City of Dallas ➢ **Finance Department**

August 28, 2008

Mr. Bob Rice
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem OR 97301

RE: City of Dallas Aquifer Storage and Recovery Program Optimization/Expansion Studies

Dear Mr. Rice:

This letter confirms that the City of Dallas has allocated $50,400 for the ASR feasibility studies (BESST and conductivity surveys) in 2008 and that $25,000 has been allocated for further feasibility studies (proposed modeling work) in 2009.

Sincerely,

Marcia Baragary
Finance Director
City of Dallas

MB:pas

187 SE Court Street • Dallas, OR 97338 • Ph. 503-623-2338 • TDD 503-623-7355 • FAX 503-623-2339

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WATER RESOURCES DEPT
SALEM, OREGON

OREGON WATER RESOURCE DEPARTMENT
WATER CONSERVATON, REUSE AND STORAGE GRANT PROGRAM

I. Grant Information

Project Name: *City of Dallas Aquifer Storage and Recovery Program Optimization/Expansion Studies*

Type of Grant Requested: ☐ Water Conservation ☐ Reuse ☐ Above Ground Storage
☒ Storage Other Than Above-Ground [Including Aquifer Storage and Recovery (ASR)]

Program Funding Dollars Requested: $ 74,600 Total cost of planning study: $ 150,000
Note: Request may not exceed $500,000

II. Applicant Information

Applicant Name: ***Jerry Wyatt, City Manager***	**Co- Applicant Name:** *N/A*
Organization: *City of Dallas*	Organization:
Address *187 SE Court St*	Address:
Dallas, Oregon 97338	
Phone *503.831.3502*	Phone:
Fax: *503.623.2339*	Fax:
Email: *jerry.wyatt@ci.dallas.or.us*	Email:

Fiscal Officer Name: ***Marcia Baragary, Finance Director***	**Principle Contact:** ***Christy Ellis, Assistant Director***
Organization: *City of Dallas Finance Department*	Organization: *City of Dallas Public Works Dept.*
Address: *187 SE Court St*	Address *187 SE Court St*
Dallas, Oregon 97338	*Dallas, Oregon 97338*
Phone *503.831.3505*	Phone *503.831.3568*
Fax: *503.623.2339*	Fax: *503.623.2339*
Email: *marcia.baragary@ci.dallas.or.us*	Email: *christy.ellis@ci.dallas.or.us*

Certification:

I certify that this application is a true and accurate representation of the proposed work for a project planning study and that I am authorized to sign as the Applicant or Co-Applicant. By the following signature, the Applicant certifies that they are aware of the requirements of an Oregon Water Resources Department grant and are prepared to implement the project if awarded.

Applicant Signature: [signature] Date: 8/28/08

Print Name: Jerry Wyatt Title: City Manager

III. Planning Study Summary

Please give a brief summary of the planning study using no more than 150 words.

The City of Dallas is currently pilot testing a single-well 0.33-million gallon per day (MGD) ASR system utilizing the saline Siletz River Volcanics (SRV) as the receiving aquifer. During recharge of the ASR system, injected source water locally displaces saline groundwater in the aquifer. Early pilot testing results show that a fresh water storage zone can be developed in the SRV, confirm that potable water can be recovered from the system, and indicate recovery efficiency has increased over successive pilot testing cycles.

This feasibility study will use existing data sets to develop and calibrate operational models of aquifer geometry and dual-density flow characteristics in the SRV aquifer. These advanced numerical models will provide a technical basis for optimizing storage capacity and recovery efficiency from the City's existing ASR well and for decision making during expansion of the City's ASR program to meet their goal of a 1-MGD capacity ASR system.

IV. Grant Specifics

Section A. Common Criteria

Instructions: Answer all questions in this section by typing the answer below the question. It is anticipated that completed applications will result in additional pages.

1. Describe how the planning study will be performed. Include:

   a. A description of the planning schedule/timeline, which includes identifying all key tasks. (Section VI provides an opportunity for a "graphical" representation of the schedule.)

   The feasibility study proposed for funding with this grant will be composed of three key tasks; (1) advanced well testing analyses to define aquifer geometry and physical parameters, (2) numerical modeling of dual-density fluid flow in the fractured rock aquifer system in the vicinity of Dallas, and (3) reporting of feasibility study results (both a quarterly update and a final report as required by the grant agreement). We expect each task to require approximately two months work, resulting in a feasibility study that will be completed in approximately six months.

   b. When the planning study could begin.

   Work on the proposed planning study can begin as soon as grant funding is awarded and the Standard Grant Agreement is executed, which is estimated to occur in January 2009. All staff identified below are available to conduct the identified work beginning January 2009, and data necessary to perform the analyses described are currently available. Assuming the project is initiated in January 2009, the final report will be completed in July 2009.

2. Provide a description of the relevant professional qualifications and/or experience of the person(s) that will play key roles in performing the planning study. If the personnel have not been decided upon, include a description of the professional qualifications and/or experience of the person(s) you anticipate will play key roles in performing the planning study.

