Summary of Attachments

LETTERS OF SUPPORT

1. Bridge Creek Ranch LLC (Robert Riecke) – Landowner/manager
2. The Freshwater Trust (Caylin Barter)
3. Wheeler County (Judge Patrick Perry, Commissioner Robert Ordway, Commissioner N. Lynn Morley)
4. Wheeler Soil and Water Conservation District (Judy Potter)
5. Confederated Tribes of the Warm Springs (Amy Charette)

MAPS

1. Location Map
2. Inundation Map
3. Painted Hills National Monument – Scenic Opportunities
4. Water Delivery Layout Map

DESIGN DOCUMENTS

1. Site Suitability Evaluation Report
2. Geotechnical Considerations
3. Breach Evaluation - Memorandum
4. Design Set

OTHERS

1. Budget
2. Communication with Affected Indian Tribes
3. Water Rights – Final Order
4. Thermal effects of cold water discharge from Painted Hills Reservoir into Bridge Creek - Memorandum

PAPÉ GROUP

January 8, 2016

Mr. Jon Unger

State of Oregon Water Resources Department

Re: Water Supply Development Grant Application –Painted Hills Reservoir Expansion

Dear Mr. Unger:

This letter is in support of the application referred to above.

By way of background, Bridge Creek Ranch LLC ("BCR"), applicant and landowner, had previously examined the feasibility of expanding the Painted Hills Reservoir but concluded that from a strictly financial basis, the cost of the expansion could not be justified and BCR ceased taking further action.

Establishment of the grant program has given new life to the abandoned reservoir expansion project.

We are aware of and agree to the Grant Proposal.

There are broad public economic benefits to this project in the form of short term increases in employment, additional recreational activity, reduction of energy use in BCR's farming activity, and increase in pastureland productivity.

Equally important are the positive environmental impacts in view of the consequences of climate change. With the release of water in-stream, water flows will increase and stream temperature will decrease, improving fish reproduction survival rates.

Lastly, there are cultural and social advantages in the form of additional wildlife, an enhanced scenic area, and protection of fish species important to local Native American tribes.

The award of the requested grant will enable BCR to proceed with its reservoir expansion and will accomplish the goals of the grant program.

We are excited about the possibilities that this project represents to the ranch, environment, and local community.

Very truly yours,

Robert J. Riecke
President of Papé Properties, Inc.
Sole Member of Bridge Creek Ranch LLC

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fax: 541-681-5333
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The Papé Group, Inc.
355 Goodpasture Island Rd., Eugene, OR 97401
PO Box 407, Eugene, OR 97440

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Papé Properties, Inc. | Papé Truck Leasing, Inc. | Papé Motive Power
Ditch Witch® Northwest, a Papé Company | Engineered Products, a Papé Company

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emeritus
Tim Boyle
Randy Labbe

January 14, 2016

Mr. Jon Unger, Program Coordinator
Water Conservation, Reuse, and Storage Grant Program
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

RE: Letter of Support for SB 839 Storage Grant Proposal to Augment Late-season Flows in Bear and Bridge Creeks

Dear Mr. Unger,

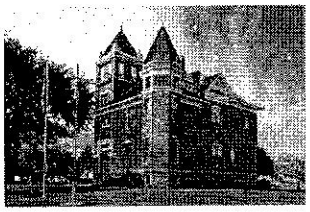
In December 2015, The Freshwater Trust was asked to review a potential water storage project involving the expansion of the Painted Hills Reservoir and the installation of a high-efficiency center pivot sprinkler in the Bridge Creek watershed in the lower John Day River Basin. By capturing high flows during a short window in early April, the proposed project aims both to increase reliability of irrigation water and to provide 125 AF of additional cool water to Bear and Bridge Creeks during mid-summer.

The Freshwater Trust has worked in the John Day River Basin for more than a decade to restore instream flows for the benefit of federally listed salmonids through voluntary water deals that improve landowners' ability to manage water. After reviewing project specifics and temperature models with the proponents and conferring with several local fisheries biologists, we believe the project could yield a net positive impact to local fisheries and agriculture. Importantly, increased springtime diversions are not expected to impact local fish populations, and summer releases of stored water could mitigate excessively high stream temperatures in Bridge Creek.

The Freshwater Trust supports this project because it better manages a limited water supply for ecological, economic, and social/cultural benefit.

Sincerely,

Caylin Barter
Flow Restoration Director



Wheeler County
County Court
PO Box 447 * Fossil * Oregon * 97830-0447
Wheeler County Courthouse * 701 Adams Street
Ph (541) 763-2912 * Fax (541) 763-4210 * www.wheelercountyoregon.com

January 6, 2015

Jon Unger
Water Resource Grant Administrator
Oregon Water Resource Department
725 Summer Street NE. Suite A
Salem, OR 97301

Subject: Support for the Bridge Creek Reservoir Application to the Water Supply Development Account, Senate Bill 839

Mr. Unger,

Wheeler County is a small, close-knit rural community with strong ties to the natural resources of the county through agriculture and tourism. The Bridge Creek Reservoir project will benefit both of these elements.

The Bridge Creek project will improve landowner's efficiency and overall production. This will help create a more sustainable agricultural business. It is important that the agricultural producers within the county work to improve their operational efficiency to remain viable over time.

The Bridge Creek project will also improve conditions at the Painted Hills National Monument. Bridge Creek flows along the proposed Sutton Mountain Wilderness area. Both areas are key tourism features of Wheeler County.

Below the project area, Bridge Creek flows through BLM lands. This provides the public with a wealth of recreational opportunities. Thousands of visitors flock to the Painted Hills National Monument each year. The improvements offered by the Bridge Creek project will be a benefit to these resources.

As representatives of Wheeler County, we feel this project will be an important piece to the local community and to the over-all health and viability of the county.

Sincerely,
Wheeler County Court

Patrick C Perry
Judge Patrick C. Perry

Robert L. Ordway
Commissioner Robert L. Ordway

N Lynn Morley
Commissioner N. Lynn Morley

WHEELER

SOIL & WATER CONSERVATION DISTRICT

January 17, 2016

Jon Unger
Water Resource Grant Administrator
Oregon Water Resource Department
725 Summer Street NE. Suite A
Salem, OR 97301

Subject: Support for the Painted Hills Reservoir Expansion Project

Mr. Unger,

I am writing on behalf of the Wheeler Soil and Water Conservation District (SWCD) to express our support for the Painted Hills Reservoir Expansion project. The Wheeler SWCD has been conducting restoration work in the Bridge Creek Watershed for nearly two decades and to date have leveraged several million dollars into the watershed and the local economy. We have seen the benefits to both the ecology and the economy from projects such as this represents.

Currently the Wheeler SWCD is wrapping up a multi-phase restoration project along Bridge and Bear Creeks on the Bridge Creek Ranch. This project has removed invasive Russian Olive, installed a stock water system, constructed a bridge to replace a ford crossing, installed several vertical post structures to aid in channel aggradations and floodplain reconnection, planted riparian tree species, and installed over 2.5 miles of riparian exclusion fence. Additionally, NOAA has completed a great deal of restoration work involving improved beaver habitat in the lower portion of Bridge Creek. Many populations of beavers are now present in this area and the program has been considered a success. All of this work will continue to improve the conditions for steelhead and Chinook as well as other fish and wildlife in the Bridge Creek ecosystem.

We feel strongly that the increased summer flows this project will create in lower Bridge Creek will be a tremendous benefit to all the work that has been done to date and will continue to be done into the future within this watershed.

Thank you for your consideration of this proposal and I would appreciate your support for the Painted Hills Reservoir Expansion project.

Sincerely,

Judy L. Potter

Judy L. Potter
District Manager

THE CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION OF OREGON

JOHN DAY BASIN OFFICE
320 W. Main Street
John Day, OR 97845
(541) 575-1866 phone
(541) 575-1869 fax

January 15, 2016

Jon Unger
Water Resource Grant Administrator
Oregon Water Resource Department
725 Summer Street NE. Suite A
Salem, OR 97301

Re: Support for the Painted Hills Reservoir Application to the Water Supply Development Account, Senate Bill 839

Mr. Unger,

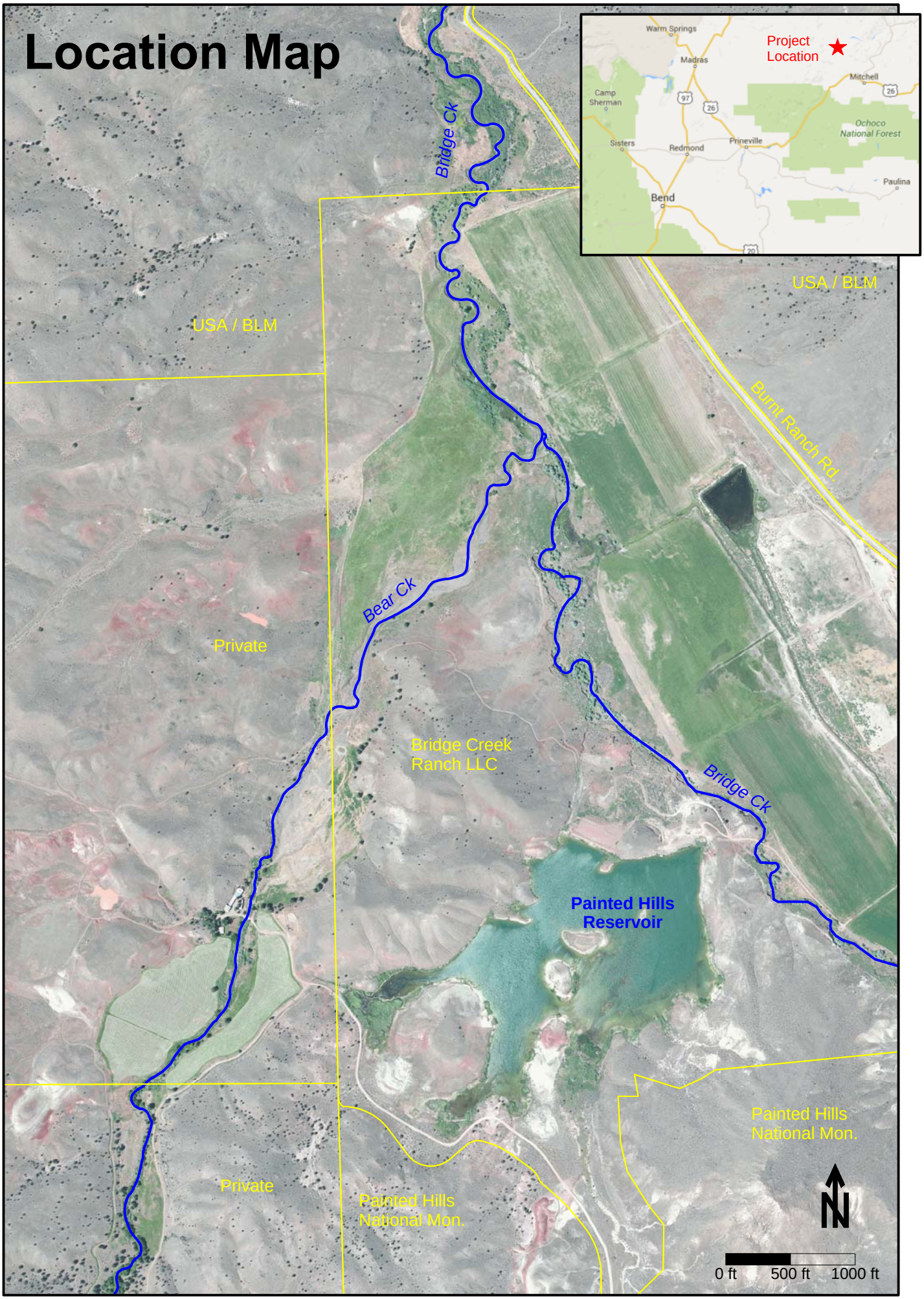
I am writing to express the Confederated Tribes of Warm Springs, John Day Basin Office's support for the Painted Hills Reservoir Application, with the understanding that the expanded reservoir includes the release of stored water back into the stream system during periods of low flow in the summer. As stated in the application, two of the primary limiting factors to fish recovery in the basin are flow and temperature. Release of the stored water back into the stream system could have a positive effect.

The John Day River basin, including Bridge Creek is within the Confederated Tribes of Warm Springs ceded lands and supporting projects that address limiting factors are an important part of maintaining cultural foods and fish populations. The mission of the CTWS Branch of Natural Resources Fisheries Department is to provide fisheries populations at harvestable levels for tribal members using information gained from research, management, production, and habitat programs while exercising our co-management authority across ceded lands and usual and accustomed stations

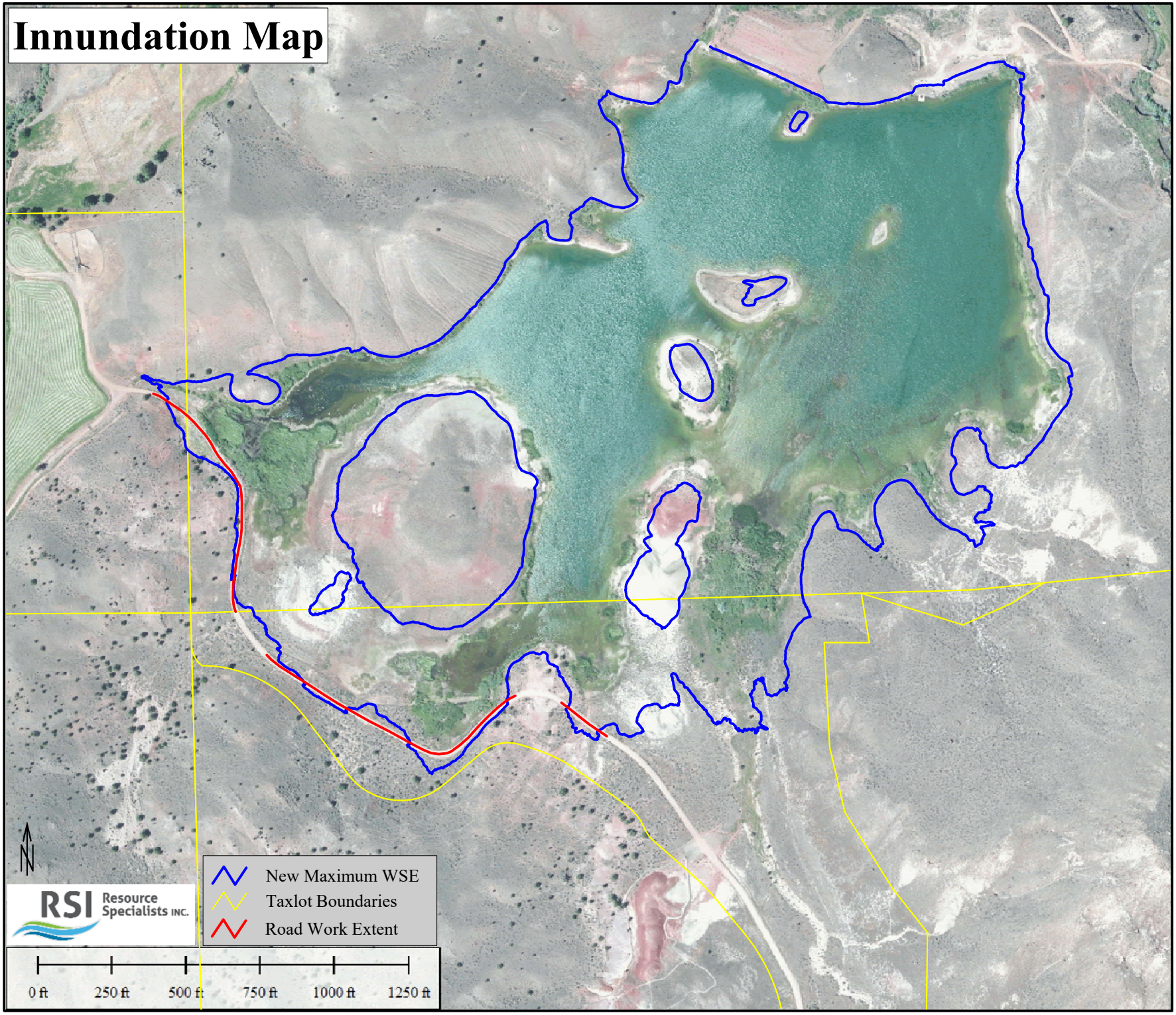
Sincerely,

Amy Charette
Watershed Restoration Coordinator
John Day Basin Office

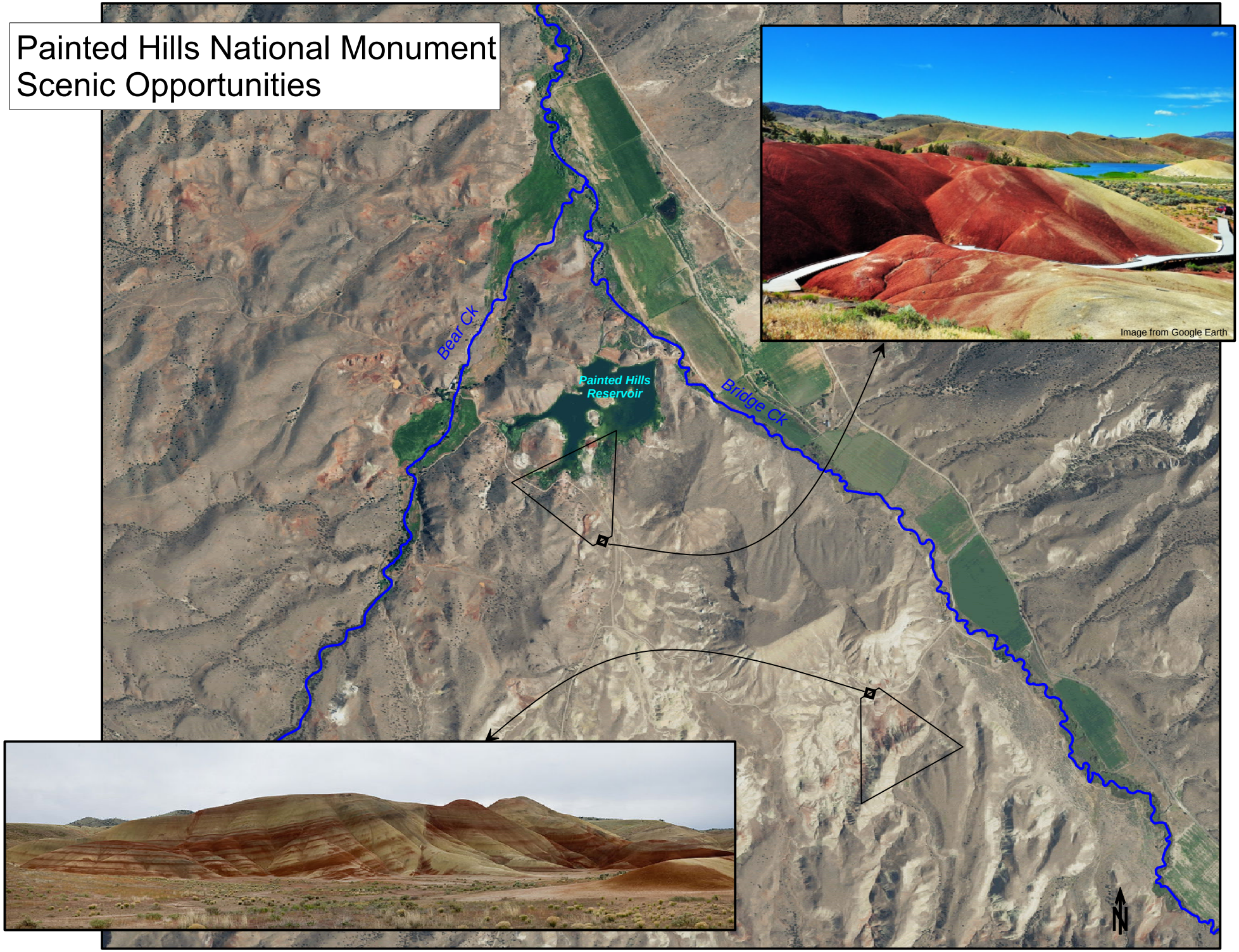
Location Map



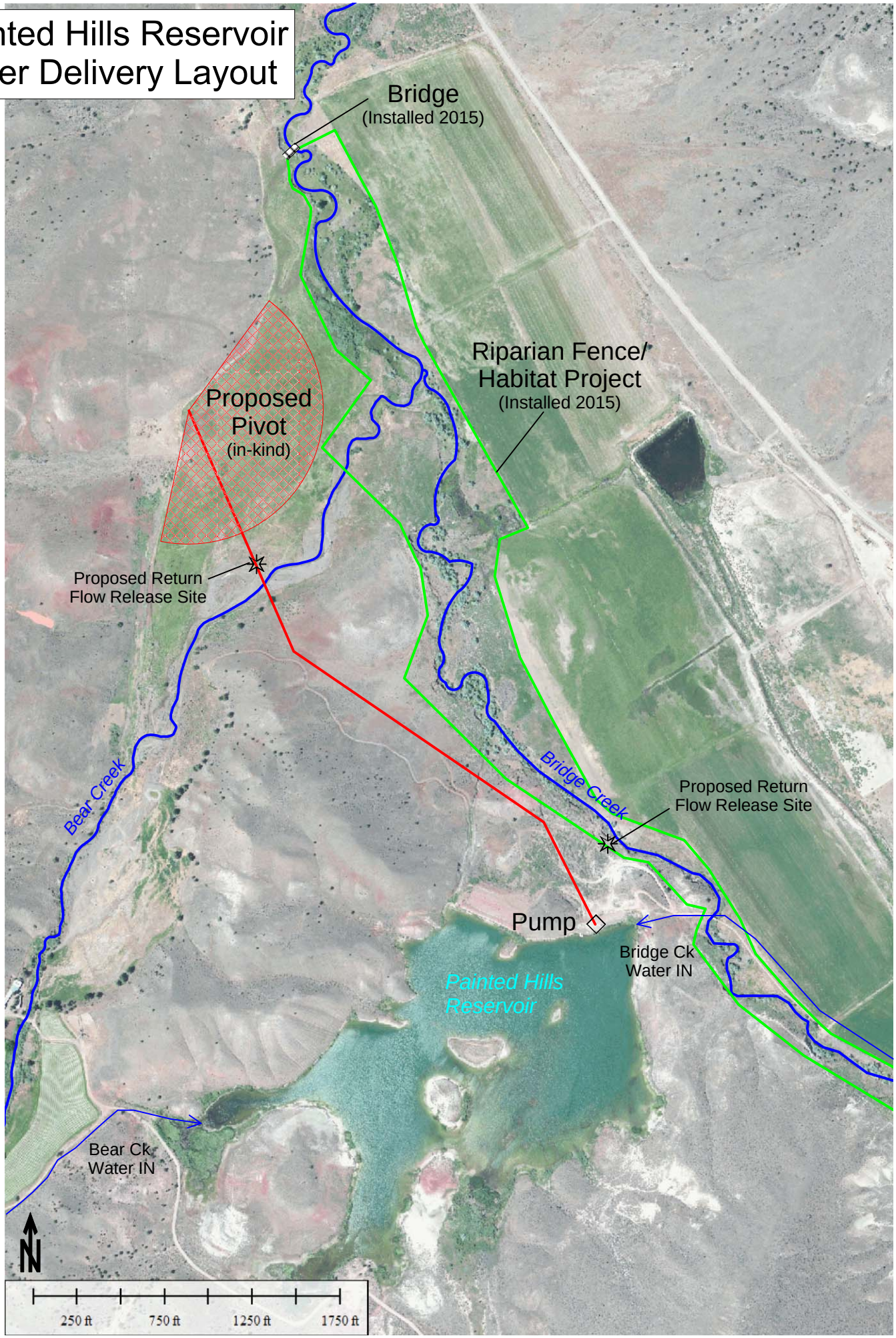
Innundation Map



Painted Hills National Monument Scenic Opportunities



Painted Hills Reservoir Water Delivery Layout



NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists

SITE SUITABILITY EVALUATION REPORT (Relative to Hydrology, Inflow Design Flood, Emergency Spillway Design, Stage and Storage Capacity Curve and Reservoir Outlet Works)

Painted Hills Reservoir
Application No. R-84459

Prepared for:

Robert Riecke
Bridge Creek Ranch, LLC
355 Good Pasture Island Road
Eugene, OR. 97401

Date: November 30, 2015

Project No.: 1139-102

SITE SUITABILITY EVALUATION REPORT

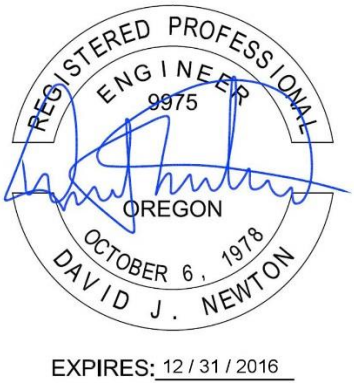
(RELATIVE TO HYDROLOGY, INFLOW DESIGN FLOOD, EMERGENCY SPILLWAY DESIGN, STAGE AND STORAGE CAPACITY CURVE AND RESERVOIR OUTLET WORKS)

PAINTED HILLS RESERVOIR - APPLICATION R-84459

BRIDGE CREEK RANCH, LLC

WHEELER COUNTY, OREGON

November 30, 2015



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Robert Riecke
Bridge Creek Ranch, LLC
355 Good Pasture Island Road
Eugene, Oregon 97401

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(RELATIVE TO HYDROLOGY, INFLOW DESIGN FLOOD, EMERGENCY SPILLWAY DESIGN, STAGE AND STORAGE CAPACITY CURVE AND RESERVOIR OUTLET WORKS)

PAINTED HILLS RESERVOIR - APPLICATION R-84459

BRIDGE CREEK RANCH, LLC

WHEELER COUNTY, OREGON

November 30, 2015

INTRODUCTION

This document was prepared by Newton Consultants, Inc. to describe hydrologic conditions, inflow design flood for design of the modified emergency spillway, the emergency spillway, stage and storage capacity curve, and the reservoir outlet works. This report is accompanied by construction drawings and specifications to raise the two existing dams, increase storage capacity in the Painted Hills Reservoir and modify the emergency spillway according to the new maximum water surface elevation. This report responds to certain of the criteria in OAR 690-020. Geotechnical considerations are addressed in a separate report entitled "Geotechnical Considerations, Construction to Raise Dam No. 1 (East Dam) and Dam No. 2 (West Dam), Painted Hills Reservoir, Application R-84459", dated November 30, 2015, which also accompanies the construction drawings and specifications for the proposed modifications.

PROJECT LOCATION

The existing Painted Hills Reservoir is located in the SW ¼ of Section 25, T10S, R20E, W.M. in Wheeler County, Oregon. The site is about 9.5 miles northwest of Mitchell, Oregon. The location of the Reservoir, Bridge Creek and Burnt Ranch Rd. are shown on Sheet 1 of the accompanying construction plans and specifications.

