Appendix P

Totem Lake/Juanita Creek Basin Retrofit Conceptual Design

TOTEM LAKE/JUANITA CREEK BASIN STORMWATER RETROFIT CONCEPTUAL DESIGN

Final Project Report for Ecology Grant G1400024

Prepared for:

Washington State Department of Ecology
Olympia, WA

Prepared by:

City of Kirkland

Total Cost of Project: $286,033
Grant Amount: $247,100

Project Start Date: November 1, 2013
End Date: August 31, 2015

July 15, 2015

Publication Information

This project is supported by U.S. Environmental Protection Agency (EPA) National Estuary Program (NEP) funding by means of a grant administered by the Washington Department of Ecology (Ecology). This project report documents identification, prioritization, and pre-design of specific stormwater retrofit projects in the Totem Lake sub-watershed of the Juanita Creek basin in Kirkland, Washington. The final documentation and project QAPP will be available on request from the City of Kirkland and Ecology. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Author and Contact Information

For more information contact:
Jenny Gaus, PE
City of Kirkland
123 Fifth Ave
Kirkland, WA 98033
jgaus@kirklandwa.gov

CREDITS AND ACKNOWLEDGEMENTS

The following City of Kirkland and consultant staff were responsible for work performed under Ecology grant G1400024 and preparation of this report.

Jenny Gaus, P.E. – City of Kirkland
Kelli Jones, P.E. – City of Kirkland
Patty Dillon, P.E. – Northwest Hydraulic Consultants Inc.
Patrick Flanagan, P.E. – Northwest Hydraulic Consultants Inc.
David Hartley, P.E. – Northwest Hydraulic Consultants Inc.
Laura Grignon, P.E. – AHBL Inc.
Wayne Carlson, AICP, LEED AP – AHBL Inc.
Doreen Gavin, P.E. – AHBL Inc.
Steve Nelson, LG, LHG – RH2 Engineering Inc.

EXECUTIVE SUMMARY

Introduction

Juanita Creek is located on the east side of Lake Washington in King County Washington. The Totem Lake Basin, a 665-acre portion of the 3600-acre Juanita Creek system, was developed prior to the advent of stormwater controls that are protective of water quality and aquatic habitat. As a result, water quality and habitat in Totem Lake and in Juanita Creek have declined. The Totem Lake Stormwater Retrofit Conceptual Design Project (G1400024) conducted planning and design work for capital and non-capital stormwater retrofit projects that will improve water quality and control flows. Specific goals of the project were as follows:

- Test the feasibility of the flow control standard recommended in Juanita Creek Basin Stormwater Retrofit Analysis report (ECY08) at a smaller scale.
- Identify opportunities for construction of stormwater facilities by examining areas already treated, soil/geologic conditions, and available land through GIS analysis and site visits.
- Develop conceptual designs and cost estimates for 2 capital projects.
- Develop 3 non-capital projects that could be used in conjunction with capital projects to improve stormwater management.
- Develop an implementation plan that prioritizes facilities for construction, identifies pathways for realization of non-capital projects, suggests funding mechanisms, and suggests a schedule for completion of the work.
- Share knowledge with and solicit input from the development community on stormwater retrofits by conducting a Technical Assistance Panel process with the Urban Land Institute.

Methods

The first step of the project was to review available information and develop maps of potentially infiltrative soils and areas that have water quality treatment and/or flow control. This information was then used to support GIS and field screening of potential retrofit sites. An HSPF model and EPA SWMM model were updated and used investigate the overall need for flow control under Ecology's 2012 *Stormwater Management Manual for Western Washington* (Ecology, 2012), and to test the impact of retrofit alternatives on peak flows and water levels at several points in the basin. Based on the results of this analysis, two sites were chosen for development of conceptual designs and cost estimates. Non-capital projects were chosen based on a listing of possible programs noted in the City's 2014 *Surface Water Master Plan* (City of Kirkland, 2014b). An implementation plan was developed to details steps to move the conceptual designs to construction, and to note non-capital projects.

A Technical Assistance Panel (TAP) process was organized and run by the Urban Land Institute. The purpose of the TAP is to solicit input from real estate developers, economists and designers on ways to move forward with stormwater retrofits in the Totem Lake Basin. The specific questions submitted to the TAP by the City centered around ways to formulate public/private partnerships to construct regional stormwater facilities on private land and how to prioritize the potential projects that are located on private property.

Results

The detention volume required to meet Minimum Requirement 7 of Ecology's 2012 *Stormwater Management Manual for Western Washington* (i.e. flow control requirement) for the Totem Lake basin is 410 acre-feet with no LID assumed, and 205 acre-feet with broad application of LID assumed. These volumes are well beyond what can be addressed through retrofits, especially in a heavily developed basin with limited available space. For that reason, it was infeasible to develop retrofit scenarios that would meet stormwater requirements for the entire basin, as targeted in the grant scope. As confirmed in a meeting with Ecology early in this project, maximizing the treatment benefit of constructible retrofit projects became the goal of the project.

GIS and field screening identified six retrofit sites for initial analysis and comparison:

- 132nd Square Park
- Totem Lake Mall
- Totem Lake Park
- Totem Square
- NE 120th Street
- Lake Washington Institute of Technology

The flow impacts of potential retrofit projects at each of the six sites were evaluated locally and on a basin scale. For inflow to Totem Lake, the average percent change in peak flows compared to baseline (existing) conditions for the individual projects ranged from -2% to -13%, with the overall impact of all projects combined being a 28% decrease in peak inflows to Totem Lake. In addition to reducing peaks, the projects that infiltrate stormwater provided measureable reduction of stormwater volumes to the lake.

When assessed in Juanita Creek downstream of the Totem Lake Tributary, individual projects had negligible impact on peak flows compared to baseline; the six projects combined produced a decrease of 2% in average peak flows. This is partially because the 665-acre Totem Lake Basin is small relative to the overall Juanita Creek Watershed area of about 3600 acres. In addition, the lake and wetlands to the west of I-405 provide a large amount of storage for the system, such that downstream flow (and possibly ecological) impacts of detention provided upstream of the lake may be negligible. Projects that provide volume reduction through infiltration of stormwater provide localized flood reduction benefits in the vicinity of Totem Lake, and unlike detention, the volume benefit is measureable, though diminished, downstream. Though it was not one of the final projects taken to conceptual design, it should be noted that the Totem Lake Outlet Modification is the only project that showed significant impact on flood discharges downstream of I-405.

Based on the analysis and screening process, the 132nd Square Park and NE 120th Street projects were selected for development of conceptual designs and cost estimates. Both projects are located on public property, which is in alignment with one of the main recommendations of the Technical Assistance Panel, that projects be located on publicly-owned or publicly-controlled property wherever possible.

The 132nd Square Park project provides regional detention and enhanced water quality treatment and infiltration for nearly 50 acres of upstream area (second only to the Totem Lake Outlet Modification in treated area). The upstream area land use is single-family residential and is thus not likely to redevelop, making this an ideal project for public investment in stormwater retrofit facilities. Although the project may provide little peak flow reduction benefit to the mainstem of Juanita Creek, it does provide volume reduction through infiltration as well as improved water quality. Plans and design notes for the project are included in Appendix F of this report. The estimated cost of construction of this project is $3.3 million in 2015 dollars, with design costs of $495,000. The Parks Department is already planning to rehabilitate fields where the facility would be placed, and so there is a great opportunity for coordination between parks and stormwater objectives.

The NE 120th Street project provides enhanced water quality treatment and partial infiltration for 4 acres of public right of way (3 acres of pavement and 1 acre of undeveloped area). This project is small, and is relatively straightforward, with treatment happening outside the travel lanes of the roadway in either Filterra or Stormfilter systems. The estimated cost of construction for the NE 120th Street project is $290,000, with design costs of $56,000.

At the beginning of the project, the expectation was that zoning incentives such as height or density bonuses could be used to encourage owners to site regional stormwater facilities on private property. This plus development of concepts for public/private partnership formation and financing concepts would constitute the non-capital project ideas. There are several reasons why this approach needed to be altered. First, it turns out that most available zoning incentives have already been granted in the Totem Lake Business District in an effort to spur redevelopment. Further, few have taken advantage of these bonuses because they are not supported by market conditions, making them of questionable use for encouraging action. For example, the current vacancy rate for office space does not encourage construction of office buildings with increased height. The Technical Assistance Panel recommended construction of stormwater facilities on public property, rather than developing public/private partnerships to install them on private property. Finally, the GIS analysis revealed that there are few sites available that could support regional facilities of sufficient size to make public/private partnerships worthwhile.

In an altered approach, staff reviewed programmatic recommendations in Kirkland's 2014 *Surface Water Master Plan* (City of Kirkland, 2014b) to determine which ones could be best applied in the Totem Lake Basin. Citywide programs to benefit water quality— including source control visits, residential stormwater audits, and private drainage system inspections—would continue in the Totem Lake Basin. Additional programs that might be considered for the Totem Lake Basin include increased street sweeping for water quality, education about and branding of Totem Lake as a watershed, and inclusion of incentives or rebates in the Surface Water Utility rate structure to encourage construction of retrofit projects. Each of these three non-capital alternatives requires analysis similar to that done for programmatic recommendations in the *Surface Water Master Plan* (City of Kirkland, 2014b).

This project sets the course for construction of regional stormwater facilities to control flows, reduce volumes, and improve water quality. In addition, it points to the need for discussions with regulatory agencies about the role of natural lakes and wetlands play in stormwater management, and the interplay between those feature and constructed facilities.

Lessons Learned

Lessons learned from this project include both items specific to the Totem Lake basin, and more general items that could apply to any stormwater retrofit project:

- The overall amount of detention volume needed for the Totem Lake basin is vast and likely cannot be provided through stormwater retrofits because of lack of available land. Thus projects need to focus on providing the maximum benefit possible for the area treated.
- Totem Lake provides significant stormwater detention for the basin, but current Ecology guidelines and regulations do not allow for use of this detention to serve upstream properties. Further discussion with Ecology on this topic is warranted, as there may be a scenario that would benefit both the ecology of Totem Lake and upstream property owners.
- Space is not available for regional projects in the most highly-developed area of the basin and where redevelopment is likely to occur. Thus it may not be possible to provide regional stormwater facilities as an incentive for redevelopment.
- The Urban Land Institute Technical Assistance Panel recommends putting facilities in the right of way or on public land as much as possible, rather than trying to partner with private development projects to place facilities on private land.
- In Totem Lake, zoning incentives have already been granted, and so are not available for use for stormwater issues. In addition, such bonuses have to mesh with market conditions to be effective. Thus customization of citywide water quality improvement programs as noted in the 2014 *Surface Water Master Plan* (City of Kirkland, 2014b) may be of more benefit than changes to land use codes in improving conditions in the basin.

Overall the Totem Lake Stormwater Retrofit provides a valuable template for conducting stormwater retrofit planning. The conceptual designs and cost estimates for the 132nd Square Park and NE 120th Street projects provide information necessary to move forward with funding and construction of these important projects. This project points out the challenges and also the benefits of planning for stormwater retrofits on a smaller scale.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Purpose

Stormwater runoff is the largest source of pollution to Puget Sound according to the Puget Sound Partnership: this is both an environmental and an economic issue. The City of Kirkland (City) is taking a variety of actions to control stormwater volumes and stormwater pollution, including cleaning and maintenance of the public drainage system, responding to spills, educating residents and businesses about source control practices, and regulating new development. But this is only part of the picture. Development prior to the last 10-15 years (the majority of development in the city) has few or no stormwater controls, and there are currently no City, State, or Federal requirements that existing development provide such controls except when properties redevelop. As the majority of stormwater in Kirkland flows from existing developed land, this portion of the problem must be addressed in order to make progress on overall improvement of stormwater quantity and quality.

The purpose of this project was to conduct planning for the Totem Lake basin to accelerate and optimize stormwater retrofits that will contribute to the health of the Juanita Creek watershed and will support economic development. The project was intended to facilitate public investment in retrofit projects and identify opportunities for supporting redevelopment by providing regional stormwater facilities.

This project built upon work completed under the Stormwater Retrofit Analysis and Recommendations for Juanita Creek Basin in the Lake Washington Watershed project (Ecology Grant G0800618) which developed ecological watershed-based goals for retrofitting and modeled various scenarios against those goals. The treatment goals that most closely matched ecological goals are the Basic water quality and "ECY08" flow control standards as included Minimum Requirements 5-7 in Ecology's 2012 *Stormwater Management Manual for Western Washington*. The Totem Lake Stormwater Retrofit Conceptual Design project applies these standards on a subbasin scale and then uses screening and analysis to develop conceptual designs for two stormwater retrofit facilities and for 3 non-capital projects.

1.2 Project Goals

Specific goals of this project were as follows:

- Test the feasibility of the flow control standard recommended in Juanita Creek Basin Stormwater Retrofit Analysis report flow control standards from the 2012 Stormwater Management Manual for Western Washington (known as ECY08 because of the inclusion of flow-duration matching to the forested condition from 8% to 50% of the 2-year event in addition to previous flow duration requirements) at a smaller scale.
- Identify opportunities for construction of stormwater facilities (capital and non-capital projects) by examining areas already treated, soil/geologic conditions, and available land through GIS analysis and site visits.
- Develop conceptual designs and cost estimates for 2 capital projects.

- Develop 3 non-capital projects that could be used in conjunction with capital projects to improve stormwater management.
- Develop an implementation plan that prioritizes facilities for construction, identifies pathways for realization of non-capital projects, suggests funding mechanisms, and suggests a schedule for completion of the work.
- Share knowledge with and solicit input from the development community on stormwater retrofits by conducting a Technical Assistance Panel process with the Urban Land Institute.

As the Totem Lake basin is poised for significant redevelopment, an ancillary goal was to identify opportunities to provide regional stormwater facilities that will benefit water resources and that will be more efficient and cost-effective than implementation of such facilities on a site-by-site basis as part of redevelopment. This would in turn encourage the redevelopment that would fund stormwater management facilities.

2 JUANITA CREEK WATERSHED AND TOTEM LAKE

2.1 Land Use and Impervious Surface

The Totem Lake basin is one of four major tributaries to Juanita Creek. The Totem Lake tributary originates from Totem Lake and flows through culverts under several roads and I-405. Downstream of I-405, the creek flows through a series of wetlands, and borders commercial business parks, Juanita High School, and residential areas, before entering a steep tightline to the valley floor where it joins Juanita Creek. This project focuses on the Totem Lake basin upstream of I-405 (Figure 1), which drains a developed 665-acre headwater area (hereinafter referred to as "the basin") with over 300 acres of effective impervious surface. The basin is a mixture of single family, multi-family residential, and commercial/light industrial with the largest developments being Totem Lake Mall, Lake Washington Institute of Technology (LWIT), and Evergreen Hospital. Elevations in the basin range between 120 feet at I-405 to 380 feet near LWIT. The 20-acre Totem Lake and wetland complex is a critical natural feature of the watershed and receives runoff from 80 percent of the drainage basin above I-405. The Cross Kirkland Corridor (CKC) acts as a critical drainage corridor that collects runoff and transports it to Totem Lake from the majority of the basin.

2.2 Pollutant Sources

Juanita Creek is a 303(d) listed waterbody for fecal coliform, temperature, and dissolved oxygen, and B-IBI (benthic index of biotic integrity) scores in Juanita Creek downstream of Totem Lake are in the poor range. Stormwater picks up pollutants such as oil/grease, fertilizers and pesticides, and heavy metals in amounts that can be predicted based on land use, traffic volumes, instances of spills and dumping, and presence of NPDES regulated industrial and construction activities. The basin was identified in Kirkland's 2008 Pollutant Hot Spots Study as a priority location for water quality treatment based on presumed pollutant loading from these sources. King County confirmed water quality impairments during the Stormwater Retrofit Analysis and Recommendations for Juanita Creek Basin in the Lake Washington Watershed project (Ecology Grant G0800618).

2.3 Economic Development and Stormwater

Current Ecology regulations require redevelopment projects to implement stormwater controls that match flows from forested conditions and provide water quality treatment. This is a necessary and significant economic burden on redevelopment projects. As highly urbanized areas such as Kirkland are trying to encourage redevelopment, and have little vacant land that is left to develop, it is in the City's interest to find ways to protect water resources while reducing the economic burden of stormwater facilities for redevelopment projects.

Totem Lake is the economic engine of Kirkland, producing over 30% of overall city tax revenue. At the same time, the area contains many properties that are underutilized and that are likely to redevelop in the next 10 to20 years. Facilitating strategies for stormwater retrofit as part of private redevelopment will be one of the quickest ways to begin to reverse the negative effects from past stormwater practices.

3 METHODS AND BACKGROUND

This section documents the available data and information used to characterize stormwater treatment needs and retrofit opportunities within the Totem Lake basin, as well as the methods used to analyze potential benefits of retrofit alternatives. Modeling and GIS analyses were conducted in this study as outlined in the project Quality Assurance Project Plan (QAPP), approved by Ecology in March 2014 (City of Kirkland, 2014).

3.1 Existing Information Review

Available information relevant to the stormwater system in the Totem Lake basin was collected and reviewed. The datasets included existing reports, GIS data, as-built drawings, monitoring data and hydrologic and hydraulic modeling. The project data and assumptions were also reviewed and discussed with City staff that have direct knowledge of the basin. This information also provided the basis for retrofit opportunity screening and model development. The information reviewed included:

- Stormwater Retrofit Analysis and Recommendations for Juanita Creek Basin in the Lake Washington Watershed, King County, 2012 (including Juanita Creek HSPF model)
- Totem Lake Boulevard Flood Control Measures, SvR, 2008
- Totem Lake/Juanita Creek EPA-SWMM Model Summary, Jones & Stokes, 2007
- City of Kirkland GIS
    - Surface geology
    - Stormwater network
    - Stormwater facilities
    - Drainage/water quality complaints
    - Critical areas
    - Potential CIP projects
    - Anticipated redevelopment parcels
    - Base layers (streets, parcels, utilities, parks, etc.)

- Stormwater facility as-built plans, City of Kirkland
- Geotechnical reports and well logs
- Stage monitoring data for Totem Lake and downstream channel

The stormwater infrastructure was generally well represented in the GIS datasets, though as-built drawings were used to provide additional detailed geometry on several stormwater facilities. The datasets for stormwater pipes, manholes, vaults, ponds, detention pipes/tanks, and ditches were all reviewed and provided a basis of understanding of the existing stormwater system. Based on input from City staff, as-built drawings were referenced in areas of new construction. The stormwater system data was used to delineate subbasins, as the basis for the hydrologic and hydraulic modeling, and for screening for existing facilities.

Geologic and boring log data were reviewed, as discussed in Section 3.1.1. The infiltration potential mapping derived from these sources was a key component in the site selection process.

Monitoring data have been collected by the City for the past several years in the form of continuous water level (stage) gaging in the vicinity of Totem Lake to downstream of I-405. More information on the monitoring data and how they were used is provided in Section 3.4.3. Water quality monitoring data were available downstream but not within the Totem Lake watershed upstream of I-405. Previous pollutant “hot spot” analysis maps (Parametrix, 2008) were reviewed and discussed with the City. For retrofit screening purposes, pollutant “hot spots” were reanalyzed using tributary pollutant generating impervious surface (PGIS) as a proxy for pollutant loading; this appears to be similar to the previous hot spot analysis, for which no additional documentation was available.

Infiltration Suitability Assessment

Current stormwater standards place an emphasis on infiltration-based stormwater treatment BMPs, which fall under the broader category of Low Impact Development (LID) techniques. Infiltration of stormwater is the only flow control technique that offsets increases in runoff volume from impervious surfaces and can also be an effective treatment for many pollutants of concern. Use of infiltrative techniques, where possible, was one of the emphases in identification and selection of potential retrofit sites in the Totem Lake basin. Since infiltration potential had not been broadly evaluated for the Totem Lake basin, this project included an evaluation of areas within the Totem Lake watershed that may be suitable for infiltration-based stormwater retrofit facilities. The full memo documenting the analysis (RH2, 2014) is included as Appendix A of this report, and key sections are summarized below.

The stormwater infiltration suitability assessment included:

- Review of existing soils, topography, surficial geology maps, well logs, geologic investigation reports, performance of existing infiltration-based stormwater facilities, and local site inspection to confirm previous findings;
- Establishment of site suitability criteria (SSCs) for selecting areas suitable for infiltration-based stormwater retrofit facilities based on the Stormwater Management Manual for Western Washington – Volume III, Section 3 (DOE, 2012); and

- Preparing a map of the locations suitable for construction of infiltration-based low impact development (LID) stormwater retrofit facilities.

The potential infiltration rate at any site in the Totem Lake watershed depends on the site geologic characteristics (permeability and stratigraphy), while the infiltration capacity depends on the degree of saturation and the ability of the infiltrated water to drain rapidly to its point of discharge, to prevent local groundwater mounding.

RH2 developed a summary of the potential suitability for infiltration BMPs throughout the Totem Lake watershed. Suitability is defined as the ability for an area to accept additional stormwater infiltration with little risk of flooding or destabilizing slopes. A highly suitable area is one that has little or no risk associated with infiltrating additional stormwater into the area at rates consistent with local soil permeability. An area considered moderately suitable would have greater, but still acceptable, risk that would require careful site selection and design components to mitigate the greater risk.

The types of infiltration BMP that could be used in suitable areas may include dispersed, concentrated, or vertical drains. Dispersed systems function at the individual lot or small road segment scale by infiltrating runoff in small ponds, swales, or perforated pipes in trenches. A concentrated system collects stormwater from several lots or long sections of roads and discharge stormwater into larger ponds or buried infiltration galleries. Vertical drains consist of vertical borings filled with gravel to convey stormwater through impermeable layers into permeable layers.

Figure 2 shows areas of the Totem Lake watershed that may be suitable for implementing infiltration-based flow control facilities. The mapping effort considered some of the gaps in understanding of site conditions and anticipated potential infiltration system performance (treatment, detention time, and volume/rate); where uncertainties are high, the areas are mapped as unsuitable.

Delineation of potential infiltration areas in the watershed was based on the following criteria:

- Permeability or intrinsic infiltration rates for different soil types in the area,
- Potentially limiting SSCs or geohazard risks in the area, and
- Potential infiltration capacity of the area, which is the area's ability to absorb and retain a volume of infiltrated water based on soil thickness, depth to groundwater, and proximity to a discharge zone.

3.2 Gap Analysis

The gap analysis task was intended to characterize existing levels of stormwater treatment in the Totem Lake basin and identify areas of the basin where stormwater treatment for water quality and/or flow control falls significantly short of current standards.

Existing Stormwater Treatment

Much of the Totem Lake basin was developed in the 1960s and 1970s, largely without stormwater treatment. Most of the effective stormwater treatment facilities in the basin, i.e. those that would be expected to provide water quality and/or flow control treatment at or near current standards, have been constructed as part of private development or redevelopment projects or public right-of-way improvements. These facilities typically treat only a small local area, so much of the basin runoff flows to Totem Lake and the downstream system largely untreated. Detention pipes and vaults scattered through the stormwater system may provide some peak flow control benefits but offer negligible contribution to the storage required to meet current high flow duration control, let alone more recent LID standards.

Figure 3 illustrates relative levels of stormwater treatment throughout the Totem Lake basin. NHC defined a level of treatment for flow control and for water quality at roughly a parcel to subdivision scale. Level of flow control treatment is designated by colored shading, and level of water quality treatment by fill pattern. Areas tributary to downstream flow control or water quality facilities (see below) are designated by hatching. This analysis uses three relative levels of treatment:

- **Significant**. An area was considered to have significant flow control and/or water quality treatment if runoff is routed directly to a facility constructed or modified within the last 10 to 15 years. Treatment through these facilities would be expected to substantially meet at least 1998 King County Surface Water Design Manual (KCSWDM) standards.

- **Partial**. An area was considered to have partial flow control and/or water quality treatment if either of the following apply:

    - Runoff is routed to an older on-site facility (***local***), which was assumed to perform well below current standards. Parcels with local “partial” treatment facilities are designated by color (flow control) and/or fill pattern (water quality) on the map.
    - On-site drainage is tributary to an in-line facility farther downstream (***downstream***). Since there are no “regional” stormwater treatment facilities in the basin, it was assumed that in-line facilities with large upstream drainage areas were not designed to fully treat the entire drainage area. Areas that drain to a downstream inline facility are designated by hatching on the map.

- **None**. An area was considered to have no flow control and/or water quality treatment if runoff does not go through a stormwater facility prior to entering Totem Lake or leaving the basin.

Totem Lake and the Totem Lake Wetland provide some level of flow control and water quality treatment of runoff from the entire upstream watershed resulting in substantial downstream benefits. However, during discussions related to this project, Ecology expressed the opinion that the lake/wetland complex is a receiving water and cannot be considered a detention facility, so treatment requirements should be met upstream of discharge to the lake. Therefore, only constructed treatment facilities were considered for this analysis, which is intended to identify treatment gaps and/or potential problem areas that could be targeted for retrofits.

Treatment Required to Meet Current Standards

As shown in Figure 3, less than 20 percent of the basin has "significant" water quality and flow control treatment, and even some of that area falls short of current standards, particularly for flow control. There are also no formal facilities in the basin providing infiltration of stormwater to reduce runoff volumes. Consequently, there is a significant deficit in the stormwater treatment that would be required to retrofit the basin, with its existing high-intensity land use, to meet current stormwater standards.

The Totem Lake HSPF model (described in Section 3.4.1) was used to approximately estimate this deficit in runoff storage at the basin scale. Hypothetical detention facilities were sized for aggregated inflows to Totem Lake and for aggregated local (below Totem Lake) runoff at I-405 to match the high flow duration standard under Minimum Requirement (MR) 7 in the 2012 Stormwater Management Manual for Western Washington (SMMWW) (DOE, 2012). The required detention for these two portions of the basin was sized for existing conditions land use with and without application of basin scale LID. The with-LID scenario used a fairly aggressive application of bioretention, assuming that 5 percent of the land surface area with infiltration potential (Figure 2) would be dedicated to bioretention facilities. Based on previous work, it was assumed that bioretention facilities could infiltrate approximately 10 acres of impervious area per acre of bioretention surface, so 50 percent of the runoff from infiltrative areas was routed to these hypothetical LID facilities.

Table 1 summarizes the level of *additional* detention (on top of significant existing facilities already included in the model) that would be required for each scenario to meet the MR7 standard for the contributing area. Size estimates were determined for single hypothetical detention facilities receiving all of the aggregated inflow; distributed facilities would produce slightly different results, though likely not appreciable differences at the basin scale.

Table 1 – Totem Lake Basin-Scale Detention Requirements

Location	**Drainage Area (ac)**	**No LID** Detention Volume (AF/inches over area)	**With LID** LID Area (ac)	Detention Volume (AF/inches over area)
Totem Lake Inflow	531	325 AF / 7.3"	10.6	163 AF / 3.7"
I-405 Local	134	85 AF / 7.5"	2.8	42 AF / 3.8"

The detention and/or LID facilities required to meet the MR7 standard are substantial and well beyond what can be addressed through retrofits, especially in a heavily developed basin with limited available space. For that reason, it is infeasible to develop retrofit scenarios that would meet stormwater requirements for the entire basin, as targeted in the grant scope. As confirmed in a meeting with Ecology early in this project, maximizing the treatment benefit of constructible retrofit projects is the more appropriate goal for retrofit planning in the Totem Lake watershed.