   The City of Dallas ASR program optimization and expansion feasibility study will be carried out by Golder Associates Inc. ***Phil Brown*** *will be the Project Manager of the study. Phil is a registered geologist (Oregon R.G. #1925) with 18 years of hydrogeologic consulting and project management experience and over 12 years of experience developing and delivering ASR projects, including the City's existing ASR system. Since 1995, Phil has focused on developing ASR and water supply projects in the Pacific Northwest, including the development of high-capacity basalt ASR/groundwater supply wells, wellfield capacity studies, aquifer recharge studies, artificial recharge feasibility studies, well performance evaluations, well interference analyses, and water quality evaluations. His specific area of technical expertise is designing and implementing ASR and other recharge projects for municipal and agricultural clients. Phil has managed these types of projects from conceptual design and project planning through pilot testing and program expansion.*

   Mark Wirganowicz *will coordinate the feasibility study and apply model results to help meet the goal of optimizing and/or expanding the City's ASR program to a 1-MGD system. Mark is a registered geologist (Oregon R.G. #1937) with 15 years of experience conducting hydrogeologic, geologic, and geotechnical assessments. His experience includes groundwater supply and development, Aquifer Storage & Recovery (ASR), hydrogeologic characterization, aquifer testing and analysis, hydrologic monitoring, water resource permitting, water quality evaluations, and groundwater flow and contaminant transport modeling. Mark is responsible for developing and delivering ASR and groundwater supply projects for public and private* *clients, and has broad experience designing and analyzing a variety of hydrogeologic assessments.*

***Tom Doe, Ph.D.**, will provide senior review of all work related to model development, validation, and final simulation results. Dr. Doe is a world recognized expert in subsurface flow and rock engineering applications in fractured rock masses, specializing in hydrogeologic characterization of fractured rock aquifers as part of the FracMan Technology Group. He has over 25 years of experience performing fractured rock investigations in the US, Japan, France, Sweden, and Switzerland. He applies his skills to assessment and simulation of fractured petroleum reservoirs, hydrogeologic assessments of landfills located on fractured basement rocks, and fracture flow studies for mine inflow and contaminant transport.*

***John Wozniewicz** will conduct Task 1 of the feasibility study, performing advanced well testing analyses to define aquifer geometry and hydraulic properties of the SRV aquifer utilized by the City's ASR system. John is a senior hydrogeologist with over 22 years of experience conducting aquifer characterizations through pumping test analyses. John specializes in using state of the art petroleum engineering analysis methods and software to interpret groundwater systems. Most recently John designed, supervised and interpreted pressure transient tests for injection pilot programs in conjunction with the Alberta Oil Sands Project in northern Canada. John has also supervised hydraulic characterization of fault zone hydrogeology at the Diavik Diamond Mine in the Northwest Territories, Canada.*

***Nicole DeNovio, Ph.D.**, will conduct Task 2 of the feasibility study, developing a numerical model of dual-density fluid flow in the fractured rock aquifer system in the vicinity of Dallas. Dr. DeNovio is a civil engineer and member of the FracMan Technology group with 10 years of numerical groundwater modeling experience. She specializes in water resources and water quality issues, with project experience including water supply, hydrologic assessment and modeling, groundwater modeling, and water quality contamination and transport. She develops groundwater flow and contaminant transport models and addresses surface water-groundwater interaction issues for clients such as small municipalities, the U.S. Department of Energy, public utilities, and private mining corporations.*

3. What local, state or federal project permitting requirements/issues do you anticipate in order for the planning study to be conducted?

    No local, state, or federal permitting requirements will be necessary for the planning study to be conducted. The study will use data collected by the City of Dallas over the past three years to evaluate methods to better utilize the storage capacity of saline fractured rock aquifers in western Oregon.

4. Are permits/governmental approvals required for the planning study? If yes, indicate whether you have obtained the necessary permits/governmental approval. If you have not obtained the necessary permits/governmental approval, describe the steps you have taken to obtain them.

    No permits or government approvals will be required for the planning study to be conducted. The study will use existing data collected by the City of Dallas over the past three years to evaluate methods to better utilize the storage capacity of saline fractured rock aquifers in western Oregon.

5. Describe your goal (which must be based on evaluating the feasibility of developing a water conservation, reuse or storage project) and how this study helps to achieve the goal.

