CITY OF MUKILTEO
Critical Areas Mitigation Program

Prepared for:

City of Mukilteo
Department of Planning and
Development

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ESA

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1.0 EXECUTIVE SUMMARY

This document describes the Critical Areas Mitigation Program (CAMP) developed by the City of Mukilteo to facilitate the review and approval of mitigation required for projects that impact wetlands, streams, or buffers in Mukilteo and neighboring areas. The program will help ensure that mitigation "is located appropriately on the landscape, addresses restoration of watershed processes, is sustainable, and has a high likelihood of ecological success" as recommended by the Washington State Department of Ecology (Hruby 2009). This program provides alternative options for critical areas mitigation by identifying pre-selected off-site mitigation sites in several sub-basins within the City, which were selected following a watershed approach.

A 2010 study by Environmental Science Associates (ESA) of three of the City's drainage basins (Japanese Gulch, Big Gulch, and Picnic Point) identified sites within Mukilteo and its urban growth area (UGA) that provide the opportunity for sustainable wetland, stream, and buffer mitigation. The methods used to assess watershed processes and identify the sites are included in Appendix A. The identified mitigation opportunity sites are summarized in Table 3.

Detailed descriptions of the sites appropriate for wetland and stream mitigation are provided in Section 7. These sites have opportunities for wetland creation, wetland restoration, and stream restoration and are located at landscape positions that will benefit the watershed processes of Mukilteo drainages and the nearshore of Puget Sound. The sites are available for land use actions anywhere in Mukilteo and its UGA that require mitigation, with the exception of a small area in the southeast corner of the UGA that drains to Swamp Creek. The sites are also available for land use actions in neighboring parts of Everett and the Snohomish County Airport. Applicants will design and build mitigation projects on these sites following review and approval of the City of Mukilteo.

Section 8 provides detailed descriptions of the three sites that are appropriate for buffer mitigation. Two of the buffer mitigation sites, which are located near the southwest end of Japanese Gulch, contain high-quality wetlands that are headwaters to Brewery Creek and a tributary stream of Japanese Gulch Creek. The area surrounding the wetlands is a relatively mature forest and together with the adjacent wetlands provides a high level of wildlife habitat functions and stream support. High-quality wetlands on undeveloped parcels provide an opportunity for wetland and buffer preservation. The third buffer mitigation site is near the mouth of Big Gulch Creek and provides the opportunity to preserve the existing forested connection between the 178-acre open space park and the riparian shoreline of Puget Sound.

The CAMP provides for the preservation of this high-quality buffer habitat by designating it as an area available for fee-in-lieu of buffer mitigation and has been named the Mukilteo Habitat Reserve (MHR). Applicants for projects that result in unavoidable impacts to critical area buffers can pay a fee to the City to be used to offset costs of preserving the MHR either through the purchase of conservation easements or the purchase of the parcels. Payment of the required fee to the City would be in-lieu of buffer mitigation and would satisfy the applicant's buffer mitigation requirement. The responsibility for the buffer mitigation will be transferred to the City. Section 8.1 provides details on the administration and management of the MHR.

2.0 INTRODUCTION

The City of Mukilteo Planning and Community Development Department established this Critical Areas Mitigation Program (CAMP) that includes off-site mitigation alternatives to compensate for development impacts to wetlands, streams, and buffers within the city limits of Mukilteo (Figure 1). This CAMP is designed to be used by both City planning staff and applicants seeking alternative methods for mitigation of impacts to critical areas and buffers. The plan addresses wetlands, streams, and buffers only and does not address specific mitigation for other critical areas, such as steep slopes, landslide hazards or flood hazard areas. Revisions to the critical areas regulations in Mukilteo Municipal Code (MMC 17.52-17.52D) were adopted on [*DATE to be added following adoption*] to ensure consistency with this CAMP.

The Washington Department of Ecology (Ecology), U.S. Army Corps of Engineers Seattle District (Corps), and the U.S. Environmental Protection Agency Region 10 (EPA) prepared a guide for selecting mitigation sites for unavoidable wetland impacts using a watershed analysis approach. This state guidance is titled *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby et al. 2009). The intention of the guide is to "promote mitigation that is located appropriately on the landscape, addresses restoration of watershed processes, is sustainable, and has a high likelihood of ecological success." The City used the process outlined by the guide to identify appropriate mitigation sites included in this city-wide mitigation program. A description of the specific methods used to both identify mitigation sites and collect data is provided in Appendix A.

3.0 PROGRAM OVERVIEW

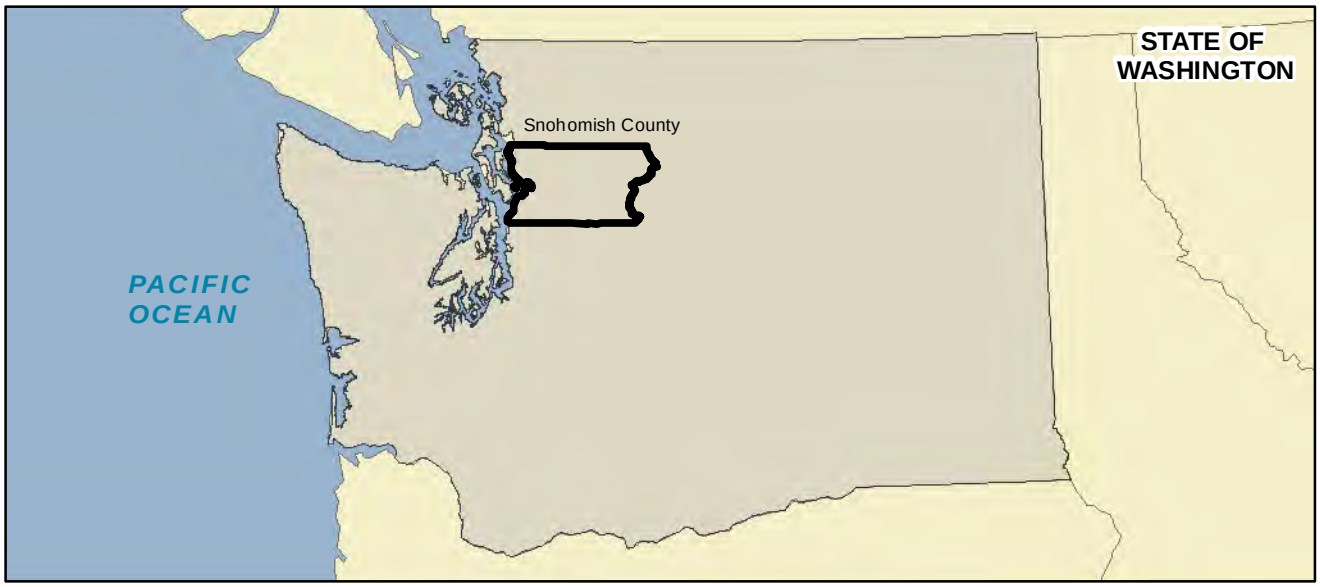
The CAMP was developed to assist the City and prospective permit applicants during the permit review process to appropriately mitigate for critical areas impacts and achieve the regulatory requirement of *no net loss*. The City's critical areas regulations (MMC 17.52) are designed to "*protect members of the public and public resources and facilities from injury, loss of life, or property damage due to landslides and steep slope failures, erosion, seismic events, liquefaction, tsunami or flooding; while maintaining healthy, functioning ecosystems through the protection of unique, fragile, and valuable elements of the environment, including ground and surface waters, wetlands, and fish and wildlife and their habitats, and to conserve the biodiversity of plant and animal species*." The CAMP is designed to further the goals of the critical areas regulations and assist with timely review of land use permit applications.

The City has developed the following goals for this CAMP in order to provide a greater degree of predictability to the critical areas permitting process and achieve a net gain in wetland, stream, and buffer habitat functions:

- Establish a critical areas mitigation program that assists with the timely review and approval of land use permit applications;
- Establish a list of pre-approved sites available for off-site wetland, stream, and buffer mitigation that ensure that biological and physical functions provided by critical areas benefit Mukilteo residents;
- Establish a locally administered fee-in-lieu program that allows for buffer mitigation;

- Improve water quality of wetlands, streams and other receiving waters;
- Reestablish and restore natural wetland and stream processes;
- Restore degraded and lost fish and wildlife habitat including buffers;
- Preserve existing high-quality wetlands, streams and buffers; and
- Improve connectivity of wetlands, streams, and other wildlife habitat areas.

The program is designed to provide alternatives for critical areas mitigation by identifying appropriate off-site mitigation sites in several sub-basins within the City and its Urban Growth Area (UGA). The site selection followed a watershed approach as recommended by state and federal agencies (Hruby et al. 2009). Pre-selection of the mitigation sites by the City will ensure that watershed processes within the City and UGA are enhanced and supported by the approved mitigation.



SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 1
Vicinity Map
Mukilteo, Washington

3.1 Off-site Wetland and Stream Mitigation

On-site mitigation is not always feasible, and identification of appropriate mitigation sites can be a lengthy and costly undertaking for a permit applicant. There are currently no wetland mitigation banks that include the entire City of Mukilteo in their service areas. A small portion of the north end of the City within WRIA 7 is included on the Snohomish Basin Bank and Skykomish Habitat Bank service area maps. The Narbeck Mitigation Bank, located east of Mukilteo on Paine Field, is approved for mitigation related to airport activities only.

This CAMP identifies mitigation sites that provide feasible options for off-site mitigation within the City. It ensures that the biological and physical functions provided by critical area mitigation remain within Mukilteo. The sites were chosen for their opportunity for preservation and/or restoration and their existing connection with highly functioning habitat areas. Directing mitigation to locations appropriate for enhancement and restoration allows for greater economic development in areas where wetlands and riparian habitat are of lower value and disconnected from other critical areas. Pre-approval of the sites is expected to result in more successful mitigation projects and a more streamlined land use permit process.

Applicants for land use actions that include impacts to wetlands, streams, or buffers would apply for use of the off-site mitigation areas and develop plans for the creation, restoration, or enhancement of critical areas or buffers. Wetland and stream impacts would require permits from one or all of the following agencies: City of Mukilteo, Ecology, Washington Department of Fish and Wildlife, and the Corps. Acquisition of privately owned parcels or easements, mitigation design, construction, surety bond, maintenance, and monitoring (5 to 10 years) would be the responsibility of the applicant.

The sites prioritized in this CAMP are pre-approved for critical areas mitigation by the City and are expected to meet general mitigation standards required by state Section 401 water quality and federal Section 404 permits as well. City, state, and federal approval of the mitigation plans will depend on design details and whether off-site mitigation for expected impacts is considered appropriate at each permit approval level. Because the off-site locations were selected based on a watershed approach, it is expected that City, state, and federal approval of off-site mitigation will proceed more quickly than if sites were selected on a project-by-project basis. Ecology staff were consulted early in the process of identifying potential mitigation sites and approved of the watershed approach used to establish this program (Anderson, pers. comm., 2010).

3.2 Off-site Buffer Mitigation: Mukilteo Habitat Reserve

In addition to wetland and stream mitigation sites, three forested sites have been identified in the CAMP to be preserved by the City to protect high-quality buffer and habitat functions. Two of these sites contain headwater wetlands and mature forested buffer. The third site contains forested buffer along the shoreline of Puget Sound and provides connectivity between wildlife habitat in a 178-acre forested ravine (Big Gulch) and the shoreline habitat. The three sites provide opportunities for preservation of high-quality habitat and are referred to in this report as the “Mukilteo Habitat Reserve” (MHR) sites.

The sites consist of privately owned parcels that are undeveloped. Building applications have been submitted in the past for each of these sites; which included proposed wetland and buffer impacts. The existing wetland, stream, and buffer habitat would be impacted by any development activity on these sites and the habitat value and connectivity to other high quality habitats would likely be lost. It is the intention of the City to preserve the high quality habitat on these sites through use of the CAMP.

The sites could be acquired, managed, and administered by the City to accept fees in-lieu of applicant-designed mitigation for buffer impacts. State and federal approval of this fee-in-lieu program has not been sought at this time. Therefore, this portion of the program is intended to provide mitigation for critical areas buffer impacts permitted by the City at the local level only. Critical areas addressed by this buffer mitigation program include wetlands and Fish and Wildlife Habitat Conservation Areas (FWHCA). As classified by the MCC 17.52C.080, FWHCA include streams and riparian habitat, as well as other habitats.

Fee-in-lieu mitigation at the MHR will be considered by the City Planning and Community Development Department when an applicant proposes an activity that impacts wetland or stream buffer habitat, and on-site mitigation is precluded for reasons of physical constraints or lack of sustainable options. In this case, the applicant would provide funds to the City instead of completing project-specific mitigation. The MHR program includes the preservation and enhancement of habitat and/or aquatic resources through funds paid to the City to satisfy compensatory buffer mitigation requirements; the responsibility for providing mitigation is transferred to the City. Procedures and management of the MHR are described in Section 8.1.

Provisions for off-site mitigation provided by this CAMP will increase wetland, stream, and buffer mitigation opportunities and are expected to ensure no net loss of critical areas function within Mukilteo. The MHR will allow further flexibility and increased success in mitigating wetland and stream buffer impacts.

4.0 MITIGATION SEQUENCING

Similar to state and federal mitigation guidelines, the Mukilteo Municipal Code (MMC) requires that applicants proposing development projects on parcels containing critical areas make every effort to avoid and minimize impacts to those critical areas (MMC 17.52.010 and 17.52B.010.B). Avoidance and minimization of project impacts is required to be considered first, prior to compensating for impacts using traditional mitigation approaches (such as creation, restoration, or enhancement). This concept of avoiding and minimizing impacts first, through site layout, project redesign, or reduction in project footprint, is referred to as “mitigation sequencing.”

Development projects that avoid wetland and stream impacts and utilize standard buffers based on the MMC will not trigger mitigation requirements. In certain circumstances, enhancement of buffer areas may be required if the existing conditions do not adequately protect the functions of the critical area (MMC 17.52B.100.F). Examples of impact avoidance include reducing the size of a project, reconfiguring project components, or reducing density to avoid critical areas or buffers. Minimization of impacts may include limiting the magnitude of the project, reducing the

project footprint, and/or using alternate construction practices that require minimal disturbance. Projects that minimize impacts will have reduced mitigation needs, which can be calculated based on guidance in Section 4.1 and addressed through the use of the alternatives in Section 5.0.

4.1 Impact Assessment and Mitigation Requirements

Prior to submittal of a land use application for sites containing critical areas, applicants must demonstrate that all practical efforts to avoid and/or minimize impacts to critical areas have been attempted. An alternatives analysis must be conducted to consider conceptual design alternatives that avoid or reduce impacts. The degree of potential impacts to wetlands, streams, and buffer areas must be assessed in order to achieve the City's overall goal of no net loss of function and value. This will include a calculation of the square footage of impact and an assessment of existing and post-construction critical areas functions. The City will review the alternatives analysis and assist the applicant with selection of the appropriate alternative that avoids or minimizes critical areas impacts. A summary of the process to follow regarding mitigation sequencing, impact assessment, and mitigation requirements is shown in Figure 2.

Following City approval of an alternative, the applicant will prepare a report that describes the plan to mitigate for the anticipated impacts (MMC 17.52B.120). The type and extent of mitigation required for critical areas impacts depends, in part, on the degree of alteration of the critical area. A high degree of impact is typically long-lasting or permanent. A low degree of impact is often temporary or transient in nature. Impacts can range from permanent impacts, such as loss of an entire wetland due to filling, to indirect impacts, such as loss of hydrologic input due to adjacent development.

Specific mitigation requirements are calculated based on the guidance in MMC 17.52B.130.B.2 and 17.52C.110-150. The following sections provide a summary of the mitigation requirements described in the MMC.

4.1.1 Wetlands

Wetlands are classified in Mukilteo as Category I, II, III, or IV using the Washington State Department of Ecology Wetland Rating System for Western Washington, Publication #04-06-025 (MMC 17.45B.090). Mitigation requirements are calculated based on the wetland category and type (forested, estuary, etc.). Ratios for required wetland area replacement are summarized in Table 2 of MMC 17.52B.130.B.2. Mitigation ratios for wetland impacts range from 6:1 for Category I forested wetlands (highest value) to 1.5:1 for Category IV wetlands (lowest value).

Category I Wetlands: Alteration of Category I wetlands is not allowed, subject to reasonable use provisions (MMC 17.52B.120. B.1).

Category II Wetlands: Alteration of Category II wetlands is discouraged, but may be allowed on a case-by-case basis (MMC 17.52B.120. B.2).

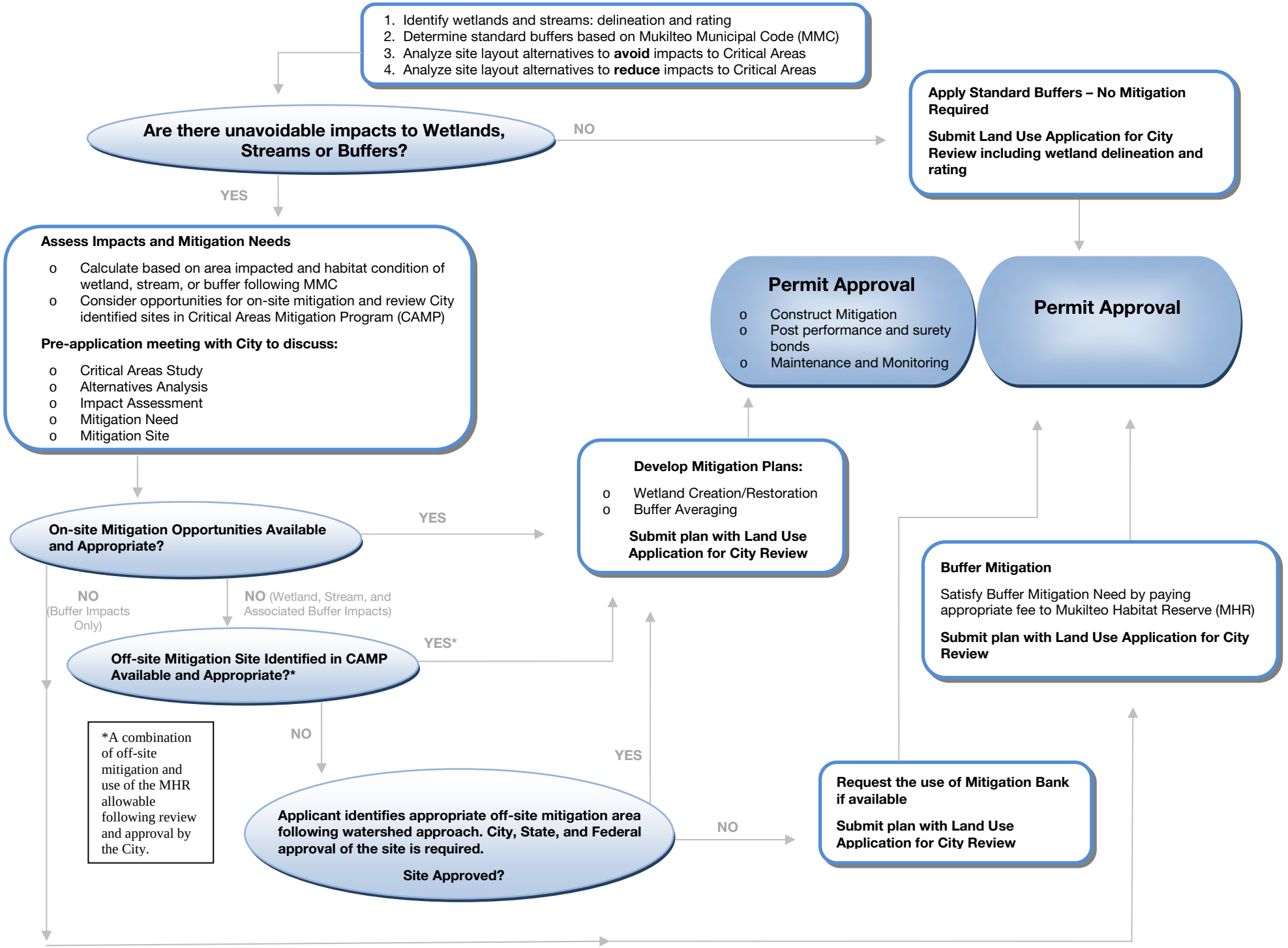
Category III and IV Wetlands: Alteration of Category III and IV wetlands is allowed if specific conditions are met (MMC 17.52B.120. B.3).

4.1.2 Fish and Wildlife Habitat Conservation Areas (Streams and Priority Habitats)

Streams and riparian habitat (considered priority habitat by Washington Fish and Wildlife) are regulated as Fish and Wildlife Habitat Conservation Areas (FWHCA) in Mukilteo (MMC 17.52C). Streams are classified based on the criteria in MMC 17.52C.080 as Type 1, 2, 3, 4, or 5 streams. There are currently no Type 1 or 2 streams in the City of Mukilteo or its UGA (Table 1 of MMC 17.52C.080); therefore all streams in the city are classified as Type 3, 4 or 5.

Impacts to Type 3 streams shall be avoided except where subject to the reasonable use provisions of MMC Section 17.52.025. Impacts to Type 4 and 5 streams are typically the result of culverts for roads or driveways. Mitigation requirements for stream and riparian habitat impacts are discussed in MMC 17.52C.110-150 and are tailored specifically to benefit the stream in question. Mitigation for stream impacts is often most beneficial on-site and in the same drainage basin. If opportunities for replacement of lost functions are not available on the site, or natural processes are altered to the point that mitigation will not be sustainable, off-site options may be considered. Off-site and out-of-kind mitigation will be considered on a case-by-case basis following review by the City. If there are opportunities on-site for replacing some of the impacted functions and not others, a combination of both on-site and off-site mitigation may be necessary to ensure no net loss of functions.

Figure 2. Land Use Action Application Process on Sites with Critical Areas



4.1.3 Critical Area Buffers

MMC 17.08.020 defines a buffer as "an area, typically adjacent or otherwise associated with an environmentally sensitive feature, which is retained in its natural state. No clearing, grading, or filling is permitted within a buffer (unless specifically conditioned otherwise)." This plan addresses buffers for wetlands and streams specifically. Buffers may also be required on other FWHCA, including riparian habitat, as determined by the planning department (MMC 17.52C.090). Stream buffers generally overlap riparian habitat, and wetlands associated with streams often have a riparian habitat area that overlaps the wetland buffer. Riparian habitat is regulated as a Critical Area in Mukilteo, therefore impacts to buffer areas that overlap riparian habitat require mitigation (MMC 17.52C.110).

Wetland Buffers

The standard buffer width required by the City around all wetlands is determined by the classification (category), the quality of the habitat, and the adjacent land use (MMC 17.52B.100). The required buffer width for wetlands range from 40 to 225 feet where adjacent to moderate-intensity land use, and 50 to 300 feet where adjacent to high-intensity land use. Standard buffer widths for wetlands are shown in Table 1.

Table 1. Wetland Buffer Width (MMC 17.52B.100)

	Cat I			Cat I-III												Cat I & II	Cat III		Cat IV
Wetland Types or Points for Habitat	**NHW**	**Bogs**	**E & L**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**≥31**	**WC 24-32 & Hab. <20**	**Interdunal**	**<20**	**<30**
High Intensity	250	250	200	100	100	120	140	160	180	200	220	240	260	280	300	100	150	80	50
Moderate Intensity	190	190	150	75	75	90	105	120	135	150	165	180	195	210	225	75	110	60	40

WC = Water Quality Score

NHW = Natural Heritage Wetland

E & L = Estuarine and Lagoons

Forested Wetlands = Buffer is based on habitat score

High Intensity = Adjacent land use commercial, urban, industrial, institutional, retail sales, residential greater than one unit/acre, high-intensity agriculture (dairies, nurseries, greenhouses, etc.), high-intensity recreation (golf courses, ball field, etc.), and hobby farms.

Moderate Intensity = Adjacent land use residential less than one unit/acre, open space (parks with biking or jogging trails), moderate-intensity agriculture (orchards, hay field, etc.), paved trails, logging roads, utility corridor or right-of-way shared by several utilities including access roads.

Stream Buffers

Standard buffer widths for streams are designated by the stream type and are shown in Table 2.

Table 2. Stream Buffer Requirements (MMC17.52C.090)

Stream Type[1]	Standard Buffer Width
Type 3	150 feet
Type 4 (H)	75 feet
Type 4 (L)	50 feet
Type 5 (H and L)	50 feet

Notes: H= High mass wasting; L= Low mass wasting (MMC17.52C.090)
[1]There are no Type 1 or 2 streams in Mukilteo or its UGA

Alterations to the required buffer width for wetlands (MMC 17.52B.100.G-N) and streams (MMC 17.52C.90.C-I) is allowed given specific conditions and approval from the City. Permitted alterations in the width of the required buffer include buffer averaging and buffer reduction.

Buffer Averaging

Buffer averaging is allowed with conditions on both wetlands and streams in Mukilteo. Buffers may be averaged on-site with a 1:1 replacement of buffer area lost through reduction of a portion of the required buffer. A portion of the buffer is reduced in width and the equivalent area of buffer is added along another portion of the wetland (MMC 17.52B.100.G) or stream (MMC 17.52C.90.C). If sufficient area is not available on-site for complete replacement of the reduced buffer, the remaining buffer area may be mitigated off-site through use of the MHR (see Section 8). The remaining buffer at its narrowest point is never less than half (50%) of the standard buffer width.

Buffer Reduction

For sites that meet specific conditions, the MMC allows for buffer reduction (17.52B.100.H and MMC 17.52C.90.D). The buffer width is reduced from that required for high-intensity land uses to that required for moderate-intensity land uses. Buffer reduction is also allowed on certain Category III and IV wetlands and Type 5 streams at the discretion of the Planning Director. Buffer reduction is allowed next to certain Category III and IV wetlands when the remaining buffer at its narrowest point is never less than half (50%) of the standard buffer width. The Planning Director may require enhancement of the remaining buffer if conditions are not sufficient to protect wetland or stream functions. The area of buffer lost due to approved buffer reduction may be mitigated through use of the MHR (see Section 8).

Buffer Elimination with Wetland Fill

In the case where an entire wetland area is allowed to be filled (usually only very small wetlands) or a section of stream is placed in a pipe, and where the buffer area is developed, compensation for the lost buffer habitat area may also be required. Buffer area that meets the WDFW definition of Priority Habitat is regulated as a Critical Area by MCC 17.52C.030. If

buffer replacement area is not available or appropriate on-site, the lost buffer area may be mitigated through use of the MHR (see Section 8).

Buffer Mitigation Ratios

Mitigation for impacts to buffers, whether through buffer averaging, buffer reduction, or another allowed use, is typically required at a 1:1 ratio for on-site mitigation. The MMC requires one-to-one replacement of buffer area impacted during development (MMC 17.52C.090).

However, if mitigation for buffer impacts is proposed at off-site locations, the required mitigation area shall be calculated with a multiplier, with the exception of low quality buffers. The proposed multiplier is based on the existing habitat quality of the impacted buffer area (functional loss). Existing buffers with higher habitat quality provide greater value, and therefore mitigation for impacts to higher quality buffer will require a larger mitigation replacement ratio (see Table 3). Habitat quality is rated by the type of plants, aerial cover, and overall vegetation structure. Low-quality habitats are those with very little or no native woody vegetation (<30%) and include areas dominated by non-native plants. High-quality habitats are those that have a well developed vegetation structure consisting of native trees and shrubs.

Table 3 summarizes the ratios used to calculate off-site buffer mitigation requirements. For example, impacted buffers that have 30% or greater aerial cover provided by native woody plants, but less than 30% aerial cover from trees, would be compensated at a 1.25:1 ratio. Therefore, if 100 square feet of this type of buffer is impacted, 125 square feet of off-site buffer mitigation is required.

Table 3. Proposed Off-Site Buffer Mitigation Ratios

Condition of Existing Buffer to be Impacted	Replacement Ratio (required mitigation area : impacted area)
Less than 30% aerial cover of native, woody vegetation [1]	1 : 1
Native woody vegetation = or > 30% aerial cover; tree[2] cover less than 30%	1.25 : 1
Tree[2] cover = or > 30%; coniferous trees[3] provide less than 30% aerial cover	1.5 : 1
Coniferous trees[3] provide = or > 30% aerial cover	2 : 1

Notes:
[1] Native, woody vegetation means shrubs and trees indigenous to western Washington.
[2] Trees greater than 20 feet tall with trunk diameter of at least 4 inches.
[3] Coniferous trees greater than 20 feet tall with trunk diameter of at least 10 inches.

5.0 MITIGATION ALTERNATIVES SELECTION PROCESS

Projects that result in unavoidable impacts to critical areas have on-site and off-site options for wetland, stream, and buffer mitigation. City staff can assist with the selection of an appropriate mitigation alternative. City approval of the mitigation approach should be sought before preliminary plans are developed. The requirements for mitigation plans are described in Section 5.5.

Once the site development alternatives analysis (Section 4.1) has been approved, and impacts to critical areas are considered unavoidable, the City shall consider proposed compensatory mitigation plans in the following order:

1. On-site mitigation;
2. Off-site mitigation at City pre-selected sites, including the MHR;
3. Off-site mitigation at applicant-identified site within the City of Mukilteo; and
4. Off-site mitigation bank.

5.1 On-Site Mitigation Analysis

Once the unavoidable impacts to wetlands, streams, or buffer have been assessed and the City concurs with the assessment, site conditions must be reviewed to determine the need and opportunity for on-site mitigation. Hydrologic, vegetation, soil, and land use conditions on the site and surrounding properties must be assessed to determine if mitigation will be appropriate for the watershed or sub-basin and sustainable over the long term. Assessment of the site must take into account the existing conditions of the sub-basin and how the site fits in with the hydrologic and geomorphic processes as well as habitat features. Acceptable watershed-based methods for assessing the feasibility of a mitigation site include:

- *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby et al. 2009);
- Best available science; and
- Other methods allowed at the discretion of the City Planning Director.

On-site wetland mitigation requires the approval of one or all of the following agencies: the City of Mukilteo, Ecology, and the Corps. On-site stream mitigation requires the approval of the City, the Washington Department of Fish and Wildlife (WDFW), and often the Corps and Ecology. Mitigation plans that are exclusively for buffer impacts require only the approval of the City. If on-site mitigation opportunities are not present or determined to be not feasible or viable over the long term, off-site options (Sections 5.2 and 5.3) may be considered. On-site mitigation may not be feasible or sustainable because of a number of factors including, but not limited to, insufficient hydrologic support, untreated or undetained stormwater inputs, disturbed soils, inappropriate position in the watershed for mitigation, off-site invasive weed input, insufficient habitat connectivity, adjacent urban land uses, and other factors.

5.2 Off-site Wetland, Stream, and Buffer Mitigation at City Pre-Selected Sites

If on-site mitigation opportunities are not present or determined to be not feasible or sustainable, off-site options at sites pre-selected by the City are considered. In certain situations it may be possible to mitigate for some functions on-site and others off-site. Moving some or all of the mitigation off-site can result in fewer functions overall contributing to a local sub-basin. However, this local loss in function in one sub-basin is expected to be made up in another sub-basin where conditions are more suitable to providing sustainable functions without the need for significant long-term maintenance.

Sixteen sites were identified following the watershed approach (Appendix A) as being appropriate for wetland, stream, and buffer mitigation (Figure 3). These sites are labeled as potential mitigation sites M1 through M13 and Mukilteo Habitat Reserve (MHR) Sites MHR1 through MHR3. The sites are located in the following sub-basins:

- Japanese Gulch and Brewery Creek sub-basin (Figure 4) – includes four sites, two of which are designated MHR to be used for buffer mitigation;
- Smuggler's Gulch sub-basin (Figure 5);
- Big Gulch sub-basin (Figure 5); and
- Picnic Point sub-basin (Figure 6) – includes six sites total. Four of the sites in Picnic Point (M10, M11, M12, and M13) were identified in the Snohomish County Drainage Needs Report (2006) and have been included in the City's CAMP.

A summary of the mitigation opportunities at each site is provided in Table 4. Detailed descriptions of each of the sites and the mitigation opportunities are included in Sections 7 and 8 of this report.

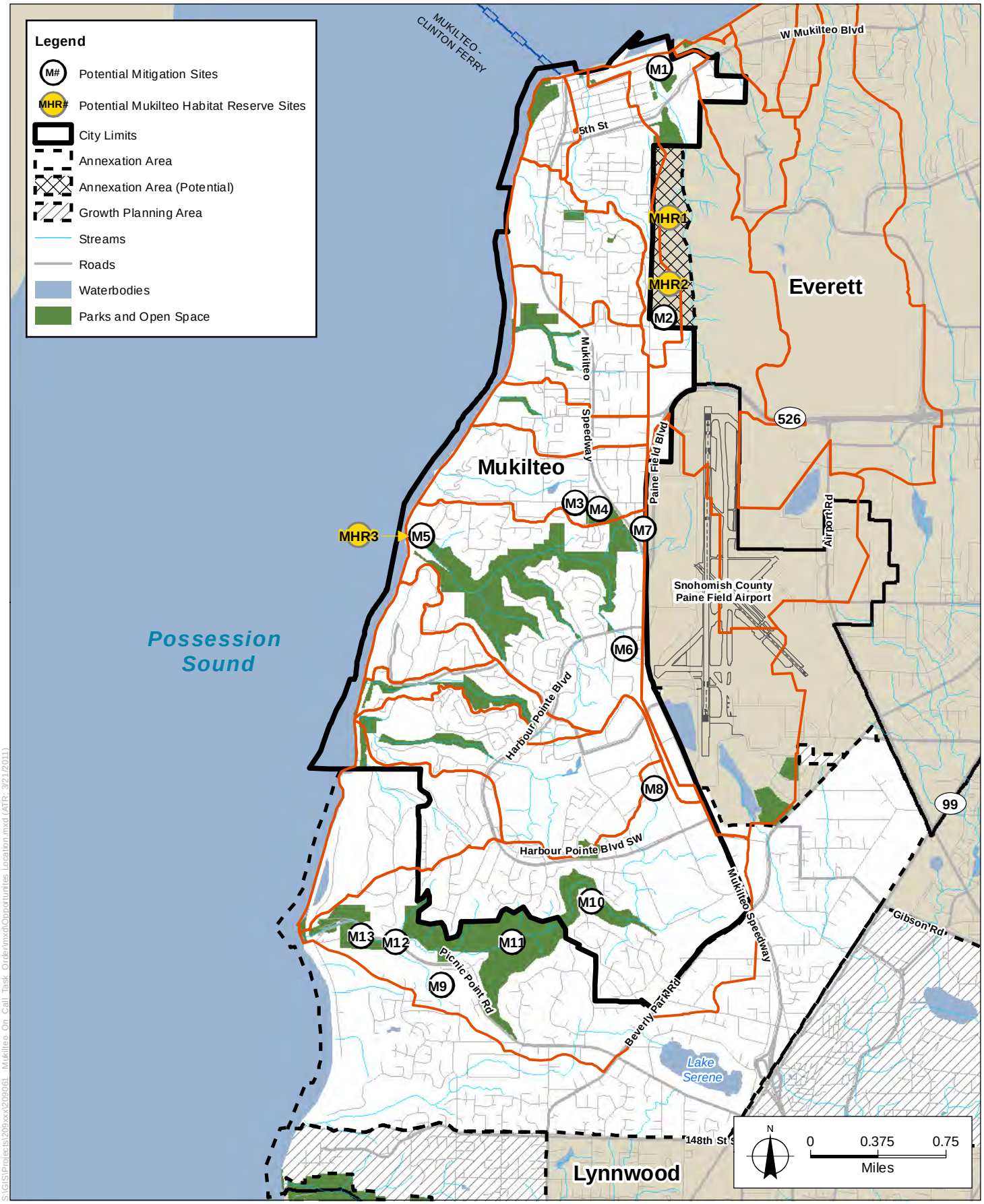
Wetland and Stream Mitigation

Off-site wetland mitigation requires the approval of one or all of the following agencies: the City of Mukilteo, Ecology, and the Corps. Off-site stream mitigation requires the approval of the City, WDFW, and often the Corps and Ecology. If the City determines that mitigation opportunities on the City-identified sites are not sufficient or appropriate for the impact, the applicant may propose the use of other sites (Section 5.3). See Section 5.5 for mitigation plan requirements.

Buffer Mitigation

Mitigation plans that are exclusively for buffer impacts require only the approval of the City. Off-site compensation for buffer impacts shall use the Mukilteo Habitat Reserve (MHR). In certain circumstances the MHR might be used to mitigate for wetland or stream impacts that affect habitat only, or when replacement of functions is best achieved at more than one location. An example of this would be if general wildlife habitat functions were replaced by using the MHR, and hydrologic and water quality functions were replaced on-site.

Plans for off-site buffer mitigation are much simpler than those required for wetland and stream mitigation (described in Section 5.5). Applicants are **not** required to prepare preliminary and/or final mitigation plan drawings for buffer mitigation using the MHR. Buffer mitigation plans shall include only a description of the on-site critical area and buffer, description of the buffer impact, area calculation of mitigation need, description of why on-site mitigation is not feasible or sustainable, and a calculation of the buffer mitigation fee following methods in Section 8. Payment of the fee satisfies the buffer mitigation requirement; the City accepts responsibility for the mitigation, maintenance, and monitoring.



