



To: Karl Morgenstern, Eugene Water & Electric Board

From: Kristiana Teige, Carpe Diem West

Date: January 20, 2016

RE: Analysis of Voluntary Incentives Program Pilot Evaluation - Summary

On Tuesday, September 29, 2015 an expert team from the Carpe Diem West Network met with McKenzie Watershed Collaborative (Collaborative) partners and Eugene Water & Electric Board staff to analyze the McKenzie Watershed Voluntary Incentives Program pilot project and evaluation.

This document summarizes their discussion, which focused on improvements that could be made to the Voluntary Incentives Program (VIP), for full rollout in 2016 and elements of the program that could be transferred to other watersheds.

Suggestions for Program Improvement

The Carpe Diem West expert team reviewed the “McKenzie Watershed Voluntary Incentives Program Pilot Project: A report to the Oregon Watershed Enhancement Board” prepared by Eugene Water & Electric Board (EWEB) and “Evaluation of EWEB’s Voluntary Incentive Program Pilot” prepared by the Community Planning Workshop at the University of Oregon. The team provided feedback and suggestions for program improvement based on the information provided in those documents.

Governance

Program Manager

The group noted that there were many partners who played a role in planning and implementing the VIP pilot. This was at times confusing for the landowners involved in the pilot. The group suggested that a new position be created at EWEB or one of the partner organizations whose role is to be the public point person as well as oversee the behind-the-scenes management of the program.

Strategic Decision Making

The Collaborative partners pointed out that while Cascade Pacific Resource Conservation and Development (CPRCD) had the technical capacity to receive, disburse and track pooled monies in the Watershed Conservation Fund (Fund), the CPRCD board may need to expand membership to include Fund contributors and partners. One suggested solution was to create a strategic planning committee consisting of representatives from EWEB, key Collaborative partner organizations, and major contributors to the Fund, such as the Oregon Watershed Enhancement Board (OWEB). This committee would be responsible for directing the Fund’s expenditures and could be bound by a charter agreement or intergovernmental agreement. The planning committee could impose mandatory term limits for President, Vice President, and Past President to avoid the “single program champion” issue highlighted in the VIP Pilot evaluation. Committee members would elect the Vice President, who at the end of the term would become

the President and subsequently the Past President, encouraging new leadership while ensuring institutional knowledge is preserved.

Another suggestion was to create a parallel 501(c)(3) organization to implement the VIP whose board was comprised of representatives from the EWEB Executive Board and strategic leaders mentioned above. This arrangement would provide flexibility in terms of decision-making, accepting tax-deductible donations, and patent or sales of products. The 501(c)(3) could contract with EWEB and Lane Council of Governments for staffing and technical assistance. See the [Clean Water Institute](#) for an example of how Clean Water Services (CWS) has implemented this strategy.

Program Oversight

It was suggested that regardless of which decision-making structure the program moves forward with, EWEB could serve as an “auditor” of the program. EWEB could perform periodic monitoring of on-the-ground project performance using remote sensing such as LiDAR or high-resolution photography with drones. A reasonable timeframe for performance monitoring would need to be established.

Funding Sources

Federal Farm Programs

The group suggested EWEB explore USDA funding programs. The riparian restoration dollars can be used as a local match for programs such as NRCS, FSA and CREP for on-farm improvements like drip irrigation. This could be done through the Soil and Water Conservation District.

Health Care Industry

With the Affordable Care Act, there has been a shift in the health care industry to focus on wellness and illness prevention. The industry recognizes a link between time spent in nature and lower stress levels and improvement in chronic health conditions such as heart disease, obesity and diabetes. Some health care providers go so far as to recommend “nature prescriptions” to their patients, encouraging them to explore local parks and open space. The health care industry may be a good partner for funding of restoration programs, if EWEB is able to connect the dots between the VIP and community health. CWS is working with Kaiser Permanente through the [Intertwine](#) Alliance, a broad coalition of public agencies, private businesses and nonprofits working together to celebrate, protect and improve the region's network of outdoor places and trails.

Program Structure

Landowner Agreements

The group discussed simplification of the landowner agreements. By tailoring each agreement to the specific landowner, there will be less room for confusion and landowners could feel greater ownership in and more positivity toward the program if they are given more specialized attention. There is also the potential that more agreements can be reached under the VIP if they are made on terms that individual landowners will accept. The group suggested the agreements be no shorter than 10 years, as visible results may not be realized until year 6 or 7, at which time landowners may feel even more positively about the program. At the end of the 10 years, agreements could automatically roll into new 10- or 20-year agreements, with an opt-out period.

Easements

Clean Water Services is in the tenth year of its riparian restoration program. As their original 10-year landowner agreements are coming to a close, CWS is rolling participants into new agreements featuring whole-parcel easements that are separate from the adaptive management plan for each property (see attached example easement and plan). By placing the easement over the whole property, CWS has dramatically reduced the processing time and cost of the easement because land surveys and assessments are not required. This also allows CWS to more creatively layer in different funding sources for different types of projects (e.g. riparian, upland, etc.) that lead to the overall ecological uplift of the land adjacent to the Tualatin River. The easements are a tangible asset, which CWS can capitalize and remove from their Operations & Maintenance budget. EWEB could consider a similar strategy in the future when renewing landowner agreements.

Communications

Strategic Communications Plan

It was suggested EWEB engage with a public relations consultant to design a strategic communications plan for the VIP. Belinda Griswold of Resource Media worked with CWS to create their strategic communications plan.

Landowner Recruitment

The VIP currently has three recruitment pathways: protection; restoration; and Naturescaping. Instead of discussing the different pathways in initial communications, EWEB could recruit landowners to join the VIP as a whole and then program staff would determine internally which pathway best fits the property. This will be less confusing from a messaging perspective and also help avoid issues associated with rumors and competition between landowners when neighbors are recruited into different pathways.

The group pointed out that the Septic System Assistance and Healthy Farms Clean Water programs were essentially “voluntary incentives programs” themselves and wondered whether they could all be rolled into one program. By combining these programs, EWEB could include community members, and in particular ratepayers, whose land wouldn’t contribute to riparian uplift, but could still impact water quality in the McKenzie. EWEB could then prioritize outreach to landowners within the riparian zone, then to residents eligible for SSA. This approach could broaden the sense of ownership of the program to the whole community. EWEB would need to examine how this approach would be implemented from an internal standpoint.

Utility Bills

EWEB staff has expressed their desire to include a line item on its water bills to call attention to the water source protection program. A voluntary check box could also be included to offer ratepayers the chance to donate additional money to the Watershed Conservation Fund. The check boxes could also appear on electricity-only bills.

Prioritization Versus Sequencing

In the event that the VIP receives a large flood of applications upon rollout in 2016, EWEB will need a system in place to prioritize restoration investments. The program could touch all landowners with an assessment of their property, while reserving restoration money for projects that meet specific criteria. The remaining projects could then be entered onto a waitlist. The waitlist itself may serve as a way to increase institutional support for the program and attract new funding sources.

By referring to this process as “phased expansion” or “sequencing” instead of “prioritization,” EWEB could avoid the message to applicants not chosen for the first round of restoration that their land is “not a priority,” which may carry a negative connotation.

Community “Glow” Programs

It was suggested that EWEB create some projects associated with the VIP that increase awareness of and community buy-in for the VIP. For example, CWS challenged their community to plant a million trees in one year. The community responded by planting 2 million trees in just 8 months. The challenge not only helped restore riparian forests in the Tualatin Watershed, but increased recognition of the program in the community, and was championed by local politicians.

A Stronger Connection to Climate Change Resilience

Connecting riparian restoration in the McKenzie to climate change resilience could help to increase support for the VIP program. Healthy riparian forests help attenuate floods associated with increased extreme weather events and protect water quality by buffering the river from human activity.

EWEB staff mentioned the possibility of the VIP being tied to the city’s goals for carbon offsetting. The group suggested ratepayers also be given the opportunity to offset their own carbon footprint by donating to the Watershed Conservation Fund.

Transferability

The transferability of the VIP is essential to achieving program goals for three reasons: 1) funders are more likely to invest in a program that has the potential to impact more than one watershed or community; 2) EWEB itself has plans to expand the VIP to two additional watersheds; and 3) EWEB would like to see its utility partners in Oregon and beyond succeed with their source water protection programs by implementing VIPs in their source watersheds.

The group discussed the elements of the VIP they believed were most readily transferrable to other communities and what basic community characteristics would help a VIP program take root in other watersheds.

VIP Components

The McKenzie VIP consists of the following components:

- **Watershed Conservation Fund**
- **Riparian assessment, metrics, scoring, reference sites (landowner pathway/process)**
- **Landowner agreements (easements, management plan)**
- **Incentives (payments, business discounts, work crews)**
- **Communications, outreach, marketing (annual events, dashboard, logo contest)**
- **Monitoring (site level and watershed level)**

The group noted that any component of the VIP could be transferred to a different watershed when tailored to that community but may include a reorganization of the roles that different collaborative partners play. For example, the local water utility may not have the trust of local landowners, but the Soil and Water Conservation District could take the lead role in implementing the VIP. Where the RCD is managing the McKenzie Watershed Conservation Fund, any entity that has the ability to receive, disburse, and track funds, and report metrics back to funders could take on managing the fund in another community.

A communications strategy may be the most readily transferrable component of the VIP. Having the right messages in place could make building other VIP components easier in a new community. It is also the least risky component a community can implement in terms of legal and financial commitments.

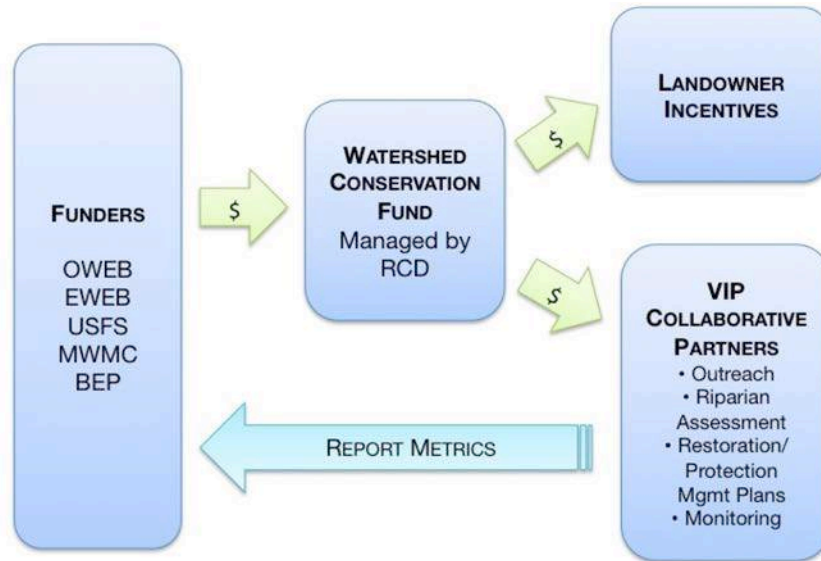


Figure 1: Proposed structure and function of the McKenzie Watershed Conservation Fund. When transferring the VIP concept to other watersheds, funders, fund managers, and collaborative partners may vary by individual community.

Community Characteristics

The group identified a number of community characteristics that would aid in the adoption of VIP programs in other watersheds.

Interested Utility

It is critical that the provider of the resource be able to make the connection between watershed health and water supply security to ratepayers and decision makers. Even if the utility is not the best messenger to community members, they need to support the program.

Sense of Urgency

A sense of urgency to prevent degradation of water supplies or, particularly in the West, water scarcity is a main driver for program support.

Local Champions

Well-respected members of the community, such as local politicians, can help make the public case for source water protection.

Utility Partners

Drinking water, wastewater, and stormwater utilities can work together through a “one water” approach to leverage different funding streams available to each.

US Forest Service Partners

Many municipal watersheds begin on National Forest land. A working relationship with the US Forest Service is key to working at the watershed scale and may open up restoration opportunities and funding streams, such as through stewardship contracting.

University Partners

Local land grant institutions or law schools are an excellent resource for a community exploring implementing a VIP. A near-by state university with a professor publishing on topics like source water protection is a natural partner. Universities can build research capacity and awareness for the program, as well as conduct and analyze surveys of landowners and ratepayers.

Analysis Team

Dr. Holly Hartmann – Director of Climate Science Applications, Carpe Diem West

Kate Greenberg – Western Organizer, National Young Farmers Coalition

Sterling Grogan – Program Consultant, Carpe Diem West

Karen Knudsen – Executive Director, Clark Fork Coalition

Mike McHugh – Environmental Permitting Coordinator, Aurora Water

Bruce Roll – Watershed Management Department Director, Clean Water Services

Attachments

Attachment 1:

Springhill Grant of Rights to Conduct Ecological Enhancement and Stewardship Activities

Attachment 2:

Upper Tualatin River Collaborative Regional Restoration Projects: Ecological Enhancement Plans for Carpenter Creek, Maroon Ponds and Penstemon Prairie Natural Areas

Tax Statements: No change requested

Project: Springhill

Tax Lot No.: 1S3180000100

Square Feet: 1,960,200 (45 acres)

**GRANT OF RIGHTS TO CONDUCT ECOLOGICAL ENHANCEMENT
AND
STEWARDSHIP ACTIVITIES**

Name of GRANTOR: METRO
Mailing Address: 600 NE Grand Avenue
Portland, OR 97232-2736

Legal Description of Property: See Exhibit A attached herein

GRANTOR, owner of the property described in Exhibit A herein (the “Property”), does hereby grant and convey to Clean Water Services, GRANTEE, the right to conduct ecological enhancement and stewardship activities on the Property. GRANTEE’s right to conduct ecological enhancement and stewardship activities is nonexclusive until such time as GRANTEE develops an ecological enhancement plan approved by GRANTOR in accordance with Section 2 below.

The consideration for this Grant of Rights is **non-monetary**.

This Grant of Rights shall be effective on the date it is recorded in the deed records of Washington County, Oregon and shall terminate twenty (20) years from that recording date. GRANTEE may renew this Grant of Rights for an additional twenty (20) year period by providing written notice to GRANTOR at least one-year but no more than two-years prior to the scheduled termination date. GRANTEE may also terminate this Grant of Rights prior to the scheduled termination date in the event of a change in GRANTEE’S available funding or business related regulatory constraints. Notice of such termination must be provided in writing at least one (1) year prior to the early termination date.

GRANTEE shall have ownership of ecological credits (e.g. Shade Credits) created on the Property as a result of GRANTEE’s ecological enhancement activities. GRANTEE shall not have ownership of ecological credits which result from activities conducted by GRANTOR unless GRANTEE and GRANTOR separately agree to such ownership.

Additional terms and conditions set forth below are hereby agreed to and binding upon the parties to this Grant of Rights:

1. The purpose of this Grant of Rights shall be to improve ecological conditions by enhancing and maintaining the Property. GRANTEE’s enhancement and maintenance activities on the Property may include, but shall not be limited to, the following: 1) using manual, mechanical or chemical means to control invasive species, provided that the chemical means are applied in accordance with GRANTEE’s Integrated Pest Management Plan; 2) planting native tree, shrub, forb and grass species; 3) placing large woody debris on the Property or in any stream adjacent to the Property; 4) irrigating planted species; 5) replacing dead tree, shrub, forb and grass species; 6) monitoring site conditions and collecting ecological data; and 7) conducting such other activities as GRANTEE determines are reasonably necessary to protect or improve riparian, fishery, upland and wetland ecological functions in accordance with mutually agreed enhancement plan (s) and applicable regulatory crediting frameworks. GRANTOR reserves the right to use and enjoy the

proposed enhancement activities will affect stream flow, the Plan shall include modeling to estimate the hydraulic impact of the enhancement activities. The Plan shall also include a twenty (20) year stewardship plan, and shall include a description of funding sources for the enhancement activities, and any transaction that may result in the transfer of mitigation obligations or ecological credits beyond the regulatory requirements of the GRANTEE. The Plan may be amended from time to time as agreed by both parties.

3. After the Plan has been approved by GRANTOR, GRANTEE shall have the right but not the obligation to conduct any of the enhancement activities described in the Plan. However, if GRANTEE has not implemented the Plan (or substantially commenced implementation of the Plan) within three years from the date the Plan was approved by GRANTOR, then such Plan shall be deemed to have expired and (a) GRANTEE's rights shall no longer be exclusive to GRANTEE and (b) GRANTEE shall be required to submit a new proposed Plan to GRANTOR before commencing any enhancement activities on the Property.
4. When GRANTEE conducts its enhancement activities pursuant to its approved Plan, GRANTEE shall thereafter maintain the resulting enhancements to the Property for the duration of this Grant of Rights. GRANTEE's obligation to maintain such enhancements shall be limited to portions of the Property GRANTEE has enhanced. GRANTEE shall be under no obligation to maintain portions of the Property GRANTEE has not enhanced. GRANTEE'S maintenance obligation shall consist of conducting activities that support the ecological function of the portion of the Property GRANTEE has enhanced. Such maintenance obligations may include, but are not limited to, reducing invasive species and planting additional native species.
5. During the term of this Grant of Rights GRANTOR shall periodically monitor the Property and shall enforce GRANTOR's ownership rights against trespassers in accordance with the policies GRANTOR has adopted for GRANTOR's other similar land. In the event GRANTOR fails to enforce GRANTOR's rights against trespassers and GRANTEE believes such failure could result in harm to the Property's ecological conditions addressed by GRANTEE's Plan, GRANTEE, in its capacity as the owner of this Grant of Rights, may pursue any and all action against trespassers available under applicable law.
6. GRANTOR and GRANTEE agree that there shall be no damming, dredging or other activities that may be detrimental to enhancement activities conducted on the Property. GRANTOR agrees not to engage in any activities on the Property which are, in the reasonable opinion of GRANTEE, inconsistent with GRANTEE's actions to preserve the natural condition of the Property in accordance with the approved Plan. The parties acknowledge that GRANTOR may lease the Property or portions thereof for farming activities, provided that such activities are consistent with the requirements of this paragraph.
7. GRANTEE and its contractors shall confine enhancement activities and any related construction operations to the Property or obtain the written permission of GRANTOR if additional area or access is required.
8. To the maximum extent permitted by law and subject to the limitations of the Oregon Tort Claims Act, ORS Chapter 30, and the Oregon Constitution, GRANTEE shall defend, indemnify, and hold harmless GRANTOR from and against any and all claims, demands, judgments, losses, damages, expenses, costs, fees (including, but not limited to, attorney, accountant, paralegal, expert, and escrow fees), fines, and/or penalties, which may be imposed upon or claimed against GRANTOR and which, in whole or in part, directly or indirectly, arise from or are in any way connected with (a) the negligent or wrongful act or omission of GRANTEE, its agents, employees or contractors acting within the scope of their employment or duties occurring on the Property and (b) the breach of any provision of this Grant of Rights by GRANTEE. It is understood and agreed that GRANTEE, by accepting this grant of Grant of Rights, is not accepting any liability and shall not be responsible for any environmental contamination on the Property, unless such contamination results from or is caused by an intentional or negligent act of GRANTEE or its agents, employees, and contractors.