    The City of Dallas is currently pilot testing a single-well 0.33-MGD ASR system utilizing the saline Siletz River Volcanics (SRV) as the receiving aquifer. During recharge of the ASR system, injected source water locally displaces naturally-occurring saline groundwater in the basalt aquifer. Pilot testing operations have been conducted over the past *three years to evaluate the efficiency and feasibility of recovering high-quality drinking water at the City's ASR facility. Pilot testing results show that a fresh water storage zone can be developed in the SRV, that potable water can be recovered from the system, and that recovery efficiency will increase over successive pilot testing cycles.*

Dallas is currently in the process of performing feasibility studies to identify the best means to optimize and/or expand their existing program to attain the City's goal of developing a 1-MGD ASR system (a goal established in the initial ASR feasibility study, Golder, 2005a). An expanded ASR system would take advantage of existing water rights for available winter stream flow in Rickreall Creek to store additional water underground, as well as increase the rate and volume of water recovered to augment the City's summer water supply. A 1-MGD ASR system would be capable of meeting 12% of the projected 2022 maximum day demand (8.63 MGD, CH2M Hill, 2002) and 27% of the projected 2022 average day demand (3.75 MGD, CH2M Hill, 2002).

The envisioned ASR system is a cost-effective water storage solution to meet future projected water demand without developing new surface water storage. ASR is also a low-impact and high-efficiency water storage approach as compared to surface water impoundment options, requiring a significantly smaller surface footprint and preventing the loss of stored water to evaporation.

ASR storage volume and recovery capacity is limited by a combination of low fracture permeability and complex density effects associated with the contrast between fresh and saline waters. Preliminary results from Year-3 pilot testing indicate that recovery efficiency improved by approximately 100% over Year-2 pilot testing, partially due to modification of operational parameters (Golder, in progress). Additional evaluation of fluid dynamics, hydraulic control, and fracture density distribution will allow the City to assess the best means to optimize the ASR system, and provide insight into how other systems may best be planned in western Oregon.

Phase 1 of the feasibility study (currently funded and in progress) was designed to identify variability in flow contribution and water quality with depth in the open borehole as a function of pumping or injection rate. A dynamic borehole survey technique developed by the USGS (Izbicki, 2005) was conducted at ASR No. 1 in July 2008. Preliminary results confirmed that ASR operations result in a density-driven stratification between lighter source water and heavier saline native water in the aquifer. Furthermore, recovered water quality has been shown to be strongly influenced by pumping rate, and resulting changes in the gravity balance affect the amount of saline water up-coning in the vicinity of the well. Up-coning of saline water increases mixing with injected source water in the borehole during recovery and adversely affects recovered water quality. Additional information on the nature and variability of the density stratification will be collected during a dynamic water quality profiling survey scheduled for September 2008. Phase 1 of the feasibility study will be concluded by December 2008.

Phase 2 of the feasibility study (for which this grant application seeks funding) will use existing information to develop and calibrate models of aquifer fracture geometry and dual-density flow characteristics. These advanced numerical methods (described in Section 6, below) will be used to evaluate approaches to optimize aquifer management and expand the City's system in a cost-effective and technically sound manner. The aquifer system beneath the City of Dallas is not unique; similar or identical conditions exist beneath the bulk of the western Willamette Valley and the Coast Range. The results of this feasibility study should provide an aquifer storage framework that will be transferrable to potential future projects by *providing a suite of recommended operational criteria for developing ASR projects in fractured saline aquifers.*

6. Describe the technical aspects of the planning study and why your approaches are appropriate for accomplishing the goal of the planning study.

Phase 2 of the feasibility study will provide a technical basis for optimizing aquifer storage and recovery in the saline SRV aquifer. The study is designed to define the aquifer geometry and the physics controlling injection and recovery of freshwater from the saline aquifer. This approach will provide both site-specific management information to meet the goal of developing a 1-MGD ASR system, as well as water-storage planning tools that may be used for developing ASR programs at similar sites.

Phase 2 will be conducted in two tasks. Task 1 will generate a geometric conceptual model of the SRV aquifer in the vicinity of ASR No. 1 using well tests and pressure response data collected during ASR pilot testing. Task 2 will build a numerical model of the target aquifer using the geometry and aquifer properties estimated from well test analyses, observations from ASR pilot testing cycles, and results of the Phase 1 analysis (described above). More detail is provided below:

Task 1

Task 1 will take advantage of advanced well test analysis codes developed for use in the oil and gas industry to define aquifer geometry in addition to aquifer hydraulic properties. Golder Associates has considerable expertise in applying petroleum engineering analysis methods and software, including Interpret-II and Saphir, to characterize subsurface fluid reservoirs (i.e., oil reservoirs and aquifer systems). The information developed in Task 1 will provide the conceptual model for Task 2 numerical modeling, and will produce data to facilitate optimization of ASR systems in the SRV aquifer and other similar sites.

Task 1 will analyze pressure derivative curves to evaluate aquifer shape, boundaries, and areal extent, all of which may be important aspects of ASR development in fractured rock systems. Geometric analysis will determine whether fault and fracture networks intersected by ASR No. 1 are planar, tabular, channelized, or part of a diffuse fractured system in an otherwise massive basalt unit. Boundary effect analysis will consider whether the aquifer is acting as a closed system, a system connected by faults to other permeable units, or a system with mixed physical and fluid boundaries.