SOURCE: City of Mukilteo 2009; Snohomish County, 2008

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 3

Pre-Selected Mitigation Sites
Mukilteo, Washington

Table 4. Identified Mitigation Opportunities by Sub-basin

(M=Mitigation Site: off-site; MHR=Mukilteo Habitat Reserve Site: fee-in-lieu)

Mitigation Site Code	Mitigation Site Name	Mitigation Opportunity	Site-Specific Potential Projects	Figure
Wetland, Stream, and Buffer Mitigation				
Japanese Gulch/Brewery Creek Sub-basins				
M1	Lower Japanese Gulch Creek and Estuary (Wetland is on City property, mouth of stream and tidelands are on privately owned parcels)	▪ Wetland Stream Enhancement ▪ Stream Restoration	▪ Daylight Japanese Gulch Creek through former Tank Farm. ▪ Install box culvert beneath BNSF railroad. ▪ Improve connection between the creek and wetlands at the mouth of the creek.	Figure 7 in Section 7.1
M2	Japanese Gulch/Brewery Creek Headwater Wetlands (City owned)	▪ Wetland Creation ▪ Buffer Restoration ▪ Wetland Enhancement	▪ Impervious surface (road) removal. ▪ Headwater wetland creation and connection to adjacent existing wetlands. ▪ Remove invasive and ornamental plants from buffer. ▪ Plant native trees and shrubs in buffer. ▪ Plant coniferous trees in existing deciduous forested wetland.	Figure 8 in Section 7.2
Smuggler's Gulch Sub-basin				
M3	92nd Street Easement Wetland and Buffer (City owned)	▪ Wetland Creation ▪ Buffer Restoration ▪ Water Quality Improvements	▪ Enlarge/enhance existing wetland. ▪ Plant native conifers and shrubs in buffer. ▪ Install bioswale to treat road runoff before entering wetland.	Figure 9 in Section 7.3

(M=Mitigation Site: off-site; MHR=Mukilteo Habitat Reserve Site: fee-in-lieu)

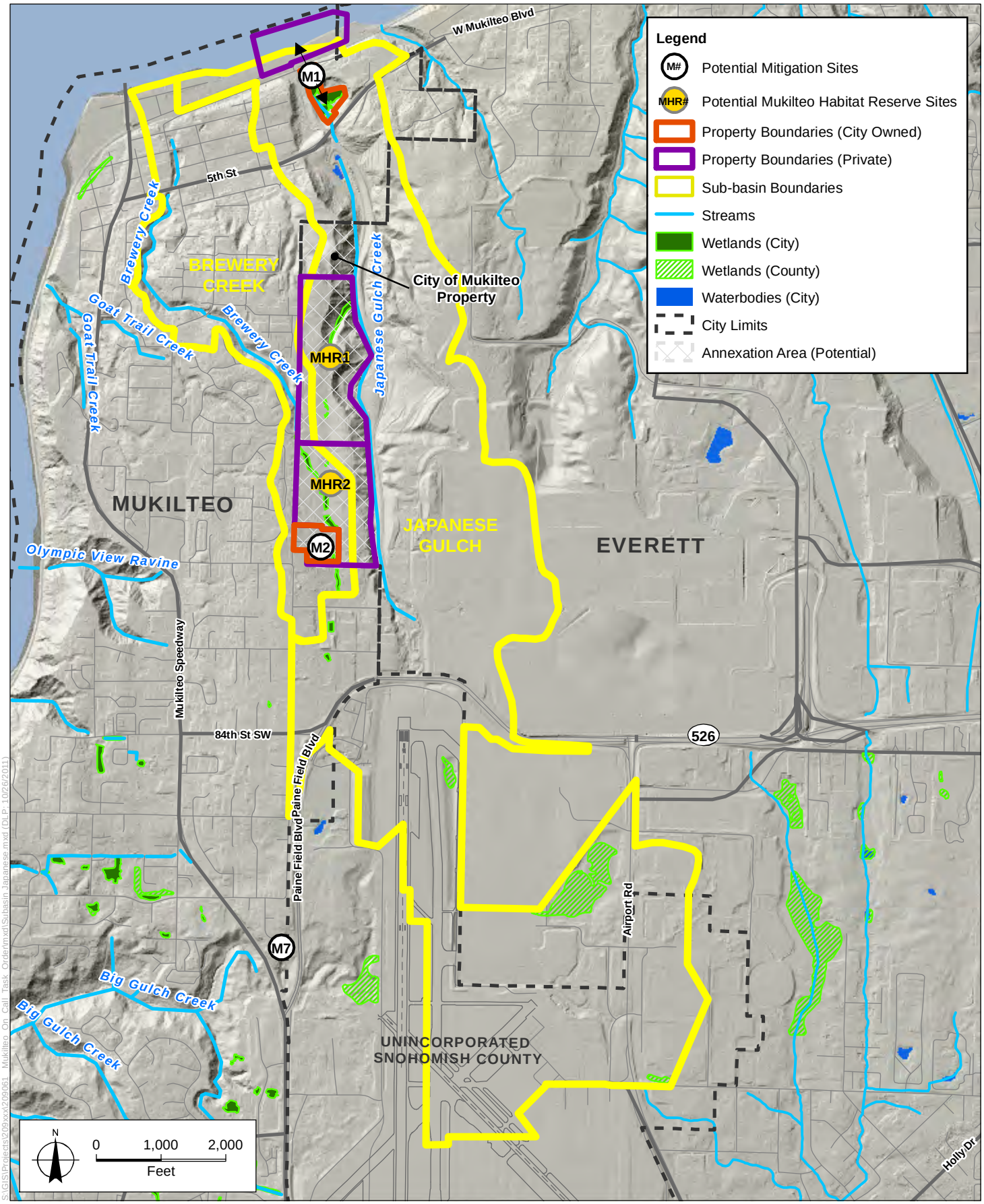
Mitigation Site Code	Mitigation Site Name	Mitigation Opportunity	Site-Specific Potential Projects	Figure
Wetland, Stream, and Buffer Mitigation				
M4	92nd Street Park Wetlands and Buffer (City owned)	▪ Wetland Creation ▪ Wetland Enhancement ▪ Buffer Enhancement	▪ Minor grading to create wetland and plant wetland vegetation. ▪ Plant native vegetation to improve habitat connectivity and buffer function. ▪ Remove invasive plants (English ivy) from existing wetland and underplant with native conifers.	Figure 10 in Section 7.4
Big Gulch Sub-basin				
M5	Lower Big Gulch Creek and Estuary (Privately owned)	▪ Wetland Creation ▪ Estuary and Nearshore Restoration ▪ Stream Restoration	▪ Restoration of Big Gulch Creek mouth and restoration of "pocket" estuary. ▪ Install box culvert under BNSF railroad. ▪ Stream realignment and restoration.	Figure 11 in Section 7.5
M6	Harbour Pointe Blvd & 47th Pl W Stream Corridor (Privately owned)	▪ Stream Buffer Enhancement ▪ Wetland Enhancement	▪ Removal of invasive plants from stream corridor and wetland buffers. ▪ Planting native conifers and shrubs throughout wetlands, stream corridor and buffers.	Figure 12 in Section 7.6
M7	North Fork of Big Gulch Creek (Privately owned)	▪ Wetland Creation ▪ Stream restoration: Stormwater Attenuation	▪ Install outlet control on culvert and grade to create floodplain wetland. ▪ Create wet pond and divert road runoff.	Figure 13 in Section 7.7

(M=Mitigation Site: off-site; MHR=Mukilteo Habitat Reserve Site: fee-in-lieu)

Mitigation Site Code	Mitigation Site Name	Mitigation Opportunity	Site-Specific Potential Projects	Figure
Wetland, Stream, and Buffer Mitigation				
Picnic Point Sub-basin				
M8	Cyrus Road Wetlands and Buffer (Privately owned)	▪ Wetland Preservation ▪ Wetland Creation ▪ Wetland Enhancement ▪ Riparian Enhancement ▪ Buffer Enhancement	▪ Purchase conservation easements on property to prohibit future development of forested headwater wetland. ▪ Grade existing buffer area to create additional wetland and plant with sedges and conifers. ▪ Remove invasive plant species. ▪ Plant conifers throughout wetland, riparian corridor and buffer.	Figure 14 in Section 7.8
M9	Forested Upland and Stream Corridor (Privately owned)	▪ Habitat Connectivity ▪ Buffer Enhancement	▪ Preserve stream and wetland buffer and upland coniferous forest. ▪ Remove invasive plants.	Figure 15 in Section 7.9
M10	Picnic Point Creek	▪ Stream Restoration	▪ Culvert replacement to allow fish passage.	Section 7.10
M11	Picnic Point Creek	▪ Stream Restoration	▪ Rebuild rock weirs to include bioengineering components. ▪ Channel improvements to improve fish habitat and passage.	Section 7.11
M12	Picnic Point Creek	▪ Stream Restoration	▪ Stabilize eroding road crossing.	Section 7.12
M13	Picnic Point Creek	▪ Stream Restoration	▪ Culvert replacement to allow fish passage.	Section 7.13

(M=Mitigation Site: off-site; MHR=Mukilteo Habitat Reserve Site: fee-in-lieu)

Mitigation Site Code	Mitigation Site Name	Mitigation Opportunity	Site-Specific Potential Projects	Figure
Wetland, Stream, and Buffer Mitigation				
Fee-in-Lieu of Buffer Mitigation				
Japanese Gulch/Brewery Creek Sub-basins				
MHR 1	Japanese Gulch North Parcels (Privately owned)	▪ Buffer Preservation (wetland and stream) ▪ Wetland Preservation	▪ Preservation of headwater wetlands, riparian buffer, and upland forest. ▪ Limited enhancement opportunities include invasive weed removal from buffers.	Figure 17 in Section 8.2
MHR 2	Japanese Gulch/Brewery Creek South Parcels (Privately owned)	▪ Buffer Preservation (wetland and stream) ▪ Wetland Preservation ▪ Stream Enhancement ▪ Wetland Enhancement	▪ Preservation of headwater wetlands, riparian buffer, and forest upland. ▪ Limited enhancement opportunities include invasive weed removal from buffers. ▪ Removal of garbage from Japanese Gulch Creek. ▪ Remove garbage from Wetland 2.	Figure 18 in Section 8.3
MHR3	Big Gulch Open Space	▪ Buffer Preservation	▪ Preservation of wetland, stream, and marine shoreline forested buffer.	Figure 19 in Section 8.4



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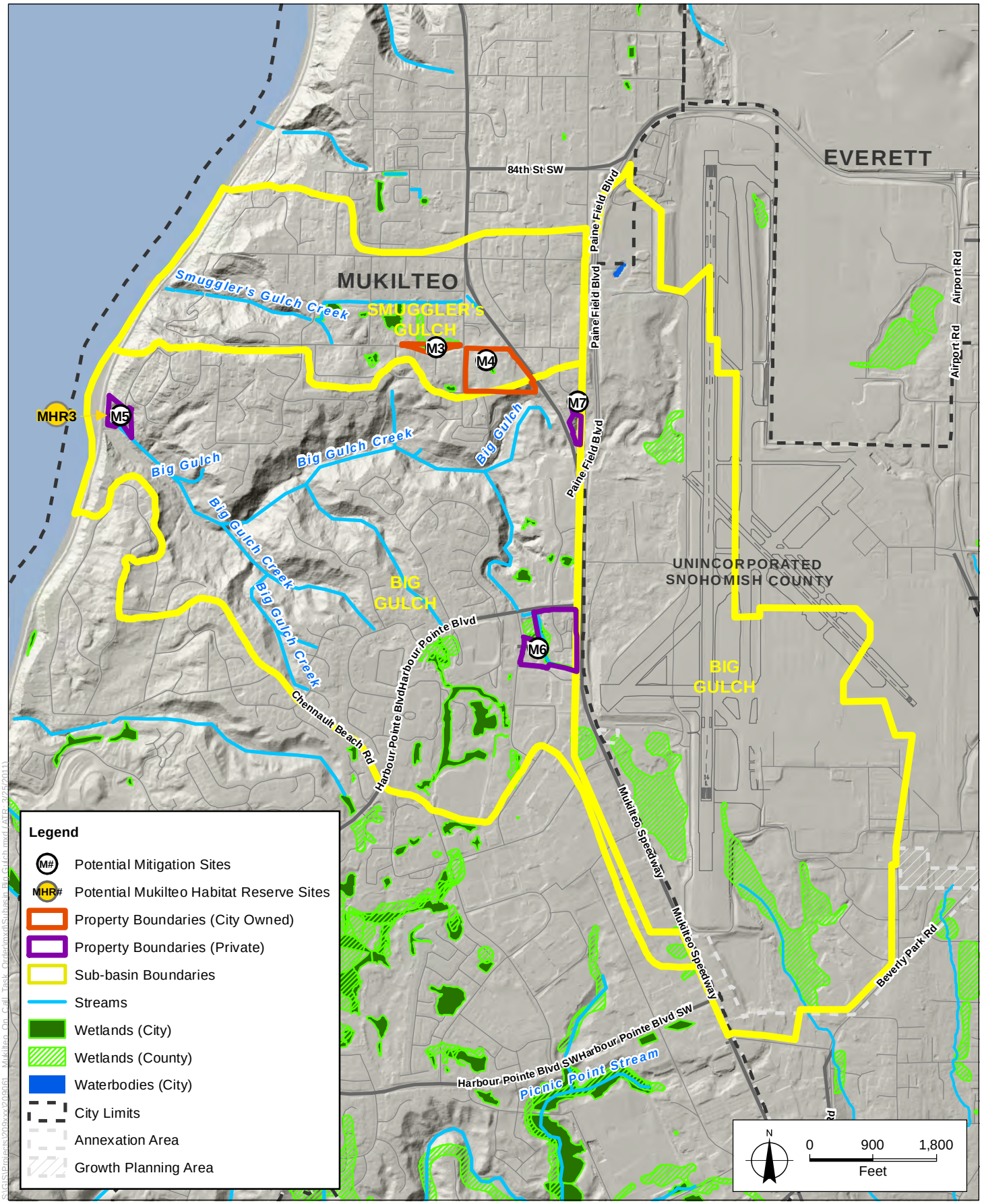
SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 4

Japanese Gulch and Brewery Creek Sub-basins
Mukilteo, Washington

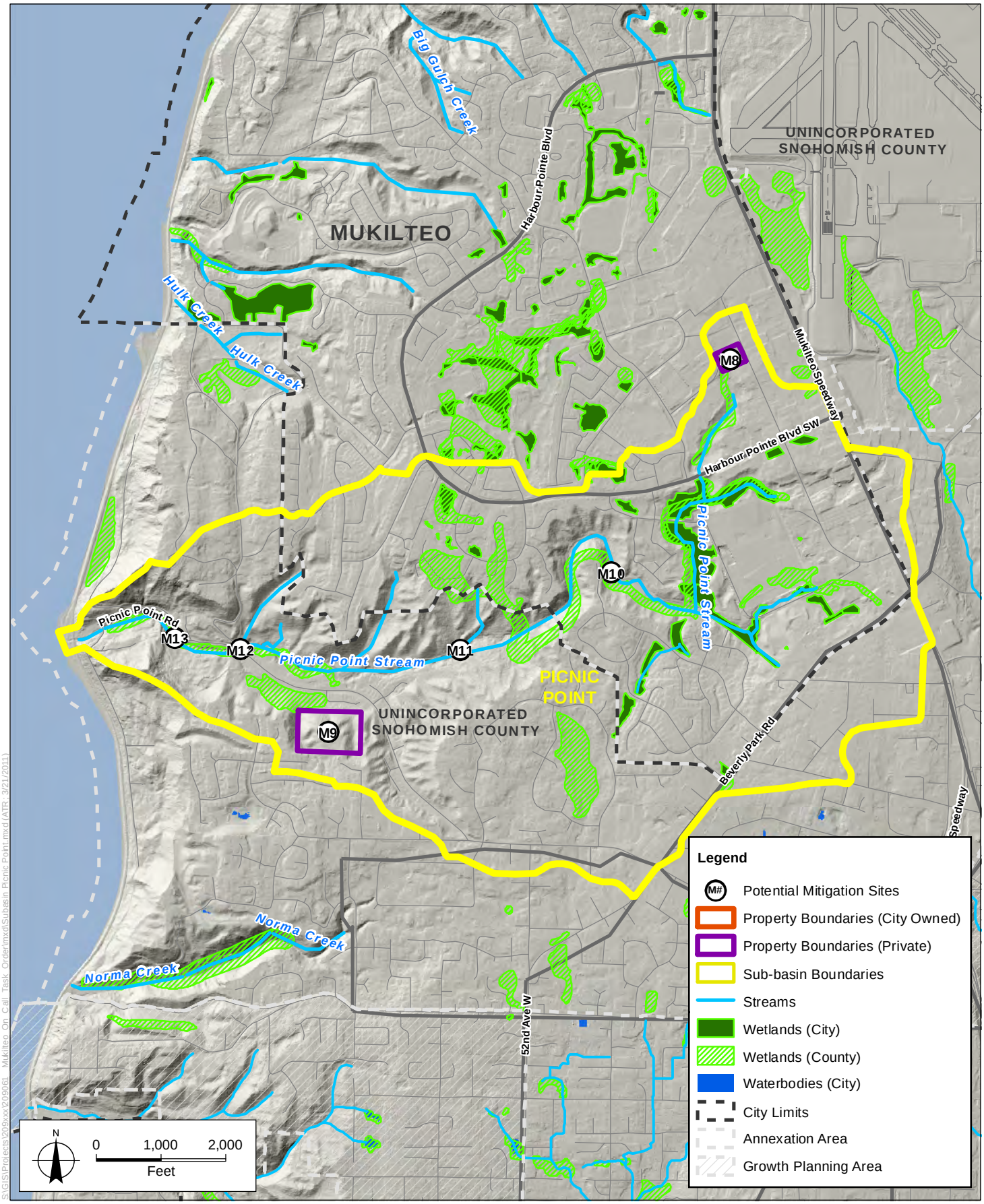


SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 5

Big Gulch and Smuggler's Gulch Sub-basins
Mukilteo, Washington



S:\GIS\Projects\209xxx\209061_Mukilteo_On_Call_Task_Order\mxd\Subasin Picnic Point.mxd (ATR: 3/21/2011)

SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 6

Picnic Point Sub-basin

Mukilteo, Washington

5.3 Off-Site Wetland or Stream Mitigation at Applicant-Identified Site

If appropriate mitigation for the proposed wetland or stream impacts is not identified on any of the City's pre-selected sites, other sites within the City of Mukilteo may be identified by the applicant, if reviewed and approved by the City. Buffer impacts must be mitigated either on-site or through use of the MHR (Section 8). Methods for identification of other mitigation sites must follow a watershed-based approach such as those in *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby et al. 2009). Selection of alternative sites not included in the City pre-approved list must be approved in advance of mitigation design by the City, Ecology, WDFW, and the Corps.

Off-site wetland mitigation requires the approval of one or all of the following agencies: the City of Mukilteo, Ecology, and the Corps. On-site stream mitigation requires the approval of the City, WDFW, and often the Corps and Ecology. If off-site mitigation opportunities are not present or determined to be not feasible or sustainable, use of a mitigation bank may be considered (Section 5.4). Off-site mitigation may not be feasible or sustainable because of a number of factors including, but not limited to, insufficient hydrologic support, untreated or undetained stormwater inputs, disturbed soils, inappropriate landscape position, off-site invasive weed input, insufficient habitat connectivity, adjacent land uses, and other factors. See Section 5.5 for mitigation plan requirements.

5.4 Off-Site Mitigation Bank

If an appropriate alternative mitigation site is not identified, mitigation through the purchase of credits from a certified mitigation bank may be considered (MMC 17.52B.130.C). There are currently no wetland mitigation banks that include the entire City of Mukilteo in their service areas. A small portion of the north end of the City within WRIA 7 is included on the Snohomish Basin Bank and Skykomish Habitat Bank service area maps. Only impacts that occur within this small area of the city could potentially be mitigated by using credits in these two banks. The Narbeck Mitigation Bank, located east of Mukilteo in Snohomish County, is approved for mitigation related to Paine Field airport activities only. Approval for use of a state and federally certified mitigation bank to fulfill mitigation requirements will be reviewed on a case-by-case basis and will only be allowed if the Planning Director determines that an appropriate mitigation site within the city limits or UGA is not available.

5.5 Mitigation Plan Requirements

For off-site wetland or stream mitigation at either a City pre-selected site or an applicant-identified site, a qualified wetland specialist shall prepare a preliminary and final mitigation plan using best available science (MMC 17.52B.140). Plans for off-site mitigation must include a complete description and assessment of existing conditions on the site, assessment of proposed impacts, plans and detailed drawings of the proposed mitigation activities, hydrologic studies if wetland creation is proposed, plans for a minimum of 5 years of monitoring and maintenance, and performance standards and other details as described in MMC 17.52B.130. Plans for off-site mitigation must also describe why on-site mitigation is not feasible or sustainable.

6.0 REGULATORY REVIEW AND PERMIT APPROVAL

The tasks described in previous sections are the responsibility of the applicant and should be discussed with City staff during a pre-application meeting. Following City approval of the development alternatives analysis, critical areas impact assessment, and conceptual mitigation plan, a full mitigation plan must be developed. The plan must be sufficient to meet the requirements of the MMC as well as the appropriate state and federal agencies.

The cost of proposed mitigation actions, both on-site and off-site, must be calculated by the applicant as a basis for determining the required performance bond and surety bond (MMC 17.52B.150.B). The costs for performing restoration activities can vary widely depending on the necessity for clearing and grading, the amount of vegetation removal or replanting, and the incorporation of habitat features such as snags, large woody debris, etc. Cost estimates should reflect true-cost accounting, including costs associated with construction, post-construction near-term and long-term maintenance, contingencies, and land acquisition. Table 5 provides a partial list of common mitigation elements and actions that need to be considered to calculate costs of a mitigation project.

Table 5. Restoration Elements to Consider for Cost Estimating

Stage of Project	Restoration Elements
Preliminary Planning	Site Identification Purchase of Property or Easement
Mitigation Design	Site Surveys Wetland/Stream Delineation Hydrologic Studies Geomorphic Studies Grading and Planting Plans
Permitting	Agency Coordination Permit Submittals
Mitigation Site Preparation	Clearing and Grading Invasive Weed Removal Export of Soil or other Materials from Site Import of Topsoil, Soil Amendments, Mulch to Site
Mitigation Installation (Material Purchase and Installation)	Native Plants Large Woody Debris Snags Fencing and Signage
Site Maintenance and Monitoring	Irrigation Weed Control Plant Replacement Monitoring Site Visits and Reporting (5 to 10 years)

The mitigation plan and cost estimate must be submitted with the land use permit application for review by the City, and to state and federal agencies with the Joint Aquatic Resource Permit Application (JARPA). Once the mitigation plan is deemed acceptable for all required City, state, and federal permits, the City will approve the mitigation plan as a condition of the land use permit. The City will calculate the appropriate amount for the performance bond (equal to 150% of the total estimated mitigation costs) and the surety bond (15% of total mitigation costs).

Following receipt of the land use permit, the applicant will be responsible for establishing performance and surety bonds and the construction, maintenance, and monitoring of the wetland or stream mitigation site. Monitoring reports shall follow the recommendations contained in the Department of Ecology's publication *Wetland Mitigation in Washington State - Part 2:* Developing Mitigation Plans (Ecology 2006) and in MCC 17.52B.150. Buffer mitigation that is satisfied through use of the Mukilteo Habitat Reserve will become the responsibility of the City.

7.0 PRE-SELECTED WETLAND AND STREAM MITIGATION SITES

This section describes the procedure for the use of sites pre-selected by the City for off-site wetland and stream mitigation. Section 8 describes the procedures for use of the MHR for fee-in-lieu of buffer mitigation.

The 13 sites described in this section were identified following a watershed approach. Methods and data from the site identification process are in Appendix A. Site assessments were conducted at 40 locations throughout Japanese Gulch, Big Gulch, and Picnic Point sub-basins. Observations were made on identified restoration needs of the watershed/sub-basin, ecological importance (landscape position, connectivity, hydrology, soils, weeds), constraints on hydrologic and habitat functions, ownership, adjacent land use, degree of disturbance, ongoing stressors, and other factors. Sites were eliminated from consideration during initial analysis based on a high degree of disturbance, disconnection from sustainable habitat, potential risk of increasing problems with slope stability or flooding, and other factors. Figure 3 shows the locations of the sites (M1-M13) which the City has pre-selected for wetland and stream mitigation.

Mitigation concepts have been developed and approved by the City for nine of the sites (M1 – M9) described in this section. Conceptual plans were developed for four of the sites (M10 - M13) by Snohomish County as part of its Drainage Needs Report in 2006. Using the mitigation concepts provided, the applicant retains a qualified wetland specialist to prepare a mitigation plan meeting the requirements of Section 5.5.

Many of the identified mitigation concepts could be constructed in phases, providing opportunities to satisfy mitigation needs for different projects in different years. Some of the phasing opportunities are shown in concept on site drawings (such as Figure 8). Alternative phasing plans can be added as approved by the City. A ledger will be kept by the City Planning Department to track the phasing of mitigation projects, the monitoring efforts, and the completion of mitigation. The ledger will be updated with all mitigation sites added to the program and any additional mitigation projects identified. The ledger will be posted to the CAMP website.

The following sections of this chapter describe conceptual mitigation projects at each of the pre-selected sites.

7.1 Japanese Gulch M1: Lower Japanese Gulch Creek and Estuary

Site Type:	Wetland and Stream Enhancement and Restoration
Sub-basin:	Japanese Gulch Creek
Stream:	Coho and chum fish bearing with blockages
Wetland:	PFO, PSS, PAB
Ownership	Private parcels on shoreline, City parcels contain wetland

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub; PAB: palustrine aquatic bed

7.1.1 Site Description

This mitigation site is located on six public and privately owned parcels (00461400003200, 29043300400400, 29043300401100, 29043300401000, 00567000000200, 00567000000300) totaling 6.17 acres. The private parcels are part of the former U.S. Air Force Tank Farm and adjacent tidelands. The public parcels are owned by the City of Mukilteo and are managed as open space park.

Stream

Japanese Gulch Creek is located on parcels off-site to the west of the potential mitigation site. This stream is several feet wide and is a perennial stream (Type 3) that is used by coho and chum. The stream bed is composed of small to medium cobbles. The banks of this stream are abrupt and approximately two feet tall. The stream runs from south to north and travels through culverts under Mukilteo Lane and the railroad tracks. North of the BNSF railroad grade, the stream runs through a series of pipes and ditches before emptying to Puget Sound. Culvert replacement projects in 2010 reestablished fish access to the portion of the stream south of the railroad tracks and north of 5th Street. Further stream improvements are planned for 2011 in the reach between the spur railroad and 5th Street. The creek flows through a vertical pipe at 5th Street, which prevents upstream fish migration.

Freshwater Wetland

The wetland that covers the southern parcels at this site is a complex, palustrine forested system with various hydroperiods. The wetland contains open water, shrub areas and an emergent area; however, these areas individually cover only a small portion of the wetland and therefore did not warrant multiple wetland habitat types according to Cowardin et al. (1979). This wetland has

slope, depressional, and riverine hydrogeomorphic (HGM) components. Dominant tree species are western red cedar and red alder. Dominant shrub understory species include salmonberry, stink currant, willow, and red elderberry. Herbaceous understory species include skunk cabbage, water parsley, pig-a-back plant, lady fern, giant horsetail, slough sedge, creeping buttercup, stinging nettle, and reed canarygrass.

The wetland has several small streams running through it that form a series of braided channels. Water leaves the wetland through a small channel and drains into a portion of Japanese Creek close to the culvert beneath Mukilteo Lane. A shallow berm along a portion of the east bank of Japanese Creek appears to prevent interaction between the streamflow and the wetland.

Shoreline and Beach

This site is a sand and gravel accretion beach that is protected from wave action by the old U.S. Air Force pier. Prior to industrial and military development at this site, the beach was one of the most productive clam beds in the region, and people continue to harvest shellfish in this area despite potential contamination from stormwater. The shoreline is riprapped along the entire length of the old Tank Farm. Japanese Gulch Creek, which is a Type 3 stream, flows out onto the beach through a culvert under the Tank Farm and the BNSF railroad. Coho and chum salmon have been known to enter the stream during fall runs.

The subtidal area along the western edge of the U.S. Air Force pier is heavily used by Dungeness crab. Eelgrass is present on the easternmost portion of the Tank Farm along the subtidal shelf and in patches in the lower intertidal portion. Several large-scale redevelopment projects are planned to replace the Mukilteo Tank Farm. These include a Mukilteo multi-modal transportation center that includes the relocated ferry terminal and a new Sound Transit commuter rail facility. A rail-barge transfer facility was added on the east side of the Tank Farm in the City of Everett. Other mixed-use development and park uses with waterfront access are also planned.

7.1.2 Potential Mitigation Projects

Figure 7 shows opportunities for potential mitigation projects:

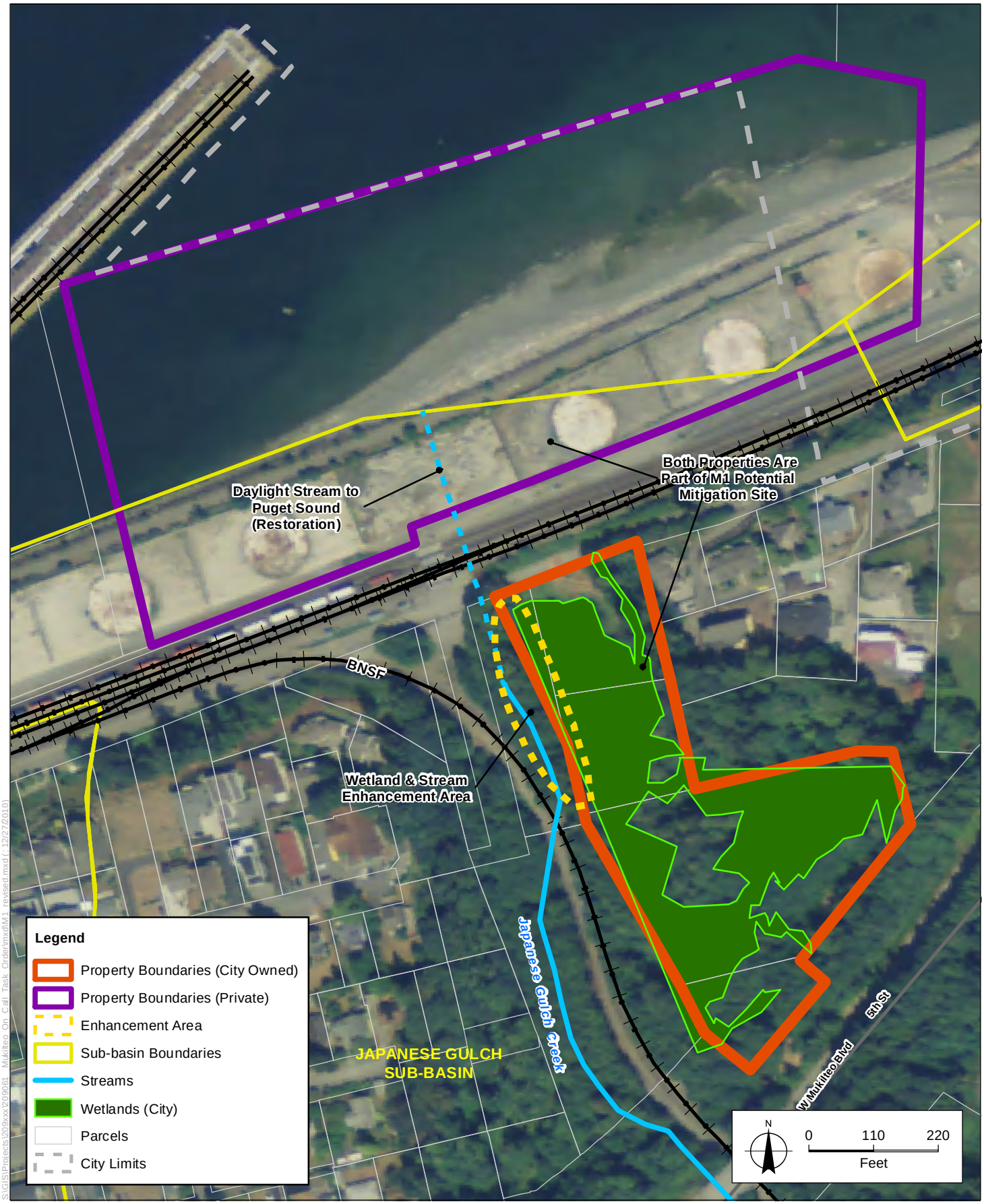
- Daylight Japanese Gulch Creek where it flows under the Tank Farm. The City is open to discussing a reduction in the riparian buffer as an incentive to daylighting.
    - Functions improved: In-stream habitat improvements, enhance fish access to upper reaches of stream, enhance general nearshore habitat.
    - Constraints and maintenance considerations: Depending on width of riparian corridor created, regular maintenance to clear debris that might cause upstream flooding may be necessary.
- Replace existing culvert with box culvert beneath BNSF railroad.
    - Functions improved: Fish access to upper reaches of stream.

  - Maintenance considerations: Regular maintenance to prevent debris from clogging culvert.

- Improve connection between Japanese Gulch Creek and the forested and aquatic bed wetland near the mouth of the stream by removing portions of a small berm along the east side of creek.

  - Functions improved: Fish access to off-channel habitat during high flow events, transfer of energy and biotic material between stream and wetland habitats.

  - Maintenance considerations: Annual monitoring to ensure excessive flooding or erosion does not occur in wetland.



SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

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Figure 7

Off-Site Mitigation: Conceptual Mitigation Opportunities (M1)
Mukilteo, Washington

7.2 Japanese Gulch M2: Japanese Gulch/Brewery Creek Headwater Wetlands

Site Type:	Wetland Creation/ Reestablishment, Buffer Restoration, Stream and Wetland Enhancement
Sub-basin:	Japanese Gulch/Brewery Creek
Stream:	No stream on-site
Wetland:	PFO, PSS
Ownership	City of Mukilteo

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub

7.2.1 Site Description

The property consists of several parcels owned by the City of Mukilteo that total approximately 7.45 acres (00628500000001, 00631400000001, 00491200000101, 28041000201400). The property is currently (2010) located in the southwest portion of the City of Everett, adjacent to the Mukilteo city limits. The City of Mukilteo and the City of Everett are discussing plans for the annexation of the area including these parcels into the City of Mukilteo. The central and northern portions of the property were once used as a cemetery and contain a paved road that extends west to east across the property. Most of the central portion of the property is covered by herbaceous vegetation and scattered shrubs. The southern quarter of the site is covered by mixed deciduous-coniferous forest. Mature second-growth forest borders the property to the north, east, and south with multiple trails observed in the area. Residential development is located to the west of the site. The property generally slopes down to the east toward Japanese Gulch and a BNSF spur railway located approximately 0.10 mile east of the property. Two wetlands occur near the south end of the site and both extend onto adjacent properties.

Wetland 2

Wetland 2 is a palustrine open water/forested wetland less than 0.5 acre in size, located in a depression in the northeast portion of the property. The majority of the wetland is located off of the property, with approximately 0.01 acre of wetland located on the property. The wetland generally occurs within an oblong depression and hydrology is likely supplied by a combination of direct precipitation and groundwater. Dominant vegetation in the wetland includes red alder

and salmonberry. Garbage including car tires were observed partially submerged in the ponded portion of the wetland.

Wetland 3

Wetland 3 is a palustrine forested wetland, greater than an acre in size, located in a shallow depression in the southeast portion of the property. A large portion of the wetland is located off of the property; approximately 0.14 acre is located on the property. Wetland hydrology is supported by direct precipitation and groundwater. Portions of the wetland contained evidence of ponding (e.g., surface water or water-stained leaves). Dominant plants include red alder, salmonberry, reed canarygrass, and Douglas spirea.

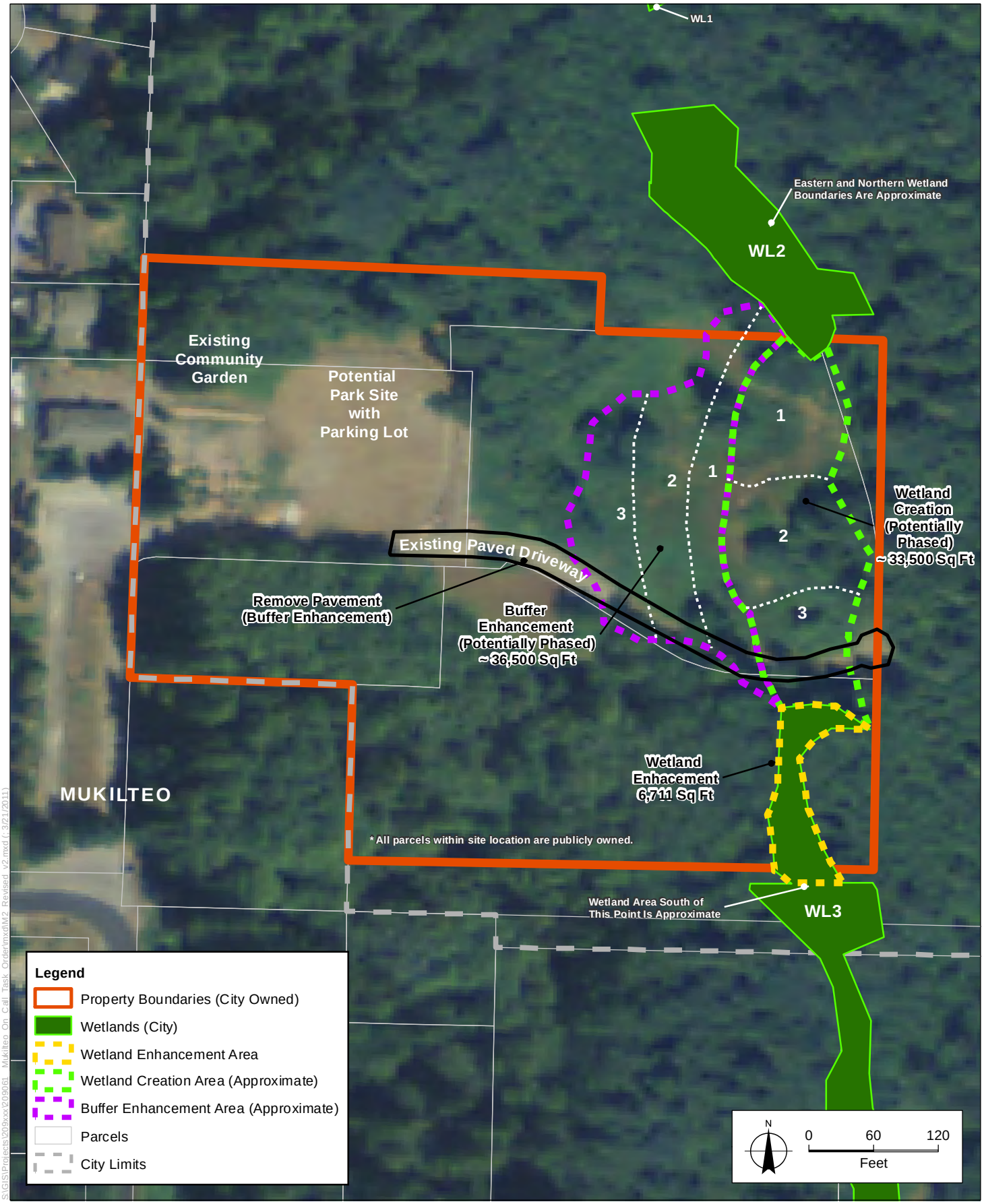
Uplands

Forest in the upland portion of the property is generally dominated by red alder, salmonberry, sword fern, and trailing blackberry. Other species present include Douglas fir and English holly. Much of the herbaceous portion of the property is dominated by reed canarygrass, Himalayan blackberry, and trailing blackberry.

7.2.2 Potential Mitigation Projects

Figure 8 shows the opportunities for potential mitigation projects on the site:

- Creation/reestablishment of headwater wetland: Approximately 33,500 square feet in disturbed area between Wetlands 2 and 3. Based on the groundwater levels in adjacent wetlands, relatively minor grading is expected to intercept shallow groundwater. No significant invasive weed problem. Phased wetland creation areas are suggested on figure.
- Wetland enhancement: Approximately 6,700 square feet, planting conifers.
- Buffer enhancement: Approximately 36,200 square feet; planting native trees, shrubs, ferns. Buffer enhancement would be required for wetland creation projects. Phased planting areas are suggested on figure.
- Buffer/upland enhancement: Less than 1acre, removing invasive and other non-native plants.
- Remove paved roadway: Approximately 13,000 square feet.



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SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 8

Off-Site Mitigation: Conceptual Mitigation Opportunities (M2)
Mukilteo, Washington

7.3 Smuggler's Gulch M3: 92nd Street Easement Wetland and Buffer

Site Type:	Wetland Creation and Buffer Enhancement
Sub-basin:	Smuggler's Gulch
Stream:	Type 5
Wetland:	PFO, PSS
Ownership	City of Mukilteo

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub

7.3.1 Site Description

This property is located in a right-of-way easement within the southeastern portion of Smuggler's Gulch sub-basin (Figure 9). The easement is located along 92nd Street Southwest between 49th and 52nd Avenue West. The property is a City-owned easement immediately adjacent to privately owned residential development to the north and south. The parcel contains a permanently ponded, forested headwater wetland which remains connected to off-site wetlands and undeveloped, forested areas to the northwest toward Smuggler's Gulch Creek. This wetland is mapped by both Snohomish County and the City of Mukilteo.

On-site Wetland

This wetland is a depressional, palustrine forested/scrub-shrub wetland less than 0.5 acre in size located within a topographic low point immediately north of 50th Place West. The wetland occurs within an oblong depression surrounded by roads and residential development. Hydrology is likely supplied by a combination of direct precipitation, groundwater, and surface runoff from surrounding roadways. Dominant vegetation includes black cottonwood (*Populus balsamifera*), red alder, willow (*Salix* sp.), and salmonberry.

Uplands

An approximately 20- to 30-foot-wide upland buffer exists within the easement between the edge of the wetland and 92nd Street. This area is primarily vegetated by mowed lawn and ornamental street trees; however, a narrow band of undisturbed salmonberry and Himalayan blackberry exists along the wetland edge.

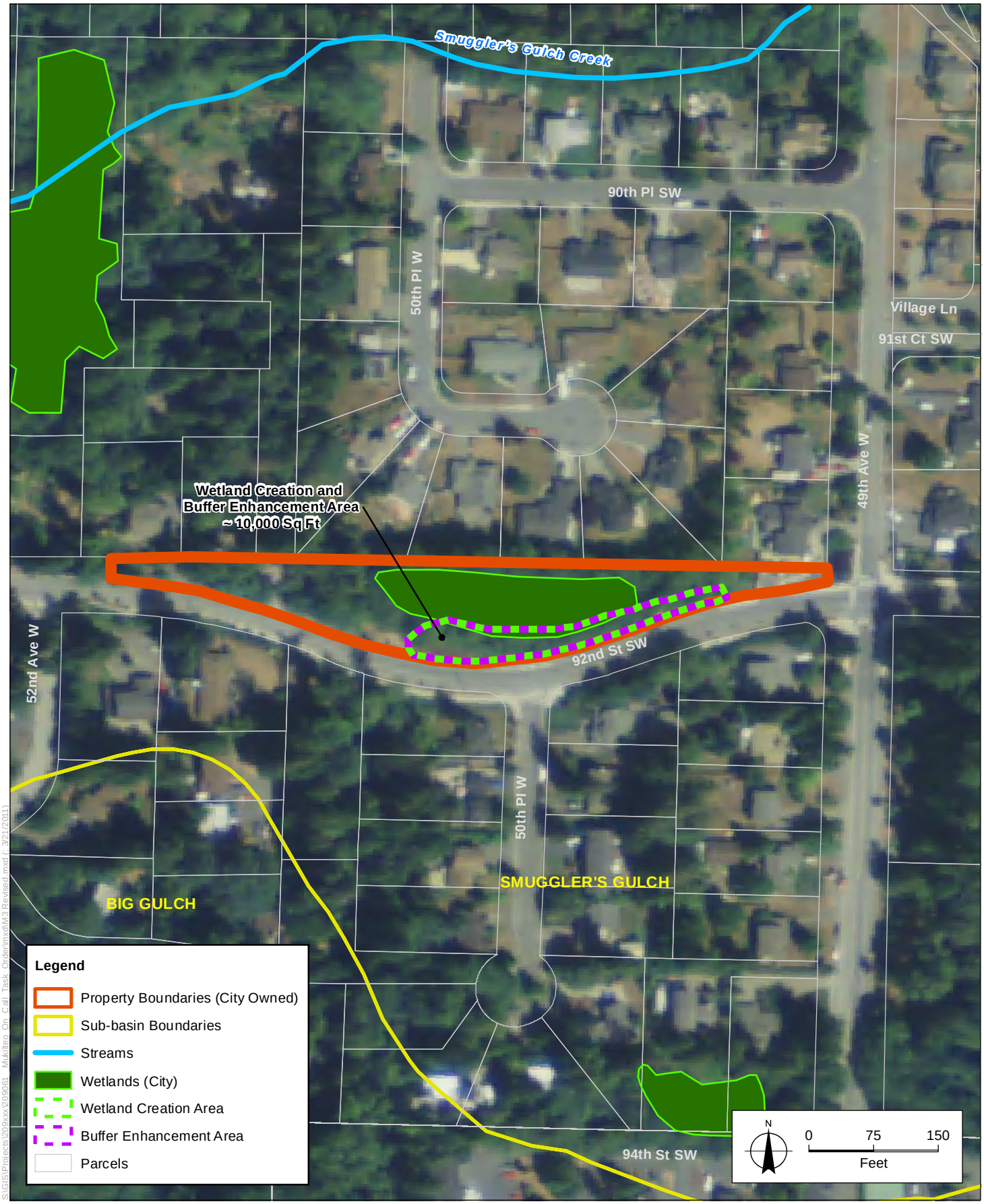
7.3.2 Potential Projects

Figure 9 highlights one area of approximately 10,000 square feet of potential mitigation opportunity at the 92nd Street easement site. Mitigation opportunities at this site include:

- Wetland creation
- Wetland buffer enhancement
- Wetland creation and buffer enhancement
- Bioswale treatment structure

Although this wetland does not provide much opportunity for wildlife habitat improvements due to small size and location along the roadway, it does have some opportunity for improvements to water quality and hydrologic support. These functions are particularly important in the Smuggler's Gulch sub-basin, where localized flooding and stream incision are ongoing problems. Wetland area could be created within the mowed buffer portion of the easement along the south side of the wetland. This alternative would increase stormwater storage capacity, potentially improving hydrologic and water quality function; however, this alternative further reduces the remaining wetland buffer along the south side. Buffer enhancement is another potential alternative at this site. This alternatives involves the removal of invasive, non-native vegetation including Himalayan blackberry, Scot's broom, tansy ragwort, and English ivy and planting of native trees and shrubs within the easement buffer area. A combination of wetland creation and buffer enhancement could also be feasible at this site.

Another potential project might involve the installation of a bioswale structure along the south easement buffer both west and east of 50th Place West. The bioswale would treat road runoff before it enters the wetland. This site appears to have sufficient space and significant drainage opportunity and should be explored for its mitigation potential.



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SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 9

Off-Site Mitigation: Conceptual Mitigation Opportunities (M3)
Mukilteo, Washington

7.4 Smuggler's Gulch M4: 92nd Street Park Wetlands and Buffer

Site Type:	Wetland Creation, Buffer Enhancement
Sub-basin	Smuggler's Gulch
Stream	Type 5
Wetland	PFO, PSS, PEM, PAB
Ownership	City of Mukilteo

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub; PAB: palustrine aquatic bed; PEM: palustrine emergent

7.4.1 Site Description

The property, 92nd Street Park, consists of three parcels owned by the City of Mukilteo (00611600012400, 00611600012300, 00611600011900). The west end of the park is undeveloped and contains mature coniferous forest with passive use trails. The more developed east side of the park contains a parking lot, an informational kiosk, public restrooms, lawn and a mix of paved and graveled recreational trails. The North Fork Big Gulch Creek ravine is located immediately south of the park. The site generally slopes east to west and two wetlands were previously identified and delineated on the east side of the park.

Wetland A

Wetland A is a 0.44-acre palustrine forested wetland located in the northeast portion of the property at the top of the North Fork Big Gulch Creek ravine. The wetland exhibits predominantly depressional hydrogeomorphic characteristics, with some slope characteristics along the north and east sides. Although this wetland is situated at the boundary of the Big Gulch sub-basin, it drains to the west and is a headwater to Smuggler's Gulch Creek. Wetland A generally occurs within an oblong depression and hydrology is likely supplied by a combination of direct precipitation and groundwater. Dominant vegetation in the wetland includes red alder and western red cedar.

Wetland B

Wetland B is a 321-square-foot, palustrine, emergent wetland located approximately 50 feet west of Wetland A. The wetland is located in a shallow swale on a slope. Wetland B is a slope wetland hydrologically connected to Wetland A by a drainage flowing through an open grassy

portion of the park. Dominant vegetation consists of regularly mowed lawn, creeping buttercup, and small patches of dandelion and English plantain.

Other On-site Wetlands

A permanently ponded, palustrine open-water/emergent wetland is located on the west side of the developed portion of the park. This wetland is hydrologically connected to Wetlands A and B.

Uplands

The west side of the park consists of second-growth coniferous forest dominated by Douglas fir and western hemlock. The understory is fairly open with scattered red huckleberry, salal, and sword fern. Other upland areas within the park are dominated by a mix of primarily deciduous species including red alder, salmonberry, thimbleberry, Himalayan blackberry, and trailing blackberry.

