January 2016

EXECUTIVE SUMMARY AND PROJECT PROPOSAL

Dungeness Off-stream Reservoir Project

Prepared by Anchor QEA in Association with

PACIFIC groundwater GROUP
Water Resource & Environmental Consulting

WASHINGTON WATER TRUST

CITY OF SEQUIM

DUNGENESS WATER USERS ASSOCIATION

Clallam Conservation District

EXECUTIVE SUMMARY

The Dungeness Watershed provides critical water supply for irrigation and domestic uses. The river and its tributaries also provide critical habitat for a variety of fish and wildlife species, including species listed under the Endangered Species Act (ESA). Several studies completed over the past two decades have identified low flows as a limiting factor for ESA-listed species in the watershed.

Water resource managers have been working with local water users for more than two decades to study, develop, and implement projects that improve water use efficiency and allow for reduced diversions from the Dungeness River. Watershed planning efforts have identified storage as a critical part of the strategy for improving water supply and reducing diversions from the Dungeness River during critical low flow periods. The proposed 1,500-acre-foot Dungeness Off-channel Reservoir project offers a relatively large storage capacity with the ability to capture and store water by gravity, without pumping, and deliver stored water for irrigation to properties east of the Dungeness River in and around Sequim.

The proposed project also offers the following benefits:

- Restoration of Dungeness River flows during the critical low-flow period by reducing late summer irrigation diversions and supplying water for irrigation during the late summer from storage
- Greater water supply reliability for irrigation, which would result from storing water when flows are high and water is available and releasing stored water for irrigation during the critical low-flow period
- Enhanced stormwater control and reduced flooding by capturing stormwater flows intercepted by irrigation ditches above the reservoir and routing peak flows to the reservoir for storage
- Potential for using stored water for aquifer recharge by infiltrating stored water in the shallow aquifer, which would enhance late summer baseflow in the Dungeness River and other streams
- Potential opportunities for public recreation, including improved access for hiking, wildlife viewing, and other recreational activities
- Potential opportunities for enhancing wildlife habitat

This document summarizes benefits of the proposed project, describes how the reservoir would be operated to deliver those benefits, and outlines the costs associated with the project. The document is intended to inform project stakeholders, including potential funding partners, about the project. Project partners plan to complete detailed designs for the proposed project within the next two years. Project partners also plan to work on securing construction funding, acquiring land, and permitting the project so that the reservoir can be constructed by the end of 2020.

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INTRODUCTION

The Dungeness River flows from the Olympic Mountains north to the Strait of Juan de Fuca on the Olympic Peninsula in Washington State. The Dungeness River Watershed supports wilderness and protected areas in Olympic National Park, working forests, a variety of fish and wildlife species, a productive agriculture industry, and a growing population. An extensive network of ditches and pipelines divert water from the Dungeness River for irrigation. Groundwater wells that provide domestic water supply for the growing population dot the lower watershed. The Dungeness River and its tributaries also provide critical habitat for fish and wildlife, including endangered fish species.

Resource managers have been working closely with water users and other stakeholders for more than two decades to implement a variety of projects aimed at increasing water use efficiency and improving management of water resources in the watershed. Several studies have recommended the creation of water storage to improve the reliability of water supply for out-of-stream water uses and maintain flows in the Dungeness River and its tributaries during critical low-flow periods to sustain passage and habitat for fish. Several storage concepts have been studied over the years, but other than two small re-regulating reservoirs used for irrigation, no storage projects have been implemented.

The proposed Dungeness Off-stream Reservoir project offers a storage concept that has broad support among local resource managers, water users, and other key stakeholders. The proposed project would create a 1,500-acre-foot, off-channel storage reservoir south of the City of Sequim. The reservoir would be filled with water diverted from the Dungeness River by gravity through existing irrigation facilities during high-flow periods. Stored water would then be released to meet summertime irrigation needs, allowing for a reduction of diversions from and an increase in flows in the Dungeness River during critical low-flow periods. The proposed storage project offers the following key benefits:

- Restoration of Dungeness River flows during the critical late-summer, low-flow period
- Greater water supply reliability for irrigation
- Enhanced stormwater control and reduced flooding in the City of Sequim
- Potential for using stored water for aquifer recharge
- Potential opportunities for public recreation
- Potential for enhanced wildlife habitat

This document was prepared under the direction of Washington Water Trust and its project sponsors, Clallam Conservation District, the Dungeness Water Users Association, the City of Sequim, and Clallam County. The intent of this document is to provide a summary of the project for other stakeholders, including potential funding partners, and outline the potential benefits and costs associated with the project.

Project Background

Project Description

The proposed Dungeness Off-stream Reservoir project was identified as part of a study that was completed in 2014 to evaluate projects that would enhance flows in the Dungeness River and its tributaries. The proposal is to construct a reservoir with 1,500 acre-feet of storage capacity on a 319-acre parcel currently

owned by the Washington State Department of Natural Resources (WDNR). The reservoir would capture water diverted by gravity from the Dungeness River via Highland Irrigation District (HID) canals. Water would be diverted and stored during the winter, spring, and early summer, when flows in the river are high and water is available. The reservoir would also capture stormwater runoff conveyed by irrigation ditches. Stored water would be released to meet irrigation needs in the late summer. Stored water could also be used for shallow aquifer recharge.

Project Partners

The project was identified and has been studied under the direction of the following project partners:

- **Washington Water Trust**, a non-profit organization focused on working with water users to improve water use efficiency and restore instream flows
- **The Dungeness Water Users Association**, an association representing the seven irrigation districts and companies that divert water from the Dungeness River and its tributaries
- **The City of Sequim**, which is located approximately one mile north of the proposed project and has been heavily involved in planning for water resource improvements in the area
- **Clallam Conservation District**, a non-regulatory sub-division of state government created to help the citizens of Clallam County conserve natural resources, has played an instrumental role in planning and implementation of irrigation efficiency projects in the Dungeness Watershed

The project has also been introduced to a larger group of stakeholders composed of representatives from the WDNR (current property owner), other state agencies, Clallam County, the Jamestown S'Klallam Tribe, and local political leaders. The project has broad support among these stakeholders.

Project Location and Property Description

Several sites were identified and evaluated for potential water storage projects as part of a study completed under the direction of the project partners in 2014 (PGG 2014). Most of the sites that were studied would have accommodated reservoirs with relatively small storage capacities; however, a site was identified between the Dungeness River and River Road, approximately one mile south of Sequim, for a potential off-channel storage reservoir, as shown in Figure 1.

The 319-acre parcel is currently owned by the WDNR, which manages the property for timber production. A large portion of the site was harvested within the last 20 years and is now covered with large stumps left from logging activities, grasses, shrubs, and small trees (Photograph 1). Vehicular access to the site is blocked, but the old logging roads that cross the site are used by the public to access the site by foot for recreation. An HID lateral bisects the site, flowing from south to north (Photograph 2). The HID lateral conveys water to the Eureka main canal, Independent main canal, and other laterals north of the proposed reservoir location.