9. The rights granted herein shall be covenants running with the land and be binding upon

rights provided in this Grant of Rights, subject to liens and encumbrances of record as of the date of execution set forth below.

IN WITNESS WHEREOF, the parties have executed this Grant of Rights as of the dates written below.

GRANTEE:
ACCEPTED

GRANTOR:

Clean Water Services

Metro,
an Oregon municipal corporation

By: _____
General Manager or Designee

By: _____
Name: _____
Title: _____

Date: _____

Date: _____

APPROVED AS TO FORM

District Counsel

State of OREGON)
)
County of _____)

This instrument was acknowledged before me on _____, 2011 by
_____, _____ of Clean Water Services, a County Service
District.

Notary Public - State of Oregon

State of OREGON)
)
County of MULTNOMAH)

This instrument was acknowledged before me on _____, 201__ by
_____, _____ of Metro.

Notary Public - State of Oregon

EXHIBIT A
Parcel Legal Description

A tract of land situated in the County of Washington and State of Oregon, and described as follows:

Beginning at stone on the section line 6.75 chains East of the corner of Sections 7, 8, 17 and 18, Township 1 South, Range 3 West, of the Willamette Meridian; running thence North to the center of Tualatin River; thence up the center of said river to the intersection with the East boundary of the W.B. Chatfield Donation Land Claim No. 52; thence South 02° 09' West 12.31 chains to the Southeast corner of said Donation Land Claim No. 52; thence South 73° 51' East 2.97 chains; thence North 68° 10' East 36.52 chains to the East boundary of the W.C. Boyd property; thence North 00° 27' West along East boundary 4.46 chains to the line between Sections 8 and 17; thence West along said line 3.25 chains to the place of beginning.

EXCEPTING THEREFROM that portion lying East of Fern Hill Road.

ALSO EXCEPTING THEREFROM that portion deeded to Cities of Hillsboro, Forest Grove, and Beaverton Joint Utilities Commission, recorded August 22, 1984 as Fee No. 84-33225, described as follows:

A tract of land in Section 18, Township 1 South, Range 3 West, of the Willamette Meridian, in Washington County, Oregon, being a portion of Parcel 2 as conveyed by Deed to Robert C. Cook and Helen M. Cook, husband and wife, recorded in Book 579, Page 667, Deed Records of Washington County, said portion being all of said Parcel 2 which lies Southerly of the following described line:

Beginning at a 1 inch x 48 inch iron pipe set at a point which bears South 16° 16' East (true solar bearing) 523.18 feet from a large stone at the Southerly Southwest corner of the A.T. Smith Donation Land Claim; from said 1 inch pipe, the herein described line extends North 73° 12' 33" West 163.96 feet, more or less, to the West boundary of the above mentioned Parcel 2, passing over a 5/8 inch x 30 inch iron rod at 100.0 feet from the pipe; from said 1 inch pipe the herein described line also extends South 73° 12' 33" East 1073.26 feet, more or less, to the Southerly boundary of the above mentioned Parcel 2, passing over a 5/8 inch x 30 inch iron rod at 500.00 feet, and another at 1000.0 feet from the pipe.

ALSO EXCEPTING that portion deeded to the United States of America by Deed recorded July 20, 1984 as Fee No. 84-28282, described as follows:

That portion of Sections 7 and 8, Township 1 South, Range 3 West, of the Willamette Meridian, in Washington County, State of Oregon, and more specifically described as follows:

Beginning at a point North 20° 14' 02" East 384.79 feet from the Southwest corner of said Section 8; thence North 75° 06' 59" West 80.00 feet; thence North 14° 53' 01" East 128.24 feet; thence North 69° 06' 17" West 36.34 feet; thence North 62° 44' 09" West 149.80 feet; thence North 58° 43' 31" West 189.84 feet; thence North 78° 37' 28" West 91.38 feet; thence South 84° 03' 36" West 195.49 feet; thence North 17° 03' 29" East 65.06 feet to a point on the thread of the Tualatin River which lies North 34° 08' 22" West 900.91 feet from the Southwest corner of said Section 8; thence downstream along the thread of the Tualatin River to a point which lies North 18° 29' 35" East 569.91 feet from the Southwest corner of said Section 8; thence South 14° 53' 01" West 185.67 feet to the point of beginning.

ALSO EXCEPTING THEREFROM that portion deeded to the United States of America by Deed recorded February 5, 1974 in Book 961, Page 571, described as
(Continued)

follows:

Beginning at an existing 5/8 inch diameter iron rod from which the section corner common to Sections 7, 8, 17 and 18 bears the following courses and distances: South 29° 21' 14" East 238.92 feet, South 67° 02' 46" West 130.68 feet to an existing 1 inch iron pipe and steel shaft, designated as road angle point No. 11 of vacated County Road No. 375, and West 660 feet to said corner; and running thence North 07° 21' 14" West 255 feet; thence West 250 feet, more or less, to the center of the Tualatin River; thence up the centerline of said river 250 feet, more or less, to the intersection of a line bearing North 14° 44' 38" East from a 2-1/2 inch diameter USBR brass cap; thence South 14° 44' 38" West 50.7 feet, more or less, to said brass cap, continuing South 14° 44' 38" West 135 feet to a 2-1/2 inch diameter USBR bass cap; thence South 71° 20' 12" East 419.31 feet to a 3/4 inch diameter iron pipe set in the center of Fern Hill Road; thence North 07° 43' 46" East 126 feet to an existing 3/4 inch diameter iron pipe found in the center of Fern Hill Road; thence South 42° 29' 14" East 67.2 feet to a PK nail found in the center of Blooming-Fern Hill road; thence South 40° 13' 14" East 75.6 feet to a 3/4 inch iron pipe set in the center of Blooming-Fern Hill Road; thence North 52° 02' 46" East 24.2 feet to the point of beginning.

UPPER TUALATIN RIVER COLLABORATIVE REGIONAL RESTORATION PROJECTS

Ecological Enhancement Plans for Carpenter Creek, Maroon Ponds and Penstemon Prairie Natural Areas

Prepared for
Clean Water Services & Metro
by ESA Vigil-Agrimis

December 2013



Project Name: **Collaborative Regional Restoration**

Site Names: **Carpenter Creek Natural Area, Maroon Ponds Natural Area & Penstemon Prairie Natural Area**

General Location: **Washington County, OR between Gaston and Forest Grove**

Organizational Points of Contact:

Clean Water Services: **Rich Hunter, Senior Water Resources Program Manager**

Metro: **Jonathan Soll, Science and Stewardship Division Manager**

Date of last update: **December 23, 2013**

Approved by: _____ Organization: _____

Approved by: _____ Organization: _____

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Appendix D – Targets, Desired Future Conditions, and Key Ecological Attributes (KEA) Tables

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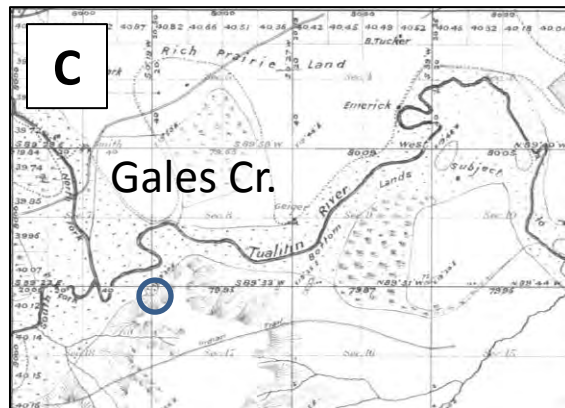
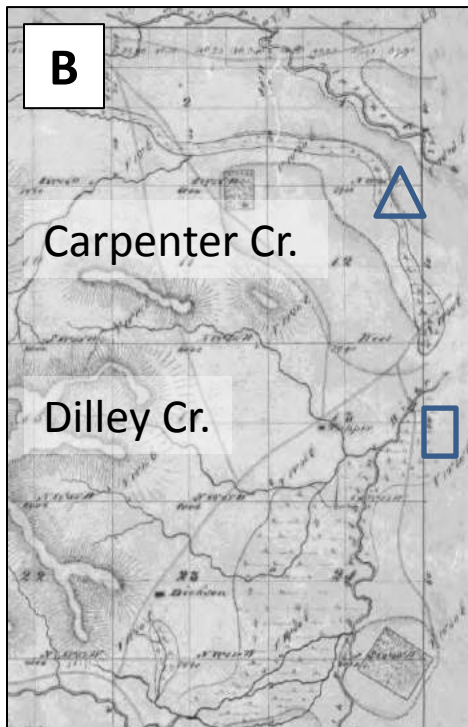
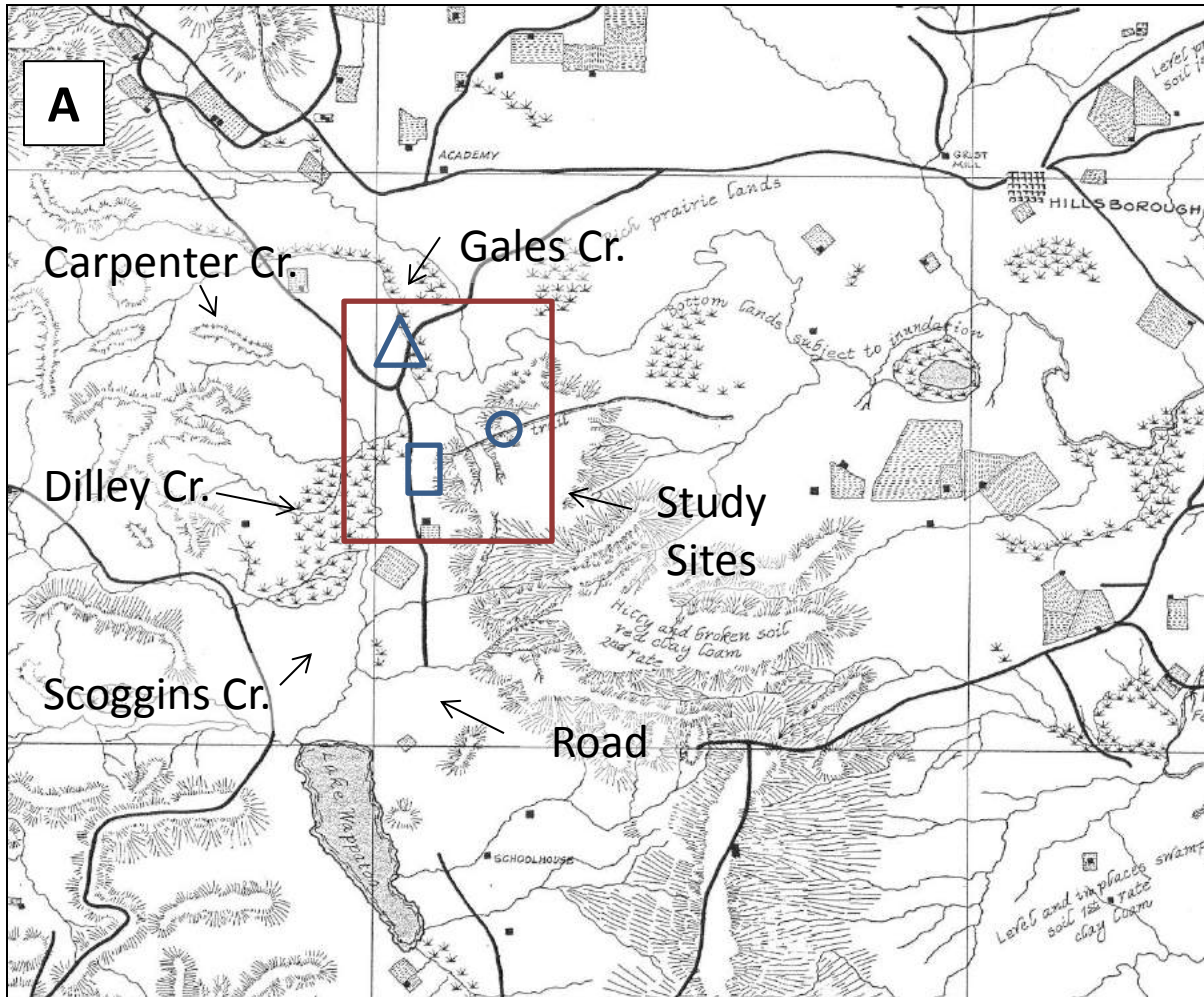
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1.0 Project Planning Area Overview

The Upper Tualatin Metro Properties are three properties of interest found within a regional collaboration planning area covering 4,750 acres within the Wapato Valley at the foothills of the eastern slopes of the Oregon Coast Range and bordered to the west by the Chehalem Ridge (Map 1). The properties are owned by Metro and Clean Water Services (CWS) has conservation easements on these properties; thus they are jointly managing this project planning area. The Wapato Valley is located primarily within the Upper Tualatin-Scoggins subwatershed of Washington County, Oregon; however, the project planning area also includes parts of the Gales and Middle Tualatin-Rock subwatersheds of the Tualatin River Watershed. Historically, this region was a river valley surrounded by wet prairie, wetlands, and upland prairie-oak habitat. Currently, it is dominated by agricultural land use. Within the project planning area, 35% of the area is publically owned (some of which is leased agricultural land) and 65% is privately held.

The upper Tualatin project area is a wet region, with annual precipitation of approximately 46 inches. The Upper Tualatin drains 136 square miles (Hawksworth et al. 2000). The Tualatin River enters the Wapato Valley at approximately river mile (RM) 62 and meets Gales Creek at RM 56.7. The valley experiences extensive flooding, as is evident in the extent of 1996 floods. Approximately 58 percent of the planning area was inundated in 1996 which was considered at or near a 100-year event for this part of the Tualatin watershed (Map 2). Because we do not have mapped 100-year floodplain for the entire planning area, the 1996 flood zone is considered a surrogate for this assessment. At the Tualatin River-Gales Creek confluence, the width of the Tualatin River flood zone frequently exceeds 1000 feet (Map 2). At Dilley Creek, about midway through the planning area, is a US Geological Survey (USGS) gage that has collected streamflow data since 1939 (USGS 2012; location see Map 1). The average discharge for the period of record is 389 cfs. Historically, flow got as low as 0.08 cfs in September 1967 and hit a high of 17,100 cfs in December 1964 (though this value is uncertain). Flow has been regulated since 1975 by Henry Hagg Lake on Scoggins Creek, which augments flow during low-flow periods.

Much of the landscape of the Wapato Valley is influenced by the historic Missoula floods, which deposited alluvium on the valley floor 10,000-15,000 years ago (O'Connor et al. 2001). Historically, water flowed from the surrounding hillslopes into the valley where lakes, wet prairies, wetlands, and streams arose and formed multiple channels and drainages down to the Tualatin River (Figure 1). Clays and silts, deposited following these floods, under laid this wet, marshy valley environment. The river floodplain is wide (average of 6700 feet) and valley low gradient, but due to the cohesive soils the active channel is primarily single-threaded. Bed and bank materials are cohesive, thus leading to a u-shaped channel with a mucky bottom covered in fine sediment. Late 19th and 20th century splash dams, dredging, and log runs may have contributed to channel change and current geometry. Currently, erosion tends to be slow and massive channel change infrequent.



Legend

- Maroon Ponds
- △ Carpenter Creek
- Penstemon Prairie

Figure 1. Historical maps of the region: A) Wapato Valley (Munch 2000) where box represents study sites, B) 1853 GLO, and C) 1852 GLO.

Topography is very flat, with a river gradient considerably lower than 1% over most of the project planning area (Hawksworth et al. 2000). Soils are fine-grained, primarily silt and clay, and fluvially deposited. Streambanks tend to be well vegetated, with shrubs overhanging the river. Wood tends to rack up in large accumulations throughout the river system. Though there are large trees in the buffers, individual pieces or small accumulations of large wood are not frequent. This wood loading pattern may be due to: 1) wood moving to culverts and bridges, then being removed, 2) wood moving to “sticky spots” in the channel and build large accumulations, 2) removal of individual pieces of wood throughout, and 3) reduced buffer widths (i.e. reduced source).

Water quality in the Tualatin River is monitored regularly at a number of locations downstream of Wapato Lake by USGS, CWS, and others such as the irrigation district. There are a number of water quality parameters that exceed criteria, only two of which have total maximum daily loads (TMDLs) approved (Table 1). The organic fluvial deposits along the valley have high phosphorus content; therefore it is naturally occurring. Other parameters are generally the result of upstream land management practices.