7.4.2 Potential Mitigation Projects

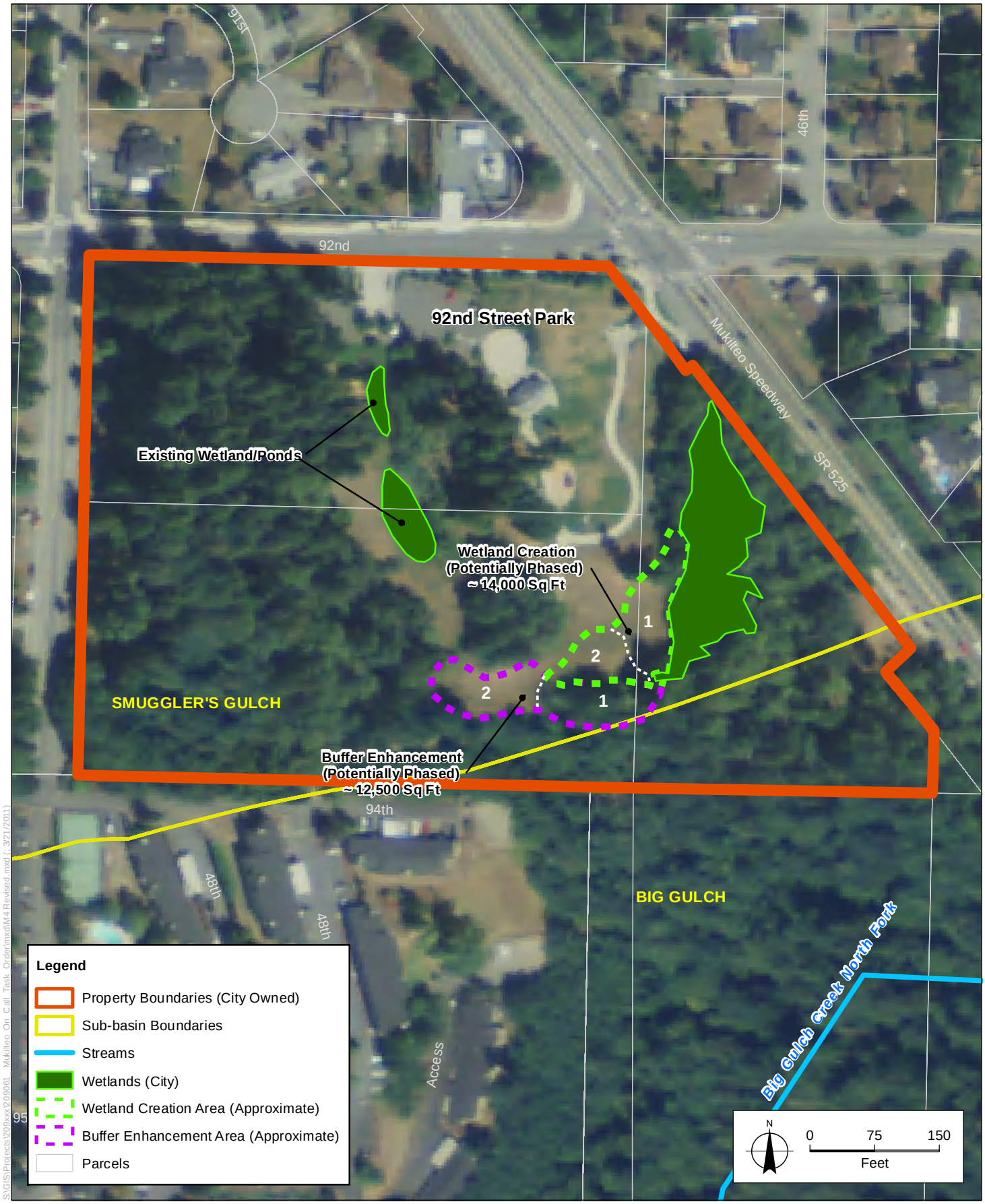
Figure 10 identifies two areas of potential opportunity for mitigation, including wetland creation and wetland buffer enhancement.

Approximately 14,000 square feet of potential wetland creation/wetland enhancement and approximately 12,600 square feet of buffer enhancement/upland habitat connection area are available within the 92nd Street Park site. These two potential mitigation areas are immediately adjacent to each other but not overlapping. The wetland creation area abuts the existing west boundary of Wetland A and encompasses the area of Wetland B.

The wetland creation/wetland enhancement alternative could involve the widening of the Wetland B drainage swale. This would involve excavating down to as much as six inches below the surface, applying organic content to the soil such as compost, and planting with native trees and herbaceous emergent plants. Shrubs may be undesirable due to visibility issues associated with the park's use. Creating additional forested wetland area surrounding Wetland B could increase the hydrologic and water quality functions at this site by slowing surface sheet flow and groundwater runoff, and allowing wetland vegetation to hold and filter sediments and other pollutants. Habitat functions would also be enhanced by increased cover, forage, and migration corridors for birds, small mammals, and amphibians. In order to provide a reliable and sufficient source of hydrology to newly created wetland area, the berm associated with the west edge of Wetland A may need to be lowered or notched in a few locations.

Buffer enhancement/upland habitat connectivity would involve the removal of invasive, non-native vegetation including Himalayan blackberry, Scot's broom, English holly, cherry laurel, and English ivy, and planting of native trees and shrubs within upland areas containing both relatively undisturbed vegetation and mowed lawn. This action would enhance hydrologic and water quality functions within the park by reducing overland sheet flow velocities into wetlands during storms. Native plantings would provide year-round cover and nesting opportunities for birds, small mammals, insects, and amphibians. Species recommended for planting include

Douglas fir, grand fir, western red cedar, bitter cherry, cascara, Indian plum, thimbleberry, black gooseberry, oceanspray, and sword fern.



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SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 10

Off-Site Mitigation: Conceptual Mitigation Opportunities (M4)
Mukilteo, Washington

7.5 Big Gulch M5: Stream Restoration and Pocket Estuary Creation

Site Type:	Wetland Creation and Estuary/Nearshore Restoration	
Sub-basin	Big Gulch Creek	
Stream	Type 3: Coho and chum fish bearing	
Wetland	<1/4 acre: PSS	
Ownership	Private	

Notes: wetland class: PSS: palustrine scrub-shrub

7.5.1 Site Description

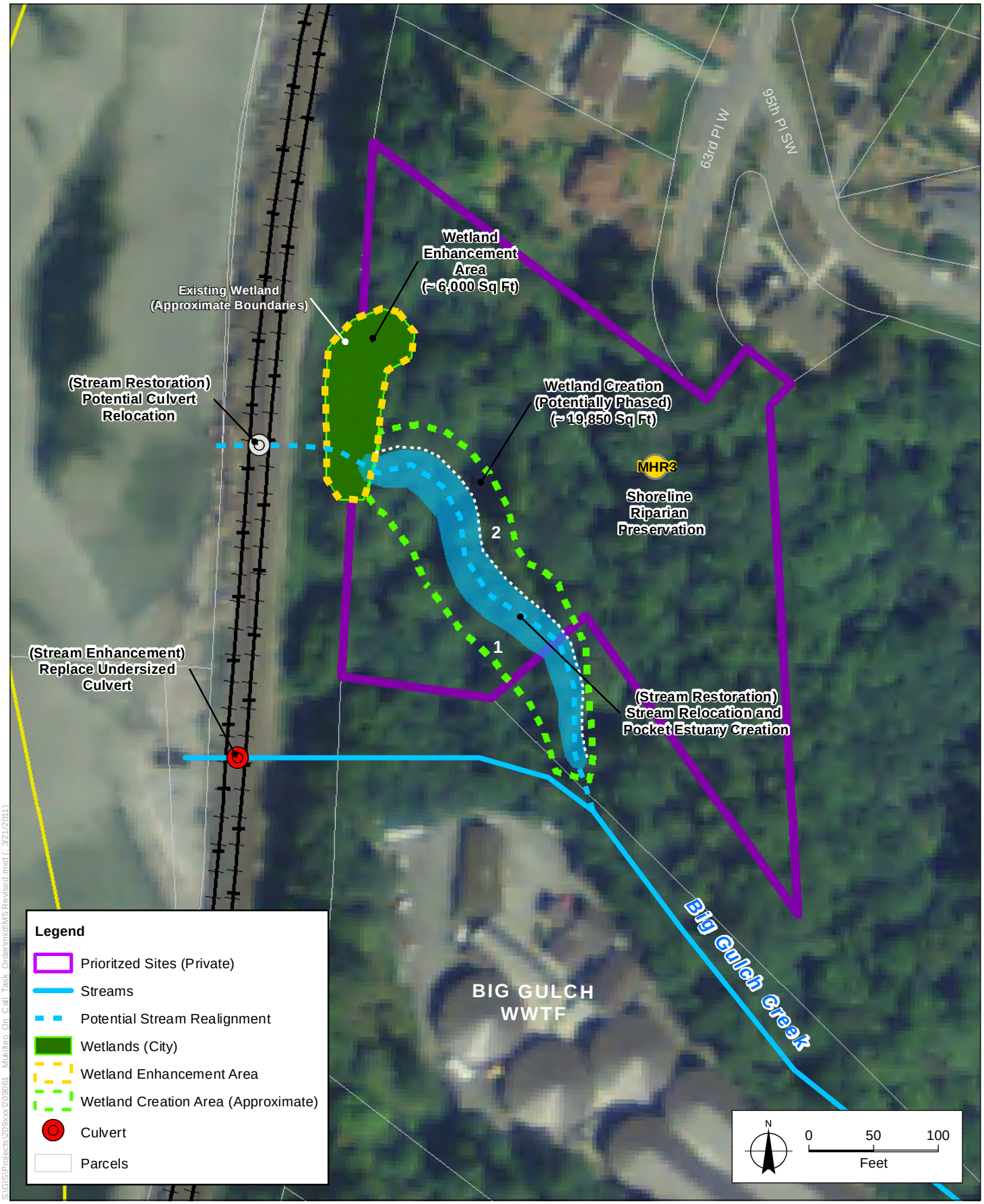
This site consists of a 2.2-acre privately owned parcel (28041700400300) at the mouth of Big Gulch Creek. The reach of Big Gulch Creek running through this site is in poor condition. The channel is confined by the sewage treatment plant roadway and a steep hillside to the north. The stream channel is incised two to three feet and has very little woody debris or other habitat features. The existing culvert beneath the BNSF railroad is not sufficient to handle high flows, and the creek often floods the treatment plant roadway in the winter.

An area of approximately 0.75 acre north of the creek appears to be a remnant floodplain that likely received flows before the stream was channelized and the railroad was constructed. This area is currently covered by shrubs and small trees. A small (approximately 6,000 square feet) wetland is located on the north end of the site and is not connected to the creek. No significant invasive weed problem was observed.

7.5.2 Potential Mitigation Projects

Figure 11 shows the approximate location of opportunities for potential mitigation projects, including the following:

- Realign Big Gulch Creek: Approximately 200 linear feet of stream restoration.
- Create wetland area along realigned stream: Approximately 19,850 square feet of created wetland, plant with native vegetation.
- Replace existing culvert with box culvert beneath BNSF railroad to allow for tidal exchange with created wetland area.
- A feasibility study and preliminary restoration plans were developed for this site in 2009 and are included in Appendix B.



SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 11

Off-Site Mitigation: Conceptual Mitigation Opportunities (M5)
Mukilteo, Washington

7.6 Big Gulch M6: Stream Buffer Restoration

Site Type:	Wetland and Buffer Enhancement
Sub-basin	Big Gulch Creek
Stream	Big Gulch Creek (Type 4)
Wetland	PFO
Ownership	Private

Notes: wetland class: PFO: palustrine forested

7.6.1 Site Description

This site is located within a privately owned 12.15-acre parcel (28042100104200). Big Gulch Creek flows south to north through this potential project site. The reach of the stream on this property is approximately 10 feet wide and has a gravel and cobble substrate. A forested wetland is located on the north end of the site along both sides of the stream and provides shade to most parts of the stream. The wetland is dominated by deciduous trees (primarily red alder) and the understory is dominated by salmonberry. A portion of the riparian buffer area on the southwest side has relatively few trees and the understory is dominated by Himalayan blackberry.

7.6.2 Potential Mitigation Projects

Figure 12 shows the approximate location of opportunities for potential mitigation projects including the following:

- Stream buffer enhancement: Approximately 10,000 square feet. Remove existing invasive weeds (mostly Himalayan blackberry) and replant with native trees and shrubs. Install fencing and Native Growth Protection Area (NGPA) signs to protect the buffer area.

- Wetland enhancement: Approximately 14,000 square feet. Underplant existing deciduous forest with conifers (western red cedar and Sitka spruce).

SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 12

Off-Site Mitigation: Conceptual Mitigation Opportunities (M6)
Mukilteo, Washington

7.7 North Fork Big Gulch Creek M7: Wetland Creation/Stormwater Detention/Water Quality Improvements

Site Type:	Riparian Restoration/ Wetland Creation
Sub-basin	Big Gulch
Stream	Type 3 (no documented fish use)
Wetland	None identified on-site
Ownership	Private Parcel and State Road Right-of-Way

7.7.1 Site Description

This site consists of a 1.23-acre private parcel (00753800000800) and a portion of the state right-of-way for SR 526. The site is a bowl-shaped depression between SR 526 and SR 525. The North Fork of Big Gulch Creek flows east to west across the site. Vegetation is primarily forest with smaller areas of shrub and grass cover. Both native and non-native plants are common on the site. The site is separated from other habitats in the area (Big Gulch) by major roadways.

Because this site lacks direct connectivity with other habitat areas and has disturbed soils and invasive weeds, it does not have significant potential for sustainably restoring habitat functions. The site does provide opportunity to improve hydrologic and water quality functions in the downstream portions of Big Gulch Creek. The North Fork of Big Gulch Creek has had significant downcutting problems in recent years. The landscape position and concave shape of this site provide opportunity for stormwater control to benefit Big Gulch Creek.

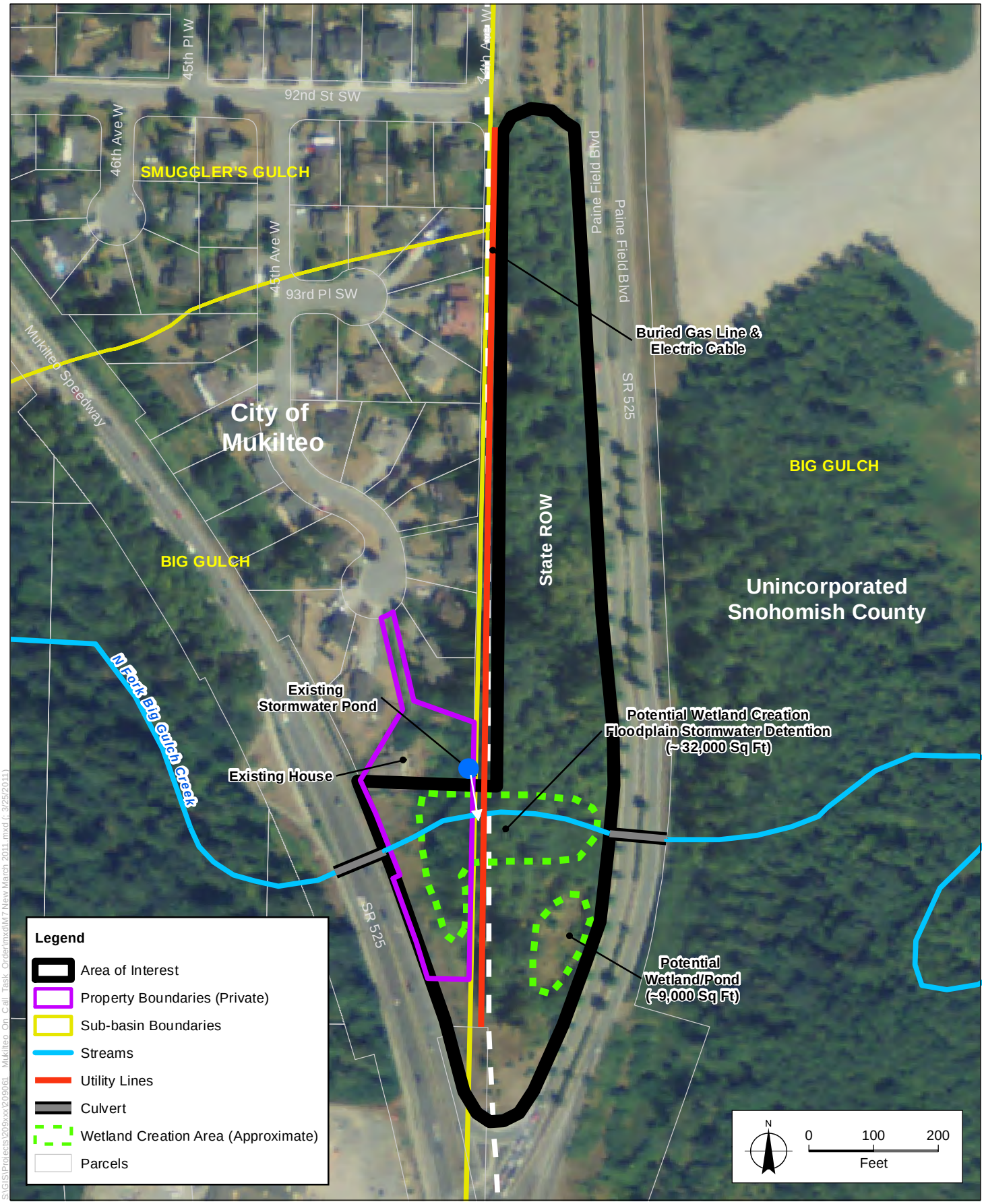
7.7.2 Potential Mitigation Projects

Figure 13 shows the approximate location and area for the following potential mitigation project:

- Wetland creation along the existing stream to provide stormwater detention and ease downcutting problems in the North Fork Big Gulch Creek.

- Water quality improvements through the creation of emergent plant communities on the wetlands created adjacent to the stream.

- Water quality improvement through diversion of road runoff and creation of wet pond upslope of stream.



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SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 13

Off-Site Mitigation: Conceptual Mitigation Opportunities (M7)
Mukilteo, Washington

7.8 Picnic Point M8: Cyrus Road Wetlands and Buffer

Site Type:	Wetland and Riparian Preservation, Wetland Creation, Wetland Enhancement, Buffer Enhancement
Sub-basin	Picnic Point Creek
Stream	Type 5; headwater tributary to Picnic Point Creek
Wetland	< 1 acre: PFO headwater
Ownership	Private

Notes: wetland class: PFO: palustrine forested

7.8.1 Site Description

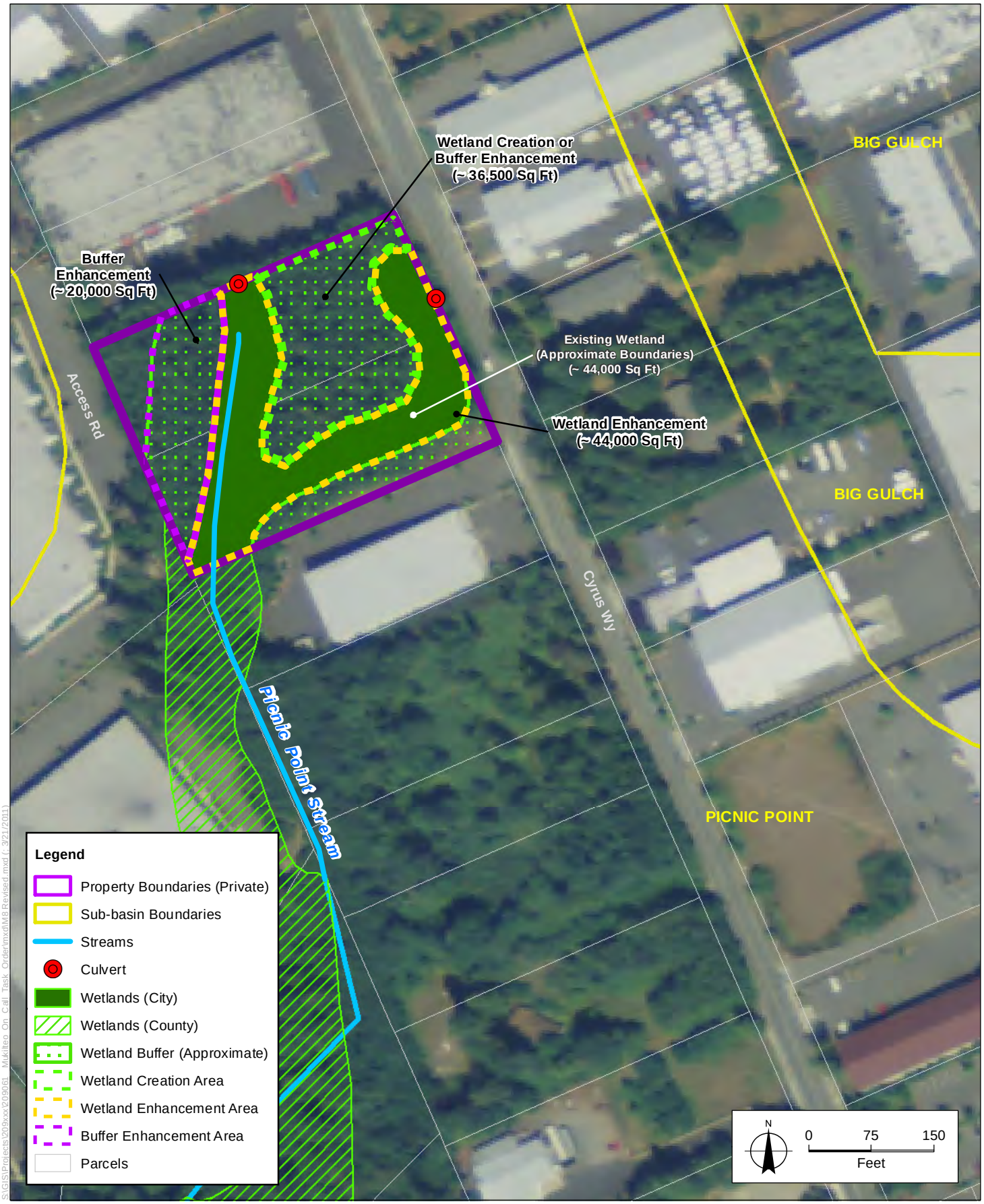
The site consists of two parcels (00441400003302, 00441400003301) totaling 2.7 acres. The site is covered by a relatively young deciduous forest consisting of primarily black cottonwood and red alder trees. A dense understory shrub layer consists of salmonberry, willow and Himalayan blackberry. Slough sedge is the most common herbaceous plant on the site. Based on the information provided in a report submitted to the City by the property owner in 2008, a Category II wetland and a Type 5 stream are located on the site. The report describes the regulated buffers for the site as being 100 feet for the wetland and 50 feet for the stream. Based on the 2008 site assessment, the entire site is encumbered by wetland, stream, or buffer, with the exception of a small area (approximately 5,000 square feet) in the northwest corner. Several other undeveloped parcels to the south may offer similar mitigation opportunities, but critical areas information for those lots was not available.

7.8.2 Potential Projects

Figure 14 shows the approximate location and area for the following potential mitigation projects:

- Wetland and buffer preservation: Approximately 80,000 square feet. Purchase conservation easement on property to prohibit future development.

- Planting of conifers throughout wetland, riparian corridor and buffer: Approximately 80,000 square feet.
- Excavate to create approximately 30,000 square feet of wetland.
- Wetland enhancement through removal of invasive plant species.



SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 14

Off-Site Mitigation: Conceptual Mitigation Opportunities (M8)
Mukilteo, Washington

7.9 Picnic Point M9: Forested Upland and Stream Corridor

Site Type:	Buffer Enhancement and Habitat Connectivity
Sub-basin	Picnic Point Creek
Stream	Seasonal
Wetland	Survey not completed
Ownership	Private

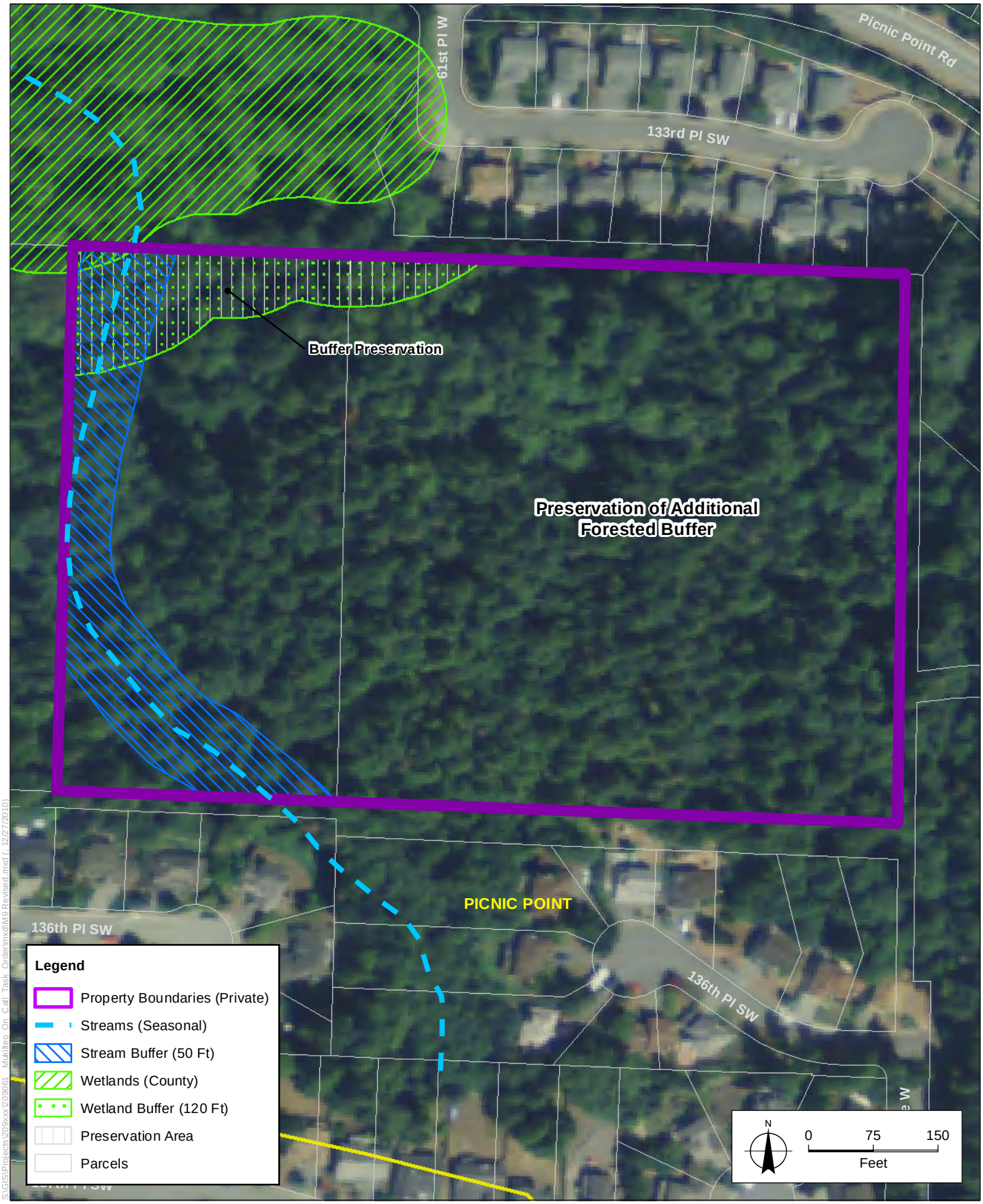
7.9.1 Site Description

This site consists of two privately owned parcels (00473300002701, 00473300002800) at a total of 14.42 acres. The sloping site is entirely forested with no development or roads. A seasonal stream runs north to south along the west side of the site and flows into a large depressional wetland off-site to the north. The forest consists of relatively mature second-growth conifers and provides a large area of wildlife habitat adjacent to the large forested wetland off-site to the north. It is possible that seep wetlands occur on the site; however, site access was not available to confirm wetland presence. Because this undisturbed forested area is located directly upslope of the wetland, it provides a high level of water quality and hydrologic support to the wetland and Picnic Point Creek.

7.9.2 Potential Mitigation Projects

Figure 15 shows the approximate location of opportunities for potential mitigation projects including the following:

- Preservation of high-quality stream and wetland buffer.
- Upland forest preservation as additional buffer for the large wetland located downslope to the north.



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SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 15

Off-Site Mitigation: Conceptual Mitigation Opportunities (M9)
Mukilteo, Washington

7.10 Picnic Point M10: Picnic Point Creek – Stream Restoration

Site Type:	Fish Passage Barrier Removal	*Photo not available*
Sub-basin	Picnic Point Creek	
Stream	Type III (Snohomish County) with coho and chum	
Wetland	Survey not completed	
Ownership	City of Mukilteo	

7.10.1 Site Description

This City of Mukilteo site is located within the Picnic Point Creek sub-basin at the convergence of a tributary with Picnic Point Creek. The Picnic Point Creek watershed drains the southern portion of the City of Mukilteo and an adjacent area of unincorporated Snohomish County. Much of this basin's headwater wetlands and upland forests have been converted to residential neighborhoods and high-intensity industry, resulting in seasonal flood issues. This project involves stabilizing eroding trail crossings and reducing streambank erosion. This site is identified in the Snohomish County Drainage Needs Report as an opportunity for stream restoration and fish passage barrier removal (CIP number PS-PP-32). Summary sheets from the Snohomish County report, including location map and cost estimates, are provided in Appendix C.

7.10.2 Potential Mitigation Projects

The sketch map in Appendix C shows the approximate location and area for the following potential mitigation projects:

- Culvert replacement to allow fish access to approximately 1 mile of suitable habitat.

This project involves stream restoration in two locations, one to the east and one to the west of 49th Avenue West. Three damaged 24-inch trail crossing culverts are allowing sediment delivery into the creek. The project would either remove or replace these culverts and stabilize the adjacent streambanks to eliminate a source of excessive sediments to Picnic Point Creek.

7.11 Picnic Point M11: Picnic Point Creek – Stream Restoration

Site Type:	Fish Passage Barrier Removal	*Photo not available*
Sub-basin	Picnic Point Creek	
Stream	Type III (Snohomish County) with coho and chum	
Wetland	Survey not completed	
Ownership	Snohomish County	

7.11.1 Site Description

This unincorporated Snohomish County site is located within the Picnic Point Creek sub-basin at the convergence of a tributary with Picnic Point Creek. The Picnic Point Creek watershed drains the southern portion of the City of Mukilteo and an adjacent area of unincorporated Snohomish County. Much of this basin's headwater wetlands and upland forests have been converted to residential neighborhoods and high-intensity industry, resulting in seasonal flood issues. This site is identified in the Snohomish County Drainage Needs Report as an opportunity for stream restoration and streambank stabilization (CIP number PS-PP-31). Summary sheets from the Snohomish County report, including location map and cost estimates, are provided in Appendix C.

7.11.2 Potential Mitigation Projects

The sketch map in Appendix C shows the approximate location and area for the following conceptual mitigation project:

- Stabilize eroding road crossing.

Erosion and sedimentation is occurring within the creek due to failure of a logging road culvert crossing. Fifty to sixty cubic yards of road fill are at risk of erosion in the near future, which would result in downstream water quality issues. The project involves the proper decommissioning of an historic logging road, removal of the existing culvert and road fill, followed by stabilization of the creek banks.

7.12 Picnic Point M12: Picnic Point Creek – Stream Restoration

Site Type:	Fish Passage Barrier Removal and Streambank Stabilization
Sub-basin	Picnic Point Creek
Stream	Type III (Snohomish County) with coho and chum
Wetland	Survey not completed
Ownership	Public road right-of-way

7.12.1 Site Description

This unincorporated Snohomish County site is located within the lower Picnic Point Creek sub-basin where Picnic Point Road crosses Picnic Point Creek. The Picnic Point Creek watershed drains the southern portion of the City of Mukilteo and an adjacent area of unincorporated Snohomish County. Much of this basin's headwater wetlands and upland forests have been converted to residential neighborhoods and high-intensity industry, with impervious surfaces associated with structures, parking lots, and roads resulting in seasonal downstream flood issues. An undersized culvert at the Picnic Point Road crossing presents a fish passage barrier and has contributed to flooding and erosion problems immediately upstream. This site is identified in the Snohomish County Drainage Needs Report as an opportunity for stream restoration and fish passage barrier removal (CIP number PS-PP-26). Summary sheets from the Snohomish County report, including location map and cost estimates, are provided in Appendix C.

7.12.2 Potential Mitigation Projects

The sketch map in Appendix C shows the approximate location and area for the following potential mitigation project:

- Culvert replacement to allow fish access to approximately 1 mile of suitable habitat.

This project is related to a series of stream improvement projects within the Picnic Point Creek sub-basin designed to improve access to in-stream fish habitat for chum and coho salmon. In addition, culvert replacement projects help restore natural streamflows and reduce erosion.

7.13 Picnic Point M13: Picnic Point Creek – Stream Restoration

Site Type:	Fish Passage Barrier Removal and Streambank Stabilization
Sub-basin	Picnic Point Creek
Stream	Type III (Snohomish County) with coho and chum
Wetland	Survey not completed
Ownership	Snohomish County

7.13.1 Site Description

This unincorporated Snohomish County site is located within the lower Picnic Point Creek sub-basin downstream of CAMP site M12. The Picnic Point Creek watershed drains the southern portion of the City of Mukilteo and an adjacent area of unincorporated Snohomish County. Much of this basin's headwater wetlands and upland forests have been converted to residential neighborhoods and high-intensity industry, resulting in seasonal flood issues. This project involves rock weir reconstruction and 800 feet of stream channel improvements for fish habitat and passage. This site is identified in the Snohomish County Drainage Needs Report as an opportunity for stream restoration and fish passage barrier removal. The CIP number assigned in the report is PS-PP-27. Summary sheets from the Snohomish County report, including location map and cost estimates, are in Appendix C.

7.13.2 Potential Mitigation Projects

The sketch map in Appendix C shows the approximate location and area for the following opportunities for potential mitigation projects:

- Rebuild rock weirs to include bioengineering components and withstand 50-year flow events. The design will conform to Washington Department of Fish and Wildlife standards.

- Channel improvements to approximately 800 feet of stream for suitable fish habitat and passage.

8.0 BUFFER MITIGATION SITES (FEE-IN-LIEU): MUKILTEO HABITAT RESERVE

Three of the mitigation sites shown on Figure 3 have been approved by the City for inclusion in the Mukilteo Habitat Reserve (MHR). Detailed descriptions and site maps are included in Sections 8.2 through 8.4. Off-site buffer mitigation specified for the sites (MHR1, MHR2, and MHR3) will not require mitigation plans with the level of detail that is required for on-site or other off-site locations. Mitigation plans submitted for use in the MHR will include a description of the project site, alternatives analysis describing impact avoidance and minimization, buffer impact assessment, and mitigation requirement (area of buffer replacement required by MMC).

If the City approves the use of the MHR for required buffer mitigation, a fee will be calculated based on the rates specified in Section 8.1.3.2. Payment of the required fee to the City will be in-lieu of buffer mitigation and will satisfy the applicant's buffer mitigation requirement. The responsibility for the buffer mitigation will be transferred to the City and applied to the preservation element of this program.

8.1 MHR Program Details

8.1.1 Objectives

The City's objectives for the Mukilteo Habitat Reserve (MHR) are to:

- Provide off-site mitigation for unavoidable wetland buffer and stream buffer impacts by preserving high-quality wetlands, streams, and buffer habitat in perpetuity;
- Preserve existing highly functioning wetlands and buffers which provide Mukilteo with a variety of valuable functions including: water quality improvement, in-stream flow support, moderation of stream water temperature, large areas of wildlife habitat with connectivity to other habitat areas, support for nearshore fish habitat, and passive recreation opportunities;
- Streamline the regulatory requirement process for compensatory buffer mitigation and reduce potential conflicts between conservation and development objectives;
- Provide off-site mitigation for small unavoidable wetland impacts on a case-by-case basis if approved by the City, Ecology, and the Corps; and
- Provide a model for the future application and approval of a state and federally recognized fee-in-lieu program for wetland and stream impacts in Mukilteo.

8.1.2 Program Sponsor

The City of Mukilteo is the primary program sponsor, and may act in cooperation with a non-governmental entity (e.g., land conservancy). The program sponsors will identify, fund, operate, maintain, and manage mitigation projects, as described in this document. This fee-in-lieu type

program will be set up as an informal City-operated program that is not initially a state-certified in-lieu fee mitigation bank.

8.1.3 Administration

8.1.3.1 Types of Fees

Under this program, impacts to wetland buffers and stream buffers are treated the same. Both will use the same rate structure to determine the fees that are assessed. Likewise, the fees collected may be applied to the preservation of either wetland or stream buffers at the mitigation sites.

8.1.3.2 Fee Structure

The mitigation fees that are the basis for the program account will be calculated using a rate based upon: (1) the estimated cost that an applicant would incur to procure or purchase easements on a mitigation receiving site, (2) the estimated cost of enhancement, maintenance, and management of the receiving site, and (3) costs associated with program administration. The rate used to calculate the fee in-lieu of buffer mitigation is $5.35 per square foot (Table 6). This rate may be adjusted by the MHR Review Team as associated costs vary over time. The MHR Review Team (Finance Director, Planning Director, and others as assigned) will be assigned by the City Council during review and approval of the Mukilteo Critical Areas Mitigation Program. The minimum fee for use of the MHR site is $100, which is required to cover the costs related to program administration and site management.

Calculating the required buffer mitigation area is discussed in Section 4.1. The buffer area calculation includes: (1) the area (square footage) of buffer that the applicants proposes to impact, and (2) the vegetation structure of the buffer impact area (which reflects the habitat function and value).

The elements considered for calculating the mitigation fee structure under the Mukilteo MHR are shown in Table 6. The MHR fee structure is based on the procurement and preservation of specific sites that are currently providing quality habitat buffers, are proposed for preservation, and require little enhancement. As such, the price is based largely on the purchase of land or conservation easements. In some cases, the program sponsors may negotiate a transfer of development rights from the mitigation site to another parcel. A detailed account of fee pricing methodology will be provided for each fee collected.

Table 6. Buffer Mitigation Fee-Based on Estimated Costs

Restoration Element	Cost per Square Foot	Notes
Purchase of land or conservation easement	$1.25	Cost based roughly on the Snohomish County 2010 assessed market value of MHR1 and 2 parcels
Native Plant Installation	$3*	Small-scale planting in areas where weeds are removed (Purchase, Installation, & Establishment)
Site Maintenance	$1	Includes invasive weed removal and control, garbage removal, signage
Program Administration	$0.1	Assumed 10% of fee is administration
Total	**$5.35****	**Rate used to calculate fee-in-lieu of buffer mitigation**

*Based on cost estimates made in 2010 for an actual buffer planting project in the City of Mukilteo.

**The rate is also based on discussions with City of Mount Vernon staff regarding costs to administer a similar buffer mitigation program. The rate used to calculate fee-in-lieu of buffer mitigation may be adjusted by the MHR Review Team as associated costs vary over time.

8.1.3.3 Program Account

The MHR program account is within an established, interest-bearing Mukilteo fund created solely for the use of the MHR. This fund is managed through the City bank of record, which is a member of the FDIC. The MHR program fund is auditable by the State of Washington and is used exclusively for this program. All interests and earnings accruing to the program account remain in the account for use by the MHR program strictly for the purposes of providing compensatory mitigation. The account funds are used for site selection, background data collection, design, permitting, construction, maintenance, monitoring, long-term management, program administration, and land acquisition.

The fees collected through the MHR program are sufficient to establish mitigation projects and to provide for maintenance and monitoring in the future, if necessary. Funds accepted from permittees are tracked separately from those accepted from other entities and for other purposes.

8.1.3.4 Disbursement of Funds from the Program Account

Funds collected under the MHR program shall only be used for preserving or replacing wetland and stream buffer functions, and not to finance non-mitigation programs and priorities (e.g., education projects, research). However, these funds may be used for mitigation project planning, permitting and administration, or for any other direct costs associated with implementation and maintenance of the MHR as described above.

Funds will be released from the program account on project basis and will be applied toward the purchase of individual parcels within the MHR, or the purchase of conservation easements on those parcels. As complete parcels are secured either through purchase or easements, any remaining balance of funds will be made available for long-term maintenance of the MHR site.

The Mukilteo Municipal Code provides regulations for the administration of the program account (MMC 17.52.025 and 17.52B.100).

8.1.3.5 Ledger

The City of Mukilteo will maintain an MHR program ledger to account for all transactions. The ledger will be used to track fees that are collected as well as funds that are released as mitigation projects (preservation) are implemented. The ledger will also track expenditures for all aspects of implementing mitigation projects (e.g., administrative costs, maintenance, and monitoring, etc.) The ledger will be reviewed on an annual basis by the MHR Review Team (Finance Director, Planning Director, and others as assigned). Review Team members will be assigned by the City Council during review and approval of the Mukilteo Critical Areas Mitigation Program.

In the case of a negative ledger balance, the sponsor will be obligated to offset the loss through other mitigation projects, or utilize contingency funds and adaptive management measures. On balance, the MHR program aspires to allocate funds towards a "neutral" program account, neither progressing significantly into the black or red on the ledger. At a minimum, however, the City will maintain a fund balance to permit ongoing monitoring, maintenance, and long-term stewardship activities, as well as to implement any necessary contingency measures. No money shall be removed from the program account for any use other than the MHR program.

8.1.3.6 Credit Fulfillment Schedule

The City, in consultation with the Review Team, shall submit an annual report to the public (posted on CAMP web site) which shall include, but not be limited to:

- Total program account fees and expenditures;
- Review of mitigation fee and, in the case of a significant positive or negative ledger balance, justification for modifying the fee amount;
- Detail of property rights or easements that have been secured;
- Summary of any enhancement or maintenance projects on the MHR site; and
- Amount and type of land that has been preserved.

8.1.4 Mitigation Receiving Sites

Three sites have been identified and approved by the City for use in this program. Two of the sites are located at the southwest end of Japanese Gulch ravine (Figure 3). One site (MHR3) is located at the mouth of Big Gulch Creek and is also associated with wetland and stream mitigation opportunities described for site M5 (Section 7.5). Detailed descriptions of the sites and the opportunities for preservation and enhancement are provided in Sections 8.2 through 8.4.

8.1.4.1 Enrolling a Candidate Site in the Program

If the need arises to add sites to the MHR program, a watershed-based approach for site identification similar to the methods described in Appendix A will be followed. A detailed analysis of proposed sites would be conducted and reviewed by the Review Team, undergo public review through the SEPA process, and be presented to the City Council for approval.

Criteria for sites to be included in the MHR include:

- Functional connectivity,
- Location in existing critical area,
- Cost-effectiveness, and
- Sustainability.