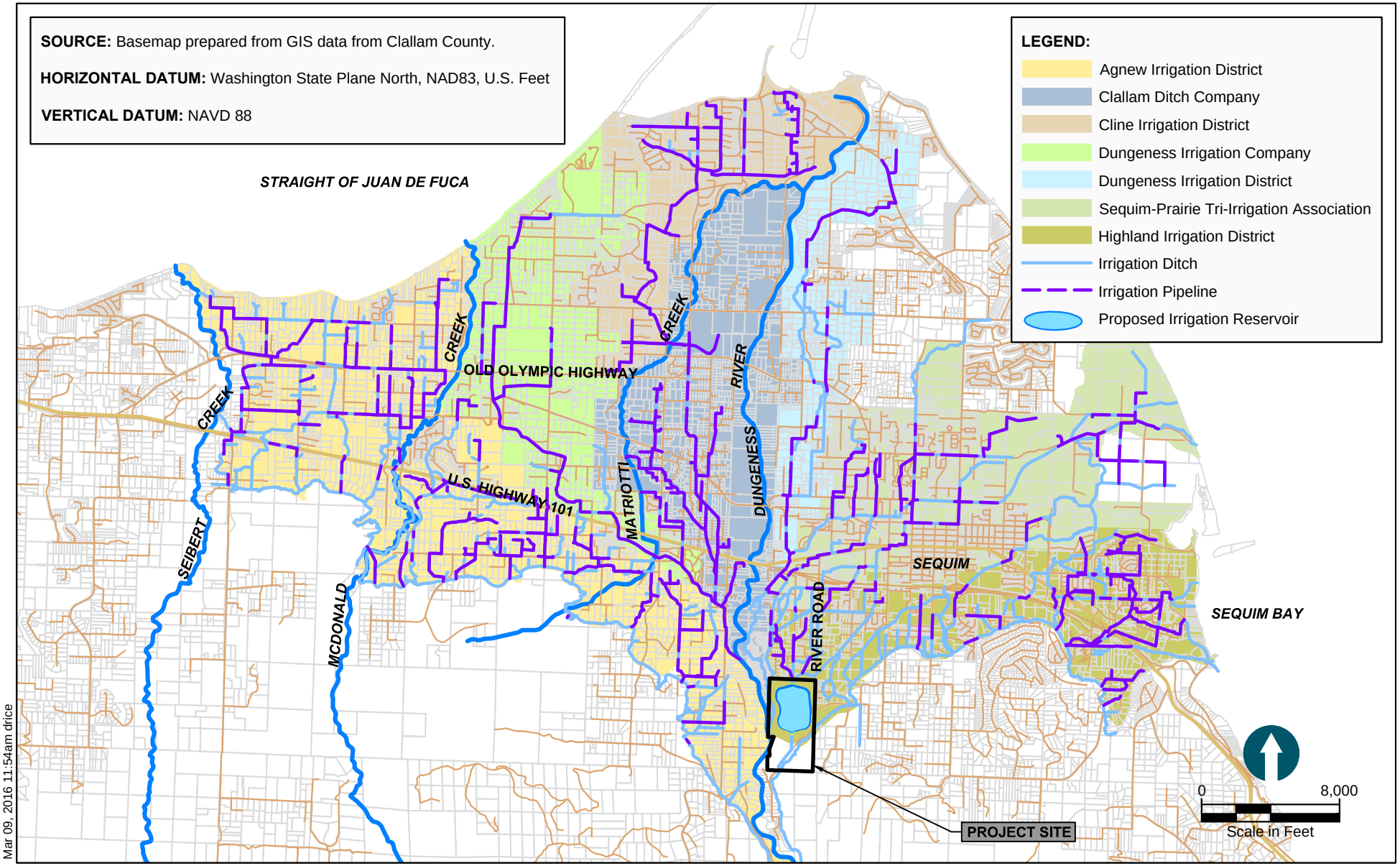


Figure 1
Location Map
Dungeness Off-stream Reservoir Project
Washington Water Trust - Clallam Conservation District - City of Sequim

PHOTOGRAPH 1

Dungeness Off-stream Storage Site from northeast corner of proposed reservoir looking southwest. The site includes a large area that was harvested for timber within the last 20 years.

PHOTOGRAPH 2

Dungeness Off-stream Storage Site from approximate location of proposed reservoir outlet looking south along the HID lateral. The lateral bisects the site, flowing south to north.

Project Status

Preliminary Design Analysis

The proposed storage site was preliminarily reviewed as part of the study completed by the project partners in 2014 (PGG 2014). A preliminary analysis was conducted of different potential reservoir configurations at the site. Eleven potential configurations were identified with capacities ranging from 550 acre-feet to more than 1,500 acre-feet. The project sponsors are proposing to design and implement a storage project that would maximize the use of the site and would have a maximum capacity of 1,586 acre-feet. That storage capacity would allow for an average release of up to 28.6 cubic feet per second (cfs) over a 4-week release period, or 17.8 cfs over a 45-day (1.5-month) release period.

Preliminary Geotechnical Evaluation

The proposed storage reservoir would be created by excavating, backfilling, and constructing an earthen embankment. Because the property slopes from south to north, the south end of the reservoir would be

constructed primarily by excavating below the existing ground elevation and the north end of the reservoir would be contained by the embankment.

A preliminary geotechnical evaluation was completed at the site to characterize on-site soils and determine the potential for material re-use and the need for a reservoir liner. Subsurface soils at the site are generally typical of dense alluvial material, consisting primarily of gravels, cobbles, boulders, and sand with some silt. The preliminary geotechnical investigation indicates that a liner will be required to prevent excessive seepage into underlying native soils. Re-use of material will require careful management to ensure that materials meet the requirements specified for the embankment.

Preliminary Design Development

Preliminary design drawings and an opinion of probable project costs have been developed for the proposed reservoir (Appendix A). The proposed reservoir project would include:

- A 1,586-acre-foot storage reservoir with a maximum water surface area of approximately 88 acres
- An embankment with 3 horizontal to 1 vertical (3H:1V) interior side slopes, 2.5H:1V exterior side slopes, and a maximum height of approximately 30 feet
- Excavation and placement of more than 700,000 cubic yards of material
- A sediment basin upstream of the proposed reservoir
- A 30-inch-diameter inlet pipeline from the HID main canal
- A reinforced concrete structure at the pipe inlet and at the discharge to the reservoir
- A reinforced concrete, low-level outlet structure with an automated gate
- A 30-inch-diameter, low-level outlet pipeline designed to deliver water to the HID lateral
- A reinforced concrete overflow spillway structure
- Reinforced concrete energy dissipating structures at the low-level outlet and spillway outlet
- A piped connection from the HID main canal at Happy Valley Road to the reservoir for peak stormwater conveyance and control

Development of detailed design documentation will be required prior to project construction. Additional design development tasks that will need to be completed prior to construction include:

- Topographic survey of the proposed storage site to provide an accurate basemap for detailed design
- Additional geotechnical investigation, including completion of borings and additional laboratory analysis of soils, to determine final design requirements for embankment side-slopes, dimensions, materials, and configuration
- Wetland and other environmental surveys
- Cultural resources surveys
- A more detailed evaluation of reservoir inflows, outflows, and operational controls
- Additional analysis to further evaluate peak stormwater flows and develop design requirements for stormwater conveyance, sediment retention, and control facilities
- Additional analysis to evaluate the potential for shallow aquifer recharge (SAR) near the reservoir site
- Coordination with regulatory agencies, including permitting agencies and the Washington Department of Ecology's (Ecology's) Dam Safety Office to verify permit and design requirements
- Water rights evaluation and preparation of water right change applications
- Development of detailed design drawings and detailed technical specifications for the project
- Refinement of the opinion of probable construction costs to reflect the detailed design

PROJECT BENEFITS

The project partners have identified the following as key benefits that would result from implementation of the Dungeness Off-stream Reservoir project:

1. Dungeness Streamflow Restoration
2. Greater Irrigation Water Supply Reliability
3. Improved Stormwater Management and Flood Control
4. Increased Potential for Aquifer Recharge
5. Potential for Public Recreation Opportunities
6. Potential for Enhanced Wildlife Habitat

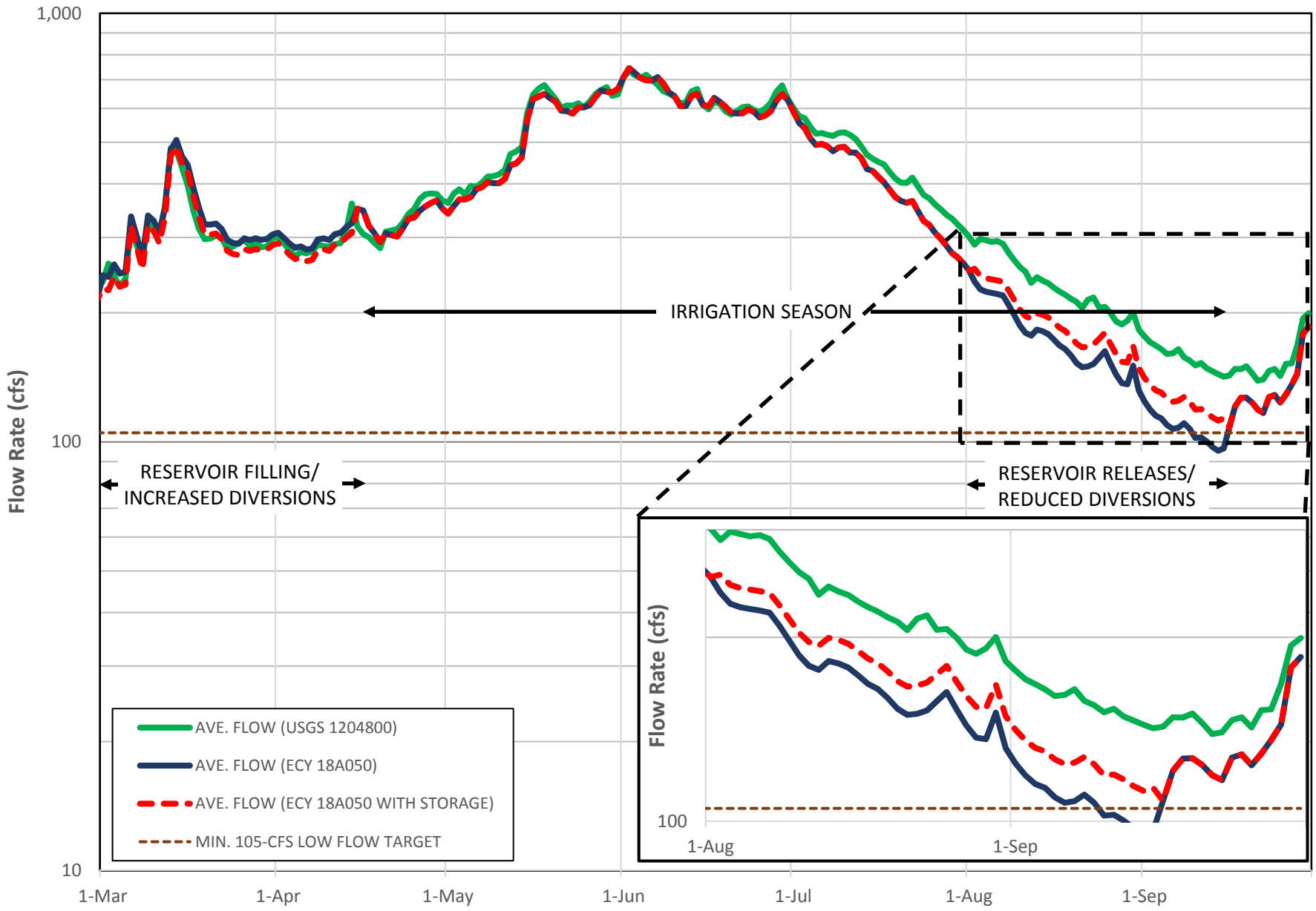
1 Dungeness Streamflow Restoration

The proposed reservoir will store water diverted by gravity from the Dungeness River and peak stormwater runoff captured by the HID main canal and laterals. Water will be released to meet irrigation needs in the late summer during the critical low-flow period (August to September). Water released from storage will allow for a corresponding reduction in surface water diversion from the Dungeness River, which will increase flows in the river during the critical low-flow period.