PROJECT DESCRIPTION

The Painted Hills Reservoir is an embankment dam which currently impounds 800 acre-feet and is to be raised an additional 6.2 feet to increase the maximum storage to 1330 acre-feet. The Reservoir is located 9.5 miles northwest of Mitchell, Oregon and 5 miles south (upstream) of the John Day River in the Bridge Creek drainage in the Painted Hills region of Wheeler County. The current surface area of the Reservoir comprises 65 acres. The Reservoir location is shown on Sheet 1.

The Reservoir is located in an off-channel situation relative to the nearby Bridge Creek and is supplied by pumping from nearby creeks and runoff from seasonal creeks in the drainage area above the Reservoir. Bridge Creek passes by the reservoir to the east, at a distance of about 400 feet from the reservoir at the closest point.

HYDROLOGY

Average Precipitation and Intensity Data

The Painted Hills Reservoir is located in the Bridge Creek drainage area component of the John Day River basin. Average annual precipitation for the general area is approximately 20 inches (ODOT Hydraulics Manual 2014). Precipitation in the area is generally more predominant during winter and spring, although the area is subject to local thunderstorm activity that can occur during summer.

Drainage Area Contributing to Dam

The drainage area upstream of the Reservoir covers approximately 4717 acres (7.37 square miles). The drainage area contributing to the Reservoir is shown with U.S. Geological Survey topography on Sheet 3.

The elevation range for the drainage area is about 1850 feet to about 4000 feet at the highest elevation of the drainage divide. The Reservoir is located in relatively open terrain, vegetated by scattered juniper, sagebrush and grasses.

INFLOW DESIGN FLOOD

Bridge Creek enters the John Day River at a location about 5 miles downstream of the Reservoir. It is a well-defined channel with a relatively large cross sectional area.

No structures were observed through evaluation of 2014 Google Earth imagery on Bridge Creek or between the Reservoir and the John Day River. An unpaved road (Burnt Ranch Rd.) follows Bridge Creek from the Reservoir to the John Day River.

Inflow Design Flood for Painted Hills Reservoir

The inflow design flood for the drainage area that contributes to the Reservoir was estimated at 70 cfs. This is the 1,000 year recurrence event interpolated from statistical data in the area generated by the OWRD Peak Discharge Estimation Mapping Tool available on the OWRD website. The output from this tool provides estimated discharges for a location by outlining the upstream drainage area which drains to that point. An equation for the region is computed using certain variable characteristics for that drainage area considering the highest flow season. Much of Eastern Oregon is ungauged by the USGS and available estimation means are of a generalized form such as the empirical equations used by this OWRD tool. The research and equations are described in “Estimation of Peak Discharges for Rural, Unregulated Streams in Eastern Oregon” (Cooper, 2006).

The characteristics of this drainage region are beyond the desired requirements for the aforementioned equation; this does not discredit the validity of the results but requires further investigation. The results report from OWRD that the mean January precipitation for the

watershed is lower than modeled for by 0.2 inches. It shows as well that the mean January temperature is 1.7 degrees higher and soils depth to bedrock is over 6 inches deeper than the ideal bounds determined by the research for this equation. All of these variables (3/5 possible bounds) affect the results in such a way as to make the prediction more conservative.
The peak discharge results from using the OWRD online tool have likely provided an over estimated flow for this drainage area. Lower January temperature could affect stored snow in the area and snow melt mixed with rain is a concern for flooding in the region. Lower precipitation values can only indicate that less moisture is available for runoff and a greater soil depth could be interpreted as improved absorption capability in the drainage area.

EMERGENCY SPILLWAY

The general cross-section and path of the existing spillway are illustrated on Sheets 4 and 7 of the accompanying construction drawings and specifications. The improved spillway crest is illustrated on Sheet 8 of the construction drawings.

Hydraulic analysis of the emergency spillway using the Manning Equation was conducted to evaluate its capacity to pass the inflow design flood of 70 cfs. The hydraulic analysis indicates that the spillway can pass the inflow design flood with approximately 0.9 feet of height at a velocity under 2.7 ft/s. Analysis of the improved spillway crest indicates that it can pass the flood flow at a velocity of about 3.3 ft/s and depth of 0.7 ft but maintain 4 feet of freeboard if the spillway improvement does not function as designed. At normal water level, the freeboard will be 6 ft.

The spillway crest improvement is modeled as a sharp crested weir and designed for ease of install in a remote location. There will be an energy dissipation pool on the downstream side of the crest and rip rap sized to the maximum possible velocity experienced by the water during free fall.

STAGE AND STORAGE CAPACITY CURVE

A complete survey of the Reservoir and dams was finished in 2001 by Bussard Engineering, LLC. It includes an ‘area and capacity curve’ for estimating the surface area of the water related to depth and volume of water. This is the reference for all data regarding the impounded water and increased dam height estimates. The stage and storage capacity curve for the reservoir is shown on Sheet 5 of the construction drawings and specifications and includes the proposed storage increase.

RESERVOIR OUTLET WORKS

Existing Outlet Works

The reservoir can be drained through an 18-inch diameter snap-tight dam conduit provided by Isco Industries, Inc. that was installed in 1999 to replace the original 18-inch diameter CMP pipe. The new outlet pipe was installed approximately 115 feet westerly of the original pipe and was encased in concrete. The pipe length is 154 feet with an outfall elevation of 1860.5 feet. The top of pipe elevation at the inlet is 1863.5 feet. The elevation drop over the pipe length is approximately 3 feet.

NEWTON
CONSULTANTS INC.
Earth, Water and Rock Specialists

GEOTECHNICAL CONSIDERATIONS
Construction To Raise Dam No. 1 (East Dam) and Dam No. 2 (West Dam)

Painted Hills Reservoir
Application No. R-84459

Prepared for:

Robert Riecke
Bridge Creek Ranch, LLC
355 Good Pasture Island Road
Eugene, OR. 97401

Date: November 30, 2015

Project No.: 1139-102

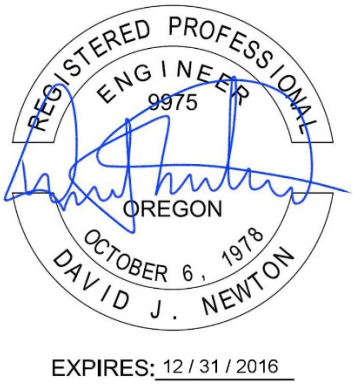
GEOTECHNICAL CONSIDERATIONS

CONSTRUCTION TO RAISE DAM NO. 1 (EAST DAM) AND DAM NO. 2 (WEST DAM)

PAINTED HILLS RESERVOIR

APPLICATION 84459

November 30, 2015



Prepared For:

Robert Riecke
Bridge Creek Ranch, LLC
355 Good Pasture Island Road
Eugene, Oregon 97401

Project: 1139-102

GEOTECHNICAL CONSIDERATIONS

CONSTRUCTION TO RAISE DAM NO. 1 (EAST DAM) AND DAM NO. 2 (WEST DAM)

PAINTED HILLS RESERVOIR

APPLICATION 84459

November 30, 2015

PROJECT DESCRIPTION

Project Background

The Painted Hills Reservoir is located in Section 25, T10S, R20E, W.M., Wheeler County, Oregon as shown on Figure 1 (Vicinity Map). The site is located 9.5 miles northwest of Mitchell, Oregon and 4.5 miles south (upstream) of the John Day River in the Bridge Creek drainage. The Painted Hills Reservoir was constructed in the early 1980's and can store 310 acre-feet of water under Certificate 68551 and 410 acre-feet under Certificate 68553. The proposed improvements to which this report applies are to increase the storage capacity by 530 acre-feet to a total impoundment of 1330 acre-feet. The water right allows up to 2050 acre-feet under Permit R-84459 and the owner has chosen to limit storage at that amount.

The reservoir is created by two existing earth dams separated by a ridge of natural ground. Dam No. 1 (the East Dam) is located on the east side of this ridge and Dam No. 2 (the West Dam) is located on the west side of this ridge. The height of the original dams ranged between approximately 27 to 35 feet. The configuration of the existing dams is shown on Figure 2 (Dam & Reservoir Configuration).

The original two dams were constructed in 1978-79 in accordance with plans and specifications prepared by Century West Engineering Corporation (CWEC). Planning and design of the original two dams anticipated future raising of both dams to increase storage capacity in stages after the two initial dams were built. Accordingly, the relatively wide top width of both dams was constructed to allow construction of additional engineered fill embankments thereon to raise the height of the dams and increase storage capacity.

The first construction to increase the height of both dams was completed in 1984. This improvement increased the storage capacity by 490 acre-feet (Permit R-67960), bringing total storage capacity to 800 acre-feet. The configuration of the dams after this work was suitable for an additional increase in dam height and storage. The configuration of the dam cross-section resulting from the 1984 improvements is illustrated on Figure 3.

Application R-84459 was filed with the Oregon Water Resources Department to obtain a permit for storing an additional 1250 acre-feet of water in addition to the authorized storage of 800 acre-feet. The Final Order was issued by the OWRD with the condition that construction plans and

specifications must be submitted to the OWRD-Dam Safety Division within 60 days after the date of OWRD approval of the Final Order. Several time extensions were requested, and granted by the OWRD. This report and the accompanying construction plans and specifications are intended to implement the storage increase and respond to the permit conditions.

Project Description

The project includes raising the existing Dam No. 1 (East Dam) and Dam No. 2 (West Dam) and improving the emergency spillway. The project objective is to increase storage capacity of the Painted Hills Reservoir from the current capacity of 800 acre-feet to 1330 acre-feet, an increase of 530 acre-feet.

Both of the existing dams will be raised by approximately 2.8 feet above the top of the existing embankment added to the dams during the first raise in 1984. The planned increase in dam height is consistent with the intent of the original owner and is consistent with the original design intent. The proposed configuration of the dams for this current increase in storage capacity is illustrated on Figure 4. Provisions for construction of the additional engineered fill embankment to raise both dams are included in the construction drawings and specifications that accompany this report.

The Painted Hills Reservoir includes an emergency spillway that was excavated into natural ground to the west of the Dam No. 2 (West Dam) as shown on Figure 2 (Dam & Reservoir Configuration). The spillway inlet is also shown with the dam profile on Figure 5 (Profiles – Dam No. 1 and Dam No. 2). The spillway entrance will be reconstructed to provide a new control section at an elevation of 1888 feet. This elevation corresponds to the maximum reservoir water surface elevation necessary to store the additional volume of 530 acre-feet. Provisions for construction of the spillway improvements to increase storage capacity and respond to the updated flow capacity requirements are included in the construction drawings and specifications that accompany this report.

PURPOSE OF REPORT

This report is consistent with the requirements of OAR 690-020-0036 and is intended to document site suitability, project feasibility and the basis for design of the proposed improvements to raise the dams and upgrade the emergency spillway.

GENERAL AND LOCAL GEOLOGY & GEOMORPHOLOGY

The two dams and the reservoir are located in an area underlain by sedimentary and volcanic materials of the John Day Formation. The general geologic setting of the site is shown on Figure 6 (Geologic Setting). The age of the Formation is thought to extend from the lower Miocene, Oligocene to the uppermost Eocene, over a time span of about 39 million to 18 million years. Formation materials in the site area consist primarily of weathered volcanic ash and tuffaceous materials. Weathering has resulted in a dominance of clay in these materials.

Site reconnaissance and review of aerial imagery (Google Earth) reveal no evidence of landslides or major lineaments which could reflect faulting in the area of the two dams and reservoir.

Geomorphic conditions include a project setting in topography with elevated terrain and ridges that have been rounded to a relatively smooth and "soft" configuration through weathering and erosion of the volcanic ash materials over geologic time. Steep, high escarpments are absent from immediate the dam and reservoir site area.

The reservoir is located in a localized basin area to the west of Bridge Creek. The principal drainage in the area is Bridge Creek which passes to the east of the two dams and the reservoir to its confluence with the John Day River about 4.5 miles to the north. The dams do not cross Bridge Creek. The horizontal distance between the reservoir and Bridge Creek at the closest point is approximately 400 feet.

SUBSURFACE INVESTIGATION

The original design and construction of the two dams was based on raising the dam and increasing storage after the initial construction of the dams and reservoir. Accordingly, provisions were included for additional embankment loading.

The original design was based on subsurface and reconnaissance investigations conducted at that time. Since original construction and the first raise of the dams in 1984, the dams have functioned with no slumping of upstream or downstream embankment slopes, obvious and significant settlements, or seepage from the downstream toe or abutments. Based on original engineering work and performance of the two dams, subsurface investigations relative to the proposed additional dam raise and spillway upgrades were not conducted. Site reconnaissance work to observe the two dams in their present condition and for engineering geology purposes was conducted for purposes of the proposed dam raise and spillway upgrades.

Soil samples representative of the material for use in constructing the proposed embankments to raise the dams were obtained and tested for maximum dry density and optimum moisture content (ASTM D-698), Atterberg Limits and grain size distribution.

SOIL AND OR ROCK EVALUATION

Existing Dam Embankments – Configuration & Estimated Hydraulic Gradients

Dam No. 1 (East Dam) and Dam No. 2 (West Dam) were designed and built with a relatively wide base. The distance between upstream toe and downstream toe of Dam No. 1 at the location of the outlet pipe is approximately 310 feet with a dam height of approximately 40 feet for the initial construction as shown on Figure 3 (Cross-Section – Dam No. 1). The same dimensions for Dam No. 2 cross-section after original construction are base width of approximately 335 feet and height of approximately 35 feet as shown on Figure 4 (Cross-Section – Dam No. 2). The raise of both dams in 1984 made no change in the base width of the dam and increased the dam height of approximately 7 feet (see Figures 3 and 4).

The base width – height configuration of the existing dams is important relative to hydraulic gradients through the dam and related seepage and piping potential. For Dam No. 1 at the section through the outlet pipe location (estimated maximum section), the basic estimated hydraulic

gradient for the original construction condition, including the 1984 dam raise, was about 0.13. The hydraulic gradient at this same section through Dam No. 1 will increase to about 0.17 for the proposed dam raise.

For Dam No. 2 at the section shown on Figure 4, the basic estimated hydraulic gradient for the original construction condition, including the 1984 dam raise, was about 0.13. The hydraulic gradient at this same section through Dam No. 2 will increase to about 0.17, similar to the estimated gradient for the section through Dam No. 1.

The estimated hydraulic gradients are relatively low for both dams and the proposed dam raise. Accordingly, the potential for piping is also relatively low under these estimated gradients. Both dams were designed and constructed with toe drains (toe filters as shown on Figure 3 and 4).

Proposed Embankment Fill to Raise Dams

The configuration of the proposed embankment fill to raise Dam No. 1 and Dam No. 2 is shown on Figure 3 and 4. The proposed embankment fill will cap the top of the 1984 embankment fill, at an approximate elevation of 1,891.2 feet, and raise the top of the dams to a new elevation of approximately 1,894.0 feet. The total vertical height increase is about 2.8 feet.

The proposed new embankment fill will extend the existing upstream slope of both dams upward at a slope angle of 3 horizontal to 1 to the new top of the dams at elevation 1,894.0 feet. The resulting top width of the elevated part of the dams will be 30 feet, which is ample for potential maintenance and repair work.

Borrow Areas

The borrow areas planned as a source for the embankment soils to raise Dam No. 1 and Dam No. 2 are located at the top of the downstream slope for each dam. These locations are shown on Figures 3 and 4. These soils were used to construct the embankments for both dams, functioning without sloughing or deteriorated performance and demonstrating they are suitable for use to raise both dams to the lines and grades shown on the accompanying construction drawings.

Soil Laboratory Testing

Samples intended to represent soil materials for use in constructing the proposed embankment to raise the dams were obtained from proposed borrow areas. The samples were tested in a certified materials testing laboratory (Wallace Group, Bend, Oregon) for maximum dry density and optimum moisture content (ASTM D-698), Atterberg Limits and grain size distribution. The Atterberg Limits and grain size analysis provide the basis for classification of the sampled soils in accordance with the Unified Soil Classification System. The test results are summarized below:

SAMPLE	LOCATION	TEST	TEST RESULT
BA-2	In-Place Fill, Existing Dam	Max Density	101.6 pcf
		Opt. Moisture	21.6%
		% Finer 200 Sieve	54.7%
		Liquid Limit	46
		Plastic Limit	21
		Plasticity Index	25
		USCS Classification	Sandy Clay (CL)
DE-1	In-Place Fill, Existing Dam	Max Density	81.8 pcf
		Opt. Moisture	31.5%
		% Finer 200 Sieve	72.1%
		Liquid Limit	63
		Plastic Limit	40
		Plasticity Index	23
		USCS Classification	Sandy Silt (MH)
		MH is typical of volcanic ash	

Permeability

The fines content including clays) of the samples and the grain size distribution reduce the permeability of the materials to very low values. Permeability of the lean clay (CL) sample is likely to fall in the range of 0.001 to 0.0001 feet per day (Cedergren, Harry R., Seepage Drainage and Flow Nets, 1977, John Wiley and Sons). Permeability of the elastic silt (MH) samples could be in the range of 0.001 to 0.01 feet per day.

Susceptibility of Soils to Piping

The two soil samples from the proposed borrow areas were tested to determine their Atterberg Limits. These test results indicate the degree of plasticity of the samples and they can be used as an indication of their resistance to piping.

The Plasticity Index (PI) of the samples is 25 for sample BA-2 and 23 for sample DE-1. Soils with the greatest piping resistance are shown to be plastic clays with PI greater than 15 *(FERC Engineering Guidelines, Risk-Informed Decision Making, Chapter R10, Internal Erosion and Piping, Draft).* The sample BA-2 classifies as a low-plasticity, low-compressibility sandy lean clay (CL) and the sample DE-1 classifies as high-plasticity, highly compressible elastic silt (MH). Although sample DE-1 is an elastic silty, it is highly plastic with relatively high resistance to piping. The relatively high plasticity of both samples also suggests they have relatively low susceptibility to cracking within the embankment due to settlement.

With the proposed configuration of the embankment fill to raise the dams as shown on Figures 3 and 4, and the proposed increase in maximum reservoir water surface elevation of 6.2 feet, piping potential is a relatively low-risk design and construction criteria for the proposed raising of the Dam No. 1 and Dam No. 2. However, the soils used to construct the existing dam embankments consist of clayey and silty soils with significant plasticity, which are dominant in the site area, suggesting that susceptibility of the existing embankment soils is generally low.

Compressibility

Compressibility characteristics of the soil samples range from low to high based on the Atterberg Limits test results. The liquid limit (LL) for sample BA-2 is 46, below the LL = 50 threshold above which soils are considered highly compressible. The LL for sample DE-1 is 63, which is consistent with highly compressible soils. Since the two samples are from the existing embankment, it is anticipated that they provide some representation of performance since the original dams were constructed. Although a topographic survey of the dam to determine degree of settlement was not performed, evidence was not observed that shows embankment settlements have been significant or they had an adverse impact on performance of the existing dams.

Placement of the soils from the proposed borrow areas on the dam in relatively thin lifts compacted with a sheepsfoot roller will reduce compressibility and potential for significant post-construction settlements. The maximum vertical thickness of the proposed fill to raise the dams is approximately 12 feet. Both dams will be raised to a maximum embankment elevation of 1894.0 feet. The maximum reservoir water surface elevation will increase to approximately 1888.0 feet, resulting in freeboard of 6 feet.

Settlement of the existing dam embankment fill under the proposed new embankment fill loads was evaluated with respect to the existing 18-inch diameter CMP outlet pipe passing through the bottom part of the Dam No. 1 and the 24-inch welded steel pipe (3/16-inch wall) for the pump sump system. Potential settlements of existing fill at the pipe depths could range approximately between 2 and 2.5 inches based on consideration of density, void ratio and compression index. Initial void ratios were calculated with assumed specific gravity values for the soils and densities assumed at 95 percent compaction based on the maximum density values for each sample. Compression Index (Cc) values were based on the Liquid Limit (LL) of the soil samples and the relationship $Cc = 0.007(LL - 10)$ for remolded soils (placed and compacted in the fill embankment).

Shear Strength

The engineering characteristics of the soil samples reflected by laboratory tests were utilized to evaluate strength parameters of the soil. Strength parameters relative to shear were evaluated by comparing the plasticity characteristics of the lean clay (CL) with published correlations testing for undrained shear testing and correlations between shear strength parameters of cohesion, angle of internal friction and plasticity characteristics. Published data for elastic silts (MH) revealed higher values of cohesion and angle of internal friction than for the lean clay (CL); therefore, the lean clay (CL) was picked as the soil for use in evaluating stability of the upstream slopes of the two dams under the relatively modest additional fill loads.

Shear testing of lean clay (CL) samples under consolidated-undrained conditions conducted through two different research efforts revealed a range of values for cohesion and internal friction angle. The first testing effort (Establishing the Correlation of Shear Strengths Between Consolidated-Undrained and Consolidated-Drained Triaxial Tests of Soft Clay, Tran Xuan Tho Thanh Long, Nguyen Le Du, May 31, 2011) resulted in the range of cohesion and internal friction angles summarized below:

SAMPLE	COHESION (PSF)	INTERNAL FRICTION ANGLE (DEGREES)
1	371	26
2	320	22
3	236	26
4	374	25

The second testing effort (Correlation of the Undrained Shear Strength and Plasticity Index of Tropical Clays, Obasi, N. L., and Anyaegbunam, A. J., Nigerian Journal of Technology, Vol. 24, No. 2, September 2005) resulted in the range of cohesion and internal friction angles summarized below:

SAMPLE	COHESION (PSF)	ANGLE OF INTERNAL FRICTION (DEGREES)
1 Secretariat Complex, Owerri	585	25
2 Eastern Highway By-pass, Port Harcourt	689	24
3 Eziorsu Bridge Site	1566	15
4 Federal School of Arts & Science, Aba	835	18

The third testing effort (Obasi, Anyaegbunam, 2005) on lean clay (CL) consisted of undrained shear tests under varying minor principal stress conditions along with Atterberg Limits determinations for the tested samples. The results summarized below for undrained strength (cohesion) are based on a minor principal stress of 1462 psf. The estimated minor principal stress for an element of soil in the approximate potential failure zone near the base of the dam is 1020 psf. Although the minor principal stress for the undrained test conditions is about 43 percent higher than the estimated value for the soil element in the dam, the results are informative in regard to ranges of cohesion and relationships to Plasticity Index.

SAMPLE	COHESION (PSF)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)
1	1888	44.0	18.5
2	1564	41.0	19.0
3	1583	48.0	20.0
4	1510	45.0	22.0
5	1483	45.0	24.0

The Liquid Limit for the lean clay (CL) from the proposed Painted Hill Reservoir borrow sites is 46 percent. The Plasticity Index for the soil sample is 25 percent.

Slope Stability

The fill embankments for Dam No. 1 and Dam No. 2 were designed and constructed with an upstream slope angle of 3 horizontal to 1 vertical. The height of the originally constructed upstream embankment slopes ranges from about 27 to 35 feet. Both dams were raised in 1984 by placement of a new fill berms on top of the dams as shown on the attached Figures __ and __.

The new berm raised the top of Dam No. 1 from its original elevation of approximately 1884.5 feet up to an approximate elevation of 1891.2 feet, a raise of approximately 6.7 feet. The new

berm raised the top of Dam No. 2 from its original elevation of approximately 1884.5 feet up to an approximate elevation of 1891.2 feet, a raise of approximately 6.7 feet.

The proposed additional raising of the Dam No. 1 and Dam No. 2 will increase the height to the top of the dam by 2.8 feet on both dams. The raising of the dams will be accomplished by placement of a 2.8-feet thick engineered fill cap on top of the "berms" placed in 1984. Engineered fill will also be placed against the upstream side of the 1984 "berm" on Dam No. 1, extending the existing upstream slope upward to match the existing slope angle of 3 horizontal to 1 vertical. The configuration of the proposed raise of Dam No. 1 is shown on Figure 3.

Engineered fill will be placed against the downstream side of the 1984 "berm" on Dam No. 2 as shown on Figure 4.

The proposed upstream slope configuration was evaluated for stability relative to deep-seated failure potential. Shear strength parameters for evaluation of stability for the upstream slopes of Dam No. 1 and Dam No. 2 were selected from the above ranges of undrained shear tests with the lowest results (the first testing effort). As such, cohesion was taken at 236 psf and internal friction angle was taken at 26 degrees. Stability evaluation was for the total height of the 3 horizontal to 1 upstream slope resulting from the proposed raising of the dams. The resulting safety factor against deep-seated slope failure under undrained conditions is at least 1.4 based on use of the lowest cohesion and internal friction values for above testing efforts.

SITE PREPARATION CRITERIA

Additional engineered fill will be placed on a relatively narrow area of the top of each dam, against the existing "berms" constructed in 1984 for the initial dam raising operation. The configuration of the proposed additional fill is shown on Figures 3 through 6. The ground surface in the area to receive additional fill supports a thin cover of grass, some sage brush and rabbit brush. Otherwise, the ground surface is relatively free of an organic topsoil layer.

The ground surface in the areas to receive fill shall be stripped of all existing vegetation and the stripped vegetation shall be removed from the site and disposed of in a suitable location. The stripped ground surface in the area to receive fill shall be excavated to form a "key" as shown on the accompanying construction drawings. The bottom of the "key" shall be scarified to a minimum depth of 6 inches, brought to the optimum moisture content plus 3 percent, and then compacted to 95 percent of the maximum dry density in accordance with ASTM D-698 prior to placement of any fill thereon.

Fill soils from the designated borrow areas shall be placed in uncompacted lifts of 6 inches or less in thickness, brought to a moisture content of optimum plus 3 percent, and then compacted to at least 95 percent of the maximum dry density in accordance with ASTM D-698.

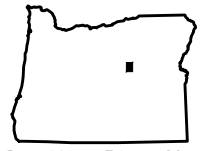
It is recommended that the soils in the borrow areas be scarified, moistened and mixed prior to their placement in the proposed fill areas in order to improve consistency and uniformity of moisture throughout the soils.

Prior to placement of new fill soils against the fill slopes of the existing 1984 “berms”, the existing fill slopes shall be benched by cutting horizontally into the slope at least 5 feet, resulting in a vertical cut wall. When new fill reaches the top of the vertical cut wall, a new bench shall be cut into the slope as before, such that the new fill will be integrated into the existing “berm” fills with a keyed interface as shown on the accompanying construction drawings.

The area of the proposed emergency spillway improvements shall be stripped of existing vegetation and other organic materials. The stripped ground surface shall be scarified to a minimum depth of 6 inches, brought to the optimum moisture content plus 3 percent and compacted to at least 95 percent of the maximum dry density prior to placement of any fill or structures thereon.