8.1.5 Service Area

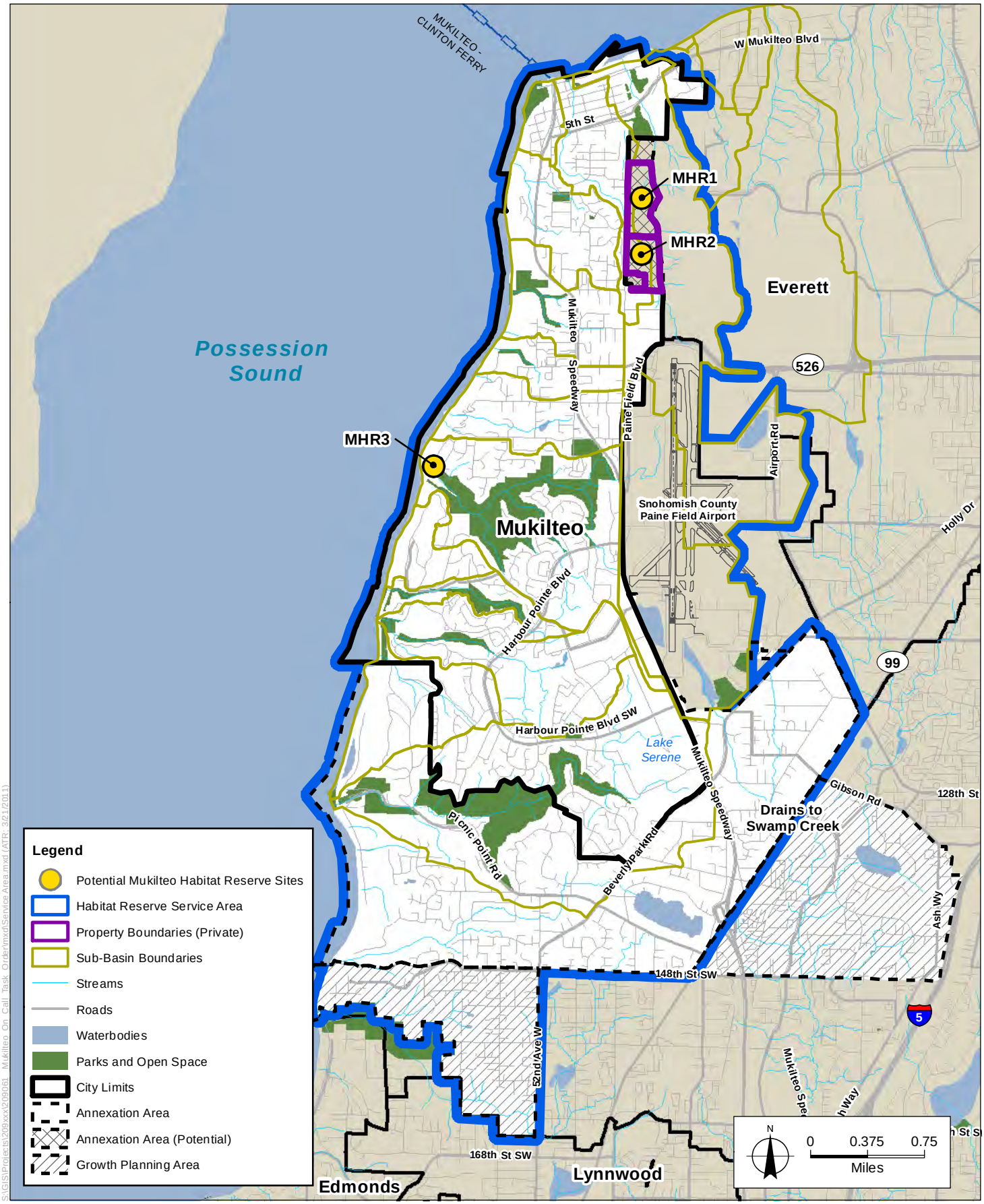
The service area for the MHR includes the area within the Mukilteo city limits and its Urban Growth Area (UGA), as they now exist or as they may be amended in the future, and including that portion of the City of Everett within the Japanese Gulch Drainage, and that portion of Snohomish County within the Japanese Gulch Drainage (Paine Field) (Figure 16). The service area for the MHR does not include that area of the City or UGA within the Swamp Creek drainage.

Multiple sub-basins are included within the MHR service area because the hydrologic and habitat functions provided within the sub-basins are similar, and they all contribute to the ecologic functions of the nearshore environment of Mukilteo. The headwaters of most of the streams in Mukilteo originate in a common area on the flat hilltop along the east side of the city. Most of the streams run west through forested ravines and empty directly to Puget Sound. The streams and forested ravines provide ecological support to the fish and wildlife habitat within the intertidal wetlands and riparian shoreline area. The relatively small size of the sub-basins, their close proximity to each other, and their common links at their headwaters and outlets, results in the sub-basins of Mukilteo functioning as a unit and not simply individual drainages. Because of this common functional link, the transfer of mitigation from one sub-basin to another within the city would meet the City's goal of no net loss in critical area and buffer function.

8.1.6 Conservation Easements

Following establishment of the receiving sites on City-owned properties, these areas would be protected from future development through conservation easements. Conservation easements would be a legal agreement between the City and a land trust or government agency that restricts development of forested sites containing wetlands, streams, and forested buffers. An easement can be written to prohibit the future development of the receiving site and prohibit the removal or cutting of native vegetation; while still allowing other minimal impact uses such as unpaved hiking trails. Easements are typically held in perpetuity and therefore offer future protection of the receiving area for the City's fee-in-lieu program.

The City, or other City-approved entity, would then become the steward for the conservation easement areas and provide long-term maintenance and monitoring. This concept is similar to the establishment of protective covenants as required for wetlands, streams, and their buffers during site development.



SOURCE: City of Mukilteo 2009; Snohomish County, 2008

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 16

Mukilteo Habitat Reserve Service Area Map
Mukilteo, Washington

8.2 Japanese Gulch MHR1: Buffer Mitigation Site

Site Type:	Buffer Preservation
Sub-basin	Japanese Gulch Creek
Stream	Japanese Gulch (Type 4) along east boundary
Wetland	PFO, PSS, PAB
Ownership	Private

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub; PAB: palustrine aquatic bed

8.2.1 Site Description

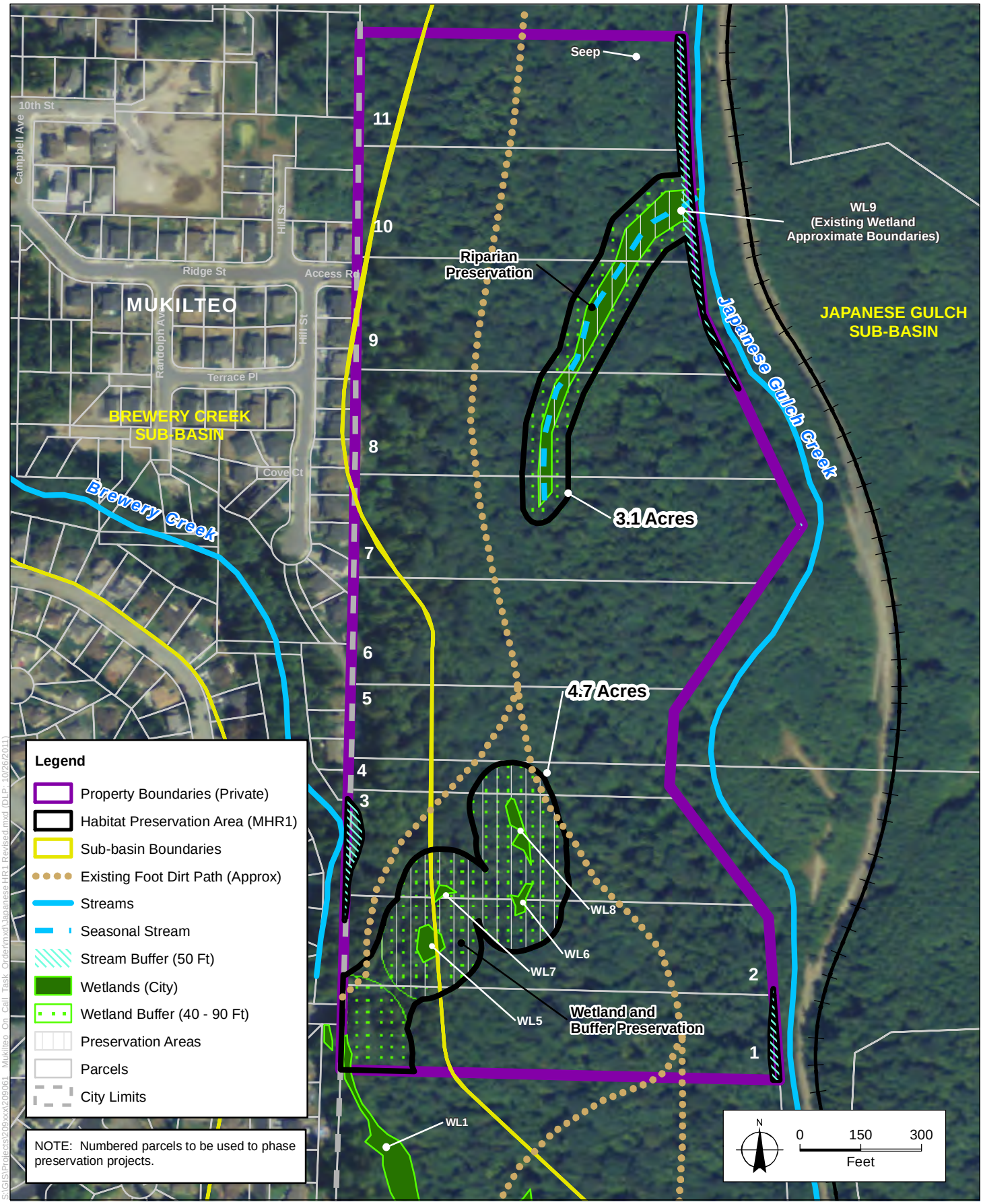
This 55.2-acre site is located on the southwest end of Japanese Gulch and consists of 11 parcels (280403000300100, 28040300300700, 28040300300800, 28040300300900, 28040300301000, 28040300301100, 28040300301200, 28041000201000, 28041000201100, 28041000201200, 28041000201300). The property is currently (2010) located in the southwest portion of the City of Everett, adjacent to the Mukilteo city limits. The City of Mukilteo is considering annexation of this area. The site is bounded to the west by residential lots, to the north by an undeveloped lot owned by the City of Mukilteo, to the south by an undeveloped forested lot (MHR2), and to the east by Japanese Gulch Creek and the BNSF spur railway.

The site is entirely covered by mature mixed coniferous/deciduous forest with a dense understory shrub layer. Several Category II wetlands are located on the flat western portion of the site. A small seasonal stream is located near the north end of the site and flows east into Japanese Gulch Creek. The wetlands, stream, and mature forested buffers together form a unique system that is one of the headwaters to Japanese Gulch Creek. The system provides a high level of function for water quality and hydrologic support to Japanese Gulch Creek, which supports coho and chum in the lower reaches. The system also provides a high level of wildlife habitat function.

8.2.2 Potential Mitigation Projects

Figure 17 shows the approximate location and area for the following potential mitigation project:

- Preservation of 7.8 acres of Category II wetlands and mature forested buffer.



S:\GIS\Projects\209xx\209061_Mukilteo_On_Call_Task_Order\mxd\Japanese HR1 Revised.mxd (DLP 10/26/2011)

SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 17

Mukilteo Habitat Reserve Site - North Parcels MHR1
Mukilteo, Washington

8.3 Japanese Gulch/Brewery Creek MHR2: Buffer Mitigation Site

Site Type:	Buffer Preservation
Sub-basin	Japanese Gulch/Brewery Creek
Stream	Japanese Gulch (Type 4) along east boundary
Wetland	PFO, PSS, PAB
Ownership	Private

Notes: wetland class: PFO: palustrine forested; PSS: palustrine scrub-shrub; PAB: palustrine aquatic bed

8.3.1 Site Description

This site is located directly south of the MHR1 site and is similar in structure and function. This site consists of a single 42.74-acre parcel (28041000200900). Like the MHR1 site, this property is currently (2010) located in the southwest portion of the City of Everett, adjacent to the Mukilteo city limits and is being considered for annexation into the City of Mukilteo. The site is bounded to the west by residential lots, to the north by an undeveloped forested lot (MHR2), to the south by an undeveloped lot owned by the City of Mukilteo (Mitigation Site B2), and to the east by Japanese Gulch Creek and the BNSF spur railway.

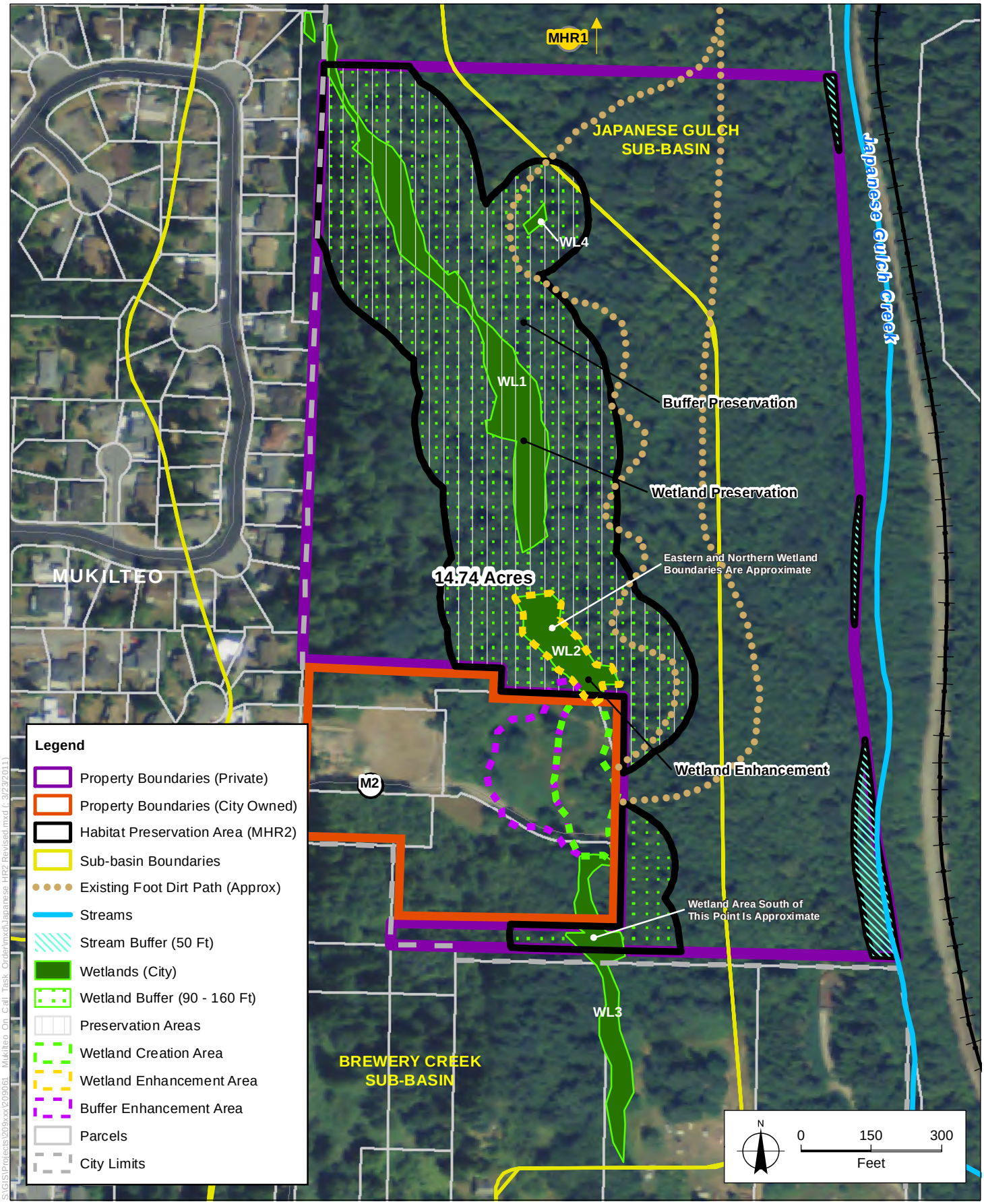
The site is entirely covered by mature mixed coniferous/deciduous forest with a dense understory shrub layer. A Category II wetland extends from near the south property boundary north to near the northwest corner of the property. Several other Category II wetlands also occur on the site. The wetlands, stream, and mature forested buffers together form a unique system that is the headwater to Brewery Creek. A portion of the site below the steep slopes is within the Japanese Gulch sub-basin, and seeps along the slope contribute to the headwaters to Japanese Gulch Creek. The system provides a high level of function for water quality and hydrologic support to Brewery Creek and Japanese Gulch Creek. The system also provides a high level of wildlife habitat function.

8.3.2 Potential Mitigation Projects

Figure 18 shows the approximate location and area for the following potential mitigation projects:

- Preservation of 14.7 acres of Category II wetlands and mature forested buffer.
- Enhancement of Wetland 2 by removing garbage from pond.

- Stream enhancement: Remove tires and other trash from Japanese Gulch Creek.



SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 18

Mukilteo Habitat Reserve Site - South Parcel MHR2

Mukilteo, Washington

8.4 Big Gulch MHR3: Buffer/Shoreline Riparian Mitigation Site

Site Type:	Buffer and Shoreline Riparian Preservation
Sub-basin	Big Gulch Creek
Stream	Type 3: Coho and chum fish bearing
Wetland	<1/4 acre: PSS
Ownership	Private

Notes: wetland class: PSS: palustrine scrub-shrub

8.4.1 Site Description

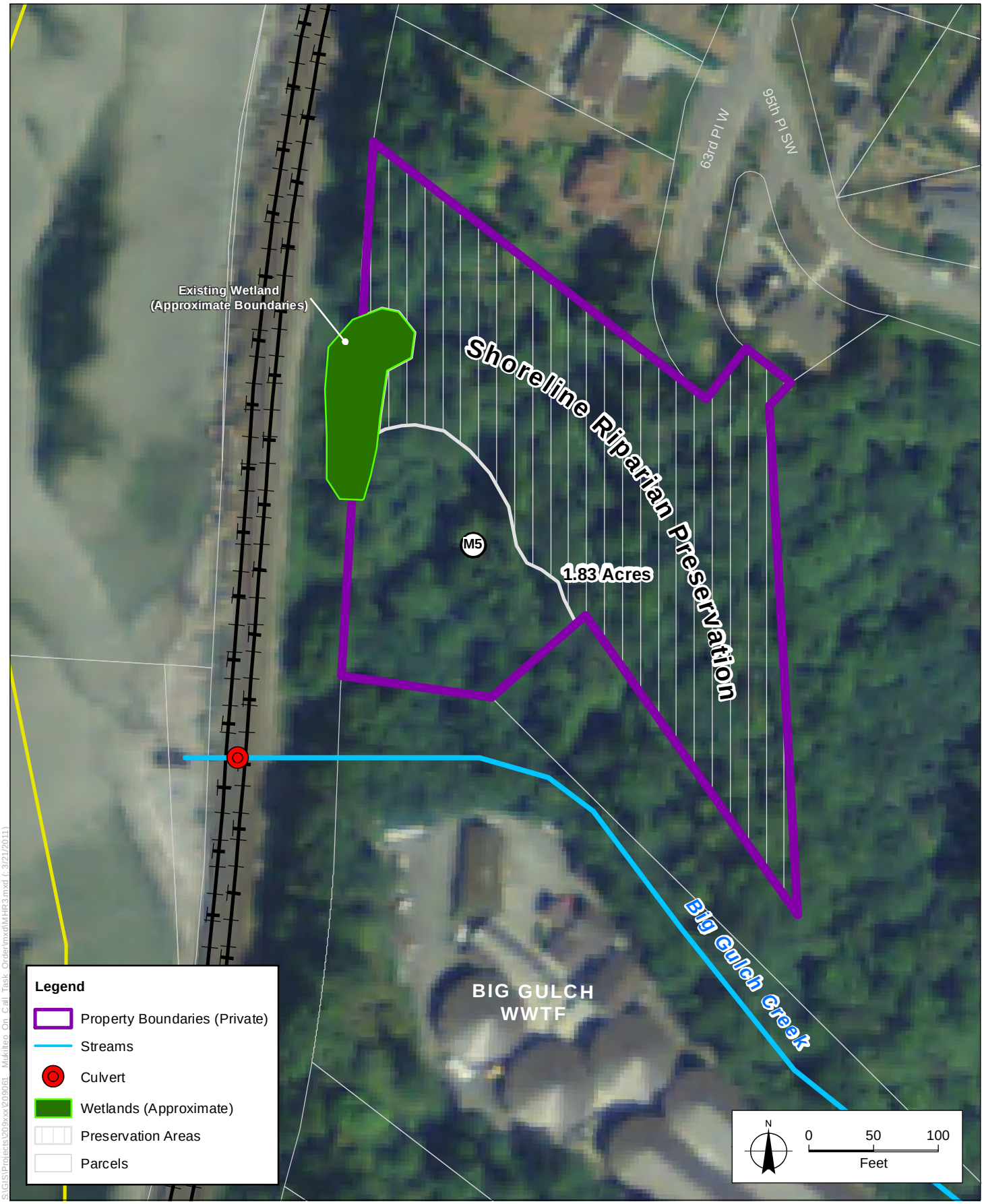
This site is a 2-acre parcel near the mouth of Big Gulch Creek. The stream flows through Big Gulch, which is a 178-acre ravine owned by the City and designated as an open space park. The open space park contains a Type 3 fish bearing stream, mature coniferous forest, steep slopes, and wetlands. It is the only private parcel between the park and Puget Sound. The parcel has a relatively mature forest (mixed deciduous/coniferous) on the steep slopes and a young alder/willow forest in a 0.5-acre level area near the stream.

Since the property is zoned single-family residential and located in a highly desirable neighborhood, it could be developed with one to four homes if purchased by a developer. The City is particularly interested in buying this property to secure the opportunity to preserve the wildlife habitat connection between the open space park and the shoreline of Puget Sound. Additionally, this site offers the opportunity for stream restoration and wetland creation (discussed as project M5 in Section 7.5).

8.4.2 Potential Mitigation Projects

Figure 19 shows the approximate location and area for the following potential mitigation project:

- Preservation of approximately 1.83 acres of forested wetland, stream buffer and shoreline riparian forest.



SOURCE: City of Mukilteo, 2009; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure 19

Mukilteo Habitat Reserve Site - MHR3

Mukilteo, Washington

9.0 PROJECTED MITIGATION NEEDS IN MUKILTEO

Residential and commercial construction as well as road and utility improvements are expected to increase within the City and UGA over the next several decades. Many of the underdeveloped parcels are adjacent to critical areas such as stream corridors and wetlands. Some of this future growth is expected to result in impacts to critical areas. Buildable lands studies by the City of Mukilteo (2010) and Snohomish County (2008) were reviewed and combined with the known wetland and streams maps for Japanese Gulch (Figure A5 in Appendix A), Big Gulch (Figure A6 in Appendix A), and Picnic Point (Figure A7 in Appendix A) to assess the future potential for wetland, stream, and buffer impacts from development of unused parcels and redevelopment of underutilized parcels.

A summary of the results of this GIS map analysis is shown in Table 7. The greatest potential for impacts is to buffers (wetland and stream), followed by direct wetland impacts. Potential buffer impacts are predicted on approximately six times as many parcels as wetland and stream impacts combined. On an individual sub-basin basis, Picnic Point had a greater potential impact for all critical areas. This analysis shows that the greatest need for future mitigation will likely be for buffer habitat. Mitigation for direct wetland impacts will likely be most needed within the Picnic Point sub-basin.

Table 7. Projected Future Impacts for Build-out of Mukilteo and UGA

	Number of Undeveloped/Underutilized Parcels with Associated Features			
Sub-Basin	Streams	Stream Buffer	Wetland	Wetland Buffer
Japanese Gulch	0	1	2	10
Big Gulch	1	7	4	13
Picnic Point	2	30	17	97
TOTALS	3	38	23	120

10.0 SUMMARY AND CONCLUSIONS

The Mukilteo Critical Areas Mitigation Program is intended to be an active document that will be revised and updated to meet the future needs of Mukilteo. Additional mitigation sites may be added in the future following a similar watershed approach that is described in Appendix A. Some of the pre-selected mitigation sites identified in the CAMP are located on private parcels. The approval and full consent of property owners will be required before sites are considered for specific mitigation projects.

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APPENDIX A: METHODS

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A-1 METHODS USED TO IDENTIFY MITIGATION SITES THROUGH A WATERSHED APPROACH

The Washington Department of Ecology (Ecology), U.S. Army Corps of Engineers Seattle District (Corps), and the U.S. Environmental Protection Agency Region 10 (EPA) (collectively the Agencies) prepared a guide on selecting mitigation sites for unavoidable wetland impacts titled *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby, et al. 2009). The Agencies encourage state, federal, and local decision-makers, as well as project applicants, to use this guide as one step in the process of making decisions on compensatory mitigation projects. The goals of the guide are to improve mitigation success and to better address the ecological priorities of Washington's watersheds. The guide provides specific recommendations on how to apply a watershed approach when selecting sites and in choosing between on-site and off-site mitigation in western Washington.

The guide provides two alternative paths depending on whether existing watershed planning documents sufficiently characterize the watershed and identify and prioritize restoration opportunities. Detailed watershed characterizations have not been conducted on the small coastal drainages in Mukilteo. Therefore, the methods in the second path suggested in the guide were used for this watershed approach to mitigation site identification.

Although the City of Mukilteo and its UGA are included within the boundaries of Water Resource Inventory Area 8 (WRIA 8) Lake Washington/Cedar/Sammamish Watershed and a small portion within WRIA 7 Snohomish Watershed, none of the sub-basins within the City flow to the Snohomish River, and only a small area in the southeast corner of the UGA flows into Lake Washington through Swamp Creek. Although only 6 square miles in area, Mukilteo has 16 distinct sub-basins. The sub-basins contain relatively small streams (no Type 1 or 2 streams in Mukilteo) that flow directly to Puget Sound. The headwaters of the streams are located on the topographically flat area along the east side of the City, including portions of Snohomish County Airport. The streams flow west and north from these headwaters within steep sided ravines, which make up most of the forested open space in the City.

This unique geologic and hydrologic setting results in a different set of watershed functions and constraints than those in the watersheds of western Washington containing large river systems. We have attempted to customize this watershed approach to mitigation site identification in Mukilteo by using the information provided by existing studies (Section A-1.1) and by applying a landscape level assessment of the geologic and hydrologic setting of Mukilteo (Section A-1.2). This information was used to identify locations where site-based assessments would be conducted (Section A-1.3). The data collected during the site-based assessments were used to prioritize the sites that have the highest likelihood of successful and sustainable wetland, stream, and buffer restoration, or have habitat areas appropriate for preservation (Section A-1.4).

A-1.1 Existing Watershed and Sub-Basin Studies

A-1.1.1 Snohomish River Basin Salmon Conservation Plan (June 2005)

The Snohomish River Basin Salmon Conservation Plan (June 2005) is a wide- reaching plan that primarily focuses on the large estuarine habitats near the mouth of the river and within the river channel. The Plan also mentions the importance of Puget Sound nearshore habitat and targets the nearshore areas for enhancement and restoration. The nearshore along the shoreline of Mukilteo has existing areas of functioning habitat as well as areas that are appropriate for restoration and enhancement, although most of the shoreline is armored to support the BNSF railroad bed. Improving access to the shoreline and expanding existing tidal lagoons along the shoreline is another opportunity that was identified. The Plan also targets the urban streams that flow into the nearshore of Puget Sound (such as Japanese Gulch Creek, Big Gulch Creek, and Picnic Point Creek) for preservation of riparian cover and wetlands, and the restoration of sediment transport processes between streams and the nearshore.

A-1.1.2 WRIA 7 and WRIA 8 Watershed Management Plans

Comprehensive watershed management plans have not been developed for Water Resource Inventory Area (WRIA) 7 or WRIA 8. An initial assessment was conducted in 1995 for WRIA 8, which focused mainly on the Cedar and Sammamish River basins. The initial assessment of WRIA 7 was also conducted in 1995, and concentrated on the Snohomish River and its major tributaries. The relatively small streams in Mukilteo that flow directly into Puget Sound do not have a direct interaction with the major river systems in WRIA 7 and 8; therefore, they are not often addressed in watershed-scale planning.

A-1.1.3 City of Mukilteo Comprehensive Surface Water Management Plan

The City of Mukilteo Comprehensive Surface Water Management Plan (April 2001) discusses the hydrologic problems identified within the sub-basins of the City and UGA. In general, the plan describes Big Gulch and Picnic Point Creeks as having multiple problems with flooding and elevated water temperature. The plan also describes problems with flooding and elevated temperature in Japanese Gulch and Brewer Creeks, but relative to the other creeks these two have fewer problems.

A-1.1.4 City of Mukilteo Stormwater System Mapping Update

The City of Mukilteo conducted a comprehensive inventory of stormwater conveyance systems within the city limits during the autumn of 2010. Preliminary inventory maps were consulted to determine and verify water flow paths into and out of wetlands and streams to aid in site-specific analysis.

A-1.1.5 Japanese Gulch 5th Street Fish Passage Feasibility Study - Stream Assessment Report

The *Japanese Gulch 5th Street Fish Passage Feasibility Study - Stream Assessment Report* (Cherry Creek Environmental, 2010) describes a stream assessment of the reaches of the stream south of 5th Street. The report concludes that stream functions are highly impaired by a large

number of fish-passage barriers (weirs and flumes), garbage in the stream including tires, and confinement by the railroad bed. The fish-passage barrier, a culvert beneath 5th Street, prevents upstream fish migration. Given all the identified constraints, there appears to be limited habitat suitable for fish, even if the 5th Street fish-passage barrier was to be removed.

A-1.1.6 Puget Sound Tributaries Drainage Needs Report (Snohomish County 2002)

The Puget Sound Tributaries Drainage Needs Report describes stream restoration needs and opportunities within Lund's Gulch Creek, Norma Creek, and Picnic Point Creek. The report includes conceptual-level design and cost information for identified Capital Improvement Program (CIP) projects that were developed for the Puget Sound Tributaries Department of Natural Resources (DNR) area. The report identified 67 stream and wetland related projects within the drainage basins (Norma Creek and Picnic Point) in Mukilteo's southern UGA. Thirty-four projects were identified in Lund's Gulch, only a few of which are within the Mukilteo UGA.

A-1.1.7 Puget Sound Characterization Project (Ecology 2011)

The Puget Sound Characterization Project is a regional-scale tool that highlights the most important areas to protect, and restore, and those most suitable for development. The program, funded by an EPA grant, is a collaborative effort between Ecology, the Puget Sound Partnership, and WDFW. The Characterization covers the entire Puget Sound drainage area — from the Olympic Mountains on the west to the Cascades on the east, including the San Juan Islands. The Characterization includes watershed assessments of:

- Water flow (surface storage, recharge, and discharge)
- Water quality (sediment, nutrients, pathogens, and metals)
- Landscape assessments of fish and wildlife habitat in three environments: Terrestrial, Freshwater, and Marine

Ecology updated the Characterization with data for Mukilteo drainages in September 2011. This information was not available at the time this landscape approach to mitigation site identification was conducted (December 2010 to May 2011). A general discussion of the characterization results (water flow and water quality) and their relevance to this study are included in Section A-1.3.

A-1.2 Landscape Approach to Site Identification in Mukilteo

To identify locations with a greater potential for successful wetland enhancement and/or creation, it is important to understand the physical setting of the City of Mukilteo. The following presents a landscape profile of the City, with special attention given to surface water processes. This section also includes a summary of the landscape approach used to identify locations for additional investigation. This analysis is based solely on GIS spatial datasets, all of which have limitations of scale and accuracy. This landscape-level effort is only intended to provide a starting point for more specific field-based investigations. The results of the field-based investigations are described in Section A-1.4 of this document.

A-1.2.1 Geologic and Hydrologic Conditions of Mukilteo

The City of Mukilteo is located in western Snohomish County between Seattle and Everett, on the eastern shore of Puget Sound. Mukilteo covers about 6 square miles. The City of Mukilteo includes 16 sub-basins, most of which drain north and west to Puget Sound. Steep slopes adjacent to Puget Sound and deep ravines cut by the streams are characteristic of all sub-basins. The surficial geology is composed primarily of continental glacial till.

The climate of Mukilteo is temperate marine. The temperature in Mukilteo is moderated by its proximity to Puget Sound and the Pacific Ocean, which provide a large amount of moisture and rainfall. Everett is located to the northeast of Mukilteo, and the closest long-term meteorological station is located there (less than 2 miles away). At this station, the annual average total precipitation is 37.5 inches, and annual average temperature is 51.5 degrees Fahrenheit (NOAA, 2010). The geology, soils, topography, surface water, wetlands, and built environment are discussed below.

A-1.2.1.1 Surficial Geology

The surficial geology and topography of Puget Sound is the end result of many cycles of glacial ice encroachments and recession over the last several million years. The Vashon glaciation, which occurred from 15,000 to 13,500 years ago, is the most recent encroachment of ice into the Puget Sound region.

Surficial geology for Mukilteo was mapped by the United States Geological Survey (USGS) and the Washington Department of Natural Resources (WDNR). The geology of the Mukilteo area consists of interglacial and Quaternary glacier deposits, primarily continental glacial Vashon till on top of sand and gravel deposits of the Fraser Glaciation (Figure A1-Surficial Geology). The continental glacial till is partially cemented, nonsorted, nonstratified, dense sandy silt to silty sand with boulders, cobbles, and gravel. The percentage of silt generally varies from 10 to 30 percent. The continental glacial till covers most of the upland areas. In many low-lying and ravine areas, landslides or erosion have removed the till, exposing surficial geology of continental sedimentary deposits, glacial outwash, and glacial drift. Additionally some locations adjacent to the Puget Sound shoreline include areas of mass-wasting deposits that were mostly formed by landslides, as well as areas of artificial fill.

The spatial pattern of surficial geologies is relatively consistent across the City. In general terms, the flat upland plain in the eastern and southern portions of the City consists primarily of glacial till. This till plain is dissected by stream ravines that flow north or west to Puget Sound. These ravines are erosional features that expose the underlying outwash and glacial drift. In some ravines, notably Big Gulch, significant exposure of deep outwash deposits has likely contributed to long-term slope instabilities.

Bedrock is exposed in some portions of the ravines, and along small portions of the Puget Sound nearshore.

A-1.2.1.2 Soils

Weathering of the geologic materials and incorporation of organics creates soil, so soil types are highly related to surficial geology. The type of soil influences the amount of runoff and infiltration that occurs during a storm. Soils for the Mukilteo area were mapped by the Natural Resources Conservation Service (NRCS). The primary surface soils in the Mukilteo area are in the Alderwood and Everett series; these soils are derived from glacial till. The Alderwood series primarily consists of gravelly sandy loam, with slopes ranging from 2 to 70 percent. The Everett series consists of gravelly sandy loam, with slopes ranging from 0 to 25 percent. Drainage is restricted by the underlying Vashon till located underneath both series, especially in areas with relatively flat slopes. Vashon till is classified as having moderately high runoff. Vashon till drains poorly and can contribute to the formation of wetlands within depressions on the upland till plain.

The scale of the mapped soil units is such that many smaller inclusions of other soil series, including hydric or wetland soils, would be expected to occur. Therefore, though neither Alderwood nor Everett series are considered hydric, this does not eliminate the possibility of wetland presence or formation in these areas.

Hydric soils are soils that have formed under conditions of ponding, saturation, or flooding of sufficient duration during the growing season to develop anaerobic conditions in the upper part of the soil profile. Hydric soils are identified in some areas in the City (Figure A2-Slopes & Soils). The relatively flat areas, primarily in the eastern portion of the City, with hydric soils are indicative of wetlands or where historical wetlands may have occurred.

A-1.2.1.3 Topography and Surface Water

The topography of Mukilteo includes three general physiographic regions. The relatively flat glacial till plain covers much of the eastern portion of the City. The till plain is dissected by a number of ravines that angle west and north to Puget Sound. These ravines are typically very steep, including slopes up to 70 percent. The ravines terminate at the interface with Puget Sound, where nearshore bluff and beach processes dominate the topography. Most of the nearshore has been modified with the installation of the armored berm for the BNSF rail line.

A large part of Mukilteo is located in areas with slopes ranging from 8 to 25 percent, with significantly steeper slopes (25 to 70 percent) adjacent to the ravines and gulches (Figure A2-Slopes & Soils). West of these ravines are coastal areas that vary from relatively flat to steep cliffs.

Numerous streams flow through the steep gullies and ravines of Mukilteo, which are cut through the glacial deposits. Some of the streams within these ravines include: Japanese Gulch Creek, Brewery Creek, Smuggler's Gulch Creek, Big Gulch Creek, Upper and Lower Chennault Creeks, Hulk Creek, Naketa Creek, and Picnic Point Creek. Other surface water features includes detention basins and facilities that handle drainage from roads and buildings. These are owned by public and private entities. There is one regional stormwater facility located within the Harbour Pointe Golf Course that includes a collection of ponds and wetlands joined by swales and streams.

A-1.2.1.4 Wetlands

Many of the wetlands in Mukilteo and surrounding Snohomish County, especially near the headwaters of streams, have been filled during the last 50 years. Mukilteo, Snohomish County, and National Wetland Inventory (NWI) have mapped wetlands in the City (Figure A2-Slopes & Soils). The NWI was based on aerial photography completed in 1973. Mukilteo and Snohomish County wetland areas have been mapped using various sources. Wetlands are mapped in some of the upland areas near the headwaters of streams, coastal areas, and other areas in the City. Wetlands and buffers are identified and mapped on a case-by-case basis during site investigations to support individual developments.

A-1.2.1.5 Built Environment

Development in Mukilteo has resulted in an increase in impervious surfaces and in a decrease in wetland areas relative to pre-settlement conditions (Figure A3: Impervious Surfaces). Increased impervious surfaces have resulted in an increased rate and volume of stormwater runoff. This has resulted in erosion and steeper ravines. The quality of stormwater runoff has been degraded in some developed areas, resulting in water quality degradation in the streams.

The Mukilteo Comprehensive Stormwater Plan identifies a relatively large problem with streambank erosion. Localized flooding in Picnic Point and Big Gulch/Smuggler's Gulch basins suggests that past filling of a large number of wetlands at the headwaters of these streams, and the increase in rate and volume of stormwater runoff from impervious surfaces, have altered the hydrologic functions of the sub-basins (Tetra Tech/KCM, 2001). In contrast, the assessment of hydrologic functions in Japanese Gulch and Brewery Creek suggested that there was relatively little localized flooding, streambank erosion, or change in water temperature.

A-1.2.2 Synthesis of Sub-basins

The potential for the landscape to support wetland enhancement or creation is typically a function of the physical characteristics discussed in the preceding sections. Key parameters are summarized for each of the City's sub-basins in Table A1. These key parameters include the type of surficial geology, percent impervious surface, percent forest cover, and inventoried wetland area for each sub-basin. Wetland area includes a combination of wetlands identified by Mukilteo, Snohomish County, and NWI. Wetland restoration and creation areas are limited by the amount of impervious surface, as well as the type of geology and slopes present. In general terms, sub-basins with higher percent forest cover and lower percent impervious cover are anticipated to be in better condition, and may provide greater potential for landscape-level habitat connectivity.

Table A1. Characteristics of sub-basins (from north to south)

Sub-basin	Size (Acres)	Percent Surficial Geology				Percent Impervious Surface	Percent Forest Cover	Wetland (Acres)
		glacial till and drift	outwash	sedimentary deposits or rocks	other			
Playfield Creek	4	75	25	25	0	5	16	0
Edgewater Creek	209	60	37	3	1	15	57	0
Japanese Gulch	1072	81	16	2	1	39	27	22
Brewery Creek	287	50	41	5	4	26	39	1
State Park	75	5	41	27	26	42	3	2
Goat Trail Ravine	281	82	18	0	0	31	27	1
Olympic View Ravine	262	75	21	0	4	25	41	0
Naketa Beach	145	79	14	0	6	31	31	2
Smuggler's Gulch	293	76	10	8	6	24	36	7
Big Gulch - West	762	63	28	9	0	25	44	22
Big Gulch - East	759	95	0	0	5	38	15	63
Chennault Beach	142	4	47	49	0	28	29	1
Upper Chennault Beach	129	54	24	20	2	24	45	6
Lower Chennault Beach	523	74	19	7	0	36	18	92
Hulk Creek	360	42	37	15	6	16	49	24
Picnic Point	1463	76	20	4	0	26	43	133
All sub-basins	*6766*	-	-	-	-	*30*	*34*	*376*

Surficial geology in all sub-basins is dominated by glacial sediments. Glacial till and glacial drift make up the primary surficial geology for the majority of the sub-basins. Glacial outwash is located in sub-basins throughout the City and is representative of areas that have experienced significant erosion. Throughout the City, most sub-basins have impervious surfaces of more than 20 percent. Forest cover in sub-basins within the City ranges from 3 to 57 percent. The number of mapped wetland acres in each drainage ranges from zero to 133 acres, which corresponds to zero to 18 percent of the total area. In total, approximately 30 percent of the City area, including the UGA, is covered in impervious surface and approximately 34 percent is forested.

A-1.2.3 Potential Historic Wetlands

Available soils and topographic information were used to identify potential areas of historic wetlands. The LiDAR Digital Elevation Model (DEM) was analyzed to identify areas with slopes of: less than 2 percent, and 2 to 10 percent. These areas were then intersected with areas of mapped hydric soils (Figure A2-Slopes & Soils). Areas with relatively low slope and mapped hydric soils have been used as a proxy for historic wetlands (Stanley et al. 2010, Gersib et al. 2004). These areas may also suggest locations with greater potential for restoring or creating wetlands.

A-1.2.4 Tiered Analysis Methods and Results

We developed a landscape-based tiered analysis for areas that may be appropriate for restoring or creating wetlands in Mukilteo. This analysis considers landscape position as the primary metric, and does not consider the built environment. The primary data sources for this analysis include:

- 2005 Topographic data based on LiDAR obtained from the Puget Sound LIDAR Consortium (PSLC).
- Existing wetland inventories from City of Mukilteo, Snohomish County, and NWI.
- Existing stream layer developed by the City of Mukilteo.
- Stormwater Comprehensive Plan for the City of Mukilteo (Tetra Tech/KCM, Inc., 2001).

GIS layers used in the analysis included wetland data, streams from City of Mukilteo, soils from NRCS data, and surficial geology from WDNR. Additionally data were analyzed to determine slopes. The tiered areas represent general locations where wetlands could be restored or created and are not specific to parcels or exact locations.

The intent of this tiered classification system is to identify areas for additional reconnaissance. One guiding assumption was that wetland creation or restoration has very limited potential in either the Puget Sound nearshore or the ravines. This is not to suggest that restoration along the nearshore is not important, it is simply that the opportunity is limited by the BNSF rail line. Thus, wetland restoration opportunities are focused the upland till plain. Headwater wetlands are likely in this area, and they are associated with streams. These headwater wetlands play a significant role in the ecological and physical stream processes for Mukilteo's streams. These wetland areas have the potential to moderate altered runoff volumes from the developed areas that drain to the streams.

These ravines are likely continually evolving; however, conditions within the ravines reflect some balance between stream flows generated in the upper watershed and the stream channels. Therefore, overall stability of the ravines is sensitive to change in the volume of runoff generated in the upper watershed. The large amount of impervious surface discussed above indicates that this change has already occurred, and ravines have, and are still, adjusting to the increase in stormwater flows. In such a situation, headwater wetlands can play a significant role in moderating downstream flows and the geomorphic response of the ravines (Brassard et al. 2000).

In addition, the ravines typically include significant forested areas on the steep sideslopes. Focusing wetland restoration efforts at the top of the ravines therefore has the potential to provide longitudinal habitat connectivity through the City.

The analysis identified three tiers:

Tier 1: Tier 1 areas were identified as most appropriate for wetland restoration or creation based on landscape position. Tier 1 areas meet all three of the following criteria:

1. Less than 2 percent slope;
2. Mapped as hydric soils; and
3. Near headwaters of streams.

Six areas met these three criteria within the City of Mukilteo (Figure A4: Mitigation Tiers). The Tier 1 areas in the northern half of Mukilteo include one in Smuggler's Gulch Creek sub-basin and another located in the Olympic View Ravine sub-basin. The Tier 1 areas in the southern half of Mukilteo include one in the Picnic Point sub-basin and the other in the Hulk Creek sub-basin. The Big Gulch-West and lower Japanese Gulch, adjacent to Puget Sound, are also included in Tier 1 because of the opportunity to interface these relatively large sub-basins with the Puget Sound nearshore.

