. Stairs will be provided for access to the operating deck. The UV system will be provided with a dedicated control system that will be mounted within the UV structure. Power and communication wiring will be provided through a new electrical building described below.



Kennedy Jenks

METROPOPITAN WASTER WATER COMMISSION
EUGENE, OREGON

FIGURE 1:
CLASS A RECYCLED WATER FACILITES CONCEPTUAL LAYOUT

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4.1.3 Effluent Sampling and Chlorination

Effluent flow measurement will be provided by a Parshall flume with ultrasonic level transducer with effluent sampling provided by auto sampler located at the UV structure. Sodium hypochlorite will be injected to provide chlorine residual needed to maintain water quality within the storage and distribution system. One of the WPCF's two existing primary effluent hypochlorite metering pumps will be used with a third pump added to provide additional redundancy. Existing double contained hypochlorite lines serving the HRCCB will be connected to and routed to the new UV structure.

4.1.4 Recycled Water Storage

The existing HRCCB will provide storage needed for the recycled water system. Modifications to the existing structure will be limited to construction of a new, ductile iron recycled water pipe from the UV structure to the HRCCB and construction of the Recycled Water Pumping Station inside the basin. The pumping station is described below. The new ductile iron recycled water pipe will connect to the HRCCB at an existing penetration on the west side of the basin.

4.1.5 Recycled Water Pumping Station

The Recycled Water Pumping Station will consist of three, 60-horsepower, vertical turbine pumps (two duty and one standby) located on the north side of the existing HRCCB. The pumps will be provided with variable frequency drives (VFDs) to allow variable speed operation and will have a maximum capacity of 730 gpm. Total firm capacity of the pumping station will be 1,460 gpm which is the projected peak instantaneous demand for the recycled water system. The pumps will be controlled based on water level in the HRCCB and system pressure.

The pumps will be installed on a new elevated concrete slab that will span from the outer wall of the basin inwards toward the internal concrete baffle walls. A section of the existing concrete baffle wall will be replaced with a 12-inch-thick reinforced concrete wall and thickened concrete pillars to provide needed support and additional strength for the overhead concrete slab. Space will be provided for installation of a future fourth vertical pump.

A hydropneumatic tank will be provided to control pump cycling and help mitigate potential pressure surges created by operation of the recycled water pumps. Sizing and placement of the hydropneumatic tank will be determined after completion of a surge analysis during detailed project design.

4.1.6 Recycled Water Distribution

Recycled water will be produced for three initial users: 1) Delta S&G for equipment washing and dust control, 2) the City of Eugene Parks & Open Space for tree watering and 3) the MWMC for landscape irrigation outside of the WPCF fence line.

A recycled water delivery point for Delta S&G consisting of an underground vault with a water meter will be constructed within public right-of-way southwest of Delta S&G's existing facilities. Delta S&G will construct piping inside their facilities to convey water to points of use. The

existing West Bank Trail pipeline will be used to convey recycled water from the WPCF to the Delta S&G delivery point.

A packaged bulk water fill station will be constructed inside the WPCF fence line near the recycled water facilities. The station will include solenoid operated flow controls, flow metering, and keypad controller to monitor and record water use. The station will be provided with side outlet piping to facilitate connection to City of Eugene Parks & Open Space water trucks. Design will allow for future addition of an overhead fill connection to permit use by a wider range of truck types and sizes.

The recycled water piping system will be connected to the WPCF's irrigation system in two locations to provide water for landscaping outside the plant fence line. One connection point will be along River Avenue to serve areas north and west of the WPCF. A second connection point will be south of the existing secondary clarifiers that will serve areas to the south and east.

4.1.7 Electrical Building

Because existing electrical rooms in the nearby Final Treatment Building do not have enough space to house electrical equipment associated with the project, a new CMU block building will be constructed near the Recycled Water Pumping Station. The building will be temperature controlled. Electrical equipment will include a 600 A switchboard (upgradeable to 1200 A in the future), VFDs for the recycled water pumps, a 480-120 V transformer, and a lighting panel.

A new pad mounted transformer will be installed and connected to the existing medium voltage system to provide 480 V power for the project. New buried conduit and conductors will connect the new transformer to the new electrical building.

4.2 Opinion of Probable Construction Cost (OPCC)

The OPCC for the recommended Class A Recycled Water Facilities Project is approximately $5.07 million. A breakdown of this estimate is presented in Table 2 below.

Table 2: Class A Recycled Water Facilities Project OPCC

Item Description	Capital Cost
Sitework	$1,154,000
Tertiary Filtration	$68,000
UV Disinfection[(a)]	$713,000
Recycled Water Storage (HRCCB)[(b)]	$0
Recycled Water Pumping Station	$353,000
Bulk Water Fill Station	$13,000
Electrical	$476,000
Instrumentation	$112,000
Subtotal	$2,889,000
Division 1 Costs (10%)	$289,000
Subtotal	$3,178,000
Contractor Overhead and Profit (15%)	$477,000
Subtotal	$3,655,000
Estimate Contingency (30%)	$1,097,000
Subtotal	$4,752,000
Bonds and Insurance (2.5%)	$119,000
Subtotal	$4,871,000
Escalate to Mid-point of Construction[(c)]	$195,000
Total Estimate[(d)]	**$5,070,000**

Notes:

(a) Includes cost for UV disinfection equipment with capacity of 1.3 mgd.
(b) Cost for the new ductile iron pipe connecting the UV disinfection system to the HRCCB is included in the sitework line item.
(c) Escalated at 2% per year assuming 24 months until mid-point of construction.
(d) Total amount rounded to nearest $10,000. Cost basis is December 2020 Seattle ENR CCI value 12,840.

The preceding cost estimate is for all elements of the recommended project, plus assumed yard piping and instrumentation costs as a percentage of the total costs. A detailed treatment of cost estimate assumptions is presented in the Cost Estimate TM dated September 11, 2020 included in Appendix H of this Report. Values contained in the September 11, 2020 TM have been adjusted to December 2020 ENR values and the cost of the UV disinfection system has been adjusted to account for the increased system capacity 1.3 mgd (from 0.65 mgd) in response to direction from the MWMC at the October 9, 2020 Commission meeting.

An appropriate accuracy range for a conceptual level OPCC is -30% to +50%. Applying this to the estimate results in the potential cost range shown in Table 2 above.

Table 3: Estimated Range of Construction Cost: 0.65 MGD Recycled Water System

Low (-30%)	Total Est.	High (+50%)
$3,550,000	$5,070,000	$7,600,000

4.3 Project Schedule

A preliminary schedule for the recommended Class A Recycled Water Facilities project is presented on Figure 2 below. Total project time including all activities from detailed design to final completion is estimated to be approximately 32 months.

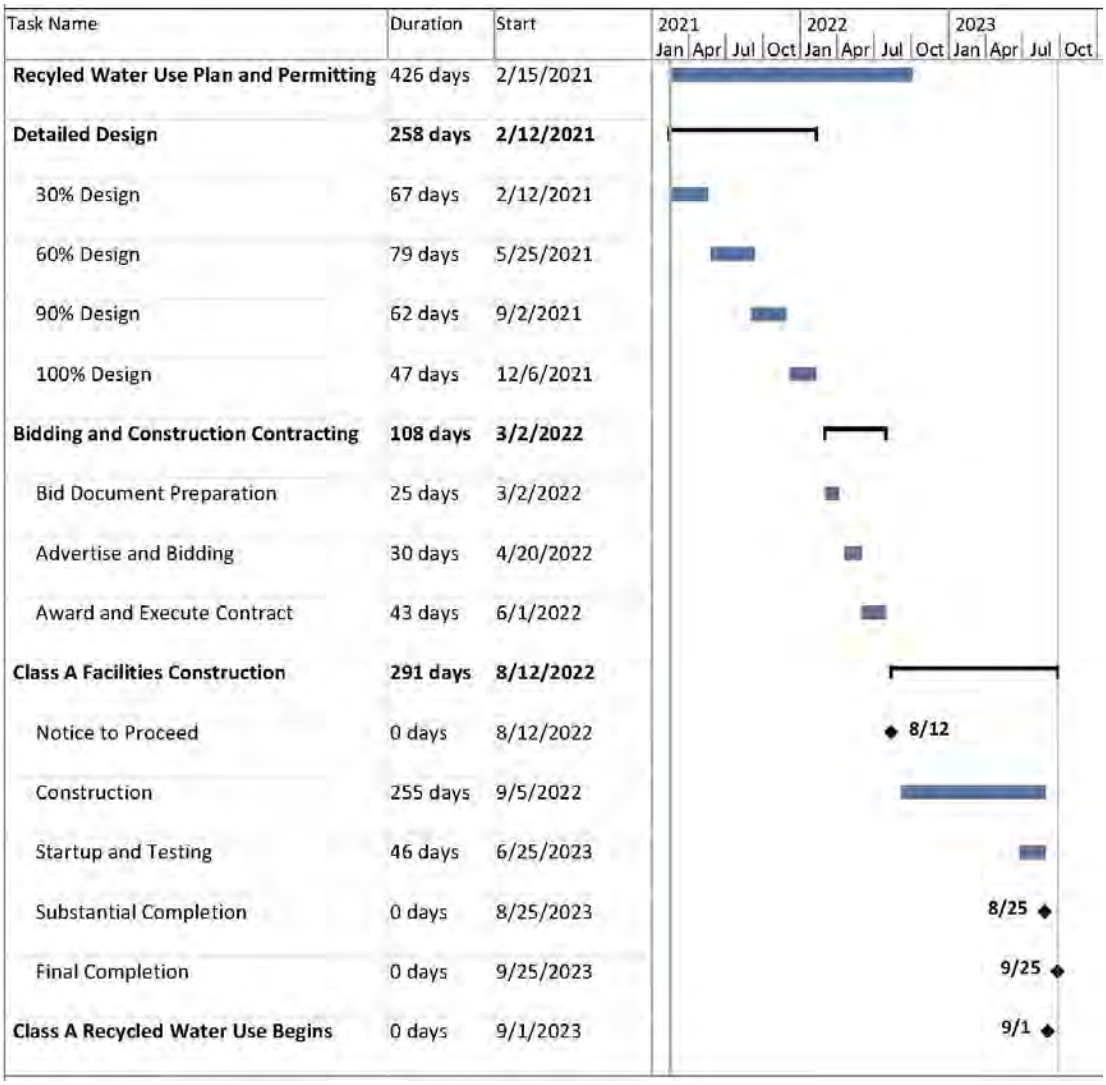


Figure 2: Class A Recycled Water Project Schedule

Appendix A: Basis of Design Technical Memorandum

28 August 2020

Technical Memorandum – Basis of Design

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Basis of Design
K/J Project Number: 1776023*00

The purpose of this Technical Memorandum (TM) is to present design criteria that will be used to guide the preliminary design of recycled water facilities for the Metropolitan Wastewater Management Commission's (MWMC) recycled water demonstration project. Criteria presented in this TM may change and will be updated, if needed, as the preliminary design process progresses. The information provided establishes an initial basis of design so project team members have a common understanding of the parameters that must be met.

Design criteria for the project have been organized into seven categories each of which is described below.

Water Quality

In Oregon, recycled water is classified as Class A, Class B, Class C, or Class D according to the level of disinfection and filtration applied to treated wastewater. Design of this project will be based on production of Class A recycled water meeting the requirements of Oregon Administrative Rule (OAR) 340-055, specifically OAR 340-55-0012(7).

Class A recycled water requires secondary treatment (oxidized), filtration and disinfection and represents the highest level of treatment requirements for the various recycled water classes. Water quality requirements for Class A recycled water are summarized in Table 1.

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Table 1: Class A Recycled Water Quality Criteria

Parameter	Not to Exceed Value
Turbidity, NTU[(a)]	
24-hour mean	2
5% of time during a 24-hour period	5
Maximum at anytime	10
Monitoring frequency	Hourly
Total coliforms (organisms per 100 mL[(b)])	
7-day median	2.2
Maximum in any sample	23
Maximum in 2 consecutive samples	
Monitoring frequency	Daily

Notes:

(a) Nephelometric turbidity units (NTU)
(b) Milliliter (mL)

Class A recycled water is suitable for many beneficial purposes including vehicle washing, supply to non-potable plumbing fixtures, and irrigation of parks and other areas that are accessible to the public. Class A recycled water may also be used for all processed and fresh pack food crops and is used on organically certified crops throughout the United States.

Water Production and Pressure Requirements

Three potential users of Class A recycled water have been identified by the MWMC that would be served by the initial demonstration phase of the recycled water program. These include Delta Sand & Gravel Co. (Delta S&G) for equipment washing and dust control, the MWMC for landscape irrigation at the WPCF, and the City of Eugene for street tree irrigation. Water demand and pressure requirements to meet the needs of these users are presented below.

MWMC staff have identified other potential uses that may be added after the demonstration project is operating and established. These include expansion at Delta S&G to include its rock crushing operation, the Eugene-Springfield Fire Training Facility for training exercises, the Seneca Bio-Energy Facility for cooling tower makeup water, the MWMC Biocycle Farm for poplar tree irrigation, and the City of Eugene for irrigating the Washington-Jefferson Park.

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Water Demand

Values for average annual, maximum day, and peak instantaneous water demand for the initial three identified users are presented in Table 2.

Table 2: Water Demand: Minimum Design Values for Demonstration Phase

Condition	Use	Demand
Avg annual		
	Delta S&G	160,000[(a)] gpd[(b)]
	WPCF irrigation	26,000[(c)] gpd
	Street tree irrigation	1,250[(d)] gpd
	Design value (Total)	190,000[(e)] gpd
Max day		
	Delta S&G	500,000[(f)] gpd
	WPCF irrigation	150,000[(g)] gpd
	Street tree irrigation	2,500[(g)] gpd
	Design value (Total)	650,000[(e)] gpd
Peak		
	Delta S&G	1,460[(h)] gpm
	WPCF irrigation	530[(i)] gpm
	Street tree irrigation	200[(j)] gpm
	Design value	1,460[(k)] gpm

Notes:

(a) Average of summer and winter time average daily values (220,000 gpd and 100,000 gpd), respectively.
(b) Gallons per day (gpd).
(c) Based on water use data for year 2017.
(d) Tree irrigation value estimated based on values provided in the MWMC staff memorandum dated February 20, 2019. Values for tree irrigation are insignificant compared to other demand values.
(e) Value rounded to the nearest 10,000 gpd.
(f) Maximum day use per e-mail correspondence from Delta S&G dated February 5, 2019.
(g) Maximum day demand provided in the MWMC staff memorandum dated February 20, 2019.
(h) Value estimated based on peaking factor (4.2) calculated for maximum hour demand using diurnal demand data provided by the MWMC staff in an e-mail dated March 13, 2019. Maximum day demand value multiplied by calculated peaking factor to determine peak demand value.
(i) Maximum capacity of existing irrigation system as provided in the MWMC staff memorandum dated February 20, 2019.
(j) Flow rate to fill 750-gallon tank in less than 5 minutes.
(k) Peak demand equal to total of Delta S&G (1,460 gpm). Irrigation assumed to occur during off peak hours.

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The values shown in Table 2 are the minimum design criteria for the demonstration phase of the recycled water project. Capacity of the demonstration project may be increased to meet the needs of some of the other potential users identified by the MWMC staff. Demand values for the other users are presented in Table 3 below. Providing capacity beyond that required for the initial demonstration phase users will be evaluated during the alternatives evaluation phase of the preliminary design process. Cost and how soon the additional demand might be needed will be considered as part of the evaluation.

Table 3: Water Demand: Other Potential Users[a]

Condition	Use	Demand
Max day		
	Delta S&G (rock crushing)	1,500,000 gpd
	Park irrigation[b]	100,000 gpd
	Biocycle farm[c]	3,000,000 gpd
	Seneca Bio-Energy[d]	324,000 gpd
	Fire training[e]	74,000 gpd
Peak		
	Delta S&G (rock crushing)	3,500 gpm
	Park irrigation[b]	300 gpm
	Biocycle farm[c]	3,470 gpm
	Seneca Bio-Energy[d]	500 gpm
	Fire training[e]	310 gpm

Notes:

(a) Values provided by MWMC staff in e-mail correspondence dated May 6, 2019.
(b) City of Eugene irrigation at the Washington-Jefferson park.
(c) Poplar tree irrigation.
(d) Cooling tower makeup water.
(e) Use at the Eugene/Springfield Fire Training Facility.

Initially, the MWMC anticipates the recycled water system will operate only during the summer irrigation season. For the purposes of these evaluations, Kennedy Jenks assumes the system will be operational during the months of May through October.

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Water Pressure

Design values for system pressure for the proposed uses are provided in Table 4.

Table 4: Water Pressure Design Criteria

Use	Pressure
Delta S&G[(a)]	30 to 50 psi[(b)]
WPCF irrigation	60 to 80 psi
Street tree irrigation	40 to 60 psi
Other uses[(c)]	40 to 60 psi

Notes:

(a) Delta S&G may require higher pressures at point of use but will be responsible for increasing pressure as needed.
(b) Pounds per square inch (psi).
(c) Pressure requirements for the other uses are not known. However, a value is assumed equal to that of typical water systems.

Values shown are assumed to be at the point of use. The minimum value shown for each use is that assumed to occur at maximum demand conditions for that use.

Storage Criteria

Storage facilities will be provided to increase system reliability and better ensure an uninterrupted supply of recycled water. Providing a reliable source of water is important to establish customer trust in the recycled water program. Design of storage facilities will be based on providing storage volume equivalent to 1 day of consumption at maximum day demand.

Treatment Criteria

Treatment design criteria consists of the order of treatment, disinfection parameters, and criteria related to maintaining water quality within the storage and distribution facilities. Chlorine or ultraviolet light (UV) can be used to meet Class A recycled water requirements. Design criteria for these disinfection alternatives are presented below.

Order of Treatment

Although the Oregon Department of Environmental Quality (DEQ) may allow exceptions, standard design is based on providing filtration prior to disinfection. This reduces the amount of suspended material in the water being treated and improves disinfection effectiveness. Design will be based on providing filtration via the WPCF's existing tertiary filters prior to disinfection.

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Chlorine Disinfection Design Criteria

Design criteria for chlorine disinfection includes chlorine contact time, minimum detention time, chlorine residual, and chlorine contact basin geometry requirements. Design values for these parameters are summarized in Table 5 and meet the DEQ requirements for the design of disinfection facilities for recycled water (as contained in the DEQ's Internal Management Directive – Implementing Oregon's Recycled Water Rules).

Table 5: Class A Chlorine Disinfection Design Criteria

Parameter	Value
CT[(a)], mg/L · min	90
Chlorine residual[(b)], mg/L	1 to 2
Contact time[(c)], min	90
Contact basin length:width ratio. ft:ft	72:1[(d)]

Notes:

(a) Chlorine concentration contact time (CT). Minimum value that will be maintained under all conditions.
(b) Minimum total chlorine residual at the end of contact time.
(c) Minimum value at peak dry weather flow.
(d) Value may be less than this if baffle walls are provided.

Requirements for disinfection design criteria vary by state. For example, the Washington Department of Ecology has two design criteria alternatives that can be applied to the design of disinfection systems. The first requires a minimum CT value of 30 mg/L·min based on a t_{10} value of 30 min where t_{10} is the residence time in the basin that is exceeded by 90 percent of the fluid entering the basin. The value of t_{10} can be significantly less than the theoretical detention time and is an indicator of hydraulic efficiency (i.e., plug flow behavior). If this design criterion is used, Washington requires site specific verification and validation of the recycled water disinfection system.

An alternative criterion used by the Washington Department of Ecology requires a minimum CT value of 450 mg/L·min with a t_{modal} time of 90 min where t_{modal} is the time required for the peak concentration of a tracer slug to pass through the basin. The t_{modal} value of the basin will be closer to the average detention time of a basin than the t_{10} value but like that measure of contact time, t_{modal} can also provide a measure of the hydraulic efficiency of the basin. If this more restrictive design criterion for CT is used (450 mg/L·min), Washington does not require site specific verification and validation of the disinfection system.

California design criteria to produce disinfected tertiary recycled water requires a CT value of 450 mg/L·min with a t_{modal} time of at least 90 min based on peak dry weather design flow.

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UV Disinfection Design Criteria

Although the DEQ does not have specific design guidelines for UV disinfection of recycled water, design would be based on guidelines published by the National Water Research Institute (NWRI) for UV disinfection. California and Washington, two states with strong recycled water programs, rely on the NWRI guidelines in administering their recycled water programs. These guidelines include minimum dosing rates, reactor design, system reliability, monitoring and alarms, and commissioning.

Criteria that would be used for design of a UV disinfection are summarized in Table 6.

Table 6: Class A UV Disinfection Design Criteria

Parameter	Value
Design UV dose, $mJ/cm^{2(a)}$	100(b)
UV transmittance, %	55(c)
UV lamp output, %	50(d)
Quartz sleeve transmittance, %	80(e)

Notes:

(a) Millijoule per square centimeter.
(b) For media filtration, the minimum design dose under maximum day flow must be the greater of either 100 mJ/cm^2 or the dose as determined by collimated-beam testing to achieve target organism deactivation.
(c) UV transmittance at a wavelength of 254 nanometers (nm).
(d) System must provide the required dosage assuming lamp output is equal to 50% of the new lamp output after an initial burn-in period.
(e) System must provide required dosage assuming 80% UV light transmittance through the quartz sleeves of the UV lamps.

Distribution System

Maintaining chlorine residual in the recycled water distribution system provides additional protection from pathogens. It also reduces the potential for biological regrowth that may plug distribution system components. A minimum total chlorine residual of 1.0 mg/L at the point of use will be assumed for this project. Distribution system components should be selected to ensure suitability for exposure to chlorine at this concentration.

Reliability

Design criteria for reliability are developed to prevent inadequately treated water from being distributed and to provide a reliable source of water for end users. Systems to increase reliability include monitoring, alarms, equipment redundancy, and standard operating procedures such as short-term retention or disposal when water quality requirements are not achieved.

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Power Supply

The WPCF has two separate sources of power to the facility. Both are capable of providing sufficient power to operate the WPCF. The existing power supply to the WPCF will provide sufficient redundancy for the recycled water facility.

Filtration

Recycled water filtration facilities should be composed of multiple filter units with a total capacity equal to the projected demand with one unit out of service. Monitoring and alarms must also be provided upstream of disinfection to ensure water quality requirements for turbidity are met.

The WPCF's existing filtration system meets both of these requirements. It includes five parallel filters with a total design capacity of 8.4 MGD assuming one filter is offline, and another is backwashing. The firm capacity of the filter system (total capacity with one filter out of service) far exceeds the projected recycled water demand. Turbidity is monitored both upstream and downstream of the existing filters.

Chlorine Disinfection

Disinfection facilities must be assured of an uninterrupted supply of chlorine. As such, the following reliability design criteria are applicable:

- Chlorine Storage: Multiple storage tanks are required and piped to allow tanks to be removed from service without interrupting the flow of chlorine.
- Dosing Pumps: Provide multiple dosing pumps with total capacity equal to the maximum design condition with one pump out of service.
- Alarms: Automatically alarm on equipment failure or failure to meet chlorine residual setpoints.

UV Disinfection

NWRI guidelines for UV disinfection reliability include the following:

- Number of reactors: A minimum of two reactors must always be simultaneously operated.
- Redundancy: A standby reactor must either be provided for each reactor train or a complete redundant UV train must be provided.

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- Contingency: Storage or other contingency measures may be used to provide system redundancy in lieu of a standby UV reactor or standby train. The intent of this provision is to prevent distribution of water not meeting Class A recycled water criteria.

Storage

As previously discussed, storage volume equivalent to 1 day of consumption at maximum day demand will be provided. This will reduce the potential for interrupting water supply should an upstream equipment failure occur.

Pumping

Redundant pumps should be provided for all potential services. Capacity of each pumping system with the largest pump out of service should meet the maximum design condition for that system.

Monitoring

Recycled water system monitoring includes both water quality and operational parameters. Design will be based on the following monitoring criteria:

Water Quality

Water quality monitoring will include the following:

- Turbidity: Online, continuous turbidity monitoring will be done immediately downstream of the existing filters prior to disinfection.

- Chlorine Residual: Continuous monitoring will be done at both inlet and outlet of the chlorine contact basin and in the recycled water storage tank. For UV disinfection, chlorine will be added immediately downstream of the disinfection system and prior to the recycled water storage tank. Chlorine residual will be monitored routinely at the various points of use to ensure adequate residual is being maintained within the distribution system.

- Total Coliforms: Recycled water will be sampled after disinfection and tested daily to show compliance with water quality standards for total coliforms.

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Operational Parameters

Operational parameters that will be monitored include the following:

- Flow Rate: Total recycled water flow rate will be measured for control of disinfection facilities. Separate flow measurement will also be provided for each water use (e.g., Delta S&G, WPCF irrigation, and City of Eugene fill station).

- Water Pressure: Distribution system pressure will be used as a control parameter for the recycled water pumping systems.

- Energy Use: Power monitoring equipment will be considered to assist in determining annual operational costs for providing recycled water.

Facility Siting

Design criteria for facility siting are as follows:

- Recycled Water Storage: Storage facilities will be located in an area towards the east end of the WPCF inside the fence line and near the existing HRCCB and filters.

- City of Eugene Fill Station: The fill station for the City's street tree watering program will be located inside the existing fence line of the WPCF. Facilities outside the fence line will not be considered.

- Delta S&G Water Meter: The Delta S&G water meter will be located within the public right-of-way immediately south of Delta S&G's existing facilities.

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Appendix B: Fatal Flaw Analysis Technical Memorandum

28 August 2020

Technical Memorandum – Fatal Flaw Screening

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract.
Thermal Load Mitigation Pre-Implementation, MWMC Project P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Fatal Flaw Screening
K/J Project Number: 1776023*00

This Technical Memorandum (TM) presents results of a fatal flaw screening of Class A recycled water facilities alternatives for the Metropolitan Wastewater Management Commission's (MWMC) recycled water demonstration project. The demonstration project is primarily focused on providing water to a small number of initial users. Design of the facilities will, however, consider future expansion to accommodate increases in demand as the recycled water program becomes established.

The goal of this screening task was to make the conceptual design process more efficient while still documenting the breadth of the alternatives considered. Alternatives that pass this screening will be further evaluated in the alternatives evaluation phase of this conceptual design process.

Alternatives screened were divided into the following five project categories:

- Disinfection
- Recycled Water Storage
- Recycled Water Pumping
- Water Truck Fill Station
- Recycled Water Distribution System

Alternatives for each project category are described with matrices showing advantages and disadvantages for each alternative. In cases where the identified advantages or disadvantages were deemed to be of greater significance in screening an alternative, bold and underlined text was used to identify those considerations.

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Disinfection

Alternatives related to disinfection consisted of those associated with technologies and contact time needed should chlorination be selected as the preferred means of disinfection.

Disinfection Technologies

Methods used for disinfection include the following:

- **Chlorination.** Disinfection using gaseous chlorine or liquid chlorine (sodium hypochlorite) is the most common means of wastewater disinfection. Chlorination requires chemical metering facilities and chlorine contact basins(CCBs) to achieve needed treatment. Existing disinfection facilities at the Water Pollution Control Facility (WPCF) include a sodium hypochlorite storage and metering system, a CCB, and a high rate chlorine contact basin (HRCCB) that is used when influent flow exceeds about 160 million gallons per day (MGD). Because of the hazards associated with chlorine gas and because the WPCF already uses sodium hypochlorite for disinfection, the use of chlorine gas will not be considered in this evaluation.

- **Ultraviolet light.** Ultraviolet (UV) disinfection is also commonly used in the production of recycled water. UV systems are available in two basic configurations: open channel and closed vessel. UV lamps in the open channel configuration are placed within a channel that is open to the atmosphere and flow is by gravity. Closed vessel systems are pressurized in-pipe type systems that are typically pumped.

- **Other methods.** Other methods of disinfection include ozone, chlorine dioxide, peracetic acid, etc. These methods are not commonly used.

A comparison of disinfection technologies is presented in Table 1 below.

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Table 1: Comparison of Disinfection Technologies

Alternative	Advantages	Disadvantages
Chlorination	• **Technology used at the WPCF.** • Most common disinfection method. • Existing sodium hypochlorite storage should be enough to also meet needs for the recycled water system. • Relatively simple process. • **Provides needed chlorine residual for storage and distribution.**	• Sodium hypochlorite is potentially hazardous. • Capital cost may be greater than UV disinfection if a new CCB is needed. • Larger footprint than UV if a new CCB is needed. • Low ammonia concentrations in secondary effluent may decrease effectiveness of chlorination. • Seasonal changes in ammonia levels may create control challenges.
Ultraviolet	• CCB not needed. • Smaller footprint than for chlorination if new CCB needed. • Does not use potentially hazardous chemicals (e.g., chlorine, ozone, etc.). • Capital cost may be less if a new CCB is needed. • Potential challenges posed by ammonia would be reduced.	• Increased complexity of equipment. • **New technology for the WPCF.** • Higher energy use. • Routine replacement of UV bulbs required. • UV light poses a potential hazard associated with eye exposure. • Higher headloss is typical. • **Chlorination still needed to maintain residual for storage and distribution.** • Potential for bacterial regrowth without chlorine residual. • Additional study may be needed to determine suitability of UV.

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Alternative	Advantages	Disadvantages
Other (e.g., ozone, chlorine dioxide, peracetic acid)	• Eliminates concern with impact of low ammonia concentration on disinfection effectiveness.	• **Few (or no) cases of full-scale application.** • **Difficulty in achieving regulatory approval.** • **New technology for the WPCF.** • **Chlorination still needed to maintain residual for storage and distribution.** • **Use of potentially hazardous chemicals.** • **Significant additional infrastructure may be needed (e.g., ozone generation, chemical storage).**

Recommendations:

- Evaluate both chlorination (sodium hypochlorite) and UV disinfection alternatives for potential implementation for the recycled water system.
- Eliminate other disinfection technologies from further consideration.

Alternatives for Chlorine Contact Time

If chlorination is selected as the preferred means of providing disinfection, a means of providing needed contact time must be provided. Oregon Department of Environmental Quality (DEQ) guidelines for recycled water require a minimum Ct (residual chlorine concentration multiplied by the contact time) of 90 minutes·milligrams/Liter (min·mg/L). Assuming a chlorine residual of 1 mg/L, 90 minutes of contact time would be needed. Five alternatives for providing this contact time have been identified and are described below.

- **Existing CCB.** One of the four existing CCBs designed for chlorinating secondary effluent would be utilized for disinfecting recycled water. Volume of each of the existing basins is about 875,000 gallons (gal).
- **Existing HRCCB.** The existing HRCCB is used to disinfect primary effluent during peak flow events greater than about 160 MGD. The HRCCB is a single serpentine basin with a total volume of about 1.4 million gal (MG).

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- **New dedicated CCB.** A new CCB would be designed and constructed specifically for recycled water production.
- **West Bank Trail pipeline.** With this alternative, contact time for disinfection would be provided in the existing West Bank Trail pipeline. The pipeline consists of three 16-inch-diameter pipes running approximately 1,000 feet (ft) from the edge of the WPCF fence line terminating near the Delta Sand & Gravel property.
- **Recycled water storage.** Contact time would be provided while in storage. Potential variations could include nested tanks (disinfection in the outer tank and storage in the inner tank) or a single tank providing both storage and contact time in the same compartment.

MWMC staff have reported the existing tertiary filters have a minimum production capacity of 3 MGD. This is significantly greater than the estimated maximum day recycled water demand (0.65 MGD) presented in the Basis of Design TM. The tertiary filters could potentially be modified to reduce their minimum production capacity to match the estimated maximum day demand for recycled water. The comparison of alternatives presented in Table 2 assumes that 90 minute of contact time is provided at a design flow rates of both 0.65 and 3 MGD.

Table 2: Comparison of Alternatives for Chlorine Contact Time

Alternative	Advantages	Disadvantages
Existing CCB	• Existing facilities used. • Tertiary filtration system includes piping needed to convey water to the CCBs for production of recycled water. • Lower cost alternative. • WPCF staff are accustomed to operating the existing CCB.	• **The WPCF must always have one redundant CCB to meet regulatory requirements. Wintertime operations require use of three basins with the fourth acting as the redundant basin.** • Operationally more complex to switch between recycled water use and normal disinfection. • Significantly larger than needed. The CCB would provide more than 2,000 minutes of detention time at 0.65 MGD and 400 minutes at 3 MGD.

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Alternative	Advantages	Disadvantages
Existing HRCCB	• Existing facilities used. • Lower cost alternative. • Tertiary filtration system includes piping intended to be connected to the HRCCB for future use for recycled water production.	• **Not available for use when needed to disinfect primary effluent (starting at influent flows greater than 160 MGD).** • Operationally more complex to switch between recycled water and normal disinfection. • Significantly larger than needed. Unless structural modifications were made, the HRCCB would provide more than 3,000 minutes of detention time at 0.65 MGD and 600 minutes 3 MGD. • Does not meet DEQ recommendations for length to width ratio. Additional baffles or tracer studies might be needed to gain regulatory approval. • If used for water storage and contact time, additional structural modifications would be needed. Modifications could interfere when used for high rate disinfection.
New CCB	• Sized specifically for the recycled water program. • Could be designed for future expansion. • Increased reliability - available during peak flow events that would otherwise stop production of recycled water (e.g., if the HRCCB were used). • Would eliminate need to clean CCB or HRCCB after use during peak flow season/events.	• Higher capital cost compared with using existing CCB or HRCCB. • Would not utilize existing infrastructure that is largely left unused (HRCCB). • Footprint of recycled water facility would be greater. • Additional process facility with additional associated operation and maintenance needs.

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Alternative	Advantages	Disadvantages
West Bank Trail pipeline	• Would eliminate need for separate CCB. • Reduced cost.	• **Would not provide needed contact time with filters operating at their minimum production capacity.** • Recycled water storage could not be located at the WPCF. • **Could face regulatory challenges.** • Regulatory compliance point would not be at the WPCF. • Additional piping would be needed to return recycled water for use at the WPCF.
Recycled water storage tank	• Would eliminate need for separate CCB. • May reduce cost. • Would reduce footprint of recycled water facility.	• **Standard tank design not suited to optimize disinfection.** • **Difficult to ensure adequate contact time achieved.** • **Could face regulatory challenges.** • May need additional flow studies prior to design. • Compliance point would shift downstream of storage.

Recommendations:

- Eliminate the CCB for use in providing needed contact time for chlorine disinfection from further consideration. Four CCBs (3 duty and 1 redundant) must be available for disinfecting secondary effluent to meet regulatory requirements.
- Evaluate the existing HRCCB for use in providing needed contact time for chlorine disinfection.
- Evaluate construction of a new CCB only if subsequent evaluation of the HRCCB shows that it is not a viable option.

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- Eliminate use of the West Bank Trail pipeline. It would not provide needed contact time and would make storage of recycled water at the WPCF difficult.
- Eliminate the alternative of combining chlorine contact and storage from further consideration. It would not adhere to normal design practices, would be difficult to ensure adequate contact time was achieved, and could be challenged by DEQ).

Recycled Water Storage

Providing storage for treated recycled water would increase system reliability. However, it would also add construction and operation and maintenance costs. The Basis of Design TM recommends the design value for storage be set equal to 1 day of consumption at maximum daily demand. Minimum design criteria for this value was calculated to be 0.65 MG.

The following storage alternatives have been identified and are described further in the sections below:

- Providing storage,
- Use of existing tanks for storage,
- Storage location, and
- Construction alternatives.

Providing Storage

The Basis of Design TM recommends using 1,460 gallons per minute (gpm) as the minimum design criteria for peak instantaneous demand for recycled water. This equals 2.1 MGD. Treatment capacity of the tertiary filters is 11 MGD. Because the capacity of the tertiary filters exceeds the minimum design criteria for peak demand, the recycled water system could potentially be designed to function without storage. However, this would require continuous operation of the filters and because their minimum production rate is 3 MGD, excess water would be generated.

The advantages and disadvantages of providing recycled water storage are presented in Table 3 below. This evaluation was based on providing storage volume equal to 1 day of consumption at maximum daily demand (0.65 MG).

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Table 3: Advantages and Disadvantages of Providing Recycled Water Storage

Alternative	Advantages	Disadvantages
Provide storage	• **Increased system reliability with associated customer satisfaction.** • Would eliminate need to continuously run the tertiary filters. • Reduced energy use. • Disinfection system would not need to match instantaneous demand making operations easier.	• Higher capital cost. • Depending on the storage alternative considered (e.g., construction of a new storage tank), the footprint of the recycled water facility would increase. • May need additional chlorine dosing depending on time in storage.

Recommendation:

- Assume recycled water storage will be provided. Doing so increases reliability, reduces operational complexity, and eliminates the need to continuously operate the tertiary filters.

Use of Existing Tanks for Storage vs New Construction

Four alternatives have been identified to provide storage. Three alternatives utilize existing infrastructure. The fourth assumes construction of a new recycled water storage tank. These alternatives are as follows:

- **Existing CCB.** Following disinfection, recycled water would be conveyed to one of the four existing CCBs for storage. One CCB has about 875,000 gal of volume. This exceeds the minimum design criteria of 0.65 MG.

- **Existing HRCCB.** Following disinfection, recycled water would be conveyed to the existing HRCCB for storage. The volume of the HRCCB is about 1.4 MG. This is significantly greater than the minimum design criteria of 0.65 MG and would facilitate future expansion of the recycled water program.

- **West Bank Trail Pipeline.** Following disinfection, the existing pipelines would be used for storage. Total volume of the existing pipes is about 250,000 gal.

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- **New Tank.** A new 0.65 MG storage tank would be constructed to meet the minimum design criteria. For reference, assuming a water depth of 30 ft, a circular tank of this volume would be 60 ft in diameter.

The advantages and disadvantages of these storage alternatives are presented in Table 4 below.

Table 4: Comparison of Using Existing Tanks vs. New Construction for Storage

Alternative	Advantages	Disadvantages
Existing CCB	• Would eliminate need for new structure. • Reduced capital cost. • Decreased footprint for recycled water facilities.	• **The WPCF must always have one redundant CCB to meet regulatory requirements. This eliminates the use of the CCB from further consideration.** • Would require cleaning when returned to recycled water service. • Operationally more complex switching between recycled water production and disinfection of normal plant effluent. • Open storage would increase chance of contamination and may increase difficulty of maintaining chlorine residual.
Existing HRCCB	• **Would eliminate need for new structure.** • **Reduced capital cost.** • Volume greater than that needed for the initial demonstration project which would facilitate future expansion. • Decreased footprint for recycled water facilities.	• Not available for use when disinfecting primary effluent (influent flows more than 160 MGD). • Would require cleaning when returned to recycled water service. • Operationally more complex switching between recycled water production and disinfection of normal plant effluent. • Open storage would increase chance of contamination and may increase difficulty of maintaining chlorine residual.

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Alternative	Advantages	Disadvantages
West Bank Trail pipeline	• Would eliminate need for new structure. • Reduced capital cost. • Decreased footprint for recycled water facilities.	• **Pipelines are pressure vessels. Not feasible to raise and lower water levels.** • **Volume significantly less than 1.15 MG design criteria for storage.**
New storage tank	• Year-round storage would be available. • **Increased reliability of recycled water system.** • Reduced operational complexity.	• **Higher capital cost.** • Existing tankage not utilized. • Larger footprint for the recycled water facilities.

Recommendations:

- Eliminate use of the existing CCB for recycled water storage from further consideration.
- Evaluate use of the existing HRCCB for recycled water storage. The HRCCB would not be available for storage when used to disinfect primary effluent. However, during initial years of operation, the recycled water system is expected to be used only during the summer irrigation season (May through October). Because the volume of the HRCCB is significantly greater than that needed for the initial demonstration phase of the recycled water program, capacity would be readily available to serve additional recycled water users. during initial years of operation
- Eliminate use of the West Bank Trail pipeline from further consideration. Use of pressure vessels for storage is not feasible.
- Evaluate construction of a new recycled water storage tank and compare with the use of the HRCCB.

Location Alternatives (Onsite vs Offsite)

Recycled water storage could be located either inside the existing fence line of the WPCF (onsite) or outside the existing fence line (offsite). Offsite locations could range from within the park area immediately to the east of the WPCF to a remote location farther away. Advantages and disadvantages of these alternatives are presented in Table 5 below.

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Table 5: Comparison of Onsite vs. Offsite Storage

Alternative	Advantages	Disadvantages
Onsite	• **Would utilize existing WPCF infrastructure (e.g., roads, electrical, security, etc.).** • **Lower cost.** • More easily monitored by WPCF staff. • Potential for easier permitting. • Lower impact to public from construction.	• Would use space within the WPCF that could be used for other purposes.
Offsite	• Would not use space within the WPCF that could be used for other purposes.	• **Higher cost.** • **Increased recycled water and facility safety concerns.** • Would extend the project delivery time. • Would require additional effort to identify an appropriate site and purchase (or negotiate an easement or lease). • Would require additional infrastructure. • Permitting would be more difficult. • Increased public impact.

Recommendation:

- Assume storage will be located onsite and within the existing fence line of the WPCF when evaluating construction of a new storage tank. Locating storage at the WPCF utilizes existing infrastructure, should result in lower construction costs, reduces safety concerns, and is likely to be more easily permitted.

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Storage Tank Construction Alternatives

Construction of a new storage tank will only be considered if analysis during the alternatives evaluation phase of the conceptual design process shows that using the HRCCB for storage is not a viable option. If new tank construction is evaluated, alternatives for tank construction could include both material type and whether the tank is constructed above the ground or in-ground. Advantages and disadvantages of alternatives for construction materials are presented in Table 6 below.

Table 6: Comparison of Construction Materials

Alternative	Advantages	Disadvantages
Concrete	• Surrounding tanks at the WPCF are concrete. • Longer expected life. • Lower life cycle cost. • Tank shape (i.e., round vs rectangle) can be made to better fit available space. • Minimal exterior maintenance. • Interior coatings are not required. • In-ground tank construction would be possible. • Less space required if built into the ground (compared to steel tank with the same roof elevation). • Roofs can be designed to support pedestrian, vehicle, and soil loads. • Flat roofs of concrete tanks would have lower profile than steel tanks. • Recycled water pumps could potentially be located on the tank roof.	• Higher construction cost. • Time for construction would be longer. • More difficult to repair joints compared to welded steel tanks. • More difficult to detect leakage. • More susceptible to being constructed by less experienced teams if prequalification requirements are not specified. • Typically greater cost to modify tank in future to accommodate changes in piping or access.

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Alternative	Advantages	Disadvantages
Steel	• Lower initial cost. • Joints are exposed facilitating inspection and testing. • Steel tanks have a zero-leakage tolerance. • More easily modified for new piping arrangements or access. • Greater wall heights possible (60 ft or more). • Shorter onsite construction time.	• Shorter expected life. • Greater maintenance with routine recoating of interior and exterior. • Higher life cycle costs. • In-ground construction not advised. • Shape cannot be changed to better fit available space. • Roofs usually only capable of supporting snow or pedestrian loads.

Advantages and disadvantages of above ground versus in-ground tanks are presented in Table 7 below.

Table 7: Comparison of Above Ground and In-Ground Tanks

Alternative	Advantages	Disadvantages
Above Ground	• Steel tanks become an option. • Would reduce construction challenges associated with groundwater and dewatering. • Tank walls more easily inspected. • Provides better suction head conditions for centrifugal pumps located at grade.	• Greater visual impact due to height. • More space required if tank height is limited. • Gravity flow from tertiary filters may not be possible. • Access to tank roof/top more difficult.

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Alternative	Advantages	Disadvantages
In-Ground	• Smaller footprint if above ground tank height is limited. • Would facilitate gravity flow from tertiary filters. • Reduced visual impact. • Easier access to tank top/roof. • Recycled water pumps could more easily be located on the tank roof.	• Steel tanks should not be constructed below ground. • Groundwater may create construction challenges.

Recommendations:

- If construction of a new storage tank is considered, evaluate use of an in-ground concrete storage tank. An in-ground concrete storage tank would minimize facility footprint, minimize corrosion concerns, and would facilitate gravity flow to the tank from the CCB.
- Evaluate an above ground steel tank only if costs for an in-ground concrete tank are deemed to be too high by the MWMC.

Recycled Water Pumping

Pumping facilities will be needed to meet flow and pressure demands of recycled water users. Applicable minimum criteria for pumping system design presented in the Basis of Design TM include those for flow rate (maximum instantaneous demand of 1,460 gpm) and pressure (30 to 60 psi). Pumping between recycled water process units (e.g., between tertiary filtration and chlorine contact) may be needed but has not been evaluated in this initial fatal flaw analysis. Pumping between processes will be considered as needed during the later alternatives evaluation phase of the conceptual design process.

Design considerations associated with recycled water pumping include the following:

- Use of existing structures,
- Pump type, and
- Number of pumping stations needed.

Alternatives for each of these design considerations are described below.

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Use of Existing Structures for Recycled Water Pumping

As described below, potential options for recycled water pumping include use of existing facilities or construction of a new pumping station.

- **Existing CCB.** If used for storage, the existing CCBs would have a maximum water depth of about 13 ft. Vertical turbine type pumps could potentially be installed in one of the four existing CCBs. Volume of each CCB is about 875,000 gal which would provide enough wet well volume for pump operation.

- **Existing HRCCB.** If used for recycled water storage, the HRCCB would have maximum water depth of about 17 ft which would potentially permit installation of vertical turbine type pumps. The total potential volume of the HRCCB (1.4 MG) would not be accessible because the tank level could not be drawn down below minimum water depth requirements for the pumps.

- **Tertiary filter flow distribution structure.** The tertiary filter flow distribution structure has a maximum water depth of about 16 ft. The structure is divided into two sections separated by a weir wall. Inside plan dimensions for each section of the distribution box are about 8 ft by 9 ft.

- **New pumping station.** A new structure would be constructed to house the recycled water pumping station. Alternatives could include construction of a dedicated wet well for vertical turbine pumps or a centrifugal type pumping station that would be constructed at grade and would draw directly from storage. Analysis of alternatives for new pumping stations is beyond the scope of this initial screening evaluation.

The advantages and disadvantages of using existing structures for recycled water pumping facilities are presented in Table 8 below.

Table 8: Comparison of Existing Structures vs. New Construction for Pumping

Alternative	Advantages	Disadvantages
Existing CCB	• Would eliminate need for new structure. • Reduced capital cost. • Decreased footprint for recycled water facilities.	• **The WPCF must always have one redundant CCB to meet regulatory requirements. This eliminates the use of the CCB from further consideration.**

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Alternative	Advantages	Disadvantages
Existing HRCCB	• **Would eliminate need for new structure.** • **Reduced capital cost.** • Decreased footprint for recycled water facilities.	• Alternative only possible if HRCCB used for recycled water storage. • Unavailable when disinfecting primary effluent (influent flows more than 160 MGD). • Entire possible storage volume of HRCCB would not be available because of water depth requirements for pumps.
Filter flow distribution structure	• Would eliminate need for new structure. • Reduced capital cost. • Decreased footprint for recycled water facilities.	• **Small structure with relatively little space to install pumps.** • **Relatively small wet well volume.** • **Upstream of CCB and recycled water storage.**
New pumping station	• Station could be specifically designed to maximize use of storage. • A greater variety of pump alternatives may be available. • Construction would not disrupt operation of the existing CCB or HRCCB.	• Potentially higher construction cost. • Greater facility footprint.

Recommendations:

- Eliminate use of the existing CCB for recycled water pumping from further consideration.
- Consider use of the HRCCB for recycled water pumping if analysis during the alternatives evaluation phase of the conceptual design process shows that using the HRCCB for storage is a viable option.
- Eliminate use of the tertiary filter flow distribution structure from further consideration. This structure, however, could be considered for use in pumping needed between unit processes (e.g., between the tertiary filter and the CCB).

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- Evaluate the construction of a new recycled water pumping station only if using the HRCCB is not a viable option.

Pump Alternatives

Multiple pump types may be suitable for pumping recycled water. These include both centrifugal and vertical turbine type pumps.

- **Centrifugal.** Centrifugal type pumps include those with overhung impellers (e.g., submersible, separately coupled horizontal type, etc.) and those with impellers between bearings (e.g., axial split case). Alternatives for centrifugal type pumps presented below include using pumps originally installed at the Biosolids Management Facility (BMF) as part of the biosolids irrigation system. The horizontal, end suction centrifugal pumps were designed for clear water applications and were not suitable for application at the BMF. They were replaced in 2005. Performance curves for the pumps show they are capable of pumping at a rate of 800 gpm at about 130 psi.

- **Vertical turbine pumps.** Vertical turbine pumps include submersible well type pumps and line shaft type pumps with the motors mounted out of the water an accessible for maintenance.

Advantages and disadvantages of the various pump types are presented in Table 9 below.

Table 9. Comparison of Pump Alternatives

Alternative	Advantages	Disadvantages
Submersible centrifugal type	• Installed directly in wet well reducing construction costs.	• Not readily accessible for inspection and maintenance. • **Typically used for lower pressure applications.**
Existing BMF irrigation pumps	• Would utilize existing equipment. • Would potentially reduce project cost.	• Condition of existing pumps is not known. • Pumps may need to be modified (e.g., impellers trimmed) to optimize them for conditions associated with recycled water system. • Cannot be installed inside tanks.

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Alternative	Advantages	Disadvantages
Centrifugal pumps (other than submersible)	• Wide selection of pumps available. • Pumps readily accessible for inspection and maintenance.	• Cannot be installed inside tanks. • Greater facility footprint. • Depending on water surface elevation of wet well could require construction of a dry well.
Vertical turbine	• Wide selection of pumps available. • Pumps could be placed directly into the storage tank. • Pump barrels (i.e., cans) could be used to eliminate need for wet well. • Motor for line shaft type pumps readily accessible for inspection and maintenance.	• Pump not readily accessible for inspection and maintenance.

Recommendations:

- Eliminate submersible centrifugal pumps from consideration.
- Consider both centrifugal and vertical turbine pumps for recycled water pumping.
- Determine condition of the existing BMF irrigation pumps and consider their use when evaluating centrifugal pumps.

Number of Pumping Stations

Alternatives for recycled water pumping include the number of pumping stations used.

- **Single pumping station.** This alternative would require that a single pumping station be designed to meet the flow and pressures requirements for all identified recycled water uses (e.g., Delta Sand & Gravel, WPCF irritation, truck fill station, etc.). Use of a single pumping station would essentially create a recycled water distribution system that would be connected to all users much like a potable water distribution system.

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- **Multiple pumping stations.** Multiple pumping stations could be specifically designed to meet the needs of individual water users. For example, a small capacity station could be provided to serve only the truck fill station with another dedicated to providing water to Delta Sand & Gravel.

Advantages and disadvantages of these two design approaches are presented in Table 10 below.

Table 10. Comparison of Alternatives for Number of Pumping Stations

Alternative	Advantages	Disadvantages
Single pumping station	• Lower number of pumps. • Reduced operational complexity. • Reduced maintenance. • Potentially lower cost. • Better suited to future expansion.	• Large capacity pumps may provide higher pressure than might otherwise be needed.
Dedicated pumping stations	• Each station could be optimized for a specific use.	• Could complicate future expansion. • **Larger number of pumps with associated additional operational complexity and maintenance.**

Recommendation:

- Eliminate design of dedicated pumping stations from further consideration unless further evaluation shows that system conditions do not make design of a single station possible.

Water Truck Fill Station

A water truck fill station will be designed for the City of Eugene's (City's) street tree water program. Trees are watered by City staff for 3 years after planting during the summer months, typically starting in May and ending in October. The City has truck-mounted tanks that are currently filled with potable water from fire hydrants. The street tree watering program has been identified as a potential use for recycled water and will require construction of a filling station for the City's water trucks. Fill station alternatives identified for this initial screening include the following:

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- **Fill station location.** The recycled water fill station could be located inside the existing fence line of the WPCF near the proposed recycled water facilities or outside the fence line near the existing RV dump station.

- **Flow metering.** Dedicated metering of water dispensed at the truck fill station could be provided.

Advantages and disadvantages of these alternatives are presented in Table 11 below.

Table 11. Comparison of Fill Station Alternatives for Number of Pumping Stations

Alternative	Advantages	Disadvantages
Locate inside WPCF fence line	• Improved security. • More easily monitored. • Reduced cost associated with shorter pipe and conduit runs.	• WPCF staff must grant access. • Increased onsite truck traffic.
Locate outside WPCF fence line	• Accessible at all hours. • Reduced onsite truck traffic.	• More difficult to monitor and less secure. • Higher cost associated with greater distance from the recycled water facilities. • Potential for vandalism.
Provide flow metering	• Ability to track use.	• Increased cost.

Recommendations:

- Locate fill station inside the existing fence line near proposed recycled water production facilities. Depending on future demand the fill station could be relocated outside the fence line.
- Provide dedicated flow metering for the truck fill station. This will add little cost to the project and will allow direct measurement of use.

Distribution System

Alternatives identified as being suitable for this initial screening process were limited to landscape irrigation at the WPCF and whether areas outside the existing fence line should be irrigated. Advantages and disadvantages of irritating outside the fence line are presented in Table 12 below.

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Table 12. Advantages and Disadvantages of Irrigating Outside the WPCF Fence Line

Alternative	Advantages	Disadvantages
Irrigate outside WPCF fence line	• Additional water use. • Decreased use of potable water. • Potential for increased public awareness.	• Potential for negative reaction from public.

Recommendation:

- Assume recycled water will be used to supply water to the WPCF's existing landscape irrigation system including those areas outside the facility's fence line. Include provisions in the design to switch back to potable water for areas outside the WPCF fence line and plant water inside the fence line.

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Appendix C: Tertiary Filter Evaluation Technical Memorandum

4 February 2021

Technical Memorandum – Tertiary Filter Evaluation

To: Barry Mays (MWMC/City of Springfield
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project Number P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Tertiary Filter Evaluation
K/J Project Number: 1776023*00

This Technical Memorandum (TM) presents the results of an evaluation of the existing tertiary filters for the Metropolitan Wastewater Management Commission's (MWMC) recycled water facility preliminary design project. The goal of this evaluation was to identify a preferred alternative for operation of the tertiary filters based on three different pumping rates that considered both economic and non-economic factors. Tertiary filtration alternatives considered include the following:

1. Alternative 1 - Base Option 3 MGD. This alternative assumes no change to the operation of the tertiary filters. It assumes the minimum production rate for the filters is 3 million gallons per day (MGD) as reported to Kennedy Jenks by MWMC staff. The tertiary filters would cycle on and off as needed to meet recycled water demand.
2. Alternative 2 - Reduced Filtration Rate. This alternative assumes no change to the existing filter pumps but would reduce the production of filtered water by limiting flow to the filters and returning the excess to the filter pump wet well. Pumps would operate at the minimum pumping rate. Filter production would range from 0.35 to 0.65 MGD.
3. Alternative 3 - Reduced Pumping Rate. This alternative assumes the addition of new filter pumps to achieve a filtration rate of 0.35 to 0.65 MGD.

The advantages to operating the tertiary filtration system at reduced flow rates include a reduction in the size of downstream disinfection facilities and to allow for the continuous operation of the filters, eliminating concerns with intermittent operation.

Background and Design Criteria

In preparing this TM, it was assumed the High-Rate Chlorine Contact Basins (HRCCB) would be used to store recycled water. The HRCCB was identified by MWMC staff as the preferred storage alternative during the August 15, 2019 Class A Disinfection Alternatives review meeting and was presented as the recommended storage alternative in the TM on recycled water storage alternatives. As a result, the daily recycled water demands presented in the Basis of Design have been revised in this TM to maintain HRCCB disinfection capacity during wet weather. For the purposes of this TM, a 6-month operating period from May through October has been assumed.

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The 2010 Tertiary Filtration Phase 1 improvements project installed a tertiary filtration system consisting of tertiary filtration pumps, tertiary filters, and backwash waste pumps. A process flow diagram is shown on Figure 1.

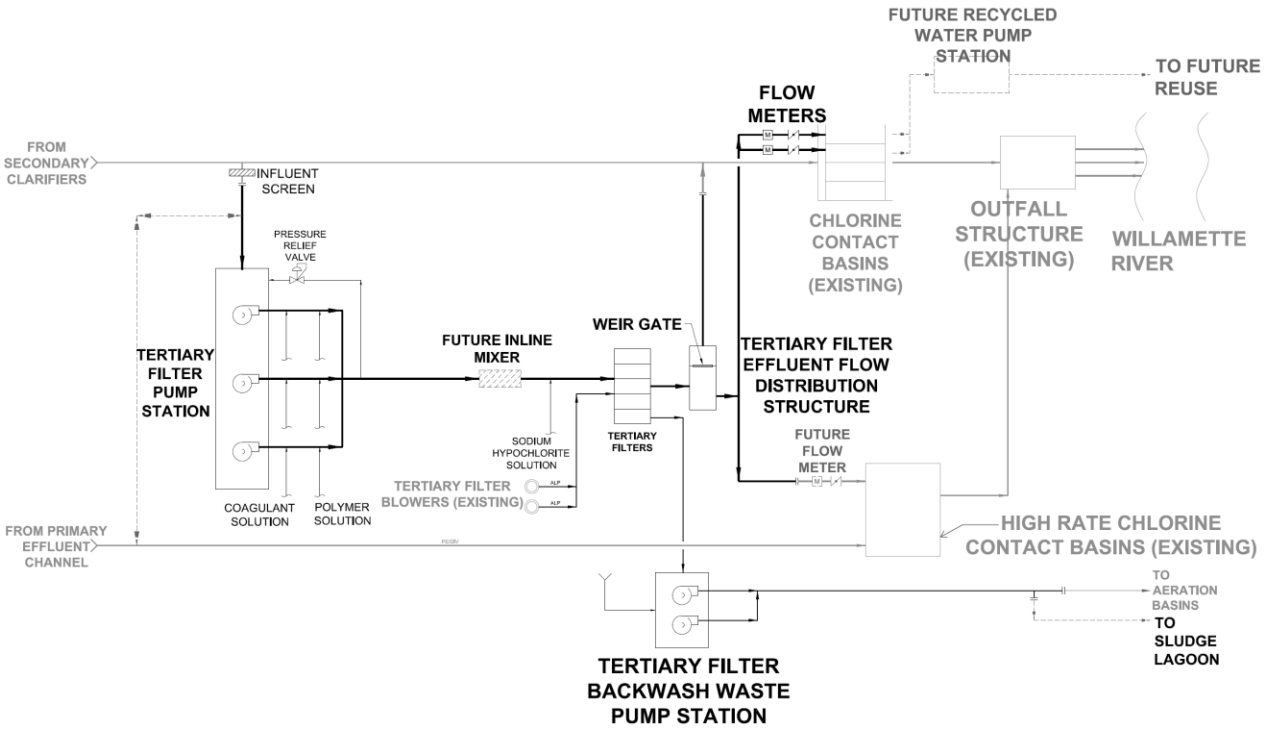


Figure 1: Tertiary Filtration Phase 1 Process Flow Diagram

The Tertiary Filter Pump Station consists of three, submersible pumps installed in a wet well. Secondary effluent is fed by gravity from the secondary clarifiers effluent channel to the Tertiary Filter Pump Station wet well. Tertiary filter pumps convey secondary effluent to five, compressible media tertiary filters that remove solids and reduce turbidity to meet Class A Recycled Water requirements. Chemical addition facilities were provided for the addition of alum and polymer to improve filter performance and to ensure these requirements were met. Filtered secondary effluent flows by gravity to the existing chlorine contact basins for disinfection. A future Recycled Water Pump Station was planned to convey Recycled Water through a distribution system to end users. Design data for the 2010 Tertiary Filtration Phase 1 project are summarized in Table 1.

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Table 1: Tertiary Filtration Phase 1 Design Data

Item	Units	Parameter
Tertiary Filter Pumps		
Type		Submersible
Drive		Variable Speed
Number		3
Capacity, each	MGD	5.5
Total Dynamic Head, each	ft	39
Motor Power, each	hp	60
Tertiary Filters		
Type		Compressible Media
Number		5
Filtration Area per Filter	sf	49
Filtration Rate per Filter	gpm/sf	5-40
Maximum Flow per Filter	MGD	2.82
Minimum Flow per Filter	MGD	0.35
Total Filtration Capacity[(a)]	MGD	11.30
Firm Filtration Capacity[(b)]	MGD	8.47
Minimum Filtration Capacity	MGD	0.35
Backwash Medium		Secondary Effluent
Backwash Rate	gpm/sf	10
Airwash Rate	scfm/sf	15
Backwash Duration, Range	min	15-40
Backwash Frequency, Dry Weather Average Loading	hr	6
Chemical Addition		
Expected Addition Time	%	15
Polymer Dose, Range	mg/L	0.05 - 0.25
Polymer Activation Units		
Number		1
Neat Capacity, each	gph	0.01 - 1.0
Coagulant Dose, Range	mg/L	2.5 - 25
Coagulant Metering Pumps		
Number	2	
Capacity, each	gph	0.052-42
Filter Blowers		
Type		Multi-stage Centrifugal
Drive		Constant Speed
Number		2
Motor Power, each	hp	50
Flow Requirement	scfm	735
Discharge Pressure	psig	8
Backwash Waste Pumps		
Type		Submersible
Drive		Constant Speed
Number		2
Capacity, each	gpm	1,500
Total Dynamic Head, each	ft	30
Motor Power, each	hp	20

Notes:
(a) Capacity with four filters in operation and one filter in backwash.
(b) Capacity with three filters in operation, one filter in backwash, and one filter out of service.

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Estimated demand for recycled water was presented in the Basis of Design TM. As shown in Table 2 below, demand is estimated to range from an average annual value of 0.19 MGD to a maximum daily demand of 0.65 MGD.

Table 2: Average Recycled Water Demand

Beneficial Use	Average	Maximum
Delta Sand & Gravel, gpd[(a)]	160,000[(b)]	500,000[(f)]
WPCF irrigation, gpd	26,000[(c)]	150,000[(g)]
Street tree irrigation[(d)], gpd	1,250	2,500[)]
Design value (Total)	190,000[(e)]	650,000[(e)]

Notes:

(a) Gallons per day (gpd).
(b) Average of summer and winter time average daily values (220,000 gpd and 100,000 gpd), respectively.
(c) Based on water use data for year 2017.
(d) Values for tree irrigation are insignificant compared to other demand values.
(e) Value rounded to the nearest 10,000 gpd.
(f) Maximum day use per Delta Sand & Gravel.
(g) Maximum capacity of existing irrigation system per MWMC staff memorandum dated February 20, 2019.

The daily average design value of 0.19 MGD shown in Table 2 is an averaged value based on the assumption that the total annual recycled water quantity is distributed over a 12-month period. Given that use of the HRCCB for storage will be limited to the months of May through October, the resulting average demand over this 6-month period would be 0.38 MGD. Based on a minimum allowable filtration rate shown in Table 1 of 5 gpm per square feet (SF) and total filter area of 49 SF, the minimum possible flow through one filter is 245 gpm (0.35 MGD). The average daily demand design value of 0.38 MGD would result in a filtration rate of 5.4 gpm per SF with one filter operating continuously. The maximum daily demand value of 0.65 MGD would result in filtration rate of 9.2 gpm per SF with one filter operating. A design flow range of 0.35 to 0.65 MGD was thus selected for the evaluation of the reduced flow alternatives for the recycled water system.

While the recycled water demand design values are within the range of the filters, MWMC staff report that the minimum capacity of the existing tertiary filters is 3 MGD (2,080 gpm). This corresponds to a single pump operating at 60 percent (%) of full speed as shown on the existing pump curve on Figure 2.

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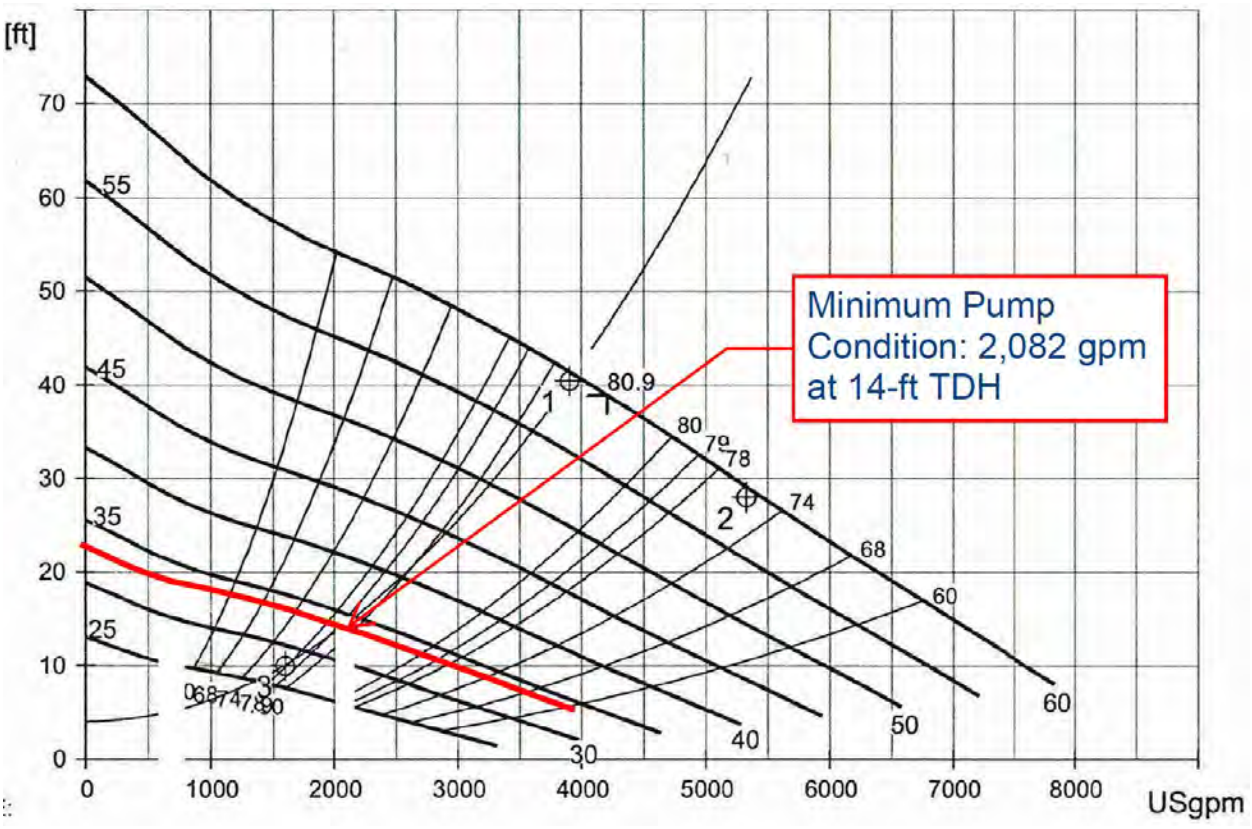


Figure 2: Existing Tertiary Filter Pump Curve

Given the demand range is below the maximum turndown of existing pumps, three alternatives for meeting the Demonstration Phase recycled water demands have been developed and described below.

Alternative 1 – Base Option 3 MGD

Alternative 1 proposes to use the existing tertiary filtration pumps with no changes to the operation of the existing pumps or filters. The pumps and filters would operate intermittently with daily manual startup and shutdown sequences performed by plant staff. Two filters would be required to operate at 3 MGD, resulting in a filtration rate of 21.2 gpm/sf per filter. One existing submersible pump would run at minimum speed to provide the 3 MGD. The pumps and filters would operate approximately 3 hours per day to provide meet the estimated average daily demand of 0.38 MG. Design data for Alternative 1 are summarized in Table 3.

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Table 3: Alternative 1 Design Data

Item	Units	Parameter
Tertiary Filter Pumps		
Condition		Existing
Pumps in Operation		1
Pumping Rate	MGD	3
Total Dynamic Head	ft	14.5
Operating Power	hp	10
Tertiary Filters		
Filters in Operation		2
Total Filter Flow	MGD	3
Filtration Rate per Filter	gpm/sf	21.30
Filter Run Time	Hours/day	3
Backwash Cycles per Day		1

Alternative 2 – Reduced Filtration Rate

Alternative 2 would continue to use the existing tertiary filtration pumps at the minimum 3 MGD flow setting. A single filter would be placed into operation and the inlet control valve would limit flow to the filter to the target range of 0.35 to 0.65 MGD. Throttling flow to the filters will increase pressure in the distribution header piping, causing the 12-inch Pressure Reducing Valve (PRV) on the bypass leading back to the wet well to open returning excess flow (2.35 to 2.65 MGD) to the wet well. The pressure setting of the PRV could be adjusted to allow the system to operate at a lower pressure setting to reduce energy use and programming changes would be needed to allow operation at the lower filtration rate. These changes are shown on Figure 3.

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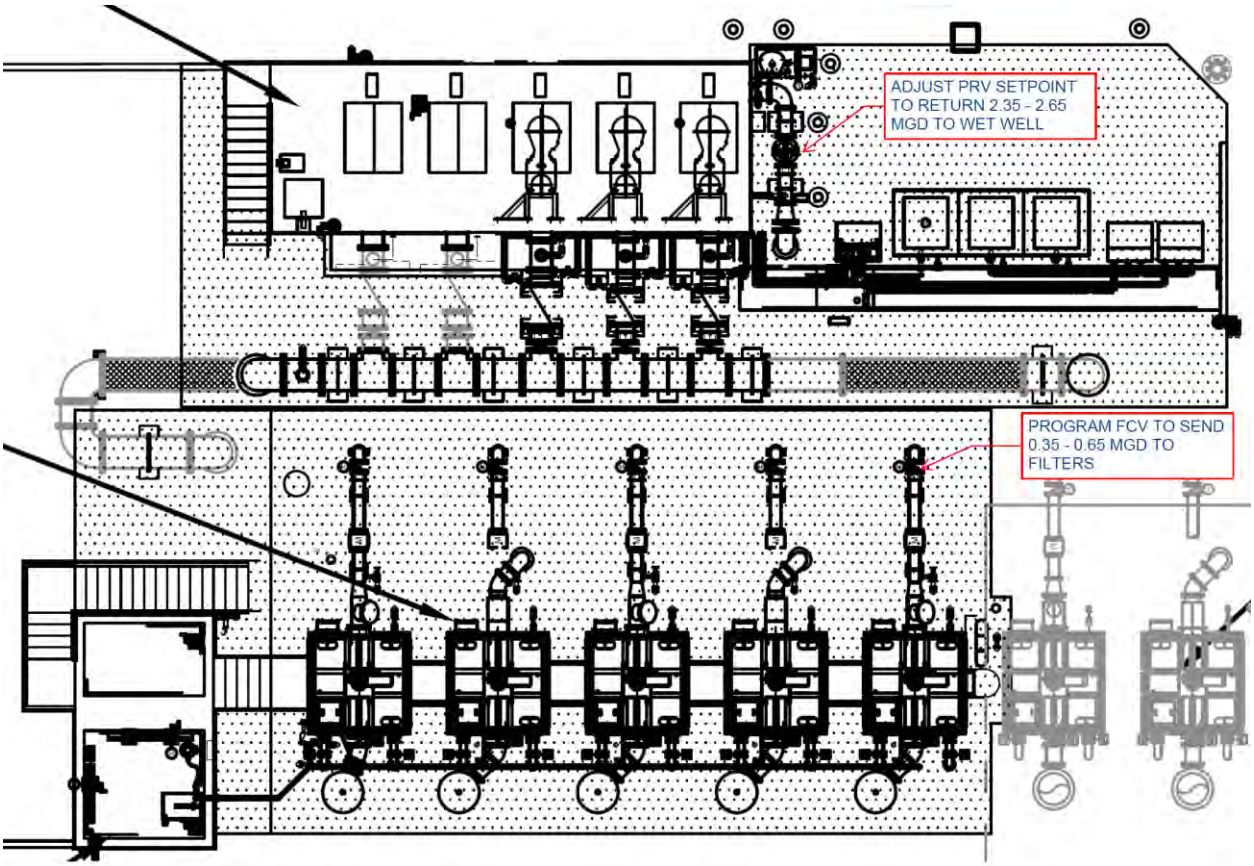


Figure 3: Alternative 2 Improvements

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The filtration system would run continuously with one filter operating at a filtration rate of 5 to 9.2 gpm/sf. Design data for Alternative 2 are summarized in Table 4.

Table 4: Alternative 2 Design Data

Item	Units	Parameter
Tertiary Filter Pumps		
Condition		Existing
Pumps in Operation		1
Pumping Rate	MGD	3
Return Rate	MGD	2.35 - 2.62
Total Dynamic Head	ft	14.5
Operating Power	hp	10
Tertiary Filters		
Filters in Operation		1
Total Filter Flow	MGD	0.35 - 0.65
Filtration Rate per Filter	gpm/sf	5.0 - 9.2
Filter Run Time	Hours/day	24

Alternative 3 – Reduced Pumping Rate

The reduced pumping option would add two, new tertiary filtration pumps to convey the design flow range of 0.35 to 0.65 MGD to the filters. This alternative assumes the installation of new pumps and piping at the Tertiary Filter Pump Station. New piping and valves for chemical injection into the pump discharge piping would also be provided. New variable frequency drives (VFDs) would be installed in the new electrical building and new conduit would run to the existing 51-MCC-3A. Existing conduits from the existing electrical building to the tertiary filter pumps would be utilized for the new pumps. This alternative would also require programming changes at the DCS for the flow control valves to work with the reduced pumping rates. These changes are shown on Figure 4.

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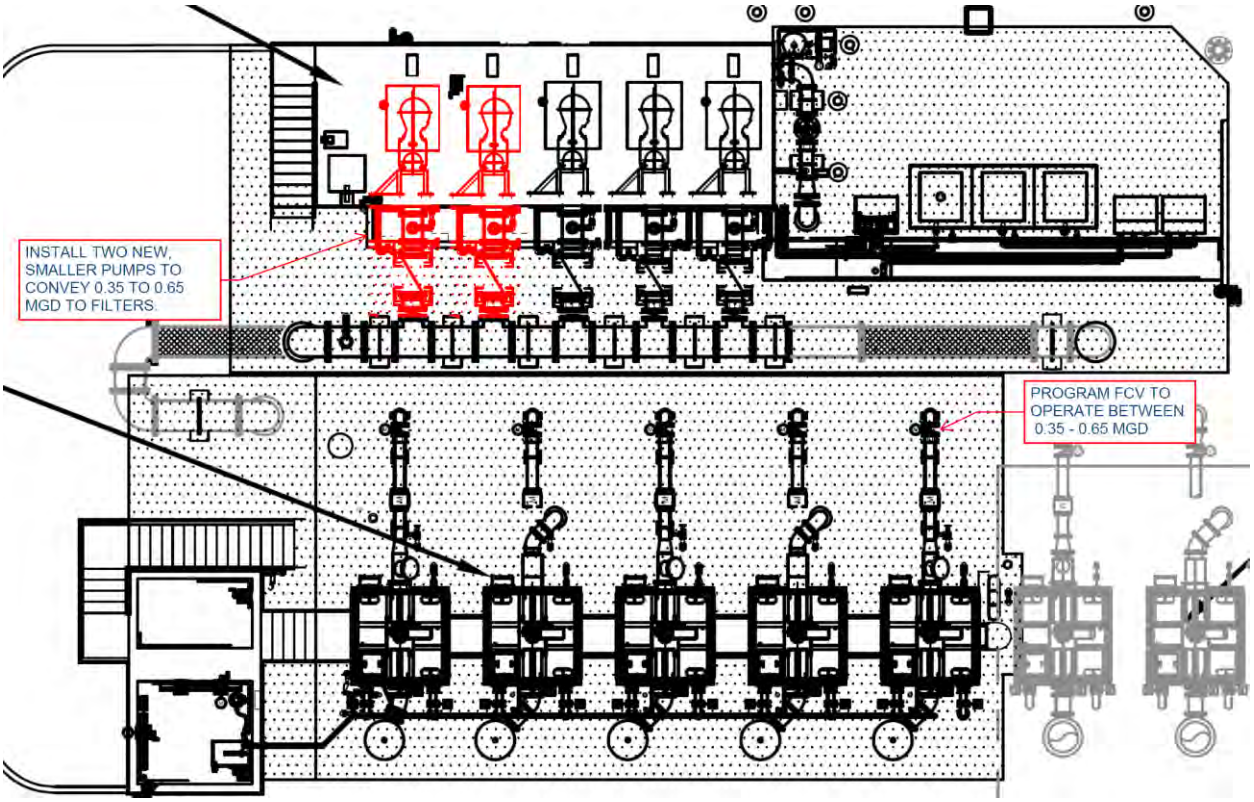


Figure 4: Alternative 3 Improvements

The filtration system would operate continuously with one filter operating at a filtration rate of 5.0 to 9.2 gpm/sf. One new pump would run at varying speeds to provide 0.35 to 0.65 MGD to the filters. An additional pump would be provided for redundancy. Design data for Alternative 3 are summarized in Table 5.

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Table 5: Alternative 3 Design Data

Item	Units	Parameter
Tertiary Filter Pumps		
Condition		New
Pumps in Operation		1
Pumping Rate	MGD	0.35 - 0.65
Total Dynamic Head	ft	11 - 11.5
Operating Power[(a)]	hp	1.5
Tertiary Filters		
Filters in Operation		1
Total Filter Flow	MGD	0.38 - 0.65
Filtration Rate per Filter	gpm/sf	5.4 - 9.2
Filter Run Time	Hours/day	24

Note:

(a) Operating power at a flow rate of 0.38 MGD (average daily flow) and head of 11 ft.

Economic Evaluation

The economic evaluation of alternatives includes development of conceptual level (AACE Level 4) Opinions of Probable Construction Costs (OPCC) as well as comparison of Operation and Maintenance (O&M) costs for each alternative. The OPCC for the three tertiary filtration alternatives are presented in Table 6. The O&M costs are presented in Table 7. Annual O&M costs for chemicals, materials, and labor are not included in the O&M cost comparison as cost per filtered gallon is not expected to vary among the options considered. For the purposes of this evaluation, no growth in demand year over year is anticipated during the lifespan of the Demonstration Phase. As a result, annual O&M costs representative of Year 1 are presented as opposed to a net present value of O&M costs over a 10- or 20-year period. The electricity costs shown in Table 7 correspond to the minimum production rate of 0.38 MGD.

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Table 6: Tertiary Filtration Alternatives OPCC

Item Description	Alternative 1	Alternative 2	Alternative 3
Sitework/Demo			$11,000
Concrete			$4,000
Metals			$4,000
Finishes			$3,000
Equipment			$30,000
Mechanical			$24,000
Electrical and Instrumentation	$0	$15,000	$56,000
Subtotal		$15,000	$132,000
Division 1 Costs (10%)		$1,500	$13,000
Subtotal		$16,500	$145,000
Contractor Overhead and Profit (15%)		$2,475	$22,000
Subtotal		$18,975	$167,000
Estimate Contingency (30%)		$5,692	$50,000
Subtotal		$24,667	$217,000
Escalate to Mid-point of Construction[(a)]		$986	$9,000
Total Estimate[(b)]	**$0**	**$30,000**	**$230,000**

Notes:

(a) Escalated at 2% per year assuming 24 months until mid-point of construction.
(b) Total Estimate rounded to nearest $10,000. Cost basis is August 2020 National Average ENR CCI value 11,455.

Table 7: O&M Cost Estimates

Item Description	Alternative 1	Alternative 2	Alternative 3
Avg daily demand	0.38 MGD	0.38 MGD	0.38 MGD
Filtration rate	3 MGD	0.38 MGD	0.38 MGD
Pumping rate	3 MGD	3 MGD	0.38 MGD
Run time, hours/day	3	24	24
Annual Electricity Costs[(b)]	$280	$2,800	$340

Note:

(a) Assuming an electricity cost of $0.069/kW-hr.

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Non-Economic Evaluation

Non-economic factors should also be considered when selecting a preferred tertiary filtration alternative. A comparison of non-economic considerations for the three tertiary filtration alternatives is presented in Table 8.

Table 8: Non-economic Comparison of Filtration Alternatives

Consideration	Alternative 1	Alternative 2	Alternative 3
Operation	• Intermittent operation with daily start/stop of the filter system would require additional operator attention to optimize filter performance.	• Filters would operate continuously at lower flows allowing for more stable operating conditions. This should result in overall reduction in time needed by operations staff in monitoring filter performance. • More complex operation with balancing of pump speed, PRV settings and filter control valve throttling. • PRV setpoints and control changes may be needed when moving between the recycled water season and wintertime operations when the larger capacity pumps could be called into service.	• Filters would operate continuously at lower flows allowing for more stable operating conditions. This should result in overall reduction in time needed by operations staff in monitoring filter performance.
Maintenance	• No significant difference between alternatives.	• No significant difference between alternatives.	• No significant difference between alternatives.
Performance	• Higher potential for exceeding turbidity requirements due to intermittent operation and higher filtration rates.	• Operating filters at lower filtration rate should result in lower potential for exceeding turbidity requirements.	• Operating filters at lower filtration rate should result in lower potential for exceeding turbidity requirements.

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Chemical Addition

The existing tertiary filtration system was provided with chemical feed equipment intended for the addition of coagulants (e.g., alum) and polymer to improve filter performance and to help ensure that effluent requirements for turbidity were met. Although provided, the chemical feed equipment was not operated during the one-year performance evaluation conducted from August 2012 to June 2013 nor has it been used since. As a result, MWMC staff do not have experience operating the chemical addition system and have expressed concern with the condition of the equipment, dosing rates, and possible negative effects on the filter media.

Tertiary filter systems such as the one in use by the MWMC are specifically designed and expected to use chemical addition to improve performance. Schreiber, the manufacturer of the compressible media type filter system, specifically reports that as many as 80% of its installations use chemical addition on a continuous basis to improve filter performance and effluent quality. Coagulants and polymers in normal use within the water and wastewater treatment industry and routinely used with their filter systems. Schreiber reports that aluminum chlorohydrate (ACH) and polyaluminium chloride (PACl) are more commonly used now instead of injecting both chemical coagulants (e.g., alum, ferric chloride) and polymers.

Kennedy Jenks recommends that prior to completing detailed design of improvements needed for the recycled water program, the MWMC should conduct a multi-month trial of the tertiary filters during which the existing chemical addition equipment would be tested. The trial operation should include the evaluation of equipment condition, chemical selection and dosing, impact on filter backwashing, and identifying controls improvements needed to help ensure consistent operation and performance.

Filter Improvements

MWMC staff have reported the need for additional filter improvements to improve the operation and reliability of the existing filters. Items that have been identified include:

- Improvements to the communication network to alleviate existing data transfer limitations. This would likely include eliminating the current Profibus communication network and replacing it with an alternate system such as Profinet. While an evaluation would be needed to identify specific improvements, communication improvements could cost as much as $100,000 to implement.
- Programming and controls improvements. The existing tertiary filter PLCs are approaching 10 years of age MWMC staff report shortcomings in existing programming. As with the communication network and a detailed evaluation should be conducted to identify specific improvements needed. Implementation of programming and controls improvements could cost approximately $40,000.

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- Instrumentation. MWMC staff report that the existing tertiary filter system needs a new turbidimeter and transmitter. Installation of a new turbidimeter and transmitter may cost approximately $10,000.
- Filter media. The tertiary filter media was installed in the summer of 2012 and was warranted for 7 years. Normal life expectancy of the media is 10 or more years. Because the media is approaching 10 years of age, the MWMC should consider the need for media replacement in the next few years. This will be more important with implementation of a recycled water program and the need for a higher level of reliability in meeting effluent turbidity requirements. The cost of replacement media is approximately $30,000 per filter, plus freight. Prior to replacing media, however, the MWMC should send samples to the filter manufacturer (Schreiber) for evaluation and determination of approximate remaining useful life.

Recommended Tertiary Filtration Alternative

Kennedy Jenks recommends that the MWMC consider implementing either Alternative 2 or 3 as part of the recycled water facility project. Although these alternatives would require additional investment in the existing filters, reducing the minimum capacity of the filters to better match initial demand for recycled water would allow the size of downstream disinfection facilities to be reduced. As presented in the Class A Disinfection Alternatives Evaluation TM, this would significantly decrease the cost of disinfection facilities and result in overall project savings.

As a stepwise approach, MWMC could consider first implementing Alternative 2. This could potentially reduce the overall project cost and allow staff to test the system prior to investing in additional infrastructure. If control of the PRV and throttling valves resulted in unstable operation, or seasonal changes in system setpoints prevented the system from reliability switching to the larger capacity feed pumps for wintertime operation, Alternative 3 could then be implemented.

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Appendix D: Class A Disinfection Alternatives Analysis Technical Memorandum

4 February 2021

Technical Memorandum – Class A Disinfection Alternatives

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project Number P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Class A Disinfection Alternatives
K/J Project Number: 1776023*00

This Technical Memorandum (TM) presents results of an evaluation of disinfection alternatives for the Metropolitan Wastewater Management Commission's (MWMC) recycled water facility preliminary design project. The alternatives considered in this TM are those that passed through the fatal flaw screening analysis as documented in the Fatal Flaw Screening TM dated June 24, 2019.

The goal of this alternatives evaluation was to identify a recommended disinfection approach for recycled water considering both economic and non-economic factors. Three disinfection alternatives were considered as follows:

1. Existing High Rate Chlorine Contact Basin (HRCCB). This alternative would use the existing HRCCB to provide both needed contact time and final storage of recycled water. Sodium hypochlorite would continue to be used for disinfection.
2. New Chlorine Contact Basin (CCB). This alternative also assumed the use of sodium hypochlorite for disinfection. However, unlike the combined disinfection and storage alternative, a new CCB would be designed and constructed specifically for the recycled water facility.
3. New Ultraviolet (UV) disinfection. This alternative assumed use of UV light for disinfection instead of sodium hypochlorite.

Kennedy Jenks presented the initial findings from this TM to MWMC staff during a review meeting at the Water Pollution Control Facility (WPCF) on August 15, 2019. Decisions made during that meeting have been added to the relevant sections below.

Following the review meeting and at the request of MWMC staff, Kennedy Jenks updated this evaluation to consider two design flow rates for the recycled water system: 0.65 million gallons per day (MGD) and 3 MGD. The higher rate (3 MGD) is the minimum rate at which MWMC staff report the existing tertiary filters can currently operate. The lower rate of 0.65 MGD is equal to the estimated maximum day demand for recycled water as presented in the Design Basis TM. Kennedy Jenks has evaluated reducing the capacity of the existing tertiary filters and has prepared a separate TM presenting the findings of that evaluation.

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A high-level carbon footprint analysis comparing the use of sodium hypochlorite with UV for disinfection was also performed and a summary of the results have been added to this TM.

HRCCB for Combined Disinfection and Storage

The existing HRCCB provides contact time for disinfecting primary effluent diverted around the secondary treatment process when influent flow to the WPCF is greater than approximately 160 MGD. The HRCCB has a total volume of about 1.4 million gallons (MG). Record drawings for the MWMC Peak Flow Management Improvements project show the HRCCB is designed to disinfect 117 MGD of diverted primary effluent during the design wet weather peak hour flow event of 272 MGD. Because wet season flows rarely exceed 160 MGD, the HRCCB operates only occasionally during the winter and never operates during summer months when demand for recycled water would be the greatest.

To make use of this infrequently used asset, the HRCCB could potentially be modified to provide both disinfection contact time to meet Class A disinfection requirements and storage of the produced recycled water for later use. A detention time of 90 minutes is required to meet Class A recycled water standards. A design flow rate of 3 MGD would require 190,000 gallons (gal) of the HRCCB be used for Class A disinfection. At 0.65 MGD, 40,000 gal would be used. The HRCCB could be reconfigured to provide a separate CCB within the existing structure through a combination of new concrete water retaining walls and fiberglass baffle walls.

Although the total volume of the existing HRCCB (1.4 MG) is significantly greater than needed for the Class A disinfection basin, Kennedy Jenks does not believe it would be feasible to construct a new CCB within the HRCCB that could be used for recycled water production during normal operation and then easily switched back to use for high rate disinfection of primary effluent. Because the outer walls of the recycled water CCB would be water retaining structures constructed of concrete, they would not be removeable. Although openings in the walls could be constructed and fitted with isolation gates, the large size needed for the openings would make this impractical. This means the volume associated with the recycled CCB would be lost from the HRCCB for high rate disinfection. At a design flow rate of 3 MGD, this would result in a 14 percent (%) reduction in HRCCB capacity. At a design flow rate of 0.65 MGD there would be a 3% reduction.

Because of the lost capacity of the HRCCB caused by this alternative, Kennedy Jenks recommends eliminating it from further consideration.

At the August 15, 2019 meeting, MWMC staff agreed with Kennedy Jenks' recommendation to eliminate use of the HRCCB for disinfecting tertiary effluent and only consider it for providing needed storage. Evaluation of the HRCCB for recycled water storage is summarized in a separate TM.

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New CCB with Sodium Hypochlorite Disinfection

This alternative assumes construction of a new dedicated CCB for disinfection of recycled water using sodium hypochlorite (hypochlorite). The following describes the CCB, chemical dosing, mixing, and instrumentation that would be needed for chlorination. Estimated capital and operation and maintenance (O&M) costs are also presented.

Chlorine Contact Basin

Preliminary design parameters for design flow rates of 3 MGD and 0.65 MGD used for this evaluation are presented in Table 1 below.

Table 1: CCB Design Parameters

Item	Value	
	0.65 MGD[(a)]	3 MGD[(b)]
Number	1	1
Detention time, min	90	90
Volume, gal	40,000	190,000
Water depth, ft	8	11.5
Length to width ratio	72:1	72:1

Notes:
(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters as reported by the MWMC staff.

The CCB would be constructed of reinforced concrete and located immediately west of the existing HRCCB. The top of the basin wall would be about 4 ft above the surrounding grade elevation and about 2 ft below the top of the HRCCB. Excavation for the basin would extend 10 to 15 ft below the surrounding grade elevation with depth being dependent on design flow rate and thus basin size. Fiberglass reinforced plastic (FRP) panels would be used to construct internal baffle walls to achieve the required length-to-width ratio.

The basin would be connected to the existing Tertiary Filter Effluent Flow Distribution Structure (Distribution Structure) using an existing 48-inch-diameter pipe penetration at the Distribution Structure that was plugged for future connection to the HRCCB. Depending on flow rate, an 18-inch or 24-inch ductile iron (DI) pipe would convey filtered water to the CCB. The basin would be connected to the WPCF's drain system and utility water stations would be provided for routine washdown.

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Chemical Dosing, Mixing and Instrumentation

Design parameters for chemical metering are presented in Table 2 below.

Table 2: Hypochlorite Design Parameters

Item	Value	
	0.65 MGD[a]	3 MGD[b]
Dose, mg/L[c]	8-16	8-16
Max dosing rate, gph[d][e]	3.6	16.7
Max daily use, gpd[f][g]	87	87

Notes:

(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters as reported by MWMC staff.
(c) Milligrams per liter.
(d) Gallons per hour.
(e) Rate calculated assuming 12.5% hypochlorite, maximum design flow rate (i.e., 0.65 MGD or 3 MGD) and dose of 16 mg/L.
(f) Gallons per day.
(g) Use at estimated maximum day recycled water production of 0.65 MGD.

For this evaluation, it was assumed that elements of the WPCF's existing hypochlorite facilities would be used for the recycled water demonstration project. This includes the existing hypochlorite storage tanks, pump building, primary effluent hypochlorite metering pumps and double contained hypochlorite piping used currently serving the HRCCB.

Record drawings for MWMC's Sodium Hypochlorite Conversion project show two existing diaphragm metering pumps for chlorination at the HRCCB, aeration basin scum box, primary effluent diversion channel, RAS tower, and secondary clarifier launders. The existing pumps have a capacity range of 0.3 to 248.3 gph which would meet the capacity needs for both design flow rates being considered. Because the record drawings show space for a future third primary effluent metering pump, Kennedy Jenks has assumed installation of a new equal sized metering pump that would be dedicated to the recycled water system. Piping could be configured so two systems (recycled water and primary effluent metering) would share a common redundant pump. Assuming the HRCCB is ultimately used to store recycled water, the recycled water system will not operate during peak flow events when the HRCCB is called into service to disinfect primary effluent. Because the HRCCB and recycled water system will not operate at the same time and the other uses for the primary effluent metering pumps (i.e., aeration scum box, RAS tower, clarifier launders, etc.) should not require the same level of redundancy, having a common redundant pump would provide sufficient redundancy for both systems.

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The record drawings also show two, 3/4-inch-diameter, double contained, pipes that are used to convey hypochlorite to the HRCCB. The existing hypochlorite lines run along the west side of the HRCCB and Kennedy Jenks has assumed the recycled water system would connect to them at a location near the HRCCB eliminating the need for additional supply piping.

Rapid, complete, initial mixing is important to ensure efficient disinfection. Kennedy Jenks has assumed that an initial mixing chamber at the inlet end of the CCB would be constructed and contain an induction type, 2-horsepower (hp), flash mixer.

Instrumentation needed for the chlorination system would include chlorine residual analyzers and flow metering. Chlorine residual analyzers would measure both initial and final chlorine concentration. Flow measurement could potentially be done using a Parshall flume or magnetic flow meter. A composite sampler would be located upstream of the storage tank to collect samples needed to prove compliance with recycled water quality criteria.

Estimated Capital and Operating Costs: New CCB with Hypochlorite Disinfection

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for the new CCB with associated hypochlorite disinfection facilities needed to produce Class A recycled water. A summary of this estimate is presented in Table 3 below. The total shown is limited to the disinfection system and is not for the entire recycled water project. Costs are presented for both the 0.65 MGD and 3 MGD design cases.

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Table 3: Conceptual Level Capital Cost Estimate: New CCB with Hypochlorite Disinfection

Item Description	Total 0.65 MGD[(a)]	Total 3 MGD[(b)]
Sitework/Demo	$100,000	$196,000
Concrete	$97,000	$277,000
Metals	$26,000	$38,000
Woods and Plastics	$33,000	$115,000
Finishes	$10,000	$10,000
Equipment	$137,000	$137,000
Mechanical	$88,000	$147,000
Electrical and Instrumentation[(c)]	$84,000	$156,000
Subtotal	$575,000	$1,076,000
Division 1 Costs (10%)	$58,000	$108,000
Subtotal	$633,000	$1,184,000
Contractor Overhead and Profit (15%)	$95,000	$177,000
Subtotal	$728,000	$1,361,000
Estimate Contingency (30%)	$218,000	$408,000
Subtotal	$946,000	$1,769,000
Escalate to Mid-point of Construction[(d)]	$38,000	$71,000
Total Estimate[(e)]	**$980,000**	**$1,840,000**

Notes:

(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters as reported by MWMC staff.
(c) Estimated at 17% of construction.
(d) Escalated at 2% per year assuming 24 months until mid-point of construction.
(e) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Annual O&M costs for the CCB and associated hypochlorite metering system were estimated and are presented in Table 4 below. Costs for projected initial average annual production of 0.19 MGD are shown compared with those estimated for average annual production of 0.65 MGD and 3 MGD (design capacity of the recycled water demonstration project). The three values are presented to illustrate the potential change in O&M costs as demand for recycled water increases.

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Table 4: O&M Cost Estimate: New CCB with Hypochlorite Disinfection

Item Description	Annual Cost		
Avg annual water production[(a)]	0.19 MGD	0.65 MGD	3.0 MGD
Energy[(b)]	$90	$1,400	$1,400
Chemical[(c)]	$7,200	$24,700	$114,000
Materials[(d)]	$4,100	$4,100	$4,100
Labor[(e)]	$16,500	$16,500	$16,500
Total	**$27,900**	**$46,700**	**$136,000**

Notes:

(a) Initial average annual water production is 0.19 MGD.
(b) Energy use for chemical metering, flash mixer, and chlorine residual sample pumps assuming an energy cost of $0.069/kW-hr.
(c) Hypochlorite dosed at 12 mg/L at a cost of $1.04/gal (per WPCF staff). No additional dosing assumed to be needed for storage and distribution.
(d) Materials include those needed for chemical mixing pumps, flash mixer, and chlorine residual pumps. Assumes pump replacement every 10 years. Cost shown are annualized costs.
(e) Labor based on 0.17 full-time employee (FTE) at a fully loaded rate of $46.42 per hour. Labor effort assumes 0.75 hr needed for daily operation and approximately 80 hrs per year for maintenance. Effort assumed to be the same regardless of basin size.

UV Disinfection

This alternative assumes construction of a UV system for disinfection to meet requirements for Class A recycled water. The following describes the UV disinfection system, instrumentation, and estimated costs for construction and annual O&M.

UV Disinfection Facilities

Although the Oregon Department of Environmental Quality (DEQ) does not have specific guidelines for UV disinfection of recycled water, Kennedy Jenks would design facilities to meet guidelines published by the National Water Research Institute (NWRI) for UV disinfection. California and Washington, two states with strong recycled water programs, rely on the NWRI guidelines in administering their recycled water programs. These guidelines include minimum dosing rates, reactor design, system reliability, monitoring and alarms, and commissioning.

Values for preliminary design criteria assumed for this evaluation are presented in Table 5 below. The values presented would be applicable to both design flow rates being considered (i.e., 0.65 MGD and 3 MGD)

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Table 5: UV Disinfection Design Criteria

Item	Value
Design dose, mJ/cm^2	100[(a)]
Configuration type	Open channel
Lamp type	Low pressure
Minimum number of operating reactors	2[(b)]
Redundant reactors	1

Notes:

(a) Design dose required when using non-membrane filtration. Dosing for membrane filtration is lower.

(b) A minimum of two, independent reactors would be required. Should one of the operating reactors fail, this ensures at least partial disinfection during the time needed to bring a standby reactor online.

For the purposes of this evaluation, Kennedy Jenks assumed use of an open-channel type UV system using low pressure UV lamps. Other UV alternatives include in-vessel (closed pipe) systems using either medium pressure or low-pressure lamps. However, because they are in common use and would be suitable for this application, an open-channel, low pressure type system was deemed to be representative of UV disinfection systems in general and used for purposes of this evaluation when comparing chlorine disinfection with UV.

Like the CCB, the UV system would be located on the west side of the HRCCB. Filtered secondary effluent would flow by gravity to the UV system via a new 18-inch or 24-inch DI pipe with size being dependent on design flow rate. The UV structure would consist of an elevated concrete channel with access stairs, concrete operating platform, and guardrail. The top of the channel wall would be about 4 ft above the surrounding grade elevation and about 2 ft below the top of the HRCCB. Channel dimensions and total number of UV banks depend on the UV system manufacturer but would be approximately those shown in Table 6.

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Table 6: UV System Dimensions

Item	Value 0.65 MGD[a]	3 MGD[b]
Number of UV banks[c]	**3**	**5**
Channel length[d], ft	53	77[e]
Channel width, ft	2[f]	3
Channel depth, ft	5.5	8

Notes:

(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters as reported by the MWMC staff.
(c) Value includes one redundant bank.
(d) Length includes inlet/outlet boxes and flow control weir.
(e) Length includes space for the addition of one future UV bank. Adding an additional bank would increase capacity to approximately 5 MGD.
(f) Width provides space for adding additional lamps to each UV bank with potential to increase capacity 1.3 MGD.

The channel would be covered with a combination of aluminum grating and solid checker plate (solid plating would be needed in areas adjacent to the UV reactors to prevent exposure to UV light).

A metal, shed-type roof with a single concrete masonry unit backwall was assumed to provide cover for the system. A discharge weir designed and provided by the UV system manufacturer would be installed downstream of the UV reactors to control upstream water level. A manual slide gate on the inlet side of the UV structure would be provided to isolate the UV channel allowing for periodic draining and cleaning. The channel would be connected to the WPCF's drain system and utility water stations provided for routine washdown.

UV specific equipment would include the following:

- Reactors. The system would consist of three to five UV reactors (banks) including one redundant unit. Each bank would consist of as many as 32 low pressure lamps. Space would be provided for future expansion. For example, the 0.65 MGD system could be easily expanded to 1.3 MGD by adding additional lamps to each of the proposed 3 banks. The 3 MGD system could be expanded to about 5 MGD with the addition of 1 bank.
- Power distribution center. Contains electronic ballasts.
- Mechanical cleaning system. Automated cleaning system that routinely cleans the quartz sleeves covering the UV lamps. Automated cleaning is done in channel and typically includes both mechanical and chemical cleaning. Depending on system manufacturer, the cleaning system may be either an electric or hydraulic drive system.

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- Controls and instrumentation. Controls and instrumentation would be provided by the system manufacturer to adjust the number of lamps in service and power level based on UV intensity and flow rate.

Like the CCB alternative, recycled water flow could be measured using a Parshall flume or magnetic flow meter. A composite sampler placed upstream of the storage tank would be provided to collect samples needed to prove compliance with recycled water quality criteria.

Hypochlorite would be injected immediately downstream of the UV system to provide needed chlorine residual for storage and distribution. Like the CCB alternative, Kennedy Jenks assumed use of the existing hypochlorite piping and metering pumps.

Estimated Capital and Operating Costs: UV Disinfection

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for UV facilities needed to produce Class A recycled water. A summary of this estimate is presented in Table 7 below. The total shown is limited to the disinfection system and is not for the entire recycled water project. Costs are presented for both the 0.65 MGD and 3 MGD design cases.

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Table 7: Conceptual Level Capital Cost Estimate: UV Disinfection

Item Description	Total 0.65 MGD[(a)]	Total 3 MGD[(b)]
Sitework/Demo	$64,000	$85,000
Concrete	$46,000	$70,000
Masonry	$10,000	$10,000
Metals	$26,000	$41,000
Thermal & Moisture Protection	$38,000	$38,000
Finishes	$10,000	$10,000
Equipment	$369,000	$663,000
Mechanical	$74,000	$74,000
Electrical and Instrumentation	$108,000	$169,000
Subtotal	$745,000	$1,160,000
Division 1 Costs (10%)	$74,000	$116,000
Subtotal	$819,000	$1,276,000
Contractor Overhead and Profit (15%)	$123,000	$191,000
Subtotal	$942,000	$1,467,000
Estimate Contingency (30%)	$283,000	$440,000
Subtotal	$1,225,000	$1,907,000
Escalate to Mid-point of Construction[(c)]	$49,000	$76,000
Total Estimate[(d)]	**$1,270,000**	**$1,980,000**

Notes:

(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters.
(c) Escalated at 2% per year assuming 24 months until mid-point of construction.
(d) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Annual O&M costs for the UV disinfection system were estimated and are presented in Table 8 below. Costs for projected initial average annual production of 0.19 MGD are shown compared with those estimated for average annual production of 0.65 MGD and 3 MGD (design capacity of the recycled water demonstration project). The three values are presented to illustrate the potential change in O&M costs that could occur as demand for recycled water increases.

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Table 8: O&M Cost Estimate: UV Disinfection

Item Description	Annual Cost		
Avg annual water production[(a)]	0.19 MGD	0.65 MGD	3.0 MGD
Energy[(b)]	$1,900	$12,100	$30,200
Chemical[(c)]	$1,200	$4,100	$19,000
Lamp replacement[(d)]	$800	$6,600	$13,100
Materials[(e)]	$4,000	$4,000	$7,100
Labor[(f)]	$10,800	$10,800	$10,800
Total	**$18,700**	**$37,600**	**$80,200**

Notes:

(a) Initial average annual water production is 0.19 MGD.
(b) Energy cost at $0.069/kW-hr.
(c) Assumes hypochlorite dosing concentration of 2 mg/L to provide needed chlorine residual for storage and distribution. Hypochlorite cost $1.04/gal per WPCF staff.
(d) Lamp life estimated to be 16,000 hrs. Cost is $200/lamp.
(e) Materials include ballasts (10-year life), quartz sleeves (2% replaced per year), and scrapers (those needed for chemical mixing pumps, flash mixer, and chlorine residual pumps. Assumes pump replacement every 10 years. Cost shown are annualized costs.
(f) Labor based on 0.11 FTE at a fully loaded rate of $46.42 per hour. Labor effort assumes 0.5 hr needed for daily operation and approximately 50 hrs per year for maintenance. Effort assumed to be the same regardless of UV system size.

As shown in Table 8, UV lamps have an expected lifespan of about 16,000 hrs. The lamps contain mercury and the major UV system manufacturers have recycling programs and will take back the used lamps. Alternatively, there are regional recycling centers that will also accept the used lamps.

Comparison of Disinfection Alternatives

A comparison of 20-year net present worth of the two disinfection alternatives is presented in Table 9. O&M present worth for the two alternatives were calculated assuming an annual increase in recycled water use of 20% per year. Assuming an initial average day demand of 0.19 MGD and a 20% annual increase in production, the system would reach the design flow (i.e., 0.65 MGD or 3 MGD) in year 2036. As shown in Table 9, the 20-year net present worth of O&M costs is less for the UV alternatives. This holds true regardless of the rate at which demand for recycled water increases.

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Table 9: Economic Comparison of Disinfection Alternatives

	0.65 MGD[(a)]		3 MGD[(b)]	
Cost Item	**CCB**	**UV**	**CCB**	**UV**
Capital cost	$980,000	$1,270,000	$1,840,000	$1,980,000
O&M present worth[(c)(d)]	$760,000	$600,000	$1,340,000	$840,000
Total present worth[(e)]	**$1,740,000**	**$1,870,000**	**$3,180,000**	**$2,820,000**

Notes:

(a) Estimated maximum day demand for recycled water.
(b) Minimum capacity of the existing tertiary filters as reported by MWMC staff.
(c) 20-year present worth values were calculated assuming recycled water use increases by 20% per year until reaching the system design flow (i.e., 0.65 MGD or 3 MGD) Assuming 2020 is the initial year of operation, the system will reach the design flow in year 2036.
(d) The 20-year real interest (inflation free) rate of 1.5% per Office of Management and Budget Circular No. A-94 was used for net present worth calculations.
(e) Total amount rounded to nearest $10,000.

Non-Economic Factors

Non-economic factors should also be considered when selecting a preferred disinfection alternative. A comparison of non-economic considerations is presented in Table 10. Bold and underlined text was used to identify considerations that were deemed to be of greater significance in selecting a preferred alternative.

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Table 10: Non-economic Comparison of Disinfection Alternatives

Consideration	CCB	UV
Operation	• **Chlorination already used at the WPCF and staff are very familiar with the process.** • Intermittent use may create operational control challenges. Detention time in the CCB is 90 minutes. During initial years, the recycled water system will operate at most for a few hours each day. This will likely cause control challenges in maintaining needed chlorine concentrations. • High chlorine concentrations needed to meet Class A recycled water requirements may create operational challenges because of low/changing ammonia concentrations with system potentially moving in and out of breakpoint chlorination.	• New technology for WPCF staff. However, UV disinfection is a well-established technology with wide application in the industry. • Slightly more complex technology. However, UV systems are completely automated potentially requiring less staff time to monitor and make operating adjustments. • Not affected by low ammonia concentrations. • **Better suited to intermittent use that will occur during initial years of operation. UV systems have short detention times. Startup takes less than 10 minutes after which time the system stabilizes and produces fully treated recycled water.** • Hypochlorite still needed to provide chlorine residual for storage and distribution. However, dosing concentrations would be relatively low and no new chemical metering facilities would be needed.
Maintenance	• Maintenance needs associated with chlorination are well understood by WPCF staff.	• Staff training needed for new maintenance tasks associated with UV system (e.g., lamp replacement, cleaning, etc.) • Total time for maintenance is estimated to be equal or less than that needed for chlorination.

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Consideration	CCB	UV
Performance	• **Performance may be hampered by low/changing ammonia concentrations that can cause the system to move in and out of breakpoint chlorination[(a)]. This can result in difficulty maintaining needed residual concentrations to ensure full disinfection.** • **Because of the relatively long detention time in the CCB, intermittent use during initial years of operation when the system operates a few hours each day may make it difficult to meet treatment criteria and result in more operating time needed than with UV systems.**	• **UV systems start-up more quickly and would be better suited for intermittent use. This should better ensure compliance with recycled water quality requirements of DEQ and customer.** • Because of its shorter response time and online measuring of UV intensity, UV would be better suited to short-term variations in water quality.
Site impact	• Would require about 3 times more area as that needed for UV disinfection. • Lower power requirement. Total installed horsepower of pumps and mixers associated with a chlorination system for the demonstration project would be about 3.3 hp.	• **Smaller footprint.** • Greater power requirement. A UV system sized for the demonstration project would have the equivalent installed power of about 110 hp. • UV disinfection would not differ from chlorination in terms of piping and other needed site improvements.

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Consideration	CCB	UV
Ease of expansion	• Future expansion would be more difficult since volume of CCB would have to be increased in direct proportion to the increase in desired production capacity making it less conducive to small increases in capacity.	• **Provides greater flexibility for future expansion with multiple options for expanding capacity.** • Initial UV structure could be designed to provide space for future installation of additional UV lamps at minimal cost. • Larger increases in capacity could be accommodated by constructing parallel UV channels.

Note:

(a) Chlorination should be maintained at a chlorine to ammonia nitrogen ratio (CL_2:NH_3-N) less than 6:1 to prevent breakpoint chlorination. Because the average summertime effluent ammonia concentration is about 3.5 mg/L with a standard deviation of 3.4 mg/L and chlorination to meet Class A requirements typically ranges from 8 to 16 mg/L it is very likely that the system will move in and out of breakpoint chlorination.

Carbon Footprint Comparison

The following presents results of a carbon footprint analysis for the two disinfection technologies under consideration: sodium hypochlorite and UV. For this evaluation, the boundary of the footprint was drawn around the disinfection technologies only including the embodied emissions as well as the annual operational emissions. Results of this analysis will enable MWMC to make an informed decision about which disinfection process results in lower emissions.

Basis of Evaluation

Carbon foot printing is an accounting process which quantifies the net carbon emissions associated with a particular process. The sum of carbon debits (emissions) and credits (sinks) result in the net carbon footprint. In a carbon footprint, the emissions are converted into equivalent reporting units (tons) of a common greenhouse gas, carbon dioxide (CO_2). In this case, the carbon debits include the embodied and annual emissions associated with installation of either of the disinfection systems.

- Embodied Emissions: The analysis includes one-time debits associated with the construction of tanks or structures for each disinfection system and use of machinery for installation.

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- Annual Operational Emissions: The analysis includes debits associated with electrical power and chemical consumption used to treat the estimated annual average demand for recycled water of 0.19 MGD.

Emissions factors used to calculate the emissions were based on review of current scientific literature and models; including models published by the Intergovernmental Panel on Climate Change and Canadian Council of Ministers of the Environment. When appropriate, emissions factors were modified to reflect specific conditions unique to the Pacific Northwest. For example, the Eugene Water and Electric board (EWEB) generates 97% of their electricity using renewable resources and the remaining 3% using coal and natural gas. Therefore, the emission factor associated with electricity use in the Eugene/Springfield area is very low.

The sodium hypochlorite disinfection system emissions were calculated for installation and operation of one new chlorine contact basin and associated yard piping. The UV disinfection system emissions were calculated for installation of a UV structure and associated yard piping and operation of an open channel low pressure UV system.

Results

The embodied emissions include the debits associated with excavation, concrete, and steel for both systems. A summary of these emissions is provided in Table 11.

Table 11: Summary of Embodied Emissions for a Sodium Hypochlorite and UV Disinfection System

Construction Debits (tons CO_2)	Sodium Hypochlorite	UV
Excavation	2	0.9
Concrete	119	16
Steel	0.06	0.04
Embodied Emissions (ton CO_2)	120	16.6

The sodium hypochlorite system resulted in the highest embodied emissions. Greater debits were accrued due to the construction of a new chlorine contact basin and more specifically due to the high use of concrete. The UV system has a much smaller footprint and required less construction materials resulting in lower debits for construction and installation.

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The annual operation emissions include debits associated with sodium hypochlorite chemical use and electrical power for system operation. The summary is provided in Table 12.

Table 12: Summary of Annual Emissions for Sodium Hypochlorite and UV Alternatives

Annual Debits (tons CO_2)	Sodium Hypochlorite	UV
Chemical	28	5
Electricity	0.01	0.3
Operation Emissions (ton CO_2)	28	5

The sodium hypochlorite system resulted in the highest annual operation emissions because the emissions factor associated with the production of sodium hypochlorite is much higher than the emissions factor associated with electricity use. While the evaluation was based the current annual average flow of 0.19 MGD, the results are scale able. The sodium hypochlorite option will produce approximately 5 to 6 times the annual carbon emissions of the UV option.

The results of this analysis are region specific because the energy production profile of the EWEB is predominately from renewable sources. Had this evaluation been conducted using electricity that is primarily generated from coal or natural gas, the emissions associated with electricity use would be much higher.

Recommended Disinfection Alternative

Chlorination is currently used at the WPCF to disinfect secondary effluent. It has many years of successful application and is well understood by WPCF staff. While it is commonly used to produce Class A recycled water, chlorination may present operational and performance challenges if used for the MWMC recycled water project. These challenges include the following two concerns:

- During summer months, the WPCF produces secondary effluent that is low in ammonia. This coupled with the relatively high chlorine concentration needed to meet Class A recycled water quality requirements may cause the system to move in and out of breakpoint chlorination leading to significant operating challenges when trying to maintain a preset effluent chlorine residual concentration.

- During initial years of operation, the CCB may operate intermittently running as little as a few hours each day to meet the demand for recycled water. When a CCB first starts up, time is be needed for the control system to stabilize the disinfection process and for it to meet preset values for effluent chlorine residual. Because chlorine dosing rates would be controlled in part by the effluent chlorine residual, the time needed for the system to

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stabilize and meet target residual concentration values would be greater than the detention of the CCB. More than one detention time worth of water production would have to be generated prior to the system meeting needed chlorine residual values. At the risk of not meeting Class A water quality requirements, the water during this startup period each day would be wasted back to the secondary treatment stream. This would require the recycled water system to operate more hours each day than would be needed for UV disinfection.

Although the UV disinfection would be a new process to the WPCF and staff would require additional operation and maintenance training, Kennedy Jenks recommends it as the preferred disinfection alternative for the following reasons:

- The capital cost for UV disinfection would not be significantly greater than that of constructing a new CCB and long-term O&M costs for UV should be lower.
- UV disinfection would be much more suitable for the intermittent use that may occur during the initial years of operation for the recycled water demonstration project.
- Performance of UV disinfection would not be hampered by changing ammonia levels in the secondary effluent.
- Site impact in terms of footprint for UV is significantly less than would be associated with construction of a new CCB.
- The carbon footprint of UV disinfection is significantly lower than the use of sodium hypochlorite.
- UV disinfection would provide more flexibility for future expansion.
- UV disinfection is a common, well understood technology readily used in the municipal wastewater industry.

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Appendix E: Recycled Water Storage Alternatives Technical Memorandum

4 February 2021

Technical Memorandum – Recycled Water Storage Alternatives

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project Number P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Recycled Water Storage Alternatives
K/J Project Number: 1776023*00

This Technical Memorandum (TM) presents results of an evaluation of water storage alternatives for the Metropolitan Wastewater Management Commission's (MWMC) recycled water facility preliminary design project. The alternatives considered in this TM are those that passed through fatal flaw screening analysis as documented in the Fatal Flaw Screening TM dated June 24, 2019.

The goal of this alternatives evaluation is to identify a recommended means of storing recycled water that considers both economic and non-economic factors. Storage alternatives considered include the following:

1. High rate chlorine contact basin (HRCCB). This alternative would use the existing HRCCB to provide storage of recycled water prior to distribution.
2. Below-ground concrete storage tank. This alternative consists of constructing a new, rectangular, cast-in-place concrete storage tank. The tank would be constructed partially below grade like the existing HRCCB.
3. Above-ground steel tank. This alternative consists of constructing a new, above-ground steel storage tank.

Use of the HRCCB for recycled water storage was identified by the MWMC staff as their preferred storage alternative during the August 15, 2019 review meeting in which results of the Class A Disinfection Alternatives evaluation were presented. Although the HRCCB was identified as the preferred alternative, Kennedy Jenks was also asked to consider construction of new storage tanks and provide high level evaluations of both concrete and steel tank alternatives. The intent behind this request was to quantify savings to MWMC that would result from the use of the existing HRCCB. It will also provide MWMC with planning level cost estimates should MWMC later decide to discontinue use of the HRCCB for recycled water storage and instead construct a dedicated storage tank for recycled water.

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HRCCB for Storage

The existing HRCCB provides contact time for disinfecting primary effluent diverted around the secondary treatment process when influent flow to the Water Pollution Control Facility (WPCF) is greater than about 160 million gallons per day (mgd). Because wet season flows rarely exceed 160 mgd, the HRCCB operates only occasionally during the winter and never operates during summer months when demand for recycled water would be the greatest. The HRCCB could be used for recycled water storage providing a low cost storage solution. Operational complexity would be slightly greater, however, when compared to use of a dedicated recycled water storage tank.

As documented in the Basis of Design TM dated June 24, 2019, the maximum day demand for recycled water has been estimated to be 0.65 mgd. The Basis of Design TM set the design criteria for storage volume equal to one day of consumption at maximum day demand. This decision was made to better ensure a reliable source of water that would build customer trust in the recycled water program.

The HRCCB has a total volume of 1.4 million gallons (MG). However, two factors would reduce its usable volume if it were used to store recycled water. The first is that the maximum water level in the HRCCB would have to be maintained below the basin's overflow weir to prevent the spilling of recycled water into the final effluent being discharge to the river outfall. The second is that the minimum water level within the basin would most likely be several feet above the floor of the basin in order to ensure adequate submergence of recycled water pumps. Assuming the maximum water level is set 2 feet (ft) below the effluent weir elevation and the minimum water level in the basin is 3 ft above the floor, total usable volume of the HRCCB for recycled water storage would be 0.98 MG. This exceeds the design criteria of 0.65 MG set for the recycled water storage.

Depending on the type of pump ultimately used for recycled water pumping, the total usable volume of the HRCCB could potentially be increased by constructing a recessed area within the floor of the basin. This would allow the entire volume of the basin to be utilized and ensure the ability to easily and completely drain the basin.

Relatively minor modifications would be needed to convert the basin to recycled water storage. Review of record drawings for the HRCCB show that there is an existing 36-inch-diameter wall penetration with associated isolation gate (06FV61-01) located on the basin's exterior west wall. The exterior face of the wall penetration is blind flanged and appears to have been installed with the intent of future connection to the tertiary filtration system. This penetration would provide a connection point for conveyance of disinfected tertiary filter effluent to the HRCCB. Depending on the type of pumping system selected for the recycled water system, a separate wall penetration would be constructed to connect the HRCCB to a separate pumping station. Alternatively, if vertical turbine type pumps were used, an elevated concrete platform would be required within the basin from which to suspend the pumps.

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Instrumentation and controls needed for the HRCCB would include those for chlorine residual measurement and water level. Record drawings show two chlorine residual sampling systems located at the inlet and outlet ends of the basin. Existing chlorine residual instrumentation could be used to monitor residual within the storage basin. This would help ensure adequate levels are maintained to prevent bacterial/virus regrowth and reduce the potential to produce biofilm within the distribution system.

Record drawings show a level element (06LE61-02) located near the outlet end of the HRCCB. A second redundant means of measuring water level would be recommended and should be added prior to use for recycled water storage.

While it should be a relatively straightforward process of switching operation of the HRCCB from disinfecting primary effluent to storing recycled water, thorough cleaning of the basin would be needed to ensure that recycled water quality was not impacted. The Oregon Department of Environmental Quality (DEQ) would need to approve use of the HRCCB for recycled water storage. Kennedy Jenks discussed this proposed use with Tim McFetridge of DEQ on August 29, 2019 and if they perceived any fatal flaws. Tim will be the engineer that reviews recycled water designs associated with the WPCF. DEQ responded that use of the HRCCB for recycled water storage would be acceptable but cleaning procedures would have to be developed and incorporated into MWMC's recycled water use plan.

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for modifications needed to use the HRCCB for recycled water storage. A summary of this estimate is presented in Table 1.

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Table 1: Conceptual Level Capital Cost Estimate: Modifications to HRCCB for Recycled Water Storage

Item Description	Total
Sitework/Demo	$37,000
Concrete	$20,000
Equipment	$36,000
Mechanical	$7,000
Electrical and Instrumentation	$18,000
Subtotal	$118,000
Division 1 Costs (10%)	$12,000
Subtotal	$130,000
Contractor Overhead and Profit (15%)	$19,000
Subtotal	$149,000
Estimate Contingency (30%)	$45,000
Subtotal	$194,000
Escalate to Mid-point of Construction[(a)]	$8,000
Total Estimate[(b)]	**$200,000**

Notes:

(a) Escalated at 2% per year assuming 24 months until mid-point of construction.
(b) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Costs presented in Table 1 do not include potential modifications that may be needed for the recycled water pumping system. These costs will be estimated as part of a separate evaluation of recycled water pumping alternatives.

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New Concrete Storage Tanks

This alternative assumes construction of a new dedicated storage tank. This alternative would have an operational advantage over use of the HRCCB in that it would not be used to disinfect primary effluent and would not require cleaning after each use.

For the purposes of this evaluation, reinforced cast-in-place concrete was the selected method of construction. Although other construction alternatives could be considered, reinforced concrete would likely be the costliest and thus be most useful to MWMC in terms of estimating the potential range of costs that could be incurred if MWMC chose to construct a new storage tank.

The storage tank would be sized to store 0.65 MG which is equivalent to the projected maximum day demand. It was assumed that the concrete tank would be partially below grade with a top of wall elevation similar to that of the HRCCB. Water depth was assumed to be 17 ft resulting in a total foot print for the tank of about 5,200 square feet (sf).

Use of below ground cast-in-place construction would provide the option of building a rectangular shaped tank making better use existing available space. A rectangular tank would also facilitate future expansion by enabling common wall construction when expanding the tank.

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for construction of a new concrete storage tank for use as recycled water storage. A summary of this estimate is presented in Table 2. Like the HRCCB alternative, Operations and Maintenance (O&M) costs were not estimated for this alternative as all alternatives should have similar O&M requirements.

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Table 2: Conceptual Level Capital Cost Estimate: New Concrete Storage Tank[(a)]

Item Description	Total
Sitework/Demo	$228,000
Concrete	$799,000
Mechanical	$182,000
Electrical and Instrumentation	$130,000
Subtotal	$1,339,000
Division 1 Costs (10%)	$134,000
Subtotal	$1,473,000
Contractor Overhead and Profit (15%)	$221,000
Subtotals	$1,694,000
Estimate Contingency (30%)	$508,000
Subtotal	$2,202,000
Escalate to Mid-point of Construction[(b)]	$88,000
Total Estimate[(c)]	**$2,290,000**

Notes:

(a) Tank assumed to be in-ground and constructed of reinforced cast-in-place construction
(b) Escalated at 2% per year assuming 24 months until mid-point of construction.
(c) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

New Steel Storage Tanks

This alternative assumes construction of a new dedicated storage tank made of steel. This alternative would have the same operational advantage as afforded by a concrete tank in that it would not be used to disinfect primary effluent and thus would not have to be cleaned after such use. As with the concrete tank, the steel tank would be sized to hold 0.65 MG which is equivalent to one day of recycled water consumption at maximum day demand. Unlike concrete tanks, steel tanks are not suitable for burying underground and would thus be constructed at grade. Steel tanks would be available in either welded or bolt together configurations.

To minimize visual impacts at the site, it was assumed that the elevation of the top of the steel tank would be no greater than that of the existing digesters (approximately 22 ft above grade). Assuming 2 ft of freeboard, tank diameter would be about 75 ft. Onsite construction time for a steel tank would be less than that for concrete with the majority of tank fabrication being done offsite. However, the circular shape of the tank would not be as efficient at making use of existing space. Future expansion would also be more difficult as common wall construction would not be possible and would require the construction of a completely separate tank.

Constructing an above ground tank would require the addition of a pumping station between disinfection and storage. Because of the higher water level in the above storage tank,

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downstream pumping needed for distribution of recycled water would be less. Regardless, total costs for pumping would be greater for the steel tank alternative than that for an in-ground concrete tank.

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for construction of a new bolted steel storage tank for recycled water storage which is presented in Table 3. Costs for bolted and welded tanks are typically within 4 percent of each other with bolted tanks being the higher of the two. Costs for a bolted steel tank are presented here to provide an upper limit for this alternative.

Table 3: Conceptual Level Capital Cost Estimate: New Steel Storage Tank[(a)]

Item Description	Total
Sitework/Demo	$163,000
Concrete	$150,000
Special Construction	$585,000
Mechanical	$182,000
Electrical and Instrumentation	$130,000
Subtotal	$1,210,000
Division 1 Costs (10%)	$121,000
Subtotal	$1,331,000
Contractor Overhead and Profit (15%)	$200,000
Subtotals	$1,531,000
Estimate Contingency (30%)	$459,000
Subtotal	$1,990,000
Escalate to Mid-point of Construction[(b)]	$80,000
Total Estimate[(c)]	**$2,070,000**

Notes:

(a) Tank assumed to be above-ground bolted steel.
(b) Escalated at 2% per year assuming 24 months until mid-point of construction.
(c) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Economic Comparison of Storage Alternatives

A comparison of conceptual level construction cost estimates for the three tank alternatives is presented in Table 4. O&M costs have not been included. These costs should be similar for the three tank alternatives although costs for steel tanks would be higher because of the need for periodic recoating.

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As shown in the table, use of the HRCCB for recycled water storage would result in a total savings of about $1.9 million when compared to construction of a dedicated storage tank. In addition to the cost savings, total usable volume provided by the HRCCB alternative would be 50 percent greater.

Table 4: Economic Comparison of Tank Alternatives[(a)]

Tank Alternative	Cost[(e)]
HRCCB[(b)]	$200,000
New Concrete Tank[(c)]	$2,290,000
New Steel Tank[(d)]	$2,070,000

Notes:

(a) Capital cost of tank modifications and/or new construction. Present worth of O&M costs are not included.
(b) Alternative assumed use of the existing HRCCB for recycled water storage. This alternative would provide approximately 0.98 MG of usable volume.
(c) Cost based on in-ground construction using reinforced, cast-in-place concrete.
(d) Cost based on at-grade, bolted steel construction.
(e) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Non-Economic Comparison of Storage Alternatives

A comparison of non-economic considerations for the three tank alternatives is presented in Table 5. Bold and underlined text was used to identify considerations that were deemed to be of greater significance in selecting a preferred alternative.

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Table 5: Non-economic Comparison of Storage Alternatives

Consideration	HRCCB	New Concrete[(a)]	New Steel[(b)]
Operation	• Although infrequent, switching between disinfecting primary effluent and storing recycled water adds operational complexity to the system.	• A new dedicated in-ground storage tank would be less operationally complex than other alternatives.	• **Although an above ground steel tank would not have the complexity of switching between uses (disinfection of primary effluent and storage) it would require an additional pumping station increasing its overall operational complexity.**
Maintenance	• The HRCCB requires cleaning after use in disinfecting primary effluent. • Routine coating of the HRCCB would not be needed.	• A dedicated tank would not be used to disinfect primary effluent and would thus require less maintenance than the HRCCB. • Routine coating of a concrete tanks is not needed.	• A dedicated tank would not be used to disinfect primary effluent and would thus require less maintenance than the HRCCB. • **Steel tanks require routine recoating.** • **An above ground steel tank would add another pumping station to the recycled water system, thus increasing overall maintenance.**

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Consideration	HRCCB	New Concrete[(a)]	New Steel[(b)]
Reliability	• Although infrequent, the HRCCB would not be available during peak flow events (>160 mgd) when it is needed to disinfect primary effluent.	• A dedicated storage tank would provide slightly more reliability for the recycled water system. This is the same for both concrete and steel tanks.	• A dedicated storage tank would provide slightly more reliability for the recycled water system. This is the same for both concrete and steel tanks.
Site Impact	• **Use of the existing HRCCB would decrease footprint of the recycled water system resulting in the least impact to the site.**	• Total footprint of a 0.65 MG, in-ground concrete tank would be about 5,200 sf. • Rectangular tank construction would make more efficient use of existing space than circular tanks.	• Total footprint of a 0.65 MG, above ground steel tank would be about 4,400 sf. • Construction of a circular tank would make less efficient use of existing space than a rectangular tank.

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Consideration	HRCCB	New Concrete[(a)]	New Steel[(b)]
Ease of Expansion	• **The existing HRCCB would provide about 0.98 MG of usable volume. This is 50 percent greater than projected maximum day demand for the initial recycled water program providing significant expansion ability at no cost to the MWMC.**	• Common wall construction could be used making expansion easier than with steel tanks.	• Because an entire new tank would have to be constructed, expansion is more difficult than other alternatives.
Construction	• **HRCCB would require minimal modification and little construction time to enable its use for storage.** • Uses existing instrumentation (chlorine analyzer and level sensors) that is connected to the distributed control system (DCS).	• Onsite construction time would be the greatest for reinforced concrete construction.	• Total construction time would be similar to that of reinforced concrete, however, a majority of this time would be offsite associated with prefabrication of tank panels.

Notes:

(a) The concrete tank alternative assumes construction of a below-grade rectangular, reinforced, cast-in-place structure.
(b) The steel tank alternative assumes construction of an above ground circular steel tank.

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Recommended Storage Alternative

Although use of the HRCCB would be more operationally complex than a dedicated storage tank, Kennedy Jenks recommends using the existing HRCCB to provide recycled water storage. Doing so will reduce project costs by approximately $1.9 million and eliminates the need for additional pumping that an above ground steel tank would require. The HRCCB also provides 50 percent more useable volume than needed for the initial recycled water program which would allow for easier and less costly expansion of the program in the future. Although concern was initially raised about DEQ's acceptance of the HRCCB for recycled water storage coupled with its infrequent use for primary effluent disinfection, DEQ has stated they see no fatal flaw with the proposed use. However, the DEQ would require development of cleaning procedures that would be included in the MWMC's recycled water use plan.

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Appendix F: Recycled Water Pumping Station Technical Memorandum

4 February 2021

Technical Memorandum – Pumping Station Alternatives

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project Number P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Recycled Water Pumping Station Alternatives
K/J Project Number: 1776023*00

This Technical Memorandum (TM) presents results of an evaluation of recycled water pumping station alternatives for the Metropolitan Wastewater Management Commission's (MWMC) recycled water facility preliminary design project. The alternatives considered in this TM are those that passed through fatal flaw screening analysis as documented in the Fatal Flaw Screening TM dated June 24, 2019.

The goal of this alternatives evaluation was to identify a preferred alternative for pumping recycled water for distribution to users that considered both economic and non-economic factors. Pumping alternatives considered include the following:

1. Horizontal centrifugal pumps. This alternative would use horizontal type centrifugal pumps located at grade that would draw water from the high rate chlorine contact basin (HRCCB).

2. Vertical turbine pumps located in the HRCCB. This alternative assumes use of vertical turbine pumps located within the existing HRCCB eliminating the need to construct a separate wet well for the pumping station.

3. Vertical turbine pumps located in a dedicated wet well. This alternative would also use vertical turbine pumps but includes construction of a dedicated wet well separate from the HRCCB.

In preparing this TM, it was assumed the HRCCB would be used to store recycled water. The HRCCB was identified by MWMC staff as the preferred storage alternative during the August 15, 2019 Class A Disinfection Alternatives review meeting and was presented as the recommended storage alternative in the September 19, 2019 TM on recycled water storage alternatives.

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Basis of Design

Design criteria for the recycled water pumping station are based on values provided in the Basis of Design TM dated June 24, 2019. Values specific to the pumping station design are presented in Table 1 below.

Table 1: Recycled Water Pumping Design Parameters

Item	Value
Number of pumps	n + 1[(a)]
System capacity, gpm	1,460[(b)]
System pressure, psi	80[(c)]

Notes:

(a) Total number of pumps is the number (n) needed to meet the required pumping rate plus one redundant pump.
(b) Peak water demand (gallons per minute) presented in Table 2 of the Basis of Design TM dated June 24, 2019.
(c) Preliminary system control set point needed to ensure delivery of water to users within an acceptable pressure range (pounds per square inch).

Kennedy Jenks has assumed the pumping station will be controlled based on a combination of system pressure, wet well water level, and pump speed. The primary control parameter was assumed to be pressure with pump operation (speed and number of pumps in service) controlled to maintain a preset pressure value. Secondary control parameters would include wet well level and pump speed.

For the purposes of this evaluation, Kennedy Jenks selected an operating pressure setpoint for the system of 80 pounds per square inch (psi). This value will meet the pressure requirements of initial recycled water users identified in the Basis of Design TM dated June 24, 2019 that range from 30 to 80 psi.

An 80-psi setpoint should also provide enough pressure to serve future users located farther away from the Water Pollution Control Facility (WPCF). For example, it would permit approximately 400 gallons per minute (gpm) to be delivered to the Washington/Jefferson Park at a final pressure of 35 psi which is within the range of pressures typical for landscape irrigation (i.e., 30 to 50 psi). This calculation was based on an elevation gain of 30 feet (ft) and use of an 8-inch, 18,000 ft ductile iron pipeline.

To minimize pump cycling at low flows, Kennedy Jenks has assumed the use of two, 6,000-gallon (gal), steel, hydropneumatic tanks located near the pumping station. Preliminary sizing calculations indicate this would limit pump starts to six per hour. Final sizing of hydropneumatic tanks should be done during detailed design. Cost estimates for pumping

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station alternatives provided later in this TM include two hydropneumatic tanks complete with automatic tank air charging systems.

A hydraulic transient analysis was not performed for this evaluation. However, an analysis should be considered during the initial phases of detailed design. This will help identify the potential for harmful water hammer conditions that may occur during the normal on/off cycling of pumps, sudden pump failure, or valve closure. If it is determined that there is a potential for pipeline or pumping station damage, steps to mitigate this potential would be included in the design of the pumping system. For example, these may include modifications to the station's control strategy, and additional air/vacuum release valves.

Horizontal Centrifugal Pumps

This alternative would use horizontal centrifugal pumps to draw water from the adjacent HRCCB that, when used for storage, will have a water surface that ranges from 2 to 13 ft below ground surface. This effectively eliminates the use of horizontal centrifugal pumps from further consideration because, if placed at grade, the pumps would always be above the water surface and unable to pump without priming. A separate priming system could be added to the station that might enable the station to function at grade. However, this would increase station complexity and would require additional evaluation to ensure that the pumps could still utilize the full storage capacity of the HRCCB. A below grade pumping station could also be constructed but would add significant cost.

Kennedy Jenks recommends eliminating the use of horizontal centrifugal pumps from further consideration unless the MWMC chooses to construct an above ground recycled water storage tank.

Vertical Turbine Pumps in the HRCCB

Line shaft driven vertical turbine pumps are configured with the pumping head (bowl assembly) placed directly into the pumped fluid. The pump column connects the bowl assembly to the discharge head to which the electric motor is mounted. The discharge head is located above the water surface and mounted to an overhead concrete deck making the motor accessible for inspection and maintenance. An example of line shaft driven vertical turbine pumps (vertical turbine pumps) are the MWMC's 2 Water Pumps located at the east end of the existing chlorine contact basin.

For this alternative, the vertical turbine pumps would be placed into the existing HRCCB near the discharge end of the basin. Placing the pumps into the HRCCB would eliminate the needed for construction of a separate wet well. An elevated concrete slab (approximately 30 ft long) would be constructed for installation of the new pumps and would likely span the full width of one of the HRCCB channels. Access to the pumping station would be via the existing stairs and

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elevated walkways surrounding the HRCCB. The new elevated slab would provide enough room for maintenance, local control stations (if any) and pump discharge valves.

Based on a design condition of 80 psi and total pumping capacity of 1,460 gpm, two 60-horsepower (hp) pumps would be needed. Each pump would be sized to deliver 750 gpm and a third pump would be provided for redundancy. Space would be included for the future installation of a fourth pump that would increase station capacity to 2,250 gpm [3.2 million gallons per day (mgd)].

Variable speed drives are recommended and would enable the pumps to achieve a minimum pumping rate of about 300 gpm. The use of two duty pumps instead of a single large pump is also recommended to provide needed turn down and to reduce the potential for excessive cycling of the pumps.

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for construction of a recycled water pumping station assuming use of vertical turbine pumps installed within the existing HRCCB. A summary of this estimate is presented in Table 2. Operations and Maintenance (O&M) costs were not included because these costs should be essentially equal for all alternatives considered.

Table 2: Conceptual Level Capital Cost Estimate: Vertical Turbine Pumps in HRCCB

Item Description	Total
Sitework/Demo	$34,0000
Concrete	$72,000
Metals	$12,000
Finishes	$20,000
Equipment[(a)]	$225,000
Mechanical[(b)]	$146,000
Electrical and Instrumentation	$87,000
Subtotal	$596,000
Division 1 Costs (10%)	$60,000
Subtotal	$656,000
Contractor Overhead and Profit (15%)	$98,000
Subtotal	$754,000
Estimate Contingency (30%)	$226,000
Subtotal	$980,000
Escalate to Mid-point of Construction[(c)]	$39,000
Total Estimate[(d)]	**$1,020,000**

Notes:

(a) Includes cost of three, 60-hp vertical turbine pumps and two, 6,000-gal hydropneumatic tanks.

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(b) Includes cost of valves and fittings associated with the pumping station and hydropneumatic tanks plus 500 ft of buried ductile iron pipe to connect to the existing 16-inch HDPE recycled water force mains.
(c) Escalated at 2% per year assuming 24 months until mid-point of construction.
(d) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

Costs presented in Table 2 were developed assuming that modification of the HRCCB would be limited to the addition of an elevated concrete slab with associated support columns tied to the basin floor. Costs do not include construction of an enclosure or roof over the pumping station.

As discussed in the Recycled Water Storage Alternatives TM dated September 19, 2019, the useable volume of the HRCCB would be limited to 0.98 million gallons (MG). This is in part because the minimum water level in the basin must be no less than about 3 ft above the basin floor to provide needed submergence depth for the pumps. The floor of the HRCCB could be modified to allow the pumps to extend below the existing floor elevation to lower the minimum water surface elevation which would then increase the available volume. However, Kennedy Jenks notes that a statement regarding the danger of floating the HRCCB when the groundwater level is high was included in the MWMC's operation and maintenance manual section on the HRCCB. For this reason, placing the pumps below the below the existing floor slab to lower the minimum water level is not recommended. In addition, the minimum allowable water level to prevent basin floating should be further investigated during detailed design of the recycled water facilities.

Costs presented in Table 2 include construction of two, 6,000-gal hydropneumatic tanks. Also included is installation of approximately 500 ft of buried, 16-inch ductile iron pipe connecting the station to one of the three existing 16-inch HDPE recycled water force mains located northeast of the WPCF. Final selection of pipe material will be done during detailed design. The MWMC may also consider connecting all three existing pipes as part of the project.

Vertical Turbine Pumps in Dedicated Wet Well

This alternative also included installation of three, variable speed, 60-hp, vertical turbine pumps (two duty and one standby) with total pumping station capacity of 1,500 gpm. However, unlike the HRCCB alternative, the pumps would be installed in a new dedicated wet well located outside and adjacent to the HRCCB. The wet well would be cast-in-place concrete construction with a top elevation 6 ft above surrounding grade elevation. The wet well floor elevation was assumed to be the same as that of the HRCCB (approximately 17 ft below surrounding grade). Minimum water level would be about 3 ft above the floor elevation to provide needed submergence of the recycled water pumps. With equal floor elevations, the minimum water level within the HRCCB would also be 3 ft above the floor of the HRCCB. Like the prior alternative, the wet well floor could be lowered allowing the HRCCB to be more fully drained. This could increase the useable volume of the HRCCB to as much as 1.2 MG. However, before this is not recommended because of the potential to float the basin when groundwater levels are high.

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The new wet well would be accessed by concrete stairs with a 33-ft-long by 15-ft-wide upper deck with spaces for four vertical turbine pumps. Three pumps would be installed initially as part of the demonstration project with a fourth space provided for a future pump. The deck would provide enough room for maintenance, local controls stations (if any) and installation of additional associated equipment including a floor hatch for access to the wet well below, sluice gate to isolate the pumping station, and pump discharge valves. An enclosure or roof for the pumping station was not included in this evaluation.

Kennedy Jenks prepared a conceptual level (AACE Level 4) capital cost estimate for construction of a recycled water pumping station assuming construction of a dedicated wet well outside of the HRCCB. A summary of this estimate is presented in Table 3. Like the prior alternative, O&M costs were not included.