Fluid boundary responses in well tests may occur in an aquifer containing fluids of contrasting properties, in this situation waters with different densities and viscosities due to variable concentrations of dissolved solids (salinity). Fluid boundary effects may change over time due to movement of interfaces between different water types during normal ASR operations at the Dallas site.

Task 1 will be approached in several steps. First, an initial geometric model will be developed based on analyses of individual well test cycles and ASR events. Observation well responses will be analyzed to provide measurements of diffusivity and storativity in the aquifer and provide a basis for calculating the volume and lateral extent of the aquifer. Existing data from nearly three years of ASR pilot testing and the results of Phase 1 of the feasibility study (described in the preceding section) will be used to ensure the model is consistent with observed conditions and measured data.

Deconvolution analysis will be performed with the developed model to interpret the entire test sequence. Deconvolution analysis is a modeling technique that allows conversion of *the entire ASR pilot testing sequence into an equivalent constant rate test, thereby allowing characterization of aquifer properties and geometry over larger stress periods as compared to analysis of individual operational phases.*

Task 1 analysis results will form the conceptual model and provide input parameters for numerical modeling in Task 2.

Task 2

Task 2 will develop a finite-element numerical model capable of addressing dual-density and temperature dependent fluid dynamics. The model will be used to assess the best approach or methods to help meet the goal of optimizing and/or expanding the City's ASR program to a 1-MGD system. Golder will test the potential for dual-intake systems, mutli-well hydraulic controls, and fracture-density enhancement as tools to enhance rates, storage volumes, and recovery efficiencies. These approaches and results may also be useful in developing cost/benefit profiles for future ASR projects in the SRV by providing a suite of recommended best management practices for developing and operating ASR projects in fractured saline aquifers to maximize recovery efficiency.

We expect to use the numerical code FEFLOW (Diersch, 2002) to construct the model. FEFLOW is a widely recognized finite element simulation package capable of representing the complex aquifer geometry and property distributions present in fracture networks more efficiently than finite difference codes such as MODFLOW (McDonald & Harbaugh, 1988). FEFLOW is also well adapted for simulations of systems that contain water with variable temperature and density properties.

The model will be constructed utilizing the geometry and aquifer parameter data compiled in Task 1. Existing data from nearly three years of ASR pilot testing and the results of Phase 1 of the feasibility study (described in the preceding section) will be used to ensure the model is consistent with observed conditions and measured data.

The FEFLOW model will be run to simulate development of a freshwater bubble and density-based stratification of fresh and saline water in the aquifer during ASR operations. Various injection and recovery schemes will be modeled to determine the optimal scenario for maximizing water storage and recovery efficiency. Ideal withdrawal rates and best management practices will be identified to optimize recovery of injected water while minimizing the upward coning of saline water during recovery.

Further simulations will be run to identify candidate locations for additional ASR wells, assess the potential to use dedicated recovery wells to optimize recovery efficiency, and assess potential impacts of ASR expansion on domestic water wells and surface flows from springs and rivers.

7. Describe the level of involvement, interest and/or commitment of different entities associated with the planning study (attach letters of support). Describe how these entities will benefit or be impacted by the planning study.

The Polk County Board of Commissioners is an interested party to this storage study (Letter of Support attached). This study is designed to result in the identification of best management practices for operating an ASR system in a low-permeability saline fractured rock aquifer. Much of the county is located above the saline Siletz River Volcanics (SRV) aquifer, and other communities and water districts in the county may wish to initiate an ASR project utilizing this aquifer in the future. Information generated during this planning study may be of use to other local or regional water providers that wish to develop ASR systems utilizing a low-permeability saline fractured rock aquifer for storage while minimizing the volume of native saline water captured during recovery.

☒ **Storage Other Than Above-Ground [Including Aquifer Storage and Recovery (ASR)]**

Please answer the following three questions **BEFORE** proceeding:

Will the project divert greater than 500 acre-feet of surface water annually? ☐ Yes ☒ No

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

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

If you answered "Yes" to any one of these questions, by signature on this application, you are committing to include the following elements in your planning study:

- **Analyses of by-pass, optimum peak, flushing and other ecological flows of the affected stream and the impact of the storage project on those flows;**
- **Comparative analyses of alternative means of supplying water, including but not limited to the costs and benefits of water conservation and efficiency alternatives and the extent to which long-term water supply needs may be met using those alternatives;**
- **Analyses of environmental harm or impacts from the proposed storage project;**
- **Evaluation of the need for and feasibility of using stored water to augment in-stream flows to conserve, maintain and enhance aquatic life, fish life and any other ecological values; and**
- **For a proposed storage project that is for municipal use, analysis of local and regional water demand and the proposed storage project's relationship to existing and planned water supply projects.**

Proceed in answering the following questions:

1. Water Conservation or Reuse projects that may result from this planning study are requested to be included in the Water Resources Department's "Inventory of Potential Conservation Opportunities". Though you may have already submitted this information earlier in the year through a separate survey, we ask that all applicants complete the information on the form provided at the end of this application.
   ☒ I have filled out the application or ☐ I have not filled out the application.