Dungeness River flows are measured at a gaging station upstream of irrigation diversions by the United States Geologic Survey (USGS Gage No 12048000). Flows are also measured downstream of irrigation diversions, near the mouth of the river, by Ecology (Ecology Gage 18A050). Figure 2 illustrates the difference in the mean daily flow rates measured at those locations in the late summer. The difference is largely due to surface water diversions for irrigation, which occur between April 15 and September 15. Irrigation efficiency projects have significantly reduced diversions from the Dungeness River during the last 20 years, but the potential to increase late summer flows remains substantial.

Figure 2 also illustrates the potential impact of storage on flow rates in the Dungeness River. The graph shows what the average Dungeness River flow rates would be under a scenario where water is diverted to storage in the spring and then released from storage in the late summer. The graph also illustrates how the proposed reservoir would enable water users to maintain a minimum 105-cfs low flow target during an average year. Actual reservoir filling and release rates and durations would be adjusted to account for stormwater captured, releases for aquifer recharge, precipitation, and evaporation, as discussed later in this proposal.

Figure 2 - Potential Impact of Storage on Dungeness River Flows



Future climate change projections for the Dungeness River, provided by the University of Washington's Climate Impacts Group, show a trend toward higher late fall and winter peak flows and lower flows in the spring and summer. The projections reflect the long-term forecast for warmer winters with more rain and less snow in the Olympic Mountains. Melting of the snow pack in the Olympic Mountains drives the peak flows in late spring and maintains flow rates through the summer. The projections indicate that climate changes will result in lower peak flows in the late spring, an earlier drop in flow through the summer, and longer critical low-flow periods. This projected trend will only exacerbate water resource management challenges in the Dungeness River Watershed. Storage will help address these challenges by allowing water users to capture and store water when there is excess for use when it is needed.

2 Greater Irrigation Water Supply Reliability

Seven irrigation districts and companies divert water from the Dungeness River. Three of those districts and companies divert water to irrigate properties to the east of the Dungeness River, where the proposed reservoir will be located. The HID diverts water furthest upstream, at river mile (RM) 10.5, and delivers water for irrigation to land south and east of Sequim. The Sequim-Prairie Tri-Irrigation Association (SPTIA) and the Dungeness Irrigation District (DID) serve lands farther north and east.

The existing reservoir would be supplied by water diverted to the HID main canal and through an HID lateral by gravity. Water would be released back to the HID lateral, which can convey water to the SPTIA and DID systems further downstream. Stored water can also be distributed to portions of the HID system near the Dungeness River.

Over the last three years, the irrigation districts and ditch companies on the east side of the Dungeness River have diverted up to 35 cfs from the river during the early summer for irrigation. Diversions are typically reduced through the late summer as less flow is available in the river and have typically been in the 20 to 30 cfs range in August and September. The proposed reservoir could supply nearly all of the late summer irrigation demand on the east side of the river from storage, rather than surface water diversions. Stored water will add reliability to the irrigation supply system because water can be diverted to storage over a longer period of time when water is abundant, then released when water is scarce.

3 Improved Stormwater Management

The City of Sequim and Clallam County have expressed interest in the potential for using the proposed storage reservoir to control stormwater and alleviate flooding issues in and near Sequim. Existing irrigation ditches capture and convey stormwater runoff from hillsides in the Burnt Hill and Happy Valley areas of unincorporated Clallam County. The *City of Sequim Draft Storm and Surface Water Master Plan* (Herrera 2015) indicates that flows from peak storm events, which typically occur during the late fall and winter, are conveyed through the network of irrigation ditches to developed areas in and near the City of Sequim. However, downstream culverts and connections to stormwater facilities are not sized to convey these flows, so flooding often occurs. Infrastructure could be designed to intercept peak stormwater flows conveyed by irrigation ditches and route the water to the reservoir for storage, reducing stormwater flows and flooding downstream. Capture of excess runoff from storm events would also reduce the diversions required to fill the reservoir in the early spring.

4 Increased Potential for Aquifer Recharge

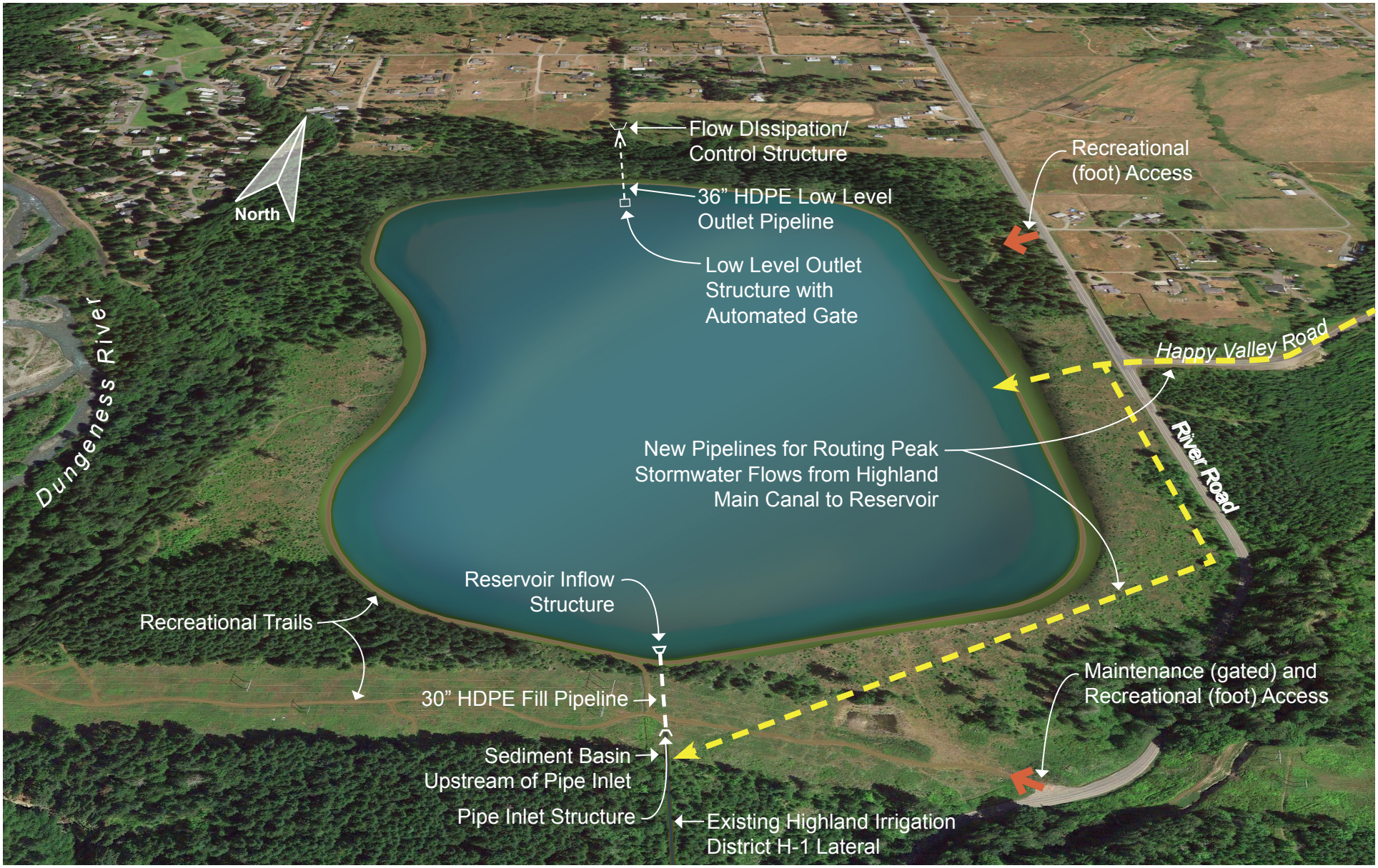
Storage in the reservoir could be used as a source for SAR to augment late summer baseflow in the Dungeness River and small streams on the Dungeness Peninsula. If the reservoir is used as a source for SAR, a site for shallow infiltration could be selected that provides the best baseflow augmentation profile relative to project objectives. A site near the reservoir would provide the highest baseflow augmentation in the Dungeness River during the low-flow season (September and early October) if infiltration were performed for two months starting in early July.