Table 3: Conceptual Level Capital Cost Estimate: Vertical Turbine Pumps in a Dedicated Wet Well

Item Description	Total
Sitework/Demo	$138,000
Concrete	$142,000
Metals	$22,000
Finishes	$20,000
Equipment[(a)]	$247,000
Mechanical[(b)]	$191,000
Electrical and Instrumentation	$129,000
Subtotal	$889,000
Division 1 Costs (10%)	$89,000
Subtotal	$978,000
Contractor Overhead and Profit (15%)	$147,000
Subtotal	$1,125,000
Estimate Contingency (30%)	$337,000
Subtotal	$1,462,000
Escalate to Mid-point of Construction[(c)]	$58,000
Total Estimate[(d)]	**$1,520,000**

Notes:

(a) Includes cost of three, 60-hp vertical turbine pumps and two, 6,000-gal hydropneumatic tanks.
(b) Includes cost of valves and fittings associated with the pumping station and hydropneumatic tanks plus 800 ft of buried ductile iron pipe to connect to the existing 16-inch HDPE recycled water force mains.
(c) Escalated at 2% per year assuming 24 months until mid-point of construction.
(d) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

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Like the HRCCB alternative, costs presented in Table 3 include construction of two, 6,000-gal hydropneumatic tanks. Also included is installation of approximately 800 ft of buried, 16-inch ductile iron pipe connecting the station to one of the three existing 16-inch HDPE recycled water force mains located northeast of the WPCF.

Non-Economic Comparison of Pumping Alternatives

A comparison of non-economic considerations for the pumping alternatives is presented in Table 4. Bold text was used to identify considerations that were deemed to be of greater significance in selecting a preferred alternative.

Table 4: Non-economic Comparison of Pumping Alternatives

Consideration	Vertical Turbine Pumps in the HRCCB	Vertical Turbine Pumps in a Dedicated Wet Well
Operation	• No perceived difference between alternatives.	• No perceived difference between alternatives.
Maintenance	• No appreciable difference in in maintenance.	
Reliability	• The pumping station cannot operate during peak flow diversion events (>160 mgd). Recycled water would not be available for the period including the peak flow diversion and the time needed to clean the basin after the event.	• Use of a separate wet well could permit continued pumping even when the HRCCB was not available. However, this would require continuous operation of the filtration and UV disinfection systems with water in excess of that used for recycled water being discharged to the secondary effluent stream. Operating without storage could increase the change of sudden shutoff of the recycled water supply should the water not meet regulatory requirements.
Site Impact	• **Placing the recycled water pumps in the HRCCB would decrease project footprint and impact to site.**	• Total footprint of a dedicated wet well would be about 800 square feet (sf).

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Consideration	Vertical Turbine Pumps in the HRCCB	Vertical Turbine Pumps in a Dedicated Wet Well
Ease of Expansion	• Kennedy Jenks recommends providing space for a fourth future pump to facilitate future expansion. However, operation would remain tied to the HRCCB and while additional storage outside of the HRCCB could be constructed, the station would still be unable to operate during peak flow diversion events. This could restrict the long-term expansion of the recycled water system. • The recycled water pump could be relocated if a separate wet well were to be constructed in the future.	• **Like the HRCCB alternative, Kennedy Jenks recommends providing space for a fourth future pump to facilitate expansion. Construction of a dedicated wet well would make long term expansion of the recycled water system easier should the MWMC decide to construct additional recycled water storage. Operation of the pumping system would not then be tied to that of the HRCCB. The station could also be designed to allow for future physical expansion of the wet well which would allow additional pumps to be installed. However, prior to expanding the station, simply increasing the size of the pumps should be considered.**
Construction	• **Placing the pumping station in the HRCCB would reduce the amount of excavation, dewatering, and concrete construction needed for the demonstration phase of the recycled water program.**	• Construction of a dedicated wet well would require additional construction effort.

Recommended Pumping Alternative

Kennedy Jenks recommends constructing the recycled water pumping station inside the existing HRCCB. Doing so would result in lower overall project costs while making better use of existing infrastructure.

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Appendix G: Bulk Water Fill Station Technical Memorandum

4 February 2021

Technical Memorandum – Bulk Water Fill Station

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project Number P80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Bulk Water Fill Station
K/J Project Number: 1776023*00

This Technical Memorandum (TM) summarizes alternatives considered for a bulk water fill station (fill station) for the Metropolitan Wastewater Management Commission's (MWMC) recycled water facility preliminary design project. The alternatives considered for the fill station at the Water Pollution Control Facility (WPCF) included those related to its location:

1. Outside the WPCF Fence Line. This alternative would place the fill station outside of, but adjacent to, the WPCF's fence line.

2. Inside the WPCF Fence Line. This alternative would place the fill station inside the WPCF's fence line at the east end of the plant near the proposed recycled water facilities.

Additional recommended features for the fill stations are also presented.

Basis of Design

Design of the fill station assumes use by City of Eugene Parks & Open Space staff, city contractors, and non-governmental organization partners. Initial use is anticipated to be associated with the City of Eugene's (City) tree watering program. As presented in the Basis of Design TM dated June 24, 2019, design criteria specific to the fill station are presented in Table 1 below.

Table 1: Recycled Water Truck Fill Station Design Parameters

Item	Value
Capacity	200 gpm[(a)]
Delivery pressure, psi	60-80[(b)]

Notes:

(a) Gallons per minute (gpm). Flow rate based on that needed to fill a 750-gallon tank in less than 5 minutes.
(b) Pounds per square inch (psi). Based on typical range for municipal water systems.

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As noted, it is expected that initial use of the fill station will be by the City of Eugene Parks & Open space staff for tree watering. Kennedy Jenks and MWMC staff met with City staff on June 25, 2019 to discuss the tree watering program and use of recycled water. At that time, Kennedy Jenks and MWMC staff were able to ride-along with City staff as they watered trees at various downtown locations. This provided Kennedy Jenks and MWMC a better understanding of how the watering program works and how the trees are irrigated.

The following are key pieces of information learned about the City's tree watering program:

- The City has one, Ford 550 truck with a permanently mounted 500-gallon (gal) tank and multiple smaller trailer mounted tanks used by the City's Urban Forest and Natural Areas groups.
- Tanks are typically filled via fire hydrants with a 2-inch fire hose and associated connection.
- The fill lines installed on both truck and trailer mounted tanks have air gaps.
- Watering season typically beings in May and continues into October when the rains begin. Watering is done in two shifts per day, 5 days per week.

Fill Station Location

Two general locations for the fill station were considered: 1) outside the fence line of the WPCF and 2) inside the fence line of the WPCF.

Fill Station Outside the WPCF Fence Line

This alternative was initially considered in the Fatal Flaw Screening TM dated June 24, 2019. A potential location would be within the pullout for the existing Recreational Vehicle (RV) dump station on River Avenue between the existing secondary clarifiers and chlorine contact basin.

Locating the station outside of the fence line would reduce traffic through the plant site and potentially provide quicker access for recycled water. However, it would be more difficult to monitor, increasing the risk of vandalism. It would also increase cost. For these reasons, this alternative was eliminated from further consideration as described in the Fatal Flaw Screening TM.

Fill Station Inside the WPCF Fence Line

This alternative would locate the fill station adjacent to the recycled water facilities at the east end of the WPCF site and would be accessible from the existing roadway. Kennedy Jenks assumes that vehicles would access the fill station using the front entrance to the WPCF. However, the station could also be made accessible through the east entrance near the RV dump station. The paved loop at the east end of the site would facilitate trailered vehicles turning around.

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Recommended Features

Additional recommendations related to the fill station include modifications to the trucks used by the City for its tree water program and construction of a packaged bulk water fill station.

Modifications to City Trucks

As previously noted, the tanks currently used by the City for its tree watering program include air gaps and are filled using 2-inch fire hose. A separate air gap should be installed on each tank and fill hose provided that would only be used when filling with recycled water. In addition, the fill station connection should be a different size than that of the existing water tanks (2 inch). This would reduce the potential to connect the hose normally used with potable water sources with the fill station. For example, the fill station could be provided with a 2½-inch connection and each tank provided with a new 2½-inch fire hose for use with the recycled water system.

Bulk Water Fill Station

A packaged bulk water fill station like those shown on Figure 1 below is recommended. Similar systems manufactured by Portalogic are currently in use by the Eugene Water and Electric Board. The station would include solenoid-operated flow controls and flow metering and a keypad controller which would allow permitted haulers access to recycled water. These stations offer both side outlet piping and overhead piping to dispense water and stations can be constructed that offer both. It is envisioned that initially the station would be provided with a side type outlet connection for use with the trucks used by the City for its tree watering program. In the future, an overhead fill connection could be added to facilitate use by a wider range and types of trucks. A side outlet and overhead filling station are shown.

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Figure 1: Side Outlet Filling Station in Brenham, TX (Left) and Overhead Filling Station in Truckee, CA (Right)

Opinion of Probable Construction Cost

Kennedy Jenks has assumed the fill station will include the following elements:

- A package bulk water fill station, by Portalogic or equivalent, which will interface with haulers and connect to the recycled water system via a 3-inch flanged connection.
- A 4-inch-diameter buried supply line which will reduce to a 3-inch-diameter above ground steel pipe that will connect to the package pump station.
- Flow metering will be provided as part of the bulk water fill station package.
- A 2½-inch fire hose connection or Camlock type fitting, for connection to the City's trucks.
- A 6 foot by 8 foot concrete slab with bollards to protect the fill station from damage.
- Heat tracing of all exposed piping with isolation valves will be provided so that the system can be drained during cold weather and during maintenance events.

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Kennedy Jenks has prepared a conceptual level (AACE Level 4) opinion of probable construction cost (OPCC) which is summarized in Table 2, below.

Table 2: OPCC: Truck Fill Station

Item Description	Total
Sitework/Demo	$12,000
Concrete	$3,000
Metals	$3,500
Finishes	$2,500
Equipment[(a)]	$29,500
Mechanical	$22,500
Electrical and Instrumentation	$11,000
Subtotal	$84,000
Division 1 Costs (10%)	$8,500
Subtotal	$92,000
Contractor Overhead and Profit (15%)	$14,000
Subtotal	$106,000
Estimate Contingency (30%)	$32,000
Subtotal	$138,000
Escalate to Mid-point of Construction[(b)]	$6,000
Total Estimate[(c)]	**$150,000**

Notes:

(a) Bulk fill station as quoted by Portalogic September 2020.
(b) Escalated at 2% per year assuming 24 months until mid-point of construction.
(c) Total amount rounded to nearest $10,000. Cost basis is November 2020 Seattle ENR CCI value 12,797.

Recommendations

Kennedy Jenks recommends constructing a bulk water fill station located inside the WPCF fence line near the proposed recycled water facilities. Access to the fill station would be through the front entrance to the WPCF although it would also be accessible from the east entrance. The fill station should be a package type filling station system that contains automated valving and flow meters and a keypad system to regulate and track water dispersal to authorized customers. The filling station should be located on a concrete slab for housekeeping, with bollards to protect the station from vehicle damage. Kennedy Jenks also recommends the City modify the trucks used for the tree watering program, adding separate piping and air gaps specifically for use with recycled water. The City should also use different sized hose than currently used for potable water sources to connect to the fill station. This will help reduce the chance of connecting hose that has been used for recycled water to the potable water system.

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Appendix H: Construction Costs Technical Memorandum

11 September 2020

Technical Memorandum – Construction Costs

To: Barry Mays (MWMC/City of Springfield)
Todd Miller (MWMC/City of Springfield)

From: Charles Wright, P.E. (Kennedy Jenks)
Mark Cullington (Kennedy Jenks)

Subject: MWMC Recycled Water Program Planning Implementation Planning Contract. Thermal Load Mitigation Pre-Implementation, MWMC Project 80062 and P80098, Amendment 9
Recycled Water Facility Preliminary Design – Opinion of Probable Construction Costs
K/J Project Number: 1776023*00

Kennedy Jenks has prepared opinions of probable construction costs (OPCCs) for four recycled water system alternatives. These include the following:

1. Existing High Rate Chlorine Contact Basin (HRCCB) and 3 MGD UV Disinfection System. This alternative assumes the existing HRCCB would be used for recycled water storage. A new 3 million gallon per day (MGD) UV disinfection system would be provided. Capacity of the disinfection system would match the current minimum capacity of the existing tertiary filters as reported by MWMC staff.

2. Existing HRCCB and 0.65 MGD UV Disinfection System. This alternative also assumes the existing HRCCB would be used for recycled water storage. However, the capacity of the new UV disinfection system would be 0.65 MGD. Capacity of the disinfection system would match the initially projected initial maximum day demand for recycled water. This alternative assumes that modifications would be made to the existing tertiary filters including installation of new lower capacity filter feed pumps.

3. New Dedicated Storage Tank and 3 MGD UV Disinfection System. This alternative assumes that a new 0.65 million gallon (MG) recycled water storage tank would be constructed. A new 3 MGD UV disinfection system would be provided. Capacity of the disinfection system would match the current minimum capacity of the existing tertiary filters as reported by MWMC staff.

4. New Dedicated Storage Tank and 0.65 MGD UV Disinfection System. This alternative also assumes that a new 0.65 MG recycled water storage tank would be constructed. However, the capacity of the new UV disinfection system would be 0.65 MGD. Capacity of the disinfection system would match the initially projected initial maximum day demand for recycled water. This alternative assumes that modifications would be made to the existing tertiary filters including installation of new lower capacity filter feed pumps.

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Cost Summary

A summary of OPCCs for the four alternatives evaluated are presented in Table 1 below.

Table 1: OPCC Total Project Costs for Alternatives Considered[(a)]

Item Description	Alt 1[(b)]	Alt 2[(c)]	Alt 3[(d)]	Alt 4[(e)]
Sitework and Yard Piping	$1,117,000	$1,079,000	$1,117,000	$1,079,000
Tertiary Filtration	$0	$63,000	$0	$63,000
UV Disinfection	$880,000	$525,000	$880,000	$525,000
Recycled Water Storage	$0	$0	$758,000	$758,000
Recycled Water Pumping Station	$330,000	$330,000	$330,000	$330,000
Truck Fill Station	$12,000	$12,000	$12,000	$12,000
Electrical	$369,000	$444,000	$369,000	$444,000
Instrumentation	$117,000	$98,000	$117,000	$98,000
Subtotal	$2,825,000	$2,551,000	$3,584,000	$3,309,000
Division 1 Costs (10%)	$282,000	$255,000	$358,000	$331,000
Subtotal	$3,108,000	$2,806,000	$3,942,000	$3,640,000
Contractor Overhead and Profit (15%)	$466,000	$421,000	$591,000	$546,000
Subtotal	$3,574,000	$3,227,000	$4,533,000	$4,186,000
Estimate Contingency (30%)	$1,072,000	$968,000	$1,360,000	$1,256,000
Subtotal	$4,646,000	$4,195,000	$5,893,000	$5,442,000
Bonds and Insurance (2.5%)	$116,000	$105,000	$147,000	$136,000
Subtotal	$4,762,000	$4,300,000	$6,040,000	$5,578,000
Escalate to Mid-point of Construction[(f)]	$190,000	$172,000	$242,000	$223,000
Total Estimate[(g)]	**$4,950,000**	**$4,470,000**	**$6,280,000**	**$5,800,000**

Notes:

(a) Costs do not include ground improvements that may be required because of future geotechnical evaluations.
(b) Alternative 1 assumes use of the existing HRCCB for recycled water storage and construction of a new 3 MGD UV disinfection system.
(c) Alternative 2 assumes use of the existing HRCCB for recycled water storage and construction of a new 0.65 MGD UV disinfection system.
(d) Alternative 3 assumes construction of a new 0.65 MG recycled water storage tank and construction of a new 3 MGD UV disinfection system.
(e) Alternative 4 assumes construction of a new 0.65 MG recycled water storage tank and construction of a new 0.65 MGD UV disinfection system.
(f) Escalated at 2% per year assuming 24 months until mid-point of construction.
(g) Total amount rounded to nearest $10,000. Cost basis is July 2019 Seattle ENR CCI value 11,999.

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Project Components

The following provides a brief description of project elements assumed for the four alternatives.

Alternative 1: HRCCB with 3 MGD UV Disinfection System

The following project elements were assumed for Alternative 1: HRCCB and 3 MGD UV system alternative.

Sitework and Yard Piping

a) **30-inch Tertiary Filter Effluent (TFE).** Ductile iron pipe would connect the tertiary filters to the UV disinfection system. Connection would be made to the tertiary filters at the 42-inch capped tee on the south side of the Flow Distribution Box. The pipe would pass under the existing 84-inch Primary Effluent/Diversion (PE/DIV) line. Pipe length would be approximately 320 feet with an average burial depth of 14 feet. Installation of the 30-inch TFE would require replacement of parallel 1½ inch W2, 8-inch W1, 14-inch filter backwash water (FBW) and 12-inch drain (D) lines because of proximity and depth of the 30-inch TFE line.

b) **24-inch Recycled Water (RW).** Ductile iron pipe would connect the UV disinfection system to storage at the existing HRCCB. Connection to the HRCCB would be made using an existing penetration on the west side of the HRCCB. Pipe length would be approximately 150 feet with an average burial depth of 12 feet.

c) **6-inch RW connections to irrigation system.** Ductile iron pipe would distribute recycled water to the plant irrigation system in two segments. The first would run about 220 feet west from the proposed truck filling station to connect to the existing irrigation system that serves the landscaping outside the fence line on the south and east sides of the Water Pollution Control Facility (WPCF). The second would run about 1,875 feet west from the proposed 16-inch RW lines near their connection to the existing three 16-inch force mains that would serve Delta Sand and Gravel (DS&G). Average burial depth was assumed to be 4 feet. Cost of the northern segment (running from the 16-inch RW lines) included those for restoration of pavement, sidewalks, and landscaping.

d) **16-inch RW.** Three, buried, parallel 16-inch HDPE pipes would connect the Recycled Water Pumping Station to the three existing 16-inch HDPE force mains northeast of the plant. Total length of the parallel force mains would be about 600 feet. One of the three force mains would be connected to the pumping station initially. The other two force mains would provide for future expansion. The average burial depth of the lines was assumed to be 5 feet. The three 16-inch lines would be installed in a common trench with 12 inches separating each line.

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e) **Paving and grading.** About 14,500 square feet of new paving would be needed to restore existing pavement that would be removed for the installation of the 30-inch TFE line and the rerouted roadway on the east side of the proposed UV structure. Paving was assumed to consist of 4 inches of asphalt over a 12-inch rock base. A total of 350 feet of concrete curb and gutter would be replaced along with four curb storm water catch basins.

UV Disinfection

a) **Structure.** The UV system would be open channel type configuration with an operating deck about 3 feet above the surrounding grade elevation. Stairs would be provided for access. The channel would be about 77 feet long, 3 feet wide, and 8 feet deep. An elevated operating deck would be provided immediately adjacent to the channel and UV equipment. The operating area would be about 45 feet long and 8 feet wide. A covered structure would be provided over the operating deck and portion of the channel containing the UV modules. The structure would be open on three sides and would have a concrete masonry unit (CMU) block wall on the fourth side to provide additional protection from the weather and an area to mount electrical/control equipment. The CMU wall would be approximately 10 feet tall by 45 feet long.

b) **Metal roofing, railing, and grating.** Metal roofing would cover the structure and be supported with structural steel. A combination of aluminum grating and solid decking would cover the UV channels. Aluminum railing would surround the elevated perimeter of the structure.

c) **UV equipment.** In-channel type UV equipment would be provided. Total number of UV banks provided would depend on the UV system manufacturer. Regardless of the manufacturer, one spare UV bank would be provided complete with controls and instrumentation.

d) **Additional equipment and piping.** One 30-inch inlet sluice gate and one 6-inch sluice gate would be provided to isolate and drain the UV channel for maintenance. A davit crane was assumed for equipment removal. Effluent flow measurement would be provided by a Parshall flume with ultrasonic level transducer. Effluent sampling would be provided by an ISCO type auto sampler located at the UV structure. Hypochlorite injection to provide needed chlorine residual to maintain water quality within the storage and distribution system would be provided by use of one of the WPCF's existing primary effluent hypochlorite metering pumps. The UV structure would be connected to the existing double contained hypochlorite lines serving the HRCCB. The UV structure would be connected to the WPCF's drain system via a 6-inch drain line. Utility water would be provided by connecting to the WPCF's W2 system.

Storage

a) **HRCCB.** The existing HRCCB would provide the needed storage for this alternative. It was assumed that there would be no capital cost associated with use of the existing HRCCB for storage. Modifications needed to construct a Recycled Water Pumping Station in the HRCCB were assumed to be captured in the cost of the pumping station.

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Recycled Water Pumping Station

a) **HRCCB modifications.** A section of existing baffle wall (23 feet tall by 8 inches thick by 30 feet long) would be removed and replaced with a 12-inch-thick reinforced concrete wall. Thickened concrete pillars would be needed to provide additional strength and support an overhead concrete slab. An elevated concrete slab (30 feet long by 18 feet wide) would be provided to support the recycled water pumps and piping. Aluminum guard rail would be provided around the new elevated platform. Access to the pumping station would be by existing stairs and walkway at the HRCCB.

b) **Pumps.** Three, 60-horsepower, vertical turbine pumps would be provided and sit on the new elevated concrete slab. Space would be provided for installation of a fourth, future pump. Ductile iron pipe (8 inch diameter) would connect each pump to a 12-inch ductile iron pipe header that would connect to the 6-inch RW line. Each pump would be provided with a swing check valve, butterfly valve, and pressure gauge. Air relief valves would be provided at high points. A magnetic flow meter would be provided for flow measurement. Additional level instrumentation would be installed in the HRCCB to measure water level and provide input for control of the pumps.

c) **Hydropneumatic tank.** It was assumed that a single 6,000-gallon hydropneumatic tank would be provided and supported by 12-inch-thick concrete slabs. Buried 12-inch ductile iron pipe would run about 30 feet to connect to one of the buried 16-inch HDPE RW lines. Inlet piping to each tank would be 8-inch ductile iron pipe. Isolation valves would be provided for each tank. A compressed air system complete with controls would be provided to maintain preset water levels and air pressure within the tanks.

Truck Fill Station

a) **Structure and piping.** Use of a 10-foot by 10-foot concrete slab on grade was assumed with bollards provided for protection from vehicle traffic. A 4-inch ductile iron pipe would connect the station to the 6-inch RW line serving the irrigation system. Pipe size would reduce to 3 inches at the fill station. Gate valves would be provided for isolation and for use in controlling the fill rate of tanker trucks using the station.

b) **Instrumentation**. A 3-inch magnetic flow meter would provide flow metering. A local control panel with touch screen and card reader will monitor water use and facilitate record keeping.

Electrical

a) **Building.** Because nearby electrical rooms do not have enough space to house electrical equipment associated with the project, construction of a new, 15-foot-wide by 25-foot-long CMU block building was assumed. The building would be temperature controlled and would be located near the Recycled Water Pumping Station.

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b) Transformer. Installation of a new pad mounted 500 kVa transformer connected to the existing medium voltage system was assumed. New buried conduit and conductors would connect the new transformer to the new Electrical Building.

c) Conduit and wire. New electrical conductors, signal/control wiring, and conduit were assumed for connection to all components of the recycled water system. It was assumed that no existing buried conduit would be available for the project. Costs include trenching and installation of all new conduit.

d) Electrical equipment. Electrical equipment would include a 600 A switchboard (upgradeable to 1200 A in the future), variable frequency drives (VFDs) for the pumps, 480-120 V transformer and lighting panel.

e) Lighting and miscellaneous power. Other items would include interior and exterior lighting of the Electrical Building and lighting of the UV structure. Convenience outlets would be provided at all new structures.

Instrumentation

a) For conceptual level cost estimating, cost for instrumentation and control was assumed to be a percent of total construction cost.

Alternative 2: HRCCB with 0.65 MGD UV Disinfection System

The following project elements are associated with Alternative 2: HRCCB and 0.65 MGD UV System and differ from those assumed for Alternative 1: HRCCB and 3 MGD UV System. All other project elements would be the same. Differences in the following project elements account for the cost difference between the alternatives.

Sitework and Yard Piping

a) 24-inch Tertiary Filter Effluent (TFE). The ductile iron pipe that would connect the tertiary filters to the new UV disinfection system would be reduced from a 30-inch-diameter pipe to a 24-inch-diameter pipe. All other piping improvements would remain the same.

b) 18-inch Recycled Water (RW). The ductile iron pipe that would connect the UV disinfection system to storage at the existing HRCCB would be reduced from a 24-inch-diameter pipe to an 18-inch-diameter pipe. There would be no change in burial depth or length.

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Tertiary Filters

a) **Filter Feed Pumps.** Two new, lower capacity submersible pumps would be installed that would allow the tertiary filters to operate at a lower rate (0.35 to 0.65 MGD) than is currently possible. The pumps would be installed in the existing filter feed pump wet well.

UV Disinfection

a) **Structure.** A slightly smaller structure would be needed for the lower capacity UV system. Channel length would be reduced from 77 feet to 53 feet. Channel width would be reduced from 3 feet to 2 feet. Channel depth would be reduced from 8 feet to 5.5 feet. Space would be provided for future installation of additional UV banks to increase system capacity from 0.65 MGD to 1.3 MGD. An open sided structure with CMU backwall and metal roofing would be like that provided for the 3 MGD system.

b) **UV equipment.** Similar in-channel type UV equipment would be provided. Total capacity would be reduced from 3 MGD to 0.65 MGD.

c) **Additional equipment and piping.** The 30-inch inlet sluice gate would be reduced to a 24-inch gate. All other equipment, piping, and instrumentation would be like that for the 3 MGD UV system.

Electrical

a) **Conduit and wire.** Additional electrical conductors, signal/control wiring, and conduit would be needed for installation of the two smaller capacity filter feed pumps at the tertiary filters.

b) **Electrical equipment.** Two additional VFDs would be required because of the new filter feed pumps.

Alternative 3: New Storage Tank with 3 MGD UV Disinfection System

The following project element associated with Alternative 3: New Storage Tank and 3 MGD UV System differs from those assumed for Alternative 1: HRCCB and 3 MGD UV System. All other project elements would be the same. Differences in the following project element account for the cost difference between the alternatives.

Recycled Water Storage

a) **Structure.** Construction of a new 0.65 MG, cast-in-place, uncovered, concrete tank was assumed. Plan dimensions of the tank would be 60 feet wide by 90 feet long. Maximum water depth would be about 16 feet. The top of the tank would be 3 feet above the surrounding grade elevation. Total excavation depth would be 19 feet. Access to enter the tank would be via the Recycled Water Pumping Station.

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b) Piping. Additional pipe and washdown facilities would be needed for the dedicated storage tank. This includes 250 feet of buried drainpipe (6-inch ductile iron), 50 feet of buried W2 pipe (4-inch ductile iron), 150 feet of exposed W2 pipe (3-inch steel), and four utility stations. The three, parallel 16-inch RW force mains would also have to be extended an additional 120 feet. Additional piping would be needed to connect the Recycled Water Pumping Station to the distribution system and were included in the costs. Costs associated with connecting the tank to the WPCF's existing utility systems (e.g., W2 and drain) were also included in the cost of the new tank.

Alternative 4: New Storage Tank with 0.65 MGD UV Disinfection System

The following project elements are associated with Alternative 4: New Storage Tank and 0.65 MGD UV System and differ from those assumed for Alternative 1: HRCCB and 3 MGD UV System. All other project elements would be the same. Differences in the following project elements account for the cost difference between the alternatives.

Sitework and Yard Piping

a) 24-inch Tertiary Filter Effluent (TFE). The ductile iron pipe that would connect the tertiary filters to the new UV disinfection system would be reduced from a 30-inch-diameter pipe to a 24-inch-diameter pipe. All other piping improvements would remain the same.

b) 18-inch Recycled Water (RW). The ductile iron pipe that would connect the UV disinfection system to storage at the existing HRCCB would be reduced from a 24-inch-diameter pipe to an 18-inch-diameter pipe. There would be no change in burial depth or length.

Tertiary Filters

a) Filter Feed Pumps. Two new, lower capacity submersible pumps would be installed that would allow the tertiary filters to operate at a lower rate (0.35 to 0.65 MGD) than is currently possible. The pumps would be installed in the existing filter feed pump wet well.

UV Disinfection

a) Structure. A slightly smaller structure would be needed for the lower capacity UV system. Channel length would be reduced from 77 feet to 53 feet. Channel width would be reduced from 3 feet to 2 feet. Channel depth would be reduced from 8 feet to 5.5 feet. Space would be provided for future installation of additional UV banks to increase system capacity from 0.65 MGD to 1.3 MGD. An open sided structure with CMU backwall and metal roofing would be like that provided for the 3 MGD system.

b) UV equipment. Similar in-channel type UV equipment would be provided. Total capacity would be reduced from 3 MGD to 0.65 MGD.

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c) **Additional equipment and piping.** The 30-inch inlet sluice gate would be reduced to a 24-inch gate. All other equipment, piping, and instrumentation would be similar to that for the 3 MGD UV system.

Recycled Water Storage

a) **Structure.** Construction of a new 0.65 MG, cast-in-place, uncovered, concrete tank was assumed. Plan dimensions of the tank would be 60 feet wide by 90 feet long. Maximum water depth would be about 16 feet. The top of the tank would be 3 feet above the surrounding grade elevation. Total excavation depth would be 19 feet. Access to enter the tank would be via the Recycled Water Pumping Station.

b) **Piping**. Additional pipe and washdown facilities would be needed for the dedicated storage tank. This includes 250 feet of buried drainpipe (6-inch ductile iron), 50 feet of buried W2 pipe (4-inch ductile iron), 150 feet of exposed W2 pipe (3-inch steel), and four utility stations. The three, parallel 16-inch RW force mains would also have to be extended an additional 120 feet. Additional piping would be needed to connect the Recycled Water Pumping Station to the distribution system and were included in the costs. Costs associated with connecting the tank to the WPCF's existing utility systems (e.g., W2 and drain) were also included in the cost of the new tank.

Electrical

a) **Conduit and wire.** Additional electrical conductors, signal/control wiring, and conduit would be needed for installation of the two smaller capacity filter feed pumps at the tertiary filters.

b) **Electrical equipment.** Two additional VFDs would be required because of the new filter feed pumps.

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Attachment 7 - Secured Permits and Regulatory Approvals Needed to Implement the Project

No secured permits/approvals at time of application

Attachment 8 - Other: EWEB Water Management and Conservation Plan

Final

Water Management and Conservation Plan

Prepared for

Eugene Water and Electric Board

July 2018

Prepared by

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Executive Summary

Water Supplier Plan

The Eugene Water & Electric Board (EWEB) is Oregon's largest customer-owned utility. It provides electricity and water to customers in the City of Eugene, Oregon; dissolved water districts; and special service water districts outside of the City of Eugene's city limits, and neighboring water districts with wholesale connections. For many years, EWEB has shown a serious commitment to delivery of high quality water and to stewardship of its water resources, as demonstrated by EWEB continually investing in its water system and in water conservation measures, products, and services.

EWEB's 2012 Water Management and Conservation Plan (WMCP or the Plan) was developed to meet the requirements of EWEB's groundwater Permit G-16371. The 5-year progress report for the 2012 WMCP was submitted in February 2017, and the Oregon Water Resources Department (OWRD) determined that the progress report had no deficiencies. The final order for extension of time for EWEB's Permit S-27441 requires that a WMCP be submitted within 3 years of the final order dated January 2, 2015. EWEB is providing this "2018" WMCP to address requirements for both Permit S-27441 and Permit G-16371. EWEB will prepare future progress reports and updates relevant to both permit requirements under the 2018 WMCP. The Plan is organized into the sections presented in **Exhibit ES-1**, each addressing specific sections of OWRD's administrative rules. Section 2 is a self-evaluation of EWEB's water supply, water use, water rights, and water system. The information developed for Section 2 is the foundation for the sections that follow, which use that information to consider how EWEB can improve its water conservation and water supply planning efforts.

Exhibit ES-1. WMCP Organization

Section	*Requirement*
Section 1 – Water Supplier Plan	*OAR 690-086-0125*
Section 2 – Water Supplier Description	*OAR 690-086-0140*
Section 3 – Water Conservation	*OAR 690-086-0150*
Section 4 – Water Curtailment	*OAR 690-086-0160*
Section 5 – Water Supply	*OAR 690-086-0170*

Notes:
OAR = Oregon Administrative Rule

Water Supplier Description

In 2016, EWEB delivered water to approximately 63,840 water delivery connections, which provided water to a population of approximately 184,700 people, including commercial/industrial establishments, public facilities, and wholesale connections. In addition,

four utilities purchase water from EWEB under wholesale agreements (River Road Water District, Santa Clara Water District, Willamette Water Company (WWC), and City of Veneta) and several districts outside of the city limits receive water delivery from EWEB (Eugene Airport Special Service District; Lane Community College Special Service District; and the dissolved Hillcrest, Oakway, and Bethel Water Districts). EWEB also has interconnections with the Springfield Utility Board (SUB) and Rainbow Water District (RWD) municipal water supply systems, which are used to increase reliability of the water systems and to assist each utility if water supply issues arise.

EWEB's water source is the McKenzie River. Raw water is pumped from water intakes on the McKenzie River and conveyed to EWEB's Hayden Bridge Water Treatment Plant (WTP). Following treatment, water is pumped from the WTP to EWEB's water distribution system.

EWEB currently relies exclusively on its McKenzie River water rights because of the seniority of those water rights and the ample amount of water available. EWEB holds three municipal surface water rights authorizing the use of up to approximately 300 cubic feet per second (cfs) from the McKenzie River: Certificate 15180 (27.08 cfs, 17.5 million gallons per day (mgd), Certificate 68537 (90 cfs, 58.2 mgd), and Permit S-27441 (183 cfs, 118.3 mgd). In addition, EWEB holds Permit G-16371 for the use of up to 18.49 cfs of groundwater, but multiple permit conditions affect the reliability of this right. EWEB also holds a surface water registration SW-354 for 30.9 cfs, but its reliability is uncertain until the validity of the claim is determined in an adjudication.

Because of the lack of reliability of Permit G-16371 and SW-354, EWEB applied for a surface water permit (Application S-87675) on December 27, 2010, that reflected the authorization provided by EWEB's existing Surface Water Registration. On February 28, 2013, OWRD issued Permit S-54805, which authorizes the use of up to 30.9 cfs (approximately 20 mgd) from the Willamette River for municipal use. Permit S-54805 stipulates that water under this permit or subsequent certificates, in combination with surface water registration SW-354 or any subsequent related decreed right, will not exceed 30.9 cfs. Furthermore, Permit S-54805 maintains EWEB's previous total combined maximum authorized rate under all of its water rights at 300.08 cfs and stipulates that use is only allowed when flows of 2,500 cfs in November through May and 2,000 cfs from June through October are met below the confluence of the Coast Fork and Middle Fork of the Willamette River. Permit S-54805 has a priority date of January 3, 2011, and a development deadline of February 28, 2033 (20 years from date of permit issuance).

Finally, EWEB has a non-consumptive industrial water right certificate (45670) for up to 128 cfs from the Willamette River.

Water Conservation

OWRD's WMCP rules require municipal water providers to have 5-year benchmarks for initiating or expanding conservation measures related to required conservation programs. The rules also require municipal water providers serving a population greater than 7,500 to implement an additional set of conservation measures or to provide documentation showing that implementation of the measures is neither feasible nor appropriate. A summary of EWEB's required conservation measures and additional conservation measures, along with the 5-year

benchmarks for implementing those measures, are provided below. The water conservation measures and benchmarks included in this WMCP were evaluated and updated in part from the work EWEB completed in preparing the "2013-2023 Water Conservation Plan." It includes a detailed evaluation of water conservation potential analysis that EWEB hired a consultant (Carollo Engineers) to prepare.

Five-Year Benchmarks for Required Existing or Expanded Conservation Measures and Additional Conservation Measures

- **Annual Water Audits**

  The purpose of the annual water distribution system audit is to identify system leakage and non-revenue water, and to better understand water system efficiency. EWEB met its annual water audit benchmark from the 2012 WMCP, and adopted the American Water Works Association (AWWA) M36 methodology and WaterAudit 4.2 spreadsheet tool. Prior to this, EWEB had been tracking unaccounted-for water for more than 10 years. EWEB continues to routinely track the unmetered uses from flushing, testing new mains, leaks, and continuous sampling equipment. EWEB also documents water production and consumption on a monthly basis.

  Five-Year Benchmark:

  - EWEB will continue its annual water audit using the adopted AWWA M36 methodology to evaluate production and consumption data to observe trends in authorized and unauthorized water uses, as well as non-revenue water (unaccounted-for water and process water). Using the audit information, EWEB will estimate any unmetered authorized and unauthorized uses that may arise.

- **System-Wide Metering**

  EWEB's system is fully metered on both the production side and demand (customer) side. Hydrants are not metered, but EWEB tracks water used for main flushing. In 2015, EWEB's Electric Division made the decision to move ahead with implementing advanced metering infrastructure (AMI) by purchasing and installing equipment with features that include outage and leak detection alarms. EWEB's Electric Division and Water Division are participating in the implementation process, and EWEB's Board of Commissioners is considering mass deployment alternatives.

  EWEB met its system-wide metering benchmark from the 2012 WMCP by continuing to require new developments to be metered, and by evaluating and moving forward with implementation of AMI.

  Five-Year Benchmark:

  - EWEB will continue to require all new development to be metered. The Water Division will provide support and input to the Electric Division to continue implementation of AMI.

- **Meter Testing and Maintenance**

  Given the longevity of EWEB meters and the lack of cost effectiveness of testing small meters (less than 3 inches in size), EWEB's meter testing and maintenance program continues to be based primarily on customer complaints. The ongoing Large Meter Maintenance Program involves maintenance and testing in the field. Based on annual consumption and maintenance history, EWEB tests the large meters every 1, 2, or 3 years. EWEB maintains records for all repairs and accuracy tests. EWEB's water production meters at the Hayden Bridge WTP are maintained according to the manufacturer's recommendation on an annual basis to ensure that the source production meters provide accurate data.

  EWEB met its meter testing and maintenance benchmark from the 2012 WMCP by reviewing its process and adopting standard operating guidelines for large water meter testing and maintenance and commissioning of meters 1.5 inches and larger. EWEB also has an established procedure for annual meter testing of production meters at the Hayden Bridge WTP.

  Five-Year Benchmark:

  - EWEB will continue to conduct large meter testing and replacement following the protocols and schedules in the standard operating guidelines. As AMI implementation continues (see system-wide metering benchmark), EWEB will evaluate water conserving opportunities. EWEB will evaluate meter testing and replacement to estimate revenue loss—resulting from inaccurate new meter installations—based on a benefit-cost analysis.

- **Unit-Based Billing Program**

  EWEB's monthly residential water bill within the City of Eugene city limits has three components: Basic Charge, Consumption Charge, and Elevation Charge. The monthly Basic Charge is based on meter size and covers the fixed operating costs of the utility that include meter reading, billing, and customer service. The Consumption Charge is a tiered rate based on the amount of water used by the customer each month and is metered at each customer's point of connection to the public utility. The Elevation Charge, if applicable, accounts for the infrastructure and energy costs required to pump water into higher sections of the water delivery area. The Elevation Charge is assessed for customers located on three elevation levels above the base level (below 800 feet).

EWEB met its rate structure and billing program benchmarks from the 2012 WMCP by providing water conservation billing best management practices (BMPs) information to the team conducting cost of service analysis during the reporting period. EWEB also evaluated customer classification as part of the 2013-2023 Water Conservation Plan. EWEB maintained the tiered consumption charges for residential customers.

Five-Year Benchmark:

- EWEB will continue to review its rates annually by analyzing funding requirements to pay for future capital and operating costs, as well as costs associated with water

conservation programs. EWEB will continue to apply rates that encourage water conservation according to water utility BMPs. EWEB also will continue a monthly billing schedule for all customer classes.

- **Leak Detection and Pipeline Repair or Replacement**

  EWEB's non-revenue water was 5.4 percent in 2016 and averaged 8.2 percent from 2010-2016; these percentages are below the 10 percent leakage rate that triggers more serious system analysis and are an indication of a well-run leak detection and repair program**.**

  EWEB's Water Distribution Operations (WDO) staff investigates suspected leaks using data loggers and sonic correlation equipment to pinpoint leaks and to determine the quantities of water being lost. WDO has a goal to replace one 6-inch or 8-inch water meter per month. EWEB provides initial onsite leak detection free of charge for residential customers with high bills or suspected leaks. If a customer requests a leak detection for large meters then EWEB will read the meter for identifying a leak. If an unknown use is confirmed as a leak in the water delivery line or irrigation system, the residential or commercial customer may be eligible for a short-term or long-term loan or grants. In addition, wholesale connections are required to conduct leak detection surveys as part of their requirement to maintain a WMCP.

  EWEB met its leak detection and repair benchmarks from the 2012 WMCP by continuing to fund the program, and maintained a capital plan for repairs at the funding level stated in the WMCP. EWEB also reviewed its leak detection and repair protocols for effectiveness.

  Five-Year Benchmark:

  - EWEB will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner; and to implement plans to invest in water system renewal and replacement projects in the next 5 years. EWEB will continue to fund pipeline replacement based on evaluation criteria in the 2015 Water Master Plan.

- **Public Education**

  EWEB has developed and implemented a comprehensive community outreach and education program. Components include: year-round conservation efforts and messaging, outdoor-specific programs aimed at reducing seasonal peak uses, and in-school education programs. Key components of the outreach and education program include the Green Grass Gauge program, Water Wise Demonstration Garden, and utility publications. The Green Grass Gauge program provides weather-based irrigation information and a free rain gauge called the "Green Grass Gauge." The educational program has distributed thousands of free rain gauges since it was started, and resulted in sustained decrease in overall residential summer water use. In 2008, EWEB facilitated a wide-ranging public/private partnership to build a Water Wise Demonstration Garden, and is committed to maintaining the garden. EWEB produces a direct mail publications often targeted to the highest 10 percent of residential water users. On occasion the mailer has been sent to all customers. The annual direct mail piece has transitioned from a pure water conservation message to a system optimization message that includes peak-hour management information.

EWEB met its public education benchmarks from the 2012 WMCP. EWEB evaluated its water conservation targets as part of the development of the 2013-2023 Water Conservation Plan. EWEB developed and continues to lead a regional water conservation promotion partnership with nearby water utilities. The partnership co-publishes water bill inserts. EWEB also continues to support education efforts by community groups.

Five-Year Benchmark:

- EWEB will continue public education initiatives and will re-evaluate those initiatives, which include: Green Grass Gauges program; and grant/loan program for residential customers. EWEB will continue to update its Web site and outreach materials as needed; and continue to provide conservation messaging in water bills. EWEB will continue to seek and sustain messaging partnerships with regional water utilities that share local media footprint to promote water conservation; and with "credible educators" in lieu of EWEB-staffed events and presentations.

- **Leak Detection and Pipeline Repair and Replacement**

  EWEB's non-revenue water was 5.4 percent in 2016 and averaged 8.2 percent from 2010-2016. Although the system's non-revenue water, and therefore system leakage, is below 10 percent, EWEB still has initiatives aimed to keep system leakage as low as possible. These initiatives include: leak detection and repair education integrated into several community-based sustainability education programs, and offering investigations of suspected leaks to commercial and industrial customers. Other required measures related to leak detection and pipeline repair are described in Section 3.3 (measure 5) addressing Oregon Administrative Rule (OAR) 690-086-0150(4).

  Five-Year Benchmark:

  - EWEB will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner, and implement plans to invest in water system renewal and replacement projects in the next 5 years. EWEB will continue to fund pipeline replacement based on evaluation criteria in the 2015 Water Master Plan.

- **Technical and Financial Assistance**

  EWEB's primary assistance program focuses on water audits for indoor use. EWEB staff has been offering commercial and industrial customers Water Use Audits since 1995. These audits are provided free of charge, at the customer's request, and provide a first step in evaluating opportunities for water savings. The service is marketed to customers through direct mail publications and customer contacts made to other parts of the utility, chiefly Energy Management Services.

  EWEB met its technical and financial assistance benchmarks from the 2012 WMCP. EWEB re-evaluated the assistance programs during the preparation of the 2012 WMCP 5-year Progress Report with technical assistance from consultants. Based on these results, EWEB's water technical and financial assistance offerings will be focused on leak detection and repair services (see also Section 3.5 (measure 3) addressing OAR 690-086-0150(6).

Five-Year Benchmark:

- EWEB will use the following analyses to support technical and financial assistance programs: use the geographic information system (GIS) water budget tool developed for the 2013-2023 Water Conservation Plan to identify conservation opportunities; determine optimal expense threshold for demand-side water conservation programs as percent of operations and maintenance (O&M) expenses; and continue to evaluate the effectiveness of conservation programs using customer focus groups and customer surveys.

- **Retrofit/Replacement of Inefficient Fixtures**

  EWEB has implemented several retrofit/replacement programs during the past 20 years, but most have been discontinued on the basis of benefit-cost analysis. Toilet rebates for residential customers continue to be implemented on the basis of the program's effectiveness. EWEB discontinued all toilet rebates in 2009 because of an annual cost/benefit analysis of the program, but re-initiated the program in 2012. Since 2012, EWEB customers have replaced about 1,007 toilets for an estimated water savings of 22 million gallons (MG) per year.

  EWEB met its retrofit/repair of inefficient fixtures benchmarks from the 2012 WMCP. EWEB re-evaluated its technical and financial assistance programs as part of the 2013-2023 Water Conservation Plan. Based on the results, EWEB decided to refocus the retrofit and replacement on toilet rebates.

  Five-Year Benchmark:

  - EWEB will continue the toilet rebate program. To continue to prioritize its program, EWEB will determine optimal expense threshold for demand-side water conservation programs as a percentage of O&M expenses; and continue to evaluate the effectiveness of conservation programs using customer focus groups and customer surveys.

- **Water Rate Structure and Billing Schedule**

  The Unit-based Billing discussion in Section 3.3 (measure 4) responsive to OAR 690-086-0150(4) details the three parts of the monthly residential water bill: Basic Charge, Consumption Charge, and Elevation Charge. In addition, EWEB currently provides information about water conservation in its water bills; this information is detailed under the Public Education Section 3.3 (measure 6) addressing OAR 690-086-0150(4).

  EWEB met its rate structure and billing program benchmarks from the 2012 WMCP by providing water conservation billing BMP information to the team conducting cost of service analysis during the reporting period. EWEB also evaluated customer classification as part of the 2013-2023 Water Conservation Plan.

  Five-Year Benchmark:

  - EWEB will continue to review its rates annually by analyzing funding requirements to pay for future capital and operating costs, as well as costs associated with water

conservation programs. EWEB will continue to apply rates that encourage water conservation according to water utility BMPs. EWEB also will continue a monthly billing schedule for all customer classes and include water conservation messaging in the bills.

- **Reuse, Recycling, and Nonpotable Water Opportunities**

  In the past, EWEB has participated in a rainwater harvesting system and a recycled water program with the Metropolitan Wastewater Management Commission, and continues to support water reuse and recycling, and nonpotable water use. EWEB does not provide rebates, but provides technical assistance to customers interested in these opportunities.

  During the reporting period for the 2012 WMCP, EWEB maintained a project-based loan and grant application process for customers to propose reuse, recycling, and nonpotable water use projects that may be eligible for incentives. No customers proposed projects during the reporting period. EWEB continues to recycle filter-to-waste at the Hayden Bridge WTP.

  Five-Year Benchmark:

  - EWEB will continue to explore opportunities for demand-side water reuse and recycling; and continue to recycle water at the Hayden Bridge WTP.

- **Other Conservation Measures**

  Currently, EWEB has the equivalent of two full-time staff members working on water conservation, who develop, coordinate, implement, monitor, and report on EWEB's water conservation programs. EWEB staff members track and evaluate the Toilet Rebate Program, Water Service Line Replacement Loan Program, and Income Eligible Leak Repair Assistance Program. EWEB also completed a water conservation program effectiveness evaluation project in 2015, which identified key programs to prioritize and continue to implement. Finally, EWEB maintains a grant/loan application process for unique residential customer proposals to increase water conservation.

  EWEB met its benchmarks for other conservation measures from the 2012 WMCP by completing the 2013-2023 Water Conservation Plan. EWEB sponsored staff time to support the City of Eugene and University of Oregon in developing landscaping and irrigation standards and specifications. EWEB staff members also participated in the first irrigation installation building code eligible to be adopted in Oregon.

  Five-Year Benchmark:

  - EWEB will continue the Green Grass Gauge program to sustain outdoor water savings; and continue grant/loan program for residential customers. EWEB will work with or monitor codes and standards-making bodies to leverage emerging efficiency codes, standards, and legislation. EWEB also will conduct or monitor studies conducted by others on emerging equipment and technology for demand-side conservation (e.g., WaterSense labeled landscape irrigation sprinkler components).

Exhibit ES-2 provides a summary of EWEB's 5-year benchmarks for water management and conservation measures.

Exhibit ES-2. Summary of Water Management and Conservation Measure 5-Year Benchmarks

Annual Water Audit • EWEB will continue its annual water audit using the adopted AWWA M36 methodology to evaluate production and consumption data to observe trends in authorized and unauthorized water uses, as well as non-revenue water (unaccounted-for water and process water). • Using the audit information, EWEB will estimate any unmetered authorized and unauthorized uses that may arise.
System-Wide Metering • EWEB will continue to require all new development to be metered. • EWEB's Water Division will provide support and input to the Electric Division to continue implementation of AMI.
Meter Testing and Maintenance • EWEB will continue to conduct large meter testing and replacement following the protocols and schedules in the standard operating guidelines. • As AMI implementation continues (see system-wide metering benchmark), EWEB will evaluate water conserving opportunities. • EWEB will evaluate meter testing and replacement to estimate revenue loss—as a result of inaccurate new meter installations—based on a benefit-cost analysis.
Rate Structure and Billing Program • EWEB will continue to review its rates annually by analyzing funding requirements to pay for future capital and operating costs, as well as costs associated with water conservation programs. • EWEB will continue to apply rates that encourage water conservation according to water utility best management practices. EWEB also will continue a monthly billing schedule for all customer classes.
Leak Detection and Repair • EWEB will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner; and to implement plans to invest in water system renewal and replacement projects in the next 5 years. • EWEB will continue to fund pipeline replacement based on evaluation criteria in the 2015 Water Master Plan.
Public Education • EWEB will continue public education initiatives and will re-evaluate those initiatives, which include: Green Grass Gauge program; and grant/loan program for residential customers. • EWEB will continue to update its website and outreach materials as needed; and continue to provide conservation messaging in water bills. • EWEB will continue to seek and sustain messaging partnerships with regional water utilities that share local media footprint to promote water conservation; and with "credible educators" in lieu of EWEB-staffed events and presentations.
Technical and Financial Assistance • EWEB will use the following analyses to support technical and financial assistance programs: use the GIS water budget tool developed for the 2013-2023 Water Conservation Plan to identify conservation opportunities; determine optimal expense threshold for demand-side water conservation programs as percent of O&M expenses; and continue to evaluate the effectiveness of conservation program using customer focus groups and customer surveys.
Retrofit/Repair of Inefficient Fixtures • EWEB will continue the toilet rebate program. • EWEB will continue to prioritize its program, by evaluating optimal expense threshold for demand-side water conservation programs as percent of O&M expenses; and continue to evaluate the effectiveness of conservation program using customer focus groups and customer surveys.

Exhibit ES-2. Summary of Water Management and Conservation Measure 5-Year Benchmarks

Reuse, Recycling, and Nonpotable Water Opportunities • EWEB will continue to explore opportunities for demand-side water reuse and recycling; and continue to recycle water at the Hayden Bridge WTP.
Other Conservation Measures • EWEB will continue the Green Grass Gauge program to sustain outdoor water savings; and continue grant/loan program for residential customers. • EWEB will work with or monitor codes and standards-making bodies to leverage emerging efficiency codes, standards, and legislation. • EWEB will conduct or monitor studies conducted by others on emerging equipment and technology for demand-side conservation (e.g., WaterSense labeled landscape irrigation sprinkler components).

Notes:
EWEB = Eugene Water and Electric Board
AWWA = American Water Works Association
AMI = Advanced metering infrastructure
GIS = Geographic information system
O&M = Operation and maintenance

Water Curtailment

The curtailment plan presented in this WMCP has four distinct stages that increase in order of severity to respond to specific water-shortage conditions. Each stage is triggered by one or more of the identified initiating conditions. The curtailment stages and initiating conditions are summarized in **Exhibit ES-3**.

Exhibit ES-3. Curtailment Stages 1 Through 4

Curtailment Stages	Initiating Conditions
Stage 1: Water Shortage Advisory Demand Reduction Target: 15 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate of up to 5 mgd • Minor maintenance work or damage repair is required at water pumps or mains
Stage 2: Water Shortage Alert Demand Reduction Target: 30 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate of up to 15 mgd • Minor damage to the water system resulting from a natural disaster • Failure of minor parts of the water system
Stage 3: Water Shortage Emergency Demand Reduction Target: 50 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate greater than 15 mgd • Serious damage to the water system resulting from a natural disaster • Failure of a significant part of the water system • Damage to pump station by a break-in • Isolated contamination of the water supply
Stage 4: System Shutdown	• Reservoir levels have reached a point where system failure is imminent • Demand management measures have been unsuccessful in reducing demand to available supply, and to preserve remaining water for rationed emergency use, reservoirs must be shut down • Extensive damage to the water system resulting from a natural disaster • Severe chemical spill immediately upstream of the intake • Failure of a critical water system component • Severe damage to pump station by a break-in • Potentially harmful contamination of the entire water supply

Notes:
MDD = maximum day demand.
mgd = million gallons per day.

Water Supply Plan

EWEB anticipates that its future water delivery area will not expand beyond its current water delivery area during the planning horizon of this WMCP. However, expansion of the City of Eugene's Urban Growth Boundary could result in a similar expansion of EWEB's water delivery area. Although EWEB does not expect expansions to its current water delivery area, EWEB may add wholesale connections to neighboring communities (the Cities of Creswell, Coburg, and Junction City) if they need additional water supplies or for redundancy. These metered connections will be made at the boundary of EWEB's water delivery area.

For the purpose of projecting future populations to be served, EWEB considered the water delivery population within its current water delivery area and the water delivery population within its current water delivery area plus current wholesale customers and potential wholesale connections, which is shown in **Exhibit ES-4**.

Exhibit ES-4. Population Projections for EWEB Current Water Delivery Area, Current Wholesale Connections, and Potential Wholesale Connections

Projected Population	2028	2038
EWEB Water Delivery Area Population within Current Water Delivery Area Plus Current Wholesale Connection	218,320	237,570
Potential Wholesale Connections	15,850	18,130
EWEB Water Delivery Area Population within Current Water Delivery Area Plus Current and Potential Wholesale Connections	234,170	255,700

Similarly, water demand projections were developed using two demand forecasts scenarios: (1) EWEB delivering water only to the population within its current water delivery area, plus its current wholesale connections; and (2) EWEB delivering water to the population within its current water delivery area, plus the current and potential wholesale connections identified. Using historical data and a set of assumptions to derive per capita water use factors and population projections derived from Portland State University Population Research Center data, the projected demands shown in **Exhibit ES-5** were developed.

Exhibit ES-5. EWEB Projected Maximum Day Demand (mgd)

Water Demand Scenarios	2028	2038
EWEB Water Delivery Area Population within Current Water Delivery Area	60	65
EWEB Water Delivery Area Population within Current Water Delivery Area plus Current Wholesale Connection	62	68
EWEB Water Delivery Area Population within Current Water Delivery Area plus Current and Potential Wholesale Connections	63	69

Notes:
mgd = million gallons per day

EWEB intends to serve future demands by continuing to use all 75.7 mgd (117.08 cfs) under its McKenzie River water right Certificates 15180 and 68537, and by continuing to develop its McKenzie River water right Permit S-27441, in addition to that permit's partially developed amount of 3.11 mgd (4.82 cfs).

Based on the demands shown in Exhibit ES-5, EWEB's existing water rights can meet the projected municipal water demands within its current water delivery area and with the addition of wholesale connections for the next 20 years, which is the planning horizon for this WMCP. Projecting when the full amount of Permit S-27441 will be needed is difficult given fluctuations that occur in the economy, as well as the inability to predict the arrival or departure of industries and changes in demographics in the long term. EWEB's most recent permit extension application for Permit S-27441 anticipated that full beneficial use would occur by October 1, 2083. However, EWEB will be reanalyzing projected demands and the need to access water under Permit S-27441 with each subsequent WMCP update.

EWEB's plans for using its Willamette River water rights for municipal use (surface water registration SW-354 and Permit S-54805) and groundwater rights (Permit G-16371) currently are being reevaluated as a result of a change in management at EWEB. Subsequent WMCP updates will clarify progress in developing a schedule for putting these water rights to beneficial use, but EWEB intends to fully develop the water rights by their authorized date of completion.

1. Municipal Water Supplier Plan

This section satisfies the requirements of OAR 690-086-0125.

This rule requires a list of affected local governments to whom the plan was made available, and a proposed date for submittal of an updated plan.

1.1 Introduction

The purpose of this Water Management and Conservation Plan (WMCP or Plan) is to guide development, financing, and implementation of water management and conservation programs that ensure sustainable water use, as well as to consider Eugene Water & Electric Board's (EWEB) future water needs. EWEB, founded in 1911, is Oregon's largest customer-owned, nonprofit utility. EWEB provides electricity and water to local residents, businesses, schools, and other customers. The City of Eugene chartered EWEB to serve the interests of the citizens, or customers, who are the owners of the utility. A five-member Board of Commissioners (Board), elected by the citizens of Eugene, is charged with setting strategic priorities and then establishing policies and/or goals to guide implementation of those priorities by EWEB's staff. The Board also oversees regulation of rates for water and electric services. EWEB's Electric and Water Divisions provide electricity and drinking water to EWEB's customers in the City of Eugene[1]. EWEB also services neighboring water districts and the City of Veneta on a wholesale basis.

EWEB's estimated water delivery area population for 2016 was 184,703. Most of these customers are served directly by EWEB, within the City of Eugene city limits or urban growth boundary (UGB), and include the City of Eugene, dissolved Bethel Water District, dissolved Hillcrest Water District, dissolved Oakway Water District, Eugene Airport Special Service District, and Lane Community College Special Service District. The remaining population is served by utilities that purchase water from EWEB under wholesale agreements: River Road Water District, Santa Clara Water District, WWC, and the City of Veneta. Additionally, several dissolved water districts outside the Eugene city limits receive water from EWEB: Hillcrest, Oakway, and Bethel Water Districts. As the population of the City of Eugene grows, so will the demand for water and the necessity to improve the management and sustainability of this crucial resource.

In response to requirements under Permit G-16371 EWEB submitted a WMCP, which was approved by the Oregon Water Resources Department (OWRD) in 2012. The 2012 WMCP 5-Year Progress Report was submitted in February 2017, and OWRD determined that the progress report had no deficiencies. The final order for extension of time for EWEB's Permit S-27441 requires that a WMCP be submitted within 3 years of the final order dated January 2, 2015. EWEB is providing this "2018" WMCP to address requirements for both Permit S-

[1] The City of Eugene holds some water rights for irrigation and other nonpotable uses; however, those water rights and water systems are not managed by EWEB.

27441 and Permit G-16371. EWEB will prepare future progress reports and updates relevant to both permit requirements under the 2018 WMCP.

1.2 Plan Organization

This Plan fulfills the requirements of Oregon Administrative Rules (OARs) adopted by the Oregon Water Resources Commission in November 2002 (OAR Chapter 690, Division 86). This Plan describes water management, water conservation, and curtailment programs to guide the wise use and stewardship of EWEB's water supply, and to fulfill the requirements of permits S-27441 and G-16371.

The Plan is organized into the following sections, each addressing specific sections of OAR Chapter 690, Division 86. Section 2 is a self-evaluation of EWEB's water supply, water use, water rights, and water system. The information developed for Section 2 is the foundation for the sections that follow. The later sections use this information to consider how EWEB can improve its water conservation and water supply planning efforts.

Section	***Requirement***
Section 1 – Water Supplier Plan	*OAR 690-086-0125*
Section 2 – Water Supplier Description	*OAR 690-086-0140*
Section 3 – Water Conservation	*OAR 690-086-0150*
Section 4 – Water Curtailment	*OAR 690-086-0160*
Section 5 – Water Supply	*OAR 690-086-0170*

Notes:
OAR = Oregon Administrative Rule

1.3 Affected Local Governments

OAR 690-086-0125(5)

The following governmental agencies may be affected by this Plan:

- City of Eugene
- Lane County
- City of Springfield
- City of Veneta
- City of Junction City
- City of Creswell
- City of Coburg

Thirty days before submitting this Plan to OWRD, EWEB made the draft plan available for review by each affected local government listed above along with a request for comments related to consistency with the local government's comprehensive land use plan. The letters requesting comments are in **Appendix A**. No comments were submitted to EWEB during the review period.

In addition, EWEB provided the following entities with notice of the draft plan as a courtesy:

- Santa Clara Water District (EWEB wholesale customer)
- River Road Water District (EWEB wholesale customer)
- Willamette Water Company (WWC; EWEB wholesale customer)
- Springfield Utility Board (SUB; water delivery area is contiguous to EWEB's water delivery area)
- Rainbow Water District (RWD; water delivery area is contiguous to EWEB's water delivery area)

1.4 Plan Update Schedule

OAR 690-086-0125(6)

As required by OAR Chapter 690, Division 86, EWEB anticipates submitting an update of this Plan within 10 years of the final order approving this Plan, and a progress report will be submitted within 5 years of the final order.

1.5 Time Extension

OAR 690-086-0125(7)

EWEB submitted a 5-year progress report in February 2017 for water conservation benchmarks approved in the 2012 WMCP. OWRD reviewed and found no deficiencies in the report (refer to **Appendix B**). The benchmarks identified in this WMCP reflect EWEB's re-evaluation and progress since the 2012 WMCP.

1.6 Definition of Key Terms

This section provides definitions for commonly used water conservation and planning related terms used in this WMCP. The list of terms is not meant to be exhaustive or to include engineering-related or water system and infrastructure terminology.

- *Apparent losses*: non-physical losses that occur in utility operations as a result of customer meter inaccuracies, systematic data handling errors in customer billing systems, and unauthorized consumption. In other words, this is water that is consumed, but is not properly measured, accounted, or paid for. These losses cost utilities revenue and distort data on customer consumption patterns.
- *Authorized consumption*: the metered and approved unmetered water uses within the system. Generally, water suppliers express demand and consumption in units of million gallons per day (mgd). They may also be expressed in cubic feet per second (cfs) or gallons per minute (gpm). One mgd is equivalent to 1.55 cfs or 694 gpm. For annual or monthly values, a quantity of water typically is reported in million gallons

(MG). Water use per person (per capita use) is expressed in gallons per person (per capita) per day (gpcd).

- *Average day demand (ADD)*: the total annual system demand divided by 365 (or 366) days.
- *Benchmark (water conservation)*: an action a water supplier commits to doing and a schedule for carrying out water conservation activities between the time a WMCP is submitted to OWRD and the next progress report or WMCP update.
- *Beneficial use*: reasonably efficient use of water without waste for a purpose consistent with the laws, rules, and the best interests of the people of the state (OAR 690-300-0010(5)).
- *Billed authorized consumption*: authorized consumption that is billed and generates revenue (also known as Revenue Water). It is equal to Billed Metered Consumption plus Billed Unmetered Consumption.
- *Customer class*: broad groups classified according to buying patterns, payment behavior, or type of consumption. For water billing purposes, examples of customer classes include residential, commercial, industrial, irrigation, and public.
- *Demand-side (water management)*: reducing the amount of water being used by customers/users for specific purposes, such as domestic use, irrigation, industrial, or municipal needs. Actions include structural or operational changes to existing infrastructure (e.g., repairing leaks), implementing financial incentives (e.g., by rates structure or rebates), and public education.
- *Final order*: decision by OWRD approving or denying a requested water right transaction (application/request).
- *Instream water right*: water right for protecting fish, minimizing effects of pollution or maintaining recreational uses. Instream water rights establish flow levels to remain in a stream on a month-by-month basis, are set for a certain stream reach, and measured at a specific point in the reach. Instream rights have a priority date and are regulated in the same way as other water rights.
- *Maximum day demand (MDD*): the highest system demand that occurs on any single day during a calendar year. MDD is an important value for water system planning. The supply facilities (treatment plants, pipelines, reservoirs) and water rights must be capable of meeting the MDD. Moreover, water rights typically are established as a rate of diversion "at the source" and the projected rate of diversion should be planned for accordingly.
- *Maximum monthly demand (MMD)*: the highest total monthly demand of the 12 months of a calendar year. MMD in mgd equals the ADD of the 1 month with the highest total demand of the 12 months of a calendar year. This statistic is valuable when MDD values are not available.
- *Non-revenue water*: water consumed or used by a customer or lost through leaks or water system operations that is not accounted for by the utility's billing system and cannot be billed to a customer or user. It consists of the following: unbilled authorized consumption (usually a minor component of water balance), apparent losses, and real losses.

- *Peaking factor*: the ratios of one demand value to another. The most common and important peaking factor is the ratio of MDD to ADD. This ratio is often used for system modeling and demand forecasting.
- *Per capita demand*: amount or rate of water use (e.g., gallons per day) per person.
- *Real loss*: physical losses of water from the distribution system, including leakage and storage overflows.
- *Residential end-use (of water)*: all places where water is used in a single-family home such as toilets, showers, clothes washers, faucets, lawn watering, etc.
- *Revenue water*: water consumed or used by a customer of a utility that is accounted for by the utility's billing system and billed to the customer or user.
- *System demand (i.e., water production)*: the quantity of water delivered to a distribution system from a water treatment plant (WTP), wholesale supplier, or an aquifer storage and recovery (ASR) well. System demand includes metered consumption (e.g., single-family residential and commercial/industrial), unmetered public uses (e.g., firefighting and hydrant flushing), water lost to leakage, and reservoir overflow.
- *Supply-side (water management)*: increasing the amount of water available by taking actions to find new sources of water, increasing storage capacities, diverting water to increase supply at a particular asset, or using technology to create potable water from a previously unusable source. These actions generally do not place a burden on users to change their own usage of the available water.
- *3-day MDD:* equals the average of the 3 consecutive days with the highest daily demands, including the MDD.
- *Water consumption (water sale)*: portion of water use that is not returned to the original water source after being withdrawn. Consumption occurs when water is lost into the atmosphere through evaporation or incorporated into a product or plant (such as a corn stalk) and is no longer available for reuse.
- *Water (system) loss*: difference between total system input of water and authorized consumption. Water losses are made up of physical losses and commercial losses.
- *Water production*: amount of water (rate or volume) of treated water put into the water supply system.
- *Water right application*: application to obtain a water right permit to use water (see "water right permit" definition).
- *Water right permit*: authorization from OWRD to begin constructing a water system and begin using water. The permit comes with conditions for developing the water right, and OWRD cannot later revoke or change the permit.
- *Water right priority date*: establishes a water right holder's place in line during times of water shortage in a prior-appropriation system. The priority date is the determining factor when water rights are cut back or curtailed in times of shortage, regardless of the type of use of the permitted right.
- *Wholesale customer*: person, political subdivision, or municipality receiving potable water supply, but is not the ultimate consumer of the service.

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2. Municipal Water Supplier Description

This section satisfies the requirements of OAR 690-086-0140.

This rule requires descriptions of EWEB's water sources, water delivery area and population, water rights, and adequacy and reliability of the existing water supply. The rule also requires descriptions of EWEB's customers and their water use, the water system, interconnections with other water suppliers, and quantification of system leakage.

2.1 Water Sources

OAR 690-086-0140(1)

EWEB currently relies on a single source of water, the McKenzie River. The intake is just upstream of Hayden Bridge near the City of Springfield at approximately River Mile (RM) 14.1. Water is pumped from the intake to EWEB's WTP located about ¼ mile away, treated, and then delivered into the water distribution system.

EWEB has a groundwater permit (Permit G-16371) to appropriate groundwater in the vicinity of the confluence of the Willamette and McKenzie Rivers. This source is intended as a secondary/redundant supply, but to-date only two wells have been drilled. The wells do not have power, pumps, or distribution connections. EWEB is evaluating how to best use this water supply for redundancy in the system because of limitations on the authorized rate of appropriation and the "mitigation" requirements in the permit.

EWEB also has a surface water permit (S-54805) for use of the Willamette River. This permit would be duplicative of EWEB's surface water claim (SW-354) and would serve as a redundant supply. The permit also would provide source flexibility. EWEB has begun the process to develop this source of supply having purchased property to site the intake and WTP, and begun preliminary design and permitting activities.

2.2 Interconnections with Other Systems

OAR 690-086-0140(7)

EWEB has interconnections with two municipal water supply systems: SUB and RWD. Interties between the utilities are used to increase reliability of the water systems and to assist each utility when a supply issue arises, such as from drought. The EWEB and SUB/RWD systems have five interties (refer to **Exhibit 2-19**), with the most recent intertie connection constructed in 2010. The interties are bidirectional and located near major transmission mains or large-diameter distribution pipes of each utility that are in close proximity to each other. Minor pressure differences exist between the systems, such that four of the five interties will produce variation in customer pressures during their use; nonetheless, the interties will still function in times of emergency. One of the interties has a portable pump station with a design capacity of

2,500 gpm to deliver water from the EWEB system into the SUB/RWD system. This intertie also has bypass piping allowing water to flow by gravity back into the EWEB system.

2.3 Intergovernmental Agreements

OAR 690-086-0140(1)

EWEB provides water on a wholesale basis to the Santa Clara Water District, River Road Water District, WWC, and City of Veneta. Under existing water supply agreements between EWEB and these wholesale connections, the wholesale connections "redistribute" EWEB's water to their retail customers, which generally are located in unincorporated areas adjacent to the City of Eugene. All entities with wholesale connections will be required to maintain a WMCP in full compliance with OAR 690, Division 086 or to adopt EWEB's WMCP, as amended from time to time. The purpose of this requirement is to promote beneficial and efficient use of the wholesale water. EWEB also has an intergovernmental agreement with SUB and RWD to plan, design, construct, and operate water system interties for water exchanges between the utilities (**Appendix C**). A summary of all current intergovernmental agreements for wholesale water supply is in **Appendix C**.

EWEB has no exchange agreements or other water supply/delivery contracts. However, EWEB has been approached at various times by neighboring communities (the Cities of Coburg, Junction City, Harrisburg, Creswell, and Cottage Grove) about EWEB potentially serving as a future supplier to help the communities meet their water needs. Consequently, water supply agreements and contracts could be developed in the future.

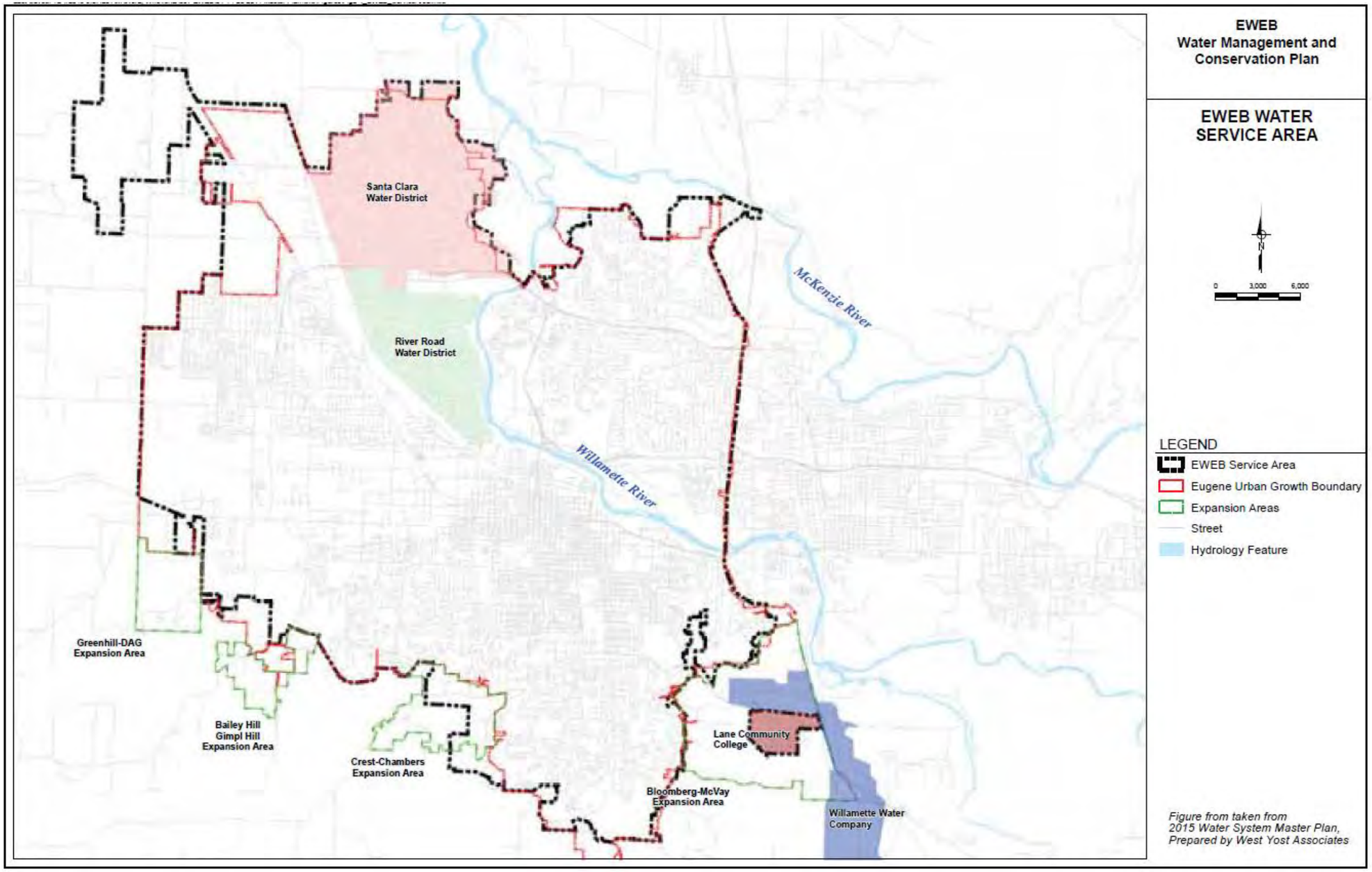
2.4 Current Water Delivery Area Description

OAR 690-086-0140(2)

Exhibit 2-1 is a current water delivery area map for EWEB. The water delivery area is generally bounded by Interstate 5 (I-5) on the east, the McKenzie and Willamette Rivers on the north, rural areas and farmland on the west, and forested hills on the south. The water delivery area includes the City of Eugene, dissolved Bethel Water District, dissolved Hillcrest Water District, dissolved Oakway Water District, Eugene Airport Special Service District, and Lane Community College Special Service District. EWEB also serves wholesale connections (Santa Clara Water District, River Road Water District, WWC, and City of Veneta) within and outside of the City of Eugene.

As of 2016, EWEB's system provided water to 63,840 accounts. These accounts serve residential customers, commercial/industrial customers, EWEB electric utility, and water districts. EWEB's estimated water delivery area population for 2016 was approximately 184,700. The water delivery area population was estimated using an annual estimate of the City of Eugene's population (within city limits) produced by Portland State University's Population Research Center (165,885) and then adding a population estimate for areas served by EWEB outside of the City of Eugene (18,818) as estimated in EWEB's 2015 Water Master Plan.

Exhibit 2-1. EWEB Water Delivery Areas



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2.5 Records of Water Use

OAR 690-086-0140(4) and (9)

Methodology

The International Water Association (IWA) and the American Water Works Association (AWWA) developed a water audit method that is widely recognized and used throughout the water industry.[2] This method defines and classifies annual water production and consumption as shown in **Exhibit 2-2.** Determination of the magnitude of the components of production and consumption helps utilities estimate how production, billing, and leak detection practices affect utility finances.

Exhibit 2-2. Components of the IWA/AWWA Water Balance, million gallons per year

A	B	C	D	E
System Input Volume = Production = System Demand (measured at Master Meters)	Authorized Consumption	Billed Authorized Consumption	Billed metered consumption (including water exported to another system). Billed unmetered consumption.	Revenue Water
		Unbilled Authorized Consumption	Unbilled metered consumption. Unbilled unmetered consumption.	Non-Revenue Water
	Water Losses	Apparent Losses	Unauthorized consumption. Metering inaccuracies. Data handling error.	
		Real Losses	Leakage from transmission and/or distribution mains. Leakage and overflows at storage tanks. Leakage from water delivery connections up to point of customer metering.	

Source: AWWA. Manual of Water Supply Practices M36. *Water Audits and Loss Control Programs, Third Edition*, 2009.

System input volume, also known as "production" and "demand," is the total quantity of water delivered to a distribution system (Exhibit 2-2). Sources of the delivered water may include WTPs, wells, or wholesale purchases from neighboring systems. The quantity of the water delivered generally is measured using large master meters located at key entry points into the distribution system. The system input volume must equal the sum of the authorized consumption and the water losses that occur in the system (Column B of Exhibit 2-2).

Authorized consumption is divided into billed and unbilled categories, where billed authorized consumption is revenue water and unbilled authorized consumption contributes to a system's non-revenue water. Authorized consumption may be either metered or unmetered. Unmetered volumes must be estimated on the basis of estimated flow rates and durations of flow. Authorized billed consumption may include metered consumption for use by residential, municipal, commercial, industrial, and irrigation customers, as well as wholesale water

[2] AWWA. Manual of Water Supply Practices M36. *Water Audits and Loss Control Programs, Third Edition*, 2009.

connections. Authorized unbilled consumption may include public uses for firefighting or hydrant flushing.

Water losses are composed of both apparent losses and real losses. Apparent losses result from meter inaccuracies, error introduced by data entry or manipulation, and unauthorized consumption, such as illegal connection to the system or unauthorized use of a fire hydrant. Real losses result from water loss caused by leakage, reservoir overflow, and evaporation. All water systems have some degree of real losses. OWRD's Water Management and Conservation Planning administrative rules set a goal for municipal systems to have "system leakage" (real losses) equal to or less than 15 percent of total system input or demand, and if feasible, less than 10 percent.

Demands and consumption in municipal systems generally are reported in units of mgd, but they may be reported in cfs or gpm, as well. Annual or monthly water quantities generally are reported in MG. Water use per person (per capita use) is reported in gpcd.

The following terms are used to describe specific values of system demands: ADD, MDD, 3-day MDD, MMD, and peaking factors. They are defined at the end of Section 1.

Historical Water Demands

Exhibit 2-3 summarizes demand, or production of finished water, for the overall system by EWEB customers.

Exhibit 2-3. Historical Average Day, Maximum Day, 3-day Maximum Day, Maximum Monthly Demands, and Peaking Factor

Year	Annual Volume Produced (MG)	ADD (mgd)	MDD (mgd)	3-d MDD (mgd)	3-d MDD Percentage of MDD (%)	MMD (mgd)	MMD (MG)	Peaking Factor MDD:ADD
2010	8,381	23.0	53.5	51.5	96.3	45.7	1,418	2.33
2011	8,093	22.2	51.4	43.7	85.1	40.7	1,261	2.32
2012	8,437	23.1	49.2	47.7	97.0	41.2	1,277	2.06
2013	8,683	23.8	49.6	48.5	97.8	43.6	1,350	2.04
2014	8,960	24.5	48.0	46.0	95.9	41.5	1,286	1.96
2015	9,182	25.2	52.0	50.6	97.3	44.3	1,373	2.01
2016	8,948	24.5	49.6	47.3	95.4	43.3	1,342	2.02
Average	8,669	23.8	50.5	47.9	95.0	42.9	1,330	2.11
Highest	9,182	25.2	53.5	51.5	97.8	45.7	1,418	2.33

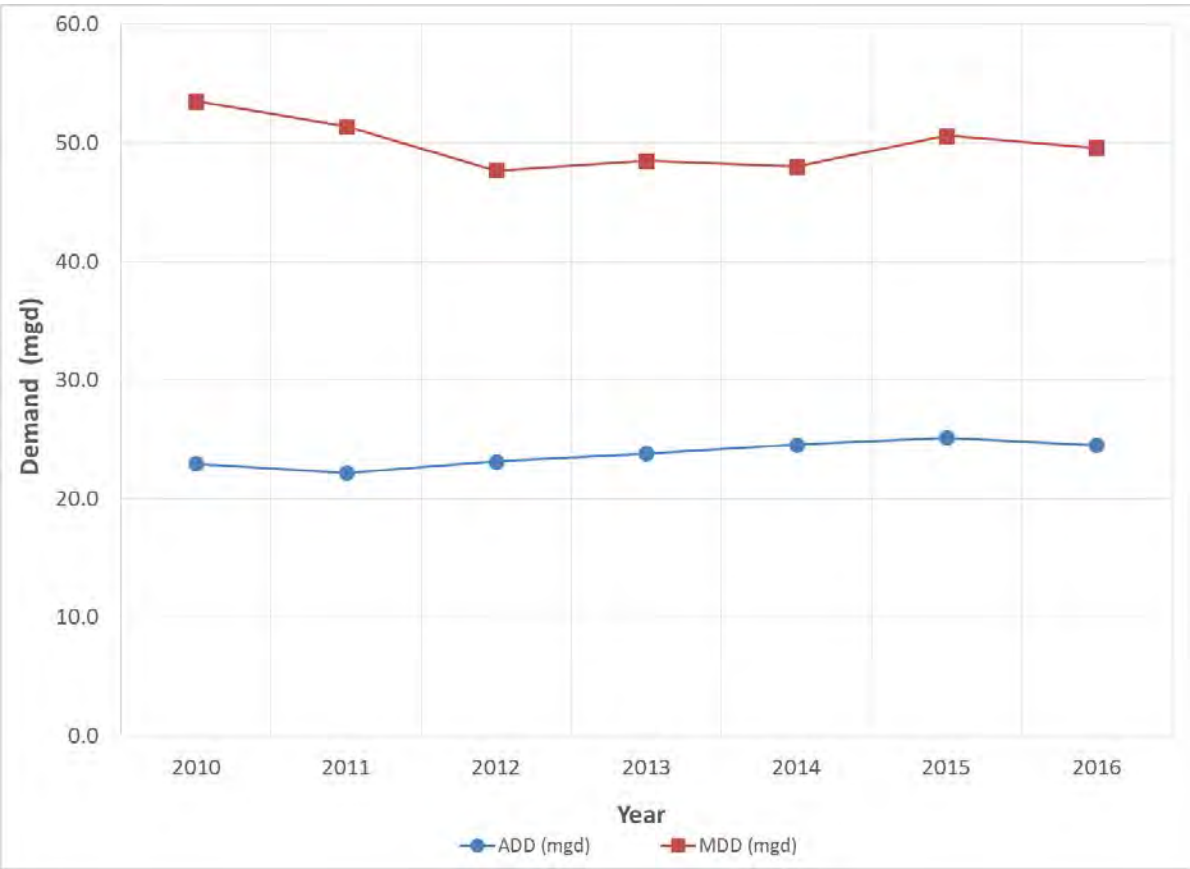
From 2010-2016, EWEB's ADD ranged from 22.2 to 25.2 mgd, and the average ADD was 23.8 mgd. During the same period, the MDD ranged from 48.0 to 53.5 mgd, and the average MDD was 49.9 mgd.

The 3-day MDD, which gives an indication of the duration of periods of maximum demand, ranged from 43.7 to 51.5 mgd and averaged approximately 95.0 percent of the MDD. This means that if the MDD equals 50.0 mgd, EWEB can be expected to experience 3 consecutive days with an average demand of approximately 47.5 mgd each day (95.0 percent of 50 mgd).

MDD is strongly influenced by weather patterns and the economy. Weather patterns often cause fluctuations in MDD from year to year. Weather patterns that influence MDD include: maximum temperatures, the number of consecutive days with high temperatures, when high temperatures occur in the summer, overall rainfall levels during the summer, and consecutive days without rainfall. Unusually hot and/or dry weather results in more outdoor irrigation, which increases the MDD. The economy can affect MDD, as well. Customers may choose to irrigate less to save money during an economic downturn. The economy also influences the number of new homes with landscapes needing intense irrigation for plant establishment and the opening or closing of industries that use water in their operations.

Exhibit 2-4 illustrates the ADD and MDD for EWEB for 2010 through 2016. From 2010 through 2016, ADD increased moderately, with a slight decrease in 2016. The highest recorded MDD was 53.5 mgd (82.7 cfs) in 2010. From 2010 through 2016, MDD had a moderate decreasing trend. These decreasing trends likely reflect benefits from EWEB's water conservation program, including the leak detection program and customer responses from the Green Grass Gauge program and education about outdoor water use. No major commercial/industrial water users changed during this period, which is reflected in the relatively stable (and slightly decreasing) water use trends.

Exhibit 2-4. Historical Average Day Demand (ADD) and Maximum Day Demand (MDD), 2010-2016



Monthly Demand

Exhibit 2-5 shows the MMD volume for 2010 through 2016. During this period, the highest recorded MMD volume was 1,418 MG in 2010. The MMD volume remained relatively steady during this period with an average MMD of 1,330 MG. The MMD always occurred in July or August during this period.

Exhibit 2-5. Historical Maximum Month Demand Volume (MG), 2010-2016

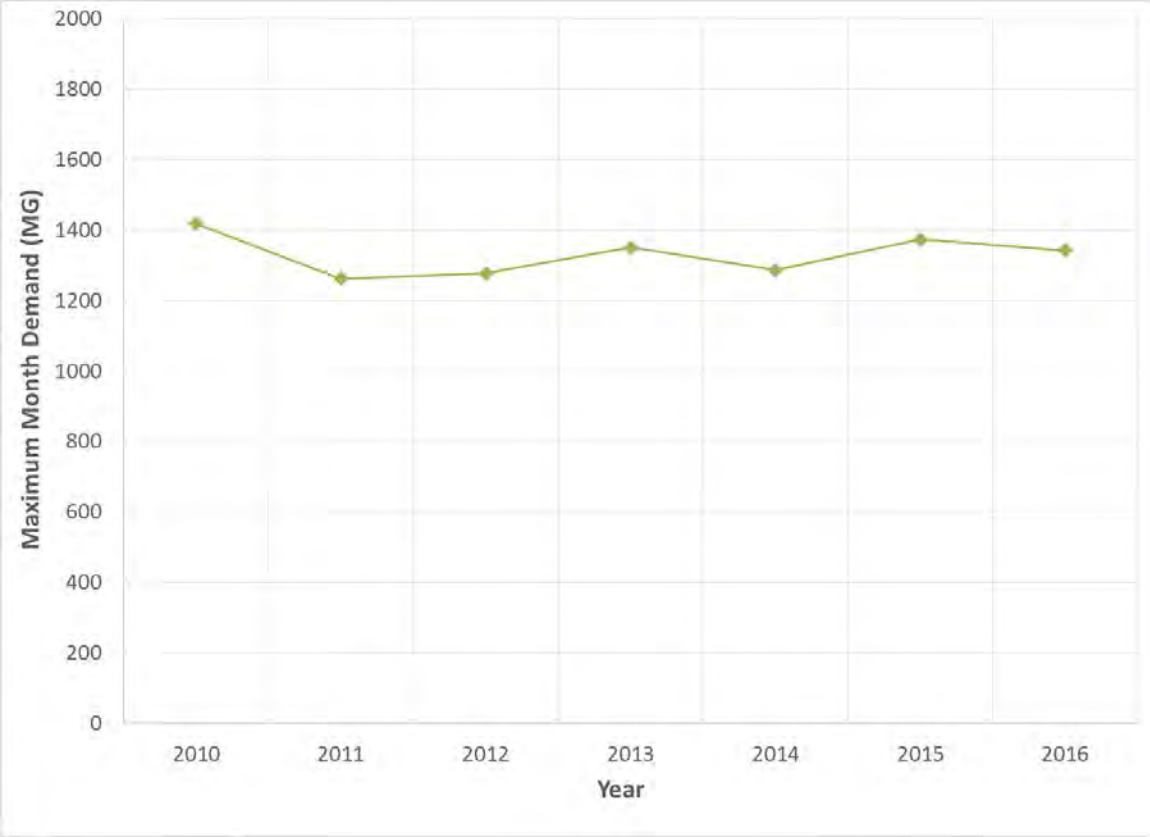
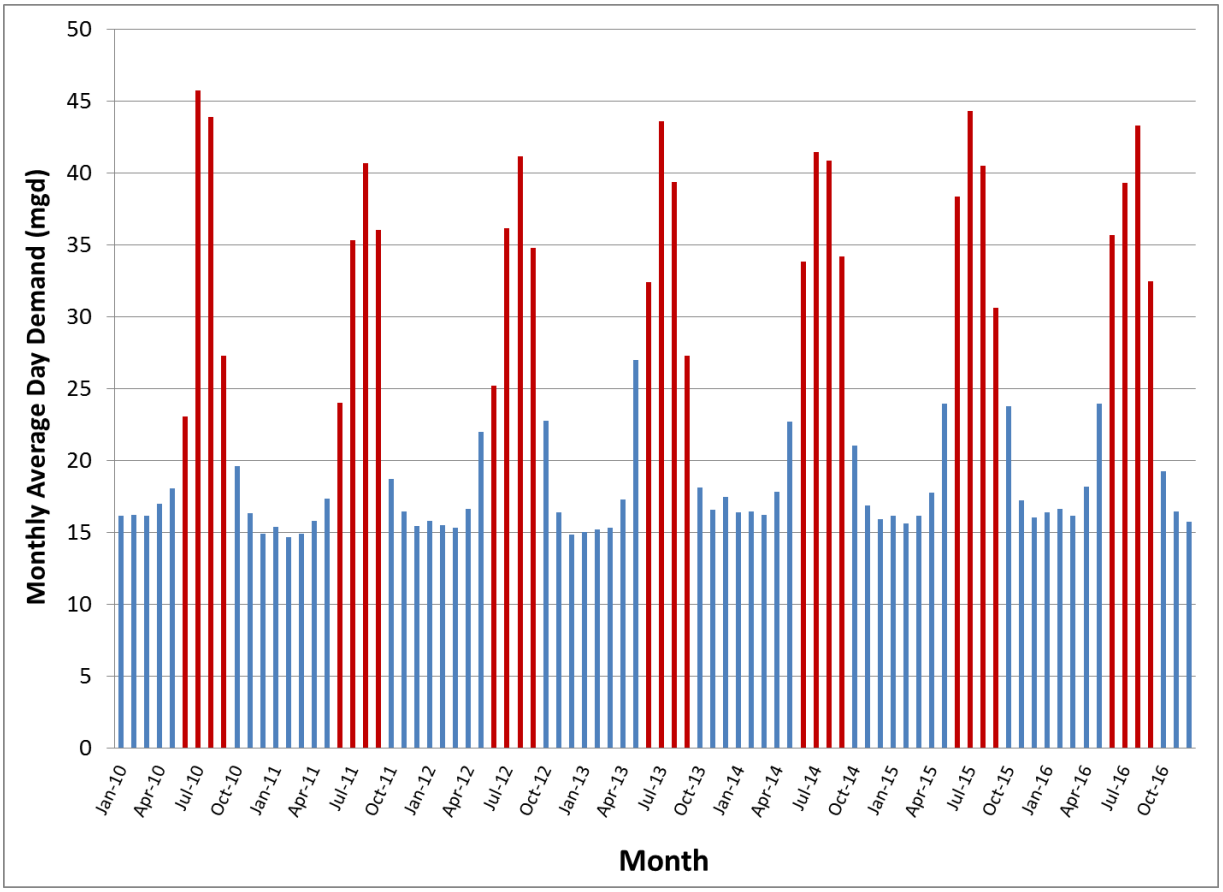


Exhibit 2-6 shows the monthly demand data expressed as ADD for the month, with the peak season months of June through September in red, from 2010 through 2016. During this period, the highest monthly ADD recorded was 45.7 mgd in 2010, as shown in **Exhibits 2-3 and 2-6**. **Exhibit 2-6** highlights the seasonal change in demand that EWEB experienced and the months with the greatest demand, July and August. Consequently, these months have been and continue to be the focus of water conservation efforts.

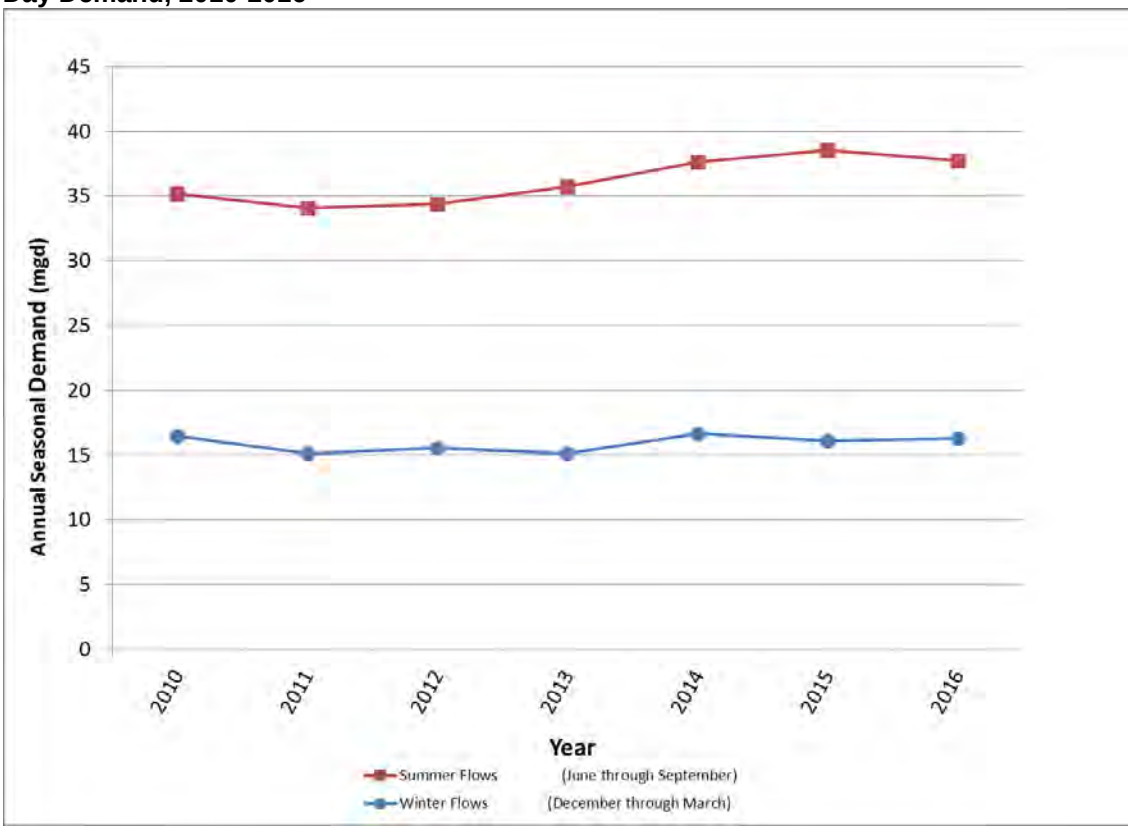
Exhibit 2-6. Historical Monthly Average Day Demand (mgd), 2010-2016



Seasonal Demand

As typical for western Oregon utilities, EWEB's demands show a marked increase during the summer months because of outdoor irrigation. **Exhibit 2-7** illustrates the summer period (defined as June through September) and winter period (December through March) ADDs for 2010 through the summer season of 2016.

Exhibit 2-7. Historical Summer (June-September) and Winter (December-March) Average Day Demand, 2010-2016



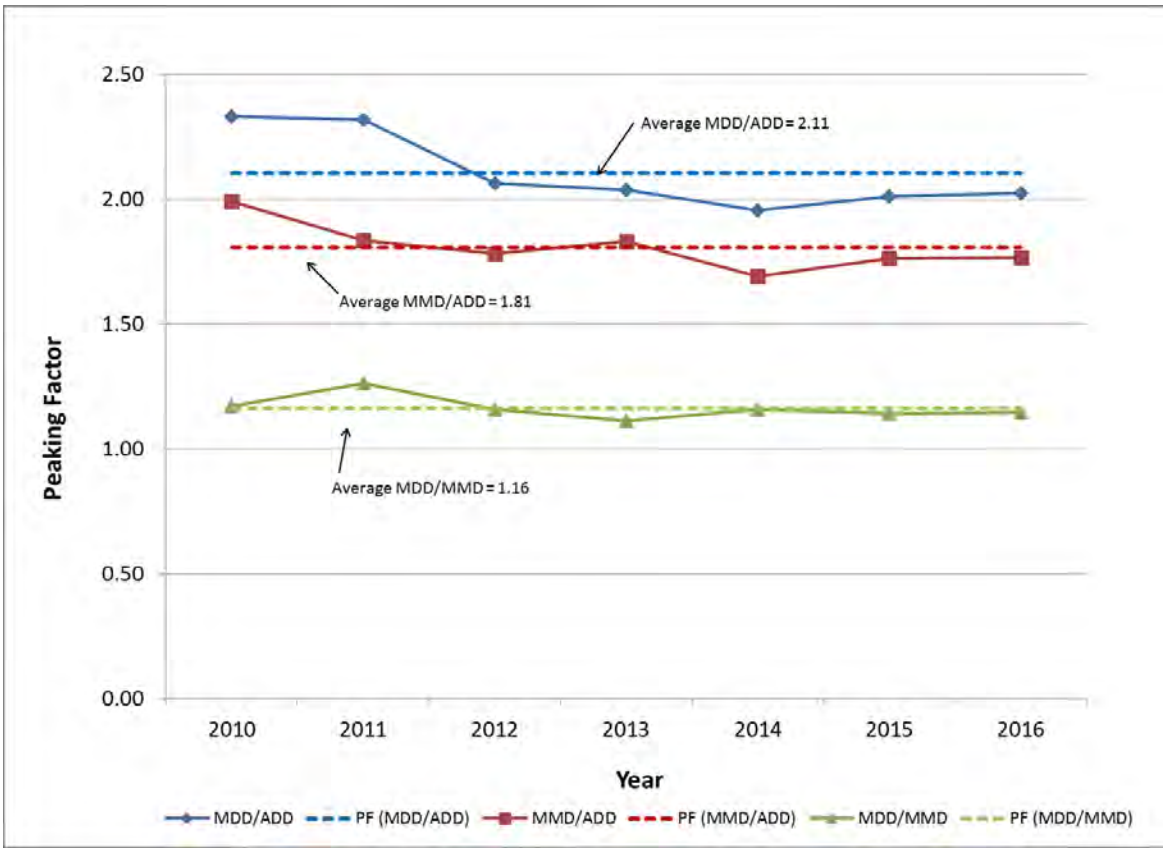
From 2010 through 2016, the summer ADD ranged from 34.1 mgd in 2011 to 38.5 mgd in 2015, and winter ADD ranged from 15.0 mgd in 2011 and 2013 to 16.7 mgd in 2014. During this period, the summer ADD averaged 2.28 times the winter ADD. There was a slightly increasing trend in the summer season ADD, while the winter ADD remained relatively flat.

Monthly volume demand data from 2010 through 2016 reveal that the 4 summer months (June-September) accounted for an average of 51 percent of EWEB's annual demand. Winter demand (December-March) accounted for 22 percent of the annual demand. The shoulder seasons (April through May and October through November) accounted for the remainder of the annual demand.

Peaking Factors

Peaking factors are the following ratios MDD:ADD, MMD:ADD, and MDD:MMD. Peaking factors are useful for estimating peak demands when only ADDs or MMDs are known or measured, as well as for hydraulic modeling of the system and for demand forecasting. **Exhibit 2-8** illustrates the peaking factors of MDD:ADD, MMD:ADD, and MDD:MMD from 2010 through 2016.

Exhibit 2-8. Historical Peaking Factors, 2010-2016



From 2010 through 2016, EWEB's average MDD/ADD peaking factor was 2.1, which is typical for Willamette Valley water utilities.

Per Capita Demand

Exhibit 2-9 shows the estimated average day per capita demands from 2010 through 2016. As previously described, the water delivery area population was estimated using an annual estimate of the City of Eugene's population (within city limits) produced by Portland State University's Population Research Center and then adding a population estimate for areas served by EWEB outside of the City of Eugene and within the UGB consistent with the value used in the 2015 Water Master Plan.

Exhibit 2-9. Historical Per Capita Demand (gpcd), 2010-2016

Year	ADD (mgd)	Estimated Water Delivery Population	Average Day per Capita Demand (gpcd)
2010	23.0	175,113	131
2011	22.2	175,828	126
2012	23.1	177,153	131
2013	23.8	178,398	133
2014	24.5	179,593	137
2015	25.2	182,218	138
2016	24.5	184,703	133
Average	23.8		133

Notes:
ADD = average day demand
mgd = million gallons per day
gpcd = gallons per capital per day

Per capita demand includes all use by commercial/industrial customers, water districts, and the electric utility, as well as residential customers. As a result, the calculated per capita demand values exceed the amounts of water actually used by a typical individual. In addition, per capita demand may not accurately portray year-to-year water use because the calculation does not account for the difference in customer demographics, climate, rainfall, and current economic conditions. The calculation also does not account for specifics, such as changes in hotel occupancy or in large commercial/industrial uses, which may not have any relationship to population or actual efficiency of use. Nevertheless, per capita demands may show year-to-year trends and often are used to compare customers' water use to that of other communities.

As described in **Exhibit 2-9**, EWEB's average day per capita demand, averaged from 2010 through 2016, was 133 gpcd. This is lower than the City of Corvallis (144 gpcd, *Corvallis 2010 Water Use and Water Conservation Project*) and the City of Lake Oswego (171 gpcd; Lake Oswego WMCP, 2010). It is also lower than several Joint Water Commission (JWC) members (JWC WMCP, 2010). For example, City of Beaverton per capita demand is 120 gpcd; City of Forest Grove is 150 gpcd, and City of Hillsboro is 170 gpcd. During the last decade, EWEB's average day per capita demand decreased from 189 gpcd in 2000 to 144 gpcd in 2009. The period from 2006 to 2009 showed the most significant decrease.

Authorized Consumption

Authorized consumption is equal to the metered and certain unmetered water uses within the system. All customers served by EWEB are metered and EWEB requires its wholesale connections, such as water districts, to fully meter all of their customers, as well. All known authorized water consumption is metered.

2.6 Customer Characteristics and Water Use Patterns
OAR 690-086-0140(6)

EWEB has three metered customer categories: residential, general services (includes commercial/industrial and electric utility), and water districts. EWEB changed the customer categories in its database as part of its migration to a new database for the customer information system. For the following comparisons of customer water use patterns, the general service category generally corresponds with the commercial/industrial and electric utility categories reported in the 2012 WMCP.

Exhibit 2-10 shows the number of accounts by customer category for 2010 through 2016. Residential accounts and general services account numbers have been steadily increasing over time. The number of accounts in Exhibit 2-10 does not include the two wholesale accounts: WWC and City of Veneta.

Exhibit 2-10. EWEB Number of Retail Accounts by Customer Category, 2010 through 2016

	2010	2011	2012	2013	2014	2015	2016
Residential	49,924	50,797	51,330	51,579	51,576	51,833	51,756
General Services	3,309	3,317	3,350	3,416	3,429	3,445	3,446
River Road Water District	3,435	3,444	3,428	3,479	3,472	3,447	3,470
Santa Clara Water District	5,089	5,065	5,211	5,184	5,188	5,170	5,169
Total	61,757	62,623	63,319	63,658	63,665	63,895	63,841

The annual metered consumption by customer category for 2010 through 2016 is shown in **Exhibit 2-11.** Annual residential water consumption ranged from 3,719 MG in 2011 to 4,057 MG in 2015. General services water consumption ranged from 2,588 MG in 2011 to 3,499 MG in 2015 and 2016 during this period. During the same period, annual water district water consumption ranged from 977 MG in 2015 to 1,022 MG in 2010. Wholesale water use outside the service area ranged from 28 MG in 2011 to 149 MG in 2015.

The residential water consumption reported between 2000 and 2009 in the 2012 WMCP ranged from 4,087 MG to 4,576, while the combined water consumption for commercial/industrial category ranged from 3,659 MG to 4,769 MG. These values fluctuated over the 2000 to 2009 period with a generally decreasing trend from 2006 to 2009. Overall, the average water consumption for the residential and general services (commercial/industrial) customer categories are lower in the 2010 to 2016 period compared to the period from 2000 to 2009.

The water district category water consumption fluctuated between 744 MG to 1,102 GM from 2000 to 2009, as reported in the 2012 WMCP. There was a slight decreasing trend from 2000 to 2009, but the period from 2010 to 2016 showed increased volumes consistently around 1,000 MG.

Exhibit 2-11. EWEB Annual Retail Metered Consumption by Customer Category (MG), 2010-2016

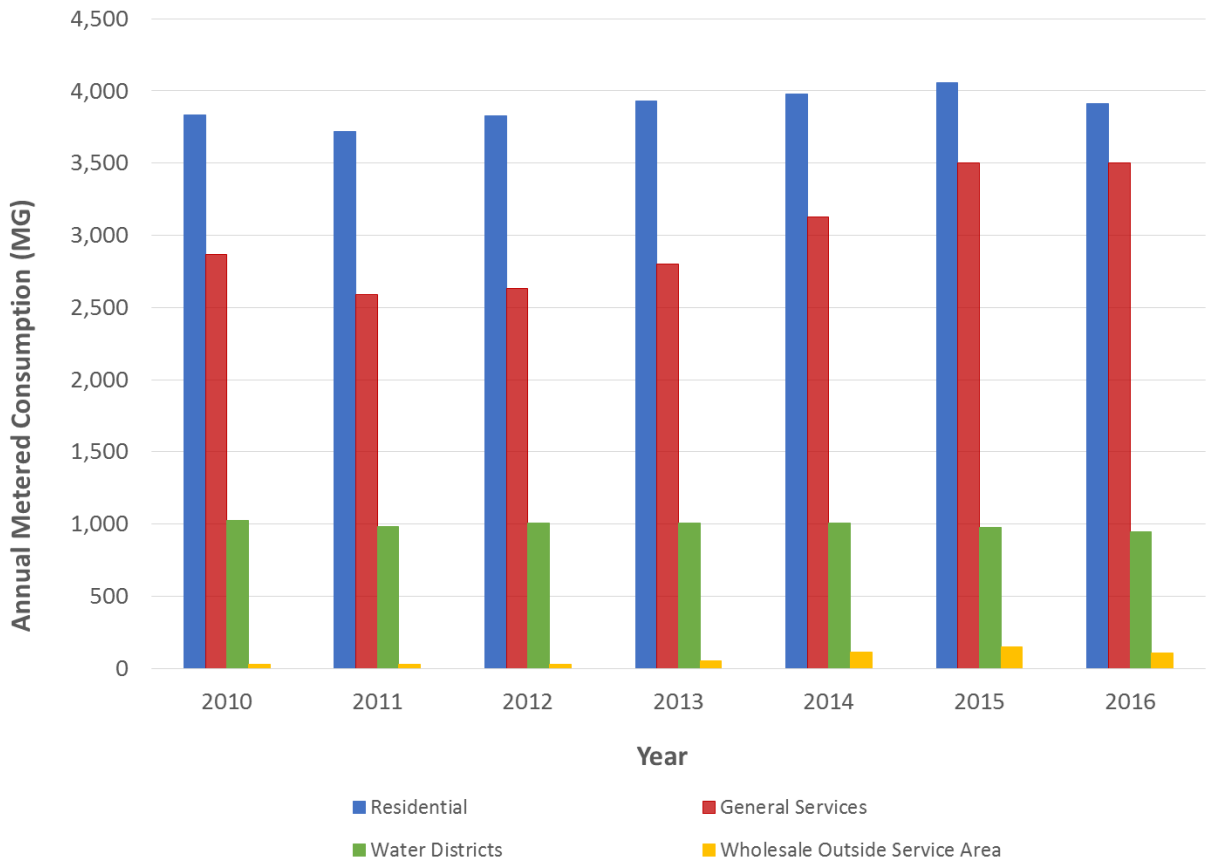
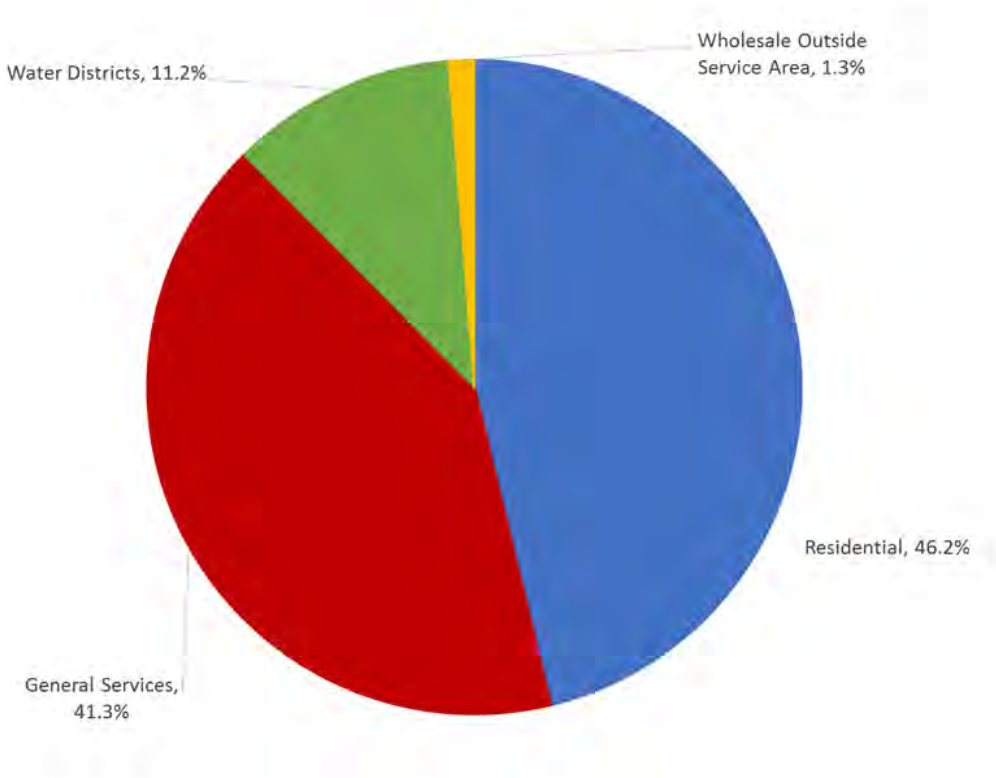


Exhibit 2-12 presents a pie chart that shows the percentage of water used by each customer category in 2016, as well as wholesale water use. Residential water use represented 44 percent and general services water use represented 39 percent of total metered retail consumption. Water districts water use and wholesale water use outside the service area (WWC and City Veneta) accounted for 11 percent and 1 percent of annual metered consumption, respectively. These percentages indicate that the greatest potential conservation opportunities are for EWEB's residential and commercial/industrial water users.

Exhibit 2-12. Percentage of Annual Water Use by Retail Customer Category, 2016



Largest Water Users

Exhibit 2-13 lists EWEB's top 10 water consumers for 2016, identified by their customer type. This list excludes wholesale connections. These 10 customers were responsible for approximately 11.1 percent of the total 2016 metered consumption of 8,464 MG. Water conservation efforts targeted at these customers potentially could result in significant water savings. EWEB also tracks water use by its residential customers and targets the top 10 percent residential water users in its water conservation efforts.

Exhibit 2-13. EWEB Largest Water System Accounts, 2016

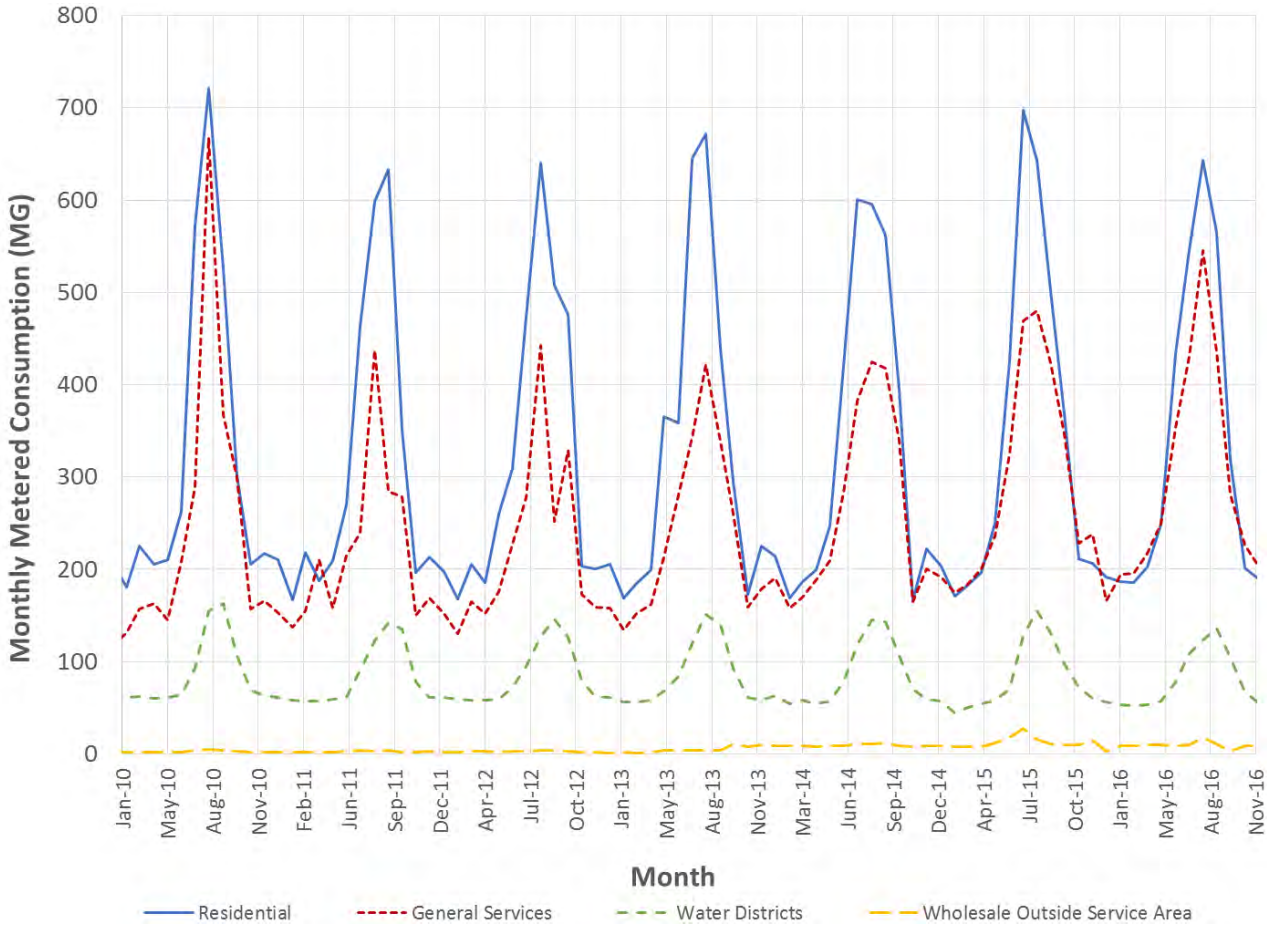
Customer Name	Annual Volume (MG)	Percent of Annual Volume
University of Oregon	287.1	3.4
City of Eugene Split	207.6	2.5
Lane County	105.9	1.3
School Dist 4J Dept	81.8	1.0
Flakeboard America Limited	66.0	0.8
Bethel School Dist #52	45.3	0.5
Lane Events Center	39.5	0.5
Shepard Investment Group LLC	36.3	0.4
Chase Village LLC	33.5	0.4
Oregon Ice Cream LLC	33.1	0.4
Total	936.1	11.1

Notes:
MG = million gallons

Monthly Water Use

Exhibit 2-14 shows the estimated monthly retail consumption by customer category for 2010 through 2016. As expected, consumption increases in the summer months were caused by increased outdoor irrigation, which occurred annually. The highest monthly consumption by category was: 721 MG in August 2010 for residential, 668 MG in August 2010 for general services, and 163 MG in August 2010 for water districts.

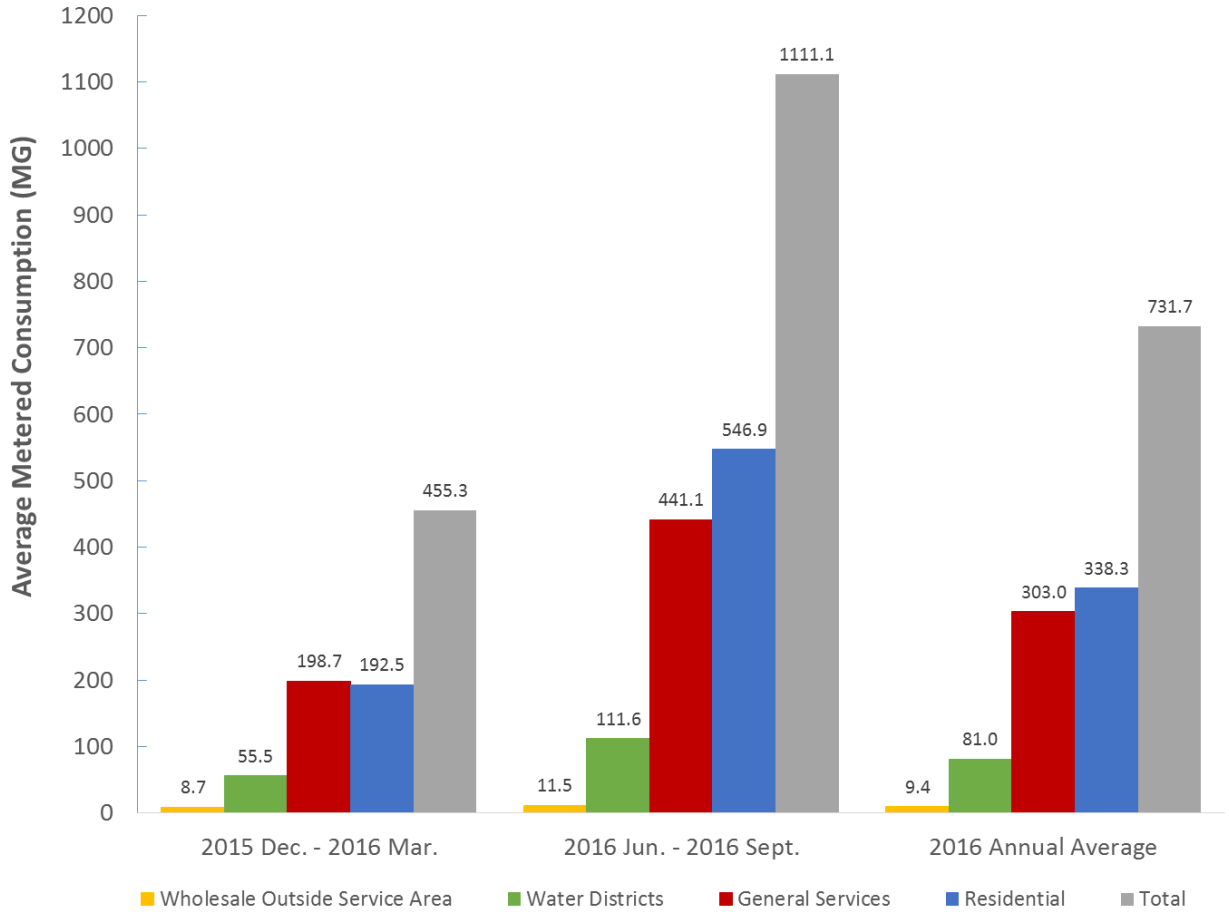
Exhibit 2-14. EWEB Monthly Metered Consumption by Customer Category, 2010-2016



Seasonal Water Use

Exhibit 2-15 presents the average monthly consumption by season and customer category for 2016. For the purposes of this Plan, the summer months are defined as June through September, and winter months are defined as December through March. EWEB's summer season use to winter season use ratio of 2.44 (1,111/455 = 2.44) is typical for Willamette Valley water utilities.

Exhibit 2-15. EWEB Average Monthly Consumption by Season and Customer Category, 2016



To understand current (2016) seasonal differences in consumption for each customer type, average monthly consumption in the summer and winter seasons were compared. Residential and water district consumption are considered together because the water district accounts are largely single-unit residential customers. Together, residential and water district water consumption was 659 MG in the summer season and 248 MG in the winter season, such that summer season consumption was approximately 2.66 times greater than the winter season consumption. General services water consumption was 441 MG in the summer season and 199 MG in the winter season, such that summer season consumption was approximately 2.22 times greater than the winter season consumption.

Indoor and Outdoor Water Use

Estimating indoor and outdoor water use by customers may provide information that can help EWEB target its water conservation efforts. The analysis below focuses on the largest customer categories: residential and general services. To estimate the amount of indoor versus outdoor water use for customer categories, water use in the winter months was assumed to be representative of annual indoor water use.

Again, because the water district customers are largely residential, the 2016 winter residential and water district monthly average consumption of 248 MG was multiplied by a 12-month period to determine the average annual residential (and water district) indoor use of 2,976 MG. The average outdoor use was determined to be 1,884 MG by subtracting the average annual indoor use from the total annual use in 2016 (4,859 MG). Based on this analysis, indoor water use represented approximately 61 percent of annual residential water use and outdoor water use represented approximately 39 percent of annual residential water use, a large percentage considering that this use occurred primarily in the (4) summer months.

These percentages indicate that water conservation efforts aimed at indoor uses year-round and aimed at outdoor uses during summer months could yield substantial savings.

Residential Per Capita Demand

Residential per capita demand offers another measure of water use by residential customers that can be used for comparisons to other communities and for developing water conservation strategies. EWEB's residential per capita demand is 72 gpcd, which was estimated by dividing the metered residential and water district consumption for 2016 (4,859 MG) by the in-city population in 2016 (184,703) and then dividing by 365 days. This demand figure includes the population served in multifamily units, but does not include consumption by both single- and multifamily units. This demand figure does not include the population served by EWEB's wholesale connections to WWC and the City of Veneta. This estimated residential per capita demand for EWEB of 72 gpcd falls within the range of other water providers in the Willamette Valley.

2.7 Water Losses and Non-Revenue Water

EWEB compared system demand data with consumption data to develop a value for non-revenue water, or water losses, which is calculated here as the difference between production of finished water and metered use. EWEB tracks water used for main flushing, but non-revenue water values have not been adjusted by subtracting this amount. The percentage of non-revenue water equals the production of finished water minus the metered use, divided by the production of finished water.

Exhibit 2-16 lists annual total production of finished water and total consumption, and illustrates the non-revenue water quantity and percentage for 2010 through 2016. The percent of non-revenue water has ranged from 11.2 to 5.4 percent with an average of 8.2 percent during the 7-year period. However, the non-revenue water has been less than 6 percent in the most recent 2 years.

Exhibit 2-16. Historical Non-Revenue Water

Year	Total Production (MG)	Total Consumption (MG)	Non-Revenue Water (MG)	Non-Revenue Water (%)
2010	8,381	7,756	625	7.5
2011	8,093	7,316	777	9.6
2012	8,439	7,495	944	11.2
2013	8,683	7,793	890	10.3
2014	8,960	8,224	736	8.2
2015	9,182	8,681	500	5.4
2016	8,948	8,464	483	5.4
Average			708	8.2

Notes:
MG = million gallons

The general causes of non-revenue water may include meter inaccuracies, evaporation, reservoir overflows, unmetered hydrant use, leakage, and unauthorized, unbilled use of fire lines.

In the past, when EWEB discovered individuals with unauthorized, unmetered connections, EWEB estimated the water loss that occurred and the information was tracked in the Customer Inquiry Database. Since 2014, EWEB estimates leak volumes in its asset management software (Oracle WAM). EWEB no longer tracks individuals with unauthorized and unmetered connections.

EWEB does not have authorized unbilled water use, except for hydrant flushing, so EWEB's non-revenue water is nearly equal to its system losses. EWEB estimates hydrant use to address this minor discrepancy. EWEB is not aware of any significant losses caused by leaks. EWEB conducts a leak detection program and repairs or replaces sections of pipeline as necessary.

2.8 EWEB Water Rights

OAR 690-086-0140(5)

EWEB holds three surface water rights that authorize the use of water from the McKenzie River for municipal purposes. These water rights allow withdrawal of up to 300.08 cfs (194 mgd) from the McKenzie River. All of EWEB's McKenzie River water rights have a point of diversion located at approximately RM 14.1 in SW ¼ SW ¼, Section 20, Township 17 South, Range 2 West, W. M. In addition, EWEB has a surface water registration (SW-354) for municipal use of water from the Willamette River and Permit G-16371 for municipal use of groundwater at the Confluence Wellfield.

EWEB's most senior water right is Certificate 15180, which authorizes the use of up to 27.08 cfs (17.5 mgd) from the McKenzie River for municipal use. The priority date of this water right is May 16, 1925.

EWEB also holds water right Certificate 68537, which authorizes the use of up to 90.0 cfs (58.2 mgd) from the McKenzie River for municipal use. The priority date of this water right is October 15, 1946.

Further, EWEB holds water use Permit S-27441 with priority date of June 14, 1961, which authorized the use of up to 183.0 cfs (118.3 mgd) from the McKenzie River for municipal use. OWRD issued a final order on January 2, 2015, approving an extension of time to develop Permit S-27441 until October 1, 2083, and included a development limitation of 4.82 cfs for Permit S-27441. This developed 4.82 cfs portion of the permit is not subject to fish persistence flow conditions. Preparation of this WMCP was also a requirement of that final order.

In addition to its McKenzie River water rights, EWEB holds a surface water registration, which is a claim for the use of Willamette River water that was initiated before enactment of Oregon's water code in 1909. In 1987, the Oregon legislature enacted a registration process for recording claims of water in unadjudicated areas. EWEB registered its Willamette River claim for 30.9 cfs under this mandate. According to surface water registration SW-354, water from the Willamette River was first used under this right on March 26, 1887, for municipal purposes. OWRD must conduct an adjudication of the claim and the circuit court must issue a decree before OWRD can issue a water right certificate confirming the water use claimed in this registration. An adjudication for the Upper Willamette Basin has not yet been initiated and OWRD anticipates it may be many years before one starts. Meanwhile, SW-354 provides EWEB with the authorization to use up to 30.9 cfs for municipal use.

OWRD received hundreds of claims for water rights in unadjudicated areas, one of which was Portland General Electric (PGE) for a claim, with a priority date of June 3, 1889, of 11,754 cfs from the Willamette River at Willamette Falls. Flow data for the Willamette River shows that during low flow periods in the summer, the entire river flow is often less than PGE's claim. In 1993, House Bill 2110 was passed by the state legislature to protect municipalities that could be impacted by PGE's claim.

To increase the level of certainty for its authorization to use Willamette River water in light of the PGE claim and others from the Willamette River, EWEB applied for a surface water permit (Application S-87675) on December 27, 2010, that reflected the authorization provided by EWEB's existing surface water registration. On February 28, 2013, OWRD issued Permit S-54805, which authorizes the use of up to 30.9 cfs (approximately 20 mgd) from the Willamette River for municipal use. Permit S-54805 stipulates that water under this permit or subsequent certificates, in combination with surface water registration SW-354 or any subsequent related decreed right, will not exceed 30.9 cfs. Furthermore, Permit S-54805 maintains EWEB's previous total combined maximum authorized rate under all of its water rights at 300.08 cfs and stipulates that use is allowed only when flows of 2,500 cfs in November through May and 2,000 cfs in June through October are met below the confluence of the Coast Fork and Middle Fork of the Willamette River. Permit S-54805 has a priority date of January 3, 2011, and a development deadline of February 28, 2033 (20 years from date of permit issuance).

In March 2014, EWEB submitted a request to modify its surface water registration SW-354 by adding an upstream point of diversion. The modification was granted provided that EWEB dedicate a 1.5 cfs portion of SW-354 instream. Based on this transaction, the municipal use portion of SW-354 has been reduced to approximately 29.4 cfs (approximately 19 mgd).

EWEB holds a permit for the use of groundwater for municipal use in addition to its surface water rights for municipal use. Permit G-16371 authorizes the use of up to 18.49 cfs (12.0 mgd) of groundwater from 12 wells. This use is further limited to a maximum cumulative rate of 4.998 cfs from Wells 1, 4, 7, 9, 10, 11, and 12, with each well limited to 2.5 cfs; and a maximum cumulative rate of 13.49 cfs from Wells 2, 3, 5, 6, and 8, with each well limited to 2.698 cfs. Further, use of water under this groundwater permit, in combination with EWEB's surface water permit and certificates, is limited to a total of 300.08 cfs. Permit G-16371 has a priority date of December 20, 2002, and a development deadline of August 13, 2028.

In addition to its municipal water rights, EWEB holds Certificate 45670 for non-consumptive industrial use (condenser cooling for steam turbine condensers). This right has an August 23, 1973, priority date and authorizes the use of up to 128.0 cfs from the Willamette River.

EWEB's remaining water rights are for hydroelectric power generation and those water rights are managed by EWEB's electric utility. Although the two utilities are operated by EWEB, the electric utility and water utility are separate entities with separate management. The electric utility operates different points of diversion and has a completely separate system of conveyance from the water utility. Consequently, the water rights for hydroelectric power generation are not considered in this Plan.

Exhibit 2-17 provides a description of EWEB's municipal and industrial rights and their status.

The values shown for historical withdrawals associated with each of EWEB's McKenzie River water rights were derived using the following method. This is consistent with EWEB's method for submitting their annual water use report to OWRD. EWEB has a single meter to measure water diverted from its McKenzie River intake. The measured flow is allocated to maximize the instantaneous flow rate allowed under it senior water right (Cert. 15180). This rate is 17.5 mgd or 6,388 MG annually. The remainder of the measured flow is then allocated to its next junior water right (Cert. 68537), which has an instantaneous flow rate of 58.2 mgd or 21,243 MG annually. Permit S-27441 is used to meet peak demands when the combined instantaneous flow rates for the certificated water rights are exceeded.

EWEB's maximum withdrawal from the McKenzie River associated with these water rights occurred in year 2000 when a total volume of 12,017 MG was withdrawn. Based on this method, 6,388 MG was allocated to Cert. 15180 and 5,629 MG was allocated to Cert. 68537. From the total measured volume diverted, the same method is used to derive the year 2016 and five-year average withdrawal volumes shown in Exhibit 2-17.

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Exhibit 2-17. EWEB Municipal and Industrial Water Rights

Application	Permit	Certificate	Transfer	Claim	Source	Priority Date	Type of Beneficial Use	Authorized Date for Completion	Quantity (cfs)	Quantity (mgd)	Maximum Withdrawal To Date		2016 Average Withdrawal		Five-Year Average Withdrawal (2012-2016)
											Instant (cfs)	Annually (MG)[4]	Monthly (MG)	Daily (MG)	Monthly (MG)
S-10168	S-8602	15180			McKenzie River	5/16/1925	Municipal	N/A	27.08	17.5	27.08	6,388	532.4	17.5	532.4
S-22037	S-17358	68537			McKenzie River, tributary to the Willamette River	10/15/1946	Municipal	N/A	90	58.2	90.0	5,629	272.7	9.0	267.1
S-35037	S-27441				McKenzie River	6/14/1961	Municipal	10/1/2083	183 (original); currently limited to 4.82[1]	118.3	4.82	3.11[5]	0	0	0
				SW 354[2]	Willamette River, tributary to Columbia River	3/26/1887	Municipal	N/A	29.4	20	0	0	0	0	0
G-15857	G-16371[3]		T-11164		Well 1, Well 2, Well 3 (LANE 61477), Well 4 (LANE 61476), Well 5, Well 6, Well 7, Well 8, Well 9, Well 10, Well 11, and Well 12 in the McKenzie and Willamette River Basins	12/20/2002	Municipal	8/13/2028	18.49 (cumulative rate no more than 4.998 cfs from Wells 1,4,7,9,10,11, and 12, and max rate of 2.5 cfs for each well; cumulative rate no more than 13.49 cfs from Wells 2,3,5,6, and 8, and max rate of 2.698 cfs for each well)	12.0	0	0	0	0	0
S-51130	S-39122	45670			Willamette River, tributary to Columbia River	8/23/1973	Condenser cooling for three steam turbine condensers operating electric generators	N/A	128	82.7	128	0	0	0	0
S-87675	S-54805				Willamette River, tributary to Columbia River	1/3/2011	Municipal	2/28/2033	30.9	20	0	0	0	0	0

Notes:
[1]Original permit authorized instantaneous use of up to 183 cfs; however, the permit extension final order included a development limitation up to 4.82 cfs, which is not subject to fish persistence conditions.
[2]Claim SW-354 modified to add an upstream point of diversion provided EWEB dedicate instream 1.5 cfs of the original 30.9 cfs authorized rate.

Notes:
[3]Permit G-16371 has been modified by Permit Amendment Application T-11164 (approved by Special Order Volume 83, Pg. 1070 on April 25, 2011)
[4] Maximum annual withdrawal to date for Certificates 15180 and 68537 and Permit 27441 occurred in the year 2000.
[5] The maximum annual volume allocated to Permit S-27441 assumes the instantaneous rate of 4.82 cfs was used over one day in year 2000.
cfs = cubic feet per second
MG = million gallons
mgd = million gallons per day
N/A = not applicable

Aquatic Resource Concerns

Every 2 years, the Oregon Department of Environmental Quality (DEQ) is required to assess water quality and report to the U.S. Environmental Protection Agency (EPA) on the condition of Oregon's waters. Section 303(d) requires identifying waters that are impaired and do not meet water quality standards and where a Total Maximum Daily Load (TMDL) pollutant load limit needs to be developed. EPA approved most of the submitted 303(d) listings and delistings on December 21, 2016. The approved 2012 list is currently effective for Clean Water Act purposes.

EWEB's Willamette River water rights authorize diversion at approximately River Mile (RM) 182 and RM 183. At the authorized diversion, the Upper Willamette River is on DEQ's 303(d) list of water quality limited streams for the following parameters: arsenic, chlorophyll a, chromium (hex), copper, dioxin (2,3,7,8-TCDD), fecal coliform, iron, manganese, nickel, nutrients, pH, sedimentation, arsenic (tri), dissolved oxygen, lead, selenium, zinc, alkalinity, ammonia, antimony, barium, beryllium, cadmium, chloride, *E. coli* (summer), phosphate, phosphorus, silver, and thallium. The Upper Willamette River at the authorized diversion was delisted for temperature, mercury, and *E. coli* (Fall/Winter/Spring) in 2010 because a TMDL was approved.

EWEB's McKenzie River water rights authorize diversion at approximately RM 14.1. At the authorized diversion, the mainstem McKenzie River currently is on DEQ's 303(d) list of water-quality-limited streams for the following parameters: alkalinity, ammonia, arsenic, atrazine, bis(2 ethylhexyl)phthalate and phenol, chlorophyll a, chromium (hex), copper, cycloate, dissolved oxygen, *E. coli*, fecal coliform, iron, manganese, nickel, nutrients, pesticides, pH, phenol, phosphate, phosphorus, and sedimentation. The McKenzie River at the authorized diversion was delisted for temperature in 2010 because a TMDL was approved.

The list of water quality impairments in the Upper Willamette River and McKenzie River can be found on DEQ's webpage for "Oregon's 2012 draft Integrated Report Database" for water bodies on the 2012 303(d) list and removed from the 303(d) list in 2012: http://www.deq.state.or.us/wq/assessment/rpt2012/results303d12.asp .

The Upper Willamette River and the McKenzie River support several fish species that are listed as threatened, species of concern, sensitive-critical, or sensitive-vulnerable under state and federal laws. The listed fish species that occur in the Upper Willamette River and McKenzie River down the main stem Willamette River to the mouth of the Columbia River are summarized in **Exhibit 2-18.**

Exhibit 2-18. Native Fish Species that Occur within the Upper Willamette River and McKenzie River Basins that are Listed as Sensitive, Threatened, or Endangered under the Oregon or Federal Endangered Species Acts (ESAs)

Species	Evolutionarily Significant Unit (ESU)	Federal Listing	State Listing	Willamette River	McKenzie River
Bull Trout	-	Threatened	Sensitive-Critical		X
Fall Chinook	Lower Columbia River	Threatened	Sensitive-Critical	X	
Spring Chinook	Upper Willamette River	Threatened	Sensitive-Critical	X	X
Coastal Cutthroat	Lower Columbia River, including up to Willamette Falls; Coastal Cutthroat Trout SMU	-	Sensitive-Vulnerable, below Willamette Falls	X	
Coho Salmon	Lower Columbia River, including up to Willamette Falls	Threatened	Endangered	X	
Oregon Chub	-	Threatened	Sensitive-Critical	X	X
Winter Steelhead	Upper Willamette River; Lower Columbia River	Threatened	Sensitive-Critical	X	
Chum Salmon	Columbia River	Threatened	Sensitive-Critical	X	
Pacific Lamprey	Columbia River System	Petitioned for Listing	Sensitive-Vulnerable	X	X
Western Brook Lamprey	Columbia River System	-	Sensitive-Vulnerable	X	X
Pacific Eulachon	Columbia River System	Threatened	Sensitive-Vulnerable	X	

Sources:

- Federal ESA listed species (threatened and endangered), from National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Protected Resources: http://www.nmfs.noaa.gov/pr/species/esa/fish.htm
- Federal Sensitive species, from the Interagency Special Status/Sensitive Species Program for Oregon and Washington State: http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/
- Oregon State ESA listed species, from the Oregon Department of Fish and Wildlife: http://www.dfw.state.or.us/wildlife/diversity/species/threatened_endangered_candidate_list.asp
- Oregon State Sensitive Species, from the Oregon Department of Fish and Wildlife: http://www.dfw.state.or.us/wildlife/diversity/species/sensitive_species.asp
- Federal Species of Concern, from the U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office: http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/default.asp

2.9 Evaluation of Water Rights/Supply

OAR 690-086-0140(3)

EWEB holds three surface water rights authorizing the use of up to approximately 300 cfs from the McKenzie River for municipal use. However, EWEB is only authorized access to 121.9 cfs from the McKenzie River. This includes the 27.08 cfs (15180) and 90 cfs from certificated water rights (15180 and 68537, respectively), and the 4.82 cfs of the extended permit (S-27441) due to the extension development limitation. EWEB also holds two surface water rights authorizing the use of water from the Willamette River for municipal use, a surface water registration for 30.9 cfs and a permit that is duplicative of the surface water registration. In addition, EWEB holds a groundwater permit for the use of up to 18.49 cfs for municipal use. Finally, EWEB holds an industrial water right for up to 128 cfs, from the Willamette River. The reliability of these rights is described below.

The amount of water available to EWEB under its McKenzie River water rights is a function of their relative seniority based on their priority dates and available stream flows. At EWEB's point of diversion, OWRD's water availability analysis indicates that water is available for further appropriation at 80 percent exceedance year round. According to stream flow records from the gage near Coburg, (U.S. Geological Survey [USGS] gage #14165500) for 1945 to 1963, the mean of daily mean flows on the McKenzie River exceeded 5,900 cfs. This gage is 10 miles below EWEB's point of diversion.

There is an instream water right on the McKenzie River in the reach where EWEB's point of diversion is located (Certificate 59757), which has a priority date of May 24, 1962. The instream right protects flows in the amount of 1,025 cfs year-round for the purpose of supporting aquatic life. The instream right protects flows above, and is measured at, the intersection of the McKenzie River and I-5 (same location as historical gauge near Coburg, USGS gauge #14165500).

Based on priority date and abundant stream flow, EWEB's Certificates 15180 and 68537 are highly reliable. EWEB's access to McKenzie River water under these rights is not affected by instream water right Certificate 59757 because of their May 16, 1925, and October 15, 1946, priority dates, respectively, which are senior to the instream right. The certificates are not, therefore, subject to regulation by priority date if the stream flows fall below the protected level. Moreover, while there are irrigation and domestic water rights on the McKenzie River that are senior to EWEB's Certificate 15180, their cumulative diversion rate is negligible.

EWEB's Permit S-27441 has a June 14, 1961, priority date and is also senior to the instream water right evidenced by Certificate 59757. Accordingly, EWEB's permit would not be subject to regulation by priority date in favor of the instream right. Despite this reliability based on regulation by priority date, EWEB's ability to obtain additional water under Permit S-27441 is subject to the permit extension conditions issued under the final order dated January 2, 2015. The Oregon Department of Fish and Wildlife has identified flows necessary to "maintain the persistence" of listed fish. According to the final order, the developed portion of Permit S-27441 of 4.82 cfs is not subject to the fish persistence conditions. The fish persistence target flow on the lower McKenzie River is 2,000 cfs from January 1 to December 31 measured at USGS gauge 14164900 above Hayden Bridge. The lowest mean daily flows of approximately 2,300 cfs occur in the month August based on 8 years of record from this gauge (2010 to 2017). Mean daily flows in July and September are approximately 2,600 and 2,350 cfs, respectively. The formula for determining the water use

reductions when flows drop below this target flow is included in the final order (see **Appendix D**).

Based on its priority date, ample water is available in the Willamette River to satisfy EWEB's surface water registration SW-354 at its points of diversion. Currently, OWRD does not have the resources to take on an adjudication of the Willamette River. Until OWRD adjudicates EWEB's surface water registration, the nature of the water right stemming from this registration is unknown. EWEB recently obtained Permit S-54805, which is duplicative of EWEB's surface water registration SW-345, to provide water supply redundancy and source flexibility. EWEB has since begun the process to plan for and improve its infrastructure for use of its Willamette River supply. The reliability of water under Permit S-54805 is affected by permit conditions that limit diversion to only those times when the combined flows of the Coast Fork of the Willamette River at the Goshen gage (USGS gage 14157500) and the Middle Fork of the Willamette River at the Jasper gage (USGS gage 14152000) meet or exceed the minimum instream flows established under Certificate 59549.