   The Inventory of Potential Conservation Opportunities application is attached to this grant form.

2. Describe the water supply need(s) that the project associated with the planning study is intended to meet. Applicant should reference supporting documentation that would be available upon request.

   The City of Dallas 2002 Water Master Plan indicates that the City has ample paper water rights from stream and reservoir sources (16.37 MGD total) to meet projected demand through the year 2022 (8.63 MGD maximum day demand,CH2M Hill, 2002). However, annual precipitation and the volume of water the City is able to store and release from the Mercer reservoir determines actual water available for diversion from the City's water intake. The potential for drought conditions and the active loss of reservoir capacity due to sedimentation create uncertainty for reliable future summer water supply.

   A viable ASR program for the City provides the means to store available winter stream flow from Rickreall Creek underground and augment the City's summer water supply. Dallas is working to develop a 1-MGD capacity ASR system as a cost-effective water storage solution to mitigate variability in annual precipitation and diminishing storage capacity in the Mercer Reservoir due to sediment buildup. Further, additional storage will allow the City to continue the practice of releasing water stored in the reservoir to maintain minimum flows in Rickreall

Creek (1.5-2.5 cfs) below the water intake during extreme low-flow periods (see section 5e below).

3. Explain how the project associated with the planning study will meet the water supply need(s), and indicate what percentage of that need will be met. (For example: If your water supply need is 20,000 acre-feet of additional water and the project will supply 10,000 additional acre-feet, 50% of your need will be met).

   The City's projected summer water supply need is variable based on changes in available water on an annual basis and the City's desire to maintain environmental flows in Rickreall Creek. Once the ASR system is built-out to the target capacity of 1-MGD, it will be capable of meeting 12% of the projected 2022 maximum day demand (8.63 MGD, CH2M Hill, 2002) and 27% of the projected 2022 average day demand (3.75 MGD, CH2M Hill, 2002). These values are percent total demand, as opposed to percent additional future need.

4. Present convincing argument that there are no other reasonably achievable alternatives that would be able to meet the water supply need(s). Applicant may reference supporting documentation that would be available upon request.

   Alternatives that have been considered for developing a more secure summer water supply include expanding Mercer Reservoir, building a second reservoir, and/or conveying water from the Willamette River. All three alternative options are cost prohibitive relative to ASR and entail uncertain permitting requirements that may not be attainable. Initial estimates indicate that expansion of the Mercer Reservoir or development of a new reservoir would require approximately $20-Million, which would have to be spent in just a few years time.

   Testing to-date indicates that ASR can be a viable and cost effective means to provide additional water storage for summer use without impounding additional surface water. Optimization and expansion of the existing ASR system to 1-MGD capacity is estimated to require approximately $3-Million to complete and can occur in small increments to spread the cost out over many years. Furthermore, water rights, pilot testing permits, and water treatment and conveyance infrastructure are already in place to support the construction and further pilot testing of an optimized and/or expanded ASR system utilizing the results of this proposed feasibility study.

5. Provide data and information on the associated project and the project's sources of water supply:
   a. The location of the associated project. (Include the basin, county, township, range and section.)

      The City's existing ASR project is located in the SE ¼ of the NE ¼ of Section 36, Township 7S, Range 6W, Willamette Meridian, located in the Willamette Basin, within Polk County.

   b. The name(s) and river mile(s) of the source water and what they are tributary to, if applicable.

      Source water is diverted from the City's existing intake structures located on Rickreall Creek, tributary to the Willamette River. The intake structure is located at approximately river mile (RM) 19.1.

   c. Water availability to meet project storage. (Typically, the Department evaluates new storage projects using a 50 percent water availability analysis.)

      Source water is diverted under existing water rights held by the City of Dallas, including Certificates 68474, 39181, and 38631. Water right priority dates for the listed certificates range between 1903 and 1967.

   d. Proposed purposes and uses of stored water.

      Stored water is used for Municipal supply purposes.

   e. Environmental flow needs and water quality requirements of source water.

There are no established instream flow requirements or reserved stream flow rates for Rickreall Creek, as reported by the Department's online Water Availability Reporting System.

Rickreall Creek is a listed 303d stream for temperature. The Environmental Quality Commission, based upon information provided by the Oregon Department of Fish and Wildlife, determined that Rickreall Creek was not salmon habitat and designated its use as "cool water." However, the cool water temperature criterion was not approved by USEPA, thus no temperature criterion currently exists for Rickreall Creek and a TMDL has not been set at this time (ODEQ, 2006).