APPENDIX A

FIGURES



Location Bing Map

5 0' 5 10

SCALE: 1" = 5 Miles

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Vicinity Map
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	
J. Newton	S. Schenck	Nov 2015	1139-102	FIGURE 1

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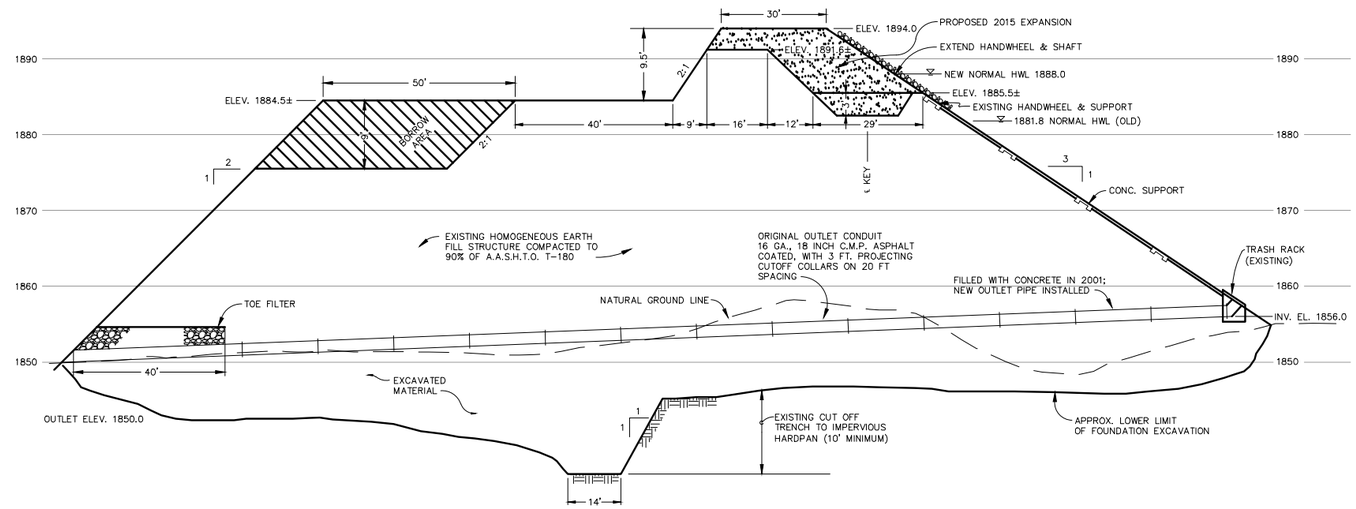
Dam and Reservoir Configuration
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

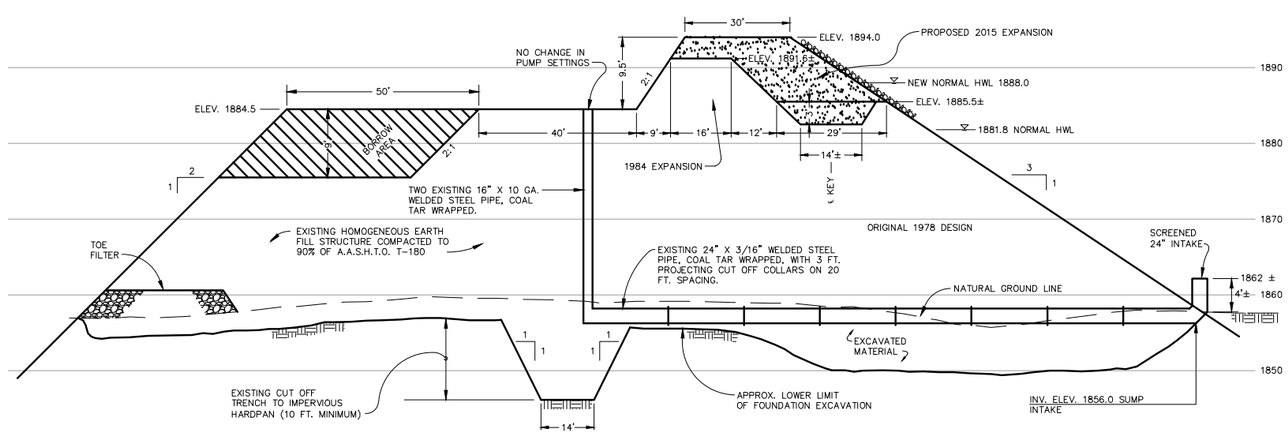
DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	
J. Newton	S. Schenck	Nov 2015	1139-102	FIGURE 2



Cross Section Outlet Dam No. 1 (East Dam)

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'



Cross Section Pump Chamber Dam No. 1 (East Dam)

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'

Cross-Sections Dam No.1 (East Dam)

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

FIGURE 3

PROJECT NO. 1139-102

DATE: Nov 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

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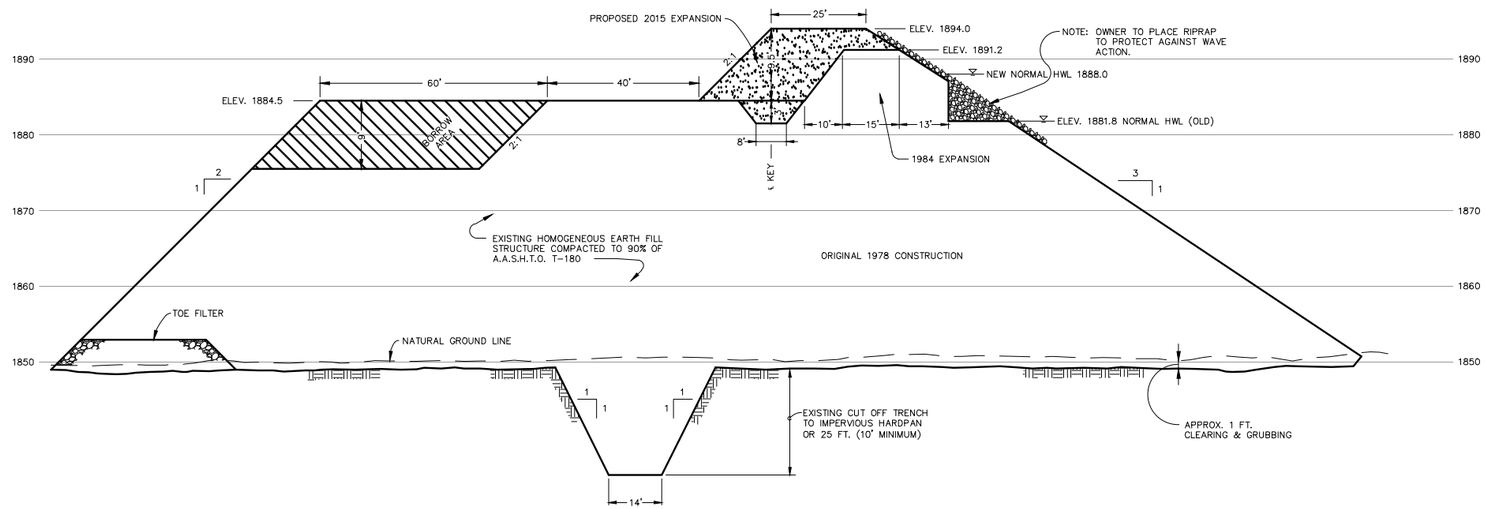

Cross Section Dam No. 2 (West Dam)

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'

Cross-Section Dam No.2 (West Dam)

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

FIGURE 4

PROJECT NO. 1139-102

DATE: Nov 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

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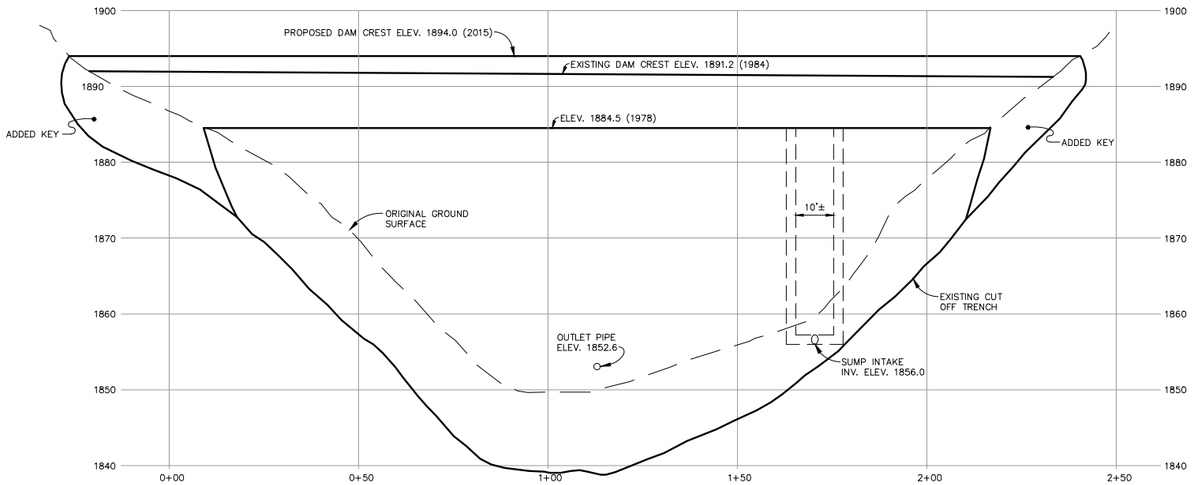
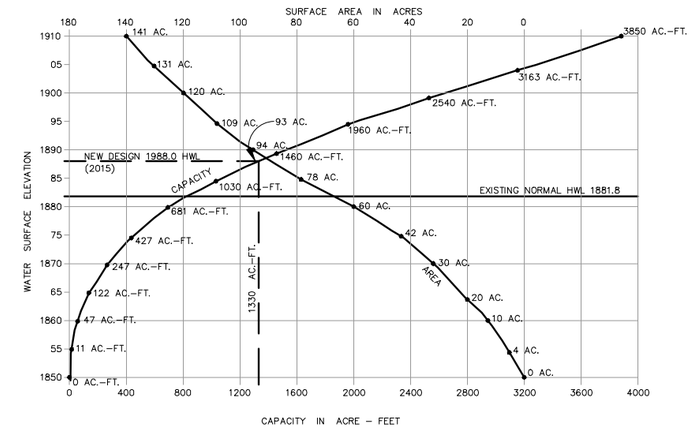
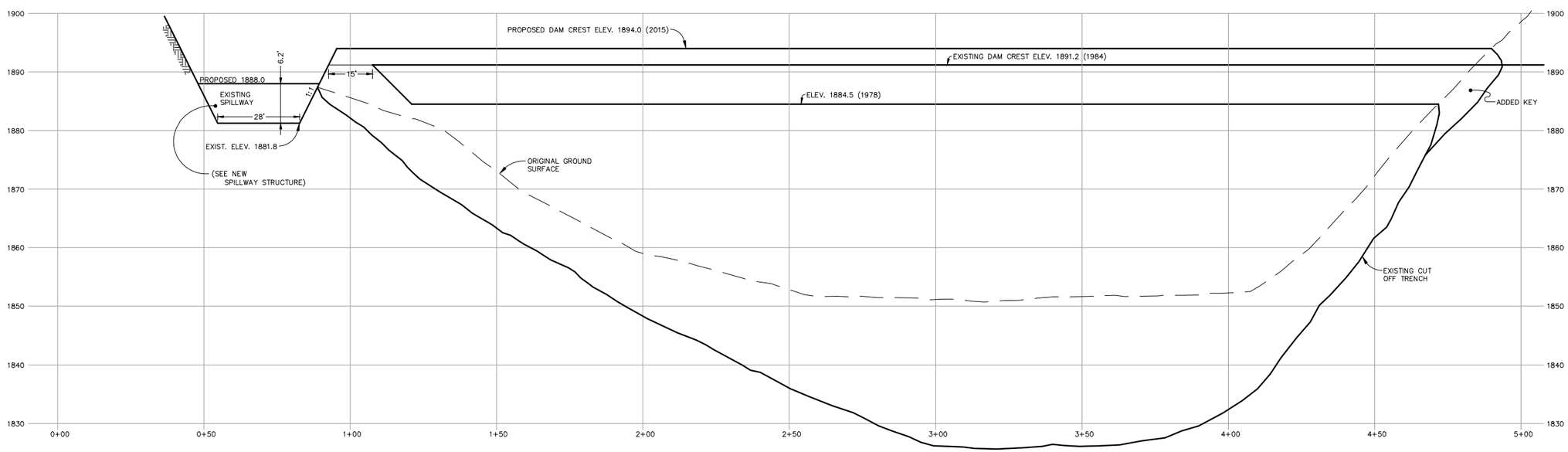


℄ Profile of Dam No. 1

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 40'



Area and Capacity Curve



℄ Profile of Dam No. 2

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 40'

Profiles - Dam No. 1 and Dam No. 2 and Area Capacity Curve
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

FIGURE 5

PROJECT NO. 1139-102

DATE: Nov 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

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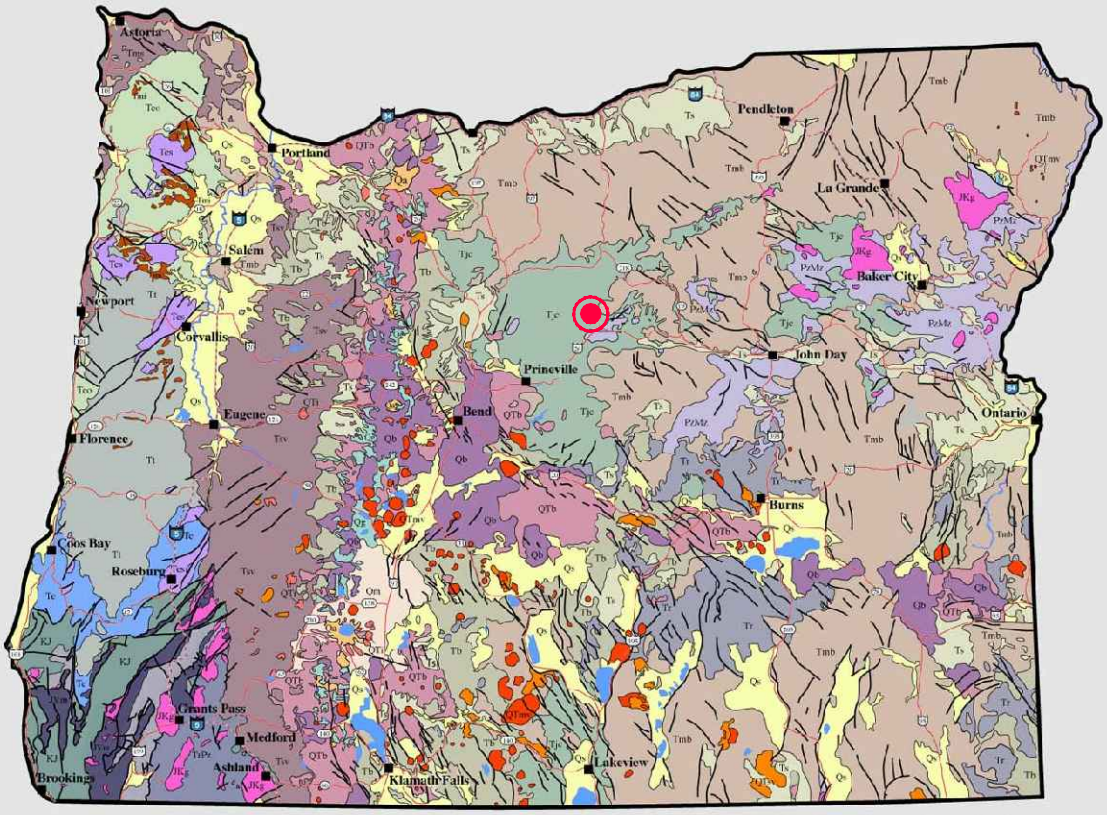
Geologic Map of Oregon



0 miles 50

0 km 50

Approximate Location of Painted Hills Reservoir

modified from Walker and MacLeod, 1991
by Marli Bryant Miller, University of Oregon

- **Qs** Quaternary sediment. Includes alluvium, colluvium, landslide, coastal dune, and terrace deposits.
- **Qm** Holocene Mazama ash and pumice. Includes air fall as well as flow deposits.
- **Qg** Quaternary Glacial Deposits.
- **Qa** Quaternary Andesite.
- **Qb** Quaternary Basalt and basaltic andesite. Forms some stratovolcanoes in the Cascades, and large basalt flows in eastern and central Oregon.
- **QTb** Quaternary, Pliocene, and some upper Miocene basalt flows.
- **Ts** Miocene, Pliocene, and some Quaternary sedimentary rocks, dominantly tuffaceous and contains tuff and volcanic breccia. Locally grades into Tb.
- **QTsv** Quaternary and Late Tertiary silicic vent complexes.
- **QTmv** Quaternary and Late Tertiary mafic vent complexes.
- **Tb** Middle to Upper Miocene and some Pliocene basalt.
- **Tmb** Middle Miocene basalt. Predominantly the Columbia River Basalt Group, including the Saddle Mtn., Wanapum, Grande Ronde, Picture Gorge, Imnaha basalt, as well as the basalt of Steens Mtn and other undifferentiated early-Miocene basalts. Also includes minor intervening tuffaceous sedimentary rocks, lakebed deposits, and silicic flows.
- **Tms** Lower to Middle Miocene marine sedimentary rock of the Coast Range.
- **Tsv** Eocene through Lower Miocene sedimentary and volcanic rock of the western Cascades. Includes the marine Eugene Fm., and the non-marine Fisher Fm of the southern Willamette Valley.
- **Tr** Eocene to Miocene rhyolite and rhyolitic tuff.
- **Tjc** Eocene to Lower Miocene sedimentary and volcanic rocks of the Clarno and John Day Formations, and related rocks.
- **Teo** Eocene to Oligocene marine volcanic-rich sedimentary and volcanic rocks. Includes Yamhill, Cowlitz, and Alsea Formations plus Yachats Basalt and Tillamook Volcanics.
- **Tt** Eocene Tyee Formation of the Coast Range.
- **Te** Eocene marine sandstone and siltstone that pre-dates Tyee Formation.

Rock of Accreted Terranes

- **Tes** Paleocene to Eocene basaltic and related rocks of the Siletz River Volcanics ("Siletzia").
- **KJ** Jurassic and Cretaceous sedimentary rock of the Franciscan Complex, found in the Klamath Mtns.
- **Jvm** Jurassic volcanic, ultramafic, and metamorphic rock of the Klamath Mtns.
- **TrPz** Paleozoic and Triassic rock of the Klamath Mtns.
- **PzMz** Paleozoic and Mesozoic rock of eastern Oregon.

Intrusive Rock

- **QTi** Quaternary and Tertiary silicic and mafic intrusions of the Cascades.
- **Tmi** Tertiary, mostly Miocene mafic intrusions of Coast Range.
- **JKg** Jurassic and Cretaceous granitic intrusions of the Klamath and Blue Mtns.

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Geologic Setting
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

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J. Newton	S. Schenck	Nov 2015	1139-102	FIGURE 6

APPENDIX B

LABORATORY TEST RESULTS

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Moisture Density Curve

Client: Newton Consultants
Project: Bridge Creek Dam
Location: Wheeler County, Oregon
Material Type: Clayey silt with sand, trace gravel, reddish brown
Material Supplier: Project Site
Material Source: On-Site native soil
Sample Location: P12-021 In Place Fill West Berm DE-1

Project No.: 10224 (1)
Lab No.: WG0589

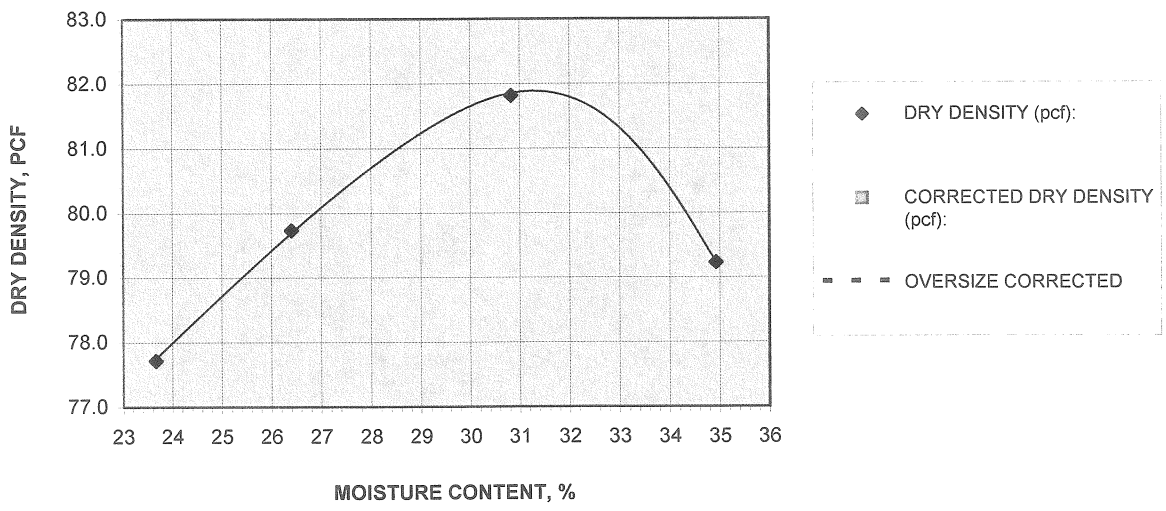
Sampled By: Jim Newton
Received By: Mike Gainey
Tested By: Shay Perry
Reviewed By: M. Herbert

Date Sampled: 21-Dec-12
Date Received: 21-Dec-12
Date Tested: 26-Dec-12
Date Reviewed: 7-Jan-13

Test Procedure: ASTM D698
Oversized Material (%): 2%

Method: A
Correction Required: [ ] yes [X] no

MOISTURE/DENSITY RELATIONSHIP CURVE



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	81.8	@ Optimum Moisture, %	31.5
Corrected Maximum Dry Density, pcf		@ Optimum Moisture, %	

MATERIAL DESCRIPTION

COARSE SIZE PERCENTAGES

Retained 3/4-inch	0%
Retained 3/8-inch	0%
Retained # 4	2%

Note: Data and results shown above include ASTM Test Method D698 or D1557, C127 and D2216. This report pertains only to the material tested and/or inspected and is not to be reproduced without prior authorization of Wallace Group. If part of a larger document, this report is not to be removed or reproduced separately. This report is the property of the Client and shall not be distributed to other parties without Client's permission.

Figure 1

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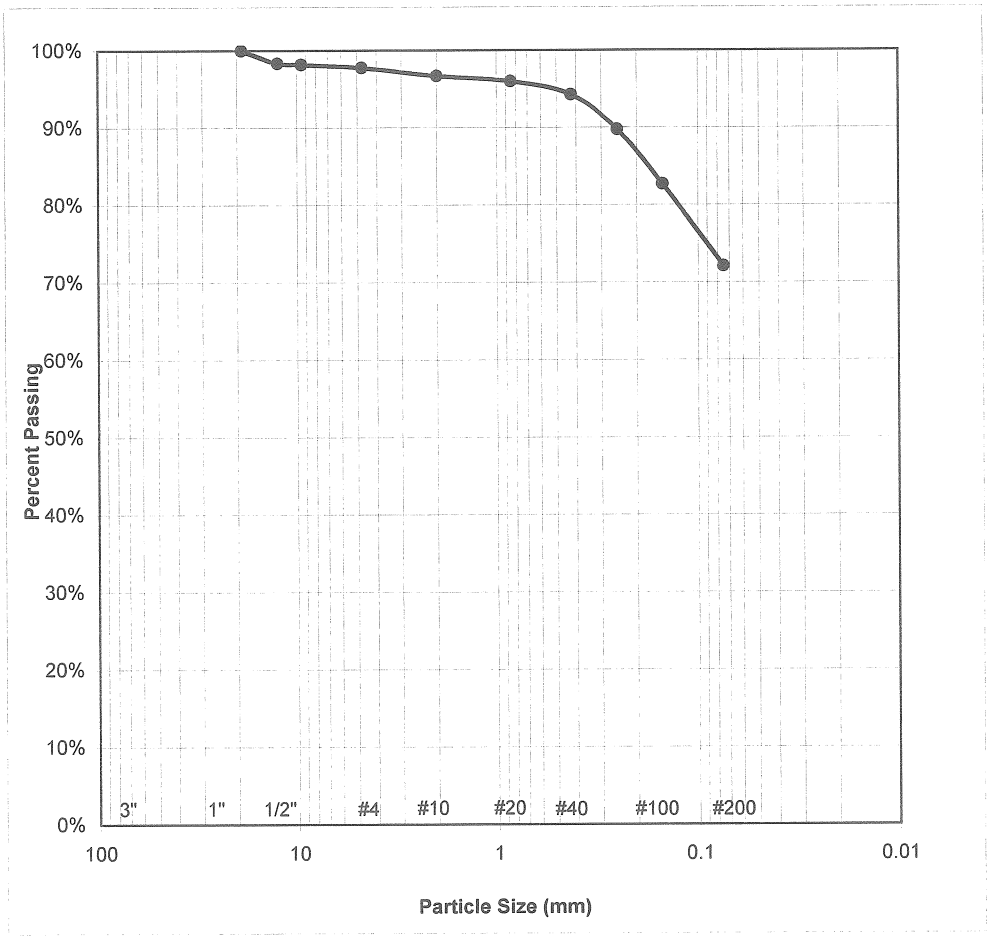
SIEVE ANALYSIS

(ASTM C136)

Client:	Newton Consultants	**Project No.:**	10224 (1)
Project Name:	Bridge Creek Dam	**Lab No.:**	WG0589
Sample Description:	Clayey silt with sand, reddish brown	**Date Sampled:**	12/21/12
Material Source:	On-site native soil	**Date Analyzed:**	12/26/2012
Sample Location:	P12-021 Painted Hills Res. DE-1, West Berm	**Moisture %:**	18.0%
		Technician:	Shay Perry
USCS Description:	Elasitc silt with sand	**Specification:**	NA
USCS Class.:	MH	**Reviewed By:**	M. Herbert

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	100%
3/4"	100%
1/2"	98%
3/8"	98%
#4	98%
#10	97%
#20	96%
#40	94%
#60	90%
#100	83%
#200	72.1%



Note: Data and results shown above include ASTM Test Method C-136.