Groundwater Permit G-16371 authorizes the use of up to 18.49 cfs; however, multiple permit conditions affect the reliability of this right. Permit G-16371 is conditioned with respect to allowable use and coordination with two municipal users with nearby groundwater rights. The pumping rate for wells within 1 mile of Ayers Pond cannot exceed 4.998 cfs unless OWRD approves a plan to mitigate impacts on the Willamette River. Further, the use of water under the permit, in combination with use under EWEB's municipal McKenzie River surface water certificates and permit, cannot exceed a total of 300.08 cfs, which is the combined maximum authorized rate of those surface water rights. EWEB also is required to have an intergovernmental agreement with SUB and RWD before using any water under this permit. Currently, only two wells have been drilled and are casing only; the wells do not yet have pumps, power, or distribution connections.

EWEB's water right for industrial use, Certificate 45670, has a priority date of August 23, 1973. Consequently, the reliability of Certificate 45670 also is affected by the target flows established under instream water right Certificate 59549.

2.10 System Description

OAR 690-086-0140(8)

EWEB operates a public drinking water system (Public Water System Identification Number is 4100287). **Exhibit 2-19** is a schematic of the EWEB's existing water distribution system. EWEB has two adjacent water intakes located on west bank of the McKenzie River, just upstream of Hayden Bridge near the City of Springfield. The combined capacity of the intake pumps is approximately 100 mgd. Two raw water transmission pipelines, one per intake, convey water approximately 2,000 feet to the Hayden Bridge WTP. The 36-inch-diameter steel pipeline was constructed in 1950 and the 42-inch-diameter steel pipeline was constructed in 1951. Water diverted from the McKenzie into each raw water pipeline is measured with ultrasonic flow meters at the connection with the water intake. EWEB conducted volumetric tests in 2009 to demonstrate accuracy of the flow meters.

The Hayden Bridge WTP is a rapid-rate granular media filtration plant. It operates as a direct filtration plant during high flows and as a conventional filtration plant when production flows are lower. Process steps include: coagulation, sedimentation, filtration, and chlorination. The capacity of the WTP is approximately 80.5 mgd, but the WTP can

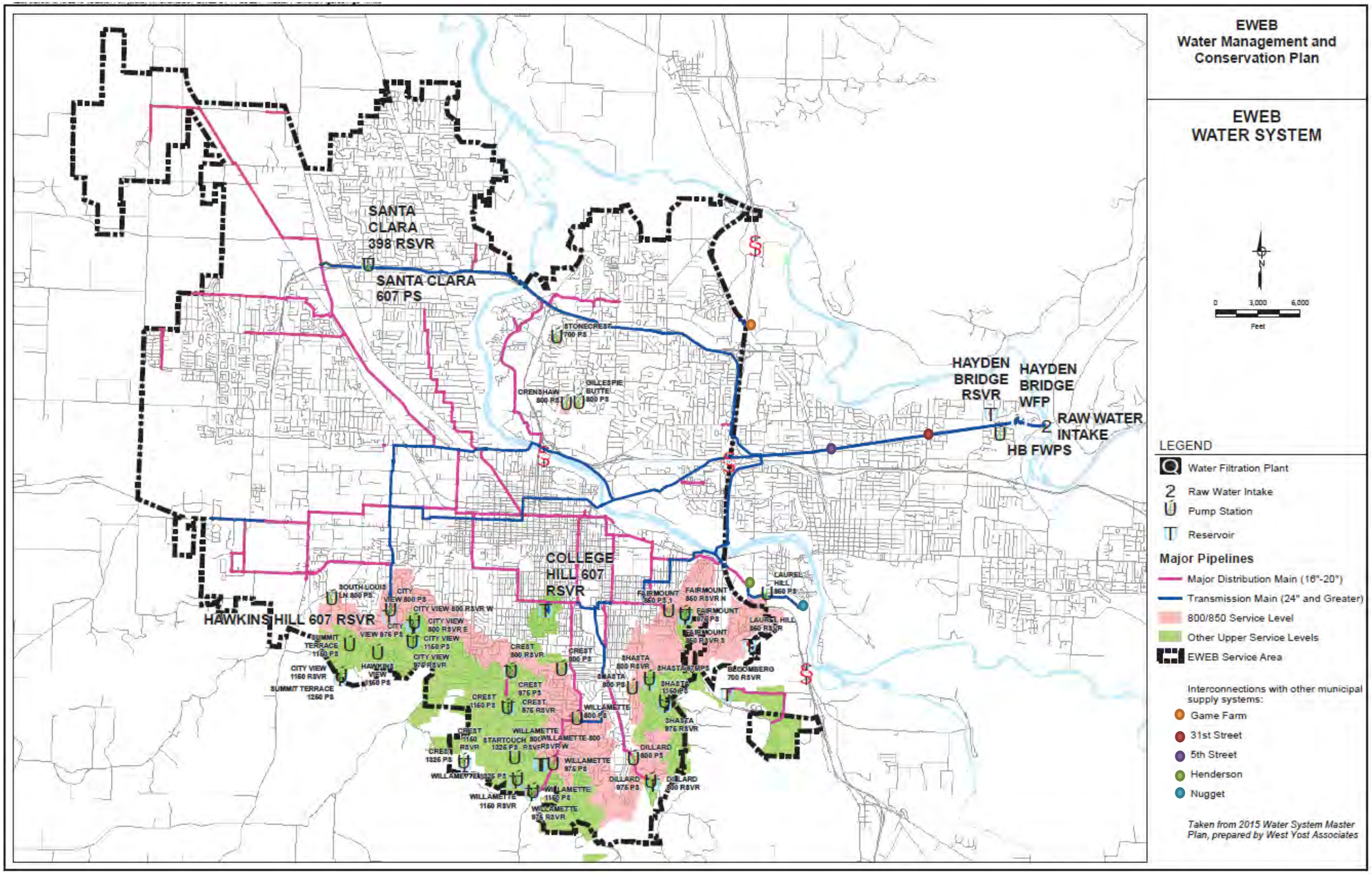
produce finished water at higher rates for short periods as needed. Following treatment, water is pumped from the WTP to EWEB's water distribution system.

EWEB has completed the conceptual design process for a second WTP on the Willamette River that would treat water diverted under its pre-1909 surface water registration[3]. The capacity of that WTP would be approximately 20 mgd (expandable to 30 mgd, depending on ability to access federal storage water or other water rights).

[3] EWEB Willamette River Water Treatment Plant Conceptual Design Report, November 18, 2009 (Black & Veatch, 2009).

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Exhibit 2-19. Schematic of EWEB's Water Distribution System



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EWEB customers are served water through a system composed of more than 820 miles of pipelines, 23 reservoirs with a total storage volume of 89.05 MG, and 28 pump stations with a total firm capacity of more than 108,000 gpm (including the Hayden Bridge Finished Water Pump Station with a firm capacity of 83,333 gpm). **Exhibits 2-20, 2-21**, and **2-22** summarize EWEB's pipelines, reservoirs, and pump stations, respectively**.** The water distribution system is divided into seven pressure zones to maintain acceptable pressures to all customers.

Exhibit 2-20. Summary of Pipeline Sizes (as of October 13, 2010)

Pipe Diameter (in)	Total Length (ft)	Total Length (mi)	Percent of Total Pipeline
<2	78,506	14.9	1.8
2	383,926	72.7	8.8
2.5	85	0.0	0.002
3	2,669	0.5	0.06
4	393,141	74.5	9.1
6	1,578,816	299.0	36.3
8	912,243	172.8	21.0
10	240,547	45.6	5.5
12	317,942	60.2	7.3
16	175,886	33.3	4.0
18	19	0.0	0.0004
20	68,171	12.9	1.6
24	22,190	4.2	0.5
30	37,303	7.1	0.9
36	44,897	8.5	1.1
42	31,657	6.0	0.8
45	37,765	7.2	0.9
60	18,275	3.5	0.4
66	610	0.1	0.0
Total	4,343,392	823.6	100.0

Notes:
in = inches
ft = feet
mi = miles

Exhibit 2-21. Summary of System Reservoirs

Reservoir	Volume (MG)	Over Flow Elevation (feet)	Depth (feet)	Completion Date
Hayden Bridge 581	15.0	581	37	5/7/2003
Santa Clara 398	20.0	398	14	12/24/1977
College Hill 607 north/south	15.0	607	20.25	3/12/1940
College Hill 607 south	7.5	607	20.25	3/12/1940
Hawkins Hill 607	20.0	607	35	6/12/1963
Bloomberg 700	1.75	700	19	6/18/1968
City View 800 east	1.0	800	19	11/14/1960
City View 800 west	1.0	800	19	12/1/2001
Crest 800	0.70	800	21	6/1/1951
Dillard 800	1.5	800	23	7/19/1967
Shasta 800	1.25	800	19	9/30/1963
Willamette 800 east	1.25	800	19	3/4/1975
Willamette 800 west	1.25	800	19	7/24/1963
Fairmount 850 north	0.15	850	15.6	7/31/1924
Fairmount 850 south	0.70	852	21	6/1/1951
Laurel Hill 850	1.0	852	21	9/2/2008
City View 975	1.75	975	19	7/28/1967
Crest 975	1.0	975	19	8/17/1973
Shasta 975	1.75	975	32	7/17/1967
Willamette 975	1.25	975	19	8/1/1966
City View 1150	0.75	1,150	42	12/9/2003
Crest Drive 1150	0.40	1,153	17	4/21/1995
Willamette 1150	0.30	1,150	23	1/1/1994
Willamette 1325	0.05	1,325	15	7/1/1995
Total	89.05			

Notes:
MG = million gallons

Exhibit 2-22. Summary of Existing Pump Stations

Name	Number of Pumps	Horsepower	Flow's GPM	Firm Capacity (gpm)	Comments
City View 800	2	100, 100	1200, 1200	1,200	
City View 975	2	50, 100	700, 1500	700	
City View 1150	4	10, 10, 50, 50	150, 150, 750, 750	1050	
Crest 800	2	125, 125	1500, 1500	1,500	
Crest 975	2	100, 100	1250, 1250	1,250	
Crest 1150	2	60, 60	1200, 1200	1,200	
Crest 1325	4	5, 5, 10	50, 50, 100	100	
Crenshaw 800	1	5	50	50	Only one pump, so firm capacity is technically zero
Dillard 800	2	25, 150	250, 2300	250	
Dillard 975	4	5, 10, 50, 50	50, 100, 750, 750	900	
Fairmount 850 No. 1	2	100, 100	800, 800	800	
Fairmount 975	4	5, 5, 25, 25	50, 50, 400, 400	500	
Gillespie Butte 800	2	5, 5	50, 50	50	
Hayden Bridge Finished	7	600 (7)		72,000	Largest pump, Out of Service
Hawkins View 1100	3	10, 25, 50	100, 200, 750	300	
Laurel Hill 850	2	40, 40	650,650	650	
Santa Clara 398	3	50, 350, 350	500, 5000, 5000	5,500	
Shasta 800	3	125, 125, 125	1600, 1600, 1600	3,200	
Shasta 975	2	40, 40	700, 700	700	
Shasta 1150	4	10, 10, 25, 25	150, 150, 700, 700	700	1000?
South Louis Lane	1	5	50	50	Only one pump, so firm capacity is technically zero
Summit Terrace 1150	2	25, 50	250, 750	250	
Summit Terrace 1250	4	5, 10, 100, 100	50, 150, 750, 750	1,050	
Stonecrest 800	2	5 , 5	50, 50	30	
Willamette 800	3	125, 125, 125	1500, 1500, 1500	3,000	
Willamette 975	2	100, 125	1200, 1500	1,200	
Willamette 1150	2	75, 25	1200, 350	350	
Willamette 1325	3	10, 60, 60	100, 850, 850	950	

Notes:
gpm = gallons per minute

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3. Municipal Water Conservation

This section addresses the requirements of OAR 690-086-0150(1) – (6).

This rule requires a progress report on conservation measures in an existing Plan, if any, and a description of any additional conservation measures. The rule also requires descriptions of specific required conservation measures and benchmarks.

3.1 Background, Progress Report, and Current Conservation Measures

OAR 690-086-0150(1) and (3)

Background

This WMCP addresses the requirements of the final order for extension of EWEB's surface water Permit S-27741, and replaces the 2012 WMCP triggered by Permit G-16371. The water conservation benchmarks developed and adopted in the 2012 WMCP have been re-evaluated in the context of EWEB's continuing effort for wise use and stewardship of its water supply. EWEB has a long tradition of progressive action for resource stewardship, with an emphasis in electric energy and water conservation. This commitment to conservation has been demonstrated by implementing programs that met or exceeded Division 86 requirements years before such requirements were established.

In the 1980s, EWEB initiated water conservation programs as an extension of its energy conservation programs, and adopted a philosophy of conservation and preserving the source of supply in its 1998 Water Supply Plan. The Water Supply Plan identified specific water conservation goals to reduce both ADDs and peak day demands. In addition, the planning process for the 1998 Water Supply Plan established the following policy-level direction that has guided the development of specific implementation strategies for water conservation:

- Be education based
- Be voluntary
- Target all customer sectors
- Provide emphasis on summertime peak use

Historically, EWEB's approach for water conservation activities focused on program development based on research and input from consultants and stakeholders. EWEB then conducted pilot efforts and field tests to refine the conservation programs before full implementation. Programs generally included one or more of the following:

- Facility audits to identify opportunities
- Technical assistance to prioritize projects and offer incentives (incentives funded to avoid cost for new capacity)

- Financing (often with payment schedules set at the savings rate for water and sewer)

As a result of these conservation program goals, EWEB has established a program aimed at reducing ADD and peak season demands. EWEB will continue to implement its water conservation program with a focus on the most cost effective measures that can be implemented efficiently with the resources available.

Progress Report

The OWRD final order approving the 2012 WMCP required EWEB to prepare and submit a WMCP progress report by February 1, 2017. The progress report is included as **Appendix B**, and summarizes EWEB's progress in implementing the associated conservation measures and activities. EWEB met all of the 5-year benchmarks included in the 2012 WMCP, as acknowledged by OWRD in its review of the February 2017 progress report. The descriptions of the updated 5-year benchmarks include a brief summary of the status and progress of measures from the 2012 benchmarks.

In support of the WMCP progress report, EWEB contracted with Carollo Engineers to prepare a Water Conservation Potential Analysis. The analysis was conducted to support EWEB achieving its public education and technical and financial assistance benchmarks. The 2012 Water Conservation Potential Analysis evaluated historical water use, researched benchmarks for efficient indoor and outdoor water use, and completed a conservation potential for specific measures. EWEB then used this information in prioritizing and focusing its implementation resources on the most effective measures for its customers and utility operations. The water conservation measures and benchmarks included in this WMCP were evaluated and updated in part from the work EWEB completed in preparing the "2013-2023 Water Conservation Plan." It includes a detailed evaluation of water conservation potential analysis from the work completed by Carollo Engineers in 2012.

Current Conservation Measures

Water conservation measures and benchmarks are influenced by the type of use, such as residential, commercial, and industrial. For example, commercial and industrial water use represents a much wider spectrum of uses and use patterns than residential water use. Even in multifamily housing complexes, which are treated and billed as commercial facilities, the configuration of the premises (e.g., high rise or campus-like), the age of the facility, and the make-up of the residents (e.g., students versus seniors) can substantially affect the water use, and, therefore, affect water conservation objectives and approaches.

EWEB's numerous water conservation measures and activities include:

- Tracking non-revenue water and EWEB's leak detection and replacement program has kept average non-revenue water at 8.2 percent (2010 through 2016) with non-revenue water at 5.4 percent in 2016.
- A fully metered system.
- Three-tiered inverted-block rate structure for residential customers.
- The Green Grass Gauge program, an outdoor watering public education effort.

- Ten thousand free rain gauges were given away each summer between 2005 and 2013. Then the program was reduced to 2,400 per summer because most customers had already received the gauges.
- Information previously presented at EWEB workshops has been integrated into several education and home visit programs, such as Oregon State University Extension's Sustainable Landscapes and Lane Community College's Water Conservation Technician Associate Degree.
- From 2012 through 2016, EWEB's EPA WaterSense toilet rebate program replaced 1,007 inefficient toilets, resulting in an estimated water savings of 22 MG per year.

Details about EWEB's water conservation measures are discussed later in this section.

3.2 Use and Reporting Program

OAR 690-086-0150(2)

EWEB has a water use measurement and reporting program that complies with the measurement standards in OAR Chapter 690, Division 85. EWEB's water use records can be found on the OWRD website: (http://apps.wrd.state.or.us/apps/wr/wateruse_report/default.aspx).

EWEB measures the water it diverts from the McKenzie River using ultrasonic flow meters on the two raw water transmission pipelines attached to the two raw water intakes. Magnetic flow meters measure flows through the finished water pipelines.

3.3 Required Conservation Programs

OAR 690-086-0150(4)

OAR 690-086-0150(4) requires that all water suppliers establish 5-year benchmarks for implementing the following required conservation measures:

- Annual water audit
- System-wide metering
- Meter testing and maintenance
- Unit-based billing program
- Leak detection and repair (if system leakage exceeds 10 percent)
- Public education

Five-Year Benchmarks for Required Existing or Expanded Conservation Measures

EWEB currently addresses all of the required conservation measures. A summary of the 5-year benchmarks for required and additional conservation measures is provided below. The benchmarks described below have been evaluated and updated, as appropriate based on the implementation and progress made since the 2012 WMCP. During the next 5 years, EWEB plans

to continue or expand the following existing conservation measures that are required of all municipal water providers.

1. **Annual Water Audits.** OWRD defines a water audit as an analysis of the water system that includes a thorough accounting of all water entering and leaving the system to identify leaks in the system and authorized and unauthorized water uses, metered or estimated. The water audit also includes analysis of the water supplier's own water use. Before the 2012 WMCP, EWEB had not conducted a formal annual water audit, but had been tracking non-revenue water for more than 10 years. EWEB routinely tracks the unmetered uses from flushing, testing new mains, leaks, and continuous sampling equipment. All known unmetered use is entered and maintained in the Customer Inquiry Database. Water leak quantities are estimated by the lead or crew leader doing the repair noted on the service order and then entered into the Customer Inquiry Database by the water operations coordinators. EWEB also documents water production and consumption on a monthly basis. This information, coupled with other known usage, has enabled EWEB to calculate non-revenue water volume. Non-revenue water averaged 8.8 percent from 1994 through 2004, 6.8 percent from 2005 through 2009, and 8.2 percent from 2010 through 2016. In 2016, non-revenue water was 5.4 percent.

   EWEB met its annual water audit benchmark from the 2012 WMCP by adopting the AWWA M36 water audit methodology[4] to conduct its annual water audit. EWEB has applied the M36 methodology in its water audits since 2013.

   Updated Five-Year Benchmark: EWEB will continue its annual water audit using the adopted AWWA M36 methodology to evaluate production and consumption data to observe trends in authorized and unauthorized water uses, as well as non-revenue water (unaccounted-for water and process water). Using the audit information, EWEB will estimate any unmetered authorized and unauthorized uses that may arise.

2. **System-Wide Metering.** System-wide metering is needed to compare consumption and production, and is critical for water distribution system audits. EWEB's system is fully metered on both the production side and demand (customer) side. Hydrants are not metered, but EWEB tracks water used for main flushing. Wholesale connection to the Santa Clara Water District does not have a master meter, but all of its retail customer connections are metered. Wholesale connection to the River Road Water District has a master meter and all of its retail customer connections are metered.

   In 2015, EWEB's Electric Division made the decision to move ahead with implementing advanced metering infrastructure (AMI) by purchasing and installing equipment, with features that include outage and leak detection alarms. EWEB's Electric Division and Water Division are participating in the implementation process. AMI is likely to enable faster detection of leaks, as well as other benefits. Currently, if a customer requests advance metering, then a meter will be installed. However, EWEB's Board is considering mass deployment alternatives.

[4] AWWA. Manual of Water Supply Practices M36. Water Audits and Loss Control Programs, Third Edition, 2009.

EWEB met its system-wide metering benchmark from the 2012 WMCP by continuing to require new developments to be metered, and by evaluating and moving forward with AMI implementation.

***Five-Year Benchmark*:** EWEB will continue to require all new development to be metered. EWEB's Water Division will provide support and input to the Electric Division to continue AMI implementation.

3. **Meter Testing and Maintenance.** Meter testing and maintenance allow the utility to collect accurate water consumption and production information. From past testing, EWEB has determined that the small meters (¾-inch, 1-inch, 1 ½-inch, and 2-inch) in the EWEB system maintain a high level of accuracy for 20 to 30 years, and sometimes longer. Because of the longevity of EWEB meters and the lack of cost effectiveness of testing small meters (less than 3 inches in size), EWEB's meter testing and maintenance program continues to be based primarily on customer complaints.

   EWEB addressed large meters (greater than 2 inches) in an upgrade and modernization program that occurred between 1987 and 1997. The ongoing Large Meter Maintenance Program involves maintenance and testing in the field. Based on annual consumption and maintenance history, EWEB tests the large meters every 1, 2, or 3 years. EWEB maintains records for all repairs and accuracy tests.

   EWEB's water production meters at the Hayden Bridge WTP are maintained according to the manufacturer's recommendation on an annual basis to ensure that the source production meters provide accurate data.

   EWEB met its meter testing and maintenance benchmark from the 2012 WMCP by reviewing its process and adopting standard operating guidelines for large water meter testing and maintenance, and commissioning of meters 1.5 inches and larger. EWEB also has an established procedure for annual meter testing of production meters at the Hayden Bridge WTP.

   Five-Year Benchmark: EWEB will continue to conduct large meter testing and replacement following the protocols and schedules in the standard operating guidelines. As AMI implementation continues (see system-wide metering benchmark), EWEB will evaluate water-conserving opportunities. EWEB will evaluate meter testing and replacement to estimate revenue loss—resulting from inaccurate new meter installations—based on a benefit-cost analysis.

4. **Unit-Based Billing Program.** Unit-based billing (conservation rate structure) provides a price signal to the customer based on water consumption. EWEB's monthly residential water bill within the City of Eugene city limits has three components: Basic Charge, Consumption Charge, and Elevation Charge. The monthly Basic Charge is based on meter size and covers the fixed operating costs of the utility that include meter reading, billing, and customer service. The Consumption Charge is a tiered rate based on the amount of water used by the customer each month and is metered at each customer's point of connection to the public utility. In November 2011, EWEB implemented tiered rates for residential water customers within the City of Eugene city limits, at the same time eliminating the last vestiges of declining block rates for commercial and industrial

customers. **Exhibit 3-1** shows the Consumption Charges put into effect at that time of implementation and current residential Consumption Charges within the City of Eugene city limits.

Exhibit 3-1. EWEB Consumption Charges

Water Use Quantity	Previous Consumption Charge As of 5/1/2011	Current Consumption Charge As of 2/1/2017
< 8,000 gallons per month	$1.280 per 1,000 gallons	$1.601 per 1,000 gallons
8,001 to 30,000 gallons per month	$2.160 per 1,000 gallons	$2.703 per 1,000 gallons
> 30,000 gallons per month	$3.500 per 1,000 gallons	$4.378 per 1,000 gallons

The Elevation Charge, if applicable, accounts for the infrastructure and energy costs required to pump water into higher sections of the water delivery area. The Elevation Charge is assessed for customers located on three elevation levels above the base level (below 800 feet).

Exhibit 3-2 provides the current Elevation Charges, as of February 2017.

Exhibit 3-2. Elevation Charges

Water Delivery Zone	Elevation Charge per 1,000 gallons As of 5/1/2011	Elevation Charge per 1,000 gallons As of 2/1/2017
Base	None	None
Pumping Level 1 (800 to 850 feet)	$0.191	$0.249
Pumping Level 2 (975 feet)	$0.381	$0.499
Pumping Level 3 (1,150 to 1,325 feet)	$0.569	$0.738

Residential customers outside of the City of Eugene city limits have a monthly Basic Charge based on meter size; a Consumption Charge of $2.081, $3.514, and $5.691 per 1,000 gallons (as of February 2017) relative to the same water use quantity ranges shown in Exhibit 3-1; and the same Elevation Charge as shown in Exhibit 3-2.

General Service (commercial and industrial) customers inside and outside of the City of Eugene city limits have a monthly Basic Charge based on meter size and a Consumption Charge of $2.885 per 1,000 gallons (as of February 2017). The General Service Charge currently is not tiered because General Service customers generally use water throughout the year rather than having peak periods of use as residential customers tend to have during the summer irrigation season. The General Service Charge has the same Elevation Charge as shown in Exhibit 3-2.

EWEB met its rate structure and billing program benchmarks from the 2012 WMCP by providing water conservation billing BMP information to the team conducting cost of service analysis during the reporting period. EWEB also evaluated customer classification as part of the 2013-2023 Water Conservation Plan. EWEB maintained the tiered consumption charges for residential customers.

Five-Year Benchmark: EWEB will continue to review its rates annually by analyzing funding requirements to pay for future capital and operating costs, as well as costs associated with water conservation programs. EWEB will continue to apply rates that encourage water conservation according to water utility BMPs. EWEB also will continue a monthly billing schedule for all customer classes.

5. **Leak Detection and Repair.** A leak detection and repair program allows a utility to maximize its beneficial use of diverted water. EWEB's non-revenue water was 5.4 percent in 2016 and averaged 8.2 percent from 2010 through 2016; these percentages are well below the 10 percent leakage rate that triggers more serious system analysis and are an indication of a well-run leak detection and repair program**.**

   EWEB's Water Distribution Operations (WDO) staff investigates suspected leaks using data loggers and sonic correlation equipment to pinpoint leaks and to determine the quantities of water being lost. EWEB also has a master map to track areas where leak detection has been completed or needs to be completed.

   Three WDO staff members are assigned 57 map tiles, based on the distribution system that must be completed with leak detection to complete the entire system in 5 years. The map tile is a geographic information system (GIS) map that is scanned into the WAM software for tracking what is completed. WDO purchased six wireless leak-correlating data loggers for nighttime leak detection in noisy areas, such as downtown. Large meter replacements do not have the leak detection features, as do the small AMI meters. Therefore, if a customer requests a leak detection, then EWEB will read the meter for identifying a leak. WDO has a goal to replace one 6-inch or 8-inch water meter per month. In addition, wholesale connections are required to conduct leak detection surveys as part of their requirement to maintain a WMCP in full compliance with OAR 690, Division 086 or to adopt EWEB's WMCP, as amended from time to time.

   For commercial and industrial customers, EWEB brought in utility crews to assist with large-diameter pipe repairs when local plumbers could not carry out the work. When EWEB began these investigations in 1995, utility crews found and repaired leaks totaling up to 30,000 gallons per day. Using water budgeting and data logging, EWEB staff is able to estimate excessive water uses that prompt investigations, which often result in discovering a leak. If an identified excessive water use is confirmed as a leak in the water delivery line or irrigation system, the commercial and industrial customer may be eligible for a short-term or long-term loan, depending on the dollar amount. In 2006, EWEB also initiated a rigorous program identifying unauthorized use of fire lines.

   To provide a complete water delivery offering for residential customers with high bills or suspected leaks, the EWEB staff provides initial onsite leak detection free of charge. If an unknown use is confirmed as a leak in the water delivery line or irrigation system, the customer may be eligible for a short-term or long-term loan, depending on the dollar amount. EWEB has leak repair grants available for income-eligible homeowners, as well as affordable housing property owners. This program works hand-in-hand with EWEB's Customer Care Program, which provides pro-active assistance for elderly, disabled, and unemployed customers. Repairs ranging from a leaking faucet to the complete replacement of failed water delivery lines are available for income-eligible customers.

Additional measures are described in Section 3.5 addressing OAR 690-086-0150(6) for water providers serving a population greater than 7,500.

EWEB met its leak detection and repair benchmarks from the 2012 WMCP by continuing to fund the program, and maintained a capital plan for repairs at the funding level stated in the WMCP. EWEB also reviewed its leak detection and repair protocols for effectiveness.

Five-Year Benchmark: EWEB will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner; and to implement plans to invest in water system renewal and replacement projects in the next 5 years. EWEB will continue to fund pipeline replacement based on evaluation criteria in the 2015 Water Master Plan.

6. **Public Education.** Public education increases awareness of the value of water and provides practical tools for customers to use water wisely. EWEB has developed and implemented a comprehensive community outreach and education program. Components include: year-round conservation efforts and messaging, outdoor-specific programs aimed at reducing seasonal peak uses, and in-school education programs. These efforts are summarized below.

   Green Grass Gauge Program. In 1996, EWEB staff began to develop a comprehensive outdoor watering education program titled the "ET Campaign" (from the technical term, evapotranspiration). In 2005, the campaign was simplified and renamed the Green Grass Gauge program. The program provides weather-based irrigation information and also provides a free rain gauge called the "Green Grass Gauge." The educational campaign has distributed thousands of free rain gauges since it was started, and resulted in sustained decrease in overall residential summer water use. In 2008, EWEB transitioned the GGG campaign education efforts into partnership opportunities throughout the community, including partnerships with higher education institutions (Oregon State University, University of Oregon, and Lane Community College). EWEB's staff continues to participate in a booth at the annual Master Gardener Plant Sale. **Appendix E** summarizes additional historical details of the campaign.

   Water Wise Demonstration Garden. In 2008, EWEB staff facilitated a wide-ranging public/private partnership to build a Water Wise Demonstration Garden. This outdoor education facility is located at the Alton Baker Park host house, also home to Nearby Nature, a community outdoor education nonprofit organization and Network Charter School, an alternative high school focused on outdoor science education. The OSU Master Gardeners use the garden as a teaching field trip as part of their Sustainable Landscape Gardener Program. EWEB coordinated installation efforts and is committed to maintaining the garden indefinitely.

   Other Publications. EWEB staff produces articles for a utility-wide tabloid publication called the Pipeline. Each year, WMS also produces a direct mail publication often targeted to the highest 10 percent of residential water users. On occasion they have been sent to all customers (as with the launch of the "Slow the Flow" drought response campaign in 2001). Recently, the annual direct mail piece has transitioned from a pure water conservation message to a system optimization message that includes peak-hour management information.

EWEB met its public education benchmarks from the 2012 WMCP. EWEB evaluated its water conservation targets as part of the development of the 2013-2023 Water Conservation Plan. EWEB developed and continues to lead a regional water conservation promotion partnership with nearby water utilities. The partnership co-publishes water bill inserts. EWEB also continues to support education efforts by community groups.

Five-Year Benchmark: EWEB will continue public education initiatives and will re-evaluate those initiatives, which include the Green Grass Gauges program and a grant/loan program for residential customers. EWEB will continue to update its website and outreach materials as needed; and continue to provide conservation messaging in water bills. EWEB will continue to seek and sustain messaging partnerships with regional water utilities that share local media footprint to promote water conservation; and with "credible educators" in lieu of EWEB-staffed events and presentations.

3.4 Expanded Use under Extended Permits

OAR 690-086-0150(5)

As part of this WMCP, EWEB is not proposing to expand or initiate diversion of water under an "extended permit" with identified resource issues. As a result, the provisions of this section are not applicable to EWEB. Further, EWEB's non-revenue water was 5.4 percent in 2016 and averaged 8.2 percent from 2010 through 2016, which are well below the 15 percent target established by this rule. Nonetheless, EWEB has an effective system-wide leak repair and line replacement program, which is described above.

3.5 Additional Conservation Measures

OAR 690-086-0150(6)

OAR 690-086-0150(6) requires municipal water providers serving a population greater than 7,500 to implement an additional set of conservation measures or to provide documentation showing that implementation of the measures is neither feasible nor appropriate. A summary of EWEB's additional conservation measures and the 5-year benchmarks for implementing those conservation measures are provided below.

Five-Year Benchmarks for Additional Conservation Measures

Benchmarks for EWEB's water conservation program include:

1. **Leak Detection and Pipeline Repair and Replacement**

   EWEB's non-revenue water was 5.4 percent in 2016 and averaged 8.2 percent from 2010 through 2016. Although the system's non-revenue water, and therefore system leakage, is well below 10 percent, EWEB still has initiatives aimed to keep system leakage as low as possible. These initiatives are described below for EWEB's different customer types. Other required measures related to leak detection and pipeline repair are described in Section 3.3 (measure 5) addressing OAR 690-086-0150(4).

Residential Customers

In addition to the leak detection and repair assistance described in OAR 690-086-0150(4), EWEB staff produces a series of brochures titled "A few minor repairs can make a major difference: Step-by-step fix-it guides for the most common household leaks." These brochures provide detailed repair information with expanded diagrams for common fixture types, including toilets (with leak detection dye tabs), faucets, and tub/shower valves. In addition, leak detection and repair education has been integrated into several community-based sustainability education programs, as described in the leak detection section of this WMCP.

Commercial and Industrial Customers

One of the first areas of success for the commercial and industrial water conservation program was in leak detection and repair. High bills, visual evidence of a leak, and rate increases often prompted customers to contact EWEB hoping to lower their cost for water. In 1995, EWEB staff began offering investigations of suspected leaks, which resulted in substantial water savings. The details of this program and its savings are described above in Section 3.3 (measure 5) addressing OAR 690-086-0150(4).

Five-Year Benchmark: EWEB will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner; and to implement plans to invest in water system renewal and replacement projects in the next 5 years. EWEB will continue to fund pipeline replacement based on evaluation criteria in the 2015 Water Master Plan.

2. Technical and Financial Assistance

Technical and financial assistance helps customers maximize the benefits of the water they purchase. EWEB has implemented several technical and financial assistance programs during the past 20 years, many of which have since been discontinued. **Appendix E** summarizes the past programs that have been implemented and discontinued.

Currently, EWEB's primary assistance program focuses on water audits for indoor use. EWEB has been offering commercial and industrial customers water use audits since 1995. These audits are provided free of charge, at the customer's request, and provide a first step in evaluating opportunities for water savings. The goal of the audit is four-fold:

1. To provide a mechanism for evaluating and establishing a baseline analysis, so facility managers can track water use over time with some reference to what is normal or expected for the particular facility. This baseline is called a Water Budget.
2. To provide a detailed analysis of current use that points to the obvious and most cost-effective opportunities for water conservation measures.
3. To provide a reference for facility and program evaluation (i.e., measuring the success of installed measures).

4. To create a catalog of water-saving opportunities that may not be cost effective today, but may become cost effective with the advent of new technologies and/or increases in the cost of water and sewer services.

Participation is voluntary and demand for the program has been limited. The service is marketed to customers through direct mail publications and customer contacts made to other parts of the utility, chiefly Energy Management Services.

EWEB met its technical and financial assistance benchmarks from the 2012 WMCP. EWEB re-evaluated the assistance programs during the 2013-2023 Water Conservation Plan with technical assistance from consultants. The study by the consultant included a conservation potential estimate for the service area, which concluded that there is much greater potential for indoor savings than outdoor savings (Carollo Engineers, 2012). Based on these results, EWEB water technical and financial assistance offerings will be focused on leak detection and repair services (see also Section 3.5 below (measure 3) addressing OAR 690-086-0150(6).

Five-Year Benchmark: EWEB will use the following analyses to support technical and financial assistance programs: use the GIS water budget tool developed for the 2013-2023 Water Conservation Plan to identify conservation opportunities; determine optimal expense threshold for demand-side water conservation programs as a percentage of operations and maintenance (O&M) expenses, and continue to evaluate the effectiveness of conservation programs using customer focus groups and customer surveys.

3. Retrofit/Replacement of Inefficient Fixtures

Promoting retrofit and repair of inefficient fixtures helps accelerate transition to newer efficient technology, which helps maximize customer benefits from water purchased. EWEB has implemented several retrofit/replacement programs during the past 20 years, but most have been discontinued following a benefit-cost analysis. Toilet rebates for residential customers continue to be implemented because of its effectiveness. **Appendix E** summarizes the past programs that have been implemented and discontinued.

From 1995 to 2008, EWEB provided toilet rebates to its water customers who replaced existing higher-volume toilets (3.5 to 7 gallons per flush) with a current model, all of which flush at a rate of 1.6 gallons per flush. New construction was excluded because the plumbing code requires the installation of current models. As WaterSense-labeled products became available, an increased rebate was offered. EWEB sent follow-up customer satisfaction surveys with toilet leak detection and repair supplies to most customers, as part of this program, to provide product/program feedback and to ensure savings. EWEB discontinued all toilet rebates in 2009 because of an annual cost/benefit analysis of the program, but re-initiated the program in 2012. Since 2012, EWEB customers have replaced about 1,007 toilets for an estimated water savings of 22 MG per year.

EWEB met its retrofit/repair of inefficient fixtures benchmarks from the 2012 WMCP. EWEB re-evaluated its technical and financial assistance programs as part of the effort to update the water conservation plan. The water conservation plan included evaluating the conservation potential estimate for the service area related to retrofit and

replacement programs. Based on the results, EWEB decided to refocus the retrofit and replacement on toilet rebates.

Five-Year Benchmark: EWEB will continue the toilet rebate program. To continue to prioritize its program, EWEB will determine optimal expense threshold for demand-side water conservation programs as percent of O&M expenses; and continue to evaluate the effectiveness of conservation program using customer focus groups and customer surveys.

4. Water Rate Structure and Billing Schedule

The Unit-based Billing discussion in Section 3.3 (measure 4) responsive to OAR 690-086-0150(4) details the three parts of the monthly residential water bill: Basic Charge, Consumption Charge, and Elevation Charge. The Consumption Charge for single-family residential customers within the City of Eugene city limits has a tiered rate structure. The monthly billing schedule for all of EWEB's customers provides customers with timely feedback on their water consumption and its related cost, such that customers can change their water usage within a relatively short period, if desired. In addition, EWEB currently provides information about water conservation in its water bills; this information is detailed under the Public Education Section 3.3 (measure 6) addressing OAR 690-086-0150(4).

EWEB met its rate structure and billing program benchmarks from the 2012 WMCP by providing water conservation billing BMP information to the team conducting cost of service analysis during the reporting period. EWEB also evaluated customer classification in the 2013-2023 Water Conservation Plan. EWEB maintained the tiered consumption charges for residential customers.

Five-Year Benchmark: EWEB will continue to review its rates annually by analyzing funding requirements to pay for future capital and operating costs, as well as costs associated with water conservation programs. EWEB will continue to apply rates that encourage water conservation according to water utility BMPs. EWEB also will continue a monthly billing schedule for all customer classes and include water conservation messaging in the bills.

5. Reuse, Recycling, and Nonpotable Water Opportunities

Encouraging reuse, recycling and nonpotable water opportunities helps reduce the need for water diversion. EWEB has participated in a rainwater harvesting system and a recycled water program with Metropolitan Wastewater Management Commission in the past, and continues to support reuse, recycling and nonpotable. EWEB does not provide rebates, but provides technical assistance to customers interested in these opportunities. Specific customer-proposed reuse, recycling, and nonpotable water use projects may be subject to additional benefit-cost analysis according to guidelines presented below in the discussion of "Other Conservation Measures."

During the reporting period for the 2012 WMCP, EWEB maintained a project-based loan and grant application process for customers to propose reuse, recycling and nonpotable water use projects that may be eligible for incentives. No customers proposed projects during the reporting period. One supply-side pilot project was identified to use

distribution system flushing water for demand-side uses, but no partners stepped forward with EWEB. EWEB continues to recycle filter to waste at the Hayden Bridge WTP.

Five-Year Benchmark: EWEB will continue to explore opportunities for demand-side water reuse and recycling; and continue to recycle water at the Hayden Bridge WTP.

6. Other Conservation Measures

In addition to the conservation measures described above, EWEB has implemented several other measures that improve water use efficiency.

- **Water Conservation Staff.** EWEB currently has the equivalent of two full-time staff members working on water conservation, although each staff member has multiple responsibilities beyond water conservation within the utility. These staff members develop, coordinate, implement, monitor, and report on EWEB's water conservation programs.
- **Program Effectiveness Evaluation**. To aid in evaluating the effectiveness of water conservation programs, spreadsheets are used to track and evaluate the Toilet Rebate Program, Water Service Line Replacement Loan Program, and Income Eligible Leak Repair Assistance Program. EWEB staff is able to track program effectiveness at the transaction level and roll up those results into a program view. EWEB also completed a water conservation program effectiveness evaluation project in 2015, which identified key programs to prioritize and continue to implement.
- **Grant/Loan Program for Customers.** EWEB maintains a grant/loan application process for unique residential customer proposals to increase water conservation. This process allows customer ideas to be considered on the merits of water use efficiency and EWEB cost/benefit analysis. If the proposal has the potential to become programmatic, EWEB may choose to initiate a study or pilot program to gather data for cost/benefit analysis calculations. EWEB also considers proposals for studies from commercial and industrial customers through the grant/loan application process.

EWEB met its benchmarks for other conservation measures from the 2012 WMCP in the 2013-2023 Water Conservation Plan. EWEB sponsored staff time to support the City of Eugene and University of Oregon in developing landscaping and irrigation standards and specifications. EWEB's staff also participated in the first irrigation installation building code eligible to be adopted in Oregon.

Five-Year Benchmark: EWEB will continue the Green Grass Gauge program to sustain outdoor water savings and the grant/loan program for residential customers. EWEB will work with or monitor codes and standards-making bodies to leverage emerging efficiency codes, standards, and legislation. EWEB also will conduct or monitor studies conducted by others on emerging equipment and technology for demand-side conservation (e.g., WaterSense-labeled landscape irrigation sprinkler components).

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4. Municipal Water Curtailment

This section satisfies the requirements of OAR 690-086-0160.

This rule requires a description of past supply deficiencies and current capacity limitation. It also requires inclusion of stages of alert and the associated triggers and curtailment actions for each stage.

4.1 Introduction

Water curtailment plans outline proactive measures that water suppliers may take to reduce demand and to find alternative supply during short-term water supply shortages. The intent of water curtailment plans is to minimize the impacts of water supply shortages, which may result from incidents such as: prolonged drought, mechanical or electrical equipment failure in the system, unanticipated catastrophic events (flooding, landslides, earthquakes, and contamination), or events not under control of the water supplier (e.g., localized or area-wide power outages and intentional malevolent acts).

4.2 History of System Curtailment Episodes

OAR 690-086-0160(1)

Curtailment messaging was first implemented in the late 1990s primarily because of operational concerns. In 2000, a project team was formed to research alternatives to address water supply shortage events and to develop response plans should those shortages occur. The project team noted that EWEB was dependent on a single surface water source of supply, which leaves the community vulnerable to impacts to that source from both human actions and natural events, such as drought. In 2001 and 2006, curtailment messaging was implemented because of weather-related concerns. Most recently in 2015, weather conditions for a long, hot summer, and concerns with new operational constraints related to fish persistence target flows, along with low reservoir water levels state-wide, led EWEB to refine its low-water-use messaging and trigger criteria. However, no formal curtailment stages have been triggered in the last 10 years.

As described in the Evaluation of Water Rights/Supply in Section 2, the EWEB's current system capacity (supply) is limited by the current treatment capacity of the Hayden Bridge WTP. EWEB's surface water intake located on the McKenzie River, has a capacity of 100 mgd, while the Hayden Bridge WTP has a capacity of 80.5 mgd. The WTP can produce finished water at higher rates (approximately 88 mgd) for short periods as needed. While the McKenzie River is a reliable source of supply, the likelihood of EWEB maintaining the ability to deliver water during a long-term drought, natural disaster, source contamination, or other water shortage trigger is currently constrained by the McKenzie River as EWEB's only operational source of supply. EWEB also has a groundwater source to develop under the Confluence wellfield water right, although there are some constraints to its use due to interference with other groundwater users in the area. Recognizing this, EWEB worked to secure a permit for an alternative second source from the Willamette River. EWEB completed a Resiliency Plan as part of its recent 2015 Water System Master Plan to improve its ability to respond to water shortages, as well as meet

future water demands. Also, EWEB recently began evaluating smaller, local, and distributed groundwater wells to provide short-term emergency supplies should a natural disaster or other extreme event impact its major source of supply.

4.3 Curtailment Event Triggers and Stages

OAR 690-086-0160(2) and (3)

EWEB will implement a Water Supply Shortage Contingency Plan if EWEB's water supply cannot keep up with consumer water demands. Scenarios that could result in a water supply shortage include: hot/dry spells, drought, severe floods, a chemical spill into the river, system or facility failure, and a natural disaster event, such as an earthquake that causes water system failures. The curtailment plan is designed to be initiated and implemented in progressive stages, which depend on the nature of the event causing the water supply shortage and the conditions preceding and following the event. **Exhibit 4-1** presents the four curtailment stages, as well as their potential initiating conditions and the estimated overall reduction in demand needed to meet current and projected water demands or to protect the water resources from serious harm. EWEB's initiating conditions focus on reservoir water levels and deficit rates in the water supply system because conditions in the system and responses to those conditions can be clearly defined. However, initiating conditions from other supply shortage scenarios also are included in **Exhibit 4-1**.

Exhibit 4-1. Curtailment Stages 1 through 4

Curtailment Stages	Potential Initiating Conditions
Stage 1: Water Shortage Advisory Demand Reduction Target: 15 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate of up to 5 mgd. • Damage repair is required at water transmission or production facilities.
Stage 2: Water Shortage Alert Demand Reduction Target: 30 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate of up to 15 mgd. • Moderate damage to the transmission or distribution.
Stage 3: Water Shortage Emergency Demand Reduction Target: 50 percent of MDD	• Base level reservoirs are losing storage volume at a deficit rate greater than 15 mgd. • Significant damage to transmission or distribution system. • Isolated contamination of the water supply.
Stage 4: System Shutdown	• Reservoir levels have reached a point where system failure is imminent. • Demand management measures have been unsuccessful in reducing demand to available supply, and in order to preserve remaining water for rationed emergency use, reservoirs must be shut down. • Severe chemical spill immediately upstream of the intake. • Failure of a critical water system component and facilities. • Potentially harmful contamination of the entire water supply.

Notes:
MDD = maximum day demand.
mgd = million gallons per day.

In 2015, EWEB developed a drought-related curtailment plan with triggers based on temperature, stream flows, and high water demands, which involved refining EWEB's voluntary water reduction messaging to its customers.

4.4 Authority and Enforcement

The Incident Commander, the responding entity within the Water Division where the incident is rooted, or the on-call supervisor, will determine and communicate the level of curtailment based on the condition of the system. The Incident Commander decides whether and when to call the Water Operations Manager, Division Director, Public Affairs Director, and other appropriate individuals. The Incident Commander is also responsible for executing the curtailment plan after an emergency declaration, if appropriate.

Depending on the curtailment stage, EWEB will request either voluntary or mandatory curtailment of water use by its customers. Voluntary curtailment will be at the customer's discretion, with EWEB providing guidelines on ways to conserve water. EWEB will request mandatory curtailment when EWEB's water system is at serious risk and will specify what type of curtailment is mandatory. EWEB also will activate customized curtailment agreements for large water users, such as school districts. As part of the condition of new water service, EWEB requires large use customers to develop customized water curtailment plans that outline the actions the customer will take in a water supply shortage.

In Curtailment Stages 3 and 4, customers with emergency medical needs and/or other health and safety considerations may appeal to the EWEB Board for an exemption in writing to EWEB Incident Commander detailing the water consumption required.

Penalties for using water for a mandatory curtailed use, as declared by EWEB, and without permission from EWEB, are:

- First violation: EWEB will send a written request to cease water use and a warning for issuance of a fine if the unauthorized use continues.
- Second violation: A fine of $300 and termination of service.

In the Water Service Conditions section of EWEB's Water Utility Customer Services Policies and Procedures manual, EWEB outlines the general policies and procedures for water shortages and curtailment.

4.5 Coordination

EWEB has coordinated its curtailment plan with neighboring water utilities (SUB and RWD) to be able to respond as effectively as possible to a water supply shortage. During all stages of curtailment, EWEB will emphasize the following in its communication with customers:

- EWEB coordinates with other agencies and water providers, and these entities are ready to provide assistance to each other.
- SUB, RWD, and EWEB have agreements to provide mutual aid should another supplier need water (**Appendix C**). Interconnections exist among these three utilities.

- Everyone is in the situation together. Many of those affected by the situation live in the City of Springfield and work in the City of Eugene, or vice versa. Everyone should approach the (chosen level) advisory/alert/emergency as good neighbors and look for ways to help one another.

4.6 Curtailment Plan Implementation and Enforcement
OAR 690-086-0160(4)

Stage 1: Water Shortage Advisory

Stage 1 activates a program to inform customers of a growing water shortage and to recommend reductions in consumption to achieve a 15 percent reduction of water use for the entire system.

Goals

1. Minimize inconvenience to customers.
2. Maintain water system performance.
3. Maximize efficiency of existing water supply.
4. Reduce potential for activating more severe water shortage stages.
5. Increase awareness and shared responsibility among utilities, customers, and city and state officials.
6. Decrease water use in all customer sectors.

Actions

1. External Communication
    - Alert public officials of supply shortage situation.
        - Begin media outreach to advise customers of the supply shortage situation and to provide specific ways customers can reduce water use. Outreach will include public service messages specific to the projected duration of the event. EWEB will publicize results of conservation efforts and progress of both customers and the utility in meeting demand reduction goals.
        - For residential customers, EWEB will suggest decreasing water use for all domestic purposes, such as minimizing outdoor watering, clothes washing, length of showers, and toilet flushing.
        - For commercial/industrial/government customers, EWEB will encourage reductions in landscape watering, use of process water, and general domestic water use.
        - Primary messages to the public:
            - EWEB/SUB/RWD is issuing a Stage 1 water advisory for customers in (*specific geographic region, if applicable*) area because (*reason for advisory*).

  - This Stage 1 advisory includes only EWEB/SUB/RWD customers in (*name of area*) area. Those customers outside the (*name of area*) area **are not** affected by this advisory.
  - Reminder that water supplies are very local, and that (*reason for advisory*) can exist elsewhere in the state without directly affecting local supplies.
  - At this time, EWEB/SUB/RWD needs a voluntary reduction in water use of 25 percent* until (*the situation*) is passed. This 25 percent reduction can be accomplished with minimal changes to daily activities.
  - **EWEB estimates that asking for a 25 percent reduction will result in reductions close to its goal of 15 percent, assuming that some water customers will not reduce use.*
  - Given the (*the reason for Stage 1 advisory*), the potential for a reduced water supply exists. EWEB/SUB/RWD is asking customers to monitor the news media in case the situation evolves and we need to ask for further reductions.

- Action messages to the public:
  - Use the Green Grass Gauge to give your lawn and landscape just enough water.
  - Be mindful of peak-time watering, and when to use drip vs. sprinklers.
  - Postpone new plantings.
  - Do not use water to clean off driveways/sidewalks.
  - Check for and repair leaks (yard sprinklers, plumbing).
  - Educate yourself on water conservation by going to EWEB/SUB websites.
  - Every little bit helps!
  - Have you reduced water use today?
  - Voluntary reductions today could negate the need for mandatory reductions tomorrow.
- EWEB will announce messages using: the EWEB website, social media, radio, TV, newspaper, neighborhood newsletters, and emails, if applicable.

2. Internal Communication
   - Alert the EWEB Board of the situation.
   - Activate the Water Supply Shortage Team to evaluate the situation and project the length of time for the supply shortage event and the anticipated time to recovery.
   - Prepare operators and field staff members to mobilize as needed for the situation.
   - Provide details to employees, particularly those in contact with the public.
3. Operations
   - Activate monitoring protocol, including supply and water quality.
   - Conduct hydraulic model runs to project supply shortage effects.

- Minimize and prioritize all operating system water uses determined not to be essential to maintain water quality, such as pipeline.

Stage 2: Water Shortage Alert

Stage 2 activates a similar program as Stage 1, but begins to prohibit particular water uses to achieve a 30 percent reduction of water use for the entire system.

Goals

1. Minimize impacts to customers while achieving demand reduction targets.
2. Minimize impacts to the system's long-term operation.
3. Eliminate any water waste through conservation.
4. Slow down or eliminate the need to activate the emergency water shortage stage.
5. Intensify awareness and shared responsibility among the utility, customers, and city and state officials.
6. Minimize economic hardship to customers and to the utility in managing system integrity.

Actions

1. External Communication
    - Intensify the media campaign to clearly communicate the supply shortage situation to customers and to provide clear communication on water use restrictions and how long restrictions will be imposed. Inform the public of the probable scenario if demand reduction is not achieved. Include the penalties and enforcement activities that will occur if customers do not comply with mandatory restrictions.
        - Residential customers: EWEB will suggest decreasing water use for all domestic purposes, such as minimizing outdoor watering, clothes washing, length of showers, and toilet flushing. EWEB will request that customers cease washing paved areas, buildings, and vehicles, as well as planting new landscapes and using water in ornamental water features.
        - Commercial/Industrial/Government customers: EWEB will encourage reductions in landscape watering, use of process water, and general domestic water use. EWEB will encourage customers to minimize or cease landscape watering. EWEB will request that the use of process water is scheduled to match the system management strategy and water uses for production be postponed or eliminated where possible.
        - Water Districts and the WWC: EWEB's Incident Commander will contact water districts and the WWC directly about what actions they need to take because these entities are categorized by EWEB as "Large Volume and Critical Needs Customers." EWEB will request that the water districts and the WWC implement the same curtailment strategy for their customers as EWEB has for its other customers. However, because water supplied to WWC is considered surplus by EWEB, the Incident Commander will have to consider whether WWC will be

curtailed differently than other EWEB customers. That amount of curtailment could depend greatly on the type of emergency given how WWC is served from EWEB's system.

- Primary messages to the public:
  - EWEB/SUB/RWD is issuing a Stage 2 water alert for customers in (*geographic region, if applicable*) area because (*reason for alert*).
  - This Stage 2 water alert includes **only** EWEB/SUB/RWD customers in (*name of area*) area. Those customers outside the (*name of area*) area **are not** affected by this advisory.
  - At this time, EWEB/SUB/RWD **MUST HAVE** a voluntary reduction in water use of 50 percent* until (*the situation*) is passed.

    **EWEB estimates that asking for a 50 percent reduction will result in reductions close to its goal of 30 percent, assuming that some water customers will not reduce use.*
  - This 50 percent reduction **will require some changes** to daily activities.
  - Given the (*reason for alert*), the potential for a reduced water supply exists. EWEB/SUB/RWD is asking customers to monitor the news media in case the situation evolves and we need to ask for further reductions.

- Action messages to the public:
  - We are all in this together. Each of us **must** reduce water use today.
  - We are asking all customers to limit water use to only those uses necessary for human health and safety.
  - We ask all customers not to water lawns and landscapes until this situation passes.
  - Use the Green Grass Gauge to give your **vegetable garden** just enough water.
  - At this time we are asking people to avoid washing their personal or business vehicles themselves (go to a commercial car wash that uses recycled water).
  - Please do not fill private pools and spas.
  - Implement water conservation by going to utility websites and applying tips.
  - Please halt all pressure washing except for construction purposes.
  - We ask you not to wash sidewalks or driveways.
  - If we don't get enough voluntary reduction, the next step is mandatory cutbacks that will be enforced.
- EWEB will announce messages using: the EWEB website, social media, radio, TV, newspaper, neighborhood newsletters, and emails, if applicable.

- Request the City of Eugene to eliminate all unnecessary uses of water except those for maintaining public health and safety, and to assist EWEB's staff in enforcement of the water use restriction.

- Assist school districts in educating and distributing water use restriction information.
- Assemble public officials to inform and solicit support for enforcement and distribution of penalties for non-compliance and for communication about the supply shortage situation.

2. Internal Communication
   - Continue actions from previous Stage 1 as appropriate, including assembling the Water Supply Shortage Team.
   - Evaluate EWEB's ability, resources, and action plan to move into emergency phase.
3. Operations
   - Intensify monitoring activities to track and assess water quality throughout the distribution system and overall system integrity.
   - Conduct hydraulic model runs to project supply shortage effects and system performance.
   - Prioritize and eliminate all operating system water uses determined to be non-essential to maintain water quality and system integrity.
   - Activate the action plan for implementing back-up water supply options that may include water tank trucks, greywater systems for outdoor irrigation of sensitive landscapes or community gardens, and interconnection with other water purveyors.
   - Impose a temporary moratorium on new water delivery connections, temporary water delivery (i.e., construction operations, special events, and temporary irrigation water delivery), testing and flushing new water mains, and/or issuance of hydrant meters for temporary purposes.
   - Mobilize resources to implement enforcement procedures for restrictions.

Stage 3: Water Shortage Emergency

In addition to the Stage 2 actions, Stage 3 expands the suite of prohibited water uses on non-essential water uses to achieve a 50 percent reduction of water use for the entire system.

Goals

1. Prevent system shutdown.
2. Prevent adverse health and safety impacts to the community.
3. Minimize economic hardship and health and safety risks to all customers.

Actions

1. External Communication
   - Continue and intensify all action itemized in the previous stage.

- Inform customers that all water use is mandatorily restricted except the minimal use required to maintain basic domestic consumption and sanitation (toilets, cooking, showers) and to prevent irreversible damage to water-using equipment.
  - Residential customers: All uses other than basic sanitation, drinking, and culinary use are prohibited.
  - Commercial/Industrial/Government customers: Use of process water and general domestic water use will be minimized to the greatest extent possible. EWEB will request that the use of process water is scheduled to match the system management strategy and water uses for production be postponed or eliminated where possible. Landscape watering is banned. All allocation of water use for industrial and commercial customers will be determined by the EWEB Board.
  - Water Districts and the WWC: EWEB will require that water districts follow all curtailment measures implemented under Stages 1 through 3 that other EWEB customers follow. However, because water supplied to WWC is considered surplus by EWEB, the Incident Commander will have to consider whether WWC will be curtailed differently than other EWEB customers. That amount of curtailment could greatly depend on the type of emergency given how WWC is served from EWEB's system.
- Primary messages to the public:
  - EWEB/SUB/RWD is issuing a Stage 3 water emergency for customers in (*geographic region, if applicable*) area because (*reason for emergency*).
  - This Stage 3 water emergency includes only SUB/RWD/EWEB customers in (*name of area*) area. Those customers outside the (*name of area*) area **are not** affected by this advisory.
  - At this time, EWEB/SUB/RWD is instituting **MANDATORY RESTRICTIONS** on water uses until (*the situation*) is passed. These mandatory reductions will require significant changes to daily activities.
  - Utilities (or EWEB/SUB/RWD is) are instituting **mandatory** water restrictions to reduce demand because voluntary decreases are not producing enough of a reduction. We must achieve a (*add number*) percent reduction.
  - Given the (*reason for emergency*), the potential for a reduced water supply exists. EWEB/SUB/RWD is asking customers to monitor the news media in case the situation evolves and we need to **require** further reductions.
  - We continue to rely on the support and cooperation of the public, but we also need to restrict certain water uses to make sure there is enough water for public health and safety.
  - Anyone violating the mandatory restrictions is subject to fines (*add $ amount of fines*). We have established a hotline for the public to report violators.
- Action messages to the public:
  - EWEB/SUB/RWD (or all of us) is/are now in a Stage 3 water emergency.

  - Thank you for temporarily reducing your water use.
  - We are informing you of mandatory reductions in water use, or we face an accelerated risk of compromised water quality.
  - We prohibit all car washing, except at commercial car washes that recycle water.
  - We prohibit the washing of sidewalks, streets, and driveways.
  - We prohibit the filling of private and recreational public swimming pools and spas.
  - We prohibit all landscape, turf, and garden watering.
  - We prohibit the installation of new turf and landscape.
- EWEB will announce messages using: the EWEB website, radio, TV, newspaper, neighborhood newsletters, emails (if applicable), and possibly door-to-door.
- EWEB will request that the City of Eugene discontinue all non-essential water use and assist EWEB in enforcement of water use restriction.
- School districts will have to be closed.
- Request activation of the emergency broadcast system.

2. Internal Communication
   - Inform all appropriate EWEB staff members (operators, field staff, and other employees) of actions and expectations in a Stage 4 scenario.
3. Operations
   - No new connections or main extension work are allowed, except those approved by the EWEB Board.
   - Connect to other sources, if available.
   - Mobilize and prepare for system shutdown and rationing protocol.

Stage 4: System Shutdown

Stage 4 responds to events that have caused immediate and sustained loss of water use. These events may include severe chemical spill in the McKenzie River upstream of the intake, failure of the WTP, failure of both intakes on the river, and a malevolent attack on the water system resulting in system contamination.

Goals

1. Preserve remaining water for rationing.
2. Minimize system damage.
3. Before system failure, issue notice for customers to boil water and that water rationing is in effect, as well as other Stage 4 curtailment actions required of customers.
4. Minimize adverse health and safety impacts to the community.

Actions

As the cause and severity of the event dictates, EWEB will:

1. External Communication
    - Contact the Oregon Drinking Water Program and the Oregon Health Authority.
    - Contact county, state, and federal law enforcement officials, as appropriate.
    - Contact local hospitals, as appropriate.
    - Contact Critical Needs and Large Volume Customers, which are defined as the top 50 percent of general service water users.
    - Communicate to all customers that all water uses are prohibited except those uses necessary for human consumption and sanitation needs, and those uses should be rationed.
        - Primary messages to the public:
            - Utilities (or EWEB/SUB/RWD is) are instituting mandatory water rationing.
            - This Stage 4 shutdown includes **only** EWEB/SUB/RWD customers in (*name of area*) area. Those customers outside the (*name of area*) area **are not** affected by this advisory.
            - To provide water for emergencies and for health and human safety, **we must achieve** a (*add number*) percent reduction in water use.
            - There are existing interconnections between SUB, RWD, and EWEB, as well as an agreement among the three utilities for mutual aid.
            - If providing mutual aid: EWEB/SUB/RWD customers are asked to follow these regulations to help in this joint effort.
        - Action messages:
            - At this time, EWEB/SUB/RWD is requiring all customers to boil water for drinking, cooking, and other public health and safety purposes.
            - EWEB/SUB/RWD has set water use limits on all residential, commercial, and industrial users.
        - EWEB will announce messages using: the EWEB website, radio, TV, newspaper, neighborhood newsletters, emails (if applicable), and possibly door-to-door.
2. Internal Communication
    - Announce implementation of the emergency action plan among employees.
3. Operations
    - Implement the emergency action plan.
    - EWEB anticipates providing an emergency water supply to selected facilities. At the time this WMCP was prepared, the locations include three federal sites near the downtown core, the Community Points of Distribution, and a portion of the water distribution points depending on which is accessible or needed following an event.

4.7 Drought Declaration

If the Governor declares a drought in Lane County, EWEB will inform customers of the drought declaration and the status of the EWEB's water supply via the EWEB website. In addition, EWEB will ask customers to voluntarily decrease water use. EWEB will outline measures that customers can take to reduce water use and it will remind customers of EWEB's availability as a water conservation resource for information and water-saving devices.

5. Municipal Water Supply

This section satisfies the requirements of OAR 690-086-0170.

This rule requires descriptions of EWEB's current and future water delivery areas and population projections, demand projections for 10 and 20 years, and the schedule for when EWEB expects to fully exercise its water rights. The rule also requires comparison of EWEB's projected water needs and the available sources of supply, an analysis of alternative sources of water, and a description of required mitigation actions.

5.1 Delineation of Water Delivery Areas

OAR 690-086-0170(1)

EWEB's current water delivery areas are described in Section 2. EWEB anticipates that its future water delivery area will not expand beyond its current water delivery area during the planning horizon of this WMCP, such that **Exhibit 2-1** can be considered the future water delivery area as well. However, there is a possibility that the City of Eugene may expand its UGB, which the City is currently considering.[5] Because EWEB's water delivery area is based, in part, on the City of Eugene's UGB, EWEB's water delivery area could similarly expand. Although EWEB does not expect expansions to its current water delivery area, EWEB likely will add wholesale connections. Several neighboring communities (Cities of Creswell, Coburg, and Junction City) have contacted EWEB regarding wholesale water supply opportunities because of the lack of other water sources available to these communities. Wholesale connections to EWEB's water supply system are made at the boundary of EWEB's water delivery area.

5.2 Population Projections

OAR 690-086-0170(1)

Projections for EWEB's water delivery area population (City of Eugene UGB) are based on population forecasts developed for Lane County by Portland State University's Population Research Center. The methods, assumptions, and data used to develop the forecasts are detailed in *Coordinated Population Forecasts for Lane County, its Urban Growth Boundaries (UGB) and Area Outside UGBs: 2015-2065, June 2015*.

In summary, the population forecasts were developed by extending historical and current demographic and housing trends into the future. Assumptions were made about the future, and projection models incorporated some of these assumptions about events that could affect future growth, such as changes in buildable land available, the economy, and local population and household composition.

[5] As part of the Envision Eugene process, Lane Council of Governments (LCOG) has identified expansion areas that could lead to growth in the EWEB service area outside of the existing UGB. However, LCOG makes no predictions on the timing and phasing of the growth in each of these expansion areas.

Projected EWEB Water Delivery Area Population within Current Water Delivery Area

The EWEB water delivery area population within the current water delivery area consists of the City of Eugene (within the city limits) and the UGB (Metro Urban Area West of I-5). This population includes wholesale customers currently served in the Santa Clara Water District and River Road Water District, and WWC. For population growth within this current water delivery area, the annual average growth rate is anticipated to continue at an average rate of 1.07 percent to 2028 and decrease slightly to 0.82 percent from 2028 to 2038. Population in the City of Veneta UGB as a wholesale customer is accounted for separately in the following demand forecast. The estimated population in 2018 is 5,340 and population growth is anticipated to average 2.83 percent to 2028 and decrease to an average of 1.76 percent from 2028 to 2038. The City of Veneta population projection is also based on the *2015 Coordinated Population Forecasts for Lane County* prepared by Portland State University's Population Research Center.

Projected Population of Potential Wholesale Connections

EWEB has had discussions with several cities about acquiring wholesale water supply to help the growing cities meet their projected water demand and to provide a separate emergency water supply source. As a result, EWEB also projected the total population of its potential wholesale connections for planning purposes. The Cities of Creswell, Junction City, and Coburg are expected to experience population growth averaging 1.1 percent to 1.7 percent annually through 2028, and reducing slightly with average growth rates ranging from 1.2 to 1.4 percent. The estimated UGB population for the three communities are 1,065 for Coburg, 5,776 for Creswell and 6,770 for Junction City. These population projections are also based on the *2015 Coordinated Population Forecasts for Lane County* prepared by Portland State University's Population Research Center.

Exhibit 5-1 summarizes EWEB's projected water delivery area population within its current water delivery area, projected population of potential wholesale connections, and total projected population for 2028 and 2038**.** These projections show a total potential population of approximately 256,000 in 2038.

Exhibit 5-1. Population Projections for EWEB Water Delivery Area and Potential Wholesale Connections

Projected Population	2028	2038
EWEB Water Delivery Area Population within Current Water Delivery Area (UGB)	211,536	229,496
Existing Wholesale Connection to City of Veneta	6,784	8,075
Potential Wholesale Connections (Cities of Creswell, Junction City, and Coburg)	15,850	18,133
Total	**234,169**	**255,703**

Note:
UGB = urban growth boundary

5.3 Demand Forecast

OAR 690-086-0170(3)

In 2015, EWEB completed its Water System Master Plan (WSMP), which includes an updated water demand forecast. For consistency, the general methodology and assumptions from the 2015 WSMP are applied here, but adjusted to align with 10- and 20-year planning periods. Water demand projections were developed for 2028 and 2038 using two demand forecasts scenarios: (1) EWEB serving only the population within its current water delivery area (including City of Veneta as wholesale customer) and (2) EWEB serving the population within its current water delivery area, plus future potential wholesale connections (Cities of Creswell, Junction City, and Coburg).

To calculate overall water system demands, the 2015 WSMP applied per capita water use factors. The water use factors for the years 2010 through 2016 are shown in Exhibit 2-9, with an annual average water demand factor of 133 gpcd. As water demand generally was decreasing during this period, the average per capita water demand for the entire period also decreased. Projecting water demands based on the current per capita value (133 gpcd) assumes that the decrease in per capita demand is permanent and that demand growth between the present and 2038 will be a function of growth. The per capita demand decrease that has occurred in the last 5 years likely is based on conservation efforts leading to more efficient water usage within the service area and by economic factors. It is unlikely that per capita water demand will rebound to the 150 gpcd or higher values experienced previously. However, it is possible that per capita demand factors will rebound somewhat as economic conditions improve during the planning period. Based on this reasoning, the 2015 WSMP assumed a value of 135 gpcd for average water demand projections.

EWEB's demand forecast consists of three components: (1) the demand forecast for EWEB's population within its current water delivery area described above; (2) demand forecast for EWEB's existing wholesale connection to City of Veneta; and (3) the demand forecast for future potential wholesale connections. These demand components are integrated using the following information:

- EWEB's existing delivery area: 135 gpcd as annual average per capita water use for EWEB water delivery area with a MDD peaking factor of 2.1, based on the assumption used in the 2015 WSMP as discussed above; EWEB's water delivery area includes the City of Eugene; the dissolved Bethel, Hillcrest, and Oakway Water Districts; Eugene Airport Special Service District; and Lane Community College Special Service District.
- EWEB's wholesale connection to City of Veneta: 150 gpcd as annual average per capita water use for City of Veneta with a MDD peaking factor of 2.3, based on values from the City of Veneta's 2012 Water Master Plan Update. This assumes EWEB would serve the full demands of the City of Veneta.
- EWEB's future potential wholesale connections: 150 gpcd as annual average per capita water use for the Cities of Creswell, Junction City, and Coburg with a MDD peaking factor of 2.1. The per capita water use values are based on a 5 percent reduction from the EWEB's 2012 WMCP, which is the same reduction that occurred for EWEB's per capita water use factor since that time.

- Population data for the above referenced communities is from Portland State University's *Coordinated Population Forecasts for Lane County, Urban Growth Boundaries (UGB) and Area Outside UGBs: 2015-2065,* June 2015.
- EWEB assumes that it would begin to add future potential wholesale connections after the year 2025 as demands rise above the existing water supplies within the neighboring communities. EWEB will provide wholesale water equal to the total water demand that occurs above the 2025 MDD for the Cities of Creswell, Junction City, and Coburg.

Demand Projection Summary

Exhibit 5-2 shows EWEB's projected MDD in 10 and 20 years with the current and potential wholesale customers. The projection for the current water delivery area plus existing wholesale connections scenario assumes that EWEB would begin to add wholesale connections after 2025. These wholesale connections would require water incrementally as demand rises above what the municipal water provider can provide with their own existing water supply as of the projected demand in year 2025 for these wholesale customers. The additional supply to wholesale connections results in approximately 1 mgd more demand than serving wholesale water to the City of Veneta alone. Under the current water-delivery-area-only scenario with the City of Veneta wholesale, EWEB is projected to need 68 mgd (105 cfs) by 2038. Under the current-water-delivery-area plus future-wholesale-connection scenario, EWEB is projected to need 69 mgd (107 cfs) by 2038.

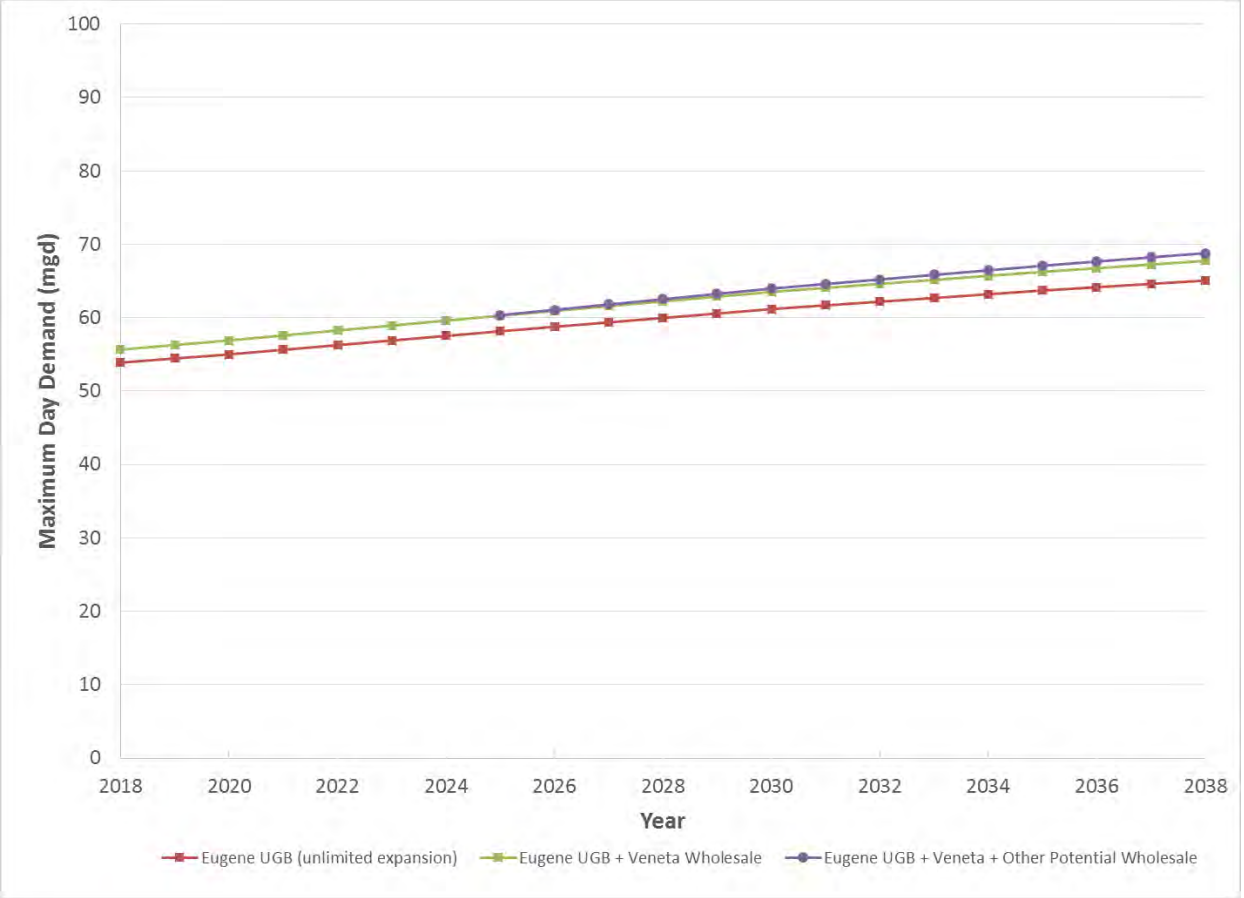
Exhibit 5-2. EWEB Projected MDD (mgd)

Water Demand Scenarios	2028	2038
EWEB Water Delivery Area Population within Current Water Delivery Area	60	65
EWEB Water Delivery Area Population within Current Water Delivery Area plus Current Wholesale Connection	62	68
EWEB Water Delivery Area Population within Current Water Delivery Area plus Current and Potential Wholesale Connections	63	69

Notes:
MDD = maximum day demand
mgd = million gallons per day

Exhibit 5-3 shows the MDD projections graphically.

Exhibit 5-3. EWEB Projected MDD



5.4 Schedule to Exercise Permits and Comparison of Projected Need to Available Sources

OAR 690-086-0170(2) and (4)

EWEB holds three surface water rights that authorize the use of McKenzie River water for municipal purposes: Certificate 15180 (27.08 cfs, 17.5 mgd), Certificate 68537 (90 cfs, 58.2 mgd), and Permit S-27441 (4.82 cfs [2.59 mgd] out of the total 183.0 cfs with extension development limitation). EWEB's McKenzie River water rights are considered reliable because of their relative seniority, as well as the limited amount of water appropriation and the abundant stream flows in the portion of the river from which EWEB appropriates water, as described in Section 2. EWEB also holds surface water registration SW-354 for up to 30.9 cfs (approximately 20 mgd) from the Willamette River and Permit S-54805, which authorizes the use of up to 30.9 cfs from the Willamette River for municipal use and is duplicative of surface water registration SW-354. Permit S-54805 maintains EWEB's previous total combined maximum authorized rate

under all of its water rights at 300.08 cfs. Permit G-16371 authorizes appropriation of up to 18.49 cfs (11.9 mgd) of groundwater from EWEB's Confluence Wellfield.

For the reasons mentioned in Section 2, Permit G-16371 is not a reliable source of supply and the final disposition of SW-354 will not be determined until the Willamette Basin is adjudicated. Permit S-54805 is intended only to provide supply redundancy and operational flexibility; the permit does not increase the combined maximum authorized rate for EWEB's water rights. Therefore, SW-354, Permit G-16371, and Permit S- 54805 are not included as EWEB's "firm" water supply for planning purposes. Consequently, EWEB intends for its future demand to be served by continuing to use Certificates 15180 and 68537, and by continuing its development of Permit S-27441 associated with the McKenzie River source. **Exhibit 5-4** shows EWEB's total McKenzie River water rights superimposed on its projected MDDs under the demand projection scenarios.

Exhibit 5-4. EWEB Projected MDD and EWEB Total McKenzie River Water Rights

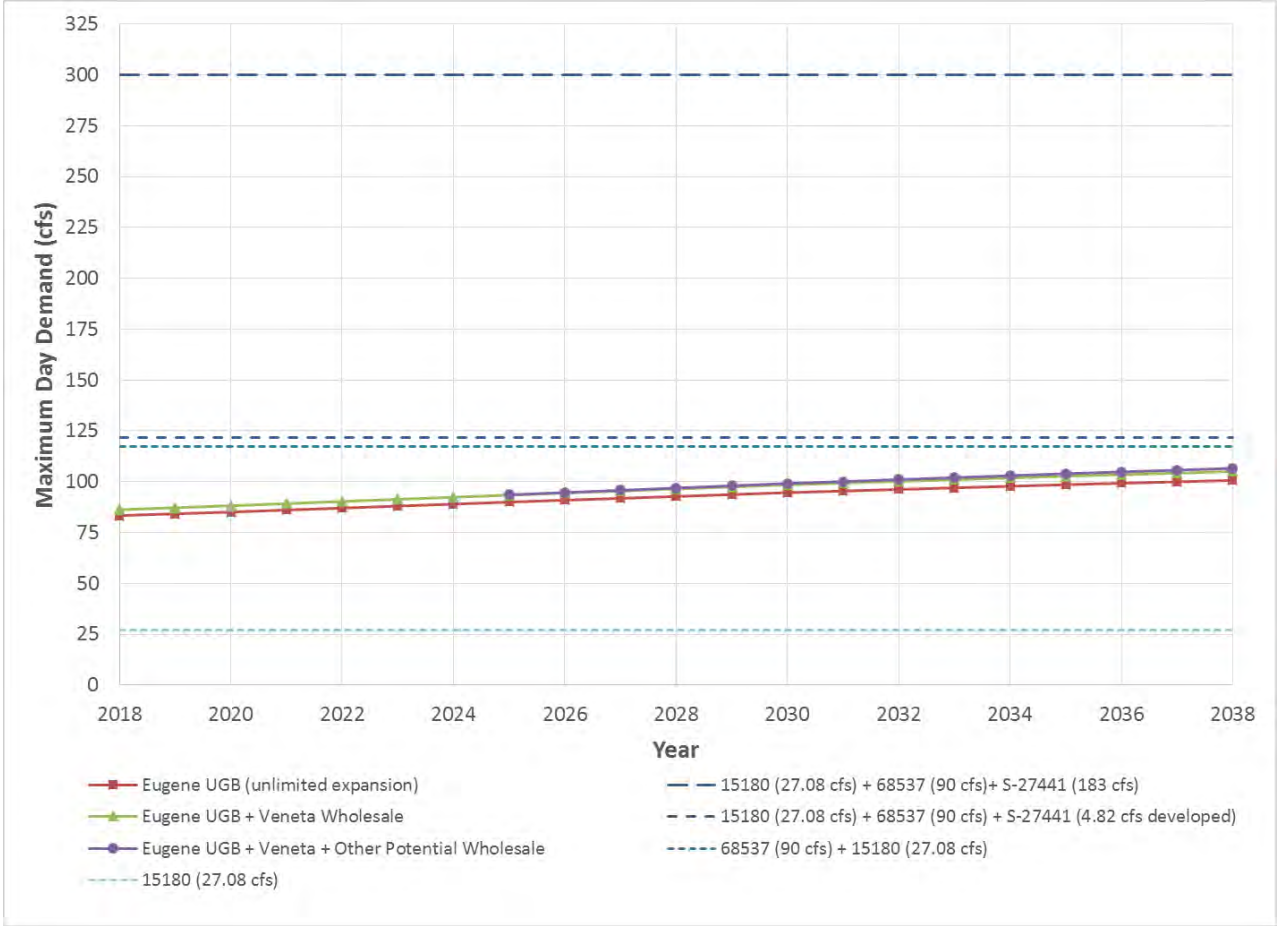


Exhibit 5-4 indicates that EWEB's existing water rights can meet the projected municipal water demands within its current water delivery area and with the addition of wholesale connections for the next 20 years, which is the planning horizon for this WMCP.

Projecting when the full amount of Permit S-27441 will be needed is difficult given fluctuations that occur in the economy, as well as the inability to predict the arrival or departure of industries and changes in demographics in the long term. As described in EWEB's most recent permit extension application for Permit S-27441, EWEB anticipates that full beneficial use will occur by October 1, 2083. However, EWEB will be reanalyzing projected demands and the need to access water under Permit S-27441 with each subsequent WMCP update.

EWEB's plans for using its Willamette River water rights for municipal use (surface water registration SW-354 and Permit S-54805) and groundwater rights (Permit G-16371) are currently being reevaluated as a result of a change in management at EWEB. Subsequent WMCP updates will clarify progress in developing a schedule for putting these water rights to beneficial use, but EWEB intends to fully develop the water rights by their authorized date of completion.

5.5 Alternative Sources

OAR 690-086-170 (5)

OAR 690-086-0170(5) requires an analysis of alternative sources of water if any expansion or initial diversion of water allocated under existing permits is necessary to meet future water demand. During the next 20-year planning period, EWEB does not intend to expand diversion of water under existing permits to meet increased municipal demands. The following subsections analyze the extent to which EWEB can meet its projected water need through other alternatives. Thus, EWEB is not required to evaluate alternative sources for this section. Regardless, EWEB will continue to its successful water conservation programs to maintain the water savings and efficient water delivery achieved during the past decade of implementation.

5.6 Quantification of Maximum Rate and Monthly Volume

OAR 690-086-0170(6)

OAR 690-086-0170(6) requires a quantification of the maximum rate of withdrawal and maximum monthly use if any expansion or initial diversion of water allocated under an existing permit is necessary to meet demands in the 20-year planning horizon. EWEB is not anticipating expanding use under existing permits during the next 20 years. Therefore, this rule does not apply.

5.7 Mitigation Actions under State and Federal Law

OAR 690-086-0170(7)

Under OAR 690-086-0170(7), for expanded or initial diversion of water under an existing permit, the water supplier is to describe mitigation actions it is taking to comply with legal requirements of the Endangered Species Act, Clean Water Act, and other applicable state or federal environmental regulations. EWEB currently is not required to take any mitigation actions under state or federal law.

EWEB received final order approving a permit extension for more time to develop Permit S-27441, which includes permit extension conditions. The Oregon Department of Fish and Wildlife has identified flows necessary to "maintain the persistence" of listed fish, and "fish persistence" conditions likely will be included in OWRD's final order on the permit extension. The conditions are detailed in the Final Order included in **Appendix D**.

5.8 New Water Rights

OAR 690-086-0170(8)

Under OAR 690-086-0170(8), an analysis of alternative sources of additional water is required if acquisition of new water rights will be necessary within the next 20 years to meet the projected water demands. EWEB does not anticipate the need to acquire a new water right to meet its projected water demands during the next 20 years.

Appendix A

Letters Requesting Comments and Comments Received

GSI Water Solutions, Inc.

November 15, 2017

Santa Clara Water District
c/o Griggs & Associates, LLC
880 Beltline Road
Springfield, OR 97477

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Santa Clara Water District:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with your planning information. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your planning information and assumptions, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

River Road Water District
105 Oakleigh Lane
Eugene, OR 97404

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear River Road Water District:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with your planning information. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your planning information and assumptions, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Willamette Water Company
P.O. Box 876
Veneta, OR 97487

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Willamette Water Company:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with your planning information. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your planning information and assumptions, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Springfield Utility Board
202 South 18th Street
Springfield, OR 97477

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Springfield Utility Board:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with your planning information. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your planning information and assumptions, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Rainbow Water District
1550 N. 42nd Street
P.O. Box 8
Springfield, OR 97477

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Rainbow Water District:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with your planning information. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your planning information and assumptions, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Denny Braud
City of Eugene
99 W. 10th Ave.
Eugene, OR 97401

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Mr. Braud:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Tom Boyatt
City of Springfield
225 Fifth Street
Springfield, OR 97477

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Mr. Boyatt:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

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If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Lisa Garbett
City of Veneta
P.O. Box 458
Veneta, OR 97487

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Ms. Garbett:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Lydia McKinney, Planning Director
Lane County
3050 N. Delta Highway
Eugene, OR 97408

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Ms. McKinney:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Jeff Kernen
City of Coburg
P.O. Box 8316
Coburg, OR 97408

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Mr. Kernen:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Madeline Phillips
City of Creswell
P.O. Box 276
Creswell, OR 97426

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Ms. Phillips:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

November 15, 2017

Jordan Cogburn
City of Junction City
P.O. Box 250
Junction City, OR 97448

Subject: Water Management and Conservation Plan for Eugene Water and Electric Board

Dear Mr. Cogburn:

Eugene Water and Electric Board (EWEB) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its draft WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. Enclosed is a USB flash drive containing EWEB's draft WMCP for your review.

Please provide comments to me within 30 days from the date of this letter (no later than December 20, 2017). If the plan appears consistent with your Comprehensive Land Use Plan, a letter response to that effect would be appreciated. You may send your comments to me by email at rigloria@gsiws.com.

If you have any questions, please feel free to contact me at 971-200-8510. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Ronan Igloria, PE, CWRE
Senior Water Resources Consultant

Enclosure

Appendix B

5-Year Progress Letter for 2012 EWEB WMCP

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

May 15, 2017

Eugene Water and Electric Board
Attn: Nathan Endicott
PO Box 10148
Eugene, OR 97440

SUBJECT: Water Management and Conservation Plan Five-Year Progress Report

Dear Mr. Endicott:

Thank you for submitting the Eugene Water and Electric Board's (EWEB) Water Management and Conservation Plan (WMCP) Five-Year Progress Report on April 3, 2017. It was a pleasure to review the detailed and thorough accounting of accomplishments and improvements made in the management and conservation of water by EWEB over the past several years.

As you know, the Oregon Water Resources Department (Department) published notice of receipt of the progress report on the Department's public notice dated April 11, 2017. The public notice initiated a 30-day public comment period on EWEB's WMCP Five-Year Progress Report. No public comments were received as a result of the public notice.

The Department's review of EWEB's WMCP Five-Year Progress Report on the implementation of its WMCP did not reveal any deficiencies. Therefore, no further action related to EWEB's progress report is needed.

The next requirement related to EWEB's approved WMCP calls for the submittal of an updated WMCP to the Department by February 1, 2022. The Department issued a Final Order approving an Extension of Time for Permit #S-27441 on January 16, 2015. As a condition of the Final Order, an updated WMCP is due to the Department within 3 years; therefore, an updated WMCP is now required to be submitted to the Department on or before **January 16, 2018.** A copy of the Final Order is enclosed for your records.

The Department recognizes and appreciates the efforts of EWEB to continue the cooperative management of water supplies in the region. We look forward to the next chapter as EWEB strives to maintain efficient water use through continued implementation of a multitude of conservation measures.

Please contact me by telephone at (503) 986-0883 or by e-mail at *Chris.C.Kowitz@oregon.gov* if I may be of any assistance, now or in the future.

Sincerely,

Chris Kowitz
Water Management and Conservation Analyst
Water Right Services Division

Enclosure

cc: WMCP File
Michael Mattick, District #2 Watermaster (*via e-mail*)

2012 Water Management and Conservation Plan Progress Report 2012 – 2016

Eugene Water & Electric Board

Prepared by EWEB Staff

February 2017

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Executive Summary

Background

The Eugene Water & Electric Board (EWEB) is Oregon's largest customer-owned utility. It provides electricity and dark fiber telecommunication services to customers in the city of Eugene and East Lane County.

Eugene Water & Electric Board (EWEB) operates a public drinking water system (Public Water System ID Number 00287) that supplies water to its customers from the McKenzie River. EWEB provides water to the city of Eugene, dissolved water districts, and special service water districts outside of the City of Eugene's city limits, and neighboring water districts through wholesale water contracts. For many years, EWEB has shown a serious commitment to delivery of high quality water and to stewardship of its water resources, as demonstrated by EWEB continually investing in its water system and in water conservation measures, products, and services.

EWEB first submitted a Water Management and Conservation Plan (WMCP) to the Oregon Water Resources Department (ORWD) in 2011 to comply with conditions in Permit G-16371 and Application S-87675. The final order was received February 2012. In February 2013 ORDW issued Permit S-54805 in response to Application S-87675. In January 2015 ORDW issued a final order extension of time for Permit S-27441 which included a condition of compliance with an approved WMCP for diversion of water beyond 4.82 cfs up to 183.0 cfs within three years of the final order. An updated WMCP is expected to be submitted in 2018.

EWEB's 2012 WMCP included descriptions of its water sources, water rights, historical water use, curtailment plan, projected water demands and strategy for meeting those future water needs. The WMCP also described EWEB's existing water management and conservation activities that were implemented in 1995. ORWD provided several benchmarks included in the 2012 WMCP that are to be met within five years. The current ORWD final order approving the 2012 WMCP requires EWEB to submit a WMCP progress report by February 1, 2017. This Progress Report was developed to meet that ORWD requirement.

Oregon Administrative Rule (OAR 690-086-0120(4) states that progress reports submitted by municipal water suppliers shall include the following:

(a) A list of the benchmarks established under OAR 690-086-0150 and a description of the progress of the municipal water supplier in implementing the associated conservation or other measure;
(b) Average monthly and daily diversions under each right held by the water supplier for the previous five years;
(c) A description of the results of the annual water audit required under OAR 690-086-0150(4)(a); and
(d) A comparison of quantities of water used in each sector as identified and described in OAR 690-086-0140(6) with the quantities of water used in each sector for the previous five years.

Progress Report Organization

This progress report fulfills the requirements of the rules adopted by the Water Resources Commission in November 2002 (OAR Chapter 960, Division 86). This progress report is organized into the following sections of OAR 690-086-0120(4):

Table 1-1: List of sections with OAR references

OAR 690-086-0120		
Section	**Title**	**Requirement**
1	Executive Summary	
2	Water Conservation Benchmarks	(4)(a)
3	Water Rights Diversions	(4)(b)
4	Annual Water Audit	(4)(c)
5	Water Consumption	(4)(d)
9	2015 EWEB Water Master Plan Demand Projections	

Section 2. Five-Year Water Conservation Benchmarks

The 2012, EWEB WMCP included ten water conservation measures that are required under OAR Chapter 690, Division 086. Since 2012, EWEB has been implementing the five-year benchmarks and progressing the conservation measures as summarized below:

1. **Annual Water Audits**
   The purpose of the annual water distribution system audit is to identify system leakage, estimate non-revenue water and better understand water system efficiency. EWEB met its annual water audit benchmark. EWEB utilized the American Water Works Association (AWWA) M36 methodology, WaterAudit4.2 (2010) spreadsheet tool, as provided by the AWWA Water Loss Control Committee.

2. **System-Wide Metering**
   The purpose of system-wide metering is to compare consumption and production, a key first step to water distribution system audits. EWEB's water system continues to be fully metered. In 2016, EWEB began to purchase and install Advance Metering Infrastructure (AMI) in the water system and plans to integrate AMI technology capabilities into existing leak detection and repair services starting in 2017.

3. **Meter Testing and Maintenance**
   The purpose of meter testing and maintenance is to provide accurate consumption and production information. EWEB has met the meter testing and maintenance benchmark. Meter testing and replacement protocols were reviewed to ensure effectiveness. As a result, EWEB developed standard operating guidelines for large water meter testing and maintenance as well as commissioning of meters 1.5-inches and larger.

   The transition to AMI has accelerated the replacement of meters 3-inches and larger. EWEB hired a contractor to replace about half of all water meters in the water districts.

   EWEB's annual water distribution system audit identified a need for annual meter testing at water production sources. Filtration plant staff consulted with professional services to establish a procedure for annual meter testing.

4. **Rate Structure and Billing Program**
   The purpose of conservation rate structure and billing is to provide a price signal to the customer based on water consumption. EWEB met its rate structure and billing program benchmark. EWEB staff provided water conservation billing best management practices information (CUWCC BMP 1.4 Retail Conservation Pricing; AWE Conservation Oriented Rate Structures) to the team conducting cost of service analysis during the reporting period. EWEB evaluated customer classifications during the 2012 Water Conservation Plan update process for the water conservation plan. No new classifications were developed during the reporting period. EWEB maintains tiered consumption charges for residential customers.

5. **Leak Detection and Repair**

The purpose of water distribution system leak detection and repair is to ensure beneficial use of diverted water. EWEB met its leak detection and repair benchmark. Annual water audit results for average non-revenue water loss is 8.2-percent with a validity score of 69-percent, which is below the 10-percent benchmark that triggers a more serious system analysis.

System leak detection and repair protocols were reviewed to ensure effectiveness. Main replacement proceeded as budget allowed. EWEB maintained a capital plan at the funding level stated in the WMCP.

6. **Public Education**

The purpose of public education is to increase awareness of the value of water and to provide practical tools for customers to use water wisely. EWEB met its public education benchmark. EWEB consultants, Carollo Engineers, assisted staff with updating water conservation targets and benchmarks captured in the 2013 – 2023 Water Conservation Plan. EWEB included public education recommendations in the 2013 – 2023 Water Conservation Plan.

During the reporting period EWEB developed, and continues to lead, a regional water conservation promotion partnership with nearby water utilities, Springfield Utility Board and Rainbow Water District. The partnership co-publishes two annual water conservation bill inserts that are included in water bills and used at events throughout the year on two consistent themes: March is Fix-a-Leak Month and a summer water use awareness bill insert. An occasional fall bill insert about preventing frozen pipes was updated by the regional partnership to avoid leaks due to frozen and broken pipes. The partnership also widened the Green Grass Gauge campaign to a regional program (RGGG) promoted by three utilities in the same media footprint. RGGG now includes social media outreach as well as vendor and TV promotion.

Community groups continue to integrate RGGG content and Water Wise Demonstration Garden tours into education and home visit programs. OSU Master Gardener Sustainable Landscape Program (SLP) has been supported by a EWEB grant throughout the reporting period. A Water Wise Demonstration Garden tour is now required as part of the SLP curriculum as a condition of the grant.

7. **Technical and Financial Assistance**

The purpose of technical and financial assistance is to help customers get maximum benefit of every gallon of water purchased. EWEB met its technical and financial assistance benchmark. EWEB re-evaluated technical and financial assistance programs during the water conservation plan update process with technical assistance from Carollo Engineers. Since EWEB has provided water conservation technical and financial assistance for many years, the plan includes a conservation potential estimate for the service area. We learned that there was a much greater potential for indoor savings than outdoor savings. Based on these results, EWEB water technical and financial assistance offerings were re-focused on leak detection and repair services.

8. **Retrofit/Repair of Inefficient Fixtures**

   The purpose of promoting retrofit and repair of inefficient fixtures is to accelerate transition to newer efficient technology which helps customers get maximum benefit of every gallon of water purchased. EWEB met its technical retrofit/repair of inefficient fixtures benchmark. EWEB re-evaluated technical and financial assistance programs during the water conservation plan update process with technical assistance from Carollo Engineers. Since EWEB has provided retrofit and replacement programs for many years, the plan includes a conservation potential estimate for the service area. We learned that there was a much greater potential for indoor savings than outdoor savings. Based on these results, EWEB water retrofit and replacement programs offerings were re-focused on toilet rebates.

9. **Reuse, recycling and non-potable water opportunities**

   The purpose of encouraging reuse, recycling and non-potable water opportunities is to reduce the need for water diversion. EWEB has maintained a project based loan and grant application process that allows customers to propose reuse, recycling and non-potable water use projects that may be eligible for incentives. No customers proposed water conservation projects during the reporting period. One supply-side water conservation pilot project was identified: using distribution system flushing water for demand-side uses. But EWEB was not able to recruit a demand-side partner to utilized water flushed from the distribution system to maintain water quality.

   EWEB continues to recycle filter to waste water at the Hayden Bridge Filtration Plant.

10. **Other conservation measures**

    The purpose of other conservation measures is to provide a reporting avenue for innovative conservation related opportunities that may arise during the reporting period. EWEB found that the city of Eugene and the University of Oregon were rigorously pursuing landscaping and irrigation standards and specifications. During the reporting period landscape and irrigation standards and codes were in the beginning stages of development by several agencies. EWEB sponsored staff time to represent water utility perspective in the standards and code-making process. Significantly, EWEB staff participated in the first irrigation installation building code eligible to be adopted in Oregon.

Section 3. Water Right Diversions

OAR 690-086-0120(4)(b): *Average monthly and daily diversions under each right held by the water supplier for the previous five years.*

Introduction

This section presents average monthly and average daily diversions under EWEB's McKenzie River water rights.

Terminology

The following terms are used to describe specific values of system demands:
Average day diversion equals the total annual diversion, (system demand) under the certificate divided by the number of days in the year. There were two leap years within the reporting period: 2012 and 2016. Demand in those years is divided by 366 instead of 365.

Table 3-1: Annual diversion from EWEB certificated water rights

Diversion of water under EWEB's McKenzie River water rights during the reporting period										
	2012		2013		2014		2015		2016	
Source	Average Monthly Diversion (MG/mo)	Average Daily Diversion (mgd)	Average Monthly Diversion (MG/mo)	Average Daily Diversion (mgd)	Average Monthly Diversion (MG/mo)	Average Daily Diversion (mgd)	Average Monthly Diversion (MG/mo)	Average Daily Diversion (mgd)	Average Monthly Diversion (MG/mo)	Average Daily Diversion (mgd)
McKenzie River Cert. 15180	525.07	17.50	525.07	17.50	525.07	17.50	525.07	17.50	525.07	17.50
McKenzie River Cert. 68537	236.63	7.50	262.83	8.76	286.23	9.54	318.50	10.20	280.03	9.00

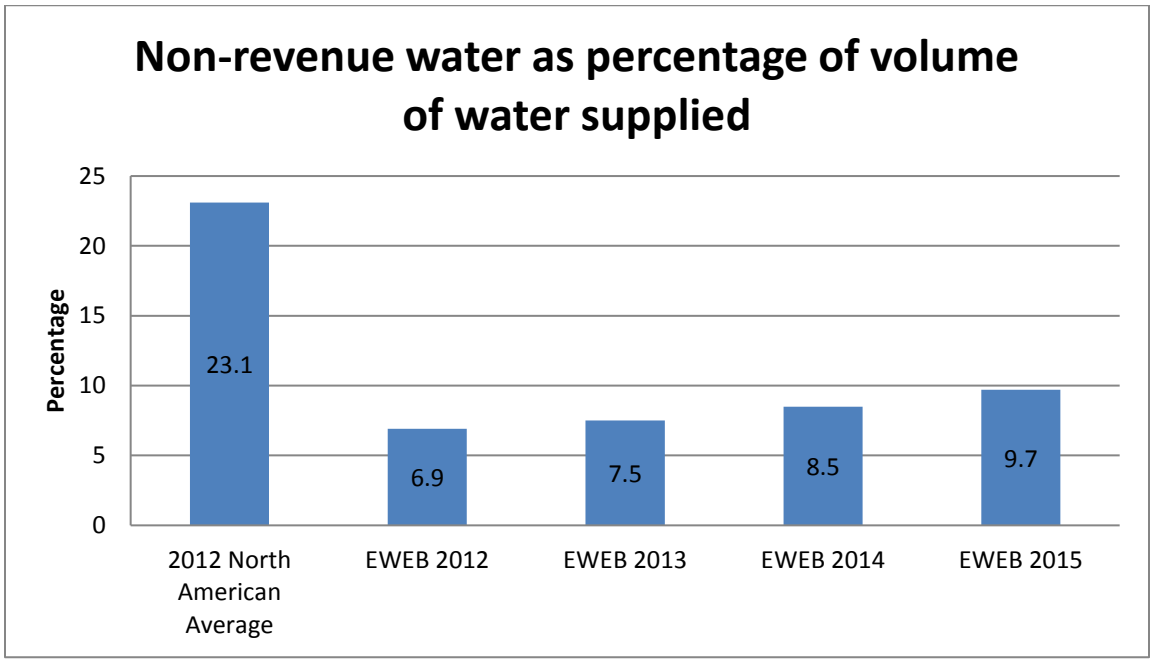
Source: Raw and Production-Monthly Summaries used for reporting to ORWD under ORS 537.099

Section 4. Annual Water Audit

OAR690-086-0120(4)(c): *A description of the results of the annual water audit required under OAR 690-086-0150(4)(a).*

Water Loss Control Performance Indicator Trends

Figure 4-1: Non-revenue water as percentage of water supplied trends



Source: EWEB Annual Water Distribution Audit Results

Note: Annual audit is typically conducted in April of each year after the financial audit is fully certified so 2016 data is unavailable for this report.

Section 5. Water Consumption

OAR 690-086-0120(4)(d): *A comparison of quantities of water used in each sector as identified and described in OAR 690-086-0140(6) with the quantities of water used in each sector for the previous five years.*

Table 5-1: Comparison of quantity of water used by EWEB customers

Water Use by Customer Category (2011 - 2015)										
Year	**Single Family Residential**	**Multi-Family Residential**	**Commercial/ Industrial**	**Institutional** (Schools & Hospital)	**Municipal**	**Irrigation**	**Wholesale Water**	**Authorized Unbilled Use**	**Other**	**Total Consumption** (including wholesale)
2011	3,965,268	894,581	1,021,008	557,997	291,830	117,885	41,914	NA	657,027	7,547,511
2012	4,133,900	923,950	1,022,963	547,012	304,032	125,800	46,956	NA	669,737	7,774,351
2013	4,311,254	953,010	1,050,019	569,469	299,277	144,341	47,344	NA	646,309	8,021,024
2014	4,269,834	1,021,046	1,107,477	535,869	333,540	197,847	50,130	NA	720,143	8,235,885
2015	4,414,703	1,082,101	1,245,336	468,762	361,036	225,946	46,444	NA	482,595	8,326,923

Source: EWEB Geographic Information System

Water use by customer category table was derived by downloading water consumption as captured by billing data correlated with Lane County land use codes by a EWEB Geographic Information System (GIS) analyst. The "Other" category represents water consumption by a customer premise that does not have a land use code assigned to the tax lot. Total consumption downloaded from EWEB's GIS was then indexed to EWEB total billed consumption for each year recorded by EWEB Fiscal Services after each annual financial audit was fully certified.

Section 6. 2015 Water Master Plan Demand Projections

EWEB's 2015 Water Master Plan demand projections considered the impact of water conservation initiatives and customer price sensitivity. Average Day Demand (ADD) for EWEB has decreased in the last decade. The existing ADD is 24 MGD which serves as the basis for future water demand projections in the master plan. A chart and a table are excerpted from the master plan that show minimal increases in projected demand, in part due to EWEB's water conservation efforts. Investments in water conservation and conservation pricing will allow EWEB to focus capital budget on building water system resilience rather than expanding capacity during the master planning period.

Figure 6-1: Historical EWEB water demand

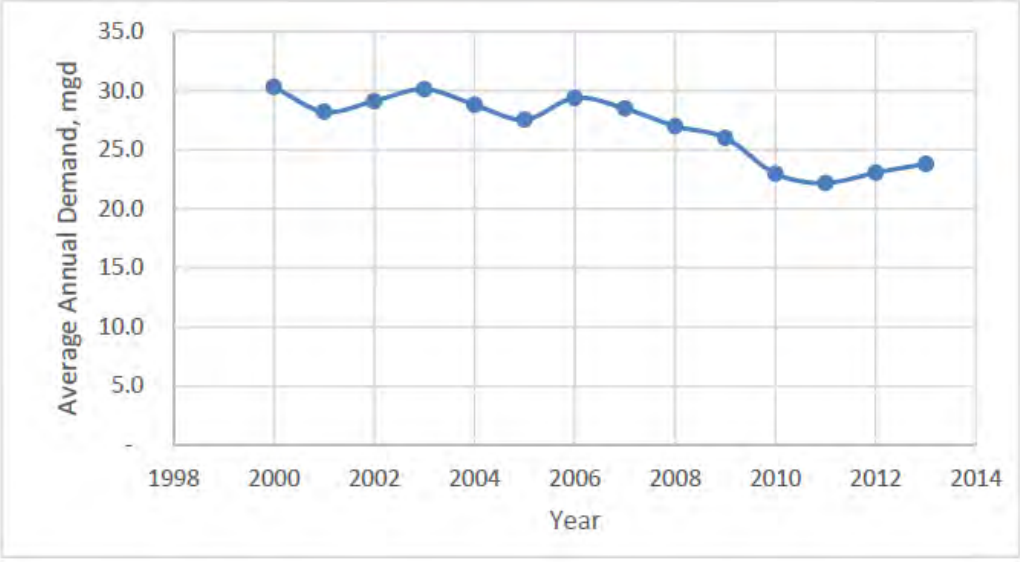


Table 6-1. Summary of projected water demand

2015 Water Master Plan Demand Projections		
Demand Scenario	**ADD (mgd)**	**MDD (mgd)**
Existing Demand	24	50
2035 Projected Demand	29	61
Demand at Build Out of the Existing UGB Service Area	32	67
Demand at Build Out with the Envision Eugene UGB Expansion	34	71

Source: EWEB 2015 Water Master Plan, West Yost Associates, November 2015

Appendix C

Intergovernmental Agreements

Summary of EWEB's Intergovernmental Agreements Related to Water Supply

Contract Supplier	Supply Source	Contract Purchaser	Date Contract Executed	Duration of Contract	Termination Provisions	Rate Adjustment Provisions	Supply Terms	Current Contract Price	Notes
EWEB	McKenzie River	Santa Clara Water District	September 2010	Perpetual	10 year notice	Annual adjustments	Firm Surplus	Winter*: $2.912/1000 gallons; Summer*: $3.009/1000 gallons	Provided water by contract since 1956
EWEB	McKenzie River	River Road Water District	September 2010	Perpetual	10 year notice	Annual adjustments	Firm Surplus	Winter*: $2.912/1000 gallons; Summer*: $3.009/1000 gallons	Provided water by contract since 1941
EWEB, Springfield Utility Board, Rainbow Water District	McKenzie River, Middle Fork Willamette R., and Groundwater	EWEB, Springfield Utility Board, Rainbow Water District	August 2006	25 years	10 year notice after the first 15 years	Annual adjustments	Water Exchanges	$1.924/1000 gallons	Rate is adjusted June 1 of each year
EWEB	McKenzie River	City of Veneta	April 2010	40 years with 10 year renewals	Not less than 5 years from termination date	Annual adjustments	Surplus	$1.176/1000 gallons	Maximum of 72,000 gallons per year
EWEB	McKenzie River	Willamette Water Company	August 2007	5 years	1 year	Annual adjustments	Surplus	$3.770/1000 gallons	Provided water by contract since 1972

** Winter: January 1 to June 30; Summer: July 1 to December 31*

Appendix D

Copy of Final Permit S-27441 & Conditions and Permit G-16371

Oregon Water Resources Department
Water Right Services Division

Water Right Application Number S-35037

Summary Order of Reconsideration of Final Order Extension of Time for Permit Number S-27441

Permit Holder: Eugene Water and Electric Board

On January 2, 2015, the Department issued a Final Order approving an extension of time for Application S-35037, Permit S-27441, subject to conditions contained therein.

Oregon Administrative Rule 137-003-0675(5) states "within 60 calendar days after the order is served, the agency may, on its own initiative, reconsider the final order or rehear the case." Pursuant to this rule, Oregon Water Resources Department is reconsidering the Final Order issued on January 2, 2015.

The Department's reconsideration is for the purpose of issuing a correcting final order to include mandatory appeal language omitted from the January 2, 2015 Final Order, and to adjust Step 3 of Example 2 within Item 2.C. of the Conditions section of the Final Order to clarify a potentially confusing step in the example. The Department's reconsideration does not include or extend to any other part of the extension final order.

The January 2, 2015 Final Order remains in effect during reconsideration until stayed or changed. OAR 137-003-0675(8).

Concurrent with this Summary Order, the Department is issuing a Correcting Final Order on Reconsideration which modifies, as specified above, the January 2, 2015 Final Order.

Dated January 16, 2015

Dwight French
Water Right Services Division Administrator, *for*
Thomas M. Byler Director,
Oregon Water Resources Department

Oregon Water Resources Department
Water Right Services Division

Water Right Application
Number S-35037

Correcting Final Order on Reconsideration
Extension of Time for Permit Number S-27441
Permit Holder: Eugene Water and Electric Board

Permit Information
Application File S-35037/ Permit S-27441
Basin 2 – Willamette Basin / Watermaster District 2
Date of Priority: June 14, 1961

Authorized Use of Water

Source of Water:	McKenzie River, a Tributary of Willamette River
Purpose or Use:	Municipal Use
Maximum Rate:	183.0 Cubic Feet per Second (cfs)

Pursuant to OAR 137-003-0675(5) the Oregon Water Resources Department (Department) has reconsidered its FINAL ORDER for this extension issued on January 2, 2015.

On reconsideration the Department issues this CORRECTING FINAL ORDER ON RECONSIDERATION which makes two modifications to the January 2, 2015 FINAL ORDER. The purpose of the first modification is to include mandatory appeal language omitted from the January 2, 2015 FINAL ORDER. The purpose of the second modification is to adjust Step 3 of Example 2 within Item 2.C. (*Conditions to Maintain the Persistence of Listed Fish*) to clarify a potentially confusing step in the example. Modifications to the FINAL ORDER are shown as follows: additions are shown in underlined text; deletions are shown in ~~strikethrough~~ text.

This Extension of Time request is being processed in accordance with Oregon Revised Statute 537.230 and 539.010(5), and Oregon Administrative Rule Chapter 690, Division 315

Appeal Rights

This final order is subject to judicial review by the Court of Appeals under ORS 183.482. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.482(1). Pursuant to ORS 536.075 and OAR 137-003-0675, you may petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Application History

Permit S-27441 was issued by the Department on August 11, 1961. The permit called for completion of construction by October 1, 1965, and complete application of water to beneficial use by October 1, 1965. On September 29, 2003, Eugene Water and Electric Board (EWEB) submitted an application to the Department for an extension of time for Permit S-27441. In accordance with OAR 690-315-0050(2), on September 23, 2014, the Department issued a Proposed Final Order proposing to extend the time to complete construction to October 1, 2083, and the time to fully apply water to beneficial use to October 1, 2083. The protest period closed November 7, 2014, in accordance with OAR 690-315-0060(1). WaterWatch of Oregon filed a timely protest, which was subsequently withdrawn by letter on December 23, 2014.

Findings of Fact

The Department adopts and incorporates by reference the findings of fact in the Proposed Final Order dated September 23, 2014.

At time of issuance of the Proposed Final Order the Department concluded that, based on the factors demonstrated by the applicant, the permit may be extended subject to the following conditions:

CONDITIONS

1. **Development Limitations**
Diversion of any water beyond 4.82 cfs up to 183.0 cfs under Permit S-27441 shall only be authorized upon issuance of a final order approving a Water Management and Conservation Plan (WMCP) under OAR Chapter 690, Division 86 that authorizes access to a greater rate of diversion of water under the permit consistent with OAR 690-086-0130(7). The required WMCP shall be submitted to the Department within 3 years of this Final Order. The amount of water used under Permit S-27441 must be consistent with this and subsequent WMCP's approved under OAR Chapter 690, on file with the Department.

The deadline established in this Extension Final Order for submittal of a WMCP shall not relieve a permit holder of any existing or future requirement for submittal of a WMCP at an earlier date as established through other orders of the Department. A WMCP submitted to meet the requirements of this final order may also meet the WMCP submittal requirements of other Department orders.

2. **Conditions to Maintain the Persistence of Listed Fish**
The developed portion of the permit, 4.82 cfs, is *not* subject to these fish persistence conditions.

A. Fish Persistence Target Flows

a. Fish persistence target flow needs in the Lower McKenzie River (approximately river mile 14.1 to the mouth) as recommended by ODFW are

in Table, 1 below; flows are to be measured on the McKenzie River above Hayden Bridge, Springfield, Oregon at USGS gage No. 14164900, or its equivalent.

Table 1

FISH PERSISTENCE TARGET FLOW ON THE LOWER MCKENZIE RIVER MEASURED AT USGS GAGE 14164900 ABOVE HAYDEN BRIDGE SPRINGFIELD, OREGON	
Months	Cubic Feet per Second
January 1 – December 31	2000

b. Alternate Streamflow Measurement Point
The location of a target flow measurement point as established in these Conditions to Maintain the Persistence of Listed Fish may be revised if the permit holder provides evidence in writing that ODFW has determined that persistence flows may be measured at an alternate streamflow measurement point and provides an adequate description of the location of the alternate streamflow measurement point, and the Water Resources Director concurs in writing.

B. Determining Water Use Reductions – Generally
The maximum amount of the undeveloped portion of Permit S-27441 that can be diverted as a result of this fish persistence condition is determined in proportion to the amount by which the flows shown in Table 1 are missed based on a seven day rolling average[1] of mean daily flows as determined or measured by the water user in the Lower McKenzie River at the specified gage location. The percent of missed target flows is defined as:

$$(1 - [Q_A - E / Q_T]) \times 100\%,$$

where Q_A is the actual flow, measured at the designated location based on the seven-day rolling average, E is the undeveloped portion of the permit, being 178.18 cfs, and Q_T is the target flow (from Table 1).

The percent by which the target flow is missed applied to the undeveloped portion of the permit provides the maximum amount of undeveloped portion of the permit that can be diverted as a result of this fish persistence condition, and is defined as:

$$E - (E \times \% \text{ missed target flow}),$$

where E is the undeveloped portion of the permit, being 178.18 cfs.

When $Q_A - E \geq Q_T$, the amount of the undeveloped portion of the permit that can be diverted would not need to be reduced as a result of this fish persistence condition.

[1] Alternatively, the water user may use a single daily measurement.

C. Examples

Example 1: Flow target met:

On September 15, the last seven mean daily flows in the Lower McKenzie River at the designated gage were 2430, 2450, 2525, 1910, 1875, 2460 and 2500 cfs. The seven day rolling average (Q_A) is 2307 cfs. Given that the undeveloped portion of this permit (E) is 178.18, then the 7 day average of mean daily flows minus the undeveloped portion is greater than the 2000 cfs target flow (Q_T) for September15. In this example, $Q_A - E \geq Q_T$.

$$2307 - 178.18 \geq 2000$$

The amount of the undeveloped portion of the permit that can be diverted would not be reduced because the target flow is considered met.

Example 2: Target flow missed.

Step 1: Given that the undeveloped portion of this permit (E) is 178.18, if on September 15, the average of the last seven mean daily flows (Q_A) was 1720 cfs, and the target flow (Q_T) is 2000, then the target flow would be missed by 22.9%.

$$(1 - [(1720 - 178.18) / 2000]) \times 100\% = 22.9\%$$

Step 2: Given that the undeveloped portion of this permit (E) is 178.18 cfs, and the undeveloped portion of the permit needs to be reduced by 22.9% (from Step 1), or 40.8 cfs, then the maximum amount of the undeveloped portion of Permit S-27441 that could be diverted as a result of this fish persistence condition would be 137.38 cfs. (This maximum amount may be limited as illustrated in Step 3, below.)

$$(178.18 \times 22.9\%) / 100) = 40.8$$

$$178.18 - 40.8 = 137.38$$

Step 3: ~~The calculated maximum amount of water that could be diverted under the permit due to the fish persistence condition may not exceed the amount of water to which the City is legally entitled to divert. In this example, if the amount of water legally authorized for diversion under this permit is 134.82 cfs (for example, authorization to divert 130.0 cfs provided through a WMCP plus the 4.82 cfs developed portion of the permit), then 134.82 cfs would be the maximum amount of diversion allowed under this permit.~~

The calculated maximum amount of water that could be diverted under the permit due to the fish persistence condition may not exceed the

amount of water to which the permit holder is legally entitled to divert. In this example, if the amount of water legally authorized for diversion under this permit is 135.0 cfs (for example, provided through a WMCP), then 135.0 cfs would be the maximum amount of diversion allowed under this permit, including the developed portion of the permit, being 4.82 cfs.

(Conversely, if the amount of water legally authorized for diversion under this permit is 150.0 cfs, then 142.2 cfs (137.38 from Step 2 + the 4.82 developed portion of the permit) would be the maximum amount of diversion allowed under this permit.)

CONCLUSION OF LAW

The applicant has demonstrated good cause for the permit extension pursuant to ORS 537.230, 539.010(5) and OAR 690-315-0080(3).

ORDER

The extension of time for Application S-35037, Permit S-27441, therefore, is approved subject to conditions contained herein. The deadline for completing construction is extended from October 1, 2000 to October 1, 2083. The deadline for applying water to full beneficial use within the terms and conditions the permit is extended from October 1, 2000 to October 1, 2083.

DATED: January 16, 2015

Dwight French
Water Right Services Division Administrator, for
Thomas M. Byler Director,
Oregon Water Resources Department

If you have any questions about statements contained in this document, please contact Ann L. Reece at (503) 986-0834.

If you have other questions about the Department or any of its programs, please contact our Water Resources Customer Service Group at (503) 986-0900

SM - 10-58

Permit No. [redacted].

27441

*APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, City of Eugene, by Eugene Water & Electric Board (Name of applicant)

of 1116 Willamette Street, Eugene, Lane County, (Mailing address),

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation a Municipal Corporation. City of Eugene inoorporated 1862.

1. The source of the proposed appropriation is McKenzie River (Name of stream), a tributary of Willamette River

2. The amount of water which the applicant intends to apply to beneficial use is 183 cubic feet per second. in addition to present permits for 27 cfs and 90 cfs. (If water is to be used from more than one source, give quantity from each)

C# 15180 P# 17358

**3. The use to which the water is to be applied is Municipal water supply for City of Eugene, Oregon and vicinity. (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located 560 ft. N. (N. or S.) and 512 ft. E. (E. or W.) from the S.W. corner of Sec. 20 of Township 17 South, Range 2 West of the Willamette Meridian (Corner (Section or subdivision) common to Sections 19, 20, 29 and 30, Township 17 South, Range 2 West, of the Willamette Meridian).

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the S.W. 1/4 of the S. W. 1/4 (Give smallest legal subdivision) of Sec. 20, Tp. 17 S. (N. or S.), R. 2 W. (E. or W.), W. M., in the county of Lane

5. The main pipe lines are (Main ditch, canal or pipe line) to be 34,000 feet (Miles or feet) in length, terminating in the S. E. 1/4 of S. E. 1/4 (Smallest legal subdivision) of Sec. 30, Tp. 17 S. (N. or S.), R. 3 W. (E. or W.), W. M., the proposed location being shown throughout on the accompanying map. and S. E. 1/4 of Sec. 32, of W.M. in the Northeasterly edge of the City of Eug.

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam No dam. feet, length on top feet, length at bottom feet; material to be used and character of construction Two intakes with pump houses (Loose rock, concrete, masonry, on solid rock olose to bank of river, with short intake section from river to pumps, rock and brush, timber crib, etc., wasteway over or around dam) through soreens.

(b) Description of headgate Timber stop logs in intake section (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description Water pumped from river to treatment (Size and type of pump) plant on near-by hill. Will require approximately 5,700 H.P. ultimately. Presently (Size and type of engine or motor to be used, total head water is to be lifted, etc.) have 2,300 H.P. installed with provisions for 1,800 additional. Plan to modify existing intakes to accommodate full requirements.

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the [illegible] Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem.

7. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) - feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(b) At - miles from headgate: width on top (at water line) ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(c) Length of pipe, 34,000 ft.; size at intake, Existing 36" + 42" Add 42" in.; size at 1,600 ft. from intake Existing 30" + 45" Add 60" in.; size at place of use Existing 30" + 42" Add 60" in.; difference in elevation between intake and place of use, 26 ft. Is grade uniform? No Estimated capacity, 300 sec. ft.

8. Location of area to be irrigated, or place of use City of Eugene and Vicinity

Township North or South	Range E. or W. of Willamette Meridian	Section	Section
T 16 S.	R. 5 W.	Section 36	
T 16 S.	R. 4 W.	Section 31	through 36 inclusive
T 17 S.	R. 5 W.	Section 1,	12, 13, 24, 25, 36
T 17 S.	R. 4 W.	Section 1	through 36 inclusive
T 17 S.	R. 3 W.	Section 6,	7, 8, 9 - 16, 17, 18, 19, 20, 21, 28, 29, 30, 31, 32, 33.
T 18 S.	R. 5 W.	Section 1,	12, 13, 24
T 18 S.	R. 4 W.	Section 1	through 24 inclusive
T 18 S.	R. 3 W.	Section 3,	4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23.

(If more space required, attach separate sheet)

(a) Character of soil -

(b) Kind of crops raised -

Power or Mining Purposes—

9. (a) Total amount of power to be developed - theoretical horsepower.

(b) Quantity of water to be used for power - sec. ft.

(c) Total fall to be utilized - feet. (Head)

(d) The nature of the works by means of which the power is to be developed -

(e) Such works to be located in - (Legal subdivision) of Sec. ....., Tp. ..... (No. N. or S.), R. ..... (No. E. or W.), W. M.

(f) Is water to be returned to any stream? - (Yes or No)

(g) If so, name stream and locate point of return -

....., Sec. ....., Tp. ..... (No. N. or S.), R. ..... (No. E. or W.), W. M.

(h) The use to which power is to be applied is -

(i) The nature of the mines to be served -

Municipal or Domestic Supply—

27411

10. (a) To supply the city of Eugene and surrounding water districts in Lane (Name of) County, having a present population of 80,000 and an estimated population of 175,000 in 19 85.

(b) If for domestic use state number of families to be supplied 50,000

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ 4,500,000.00

12. Construction work will begin on or before Spring of 1968

13. Construction work will be completed on or before Spring of 1982

14. The water will be completely applied to the proposed use on or before Summer of 1985

Byron Price
(Signature of applicant)
Byron Price, Superintendent-Secretary

Remarks: Recent developments in the technique of water treatment will increase the design capacity of the present treatment plant by approximately 2.4 times, allowing an ultimate peak treatment capacity of 180 M.G.D. in place of the original 75 M.G.D. ultimate design capacity. The present water appropriation is based on this 75 M.G.D. capacity. Prognosis indicates this rate will be reached about 1972.

The purpose of this filing is to cover enough water to safely proceed with an orderly expansion of plant to the new ultimate capacity of 180 M.G.D.

A proposed schedule of expansion is as follows:

YEAR	CAPACITY	REMARKS
61 - 62	To 63 M.G.D.	Existing Plant Modification
1968	To 90 M.G.D.	Const. new Transmission Line, Modify intake.
1972	To 120 M.G.D.	Const. Additional Filtration Plant
1977	To 150 M.G.D.	Const. Additional Filtration Plant - New Transmission Line
1982	To 180 M.G.D.	Const. Additional Filtration Plant

STATE OF OREGON, } ss.
County of Marion, }

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before , 19

WITNESS my hand this day of , 19

STATE ENGINEER

County of Marion, } ss.

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 1.83 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* McKenzie River

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to - - *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is June 14, 1961

Actual construction work shall begin on or before August 11, 1962 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*65

*Complete application of the water to the proposed use shall be made on or before October 1, 19*65

WITNESS my hand this 11th *day of* August, 19 61

Lewis A. Stanley
STATE ENGINEER

Application No. 35037
Permit No. 27411

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 14th *day of* June, 19 61, *at* 8:00 *o'clock* A *M.*

Returned to applicant:

Approved:

August 11, 1961

Recorded in book No. 75 *of Permits on page* 27411

LEWIS A. STANLEY
STATE ENGINEER

Drainage Basin No. 2 *page* 24B

Fees [redacted]

State Printing 9837

STATE OF OREGON

COUNTY OF LANE

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

EUGENE WATER AND ELECTRIC BOARD
PO BOX 10148; 500 E 4TH AVE
EUGENE, OREGON 97440-2148

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: G-15857

SOURCE OF WATER: WELL 1, WELL 2, WELL 3 (LANE 61477), WELL 4, WELL 5 (LANE 61476), WELL 6, WELL 7, WELL 8, WELL 9, WELL 10, WELL 11 AND WELL 12 IN WILLAMETTE RIVER BASIN

PURPOSE OR USE: MUNICIPAL USE

MAXIMUM RATE: 18.49 CUBIC FEET PER SECOND (CFS);

BEING A CUMULATIVE RATE OF NOT MORE THAN 4.998 CFS FROM WELL 1, WELL 4, WELL 7, WELL 9, WELL 10, WELL 11, AND WELL 12, FURTHER LIMITED TO A MAXIMUM RATE OF 2.5 CFS FOR EACH WELL;

AND A CUMULATIVE RATE OF NOT MORE THAN 13.49 CFS FROM WELL 2, WELL 3 (LANE 61477), WELL 5 (LANE 61476), WELL 6, AND WELL 8, FURTHER LIMITED TO A MAXIMUM RATE OF 2.698 CFS FOR EACH WELL

PERIOD OF USE: YEAR ROUND

DATE OF PRIORITY: DECEMBER 20, 2002

WELL LOCATIONS:

WELL 1: SE ¼ NE ¼, SECTION 17, T17S, R3W, W.M.; 2050 FEET SOUTH AND 270 FEET WEST FROM THE NE CORNER OF SECTION 17

WELL 2: NW ¼ NW ¼, SECTION 9, T17S, R3W, W.M.; 600 FEET SOUTH AND 400 FEET EAST FROM NW CORNER, SECTION 9

WELL 3 (LANE 61477) : NE ¼ NW ¼, SECTION 16, T17S, R3W, W.M.; 30 FEET SOUTH AND 2180 FEET EAST FROM THE NW CORNER OF SECTION 16

WELL 4: SE ¼ SE ¼, SECTION 8, T17S, R3W, W.M.; 50 FEET NORTH AND 50 FEET WEST FROM SE CORNER, SECTION 8

WELL 5 (LANE 61476): NW ¼ SW ¼, SECTION 9, T17S, R3W, W.M.; 1880 FEET NORTH AND 500 FEET EAST FROM SW CORNER, SECTION 9

WELL 6: SE ¼ NW ¼, SECTION 16, T17S, R3W, W.M.; 2270 FEET SOUTH AND 2250 FEET EAST FROM NW CORNER, SECTION 16

WELL 7: NW ¼ NW ¼, SECTION 8, T17S, R3W, W.M.; 4065 FEET NORTH AND 310 FEET EAST FROM SW CORNER, SECTION 8

WELL 8: SE ¼ NW ¼, SECTION 9, T17S, R3W, W.M.; 1825 FEET SOUTH AND 1435 FEET EAST FROM NW CORNER, SECTION 9

WELL 9: SE ¼ NW ¼, SECTION 17, T17S, R3W, W.M.; 2190 FEET SOUTH AND 1750 FEET EAST FROM NW CORNER, SECTION 17

WELL 10: SW ¼ SE ¼, SECTION 8, T17S, R3W, W.M.; 110 FEET NORTH AND 1810 FEET WEST FROM SE CORNER, SECTION 8

WELL 11: SE ¼ SW ¼, SECTION 8, T17S, R3W, W.M.; 130 FEET NORTH AND 2200 FEET EAST FROM SW CORNER, SECTION 8

WELL 12: SW ¼ NE ¼, SECTION 8, T17S, R3W, W.M.; 3150 FEET NORTH AND 3300 FEET EAST FROM SW CORNER, SECTION 8

THE PLACE OF USE IS WITHIN THE SERVICE BOUNDARY OF EUGENE WATER AND ELECTRIC BOARD

The use of water under this permit or subsequent certificate, in combination with the water rights originating under Applications S-10168, S-22037, and S-35037 shall not exceed a total of 300.08 cubic feet per second.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a totalizing flow meter or other suitable measuring device as approved by the Director at each point of appropriation. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month, and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water-use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

The water user shall develop a plan to monitor and report the impact of water use under this permit on water levels within the aquifer that provides water to the permitted well(s). The plan shall be submitted to the Department within one year of the date the permit is issued and shall be subject to the approval of the Department. At a minimum, the plan shall include a program to periodically measure static water levels within the permitted well(s) or an adequate substitute such as water levels in nearby wells. The plan shall also stipulate a reference water level against which any water-level declines will be compared. If a well listed on this permit (or replacement well) displays a total static water-level decline of 25 or more feet over any period of years, as compared to the reference level, then the water user shall discontinue use of, or reduce the rate or volume of withdrawal from, the well(s). Such action shall be taken until the water level recovers to above the 25-foot decline level or until the Department determines, based on the water user's and/or the Department's data and analysis, that no action is necessary because the aquifer in question can sustain the observed declines without adversely impacting the resource or senior water rights. The water user shall in no instance allow excessive decline, as defined in Commission rules, to occur within the aquifer as a result of use under this permit.

Use of any or all water under this permit is only allowed if an Intergovernmental Agreement is in place between the Eugene Water and Electric Board, Springfield Utility Board, and the Rainbow Water district that addresses injury issues with senior users.

The combined pumping rate from all wells that are less than one mile from Ayers Pond (Well 1, Well 4, Well 7, Well 9, Well 10, Well 11, and Well 12 in the current proposed wellfield configuration) shall not exceed 4.998 cfs unless the Department approves a plan to mitigate impacts on the Willamette River.

The combined pumping rate from all wells that are less than one mile from the Willamette River (only Well 7 in the current proposed wellfield configuration) shall not exceed 4.998 cfs unless the Department approves a plan to mitigate impacts on the Willamette River.

The wells shall be completed to produce water from the confined portion of the alluvial aquifer system at depths greater than about 100 feet below land surface.

The applicant shall submit an updated water management and conservation plan consistent with current Oregon Administrative Rule Chapter 690, Division 86 within two years of issuance of this permit. Extensions for this submission may be allowed for good cause.

The use may be restricted if the quality of hydraulically connected surface waters or downstream waters decrease to the point that those waters no longer meet existing state or federal water quality standards due to reduced flows.

STANDARD CONDITIONS

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

If the number, location, source, or construction of any well deviates from that proposed in the permit application or required by permit conditions, this permit may not be valid, unless the Department authorizes the change in writing.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

The well(s) shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times.

Where two or more water users agree among themselves as to the manner of rotation in the use of water and such agreement is placed in writing and filed by such water users with the watermaster, and such rotation system does not infringe upon such prior rights of any water user not a party to such rotation plan, the watermaster shall distribute the water according to such agreement.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

The permit holder shall commence and complete the construction of any proposed works within 20 years from the date of permit issuance. The Department may order and allow an extension of time to complete construction or to perfect a water right beyond 20 years from the date of permit issuance.

Within one year after complete application of water to the proposed use, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner (CWRE).

Issued August 13, 2008

E. Timothy Wall

for Phillip C. Ward, Director
Water Resources Department

Appendix E

Summary Overview Water Conservation Program Measures

Summary Overview of Water Conservation Program Measures

2018 EWEB Water Management and Conservation Plan

EWEB evaluates its conservation water program on a regular (typically annual) basis to evaluate a program or measure based on benefit-cost and staff resource availability. Some programs are discontinued because the evaluation determines that other concurrent programs are achieving similar goals, or customer participation is very limited, and in other situations available EWEB staff resources does not allow a program to continue to be implemented. The table below includes an overview summary of important water conservation program measures that EWEB implemented, but have been discontinued based on these two key factors. The list demonstrates EWEB's commitment to water conservation of the past three decades, while meeting its responsibility to its rate payers.

History of "ET" and "Green Grass Gauge" Campaign

Consistent with the methodologies incorporated in weather-based automated irrigation control (e.g., Rainbird's Maxicom system), in 1995 EWEB staff provided information on the watering requirements of different types of plants in a summer bill stuffer titled "Wondering About Water?" This was followed by a system-wide roll-out of a weekly weather-based watering guideline using weather station gathered ET rates in 1998. The bill stuffer titled "Still Wondering About Watering? Get Some Help From ET!" introduced this new service. During each growing season from 1997-2004, WMS provided weekly ET-based watering guidelines to customers through a variety of media, including Web site, newspaper, voicemail information system, seasonal announcements on television, and radio.

In 2005, WMS renamed the program the Green Grass Gauge (GGG) campaign and simplified it. The watering guidelines are now broadcast on local television as part of the weather reporting on a weekly basis throughout the growing season. The GGG campaign provides the same weather-based irrigation information and also provides a free rain gauge called the "Green Grass Gauge." Ten thousand free rain gauges have been given away each summer since they were introduced in 2005. EWEB refreshed all brochures, Web pages, and other related information to support the GGG campaign and retired previous materials from use. EWEB discontinued newspaper advertising in 2005 because market research revealed questionable effectiveness. By 2007, annual evaluation determined that there had been a sustained decrease in overall residential summer water use for the 3 years since the GGG campaign had been launched. This has been confirmed in subsequent evaluations. In 2009, WMS added a direct e-mail subscription service to the campaign, which gained nearly 500 subscribers by May 2010. These subscribers, excluding four media outlets that subscribe, represent 10 percent of EWEB's top 10 percent residential water user target audience.

To present a more in-depth version of the GGG campaign information, from 1995 to 2007, WMS scheduled and conducted a series of landscape workshops at local nurseries, local garden clubs, and education organizations (e.g., Master Gardeners, KLCC, and OASIS). These workshops provided several opportunities to promote ET/GGG campaign information each season. WMS also promoted the ET/GGG campaign as a cornerstone of the Home Water Survey program (i.e., residential water audits).

Community groups developing sustainability programs sought EWEB's water conservation expertise, so EWEB helped the groups integrate information that EWEB previously presented at its workshops into several education and home visit programs, such as Oregon State University Extension's Sustainable Landscapes program, University of Oregon's Climate Masters at Home and at Work program, Re:Think (a small business sustainability initiative offered by BRING Recycling), and Lane Community College's Water Conservation Technician Associate Degree. These education efforts fill the niche previously filled by EWEB staff presentations, resulting in EWEB's core messages and conservation tools continuing to spread throughout the water delivery area despite fewer requests for EWEB water conservation events.

EWEB's WMS organizes its annual information campaigns in a coordinated roll out with each campaign and information piece following a "template" with work specifications to outline the timing, responsibilities, and dependencies. Each year, various pieces of the campaign are evaluated and updated as appropriate. The intention is to refine the campaign throughout the season through strategically linking each campaign piece and to build on campaigns from previous years. The typical water conservation season launches in March with the posting of the GGG Web page and a direct e-mail to GGG subscribers. WMS staffs information booths annually at the Master Gardener Plant Sale, Oregon Plant Fair, and KLCC Garden Tour, and occasionally at other appropriate events that may arise. In mid-June, the GGG Web page is linked to EWEB's home page for the summer season and free gauges are available at local garden centers while supplies last.

Peak Campaign

In addition to the ET Campaign, each year from 1995 to 2008, WMS prepared a contingent "Peak Campaign" aimed at raising awareness and gaining customer participation in managing summertime peak day demands. Often using the slogan "One Water Task At at A Time," EWEB prepares to run this campaign (July through August) by pre-recording radio advertisements and drafting public service announcements (PSA). EWEB launches this heightened conservation campaign any time the temperature is predicted to be above 95 degrees F and seasonal water demand is sustained at 65 mgd or greater, as peak demand days often correspond to hot weather events.

Water Wise Award Program

From 2005 to 2008, EWEB conducted the Water Wise Award program for Home Water Survey Program (residential water use audit program) participants that reduced water use. The Water Wise Award program also created an opportunity to interview and write media articles. As a result of this program, EWEB has a library of success stories to enhance key messaging when needed.

Water Conservation Curriculum

From 1998 to 2015, EWEB staff led a water conservation curriculum with local school districts. EWEB does not support the program directly anymore, leaving it in the hands of teachers at the different schools. During the program, EWEB reached out to children with an award-winning Grade 3-8 curriculum titled "Exploring Planet Water" (EPW). The 15 water science and conservation lessons in EPW were aligned with Oregon education benchmark

requirements in math, biology, physical science, and social science. One of Eugene's two local school districts (School District 52) adopted the EPW curriculum for use in all of its 6th grade classes in 1999. In 2010, School District 52 contracted with EWEB to update this curriculum to align to new education benchmarks and incorporate classroom discoveries into the lessons. School District 52 entered into a 5-year contract with EWEB to manage distribution and refurbishing of classroom kits used in EPW lessons in School District 4J, as well as within School District 52. School District 52 provided in-service training for new 6th grade teachers on an as-needed basis. Since 1998, EWEB trained more than 70 local teachers in the EPW curriculum.

Major Appliance Rebates

EWEB began providing appliance rebates for clothes washer and dishwashers in 1985 through the electric utility. The electric utility discontinued funding large appliances in 2012. Rebates were provided to customers regardless of the hot water energy source (i.e., gas customers can qualify). The EWEB water utility co-funded clothes washer rebates to gas customers since 2002 to sustain rebate levels for customers who did not use electricity to heat water. Between 2002 and 2008, the water utility contributed more than $32,000 to the clothes washer rebate program and it estimates that the program saved 18 MG annually. An additional estimated 37 MG in water savings are attributable to electric-utility-funded clothes washer and dishwasher rebates during the same time period. The qualifying criteria of the rebate program were reviewed annually and changed if necessary to meet or exceed EPA Energy Star efficiency standards. The Consortium for Energy Efficiency provided the source for industry-tested efficiency thresholds that exceeded federal standards.

Irrigation System Timer Rebates

Irrigation system timer rebates were available from 2002 to 2012 for both new construction and retrofit. These rebates included a consultation with the owner for two purposes. First, the consultation provided verification that the installation qualified for the rebate. Second, it provided an opportunity to educate the customer on the water savings opportunities afforded by the water budget feature using the GGG campaign. The program, called the Water Budget Sprinkler Timer Rebate program, offered $25 rebates per qualifying unit. The sprinkler timers allowed users to make simple adjustments to automatically reduce or increase the amount of water for their lawn or garden and EWEB provides weekly watering recommendations.

Residential Water Use Audits

From 1996 to 2007, EWEB conducted an award-winning residential water use audit program titled the "Home Water Survey Program" (HWS) targeting the top 10 percent of residential water users. EWEB staffed this program with student interns recruited from the University of Oregon (landscape architecture and environmental studies programs) and Oregon State University (agriculture and horticulture programs), employing up to eight interns each season. The HWS provided a complete audit of home water use with an emphasis on outdoor watering.

In 2005, the annual evaluation revealed that the margin between HWS participants and the control group had abruptly narrowed. This was also the year the GGG campaign began

broadcasting on TV weather reports. The margin narrowed further through 2007 such that the cost/benefit analysis no longer supported this expensive program, resulting in the discontinuation of HWS. The GGG campaign appeared to meet seasonal peak management goals at a fraction of the cost. Since that time, HWS service offerings have been integrated into several community-based programs.

HWS service offerings included: identify leaks; measure fixture use rates; provide showerheads, aerators, replacement toilet flappers, and other water saving devices where applicable. Outdoor services provided by the auditor included: identify the plants and associated water requirements for the landscape; perform a catch can test to teach the customer how to measure the amount of water being applied; review the controller/timer settings to establish a base program of 1-inch per week.

The customer then was shown how to make weekly adjustments to follow the ET watering guidelines (now called the GGG). EWEB documented all of this information and provided it to the customer in a follow-up report within a few days of the audit, along with a customer satisfaction survey. One unique feature of HWS was a proprietary database application, which facilitated and automated the administrative support functions of the program, as well as the seasonal program evaluation. From program inception until 2007, more than 2,500 customers participated in this program and sustained an average reduction of 24 percent in outdoor water use in the peak month alone. During the same time, the customer group with the top 10 percent water use grew from 4,000 to 5,000 customers. Essentially, about half of EWEB's target audience received a home visit during the productive arc of this program.