Summer flow rate in Rickreall Creek is largely controlled by water releases from Mercer Reservoir, located at RM 23.6 near the headwaters of the creek. The dam provides water storage in the winter, and augments flow in Rickreall Creek in the summer and fall. During low flow periods, the City of Dallas adjusts the volume of water released from Mercer Reservoir, at a minimum, to match flows entering the reservoir. This practice ensures that flows in the individual streams entering the reservoir in excess of the City's water right are passed through below the City's water intake. During extreme low flow periods, when flow into the reservoir is less than the City's in-stream water right, it has been the City's practice to use water stored in the reservoir to maintain minimum flows (1.5-2.5 cfs) below the water intake (ODEQ, 2006).

f. Water quality, storage capacity, and geologic aspects of the associated aquifer(s) and/or recharge zones.

The City's ASR system utilizes the saline Siletz River Volcanics (SRV) basalt aquifer, a sequence of massive basalt, pillow basalt, tuff, volcanic materials, and sediments which underlie the Yamhill formation in the vicinity of Dallas and form topographic uplands surrounding Dallas to the west and north. Deep wells west of Dallas completed in the SRV encounter massive basalts where permeability associated with fracturing yields sufficient quantities of groundwater to support domestic and limited irrigation use. Logs of wells completed in SRV rocks indicate average specific capacity values between 1 and 2 gpm/foot of drawdown. However, wells with specific capacities greater than 7 gpm/ft of drawdown exist and are likely completed adjacent to significant faults or fracture zones.

The City's existing ASR well (ASR No. 1) has a specific capacity of approximately 1 gpm/ft, with the ability to recharge the SRV aquifer at approximately 165 gpm and store in excess of 52 million gallons (MG) over a 7 month recharge period. ASR No. 1 is capable of sustained recovery at 250 gpm, yielding approximately 0.33 MGD to the City's distribution system.

Native groundwater quality (measured before ASR pilot testing began) has a slightly alkaline pH, is slightly reducing, and is high in total dissolved solids (4,190 mg/L), dominantly calcium and chloride. The concentrations of most metals and nitrate/nitrite are below their respective detection limits.

During recharge of the ASR system, injected source water locally displaces naturally-occurring groundwater in the basalt aquifer. Pilot testing operations have been conducted over the past three years to evaluate the efficiency and feasibility of recovering high-quality drinking water at the City's ASR facility. Pilot testing results show that a fresh water storage zone can be developed in the SRV, that potable water can be recovered from the system, and that recovery efficiency has increased over successive pilot testing cycles. Dallas is currently *in the process of performing feasibility studies to identify the best means to further optimize and/or expand their existing ASR system.*

6. Provide a review of the local, state, and/or federal permitting requirements and issues posed by the implementation of the project associated with the planning study.

This study is designed to evaluate options for optimizing storage capacity and recovery efficiency from the City's existing ASR well and the best way to expand the City's existing ASR program. A new recovery well and/or ASR well may be installed according the findings of this planning study.

The Department of Human Services Drinking Water Program (DHS DWP) requires that municipal water providers submit a well installation plan for review and approval by DHS before installation of a new well. A plan detailing the proposed location and construction of any additional wells will be submitted in compliance with DHS requirements.

A detailed ASR feasibility study and pilot testing work plan for the City's existing ASR system were prepared in 2005 (Golder, 2005a and 2005b). The Department has reviewed and accepted the planning documents, and issued ASR Limited License #011 to permit ASR pilot testing through 2011. Additional pilot testing of any new wells associated with the City's ASR system will be conducted under the existing work plan and limited license. Two documents will be submitted to the Department in the event of expansion of the ASR system under Limited License #011:

1. *A letter to notify the Department of the City's intention to install and test additional well(s). This letter will outline the location and approach to construction of the well(s) and be submitted before drilling begins.*
2. *A technical report to describe the results of post-construction aquifer testing at the new well(s), provide revised estimates of well interference and storage capacity at the WTP site based on the results of aquifer testing, and provide recommendations for pilot testing and monitoring of the new well(s) on a combined wellfield basis (rather than identical monitoring at both the existing and the new well(s). This report will be composed and delivered after well installation and testing.*

References cited in this application, on file with the Department and/or available upon request:

CH2M Hill, 2002. City of Dallas Water Master Plan Update. June 2002.

Diersch, H.-J. G., 2002. "FEFLOW Reference Manual", Finite Element Subsurface Flow & Transport Simulation System, WASY Institute for Water Resource Planning and Systems Research Ltd., Berlin, 278 p.

Golder Associates Inc., 2005a. City of Dallas ASR Feasibility Study. April 2005.

Golder Associates Inc, 2005b. City of Dallas ASR Pilot Test Work Plan, December 2005.

Golder Associates Inc, in progress. Results from the Third Year of ASR Pilot Testing at the City of Dallas, Oregon. Submittal planned for February, 2009.

Izbicki, J.A., A.H. Christensen, M.W. Newhouse, G.A. Smith, and R.T. Hanson. 2005. Temporal Changes in the Vertical Distribution of Flow and Chloride in Deep Wells. Groundwater. Jul/Aug 2005, Vol. 43 No. 4 pp. 531-344.