3.3 Retrofit Site Identification

A multi-level screening process was used to select suitable stormwater retrofit sites for analysis in this project. The Totem Lake Basin upstream of I-405 has over 800 "parcels" (including right-of-way (ROW) segments) and the goal of the screening process was to identify about 20 of the most suitable retrofit sites in the basin. The selected 20 sites were then investigated by an engineer in the field for feasibility. The site selection process is described in the following sections.

GIS Site Screening

The GIS screening process, used to identify suitable retrofit sites in the Totem Lake basin, consisted of two levels of analysis:

- Initial Screening: Identify sites with a range of characteristics indicating potential opportunity for retrofits.
- Weighted Screening: Narrow retrofit opportunity sites using criteria targeted at identifying treatment needs and potential benefit.

The screening analysis used parcels to represent potential retrofit "sites". There are 745 assessor parcels in the Totem Lake basin, not including publicly-owned ROW. The ROW in the basin was divided into sites using natural breaks at intersections, blocks, and drainage basin boundaries, keeping segment areas similar to the surrounding parcels. ROW sites were combined with the parcel layer for purposes of retrofit site identification. The resulting coverage included over 800 potential sites in the Totem Lake basin.

In addition to data discussed in Section 3.1, other datasets that were reviewed and used in the screening analysis included:

- Pipe outfalls to open channels
- Critical areas such as wetlands, ponds, streams, landslide areas, shoreline and floodplain
- Planned Capital Improvement Project (CIP) sites
- Site ownership and use, such as parking lots, vacancy, redevelopment potential
- Topography of site
- Existing stormwater treatment (as described in Section 3.2.1 and shown in Figure 3)

The GIS datasets and other stormwater system information were used to identify locations throughout the basin that provide opportunity for stormwater retrofits. The site screening and selection process was developed based on the criteria and guidelines from Chapter 4 of the Urban Stormwater Retrofit Practices Manual (CWP, 2007). The objective of the initial screening was to identify sites that provide opportunities to construct retrofits. These can include existing stormwater ponds, pipe outfalls, ditches, pollutant hot spots (identified based on tributary PGIS area), parking lots, planned capital projects (or redevelopment in this case), and vacant or publicly-owned parcels or ROW. Sites were ranked according to the number of these opportunity criteria they met. The initial screening revealed that at least 230 sites provided some level of opportunity for a stormwater retrofit project. The initial site screening results are shown in Figure 4, colored by ranking. Retrofit opportunity sites were then analyzed using additional metrics to determine those that would offer the most potential stormwater treatment benefit. Additional factors considered in this screening included level of existing treatment (see Section 3.2.1) and infiltration potential. Table 2 lists all of the criteria evaluated for the GIS screening.

Table 2 – Stormwater Retrofit Site Screening Criteria

Criterion	Typical Values	Description	Purpose
Parcel Size	# acres	Area	n/a
Ownership	0 1	Private Public	Opportunity
Redevelopment Potential	0 1	No Redevelopment Redevelopment Planned	Opportunity
Vacancy	0 1	Occupied Vacant	Opportunity
Parking Lot	0 1 2	No Lot Residential Lot Commercial Lot	Opportunity
CIP	0 1	No CIP Planned CIP	Opportunity
Pollutant Hot Spots	# acres 0 – 3	Effective PGIS Area Aggregated	Opportunity, Benefit
Existing Flow Control Facilities	0 1 – 2	No Facility Existing Facility	Opportunity, Benefit
Existing Water Quality Facilities	0 1 – 2	No Facility Existing Facility	Opportunity, Benefit
Upstream Flow Contribution	# acres 0 – 5	Contributing Area Aggregated	Benefit
Infiltration Potential	0 1 2	None Moderate High	Benefit
Ditches, Streams, Wetlands or Outfalls	0 1	None Yes, on-site	Opportunity
Topography	0 1 2	Hilly (>15 deg) Moderate Slope (8-15 deg) Mostly Flat (0-8 deg)	Opportunity

The "Opportunity" factors in Table 2 were the focus of the initial screening, while the refined screening emphasized the "Benefit" factors. Based on the basin characteristics and retrofit goals, the City and consultant team identified three factors to be weighted more heavily for identification of the most suitable retrofit sites:

- Upstream effective impervious area. This attribute is a proxy for runoff potential and flow control needs and is generally similar in this basin to upstream PGIS and water quality needs.
- Infiltration suitability. Infiltration retrofits are highly desirable in the Totem Lake basin.
- Public ownership or potential to redevelop. These sites provide fewer hurdles to project implementation. Redevelopment potential was included to open the selection to private sites, based on the City's interest in public-private partnership to meet stormwater needs

Several weighted screenings were evaluated and compared to produce a balanced, diverse group of sites that were well spread across the basin. The sites were then ranked using the weighted screening results and a list of the top sites was developed. In areas where adjacent sites in the same drainage path were selected, the project team performed a cursory desktop engineering review to select the most suitable site(s) from the group for stormwater retrofits. Results of the screening analysis are presented in Section 4.1.

Field-based Feasibility Assessment

The first step in the rating process for potential retrofit sites identified in the GIS screening was a field reconnaissance of each site to evaluate feasibility criteria. This was performed by a stormwater engineer with expertise in stormwater Best Management Practices (BMPs) and their siting requirements. The engineer completed a reconnaissance report with the following information:

- A description of the site including address or location, ownership, unique elements, and photo documentation.
- Confirmation of tributary area and existing drainage infrastructure.
- Identification of existing utilities, uses, pollution hot spots, and their potential impact on the project.
- Determination of whether water quality, flow control, habitat, or a combination of these can be accomplished at the site.
- An evaluation of alternative BMPs that might be suitable for the site, considering available area, tributary area, land use, drainage patterns, and mapped underlying soils.

This assessment provided a "boots on the ground" understanding of the sites and site-specific opportunities and constraints. Field observations were also used to eliminate sites that would be infeasible for stormwater facilities for reasons such as unfavorable local topography, existing utility constraints, and recent site development not shown in the GIS.

Preliminary Site Selection

Following field reconnaissance, sites were rated based on 13 criteria including:

- Ease of Permitting and Number of Environmental Permits
- Potential Utility or Site Constraints
- Parcel Ownership
- Access for Construction and Maintenance

- Upstream PGIS
- Infiltration Potential
- Upstream Impervious Surface
- Project Impact on Site Uses and Operations (Long-Term)
- Sufficiency of Space Given Setback Requirements, etc.
- Sufficient Head for Treatment/Flow Control Options
- Drainage Infrastructure can be Reasonably Modified
- Level of Existing Treatment and Flow Control for Stormwater
- Redevelopment Potential

These criteria combine information from the GIS screening related to treatment opportunities and potential benefits with on-site observations and judgment of site constraints and suitability. The rating form used and a description of the evaluation criteria are included in Appendix B. Site scores from this rating were ranked to determine the top retrofit candidate sites. The consultant team met with City staff from multiple departments to solicit additional information and feedback about particular sites and opportunities and to select the top candidate sites for development of alternative retrofit concepts.

3.4 Hydrologic and Hydraulic Modeling

The following sections describe the development of the hydrologic and hydraulic models used to support selection and analysis of potential retrofit projects. Continuous hydrologic modeling with HSPF was used to simulate basin flows and assess compliance with Ecology flow control standards. SWMM, which was identified in the grant scope, is less suitable for long-term continuous modeling but was to characterize the hydraulically-complex drainage between Totem Lake and the downstream limit of the study area at I-405 and employed to assess impacts of retrofits on known flooding problems. The model development approach and input data are consistent with those described in the project QAPP (City of Kirkland, 2014).

HSPF Hydrologic Runoff Model

An HSPF hydrologic model was developed for the Totem Lake basin upstream of Interstate 405 (I-405) to provide flows for input to the hydraulic model and to evaluate flow control impacts of potential stormwater retrofit solutions across multiple spatial scales. This model updates and adds detail to the Totem Lake portion of the Juanita Creek basin HSPF model previously developed by King County (King County, 2012). The water quality components of the King County version of the model have not been applied in this project.

Input Data (Subbasins, Soils and Land Use)

For purposes of this analysis, the basin was divided into 61 subbasins (Figure 5) upstream of I-405. NHC delineated the subbasins using the City of Kirkland’s stormwater GIS datasets, as-built plans, and topographic data. The updated delineation provides a much more detailed representation of drainage pathways and features in the Totem Lake basin than the Juanita Creek basin model, which included only two subbasins upstream of Totem Lake. With more refined drainage system information available, the updated basin delineation also adds areas not represented as tributary to Totem Lake in the Juanita Basin model. The most significant change to the basin boundary is in the northeast, where the Totem

Lake basin was determined to extend farther north along 132nd Avenue NE and include several areas east of 132nd Avenue NE.

The Totem Lake basin has a mixture of till, outwash, and peat soils, with till capping most of the upland plateau areas and outwash emerging on the steeper slopes and valley edges. Peat and other saturated wetland soils dominate the valley saddle and area around Totem Lake and down valley past I-405, including the Totem Lake Mall property.

For consistency with the Juanita Creek basin model, NHC used the same remotely sensed land use/land cover as the King County modeling effort. The 2002 King County landuse coverage was used to determine the area in each subbasin of forest, pasture, residential forest, high density grass, wetlands, and impervious surface. The impervious surface was further divided into categories for residential, commercial/industrial, and roadways. The soils, landuse and slope datasets were overlaid to determine the runoff area for each subbasin and input into the HSPF model using the same PERLND and IMPLND categories defined for the Juanita Creek basin model. Table 3 summarizes the soil-land cover breakdown for the Totem Lake portion of the basin (slope categories aggregated). The Totem Lake model adopted the HSPF runoff parameters calibrated by King County for the Juanita Creek basin, and no further runoff calibration was performed as part of this work. A forested condition HSPF scenario was also developed to represent pre-development conditions for purposes of determining flow control targets and analyzing detention needs.

Table 3 – Land Surface Categories in the Totem Lake HSPF Model

HSPF PERLND or IMPLND Category	Area Upstream of I-405 (acres)	Soil Type	Land Cover
11-14	76.4	Till	Forest
21-24	13.6	Till	Pasture
31-34	0.11	Till	Residential Forest
61-64	98.3	Till	High Density Grass
71	37.0	Outwash	Forest
72	7.1	Outwash	Pasture
73	0.5	Outwash	Residential Forest
76	89.0	Outwash	High Density Grass
81	5.2	Saturated	Forest
82	0.8	Saturated	Pasture
86	16.8	Saturated	High Density Grass
87	12.9	Saturated	Wetlands
92	45.7	Impervious	Residential
93	192.1	Impervious	Commercial/Industrial
94	64.3	Impervious	Roads
99	3.8	Water	Water

Meteorological Data

The precipitation record for the Totem Lake HSPF model was developed using local King County rain gage stations 27u and 51u and the long-term SeaTac record. Rainfall from SeaTac was used for water years 1948 through 1990, when the local gages were established. From 1990 forward, the average of gages 27u and 51u was used for each 15-minute time step. Precipitation data through 2009 were assembled in previous studies and extended through January 2015 as part of this work. The observed daily evaporation record from Puyallup was extended using monthly averages to provide the evaporation input data. The HSPF model was run at a 15-minute time step for water years 1948 through January 2015.

HSPF Routing

HSPF routing reaches (RCHRES) were defined for 28 of the 61 subbasins. Many of the subbasins are stormwater pipe conveyance systems with little or no storage and were routed using COPY operations in HSPF. Reaches were included in the model for storage that appeared to be significant based on a review of the GIS data. Additional locations were defined to create flow time series needed for input to the SWMM model. Detailed hydraulic routing is performed in the SWMM model, as HSPF cannot accurately route flow in reaches that are subject to dynamic backwater conditions and flow reversals.

Stage-storage-discharge rating tables (HSPF FTABLEs) were developed using various sources including an existing HEC-RAS model (see below), the Totem Lake SWMM model, and hydraulic analysis of as-built or GIS data. Reaches represented in the baseline existing conditions model are summarized in Table 4.

Table 4 – Routing and Stormwater Facilities in the Totem Lake HSPF Model

HSPF RCHRES ID	Feature or Facility	Data Source
402	Channel d/s Totem Lake to I-405	HEC-RAS/GIS
404	Ditch and culvert system	GIS/survey
406	Stormwater pipe system	GIS
414	Evergreen Hospital vaults	As-builts
424	Evergreen Gateway Center	As-builts
426	Totem Lake	HEC-RAS/GIS
428	Ditch and culvert system	GIS/survey
434	Ditch and culvert system	GIS/survey
437	Slater Rd vault south of CKC	As-builts
438	Ditch and culvert system	GIS/survey
440	King County ponds 132nd Ave	As-builts
441	132nd Ave flow splitter	As-builts
443	132nd Square Park pond (existing, SE corner)	GIS
456	Ditch and culvert system	GIS/survey
458	Stormwater pipe system	GIS
460	Slater Rd vault north of 120th Ave	As-builts
464	Stormwater pipe system	GIS
468	Ditch and culvert system	GIS/survey
471	Totem Square detention pipe	GIS
475	124th Ave vault south of 124th St	As-builts
478	Ditch and culvert system	GIS/survey
480	Comfort Inn detention pond	GIS (no as-builts)
482	Ditch and culvert system	GIS/survey
488	WSDOT I-405 pond	Partial as-builts*
493	LWIT wet pond (north)	As-builts
495	LWIT/Allied Health vault	As-builts
497	Kirkland Campus subdivision detention pipe	As-builts
499	LWIT dry pond (east)	Partial as-builts*

*Control structure detail not available; control structure estimated

The City of Kirkland completed a project in the fall of 2013 that replaced several culverts between I-405 and Totem Lake. A HEC-RAS model was developed for the City by CH2M Hill to evaluate the culvert replacement project and subsequent planned downstream channel improvements. The HEC-RAS model demonstrates the significant impact of the new culverts on the stage-discharge relationship for Totem

Lake. Refer to Section 3.4.3 for further discussion on pre-2013 and post-2013 conditions. The baseline existing condition for this study was defined to be post-2013 culvert conditions.

Selection of Design Events

Design events were extracted from the Totem Lake HSPF model results for use in the SWMM hydraulic model. A flow frequency analysis was performed at several durations on the simulated inflow to Totem Lake to determine the events and multipliers for representative 10- and 100-year events. Flows from the December 1996 event were multiplied by 1.096 to represent the 100-year event and from the October 1986 event by 1.153 to represent the 10-year event. The initial stages were also extracted from HSPF and used as initial boundary conditions for key storage facilities (vaults, ponds, Totem Lake).

Stormwater Retrofit Modeling

Hydrologic analysis was conducted for each of the alternative flow control retrofit concepts to assess relative hydrologic performance and flow control benefits. The 120th Avenue NE retrofit concept, which is designed for water quality treatment only, was not modeled in HSPF as it would be expected to have minimal impact on flows. For each simulated retrofit alternative, new FTABLEs for affected reaches were developed to represent the retrofit concept to determine the impact on flows from the area tributary to the retrofit and downstream. The updated FTABLEs (and any associated changes to routing) were the only changes in the retrofit versions of the HSPF models. Assumed infiltration rates, where applicable, were based on hydrogeologist recommendations for the respective sites.

Following project selection and conceptual design, the proposed configuration of the 132nd Square Park project was also added to the model to estimate the stormwater treatment benefit of the more refined project design.

SWMM Hydraulic Routing Model

A SWMM5 unsteady hydraulic network model of the Totem Lake basin was configured using PC-SWMM software. The unsteady model provides a more accurate hydraulic routing and simulation of water levels than the HSPF model. The objectives of the hydraulic modeling were to identify and characterize existing flooding problems, and evaluate the impact of the proposed stormwater retrofits on existing flooding. The major drainage paths in the basin were incorporated into the model as shown in Figure 6.

The Totem Lake SWMM hydraulic model was developed using the City's GIS drainage layers and survey data of manhole and ditch cross-sections collected for this project. As-built drawings were also utilized along portions of the 132nd Avenue NE/Slater Avenue NE corridor and at key storage facilities to determine their physical geometry. The CH2M Hill HEC-RAS model was imported into SWMM to define the reach from the outlet of Totem Lake through the I-405 twin culverts downstream to the culvert at the Tanager property. The imported HEC-RAS geometry corresponded to the current (post-2013) conditions with the culverts replaced upstream of I-405. Typical Manning's roughness values were applied throughout the SWMM model as shown in Table 5 below.

Table 5 – Hydraulic Model Roughness Values

Material	Roughness, *n*
Solid Wall Polyethylene Pipe	0.013
Concrete or Cement Pipe	0.016
Ductile Iron Pipe	0.016
PVC or Lined PE Pipe	0.016
Corrugated Pipe	0.023
Road Surface for Overflows	0.020
Channel or Ditch	0.030 – 0.100
Overbank or Floodplain	0.040 – 0.200

Inflows

The HSPF hydrologic model was used to generate inflow hydrographs at 43 locations for use in the SWMM model. The 10-year and 100-year events were simulated in SWMM using the events and multipliers described above.

Storage Facilities

Significant flow control facilities within the SWMM model extents were incorporated into the SWMM model. Storage vaults and ponds were typically included based on as-built geometry, including the flow control outlet structure. For small facilities, or when as-built information was not readily available, the GIS datasets were used to estimate geometry. The included storage facilities (shown in Figure 6) vary in size and effectiveness.

Totem Lake has far more volume than any constructed storage facility in the basin, and thus has a significant impact on peak flows. Totem Lake was modeled in SWMM using a stage-area curve derived from the topographic and aerial photograph datasets. No bathymetry data were available for the lake. Lake-level monitoring data were used to refine the model geometry, particularly the lake outlet and downstream channel, as discussed in Section 3.4.3 below.

Overflows

Several locations in the system are overtopped or flooded at the 10-year and/or 100-year events. Depending on the system geometry, the floodwaters may pond locally or overflow to another location. The significant overflow pathways were approximated in the SWMM model to convey floodwaters downstream and provide a more accurate representation of system capacity. Overflows were typically routed based on topographic data and information provided by City staff.

Stormwater Retrofit Modeling

Impacts of retrofit alternatives on flooding in the Totem Lake basin were evaluated using the SWMM model. For the potential retrofit sites within the SWMM model extents (all except 120th Avenue and LWIT), the proposed facility concept was added to the SWMM geometry and the 10- and 100-year events were simulated. It should be noted that outlet flow control structure configurations for proposed detention facilities were not designed at the concept stage. For modeling purposes, flow control structures were roughly sized to target the Ecology duration standard, which would be a likely design objective. Inflow hydrograph locations were adjusted for several of the retrofit concepts to capture proposed routing modifications. The stormwater retrofit results were compared to existing conditions at the proposed facility, as well as at downstream locations with significant existing conditions flooding.

Following project selection and conceptual design, the proposed configuration of the 132nd Square Park project was also added to the model to estimate flow impacts of the more refined project design.

Comparison to Observed Data

The simulated water surface elevations in the Totem Lake HSPF and SWMM models were compared to lake-level (stage) monitoring data that has been collected by the City. The comparison showed that the initial channel and culvert geometry recommended by the City for the baseline condition did not produce a good fit to historic (pre-2013) or current (2014-2015) water levels from Totem Lake downstream. Therefore, the geometry was adjusted in the downstream model reach from Totem Lake to 116th Avenue NE to better represent observed conditions and provide a more reliable model for assessment of proposed retrofits. The adjustments made to the geometry are described below, and the simulated results are compared to the observed stage data.

Observed Data and Background

The City has collected stage data at seven locations as shown in Figure 7. The stage data collection began in November 2011 and was available through January 2015 for use in this project. Additional information was available in the form of photographs and anecdotal descriptions of historic flooding of Totem Lake Boulevard during the December 2007 event. This event overtopped Totem Lake Boulevard near the Comfort Inn and at the intersection of 120th Avenue NE.

The upper reach of the Totem Lake tributary, from downstream of I-405 to the lake, is quite complex to simulate in hydraulic and hydrologic models due to multiple hydraulic controls, different historic system geometries as a result of multiple construction projects both upstream and downstream of I-405, local bypass pumping, sediment deposition, and beaver activity. This reach has been previously documented and analyzed (Jones & Stokes, 2007; SvR, 2008; CH2M Hill, 2014); however those studies were unable to reproduce the historic and observed water surface stages. The previous studies did not perform continuous simulations using HSPF, instead using design flows or hydrographs.

The previous studies provided necessary background information and geometry data about the changing hydraulic controls and system geometries. The following list briefly describes our understanding of the most critical hydraulic controls and system geometries that are relevant to modeling water surface profiles from I-405 upstream to Totem Lake.

- Culvert Replacement Project (constructed Summer/Fall 2013): The City project replaced the majority of the culverts between I-405 and Totem Lake with larger, less-constrictive box culverts. The pre-2013 culverts were a significant constriction at higher flows.

- Channel Modification Downstream of I-405 (Summer/Fall 2014): The City project removed a small sediment deposit downstream of I-405 near a fence crossing. The project anticipated lowering the thalweg to a maximum elevation of 119.0 feet downstream of I-405 (personal communication, CH2M Hill 2014).

- 116th Ave NE Bridge. The culvert crossing present through the 2007 event has since been replaced with a bridge (Jones & Stokes, 2007). Multiple scenarios for this crossing were not considered in the present analysis; however culverts (in place of the current bridge) may have further constricted the system and produced higher water surfaces than simulated for the 2007 event.

- Beaver Activity: Numerous beaver dams are present in the reach downstream of I-405. We are aware of the removal of several dams at different times since 2010, though each time the beavers quickly rebuilt. The beaver dams create constantly changing hydraulic controls downstream of I-405, and complete survey and documentation of the dams was not available. The beaver activity can be best incorporated in aggregate by comparing the monitoring data along the reach. The beaver dams create more quiescent flow conditions, which allow more sediment to be deposited in the channel, and backwater conditions that can extend well upstream on this relatively flat reach.

- Pumping: An emergency bypass pump was installed by the City in November 2011 to pump water from immediately downstream of I-405 to between 116th Avenue NE and the Tanager culvert crossing. The pump has been operated sporadically since being installed, primarily to dewater the I-405 culverts and upstream channel for construction projects (personal communication, CH2M Hill, 2014).

- WSDOT Culverts under I-405: There are twin 42-inch diameter corrugated metal pipe culverts under I-405 that convey all flow from the Totem Lake basin. The City vactored out the sediment basin at the downstream end of the culverts during the 2013 construction project. Based on personal communication (CH2MHill, 2014 and City of Kirkland, 2014), we understand that the culverts were significantly blocked by sediment deposition, and sediment has likely deposited inside the culverts. It is our understanding that the culverts are not likely to be fully open or functioning at design capacity. During our site visits, the culverts were completely submerged at both ends, preventing direct verification of their condition.

Approach

The Totem Lake SWMM and HEC-RAS hydraulic models were used in conjunction with the continuous HSPF model to simulate the impacts of the various hydraulic controls on lake levels. The hydraulic models were used to generate representative FTABLEs—which incorporate shifting hydraulic controls at different flows—for use in the HSPF model. Two geometries were developed and simulated: pre- and post-2013 culvert replacement project. The geometry for post-2013 culvert replacement also included the 2014 channel modification project and is defined as the existing conditions baseline for comparison with proposed stormwater retrofits.

The HSPF-simulated water levels for Totem Lake and the downstream channel were compared to the observed stage records at Totem Lake and at the inlet of the I-405 culverts, respectively. Based on the simulation results, the hydraulic model geometry assumptions were modified and the HSPF model rerun until the simulation provided a reasonable fit to the observed stage data. The modifications to the geometric assumptions were reasonable, given the available system information and history.

Adjusted Geometry and Results

The simulated results from the Totem Lake HSPF model are compared to the observed stage data in Figures 8 to 11. The HSPF simulation results are a reasonably close fit to the observed data for hydrograph shape and elevation. Pumping was not represented in the HSPF model, which likely accounts for much of the differences during late summer and fall. As shown in Figure 7, the simulated stages at the I-405 culvert inlet should most closely match the stage record at MP-02, while the Totem Lake stages should match the gage for MP-01a.

The simulations show significant differences in high flow water levels at Totem Lake before and after the 2013 culvert replacement project. For the December 2007 event, the HSPF pre-2013 geometry simulated a peak water surface of 127.4 feet, which would correspond to overtopping of Totem Lake Boulevard and relatively widespread flooding, as was observed. Were the same event to occur with the modified culverts in place (i.e. post-2013 geometry), the peak water surface would be about a foot lower. These HSPF-generated water surface elevations should be considered very coarse estimates, however, as the SWMM model shows that during very high flows the I-405 culverts are at capacity, causing the reach along Totem Lake Boulevard to reverse and flow back toward Totem Lake. These high flow conditions are not well-represented in the HSPF model, which uses a static stage-storage-discharge relationship. However this only impacts a few of the largest events, and the HSPF representation is considered adequate overall for evaluating impacts of stormwater retrofit projects on lake levels. For other projects that may require a more accurate representation of historic water levels at Totem Lake, the SWMM hydraulic model should be run for the highest events using HSPF-generated boundary conditions.

The significant hydraulic controls that were added or modified in the models to reproduce the observed data are described below.

Post-2013 Culvert Replacements (Baseline)

- Beaver dam(s) between 116th Avenue NE and I-405 culverts: This controls the low flow levels and causes a higher tailwater condition on the culverts. The highest thalweg was set to elevation of 120.9 feet based on the model runs to fit the observed stage data. This is nearly 6 feet above the I-405 culverts outlet invert.

- Channel modification downstream of I-405: The channel was modified to represent the removal of a small hump of sediment downstream of the I-405 culverts. As simulated, this has a negligible impact due to the presence of beaver dam(s) between 116th Avenue NE and I-405 culverts, which provide overriding hydraulic control.

- I-405 culvert blockage: There are two 42-inch diameter CMP culverts under I-405. The culverts are a major hydraulic control at high flows. At low flows, the impact of these culverts depends on how much sediment has accumulated that is blocking conveyance. The modeling showed that a good fit to the observed data was achieved when the two 42-inch culverts were blocked to depths of 6 and 36 inches, respectively.

- Culvert replacement project along Totem Lake Boulevard: The modeling included the replacement culverts and channel maintenance along Totem Lake Boulevard constructed in summer of 2013. The replacement culverts provide increased conveyance between I-405 and Totem Lake, which has a significant impact on water surface profiles at higher flows.

- Beaver dam or natural control of Totem Lake: The observed data indicate a hydraulic control between the inlet to the Totem Lake Boulevard culverts (upstream of 120th Avenue NE) and the main body of the lake (Figure 8). The low flow water levels are about one foot higher at the lake (gage MP-01a) than at the culvert inlet (gage MP-01). There does not appear to be an obvious primary channel between the lake and the culvert inlet. Instead flow is likely conveyed through many smaller flow paths through the wetlands surrounding the lake. Beavers may be active in this reach, and vegetation choking of flow paths is also likely. A simple elevated channel section with a constricted low flow path and broad high flow path was used to represent the outlet of the lake.