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Figure 2

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ATTERBERG LIMITS

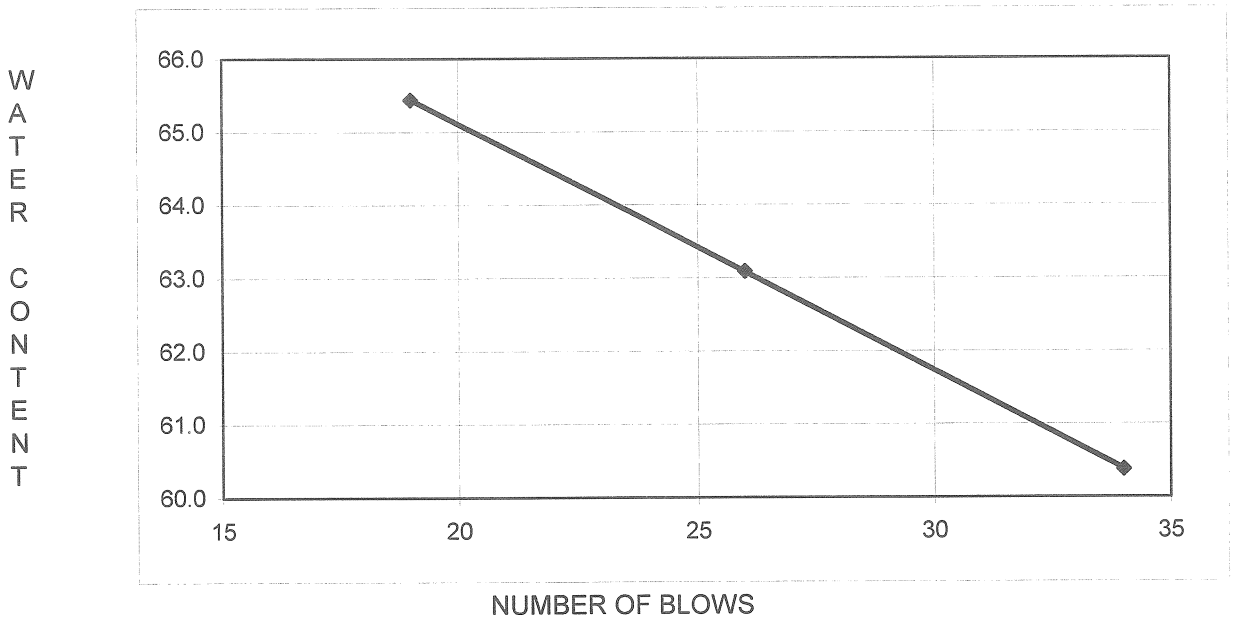
(ASTM D-4318)

Client:	Newton Consultats	**Date Sampled:**	12/21/12
Project Name:	Bridge Creek Dam	**Project No.:**	10224 (1)
Sample Description:	Elastic silt with sand (MH)	**Lab No.:**	WG0589
Sample Location:	P12-021 Painted Hills Res DE-1	**Date Analyzed:**	12/28/12
In Place Moisture:	18.0%	**Technician:**	Shay Perry
		Reviewed By:	M. Herbert

TRIAL NO.	1	2	3
TYPE OF TEST	LL	LL	LL
TARE NO.	20	22	23
NO. OF BLOWS	34	26	19
WT. SAMPLE WET + TARE	31.10	30.72	31.81
WT. SAMPLE DRY + TARE	25.37	24.72	25.22
WT. WATER	5.73	6.00	6.59
WT. TARE	15.88	15.21	15.15
WT. DRY SOIL	9.49	9.51	10.07
WATER CONTENT %	60.4	63.1	65.4

TRIAL NO.	1	2
TYPE OF TEST	PL	PL
TARE NO.	4	5
WT. SAMPLE WET + TARE	22.67	21.54
WT. SAMPLE DRY + TARE	20.72	19.82
WT. WATER	1.95	1.72
WT. TARE	15.90	15.51
WT. DRY SOIL	4.82	4.31
WATER CONTENT %	40.5	39.9

Liquid Limit	63
Plastic Limit	40
Plasticity Index	23



Note: Data and results shown above include ASTM Test Methods D-4318 and D-2216.

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Moisture Density Curve

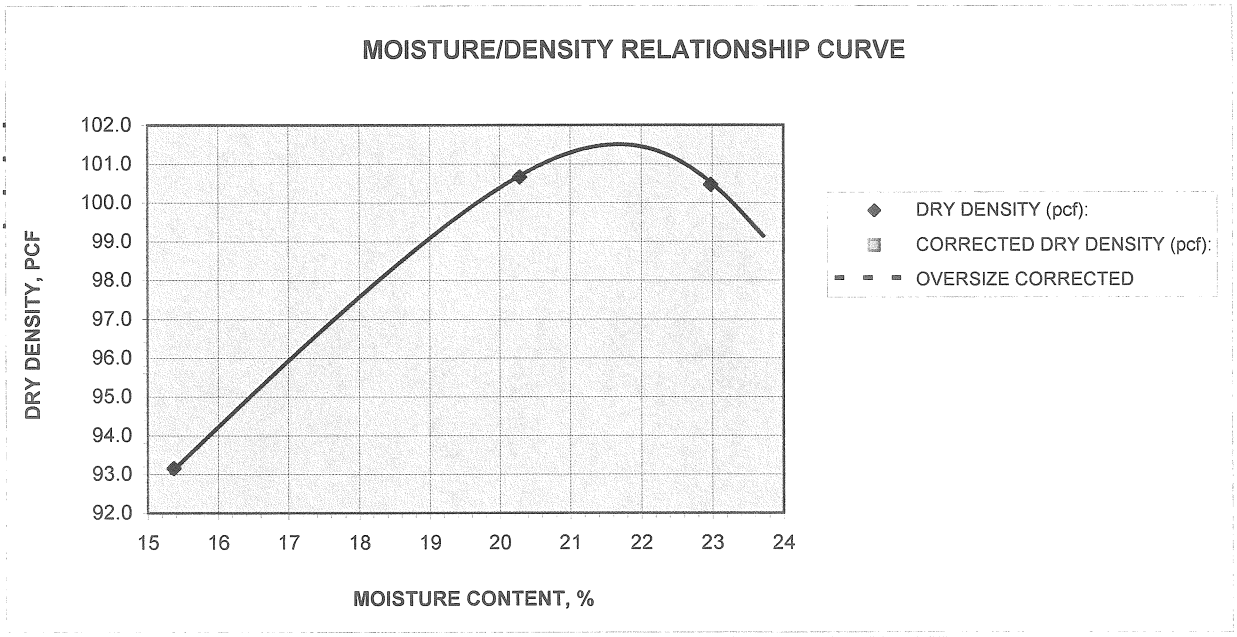
Client: Newton Consultants
Project: Bridge Creek Dam
Location: Wheeler County, Oregon
Material Type: Sandy clay, dark reddish brown
Material Supplier: Project site
Material Source: On-site native soil
Sample Location: P12-021 In Place Fill BA-2

Project No.: 10224 (1)
Lab No.: WG0589

Sampled By: Jim Newton
Received By: Mike Gainey
Tested By: Shay Perry
Reviewed By: M. Herbert

Date Sampled: 21-Dec-12
Date Received: 21-Dec-12
Date Tested: 26-Dec-12
Date Reviewed: 7-Jan-13

Test Procedure: ASTM D698
Method: A
Oversized Material (%): 5%
Correction Required: [ ] yes [X] no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	101.6	@ Optimum Moisture, %	21.6
Corrected Maximum Dry Density, pcf		@ Optimum Moisture, %	

MATERIAL DESCRIPTION

Sandy clay, dark reddish brown

COARSE SIZE PERCENTAGES

Retained 3/4-inch	0%
Retained 3/8-inch	0%
Retained # 4	5%

Note: Data and results shown above include ASTM Test Method D698 or D1557, C127 and D2216. This report pertains only to the material tested and/or inspected and is not to be reproduced without prior authorization of Wallace Group. If part of a larger document, this report is not to be removed or reproduced separately. This report is the property of the Client and shall not be distributed to other parties without Client's permission.

Figure 4

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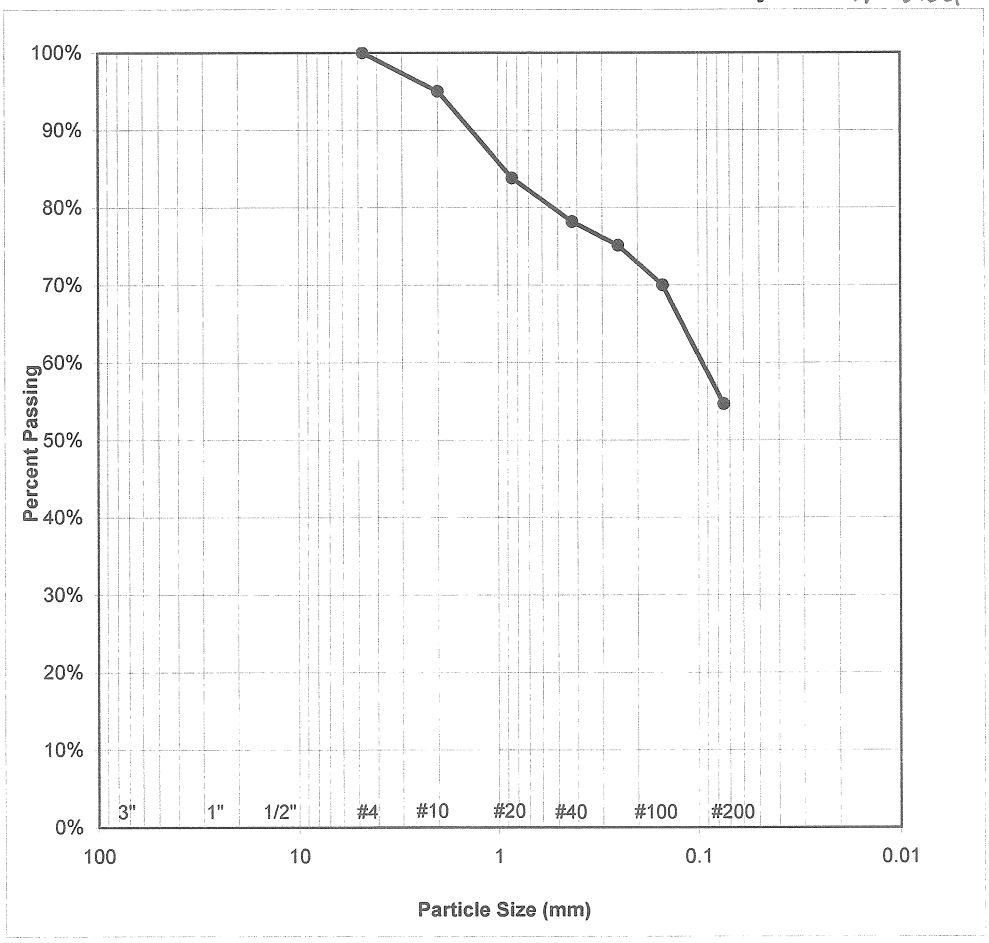
SIEVE ANALYSIS

(ASTM C136)

Client:	Newton Consultants	**Project No.:**	10224 (1)
Project Name:	Bridge Creek Dam	**Lab No.:**	WG0589
Sample Description:	Sandy clay, dark reddish brown	**Date Sampled:**	12/21/12
Material Source:	On-site native soil	**Date Analyzed:**	12/26/2012
Sample Location:	P12-021 in place BA-2	**Moisture %:**	13.7%
USCS Description:	Lean clay with sand	**Technician:**	Shay Perry
USCS Class.:	CL	**Specification:**	NA
		Reviewed By:	M. Herbert

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	100%
3/4"	100%
1/2"	100%
3/8"	100%
#4	100%
#10	95%
#20	84%
#40	78%
#60	75%
#100	70%
#200	54.7%



Note: Data and results shown above include ASTM Test Method C-136.

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Figure 5

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ATTERBERG LIMITS

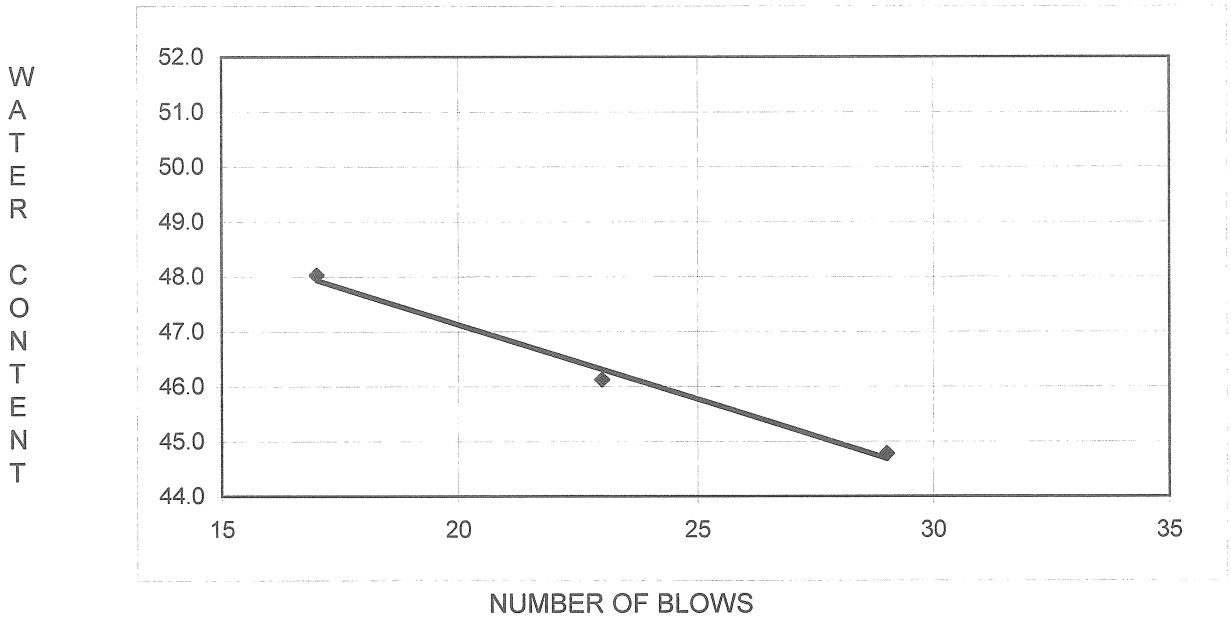
(ASTM D-4318)

Client:	Newton Consultats	**Date Sampled:**	12/21/12
Project Name:	Bridge Creek Dam	**Project No.:**	10224 (1)
Sample Description:	Lean clay with sand (CL), dark reddish brown	**Lab No.:**	WG0589
		Date Analyzed:	12/28/12
Sample Location:	P12-021 Painted Hills Res BA-2	**Technician:**	Shay Perry
In Place Moisture:	13.7%	**Reviewed By:**	M. Herbert

TRIAL NO.	1	2	3
TYPE OF TEST	LL	LL	LL
TARE NO.	15	10	11
NO. OF BLOWS	29	23	17
WT. SAMPLE WET + TARE	26.53	28.06	28.22
WT. SAMPLE DRY + TARE	22.97	23.95	24.20
WT. WATER	3.56	4.11	4.02
WT. TARE	15.02	15.04	15.83
WT. DRY SOIL	7.95	8.91	8.37
WATER CONTENT %	44.8	46.1	48.0

TRIAL NO.	1	2
TYPE OF TEST	PL	PL
TARE NO.	1	2
WT. SAMPLE WET + TARE	22.89	21.27
WT. SAMPLE DRY + TARE	21.69	20.22
WT. WATER	1.20	1.05
WT. TARE	15.92	15.15
WT. DRY SOIL	5.77	5.07
WATER CONTENT %	20.8	20.7

Liquid Limit	46
Plastic Limit	21
Plasticity Index	25



Note: Data and results shown above include ASTM Test Methods D-4318 and D-2216.

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Memorandum

REGISTERED PROFESSIONAL ENGINEER 9975 OREGON OCTOBER 6, 1978 DAVID J. NEWTON
EXPIRES: 12 / 31 / 2016

Date: November 30, 2015

To: Mr. Keith Mills, P.E.
Oregon Water Resources Department
Dam Safety Division
725 Summer Street, NE, Suite A
Salem, OR 97301

From: David Newton, P.E., C.E.G. **Project No.:** 1139-102

Subject: Dam Breach Evaluation **Project Name:** Painted Hills Reservoir

This memorandum describes a dam breach evaluation related to the Painted Hills Reservoir, Oregon Water Resources Department (OWRD) reservoir storage permit application R-84459.

INTRODUCTION

Preparation of construction drawings and specifications to raise the two existing earth fill dams for the Painted Hills Reservoir (Reservoir) in Wheeler County, Oregon is complete at this time. This work includes improvements to the existing emergency spillway located on the west end of the Dam No. 2 (West Dam). The spillway improvements were designed for a 1,000-year runoff event. Specific spillway improvement requirements depend on the hazard classification of the Reservoir and the related flood event for which the spillway must be designed to pass without overtopping the dams.

The hazard classification of the Reservoir to be determined by the Oregon Water Resources Department, Dam Safety Division (OWRD-DS) requires consideration of the potential for loss of human life downstream of the Reservoir in the event of a breach of the dams and release of stored water into Bridge Creek downstream of the Reservoir.

PURPOSE

This memorandum was prepared to present the results of a dam breach evaluation by Newton for use by the OWRD-DS in assigning the hazard classification to the Reservoir. Based on the hazard classification of the Reservoir, Newton will conduct hydrologic analysis and design the spillway improvements to accommodate the runoff from the design runoff event.

PROJECT LOCATION

The Reservoir is located 9.5 miles northwest of Mitchell, Oregon and 4.5 miles south (upstream) of the John Day River in the Bridge Creek drainage. The Reservoir location is in the SW quarter of Section 25, Township 10 South, Range 20 east, Willamette Meridian, in Wheeler County. The location of the Reservoir, Bridge Creek and the John Day River are shown on Figure 1.

PROPOSED IMPROVEMENTS

Water can presently be stored in the Reservoir under OWRD certificate 68553. The Reservoir owner (Bridge Creek Ranch, LLC, previously William Smith Properties) applied for and received a Final Order approving the owner request to store an additional volume of 1250 acre-feet in the Reservoir. Previous time extensions for submittal of engineering plans and specifications to the OWRD-DS for review have been granted by the OWRD. The current administrative hold request expires on November 30, 2015 and submittal of construction drawings and specifications being developed by Newton are planned for submittal on approximately that date.

The proposed improvements include raising the top of both earth fill dams by approximately 2.8 feet and improving the existing emergency spillway. The maximum storage volume of the Reservoir after the planned improvements are completed will be 2,050 acre-feet. Discharge from the Reservoir will be conveyed downstream by Bridge Creek, to the John Day River. The confluence of Bridge Creek and the John Day River is 4.5 miles downstream from the Reservoir. The maximum storage increase to be included under permit application will be to raise the maximum storage elevation approximately 6.20 feet, to a total storage volume of 1,330 acre-feet, however, the breach analysis contained herein assumed a potential reservoir volume of 2,050 acre-feet to maintain a more conservative analysis and incorporate the full limits of the existing water right for safety concerns.

MAN-MADE STRUCTURES DOWNSTREAM OF THE RESERVOIR

Man-Made Structures – Bridge Creek Downstream of Reservoir

Observations for the presence of man-made structures downstream of the Reservoir were conducted by review of Google Earth satellite imagery (imagery dates 7/6/14 and 8/17/14) and U.S. Geological Survey (USGS) Quadrangle map 20140725. Man-made building structures were not observed in the Bridge Creek drainage feature downstream of the Reservoir. The only man-made structure observed in the Bridge Creek drainage downstream of the Reservoir is the Burnt Ranch Road. This road is an unpaved, gravel-surfaced road that follows Bridge Creek between the Reservoir area and the John Day River. Figures 2 and 3 show the conditions in the Bridge Creek drainage downstream from the reservoir as reflected by the imagery and maps.

Dwellings for Living/Shelter Purposes – Bridge Creek Downstream of Reservoir
Dwellings for human living and shelter purposes were not observed during the review of satellite imagery. Dwellings or other building structures are also not shown on the reviewed USGS maps. Structures for animal shelter were also not observed.

Man-Made Structures Summary – Bridge Creek Downstream of Reservoir
The observations for man-made structures in the Bridge Creek drainage downstream of the Reservoir revealed no apparent structures for the purpose of human occupancy, living and shelter. No structures were observed for animal shelter use. The only man-made structure observed is the unpaved, gravel-surfaced Burnt Ranch Road which generally runs parallel to Bridge Creek from the Reservoir area to the John Day River. The Bridge Creek drainage between the Reservoir and the John Day River is relatively remote with occasional human presence on the Burnt Ranch Road.

Man-Made Structures – Confluence of Bridge Creek and John Day River
More than one mile west of the confluence with the John Day River there is a farm with four structures; one of which appears to be a residence. These structures are close to the river.

BREACH ANALYSIS APPROACH

The Reservoir site is relatively remote in terms of human population access and concentration. Occasional human presence in the area below the Reservoir is possible by the access benefit of the Burnt Ranch Road. No structures for human inhabitation were observed downstream of the Reservoir in the Bridge Creek drainage.

Based on the existing conditions downstream of the Reservoir, the breach analysis was conducted in a “simplistic” manner. The analysis was conducted by use of USGS topographic information relative to the Burnt Creek Road and the Bridge Creek floodway and calculation of flow velocities and depths based on the Manning equation and Manning coefficients for the floodway. The analysis also included consideration of dam breach case histories summarized in RCEM–Reclamation Consequence Estimating Methodology, Dam Failure and Flood Event Case History Compilation, 2014 Interim Draft report and in the Journal of Dam Safety, Volume 13, Issue 2, 2015 (Feinberg, Engemoen, Fiedler, Osmun). These case histories provide information relative to the time frame for actual breach events to fully drain the reservoir.

Empirical models (Washington State (2007) and MacDonald, Monopolis (1984)) for estimating breach formation time and consequent peak flows were used to corroborate the calculations based on drawdown times.

BRIDGE CREEK DRAINAGE – TOPOGRAPHIC CONDITIONS RELATIVE TO HAZARD POTENTIAL

The Burnt Ranch Road runs generally parallel to Bridge Creek downstream of the Reservoir. In general, the elevation of the road is above the elevation of the creek. The horizontal distance between the creek and the road varies. Considering that the road is a man-made structure which provides human access along its route, hazard potential relative to dam breach was focused on topographic conditions of the Bridge Creek drainage and the road.

Topography of the Bridge Creek drainage was evaluated by use of USGS quadrangle maps. Google Earth imagery was used as an approximate cross-check on elevation differences between the creek channel bottom and the road surface. Topographic evaluation was focused on "pinch points" in the drainage where topographic variations in the drainage result in narrowing of the creek floodway. These locations constrain flood flows to narrower channels, which can result in increased flow depths and overtopping of the road.

Cross-sections were prepared for four sites along the road where the width of the creek floodway is relatively narrow. These cross-sections are shown on attached Figures 4 and 5. Wetted perimeter (Pw), cross-sectional flow area (A) and elevation (Y) were determined for each of the cross-sections. These determinations were used as inputs to the breach analysis.

ANALYSIS

Breach Flow Condition

The breach analysis was conducted on the basis of a steady flow condition while realizing that a peak wave is a most probable condition with peak wave magnitude depending on the time over which a dam breach and reservoir release occurs. Considering the unmeasurable population at risk (PAR) downstream, which is considered to be zero, along with the absence of habitable structures and recreational sites, this investigation was conducted in a simplified manner. Using a steady flow analysis in this case provides knowledge of expected flooding effects and their duration on a general scale. The steady flow estimate is intended to illustrate the largest expected flow which is most likely to occur for a noteworthy duration.

Flow rate will attenuate downstream and studies have estimated that the effects of dry ground and plant life could reduce flow in the range of 29% to 56% (Ainan; Zakaria, (2004)). This measurement comes from swale studies with a greater plant population. It is conservative to reduce the peak flow from this breach by 34% considering the topography and plant life downstream. The peak flow estimates from empirical models will be reduced so that they may be compared to the steady state flow on a more reasonable basis.

Time Span for Full Reservoir Drawdown

The time period for complete drawdown of the Reservoir was estimated by considering the BOR case history information, types of soils used to construct the dams and configuration of the existing dam embankments (relatively large widths). Erodibility of soil materials greatly affects drawdown time for a dam. The Reservoir dams are constructed with clayey, relatively cohesive soils, which will resist erosion more effectively than sands or sands/silts mixtures. These estimates were then corroborated by the most recent empirical formulas used for dam safety evaluations.

The case history summary for the failure of the 205-feet high St. Francis Dam in southern California indicates that the failure was sudden and the entire reservoir was drained in less than 72 minutes. The case history for the Big Bay Dam failure in Mississippi indicates the entire reservoir was drained in 90 minutes. Normal capacity for this reservoir is 14,200 acre-feet. The summary for the Laurel Run Dam failure in Pennsylvania indicates the reservoir contained about 450 acre-feet at failure (typical storage was 300 acre-feet). Failure resulted from 11.82 inches of rain over 10 hours. The storm event was estimated at a 5,000 to 10,000 year rainfall event. Breach flow rates were estimated at up to 56,000 cubic feet per second (cfs) with rapid attenuation downstream. This flow most likely included basin runoff in addition to the volume of storage in the reservoir and the time to drain the entire volume of stored water in the reservoir due to breach is uncertain. Potential failure modes for dam safety risk considerations generally fall in to one of three basic categories ((Fienberg, Engemoen, Fiedler, Osmun): 1) static; 2) seismic; and 3) hydrologic. Considering the relatively large cross-sectional configuration of the existing dams and Newton experience with their original design and construction, the most likely failure mode for the Reservoir is hydrologic.

Hydrologic conditions that develop to the point of dam failure occur over some time span which can lead to an overtopping event. When a dam is overtopped, flow over the crest and down the downstream embankment slope can erode the embankment, opening a cut which then grows into a larger and larger breach over time. Considering cross-sectional dimensions and configuration of the two reservoir dams and the cohesive soils used to construct them, empirical methods estimate that a breach which could drain the entire reservoir could occur over a period of 80 minutes or more. This is the breach formation time or time to failure.

Based on the case history information and the probable hydrologic failure mode, the analysis for the Reservoir was conducted for drawdown time spans of 30, 60 and 90 minutes, which are anticipated to account for the more probable failure mode of the reservoir dams. The 30 minute drawdown depicts a worst case scenario and a nearly instantaneous failure of the dam. A seismic event is the most likely precursor to this; a fault line active within the past 15,000 years is over 100 miles away and is the nearest, most active fault according to USGS data.

To confirm the steady state flow estimates, empirical models for determining breach formation time and peak flows were conducted. The Macdonald & Langridge-Monopolis (1984) and Washington State (2007) methods derived from numerous dam failure evaluations are the most suitable for this dam considering its abnormal size and cohesive soils:

> Washington State (2007) took the MacDonald & Langridge-Monopolis method and adjusted it based upon whether the dam is made of cohesionless or cohesive material. Comparing the predicted earth-fill embankment volume eroded, the Washington State cohesionless equation results in a slightly larger eroded volume estimate than the best fit curve estimates of the MacDonald & Langridge-Monopolis method. As would be expected, results from the Washington State cohesive soil equation show less embankment volume eroded than the MacDonald & Langridge-Monopolis method. The Washington State method estimates the breach development time for cohesionless soil using the MacDonald & Langridge-Monopolis method and developed its own equation to estimate breach development time for cohesive soil using a best fit to the midpoint of the data instead of an envelope equation. Discussion in the Washington State Technical Note suggests a minimum breach formation factor (BFF), of 100 ac-ft2. This method therefore appears more suited to Small or Large dams, while the MacDonald & Langridge- Monopolis method appears to be more appropriate for Minor dams and some small dams with a BFF less than 100 ac-ft2.

Froehlich (2008) does not take consideration for volume of eroded material nor the characteristics of the material and is over conservative.