Water Audits, Irrigation Use

From 1999 to 2011, EWEB provided commercial and industrial customers with detailed landscape irrigation system audits using methodologies developed by the IA, along with the water use audit and baseline analysis. EWEB provided landscape irrigation system audits at the customer's request, free of charge. The goal of this audit, called a Commercial Industrial Landscape Audit (CILA), was to promote best practices in landscape management. The CILA program createed a point of entry with customers by validating the utility's contention that: (a) customers can reduce their utility bill without giving up anything and (b) it is worth taking the time to explore opportunities for saving water. The program described according to levels was as follows:

- **Tune-up Report**. The tune-up served to identify basic maintenance needs and maintenance recommendations aimed at optimizing the system's performance. Identification of leaks, improperly adjusted heads, damaged heads, nozzle recommendations, zoning problems, and a water budget are included in the tune-up report. When the water budget indicated little opportunity for water savings, audit services are not offered. When the water budget indicated opportunity for water savings, EWEB staff initiated audit services.
- **Irrigation Audit**. This program worked to build understanding of the operation of irrigation systems, how much water they apply, how evenly they apply water, and how long they need to run to meet the water needs of the landscapes. These systems were often evaluated solely on the appearance of the landscape, such that inefficiencies that can be compensated for by simply increasing the systems run times

often are ignored. After a system was audited, the customer received a detailed report outlining the system's efficiency or distribution uniformity and specific watering recommendations tailored to the onsite controller. For example, customers with standard controllers received different programming recommendations than customers with water budget features, smart controller, or central control.

Retrofit of Inefficient Fixtures

Residential Showerhead and Aerator Replacement. EWEB began replacing showerheads and aerators in 1982. EWEB furnished and/or installed more than 60,000 showerheads and more than 100,000 aerators. EWEB continued to replace existing showerheads (that flow more than 2.5 gpm) and aerators through the HWS program until 2007, when the program was discontinued.

Residential Advanced Sprinkler Head Retrofits. This program replaced inefficient sprinkler nozzles on customers' existing underground irrigation systems. Inefficient sprinkler nozzles were replaced with advanced multi-stream, multi-trajectory matched precipitation rate (MSMT-MPR) sprinkler nozzles. The 10 initial participants in this pilot program saved a cumulative 153,000 gallons in the first year of installation. EWEB continued this pilot program for a second year in 2009.

Commercial and Industrial CustomersFixture Retrofit. From 1996 to 2008, WMS staff worked with property managers to promote the retrofit of fixtures in high-rise multifamily housing complexes. Such retrofits included: toilet tank displacement devices, quick-closing toilet flappers, water-saving flush valve diaphragm kits, low-flow showerheads, and faucet aerators. WMS's staff worked closely with building maintenance staff to systematically update fixtures in four complexes in 1996. In 2009, EWEB discontinued all toilet rebates because of an annual cost/benefit analysis of the program. That same year, EWEB also discontinued all showerhead and faucet aerator programs that involved storage of items at EWEB because of preparation for the WMS move to a new site with no storage.

Commercial and Industrial Customer Cooling System Retrofit. EWEB's Cooling System Retrofit program addressed the following: the conversion of water-cooled to all-electric refrigeration (for air conditioning and cold storage); the upgrade of refrigeration condensers; and the upgrade of cooling tower controls to automate chemical addition and blow down. Although not fully quantified, cooling loads represent a significant segment of summertime peak demands, estimated at 2 to 5 mgd on peak days. Beginning in 1997, pilot projects have proved the value of refrigeration condenser upgrades, cooling tower control upgrades, and water-cooled refrigeration compressor retrofits. A 2003 pilot project included retrofits from single pass cooling to large (40-ton) chillers at two institutional facilities that reduced peak day water use by 250,000 gallons per day. A 2008 pilot project included a retrofit from single pass cooling to a cooling tower that saved 5,053,000 gallons in the first year of installation for one commercial customer.

Reuse, Recycling, Nonpotable Water

EWEB sponsored a rainwater harvesting study from 2005–2007 to explore the conservation potential and assess the cross connection risks of rainwater harvesting. EWEB determined that rainwater harvesting was not eligible for residential rebates according to annual cost/benefit analysis protocol. As a result, EWEB provided only technical assistance to interested customers. In addition, the City of Eugene provided funding for a rainwater harvesting system to be installed at the Water Wise Demonstration Garden (described in the Public Education section above). EWEB coordinated design and installation of this system in mid-2010.

Changes to the plumbing code now allow greywater reuse. However, a white paper jointly sponsored by the WateReuse Foundation, Water Environment Federation, and AWWA in 2010 determined that the payback period exceeds the life of the most complex of the residential systems. Therefore, EWEB and the Metropolitan Wastewater Management Commission (MWMC), which serves the wastewater needs of the Cities of Springfield and Eugene, and parts of Lane County, got involved in an implementation planning phase of a recycled water program. The planning work included community involvement, demonstrations, and alternatives evaluation. MWMC led the effort, which a customer proposed through EWEB's grant/loan program.

From 2005 to 2007, EWEB conducted a rainwater harvesting study to assess the conservation potential and cross connection risks of rainwater harvesting for commercial and industrial customers. Based on results of this study, EWEB determined that rainwater harvesting in the commercial and industrial sector was not eligible for rebates according to annual cost/benefit analysis protocol. Nonetheless, EWEB still provides technical assistance to commercial and industrial customers interested in rainwater harvesting.

The white paper on greywater reuse, described above, also determined that the payback period of greywater reuse projects exceeds the life of the type of complex systems that commercial and industrial installations require. Although EWEB does not provide financial assistance based on results of that white paper, it provides technical assistance upon request.

EWEB's largest former water customer, Hynix Semiconductor of America, implemented two process water reuse projects in support of water conservation goals. One project reclaims ultra-pure water used in the chip manufacturing process and re-processes it for reuse in the same processes. A second project diverts reverse osmosis reject water for use in cooling processes within the plant. These facilities have remained in place for use by the new owner when the facility is sold.

Attachment 9 - Other: Eugene-Springfield Natural Hazards Mitigation Plan

Eugene-Springfield Area Multi-Jurisdictional
NATURAL HAZARDS MITIGATION PLAN

City of Eugene
940 Willamette #200
Eugene, Oregon 97401

City of Springfield
225 Fifth Street
Springfield, Oregon 97477

January 2020

Eugene Water & Electric Board
500 East Fourth Ave.
Eugene, Oregon 97401

Rainbow Water District
1550 N. 42nd St.
Springfield, OR 97477

Springfield Utility Board
250 A Street
Springfield, Oregon 97477

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COUNCIL RESOLUTION NO. 5303

A RESOLUTION ADOPTING THE EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN 2020 AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 5126.

PASSED: 7:0

REJECTED:

OPPOSED:

ABSENT: Evans

CONSIDERED: June 24, 2020

RESOLUTION NO. 5303

A RESOLUTION ADOPTING THE EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN 2020 AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 5126.

The City Council of the City of Eugene finds that:

A. On February 9, 2015, Resolution No. 5126 was adopted approving the December 2014 "Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan." The Federal Emergency Management Agency ("FEMA") requires that Natural Hazards Mitigation Plans be updated every five years.

B. The City of Eugene recognizes the threat that natural hazards pose to people and property within our community.

C. Undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences.

D. An adopted Multi-Jurisdictional Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs.

E. The City of Eugene fully participated in the FEMA-prescribed mitigation planning process to prepare the Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan 2020 attached as Exhibit A.

F. The Oregon Office of Emergency Management and Federal Emergency Management Agency, Region 10 (X) officials have reviewed the "Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan 2020," dated January 2020, and have pre-approved it contingent upon this official adoption of the participating governments and entities.

NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF EUGENE, a Municipal Corporation of the State of Oregon, as follows:

Section 1. The "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan 2020" attached as Exhibit A is adopted and replaces the Plan adopted by Resolution No. 5126.

Section 2. The City Manager, or the Manager's designee, is requested to submit a copy of this Resolution, including Exhibit A, to the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region 10 (X) officials to obtain formal approval of the Plan.

Section 3. This Resolution is effective immediately upon its passage by the City Council.

The foregoing Resolution adopted the 24th day of June, 2020.

City Recorder – Deputy

CITY OF SPRINGFIELD, OREGON
RESOLUTION NO. 2020-04

A RESOLUTION OF THE CITY OF SPRINGFIELD COMMON COUNCIL ADOPTING THE JANUARY 2020 EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 2015-04

WHEREAS, on February 17, 2015, the Common Council of the City of Springfield adopted its Resolution No. 2015-04 thereby approving the December 2014 "Eugene/Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan"; and

WHEREAS, Springfield recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five years to maintain their eligibility to receive funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, Springfield actively participated in the FEMA-prescribed mitigation planning process to prepare this January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*"; and

WHEREAS, the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan*" and approved it as of January 13, 2020, contingent upon its official adoption by the participating governments and entities;

NOW, THEREFORE, BE IT RESOLVED, BY THE COMMON COUNCIL OF THE CITY OF SPRINGFIELD:

Section 1. The January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*" is adopted as an official plan and replaces the Plan adopted by Council Resolution 2015-04.

Section 2. The Springfield City Manager will submit this Adoption Resolution to the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region X officials to enable the Plan's final approval.

Section 3. This Resolution will take effect upon adoption by the Council and approval by the Mayor.

ADOPTED by the Common Council of the City of Springfield, this 18 day of February, 2020 by a vote of 5 for and 0 against. (1 absent - Woodrow)

Mayor

ATTEST:

City Recorder

REVIEWED & APPROVED AS TO FORM

Kristina Kraaz

DATE: 2/13/2020

SPRINGFIELD CITY ATTORNEY'S OFFICE

Eugene Water & Electric Board
PO Box 10148
Eugene, OR 97440-2148
541-685-7000
www.eweb.org

July 17, 2020

Kevin Holman, Emergency Management Program Manager
City of Eugene
Emergency Management
Employee Resource Center
940 Willamette St., Suite 200
Eugene OR 97401

Re: EWEB Board Approval of 2020 Eugene/Springfield Natural Hazard Mitigation Plan

Mr. Holman:

The EWEB Board of Commissioners approved the 2020 Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan via the consent calendar at its February 4, 2020 regular meeting.

By adopting the plan, the Eugene Water & Electric Board commits to work on the mitigation actions described in the EWEB Annex.

Anne Kah
Executive Assistant/Assistant Board Secretary
Eugene Water & Electric Board

SPRINGFIELD UTILITY BOARD

RESOLUTION 20-02

WHEREAS, the Springfield Utility Board, organized under the laws of the State of Oregon and the Charter of the City of Springfield, is authorized under the provisions of ORS Chapter 402 to establish by resolution the adoption of the January 2020 Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, the Springfield Utility Board recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five (5) years to be eligible to receive funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, Springfield Utility Board fully participated in the FEMA-prescribed mitigation planning process to prepare this January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*"; and

WHEREAS, the Oregon Office of Emergency Management and Federal Emergency Management Agency officials have reviewed the January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan"* and approved (January 13, 2020) it contingent upon this official adoption of the participating governments and entities;

NOW THEREFORE BE IT RESOLVED THAT

The January 2020 "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan" is adopted as an official plan by Springfield Utility Board's Resolution 20-02.

PASSED AND ADOPTED this 12th day of February, 2020, by a vote of 5 for and 0 against.

John DeWenter, Board Chair

ATTEST:

Jeff Nelson, Board Secretary

RESOLUTION 2020-02
RAINBOW WATER DISTRICT
RESOLUTION ADOPTING 2020 NATURAL HAZARDS MITIGATION PLAN

WHEREAS, Rainbow Water District (Rainbow) is a domestic water supply district organized under Oregon Revised Statues (ORS) Chapter 264, and ORS 264.410 provides "the power and authority given to districts is vested in and shall be exercised by a board of five commissioners", and

WHEREAS, Rainbow recognizes the threat that natural hazards pose to people and property within our community; and undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, Rainbow Water District participated in the December 2014 "Eugene/Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan" and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five years to be eligible to receive grant funding from FEMA for disaster mitigation projects; and

WHEREAS, Rainbow participated in the FEMA-prescribed process to prepare this January 2020 "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan" along with the Cities of Eugene and Springfield, the Eugene Water and Electric Board, and the Springfield Utility Board, with Rainbow providing an opportunity for public comment on February 12, 2020; and

WHEREAS, officials with the Oregon Office and Emergency Management (OEM) and FEMA Region X have reviewed the 2020 Natural Hazards Mitigation Plan and approved it January 13, 2020 contingent upon the official adoption by all participating governments and entities; and

NOW, THEREFORE, BE IT RESOLVED, the Rainbow Water District Board of Commissioners hereby:

- Adopts the January 2020 Natural Hazards Mitigation Plan, replacing the previous plan, and
- The Rainbow Superintendent will submit this adopting Resolution to the Oregon OEM and FEMA Region X officials to enable the Plan's final approval, and
- This Resolution will take effect upon adoption by the Rainbow Board of Commissioners.

ADOPTED AND APPROVED by a vote of 5 Yes votes and 0 No votes, this 12th day of February 2020.

President, Board of Commissioners

Attest:

Secretary-Treasurer, Board of Commissioners

Acknowledgements

This plan and the work it represents was funded by the City of Eugene, the City of Springfield, Eugene Water & Electric Board, Rainbow Water District, and Springfield Utility Board.

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Ken Vogeney, City of Springfield Emergency Management
Kevin Holman, City of Eugene Emergency Management

Vulnerability Assessment Sector Experts
In addition to the steering group listed above, individuals from more than 20 businesses, non-profits and government agencies were consulted for their expertise and perspective during the vulnerability assessment process. A complete list of these participants can be found in Appendix B, Planning and Public Process.

Lane Preparedness Coalition NHMP Subcommittee
Members of the Lane Preparedness Coalition Natural Hazards Mitigation Plan subcommittee contributed time and expertise to the development of this plan.

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1 Mitigation Planning

This document serves as the long-term natural hazard mitigation strategy for the Cities of Eugene and Springfield as well as the Sub-Plan Holders.[1] The following sections make up the Natural Hazard Mitigation Plan 2020.

- *Section One* is an overview of the plan and development process.
- *Section Two* reviews each hazard, how it has historically affected the area, and what are the potential various impacts.
- *Section Three* includes hazard and demographic maps.
- *Section Four* covers the vulnerability assessment process.
- *Section Five* is comprised of the Sub-Plan Holders' annexes.
- *Section Six* is the final section containing appendixes which include all supporting and hazard impact documentation.

1.1 What is Natural Hazard Mitigation?

Natural hazard mitigation is defined as permanently reducing or alleviating the losses of life, property, and injury resulting from natural hazards through long and short-term strategies. Strategies can include policy changes, such as updating ordinances; projects, such as seismic retrofits to critical facilities; or education and outreach to targeted audiences, such as slide risk reduction measures provided to residents in landslide-prone areas.

Engaging in mitigation activities provides jurisdictions with many benefits, including reduced loss of life and property, improved delivery of essential services, economic stability, reduced cost, and a shortened recovery period following natural hazard events.

Finally, mitigating hazards makes financial sense. A report submitted to Congress by the National Institute of Building Science's Multi-Hazard Mitigation Council (MMC) indicated for every dollar spent on mitigation society can expect an average savings of up to six dollars.[2] Successful, hazard mitigation is the responsibility of individuals, private businesses, and all levels of government.

[1] Eugene Water & Electric Board, Rainbow Water District, and Springfield Utility Board.
[2] United States. National Institute of Building Sciences. *Natural Hazard Mitigation Saves: 2017 Interim Report* Multihazard Mitigation Council - National Institute of Building Sciences.

1.2 Why Develop a Mitigation Plan?

Understanding the relationships between the natural hazards we face, our vulnerable systems, and our existing response capability helps us identify and implement actions aimed at reducing the community's overall risk. The planning process aids in communication, cooperation, and prioritization of mitigation actions within the community. Maintaining a current plan increases the potential for state and federal funding for mitigation and recovery projects.

The Cities of Eugene and Springfield along with Eugene Water & Electric Board (EWEB), Rainbow Water District (RWD), and the Springfield Utility Board (SUB) jointly developed the 2020 Natural Hazards Mitigation Plan (NHMP), which is the third edition of this multi-jurisdictional plan.

1.3 How Does this Plan Work?

This plan is strategic and non-regulatory in nature, meaning it does not set forth any new policies. It does provide:

- A foundation for coordination and collaboration among agencies and the public;
- Identification and prioritization of future mitigation activities; and
- Aid in meeting Federal requirements for assistance programs.

This mitigation plan works in conjunction with other municipal plans and programs, including local comprehensive land use plans, the Eugene-Springfield Multi-Jurisdictional Emergency Operations Plan, the Lane County Natural Hazards Mitigation Plan, local capital improvement plans, the Eugene-Springfield Public Facilities and Services Plan, and the State of Oregon's Natural Hazards Mitigation Plan.

The actions described in this plan are intended to be implemented primarily through existing plans and programs within Eugene and Springfield; however, some of the mitigation actions described may require development of new or adjustments to existing programs, plans, or policies.

1.4 The Eugene-Springfield Area NHMP 2020

The City of Eugene and the City of Springfield have a history of mitigation work and planning spanning decades. One of the most notable efforts in mitigation work has occurred in flood mitigation. The use of parks and open space in and

December 2017. Accessed October 2017. http://www.wbdg.org/files/pdfs/MS2_2017Interim%20Report.pdf

around the cities and levies has contributed to flood mitigation as demonstrated in the 2019 Spring flooding. Formal planning between the two cities, working as partners, to address natural hazard planning began in 2009. The following sections (Section 1.1 – 1.5.2) provide a high-level overview of historical planning efforts, who was involved in the completion of the 2020 NHMP, the conclusions reached through the plan development, and the cities vital steps forward.

1.4.1 How was the 2020 NHMP Developed?

Previous planning and new information guided the 2020 NHMP mitigation actions items. In 2009, Eugene and Springfield and partner agencies developed the 2009 NHMP for the most significant natural hazards for our area.

In 2013, Eugene and Springfield, with support from the Oregon Partnership for Disaster Resilience, conducted a 2014 Regional Climate and Hazards Vulnerability Assessment,[3] or the 2014 Vulnerability Assessment for short.

In 2014, Eugene and Springfield and partner agencies developed the 2014 NHMP for the most significant natural hazards for our area. This plan was based on many of the findings from the previous 2009 NHMP and the 2014 Vulnerability Assessment.

In 2016 and 2017, the Cities of Eugene and Springfield conducted seismic evaluations of their critical infrastructure. The Oregon Department of Transportation (ODOT) also completed seismic evaluations of priority bridges,[4] and the Oregon Department of Geology and Mineral Industries (DOGAMI) completed an extensive landslide hazard and risk study[5] in central Lane County.

The Eugene Water and Electric Board (EWEB) and Springfield Utility Board (SUB) are both long time participants in the Eugene-Springfield Area Multi-Jurisdictional NHMP. Additionally, the Rainbow Water District participated in the 2020 NHMP update.

EWEB's utility specific NHMP information is in Annex A, Rainbow Water District's is in Annex B, and SUB's is in Annex C. Each participant developed

[3] United States. City of Eugene. Emergency Management. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

[4] United States. Oregon Department of Transportation. Bridge and Geo-Environmental Sections Technical Services Branch. *Oregon Highways Seismic plus Report*. OR: Oregon Department of Transportation, 2014. 1-114.

[5] United States. Oregon Department of Geology and Mineral Industries. *Interpretive Map 60: Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon*. By Nancy Calhoun, William Burns, Jon Franczyk, and Gustavo Monteverde. Portland, OR: Oregon Department of Geology and Mineral Industries, 2018. 1-42.

their own specific annexes to better explain sector-specific risks and mitigation strategies.

The Project Team supporting the 2020 Natural Hazards Mitigation Plan update was composed of the following individuals:

- Jessica Gourley – Project Manager – City of Eugene
- Kevin Holman – City of Eugene
- Carrie Karl – City of Eugene
- Ken Vogeney – City of Springfield
- Jeannine Parisi – Eugene Water and Electric Board
- Tracy Richardson – Springfield Utility Board
- Jamie Porter – Rainbow Water District

In addition to the 2020 Project Team, a Steering Committee and an Advisory Board were formed. Together these entities compose the NHMP Update Committee. A fourth group involved in the plan development included the public. Each group was responsible for the following:

- Project Team was responsible for physically updating and editing the NHMP.
- Steering Committee was composed of departments and sub-plan holders responsible for implementing mitigation items. (Appendix B lists the members of the committee.)
- Advisory Board stakeholders, though not responsible for implementation, lent their knowledge based on their experience, training, or insight to help develop mitigation items.
- The Community – residents of Eugene and Springfield were engaged throughout the NHMP process to offer their insight, input, concerns, and support for hazards as well as possible mitigation items.

A more detailed description and associated documentation of the planning process are provided in Appendix B: Planning and Public Process.

1.4.2 Natural Hazards

This plan focuses on natural hazards affecting Eugene and Springfield.

1.4.3 Mission

The mission of the 2020 NHMP Update Committee was to identify and reduce vulnerabilities to natural hazards, and to make the Cities of Eugene and Springfield more resilient to disasters.

1.4.4 Plan Goals

The NHMP Update Committee compared the goals identified in the Oregon and Lane County NHMP with the (2014) Eugene-Springfield Area Multi-Jurisdictional NHMP. Based on this review, the Committee adjusted the goals to better align with companion plans and reflect current community hazard mitigation needs.

2020 Goals

One:	Save lives and reduce injuries.
Two:	Minimize damage to buildings and infrastructure, especially to critical facilities.
Three:	Minimize economic losses and strengthen the economic well-being of the Eugene-Springfield Metro Area.
Four:	Decrease disruption and speed restoration of public services, businesses, schools, and families.
Five:	Protect environmental resources and utilize natural systems to reduce natural hazard impacts.
Six:	Foster public-private partnerships to achieve mitigation outcomes.
Seven:	Utilize land development codes to mitigate risks posed by natural hazards.
Eight:	Protect natural, historic, and cultural resources.
Nine:	Maintain and enhance current spirit of collaboration, communication, and coordination among non-governmental organizations (NGO), private sector, and public hazard mitigation partners.
Ten:	Integrate local natural hazard mitigation strategies into significant community-wide plans.
Eleven:	Document and evaluate the Eugene-Springfield metro region's progress in implementing hazard mitigation strategies.

1.4.5 Crucial Sectors

During the development of the 2014 Vulnerability Assessment[6] the assessment team identified a unique culture of collaboration and information sharing within our community. They also identified three sectors fundamental to the maintenance, and restoration of all other sectors; electricity, fossil fuels, and transportation.

In addition to assessing the impacts of natural hazards on these sectors, the 2014 Vulnerability Assessment Team investigated the impact of climate change and fossil fuel dependency on the sectors' ability to mitigate, respond to, and recover from natural disasters.

Refer to Section 4 – Risk and Vulnerability, for more information about the risk and vulnerability process used to develop this plan.

1.5 Summary of Risk (2020)

Table 1-1 represents the Risk Assessment Matrix adopted by NHMP Update Committee for the 2020 NHMP.

Table 1-1 Risk Assessment Matrix

Natural Hazard	Risk Rating
Geomagnetic Disturbance (GMD)	Very High
Earthquake	Very High
Winter Storm	High
Drought	High
Wildfire	High
Windstorm	High
Flood Riverine	Moderate
Landslide	Moderate
Flood Stormwater	Low
Extreme Weather	Low
Volcano	Low

1.6 Impacts – Cascading Incidents

In previous versions of this NHMP two impacts, dam failures and hazardous materials, were their own standalone hazards. In risk assessment a natural hazard

[6] United States. City of Eugene. Emergency Management. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

is a source of harm or difficulty created by a meteorological, environmental, or geological event. Impacts are the consequences or effects of a hazards on the community and its assets.[7] For this update, four significant impacts or cascading incidents: civil unrest; dam or levee failures; epidemics; and hazardous material spills or releases, were viewed as secondary life threats to the primary natural or biological disaster. These incidents can occur absent of a natural hazard, but such an incident would be human caused, and not due to a natural force; the focus of this plan.

For each hazard the likelihood of it causing one of the four cascading incidents was evaluated and categorized (Figure 1-1 and Table 1-2). A summary of the natech (natural hazard trigged technological disasters) evaluation process is included in Section 4 and an in-depth review of the natech impacts for each natural hazard is located throughout Section 2.

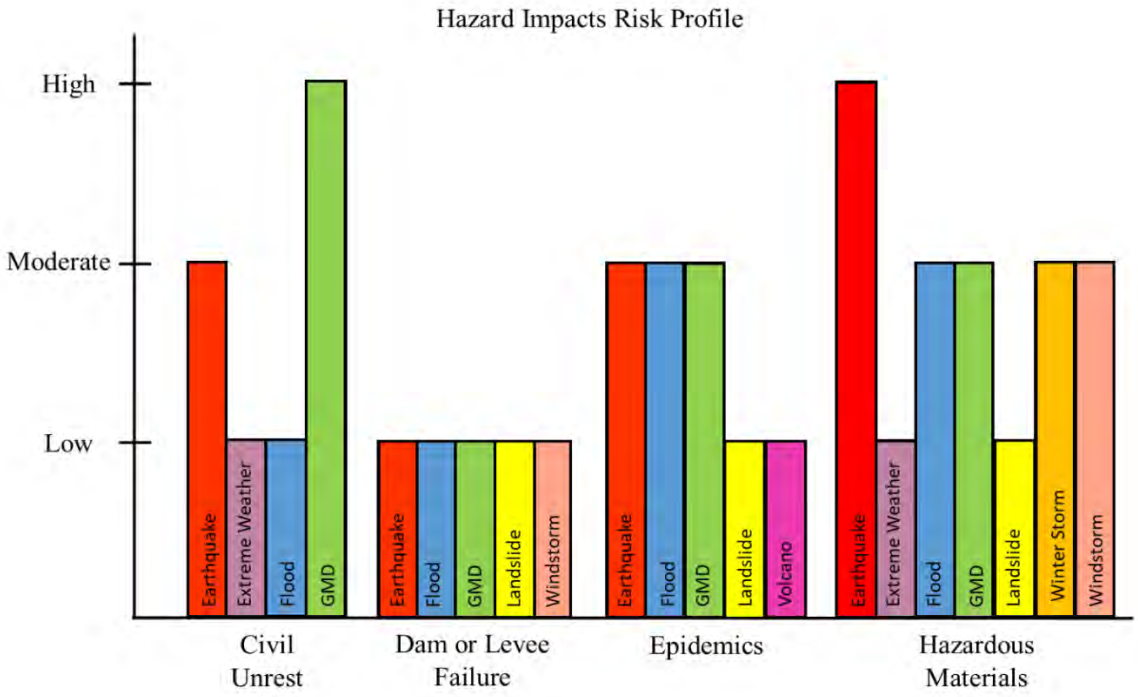


Figure 1-1. The "y" axis represents the level of risk each impact poses to the Cities of Eugene and Springfield while the x axis represents the impact for each specific hazard (the individual bars).

[7] United States of America. FEMA. *Local Mitigation Planning Handbook.* 2013. 5-1.

Table 1-2 Impact Risk	
Level	**Description**
No Known	No known (significant) possibility for impact to occur.
Low	Very unlikely for impact to occur with mitigation.
Moderate	Significant mitigation needed to prevent impact.
High	Still likely to occur even with mitigation.

1.7 Mitigation Strategy Summary

Based on the existing (2014) Eugene-Springfield Area Multi-Jurisdictional NHMP as well as findings from numerous studies and projects completed since its release, the 2020 update committee developed several mitigation actions as summarized in Table 1-3 for the 2020 NHMP.

Prioritization of Mitigation Actions - 2020 NHMP

Eugene and Springfield Emergency Management staff placed a higher priority on a small number of mitigation actions which are identified in bold type in the following table (Table 1-3). The actions were developed using the following information:

- The 2014 Vulnerability Assessment emphasized strengthening the fossil fuel, transportation, and electricity sectors because they are crucial to the operation of all other sectors. Sector experts identified earthquakes, winter storms, floods, and wildfire events as the hazards of greatest concern. Actions supporting these systems were raised in priority.

- The Cities of Eugene and Springfield along with Sub-Plan Holders have done extensive work mitigating natural hazards. Several studies were done to better understand the areas' risk which was also incorporated into evaluating Mitigation Action Items.

- Finally, many community members took time to provide feedback at numerous NHMP public outreach events. This feedback provided input on local hazard mitigation priorities (survey results are detailed in Appendix B). Respondents indicated earthquakes, geomagnetic disturbances, flooding, and winter storms are the hazards the two City governments should prioritize. Respondents also indicated a strong preference for actions protecting utilities and critical facilities.

Based on these criteria and an understanding of local conditions, emergency managers selected those actions most likely to mitigate these priority vulnerabilities.

Additional detail about each of the mitigation actions is outlined in Appendix A. Sub-Plan Holders short form Mitigation Action Item tables are in their specific annex's and on the full action item table in Appendix A. Status updates for 2014 Eugene-Springfield NHMP Action Items are in Appendix E.

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
Drought	1	Resistant Landscaping	Adopt drought resistant landscaping policies.
	2	Water Reuse	Pursue a water reuse partnership with MWMC.
Earthquake	3	Local active Transportation Infrastructure Evaluation	Evaluate off-street path bridges, crossing over the Willamette River, to complete a high-level seismic assessment of all major City bridges.
	4	**Local Transportation infrastructure Seismic Upgrades**	**Complete seismic improvements to three of the thirteen priority transportation structures.**
	5	Unreinforced Masonry Building Database	Develop a database of unreinforced masonry buildings (URMs) for first responders to utilize for planning and response operations.
	6	**Springfield Critical Facilities Retrofit**	**Implement phase two of the seismic retrofit of Springfield City Hall and three Springfield Fire Stations.**
	7	**Emergency Fuels Assessment - Phase II**	**Finish phase two of the Emergency Fuels Assessment for Lane County.**
	8	**Increased Fuel Capacity**	**Research methods to increase fossil fuel capacity around critical facilities; such as upgrading generator fuel tanks to high capacity tanks.**
	9	**Seismically Retrofit Eugene Fueling Station**	**Seismically retrofit the Eugene fueling station and associated buildings to ensure it is usable after a Cascadia Subduction Zone (CSZ) earthquake.**
	10	Earthquake Damage Study	In partnership with DOGAMI, update the earthquake damage estimate study for the Eugene-Springfield area.
	11	Seismic Upgrades – Eugene	Finish seismic upgrades to City owned facilities.
	12	Wastewater Pump Station Retrofit	Retrofit the Pump Stations to meet current seismic standards.
Extreme Weather	13	Outreach Awareness	Research and incorporate extreme weather safety awareness into the Cities' public outreach program.

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
Flood Riverine	14	Update Floodplain Maps	Actively seek funding to update the Eugene-Springfield floodplain maps focusing on the Willamette River through Eugene and the Mill Race, Willamette River through Glenwood, and the 42nd St Levee seclusion zone in Springfield.
	15	**Levee Certification**	**Seek and maintain certification of the 42nd Street Levee and other flood control structures within Springfield.**
	16	Streambank and Erosion Control	Stream bank stabilization near the 42nd street levee.
Flood Stormwater	17	Stormwater Improvements	Projects include culvert replacements and streambank stabilization. Using prioritization criteria, the highest priority stormwater capital projects are selected for inclusion in the Cities' Capital Improvement Programs. Projects prioritization criteria include whether a project addresses a potential risk to life or property (e.g. flooding), and whether it resolves an ongoing repetitive issue.
	18	Stormwater Master Plan Updates	Update the City of Eugene's 2002 Stormwater Basin Plan and Springfield's 2008 Stormwater Facility Master Plan.
	19	Stormwater and Climate Change Impacts	Evaluate stormwater design standards taking into consideration climate change modeling.
Geomagnetic Disturbance (GMD)	20	Continuity of Operations Plans	Develop Continuity of Operations Plans (COOP) for the City of Eugene's Public Works, Police, and Fire departments, and all Springfield departments.
Landslide	21	Analysis of 2018 DOGAMI Landslide Study	Using the DOGAMI landslide study released the summer of 2018 (IMS-60), determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.
Wildfire	**22**	**Fuels Reduction**	**Reduce fuels on public lands, focusing on the hillsides in the southern portions of both Cities.**
	23	Community Wildfire Protection Plan (CWPP)	Develop the Eugene-Springfield Community Wildfire Protection Plan (CWPP).

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
	24	Update the Wildland-Urban Interface (WUI) Plan	Update the Eugene-Springfield WUI plan and address access routes.
	25	Species Specific Tree Removal	Identify and remove species with known failure profiles and potential defects. Plant or replant drought tolerant and disease, pest and damage resistant tree species. Work with City departments, contractors and non-profits to complete this work.
Windstorm	**26**	**Defective Tree Maintenance**	**Utilize contract crews to perform maintenance pruning. Provide clearance and mitigate defects, such as overextended branches prone to failure under increased loads, along major arterials and priority traffic routes. Unhealthy or structurally unsound trees will be removed and replanted.**
Winter Storm	27	Sheltering	Develop a consolidated plan for community sheltering and associated outreach needs to provide sheltering, during large scale events or incidents when American Red Cross resources are diverted elsewhere.
Volcano	28	Lahar Risk Study	Evaluate the lahar risk to the McKenzie River valley.
	29	Ash Removal	Research ash removal methods.
Multi-Hazard	30	Food Supplier Coalition	Develop a coalition of food suppliers to identify options to address supply chain concerns after a major disaster.
	31	Vulnerable Populations Two Weeks Ready	Utilizing relevant vulnerable populations maps developed for the Lane Livability Consortium, develop an outreach plan to engage vulnerable populations to be Two Weeks Ready with emergency supplies.
	32	Long-term Care and Nursing Home Facilities Emergency Planning Assistance	Support and assist Lane County Public Health in developing and conducting trainings or outreach on emergency preparedness and planning for long-term and nursing home facility leadership as they take steps to comply with the Emergency Preparedness Rule set forth by the Centers for Medicare and Medicaid Services.
	33	Public Safety Communications Reliability	Work with the Lane Radio Interoperability Group (LRIG) System partners to develop a first responder communication system with public safety grade reliability.
	34	Damage Assessment Plan	Finalize the Eugene-Springfield Damage Assessment Plan
	35	**Mass Evacuation**	**Develop and exercise a City evacuation plan**

1.8 Plan Adoption, Implementation and Maintenance

The Eugene-Springfield Natural Hazard Mitigation Plan originally adopted in 2009 and later updated in 2014 and 2020 will be due for revision and subsequent adoption in 2025. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events.

This section details the formal process to ensure the Eugene-Springfield NHMP remains an active and relevant document. The plan implementation and maintenance processes include a schedule for monitoring and evaluating the plan annually, as well as producing an update every five years. Finally, this section describes how Eugene and Springfield will integrate public participation throughout the plan's maintenance and implementation process.

1.8.1 Plan Review, Update, and Adoption 2020

The process for plan review, update, and adoption was conducted in the following order.

Step 1 - Emergency Management planners assigned to the NHMP and appropriate community partners, updated and re-evaluated this latest version of the NHMP based on current knowledge, accuracy, and relevance of the natural hazards in our area. Planners developed, from the existing plan, a new and updated edition called the NHMP 2020. Adhering to Federal Emergency Management Agency (FEMA) requirements, planners included local outreach activities to engage the community in determining needs and concerns, as well as captured their input for further plan revisions.

Step 2 - The draft Eugene-Springfield Area Multi-Jurisdictional NHMP 2020 was reviewed by both Emergency Managers. Updates and corrections were made as needed.

Step 3 - On or before September 20, 2019 the Cities jointly submitted the draft to the State Hazard Mitigation Officer at the Oregon Military Department, Office of Emergency Management (OEM).

Step 4 - OEM reviewed the plan and provided comment, requested revisions, and or retractions by the cities or their sub-plan holders.

Step 5 – Upon the Cities completing the requested edits, OEM determined the plan complete and ready for FEMA's review and subsequent approval. OEM then submitted the NHMP 2020 to FEMA Region 10. The Cities also

submitted the NHMP 2020 to Bonneville Power Administration (BPA)[8] and neighboring jurisdictions[9] for review.

Step 6 - FEMA and neighboring jurisdictions reviewed the plan and provided comment, requested revisions, and/or retractions by the Cities or their sub-plan holders.

Step 7 - Upon the Cities completion of the requested edits, FEMA provided all entities an "Approvable Pending Adoption" letter at which point the plan was adopted by local governing bodies.

Step 8 - After the plan was adopted by all entities, the adoption resolution was submitted to FEMA. Once FEMA received this documentation each multi-jurisdictional holder was awarded their approval letter.

Step 9 - The City of Eugene and City of Springfield elected Councils provided final jurisdictional approval as the governing body for the City of Eugene and the City of Springfield.

Following completion of the nine-step approval process Eugene, Springfield, EWEB, RWD, and SUB became eligible for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and the Flood Mitigation Assistance Program. Throughout the process both Cities worked closely with sub-plan holders to add their annexes. This review and subsequent update adheres to the provisions and federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201.

1.8.2 Implementation Coordination (2020 and Beyond)

Convening

Eugene and Springfield Emergency Management will jointly maintain a Project Team to oversee the implementation, by the Steering Committee, of the Eugene-Springfield NHMP.

Eugene and Springfield Project Team responsibilities include:

- Coordinating Steering Committee meeting dates, times, locations, agendas, and member notification;
- Documenting outcomes of Committee meetings;
- Engaging Advisory Board members;
- Incorporating, maintaining, and updating the jurisdiction's natural hazard risk GIS data elements;

[8] BPA is cited as a source of power by our sub-plan holders.
[9] Coburg, Cottage Grove, Creswell, Junction City, Lane County, Santa Clara, and Veneta.

- Prioritizing new study and hazard research needs;
- Serving as a communication conduit between the Steering Committee and key plan stakeholders;
- Submitting future updates to OEM for review;
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects; and
- Developing the 2025 Eugene-Springfield NHMP.

Roles and Responsibilities

To ensure the entire community is involved, this NHMP update includes roles and responsibilities of NHMP members. The NHMP Project Team manages three main entities as part of the NHMP Update Committee. These entities and their associated responsibilities for maintaining and developing this multi-jurisdictional plan are as follows:

- Steering Committee is composed of departments and sub-plan holders who are responsible for development and implementation of mitigation items.
- Advisory Board stakeholders lend their knowledge based on their experience, training, or insight to help develop mitigation items.
- The Community – residents of Eugene and Springfield offer their support and provide insight, input, and concerns regarding possible mitigation items.

Implementation

The Cities emergency management staff and sub-plan holders lead the implementation of the plan in coordination with Steering Committee members. Following is a list of their duties for implementation of the current update in 2020 and the next update in 2025.

Emergency management staff:

- Evaluate funding opportunities such as the Pre-Disaster Mitigation Grant Program, Hazard Mitigation Grant Program, and Flood Mitigation Assistance Program;
- Consult with partner agencies, businesses, and organizations on implementing projects;
- Convene the NHMP Steering Committee on a quarterly basis;
- Document successes and lessons learned;
- Evaluate and update the NHMP following a disaster; and
- Evaluate and update the NHMP in accordance with the prescribed schedule.

Plan Maintenance

The NHMP Steering Committee is required to meet biannually. Eugene and Springfield Emergency Management staff schedule four meetings each year and typically meet quarterly.

During these meetings the NHMP Steering Committee will review the progress on mitigation actions, discuss implementation challenges and opportunities, invite guest presenters to provide technical information, and annually review priorities (as detailed below under Annual Review and Update).

Ongoing Annual Review and Update

The Steering Committee will use one of the quarterly meetings to review and maintain the NHMP, including the following tasks:

- Review progress toward mitigation goals made over the previous year;
- Review and re-evaluate priority of remaining mitigation actions;
- Review and adjust priorities, as needed;
- Consider new mitigation actions for inclusion within the plan;
- Consider adjustments to existing mitigation actions to improve feasibility, add critical detail, or refocus the strategy;
- Consider additional implementation partners as necessary, and develop a plan for their inclusion;
- Review public outreach conducted over the previous year; and
- Identify opportunities for outreach over the coming year.

Ongoing Public Involvement

The City of Eugene, City of Springfield, EWEB, RWD, and SUB will continue to share information about, and gather input on, the Natural Hazards Mitigation Plan. At least once a year the Cities will host presentations for the public to provide information, describe progress toward implementation, and collect feedback on the NHMP. Presentations through the Eugene-Springfield Community Emergency Response Team (CERT) program or Lane Preparedness Coalition meetings hosted quarterly will provide engagement opportunities for the interested public.

During the last two years of the NHMP update cycle, each jurisdiction will hold a minimum of one NHMP event. For the City of Eugene this also includes National Flood Insurance Program (NFIP) and Community Rating System (CRS) outreach. During these events, the community will be updated on mitigation projects, and given an opportunity to provide input on mitigation items.

2 Hazard Descriptions

2.1 Hazard Descriptions

The Cities of Eugene and Springfield are subject to the following natural hazards, listed alphabetically and without considering risk or mitigation priorities:

- Drought
- Earthquake
- Extreme Weather
- Flood
- Geomagnetic Disturbance (GMD)
- Landslide
- Volcano
- Wildfire
- Windstorm
- Winter Storm

Additionally, the Eugene-Springfield NHMP addresses four "non-natural" hazards or impacts. These four impacts may occur due to natural hazard incidents:

- Civil Unrest
- Dam or Levee Failure
- Epidemics
- Hazardous Materials

The following sections identify and profile the location, extent, previous occurrences, and future probability of each hazard listed above. Additional information on many of these hazards can be found in the Oregon Natural Hazards Mitigation Plan – Region 3: Regional Profile.[10]

[10] United States. Oregon Department of Land Conservation and Development. *Oregon Natural Hazards Mitigation Plan 2015*; *Chapter 2 Risk Assessment*; *Region 3*. September 2015. Accessed August 2019. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

2.2 Drought

Drought is a prolonged period of dry weather which persists long enough to cause adverse deficiencies in the water supply. Droughts are a slow-onset hazard, meaning over time they can have severe impacts on agriculture, municipal water supplies, recreational resources, and wildlife. A prolonged drought poses a significant threat to the economy.

2.2.1 Causes and Characteristics of the Hazard

Droughts are caused by the lack of precipitation in large geographic areas typically across counties, states, or regions. Generally, precipitation occurs in the Pacific Northwest as rain in the coastal regions and snow in the higher elevation mountainous areas. Rain and snowfall help to sustain the State's aquifers and provide river flow. Aquifers and rivers play a critical role by providing irrigation and potable water throughout the region. Snowpack and aquifers act as forms of natural water storage, balancing out the ups and downs of annual precipitation levels.

Short term effects of drought include declining stream, river, reservoir, lake, and ground water levels. The decline reduces agricultural yields, increases the potential for wildfires, and makes it difficult to maintain satisfactory quantities of municipal and private water levels. Long term effects of a depleted water supply can affect the economic viability of a community. According to NOAA, drought ranks second for the most economically destructive weather- related incident with losses around $9 billion per year.[11]

The three types of drought are meteorological, hydrological, and agricultural.

1. Meteorological drought is the most well-known and is due to low or no precipitation compared to the regional average. It is highly specific to a region.

2. Hydrological drought is when decreased precipitation affects soil moisture, groundwater, and snowpack as well as streamflow, lake, and reservoir levels.

3. Agricultural drought occurs when the available water supply cannot meet crop demand. It can occur in the absence of a Meteorological Drought due to timing of water availability or decreased access. (Figure 2-1)

[11] United States. NOAA National Centers for Environmental Information. *DROUGHT: Monitoring Economic, Environmental, and Social Impacts*. Accessed October 2017. https://www.ncdc.noaa.gov/news/drought-monitoring-economic-environmental-and-social-impacts

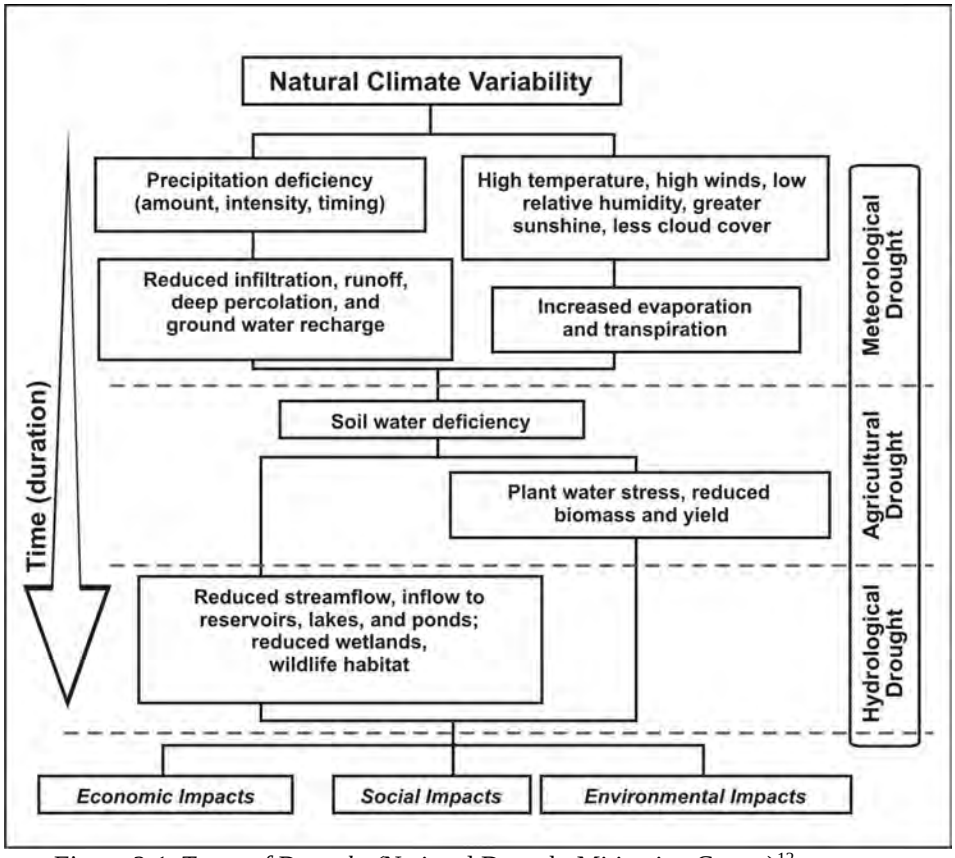


*Figure 2-1. Types of Drought (*National Drought Mitigation Center)[12]

2.2.2 Climate Change

Since the mid-1900s, the mountains in the Pacific Northwest have experienced a decline in spring snowpack due to a change in precipitation type from snow to rain and a shift in the timing of snowmelt. Warmer temperatures are causing earlier snowmelts which can lead to the water supply being increasingly out of sync with the area's typical water demands.[13] The National Climate Assessment predicts a slight decrease in the average annual precipitation and an increase in temperatures. This could mean longer, more severe, droughts.[14]

2.2.3 History of the Hazard in Eugene-Springfield

The National Drought Mitigation Center at the University of Nebraska-Lincoln tracks drought conditions across the country. Data can be broken down at the county or watershed basin levels. This data is recorded as a percentage of the area

[12] United States. University of Nebraska National Drought Mitigation Center. *Types of Drought.* Accessed August 2019. https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx
[13] Cook, Edward R., Richard Seager, Mark A. Cane, and David W. Stahle. *North American drought: reconstructions, causes, and consequences.* (Earth-Science Reviews 81, no. 1, 2007), 93-134.
[14] United States. US Global Change Research Program *National Climate Assessment Overview: Region Impacts.* 2014. Accessed October 2017. http://nca2014.globalchange.gov/highlights/overview/overview.

experiencing abnormally dry conditions. As shown in Figure 2-2, 100% of Lane County experienced severe droughts in 2001, 2014, and 2015.

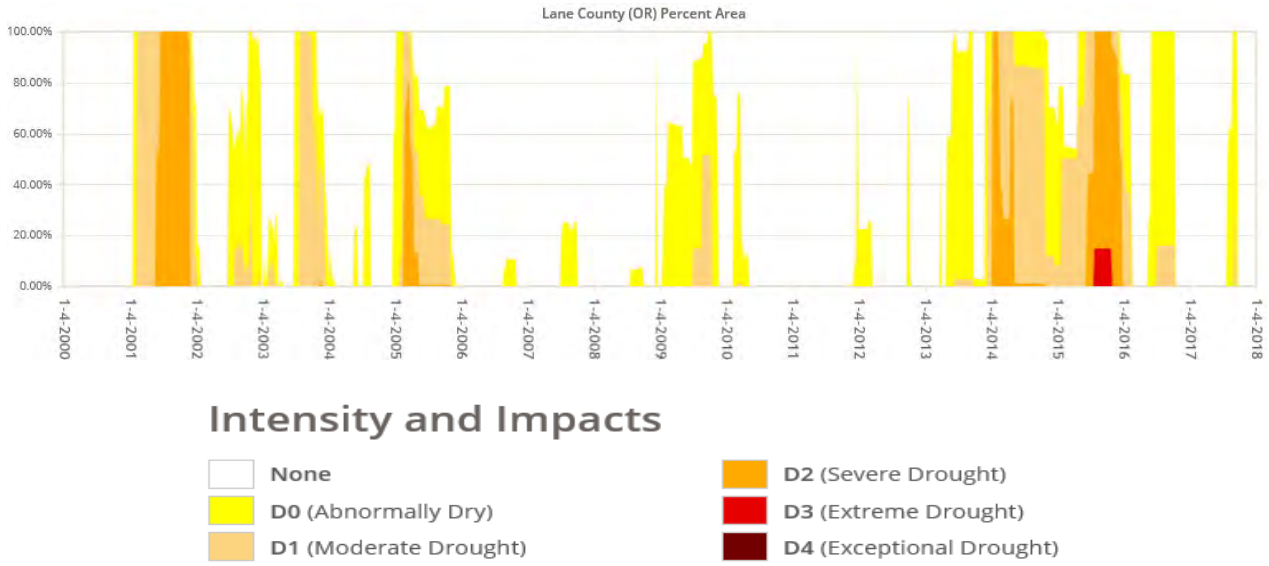


Figure 2-2. Source: National Drought Mitigation Center – *http://droughtmonitor.unl.edu/Data/Timeseries.aspx*

2.2.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, civil unrest is not a known impact of droughts.

Dam or Levee Failure

Dam or levee failure is not a known impact of droughts.

Epidemics

Epidemics are not a known significant impact of droughts in the Eugene-Springfield area.

Hazardous Materials

Hazardous Material spills are not a known significant impact of droughts.

2.2.5 Probability of Future Occurrence

Three severe droughts have occurred in Lane County since 2000. In addition, on September 30, 2015 some of the nation's top water scientists, lawyers, and policy-makers convened in Eugene, Oregon, to discuss the severe drought the area was

experiencing. They concluded droughts in Oregon are likely to become more frequent and severe, largely due to climate change.[15] Based upon these recent events the probability for future severe droughts is high.

2.2.6 Vulnerability and Capacity Assessment

Droughts are typically associated with summer, but often start during winter months with declining precipitation levels. Drought forecasting is commonly generated through temperature and ocean current patterns relative to recent and current conditions. This allows scientist to predict future droughts well before they occur. Drought is classified as having a high vulnerability level because a severe drought could impact every citizen in the Eugene-Springfield area. Despite being vulnerable to this hazard, the Eugene-Springfield area has a high capacity to respond to and recover from droughts. This is largely due to the slow onset of a drought and available resources.

2.2.7 Risk Assessment

The probability of drought in the Eugene-Springfield area is high and the vulnerability and capacity to deal with a drought are also high. Based on these factors, the Eugene-Springfield area's risk to this hazard is categorized as high. For a summary of Impact Risks see Table 2-1.

Table 2-1 Drought - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	No Known

2.2.8 Existing Hazard Mitigation Activities

While drought was referenced in prior editions of this NHMP, a risk assessment of drought was not included. Therefore, no existing hazard specific mitigation activities were identified in those prior plans.

2.3 Earthquake

The 2015 Oregon Natural Hazards Mitigation Plan – Region 3 Profile determined the chief earthquake hazard for the Mid/Southern Willamette Valley is the Cascadia

[15] Oregon. Oregon Environmental Council Samantha, Murray. *Drought is the "New Normal.* September 30, 2015. Accessed October 2017. http://www.oeconline.org/drought-is-the-new-normal/.

Subduction Zone (CSZ) or combined crustal events.[16] Given the potential for damage and the probability of a CSZ occurrence, Eugene and Springfield are primarily focused on a potential CSZ incident for earthquake mitigation planning purposes.

2.3.1 Causes and Characteristics of the Hazard

Seismic incidents were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate the risk to people and property is much greater than previously considered. Oregon, and the Pacific Northwest in general, are susceptible to earthquakes from four sources:

1. The offshore Cascadia Subduction Zone;
2. Deep intraplate incidents within the subducting Juan de Fuca Plate;
3. Earthquakes associated with renewed volcanic activity; and
4. Shallow crustal incidents within the North American Plate.

An earthquake could impact the entire Eugene-Springfield metro area as well as surrounding areas. The specific hazards associated with an earthquake include:

Ground Shaking

Ground shaking is defined as the motion of seismic waves felt on the Earth's surface caused by an earthquake. Ground shaking is the primary cause of earthquake damage.

Ground Shaking Amplification

Ground shaking amplification refers to how soils and soft sedimentary rocks, located near the surface, affect ground shaking from an earthquake. They can increase or decrease the amplification as well as the frequency of the shaking.

Surface Faulting

Surface faulting occurs when displacement reaches the earth's surface during a movement along a fault. Such faulting can result from movement deep within the earth or at the surface.

Earthquakes occurring from deep-lying faults usually create only ground shaking.

[16] United States. Salem, OR. Oregon Military Department Office of Emergency Management. *Oregon Natural Hazards Mitigation Plan.* 2015. Accessed October 2017. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

Earthquake-Induced Landslides

Landslides occur due to the shaking motion of an earthquake destabilizing the ground. Areas already prone to landslides have a much higher risk of an incident occurring during an earthquake.

Liquefaction

Liquefaction is a process by which water-saturated sediment temporarily loses strength and acts as a fluid instead of a solid. As the sediment loses strength, it also loses the ability to support weight. This effect can be caused by ground shaking.

Severity

The severity of an earthquake is dependent upon several factors including the distance from the earthquake's source (epicenter,) the ability of the soil and rock to conduct seismic energy, the degree (i.e. angle) of slope, the composition of slope, the magnitude of the earthquake, and the type of earthquake.

Maps showing the location of various earthquake related hazards are in Section 3.

2.3.2 Climate Change

At this point, it is unknown how climate change may affect how an earthquake impacts Eugene and Springfield. Changing soil conditions, due to climate change, could affect how earthquakes propagate throughout the area, but the extent or effect of this factor is unknown at this time.

2.3.3 History of the Hazard in Eugene-Springfield

Historically, earthquakes of sufficient intensity to cause significant damage in the Mid/Southern Willamette Valley region have occurred as offshore Cascadia Subduction Zone (CSZ) earthquakes of magnitudes of around 8 to 9. Approximate years of significant CSZ incidents are:

- 1400 BCE
- 1050 BCE
- 600 BCE
- 400 CE
- 750 CE
- 900 CE
- 1700 CE

The Cascadia Subduction Zone is a 620-mile fault line off the coast of Northern California, Oregon, Washington, and Southern British Columbia. When the fault moves, causing an earthquake, it is called a "rupture." The CSZ does not always rupture along its entire length. Research suggests, over the last 10,000 years the entire fault has ruptured 20 times with a magnitude 9.0 or larger. Three quarters of the fault has ruptured 2 to 3 times producing an earthquake between 8.8 and 8.5 magnitudes. The southern portion has ruptured 19 times producing earthquakes between a magnitude 7.6 and 8.5.[17] (Figure 2-3 and 2-4)

Native American oral records and geologic evidence has shown the most recent Cascadia Subduction Zone (CSZ) earthquake occurred in January 1700 with an approximate magnitude of 9.0. The earthquake generated a tsunami striking Oregon, Washington, and Japan. Native American villages along the Oregon coast were destroyed. There are no known reports of structural damage from earthquakes occurring or felt in the Eugene-Springfield area in recent history. A map of local historic earthquakes is included in Section 3, within the hazard maps.

Since November 2014 there have been three smaller crustal earthquakes in the Eugene and Springfield area. These incidents occurred on:

- 11/12/2014 – 14 Km East of Coburg, Oregon – Magnitude 2.6
- 01/12/2015 – 13 Km East of Coburg, Oregon – Magnitude 2.6
- 07/04/2015 – 15 Km East Northeast of Springfield, Oregon – Magnitude 4.8

Even though no major damages were reported for these incidents, they are a reminder a CSZ earthquake is not the only threat the area faces. Due to the potential severity of a CSZ earthquake, it is the goal of the Multi-jurisdictional NHMP partners to prepare for, and mitigate the risks of, such an incident. By doing this, the Cities of Eugene and Springfield will not only be prepared for a major earthquake from the Cascadia Fault, but also from those closer and more centrally located.

[17] United States. Oregon Department of Geology and Mineral Industries (DOGAMI). *Cascadia Earthquake Facts: What You Need to Know.* Slide 15-16. Accessed November 2017. http://slideplayer.com/slide/3475601/.

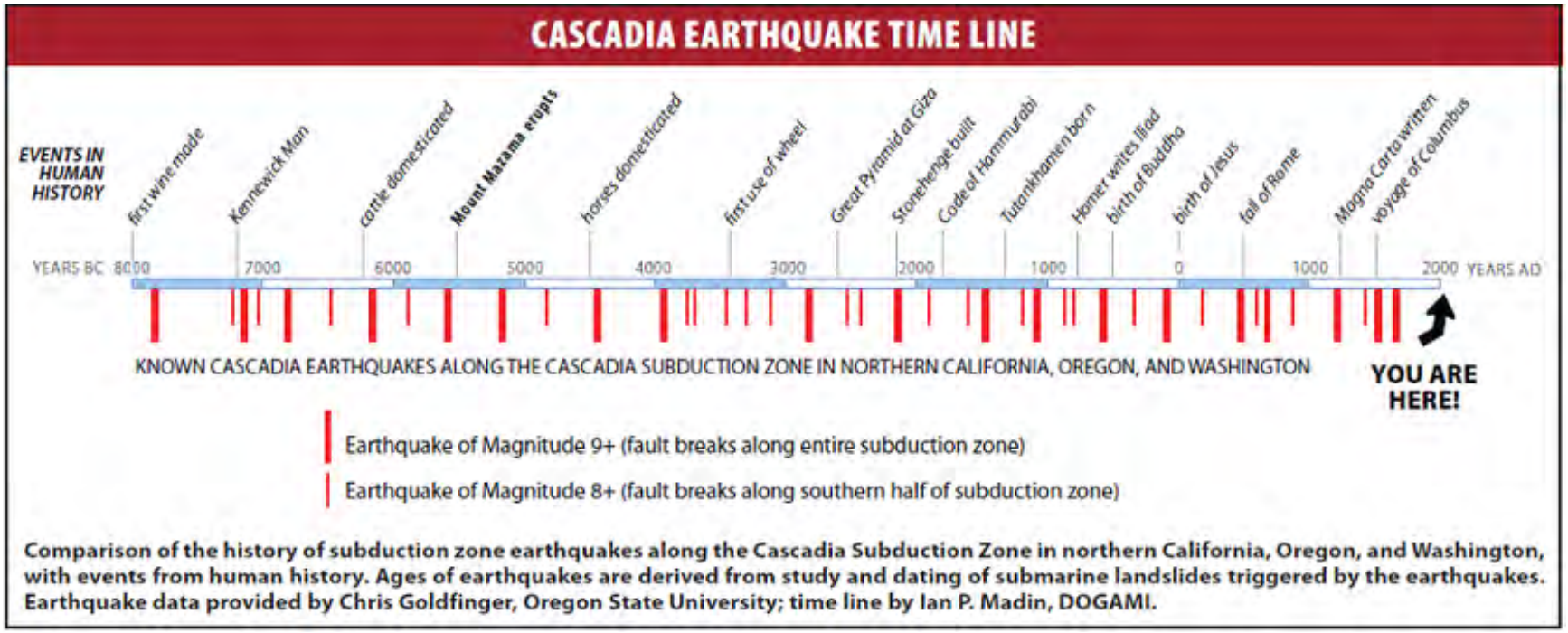


Figure 2-3. Source: Oregon Resilience Plan – *Cascadia Earthquake Time Line*

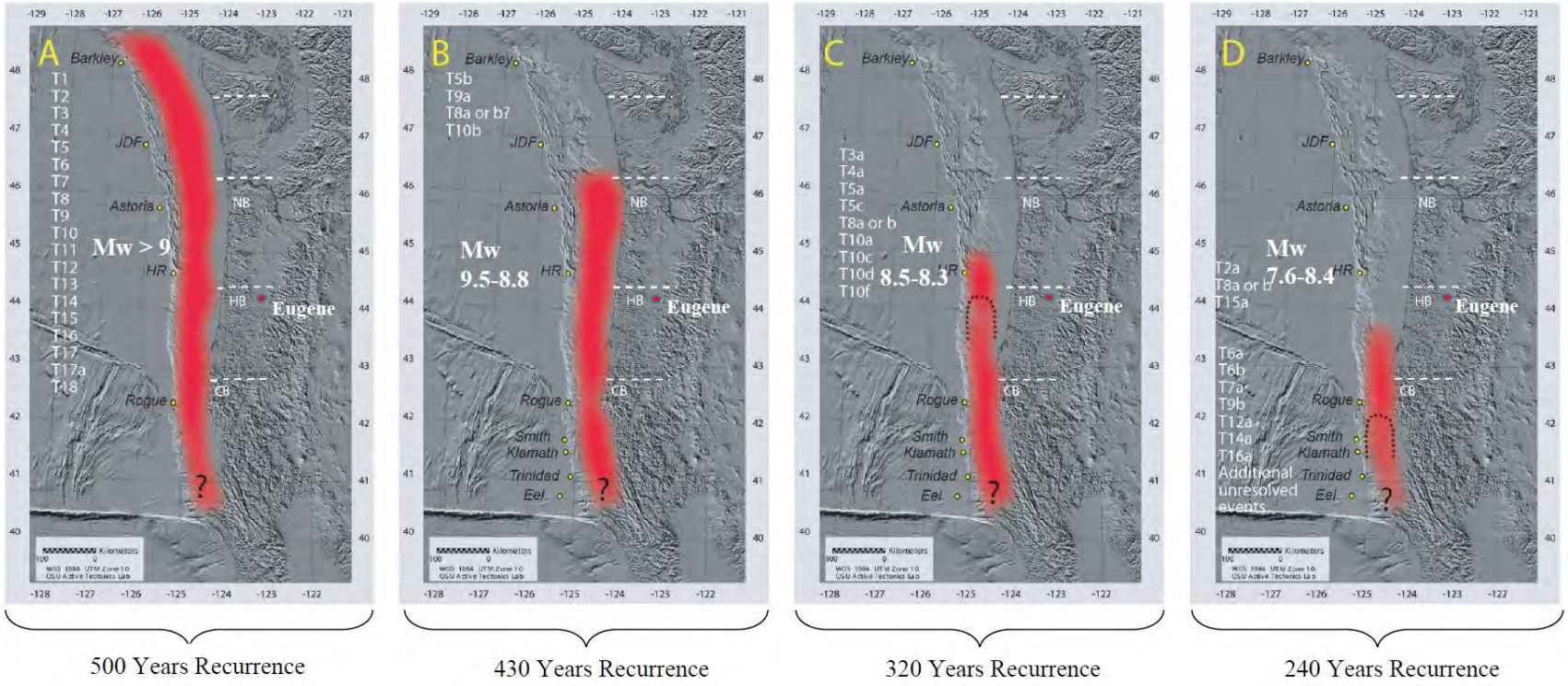


Figure 2-4. Source: Oregon Department of Geology and Mineral Industries – *Cascadia Subduction Zone Earthquakes.* The white lettering and numbering on the left indicates significant turbidite samples showing over 42 earthquakes in the last 10,000 years. Mw denotes the average magnitude of different fault ruptures.

2.3.4 Impacts – Cascading Incidents

Civil Unrest

Due to misinformation and the chaotic nature of incidents after a major natural disaster, it is difficult to determine the frequency of natural hazard induced civil unrest. One study cites the incidents of hurricane Katrina and the media's role in over broadcasting minor looting or rioting activities giving an impression such actions were prevalent.[18]

A study by the University of Otago (New Zealand) determined earthquakes and volcanic eruptions pose the highest risk of civil unrest in areas with income inequality, mixed political regimes, marginalization of certain groups, and when the State's capacity and legitimacy is weakened.[19] Figure 4-4 in Section 4 highlights several conditions noted as contributing factors for civil unrest after a natural disaster.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of an earthquake in Eugene or Springfield. While some studies have determined disaster impacted victims respond and adapt well, others have concluded there is a higher chance of violence when certain conditions are met.[15, 16] Conflicting data and a wide range of contributing factors make it difficult to determine the likelihood of civil unrest occurring in the Eugene-Springfield area after a major earthquake.

Despite the difficulties of predicting such an incident, it is safe to assume the area will experience many, if not all, of the contributing factors identified for civil unrest. This could result in anything from small ad-hoc looting incidents to large scale violent civil unrest. Additionally, on multiple occasions riots not associated with a disaster have occurred in Eugene, which indicates the area is already susceptible to such incidents.

Risk of Impact

Based on historical occurrences of civil unrest after disasters along with our area's societal composition, the risk of an earthquake induced civil unrest incident occurring is moderate.

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[18] Tierney, Kathleen, Christine Bevc, and Erica Kuligowski. "Metaphors matter: Disaster myths, media frames, and their consequences in Hurricane Katrina." *The annals of the American academy of political and social science* 604, no. 1 (2006): 57-81

[19] Nel, Philip, and Marjolein Righarts. "Natural disasters and the risk of violent civil conflict." *International Studies Quarterly* 52, no. 1 (2008): 159-185.

Dam or Levee Failures

Dam failures can occur at any time in a dam's life. Failures are most common when water storage is near or exceeding design capacity. At high water levels, the water force on a dam is higher and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

There are several ways an earthquake can cause an earthen fill dam, embankment dam, or levee to fail.

Compaction failure

The most common mode of dam failure, due to an earthquake, occurs when the embankment is not properly compacted. Dams can settle or spread laterally. By itself, such settlement does not generally lead to immediate failure. However, if the reservoir is full, relatively minor amounts of settling may cause overtopping to occur, resulting in scour and erosion which could progress to failure.

Structural failure

Ground shaking can also cause structural failures or overtopping of dams. For any dam, improper design or construction, or inadequate preparation of foundations and abutments can also cause failures.

Landslide tsunamis

Landslides into the reservoir, which may occur on their own or triggered by earthquakes, may lead to surge waves which overtop dams, or hydrodynamic forces which cause dams to fail under the unexpected load.

Seismic Seiches

Overtopping or overloading of a dam structure can also occur when an earthquake causes seismic seiches (waves) in the reservoirs. A seismic seiche is a standing wave in which the largest vertical oscillations are at each end of a body of water with very small oscillations at the center.

Equipment Failure

An earthquake can damage spill ways, gates, turbines, and electrical equipment used to operate the dam. When such failures occur water can quickly rise behind a dam causing it to be overtopped.

More information on local dams is in Appendix H.

History of Impact in Eugene-Springfield

There have been no dam failures in Oregon due to an earthquake. No historical local occurrences have been recorded, but the impact of large earthquakes on dams has been observed in other areas. Research shows 1.5 percent of embankment dam failures have been attributed to earthquakes, which is the most common form of dam to fail in a seismic incident.[20] According to the International Commission on Large Dams (ICOLD), until the 2011 earthquake in Japan no casualties had been attributed to a dam or levee failure induced by an earthquake.[21]

The 2008, magnitude 8.0, earthquake in China caused 1,803 concrete and embankment dams, and 403 hydropower plants to be damaged with no complete failures.[22] The 2010, 8.8 magnitude, earthquake in Chile damaged several dams, also with no complete failures. During the 2011 earthquake in Japan roughly seven dams and hundreds of levees had suffered damage. Only one of these, the Fujinami irrigation dam, had a complete failure resulting in the only known casualties from an earthquake induced dam failure. This failure destroyed five homes and killed eight people. It is thought this impact was magnified by inadequate design and construction.[23]

Risk of Impact

Based on history and the condition of the dams and levees in and around the Eugene and Springfield area, the risk from an earthquake induced failure is low.

Epidemics

Historically, fears of disease outbreaks after a natural disaster have been a prominent concern. Despite this, epidemics following natural disasters are rare, especially in developed countries.[24] [25] After a natural disaster, water related

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[20] United States. US Army Corps of Engineers and US Department of the Interior. *Best Practices in Dam and Levee Safety Risk Analysis IV-6 Seismic Risks for Embankments.* April 2, 2015. Accessed October 2017. https://www.usbr.gov/ssle/damsafety/risk/BestPractices/Presentations/IV-6-20150402-PP.pdf

[21] Wieland, Martin. "Dam safety and earthquakes." *International Water Power & Dam Construction,* August 2010, 12-14. Accessed October 2017. https://www.preventionweb.net/files/15259_9694491.pdf

[22] United States. United States Society of Dams. *Observed Performance of Dams During Earthquakes Vol. III.* February 2014. Accessed August 2019. https://damfailures.org/wp-content/uploads/2018/02/EQPerfo2_v3.pdf

[23] United States. United States Army Corps of Engineers Portland District. "Don't freak out: Dams generally do well in earthquakes." January 2016. Accessed October 2017. http://usaceportland.armylive.dodlive.mil/index.php/2016/01/shakeout-dont-freak-out-dams-generally-do-well-in-earthquakes/

[24] Lemonick, David M. "Epidemics after natural disasters." *American Journal of Clinical Medicine* 8, no. 3 (2011): 144-152. https://www.aapsus.org/wp-content/uploads/ajcmsix.pdf

[25] Watson, John T., Michelle Gayer, and Maire A. Connolly. "Epidemics after natural disasters." *Emerging infectious diseases* 13, no. 1 (2007): 1-5

communicable diseases and large populations of displaced citizens are primary concerns.

Though diseases can be introduced to a population by emergency personnel, such as the 2010 Cholera outbreak in Haiti, generally, a disease must be endemic prior to the disaster for it to become an epidemic afterward. Cold conditions favor airborne pathogens while warm weather favors waterborne pathogens. Large dust clouds generated by an earthquake can also disperse a variety of spores causing respiratory illnesses.

History of Impact in Eugene-Springfield

There have been no post-earthquake epidemics in the Eugene-Springfield area. The worldwide risk of communicable diseases after an earthquake is deemed a moderate risk for person to person, water, and food borne transmission paths. Contributing factors to disease transmission are environmental considerations, endemic organisms, population characters, overcrowding, pre-incident structure and type of healthcare system, immunization levels, and the magnitude of the disaster itself.[26]

Though not an epidemic per se, our area may see an increase of respiratory illnesses after a major earthquake in which homes and buildings are destroyed. This is due to dangerous mold, common to our area, being released into the surrounding environment. Those with compromised immune systems or existing respiratory complications would be at a higher risk than the general population.

Risk of Impact

Based on historical occurrences of earthquake induced epidemics along with our area's societal composition, the risk from this impact occurring is moderate.

Hazardous Materials

Worldwide, there have been many earthquake induced hazardous material (HazMat) spills.[27] Given increases in industrial development and population

[26] Sandrack, C. "Infectious Diseases After Natural Disasters." *California Preparedness Education Network.* A program of the California Area Health Education Centers. March 7, 2006. Funded by HRSA Grant. PowerPoint presentation online. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwixjd6Gv6HZAhVC-GMKHTK1CMAQFgguMAE&url=http%3A%2F%2Fwww.aapsus.org%2Fwp-content%2Fuploads%2Fajcmsix.pdf&usg=AOvVaw3FpqcwnfbDsr_FktcQtDGn. Accessed October 09, 2017.

[27] Reitherman, Robert K. *Earthquake-Caused Hazardous Material Releases*. Proceedings of 1982 Hazardous Material Spills Conference Proceedings, Wisconsin, Milwaukee. Rockville, MD: Government inst., 1984. 170-77

density in areas prone to natural hazards, the odds of human exposure to hazardous materials, after a seismic incident, is also increasing.[28]

Earthquakes not only cause HazMat spills, they may also obstruct emergency personnel incident response. Response to the natural disaster itself may divert resources which would otherwise be dedicated to the spill or release. Restricted site and life line access along with limited resources such as personnel and equipment can further slow a HazMat response. This chaotic post disaster environment poses significant challenges to first responders' primary missions of containing the hazardous material and stabilizing the scene.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There have been no earthquake induced HazMat spills or releases in the Eugene-Springfield area. Despite this, with the threat posed by the Cascadia Subduction Zone, and numerous sources of hazardous materials within the Cities, such an incident occurring is of concern. Historically, earthquakes have caused HazMat incidents by sloshing vats, damaging connections and piping on tanks, tank collapses, truck accidents, and train derailments.

Some notable earthquake induced hazardous material incidents include:

- 1994 Northridge, CA-magnitude 6.7: 9 petroleum pipeline ruptures, 752 natural gas line breaks, and 60 emergency HazMat incidents
- 1987 Whittier Narrows, CA-magnitude 5.9: 1411 natural gas line breaks and 30 HazMat releases
- 1989 Loma Prieta, California-magnitude 6.9: 300-400 natural gas line breaks and 300 hazmat releases

Risk of Impact

Based on the amount of hazardous materials in and around the Eugene-Springfield area, and historical occurrence of earthquake induced HazMat spills or releases in other parts of the County, the risk from this impact occurring is high.

2.3.5 Probability of Future Occurrence

The State estimates earthquake probability for the mid-Willamette Valley region in two ways. One way uses a probabilistic model which considers all known

[28] Young, Stacy, Lina Balluz, and Josephine Malilay. "Natural and technologic hazardous material releases during and after natural disasters: a review." *Science of the Total Environment* 322, no. 1-3 (2004): 3-20. doi:10.1016/s0048-9697(03)00446-7.

information about possible earthquakes on Oregon faults. This model presents an expected level of damage associated with an earthquake with a 2-percent chance of occurring in the next 50-years. This probabilistic model suggests the Eugene-Springfield area can expect the partial collapse of weak buildings and the movement of unsecured wood-frame houses.

While all earthquakes possess the potential to cause major damage, subduction zone earthquakes pose the greatest danger due to the severity, duration, and extent of ground shaking. Within Oregon, a major CSZ incident could generate an earthquake with a magnitude of 9.0 or greater, likely resulting in significant damage and loss of life in Eugene-Springfield. Another way to assess the probability of an earthquake for Oregon communities west of the Cascades is to consider the CSZ incident independently.

According to the Oregon NHMP, the reoccurrence interval period for the largest of the CSZ earthquakes (magnitude 9.0+) is 530 years with the last incident occurring 320 years ago in January of 1700. The probability of a 9.0+ CSZ incident occurring in the next 50 years ranges from 7 - 12%. Notably, 10 - 20 “smaller” magnitude 8.3 - 8.5 earthquakes identified over the past 10,000 years affected only the southern half of Oregon and northern California. The average reoccurrence interval period for these incidents is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%. This puts the odds of having a significant (magnitude 8.0+) earthquake from the Cascadia fault line at roughly one in three over the next 50 years.[29]

Eugene-Springfield categorizes the probability of a CSZ incident as moderate and the probability of intraplate and crustal earthquakes as low. Given the potential for damage and the probability of occurrence, Eugene-Springfield is primarily focused on a potential CSZ incident for earthquake mitigation planning purposes.

2.3.6 Vulnerability and Capacity Assessment

In 2014 the Cities of Eugene and Springfield conducted a Regional Climate and Hazards Vulnerability Assessment to inform the prior edition of the NHMP. The Project Team, for this edition, determined the vulnerabilities listed below generally remain valid for preparing this edition. The assessment team met with local and regional experts in the communication, drinking water, electricity, food, healthcare, housing, natural systems, public health, public safety, transportation, stormwater, and wastewater sectors. The assessment identifies the following specific earthquake-related vulnerabilities:

[29] United States of America. Oregon National Guard. Office of Emergency Management. *Oregon Natural Hazards Mitigation Plan: Region 3 - Mid/South Willamette Valley*. Salem, OR: Office of Emergency Management, 2015. 534-46.

- Except for natural systems, all sectors are extremely sensitive to a magnitude 9.0 CSZ earthquake incident.
- Very little has been done to prepare any systems, infrastructure, or personnel to handle the initial impact and ongoing response and recovery from a CSZ incident.
- Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or mitigate.
- Every sector will experience substantial failures and interruptions unfamiliar to the area and therefore difficult (though possible) to plan for.
- Very few Eugene and Springfield residents have first- hand experience with a major earthquake, making it difficult to describe the potential experience and results.

Additional system vulnerability details are included in Section 4 as part of the 2014 Climate and Hazard Vulnerability Assessment Report.

In 2007, the Oregon Department of Geology and Mineral Industries (DOGAMI) completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon legislature in Senate Bill 2 (2005). RVS is a technique, used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank a building's potential vulnerability to seismic incidents. DOGAMI surveyed a total of 3,349 buildings, giving each a low, moderate, high, or very high rating for collapse potential from a high magnitude earthquake. The RVS assessed a total of 174 buildings in the Eugene-Springfield area.[30]

It is important to note these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings. To fully assess a building's collapse potential, a detailed engineering study completed by a qualified professional is required, but the RVS study can help prioritize which buildings to survey.

Table 2-2 shows the number of Oregon education and emergency services buildings surveyed in Eugene and Springfield with their respective rankings. Based on the RVS study, Eugene and Springfield performed further seismic evaluations on much of their critical infrastructure. These more detailed assessments resulted in a prioritized list of facilities in need of seismic retrofits. Several of these sites have already undergone seismic retrofitting work, and funding for more projects is being actively pursued.

[30] United States. State of Oregon Department of Geologic and Mineral Industries. *Statewide Seismic Needs Assessment: Implementation of Oregon 2005 Senate Bill 2 Relating to Public Safety, Earthquakes, and Seismic Rehabilitation of Public Buildings.* May 22, 2007. Accessed August 2019. https://www.oregongeology.org/rvs/default.htm

Table 2-2 Building Level of Collapse Potential for Eugene and Springfield				
City	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100 %)
Eugene	56	52	29	0
Springfield	28	4	3	2

Table 2-2. Source: DOGAMI 2007 – *Open File Report 07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.*

More recently, Oregon published the Oregon Resilience Plan. Findings in the plan suggest communities in the Willamette Valley can expect the following potential impacts to critical service sectors following a CSZ incident:

Table 2-3 Critical Service Impacts	
Critical Service	**Estimated Time to Restore**
Electricity	1 to 3 months
Police/Fire Stations	2 to 4 months
Drinking Water	1 year
Critical Service	**Estimated Time to Restore**
Sewer	1 month to 1 year
Top-priority Highways (partial restoration)	6 to 12 months
Healthcare Facilities	18 months

Table 2-3 Source*:* Oregon Resilience Plan, February 2013.

The Steering Committee ranked Eugene-Springfield's vulnerability to all earthquakes (crustal, intraplate, and subduction earthquake incidents) as 'high' because more than 10% of the population would likely be impacted by each type of earthquake. The probability of an earthquake occurring is difficult to determine. A Cascadia Subduction Zone incident currently has a one in three chance of happening in the next 50 years. For other faults capable of producing earthquakes the odds of an incident occurring are 2% in the next 50 years. For these reasons, the probability of an earthquake, regardless of the source, is moderate. Due to the large geographical scale of an earthquake and limited resources to deal with such an incident, Eugene and Springfield's capacity to respond to, and recover from, an earthquake is low.

2.3.7 Risk Assessment

DOGAMI has developed two earthquake loss models based on the most likely sources for an Oregon earthquake. One model uses a Cascadia Subduction Zone (CSZ) earthquake, and the other uses a magnitude 6.5 arbitrary crustal earthquake. Both models are based on HAZUS-MH software currently used by FEMA as a means of determining potential losses from earthquakes.

The CSZ scenario model is based on a potential 9.0 magnitude earthquake generated off the Oregon coast. The model does not consider a tsunami, which would likely develop from the earthquake incident. The magnitude 6.5 arbitrary crustal earthquake scenario model does not look at a single earthquake (as in the CSZ model). It encompasses many faults, each with a 2% chance of producing an earthquake in the next 50 years. The model assumes each fault will produce a single "average" earthquake during this time.

The models contain a high degree of uncertainty and should be used only for general planning purposes. Though these models were considered when evaluating the risk from earthquakes to the Eugene-Springfield area, they need to be updated to include local infrastructure data. The existing earthquake loss models are found in the 2014 Eugene-Springfield NHMP as well as the 2015 Oregon NHMP. Updated studies will be pursued by DOGAMI and the Cities for the 2025 NHMP update.

Eugene and Springfield categorize the probability of a Cascadia Subduction Zone (CSZ) earthquake or intraplate and crustal earthquakes as moderate. Vulnerability to an earthquake is high while capacity to deal with such incidents is low. The overall risk rating to earthquakes is very high.

For a summary of Impact Risks see Table 2-4.

Table 2-4 Earthquake - Impact Risks

Cascading Incident	Ranking
Civil Unrest	Moderate
Dam or Levee Failure	Low
Epidemic	Moderate
Hazardous Materials	High

2.3.8 Existing Hazard Mitigation Activities

Eugene and Springfield have taken steps to mitigate earthquake risks. Efforts include:

- Enforcing of the International Building Codes and Oregon Structural Specialty Code, both of which address earthquake mitigation measures for new construction.
- Creating and training a Damage Assessment team for evaluating structural damage to buildings and bridges after an earthquake. This team includes staff members from Lane County, Eugene, and Springfield.
- Moving the City of Eugene police, fire, City management, and administration functions out of City Hall due to the building's seismic deficiency. Eugene is currently in the process of designing a new City hall.
- Constructing an enlarged, seismically sound, emergency operations center (EOC) with a larger generator and increased food, water, and fuel storage.

The EOC acts on the City's behalf to link our emergency responders with mutual-aid, local partners, and County, State, and Federal response agencies.

- Conducting community outreach to support our resiliency strategy by increasing community personal preparedness. A prepared community eases the burden on first responders by reducing the immediate need for food, water, and personal care for individuals in the days and weeks following a disaster or emergency.
- Connecting the City of Eugene to data and voice through a portable redundant communications system using satellite technology. This system allows the Eugene EOC to communicate beyond our local radio and microwave footprint in a degraded communications environment.
- Constructing seismic retrofits for several critical City-owned bridges.
- Initiating seismic retrofits to Springfield City Hall with additional retrofits to be performed pending available funding.

2.4 Extreme Weather

Extreme weather includes hail, lightning, tornados, and severe heat. The Eugene-Springfield area has had documented occurrences of all four of these meteorological incidents though they tend to be infrequent resulting in little to no damage. It is possible more damaging incidents could occur in the future.

2.4.1 Causes and Characteristics of the Hazard

Thunderstorms

Thunderstorms can produce wind, hail, lightning, and even tornadoes. A combination of unstable air, moisture, and an upward lifting motion forms a thunderstorm. Generally, this upward motion, convection, is produced by surface heating. Convection forces the warmer air up into a cooler air mass causing instability.

A thunderstorm has three stages of development:

- Developing
- Mature
- Dissipating

The mature phase of a thunderstorm is the most likely time for hail, heavy rain, lightning, strong winds, and tornadoes. Once enough precipitation has accumulated

the updraft is overcome by the downdraft and the dissipating stage begins. Lightning can remain a danger throughout all three stages of a storm.[31] (Figure 2-5)

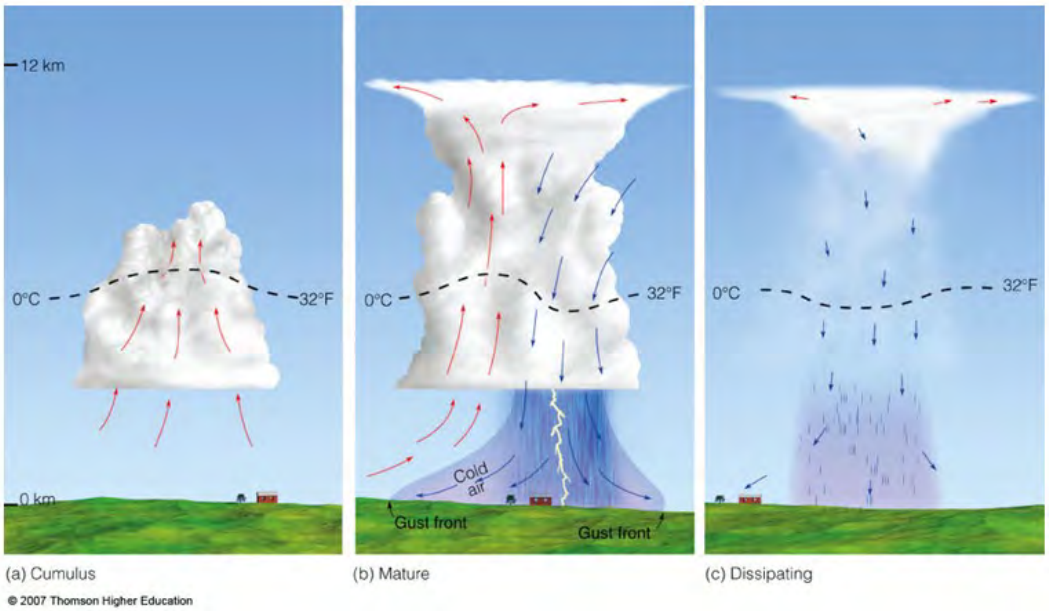


Figure 2-5 Three different stages of thunderstorm development. Source: Global Sailing Weather - h*ttp://globalsailingweather.com/thunderstorms.php*

Hail

Hail occurs when updrafts in a thunderstorm carry raindrops into extremely cold areas of air where they freeze into balls of ice. This cycle is repeated, and the ball of ice grows, until the storm's updraft is no longer able to support the weight of the ice. The hail then falls to the ground when the size of hail is too large for the storm to support or the updraft weakens.

Large hail can cause significant damage. Usually, hail is pea to marble size, but large storms can produce larger hail. The largest hail ever recorded in the United States was in Vivian, SD. It had a diameter of 8 inches, a circumference of 18.62 inches, and weighed 1 lb. 15 oz.[32] Hail with an inch diameter is considered severe, but there are only anecdotal accounts of such weather phenomenon occurring in the Eugene-Springfield area.

[31] United States. NOAA The National Severe Storms Laboratory. *Thunderstorm Basics*. Accessed November 2017. http://www.nssl.noaa.gov/education/svrwx101/thunderstorms/.
[32] United States. NOAA The National Severe Storms Laboratory. *Hail Basics*. Accessed November 2017. http://www.nssl.noaa.gov/education/svrwx101/hail/.

Tornadoes

Tornadoes are the most violent of all atmospheric storms.[33] They are a narrow fiercely rotating column of air. Tornadoes become visible when there is enough condensation of water droplets, dust and debris. Once on the ground, tornadoes can cause significant property damage and threaten human life (Picture 2-1).

Tornadoes form at the base of a thunderstorm (Figure 2-6). This weather phenomenon can happen any time of the year, but in Oregon they most often occur during the milder months of fall and spring.[34] When over water, a tornado is referred to as a waterspout.



Picture 2-1. Source: KPTV-*Manzanita, Oregon tornado damage October 2016*

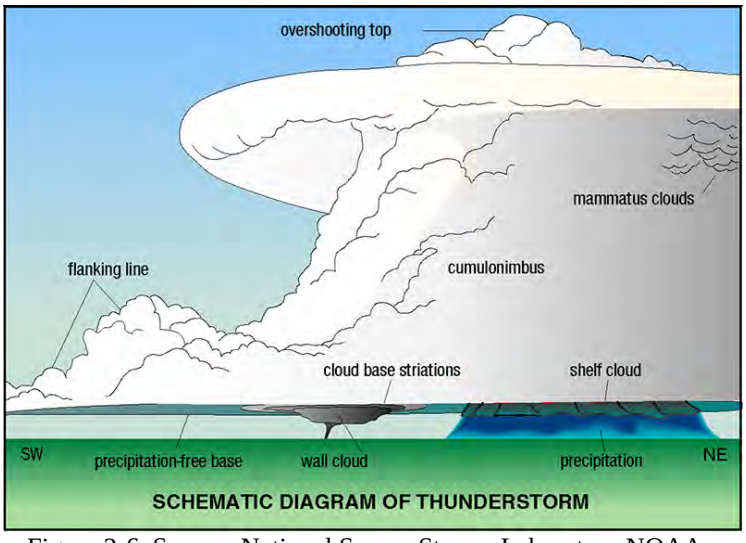


Figure 2-6. Source: National Severe Storms Laboratory NOAA - https://www.nssl.noaa.gov/education/svrwx101/tornadoes/

[33] "Tornado Basics." NOAA National Severe Storms Laboratory. Accessed November 08, 2017. http://www.nssl.noaa.gov/education/svrwx101/tornadoes/

[34] Livingston, Ian. "Monthly tornado averages by state and region." U.S. Tornadoes. March 16, 2013. Accessed November 08, 2017. http://www.ustornadoes.com/2013/03/19/monthly-tornado-averages-by-state-and-region/

Severe Heat

Severe heat incidents are possible, though historically rare, in Eugene and Springfield. When they do occur, severe heat incidents tax utility systems and endanger the health of some citizens, particularly the elderly, the very young, and those with compromised health. Heat is the number one weather related killer in the United States.[35] Heat related illnesses include heat cramps, exhaustion, and stroke. Heat stroke is a life-threatening condition.

Generally, a period of severe heat, often referred to as a "heat wave," is caused by a trapped or stagnant air pattern. The air mass does not move, but rather remains in an area, progressively warming. This is commonly seen when high-pressure systems push air downward preventing it from rising to cooler portions of the atmosphere.

2.4.2 Climate Change

Climate change will affect all four of these weather incidents, although the extent and severity of these affects are unknown. Climate change is expected to increase both summertime high and low temperatures, thereby reducing the natural cooling of homes, buildings, and heat absorbing surfaces such as concrete and asphalt.[36] Most residents in Eugene and Springfield lack mechanical cooling systems, putting them at greater risk of heat illnesses during an extreme heat incident.

2.4.3 History of the Hazard in Eugene-Springfield

Thunderstorms

Lightning can occur in conjunction with thunderstorms in the Eugene-Springfield area (Picture 2-2). Lightning damage to buildings or infrastructure is generally minor and few practical mitigation alternatives are applicable to lightning, other than installing lightning arrestors on critical facilities subject to lightning damage. In Oregon, casualties from lightning are very low, with a total of 7 deaths and 19 injuries reported over a 35-year period.[37] The level of risk posed by lightning strikes is very low. Public education about safe practices during electrical storms is the only available mitigation measure.

[35] Borden, Kevin A., and Susan L. Cutter. "Spatial patterns of natural hazards mortality in the United States." *International Journal of Health Geographics* 7, no. 64. December 2008. https://ij-healthgeographics.biomedcentral.com/articles/10.1186/1476-072X-7-64
[36] United States. Oregon Department of Land Conservation and Development. *The Oregon Climate Change Adaptation Framework.* December 2010. Accessed August 2019. https://www.oregon.gov/lcd/Publications/Climate_Change_Adaptation_Framework_2010.pdf
[37] United States. NOAA National Weather Service. *Lightning Deaths by State.* Accessed August, 2019. https://www.weather.gov/cae/lightningdeaths.html



Picture 2-2. Source: The Register Guard - Skinner Butte Aug. 22, 2013.

Hail

Hail incidents are possible in the Eugene-Springfield area, generally during summer thunderstorms. Hail damage is usually minor and few practical mitigation alternatives are applicable.

Tornadoes

Tornadoes do occasionally occur in Oregon; however, it is not among the 39 states with any reported tornado deaths since 1950. The tornado originated in Portland Oregon causing significant damage and traveled in a northern direction to Vancouver Washington. It crossed over the Columbia River, and entered Vancouver Washington where it killed 6 people. In total, 300 people were injured during this incident.

NOAA records (Portland office) show five historical tornadoes in Lane County.

- November 24, 1989: a tornado touched down in the south hills of Eugene, uprooting several tall fir trees, and damaging utility lines and a camper, but causing no injuries.
- 1984: a small tornado was reported near Junction City with damage to a barn and shelter.
- 1975: a poorly documented tornado may have occurred near Eugene, with very minor damage.
- 1951: a small tornado touched down near Eugene destroying a barn.
- 1937: a possible tornado uprooted hundreds of trees and demolished summer homes and camps near McKenzie Bridge.

In addition to these five historic tornadoes, on April 14, 2015 an EF-0 (Enhanced Fujita) tornado touched down at Lane Community College. The funnel cloud was reported to have remained on the ground for a minute.[38] Damage was sustained by several cars lifted by the tornado. One of the cars had two people in it, but no injuries were reported. This tornado resulted in $(2015)25,000 dollars in damage.[39] (Picture 2-3)



Picture 2-3. Source: OregonLive – Lane Community College Tornado.

Severe Heat

The summer of 2014 set a record for the number of days with high temperatures over 90 degrees.[40] From the end of July into the beginning of August 2017 the area saw one of its longest heat waves in history. The first nine days were the hottest period on record according to data compiled by the Southeast Regional Climate Center.[41] During this period of severe heat Eugene and Springfield opened several

[38] Binder, Melissa. "Tornado touches down near Eugene, flips car at Lane Community College." April 15, 2015. Accessed August 2019. https://www.oregonlive.com/pacific-northwest-news/2015/04/tornado_touches_down_near_euge.html
[39] United States. Lane County. Emergency Management. *Lane County Multi-Jurisdiction Hazard Mitigation Plan.* April 2017. Accessed November 6, 2017. https://www.lanecounty.org/cms/One.aspx?portalId=3585881&pageId=15929453
[40] United States. Wihtol, Christian. The Register Guard. *Sizzling Summer.* Accessed August 2019. http://registerguard.com/rg/news/local/32166313-75/hot-summers-better-get-used-to-em.html.csp
[41] United States. Erdman, Jon. The Weather Channel. "Record Pacific Northwest Heat Wave Finally Comes to a Close." August 13, 2017. Accessed November 2017. https://weather.com/forecast/regional/news/pacific-northwest-heat-relief-washington-oregon-aug2017 https://weather.com/forecast/regional/news/pacific-northwest-heat-relief-washington-oregon-aug2017

"cooling centers" for people to escape the unsafe temperatures.[42] According to Kathie Dello at the Oregon Climate Change Research Institute, these are the types of conditions we should expect to see in the future.

2.4.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, due to the limited frequency and size of hail, thunderstorm, or tornado events, a civil unrest incident is unlikely for these weather hazards. It is possible a prolonged heat wave could produce many of the contributing factors often seen with civil unrest (Figure 4-4). Such an incident has not occurred in the area. Therefore, the Eugene-Springfield area does not expect such a situation to occur within the next five to ten years.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of an extreme weather incident in Eugene or Springfield.

Risk of Impact

Based on historical occurrences of civil unrest after natural disasters, along with the area's societal composition, the overall risk of a civil unrest event developing due to an extreme weather incident is low, mainly due to the possibility of such incidents developing during a severe and prolonged heat wave.

Dam or Levee Failure

Extreme weather may cause a dam or levee failure if electrical systems are affected and/or conditions are severe enough to cause overtopping or erosion. It is difficult to determine how many levees have failed due to this hazard because of the incomplete inventory and monitoring systems in place within the United States for such structures.

More information on dams and levees is located in Appendix H.

History of Impact in Eugene-Springfield

There have been no incidents for a dam or levee failures due to an extreme weather incident in the Eugene-Springfield area.

[42] United States. Eugene. KVAL News. "Beat the Heat!" July 31, 2017. Accessed August 2019. https://kval.com/news/local/beat-the-heat-heres-where-to-chill-in-eugene-with-scorching-weather-on-the-way

After reviewing 90 dam failures dating from 1802 to 2015, only one was attributed to extreme weather. In 1986, a lightning strike caused electrical failures at two Upriver power plants in Spokane, Washington. The turbines stopped working, and water quickly rose behind the dam. Backup power systems failed, and spillway gates were not raised in time, causing the dam to be overtopped. The facility sustained almost $(1986)11.5 million in damages, but no reported fatalities. The subsequent investigation determined several design and operational errors contributed to the failure.[43]

As the Upriver Dam incident shows, a direct hit by an extreme weather incident could cause a dam or levee to fail though this is extremely rare.

Risk of Impact

Based on historical occurrences and the condition of dams and levees in and around the Eugene and Springfield area, the risk from an extreme weather induced failure is low.

Epidemics

Epidemics are not a known significant impact of an extreme weather incident.

Hazardous Materials

Hazardous material incidents can occur if weather incidents directly impact a hazardous material facility, or its operational components. Due to the limited scale of these weather incidents, response to such a HazMat situation would likely experience little to no interference.

More information on HazMat spills and releases can be found in Appendix I.

History of Impact in Eugene-Springfield

There have been no incidents of hazardous material spills or releases in the aftermath of an extreme weather incident in Eugene or Springfield. Data collected throughout the United States shows tornadoes and thunderstorms do cause some HazMat incidents.[44] A 2015 review of natech (natural hazard triggered technological disasters) incidents effecting the U.S. oil industry determined hail,

[43] Hokenson, Reynold A., W. Lowell Shelton, William M. Verigin, George W. Miller, and Mallur R. Nandagopal. "Upriver Dam Hydroelectric Project Rehabilitation After Failure, Part A: Failure Investigation and Lessons to be Learned." Civil Engineering Database. January 01, 1988. Accessed November 30, 2017. http://cedb.asce.org/CEDBsearch/record.jsp?dockey=0055754

[44] Turkey. Sengul, Hatice, Nicholas Santella, Laura J. Steinberg, and Ana Maria Cruz. "Analysis of hazardous material releases due to natural hazards in the United States." *Disasters* 36, no. 4 (2012): 723-743. Hacettepe University Department of Environmental Engineering.

heat, and tornadoes can cause oil spills however, they do not account for a significant number of incidents.

Lightning does account for a sizable portion of natech incidents in the oil industry. In the United States, 8,121 barrels were released from pipelines, 6,134 barrels from aboveground storage units, and 7,786 barrels from pump/meter stations due to lightning damage. Lightning is the third most costly natural hazard to oil infrastructure, with over $120 million in damages. Lightning accounts for five of the twenty-four most significant natech incidents, with respect to economic costs, from 1994 to 2012.[45]

Risk of Impact

Based on the amount of hazardous materials in and around the Eugene-Springfield area, and the historical occurrence of extreme weather impacting HazMat facilities, the risk of impact is low.

2.4.5 Probability of Future Occurrence

The probability of experiencing an extreme weather incident is moderate for the Eugene-Springfield area. It is likely at least one of these extreme weather incidents will happen on a scale severe enough to cause property damage or threaten life within the next 35 to 75 years.

2.4.6 Vulnerability and Capacity Assessment

The loss of life as well as economic and property concerns are significant with extreme weather incidents. Unlike severe heat, tornado, hail, or thunderstorms may geographically affect a small portion of the population. For this reason, it is determined the Eugene-Springfield area's vulnerability to such incidents is low. Additionally, the area's capability to respond to, and recover from, an extreme weather incident is high.

2.4.7 Risk Assessment

Based on the probability of future occurrence, vulnerability, and capacity to deal with extreme weather, the Eugene-Springfield area's risk to this hazard is categorized as low.

For a summary of Impact Risks see Table 2-5.

[45] Girgin, Serkan, and Elisabeth Krausmann. "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development." *JRC Science and Policy Report, EUR* 26913 (January 2015). http://publications.jrc.ec.europa.eu/repository/handle/JRC92700

Table 2-5 Extreme Weather - Impact Risks	
Cascading Incident	**Ranking**
Civil Unrest	Low
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	Low

2.4.8 Existing Hazard Mitigation Activities

Extreme Weather is a new addition to this NHMP update, so hazard specific mitigation activities have yet to occur.

2.5 Flood

The probability of riverine flooding in Eugene and Springfield is moderate, and the probability is high for stormwater system flooding. The vulnerability in Eugene and Springfield for riverine flooding is moderate and for stormwater system flooding is low. A moderate vulnerability indicates 10% to 69% of the population would be impacted, and a low vulnerability indicates less than 9% of the population would be impacted (Table 4-1).

2.5.1 Cause and Characteristics of the Hazard

The Eugene-Springfield area considers two primary flood hazard categories: riverine flooding and stormwater system (urban) flooding. Riverine flooding occurs when water overtops the banks of a naturally occurring waterway, while urban flooding is most often caused by inadequate stormwater drainage systems or maintenance.

The Eugene-Springfield area is subject to flooding from several sources, including:

- Riverine flooding from the Middle Fork of the Willamette River, the Willamette River, and the McKenzie River;
- Riverine flooding from numerous smaller creeks and sloughs; and
- Local stormwater drainage flooding.

Flooding in Eugene and Springfield typically occurs in December and January. Incidents are usually associated with La Niña conditions, which result in prolonged rain and rapid snowmelt on saturated or frozen ground. This sudden influx of water causes rivers to swell, forcing tributary streams to back up and flood communities. Eugene-Springfield is largely protected from riverine flooding by multiple upstream flood control dams in both the McKenzie and Willamette River watersheds.

2.5.2 Climate Change

Though the full extent of climate change's effect on flooding is unknown, existing research shows it will influence this hazard. Summer precipitation is projected to decline by as much as 30%. This will be accompanied by less frequent, but heavier downpours.[46] Already, the Northwest has experienced a 12% increase in very heavy precipitation incidents (the heaviest 1%) from 1958 to 2012.[47] Though there are many contributing factors for flooding, climate change is expected to increase flood risk in water basins with both rainfall and late spring snowmelt-related runoff peaks.

Warmer winter temperatures will lead to more precipitation falling as rain instead of snow, which reduces the amount of water stored as snow and increases wintertime river flows. Increased potential for heavier precipitation incidents will also exacerbate the risk of flooding. The Oregon Climate Change Adaptation Framework lists 11 risks including "increased frequency of extreme precipitation incidents, and incidence and magnitude of damaging floods."[48]

2.5.3 History of the Hazard in Eugene-Springfield

Flooding has been recorded in Eugene and Springfield ever since the first European settlers arrived in the area in the mid-1800s. The FEMA Flood Insurance Study (FIS) for Lane County (June 2, 1999) summarizes the history of major historical floods in the Eugene- Springfield area. Major floods occurred in 1861, 1890, 1945, 1956, 1964 and 1996. The 1964 flood was the largest flood incident recorded in Lane County.

Notably, the construction of flood control dams in the 1940s-1960s has substantially reduced the potential for significant riverine flooding in Eugene and Springfield. These dams have reduced the expected base flood discharges of water flowing into the local rivers. Accordingly, expected flood elevations and overall flood potential for major incidents along the rivers have been substantially reduced.

In addition to the flood control dams, the U.S. Department of Agriculture Soil Conservation Service (now known as the Natural Resource Conservation Service) and Lane County constructed a flood control levee in 1960 to protect a large area of Springfield from McKenzie River flooding. Ownership and maintenance responsibilities for this levee transferred to the City of Springfield in 1983. This

[46] U.S. Global Change Research Program. *Climate Change Impacts in the United States: The Third National Climate Assessment*. By Jerry M. Melillo, Terese Richmond, and G.W. Yohe. 2014. 487-513.
[47] United States. Environmental Protection Agency. Office of Policy. *Adapting to Climate Change Northwest.* June 2016. Accessed November 13, 2017. EPA-230-F-16-018 https://www.epa.gov/sites/production/files/2016-07/documents/northwest_fact_sheet.pdf
[48] The Oregon Climate Change Adaptation Framework. Oregon Department of Land Conservation and Development. December 2010. https://drought.unl.edu/archive/plans/Climate/state/OR_2010.pdf

levee, known today as the 42nd Street Levee, successfully contained the January 1964 and February 1996 flood incidents.

The flood hazard areas shown on the current Flood Insurance Rate Maps (FIRM) for Eugene-Springfield assume the dams are operating properly. Dam failure hazards are not addressed by the FIS or the FIRM.

Despite the reduction in flood potential from the construction of dams, the Eugene-Springfield area continues to have flood risk from major rivers as well as from the numerous creeks and sloughs running through the area. Flood risk on these smaller streams has not been reduced by the dams on the larger rivers and their tributaries.

A historic statewide flood incident with local impacts occurred in February 1996. Unusually heavy rains over the four-day period from February 5th to February 8th resulted in significant flooding on numerous rivers and streams throughout western Oregon. During the incident, rising waters in the McKenzie River forced the evacuation of 1,200 to 1,500 people in low-lying areas of Springfield. In the Springfield/Thurston area along the McKenzie River, 35-40 homes, about 20 private roads and bridges, and roughly 20 vehicles were damaged.

Widespread flooding during February 1996 was also experienced in the Mohawk Valley from Marcola to Springfield with flooded homes on Sunderman Road and Goat Road. The Springfield Golf Course suffered substantial damage with about 6 inches of silt and debris deposited on the greens and fairways. There were widespread road closures in Lane County and Interstate 5 had water flowing across it just north of Eugene near the Boston Mill Road overpass.[49]

In December of 2005, days of heavy rains led to flooding on the Mohawk River near Springfield. The flood stage of the Mohawk is 15 feet. On December 31st, the river was at 18 feet. This area flooded again in January 2006 (reaching 17.8 feet), in 2012 [reaching 17.8 feet on January 19th (Figure 2-4)], and in December 2015 (reaching 15.42 feet.)[50]

[49] United States. NOAA National Weather Service. *Flooding in Oregon.* Accessed August 2019. https://www.weather.gov/safety/flood-states-or

[50] US Department of Commerce, NOAA, National Weather Service. "Mohawk River (OR) Near Springfield Water Gauge - Historic Crests." NOAA. Accessed November 17, 2017. http://water.weather.gov/ahps2/crests.php?wfo=pqr&gage=spro3&crest_type=historic.



Picture 2-4 Source: Michael Ciaglo/Oregon Daily Emerald. *University of Oregon student watches water from the Mohawk River flow over a driveway in northern Springfield 2012.*

2.5.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, a civil unrest incident induced by a flood would be unlikely. Many of the motives, incentives, and opportunities highlighted in Figure 4-4 would not be present during a flood. Nevertheless, a flood-induced civil unrest incident could occur under the right conditions.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of a flood in Eugene or Springfield.

Risk of Impact

This impact is categorized low risk to the area.

Dam or Levee Failure

It is important to note the information located within this subsection only covers basic methods of flood-induced dam failure. There are many flood control measures employed by dams. What measures the nine dams upstream of the Eugene-Springfield area utilize is unknown, however. Generally, information on dams and dam operations is protected due to security concerns; known public information on local dams can be found in Appendix H.

The failure rate for dams is less than 1%,[51] with overtopping due to flooding accounting for 34% of the failures. Embankment dams cannot normally withstand a significant overtopping incident. For embankment dams, the most common failure mode is erosion during prolonged periods of rainfall and flooding.

When reservoirs are full and water inflow rates exceed the capacity of the controlled release mechanisms (spillways and outlet pipes), overtopping may occur. Overtopping can scour and erode the dam itself and/or the abutments which may lead to partial or complete failure of the dam. Especially for embankment dams, internal erosion, piping, or seepage through the dam's foundation or abutments can also lead to failure.

Willamette River Basin dams are designed for spillway opening only during infrequent severe events. Increased use can cause wear on spillway parts and lead to greater maintenance needs and an increased risk of failure. Vegetative growth and burrowing animals can cause erosion and weakening of smaller dams which can also be a common cause of failure.

Levees are very similar to dams but are only used for flood control. They run parallel to the body of water. Both dams and levees fail in similar ways. Most levees in the United States (97%) are operated and maintained by local governments or private entities.[52]

History of Impact in Eugene-Springfield

There have been no reported flood-induced dam failures for the Eugene or Springfield area. Although the likelihood of failure is very low, all dams upstream from the Eugene-Springfield area have the potential of causing widespread flooding, should they fail. Nine dams in the area could significantly impact the area if any one of them was to fail (Appendix H).

All the major dams which could affect the area were built to flood standards and the probability of a failure is low according to the Army Corp of engineers. Additionally, the Hills Creek Dam is likely to withstand floods at least as large as a 1,000-year incident without damage expected.

There are several non-certified levees in the Eugene-Springfield area. Though a failure of one of these structures would be limited in scope, compared to a dam failure, the likelihood of such an incident occurring is unknown.

[51] "Dams' safety is at the very origin of the foundation of ICOLD." ICOLD. Accessed November 15, 2017. http://www.icold-cigb.net/GB/dams/dams_safety.asp
[52] United States. Army Corps of Engineers. FEMA. *National Levee Database*. Accessed August 2019. https://levees.sec.usace.army.mil/#/public-dashboard

Risk of Impact

Though a flood-induced dam failure is slightly more likely to occur than an earthquake-induced failure, the likelihood of such an incident happening is still low.

Epidemics

The risk of a flood-induced epidemic is low unless there is significant population displacement and/or water source contamination.[53] A study in the American Journal of Clinical Medicine determined the possibility of contracting a person-to-person, waterborne, or foodborne communicable disease during a flood is a moderate risk. The World Health Organization (WHO) does note an increase in water- and vector- borne diseases seen with floods. Flood waters also increase the risk of infection.

The only epidemic-prone infection is leptospirosis which is transmitted from items contaminated with rodent urine. Vector-borne diseases often seen after flooding are malaria and West Nile virus. Waterborne diseases include leptospirosis, hepatitis A, and cholera.[54]

History of Impact in Eugene-Springfield

There have been no cases of flood-induced epidemics in the Eugene-Springfield area. Nationally, there have been several increases in communicable diseases after a water-related disaster, but the majority of these were small. The major factor in flood-induced epidemics is the contamination of drinking water. The risk of outbreaks can be minimized, however, if the risk is recognized and alternative water treatment measures utilized, both of which occurred in the Iowa and Missouri floods of 1993.

Risk of Impact

Considering the odds of an epidemic increase after a flood, some actions, possibly significant ones, need to be taken to prevent an epidemic from occurring. The risk from this impact is categorized as moderate.

Hazardous Materials

Though the size and scope of a HazMat release is largely dependent on the type of material involved, the release of the material may be caused by natural hazards such as floods and rain. Whether it is biological waste released from backed up sewer systems, the release of household chemicals, or large-scale releases from chemical plants, almost all floods release some hazardous materials. These incidents can

[53] "Flooding and communicable diseases fact sheet." WHO. Accessed November 2017. http://www.who.int/hac/techguidance/ems/flood_cds/en/
[54] Ibid

occur when tanks are swamped, or equipment needed to contain a chemical is compromised or destroyed by flood water.

In addition to potentially causing a release of hazardous materials, floods can spread the spill further than in non-flooding situations. Floods can also severely hamper response to an incident and any necessary evacuations.

History of Impact in Eugene-Springfield

There have been no reports of significant flood-induced hazardous material spills or releases in the Eugene-Springfield area. Some notable flood-induced HazMat incidents from around the world include:

- 1976 floods in Southern Idaho where at least 2000 pounds of granular Di-Syston® and 200 gallons of liquid Furadan® in addition to unknown quantities of DDT, PCBs, Guthion®, Dinitro®, 2,4-D, Thimet®, Syston®, and malathion were released from three commercial facilities and storehouses on farms;
- 1993 Midwest floods in the U.S. where 22 Superfund sites possibly containing toxins such as benzene, toluene, lead, and chromium, as well as household paints, solvents, and insecticides, were released in varying quantities;
- 1993 and 1995 floods on the River Meuse which runs through the Netherlands, France, and Belgium where cadmium, zinc, lead, copper, pesticides and PAHs were released; and
- 2017 floods caused by Hurricane Harvey; though exact chemicals and release totals are unknown, at this point, the refrigeration system of one plant was disabled resulting in an evacuation before one of the peroxide tanks spontaneously combusted.[55]

Overall, many flood-induced hazardous material spills are considered small in scale. The risk of flooding to facilities housing hazardous materials is well known, and thus generally well mitigated.

Risk of Impact

Considering the frequency of flood induced hazardous material spills or releases, along with the number of floods and hazardous material facilities in the area, the risk of a HazMat release occurring in the Eugene-Springfield area, due to a flood, is moderate.

[55] United States "Arkema Inc. Chemical Plant Fire." U.S. Chemical Safety Board. Accessed November 2017. http://www.csb.gov/arkema-inc-chemical-plant-fire-/

2.5.5 Probability of Future Occurrence

The probability of riverine flooding in Eugene-Springfield is moderate and the probability of stormwater flooding is high. A moderate probability indicates one riverine flooding incident is likely in the next 35 to 75 years. A high probability indicates one stormwater flooding incident is likely within the next 35 years.

2.5.6 Vulnerability Assessment and Capacity

The level of flood hazard (frequency and severity of flooding) is not determined simply by whether the footprint of a given structure is or is not within the base floodplain (also referred to as the 100-year floodplain). A common error is to assume structures within the base floodplain are at risk of flooding while structures outside of the base floodplain are not. Some important guidance for interpreting flood hazard is given below.

- Being in the 100-year (or base) floodplain does not mean floods happen once every 100 years. Rather, it means the probability of a flood in the 100-year base flood level or higher has a 1% chance of happening each year.
- Much flooding happens outside of the mapped base floodplain. First, the 100-year flood is by no means the worst possible flood. For flooding along the Willamette River, the 500- year flood is 4 feet higher than the 100-year base flood. Second, many flood prone areas flood because of local stormwater drainage conditions. Such flood prone areas may have nothing to do with the base floodplain boundaries.
- The key determinant of a structure's flood hazard is the relationship of the structure's elevation to the flood elevations for various flood incidents. Thus, homes with first floor elevations below or near the 10-year flood elevation have drastically higher probabilities of flooding than other structures with first floor elevations near the 50-year or 100-year flood elevation.
- Areas protected by flood control levees, such as Springfield's 42nd Street Levee, were originally mapped as being protected from the 100-year flood incident. However, in response to numerous levee failures during Hurricane Katrina, levees now must also be certified as being structurally adequate to retain their accreditation as flood control structures. If the City of Springfield is unable to obtain certification for the 42nd Street Levee, the next update of the flood control maps for the section of the McKenzie River paralleled by the levee may be prepared as if the levee was not in place. This would greatly increase the area of the City within the mapped 100-year floodplain.
- In Oregon, Oregon Administrative Rule 660-008 requires local governments, when planning for needed housing, ensure it is located on buildable land "…suitable, available and necessary for residential uses."

> Land "within the 100-year floodplain" is not considered "suitable and available" under the buildable land definition. Due to State planning requirements, City floodplain development requirements, and the small number of dwelling units located in Special Flood Hazard Areas, the vulnerability of residential development to the flood hazard is low.

Eugene and Springfield are in the process of identifying resources to update flood hazard information through new mapping. Once complete, a thorough quantification of vulnerable structures can be completed, provided the resources are available.

The 2014 Regional Climate and Hazards Vulnerability Assessment found, while flood incidents have the potential to cause severe loss and damage in localized areas, flooding is not likely to result in significant damage to critical systems or systemic failures across multiple sectors. The reason vulnerability to this hazard is rated as moderate for riverine flooding relates to the primary impacts and potential inconvenience for many members of the population (transportation impacts, drain on emergency response resources, etc.). The area's capacity to respond to this hazard is moderate due to resources and the prolonged onset period of flood hazards.

2.5.7 Risk Assessment

FEMA Flood Insurance Rate Maps (FIRMs) are the most comprehensive resource for identifying flooding hazards in the Eugene-Springfield area. The Eugene-Springfield area's most recent FIRMs became effective on June 2, 1999. It is common knowledge the Eugene-Springfield metro area flood maps are based on outdated information. The availability of LiDAR data and other technologies offers superior ability to project and map riverine flooding in the area. Eugene and Springfield are actively working with FEMA and the State of Oregon to identify resources needed to update the Eugene-Springfield regulatory floodplain maps.

Notably, some areas within Springfield have recently been re-mapped. These include the Willamette River through the southern portion of Glenwood, as well as the confluence of the Middle Fork and Coast Fork of the Willamette River.

Flood prone areas of the Eugene-Springfield area include the FEMA-mapped floodplains for major rivers including the Mohawk, McKenzie, and Willamette (including the Middle Fork and the Coast Fork). FEMA-mapped floodplains also include areas along Amazon Creek, Mill Race and several smaller creeks (mostly in the western portion of Eugene).

Historical experience and hydrologic/hydraulic modeling suggest the most problematic areas for local stormwater drainage flooding in Eugene are the Amazon Creek, Willow Creek, and Laurel Hill basins in the South Hills. Drainage problems in these areas are exacerbated by relatively thin, impermeable soils. Vulnerability

to local stormwater system flooding is rated low because less than 10% of the population or assets are typically affected. The capacity to address stormwater system flooding is rated high.

Maps showing the location of the floodway and the special flood hazard area (SFHA) are included in Section 3.

For a summary of Impact Risks see Table 2-6.

Table 2-6 Flood - Impact Risks

Cascading Incident	Ranking
Civil Unrest	Low
Dam or Levee Failure	Low
Epidemic	Moderate
Hazardous Materials	Moderate

2.5.8 Existing Hazard Mitigation Activities

Historically, the focus of local stormwater maintenance practices has been limited to drainage and flood control. More recently, the focus has widened to include management of riparian vegetation by allowing it to remain in streams and channels for the beneficial effects of slowing runoff for filtration and sedimentation. Eugene and Springfield have actively pursued several flood hazard mitigation activities to reduce vulnerability to damage and disruption from flooding incidents. Efforts include:

- Both Cities participate in the National Flood Insurance Program, which enables property and business owners to qualify for federally underwritten flood insurance.
- Eugene is a participant in the Community Rating System (CRS) program and has a rating of 7.
- Both Eugene and Springfield have Stormwater Management Plans. The first goal of these plans is to protect citizens and property from urban flooding through planning for and building adequate stormwater systems.
- Springfield owns, operates and maintains the 42nd Street Levee to protect a large area of the City from McKenzie River flooding. Springfield is also working toward obtaining certification and accreditation of this levee.

2.5.9 National Flood Insurance Program Participation

Eugene and Springfield both participate in the National Flood Insurance Program (NFIP). Eugene's initial Flood Hazard Base Map is dated June 7, 1974 and its initial Flood Insurance Rate Map (FIRM) became effective September 29, 1986. As mentioned above, the current effective FIRM date is June 2, 1999. As of October

2018, Eugene has 828 NFIP policies valued at $264,082,600. Cumulatively, since 1978, there have been 17 claims, 10 of which were closed with payment and the rest were closed without payment. Total loss payments amount to $116,465. Eugene also participates in the FEMA Community Rating System (CRS) program. The City has a CRS classification of 7 which translates to a 15% reduction to all NFIP policy premiums in Eugene.

Springfield's initial Flood Hazard Base Map is dated June 18, 1971 and its initial FIRM is dated September 27, 1985. Like Eugene, Springfield's current effective FIRM is dated June 2, 1999. As of May 2018, Springfield has 92 NFIP policies valued at $31,635,700. Cumulatively, since 1978, there have been 27 claims, 22 of which were closed with payment and the rest were closed without payment. Total loss payments amount to $402,491.98. Springfield is working through a Community Assistance Visit (CAV) with Oregon Department of Land Conservation and Development (DLCD) staff. There are 61 Effective Letters of Map Change in Springfield.

2.5.10 Repetitive Flood Loss Properties

No properties are listed on FEMA's repetitive loss or severe repetitive loss lists within Eugene's or Springfield's jurisdictional boundaries.

2.6 Geomagnetic Disturbance (GMD)

The probability and vulnerability of a national-scale GMD affecting the Eugene-Springfield area is high for the worse case predictions. A geomagnetic disturbance is a naturally occurring energy pulse like an electromagnetic pulse (EMP). These incidents are most commonly caused by solar flares but can also come from other natural sources such as lightning. Due to the large scale of GMDs caused by solar flares, this plan will focus primarily on this source for mitigation purposes.

2.6.1 Causes and Characteristics of the Hazard

As mentioned previously, there are several natural causes for geomagnetic disturbances, but solar flares are the largest and potentially most destructive. They occur when there is an explosion which emits the "solar flare" from the magnetic canopy of a sunspot on the Sun. The side-effects of a solar flare are the elements of a GMD which are very similar to a manmade EMP.

When the sun emits a solar flare, X-rays and ultra-violet (UV) radiation are released and travel to earth at the speed of light, ionizing the upper layer of the atmosphere. A severe GMD starts with radio blackouts and GPS navigation errors as a result of the arrival of x-ray and UV radiation. Minutes to hours later, when the energetic particles (protons, electrons, and high atomic number and energy ions) arrive, satellites can be electrified, and their electronics damaged. This can be followed a day or more later by the arrival of coronal mass ejections (CMEs,) which are clouds

of magnetized plasma. It is believed a direct hit by an extreme CME may cause widespread power blackouts which could disable everything plugged into a wall socket.[56] Anything running on electricity or utilizing electronics could be damaged or ruined unless properly shielded.

2.6.2 Climate Change

At this point, it is unknown how climate change may affect a major GMD incident.

2.6.3 History of the Hazard in Eugene-Springfield

There are no known instances of a significant GMD affecting the Eugene-Springfield area. Solar flares hit the earth often, also seen as the phenomenon known as the "Northern Lights". Most of the time, however, they do little to no damage. Most people have experienced GMDs in the form of radio and satellite disruptions. What is not as common is the more destructive portion of a solar flare, the CMEs, directly striking earth.

Geomagnetic disturbances fluctuate with the Sun's 11-year Solar Cycle. More solar flares are observed during the Solar Maximum when sunspots and solar activity are at their highest. Scientists number these cycles in sequential order as they occur. Solar Cycle 24 started around December 2008, and the solar maximum was seen around November 2014. Solar Cycle 25 is predicted to start around 2019 or 2020.

One of the strongest GMD incidents to hit earth occurred in 1859 and is dubbed the Carrington Incident. This is believed to be near the peak of Solar Cycle 10. At the time, the Northern Lights could be seen in Cuba, and global telegraph lines sparked causing many fires and service disruptions.[57] The National Academy of Sciences predicts a similar incident occurring now would exceed $2 trillion in damages and recovery would take years. In February 2012 earth had a near miss as the strongest CME seen since the Carrington Incident missed earth by a week.

The strongest modern era GMD to hit earth occurred on March 13, 1989 during Solar Cycle 22's maximum. It immediately caused short-wave radio interference. The Northern Lights were reported in Southern Florida and Cuba. Several satellites lost control, and the Shuttle Discovery experienced mysterious electrical problems. The large GMD caused a blackout across all of Quebec, Canada. There were hundreds of power grid problems in the U.S. though no blackouts due to low

[56] United States. Phillips, Tony. "Near Miss: The Solar Superstorm of July 2012." NASA. July 23, 2014. Accessed November 17, 2017. https://science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm.
[57] United States. Lovett, Richard. National Geographic News. *What if the Biggest Solar Storm on Record Happened Today?* March 2011. Accessed August 2019. https://www.nationalgeographic.com/news/2011/3/110302-solar-flares-sun-storms-earth-danger-carrington-event-science/

demands on the grid in the early morning hours.[58] This incident registered a disturbance storm time (Dst) of 600 nT (nanoTesla). The Dst during the 1859 Carrington Incident was estimated to be between 800 and 1750 nT. As a point of reference, the Northern Lights around the Arctic Circle have an average Dst of 50 nT.

2.6.4 Impacts – Cascading Incidents

Civil Unrest

A large scale and destructive GMD could easily generate all the contributing factors identified for violent conflict or civil unrest to occur (Figure 4-4). With reliable news limited or absent, tensions and anger can rise. Little information is known on how a GMD could trigger this impact. An incident has not been witnessed since the advent of modern technology, but it is reasonable to assume civil unrest could quickly spring from such a situation.

History of Impact in Eugene-Springfield

There is no known history of a civil unrest incidents due to a geomagnetic disturbance.

Risk of Impact

A large GMD has the potential of causing widespread confusion and panic, especially if it impacts the entire country. A large-scale GMD incident combined with very limited mitigation activities and the extreme dependency on modern technology means the risk of civil unrest is high.

Dam or Levee Failure

Scientists are studying GMDs and their effects on modern technology. Large solar flare incidents have the potential of causing devastating damage to unprotected electronics. It is plausible a GMD could cause damage to electronic dam control and operation systems.

More information on dams or levees is in Appendix H.

History of Impact in Eugene-Springfield

There is no known history of dam or levee failure due to a geomagnetic disturbance.

Risk of Impact

[58] Odenwald, Sten. "The Day the Sun Brought Darkness." NASA. Updated August 2017. Accessed November 2017. http://www.nasa.gov/topics/earth/features/sun_darkness.html

Based on the predicted probability and potential damage from a large GMD, Eugene-Springfield's risk from this impact is moderate.

Epidemics

Epidemics could also be an impact of a GMD based on its size, severity, and the recovery time for damages. The probability of an epidemic, however, is extremely hard to predict due to the vast number of variables involved. If Earth was to receive a direct hit from a large GMD in which medical and pharmaceutical manufacturing facilities are non-operational for an extended period, an increase of epidemics should be expected. If this were to happen, containment and palliative care of sick individuals may be the only option until health care services are fully restored. Water and wastewater services could also be affected, increasing the likelihood of an epidemic.

History of Impact in Eugene-Springfield

There is no known history of epidemics due to a geomagnetic disturbance.

Risk of Impact

Due to the possibility of a large GMD occurring and incapacitating electronic devices, which the medical community relies upon, the risk from this impact is moderate.

Hazardous Materials

Hazardous material spills due to the impact of a GMD are plausible. Many facilities containing hazardous substances depend upon electronics technology for their control and operation systems. Improperly or non-shielded electronics may be affected by a GMD.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There is no known history of a hazardous material incident due to a geomagnetic disturbance.

Risk of Impact

The risk of a GMD induced HazMat incident is moderate due to the electrical requirements for storage of hazardous materials and the probability of a large GMD occurring.

2.6.5 Probability of Future Occurrence

Current research suggests, the probability of a significant GMD effecting the Eugene-Springfield area is high. In 2012, the probability of a Carrington size GMD hitting Earth in the next ten years was estimated to be 12%.[59]

2.6.6 Vulnerability and Capacity Assessment

Due to the potential size and severity of a GMD, the damages from such an incident could be wide ranging and severe. Eugene and Springfield's vulnerability to a GMD incident is high while capacity to deal with such an incident is low.

2.6.7 Risk Assessment

Based on the probability of future occurrence, vulnerability, and capacity to deal with a national-scale geomagnetic disturbance, the Eugene-Springfield area's risk to this hazard is categorized as very high.

A summary of Impact Risks is in Table 2-7.

Table 2-7 Geomagnetic Disturbance - Impact Risks

Cascading Incident	Ranking
Civil Unrest	High
Dam or Levee Failure	Moderate
Epidemic	Moderate
Hazardous Materials	Moderate

2.6.8 Existing Hazard Mitigation Activities

Geomagnetic disturbances are a new addition to the 2020 NHMP update. Hazard specific mitigation activities have yet to occur.

2.7 Landslide

In December 2018, the Oregon Department of Geology and Mineral Industries (DOGAMI) released a new analysis of landslides in the Eugene-Springfield area titled IMS-60, Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon (IMS-60)[60]. Based upon the results of this study, the Steering Committee determined the probability of a landslide is high in Eugene and Springfield and vulnerability to landslide is low in both cities.

[59] Riley, P. On the probability of occurrence of extreme space weather events. *Space Weather* **10**, S02012, https://doi.org/10.1029/2011SW000734 (2012). Accessed August 2, 2019
[60] Oregon Dept. of Geology and Mineral Industries, IMS-60. https://www.oregongeology.org/pubs/ims/p-ims-060.htm. Accessed August 5, 2019

2.7.1 Causes and Characteristics of the Hazard

The term "landslide" refers to a variety of slope instabilities resulting in the downward and outward movement of slope-forming materials including rocks, soils, and artificial fill. The IMS-60 Study evaluated two categories of landslide types:

- Shallow Landslides: failure plane is 15 feet or less below ground surface;
- Deep Landslides: failure plane is greater than 15 feet below ground surface.

The IMS-60 Study found some areas are more susceptible to shallow landslides, whereas other areas are more susceptible to deep landslides, and some are susceptible to both. Maps showing the areas susceptible to shallow and deep landslides are included in Section 3.

The Eugene-Springfield area is susceptible to four types of landslides (Figure 2-7) which may occur as either shallow or deep landslides:

- Rockfalls are abrupt movements of masses of material (rocks and soils) detached from steep slopes or cliffs. Movement occurs by free-fall, bouncing, and/or rolling. Falls are strongly influenced by gravity, weathering, undercutting, and/or erosion.
- Rotational slides are those in which the rupture surface is curved concavely upwards and the slide movement is rotational about an axis parallel to the slope. Rotational slides usually have a steep scarp at the upslope end and a bulging "toe" comprised of the slope material at the bottom of the slide (Figure 2-8). Roads constructed by cut and fill along the side of a slope are prone to slumping on the fill side of the road. Rotational slides may creep slowly or move large distances suddenly.
- Translational slides are those in which the moving material slides along a flat surface. Translational slides occur on surfaces of weaknesses, such as faults and bedding planes or at the contact between firm rock and overlying loose soils. Translational slides may creep slowly or move large distances suddenly.
- Flows are plastic or liquid in nature and the slide material breaks up and flows during movement. This type of landslide occurs when a landslide moves downslope as a semi-fluid mass, scouring or partially scouring rock and soil from the slope along its path. A flow landslide is typically rapid-moving and tends to increase in volume as it moves downslope as it scours out its channel.

Though immediate damage is limited to where the slide occurs, landslides can have far reaching repercussions if infrastructure or water ways are involved. Historic

landslides (within the past 150 years) in Eugene-Springfield tend to be smaller slides or slumps near waterways or slides related to development activity. The potential for larger slides exists primarily in the south hills of Eugene and Springfield.

Rockfall incidents are primarily limited to quarry sites where rock has been exposed (e.g., the west face of Skinner's Butte).

The primary factors affecting or increasing the likelihood of landslides in Eugene-Springfield are:

- Natural conditions and processes including the geology of the site, rainfall, water action, seismic activity, and volcanic activity.
- Excavation and grading on slopes for homes, roads, and other structures.
- Natural or human-caused drainage and groundwater alterations can trigger landslides. Human activities such as broken or leaking water or sewer lines, water retention facilities, irrigation, stream alterations, ineffective stormwater management, and excess runoff due to increased impervious surfaces.
- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing, and wildfire.
- The water content of soils/rock is a major factor in determining the likelihood of sliding for any given slide-prone location. Thus, most landslides happen during rainy months, when soils are saturated with water. Winter storms with intense rainfalls are a common trigger for landslides in the Eugene-Springfield area.

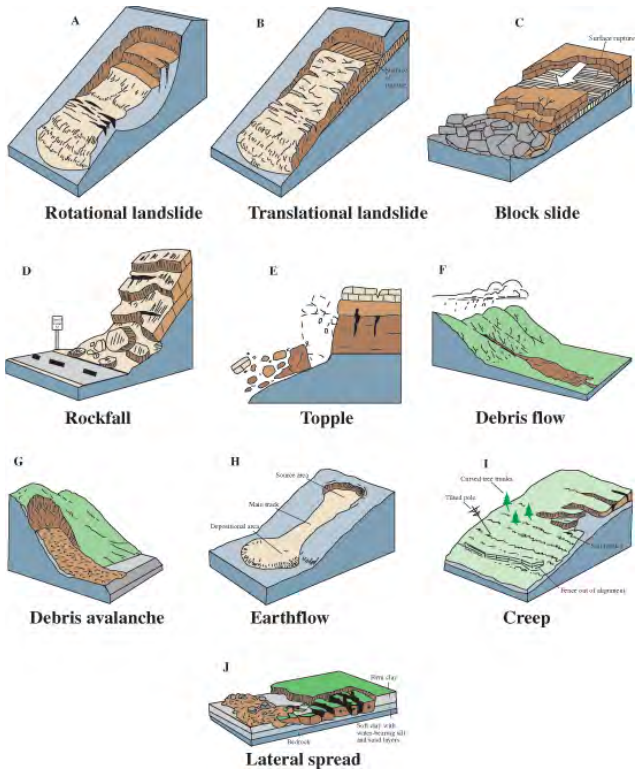


Figure 2-7. Source: USGS – Types of Landslides. 2004. *https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html*

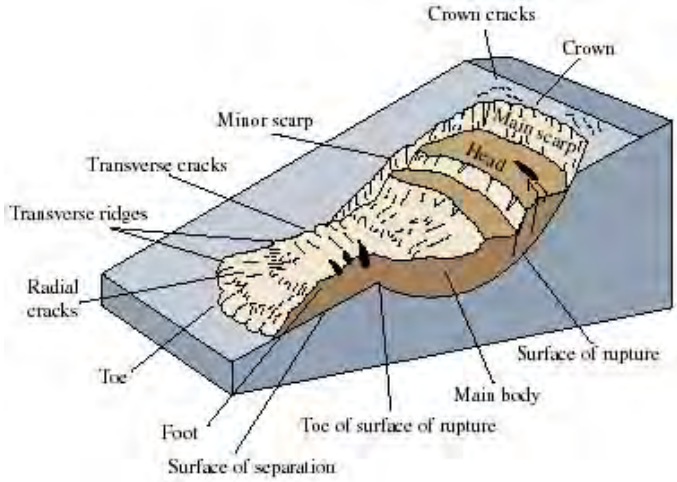


Figure 2-8. *Source USGS* – Common Landslide Anatomy. 2004. *https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html*

2.7.2 Climate Change

While the full extent of the effect of climate change on landslides is unknown, existing research suggests it will influence this hazard. Precipitation is expected to

decrease, occurring as less frequent, but heavier downpours. [61] Shifting peak snowmelt periods will change how and when soil levels have reached saturation. With soil saturation being a significant factor for landslides, we expect to see changes in this hazard, if climate predictions are correct.

2.7.3 History of the Hazard in Eugene-Springfield

The IMS-60 Study included updating the inventory of historic (<150 years) and prehistoric (>150 years) landslides in the Eugene-Springfield area utilizing LIDAR and records provided by the Cities and Lane County. The inventory identified over 700 existing landslides covering about 6% of the 230 square mile study area, more than 3 times the previous number of inventoried landslides.

Table 2-8 provides a summary of the landslide inventories for the communities included in the IMS-60 Study. The Special Paper 42 (SP-42) Inventory landslides were identified using LIDAR methods and the Historic Landslide Point Inventory represents landslide records from 1979 to 2016.

Table 2-8 Summary of Landslide Inventories for each Community (IMS-60 Table 4-1)

Community	SP-42 Inventory*	Historic Landslide Point Inventory
Lane County**	575	38
City of Springfield (East) City of Springfield (West)	20 2	7 4
City of Coburg	0	0
City of Eugene Neighborhoods Eugene North Eugene South Eugene Southwest Eugene West City of Eugene Totals	 1 63 0 0 64	 1 24 0 1 26

Table 2-8 Source *IMS-60 Table 4-1*

* Some landslides overlap community boundaries, so totals will not equal total landslides in study area.

**Unincorporated Lane County included in study.

[61] United States. Melillo, Jerry M., Terese Richmond, and G.W. Yohe. U.S. Global Change Research Program. *Climate Change Impacts in the United States: The Third National Climate Assessment.* 2014. 487-513.

2.7.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of a landslide.

Dam or Levee Failure

As discussed in section 2.3.4, landslides do have the potential to cause dam failure due to overtopping. This is more likely to occur when the reservoir behind the dam is at full capacity. The Army Corp of Engineers takes this into account during design and operations, so failure due to this impact is very low.

More information on dams and levees is in Appendix H.

History of Impact in Eugene-Springfield

Landslide induced dam or levee failure has not occurred in the Eugene or Springfield area. Additionally, such incidents are extremely rare. Out of the 90 dam failures reviewed, between 1802 and 2015, only one was due to a landslide. The Vajont Dam (Italy) was overtopped by a wave produced by a massive landslide in 1963. This incident destroyed five villages, killing 2,000 people. Poor construction and operation were thought to have worsened the impact to the dam.[62]

Risk of Impact

Based on historical occurrences, the condition of local dams and levees, and the probability of a significant landslide into a large body of water contained by such structures, the risk from this impact has been determined to be low.

Epidemics

Though the odds of landslide induced epidemics is unknown, a landslide could cause this impact. Search and rescuers may be exposed to contaminated biological waste. Additionally, a slide may contaminate water supplies, though this should be detected relatively quickly thus limiting transmission.

History of Impact in Eugene-Springfield

There has been no landslide-induced epidemics in the Eugene-Springfield area.

Risk of Impact

[62] Bressan, David. "Expecting A Disaster: The 1963 Landslide of the Vajont Dam." Forbes. October 10, 2017. Accessed November 30, 2017. https://www.forbes.com/sites/davidbressan/2017/10/09/expecting-a-disaster-the-1963-landslide-of-the-vajont-dam/#34fc306f11f8

Though no noted historical occurrences of a large-scale landslide induced epidemic has been documented, there is a possibility it may occur. Unless water sources are contaminated, an outbreak would be limited to responders and, potentially, those with whom they come into contact. Due to this, some mitigation would be necessary to prevent the spread of viral or bacterial contaminants. The risk of this impact occurring is low.

Hazardous Materials

A hazardous material spill or release can occur any time there is a landslide in a developed area. Commonly, spills are seen when household chemicals, fuel tanks, and wastewater components are involved. Larger spills can occur when a landslide damages hazardous material infrastructure such as holding tanks or power supplies.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There has been no known significant landslide induced hazardous materials spills or releases in the Eugene-Springfield area.

Risk of Impact

Due to historical occurrences and the number and location of hazardous materials within the area, the risk of this impact occurring has been deemed to be low.

2.7.5 Probability of Future Occurrences

The probability of a landslide occurring in the Eugene-Springfield area depends upon several factors, including steepness of slope, slope composition (i.e. soil type), local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides. Most landslides occur during the rainy months of the year. The Steering Committee rated the probability of a landslide occurrence as high. A high rating means one incident is likely in a 10 to 35-year period.

2.7.6 Vulnerability and Capacity Assessment

Landslides can occur during any season in the Eugene-Springfield area. Given local development patterns, residential and public land use is most likely to be impacted by landslides. In Oregon, residential development is explicitly prohibited or restricted in areas with steep slopes. Specifically, Chapter 197 of the Oregon Revised Statute in the Oregon Administrative Rules provides for needed housing "…suitable, available and necessary for residential uses." Lands "(c) [having]

slopes of 25 percent or greater" are not considered "suitable and available" under the buildable land definition.

A summary of the results of the IMS-60 Study (Table 2-9) show the applicable zone and associated estimated population and building and land value for each zone identified in the study. As such, residential vulnerability to landslides is low.

Table 2-9 Summary of Exposure of Select Assets to Landslides (Adapted from IMS-60 Tables 4-4 and 4-5)

Landslide Zone	Estimated Population	Estimated Building & Land Value
Existing Landslides	4,615	$1.13B
Shallow Landslides – Highly Susceptible	4,649	$4.92B
Deep Landslides – Highly Susceptible	5,232	$0.87B

Table 2-9 Source: DOGAMI IMS-60 Landslide Hazard and Risk Study. (Adapted from IMS-60 Tables 4-4 and 4-5) 2018

One additional analysis provided in the IMS-60 Study is the risk of earthquake-induced landslides. The study indicates about 1.5% of the building damage, within the overall study area, may be caused by landslides triggered by a Cascadia Subduction Zone (CSZ) earthquake. By contrast, nearly 20% of the building damage in the East Springfield study area following a CSZ earthquake may be from landslides.[63]

The Eugene-Springfield Steering Committee rated the Cities' vulnerability to landslides as low, meaning less than 10% of the population and/or regional assets would be affected by a landslide incident. Additionally, due to available resources and the generally limited scale of a landslide, the area's overall capacity to deal with such an incident is moderate.

2.7.7 Risk Assessment

The IMS-60 Study identified four primary conclusions about the risk of landslides in the Eugene-Springfield area:

- Large, deep landslides are a primary threat in the study area, and asset exposure to these landslides is significant. More than 4,500 residents and

[63] United States. DOGAMI. *Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon.* 2018. Accessed August 2019. https://www.oregongeology.org/pubs/ims/IMS-60/IMS_60_report.pdf

2,500 buildings, and a combined building and land value of about $950 million would be affected.

- 8,350 buildings are located in the high shallow landslide susceptibility zone, with close to $5 billion worth of land and buildings exposed.
- Annual historic landslide losses range from $99,000-$306,000; in extreme years (such as 1996), this increases to several million.
- Damage and losses from landslides alone, induced by a local crustal or a Cascadia Subduction Zone earthquake, may result in an estimated 2,770 buildings being moderately to completely damaged and close to 600 residents in need of shelter. In most communities, <5% of earthquake damage would come from landslides. However, in some communities, potential landslides triggered by the earthquakes could cause a 20% increase in damage and losses.

Based upon these conclusions, DOGAMI considers the overall risk of landslide in the study area to be moderate. The Steering Committee concurs.

A summary of Impact Risks is in Table 2-10.

Table 2-10 Landslide - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	Low
Epidemic	Low
Hazardous Materials	Low

2.7.8 Existing Hazard Mitigation Activities

In Eugene and Springfield, mitigation of the landslide hazard is accomplished through land use and development regulations. Both require geotechnical analysis of steep slopes prior to development to determine whether a development is appropriate for the area.

2.8 Volcano

The probability of volcanic activity impacting Eugene-Springfield is low. Vulnerability to volcanic activity is moderate for the Eugene-Springfield area.