Pre-2013 Culvert Replacements (Historic)

- Beaver dam(s) between 116th Avenue NE and I-405 culverts: This controls the low flow levels and causes a higher tailwater condition on the culverts. The highest thalweg was set to elevation 120.5 feet based on conversations with the channel modification project team. This is approximately 5.5 feet above the I-405 culverts outlet invert.

- I-405 culvert blockage: The twin 42-inch diameter CMP culverts under I-405 were assumed to have more sediment accumulation at the outlet prior to vactoring associated with the Totem Lake Boulevard culvert replacement project. The culverts were simulated with sediment blocking flow to depths of 18 and 36 inches, respectively.

- Previous culverts along Totem Lake Boulevard: The culverts along Totem Lake Boulevard were simulated using the dimensions prior to the 2013 replacement. The observed stage data showed relatively high losses through these culverts, and the most upstream culvert was modeled with sediment accumulated to an elevation of 121.5 feet. The observed data and modeling show the culverts to have been a significant hydraulic control between I-405 and Totem Lake, especially at higher flows.

3.5 Technical Assistance Panel (TAP) Process

A Technical Assistance Panel (TAP) process was managed and led by the Urban Land Institute. The TAP process brings together a group of volunteer experts in real estate, land development, economics, and landscape/engineering design to discuss questions posed by the sponsoring agency. The panel members participate in a half-day field visit followed by a full day of deliberation on the questions posed. At the end of the deliberation day, the panel presented answers and thoughts on the questions posed. The final presentation was developed into a report documenting the process and conclusions.

Kirkland posed questions about the Totem Lake Stormwater Retrofit project that centered around how to structure public/private partnerships for stormwater retrofit projects and what priorities to assign to the potential retrofit projects located on private property.

The TAP final report (Appendix C) notes the following:

- Conduct economic analysis of stormwater retrofits that includes triple bottom line analysis to determine size and distribution of benefits
- Consider altering land use codes to allow construction of underground facilities in critical area buffers or to require soil amendments or use of certain tree species that improve stormwater management.
- Consider zoning height or density bonuses to encourage installation of specific LID facilities

The TAP prioritized the three private sites for potential stormwater retrofits, and also noted that purchase and use of public land for these facilities would be preferable to encumbering the private sites. The TAP process helped the city to focus on publicly owned sites for development of conceptual design and cost estimates for capital projects.

4 RETROFIT ANALYSIS

4.1 Alternative Site Selection

Through the GIS screening process described in Section 3.3.1, NHC identified 29 sites for retrofit consideration, shown on Figure 12. AHBL performed field investigations of the 29 sites to evaluate the feasibility for constructing stormwater retrofits on each site. Seven sites were immediately eliminated for reasons such as unfavorable local topography, prohibitive utility constraints, and recent site development not shown in the GIS. Retrofit Reconnaissance Investigation (RRI) reports were filled out for the remaining 22 sites, and AHBL identified potentially suitable retrofit BMPs (for infiltration, water quality treatment, and/or detention) for each site, shown in Appendix D. GIS- and field-based information were then used to rate and rank sites for feasibility and potential benefit of stormwater retrofit projects. Table 6 summarizes the site rankings for the 22 candidate sites—lower scores are better. The RRI and feasibility rating forms for all 22 sites are also included in Appendix D.

Table 6 – Candidate Retrofit Site Feasibility Ratings

Site #	Location	Avg Score	Rank
2	132nd Square Park	1.69	1
22	Totem Square	1.85	2
14	Totem Lake Mall	2.15	3
25	NE 120th ROW between Slater Ave NE and 132nd Ave NE	2.31	4
8	Toyota - NE 126th Pl	2.38	5
16	Totem Lake/Totem Lake Park	2.38	5
26	LWIT N parking lot	2.38	5
1	132nd Ave NE	2.46	8
13	Vegetated area between I-405 and Totem Lk Blvd	2.54	9
15	Yuppie Pawn site - NE Totem Lk Way	2.54	9
24	GTE Telephone - Slater Ave NE	2.54	9
3	WSDOT Ponds - Slater Ave NE/NE 126th Pl	2.62	12
18	King County Wastewater Parcel along CKC	2.62	12
27	LWIT SE parking lot	2.77	14
19	Comfort Inn	2.85	15
10	CKC between 128th Ln NE and Slater Ave NE	2.92	16
11	Rairdon Chrysler - NE 124th St	2.92	16
20	CKC west of NE 120th Ave	3.00	18
21	CKC between NE 120th and NE 124th	3.00	18
17	CKC between Totem Lk Blvd and NE 128th	3.08	20
4	United Rentals - Slater Ave NE	3.15	21
23	Intersection of NE 124th St and 124th Ave NE	3.15	21

The project team held a workshop with City staff from multiple departments on June 12, 2014. The purpose of the meeting was to solicit additional information and feedback about particular sites—e.g. upcoming redevelopment, partnering opportunities, parallel City projects—and to select the top candidate sites for development of alternative retrofit concepts. Six sites (highlighted on Figure 12) were selected for development of stormwater retrofit concepts:

- 132nd Square Park (Site 2)
- Totem Square (Site 22)
- Totem Lake Park (Site 16)
- NE 120th Street (Site 25)
- LWIT (Sites 26/27) – combined alternative for LWIT campus
- Totem Lake Mall (Sites 14/15) – combined alternative for Totem Lake Mall area

4.2 Retrofit Concepts

Multiple project planning concepts were developed for the top six sites. The types of projects considered addressed both flow control and water quality. Four BMPs were considered for flow control:

infiltration pond, detention pond, underground injection control wells (UICs), and vaults. Three BMPs were considered for water quality treatment: bioretention, wetvault, and proprietary media filter devices such as Filterra or StormFilter. The following sections briefly describe the nine retrofit alternatives developed for the six sites; multiple concepts were evaluated for 132nd Square Park (site 2), LWIT (site 26), and Totem Lake Mall (site 14). Planning level construction cost estimates are also provided for each alternative. Projects on private sites are assumed to be coordinated with landowners/developers; costs do not include land acquisition or lease. Additional information about each project is included in project summary sheets provided in Appendix E.

132nd Square Park Regional Detention Pond with UICs (2A)

Construct a regional stormwater facility that would provide infiltration, flow control, and water quality treatment. Construct underground injection control (UIC) wells at southeast corner of park. Stormwater would be captured from the park and area north of NE 132nd Street. The project would reduce flooding at NE 126th Place and along CKC west of 132nd Avenue NE. In addition to stormwater treatment, infiltration would reduce downstream flow volumes to Totem Lake. Approximate cost of the project is $2,000,000.

Pre-Treatment Pond:

- 14,400 square feet top area
- 6 feet deep
- 3H:1V side slopes
- Lined

Detention Pond:

- 73,200 square feet top area
- 8 feet deep live storage (Approx. El. 276-284')
- 3H:1V side slopes
- Lined, no infiltration due to adjacent landslide hazard area

UIC Wells:

- 33 UIC casings to 100' depth
- 40' spacing between wells
- Assumed 15 gpm capacity

132nd Square Park Regional Detention Pond (2B)

Construct a regional detention facility that would provide flow control treatment. Stormwater would be captured from the park and area north of NE 132nd Street. The project provides significant flow control but does not meet stormwater standards for the 48.5-acre contributing area. The project would reduce flooding at NE 126th Place and along CKC west of 132nd Avenue NE. Approximate cost of the project is $1,400,000.

Detention Pond:

- 103,500 square feet top area
- 8 feet deep live storage (Approx. El. 276-284')
- 3H:1V side slopes
- Lined, no infiltration due to adjacent landslide hazard area

Totem Lake Mall East Detention Vault and Water Quality Treatment (14E)

Construct a regional stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from the large mall parcel and from the existing 120th Avenue stormwater line. The project would improve stormwater conditions downstream of Totem Lake, though the lake naturally attenuates some of these effects. This project would require coordination with private developers. Approximate cost of the project is $14,300,000 for the vault plus $640,000 for optional bioretention.

Vault:

- 108,000 square feet top area
- 8 feet deep total storage
- 4 feet deep live storage (Approx. El. 124-128')
- 4 feet deep dead storage for water quality
- Assumed outlet to Totem Lake via 120th Ave; vault could be adjusted to start live storage at El. 125' and outlet to the west.

Optional Bioretention for Enhanced Water Quality:

- 13,300 square feet top area proposed as concept
- Provides Enhanced Water Quality treatment for 25% of parcel
- 9 inches deep (3 inches ponding + 6 inches freeboard)
- 3H:1V side slopes
- Lined, no infiltration due to saturated soils
- Bypasses detention vault due to elevation limitations

Totem Lake Mall West Detention Vault and Water Quality Treatment (14W)

Construct a stormwater facility that would provide flow control and water quality treatment. The project would improve stormwater conditions downstream of Totem Lake. This project would require coordination with private developers. Approximate cost of the project is $8,700,000 for the vault plus $730,000 for optional bioretention.

Vault:

- 65,500 square feet top area
- 8 feet deep total storage
- 4 feet deep live storage (Approx. El. 124-128')
- 4 feet deep dead storage for water quality

Optional Bioretention for Enhanced Water Quality:

- 15,350 square feet top area proposed as concept
- Provides Enhanced Water Quality treatment for 40% of parcel
- 9 in. deep (3 in. ponding + 6 in. freeboard)
- 3H:1V side slopes
- Lined, no infiltration due to saturated soils
- Bypasses flow control vault due to elevation limitations

Totem Lake Outlet Modification (16)

Construct a weir upstream of the Totem Lake outlet to enhance flow control and regulate storage in the lake. Construct new 48-inch equivalent culvert under the CKC to replace existing buried culvert. The project would potentially reduce duration and frequency of flooding on Totem Lake Boulevard and along the CKC. There are significant challenges associated with this project, particularly in regards to potential wetland impacts. Coordination with Ecology and permitting agencies regarding project feasibility is recommended at the outset of any further design process. Approximate construction cost of the project is $400,000; permitting costs would be higher than average.

- Weir crest elevation 125.5’
- 2 low flow openings or active gate structure

Totem Square Regional Detention Vault and Water Quality Treatment (22)

Construct a regional stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from two locations along the west side of 124th Avenue NE, and one location from the private property to the south (same as existing drainage). The project would reduce flooding in the vicinity of NE 124th Street and 124th Avenue NE. This project would require coordination with private developers. Approximate cost of the project is $6,400,000 for the vault plus $140,000 for optional bioretention.

Vault:

- 24,000 square feet top area
- 16.5 feet deep total storage
- 12.5 feet deep live storage
- 4 feet deep dead storage for water quality

Optional Bioretention for Enhanced Water Quality:

- 9,400 square feet top area
- 9 in. deep (3 in. ponding + 6 in. freeboard)
- 3H:1V side slopes
- Lined, no infiltration
- Flow control compliance assumes outflow directed to vault

120th Avenue NE ROW Water Quality Treatment (25)

Construct stormwater facilities that would provide enhanced water quality treatment for the 120th Avenue NE ROW east of Slater Avenue. Stormwater would be captured from approximately 4 acres of ROW. A bottomless StormFilter would be used at the intersection of NE 120th Street and Slater Avenue to take advantage of infiltrative soils. Approximate cost of the project is $310,000.

- 6 water quality treatment units
- StormFilter CB or Filterra units at 4 catchbasins
- StormFilter MH units at two locations
- Bottomless StormFilter MH unit at intersection with Slater Ave

LWIT Water Quality and Detention Vault (26A)

Construct a stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from 23.4 acres of the LWIT campus. This project would require coordination with the Lake Washington Institute of Technology. Approximate cost of the project is $5,300,000.

Vault:

- 25,000 square feet top area
- 4 feet deep dead storage
- 6 feet deep live storage

LWIT Infiltration Vault (26B)

Construct a stormwater facility that would provide infiltration, flow control and water quality treatment. Stormwater would be captured from 23.4 acres of the LWIT campus. In addition to stormwater treatment, infiltration would reduce downstream flow volumes to Totem Lake. This project would require coordination with the Lake Washington Institute of Technology. Approximate cost of the project is $2,500,000.

Pre-Treatment Vault:

- 5,000 square feet top area
- 6 feet deep

Infiltration Vault:

- 15,000 square feet top area
- 10.5 feet deep live storage
- Assumed 2” per hour infiltration rate

4.3 Evaluation of Alternatives

Treatment effectiveness of each retrofit alternative was characterized relative to Ecology standards (SMMWW Minimum Requirements 5 through 7) for consistency with the grant emphasis. Table 7 summarizes performance of the retrofit alternatives in terms of compliance with the 2012 DOE stormwater standards for the treated tributary area. It should be noted that many retrofit projects would not trigger those specific requirements at all, or would only require compliance for impacted areas much less than the tributary areas for which compliance was assessed. Flow control (MR7) compliance was evaluated using the HSPF model; outlet control structure configuration was not part of the conceptual designs so was approximated in HSPF to maximize flow control performance. Because MR5 (On-Site Stormwater Management) can be very site and design-specific, it is difficult to assess the degree to which MR5 would be met at this preliminary stage. The table instead notes whether each proposed retrofit has an infiltration component.

Table 7 – Retrofit Concept DOE 2012 Stormwater Compliance

Site ID	Site Name	Retrofit Concept	Treated Area (ac)	Includes Infiltration[1]	MR6 Runoff Treatment[2]	MR7 Flow Control[2]
2	132nd Square Park	2A: Wetpond with UIC	48.5	Yes	Enhanced	Yes
		2B: Detention pond		No	None	Partial
14E	Totem Lake Mall East	Vault with WQ	24.7	No	Basic	Partial
		Add-on: Bioretention	6.0	No	Enhanced	n/a
14W	Totem Lake Mall West	Vault with WQ	14.0	No	Basic	Partial
		Add-on: Bioretention	5.9	No	Enhanced	n/a
16	Totem Lake Park	Lake outlet control[3]	531	No	None	Partial
22	Totem Square	Vault with WQ	20.3	No	Basic	Yes
		Add-on: Bioretention	3.5	No	Enhanced	n/a
25	120th St	Filterra/Stormfilter	4.0	Partial	Enhanced	No
26	LWIT North Parking Lot	26A: Vault with WQ	23.4	No	Basic	Partial
		26B: Infiltration vault with WQ		Yes	Enhanced	Yes

[1]MR5 compliance not determined at this stage.
[2]Assessed for entire treated area.
[3]Would affect wetland water levels; MR8 compliance not determined.

The individual retrofits were modeled in HSPF and SWMM to evaluate their impact on flows both locally and downstream. The HSPF model was used to assess impacts of the individual alternatives, as well as the retrofit concepts collectively[1], on downstream peak flows and runoff volume at Totem Lake, at I-405, and on Juanita Creek downstream of the Totem Lake tributary. Flow and volume impacts at these three locations are summarized in Table 8, Table 9, and Table 10, respectively. Percent change shown in the

[1] HSPF modeling was performed only for the concepts with detention and/or infiltration components. Water quality only concepts (120th Street and enhanced treatment for Totem Lake Mall) would have minimal impact on flow and were not explicitly modeled.

tables compares the retrofit scenario to baseline conditions. Forested scenario results are not included in Table 10 because forested land use was not simulated for the entire Juanita Creek basin.

The modeling results show that the selected retrofit concepts can have an impact at the basin scale. Peak flow reduction impacts diminish rapidly moving downstream through the system, however. Notably, the storage in Totem Lake damps out peak flow impacts of retrofit projects upstream of the lake, and retrofits in the Totem Lake basin have no impact on the much larger Juanita Creek system, with the exception of the basin-scale Totem Lake Park project. Reductions in flow volumes provided by infiltration retrofits are more persistent. Although effects obviously diminish downstream as additional tributary area is added, small changes are still detectable even on lower Juanita Creek.

Table 8 – Retrofit Concept Peak Flow Impacts – Totem Lake Inflow

Scenario	Peak Flows (cfs)			Percent Change from Baseline	
	2-year	10-year	100-year	Peaks (Avg)	Total Volume
Forested	3.2	9.6	42.9	n/a	n/a
Baseline	62.9	111.4	199.9	n/a	n/a
2A	55.6	97.2	171.5	-13%	-9%
2B	55.8	97.3	171.6	-13%	0%
14E/W[1]	58.9	103.6	187.2	-7%	0%
16	62.9	111.4	199.9	n/a	n/a
22	58.8	104.5	189.7	-6%	0%
26A	61.4	109.2	196.1	-2%	0%
26B	61.2	109.2	196.1	-2%	-4%
All concepts[2]	45.9	80.2	144.8	-28%	-13%

[1]Due to subbasin boundary definitions, Totem Lake Mall concepts modeled in a single scenario
[2]Includes infiltration options for site 2 (2A) and site 26 (26B)

Table 9 – Retrofit Concept Peak Flow Impacts – I-405

Scenario	Peak Flows (cfs)			Percent Change from Baseline	
	2-year	10-year	100-year	Peaks (Avg)	Total Volume
Forested	4.0	7.6	13.7	n/a	n/a
Baseline	27.4	36.2	43.3	n/a	n/a
2A	26.6	35.5	42.7	-2%	-7%
2B	26.7	35.6	42.8	-2%	0%
14E/W[1]	24.3	32.6	38.8	-11%	0%
16	18.7	35.8	42.9	-11%	0%
22	27.0	35.9	43.1	-1%	0%
26A	27.2	36.0	43.1	-1%	0%
26B	27.1	36.0	43.1	-1%	-3%
All concepts[2]	14.7	25.5	42.3	-26%	-10%

[1]Due to subbasin boundary definitions, Totem Lake Mall concepts modeled in a single scenario
[2]Includes infiltration options for site 2 (2A) and site 26 (26B)

Table 10 – Retrofit Concept Flow Peak Impacts – Juanita Creek d/s Totem Lake Trib

Scenario	Peak Flows (cfs)			Percent Change from Baseline	
	2-year	10-year	100-year	Peaks (Avg)	Total Volume
Baseline	178	276	355	n/a	n/a
2A	177	275	354	0%	-1%
2B	178	275	355	0%	0%
14E/W[1]	178	275	354	0%	0%
16	175	273	352	-1%	0%
22	178	275	355	0%	0%
26A	178	276	355	0%	0%
26B	178	275	355	0%	-1%
All concepts[2]	174	272	350	-2%	-2%

[1]Due to subbasin boundary definitions, Totem Lake Mall concepts modeled in a single scenario
[2]Includes infiltration options for site 2 (2A) and site 26 (26B)

SWMM model scenarios were developed for six of the nine retrofit concepts[2] and used to assess flood reduction for 10-year and 100-year events at existing flooding locations. Flooding assessment (Table 11) was semi-quantitative, using hydraulic modeling results to characterize relative benefits of the simulated retrofit alternatives.

[2] Sites 25 and 26 were beyond the limits of the SWMM model. The 120th Ave retrofit (Site 25) would have negligible flow impacts, and peak flow impacts from the LWIT retrofit alternatives are marginal by the time flows reach the valley drainage system.

Table 11 – Flood Reduction Benefit Summary

Site 2	• Very little difference at peak flow between 2A and 2B for 10-year and higher events. • Very effective at reducing flooding downstream to the CKC. Flow to the hillside channel east of 132nd Ave would be significantly reduced, resulting in near elimination of flooding across 126th Pl during the 100-year event (currently overtops during the 10-year event). • Also reduces the risk of flooding at 132nd Ave and the CKC, as well as along the flood-prone south side of the CKC west of 132nd Ave.
Site 14E/W	• 14E would have negligible impact on flooding other than locally along 120th Ave NE. Reduction in the peak inflow to Totem Lake translates to very little change in peak lake levels (few inches at 10- or 100-year). The impact of 14E is muted downstream due to the storage of Totem Lake. • 14E and 14W would have a small impact on flood flows downstream. Detention is only enough to provide about a 10% reduction in the 10-year peak, and less for the 100-year event.
Site 16	• Outlet control to enhance detention would increase water levels at many flows. This project would need to carefully balance lake levels with overtopping of Totem Lake Blvd from the Comfort Inn stormwater line and on the southeast side of the CKC west of 128th Ln NE. • Only retrofit alternative that would have a significant impact on flood discharges downstream of I-405. Peak flows downstream of I-405 could be reduced by about 40% for the 10-year event. Duration of 100-year flooding downstream of I-405 would be significantly reduced, despite only minor reductions in peak flow.
Site 22	• Significant reduction in overtopping/flooding of 124th St between the CKC and 124th Ave. Flooding at the CKC crossing would be eliminated for the 10-year and slightly reduced for the 100-year. • Flooding along the west side of 124th Ave south of 124th St would be nearly eliminated during the 10-year and 100-year events. • Flooding along the east side of 124th Ave south of 124th St would be significantly reduced for the 10-year event, and slightly reduced for the 100-year event.

4.4 Capital Project Selection

Following the alternatives analysis and TAP panel report, the consultant team met with the City to rank and select retrofit alternatives to be carried forward to conceptual design. The key considerations for selection of capital projects were retrofit performance (i.e. flow and water quality benefits), implementability, and cost. Although the City remains interested in partnering with private development, input from the TAP and uncertainty of timing for redevelopment projects resulted in a preference for public sites. Information considered in making the project selections is summarized in Table 12.

Three projects were initially selected, including the Totem Lake Park alternative, which is the only retrofit option that would offer significant flow control at the basin scale. There are significant permitting questions and additional study that would be required to further develop the Totem Lake Park alternative, however, which are beyond the scope of the current project. Given the potential benefit of the project and synergy with the Totem Lake Park and neighborhood master plans, the City will likely continue to explore opportunities to enhance stormwater treatment in the area. However, following discussion of the project with Ecology, Totem Lake Park was eliminated from further consideration under this grant project.

The other two projects—NE 120th Street and 132nd Square Park—offer contrasting retrofit opportunities. NE 120th Street is a very straightforward, low-cost project entirely within City right-of-way that will provide water quality treatment to a small but previously untreated area. The 132nd Square Park project is regional in scale, treating nearly 50 acres (second only to Totem Lake in treated area) in an area of the basin that is unlikely to experience significant redevelopment and associated stormwater facilities. The park site offers significant opportunities for infiltration, water quality, and flow control treatment.

While site selection placed an emphasis on area that could be treated, even collectively the alternative sites cannot come close to retrofitting the entire Totem Lake basin to current standards. As discussed with Ecology in an earlier project meeting, the emphasis of the selected retrofits is on maximizing benefit ("doing what we can") with constructible projects, and it is unrealistic in this basin to expect retrofit projects to achieve stormwater treatment performance equivalent to what would occur if the entire basin were developed or redeveloped under current standards.

4.5 Non-Capital Projects

One of the goals of this project was to investigate whether/how zoning incentives or measures could be used to encourage private developers to accommodate regional stormwater retrofit projects and/or to use low impact development facilities on their property. Review of the zoning code for this area revealed that incentives and bonuses for height and density had already been granted in an effort to spur redevelopment in the Totem Lake Business District. Thus few to no incentives were available for use as incentives for stormwater retrofit projects. In addition, the TAP indicated that market demand (for increased height on an office building, for example) must be present in order for zoning incentives to be an effective enticement. Currently, few projects are using existing zoning height/density incentives. Another issue encountered is that the City cannot grant bonuses or incentives in the Zoning Code for items that are required under other codes. As the 2012 Ecology Manual requires use of low impact development facilities, the Zoning Code cannot grant low impact facility bonuses or incentives (though these may be considered during the low impact development code review that is required by the Phase II Western Washington NPDES Permit).

In planning the project, staff assumed that zoning code incentives and bonuses would be one of the main non-capital alternatives developed as part of this project. As noted above, zoning code changes did not turn out to be feasible. Zoning restrictions on impervious surface or other measures conflict with city interest in encouraging redevelopment.

Other non-capital project types are behavioral in nature, meaning that they attempt to change the manner by which property owners wash vehicles or provide care to landscaped areas and lawns, or sweep city streets. Other non-capital project types involve the retrofit of developed sites to minimize stormwater flows to the City's Municipal Separate Storm Sewer System (MS4) by minimizing impervious surface coverage or constructing bioretention facilities or rain gardens within existing landscape areas to provide distributed onsite treatment.

The City already has a variety of successful programs that address the non-capital project types described broadly above. Existing programs include:

- Neighborhood rain gardens
- Natural yard care neighbors program
- Cascade/Savvy Gardener classes
- Residential stormwater audits
- Source control visits
- Private drainage system inspections and technical assistance
- Car wash kit program

The opportunity for the City of Kirkland is to expand these programs and emphasize the importance of their use within the Totem Lake basin. For example, source control visits can be emphasized within the Totem Lake basin and be publicized as part of the Green Building Program.

Table 13 describes some of the non-capital project opportunities that the City of Kirkland may wish to pursue within the Totem Lake basin. Some of the project opportunities would be enhancements to existing City programs, and others would be new endeavors.

Table 12 – Stormwater Retrofits Alternative Summary

Site ID	Site Name	Property Ownership	Project Concept	Treated Area, ac	Project Capital Cost	Cost per Treated Acre, $1000/ac	DOE 2012 Stormwater Compliance[1]				Downstream Flow Benefits[3]				Flood Reduction Benefits[4]	
							Includes Infiltration[2]	MR6 Runoff Treatment (Water Quality)	MR7 Flow Control	MR8 Wetlands Protection	Totem Lake Inflow: Avg % Peak Flow Reduction	Totem Lake Inflow: % Volume Reduction	Flow at I-405: Avg % Peak Flow Reduction	Flow at I-405: % Volume Reduction	10-yr	100-yr
2	132nd Square Park	City of Kirkland	2A: Stormwater Pond with UIC and WQ pre-treatment	48.5	$2M	$41	Yes	Enhanced WQ	Yes	N/A	13%	9%	2%	7%	Significant	Significant
			2B: Stormwater Pond, no WQ	48.5	$1.4M	$29	No	No	Partial	N/A	13%	0%	2%	0%	Significant	Significant
14E	TL Mall East	Private	Stormwater Vault with WQ	24.7	$14.3M	$579	No	Basic WQ	Partial	N/A	7%	0%	1%[5]	0%	Moderate	Minimal
			Add-on: Bioretention 13,300 sq ft of rain gardens	6.0	$640K	$107	No	Enhanced WQ	N/A	N/A	--	--	--	--	--	--
14W	TL Mall West	Private	Stormwater Vault with WQ	14.0	$8.7M	$621	No	Basic WQ	Partial	N/A	0%	0%	10%[5]	0%	Moderate	Minimal
			Add-on: Bioretention 15,350 sq ft of rain gardens	5.9	$730K	$124	No	Enhanced WQ	N/A	N/A	--	--	--	--	--	--
16	Totem Lake Park	City of Kirkland/ KCCD	Flow control structure at Lake outlet	531.0	$400K	N/A	No	No (lake currently provides some treatment)	Partial	Would affect wetland water levels	0%	0%	11%	0%	Significant	Moderate
22	Totem Square	Private	Stormwater Vault with WQ	20.3	$6.4M	$315	No	Basic WQ	Yes	N/A	6%	0%	1%	0%	Significant	Moderate
			Add-on: Bioretention 15,350 sq ft of rain gardens	3.5	$140K	$40	No	Enhanced WQ	N/A	N/A	--	--	--	--	--	--
25	120th St East of Slater	City of Kirkland (ROW)	6 Filterra/Stormfilter units, 1 bottomless for infiltration	4.0	$310K	$78	Partial	Enhanced WQ	No	N/A	--	--	--	--	--	--
26	LWIT North Parking Lot	Institutional	26A: Stormwater Vault, with WQ	23.4	$5.3M	$226	No	Basic WQ	Partial	N/A	2%	0%	1%	0%	--	--
			26B: Stormwater Vault with infiltration and WQ pre-treatment	23.4	$2.5M	$107	Yes	Enhanced WQ	Yes	N/A	2%	4%	1%	3%	--	--

1 Assessed for entire treated area. Retrofit projects would require compliance for smaller area, if any.
2 LID requirements and feasibility under MR5 are site- and design-specific; compliance not determined at this stage.
3 Compared to existing; determined from HSPF modeling of Totem Lake/Juanita Creek basins.
4 Determined from SWMM modeling of Totem Lake drainage system.
5 Site 14 alternatives combined in HSPF modeling; benefit distribution between 14E/14W estimated.