Tier 2: Tier 2 areas were identified as having reasonable potential for wetland restoration or creation based on being located near headwaters of streams and meeting one of the following criteria:

1. Less than 2 percent slope; or
2. Mapped as hydric soils.

There are four areas where at least two of the criteria were met (Figure A4: Mitigation Tiers). The four Tier 2 areas include one area located in the Japanese Gulch sub-basin, two in the Big Gulch sub-basin, and one in the Picnic Point sub-basin.

Tier 3: Tier 3 areas were identified as having potential for headwater wetland restoration or creation based on the geographic location, looking at a radius of 2,000 feet around the upslope end of the mapped streams. Tier 3 areas potentially can protect hydrology in ravines, but may take more design/construction effort than Tier 1 and Tier 2 areas. Ten areas meet the criteria for Tier 3 (Figure A4: Mitigation Tiers). Many of these areas are located at the headwaters of streams.

A-1.3 Potential Mitigation Sites Identified

The Tiered Analysis (Section A-1.2), based on assessment of geologic and hydrologic conditions, was the primary method for identifying areas to conduct field visits and collect site-based information. Within these areas, preference was given to sites that were adjacent to, or within, existing forested areas along stream corridors. Although Mukilteo is an urban landscape, the several forested ravines that drain directly to Puget Sound provide the opportunity for sites with significant and sustainable wildlife habitat functions. The mature coniferous forest provides connectivity between wetlands, riparian areas, upland habitats, and Puget Sound shoreline as well as breeding and feeding habitats for a wide variety of wildlife. This connection to relatively undisturbed habitat is expected to contribute to sustainable wildlife habitat functions without the need for extensive long-term maintenance. The information on identified stream and wetland restoration needs contained in existing studies discussed in Section A-1.1 further refined the list and added sites within three of the City's sub-basins. This screening process resulted in 40 sites where more detailed analysis of the potential for critical areas mitigation sites could be performed.

Due to budget and time constraints, the decision was made to limit this initial field study to three of the City's sub-basins: Japanese Gulch, Big Gulch, and Picnic Point. Future studies of the remaining sub-basins within the City and in annexation areas would follow a similar methodology. These three sub-basins were chosen because they contain a large number of the

areas identified in the tier analysis, are relatively large sub-basins and therefore cover a large portion of the City, and have large areas of forested slopes that remain undeveloped. All three sub-basins were identified as priority project areas for Critical Area protection in Mukilteo's 2009 Habitat Management Plan (adopted December 7, 2009). The three sub-basins include 3 of the 6 Tier 1 areas, all 4 of the Tier 2 areas, and 6 of the 10 Tier 3 areas. During site reviews it became clear that some of the mitigation opportunity sites straddle sub-basin boundaries. Therefore some of the sites reviewed were in adjacent sub-basins: Brewery Creek and Smuggler's Gulch.

The Puget Sound Characterization Project provides further evidence that the sub-basins identified in this study are appropriate for restoration and protection of watershed functions. The Characterization has been completed for water flow and water quality (sediment) functions (Stanley, 2011). The potential for restoration or development in relation to the watershed functions studied (water flow and water quality) is described for each of the sub-basins in Mukilteo. The sub-basins identified in this study (Japanese Gulch, Big Gulch, and Picnic Point) are shown in the Characterization to have conditions appropriate for restoration, preservation, or conservation for most of the watershed functions. The results of the Characterization are consistent with and provide support to the results of the Tiered Analysis conducted for this project. Further explanation and future updates can be accessed on the Washington Department of Ecology website: *http://www.ecy.wa.gov/puget_sound/characterization/index.html*.

A-1.3.1 Japanese Gulch/Brewery Creek

The Japanese Gulch sub-basin is 1,072 acres including portions of Mukilteo, Everett, and Snohomish County. Twenty-seven percent of the sub-basin has forested cover, which is largely concentrated in the ravine containing Japanese Gulch Creek on the north end of the sub-basin. Thirty-nine percent of the sub-basin is covered by impervious surfaces, which are in large part concentrated on the industrial properties and the airport (Paine Field) located on the southern half of the sub-basin.

The Brewery Creek sub-basin borders Japanese Gulch sub-basin to the west, and the two basins share a common headwater wetland complex (Figure A5). The wetland complex is located on a relatively level area on the southwest flank of the forested ravine containing Japanese Gulch Creek, and provides hydrologic support to the mainstem of Brewery Creek and a small tributary of Japanese Gulch Creek. Brewery Creek sub-basin is 287 acres in size. Thirty-nine percent of the sub-basin has forested cover, which is largely located in the area containing the headwater wetland complex. Twenty-six percent of the sub-basin is covered by impervious surfaces. A summary of existing conditions that contribute to or impair sub-basin functions is included below.

Conditions Contributing to Sub-Basin Functions

Japanese Gulch:

- Riparian vegetation largely intact along Japanese Creek and many tributaries within the ravine.
- Almost a third of the sub-basin has forested cover.

- Coho breeding habitat in lower portions of stream (two fish-passage barriers removed along lower reaches in 2010).
- Undisturbed headwater wetlands on the west side of ravine.

Brewery Creek:

- Riparian vegetation approximately 25 to 50 feet wide along most of upper reaches of Brewery Creek.
- Almost 40 percent of the sub-basin has forested cover.

Conditions Impairing Sub-basin Functions

Japanese Gulch:

- Stream mouth is within pipes and ditches for hundreds of feet.
- Pollutant input to stream from industrial sites and airport to the east and south.
- Increased stormwater flows from industry and airport.
- Fish access to Japanese Creek is limited by many concrete weirs on the upper reached south of 5th Avenue.
- Fish access to the reach south of 5th Street is prevented due to an impassable culvert.
- Waste including a large pile of garbage including tires is found within and along the stream bank on the south end of Japanese Creek.

Brewery Creek:

- The stream passes through culverts beneath four roads, and the mouth of the stream is within a culvert for greater than 800 feet.
- Historic mid-slope wetlands in Brewer Creek were likely filled.

A-1.3.2 Big Gulch

The Big Gulch sub-basin is over 1,500 acres in size; approximately half within the City (Big Gulch West) and the remainder (Big Gulch East) east of the Mukilteo Speedway in the primarily developed areas of Paine Field in Snohomish County. Forested cover makes up 44 percent of Big Gulch West and only 15 percent of Big Gulch East. Correspondingly, impervious surfaces cover 25 percent of Big Gulch West and 38 percent of Big Gulch East sub-basins. The forested areas are concentrated within Big Gulch Ravine and in an area west of the Paine Field runways. Figure A6 shows both portions of the Big Gulch sub-basin. A summary of existing sub-basin function condition and impairments is included below.

Conditions Contributing to Sub-Basin Functions

- Several headwater wetlands remain: along the west and south side of Paine Field and on the high school property south of the gulch.
- Many mid-slope wetlands existing within the Big Gulch ravine.
- Existing riparian habitat is intact along most of Big Gulch Creek within the open space park.
- Approximately 30 percent of the sub-basin has forested cover.

Conditions Impairing Sub-basin Functions

- Many of the historic headwater wetlands were filled.
- The north fork of Big Gulch Creek is deeply incised.
- The lower portion of the main stem of Big Gulch Creek is channelized and confined for several hundred feet prior to flowing through an undersized culvert under the BNSF tracks.
- Stormwater runoff enters the main stem of Big Gulch Creek in the lower half of the stream.

A-1.3.3 Picnic Point

Picnic Point sub-basin is almost 1,500 acres in size and is located in the south end of Mukilteo. Approximately one-third of the sub-basin is within the City limits and the remainder is in Snohomish County, where it is designated as Municipal Urban Growth Area (Figure A7). Forested areas cover 43 percent of the sub-basin and impervious surfaces cover 26 percent of the sub-basin.

A summary of existing sub-basin function condition and impairments is included below.

Conditions Contributing to Sub-Basin Functions

- The sub-basin has greater than 40 percent forested cover.
- Much of the stream reaches have forested riparian corridors.
- Some headwater wetlands remain.

Conditions Impairing Sub-basin Functions

- 303(d) listed for poor water quality.
- Many historic headwater wetlands filled.
- Channel migration zone on lower portions of stream restricted.

A-1.4 Prioritization of Sites

Site visits were conducted during autumn 2010 to each of the 40 potential mitigation sites identified by the process described above. The sites were assessed for multiple factors, including those recommended in *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby, et al. 2009). Observations were made on identified needs of the watershed/sub-basin, ecological importance (landscape position, connectivity, hydrology, soils, weeds), constraints on hydrologic and habitat functions, ownership, adjacent land use, degree of disturbance, ongoing stressors, and other factors. Information collected at each of the 40 sites will be made available upon request.

Many sites were eliminated from consideration as mitigation sites based on a high degree of disturbance (existing or planned) on or surrounding the site, which constrains natural processes and therefore would inhibit functions and preclude sustainable restoration. The methods recommended by the Agencies (Hruby, et al. 2009) discourage the use of mitigation sites within urban areas that do not have a high likelihood of long-term success. Sites that did not have an existing vegetated connection (or the potential for reestablishing the connection) with larger

forested areas were excluded because sustaining habitat functions over the long term would be difficult or impossible. Many of the sites visited had obvious and significant constraints on restoring the processes that support hydrologic, water quality, or habitat functions; such as recently constructed buildings or roads, alterations to the natural water regime that cannot be feasibly corrected, large populations of invasive weeds on and adjacent to the site, and poor buffers and lack of connectivity to other habitat. Several sites were eliminated due to the potential for increasing problems with slope stability or flooding.

This site-based assessment resulted in the identification of a subset of 11 sites where wetland, stream, or buffer mitigation was identified as being potentially feasible and sustainable. Specific site information was collected at the 11 sites based on observed alterations to natural processes and the constraints on function. Conditions at the 11 sites are summarized in the following sections and include a summary of potential mitigation opportunities. Detailed descriptions of the 11 sites are provided in Sections 7 and 8 of the Mukilteo Critical Areas Mitigation Program document. The identification systems used in this appendix and in the CAMP report differ, so both identities are included below.

A-1.4.1 Japanese Gulch/Brewery Creek

A-1.4.1.1 J1 (M2 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Existing headwater wetlands only minimally disturbed; not filled or ditched.
- Only small populations of non-native invasive plants.
- Forested buffers and direct connection to large mature forested area with a variety of habitats including Japanese Gulch Creek.
- Native plant seed sources immediately adjacent on 3 sides of site.

Conditions Impairing Wetland/Stream Functions

- Small area of fill (paved driveway) in area that was likely historic wetland.
- Stormwater runoff from paved driveway enters existing wetland.

Mitigation Opportunities

- Remove existing paved driveway and stormwater conveyance pipes (corrects hydrologic constraints).
- Creation/recreation of headwater wetland (Improves hydrologic support and improves general wildlife habitat).
- Wetland buffer restoration (improves general wildlife habitat).
- Stream enhancement (removal of large amounts of trash from Japanese Gulch Creek (removes water quality constraint).

A-1.4.1.2 J2 and J3 (MHR1 and MHR2 in Section 8 of CAMP)

Conditions Contributing to Wetland Functions

- Existing headwater wetlands undisturbed.
- Only isolated occurrences of non-native invasive plants.
- Forested buffers and direct connection to large mature forested area with a variety of habitats including Japanese Gulch Creek and Brewery Creek.
- Native plant seed sources immediately adjacent on all sides of site.
- Soils undisturbed.
- Hydrology undisturbed.

Conditions Impairing Wetland Functions

- Water quality impairments (small amount of garbage in wetland on south end of site (Wetland 2).

Mitigation Opportunities (outside of current City limits)

- Preservation of headwater wetlands (supports hydrologic, water quality and wildlife habitat functions for the sub-basin).
- Preservation of mature forested buffer (supports hydrologic, water quality and wildlife habitat functions for the sub-basin).
- Wetland restoration: remove trash from Wetland 2 (improves water quality for on-site wetlands and potentially Brewery Creek).

A-1.4.1.3 J4 (M1 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Wetland soils undisturbed.
- Wetland hydrologic support relatively undisturbed.
- Riparian vegetation largely intact along Japanese Creek where it is adjacent to wetland.
- Coho breeding habitat on site in lower portions of stream (two fish-passage barriers removed along lower reaches in 2010).
- Connected with habitat areas within Japanese Gulch Ravine and with Puget Sound.

Conditions Impairing Wetland/Stream Functions

- Altered water regime in stream; stormwater flows from industrial area in upper watershed.
- Fill and Culverts: mouth of stream at Puget Sound is within pipes buried beneath former industrial site.
- Highly disturbed soils in area for potential stream daylighting.
- Fill: small earthen berm separates creek from wetland.

Mitigation Opportunities

- Stream enhancement: daylight Japanese Gulch for several hundred feet at stream mouth and restore vegetated riparian buffer.

- Remove portions of the small earthen berm to improve salmon access and direct surface water connection between Japanese Gulch Creek and wetland.

A-1.4.2 Smuggler's Gulch

A-1.4.2.1 B2 (M3 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Existing headwater wetland on tributary of Smuggler's Gulch Creek.

Conditions Impairing Wetland/Stream Functions

- Stormwater runoff from roads enters this portion of wetland without treatment.
- Non-native invasive weeds present on site: Himalayan blackberry, reed canarygrass.
- Buffer and connectivity to other habitats is poor.

Mitigation Opportunities

- Wetland creation: Expand wetland in small area adjacent to roadway.
- Construct bioswale to capture and treat road runoff before it enters existing wetland.
- Enhance wetland buffer with native shrubs and coniferous trees.

A-1.4.2.2 B3 (M4 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Existing headwater wetlands on tributary of Smuggler's Gulch Creek.
- Direct connection with large habitat area in the mature forest of Big Gulch Ravine.
- Native plant seed sources immediately adjacent on 3 sides of site.
- Shallow groundwater emerging from depressional wetland sustains slope wetland to the west.

Conditions Impairing Wetland/Stream Functions

- Stormwater runoff from residential area east of Mukilteo Speedway may enter existing wetland.
- Non-native invasive weeds present on site: English ivy, Himalayan blackberry.

Mitigation Opportunities

- Wetland creation: shallow groundwater flowing from depressional wetland west across existing lawn might support the creation of slope wetland.
- Buffer restoration could improve habitat connectivity between existing wetland and habitat areas in mature forest on the west end of park.
- Wetland Enhancement: remove invasive weeds (English ivy) from wetland, underplant the deciduous forest wetland with native conifers.

A-1.4.3 Big Gulch

A-1.4.3.1 B1 (M5 and MHR3 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Only small populations of non-native invasive plants.
- Forested buffers on two sides and direct connection to large mature forested area with a variety of habitats in Big Gulch Creek ravine.
- Adjacent to near shore habitats in Puget Sound.
- Native plant seed sources immediately adjacent on 3 sides of site.

Conditions Impairing Wetland/Stream Functions

- Potential disturbance to wildlife from BNSF railway to the west and sewage treatment plant facility immediately adjacent to the south.
- Stormwater runoff from paved roadway to south flows directly to stream.
- South bank of Big Gulch Creek is armored and hardened with gabion wall for several hundred feet through site.

Mitigation Opportunities

- Wetland creation at mouth of Big Gulch Creek, possibly "pocket" estuary.
- Stream realignment away from gabion wall and restoration, including culvert replacement and restoration of limited area of floodplain "bench".
- Preservation of forested connection between Urban Natural Open Space (Big Gulch Ravine) and Puget Sound shoreline.

A-1.4.3.2 B8 (M6 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Riparian area well shaded with dense layers of trees and shrubs.
- Riparian area directly connected with forested wetland.
- Low gradient in stream habitat available: stream reach has areas with gravel substrate and off-channel refuge habitat in the wetland.

Conditions Impairing Wetland/Stream Functions

- Non-native invasive plant species (Himalayan blackberry) are common and locally dominant in some portions of the stream buffer.
- Water quality likely impaired due to upstream stormwater sources.
- Wetland and stream reach are disconnected from other habitat areas downstream in Big Gulch Creek.
- Downstream blockages prevent anadromous fish access to this reach.

Mitigation Opportunities

- Stream buffer restoration: weed (Himalayan blackberry) removal and native riparian planting in private parcels along Big Gulch Creek.
- Wetland enhancement: underplanting existing deciduous forest with native conifers.

A-1.4.3.3 B4 (M7 in CAMP)

Conditions Contributing to Stream Functions

- Riparian area well shaded with dense layers of trees and shrubs.

Conditions Impairing Stream Functions

- Stream hydrology is likely quite flashy due to stormwater runoff from paved areas of airport upslope of the site and adjacent roadways.
- No wetlands observed along stream reach on site.

Mitigation Opportunities

- Wetland creation along the existing stream to provide stormwater detention and ease downcutting problem in the north fork Big Gulch Creek.
- Water quality improvements through planting native herbaceous plants within the created wetland adjacent to the stream.
- Water quality improvement through diversion of road runoff and creation of wet pond upslope of stream.

A-1.4.4 Picnic Point

A-1.4.4.1 P2 (M8 in CAMP)

Conditions Contributing to Wetland/Stream Functions

- Remaining headwater wetland not filled.
- Riparian area well shaded with dense layers of trees and shrubs.
- Wetland and stream not ditched.
- Emergent vegetation (slough sedge) present in understory of forested wetland.
- Wetland is connected by way of forested riparian corridor greater than 100 feet wide to large forested wetlands and uplands downslope along the upper reaches of Picnic Point Creek.

Conditions Impairing Wetland/Stream Functions

- Non-native invasive plant species (Himalayan blackberry) present on site (not dominant).
- Water quality impaired by direct stormwater discharge from adjacent roadways to east and parking lot to north.
- Hydrologic modifications to the surrounding areas due to wetland fill and addition of impervious surface contributes to “flashy” hydrology in Picnic Point Creek.

Mitigation Opportunities

- Wetland creation and stream enhancement: excavation of existing upland on site would increase storage capacity of the wetland and modulate flows in the upper reaches of Picnic Point Creek.
- Wetland and buffer enhancement through underplanting of deciduous forest with native conifers.

A-1.4.4.2 P19 (M9 in CAMP)

- Habitat Connectivity in forested sites south of stream (outside of current City limits)

Conditions Contributing to Wetland/Stream Functions

- Relatively large area of mature deciduous forest immediately upstream of large wetland provides hydrologic support to the wetland and downstream sections of Picnic Point Creek.
- Native trees and shrubs provide the dominant cover on the site; no large-scale invasive weed problems were observed.
- Undisturbed native soils on the site provide infiltration of precipitation and downgradient support to wetlands and streams.
- Forested area has forested connection with larger forested habitats along Picnic Point Creek.

Conditions Impairing Wetland/Stream Functions

- Residential areas upslope to the south and west may have some stormwater impacts to the seasonal stream on site. Direct observations were not made of the seasonal stream on the west end of the site.

Mitigation Opportunities

- Preservation of mature forest providing habitat and hydrologic support to downslope wetlands and fish stream (Picnic Point Creek).

A-1.4.4.3 P27 (M10, M11, M12, M13 in CAMP)

Four stream restoration projects were identified in the *Snohomish County Drainage Needs Report (2002)* and are included in the project descriptions in Sections 7 and 8 of the CAMP.

Conditions Contributing to Stream Functions

- The riparian vegetation (forest and dense understory shrubs) at each of these sites provides nearly full shade to Picnic Point Creek.
- Direct connection with a variety of wildlife habitat in large forested areas along slopes adjacent to stream.

Conditions Impairing Stream Functions

- Undersized culverts and failed rock weirs restrict stream flows and inhibit upstream fish migration.

Mitigation Opportunities

- Replace culverts with fish passable structures.
- Replace failed rock weirs and conduct in-stream restoration for 800 feet of stream.

SUMMARY

The locations identified through this watershed approach are appropriate for restoration, creation, and enhancement of wetland, stream, or buffer habitat. The sites have existing conditions, or can be restored to the conditions, which should support sustainable mitigation projects. Detailed descriptions of each site along with conceptual ideas for mitigation projects are provided in Sections 7 and 8 of the Mukilteo Critical Areas Mitigation Program (CAMP) document. Further site analysis and mitigation plan development would be necessary at each site in order to have a mitigation plan that would meet Federal, State, and/or City permitting standards.

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FIGURES FOR APPENDIX A

Possession Sound

W Mukilteo Blvd
Qgt
Qgo
Qb
Qc(w)
5th St
Qga(t)
Brewery Creek
Qga
Japanese Gulch Creek
Japanese Gulch
Qls
Qa
Qf
84th St SW
Smuggler's Gulch Creek
Paine Field Blvd
Qgp(d)
Big Gulch
Big Gulch Creek
Chennault Beach Rd
Harbour Pointe Blvd
Holly Dr
Airport Rd
Mukilteo Speedway
Hulk Creek
Point Stream
Harbour Pointe Blvd SW
Picnic Point Stream
Harbour Heights Creek
Picnic Point Rd
Beverly Park Rd
Lake Serene
Norma Creek
52nd Ave W
148th St SW

Legend

- Sub-basin Boundaries
- Streams
- Hydric Soils
- Wetlands (City)
- Wetlands (County)
- Wetlands (NWI)
- City Limits
- Annexation Area
- Growth Planning Area

Surficial Geology (Symbol, Description)

- Qa, alluvium
- Qb, beach deposits
- Qc(w), continental sedimentary deposits or rocks
- Qf, artificial fill, including modified land
- Qga(t), advance continental glacial outwash, Fraser-age
- Qga, advance continental glacial outwash, Fraser-age
- Qgo, continental glacial outwash, Fraser-age
- Qgp(d), continental glacial drift, pre-Fraser
- Qgp(p), continental glacial drift, pre-Fraser
- Qgt, continental glacial till, Fraser-age
- Qls, mass-wasting deposits, mostly landslides

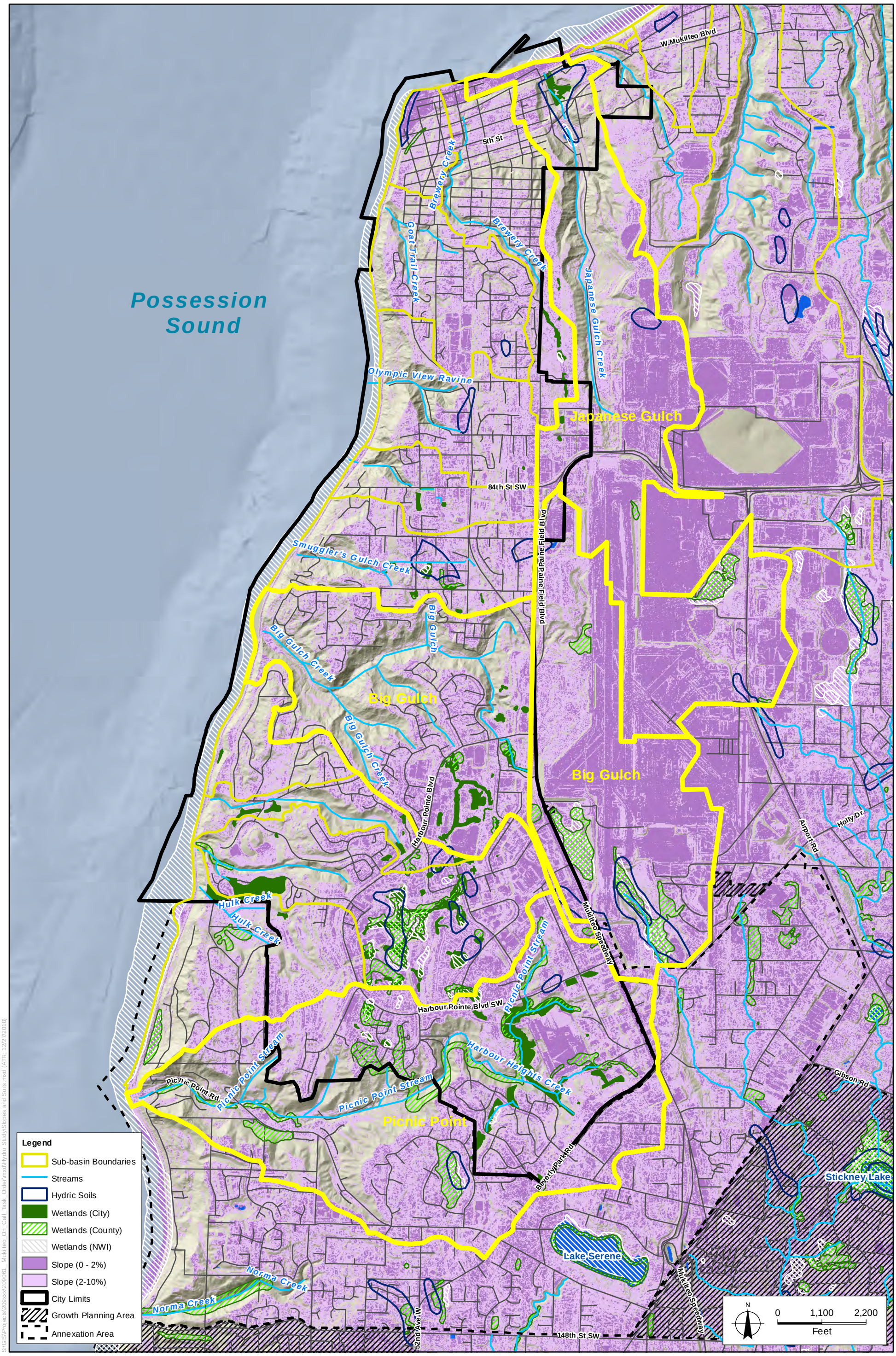
N
0 1,100 2,200
Feet

S:\GIS\Projects\209xx\209061 Mukilteo On Call Task Order\wildlife\dro Study\Surficial Geology.mxd (ATR 12/27/2010)

SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005; WDNR, 2005.

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A1
Surficial Geology
Mukilteo, Washington



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SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A2

Slopes and Soils

Mukilteo, Washington

Possession Sound

W Mukilteo Blvd
5th St
Brewery Creek
Brewery Creek
Goat Trail Creek
Japanese Gulch Creek
Olympic View Ravine
Japanese Gulch
84th St SW
Smuggler's Gulch Creek
Paine Field Blvd
Big Gulch
Big Gulch Creek
Big Gulch
Big Gulch Creek
Harbour Pointe Blvd
Big Gulch
Holly Dr
Airport Rd
Hulk Creek
Hulk Creek
Mukilteo Speedway
Harbour Pointe Blvd SW
Picnic Point Stream
Picnic Point Rd
Picnic Point Stream
Picnic Point Stream
Harbour Heights Creek
Picnic Point
Beverly Park Rd
Lake Serene
Norma Creek
52nd Ave W
148th St SW

Legend

- Sub-basin Boundaries
- Streams
- Hydric Soils
- Wetlands (City)
- Wetlands (County)
- Wetlands (NWI)
- Forested Land Cover
- City Limits
- Annexation Area
- Growth Planning Area

Impervious Surface

- Developed, High Intensity (> 80%)
- Developed,Medium Intensity (50-79%)
- Developed, Low Intensity (21-49%)
- Developed, Open Space (< 20%)

N

0 1,100 2,200

Feet

S:\GIS\Projects\209xxx\209061 Mukilteo On Call Task Order\mxd\Hydro Study\Impervious Surfaces.mxd (ATR 12/27/2010)

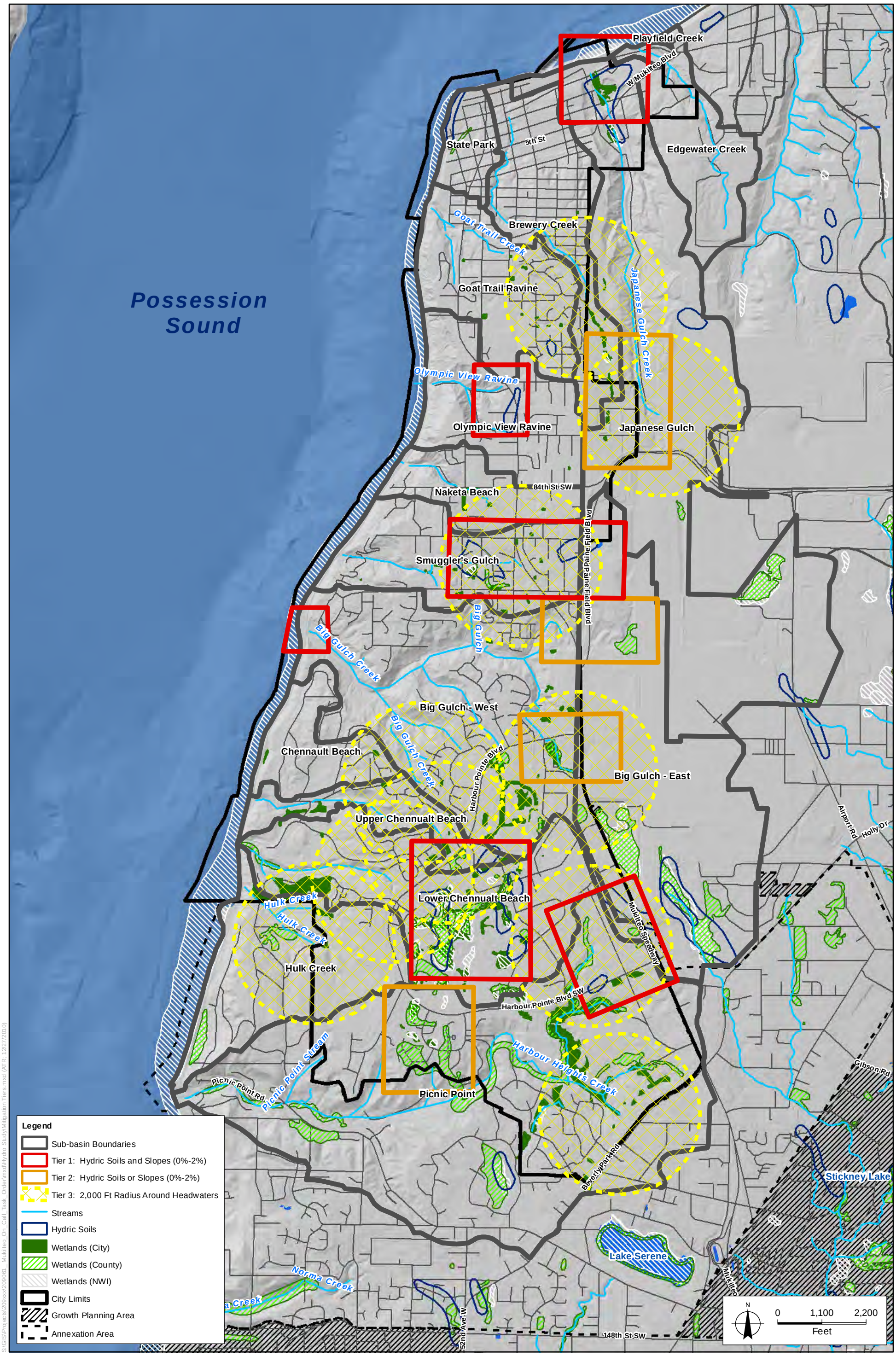
SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A3

Impervious Surface

Mukilteo, Washington



S:\GIS\Projects\209xx\209061_Mukilteo_On_Call_Task_Order\mxd\Hydro Study\Mitigation Tiers.mxd (ATR: 12/27/2010)

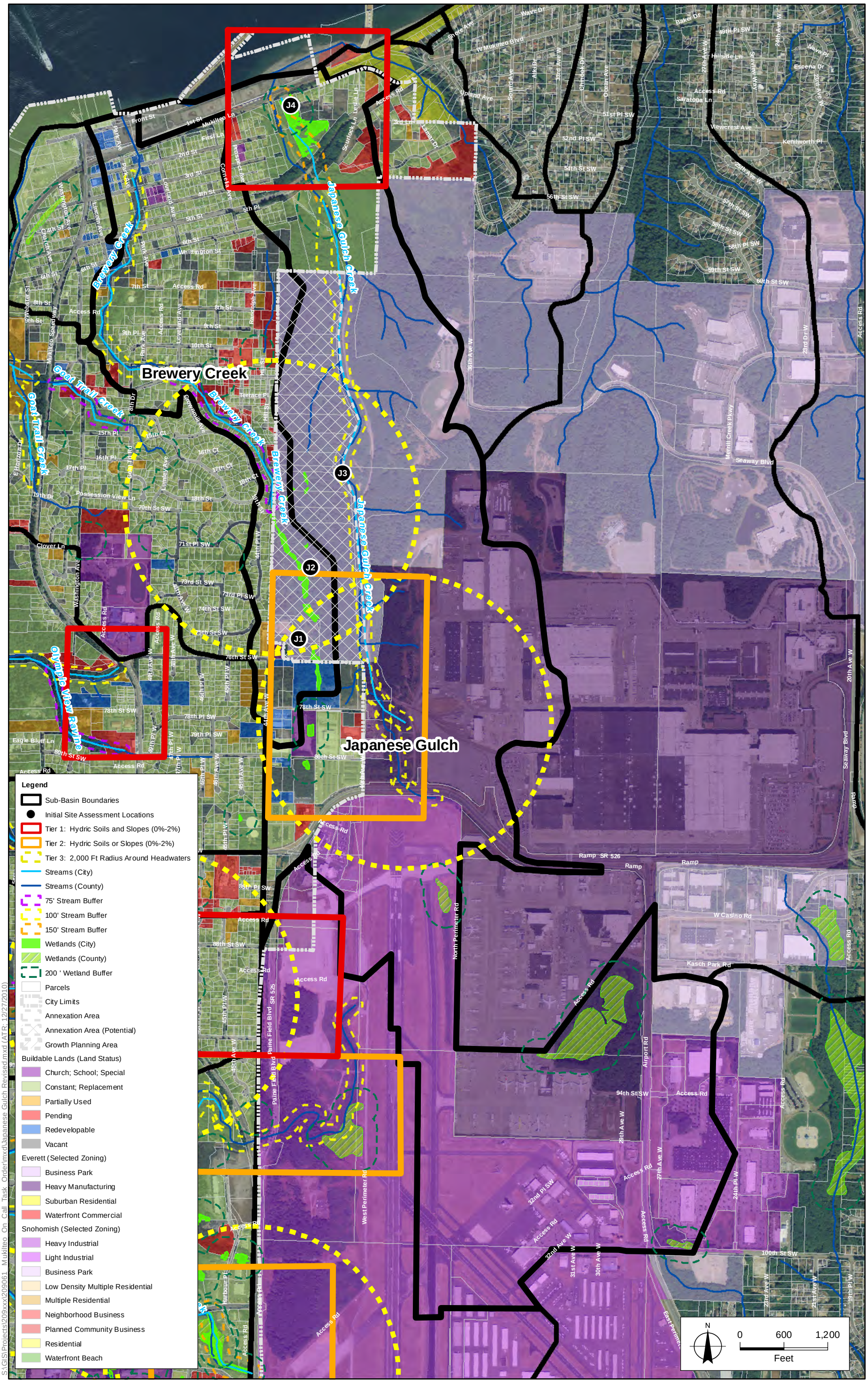
SOURCE: City of Mukilteo 2009; Snohomish County, 2008; PSLC (LidAR), 2005

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A4

Tiers of Potential Wetland Restoration Target Areas

Mukilteo, Washington



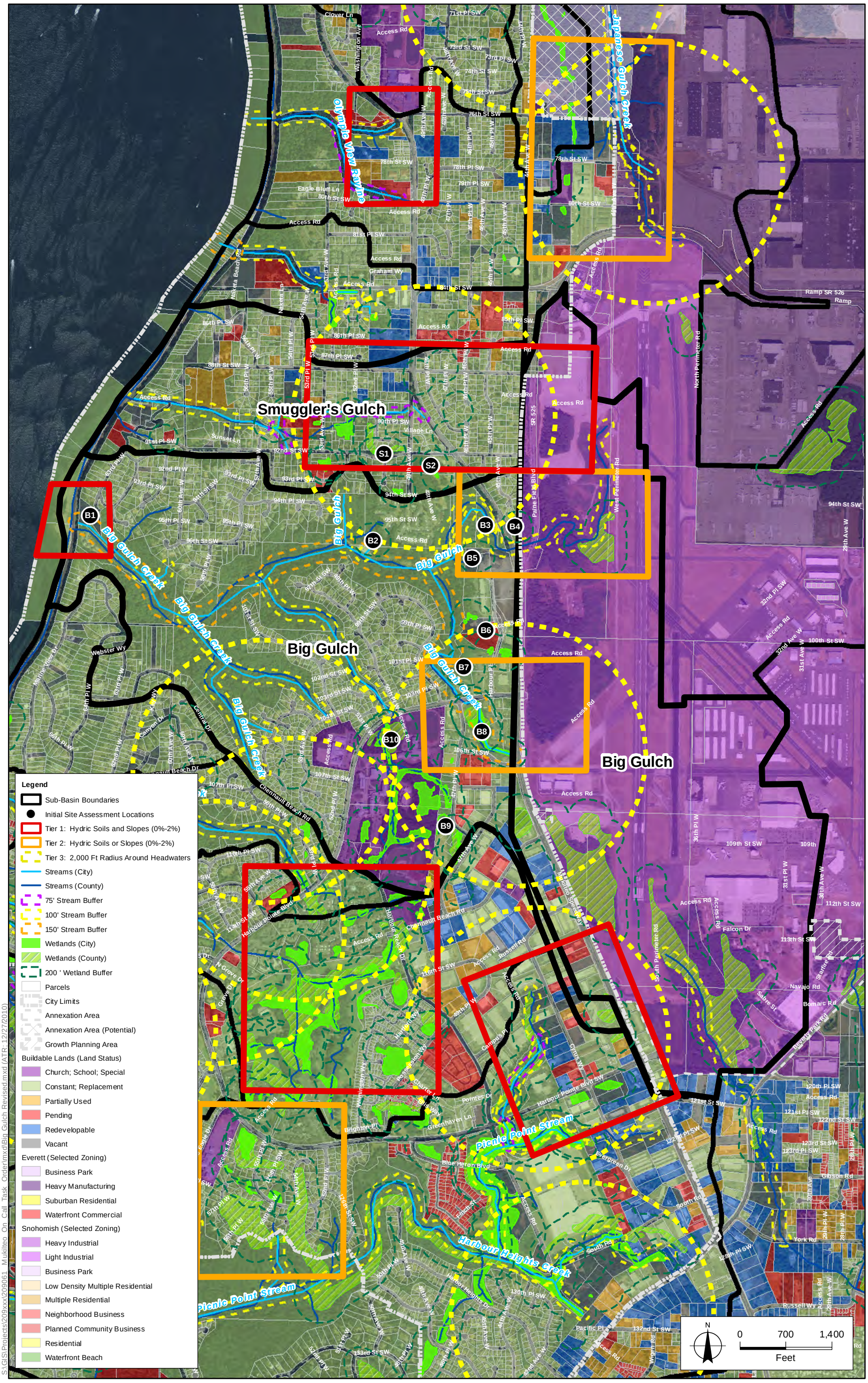
S:\GIS\Projects\209xxx\209061 Mukilteo On Call Task Order\mxd\Japanese Gulch Revised.mxd (ATR: 12/27/2010)

SOURCE: City of Mukilteo, 2010; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A5

Japanese Gulch and Brewery Creek
Wetlands, Streams, and Buildable Lands
Mukilteo, Washington

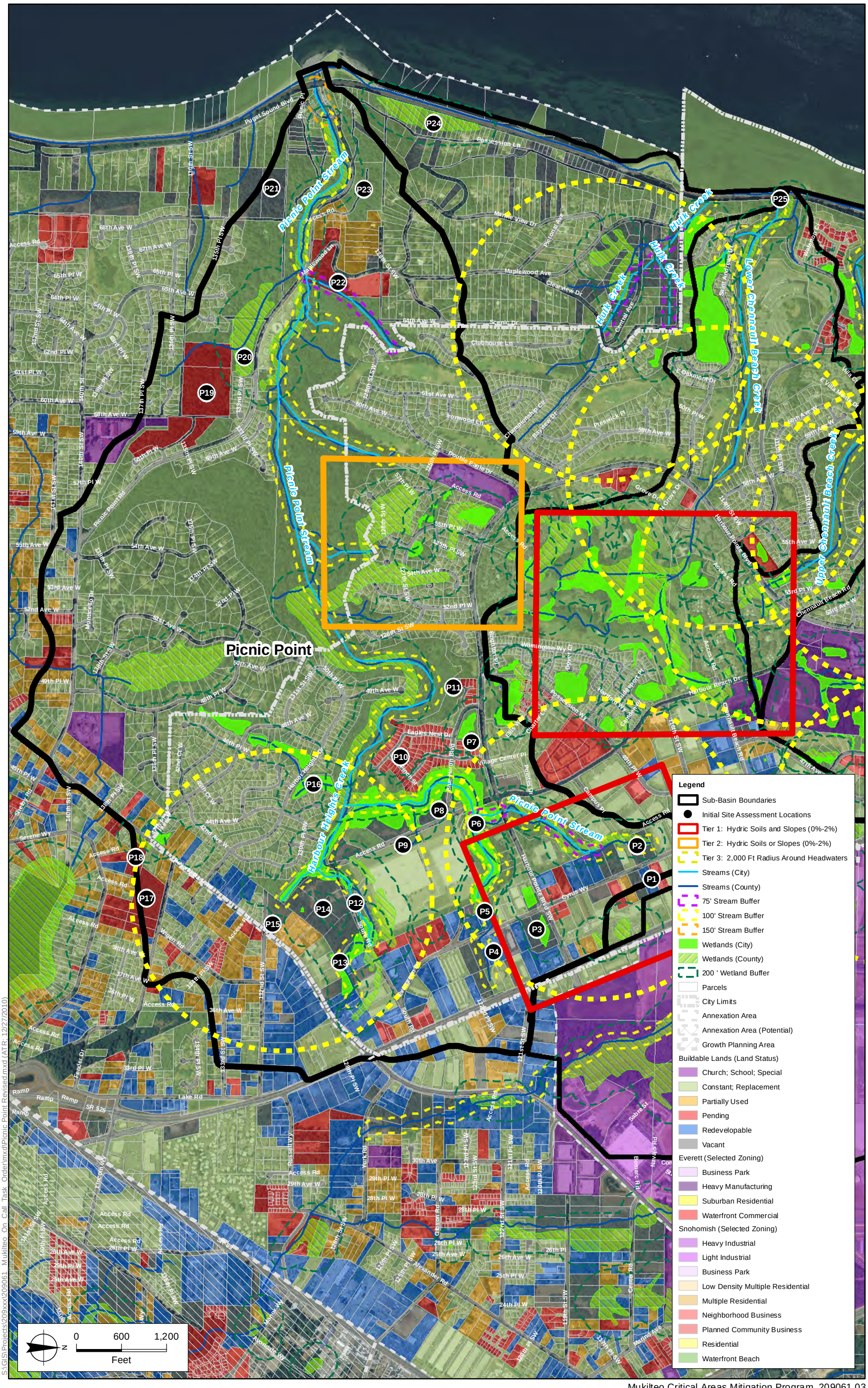


SOURCE: City of Mukilteo, 2010; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A6

Big Gulch and Smuggler's Gulch
Wetlands, Streams, and Buildable Lands
Mukilteo, Washington



SOURCE: City of Mukilteo, 2010; Snohomish County, 2008; NAIP (USDA), 2009 (Aerial)

Mukilteo Critical Areas Mitigation Program. 209061.03

Figure A7

Picnic Point

Wetlands, Streams, and Buildable Lands

Mukilteo, Washington

APPENDIX B: PRELIMINARY RESTORATION PLANS: BIG GULCH "POCKET" ESTUARY

BIG GULCH ESTUARY RESTORATION PROJECT

Initial Alternative Development and Feasibility Study

Prepared for:

City of Mukilteo

June 2009

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APPENDIX A. CHANNEL CROSS SECTIONS

APPENDIX B. CONCEPTUAL DESIGN DRAWINGS

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1.0 INTRODUCTION

The City of Mukilteo has the opportunity to acquire a land parcel north of the current mouth of Big Gulch Creek. This parcel has previously been identified for restoration potential because of its proximity to both the mouth of Big Gulch Creek and the marine nearshore of Puget Sound (WRIA 8, 2005). The purpose of this report is to identify specific restoration actions that could occur in this location and investigate the feasibility of those actions.