2.8.1 Causes and Characteristics of the Hazard

The Cascade Range, which runs from British Columbia through Washington, Oregon, and into northern California, contains more than a dozen major volcanoes and hundreds of smaller volcanic features. In the past 200 years, seven of the

Cascade volcanoes have erupted, including Mt. Baker, Glacier Peak, Mt. Rainier, Mount St. Helens, Mt. Hood, Mt. Shasta, and Mt. Lassen.

Over the past 4,000 years, Oregon has experienced three eruptions of Mt. Hood, four eruptions in the Sisters area, and two eruptions in the Newberry Volcano area. Minor eruptions have taken place near Mt. Jefferson, at Blue Lake Crater in the Sand Mountain Field (Santiam Pass) near Mt. Washington, and near Belknap Crater. During this period, the most active volcano in the Cascades has been Mount St. Helens with over 14 eruptions.

Volcanic eruptions often involve several distinct types of hazards to people and property, as evidenced by the Mount St. Helens eruption in 1980. Major volcanic hazards include lava flows, blast effects, pyroclastic flows, ash falls, lahars, landslides, and debris flows. Some of these hazards (e.g., lava flows) only affect areas very near to the volcano. Other hazards may affect areas 10 to 20 miles away. Ash falls may affect areas hundreds of miles downwind of the eruption site. The primary volcanic hazards of concern for Eugene-Springfield are:

- **Ash falls** result when explosive eruptions blast rock fragments into the air. Such blasts may include tephra (solid and molten rock fragments). The largest rock fragments (sometimes called “bombs”) generally fall within two miles of the eruption vent. Smaller ash fragments (less than about 0.1 inch) typically rise into the area forming a huge eruption column. In very large eruptions, ash falls may total many feet in depth near the vent and extend for hundreds or even thousands of miles downwind.

- **Lahars** are common during eruptions of volcanoes with heavy loading of ice and snow or glaciers. These flows of mud, rock, and water can rush down channels at 20 to 40 miles an hour and can extend for more than 50 miles. For some volcanoes, lahars are a major hazard because highly populated areas are located on lahar flows from previous eruptions.

2.8.2 Climate Change

Climate change may impact the effect of a volcanic eruption in many ways. The most plausible, and perhaps most significant, is the severity of a lahar. Warming temperatures are causing a steady decline in mountain snowpack. This directly correlates to the amount of snow and ice available to form a lahar during an eruption. Significant long-term climate change implications for volcanic eruptions will, more than likely, not be known for some time.

2.8.3 History of the Hazard

The history of volcanic activity in the Cascades is contained in its geologic record and the age of the volcanoes vary considerably. Figure 2-9 shows the history of volcanic incidents in the Cascades. Scientists utilize a range of techniques to

identify areas subject to volcanic hazards. For more information on volcano hazard identification in Oregon, refer to the Oregon Natural Hazards Mitigation Plan.

Several of the 20 active volcanoes in Oregon are located along the crest of the Cascades near the eastern boundary of Lane County. These volcanoes include the Three Sisters and Mount Jefferson. The active volcanoes posing the greatest threat to the Eugene-Springfield area are the Three Sisters, which are approximately 50 miles to the east. Lava flow, pyroclastic flows, debris flows, and avalanches from an eruption in the Three Sisters will be limited to the immediate area of the eruption and will not impact Eugene and Springfield. However, hazard zone maps for the Three Sisters show landslides, debris flows, and lahars from an eruption could enter the McKenzie River and its tributaries. This could cause flooding on the McKenzie possibly extending to the Thurston area on the east side of the Eugene-Springfield metro area (Figure 2-10).

Lahars can occur both during an eruption and when a volcano is quiet. The water creating a lahar can come from melting snow and ice (especially water from a glacier melted by a pyroclastic flow or surge), intense rainfall, or the breakout of a summit crater lake. Some lahars contain so much rock debris (60 to 90% by weight) they look like fast-moving rivers of wet concrete. Historically, lahars are one of the deadliest volcano hazards. Close to their source, these flows are powerful enough to rip up and carry trees, houses, and huge boulders miles downstream. Farther downstream, they can entomb everything in their path in mud. In Eugene-Springfield, lahar impact areas are expected to be similar to the FEMA- mapped floodplains of the McKenzie River.

Lahars running through the McKenzie River could also lead to temporary damming of the River or high turbidity in the water. These impacts could cause degradation of water quality and operational problems at water treatment plants. For the City of Eugene, which currently relies on the McKenzie River as its sole source of drinking water, the Eugene Water and Electric Board (EWEB) has developed procedures to manage high-turbidity incidents and is actively seeking to diversify its sources of drinking water, as described in Annex A. Minimal lahar impact is expected to the groundwater sources used by Springfield Utility Board (SUB) and Rainbow Water District along the McKenzie and Willamette Rivers.

Ash fall could extend to the Eugene-Springfield area from an eruption in the Three Sisters, as well as from other eruptions including Mount St. Helens. In all but the most extreme incidents, ash falls in the Eugene-Springfield Metro Area are likely to be very minor, with an inch or less of ash accumulation likely. There is the possibility heavy ash fall into streams and rivers upstream from public water supply intakes from a major eruption in the Cascades could affect public water supplies.

In Oregon, awareness of the potential for volcanic eruptions was greatly increased by the 1980 eruption of Mount St. Helens in Washington, which killed 57 people. During this eruption, a debris avalanche moved 3.3 billion cubic yards of material

14 miles down the North Fork Toutle River, and the lateral blast effects covered 230 square miles and devasted an area 19 miles from west to east of the crater. The ash cloud spread across the United States in three days and circled the Earth in 15 days. Major ash falls occurred as far away as central Montana, and ash fell visibly as far asway as the Great Plains. A lahar eroded material from the North Fork Toutle River, increasing in size as it travelled downstream destroying bridges and homes. It eventually flowed into the Cowlitz River about 50 miles downstream of the volcano.[64]

There are no known damages, due to volcanoes, for Eugene or Springfield in recorded history.

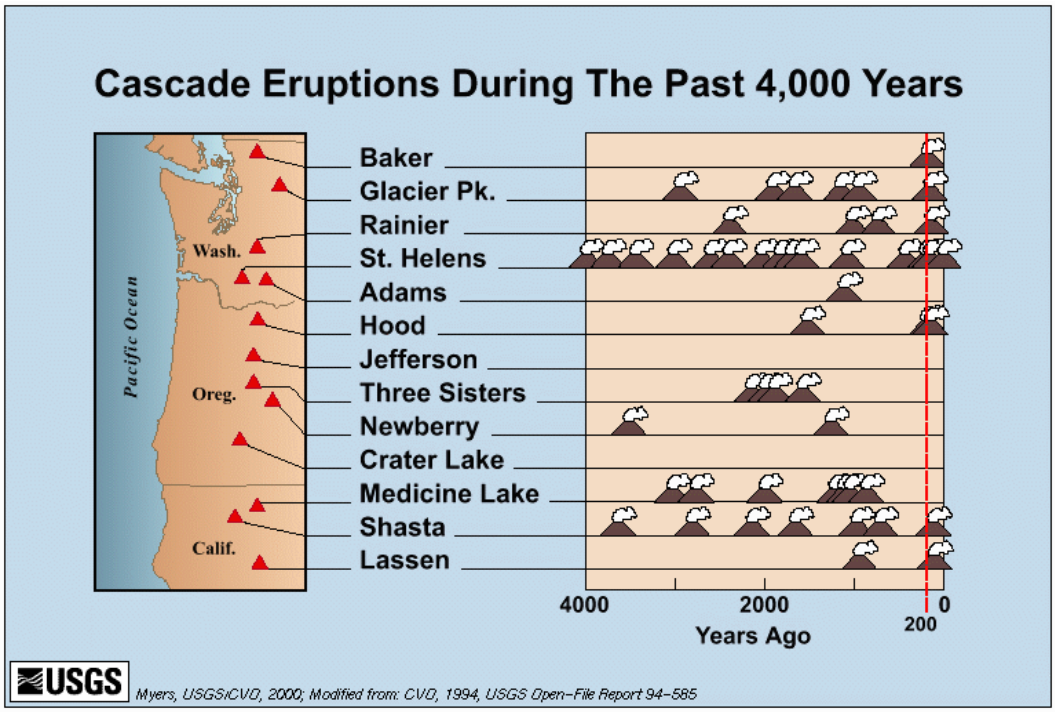


Figure 2-9. Source: W.E. Scott et al., 1997 - *http://vulcan.wr.usgs.gov/Volcanoes/Cascades/EruptiveHistory/cascades_eruptions_4000yrs.html*

[64] United State. USGS. *1980 Cataclysmic Eruption.* https://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_geo_hist_99.html Accessed August 2019.

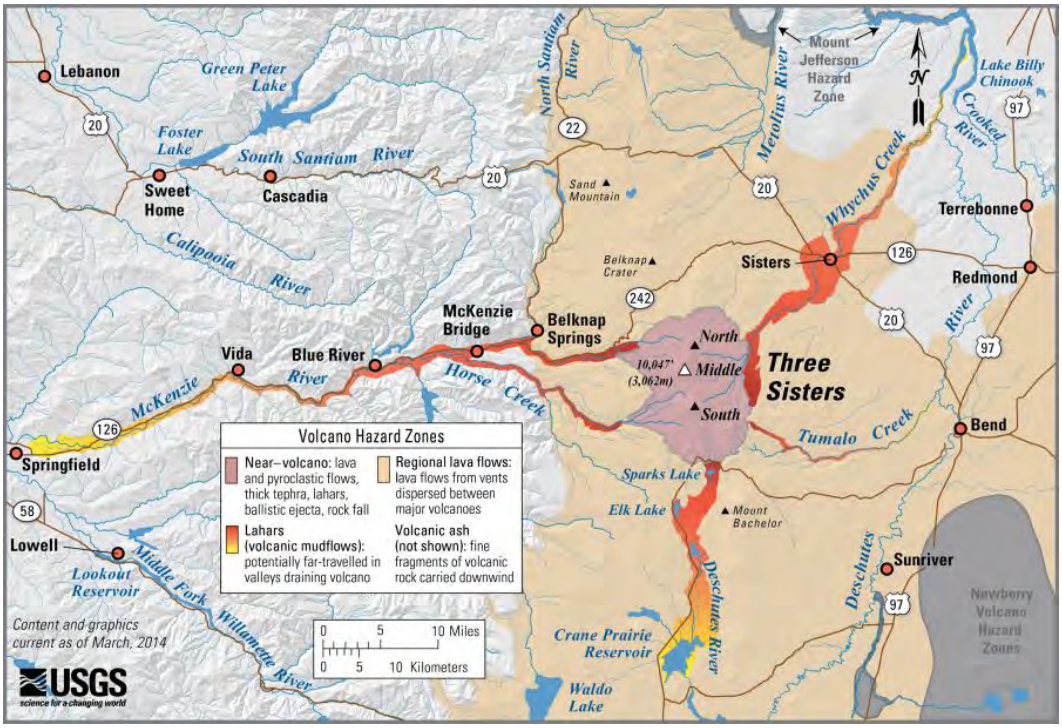


Figure 2-10. Source: USGS 2014 – Three Sisters, Oregon simplified hazards map showing potential impact area for ground-based hazards during a volcanic incident.
https://volcanoes.usgs.gov/volcanoes/three_sisters/three_sisters_hazard_98.html

2.8.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a significant impact of a volcanic incident for the Eugene or Springfield area.

Dam or Levee Failure

Dam failure is not a significant impact of a volcanic incident for the Eugene or Springfield area since all major dams or levees are outside of the predicted lahar flow. Additionally, there are no historical records of such an incident occurring.

Epidemics

The risk of communicable diseases after a volcanic incident is deemed moderate for person to person, water born, and food born modes of transmission. The data is largely collected from undeveloped countries in which volcanic incidents displaced large populations. Due to the limited implications of a volcanic incident for the Eugene-Springfield area the risk of epidemics arising from such an incident is also limited. The most significant threat would be if the McKenzie River's use as a drinking water source were no longer viable.

History of Impact in Eugene-Springfield

There have been no volcano induced epidemics in the Eugene-Springfield area.

Risk of Impact

Though worldwide risk of an epidemics arising after a volcanic eruption is moderate, the healthcare system and demographics of an area must be considered. Due to these facts the Eugene-Springfield area's risk is low.

Hazardous Materials

Volcano induced hazardous material spills or releases are not a significant impact for the Eugene or Springfield area.

2.8.5 Probability of Future Occurrence

The 2015 Oregon Natural Hazards Mitigation Plan indicates the annual probability of the South and Middle Sister entering a new period of eruptive activity is estimated from 1 in several thousand to 1 in 10,000. However, the ability to calculate the probability of a volcanic eruption is limited due to the fragmented nature of the geologic history for these volcanoes.

Uplift was discovered on South Sister in 2001 when geologists and volcanologists observed an area roughly 10 miles in diameter rise by roughly 4 inches at the center. The center of this area was approximately 3 miles from the summit of the South Sister volcano. Uplift continued at roughly 1 inch per year until 2004, when it decreased to one half inch per year. As of 2017, the rate of inflation decreased to 0.2 inches per year.[65] While this uplift is significant, it does not indicate an eruption is imminent.

Although the presence of active volcanoes in the Cascades threatens the area, Eugene and Springfield estimate the probability of a new volcanic occurrence as low. A low rating means one incident is likely within a 75 to 100-year period.

2.8.6 Vulnerability and Capacity Assessment

The Steering Committee rated the vulnerability to a volcanic incident as moderate, meaning 10% to 69% of the population and/or regional assets could be impacted by a volcanic incident. This moderate rating is due to the fact the repercussions of an eruption for Eugene would be limited to ash fall, and a decrease in water quality from the McKenzie River. Due to the expected slow onset, advanced warning, and

[65] USGS, Cascades Volcano Observatory. Long-Term Monitoring Tracks Subtle Surface Changes at some Cascade Range Volcanoes – Uplift at South Sister, December 05, 2017. https://volcanoes.usgs.gov/observatories/cvo/cvo_news_archive.html

available resources, Eugene-Springfield's capacity to respond to a volcanic incident is high.

2.8.7 Risk Assessment

Based on the vulnerability, probability, and capacity scores determined by the Steering Committee this hazard poses a low risk to the Cities. Volcanic eruptions can occur any time in the Eugene-Springfield area, but the average recurrence interval is about 1,500 years making this hazard rather rare compared to others within this plan. Despite the rarity, we know such incidents have affected the area and will affect it in the future.
A summary of Volcanic Impact Risks is in Table 2-11.

Table 2-11 Volcano - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	Low
Hazardous Materials	No Known

2.8.8 Existing Hazard Mitigation Activities

There are no hazard specific mitigation activities for a volcanic eruption. Several existing multi-hazard mitigation items may also mitigate the effects of a volcanic incident.

2.9 Wildfire

The probability of wildfire is high in Eugene-Springfield while vulnerability is moderate in both cities.

2.9.1 Causes and Characteristics of Wildfires

Fire is an essential part of Oregon's ecosystem, but it is also a serious threat to life and property particularly where urban areas encroach upon forested, open range, or grassland areas. Wildfires occur when fire consumes large vegetated areas, in some cases requiring responder suppression.

In this region, changes in historic vegetation, climate, and fire occurrence are resulting in changes to the patterns and character of fire. In short, the risks and potential impacts of wildfire are increasing.

The Eugene-Springfield area is bordered by grassland, agricultural land, and forest. The wildfire hazard is primarily located in the south hills of both Eugene and Springfield where forested areas interface directly with homes, businesses, and

infrastructure. Other areas, like northeast Springfield, have large areas with high vegetative fuel loads located close to developed and developing areas.

Relative Fire Hazard maps are in Section 3.

Areas in Eugene and Springfield are vulnerable to wildfire, depending on the following factors:

- Amount of vegetative fuel loads on the property, and the degree of continuity of fuel load (i.e. number of significant firebreaks). If properties are surrounded by large amounts of fuel without significant firebreaks, vulnerability to wildfire is greater. Risk may be particularly high if the fuel load is grass, brush, and smaller trees. These types of vegetation have low moisture levels in short-duration drought periods.
- Degree of slope. Steeper slopes can allow fire to spread more rapidly than on flatter terrain.
- Limitations in fire suppression capacity can increase vulnerability to wildfire incidents in Eugene and Springfield. Fire suppression capacity is affected by limited water supplies, personnel, apparatus, steep slopes, and long response times.
- Access for firefighting apparatus and resident evacuation. Limited access and egress increase vulnerability.
- Construction materials for infrastructure in the path of fire.
- Maintenance of firebreaks and defensible space around structures.

Oregon Wildfires

Large scale wildfires in Oregon include the Long Draw fire and the Miller Homestead fire. The Long Draw and Miller homestead fires of 2002 were started by lightning and dry thunderstorms. The Long Draw fire burned over 500,000 acres in southeast Oregon and was the worst fire the State had seen in 150 years.[66] The Bureau of Land Management owned most of the land. However, forty, mainly agricultural, property owners were affected.[67] The Miller Homestead fire alone caused over $(2012)8 million in damage.[68]

[66] Blackwood, Jeff D. Long Draw/Miller Homestead Fire Review. April 2013. http://www.blm.gov/or/news/files/long-draw.pdf
[67] Oregon.gov. Governor Kitzhaber announces funds to help repair fences, re-seed land, and retail rural jobs in Southeastern Oregon. http://www.oregon.gov/gov/media_room/pages/press_releases/press_060613.aspx
[68] Bureau of Land Management. BLM Oregon Post-Fire Recovery Plan. August 23, 2012. http://www.blm.gov/or/districts/burns/plans/files/MilleESRPlan_1.pdf.
http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire

In July 2017, the Chetco Bar fire in southwest Oregon burned over 191,000 acres. The fire threatened the town of Brookings but was contained before mandatory evacuation of the city occurred. During August 2017 a series of fires collectively known as the Horse Creek Complex fire began east of Springfield in the Deschutes and Willamette National Forests, burning over 42,480 acres and causing several evacuation orders. Evacuation orders were also issued during the Eagle Creek fire in the Columbia Gorge beginning in September 2017. The fire burned over 50,000 acres and jumped the Columbia River into the State of Washington.

Fires in Other Parts of the West

The Black Forest fire occurred in Colorado in 2013. This fire damaged 595 homes; 498 of which were destroyed.[69] It cost nearly $(2013)8.5 million to contain the fire.[70] The Carlton Complex fire occurred in Washington in 2014, damaged over 300 homes, and cost the State over $(2014)23.3 million in damages, bringing the total damages from wildfires in Washington to over $(2014)50 million.[71]

Wildfires are not just a rural phenomenon. The impact on urban areas from wildfire can be significant. In 1990, Bend's Awbrey Hall fire destroyed 21 homes, caused $(1990)9 million in damage, and cost over $(1990)2 million to suppress. In 1991, the Oakland Hills firestorm in Oakland, California killed 25 people, injured 150 others, destroyed 3,791 dwelling units, and resulted in roughly $(1991)1.5 billion in economic losses. The 1996 Skeleton fire in Bend burned over 17,000 acres and damaged or destroyed 30 homes and structures. The Camp Fire in California in 2018 is the sixth-deadliest wildfire in the U.S., with at least 85 casualties and over 19,300 structures destroyed.[72]

For the purpose of this plan wildfire was categorized into the following three types:

- Interface fire occurs where wildland and developed areas come together at the wildland-urban interface with both vegetation and structural development combining to provide fuel.
- Wildland fires main fuel source is natural vegetation. Often referred to as forest or rangeland fires, they occur in national forests and parks, private timberland, and on rangeland. A wildland fire can become an interface fire if it encroaches on developed areas.

[69] 12 FEMA. Colorado Black Forest Wildfire. http://www.fema.gov/media-library-data/c25715894278ad44c82ddd9d0c7e3243/PDA_Report_FEMA-4134-DR-CO.pdf
[70] The Denver Post. Officials: 511 homes burned in Black Forest Fire. June 2013. http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire

[71] The Oregonian. Washington Wildfire-Fighting Costs Soar past $50 Million for Season. July 27, 2014. http://www.oregonlive.com/pacific-northwest-news/index.ssf/2014/07/washington_wildfire-fighting_c.html
[72] United States. InciWeb Plumas National Forest. *Camp Fire Incident Overview.* https://inciweb.nwcg.gov/incident/6250/ June 2019. Accessed August 2019.

- Firestorms are incidents of such extreme intensity they create and sustains their own wind system.[73] Firestorms often occur during dry, windy weather and generally burn until conditions change, or the available fuel is consumed.

Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, recreational activities, and industrial accidents. Once started, four main conditions affect the fire's behavior: fuel, topography, weather, and urban development.

- Fire needs fuel. Fuel is classified by volume and type. As a western state, Oregon is prone to wildfires due to its prevalent conifer, brush, and rangeland fuel types.
- Topography influences the movement of air and directs a fire's course. Slope and hillsides are key factors in fire behavior. Unfortunately, hillsides with steep topographic characteristics are also desirable areas for residential development.
- Weather is the most variable factor affecting wildfire behavior. High-risk areas in Oregon share a hot, dry season in late summer and early fall with high temperatures and low humidity.
- The degree of urban development influences the amount of fuel available.

2.9.2 Climate Change

Global climate change is expected to increase the length and severity of summer drought along with an increase in summer high and low temperatures. By 2030, climate change is expected to result in:

- Average annual temperature increases of 2-4°F;
- Reduced precipitation in spring, summer and fall; and
- An increase in extreme heat incidents.

These changes will likely result in an increase in wildfire frequency and intensity as well as the probability of future wildfires in the Eugene-Springfield area.

2.9.3 History of the Hazard

While some small wildfires have been recorded by the Eugene and Springfield fire departments, there is no history of large wildfires in the immediate area.

[73] Science Daily. *Reference Terms.* https://www.sciencedaily.com/terms/firestorm.htm Accessed August 2019.

2.9.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of wildfires.

Epidemics

Epidemics are not a known significant impact of wildfires.

Dam or Levee Failure

Dam or levee failures are not a known significant impact of wildfires.

Hazardous Materials

Hazardous material spills or releases are not a known significant impact of wildfires.

2.9.5 Probability of Future Occurrence

The Steering Committee identified the probability of a wildfire occurring in the Eugene-Springfield area as high given the high fuel load in nearby forested areas, hilly topography, and dry summers. A high probability means one incident is likely to occur within a 0 to 35-year period. As previously noted, climate change is expected to make wildfires more likely as well.

2.9.6 Vulnerability and Capacity Assessment

Given the amount of residential development in the south hills of Eugene, the Steering Committee rated the vulnerability to wildfire as moderate, meaning a wildfire may impact 10% to 69% of the population and/or regional assets.

The 2014 Climate and Hazard Vulnerability Assessment confirmed these ratings. Specifically, the assessment found, while wildfire incidents have the potential to cause severe loss and damage in localized areas, the wildfire hazard is not likely to result in systemic failures across multiple sectors or significant damage to critical systems.

Capacity to respond to and recover from a forest fire is moderate for both Eugene and Springfield. This is due to the amount of available resources as well as an established conflagration process within the State of Oregon instituted through the Office of the State Fire Marshal.

2.9.7 Risk Assessment

The 2008 update to the Lane County Community Wildfire Protection Plan's (CWPP) risk assessment identifies specific neighborhoods in Eugene and Springfield as areas at risk. The areas of concern include the south hills neighborhoods in Eugene, the southwest Eugene/Spencer Creek area, Thurston Hills in Springfield, and the Harbor Drive/South 2nd area in Springfield. Based on the vulnerability, probability, and capacity ratings determined by the Steering Committee, the Eugene-Springfield area's wildfire risk is high.

Table 2-12 shows the percentage of each community at risk-by-risk category.

For a summary of Impact Risks see Table 2-13.

Table 2-12 CWPP Communities at Risk Summary for Eugene-Springfield

Community at Risk	Total Acreage	Percentage of Community at Risk		
		High	Medium	Low
Eugene	37,747	2.1	17.7	80.2
Springfield	9,445	3.9	15.8	80.2

Table 2-13 Wildfire - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	No Known

2.9.8 Existing Mitigation Activities

In 2010, the Springfield and Eugene Fire Departments began operating under an intergovernmental agreement to share the services of key administrative positions in both departments. In 2014, the two departments functionally merged into one department. This merger has facilitated better sharing and utilization of resources and improved communication. For example, Eugene Springfield Fire offers educational campaigns to inform residents about actions they can take to reduce wildfire hazards on their property. In addition, Eugene Springfield Fire completed an Urban Interface Fire Plan in 2016 addressing specific wildfire hazards for the metro area.

The City of Eugene's Parks and Open Space Division of the Department of Public Works conducts wildfire hazard mitigation activities yearly. Objectives of this work are to:

1. Implement landscape-scale fuels reduction treatments to reduce the risk of damaging wildfires in the Wildland Urban Interface of the South Hills of Eugene and the West Eugene Wetlands to create a more fire resilient landscape;
2. Provide the framework for reducing the risks and consequences of wildland fire to the community. Promote public awareness of wildfire hazard, engage participation, and enhance partnerships through education, outreach, and coordination of diverse and representative groups of the City of Eugene's population; and
3. Implement and maintain greater coordination among local, State, and Federal land management agencies and private landowners to effectively prioritize hazardous fuels treatments.

Efforts include, but are not limited to:



Picture 2-5. Before (left) and after (right) thinning at Wild Iris Ridge park, showing decrease in stem density following thinning.

- July 30, 2015 – July 29, 2016: Thinned 18 acres at Wild Iris Ridge Park, a City-owned property located adjacent to residential developments and rural residential houses (Picture 2-5). Designed, produced, and placed large-format kiosk posters at 11 trailheads. Delivered 9,983 educational mailers targeting residences and businesses close to project areas deemed at high risk from wildland-urban interface fires. Distributed over 2,000 pocket-sized 'trading cards' with project information and web addresses where interested parties can obtain more information concerning local wildfire mitigation efforts. Along with the Eugene-Springfield Fire Department, produced a 30 second PSA which ran 140 times on five different radio stations. Conducted three in-person outreach events reaching more than 175 people.
- July 30, 2016 – July 29, 2017: Thinned 23 acres at the City's Suzanne Arlie Park to protect critical infrastructure crossing the property. Placed large-format posters at 8 trailhead kiosks. Designed and built two new kiosks (Picture 2-6). Installed one of the two new kiosks with the other one installed during the July 30, 2017 thru July 29, 2018 reporting period. Distributed 1,505 pocket-sized 'trading cards' with project information and

web addresses where interested parties can obtain more information concerning local wildfire mitigation efforts. Mailed 379 letters to residents and businesses surrounding Skinner Butte Park as well as hosted an evening public tour of the project.



Picture 2-6. New kiosk at Wild Iris Ridge Park and first kiosk the western portion of the Ridgeline Park System, reaching a new area of the community with outreach information.

- July 30, 2017 – July 29, 2018: Thinned 6 acres by hand at Skinner Butte (Picture 2-7) and thinned 29 acres at Arlie Park. Placed "Team Up for Fire Safety" posters at 7 trailhead kiosks. Placed large-format poster at Skinner Butte's kiosk which receives 50-100 visitors per day during the summer. Installed one new kiosk built during the July 30, 2016 thru July 29, 2017 reporting period. Conducted a "Cascadia Prairie-Oak Cooperative Field Tour" for 25 ecologists, restoration practitioners, and land managers from regional government agencies and non-profit organizations. This daylong event covered mutual goals of habitat improvement and fuels reduction in oak and prairie habitats of western Oregon, the use of prescribed fire to prevent establishment of new woody vegetation, and forestry techniques used for thinning shrubs and trees. From an outreach perspective, the Skinner Butte project was highly visible and offered the opportunity to spread wildfire risk and awareness information to a new segment of the community – a more urban population comprised of residences, businesses, and incidental site users from across the City.



Picture 2-7. Before (left) and after (right) thinning at Skinner Butte, showing removal of dense, invasive shrubs. Note trail marker post in both photos.

2.10 Windstorm

The probability of a windstorm in the Eugene-Springfield area is high while vulnerability to a windstorm is moderate. Windstorms are storms with damaging "straight-line" winds. The term "straight-line" is used to differentiate from wind damage caused by tornadoes.

2.10.1 Causes and Characteristics of the Hazard

Windstorms are relatively common for the Eugene-Springfield area. These storms occur any time of the year but are more typical during winter months. Destructive winds are generally from the southwest and associated with cyclone storms which move in from the Pacific Ocean. Winds from the west are generally slowed by the Coast Mountain Range before reaching the Willamette valley.

Windstorm damage generally consists of fallen trees and power outages. Damage may be much worse if the ground is heavily saturated with water increasing the likelihood of trees falling. Typically, these storms have sustained winds more than 50 mph.[74]

2.10.2 Climate Change

It is unknown how climate change may affect the severity or frequency of windstorms in the Eugene-Springfield area.

2.10.3 History of the Hazard in Eugene-Springfield

Oregon's most destructive windstorm was the Columbus Day Storm in October 1962. Wind speeds of 116 mph were recorded in the Willamette Valley. Eighty-four

[74] United States. NOAA The National Severs Storms Laboratory. *Severe Weather 101-Damaging Winds.* https://www.nssl.noaa.gov/education/svrwx101/wind/. Accessed August 2019.

homes were destroyed and five thousand were severely damaged. Estimates put the damage at approximately $(1962)230 million to $280 million for California, Oregon and Washington combined. Those figures in translate to $1.8 Billion to $2.2 Billion in 2014 Dollars. Oregon's share exceeded $(1962) 200 million.[75] Other notable incidents are identified in table 2-14.

Table 2-14 Significant Eugene-Springfield Windstorms Since 1990

Date	Location	Comments
January 7-8, 1990	Statewide	Peak gusts up to 58 mph in Eugene
December 1995	Statewide	Peak gusts up to 49 mph in Eugene and up to 62 mph in the Willamette Valley in general. Saturated soils compounded damage. (FEMA-1107-DR-Oregon)
February 7, 2002	Lane County	Peak gusts up to 70 mph in Eugene. Damages of public properties were greater than $(2002)6 million. (FEMA-1405-DR-Oregon)
February 3-4, 2006	Western Oregon	Peak gusts of 46 mph in Eugene. 3500 without power in Lane County and $(2006)300,000 in damages.
May, 2006	Lane County	$(2006)5,000 in property damage in Eugene, and Approximately 13,000 without power.
March 13, 2011	Lane County	Peak gusts of 60 mph in Eugene. 25,000 residence without power in Lane County. Trees toppled and buildings damaged.
December 10, 2015	Lane County	Peak gusts of 47 mph in Eugene and Creswell due to a thunderstorm. Widespread electrical outages and $(2015)260,000 in damages.
January 16, 2016	Lane County	Peak gusts of 63 mph winds from a thunderstorm. Several down trees, damaged roofs, electrical outages, and $(2016)15,000 in damages reported.

Significant windstorm incidents. Compiled from FEMA Disasters. https://www.fema.gov/disasters

[75] https://en.wikipedia.org/wiki/Columbus_Day_Storm_of_1962. Accessed August 7, 2019.

2.10.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, civil unrest is not a known impact of windstorms.

Dam or Levee Failure

Dam or levee failure is not a known impact of windstorms.

Epidemics

Epidemics are not a known impact of windstorms.

Hazardous Materials

Hazardous Material spills or releases may occur when debris impacts holding tanks, pipelines, or equipment vital to operating a facility.

History of Impact in Eugene-Springfield

There have been no known HazMat spills or releases due to a windstorm in the Eugene-Springfield area.

Risk of Impact

Based on historical incidents the risk from this impact is low.

2.10.5 Probability of Future Occurrence

Windstorms have a three-year recurrence interval in Lane County. These storms cause limited damage.[76] A 25-year recurrence windstorm has average wind speeds of 47 to 61 mph. A 50-year incident has wind speeds between 62-75 mph, and a 100-year incident, for the Willamette Valley, is considered a storm with average speeds over 75 mph. As indicated by the Beaufort Scale, storms with average wind speeds in excess of 47 mph can cause significant damage (Figure 2-11).

[76] NOAA. Storm Interval Calculation based on the significant windstorm record (Table 2-14).

Beaufort	1-min Wind speed	Effects on land
0 Calm	0 - 1 mph	Calm. Smoke rises vertically.
1 Light air	1 - 3 mph	Smoke drift indicates wind direction and wind vanes cease moving.
2 Light breeze	3 - 7 mph	Wind felt on exposed skin. Leaves rustle and wind vanes begin to move.
3 Gentle breeze	7 - 12 mph	Leaves and small twigs constantly moving, light flags extended.
4 Moderate breeze	12 - 17 mph	Dust and loose paper raised. Small branches begin to move.
5 Fresh breeze	17 - 24 mph	Branches of a moderate size move. Small trees in leaf begin to sway.
6 Strong breeze	24 - 30 mph	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over.
7 Near gale	30 - 38 mph	Whole trees in motion. Effort needed to walk against the wind.
8 Gale	38 - 46 mph	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9 Severe gale	46 - 54 mph	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over.
10 Storm	54 - 63 mph	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11 Violent storm	63 - 73 mph	Widespread damage to vegetation. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12 Hurricane	73 - 99 mph	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.

Figure 2-11 Source*:* Ben Lee-Rodgers, 2017- *Beaufort Scale*
http://nw3weather.co.uk/BeaufortScale.php

2.10.6 Vulnerability and Capacity Assessment

Property damage concerns are significant with windstorms. These incidents could affect almost every Eugene-Springfield resident which classifies the Cities' vulnerability to this hazard as moderate. The area's capacity to respond to, and recover from, a windstorm is also moderate. This is largely due to the frequency in which these storms occur as well as the resources available to respond to them.

2.10.7 Risk Assessment

Based on the probability of future windstorms, the area's vulnerability, and capacity to deal with them, the Eugene-Springfield NHMP Steering Committee determined the overall risk from this hazard is high.

For a summary of windstorm impact risks see table 2-15.

Table 2-15 Windstorm- Impact Risks	
Cascading Incidents	**Ranking**
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	Low

2.10.8 Existing Mitigation Activities

The Cities of Eugene and Springfield along with EWEB and SUB routinely trim trees to prevent power outages due to falling limbs and trees. Additionally, funding is being actively pursued to equip all Eugene fire stations with backup generators.

2.11 Winter Storm

The probability of, and vulnerability to, winter storms in Eugene and Springfield is high. In previous Eugene-Springfield NHMPs extreme weather, windstorms, and heavy rain were included under winter storms. This update addresses extreme weather, windstorms, and the repercussions of heavy rain (flooding and landslides) with dedicated assessments within Section 2. Winter storms are storms where below freezing temperatures and precipitation combine to produce adverse conditions. These storms could include snow, ice, extreme cold, and/or frost heave.

2.11.1 Causes and Characteristics of the Hazard

Extreme Cold

Extreme cold periods vary in severity based on temperature and duration. Long durations and/or extreme lows increase the severity of a cold wave incident. Extreme cold incidents can be life-threatening for those exposed to the elements. These conditions can worsen when mixed with wind creating dangerous “wind chill” (Figure 2-12).

Frost Heave

Frost heave occurs when soil swells upwards due to ice forming within the ground. Generally, its effects are mild in the Eugene-Springfield area. When subzero temperatures occur, and the ground is saturated with water, more damaging frost heave incidents can occur. Primary damage from frost heave is seen when structures such as utility poles and storage tanks tilt or topple due to destabilization of the supporting ground.

Snow and Ice

The most likely effects of snow and ice incidents are road closures limiting access to and from the Eugene-Springfield area. Closures especially affect roads to higher elevations, such as the highways into the Cascades or Coast Range. Winter storms with wet heavy snow and ice storms may also result in significant power outages from downed transmission lines and/or poles.

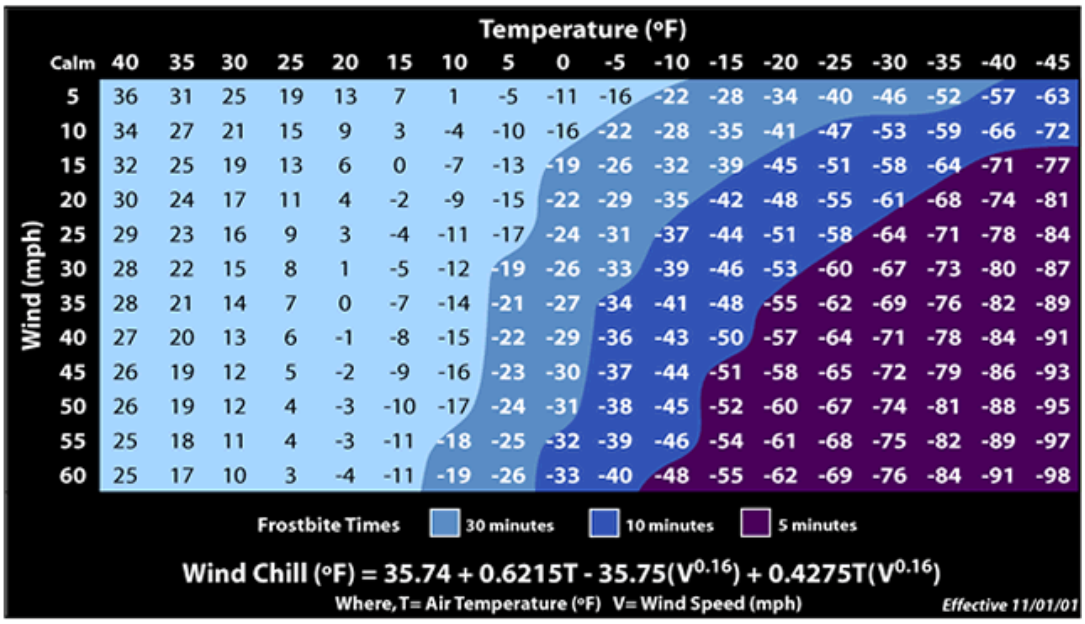


Figure 2-12. Source: National Weather Service – *Wind Chill Chart*

2.11.2 Climate Change

As previously discussed in section 2.2.2 (Drought: Climate Change), average annual temperatures along with high and low temperatures are expected to rise in the coming decades. In addition, the total precipitation is predicted to decrease. These conditions will produce fewer winter storms for the Eugene-Springfield area, although there may be an increase in severe winter storms due to the fluctuating climatic conditions as discussed in section 2.5.2 (Flood: Climate Change).

2.11.3 History of the Hazard in Eugene-Springfield

For the Eugene-Springfield area, most winters result in little snowfall. Major snow falls of 10 inches or more typically occur every 10 to 20 years. Significant winter storms have a reoccurrence rate of 2.9 years.[77]

[77] United States. Eugene, Oregon. NOAA. *Eugene Ice Storm Benefit Cost Analysis 2016.*

Major winter storms affecting the Willamette Valley occurred in 1884, 1892, 1909, 1916, 1919, 1937, 1950, 1969, 1989, 2002, 2004, 2008, 2010, 2012, 2013, 2014, 2016, and 2019. January 1950 snowfalls were especially high, with 54" in Albany and 36" in Eugene. In January 1969, Eugene received 47" of snow. In December 2008, January 2012, February 2014, December 2016, and February 2019 significant snow and ice disrupted electrical service and transportation systems throughout the Willamette Valley. All five (Table 2-16) of these storms resulted in Federal Disaster Declarations for Lane County.

Average annual snowfall gauged by the Eugene Airport weather station is 6.4". Since the weather station was established in 1939, the maximum monthly snowfall has been 47.1" (January 1969), with the maximum seasonal snowfall also at 47.1" (1969).

Significant winter storm incidents affecting the area since 1990 are listed in Table 2-16.

Table 2-16 Significant Eugene-Springfield Winter Storm Incidents Since 1990

Date	Location	Comments
February 11-16, 1990	Statewide	Heavy Snow: Average of 8 inches across the Willamette Valley
December 16-17, 1992	Western Oregon	Heavy Snow
February 18-19, 1993	Northwestern Oregon	Heavy Snow: 6 to 12 inches fell in the Willamette Valley
Winter 1998-1999	Statewide	Series of Snowstorms: One of the snowiest winters in Oregon history
March 12, 2002		Snow
December 2003- January 2004		Snow
NOTE: the following incidents were compiled from the list of Eugene Public Works Emergency Command Center activations between 2009 and 2014 and crossed referenced with State and County NHMPs as well as news outlets to ensure accuracy		
December 2008- January 2009	Southern Willamette Valley	Heavy Snow/Ice Incident.
November 23-24, 2010	Cascades and Foothills in Lane County	Heavy Snow
December 27-29, 2010	Cascades and Foothills in Lane County	Ice Incident: Road icing
March 13, 2011		Rain storm: Downed trees
January 17 to 21, 2012		Snow and Ice incident. 2,000 power outages. **Federal Disaster Declaration (DR-4055)**

Table 2-16 Significant Eugene-Springfield Winter Storm Incidents Since 1990

Date	Location	Comments
March 21-24, 2012	Southern Willamette Valley	Heavy Snow: Eugene received eight inches in eight hours. Reports of trees down, power lines down, local roads closed. $(2012)317,612 in damages to the City of Eugene and several power outages.
January 10, 2013	Lane County	De-icing incident: Freezing Temps
December 4-13, 2013	Central & Southern Willamette Valley	Heavy Snow & Extreme Cold: 8-9 inches of snow recorded in Creswell. De-iced
February 6-24, 2014	Northwest Oregon	Heavy Snow & Freezing Rain: Reports of up to 0.75 inches of ice in Eugene. $(2014)1.7 million in damages to the City of Eugene and roughly 10,000 power outages lasting up to six days. **Federal Disaster Declaration (DR-4169)**
December 15-22, 2016	Lane County	Ice Storm. $(2016)1.6 million in damages to the City of Eugene and roughly 20,000 power outages lasted several days. **Federal Disaster Declaration (DR-4269)**
February 25 – March 1, 2019	Lane County	Heavy Snow: 9 inches in and around the Eugene area with 12 inches reported in the South Hills of Eugene. **Federal Disaster Declaration (DR-4432)**

2.11.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of winter storms.

Dam or Levee Failure

Winter storms can cause dam or levee failures when ice and snow compound flooding incidents, clog drainage, or disrupt power to control or operating systems. Such incidents cause failures due to overtopping or erosion.

History of Impact in Eugene-Springfield

Dam or levee failure has not been an impact from a winter storm in the Eugene or Springfield area.

Historically, two dams have failed during winter storms in the United States. In 1890 heavy snow, flooding, and poor design contributed to the failure of the Walnut Grove Dam (AZ) killing 100 people. The Meadow Pond Dam (NH) failed in 1996

due to heavy icing, compounded by poor design and construction, killing one person.

Risk of Impact

Based on historical occurrences, and the condition of the dams and levees in and around Eugene and Springfield, the risk of this impact occurring is low (Appendix H).

Epidemics

Epidemics are not a known significant impact of winter storms.

Hazardous Materials

There is a moderate risk of winter storms causing hazardous material spills or releases. Adverse winter driving conditions make transportation of hazardous materials via trains or roads dangerous. Freezing temperatures and frost heave may severely damage tanks and piping, as well.

History of Impact in Eugene-Springfield

There have been no significant HazMat incidents in the Eugene or Springfield area due to winter weather. Nationally, winter weather related-natech incidents have resulted in over $6 million in damages and account for roughly 25,000,000 barrels spilt by the US oil and gas industry.[78] These incidents tend to be small in scope (less than 500 barrels), and companies take protective measures to preempt them, but they are a possibility.

Risk of Impact

Based on the frequency and volume of previous HazMat incidents induced by winter storms, this impact poses a moderate risk to the Eugene-Springfield area.

2.11.5 Probability of Future Occurrence

The Oregon NHMP Hazard Profile for the region indicates the probability of winter storms in the area is high. Significant winter storms have a recurrence rate of 2.9[79] years while major snowstorms reoccur every 10 to 20 years. This means, on average, two or more severe winter storms occur each decade.

[78] Italy. Girgin, Serkan, Elisabeth Krausmann. European Commission Joint Research Centre. *Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development.*2015. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/lessons-learned-oil-pipeline-natech-accidents-and-recommendations-natech-scenario
[79] Wilde, Tyree, NOAA, 2017. DR-4269 Benefit Cost Analysis for City of Eugene.

Eugene-Springfield rates the probability for local winter storms as high, which indicates at least one incident is likely within a 0 to 35-year period.

2.11.6 Vulnerability Assessment and Capacity

Findings from the 2014 Climate and Hazards Vulnerability Assessment confirmed severe winter storms in Eugene-Springfield have the potential to cause region-wide cascading system failures. Specifically, severe winter storms disrupt electricity and transpiration sectors, two of the three sectors all others depend upon. This is especially true if the snow and ice accumulations are significant and the storm lasts more than a couple of days.

The Steering Committee rates winter storm vulnerability as high, indicating a winter storm would impact more than 70% of the region's population. With the electric and transportations sectors particularly vulnerable to winter storms, almost every citizen in Eugene and Springfield is impacted.

The Eugene-Springfield area's capacity to deal with such incidents is moderate. Historically, it takes a very significant winter storm to drain the area's resources.

2.11.7 Risk Assessment

Based on the probability of future occurrences, vulnerability, and capacity to respond to, and recover from, winter storms, the Eugene and Springfield's risk to this hazard is categorized as being high. One factor limiting the area's capacity to respond to these incidents is the large number of the storms. Historically, these incidents tend to involve multiple counties and, at times, the entire State, if not multiple states, which limits mutual aid resources.

For a summary of winter weather impact risks see table 2-17.

Table 2-17 Winter Storm- Impact Ricks

Cascading Incident	Rating
Civil Unrest	No Known
Dam or Levee Failure	Low
Epidemic	No Known
Hazardous Materials	Moderate

2.11.8 Existing Hazard Mitigation Activities

Eugene and Springfield are participating in winter storm mitigation activities.

- Development Codes: Both jurisdictions require utilities in all new subdivision developments to be installed underground. This assists in the prevention of damaged power and communication lines during an incident.
- Tree-Trimming: The Eugene Water & Electric Board and the Springfield Utility Board engage in tree-trimming around power lines.
- Building Codes: Eugene and Springfield Building Codes adhere to the Oregon Structural Specialty Code guidelines for new development.
- In 2017, after DR-4269, Eugene and Springfield each purchased another storage tank for deicer fluid.

2.12 Conclusions

The results of the natural hazards identified by the Project Team are compiled below in Risk Assessment Matrix for the City of Eugene and the City of Springfield. Table 2-18 was used in the development of table 2-19.

In both tables the following applies to the rating levels:

- High = 3
- Moderate = 2
- Low = 1
- No Known = 0

Table 2-19 uses the following formula to calculate Risk Total

- (Vulnerability x Probability)/Capacity = Risk Total

Risk Total is rated using the following index:

- <1.5 = Low
- 1.5-2.9 = Moderate
- 3-4.5 = High
- >4.5 = Very High

Table 2-18 Summary of Cascading Incidents- By Hazard

Hazard	Civil Unrest	Dam/Levee Failure	Epidemic	Hazardous Materials	Cascading Incident Rating
Geomagnetic Disturbance (GMD)	High	Moderate	Moderate	Moderate	9
Earthquake	Moderate	Low	Moderate	High	8
Flood	Low	Low	Moderate	Moderate	6
Landslide	No Known	Low	Low	Low	3
Winter Storm	No Known	Low	No Known	Moderate	3
Extreme Weather	Low	No Known	No Known	Low	2
Volcano	No Known	No Known	Low	No Known	1
Windstorm	No Known	No Known	No Known	Low	1
Drought	No Known	No Known	No Known	No Known	0
Wildfire	No Known	No Known	No Known	No Known	0
Cascading Incident Rating	7	6	8	12	

Table 2-19 Risk Assessment Matrix

Hazard	Vulnerability	Probability	Capacity	Risk Total	Risk Rating
Geomagnetic Disturbance (GMD)	3	3	1	9	Very High
Earthquake	3	2	1	6	Very High
Winter storm	3	3	2	4.5	High
Drought	3	3	3	3	High
Wildfire	2	3	2	3	High
Windstorm	2	3	2	3	High
Flood Riverine	2	2	2	2	Moderate
Landslide	1	3	2	1.5	Moderate
Flood Stormwater	1	3	3	1	Low
Extreme Weather	1	2	3	0.7	Low
Volcano	2	1	3	0.7	Low

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3 Maps

3.1 Eugene-Springfield Hazard Maps

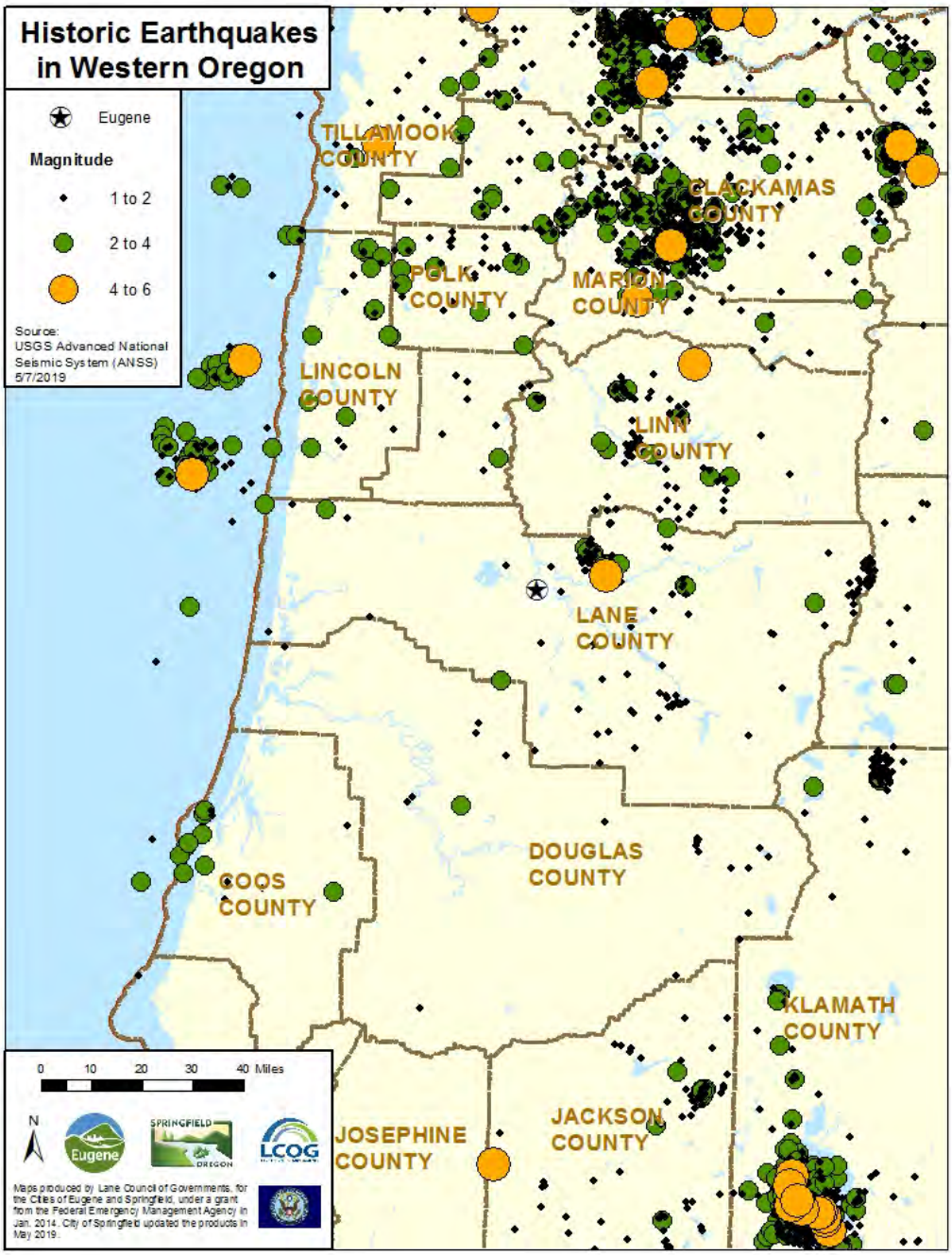
The maps in this section describe the location and intensity of individual hazards including earthquake, flood, urban wildfire, and landslide. The maps were originally prepared by Lane Council of Governments using federal funds and were updated for this Plan by the City of Springfield.

A description of the map and source data is contained within each map.
A complete description of the history, probability, and risk of each hazard is discussed within Section 2, Hazard Descriptions.

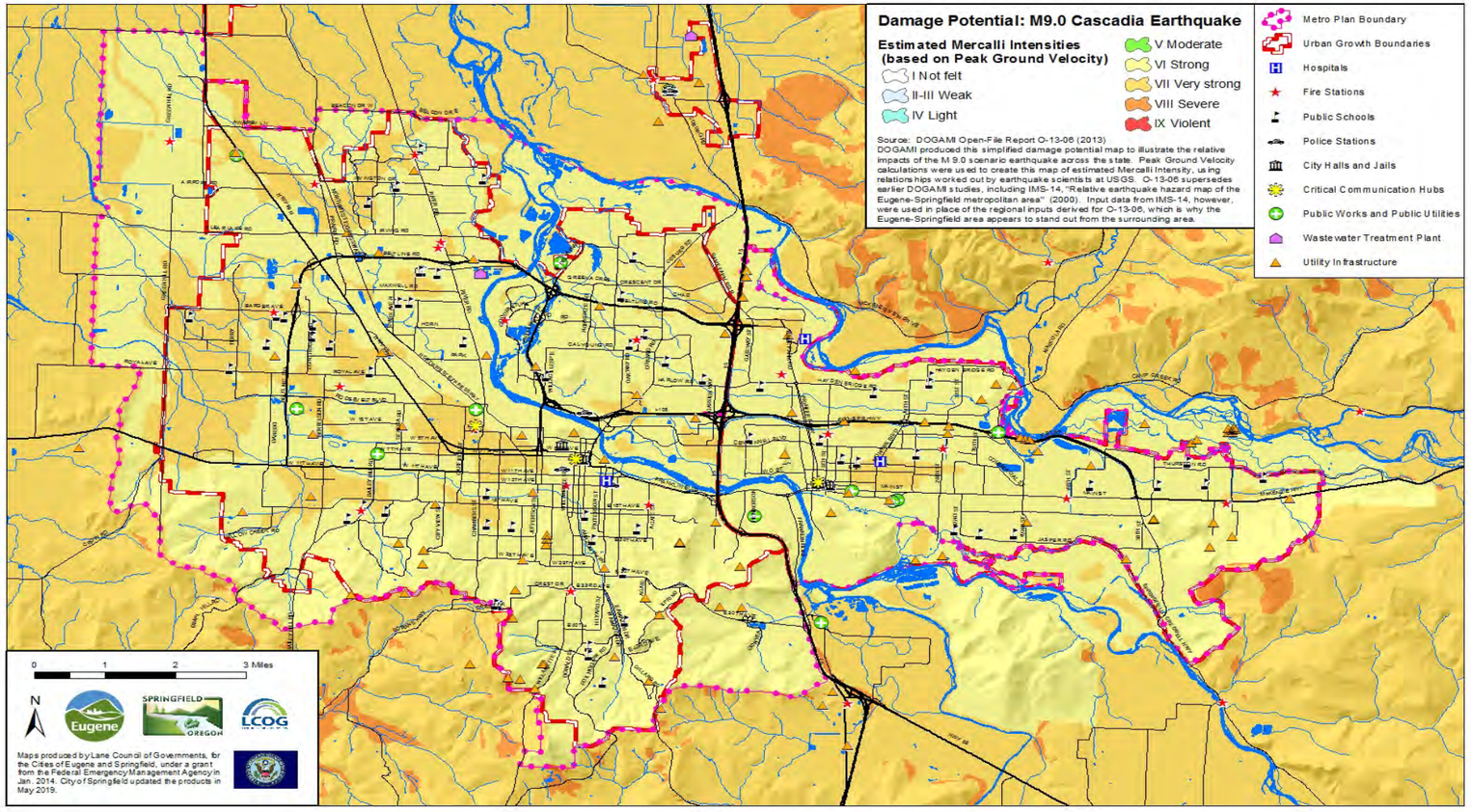
The following maps are included:

- Historic Earthquakes in Western Oregon
- Earthquake Damage Potential
- Relative Fire Hazard
- Flood Hazard Areas
- Chronic Urban Flooding
- Landslide Inventory
- Shallow Landslide Susceptibility
- Deep Landslide Susceptibility
- Liquefaction Susceptibility
- Metro Land Use Zones
- Metro Transportation System

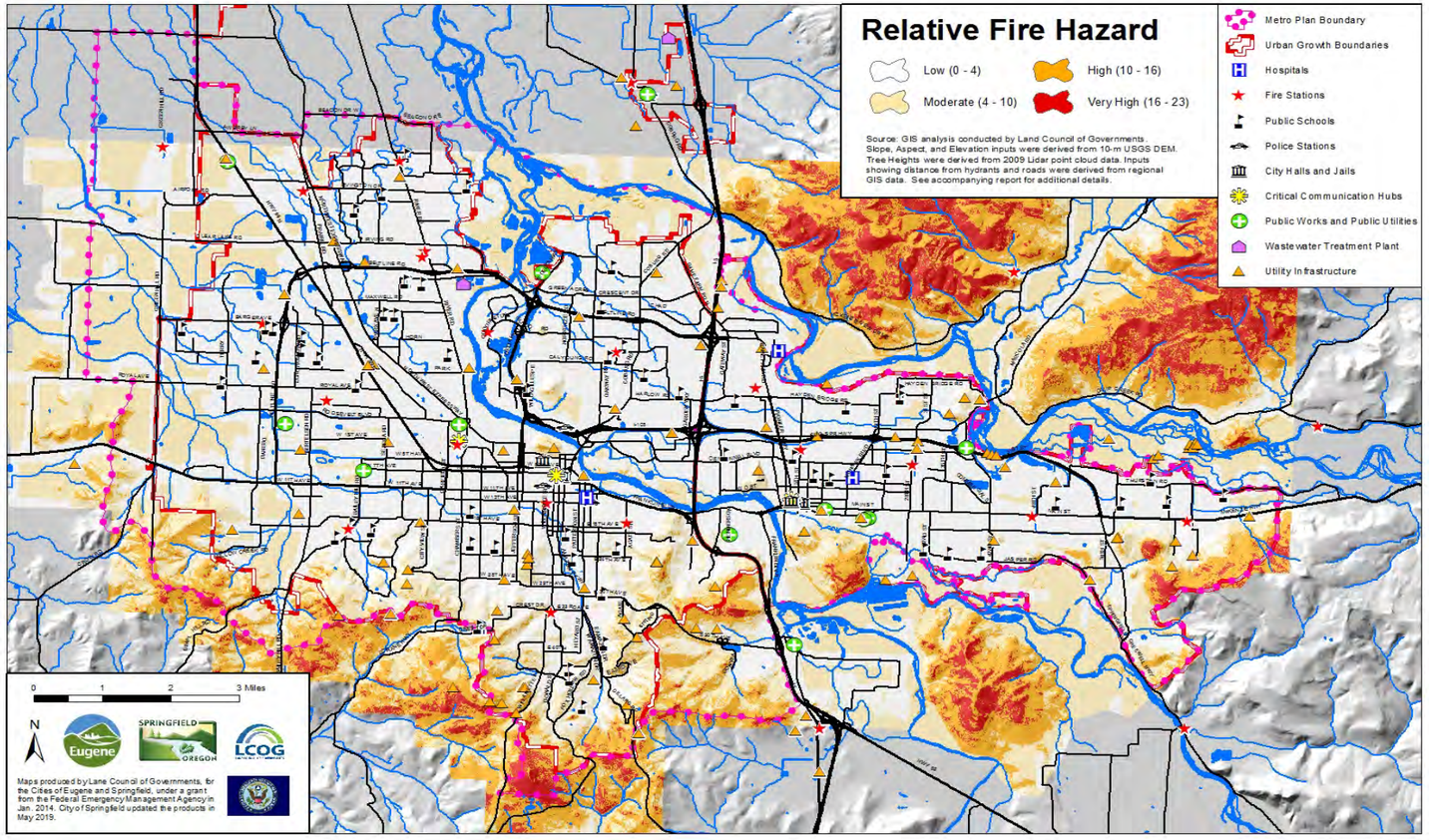
3.1.1 Historic Earthquakes in Western Oregon



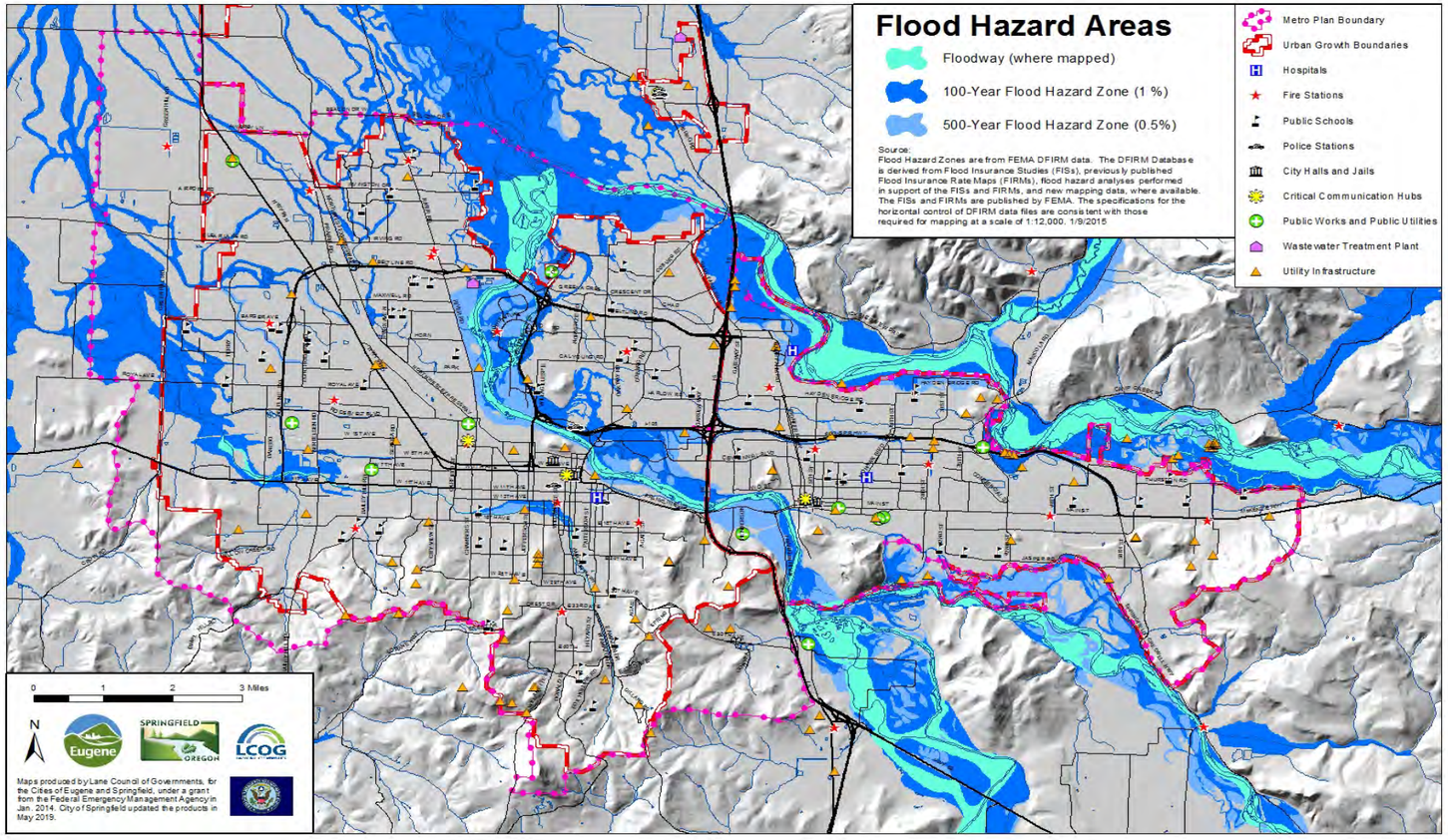
3.1.2 Earthquake Damage Potential



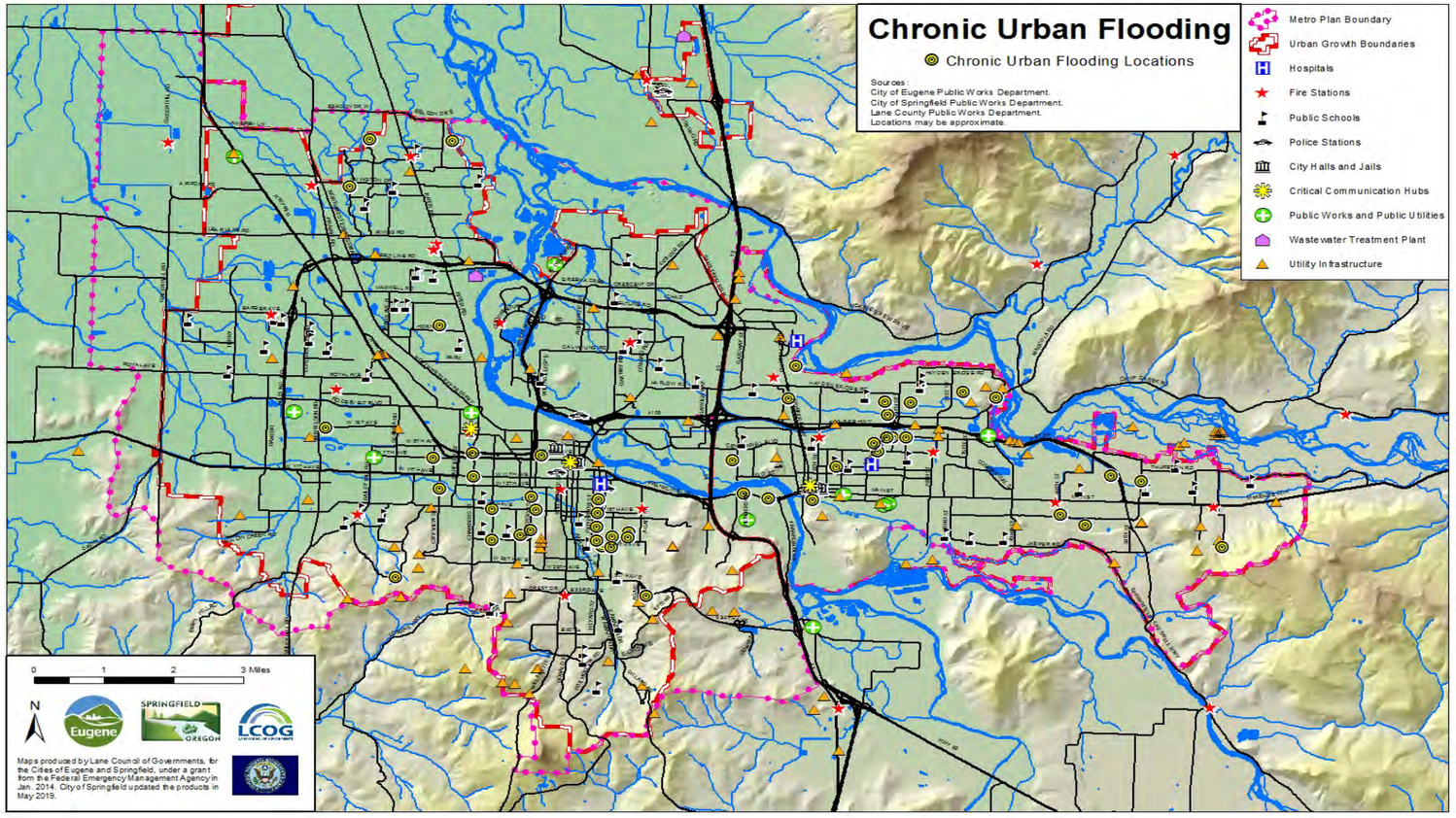
3.1.3 Relative Fire Hazard



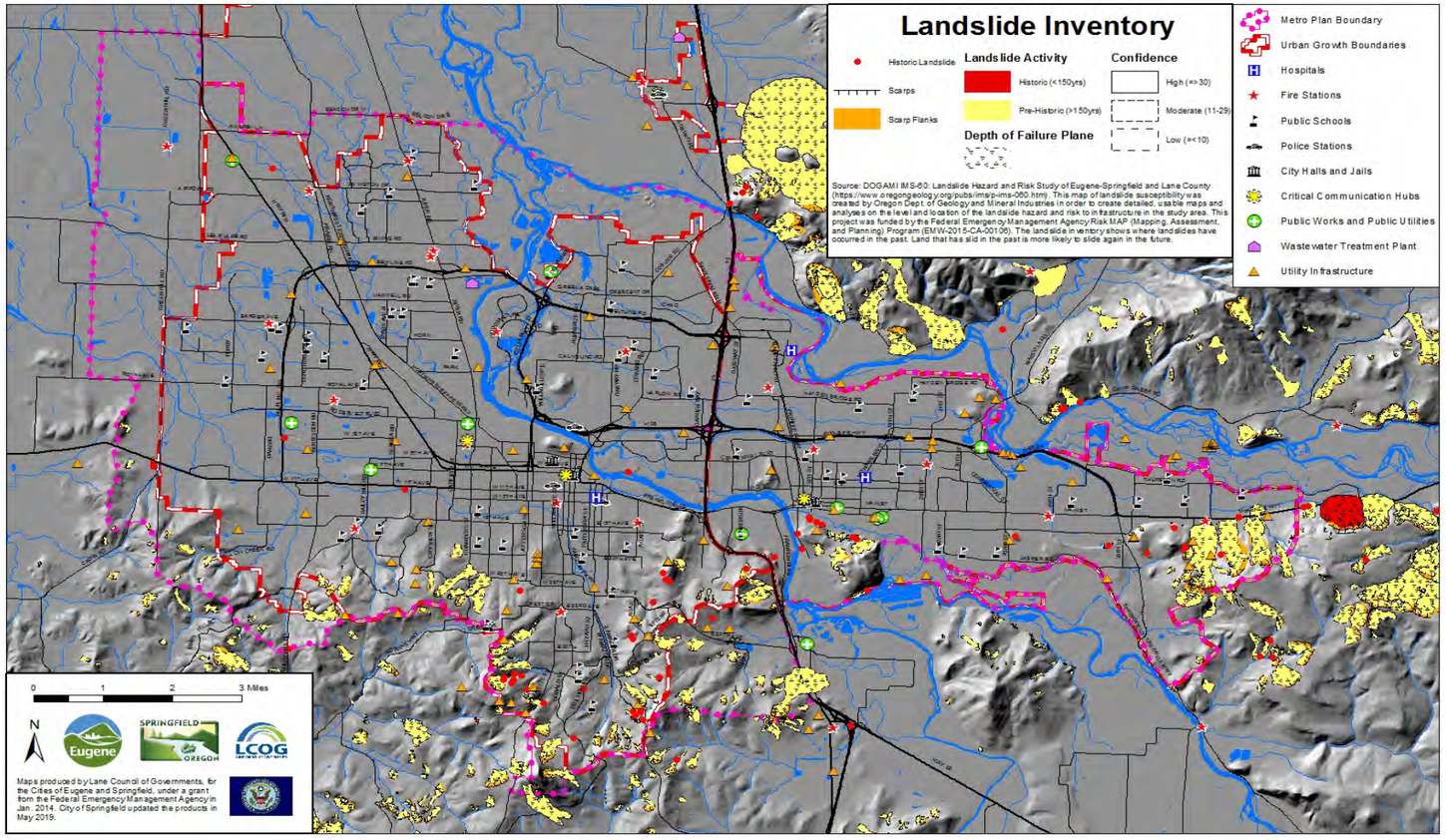
3.1.4 Flood Hazard Areas



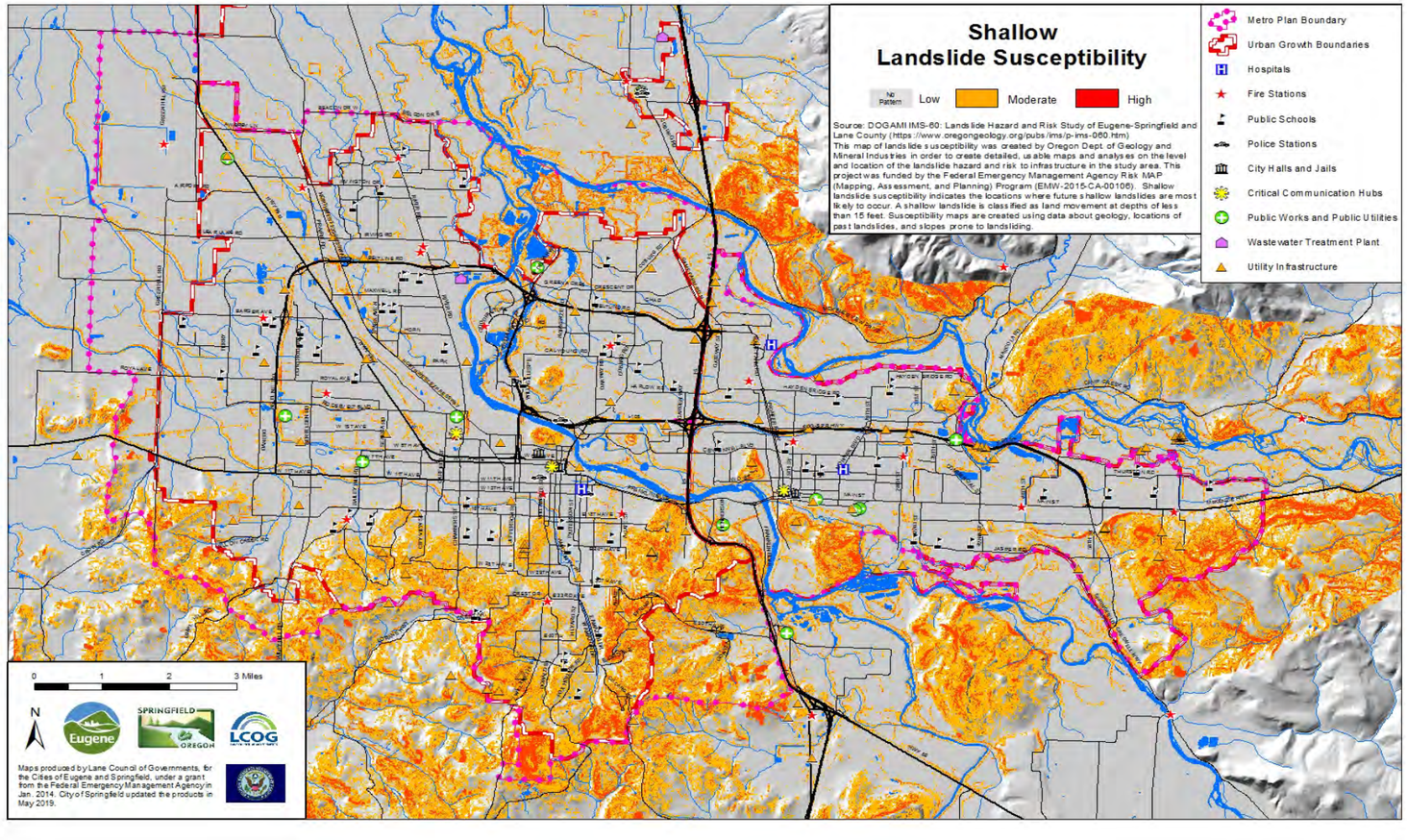
3.1.5 Chronic Urban Flooding



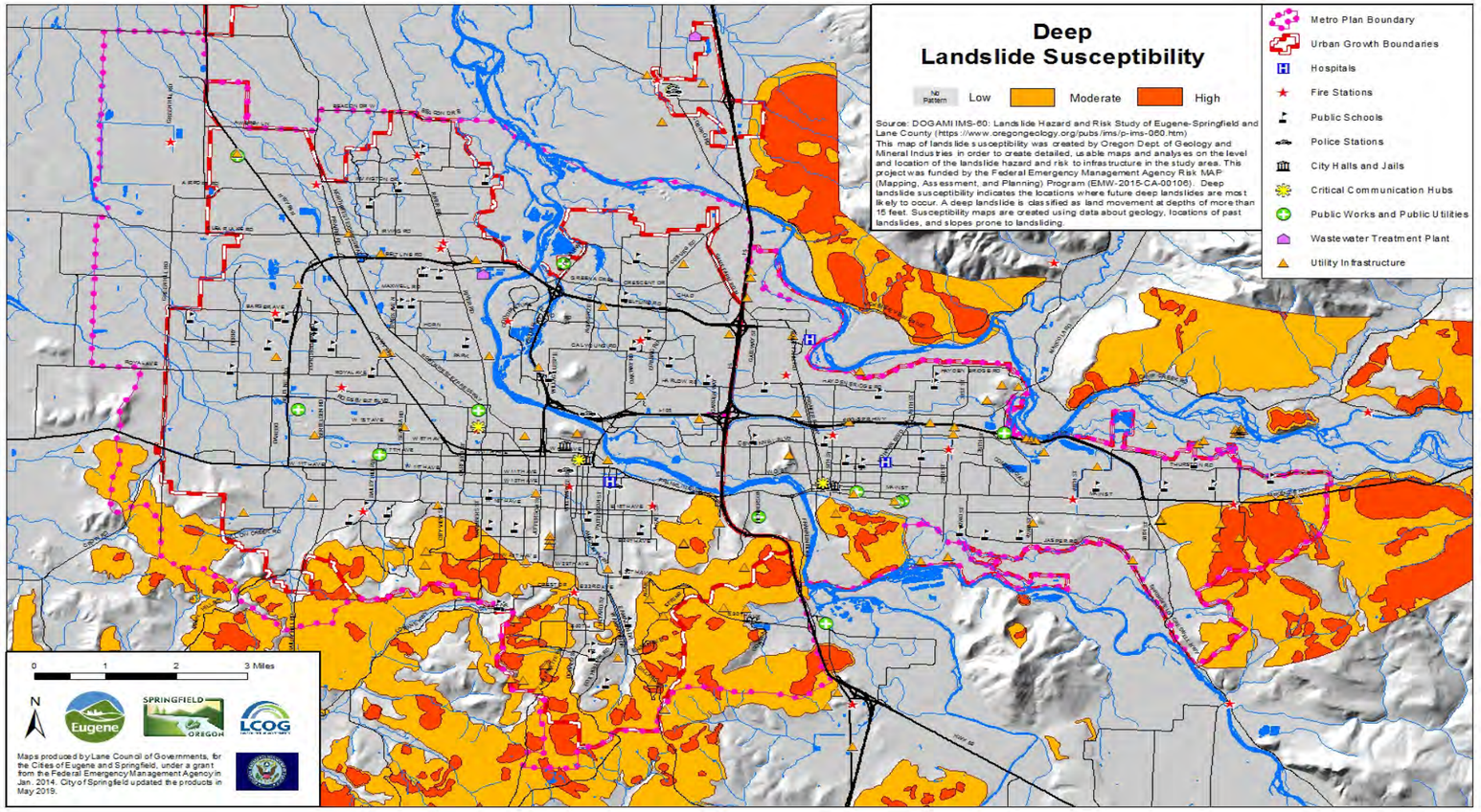
3.1.6 Landslide Inventory



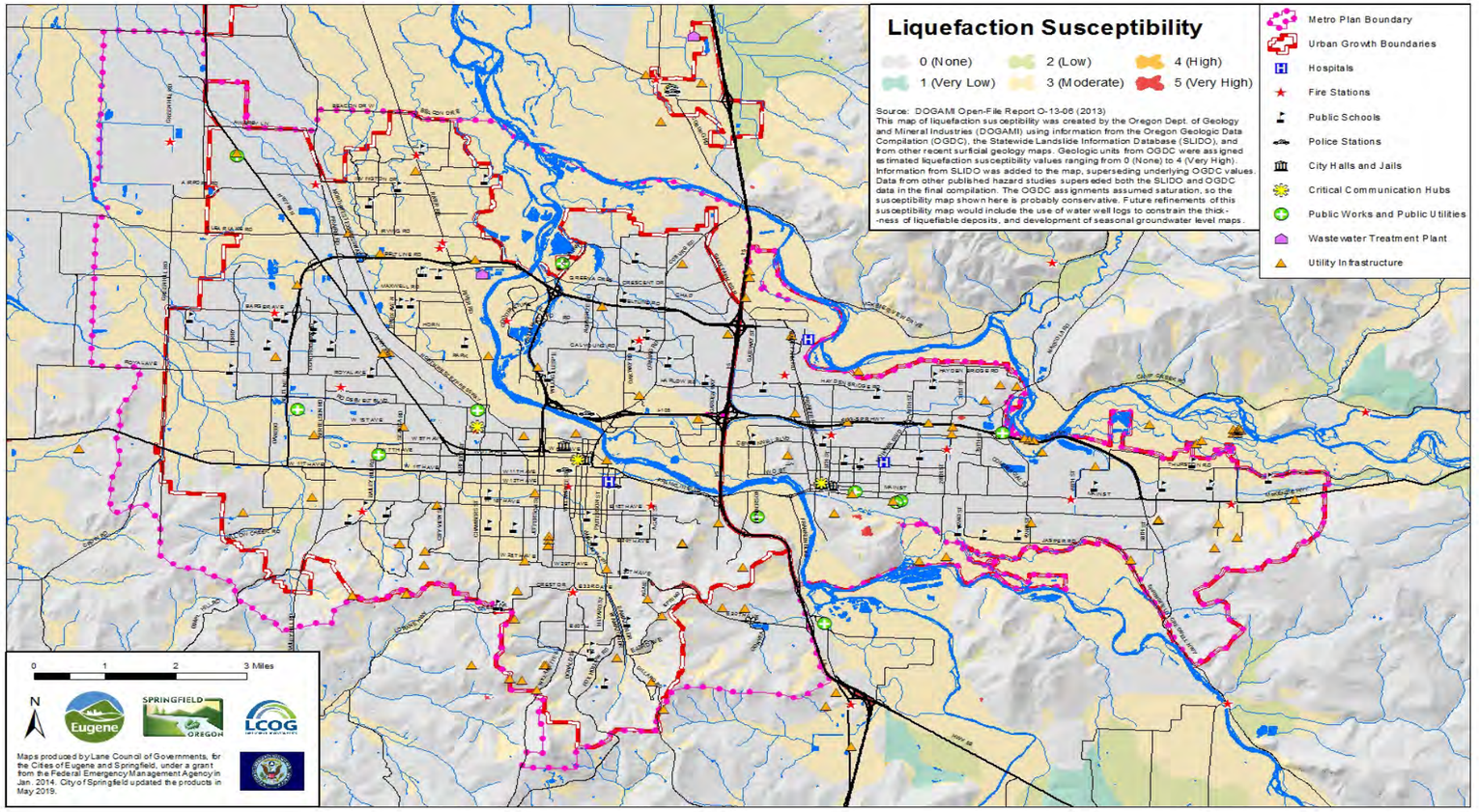
3.1.7 Shallow Landslide Susceptibility



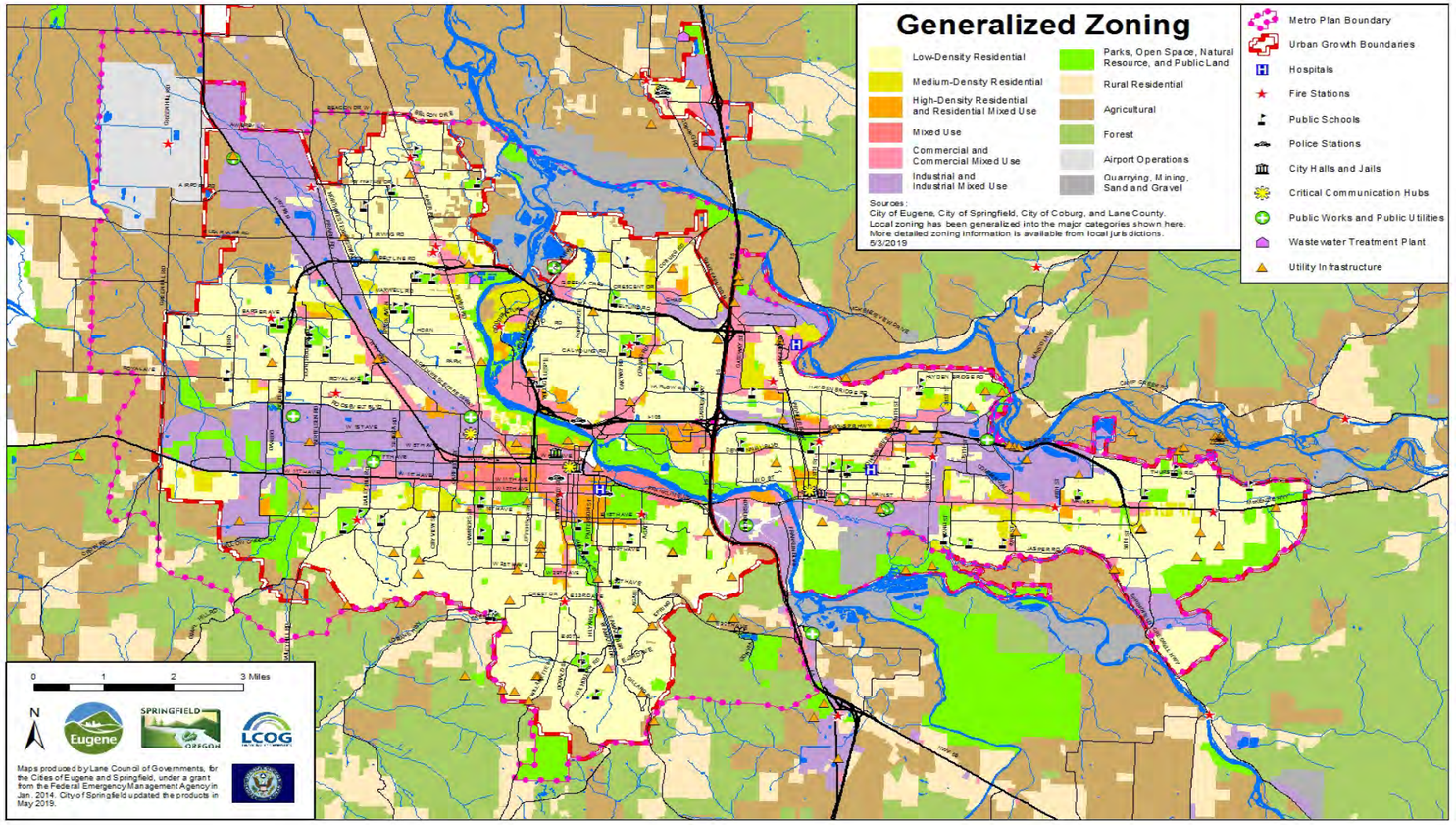
3.1.8 Deep Landslide Susceptibility



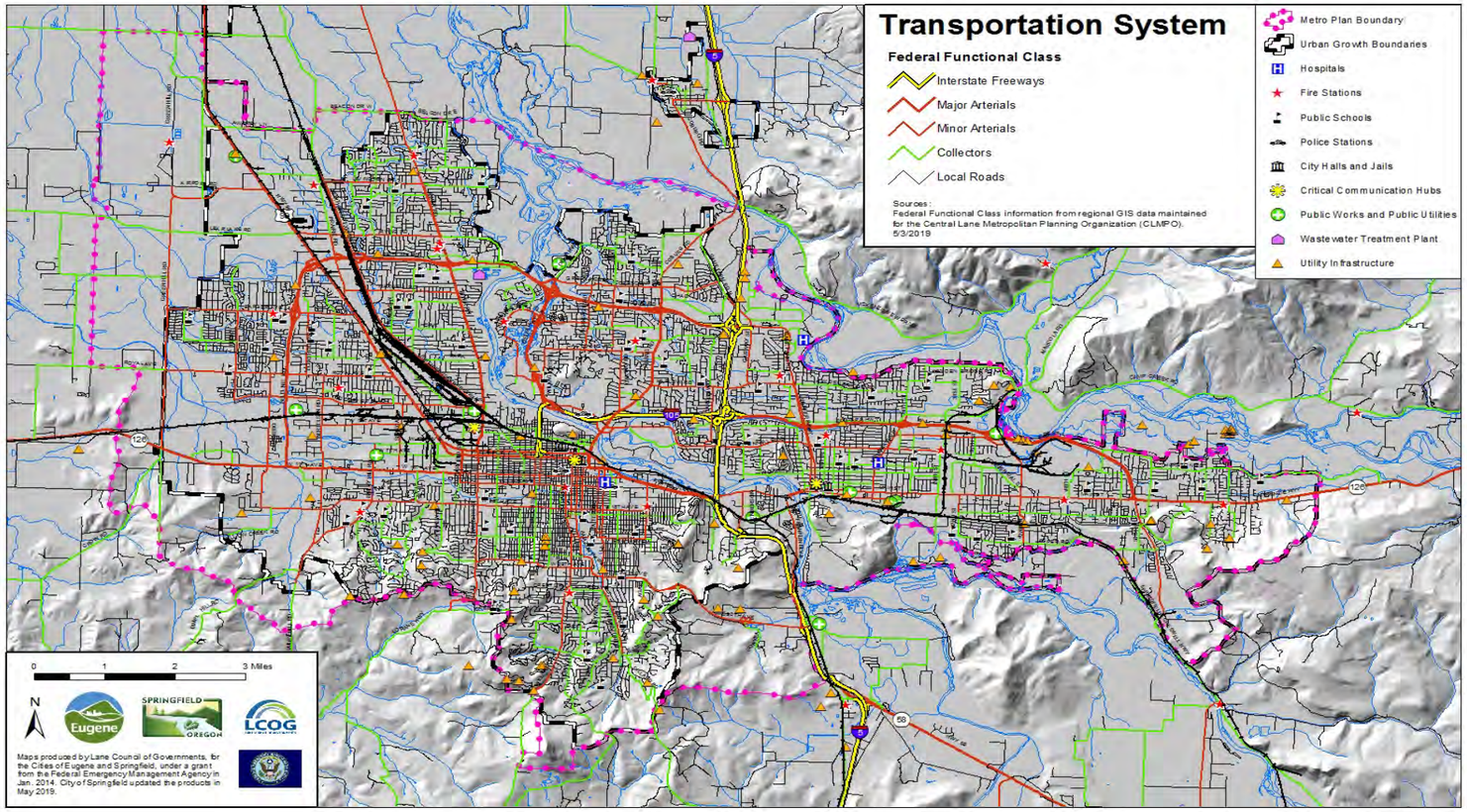
3.1.9 Liquefaction Susceptibility



3.1.10 Metro Land Use Zones



3.1.11 Metro Transportation System



3.2 Vulnerable Population Maps

The maps in this section describe the populations vulnerable to natural hazards and climate change for the Cities of Eugene and Springfield. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

A description of the map and source data is contained within each map.

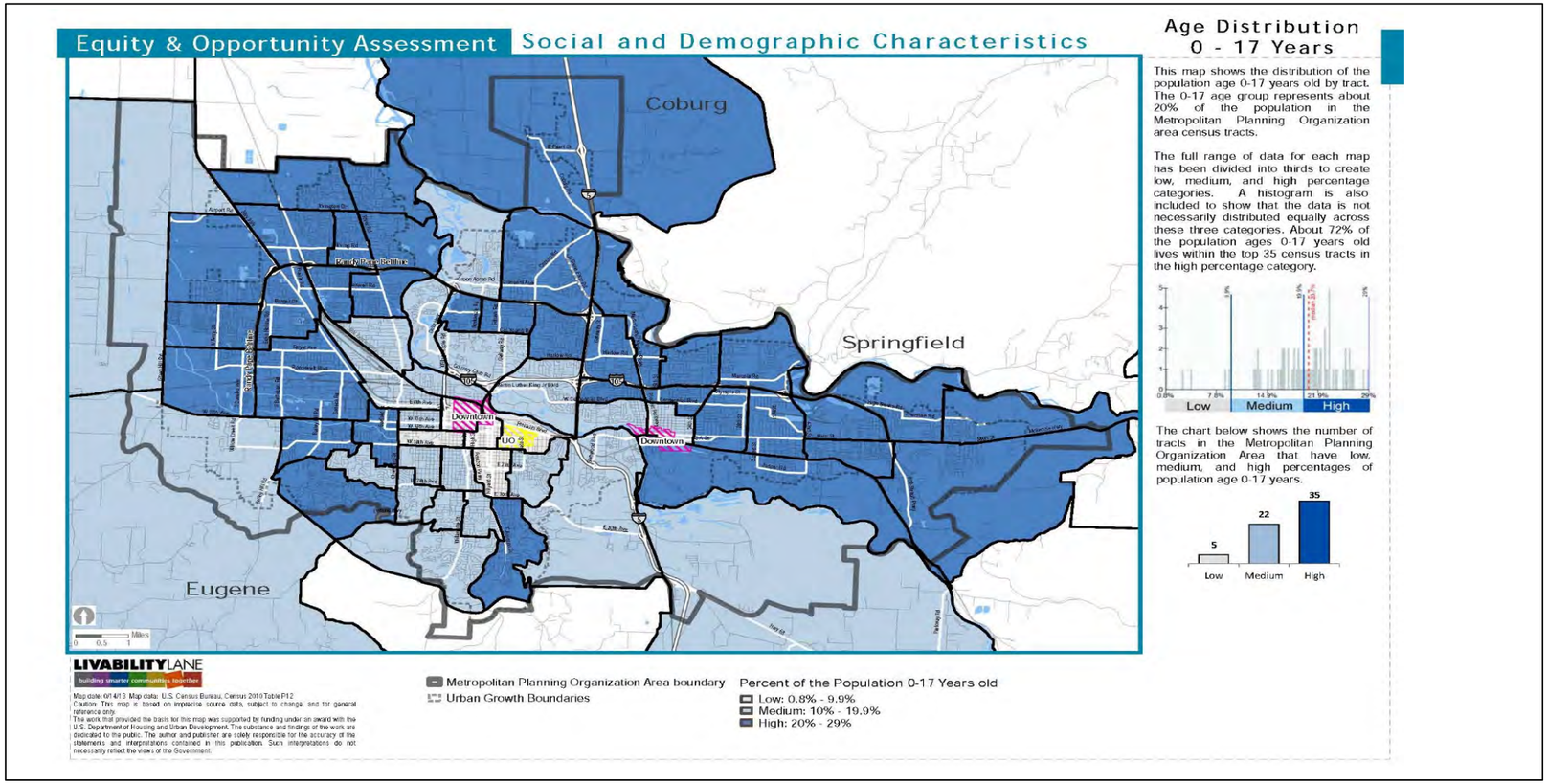
A complete description, research, and references for the source data is in Section 4.6 Social Vulnerability.

The following maps are included:

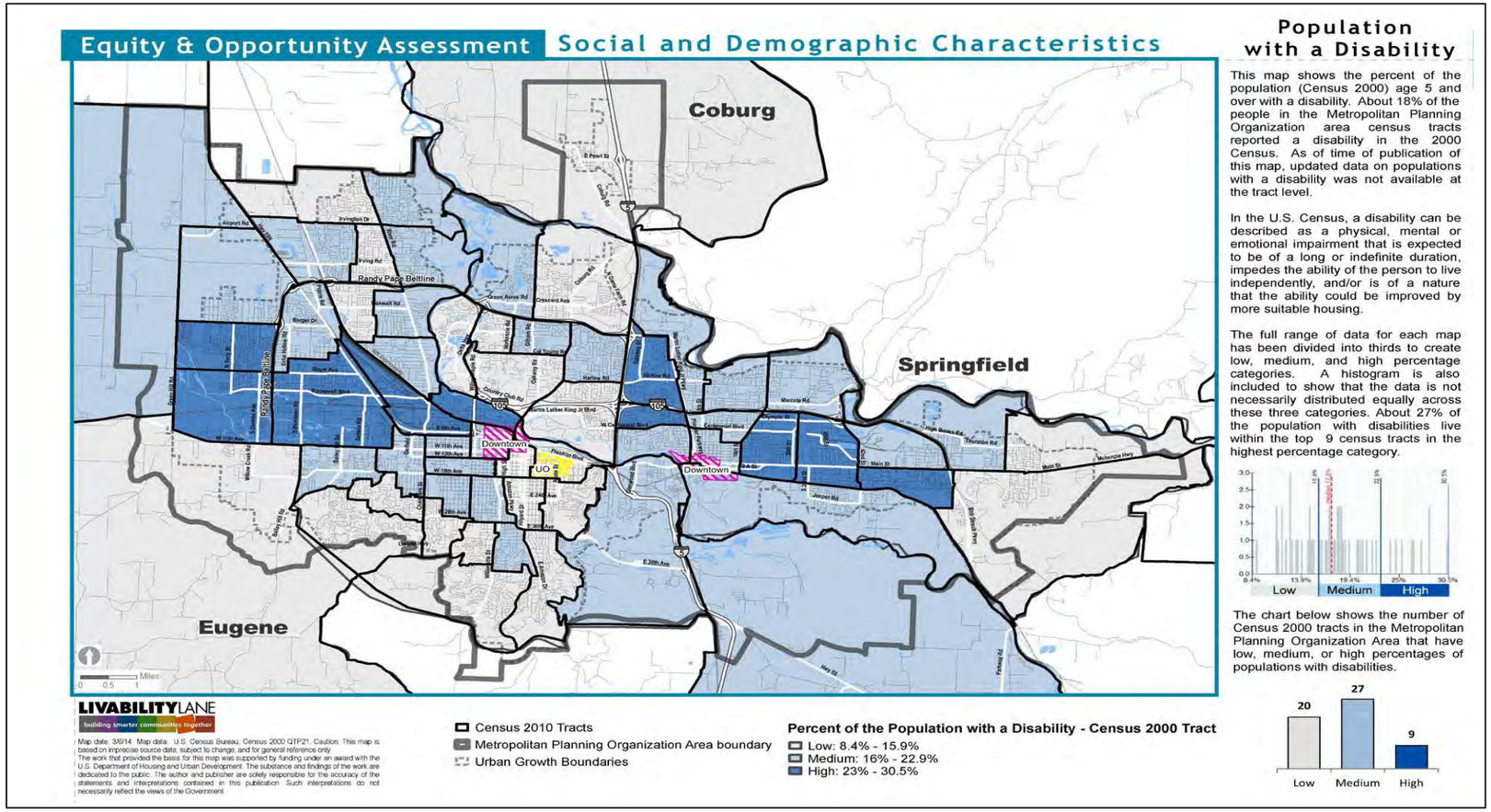
- Children 17 and Under
- Population Experiencing a Disability
- Female Headed Households
- Households Without Access to a Vehicle
- Income and Poverty: Economic Vulnerability
- Latino and Minority Households
- Manufactured Homes
- Households in Poverty
- Residents Living in Rental Housing
- Seniors 80 and Older

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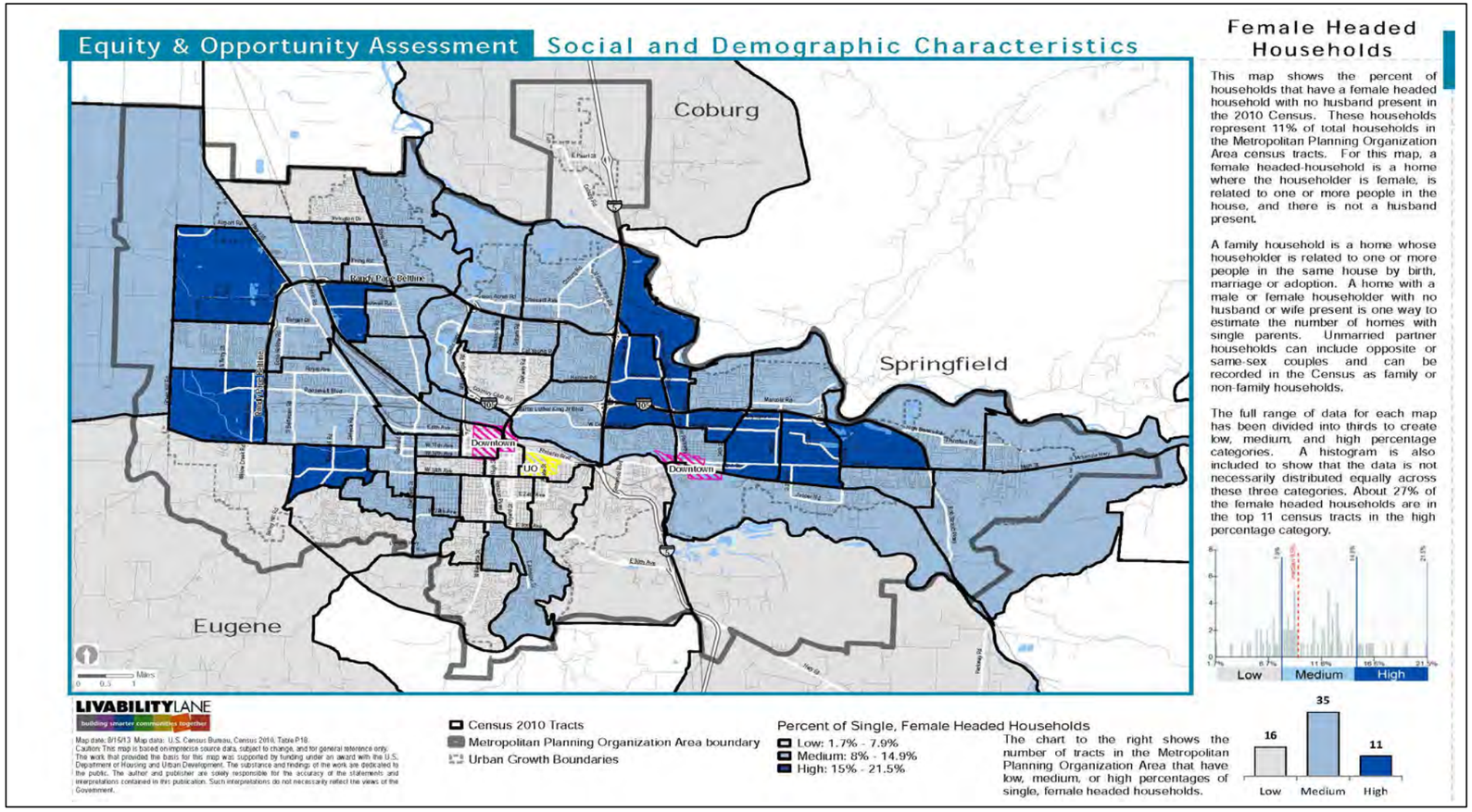
3.2.1 Children 17 and Under



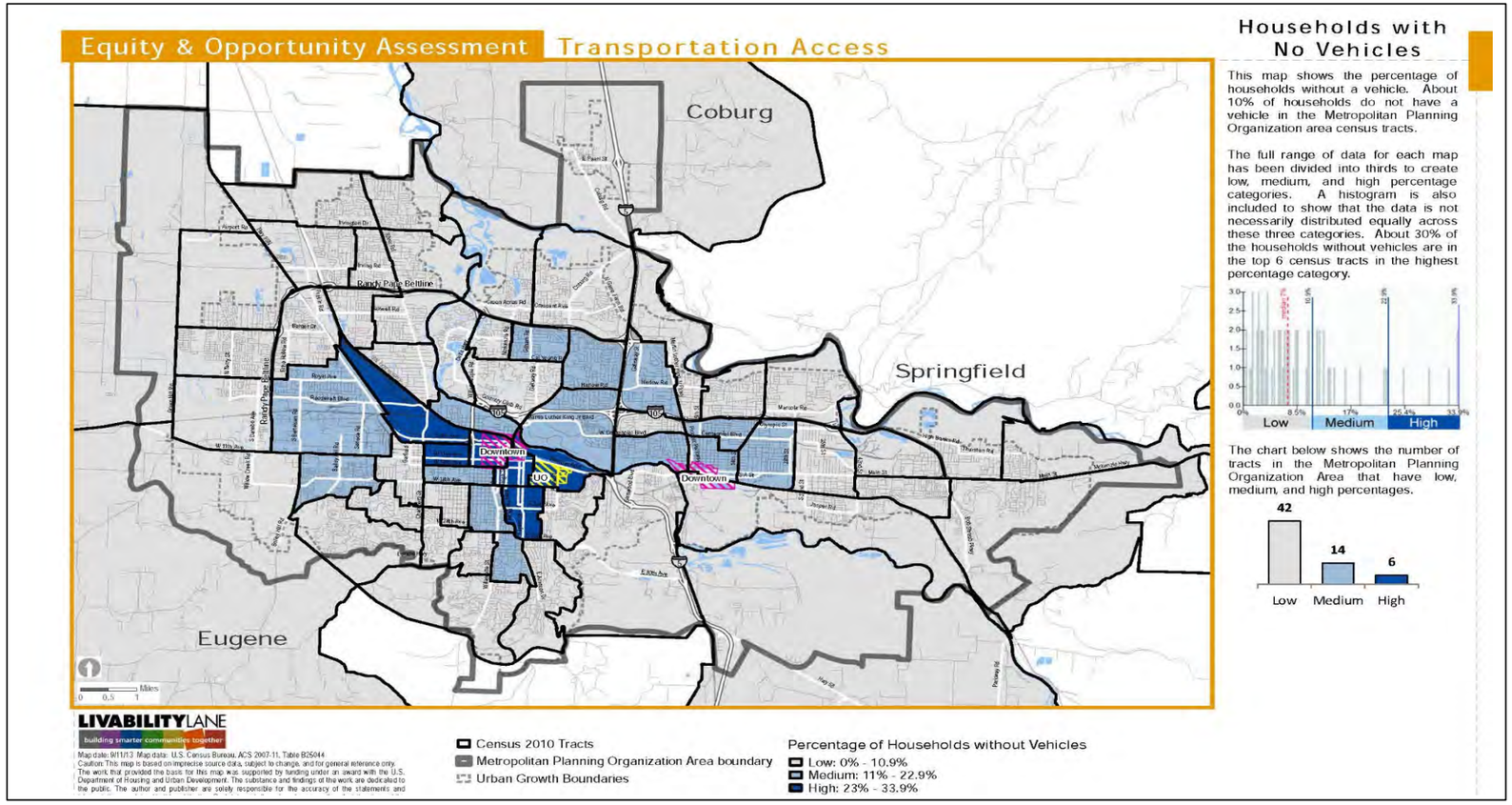
3.2.2 Population Experiencing a Disability



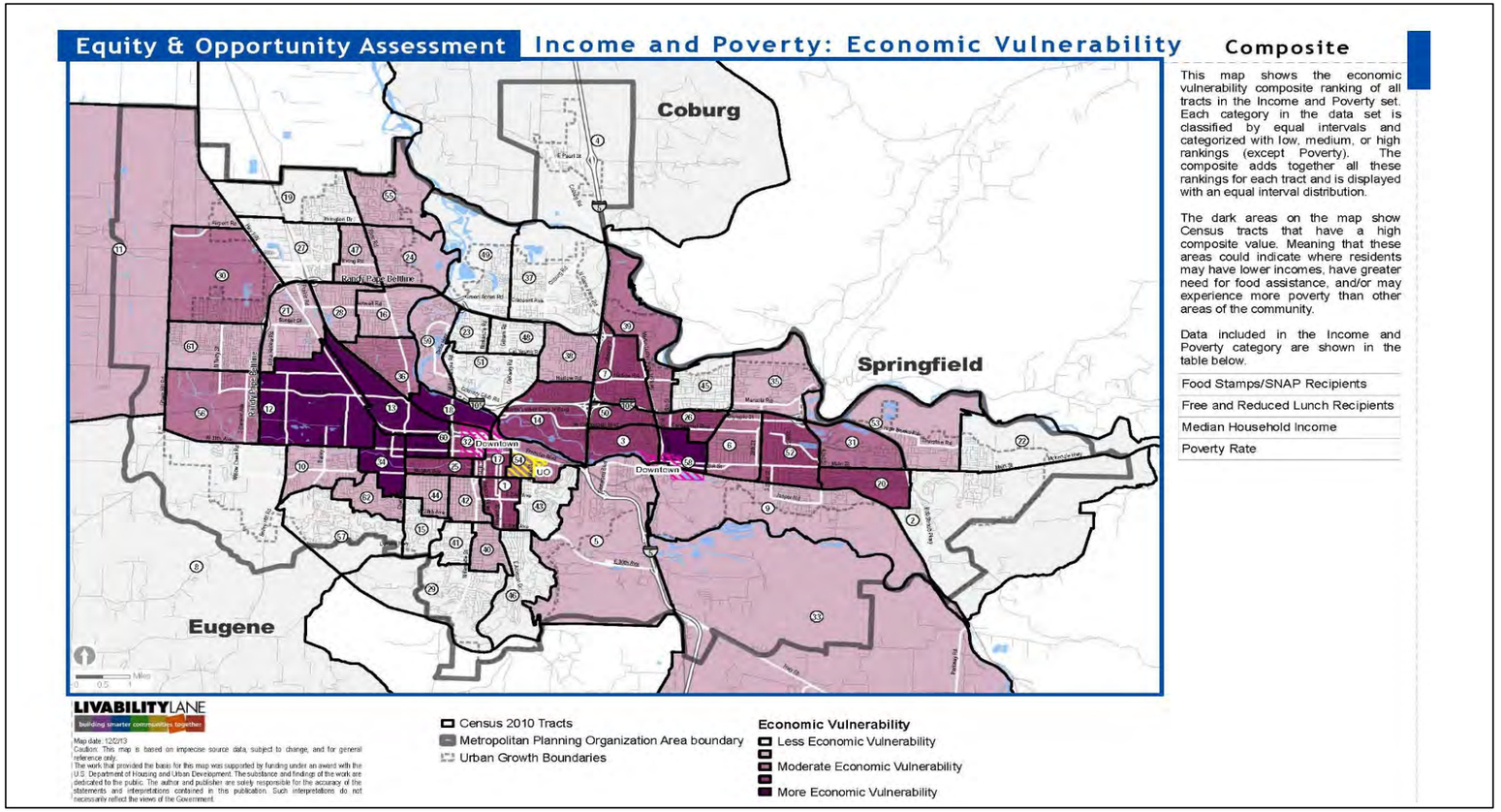
3.2.3 Female Headed Households



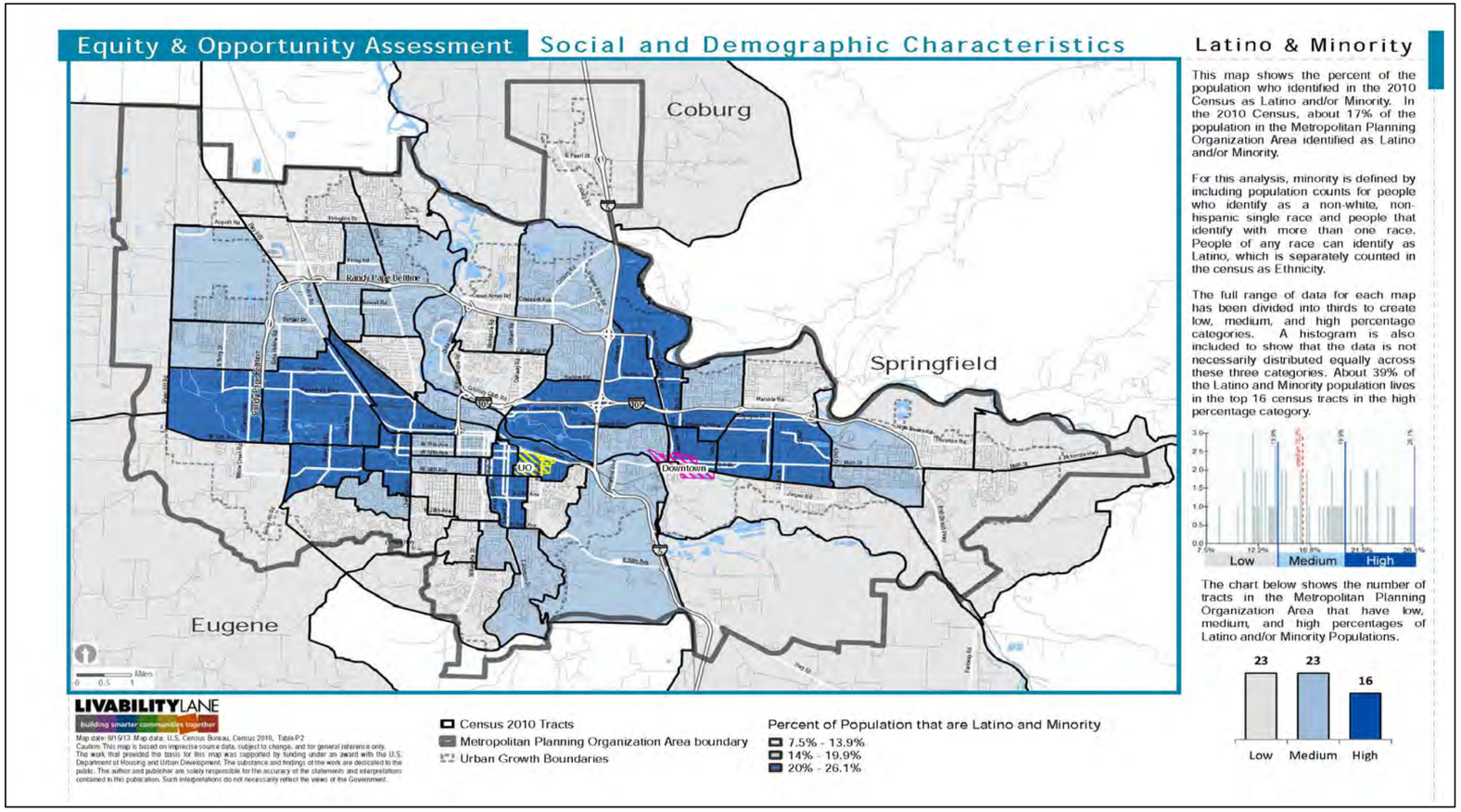
3.2.4 Households Without Access to a Vehicle



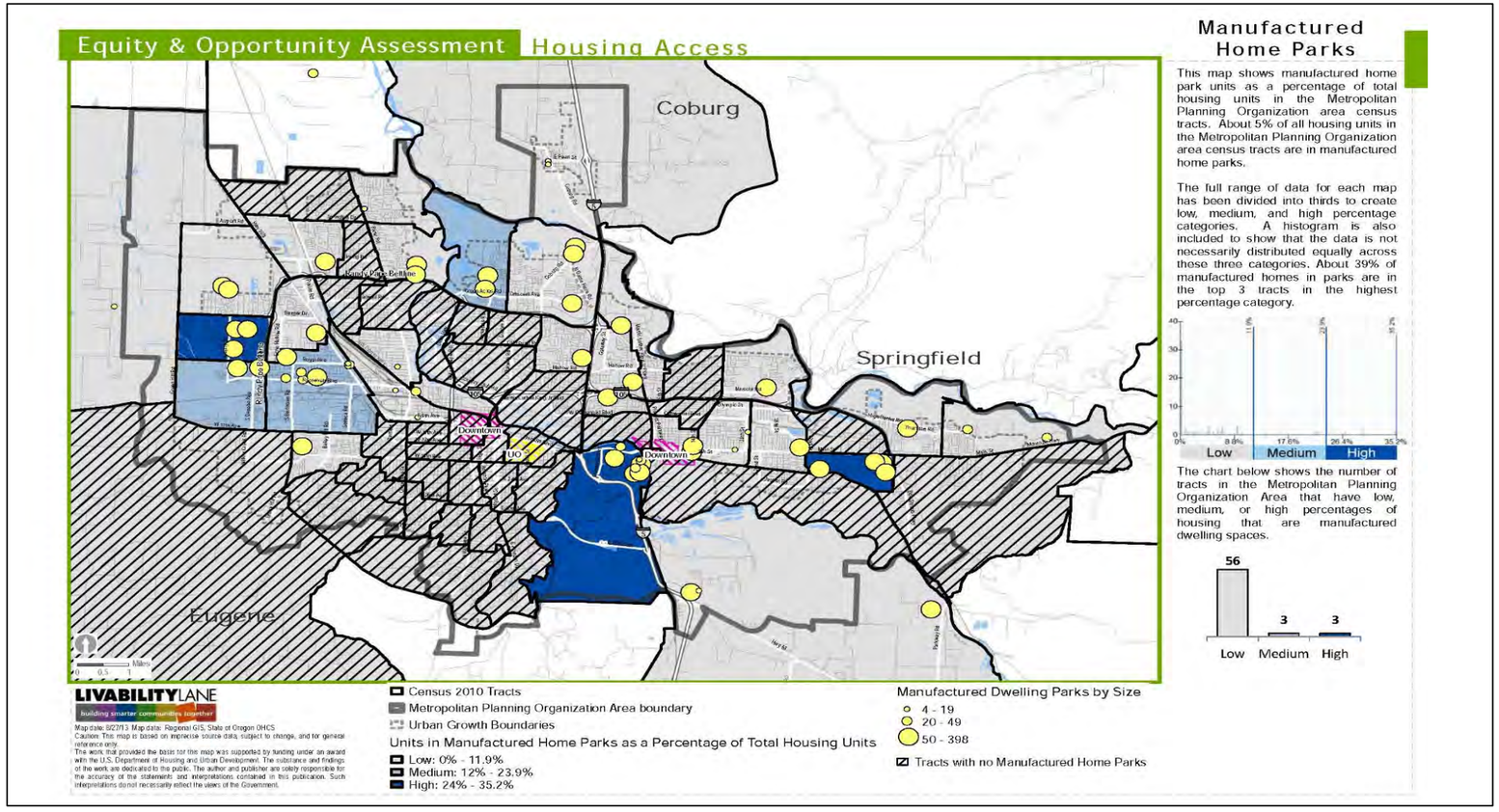
3.2.5 Income and Poverty: Economic Vulnerability



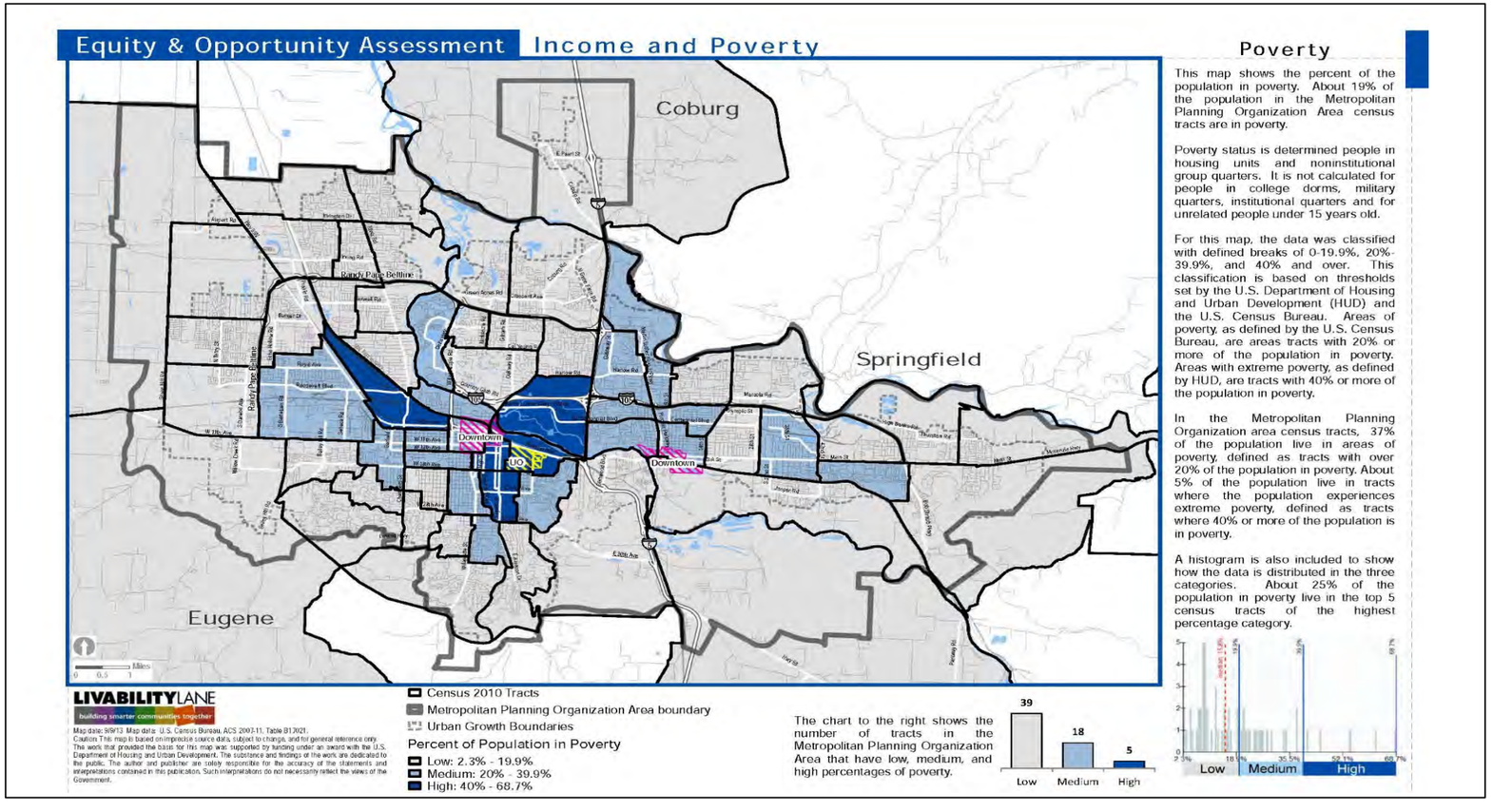
3.2.6 Latino and Minority Households



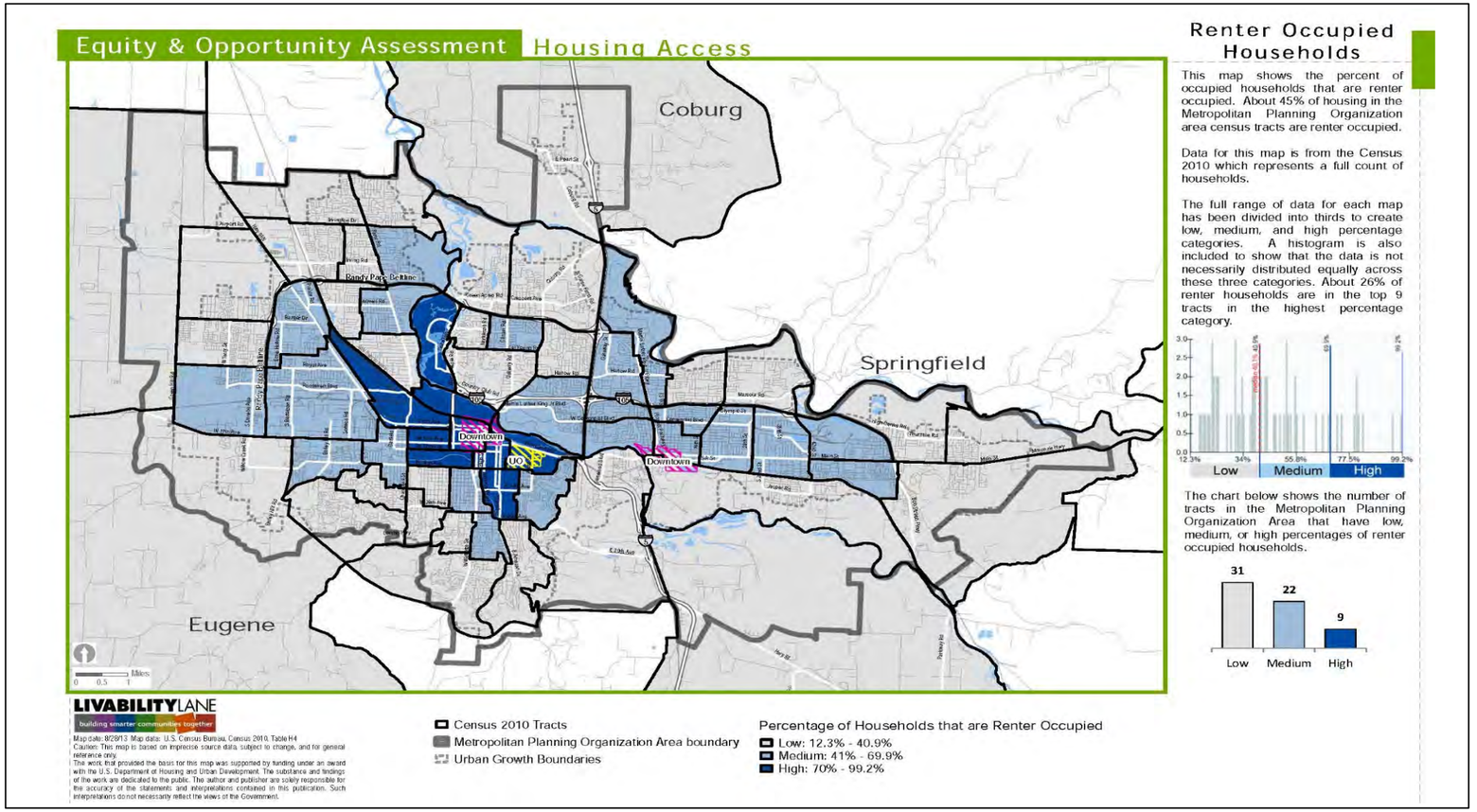
3.2.7 Manufactured Homes



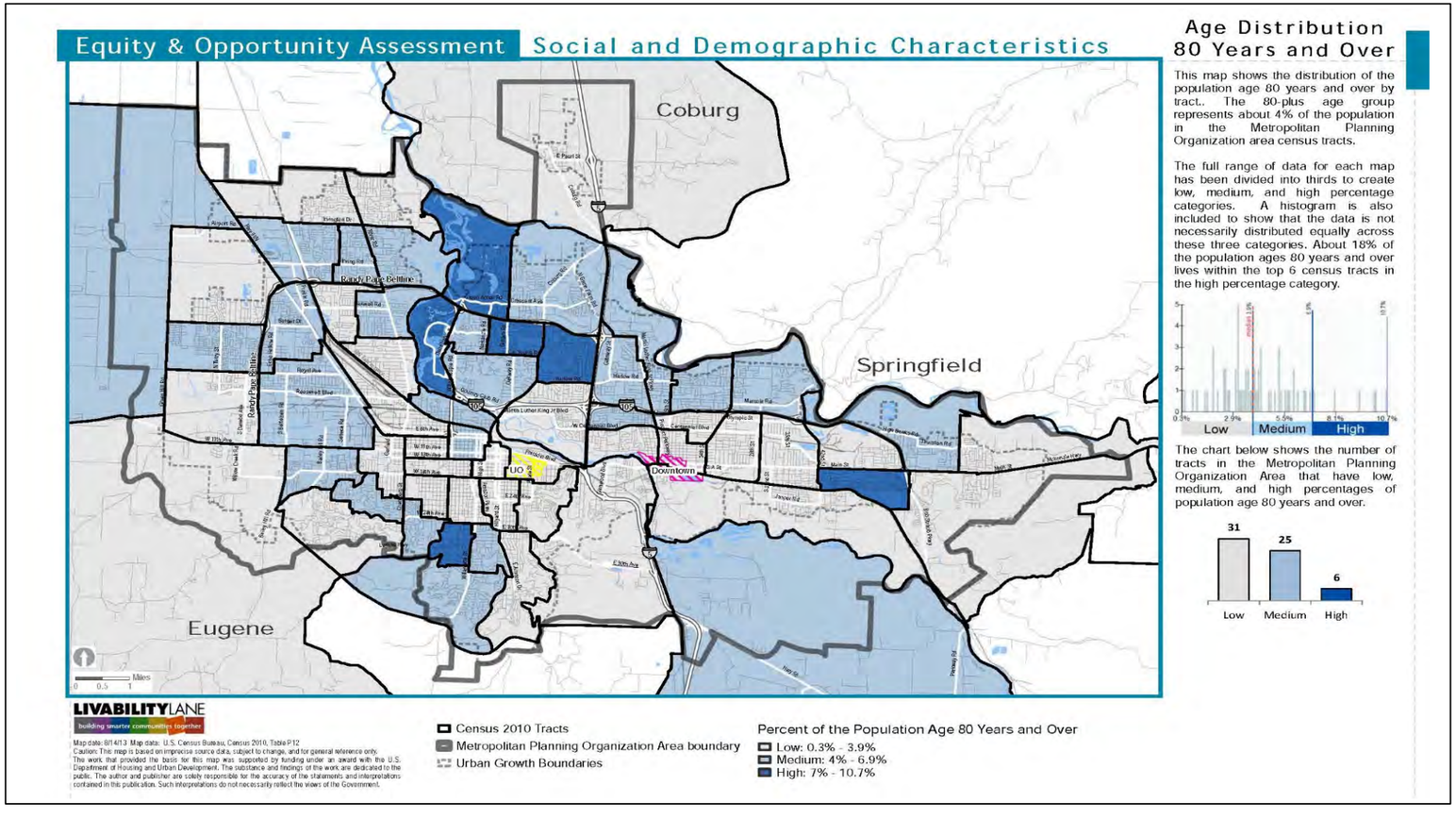
3.2.8 Households in Poverty



3.2.9 Residents Living in Rental Housing



3.2.10 Seniors 80 and Older



4 Risk and Vulnerability

4.1 Overview of Section 4

This section explains the processes and research data used to develop the mitigation actions in the 2020 NHMP.

Section 4.2 Provides an overview and description of the risk assessment process.

Section 4.3 Identifies the methodology for the development of probability, vulnerability, and capacity assessments found in Section 2 of the Eugene-Springfield Area Multi-jurisdictional 2020 NHMP

Section 4.4 Is a summary of the 2014 Regional Climate and Hazards Vulnerability Assessment.

Section 4.5 Includes the 2014 Sector research and system analysis process and conclusions.

Section 4.6 Includes the 2014 Population studies of social venerability, process, and conclusions.

Section 4.7 Contains the recent mitigation work stemming from the 2014 Eugene-Springfield Multi-jurisdictional NHMP.

Section 4.8 Explores the probability studies of impacts for cascading incidents.

Section 4.9 Discusses the prioritization of Mitigation Action Items.

4.2 Assessing Risk

The foundation of any Natural Hazards Mitigation Plan is the vulnerability and risk assessment.[80] Risk assessments provide information about the areas where the hazards may occur, the value of existing land and property in those areas, and an analysis of the potential risk to life, property, and the environment resulting from natural hazard events (Figure 4.1).

[80] United States. Department of Homeland Security. FEMA. *Local Mitigation Planning Handbook*. Washington, D.C.: FEMA, 2013. 5-1-20.



Figure 4-1. Source: USGS – The Partnership for Disaster Resilience Research Collaborative, 2006

This section explains what risk assessments are, provides a summary of the Eugene-Springfield Regional Climate and Hazards Vulnerability Assessment conducted in 2013, and a description of the additional vulnerability and risk assessment efforts incorporated into this plan.

4.2.1 What is a Risk Assessment?

A risk assessment consists of three phases (or levels): hazard identification, vulnerability assessment, and risk analysis (Figure 4-2). Risk assessments help to inform the local mitigation strategy. This assessment can be used to establish emergency preparedness and response priorities, for land use and comprehensive planning, and for decision making by elected officials, local departments, businesses, and organizations in the community.

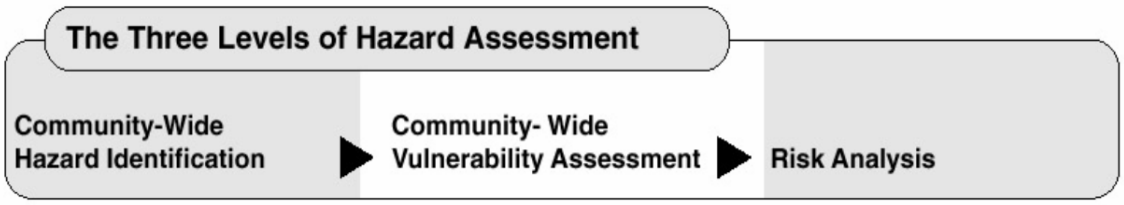


Figure 4-2. The Three Phases of a Risk Assessment. Source: Planning for Natural Hazards: Oregon Technical Resource Guide, 1998

The first phase, hazard identification, involves identifying the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves mapping of assets and hazards and is covered in Section 2, Hazard Descriptions, and Section 3.1, Hazard Maps. The outputs from this phase can be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation.[81]

The second phase, vulnerability assessment, combines the information from the identified hazards with an evaluation of the existing (or planned) infrastructure and the population exposed to a hazard. It attempts to predict how the identified hazards could affect various infrastructure and population groups. This phase can also assist in identifying necessary changes to building codes or development of regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk.[82] Section 4.4 describes the 2014 Regional Climate and Hazard Vulnerability Assessment.

The third phase, risk analysis, involves estimating the damage, injuries, and costs likely to occur in the geographic area for each identified hazard. Section 4.3 describes this phase.

This three-phase approach is conducted sequentially because each phase builds upon data from previous phases. However, gathering data for a risk assessment need not occur sequentially.

4.2.2 Components of Risk Analysis

Risk assessment for natural hazards includes three waited components. Each component is important to assessing risk and is described below.

> *Vulnerability* estimates are based on the percentage of the population or assets negatively affected by the natural hazard. Assets are any infrastructure or properties within jurisdictional boundaries or owned by one of the Plan Holders.
>
> *Probability* estimates are based on the frequency of previous events.
>
> *Capacity* is the community's ability to respond to, and recover from, a natural hazard event. Estimates for this variable are based on the potential number of outside resources needed to respond to, and recover from, a specific natural hazard event. Capacity is a new variable added in the 2020 Eugene-Springfield NHMP Risk Matrix.

[81] Burby, Raymond J. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities*. Washington, D.C.: Joseph Henry Press, 1999. 126.
[82] Ibid.

The following section further describes each of the components and the methodology for the assessment.

4.3 Probability, Vulnerability, and Capacity Assessment Process

This Section explains the methodology used to arrive at the conclusions found in Section 2 of this plan. It does not represent the analysis used to determine the risk for specific natural hazards threatening the Eugene-Springfield area.

The processes used by the Project Team to arrive at the conclusions of probability of future occurrence of natural hazards and the overall vulnerability and capacity to respond to each identified hazard was critical to prioritizing risk for the Eugene-Springfield area.

Table 4.1 provides the relative ratings used to assess the vulnerability to, probability of, and capacity of Eugene and Springfield to respond to, and recover from each natural hazard.

Table 4-1 Hazard Analysis Methodology

Vulnerability	
High	More than 70% of population or assets affected
Moderate	10% - 69% of population or assets affected
Low	Less than 9% of population or assets affected
Probability	
High	One incident likely within 0-35 years
Moderate	One incident likely within 35-75 years
Low	One incident likely within 75-100 years
Capacity	
High	No outside resources needed
Moderate	Less than 49 outside resources needed
Low	More than 50 outside resources needed

4.3.1 Natural Hazards

The natural hazards affecting the Cities of Eugene and Springfield, EWEB, Rainbow Water District, and SUB include, but are not limited to, droughts, earthquakes, extreme weather, floods, GMD, landslides, volcanoes, wildfires, and wind and winter storms. This plan also addresses civil unrest, dam or levee failures, epidemics, and hazardous material spills; four anthropogenic hazards closely connected to natural hazards. Referred to as cascading incidents, these hazards can occur independently, or because of natural hazards.

This plan does not address algal blooms, asteroids or meteors, and pandemics because:

- The risk is very low with extremely costly and limited mitigation activities available, thus mitigating the natural hazard is not warranted or is not practical; and/or
- The Cities of Eugene and Springfield do not have authority to mitigate the natural hazard.

Algal Bloom – Since the Cities get water from the McKenzie River, which is fed from reservoirs far outside their jurisdictional boundaries, or wells, the influence of natural systems and the operational aspects of the built system make this risk very low.

Asteroid or Meteor - Mitigating asteroid or meteor strikes is beyond the financial capacity of the Cities. Mitigation is largely left to the federal government.

Pandemic - Lane County Public Health Department is the primary agency responsible for mitigating pandemics.

4.3.2 Risk Matrix

Below is the Summary Risk Assessment Matrix (Table 4-2) providing an overview of each hazard and the associated vulnerability, probability, and capacity in the Eugene-Springfield area. See also Table 2-19 Risk Assessment Matrix.

Table 4-2 Summary Risk Assessment Matrix

Hazard	Vulnerability	Probability	Capacity	Risk Rating
Geomagnetic Disturbances (GMD)	High	High	Low	Very High
Earthquake	High	Moderate	Low	Very High
Winter Storm	High	High	Moderate	High
Drought	High	High	High	High
Wildfire	Moderate	High	Moderate	High
Windstorm	Moderate	High	Moderate	High
Flood Riverine	Moderate	Moderate	Moderate	Moderate
Landslide	Low	High	Moderate	Moderate
Flood Stormwater	Low	High	High	Low
Extreme Weather	Low	Moderate	High	Low
Volcano	Moderate	Low	High	Low

4.4 Summary 2014 Climate and Hazards Vulnerability Assessment

The following is a high-level overview of the Eugene-Springfield Climate and Hazards Vulnerability Assessment (Vulnerability Assessment) completed in 2014.
Using the findings of the assessment the 2020 NHMP Project Team looked at how each natural hazard may, or may not, be affected by climate change. Included in this research was our fossil fuel dependency. The 2020 Project Team used a long-range lens developed by the 2014 research to assist and influence development of mitigation action items needed to align with the hazards we face today. The lens considered future conditions to ensure mitigation actions taken now will not be obsolete or counterproductive in the next several decades.

Working from a standardized list of questions, the Vulnerability Assessment Team collected information about the adaptive capacity and sensitivity of each system to specific hazards.[83] The summary of findings below provides a description of key themes from across all surveyed community sectors.

These sector summaries include sector descriptions, an assessment of adaptive capacity, critical vulnerabilities, hazard specific sensitivities, and key sector interdependencies. The assessment does not reflect all hazards for all sectors.

4.4.1 Vulnerability Assessment - Hazards

The Vulnerability Assessment reflects sensitivities to earthquakes, floods, wildfires, winter storms, climate changes, and rising fuel prices. While flood and wildfire events have the potential to cause severe loss, damage, inconvenience, and drain emergency response resources in localized areas these hazards are not likely to result in systemic failures across multiple sectors. Both large earthquake and severe winter storm events have the potential to cause region-wide system failures and other cascading incidents.

Much of the region's adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during region-wide events such as a Cascadia Subduction Zone earthquake or severe winter storms such as the big snow incidents of 1969.

4.4.2 Earthquake-Specific Findings

According to the Oregon Resilience Plan 2013, all sectors (except for natural systems)

[83] United States. Oregon. City of Eugene. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed August 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=

are extremely vulnerable to a Cascadia Subduction Zone (CSZ) earthquake.[84] Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or solve in advance. Every sector will experience substantial failures and interruptions. Some possible impacts from a large earthquake can be anticipated and others may not. Unanticipated impacts and the sheer magnitude of a large earthquake will challenge local, State, and Federal preparedness and response efforts. Very few residents have first-hand experience with a major subduction zone earthquake, making the potential experience and results difficult for the population to fully prepare for and survive without significant resources from outside of the area.

Since the completion of the Vulnerability Assessment and the 2014 NHMP, both Eugene and Springfield conducted seismic evaluations on some critical infrastructure of concern.

4.5 Vulnerability Assessment – Process

In 2013 staff from the City of Eugene and the City of Springfield, with support from Oregon Partnership for Disaster Resilience (OPDR), convened meetings with representatives from each of the crucial sectors. The team met for six hours with each sector. Working from a standard list of questions, the team collected information about the adaptive capacity and sensitivity to specific hazards. The sector summaries below are the result of these interviews and reflect the conversations and thinking of the participants. The Participant List in Section 4.2.6 of the 2014 Regional Climate and Hazards Vulnerability Assessment catalogs those system managers who provided their expertise.[85]

The 2014 Assessment became the foundation of the 2014 Eugene-Springfield Natural Hazard Mitigation Plan and allowed staff to identify gaps in information. The Vulnerability Assessment continues to be the foundation of the 2020 Eugene-Springfield NHMP. The Risk Matrix (Table 4-2) has been, and will continue to be, modified as additional studies are completed to ensure this document is accurate.

The following sections describe the methodology and results of the 2014 Vulnerability Assessment in more detail. Figure 4-3 shows the process flow leading to ascertaining the results.

[84] United States. Oregon Seismic Safety Policy Advisory Commission. *The Oregon Resilience Plant: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami.* February 28, 2013. https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf.