Table 13 – Non-Capital Project Opportunities

Non-Capital Techniques	General Description	Purpose/Rationale	Costs and Challenges	Potential Applicability
Reduced Review Time/Expedited Review	Commit to a priority status for retrofit projects with a maximum time between receipt and review.	Applicants that voluntarily retrofit a developed site do not want to wait in a long queue for permission to do a "good deed."	Impacts to staffing resources and other project review schedules. Outside consultants could also be used to expedite.	High
Reduced Application Fees	Waive all or a portion of the submittal fees for voluntary retrofit proposals.	Due to potential positive effects within the Totem Lake Basin, lower fees are justified.	Impacts to City resources.	Medium-High
Public Recognition	Emphasize the voluntary good deeds of applicants that are voluntarily retrofitting sites within the Totem Lake Basin.	Highlight the voluntary nature of the proposal to create additional public awareness for other owners of other developed sites within the basin.	Staff resource impacts for updates to the City's website and other publicity efforts.	Medium
Adjustments to Parking Requirements	Reduce onsite parking requirements.	Reducing parking is a technique for reducing impervious surfaces that will result in improvements within the basin.	May conflict with other community objectives.	Low, because most non-residential uses consider parking an amenity.
Surface Water Utility Fee Reductions	Reduction of monthly surface water utility fees for developed sites that voluntarily retrofit stormwater facilities within the Totem Lake Watershed.	The use of onsite, infiltration-based LID practices will place less strain on the City's MS4 and result in improvements to the Totem Lake Basin, thereby justifying the reduction in the monthly surface water utility fee.	Reduced capital funds. Should the reduction in the surface water utility fee be permanent or for some fixed period of time?	Generally high potential interest for non-residential uses. Developed single-family residential property owners may be less interested in the fee reduction.
Free or Low Cost Materials	Using the City's Neighborhood Rain Garden Program as a model, emphasize the retrofit assistance in the Totem Lake Basin by providing free technical assistance and/or materials for rain garden/bioretention facility construction on developed sites.	The use of onsite, infiltration-based LID practices will place less strain on the City's MS4 and result in improvements to the Totem Lake Watershed.	Monetary cost to the City.	Medium to high interest, particularly if property owners can be made aware of the attractiveness of rain gardens/bioretention facilities.
Downspout Disconnection	Disconnect roof downspouts and direct the stormwater into onsite landscaped areas.	The disconnection of the roof downspouts will distribute stormwater more broadly across onsite landscaped areas and allow for infiltration, where feasible, and/or direction of flows to onsite rain gardens.	Communicating the value of this "low-tech" technique can be challenging. There is also some resistance to making onsite landscape areas "soggy."	Low
Residential Stormwater Audit Program	Audit of onsite stormwater management practices and opportunities for improvements and cost savings.	The Stormwater Audit Program can raise awareness and facilitate the retrofit of sites for improvements to the Totem Lake Basin.	Staff time is a cost to the City. The challenge is that the audit may merely collect dust on a shelf if no retrofits are made.	Medium
Car Wash Kits for Businesses and Charity Car Wash Events	Distribution of car wash kits for businesses and charity car washes.	Prevention of illicit discharges; proper techniques for discharge of wash water to the City's sanitary sewer.	Monetary cost to the City.	Low-Medium
Street Sweeping Program	Sweeping of streets with a water quality, as opposed to localized flooding, focus	Source control of pollutants before migration to the City's MS4.	Monetary cost to the City	Medium
Neighborhood-scale Mapping of LID Improvements and Opportunities	Mapping of LID treatment and flow control improvements to assist with NPDES reporting requirements.	Will aid in IDDE and other elements of the City's stormwater program.	Monetary cost to the City	Low-Medium

5 SELECTED PROJECTS

5.1 Capital Projects

Two candidate retrofit projects—NE 120th Street and 132nd Square Park—were selected by the project team and City stakeholders for conceptual design and consideration for implementation. Each project is described below, and conceptual designs and cost estimates are provided in Appendix F.

These projects will provide significant water quality and flow control benefits in subbasins where currently little to no treatment exists. These two projects are recommended for inclusion in the City of Kirkland Capital Improvement Project six-year program. Both projects would be anticipated to receive favorable scores from Ecology if design and construction funding grants are pursued.

NE 120th Street CIP

This CIP would provide water quality treatment to the NE 120th Street right-of-way and adjacent tributary areas between the Lake Washington Institute of Technology and Slater Avenue NE. Approximately 1.9 acres would be treated to the Enhanced standard with five individual Filterra units, and one additional acre would be treated to the Basic standard with two StormFilter units. The StormFilter unit, to be located near the intersection NE 120th Street and Slater Avenue NE, is designed to infiltrate stormwater to take advantage of highly infiltrative soils anticipated to be in the area. The concept-level construction cost estimate is $290,000, with design and permitting costs estimated to be $56,000 (all in 2015 dollars). Refer to Appendix F for the conceptual plans and cost estimate.

This project was selected for CIP development for the following reasons:

- The project area of nearly 3 acres drains developed impervious surfaces that are subject to vehicular traffic and currently receive no treatment.
- The topographical slope provides sufficient head for various treatment options,
- The City owns the right-of-way.
- Access for construction and maintenance is good.
- The existing drainage infrastructure can be reasonably modified.
- There are no environmental or critical area impacts.
- Permitting is expected to be straightforward.

The water quality treatment facilities were sized using the Western Washington Hydrologic Model (WWHM). The sizing for the Filterra units and the StormFilter units is based on the water quality design flow rate at or below which 91 percent of the runoff volume will be treated.

Next steps for this project include the following:

1) Pothole the proposed locations, particularly near the intersection of NE 120th Street and Slater Avenue NE, to confirm existing utility locations.

2) Confirm the existence of infiltrative soils and test for the infiltration rate to determine the volume of runoff that could be infiltrated through the StormFilter Infiltrator unit.
3) Finalize design and obtain necessary permits.
4) Construct project.

132nd Square Park CIP

This CIP would provide water quality treatment, flow control, and infiltration for approximately 48.5 acres of single-family residential and right-of-way area in the northeast corner of the Totem Lake Basin. The Park is located at the corner of NE 132nd Street and 132nd Avenue NE, and contains ball fields, open space, and a parking area. The Parks Department has plans to rehabilitate the grass ball fields to improve usability, which provides an opportunity for synergy with this CIP.

The original concept plan for this site proposed a large surface detention pond along with UIC wells. Upon discussing the plan with the Parks Department, the team learned that the area proposed for the expanded pond is heavily used as an informal soccer field and that the Parks Department had plans to rehabilitate and improve the field because of heavy use by the community. Based on City preferences, the plan was altered to move the stormwater facilities underground. This reduces the storage volume for flow control but accommodates needs of park users to a greater degree.

The project design calls for two combination wetpool/detention vaults and 21 UICs. The combined volume of both vaults provides 92,800 cubic feet of water quality storage and 50,600 cubic feet of live (detention) storage volume. Treated outflows from the vaults are directed into UICs, and flows exceeding the capacity of the UICs are directed back to the City's storm system in 132nd Avenue NE.

Under this proposed CIP, water quality treatment would be provided to the Basic standard for the entire 48.5-acre tributary area through the use of wetvaults. More than 95 percent of the area would be treated to the Enhanced standard by infiltration via UICs downstream of the basic pretreatment facility. In addition, significant flow control and runoff infiltration are provided through the use of detention vaults and underground infiltration control wells (UICs). The design, assuming conservative infiltration rates, would infiltrate about 90 percent of the total inflow. Water quality treatment performance was verified using the Totem Lake HSPF model.

Runoff volume reductions from proposed infiltration at this site would have a significant impact basinwide (8 percent reduction in total volume inflow to Totem Lake) and even down to Juanita Creek (1 percent reduction in total flow volume below Totem Lake Tributary confluence). The project would also provide significant local reductions in peak flows, which would reduce flooding at 126th Street and along the eastern end of the CKC.

The concept-level construction cost estimate is $3,310,000, including $360,000 for field rehabilitation. Design and permitting costs are estimated to be $495,000 (all costs in 2015 dollars). Refer to Appendix F for the conceptual plans and cost estimate.

This project was selected for CIP development for the following reasons:

- The site drains a large area of existing development with minimal stormwater treatment that is not expected to redevelop in the foreseeable future.
- The City owns the parcel.
- The parcel is large enough to accommodate regional-scale treatment facilities.
- Access for construction and maintenance is good.
- The existing drainage conveyance system is conveniently located to enable interception of upstream flows and discharge of treated flows.
- Topographical slope provides sufficient head for various treatment options.
- The potential exists for infiltration through UICs.

The potential suitability and capacity for deep injection of stormwater using UIC wells at the Park was evaluated using available geologic and geotechnical information. Existing soil investigations at other nearby areas informed the hydrogeologist's assessment of the suitability of the Park site for a UIC system (included as Appendix F). Based on this assessment, it was assumed for planning purposes that each UIC well at the Park could provide an infiltration rate of 15 gallons per minute (gpm), with a spacing of 40 feet between the wells. Each UIC well would consist of a 24- to 36-inch diameter boring drilled to a depth of up to 100 feet. The critical next step for this project is evaluation of on-site subsurface geology and groundwater conditions to refine design of the UICs (see step 1 below).

Next steps for this project include the following:

1) Drill borings and a UIC test well to depths of up to 100 feet and install downstream groundwater monitoring well to characterize on-site subsurface geology and observe groundwater response to UIC injection.
2) Size the control structures based on the design injection rate.
3) Design an irrigation pump system to utilize the stored stormwater for field irrigation.
4) Finalize the design of the UICs, conveyance piping, storage vaults, grading, and field improvements.
5) Obtain the necessary permits, including permitting for facilities near the top of a landslide hazard area.
6) Construct project.

5.2 Non-Capital Projects

Based on an evaluation of existing City programs and those in other jurisdictions and discussion with City staff, three non-capital projects were identified as priorities for implementation in the Totem Lake basin. These programs are intended to supplement successful existing programs, listed in Section 4.5, which are assumed to continue unabated. The following new or recommitted programs were selected for priority application in the Totem Lake basin:

Street sweeping program

Increase the frequency of the street sweeping program throughout the Totem Lake basin.

Totem Lake basin education and branding

Develop a consistent theme and identity for the Totem Lake basin that can be used in basin education. Prepare signage and other identifying collateral to inform people that they have entered the Totem Lake basin and of its importance to Kirkland. It is important that this "branding" of the basin occurs simultaneously with the reopening of the park to emphasize the importance of Totem Lake as a place and the community's feeling of ownership for the wellbeing of the waterbody.

The branding of the Totem Lake basin should also be tied to other education and outreach activities, including the Residential Rain Garden Program, the Car Wash Program, and the Stormwater Audit Program, so that residents participating in these activities in the Totem Lake basin understand that the activities have tangible impacts on water quality in Totem Lake.

Retrofit incentives and rebates in the Surface Water Utility rate structure

Stormwater retrofits of existing private development will play an important role in water quality and flow control improvements within the watershed. Stormwater treatment to current standards is required when a property redevelops and rate bonuses or incentives could not be applied to stormwater facilities that are required. However, there may be properties where significant redevelopment is not planned, and where voluntary water quality treatment could be provided at a low cost. Economic analysis is needed to determine the number of properties where this might apply, and then to develop appropriate rate incentives to encourage those investments.

5.3 Implementation Plan

The City of Kirkland has historically funded stormwater capital improvement projects largely through revenue from the surface water management utility fees. Grants from external sources have been used where possible. In the 2014 *Surface Water Master Plan* (City of Kirkland, 2014b), the possibility of bonding or use of other financial mechanisms was introduced, and the City Council has expressed interest in exploring these options for larger regional projects. The surface water management utility project list includes around a dozen funded projects and an equal number of unfunded projects for future consideration.

The annual revenue from the utility rate structure is about $1.6 million. The six-year CIP program for funded stormwater projects totals about $13.5 million. The two Totem Lake capital projects described in this report are not currently listed on the City's funded or unfunded CIP Program.

External sources for design and construction funding may be available from Ecology. The City of Kirkland is eligible for up to $5 million in grant funds per biennium. The Ecology grants typically require a 25 percent contribution form the local agency. Projects receive more favorable scoring if they have completed a pre-design that has been reviewed and approved by Ecology. The following steps are suggested for implementing the capital improvement projects:

1) Add the NE 120th Street and the 132nd Square Park projects to the Surface Water CIP program.

2) Complete environmental permitting for both projects.
3) Apply for Ecology grant funding for FY 2017, which will open for applications in August 2016. If Ecology funding is awarded, go to Council for permission to use Surface Water Utility Reserves to fund the 25 percent match portion of the project.
4) Coordinate design and construction of the 132nd Square Park with the Parks Department, and leverage the Parks project to rehabilitate the grass ball fields in coordination with this CIP.
5) Complete design of both projects and the complete bid ready documents.
6) Once Ecology grant funds are secured, bid and construct the project.

The prioritized non-capital projects are recommended for immediate action. Steps for implementing these programs are described below:

- Street sweeping program. Increase the frequency of street sweeping throughout the Totem Lake watershed. The cost of increased street sweeping could be offset by the collection of basin-specific surface water fee surcharge.

- Totem Lake basin education and branding. Developing a consistent theme and identity for the Totem Lake basin that can be used in basin education will take some time. It is important to begin this process so that elements of the basin branding can be implemented simultaneously with planned improvements identified in the Totem Lake Park Master Plan adopted in December 2013.

- Retrofit incentives and rebates in the Surface Water Utility rate structure. A rate studies and economic evaluation may be necessary to determine the cost and applicability of this approach.

6 OUTCOMES AND LESSONS LEARNED

This project has produced both information about the basin and ways to proceed with Totem Lake retrofit projects, as well as general lessons that could be applied to other similar planning efforts.

6.1 Outcomes

This project creates a template for screening and identification of retrofit sites that can be broadly applied in the Puget Sound region. Conceptual designs and cost estimates for the 132nd Square Park and NE 120th Street projects will lead directly to construction of these beneficial projects. The implementation plan sets out next steps and strategies for proceeding to construction, and suggests non-capital projects that would support water quality improvement in the basin.

Deliverables created for this project will have positive impacts on surface water quality in the city. The following are a few ways in which specific products will be used:

- Map of potentially infiltrative soils will assist in siting and designing low impact development facilities, and in conducting feasibility analysis for redevelopment projects.
- Map of areas treated will serve as a base for measurement of performance relative to flow control and water quality standards. The percentage of percentage or acreage that has “significant” flow control and water quality treatment will increase over time, and the baseline provides a quantitative way to measure that progress.
- GIS screening narrows down the list of potential retrofit sites, and focusses efforts on projects that have the greatest potential to improve conditions in the basin.
- Project lays the groundwater for discussions with Ecology and other regulatory agencies regarding the role that lakes and wetlands play in stormwater retrofit at the basin scale.

These outcomes are in addition to those which met specific goals of the project.

6.2 Totem Lake Stormwater Retrofit Projects – Lessons Learned

The following are lessons learned from the specific study of Totem Lake, which will each be detailed below:

- Totem Lake provides detention and treatment, but can’t be used as such as redevelopment occurs
- Space is not available for regional projects in the most highly developed area of the basin, and where redevelopment is likely to occur
- The Urban Land Institute Technical Assistance Panel recommends putting facilities in the right of way as often as possible rather than trying to partner with private development projects to place facilities on private land
- In Totem Lake, zoning incentives have already been granted, and so are not available for use for stormwater issues. In addition, such bonuses have to mesh with market conditions to be effective. Thus customization of citywide water quality improvement programs as noted in the 2014 *Surface Water Master Plan* (City of Kirkland, 2014b) may be of more benefit than changes to land use codes in improving conditions in the basin.

The majority of water moving through the Totem Lake basin flows through Totem Lake. This lake and its associated wetlands provide large amounts of both live and dead storage. In essence, the lake and wetlands act as detention and treatment that protect downstream areas of the Totem Lake tributary and Juanita Creek. One concept considered as part of this study was to examine whether the lake outlet could be modified to provide enhanced storage in the lake and wetlands, a condition which likely existed prior to construction of high-capacity piped conveyance systems. The idea was to protect and potentially enhance the ecology of the lake and surrounding wetlands while providing some of the needed flow control as the basin redevelops (water quality would be provided in facilities upstream of the lake).

Current Ecology guidelines regarding use of wetlands for stormwater detention (Ecology, 2012) require that existing hydrologic conditions be maintained. This is in conflict with stormwater design guidelines which require that flow control be provided to match forested conditions at redevelopment sites. The hope was that a happy medium between these two sets of guidelines could be found that would improve ecological conditions in the lake and wetlands while reducing flow control requirements for upstream properties. Discussions with Ecology staff, however, determined that per the Phase II Western Washington NPDES Permit, stormwater requirements must be met *prior* to the point of discharge from the municipal separate storm sewer system (MS4). As the lake is downstream of the point of discharge from the MS4, any detention provided by the lake could not be used to meet flow control requirements for development projects.

Other than Totem Lake and associated wetlands, there is little to no vacant land available in the Totem Lake basin that is not set aside because of critical areas concerns such as landslides, streams, or wetlands. One of the hopes for this project was that it would be possible to find locations suitable for large regional flow control and water quality treatment facilities. The 132nd Square Park site turned out to be the best available site, in that it is publicly-owned and could treat almost 50 acres of upstream area. This is still less than 10 percent of the area of the basin. This site serves an area that is largely residential and is not likely to redevelop, making it an ideal candidate for a publicly-funded stormwater retrofit project. At the same time, this project cannot serve the purpose of facilitating redevelopment by providing flow control and treatment for multiple redevelopment sites.

Private parcels can provide limited space for regional facilities (one site was estimated to be able to provide flow control for 10 acres of upstream area, for example), but use of that space likely comes at a high cost given the land values in the area and the trend toward highly dense urban development (for example, structured parking is becoming common in the area). This is a conundrum; the high cost of stormwater facilities may serve as a deterrent to redevelop, and yet redevelopment may be the only way in which such facilities can be built given the lack of available land. This may point to the need for consideration of alternative strategies such as area-swapping or equivalent-area treatment on a basin scale as have been used by the City of Redmond.

In the initial materials presented to the Urban Land Institute Technical Assistance Panel (TAP), several questions were posed about how to prepare for and how to structure public/private partnerships to construct stormwater control facilities. In their final report, the TAP recommended that the City proceed with constructing facilities on public property, rather than attempting to structure public/private partnerships. The TAP seemed to feel that the timing of private development was too much of an unknown, and that land values are such that it would be challenging to make space for regional stormwater facilities on any given project. Again, this points to the need to consider other strategies for providing stormwater controls to serve redevelopment in an efficient and cost-effective manner.

One of the goals of this project was to investigate whether/how zoning incentives or measures could be used to encourage private developers to accommodate regional stormwater retrofit projects and/or to use low impact development facilities on their property. Review of the zoning code for this area revealed that incentives and bonuses for height and density had already been granted in an effort to spur redevelopment in the Totem Lake Business District. Thus few to no incentives were available for use as incentives for stormwater retrofit projects. In addition, the TAP indicated that market demand (for increased height on an office building, for example) must be present in order for zoning incentives to be an effective enticement. Currently, few projects are using existing zoning height/density incentives. Another issue encountered is that the City cannot grant bonuses or incentives in the Zoning Code for items that are required under other codes. As the 2012 Ecology Manual requires use of low impact development facilities, the Zoning Code cannot grant low impact facility bonuses or incentives (though these may be considered during the low impact development code review that is required by the Phase II Western Washington NPDES Permit).

In planning the project, staff assumed that zoning code incentives and bonuses would be one of the main non-capital alternatives developed as part of this project. As noted above, zoning code changes did not turn out to be feasible. Zoning restrictions on impervious surface or other measures conflict with city interest in encouraging redevelopment. Other non-capital projects that apply to the Totem Lake basin are detailed in Kirkland's *Surface Water Master Plan* (SWMP) which was updated in November of 2014 (City of Kirkland, 2014b). The SWMP sets priorities for the next 5-10 years of operation of the Surface Water Utility in the goal areas of flood reduction, water quality improvement, and aquatic habitat improvement. Development of the programmatic recommendations took extensive coordination, cost estimation, and vetting of political priorities, and all of the recommendations apply citywide. It likely would be more effective in the future to rely on the citywide surface water planning processes for non-capital recommendations instead of trying to develop basin-specific non-capital projects without the time or resources to conduct a thorough process to vet recommendations.

6.3 General Lessons Learned for Stormwater Retrofit Planning

Future stormwater retrofit projects will benefit from the following lessons learned on this project:

- Review parcel-level data for multi-parcel opportunities
- Keep designs for private property at a rough level of design – have enough information available to be able to discuss with developer, then be ready and willing to work with developer when a project is imminent
- Retrofit planning must proceed to the conceptual level in order to have information for discussion of costs and funding strategies

The GIS analysis was conducted at the parcel level. This allowed for fast and automated identification of potential retrofit sites. At the same time, it would be beneficial to conduct a second level of screening to determine cases where it may make sense to aggregate parcels to site stormwater facilities. For example, if there is a location that appears beneficial because of upstream impervious area or because of the layout of the drainage system (several pipes come together), then a review of that site would be done to determine if it makes sense to combine several parcels for use in a retrofit facility. This type of screening would best be done by someone familiar with existing development and the drainage system in the watershed, and someone that has knowledge of potential development/redevelopment and/or City land or easement purchases.

In future projects, design of facilities that would be located on private property should be limited to rough calculations of volume, rather than proceeding to facility type and layout. If a private property appears to be a good candidate for a retrofit project, approximate desirable volume for the facility would be developed, but this project would not move into the pre-design phase. This will facilitate discussions regarding easements and acquisition but recognize the fact that if the City does not control a given property, proceeding to the pre-design phase may not be the best use of grant funds as the likelihood of construction is lower than a project sited on public property.

REFERENCES

Center for Watershed Protection, 2007. *Urban Stormwater Retrofit Practices, Version 1.0.* Urban Subwatershed Restoration Manual Series, Manual 3. Prepared for U.S. Environmental Protection Agency Office of Wastewater Management.

CH2M Hill, 2014. *Totem Lake Outlet Channel Near-Term Action Strategy.* Draft memo prepared for City of Kirkland, May 2014.

City of Kirkland, 2014. *Quality Assurance Project Plan: Totem Lake/Juanita Creek Basin Stormwater Retrofit Conceptual Design.* Prepared for Washington Department of Ecology and U.S. Environmental Protection Agency for Ecology Grant G1400024, March 2014.

City of Kirkalnd, 2014b. *Surface Water Master Plan*. Prepared with the assistance of Brown & Caldwell, November 2014.

King County, 2012. *Stormwater Retrofit Analysis for Juanita Creek Basin in the Lake Washington Watershed. Ecology Grant: G0800618.* King County Department of Natural Resources and Parks, Water and Land Resources Division, Seattle, WA.

Jones & Stokes, 2007. *Totem Lake/Juanita Creek EPA-SWMM Model Summary*. Memorandum prepared for SvR (for City of Kirkland), December 2007.

Parametrix, 2008. Totem Lake Pollutant Hot Spots maps in *Totem Lake/Juanita Creek Basin Stormwater Retrofit Conceptual Design*, application to Department of Ecology Watershed Protection & Restoration Grant Program, City of Kirkland, April 2013.

RH2 Engineering, 2014. *Hydrogeology and Infiltration Assessment*. Technical memorandum prepared for City of Kirkland, April 2014.

SvR Design Company, 2008. *Totem Lake Boulevard Flood Control Measures*. Technical memorandum prepared for City of Kirkland, January 2008.

Washington Department of Ecology, 2012. *Stormwater Management Manual for Western Washington.* Olympia, WA.

Appendix A

Infiltration Suitability Memo

RH2 TECHNICAL

Memorandum

Client: Northwest Hydraulic Consultants and City of Kirkland

Project: Totem Lake Stormwater Retrofit Conceptual Design

Project File: NHC 114.014.01.101 **Project Manager:** Rick Ballard, P.E.

Composed by: Steve Nelson, L.H.G.

Subject: Hydrogeology and Infiltration Assessment

Date: April 22, 2014

4/22/2014

4/22/2014

INTRODUCTION

This memorandum summarizes the identification and evaluation of areas within the Totem Lake watershed (the study area, **Figure 1**) that may be suitable for infiltration-based stormwater retrofit facilities. The evaluation was completed under the funding provided by the Washington State Department of Ecology (Ecology) Grant No. G1400024 to the City of Kirkland to conduct the Totem Lake Stormwater Retrofit Conceptual Design. The scope of work is described in Northwest Hydraulic Consultants, Inc., (NHC) Agreement for Consultant Services, dated January 17, 2014.

Objective

Retrofitting existing stormwater systems is intended to overcome some of the effects of urbanization on urban hydrology that include reduced infiltration through creation of impervious surface, reduced infiltration rates and stormwater absorption of compacted soils, increased flashiness of streams, increased erosion and sedimentation, and decreased water quality. Infiltration facilities can help accomplish the following:

- Groundwater recharge to promote and stabilize stream base flow;
- Improving water quality through soil zone treatment;
- Reduction in peak stormwater runoff rates and stream "flashiness;" and
- Reduction in streambank erosion control and sediment discharge.

Approach

The tasks for identifying and summarizing the potential areas for stormwater infiltration within the Totem Lake watershed included:

- Review of existing soils, topography, surficial geology maps, well logs, geologic investigation reports; performance of existing infiltration-based stormwater facilities; and local site inspection to confirm previous findings;
- Establishing criteria for selecting areas suitable for infiltration-based stormwater retrofit facilities based on the *Stormwater Management Manual for Western Washington – Volume III, Section 3.3* (Ecology, 2012); and
- Preparing a GIS-based map of the locations suitable for construction of infiltration-based low impact development (LID) stormwater retrofit facilities.

Review of Geologic Mapping and Geologic Investigation Data

RH2 Engineering, Inc., (RH2) reviewed available geologic mapping and geologic investigation data for the study area (**References**), and conducted a field reconnaissance of the study area on February 13, 2014.