Table 1. Water quality characteristics for Tualatin River (ODEQ 2010)

Water Quality Parameter	Season of impairment	Status relative to the 303(d) list of impaired waterbodies
Ammonia	June 1 – Sept 30	Attaining, some exceedances recorded
Biological Criteria	Year Around	303(d)
Chlorophyll a	Summer	TMDL approved
Dissolved Oxygen	Jan 1 – May 15	303(d)
<i>E. coli</i>	Fall/Winter/Spring	Attaining, but some exceedances recorded
Iron	Year Around	303(d)
Manganese	Year Around	303(d)
pH	Fall/Winter/Spring	Attaining, but some exceedances
Phosphorous	June 1 – Sept 30	TMDL approved
Temperature	Summer	Attaining, but some exceedances recorded

The Tualatin River and its tributaries support a number of native fish species, including salmonid species of interest. Winter steelhead trout (*Oncorhynchus mykiss*) and Coho (*O. kisutch*) use portions of the project planning area for spawning, rearing and migration (StreamNet 2013). Resident cutthroat trout (*O. clarkii*), lamprey, sculpin, dace, coarcescale sucker and redbside shiner are also found in the area (Hawksworth et al. 2000). Further, Gales Creek is considered critical habitat for threatened winter steelhead and coastal cutthroat trout (Tualatin River Watershed Council 1999). Introduced warm water fish species in the Tualatin River system include largemouth bass, bluegill, yellow perch, yellow bullhead, brown bullhead, and mosquitofish (ODFW 1996).

Historically, much of the planning area was closed riparian forest with emergent wetlands and prairie vegetation communities (CWS 2005). Currently, riparian tree canopies are relatively intact, though

buffer widths are frequently less than 100 feet. Riparian overstory communities are primarily Oregon ash, big-leaf maple, and red alder with occasional oak trees on knolls. The understory is dominated by rose, Pacific ninebark, black twinberry, red osier dogwood, and blackberry and reed canarygrass in riparian areas not yet under conservation easements. Riparian buffers have been planted, restored and maintained by the Tualatin Soil and Water Conservation District (TSWCD) and CWS where conservation easements can be obtained. Many of the wetlands and wet prairies have been drained during agricultural uses; therefore have a more limited distribution than historically. Metro has attempted to restore these native plant communities where opportunities and funding have arisen.

Despite the alteration of the landscape from agriculture and rural residential development, the study parcels and surrounding areas provide habitat for a multitude of resident and migratory species commonly found in the Tualatin Basin. Forested riparian buffers are present at all three of the study areas and support foraging, breeding, loafing, and movement functions for numerous species of birds, mammals, amphibians and reptiles. Conditions in the riparian buffers vary for each site, but all have been reduced and disturbed compared to historic conditions.

The reduction in riparian buffers and wetlands may have adversely impacted the quality and quantity of native amphibians and other wetland and riparian species. Non-native species, such as bullfrogs, are likely causing further declines. These wet prairie, emergent wetland and riparian plant communities are also important habitats for supporting declining songbird and amphibian communities in the Willamette Valley. Diverse plant communities support strong terrestrial arthropod communities, which form the basis for food web relationships with drift fisheries such as salmonids (Nakano et al. 1999; Woodward 2008).

The Oregon Conservation Strategy has identified the plant communities in the study areas as important for a variety of sensitive and threatened species such as Nelson's checkermallow (*Sidalcea nelsoniana*), Hesperius penstemon (*Penstemon hesperius*), Yellow-breasted chat (*Icteria virens*), (during a transitional phase); and the Northern red-legged frog (*Rana aurora aurora*). The streaked horned lark (*Eremophila alpestris strigata*), a rare subspecies of the horned lark, is also a sensitive species that was once more prevalent in the open landscapes of the Willamette Valley (Pearson and Altman, 2005). The streaked horn lark was listed as threatened under the Endangered Species Act in October 2013.

The Wapato Valley has been influenced by a number of land management decisions since settlement began in the mid-1800s. Beaver were trapped and the population severely reduced by the mid-1800s. Log drives ran through this section of the Tualatin River, which resulted in scouring out of vegetation, removal of large wood, and likely some scouring of bed and banks (Miller 2010); there are few signs of extensive damage remaining today. Many of the small tributaries that existed as swales and connected wetland and prairies across the valley were ditched and consolidated to drain agricultural areas. In the southern part of the Wapato Valley, the river was sometimes straightened and channelized, altering the local hydrology.

The three Upper Tualatin Metro Properties of interest are: Carpenter Creek, Maroon Ponds, and Penstemon Prairie natural areas. These properties cover a total of 530.2 acres owned by Metro and CWS has agreements for planting the riparian buffer as well as other ecological enhancements on all three properties. These two organizations expect to work with additional partners to identify landscape-scale opportunities that will enhance ecological functions and support the establishment of a vibrant mosaic of habitat types. The next sections of this report describe existing conditions, desired future conditions, threats and stressors, and opportunities for each of the properties.

2.0 Methods

ESA developed this assessment of the CWS / Metro planning areas using existing information combined with a reconnaissance-level site visit to observe existing conditions in the field. The following were the primary sources of existing information reviewed:

- GIS spatial data provided by Washington County, CWS, and other publically available spatial data;
- Upper Tualatin – Scoggins Watershed Analysis (Hawksworth et al. 2000);
- Washington County Soil Survey (NRCS 1982); and
- Healthy Streams Plan (CWS 2005).

The two-day field assessment provided a “snapshot” of existing conditions and relied primarily on reconnaissance-level data collection, photographs, and information from CWS and Metro. The primary field visits were conducted on May 29 and 30, 2013 by a team consisting of a geomorphologist / hydrologist, a wetlands and wildlife biologist, a water resources engineer, and CWS staff. The field assessment consisted of a walking reconnaissance survey, observing stream conditions, estimating the extent of wetlands, and noting dominant vegetation communities. The field visits were documented by field notes, field maps on aerial photos, and photographs (Appendix A). Field investigations did not include wetland delineations, ordinary high water line marking, stream habitat assessments or other detailed analyses requiring additional time on the ground.

A strategic planning workshop was held on July 22, 2013 and follow up meeting on August 5, 2013 with CWS, Metro and consultants present. At the workshop, the following objectives were met for Maroon Ponds and Carpenter Creek Natural Areas: collect additional background information, rank ecological targets, discuss strategies, and determine enhancement goals that could either be implemented within or begun in the next five years (meeting notes in Appendix B). Penstemon Prairie Natural Area was addressed during the follow-up meeting.

On August 20 and 21, 2013, sites were revisited by the geomorphologist to aid in the assessment of hydrologic conditions at each site. Each site was investigated for locations where water enters and leaves the site, connectivity of wetlands to the stream, and infrastructure crossing the watercourse.

A final meeting was held on October 24, 2013 with CWS, Metro and consultants to review concept plans, decide which restoration actions would be moving forward, and plan a preliminary schedule for approach.

3.0 Vision, Approach & General Project Goals

The vision for these three Upper Tualatin River Metro properties is a diverse landscape of native riparian, wetland (emergent, forested and scrub-shrub), and upland (oak, pine and/or prairie) communities. Each of the properties will provide significant ecological functions such as providing: shade for stream temperature control; foraging, breeding, or wintering habitat for wildlife; flow attenuation and storage; and enhancement and maintenance of biodiversity of the Upper Tualatin River. Native plant species will dominate the vegetative communities on the site. Invasive species will be greatly reduced, in some cases eradicated, or controlled and monitored. Riparian vegetation will provide organic matter and natural wood recruitment for the stream. Channel conditions will be dynamically stable (i.e. no excessive erosion or degradation but subject to minor changes in morphology) and sufficiently complex to provide floodplain connectivity, flood attenuation, and high quality aquatic habitat. All properties will have intact native emergent plant communities and those conditions will be maintained and enhanced wherever feasible. Wetland ponds and adjacent areas will support native amphibians and other herpetofauna such as turtles. Beaver activity will be encouraged or supported in waterways where passive engineering by the rodents restores appropriate hydrology.

In order to enhance and maintain biodiversity, the approach to establishing the vision landscapes will be to work with or actively reinforce through management actions, the natural processes that maintain those landscapes. First steps will focus on re-establishing physical processes such as hydrology, hydraulics, and sediment regimes that support the biological and chemical process that influence vegetation, habitat, and water quality. Specific recommendations for each property are to be developed and revisited when appropriate by a multidisciplinary team including biologists, geomorphologists, ecologists, engineers, and others.

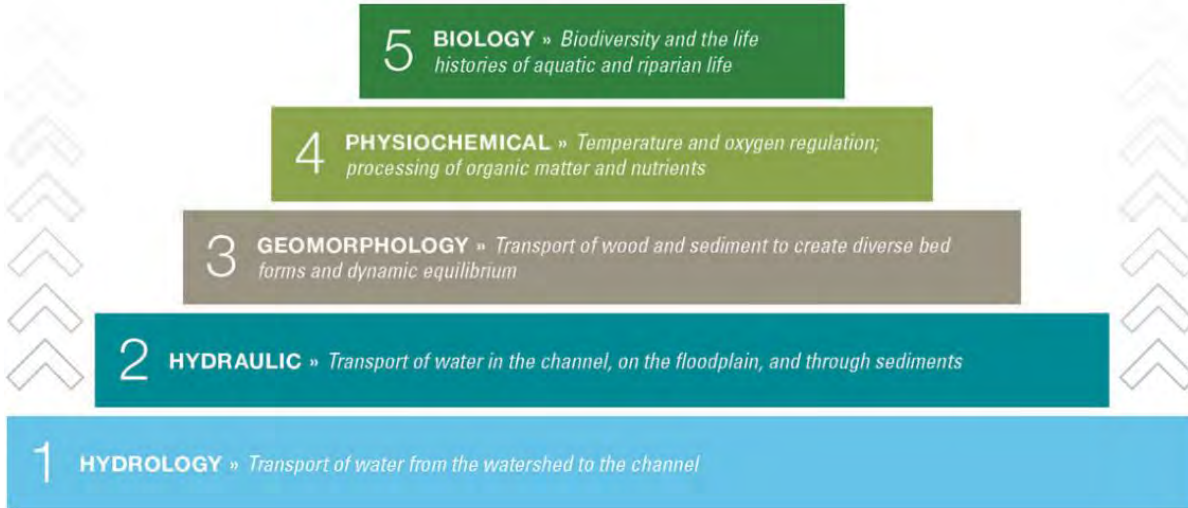


Figure 2. Stream Function Pyramid taken from: USFWS "A Function-Based Framework for Stream Assessments, Restoration Goals Performance Standards, and Standard Operating Procedures."

To achieve this vision, the ecological enhancement plan establishes these priority goals, including:

- Restore and maintain high quality mixed deciduous/coniferous riparian forest conditions with a high percentage of native species and dense canopy cover as indicated by landscape history.
- Restore and maintain native upland habitat, such as oak woodlands, oak-pine woodland, or upland prairie (dependent on site conditions), which were once prevalent in the region.
- Restore and maintain high quality emergent wetland conditions and re-introduce scrub-shrub/forested wetland plant communities where it can be used to control reed canarygrass and where it best supports water quality and wildlife related goals.
- Wherever appropriate, use active and passive management practices to encourage the creation and maintenance of mosaics of habitat types that provide the greatest benefits to multiple species of wildlife.
- Enhance or support connectivity between wetlands and the river or stream such that greater flood attenuation is achieved, and native plant or wildlife communities are supported by hydrologic or geomorphic processes.
- Restore and maintain high quality channel conditions through encouraging natural channel evolution, stabilization or passive management of stream hydrology on the site.
- Work with partners to manage impacts from agricultural and transient uses of the sites. If deemed appropriate to introduce recreational opportunities to one of these sites, recreational opportunities will be managed and compatible with stable ecosystem resilience.
- Develop appropriate funding strategies to implement and sustain environmental and other objectives through a time period that ties to achieving overall targets and ecological benefits.

5.0 Maroon Ponds Natural Area

5.1 Existing Conditions and Management

Maroon Ponds encompasses 47.2 acres along 2,800 feet of the Tualatin River in the Upper Tualatin-Scoggins sub-watershed of the Tualatin River basin (Map 1). The site is bordered on the east by SW Fernhill Road, to the west by the Tualatin River, to the south by Joint Water Commission (JWC) property and on the north by Bureau of Reclamation (BOR) property. Two drinking water lines and a power line run north-to-south across the site (Map 10). Across the river is the Zurcher property owned by CWS and currently under a lease agreement for continued agricultural use. A man-made levee impounds a historic tributary in the southeast portion of the site.

5.1.1 River Conditions

Tualatin River flows 2,800 feet along the western border of the site (Map 2). The channel has incised, likely due to historical land use, and is lined by fine sediment, as described in the site overview. Stream width varies little through the project area and it is assumed that there is minimal habitat complexity due to its incised condition (Table 6). Banks are frequently steep (> 60 degrees) and high (> 10 feet). Few pieces of wood were observed in the channel and much of the wood was small in diameter (Photo 14). Though the riparian area was diverse with a number of large diameter trees providing shade, wildlife resources and potential wood recruitment, the forested riparian buffer is relatively narrow in places, ranging from only 50 feet to 150 feet wide. Shrubs grew on the steep banks and frequently hung over the water (Photo 15).

Table 8. Stream geomorphic characteristics for the Tualatin River, Maroon Ponds Site

Stream Measure	Value
Channel Width – Average	40-45 feet
Channel Slope	<0.5%
Sinuosity	1.3
1996 Flood Zone Width	630 feet

Fifty-nine percent of the project area lies within the 100 year FEMA floodplain and was inundated during the 1996 floods (Map 2). It is possible that the wetlands and ponds that remain on site could be artifacts of a historic channel as they are lower in elevation from the rest of the site, follow a sinuous line of low elevation topography running from upstream to downstream and contain habitats indicative of an oxbow or historic channel. As evidenced by property boundaries no longer aligned with the river, the river has meandered westward in the downstream end of the project site.

Except for the river levee which is at a higher elevation, the floodplain wetland-pond complexes (Wetlands A and D) are typically inundated during 2-year (Q_2) events (Map 11, Figure 3). As river levels approach 158 ft, water likely begins to backwater onto the site from the downstream Bureau of Reclamation (BOR) property. However, the river levee is only a few feet higher than Q_2 stage/water surface elevation and the entire floodplain would be inundated by the Q_5 event. Wetlands A and D occur

below 156-155 ft. and contain ponded areas year-round. Surface water connects Wetlands A and D via a seasonal forested wetland when water levels are between 155 and 158 ft.

Water enters Wetland C year-round from the Joint Water Commission (JWC) and Portland General Electric (PGE) properties to the south (Map 12). The current headwaters of the tributary wetland is on JWC property, but historically the headwaters were upslope and ran from the hillslope across the JWC site. JWC stormwater drains into the head of the wetland, but this contribution occurs in the wet season. Groundwater is also a source of hydrology as evidenced by the presence of running water through the dry season. Wetland B water level remains at the height of the dam throughout the dry season, despite drops in water levels for the lower elevation wetlands.

5.1.2 Plant Communities

Plant communities found on the Maroon Site include riparian forest; emergent and open water wetlands; scrub-shrub wetlands; forested wetland; upland shrub; and upland forest (Map 12).

The riparian forest is approximately 50 to 150 feet wide with a continuous canopy dominated by big-leaf maple, Oregon ash, and the occasional Oregon white oak (Photo 16). A few mature Douglas fir trees and western red cedar are also present in the riparian zone on the study area and off-site on the opposite bank. The understory is relatively dense and multi-layered. Dominant shrubs include common snowberry, Indian plum, and red-osier dogwood. Other shrubs observed on-site were poison oak, tall Oregon grape, oceanspray, thimbleberry, Himalayan blackberry, and elderberry. The groundcover was a mix of native and non-native species such as sword fern, bleeding heart, and lemon balm to name a few.

Wetland plant communities on-site generally coincide with low-lying areas mapped as Jory silty clay loam. The low elevation areas appear to be an old oxbow of the Tualatin River. The largest wetland complex, Wetland A (Map 12), is located at the base of the man-made levee in the northeast portion of the site (Photos 17 and 18). This wetland consists of two ponds connected by a narrow channel. Yellow pond lily and other aquatic vegetation cover approximately 30 percent of the south pond of Wetland A and cover more than 50 percent of the north pond. Lush stands of creeping spike rush fringe the south pond. Other hydrophytes observed in and around Wetland A include reed canarygrass, water pepper, soft rush, and harefoot sedge.

Wetland B was formed from levee construction and is approximately 20 feet higher in elevation than Wetland A. Yellow pond lily and other aquatics cover approximately 40 percent of the water surface (Photos 19). A wide band of reed canarygrass is located at the south end of the wetland, otherwise the banks are relatively steep and the emergent vegetation is limited. Water is piped through the levee and also seeps in rivulets over the top and down the vegetated slope into Wetland A (Photos 20 and 21).

Wetland C is connected to Wetland B via a culvert under the dirt roadway (Photo 22). Wetland C is a small emergent wetland vegetated with skunk cabbage, reed canarygrass, and some Douglas spirea (Photo 23).