McDonald, M.G., and Harbaugh, A.W., 1988, A modular three- dimensional finite-difference ground-water flow model: U.S. Geological Survey Techniques of Water-Resources Investigations, book 6, chap. A1, 586 p.

ODEQ, 2006. Willamette Basin TMDL, Chapter 7: Middle Willamette Subbasin. September 2006.

V. Match Funding Information

Applicants must demonstrate a minimum dollar-for-dollar match based on the total funding request. The match may include a) secured resources, b) previously expended resources, and/or c) pending resources. For secured funding, you must attach a letter of support from the match funding source that specially mentions the dollar amount shown in the "Amount/Dollar Value" column. For pending resources, documentation showing a request for the matching funds must accompany the application. For resources that have been previously expended, the expenditure must have occurred on or after July 1, 2005. Resources expended prior to July 1, 2005 are not eligible for match purposes.

The Type of matching funds may include:	The Status of matching funds may include:
• The value of in-kind labor, equipment rental and materials essential to the planning study provided by the applicant or partner*.	• Secured funding commitments from other sources.
• Cash is direct expenditures made in support of the planning study by the applicant.	• Associated and documented expenditures for the planning study from non-program sources incurred on or before July 1, 2005.
	• Pending commitments of funding from other sources. In such instances, Department funding will not be released prior to securing a commitment of the funds from other sources. Pending commitments of the funding must be secured within 12 months from the date of the award.

*"Partner" means a non-governmental or governmental person or entity that has committed funding, expertise, materials, labor, or other assistance to a proposed planning study. OAR 690-600-0010.

Match Funding Source (if in-kind, briefly describe the nature of the contribution)	**Type** (✓ One)	**Status** (✓ One)	**Amount/ Dollar Value**	**Date Match Funds Available** *(Month/Year)*
Funding for Phase 1 of current feasibility study (dynamic borehole surveys- funded and in progress).	☒ cash ☐ in kind	☒ secured ☒ expended ☐ pending	*$50,400*	*Secured funds for 2008, Approximately 81% spent to date*
Budgeted and secured funding for Phase 2 of current feasibility study (dual-density fractured rock aquifer numerical modeling – grant funding requested to complete).	☒ cash ☐ in kind	☒ secured ☐ expended ☐ pending	*$25,000*	*Budgeted funds for 2009, available 01/09*
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		
	☐ cash ☐ in kind	☐ secured ☐ expended ☐ pending		

VI. Project Planning Study Schedule

Estimated Project Duration: <u>January 2009</u> to <u>July 2009</u>

Place an "X" in the appropriate column to indicate when each element (key task) of the project will take place.

	2009				2010				2011
Project Planning Study Element (Key Tasks)	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**& Beyond**
Phase 1 Task 1: Dynamic borehole survey analysis (in-progress, began February 2008, to be completed December 2008)									
Phase 1, Task 2: Subcontracted borehole investigation (completed July 2008)									
Phase 2, Task 1: Define aquifer geometry and physical parameters	X								
Phase 2, Task 2: Numerical modeling	X	X							
Phase 2, Task 3: Reporting (quarterly progress and final reports)	X	X							

VII. Project Planning Study Budget

Section A

Please provide an estimated line item budget for the project planning study. An example would include: labor, materials, equipment, contractual services and administrative costs.

Line Items *Note: Administrative costs may not exceed 10% of the total funding requested by the Department.*	**Unit Number** *(e.g. # of hours)*	**Unit Cost** *(e.g. hourly rate)*	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
Feasibility study phase 1 (dynamic borehole survey analysis – funded and in progress, value is secured funds, approximately 60% spent to date)	*198 hrs*	*$120/hr*		*$23,700*		*$23,700*
Borehole survey (sub-contracted and completed)	*Lump Sum*	*$26,700*		*$26,700*		*$26,700*
Feasibility study phase 2 (dual-density fractured rock aquifer numerical modeling – grant funding requested to complete)	*586 hrs*	*$170/hr*		*$25,000*	*$74,600*	*$99,600*
Administrative Costs		*$0**				
		Total for Section A		*$75,400*	*$74,600*	*$150,000*
		Percentage for Section A		***50.3%***	***49.7%***	***100%***

**Note: A contract for consulting services between the City of Dallas and Golder Associates is currently in place. No additional administrative costs will be incurred to execute this feasibility study.*

Section B

If Grant amount requested is $50,000 or greater, you MUST complete Section B. Elements (key tasks) in Section B should be the same as the elements (key tasks) in Section VI (Project Planning Study Schedule).