[85] United States. City of Eugene. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed August 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=

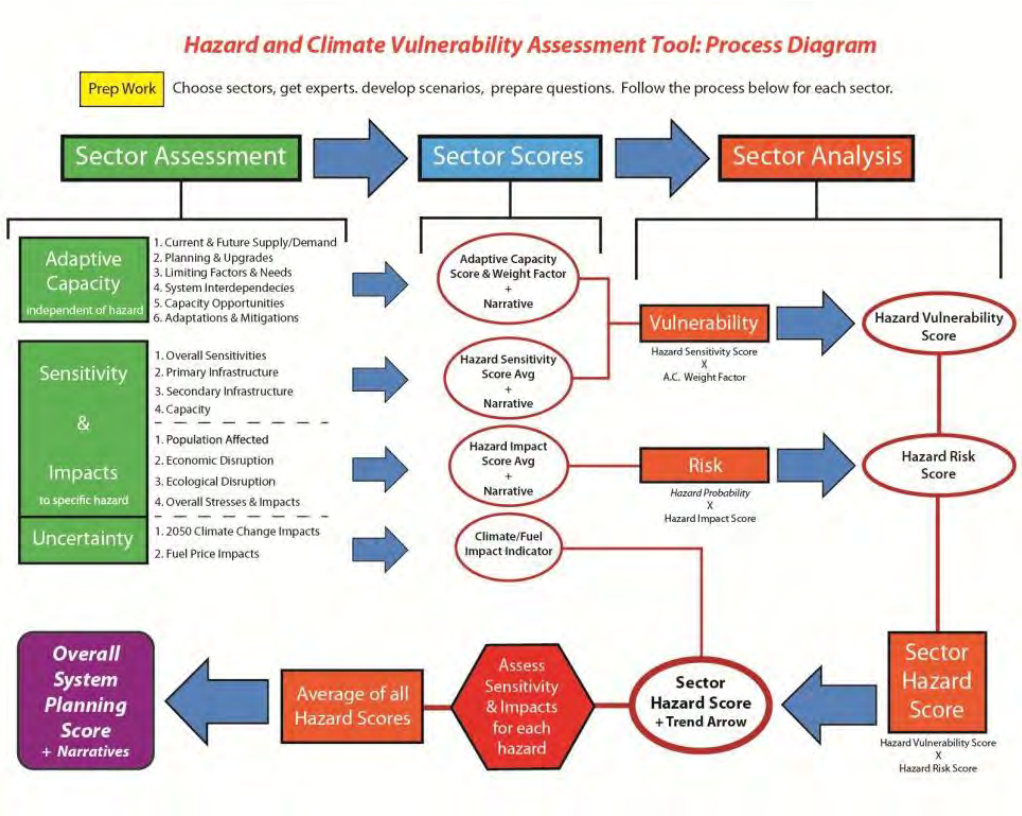


Figure 4-3. Process Diagram. Source: Oregon Partnership for Disaster Resilience

4.5.1 Crucial Sector Summaries

The crucial sector summaries from 2014 Regional Climate and Hazard Vulnerability assessment within the Eugene-Springfield metro area are:

- Drinking Water
- Health Care and Public Health
- Electricity
- Transportation
- Food
- Housing
- Communication
- Stormwater
- Wastewater
- Natural Systems
- Public Safety

4.5.2 Hazards

The sector summaries describe sensitivities to earthquakes, floods, wildfires, and winter storms, as well as, climate change, and rising fuel prices. Because of limited meeting time with system experts, the assessment does not reflect all hazards for all sectors. The flood scenario used does not include dam failure and associated inundation. It reflects river flooding due to precipitation and snow melt as well as some impacts of urban street flooding.

4.5.3 Geographic Boundaries

The geographic extent for this assessment was the area within both Cities' urban growth boundary. Due to the regional nature of some systems and hazards, several of the summaries briefly discuss areas beyond this boundary.

4.5.4 High Level Findings

Below is a list of high-level findings from the 2014 Assessment. This does not represent all lessons learned or all relevant information collected during the assessment. It is a short collection of the common themes from across multiple sectors.[86]

Overall

A. There exists a unique culture of collaboration and information sharing within our community. Overall, this increases our adaptive capacity in several areas. Information sharing is particularly visible within the health, public safety, electricity, and transportation sectors. There is a noticeable willingness to share information within other sectors as well, including both food and communications.

B. Participants voiced the value in hazard planning and exercises. Multiple participants in multiple sectors indicated they valued the assessment, and many stated their support for continuing this discussion and engaging in multi-sector planning and exercises.

C. Many sectors are heavily dependent on resources and decisions made outside of the Eugene-Springfield area, most notably the food, electricity, and fossil fuel sectors.

D. There are three sectors fundamental to the operation, maintenance, and restoration of all other sectors; those are electricity, fossil fuels, and transportation.

E. For several sector managers, finding and keeping qualified staff is an important concern over the next decade with few obvious solutions.

F. There is a high level of interdependence among sectors. Nearly every sector relies on several other sectors to function, with stormwater and natural systems being the least dependent on other sectors.

[86] United States. City of Eugene. Emergency Management. *Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

Hazard Specific Findings

While flood and wildfire events have the potential to cause severe loss and damage in localized areas, as well as, inconvenience for many and a drain on emergency response resources, these hazards are not likely to result in systemic failures across multiple sectors.

Much of our regional adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during region-wide events. Severe earthquake, winter storm, and, to a lesser degree, flooding events have the potential to cause region-wide cascading system failures.

Earthquake – Specific Findings

The impacts resulting from a 9.0 Cascadia earthquake[87] will be staggering. Results from the Vulnerability Assessment determined:

- Except for Natural Systems, all sectors are extremely sensitive to an earthquake of this magnitude.
- Very little has been done to prepare any systems, infrastructure, or personnel to handle the initial impact and ongoing response and recovery a Cascadia earthquake would require.
- Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or solve.
- Every sector will experience substantial failures and interruptions unfamiliar to the area and therefore difficult (though possible) to plan for.
- Very few locals have first-hand experience with a major earthquake, making it difficult to describe the potential experience and aftermath.

Winter Storm – Specific Findings

- Severe winter storms disrupt electricity and transportation, two of the three sectors all others depend upon; especially if the storm lasts more than a couple of days and has significant snow and/or ice accumulation.

Other Factors Considered

Dam Failure – Specific Findings

[87] See the Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Report to the 77th Legislative Assembly.

- While not the focus of this phase of the regional vulnerability assessment, participants repeatedly articulated a broad concern about the potential consequences of a dam failure.

Climate Change – Specific Findings

- Sectors most likely to experience negative impacts associated with climate change are natural systems, drinking water, and, to a lesser extent, food, electricity, and public health.
- Several sector managers in the drinking water, public health, and natural systems sectors are actively planning for the impacts of climate change. For the most part, other sectors are not.
- Most built community sectors don't appear to be at severe risk from projected climate-related impacts such as increasing temperatures, reduced snowpack, or changes in precipitation. However, the region's natural systems are highly sensitive to climate change and the resulting secondary impacts on community sectors and regional economy could become substantial.

Population

- While not a focus of this assessment, the added pressures from an increasing Willamette Valley population – adding 1.2 million people[88] in the valley over the next 25 years - will likely place further strain on fresh water resources. Stresses would be even greater if the population grows faster than projections suggest.

Fossil Fuels

- All but one group indicated their sectors rely heavily on fossil fuels and fossil fuel-derived products to operate. Health care, food, water, transportation, public safety, electricity, and housing appear most dependent.
- Natural systems is the only sector with a low dependency on fossil fuels to function
- There is not yet widespread planning for how sectors will manage the rising fuel prices anticipated in the coming decades. Most indicate added cost will be passed on to the customer. A notable exception is public safety, where sector managers indicated service levels would be reduced if there is no customer base or political will to absorb the increased costs.
- Nearly every group indicated the rate at which fuel prices increase makes all the difference. A slow increase in prices is manageable; a sharp increase in prices

[88] Environmental Migrants and the Future of The Willamette Valley: A Preliminary Exploration. USP 594: Planning in the Pacific Northwest Fall 2011

would strain sectors – some of them dramatically.

- Almost all backup power systems in Eugene and Springfield rely on diesel or natural gas transported by pipeline from Portland and beyond.
- There is an information gap regarding the fossil fuel sector. Because we were unsuccessful at convening representatives from this sector. There is a need for more information about how this sector operates. Due to this information gap the following studies were considered when conducting the 2014 Vulnerability Assessment.
  - As part of The Oregon Resilience Plan,[89] DOGAMI completed an Earthquake Risk Study for Oregon's Critical Energy Infrastructure Hub[90] containing useful information about the petroleum hub and its operability following an earthquake – with some implications for performance following other natural hazards.
  - The 2012 Oregon State Energy Assurance Plan[91] offers insights into the existing risks to energy infrastructure and systems statewide.

Based on these findings, the City of Eugene, in cooperation with several neighboring cities, applied for, and received a 2016 and 2017 Homeland Security Program Grant award via OEM to fund a Fossil Fuel Assessment Study for the majority of Lane County. This study is in progress and the results will be used to inform future NHMP updates.

4.5.5 Vulnerability Assessment – Scoring Summary

Introduction

This section describes the scoring results from the Eugene-Springfield 2014 Climate and Hazards Vulnerability Assessment. Ultimately, the results should help establish a course towards adaptive local and regional networks, and a more resilient community. These findings were used to inform the prioritization of infrastructure improvements and hazard mitigation strategies, as well as, for the development of natural hazard studies and climate adaptation strategies.

Adaptive Capacity

Adaptive capacity is a natural, built, or human system's ability to accommodate a new

[89] United States of America. Seismic Safety Policy Advisory Commission (OSSPAC). *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the next Cascadia Earthquake and Tsunami*. Salem, OR, 2013.
[90] United States. Oregon Department of Geology and Mineral Industries. *Earthquake Risk Study for Oregon's Critical Infrastructure Hub*. By Yumei Wang, Steven F. Barlett, and Scott B. Miles. O-12-09. 2013.
[91] United States. Oregon Department of Energy. Oregon Public Utility Commission. *Oregon State Energy Assurance Plan*. 2012.

or changing environment, exploit beneficial opportunities, and/or survive moderate negative effects. In short, it reflects a sector's ability to adapt to changing circumstances. The adaptive capacity questions were asked in a series of six sections. The score of each section was averaged, and then all six section scores were again averaged to obtain an overall adaptive capacity score. Table 4-3 contains the scoring system used in the adaptive capacity scoring.

Table 4-3 Adaptive Capacity Ranking Systems

Score	Ranking
1.00 – 1.99	Very Low
2.0 – 2.74	Low
2.75 – 3.24	Medium
3.25 – 3.99	High
4.00 – 5.00	Very High

Table 4-4 contains the average adaptive capacity scores for each alphabetically listed sector. Nine out of eleven sectors have a rating of medium. The range of the averaged scores was 2.31- 3.21, on a scale of 1.0-5.0. Note, the digit in the hundredth place does not translate to a level of precision—it is used to further differentiate the scores, so they may be ranked.

Table 4-4 Average Adaptive Capacity Scores

Sector	Average Adaptive Capacity	Rating
Communication	3.21	Medium
Drinking Water	2.99	Medium
Electric	2.94	Medium
Food	2.80	Medium
Housing	2.31	Low
Natural Systems	2.76	Medium
Public Health	2.75	Medium
Public Safety	2.52	Low
Stormwater	3.04	Medium
Transportation	3.12	Medium
Waste Water	3.17	Medium

Comparison

After the adaptive capacity scores were calculated, OPDR looked for ways to compare sectors. The adaptive capacity eventually became a multiplier influencing the overall sector planning score. The three metrics for comparison are:

- The lowest averaged score,

- The lowest self-evaluation score, and
- The greatest discrepancy between the scores (i.e. the difference between the scores provided by system managers and the scores assigned by the project team based on the narrative.)

Table 4-5 contains the lowest overall averaged adaptive capacity scores.

Table 4-5 Three Lowest Averaged Adaptive Capacity Scores

Sector	Average Adaptive Capacity
Housing	2.31
Public Safety	2.51
Public Health	2.75

Table 4-6 highlights the three lowest adaptive capacity scores based on self- evaluation.

Table 4-6 Three Lowest Self-Evaluation Scores

Sector	Average Adaptive Capacity
Housing	1.92
Food	2.08
Public Safety	2.33

Table 4-7 shows the systems with the greatest discrepancies between the average score and the self-evaluation score provided by system managers. Here a bigger percent difference indicates the system managers felt their sector was in better condition than the average scores would suggest.

Table 4-7 Three Systems with the Greatest Discrepancies Between Averaged and Self-Evaluated Adaptive Capacity Scores

Sector	Percent Differences in Estimated vs Average Adaptive Capacity
Natural Systems	-48%
Public Health	-15%
Transportation	-12%

Sensitivity and Impacts

The second half of the assessment measured the sectors' sensitivity to three hazards and their impacts. Earthquakes and floods were assessed for all sectors, then either wildfires or winter storms was assessed depending on which hazard was expected to be most detrimental to the system. Table 4-8 list the sectors hazard sensitivity scores. Table 4-9 list the sectors sensitivity to the impact from each hazard.

Table 4-8 Hazard Sensitivities				
Sector	**Earthquake**	**Flood**	**Wildfire**	**Winter Storm**
Drinking Water	4.67	2.00	4.14	
Public Health	4.25	3.63		
Waste Water	4.00	3.13		
Electric	4.13	2.38	2.75	
Transportation	4.25	2.88		
Stormwater	3.50	3.50	2.63	
Food	3.75	1.67		
Housing	3.67	2.67	2.50	
Communications	4.50	1.75		
Natural Systems	3.50	2.50	3.00	
Public Safety	4.50	3.55		3.83

Table 4-9 Hazard Impacts				
Sector	**Earthquake**	**Flood**	**Wildfire**	**Winter Storm**
Communications	3.75	1.50		
Drinking Water	4.40			
Electric	3.80	1.90	2.00	
Food	2.33	1.67		2.33
Housing	3.71	2.00	1.36	
Natural Systems	2.39	2.11	2.67	
Public Health	4.17	2.67		
Stormwater	4.18	3.36	1.64	
Transportation	5.00	2.00		5.00
Waste Water	4.00	2.75		2.25

Overall System Analysis

The adaptive capacity scores are combined with the hazard sensitivity and impact sensitivity scores to obtain an overall system planning score. Table 4-10 contains the overall system planning scores, ranked from highest to lowest. Drinking water, transportation and public safety received the highest total scores based on this assessment, suggesting they should be considered for prioritization for hazard mitigation activities in Eugene and Springfield. The absolute numbers do not imply greater or lesser significance. Rather, the numbers should be used to provide a method to rank sectors in comparison with each other.

Table 4-10 System Planning Scores	
Sector	**System Planning Score**
Drinking Water	61.6
Transportation	47.0
Public Safety	42.2
Public Health	41.1
Waste Water	31.7
Stormwater	30.7
Electric	25.7
Communications	24.5
Housing	22.4
Natural Systems	21.7
Food	19.7

Conclusion

When considering sectors to address for hazard mitigation, emergency managers, planners, system managers, and public officials should bear in mind the results of this assessment. Importantly, the housing and public safety sectors experience relatively low adaptive capacity compared to other sectors. Overall, the drinking water, transportation, and public safety sectors are in greatest need of attention.

4.6 Social Vulnerability

The following tables (Tables 4-11 and 4-12) summarize peer-reviewed research indicating what variables are most important when considering populations vulnerable to both natural hazards and climate change. These populations are particularly important for natural hazards planning as they are often disproportionately affected by hazard events. Therefore, it is important planners pay attention to the locations and characteristics of these populations.

The associated maps (Section 3.2.1 - 3.2.10) of the Eugene-Springfield metro region are available within Section 3 of the 2020 Eugene-Springfield NHMP. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

Table 4-11 Natural Hazard Social Vulnerability Factors		
Number	**Indicator**	**References (listed below)**
1	Age	1, 2,3,4,5
2	Income	1,2,6
3	Residence	2,6
4	Tenure	2, 7
5	Employment	8
6	English Skills	7, 8

7	Household Type	4,5,7,8
8	Disability	2,8
9	Home Insurance	
10	Health Insurance	
11	Debt and savings	
12	Car	1,5,8
13	Gender	2,5,9
14	Injuries (hazard specific)	10
15	Residence Damage (hazard specific)	10

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3	P. Buckle. A framework for Assessing Vulnerability. *The Australian Journal of Emergency Management*, 13(4):21–26, 1995.
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5	K. Granger, T. Jones, and G. Scott. Community Risk in Cairns: a multi-hazard risk assessment. Technical report, Geoscience Australia, Commonwealth Government of Australia, Canberra, Australia, 1999.
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7	B. H. Morrow. Identifying and Mapping Community Vulnerability. Disasters, 23(1):1–18, 1999.
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9	M. Fordham. The Place of Gender in Earthquake vulnerability and mitigation. In Second Euro Conference on Global Change and Catastrophic Risk Management - Earthquake Risks in Europe, Laxenburg, Austria, 2000.
10	Federal Emergency Management Authority. HAZUS 99 Technical Manual. Technical report, Federal Emergency Management Authority Agency, (FEMA), United States Government, Washington, USA, 1999.

Table 4-11. Natural Hazard Social Vulnerability Factors. Source: Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S., 2004. Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *Geoscience Australia Record 2004/14.* Table title: *The thirteen socio-economic indicators and two hazard indicators used in this study to establish the vulnerability of a person within a household to natural hazard impacts.*

Table 4-12 Climate Change Social Vulnerability Factors

Category	Vulnerability Factor(s)/Vulnerable Population	References
Socio-economic	Low Income	1,2, 3, 4, 5
	People of color (ethnic minorities)	3, 5, 7
	Women	5
Age	Elderly	5
	Children	5
Housing Conditions	Home renters	4
	Flammable roof, vegetation within 10 meters of home	8, 9
Isolation	Language ability/linguistic isolation	10
	Isolation from public agencies for fear of interacting with public agencies	10
	Geographic isolation	11
Other	No health insurance	12
	No vehicle	13
	Disabled (or family member disabled)	5, 13
	Institutionalized populations	11, 14

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2	Fothergill, A., and L. Peek. 2004. “Poverty and Disasters in the United States: A Review of Recent Sociological Findings.” Natural Hazards 32:89–110.
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14	Caruson, K., and S. A. MacManus. 2008. "Disaster Vulnerabilities: How Strong a Push Toward Regionalism and Intergovernmental Cooperation?" The American Review of Public Administration 38 (3): 286–306. http://arp.sagepub.com/content/38/3/286.full.pdf+html.

Table 4-12. Climate Change Social Vulnerability Factors. Source: Social Vulnerability to Climate Change in California. A white paper from the California Energy Commission's California Climate Change Center. Prepared by Pacific Institute, July 2012

4.7 City of Eugene (Current Work)

Since the adoption of the Eugene-Springfield Multi-jurisdictional NHMP in 2014 many mitigation actions have occurred in both cities. The Project Team recognized and was influenced by the continued mitigation progress, support, and trends when determining the proposed 2020 mitigation action items. The following has occurred since in the past five years.

City of Eugene-owned buildings were evaluated utilizing either Federal Emergency Management Agency's (FEMA) Rapid Visual Screening (RVS) or the American Society of Civil Engineers (ASCE) standard methodology.

For General Fund facilities, 536,014 square feet (ft^2) out of 743,572 ft^2, or approximately 72%, of the structures were evaluated. Additionally, 126,225 ft^2 of Public Works', 48,000 ft^2 of Planning and Development Departments', and 25,800 ft^2 of the Eugene Airport, which included the terminal and fire station, facilities were evaluated. Currently, Metropolitan Wastewater Management Commission facilities are being evaluated.

In the past five years 100% of Essential Facilities (Fire and Police) and non-Essential facilities identified as shelters according to an Intergovernmental Agreement (IGA) with the American Red Cross have been evaluated. Three fire stations were retrofitted to meet current seismic standards totaling 13,979 ft^2. No non-essential facilities have been retrofitted in the last five years. Three recreation facilities are slated to be expanded and renovated by 2022 and will be evaluated and upgraded to the 'Life Safety' level for seismic stability.

4.7.1 City of Springfield

The City of Springfield City Hall and several city-owned bridges were evaluated using ASCE standard methodologies. Some of the seismic retrofits to City Hall have been completed, while the remaining retrofits for this building and the bridges are delayed pending additional funding.

4.7.2 Winter Storm-Specific Findings

Severe winter storms disrupt two of the three sectors all others depend upon: electricity and transportation. The disruption is more pronounced if the storm lasts more than a few days and if snow or ice accumulation is significant. The City of Eugene, in conjunction with the National Weather Service, concluded the Central Lane County winter storm interval is one every 2.9 years.

4.7.3 Landslide-Specific Findings

Since the 2014 NHMP, DOGAMI conducted a thorough study using the latest technology to create detailed, usable maps, and analyses on the level and location of the landslide hazard and risk to infrastructure using FEMA Risk Mapping, Assessment, and Planning (Risk MAP) funds.[92] The Eugene-Springfield metropolitan area was the primary focus of the study.

Landslides can stand alone as a natural hazard or be a cascading event triggered by winter storms, heavy rain, earthquakes, or technological threats. Major findings from the study include:

- 700 existing landslides were identified, including historic landslide points, covering 6% of the study area;
- More than 4,500 residents live on existing deep-seated landslides; and
- Approximately $476 million worth of buildings are located on existing deep landslides.

[92] United States. Oregon Department of Geology and Mineral Industries. *Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon*. By William J. Burns, Nancy C. Calhoun, Jon J. Franczyk, and Gustavo Monteverde. 2018.

The highest risk areas identified were the south hills of Eugene and southeast hills of Springfield. The report identified existing structures located on deep landslides as the primary landslide hazard in the study area. Report recommendations included:

- Increased public outreach for property owners to heighten awareness of the hazard and precautions needed, through mitigation, to reduce the risk posed by landslides;
- Incorporate landslide hazard maps and risk reduction strategies into community planning efforts; and
- Create a landslide emergency response plan to better prepare and react to a landslide occurrence.

Over the course of the next five years Emergency Management and Planning staff will analyze the study to determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.

4.7.4 Lifelines and Critical Bridge Evaluations

In 2017 the Oregon Department of Transportation (ODOT) has asked Lane County to complete these two tasks:

1. Review locations of seismically vulnerable bridges along the ODOT lifelines and identify alternate routes that can be used if an earthquake occurs before the necessary bridge work is completed. Assess the feasibility, seismic vulnerability and corrective cost of these alternate routes.

2. Identify local lifelines and assess corrective costs of any vulnerable bridges. Prioritize the replacement/rehab work to remove seismic vulnerabilities in a reasonable timeline. There will be priorities placed on bridges along these routes needing retrofitting or replacement. Some of these bridges can be avoided using alternate routes, saving money for other bridges that cannot be avoided. *(See the Lane County Bridge Resiliency in the Event of an Earthquake Study, by the Engineering and Construction Services Division 4/1/2017.)*

The Cities of Eugene and Springfield understand the main ODOT routes in our area are Hwy 58 to I-5; which will be critical lifelines during a Cascadia event. However, just as critical will be the need to get equipment, personnel, and supplies from these routes to the City's internal transportation routes, supplying our Points of Distribution and Staging Areas. To this end we selected the bridges for upgrades to the ODOT routes. The Cities of Eugene and Springfield can support each other in many ways, but without these critical lifeline bridges we are virtually cut off from one another. The most glaring example is the only two major hospitals that support the area reside in the City of Springfield. This alone will put more than 165,000 people without access to a major medical facility.

The following is the recommendation submitted to the State on April 1, 2017:

The conclusions of this report identify the Eugene and Springfield's minimum number of bridges needed to be operational after the Cascadia Seismic Event.

Methodology

Eugene and Springfield have identified detour routes around most bridge structures on their critical response routes. Detour routes are not presented in this report. This report addresses only the critical route bridges lacking realistic detour routes.

Several assumptions set the context of this memo:

1) ODOT has determined that HELP will come from Eastern Oregon via HWY 58;
2) Overcrossings over I-5 that may collapse onto I-5 will be driven around or pushed out of the way;
3) Beltline Interchange at I-5 is anticipated to be operational directly after the seismic event;
4) Riverbend Peace Health and McKenzie-Willamette Hospital will be operational and the triage point for mass casualties;
5) The Eugene Airport will be a critical lifeline for transportation, response personnel and equipment, medical personnel, pharmaceuticals, and water purification needed almost immediately (and long into the recovery effort) after the event;
6) There will be no help from Salem or Portland because they will be caught in the same event; yet Eugene-Springfield will be the gathering point for refugees from the coast and the south.
7) Eugene Springfield have a combined Fire and EMS department needing access across the Eugene, Springfield, and surrounding area.

Conclusion

Bridges that must be Operational after the Event
1) 08638: Beltline over Willamette River – Sufficiency rating= 74. Cost to upgrade = $2,000,000.
2) 08705: Debrick Slough WB On Ramp to Beltline – Suff [Sufficiency] rating = 64. Cost to upgrade = $450,000.

The following three bridges are critically needed to bring HELP from I-5/HWY 58 to the southern end of Springfield and Eugene. The Glenwood area is planned to be a freight off-load and redistribution point.
1) 016329: Glenwood Blvd over UPRR [Union Pacific Railroad] – Suff [Sufficiency] rating = 93. Cost to upgrade = $300,000.
2) W6099C: Franklin Blvd over HWY 1 W and UPRR [Union Pacific Railroad] – Suff [Sufficiency] rating = 55. Cost to upgrade =$2,000,000.
3) 08051: Main Street over Willamette River (Springfield) - Suff [Sufficiency] rating =

76. Cost to upgrade = $2,250,000.

There is one bridge in each City that provides a critical intercity link over a river or a HWY that needs to be operational to access a hospital or other vital resource:
1) 6648: Ferry Street Bridge over the Willamette (Eugene) – Suff [Sufficiency] rating = 31. Cost to upgrade $2,000,000.
2) 09596: Mohawk Blvd over HWY 126 (Springfield) - Suff [Sufficiency] rating = 64. Cost to upgrade = to be determined.

The 5 high priority bridges in the list above total $6,700,000. The phase 2 intercity bridges above are estimated at $2,000,000 plus.

4.8 Impacts – Cascading Incidents

When a natural occurrence causes a man-made technological disaster, it is referred to as a natech incident. Large-scale natech impacts are rare, so determining the exact likelihood of their occurrence is difficult. Nevertheless, they may occur, so careful consideration of how Eugene and Springfield's natural hazards could cause them is imperative to understanding the risks faced by the Cities. To accomplish this, data and incidents throughout modern history, across the United States, and in some cases around the world, were reviewed. For each hazard the likelihood of it causing one of the four cascading incidents was evaluated and categorized in Section 1 (Table 1-1 and 1-2). A summary of the natech evaluation process is included below and a review of the natech impacts for each natural hazard are in Section 2.

4.8.1 Civil Unrest

Research suggests natural disasters increase the risk of civil unrest by at least 30% especially when there is motive, incentive, and opportunity for such actions (Figure 4-4). The exact number of civil unrest incidents induced by a natural hazard is hard to determine due to different reporting methods, classifications, and societal compositions. For this plan, significant civil unrest is considered as any large-scale illegal incident to which law enforcement would have difficulty responding. This was weighed against the area's incentives, motives, opportunities, and history to determine the likelihood of such incidents occurring for each specific hazard.

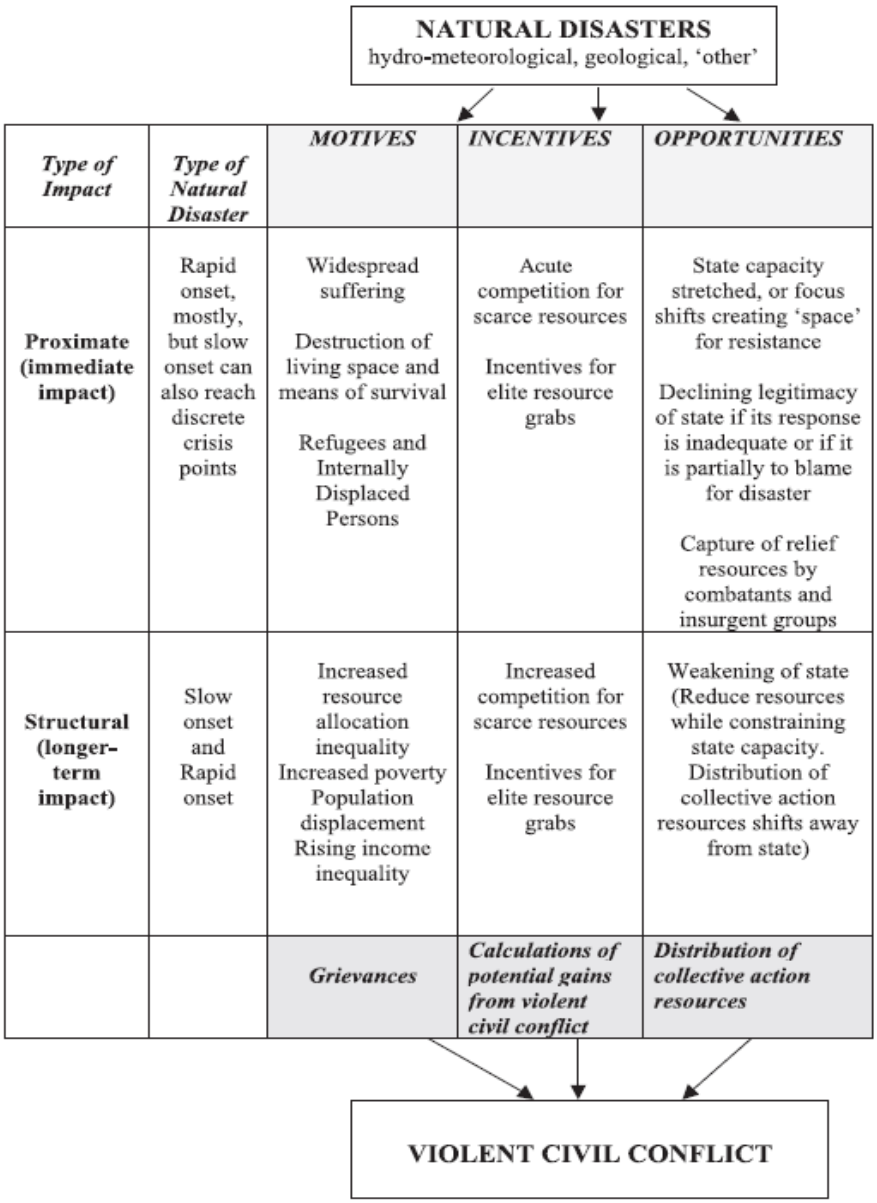


Figure 4-4 Source*:* International Studies Quarterly, 2008 - *Summary of Casual Argument Linking Natural Disasters and Violent Civil Conflict*

4.8.2 Dam or Levee Failure

This plan only considered dam failure a significant impact of a natural hazard. To evaluate the risk posed by this impact, 90 substantial dam failures since 1802 were evaluated (Appendix H). The review only included manmade dams and did not consider the failure of natural dams. The mode of failure was cross referenced to ensure natural hazards were, in fact, the cause.

Dam and levee failures are extremely uncommon. Due to the rarity of natural hazard induced dam failures, determining the odds of such an event is difficult. Less than one percent of dams fail and only a very small portion of those are caused by natural events.[93] Additionally, for most natural hazard-induced dam failures structural (design), operational, and/or construction problems compounded the natural hazard's impact on the dam or its components.

Levee failures were not evaluated due to the regulatory variances found throughout the country complicating accurate record keeping.

More information on dams and levees affecting the Eugene-Springfield area is in Appendix H.

4.8.3 Epidemics

An epidemic is the spread of an infectious disease affecting, or tending to affect, a disproportionally large number of individuals within a population, community, or region at the same time. Epidemics are not rare following a natural disaster, but typically manifest themselves in under developed countries. The cholera epidemic in 2010-2011 after the Haitian earthquake spread quickly affecting more than 500,000 people at a significant cost to the community. Worldwide risk assessments have been determined for many natural hazard-induced epidemics.[94] Identified risk factors and data from the worldwide risk assessment was reviewed to determine the Eugene-Springfield area's risk to such an event.

4.8.4 Hazardous Materials

In general, hazardous material releases and spills occur more frequently than dam or levee failures but are still difficult to identify due to security issues concerning release of information, different reporting standards and regulations, and differing classification of what constitutes a hazardous material. Despite the differences, industries, which handle hazardous materials and have strict reporting policies, can be used to better understand the odds of a natural hazard induced hazardous material spills or release from oil pipelines. See Figure 4-5 for the percentage of natechs by hazard.

[93] "Dams' Safety Is at the Very Origin of the Foundation of ICOLD." Dams' Safety Is at the Very Origin of the Foundation of ICOLD. Accessed April 2016. https://www.icold-cigb.org/GB/dams/dams_safety.asp.

[94] Lemonick, David M. "Epidemics after natural disasters." *American Journal of Clinical Medicine* 8, no. 3 (2011): 144-152.

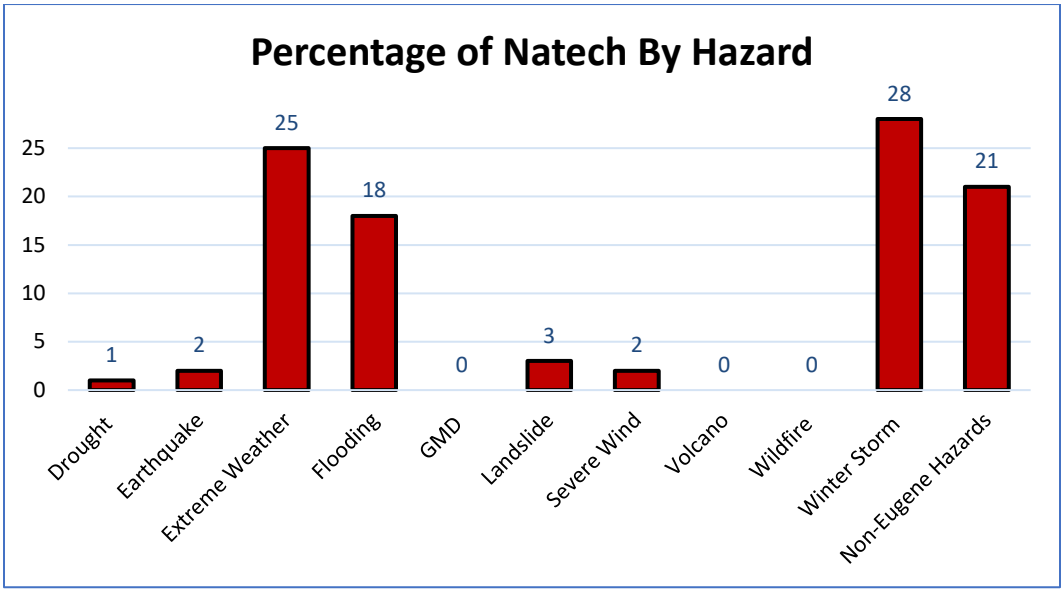


Figure 4-5 Source: Data from "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development" – *Percentage of natechs broken down by hazard. 2015.*

The Project Team reviewed indirect unintentional releases to determine the risks of hazardous materials natech events in Eugene or Springfield in Section 1 – Table 1- 2. It considered any natural hazard responsible for releasing 500 or more barrels of oil a significant impact. Additionally, hazards which could release large quantities of household hazardous materials were considered.

A JRC Science and Policy Report is helpful in determining the frequency of natural hazard induced HazMat incidents. The report analyzed the U.S. Department of Transportation's hazardous liquid transmission pipeline incident data from 1986-2012. The review included crude, hot, and white oil (paraffin, liquid petroleum, etc.) products in pipelines, terminals, tank farms, pumps, and metering stations. This report determined 5.5% of all oil industry spills in the United States were due to natural hazards.[95]

[95] Girgin, Serkan, and Elisabeth Krausmann. "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development." *JRC Science and Policy Report, EUR* 26913 (2015).

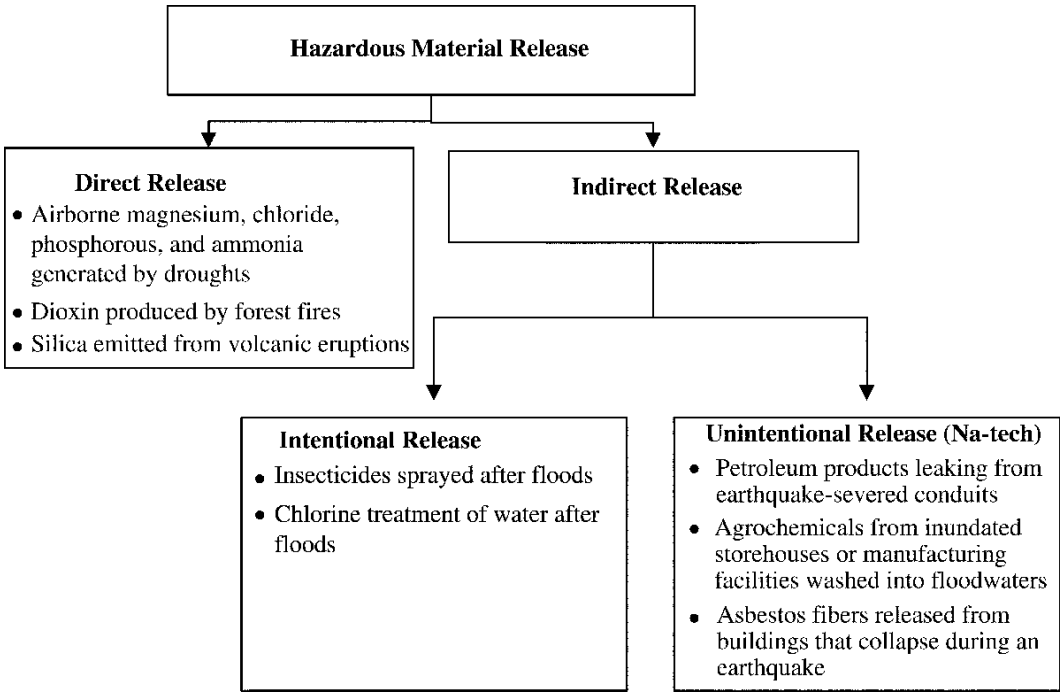


Figure 4-6 Source: Science of the Total Environment – *Classification of hazardous material releases associated with natural disasters. 2004.*[96]

4.9 Prioritization of Mitigation Action Items

For the 2020 NHMP update, the 2014 Vulnerability Assessment scores (Section 4.5.5), the research examining social vulnerability (Section 4.6), and results from public outreach conducted between 2017-2019 (Appendix B) were all considered when prioritizing Mitigation Action Items. This approach ensured the Project Team considered our community research, what community members feel is most important (public outreach), and what vulnerable populations require specific attention as part of our natural hazard's mitigation planning.

Eugene and Springfield Emergency Management developed a list of Mitigation Action Items (Appendix A) using the following information:

- The 2014 Vulnerability Assessment emphasized strengthening the fossil fuel, transportation, and electricity sectors because they are crucial to the operation of all other sectors. Sector experts identified earthquakes, winter storms, floods, and wildfire events as the hazards of greatest concern. Actions supporting these systems were raised in priority.
- The Cities of Eugene and Springfield along with Sub-Plan Holders have done

[96] Young, Stacy, Lina Balluz, and Josephine Malilay. "Natural and technologic hazardous material releases during and after natural disasters: a review." *Science of the Total Environment* 322, no. 1-3 (2004): 3-20. doi:10.1016/s0048-9697(03)00446-7.

extensive work mitigating natural hazards. Several studies were done to better understand the areas' risk which was also incorporated into evaluating Mitigation Action Items.

- Finally, many community members took time to provide feedback at numerous NHMP public outreach events. This feedback provided input on local hazard mitigation priorities (survey results are detailed in Appendix B). Respondents indicated earthquakes, geomagnetic disturbances, flooding, and winter storms are the hazards the two City governments should prioritize. Respondents also indicated a strong preference for actions protecting utilities and critical facilities.

Based on these criteria and an understanding of local conditions, emergency managers selected those actions most likely to mitigate these priority vulnerabilities.

5 Special Jurisdictions

5.1 Multijurisdictional Planning History

In 2004 and 2005, the Cities of Eugene and Springfield developed their first Natural Hazards Mitigation Plan (NHMP) entitled "Multi-Hazard Mitigation Plan for the Eugene/Springfield Metropolitan Area." Due to the proximity of the cities and shared risks for a majority of the identified natural hazards, it was determined pooling resources and developing a multijurisdictional plan was the best course of action. The Eugene-Springfield NHMP, along with the shared Emergency Operation Plan (EOP), was so successful the partnership continues to this day.

Since the initial NHMP, Eugene Water and Electric Board (EWEB), Rainbow Water Board (RWD), and Springfield Utility Board (SUB) collaborated with the cities to develop the plan. All three utilities' involvement increased significantly over the years.

In 2017, with the guidance from the Oregon Office of Emergency Management (OEM), both jurisdictions decided to reorganize the structure of the NHMP to better align with "special district" requirements set forth by the Robert T. Stafford Act, as amended by the Disaster Mitigation Act (DMA). Since EWEB, RWD, and SUB invested a significant amount of time assisting with the development of this plan, they agreed formal adoption of the NHMP was in their best interest to ensure their eligibility to participate in the programs outlined within the Stafford Act.

This annex sets forth the expectations and requirements for a special district wishing to become an official Eugene-Springfield NHMP Sub-Plan Holder.

5.1.1 Benefits of Multijurisdictional Plans

There are many reasons why a jurisdiction or special district may choose to join a multijurisdictional NHMP. Benefits of such a partnership include:

- improved communication and coordination;
- comprehensive mitigations approach to reduce risks;
- maximized economies of scale by leveraging individual capabilities;
- support from varying disciplines and backgrounds;
- shared costs and resources for the implementation of mitigation items; and
- avoidance of duplication of efforts.

5.1.2 What is a Special Jurisdiction?

A multijurisdictional hazard mitigation plan is jointly prepared by more than one jurisdiction. The Code of Federal Regulations (CFR) Title 44 Part 201, Mitigation Planning, defines jurisdictions as a "local government" which is any "county, municipality, city, town, township, public authority, school district, special district, intrastate district, or council of governments…" The 2017 Oregon Revised Statute (ORS) 198.01 defines "district," as approved by the Oregon State Legislature. These approved districts are, generally, public entities providing a service to the public, and have an independent governing body.

Within this plan these "local governments" are referred to as special districts or Sub-Plan Holders.

5.2 Expectations

The Stafford and Disaster Mitigation Acts require the plan must clearly document how each planning partner (Plan Holder), seeking eligibility under a NHMP, participated in the plan's development. The joint Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan will be considered as the base plan with each special district added as an annex. For this planning process, "participation" is defined by the following criteria:

- **Point of Contact (POC)** – Each entity is required to provide a current POC to the NHMP Project Manager.
- **Level of Effort** – There is no estimated time commitment required to become a NHMP Sub-Plan Holder. Planning effort is determined by a Sub-Plan Holder successfully completing the requirements, set forth by FEMA, to obtain an "Approvable Pending Adoption" notice within the required timeframe.
- **Participation** – Sub-Plan Holders are encouraged to attend all NHMP Update Committee meetings but are required to attend at least one a year. Each Sub-Plan Holder is responsible for completing their own public outreach, though pooling resources to do so is encouraged.
- **Duration of Process** – Sub-Plan Holders must be committed to the entire NHMP process which includes the five-year plan update cycle as well as execution of mitigations actions.
- **Hazard Identification and Risk Assessment** – All Sub-Plan Holders must complete this assessment. This includes analyzing what degradation or loss of their infrastructure would do to the surrounding community and how their risk differs from the planning area.
- **Mitigation Action Review** – At least annually, all Sub-Plan Holders must take part in a review of standing mitigation action items at a NHMP Update Committee meeting and identify at least one mitigation action for each hazard

that creates significant vulnerability to the Sub-plan Holder.

- **Plan Adoption** – The governing boards of each entity must adopt the NHMP and provide adoption documentation to FEMA via OEM in a timely manner.

The Project Manager will provide planning tools and instructions to assist in the initial creation, and subsequent updates, of each entity's respective annex. Though the Project Manger's role is to coordinate the NHMP updates, they are not responsible for creating and/or updating a special district's annex.

5.3 Procedures for Becoming a NHMP Sub-Plan Holder

To be eligible for programs under DMA a jurisdiction or special district must maintain an approved and current NHMP. Not all eligible entities within Eugene or Springfield are included within this NHMP. It is only a requirement to have such a plan if an entity wants to participate in programs laid out by the Stafford and Disaster Mitigation Acts. Entities may choose to adopt a NHMP at any time. Additionally, they can decide to absolve their involvement in this program at any time.

5.3.1 New Requests for Partnership

Eligible special districts within the Eugene-Springfield planning area may request to become a formal Sub-Plan Holder to this NHMP at any point. It's requested that interested special districts submit inquiries to the City of Eugene's Emergency Management team. The most up-to-date contact information can be found on the city's emergency management webpage.

5.3.2 Review of Requests to Become an Official Sub-Plan Holder

Upon notification by an interested special district, the NHMP Project Manager will provide any additional information and/or collect needed information from the interested party. The NHMP Project Team will then review the request. This review will look at:

1. Is the entity eligible under the guidelines set forth by the Stafford and Disaster Mitigation Acts?
2. Are the entity's hazards similar to the base plan's identified hazards?

After this review the entity will be notified of either:

- their approval; or
- their denial with an explanation and recommendation on what NHMP development path may better suit their special district.

An example of this would be a publicly owned utility, with its own governing board, serving half of a county. This utility fits the definition of a "special district" outlined within the Stafford Act. Since the service area is much larger than a single city, however, their request would be declined. This is due to the fact they do not share the same hazards or planning area as the base plan. It would be recommended for this special district to either develop their own NHMP or partner on the county's NHMP. If this was a real example, the Project Manager would offer information and guidance on the best way to pursue this course of action.

5.4 Terminating Sub-Plan Holder Partnerships

The eligibility afforded under this process to official NHMP Sub-Plan Holders can be terminated in two ways. First, a Sub-Plan Holder can request to be removed from the plan. This may be done because the Sub-Plan Holder has decided to develop its own plan, identified another NHMP better suited to its needs, or they no longer wish to take part in the programs for which an approved and current plan makes them eligible.

A Sub-Plan Holder wishing to voluntarily leave the plan shall inform the NHMP Project Manager of this request in writing. This notification can occur at any time during the course of the planning cycle. A Sub-Plan Holder wishing to purse this course of action is advised to make sure they are eligible under a new planning effort to avoid any period of noncompliance under the DMA.

Upon notification of this intent the Project Manager will immediately notify both the Oregon Office of Emergency Management (OEM) and FEMA in writing of the Sub-Plan Holder's desire to no longer be a part the planning effort, and the eligibility afforded to the Sub-Plan Holder should be rescinded upon the plan's expiration.
The second way a Sub-Plan Holder may terminate their partnership with this plan is by failing to meet the expectations for a NHMP Sub-Plan Holder (see Section A.2). Each Sub-Plan Holder agreed to these terms upon adopting the plan.

The Project Manager and Project Team will monitor a Sub-Plan Holder's eligibility status. The determination of whether a partner is following the expectations of a Sub-Plan Holder will be based on the following factors:

- Is the Sub-Plan Holder providing current POC information to the NHMP Project Manager in a timely manner?
- Is the Sub-Plan Holder supporting the NHMP Update Committee by attending the required number of meetings?
- Is the Sub-Plan Holder completing and maintaining an approvable annex?
- Is the Sub-Plan Holder making a reasonable effort to complete mitigation action items?

- Is the Sub-Plan Holder completing adequate natural hazard mitigation outreach as laid out under regulation 44 CFR 201.6 for local mitigation plans?

Completing an annex does not end with plan approval. This partnership was formed on the premise Sub-Plan Holders would pool resources and strive to reduce risk within the planning area. Failure to support this lessens the effectiveness of this effort. Before removing a Sub-Plan Holder from this planning process the NHMP Project Manager will:

- collect justifications for this decision;
- inform the NHMP Project Team of this information;
- notify the Sub-Plan Holder of possible termination of partnership and request their explanation and intentions;
- confirm Sub-Plan Holder's wish to no longer participate in the NHMP;
- conduct a vote by the NHMP Project Team to terminate the partnership with the Sub-Plan Holder in question; and
- provide written notification to the Sub-Plan Holder's POC of termination of partnership, and information on when eligibility under the current NHMP expires.

There is no penalty for terminating this partnership. The special district in question is responsible for ensuring their eligibility under the Stafford and Disaster Mitigation Acts via a different NHMP planning process, however. If the special districts wish to terminate their involvement in maintaining a NHMP completely, it is their responsibility to understand what that means for their special district and take full responsibility for any programs for which they are no longer eligible.

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A Eugene Water & Electric Board

NHMP Project Team Member:

Jeannine Parisi, Customer Relations Manager

A.1 Jurisdictional Profile

A.1.1 Introduction

The Eugene Water & Electric Board (EWEB) is the largest publicly owned electric and water utility in Oregon. The City of Eugene (the City) commenced utility operations in 1908 with the purchase of a privately-owned water system. In 1911, upon completion of the City's first municipal hydroelectric power plant, the City organized the Eugene Water Board to operate the City's electric and water utilities. The name of the Eugene Water Board was changed to the Eugene Water & Electric Board in 1949.

EWEB is chartered by the City and supplies electric and water service within the city limits of Eugene and to certain areas outside the city limits. Employing about 500 people, EWEB operates as a primary government, and is not considered a component unit of the City. EWEB is governed by a five-member Board of Commissioners who are elected by voters residing in the City. The Board is responsible for the adoption of this plan and funding for priority activities. The General Manager will oversee plan implementation

- **Population served**: 168,916 (2017 estimate, U.S. Census Bureau)
- **Land area served**: 236 square miles
- **Land area owned**: 44.15 square miles

This annex notes EWEB specific variances from the Eugene-Springfield Area NHMP base plan (Sections 1-4, 6). Variances arise due to differing risks faced by EWEB compared to the Cities of Eugene and Springfield. The different risks are due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, EWEB complies with the 2020 NHMP. Public outreach activities are located in Appendix B.

A.1.2 Electric System

The Electric System supplies service to 93,000 residential, commercial, and industrial customers within the City of Eugene and areas along the McKenzie River between the cities of Walterville and Vida, where two of EWEB's hydro-power plants are located.

Power delivered to customers is supplied by the Bonneville Power Administration (BPA) via EWEB-owned generation resources, other contracted resources, and purchases from the wholesale energy markets. EWEB's power supply sources are primarily hydro-power, but also include wind, biomass, and solar. The electric utility's 2019 operating budget is $212 million. The budget for capital improvements is $37 million and the budget for debt service is $16 million.

- **Total Electric System Service Area**: 236 square miles
- **Transmission and distribution lines**: 1,300 miles
- **Substations**: 38
- **Utility-owned hydroelectric facilities**: 4

Electric System operating assets historical costs[1] are listed below (Table A-1). A new operating license for the Carmen-Smith Hydroelectric Project was issued in May 2019. Capital improvements at this facility under the new licensing requirements are projected to cost $116 million. The insured value of all hydro-electric production facilities, which approximates replacement value, is over $320 million as of March 2019.

The estimated values of major electric assets are listed in below.

Table A-1 Historical Cost

Major Electric Asset	Historical Cost (As of Dec 2018)
Land	$8,969,999
International Paper Biomass (Turbine #4)	$10,363,488
Foote Creek[2] Wind Farm	$11,789,767
Hydro Production[3]	$162,579,170
Transmission	$84,785,666
Distribution	$313,808,256

[1] Cost when the asset was first placed in service and capital improvement costs to that asset over time.
[2] Windfarm located in Carbon County, Wyoming, co-owned with Pacific Power Corp.
[3] Includes $29 million for the Stone Creek Hydroelectric project located on Clackamas River, Oregon.

General Plant[4]	$158,027,521
Telecommunications	$19,452,088
Completed Construction, not yet classified	$16,979,283
Construction Work in Progress	$16,972,396
TOTAL:	$803,727,634

Source: EWEB

Current and Anticipated Service Trends

Studies commissioned by the City of Eugene estimate the area's population will grow by 34,000 people by 2031, or by an average annual rate of 1.4 percent. However, unless a large industrial facility locates in our service territory, electric consumption trends are expected to stay relatively flat, with most new customers served through existing facilities and energy resources. This is due to higher energy efficient buildings and equipment, use of natural gas for heating and industrial uses, and the on-going success of utility energy conservation programs.

A.1.3 Water System

EWEB provides treated drinking water to 61,000 residential, commercial, industrial, and public sector customers within its Eugene service territory. EWEB also supplies wholesale water to the River Road and Santa Clara water districts in unincorporated North Eugene and has wholesale water contracts with the City of Veneta and the Willamette Water Company.

The water utility maintains three water rights for drinking water at a single point of delivery on the McKenzie River. EWEB efforts to diversify water supply sources include a groundwater permit issued in 2008 and a surface water registration and permit issued on the Willamette River. Water permits will not be certificated until a sufficient volume of water from these sources is distributed for municipal use.

Raw water is collected via two river intake structures located at Hayden Bridge in Springfield and delivered to a nearby treatment plant. The water treatment plant pre-treats, filters, and treats the raw water for consumption. Two large transmission lines in a seven-mile long corridor bring treated water to the Eugene city limits. From there, transmission and distribution pipelines deliver water to customers.

EWEB operates three primary baseline reservoirs to store water, and a number of smaller reservoirs at upper elevations. Pressure to deliver the water is controlled largely from the filtration plant which is capable of serving approximately 85 percent of EWEB

[4] Includes electric utility portion of fleet and administration/operational buildings.

consumers. A system of pumps and reservoirs serve EWEB's remaining consumers. The Water System's 2019 operating budget is $20 million. The budget for capital improvements is $15 million and the budget for debt service is $5 million.

- Reservoirs: 23 (89 M gallons capacity)
- Pump stations: 27
- Water distribution system: 800 miles

The estimated value of major water utility assets, in historical cost and insured values (when value approximates replacement costs) is listed below (Table A-2).

Table A-2 Estimated Value of Major Water Utility Assets

Major Water Utility Assets	Historical Cost (as of Dec 2018)	Insured Value (as of March 2019)
Land	$1,258,733	
Hayden Bridge Treatment Plant	$35,742,975	$99,332,597
Source of Supply	$24,411,213	
Water Transmission & Distribution	$145,416,693	
Reservoirs/Pumping	$38,653,795	$74,279,546
General Plant	$37,847,775	
Completed Construction, net yet classified	$6,418,961	
Construction Work in Progress	$6,551,690	

Source EWEB.

Current and Anticipated Service Trends

Similar to the electric utility, water consumption remains nearly flat despite population growth. While annual usage is highly weather dependent, the growth trend is marginal over time due to efficiency standards in plumbing codes and changing irrigation practices. Additional wholesale water contracts to nearby small cities are technically feasible but not likely in the near future.

A.2 Applicable Regulations, Plans

EWEB's elected Board of Commissioners annually reviews and adopts the ten-year capital improvement plans for the water and electric utility. Resiliency is a strategic priority for the utility, therefore the mitigation actions described in the Natural Hazard Mitigation Plan are reflected in the capital improvement plans. Over the next five years, EWEB has plans for $204M in electric capital projects and $95M in water system upgrades. Annual Board review and adoption of the capital improvement plans ensures that mitigation action items have both policy-level and financial commitments for implementation and affords a mechanism to explicitly track project progress or delays in a public meeting setting. Once adopted, EWEB's NHMP priority actions will be included as an attachment to the capital improvement plans to further reinforce integration of the plans.

- **Eugene City Charter Chapter X, Section 44:**
  Conveys authority to maintain and operate the electric and water utility to the Eugene Water & Electric Board.

- **Eugene City Code 2.175 – 2.212**
  Sets forth powers and duties of the Eugene Water & Electric Board.

- **2019 Electric and Water 10-Year Capital Improvement Plans**
  Describes routine capital work like pole and water main replacements, specific upgrades over $1 million such as reservoir rebuilds, and large multi-year projects typically financed through bonds. The $311 million electric and $212 million water plans have a strategic focus on reliability and resiliency.
- **2018 – 2022 Water Management and Conservation Plan**
  Required submission to Oregon Water Resources Board that includes water curtailment response.

- **2016 Emergency Action Plans for Carmen-Smith Hydroelectric Project and Leaburg/Walterville Power Canals**
  Provides guidance to EWEB staff and emergency response personnel to safeguard the lives and property of people living in close proximity to and downstream of EWEB hydroelectric facilities; required and approved by the Federal Energy Regulatory Commission.

- **2015 EWEB Water System Master Plan**
  Outlines long term planning options for resiliency, reliability and optimization of EWEB's water System.

- **2012 EWEB Emergency Water Supply Plan**
  Analyzes options for secondary drinking water supplies and outlines a path forward to provide provisional water to EWEB customers.

- **Mutual Aid Agreements for Electric Restoration Efforts**
  - Lane Mutual Aid Agreement (2017)
  - Western Region Mutual Assistance Agreement (2014)
  - EWEB, Rainbow Water District, and Springfield Utility Board Mutual Aid Agreement (2006)

- **NERC Emergency Operations Plans**
  Specifies electric load shedding required under emergency conditions. Dictates communications with outside electrical supply entities and required restoration actions and coordination.

A.3 Jurisdiction-Specific Natural Hazard Event History

Table A-3 lists past occurrences of natural hazards affecting EWEB over the past 15 years and the damage received to EWEB assets for each incident.

Table A-3 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Severe Winter Storm	TBD	February 25 – March 4, 2019	$4.3M
Windstorm	N/A	April 7, 2017	
Winter Storm/Freezing Rain	DR-4296-OR	December 14 -17, 2016	$4.2 M
Severe Winter Storm	DR-4258-OR	December 6 – 23, 2015	$195,000
Severe Winter Storm	DR-4169-OR	February 6 – 14, 2014	$1.9 M
Severe Winter Storm	DR-4055-OR	January 17-21, 2012	$35,000
Severe Winter Storm		March 21-26, 2012	
Windstorm		March 13 - 16, 2011	
Severe Winter Storm		December 27 – 29, 2008	
Windstorm		February 2-4, 2006	
Windstorm	FEMA-1405-DR-OR	February 7, 2002	$1.5 M

Source EWEB.

A.4 Hazard Risk Ranking

Table A-4 presents the ranking of hazards of concern, using vulnerability multiplied by probability divided by capacity to calculate and prioritize total risk to Eugene Water and Electric Board (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to EWEB and may vary from those listed in Section 1, Table 1-1.

Table A-4 EWEB Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Windstorm	3	3	2	4.5	High
Winter storm	3	3	2	4.5	High
Wildfire	2	3	2	3	High
Flood - Riverine	2	2	2	2	Moderate
Drought	1	3	2	1.5	Moderate
Geomagnetic Disturbance	1	2	2	1	Low
Landslide	1	2	2	1	Low
Volcano	1	1	3	.33	Low

Source EWEB.

As Table A-4 above indicates, EWEB's risk ranking is nearly identical to the planning area. The one exception is geomagnetic disturbances, which ranked low in EWEB's evaluation. As a local utility, EWEB manages relatively little electric transmission infrastructure, which is most sensitive to this phenomena therefore our asset vulnerability is comparatively small. Further, events of this nature are managed proactively by the Bonneville Power Administration which has protocols and actions EWEB would take to shed electric load in advance of a predicted event and

requirements EWEB would follow during an actual geomagnetic disturbance to limit damage to our systems.

A.5 Evaluation of Recommended Action Items

Table A-5 lists the initiatives that make up the EWEB hazard mitigation plan. EWEB is the lead agency and funding source for these initiatives unless otherwise noted.

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
	X	Earthquake, Geomagnetic disturbances	Seismic upgrades of critical facilities: Rebuild Currin Substation using IEEE[5] standards to reduce risk of interference with electrical equipment from geomagnetic disturbances.	$750K[6] (substation)	2020-2021
X	X	Earthquake	Seismic upgrade of critical facilities: Changes to EWEB Roosevelt Operations Center (ROC) to remain operational after earthquake event; move EWEB dispatch into ROC from EWEB Headquarters and build new back-up control center in seismically sound building at Hayden Bridge.	$3.5 M	2019-2025
	X	Earthquake	Seismically anchor transformers, and control building, and add flexible bus connections at nine substations.	$1.2 M	2019-2027
X		Multi-Hazard (earthquake, flood-riverine, winter storms, windstorms, geomagnetic disturbances)	Seismic upgrade to critical facilities: New Holden Creek Substation built to seismic standards replacing Leaburg Substation on riverbank using IEEE standards; removes 17 miles overhead electric lines. Add second transformer for resiliency.	$7.5M	2018-2020

[5] Institute of Electrical and Electronics Engineers (IEEE) 693

[6] Total project cost of Currin Substation Rebuild is estimated at $7.5M. Only costs associated with seismic upgrade, estimated at 10% of new construction overall costs, are included.

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
X		Earthquake	Replace baseline reservoirs[7] with seismic-code facilities	$10M per site	2023 (first reservoir)
X		Earthquake, Landslide	Use all-restraint water mains in areas prone to landslides	2 times cost of standard pipe	2030
X		Earthquake, Flood-Riverine	Replace gaseous chlorine at filtration plant with on-site liquid hypochlorite system with 90 days on-site storage	$3.5M	2019
	X	HazMat	Change out mineral oil to non-toxic FR3[8] in new transformers to reduce spill risk when poles fall or transformers fail, focusing on 427 upriver transformers.	Approx. $800k/year	2030
X		Multi-Hazard (earthquake, wildfire, drought)	Establish micro-grids and emergency pumping and filtration systems at critical facilities for drinking water distribution and independent electric operation. Micro-grids at Howard Elementary School has been installed, and a 1 MW system at EWEB Roosevelt Operations Center are currently under development.	$1M per site[9]	2018 - 2023
	X	Multi-Hazard (earthquake, wildfire, volcano, windstorm)	Test blackstart capabilities, load requirements, and transmission switching needs for Leaburg hydro-electric plant to power critical facilities in Eugene during major outages.	$50,000	2019 - 2023

[7] EWEB has three 'base' elevation reservoirs that serve over 80% of our customers.
[8] FR3 fluid is a natural ester derived from renewable vegetable oils – providing improved fire safety, transformer life/loadability, and environmental benefits.
[9] Howard Elementary School installation supported in part by Oregon Department of Energy grant ($300k).

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
	X	Multi-Hazard (windstorm, winter storms)	Re-frame 4.3 miles of electric line and undergrounding 1.5 miles of line in 15 high outage areas.	$2.7M[10]	2019-2020
X		Multi-Hazard (earthquake, wildfire, drought)	Develop emergency water distribution sites using wells at area schools/community centers – two sites completed, and three other sites are in design or construction.	$200K per site	2018 - 2023
X		Multi-Hazard (earthquake, wildfire, drought)	Construct new water filtration plant on the Willamette River for secondary source of supply and treatment/delivery options for drinking water.	$50M	2023-2030
X		Multi-Hazard (earthquake, wildfire, drought)	Construct and test mobile treatment trailer that can deliver potable water from sources like rivers or pools.	$80,000	2020

Table A-6 below lists the action items contained in EWEB's hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Rebuild/Seismic Upgrades to Currin Substation	Earthquake, GMDs	Low	Moderate	Yes	Yes	Yes	High

[10] $1.5M of project funded via FEMA Public Assistance grant award (DR-4296) following 2016/17 winter storms.

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible?	Can be funded under existing programs or budgets?	Priority
Seismic Upgrades to Critical Facilities: EWEB Operations and Dispatch	Earthquakes	Moderate	Moderate	Yes	Yes	Yes	Moderate
Anchor Substation Transformer	Earthquake	Moderate	Moderate	Yes	Yes	Yes	High
Replace Leaburg Substation w/New Holden Creek Substation	Earthquakes, Multi-hazard	Low	High	Yes	Yes	Yes	High
Rebuild/Rebuild Baseline Reservoirs	Earthquakes	Moderate	Moderate	Yes	Yes	Yes	Moderate
All-Restraint Water Mains	Earthquake, Landslide	Moderate	Moderate	Yes	Yes	Varies	Low
Build Hypochlorite System at Filtration Plant	HazMat, Earthquake, Riverine flood	Moderate	High	Yes	N/A	Yes	High
Replace Mineral Oil with FR3 in Transformers	Earthquakes, Multi-hazard	Low	Moderate	Yes	N/A	Yes	Low
Establish Micro-Grids @ Emergency Facilities	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Moderate	Low	No	Varies	No	Low
Enable Localized Generation to Power Critical Facilities	Multi-Hazard (Earthquake, Wildfire, Volcano, Windstorm)	Moderate	Moderate	Yes	Varies	Yes	Moderate

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible?	Can be funded under existing programs or budgets?	Priority
Undergrounding /Re-Framing Electric Distribution	Winter Storm, Windstorm	Low	High	Yes	Yes	Yes	High
Develop Emergency Water Distribution Sites	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Low	Moderate	Yes	Yes	Yes	High
Develop Emergency Water Distribution Sites	Multi-Hazard (Winter Storm, windstorm, landslide)	Low	Moderate	Yes	Yes	Yes	High
Secondary Water Filtration Plant	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	High	High	Yes	No	No	Moderate
Mobile Water Treatment Trailer	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Low	Moderate	Yes	Yes	Yes	High

A.6 Future Needs

EWEB will be conducting a water system risk and resilience assessment in accordance with recent updates to Section 1433 of the Safe Drinking Water Act. This risk assessment of both natural disasters and bio-terrorist attacks is to be submitted to the Environmental Protection Agency by March 31, 2020.

Additional analysis is also planned around improving our ability to isolate and serve critical facilities using just our localized energy resources. Studies planned include modeling the load capabilities of additional generation supplies beyond EWEB hydro-electric facilities such as the University of Oregon natural gas plant and industrial co-

generation plants, and assessing what electric distribution system automation is needed to quickly shed load and redirect power to critical facilities.

As part of our focus on resiliency, the utility will be developing staff evacuation plans for flood/wildfire events and updating EWEB business continuity plans.

A.7 Additional Comments

Since the adoption of the 2014 NHMP, EWEB has completed several initiatives to mitigate community risk to hazards of concern. Some of these were listed in the plan, while others were not included at the time. Action Item updates for the 2014 NHMP are in Appendix A. Some mitigation initiatives completed but not outlined in the 2014 NHMP include:

- Seismic upgrades of critical facilities: a $3 million upgrade to the Hayden Bridge Filtration Plant was completed in 2017 and constructed the seismically-rated Holden Creek Substation.
- Back-up power at critical facilities: a $1.0 million project to add back up power to the Hayden Bridge raw water intake system and treatment plan was completed in 2018. The back-up generation is sufficient to deliver 20 million gallons of water per day and has the fuel capacity to run 24- hours without re-fueling.
- Purchased property and completed preliminary design for construction of secondary water treatment plant on the Willamette River ($2.5M).
- Installed seismic early warning systems at two hydro-electric plants to automate safety actions and reduce risk to life/property in partnership with the University of Oregon ($25K).
- Provided approximately 15,000 three-gallon emergency water containers to EWEB customers at discounted price to use at emergency distribution sites/mobile trailers, with considerable outreach and education as part of the distribution process (approximately $100k).
- Purchased and equipped three mobile water distribution trailers to provide emergency drinking water during outages ($80,000 each). Two trailers were loaned to Salem/Keizer personnel to provide drinking water to residents during a multi-week water curtailment due to algal bloom in summer 2018.
- Completed two emergency water distribution well sites and hosted utility/community drills where residents could fill free water storage containers using distribution equipment and learn how to disinfect water for public use (October 2018 and May 2019). Next step is to create an operating manual so that non-utility personnel can set up and disperse water during emergencies enabling EWEB staff to focus on system repairs and service restoration. Our goal is to have another two sites up and running by the end of 2019.

- Installed microgrid for back-up power to the emergency well and other facilities at Howard Elementary School. Final commissioning will be completed this summer.
- Conducted power system and generator capability studies in 2018 for islanded operation of critical loads at Leaburg facility.
- Completed seismic anchoring retrofit of Spring Creek and Prairie Substation transformers.

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B Rainbow Water & Fire District

NHMP Project Team Member:

Jamie Porter, Superintendent

B.1 Jurisdictional Profile

B.1.1 Introduction

Rainbow Water & Fire District was incorporated as a domestic water supply district by a Lane County election held August 22, 1949. On June 9, 1952, Lane County voters also empowered the district to protect its inhabitants from fire, which Rainbow has fulfilled by contracting with the City of Springfield under an intergovernmental agreement for fire protection and emergency medical services. In 1985, Rainbow formally changed its name to Rainbow Water and Fire District to provide clarity on property tax bills but continues to do business as Rainbow Water District.

Rainbow is a special district, a political subdivision of the State of Oregon serving residents of unincorporated Lane County adjacent to the Springfield city limits. Rainbow's primary purpose is to provide water for domestic use, secondarily providing fire protection and operating a small system of streetlights on higher volume county roads in Rainbow's service area. A five-member Board of Commissioners, elected by the residents within its service boundaries, governs the district. RWD employs seven employees. The Board is responsible to adopt this plan and fund priority activities. The Superintendent will oversee plan implementation.

- **Population served**: 23,000 (City and County customers in north Springfield comprise about 37% of the population of Springfield, which was 62,353 per the 2017 U.S. Census Bureau estimate)
- **Land area served**: 8.0 square miles (Rainbow-served portions of north and west Springfield)
- **Land area owned:** 23.3 acres

This annex notes the Rainbow Water District specific variances from the Eugene-Springfield Area NHMP Base Pan (Sections 1-4). Variance arise due to differing risks faced by RWD compared to the Cities of Eugene and Springfield. This is due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, RWD complies with the Base Plan. Public outreach activities are in Appendix B.

B.1.2 Water System

Rainbow provides drinking water to 2,400 residential customers within its county service area in north Springfield. Rainbow also provides wholesale water to the Springfield Utility Board for use by residential, commercial, industrial, and public sector customers inside the city limits.

The utility maintains permitted and certificated water rights to use groundwater from eleven wells located at four different wellfield facilities in North Springfield. Groundwater is pumped to the surface and disinfected with chlorine. Transmission piping delivers the treated water to the distribution system for consumption.

Chase Well #2 is classified as groundwater under the influence of surface water and receives additional filtration. The Chase Wellfield also raises the pH of the water to reduce the potential for corrosion. The Weyerhaeuser Wellfield is jointly owned and operated by Springfield Utility Board (SUB), and has additional treatment provided by granular activated carbon filters.

Rainbow operates two storage reservoirs (Kelly Butte and Moe Hill/Vitus Butte) to store water for fire protection and daily demand in the North System. (Springfield Utility Board is a part owner of Moe Reservoir, and has six other reservoirs to serve other parts of Springfield.) The discharge pressure of the deep well pumps delivers water directly to the reservoirs. Rainbow's annual operating budget is $2.5M.

- **Reservoirs**: 2 (5 million gallons total capacity)
- **Wells**: 11 (including 3 jointly owned with Springfield Utility Board)
- **Water transmission/distribution system**: 12 miles

Total value of critical infrastructure and equipment owned by the water district is $9.9M.

The estimated value of major water district assets is listed below in Table B-1.

Table B-1 Estimated Value of District Assets

Asset	Estimated Value
Chase Wellfield Water Treatment	$2,876,329
Source of Supply	$2,363,657
Water Transmission & Distribution	$3,144,568
General Plant	$1,520,636

B.1.3 Current and Anticipated Service Trends

Rainbow primarily serves single family residential county customers on septic systems. Most new development takes place inside the City of Springfield limits, to allow higher

densities and connection to public sewer. Because of this development pattern, Rainbow sees very little new construction activity, yet helps serve new City customers through our wholesale contract with SUB.

As property within the boundaries of Rainbow is annexed to the City, water customers are transferred to SUB who will be the eventual water provider as the City expands. Small infill housing developments have provided new customers, however, so the Rainbow customer count has been stable and is anticipated to remain steady for the duration of this plan.

The Springfield area has experienced modest population growth, but more efficient plumbing codes and irrigation practices have offset increased demand to keep water consumption trends relatively flat. Annual usage is weather dependent, so seasonal fluctuations still do occur.

With the low volume of private development, Rainbow staff have been able to invest time in the management and operations of the water systems for the unincorporated communities of Marcola, Deerhorn, and Shangri-La. These small systems operate independently with their own water supplies and part-time operators, under the supervision of Rainbow's licensed staff.

B.2 Applicable Regulations, Plans

- **Oregon Revised Statutes, Chapter 264**
  Conveys the statutory authority to operate as a domestic water supply district.
- **1995 Urban Services Agreement**
  Guidance for coordination of water services inside the Urban Growth Boundary.
- **2006 Mutual Aid Agreement for Cooperative Interties**
  Provision for the emergency exchange of water between Eugene Water & Electric Board (EWEB), SUB and Rainbow, with the Eugene-Springfield water utilities sharing water supplies during times of potential or actual water shortage.
- **2010 Water System Master Plan (joint SUB & Rainbow)**
  Outlines long-term planning options for resiliency, reliability and optimization of the joint SUB and Rainbow water System. (A 2019 master plan update is in progress)
- **2018 – 2023 Water Management and Conservation Plan**
  Required submission to Oregon Water Resources Board that includes water curtailment response.
- **Oregon Water/Wastewater Emergency Response Network**
  Voluntary mutual aid agreement between Oregon utilities to share resources and equipment, and improve emergency planning, coordination, and training.

Opportunities for Rainbow Water District to expand upon or otherwise improve existing policies and programs include:

- Incorporate NHMP 2020 findings or projects into the pending SUB-RWD 2020 Water System Master Plan.
- In accordance with policies promulgated by the 2013 Oregon Resilience Plan, develop a seismic risk assessment and mitigation plan that both identifies critical facilities and evaluates the likelihood and consequences of seismic failures. (This will take our existing analysis of storage reservoirs and expand upon it to include pipelines and buildings.)
- Provide additional information on Flood Riverine impacts expected from climate change or private development responses to support regional FEMA remapping efforts.
- Map critical facilities in relation to each hazard.
- Conduct one or more Rainbow-specific events to educate customers about natural hazard risks and the district's mitigation efforts.

B.3 Jurisdiction-Specific Natural Hazard Event History

Table B-2 lists occurrences of natural hazards which have impacted Rainbow Water District over the past 5 years.

Table B-2 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Flooding Event		April 7-9, 2019	
Heavy Snow Event	DR-4432-OR	Feb. 23-26, 2019	
Windstorm		April 7, 2017	
Winter Storm/ Freezing Rain	DR-4296-OR	December 14-17, 2016	$5,000 (actual $4963 paid out on 3/16/18)
Severe Winter Storm	DR-4258-OR	December 6-23, 2015	
Severe Winter Storm	DR-4169-OR	February 6-14, 2014	

B.4 Hazard Risk Ranking

Table B-3 presents the ranking of hazards of concern, using vulnerability multiplied by probability divided by capacity to calculate and prioritize total risk to Rainbow Water District (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to RWD and may vary from those listed in the Section 1, Table 1-1.

Table B-3 RWD Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Winter Storm	3	3	2	4.5	High
Flood - Riverine	3	3	2	4.5	High
Windstorm	2	2	1	4	High
Drought	2	3	2	3	High
Wildfire	2	2	2	2	High
Geomagnetic Disturbance (GMD)	1	3	2	1.5	Low
Landslide	1	2	2	1	Low
Volcano	1	1	3	.33	Low

The RWD risk matrix differs slightly from the planning area. Flood – riverine risk is raked high for RWD due to the location of our wellfields. Adjacent to the McKenzie River, our wellfields are susceptible to flooding which could directly impact our access to the wellfields and our ability to continue to safely supply water. Alternatively, landslide risk is rated low because we do not have facilities in identified landslide-prone areas, although pipelines still have some vulnerability. Finally, we rank geomagnetic disturbance risk as low. A GMD could interrupt the electric grid or our control systems, however we have multiple wells and expect to be able to continue

providing water under emergency conditions using portable generators and manual level controls.

B.5 Evaluation of Recommended Action Items

Table B-4 lists Rainbow Water District's natural hazard Mitigation Action Items. RWD is the lead agency and funding source for these initiatives unless otherwise noted.

Table B-4 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazards Mitigated	Mitigation Action	Estimated Cost	Timeline
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch and used backup generator at Rainbow office (primary control center)	$12,000	2016-17 Completed
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch at Chase Wellfield for emergency water supply and treatment power	$55,000	2017-18 Completed
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Purchase generator and install transfer switch at Chase Wellfield for backup EOC SCADA/lighting	$8,000	2017-18 Completed
X	X	Earthquake	Flexible joints and seismically-actuated isolation valves at Moe Hill (Vitus Butte) Reservoir	$535,000	2017-21
X	X	Earthquake, Flood-Riverine	Install automatic valve actuators for chlorine gas cylinders at all wellfields (Chase equipped 2018)	$50,000	2018-20
X		Multi-Hazard (earthquake, winter storm, wildfire)	Install ham radio and emergency data transmission antennas at Kelly Butte and/or Moe Hill Reservoirs.	$30,000	2019-21
X	X	Multi-Hazard (earthquake, winter storm, wildfire)	Install redundant control system capability at Chase WTP.	$35,000	2019-21

Table B-4 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazards Mitigated	Mitigation Action	Estimated Cost	Timeline
X	X	Flood-Riverine	NOAQ Boxwall or equivalent for flood protection at Chase WTP.	$20,000	2019-21
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch at I-5 Wells and obtain trailer-mounted generator[1] for Chase or I-5 Wells.	$150,000	2019-21
X		Earthquake, Drought	Develop small emergency water distribution sites located at/near private wells with tested water.	$25K per site (3 sites)	2019-23
X		Earthquake, Landslide	Use all-restraint water mains for landslide risk transmission mains	2 times cost normal pipe	2019-29
	X	Multi-Hazard (all hazards)	More customer outreach (social media/promotions/bill inserts) for emergency prep education.	$5,000 / year	2019-29

[1] Awarded a 2019 SPIRE Grant for a 108kW diesel generator capable of running two Chase wells.

Table B-5 below lists the Action Items contained in RWD hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability, and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table B-5 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Moe Hill Reservoir Seismic Upgrades	Earthquake	High	High	Yes	Yes	Yes	High
Chlorine Cylinder Actuators	Multi-hazard	High	High	Yes	No	Yes	High
Emergency Communication Equipment	Multi-hazard	Low	Low	Yes	Yes	Yes	Moderate
Secondary Control System	Multi-hazard	Low	Moderate	Yes	Varies	Yes	Moderate
I-5 Wells Transfer Switch	Multi-hazard	Moderate	Moderate	Yes	Varies	Yes	Moderate
Portable Backup Generator	Multi-hazard	Moderate	Moderate	Yes	Yes	Possibly	Moderate
Emergency Supply Wells	Earthquake	Moderate	Moderate	Yes	Varies	Yes	Low
Restrained Water Mains	Earthquake	High	Moderate	No	Varies	No	Low
Increased Public Outreach	Multi-hazard	Low	Moderate	Yes	Yes	Yes	Moderate

B.6 Future Needs

Below is a list of identified research needs concerning risk posed by specific hazards to Rainbow Water District, its assets, and the associated community.

- Investigating seismic early warning systems at Moe Reservoir which would automate safety actions and reduce risk to life and property in partnership with the University of Oregon. One option is joining the ShakeAlert network, another is working with SUB to utilize two or more independent Flo-Loc sensor to compare signals and improve detection accuracy.
- To protect electrical transformers, wells, and treatment equipment from Riverine Flood risks that could interrupt public water supply, investigate possible portable flood barrier systems such as NOAQ Boxwall which could be erected in the event of rising flood waters.

B.7 Additional Comments

Since the adoption of the 2014 NHMP, Rainbow has started and/or completed several initiatives to mitigate risk to the community from hazards of concern. These items were not listed in the 2014 Eugene-Springfield NHMP as Rainbow was not a formal participant. RWD became a formal Sub-Plan Holder with the adoption of this 2020 Natural Hazards Mitigation Plan.

- Pursue seismic upgrades of critical Springfield water facilities as recommended in a 2014 seismic analysis report. In October 2017, SUB and Rainbow jointly began engineering design of seismic improvements to three Springfield reservoirs. Improvements to SUB's 57th Street Reservoirs 1 and 2 were under construction over 2018-19, and upgrades to the jointly owned Moe Reservoir are under design with construction pending for 2019-20. Total Moe design and construction estimated at $535,000.
- Install a $12,000 backup generator and manual transfer switch at the Rainbow Water District office, a critical facility.
- Purchase a $8,000 portable generator and install a manual transfer switch at the Chase Wellfield to power computers and lights for a backup SCADA/EOC.
- Install a $55,000 manual transfer switch at the Chase Wellfield to allow connection to a larger portable generator capable of powering up to three wells and treatment equipment. (We have been awarded a SPIRE grant to obtain a trailer-mounted generator that would be enough to run two wells and provide one million gallons of treated water per day.)
- Provided nearly 800 three-gallon emergency water containers to Rainbow customers at a discounted price. These were provided for use at emergency

distribution sites or for home storage and tied to emergency preparedness public education (approximately $6,000).

- We purchased a used box trailer and are investigating the possibility of equipping it as a mobile water treatment and/or distribution trailer, to provide emergency drinking water during outages. This might be shared with small neighboring Lane County water systems that Rainbow supports.
- Water has been tested at a private well at Northwood Community Church. This is our first target site for an emergency well that could be powered by a generator and utilize area volunteers to distribute a small volume of water (20-30 gpm) to provide bare minimum drinking and sanitation water at a neighborhood level.

C Springfield Utility Board

NHMP Project Team Member:

Tracy Richardson, Utility Planner

C.1 Jurisdictional Profile

C.1.1 Introduction

Springfield Utility Board was founded in 1949 and is an independently operated municipal electric and water utility governed by a locally-elected board. The utility offers its customers some of the lowest water and electric rates in the Pacific Northwest, with equity in excess of $100 million and with no debt.

- **Population served**: Approximately 32,000
- **Land area served**: 25 square miles

This annex notes the SUB specific variances from the Eugene-Springfield Area NHMP base plan (Sections 1-4). Variances arise due to differing risks faced by SUB compared to the Cities of Eugene and Springfield. This is due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, SUB complies with the base plan.

C.1.2 Electric System

The Electric System supplies service to approximately 31,151 residential, commercial, and industrial customers within the City of Springfield.

Power delivered to customers is supplied by Bonneville Power Administration (BPA). The electric utility's annual operating budget is approximately $60M, with $6.2M budgeted for capital work.

- **Total Electric System Service Area**: 25+ miles
- **Miles of Overhead Transmission Line**: 24
- **Miles of Overhead Distribution Line**: 192
- **Miles of Underground Distribution Line**: 140
- **Substations**: 8

C.1.3 Current and Anticipated Electrical Service Trends

Springfield Utility Board has an annual electric peak load of 162 Megawatts, with Bonneville Power Administration (BPA) as the sole source of power. Unless a large customer load locates in our service territory, electric consumption is anticipated to stay relatively flat. This is due to ongoing success of utility energy conservation programs.

C.1.4 Water System

SUB provides approximately three billion gallons of water to 20,000 residential, commercial, and industrial customers within its Springfield service territory annually. SUB also provides wholesale water to the Rainbow Water District. In addition, SUB has a wholesale water contract with the City of Glenwood.

The water utility's water source is ninety (90) percent from its thirty-four (34) wells and ten percent (10) from the Willamette River.

The majority of SUB's water comes from a system of seven wellfields that tap groundwater form a vast aquifer that lies beneath Springfield. Supplementing this is water drawn from the Middle Fork Willamette River. The water utility's annual operating budget is approximately $16M, with $7.7M budgeted for capital work.

- **Total Water System Service Area**: 25 miles
- **Pump Stations**: 6
- **Wellfields**: 7
- **Annual Water Served**: 3 billion gallons
- **Water Distribution System**: 240 miles

C.1.5 Current and Anticipated Water Service Trends

SUB's water service provides approximately three billion gallons per year. Similar to the electric utility, water consumption remains nearly flat despite population growth. While annual usage is highly weather dependent, the growth trend is marginal.

C.2 Applicable Regulations, Plans

- **Springfield City Code Chapter XI, Sections 36-46**
  Sets powers and duties and conveys authority to maintain and operate the electric and water utility to Springfield Utility Board.

- **2018 Electric and Water 10-Year Major Capital Improvement Plans**
  Describes capital work like pole and water main replacements and large multi-year projects. These plans have a strategic focus on reliability, resiliency, and compliance.
- **2010 SUB Water System Master Plan**
  Provides an assessment of SUB's Water system and plans for future water supply and growth within the SUB service area over the next twenty years.
- **2019 Emergency Operations Plan**
  Provides guidance to SUB staff and emergency response personnel during emergency operations.
- **Mutual Aid Agreements for Electric Restoration Efforts**
  - American Public Power Association Mutual Aid Agreement
  - Bonneville Power Administration Mutual Assistance Agreement (2016)
  - Oregon Municipal Electric Utilities Mutual Aid Agreement(s)
  - Western Region Mutual Assistance Agreement (2014)

SUB integrates the mitigation plan into other planning mechanisms through our capital planning. The actions, contents, and strategies identified in the NHMP 2020 serve as SUB's Capital Planning process.

C.3 Jurisdiction-Specific Natural Hazard Event History

Table C-1 lists past occurrences of natural hazards affecting SUB over the past 15 years and the damage received to SUB assets for each incident.

Table C-1 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Winter Storm/Freezing Rain	DR-4296-OR	December 14 -16, 2016	$205,750
Severe Winter Storm	FEMA-4169-OR	February 6 – 10, 2014	$308,750
Windstorm		February 2-4, 2006	
Severe Winter Storm	FEMA-1510-OR	January 1-7, 2004	$33,500
Windstorm	FEMA-1405-DR-OR	February 7, 2002	$551,000

C.4 Hazard Risk Ranking

Table C-2 presents the ranking of hazards of concern, using Vulnerability multiplied by Probability divided by Capacity to calculate and prioritize total risk to Springfield Utility Board (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to SUB and may vary from those listed in the Section 1, Table 1-1.

Table C-2 SUB Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Windstorm	3	3	2	4.5	High
Winter storm	3	3	2	4.5	High
Geomagnetic Disturbance	2	2	1	4	High
Wildfire	2	3	2	3	High
Flood - Riverine	2	2	2	2	High
Landslide	2	2	2	2	Moderate
Drought	1	3	2	1.5	Low
Volcano	1	1	3	.33	Low

As Table C-2 above indicates, SUB's risk matrix differs slightly from the planning area. Drought is ranked low in SUB's evaluation due to a reliance on groundwater. Short-term droughts have limited impact to services and water availability for the utility. Alternatively, flood-riverine is ranked high in SUB's evaluation due to wellfield location. SUB's Thurston and Willamette Wellfields are located within the floodplain and are susceptible to flooding which could directly impact access to the wellfields and SUB's ability to continue to safely supply water.

C.5 Evaluation of Recommended Action Items

Table C-3 lists the initiatives that make up the SUB hazard mitigation plan. SUB is the lead agency and funding source for these initiatives unless otherwise noted.

Table C-3 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
X		Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Construction of new Glenwood Substation.	$5M	2015-2022
X		Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Construction of Thurston Water Treatment Plant (Pilot)	Pending	2020-2028
	X	Earthquake	Seismic upgrade to critical Electric facilities.	$7M	2018-2019
	X	Earthquake	Seismic retrofit of South 57th Street Reservoirs	$2.4	2019-2023
	X	Earthquake	Seismic retrofit of Moe Reservoir	$279,900	2020-2024
X	X	Earthquake	Replace 4000 feet of water distribution system pipeline	$910,000	2019-2028
	X	Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Substation Protection Upgrades	$1.14M	2019-2028
	X	Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Electric Distribution System Upgrades	$242,000	2019

Table C-4 below lists the action items contained in SUB's hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table C-4 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Build Glenwood Substation	Earthquake	High	High	Yes	Unsure	Yes	High
Seismic Retrofits and Upgrades to Critical Facilities: SUB Water Operations	Earthquake	High	High	Yes	Yes	Yes	High
Seismic Retrofits and Upgrades to Critical Facilities: SUB Electric Operations	Earthquake	High	High	Yes	Yes	Yes	High
Upgrade or Replacement of Electric Distribution Poles	Multi-Hazard (Earthquake, Winter Storm)	High	High	Yes	Yes	Yes	Moderate
Replace Aging Water Distribution Pipelines	Earthquake	High	High	Yes	Unsure	Yes	High
Electric Voltage Conversion Project: Glenwood, Hayden Bridge, Mohawk	Multi-Hazard (Earthquake, Winter Storm)	High	Moderate	Yes	Unsure	Yes	Moderate
Secondary Water Filtration Plant	Multi-Hazard (Earthquake, Wildfire, Drought, Winter Storm)	High	High	Yes	No	No	Moderate

Appendix A: NHMP 2020 Action Items Table

6. Appendices

P = High correlation to hazard. S = Moderate correlation to hazard. Blank = Minimal or low correlation to hazard. Bold = Priority Action Items.

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
1	P											Resistant Landscaping	The majority of Oregon has been in a drought for the past several years. Though mandatory water rationing has never been instituted in the Cities of Eugene and Springfield, it has become apparent water conservation measures need to be taken now to prevent/delay public water rationing in the future.	Adopt drought resistant landscaping policies.	Eugene Public Works	Employee Time	2025
2	P											Class A Recycled Water Demonstration Project	The majority of Oregon has been in a drought for the past several years. Though mandatory water rationing has never been instituted in the Cities of Eugene and Springfield, it has become apparent water conservation measures need to be taken now to prevent/delay public water rationing in the future.	Pursue a water reuse partnership with MWMC. The Metropolitan Wastewater Management Commission (MWMC) will add facilities to the wastewater treatment plant to produce the first ever stream of Class A recycled water - the highest quality recycled water class in Oregon, suitable for all water uses except drinking. Initially, 0.5-1.0 million gallons per day of recycled water will be produced for use at local sand and gravel operations, City street tree watering, and 100% of landscape irrigation at the wastewater plant. The Eugene-Springfield Fire Training Facility is also being pursued as a demonstration site. Demonstration sites will build community awareness and user familiarity with recycled water to expand uses to more urban greenspace irrigation, industrial users, and other Public Works uses.	MWMC, Eugene Public Works, Springfield Development & Public Works	$4-5 Million	Facility completion 2020; full-scale demonstration uses summer 2021
3		P										Local Active Transportation Infrastructure Evaluation	Though many street bridges have been evaluated for seismic stability no off-street or pedestrian bridges have been. Foot bridges will be vital after a large earthquake, so ensuring their seismicity is vital.	Evaluate off-street path bridges crossing over the Willamette River to complete a high-level seismic assessment of all major City bridges.	Eugene Public Works	$30,000	2020

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4		**P**										**Local Transportation infrastructure Seismic Upgrades**	**Eugene Public works Engineering identified thirteen priority transportation structures as part of a vulnerability assessment study. These structures a slated for the first phase of seismic improvements to local transportation infrastructure.**	**Complete seismic improvements to three of the thirteen priority transportation structures.**	**Eugene Public Works**	**$3 million**	**2023**
5		P										Unreinforced Masonry Building Database	Currently, there is no inventory of unreinforced masonry buildings within the Eugene-Springfield area. Since these structures are at a greater risk from various natural disasters, such a database would improve Eugene-Springfield Fire, and other planning/response departments, to plan for and respond to structural collapses after a major event.	Develop a database of unreinforced masonry buildings (URMs) for first responders to utilize for planning and response operations. Areas include Eugene, Springfield, and parts of Lane County (Eugene-Springfield Fire's response area).	Eugene-Springfield Fire, Eugene Emergency Management, Springfield Emergency Management	Employee Time	2023
6		**P**										**Springfield Critical Facilities Retrofit**	**Many structures in the Eugene-Springfield area are not up to current seismic standards. With the risk posed by earthquakes to this area, it is vital critical infrastructure is retrofitted.**	**Implement phase two of the seismic retrofit of Springfield City Hall and three Springfield Fire Stations.**	**Springfield Facilities, Springfield Emergency Management**	**$1.5 million**	**2025**
7		**P**								**S**		**Emergency Fuels Assessment - Phase II**	**In the Fall of 2019, the City of Eugene completed phase one of the Emergency Fuels Assessment for Lane County to evaluate how a major event could disrupt the areas' fossil fuel supplies critical for emergency response after a large event. It is well documented Oregon's fossil fuel infrastructure is extremely vulnerable, especially from a major earthquake.**	**Finish phase two of the Emergency Fuels Assessment for Lane County to determine the best allocation and rationing methods for fossil fuels after a catastrophic event such as a Cascadia Subduction Zone (CSZ) earthquake when usable fuel to run emergency response operations will be very limited.**	**Eugene Emergency Management**	**$45,000**	**October 2021**

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8		**P**								**S**		**Increase Fuel Capacity**	**It is well documented a CSZ earthquake would severely limited available fossil fuel resources critical for emergency response and recovery. With limited options for the refueling of publicly owned emergency response vehicles it is critical that methods to expand fuel capacity within the Cities are explored.**	**Research methods to increase fossil fuel capacity around critical facilities such as upgrading generator fuel tanks to high capacity tanks.**	**Eugene Emergency Management, Springfield Emergency Management, Eugene Public Works, Springfield Development & Public Works**	**Employee Time**	**2024**
9		**P**										**Seismically Retrofit Eugene Fueling Station**	**The City of Eugene owns one fueling station build before current seismic standards were adopted.**	**Seismically retrofit the Eugene fueling station and associated buildings to ensure it is usable after a CSZ earthquake.**	**Eugene Emergency Management, Eugene Public Works**	**TBD**	**TBD**
10		P										Earthquake Damage Study	In 2018, City of Eugene Emergency Management staff members identified discrepancies between the HAZUS earthquake damage estimates, highlighted in the State of Oregon's 2015 NHMP and in the 2014 Eugene-Springfield Multi-Jurisdictional NHMP, and their planning assumptions. Through working with DOGAMI, it was determined that the initial earthquake damage assessment was completed using generic infrastructure information. Updated data inputs could dramatically increase earthquake damage estimates which are vital for planning purposes.	In partnership with DOGAMI, update the earthquake damage estimate study for the Eugene-Springfield area.	Eugene Emergency Management, Springfield Emergency Management, in partnership with DOGAMI	TBD	2021
11		P										Seismic Upgrades - Eugene	Many structures in the Eugene-Springfield area are not up to current seismic standards. With the risk posed by earthquakes to this area, it is vital critical infrastructure is retrofitted.	Finish seismic upgrades to City owned facilities.	Eugene Emergency Management, Eugene Facilities	TBD	2030

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12		P										Wastewater Pump Station Retrofit	A recent review of the West Irwin Pump Station's vulnerability indicated the station is not seismically sound. The West Irwin Pump Station was originally constructed in 1964. It is the second largest pump station in Eugene, with a service area of approximately 3,300 acres. This station has a firm capacity of 11 million gallons a day (MGD), with a maximum flow of 21 MGD.	Retrofit the Pump Stations to meet current seismic standards.	Eugene Public Works, MWMC , Springfield Development and Public Works	$8 Million	June 2022
13			P									Outreach Awareness	Extreme weather (tornadoes, damaging hail, and lightening) are rare in the Eugene-Springfield area, but could occur. With the rarity of these events, many people do not know what to do if a large tornado or damaging lightening or hail were to occur.	Research and incorporate extreme weather safety awareness into the Cities' public outreach program.	Eugene Emergency Management, Springfield Emergency Management	Employee Time	2023
14				P								Update Floodplain Maps	Current floodplain maps are extremely outdated and do not reflect current river conditions.	Actively seek funding to update the Eugene-Springfield floodplain maps focusing on the Willamette River through Eugene and the Mill Race, Willamette River through Glenwood, and the 42nd Street Levee Seclusion Zone in Springfield.	Eugene Emergency Management, Springfield Emergency Management	$5 million	2030
15				**P**								**Levee Certification**	**There are several existing levee or flood control structures in Springfield that were built prior to certification standards.**	**Seek and maintain certification of the 42nd Street Levee and other flood control structures within Springfield.**	**Springfield Emergency Management, Springfield Development and Public Works**	**$2 million**	**2025**
16				P								Streambank and Erosion Control	Several areas along the McKenzie River are experiencing erosion. This erosion is risking both the 42nd Street Levee and the EWEB water intake.	Stream bank stabilization near the 42nd street levee.	Springfield Emergency Management, Springfield Development and Public Works, EWEB	$2 million	2024

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17					P							Stormwater Improvements	Several areas within the Cities of Eugene and Springfield experience mild to moderate flooding due to stormwater. Some locations experience regular flooding and significant damages or road closures.	Projects include culvert replacements and streambank stabilization. Using prioritization criteria, the highest priority stormwater capital projects are selected for inclusion in the Cities' Capital Improvement Programs. Projects prioritization criteria include whether a project addresses a potential risk to life or property (e.g. flooding), and whether it resolves an ongoing repetitive issue.	Eugene Public Works, Springfield Development and Public Works	$1 million	2030
18					P							Stormwater Master Plan Updates	Several areas within the Cities of Eugene and Springfield experience mild to moderate flooding due to stormwater. Some locations experience regular flooding and significant damages or road closures.	Update the City of Eugene's 2002 Stormwater Basin Plan, and Springfield's 2008 Stormwater Facility Master Plan, including stormwater-related data, hydraulic modeling of the system, any recommended changes to design standards, and a prioritized list of stormwater capital projects. This plan guides stormwater management in each City's local stormwater basins for the next decade and beyond.	Eugene Public Works, Springfield Development and Public Works	$800,000	December 2025
19					P							Stormwater and Climate Change Impacts	It is known climate change will effect our weather. Rain is expected to become less frequent, but with more intense showers. This is expected to change flooding traditionally seen in this area and tax the local stormwater system event further.	Evaluate stormwater design standards taking into consideration climate change modeling.	Eugene Public Works, Springfield Development and Public Works	$250,000	2022
20	S	S	S	S	S	P	S	S	S	S	S	Continuity of Operations Plans	During a moderate to catastrophic event normal methods of document storage and retrieval may not be available. Limited or no access to critical documents can cripple response and recovery efforts.	Develop Continuity of Operations Plans (COOP) for the City of Eugene's Public Works, Police, Fire departments, and all Springfield departments.	Eugene Emergency management, Springfield Emergency Management	Staff Time	2025

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21		S					P					Analysis of 2018 DOGAMI Landslide Study	The Willamette Valley is prone to landslides. A new DOGAMI study puts the risk to the South Hills of Eugene and Southeast Hills of Springfield at a higher risk than previously expected. With development expected in those area, a committee must review and recommend next actions based on the DOGMAI report to ensure safe and resilient development.	Using the DOGAMI landslide study released the summer of 2018 (IMS-60), determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.	Eugene Emergency Management, Springfield Emergency Management, Eugene Planning and Development Department, Springfield Development and Public Works Department	Staff Time	2024
22								**P**				**Fuels Reduction**	**The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.**	**Reduce fuels on public lands, focusing on the hillsides in the southern portion of both Cities.**	**Eugene-Springfield Fire, Eugene Public Works, Springfield Development and Public Works.**	**$200,000**	**2025**
23								P				Community Wildfire Protection Plan (CWPP)	The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.	Develop the Eugene-Springfield Community Wildfire Protection Plan.	Eugene-Springfield Fire, Eugene Public Works, Springfield Development and Public Works, Eugene Emergency Management, Springfield Emergency Management	$90,000	2022

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24								P				Update the Wildland-Urban Interface (WUI) Plan	The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.	Update the Eugene-Springfield WUI plan and address access routes.	Eugene-Springfield Fire	Staff Time	2025
25								S	P	S		Species Specific Tree Removal	We have a number of tree species in our inventory that are known to be susceptible to failure in storms and under normal weather conditions. This is due to pests (i.e. emerald ash borer), disease (i.e. thousand canker disease) and structural problems endemic to the species (i.e. sweetgum with included bark, big leaf maple) with decay, etc.	Identify and remove species with known failure profiles and potential defects. Plant or replant drought tolerant and disease, pest and damage resistant tree species. Work with City departments, contractors and non-profits to complete this work.	Eugene Public Works, Springfield Development and Public Works	$200,000	2020
26									**S**	**P**		**Defective Tree Maintenance**	**Wind, ice, and heavy snow can topple trees or cause large limb failure leading to blocked roads, infrastructure damage, and electrical hazards and outages. This was evident during the ice storm of 2016 and snow storm of 2019.**	**Utilize contract crews to perform maintenance pruning. Provide clearance and mitigate defects, such as overextended branches prone to failure under increased loads, along major arterials and priority traffic routes. Unhealthy or structurally unsound trees will be removed and replanted.**	**Eugene Public Works**	**$200,000**	**2022**
27										P		Sheltering	During the snowstorm of 2019 the American Red Cross's sheltering resources were utilized in rural areas leaving the Cities without the sheltering reserves they typically rely on.	Develop a consolidated plan for community sheltering and associated outreach needs to provide sheltering, during large scale events or incidents when American Red Cross resources are diverted elsewhere. This will allow the Cities to provide emergency shelters even during events or incidents when the American Red Cross may not be able to provide these services to the Cities.	Eugene Emergency Management, Springfield Emergency Management	$250,000	2026

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28											P	Lahar Risk Study	Lahars can often be the most damaging port of a volcanic eruption to a community. Initial USGS predictions show the Eugene-Springfield area could be impacted by such an event during an eruption of one of the nearby volcanoes. It is unknown what impacts the local area would experience, however.	Evaluate the lahar risk to the McKenzie River valley.	Eugene Emergency Management, Springfield Emergency Management	$200,000	2024
29											P	Ash Removal	At this time, though volcanic ashfall is a low risk hazard, it is unknown how the Cities would remove and dispose of such debris.	Research ash removal methods.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2025
30		P		S						S		Food Supplier Coalition	Some 90% of food consumed locally is produced outside of the area. The vast majority of food consumed in the Eugene-Springfield area is brought in by truck and trailer on I-5 from distribution centers in San Francisco and Portland. Local grocery stores have a three-day supply of food at any one time. Severe flooding, severe winter storm, or severe earthquake events can cause disruption to the resupply of local grocery stores.	Develop a coalition of food suppliers to identify options to address supply chain concerns after a major disaster.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2027
31	S	P	S	S	S	S	S	S	S	S	S	Vulnerable Populations Two Weeks Ready	Vulnerable populations are often disproportionally negatively effected by natural disasters. In 2017 the Cities of Eugene and Springfield started pursuing outreach to non-governmental organizations which support these populations, specifically those individuals with mobility issues. These initial outreach events were very successful, but a coordinated effort to conduct such outreach regularly has yet to be pursued.	Utilizing relevant vulnerable populations maps, developed for the Lane Livability Consortium, develop an outreach plan to engage vulnerable populations to be two weeks ready with emergency supplies.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2022

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32	S	P	S	S	S	S	S	S	S	S	S	Long-term Care and Nursing Home Facilities Emergency Planning Assistance	In 2017 the Centers for Medicare & Medicaid Services started enforcement of their final rule "Emergency Preparedness Requirements for Medicare and Medicaid Participating Providers and Suppliers" which set specific requirements for long-term care and nursing home facilities emergency planning and preparedness. Despite the rule, significant support and/or resources were not provided. Since the rule was put in place the Cities along with Lane County Public Health have received numerous phone calls requesting information or assistance by various long-term and nursing home facilities in the local area.	Support and assist Lane County Public Health in developing and conducting trainings or outreach on emergency preparedness and planning for long-term and nursing home facility leadership as they take steps to comply with the Emergency Preparedness Rule set forth by the Centers for Medicare and Medicaid Services.	Lead: Lane County Public Health Support: Eugene Emergency Management, Springfield Emergency Management	Staff Time	2025
33	S	P	S	S	S	S	S	S	S	S	S	Public Safety Communications Reliability	Many of the components of the LRIG Radio System were not designed and/or installed to provide public safety grade reliability directly or via back-up systems. This radio system is critical for first responder communications following a disaster.	Work with the Lane Radio Interoperability Group (LRIG) System partners to develop a first responder communication system with public safety grade reliability.	Eugene-Springfield Fire, Eugene Police, Eugene Public Works, Springfield Development and Public Works, Springfield Police	$10 million	2030
34		P	S	S	S	S	S	S	S	S		Damage Assessment Plan	Eugene is currently preparing a comprehensive all-hazards Damage Assessment Plan. Springfield intends to modify Eugene's Plan for its use so that both cities have a coordinated Plan.	Finalize the Eugene-Springfield Damage Assessment Plan	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2022

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35		**P**	**S**	**P**	**S**		**S**	**P**				**Mass Evacuation**	**Eugene and Springfield do not have all-hazard Mass Evacuation Plans.**	**Develop and exercise a City evacuation plan**	**Eugene Emergency Management, Springfield Emergency Management**	**$450,000**	**2024**
36		P				P						Currin Substation Upgrades	EWEB operates 33 substations that are essential assets for power delivery to our community; most were built before awareness of seismic risk to the Northwest electric grid. EWEB will systematically upgrade each substation to meet current seismic codes and increase reliability of these assets to withstand a range of natural disasters.	Rebuild Currin Substation to include seismic upgrades and the Institute of Electrical and Electronics Engineers standards to reduce risk of interference with electrical equipment from geomagnetic disturbances.	EWEB	$750,000	2020-2021
37		P										Roosevelt Operations Center (ROC) Seismic Upgrades	This critical facility was originally built for electric and water operations, engineering and field crews, but is being updated to consolidate nearly the entire utility workforce. Seismic upgrades as well as re-location and reinforcement of primary and secondary communications are an essential component of the consolidation efforts.	Seismically retrofit EWEB's Roosevelt Operations Center (ROC) to remain operational after an earthquake. After completion move EWEB's dispatch into ROC from the EWEB Headquarters and build a new backup Dispatch Center in a seismically sound building near Hayden Bridge.	EWEB	$3.5 million	2018-2021
38		P			S	P			S	S		New Holden Creek Substation	This project replaced an older substation and electrical equipment located right along the river's edge to a more secure location with equipment built to current seismic standards. The next phase will add a second transformer to create more redundancy for upriver customers, while re-wiring significantly reduces exposure to electric outages caused by tree limbs on wires.	Replace older substation with new Holden Creek Substation to include seismic upgrades and the Institute of Electrical and Electronics Engineers standards to reduce risk of interference with electrical equipment from geomagnetic disturbance. This project will replace the Leaburg Substation on the riverbank and move 17 miles of overhead electrical lines.	EWEB	$7 million	2018-2019

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39		P										Baseline Reservoirs Seismic Upgrades	None of EWEB's main reservoirs meet current seismic or drinking water site security standards, the oldest of which was built in 1939. EWEB plans to upgrade these facilities as well as build a reservoir on another site to further diversify our water supplies.	Replace baseline reservoirs with facilities meeting current seismic codes.	EWEB	$10 million per site	2023 (First Reservoir)
40		S					P					All-Restraint Water Mains - EWEB	For areas on our service territory that are prone to landslides, using this technology when main replacements occur will reduce the likelihood of water main breaks, causing outages and potential boil-water notices.	Use all-restraint water mains in areas prone to landslides.	EWEB	Two times the cost of standard piping.	2030
41		S		P								Upgrade Water Chlorination System	The existing water chlorination process was identified as a single point of failure as there is one product supplier in our region. The new liquid hypochlorite system also reduces the risk of a hazardous materials exposure to employees and nearby residents during natural disasters.	Replace gaseous chlorine at the filtration plant with an on-site liquid hypochlorite system with a 90 day on-site storage supply.	EWEB	$3 million	2019
42		S	S				S	S	S	P		Replace Transformer Mineral Oil	EWEB has over 16,000 transformers in our electric distribution system, many of which or mounted on electric poles. When poles are hit by cars or fail during storms, the transformers leak oil which creates hazardous materials risk and slows restoration times. 427 transformers will be replaced in the upriver portion of our system, replacing mineral oil with a less toxic transformer oil.	Replace mineral oil with nontoxic FRP, a natural ester derived from renewable vegetable oils providing improved fire safety, transformer life, and environmental benefits, in all new transformers to reduce spill risk when poles fall or transformers fail.	EWEB	$800,000	2030
43	S	P						S				Micro-Grids	Micro-Grid technology allows facilities to operate independently of the electric grid. EWEB installed micro-grids may use a combination of solar, battery and generator technologies to operate well pumps to supply emergency water to our community.	Establish micro-grids at critical facilities for drinking water distribution and independent electrical operation. Micro-grids at Howard Elementary School and ROC are currently under development.	EWEB	$1 million	2018-2023

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44		S						S	P	S	S	Blackstart Capabilities	Most of EWEB's power comes from the Bonneville Power Administration and EWEB is in the southern-most portion of their transmission system. In the event of a regional power failure involving the BPA system, Eugene is not expected to be a high restoration priority. EWEB is contracting out technical studies to better understand capabilities and what investments are needed to enable our local generating facilities to serve at least a portion of our community's power needs.	Test blackstart capabilities, load requirements, and transmission switching needs for Leaburg hydro-electric plant to power critical facilities in Eugene during major outages.	EWEB	$50,000	2019-2023
45									S	P		Electric Line Re-framing and Undergrounding	FEMA Hazard Mitigation Project #406 addresses system resiliency improvements in areas experiencing more frequent and prolonged electrical outages.	Re-frame 4.3 miles of electric line and underground 1.5 miles of line in 15 high outage areas.	EWEB	$2.7 million	2019-2020
46	S	P						S				Emergency Water Distribution	With one source of supply and a single transmission corridor delivering water to 200,000 residents, our drinking water system is particularly vulnerable. Emergency water sites will be distributed throughout neighborhoods to provide 2-3 gallons of water to area residents for public health and safety.	Develop emergency water distribution sites using seismically sound wells at local schools or community centers. There are three sites currently in design and construction.	EWEB	$200,000 per site	2018-2023
47							S		S	P		Seismic Upgrades - Substation Equipment	EWEB has prioritized nine most critical substations to reinforce equipment to better withstand earthquakes.	Seismically anchor transformers and control buildings and add flexible bus connections at each substation.	EWEB	$1.2 million	2019-2027
48	S	P						S				Secondary Water Treatment Facility	While EWEB has invested heavily to upgrade infrastructure at the Hayden Bridge Filtration Plant, it is still a single facility built sixty years ago. A smaller, second water treatment plant, preferably on a different river, would greatly increase redundancy of our water supply.	Construct a new water filtration plant on the Willamette River for a secondary source of and treatment/delivery option for drinking water.	EWEB	$50 million	2023-2030

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49	S	P						S				Mobile Water Treatment	A significant portion of Eugene does not have access to groundwater, restricting the location of emergency water distribution sites. A mobile treatment facility would enable EWEB to provide emergency water to such locations, particularly southwest Eugene.	Construct and test a mobile treatment trailer capable of delivering potable water from sources like rivers or pools using a bio-filtration process.	EWEB	$80,000	2019
50		P										Seismically Stable Pipes and Valves	Pipes and valves not specially designed to resist earthquakes experience significant failure after an earthquake.	Install flexible joints and seismically activated isolation valves at Moe Hill (Vitus Butte) Reservoir.	Rainbow Water District	$535,000	2017-2021
51		P		S								Chlorine Gas Valve Actuators	In the event of strong ground shaking, a chlorine cylinder may become damaged and release gas that could be detected by a chlorine gas sensor.	Install automatic valve actuators for chlorine gas cylinders at all wellfields (Chase equipped 2018).	Rainbow Water District	$50,000	2018-2020
52		P	S	S		S	S	S	S	S	S	Emergency Communication	Standard voice and data communications rely on fiber optic lines that may become damaged, requiring line-of-sight radio communications as a backup.	Install HAM radio and emergency data transmission antennas at Kelly Butte and/or Moe Hill Reservoirs.	Rainbow Water District	$30,000	2019-2021
53		P	S	S		S	S	S	S	S	S	Redundant Control System	Damage to the 42nd Street levee or a has mat incident on Highway 126 could result in the evacuation of the primary control center, requiring relocation to a backup facility for water system control and operations.	Install redundant control system capability at Chase WTP.	Rainbow Water District	$35,000	2019-2021
54				P								NOAQ Boxwall	Water source and treatment facilities near the McKenzie River have some increased risk of flooding and would benefit from a portable flood barrier that could provide an additional margin of safety during high water events.	NOAQ Boxwall or equivalent for flood protection at Chase WTP.	Rainbow Water District	$20,000	2019-2021
55	S	P	S	S		S	S	S	S	S	S	Transfer Switch and Generator	In the event of a regional power outage, a trailer-mounted generator could be transported and connected by transfer switch to larger wells to provide on the order of one million gallons per day if piping systems are intact.	Install transfer switch at I-5 wells and obtain trailer-mounted generator for Chase or I-5 wells.	Rainbow Water District	$150,000	2019-2021

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56	S	P	S	S		S	S	S	S	S	S	Emergency Water Distribution Site	In the event of a regional power outage, or broken distribution piping, emergency water sites distributed throughout neighborhoods would allow portable generators and small wells to provide 2-3 gallons of water per day to area residents for health and safety.	Develop three small emergency water distribution sites located at or near private wells with tested water.	Rainbow Water District	$25,000 per sites	2019-2023
57		S					P					All-Restraint Water Mains - RWD	For areas prone to landslides, using this technology when main replacements occur will reduce the likelihood of water main breaks causing outages and potential boil-water notices.	Use all-restraint water mains for landslide risk transmission mains.	Rainbow Water District	Two times the cost of standard piping.	2019-2029
58		P		S		S			S	S		Glenwood Sub Station			Springfield Utility Board	$5 million	2015-2022
59		P		S		S			S	S		Thurston Water Treatment Plan			Springfield Utility Board	TBD	2020-2028
60		P										Seismic Upgrades		Seismically retrofit critical electric facilities.	Springfield Utility Board	$7 million	2018-2019
61		P										57th Street Reservoir Retrofit		Seismically retrofit the South 57th Street Reservoirs.	Springfield Utility Board	$2.4 million	2019-2023
62		P										Moe Reservoir Retrofit		Seismically retrofit the Moe Reservoir.	Springfield Utility Board	$279,900	2020-2024
63		P										Seismically Stable Pipes		Replace 4000 feet of water distribution system pipeline.	Springfield Utility Board	$910,000	2019-2028
64		P		S					S	S		Substation Protection Upgrades			Springfield Utility Board	$1.14 million	2019-2028
65		P		S		S			S	S		Electric Distribution System Upgrades			Springfield Utility Board	$242,000	2019

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Appendix B: Planning and Public Process Part 1: Planning
Part 1: Plan

Development Process Overview

As discussed in Section 1, the NHMP Update Committee is composed of four distinct groups:

- The **Project Team** is responsible for physically updating and editing the NHMP and was composed of the following individuals:
    - Jessica Gourley – Project Manager – City of Eugene
    - Kevin Holman – City of Eugene
    - Carrie Karl – City of Eugene
    - Ken Vogeney – City of Springfield
    - Jeannine Parisi – Eugene Water & Electric Board
    - Tracy Richardson – Springfield Utility Board
    - Jamie Porter – Rainbow Water District

- The **Steering Committee** is composed of departments and sub-plan entities responsible for development and implementation of mitigation items. The following individuals represented the associated entities:
    - Randi Bowers-Payne, City of Eugene
    - Myrnie Daut, City of Eugene
    - Greg Ferschweiler, City of Springfield
    - Chris Heppel, City of Eugene
    - Jill Hoyenga, Eugene Water & Electric Board
    - Louranah Janeski, City of Eugene
    - Eric Johnson, City of Eugene
    - Ray Joseph, City of Eugene
    - Doug McGillivray, Eugene Water & Electric Board
    - Lisa McLaughlin, Eugene Water & Electric Board
    - Matt McRae, City of Eugene
    - Mark Rust, City of Springfield
    - Tod Schwartz, City of Springfield
    - Melysa Slavkovsky, City of Eugene
    - Katie Terrazas (Blair), City of Eugene
    - Patence Winningham, City of Eugene

- The **Advisory Board** is composed of stakeholders who lend their knowledge based on their experience, training, or insight to help develop mitigation items.

- The **Community**– residents of Eugene and Springfield offer their insight, input, concerns, and support for hazards as well as possible mitigation items. This entity is usually represented by members of the Eugene-Springfield Community Emergency Response Team (CERT) or by specific mitigation outreach events for the community.

The primary implementation group for the Eugene-Springfield Area Natural Hazards Mitigation Plan is the NHMP Steering Committee. The NHMP Update Committee is composed of all four groups and meets quarterly to coordinate implementation efforts.

The NHMP Project Team conducted the initial vulnerability assessment utilizing the 2014 Regional Climate and Hazards Vulnerability Assessment and the studies which developed out of it. The Risk Matrix is part of this assessment. Once complete, the Project Team brought the Vulnerability Assessment results to the full NHMP Update Committee on October 29, 2018 for review. Based on this review, edits were made, and the Vulnerability Assessment and Risk Matrix were finalized.

Once the vulnerability assessment process (described in Section 4) was complete, the NHMP Project Team (identified in Section 1.1.1) and members of the NHMP Steering Committee (identified in Section proposed a number of mitigation strategies to address some of the most pressing vulnerabilities highlighted by the assessment. The Project Team met in January and the Steering Committee met in April of 2019. Purposed mitigation strategies were brought to the full NHMP Update Committee at the end of April 2019 for review.

The NHMP Project Team and Steering Committee vetted mitigation strategies through a detailed review and discussion of each strategy proposed. Following this review, actions in need of additional refinement were identified by the Project Manager who then met with partners critical to the implementation of the mitigation action in question. For example, for the Mitigation Action Item *Community Wildfire Protection Plan (CWPP)* a meeting was set up with staff from Eugene Public Works, Eugene-Springfield Fire, Lane County Emergency Management, and the U.S. Forest Service to discuss the implications of the mitigation strategy. This process was repeated for any critical Mitigation Action Item requiring more development. NHMP Sub-Plan Holders (EWEB, RWD, and, SUB) conducted similar reviews for their purposed Mitigation Action Items.

Meeting Descriptions

Below is a brief description of the NHMP Update Committee, Project Team, and Steering Committee meetings – starting with the most recent, including those scheduled, but not yet completed at the time of this update's publishing:

NHMP Update Committee

Date: August 27, 2019 3:00 pm to 4:30pm

Attendees:

- Ken Vogeney, City of Springfield Emergency Management
- Kevin Holman, City of Eugene Emergency Management
- Frank Wilson, Lane Transit District (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Selene Jaramillo, Lane County Public Health (Advisory Board)
- Zach Silva, Lane County Public Health

Topics:

- Review of the full 2020 Eugene-Springfield Area Natural Hazards Mitigation Plan 2020 Update.
- Update timing of formatting of NHMP 2020
- Next steps toward approval of NHMP

NHMP Update Committee

Date: April 29, 2019 3:00 pm to 4:30 pm

Attendees:

- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- 2020 Mitigation Action Item review and approval.
- 2014 NHMP Mitigation Action Item updates.

NHMP Steering Committee

Date: April 2, 2019 9:00 am to 11:00 am

Attendees:
- Eric Johnson, City of Eugene Public Works – Maintenance Division
- Matt Rodrigues, City of Eugene Public Works – Engineering Division
- Mel Damewood, Eugene Water & Electric Board – Engineering and Operations Chief
- Ken Vogeney, City of Springfield Emergency Management
- Kevin Holman, City of Eugene Emergency Management

Topics:
- 2020 Mitigation Action Item selection.

NHMP Project Team

Date: January 22, 2019 10:30 am to 12:30 pm

Attendees:
- Jessica Gourley, City of Eugene
- Katie Terrazas (Blair), City of Eugene
- Ken Vogeney, City of Springfield
- Kevin Holman, City of Eugene
- Patence Winningham, City of Eugene

Topics:
- Review of 2014 Mitigation Action Items
- What 2014 Mitigation Actions Items to move forward to the 2020 NHMP Update.
- What 2014 Mitigation Action Items are completed, modified, or canceled.
- Selection of 2020 NHMP Mitigation Action Items

NHMP Update Committee

Date: January 28, 2019 3:00 pm to 4:30 pm

Attendees:
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)

- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas (Blair), City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Sarah Pulse, Lane County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- Review of the full 2020 Eugene-Springfield Area Natural Hazards Mitigation Plan 2020 Update.

NHMP Update Committee

Date: October 29, 2018 3:00 pm to 4:30 pm

Attendees:

- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Ken Vogeney, Springfield Emergency Management (Project Team)
- Kevin Holman, Eugene Emergency Management (Project Team)
- Mark Nystrom, City of Eugene City Manager's Office (Advisory Board)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Selene Jaramillo, Lance County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- DOGAMI Landslide Conclusion Briefing
- Public Outreach Update
- 2014 NHMP Mitigation Action Item Updates

NHMP Update Committee

Date: July 30, 2018 3:00 pm to 4:30 pm

Attendees:

- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Jeannine Parisi, Eugene Water &Electric Board (Project Team)
- Ken Vogeney, Springfield Emergency Management (Project Team)
- Kevin Holman, Eugene Emergency Management (Project Team)
- Mark Nystrom, City of Eugene City Manager's Office (Advisory Board)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Selene Jaramillo, Lance County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- Detailed review, status, and updates of the 2014 NHMP Mitigation Action Items
- Public Outreach update
- Group Share concerning Mitigation Action Items or other mitigation work

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NHMP Project Team

Date: April 30, 2018 10:30 am to 12:30 pm

Attendees:

- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Carl Stubbs, Eugene School District 4J (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Frank Wilson, Lane Transit District (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Geoff Simmons, Eugene-Springfield Community Emergency Response Team (CERT)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas (Blair), City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Linda Cook, Lane County Emergency Management (Advisory Board)

- Louranah Janeski, City of Eugene Public Works – Floodplain Manager (Steering Committee)
- Mark Rust, City of Springfield (Steering Committee)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Sarah Puls, Lane County Public Health (Advisory Board)

Topics:
- DOGAMI Landslide Mapping and Mitigation Update
- Public Outreach Update
- 2014 NHMP Mitigation Action Item Update

NHMP Update Committee

Date: January 29, 2018 3:00 pm to 4:30 pm

Attendees:
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Linda Cook, Lane County Emergency Manager (Advisory Board)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Randi Bowers-Payne, City of Eugene (Steering Committee)

Topics:
- Review the 2020 NHMP Section 1 update
- Review the 2020 NHMP Section 2 update
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: October 30, 2017 3:00 pm to 4:30 pm

Attendees:
- Doug McGillivray, Eugene Water & Electric Board (Steering Committee)
- Frank Wilson, Lane Transit District (Advisory Board)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)

- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Lily Gillilan, Upper Willamette Soil and Water Conservation District (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Sarah Pulse, Lane County Public Health (Advisory Board)
- Tina Romero, Student/Community Member (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- Work plan and quarterly meeting outline
- 2020 NHMP Section 1 update review
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: July 31, 2017 3:00 pm to 4:30 pm

Attendees:

- Chris Heppel, City of Eugene (Steering Committee)
- Doug McGillivray, Eugene Water &Electric Board (Steering Committee)
- Greg Ferschweiler, City of Eugene (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Jim Polston, City of Springfield (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeskie, City of Eugene Flood Plan Manger (Steering Committee)

Topics:

- “Special Districts” and other FEMA updates
- 2020 NHMP update/rewrite timeline update
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: April 24, 2017 3:00 pm to 4:30 pm

Attendees:

- Bill Burns, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Frank Wilson, Lane Transit District (Advisory Board)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Matt Hastings, 4J School District (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Nancy Calhoun, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Teresa Lang, Lane Transit District (Advisory Board)
- Tod Schwartz, City of Springfield (Steering Committee)

Topics:

- "Special Districts" official partners to NHMP
- PDM concerns/financial constraints
- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: January 30, 2017 3:00 pm to 4:30 pm

Attendees:

- Becca Puleo, University of Oregon (Advisory Board)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Mark Walker, McKenzie-Willamette Medical Center (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Selene Jaramillo, Lane County Public Health (Advisory Board)
- Tod Schwartz, City of Springfield (Steering Committee)

Topics:

- LPC Economy and Recovery Finance Project
- 2014 NHMP Action Item updates
- Next quarter priorities
- 2020 NHMP update planning

NHMP Update Committee

Date: October 25, 2016 3:00 pm to 5:00 pm

Attendees:

- Becca Puleo, University of Oregon (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)
- Nancy Calhoun, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Selene Jaramillo, Lane County Public Health (Advisory Board)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities
- DOGAMI landslide hazards project update
- Emergency water supply guidebook
- NFIP-ESA biological opinion overview
- 2020 NHMP update planning

NHMP Update Committee

Date: May 24, 2016 4:00 pm to 5:00 pm

Attendees:

- Not available

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities
- Emergency water supply guidebook update
- Portland equity planning and mitigation material share
- Community energy planning, eLab
- NHMP progress report, timeline, and roles

NHMP Update Committee

Date: January 26, 2016 3:00 pm to 5:00 pm

Attendees:

- Bill Burns, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Matt McRae, City of Eugene (Steering Committee)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: October 27, 2015 3:00 pm to 5:00 pm

Attendees:

- Bill Clingman, Lane Council of Governments (Advisory Board)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Mark Walker, Mackenzie Willamette Medical Center (Advisory Board)
- Matt McRae, City of Eugene (Steering Committee)
- Melysa Slavkovsky, City of Eugene (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, 4J School District (Advisory Board)
- Selene Jaramilo, Lane County Public Health (Advisory Board)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: May 11, 2015 1:00 pm to 3:00 pm

Attendees:
- Not available

Topics:
- 2014 NHMP Action Item updates
- Form implementation teams for priority NHMP Action Items
- Updates and adjustments process

NHMP Update Committee

Date: January 26, 2015 3:00 pm to 5:00 pm

Attendees:
- Not available

Topics:
- 2014 NHMP Action Item updates
- Priorities for next quarter

Part 2: Public Process

Public involvement in the update of the Eugene-Springfield Area Natural Hazards Mitigation Plan has been accomplished in multiple ways:

A. 2014 Regional Climate and Vulnerability Assessment
There was extensive stakeholder involvement from community businesses, partner agencies, and non-governmental organizations (NGOs) within the process of conducting the community climate and hazards vulnerability assessment. The 2014 Regional Climate and Vulnerability Assessment Project Team met with a group of eight to twelve representatives from each of the eleven different sectors for six hours each. This extensive effort provided rich detail and clear guidance about the priority areas for natural hazard mitigation in Eugene-Springfield. More detail about the process is in Section 4.4.

B. Lane Preparedness Coalition

The Lane Preparedness Coalition Steering Committee meets multiple times a year. These meetings often included a 5-10 minute status briefing by the NHMP Project Manager. The NHMP update reflects their feedback.

C. Open Houses

EWEB offers yearly open houses (Table BB-1) for the public to learn about project updates, incentive programs, and winter storm mitigation efforts. This yearly effort includes a social media campaign for those unable to attend in person.

Table BB-1 EWEB Open Houses

Date	Event	Audience	# of Attendees	# Reached by Social Media
10/17/2017	EWEB Open House (Figure B-1)	Community Members	70	44,620
10/16/2018	EWEB Open House (Figure B-2)	Community Members	100	21,220

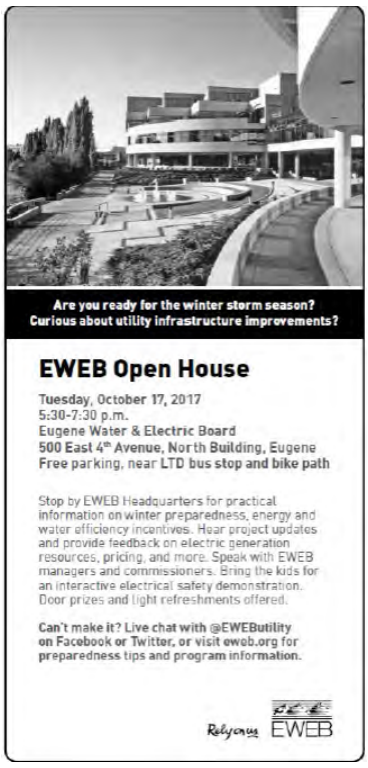




Figure B-1 and B-2. EWEB Open House

D. In Public Events

The NHMP Project Team attended multiple community events to make natural hazard mitigation outreach more engaging and relatable. Community members were asked to provide input through direct comment or voting on specific hazards they would like the Cities to mitigate against as well as specific mitigation projects they would like pursued.

Many projects listed within this plan are 5, 10, or even 15-year projects. With the long-term focus of this plan, in 2018 the Project Team started to involve children in their outreach since some of the projects outline in this plan will be completed after they come of age. Voting results will aid in the selection of Mitigation Action Items as well as track educational outreach efforts.

To record this information, large posters were made with various voting options. Event attendees were asked to place a sticker on the item receiving their "vote". Each attendee received one vote per poster. Adult votes were documented with gold stars while votes from children were recorded using various colored stars (excluding gold).

By making natural hazard mitigation outreach more relatable and engaging Plan and Sub-Plan Holders saw an increase in the number of community members involved in the plan update. Two of the events, Disaster Movie in the Park (Figure B-7) and Public Works Day (Figure B-6), were highlighted in the Strategic Alliance for Risk Reduction (STARR) newsletter for FEMA Region 10 (Figure B-3 and B-4).

News from Region 10

Hazard Mitigation Planning Can Be Fun!

The City of Eugene shows us how

Eugene-Springfield Natural Hazards Mitigation Planning (NHMP) staff, with guidance from OEM and FEMA mitigation experts, decided to switch tactics for their 2020 NHMP update to generate more public involvement. The new outreach efforts started May 17th at Eugene's annual Public Works Day. Staff wanted to determine if there were any gaps between children and adults in their understanding of hazards. Recognizing today's children will manage and influence the plan in 5, 10, or 15 years, staff developed an activity both children and adults could participate in and understand, while helping guide planning efforts.

It was a fast-paced, hands-on event with thousands of people attending. Children and adults talked with staff to learn some of what goes on behind the scenes with the NHMP. While at the booth, participants ranked the natural hazards they thought were the most important to "be stronger against." People were eager to engage with staff. Many were surprised and interested to learn there are people employed in mitigating natural hazards for their community. People asked a host of questions concerning the NHMP and natural hazards the City of Eugene faces.

Responses from the event produced some surprising results. One thing the City recognized was how comparable the public's view of risk was to the NHMP Project Team's risk assessment for the City. Many of the children seemed to have a realistic grasp on many of the



hazards in question. Very few children placed their vote on winter storms while several adults did. We believe this is due to adults remembering the devastating Ice Storm of 2016 and "snow days" are hoped for by children across the nation. Making NHMP outreach more engaging and hands-on proved successful and far surpassed the expectations of NHMP staff.

The next large event will be a "Disaster Movie in the Park" on August 31st. Eugene Water and Electric Board (EWEB) and the City of Eugene, along with support from the City of Springfield, Rainbow Water District, and Springfield Utility Board (SUB), will be partnering to host this event. The format will be similar to the Public Works Day NHMP outreach. Attendees will be asked to vote on specific mitigation action items they would like to see completed followed by an interactive disaster movie.

– Jessica Gourley is an Emergency Management Analyst with the City of Eugene, Oregon. For more information about the event, email Jessica.K.Gourley@ci.eugene.or.us.

RiskMAP
Increasing Resilience Together

Figure B-3. Public Works Day

Movies for Mitigation

By Amanda Siok, FEMA Region 10 Earthquake Program Manager



Our June 2018 Newsletter featured a story on the City of Eugene, Oregon's public outreach efforts for their hazard mitigation plan. Since then, the City has been increasing their reach and expanding their audience in an effort to really learn what their residents want to do to reduce their vulnerability to natural hazards.

In cooperation with the Eugene Water and Electric Board (EWEB), City of Springfield, Rainbow Water District, and Springfield Utility Board (SUB), they hosted a "Disaster Movie in the Park" this August. Using a local park, the city set up voting tables where residents of all ages could vote on specific mitigation projects they want the city to complete. The publicly prioritized projects will feed directly into the plan's hazard mitigation strategy (Elements C4 and C5).

The city had other engaging booths set up for the public to visit. Residents could sign up for Map Your Neighborhood, win prizes by spinning the Water & Electric Board wheel, and learn about mitigation, CRS, and the city's flood programs.

By the time the sun went down, the disaster film "San Andreas" was queued up, the popcorn was ready, and 150 people had voted on mitigation projects. Before the film began, Jessica Gourley with Eugene Emergency Management briefly spoke to the audience about reducing vulnerability to disasters and the value of proactively strengthening the city's infrastructure. Once the movie was over, many residents commented on wanting to prevent damage to their homes and workplaces.

An approved Hazard Mitigation Plan must "document how the public was involved in the planning process during the drafting stage" (Element A3- Local, A2 Tribal). Eugene's efforts met this requirement because the public helped to prioritize the hazards of concern that the city "should be stronger against". In fact, the city of Eugene went above and beyond minimum requirements to fully engage input from the public.

The city of Eugene has done a tremendous job obtaining buy-in to the mitigation message, meaningfully engaging the public in their mitigation plan, and making the required plan update a worthwhile process to increase the resilience of the city. Kudos to Jessica and the rest of the Eugene Emergency Management Team!



Figure B-4. Disaster Movie in the Park



Figure B-5. (left to right) Tracy Richardson (SUB), Jessica Gourley (City of Eugene), (CERT Volunteer), and Ken Vogeney (City of Springfield) and Willamalane Children's Celebration.



Figure B-6. Jessica Gourley (City of Eugene) speaking with voters at Public Works Day


Disaster Movie in the Park
SAN ANDREAS
When: August 31st, festivities begin @ 7:30 pm
movie @ dusk
Where: Washington Park
2025 Washington St. Eugene, OR
➢ Learn about the Eugene-Springfield Natural Hazard Mitigation Plan.
➢ Vote on mitigation projects you think Eugene should complete.
➢ See what EWEB is working on.
➢ Play the Hazards game and win prizes!
➢ Free popcorn!
➢ Fun for the whole family!
Questions:
Jessica.K.Gourley@ci.eugene.or.us
or call 541-682-5762
EWEB
Eugene
Rainbow Water District
SUB
SPRINGFIELD UTILITY BOARD
SPRINGFIELD
OREGON

Figure B-7

Voting Results

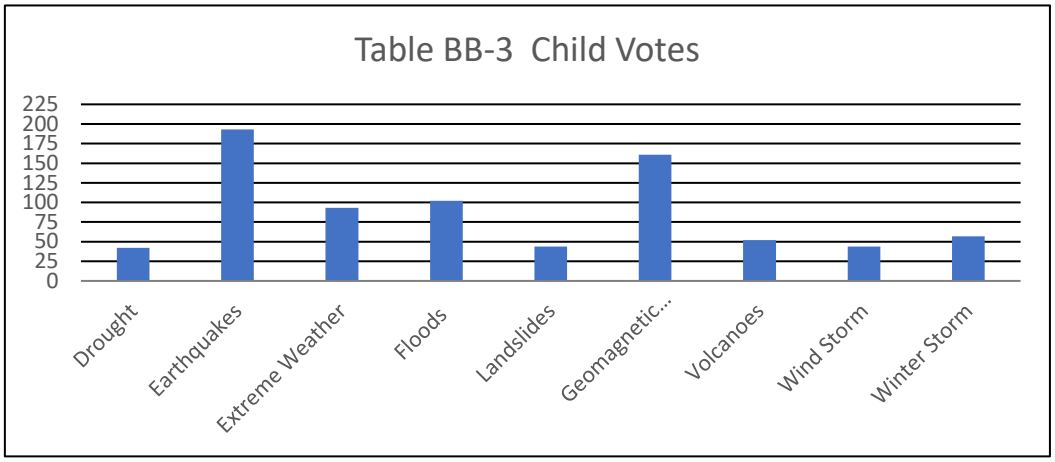
Residents of Eugene and Springfield were asked to vote for what hazard they feel mitigation efforts should focus on as well as specific projects they would like to see completed. Table BB-2 shows votes cast at each outreach event and total votes for all public outreach events. For adults, the hazard mitigation area of focus which received the most votes was earthquakes, followed by floods, geomagnetic disturbances, and winter storms (Table BB-5). The top three hazards children wanted mitigation efforts to focus on were earthquakes, geomagnetic disturbances, and floods (Table BB-3). Adults selected earthquakes, floods, and winter storms (Table BB-4).

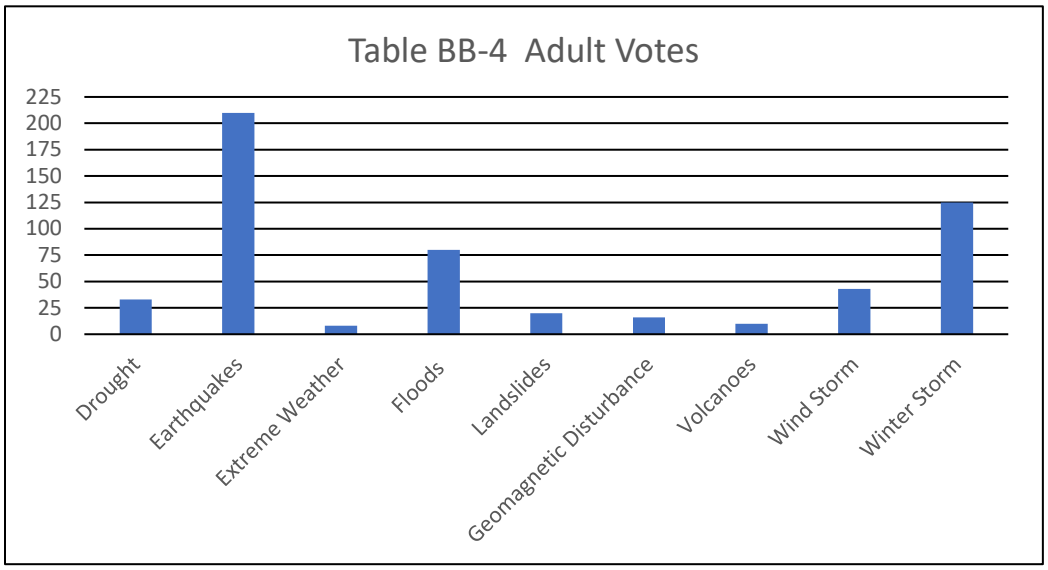
For the second voting option, Disaster Movie in the Park attendees were asked to vote on a selection of mitigation projects grouped by categories (seismic stability for infrastructure, large scale transportation planning projects, and mitigation projects for hazards of moderate risk). Attendees were asked to vote for the project they would like to see competed within each category. The top three projects were:

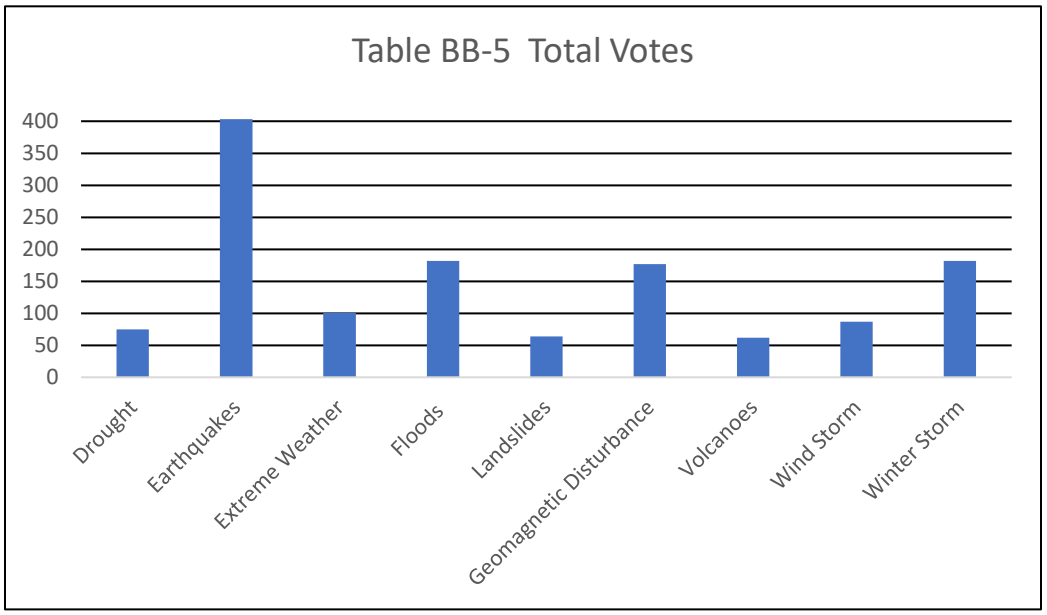
- Seismic retrofits for critical and public infrastructure;
- Dam notification and evacuation planning, with local transportation and lifeline planning, and seismic retrofit projects coming in at a close second; and
- Wildland-urban interface zoning and land development planning.