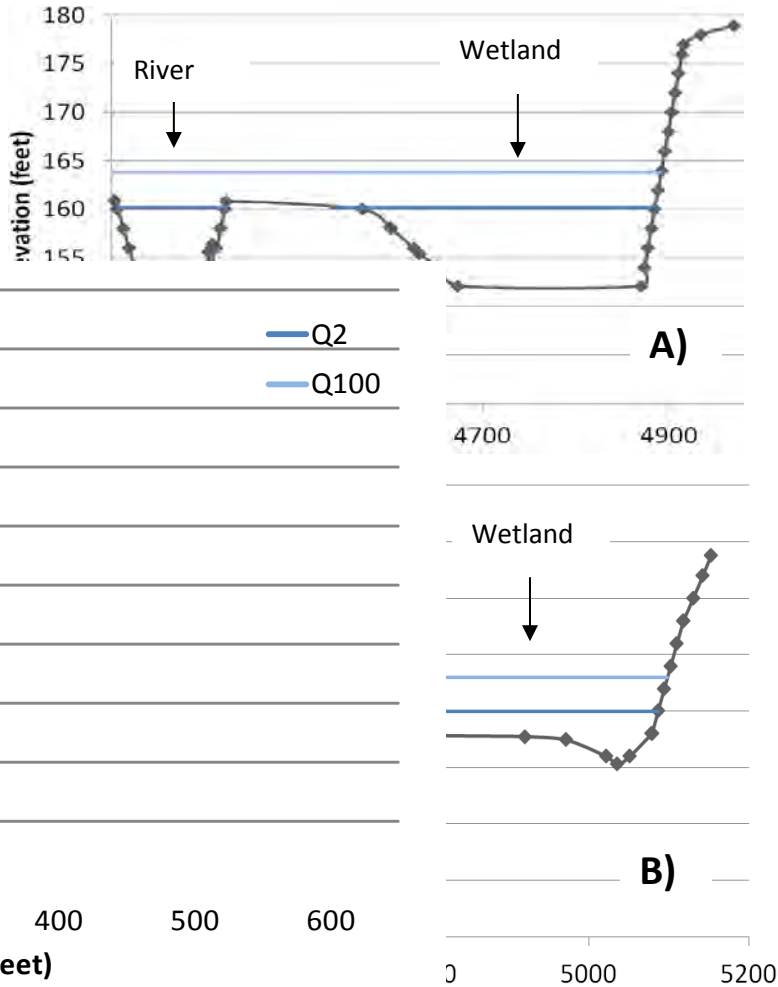


Figure 4. Cross-sectional profiles of the site as they correspond with Map 11. Q₂ and Q₁₀₀ represent the 2-year and 100-year event water surface profile as determined by HEC-RAS modeling of the Upper Tualatin River.

Wetland D is a shallow pond at the west end of the site dominated by Wapato (greater than 25 percent cover) (Photos 24 and 25). The water was noticeably turbid throughout the wetland compared with the other ponds on-site. Possible causes of the turbid water could have been due to recent foraging activity of ducks, fish, rough-skinned newts, or beavers – although no animals were observed in Wetland D during the field visit. Scrub-shrub wetland dominated by reed canarygrass and willows occurs east of Wetland D.

Forested wetland occurs in the center of the site and consists of Oregon ash trees and reed canarygrass (Photos 26). The wetland has upland inclusions and a deep, unvegetated swale due to the hummocky terrain (Photo 27).

Upland shrub habitat is the most extensive plant community on-site and occurs in areas previously cultivated (Photo 28). Shrub density varies throughout this community, with the highest densities between the man-made levee of the southern property line. Shrubs and saplings in the shrub - dominated areas were planted by Metro and include valley pine, Douglas fir, Oregon ash, rose, ninebark, and a stand of blueberries at the south end. A Douglas fir plantation remains along the west side of Wetland B. Some of the young firs had turned entirely brown, possibly due to drought stress.

The herbaceous layer in the upland shrub areas is a dense mix of tall forbs and grasses. Dominant grasses include meadow foxtail, common velvetgrass, reed canarygrass, fescue, and bentgrass. Other species observed were St John's wort, yarrow, Shasta daisy, teasel, creeping buttercup, and century plant. Common teasel and Himalayan blackberry are forming dense stands at the northwest end of the upland scrub-shrub habitat.

Mature Douglas fir trees dominate the upland forest located on a steep slope in the center of the site. Canopy cover is estimated from 75-90 percent. The understory appears relatively undisturbed, although a small patch of shiny geranium, a Category 1 weed, has established along a deer trail through the forest. Shrubs consist of elderberry, Indian plum, and vine maple. Ground cover includes sword fern, fringe cup, dull Oregon grape, bleeding heart, and trailing blackberry.

5.1.3 Wildlife Habitat

With its diversity of habitats, Maroon Ponds supports a variety of resident and migratory species typical to the Tualatin Basin.

A number of songbirds, wood peckers, and red-tailed hawks were seen and heard during the May field visit. Several common yellowthroats, Bewick's wren, song sparrows, and lesser goldfinch were observed in the upland shrub habitat which covers a large portion of the site. The Bewick's wren had fledglings and likely nested in the upland shrub or along the edges the wooded habitat. A red-bellied sapsucker was also observed in the upland shrub, which contained several snags suitable for nesting on the east side of the site (Photo 29). Neotropical migratory species seen and heard in the riparian forest and along the edges include orange-crowned warbler, yellow warbler, Swainson's thrush, and black-headed grosbeak. These species may have been using the site as stopover habitat or may have been establishing breeding territories on-site.

The extensive edge habitat and open scrub-shrub/grassland is ideal for swallows, swifts, and flycatchers, including the Western wood pewee observed foraging from a snag. Spotted towhees were seen in the stand of Douglas fir trees, which is also expected to provide foraging and nesting habitat for the brown creeper, red-breasted nuthatch, and possibly Western screech owl. Other native species seen in the open shrub include American robin, scrub-jay, and Cedar waxwings. The brown headed cowbird, a native brood parasite, was also observed.

With the exception of a pair of mallards foraging in the pond below the levee, no waterfowl were observed in the wetlands on-site. While the open water habitat is not extensive, the wetlands are expected to provide feeding and resting habitat for small flocks of common dabbling ducks like blue-winged teal, green-winged teal, wood duck, northern pintail, northern shoveler, and gadwall. Dabbling ducks will also use the Tualatin River in the study area for feeding, resting, and breeding functions. The ponds on-site are too small and shallow to support significant numbers of diving ducks or geese such as bufflehead, common merganser, lesser scaup, or goldeneye.

Shorebirds likely use the ponds as stopover habitat during migration. Great blue heron are expected to forage in the open meadow in the scrub-shrub wetland habitat and roost in the riparian forest.

Evidence of mammals detected during the field visit includes deer and coyote scat, and rodent herbivory (moles, voles, and beaver). Felled trees and pointed stumps were observed around the south pond of Wetland A where beavers have constructed a lodge. Beaver herbivory was observed around Wetland D as well. The project site is also expected to provide habitat for other mammals typical of the Tualatin basin including bobcat, skunk, weasel, brush rabbits, mice, raccoons, opossum, and possibly black bear.

The project site provides habitat for native and non-native amphibians and reptiles. American bullfrogs were heard in Wetland A and likely inhabit the other ponds on-site. Surface water in the ponded areas is expected to persist year-round, which is ideal for the non-native bullfrog. Native pond breeding amphibians also benefit from deep ponds (greater than three feet) but may be adversely affected and outcompeted by the aggressive non-native bullfrog. The rough-skinned newt, a common native salamander, is expected to occur on-site because of its adaptation to a wide variety of wetland habitat types. The rough-skinned newt is known to consume eggs of other native amphibians and is occasionally the only native species in some ponds (Corkran and Thoms 1996). Other native amphibians that may breed in the ponds on-site include the red-legged frog, a state sensitive species, and long-toed salamanders.

Western pond turtles were observed in Wetland B, the deepest pond, during a June field visit by CWS (R. Emanuel, pers. comm. 2013). One to two small logs extend from the shoreline of Wetland B and may serve as basking sites; however, basking sites are generally absent or are less than optimal for suitable thermoregulation. Several garter snakes were observed in the grass in the scrub-shrub habitat. Other snakes that may occur on-site include the rubber boa and racers.

5.2 History of Land Use and Ecological Enhancements

In the 1850s, the low elevation portion of this site was identified as “bottom lands subject to inundation,” with at least one wetland complex at the section mark (Figure 1). Otherwise the site was recognized as being at the foothills of the Chehalem Ridge. Since then, this project area likely has had limited farming use due to the low depression that bisected the site. Additionally, water draining from the hillslope entered the site from the south, ran through what is now Wetland B and then west through the low depression until meeting another tributary and entering the Tualatin (Map 13). The upland bench has been farmed since at least the mid-1900s and was more recently a blueberry farm. Sometime after the 1960s, a levee was built across this tributary channel forming a pond, possibly to support the blueberry farm.

Past ecological enhancements include plantings in several regions across the site and continual maintenance of the berm. Along the riparian area as part of the CWS program, plantings were conducted along the riparian corridor to gain shade credits. CWS is currently planning additional plantings along the corridor to enhance the buffer width, with site-prep to begin in fall of 2013. Upland in the old blueberry farm plot, Metro has mowed and sprayed, followed by plantings to establish an upland woody plant community. Blueberries have returned to the site despite spraying. Additionally, Metro has planted ash in the land between Wetlands A and D, but maintenance was sparse and the plantings were not successful. Throughout the higher elevations of the floodplain, valley pine have been planted, some of which have been successful despite low levels of maintenance. Though maintenance of the dam is not strictly an ecological enhancement, maintenance has been key to providing an intact dam and the pond behind the dam.

5.3 Ecological Targets, Desired Future Conditions, and Key Ecological Attributes

At Maroon Ponds, there is a broad diversity in habitat and community types of interest. Each of the communities of interest are described as ecological targets, with key ecological attributes of the target identified which can serve as measures of the target condition (Appendix D - Table 2). KEAs for targets already identified by Metro were compared (Appendix E).

5.4 Threats and Stressors

Threats and stressors to the Maroon Ponds project area are relatively limited (Table 7, Map 14). There is a high priority action to remove shiny geranium, but there is otherwise little current human interaction with the site that creates ongoing problems. The presence of non-native bullfrog should be addressed. The primary issues are with infrastructure, either constructed onsite, running through the site, or limiting the enhancement of functions by reducing connectivity to adjacent properties.

Table 9. Threats and stressors for Maroon Ponds

Threat/Stressor	Source(s)	Intensity	Priority	Comments
Invasive plants	Human, wildlife, wind streamflow	Moderate	High/Low	Treatment of EDRR species such as shiny geranium (<i>Geranium lucidum</i>) and leafy spurge (<i>Euphorbia esula</i>) should be top priorities. Additional weed control is needed for reed canarygrass, teasel and blackberry.
Berm failure of upper elevation pond (Wetland B)	Human or beaver	Moderate	Moderate	There is already evidence of water flowing over the top of the berm. Water sources for the pond should be identified before any action is taken. The drinking water line runs along the edge of the pond and should also be addressed if changes are to be made.
Low occurrence of downed wood, brush piles	Natural processes; past land use	Low/Moderate	Low	Some downed wood is present, but more submerged logs could be added to the wetlands to enhance turtle habitat.
Invasive wildlife	Natural processes	Moderate	Moderate	Non-native species such as bullfrog could threaten turtle and native amphibian populations. Recommend removal of bullfrog from site. European starlings could impact bluebird habitat (if that should be a species that uses this site).
Existing utilities	Human	Low	Low	Potential maintenance issues could arise and land kept maintained for access to power lines and drinking water lines.
Lack of unvegetated areas for reptile solarization	Vegetation encroachment; lack of periodic fire or disturbance	Moderate	Low	Western pond turtles require loose soils with sparse vegetation for nesting.

5.5 Opportunities for Ecological Enhancement

There are a number of opportunities for improving conditions at the Maroon Ponds site (Map 15):

- Remove berm and expand Wetland A. The existing pond (Wetland B) is deep and is expected to provide suitable habitat for red-legged frogs, western pond turtles and amphibians. If the berm is removed and the pond drained, it would be beneficial to existing wildlife to provide for a deep-water habitat elsewhere on the site. Additionally, once the berm is removed, the wetlands downstream of the berm would need to be enhanced to store additional water.
- Alternative to the opportunity above: keep the berm in place and install pond leveling device as well as an associated “beaver deceiver” to maintain water levels without threatening the berm.
- Increase connectivity between Wetland A and the Tualatin River to encourage more frequent inundation on to the floodplain and increase storage capacity during high flows. Note that this option could also have deleterious effects to the wetland-pond complexes by increasing risk of invasion by non-native plants or wildlife that could impact the integrity of existing communities. Another consideration is impacts to infrastructure (power and water lines) within the floodplain.
- Expand, preserve and enhance emergent habitat plant communities wherever possible. This includes treatment of reed canarygrass where feasible and replacing with scrub-shrub, wet prairie or open water/emergent plant communities.
- Create Oregon white oak / valley pine woodland habitat on the highest benches. Old roadway, however, may be too compacted for planting. Nursery operations along Fernhill Road have also compacted soils sufficient to make tree establishment impractical within the first 25’ of the road. Easement along the road for the Joint Water Commission raw water pipeline would also discourage planting of large trees along the easement area.
- Restore prairie species such as Nelson’s checkermallow and Kincaid’s lupine in low density oak/pine woodlands.
- Establish and maintain prairie or herbaceous communities on all locations where utilities may require access.
- Expand riparian ash forest in low depression between wetlands and connect to riparian forest to the north. Monitoring and/or removal of ash seedling in the adjacent Wetland D (wapato wetland) will likely be required.
- Expand riparian buffer and floodplain forest communities within the first 200’ from the stream edge. Encourage mosaic of prairie and other herbaceous-dominated plant communities among lower density areas.

- Address invasive plants, specifically shiny geranium and leafy spurge. Prevent staff and contractor vectoring of these weeds to new area of property or off-site; implement a boot cleaning system to prevent the spread of weed seeds off-site.

5.6 Strategies, Treatments and Management Activities

At Maroon Ponds Natural Area, historic hydrologic connectivity between hillslope and floodplain has been disconnected, a man-made earthen dam has altered flow from the upper plateau to the floodplain and created a pond, and some downcutting has likely occurred in the mainstem Tualatin, reducing connectivity between river and floodplain. High priority targets include the wetland-pond complexes, western pond turtle habitat, forested wetlands, riparian forest, and the mainstem river. Four restoration or enhancement projects are proposed at the Maroon Ponds site and each has several design components: 1) create a channel to increase connectivity between the Tualatin River and wetland, 2) remove berm and restore historic tributary, 3) replace road culvert, and 4) deepen and enhance wetland. Enhancement opportunities reflect the interest in these targets, and provide a number of options for addressing individual KEAs. Breaching the natural levee or bank along the Tualatin River would address the hydrologic connectivity KEA listed for the river and would also improve wetland hydrology, size and composition. There are both positives and negatives to creating more frequent connectivity. Removal of the berm will reduce maintenance activities on the site and restore natural site hydrology to the wetlands. However, by removing Wetland B, deep water habitat would disappear affecting western pond turtle habitat, thus the interest in deepening and enhancing Wetland A. Wetland C is formed in part due to a blocked road crossing, which may need to be replaced to prevent beaver from blocking the culvert and restore natural site hydrology to the wetlands.

5.6.1 Increase Connectivity

One potential restoration action is to increase the site's connectivity with the Tualatin River, resulting in more frequent flooding in the low-lying areas on-site. The ideal location for increasing floodplain connectivity from an ecological perspective is just off-site on Bureau of Reclamation (BOR) property, which is an old river meander or blind slough. However, current ownership and potential property damage issues downstream make it problematic. The next best location is within the S-curve to the west of the northernmost pond on the site (Map 16). This site was chosen because of the lower river bank elevations and relatively short distance to wetlands. A channel approximately 20 feet wide and set at a bottom elevation of 156 feet would allow for more frequent inundation during the wet season (Map 16). The new channel would traverse approximately 240 feet from the river towards the northernmost pond in Wetland A. It would cross the water transmission line, but be approximately 5 feet or more above the line.

In general, restoring floodplain connectivity is viewed as having numerous benefits to the watershed, but some project sites may not be suited for connectivity. The positive and negative aspects of increasing floodplain connection at Maroon Ponds are outlined below, including suggestions provided by ODFW (Tom Murtagh, personal communication, 2013):

Positive aspects:

- Increase groundwater recharge;
- Improve water quality; reduce sediments, nutrients, and pesticides in the river;
- Reduce wetland water temperatures;
- Promote natural recruitment of riparian vegetation (Oregon ash, black cottonwood, e.g.) and create plant communities with different age classes which in turn enhances biodiversity;
- Provide nutrient cycling for zooplankton, plankton and aquatic insects that support native fisheries; and
- Increase overall in watershed and wildlife functions including waterfowl habitat.

Negative aspects:

- Increase the chance for introducing/expanding populations of non-native aquatic plants and animals such as reed canarygrass, Japanese knotweed, common carp, and American bullfrog, to name a few;
- Disrupt intact wetland communities (i.e. the spikerush stands of Wetland A or wapato community of Wetland D);
- Potentially create erosion risk across the water transmission line; and
- Entrap juvenile salmon during flood events.

A number of non-native, invasive plants and animals are present in the Tualatin River Basin and were introduced many decades ago. An example is the common carp, which was introduced in the late 1800s early 1900s and feeds largely on plankton, invertebrates and aquatic macrophytes. Carp can degrade wetland communities by uprooting plants, increasing turbidity, and disrupting native fish, amphibian and waterfowl habitat. Once established in an area, carp are difficult and costly to remove (Tom Murtagh, personal communication, 2013). Carp may or may not be present at Maroon Ponds, but we suspect they have not yet invaded the ponds. Visual surveys would confirm their presence as carp often come to the surface for air can be seen thrashing in shallow water. Another concern of increasing connectivity is how the existing spikerush / wapato plant communities in Wetlands A and D would change.