Hydraulic Analysis Parameters

Cross-sections were developed for each critical section (floodway “pinch points”) along Bridge Creek. For each critical section, the cross-section was divided into segments of 1 foot vertical increments. Corresponding wetted perimeters and cross-sectional areas were calculated for each segment. Finally, the hydraulic radius was calculated for each cross-sectional area with increasing elevation of the water surface using AutoCAD-created profiles from USGS topography. Satellite imagery along with site knowledge provides terrain characteristics useful in determining Manning coefficients.

Plan drawings for the larger, west dam were conferred to measure dimensions of the physical dam structure that is proposed to be built.

Soil laboratory analysis data previously conducted by The Wallace Group materials testing laboratory in 2013 confirms soil characteristics such as cohesiveness and plasticity among other things.

Hydraulic Calculations

The velocity of flow for the various flood water elevations at the critical sections was calculated with the Manning equation. This velocity was then compared to the estimated steady flow rate based on draw down times (30, 60 and 90 min) and the cross sectional area required to convey that flow. This required cross section was graphically compared to the measured cross section and a solution for each estimated flowrate was determined. This solution for cross sectional area provides the necessary information to estimate inundation depths.

The Washington State (2007) method uses empirical data to estimate breach formation time and peak flow resulting from a failure. Using the proposed dimensions and storage possibilities of Dam No. 2, the results for peak flow during two failure scenarios were calculated. At normal operation level, a breach failure was estimated at 35,150 cfs. For an overtopping event which requires seven feet of water over the spillway crest, the estimated peak flow is 39,570 cfs. These were averaged due to the overly conservative nature of the overtopping requirements and that the nearby environment does not provide sufficient material to block the spillway. The average value of 37,360 cfs is reduced by 34% for attenuation, as previously mentioned, resulting in a more stable flow value of 24,700 cfs.

This flow value closely resembles the results found in the 60 minute draw down time analysis and is considered to be a conservative, yet realistic estimate of a failure for this dam.

Figure 6 on the next page shows results based on each flow rate (Q30, Q60 and Q90) for each cross section (1, 2, 3, and 4). Values given for each are as follows:

y= depth of inundation from creek bed.
Δh= depth of nearby road inundation.
V= velocity of flow in that cross section.
A= cross sectional area of flow in that cross section.

Those sections that are highlighted are considered high risk and pose a threat to travelers on the road.

Q30-1	Q30-2	Q30-3	Q30-4
Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions
y=12.6ft A=3250 ft^2	y=18.5 ft A=3350 ft^2	y=18.3 ft A=2700 ft^2	y=12.9 ft A=3075 ft^2
V=15.2 ft/s Δh=-9.4ft	V=14.8 ft/s Δh=8.5ft	V=18.6 ft/s Δh=6.3ft	V=16.1 ft/s Δh=5.9ft

Q60-1	Q60-2	Q60-3	Q60-4
Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions
y=9.7 ft A=2050 ft^2	y=14.0 ft A=2100 ft^2	y=13.5 ft A=1700 ft^2	y=8.8 ft A=2000 ft^2
V=12.1 ft/s Δh=-12.3ft	V=11.9 ft/s Δh=4.0ft	V=14.8 ft/s Δh=1.5ft	V=12.4 ft/s Δh=1.8ft

Q90-1	Q90-2	Q90-3	Q90-4
Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions	Estimated Flow Conditions
y=8.2 ft A=1520 ft^2	y=12.0 ft A=1600 ft^2	y=10.3 ft A=1160 ft^2	y=6.8 ft A=1480 ft^2
V=11 ft/s Δh=-13.8ft	V=10.3 ft/s Δh=2.0ft	V=14 ft/s Δh=-1.7ft	V=11.6 ft/s Δh=-0.2ft

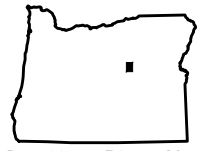
Figure6: Flowrate results at each cross section.

CONCLUSIONS

Considering the flowrate of Q60 (24,800 cfs), the nearby road may become inundated by four feet in at least one area and remain flooded for over 60 minutes. In that area with the deepest inundation, the velocity could reach 12 ft/s while other areas may experience velocities over 15 ft/s.

This flowrate is a conservative estimate of the more typical effects that might occur along Bridge Creek in the event of a dam failure. Considering the peak volume currently being proposed for a dam raise a the Reservoir is 1,330 acre-feet, versus the 2,050 acre-feet of this analysis, a reduced peak breach discharge, road inundation and velocity could be expected, however, considering the most conservative approach based on the potential to raise the Reservoir to 2,050, the higher storage volume was used in this breach evaluation.

Figures



Location Bing Map

5 0' 5 10

SCALE: 1" = 5 Miles

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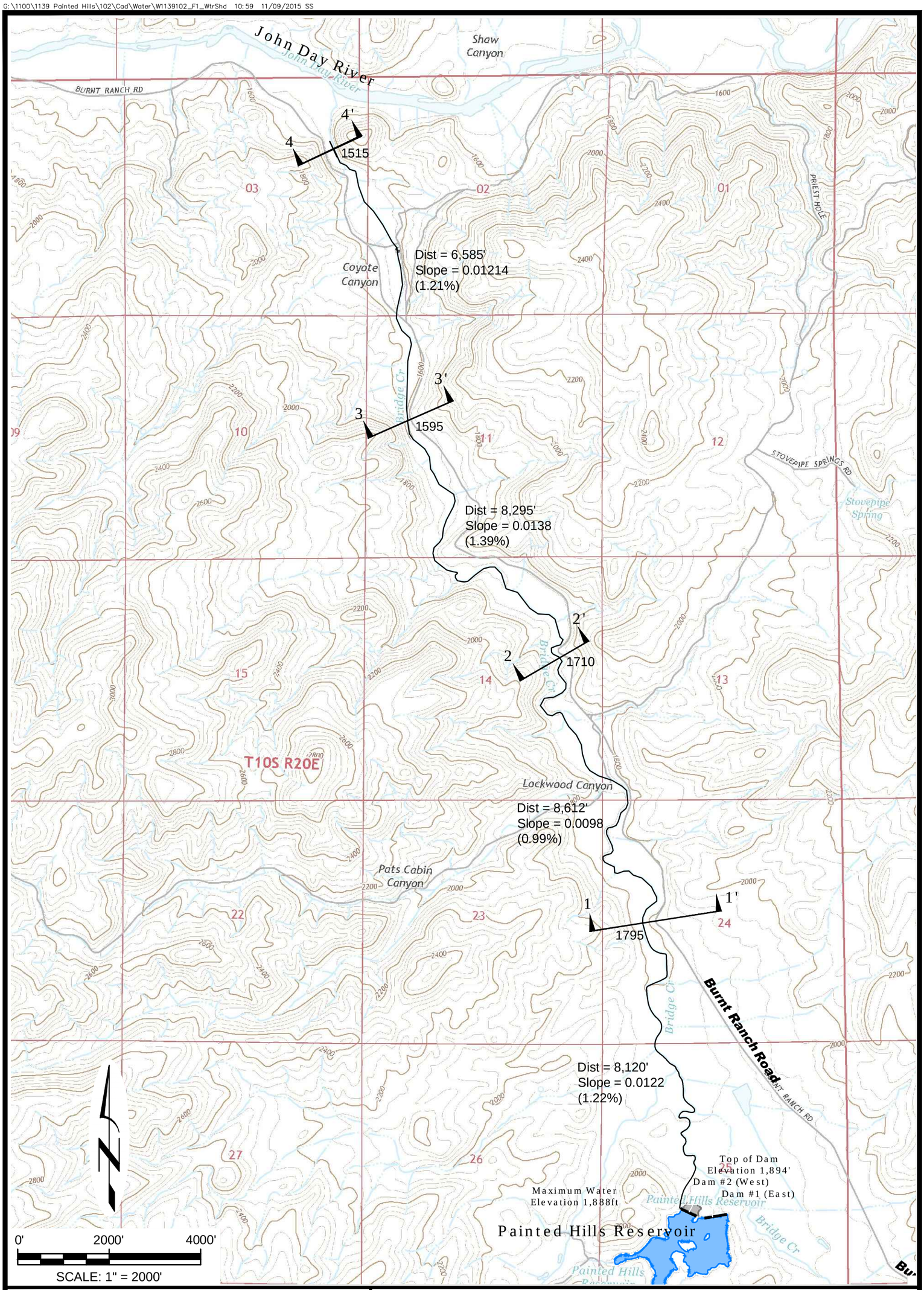
Vicinity Map
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	
J. Newton	S. Schenck	Dec 2015	1139-102	FIGURE 1

G:\1100\1139 Painted Hills\102\Cad\Water\W1139102_F1_WtrShd 10:59 11/09/2015 SS



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Vicinity Map & Cross-Section Locations (USGS Map)

Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	
J. Bannon	S. Schenck	Dec 2015	1139-102	FIGURE 2

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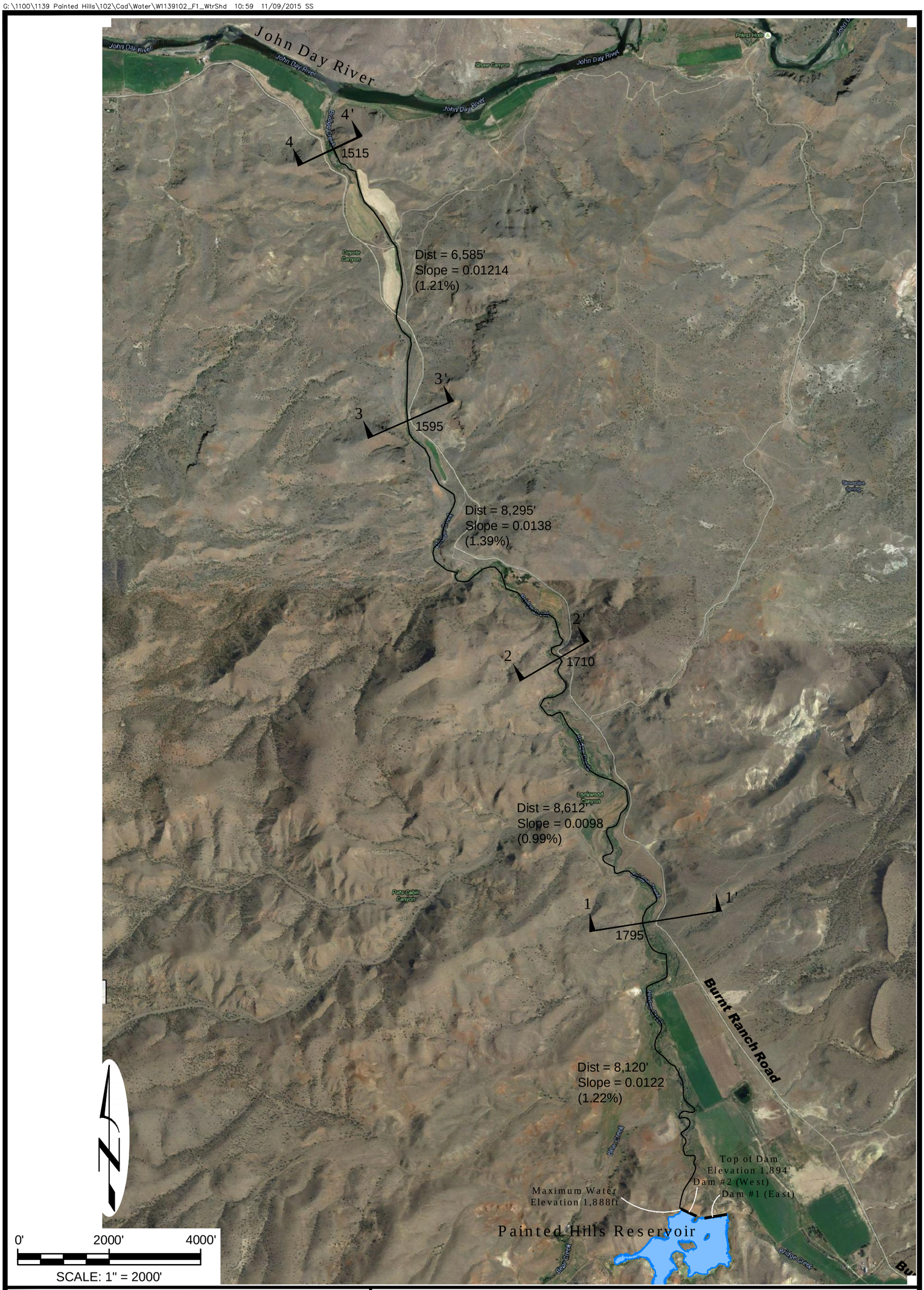

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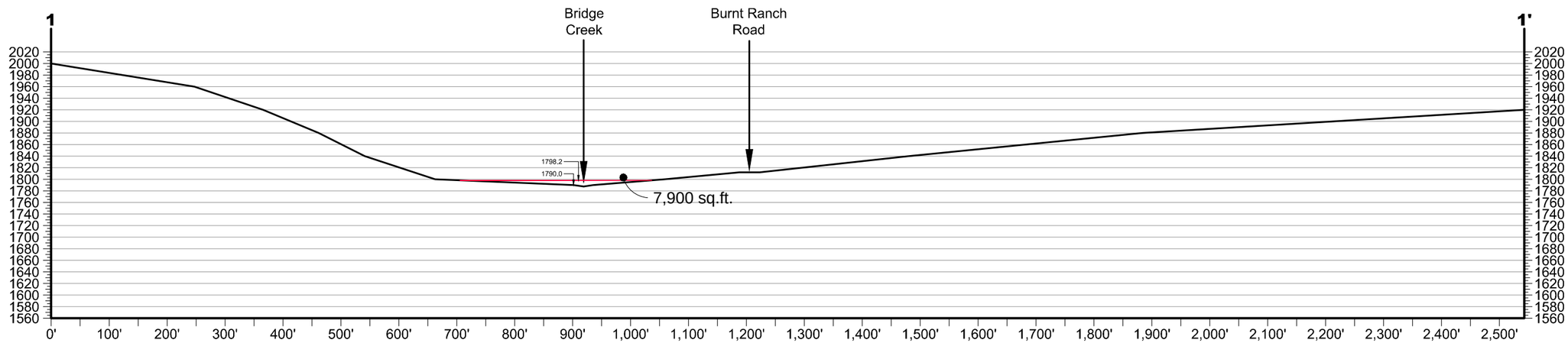
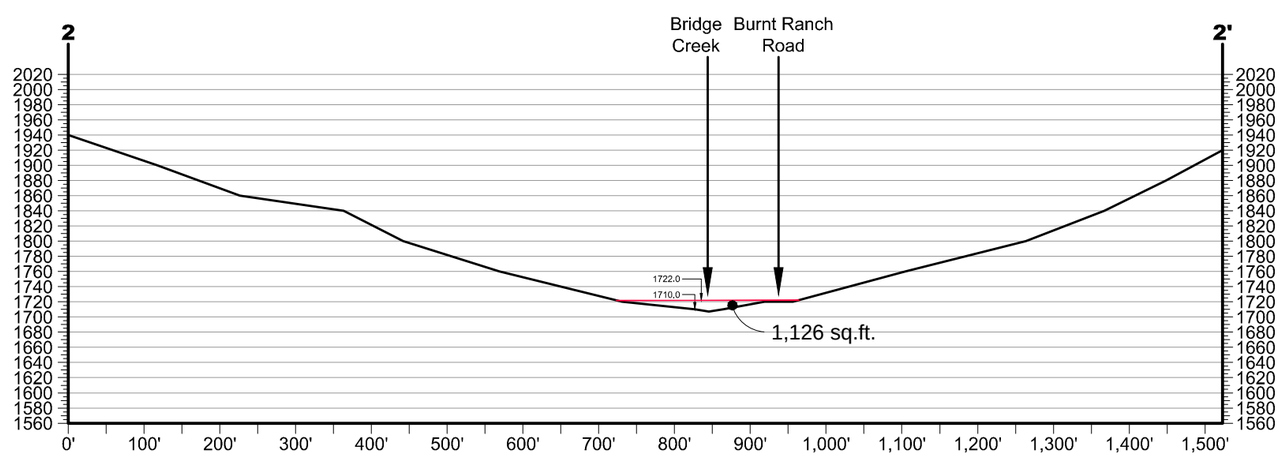
Cross Section Locations (Aerial Map)

Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

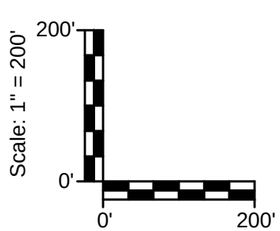
DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	
J. Bannon	S. Schenck	Dec 2015	1139-102	FIGURE 3



Cross Section 1-1'



Cross Section 2-2'



Scale: 1" = 200'

Bridge Creek Cross Sections 1-1' and 2-2'

Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

FIGURE 4

PROJECT NO. 1139-102

DATE: Dec 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Bannon

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Ph: 541 504-9960
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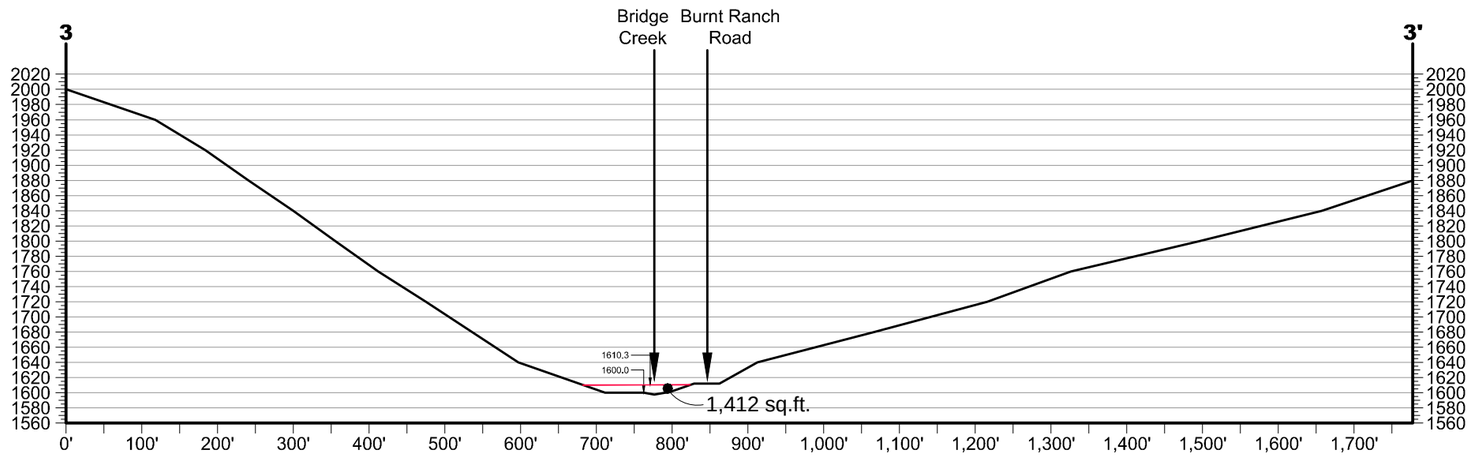
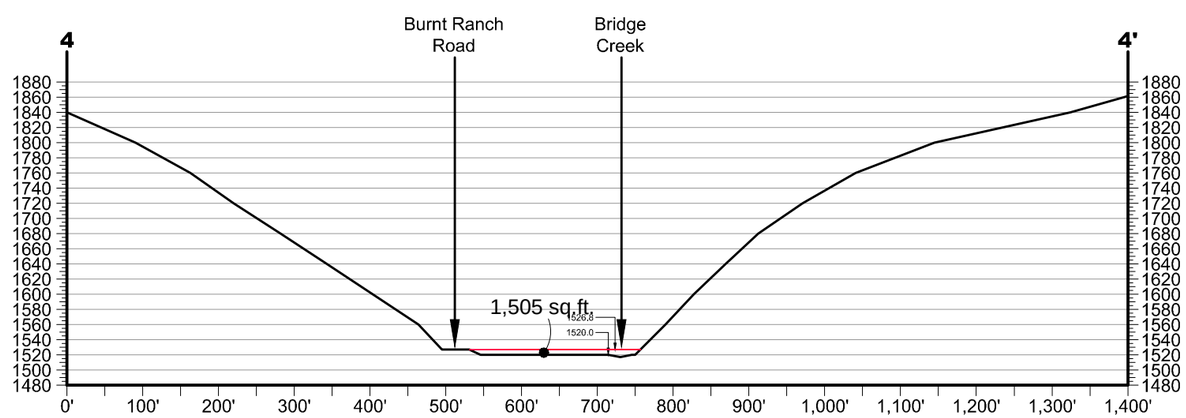
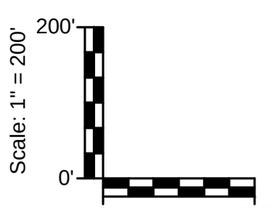


Cross Section 3-3'



Cross Section 4-4'



Scale: 1" = 200'

Bridge Creek Cross Sections 3-3' and 4-4'

Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

FIGURE 5

PROJECT NO. 1139-102

DATE: Dec 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Bannon

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960
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G:\1100\1139 Painted Hills\102\Cad\Water\WI139102_F1_WtrShd 10:59 11/09/2015 SS

Painted Hills Reservoir - Application No. 84459
Construction Drawings & Specifications to Raise Existing Dam & Construct New Emergency Spillway Structure
Township 10 South, Range 20 East, Section 25, W.M.
Wheeler County, Oregon - John Day Basin

VICINITY MAP

Scale: 1" = 6 Miles

SHEET INDEX

1. Cover Sheet
2. Site Map
3. Existing Site Map
4. Site Improvements Map
5. Cross-Sections Dam No.1 (East Dam)
6. Cross-Section Dam No.2 (West Dam)
7. Profiles Dam #1 (East) & Dam #2 (West), Area & Capacity Curve
8. Details: Emergency Spillway Modifications
9. Specifications

REGISTERED PROFESSIONAL ENGINEER 9975 OREGON OCTOBER 6, 1978 DAVID J. NEWTON

EXPIRES: 12 / 31 / 2016

PREPARED BY:

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists

1937 N. Business 97
Redmond, Oregon 97756
PH: (541) 504-9960
FAX (541) 504-9961

PATH: G:\1100\1139 Painted Hills\102\Cad\Water\W139102_S1_Cvr 08:24 11/24/2015 SS

REGISTERED PROFESSIONAL ENGINEER 9975 OREGON OCTOBER 6, 1978 DAVID J. NEWTON

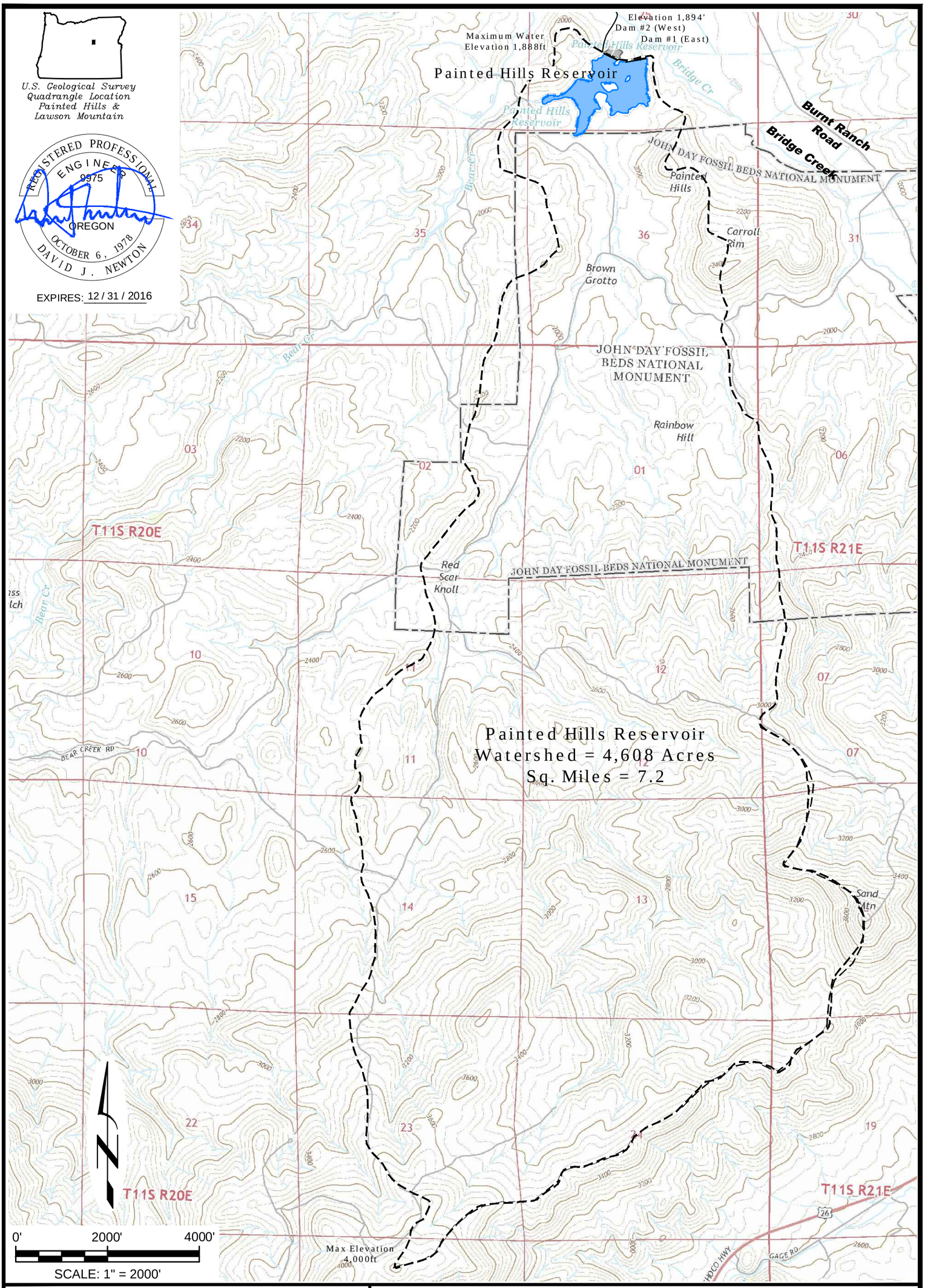
EXPIRES: 12 / 31 / 2016

Site Plan - Existing Dam #1 (East) & Dam #2 (West) - & Emergency Spillway
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960 Fax: 541 504-9961