5 Potential for Public Recreation Opportunities

The proposed reservoir site is currently used by the public for a variety of recreational activities, including hiking, dog walking, and wildlife viewing. Old logging roads cross the existing parcel and are used to access the property by foot for these activities. Vehicular access to the site is currently blocked. Proposed site improvements could include trails that would preserve and enhance access to the site for recreation. The trails could extend around the top of the reservoir, as shown on the aerial rendering included in Figure 3. The reservoir water surface will fluctuate several feet in elevation over the course of a year. In the spring and early summer, the reservoir will be full. In the late summer, the reservoir will be nearly empty. The variation in water levels and public safety concerns may limit access to and use of the reservoir for water-based recreation, such as fishing, boating, or swimming. Recreational opportunities will be evaluated further by the stakeholder group and the public as part of the final design of the facilities.

6 Potential for Enhanced Wildlife Habitat

The proposed reservoir will also provide enhanced habitat for wildlife that use the property. The 88-acre reservoir will attract waterfowl, amphibians, and other wildlife. Site improvements made as part of the project, including plantings around the perimeter of the reservoir, will also enhance habitat at the site for the variety of animals that access the site. The most important habitat benefit that will result from the project will be increased flow during the late summer in the Dungeness River. The Dungeness River provides critical habitat for endangered fish species and other animals. Summer low flow is a limiting factor to the quality and quantity of habitat in the Dungeness River.



ANCHOR QEA

Figure 3
Conceptual Rendering
Dungeness Off-stream Reservoir
Washington Water Trust - Clallam Conservation District - City of Sequim

PROPOSED RESERVOIR OPERATIONS

The following describes how the reservoir can be operated to restore Dungeness River flows, provide greater reliability of water supply for irrigation, improve stormwater control, and recharge the shallow groundwater aquifer.

Reservoir Filling

The Dungeness Off-channel Reservoir will be filled primarily with Dungeness River water diverted during the late winter and spring high-flow periods when excess water is available. Flow to the reservoir will be controlled by gates at the HID diversion on the Dungeness River and at the upstream end of the irrigation lateral that will feed the reservoir. To minimize impact on the river, filling would occur when river flows are high. The rate of filling will be limited by the capacity of the HID main canal. The capacity of the canal appears to be sufficient to allow for filling of the reservoir within a four- to six-week period.

Stormwater Flow Control

Peak stormwater flows captured and conveyed in the irrigation ditches could be routed to the reservoir for storage, which would help reduce flooding in and near Sequim. The major facilities that would be needed to capture and route peak stormwater flows from the HID main canal to the reservoir are shown schematically in Figure 4 and include the following:

- An overflow structure constructed on the HID main canal near Happy Valley Road
- A stormwater pipeline designed to convey flows by gravity from the overflow structure along Happy Valley Road to the proposed reservoir
- A sediment trap adjacent to the reservoir to reduce sediment input to the reservoir
- A controlled outlet structure at the reservoir

The availability of reservoir capacity for stormwater flows will depend on the timing of peak storm events. Peak storm events typically occur during the fall and winter when the reservoir levels will be low. Capacity would be limited to store flows from late spring or early summer peak storm events because the reservoir would be full. The volume of stormwater stored in the reservoir would reduce the volume that would have to be diverted from the Dungeness River.

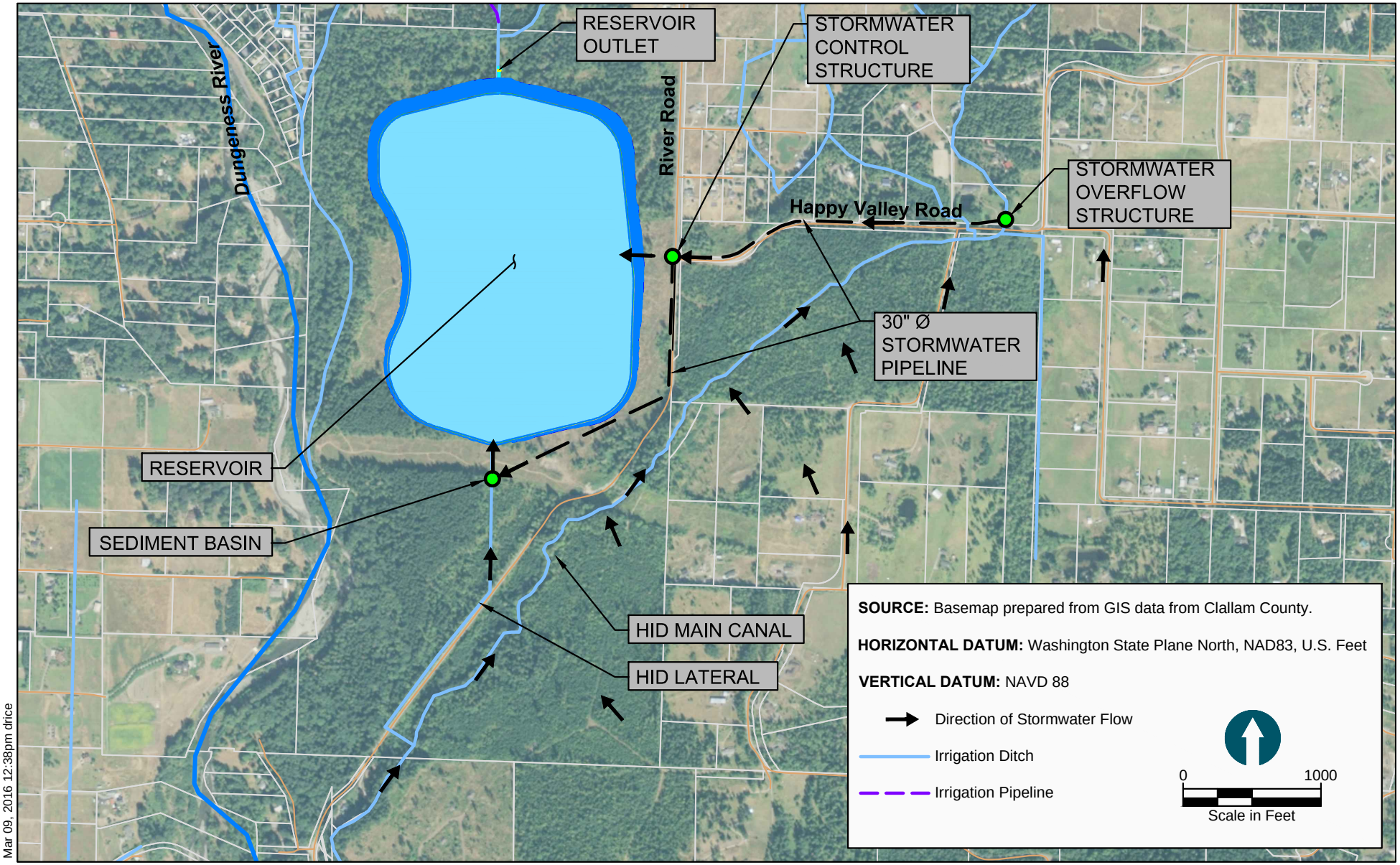


Figure 4
Potential Use of Reservoir for Stormwater Control
Dungeness Off-stream Reservoir Project
Washington Water Trust - Clallam Conservation District - City of Sequim

Irrigation Deliveries

The Dungeness Water Users Association has indicated that reservoir releases could be conveyed to serve HID, SPTIA, and DID water users downstream of the reservoir. The Dungeness Water Users Association has identified that up to approximately 20.9 cfs of late-summer irrigation demand could be served by the reservoir with some limited upgrades to the existing delivery system, including:

- Upgrades to the HID lateral to increase conveyance capacity
- Upgrades to the Independent Ditch, operated by SPTIA, to increase conveyance capacity
- Construction of a piped connection from the Independent Ditch to the shared DID/SPTIA diversion facility near Rondale Drive

Figure 5 illustrates potential for delivery of stored water for irrigation during the late-summer low-flow period. Improvements would be designed for a maximum release rate of up to 25 cfs to provide flexibility in the duration and timing of releases. Water would be released from the reservoir through a low-level outlet pipe. Flow through the low-level outlet pipe would be controlled by an automated gate. An energy dissipating structure would be included at the downstream end of the outlet pipeline to transition flow to the open canal system. Additional outlet facilities would include an emergency spillway, designed to meet Ecology Dam Safety Office requirements and prevent overtopping of the embankment.

Aquifer Recharge

Reservoir water could be released to a nearby SAR facility for infiltration during the early summer to augment baseflows in the Dungeness River baseflow during the critical low-flow period in the late summer. The operational challenge with using reservoir storage for SAR in the early summer is that the volume released for SAR would not be available for irrigation releases later in the summer. Timing and use of stored water for SAR will be evaluated with stakeholders as part of the detailed design.

Operations and Maintenance Needs

One of the key benefits to this proposed reservoir project is the fact that the reservoir can be filled by gravity, rather than pumping. The proposed reservoir will not require pumping and associated costs, but regular inspection and maintenance will be needed to ensure safe operation. Regular operations and maintenance activities will include visual inspection of the reservoir and associated control structures, monitoring of embankment seepage and settlement, and cleaning and repair of the facilities.