Compilation of geologic information by the Washington State Department of Natural Resources (DNR) created a geologic map that identified three geologic units: glacial till and glacial advance outwash in the uplands of the northeastern, southeastern, and western areas of the watershed, and glacial outwash along the central lowlands near Totem Lake.

A significant number of geologic and geotechnical investigations have been conducted in the study area related to site development for residential and commercial uses. The locations of the soil boring and test pit explorations for these investigations are shown on **Figure 1**. Most investigations explored to depths of 5 to 20 feet to sufficiently characterize shallow soil and geologic units for engineering properties at the sites.

Soil borings and test pits are generally well distributed within the study area, except in the extreme northeast portion and in the areas south of Totem Lake and west of the Lake Washington Institute of Technology (LWIT) campus (**Figure 1**).

Mapping by Troost and Wisher (2010), based on their review of available geologic investigation reports and field confirmation, refined the DNR mapping and identified several additional geologic units, including pre-glacial deposits formed before the advance of the most recent glacial ice, fine-grained and coarse-grained glacial recessional deposits, and more recent peat deposits near Totem Lake. The recessional outwash deposits and peat are in areas mapped by DNR as glacial outwash and pre-glacial deposits are in areas mapped by DNR as glacial till. The refined geologic mapping was used to develop the interpreted geologic mapping in **Figure 1**.

During the February 2014, field reconnaissance, RH2 observed limited soil and geologic outcrop exposures except along the deeper gullies on the north and south upland areas of the watershed.

Detailed review of the boring logs and geotechnical reports on file with DNR indicates that some of the subsurface units identified by Troost and Wisher (2010) as dense, consolidated pre-glacial silty deposits may actually be less dense, post-glacial lacustrine deposits that overlie glacial advance outwash which consist of slightly consolidated silt and clay. Pre-glacial dense silty deposits and post-glacial less-dense glaciolacustrine deposits have similar composition and permeability characteristics, but will be identified separately in this memo where their relative position with respect to advance outwash is known.

Summary of Geologic Unit Characteristics

The composition and type of geologic units in the Totem Lake watershed vary widely. The geologic units observed in the Totem Lake watershed include pre-glacial deposits, glacial advance outwash, glacial recessional outwash, glacial till (fresh and weathered), and peat. **Table 1** generally summarizes the characteristics of these geologic units, which are ordered from shallow, surficial deposits to deeper, typically buried deposits. The interpreted locations of the geologic units in the Totem Lake watershed are shown in **Figure 1**.

Table 1. Summary of Typical Geologic Units in Totem Lake Watershed

Geologic Unit	Composition	Density	Characteristics and Location
Peat	Silt and organic matter	Low	Low permeability, low storage potential, thin and continuous to more than 25 feet thick near Totem Lake, low capacity to transmit water to discharge areas. Usually saturated during wet seasons, significantly reducing infiltration rates and storage.
Recessional Outwash	Sand, gravel, and silt	Low to Moderate	High permeability, moderate to high soil storage potential, relatively thin, and may be discontinuous. High capacity to transmit water to discharge areas.
Glacial Till (Weathered)	Sand, silt, and gravel	Moderate	Low to moderate permeability and soil storage potential, relatively thin, and may be discontinuous. Water may perch within this unit and move laterally above dense glacial till before discharging from slopes.
Glacial Till	Silt, sand, gravel	High	Low permeability and soil storage potential, relatively thin, and may be discontinuous or absent beneath northeast uplands at Evergreen Hospital.
Glaciolacustrine	Silt, clay, minor sand	Moderate to High	Low permeability and soil storage potential, relatively thin, and may be continuous. Glaciolacustrine deposits may underlie much of the lowland and part of the northwestern upland, west of the Evergreen Hospital.
Advance Outwash	Sand and gravel, minor silt	Moderate to High	High permeability, moderate to high soil storage potential, moderately thick, and may be continuous. May be absent beneath LWIT. High capacity to transmit water to discharge areas. Saturated outwash may increase slope instability.
Pre-Glacial	Silt, clay, minor sand	Moderate to High	Low permeability and soil storage potential, relatively thin, and may be continuous. Pre-glacial deposits underlie the advance outwash of the northeastern upland and the glacial till of the southeastern uplands.

Summary of Groundwater Conditions

Shallow Groundwater

Test pits and boring logs constructed for geotechnical purposes in most areas of the watershed occasionally reported shallow perched groundwater at depths of 10 feet or less in more permeable shallow soil layers above glacial till and in areas mapped as peat. Minor seeps of a few to tens of gallons per minute typically discharge from slopes where permeable recessional outwash overlies glacial till and where permeable advance outwash overlies pre-glacial deposits. During field reconnaissance, seeps and wet areas were noted on slopes of the northeastern and southwestern uplands several days after the most recent rainfall. These observations of seepage indicate the presence of shallow, perched groundwater in the upper soil and surficial geologic units of the watershed. These shallow seeps likely discontinue during late summer and fall.

<u>Deeper Groundwater</u>

Boring logs in the watershed were generally installed to identify geotechnical properties of soil and were too shallow to encounter the uppermost regional aquifer, which likely exists within the advance outwash geologic unit at depths of 20 to 50 feet.

Only one boring in the Totem Lake watershed is recorded with Ecology as a water supply well. The 8-inch-diameter well was completed for Evergreen Hospital. Groundwater was encountered in the boring at a depth of 74 feet, and the static groundwater level in the 167-foot deep well in 1996 was reported as 82 feet below ground surface (bgs). This water depth corresponds to a groundwater elevation of approximately 130 feet above sea level, which is equivalent to the level of Totem Lake and its outlet creek.

Several deeper geotechnical borings (greater than 50 feet bgs) were drilled along the Interstate 405 corridor and along the Cross Kirkland rail-to-trail corridor. Saturated soil and geologic units were generally encountered below depths of 5 to 15 feet, and groundwater elevations in wells completed in these borings generally were within 5 feet of ground surface, indicating confining groundwater conditions and an upward vertical gradient in the deeper geologic layers along these corridors.

Several deep borings (greater than 50 feet bgs) were drilled in the northeastern upland area to evaluate groundwater and infiltration characteristics at John Muir Elementary (AMEC, 2010). The borings encountered approximately 20 to 30 feet of glacial till underlain by 40 to 50 feet of glacial advance outwash that was partially saturated at its base above pre-glacial fine-grained deposits. The findings indicate that groundwater elevations below the northeastern upland are approximately 30 to 40 feet bgs.

Infiltration Rate and Infiltration Capacity of Geologic Units

Infiltration of stormwater is a preferred retrofit best management practice (BMP), where feasible, because it detains, disperses, and potentially provides treatment of stormwater that under pre-developed conditions would have infiltrated into undisturbed soil. The potential infiltration rate of the geologic unit exposed at the surface is based on the inherent permeability of the geologic unit and its ability to transmit water vertically downward from the surface into underlying deeper geologic layers.

The potential infiltration capacity of the surficial geologic unit to absorb and transmit water depends on several conditions, including the degree of water saturation of the unit at the time stormwater is applied, which varies seasonally; the presence, composition, and depth of lower permeability layers below the surficial geologic unit, which varies laterally; and the distance between the infiltration area and its ultimate discharge point.

In summary, the potential infiltration rate at any site in the Totem Lake watershed depends on the site geologic permeability and stratigraphy characteristics, and the potential infiltration capacity of the site depends on the degree of saturation and the ability for the stored water in the underlying geologic unit to drain rapidly to its point of discharge. For example, during the months of

September to November, soils and surficial geologic units are typically at their lowest degree of saturation and have their greatest infiltration capacity, compared to saturated conditions in the months of February to April. A sandy outwash unit may have a high potential infiltration rate throughout the year, but may only have a high infiltration capacity for 3 or 4 dry months and a low infiltration capacity during 8 or 9 wet months when the ground is saturated. A sandy outwash unit on an upland plateau where infiltration rates and vertical drainage rates are high may have a high infiltration capacity, while the same sandy outwash with a high infiltration potential may have a low infiltration capacity when located near a stream channel where the ground is nearly always saturated and any infiltrated water is quickly discharged to the stream without detention.

Low permeability units such as glacial till and peat have low infiltration rates and limited capacity to accept infiltrated water; tight glacial till soil has no porosity to hold water and porous peat is usually saturated with water.

Glacial till may consist of either densely consolidated sand, silt, and gravel, which tends to appear fresh and blue or grey in boring samples and surface exposures, or less dense sand, silt, and gravel, which tends to appear weathered and tan or light brown in boring samples and surface exposures. The reinterpreted geologic mapping did not distinguish areas of relatively fresh glacial till from weathered glacial till, which have distinct permeability characteristics (**Table 1**). Also, weathered glacial till tends to blend into recessional outwash. These variations in composition and density are difficult to observe in soil boring and surface exposures; and therefore, the mapped boundaries between glacial till and weathered glacial till, and between till and recessional outwash should be considered approximations. The mapping indicates that the surficial geology of the Totem Lake area in the upland areas of the Totem Lake watershed vary widely, and the actual suitability of a site would require investigation to confirm the till characteristics. Pre-glacial silty deposits limit the downward vertical migration of groundwater from overlying advance outwash deposits, which potentially causes groundwater mounding on top of the silty deposits or causes groundwater to seep laterally and discharge from nearby slopes. Glaciolacustrine deposits underlying recessional outwash may create a similar potential for groundwater mounding or lateral seepage from slopes. In addition, glaciolacustrine deposits would limit vertical migration of groundwater into underlying advance outwash.

The pre-glacial/glaciolacustrine deposits underlying the uplands of the watershed form a significant barrier to vertical groundwater seepage and control the infiltration capacity of overlying geologic units. Precipitation on the northern uplands of the watershed near Evergreen Hospital percolates quickly into and through glacial outwash units and into underlying advance outwash. From there, it migrates laterally within the outwash above the pre-glacial/glaciolacustrine deposits and discharges from slopes below the upland and into the small ravines and gullies north of Totem Lake.

The pre-glacial/glaciolacustrine deposits underlying the lowlands of the central portion of the watershed restrict downward percolation of infiltrated precipitation which results in shallow groundwater elevations in overlying peat and recessional outwash, particularly in the lowest topographic elevations near Totem Lake.

The areas of thick recessional and advance outwash provide the greatest infiltration rates and infiltration capacity in the watershed, particularly where the glaciolacustrine deposits are deep. For example, infiltration testing at the Hyundai of Kirkland site (ESNW, 2013) at 124th Avenue NE north of 116th Street NE indicated infiltration rates of 10 inches per hour for a 10-foot-thick layer of recessional outwash overlying glaciolacustrine deposits.

The presence of an overlying low permeability layer that limits surficial inflation rates into underlying permeable outwash may be overcome using vertical drains to transmit water through and below the upper layer using underground injection control (UIC) wells, which are regulated and permitted by Ecology. This approach is being used at John Muir Elementary at the far northeast corner of the Totem Lake watershed (**Figure 1**). Treated stormwater is directed into gravel-filled, 3-foot-diameter, 60-foot-deep borings which convey water through surficial impermeable glacial till and into underlying permeable glacial advance outwash. Vertical UIC wells like these may be one option for stormwater infiltration elsewhere in the Totem Lake watershed where glacial till caps permeable advance outwash.

Table 2 summarizes the relative infiltration rates and infiltration capacities of the geologic units in the Totem Lake watershed.

Table 2. Summary of Infiltration Rates and Capacities of Geologic Units in Totem Lake Watershed

Geologic Unit	Site Location	Infiltration Rate	Infiltration Capacity (Dry Season)	Infiltration Capacity (Wet Season)
Peat	Valley, Wetland	Low to Moderate	Moderate	Low
Recessional Outwash	Upland, Slope	High	High	Moderate to Low
Weathered Till	Upland, Slope	Moderate	Moderate	Low
Glacial Till	Upland, Slope	Low	Low	Low
Glaciolacustrine	Slope	Low	Low	Low
Advance Outwash	Upland, Slope	High	High	High to Moderate
Pre-Glacial/	Slope	Low	Low	Low

Criteria for Infiltration Suitability

Site suitability criteria (SSC) for potential infiltration systems are summarized in the *Stormwater Management Manual for Western Washington – Volume III* (Ecology, 2012). These SSC were reviewed for their applicability to the Totem Lake watershed and to support identification of suitable infiltration and groundwater recharge sites within the Totem Lake watershed. Future site investigations and more detailed design will likely provide additional guidance on the applicability of the SSC, and if additional mitigation measures are needed, so that an infiltration facility will not pose a threat to safety, health, or the environment.

The SSC that are applicable to the siting of infiltration systems in the Totem Lake watershed are summarized below. Comments in italics indicate how these SSC are or would be implemented as part of final design.

<u>SSC-1 Setback Criteria</u>

- Additional setbacks must be considered if roadway deicers or herbicides are likely to be present in the influent to the infiltration system. *City of Kirkland (City) code would describe any limitations in the use of deicers and/or herbicides in the Totem Lake watershed.*
- From building foundations: ≥ 20 feet downslope and ≥100 feet upslope. *Generally addressed as "Disturbed Areas/Cut and Fill Areas" in the site suitability evaluation summarized below. The actual design at preferred site(s) will incorporate this SSC.*
- From a Native Growth Protection Easement (NGPE): ≥20 feet. *The actual design at preferred site(s) will incorporate this SSC.*
- From the top of slopes >15 percent and near potentially unstable slopes: ≥ 50 feet. *Addressed as "Steep Slopes" in the site suitability evaluation summarized below.*

<u>SSC-2 Ground Water Protection Areas</u>

- None applicable to the Totem Lake watershed.

<u>SSC-3 High Vehicle Traffic Areas</u>

- Infiltration BMPs would address potential contaminant runoff from areas of industrial activity and high vehicle traffic areas, including commercial or industrial sites and high traffic road intersections.

<u>SSC-4 Soil Infiltration Rate/Drawdown Time</u>

- None applicable to the Totem Lake watershed. All geologic units where infiltration is proposed would meet these criteria.

<u>SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer</u>

- Base of all infiltration systems shall be 3 to 5 feet above the seasonal high water mark, bedrock (or hardpan), or other low permeability layer. *Generally addressed as "Geologic Unit" in the site suitability evaluation summarized below.*

<u>SSC-6 Soil Physical and Chemical Suitability for Treatment</u>

- None applicable to the Totem Lake watershed. All geologic units meet these criteria.

<u>SSC-7 Seepage Analysis and Control</u>

- No adverse effects caused by seepage zones on nearby building foundations, basements, roads, parking lots, or sloping sites. *Generally addressed as "Developed Areas" in the site suitability evaluation summarized below.*

<u>SSC-8 Cold Climate and Impact of Roadway Deicers</u>

- Same condition as SSC-1, above.

Additional Considerations for Infiltration Suitability

Infiltration facilities designed to include water quality treatment typically rely on the soil profile to provide treatment for organic compounds, metals, and nutrients present in stormwater. Pre-treatment for removal of total suspended solids is necessary prior to discharge to an infiltration facility if any runoff comes from a pollution-generating surface. Use of the soil and surficial geologic unit to provide water quality treatment is an additional benefit of stormwater infiltration as long as it is preceded by a pre-settling vault or basin or a basic treatment BMP. This pre-treatment should reduce incidents of plugging and extend operational times between major maintenance.

The uncertainty and complexity of soil conditions and risk of infiltration near steep slopes warrant a setback from Totem Lake and its tributaries more than the 100-foot SSC. A setback of 200 feet provides an additional factor of safety for inadvertent discharge of stormwater from slopes downhill from infiltration areas.

The potential use of UIC wells to infiltrate treated stormwater would require additional analysis of groundwater characteristics and the potential risk to slope stability near the UIC wells.

Site Suitability Evaluation

RH2 developed a summary of the potential suitability for infiltration BMPs in areas with specific geologic and topographic characteristics in the Totem Lake watershed. Suitability is herein defined as the ability for an area to accept additional stormwater infiltration with little risk of flooding or destabilizing slopes. An area of the watershed that is considered highly suitable has little or no risk of infiltrating stormwater into the area at rates calibrated to the intrinsic soil permeability. An area considered moderately suitable would have greater, but still acceptable, risk that would require careful site selection and design components to mitigate the greater risk.

The type of infiltration system that could occur in suitable areas may include dispersed, concentrated, or vertical drains. A dispersed system would infiltrate water from individual lots or short sections of roads using small ponds or perforated pipes in trenches. A concentrated system would collect stormwater from several lots or long sections of roads and discharge stormwater into larger ponds or larger diameter buried infiltration galleries. Vertical drains would consist of large diameter vertical borings filled with gravel to convey stormwater through impermeable layers into permeable layers.

Table 3 summarizes the general criteria for site suitability for infiltration, and the type of infiltration system that would be suitable based on the criteria. The actual suitability of an area will depend on these criteria and whether the area has the capacity to receive additional stormwater without causing unacceptable risk to infrastructure or the environment. The degree of site suitability (high, moderate) identifies those areas where infiltration or recharge could occur with minimal risk or the risk is high enough that the area is unsuitable for infiltration.

Table 3. Site Characteristics that Indicate Site Suitability for Infiltration

Geologic Unit	Permeability	Steep Slopes	Setbacks from Streams	Disturbed Areas, Cut & Fill Areas	Site Suitability for Surface Infiltration, Type of Infiltration
Glacial (Weathered) Till	Low	0 to 5 percent	> 200 feet	Limited	High, Dispersed
		5 to 15 percent		Limited to Moderate	Moderate, Dispersed
Recessional/Advance Outwash	High	< 15 percent	> 200 feet	Limited to Moderate	High, Dispersed, or Concentrated
		5 to 15 percent		Limited to Moderate	Moderate, Dispersed
Pre-Glacial/ Glaciolacustrine	Very Low	Any	Any	Any	Unsuitable
Peat	Very Low	Any	Any	Any	Unsuitable
Advance Outwash below overlying impermeable layers	High	< 15 percent	> 200 feet	Any	High, Dispersed, or Concentrated
All types	Any	**>15 percent**	Any	Any	Unsuitable
	Any	Any	**< 200 feet**	Any	
	Any	Any	Any	**Extensive**	

Summary of Site Suitability in Totem Lake Watershed

RH2 developed a GIS-based infiltration site suitability map (**Figure 1**) showing areas that may be suitable for implementing infiltration-based flow control facilities in the Totem Lake watershed. This mapping effort considered some of the gaps in understanding of site conditions and anticipated potential infiltration system performance (treatment, detention time, and volume/rate); where uncertainties are high, the areas are mapped as unsuitable.

The delineation of potential infiltration areas in the watershed were based on the following criteria:

- the permeability or intrinsic infiltration rates for different soil types in the area (Table 3)
- potentially limiting SSCs and geohazard risks in the area (Table 3)
- the potential infiltration capacity of the area, which is the area's ability to absorb and retain a volume of infiltrated water based on soil thickness, depth to groundwater, and proximity to a discharge zone

The northeast uplands consist primarily of residential and park areas that are underlain by glacial till and weathered till deposits. The area is essentially flat and capable of receiving dispersed infiltration with a low risk of inadvertent discharge from slopes. The far northeastern portion contains more disturbed areas and may be more susceptible to limited infiltration rates and discharge from cut slopes. Any designs for these areas would have to confirm that setbacks from underground utility corridors and subsurface structures are sufficient.

The northwestern upland near the Evergreen Hospital is underlain by recessional outwash and could accommodate dispersed infiltration systems. The density of buildings and numerous cut slopes and subsurface structures would restrict the type of infiltration system to dispersed systems to avoid inadvertent discharge from slopes.

The southeastern upland near the LWIT site is underlain by glacial till, weathered till and thin recessional outwash deposits. The area is essentially flat and capable of receiving dispersed infiltration but with a low risk of inadvertent discharge from slopes.

The lowland areas between the LWIT and Interstate 405 are underlain by recessional outwash with sufficient thickness to potentially accommodate concentrated infiltration systems in addition to dispersed systems.

Much of the area around Totem Lake and along the Cross Kirkland Corridor is underlain by peat or thin recessional outwash overlying pre-glacial/glaciolacustrine deposits. This area likely is not suitable for developing additional infiltration due to saturated soil, a high groundwater table, and limited infiltration rates and soil storage volumes.

The southwestern upland west of Interstate 405 is underlain by glacial till, weathered till, and thin recessional outwash deposits. The area is essentially flat and capable of receiving dispersed infiltration with a low risk of inadvertent discharge from slopes. It is possible that the 116th Street corridor may accept limited infiltration of street runoff using buried perforated pipe along the corridor, but the steep slopes north and south of the street pose risk that would require more detailed evaluation of potential subsurface migration of infiltrated stormwater.

FIGURES

Figure 1 – Geologic Units and Infiltration-based Site Suitability

REFERENCES

AMEC. 2010. *Hydrogeology Report. Presumptive Approach for Rule-Authorized UIC Wells, John Muir Elementary School. Report* prepared for Lake Washington School District.

Earth Solutions NW, LLC (ESNW). 2013. *Geotechnical Engineering Study, Hyundai Service Building, 11651 Slater Avenue NE, Kirkland Washington*. Prepared for Lance Mueller & Associates.

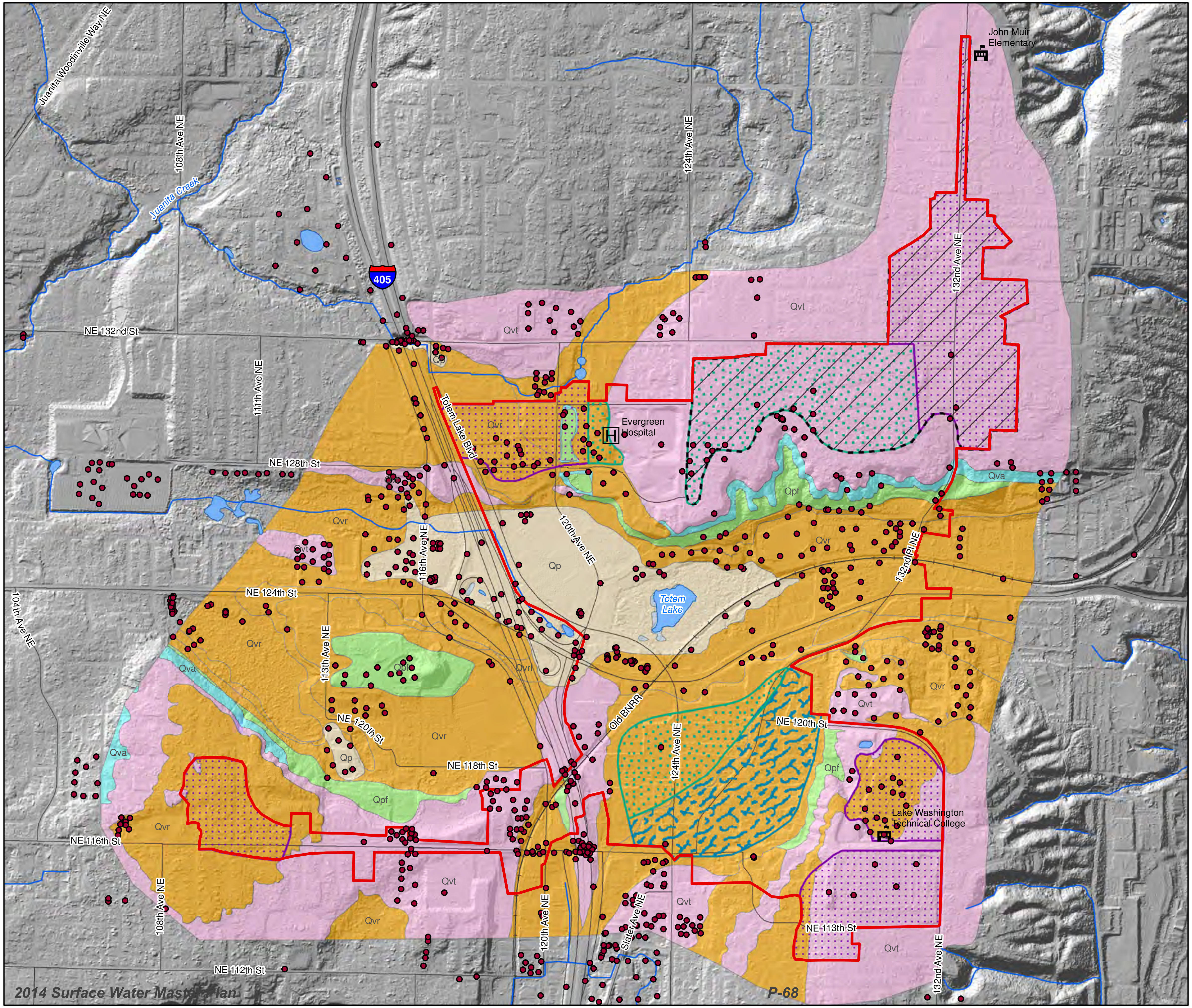
Troost, Kathy Goetz and Wisher, Aaron, P. 2010, Infiltration Potential Map of the City of Kirkland Washington. Prepared for the City of Kirkland.

Washington State Department of Ecology. Washington State Well Log Viewer. https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx

Washington State Department of Natural Resources. Washington Interactive Geologic Map. http://wigm.dnr.wa.gov/

TOTEM LAKE LID FEASIBILITY ASSESSMENT & MAPPING

Figure 1.
Geology and Infiltration Suitability



1 inch = 1,000 feet

0 400 800 1,600 2,400 feet

Map is full scale when bar measures 2 inches

Overview Map

Woodinville, Kirkland, Redmond, NE 132nd St, NE 128th St, NE 124th St, NE 116th St, 100th Ave NE, 124th Ave NE, BNRR, Willows Rd NE, 405

Legend

- exploration_points
- Infiltration Suitability and Approach (RH2)
  - Moderate, Dispersed
  - High, Dispersed
  - High, Dispersed/Concentrated
  - High, Vertical Drains
- Geologic Units (Troost & Wisher)
  - Qpf, Pre-glacial deposits
  - Qp, Peat
  - Qva, Glacial advance outwash
  - Qvr, Glacial recessional outwash
  - Qvt, Glacial till
  - Water
- Totem Lake Subbasin Boundary (NHC)
- Waterbody (King County)
- Water Course (King County)
- Old BN Railroad (King County)
- Roads (King County)

Note: Geologic units were reinterpreted by RH2 for this basin using data from Troost and Wisher (2010) and WA DNR (various dates)

Data from RH2, Kirkland, King County, WA DOT, PSLC, WA DNR, Troost and Wisher, and NHC (various dates).

City of Kirkland Washington — nhc northwest hydraulic consultants — RH2 Engineers Planners

Date Saved: 4/18/2014 1:43:11 PM

Path: J:\Data\NHC\114-014\GIS\maps\totemlk-lid-suitability.mxd

Appendix B

Site Feasibility

Project Feasibility Rating

The first step in the project rating process is to evaluate each project based on feasibility criteria. This is accomplished by a person with a good level of understanding of the site and the type of project, and a site reconnaissance report.

The site reconnaissance report includes the following:

- An evaluation of alternative Best Management Practices (BMPs) that might be suitable for the site.
- An assessment of permitting requirements.
- Identification of existing utilities and their potential impact on the project.
- Determination whether water quality, flow control, or a combination of these can be accomplished at the site.