DESIGNED BY: J. Newton	DRAWN BY: S. Schenck	DATE: Nov 2015	PROJECT NO. 1139-102

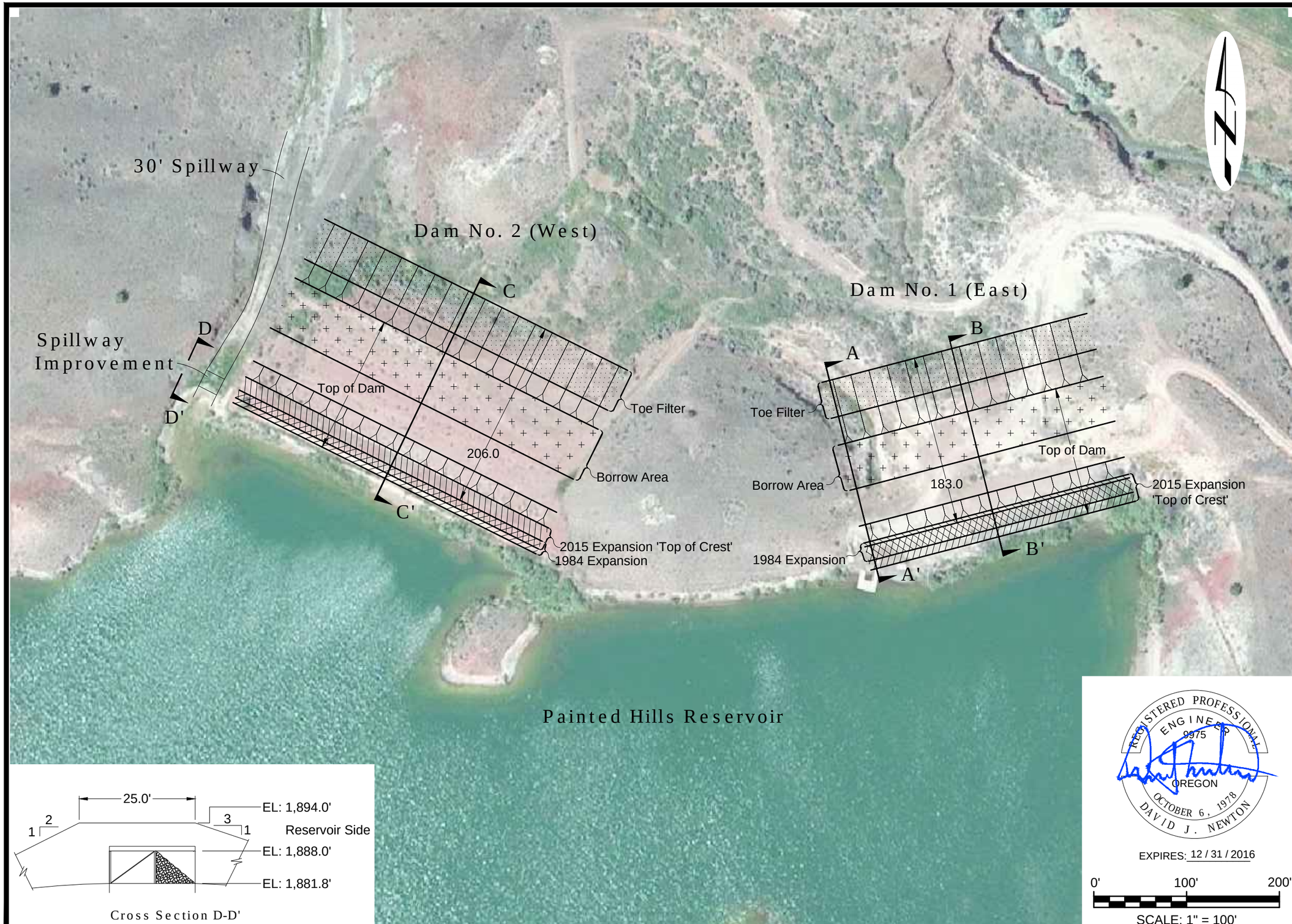
SHEET 2 OF 9



NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960 Fax: 541 504-9961

Site Plan - Existing Dam #1 (East) & Dam #2 (West) - & Watershed Area
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

DESIGNED BY:	DRAWN BY:	DATE:	PROJECT NO.	SHEET 3 OF 9
J. Newton	S. Schenck	Nov 2015	1139-102	



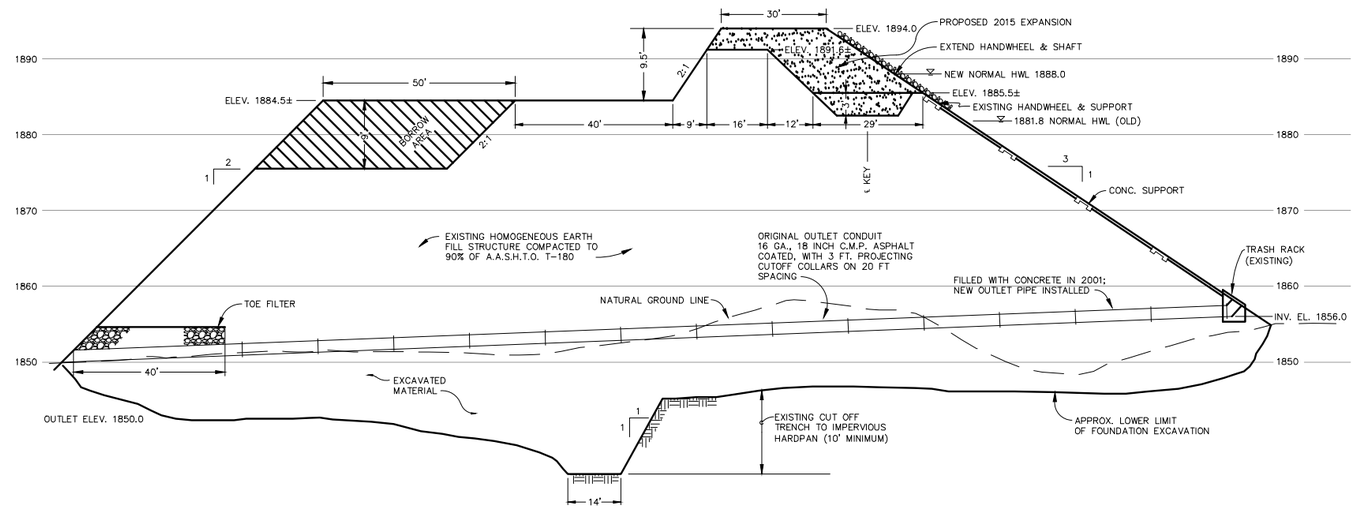
Proposed Improvements to Raise Dam #1 (East) & Dam #2 (West) - and to Modify Emergency Spillway

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960
Fax: 541 504-9961

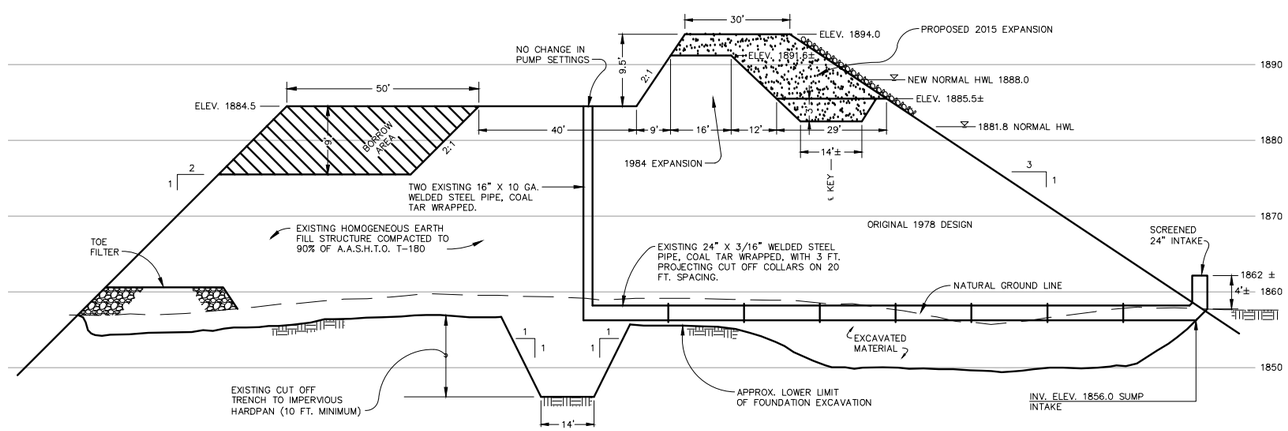
DESIGNED BY:	J. Newton
DRAWN BY:	S. Schenck
DATE:	Nov 2015
PROJECT NO.	1139-102
SHEET	4 OF 9



Cross Section Outlet Dam No. 1 (East Dam) A-A'

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'



Cross Section Pump Chamber Dam No. 1 (East Dam) B-B'

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'

EXPIRES: 12 / 31 / 2016

Cross-Sections Dam No.1 (East Dam)

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960 Fax: 541 504-9961

SHEET	5 OF 9
PROJECT NO.	1139-102
DATE:	Nov 2015
DRAWN BY:	S. Schenck
DESIGNED BY:	J. Newton

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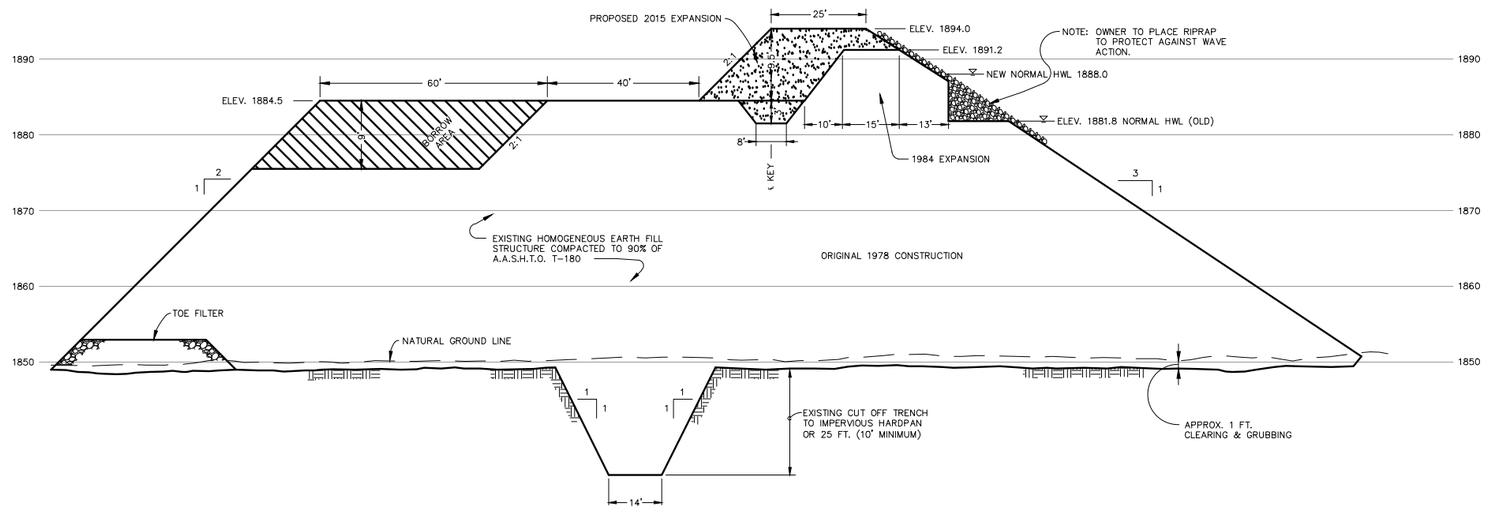

Cross Section Dam No. 2 (West Dam) C-C'

VERTICAL SCALE: 1" = 20'

HORIZONTAL SCALE: 1" = 40'

REGISTERED PROFESSIONAL ENGINEER 9975 OREGON OCTOBER 6, 1978 DAVID J. NEWTON

EXPIRES: 12 / 31 / 2016

Cross-Section Dam No.2 (West Dam)

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

SHEET 6 OF 9

PROJECT NO. 1139-102

DATE: Nov 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960 Fax: 541 504-9961

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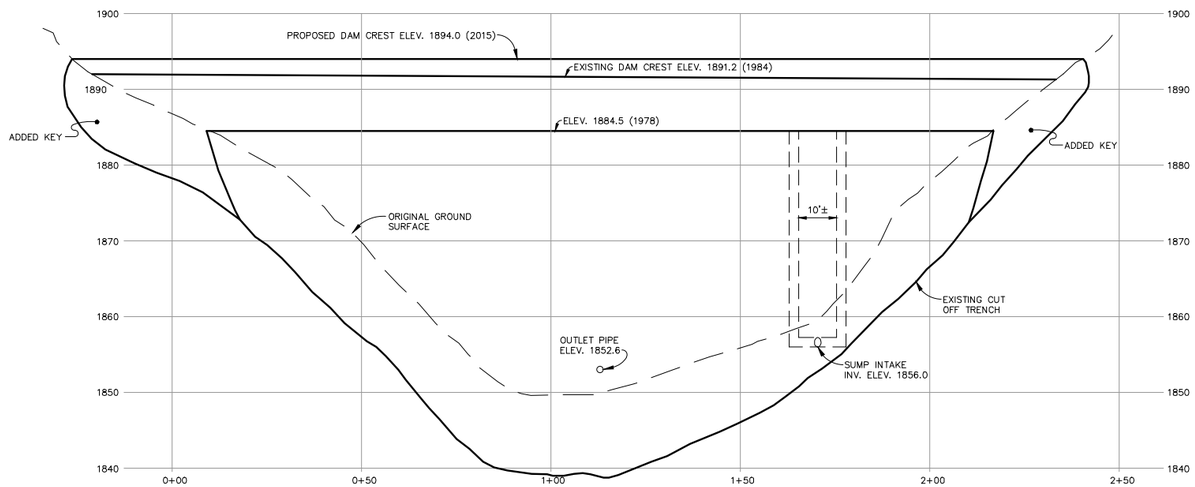
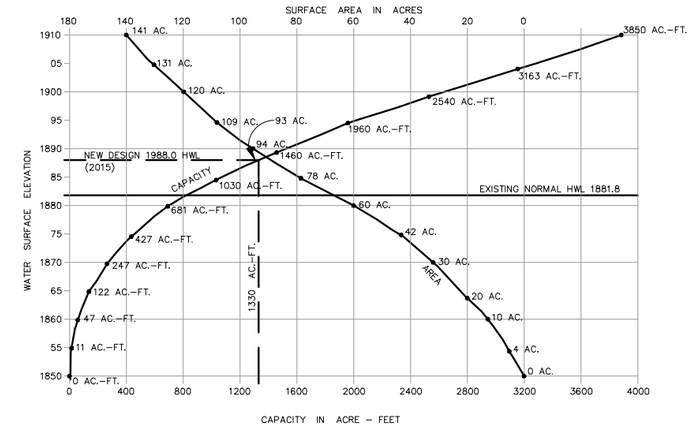
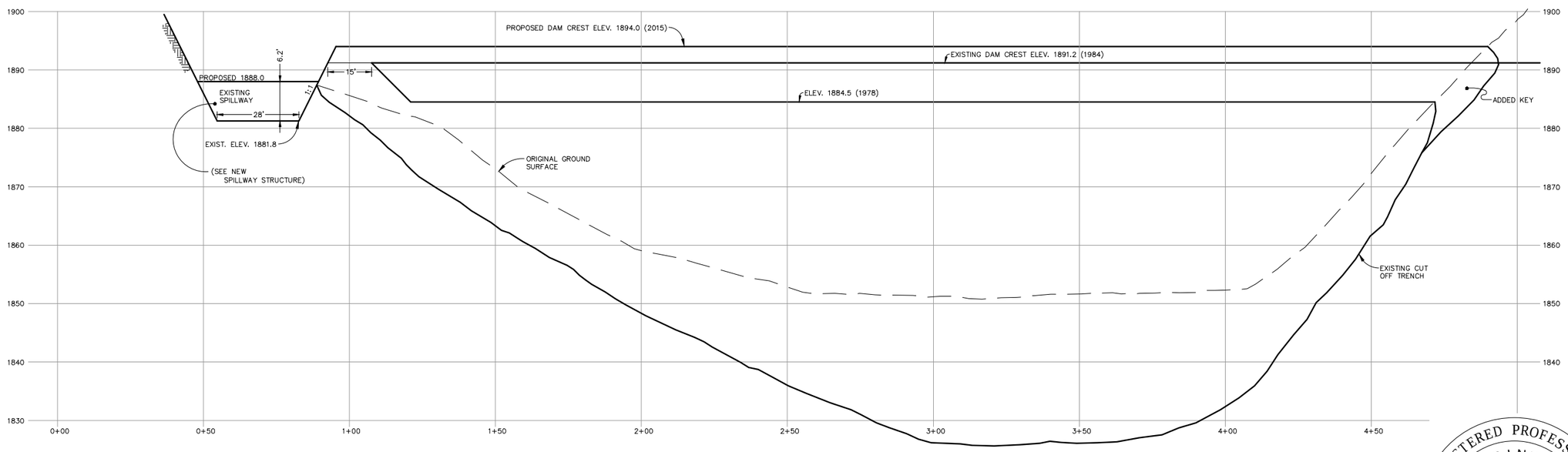


℄ Profile of Dam No. 1

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 40'



Area and Capacity Curve



℄ Profile of Dam No. 2

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 40'

REGISTERED PROFESSIONAL ENGINEER
9975
OREGON
OCTOBER 6, 1978
DAVID J. NEWTON

EXPIRES: 12 / 31 / 2016

Profiles Dam #1 (East) & Dam #2 (West) - Area and Capacity Curve
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

SHEET 7 OF 9

PROJECT NO. 1139-102

DATE: Nov 2015

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960
Fax: 541 504-9961

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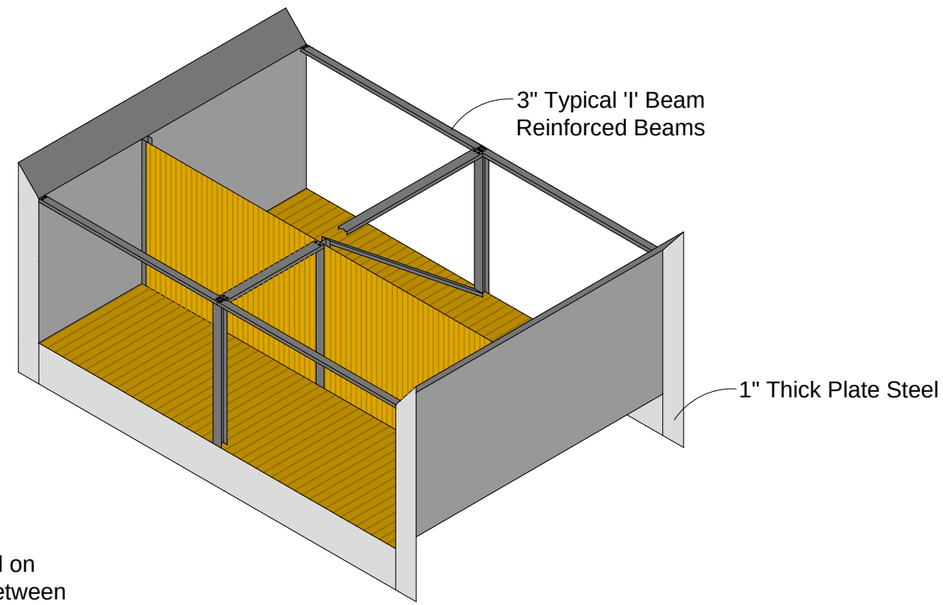
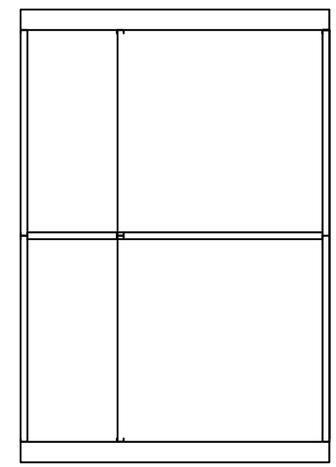
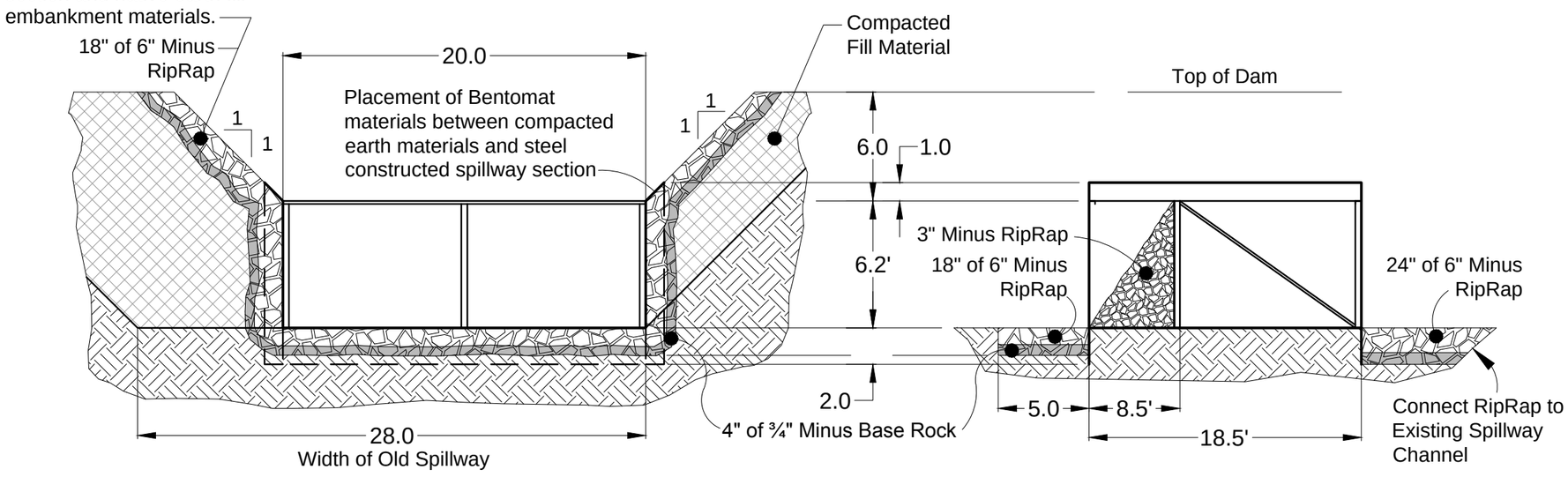




EXPIRES: 12 / 31 / 2016



Details - Emergency Spillway Modifications
Painted Hills Reservoir - Application No. R-84459
Wheeler County, Oregon

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960
Fax: 541 504-9961

SHEET	8 OF 9
PROJECT NO.	1139-102
DATE:	Nov 2015
DRAWN BY:	S. Schenck
DESIGNED BY:	J. Newton

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INSTALLATION SPECIFICATIONS - PAINTED HILLS RESERVOIR

CAST-IN-PLACE CONRETE

This work shall consist of construction of the modified steel emergency spillway structure in conformance with these specifications and in reasonable close conformity to the lines, grades and dimensions shown on the construction drawings established herein by the Engineer.

Concrete under this section shall be certified by the material supplier or Contractor to meet a compressive strength of 3000 psi at twenty-eight (28) days unless modified in the Special Provisions.

- A minimum of six sacks of cement shall be used per cubic yard of concrete and the maximum aggregate size shall be one and one-half (1 ½) inches.
- The cement, sand, aggregate, bentonite (4% by volume) shall be proportioned in a workable mix so as to meet the strength and durability required.
- The Engineer prior to their use shall approve all admixtures; however, the Engineer may require certain admixtures such as retarders if they are deemed necessary.
- The concrete slump, as measured at the site, shall not exceed four (4) inches.

DAM EMBANKMENT MATERIALS

Soil Types

Soil material for the dam embankment will be excavated from the area of the downstream face of each respective dam as see on Sheets 5 and 6. Soil encountered in the general borrow area appear consist of primarily Sandy Clay (CL) and Sandy Silt (MH). The CL and MH soils appear to be the prevailing soil type which will make up a large part of the dam embankment fill, as appears to be the case of the existing Dam No. 1 and Dam No. 2. (See *GEOTECHNICAL CONSIDERATIONS CONSTRUCTION TO RAISE DAM NO. 1 (EAST DAM) AND DAM NO. 2 (WEST DAM) PAINTED HILLS RESERVOIR APPLICATION 84459 November 30, 2015*)

Preparation of Subgrade to Receive Fill

Subgrade includes ground upon which new embankment fill is to be placed. This includes any existing dam fill. Prior to placement of any fill, the existing ground surface shall be stripped of vegetation and organic debris. The stripped ground surface in the area to receive fill shall be excavated to form a "key" as shown on Sheets 5 and 6. The bottom of the "key" shall be scarified to a minimum depth of 6 inches, brought to the optimum moisture content plus 3 percent, and then compacted to 95 percent of the maximum dry density in accordance with ASTM D-698 prior to placement of any fill thereon.

Placement and Compaction of Dam Embankment Materials

Dam embankment fill shall be spread over the embankment surface and blended to avoid concentrations of relatively clean sandy or gravelly soils in layers or lenses that could provide pathway for water to migrate from the reservoir through the dam embankment. Blending shall result in an integrated fill matrix without layers or lenses of sand or gravely materials. Moisture conditioning shall also be conducted during spreading and blending of embankment soils to help develop more uniform moisture conditions throughout the fill material. Cobbles larger than 6 inches shall be removed from the fill.

Fill soils from the designated borrow areas shall be placed in uncompacted lifts of 6 inches or less in thickness, brought to a moisture content of optimum plus 3 percent, and then compacted to at least 95 percent of maximum dry density in accordance with ASTM D-698.

It is recommended that the soils in the borrow areas be scarified, moistened and mixed prior to their placement in the proposed fill areas in order to improve consistency and uniformity of moisture throughout the soils.

Prior to placement of new fills against the fill slopes of the existing 1984 "berms", the existing fill slopes shall be benched by cutting horizontally into the slope at least 5 feet, resulting in a vertical cut wall. When new fill reaches the top of the vertical cut wall, a new bench shall be cut into the slope as before, such that the new fill will be integrated into the existing "berm" fills with a keyed interface as shown on the accompanying construction drawings.

The area of the proposed emergency spillway improvements shall be stripped of existing vegetation and other organic materials, including previously placed riprap materials. The stripped ground surface shall be scarified to a minimum depth of 6 inches, brought to the optimum moisture content plus 3 percent and compacted to at least 95 percent of the maximum dry density prior to placement of any fill or structures thereon.

EROSION PROTECTION - DAM SPILLWAY

RipRap

Riprap material for the upstream embankment slope, spillway and outfall apron, shall consist of well-graded, durable rock with a specific gravity of at least 2.4.

Slope Protection for Upstream Dam Face

Rock for riprap shall be graded as follows.

- 6-inch base layer of 3-inch minus rock
- 8-inch base layer of 6-inch riprap
- 18-inch layer of 12-inch riprap

Blending material underlying the riprap shall consist of a 6-inch thick layer of coarse sandy grave or grave.

Spillway Control Section

The spillway control section shall be constructed of 1 inch thick plate steel welded in accordance with AWI applicable standards, see Sheet 8 for spillway control section *Emergency Spillway Modifications.* The steel spillway control section shall be placed upon an area of stripped and compacted native or fill materials and cast with 4 percent hydrated bentonite concrete meeting CAST-IN-PLACE CONCRETE specifications herein.