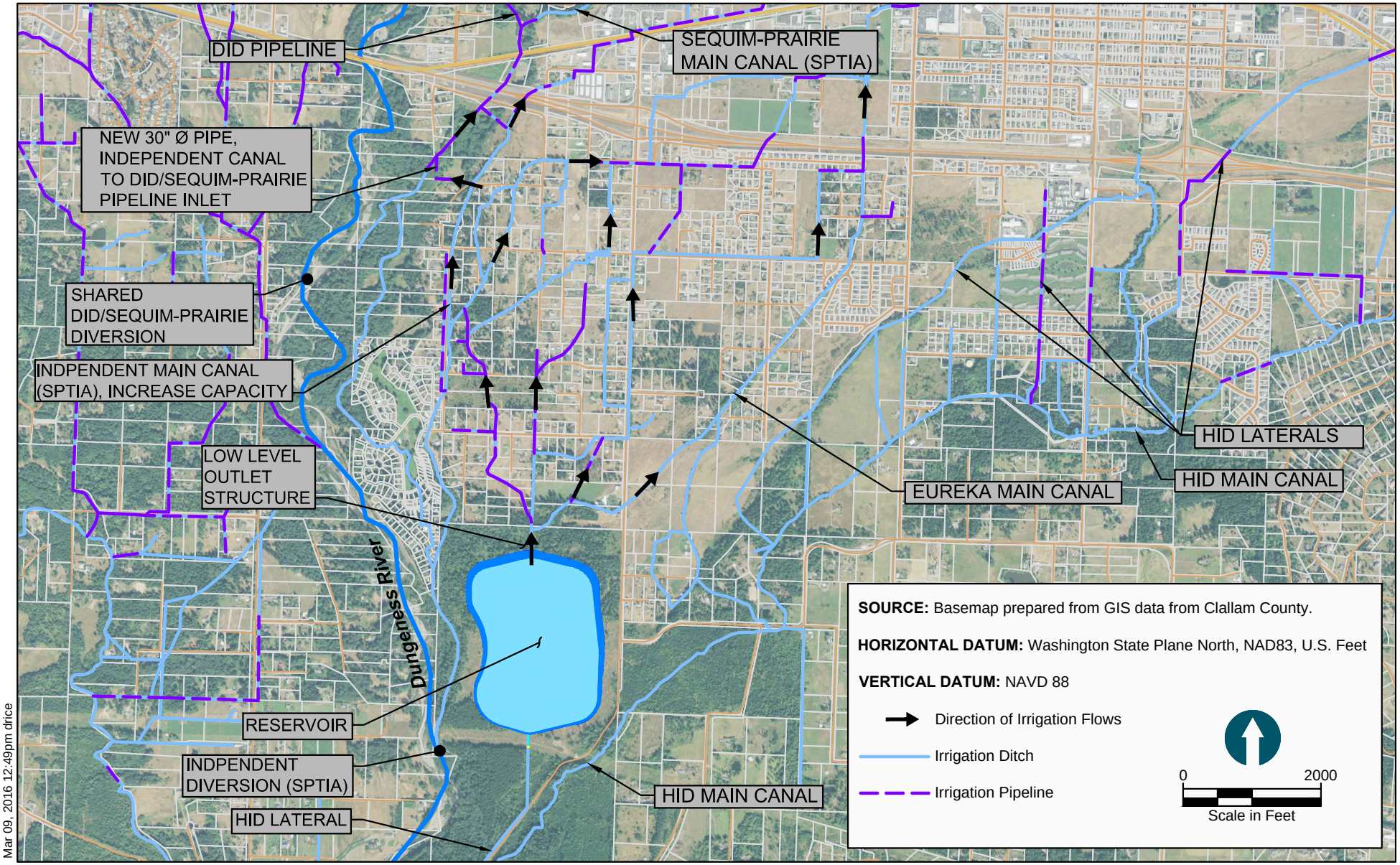


Figure 5
Delivery of Reservoir Releases for Irrigation
Dungeness Off-stream Reservoir Project
Washington Water Trust - Clallam Conservation District - City of Sequim

ANTICIPATED PROJECT COSTS

Implementation Costs

A preliminary opinion of probable construction costs was prepared based on the preliminary project design drawings (Appendix A). Table 1 provides a summary of the opinion of probable implementation costs for the project. Construction costs were divided into three categories: 1) costs related to the construction of the storage reservoir and appurtenances; 2) costs related to the construction of stormwater conveyance facilities; and 3) costs related to improvements to the downstream irrigation system to allow for deliveries to a wider range of users. The project implementation costs also include allowances for detailed design, permitting, and construction administration, as shown in Table 1. Each item included in Table 1 includes the following:

- A contingency to reflect the preliminary level of design; the low end of the range includes a 15% contingency and the high end of the range includes a 30% contingency
- Sales tax (8.4%)

The proposed project is a large project with many variables that have not been evaluated in detail and are not well understood. The contingency will be reduced as these variables are evaluated in more detail. Costs are reported in January 2016 dollars. Other project-related costs that may be incurred, but are not listed in Table 1, include the cost of land acquisition and the cost of any agreements required between agencies or stakeholders.

TABLE 1: OPINION OF PROBABLE PROJECT COSTS

Item	Opinion of Probable Cost[1]
Construction Cost – Reservoir and Appurtenances	$22.37 million to $25.29 million
Construction Cost – Stormwater Conveyance	$816,000 to $924,000
Construction Cost – Related Irrigation System Improvements	$196,000 to $221,000
Total Construction Cost	$23.38 million to $26.44 million
Detailed Design	$1.15 million to $1.30 million
Permitting, Administration	$180,000 to $200,000
Construction Management	$800,000 to $900,000
Total Project Implementation Costs	$25.51 million to $28.84 million

Notes:
1 Costs are in February 2016 dollars.

Long-term Operating Costs

Long-term operating costs will include operation and maintenance costs and the cost of funding replacement of the facilities when they have reached the end of their design life cycle. Operations and maintenance costs were estimated based on the cost of operating storage facilities of similar size, and include salary and benefits for a government employee at a rate of 1/4 full-time equivalency, administrative costs, transportation costs, supplies, maintenance, repairs, and contracted labor costs.

Replacement costs were evaluated to determine the annual deposit that would need to be made to an account to fund replacement of critical facilities at the end of an assumed 50-year design life cycle for the project. Key components that would need to be partially or fully replaced sometime during the 50-year design life of the project include the reservoir liner, pipelines, structures, control equipment, and monitoring equipment. It is unlikely that all of these facilities would need to be completely replaced within that assumed life cycle, so the analysis was done for three levels of replacement funding: 25%, 50%, and 100%. The analysis assumes that the annual interest rate on the replacement fund is 3% and an annual inflation rate is 3%. The analysis also assumes that the annual deposit would escalate at the assumed annual inflation rate.

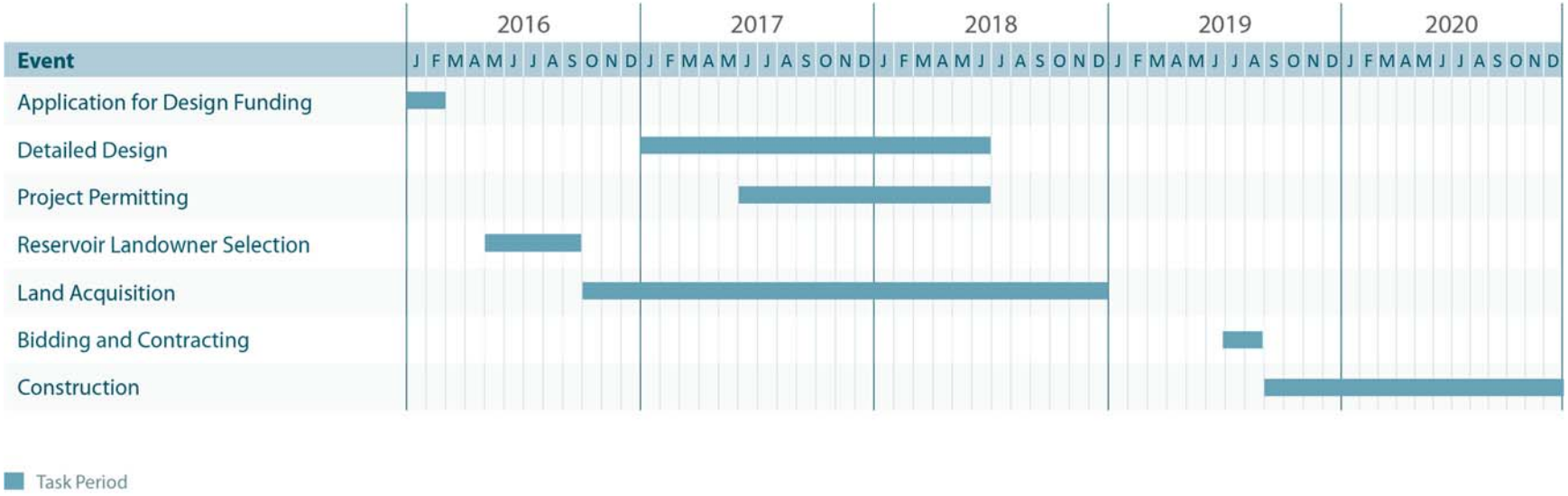
Table 2 provides a summary of the opinion of probable long-term operating costs for the project.