5.6.2 Remove Berm and Replace Culvert

Wetlands B and C were historically part of a small drainage that flowed from the adjacent hillslopes to the site (Map 13). Development of Fernhill Road and adjacent properties altered the natural hillslope runoff. Currently, water flows from the hillslope through an 18 inch culvert under Fernhill Road and empties into the southern half of the Joint Water Commission (JWC) facility, where it ponds and eventually dries out. Stormwater runoff from the JWC property runs into a drain pipe that outlets at the head of Wetland C. Additionally, JWC irrigates their property and suspects that some of this water makes it to Wetland C (Peter Martin, personal communication, 2013).

During an August site visit, Wetland C was a system of step-pools created by small beaver dams, with water running from the southern property boundary towards the road. Some of the water is from the JWC storm pipe and irrigation run-off, but it is suspected that there may be groundwater seepage into

the wetland. The groundwater table is fairly high on the JWC property and they have needed to dewater trenches when constructing facilities. Additionally, property owners across Fernhill Road have spring-fed water systems.

Water in Wetland B overtops the berm year-round. The berm is an earthen dam approximately 9 feet tall, 15 feet wide and 175 feet long with two concrete drains about mid-height. Beaver regularly plug the drains, which forces water to flow over the top of the berm year-round and creates a maintenance issue. The pond holds water year-round and has shallow water with aquatic vegetation as well as areas deeper than 5-6 feet. Western pond turtles have been seen in Wetland B, but not in the other wetlands on-site.

There is interest in removing the berm to reduce maintenance needs on-site and to provide historic habitat conditions (Map 16). Berm removal would result in removal of approximately 1800 cubic yards of material. Water would be pumped from Wetland B to Wetland A before the dam is removed and water from upstream would be routed around the construction area in a temporary pipe. Dewatering should ideally be done at the end of the dry season (September to October) to minimize impacts to aquatic species. The fill material would be moved off-site to Fernhill Wetlands.

The course of the drainage through the Wetland B pond would need to be inspected for instabilities that may create significant erosion of the slope and over time compromise the integrity of the access road. Grade control may be necessary to keep the stream bed intact, especially just downstream of the road where the landscape is steeper. The remaining channel can either meander through the former pond bed or run as step-pools into the wetland, similar to the shallow step-pool sequencing created by beaver in the Wetland C complex. Large wood structures could be used to temporarily create a step-pool system that ultimately would be augmented or replaced by beaver dams (Map 16). It may be possible to install upright posts and encourage beaver to create dams along the reach since they are already present on the property.

Water would enter Wetland C in peaks during storms, and provide a limited continuous water source year-round. However, the access road would continue to be a barrier to flow as the 24 inch culvert is blocked, likely by beaver. Pondered water is 3 feet deep and at the lowest point in the summer, trickles across the road. In the winter (non-flood), the access road remains passable, but wet. To prevent water from backing up behind the access road, the culvert should be replaced with a pre-fabricated bridge.

5.6.3 Expand and Deepen Emergent Wetland

An action of interest is to expand the existing emergent wetland along the southwestern boundary of Wetland A (Map 16). This area is currently dominated by a mixture of reed canarygrass and other pasture grasses with elevations ranging from below 154 to 160 feet. The restoration concept would involve lowering the contours to 153 to 156 to promote a mix of inundated areas and saturated-only areas. The expanded emergent wetland area would also include opening up the connection to the northern end of the Wetland A pond complex and deepening the water level to provide more diverse water regimes for native amphibians, reptiles and waterfowl. Deepening the pond is also recommended

to off-set sediment deposition that is expected to result from the berm removal. The upper portions of the expanded emergent wetland would be planted with riparian trees and understory plants. Proposed wetland plants are presented in Table 8 along with preferred water depths. The list of wetland plants is neither comprehensive nor exclusive.

Amphibian egg-mass surveys should be conducted in the spring prior to the commencement of any earthwork. Earthwork and other in-water activities should be coordinated to minimize impacts on young or breeding amphibians occupying the wetlands.

Table 10. Proposed wetland plant species for expanding the Wetland A pond complex

Species	Common Name	Indicator Status	Notes
<i>High marsh - seasonally dry</i>			
Carex stipata	Sawbeak sedge	FACW	Tufted clumps; non-rhizomatous
Carex unilateralis	One-sided sedge	FACW	Moist or wet sites
Deschampsia caespitosa	Tufted hairgrass	FACW	Wet meadows; wide variety of sites
Deschampsia elongata	Slender hairgrass	FACW	Wet meadows; margins of ponds
<i>Mid-marsh - Persistently saturated or for prolonged periods</i>			
Beckmannia syzigachne	American sloughgrass	OBL	Seasonal wetlands to shallow water
Carex obnupta	Slough sedge	OBL	Seasonal wetlands to shallow water
Downingia elegans	Downingia	OBL	Annual; wet meadows, vernal pools
Juncus ensifolius	Dagger-leaf rush	FACW	Moist sites, not standing water
Leersia oryzoides	Rice cutgrass	OBL	Can also grow in standing water
Ranunculus alismafolius	Marsh buttercup	FACW	Low tolerance for dry sites
<i>Low marsh – standing water</i>			
Alopecurus geniculatus	Water foxtail	OBL	Saturated soils to shallow water
Eleocharis palustris	Spreading spikerush	OBL	Heavily rhizomatous; dense roots
Sagittarius latifolia	Broadleaf arrowhead	OBL	Wet to inundated
Scirpus microcarpus	Small-fruited bulrush	OBL	Wet to inundated

An area that is south-facing and sparsely vegetated would be created along the north side of the Wetland A complex. This area should be a minimum of 400 square feet and on a gentle slope or flat ground with a clear path to the water. Native reptiles require dry, sparsely vegetated soils for solarization and nesting. This area could be created by using the excavated soils from deepening the wetland or from the berm removal. Oregon Department Fish and Wildlife guidance indicates that silt and clay soils are suitable turtle nesting material (ODFW 2013). Logs are also proposed for installation in Wetland A to provide basking sites for turtles.

5.6.4 Project Sequencing and Relative Cost

Removing the berm and restoring the historic tributary would be the most costly of the enhancement projects due to the amount of earthwork required. Earthwork is recommended to occur prior to

vegetation plantings in the riparian and wetland areas. Additionally, removal of the berm is expected to result in changes to Wetland A that could inform wetland enhancement activities. Expanding/enhancing Wetland A and increasing connectivity with the Tualatin River should occur prior to berm removal to provide refugia for turtles and other species during the Wetland B drawdown. Basking log placement and turtle nesting habitat should be constructed during wetland enhancement. Replacement of the culvert with a bridge is a second-level priority and can be sequenced with berm removal activities or occur at a later date. Regardless, the road needs to remain accessible throughout the planting and maintenance season for 10 years post-revegetation activities.

Decisions were made between CWS and Metro on how to proceed with restoration actions for the North Carpenter property (Table 9).

Table 11. Maroon Ponds - Decisions, October 24, 2013.

	Consensus Decision	Implementation Period	Notes
Earthwork			
Culvert replacement	Supported	1-2 years	More design work needed.
Berm/dam removal	Supported	1-2 years	More design work needed.
Wetland excavation – Wetland A	Supported	1-2 years	More design work needed.
Log placements (basking)	Supported	1-2 years	More design work needed.
Step pool/beaver anchors construction	Supported	1-2 years	More design work needed.
Floodplain connection	Not Supported	5+	More design and discussion needed if project is to be revisited in the future.
Revegetation Treatments			
Riparian Forest	Supported	1-2 years	
Oak woodland and savannah	Supported	1-2 years	
Channel sideslope revegetation	Supported	1-2 years	
Forested/wetland mosaic	Supported	1-2 years	
Scrub-shrub buffer	Supported	1-2 years	
Emergent wetland	Supported	1-2 years	
Step pool side slopes	Supported	1-2 years	

Table 12. Maroon Ponds – Task Sequence

TASK	STATUS	RESPONSIBLE PARTY
CONCEPTUAL PLAN 10% DESIGN	FINALIZING	CWS/METRO
PLANTING FINAL DESIGN (90%)	COMPLETED	CWS/METRO/ESA
CONTRACTING - SITE PREP	FALL 2014	CWS
SITE PREP - RIPARIAN STAGE 1: RIPARIAN BENCH; STAGE 2: BENCH-WETLAND BOUNDARIES; STAGE 3: OTHER WETLAND BOUNDARIES	FALL 2013, SPRING-FALL 2014, SPRING-FALL 2015	CONTRACTOR
CONTRACTING FOR FINAL DESIGN	NOV - DECEMBER 2014	CWS
SITE PREP - UPLANDS	SPRING - FALL 2015	CONTRACTOR
FINAL DESIGN - PERMITTING	JAN-MAY 2014	CONTRACTOR
CONTRACTING FOR EARTHWORK	SUMMER 2014	CWS
EARTHWORK	FALL 2014	CONTRACTOR
CONTRACTING FOR WETLAND REVEG	WINTER 2015	CWS
WETLAND VEG SITE-PREP	SPRING-FALL 2015	CONTRACTOR
WETLAND REVEG	FALL-WINTER 15-16	CONTRACTOR
RIPARIAN REVEG	WINTER 2015-2016	CONTRACTOR
UPLAND REVEG	WINTER 2015	CONTRACTOR

Costs for projects in Maroon are provided in Table 10. Unit costs were estimated for earthwork using current prices. Unit costs for revegetation were based on a per acreage cost estimated by CWS for riparian planting activities. An assumption was made that any material excavated would be used on site where possible or taken to the CWS Fernhill Wetlands project. Design and permitting fee estimates are calculated for the earth work only and do not include revegetation design. Long-term maintenance, stewardship and monitoring are also not included in this estimate.

Table 13. Maroon Design and Construction Planning-level Cost Estimate

Item	Qty	Unit	Unit Cost	Total
Mobilization / Demob.			3%	\$ 23,000
Site Preparation			3%	\$ 23,000
Site & Water Management			2%	\$ 15,000
Earthwork				
Culvert Replacement	1	LS	\$ 30,000	\$ 30,000
Channel Excavation	1,500	CY	\$ 25.00	\$ 37,500
Wetland Excavation	5,400	CY	\$ 25.00	\$ 135,000
Berm Removal	1,800	CY	\$ 25.00	\$ 45,000
Logs for turtle basking / complexity	4	EA	\$ 500.00	\$ 2,000
Large Wood for Step pool habitat	1	LS	\$ 10,000	\$ 10,000
Subtotal Earthwork and Related Costs				\$ 312,500
Revegetation				
Riparian Forest	13.5	AC	\$ 5,000	\$ 67,500
Oak woodland	9.5	AC	\$ 4,500	\$ 42,750
Oak savannah	4.5	AC	\$ 4,000	\$ 18,000
Channel Sideslopes	0.50	AC	\$ 4,000	\$ 2,000
Forested/Wetland Mosaic	3.00	AC	\$ 4,600	\$ 13,800
Scrub-shrub wetland	3.40	AC	\$ 3,500	\$ 11,900
Emergent Wetland	9.50	AC	\$ 4,500	\$ 42,750
Step Pool Sideslopes	0.80	AC	\$ 4,000	\$ 3,200
Subtotal Revegetation				\$ 201,900
Direct Construction Subtotal				\$ 514,400
Design & Construction Contingency			30%	\$ 154,320
TOTAL CONSTRUCTION				\$ 669,000
Design Fees				\$ 40,000
Permitting Fees				\$ 35,000
TOTAL DESIGN, PERMITTING AND CONSTRUCTION				\$ 744,000

5.6.5 Financing Plan

The project costs listed above represent planning-level estimates only. More detailed and specific cost estimates for further design, permitting, construction and stewardship or monitoring will be determined by partner project managers as the project moves forward. Commitments of funding for implementing project elements will be documented in amendments to an Intergovernmental Agreement (IGA) between Metro and Clean Water Services.

7.0 Monitoring

Monitoring protocol for assessing current conditions has been identified for the targets identified in Appendix D (Table 16). Some additional monitoring may be of interest, specifically to assess and track species of interest such as amphibians, songbirds or waterfowl. Although these are not specific targets identified in this plan, they are included in the table below. All protocols are available on file with Clean Water Services and Metro.

Table 22. Monitoring Plan

Target	Indicator	Protocol/Method	Organization
Riparian forest	Stem Density Native Aerial Cover Structure/Diversity Invasive Plants <20%	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Emergent wetland	Native Aerial Cover Structure/Diversity Invasive plants <20% Prevalence Index	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Forested wetlands	Stem Density Native Aerial Cover Structure/Diversity Invasive Plants <20% Prevalence Index	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Wetland-pond complexes	Native Aerial Cover Structure/Diversity Invasive plants <20% Prevalence Index	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Scrub-shrub	Stem Density Native Aerial Cover Structure/Diversity Invasive Plants <20% Prevalence Index	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Wet/mesic prairie	Native Aerial Cover Structure/Diversity Invasive plants <20% Prevalence Index	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Upland prairie	Native Aerial Cover Structure/Diversity Invasive plants <20%	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Upland forest	Stem Density Native Aerial Cover Structure/Diversity Invasive Plants <20%	CWS Vegetation Monitoring Protocol and Performance Standards	CWS
Stream banks and channel	Bed and banks shape	ACE Channel Monitoring Protocol	CWS/Metro

Target	Indicator	Protocol/Method	Organization
Western pond turtle	Total number of turtles	Turtle Presence / Absence Sampling Protocol	Metro
Amphibians	Number of egg masses by species	Amphibian Egg Mass Protocol	Metro
Waterfowl	Total number of birds (juveniles tallied separately)	Avian Wader and Waterfowl Monitoring Protocol	Metro
Songbirds	Species presence, species richness, species diversity	Metro avian point count protocol: 50 meter radius point count 0-3 and 3-5 min.	Metro

8.0 Reference Sites

Several reference sites were observed to determine the natural communities where human disturbances have not occurred. Reference sites are described briefly below based upon habitat unit of interest. Key characteristics of each reference site are discussed and suggestions for locations provided. It is intended that at this time, the references are starting points for discussion. The goal is to identify more definitive reference locations as we enter the conceptual design phase of this project.

Stream geomorphic and hydrologic reference – Many of the tributaries to the Tualatin River were historically dammed by beaver. Low gradient streams such as Carpenter Creek were probably frequently flooded due to a number of dams running the length of the channel. An appropriate reference for Carpenter Creek would be a stream such as an unnamed tributary that enters the Tualatin from the north, just upstream of Fanno Creek (Photo 43). This tributary has a small contributing basin, low gradient, and is forested. Additionally, beaver are present promoting natural hydrology, bed stability and bank stability.

River geomorphic and hydrologic reference – The sinuous, meandering pattern of the Tualatin River has changed marginally since the 1850s GLO surveys in this part of the basin. Along a substantial length of the Tualatin River through the Wapato Valley, there is a continuous riparian buffer with a number of large trees. Though the hydrology has changed and the buffers are not as wide as in the past, the best reference for the Tualatin River from Scoggins Creek to Gales Creek is the current river system. This is true in part because of the unique gradient and soils in the upper basin as compared to other river systems in the region. The soils are cohesive and the river is dominated by fine sediment, which is unique in the region, and makes it difficult to find a surrogate reach.

Riparian buffer reference site – Zurcher property; Gales Creek just east of the North Carpenter Natural Area (Many mature crowns; diverse species).

Wetland reference site – wetland complex at Penstemon Prairie with emergent marsh intermixed with scrub-shrub (willow) (Photos 40 and 41).

Pond reference – South pond in Wetland A complex at Maroon Ponds (Photo 18).

Oregon white oak / valley pine forest reference - Tualatin Hills Nature Park (Photo 44).

Upland prairie/wet prairie reference sites – Finley National Wildlife Refuge (NWR) 10 miles south of Corvallis (Photo 45). Finley NWR supports populations of rare prairie species including Nelson’s checkermallow, Bradshaw’s lomatium, and peacock larkspur.

9.0 Conclusions

Historically, the Wapato Valley was a wide river valley with wet prairies, riparian and floodplain forests, wetlands and swales; surrounded by prairie, oak woodlands and forested hillslopes. Land use practices have altered the landscape by ditching and draining of wetlands for agriculture, alteration of existing vegetation and building of infrastructure. CWS and Metro have a unique opportunity to address threats and stressors to the key ecological attributes of the area by focusing on several properties concentrated at or near the Tualatin River – Gales Creek confluence.

All three sites – North and South Carpenter Creek sites, Maroon Ponds, and Penstemon Prairie – afford challenges and opportunities for enhancing the ecological integrity in this area. North and South Carpenter Creek sites provides some opportunities for short-term solutions in increasing shade by enhancing the riparian buffer and wetlands, and buffering the site by planting along the transportation corridor. Maroon Ponds has a diverse collection of habitats that could each be enhanced to support a broader diversity of wildlife. Penstemon Prairie has the opportunity to provide refuge for multiple rare and threatened species.

10.0 References

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APPENDIX A – PHOTOS



Photo 13. Cultivated field with mature forest looking west towards Gales Creek (off-site), 5-29-13.



Photo 14. Tualatin River, looking upstream, 5-29-13.

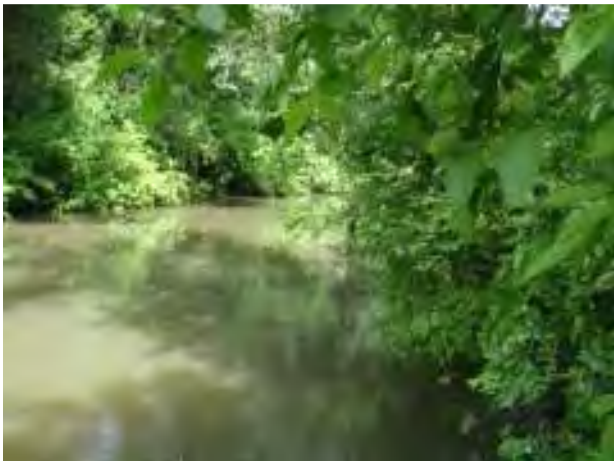


Photo 15. Tualatin River, looking downstream (northeast), 5-29-13.