The sidewalls of the steel spillway control section shall be compacted in accordance with Placement of Dam Embankment Fill Materials contained herein. Upon completion of prepared embankment fill material, prior to final placement of the steel spillway control section, the sidewalls shall be lined with Bentomat® "CS" in accordance with Structure - Edge Sealing as outlined by Bentomat®, which include;

Installing a small notch against the edge of the embankment fill material, the Bentomat should be place against the fill embankment and trimmed to fit snugly in the installed notch. The notch should then be packed half full with the rich soil/bentonite mixture or pure Volclay® (4 parts soil to 1 part Volclay® bentonite). The flap of Bentomat® may then be placed into the notch and once the steel spillway control section is placed, any remaining gap can be packed with the remaining Volclay®. Once the Bentomat® and Volclay® are placed, these sections should be hydrated.

Once hydrated, the Veloclay® bentonite seal will allow for settlement or other stresses that may ted to pull the Bentomat® from the edge or separate from steel controlled spillway section.

RipRap:

Steel Spillway Control Section and Approach shall be graded as follows:

- 4-inch thick layer of ¾"-inch minus base rock
- 18-inch thick layer of 6-inch minus riprap; most stones of 4 to 6-inch size

Spillway Channel Downstream and Control Section

Riprap:

Spillway Channel shall be graded as follows:

- 4-inch thick layer of ¾"-inch minus base rock
- 24-inch thick layer of 6-inch minus riprap; most stones of 4 to 6-inch size

REGISTERED PROFESSIONAL ENGINEER 9975 OREGON OCTOBER 6, 1978 DAVID J. NEWTON

EXPIRES: 12 / 31 / 2016

Specifications

Painted Hills Reservoir - Application No. R-84459

Wheeler County, Oregon

SHEET 9 OF 9

PROJECT NO. 1139-102

DATE: Nov 2015

NEWTON CONSULTANTS INC.
Earth, Water and Rock Specialists
Ph: 541 504-9960 Fax: 541 504-9961

DRAWN BY: S. Schenck

DESIGNED BY: J. Newton

G:\1100\1139 Painted Hills\102\Cad\Water\W1139102_S5_XSecDam 08:04 11/24/2015 SS

Line Item	# of Units	Unit Cost	In-Kind Match	Cash Match	OWRD Funds	Total Cost
Materials Reservoir						
steel for spillway (lbs)	42,000	$ 0.76			$ 31,920.00	$ 31,920.00
flow measuring devises (4 flow, 1 staff)	5	$ 4,350.00			$ 21,750.00	$ 21,750.00
pipe for flow measuring devises	1	$ 14,000.00			$ 14,000.00	$ 14,000.00
					$ -	$ -
Materials Road Work					$ -	$ -
railcar for bridge replacement	2	$ 8,500.00			$ 17,000.00	$ 17,000.00
bridge footers	2	$ 3,500.00			$ 7,000.00	$ 7,000.00
rock for road base (yrds)	5,000	$ 5.50			$ 27,500.00	$ 27,500.00
gravel for road (yrds)	1,500	$ 15.75			$ 23,625.00	$ 23,625.00
large rock for bridge (yrds)	300	$ 24.00			$ 7,200.00	$ 7,200.00
Materials Bear Creek Conveyance					$ -	$ -
24" class 125 PVC	3,000	$ 31.00		$ 93,000.00	$ -	$ 93,000.00
					$ -	$ -
Materials Irrigation					$ -	$ -
2-o power wire (ft)	3,200	$ 2.85		$ 9,120.00	$ -	$ 9,120.00
8" class 125 pvc	3,200	$ 4.67		$ 14,944.00	$ -	$ 14,944.00
misc fittings and valves	1	$ 4,500.00		$ 4,500.00	$ -	$ 4,500.00
					$ -	$ -
Contractual Services Reservoir					$ -	$ -
raise reservoir	1	$ 249,120.00			$ 249,120.00	$ 249,120.00
replace drain valve	1	$ 12,000.00			$ 12,000.00	$ 12,000.00
					$ -	$ -
Contractual Services Road Work					$ -	$ -
raise south road w/ new phoneline (ft)	3,000	$ 14.50			$ 43,500.00	$ 43,500.00
bridge installation	1	$ 15,000.00			$ 15,000.00	$ 15,000.00
					$ -	$ -
Contractual Services Bear Creek Conveyance					$ -	$ -
24" class 125 PVC installation	3,000	$ 12.75		$ 38,250.00	$ -	$ 38,250.00
Contractual Services Irrigation					$ -	$ -
900ft Reinke Pivot installed	1	$ 56,000.00		$ 56,000.00	$ -	$ 56,000.00
100 hp frequency drive unit installed	1	$ 13,500.00		$ 13,500.00	$ -	$ 13,500.00
100 hp pump modification/rebuild	1	$ 12,500.00		$ 12,500.00	$ -	$ 12,500.00
pipe/power installation (ft)	3,200	$ 7.75	$ 24,800.00		$ -	$ 24,800.00
misc labor	1	$ 3,500.00		$ 3,500.00	$ -	$ 3,500.00
					$ -	$ -
Contractual Services					$ -	$ -
reservoir and dam engineering oversight (Newton)	1	$ 18,500.00			$ 18,500.00	$ 18,500.00
road and bridge engineering and survey services (RSI)	1	$ 14,850.00			$ 14,850.00	$ 14,850.00
pump, pipe, pivot, measuring devise engr (RSI)	1	$ 11,500.00			$ 11,500.00	$ 11,500.00
cutlural survey	1	$ 5,500.00			$ 5,500.00	$ 5,500.00
Wheeler SWCD fiscal administration	1	$ 4,500.00			$ 4,500.00	$ 4,500.00
claim of benefical use, 25% release cert.,	1	$ 6,500.00			$ 6,500.00	$ 6,500.00
Total			$ 24,800.00	$ 245,314.00	$ 530,965.00	$ 801,079.00

Benn Eilers <benn80@gmail.com>

Affected Tribes for Water Supply Development Account Grants

5 messages

Benn Eilers <benn@rsiengr.com> Mon, Jan 4, 2016 at 5:42 AM
To: karen.m.quigley@state.or.us

Karen -

I am writing to request a list of possible affected Indian Tribes for two Water Supply Development Account grants that we are working on.

The first project is a 2.5 mile long pipeline located in Crook County.
Lat Long: 44.377, -120.184
Township 14S , Range 21E, Sections: 2,3,10,11

The second project is a reservoir expansion project located in Wheeler County.
Lat Long: 44.668, -120.277
Township 10S, Range 20E, Section 25 (SW quarter)

Let me know if you need any further information.
Thank you in advance for your assistance.

Benn Eilers

Engineering Technician
RSI
Redmond, OR
541 678-3969

Quigley Karen M <karen.m.quigley@state.or.us> Mon, Jan 4, 2016 at 7:34 AM
To: Benn Eilers <benn@rsiengr.com>

Good Morning, Ben.
Could you please provide the names of nearest city/town for your projects.
Thanks,
Karen

Sent from my Verizon Wireless 4G LTE DROID
[Quoted text hidden]

Benn Eilers <benn@rsiengr.com> Mon, Jan 4, 2016 at 7:52 AM
To: Quigley Karen M <karen.m.quigley@state.or.us>

Hi Karen -

The closest town to both projects is Mitchell.
The pipeline project is located approximately 15 miles due south of Mitchell (and 35 miles E-NE of Prineville). It is located on Big Summit Prairie, a large private in-holding in the center of a section of Ochoco National Forest.
The reservoir expansion is located approximately 9 miles NW of Mitchell, adjacent to the Painted Hills National Monument.

Thanks
Benn

[Quoted text hidden]

Quigley Karen M <karen.m.quigley@state.or.us> Mon, Jan 4, 2016 at 9:21 AM
To: Benn Eilers <benn@rsiengr.com>

Hello, Benn.
Thanks for the additional info.
There are three Oregon Tribes who may have ancestral ties/or consider this area to be a traditional area of interest. Here is contact info for the respective Tribes' cultural resources directors:
Kathleen Sloan, Confederated Tribes of Warm Springs. Kathleen. Sloan@ctwsbnr.org
Diane Teeman, Burns Paiute Tribe, dlteeman.burns.paiute@gmail.com
Perry Chocktoot, the Klamath Tribes
Perry.Chocktoot @klamthtribes.com
Regards,
[Quoted text hidden]
[Quoted text hidden]

Benn Eilers <benn@rsiengr.com> Mon, Jan 4, 2016 at 10:24 AM
To: Quigley Karen M <karen.m.quigley@state.or.us>

Thank you very much Karen!
[Quoted text hidden]

Benn Eilers <benn80@gmail.com>

Upcoming Water Supply Projects

3 messages

Benn Eilers <benn80@gmail.com> Mon, Jan 4, 2016 at 12:15 PM
To: perry.chocktoot@klamathtribes.com

Perry -

I work for an engineering consulting firm (RSI) out of Central Oregon and was given your contact info from Karen Quigley at LCIS. I am in the process of putting together two Water Supply Development Account grants (http://www.oregon.gov/owrd/Pages/Water_Supply_Development_Account.aspx) that may be in areas of interest to the Klamath Tribes.

The first project is a 2.5 mile long pipeline located in Crook County.
Lat Long: 44.377, -120.184
Township 14S , Range 21E, Sections: 2,3,10,11
This project is located approximately 15 miles due south of Mitchell (and 35 miles E-NE of Prineville). It is located on Big Summit Prairie, a large private in-holding in the center of a section of Ochoco National Forest.

The second project is a reservoir expansion project located in Wheeler County.
Lat Long: 44.668, -120.277
Township 10S, Range 20E, Section 25 (SW quarter)
The reservoir expansion is located approximately 9 miles NW of Mitchell, adjacent to the Painted Hills National Monument.

I've attached location maps as PDFs to this email
If you could advise on the likelihood of encountering any culturally significant sites in this area it would be very helpful.

Thank you in advance
Benn Eilers

Engineering Technician
RSI
Redmond, OR
541 678-3969

------- Forwarded message ------
From: **Quigley Karen M** <karen.m.quigley@state.or.us>
Date: Mon, Jan 4, 2016 at 9:21 AM
Subject: Re: Affected Tribes for Water Supply Development Account Grants
To: Benn Eilers <benn@rsiengr.com>

Hello, Benn.
Thanks for the additional info.
There are three Oregon Tribes who may have ancestral ties/or consider this area to be a traditional area of interest. Here is contact info for the respective Tribes' cultural resources directors:
Kathleen Sloan, Confederated Tribes of Warm Springs. Kathleen. Sloan@ctwsbnr.org
Diane Teeman, Burns Paiute Tribe, dlteeman.burns.paiute@gmail.com
Perry Chocktoot, the Klamath Tribes
Perry.Chocktoot @klamthtribes.com
Regards,
Karen

Sent from my Verizon Wireless 4G LTE DROID

Benn Eilers <benn@rsiengr.com> wrote:

Hi Karen -

The closest town to both projects is Mitchell.
The pipeline project is located approximately 15 miles due south of Mitchell (and 35 miles E-NE of Prineville). It is located on Big Summit Prairie, a large private in-holding in the center of a section of Ochoco National Forest.
The reservoir expansion is located approximately 9 miles NW of Mitchell, adjacent to the Painted Hills National Monument.

Thanks
Benn

On Mon, Jan 4, 2016 at 7:34 AM, Quigley Karen M <karen.m.quigley@state.or.us> wrote:

> Good Morning, Ben.
> Could you please provide the names of nearest city/town for your projects.
> Thanks,
> Karen
>
> *Sent from my Verizon Wireless 4G LTE DROID*
>
> Benn Eilers <benn@rsiengr.com> wrote:
>
> Karen -
>
> I am writing to request a list of possible affected Indian Tribes for two Water Supply Development Account grants that we are working on.
>
> The first project is a 2.5 mile long pipeline located in Crook County.
> Lat Long: 44.377, -120.184
> Township 14S , Range 21E, Sections: 2,3,10,11
>
> The second project is a reservoir expansion project located in Wheeler County.
> Lat Long: 44.668, -120.277
> Township 10S, Range 20E, Section 25 (SW quarter)
>
> Let me know if you need any further information.
> Thank you in advance for your assistance.
>
> Benn Eilers
>
> Engineering Technician
> RSI
> Redmond, OR
> 541 678-3969

---

2 attachments

Allen Ck Pipeline Location Map.pdf
3168K

Painted Hills RES Basemap.pdf
723K

Perry Chocktoot <perry.chocktoot@klamathtribes.com> Mon, Jan 4, 2016 at 1:23 PM
To: Benn Eilers <benn80@gmail.com>

I appreciate the notification but these projects are outside our aboriginal territories. We will have to defer to the Warm Springs Nation.

From: Benn Eilers [mailto:benn80@gmail.com]
Sent: Monday, January 04, 2016 12:16 PM
To: Perry Chocktoot
Subject: Upcoming Water Supply Projects

[Quoted text hidden]

Benn Eilers <benn80@gmail.com> Mon, Jan 4, 2016 at 1:27 PM
To: Perry Chocktoot <perry.chocktoot@klamathtribes.com>

Thank you for your quick response. It is greatly appreciated

Benn
[Quoted text hidden]

Benn Eilers <benn80@gmail.com>

Upcoming Water Supply Projects and cultural resources

Kathleen Sloan <kathleen.sloan@ctwsbnr.org> Wed, Jan 6, 2016 at 1:13 PM
To: benn@rsiengr.com
Cc: Roberta Kirk <roberta.kirk@ctwsbnr.org>, Quigley Karen M <karen.m.quigley@state.or.us>

Hello Benn,

I received an email fwd from Karen Quigley re: your inquiry into 2 project areas slated for water supply improvements. The first project is a 2.5 mile long pipeline located in Crook County.

> Lat Long: 44.377, -120.184
> Township 14S , Range 21E, Sections: 2,3,10,11
> This project is located approximately 15 miles due south of Mitchell (and 35 miles E-NE of Prineville). It is located on Big Summit Prairie, a large private in-holding in the center of a section of Ochoco National Forest.
>
> The second project is a reservoir expansion project located in Wheeler County.
> Lat Long: 44.668, -120.277
> Township 10S, Range 20E, Section 25 (SW quarter)
> The reservoir expansion is located approximately 9 miles NW of Mitchell, adjacent to the Painted Hills National Monument.

We have completed an initial review of the proposed project areas and our files and both locations are in close proximity to previously recorded sites (pre-contact lithic scatters) and also traditional use areas for the Confederated Tribes of Warm Springs. The area has had little prior field inventory for cultural resources but we consider both locations to have a high probability for cultural and archaeological resources. We would recommend a full field inventory of the project in order to identify and protect any cultural resources that could be impacted by proposed project activities.

Thank you for contacting us about your project.

Kathleen Sloan, PhD
Manager

Warm Springs Geo Visions
Cultural Resource Department
Confederated Tribes of the Warm Springs Reservation of Oregon

PO Box 460
Warm Springs, Oregon 97761

ph: 541.553.3464
fax: 541-553-3584
kathleen.sloan@ctwsbnr.org

Oregon Water Resources Department
Water Rights Division

Water Rights Application
Number R-84459

Final Order

Application History
On JUNE 21, 2000, WILLIAM L SMITH FOR DERBY SMITH PARTNERS LLC submitted an application to the Department for a water use permit. The Department issued a Proposed Final Order on February 18, 2003. The protest period closed April 4, 2003, and no protest was filed.

The proposed use would not impair or be detrimental to the public interest, but the Department's continuing evaluation reveals that the Proposed Final Order requires modification to correctly describe the dam location and points of diversion.

Order

Upon payment of outstanding permit recording fees, and Department approval of dam plans and specifications, Application R-84459 shall be approved as proposed by the Proposed Final Order and as provided on the attached draft permit.

Permit recording fees are required in the amount of $ 175.00.00. Said fees are due and payable no later than 60 days from the date of this Final Order. Failure to pay the required permit recording fees, and/or submission of plans and specifications to be approved by the Department, within 60 days from the date of this Final Order may result in the proposed rejection of Application R-84459.

If you need to request additional time to submit the required fees, the written request should be received in the Salem office of the Department by the deadline above. The Department will evaluate the request and determine whether or not the request may be granted.

DATED May 1, 2003

Dwight Ferrell for
Paul R. Cleary, Director

Hear and Appeal Rights

Under the provisions of ORS 537.170 and ORS 537.622, the applicant may request a contested case hearing by submitting the information required for a protest under ORS 537.153(6) or ORS 537.621(7) to the Department within 14 days after the date of mailing of this order as shown below. If a contested case hearing is requested,

the Department must schedule one. In the contested case hearing, however, only those issued based on the above modifications to the proposed final order may be addressed.

ORS 536.075 allows for additional appeal rights for other than contested case. This is a final order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review of this order must be filed within the 60 day time period specified by ORS 183.484(2).

This statement of judicial review rights does not create a right to judicial review of this order, if judicial review is otherwise precluded by law. Where no changes have been made to a Proposed Final Order on a water right application and no protests have been filed during the protest period, the final order is not subject to judicial review.

This document was prepared by Anita Huffman. If you have any questions about any of the statements contained in this document I am the most likely the best person to answer your questions. You can reach me at 1-503-378-8455 extension 229.

If you have questions about how to file a protest or if you have previously filed a protest and want to know the status, please contact Renee Moulun. Her extension number is 239.

If you have other questions about the Department or any of its programs please contact our Water Rights Information Group at extension 201. Address all other correspondence to: Water Rights Section, Oregon Water Resources Department, 158 12th ST. NE Salem, OR 97301-4172, Fax: (503)378-2496

STATE OF OREGON

COUNTY OF WHEELER

DRAFT PERMIT TO CONSTRUCT A RESERVOIR AND STORE THE PUBLIC WATERS

THIS DRAFT PERMIT IS HEREBY ISSUED TO

WILLIAM L SMITH
DERBY SMITH PARTNERS LLC
15 SW COLORADO AVE STE A
BEND, OREGON 97702

(541) 382-6691

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: R-84459

SOURCE OF WATER: BEAR CREEK, A TRIBUTARY OF BRIDGE CREEK AND BRIDGE CREEK, A TRIBUTARY OF JOHN DAY RIVER

STORAGE FACILITY: PAINTED HILLS RESERVOIR

PURPOSE OR USE OF THE STORED WATER: FISH LIFE

MAXIMUM VOLUME: 500.0 ACRE FEET EACH YEAR

WATER MAY BE APPROPRIATED FOR STORAGE: APRIL 1 THROUGH APRIL 14

DATE OF PRIORITY: JUNE 21, 2000

The area submerged by the reservoir, when full, will be 120 ACRES.

DAM LOCATION: NE ¼ SW ¼, SECTION 25, T10S, R20E, W.M.; 1620 FEET NORTH & 240 FEET WEST FROM SOUTH CORNER, SECTION 25

POINTS OF DIVERSION:

POD #1 (BEAR CREEK) SW ¼ NE ¼, SECTION 35, T10S, R20E, W.M.; 2550 FEET SOUTH & 2600 FEET WEST FROM NE CORNER, SECTION 35

POD #2 (BRIDGE CREEK) NE ¼ NE ¼, SECTION 6, T11S, R21E, W.M.; 590 FEET SOUTH & 2160 FEET EAST FROM NORTH CORNER, SECTION 6

THE AREA TO BE SUBMERGED BY THE RESERVOIR IS LOCATED AS FOLLOWS:

NE ¼ SW ¼
NW ¼ SW ¼
SW ¼ SW ¼
SE ¼ SW ¼
NW ¼ SE ¼
SW ¼ SE ¼
SECTION 25
SE ¼ SE ¼
SECTION 26
NE ¼ NE ¼
SECTION 35
NW ¼ NE ¼
NE ¼ NW ¼
NW ¼ NW ¼
SE ¼ NW ¼
SECTION 36
TOWNSHIP 10 SOUTH, RANGE 20 EAST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. 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.

If the riparian area is disturbed in the process of developing a point of diversion, the permittee shall be responsible for restoration and enhancement of such riparian area.

The use may be restricted if the quality of the source stream or downstream waters decrease to the point that those waters no longer meet existing state or federal water quality standards due to reduced flows.

The permittee shall install, maintain, and operate fish screening to prevent fish from entering the proposed diversion. The permittee shall also install a fishway at the obstruction that will provide adequate upstream and downstream passage for fish. The permittee may submit evidence that the Oregon Department of Fish and Wildlife (ODFW) has determined screens and/or fishways are not necessary. The required screens and fishways are to be in place, functional, and approved by ODFW before diversion of any water.

The permittee shall install and maintain gaging stations with real time access. Operation of the gaging station shall occur during April 1 through April 14 of each year.

The permittee shall measure the total storage capacity on a weekly basis and shall submit the information to the watermaster within two days after April 1, April 7 and April 14 of each year.

The report shall include the stored acre-feet on April 1 and April 14, and the average cubic feet per second diversion from each creek on a daily basis.

The permittee shall also measure the total storage capacity of the reservoir on a monthly basis outside the allowed storage period. This information shall be submitted to the watermaster on a regular basis as required by the watermaster.

No water shall be stored until this department receives written certification from the engineer that construction has been completed in accordance with the approved plans and specifications, and written authorization for storage is received from this department.

STANDARD CONDITIONS

Use under this permit is limited to the reservoir area. This permit does not provide for the appropriation of water for maintaining the water level or maintaining a suitable fresh water condition.

The storage of water allowed herein is subject to the installation and maintenance of a fully functional conduit/gate assembly having a minimum diameter of 8 inches.

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.

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 allowed herein may be made only at times when sufficient water is available to satisfy all prior rights, including prior rights for maintaining instream flows.

The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

The reservoir shall be filled and complete application of the water to the use shall be made on or before October 1, 2007. If the water is not completely applied before this date, and the permittee wishes to continue development under the permit, the permittee must submit an application for extension of time, which may be approved based upon the merit of the application.

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 _____, 2003

DRAFT - THIS IS **NOT** A PERMIT

_____

Paul R. Clearly, Director
Water Resources Department

REAL ESTATE TRANSACTIONS: Pursuant to ORS 537.330, in any transaction for the conveyance of real estate that includes any portion of the lands described in this permit, the seller of the real estate shall, upon accepting an offer to purchase that real estate, also inform the purchaser in writing whether any permit, transfer approval order, or certificate evidencing the water right is available and that the seller will deliver any permit, transfer approval order or certificate to the

purchaser at closing, if the permit, transfer approval order or certificate is available.

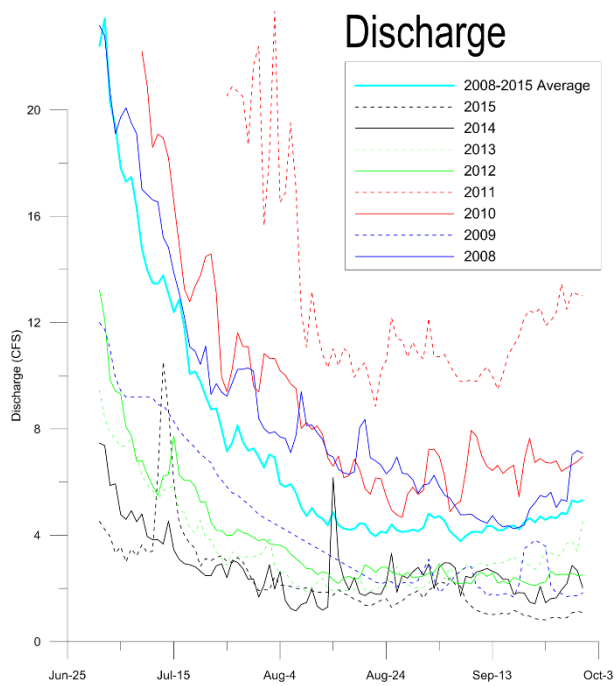
CULTURAL RESOURCES PROTECTION LAWS: Permittees involved in ground-disturbing activities should be aware of federal and state cultural resources protection laws. ORS 358.920 prohibits the excavation, injury, destruction or alteration of an archeological site or object, or removal of archeological objects from public and private lands without an archeological permit issued by the State Historic Preservation Office. 16 USC 470, Section 106, National Historic Preservation Act of 1966 requires a federal agency, prior to any undertaking to take into account the effect of the undertaking that is included on or eligible for inclusion in the National Register. For further information, contact the State Historic Preservation Office at 503-378-4168, extension 232.

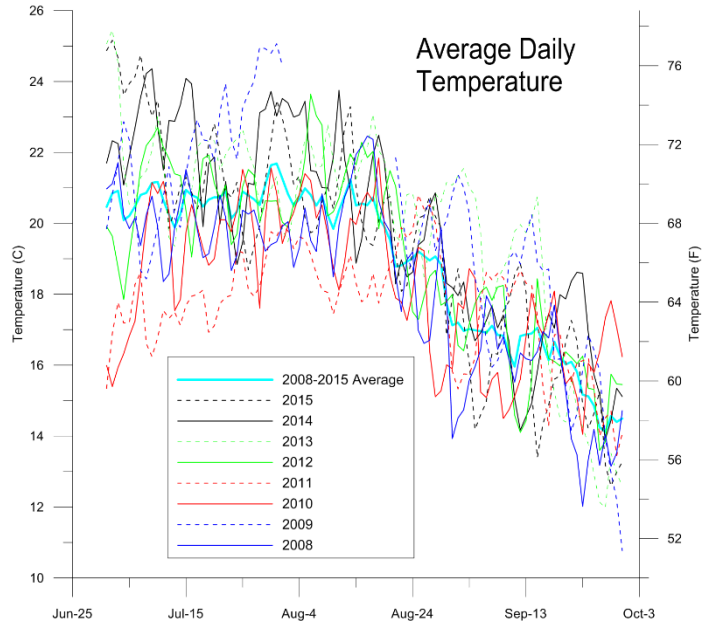
Memorandum

Date:	December 28, 2015
To:	Gabe Williams, Resource Specialists Inc.
From:	Joseph Eilers PH-WQ, President MaxDepth Aquatics, Inc.
Re:	Thermal effects of cold water discharge from Painted Hills Reservoir into Bridge Creek.