The feasibility rating generates an overall score of 1 to 5 based on rating each of 12 feasibility criteria on a scale of 1 to 5, with 1 being the best and 5 being the worst. A checkmark is made in the feasibility criteria matrix for each criteria based on the score for that criteria. After completing the matrix, the average rating for the site is computed. Final selection of preferred sites was based on ranking of site feasibility ratings, with some consideration of outside factors.

PROJECT FEASIBILITY RATING SHEET

Prior to completing this section, a project feasibility analysis should be completed. The feasibility analysis should provide information to score each of the following feasibility criteria, as well as alternative methods of providing runoff treatment, flow control, and habitat enhancements at the project location.

#	Criteria	Score (1 to 5)
F1.1	**Ease of Permitting & Number of Environmental Permits**	

Guidance

Different projects will have different permitting requirements. The number of permits required, permitting agency, and anticipated difficulty in obtaining permits should be factored into the project feasibility. Also consider the number and type of special studies that might be required to obtain permits, such as habitat plans, geotechnical reports, etc. Permits that may be required include:

1. Hydraulic Project Approval – for work below the ordinary high water mark of streams, lakes, and salt water.
2. Critical Areas Review – For work within or near certain critical areas, including wetlands, streams, shorelines, steep slopes, geologically sensitive areas, and critical habitats.
3. Public Works (Right-of-Way) Permit – Issued by City of Kirkland for work in the right-of-way. May require WSDOT permit if road is a state highway.
4. Construction and/or Grading Permit – Issued by City of Kirkland, requirements vary by amount of grading.
5. SEPA Compliance – At a minimum, a SEPA Checklist will be required.

6. Army Corps of Engineers Permit – For work within wetlands and waterways designated as navigable or associated with navigable waters.
7. Mechanical, Electrical, Plumbing, or Building permits – Issued by City of Kirkland for projects with mechanical equipment or structures, including retaining walls.
8. UIC Certification and/or Permitting – Issued by Ecology for certain infiltration projects that meet the criteria for requiring compliance with Ecology Underground Injection Control Requirements.
9. Lot Line Adjustment– Issued by City of Kirkland if a parcel line will be relocated to accommodate a project or a separate parcel is required to be created from an existing parcel.
10. Construction NPDES Permit – Issued by Ecology for projects disturbing greater than 1-acre of land.
11. Shorelines Permit – Issued by City of Kirkland; may require Ecology approval for projects meeting certain requirements and located within designated shorelines.

Scoring Guide

- Project is small and requires no permits or only requires standard permits issued by City of Kirkland, including SEPA and a Construction or Grading permit. → **Score = 1**
- Project does not meet the above criteria but only requires City of Kirkland permits, and none of the permits requires a board review process. → **Score = 2**
- Project meets one of the above criteria, but also requires one permit from an outside agency such as Ecology, Army Corps of Engineers, or WDFW. → **Score = 3**
- Project requires special permits requiring a board review process or requires more than one permit from an outside agency. → **Score = 3 or 4**
- Multiple permits required local and outside agencies or permitting process anticipated to be difficult and lengthy and may not be successful. → **Score = 4 or 5**

#	Criteria	Score (1 to 5)
F1.2	**Potential Utility or Site Constraints**	

Guidance

Existing utilities and other site constraints can make a stormwater retrofit project difficult and more expensive. Projects in urbanized areas are more likely to face these types of constraints; however, utility service in more rural areas can also be a constraint. A site visit should be conducted and a utility locate considered to identify the location of utilities in the project vicinity. Some examples of utility conflicts and site constraints to consider include:

1. Existing Sanitary Sewer or Water Mains.
2. Side sewer and water service lines (these are more easily relocated).
3. Electrical power lines (underground and overhead) and power service lines such as roadway lighting and landscape lighting.
4. Other franchise utility lines such as cable, gas, and phone. Locating these utility lines can frequently be difficult.
5. Existing fencing, structures, roads, gates, etc.

6. Existing drainfields, septic tanks, underground tanks, or structures.
7. Existing or abandoned water wells for drinking or irrigation.
8. Location of existing buildings and other structures and the type/location of foundations for those structures.
9. History of waste disposal or hazardous/dangerous waste handling or spillage at the location.

Scoring Guide

- No, or only minor utility, structure, or other site constraints exist in the project location. → **Score = 1**

- Minor utility, utility, structure, or site constraints exist, but are easily accommodated or relocated. → **Score = 2**

- Special construction practices and precautions will be required to avoid utility or structure impacts. → **Score = 3**

- Significant utility relocation of sewer or water mains or electrical power will be required to accommodate the project. → **Score = 3 or 4**

- Major utility conflicts exist that would require major efforts to accommodate construction or require relocating several utilities and service lines or result in loss of a significant structure or the site has a history of waste disposal that may require cleanup action. → **Score = 5**

#	Criteria	Score (1 to 5)
F2.1	**Parcel Ownership**	

Guidance

The feasibility of a stormwater retrofit project can be affected by the existing ownership of the property where the project is proposed. Ideally, City of Kirkland would already have ownership of the property, or it would be located within City right-of-way. Other considerations include:

1. Property is owned by another governmental organization such as a school district, state or federal agency, or local government agency (port district, water utility, etc.).
2. Property is privately owned, but ownership is with a large organization such as a land trust, institution, or other large organization.
3. Property is privately owned by a homeowners association.
4. Property is privately owned by a single individual property owner.
5. Property is privately owned by multiple individuals. This can be the most difficult since multiple individual have to agree to any use of the property.

Scoring Guide

- Project is located on property owned by City of Kirkland or within an easement that City of Kirkland already has with the property owner. → **Score = 1**

- Project is located on property owned by another government organization with a high likelihood that they would cooperate in the use of the site. → **Score = 2**

- Project is located on property owned by a large institutional private property owner. → **Score = 3 or 4**

- Property is privately owned by a homeowners association. → **Score 3 or 4**

- Property is owned by a single or multiple individual private property owners. → **Score = 4 or 5**

#	Criteria	Score (1 to 5)
F2.2	**Access for Construction and Maintenance**	

Guidance

Access to the project site for construction and continued access after construction to provide for maintenance and repair of a facility are important factors in project feasibility. In some instances, a construction and/or maintenance easement may be required if the area for the project is small such as a narrow easement or small parcel. Ideally, the site has adequate area to maneuver construction vehicles, park worker vehicles and equipment during construction, and provide access after construction for maintenance, inspection, and repair.

Scoring Guide

- Project site has full access for construction and maintenance and additional area for storage of construction materials and vehicles with no special permissions or temporary easements required. → **Score = 1**

- Project site has full access for future maintenance but may require special permission for some construction work, material stockpiling, or vehicle storage/parking. → **Score = 2**

- Project will require obtaining special permissions for construction access and maintenance access from a property owner likely to grant the permission (i.e., government agency, large institutional landowner, etc.). → **Score = 3**

- Project will require obtaining easements or special permissions for either construction or maintenance access from a property owner less likely to grant permission. → **Score = 4**

- Maintenance or construction access may not be obtainable without extensive and/or lengthy negotiation, payment for easements, etc. → **Score = 5**

The **F3** criteria are somewhat different from many others on the list as they score primarily for opportunity at each site, rather than strictly feasibility. These three criteria were identified by the City of Kirkland as factors to be highly weighted in potential retrofit site rankings.

#	Criteria	Score (1 to 5)
F3.1	**Upstream PGIS**	

Guidance

Much of the Totem Lake basin was developed without significant stormwater treatment facilities, and the amount of untreated (or under-treated) upstream pollution-generating impervious surface (PGIS) is an indicator of need for and potential benefit of water quality retrofits at a site. This criterion is intended to identify "water quality hot spots" that present opportunity for significant water quality benefit.

Scoring Guide

Scores are based on estimated PGIS tributary to the retrofit site. PGIS was determined as the combined area of COMMERCIAL/INDUSTRIAL and ROADS IMPLND categories in the Totem Lake (Juanita Creek) HSPF model. Consideration was also given to presence and extent of upstream water quality treatment.

- Upstream area has high PGIS area and little or no water quality treatment. → **Score = 1**
- Upstream area has high PGIS area and some but no significant water quality treatment. → **Score = 2**
- Upstream area has moderate to high PGIS area with at least partial significant water quality treatment. → **Score = 3 or 4**
- Upstream area has low PGIS area or all PGIS area goes through significant water quality treatment. → **Score = 5**

#	Criteria	Score (1 to 5)
F3.2	**Infiltration Potential**	

Guidance

On-site or infiltration-based stormwater BMPs (often referred to as low impact development (LID) or green stormwater infrastructure) are increasingly encouraged and even required by DOE stormwater regulations. Minimum Requirement 5 of the latest DOE stormwater management manual requires implementation of LID BMPs where feasible, and infiltration can significantly reduce detention volume required to meet flow control standards (Minimum Requirement 7). This criterion is scored based on infiltration suitability of the parcel.

Scoring Guide

- Site has high potential for concentrated or dispersed surface infiltration. → **Score = 1**
- Site has high potential for dispersed surface infiltration. → **Score = 2**
- Site has moderate surface infiltration potential and/or may be suitable for vertical drains. → **Score = 3**
- Site has low surface infiltration potential. → **Score = 4**
- Site is not suitable for infiltration. → **Score = 5**

#	Criteria	Score (1 to 5)
F3.3	Upstream Impervious Surface	

Guidance

Impervious surface is the primary indicator of the runoff generating potential of an area. Watersheds with greater than 25% impervious surface are typically urban in nature and impacts to streams within the watershed are virtually guaranteed. Projects that treat areas with a higher percentage of impervious surfaces are likely to be more beneficial than those that treat areas with less impervious surface.

Scoring Guide

Scores are based on estimated impervious area tributary to the retrofit site. Impervious area was determined as the total effective impervious area from the Totem Lake (Juanita Creek) HSPF model. Category thresholds were determined based on distribution in Totem Lake basin and may not be appropriate to transfer to other basins.

- Upstream area has more than 100 acres of impervious surface. → **Score = 1**
- Upstream area has 50-100 acres of impervious area. → **Score = 2**
- Upstream area has 20-50 acres of impervious area. → **Score = 3**
- Upstream area has 10-20 acres of impervious area. → **Score = 4**
- Upstream area has less than 10 acres of impervious area. → **Score = 5**

#	Criteria	Score (1 to 5)
F4.1	**Project Impact on Site Uses & Operations (Long-Term)**	

Guidance

Some stormwater retrofit locations may be associated with commercial or industrial operations or may be in areas that are designated to recreational use such as parks, trails or open spaces. This criterion rates the long-term impact of the project on the current site use and operations.

Scoring Guide

- Project is located in an area where no potential impact to site use or operations is anticipated. **→ Score = 1**
- Project is located in an area where there are site uses and operations that might be impacted but it is anticipated that little or no impact will occur **→ Score = 2**
- Project is located in an area where there are site uses and operations that might be impacted but impact occurs only during construction with minimal long-term impact. **→ Score = 3**
- Project is located in an area where there are site uses and operations that might be impacted and impacts will occur both during construction and long-term, but can be mitigated or managed. **→ Score = 4**
- Project will significantly impact site uses and operations during construction and long-term. **→ Score = 5**

#	Criteria	Score (1 to 5)
F4.2	**Sufficiency of Space Given Setback Requirements, etc.**	

Guidance

To evaluate this criterion, an idea of what type of BMP would be installed is necessary. For some BMPs such as infiltration, certain setback criteria must be met such as setbacks to property lines, structures, drinking water wells, steep slopes, etc. Also important is a rough estimate of the area required to install the BMP and still meet minimal treatment and flow control requirements for the project.

Scoring Guide

- Based on the type of BMP proposed, the site appears to have adequate space to provide for full treatment and/or flow control and meet all setback requirements. **→ Score = 1**
- Site can meet all setback requirements, but may be limited in area to meet full flow control or treatment requirements, while still meeting a minimum level to support the project. **→ Score = 2**
- Site constraints limit ability to meet full flow control and/or treatment, or limit type of BMPs

allowed based on setback criteria, or special reports are required such as geotechnical or hydrogeologic (for depth to water table). → **Score = 3**

- Site has limited area and will severely constrain types and size of BMPs, but a project is still feasible. → **Score = 4**

- Site constraints may make project not feasible, or will require extensive specialty reports to determine feasibility. → **Score = 5**

#	Criteria	Score (1 to 5)
F5.1	**Sufficient Head for Treatment/Flow Control Options**	

<u>Guidance</u>

Many BMPs that might be used for a retrofit require some change in grade to function properly. A detention pond needs to have a change in grade that allows the discharge pipe to be at an elevation near the bottom of the pond, typically a grade change of 5 to 10 feet is necessary. Even proprietary BMPs such as storm filters will require some grade change to function – typically at least 2.3 feet from grate elevation to outlet elevation. Bioretention that uses an underdrain may also require a grade change to allow for infiltrated runoff to be conveyed to an outlet conveyance system. Grade change is also necessary to facilitate conveying stormwater runoff from the area from which stormwater is collected to get it to the BMP. The location of the BMP in relation to site contours should be evaluated in scoring this criterion.

Alternatively, in some instances, site grades may be too steep to allow use of certain BMPs. Swales typically need between 1% and 4% slopes to function for water quality treatment. Bioretention and infiltration is typically not feasible on slopes exceeding 10%.

<u>Scoring Guide</u>

- Site grades allow for conveyance of runoff to the BMP and grades in the vicinity of the BMP allow for proper functioning. → **Score = 1**

- Site and BMP location grades create limits on type, size, and location of BMPs and conveyance systems. → **Score = 3**

- Site and BMP location grades create severe limitations on conveyance and BMP design or may make a retrofit impractical without major re-grading. → **Score = 5**

#	Criteria	Score (1 to 5)
F5.2	**Drainage Infrastructure Can be Reasonably Modified**	

Guidance

Where stormwater is already collected in piping systems and other conveyances it becomes important whether the existing system can be reasonably modified to route flows to new BMPs for treatment and flow control without major system modification. Examples of circumstances that can cause problems include:

1. Deep burial conveyance piping – e.g., greater than 8 feet.
2. Existing infrastructure that is fragile and may be damaged by new connections.
3. System lacks structures or has long runs of pipe between existing structures.
4. Existing ponds or other treatment devices have been encroached upon by structures, roads, etc. and leave little room for expansion or improvement.

Scoring Guide

- Existing facilities and conveyance systems are easily modified to accommodate the project. → **Score = 1**

- Existing facilities and conveyance systems have limitations that may impact ability to implement the project. → **Score = 3**

- Existing facilities and conveyance systems have multiple limitations that will impact ability to implement the project. → **Score = 5**

#	Criteria	Score (1 to 5)
F5.3	**Level of Existing Treatment and Flow Control for Stormwater**	

Guidance

A retrofit project may be identified for an area that already receives some level of runoff treatment or flow control. The level of existing treatment and flow control may be based on an old standard that is not considered adequate under current standards or the treatment may be inadvertent as a result of conveyance systems that provide treatment, but were not designed to provide treatment, such as grass-lined channels or sheet flow across vegetated surfaces.

The feasibility of a retrofit project should be considered in part on whether the area currently receives significant, some, or no treatment or flow control and to what standards it is provided.

Scoring Guide

- Project site has little or no existing treatment of stormwater runoff and provides little or no flow control. → **Score = 1**

- Project site has some existing treatment or flow control, but is not a designed system or is no longer functioning. → **Score = 2**

- Project site provides either flow control with no treatment or treatment with no flow control and treatment/flow control is based on pre-1995 standards. → **Score = 3**
- Project site provides treatment and flow control to pre-1995 standards. → **Score = 4**
- Project site provides treatment or flow control to 1995 or more current standards. → **Score = 5**

#	Criteria	Score (1 to 5)
F5.4	**Redevelopment Potential**	

Guidance

Much of the Totem Lake basin, particularly the commercial/industrial areas, is expected to redevelop over the next several decades. Redevelopment projects offer opportunities to reconfigure the site and possibly include stormwater facilities that could not be incorporated into the current layout. The City of Kirkland is interested in taking advantage of coordinating stormwater retrofits with redevelopment, including exploring public/private partnerships.

Scoring Guide

- Redevelopment is planned for the site. → **Score = 1**
- Site is publicly owned and there are no current plans for redevelopment. → **Score = 3**
- Site is privately owned and there are no current plans for redevelopment. → **Score = 5**

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT:

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.	Location: Date:		**PROJECT DESCRIPTION**
FEASIBILITY RATING (1-5):	**0.0**	**1=HIGHEST; 5=LOWEST FEASIBILITY**	
PROJECT SCORE (0-100)		**100 = HIGHEST (FROM STEP 2)**	
ESTIMATED PROJECT COST:	**$**		
NOTE: GRAY BOX = DATA INPUT	**X**	**PINK BOX=CALCULATED VALUE**	**X.X**

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	**1** (Best)	**2**	**3**	**4**	**5** (Worst)	**RATING**	**NOTES & INSTRUCTIONS**
F1.1 Ease of Permitting & Number of Environmental Permits							1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints							
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)							
F2.2 Access for Construction and Maintenance							
F3.1 Upstream PGIS							
F3.2 Infiltration Potential (High = 1, Low = 5)							
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)							
F4.1 Project Impact on Site Uses & Operations (Long-term)							
F4.2 Sufficiency of Space Given Setback Requirements, etc.						**0.00**	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)							
F5.2 Drainage Infrastructure Can be Reasonably Modified							
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)							
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)							

Appendix C

Technical Assistance Panel
Final Report

Urban Land Institute
Northwest

ULI Technical Assistance Panel Recommendations

City of Kirkland - Totem Lake Stormwater Retrofit

CITY OF KIRKLAND WASHINGTON

ULI Northwest

The Urban Land Institute provides leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. ULI Northwest, a district council of the Urban Land Institute, carries forth that mission as the preeminent real estate forum in the Pacific Northwest, facilitating the open exchange of ideas, information and experiences among local, national and international industry leaders and policy makers.

Our mission is to:

- Build a regional vision of the Pacific Northwest that embraces and acts upon quality growth principles.
- Encourage the collaboration among all domains – public and private – of the real estate industry.
- Build consensus among industry and public leaders who influence land use, transportation, environmental, and economic development policies.

City of Kirkland

Kirkland is a suburban city located on the eastern shore of Lake Washington, surrounded by Redmond, Bellevue, and areas of unincorporated King County. Major transportation routes make Kirkland accessible to the region, including Interstate 405, which connects it with other nearby communities.

The City of Kirkland offers a unique downtown waterfront, which is the only Eastside downtown frontage along Lake Washington's shoreline.

Totem Lake

The Totem Lake sub-basin is a densely developed area, consisting of both commercial and residential development, as well as major arterial roadways. The area was largely developed in the 1970s, prior to the widespread implementation of protective stormwater controls. Totem Lake is often overwhelmed by high flows, which have caused flooding and contributed to water quality problems that may also impact the greater Juanita Creek watershed.

The City of Kirkland seeks recommendations from the ULI Technical Assistance Panel to determine how to implement stormwater retrofit facilities given the current land use and redevelopment potential of the Totem Lake area.

Contact us:

ULI Northwest
1111 Third Avenue, Suite 2150
Seattle, WA 98101

tel: 206.224.4500
fax: 206.224.4501
email: northwest@uli.org
northwest.uli.org

Urban Land Institute Northwest

Table of Contents

ULI Technical Assistance Panel Recommendations

City of Kirkland

EXECUTIVE SUMMARY

Totem Lake is destined to become an increasingly important center of employment, with substantial residential and mixed-use development, in the next 25 years.

At this time there is high potential for redevelopment within the boundaries of the urban center. With pressure for development increasing, the City of Kirkland should take steps to secure future environmental quality in Totem Lake and the region.

The construction of a regional stormwater detention facility can be an important part of a larger stormwater retrofit project that includes code revisions and a menu of low impact development options for public and private owners. A detention facility would have regional benefits, and could be financed based on City-wide or regional obligations for stormwater management.

The City has identified three redevelopable sites that represent important opportunities for stormwater treatment and detention. They include Totem Lake Mall East, Totem Lake Mall West and Totem Square.

Totem Lake Mall East appears to present important advantages over the other two sites. It would leverage investments already committed, including $15 million from the City to complete pedestrian-oriented improvements in a mixed-use center planned there. Also, there is regional value in investing in stormwater management in the Totem Lake Mall area because it is high in the watershed and would help with stormwater control downstream while precluding flooding from upstream stormwater. It could be placed partially or completely beneath the 120th Avenue Northeast right-of-way.

At the smaller scale, there are a number of options for specifying and incentivizing projects that are based on the principals of low-impact development.

The value of stormwater management accrues to every citizen and business in Totem Lake and the City of Kirkland, as they work toward a healthy and sustainable environment. It also safeguards the entire watershed, upstream and downstream, in the prevention of flooding and related damages.

BACKGROUND

Totem Lake's projected employment and residential growth is based on the growing population in Kirkland and in the region, and it is supported by the designation of Totem Lake as an Urban Center in regional plans, including those of King County and Puget Sound Regional Council. Urban Centers have priority in transportation funding. The target density, according to the designation, is 15 households per acre and 50 employees per acre, with a minimum of 15,000 jobs within a half mile of a transit center.

Transit improvements in Totem Lake are consistent with its designation as an Urban Center. Totem Lake's Transit Center, dedicated to bus service, is co-located with two five-story office buildings at the Evergreen Medical Center, with two levels of parking below grade. It includes six bus bays, sheltered passenger waiting areas, and bus layover space. It is located on Northeast 128th Street, within walking distance Northeast 128th Street Overpass and Freeway Station, a transit stop with direct access to HOV lanes on I-405. Totem Lake is served by South Transit Express and Metro Transit buses.

Currently, commercial activity in Totem Lake is dominated by auto sales and service, which accounts for 60 percent of sales taxes in the Urban Center. The largest employer is Evergreen Medical Center, with over 3,000 employees. The medical facility is convenient to transit, and has recently adopted a master plan. The 26-acre site of Totem Lake Mall, on 120th Avenue Northeast, has a new owner, a subsidiary of CenterCal Properties LLC. The company plans a low-rise million-square-foot mixed-use development with ground floor retail and restaurants. Office and residential space would rise above, under new regulations allow heights between 75 feet and 135 feet. A conceptual plan shows a pedestrian-oriented shopping area with new

east-west boulevard through the site. Generous public spaces are planned, with plazas, courtyards and pedestrian amenities. Working with owner, the City of Kirkland has committed $15 million to fund road improvements related to the redevelopment of the Totem Lake Mall site, which is now completely paved and impervious to stormwater.

The Totem Lake sub-watershed is part of the Juanita Creek watershed. As such, it has a critical role to play in the environmental health and water quality of the region. At this time, only about 20 percent of the basin has stormwater treatment at or near current standards defined in the 2009 King County Surface Water Design Manual. The Urban Center contains more than 500 acres for which stormwater is untreated or well below current standards. These factors, combined with increasing redevelopment pressures, mean that the Totem Lake sub-watershed is in need of a substantial stormwater retrofit.

The timeliness of building stormwater management infrastructure cannot be overstated. Factors include:

Storm Events. Climate change may mean greater volatility of weather conditions and more frequent and intense storm events. In urban areas, the intensity of rainfall (as opposed to the total amount of rainfall over a period of time) is often what causes flooding, as pipe systems become overwhelmed. Stormwater retrofit would help to control runoff from these intense events and avoid or reduce the severity of downstream flooding, associated safety hazards, and property damage.

Opportunity and the leveraging of public investment. Because there are sites in Totem Lake that are presently underdeveloped, designing and building stormwater management facilities and features adds only incremental cost to redevelopment, instead of imposing the disruption and greater cost of retrofitting a recently redeveloped site.

The City of Kirkland was awarded a grant from the National Estuary Program, which has enabled it to engage in study of strategies and sites for stormwater treatment and retrofit. To begin, 230 discrete parcels were analyzed using desktop GIS screening tools. Criteria for selection included the presence of existing treatment and detention facilities, pollutant "hot spots" in Totem Lake, and available space.

Of the 230 parcels, 27 sites were evaluated using a rating system based on a combination of factors that include:

- Position within the watershed (upstream drainage potential and existing impervious conditions upstream);
- Natural qualities (infiltration potential) and current uses of the site (existing treatment);

- Potential for public private partnership in redevelopment that includes stormwater treatment.

Based on this rating system, the list of 27 potential sites was narrowed to six properties, three publicly owned and three privately owned. For the consideration of the ULI Northwest Technical Assistance Panel and their findings and recommendations on stormwater management covered in this report, these six were further narrowed to three privately owned sites: Totem Square, Totem Lake Mall West, and Totem Lake Mall East.

ECONOMIC ANALYSIS

As the City of Kirkland moves forward with a plan for stormwater retrofit, an economic analysis will provide assurance that the investment will yield returns at many levels, from housing demand to business growth to a healthy and attractive environment in Totem Lake. The investment should support economic development, not only in Totem Lake, but elsewhere in the basin.

The City's first task, already underway, is to define the benefit area with the economic basis and land uses within it. If the benefit area can be shown to be larger than Totem Lake, extending upstream and downstream in the watershed, there may be opportunities for partnership with other neighborhoods or regional agencies. If the retrofit is a Citywide problem with related maintenance expense, a capital facilities fee may be called for.

As the City moves forward, stormwater requirements under current laws and regulations should be clarified. This will become the basis for defining proportional responsibilities among private property owners and developers, and setting out guidelines for becoming vested in a Citywide stormwater retrofit.

As the retrofit and related fees are being introduced to elected officials and property owners, it may be helpful to consider:

- Triple bottom line analysis

H:\Pw\Storm\Totem Lake Retrofit Grant\TAP Process\Map of Sites.mxd

- Risks involved in waiting, including emergency management and civil liability

To arrive at an overall financial plan for achieving the retrofit, it is important to assess what resources are already available to the City in the form of design capability. These may be sufficient to arrive at a preliminary overall project cost for the retrofit.

The next step is to assess the funding sources available to apply to the retrofit, and to quantify the monetary gap between project cost and resources.

If an individual property owner is not required to treat stormwater to the standards desirable for a Citywide stormwater retrofit, then it may be necessary to understand the difference in costs between the required standard and the optimum standard, and provide incentives for reaching the higher standard.

The City has a range of options for financing the retrofit. These could include:

Conventional sources of revenue. These might include bonding, grants, Surface Water Utility fees, or the creation of a community facilities district.

Other sources. To spread and balance the costs of regional stormwater retrofit, other sources of revenue might include a Local Improvement District, connection fees, latecomer fees, or a fee-in-lieu program. The fee-in-lieu program would apply to known projects, and would be based on a number of factors including the size of the retrofit area, the number of property owners involved and current code restrictions, redevelopment potential, multi-phased development and the market cycle. When the market is down, so too will be the fees collected to support the project.

As a long-range option for financing stormwater retrofit, the City might consider the participation of a third-party investor.