Photo 16. Typical riparian forest looking northeast, 5-29-13.



Photo 17. South pond of Wetland A complex, view to the northeast, 5-29-13.



Photo 18. South pond of Wetland A complex, view to the north, 5-29-13.



Photo 19. Wetland B, view to the south, 5-29-13.



Photo 20. Pipes draining Wetland B through the levee into Wetland B, 5-29-13.



Photo 21: Water overtopping levee from Wetland B into Wetland A, 5-29-13.



Photo 22. Narrow channel connecting the two ponds of Wetland A complex, looking north, 5-29-13.



Photo 23. Wetland A, south pond, view to the northwest, 5-29-13.



Photo 24. Wetland D, view to the southwest, 5-29-13.



Photo 25. Wetland D, view to the southwest, 5-29-13.



Photo 26. Reed canarygrass dominated wetland habitat with palustrine forested wetland dominated by Oregon ash, 5-29-13.



Photo 27. Unvegetated swale in ash forest, 5-29-13.



Photo 28. Upland shrub habitat, view to the east, 5-29-13.



Photo 29. Snag in Wetland A, 5-29-13.



Photo 30. Large wood in Tualatin River at Penstemon Prairie, looking northwest off-site at left bank (downstream), 5-30-13.

APPENDIX B – WORKSHOP MEETING NOTES, JULY 22, 2013



DRAFT meeting notes

Project	CWS Tualatin	Proj. no.	D120801.01
Date	7-22-2013	Time	12:15 pm to 4:00 pm
Present	Robert Emanuel, CWS; Rich Hunter, CWS; Jared Kinnear CWS; Laura Porter, CWS; Elaine Stewart, Metro; Jonathan Soll, Metro; Nicole Czarnomski, ESA; Sarah Hartung, ESA	Route to	Attendees
Subject	Prioritizing target habitats and restoration projects for Maroon Ponds, Carpenter Creek, and Penstemon Prairie		

General

- We skipped a detailed discussion of the baseline site conditions, as all attendees had some knowledge of the sites.
- Rob stated that the aim of this process is to build consensus in prioritizing projects and move to a preliminary design for a select few, not more than 15% design, but enough to cost them out and start to seek funding as early as this September.
- Jonathan indicated that the passing of the levy will enable giving a green light to some projects that would have taken more time/effort in gathering funding.

Maroon Ponds

General Comments:

- Brief overview of site; need to add contours to the site maps;
- Jonathan stated that Maroon Ponds offers the cleanest opportunity to implement restoration activities, compared to Carpenter which has some site constraints, and Penstemon which is farther along in the planning stages;
- Discussion of ranking the target habitats; Jonathan suggested to rank the target (with a high, medium, or low) in terms of its importance irrespective of existing site conditions;
- The entire lower elevation areas on Maroon Ponds flooded in 1996 – which is just about the same area as the FEMA floodplain map;
- The group agreed that Riparian Habitat at Maroon Ponds is a high priority;
- We continued to rank the targets in terms of general importance for the Tualatin River system – Upland Forest (Low); Wetland Pond Complexes (High); River Channel and Banks (High); White Oak/Valley Pine Woodland (Medium).
- We started to dig into ranking the attributes and Jonathan suggested a few things – attributes should all be positive and threats are negative. For example, invasive species threaten achieving restoration goals,

therefore should not be an attribute. Jonathan also suggested skipping ranking the attributes in part because we've already decided that they are "key" attributes.

- Discussion of whether we are really ranking the strategies or the attribute itself.
- Metro indicated to note whether a habitat is supposed to be a mosaic in the comments section of the attribute tables;
- the "habitat" attribute in the KEA table is not really clear; one idea is to separate turtle habitat as a target and then go into detail on specific habitat requirements for the turtle;

Riparian:

- Elaine shared Metro's attribute tables for riparian forest (she also has tables for prairie and wetlands); the tables are similar to one's presented in the ESA memo for the sites, but Metro has literature citations in the comment; a measurable indicator for every attribute, and has 4 scores for the indicators from poor to very good. The attributes are intended to be generic but the user could tailor the scoring system for a particular site – such as riparian width, which is not going to have the same goal for a headwater small stream compared to a larger, lower gradient stream.
- More detailed discussion of strategy for the riparian forest: "promote regeneration of native riparian canopy trees; tolerate gaps but control thicket-forming weeds like blackberry;"
 - o Rich inquired if there was a specific action associated with "promoting regeneration" but mainly the intent was to control weeds to allow for natural regeneration. Jonathan thought the strategy was decent and commented that it speaks to managing for native shrubs in the understory.
 - o Jared asked Elaine how they manage canopy gaps; Elaine said it was mainly an EDRR based response;
 - o Jonathan asked Rich how CWS rates attributes; Rich replied that they start out tracking plant density then transition to cover estimates.
- Strategies were ranked:
 - o Promote regeneration of canopy: high
 - o Install plants: high
 - o Top selected trees to create snags: low (long-term)
 - o Control weeds: high

Floodplain Forest:

- Elaine pointed out that some of the area currently mapped as "upland shrub" should be floodplain forest – this is an area where Oregon ash trees have been installed, but haven't established very well; madrone, ponderosa-pine, and fir have also been planted in the upland shrub on the south site;
- Topping trees may belong as a strategy here

River

- Discussion of how the river channel and banks are in relatively good condition, not much to be done for improvement – other than enhancing the riparian forest - but that the proximity of the Gales Creek confluence made it a high priority for some attendees.
- We returned to the river channel and banks topic – Rich asked Nicole about the aquatic habitat perspective; Nicole stated that there is some hydraulic diversity in areas where bank vegetation touches the water surface and creates hiding spots, but there could be more diversity. We could only pop in at a few locations and it was hard to get a full assessment of the Maroon Pond reach.
- Laura Porter mentioned that DEA might have some more info on bank condition from previous survey work they did in the area; Laura was also ranked "off" channel projects as high priority and "on" channel projects as low in part because of the location of the intake.

Wetlands, Ponds and Turtles

- The group agreed to add “forested wetland” as a target separate from the wetland/pond complexes in part because of the different strategies that will be employed to enhance or manage the target.
- Discussion of Wetland Pond Complex attributes:
 - o Longevity might not be the correct attribute – it might actually be hydroperiod or hydrology;
 - o Call-out emergent vegetation as an attribute
 - o Add in size/extent as an attribute
- Elaine mentioned that turtle habitat often overlaps with other targets; for example turtles need loose, dry, sparsely vegetated soil for nesting, which would be an upland component; turtles also need cool duff in the woods to complete life cycle. Consider adding as a separate target.
- Rich expressed some reservation about altering the existing wetland/pond complexes because the Eleocharis and yellow pond lily appear to be doing really well. Something is working right for the native aquatic species; and the reed canarygrass doesn’t seem to be able to get a foot hold in the ponds – only on the edges.
- Rich asked if we want to put shrubs in the reed canarygrass area. Elaine indicated that planting shrubs is a good way to get a handle on reed canarygrass, but that scrub-shrub wetland is a lot like upland conifer forest – it’s common and a lot of people are creating it; there’s not a need to restore it.
- Elaine has a great deal of interest in emergent habitat;
- The best way CWS has seen for controlling RCG is to alternately disc/spray; disc/spray for a few years. Good results at Jackson Bottoms.
- Levee on Pond B / connectivity with the river:
 - o Elaine mentioned that Nathaniel spends a lot of time clearing brush from the levee culvert, which the beavers are constantly trying to cover-up;
 - o The levee is at risk every year of failing;
 - o Rob brought the topic back to a possible alcove idea to provide for turtles; Elaine thought the water would drain too fast;
- Strategies ranked:
 - o Install plugs: high
 - o Mechanical and chemical control: high

White Oak/Valley Pine

- On to White Oak/Valley Pine woodland – Elaine suggested that the area next to the roadway might not be suitable for planting woody material because it’s so beaten down from past nursery activity. And the blueberry shrubs at the south end just won’t die, despite several efforts to chop, mow, and spray them down.
- My consider title of “mixed forest” for this target

Action Items for Maroon Ponds:

- Look into river connectivity as a project - Jonathan suggested we put some more thought into the pros and cons of connecting the site to the river – how would it affect the existing veg/wildlife communities; i.e. would carp be introduced (are they on-site now?); what would happen to the beaver? And what would happen if the levee is opened-up and no grading occurs? Do some basic feasibility assessments;
- Explore expanding emergent wetland as a project;
- Look into combining site prep/planting for white oak/valley pine target along with the next phase of riparian plantings.

Carpenter Creek

General Comments:

- Jonathan suggested looking into a 10% design for a berm that allows flooding on-site, but protects adjacent property owners; it's worth a planning-level look;
- Ownership of the land between North Carpenter Creek and Gales Creek is an issue;
- Discussion of how the targets were decided upon – mixture of soil survey; historic survey notes; and what seems do-able;
- Whatever the target is rated – it's reasonable to still move forward with a project if the opportunity arises
- We rated the targets as follows: Riparian forest (High); Wetland south of railroad (High); Wet/Mesic Meadow (High); Stream Channel and Banks – (Gales = High; Carpenter = Medium); Oak Savanna/Woodland (Medium);

Cultivated Land:

- Laura asked if the existing hydrology could support the floodplain forest/wet prairie/shrub thicket target and essentially we don't know. There appears to be some wetland signatures in the fields and the area used to be a broad swale; it is mapped in hydric soils. There may be tiles in the fields that could be broken up like at Penstemon.
- Elaine would like to see more emergent wetland/ wet-mesic prairie complex in the large cultivated field at North Carpenter (not woody species); there is some concern that the patch size is not quite big enough for prairie species (i.e. streaked horned larks), but when combined with the landscape context (i.e. Zurcher property owned by CWS) – it might be worth a shot at establishing. Riparian forest along the edges diminishes the attraction for certain prairie species – but other species can tolerate some shrubs/woody thickets in the fields and nearby – like yellow breasted chat, warblers, and flycatchers. Penstemon attracted meadowlarks, which could conceivably use Carpenter.
- Elaine indicated that they could always experiment with seeding to see how the topography affects species; mesic species can do well in floodplains that are flashy and dry out quickly. Kincaid's lupine; however; does not like to get its feet wet at all.
- Floodplain forest...meadow target should be more focused on emergent wetland/mesic prairie

Riparian:

- Rob stated that CWS can still get shade credit for establishing shrubs in the riparian zone, which might be an option for the south end of Carpenter Creek on the north parcel.

Oak woodland

- Oak savanna/woodland was suggested as a target along the western boundary of both North and South Carpenter, instead of upland shrub/forest. Elaine stated that they use the TNC definition of savanna as 10-25% tree cover; and woodland is up to 60% cover. ESA will revise the memo accordingly and define "savanna" versus "woodland."

Hydrology – Streams and Wetlands

- Discussion of how to get Carpenter Creek to flow more broadly across the site; ideally promote beavers to do the work and avoid damaging adjacent properties;
- Carpenter Creek is likely good amphibian habitat, but is not expected to be high on list for fish habitat;
- There may be some upstream flow restoration options in Carpenter Creek
- If the large wetland is full of Penstemon, it won't change a restoration plan too much.

Action Items for Carpenter Creek:

- At some point survey for *P. hesperius* in the large wetland; do this before any chemical control of RCG;

- Regardless of plant surveys – move forward with a conceptual design for improving the wetland/Carpenter Creek in the North parcel;
- Get a long profile of Carpenter Creek / investigate hydrology in more detail

Action Items for Penstemon Prairie:

- Elaine will review the ESA memo in more detail and meet with ESA and Rob on August 5 to discuss.

APPENDIX C – DOCUMENTATION OF ECOLOGICAL ENHANCEMENTS FROM CWS AND METRO

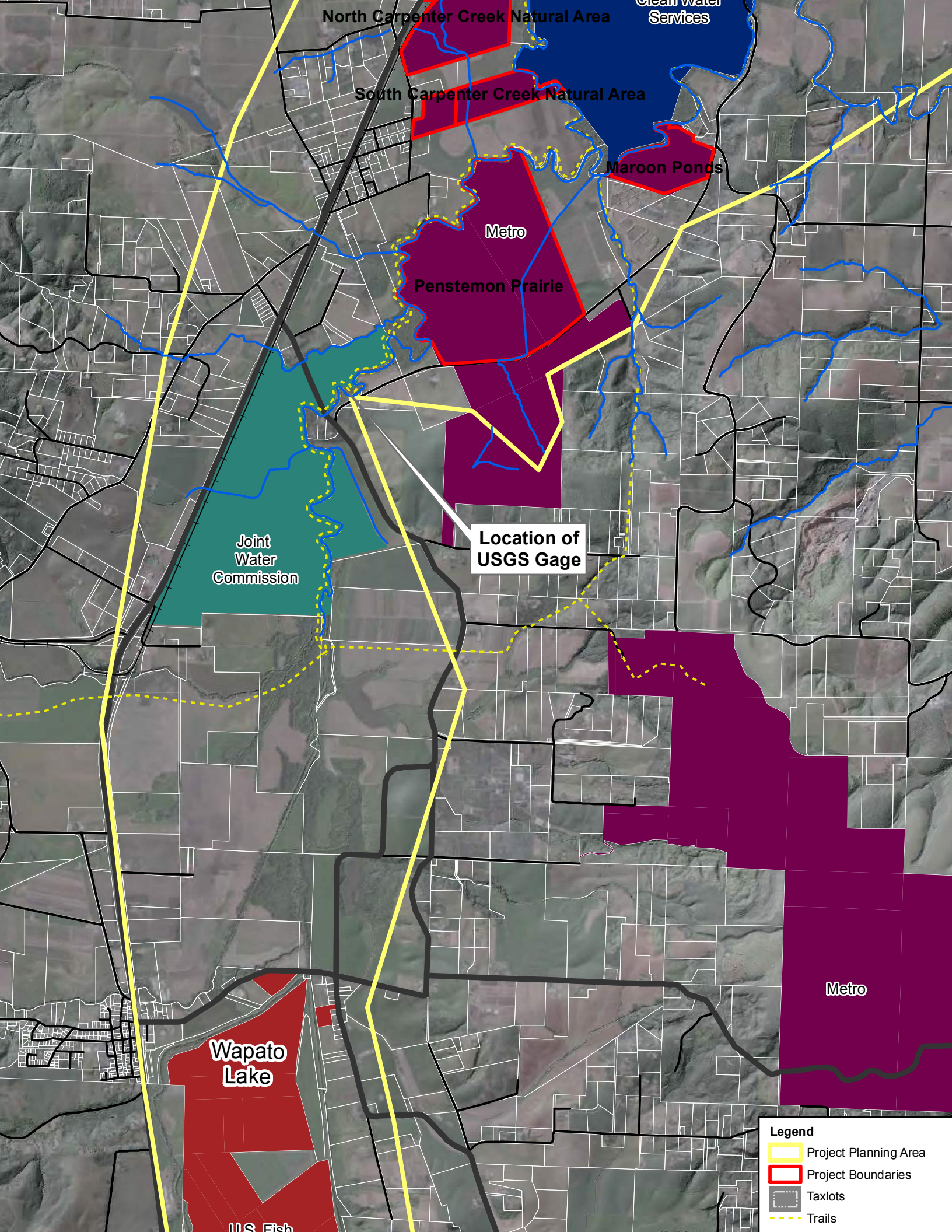
APPENDIX D – TARGETS, DESIRED FUTURE CONDITIONS AND KEY ECOLOGICAL ATTRIBUTES (KEAs) TABLES

Goals				
KEA	Current	Short-term (< 10 yrs)	Long-term (> 10 – 50 yrs)	Strategy
Size/extent (feet)	Stand 40-200 ft. wide	Increase buffer width to a min. of 135 ft* Control weeds (lemon balm, St. John's wort)	Maintain multi-age; mixed deciduous/coniferous riparian forest	Promote regeneration of native riparian species; control weeds; tolerate canopy gaps but control those like Himalayan blackberry
Composition: density / cover	Dense, narrow buffer adjacent to open grassland	Establish lower density riparian forest adjacent to existing forest	≥ 85% canopy cover in narrow buffer and 60% cover in adjacent buffer	Install mixed coniferous/deciduous at 15' on center (o.c.) for trees; 8' o.c. for shrubs; plant native species between plantings
Composition: diversity / structure	Diverse, multi-age stand	Maintain existing composition	> 90% native species; promote large snags	Top selected trees to create snags
Native cover	0.25 acre of leafy spurge; 10-20% cover by teasel, blackberry, etc.	EDRR** species removed; all other species at or below 10%	Below 10%	Control weeds annually through mechanical means; develop and implement best management practices; replace with native species
Composition: diversity / structure	Douglas fir stand with predominantly native understory and a few madrones	Maintain composition and structure	Maintain composition and structure	Preserve as a pocket of habitat diverse species; allow for succession or changes; to increase diversity
Native cover	1,000 to 2,500 sf (< 0.05 ac) of shiny geranium	EDRR species removed; all other weedy species maintained ≤ 20%	Below 10%	Control weeds annually through mechanical means; replace with native species
Size/extent (acres)	Small pocket on-site (< 10 acres)	Connect canopy cover with adjacent riparian/floodplain forest	Maintain canopy connection with adjacent riparian/floodplain forest	Install woody species in a corridor to connect to adjacent riparian/floodplain forest
Composition: diversity / structure	Oregon ash canopy with a few black cottonwood over reed canarygrass	Increase shrub layer to 30%	Increase shrub layer to 60%	Plant understory with native shrubs
Native tree recruitment	Few ash seedlings due to extensive reed canarygrass	1-5 ash seedlings per acre	5-10 ash seedlings per acre	Control reed canarygrass in understory; encourage native tree seedling recruitment; monitor seedling establishment
Size/extent (acres)	Approx. X acres	Expand emergent zone in Wetland A and deepen to compensate for potential loss of Wetland B	Maintain open water areas	Lower contours around Wetland A, north pond of Wetland A; prevent wetland loss
Composition: diversity / structure	Somewhat diverse emergent vegetation interspersed with open water; deep water (5-6 ft.) habitat in Wetland B	Increase diversity of emergent and aquatic plants by five species	Maintain diversity	Install plugs of native sedges, Juncus, and other emergent species; transplant Wapato from Wetland D to Wetland B; avoid herbicides without adversely affecting vegetation; monitor species diversity
Native cover	Reed canarygrass in portions of Wetland B and Wetland A	Manage reed canarygrass at current distribution	Manage canarygrass below 5%	Mechanical and chemical control
Longevity	Wetland B is artificial & overtopping berm; Wetland D very shallow	Determine feasibility of berm removal	Free-flowing drainage from south of site to Wetland A	Remove berm (Wetland B); expand Wetland D; create a buffer to off-set loss of surface water area