Project Planning Study Element (Key Tasks)	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
Phase 1,Task 1: Dynamic borehole survey analysis (Labor)		*$23,700*	*$0*	*$23,700*
Phase 1, Task 2: Subcontracted borehole investigation		*$26,700*	*$0*	*$26,700*
Phase 2, Task 1: Define aquifer geometry and physical parameters		*$3,000*	*$9,000*	*$12,000*
Phase 2, Task 2: Numerical modeling		*$14,700*	*$43,900*	*$58,600*
Phase 2, Task 3: Reporting (quarterly progress and final reports)		*$7,300*	*$21,700*	*$29,000*
Total for Section B		*$75,400*	*$74,600*	*$150,000*

Totals in Section B must match the totals in Section A

Request to be added to the Oregon Water Resources Department's

Inventory of Potential Conservation Opportunities

The purpose of this inventory is to catalogue potential conservation projects that water users themselves have identified but not yet pursued because of financial, institutional, or other barriers. For the purpose of this application, water storage other than above-ground are included as conservation opportunities and are most likely capital conservation projects.

As a water provider or user, you know your water demands and water conservation opportunities better than anyone. We would appreciate your assistance with this important data collection effort by completing this survey. Your participation will help provide the building blocks we need to begin to identify and achieve potential future water supplies. Please answer the questions as completely as possible, to the best of your ability. We appreciate your help with this important effort.

This inventory of already-identified, potential conservation projects includes both capital and programmatic projects. Capital projects are defined as one-time, large investments resulting in water savings. Examples include reclaimed water plants, reservoir covering, transmission line upgrades reducing leaks, or industrial engineering modifications to re-use process water. Programmatic projects are defined as ongoing investments resulting in water savings. Examples include facilitating upgrades to more efficient water using devices (e.g., distributing free showerheads, toilet rebates) and distribution system leak detection programs. The conservation inventory is primarily intended to include "planned" projects rather than projects that are currently being implemented. However, currently active programmatic projects may be listed if they will continue or expand in future years. The inventory of projects submitted will be compiled by county or basin.

Examples are provided below.

	Example Capital Conservation Project	**Example Programmatic Conservation Project**
Project Description Provide brief sentence	Line 3 miles of unlined ditch.	Toilet rebate program for residential customers
Estimated Future Savings Provide brief sentence, including information regarding savings seasonality.	20 acre feet of water per year	If we spend our full budget each year, we estimate 50,000 gallons of water save per year
Seasonality Indicate what part of the year savings are generated (e.g. year-round; summer only; etc.).	Peak (irrigation) season savings.	Savings should occur throughout the year.
Estimated Future Costs Provide brief sentence.	$500,000 total project costs.	$40,000 a year.
Implementation Schedule Provide brief sentence.	Not set. Have conducted cost and savings estimate, but still seeking funding.	We started the program in 2005 and plan to implement until 2015.
Project Funded? Designate either "yes", "no", or provide brief sentence if necessary	No. Pursuing grant funding.	Yes. IN our CIP through the next 5 years.

To add a project to the inventory of potential conservation opportunities, please provide the following information for each conservation project.

This is a ☒ Capital Conservation Project ☐ Programmatic Conservation Project	
Project #/Name	**City of Dallas Aquifer Storage and Recovery Program**
Project Description	The City has developed an ASR system to help meet increasing water demand without developing a new water supply source.
Estimated Future Savings	Up to 1 MGD of water during summer months.
Seasonality	Summer months during high demand periods.
Estimated Future Costs	Approximately $3 Million for planning studies, installation of additional well(s) and infrastructure, and pilot testing.
Implementation Schedule	Active, expansion of the ASR program is under consideration.
What are the barriers to implementation, e.g. funding?	Uncertainty in receiving aquifer characteristics and the potential interaction of multiple ASR wells in a fractured rock system. Additional wells need to be carefully placed, designed, and managed to intercept permeability zones that have previously been developed for freshwater storage and recovery.

This is a ☐ Capital Conservation Project ☐ Programmatic Conservation Project	
Project #/Name	
Project Description	
Estimated Future Savings	
Seasonality	
Estimated Future Costs	
Implementation Schedule	
What are the barriers to implementation, e.g. funding?	

- Include this form with your application -

POLK COUNTY

BOARD OF COMMISSIONERS

POLK COUNTY COURTHOUSE ★ DALLAS, OREGON 97338-3174
503-623-8173 ★ FAX 503-623-0896

Commissioners
MIKE PROPES
TOM RITCHEY
RON DODGE

GREGORY P. HANSEN
Administrative Officer

August 26, 2008

City of Dallas Public Works Department
Attention: Jerry Wyatt, City Manager
187 SE Court St.
Dallas, Oregon 97338

RE: City of Dallas ASR Expansion/Optimization Feasibility Study Grant Application

Dear Mr. Wyatt:

The Polk County Board of Commissioners supports your application for a grant from the Water Conservation, Reuse, and Storage Grant program administered by the Oregon Water Resources Department. We understand the grant will be used to conduct studies to evaluate the potential to expand and optimize the City's underground storage project in the saline Siletz River Volcanic aquifer. The information you gather during this project may be of use to others in Polk County. This geologic unit is present under much of Polk County and the information generated during this planning study may assist other water providers in the county that might consider ASR projects utilizing similar aquifers in the future.

Sincerely,

Ron Dodge, Chair
Polk County Board of Commissioners