TABLE 2: OPINION OF PROBABLE LONG-TERM ANNUAL OPERATING COSTS

Item	Opinion of Probable Annual Cost[1, 2]
Annual Operation and Maintenance Cost	$39,200
Annual Replacement Fund Cost (25% of Critical Facilities Replaced)	$46,300
Annual Replacement Fund Cost (50% of Critical Facilities Replaced)	$92,700
Annual Replacement Fund Cost (100% of Critical Facilities Replaced)	$185,400

Notes:
1 Costs are in February 2016 dollars.
2 Annual replacement fund cost represents the deposit required during the first year of operation to fund replacement of equipment over a 50-year design life cycle.

PROJECT TIMELINE



REFERENCES

PGG (Pacific Groundwater Group), 2014. *Dungeness Flow Enhancement Project: Designs and Supporting Analyses*. Prepared for Washington Water Trust. May 2014.

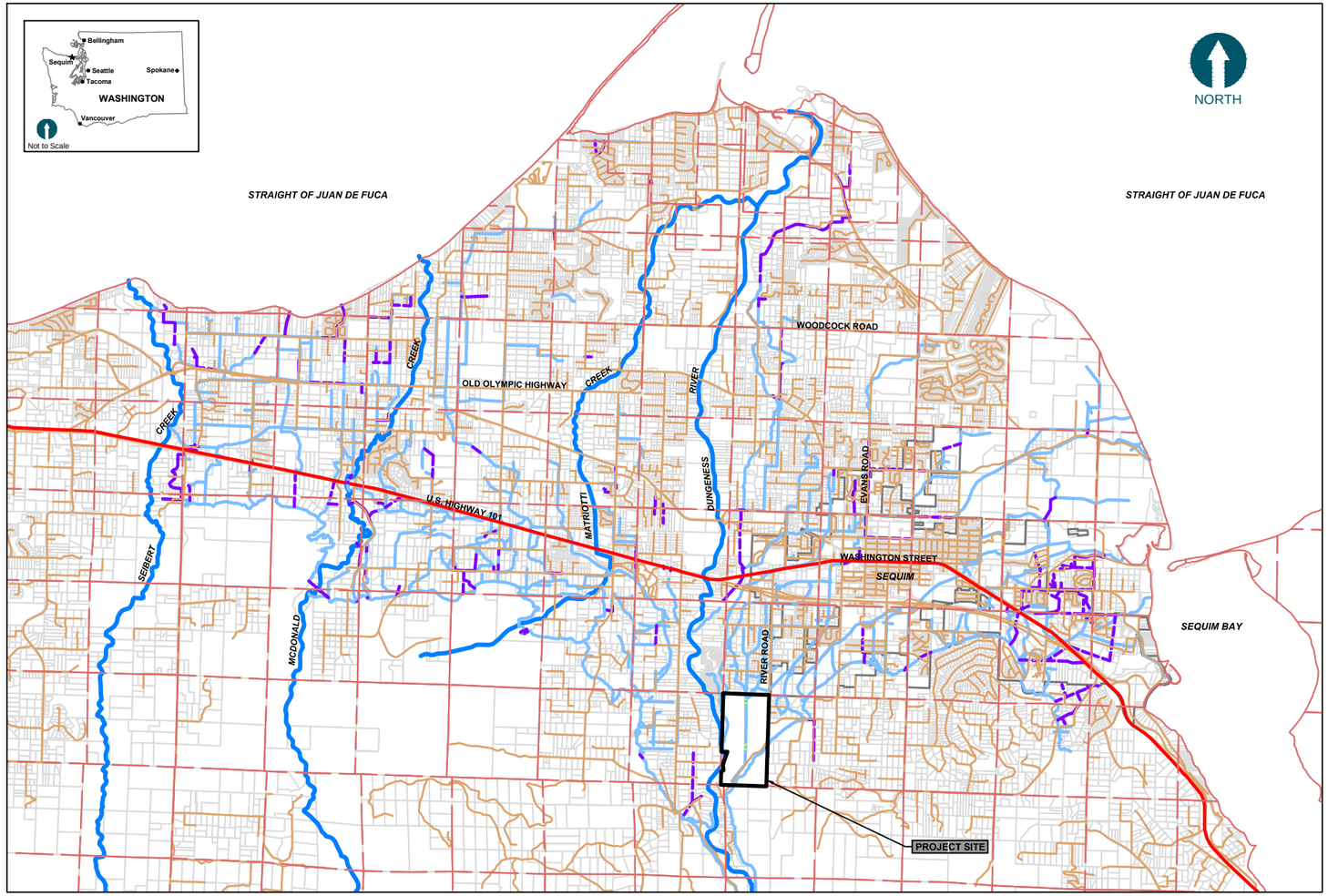
Herrera, 2015. *City of Sequim Draft Storm and Surface Water Master Plan*. Project Title. Prepared for the City of Sequim. May 2015.

Appendix A:
Preliminary Design Drawings

PRELIMINARY DESIGN

DUNGENESS OFF-STREAM RESERVOIR PROJECT

WASHINGTON WATER TRUST



LOCATION MAP

0 4,000 8,000

SCALE IN FEET

DRAWING INDEX	
DRAWING NO.	**TITLE**
G-1	COVER SHEET
G-2	GENERAL NOTES, ABBREVIATIONS, AND LEGEND
C-1	PRELIMINARY RESERVOIR PLAN
C-2	PRELIMINARY RESERVOIR SECTIONS

PROJECT DATA

LOCATION: CLALLAM COUNTY PARCEL 04036210000
NW 1/4 AND SW 1/4, SECTION 36, TOWNSHIP 30N, RANGE 04W

PROJECT ENGINEER: DAVID RICE, P.E.
ANCHOR QEA, LLC
720 OLIVE WAY, SUITE 1900
SEATTLE, WA 98101
(206) 219-5902

PROJECT ADMINSTRATOR: AMANDA CRONIN
WASHINGTON WATER TRUST
1530 WESTLAKE AVE N, SUITE 400
SEATTLE, WA 98109
(206) 675-1585 EXT 1000

PROPERTY OWNER: WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES (DNR)
P.O. BOX 47016
OLYMPIA, WA 98504-7016

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: DWR
DRAWN BY: DWR
CHECKED BY: RAM
APPROVED BY: DWR
SCALE: AS NOTED
DATE: JANUARY 27, 2016

DUNGENESS OFF-STREAM RESERVOIR PROJECT

COVER SHEET

G-1

SHEET NO. 1 OF 4

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Jan 27, 2016 5:57pm dirice

GENERAL CONSTRUCTION NOTES:

1. CONTRACT DOCUMENTS REFER TO THESE DRAWINGS, THE PROJECT SPECIFICATIONS, AND THE BIDDING DOCUMENTS, AND THE CONSTRUCTION CONTRACT.

2. EXCEPT AS OTHERWISE NOTED HEREIN, ALL MATERIAL AND WORK SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, THE WSDOT/APWA "STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION" (2014 EDITION), OTHER APPLICABLE STANDARDS, AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

3. THE CONTRACTOR SHALL HAVE COPIES OF THE APPROVED CONTRACT DOCUMENTS AND THE WSDOT/APWA "STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION" (2014 EDITION) ON THE JOBSITE AT ALL TIMES.

4. THE CONTRACTOR SHALL VISIT THE JOB SITE PRIOR TO CONSTRUCTION AND SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITIONS AND DIMENSIONS, AND CONFIRMING THAT THE WORK CAN BE ACCOMPLISHED AS SHOWN ON THESE CONTRACT DOCUMENTS. ANY DISCREPANCIES BETWEEN THE EXISTING FIELD CONDITIONS AND DIMENSIONS SHOWN ON THE CONTRACT DOCUMENTS AND THOSE OBSERVED BY THE CONTRACTOR SHALL BE BROUGHT TO THE ATTENTION OF THE CONTRACTING AGENCY PRIOR TO PROCEEDING WITH CONSTRUCTION.

5. A PRE-CONSTRUCTION MEETING BETWEEN THE CONTRACTOR, THE CONTRACTING AGENCY, THE PROPERTY OWNER, SEQUIM PRAIRIE TRI-IRRIGATION ASSOCIATION, AND THE ENGINEER SHALL BE REQUIRED PRIOR TO ANY ON-SITE WORK.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING RIGHT-OF-WAY PERMITS FROM CLALLAM COUNTY PRIOR TO PROCEEDING WITH THE WORK. THE CONTRACTOR SHALL SUBMIT RIGHT-OF-WAY USE PERMIT APPLICATIONS AND PAY ALL APPLICABLE FEES.

7. THE CONTRACTOR SHALL RECEIVE, IN WRITING, AUTHORIZATION TO PROCEED BEFORE STARTING WITH ANY WORK ON ITEM NOT CLEARLY DEFINED OR IDENTIFIED BY THE CONTRACT DOCUMENTS.

8. ALL WORK SHALL BE IN CONFORMANCE WITH EXISTING LABOR LAWS, SAFETY REQUIREMENTS, AND OTHER REGULATIONS, AS REQUIRED BY CLALLAM COUNTY, THE STATE OF WASHINGTON, AND THE FEDERAL GOVERNMENT. THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS.