Table BB-2 Votes Cast

Date	Event	Hazards of Concern Poster		Project Poster
		# of Child Votes	# of Adult Votes	Project Votes
05/17/2018	Public Works Day (Figure B-6)	524	134	-
07/14/2018	Active Bethel Citizens Family Fun Night	25	30	-
07/28/2018	Willamalane Children's Celebration (Figure B-5)	135	126	-
08/31/2018	Disaster Move in the Park	4	29	121
09/29/2018	BRING Event	A2	38	-
10/10/2018	Employee Wellness Fair	0	121	-
10/10/2018	Agnes Stewart Class (AS1)	23	1	-
12/03/2018	Agnes Stewart Class (AS3)	24	0	-
01/15/2019	A3 School	21	2	-
02/12/2019	Agnes Stewart Class (AS2)	25	0	-
01/19/2019	Springfield LDS Stake	5	64	-
Totals		786	542	121


Table BB-3 Child Votes
225
200
175
150
125
100
75
50
25
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic...
Volcanoes
Wind Storm
Winter Storm


Table BB-4 Adult Votes
225
200
175
150
125
100
75
50
25
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic Disturbance
Volcanoes
Wind Storm
Winter Storm


Table BB-5 Total Votes
400
350
300
250
200
150
100
50
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic Disturbance
Volcanoes
Wind Storm
Winter Storm

Emergency Water Station Events

A project to utilize well water, either through rebuilt or new water wells at public sites such as schools, for distribution of water during an emergency emerged out of the 2014 NHMP. As a result, two emergency well sites were commissioned and built in the Eugene-Springfield area. Opening events (Picture B-1 and B-2) allowed Sub-Plan Holders the opportunity to show attendees how to use the emergency wells under non-crisis situations, as well as promote similar mitigation work. These events gave the unique opportunity to not only show community members how to prepare for a water emergency but also how loss of electric and other vital services could impact the delivery of drinking water (Table BB-6).

Table BB-6 Emergency Drinking Water Events

Date	Event	Audience	# of Attendees
10/06/2018	Emergency Water Distribution Station – Bethel Farm (Figure 8)	Community Members	200
9/30/2014	Emergency Water Distribution Station – Howard Elementary (Figure 7)	Community Members	300
N/A	Water containers distributed	Community Members	600



Picture B-1



Picture B-2

Upcoming Public Outreach

The following events (Table BB-7) will occur after we get approval pending adoption from FEMA.

Table BB-7 Public Outreach Events

Date	Event	Audience	# of Attendees
TBD	Display on the City of Eugene website.	Community Members	TBD

Appendix C: Community Profile

Geography and Climate

The Eugene-Springfield area is located in the south end of the Willamette Valley, at the confluence of the Willamette and McKenzie Rivers, between the Coast Range and the Cascade Mountains. The Eugene-Springfield area contains a diversity of landscapes: wetlands, rivers, lakes, creeks, riparian areas, grasslands, uplands, and foothills. In addition to the Willamette and McKenzie Rivers, there are numerous creeks and a canal system running through the area as well as several large lakes and reservoirs including Fern Ridge Reservoir.

The climate for the Eugene-Springfield area is moderate. The average range of high temperature in January is 47 degrees while the average low is 34 degrees. In August, the average high temperature is 83 degrees with an average low of 51 degrees. The recorded annual range of daily temperatures is between 42 degrees and 64 degrees. Each year the Eugene-Springfield area receives about 38 inches of precipitation.[1]

Population and Demographics

Eugene and Springfield make up the largest cities in the Lane Metropolitan Planning Organization (MPO) area. The estimated population of Eugene in 2018 was 169,695 people which is a 20.7% increase since 2010. The annual growth rate is .99%. The estimated population for Springfield in 2018 was 60,865, a 14.1% increase since 2010. Springfield has an annual average growth rate of 1.52%.

Within the Lane MPO, key population and demographic trends include:

- 79.9% of the population identifies as white (non-Latino).
- 14.9% of the population identifies as minority.
- 8% of the population identifies as Latino, an 81% increase since 2000.
- Almost 90.5% of the population speaks only English.
- About 9.5% of the population speaks a language other than English at home, mainly Spanish, Chinese, German, Japanese, and French.
- Nearly 16.5% of people living in the Lane MPO area have one or more disability.
- In Eugene, 52% of all households are family households; and in Springfield 59% of all households are family households. Students living together near the University of Oregon and Lane Community College in Eugene can account for the difference in the number of family households between the two cities.

[1] Western Regional Climate Center. www.wrcc.dri.edu, Eugene, Oregon (352706), accessed. July 26, 2019.

- The largest population by age in the Lane MPO is 25 to 34 year's old and makes up 14.7% of the population.[2]

Additional data regarding Eugene and Springfield's population and social demographics can be found on the Lane Council of Governments' webpage and the Livability Lane Equity and Opportunity Assessment from July 2014.[3] [4]

Employment and Economics

Employment

Eugene and Springfield are the largest centers for employment in the Lane MPO area. The economy has generally been moving away from timber and manufacturing centers and towards a retail and service-based economy. Many jobs are now geared towards retail, healthcare, professional and business services, leisure, and hospitality. In 2018, Eugene's unemployment rate was 4.6% and Springfield's was 4.7%. Unemployment rates have remained generally stable since the 1990s with the highest rates peaking from 2008-2010 during the national economic downturn. Additional information regarding Eugene and Springfield's employment and economy can be found in the Springfield Commercial and Industrial Buildable Lands Inventory and Economic Opportunity Analysis (2015) and the City of Eugene Economic Opportunity Analysis (2010).

Median Household Income

In 2017, the median household income for Eugene was $50,184 and Springfield's was $41,700. For comparison, the median household income for Lane County was $47,710, Oregon was $60,212, and the median income for the United States was $61,372.[5]

Poverty

Using data from 2009-2011, Eugene's poverty rate was 23.5%, and Springfield's was 22.4%. Eugene's rate is affected by a large student population attending University of Oregon and Lane Community College. When college students are removed from the calculation, the poverty rate lowers to 16.2% for Eugene.[6]

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[2] US Census 2010 Block level data, Table P12.
[3] Lane Counsel of Governments 2014. "Demographic Information." http://lcog.org/589/Demographic-Information, accessed July 26, 2019.
[4] Lane Livability Consortium. 2014. "Equity and Opportunity Assessment." http://www.livabilitylane.org/files/EOA_report/LLC%20EOA%20Report%207AUG14_FINAL_sm.pdf, accessed October 29, 2014.
[5] Lane Counsel of Governments 2014. "Demographic Information."
[6] U.S. Census Bureau. 2013. "Examining the Effect of Off-Campus College Students on Poverty Rates." https://www.census.gov/newsroom/blogs/random-samplings/2017/12/off-campus.html?CID=CBSM, accessed June 25, 2019.

Transportation

Transportation is an important consideration when planning for emergency service provisions. Future growth will put pressure on roads, the airport, rail systems, and rivers. The Eugene-Springfield area has been a longstanding choice for transportation interchanges to occur due to the location.

Interstate 5, the major highway that connects Oregon to Washington and California, runs between the cities of Eugene and Springfield. State Highway 99 also runs north-south through the City of Eugene, connecting the area to Junction City to the north and Goshen to the south. State Highway 126 runs east-west through both Eugene and Springfield connecting the Cities to nearby communities such as Walterville to the east and Veneta to the west.

Union Pacific owns and operates the rail system which runs north-southeast through Eugene. Additionally, there is a smaller cargo rail connecting the Eugene-Springfield area to the coast. Amtrak runs passenger trains daily through the area.

The Eugene-Springfield area is home to the Eugene Airport, which is the second largest airport in Oregon and the fifth largest airport in the Pacific Northwest. The airport is owned and operated by the City of Eugene. [7]

Please refer to Section 3 for Eugene and Springfield transportation maps.

Land Use

Eugene contains nineteen different land use designations. Public land is scattered throughout the entire City limits for both Eugene and Springfield. Industrial infrastructure (heavy and light) is centered around Highway 99 and the Pacific Union rail yard as well as along Highway 126 heading west. The majority of the City is zoned Low-Density Residential.

Springfield has designated twenty-two different zones for land use purposes. The majority of Heavy Industrial Zoning is located in the central part of the City and in the northwest corner. Areas zoned for Public Lands & Open Space are spread throughout the City. Additionally, most of the City is zoned Low-Density Residential.

Refer to Section 3 for the Eugene and Springfield Zoning maps.

[7] City of Eugene. 2019. “Transportation Options.” https://www.eugene-or.gov/487/Transportation-Options, accessed July 26, 2019.

Housing

In Eugene, there has been an increase in multi-family housing, due in large part to additional student housing near the University of Oregon. Both Eugene and Springfield have seen a decline in the construction of single-family housing. Regardless, the majority of both Cities are composed (over 50%) of single-family housing with 30% of total housing categorized as multi-family housing. Less than 5% of Eugene, and 9% of Springfield is composed of mobile homes, boats, RVs, and vans.

In Eugene, renters occupy 51.7% of housing and 48.3% is occupied by owners. Springfield is similar with 49.2% of housing occupied by renters and 50.8% occupied by owners. On average, renters in Eugene have a median gross rent of about $959 a month while Springfield is about $862 a month. Eugene's median gross rent is slightly higher than that of Lane County ($921), but lower than Oregon ($988) and the US ($982)[8]. The median monthly owner costs, with a mortgage, are about $1,614 a month for Eugene, and $1,283 for Springfield. Eugene's median monthly owner costs are higher than Lane County ($1,454), Oregon ($1,594), and the US ($1,515).[9]

Historic and Cultural Resources

Historic and cultural resources such as historic structures and landmarks can help define a community and generate revenue from tourism. Because of their role in defining and supporting the community, protecting these resources is important. Eugene has sixty-three sites on the National Register of Historic Places and Springfield has seven. Table CC-1 summarizes the historic sites in Eugene and Springfield built before 1900. Eugene has sixteen pre-1900 sites on the National Historic Registry, and Springfield has five.[10]

[8] US Census Bureau. 2013-2017. American Community Survey, table DP-4.
[9] US Census Bureau. 2013-2017. American Community Survey, table B25088.
[10] National Register of Historic Places. http://www.nps.gov/nr/, accessed July 26, 2019.

Table CC-1 Pre-1900 Historic Sites		
City	**Site**	**Estimated Year Built**
Eugene	Flanagan Site (specific location information restricted)	Pre-European Native American archaeological site
Eugene	Frank L. & Ida Chambers House	1891
Eugene	Chase Gardens Residential Grouping	1889
Eugene	Danie & Catherine Christian House	1885
Eugene	Christian-Patterson Rental Property	1890
Eugene	Deady Hall	1873
Eugene	Blair Boulevard Historic Commercial Area	1875
Eugene	Pioneer Cemetery	1872
Eugene	Masonic Cemetery and Hope Abbey Mausoleum	1859
Eugene	A.V. Peters House	1869
Eugene	Shelton-McMurphy House and Grounds	1888
Eugene	Smeede Hotel	1884
Eugene	Villard Hall	1885
Eugene	Benjamin Franklin Dorris House	1850-1874
Eugene	East Skinner Butte Historic District	1850-1874
Eugene	Lane County Clerk's Building	1853
Springfield	Brattain-Hadley House	1893
Springfield	Robert E. Campbell House	1870
Springfield	Dorris Ranch	1899
Springfield	Southern Pacific Railroad Passenger Station and Freight	1891
Springfield	Larimer House	1885

Table CC-1. Pre-1900 Historic Sites. Source: National Register of Historic Places National Register Information System, accessed November 201442.

Additionally, the National Registry of Historic Places has listed Springfield's Washburne Historic District as worthy of preservation. The Washburn Historic District, established in 1985, has fifteen buildings built between 1885 and 1924.[11]

[11] Springfield Historic Commission. "Washburne Historic District." http://www.ci.springfield.or.us/dsd/planning/hcommission/Site%26Bldgs/Washburne.html, accessed October 29, 2014.

Although not listed on the National Register of Historic Places, the Gray/ Jaqua house on Highway 126 east of Springfield is considered one of the oldest existing buildings in the City of Springfield and is currently being developed into a City park.

Throughout the year, the Cities of Eugene and Springfield have many community events and annual traditions. A few examples include: the Eugene Marathon; track and field events at University of Oregon's Hayward Field, and the weekend markets in both Eugene and Springfield.

Critical Facilities

Critical facilities are facilities that are essential to government response and recovery activities (e.g., hospitals, police, and fire stations). The interruption or destruction of any of these facilities would have a debilitating effect on incident management.

The City of Eugene owns and manages the following facilities:

- Eleven fire stations and a training center
- Three police stations
- A Public Works facility on Roosevelt Boulevard

The City of Eugene and the City of Springfield participate in joint management of the regional wastewater treatment facility.

As the Lane County seat, Eugene also contains several county government facilities including the Lane County Sheriff's Office and Lane County Jail.

The City of Springfield owns and manages the following facilities:

- City Hall
- Five fire stations
- The Springfield Justice Center Facility containing the police department, jail, and courts
- The Maintenance Division facility

The following utilities are locally owned and operated, and work in close partnership with the City of Eugene and the City of Springfield. Information regarding their facilities are located within their respective annexes.

- Eugene Water & Electric Board (EWEB)
- Rainbow Water District (RWD)
- Springfield Utility Board (SUB)

As of 2010, the Eugene and Springfield Fire Departments and Emergency Medical Services (EMS) have merged, and the departments are now jointly serve the Eugene and Springfield communities.

Eugene and Springfield contain a number of significant federal facilities. In Springfield, the National Guard Resource Center houses the National Guard, Federal Reserve forces, and the dispatch center for the U.S. Forest Service's fire fighting forces. Eugene houses the U.S. District Court for the District of Oregon and the 970th Transportation Detachment for the United States Army Reserve 654th Regional Support Group. The Eugene-Springfield area is home to the following hospitals: Sacred Heart Medical Center University District, Sacred Heart Medical Center at RiverBend, and McKenzie-Willamette Medical Center.

Government Structure

Eugene and Springfield both operate under a council-manager framework. The councils enact policy and the City Manager is responsible for operations.

In Eugene, the City Council consists of a mayor and eight City Councilors. The City of Eugene contains the following City departments:

- **Central Services**: Provides centralized support for other City departments. It includes the City Manager's Office, Municipal Court, City Prosecutor's Office, Employee Resource Center, Finance, Facilities Management and Information Services.
- **Eugene Springfield Fire**: Protecting and preserving life, property and the environment through prevention, education, medical, rescue, and fire suppression services.
- **Library, Recreation, and Cultural Services**: Supports an informed society, offers opportunities for lifelong learning and health, and provides cultural experiences.
- **Planning and Development**: Enforces zoning ordinances, works with general public to plan and monitor development activities.
- **Police**: Protecting, training, and enhancing the lives of the residents.
- **Public Works**: Provides a wide range of services and programs related to parks and open space, transportation, stormwater and wastewater infrastructure, and natural resource stewardship.

The Springfield City Council consists of the mayor and six City Councilors elected for four-year terms. The mayor and council are responsible for the appointment of the City Manager, City Attorney, municipal court judges, and advisory committees. Springfield City Hall and the separate Justice Center contain the offices of the following City departments:

- **City Attorney's Office**: Responsible for the legal representation of the City of Springfield. Provides advice and support to the City Council, City staff, and boards and commissions.
- **City Manager's Office**: Directs and coordinates City department plans to help meet City Council goals. Oversees the administration of all City departments and appoints department directors.
- **Development and Public Works**: Enforces zoning ordinances, works with general public to plan and monitor development activities. Designs, constructs, operates, and manages public infrastructure including streets, sanitary sewers, stormwater management facilities, public buildings, and other facilities.
- **Eugene Springfield Fire**: Protecting and preserving life, property and the environment through prevention, education, medical, rescue, and fire suppression services.
- **Finance**: Manages the finances of the City and Metropolitan Wastewater Management Commission and operates Municipal Court.
- **Human Resources**: Supports and develops staff.
- **Information Technology**: Ensures the City's computer and communication systems are efficient, and up to date.
- **Library**: Gives the community access to reading and learning through books, computers, technology, and children's cultural events.
- **Police**: Protects lives and property by enforcing laws, preventing crimes, and operating the municipal jail.

The Willamalane Parks and Recreation District is responsible for managing parks within the City of Springfield.

Existing Plans and Policies

Communities often have existing plans and policies which guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports of studies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt to changing conditions and needs.[12]

At the state level, Statewide Planning Goals, related statutes and administrative rules provide a framework for all local land use planning. Statewide Planning Goal 7 (Natural Hazards) requires local governments to adopt comprehensive plans

[12] Burby, Raymond J., ed 1998. *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.*

(inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards including floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires. In accordance, the Eugene-Springfield Metropolitan Plan is the guiding document for regional land use planning and includes policies related to development in the floodway and floodplain, geologic conditions, and on hillsides. Statewide Planning Goal 7 further states local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery, and mitigation plans.[13] As the City of Eugene and City of Springfield plans, listed below, are being developed or renewed the Eugene-Springfield Area NHMP 2020 findings will be incorporated into the planning process.

The Eugene-Springfield Area Natural Hazards Mitigation Plan includes a range of recommended action items to reduce the area's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the area's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify existing resources which can be used to implement the Mitigation Action Items. Implementing action items through existing plans and policies increases the likelihood projects will be supported, implemented, and updated.

The City of Springfield manages its comprehensive, land use, infrastructure, and capital improvement planning all through a single city department – the Development and Public Works Department. This integration of functions provides a direct conduit for identifying community needs and improvements and integrating them into codes, procedures, and plans. A specific example of this integration would be the update of the City of Springfield's Development Code standards. The City's Emergency Manager is a member of the project team providing recommendations for code amendments related to natural hazards and other relevant issues. Integrated planning also extends to the plans themselves. For example, the City's 5-year Capital Improvement Program (CIP) – A Community Reinvestment Plan, contains a project list which includes a listing of the other plans, such as the Natural Hazards Mitigation Plan, that are related to the project. The City Council conducts a public hearing and adopts the updated CIP every other year.

The following list documents the plans and policies already in place in the Eugene-Springfield area.

- **Plan: Public Facilities and Services Plan**
  Date of Last Revision: 2001, amendments 2011
  Author/Owner: City of Eugene, City of Springfield, Lane County

[13] United States. Oregon Planning Department of Land Conservation and Development. *Goal 7: Areas Subject to Natural Disasters and Hazards; Guidelines A Planning.* September 2001. Accessed November 2019. https://www.oregon.gov/lcd/OP/Pages/Goal-7.aspx

Description: An appendix to the Metro Plan described above, that describes the water, sewer and transportation facilities which are to support the land uses designated in the Comprehensive Plans.
Relation to Natural Hazard Mitigation: Mitigation actions relating to water and wastewater treatment facilities should be linked to goals and policies outlined in the Public Facilities and Service Plans.

- **Plan: Regional Transportation Plan**
  Date of Last Revision: 2017
  Author/Owner: Lane County, City of Eugene, City of Springfield, City of Coburg, Oregon Department of Transportation, Lane Transit District
  Description: Guides the management and development of appropriate transportation facilities in Lane County, incorporating the community's vision, while remaining consistent with State, regional, and local plans including the metro area's comprehensive plan.
  Relation to Natural Hazard Mitigation: Mitigation actions relating to improving transportation facilities should be linked with goals and policies expressed in the transportation system plan.

- **Plan: Eugene-Springfield Metropolitan Area General Plan**
  Date of Last Revision: 2015
  Author/Owner: City of Eugene, City of Springfield, Lane County
  Description: The Eugene-Springfield Metropolitan Area General Plan (also known as the Metro Plan) formerly served as Eugene and Springfield's comprehensive plans. Its current purpose is to provide overarching metro-wide support for the Eugene Comprehensive Plan and the Springfield Comprehensive Plan described below.
  Relation to Natural Hazard Mitigation: Provides overarching policy guidance for future development and land use in the Eugene-Springfield metro area.

- **Plan: Eugene-Springfield Multi-jurisdictional Emergency Operations Plan**
  Date of Last Revision: 2019
  Author/Owner: City of Eugene, City of Springfield
  Description: Details plans and policies for emergency response in all aspects of city life.
  Relation to Natural Hazard Mitigation: This document is primarily response-based but contains elements that are pertinent to mitigation.

- **Plan: Envision Eugene Comprehensive Plan**
  Date of Last Revision: 2017
  Author/Owner: City of Eugene
  Description: The Eugene Comprehensive Plan is new. Previously the Metro Plan served as Eugene and Springfield's comprehensive plans. The plan purpose is to promote sustainability and sustainable land use development, contain urban development, promote redevelopment, protect natural resources, foster

economic vitality, provide efficient and cost-effective services, and ensure a sense of history and place.
Relation to Natural Hazard Mitigation: Provides policy guidelines for future development and land use in Eugene.

- **Plan: Eugene Capital Improvement Program, 2020-2025**
  Date of Last Revision: 2019
  Author/Owner: City of Eugene
  Description: The City of Eugene's Capital Improvement Program (CIP) forecasts the City's capital needs over a six-year period based on various long-range plans, goals, and policies. The program is updated every two years and provides a list of capital improvements programmed for funding in the next five years. These improvements are aimed at improving neighborhoods, providing economic growth, improving traffic safety, complying with environmental standards, and maintaining the existing infrastructure.
  Relation to Natural Hazard Mitigation: CIP projects are selected based on identified needs, available funding and associated limitations, and support or direction from official advisory groups, City Council and other sources of guidance. Projects are compiled from plans and reports including the NHMP 2020.

- **Plan: Development Code (Eugene)**
  Date of Last Revision: 2012
  Author/Owner: City of Eugene
  Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
  Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas. Contains regulations for development on steep slopes

- **Plan: Climate Action Plan 2.0 Draft**
  Date of Last Revision: 2010 (Community Climate and Energy Action Plan, draft 2019
  Author/Owner: City of Eugene
  Description: Builds on the momentum created by Eugene's Climate Recovery Ordinance (CRO) by identifying research-based actions that help the community reach its climate goals.
  Relation to Natural Hazard Mitigation: CAP 2.0 incorporates policies, plans, and strategies adopted by City Council which allows the community to become more resilient by working on actions that we are committed to implementing. The CAP 2.0 identifies the NHMP as an action item as part of Section 5: Resilience – Health, Emergency and Natural Resources.

- **Plan: Springfield 2030 Refinement Plan**

Date of Last Revision: 2016
Author/Owner: City of Springfield
Description: Springfield is developing a City-wide refinement plan called the Springfield 2030 Refinement Plan that will guide growth and development for the Metro area east of Interstate 5 through the 2010-2030 planning period. Updates to the Downtown Refinement Plan, Glenwood Refinement Plan and Visioning for Main Street refinement plan updates are also underway.
Relation to Natural Hazard Mitigation: Provides land use policy and maps areas for future development in Springfield.

- **Plan: Development Code (Springfield)**
  Date of Last Revision: June 2019
  Author/Owner: City of Springfield
  Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
  Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas.

- **Plan: Springfield Capital Improvement Program, 2012-2016**
  Date of Last Revision: 2011
  Author/Owner: City of Springfield
  Description: The City of Springfield's Capital Improvement Program (CIP) is a five-year Community Reinvestment Plan that describes the funding and construction of City public facilities. A fundamental purpose of the CIP is to facilitate the efficient use of limited capital resources. The stated goals for the CIP are to: provide a balanced program for capital improvements given reasonably anticipated funding over a five-year or greater planning period and identifying the extent to which resources can meet capital needs; improve neighborhoods; provide for economic and community growth; improve safety, access, and mobility of transportation modes; comply with environmental standards and improving environmental quality; maintain the existing City infrastructure; and protect public health and safety.
  Relation to Natural Hazard Mitigation: Mitigation items linked with capital improvements are linked with goals and policies of the capital improvement plan.

Social Systems and Service Providers

Social systems can be defined as community organizations and programs that provide social and community-based services, such as health care or housing assistance, to the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community due to their existing connections to the public. Often, actions identified by this plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income). The Cities of

Eugene and Springfield can use existing social systems as resources for implementing such communication.

The following is a brief explanation of how the communication process works (Figure C-1) and how the community's existing social service providers can be utilized to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible;
- The message must be appropriately designed;
- The channel for communicating the message must be carefully selected;
- The audience must be clearly defined; and
- The recommended action must be clearly stated, and a feedback channel established for questions, comments and suggestions.

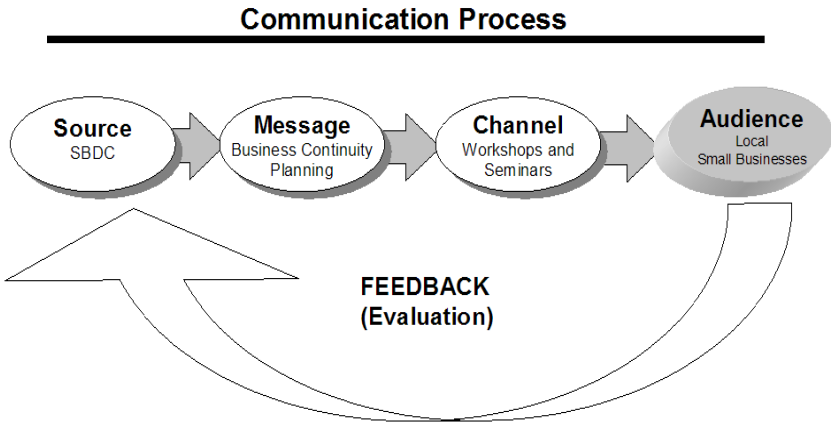


Figure C-1. Communication Process Source: Adapted from the U.S Environmental Protection Agency Radon Division's outreach program.

The following table (Table CC-2) provides a list of several local service agencies and organizations within Eugene and Springfield. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach - organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination - organization could partner with the community to provide hazard related information to target audiences.

- Plan/project implementation - organization may have plans and/or policies that may be used to implement mitigation activities, or the organization could serve as the coordinating or partner organization to implement mitigation actions.

The information provided in the table can also be used to complete action items by identifying potential coordinating agencies and internal and external partners.

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Chamber of Commerce 1401 Willamette St Eugene, OR 97401 (541) 484-1314	Represents the local businesses and disseminates information to businesses and visitors.	Eugene	X						Education and outreach & Information dissemination
Springfield Chamber of Commerce 101 South A Street Springfield, OR 97477 (541) 746-1651	Represents the local businesses and disseminates information to businesses and visitors	Springfield	X						Education and outreach & Information dissemination
Sacred Heart Medical Center 1255 Hilyard St. Eugene, OR 97401 (541) 686-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
Sacred Heart Medical Center- RiverBend 3333 RiverBend Dr. Springfield, OR 97477 (541) 222-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
McKenzie-Willamette Medical Center 1460 G St, Springfield, OR 97477 (541) 726-4400	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Lions Club International 1075 Washington St #212 Eugene, OR 97401 (541) 484-0452	Community Organization	Eugene, Springfield, and the surrounding area	X	X	X	X	X	X	Education and outreach & Information dissemination
Rotary Club of Eugene 66 E 6th Ave Eugene, OR 97401 (541) 485-5983	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport Rotary Club, Eugene Airport 28855 Lockheed Dr Eugene, OR 97402 (541) 688-1406	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Emerald Rotary Club, Valley River Inn 1000 Valley River Way Eugene, OR 97401 (541) 510-3042	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene-Metropolitan Rotary Club, Downtown Athletic Club 999 Willamette St Eugene, OR 97401 (541) 345-3733	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Mid-Valley Rotary Club, Oregon Electric Station, 27 E 5th Ave Eugene, OR 97401 (541) 484-6717	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Southtowne Rotary Club, Vet's Club 1626 Willamette St Eugene, OR 97401 (541) 689- 6872	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Delta Rotary Club, 66 E 6th Ave Eugene, OR 97401 (541) 914-1365	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Delta Rotary Club, 66 E 6th Ave Eugene, OR 97401 (541) 914-1365	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield- Twin Rivers Rotary Club, Royal Caribbean Cruise 1000 Royal Caribbean Way Springfield, OR 97477 (541) 986-3277	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Rotary Club, Holiday Inn 919 Kruse Way Springfield, OR 97477 (541) 689-2984	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Elks Club 2470 W 11th Ave Eugene, OR 97402 (541) 338-7848	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Elks Club 1701 Centennial Blvd Springfield, OR 97477 (541) 747-2145	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Lane County Historical Society 740 W 13th Ave Eugene, OR 97402 (541) 682-4242	Community Historical Society	Lane County, including Eugene and Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Public Library 100 W 10th Ave Eugene, Oregon 97401	Public Library	Eugene		X	X	X	X	X	Education and outreach & Information dissemination
Springfield Public Library 225 Fifth St Springfield, OR 97477	Public Library	Springfield		X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport 28855 Lockheed Drive Eugene, OR 97402 (541) 682-5430	Regional Airport	Eugene and Springfield	X				X		Education and outreach & Information dissemination
University of Oregon Eugene, OR 97403 (541) 346-1000	State University	Eugene and Springfield	X				X		Education and outreach & Information dissemination
Lane Community College 4000 E 30th Ave Eugene, OR 97405 (541) 463-3000	Local Community College	Eugene and Springfield	X	X			X	X	Education and outreach & Information dissemination
Lane Transit District P.O. Box 7070 Eugene, OR 97401 (541) 682-6100	Local Public Transit System	Lane County and Cities	X	X	X	X	X	X	Education and outreach & Information dissemination
United Way Lane 3171 Gateway Loop Springfield, OR 97477 (541) 741-6000	Community Organization	Lane County and Cities	X	X			X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
American Red Cross Oregon Pacific Chapter 862 Bethel Drive Eugene, OR 97401 (541) 344-5244	Regional American Red Cross Headquarters	Benton, Coos, Curry, Douglas, Lane, Lincoln and Linn counties	X	X	X	X	X	X	Education and outreach & Information dissemination

Appendix D: Funding Programs

Introduction

There are numerous local, state and federal funding sources available to support natural hazard mitigation projects and planning. The Oregon Natural Hazard Mitigation Plan includes a comprehensive list of funding sources (refer to Oregon NHMP Chapter 2 Section F(1)). The following section includes an abbreviated list of some of the common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Federal Programs

Post Disaster Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

More information at: http://www.fema.gov/hazard-mitigation-grant-program

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) Grant Program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

More information at: http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Grant Program

The overall goal of the Flood Mitigation Assistance (FMA) Grant Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

More information at: http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre- disaster programs can be found in the 2015 Hazard Mitigation Assistance Guidance and Addendum, available at: https://www.fema.gov/media-library/assets/documents/103279 Note that guidance regularly changes. Verify that you have the most recent edition.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit: https://www.oregon.gov/oem/emresources/Grants/Pages/default.aspx

Community Development Block Grant Program

The Community Development Block Grant Program (CDBG) promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible activities most relevant to hazard mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; and community planning activities. Under special circumstances, CDBG funds can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.

More information at: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program

Through broad based participation, the National Earthquake Hazard Reduction Program (NEHRP) attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the United States Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and

development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery.

More information at: http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation

The Decision, Risk, and Management Sciences (DRMS) supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time- critical or high-risk, potentially transformative nature.

More information at: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood insurance rate maps and floodplain management maps for all NFIP communities.

More information at: http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

FEMA Mapping Information Platform

For use in mapping of flood and other hazards.

More information at: https://hazards.fema.gov/femaportal/wps/portal

Mapping Standards Support, Department of the Interior (DOI)-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program.

More information at: http://ncgmp.usgs.gov/standards.html

Soil Survey, United States Department of Agriculture (USDA)-Natural Resources Conservation Service

Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation, or related purposes.

More information at: http://soils.usda.gov/survey/printed_surveys/

Project Support

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- income persons.

More information at: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs

National Fire Plan (DOI – USDA)

The National Fire Plan (NFP) provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.

More information at: http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA Assistance to Firefighters Grant Program (AFG) grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER).

More information at: https://www.usfa.fema.gov/grants/

Emergency Watershed Protection Program, USDA-NRCS

The Emergency Watershed Protection Program (EWPP) provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce

vulnerability of life and property in small watershed areas damaged by severe natural hazard events.

More information at:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/

Rural Utilities Service –USDA- Rural Development

Rural Utilities Service (RUS) provides much-needed infrastructure or infrastructure improvements to rural communities.

More information at: https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

Rural Development Assistance – Housing, USDA

The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.

More information at: https://www.usda.gov/topics/rural/housing-assistance

Public Assistance Grant Program, FEMA

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to state, tribal and local governments, and certain types of Private Non-Profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

More information at: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

The National Flood Insurance Program, FEMA

NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements.

More information at: http://www.fema.gov/national-flood-insurance-program

Disaster Resources, HUD

HUD Disaster Resources occasionally provides grants to fund gaps and partners with Federal and state agencies to help implement disaster recovery assistance.

More information at: https://www.hud.gov/info/disasterresources

Emergency Management Performance Grants, FEMA

The Emergency Management Performance Grant Program (EMPG) helps state and local governments to sustain and enhance their all-hazards emergency management programs.

More information at: https://www.fema.gov/emergency-management-performance-grant-program

North American Wetlands Conservation Act, DOI-Fish & Wildlife Service

North American Wetlands Conservation Act (NAWCA) provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats.

More information at: https://www.fws.gov/birds/grants.php

Wetlands Reserve program, USDA-NCRS

The Wetlands Reserve Program provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements.

More information at:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/

Secure Rural Schools and Community Self-Determination Act of 2000, USDA-United States Forest Service.

Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies.

More information at: http://www.fs.usda.gov/pts/

State Programs

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings to diminish damage during an

earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP.

More information at: http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Oregon Watershed Enhancement Board

While Oregon Watershed Enhancement Board's (OWEB) primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can also benefit efforts to reduce flood and landslide hazards. OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually.

More information at: https://sos.oregon.gov/blue-book/Pages/state/executive/watershed-enhancement.aspx

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Appendix E: Status of NHMP 2014 Actions

Mitigation Action Item Progress Report Forms

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#1: Dam Safety Evacuation	
Responsible Agency	City of Eugene: Public Works City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four “impacts” the plan considers for each hazard.

2. What obstacles, problems, or delays did the project encounter?

   No obstacles or problems experienced. These mitigation action items are going to be reorganized and placed within the appropriate hazard to better align with the objectives of Natural Hazard Mitigation Plans.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are going to be revised to fit within the new identified natural hazard categories as outlined in the 2020 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#2: Dam Safety Notification	
Responsible Agency	City of Eugene: Public Works City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☒ Project delayed: Anticipated Completion Date: TBD

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four “impacts” the plan considers for each hazard.

2. What obstacles, problems, or delays did the project encounter?

   No obstacles or problems experienced. These mitigation action items are going to be reorganized and placed within the appropriate hazard to better align with the objectives of Natural Hazard Mitigation Plans.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are going to be revised to fit within the new identified natural hazard categories as outlined in the 2020 NHMP. Moving forward, this mitigation action item will be revised with Lane County as the lead.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#3: Inundation Maps for Planning	
Responsible Agency	Emergency Management	
Contact Phone/Email	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard. Both Cities have spoken with the Army Corp of Engineers, and are up to date on new mapping changes.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete though the final product was revised from what initially appeared in the 2014 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#4: Dam Seismic Assessment	
Responsible Agency	Emergency Management	
Contact Phone/Email	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard. Both Cities have spoken with the Army Corp of Engineers, and confident in their assessments of the dam infrastructure.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?
4.

   This project is considered complete since it has been canceled in favor of more appropriate mitigation items.

5. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#5: Local Transportation Infrastructure Seismic Evaluation	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Eric Johnson	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Fifteen of the City's highest priority bridges were analyzed for vulnerability to seismic events. Results of the high level analysis indicated the Ferry Street Viaduct project will utilize the bulk of the seismic retrofitting funding.

2. What obstacles, problems, or delays did the project encounter?

   Seismic retrofitting of bridges is expensive and often a multijurisdictional projects. The City is actively pursuing possible funding sources for future projects concerning the retrofitting of bridges.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects developed from the high level seismic assessments of the City's top fifteen priority bridges.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#6: Seismic Evaluation of Critical Facilities	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A prioritized list of critical and City owned and/or rented facilities was developed. This list was then assessed for seismic stability. From this, a short list of facilities to either be looked at in closer detailed or retrofitted as is was developed.

2. What obstacles, problems, or delays did the project encounter?

   Not all buildings used by the City of Eugene are owned by the City. Getting approval for assessments and projects can be difficult.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete and will help determine more specific future mitigation projects concerning critical infrastructure and seismic stability

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#7: Seismic Evaluation of Non-Critical Facilities (FEMA 154)	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Eric Johnson	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A Damage Assessment Group was formed. This group has developed an Emergency Operations Plan Annex for damage assessment and conducted Safety Assessment Program and Bridge Assessor training. The foundations of the group is in place, and will continue to be reviewed, evaluated, and changed as necessary

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects developed by the Damage Assessment Group.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#8: Non-Structural Seismic Evaluation (FEMA E74)	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Eric Johnson	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   This projected has been removed from the 2020 NHMP update in favor of more pressing mitigation action items. It will be revisited once higher priority items have been completed.

2. What obstacles, problems, or delays did the project encounter?

   It has been determine that staffing and resources would be better suited to address higher priority concerns, at this time.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is still relevant, but for the time being individual departments are addressing non-structural seismic evaluations on their own. A more formalized program will be addressed in a later NHMP update.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#9: Home Seismic Retrofits	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Emergency Management team members met with representatives from Enhabit in 2017 to discuss a possible seismic retrofit program for residential homes similar to the project completed in Portland. It was determine that this project was not possible for the City to maintain, at this time.

2. What obstacles, problems, or delays did the project encounter?

   A seismic retrofit program for homes using federal grant money has many moving parts. It has been determine that resource be used to compete other projects before the time and man hours can be dedicated to such a project.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project will be revisited in a later update of the NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#10: Flood Maps	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   FEMA and partners have been remapping the floodplain maps for various locations of interest around Eugene and Springfield, but the project has been often delayed. A definitive timeline and/or release date for the new maps currently being worked on is unknown at this time.

2. What obstacles, problems, or delays did the project encounter?

   Federal partners are necessary to complete this project, and their timelines are often delayed due to other projects on emergencies within the United States.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is being restructured to address specific locations flood maps are believed to be incorrect or outdated using Risk Map funds.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#11: Flood Control Levee Certification and Maintenance	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Emergency Management	
Contact Phone/Email	Jesse Cary-Hobbs (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works receives a report from the US Army corps of Engineers annually that lists follow-up items related to levee maintenance. The department merges these items into annual work plans.

2. What obstacles, problems, or delays did the project encounter?

   With levee certification and maintenance delays are common since most of these projects are multijurisdictional in nature. Additionally, some, but not all, of the levee infrastructure that could affect Eugene-Springfield are owned by private or Federal partners.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete for the City of Eugene. Projects moving forward will address specific mitigation projects necessary for levee operation or maintenance. The City of Springfield will be pursuing a separate mitigation action item to seek and maintain certification for the 42st levee.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#12: Flood Insurance Study	
Responsible Agency	City of Eugene: Public Works Engineering, City of Springfield: Development and Public Works	
Contact	Ray Joseph (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A Flood Insurance Program is maintained by the City of Eugene. The City of Springfield has been working to advance their program.

2. What obstacles, problems, or delays did the project encounter?

   Federal partners are necessary to complete this project, and their timelines are often delayed due to other projects on emergencies within the United States.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete for the City of Eugene. This project is being restructured to address specific locations flood maps are believed to be incorrect or outdated using Risk Map funds thus it is being combined with action item #10: Flood Maps from the 2014 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#13: Repetitive Loss Records	
Responsible Agency	City of Eugene: Public Works Engineering, City of Springfield: Development and Public Works	
Contact	Ray Joseph (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Cities' Flood Insurance Programs maintain and provide repetitive loss property records to FEMA.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 04-2017
Action Item title	#14: Explore Flood Mitigation Actions With Property Owners (upon request)	
Responsible Agency	City of Eugene Public Works, City of Springfield Development and Public Works	
Contact Phone/Email	Formally Louranah Janeski	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene NFIP and CRS along with the City of Springfield's NFIP staff routinely provide flood risk literature, for outreach, as needed. This includes households within the 100 year floodplain.

2. What obstacles, problems, or delays did the project encounter?

   None.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This Action Item was removed from the 2020 NHMP Action Item list due to the fact it is general operating procedure for the Cities. Future Action Items will focus on attainable and targeted projects to improve NFIP or CRS standings.

4. Other comments

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#15: Maintain Frequent Stormwater Flooding Location Inventory	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Rob Hallett	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works Maintenance Division maintains an Urban Stromwater Flooding Quick Check List for inspection and maintenance of the stormwater conveyance systems. Included in this list are priority inlets, outfalls, catch basins, and curb inlets. Staff use this list prior to, during, and after rain and snow events. The list is updated on a yearly basis and is included in the department's emergency on-call book.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects the Urban Stormwater Flooding Quick Check List may identify.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#16: Upgrade Culverts	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Jesse Cary-Hobbs	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works has developed and maintains a list of culverts and ditches that have historic flooding issues. These assets are checked during rain events by Public Works staff. Additionally, staff have a maintenance standard for roadside ditches that outlines the thresholds for maintenance of ditches.

2. What obstacles, problems, or delays did the project encounter?

N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address problems or issues to specific areas/culverts.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#17: NFIP Compliance	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   NFIP Compliance is now normal operation for the Cities of Eugene and Springfield.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#18: HazMat Locations	
Responsible Agency	City of Eugene and Springfield Fire and EMS	
Contact	Chris Heppel	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Lane Preparedness Coalition (LPC) has developed and complete an inventory of hazardous material locations of concern readily-available to response personnel.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#19: HazMat Preparedness	
Responsible Agency	City of Eugene and Springfield: Fire and EMS	
Contact	Chris Heppel	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Eugene Springfield Fire and EMS currently staffs and maintains one of the State's Hazardous Material response teams.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Any further projects relating to this mitigation action item will be address as they are identified as the Eugene Springfield Fire and EMS Hazardous Material team.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#20: Landslide Mapping	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   An updated landslide study, in partnership with the Oregon Department of Geology and Mineral Industries (DOGAMI), was completed for the Eugene-Springfield area and was release for publication the summer of 2018

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Any further projects relating to this mitigation action item will be address finds specific to the completed study.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#21: Landslide Planning	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   An updated landslide study, in partnership with the Oregon Department of Geology and Mineral Industries (DOGAMI), was completed for the Eugene-Springfield area and was release for publication the summer of 2018. This mitigation action item was postponed until the release of the updated study.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This mitigation action item will be restructured to address specific projects identified by the completed study.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#22: Emergency Fuel Distribution Plan	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: TBD

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   This mitigation action item has been delayed while the Emergency Fossil Fuels Assessment (2014 NHMP Action Item #33: Fossil Fuel Sector Assessment.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This mitigation action item will commence after the completion of the Emergency Fossil Fuel Assessment in 2020 to address the specific issues identified by the assessment.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#23: Community Recovery Planning	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Various recovery plans have been developed between 2015-2020.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item is going to be restructured to address more specific community recovery planning needs.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#24: Local Electricity Generation	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Complete ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☒ Project On Schedule Anticipated Completion Date: 2020	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In 2018, EWEB commissioned a study to better understand black start capabilities of its Leaburg and Walterville hydro-electric plants and identified the amount and location of critical loads in our service territory that should be served during emergency conditions. The study found that the Leaburg plant has the ability to operate independently from the grid but that the critical loads identified were slighter higher than the plant capacity at Leaburg.

   EWEB will also complete and test installation of our first 1MW microgrid at Howard elementary school. The microgrid will power the pump to the new well installed to provide emergency water to the community should EWEB's water filtration or distribution system fail in an emergency.

2. What obstacles, problems, or delays did the project encounter?

   To match critical loads, EWEB is now looking at other facilities for potential additional generation. EWEB co-owns generation at the International Paper plant and a secondary study is planned in 2019 to determine black start and load capabilities for this generator. We are also in the process of developing an Intergovernmental Agreement with the University of Oregon for their natural gas generator to feed EWEB's distribution system under emergency conditions.

   Regarding microgrid technology, these projects are very expensive to scale. The Howard micro grid lacks remote access to collect and analyze data and requires additional investment to operate as intended. However, staff believe the learning

from Howard can be used for smaller scale projects at other emergency well sites.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are still relevant but require on-going resources, both engineering, design and capital improvements such as new switch gear to direct power just to critical loads to fully implement. As originally scoped, this mitigation item focused on developing a plan with implementation in 2020 so in this regard we are ahead of schedule.

4. Other comments:

   Back-up generation and adequate fuel storage is another important solution to maintain operability of critical facilities. In 2018, EWEB placed two new back-up generators at its Hayden Bridge filtration plant which are sufficient to deliver about 20 mgd of water to the community.

   We plan to have another emergency water station installed at the Sheldon Fire Station in 2019 and are sharing costs for an upsized fuel storage tank at the fire station to ensure we can run the emergency well in addition to the fire station loads, during emergency conditions.

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#25: Downed Power Lines	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   EWEB was successfully awarded FEMA grant funds to re-frame 4.3 miles of electric line and underground 1.5 miles of distribution services in over a dozen high outage areas across Eugene. In most cases, EWEB will reconfigure and replace older overhead power lines that require two wires and replace them with new, higher capacity cable that requires only one wire. This reduces brown-outs when a tree limb falls on one wire and allows for the removal of crossarms, which are susceptible to falling tree limbs and a common culprit causing outages. Overall project costs are estimated at $2.7M with FEMA grant funding about 75% of those costs. The first projects will being in 2019.

2. What obstacles, problems, or delays did the project encounter?

   Coordination to correlate priority transportation routes with high priority distribution feeds did not occur and may not align with where electric feeds to service critical loads are located. The latter is of higher importance and focus to the utility in terms of mitigating risks from prolonged outages.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Reducing outages by hardening and reconfiguring our transmission and distribution system is highly important. This mitigation item could be broadened

beyond distribution to encapsulate EWEB current efforts to seismically anchor transformers at substations, as well as replace older two wire distribution with more resilient single cable lines.

4. Other comments:

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#26: Credentials	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Credentialing will be address via the Emergency Operation Plan (EOP).

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#27: Broadcast Radio Communications	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Communication protocol will be address via the Emergency Operation Plan (EOP). Any future mitigation projects concerning broadcast radio will focus on mitigating the effects of natural disasters on communication infrastructure.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#28: Continuity of Operations Plans	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In 2014 the City of Eugene started to develop Continuity of Operations Plans (COOP) for all divisions and some work groups. Participation waned over the years due to staffing changes. A renewed emphasis was placed on COOP plans in 2018 with at least two divisions completing/updating theirs, and several more redeveloping plans.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   A version of this action item will be in the 2020 update of the NHMP, but will focus on more specific needs for COOP development.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#29: Staffing for Critical Systems	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This item has been combined with the 2014 NHMP Action Item #28: Continuity of Operations Plans for the 2020 NHMP update.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#30: Local Food Availability	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☐ Project Canceled ☒ Project delayed: ☐ Project On Schedule Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#31: Water Source	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: 2028

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Significant resources were allocated to this project from 2015-2018. With a conditional water right in hand, property was purchased for both the intake and for siting a 10 – 15 MGD water treatment plant. Water rates were increased by 3% per year to start paying for the project, accompanied with considerable public outreach and education on the need for a redundant supply of water. A team of experts were hired to help develop a preliminary design and more accurate costs for the plant.

2. What obstacles, problems, or delays did the project encounter?

   Land use issues for the treatment plant site required all three jurisdictions to concur on updating the Eugene-Springfield Metro Plan. While two of the three jurisdictions were in support, it was clear that one was not convinced that the site was appropriate for a water treatment facility. The project was deferred due to the combination of the high price tag, political risk and an overarching concern that under earthquake scenarios, the distribution system was vulnerable and would not be able to deliver water to the community. Instead, a revised emergency water supply program was adopted focusing on multiple, micro-distribution sites where people could fill containers with water under emergency conditions.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

Yes, discussions with partners are on-going and the secondary treatment plant is in EWEB's capital improvement plan with construction beginning in 2025.

4. Other comments:

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#32: Evacuation	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Evacuation plans will be addressed via the Emergency Operation Plan (EOP). This project will be replaced with alternative project to mitigate the effects of natural disasters.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#33: Fossil Fuel Sector Assessment	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: Fall 2020

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Emergency Fossil Fuels Assessment was initiated Spring of 2018. It is expected to conclude fall of 2020. The project was funded using Homeland Security Grant Program funding.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   No revisions necessary.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#34: Water Storage	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: Fall 2020	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Enough water was stored at the Emergency Operations Center (EOC) to last twenty EOC staff members for two weeks. Additional water was stored in strategic locations in some essential facilities.

2. What obstacles, problems, or delays did the project encounter?

   Logistics of storing so much water for an unknown time is costly and difficult with limited space.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   No revisions necessary. Enough water was stored to support initial response operations. This action item reaffirmed the need for the 2014 NHMP action item #31 Water Source which seeks to obtain multiple sources for emergency water within the Cities of Eugene.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#36: Lane Preparedness Coalition	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Cities of Eugene and Springfield are Steering Committee members for the Lane Preparedness Coalition (LPC). At this time, both Cities will continue in these roles for the foreseeable future. This role is now considered normal day to day operation for both Cities. Due to this, the Action Item was removed from the 2020 NHMP update to allow for mitigation specific projects.

2. What obstacles, problems, or delays did the project encounter?

   None

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   LPC is still a relevant preparedness outreach tool/resource. Both Cities will continue to participate as LPC Steering Committee members.

4. Other comments;

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#37: Community Education and Outreach	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene and Springfield Emergency Management staff routinely provides preparedness information to both employees and citizens.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is complete since it is now a normal portion of both Cities' day to day operations. Outreach will continue, and future mitigation items concerning this subject will focus on specific problems or issues to mitigate regarding outreach.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#38: 72 Hour Kits	
Responsible Agency	City of Eugene and Springfield Emergency Management	
Contact Phone/Email	Patence Winningham	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene and Springfield Emergency Management staff routinely provides preparedness information to both employees and citizens. The City of Eugene's emergency supply sale for employees continued to have record sales numbers as of 2017.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete, but it is also not relevant. Emergency Management staff across the State of Oregon now encourage people to have 2 weeks' worth of supplies. Future Action Items will focus on attainable and targeted projects to improve community and employee preparedness.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#39: Springfield Wildfire Plan	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: 2025

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Springfield was added to the Eugene-Springfield Fire, Urban Interface Fire Plan.

2. What obstacles, problems, or delays did the project encounter?

   With such a large group of stakeholders, meeting coordination has proven difficult.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#40: Wildfire Risk and Building Code	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: 2025

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In late winter/early spring, the Cities of Eugene and Springfield started discussions with the Western Lane District of the Oregon Department of Forestry to develop and implement a Community Wildfire Protection Plan (CWPP). As of April 2019, a diverse group of stakeholders have met twice to discuss the development and timeline for a Eugene-Springfield CWPP.

   Some fire hazard mapping was completed for the 2014 NHMP. This project has since been postponed until the completion of the Eugene-Springfield Community Wildfire Protection Plan (CWPP) (2014 NHMP Action Item 39: Springfield Wildland Plan). Refer to 2020 NHMP project #23.

2. What obstacles, problems, or delays did the project encounter?

   A CWPP must be completed prior to the start of this project.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is still relevant.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#41: Downed Power Lines	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date: _____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Please see 2014 NHMP Action Item 25: Down Power Lines.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#42: Tree Trimming	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Development and Public Works	
Contact	Eric Johnson (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: _____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   As is, this Mitigation Action Item was removed from the 2020 NHMP update due to the fact tree trimming is everyday operations for both Cities.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   As is, this Mitigation Action Item is complete. Its concept will be restructured, however. Future mitigation projects will focus on removing tree species known to be prone to failure during snow or wind events based off of FEMA's guidance after the Ice Storm of 2016.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#43: Property Owner Education	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Development and Public Works	
Contact	Eric Johnson (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: _____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Both the Cities of Eugene and Springfield regularly provide natural hazard education for property owners. The most common form of this is wildland-urban interface education; a partnership between Eugene-Springfield Fire, the Fire Marshal, and both Cities' Emergency Management programs.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Since this Mitigation Action Item is now day to day operations for both Cities, it was removed from the 2020 NHMP update. Future mitigation projects will focus on specific projects to address mitigation of natural hazards on or near private property.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#44: Backup Power	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Almost all critical facilities for both Eugene and Springfield are equipped with generators. New generators are being installed with expanded fuel tanks to allow for operations during prolonged power outages. In 2013 the city of Eugene began developing department/division specific Continuity of Operations Plans.

2. What obstacles, problems, or delays did the project encounter?

   Some critical facility locations are too small or inadequate for generator installation. Other locations are privately owned and either leased/rented by the Cities. In these situations, generator installation is not permitted by the property owner. Continuity of Operations Planning has been steady moving forward for the City of Eugene but is often delayed due to conflicting projects and/or limited staff time.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, is complete. Future Mitigation Action Items will focus on specific projects to mitigate further power disruptions.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#45: Undergrounding Utilities in New Developments	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Both Springfield Utility Board and Eugene Water and Electric Board underground utilities lines in new developments, within reason.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, is complete and is now part of day to day operations for both Cities and their respective utilities. Future Mitigation Action Items will focus on specific projects to mitigate further power disruptions.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#46: Ash Fall	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   No specific mitigation item was identified in the 2014 NHMP. "All hazard" items helped to mitigate this natural hazard, however.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, was removed from the 2020 NHMP update. Future Mitigation Action Items will focus on specific projects to mitigate the effects of ash fall.

4. Other comments;

   N/A

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Appendix F: Land Use and Development Trends

The Eugene/Springfield Metro Region is growing. To accommodate the next 20 years of population growth, Eugene and Springfield will have to expand their Urban Growth Boundaries (UGB), increase density within their UGB's, or both.

In 2009, ECONorthwest created the City of Springfield Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.[1] Similarly, in 2010, ECONorthwest, Lane Council of Governments, the Ulum Group, and Winterbrook Planning prepared the Eugene Comprehensive Lands Assessment for the City of Eugene Planning and Development Department.[2]

Per Oregon House Bill 3337 requirements[3] the reports include a buildable lands inventory, an economic opportunity analysis, and for Eugene and Springfield, a housing needs analysis. The report also accounts for partially constrained lands related to natural hazards, such as slopes, 100-year floodplains, geologic hazards, and wetlands in looking at potential developable lands. The assessment will help Eugene and Springfield determine the amount of land needed to accommodate population and employment growth, as well as the amount of land within the current UGB that can accommodate this growth.

The Eugene Comprehensive Lands Assessment relies on population projections provided by Lane County that estimates Eugene will grow from 179,338 people in 2011 to 213,238 people in 2031 at an average annual growth rate of 0.88%.[4]

In January 2017, after several years of community input, research and analysis, public meetings, and revisions, the City of Eugene adopted a new UGB. The new UGB addresses Eugene's land needs for housing, jobs, parks, and schools from 2012-2032, and is based on the state land use planning framework, Envision Eugene pillars, and seven years of technical analysis, community input, and Council direction. Eugene anticipates approximately 34,000 new residents and 36,000 new jobs by 2032. While the majority of these residents and jobs can be accommodated on land inside the UGB,

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[1] ECONorthwest (2009). *City of Springfield: Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.* Retrieved from http://www.springfield-or.gov/wp-content/uploads/2016/11/Draft_CIBL_Analysis_9_09.pdf, accessed August, 2019.

[2] ECONorthwest (2010). *Eugene Comprehensive Lands Assessment.* Retrieved from https://www.eugene-or.gov/index.aspx?NID=788, accessed August 2019.

[3] City of Eugene. *Oregon House Bill.* https://www.eugene-or.gov/DocumentCenter/View/581/Oregon-House-Bill-3337?bidId=. Accessed August 2019

[4] Portland State University (Population Research Center) 'Lane County Coordinated Population Forecast 2015-2065'. June 2015. https://www.pdx.edu/prc/sites/www.pdx.edu.prc/files/Lane_Forecast_Report_201506.pdf, accessed August 5, 2019

an expansion was necessary to accommodate additional jobs, park, and school needs. Major components of the UGB include:

- Clear Lake Road expansion area for 3,000 jobs, a park, and a school in the Bethel Neighborhood, and the proposed Clear Lake Overlay Zone.
- Santa Clara expansion area for a new community park.
- Development of a new Eugene-specific Comprehensive Plan with chapters addressing Economic Development, Transportation, Administration and Implementation (including growth monitoring), and the Urban Growth Boundary.
- Proposed housing strategies, including planning for 1,000 high density homes in downtown and 600 medium density homes in existing medium density areas.

The expansion areas do not include land with a slope of 25% or greater or land in the 100-year floodplain. The areas are partially constrained by the presence of wetlands. Development impacts in wetland-constrained areas will be mitigated through the development of "green infrastructure" practices described in the Eugene Stormwater Master Plan.[5]

The remainder of Eugene's housing need will be accommodated on existing vacant and partially vacant lands and through redevelopment. Additionally, the City Council provided direction committing the City to monitor and report on growth assumptions and outcomes, improve the land use code for needed housing development, and begin urban reserves planning for the long-term population growth.

The Springfield Residential Land and Housing Needs Analysis (RLHNA) documented that the land currently designated as High, Medium and Low Residential and Nodal Mixed-Use plan designations will accommodate the expected residential housing need. Therefore, Springfield is focused on the need for industrial and employment lands. The Commercial and Industrial Buildable Lands Inventory for Springfield concludes that there will be a 32% increase in the number of employees between 2010 to 2030, equaling roughly 13,000 new jobs.

The City of Springfield co-adopted an ordinance with Lane County to expand Springfield's UGB, and to change Economic and Urbanization land use policies and zoning to establish a 20-year supply of land for job creation. The expansion and land use policies and zoning changes became final after acknowledgement by the Oregon Department of Land Conservation and Development in 2019. In order to provide for this growth in employment, the City of Springfield will need to expand its UGB. The UGB expansion will provide the 257 acres needed for seven employment sites, on 223 suitable unconstrained acres.[6] The two areas being considered for UGB expansion are

[5] City of Eugene, 'Urban Growth Boundary', https://www.eugene-or.gov/2988/Urban-Growth-Boundary#howplan, accessed August 2019

[6] City of Springfield, 'Comprehensive Planning', *Springfield Ordinance 6361,* http://www.springfield-or.gov/city/development-public-works/comprehensive-planning/, accessed August 2019

the North Gateway Area and the Mill Race. The Springfield Commercial and Buildable Lands Inventory does not consider constrained land as part of the UGB expansion. Wetlands, floodways, slopes greater than 15 percent, and riparian areas will not be included as a possibility for development. However, though considered constrained, development can occur in the floodplain, the Willamette River Greenway, and BPA Easements.

Regarding new development in areas prone to natural hazards, the Oregon land use program explicitly prohibits or restricts development in said areas. With statutory authority granted under Oregon Revised Statute Chapter 197, Oregon Administrative Rules provide for needed housing that is, "…suitable, available and necessary for residential uses." Land that, "(a) [i]s severely constrained by natural hazards as determined under Statewide Planning Goal 7," "(c) [h]as slopes of 25 percent or greater," or "(d) [i]s within the 100-year floodplain," are not considered "suitable and available" under the buildable land definition.[7] In practice, development is either prohibited or restricted through development regulations. While the process of UGB expansion is ongoing in Eugene and Springfield, the proposed expansion sites are in compliance with the above statute. For more information on development trends in the community, see Appendix C, Community Profile.

[7] Oregon Secretary of State, 'Land Conservation and Development Chapter 660 Division 24, Urban Growth Boundaries', https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3074 , accessed August 2019

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Appendix G: Economic Analysis of Natural Hazard Mitigation Projects

This appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. They serve as a means for documenting how action prioritization shall include a special emphasis on the extent to which benefits are maximized according to the proposed projects and their associated costs. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: The Interagency Hazards Mitigation Team, State Hazard Mitigation Plan, (Oregon State Police – Office of Emergency Management, 2000), and Federal Emergency Management Agency Publication 331, Report on Costs and Benefits of Natural Hazard Mitigation. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce “ripple-effects” throughout the community, greatly increasing the disaster’s social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Office of Emergency Management (OEM), the Federal Emergency Management Agency (FEMA), and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation projects may occur based on one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective buyers. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of sale, regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints, and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process."

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or county planning commission, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?

- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure (Figure G-1) serves as a guideline for when to use the various approaches.

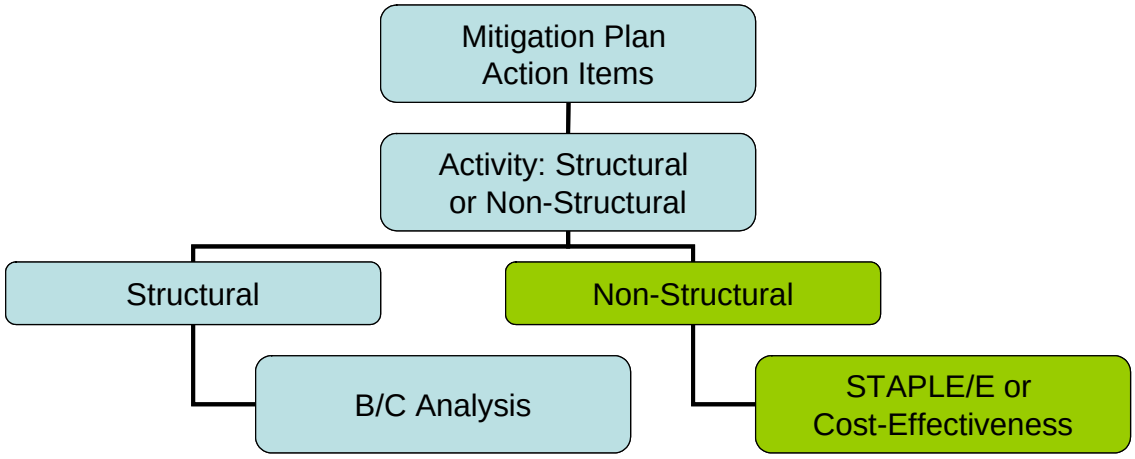


Figure G-1: *Economic Analysis Flowchart* Source: Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center, 2005

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. **Identify the Activities**
   Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards but do so at varying economic costs.

2. **Calculate the Costs and Benefits**
   Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

   - **Determine the project cost**. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
   - **Estimate the benefits**. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment.

This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- **Consider costs and benefits to society and the environment**. These are not easily measured but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- **Determine the correct discount rate**. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and a risk premium. Including inflation should also be considered.

3. **Analyze and Rank the Activities**
   Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

   - **Net present value**. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate and identifying the present and future costs and benefits of the project calculates the net present value of projects.
   - **Internal rate of return**. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked, based on economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of

mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994

Appendix H: Dam Failure

The probability of a dam failure impacting Eugene-Springfield is low; vulnerability to a dam failure event is high.

H.1 Characteristics of Dams

Dams are impervious structures that impound water by blocking the flow of a river or stream. Dams serve many purposes including water storage for potable water supply, flood control, hydroelectric power generation, agricultural irrigation, fire suppression, navigation, recreation, and others. Dams are typically multifunctional; however, the United States Army Corps of Engineers prioritizes flood control when operating Willamette Basin dams.[1]

Modern dams employ control mechanisms such as gated spillways or outlet pipes to manage the release of water, governing the natural variations in stream flow.[2] During periods of high flow, water is stored behind a dam then released to increase water levels during periods of low flow. Controlled releases results in lower peak flows and higher minimum flows than in uncontrolled streams. Water storage and release patterns vary from dam to dam, depending on the primary purpose(s) and a wide variety of economic, regulatory and environmental considerations.

Large modern dams usually fall into two categories embankment or concrete. Both are typically constructed on a foundation, which may be concrete, natural rock or soils, or compacted soils. The surrounding natural valley walls become the abutments of the dam structure itself and dams are often sited along a constricted part of a river valley to minimize cost.

Embankment dams are commonly termed earthfill or rockfill dams, depending on the primary material (soil or rock) used in their construction. Built as broad flat structures they are often twice as wide at the base to provide stability to the structure. Impervious layers may be added to the dam structure to reduce leakage. Subject to erosion by running water, embankment dams utilize erosion-resistant materials in the water release and control mechanisms of the dam. For example, concrete spillways with concrete or steel gates or outlet pipe systems with concrete or steel pipes as part of the water release control system help to reduce erosion.[3]

Modern concrete dams fall into three major classes: gravity, buttress and arch.[4] Concrete gravity dams are designed on principles similar to embankment dams. They are broad structures with a flat base and a narrow top; the upstream side is flat while the

[1] United States. Association of State Dam Safety Officials. *Benefits of Dams.* https://damsafety.org/dams101 Accessed August 2019.
[2] Ibid
[3] Paul Breeze. *Power Generation Technologies (Second Edition)* 2014.
[4] United States. Association of State Dam Safety Officials. *Benefits of Dams.* https://damsafety.org/dams101 Accessed August 2019.

downstream side is broadly sloping. Much of the dams' capacity to impound water arises from the weight of the structure. Gravity dams are often anchored into bedrock foundations and abutments to increase stability.

Concrete arch dams rely primarily on the strength of concrete to impound water. Much thinner in cross section than concrete gravity dams and they are always convex on the upstream side and concave on the downstream side because concrete is much stronger in compression than in tension. The arch design uses the pressure of impounded water to compress the concrete, making the dam stronger. Concrete arch dams are also keyed into bedrock foundations and abutments to provide stability. A less common variation of a concrete arch dam is a buttress dam. Buttress dams are arched or straight dams with additional strength provided by buttresses perpendicular to the long axis of the dam.

H.2 Causes of Dam Failure

Dam failures can occur at any time in a dam's life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher and several of the most common failure modes are more likely to occur.

Correspondingly the probability of dam failure is much lower when water levels are substantially below the design capacity for the reservoir.

For embankment dams, the most common failure mode is erosion during prolonged periods of rainfall and flooding. When dams are full and inflow rates exceed the capacity of the controlled release mechanisms, overtopping may occur. Overtopping can scour and erode either the dam itself and/or the abutments which may lead to partial or complete failure of the dam. Internal erosion, piping or seepage through the dam, foundation, or abutments can lead to failure. Willamette River Basin dams are designed for spillway opening only during infrequent severe events. Increased use can cause wear on spillway parts and lead to greater maintenance needs and an increased risk of failure. Twenty percent of dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around pips and spillways; through animal burrows; around roots or woody vegetation; and through cracks in dams.[5]

Earthquake activity may cause embankment dams to settle or spread laterally. Such settlement does not generally lead to immediate failure. However, if the dam is full, relatively minor amounts of settling may cause overtopping to scour and erode the dam leading to potential failure.

[5] United States. Association of State Dam Safety Officials. *Dam Failures and Incidents.* https://damsafety.org/dam-failures Accessed August 2019.

Concrete dams are subject to failure due to seepage of water through foundations or abutments. Waterways with more than one dam have downstream dams that are subject to failure induced by the failure of an upstream dam. If an upstream dam fails, then downstream dams also fail due to overtopping or hydrodynamic forces.

The following may lead to failure for any type of dam:

- Improper design or construction.
- Inadequate preparation of foundations and abutments.
- Improper operation of a dam, such as failure to open gates or valves during high flow periods.
- Unusual hydrodynamic forces.
- Landslides may cause surge waves to overtop dams or create hydrodynamic forces.
- Earthquakes can cause seiches (waves) in reservoirs that may overtop or overload dam structures.
- High winds, in rare cases, may cause waves to overtop or overload dam structures.
- Deliberate damage via sabotage or terrorism.

The Association of State Dam Officials, using data collected from the Dam Incident Database between 2010-2017, indicated overtopping to be the most common cause of dam failure in the United States.

H.3 History of the Hazard in Eugene-Springfield

There have been no reported dam failures in Oregon that have impacted Eugene-Springfield.

H.4 Risk Assessment

H.4.1 How are Hazard Areas Identified?

Although the likelihood of failure is very low, all dams upstream from the Eugene-Springfield area have the potential of causing widespread flooding should they fail. All dams in the Eugene-Springfield area have been inventoried by the Army Corps of Engineers in the National Inventory of Dams (NID). The NID lists 26,983 dams[6] in the

[6] Army Corps of Engineers, 'National Inventory of Dams, *Interactive Map & Charts*, 2018, https://nid.sec.usace.army.mil/, (accessed 1 August 2019).

US that have significant or high hazard potential.[7] The NID rates each dam as either high, significant, or low hazard potential depending on the probable impacts if a dam fails. High hazard potential indicates loss of human life is likely if the dam fails. In Lane County, there are 13 high hazard potential dams which are listed below in Table H-1. All dams, except Fern Ridge and Santa Clara, are upstream from the Eugene-Springfield area.

Table H-1 NID High Hazard Potential Dams Lane County

County	Dam Name	River	NID City	NID Height (feet)	NID Storage (acre feet)
Lane	Cottage Grove	Coast Fork Willamette River	COTTAGE GROVE	103	50,000
Lane	Dexter	Middle Fork Willamette River	EUGENE	117	29,900
Lane	Fall Creek	Fall Creek	SPRINGFIELD	205	125,000
Lane	Dorena	Row River	COTTAGE GROVE	154	131,000
Lane	Lookout Point	Middle Fork Willamette River	EUGENE	276	477,700
Lane	Blue River	Blue River	SPRINGFIELD	312	89,000
Lane	Hills Creek	Middle Fork Willamette River	OAKRIDGE	341	356,000
Lane	Cougar	South Fork McKenzie River	SPRINGFIELD	519	219,000
Lane	Fern Ridge	Long Tom River	EUGENE	49	121,000
Lane	Walterville Storage Pond	McKenzie River	WALTERVILLE	10	345
Lane	Leaburg Canal and Forebay	McKenzie River	LEABURG	15	459
Lane	Walterville Forebay	McKenzie River	SPRINGFIELD	24	275
Lane	Santa Clara	In System	SANTA CLARA	17	64

The extent of the flood hazard from these dams depends on which dam fails, amount of impounded water, time of day, degree of failure, and proximity to population centers. For example, if the Hills Creek Dam were to fail completely, the volume of water

[7] Ibid

released would breach Lookout Point and Dexter dams, increasing the potential impact to the Eugene-Springfield area.

In 2010 and 2011, the Portland District of the U.S. Army Corps of Engineers updated the Dam Failure Inundation Maps and the Emergency Action Plans for their projects in Lane County. Copies of these maps have been provided to Lane County and the cities of Eugene and Springfield for emergency planning purposes, however distribution of the maps is restricted because they contain sensitive information. Persons wishing to obtain copies of the maps should contact the Portland District of the U.S. Army Corps of Engineers.

H.4.2 Probability of Future Occurrence

To evaluate the probability of a collapse, the dam type for each high hazard potential dam in Lane County should be considered. Table H-2 provides additional information for each dam including type, year built, owner and Emergency Action Plan status.

Table H-2 Additional Data on NID High Hazard Potential Dams

County	Dam Name	River	Storage (acre feet)	Year Built	Dam Type	EAP	Owner
Lane	Cottage Grove	Coast Fork Willamette River	50,000	1942	RE	Y	Corps
Lane	Dexter	Middle Fork Willamette River	29,900	1955	RE	Y	Corps
Lane	Fall Creek	Fall Creek	125,000	1965	ER	Y	Corps
Lane	Dorena	Row River	131,00	1949	RE	Y	Corps
Lane	Lookout Point	Middle Fork Willamette River	477,700	1953	RE	Y	Corps
Lane	Blue River	Blue River	89,000	1968	RE	Y	Corps
Lane	Hills Creek	Middle Fork Willamette River	356,000	1962	RE	Y	Corps
Lane	Cougar	South Fork McKenzie River	219,000	1964	ER	Y	Corps
Lane	Fern Ridge	Long Tom River	121,000	1941	RE	Y	Corps
Lane	Walterville Storage Pond	McKenzie River	345	1951	PGRE	Y	EWEB

Table H-2 Additional Data on NID High Hazard Potential Dams							
County	Dam Name	River	Storage (acre feet)	Year Built	Dam Type	EAP	Owner
Lane	Leaburg Canal and Forebay	McKenzie River	459	1930	PGRE	Y	EWEB
Lane	Walterville Forebay	McKenzie River	275	1911	CNPGRE	Y	EWEB
Lane	Santa Clara	In System	64	1976	RE	Y	EWEB

Source Army Corps of Engineers *National Inventory of Dams (NID)*

The NID dam type classification includes the following types of dams:

- **RE**: rockfill/earthfill embankment dams, primarily rockfill (fill >3" size)
- **ER**: rockfill/earthfill embankment dams, primarily earthfill (fill <3" size)
- **CN**: Concrete
- **PG**: Gravity

Lane County's high hazard potential dams were built between 1911 and 1976. All dams are rockfill/earthfill embankment dams, except Cougar which is an earthfill/rockfill embankment dam. All dams are operated by the US Army Corps of Engineers and Eugene Water & Electric Board (EWEB) and have emergency action plans in place. All dams are maintained on a regular schedule and undergo regular inspections, with major re-inspections every five years. Furthermore, the Corps is highly experienced in the construction, operation, and maintenance of dams.[8]

For embankment dams the most common failure modes are overtopping, structural failures, and seepage through the dam.[9] However, all the Corps dams were designed and built with specific flood capacities. In addition, the Hills Creek Dam likely has the capacity to withstand floods at least as large as a 1,000-year flood event without expected damage. The other Corps dams have similar margins of flood design safety. Under normal or flood conditions, the probability of failure of the Corps operated dams appears highly unlikely. However, all of Lane County's dams were designed and built before seismic design standards were put in place.

[8] Army Corps of Engineers, 'National Inventory of Dams, *Interactive Map & Charts*, 2018, https://nid.sec.usace.army.mil/, (accessed 1 August 2019).
[9] United States. Association of State Dam Safety Officials. *Earth Dam Failures.* 2019. https://damsafety.org/dam-owners/earth-dam-failures Accessed August 2019.

EWEB dams meet current standards and in compliance with state and federal regulations.[10] Regulators works with EWEB to perform annual inspections to ensure safe operating conditions. Each EWEB dam receives weekly, monthly, semi-annual, and annual inspections. Every five years, the Federal Energy Regulatory Commission requires EWEB to test emergency action plans for the dams.

As Table H-3 shows, seismic considerations were completely absent in the design of Dorena and Fern Ridge dams. The others were explicitly designed to ground shaking levels of 0.10 g, which is the maximum seismic design level for any of the Corps dams in western Oregon. In contrast, the current Corps seismic design levels for dams at these sites (i.e., if new dams were to be built today) would be 0.21 g to 0.24g for the dams in eastern Lane County and 0.35 g for Fern Ridge. Current seismic design requirements are for levels of ground shaking about two times higher than the probable design levels for most of these dams and about three times higher for Fern Ridge. To ensure that the probability of dam failures in Lane County remains low, the Army Corps of Engineers conducts regular seismic evaluations of each dams to ensure that all dams meet current safety requirements.[11]

Table H-3 Seismic Design, Evaluation and Inspection Data

Dam	Date of Last Seismic Evaluation	Seismic Design Basis		Date of Last Periodic Inspection
		Original	Current	
Cottage Grove	1981	None	0.21 g	1997
Dexter	1981	0.10 g	0.21 g	1996
Fall Creek	1981	0.10 g	0.21 g	1999
Dorena	1981	none	0.21 g	1997
Lookout Point	1981	0.10 g	0.21 g	1999
Blue River	1994	0.10 g	0.24 g	1996
Hills Creek	2000	0.10 g	0.22 g	1999
Cougar	1994	0.10 g	0.24 g	1997
Fern Ridge	2001	none	0.35 g	2000

Source: Army Corps of Engineers, Portland District, March 2001.

[10] Oregon. EWEB, 'Dam Safety', *Dam Safety is a Top Priority*, Eugene, OR, 2017, http://www.eweb.org/about-us/news/dam-safety-is-a-top-priority, Accessed August 2019.
[11] United States. Army Corps of Engineers, Portland District Office. *Seismic Design, Evaluation and Inspection Data for Corps of Engineers Dams.* March 2001.

The probability of catastrophic failure of these dams is impossible to estimate with any accuracy, from present data. The Army Corps of Engineers indicates that Lane County's Dams all meet seismic standards and flood standards and that the probability of a dam failure is low, meaning that one incident is likely in a 75 to 100 year period.

The 2020 NHMP Steering Committees agree with this assessment.

H.4.3 Vulnerability Assessment

Eugene and Springfield are both highly vulnerable to inundation from a flood should one of the dam's collapse. Both the Eugene and Springfield steering committees' rate both cities as highly vulnerable to flooding events caused by dam failure, meaning that more than 10% of the population or regional assets could be affected.

H.4.4 Risk Analysis

Detailed loss estimates for possible failures of these dams are beyond the scope of this mitigation plan. Detailed damage and casualty estimates have not been made for catastrophic dam failures affecting Lane County. However, given the large inundation areas, high water depths, and the logistical difficulties for evacuation, it is not difficult to imagine that a truly catastrophic dam failure could potentially result in loss of life and significant economic impact.

H.4.5 Existing Mitigation Activities

The Army Corps of Engineers and Eugene Water & Electric Board conducts annual inspections of all dams that it owns, has completed Emergency Action Plans for all dams should they fail, and completes thorough evaluations of each dam every five years. All these actions help to significantly reduce the probability that a dam will fail.

The following tables (Table H-4 and H-5) detail significant historic dam and levee failures.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
1	Pantano De Puentes Dam	1802	Lorca, Spain	608	Heavy rain/ flooding
2	Bilberry Reservoir	1852	Holme Valley, United Kingdom	81	Heavy rain/ flooding
3	Dale Dike Reservoir	1864	South Yorkshire, United Kingdom	244	Structural deficiencies
4	Iruka Lake Dam	1868	Inuyama, Aichi Prefecture, Japan	941	Heavy rain/ flooding
5	Mill River Dam	1874	Williamsburg, VA, United States	139	Insufficient design
6	South Fork Dam	1889	Johnstown, PA, United States	2,209	Heavy rain and poor maintenance
7	Walnut Grove Dam	1890	Wickenburg, AZ, United States	100	Heavy snow, rain, and poor design
8	Austin Dam	1900	Texas, United States	8	Heavy rain/ flooding
9	Hauser Dam	1908	Helena, MT, United States	0	Heavy rain/ insufficient design
10	Broken Down Dam	1908	Fergus Falls, MN, United States	0	Insufficient design
11	Austin Dam	1911	Texas, United States	78	Insufficient design
12	Desana Dam	1916	Desana, Austria-Hungary	62	Structural deficiencies
13	Lake Toxaway Dam	1916	Transylvania County, NC, United States	0	Heavy rain/ flooding
14	Sweetwater Dam	1916	San Diego County, CA, United States	0	Heavy rain/ flooding
15	Lower Otay Dam	1916	San Diego County, CA, United States	14	Heavy rain/ flooding
16	Tigra Dam	1917	Gwalior, India	1,000	Heavy rain/ flooding and poor design
17	Gleno Dam	1923	Province of Bergamo, Italy	356	Structural deficiencies
18	Llyn Eigiau Dam and Coedty Reservoir	1925	Dolgarrog, United Kingdom	17	Heavy rain/ flooding and structural deficiencies

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
19	St. Francis Dam	1928	Santa Clarita, CA, United States	600	Insufficient design and operation
20	Secondary Dam of Stella Zerbino	1935	Molare, Italy	111	Heavy rain/ flooding, insufficient design and construction
21	Horonai Dam	1941	Omu, Hokkaido, Japan	60	Heavy rain/flooding.
22	Nat-y-Gro Dam	1942	Elan Valley, United Kingdom	0	World War II
23	Eder Dam	1943	Hesse, Germany	70	World War II
24	Möhne Dam	1943	Ruhr, Germany	1,579	World War II
25	Heiwa Lake Dam	1951	Kameoka, Kyoto Prefecture, Japan	117	Heavy rain/flooding.
26	Vega de Tera	1959	Rivadelago, Spain	144	Insufficient design and construction. Heavy Rain/flooding.
27	Malpasset Dam	1959	Côte d'Azur, France	423	Geologic, design, and structural deficiencies.
28	Kurenevka Mudslide	1961	Kiev, Ukraine	>1500	Heavy rain/flooding.
29	Panshet Dam	1961	Pune, India	>1000	Insufficient design and construction. Heavy Rain/flooding.
30	Baldwin Hills Reservoir	1963	Los Angeles, CA United States	5	Geologic, design, and structural deficiencies.
31	Spaulding Pond Dam	1963	Norwich, CT United States	6	Heavy rain/flooding. Structural deficiencies.
32	Vajont Dam	1963	Monte Toc, Italy	2,000	Landslide
33	Swift Dam	1964	Montana, United States	28	Heavy rain/flooding
34	Mina Plakalnitsa	1966	Vratsa, Bulgaria	>107	Insufficient design and construction

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
35	Sempor Dam	1967	Central Java Province, Indonesia	2,000	Heavy rain construction not complete.
36	Certej Dam Failure	1971	Certej Mine, Romania	89	Insufficient design and construction.
37	Buffalo Creek Flood	1972	West Virginia, United States	125	Insufficient construction. Heavy rain/flooding.
38	Canyon Lake Dam	1972	South Dakota, United States	238	Heavy rain/flooding.
39	Banqiao and Shimantan Dams	1975	Zhumadian, China	171,000	Heavy rain/flooding.
40	Teton Dam	1976	Idaho, United States	11	Insufficient design and construction.
41	Laurel Run Dam	1977	Johnstown, PA, United States	40	Heavy rain/flooding.
42	Kelly Barnes Dam	1977	Georgia, United States	39	Insufficient design, construction, or operation.
43	Machchu-2 Dam	1979	Morbi, India	5,000	Heavy rain/flooding.
44	Wadi Qattara Dam	1979	Benghazi, Libya	0	Heavy rain/flooding.
45	Lawn Lake Dam	1982	Rocky Mountain National Park, United States	3	Insufficient operation.
46	Tous Dam	1982	Valencia, Spain	8	Heavy rain/flooding. Insufficient operation.
47	Val di Stava Dam	1982	Tesero, Italy	268	Insufficient operation.
48	Upriver Dam	1986	Washington State, United States	0	Lightning
49	Kantale Dam	1986	Kantale, Sri Lanka	180	Insufficient operation.
50	Peruća Dam	1993	Split-Dalmatia County, Croatia	0	Destroyed by Serbian military forces.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
51	Merriespruit Tailings Dam	1994	Free State, South Africa	17	Heavy rain/flooding.
52	Saguenay Flood	1996	Quebec, Canada	10	Heavy rain/flooding. Insufficient operation.
53	Meadow Pond Dam	1996	New Hampshire, United States	1	Heavy icing. Insufficient design and construction.
54	Opuha Dam	1997	Canterbury, New Zealand	0	Heavy rain/flooding during construction.
55	Donana Disaster	1998	Andalusia, Spain	0	Insufficient construction and operation.
56	Shihgang Dam	1999	Taiwan	0	Earthquake - 7.6 magnitude (partial failure)
57	Martin County Coal Slurry Spill	2000	Martin County, KY, United States	0	Insufficient operation and construction.
58	Vodni nádrz Sobenov	2002	Sobenov, Czech Republic	0	Heavy rain/flooding.
59	Zeyzoun Dam	2002	Zeyzoun, Syria	22	Insufficient operation and structural deficiencies.
60	Hope Mills Dam	2003	North Carolina, United States	0	Heavy rain/flooding.
61	Silver Lake Dam	2003	Michigan, United States	0	Heavy rain/flooding. Large frost depth.
62	Big Bay Dam	2004	Mississippi, United States	0	Insufficient operation and structural deficiencies.
63	Camará Dam	2004	Paraiba, Brazil	3	Insufficient operation and structural deficiencies.
64	Shakidor Dam	2005	Pakistan	70	Heavy rain/flooding.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
65	Taum Sauk Reservoir	2005	Lesterville, United States	0	Insufficient operation and structural deficiencies.
66	Campos Novos Dam	2006	Campos Novos, Brazil	0	Insufficient operation and structural deficiencies.
67	Gusau Dam	2006	Gusau, Nigeria	40	Heavy rain/flooding. Insufficient operation.
68	Ka Loko Dam	2006	Kauai, United States	7	Heavy rain/flooding. Insufficient operation.
69	Lake Delton	2008	Lake Delton, WI, United States	0	Heavy rain/flooding.
70	Koshi Barrage	2008	Koshi Zone, Nepal	250	Heavy rain/flooding.
71	Kingston Fossil Plant Coal Fly Ash Slurry Spill	2008	Roane County, TN, United States	0	Insufficient operation and structural deficiencies.
72	Algodoes Dam	2009	Piaui, Brazil	7	Heavy rain/flooding.
73	Sayano-Shushenskaya Dam	2009	Sayanogorsk, Russia	75	Insufficient operation and construction.
74	Situ Gintung Dam	2009	Tangerang, Indonesia	98	Heavy rain/flooding. Insufficient operation and structural deficiencies.
75	Kenmare Resources Tailings Dam	2010	Mozambique	1	Insufficient operation and structural deficiencies.
76	Kyzyl-Agash dam	2010	Qyzylaghash, Kazakhstan	43	Heavy rain/flooding. Insufficient operation.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
77	Hope Mills Dam	2010	North Carolina, United States	0	Sinkhole.
78	Testalinden Dam	2010	Oliver, BC, Canada	0	Heavy rain/flooding. Insufficient operation.
79	Delhi Dam	2010	Iowa, United States	0	Heavy rain/flooding.
80	Niedow Dam	2010	Lower Silesian Voivodeship, Poland	1	Heavy rain/flooding.
81	Ajka Alumina Plant Accident	2010	Ajka, Hungary	10	Insufficient operation and structural deficiencies.
82	Fujinuma Dam	2011	Sukagawa, Japan	8	Earthquake - 9.1 magnitude. Insufficient operation.
83	Campos dos Goytacazes	2012	Campos dos Goytacazes, Brazil	0	Heavy rain/flooding.
84	Ivanovo Dam	2012	Biser, Bulgaria	8	Heavy rain/flooding. Insufficient operation.
85	Köprü Dam	2012	Adana Province, Turkey	10	Insufficient operation.
86	Dakrong 3 Dam	2012	Quảng Trị Province, Zimbabwe	0	Heavy rain/flooding. Insufficient operation and structural deficiencies.
87	Tokwe Mukorsi Dam	2014	Masvingo Province, Zimbabwe	0	Heavy rain/flooding. Insufficient construction.
88	Mount Polley Tailings Dam Failure	2014	British Columbia, Canada	0	Insufficient construction and operation
89	Germano Mine Tailings Dams	2015	Mariana, Minas Gerais, Brazil	17	Insufficient operation

Table H-5 Significant Levee Failures

Reference Number	Levee	Year	Location	Fatalities	Cause
1	St. Elizabeth's Flood	1421	Netherlands	2,000-10,000	Heavy rain/flooding
2	All Saints' Flood	1570	Netherlands	>20,000	Heavy rain/flooding
3	St. Peter's Flood	1651	Amsterdam, Netherlands	>15,000	Heavy rain/flooding
4	St. Martin's Flood	1686	Groningen, Netherlands	1558	Heavy rain/flooding
5	Great Strom of 1703	1703	Netherlands and Great Britain	8,000-15,000	Heavy rain/flooding
6	Christmas Flood of 1717	1717	Netherlands, Germany, and Scandinavia	14,000	Heavy rain/flooding
7	De Biesbosch Freeze	1809	Netherlands	N/A	Ice.
8	Alblasserwaard	1820	Alblasserwaard, Netherlands	N/A	N/A
9	Netherlands	1825	Netherlands	>800	N/A
10	Lower Rhine	1855	Netherlands	N/A	Ice.
11	Zuyderzee	1916	Netherlands	N/A	Heavy rain/flooding
12	Great Mississippi Flood of 1927	1927	United States	246	Heavy rain/flooding
13	Okeechobee Surge	1928	Florida	2,500	Heavy rain/flooding
14	1938 Yellow River Flood	1938	China	500,000	War
15	Feather River	1955	Yuba City, United States	38	Heavy rain/flooding
16	Vliet Dike Failure	1976	Belgium	N/A	Heavy rain/flooding
17	Yuba River	1986	United States	N/A	Heavy rain/flooding
18	Feather River	1997	United States	3	Heavy rain/flooding

Table H-5 Significant Levee Failures

Reference Number	Levee	Year	Location	Fatalities	Cause
19	Wilnis	2003	Netherlands	0	Insufficient operation.
20	Jones Tract	2004	United States	N/A	Insufficient operation.
21	Hurricane Katrina	2008	United States	1,833	Heavy rain/flooding
22	Fernley, Nevada	2008	Nevada, United States	0	Heavy rain/flooding
23	Munster, Indiana	2008	Indiana, United States	N/A	Heavy rain/flooding
24	Typhoon Morakot	2009	Taiwan	N/A	Heavy rain/flooding
25	Xynthia Storm	2010	France	N/A	Heavy rain/flooding
26	Black River	2011	Missouri, United States	N/A	Heavy rain/flooding

Appendix I: Hazardous Materials

The probability of a hazardous materials incident in Eugene-Springfield is high; vulnerability to such an event is moderate.

I.1 Causes and Characteristics of the Hazard

For mitigation planning, hazardous materials may be defined as any substance that may have negative impacts on human health. Exposure to hazardous materials may result in injury, sickness, or death. Negative health impacts from hazardous materials may be acute, causing harm after a single, episodic exposure or they may be chronic, occurring after prolonged exposure to the material. Certain hazardous materials may also threaten property and the environment.

Hazardous material toxicity varies widely. The term toxic is a synonym for the more common term poisonous. Highly toxic hazardous materials may cause harm or death even after brief exposures to small amounts. Other hazardous materials are much less toxic resulting in negative health effects only after exposure to large amounts over longer periods of time.

Hazardous chemicals are widely used in heavy industry, manufacturing, agriculture, mining, oil and gas industry, forestry, and transportation as well as in medical facilities and commercial, public, and residential buildings. There are numerous materials that may be hazardous to human health. A typical single-family home may contain dozens of potentially hazardous materials including fuels, paints, solvents, cleaning agents, pesticides, herbicides, medicines, and others.

For mitigation planning purposes, small quantities of low to moderately toxic hazardous materials utilized by residents are of limited interest due to low potential impact. The industrial use and transportation of hazardous materials are of significant interest for mitigation planning. Situations involving extremely toxic or large quantities of hazardous materials in locations where accidents or malevolent actions (terrorism or sabotage) may result in significant public health risk are of special concern for planning purposes.

The toxicity of a hazardous material is only one important measure of the potential impact on an affected community. The quantity of material and the ease of dispersal may be as important as toxicity in governing the level of potential threat to a community. For example, a small quantity of a very toxic solid hazardous material in a laboratory may pose a much smaller level of risk for a community than a large quantity of a less toxic gaseous hazardous material upwind from a populated area.

The severity of any hazardous material release for an affected community depends on several factors including the:

A. Toxicity of the hazardous material.
B. Quantity of the hazardous material released.
C. Dispersal characteristics of the hazardous material,
D. Local conditions such as wind direction, topography, soil and ground water characteristics, and proximity to vulnerable resources such as drinking water.
E. Population density in areas likely to be affected by hazardous materials incidents.
F. Efficacy of response and recovery actions.

The principal modes of human exposure to hazardous materials are:

A. **Inhalation** of gaseous or particulate materials via the respiratory (breathing) process.
B. **Ingestion** of hazardous materials via contaminated food or water.
C. **Direct contact** with skin or eyes.

Exposure to hazardous materials can result in a wide range of negative health effects on humans. Hazardous materials are generally classified by their health effects and the most common classes are summarized below.

Flammable materials are substances where fire is the primary threat, although explosive and chemical effects may also occur. Common examples include gasoline, diesel fuel, and propane.

Explosives are materials where explosion is the primary threat, although fire and chemical effects may also occur. Common examples include dynamite and explosives used in construction or demolition.

Irritants may inflame or burn the skin, eyes or airways after contact. Common examples of irritants are acids, solvents, or detergents.

Asphyxiants are substances which interfere with respiration by displacing oxygen. Nitrogen is a common atmospheric gas that when released in a confined space may result in asphyxiation. Chemical asphyxiants are substances that prevent the body from using oxygen or otherwise interfere with respiration. Common examples are carbon monoxide and cyanides.

Anesthetics and Narcotics are substances which depress the central nervous system. Signs and symptoms include drowsiness, weakness, fatigue, incoordination, unconsciousness, paralysis of the respiratory system and death. Examples include hydrocarbons and organic compounds.

Hazardous materials may also have a wide variety of more specialized impacts on human health. Other types of toxic effects are briefly summarized in Table I-1.

Table I-1 Other Types of Hazardous Materials

Type of Hazardous	Effects on Humans
Hepatotoxin	Liver damage
Nephrotoxin	Kidney damage
Neurotoxin	Neurological (nerve) damage
Carcinogen	May result in cancer
Mutagen	May produce changes in the genetic material of cells
Teratogen	May have adverse effects on sperm, ova, or fetal tissue
Radioactive materials	May result directly in radiation sickness at high exposure levels or act as carcinogen, mutagen, or teratogen
Infectious substances	Biological materials such as bacteria or viruses that may cause illness or death

I.2 History of the Hazard in Eugene-Springfield

Large-scale hazardous materials events have been rare. Small-scale or household spills or events are also deemed to be relatively uncommon.

I.3 Risk Assessment

At the present time, there isn't reliable data for assessing the level of risk posed by hazardous materials.

How are Hazard Areas Identified?

Any area within the Eugene-Springfield area may have hazardous materials present. The railroad passing through Eugene-Springfield transports hazardous substances in large quantities. The Extremely Hazardous Substance Plan is completed and identifies each area and associated risk in the pre-incident plan.

Probability of Future Occurrence

Hazardous materials incidents of varying magnitude have occurred in the Eugene-Springfield area over the last 5 years, totaling approximately 707 incidents.[1] The number of incidents may increase as the Eugene-Springfield population continues to grow.

The Eugene and Springfield Steering Committee listed the probability of a hazardous material incident as 'high'.

Vulnerability Assessment

The Eugene-Springfield areas most vulnerable to hazardous materials incidents are those where materials are transported or stored and any adjacent property. Transportation corridors include the railroads and any pipelines that pass through the cities of Eugene and Springfield.

The Eugene and Springfield Steering Committee estimate the vulnerability to hazardous material incidents as 'moderate'.

Risk Analysis

Due to insufficient data, Eugene and Springfield are unable to perform a quantitative risk assessment currently. As data and resources become available an assessment will be completed.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The potential impacts of hazardous materials incidents on the Eugene-Springfield area are summarized below on Table I-2.

[1] Office of the State Fire Marshal, 'Annual Hazardous Substance Incident Report', *Hazardous Incident Search*, Salem, OR, 2014-2018, https://www.oregon.gov/osp/programs/sfm/Pages/Hazardous-Incident-Database.aspx, (accessed 30 July 2019).

Table I-2 Potential Impacts of Hazardous Material Incidents on the Eugene- Springfield Area	
Inventory	**Probable Impacts**
Portion of Eugene-Springfield Metro Area affected	Would be localized, except for large spills which could have extensive evacuation zones and affect a significant portion of the Eugene-Springfield Metro Area.
Buildings	Are negligible except for incidents which involve explosive and flammable materials near structures.
Streets within Metro Area	Could include temporary closures.
Roads to/from Metro Area	Could include temporary closures.
Electric power	Would be negligible except for incidents involving explosive and flammable materials near utilities.
Other Utilities	Would be negligible except for incidents impacting rivers upstream from drinking water intakes for the both communities.
Casualties (deaths and injuries)	Would depend on location and identity of hazardous material, time of day, and evacuation effectiveness.

Existing Hazard Mitigation Activities

The single most critical factor in enhancing both mitigation and emergency response planning is specific inventory awareness of major hazardous materials sites within each jurisdiction. Specific inventory awareness maintains detailed knowledge of the types and locations of significant quantities of hazardous materials for every location in a jurisdiction. What constitutes a significant quantity varies depending on the toxicity of the material, dispersal characteristics, and the nature and population of the potential affected areas.

The Office of State Fire Marshal (OSFM) conducts an annual Hazardous Substance Information System Survey (HSIS) of Oregon facilities. The database created from the survey contains the inventories of hazardous materials at fixed locations in the Eugene-Springfield area. Transportation data of hazardous materials within or through the Eugene-Springfield area and the HSIS data are the foundation for the specific inventory awareness currently integrated into Eugene Springfield Fire Department.

Eugene and Springfield Fire has completed an Extremely Hazardous Substance (EHS) pre-incident plans for all EHS sites, excluding towers due to their low level of risk. Hazardous substance storage locations and transportation sites have been identified detailing worst-case scenarios for risk.

The City of Springfield obtains most of its water from wells and the best way to protect well heads is through the careful management of hazardous material and harmful chemical storage. The Springfield Utility Board has created a Wellhead Protection Program that identifies wellhead protection areas and limits hazardous materials and harmful chemicals from being stored near wellheads.

Attachment 10 - Other: Water Rights Certificates

STATE OF OREGON

COUNTY OF LANE

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

STATE OF OREGON
WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310

confirms the right to use the waters of WILLAMETTE RIVER, a tributary of the COLUMBIA RIVER, in the WILLAMETTE BASIN to maintain an instream flow for the purpose of SUPPORTING AQUATIC LIFE AND MINIMIZING POLLUTION.

The right is for flows to be maintained IN THE WILLAMETTE RIVER FROM THE CONFLUENCE OF COAST FORK AND MIDDLE FORK (RM 187) TO THE CONFLUENCE WITH THE MCKENZIE RIVER (RM 173.7, SECTION 6, T 17 S, R 3 W, W.M.).

The right is established under Oregon Revised Statutes 537.346.

The date of priority is NOVEMBER 3, 1983.

The right is limited to not more than the amounts during the time periods listed below:

Period	Flows (cubic feet per second)
OCT 1 - OCT 31	2000
NOV 1 - MAY 31	2500
JUN 1 - SEP 30	2000

This instream water right shall not have priority over domestic and livestock consumption or water legally released from storage for other purposes.

Witness the signature of the Water Resources Director affixed this 9th day of JUNE, 1989.

William H. Young
Water Resources Director

Recorded in State Record of Water Right Certificates number 59549.

MF185 2.WILLAMETTE R & TRIBS.VOL26.DIST16

STATE OF OREGON

COUNTY OF LANE

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

MORSE BROS., INC.
1001 DIVISION AVENUE
EUGENE, OREGON 97404

confirms the right to use the waters of WILLAMETTE RIVER, a tributary of COLUMBIA RIVER, for PRODUCTION OF ASPHALT AND PORTLAND CEMENT CONCRETE AND RELATED FUNCTIONS.

This right was perfected under Permit 50737. The date of priority is SEPTEMBER 24, 1987. This right is limited to 4.5 CUBIC FEET PER SECOND or its equivalent in case of rotation, measured at the point of diversion from the source.

The point of diversion is located as follows:

SW 1/4 SW 1/4, SECTION 7, T 17 S, R 3 W, W.M.; 86 FEET NORTH AND 753 FEET EAST FROM SW CORNER OF SECTION 7.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use to which this right is appurtenant is as follows:

SW 1/4 SW 1/4
SECTION 7
TOWNSHIP 17 SOUTH, RANGE 3 WEST, W.M.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described. The use confirmed herein may be made only at times when sufficient water is available to satisfy all prior rights, including rights for maintaining instream flows.

WITNESS the signature of the Water Resources Director, affixed APRIL 14, 1992.

/s/ WILLIAM H. YOUNG
William H. Young

BASIN 2 VOLUME 26 WILLAMETTE RIVER & TRIBS. DISTRICT 16

Recorded in State Record of Water Right Certificates numbered 67279.

69317.DSM

STATE OF OREGON

COUNTY OF LANE

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

DELTA SAND AND GRAVEL COMPANY
999 DIVISION AVENUE
EUGENE, OREGON 97404

confirms the right to use the waters of WILLAMETTE RIVER, a tributary of COLUMBIA RIVER, for the purpose of WASHING SAND AND GRAVEL.

This right has been perfected under Permit 50130. The date of priority is AUGUST 4, 1987. This right is limited to 7.14 CUBIC FEET PER SECOND or its equivalent in case of rotation, measured at the point of diversion from the source.

The point of diversion is located as follows:

LOT 4 (NW 1/4 NW 1/4), SECTION 18, T 17 S, R 3 W, W.M.; 402 FEET SOUTH AND 626 FEET EAST FROM THE NW CORNER OF SECTION 18.

This certificate is issued subject to the maintenance and use of adequate treatment facilities to remove the sediment before returning the water to the stream.

This right shall conform to any reasonable rotation system ordered by the proper state officer.

A description of the place of use under this right, and to which this right is appurtenant, is as follows:

LOT 4 (NW 1/4 NW 1/4)
SECTION 18
TOWNSHIP 17 SOUTH, RANGE 3 WEST, W.M.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described. This right is subject to minimum flows established by the Water Resources Commission with an effective date prior to this right.

WITNESS the signature of the Water Resources Director, affixed APRIL 22, 1991.

/s/ WILLIAM H. YOUNG
William H. Young

Recorded in State Record of Water Right Certificates numbered 65679.

69219.DLM

STATE OF OREGON

COUNTY OF LANE

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* WILDISH SAND & GRAVEL COMPANY

of Box 1106, Eugene *, State of* Oregon *, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Wildish Cascade Concrete Company well

a tributary of Willamette River *for the purpose of* industrial (concrete batching plant)

under Permit No. G-2119 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* April 19, 1962

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.11 cubic foot per second

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the Lot 13 (NE¼ NE¼) Section 13, T. 17 S., R. 4 W., W. M. Well located S. 51° 46.5' E. 3758.16 feet from the South SE corner of Poindexter DLC #52.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to - - - - - - - *of one cubic foot per second per acre, and shall conform to such reasonable rotation system as may be ordered by the proper state officer.*

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

Lot 13 (NE¼ NE¼)
Section 13
T. 17 S., R. 4 W., W. M.

The right to the use of the water for purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed this date. May 24, 1965

CHRIS L. WHEELER
State Engineer

Recorded in State Record of Water Right Certificates, Volume 24 *, page* 32195

STATE OF OREGON

COUNTY OF LANE

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

STATE OF OREGON
WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310

confirms the right to use the waters of WILLAMETTE RIVER, a tributary of the COLUMBIA RIVER, in the WILLAMETTE BASIN to maintain an instream flow for the purpose of SUPPORTING AQUATIC LIFE AND MINIMIZING POLLUTION.

The right is for flows to be maintained IN THE WILLAMETTE RIVER FROM THE CONFLUENCE OF COAST FORK AND MIDDLE FORK (RM 187) TO THE CONFLUENCE WITH THE MCKENZIE RIVER (RM 173.7, SECTION 6, T 17 S, R 3 W, W.M.).

The right is established under Oregon Revised Statutes 537.346.

The date of priority is NOVEMBER 3, 1983.

The right is limited to not more than the amounts during the time periods listed below:

Period	Flows (cubic feet per second)
OCT 1 - OCT 31	2000
NOV 1 - MAY 31	2500
JUN 1 - SEP 30	2000

This instream water right shall not have priority over domestic and livestock consumption or water legally released from storage for other purposes.

Witness the signature of the Water Resources Director affixed this 9th day of JUNE, 1989.

William H. Young
Water Resources Director

Recorded in State Record of Water Right Certificates number 59549.

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Attachment 11 - Other: Industrial Aggregate Recycled Water Use Planning Study

see Attachment 4 for this document

Attachment 12 - Other: Triple Bottom Line Assessment of Thermal Load Mitigation Alternatives

Triple Bottom Line Assessment of Thermal Load Mitigation Alternatives

Including:



Riparian Shade Credit Contracting



Recycled Water Use for Agricultural Irrigation



Recycled Water Use for Industrial Aggregate Production

Prepared by
Aaron Toneys and Joshua Proudfoot of Good Company
For
Metropolitan Wastewater Management Commission

May 2014

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1. EXECUTIVE SUMMARY

The discharge of treated effluent from the Eugene-Springfield Water Pollution Control Facility (WPCF) is regulated by the Oregon Department of Environmental Quality (ODEQ) through a National Pollutant Discharge Elimination System (NPDES) permit issued to the Metropolitan Wastewater Management Commission (MWMC). A requirement of the NPDES permit is compliance with temperature standards, which limits daily thermal discharge into the Willamette River. ODEQ is in the process of revising the 2006 Willamette Basin total maximum daily load (TMDL) for temperature. The temperature TMDL is driven by cold water criteria for salmon habitat, which vary by geography and season. Under the TMDL, the MWMC will be issued an allocation for allowable daily thermal load discharge from the WPCF.

The MWMC will be required to have a strategy in place to mitigate for excess thermal load risk under current conditions (determined from historical WPCF discharge data and the MWMC's permitted waste load allocation). To meet the anticipated mitigation need under the TMDL, the MWMC is in the process of comparing the feasibility of a number of thermal load mitigation alternatives. To support the comparison, the MWMC requested that Good Company complete a Triple Bottom Line (TBL) Assessment to inventory and compare the economic, social and environmental performance for *three* of the most promising thermal mitigation project alternatives, including:



Riparian Shade Credit Contracting

Under a water quality trading strategy involving regulatory credit for restoring riparian shading, no modification to WPCF effluent treatment and discharge into the Willamette River is necessary. In this conceptual alternative MWMC would contract for the production of Riparian Shade Credits with the Freshwater Trust. The contract would result in a series of riparian restoration projects in the McKenzie River watershed that would plant trees and other native vegetation that increase shade on the river to offset the WPCF's excess thermal load.



Recycled Water Use for Agricultural Irrigation at MWMC's Facilities

Effluent from the WPCF (currently treated to Class D recycled water standards) would be piped via existing and upgraded recycled water piping to a storage lagoon and used for agricultural irrigation at two MWMC-owned facilities including the Biocycle Farm (Biocycle) and the Beneficial Reuse Site (BRS). This project would include upgrading sections of recycled water pipeline infrastructure between the WPCF, Biosolids Management Facility (BMF), and the BRS along the Northwest Expressway. At the Biocycle Farm the existing method of irrigating via hose reels would be upgraded to a dedicated irrigation system, which includes new pipe, valves and irrigation outlets. At the BRS, the existing storage lagoon would be upgraded and relined, the pumping system would be upgraded, a dechlorination system would be added and various automated controls and instrumentation would be upgraded. The existing pivot irrigation system would be used with only minor upgrades. Recycled water would be applied at agronomic rates at both facilities for a combined daily demand of up to 3.1 million gallons per day (MGD), but demand would vary significantly throughout the year and be subject to climatic conditions. However, the 35 to 57 million gallons (MG) of off-line recycled water storage capacity provided at the BRS would allow effluent diversion to be managed for thermal mitigation drivers with subsequent reuse from storage based on seasonal demand.



Recycled Water Use for Industrial Aggregate Production

This alternative would divert a portion of treated effluent from the WPCF currently discharged to the Willamette River (currently treated to Class D recycled water standards), further treating it to the highest Class A recycled water standards for distribution to the site shared by Delta Sand & Gravel (Delta) and Knife River (Delta-Knife site) where it would be used in lieu of Willamette

River water for production. Water is used at the Delta-Knife site for a variety of industrial aggregate processes, including gravel washing, equipment rinsing, concrete batching, and asphalt production. The construction required for this alternative includes a segregated Class A recycled water production stream at the WPCF, distribution pumping, a pressurized storage tank, and dedicated recycled water distribution infrastructure at the Delta-Knife site. This alternative would utilize some existing infrastructure, including a recycled water pipeline between the WPCF and the Delta-Knife site, filtration units, and chlorine contact basins.

The purpose of this TBL assessment is to provide MWMC, wastewater staff[1] and other pertinent decision-makers with a summary of relevant economic, environmental and social performance data to compare the alternatives. In addition to this specific TBL Assessment, this project provided the following:

- A TBL framework that will allow MWMC to compare additional alternatives in the future
- Education and training for TBL process development to allow for future TBL assessments to be conducted internally, by staff (i.e. without consultant assistance)
- This assessment served as a "pilot project" for the TBL process within MWMC

TBL Scoring Methodology

The TBL process assembles an array of data that is largely qualitative in nature. Many measures of particular criteria are not expressed in units, but as a professional assessment of the project effect on the measure. This TBL imposed a scoring methodology to provide side-by-side numeric comparison of the evaluated alternatives. The methodology resulted in a weighted technical score for each of the nine criteria for each alternative.

Assigning Criterion Weight

A pairwise comparison was completed individually by each of the seven MWMC commissioners via an online survey. This method asked each member of the commission to compare each of the nine Criteria versus each of the remaining Criteria, one pair at a time. Then, for the Criterion selected for each pair, the respondent applied a scale of 1 to 3 to signify the degree of importance of the chosen Criterion over the compared Criterion. The responses to the survey were used to calculate weights (as a percentage) for each Criterion. The results of the seven individual commissioner responses were then averaged to arrive at an overall Criterion weight.

Assigning Criterion Score

The Project Technical Team assigned scores to the alternatives for each Measure. The scores for each individual Measure were then averaged to determine the Criterion Score. The team consisted of regional wastewater planning and operations staff and the consultant team (Kennedy/Jenks Consultants and Good Company staff). Scores were assigned on a scale of 1 to 10. The lower end of the scale indicated high risk / low value and, conversely, the upper end of the scale indicated low risk / high value. A score of 5 indicated neutral or existing conditions.

[1] "Wastewater staff" within the context of this report refers to City of Eugene and City of Springfield staff designated to support the MWMC's regional wastewater program.

Findings in Brief

The findings of this TBL assessment are summarized in Figures 1 - 5. Figure 1 provides the highest-level summary of the results of this assessment in the form of *TBL Score* for each alternative. Figure 2 provides the details of Criterion Weighting and Scoring process. Figures 3 – 5 provide a highly summarized comparison of the significant economic, environmental and social differences between alternatives. The following points briefly summarize the results of the TBL assessment:



Riparian Shade Credits

This alternative provides the thermal mitigation needed to meet 2006 TMDL requirements for late October. Riparian shade credits represent the lowest-cost alternative (based on 20-year NPV and cost effectiveness) and externalize all operational requirements associated with thermal mitigation from the WPCF/MWMC to the shade credit vendor. Riparian restoration reduces impacts on the aquatic environment, but *also* enhances the terrestrial ecosystem for birds and other wildlife. The primary risk associated with this alternative includes the possibility of legal challenges to credits as a compliance mechanism under the Clean Water Act.



Recycled Water Use for Agricultural Irrigation

This alternative provides 130% of the thermal mitigation needed to meet 2006 TMDL requirements for late October. This alternative offers the greatest operational flexibility as a result of the proposed upgrades to recycled water transmission and storage infrastructure. The location of project infrastructure provides the greatest potential recycled water demand (within 1 mile) of the two recycled water alternatives. The use of recycled water for this and the Aggregate Production alternative offers the community a means for adapting to the effects of climate change, specifically long, intense drought conditions. Finally, this alternative is considered by the project team to offer the greatest relative permitting certainty. While this alternative provides many benefits, it comes at the greatest financial cost. Other risks associated with this alternative include wet weather conditions limiting irrigation demand and nitrate levels in the groundwater and associated testing requirements.



Recycled Water Use for Industrial Aggregate Production

Does not provide the thermal mitigation needed by the 2006 TMDL requirements (85% of total needs) during late October. The Delta-Knife site and operations provide a unique opportunity for development of recycled water infrastructure within our community as the site is close to the WPCF and site maximum daily use is nearly equivalent to the projected recycled water diversion needed to reduce thermal load in late October. From a Delta-Knife operational point of view, the project offers installation of recycled water infrastructure at no cost and reduced energy costs. However, there are numerous, significant and potentially insurmountable financial and operational barriers to overcome, which include; Delta Sand & Gravel has stated that they are not interested in participating in further study unless they can be assured of acceptable costs and regulatory burdens; neither Delta or Knife River are water limited for production (i.e. there is not a water need); the project may require a new NPDES permit; unknown quality impacts on Delta-Knife River products; concerns about health and safety; and a limited lifetime of Delta's production at the site before their source of material is consumed (significantly reducing water use).

Sources of Uncertainty in the Assessment

This assessment is based on currently available information, but there are four factors that are highly uncertain and could significantly change the outcome of this assessment.

- **Regulatory Requirements:** This assessment assumes 2006 Temperature TMDL requirements and estimates thermal mitigation need accordingly, including theoretical conditions, which would exacerbate the mitigation need presented by the 2006 TMDL. Any change to the TMDL would alter

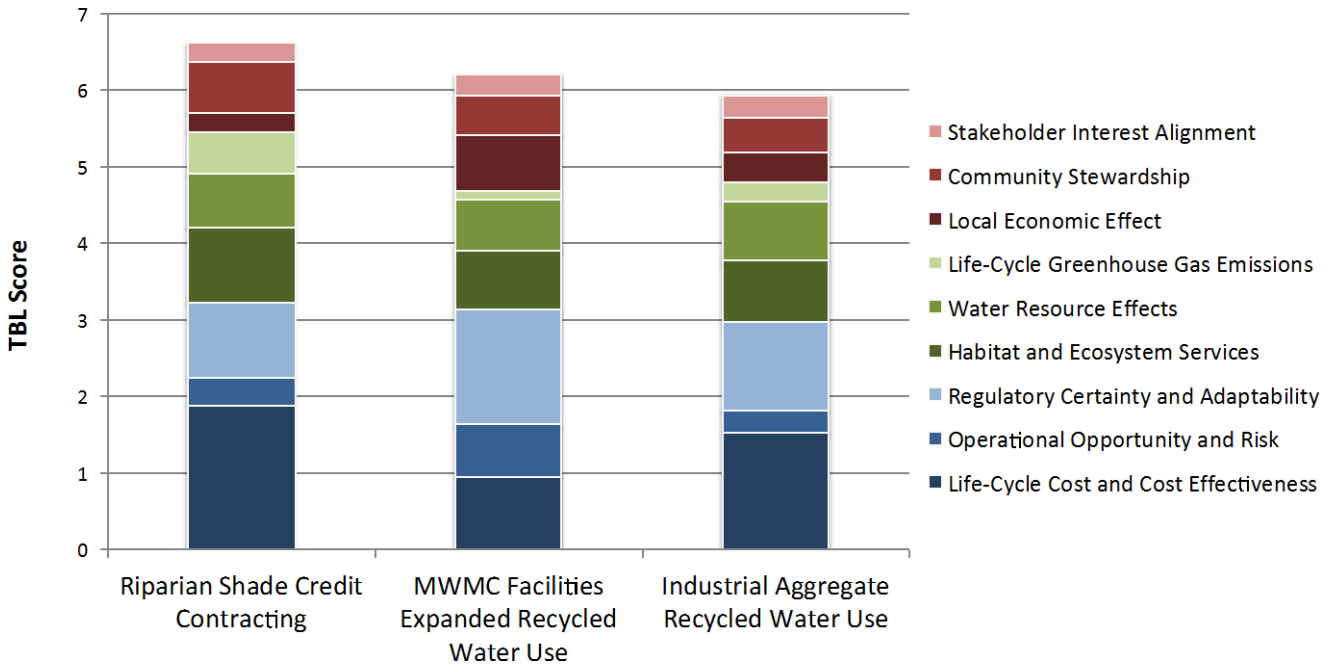
the most fundamental criteria used to assess alternatives – their ability to mitigate thermal discharge.

- **Timing and Severity of Climate Change Impacts:** The effects of climate change, specifically more frequent and severe drought could significantly increase the value of water resources within our community and therefore could increase the value of recycled water.
- **Large-Scale Recycled Water Customers:** The use of recycled water by private customers offers the promise of a net financial advantage to both external water users (reduced water costs) and to MWMC (sale of a recycled water product to offset treatment and conveyance costs). The net financial outcome depends on a variety of factors, but partnership with a large-scale water user nearby one of the recycled water alternatives could significantly alter the financial analysis.
- **Delta Sand & Gravel and Knife River Aggregate Water Demand:** Demand for this alternative is based on maximum water rights and estimates of demand and seasonal variation of demand.

Figure 1 shows that Riparian Shade Credits achieve the highest TBL Score of the three alternatives, followed by Recycled Water Use for Agricultural Irrigation for Agricultural Irrigation at MWMC Facilities and finally Recycled Water Use for Industrial Aggregate Production for Industrial Aggregate, Asphalt and Concrete.[2]

Figure 2 shows a detailed version of the variables used to calculate the TBL Scores shown on Figure 2 and includes: Criterion Score, Criterion Weights, Weighted Criterion Score and the final TBL Score, by thermal mitigation alternative. It is recommended the reader consider Figure 1 and 2 in parallel with Figures 3 – 5. Figures 1 and 2 present a highly summarized version of the TBL results and Figure 3, 4, and 5 presents the data used to assign the Criteria Scores shown on Figure 2.

Figure 1: Comparison of the alternatives, by TBL Score, with the highest score being best.



[2] Details of the TBL Scoring methodology may be found in Section 6 of this report.

Figure 2: Comparison of the alternatives, by TBL Score, with the highest score representing the highest value and lowest risk.

Triple Bottom Line (TBL) Categories / Criteria	Criterion Scores						Weighted Criterion Scores		
	Riparian Shade Credit Contracting	MWMC Facilities Expanded Recycled Water Use	Industrial Aggregate Recycled Water Use		Criteria Weights (%)		Riparian Shade Credit Contracting	MWMC Facilities Expanded Recycled Water Use	Industrial Aggregate Recycled Water Use
Economic Criterias					**48%**				
Life-Cycle Cost and Cost Effectiveness	10.0	5.0	8.1	X	19%	=	1.9	1.0	1.5
Operational Opportunity and Risk	3.8	7.0	3.0	X	10%	=	0.4	0.7	0.3
Regulatory Certainty and Adaptability	5.0	7.8	6.0	X	19%	=	1.0	1.5	1.2
Environmental Criterias					**30%**				
Habitat and Ecosystem Services	8.4	6.6	6.8	X	12%	=	1.0	0.8	0.8
Water Resource Effects	5.4	5.2	6.0	X	13%	=	0.7	0.7	0.8
Life-Cycle Greenhouse Gas Emissions	10.0	1.9	4.6	X	6%	=	0.6	0.1	0.3
Social Criterias					**22%**				
Local Economic Effect	3.0	9.0	4.8	X	8%	=	0.2	0.7	0.4
Community Stewardship	6.7	5.3	4.7	X	10%	=	0.7	0.5	0.5
Stakeholder Interest Alignment	6.4	6.8	7.3	X	4%	=	0.3	0.3	0.3
TBL Scores:					**100%**		**6.6**	**6.2**	**5.9**

Figure 3: Highest-level summary and comparison of Economic TBL Criteria.

Economic Criteria	Measure	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Life-Cycle Cost and Cost Effectiveness	**20-Year Net Present Value**	$4,650,000	$11,924,000	$6,801,000
	Cost Effectiveness	$0.13 / kcal / day	$0.21 / kcal / day	$0.14 / kcal / day
Operational Opportunity and Risk	**Additional Recycled Water Conveyance Capacity**	0	1.7 – 2.2 MGD	7.2 MGD
	Additional Recycled Water Storage Capacity	0	41 MG	0.1 MG
	Other Significant Operational Opportunities or Risks	Opportunity • Externalizes all operational requirements and risk to a third party. Risk • None to note.	Opportunities • Develops recycled water operational experience that could be utilized in the future. • Utilizes existing infrastructure. Risk • Wet weather limits irrigation demand.	Opportunities • Develops recycled water operational experience that could be utilized in the future. • Utilizes existing infrastructure. Risks • Change to business model. The WPCF would be required to produce a product with consistent quality based on external specifications. • Liability for Delta-Knife River product failures as a result of recycled water composition. • Risk of Delta ceasing operations in 10-12 years.
	Resilience to Seismic Event	High to Mid	Mid	Mid to Low
Regulatory Certainty and Adaptability	**Permitting Certainty and Potential Challenges**	• Subject to ongoing third party challenges.	• Greater relative certainty and lower risk because it's an existing practice at MWMC-owned facilities.	• Uncertainty associated with permitting of thermal discharges from Delta-Knife settling ponds.
	Other Regulatory or Permitting Opportunities or Risk	Risks • Inability of credit vendor to recruit the landowners required to generate the needed thermal offset.	Opportunity • Reduces discharges of permitted constituents including CBOD, suspended solids and coliform. Risk • Nitrate levels in the Southern Willamette GWMA. • Additional groundwater testing requirements.	Opportunity • Reduces discharges of permitted constituents including CBOD, suspended solids and coliform. Risks • Delta-Knife River may need a new NPDES permit for thermal discharge. • WPCF permit compliance would be reliant on the water demand and timing of demand of external parties.
	Potential for Onsite Mitigation Expandability	• No potential for expansion.	• 3.5 - 35 MGD for discharge to constructed onsite wetlands.	• Gravel pit reclamation and habitat enhancement could be significant, but are not quantified.
	Decision-to-Project Implementation Period	5 – 7 years	2 - 3 years	2 - 3 years

Figure 4: Highest-level summary and comparison of Environmental TBL Criteria.

Environmental Criteria	Measure	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Water Resource Effects	**Thermal Reduction Potential (indexed value)**	252	393	340
	Surface Water Quality Effects (Other than Thermal)	• Reduces discharges of sediment and nitrogen. Quantities of reduction are site dependent.	• Reduces discharge of all constituents contained in WPCF effluent in quantities that correspond to the volume of avoided discharge.	• Reduces discharge of all constituents contained in WPCF effluent in quantities that correspond to the volume of avoided discharge.
	Ground Water Quality Effects	• No known effects.	• Potential source of additional nitrates in the Southern Willamette Valley Ground Water Management Area.	• Not a significant concern.
	Net Change to River Flow	• No net change.	• Net decrease. Average decrease of 1.98 MGD (June through September) and a peak of 3.07 MGD (July)	• No net change.
	Offset of Surface or Groundwater Use	• *Surface*: No change. • *Ground:* No change.	• *Surface*: No change. • *Ground*: 0.0001 *MGD*.	• *Surface*: 2.36 MGD. • *Ground:* 0.06 MGD.
	Future Project Site Aquifer or Stream Flow Augmentation Opportunities	• No opportunities identified.	• Discharge to groundwater if treated to Class A standards. • Discharge to surface water through constructed wetland.	• No opportunities identified.
Habitat and Ecosystem Services	**Scale of Enhanced Habitat**	• *Acres:* 36 – 73 • *Stream Miles:* 5 - 10	• *Acres:* 0 • *Stream Miles:* 0	• *Acres:* 0 • *Stream Miles:* 0
	Soil Quality Effects	• Soil health improved by reducing compaction, improving drainage and reducing erosion.	• Low salinity hazard[3]	• No significant benefits or risks were identified.
	Future Project Site Habitat and Ecosystem Opportunities	• As restoration site matures it will increase habitat complexity for aquatic and terrestrial species.[4]	• If the maximum onsite wetland restoration potential were developed in the future it would create roughly 100 acres of wetland habitat.[5]	• No opportunities identified.
Life-Cycle GHG Emissions	**Net 20-Year Life-Cycle GHG Emissions**	1,092 MT CO_2e	5,680 MT CO_2e	2,395 MT CO_2e

[3] Based on Class C water quality testing results of 244 ppm compared to low hazard range in ODEQ's – *Implementing Oregon's Recycled Water Rules*, Table 18 and page 64.
[4] Oregon Department of Fish and Wildlife (2006). *Oregon Conservation Strategy*. Downloaded 3/14 at http://www.dfw.state.or.us/conservationstrategy/docs/document_pdf/b-habitat_10.pdf.
[5] Wetland habitat includes an estimated 90 acres at Biocycle Farm and 10 acres at BRS.

Figure 5: Highest-level summary and comparison of Social TBL Criteria.

Social Criteria	Measure	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Local Economic Effect	**Construction Jobs**	17 FTE-years	55 FTE-years	30 FTE-years
	External Demand for Recycled Water	0 MGD	10.3 MGD	3.1 MGD
	Change in External Profit or Cost Avoidance	No change.	Increased profit for BRS tenant farmer. Irrigation could increase annual harvests by 3x.	Delta-Knife cost avoidances could include: process water pumping costs and process water heating costs.
Community Stewardship	**Human Health and Safety Concerns**	• No concerns identified.	• Concern from farm adjacent to BRS site about the risk of overspray on food crops.	• Concern for Delta S&G employees who are significantly exposed daily to aggregate wash water.
	Aesthetic Site Improvements	• Restoration will likely significantly improve aesthetics on privately owned land. Public benefit will be site-dependent and likely only accessible via navigable waterways.	• Potentially more greenery at Biocycle and BRS sites from increased irrigation particularly during dry months.	• No change expected.
	Develops Climate Change Adaptation Capacity	• Provides increased ecosystem services. The value of these services varies with site selection.	• Provides a substitute for sources of ground or surface water that could be utilized during future extreme drought conditions to maintain in-stream flows and groundwater supplies.	• Provides a substitute for sources of ground or surface water that could be utilized during future extreme drought conditions to maintain in-stream flows and groundwater supplies.
Stakeholder Interest Alignment	**Potential Project Partnerships**	• McKenzie Watershed Council: Riparian restoration facilitator. • EWEB: Depending on project location, could support their *Drinking Water Protection Plan*.	• EWEB: Supports goals of Water Management Conservation Plan • To-Be-Determined Recycled Water Users	• EWEB: Supports goals of Water Management Conservation Plan
	Alignment with Local & State Plans & Programs	Alignment with 2 of 5	Alignment with 2 of 5	Alignment with 2 of 5
	Stakeholder Acceptability and Alignment (Indexed Value)	9.8	11.6	15.8

2. INTRODUCTION

The discharge of treated effluent from the Eugene-Springfield Water Pollution Control Facility (WPCF) is regulated by the Oregon Department of Environmental Quality (ODEQ) with a National Pollutant Discharge Elimination System (NPDES) permit.[6] ODEQ is in the process revising the 2006 Willamette Basin total maximum daily load (TMDL) for temperature. A requirement of the NPDES permit is compliance with temperature standards, which will include a limitation of total daily thermal discharge into the Willamette River when the ODEQ issues the next permit renewal to the Metropolitan Wastewater Management Commission (MWMC) for the WPCF. Revisions to temperature TMDL requirements are driven by cold-water criteria for salmon habitat, which vary by geography and seasonality. Under the TMDL, the MWMC will be issued a waste load allocation for allowable daily thermal load discharged from the WPCF. The MWMC will be required to have a strategy in place to mitigate for any excess thermal load (determined from historical WPCF discharge data and the MWMC's permitted waste load allocation).

Based on the 2006 TMDL, historic WPCF data, and hypothetical future conditions which would exacerbate excess thermal loads, there are three critical time periods during the year when the WPCF effluent thermal load is most at risk of exceeding the projected permit limits for 2035 – early May, August - September and late October. Of these periods, the period of greatest risk is late October in terms of frequency and intensity (i.e. how often the event might recur and the degree of excess thermal loading) and August - September in terms of duration (i.e. the number of at-risk days for excess thermal load). The MWMC is currently evaluating the feasibility of a number of temperature TMDL compliance alternatives. This TBL Assessment was completed to support the MWMC's evaluation efforts.

Project Description

There are a number of thermal mitigation project alternatives possible to meet the WPCF's discharge requirements including: restoration of riparian areas, diverting discharge water to beneficial uses (e.g., irrigation or industrial use), temporarily storing the water in a lagoon, or mechanically cooling the water prior to discharge. To consider the best value to the community, the Metropolitan Wastewater Management Commission (MWMC) contracted with Kennedy/Jenks Consultants and Good Company to complete a Triple Bottom Line (TBL) assessment that inventories and compares the economic, social and environmental performance for the ***three*** most developed and promising thermal mitigation alternatives. These alternatives are well suited to a TBL assessment because they all have the opportunity to develop community partnerships as well as having implications for the community and environment beyond the issue of thermal load compliance. For all of the alternatives this assessment assumes a project term of 20 years. The alternatives considered in this report include:



Riparian Shade Credit Contracting (Riparian Shade Credits)
Under a water quality trading strategy involving regulatory credit for restoring riparian shading, no modification to WPCF effluent treatment and discharge into the Willamette River is necessary. In this conceptual alternative the MWMC would contract for the production of Riparian Shade Credits with the Freshwater Trust. The contract would result in a series of riparian restoration projects in the McKenzie River watershed to offset the WPCF's excess thermal load. The restoration projects would plant trees and other native vegetation, creating new shade onto the river, which offsets the excess thermal load in WPCF effluent.

[6] As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.



Recycled Water Use for Agricultural Irrigation (Agricultural Irrigation)
Effluent from the WPCF (currently treated to Class D recycled water standards) would be piped via upgraded recycled water piping to a storage lagoon and used for agricultural irrigation at two MWMC-owned facilities including the Biocycle Farm (Biocycle) and the Beneficial Reuse Site (BRS). This project would include upgrading sections of recycled water pipeline infrastructure between the WPCF and the BRS along the Northwest Expressway. At the Biocycle Farm the existing method of irrigating via hose reels would be upgraded to a dedicated irrigation system, which includes new pipe, valves and irrigation outlets. At the BRS, the existing storage lagoon would be upgraded and relined, the pumping system would be reconditioned, a dechlorination system would be added and various electrical controls and SCADA equipment would be upgraded. Additionally, redundant WPCF pumping systems would be needed to ensure system functionality for thermal load compliance. The existing pivot irrigation system would be used with only minor upgrades. Recycled water would be applied at agronomic rates at both facilities for a combined daily demand of up to 3.1 million gallons per day (MGD), but demand would vary significantly throughout the year and be subject to climatic conditions.



Recycled Water Use for Industrial Aggregate Production (Industrial Aggregate)
This alternative would divert a portion of treated effluent from the WPCF currently discharged to the Willamette River (currently treated to Class D recycled water standards), further treating it to the highest Class A recycled water standards for distribution to the site shared by Delta Sand & Gravel (Delta) and Knife River where it would be used in lieu of Willamette River water for production. Water is used at the Delta-Knife site for a variety of industrial aggregate processes, including gravel washing, equipment rinsing, concrete patching, and asphalt production. The construction required for this alternative includes a segregated Class A recycled water production stream at the WPCF, distribution pumping, a pressurized storage tank, and dedicated recycled water distribution infrastructure at the Delta-Knife site. This alternative would utilize some existing infrastructure, including a recycled water pipeline between the WPCF and the Delta-Knife site, filtration units, and chlorine contact basins.

The purpose of this TBL assessment is to provide MWMC, wastewater staff[7] and other pertinent decision-makers with a summary of relevant economic, environmental and social performance data to compare the alternatives. In addition to this specific TBL Assessment, this project provided the following:

- A TBL framework that will allow MWMC to compare additional alternatives in the future
- Education and training for TBL process development to allow for future TBL assessments to be conducted internally, by staff (i.e. without consultant assistance)
- This assessment served as a "pilot project" for the TBL process within MWMC

Structure of Report

This report consists of 7 sections, which include the following:

1. **Executive Summary:** A highly summarized version of the assessment and results.
2. **Introduction:** An expanded version of the introduction included in the Executive Summary.
3. **Terminology and Methodology:** Defines the TBL terms used throughout this report and the approach and process used to complete this TBL assessment.
4. **Selection of TBL Criteria and Measures:** The selection of the Criteria and Measures is the single most important step in a TBL assessment because this selection defines the basis of the assessment and comparison. This section provides a description of the process and summary of

[7] "Wastewater staff" within the context of this report refers to City of Eugene and City of Springfield staff designated to support the MWMW's regional wastewater program.

the TBL Criteria and Measures that were selected for this assessment.

5. **Inventory of Data and Comparison of Alternatives:** Detailed inventory of available data to support comparison of the thermal mitigation alternatives according to the TBL Criteria and Measures.
6. **Scoring the Alternatives - Methodology and Results:** The inventory of data was used in conjunction with organizational values to "Score" the thermal mitigation alternatives. The process and results of this scoring exercise are documented in Section 6 of the report.
7. **Suggestions for Improving the TBL Process:** This assessment serves as the "pilot" TBL project for MWMC. The TBL framework is integrated differently by each organization and inevitably will evolve within MWMC over time. A few suggestions are offered for the next TBL assessment to improve efficiency and increase organization value.

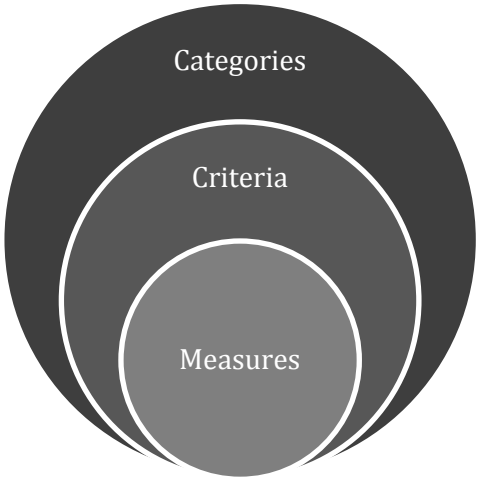
3. TERMINOLOGY AND METHODOLOGY

This section defines terms that are used throughout the report that are unique to this TBL assessment. The intent is to keep jargon to a minimum, but the terms listed here are required to provide structure, order and meaning for this assessment. This section also describes the methodology and approach used to complete this assessment.

Terminology

The following terms will be used consistently throughout this report to differentiate between the concepts and hierarchy within those concepts. The sub bullet points are used to illustrate hierarchy.

- **Categories:** The three broad groupings of issues considered within TBL thinking, frameworks and assessments. The three Categories are – *Economic, Environmental* and *Social.*
    - **Criteria:** Within each *Category* are sub-categories, called *Criteria*, which represent various decision-making considerations. For example Economic *Criteria* in this assessment include: Life-Cycle Cost, Operational Opportunity and Risk, and Regulatory Certainty and Adaptability.
        - **Measures:** A group of significant metrics or indicators, called *Measures*, is used to assess the alternatives for each *Criterion*. For example, *Measures* for the Life-Cycle Cost *Criterion* includes 20-Year Net Present Value and Cost Effectiveness of Thermal Mitigation.



- **TBL Score:** A numeric value calculated for each alternative based on *Criterion Weight* and *Criterion Score*. *Criterion Weight* is multiplied by *Criterion Score* for each thermal mitigation alternative to determine a weighted score. The weighted scores are summed across all *Criteria* to determine an alternative's *TBL Score*. See the *Scoring the Alternatives* section for details.
    - **Criterion Weight:** A relative percentage calculated for each individual *Criterion* to indicate its relative importance for this decision-making process. The sum of the nine *Criterion Weights* is equal to 100%. The Criterion Weights were calculated using data from a survey distributed to MWMC commissioners.
    - **Criterion Score:** A numeric value from 1 to 10 (10 = high value) applied by the technical project team to each thermal mitigation alternative, by individual *Measure,* to represent differences between the alternatives. The scores for all *Measures* are averaged, by *Criterion*, for each project alternative to determine the alternative's *Criterion Score*.



Methodology

TBL is an evaluation framework used to identify and scale significant economic, environmental and social benefits and costs in order to assess the overall value of an investment. The primary purpose and value of TBL is that a project's social and environmental performance is evaluated alongside typical "bottom line" financial considerations. TBL is particularly useful for high-stakes projects and long-term decision making to ensure all predictable or potential project consequences are considered to extract maximum value for large investments and to avoid short- or long-term negative impacts.

No single established protocol or methodology has been widely recognized as the best practice for conducting a TBL analysis. This is because the social, environmental and economic Criteria that are significant will change depending on the organization, project, or alternative being assessed. However, there are a variety of publically available TBL frameworks and guidelines, such as those developed by the Global Reporting Initiative[8], from which to take guidance.

The TBL approach used for this assessment consisted of three primary steps, which are described in detail in the following sections of this report:

- Selection of TBL Criteria and Measures
- Inventory of Data and Comparison of Alternatives
- Scoring the Alternatives

4. SELECTION OF TBL CRITERIA AND MEASURES

The process of selecting the TBL Criteria that are significant for this assessment began with a meeting of regional staff coordinated by the project manager. At this meeting staff was asked to assess the relevance of the alternatives based to a broad set of commonly used TBL Criteria summarized in Good Company's *TBL Screening Tool*. If relevance was established, staff was asked to describe significant benefits and concerns associated with each alternative for that specific Criterion. In addition to the group interview, the research team reviewed a variety of existing technical memos, documentation of other stakeholder interviews and other data to determine the key TBL Criteria.

The Criteria that were ultimately selected by the project technical team represent those that characterize a significant difference between the project alternatives – either as a benefit or a concern. The Criteria selected are presented in Figure 6 through Figure 8. The research team[9] considered other Criteria, which were ultimately excluded due to finding no significant difference between the alternatives. The excluded Criteria are summarized in Figure 9 and the reason for their exclusion is provided.

Once Criteria were selected, Measures within those Criteria were selected. The Measures highlight specific areas of benefit or concern that can be used to make a more side-by-side comparison across the group of alternatives. When possible, a Measure is represented by quantitative data, but some Measures use qualitative data for comparison. Each of the Measures used to compare the alternatives are listed by Criterion in Figure 6 - Figure 8.

[8] The Global Reporting Initiative (GRI) is a leading organization in the sustainability field. GRI promotes the use of sustainability reporting as a way for organizations to become more sustainable and contribute to sustainable development. For more details visit https://www.globalreporting.org.

[9] The research team fpr this assessment included City of Springfield staff, City of Eugene staff and a consultant team (Kennedy Jenks Consultants and Good Company).

Figure 6: Summary of Economic TBL Criteria and Measures.

TBL Category Triple Bottom Line (TBL) frameworks consist of three assessment *Categories*: Economic, Environmental and Social.	Criteria Criteria represent the significant economic, environmental and social considerations within the TBL assessment Categories to frame decision making by MWMC.	Measures of Criteria[1] Measures are used to evaluate and compare performance for Criteria across the project alternatives. Measures may be expressed in different ways, ranging from detailed quantitative measurements to qualitative evidence that is observable and / or scalable.
Economic	**Life-Cycle Cost and Cost Effectiveness:** Accounting for costs across the full life cycle by considering initial construction costs, on-going operation and maintenance expenses, and the value of potential revenue or cost avoidance provides a comprehensive comparison of the budget implications of each of the mitigation alternatives. Another way to evaluate the financial implications of each alternative is to evaluate it in the context of its potential to mitigate thermal load, or its cost-effectiveness. This Criterion describes the relative efficiency of each of the alternatives.	• **20-Year Net Present Value** - *Capital and Construction Cost* - *Annual Operations and Maintenance Cost* - *MWMC's Revenue Potential or Cost Avoidance* • **Indexed Cost Effectiveness of Thermal Mitigation** - *Late October Compliance Period* - *Late August Compliance Period* - *Early May Compliance Period*
	Operational Opportunity and Risk: It is important to recognize both the potential benefits, such as system capacity, and potential challenges, such as increased operational requirements, of different alternatives.	• **Additional Recycled Water Conveyance Capacity** • **Additional Recycled Water Storage Capacity** • **Other Significant Operational Opportunities or Risks** • **Resilience to Seismic Event**
	Regulatory Certainty and Adaptability: The ultimate purpose of a mitigation alternative is to ensure that it meets anticipated regulatory needs over the short- and long-term. It is also important to identify potential complications that might delay or otherwise jeopardize an alternative from meeting regulatory needs.	• **Permitting Certainty and Potential Challenges** • **Other Regulatory or Permitting Opportunities or Risks** • **Potential for Onsite Expandability of Thermal Mitigation** • **Decision-to-Project Implementation Period**

Note 1: Measures are listed in **bold**. Sub-measures, listed in *italics*, are used to calculate the Measures and are provided in the data summary, but are not used in the scoring process.

Figure 7: Summary of Environmental TBL Criteria and Measures.

TBL Category	Criteria and Descriptions	Measures of Criteria[1]
Environmental	**Water Resource Effects:** All living organisms depend on access to clean water. Each mitigation alternative could have different effects on surface or ground water quality or quantity. In addition, some project alternatives and their locations provide future opportunity to augment and enhance aquifer or stream flow.	• **Thermal Mitigation Potential** • **Surface Water Quality Effects (other than thermal)** • **Ground Water Quality Effects** • **Net Change to Willamette River In-Stream Flow** • **Offset of Current Water Use** - *Surface Water* - *Ground Water* • **Future Project Site Aquifer or Stream Flow Augmentation Opportunities**
	Habitat and Ecosystem Services: Water quality protection and improvement is important for aquatic ecosystem health. Projects may have additional benefits or unintended impacts to habitat or ecosystem functions.	• **Scale of Enhanced Habitat** • **Soil Quality Effects** • **Future Project Site Habitat and Ecosystem Opportunities**
	Life-Cycle GHG Emissions: Human-caused emissions of greenhouse gases (GHGs) are causing changes to the global and regional climate. Considering the scale of GHG impacts of the alternatives is consistent with elements of MWMC's ISO 14001 Environmental Management System.	• **Net 20-Year Life-Cycle Greenhouse Gas Emissions** - *Construction Emissions* - *Operational and Maintenance Emissions* - *Carbon Sequestration by Vegetation*

Note 1: Measures are listed in **bold**. Sub-measures, listed in *italics*, are used to calculate the Measures and are provided in the data summary, but are not used in the scoring process.

Figure 8: Summary of Social TBL Criteria and Measures.