Big Gulch Creek is the largest ravine in the City of Mukilteo, draining approximately 1.9 mi^2. Big Gulch Creek is a perennial stream that flows past the Mukilteo Water and Wastewater Treatment Plant (WWTP) prior to flowing under the Burlington Northern Santa Fe (BNSF) railroad tracks into Puget Sound via a 60-inch corrugated metal pipe (CMP). The creek currently flows through a straightened and armored reach for approximately 550 feet along the WWTP.

The site's restoration potential has previously been discussed in WRIA salmon recovery documents. In general, there appears to be the opportunity to create intertidal habitat on the landward (east) side of the BNSF tracks. This would create a small estuary in this location as Big Gulch Creek would flow through this feature and through a larger culvert or trestle system.

This type of restoration action is considered to be technically challenging because: (1) the site has been significantly disturbed, (2) changes have occurred to the natural hydrology of Big Gulch Creek, and (3) the project target is to create a system that was not necessarily present prior to site disturbance.

This report is organized to:

1. Present the landscape context of the site.
2. Identify goals, objectives, and constraints to restoration on the site.
3. Present two restoration alternatives.
4. Provide hydraulic model results investigating the two alternatives.
5. Discuss findings and implications of this work.

2.0 LANDSCAPE CONTEXT

Big Gulch Creek flows into the eastern shore of Puget Sound, approximately 10 shoreline miles south of the lower Snohomish River estuary, and near the southern end of Whidbey Island. Big Gulch contains a perennial stream that is currently conveyed to the Sound via a 60-inch CMP under the BNSF railroad. A recent survey by Hammond Collier Wade Livingstone (HCWL) indicates that the culvert invert elevation is at 7 to 8 feet, using NAVD 88 vertical datum (note: all elevations discussed herein are presented in NAVD 88).

The property that is proposed to be acquired is approximately 2.2 acres, bounded to the west by the BNSF railroad right-of-way. To the south and east, the site is bounded by Mukilteo Water and Wastewater District and City of Mukilteo property. The site is forested with young alders (10 to 20 years old). The existing channel of Big Gulch Creek is straight, and has been constrained by development of the WWTP to the south.

2.1 Nearshore Processes

Nearshore processes clearly dominate on the western side of the BNSF railroad berm. Daily tidal elevations reach the rock riprap on the berm, and many high tides reach into the existing Big Gulch Creek culvert.

Drift cell mapping developed and maintained by the Department of Ecology indicates a prevailing right to left (south to north) drift pattern in this area. Washington Department of Natural Resources (DNR) shorezone mapping indicates that the entire shoreline is disturbed in this area, likely due to the railroad berm.

Substrate mapping in this area shows “sand and gravel beach, narrow” south of the culvert and “sand flat” north of the culvert. This shift in substrate condition is probably the result of the northerly drift of sediment from the creek once it reaches the Sound. Eelgrass is mapped as patchy through this area. Topographic variation on the delta surface, especially the northern portion, could support marine communities.

The stream that drains Big Gulch has formed a delta extending into Puget Sound. The feature is evident on recent aerial photography, and most shoreline mapping recognizes the delta shape in this location. The functioning of the delta has been altered by the installation of the railroad berm and the WWTP. The tendency of the stream channel to meander on the delta surface has been reduced or eliminated by the placement of the culvert and straightened channel above the berm.

Using geomorphic classification schemes by Shipman and others, this delta was likely a tide and wind dominated river delta (PSNERP, 2008). The surrounding uplands result in a relatively narrow gap (380 feet) at the transition between fluvial and nearshore processes. This gap likely has influenced the form of the delta and limited the upstream extent of tidal influences to the stream valley.

The form and functioning of nearshore areas is strongly influenced by tidal processes. Key tidal elevations from the NOAA tide gauges in Everett and Seattle are presented in Table 1.

Table 1. Tidal elevations for NOAA Seattle and Everett gauges for the most recent epoch. Heights are in feet NAVD 88.

Datum	Seattle	Everett
Mean Higher High Water (MHHW)	9.02	9.06
Mean High Water (MHW)	8.15	8.18
Mean Low Water (MLW)	0.49	0.77
Mean Lower Low Water (MLLW)	-2.34	-2.03

Seattle data based on continuous measurements from 1983 to 2001
Everett data based on continuous measurements from 1983 to 1996

Using these elevations along with field measurements and observations, it appears that the high tide currently moves through the existing 60-inch CMP culvert. However, the distance it moves into the existing channel east of the BNSF railroad berm is limited to less than 100 feet from the upstream end of the culvert, and does not extend out of the active channel on either bank. The greatest extent of marine influence likely occurs at high tides combined with westerly winds driving waves through the culvert.

2.2 Freshwater Riverine Characteristics and Processes

Big Gulch Creek flows along the north side of the WWTP facility along its lower 1,000 feet. For much of that reach, the left bank has been armored with rock riprap and/or gabion wall to protect the access road for approximately 450 feet.

This entire reach is shaded under a riparian forest canopy that is dominated by red alder with few conifers. The understory is dominated by Himalayan blackberry. Riparian forest occurs along the river-right (north bank) and shades the entire channel. Riparian forest also occurs on the river-left (south) side of the channel in the lower 150 feet.

On May 11, 2009, ESA Adolfson staff surveyed seven cross-sections of the channel to assess channel geometry and support the development of a hydraulic model of the site (Appendix A). The data were collected during low tide, so the profile was extended approximately 350 feet west of the culvert onto the beach (Figure 1). Elevations were compared to site features (e.g., catch basins, culvert inverts) shown on the HCWL survey, and should be considered internally consistent but approximate.

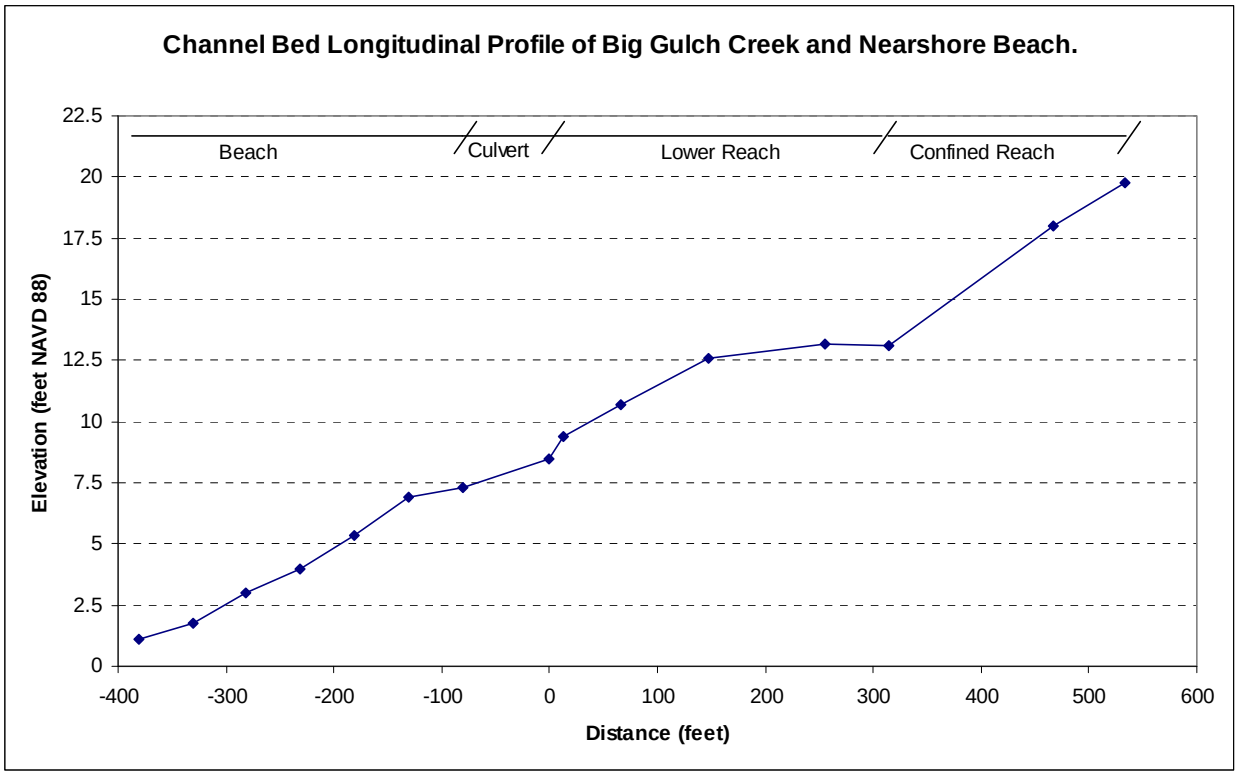

Figure 1. Longitudinal profile of lower Big Gulch Creek, collected in May 2009

The channel profile through the site shows an overall bed slope of 2%. An interesting deviation from the overall bed slope occurs at the downstream end of the confined and armored reach. Our interpretation is that bed load is conveyed within the confined reach, and aggrades at the point where the channel cross-section broadens out.

We also collected two 100-particle pebble counts (Wolman, 1954) within the project reach. One was collected in the confined reach and one in the lower, broader section. Both results were similar, consisting mainly of fine gravels. Particle sizes are shown in Table 2.

Table 2. Particle sizes at two locations within lower Big Gulch Creek.

Size	Location 1: 70 feet upstream of culvert (inches)	Location 2: In gabion-confined reach (inches)
D16	0.50	0.72
D30	0.93	1.01
D50	1.25	1.34
D84	2.28	2.48
D95	3.27	3.86

2.3 Hillslope Characteristics and Processes

Big Gulch is one of several ravines that drain into Puget Sound along this portion of the coastline. Mass failures along the tall, steep sides of these ravines are thought to be significant sources of sediment to stream channels and the nearshore (Snohomish County, 2002). Several recent slope failures are evident along this reach of stream. These types of failures can have significant impacts on the function of the stream system and certainly have the potential to influence how a potential restoration site would develop.

2.4 Existing Flooding Patterns

Flooding can occur in this location as a result of Big Gulch Creek overflowing its banks, coastal flooding from Puget Sound, or a combination of the two. WWTP staff indicate that Big Gulch Creek overflows its banks onto the access road on a regular basis (every other year). This location has a sandbag berm on top of the gabion wall. The cross-sectional area of this portion of the creek is smaller than the up- and downstream reaches, as the channel is confined between armoring to protect the access road and the hillslope. This appears to be a hydraulic constriction in the system. Other less frequent flooding is typically associated with a debris jam in the creek, according to WWTP staff. This project would not specifically address either flooding issue, but would provide greater floodplain volume.

Coastal flooding can occur as a result of tides, winds, and storm surge. FEMA has mapped the coastal flood zone in this location at elevation 13.7 NAVD 88. This elevation is currently contained within the channel on the site. Any proposed excavation of a new channel would therefore increase the area of potential coastal flooding on the project site, but would not extend coastal flooding toward the WWTP.

3.0 PROJECT GOALS AND CONSTRAINTS

Considering the alterations that have occurred, it seems reasonable to approach the restoration effort with the following general goals:

- Enhance fish habitat within the lower reach of the creek by improving passage through the culvert, and increasing tidal influence within the channel.
- Increase the spatial and vertical extent of saltwater and freshwater mixing in this location. The formation of a longer, deeper channel system in this location will maximize potential saltwater and freshwater mixing.
- Increase water storage volume on the site, especially below MHHW. This will support greater saltwater and freshwater mixing, and maximize the tidal prism on the site to allow for a self-maintaining channel system.
- Create a more dynamic channel system. This system would maximize channel length, utilize multiple channels, and provide greater water storage.
- Improve water quality by maximizing water-soil contact time.

These goals are generally consistent with the "channel modification" management technique described in a recent Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) guidance document that is currently in preparation (PSNERP, in prep.). The overall objectives of channel modification are shown in the conceptual relationship in Figure 2.

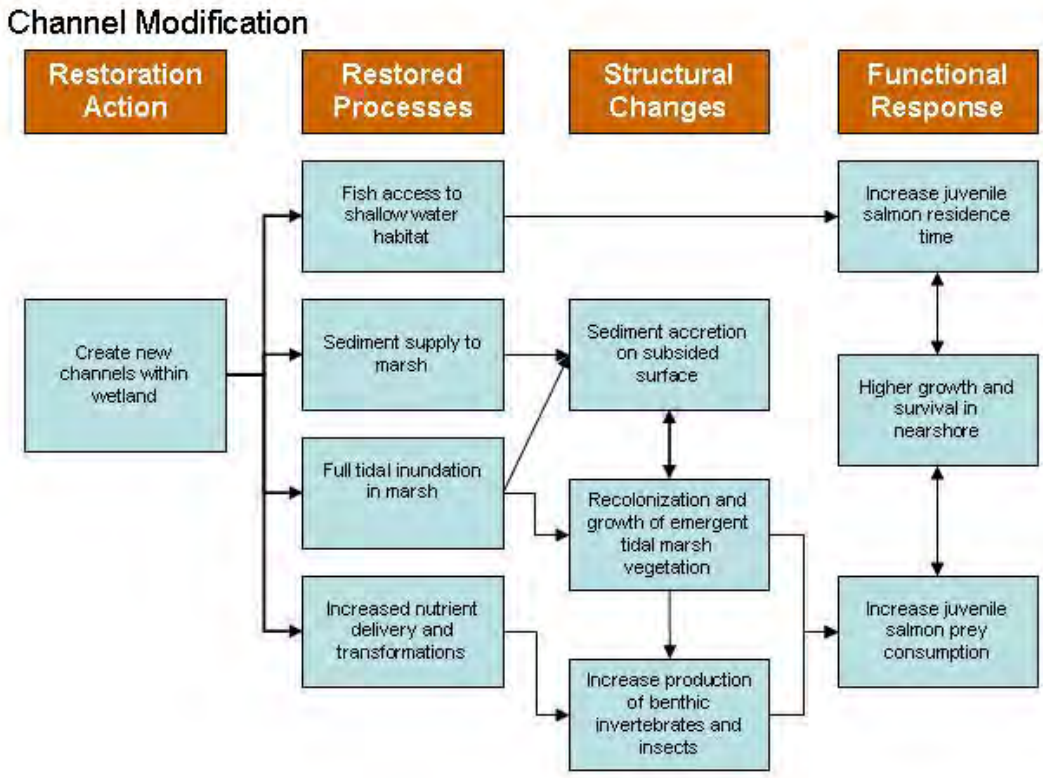

Figure 2. Conceptual functional response patterns targeted for the proposed restoration actions. From PSNERP, in prep.

3.1 Specific Goals and Objectives

Setting goals and objectives is a key first element in any restoration project. Determining the desired outcomes provides the design process with benchmarks to measure against and provides a framework that can be used to guide key decisions. In considering the potential restoration of ecosystem functions discussed above, we have identified the following goals and specific objectives.

Goal 1: Maximize water depth, duration of inundation, and tidal flux of water within the intertidal zone east of the railroad tracks.

Currently, aquatic habitat east of the railroad berm is limited to a narrow, straightened channel upstream of a failing culvert. The site currently provides very limited intertidal habitat, consisting of backwater and limited wave action upstream through the culvert at high tides. The transition between freshwater riparian and saltwater beach is abrupt, occurring at the culvert under the railroad berm. This project is intended to maximize intertidal habitat to the extent possible.

Objective G1.1: Excavate a new channel/estuary system that extends below MHHW.

Objective G1.2: Install larger/lower culvert under the BNSF tracks.

Goal 2: Target a self-sustaining, dynamic, fluvial ecosystem.

Big Gulch Creek forms a delta at the project site as sediments generated in the gulch are deposited in the intertidal zone. Therefore, sedimentation is a natural process that could act to reduce tidal flux into the site as sediments are deposited within the new channel/estuary system. Therefore, the excavated channel will need to be constructed to anticipate and work with this natural process.

Objective G2.1: Anticipate natural sedimentation processes and design the channel/estuary system to allow for natural sediment dynamics within the delta, but still meet Goal 1.

Goal 3: Restore a diverse native vegetation community.

This type of project provides an opportunity to install a diverse native vegetation community. In this case, the project could protect and restore the marine riparian forest and establish estuarine intertidal habitat.

Objective G3.1: Install native tree, shrub, and herbaceous plant species.

Objective G3.2: Maintain and manage the developing plant community to eliminate non-native invasive weeds and foster a trajectory toward mature riparian forest and estuarine intertidal habitat.

3.2 Project Constraints

There are a number of constraints on the project site. Major constraints include topographic elements, operational elements associated with the WWTP, and uncertainties regarding the speed of fluvial and coastal processes after this type of restoration.

3.2.1 Topographic Constraints

The steep hillsides to the north and east of the project area limit the extent of excavation that is practicable on the site. The hillslope also reaches the right bank of the existing active channel approximately 300 feet east of the railroad tracks. This location marks the upstream extent of any proposed work in the intertidal zone. Vertical excavation beyond this point would require substantial earth removal and hillslope stabilization, which was deemed impractical for this project.

The BNSF railroad berm and nearshore beach form the western extent of the project area. The BNSF railroad berm extends up to approximately 18 feet NAVD 88. On the landward side of the berm, there is a slight swale, but the berm is near existing grade for much of the area. On the waterward side, the berm is approximately 1H:1V and is stabilized with large rock riprap.

This area of the nearshore has a gravel beach, transitioning to sand to the north. The beach has a variable surface that is higher near the culvert outfall. This area is around 7.0 feet NAVD 88, extending up to 10 NAVD 88 feet in small areas. To the north, the beach profile drops to 5 to 6 feet elevation NAVD 88. Therefore, it is not feasible to have a mouth or significant volume below 5 feet NAVD 88, as nearshore sediment transport would quickly fill that volume.

The existing culvert under the BNSF berm is a 60-inch CMP, with the upstream invert at 7.2 feet and downstream invert at 7.0 feet. We observed 0.1 to 0.2 feet of sediment accumulation in the bottom of the culvert during the field survey.

3.2.2 Operational Constraints

The WWTP will continue to operate on this site. The primary influences this has on the restoration design include:

- We assume that the overall site layout (e.g., buildings and access road) will remain the same.
- We will avoid disturbance to the existing WWTP outfall pipe. The base map suggests that the pipe is approximately 8 to 10 feet NAVD 88, which prevents excavation to intertidal depths along the pipe alignment.
- The restoration project needs to be designed to either maintain or reduce the level of flooding within the WWTP facility.

There is also the potential to develop a more formal access from the main WWTP to the outfall pipe catch basins as part of this project. This has not been pursued at this time but should be considered during the design process.

3.2.3 Design Uncertainty

This feasibility study is designed to assess elements of how the restoration alternatives will perform. However, the restoration alternatives are specifically designed to engage natural processes where the outcomes will be uncertain. Additional studies can be done to limit or constrain this uncertainty, but it will never be fully eliminated.

4.0 RESTORATION ALTERNATIVES

We developed two general restoration alternatives for this effort using the project goals, objectives, and constraints discussed above in Section 3. In general, these alternatives are intended to provide an envelope around the maximum and minimum excavation quantities necessary to develop some level of intertidal habitat on the project site. Both alternatives rely on a passive restoration approach that anticipates that riverine and coastal processes will act to shape the site and finetune the overall form. This approach recognizes that there is uncertainty about the rapidity of geomorphic processes in this area, and therefore provides an initial form that meets design objectives but allows the site to develop. Elements of the design are included to prevent undesirable outcomes (e.g., significant erosion, hillslope destabilization).

The sheets in Appendix B provide conceptual grading plans, sections, and profiles for each alternative.

4.1 Alternative 1

Alternative 1 consists of the excavation of a bowl to resemble a pocket estuary separated from Puget Sound by a barrier beach (the BNSF berm) (Sheets 3 and 4). This alternative would result in flow within Big Gulch Creek being routed through a broad excavated area north of the existing channel. This excavated area would flow out of new larger culvert under the BNSF berm directed to a lower portion of the existing beach. Alternative 1 was developed to maximize the area below MHHW within the constraints of:

- Avoiding excavation over the existing WWTP outfall pipe.
- Avoiding disturbance to the toeslope of the hill (approximately 20 feet NAVD 88).
- Limiting slopes to 3H:1V or less steep.
- Limiting earthwork within the BNSF right-of-way.

The bottom elevation of the excavation was chosen to be 4 feet NAVD 88 to provide greater than 3 feet of depth below MHHW. This bottom elevation also limits the channel bed slope required to match the grade in the existing channel.

One consequence of this level of excavation is that the channel bed slope is necessarily increased from the relatively consistent overall 2% grade to over 5% since a greater drop is occurring over a shorter distance. This will result in greater velocities during low tide that have implications for channel stability on this site and for upstream reaches. This change will be limited to some extent since high tides will reduce the actual water surface slope. The initial hydraulic model results confirm high velocities in this area during low tide (discussed further in Section 5). To address this issue, we included a log weir structure to control the elevation drop in this area.

Alternative 1 would also include installing a log sill and retaining the existing channel and culvert. This has the benefit of increasing conveyance during high flows, and increasing the area of wetland on the site. This channel could also capture some sediment during high flows.

4.2 Alternative 2

Alternative 2 was developed to minimize excavation while still developing intertidal habitat (Sheets 5 and 6). Alternative 2 is similar to Alternative 1, but is generally smaller in all dimensions. Alternative 2 was also developed with a focus on providing a more defined channel for freshwater flows. This is intended to reduce the potential for sediment deposition within the excavation. This channel would also have a broad mouth directly upstream of the culvert which will allow tidal access to an intertidal bench.

Alternative 2 would fill the lower 130 feet of the existing channel. This would further minimize the off-site haul of excavated materials, and would allow the existing culvert to be filled and abandoned. Leaving this lower section of channel open could easily be added to Alternative 2, if desired.

Alternative 2 was also envisioned to be a possible future outcome of Alternative 1. This scenario assumes that Alternative 1 results in net sedimentation over time, and at least a portion of the site fills in with sediment. Alternative 2 allows for two-thirds of the excavated volume (10,000 CY) to be filled.

4.3 Culvert Design

To streamline this analysis, we selected a 10-foot-wide box culvert with 45-degree wingwalls for the new passage through the BNSF railroad berm. This culvert would more than double the current cross-sectional area of the pipe. The proposed culvert has the following characteristics:

- Top elevation at 13 feet NAVD 88 – this provides 5 feet of clearance to the tracks, and replicates the existing top of culvert.

- Bottom elevation at 3 feet NAVD 88 or below. This allows for the use of a standard 10-foot by 10-foot box and would locate the bottom well below any expected channel invert elevation.

- The culvert would have a natural channel substrate.

- The initial culvert bed elevation would be placed at 5 feet NAVD 88, consistent with the general elevation of the beach in the new stream mouth location. We have assumed that the profile will build up to around 7 feet, consistent with existing conditions at the culvert. If the opening remains at or near 5 feet, it would allow greater tidal flux into the site.

This culvert design is considered as the minimum conveyance feature that would be installed in this location. Other designs, including trestles, or larger box culverts that could also allow public access to the beach, could be considered for this location. The culvert considered here was used to support the hydraulic analysis, and other larger configurations would only improve conveyance through this location.

4.4 Alternative Comparison

Both alternatives are shown in conceptual plans and sections on Sheets 3-6. To allow for more direct comparison, Table 3 provides specific characteristics of each alternative.

Table 3. Big Gulch Estuary alternative comparison.

	Existing Conditions	Alternative 1	Alternative 2
Required excavation	--	15,000 CY	5,000 CY
Volume below MHHW (9 feet NAVD 88)	<15 CY (<11.5 m^3)	2,100 CY (1,600 m^3)	580 CY (443 m^3)
Area below MHHW	<200 ft^2	19,850 ft^2	11,500 ft^2
Area below 6 feet NAVD 88	0 ft^2	11,800 ft^2	1,100 ft^2
Overall channel bed slope (ft/ft)	2%	1.6%	1.5%
Maximum channel bed slope (ft/ft)	2%	5%	4%

The most significant difference between the two alternatives is the amount of excavation below MHHW. Both result in similar plan-view areas that would be inundated by tides, but Alternative 1 would have substantially more volume of tidal flux. From a cost perspective, assuming $15/CY for excavation and haul, the difference in excavation costs between the two alternatives is approximately $150,000 more for Alternative 1 than Alternative 2.

For Alternative 1, the volume below MHHW is at the low end of the regression equations developed for San Francisco Bay tidal marshes (Williams et al., 2002). This volume (1,600 m^3) was found to support outlet channels that have top widths of around 6 feet and depths below MHHW of around 3 feet. This suggests that the tidal volume that could be created within the site has reasonable likelihood of maintaining an open outlet channel in the absence of freshwater inputs. Furthermore, this would locate the channel invert elevation at around 6 feet NAVD 88, in the middle of our anticipated range of 5 to 7 feet. For this situation, tidal processes are modified by the significant freshwater and potential sediment inflow process from Big Gulch

Creek. In the current state, Big Gulch Creek appears to be able to transport gravel through the lower reach, and a current and continuing supply of gravel is available from upstream. Therefore, since tidal flux within a protected embayment often is limited in terms of sediment transport, it appears likely that an excavation like Alternative 1 would result in a depositional environment.

Deposition would be expected to continue until the site reached a dynamic equilibrium between the sediment and freshwater inputs and the tidally-driven water levels. The rate at which the site will develop to a more stable form is difficult to predict, and is in part dependant on climatic conditions and activities throughout the watershed. In general, the significant work that has been performed throughout the Big Gulch Creek channel for the sewer line project is anticipated to reduce sediment production and loading over time.

5.0 HYDRAULIC MODEL

Several hydrologic and hydraulic issues could be used to guide the development and comparison of restoration alternatives for Big Gulch in this location. The depth and durations of tidal inundation, flooding extents, and velocities through the restored channels could also influence patterns of sediment transport.

To provide an initial investigation into the hydraulics of the proposed restoration site, an unsteady one-dimensional (1D) model of the site using the Hydrologic Engineering Center – River Analysis System (HEC-RAS) version 4.0 was developed. This is a standard hydraulic model distributed by the Corps of Engineers. A model of existing conditions was developed and adjusted to generally match site observations and anecdotal accounts of flooding during high flows. Models of the proposed alternatives were developed using the conceptual grading plans shown on Sheets 3 and 5.

5.1 Methods

The unsteady model requires three general types of inputs: (1) upstream and downstream boundary conditions, (2) channel geometry, (3) channel roughness. The data type and source used in this model are presented in Table 4.

Table 4. Model inputs for Big Gulch Estuary.

Input	Existing Conditions	Proposed Alternatives
Upstream boundary condition (flow)	Low (2 cfs) and high (200 cfs) [1] flows based on Comprehensive Stormwater Master Plan (TetraTech, 2001). Hydrographs synthesized using shape factors based on watershed characteristics. Low flows investigated for a longer time period to analyze potential durations during juvenile salmonid migration. High flows investigated for a shorter duration to simulate winter storms.	Same as existing.

Input	Existing Conditions	Proposed Alternatives
Downstream boundary condition (stage)	NOAA tides measured at Seattle for June 2008. This era was chosen to correspond with juvenile outmigration in the Sound. High flows were coupled with a shorter tidal period from January 2009, chosen to correspond with this year's significant storms.	Same as existing.
Channel geometry	ESA Adolfson surveyed cross-sections in May 2009. Sections were extended to the overbank using 2005 LiDAR data.	Developed from conceptual grading plan, extended to hillslope using 2005 LiDAR data.
Channel roughness	Estimated to be 0.035 in the active channel, 0.045 on densely vegetated banks, 0.040 on rock riprap banks.	Estimated to be 0.035 in the active channel, 0.045 on densely vegetated banks, 0.040 on rock riprap banks.
Culvert	60" CMP	10' box culvert open from elevation 7' to 13' NAVD 88.

[1] *After initial modeling was complete, we received new data from HCWL suggesting that high flows can reach over 330 cfs, based on their measurements. This should be further investigated in future design work.*

We understand that previous stormwater modeling for Big Gulch may have overestimated peak flows. We have retained the higher value as an overestimate to assess high flow scenarios.

5.2 Results

Overall, the results appear to be physically realistic within the limitations of a 1D model. That said, we did not perform any sensitivity analyses on these results.

Our initial findings from these results are summarized below:

1. The 10-foot-wide culvert appears to allow for full tidal inundation of the excavated area with no or limited hydraulic constriction. The culvert does flow full width during high tide.

2. The tidal influence does not have backwater influence past the proposed excavation during lower flows.

3. High flows (200 cfs) backwater at high tide, but the culvert remains clear during January 2009 tides. Flooding reaches elevations up to 11 feet during high tide/high flow conditions.

4. A single run was performed using January 2009 tides adjusted upward to reach the FEMA coastal flood elevation of 13 feet NAVD 88. The top of the proposed culvert is at 13 feet, so the culvert was full for a short time during the simulation. Water surfaces upstream of the culvert were less than 1 foot above the culvert, so no flooding beyond elevation 14 feet is expected.

5. Velocities in the excavated inlet channel to the larger excavation are high (greater than 10 ft/s), suggesting the need for channel stabilization in this reach.

6. Velocities within the broader excavation proposed for Alternative 1 are very low (less than 0.1 ft/s) throughout most of the tide cycle. This is a depth-averaged velocity, so it does not capture the higher velocities that would occur in the upper portion of the flow during ebb tide.

7. Velocities through the channel portion of Alternative 2 are more consistent with the upstream reach, suggesting that this configuration would be able to transport sediment through the restored area. Backwater within the existing channel is limited to high tide, and does not extend more than 400 feet upstream from the culvert.

Selected water surface profiles are included as Appendix C. These results were selected to show high and low tides, with high and low freshwater inflows for both restoration alternatives.

6.0 DISCUSSION

This report provides a context for a restoration site at the mouth of Big Gulch Creek in Mukilteo, Washington. Two restoration alternatives are presented to achieve several project goals, most notably the creation of intertidal habitat in the area east of the BNSF railroad berm.

For Alternative 1, this work suggests that:

- The site can be excavated to provide approximately 19,850 ft^2 and 2,100 CY of intertidal habitat between approximately mean sea level (4 feet NAVD 88) and MHHW (9 feet NAVD 88) without directly disturbing the surrounding toeslope or the WWTP outfall pipeline.

- The hydraulic model confirms that, in its initial state, the area would be completely filled during high tide, and that flooding would not be exacerbated on the site.

- Using tide durations from July 2009, tides will inundate the site approximately 50% of the time, with depths of over 2 feet limited to approximately 25% of the time.

Taken together, these items appear to support the concept that intertidal habitat can be created at the project site with either of the proposed alternatives. We have identified ongoing processes that may limit the long-term sustainability of this habitat. These include:

- The apparent ongoing sediment load from the watershed, combined with the concave longitudinal channel profile through the site and increasing dominance by tidal forces, will likely result in a net depositional environment in the deeper portions of the site.

- To achieve target depths within the excavated area, it will be necessary to increase the channel bed slope to between 4% and 5% in the upper 100 feet of the project reach. This type of channel slope could result in overall channel instability, with the potential for erosion and knickpoint migration upstream. To address this issue, log weirs are proposed in both alternatives to stabilize the channel profile at the upper end of the excavation.

The potential for a depositional area to occur within the excavation could significantly impact the overall feasibility of this project. To assess how fast the proposed intertidal volume could fill, we reviewed watershed sediment yields calculated for generally comparable basins in the Puget Sound lowlands (Table 5). We used these relationships for Big Gulch to estimate potential annual sediment loads at the stream mouth.

Table 5. Calculated watershed sediment yields in the Puget Sound lowlands.

Source	Stream	Drainage Area (mi^2)	Dominant Land Uses	Sediment Yield (tons mi^{-2} $year^{-1}$)
Nelson and Booth (2002)	Issaquah Creek	55	Forest/urban	61
Madej (1982)	Big Beef Creek	14.7	Forest/Logging/ Urban	204
Barton (2002)	Pipers Creek	2.9	Urban/Forest	132

Big Gulch drains approximately 1.9 mi^2 and has urban and forested land uses. For Alternative 1, approximately 2,100 CY of volume below MHHW would be excavated. Using the ranges of sediment yields in Table 5, the annual sediment load at the mouth could be between 116 and 388 tons/year. Using these values and assuming a ratio of 1.4 tons/CY, it would take between 7 and 25 years for enough sediment to be generated from the watershed to fill the intertidal area. This time range is a low estimate of time to fill, since it is likely that at least the finer sediment fraction will be transported through the site to the nearshore. Also, significant work is currently ongoing throughout the basin to reduce sediment input and stabilize the existing channel. This analysis does not include sediment input from the nearshore.

Using the same assumptions for Alternative 2, it would take approximately 2 to 7 years for enough sediment to be generated to fill the volume below MHHW. However, this time frame is not anticipated to occur, as the more focused flows through Alternative 2 would allow for greater transport to the nearshore.

The possibility of deposition within the excavated area could be addressed in two ways. First, the system could be allowed to self-adjust. This has the benefit of achieving long-term sustainability with minimum maintenance. The drawback is that the system may evolve to have minimal intertidal habitat. Second, dredging could be implemented within an adaptive management framework. This would increase the long-term level of effort for the project, and would require that the plantings and site development be designed to allow future vehicle access. This could be coordinated with the WWTP operations to access the outfall pipe. Both alternatives will benefit from careful post-construction monitoring.

6.1 Sea Level Rise

Another process to consider in the long-term functioning of this project is the possibility of sea level rise. Mote et al. (2008) recently calculated potential sea level rise projections specific to the Puget Sound region. These scenarios predict sea level rise ranging from 3 to 22 inches by 2050 and 6 to 50 inches by 2100, depending on the emissions scenario. Likely amounts of rise are around 12 inches with significant variance in the predictions. This level of rise would certainly have implications for this project.

In general terms, this project has been designed in a way that allows the system to respond to external forces, including tidally driven water levels. Higher average water levels would be able to enter the site through the proposed culvert, and may result in greater tidal flux than was used during the design. Potential implications of this rise include:

- Greater erosion through time as the overall tidal prism increases.
- Adjustment of plant and animal communities to the new typical water levels.

The restoration alternatives provide a relatively shallow gradient from the aquatic to upland areas, so they should provide space for plant and animal communities to adjust. However, adaptive management may be necessary over the long term to address changes if water level adjustments occur faster than ecological processes can adjust.

Greater sea level rise could also force adjustments to infrastructure in the area, such as the BNSF rail line or the WWTP, that could have implications for this project. These should be anticipated in any longer term adaptive management plan.

6.2 Future Work

Several issues will require additional design work in future phases. The most notable elements of this work include:

- Geotechnical investigation to assess the impacts this excavation may have on the surrounding hillslopes.
- Revise model to simulate the higher measured flows.
- Development of planting plans.
- Hydrologic monitoring.
- Development of a monitoring and adaptive maintenance plan. This will need to determine if dredging will be a part of the long-term plan for this site.

7.0 REFERENCES

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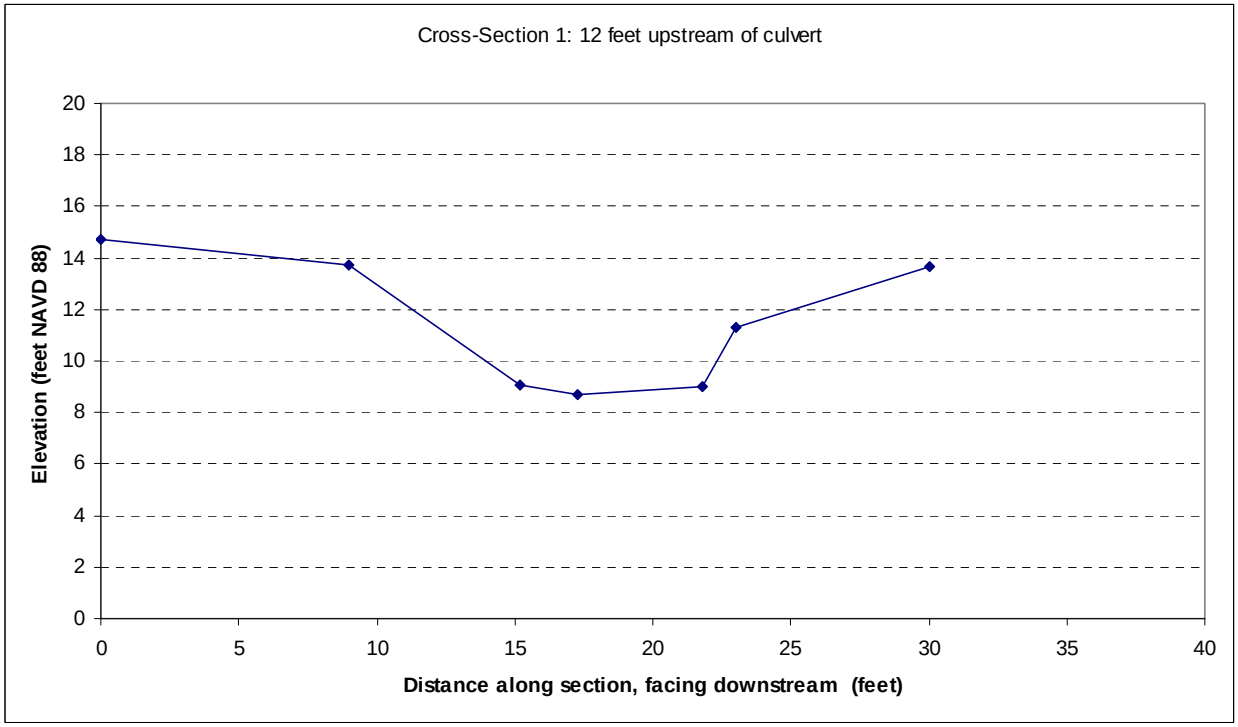
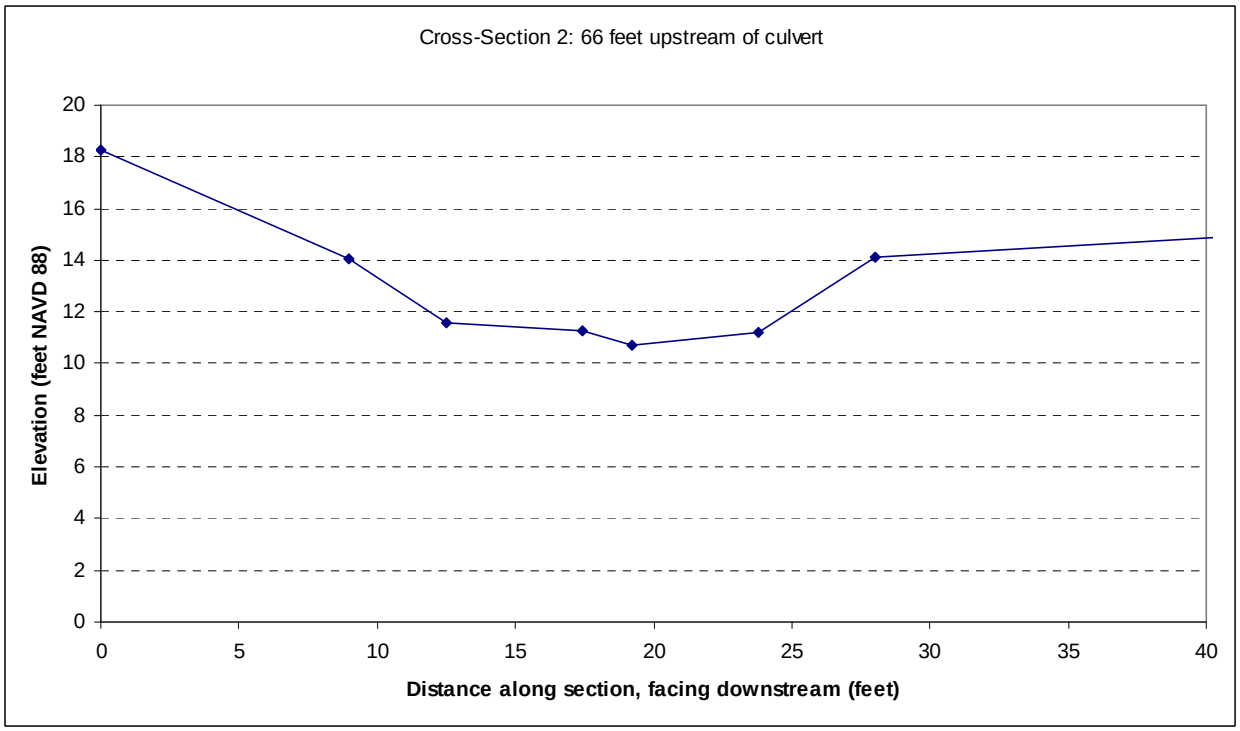
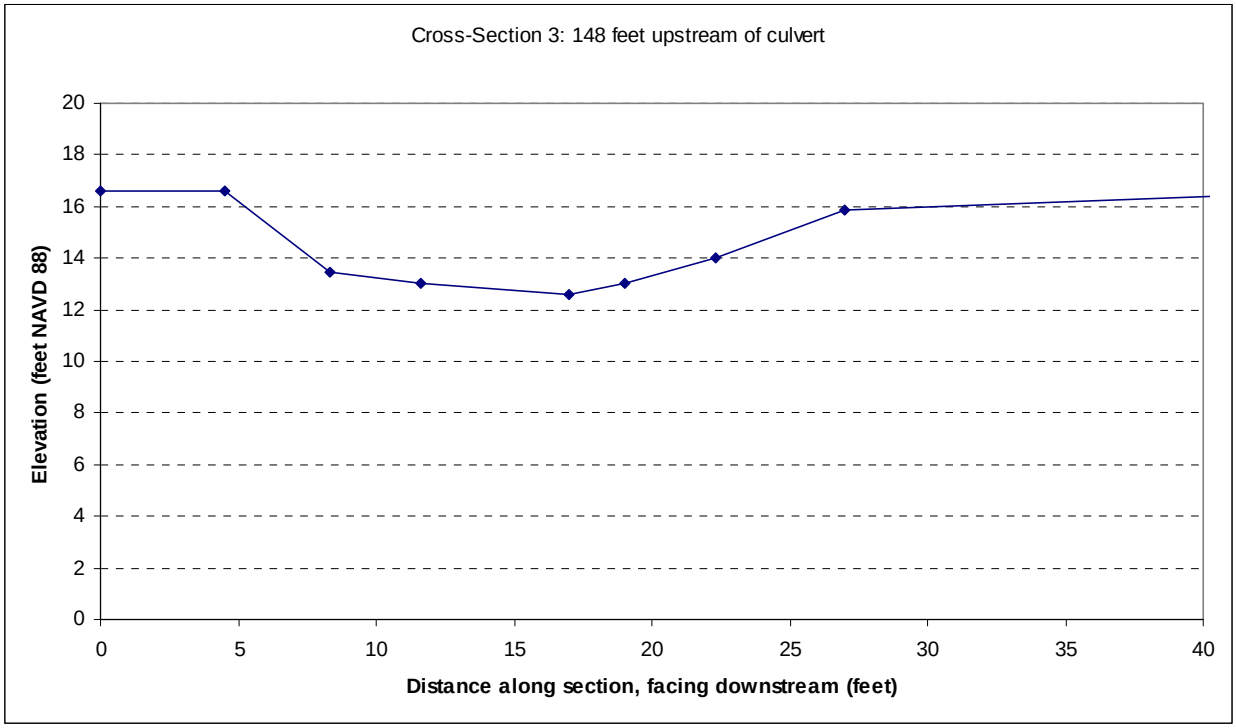
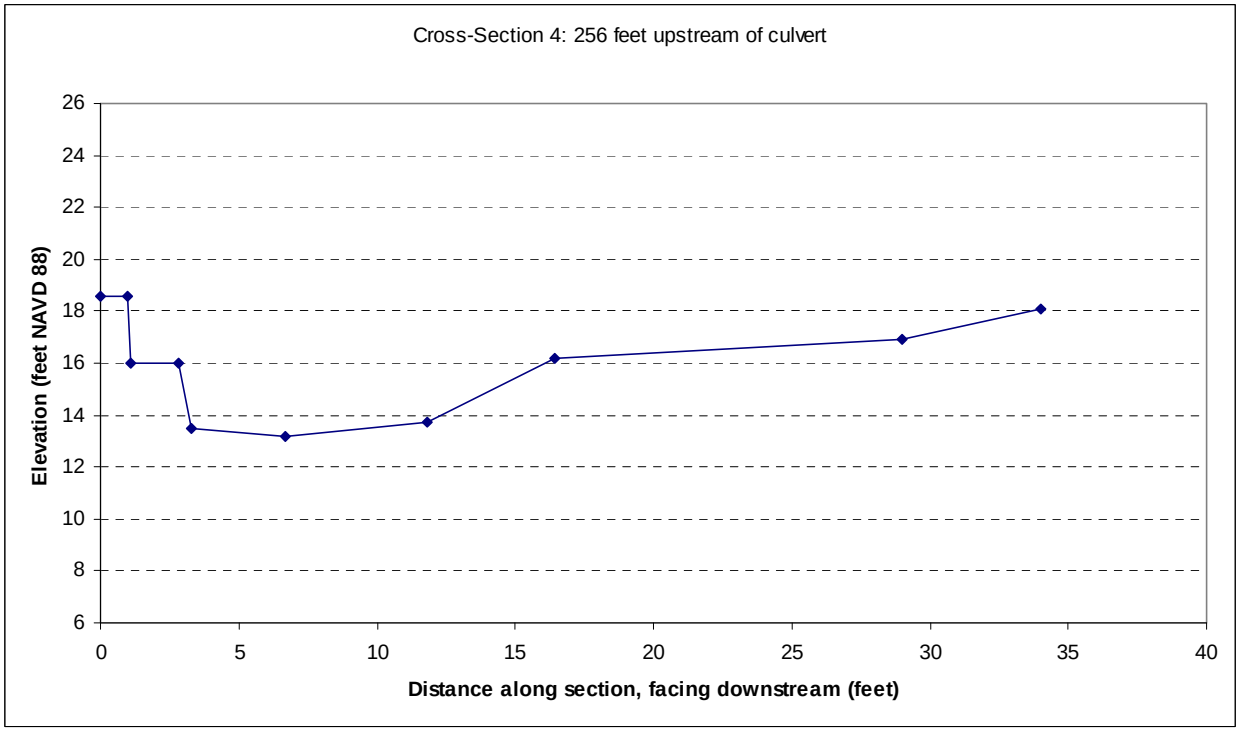
APPENDIX A. CHANNEL CROSS SECTIONS