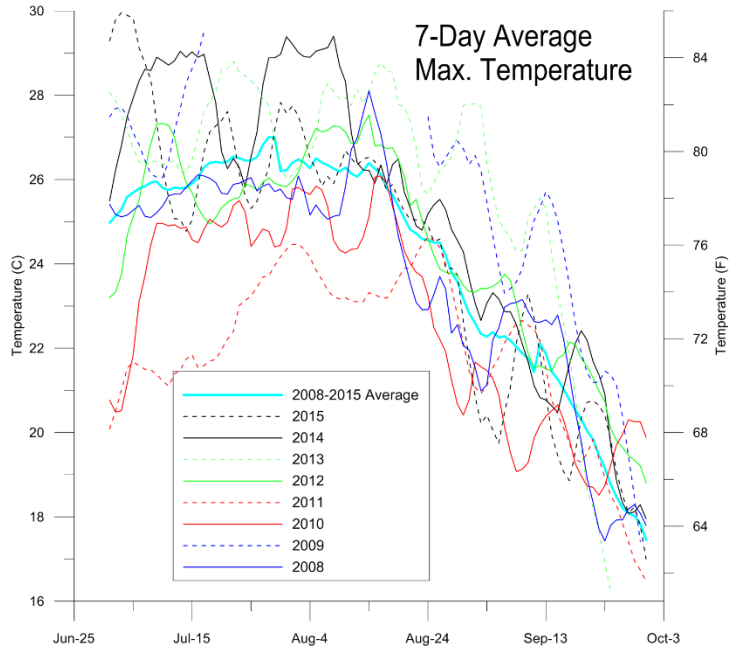
This memorandum is being prepared by MaxDepth Aquatics Inc. in response to a request from Resource Specialists Inc. Engineering design and analysis has been completed for the expansion of the Painted Hills Reservoir located near the confluence of Bridge Creek and Bear Creek in Wheeler County, Oregon. Part of the operating plan for the newly expanded reservoir includes the release of stored water back into the stream system during periods of low flow during the summer. This discharge is designed to improve in-stream conditions by increasing flows and reducing temperatures. This memorandum attempts to quantify the degree of both of these improvements.

The current design calls for the storage volume of the reservoir to be increased by approximately 500 acre-feet. Of this 500 acre-ft, 25%, or 125 acre-ft, will be designated for instream release. This released water will be most beneficial if returned to the stream during periods of low flow and elevated temperatures. There is a USGS flow gauge (14046778) on Bridge Creek approximately 7 miles downstream from the reservoir and one-half mile above the confluence with the John Day River. This gauge has flow and temperature data beginning in October of 2007. As there are no major tributaries or irrigation withdrawals between the project site and the gauge, the data from this site can be used as a surrogate for data at the project site. Discharge, average daily stream temperature, and 7-day average maximum temperature for the summer months over the period of record are shown on the following page. There are several trends that become evident when looking at these data: (1) base flow generally occurs from mid-July onwards, (2) peak temperatures subside towards the end of August, (3) years with higher summer discharge showed reduced temperatures throughout the summer and (4) the past four years (2012-2015) have had extremely low flows. The plot showing the 7-day average maximum temperature most strongly exhibits the relationship between low flows and elevated temperatures with average peak temperature measurements reaching above 27° C (80.6° F) for each of the past four years.

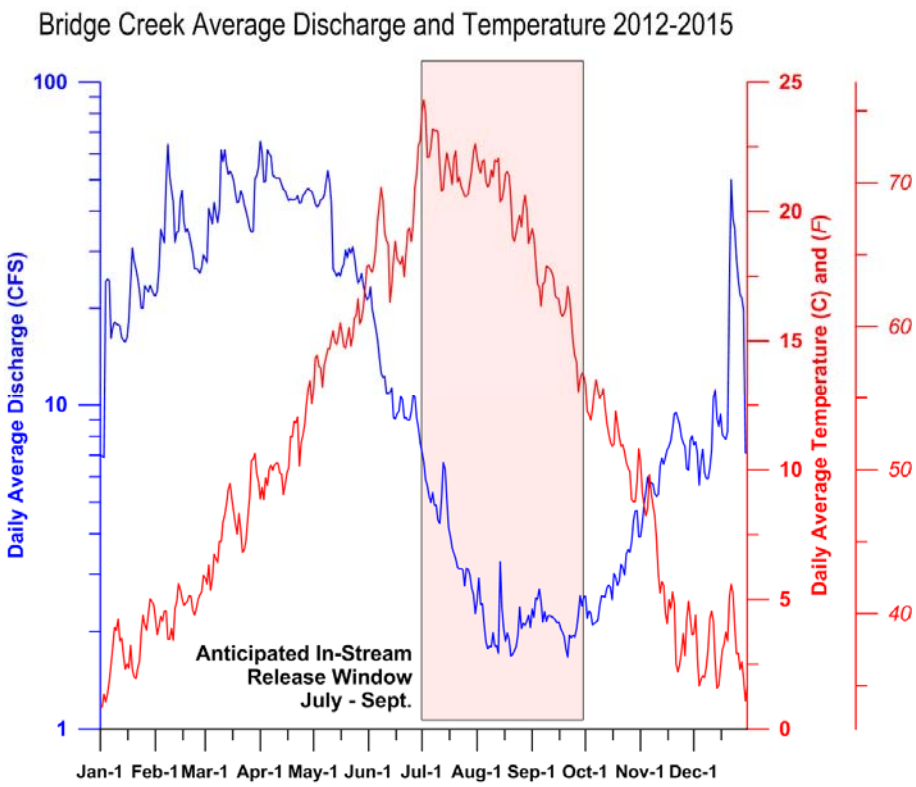




As touched on earlier, the most beneficial time period to release the cooler stored water would be during periods of relatively low flow with elevated temperatures. The window examined in these three plots shows the trends from July 1 through the end of September. By the beginning of July average temperatures are already exceeding 20° C (68° F) on average, but flows are still generally elevated. Conversely towards the end of August stream flows have just started to increase, yet average stream temperatures have declined below 15° C (59° F).

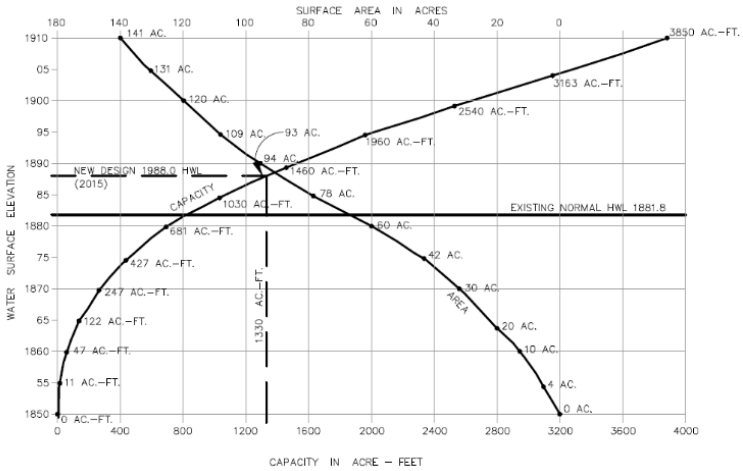


While the continuation of the drought cycle that has been seen over the past four years is uncertain, it can be deduced that the additional influx of cold water would have had the greatest positive effect during this period. The average discharge and temperature from this four year period is examined in the plot on the following page. A preliminary suggested discharge window is highlighted from July 1st through the end of September. This timing window encompasses the time period where elevated temperatures are seen in conjunction with low flows.



Reservoir Release Assumptions and Consequences

For this cursory examination, it is assumed that water will be discharged at a constant rate from July 1st through September 30th, a period of 92 days. The total volume of water available to be discharged is 125 acre-ft, which is equivalent to 0.685 cfs over this 92-day period. The greatest assumption in this analysis is the expected temperature of the release water. Temperature profiles of the reservoir are not available and the assumptions put forth in this memorandum are based largely on professional judgment derived from over 35 years of experience in working with lakes and reservoirs in a variety of regions. Once the impoundment is expanded, the high water level will be 1888 ft, with an outlet pipe elevation of 1852.6 ft, and a sump elevation of 1856 ft. So at maximum reservoir stage, the outlets will be approximately 32-35 ft below the surface. The volume of water in the lower 10 feet of the reservoir (1850-1860) is small (47 acre-ft) , whereas the volume of water in 10 ft – 20 ft range (1860-1870 ft) equals 200 acre-ft. This means that the deepest (and coldest) water from the reservoir could be exhausted quickly from withdrawals. It is important to note that the highest stream temperatures occur towards the beginning of the release period and



towards the end of the release period stream temperatures have greatly subsided. However, discharges would remain low. The majority of the stored water will be captured during April, when stream temperatures in Bridge Creek average near 10° C (50° F). It is anticipated that a thermocline will develop in the reservoir in June near a depth of 18 to 20 ft. Temperatures above this thermocline will reach about 23-25 °C with temperatures below the thermocline generally in the 12-14°C range. As summer progresses, the depth to the thermocline will increase as the surface waters are warmed through atmospheric and solar inputs. Over half of the volume of water of the reservoir is contained in the top 10 feet, meaning that once the volume of the reservoir is reduced by half the depth to the withdrawal will be 22-25 feet.

As indicated above, one of the larger uncertainties in this analysis is estimating what the temperature profile will be in the reservoir after it has been deepened. Where adequate resources are available, this can be accomplished using a hydrodynamic model with access to nearby climate data. However, in this case we must rely on judgment to help determine how the reservoir will behave. Wind velocity, direction, and duration are some of the important variables that will alter the temperature profile of an impoundment. Additionally, the changing geometry of the lake basin will affect the fetch and sheltering from wind. We can gain some perspective how Painted Hills Reservoir will distribute the incoming solar energy by examining similar impoundments. Two examples from the Atlas of Oregon Lakes (http://aol.research.pdx.edu/) and shown below suggest that some degree of thermal stratification will occur in Painted Hills Reservoir. Cottonwood Reservoir and Morgan Lake are smaller and higher elevation systems than is Painted Hills Reservoir (Table 1). The lower elevation will allow for greater thermal loading on Painted Hills Reservoir compared to the two examples and the greater fetch of Painted Hills Reservoir will allow for greater wind mixing than the other two reservoirs. Nevertheless, we should observe some thermal stratification in Painted Hills Reservoir that will be firmly established when the proposed period of water release begins on or about July 1. As the reservoir depth decreases during the drawdown, it will become less stable and more prone to destratification from strong wind events. Again, geometry of the diminished reservoir will factor into when the reservoir will destratify. The complex shape of Painted Hills Reservoir provides additional resistance to destratification and may allow the reservoir to retain some degree of stratification through the summer. Note that estimates of thermal stratification vary considerably among years, reflecting changes in air temperature, cloud cover, precipitation and wind.

Table 1. Attributes of three reservoirs in eastern Oregon.

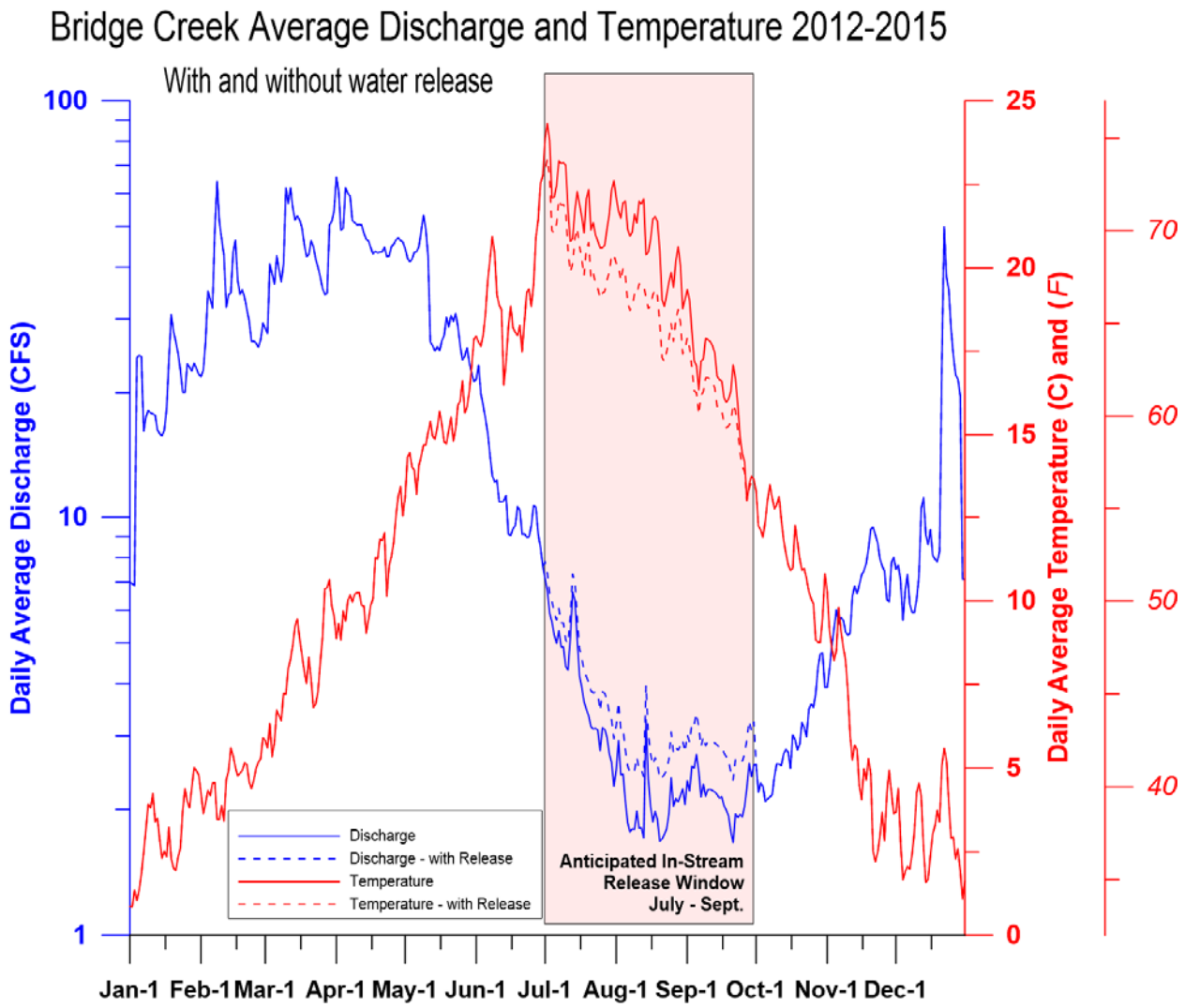
Attribute	**Cottonwood[a]**	**Morgan[b]**	**Painted Hills**
Lake Area (acres)	98	60	93
Maximum depth (ft)	46	26	38
Mean Depth (ft)	16	16	14
Volume (ac-ft)	1582	978	1330
Elevation (ft)	3988	4154	1888
Surface Temperature (°C)	20	23	*24[c]*
Bottom Temperature (°C)	8	10	*13[c]*
Maximum Fetch (ft)	5000	2600	8000

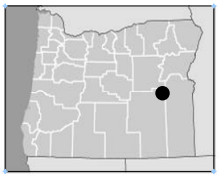
[a] Measured on June 23, 1982

[b] Measured on July 31, 1982

[c] Estimated

Using an estimated release temperature of 13° C (55.4° F) and a release rate of 0.685 CFS it is possible to examine the anticipated in-stream results of the water release. As expected, the greatest reduction in temperature occurs once flows have subsided in late July. The greater the summer flows, the less impact the water release will have. Consequently, and most importantly, the water release will have the greatest impact when it is most needed; periods of low flow and elevated temperature.





Cottonwood Reservoir

Harney County

Malheur River Basin

Location			
Area	98 acres (39.7 hect)	Elevation	3,988 ft (1,215.5 m)
Type	reservoir	Use	irrigation, recreation
Location	17 miles northwest of Juntura		
Access	11 miles on gravel and dirt roads from Drewsey		
USGS Quad	Cottonwood Reservoir (24K), Stinking Water Mountains (100K)		
Coordinates	43° 55' 36" N, 118° 17' 48" W		
USPLSS	township 19S, range 36E, section 09		

Cottonwood Reservoir is a small irrigation impoundment in the drainage of the Middle Fork of the Malheur River in eastern Oregon. It was formed in the mid-1960s with the construction of a 73-foot high earthfill dam on Cottonwood Creek. It is reported to have a capacity of 3700 acre-feet, but when mapped in August 1982 it was more than 20 feet below full pool and held less than half this volume. Irrigation storage is the primary use of the water, thus the water level drops considerably through the summer as withdrawals are made and delivered to irrigated agricultural land downstream on Cottonwood Creek.

The headwaters of Cottonwood Creek are in forested land within the Malheur National Forest, while in the lower reaches is land administered by the Bureau of Land Management. The reservoir itself is entirely on B.L.M. land. Fish have grown well in Cottonwood Reservoir since it was first stocked in the 1960s; however, there has been relatively little angling activity. No facilities have been provided for visitors, although improvements are planned.

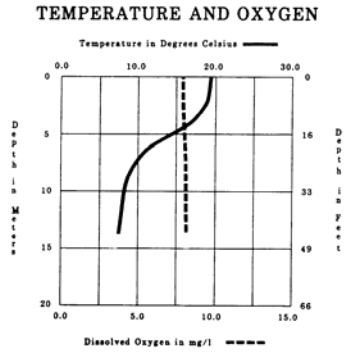
Cottonwood Reservoir is eutrophic; it has high concentrations of major ions and total phosphorus. The bottom of the reservoir is mud, and wave action sometimes gives rise to turbid water. Water transparency is reduced by both the suspended sediment and an abundance of phytoplankton (Aphanizomenon flos-aquae) blooms. In 1982, the reservoir was stratified as early as June 23, with the thermocline about 16 feet (5 meters) deep. Dissolved oxygen in the hypolimnion was near saturation levels; however, lower dissolved oxygen concentrations would be expected later in the summer. Water levels fluctuate greatly, and this prevents establishment of macrophytes.

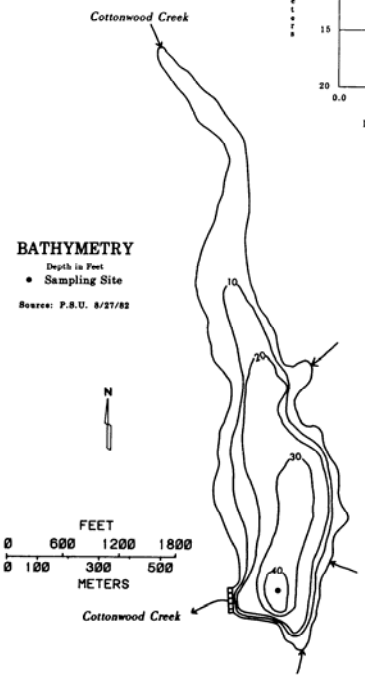
Source: Oregon National Guard, 1981-82. View looking north.

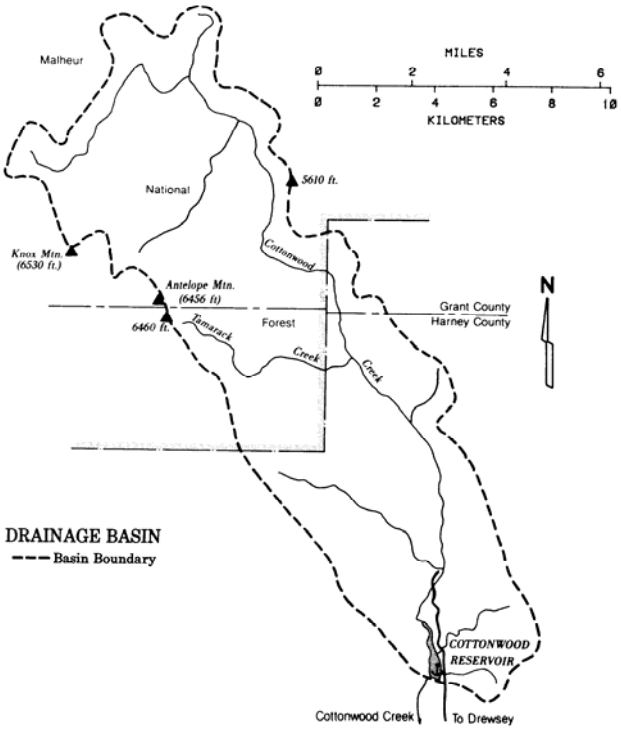
Drainage Basin Characteristics							
Area	58.2 sq mi (150.7 sq km)	Relief	moderate	Precip	12-25 in (30-64 cm)		
				Agriculture			
Land Use %	Forest	Range	Water	Irrig	Non Irrig	Urban	Other
	39.5	60.1	0.3	-	-	-	0.1
Notes	-						

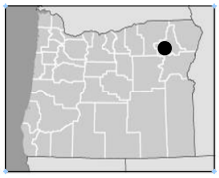
Lake Morphometry					
			Maximum	Average	
Area	98.0 acres (39.7 hect)	Depth	46 ft (14.0 m)	16ft (4.9 M)	
Ave/Max Depth Ratio	0.350	Volume	1,582 acre ft (1.95 cu hm)		
Shoal area	42%	Volume factor	1.05	Shape factor	2.07
Length of Shoreline	2.9 mi (4.7 km)	Retention time	2 mo		
Notes	-				

Water Quality						
Trophic status	eutrophic, suspended sediment and abundance of phytoplankton					
Sample date	06/23/82	Temp	67.1F (19.5C)	Diss. Oxygen (mg/l)	7.9	
Transparency	4.9 ft (1.5 m)	Phosp (mg/l)	0.069	Cholorophyl a (mg/l)	2.6	
Alkalinity	36	Conductivity (umhos/cm)	84	pH	7.8	
Major Ions	Na	K	Ca	Mg	Cl	SO4
	5.5	1.6	7.8	3.0	1.0	2.5
Notes	-					









Morgan Lake

Union County

Grande Ronde Basin

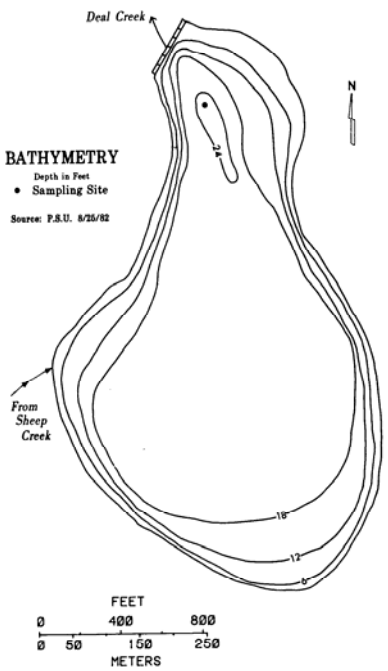
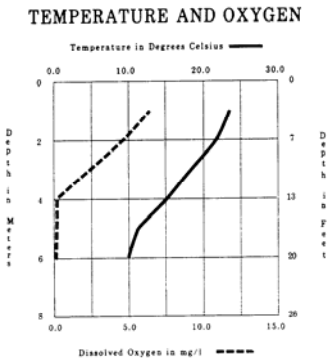
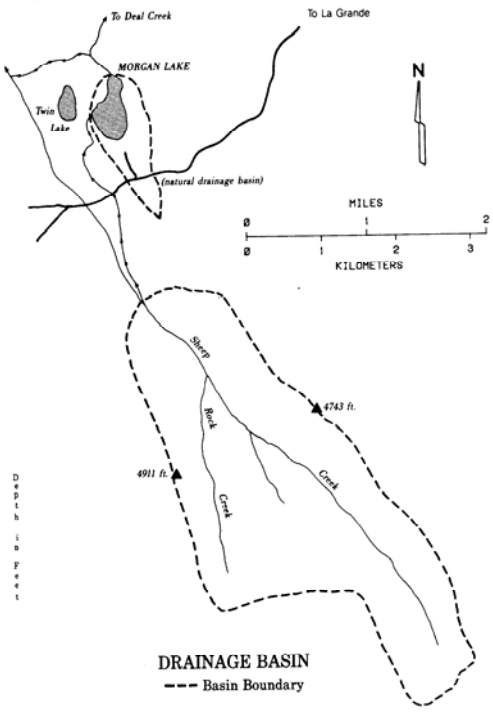
Location			
Area	60 acres (24.3 hect)	Elevation	4,154 ft (1,266.1 m)
Type	reservoir	Use	recreation, w ildlife habitat
Location	5 mi. southw est of LaGrande		
Access	Morgan Lake Road (gravel) from LaGrande		
USGS Quad	Hilgard (24K), La Grande (100K)		
Coordinates	45° 18' 05" N, 118° 08' 05" W		
USPLSS	tow nship 03S, range 37E, section -		

Morgan Lake is a small reservoir in the Powder River Valley near the city of LaGrande. It was built early in the century with the construction of a 22-foot high dam on Deal Creek, and it served originally as a private water supply. It has since been acquired for public fishing under a cooperative agreement among the city of LaGrande, the Oregon Department of Fish and Wildlife, and the Isaak Walton League. The lake is stocked regularly with rainbow trout, and the fish grow rapidly in the productive water; most anglers catch their limits. No motorboats are allowed on the lake. There are sanitary and picnic facilities available for visitors, but no campgrounds. However, there are several undeveloped campsites located on the shoreline. The natural drainage basin to Morgan Lake is very small, and the major inflow is water diverted through a canal from Sheep Creek. Outflow is into Deal Creek, with much of it returned immediately back to Sheep Creek. The terrain surrounding the lake is relatively flat and rocky and much of it is covered by a sparse pine forest. It is, for the most part, private land, although the lake itself is owned by the city of LaGrande.

The concentrations of major ions, alkalinity and conductivity in Morgan Lake are above average for lakes in northeastern Oregon. Water transparency is moderate (7.8 feet; 2.4 meters) and the chlorophyl concentrations are low. The concentration of phosphorus is surprisingly high and indicates that the lake should be classified as eutrophic. The environs are managed as a wildlife refuge, and there is a substantial population of ducks and other waterfowl on the lake. There is also some cattle grazing in the drainage basin, and both of these activities contribute to the elevated concentrations of phosphorus. Much of the lake is shallower than 10 feet, thus making nutrients available to the surface water. The lake develops a strong thermal stratification, and by late summer is sometimes anoxic below 15 feet depth. This clinograde oxygen curve is further evidence that the lake should be classified as eutrophic. The reducing conditions in the hypolimnion also accelerate the recycling of phosphorus from bottom sediments, further contributing to the elevated phosphorus in the surface water. Cattails, skunk cabbage, water lilies and other macrophytes develop in shallow areas.

Source: U.S. Forest Service, 1976. Vertical photograph.

Drainage Basin Characteristics							
Area	4.6 sq mi (11.9 sq km)	Relief	low	Precip	22 in (56 cm)		
				Agriculture			
Land	Forest	Range	Water	Irrig	Non Irrig	Urban	Other
Use %	65.5	32.5	2.0	-	-	-	-
Notes	-						

Lake Morphometry					
			Maximum	Average	
Area	60.0 acres (24.3 hect)	Depth	26 ft (7.9 m)	16ft (5.0 M)	
Ave/Max Depth Ratio	0.630	Volume	978 acre ft (1.21 cu hm)		
Shoal area	18%	Volume factor	1.88	Shape factor	1.20
Length of Shoreline	1.3 mi (2.1 km)	Retention time	indet.		
Notes	-				

Water Quality						
Trophic status	eutrophic, high concentration of phosphorous due to cattle grazing and w aterfow l					
Sample date	07/31/82	Temp	74.3F (23.5C)	Diss. Oxygen (mg/l)	6.3	
Transparency	7.9 ft (2.4 m)	Phosp (mg/l)	0.056	Cholorophyl a (mg/l)	1.8	
Alkalinity	28	Conductivity (umhos/cm)	73	pH	8.1	
Major	Na	K	Ca	Mg	Cl	SO4
Ions	4.4	1.5	6.4	2.6	2.1	2.6
Notes	Temp and D.O. at 1 meter