TBL Category	Criteria and Descriptions	Measures of Criteria[1]
Social	**Local Economic Effect:** Infrastructure investments can result in significant local economic benefits in the form of both direct job creation and the provision of public goods that enhance economic development.	• **Creation of Construction Jobs** • **Nearby Private Demand for Recycled Water** • **Change in External Business Profit or Cost Avoidance**
	Community Stewardship: The siting or operation of mitigation alternatives can affect adjacent communities, including effects to health and safety, and changes in quality of life, now and in the future.	• **Human Health and Safety Concerns** • **Aesthetic Site Improvements** • **Develops Adaptation Capacity to Climate Change**
	Stakeholder Interest Alignment: Alignment with stakeholder priorities and engagement with community partners are project attributes that add overall community value.	• **Potential Project Partnerships** • **Alignment with Local and State Plans and Programs** • **Acceptability and Alignment with Local Stakeholders**

Note 1: Measures are listed in **bold**. Sub-measures, listed in *italics*, are used to calculate the Measures and are provided in the data summary, but are not used in the scoring process.

Figure 9: Summary of considered, but excluded Criteria and reason for exclusion.

Considered, but Excluded Criteria	Reason for Exclusion
Equity and Access	MWMC would consider supplying recycled water to any private customer that uses water for a purpose specified as a beneficial use for recycled water. Assumed: Customers have significant demand and agree to meet associated recycled water set-back requirements and in a location close to existing or planned recycled water infrastructure. None of the projects will limit site access beyond existing conditions.
Climate Mitigation	The primary purpose of these projects is not climate mitigation (i.e., reduction of greenhouse gas emissions). It is temperature TMDL compliance. There may be climate benefits associated with these alternatives, but those will be noted under the Criteria titled, Life-Cycle GHG Emissions.
Skill Development	None of the projects being considered in this analysis develop new skills for any of the stakeholders or their employees. The skills required to implement and operate the alternatives are already within existing employee skill sets and organization functions.
Noise and Vibrations	No new, significant sources of noise or vibrations are anticipated. Expected noise and vibrations will be confined to private property and not have significant outside-the-fence impacts beyond temporary construction impacts.
Odor or Noise	No new, significant sources of odor or noise are anticipated.
DMWESB Support	Disadvantaged, minority-owned, women-owned or emerging small businesses should be given equal opportunity and consideration for publically funded projects given their capability to deliver. This Criterion will become more relevant as the project moves into the implementation phase, and at that point be considered. This particular Criterion has limited relevance in the planning phase.
Criteria Air Pollutants	None of these alternatives is expected to be a significant, long-term source of criteria air pollutants. No combustion or treatment processes that will emit criteria pollutants, beyond existing conditions, will be used. As with any construction project, there may be a short-term need for dust control, but this will be limited to only the construction phase.
Green Building Practices	This Criterion will become more relevant as an alternative is selected and implemented and more resources are directed towards finalizing designs. It is premature to assess this Criterion in detail.

5. Inventory of Data and Comparison of Alternatives

Economic Criteria

Economic Criteria:

- Life-Cycle Cost and Cost Effectiveness
- Operational Opportunity and Risk
- Regulatory Certainty and Adaptability

Life-Cycle Cost and Cost Effectiveness

Criterion Description: Accounting for costs across the full life cycle, by considering initial construction costs, on-going operation and maintenance expenses, and the value of potential revenue or cost avoidance, provides a comprehensive comparison of the budget implications of each of the mitigation alternatives. Another way to evaluate the financial implications of each alternative is to evaluate the total cost in the context of its potential to mitigate thermal load, or its cost-effectiveness.

Measures:

- 20-Year Net Present Value
- Indexed Cost Effectiveness for Thermal Mitigation

Summary of Results: The lowest-cost alternative, based on 20-year NPV, is Riparian Shade at a cost of $4.7 million. Recycled Water Use for Industrial Aggregate Production is next at $6.8 million and highest-cost alternative is Recycled Water Use for Agricultural Irrigation at $11.9 million. While life-cycle cost is a critical decision-making factor, cost effectiveness may be an even more meaningful Measure for this assessment. Riparian Shade is the preferred alternative for the cost effectiveness Measure at $0.13 / kcal / day based on price estimates from the Freshwater Trust.

Figure 10: Summary of Life-Cycle Costs and Cost Effectiveness Criteria and Measures, by Alternative.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation[1]	Recycled Water Use for Industrial Aggregate Production
20-Year Net Present Value (2014 $)	**$4,650,000**	**$11,924,000**	**$6,801,000**
First Costs	*$4,650,000*	*$7,852,000*	*$4,299,000*
O&M Costs (20-year NPV)	*$0*	*$1,323,000*	*$2,502,000*
MWMC 20-Year Revenue Potential	*$0*	*$507,691*[2]	*$0*
Indexed Cost Effectiveness[10] of Thermal Mitigation ($ / Kcal / day)	**$0.13**	**$0.21**	**$0.14**
Late October (Oct. 22 – 31)	*$0.05*	*$0.10*	*$0.11*
Late August (Aug. 17 – Sept. 9)	*$0.15*	*$0.33*	*$0.16*
Early May (May 8 – May 14)	*$0.29*	*$0.26*	*$0.17*
Data Gaps: • Valuation of project risks, particularly for the Outside-the-Fence alternative. These risks include a significant change to the WPCF operational model (i.e., producing Class A water for an external customer). • Valuation of staff time for project planning and implementation, program administration, customer relations, additional lab services, etc.			

Note 1: Inside-the-fence 20-year NPV does not include 20-year revenue potential. The uncertainty associated with this valuation is high; therefore it was excluded from NPV calculations.
Note 2: NPV calculations use an inflation rate of 5% and a discount rate of 2.5%.

[10] See the Indexed Cost Effectiveness section of this report for methodology details.

20-year Net Present Value

Measure Description: Accounting of costs across a project's full life cycle provides a comprehensive comparison measure of the budget implications related to construction costs as well as annual operational and maintenance costs.



Riparian Shade Credits: $4.65 million.[11]

- ***Construction and Implementation Cost:*** $4.65 million. The Freshwater Trust's delivery of restoration credits costs $43,210 per acre, including 20 years of monitoring, maintenance, landowner payments, and reporting (based on estimated average costs from The Freshwater Trust). Per a discussion with The Freshwater Trust staff, a project of this scale could include 3 payments (i.e., 3 distinct restoration projects) over the course of ~7 years. The payments would coincide with the generation of credits by each of the three projects. MWMC would pay as a restoration project is completed and marketable credits are available for compliance purposes. After the 20-year contract term is complete, the MWMC could continue the contract with The Freshwater Trust as long as the landowner is willing to renew the lease. At this point, 20 years hence, the MWMC's cost for the credits would decrease, as they would not include the restoration cost. Instead the payments will be based on lease, maintenance and monitoring costs at market value in 20 years.
- ***Annual O&M Costs:*** $0 / year.[12] Note: This sub-measure only represents O&M costs to the MWMC. The Freshwater Trust will incur annual O&M costs over the life of the project, but these costs are built into the price of the shade credits and therefore will not impact the MWMC's annual operating budget.
- ***Financial Incentives:*** $0. No source of financial incentives was identified.



Recycled Water Use for Agricultural Irrigation: $11.9 million[13]

- ***Construction and Implementation Cost:*** $7.9 million. Costs are estimated at $5.4 million for construction and $2.8 million for design, engineering, admin, legal, etc.
- ***Annual O&M Costs:*** $99,000 / year (years 1-10), $75,374 / year (years 11-20). These annual costs have a 20-year net present value (NPV) of $1.3 million.
- ***Financial Incentives:*** $0. A search for state and federal grants and other financial incentives that could support this alternative was completed, but no funding sources were identified.
- ***Revenue Potential:*** $507,000 / 396-acres of poplar for 20 years of growth. The new source of revenue scaled for this assessment (beyond existing conditions) is based on the potential for increased biomass production as a result of increased irrigation. A range of $40,000 to $765,000 of additional net revenue for poplar plantations is estimated for a 52-acre plot.[14] The lower end of that range is used here to be conservative. Assuming that an additional $40,000 / 52-acres over a 12-year growth period, MWMC's 396 acres of poplar plantations would result in additional profit of $304,615 for a 12-year growth cycle.[15] The 12-year value is scaled up to account for 20 years of growth (the assumed project lifecycle), which equals $507,691 / 396 acres for 20 years.[16]

[11] MWMC Recycled Water Program Briefing Book (March 2013)
[12] Interview with The Freshwater Trust staff.
[13] Cost details (including first costs, annual O&M and calculation of 20-year NPV) for this alternative are presented in a technical memorandum by Kennedy/Jenks Consultants titled *Thermal Load Mitigation Pre-Implementation Biocycle Farm, Beneficial Reuse Site and W2 Line Upgrades – Recycled Water Conceptual Design.*
[14] Technical Memorandum 19, Version 2 (Draft Date: Oct. 24, 2013)
[15] 396 acres / 52 acres X $40,000 / 52 acres of growth for 12 years = $304,615 / 396 acres for 12 years.
[16] (($304,615 / 12 years) X (8 years / 12 years)) + ($304,615 / 12 years) = $507,691 / 20 years

Recycled Water Use for Industrial Aggregate Production: $6.8 million[17]

- ***Construction and Implementation Cost:*** $4.3 million.
- ***Annual O&M Costs:*** $179,000 / year (years 1-10), $162,000 / year (years 11-20). These annual costs have a 20-year net present value (NPV) of $2.5 million.
- ***Financial Incentives:*** $0. A search for state and federal grants and other financial incentives that could support this alternative was completed, but no funding sources were identified. A possible opportunity could be through the U.S. Department of the Interior – Bureau of Reclamation's Water Reuse and Recycle Program (Title XVI).[18] The application process for this program is closed for this year, but may be open again for next calendar year. The application period is primarily in December.
- ***Revenue Potential:*** $0. Developing recycled water infrastructure does offer the potential for a revenue source for MWMC related to the sale of recycled water, but at this point in time no definitive information or data is available about potential customers or how the recycled water resource would be valued in the market and priced by MWMC.

Indexed Cost Effectiveness for Thermal Mitigation

Measure Description: A second metric to evaluate financial performance is cost effectiveness, or normalizing the 20-year NPV cost by the desired outcome of the investment (i.e., mitigation of thermal load in the WPCF's effluent). There are three potential critical thermal compliance periods for the WPCF: October, May and August. Each of these periods has its own cost based on the thermal mitigation potential during that period.

Riparian Shade Credits:
$0.13 / kcal / day.[19] Given the early planning stage, and that no project sites have been selected, an estimated price of $0.025 per credit (i.e., 1 kcal / day) was provided by The Freshwater Trust for the October compliance period. There would be a 2:1 credit purchasing requirement for compliance, per ODEQ, so the total cost per "compliance credit" is $0.05 / kcal / day. Per The Freshwater Trust staff, the economics of this option are primarily driven by the thermal reduction potential at the site, which is highly variable. In other words, the greater the thermal reduction potential for a given acre of land, the lower the cost per unit of thermal reduction. Factors that increase shade values (and lower costs) include wider streams (which provide greater surface area per foot of bank), lack of existing vegetation, lack of steep banks and hill shade, and dominant southern exposure. See Figure 11 for details.

Recycled Water Use for Agricultural Irrigation: $0.21 / kcal / day.[20] See the Methodology section and Figure 11 for details.

Recycled Water Use for Industrial Aggregate Production: $0.14 / kcal / day.[21] See the Methodology section and Figure 11 for details.

[17] Cost details (including first costs, annual O&M and calculation of 20-year NPV) for this alternative are presented in a technical memorandum by Kennedy/Jenks Consultants titled *Thermal Load Mitigation Pre-Implementation Biocycle Farm, Beneficial Reuse Site and W2 Line Upgrades – Recycled Water Conceptual Design.*
[18] For more information visit http://www.usbr.gov/WaterSMART/title/.
[19] The thermal reduction potentials are taken from an MWMC staff produced spreadsheet titled *ThermalRXMeasures* (DRAFT Date: May 1, 2014). The thermal mitigation values are provided in detail in a separate section of this this report describing the Thermal Reduction Potential measure, page 36. Indexed cost effectiveness calculations are performed in a separate spreadsheet created by Good Company titled *MWMC-TBL_Cost_Eff-030514.xlsx*.
[20] Ibid
[21] Ibid

Indexed Cost Effectiveness Methodology

The cost effectiveness for each alternative is calculated with the 20-year NPV divided by the average daily thermal reduction ($ / average kcal / day), which results in a cost effectiveness for each time period. The cost effectiveness for each time period is weighted to represent the importance of the compliance period to MWMC and the WPCF. The October time period is weighted most heavily (at 3) because this is the time period that has the greatest probability of exceeding the TMDL based on historic data, next is August (at 2) and finally May (at 1). These weights are multiplied by the cost effectiveness; the weighted values are summed and divided by 6 to determine the weighted cost effectiveness value for each alternative.

Figure 11: Summary of cost effectiveness variables and calculated values.

Alternative / Time Period	20-Year NPV 2014 $	Average Reduction kilocalories / day	Cost Effectiveness $ / kcal / day	Weight unitless	Weighted Cost $ / kcal / day
Riparian Shade Credits					
October 22 – 31	$4,650,000	87	$0.05	3	$0.16
May 8 – May 14	$4,650,000	16	$0.29	1	$0.29
Aug. 17 – Sept. 9	$4,650,000	31	$0.15	2	$0.30
Summed Values				6	$0.75
Weighted Cost Effectiveness					**$0.13**
Recycled Water Use for Agricultural Irrigation					
October 22 – 31	$11,924,000	116	$0.10	3	$0.31
May 8 – May 14	$11,924,000	45	$0.26	1	$0.26
Aug. 17 – Sept. 9	$11,924,000	36	$0.33	2	$0.66
Summed Values				6	$1.24
Weighted Cost Effectiveness					**$0.21**
Recycled Water Use for Industrial Aggregate Production					
October 22 – 31	$6,801,000	63	$0.11	3	$0.32
May 8 – May 14	$6,801,000	41	$0.17	1	$0.17
Aug. 17 – Sept. 9	$6,801,000	42	$0.16	2	$0.32
Summed Values				6	$0.81
Weighted Cost Effectiveness					**$0.14**

Operational Opportunity and Risk

Criterion Description: It is important to consider both the potential operational benefits, such as system conveyance and storage capacity, and potential risks, such as increased operational requirements, for the various alternatives.

Criterion Measures:

- Additional recycled water conveyance capacity
- Additional recycled water storage capacity
- Other significant operational opportunities or risks
- Resilience of project to seismic event

Summary of Results: A significant advantage of the Shade Credit alternative is that it involves a largely "turn-key" contract mechanism to the MWMC, deferring all project implementation and long-term management to The Freshwater Trust as well as a large part of the potential risk. In addition, green infrastructure (i.e., planted riparian vegetation) is likely more resilient to a seismic event, compared to built infrastructure, and therefore should require less repair time and costs. The recycled water alternatives result in built infrastructure, which could provide operational flexibility or future opportunities, such as expanded distribution of recycled water to external customers. In addition, the recycled water alternatives would build organizational experience and knowledge that would be future assets should community demands for emerge. Finally, the recycled water alternatives would make significant use of existing pipe and irrigation infrastructure.

Figure 12: Summary of Operational Opportunities and Risk Measures, by alternative.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Additional RW Conveyance Capacity	0	1.7 – 2.2 MGD	7.2 MGD
Additional RW Storage Capacity	0	41 MG	0.1 MG
Resilience to Seismic Event	High	Medium-Low	Low
Other Significant Operational Opportunities or Risks	Opportunity • This alternative externalizes all operational requirements and risk to a third party. Risk • None to note.	Opportunity • Operational experienced gained though this project could be leveraged in the future if demand for Class D recycled water increased. • Utilizes some existing pipe and irrigation infrastructure. Risk • Wet weather limits irrigation demand.	Opportunity • Operational experience gained though this project could be leveraged in the future if demand for Class A recycled water demand increased. • Utilizes some existing pipe and treatment infrastructure. Risk • Change to existing business model. The WPCF would be required to produce a product to be used as a feedstock that meets external quality and quantity requirements. • Liability for Delta-Knife product failures as a result of recycled water composition. • Risk of Delta Sand & Gravel ceasing operations in 10-12 years.
Data Gaps: • None to note.			

Additional Recycled Water Conveyance Capacity

Measure Description: The ability to convey recycled water and biosolids is a mission critical activity for MWMC and its facilities. Increasing this capacity provides additional operational flexibility in the treatment of wastewater or in the delivery of recycled water to internal or external customers.



Riparian Shade Credits:
0 MGD. This alternative does not provide the MWMC with any additional capacity to convey recycled water or biosolids between the WPCF and the Biocycle/BRS facilities.



Recycled Water Use for Agricultural Irrigation:
0.9 – 1.1 MGD (12 hours) and 1.7 – 2.2 MGD (24 hours).[22] This alternative increases the conveyance capacity of the existing infrastructure by upgrading the W2 line between the WPCF and the Biocycle / BRS sites. The existing W2 line conveyance capacity is 2.8 MGD (24 hours). This proposed conveyance capacity would be increased to between 4.5 and 5 MGD. The resulting increase is 1.7 – 2.2 MGD. This increased capacity allows for inside-the-fence operational flexibility and provides additional capacity to distribute recycled water.



Recycled Water Use for Industrial Aggregate Production:
3.6 MGD (12 hours) and 7.2 MGD (24 hours).[23] This new conveyance capacity would be installed between the WPCF and Delta-Knife facilities. This increased capacity provides operational flexibility to distribute recycled water in the future to external customers.

Additional Recycled Water Storage Capacity

Measure Description: The ability to store recycled water provides two primary operational flexibility benefits to MWMC. First, storage provides a means for thermal load mitigation when required. Second, it allows storage of recycled water for irrigation during times of surplus supply to use for future demand.



Riparian Shade Credits:
0 MG. This alternative does not provide MWMC with any additional recycled water storage capacity.



Recycled Water Use for Agricultural Irrigation:
41 MG of usable capacity for recycled water storage.[24] Total lagoon capacity is 57.3 MG. The difference between usable and total capacity is the volume that will be required to store average annual rainfall and minimum water depth to maintain liner integrity. It should be noted that the lagoon is currently in existence, but the existing liner does not permit it to be used at full capacity.



Recycled Water Use for Industrial Aggregate Production:
0.1 MG. This alternative provides a small amount of potential storage in the pressurized tank (12,500 gallons) and the recycled water pipelines (93,500 gallons).[25]

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[22] Kennedy/Jenks Consultants (2014). *Thermal Load Mitigation Pre-Implementation Biocycle Farm, Beneficial Reuse Site and W2 Line Upgrades – Recycled Water Conceptual Design.*
[23] Kennedy / Jenks Consultants (2013). Recycled Water Program Implementation Planning Phase 2 Technical Memorandum - Delta Sand/Knife River Industrial Aggregate Site Recycled Water Conceptual Design Estimate.
[24] Technical Memorandum 15, Version 1 - *Operational Assumptions for Conceptual Beneficial Reuse Site Recycled Water Use*
[25] Todd Miller email exchange 5/1/2014.

Resilience to Seismic Event

Measure Description: It is well know that the Pacific Coast and the Willamette Valley are at risk of seismic events that, when they occur, may cause significant damage to wastewater infrastructure. While it is impossible to determine the exact scale of risk, this Measure seeks to highlight significant differences between "green" infrastructure (i.e., planted riparian vegetation) and "grey infrastructure" (i.e., infrastructure built from concrete, steel or plastic). Selecting infrastructure that is resilient may reduce repair time and costs after a seismic event.



Riparian Shade Credits:
High resilience. For this purpose of this assessment, it is assumed that "green" infrastructure will be more resilient to a seismic event compared to "grey" infrastructure. This increased resilience will result in less damage following a seismic event that will require repair or new investment. It is assumed that "green" infrastructure will require no repair by the MWMC and that any damage done at the riparian restoration sites will repair itself over time. It is worth noting that if the seismic event is serious and the restoration project is destroyed – The Freshwater Trust is not liable or required (per their contract) to rehabilitate the site in the event of a *Force Majeure*.[26]



Recycled Water Use for Agricultural Irrigation:
Medium-low resilience. It is assumed that "grey" infrastructure will require repair following a seismic event and will cause a delay in thermal load mitigation capacity for MWMC. Resilience is found as medium to low for this alternative because the infrastructure will be a mix of "legacy" and "new" construction, and because the infrastructure is below ground. This designation is supported by the findings of Oregon's Seismic Safety Policy Advisory Commission.[27] The Oregon Resilience Plan's chapter on Water and Wastewater Systems[28] found the following:

> ***"****The Willamette Valley would experience moderate ground shaking. Well-engineered structures may perform well, but many older structures would likely fail, including treatment facilities, reservoirs, and pump stations. One of the major impacts to large population centers would be from liquefaction: extensive alluvial and fill deposits along rivers would lose strength, lose bearing capacity, and move towards riverbanks. Old cast iron water pipelines buried in the liquefied soil would snap, and modern pipelines constructed of ductile iron and PVC would likely pull apart at joints, resulting in a total loss of water pressure throughout communities. Large drainage structures along riverbanks in liquefiable areas would likely move, severing connecting piping and rendering the structures useless."*



Recycled Water Use for Industrial Aggregate Production:
Low. For the purpose of this assessment, it is assumed that "grey" infrastructure will require repair following a seismic event and will cause a delay in thermal load mitigation capacity for MWMC. Resilience is found as low for this alternative because the infrastructure is located below ground along a riverbank and therefore is susceptible to soil liquefaction and the associated impacts. This designation is supported by the findings of Oregon's Seismic Safety Policy Advisory Commission. See excerpt from Seismic Safety Policy Advisory Commission findings in previous section.

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[26] "Force Majeure" is an unforeseeable and unavoidable event or circumstance not within the reasonable control of TFT, which could not have been brought within control through commercially reasonable efforts, which causes a delay or non-performance of a duty or obligation under this Contract.

[27] State of Oregon - Oregon Seismic Safety Policy Advisory Commission (2013). *Oregon Resilience Plan's chapter on Water and Wastewater Systems*. This document may be downloaded online at http://www.oregon.gov/OMD/OEM/osspac/docs/08_ORP_Water.pdf.

[28] State of Oregon - Oregon Seismic Safety Policy Advisory Commission (2013). *Oregon Resilience Plan's chapter on Water and Wastewater Systems*. This document may be downloaded online at http://www.oregon.gov/OMD/OEM/osspac/docs/08_ORP_Water.pdf.

Other Significant Operational Opportunities or Risk

Measure Description: This Measure is meant to capture other significant operational opportunities and risks that are were not previously addressed for this Criterion.



Riparian Shade Credits:

Opportunities:

- This alternative externalizes all operational requirements and risk to a third party. MWMC would be purchasing a finished riparian shade credit product from The Freshwater Trust or other qualified restoration organization.

Risks:

- None to note.



Recycled Water Use for Agricultural Irrigation:

Opportunities:

- This project develops a recycled water infrastructure and production experience that could be further utilized to meet future temperature TMDL requirements or Class D recycled water demand.
- Utilizes some existing pipe and irrigation infrastructure. This alternative utilizes existing sections of the W2 pipeline infrastructure as well as the parts of the pivot irrigation infrastructure at BRS.[29]

Risks:

- Wet weather limits irrigation demand. If a wet weather pattern coincides with thermal mitigation needs, the capacity of this alternative to deliver mitigation capacity may limited or compromised.
- There is of course additional risk associated with having to maintain and repair additional equipment, infrastructure and irrigation processes, but this risk is estimated and accounted for in the 20-year O&M costs for equipment repair and associated staff and contracted labor.[30]



Recycled Water Use for Industrial Aggregate Production:

Opportunities:

- This project develops recycled water infrastructure and production experience that could be further utilized to meet future temperature TMDL requirements or future Class A recycled water demand.
- Utilizes the existing West Bank pipeline and connections and Class A treatment infrastructure.

Risks:

- Change to existing WPCF business model. The WPCF would be required to supply recycled water in daily quantities equal to Delta-Knife operational demand based on an external organization's water quality specifications.
- Potential liability risk for Delta-Knife product failure as a result of recycled water composition.
- Based on discussions with Delta management, the Delta site has 10-12 years of remaining minable materials, although that life span could be extended if Delta is approved to expand its minable land base. Given unfavorable land use judgments regarding expansion, the MWMC expects that Delta will wind down gravel mining operations in the 10-12 year time frame. At that time, both Delta and Knife River

[29] Kennedy/Jenks Consultants (2014). *Thermal Load Mitigation Pre-Implementation Biocycle Farm, Beneficial Reuse Site and W2 Line Upgrades – Recycled Water Conceptual Design.*
[30] Ibid

expect to continue construction business operations located at the site. Recycled water demand would decrease significantly with the loss of gravel washing operations, but gravel pit reclamation could open up opportunities for recycled water use for indirect discharge and habitat enhancement.

Regulatory Certainty and Adaptability

Criterion Description: The ultimate purpose of a mitigation alternative is to ensure that it meets anticipated regulatory needs over the short- and long-term. It is also important to identify potential complications that might delay or otherwise jeopardize an alternative from meeting regulatory needs.

Measures:

- Permitting Certainty and Potential Challenges
- Other Regulatory or Permitting Opportunities or Risks
- Potential for Future Expansion of Project Site Thermal Mitigation Capacity
- Decision-to-Project Implementation Period

Summary of Results: Recycled Water Use for Agricultural Irrigation offers many advantages for this Criterion. Reducing effluent discharge to the Willamette River reduces other permitted constituents, in addition to thermal load, including biological oxygen demand (BOD), suspended solids and coliform. This advantage is also true for Recycled Water Use for Industrial Aggregate Production and to a greater degree as the annual demand for recycled water would be greater by Delta-Knife operations compared to Biocycle / BRS. The recycled water projects also have permitting risks. The Agricultural Irrigation alternative could potentially be an additional source of nitrogen to the Southern Willamette Ground Water Management Area. The Industrial Aggregate has two primary sources of risk to the MWMC. First, it is likely that some quantity of the effluent will continue to require permitting (by WPCF or Delta-Knife) as it is discharged back to the river through Delta-Knife settling ponds. Second, WPCF temperature compliance would be reliant on the timing of an external entity's water demand. Project permitting certainty is greatest for the Agricultural Irrigation Recycled Water project. The other two alternatives both have regulatory and permitting uncertainty or face potential challenges. The Riparian Shade Credits alternative does not offer any additional permitting opportunities or risks to the WPCF.

Figure 13: Summary of Regulatory Certainty and Adaptability Measures, by alternative.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Permitting Certainty and Potential Challenges	• Currently acceptable practice by EPA and DEQ. Not valid under MWMC's current NPDES permit. Subject to ongoing third party challenges.	• Greater relative certainty and lower risk because it's an existing practice at MWMC-owned facilities.	• Uncertainty associated with permitting of thermal discharges from Delta-Knife settling ponds.
Other Regulatory or Permitting Opportunities or Risks	<u>Risks</u> • Inability of credit vendor to recruit landowner and lease land in the area required to generate the needed thermal offset.	<u>Opportunity</u> • Reduces discharges of CBOD, total suspended solids, residual chlorine and ammonia. <u>Risk</u> • Wet weather could limit mitigation capacity during critical periods of compliance. • Potential for increased nitrate levels in the Southern Willamette GWMA. • Likely would require additional groundwater testing. • Could require Class A treatment if infiltration into groundwater is expected.	<u>Opportunity</u> • Reduces discharges of CBOD, total suspended solids, residual chlorine and ammonia. <u>Risks</u> • New permit for WPCF discharge at Delta-Knife site. • Compliance would be reliant on recycled water demand and timing of demand by private companies.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Potential for Project Site Expandability to Meet Future Mitigation Needs	• None onsite, but depending on the site(s) selected, there may be additional, adjacent land suitable for restoration.	• Total alternative potential is between 3.5 and 35 MGD for indirect discharge of recycled water to constructed onsite wetlands at Biocycle Farm and BRS.	• Gravel pit reclamation and habitat enhancement could potentially be significant, but are not quantified.
Decision-to-Project Implementation Period	5 – 7 years	2 - 3 years	2 - 3 years
Data Gaps: • Actual water use data and timing of use (daily and seasonal) for Delta-Knife operations. • Scale of thermal reduction potential from gravel pit reclamation at the Delta-Knife site. • Scale of thermal reduction potential from wetland creation or groundwater recharge projects at the Biocycle / BRS sites.			

Permitting Certainty and Potential Challenges

Measure Description: The regulatory framework and requirements for temperature TMDL are still being finalized and likely won't be complete for years. While the exact requirements and allowed means of compliance are still being determined, there is precedent that separates the alternatives.



Riparian Shade Credits:
The purchase of Riparian Shade Credits is acceptable practice by EPA and DEQ as of this writing; however, it is not valid under MWMC's current NPDES permit. The ability to use compliance mechanism is at ODEQ's discretion and would be addressed during revision of the WPCF's existing NPDES permit. The use of Riparian Shade Credits is also subject to ongoing third party challenges. There is precedent for legal challenges to water quality credits as a compliance mechanism.[31]



Recycled Water Use for Agricultural Irrigation:
MWMC staff and K/J Consultants consider this alternative to have the greatest permitting certainty. The project sites are owned by the MWMC, are part of existing operations and, in the case of Biocycle, already use recycled water for irrigation. The planned uses of recycled water for agricultural irrigation under this alternative (i.e. poplar trees at Biocycle and forage crops at BRS) are on Oregon's defined list of beneficial uses for Class D recycled water.



Recycled Water Use for Industrial Aggregate Production:
There is permitting uncertainty related to the thermal load remaining in the recycled water that would return to the Willamette River via Delta-Knife settling ponds after its use in industrial aggregate processing. Use of recycled water for gravel washing and related activities, and subsequent discharge into infiltration ponds connected to the river hyporheic zone could require consideration of an NPDES outfall permit instead of the general WPCF permit for sand and gravel operations. Information on the scale of thermal load that would be discharged from the

[31] Northwest Environmental Advocates (NWEA) wrote a letter to the Environmental Protection Agency (EPA) outlining concerns associated with a restoration project in Medford by The Freshwater Trust on behalf of Medford's wastewater treatment plant. The Freshwater Trust provided a written response to NWEA's concerns which is available upon request.

ponds and who would be permitted for that discharge would require more extensive field study and determination.

Other Regulatory or Permitting Opportunities or Risks

Measure Description: Beyond temperature TMDL compliance, the alternatives may also offer MWMC or a project partner other regulatory opportunities or risks, such as reducing discharges of other permitted pollutants or creating the need for a new permit.



Riparian Shade Credits:

Opportunities:

- None to note.

Risks:

- Inability of credit vendor to recruit landowner and lease land in the area required to generate the needed thermal offset.



Recycled Water Use for Agricultural Irrigation:

Opportunities:

- Reduces discharges of CBOD, total suspended solids, residual chlorine and ammonia to the Willamette River. The discharge of most of these constituents is not regulated when land applied. The average aggregate irrigation demand is 1.98 MGD (12-hours) at the Biocycle / BRS sites. This daily demand was used in conjunction with analytical testing results for discharged WPCF effluent to calculate the weight (in pounds) of avoided discharges that are presented in Figure 14.[32]

Risks:

- Wet weather could limit mitigation capacity during critical periods of compliance.
- Potential source of nitrogen within the Southern Willamette Ground Water Management Area (GWMA). ODEQ manages the GWMA through an education and outreach campaign for voluntary action. However, certain nitrate (the nitrogen chemical of concern) sources such as wastewater treatment facilities are directly regulated and ODEQ can place special scrutiny of nitrate management on those sources. As part of the biosolids management program and former use of the BRS as a food processing waste facility, the MWMC monitors groundwater wells for nitrates. Based on the recent observations of elevated nitrate trends in groundwater beneath the BRS, use of recycled water at the site for irrigation will need to be done in special consideration of overall site nutrient management and continued monitoring for on- or off-site nitrate sources.
- It is also likely that ground water monitoring would be required with any new recycled water activities at the site.[33]
- Could require Class A treatment if infiltration into groundwater is expected.[34]



Recycled Water Use for Industrial Aggregate Production:

Opportunities:

- Reduces discharges of CBOD, total suspended solids, coliform and ammonia to the Willamette River. Most of these constituents (except ammonia) are not regulated as discharges when land applied. Delta-Knife operational water demand is assumed to be 3.09 MGD (10-hours), based on the operational pumping rates at the site. This daily demand was used in conjunction with analytical testing results for discharged WPCF effluent to calculate the weight of avoided discharges that are presented in

[32] Calculations are documented in a separate Excel spreadsheet titled MWMC-TBL_Water_Quality_Calcs-022514.
[33] CH2MHill (2013). *Beneficial Reuse Site Irrigation System and Agronomic Alternatives Assessment.*
[34] Casey Hanson (2013). *Preliminary Findings for Constructed Wetlands as Thermal Load Reduction Alternatives.*

Figure 14.[35]

Risks:

- Per discussion with the ODEQ, the project would likely require a modified discharge permit to reflect recycled water discharge as opposite to aggregate wash discharge. The recycled water used as wash water by Delta-Knife would ultimately be directed to their settling ponds, which discharge through infiltration into the subsurface (and indirectly to the Willamette River). Therefore, the discharge of used recycled water to the settling ponds would likely require an NPDES permit for a new outfall. While the burden of the permit could possibly fall on the MWMC under an NPDES permit (as opposed to Delta's onsite WPCF permit), Delta would still incur additional regulatory scrutiny at its site, and the MWMC would have additional discharge reporting requirements.[36]
- Compliance would be reliant on recycled water demand and timing of demand by private companies.

Potential for Future Expansion of Project Site Thermal Mitigation Capacity

Measure Description: Investment in an alternative will have greater long-term value if that initial investment funds a project that has additional, undeveloped on-site thermal load mitigation potential that may be developed in the future. The geographic boundaries of this measure are limited to the alternative site boundaries.



Riparian Shade Credits:
None onsite, but depending on the site(s) selected, there may be additional, adjacent land suitable for restoration. The purchase of Shade Credits are highly scalable, may be tailored to organizational compliance needs, and may benefit from economy of scale for the project (e.g., initial site selection and long term O&M are more cost effective in clustered locations rather than spread out).



Recycled Water Use for Agricultural Irrigation:
This alternative offers the potential for future add-on, onsite expandability of thermal load mitigation via wetland creation or groundwater recharge. A preliminary estimated that the potential at Biocycle Farm is between 2.8 and 28 MGD. The discharge potential at BRS is between 0.7 and 7.0 MGD. The total potential is between 3.5 and 35 MGD.[37] The cost or scale of thermal reduction associated with these future opportunities is not available and would require additional study.



Recycled Water Use for Industrial Aggregate Production:
There may be potential associated with reclamation of gravel pits at the Delta-Knife sites. The potential for gravel pit reclamation and habitat enhancement is likely to be significant in scale and may represent significant thermal mitigation potential, but quantification of this opportunity would require more study. Like the Agricultural Irrigation alternative, the Industrial Aggregate alternative offers the potential for additional, future thermal reduction capacity based on the initial infrastructure development for the industrial aggregate use of recycled water. This infrastructure could be used to convey water to the pits created on Confluence Island from gravel extraction. An estimate of pit area and volume post-full gravel extraction is 81 acres and 660 million gallons.[38]

[35] Calculations are documented in a separate Excel spreadsheet titled MWMC-TBL_Water_Quality_Calcs-022514.
[36] Todd Miller (2013). Email, subject line "Updates_MWMC_Recycled_Water_Study-051413," May 21, 2013.
[37] Casey Hanson (2013). *Preliminary Findings for Constructed Wetlands as Thermal Load Reduction Alternatives.*
[38] Sara Robertson (2011). *Three Scenarios For the Future of Confluence Island, their Effects and their Adaptability.*

Decision-to-Project Implementation Delay

Measure Description: The time between the decision-to-implement and actual thermal load mitigation may be an important factor given the uncertainty of final temperature TMDL regulatory requirements, particularly the compliance implementation period.



Riparian Shade Credits:
5 – 7 years. The lower end of this range is based on the expected regulatory time frame. The upper end of the range is based on an estimate from The Freshwater Trust staff about the timeline for implementation of the projects to generate credits equal to 93 Mkcal / day.[39] This estimate is based on an assumption of 3 individual projects that restore a total of between 5 and 10 miles of stream bank.



Recycled Water Use for Agricultural Irrigation:
2 - 3 years. This value assumes the full implementation period 0.5 – 1.5 years for the biding process and design and 1.5 years for construction.[40]



Recycled Water Use for Industrial Aggregate Production:
2 - 3 years. Same as above.

[39] Phone interview with Alex Johnson of The Freshwater Trust (July 2013).
[40] Email correspondence with Ron Walz of K/J Consultants (February 2014).

Environmental Criteria

Environmental Criteria

- Water Resource Effects
- Habitat and Ecosystem Services
- Life-Cycle Greenhouse Gas Emissions

Water Resource Effects

Criterion Description: All living organisms depend on access to clean water. Each mitigation alternative could have different effects on surface or ground water quality or quantity. In addition, some project alternatives and their locations provide future opportunity to augment and enhance aquifer or stream flow.

Measures:

- Thermal Reduction Potential
- Surface Water Quality Effects
- Ground Water Quality Effects
- Net Change to Willamette River In-Stream Flow
- Offset of Surface or Groundwater Use
- Future Project Site Aquifer or Stream Flow Augmentation Opportunities

Summary of Results: All of the alternatives will improve surface water quality. The benefits are quantifiable for the recycled water alternatives based on the quantity of WPCF effluent that is not discharged to the Willamette River; therefore the Industrial Aggregate of alternative (with the greater demand of the two) is the superior alternative. Riparian Shade will also improve water quality, but quantifiable information is not available. The primary risk to ground water is addition of nitrogen for the Agricultural Irrigation alternative - other impacts or benefits of soil infiltration would need to be assessed. The Agricultural Irrigation alternative results in a net decrease of Willamette River in-stream flow. The Industrial Aggregate alternative offers the greatest offset of surface and ground water use. The Agricultural Irrigation alternative site provides future potential for stream or groundwater augmentation.

Figure 14: Summary of data for Water Resource Effects TBL Measures.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Indexed Thermal Reduction Capacity	252	393	340
Surface Water Quality Effects (Other than Thermal Loading)	• Data is not available for this alternative, but depending on the site, restoration could have a significant impact on buffering surface water from non-point sources of pollution.	• This project reduces annual surface water discharge from WPCF by an estimated 264 MG. This results in the following estimated reductions of permitted constituents as well as other non-regulated constituents.	• This project reduces annual surface water discharge from WPCF by an estimated 575 MG. This results in the following estimated reductions of permitted constituents as well as other non-regulated constituents.
$CBOD_5$	• *Reduction possible*	• *Daily: -50 lbs./12 hours* • *Annual: -6,609 lbs.*	• *Daily: -77 lbs./10 hours* • *Annual: -14,771 lbs.*
Suspended Solids	• *Reduction likely*	• *Daily: -99 lbs./12 hours* • *Annual: -13,218 lbs.*	• *Daily: -155 lbs./10 hours* • *Annual: -29,541 lbs.*
Coliform	• *Reduction possible*	• *Daily: -6,692 lbs./ 12 hours* • *Annual: -892,274 lbs.*	• *Daily: -7,976 lbs./10 hours* • *Annual: -1,994,038 lbs.*
Ammonia (as Nitrogen)	• *Reduction likely for nitrogen reductions*	• *Daily: -119 lbs./12 hours* • *Annual: -15,862 lbs.*	• *Daily; -186 lbs./10 hours* • *Annual: -35,450 lbs.*

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Ground Water Quality Effects	• No known effects.	• Risk of additional nitrogen source to Ground Water Management Area.	• Not a significant concern.[41]
Net Change to Willamette River In-Stream Flow	• No net change.	• Net decrease. Average decrease of 1.98 MGD (June through September) and a peak of 3.07 MGD (July)	• No net change.
Offset Surface or Groundwater Use	• *Surface:* No change. • *Ground:* No change.	• *Surface:* No change. • *Ground:* 0.0001 MGD.	• *Surface:* 2.36 MGD. • *Ground:* 0.06 MGD.
Future Onsite Aquifer or Stream Flow Augmentation Opportunities	• No opportunities identified.	• Discharge to groundwater is possible if treated to Class A standards. • Discharge to surface water via constructed wetland.	• No opportunities identified.
Data Gaps: • Data or modeling related to potential water quality impacts for riparian restoration. • Water quality testing results for Class A recycled water.			

Thermal Reduction Potential

Measure Description: The ability to mitigate thermal load discharged to the Willamette River is the most fundamental Measure for the primary purpose of this assessment – comparing thermal mitigation alternatives. The highest-level finding for this Measure is an indexed value that assesses mitigation potential for the period May through October based on a 20-year projection of mitigation need.



Riparian Shade Credits: 252 (indexed value).
This alternative **can provide 100%** of the thermal mitigation needed to provide the 93 Mkcal per day near-term compliance needs for the late October period based on the 2006 TMDL requirements and historic data. The Riparian Shade Credit alternative provides the thermal reduction potential required to meet a portion of the projected 2035 excess thermal load in early May, mid-July, September and late October. In May and from mid-July through early September the thermal mitigation potential only reaches about 30% of the total required for compliance purposes. This annual time period of low thermal reduction potential is the reason scores the lowest indexed thermal reduction score for the group of alternatives.



Recycled Water Use for Agricultural Irrigation: 393 (indexed value).
This alternative **can provide 100%** provide the thermal mitigation needed to provide the 93 Mkcal per day near-term compliance needs for the late October period based on the 2006 TMDL requirements and historic data. It provides approximately 130% of the total need based on 2006 TMDL requirements. The Agricultural Irrigation alternative provides a the thermal reduction potential required to meet projected 2035 excess thermal load in May and a portion of the reduction in mid-July and from mid-September through early October. From mid-July through early September the thermal mitigation potential reaches about 70% - 85% of the total required.

[41] Technical Memorandum 9, Version 2 - *Industrial Aggregate Water Fate and Discharge Assessment.* Because of the way water is known to migrate through the Willamette River's hyporheic zone, groundwater contamination is not a significant concern, as any leakage into the soil will likely migrate back to the River, not into groundwater aquifers or wells.



Recycled Water Use for Industrial Aggregate Production: 340 (indexed value). This alternative ***might not*** provide the thermal mitigation needed to provide the 93 Mkcal per day near-term compliance needs for the late October period based on the 2006 TMDL requirements and historic data. It provides approximately 85% of the total need based on 2006 TMDL requirements. This alternative provides the thermal reduction potential required for the projected 2035 excess thermal load in May. From mid-July through mid-September the thermal mitigation potential reaches between 60% and 95% of the total required for compliance purposes and about 30% of the potential needed in October. This alternative scores the highest of any alternative. It's important to note that these results are highly dependent on the assumptions made about volume and timing of water demand at the Delta-Knife site.

Thermal Reduction Potential Methodology

The 2006 TMDL presented the MWMC with a potential need to mitigate for excess temperature impacts in late October. Given that the 2006 TMDL is in the process of being updated and potentially impose a different temperature compliance regime, conceptual temperature mitigation alternatives were also evaluated against a theoretical future risk of thermal load exceedance.

For planning purposes, regional wastewater staff developed theoretical projections of the WPCF's daily maximum excess thermal load risk by calendar day based on the 2006 TMDL under a series of exacerbating conditions. Those conditions included a combination of population influenced wastewater influent flow increases, federal dam management influenced river flow changes, and climate change influenced river flow and temperature changes. Projecting incremental annual changes out over a 20 year period (i.e. a theoretical year 2035 condition) provided a basis for planning for potential future thermal load constraints. This planning basis provided a means of judging how well a particular mitigation alternative could serve the MWMC's potential future needs.

For the period of May through October the excess thermal load from the WPCF is compared to the ability of the alternative to mitigate the thermal load based on the theoretical future projections. The average excess thermal load for any given day from May to October is based on historical data and is weighted by the number of years that day exceeded the WPCF's temperature waste load allocation. For the Riparian Shade Credit alternative the thermal reduction potential is estimated with a shade model.[42]

[42] Technical Memo 21 - Estimation of Riparian Shade Thermal Mitigation Benefit and the associated calculations in an Excel spreadsheet called ThermalRxMeasures.

Surface Water Quality Effects (Other than Thermal Load)

Measure Description: Compare the effect on surface water quality, by estimating the average daily and annual net change to the quantity of known water pollutants.



Riparian Shade Credits:
A riparian restoration project creates a vegetative buffer between a waterway and the adjacent land. Besides providing shade, this buffer could serve as a filter to capture run-off from storm events and irrigation, and reduces sources of non-point water pollution. The scale and types of the thermal reductions associated with the purchase of Riparian Shade Credits are site-and restoration-dependent. A site with baseline conditions of bare ground will result in greater thermal reductions than a site with existing vegetation. Likewise, a site adjacent to a dairy farm may have different effects than unused agricultural land. Some of the many variables that are important when considering water quality impacts[43] include: vegetation types, vegetation density, width of vegetation from stream bank, slope of bank, etc. For the purpose of this analysis, it is assumed that suspended solids, fecal coliform bacteria and nitrogen discharges will be reduced. The scale of these reductions is impossible to estimate without detailed information about the project site, baseline conditions and restoration plans. Once that information is available, existing publically available tools could be used to estimate the benefits.



Recycled Water Use for Agricultural Irrigation:
Discharge effluent from the WPCF includes permitted and unpermitted constituents that affect water quality. Using recycled water for irrigation will divert water from aquatic discharge to land application. This diversion reduces loading of effluent constituents including: total suspended solids, biochemical oxygen demand, coliform, ammonia and others.[44]



Recycled Water Use for Industrial Aggregate Production:
Discharge effluent from the WPCF includes permitted and unpermitted constituents that affect water quality. Using recycled water for irrigation will divert water from aquatic discharge to land application. This diversion reduces loading of effluent constituents including: total suspended solids, biochemical oxygen demand, coliform, ammonia and others.[45]

Ground Water Quality Effects

Measure Description: Compare the effect on ground water quality.



Riparian Shade Credits:
No known effects.



Recycled Water Use for Agricultural Irrigation:
The primary concern for groundwater impact is the addition of nitrogen contained within the recycled water used for irrigation within the context of the baseline levels in the Ground Water

[43] EPA. Effectiveness of Riparian Buffers for Managing Nitrogen. Accessed online Feb. 2014 at http://www.epa.gov/ada/eco/pdfs/riparian_buffer.pdf.
[44] Calculations related to the values presented in Figure 14 are documented in a Good Company created Excel spreadsheet titled *MWMC_TBL-Water_Quality_Calcs-030314.*
[45] Ibid

Management Area given the a relatively high water table thereby limiting soil attenuation potential at the project site.[46]



Recycled Water Use for Industrial Aggregate Production:
No known effects. Because of the way water is known to migrate through the Willamette River's hyporheic zone, groundwater contamination is not a significant concern, as any leakage into the soil will likely migrate back to the River through the hyporheic zone, not into groundwater aquifers or wells. [47]

Net Change to Willamette River In-Stream Flow

Measure Description: Compare the net change to the in-stream flow of the Willamette River in terms of scale and timing of change.



Riparian Shade Credits:
No net change.



Recycled Water Use for Agricultural Irrigation:
Net decrease. WPCF discharge to the Willamette River would decrease by an average of 1.98 MGD during June through September, with a peak reduction of 3.07 MGD during July.[48]



Recycled Water Use for Industrial Aggregate Production:
No net change. It is assumed that recycled water would offset the use of surface water currently pumped by Delta-Knife operations from the Willamette River in equal quantities. In other words, the volume of water the WPCF discharges to the Willamette River would be maintained in the Willamette because Delta-Knife operations would *not* be withdrawing an equal amount of water.

Offset Surface or Groundwater Use

Measure Description: An advantage of recycled water is that it allows our community to offset the use of surface and ground water resources. This Measure assesses the scale and timing of that offset. The most valuable time for demand offset of water resources in during late summer and early fall when our water reserves and river levels are at their lowest.



Riparian Shade Credits:
No offset of surface or ground water.

[46] Technical Memorandum 20
[47] Technical Memorandum 15, Version 2 - *Industrial Aggregate Water Fate and Discharge Assessment*
[48] Kennedy/Jenks Consultants (2014). *Thermal Load Mitigation Pre-Implementation Biocycle Farm, Beneficial Reuse Site and W2 Line Upgrades – Recycled Water Conceptual Design.*



Recycled Water Use for Agricultural Irrigation:
No offset of surface water. Offset of ground water is approximately 0.004 MG per year, or about 4,000 gallons per year, used for irrigation.[49] It is assumed the existing irrigation is applied during the dry summer months of July – September. While the volume of groundwater used for irrigation has been minimal in recent history, the MWMC's maximum groundwater rights are much greater and this project could potentially free us those rights for other uses.



Recycled Water Use for Industrial Aggregate Production:
Average annual aggregate surface water demand at the Delta-Knife site is 2.36 MGD, with peak demand occurring between June and August. The average annual ground water demand is 0.06 MGD with a peak of 0.16 MGD in May.[50] Both are assumed to be offset for this alternative.

Future Aquifer or Stream Flow Augmentation Opportunities at Project Site

Measure Description: The water currently discharged from the WPCF into the Willamette River may be found to have a higher and better use in augmenting stream flow or recharging aquifers. This Measure is not directly relevant to the alternatives being considered in this assessment, but is indirectly relevant in that implementing some of the alternatives would provide the foundational infrastructure that would support these opportunities in the future. This Measure also supports the assessment of other thermal mitigation alternatives in the future with this TBL framework.



Riparian Shade Credits:
No opportunities identified.



Recycled Water Use for Agricultural Irrigation:
Potential for augmentation. A preliminary research report, completed by Casey Hanson (MWMC Research Intern), found that there are opportunities at the Biocycle and BRS sites to discharge recycled water to groundwater resources provided the recycled water is treated to Class A standards. There is also the opportunity to discharge directly to surface water. It may be possible to discharge to surface water through subsurface soils, but it depends on the onsite soil attenuation.[51]



Recycled Water Use for Industrial Aggregate Production:
No opportunities identified.

[49] Randy Gray, City of Eugene staff, reported that 12,200 gallons of well water were applied over the last 3 years, or about 4,000 gallons per year.
[50] MWMC staff created Excel spreadsheet titled *Industrial Balance*
[51] Casey Hanson (2013). *Preliminary Findings for Constructed Wetlands as Thermal Load Reduction Alternatives.*

Habitat and Ecosystem Services

Criterion Description: All living organisms depend on "ecosystem services," such as clean water and habitat, provided by the healthy functioning of biological systems. While each mitigation alternative is intended to enhance water quality by reducing temperature, an alternative may have co-benefits that enhance the provision of ecosystem services. Alternatively, a mitigation option may have unintended negative impacts to ecosystem services.

Measures:

- Scale of Enhanced Habitat
- Soil Quality Effects
- Future Project Site Habitat and Ecosystem Opportunities

Summary of Results: Riparian Shade Credits offer the greatest benefits of all the alternatives, except for the thermal reduction potential measure. The project would enhance riparian shade habitat, improve soil quality and offer the greatest long-term habitat benefits as the riparian restoration matures and become a more complex ecosystem. The Agricultural Irrigation project provides infrastructure for future wetland restoration projects, but at additional cost beyond what is considered in this assessment. The greatest thermal reduction potential is the result of the Industrial Aggregate alternative, followed by Agricultural Irrigation and finally Riparian Shade Credits. It's important to note that *none* of the alternatives provide 100% of the thermal reduction potential needed to meet the estimated mitigation requirements based the 2006 temperature TMDL. See the following sections for details.

Figure 15: Summary of Findings for the Habitat and Ecosystem Services TBL Measures.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Scale of Enhanced Habitat	• *Acres:* 36 - 73 • *Stream Miles:* 5 - 10	• *Acres:* 0 • *Stream Miles:* 0	• *Acres:* 0 • *Stream Miles:* 0
Soil Quality Effects	• Soil health may be improved by reducing soil compaction, improving drainage and reducing erosion.[52]	• No significant benefits or risks were identified. Class D recycled water analytical testing results were compared with the EPA's Recommended Limits for Constituents in Recycled Water for Irrigation.[53]	• No significant benefits or risks were identified. Class D recycled water analytical testing results were compared with the EPA's Recommended Limits for Constituents in Recycled Water for Irrigation.[54]
Future Project Site Habitat and Ecosystem Opportunities	• None assumed beyond the project life-cycle benefits of the initial restoration.	• If the maximum onsite wetland restoration potential were utilized it would create roughly 100 acres of wetland habitat.[55]	• No opportunities identified.
Data Gaps: • Delta-Knife water demand and timing of demand data.			

[52] Hoorman, J. and McCutcheon, J. *Understanding the Benefits of Healthy Riparian Areas*. Access online in Feb. 2014 at http://ohioline.osu.edu/ls-fact/0001.html.
[53] Oregon Department of Environmental Quality (2009). *Implementing Oregon's Recycled Water Rules.* Accessed online in Feb. 2014 at http://www.deq.state.or.us/wq/pubs/imds/RecycledWater.pdf.
[54] Oregon Department of Environmental Quality (2009). *Implementing Oregon's Recycled Water Rules.* Accessed online in Feb. 2014 at http://www.deq.state.or.us/wq/pubs/imds/RecycledWater.pdf.
[55] Casey Hanson (2013). *Preliminary Findings for Constructed Wetlands as Thermal Load Reduction Alternatives.*

Note 1: The methodology used to calculate the Indexed Thermal Reduction Capacity values is described on page 40 of this report.

Scale of Enhanced Habitat

Measure Description: Enhancing the quality of any habitat through restoration will have direct effects on a variety of terrestrial and aquatic species of flora and fauna as well as on the soil. Riparian restoration is particularly important because riparian areas are known to support higher diversity of species than most other habitat types. In Oregon and Washington it is estimated that 359 animal species utilize riparian or wetland habitat at some point during their life. Therefore, riparian restoration has a significant, long-term beneficial impact on the local ecosystem.



Riparian Shade Credits:
The project will result in riparian restoration of 5 – 10 miles of stream bank at a width of 60 feet, or approximately 35 – 75 acres.[56]



Recycled Water Use for Agricultural Irrigation:
Habitat enhancement is not part of this alternative.



Recycled Water Use for Industrial Aggregate Production:
Habitat enhancement is not part of this alternative.

Soil Quality Effects

Measure Description: Compare the effects of the project on soil quality and health.



Riparian Shade Credits:
Net improvement to soil quality. The total soil effects realized from riparian restoration project will be site-dependent. However it is assumed for the purpose of this analysis that riparian restoration will have a significant beneficial and long-term effect on soil quality at the restoration sites by potentially reducing soil compaction, improving soil drainage, improving bank stability and reducing soil erosion.[57]



Recycled Water Use for Agricultural Irrigation:
Net negative to soil. Low hazard for soil salinity. Class C recycled water-testing results for total dissolved solids (used as a proxy for Class A data, which is unavailable) were compared to Table 18 in ODEQ's - *Implementing Oregon's Recycled Water Rules*. This table is meant to assess the general salinity hazard from recycled water. Class C water has a TDS concentration of 244ppm, which is considered "Low Salinity Hazard". The effects of this hazard class are that sensitive plants may show stress; moderate leaching prevents salt accumulation in soil. The Class C recycled water analytical testing results were also compared with the EPA's

[56] The Freshwater Trust staff estimated that 5-10 miles of stream bank would be restored at a width of 60 feet or 36-73 acres.
[57] Hoorman, J. and McCutcheon, J. *Understanding the Benefits of Healthy Riparian Areas*. Access online in Feb. 2014 at http://ohioline.osu.edu/ls-fact/0001.html.

Recommended Limits for Constituents in Recycled Water for Irrigation[58], but no other significant impacts were identified.



Recycled Water Use for Industrial Aggregate Production:
No significant benefits or risks were identified. Class A recycled water analytical testing results[59] were compared with the EPA's *Recommended Limits for Constituents in Recycled Water for Irrigation*[60], but no significant impacts were identified.

Future Project Site Habitat and Ecosystem Opportunities

Measure Description: This Measure assesses the potential of the project to facilitate future habitat and ecosystem benefits.



Riparian Shade Credits:
As restoration site matures it will increase habitat complexity for aquatic and terrestrial species.[61]



Recycled Water Use for Agricultural Irrigation:
The initial investment in this alternative would support future projects onsite to restore onsite wetlands. If the maximum onsite wetland restoration potential were utilized, this alternative would create roughly 100 acres of wetland habitat (90 acres at Biocycle Farm and 10 acres at BRS).[62]



Recycled Water Use for Industrial Aggregate Production:
No future opportunities identified.[63]

[58] Oregon Department of Environmental Quality (2009). *Implementing Oregon's Recycled Water Rules.* Accessed online in Feb. 2014 at http://www.deq.state.or.us/wq/pubs/imds/RecycledWater.pdf.
[59] Class A analytical results were not available so Class C testing results were used as a proxy.
[60] Oregon Department of Environmental Quality (2009). *Implementing Oregon's Recycled Water Rules.* Accessed online in Feb. 2014 at http://www.deq.state.or.us/wq/pubs/imds/RecycledWater.pdf.
[61] http://www.dfw.state.or.us/conservationstrategy/docs/document_pdf/b-habitat_10.pdf
[62] Casey Hanson (2013). *Preliminary Findings for Constructed Wetlands as Thermal Load Reduction Alternatives.*
[63] Sara Robertson (2011). *Three Scenarios For the Future of Confluence Island, their Effects and their Adaptability.*

Life-Cycle Greenhouse Gas (GHG) Emissions

Criterion Description: Man-made emissions of greenhouse gases (GHGs) are causing changes to the global and regional climate. Considering the scale of GHG impacts of the alternatives is consistent with the MWMC's ISO 14001 Environmental Management System.

Measures:

- Net 20-Year Life-Cycle Greenhouse Gas Emissions (20-year MT CO_2e). All GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO2e), which is the international reporting standard in greenhouse gas inventory protocol.

Summary of Results: The Riparian Shade Credits alternative has the lowest life-cycle greenhouse gas impacts of the three alternatives. These results are based on a 20-year project life span. If the riparian restoration were allowed to mature, at year 35 the life-cycle carbon footprint would be net-zero and if the project had a 100-year life span the net carbon footprint would equal -6,555 MT CO_2e.

Figure 16: Summary of Net Life-Cycle Carbon Footprint Measure, by alternative.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Net 20-Year Life-Cycle GHG Emissions	**1,092 MT CO_2e**	**5,680 MT CO_2e**	**2,395 MT CO_2e**
Construction (Materials and Fuel Use)	*1,232*	*3,574*	*1,545*
20-Year O&M Equipment Replacement and Maintenance	*119*	*294*	*850*
Net 20-Year Energy Use (Compared to Existing Conditions)	*0*	*1,812*	*0*[64]
20-Year Carbon Sequestration by Vegetation	*-259*	*0*	*0*

Net 20-Year Life-Cycle Greenhouse Gas Emissions

Measure Description: The GHG emissions reported for this Measure are a net value of project emissions minus existing conditions. This net value is particularly important for the Industrial Aggregate alternative, as this recycled water project will not require any additional net energy use for water pumping. Instead the energy required will offset energy already being consumed to supply industrial aggregate operations with process water.

The calculations for this Measure are documented in a separate Excel spreadsheet titled *MWMC-TBL-GHGs-030414.*



Riparian Shade Credits: 1,092 MT CO_2e

- ***Construction:*** 1,232 MT CO_2e. This category of emissions includes embodied emissions in the materials and equipment used in the restoration project[65] and onsite fuel

[64] This value represents net energy use of the project compared to existing conditions. It is assumed that the energy Delta Sand and Knife River currently use to pump water from the river is equal to the energy the MWMC will use to pump recycled water to the Delta-Knife River site for the Industrial Aggregate alternative. Ideally this energy consumption would be split between pumping and treatment energy, but that level of detail is available. If it were available pumping energy would be excluded (as equal to EC), but treatment energy would be included.

[65] Embodied emissions are production emissions from raw material extraction through the point of retail or wholesale purchase.

used for powered equipment.

- ***20-Year Operations (Site Monitoring):*** 119 MT CO_2e. Over the course of the 20-year contract, emissions will be incurred for site monitoring and replanting (as necessary).
- ***Net 20-Year Electricity Use:*** 0 MT CO_2e. No operational energy use required for this alternative.
- ***Carbon Sequestration by Vegetation:*** -259 MT CO_2e. This value represents the maximum 20-year carbon sequestration for 55 acres. This sequestration value is allocated to this project with the assumption that the restoration project will be long-term and survive in its restored form well past the shade credit contract. It represents the maximum because a fundamental assumption in the per acre carbon sequestration value provide by The Freshwater Trust and used for this estimate is that the project site is bare ground devoid of any existing vegetation. In all likelihood, there will be some vegetation at the project site that has the potential to sequester carbon, which would reduce this maximum value to a net value that considers the difference between project carbon sequestration and existing conditions. As of this writing, details about vegetation at the project site are unavailable.

  The scale of 20-year carbon sequestration compared to project emissions may be a surprise to some (i.e., the project emissions are greater than carbon sequestration). To show the full beneficial effect of carbon sequestration from riparian restoration, one needs to look 100 years into the future. The period of rapid carbon sequestration in a riparian ecosystem is between year 30 and year 70. If carbon sequestration is estimated for a project life span of 100 years it changes the quantity significantly, from -259 MT CO_2e (20 years) to -7,960 MT CO_2e (100 years). Figure 17 shows the difference in scale. The 100-year sequestration is added (light green) for scaling purposes to the 20-year GHG emissions by alternative.



Recycled Water Use for Agricultural Irrigation: 5,680 MT CO_2e

- ***Construction:*** 3,574 MT CO_2e. This category of emissions includes embodied emissions in the materials and construction equipment used during project construction as well as onsite fuel used for powered equipment.
- ***20-Year Equipment Maintenance:*** 294 MT CO_2e. This category of emissions accounts for embodied emissions in the materials used in pump maintenance and replacement as well as the fuel used to provide the maintenance or replacement services.
- ***Net 20-Year Electricity Use:*** 1,812 MT CO_2e. Additional energy (compared to existing conditions) will be required for this alternative in order to pump the recycled water to Biocycle / BRS and distribute it onsite for irrigation.
- ***Carbon Sequestration by Vegetation:*** 0 MT CO_2e. While this project will increase biomass production at both the Biocycle / BRS sites, this increased biomass and the carbon it sequesters will only be stored for a relatively short period of time before it is returned to the atmosphere via combustion (poplars to hog fuel) or decomposition (hay is digested by animals).



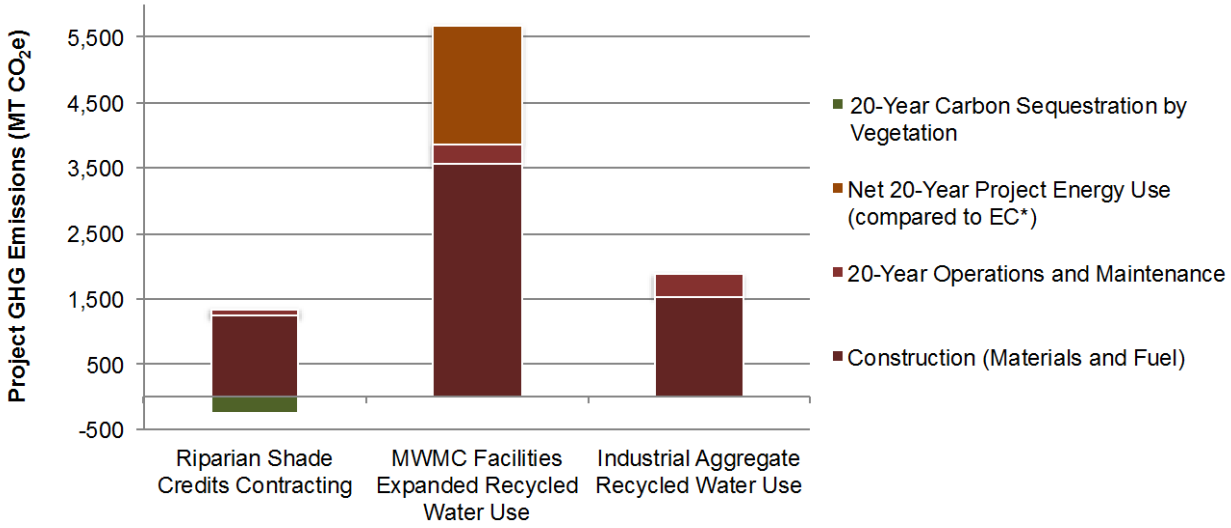
Recycled Water Use for Industrial Aggregate Production: 2,395 MT CO_2e

- ***Construction:*** 1,545 MT CO_2e. This category of emissions includes embodied emissions in the materials and construction equipment used during project construction as well as onsite fuel used for powered equipment.
- ***20-Year Operations (Treatment Chemical Use):*** 850 MT CO_2e. Emissions from this source represent the embodied emissions of the sodium hypochlorite used to treat the recycled water to Class A standards. No new pump maintenance or replacement is expected beyond existing conditions (i.e., pump maintenance and replacement by Delta-Knife) and therefore these emissions are excluded from this analysis.
- ***Net 20-Year Electricity Use:*** 0 MT CO_2e. Electricity is used in the 20-year operation of this alternative to pump the water from the WPCF to the Delta-Knife site. However,

compared to existing conditions, no new energy would be used. A benefit of this project is it accomplishes two tasks for the electricity currently being consumed for one under existing conditions. Delta-Knife is already using electricity to pump their process water from the Willamette River. This alternative meets that end of furnishing process water while also providing thermal mitigation load to the WPCF using the same electrical input. Because no additional energy is required for this alternative, emissions are accounted for as 0 MT CO_2e.

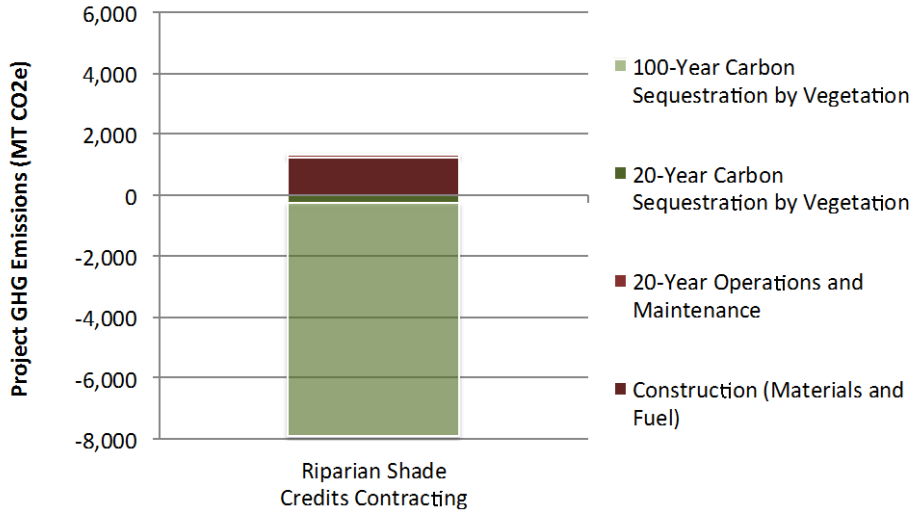
- ***Carbon Sequestration by Vegetation:*** 0 MT CO_2e. This project does not include changes to vegetation management that would result in significant sequestration.

Figure 17: Comparison of the 20-year Lifecycle GHG Emissions for All Alternatives, by emissions source, with 20-years of c-Sequestration by the Riparian Shade Credits Project.



*EC = Existing Conditions

Figure 18: Comparison of the 20-year Lifecycle GHG Emissions for All Alternatives, by emissions source, with 100-years of c-Sequestration by the Riparian Shade Credits Project.



Social Criteria

Social Criteria

- Local Economic Effect
- Community Stewardship
- Stakeholder Interest Alignment

Local Economic Effect

Criterion Description: Infrastructure investments can result in significant local economic benefits in the form of both direct job creation and the provision of public goods that enhance economic development.

Measures:

- Creation or Retention of Construction Jobs
- External Demand for Recycled Water
- Change in External Profit or Cost Avoidance

Summary of Results: Recycled Water Use for Agricultural Irrigation creates the greatest number of construction jobs. The Agricultural Irrigation alternative also has the greatest estimated theoretical private demand for recycled water within 1 mile of the alternative's infrastructure. This alternative also provides potential for the BRS tenant farmer to increase in the number of crop rotations per year. The Industrial Aggregate alternative also provides the potential for private entities utilizing recycled water for operations, as well as providing a cost avoidance opportunity for Delta-Knife operations.

Figure 19: Summary of findings for Local Economic Effect TBL Measures.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Creation of Construction Jobs	17 FTE-years (7.4 FTE / $1 million)	55 FTE-years (7.1 FTE / $1 million)	30 FTE-years (7.1 FTE / $1 million)
External Demand for Recycled Water	0 MGD	10.3 MGD	3.1 MGD
External Profit or Cost Avoidance	• The purchase of credits result in a lease payment for participating land owners who host the restoration projects.	• Potential for increased profit by BRS tenant farmer. Irrigation water would allow for more crop rotations in a given year (potentially increasing from 1 rotation to 3). Details are not currently available to scale this potential benefit in dollars.	• Sources of cost avoidance for Delta-Knife: 1. Process water pumping costs. The MWMC may assume a share the estimated annual cost of $55,000. 2. There may also be a small savings for Delta-Knife operators, relative to pumping costs, from the thermal load in the recycled water displacing the need to heat process water.
Data Gaps: • Identify specific businesses along the recycled water pipeline corridor that consume significant quantities of water for approved recycled water uses.			

Creation of Construction Jobs

Measure Description: The creation of short-term construction jobs or long-term operational positions has significant value to individuals, their families, the community and the local economy. The focus of this Measure is on construction jobs because, while all of the alternatives all create new operational responsibilities, it is not clear if these new responsibilities will be met by creating new positions or by reorganization or reallocation of existing staff time and responsibilities.



Riparian Shade Credits:
The University of Oregon's Ecosystem Workforce Program[66] has done considerable analysis on the economic impacts of riparian restoration contracting and projects in Oregon, which it summarized in a 2010 report titled *Economic and Employment Impacts of Forest and Watershed Restoration in Oregon*. The study found that for every $1 million spent on riparian restoration in Oregon, 7.4 construction jobs (FTE for 1 year) are created. For riparian shade credit contracting it is estimated that 50% of the costs go towards standard restoration and 50% are associated with regulatory crediting. Therefore for a project that costs $4.65 million, half of the cost will go towards construction ($2.35 million), which will result in approximately 17 FTE jobs will be created.



Recycled Water Use for Agricultural Irrigation:
PA Consulting Group, on behalf of the Clean Water Council, conducted an analysis on the economic impacts of wastewater infrastructure projects in the U.S., which it summarized in a 2009 report titled *Sudden Impact: An Assessment of Short-Term Economic Impacts of Water and Wastewater Construction Projects in the United States*. The report provides case studies for a number of states, not including Oregon. California is used as the closest geographic proxy for Oregon. For every $1 million spent on wastewater construction projects in California 7.1 construction jobs (FTE for 1 year) are created. Applying this multiplier to this alternative with construction costs of $7.9 million, approximately 55 FTE-years jobs will be created.



Recycled Water Use for Industrial Aggregate Production:
Applying the multiplier described in the previous section this alternative's construction costs of $4.3 million provide an estimate that 30 FTE-years jobs will be created.

External Demand for Recycled Water

Measure Description: The development of recycled water infrastructure offers the potential to deliver a recycled water product to interested outside-the-fence customers for whom it would provide a financial advantage over their existing source of water. The expansion of the recycled water system and service could benefit the MWMC in the future by expanding thermal mitigation capacity and/or as a source of revenue. The first step in assessing this potential is to scale and compare theoretical private demand for recycled water within 1 mile of the proposed project infrastructure. This estimate is not meant as a quantitative final answer, rather as a first step in assessing this potential opportunity.



Riparian Shade Credits:
Not applicable.

[66] The EWP was founded in 1994 to support the development of a high-skill, high-wage ecosystem management industry in the Pacific Northwest. Since that time, we have fostered forest-based sustainable rural development in forest communities by developing restoration workforce training curriculum and supporting local quality jobs programs in forest communities.

Recycled Water Use for Agricultural Irrigation:
10.3 MGD. Large demand sites (>1MGD) for this alternative are dominated by agricultural uses (3 tax lots that consist of 324 acres) followed by 1 green space site (135 acres). Medium demand sites (0.1 – 1 MGD) have the largest aggregate demand of three demand tiers, which are dominated by agricultural use (8 tax lots and 197 acres) followed by green space (2 tax lots and 92 acres). Small demand sites (<0.1 MGD) have the least aggregate demand of the three demand tiers and use is dominated by industry (9 tax lots and 238 acres). See Figure 20 and 21.

Recycled Water Use for Industrial Aggregate Production:
3.1 MGD. There were no large or medium demand sites identified within 1 mile from the project boundaries. Small demand sites are dominated by industry (27 tax lots at 391 acres). See Figure 20 and 21.

Private Recycled Water Demand Estimation Methodology
The estimates for potential future demand of recycled water are based on a GIS analysis completed by wastewater staff to support the TBL analysis. The analysis identified all of the properties (by tax lot) with at least one boundary within 1 mile of the proposed project corridors (W2 pipeline) and sites (Biocycle / BRS). For each property, staff identified three tiers of current water demand (based on OWRD and EWEB data): greater than 1 million gallons per day (>1MGD), between 0.1 and 1 MGD (0.1 – 1 MGD) and less than 0.1 MGD (<0.1MGD). Water demand was estimated by adding up the number of properties in each tier and multiplying the number by the most conservative estimate of water demand (1 MGD for large demand, 0.5 MGD for medium demand and 0.1 MGD for small demand).

Figure 20: Estimated Recycled Water Demand Within 1 Mile of the Agricultural Irrigation RW Alternative.

Potential Recycled Water Demand	Large Demand (>1 MGD)			Medium Demand (0.1 – 1 MGD)			Small Demand (<0.1 MGD)		
Land Use Type	Demand (MGD)	Tax Lots	Acres	Demand (MGD)	Tax Lots	Acres	Demand (MGD)	Tax Lots	Acres
Industrial	0	0	0	0	0	0	0.9	9	238
Agricultural	3	3	324	4	8	197	0	0	0
Green Space	1	1	135	1	2	92	0.4	4	31
Totals	**4**	**4**	**459**	**5**	**10**	**289**	**1.3**	**13**	**269**

Figure 21: Estimated Recycled Water Demand Within 1 Mile of the Outside-the-Fence RW Alternative.

Potential Recycled Water Demand	Large Demand (>1 MGD)			Medium Demand (0.1 – 1 MGD)			Small Demand (<0.1 MGD)		
Land Use	Demand (MGD)	Tax Lots	Acres	Demand (MGD)	Tax Lots	Acres	Demand (MGD)	Tax Lots	Acres
Industrial	0	0	0	0	0	0	2.7	27	391
Agricultural	0	0	0	0	0	0	0.1	1	23
Green Space	0	0	0	0	0	0	0.3	3	13
Totals	**0**	**0**	**0**	**0**	**0**	**0**	**3.1**	**31**	**427**

External Profit or Cost Avoidance

Measure Description: The ability and scale of the project alternative to financially benefit an external party – be it a project partner or other– provides a social benefit to members of our community.



Riparian Shade Credits:
The purchase of credits result in a lease payment for participating land owners who host the restoration projects.



Recycled Water Use for Agricultural Irrigation:
Increased profit. Potential for increased annual profit for BRS tenant farmer. Irrigation at the BRS site has the potential to allow the tenant farmer at BRS to increase from 1 harvest per year to 3 harvests.[67] The net profit from increased harvests is not known as of this writing and will likely change significantly based on a number of variables including crop type, market prices, etc. It is assumed that on average increased harvests will result in increased profits for the farmer.



Recycled Water Use for Industrial Aggregate Production:
Increased profit through cost avoidance. Estimated annual Delta-Knife savings for water pumping is $55,000 per year.[68] This project would transfer electricity costs related to pumping water for Delta-Knife River operations to the WPCF. The distribution of these cost have not been determined. For this analysis it is assumed that the annual electricity savings are realized solely by Delta-Knife River.

[67] CH2MHill (2013). Beneficial Reuse Site Irrigation System and Agronomic Alternatives Assessment.
[68] Based on the design cost estimate for annual operational electricity requirements.

Community Stewardship

Criterion Description: The siting or operation of mitigation alternatives can affect adjacent communities, including effects to health and safety and changes in quality of life, now and in the future.

Measures:

- Human Health and Safety Concerns
- Aesthetic Site Improvements
- Develops Climate Change Adaptation Capacity

Summary of Results: Each alternative carries its own set of potential or perceived health and safety risks due to construction, operation, or as a legacy of use. Given that recycled water use is regulated by Oregon statute and rules to be protective of human health and the environment, the perception of user risk could be the most limiting aspect of the project (or conversely, the key to community acceptance). Other project elements that bear on community livability and project acceptability include whether or not the project is within the ratepayer community, whether landscape aesthetics are impacted, and how the project provides assets for climate change resilience and adaptation.

Figure 22: Summary of Community Stewardship TBL Measures.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Human Health and Safety Concerns	• No concerns identified.	• Concern from farm adjacent to BRS site about the risk of overspray on food crops.	• Concern for Delta S&G employees who are significantly exposed daily to process water.
Aesthetic Improvements	• Restoration will likely significantly improve aesthetics on privately owned land. Public benefit will be site-dependent.	• No significant change expected.	• No change expected.
Develops Climate Change Adaptation Capacity	• Provides increased ecosystem services. Restoration increases capacity of the land to moderate flood and drought. The value of these services varies with site selection.	• Provides a substitute for sources of ground or surface water that could be utilized during future extreme drought conditions.	• Provides a substitute for sources of ground or surface water that could be utilized during future extreme drought conditions.
Data Gaps: • Analytical data of coliform levels to compare Class A recycled water to current process water used for rock crushing by Delta Sand & Gravel to assess employee risks and significance of exposure. • Timing, intensity and form of local impacts related to climate change. • Actual location of riparian restoration to scale aesthetic improvements and determine the project location.			

Human Health and Safety Concerns

Measure Description: Assess human health and safety concerns related to project construction and operation. It is assumed that health and safety risks for the alternatives considered here are equal.



Riparian Shade Credits:
No significant concerns.



Recycled Water Use for Agricultural Irrigation:
Irrigation at the Biocycle Farm with recycled water is an existing practice. Recycled water storage and irrigation at the BRS would be a modification, although not largely different from the historical practice of storage and irrigation. Recycled water rules dictate setback requirements and protections against overspray and drift from overhead irrigation as well as against site runoff. Maladjustments/malfunctioning equipment could present risks of inadvertent misapplication of recycled water. Primary concerns in this regard include unmanaged groundwater infiltration or runoff to Flat Creek and irrigation drift to neighboring properties. A neighbor of the BRS site has expressed concern about Class D recycled water overspray coming into contact with food crops. The overspray concern could be mitigated by either not applying recycled water, or not applying recycled water with the existing irrigation pivot, at the easternmost pivot irrigator.



Recycled Water Use for Industrial Aggregate Production:
The primary concern is risk of infection to Delta-Knife employees who would be frequently exposed to the recycled water in the course of their duties and workday. The employee group of greatest concern is those who work in the rock crushing operations at Delta Sand & Gravel, where large quantities of water are used for dust control. It is common for employees present during operation to be significantly exposed to the water, including exposure to their mouth and eyes. In order to determine the actual risk of exposure for these employees Class A recycled water should be tested, as should the river water currently being used for the operations to determine any significant difference and risk. A public multi-use bike path runs along the south property line near the facility entrance, but the site is fenced and isolated from public access or use. Class A recycled water has very few restrictions and does not require any setback distances. This alternative may require onsite training for aggregate staff and annual inspection by the MWMC staff. This is not a requirement per Oregon Rule, but is best practice in California.

Aesthetic Site Improvements

Measure Description: Significant aesthetic site improvements compared to existing conditions has the potential to improve property values for the project site as well as adjacent sites as well as providing a general public benefit.



Riparian Shade Credits:
Site aesthetics will likely be improved relative to existing conditions. These improvements will likely be located on privately owned land, per The Freshwater Trust staff, and therefore public access to the restoration site(s) will be limited use of adjacent waterways and associated recreational activities. Depending on the site location – aesthetics may be improved and highly visible to public roadways, lands and neighbors. See Figure 23 for an extreme example of before and after images from a restoration project.

Recycled Water Use for Agricultural Irrigation:
No significant improvements are anticipated beyond existing conditions. There may be a slight increase in the quantity and duration of greenery throughout the year due to irrigation. The Biocycle/BRS sites are not publically accessible, but they are highly visible from a nearby highway and airport.

Recycled Water Use for Industrial Aggregate Production:
No improvements are expected beyond existing conditions.

Develops Climate Change Adaptation Capacity

Measure Description**:** The climate is changing and will have effects on water resources and wildlife habitat among others. While the exact form, timing and intensity of the changes are unknown, developing the capacity to adapt to predicted changes benefits those who will face the acute and chronic climate challenges in the future.

Riparian Shade Credits:
Yes, provides increased ecosystem services. Restoration increases capacity of the land to moderate flooding by increase soil infiltration, provides enhanced native plant and wildlife habitat and provides the water quality benefits previously discussed (thermal load, sediments, nitrogen, etc.).[69] The value of these services will vary with site.

Recycled Water Use for Agricultural Irrigation:
Yes, recycled water could provide a substitute for sources of ground or surface water to be utilized during future drought conditions. The location of the Biocycle / BRS site may provide advantageous to nearby agricultural operations should ground water resources become limited.

Recycled Water Use for Industrial Aggregate Production:
Yes, recycled water could provide a substitute for sources of ground or surface water to be utilized during future drought conditions.

Figure 23: An Example of Before and After Riparian Shade Site Aesthetics.



[69] City of Eugene (2010). *A Community Climate and Energy Action Plan for Eugene*. Accessed online in Feb. 2014 at http://www.eugene-or.gov/ArchiveCenter/ViewFile/Item/2385.

Stakeholder Interest Alignment

Criterion Description: Alignment with stakeholder priorities and engagement with community partners is important for maintaining and enhancing important relationships aligning goals within the relevant community(s).

Measures:

- Potential project partnerships
- Alignment with local and state plans and goals
- Acceptability and alignment with local stakeholders

Summary of Results: All of the alternatives are very similar for the Stakeholder Interest Alignment Measures. The most significant difference is for the Acceptability and Alignment with Local Stakeholders Measure for which the indexed score shows a stakeholder preference for the Recycled Water Use for Industrial Aggregate Production alternative.

Figure 24: Summary of Findings for Stakeholder Interest Alignment Measures.

Measures	Riparian Shade Credits	Recycled Water Use for Agricultural Irrigation	Recycled Water Use for Industrial Aggregate Production
Potential Project Partnerships	• EWEB • McKenzie Watershed Council	• EWEB	• EWEB
Alignment with Local and State Plans and Programs	2 of 5	2 of 5	2 of 5
Oregon's Integrated Water Resource Strategy	*Yes*	*Yes*	*Yes*
Oregon Water Reuse Program	*No*	*Yes*	*Yes*
Eugene Climate and Energy Action Plan	*No*	*No*	*No*
EWEB Water Management Conservation Plan	*No*	*Maybe*	*Maybe*
EWEB Drinking Water Protection Plan	*Yes*	*No*	*No*
Stakeholder Acceptability and Alignment (Indexed Score)	9.8	11.6	15.8

Potential Project Partnerships

Measure Description: Project partners could provide the project with financial, technical or resource support and reduce barriers to implementation as well as the potential to work collaboratively on community goals.

Riparian Shade Credits:
EWEB and McKenzie Watershed Council. Depending on the location selected for the restoration projects and if the projects supports the goals of EWEB's Drinking Water Plan, EWEB may be interested in project partnership. Other potential project partners, depending on project location, could be the McKenzie Watershed Council, who also is a local restoration

organization working in tandem with EWEB and TFT to implement watershed protection and restoration projects with private and public landowners. TFT could leverage EWEB's VIP [footnote what this is: Voluntary Incentives Program to reward landowners who host protected, high-functioning riparian lands] to conduct landowner outreach and identify high-value shade restoration sites.



Recycled Water Use for Agricultural Irrigation:
EWEB and potential recycled water users. Recycled water supports EWEB's goals laid out in its *Water Management Conservation Plan*. Of the two recycled water alternatives, the Agricultural Irrigation alternative project boundaries (W2 pipeline corridor, Biocycle / BRS) present greater potential recycled-water demand. According to the high-level estimate conducted for this TBL assessment, agricultural and green space managers should be contacted in the future to determine feasibility of recycled water use at these sites. See the Private Demand for Recycled Water Measure for more details.



Recycled Water Use for Industrial Aggregate Production:
EWEB. Recycled water supports EWEB's goals laid out in its *Water Management Conservation Plan*. In addition, there is potential for other recycled water users to become project partners, as there is an estimated 3.1 MGD of theoretical potential within 1 mile of the project site and infrastructure. While potential exists, none of the 31 tax lots that represent the 3.1 MGD of demand have been contacted or have expressed interest in partnering or using recycled water. In addition, the obvious project partners, Delta-Knife, have stated to MWMC staff that they are not currently interested in partnering on this project.

Alignment with Local and State Plans and Programs

Measure Description: The degree to which a project aligns with Oregon state or local (Eugene and Springfield) plans or goals provide a way to measure the project contribution towards regional goals. There are many state and local goals that could be interpreted to be relevant to the project at hand. Five plans were identified as most relevant to the projects being assessed. These include:

- *Oregon's Integrated Water Resource Strategy (2012)*[70]
- *Oregon Water Reuse Program*[71], *Eugene Climate and Energy Action Plan (2010)*[72]
- *EWEB Water Management Conservation Plan (2012)*[73]
- *EWEB Drinking Water Protection Plan (2000)*[74]
- *EWEB Proposal for Implementation of the Drinking Water Source Protection Program (2001)*[75].



Riparian Shade Credits: This project does not change profit or cost avoidance for external parties.

- *Oregon Integrated Water Resource Strategy:* Yes, project is aligned with the strategy. The importance of riparian areas is mentioned throughout the strategy in terms of water temperature, water quality, climate change, flood control, ecosystem and habitat.
- *Oregon Water Reuse Program:* No, project is not aligned with program. The Program focus is on water reuse and not riparian restoration.

[70] Oregon Water Resources Department (2012). *Oregon's Integrated Water Resource Strategy*. Accessed online in Feb. 2014 at http://www.oregon.gov/owrd/LAW/docs/IWRS_Final.pdf.
[71] Oregon Department of Environmental Quality. *Water Reuse Program webpage*. Accessed online in Feb. 2014 at http://www.deq.state.or.us/wq/reuse/reuse.htm.
[72] City of Eugene (2010). *A Community Climate and Energy Action Plan for Eugene*. Accessed online in Feb. 2014 at http://www.eugene-or.gov/ArchiveCenter/ViewFile/Item/2385.
[73] GSI Water Solutions, Inc. (2012). EWEB Water Management and Conservation Plan. Accessed online in Feb. 2014 at http://www.eweb.org/public/documents/water/waterCurtailment.pdf.
[74] EWEB (2000). Drinking Water Protection Plan. Accessed online Feb. 2014 at http://www.eweb.org/public/documents/water/WaterProtectionPlan.pdf.
[75] EWEB (2001). *Proposal for Implementation of the Drinking Water Source Protection Program. Accessed online in Feb. 2014 at http://www.eweb.org/public/documents/water/SourceProtectionProgramProposal.pdf.*

- *Eugene Climate and Energy Action Plan:* No, project is aligned with plan. Specifically Objective 26 of the plan, which focuses on protection of sensitive urban natural areas including riparian areas, wetlands and floodplains to improve water quality, reduce water temperatures, and reduce flooding. The degree of alignment is dependent on restoration project location as the Plan is specific to Eugene.
- *EWEB Water Management Conservation Plan:* No, project is not aligned with plan. There is no mention of riparian restoration projects in the plan.
- *EWEB Drinking Water Protection Plan:* Yes, the project is aligned with the Implementation Plan. Riparian restoration is named as a mitigation strategy in the Implementation Plan to "implement projects to enhance riparian functions in the vicinity of nonpoint source problem areas to increase filtering capabilities and stream health".



Recycled Water Use for Agricultural Irrigation:

- *Oregon Integrated Water Resource Strategy:* Yes, project is aligned with strategy. The strategy encourages the use of recycled water so long as the use protects human health and the environment.
- *Oregon Water Reuse Program:* Yes, project is aligned with program. This Program encourages water reuse (use of recycled water) in a manner that protects public health, the environment and provides a resource benefit.
- *Eugene Climate and Energy Action Plan:* No, project is not included as a strategy in the plan. That said – recycled water use might provide a strategy to reduce energy use and emissions compared to the requirements for treatment and distribution of potable water. Further analysis is required to define the scenarios that would result in a net benefit and to scale of the potential energy and emissions savings.
- *EWEB Water Management Conservation Plan:* Maybe, project is aligned with plan. Within the next 5 years, EWEB will continue to explore opportunities for water reuse and recycling, such as on playing fields and golf courses.
- *EWEB Drinking Water Protection Plan:* No, project is not relevant to plan. Recycled water use for industrial aggregate production does not offer any protection to Eugene's source of drinking water, the McKenzie River.



Recycled Water Use for Industrial Aggregate Production:

- *Oregon Integrated Water Resource Strategy:* Yes, project is aligned with strategy. The strategy encourages the use of recycled water so long as the use protects human health and the environment.
- *Oregon Water Reuse Program:* Yes, project is aligned with program. This Program encourages water reuse (use of recycled water) in a manner that protects public health, the environment and provides a resource benefit.
- *Eugene Climate and Energy Action Plan:* No, project is not included as a strategy in the plan. That said – recycled water use might provide a strategy to reduce energy use and emissions compared to the requirements for treatment and distribution of potable water. Further analysis is required to define the scenarios that would result in a net benefit and to scale of the potential energy and emissions savings.
- *EWEB Water Management Conservation Plan: Maybe,* project is aligned with plan. Within the next 5 years, EWEB will continue to explore opportunities for water reuse and recycling, such as on playing fields and golf courses.
- *EWEB Drinking Water Protection Plan:* No, project is not relevant to plan. Eugene's source of drinking water is the McKenzie River and this alternative affects water flow in the Willamette River.

Stakeholder Acceptability and Alignment

Measure Description: Assessing a project's acceptability to local and significant stakeholders is an important step in determining potential success of implementation. Public outreach can identify potential project partners, barriers and opportunities from a variety of perspectives.



Riparian Shade Credits:
9.8 indexed score. Based on the results of a stakeholder survey, Riparian Shade Credits scored lowest of the alternatives. The results are summarized in Figure 25 and the methodology used to calculate the index score is described on the next page.



Recycled Water Use for Agricultural Irrigation:
11.6 indexed score. Based on the results of a stakeholder survey, Agricultural Irrigation scored in the middle of the three alternatives. Agricultural Irrigation performed better than Riparian Shade due to its ability to convey significant volumes of recycled water by pipe.



Recycled Water Use for Industrial Aggregate Production:
15.8 indexed score. Based on the results of a stakeholder survey, Aggregate Production scored the highest of the three alternatives. Aggregate Production performed better than Riparian Shade due to its ability to convey significant volumes of recycled water by pipe, its utilization of indirect discharge into floodplain system (i.e. discharge of recycled water back to the Willamette via the Delta-Knife settling ponds), and its ability to augment river flow.

Figure 25: Relative index of stakeholder acceptability and issues alignment.

Relative Index of Stakeholder Acceptability and Issues Alignment Evaluation of three thermal load mitigation alternatives.	Alternative 1: Industrial Aggregate Use		Alternative 2: MWMC Storage and Irrigation		Alternative 3: Riparian Shade Contracting	
Evaluation question	Reponse	Points	Reponse	Points	Reponse	Points
Does the project address or provide socio-economic benefits such as business opportunities, new water uses, recreational features, or reduced costs or carbon footprint?	N	0.0	N	0.0	Y	0.5
Does the alternative involve addressing community behavior and/or adopting a decentralized approach to wastewater management?	N	0.0	N	0.0	N	0.0
Does the alternative maintain an "inside the fence" or demonstration project as a step toward recycled water adoption?	N	0.0	Y	1.2	N	0.0
Does the alternative result in ecosystem enhancements (other than temperature)?	N	0.0	N	0.0	Y	3.9
Does the alternative maintain or augment river or groundwater flow?	Y	2.5	N	0.0	N	0.0
Does the alternative utilize indirect discharge into wetland or floodplain systems?	Y	2.8	N	0.0	N	0.0
Is the alternative a large scale project involving significant volume of piped water?	Y	5.2	Y	5.2	N	0.0
Does the alternative complement regional water supply needs?	N	0.0	N	0.0	N	0.0
Does the alternative Involve irrigation or land-based application of recycled water?	N	0.0	Y	-0.2	N	0.0
Does the alternative directly result in river temperature reduction and/or provide other water quality benefits?	Y	5.4	Y	5.4	Y	5.4
TOTAL POINTS		15.8		11.6		9.8

Stakeholder Acceptability and Issues Alignment Index Methodology

The results of a survey of stakeholders were used to identify a set of key indicators used to assess stakeholder acceptability and alignment with recycled water use concepts. The survey included general questions about recycled water infrastructure investment, groundwater protection, and human and environmental health. The results of the survey were analyzed and used to generate the indexed score for each alternative.

The Interest Group Alignment Tool, a separate Excel spreadsheet created by Todd Miller, presents how survey questions were categorized into unifying themes and distilled into weighted indicators that can be applied to any alternative. Questions were grouped into related categories and question responses were tallied to calculate an average category weight. The three alternatives were screened using this tool. An answer of “yes” to category screening questions were given a value of “1” multiplied by the weight of the category, and answers of “no” were given a value of “0”.

While the study focus is on recycled water acceptance and urban water resource management, the indicators were developed in order to be applicable to non-recycled water, such as riparian shade contracting. Figure 25 presents the index results for the study alternatives. The higher the index value the higher the degree of stakeholder alignment.

6. SCORING THE ALTERNATIVES – METHODOLOGY AND RESULTS

The TBL Criteria, supporting data and comparison of alternatives, summarized and presented in the previous section, were used to derive a numeric TBL Score for each alternative. Scoring of the criteria for each alternative provides a representation of the assessed project values, which can be expressed in table or chart form for ease of reference and comparison. The scoring process involved two key stakeholder groups directly into the TBL process: (1) the MWMC decision-making body for weighting the relative importance of each criterion to the overall score, and (2) the staff and consultant technical project team for assessing the relative value of each alternative's criteria as indicated by their individual measures. There are noted limitations associated with the scoring process.

The process used to calculate TBL Scores for each alternative in this assessment relied on the creation of two variables, generated by two independent groups who were blind to one another's work:

- Criterion Weight
- Criterion Score

The following subsections provide a detailed description of each variable, the process used to generate them, and how the variables were used to calculate a TBL Score for each thermal mitigation alternative.

Assigning Criterion Weight

For any decision there will be a number of Criteria used to make the decision, but they rarely hold equal importance. Take purchasing a house, for example. The set of Criteria used to make this decision may include cost, location and features. Depending on the buyer – the importance (or weight) of any single Criteria may vary significantly – based on the buyers values. If it is the buyer's first house, cost may far outweigh the other Criteria, whereas if the buyer is upgrading, location and features may rise significantly in importance and weight.

For this TBL assessment and scoring process, the MWMC's commissioners were responsible for assigning Criterion Weights. As appointed officials and the decision-making body for the organization, they are in the best position to represent organizational and community values.

A Pairwise Comparison method was used to determine the Criterion Weights. This method asked each member of the commission to compare each of the nine Criteria versus each of the remaining Criteria. This process results in 36 pairs to compare. See Figure 26 for a visual depiction of the Pairwise Comparison used for this assessment.

For each pair, each commissioner selected one of the two Criteria as more important in the overall decision making than the other, even if the difference between the two is perceived as nearly equal. Then, for the chosen Criterion, the respondent applied a scale of 1 to 3 to signify the degree of importance of the chosen Criterion over the compared Criterion. The numbers of the scale signify the following degrees of importance:

1 = slightly higher in importance
2 = higher in importance
3 = significantly higher in importance

The pairwise comparison was completed individually by each of the seven MWMC commissioners via an online survey. The survey did not provide the respondent with a real-time indication of how the weightings were impacted by the selections for each paired comparison. The intent was to record the pair-by-pair selection without consideration of impact on the overall Criteria weighting. The responses to the survey were used to calculate weights (as a percentage) for each Criterion. The results of the seven individual commissioner responses were averaged. The average Criteria weights were presented to the

commission to determine if any adjustments were required, resulting in the final TBL Criteria Weights. The results are presented in Figure 27.

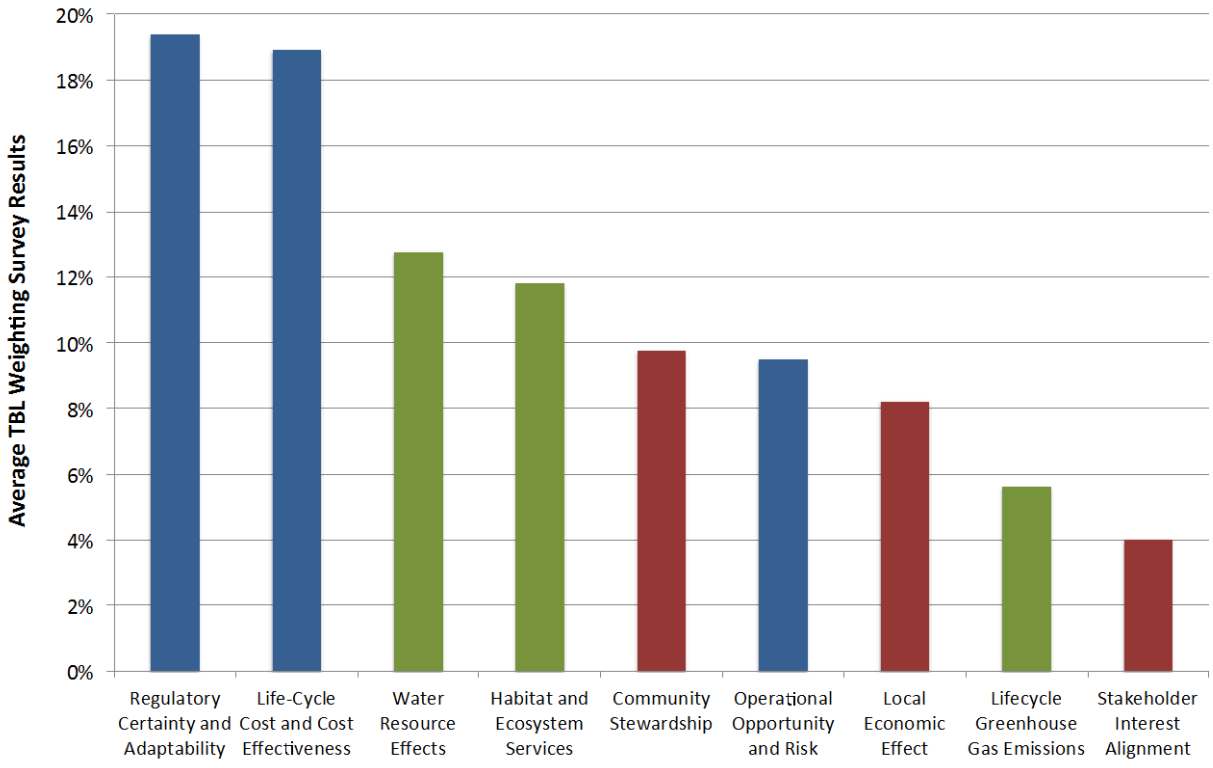
Figure 26: Pairwise Matrix Used in the Commissioner Survey to Generate the Criterion Weights.

Instructions for criteria weighting:

In each yellow cell
* Enter a **letter** (A - I) and a **number** (1 -3)
* Choose letter of preferred criterion
* Rate criterion on following scale:
  1 = *slightly higher* in priority
  2 = *higher* in priority
  3 = *significantly higher* in priority

		Economic			Environmental			Social		
		Life-Cycle Cost and Cost Effectiveness	Operational Opportunity and Risk	Regulatory Certainty and Adaptability	Water Resource Effects	Habitat and Ecosystem Services	Life-Cycle Greenhouse Gas Emissions	Local Economic Effect	Community Stewardship	Stakeholder Interest Alignment
		A	B	C	D	E	F	G	H	I
Life-Cycle Cost and Cost Effectiveness	A									
Operational Opportunity and Risk	B									
Regulatory Certainty and Adaptability	C									
Water Resource Effects	D									
Habitat and Ecosystem Services	E									
Life-Cycle Greenhouse Gas Emissions	F									
Local Economic Effect	G									
Community Stewardship	H									
Stakeholder Interest Alignment	I									

Figure 27: Summary of Averaged Criterion Weights Ordered According to Weight Percent.



Assigning Criterion Score

The Project Technical Team assigned scores to the alternatives for each Measure. The scores for each individual Measure were then averaged to determine the Criterion Score. The team consisted of the MWMC planning and operations staff, consultant team (Kennedy / Jenks Consultants staff and Good Company). This group consisted of those individuals with knowledge of the alternatives and related data sets or how the alternatives would impact the MWMC's operations.

Scores were assigned on a scale of 1 to 10. The lower end of the scale indicated high risk / low value and, conversely, the upper end of the scale indicated low risk / high value. A score of 5 indicated neutral or existing conditions. The primary intent of the Criterion Scoring is to represent the difference between alternatives numerically.

Scores were assigned in one of two ways, either with a quantitatively (with a formula) or qualitatively (with professional judgment).

- *Formula:* For the TBL Measures that had quantitative data available, a formula was used to assign a score. The "preferable" alternative was assigned the highest score possible, a 10. The other alternatives were assigned a score based on the proportional difference between it and the preferred alternative.
- *Professional Judgment:* For the TBL Measures that had either qualitative data or incomplete data, scores were assigned using the best possible information and professional judgment.

The results of the Criterion Scoring process are documented in Figure 33. In addition, notes were taken describing how scores were assigned (documented in Appendix A).[76]

Using the Variables to Calculate TBL Scores

Figure 28 shows how the Criterion Weight and Criterion Scores are used to calculate the TBL Score for each alternative. The Project Technical Team scored each individual Measure. The values presented are the average of these Measure scores. See Appendix A for the full presentation of Measure Scoring results.

The Criterion Scores are multiplied by the Criterion Weights to arrive at the weighted Criterion Scores presented on the right-hand side of Figure 28. The 9 weighted Criterion Scores are summed and the result is a TBL Score for each alternative (see the three values in larger text on the right-hand side of the bottom grey row of Figure 28).

[76] The formulas used to calculate scores may be found in a separate Excel spreadsheet titled *MWMC-Temp_Mitigation-TBL_Score-032814*

Figure 28: Summary of Criterion Scores, Criterion Weights and TBL Scores, by alternative.

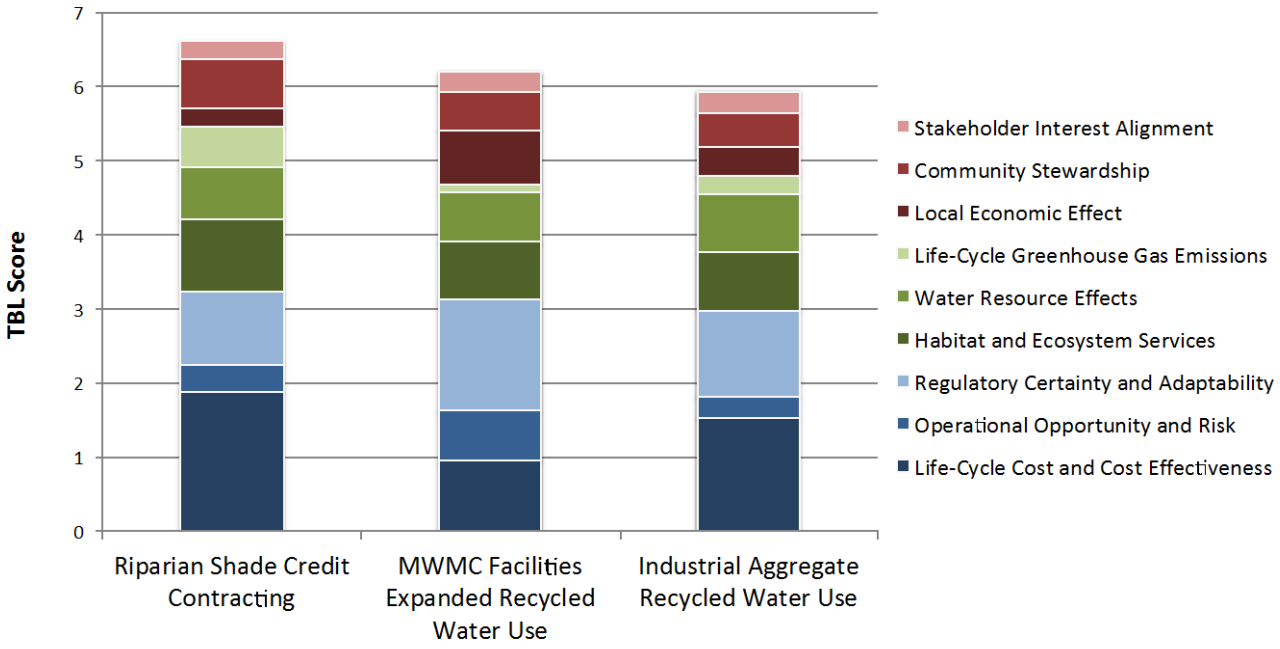
Triple Bottom Line (TBL) Categories / Criteria	Criterion Scores: Riparian Shade Credit Contracting	Criterion Scores: MWMC Facilities Expanded Recycled Water Use	Criterion Scores: Industrial Aggregate Recycled Water Use		Criteria Weights (%)		Weighted Criterion Scores: Riparian Shade Credit Contracting	Weighted Criterion Scores: MWMC Facilities Expanded Recycled Water Use	Weighted Criterion Scores: Industrial Aggregate Recycled Water Use
Economic Criterias					**48%**				
Life-Cycle Cost and Cost Effectiveness	10.0	5.0	8.1	X	19%	=	1.9	1.0	1.5
Operational Opportunity and Risk	3.8	7.0	3.0	X	10%	=	0.4	0.7	0.3
Regulatory Certainty and Adaptability	5.0	7.8	6.0	X	19%	=	1.0	1.5	1.2
Environmental Criterias					**30%**				
Habitat and Ecosystem Services	8.4	6.6	6.8	X	12%	=	1.0	0.8	0.8
Water Resource Effects	5.4	5.2	6.0	X	13%	=	0.7	0.7	0.8
Life-Cycle Greenhouse Gas Emissions	10.0	1.9	4.6	X	6%	=	0.6	0.1	0.3
Social Criterias					**22%**				
Local Economic Effect	3.0	9.0	4.8	X	8%	=	0.2	0.7	0.4
Community Stewardship	6.7	5.3	4.7	X	10%	=	0.7	0.5	0.5
Stakeholder Interest Alignment	6.4	6.8	7.3	X	4%	=	0.3	0.3	0.3
TBL Scores:					**100%**		**6.6**	**6.2**	**5.9**

Results of Scoring

The TBL Scores presented in tabular form in Figure 28 are presented in graphical form in Figure 29. Each stacked bar represents an alternative. Each stack within the bar represents a single Criterion. The colors of the bars are consistent with the rest of the report: Red (Social), Green (Environmental) and Blue (Economic). As can be seen, the Riparian Shade alternative has the highest TBL Score of the group, followed by the Recycled Water Use for Agricultural Irrigation, and finally Recycled Water Use for Industrial Aggregate Production.

These Scores do not represent a definitive answer to the question of which alternative is most advantageous as a thermal mitigation alternative. It is, however, a numeric summary of the available data combined with organization values, which could be used to provide direction. Figure 29 will be most useful when used in parallel with review of the raw data.

Figure 29: Comparison of TBL Scores by Alternative.



TBL Scoring Limitations

Scoring a TBL assessment of alternatives is a useful exercise - it provides a numeric summary and comparison for a set of Criteria that are difficult to compare in terms of units or intent. Another high value function of the scoring process is that it required participation by many individuals within the MWMC (including a variety of staff members and all commissioners), outside consultant experts and many external members of the community through project outreach (surveys and interviews). The internal portion of this process provided a "pilot project" for TBL within the MWMC and laid the groundwork for future use by establishing a draft process and a common understanding of the process and terminology.

There are also limitations, inherent to the TBL Scoring process that should be reconsidered prior to the next use of the next TBL by the MWMC.

- **Incomplete or unavailable data:** There are commonly data gaps for one or more alternatives for a single Criterion or Measure. This lack of data may warrant exclusion of the Criterion or Measure. If the decision is made to keep the Measure, even with the known data gap, the Project Team should be aware that scoring that Measure will be a unique challenge.
- **Mix of quantitative and qualitative data:** Those Criteria chosen as significant for the TBL assessment will have a mix of quantitative and qualitative data between Criteria and also potentially with a single Criterion.
- **Defining a scoring system:** Defining the system used to score the alternatives across various alternatives and Measures is a challenge. Measures with quantitative data are relatively easy to score compared to those with qualitative data. The scoring for each individual Measure will need to be discussed and method agreed upon during the Criterion Scoring process.
- **Scores are relative:** Scores are relative to alternatives considered, not absolute. Rescoring may be necessary if broadening the alternatives.
- **Transparency of results:** The resulting TBL score (see Figure 28) is built upon a complex series of decisions. Many decisions are made during the selection of the Criteria and Measures as well as in the scoring process. These decisions should be documented for full transparency and future reference.

7. SUGGESTIONS FOR IMPROVING THE TBL PROCESS

During the course of this TBL Assessment a number of potential improvements were identified that should be incorporated during future TBL Assessments conducted by the MWMC.

- Clearly define the question being assessed. If the purpose isn't clear it becomes very difficult to select effective and meaningful Criteria and Measures.
- Clearly define the alternatives. Limiting the alternatives or clearly defining all alternatives will provide clarity to the selection of Criteria, data inventory and final results.
- Keep the number of Criteria and Measures limited to only the most significant factors.
- Be as inclusive as possible within the organization during the Criteria and Measure selection process. The process used in for this assessment included MWMC staff, Kennedy/Jenks staff and Good Company. In the future, if possible, it is suggested that the selection of Criteria and Measures is discussed with commissioners as well as all managers who will be affected by the project as early in the process as possible. The success of a TBL assessment requires repeated, focused discussion by many, not subjective decision making by a few. If the results are to be valued by the organization, all relevant stakeholders should be given a voice in the process.
- Consider having staff complete the Criterion Weighting Survey in parallel with the commissioners. This would allow both staff and commissioners alike to gauge alignment on organization values.

APPENDIX A: DETAILS OF TECHNICAL SCORING SESSION

Triple Bottom Line (TBL) Criterion / Measure Description	Assign TBL Measure Points to Alternatives Riparian Shade Credit Contracting	MWMC Facilities Expanded Recycled Water Use	Industrial Aggregate Recycled Water Use	Discussion of Scores
Economic Aspects				
Life-Cycle Cost and Cost Effectiveness	10.0	5.0	8.1	
20-Year Net Present Value	*10.0*	*3.9*	*6.8*	Calculated. See E26-G26 for formula. Riparian Shade Credits have lowest cost of the group and therefore are assigned a score of 10. The other alternatives are proportionally assigned scores based on the delta between Riparian and the other alternative.
Cost Effectiveness	*10.0*	*6.2*	*9.3*	Calculated. See E27-G27 for formula. Riparian Shade Credits have lowest cost of the group and therefore are assigned a score of 10. The other alternatives are proportionally assigned scores based on the delta between Riparian and the other alternative.
Operational Opportunity and Risk	3.8	7.0	3.0	
Additional Recycled Water Storage Capacity	*0.0*	*10.0*	*0.0*	This measure is not directly applicable to Riparian Shade or the Outside-the-Fence alternatives; therefore the Inside-the-Fence recieves the highest possible score of 10 and the other alternatives recieve a score of 0 to reflect no addtional capacity. There is a possible future storage opportunity for Delta/Knife if Confluence Island or gravel pit became available.
Additional Recycled Water Conveyance Capacity	*0.0*	*7.0*	*5.0*	*Not applicable to Riparian Shade. No control / shared control over Delta/Knife capacity, but possible future opportunity for Delta/Knife conveyance infrastructure to be expanded for additional recycled water users. BMF/BRS offers some flexibility. Riparian scored a 0 to reflect no capacity, Inside-the-Fence scored a 7 to represent the increased operational flexibility the increased capacity provides. Outside-the-fence scored a neutral 5 to reflect infrastructure in conjunction with no / shared control over use of the conveyance infrastructure.*
Resilience to Seismic Event	*7.0*	*4.0*	*3.0*	*Riparian has no operational risk to MWMC. Alternatives with pipes and pumps comparitvely assume more risk. As green infrastructure, riparian restoration is most relilianct and therefore score a 7. Outside-the-fence scores the lowest at 3 as gray infrastructure located near the riverbank where soils are prone to liquification. Inside-the-fence score a 4 as grey infrastructure, but not along a riverbank.*
Other Significant Operational Opportunities or Risks	*8.0*	*7.0*	*4.0*	Riparian resporation contract externalizes most project related risks; operationally staff doesn't have to do anything. BMF/BRS has infrastructure in place highest operational opportunity but risk of possible maintenance failures. Delta/Knife has some infrastructure in place (pipe), additional experience gathered with recycled water; risk is change to MWMC business model - producing Class A water at a consistent quantity and any liability that may come with that could be significant; high risk with public perception if something goes wrong. If MWMC built a pump station in Delta/Knife vicinity staff would have the infrastructure to able to deliver RW from a different set of equipment through a different pipeline that has some T's and maybe have the capacity to send it somewhere else. Riparian shade is scored at 8 to represent externaliztion of risk. Inside-the-fence is scored at 7 to represent benefits of utilizing existing infrastructure and operationa benefits and opportunities. Outside-the-fence is scored at 4 to represent the risk associated with new operational model (i.e. suppling water to an externall business and liability for product quality)
Regulatory Certainty and Adaptability	5.0	7.8	6.0	
Decision-to-Project Implementation Period	*4.2*	*10.0*	*10.0*	Calculated. See E44-G44 for formula. Riparian Shade has the longest implementation period due to the time it takes to identify and contract with landowners and establish vegetation. The recycled water products have similar design and construction time periods.
Other Regulatory or Permitting Opportunities or Risks	*5.0*	*7.0*	*4.0*	Biocycle /BRS (Class D) not discharging into the river provides benefits for some of MWMC's permitting constituents; some risk in nitrate levels. Delta/Knife (Class A) same opportunity as Biocycle /BRS though larger in scale; risk is Delta/Knife River would probably need NPDES permit for thermal load, and WPCF compliance would be reliant on an external organization. Riparian shade offers no change from existing conditions.
Permitting Certainty and Potential Challenges	*4.0*	*8.0*	*4.0*	Permitting certainty high at Biocycle/BRS not changing the use of recycled water; just increasing irrigation volume. Riparian Shade is considered the most uncertain as EPA has not made a final decision on the use of trading credits combined with the precedent for Riparian Shade Credit permit challenge in Medford. DEQ could prescribe a regulatory compliance program strategy that requires Delta/Knife River to obtain a new NPDES permit.
Potential for Onsite Expandability to Meet Future Mitigation Needs	*7.0*	*6.0*	*6.0*	Riparian Shade restoration sites lend themselves to expansion - albeit at the same per credit cost. The thermal mitigation potential at Confluence Island at the Delta/Knife River site is considered equivalent to the potential for wetland construction at Biocycle / BRS.

Triple Bottom Line (TBL) Criterion / Measure Description	Assign TBL Measure Points to Alternatives Riparian Shade Credit Contracting	MWMC Facilities Expanded Recycled Water Use	Industrial Aggregate Recycled Water Use	Discussion of Scores
Environmental Aspects				
Habitat and Ecosystem Services	8.4	6.6	6.8	
Scale of Enhanced Riparian Habitat	*10.0*	*5.0*	*5.0*	Riparian Shade Credits offers a significant increase in enhanced riparian habitat. The two recycled water options are equal to existing conditions.
Soil Quality Effects	*8.0*	*6.0*	*5.0*	Riparian shade possible for benefits reducing compaction and improving health of soil as that land is brought back to a highly functioning riparian habitat. BMF/BRS RW would be offsetting chemical fertilizer use somewhat. Delta/Knife River would be equal to existing conditions.
Future Habitat and Ecosystem Opportunities	*9.0*	*7.0*	*7.0*	Riparian creates more habitat and the benfit of that habitat will expand as the restoration ages. Biocycle-BRS has potential for future wetland habitat. Likewise for the Delta-Knife site at Confluence Island.
Thermal Mitigation Potential	*6.4*	*8.3*	*10.0*	Calculated. See E75-75 for formula. Outsie-the-Fence has the greatest indexed thermal mitigation potential and therefore is assigned a score of 10. The other alternatives are proportionally assigned scores based on the delta between Outside-the-Fence and the other alternative.
Water Resource Effects	5.4	5.2	6.0	
Surface Water Quality Effects (other than thermal)	*7.0*	*6.0*	*8.0*	Quantifiable information on BMF/BRS and Delta/Knife River reductions; none on Riparian, but research on the subject indicates likely benefits for sediment and nitrogen removal. The difference between the recycled water alternative reflects the difference in annual onsite recycled water demand (i.e. greater demand at Delta/Knife River site compared to Biocycle/BRS). Riparian score was a semi-educated guess based on the scale of stream bank enhancement. Group thought this is highly imperfect exercise for this one measure.
Ground Water Quality Effects	*5.0*	*4.0*	*5.0*	BMF/BRS concerns about nitrates in groundwater management area. Chlorine impacts as Class A RW makes its way from Delta/Knife discharge very little impact once used for aggregate purposes before sending back into the river. No quantifiable information on Riparian.
Net Change to Willamette River Flow	*5.0*	*4.0*	*5.0*	Riparian is just shade and doesn't impact the river flow. BMF/BRS taking effluent currently discharged to the river and repurposing it at the facility for irrigation. Delta/Knife we are short circuiting the river instead of discharge going to the river gets pumped back out by Delta/Knife; MWMC just delivering to Delta/Knife and whatever happens to the water on that end is still whatever happens and basically no change.
Displacement of "Virgin" Surface or Groundwater Use	*5.0*	*6.0*	*7.0*	Displacement of what Delta/Knife is currently pumping out of the river with RW. BMF/BRS based on slight displacement of groundwater at the Biocycle/BRS site. Riparian Shade offers no advantage over existing conditions.
Future Aquifer or Stream Flow Augmentation Opportunities at Site	*5.0*	*6.0*	*5.0*	Increasing flow to the stream or discharging to an aquifer. BMF/BRS holds some opportunity, feasible or not is yet to be explored in much greater detail but plausible.
Lifecycle Greenhouse Gas Emissions	10.0	1.9	4.6	
20-Year Net Greenhouse Gas Emissions	*10.0*	*1.9*	*4.6*	Calculated. See Cells for Forumla. Riparian Shade Credits have lowest 20-year net GHG emissions of the group and therefore are assigned a score of 10. The other alternatives are proportionally assigned scores based on the difference between Riparian and the other alternative.

Triple Bottom Line (TBL) Criterion / Measure Description	Assign TBL Measure Points to Alternatives Riparian Shade Credit Contracting	MWMC Facilities Expanded Recycled Water Use	Industrial Aggregate Recycled Water Use	Discussion of Scores
Social Aspects				
Local Economic Effect	3.0	9.0	4.8	
Construction Jobs	3.1	10.0	5.5	Calculated. See E118-G118 for Forumla. Inside-the-Fence has the greatest creation of construction jobs and therefore are assigned a score of 10. The other alternatives are proportionally assigned scores based on the difference between Riparian and the other alternative.
Outside-the-Fence Potential Demand for Recycled Water	0.0	10.0	3.0	Calculated. See E119-G119 for Forumla. Inside-the-Fence has the greatest creation of construction jobs and therefore are assigned a score of 10. The other alternatives are proportionally assigned scores based on the difference between Riparian and the other alternative.
Change in Outside-the-Fence Profit or Cost Avoidance	6.0	7.0	6.0	Riparian could provide some benefit. BMF/BRS could increase crop rotation. Delta/Knife assumes some sort of savings in cost.
Community Stewardship	6.7	5.3	4.7	
Human Health and Safety	5.0	4.0	3.0	BMF/BRS risk is around a concern about over spray on food crops. Delta/Knife River concern is high particularly with the rock crusher. Riparian no risk.
Aesthetic Site Improvements	8.0	6.0	5.0	Riparian Shade offers the greatest aestetic benefit in terms of sclae of improvement, but the project will likey be on private land without public access. BMF/BRS may be greener but no public access or significant improvements.
Develops Capacity to Adapt to Climate Change	7.0	6.0	6.0	Riparian - more climate change provokes non-native plants to take over areas that aren't established with natives and enhanced soil infiltration provides flood control. These benefits were scored higher than the recycled water alternatives that provide a substitute source of water for our community in times of extreme drought.
Stakeholder Interest Alignment	6.4	6.8	7.3	
Potential Project Partnerships	*7.0*	*7.0*	*6.0*	Riparian partner with The Freshwater Trust or Long-Tom could be a vendosr for credits and a partner in this process. EWEB with drinking water protection plan. RW supports EWEBs water management conservation plan. If big RW user wants to play it could change the nature of the alternatives significantly. BMF/BRS existing relationship theoretically MWMC is providing an additional opportunity and more potential in water limited time, more acreage and tax lots within a mile of the pipeline. Delta/Knife and Riparian have more potential for partners that would be served.
Alignment with State and Local Plans and Goals	*6.0*	*6.0*	*6.0*	All three alternatives were found to be equivalent.
Alignment with Stakeholders	*6.2*	*7.3*	*10.0*	Calculated. See E138-G138 for Forumla. Outside-the-Fence was found to have the greatest alignment with stakeholders based on an indexed scoring methology for survey result and therefor is assigned a score of 10. The other alternatives are proportionally assigned scores based on the difference between Riparian and the other alternative.

Attachment 13 - Other: MWMC Environmental Review Checklist

MWMC Recycled Water Implementation Planning: Environmental Compliances Review Checklist

Compliance Driver	Required Actions	Reference Sources
REGULATORY ARENA: Comprehensive		
National Environmental Policy Act (NEPA) ☒ NEPA ☐ SERP ☐ State Agency ☐ Local Code	Purpose: "to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation." Trigger: Federally permitted or funded project. Requirement: Comprehensive review of project's environmental impacts. Could necessitate an *Environmental Assessment* and *Environmental Impact Statement* if *Categorical Exclusion* is not applicable. ☐ Complete all NEPA cross-cutting authorities (see compliances checked 'NEPA'). ☐ Determine if project would have adverse effects on or direct relationship to any of the following: o Public health or safety. o Unique geographic characteristics such as historic or cultural resources, park, recreation or refuge lands, wilderness areas, wild or scenic rivers, sole or principal drinking water aquifers, prime farmlands, wetlands, floodplains, or ecologically significant or critical areas. o Highly controversial environmental effects. o Highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks. o Set precedent or principle about future actions with potentially significant environmental effects. o Direct relationship to other actions with individually insignificant, but cumulatively significant environmental effects o Properties listed or eligible for listing on the National Register of Historic Places. o Species listed or proposed to be listed on the List of Endangered or Threatened Species or have adverse effects on designated Critical Habitat for these species. o Resources requiring compliance with Executive Order 11988 (Floodplain Management), Executive Order 119 90 (Protection of Wetlands), or the Fish and Wildlife Coordination Act. o Federal, State, local or tribal law or requirement imposed for the protection of the environment. o Disproportionate effect on low income or minority populations (Executive Order 12898). o Physical integrity of or ccess to Indian sacred sites on Federal lands (Executive Order 13007). o Introduction, continued existence, or spread of noxious weeds or non-native invasive species (Federal Noxious Weed Control Act and Executive Order 13112). ☐ Document request for Categorical Exclusion, if appropriate. ☐ If no CE, develop Environmental Assessment. ☐ If EA does not result in Finding of No Significant Impact (FONSI), develop Environmental Impact Statement. ☐ Procure Record of Decision (ROD) if CE or FONSI not obtained.	▪ SERP Manual (DEQ): Section 4

Compliance Driver	Required Actions	Reference Sources
REGULATORY ARENA: Discharge and Emissions		
Clean Air Act ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Trigger: creation of air emissions, including dust and odors Requirements: Any recycled water project will be covered in part under the wastewater treatment plant's air emissions permit via Lane Regional Air Protection Agency (LRAPA). ☐ Consult with LRAPA (as local proxy for DEQ authority) on project ☐ If project results in air emissions, issue Notice of Intent to Construct	▪ SERP Manual (DEQ): Section 3.8
NPDES/WPCF permit (DEQ) ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: The NPDES permit is a requirement of the Clean Water Act and Oregon law. DEQ has been given authority from the Environmental Protection Agency (EPA) to issue these permits. Trigger: NPDES permits are required for "point source" discharges of pollutants to surface waters. Requirements: The MWMC's current NPDES permit allows for recycled water use under an approved recycled water use plan (see Recycled Water Use Plan compliance). Depending on conceptual alternative water use and fate, coordination of additional NPDES/WPCF requirements may be required. ☐ Consult DEQ groundwater and surface water discharge compliance and permit writers.	▪ DEQ Website ▪ Oregon Guide to Permits ▪ DEQ IMD for Recycled Water Use
Recycled Water Use Plan (OAR 240-055) ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: to protect human health and the environment by ensuring recycled water is used in manner consistent with Oregon rules and regulations and approved by authorization agencies, including DEQ, OWRD, and DHS. Trigger: Use of recycled water for anything other than discharge and on-site landscape use as covered under existing NPDES permit. Requirements: A recycled water use plan describing the operational requirements and safeguards for industrial aggregate operation use of recycled water would need to be approved by DEQ and OWRD and incorporated into the MWMC's NPDES permit. ☐ Verify proposed use is consistent with recycled water use guidelines ☐ Evaluate proposed use site zoning requirements ☐ Identify distances to nearest properties, land uses, and wells, groundwater, and water supplies ☐ Identify site public access control needs, water application methods, and run off points ☐ Consult with DEQ recycled water use coordinators and permit writers.	▪ EPA Guidelines for Recycled Water Use ▪ DEQ IMD for Recycled Water Use ▪ OAR 240-055

Compliance Driver	Required Actions	Reference Sources
REGULATORY ARENA: Water Resources		
Safe Drinking Water Act (SDWA) ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: protect public water supplies from harmful contaminants. Trigger: Determination of direct or indirect groundwater discharge resulting from the project, and if the project is within vicinity of a sole source aquifer. The nearest sole source aquifer is in Florence. Requirements: ☑ NOT APPLICABLE – not within vicinity of a sole source aquifer	▪ SERP Manual (DEQ): Section 3.9
Clean Water Act ☒ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Trigger: Discharge of any pollutant from a point source into waters of the United States. Requirements: Ultimately, projects will comply with the CWA via NPDES and WPCF permits administered under state authority of the DEQ. Compliance with water quality standards and TMDLs promulgated under the CWA is done through the permitting system. There may be other CWA compliances associated with the construction of projects that would need to be considered. ☐ Determine if any CWA compliances other than NPDES permitting or Section 401/404 wetland impacts are required for the project (NPDES and Section 401/404 requirements are elsewhere on this checklist).	▪ See NPDES and Wetland compliances
Oregon Groundwater Quality Protection Act ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: The DEQ established the Southern Willamette Groundwater Management Area (GWMA) under the Act. Managed for nitrate contamination, primarily from agricultural sources; septic systems and wastewater treatment facilities are possible other sources. Nitrate concentrations are required to be below a 7 mg/L threshold to ensure attainment of the EPA action level of 10 mg/L to be protective of human health. Trigger: Potential impacts within the boundary of the GWMA, which extends southwestward to Prairie and Beacon Roads, thereby including the BRS. Operations near the boundary (such as Biocycle Farm) may also be considered for GWMA impacts. Requirements: ☐ Consult with Southern Willamette groundwater coordinator at DEQ.	▪ Website: gwma.oregonstate.edu

Compliance Driver	Required Actions	Reference Sources
Lane County Designated Groundwater Limited Area ☐ NEPA ☐ SERP ☐ State Agency ☒ Local Code	Purpose: prevention of water supplies being drawn from known groundwater quality limited supplies. Trigger: water withdrawal project in water quality limited area described in LC 13.010, including (a) River Road/Santa Clara area as defined by the Willamette River on the east, the Northwest Expressway on the west and south and Beacon Drive on the north for nitrate and biological contamination, and (b) the Junction City South area as defined by Junction City city limits on the north, Prairie Road on the west and Highway 99 on the east to the intersection with Prairie Road for nitrate and biological contamination. Requirements: ☑ NOT APPLICABLE – no proposed groundwater withdrawal as part of projects	▪ Lane County Planning Dept.
Oregon Water Rights Law ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: ensure sustained supplies for existing water users and to protect important natural resources. Trigger: new uses of water, abandonment of use, and interference of use. Requirements: Recycled water use must be managed to not interfere with water rights of downstream users. The Willamette River is under-allocated downstream of the McKenzie confluence and therefore no water right conflicts would exist. The Willamette River has an instream flow requirement between the Coast Fork and Middle Fork confluence and McKenzie-Willamette confluence. ☐ Determine changes to surface water discharges, withdrawals, and net flows. ☐ Determine potential impacts to existing water rights holders and instream flow rights. ☐ Consult with OWRD Watermaster, district 2.	▪ Guide: Water Rights in Oregon (OWRD, 2009). ▪ OWRD District 2 Watermaster
REGULATORY ARENA: Wetlands and Watersheds		
Protection of Wetlands (Executive Order 11990) ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands." Trigger: Relates to Section 404 of the CWA – remove/fill permits related to work in navigable waters/ waters of the United States. Requirements: ☐ Follow requirements of Section 404 of the Clean Water Act (see below).	▪ SERP Manual (DEQ): Section 3.2

Compliance Driver	Required Actions	Reference Sources
Clean Water Act Sections 401/404 ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: Ensure water quality protection of streams and wetlands (Section 401 certification). Prevent illicit discharges into wetlands, including dredge and fill material (Section 404 certification). Trigger: Requires project to be outside of known wetland resources. If project has potential to impact wetlands or potential wetlands, appropriate site identification and project mitigation must occur. Requirements: ☐ Identify if project is within existing construction footprint. ☐ Consult national and local wetland inventory maps. ☐ Consult with US Army Corps of Engineers for Remove/Fill permit requirements or approval of no-impact. ☐ Secure joint remove/fill permit (covering DSL and Army Corps compliances) if needed.	▪ SERP Manual (DEQ): Section 3.2
Oregon Removal/Fill Law (ORS 196.795-990) ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: prevent the extinction of imperiled plant and animal life, and secondly, to recover and maintain those populations by removing or lessening threats to their survival. Trigger: Activity in "waters of the state" including isolated wetlands, perennial streams, and "essential salmonids habitat," as well as navigable waters of the US. For most waters, a permit is required if a project will involve 50 cubic yards of fill and/or removal (cumulative) within the jurisdictional boundary. For activities in Essential Salmon Habitat streams, State Scenic Waterways and compensatory mitigation sites, a permit is required for any amount of removal or fill. Requirements: ☐ If project within existing construction footprint – no further action needed. ☐ Consult with wetland inventories. ☐ If project may impact wetlands, submit Wetland Determination Request form to DSL. ☐ Consult with DSL and local land use planners for special considerations.	▪ Oregon Guide to Permits ▪ DSL staff ▪ ODFW staff
Flood Plain Management (Executive Order 11988) ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "avoid impacts to floodplains and to avoid direct and indirect support of floodplain development to the extent practicable." Trigger: Federally permitted/funded project located with 500-year floodplain per Federal Emergency Management Agency (FEMA)'s Flood Insurance Rate Map (FIRM). Requirements: Document project location is outside of 500- and 100-year floodplains, *or* ensure project will not negatively impact floodplain. ☐ Review FEMA FIRMs ☐ If project outside 500-year floodplain, no further action. ☐ If project within 500-year floodplain, confirm any additional requirements. ☐ If project within 100-year floodplain, conduct Floodplain Assessment and submit alternatives/mitigation to DEQ for approval.	▪ SERP Manual (DEQ): Section 3.3

Compliance Driver	Required Actions	Reference Sources
Coastal Zone Management Act ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "Preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." Trigger: Project located within a state-designated Coastal Zone Management area. Requirements: Additional compliances if project is located in Oregon's Coastal Zone Management area (begins at the crest of the Coast Range and extends to the Pacific Ocean). All project alternatives are within the Willamette River basin and are therefore not within the coastal zone management area. ☑ NOT APPLICABLE – project area not within Coastal Zone Management area	▪ SERP Manual (DEQ): Section 3.5
Wild & Scenic Rivers Act ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations." Trigger: Project located within a Wild & Scenic River watershed. Requirements: The Willamette River in the project area is not a designated Wild & Scenic River. No further requirements. ☑ NOT APPLICABLE – only segments of the upper McKenzie River and North Fork Middle Fork Willamette River are designated as Wild & Scenic.	▪ SERP Manual (DEQ): Section 3.6
REGULATORY ARENA: Habitat & Wildlife		
Endangered Species Act (ESA) Sections 4(d), 7, and 9 ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: prevent the extinction of imperiled plant and animal life, and secondly, to recover and maintain those populations by removing or lessening threats to their survival. Trigger: Project activities within habitats of listed threatened or endangered species. Requirements: Evaluation of effects of a project in consultation with US Fish and Wildlife Service (FWS).Protected salmon species and endangered aquatic species may be present in the source water body, but not within the project footprint. Consultation with EPA is anticipated. ☐ Consult with ODFW, ONHIC, USFWS, and NMFS listings of potentially impacted plant and animal species. ☐ Confirm project activity will be minor requiring only informal consultation with agencies. ☐ Determine if project triggers need for a Biological Assessment (BA).	▪ SERP Manual (DEQ): Section 3.7 ▪ A Citizen's Guide to the 4(d) Rule for Threatened Salmon and Steelhead on the West Coast. ▪ Oregon Guide to Permits

Compliance Driver	Required Actions	Reference Sources
Bald and Golden Eagle Protection Act 16 U.S.C. 668-668d ☒ NEPA ☐ SERP ☐ State Agency ☐ Local Code	Purpose: prevent the taking or disturbance of bald and golden eagles. Trigger: activity or project near an eagle nest (whether active or inactive) or near an area where eagles roost or forage. Requirements: ☐ Consult with ODFW for potential presence of eagle habitat ☐ Complete an eagle non-purposeful take permit, if warranted	
Magnuson-Stevens Fishery Conservation and Management Act ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: to conserve and manage the fishery resources found off the coasts of the United States, and the anadromous species and Continental Shelf fishery resources of the United States. Trigger: potential impact on habitat of anadromous species (salmonids) Requirements: Protection of Essential Fish Habitat (EFH); ultimately EFH protection is at the root of the water quality objectives for recycled water uses to reduce effluent impact on the Willamette River. ☐ Consult with NOAA Fisheries/NMFS on project details and requirements ☐ Obtain letter of project approval or project requirements	▪ SERP Manual (DEQ): Section 3.7 ▪ NOAA Fisheries approval of West Bank Trail pipeline for recycled water use
Fish and Wildlife Coordination Act ☒ NEPA ☐ SERP ☐ State Agency ☐ Local Code	Purpose: the FWCA requires that wildlife conservation be given equal consideration to other features of water-resource development programs through planning, development, maintenance and coordination of wildlife conservation and rehabilitation. Trigger: federal nexus; NEPA compliance on water diversions or projects affecting water bodies. Requirements: Consultation with Fish and Wildlife Service.	
REGULATORY ARENA: Cultural Values		
Protection of Publicly Owned Historic Properties (ORS 358.653) ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: avoid inadvertent impacts to historic properties for which state agencies and political subdivisions are responsible. Trigger: State and local government construction/remodeling projects on historic properties greater than 50 years old. Superseded by NHPA Section 106 when there is a federal nexus. Requirements: ☐ Consult with SHPO if historical status is uncertain. ☐ Determine if building is listed or eligible for listing in the National Register of Historic Places. ☐ Determine if local historical commission or landmarks board involvement applies. ☐ Submit SHPO clearance form, including proposed project impact and all supporting maps, photos, and documents.	

Compliance Driver	Required Actions	Reference Sources
National Historic Preservation Act Section 106 Review **Archeological and Historic Preservation Act** (aka Archeological Recovery Act) ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "foster conditions under which our modern society and our prehistoric and historic resources can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations" (NHPA). Preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of construction or alteration of terrain. (AHPA). Trigger: Federally permitted or funded project undertakings that could impact historical properties. Requirements: avoid disturbing historical structures or cultural artifacts. Project either needs to be shown to not necessitate any land disturbance or impact on existing structures or to document that the project site is a previously disturbed, non-intact condition. If previously non-impacted, or identified resource, sites may be impacted, proper procedures must be followed. ☐ If project is within existing construction footprint, document. No further Section 106 consultation needed. ☐ Consult with SHPO for site inventories and particular requirements. ☐ Consult with local tribes (Siletz and Grande Ronde) for clearance of native American site impacts. ☐ Secure authorization and appropriate protective measures as required.	▪ SERP Manual (DEQ): Section 3.1
Protection of Publicly Owned Historic Properties (ORS 358.653) ☐ NEPA ☐ SERP ☒ State Agency ☐ Local Code	Purpose: avoid inadvertent impacts to historic properties for which state agencies and political subdivisions are responsible. Trigger: State and local government construction/remodeling projects on historic properties greater than 50 years old. Superseded by NHPA Section 106 when there is a federal nexus. Requirements: ☐ Consult with SHPO if historical status is uncertain. ☐ Determine if building is listed or eligible for listing in the National Register of Historic Places. ☐ Determine if local historical commission or landmarks board involvement applies. ☐ Submit SHPO clearance form, including proposed project impact and all supporting maps, photos, and documents.	
REGULATORY ARENA: Community Impacts		
Environmental Justice (Executive Order 12898) ☒ NEPA ☐ SERP ☐ State Agency ☐ Local Code	Purpose: identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority populations and low-income populations. Trigger: federal nexus Requirements: Requires assurance that project would not result in inordinate and inequitable environmental burden on disadvantaged communities. The project triple bottom line process should include metrics directly linked to this executive order.	

Compliance Driver	Required Actions	Reference Sources
REGULATORY ARENA: Land Use		
Farmland Protection Policy Act ☒ NEPA ☒ SERP ☐ State Agency ☐ Local Code	Purpose: "minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses." Trigger: federal nexus Requirement: Requires the project to be located outside of identified special farm use designations or be compatible with the farm use designation. ☐ Document if project is within existing construction footprint or city limits. No further action required if so. ☐ If project location is within UGB and is zoned EFU, apply for ORS 215 exclusion. ☐ Consult with NRCS or RLID maps to determine farmland designation of project ☐ Complete a Farmland Conversion Impact Rating Form (form AD-1006) and submit to NRCS.	▪ SERP Manual (DEQ): Section 3.4
Airport Vicinity District Zone Compliance ☐ NEPA ☐ SERP ☐ State Agency ☒ Local Code	Purpose: Ensure compatible land uses within the flight paths of commercial and private airports. Trigger: Project location within an airport vicinity district (the Biocycle Farm and BRS are within airport zone) Requirement: Proposed land use must comply with deemed acceptable uses within the zone. ☐ Refer to Lane County code for airport district requirements. ☐ Consult with Lane County planning department for site review and conditional use approval.	▪ Lane County Planning Dept. ▪ Lane County Code 10.201
Building Permit ☐ NEPA ☐ SERP ☐ State Agency ☒ Local Code	Purpose: protect public health, safety, and general welfare as they relate to the construction, operation, and occupancy of buildings and structures. Trigger: Any construction of new infrastructure, including upgrades of electrical, plumbing, mechanical, and other appurtenances. Requirements: Projects would take place in Lane County and within the City of Eugene, requiring both county and city building permit applications and approvals. ☐ Consult with local planning departments to determine necessary building permits	▪ City of Eugene Planning Dept. ▪ Lane County Planning Dept.

Compliance Driver	Required Actions	Reference Sources
Land Use Approval / Conditional Use Permit ☐ NEPA ☐ SERP ☒ State Agency ☒ Local Code	Purpose: Ensure that state agencies act in accordance with State land use planning goals and approved city and county comprehensive land use plans. Trigger: Application for a permit from a state agency. Requirements: A Land Use Compatibility Statement (LUCS) must be issued by the local planning authority working under authority of Department of Land Conservation and Development (DLCD). Revisiting and amendment of Conditional Use Permit and other land use permits may be required for both MWMC and Delta/Knife properties. However, project activities are believed to be covered under existing land use permits. ☐ Determine if project would result in any of the following: o increase population o increase traffic or change traffic patterns o increase noise or pollution problems close to residential areas o increase work shifts on nights or weekends, or o involve a physical expansion ☐ Determine applicability of any Lane County or Eugene codes, including all local land use zoning, riparian setbacks, and noise, odor, or similar requirements. ☐ Complete and submit a LUCS application to appropriate planning authority.	▪ City of Eugene Planning Dept. ▪ Lane County Planning Dept.