KEA	Current	Short-term (< 10 yrs)	Long-term (> 10 – 50 yrs)	Strategy
<i>Wildlife habitat</i>	Beaver lodge in Wetland A; invasive bullfrogs likely in all wetlands; winter waterfowl habitat	Maintain mix of open water, emergent, and aquatic plants for various wildlife species	Provide productive amphibian, and beaver habitat	Tolerate beaver; remove bullfrog from encourage use by native amphibians
<i>Hydrology (duration and extent)</i>	Wetlands perennial	Visit sites in late summer to verify extent of hydrology	Maintain perennial surface water for beavers and turtles; potentially encourage connectivity with river	Allow beavers to manipulate hydrology; adaptive approach to beaver activity
<i>Bank vegetation composition and density</i>	Dense thickets of shrubs and some mature trees with pockets of blackberry or reed canarygrass	All native shrubs, grasses and trees along banks	All native shrubs, grasses and trees along banks	Monitor and maintain plantings along
<i>Bank integrity</i>	Steep, tall, and well-vegetated; no signs of significant erosion	Maintain current erosion patterns (outside of meander bends)	Maintain condition of localized low-level erosion	Maintain bank vegetation to provide
<i>Bed integrity</i>	Intact, with fine sediment layer; not much hydraulic diversity	Maintain conditions	Maintain conditions	Monitor conditions; look into opportunity bed profile
<i>Hydrologic connectivity</i>	Tualatin River is connected to the wetland complex during Q ₂ events, possibly more frequently	Wetland is connected twice as frequently	Maintain increased connectivity	Excavate a breach in the river levee; frequent inundation of the wetlands
<i>Large wood and habitat complexity</i>	Few large wood pieces observed; bank vegetation dense	Wider riparian buffers with areas of higher mature tree density	More instream wood provided naturally by adjacent forest	Enhance riparian buffer to be a future wood. Larger age-class conifers for
<i>Composition: diversity / structure</i>	Upland shrub/saplings and herbs with young Douglas-fir, a few valley pines; pasture grasses, yarrow, and lupine	70% white oak and 30% valley pine (relative cover); absolute canopy cover of 15-20% at end of 10 years	50% white oak and 50% valley pine (relative cover); absolute canopy cover 50-80%	Plant at a higher density than expected to anticipate mortality; remove all existing fir; thin valley pine and oak to meet
<i>Native cover</i>	0.5 acres of leafy spurge	No EDRR species present and < 20% invasives	No EDRR species present and < 10% invasives	Control weeds annually through mechanical means; replace with native
<i>Population</i>	Individual turtles have been seen basking in Wetland B	Numbers are stable and juveniles are present	Increasing numbers of turtles including juveniles	Maintain berm or deepen Wetland A; monitor turtles
<i>Basking site availability</i>	Unknown if turtles nest on-site; limited areas with sparse plants	Add 2 basking sites to each Wetland A and B (Wetland D is too shallow)	Maintain 2 nesting areas	Add basking sites; monitor turtles
<i>Nesting habitat</i>	Pasture grasses; few shrubs/saplings	Establish Oregon white oak saplings to achieve 10-20% minimum cover at the end of 10 years	Maintain Oregon white oaks at 25% canopy cover, other canopy species (if present) at no more than 5% cover	Weed and/or mow 2 areas ~ 2,000 near Wetland A in upland soils.
<i>Composition: diversity / structure</i>	Dense, mostly exotic grass; compact soil from past landscape activities	Establish prairie species in understory; plant oaks sparsely at 50' on center	Maintain Oregon white oaks with open-grown canopy	Manage open-grown, oak savanna 50-ft. setback from road of just herbaceous oaks as needed to maintain open-grown remove shrubs
<i>Native cover</i>	Weedy pasture grasses; mainly reed canarygrass	Reed canarygrass at or below 10%	Maintain reed canarygrass below 10%	Chemical and mechanical control of

KEA	Current	Short-term (< 10 yrs)	Long-term (> 10 – 50 yrs)	Strategy
<i>Composition: diversity / structure</i>	Grassland with shrubs; compacted ground from past plant nursery activity	Establish native prairie in area adjacent to roadway; remove or thin existing shrubs	Manage woody encroachment into prairie	Till soil and amend as needed to establish native prairie species; selectively thin or remove woody species
<i>Size/extent (feet)</i>	Existing grassland/forbs mixed with shrubs	Establish prairie within 50 feet of roadway over utility lines	Maintain location of prairie species over utility lines next to road	Seed forb/grass mix; mow annually to reduce woody encroachment
<i>Composition: diversity / structure</i>	Scrub-shrub not currently present; current location is upland grassland/shrubs	Install at least three different wetland shrub species to achieve 10% cover	Maintain at least 20% scrub-shrub cover; prevent dominance by trees	Lower contours to create scrub-shrub habitat; plant with native woody shrubs – willow, dogwood
<i>Composition: density</i>	Dense, mostly exotic grass; some planted shrubs	Install dense patches of wetland shrubs; Establish native emergent species in understory	Promote patches of dense shrub thickets mixed with emergent wetland plants	Mow, disc, spray, re-seed understory species; maintain open areas within habitat
<i>Native cover</i>	Weedy pasture grasses	Reed canarygrass at or below 10%	Maintain reed canarygrass below 10%	Chemical and mechanical control of reeds

or Vegetated Corridors on the Tualatin River with slopes < 25 percent. **Early Detection and Rapid Response