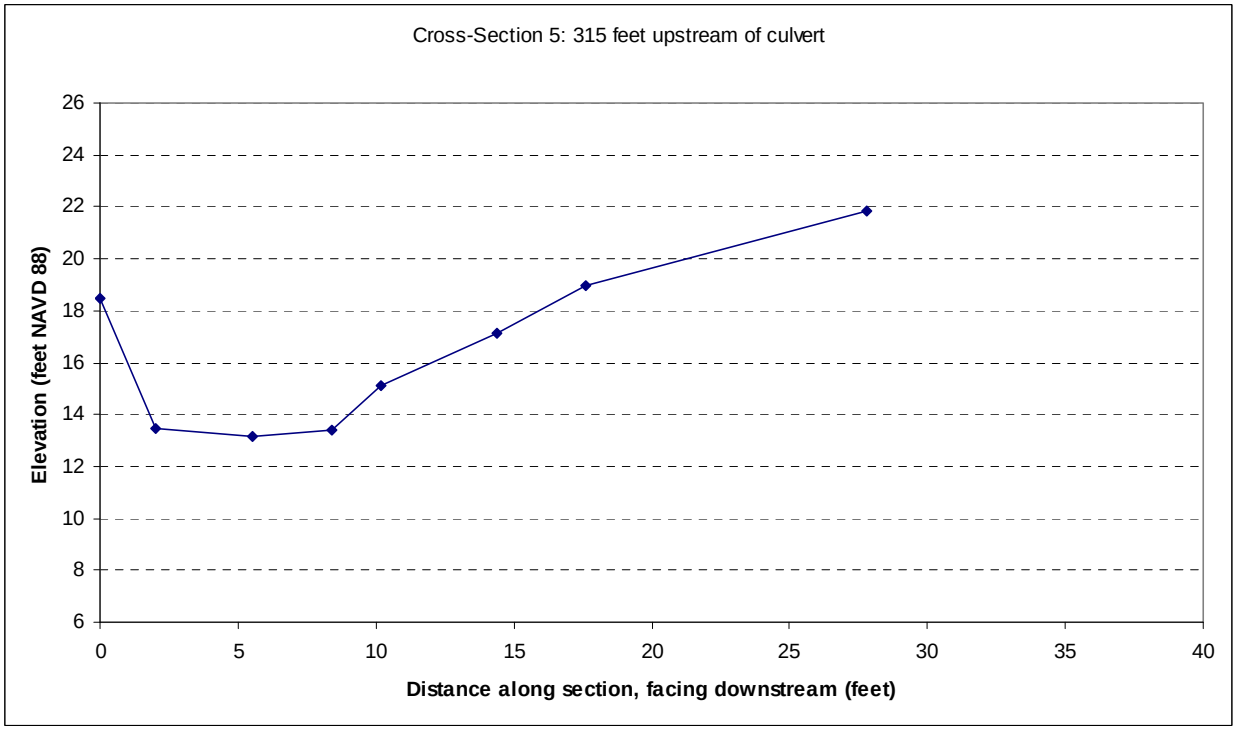
Appendix A. Surveyed Cross-Sections for Big Gulch Creek Elevations based on comparison to HCWL survey of site features (e.g., catchbasins).

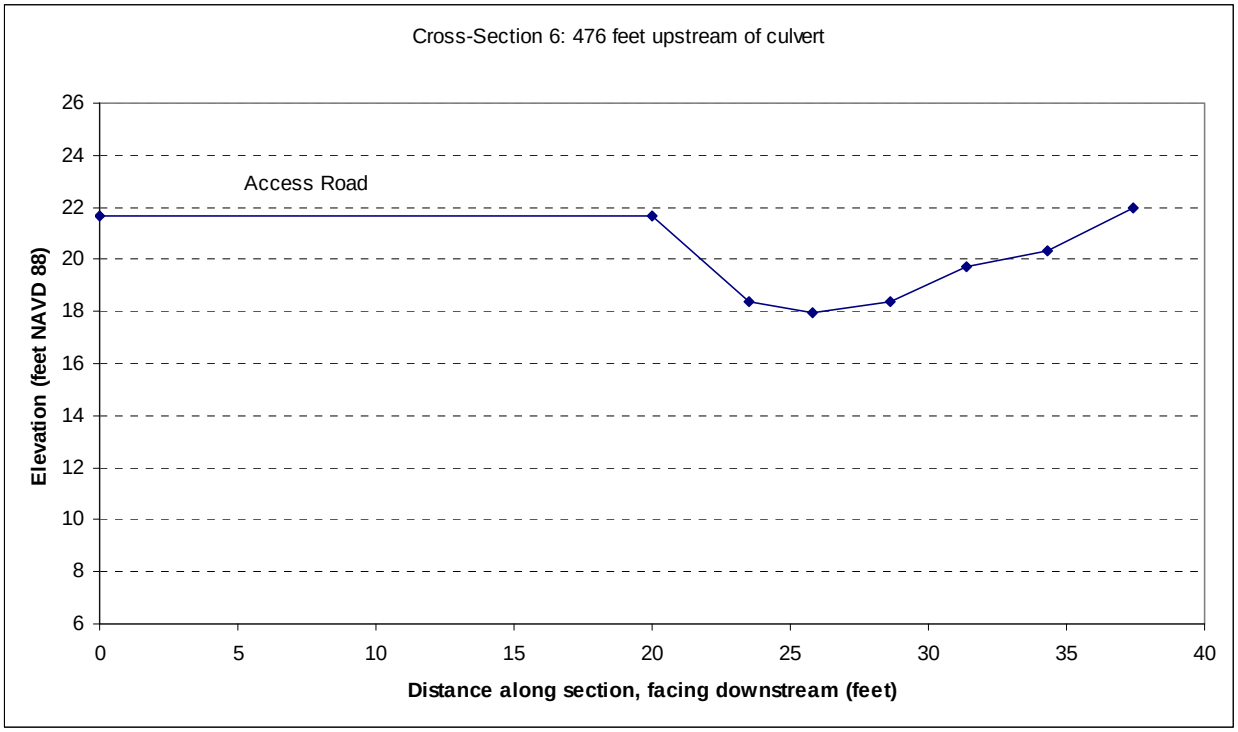


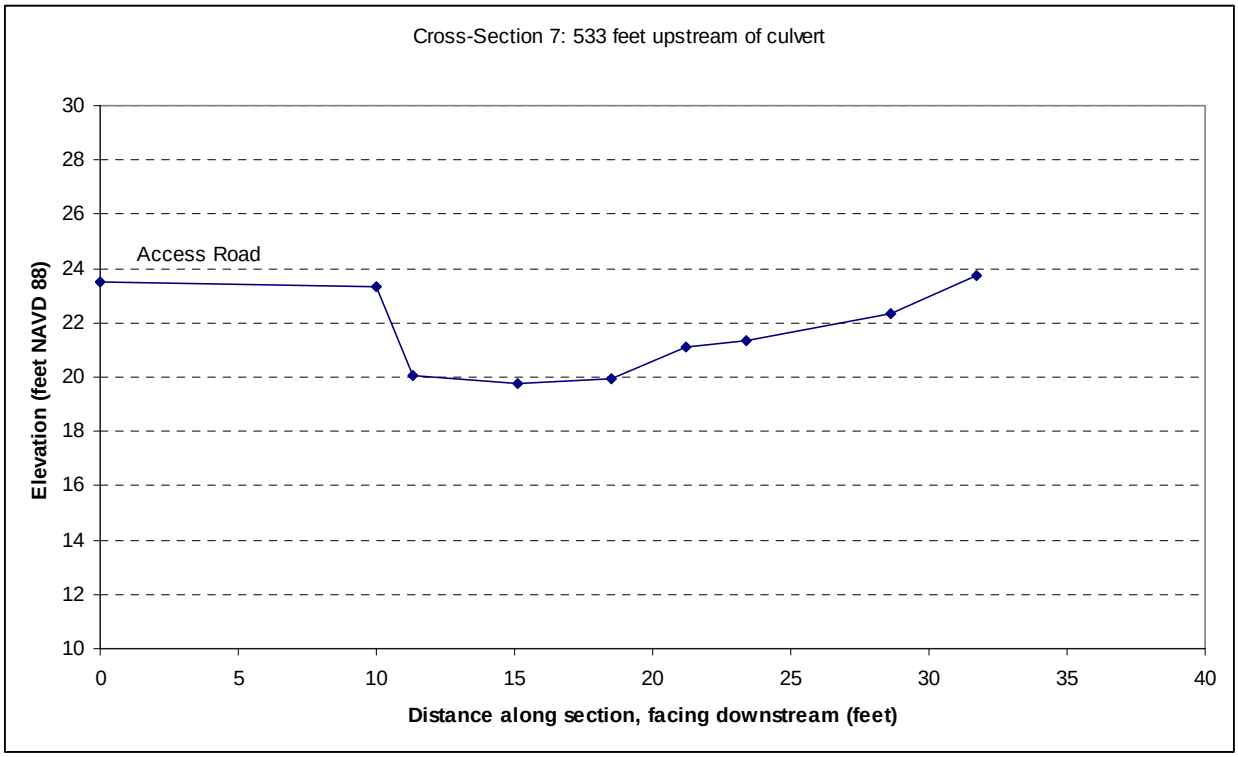



Cross-Section 3: 148 feet upstream of culvert
Elevation (feet NAVD 88)
20
18
16
14
12
10
8
6
4
2
0
0
5
10
15
20
25
30
35
40
Distance along section, facing downstream (feet)


Cross-Section 4: 256 feet upstream of culvert
Elevation (feet NAVD 88)
26
24
22
20
18
16
14
12
10
8
6
0
5
10
15
20
25
30
35
40
Distance along section, facing downstream (feet)


Cross-Section 5: 315 feet upstream of culvert
Elevation (feet NAVD 88)
26
24
22
20
18
16
14
12
10
8
6
0
5
10
15
20
25
30
35
40
Distance along section, facing downstream (feet)


Cross-Section 6: 476 feet upstream of culvert
Access Road
Elevation (feet NAVD 88)
26
24
22
20
18
16
14
12
10
8
6
0
5
10
15
20
25
30
35
40
Distance along section, facing downstream (feet)


Cross-Section 7: 533 feet upstream of culvert
Access Road
Elevation (feet NAVD 88)
30
28
26
24
22
20
18
16
14
12
10
0
5
10
15
20
25
30
35
40
Distance along section, facing downstream (feet)

APPENDIX B. CONCEPTUAL DESIGN DRAWINGS

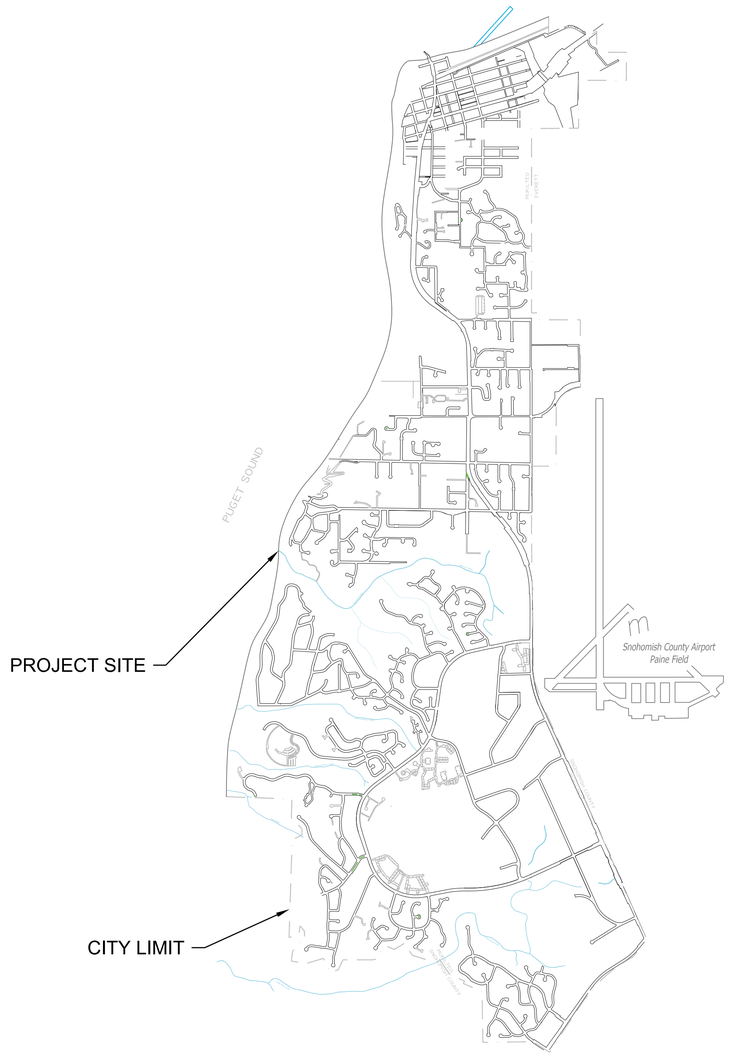
BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
AND FEASIBILITY STUDY

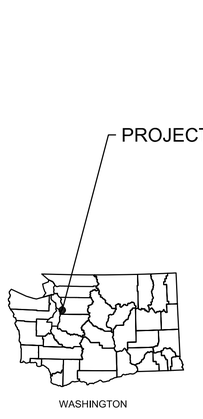
SHEET INDEX:

SHEET 1: COVER
SHEET 2: EXISTING CONDITIONS
SHEET 3: ALTERNATIVE 1 CONCEPTUAL GRADING
SHEET 4: ALTERNATIVE 1 SECTIONS
SHEET 5: ALTERNATIVE 2 CONCEPTUAL GRADING
SHEET 6: ALTERNATIVE 2 SECTIONS
SHEET 7: ALTERNATIVES 1 AND 2 PROFILES

NOTES:

1. THE INTENT OF THIS DRAWING SET IS TO ILLUSTRATE RESTORATION ALTERNATIVES AND SUPPORT A FEASIBILITY STUDY FOR THE MOUTH OF BIG GULCH CREEK IN MUKILTEO, WASHINGTON.
2. THESE DRAWINGS ACCOMPANY A FEASTIBILITY MEMO BY ESA ADOLFSON, JUNE 2009.
3. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HAMMOND COLLIER WADE LIVINGSTON SURVEY.
4. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 2005.
5. PARCEL DATA FROM SNOHOMISH COUNTY
6. VERTICAL DATUM NAVD 88.





CITY OF MUKILTEO • WASHINGTON •
Incorporated 1947

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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ESA Adolfson
5309 Shilshole Ave. NW
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGINEER:	D. CARLTON
DESIGNER:	S. WINTER
DRAFTED BY:	S. WINTER
SCALE:	AS SHOWN
DATE:	JUNE 30, 2009

REVISION	DATE	BY

COVER SHEET

BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET

1 of 7

LEGEND:

- FENCE
- 10' CONTOUR LINE
- 2' CONTOUR LINE
- PROPERTY LINE
- WETLAND
- ORDINARY HIGH WATER EXISTING (APPROX.)
- STORMDRAIN

NOTES:

1. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HCWL 2008 SURVEY.
2. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 2005.
3. PARCEL DATA FROM SNOHOMISH COUNTY
4. VERTICAL DATUM NAVD 88.

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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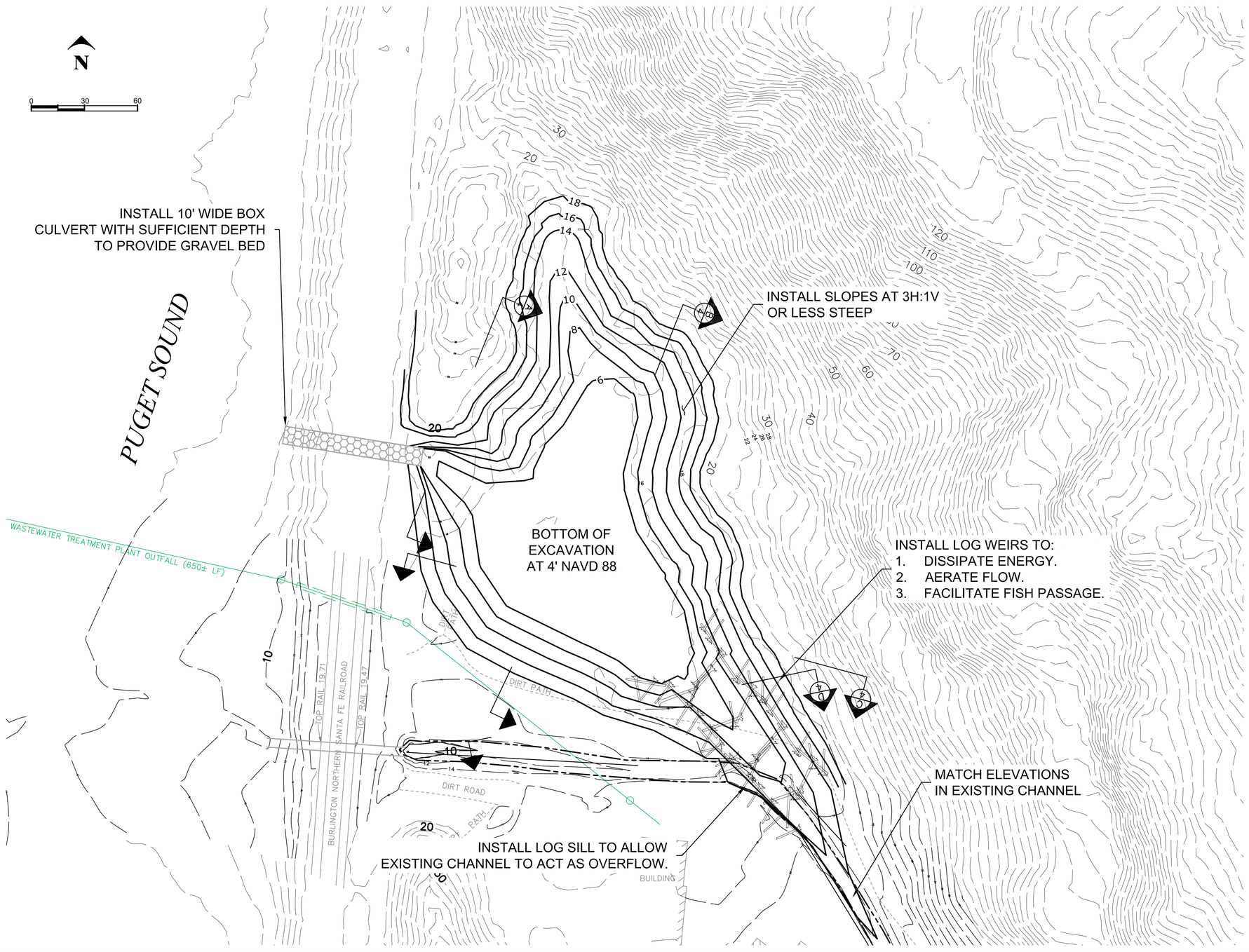
PROJECT ENGINEER:	D. CARLTON
DESIGNER:	S. WINTER
DRAFTED BY:	S. WINTER
SCALE:	AS SHOWN
DATE:	JUNE 30, 2009

REVISION	DATE	BY

EXISTING CONDITIONS

BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON



LEGEND:

- ORDINARY HIGH WATER MARK (APPROX.)
- FENCE
- 10' CONTOUR LINE
- 2' CONTOUR LINE
- PROPERTY LINE
- WETLAND
- STORMDRAIN
- 16 — PROPOSED 2' CONTOURS
- PROPOSED LOG JAM

DESIGN CONCEPTS:

1. MAXIMIZE AREA AT OR BELOW 6' NAVD 88.
2. AVOID EXCAVATION OVER EXISTING WWTP OUTFALL PIPE.
3. MAINTAIN EXCAVATED SLOPES AT 3H:1V OR LESS STEEP.
4. MAXIMIZE VOLUME BELOW 9' NAVD 88 (MEAN HIGHER HIGH WATER).
5. ASSUME BOX CULVERT IS 10 FEET WIDE, OPENING TOP AT 13' NAVD 88 AND BOTTOM IS BELOW 5'.
6. BOX CULVERT WILL HAVE NATURAL CHANNEL SUBSTRATE.
7. MINIMIZE EARTHWORK WITHIN BNSF RIGHT-OF-WAY.

NOTES:

1. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HCWL 2008 SURVEY.
2. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 200X.
3. VERTICAL DATUM NAVD 88.

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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5309 Shilshole Ave. NW
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DESIGNER:	S. WINTER
DRAFTED BY:	S. WINTER
SCALE:	AS SHOWN
DATE:	JUNE 30, 2009

REVISION	DATE	BY

ALTERNATIVE 1 CONCEPTUAL GRADING AND SITE FEATURES

BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET 3 of 7

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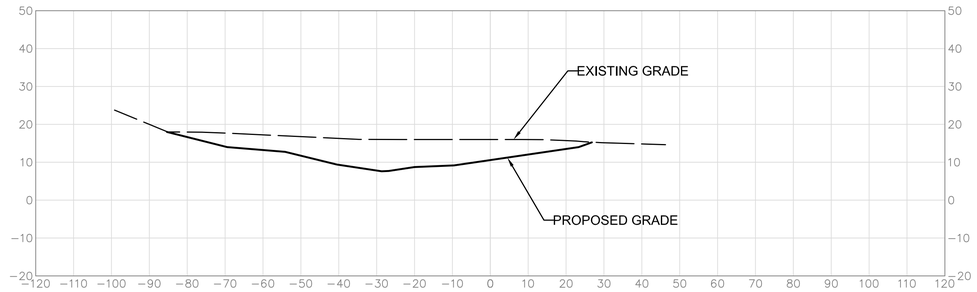
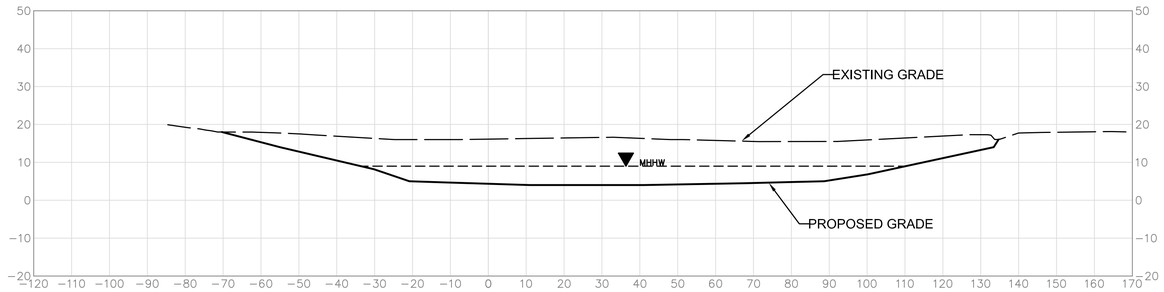


SECTION D (STATION 3+50)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE



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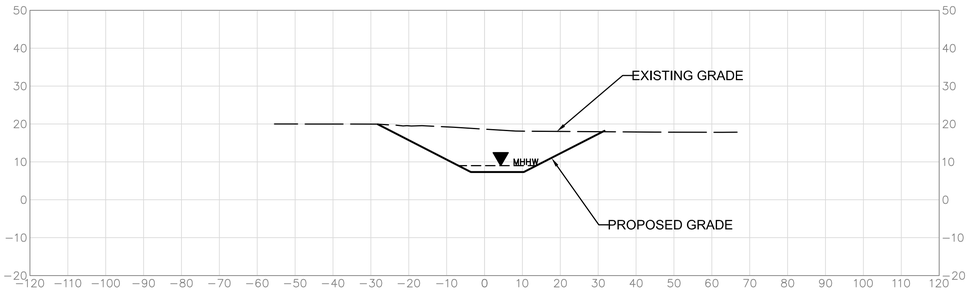
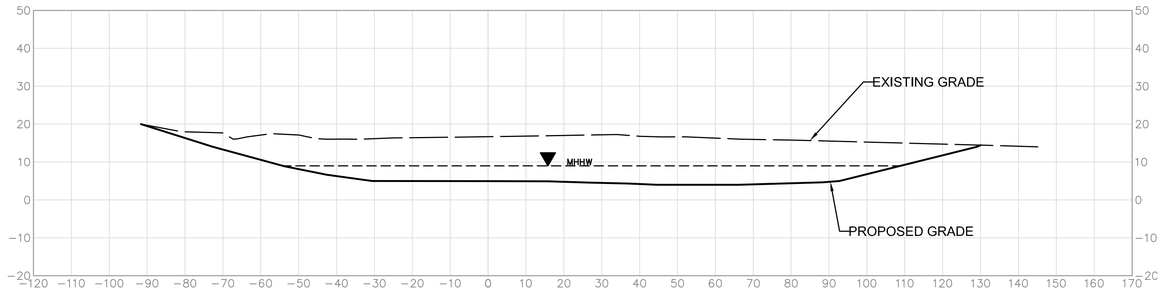
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE



SECTION A (STATION 1+00)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE



SECTION B (STATION 2+00)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE

NOTES:
1. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HCWL 2008 SURVEY.
2. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 2005.
3. VERTICAL DATUM NAVD 88.
4. SECTIONS FACE UPSTREAM
5. MHHW = MEAN HIGHER HIGH WATER

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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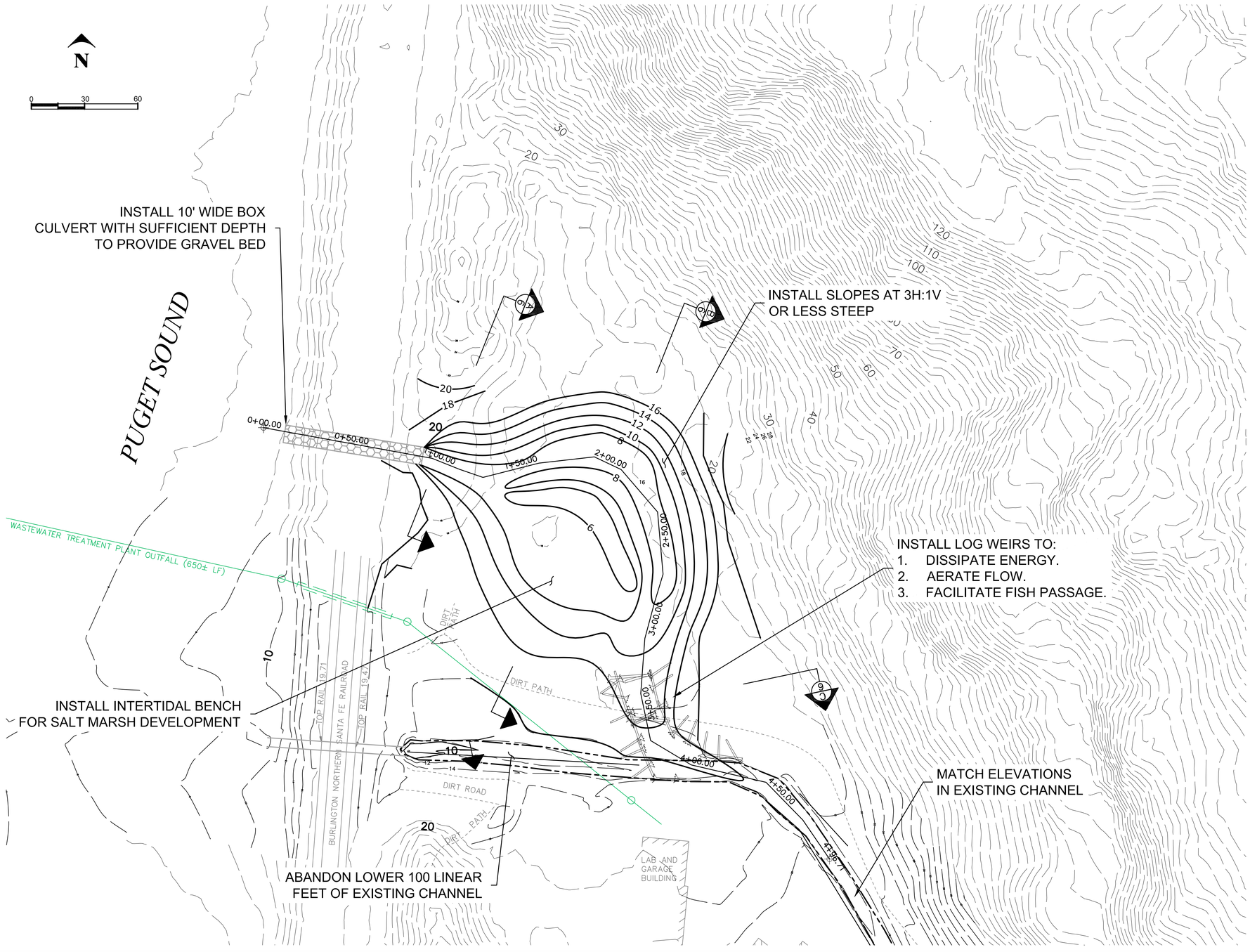
ESA Adolfson
5309 Shilshole Ave. NW
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGINEER:	D. CARLTON
DESIGNER:	S. WINTER
DRAFTED BY:	S. WINTER
SCALE:	AS SHOWN
DATE:	JUNE 30, 2009

REVISION	DATE	BY

ALTERNATIVE 1
PROPOSED SECTIONS
BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET
4 of 7



LEGEND:

- ORDINARY HIGH WATER MARK (APPROX.)
- FENCE
- 10' CONTOUR LINE
- 2' CONTOUR LINE
- PROPERTY LINE
- WETLAND
- STORMDRAIN
- 16 — PROPOSED 2' CONTOURS
- PROPOSED LOG JAM

DESIGN CONCEPTS:

1. AVOID EXCAVATION OVER EXISTING WWTP OUTFALL PIPE.
2. MAINTAIN EXCAVATED SLOPES AT 3H:1V OR LESS STEEP.
3. FOCUS FRESHWATER FLOWS THROUGH A SMALLER CROSS-SECTIONAL AREA .
4. PROVIDE BENCH AT 7 - 9' NAVD 88 FOR SALT MARSH DEVELOPMENT.
5. ASSUME BOX CULVERT IS 10 FEET WIDE, OPENING TOP AT 13' NAVD 88 AND BOTTOM IS BELOW 5'.
6. BOX CULVERT WILL HAVE NATURAL CHANNEL SUBSTRATE.
7. MINIMIZE EARTHWORK WITHIN BNSF RIGHT-OF-WAY.

NOTES:

1. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HCWL 2008 SURVEY.
2. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 2005.
3. VERTICAL DATUM NAVD 88.

CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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DATE:	JUNE 30, 2009

REVISION	DATE	BY

ALTERNATIVE 2 CONCEPTUAL GRADING AND SITE FEATURES

BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET

5 of 7

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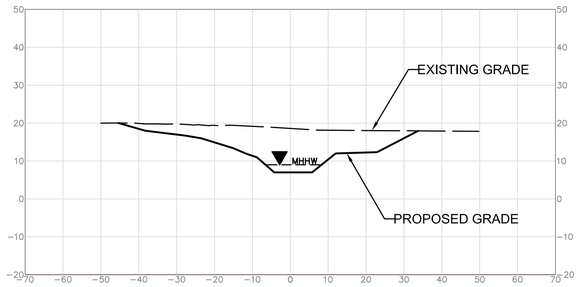
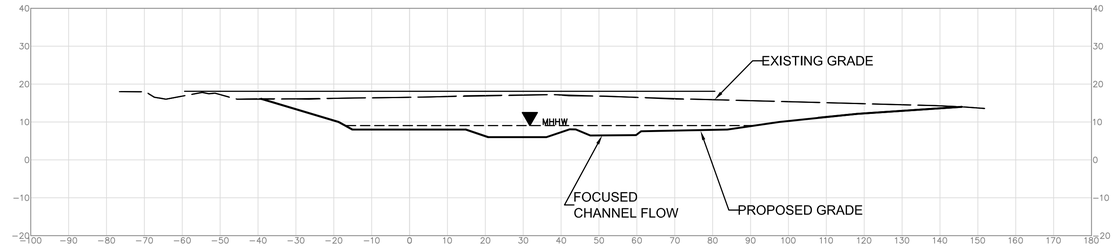
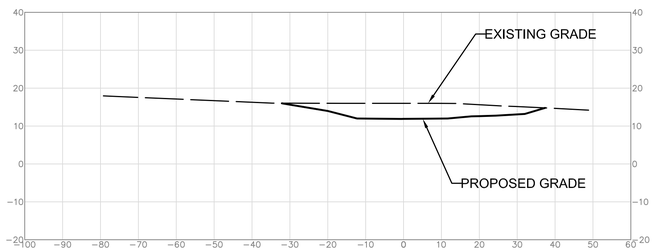


SECTION A (STATION 1+00)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE



SECTION B (STATION 2+00)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE



SECTION C (STATION 3+50)
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE

NOTES:
1. WWTP SITE FEATURES AND CHANNEL TOPOGRAPHY FROM HCWL 2008 SURVEY.
2. SURROUNDING TOPOGRAPHY BASED ON PSLC LIDAR DATA FROM 2005.
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4. SECTIONS FACE UPSTREAM
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CONCEPTUAL PLANS - NOT FOR CONSTRUCTION. ORIGINAL PREPARED AT 22" X 34"

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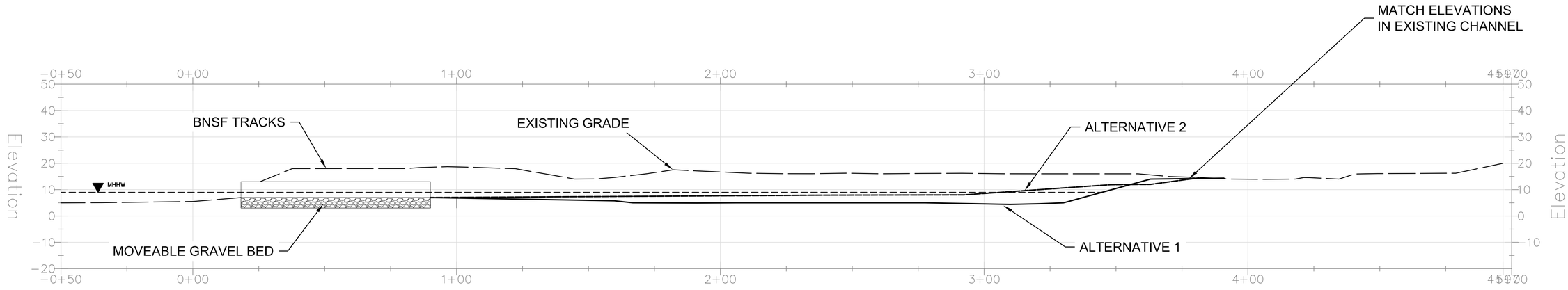
SCALE:	AS SHOWN
DATE:	JUNE 30, 2009

REVISION	DATE	BY

ALTERNATIVE 2
PROPOSED SECTIONS
BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET
6 of 7



CONCEPTUAL PROFILE FOR ALTERNATIVES 1 AND 2
1 INCH = 20 FEET
AT 22 BY 34 INCH SHEET SIZE

NOTES:
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ALTERNATIVES 1 AND 2 PROPOSED PROFILES

BIG GULCH ESTUARY
CONCEPTUAL RESTORATION PLAN
MUKILTEO, WASHINGTON

SHEET

7 of 7

APPENDIX C. SELECTED WATER SURFACE PROFILES

Appendix C: Selected results from 1D unsteady hydraulic model using HEC-RAS

These figures capture the water surface profile through the project area for high and low tides, and high (200 cfs) and low (2 cfs) freshwater flows for each restoration alternative. Elevations based on NAVD 88.