9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK UNDER THIS CONTRACT.

10. ALL MATERIALS SHALL BE NEW AND UNDAMAGED UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER AND HIS ENGINEER. THE SAME MANUFACTURER OF EACH ITEM SHALL BE USED THROUGHOUT THE WORK UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

11. ALL SITE WORK SHALL BE AS INDICATED ON THE DRAWINGS. THE CONTRACTOR SHALL NOT EXCAVATE OR DISTURB BEYOND THE CLEARING LIMITS SHOWN ON THE DRAWINGS UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

12. THE CONTRACTOR SHALL MAKE ALL NECESSARY PROVISIONS TO PROTECT EXISTING IMPROVEMENTS, ROADWAYS, DRAINAGE WAYS, CULVERTS, AND VEGETATION UNTIL SUCH ITEMS ARE TO BE DISTURBED OR REMOVED AS INDICATED ON THE CONTRACT DOCUMENTS.

13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIR OF PROPERTY IN AND AROUND THE PROJECT AREA. UNLESS OTHERWISE NOTED ON THESE DRAWINGS, ITEMS SUCH AS MAILBOXES, CULVERTS, LAWN ORNAMENTS, FENCING, DRIVEWAYS, IRRIGATION BOXES, ETC., THAT ARE AFFECTED BY CONSTRUCTION ACTIVITIES SHALL BE REPAIRED OR REPLACED FOLLOWING CONSTRUCTION.

14. RUBBISH, DEBRIS, AND GARBAGE SHALL BE REMOVED FROM THE JOB SITE PRIOR TO ACCEPTANCE AND DISPOSED OF LEGALLY. SEE THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

15. DISTURBED AREAS SHALL BE GRADED SMOOTH AND PROTECTED AND/OR REVEGETATED AS INDICATED IN THE SPECIFICATIONS.

17. THE NOTES, DETAILS AND SPECIFICATIONS ON THE CONTRACT DOCUMENTS SHALL TAKE PRECEDENCE OVER THESE GENERAL NOTES.

18. DIMENSION CALL-OUTS SHALL TAKE PRECEDENCE OVER SCALES SHOWN ON THE DRAWINGS.

17. THE CONTRACTOR SHALL MAINTAIN HAND DRAWN REDLINES, FIELD NOTES AND PHOTOGRAPHS ("FIELD DOCUMENTATION") OF ALL IMPROVEMENTS AS THE WORK PROGRESSES. THE CONTRACTOR'S FIELD DOCUMENTATION SHALL BE MAINTAINED ON-SITE AND SHALL BE AVAILABLE FOR REVIEW BY THE ENGINEER AT ALL TIMES. THE CONTRACTOR SHALL PROVIDE FIELD DOCUMENTATION TO THE ENGINEER FOR PREPARATION OF CERTIFIED RECORD DRAWINGS PRIOR TO PROJECT ACCEPTANCE.

18. LOCATIONS OF ROADWAYS AND STRUCTURES SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

19. GEOTECHNICAL INVESTIGATIONS HAVE BEEN COMPLETED AT THE SITE. GEOTECHNICAL REPORTS AND RECOMMENDATIONS ARE PROVIDED AS APPENDICES TO THE SPECIFICATIONS.

20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE SAFEGUARDS, SAFETY DEVICES, PROTECTIVE EQUIPMENT, TRAFFIC CONTROL, SHORING, AND ANY OTHER ACTIONS NEEDED TO PROTECT THE LIFE, HEALTH, AND SAFETY OF WORKERS, THE PUBLIC, AND PROPERTY IN CONNECTION WITH THE PERFORMANCE OF WORK COVERED BY THE CONTRACT.

23. THE CONTRACTOR SHALL PROVIDE TEMPORARY CUT SLOPES AND SHORING, AS NEEDED TO COMPLETE THE WORK SHOWN ON THESE DRAWINGS. THE STABILITY OF TEMPORARY SLOPES AND SHORING IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

24. ANY WORK WITHIN THE TRAVELED RIGHT-OF-WAY SHALL REQUIRE TRAFFIC CONTROL .

LOCATION OF EXISTING UTILITIES:

1. THE LOCATIONS OF EXISTING UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE. THE LOCATIONS OF EXISTING UTILITIES HAVE NOT BEEN FIELD VERIFIED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL CONTACT THE UTILITY LOCATION REQUEST CENTER (ONE-CALL CENTER) AT 811 OR 1-800-424-5555 FOR UTILITY LOCATIONS NOT LESS THAN TWO (2) BUSINESS DAYS BEFORE THE SCHEDULED DATE FOR EARTHWORK OR TRENCHING THAT MAY IMPACT EXISTING UTILITIES.

2. THE SIZE, LOCATION, AND TYPE OF UNDERGROUND UTILITIES EXPOSED OR MODIFIED BY THE CONTRACTOR SHALL BE ACCURATELY NOTED AND PLACED ON THE CONTRACTOR'S AS-BUILT DRAWINGS. SEE GENERAL CONSTRUCTION NOTE 19 FOR ADDITIONAL REQUIREMENTS RELATED TO THE CONTRACTOR'S AS-BUILT DRAWINGS AND FIELD DOCUMENTATION.

SURVEY AND BASEMAP INFORMATION:

1. HORIZONTAL AND VERTICAL DATUM:
   - 1.1. VERTICAL DATUM - NAVD 88
   - 1.2. HORIZONTAL DATUM - WASHINGTON STATE PLANE NORTH ZONE, NAD 83, FEET

2. CONTOURS - FROM PUGET SOUND LiDAR CONSORTIUM (PSLC) DATA

3. AERIAL PHOTOGRAPHY - 2011 NAIP AERIAL PHOTOGRAPHY

4. OTHER BASEMAP INFORMATION - FROM CLALLAM COUNTY GIS DATA

ABBREVIATIONS:

'	FEET, MINUTES
"	INCHES, SECONDS
°	DEGREES
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
AWWA	AMERICAN WATER WORKS ASSOCIATION
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
CB	CATCH BASIN
CFS	CUBIC FEET PER SECOND
CONC	CONCRETE
CY	CUBIC YARDS
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST, EASTING
ELEV	ELEVATION
EX	EXISTING
FG	FINISHED GRADE
FL	FLOW LINE, FLANGE, FLANGED
FPS	FEET PER SECOND
FT	FEET
GALV	GALVAINIZED
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HPDE	HIGH-DENSITY POLYETHYLENE
I.D.	INSIDE DIAMETER
IE	INVERT ELEVATION
IN	INCHES
L	LENGTH
LF	LINEAR FEET
MAX	MAXIMUM
MIN	MINIMUM
MJ	MECHANICAL JOINT
N	NORTH, NORTHING
NAD	NORTH AMERICAN DATUM
NGVD	NATIONAL GEODETIC VERTICAL DATUM
NO.	NUMBER
O.C.	ON CENTERS
O.D.	OUTSIDE DIAMETER
P	POWER
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
P.E.	PROFESSIONAL ENGINEER
R, RAD	RADIUS
REINF	REINFORCED, REINFORCEMENT
ROW	RIGHT OF WAY
S	SLOPE, SANITARY SEWER, SOUTH
SCH	SCHEDULE
SPTIA	SEQUIM PRAIRIE TRI-IRRIGATION ASSOCIATION
STA	STATION
SY	SQUARE YARD
T	TELEPHONE
TYP	TYPICAL
W	WEST, WATER
W/	WITH
WSDOE	WASHINGTON STATE DEPARTMENT OF ECOLOGY
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
WSEL	WATER SURFACE ELEVATION
WWT	WASHINGTON WATER TRUST

LEGEND:

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

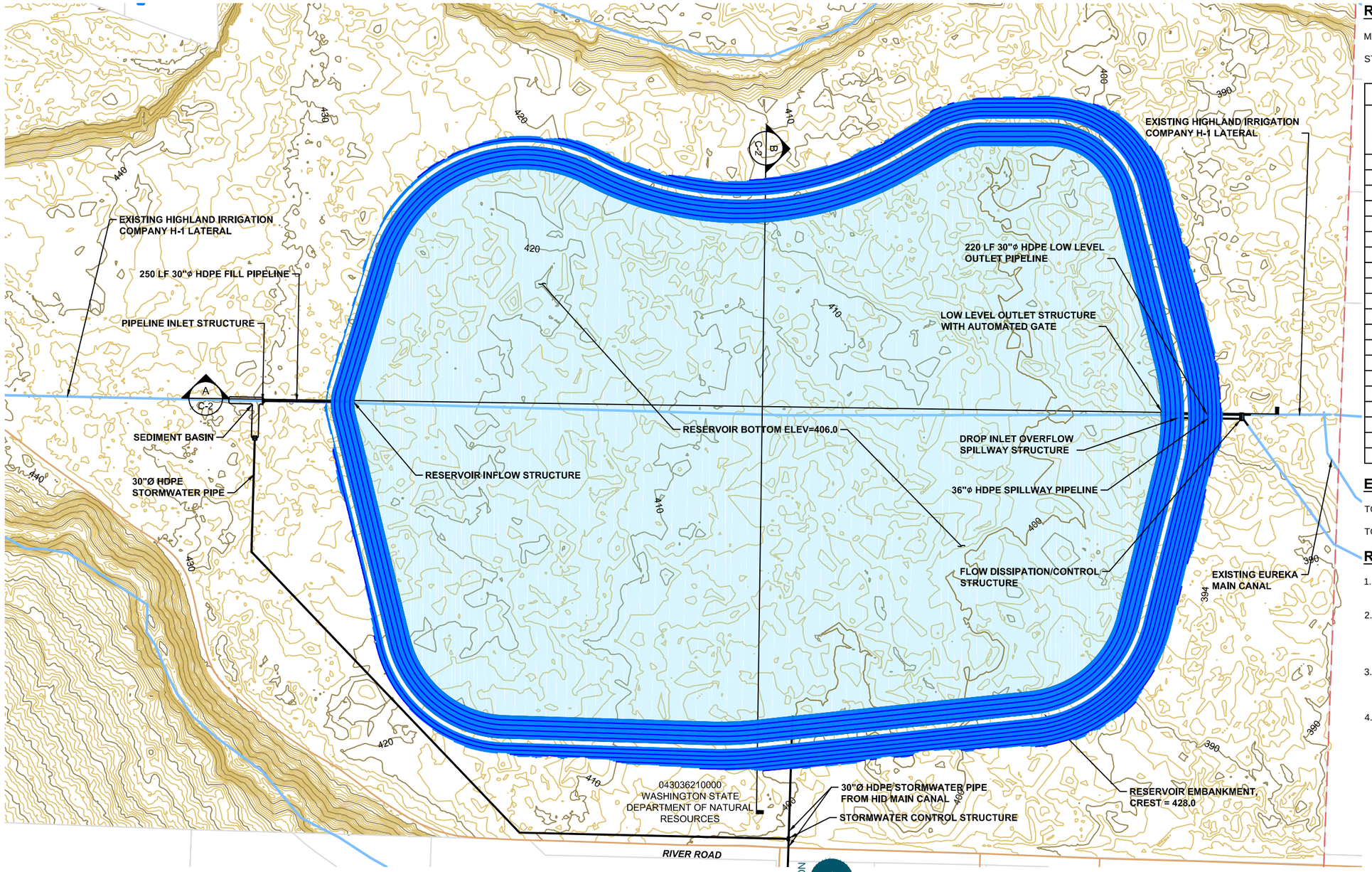
DESIGNED BY: DWR
DRAWN BY: DWR
CHECKED BY: RAM
APPROVED BY: DWR
SCALE: AS NOTED
DATE: JANUARY 27, 2016

DUNGENESS OFF-STREAM RESERVOIR PROJECT

GENERAL NOTES, LEGEND, AND ABBREVIATIONS

G-2

SHEET NO. 2 OF 4



PRELIMINARY PLAN

0 160 320

SCALE IN FEET

RESERVOIR ELEVATIONS AND VOLUMES:

MAXIMUM WATER SURFACE ELEVATION = 425.0 FEET

STORAGE CAPACITY = 1,585.5 ACRE-FEET

RESERVOIR RATING CURVE

WATER SURFACE ELEVATION (FEET)	WATER SURFACE AREA (ACRES)	STORAGE VOLUME (ACRE-FEET)	DESCRIPTION
406	78.7	0.0	BOTTOM
407	79.2	78.9	
408	79.7	158.4	
409	80.2	238.3	
410	80.7	318.7	
411	81.2	399.6	
412	81.7	481.1	
413	82.2	563.0	
414	82.7	645.4	
415	83.2	728.3	
416	83.7	811.8	
417	84.2	895.7	
418	84.7	980.1	
419	85.2	1,065.1	
420	85.7	1,150.5	
421	86.2	1,236.5	
422	86.7	1,323.0	
423	87.3	1,410.0	
424	87.8	1,497.5	
425	88.3	1,585.5	SPILLWAY

EARTHWORK VOLUMES:

TOTAL ESTIMATED CUT = 710,867 CY

TOTAL ESTIMATED FILL = 768,082 CY

RESERVOIR GRADING NOTES:

1. CONTOURS AND ELEVATIONS ARE FINISHED GRADES UNLESS OTHERWISE NOTED.
2. GRADING IS BASED ON 2-FOOT CONTOURS GENERATED FROM LIDAR DATA. TOPOGRAPHIC SURVEY TO VERIFY EXISTING FIELD CONDITIONS SHALL BE COMPLETED PRIOR TO FINAL DESIGN.
3. THE HORIZONTAL AND VERTICAL CONTROL SHALL BE STAKED USING THE CONTROL POINTS PROVIDED AND DIGITAL DATA PROVIDED BY THE CONTRACTING AGENCY.
4. THE GEOTECHNICAL ENGINEER SHALL OBSERVE SUBGRADE CONDITIONS PRIOR TO PLACEMENT OF EMBANKMENT MATERIALS AND LINING. ANY IRREGULARITIES OR UNSUITABLE SUBGRADE MATERIAL SHALL BE REMOVED AND REPLACED, AS DIRECTED BY THE GEOTECHNICAL ENGINEER, PRIOR TO PLACEMENT OF EMBANKMENT MATERIALS.

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: DWR
DRAWN BY: DWR
CHECKED BY: RAM
APPROVED BY: DWR
SCALE: AS NOTED
DATE: JANUARY 27, 2016

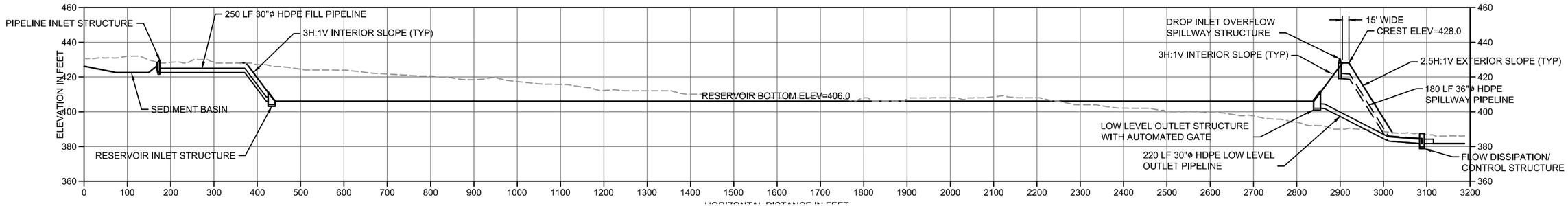
DUNGENESS OFF-STREAM RESERVOIR PROJECT

PRELIMINARY RESERVOIR PLAN

C-1

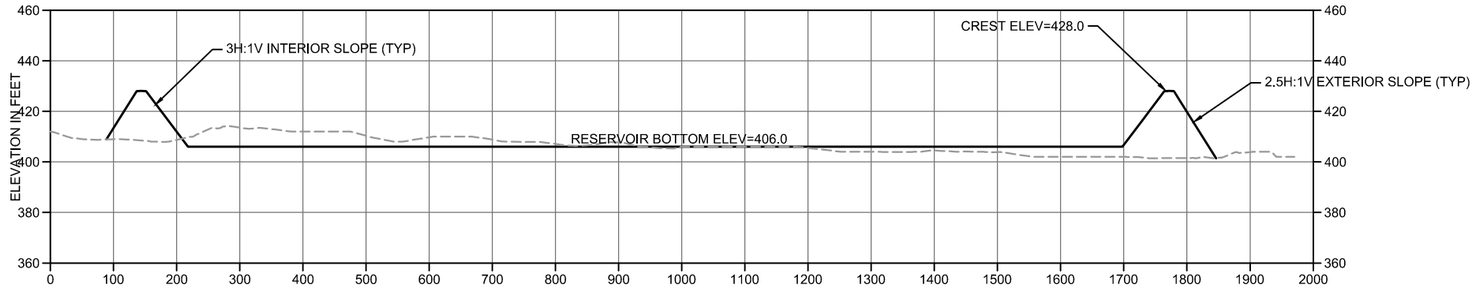
SHEET NO. 3 OF 4

L:\Projects\Washington Water Trust\Dungeness_Off-stream_Reservoir_Proposal_(151019-02.01)\CAD\151019-02-PL-001-Dungeness Storage-Prel.dwg C-1
Jan 27, 2016 8:43pm drice



A / C-1 PRELIMINARY RESERVOIR SECTION

SCALE:1" = 5' HOR
4 X VERT EXAGGERATION



B / C-1 PRELIMINARY RESERVOIR SECTION

SCALE:1" = 120' HOR
4 X VERT EXAGGERATION

ONE INCH
AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: DWR
DRAWN BY: DWR
CHECKED BY: RAM
APPROVED BY: DWR
SCALE: AS NOTED
DATE: JANUARY 27, 2016

DUNGENESS OFF-STREAM RESERVOIR PROJECT

PRELIMINARY RESERVOIR SECTIONS

C-2

SHEET NO. 4 OF 4

Jan 27, 2016 8:50pm drice L:\Projects\Washington_Water_Trust\Dungeness_Off-stream_Reservoir_Proposal_(151019-02.01)\CAD\151019-02-PL-001-Dungeness Storage-Prel.dwg C-2