North Carpenter Creek Natural Area

Clean Water Services

South Carpenter Creek Natural Area

Maroon Ponds

Metro

Penstemon Prairie

Joint Water Commission

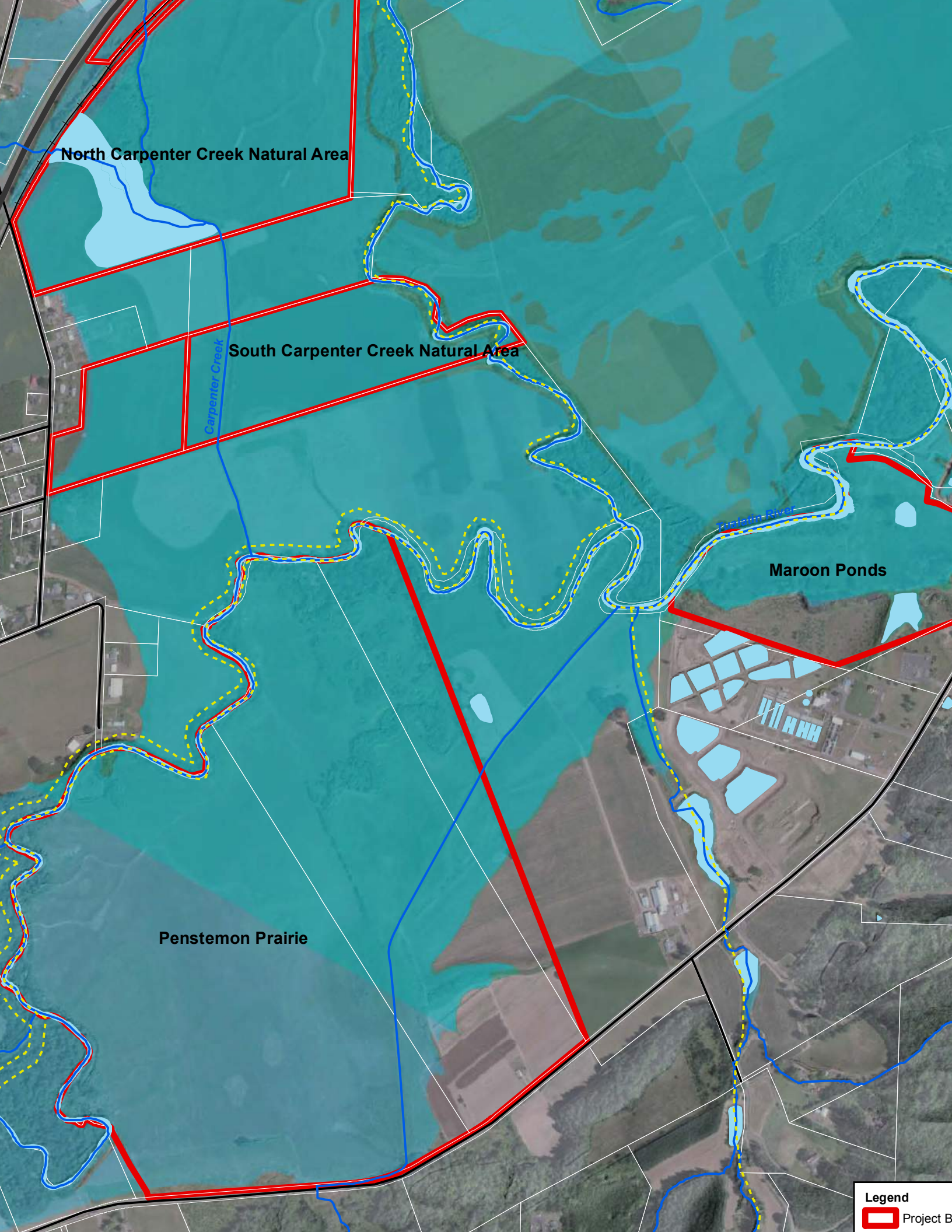
Location of USGS Gage

Wapato Lake

IIS Fish

Metro

- Legend**
- Project Planning Area
 - Project Boundaries
 - Taxlots
 - Trails



North Carpenter Creek Natural Area

South Carpenter Creek Natural Area

Maroon Ponds

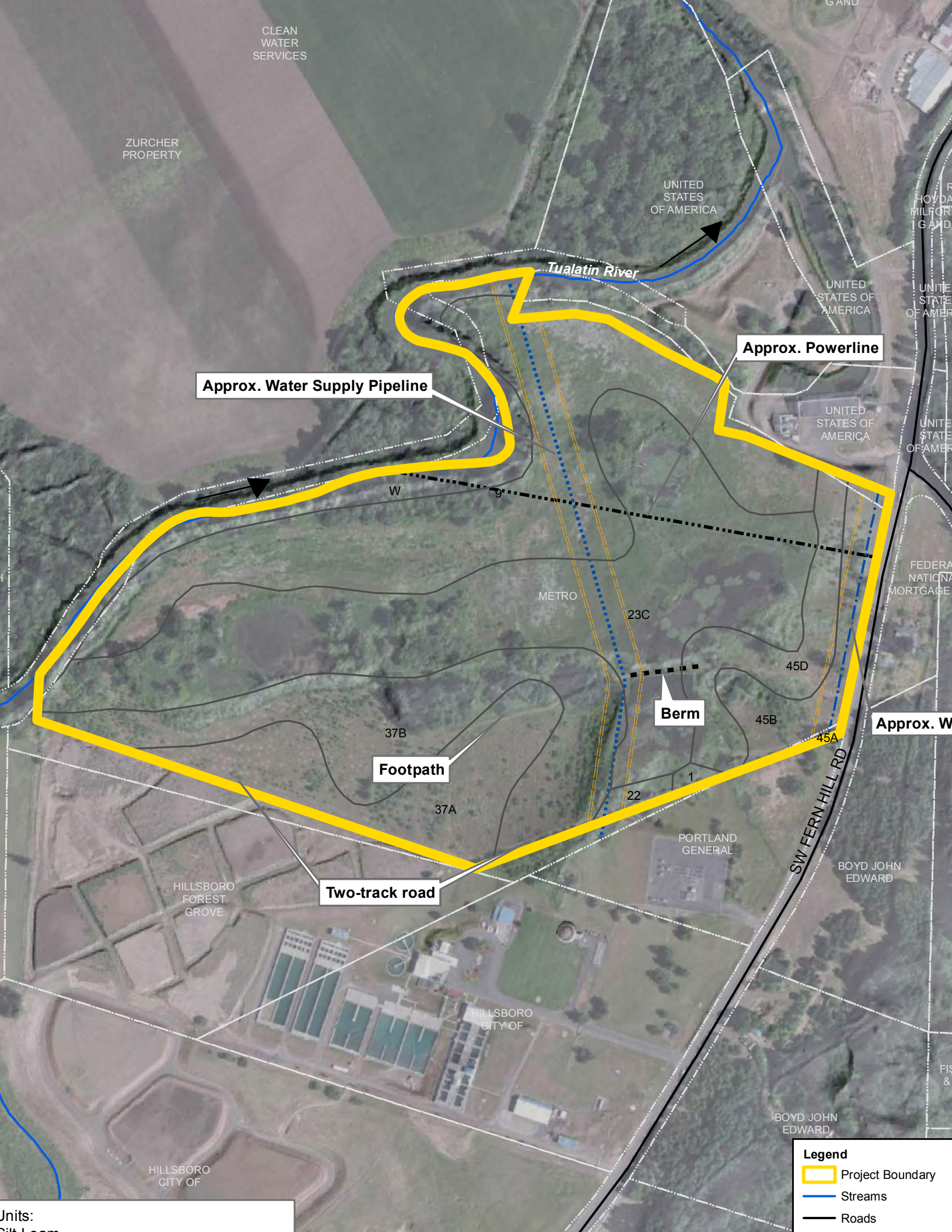
Penstemon Prairie

Carpenter Creek

Maroon Pond

Legend

Project B



CLEAN WATER SERVICES

ZURCHER PROPERTY

UNITED STATES OF AMERICA

Tualatin River

Approx. Powerline

Approx. Water Supply Pipeline

W

METRO

23C

45D

45B

Approx. W

Berm

Footpath

37B

37A

22

1

45A

PORTLAND GENERAL

SW FERN HILL RD

BOYD JOHN EDWARD

HILLSBORO FOREST GROVE




Two-track road

HILLSBORO CITY OF

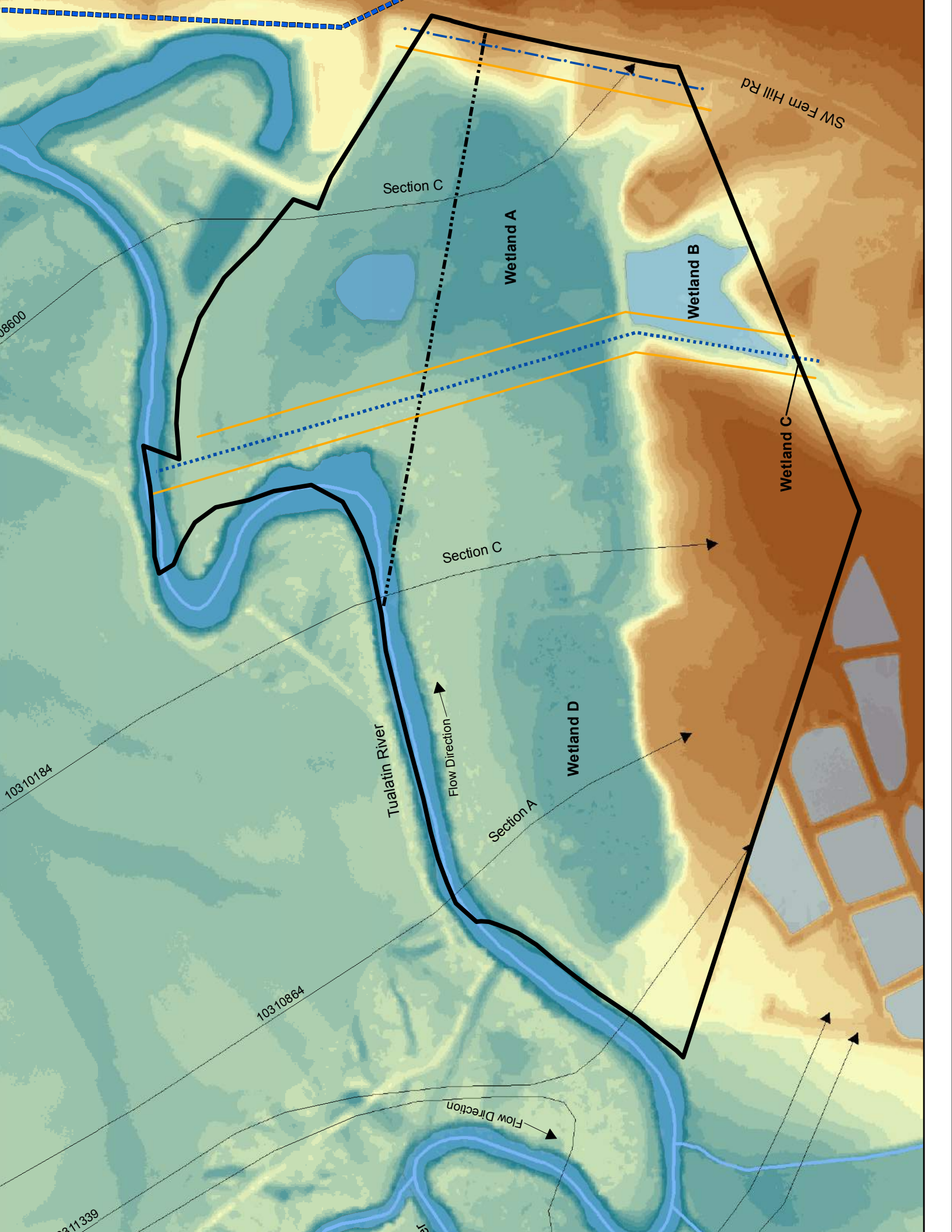
BOYD JOHN EDWARD

HILLSBORO CITY OF

Legend

-  Project Boundary
-  Streams
-  Roads

Units:
Silt L.com



SW Fern Hill Rd

Section C

Wetland A

Wetland B

Wetland C

Section C

Tualatin River

Flow Direction

Wetland D

Section A

10310864

Flow Direction

10311339



Tualatin River

Wetland A

Riparian Forest

Riparian Forest

Wetland D

Floodplain Forest

Scrub-Shrub Wetland

Emergent Marsh & Open Water Wetland

Transitional Trees

Forested Wetland

Upland Forest

Island & Beaver Lodge

Emergent Marsh & Open Water Wetland

Upland Shrub

Be

Wetland B

Upland Shrub

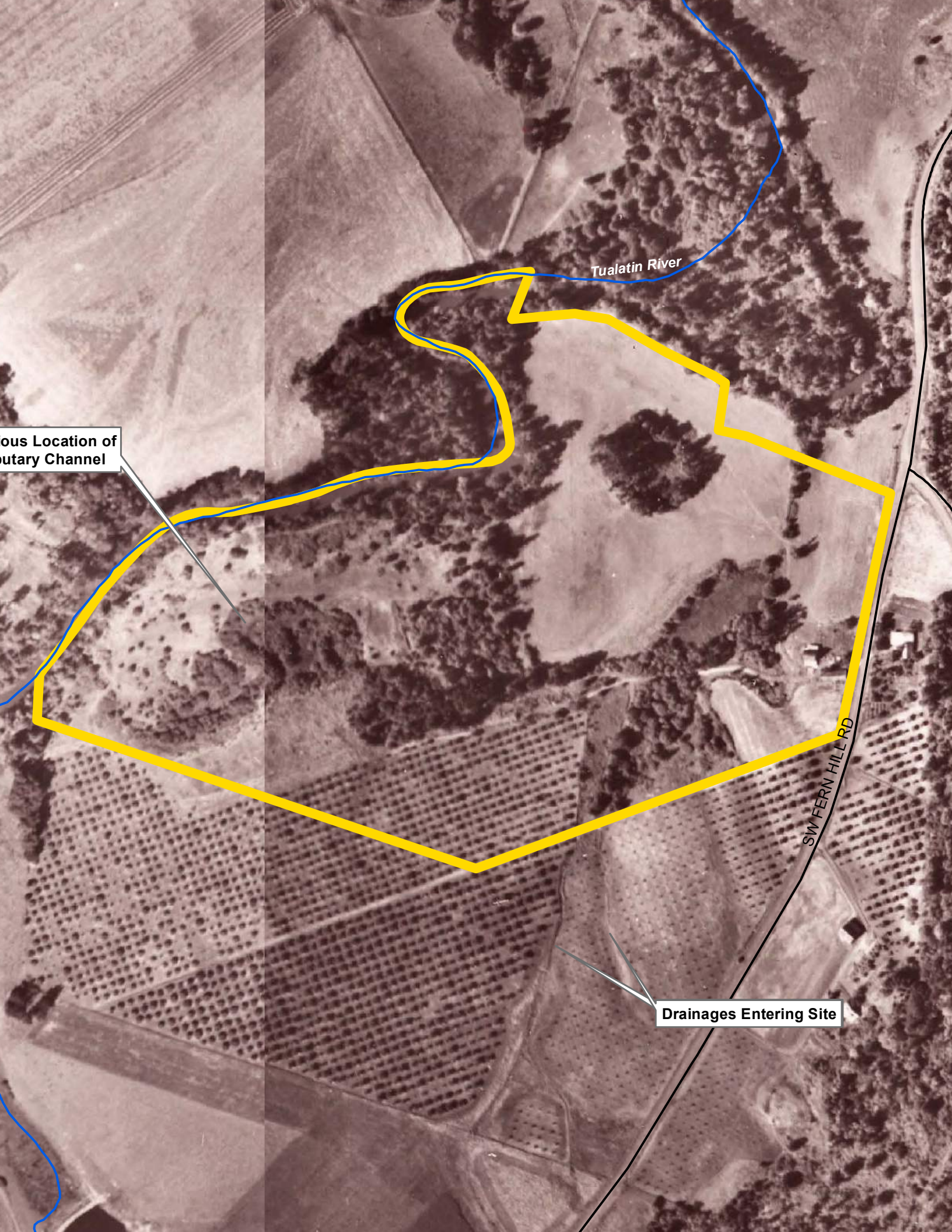
Wetland C

SW FERN HILL RD

Legend

- Project Boundary
- Streams
- Roads
- Railroad

- Existing Habitat
- Island & Beaver Lodge
 - Emergent Marsh & Open Water Wetland
 - Forested Wetland

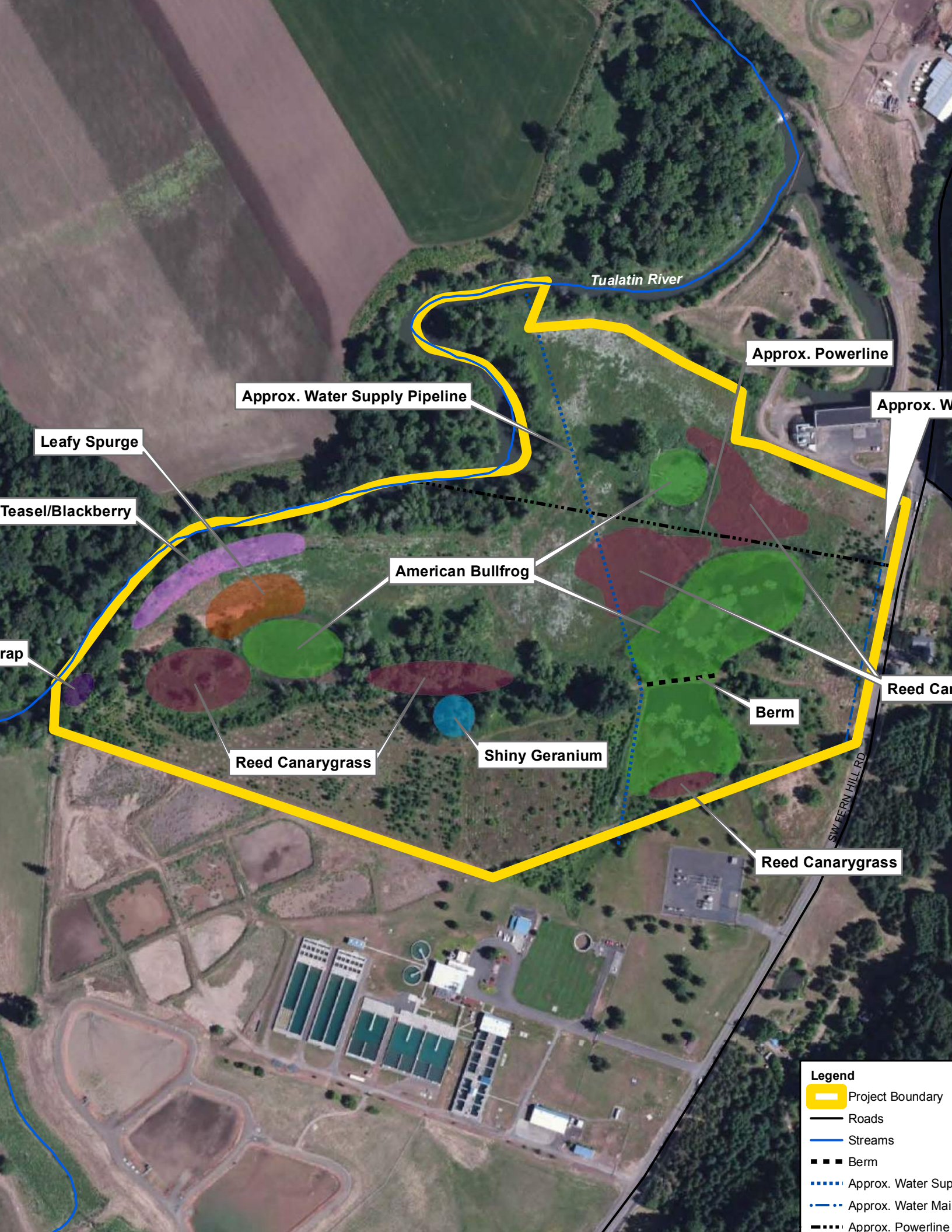


Tualatin River

Previous Location of
Outlet Channel

SW FERN HILL RD

Drainages Entering Site



Tualatin River

Approx. Water Supply Pipeline

Approx. Powerline

Approx. W

Leafy Spurge

Teasel/Blackberry

American Bullfrog

rap

Reed Canarygrass

Shiny Geranium

Berm

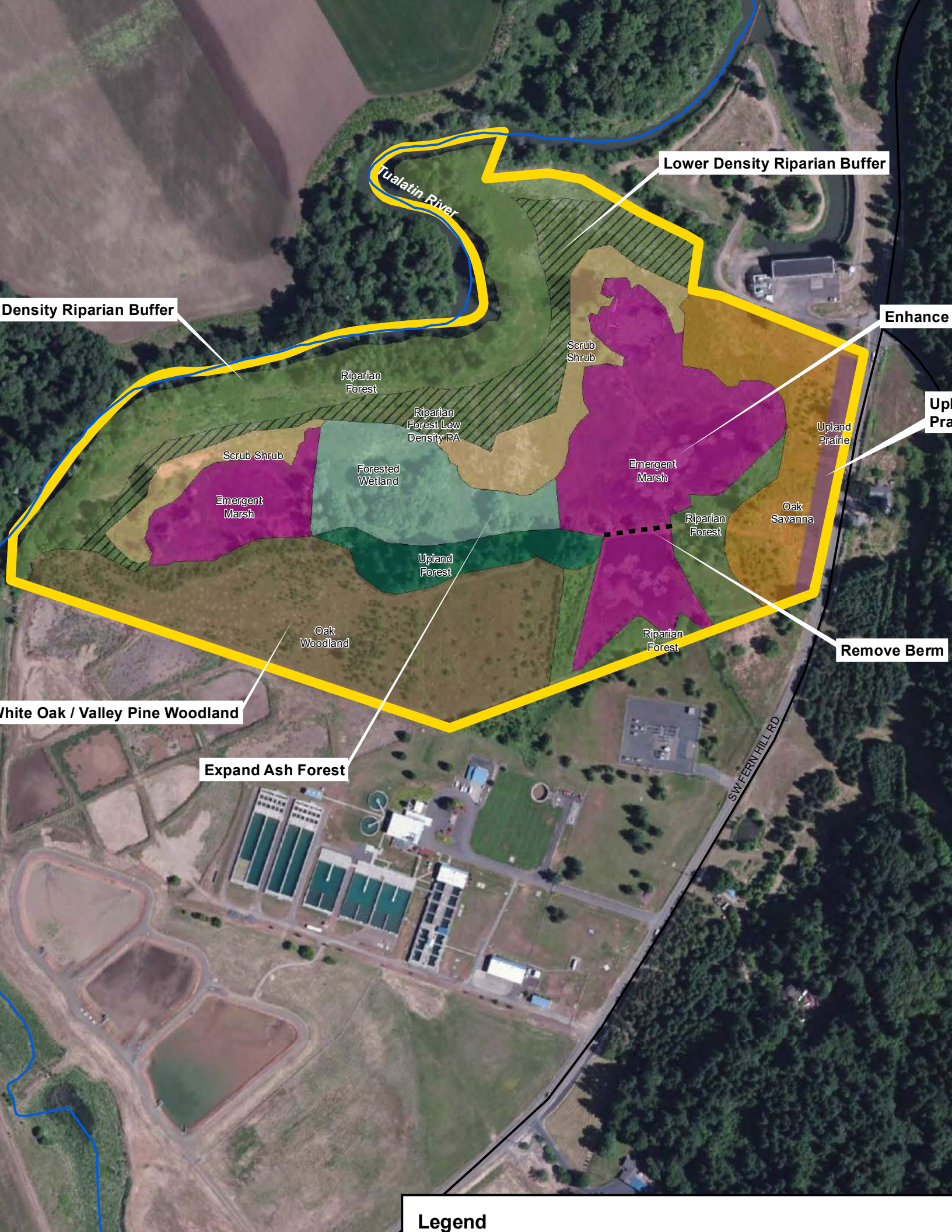
Reed Car

SW FERN HILL RD

Reed Canarygrass

Legend

-  Project Boundary
-  Roads
-  Streams
-  Berm
-  Approx. Water Sup
-  Approx. Water Mai
-  Approx. Powerline



Tualatin River

Lower Density Riparian Buffer

Density Riparian Buffer

Enhance

Upl
Pra

Riparian
Forest

Scrub
Shrub

Riparian
Forest Low
Density PA

Upland
Prairie

Scrub
Shrub

Emergent
Marsh

Forested
Wetland

Emergent
Marsh

Oak
Savanna

Upland
Forest

Riparian
Forest

Remove Berm

Oak
Woodland

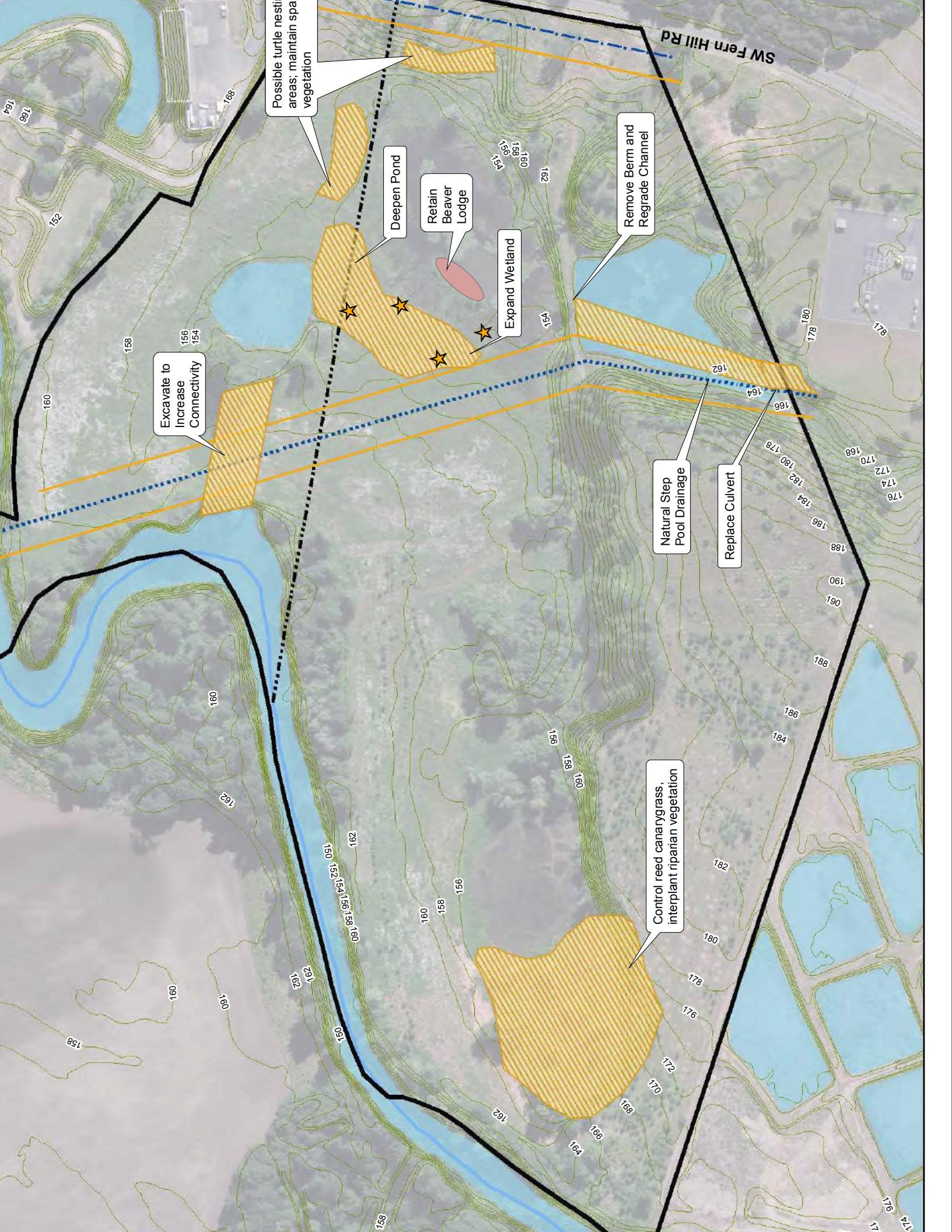
Riparian
Forest

White Oak / Valley Pine Woodland

Expand Ash Forest

SW FERN HILL RD

Legend



SW Fern Hill Rd

Possible turtle nesting areas; maintain spa areas; maintain spa vegetation

Deepen Pond

Retain Beaver Lodge

Expand Wetland

Remove Berm and Regrade Channel

Excavate to Increase Connectivity

Natural Step Pool Drainage

Replace Culvert

Control reed canarygrass, interplant riparian vegetation