When the objective is to site a substantial stormwater retention or treatment facility on a redeveloping private property, it is important that the City engage with the owner to find mutual benefit, define cost and refine design for maximum return on investment. A long-term agreement with the private owner is the key to reaching the goals of the City and the goals of the redevelopment. As much of the facility as possible should be positioned on public land or in the right-of-way. For the part located on private property, the owner-developer must have maximum use of land above a detention facility, while at the same time ensuring that the City has access for maintenance over the long term, as needed. Many factors are involved in balancing the two, including:

- Phasing
- Utility connections
- Site access
- Other (concurrent) land uses

- Environmental conditions (soils, groundwater levels, critical areas)

The City should be as flexible and creative as possible in finding advantages for the owner that could offset the extra costs. A preexisting obligation of the owner involved could be applied to a planned facility that is partially or completely on private land. Other offsets may include:

- Additional density allowances or lower parking requirements
- Increased lot coverage
- Purchase of easement
- Beneficial land use changes
- Right-of-way transfer

In and of itself, low-impact development is not a marketing tool to increase the value or desirability of a project. But elements of the low-impact development toolkit can provide multiple place-making benefits that accrue to the value of private property, along with factors like walkability and proximity to transit. The toolkit includes options that add livability and scenery to the urban environment when they are designed with care and sensitivity.

LAND USE REGULATION

To spread the benefit and the responsibility of stormwater retrofit in Totem Lake, flexible land use code revisions can enhance the benefits of low impact development. These revisions must balance overall stormwater management requirements with sensitive and critical areas, and take into account the values of greater lot coverage.

Options for surface water quality treatment include:

- Underground facilities in buffer areas
- Prescriptions for soil amendments
- Benefits of certain tree species

Height bonuses may not be an effective incentive for low impact development in Totem

Lake, because the additional, incentivized density may not be supported by the market in Totem Lake.

Several stormwater management systems that provide some combination of retention and filtration in urban environments can be encouraged through incentives in the zoning code. These include:

Green roofs. Shallow planting beds on roof surfaces can support hardy plant species. When deployed extensively, green roof systems can absorb up to 60 percent of runoff and reach 90 percent filtration.

Stormwater planters. These planting systems consist of basic street greening elements like trees and herbaceous plants, enhanced by new technical knowledge and building strategies. Typically contained by concrete and often open at the bottom to the substrate, they provide retention and/or filtration for stormwater runoff.

Modular suspended pavement systems. A manufactured underground structure can support surface paving and traffic while providing loosely compacted soil within. The structure is hospitable for tree roots, and the mixture contained within can be enhanced for bioretention.

Permeable paving. Widely defined as any surface with a network of voids that allows for rapid infiltration of water into the ground, permeable paving can be made of a variety of traditional materials like stone, concrete and asphalt. The category also includes porous

concrete and specialized systems that encourage plant growth. Installations typically provide 40 percent void space and may include undersurface reservoirs or drainage systems.

REGIONAL SOLUTIONS

When considering stormwater detention and treatment at the regional scale, major capital investments like detention vaults may be appropriate. Major design decisions include open water or basin versus open space over an underground facility such as a vault. These kinds of large facilities are called for where there is insufficient space or opportunity to slow or infiltrate stormwater by other means, and they can prevent flooding and erosion downstream.

A detention vault could be designed to contribute toward open space requirements for Totem Lake and the City. Such an open space could become a part of the connections between major features of Totem Lake, from the medical center to the transit station to Totem Lake Park or the trail network that includes the new Cross Kirkland Corridor.

The presence of a large detention facility below grade need not preclude many types of land use above it, or features that add value to the public realm. When specifying permissible uses and non-permissible uses over and underground facility, it is important to be inclusive. Code language should be checked so that it does not preclude structures, public open space or a water feature. When placing any regional detention facility within the public right-of-way, it is important to specify conditions and maintenance activities and responsibility.

A surface level retention facility could be designed to support certain public amenities like a park, water feature, community garden, sports field or pedestrian-friendly street. A sub-surface facility could support an open market, parking, a plaza, or a fountain.

The City has completed an exhaustive review of potential sites for regional stormwater detention in an at-grade or below-grade facility (vault). As the City of Kirkland moves toward implementation of a stormwater retrofit program, it should continue modeling performance, conducting economic analysis, and discussing alternatives with property owners.

Three large, redevelopable sites were advanced to the predesign phase as part of preliminary studies. They include Totem Lake Mall East, Totem Lake Mall West, and Totem Square.

The two mall sites are located on the east and west sides, respectively, of 120th Avenue Northeast, south of Northweast 128th Street and the Evergreen Medical Center. The Totem Square site is to the south of that, bounded by 124th Avenue Northeast to the east and the Cross Kirkland Corridor along the northwest side.

All three sites present opportunities for stormwater treatment and detention. The following considerations may apply in choosing to focus on a site.

Totem Lake Mall East. Of the three sites, Totem Lake Mall East appears to present important advantages:

- It would leverage investments already made, including a commitment by the City of $15 million to complete a new pedestrian amenities and improvements through a mixed-use center.

- There is regional value in placing an at-grade or below-grade stormwater management facility in the Totem Lake Mall area because it is high in the watershed and would help with stormwater control downstream and preclude flooding from upstream stormwater.

- The location presents potential to place a stormwater management facility partially or completely beneath the 120th Avenue Northeast right-of-way.

- There is potential for connections, on grade and below, with Totem Lake and the surrounding wetlands.

Totem Lake Mall West. This is a less opportune site, because the high water table there limits the constructability and location of a stormwater management facility. Because there is no plan in process for redevelopment there, planning an underground stormwater management facility may preclude optimum future development of the site.

Totem Square. Based on preliminary design for a stormwater vault and bioretention strategies, this site could provide full flow control for 20.3 acres, contributing substantially to bringing the City into compliance with current standards. Disadvantages include constrained access. It is bounded by 124th Avenue Northeast (a major arterial), and the Cross Kirkland Corridor (a natural area and trail).

CONCLUSION

The construction of a regional stormwater detention facility, at or below grade, is an intensive approach to stormwater management that involves significant engineering and construction, depending upon other uses of the surface. But it can be an important part of a larger stormwater retrofit project that includes code revisions and a range of low impact development options for public and private landowners and developers.

With public benefit in mind, the City should consider purchasing land around Totem Lake itself, and creating additional wetlands that could serve as a scenic amenity as well as a stormwater management option. In this connection, low-impact development is a factor in attracting other amenities in the form of private open space or pedestrian-friendly features. Near a regional system of natural areas like Totem Lake Park, with green streets, pedestrian amenities, and trails like the Cross Kirkland Corridor, investment in low-impact development and stormwater management at the street level can yield very high returns on investment. These features add to the market value of any property they adjoin, and that value is enhanced when there is an attractive and pedestrian-friendly public realm and urban environment.

Through high quality design and private participation, stormwater retrofit measures can become part of the identity and branding of the Totem Lake Urban Center. All of these are part of a larger path toward sustainable redevelopment that will make Totem Lake an attractive and marketable place to live, shop, and work.

GLOSSARY

Because water quality decisions and stormwater management can be very technical in their application, the following terms are defined for the purpose of this report.

Bioretention: a process in which contaminants and sedimentation are removed from stormwater runoff. Stormwater is collected into a treatment area, which consists of some combination of grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants.

Filtration: removal of undesirable constituents by absorption into a filter medium. Significant stormwater treatment can be provided in a broad mix of soils and planting, but filtration systems can also be engineered and installed for precise results in a larger system.

Flow control: management of the rate at which stormwater passes through a retention or filtration system.

Retention: the rate at which stormwater is held in place by various natural means (like permeable soil and plant roots).

Runoff: stormwater that flows on the surface until it is gathered into a sewer system or natural surface water. Traditional impermeable paving produces runoff.

Stormwater management facility: an underground structure designed to hold runoff on a developed site. It is a choice for managing the quantity of stormwater that flows into nearby surface waters, helping to reduce flooding and erosion. It will not improve water quality unless it is part of a system that includes a filtration element.

Stormwater retrofit: The planning and construction of flow attenuation (water slowing) and/or water quality improvement facilities to serve existing development, with the goal of protecting the integrity of habitat in streams and lakes.

Watershed-basin: a land area where stormwater naturally gathers, running toward a common stream. A watershed is separated from neighboring watersheds by a drainage divide.

ULI Northwest Technical Assistance Panel Professional Biographies

Amalia Leighton, SVR Design Company, Seattle, WA (Panel Chair)
Amalia Leighton, PE, AICP, is a director, civil engineer, and planner at SvR Desgin Company. Amalia's experience encompasses leading complex teams with specialty consultants such as bicycle and pedestrian planners, health and walking specialists, social equity stakeholders, and urban designers specializing in sub-area or land-use policy. Amalia is a registered engineer and holds a bachelor of science in civil engineering from the University of Washington. She is vice chair of the Seattle Planning Commission.

Maiya Andrews, City of Burien, Burien, WA
Maiya Andrews is the Public Works Director for the City of Burien, and has previously worked for the cities of Des Moines and Newcastle. In addition to her public sector experience, Maiya was a consultant with contractor CH2M Hill, where she focused on transit improvements for Coal Creek Parkway.

Mark Griffin, Port of Seattle, Seattle, WA
Mark is Director of Real Estate Development for the Port of Seattle. He was previously with the City of Seattle's Office of Economic Development. Before entering the public sector, Mark practiced law, handling a variety of commercial real estate transactions. He is a graduate of the University of North Carolina and the University of Virginia and is a member of the ULI Northwest Advisory Board.

Deb Guenther, Mithun, Seattle, WA
As a partner and landscape architect at Mithun, Deb has built a team of landscape architects that bring exceptional quality, critical thinking, and award-winning design to projects. Deb is interested in the role of the public realm in our cities – how it connects people with their surroundings and each other. Nationally recognized for her leadership on green infrastructure and ecosystem service issues, she was awarded the American Society of Landscape Architect's Presidents Medal in 2010.

Matt Hoffman, Heartland, Seattle, WA
As a key member of Heartland's Project Management team, Matt is at the leading edge of the effort to leverage spatial and economic data to uncover opportunities and constraints in complex real estate markets. Before joining Heartland, Matt worked at a real estate economics-consulting firm and served as a project manager for an environmental engineering and firm based in Southeast Michigan. Matt is a licensed real estate broker in the State of Washington, and is an active member of NAIOP and the Urban Land Institute. He is a recent graduate of the ULI Northwest Center for Sustainable Leadership program.

Alison Lorig, Lorig Associates, Seattle, WA
Alison Lorig is co-owner of Lorig Associates, and serves as its President. Alison applies her extensive expertise as an engineer and project manager to ownership oversight of Lorig's portfolio of development projects and properties to ensure Lorig's work is delivered with the highest possible quality. Her commitment to carrying the company's tradition of excellence forward is helping to create lasting client satisfaction and ongoing positive impacts to communities throughout the region.

Tom Phillips, Tom Phillips & Associates, Seattle, WA
Tom is a planning and development consultant with his own practice, Tom Phillips & Associates. Previously, he served as a Senior Development Manager with the Seattle Housing Authority for close to ten years. As a lead project manager, Tom oversaw the development of the High Point neighborhood in West Seattle, a master-planned, mixed income community and winner of ULI's 2007 Global Award for Excellence. Tom is the President of the Board of the Neighborhood Farmers Market Alliance.

Sandip Soli, Caincross & Hempelmann, Seattle, WA
Sandip heads the Real Estate group, as well as the retail, hotel, and restaurant industry team at Cairncross & Hempelmann. He practices primarily in the area of commercial real estate transactions, including retail, office, and industrial leasing, purchase and sale agreements and real estate financings. He holds a J.D. from the University of Washington School of Law.

ULI Northwest Technical Assistance Panel Professional Biographies

Stakeholders

Mayor of Kirkland
Amy Walen

Kirkland City Council Members
Penny Sweet
Jay Arnold
Shelley Kloba
Toby Nixon
Dave Asher
Doreen Marchione

Kirkland City Staff
Wes Ayers
Kathy Brown
Dorian Collins
Tracey Dunlap
Jenny Gaus
Rob Jammerman
Kelli Jones
Ellen Miller-Wolfe
Paul Stewart

Support Team
Kelly Mann, ULI Northwest
Jared Jonson, ULI Northwest
Eric Sanford, ULI Northwest
Victoria Oestreich, ULI Northwest
Clair Enlow, Freelance Writer

Urban Land Institute
Northwest

Contact us:

ULI Northwest
1111 Third Avenue, Suite 2150
Seattle, WA 98101

tel: 206.224.4500
fax: 206.224.4501
email: northwest@uli.org
northwest.uli.org

Appendix D

Site Selection

Totem Lake Stormwater Retrofit

Potential Retrofit Options

June 11, 2014

Site #	Bioret./ Raingarden	Bioswale	Wetpool	Vegetated Filter Strip	Media Filter Drain	Tree Box Filter	Filter Canisters	Flow Control Vault/Tank	Flow Control Pond	UIC
1	X[i]	X[i]	X			X	X	X		X
2	X[i]	X[i]	X				X	X	X	X
3			X						X	
4	X		X							
5										
6	X	X	X				X	X		
7	X	X	X				X	X		
8	X	X	X				X	X		
9	X		X				X	X		
10								X		
11	X	X	X		X			X		
12	X	X	X		X			X		
13	X		X	X	X			X	X	
14	X	X	X	X	X	X	X	X		
15	X	X	X				X	X		
16			X	X	X				X	
17								X		
18	X		X						X	
19	X	X	X	X	X				X	
20								X		
21										
22	X[i]		X			X	X	X		
23						X	X			
24N	X[i]		X					X		
24S	X[i]		X					X		
25						X	X			X
26	X[i]	X[i]	X				X	X	X	
27	X[i]	X[i]	X				X	X	X	

[i] Limited amounts of infiltration could occur along with treatment in these facilities.

	UNIQUE SITE ID: 1		
DATE: May, 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: NE 132nd Street and 132nd Avenue NE
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
☑ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other: Convey to Site 2 - Park

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☑ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 39.2
Imperviousness ≈ %
Impervious Area ≈ 20.1

Notes:

Drainage Area Land Use:
☐ Residential
☑ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Swale and W.G. tank at northwest corner of intersection.
Some trib. areas have F.C and W.Q.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Developed two-lane arterial W/C/G/SW/DR/OP/Trees.
Right-of-way too narrow except near top of basin for roadside raingardens.
Some areas suitable for CB SF or Filtera.

PROPOSED RETROFIT

Purpose of Retrofit:
- [x] Water Quality
- [x] Recharge
- [ ] Channel Protection
- [x] Flood Control
- [ ] Demonstration / Education
- [ ] Repair
- [ ] Other:______

Retrofit Volume Computations - Target Storage:
STD: 460,000 CF (assumes Ø infiltration)
8' x 300' x 195'

Retrofit Volume Computations - Available Storage:
Use Park?

Proposed Treatment Option:
- [ ] Extended Detention
- [ ] Wet Pond
- [ ] Created Wetland
- [ ] Bioretention
- [ ] Filtering Practice
- [ ] Infiltration
- [ ] Swale
- [ ] Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Right-of-way too narrow except at top of basin for roadside raingardens.
Some areas suitable for CB SF or Filterra.
Up-size detention tank at southwest end?
or direct flows to UIC (new) in park. See Site 2

SITE CONSTRAINTS

Adjacent Land Use:
- [x] Residential
- [ ] Commercial
- [x] Institutional
- [ ] Industrial
- [ ] Transport-Related
- [ ] Park
- [ ] Undeveloped
- [ ] Other:______

Possible Conflicts Due to Adjacent Land Use? [x] Yes [ ] No
If Yes, Describe: Residential with fences directly behind sidewalks.

Access:
- [x] No Constraints

Constrained due to
- [ ] Slope
- [ ] Space
- [ ] Utilities
- [ ] Tree Impacts
- [ ] Structures
- [ ] Property Ownership
- [ ] Other:______

Conflicts with Existing Utilities:
- [ ] None
- [ ] Unknown

Yes	Possible	
[ ]	[ ]	Sewer
[ ]	[ ]	Water
[ ]	[ ]	Gas
[ ]	[ ]	Cable
[ ]	[ ]	Electric
[x]	[x]	Electric to Streetlights West
[x]		Overhead Wires East Side
[ ]	[ ]	Other:______

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[ ] Probable	[x] Not Probable
Impacts to a Stream	[ ] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[x] Not Probable

How many?______
Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	[ ] Yes	[ ] No
Evidence of poor infiltration (clays, fines):	[ ] Yes	[ ] No
Evidence of shallow bedrock:	[ ] Yes	[ ] No
Evidence of high water table (gleying, saturation):	[ ] Yes	[ ] No

Qvt. till moderate dispersed

AERIAL VIEW

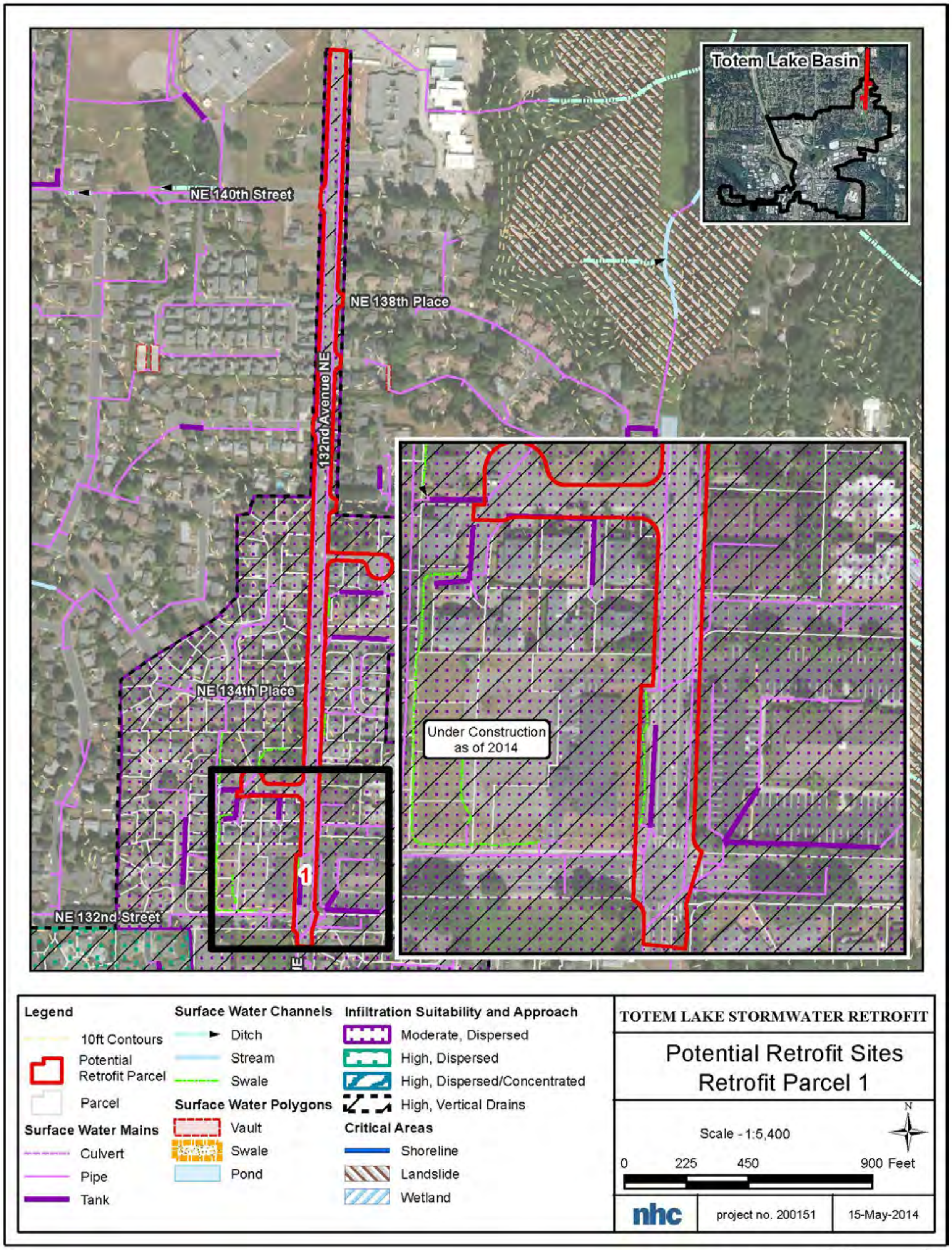


Figure 1

DESIGN OR DELIVERY NOTES

Potential Facilities (Both F.C. and W.Q.)
Expand detention tank at south end.
and/or direct runoff to park in next basin.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- [ ] Confirm property ownership
- [x] Confirm drainage area
- [x] Confirm drainage area impervious cover
- [x] Confirm volume computations
- [x] Complete concept sketch
- [x] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [ ] Obtain detailed topography
- [x] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [x] Confirm soil types
- [ ] Other:______

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Convey to Site 2 - UIC

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☑ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):______

	UNIQUE SITE ID: 2		
DATE: May 10, 2014	ASSESSED BY: LG	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: 132nd Square Park
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☑ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ <67.2 (with Site 1 Basin)
Imperviousness ≈ %
Impervious Area ≈ 30.3

Notes: Verify TRIB. Area.

Drainage Area Land Use:
- ☑ Residential
  - ☑ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☑ Transport-Related
- ☑ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☑ Possible
If Yes, Describe:
Pond in southeast corner.
Outlet to a manhole (C.S.?)

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Ball Fields/Park
Large big-leaf maple near outlet.
Large cedars near but can avoid.
Lots of area available to enlarge pond and/or provide W.Q. prior to UICs.

Existing Head Available and Points Where Measured:
Need to confirm IE of drainage from 132nd.

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☑ Channel Protection ☑ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:________

Retrofit Volume Computations - Target Storage:
Sites 1 and 2
685,000 CF (assuming Ø infiltration).
10' x 300' x 230'

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☑ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Increase volume of existing pond. Add wetpond for treatment (or swale).
Consider UICs

SITE CONSTRAINTS

Adjacent Land Use:
☑ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☑ Park
☐ Undeveloped ☐ Other:________
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☑ Tree Impacts-can avoid
☐ Structures ☐ Property Ownership
☐ Other:________

Conflicts with Existing Utilities:
☑ None
☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:________

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many? Can Avoid
Approx. DBH________

Other factors:________

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvt. glacial till
Moderate dispersed
1 exploration point

AERIAL VIEW

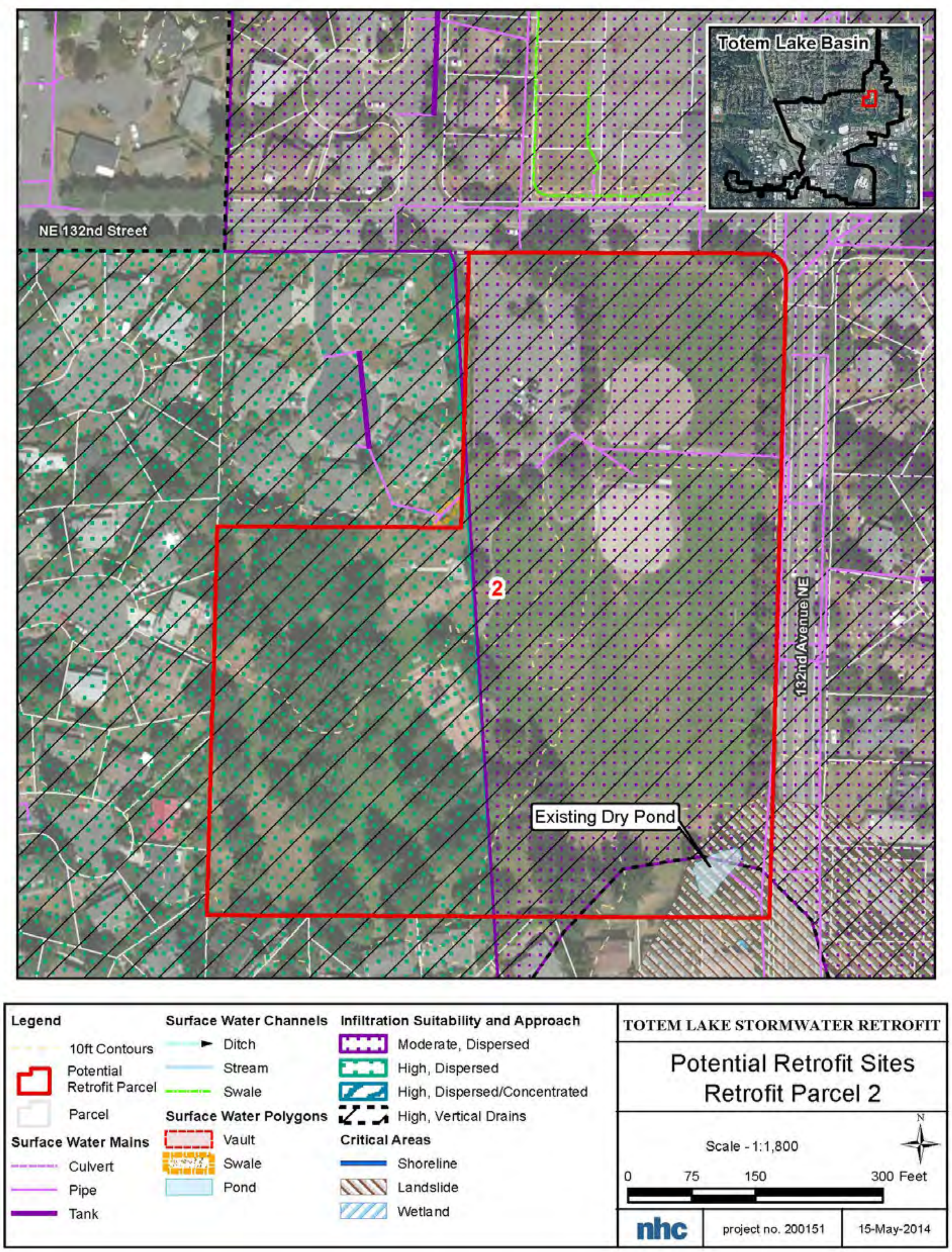


Figure 2

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☑ Confirm drainage area
- ☑ Confirm drainage area impervious cover
- ☑ Confirm volume computations
- ☑ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☑ Confirm storm drain invert elevations
- ☑ Confirm soil types
- ☑ Other: Estimated infiltration rate?

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Work with Geotech to estimate area needed to infiltrate via UIC.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☑ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S): ______

	UNIQUE SITE ID: 3

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: SE corner Slater Avenue NE and NE 126th Place
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☑ DOT ☑ Other: WSDOT

Proposed Retrofit Location:

Storage
☑ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
☑ Residential
- ☑ SFH (< 1 ac lots)
- ☐ SFH (> 1 ac lots)
- ☐ Townhouses
- ☐ Multi-Family

☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☑ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Wetponds constructed by WSDOT for 132nd Avenue NE.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Appears to be 4 wet ponds and a wetland

Site is elevated 10' +/- above property to south.

Doesn't appear to be much room left; unless can lower outlet, thus wetponds, thus add more F.C.