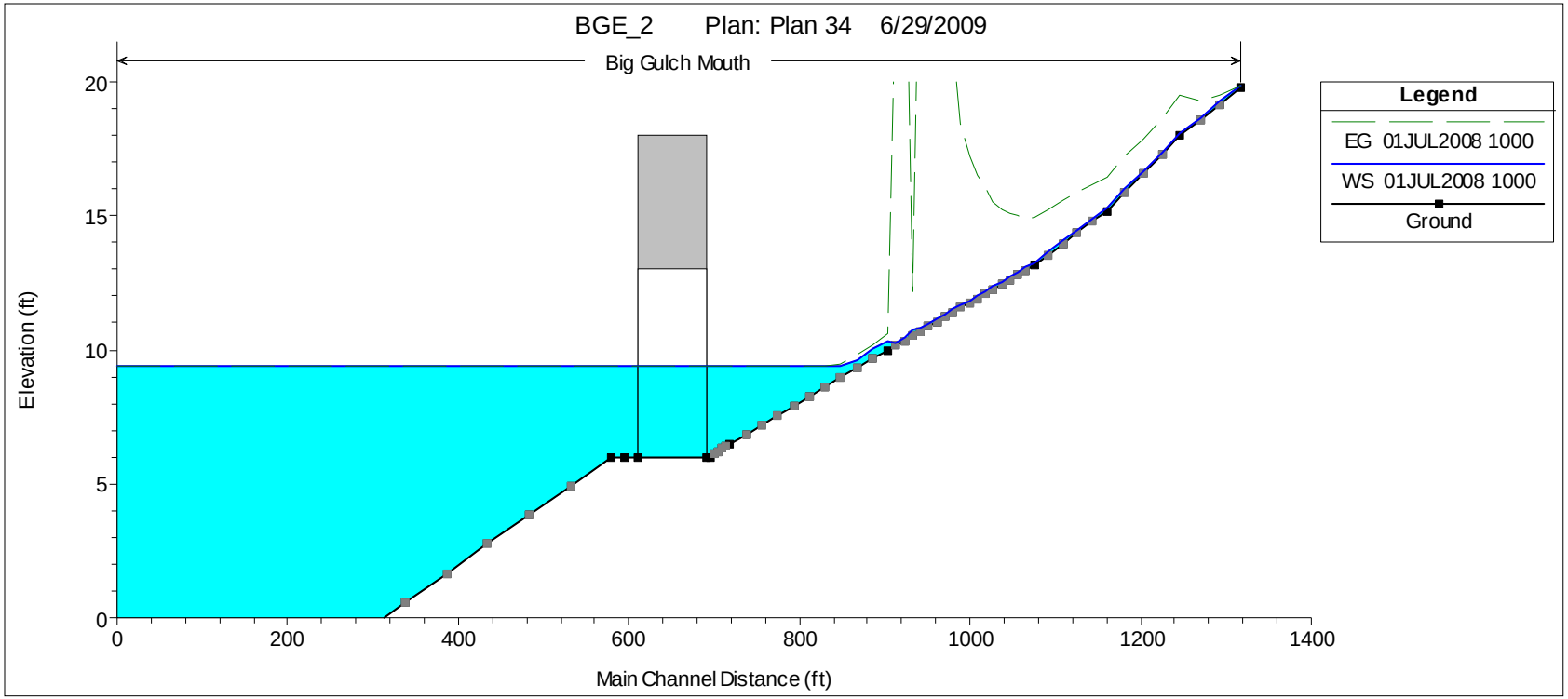


Figure 1. Alternative 2: High tide with low flow (2 cfs)

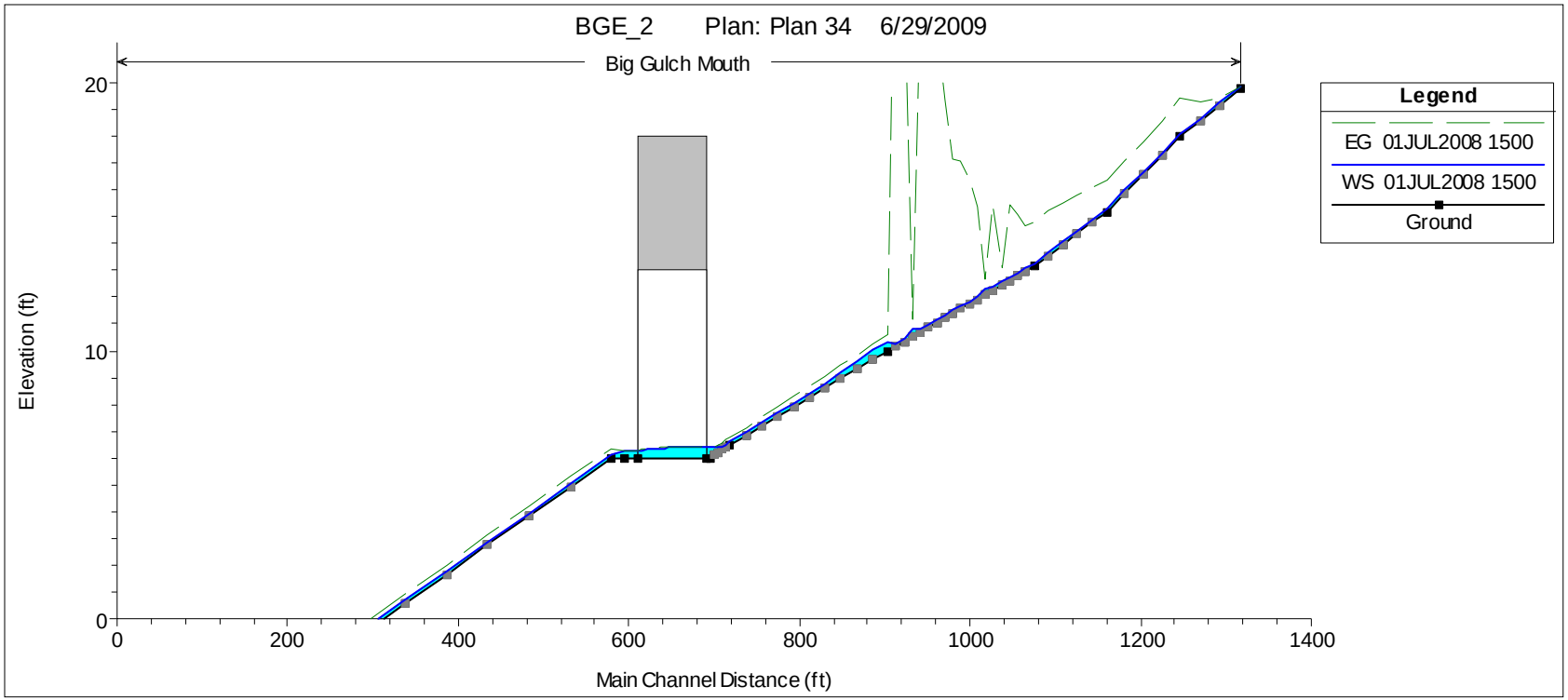


Figure 2. Alternative 2: Low tide low flow (2 cfs)

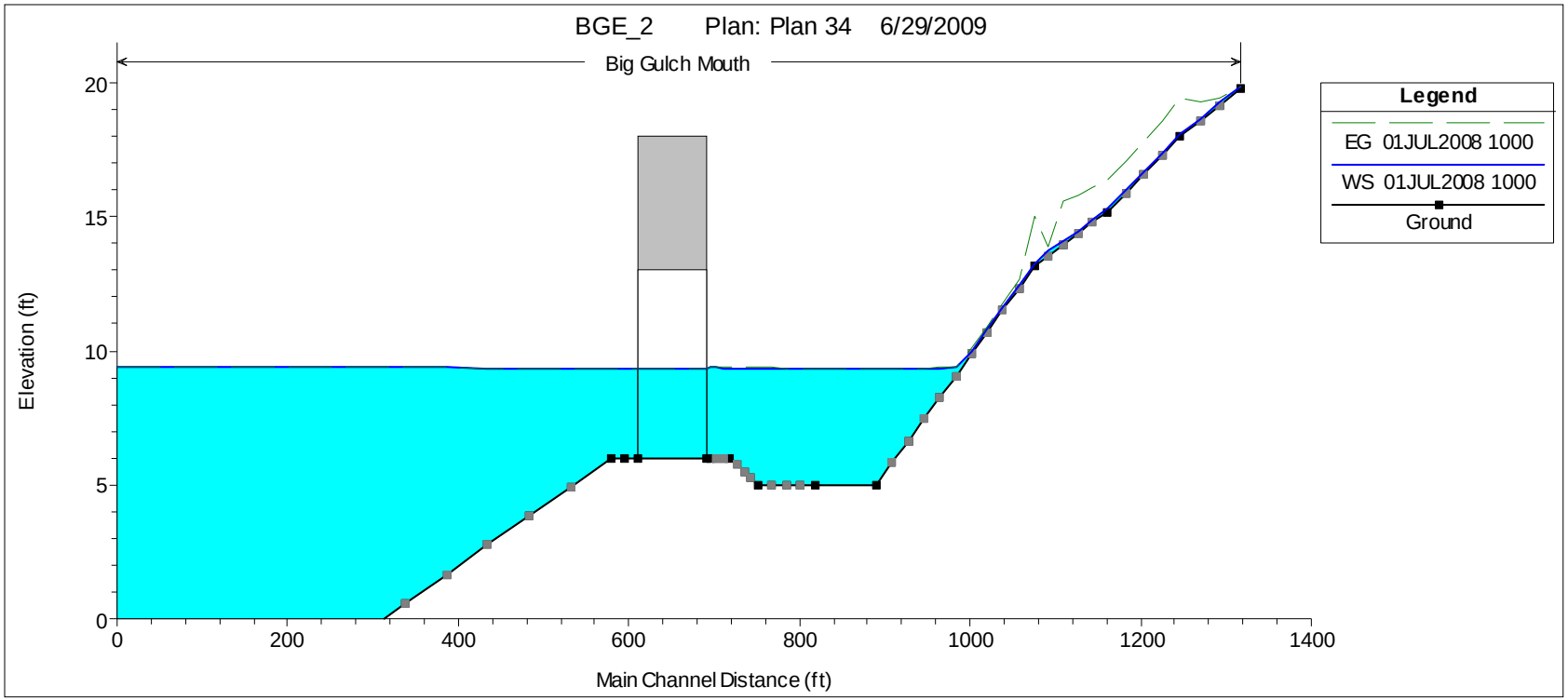


Figure 3. Alternative 1: High tide, low flow (2 cfs)

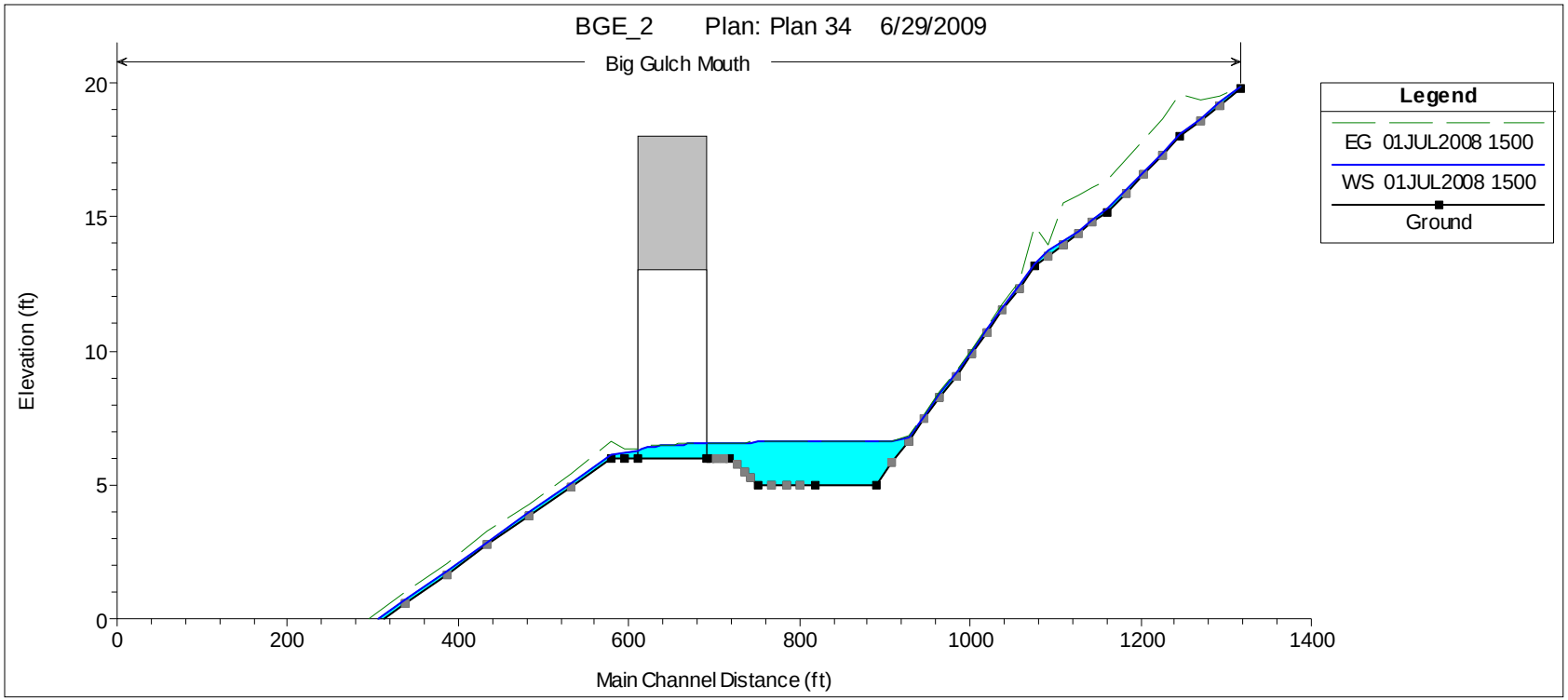


Figure 4. Alternative 1: Low tide, low flow (2 cfs)

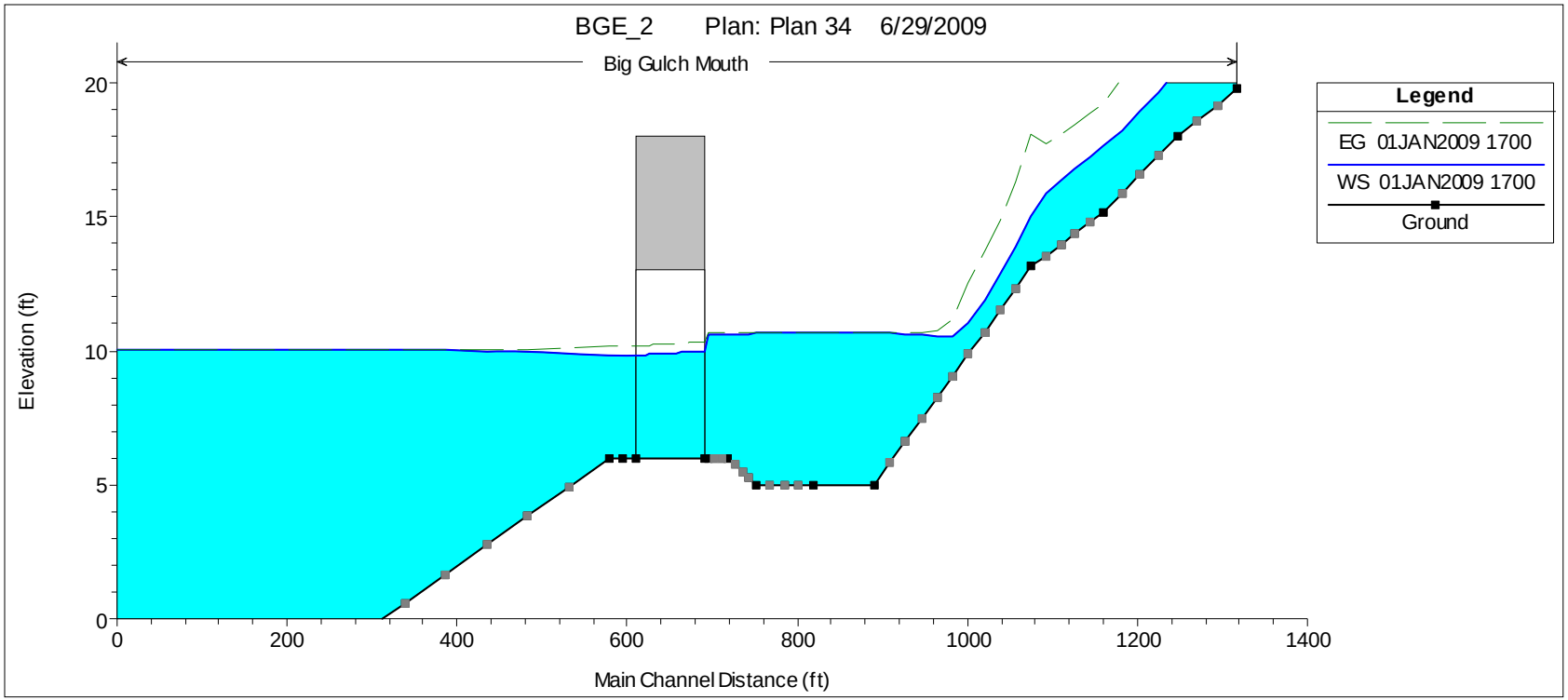


Figure 5. Alternative 1: High tide, high flow (200 cfs)

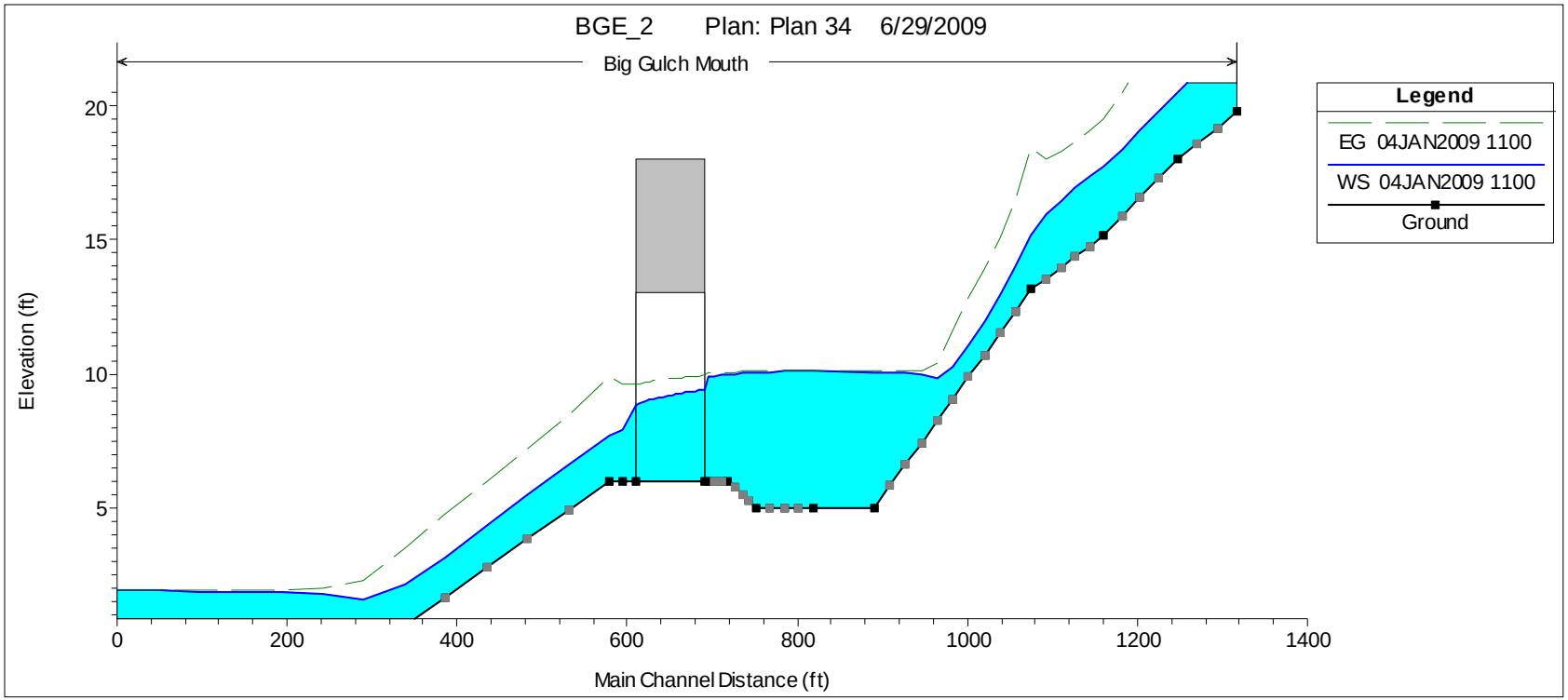


Figure 6. Alternative 1: Low tide, high flow (200 cfs)

.

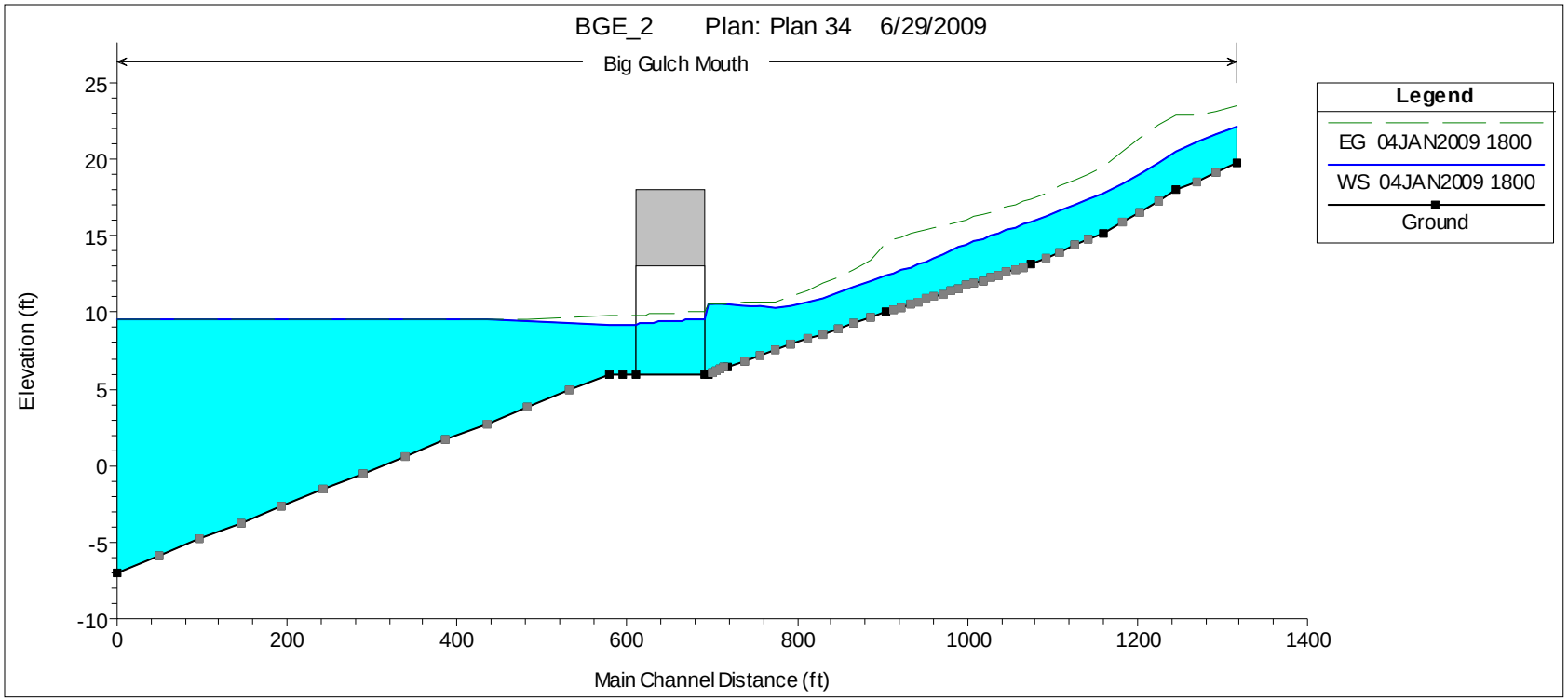


Figure 7. Alternative 2: High tide, high flow (200 cfs)

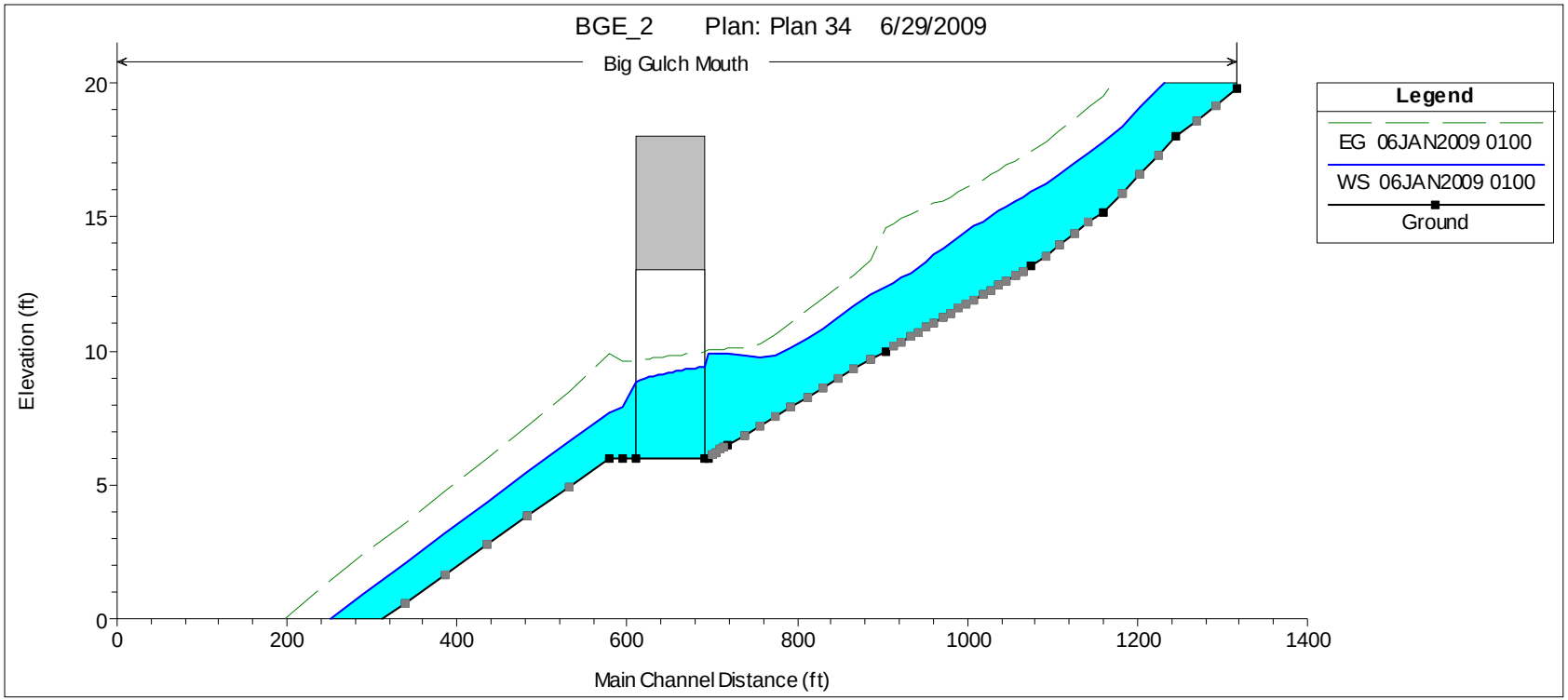


Figure 8. Alternative 2: Low tide, high flow (200cfs)

APPENDIX C: SNOHOMISH COUNTY DRAINAGE NEEDS REPORT (PARTIAL)

Snohomish County

Puget Sound Tributaries Drainage Needs Report

APPENDIX G

Project Summaries and Cost Estimates

CIP SUMMARY SHEET

CIP Number:	**PS-PP-26**
Project Title:	Picnic Point Road Culvert Replacement
Problem Description:	Culvert presents fish passage barriers. Inadequate culvert capacity has caused problems with upstream side of road embankment (PS-PP-H-EX-05).
Project Description:	Replace existing fish barrier culvert with a culvert that improves fish passage.
Design Assumptions:	Hydrologic modeling has not been completed for this basin. Design flows would need to be derived or culvert oversized.
Project Benefits:	Improve fish passage to approximately one mile of suitable habitat. Improve structural integrity of road embankment. Repairs/replacement of culvert likely needed within next five years.
Estimated Project Cost:	$181,000
Associated Projects:	CIP PS-PP-27 – Picnic Point Creek Rock Weir Reconstruction should be done along with CIP PS-PP-26 to provide access to upstream habitat.

Project Sketch: CIP PS PP 26

Snohomish County Public Works
Drainage Needs Report (DNR) Project
PLANNING LEVEL CONSTRUCTION COST OPINION

PROJECT:	**Picnic Point Road Culvert Replacement**		
PROJ. NO.:	**PS-PP-26**	**CHECKED BY:**	
BY:	**EJM Otak**	**DATE:**	**7/31/2002**

ITEM NO.	BID ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	AC Removal	67	SY	$20	$ 1,333
2	Base Course	28	TN	$23	$ 634
3	Top Course	14	TN	$30	$ 407
4	AC Replacement	15	TN	$80	$ 1,216
5	Remove Existing Culvert	120	LF	$15	$ 1,800
6	Install Arched Culvert	120	LF	$290	$ 34,800
7	Re-vegetate Banks	6,000	SF	$0.69	$ 4,132
8	Temporary Construction Access/Restoration	1	LS	$12,000	$ 12,000
9	Temporary Water Bypass	1	LS	$5,000	$ 5,000
				Subtotal	$ 61,322
	Erosion & Sedimentation Control	10%	(1)		$ 6,132
	Traffic Control	3%	(2)		$ 1,840
	Contingency	30%			$ 18,397
				Subtotal	$ 87,691
	Mobilization (General Requirements)	10%			$ 8,769
		Construction Subtotal (Rounded)			$ 96,000
	Sales Tax	8.9%			$ 8,544
	Engineering/Legal/Admin	50%			$ 48,000
	Construction Management	20%			$ 19,200
	Permitting	10%			$ 9,600
2002 Dollars		**Total Estimated Project Cost (Rounded)**			**$ 181,000**

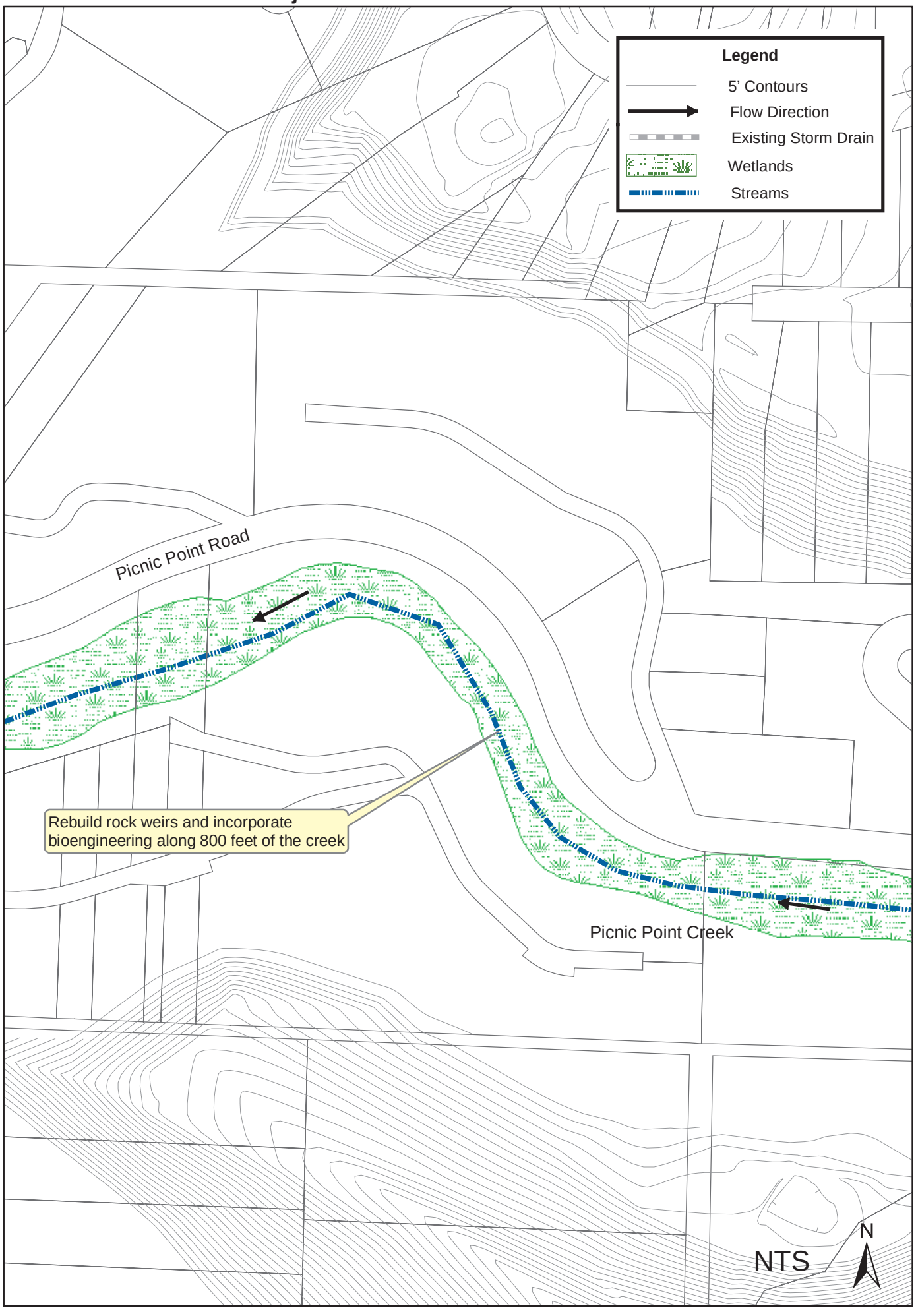
Notes:

1. The above cost opinion is in 2002 dollars and does not include future escalation, financing, or O&M costs.
2. The order of magnitude cost opinions have been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of thes factors, funding needs for individual projects must be scrutinized prior to establishing final project budgets.
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial or other high volume road or temporarily closes a roadway.
5. Land acquisition costs include Administrative Costs and Condemnation.

CIP SUMMARY SHEET

CIP Number:	**PS-PP-27**
Project Title:	Picnic Point Creek Rock Weir Reconstruction
Problem Description:	Rock weirs/road embankment reinforcement structures have failed along section of creek downstream from Picnic Point Road stream crossing (PS-PP-H-EX-07).
Project Description:	Rebuild rock weirs, incorporate bioengineering components. Include 800 feet of channel improvements.
Design Assumptions:	Rock weirs must be strong enough to withstand the future 50-year flow event. The design needs to conform to WDFW standards.
Project Benefits:	Improve fish habitat and passage. Provide passage to upstream habitat. Improve structural integrity of road embankment.
Estimated Project Cost:	$244,000
Associated Projects:	CIP PS-PP-26 – Picnic Point Culvert Replacement must be done along with CIP PS-PP-27 to provide access to upstream habitat.

Project Sketch:CIP PS PP 27



Snohomish County Public Works
Drainage Needs Report (DNR) Project
PLANNING LEVEL CONSTRUCTION COST OPINION

PROJECT:	**Picnic Point Creek Rock Weir Reconstruction**		
PROJ. NO.:	**PS-PP-27**	**CHECKED BY:**	
BY:	**EJM Otak**	**DATE:**	**7/31/2002**

ITEM NO.	BID ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Re-build Rock Weirs	30	LS	$2,000	$ 60,000
2	Re-vegetate Banks	16,000	SF	$0.69	$ 11,019
3	Temporary Construction Access	1	LS	12,000	$ 12,000
				Subtotal	$ 83,019
	Erosion & Sedimentation Control	20%	(1)		$ 16,604
	Traffic Control	3%	(2)		$ 2,491
	Contingency	30%			$ 24,906
				Subtotal	$ 127,020
	Mobilization (General Requirements)	10%			$ 12,702
		Construction Subtotal (Rounded)			$ 140,000
	Sales Tax	8.9%			$ 12,460
	Engineering/Legal/Admin	35%			$ 50,000
	Construction Management	20%			$ 28,000
	Permitting	10%			$ 14,000
2002 Dollars		**Total Estimated Project Cost (Rounded)**			**$ 244,000**

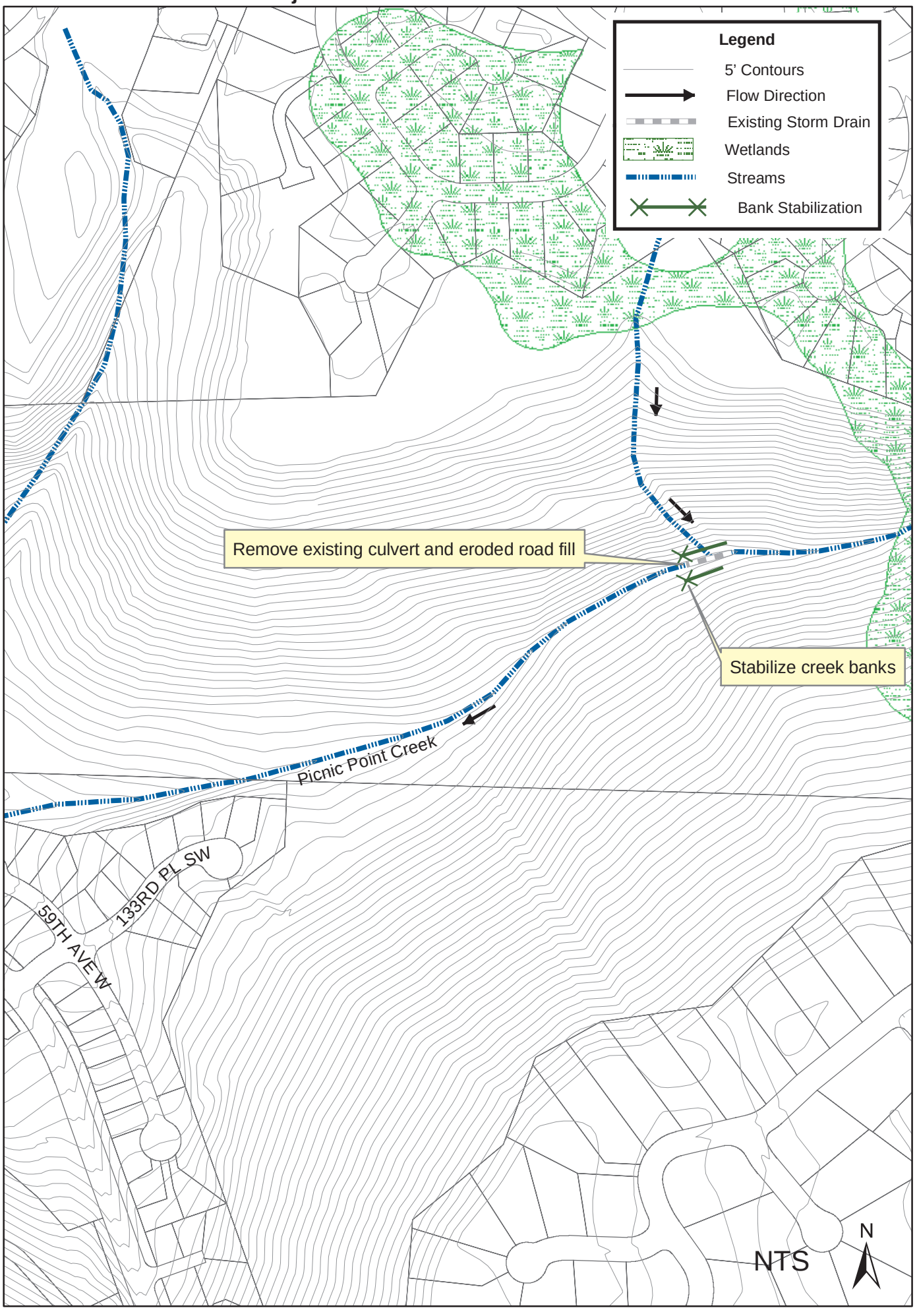
Notes:

1. The above cost opinion is in 2002 dollars and does not include future escalation, financing, or O&M costs.
2. The order of magnitude cost opinions have been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of thes factors, funding needs for individual projects must be scrutinized prior to establishing final project budgets.
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial or other high volume road or temporarily closes a roadway.
5. Land acquisition costs include Administrative Costs and Condemnation.

CIP SUMMARY SHEET

CIP Number:	**PS-PP-31**
Project Title:	Stabilize Eroding Road Crossing
Problem Description:	Erosion and sedimentation is occurring within the creek due to failure of a logging road culvert crossing. 50-60 cubic yards of road fill are subject to erosion in the near future (PS-PP-E-EX-06) (PS-PP-H-EX-06).
Project Description:	Properly decommission the logging road. Remove the culvert and eroded road fill and stabilize the creek banks.
Design Assumptions:	None.
Project Benefits:	Removes point source of sediment.
Estimated Project Cost:	$16,000
Associated Projects:	None.

Project Sketch: CIP PS PP 31



Snohomish County Public Works
Drainage Needs Report (DNR) Project
PLANNING LEVEL CONSTRUCTION COST OPINION

PROJECT:	**Stabilize Eroding Road Crossing**		
PROJ. NO.:	**PS-PP-31**	**CHECKED BY:**	
BY:	**DRO Otak**	**DATE:**	**8/1/2002**

ITEM NO.	BID ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Channel Grading	60	CY	$16	$ 960
2	Revegetate Channel Banks	2,000	SF	$0.69	$ 1,377
3	Remove Pipe	20	LF	$15.00	$ 300
				Subtotal	$ 2,637
	Erosion & Sedimentation Control	10%	(1)		$ 264
	Traffic Control	3%	(2)		$ 79
	Contingency	30%			$ 791
				Subtotal	$ 3,771
	Mobilization (General Requirements)	10%			$ 377
		Construction Subtotal (Rounded)			$ 4,000
	Sales Tax	8.9%			$ 356
	Engineering/Legal/Admin	100%			$ 10,000
	Construction Management	20%			$ 800
	Permitting	10%			$ 400
2002 Dollars		**Total Estimated Project Cost (Rounded)**			**$ 16,000**

Notes:

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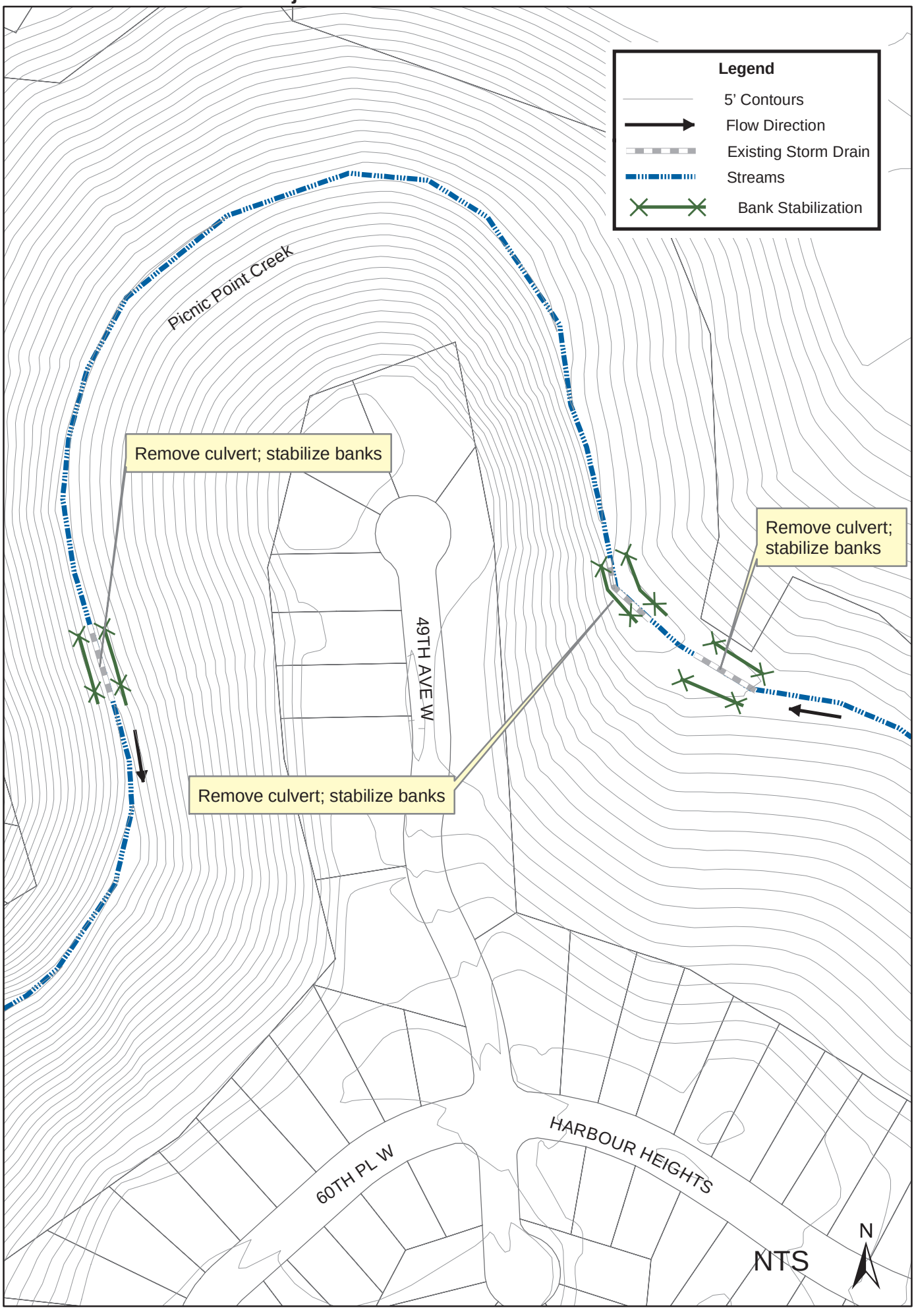
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial or other high volume road or temporarily closes a roadway.
5. Land acquisition costs include Administrative Costs and Condemnation.

CIP SUMMARY SHEET

CIP Number:	**PS-PP-32**
Project Title:	Stabilize Eroding Trail Crossings
Problem Description:	Three damaged 24-inch culverts at trail crossings are allowing sediment delivery to the creek (PS-PP-E-EX-03, -04, -05).
Project Description:	Remove culverts and stabilize creek banks.
Design Assumptions:	Culverts could be replaced instead of being removed depending on use.
Project Benefits:	Eliminates point source of sediment.
Estimated Project Cost:	$24,000
Associated Projects:	None.

Project Sketch: CIP PS PP 32



Snohomish County Public Works
Drainage Needs Report (DNR) Project
PLANNING LEVEL CONSTRUCTION COST OPINION

PROJECT:	**Stabilize Eroding Trail Crossings**				
PROJ. NO.:	**PS-PP-32**	**CHECKED BY**	**EJM**		
BY:	**DRO Otak**	**DATE:**	**8/1/2002**		

ITEM NO.	BID ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Channel Grading	180	CY	$16	$ 2,880
2	Revegetate Channel Banks	4,000	SF	$0.69	$ 2,755
3	Remove Pipe	60	LF	$15.00	$ 900
				Subtotal	$ 6,535
	Erosion & Sedimentation Control	10%	(1)		$ 653
	Traffic Control	3%	(2)		$ 196
	Contingency	30%			$ 1,960
				Subtotal	$ 9,345
	Mobilization (General Requirements)	10%			$ 934
		Construction Subtotal (Rounded)			$ 10,000
	Sales Tax	8.9%			$ 890
	Engineering/Legal/Admin	100%			$ 10,000
	Construction Management	20%			$ 2,000
	Permitting	10%			$ 1,000
2002 Dollars		**Total Estimated Project Cost (Rounded)**			**$ 24,000**

Notes:

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4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial or other high volume road or temporarily closes a roadway.
5. Land acquisition costs include Administrative Costs and Condemnation.