PROPOSED RETROFIT

Purpose of Retrofit:

- [x] Water Quality
- [ ] Recharge
- [ ] Channel Protection
- [ ] Flood Control
- [ ] Demonstration / Education
- [ ] Repair
- [ ] Other:____________________

Retrofit Volume Computations - Target Storage:
STD: 440,000 CF

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:

- [ ] Extended Detention
- [ ] Wet Pond
- [ ] Created Wetland
- [ ] Bioretention
- [ ] Filtering Practice
- [ ] Infiltration
- [ ] Swale
- [ ] Other:____________________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Increase size of ponds. Add F.C.
F.C. in southwest corner?

SITE CONSTRAINTS

Adjacent Land Use:

- [ ] Residential
- [ ] Commercial
- [ ] Institutional
- [x] Industrial
- [ ] Transport-Related
- [ ] Park
- [ ] Undeveloped
- [ ] Other:____________________

Possible Conflicts Due to Adjacent Land Use? [ ] Yes [x] No
If Yes, Describe:

Access:

- [ ] No Constraints

Constrained due to

- [x] Slope
- [x] Space
- [ ] Utilities
- [ ] Tree Impacts
- [ ] Structures
- [x] Property Ownership
- [ ] Other:____________________

Conflicts with Existing Utilities:

- [ ] None
- [x] Unknown

Yes	Possible	
[ ]	[ ]	Sewer
[ ]	[ ]	Water
[ ]	[ ]	Gas
[ ]	[ ]	Cable
[ ]	[ ]	Electric
[ ]	[ ]	Electric to Streetlights
[ ]		Overhead Wires
[ ]	[ ]	Other:____________

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[ ] Probable	[x] Not Probable
Impacts to a Stream	[ ] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[x] Not Probable

How many?____________
Approx. DBH____________

Other factors:____________________

Soils:

Soil auger test holes:	[ ] Yes	[ ] No
Evidence of poor infiltration (clays, fines):	[ ] Yes	[ ] No
Evidence of shallow bedrock:	[ ] Yes	[ ] No
Evidence of high water table (gleying, saturation):	[ ] Yes	[ ] No

Recessional outwash
HGW
2 exploration points

AERIAL VIEW

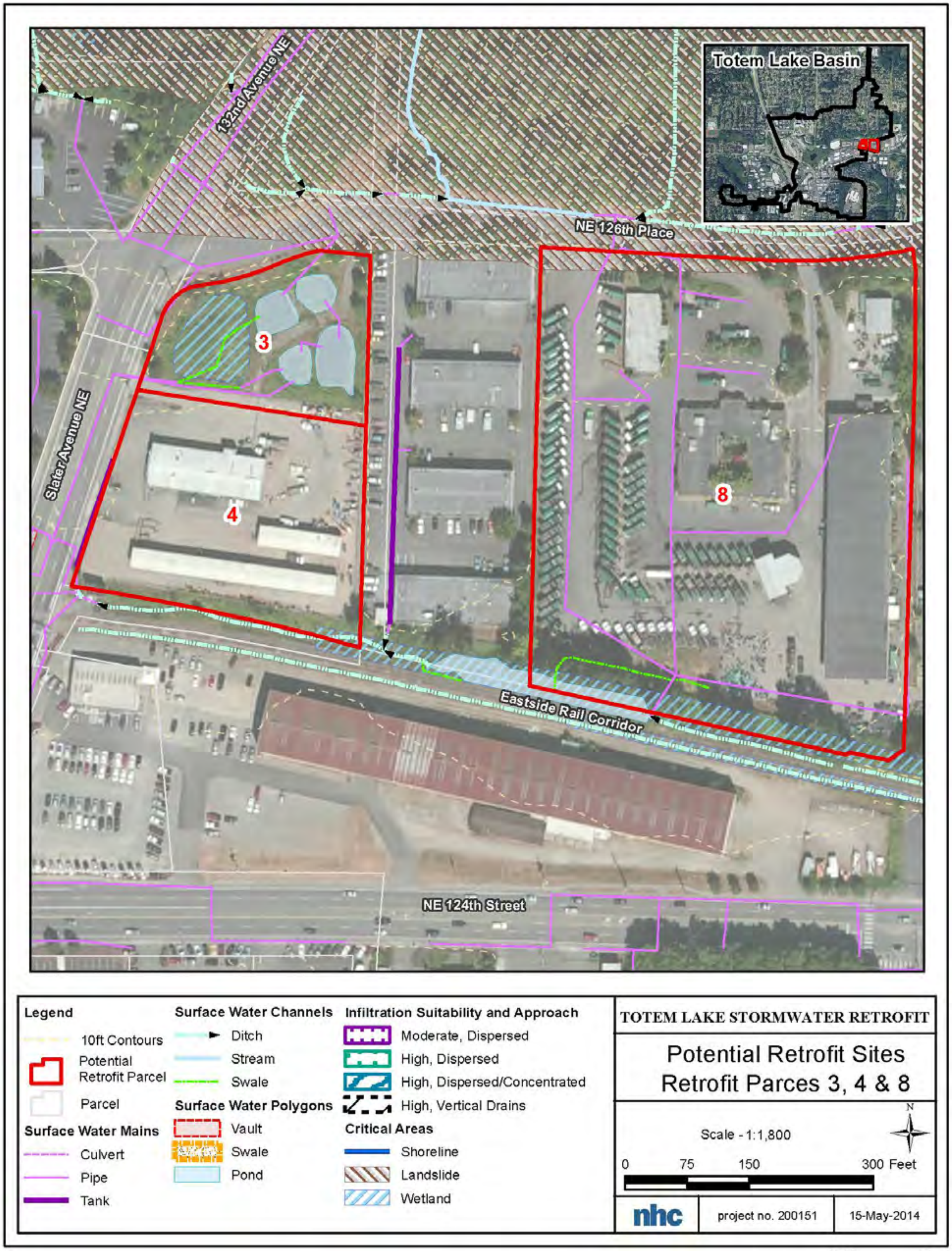


Figure 3

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☑ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):

	UNIQUE SITE ID: 4		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: United Rentals
Address: Slater Avenue

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
No stormwater facilities in GIS.
Parking and commercial building.
Drains to Cross Kirkland Corridor.

Existing Head Available and Points Where Measured:
≈ 5' above Cross Kirkland Corridor ditch

PROPOSED RETROFIT

Purpose of Retrofit:

- ☐ Water Quality
- ☐ Recharge
- ☐ Channel Protection
- ☐ Flood Control
- ☐ Demonstration / Education
- ☐ Repair
- ☐ Other:

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:

- ☐ Extended Detention
- ☐ Wet Pond
- ☐ Created Wetland
- ☐ Bioretention
- ☐ Filtering Practice
- ☐ Infiltration
- ☐ Swale
- ☐ Other:

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:

- ☐ Residential
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No

If Yes, Describe:

Access:

☐ No Constraints

Constrained due to

- ☑ Slope
- ☐ Space
- ☐ Utilities
- ☐ Tree Impacts
- ☐ Structures
- ☑ Property Ownership
- ☐ Other:

Conflicts with Existing Utilities:

☐ None

☑ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream or Ditch?	☑ Probable	☐ Not Probable
Floodplain Fill	☑ Probable	☐ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?

Approx. DBH

Other factors: Cross Kirkland Corridor at south - ditch or stream

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvr., but high GW

AERIAL VIEW

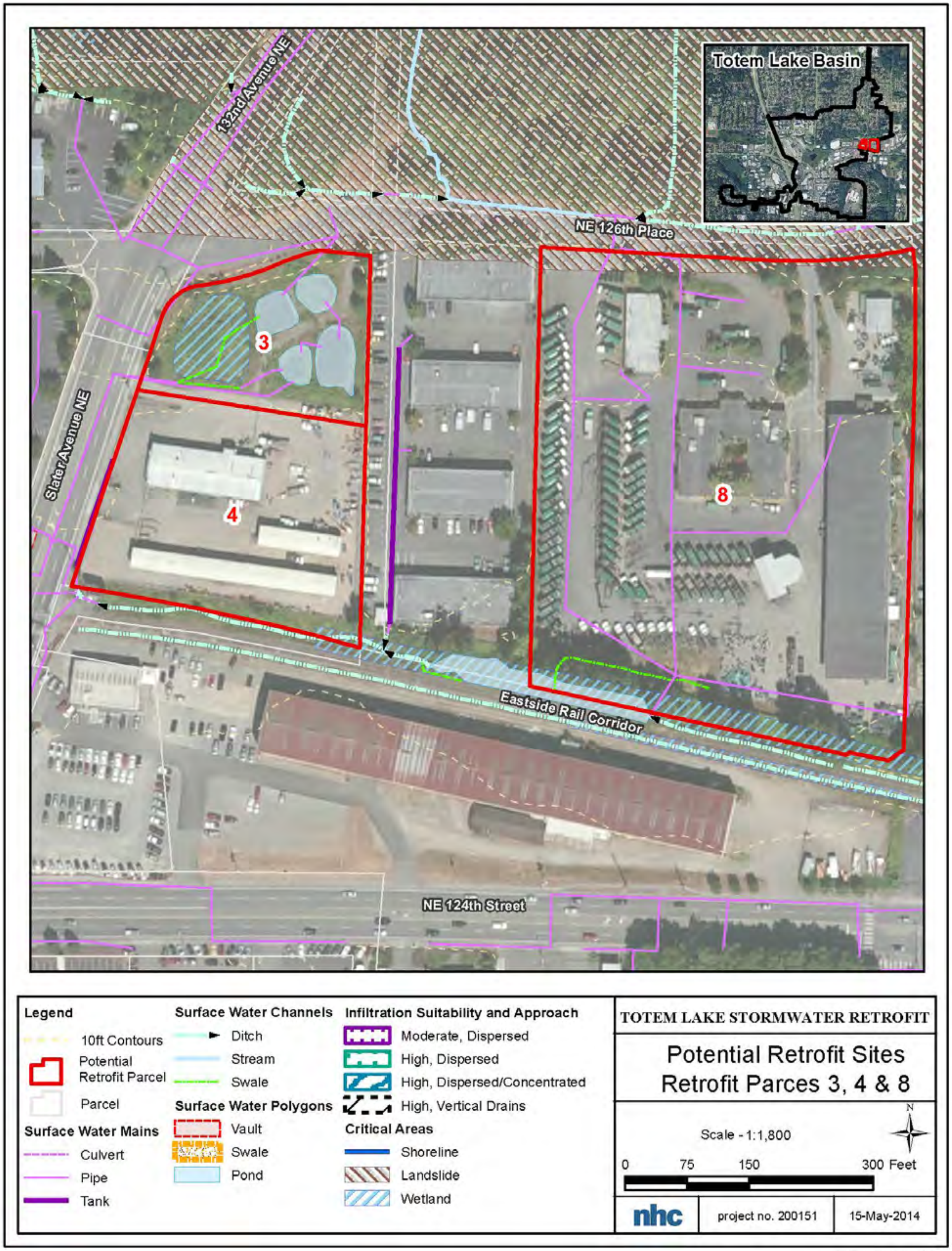


Figure 3

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:____________________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

If redevelop, could potentially provide additional F.C. downstream of WSDOT.
Pretty low in basin with likely HGW.
How to get water? From WSDOT ponds in best place.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):____________________

	UNIQUE SITE ID: 8		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: OB Kirkland Properties
Address: NE 126th Place

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☑ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:
Conveyance pipe to Cross Kirkland Corridor ditch and W.L.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Commercial with large parking.
Water from upstream ditch and streams conveyed through to Cross Kirkland Corridor.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:__________

Retrofit Volume Computations - Target Storage:	**Retrofit Volume Computations - Available Storage:**

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:__________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Consider F.C. in northern portion - intercept runoff from northeast residential basin.
Check for sufficient separation from GW to infiltration in northern portion.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☑ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:__________
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☑ Property Ownership
☐ Other:__________

Conflicts with Existing Utilities:
☐ None
☑ Unknown Redevelopment

Yes	**Possible**	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:__________

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream/Ditch?	☑ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?__________
Approx. DBH__________

Other factors:__________

Soils:

Soil auger test holes:	☐ Yes	☐ No	Qvr. outwash
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No	HGW
Evidence of shallow bedrock:	☐ Yes	☐ No	
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No	

AERIAL VIEW

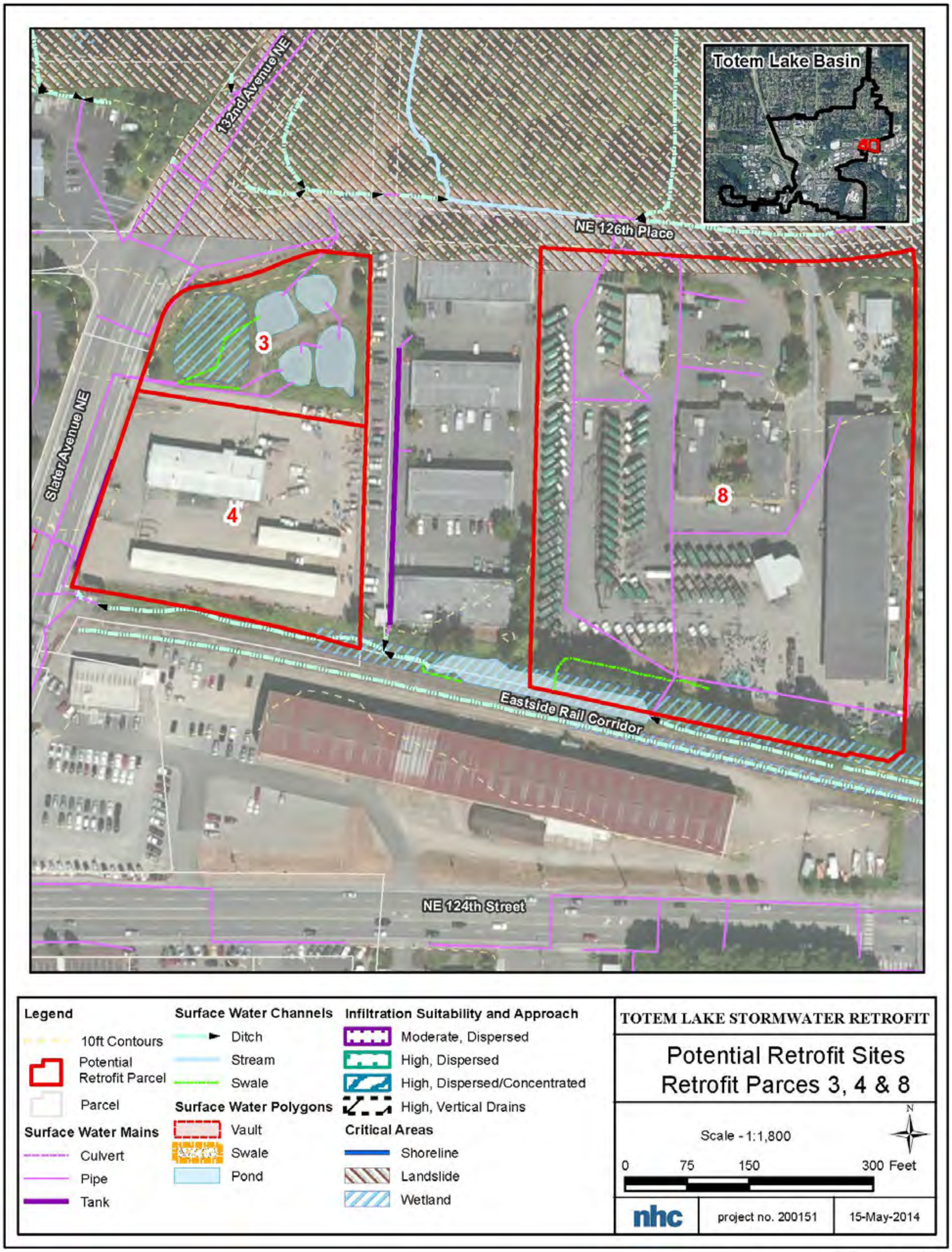


Figure 3

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- ☐ Confirm property ownership
- ☑ Confirm drainage area
- ☑ Confirm drainage area impervious cover
- ☑ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☑ Confirm soil types
- ☑ Other: Check w/City,see if sediment load is excessive-scouring of channel down slope-too brambled to walk

Initial Feasibility and Construction Considerations

Redevelopment required

Site Candidate for Further Investigation:	☐ Yes	☐ No	☑ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☑ No	☐ Maybe
If No, Site Candidate for Other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s): ______

	UNIQUE SITE ID: 10		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Cross Kirkland Corridor between 128th Lane and Slater Avenue
Address: ______

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other: ______

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: ______
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other: ______

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ ______
Imperviousness ≈ ______%
Impervious Area ≈ ______

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: ______

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Ditch/stream along Cross Kirkland Corridor - confirm status and presence of wetlands.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Gravel multi-use trail with ditch at north side and south side.
G.W. at/near surface.
Southwest corner potentially used for parking.

Existing Head Available and Points Where Measured:
0 - 1'

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality
- ☐ Demonstration / Education
- ☐ Recharge
- ☐ Repair
- ☐ Channel Protection
- ☐ Other:____________
- ☐ Flood Control

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- ☐ Extended Detention
- ☐ Filtering Practice
- ☐ Wet Pond
- ☐ Infiltration
- ☐ Created Wetland
- ☐ Swale
- ☐ Bioretention
- ☐ Other:____________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
- ☐ Residential
- ☐ Industrial
- ☐ Undeveloped
- ☑ Commercial
- ☐ Transport-Related
- ☐ Other:____________
- ☐ Institutional
- ☐ Park

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
- ☑ No Constraints

Constrained due to
- ☐ Slope
- ☐ Utilities
- ☐ Structures
- ☐ Other:____________
- ☐ Space
- ☐ Tree Impacts
- ☐ Property Ownership

Conflicts with Existing Utilities:
- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:____________

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream	☑ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?____________
Approx. DBH____________

Other factors:____________

Soils:

Soil auger test holes:	☐ Yes	☐ No	Qvr. outwash
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No	HGW
Evidence of shallow bedrock:	☐ Yes	☐ No	
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No	

AERIAL VIEW

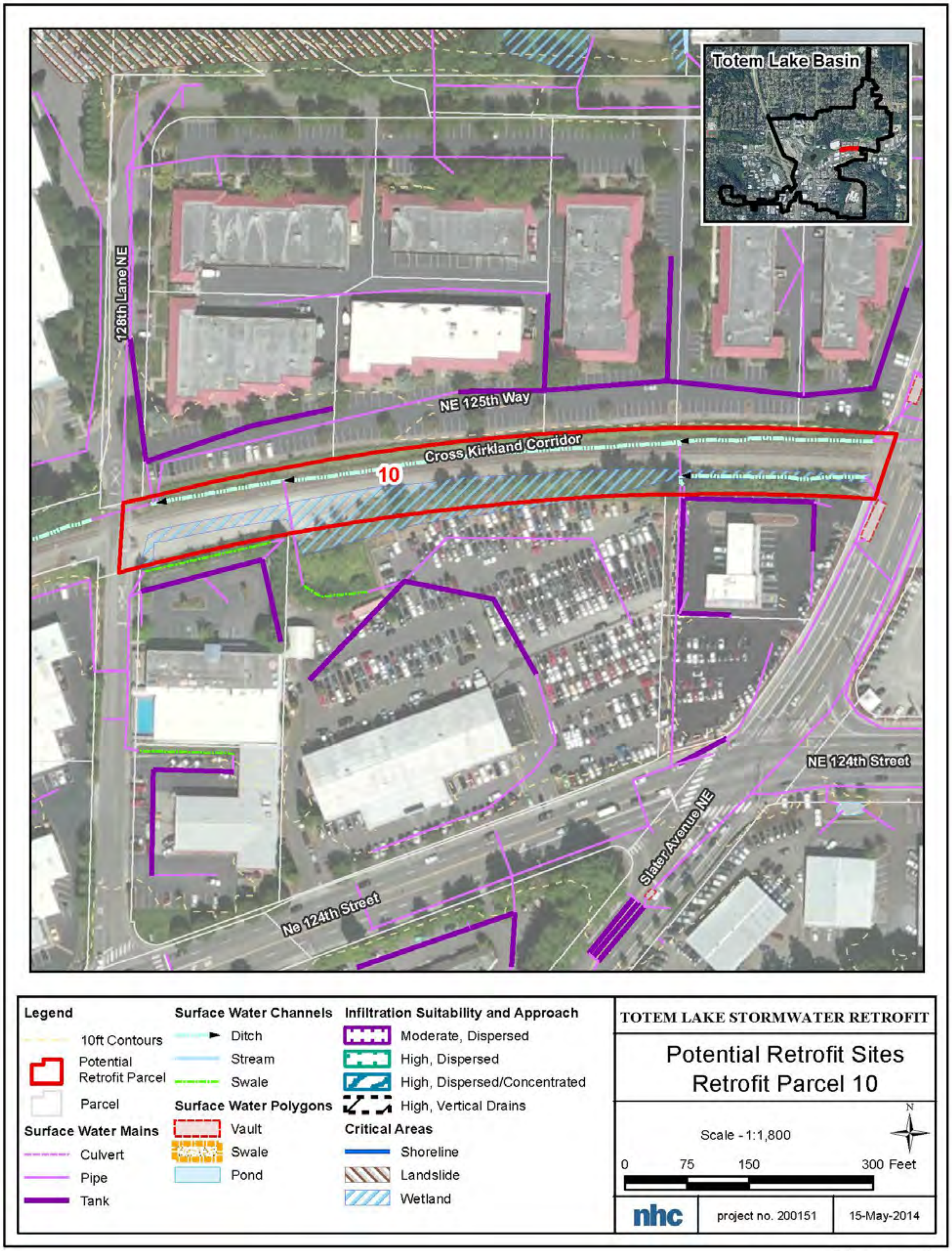


Figure 4

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

G.W. at/near surface.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):

	UNIQUE SITE ID: 11		
DATE: May 10, 2014	ASSESSED BY: LG	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Dodge Dealership
Address: NE 124th Street

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:
Underground tank and swale.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
- ☐ Demonstration / Education ☐ Repair ☐ Other:____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- ☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
- ☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:____

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
- ☐ Residential ☑ Commercial ☐ Institutional
- ☐ Industrial ☐ Transport-Related ☑ Park Cross Kirkland Corridor
- ☐ Undeveloped ☐ Other:____

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
- ☐ No Constraints
- Constrained due to
  - ☐ Slope ☐ Space
  - ☐ Utilities ☐ Tree Impacts
  - ☐ Structures ☑ Property Ownership
  - ☐ Other:____

Conflicts with Existing Utilities:
- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream	☑ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?____
Approx. DBH____

Other factors:____

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvr. outwash
HGW

AERIAL VIEW

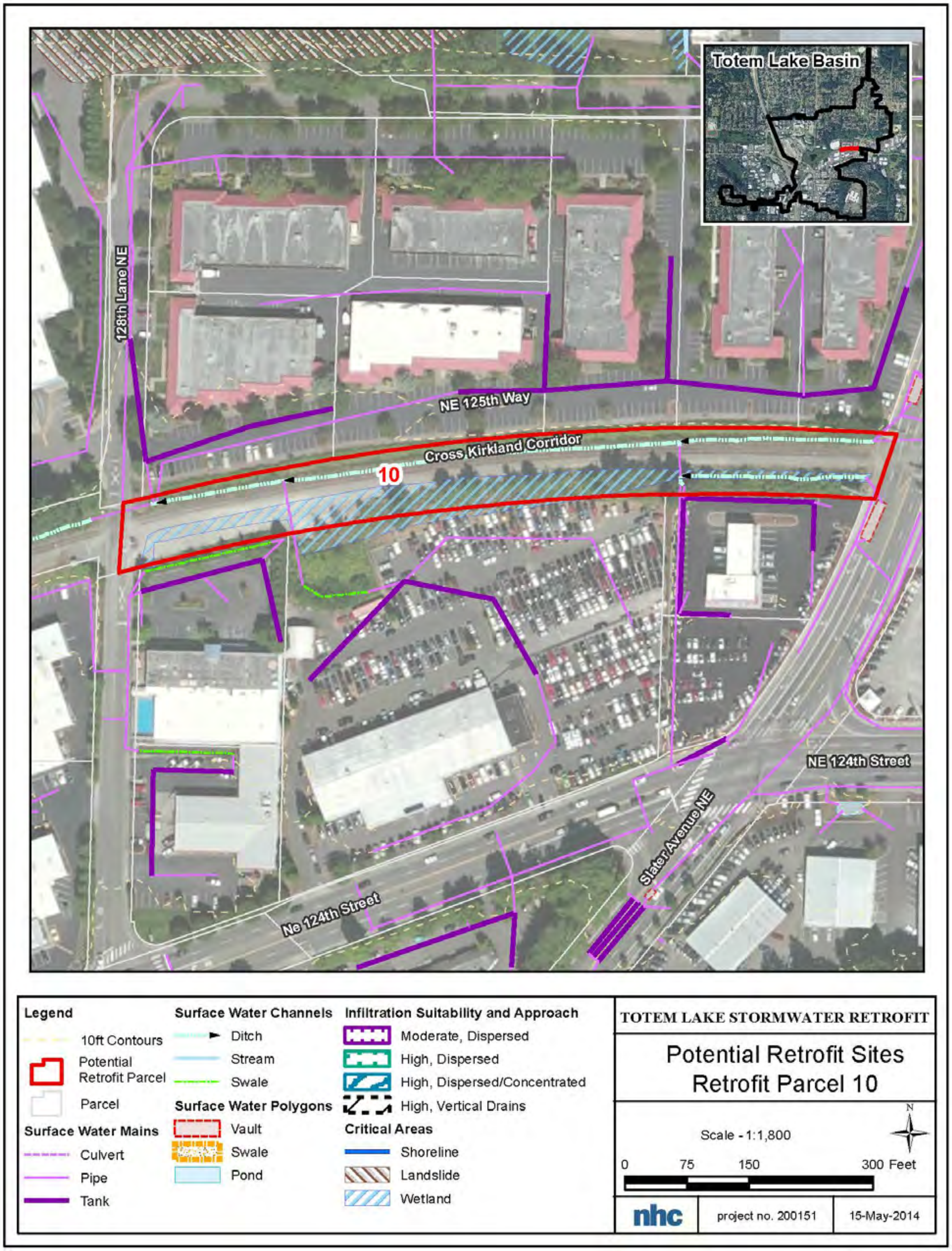


Figure 4

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Private, has some F.C and W.Q.
Potential HGW.
If redevelops, could potentially provide more F.C. and W.Q.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):

	UNIQUE SITE ID: 13

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Vegetated area between I-405 and Totem Lake Boulevard
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☑ DOT ? ☑ Other: WSDOT and City of Kirkland

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☑ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Ditch between I-405 and Totem Lake Boulevard.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Vegetated ditch.
North end - 25 + % slope down to I-405
- flat spot constrained with traffic vaults.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:______

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☑ Extended Detention ☑ Wet Pond ☐ Created Wetland ☐ Bioretention
☑ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☑ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:______

Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☐ No
If Yes, Describe: WSDOT owns some/all.

Access:
☐ No Constraints
Constrained due to
☑ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☑ Property Ownership
☐ Other: WSDOT

Conflicts with Existing Utilities:
☐ None
☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☑	Electric to Streetlights
☐		Overhead Wires
☐	☑	Other: WSDOT Vaults

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands ?	☐ Probable	☐ Not Probable
Impacts to a Stream ?	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?______
Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvt. till
Qvr. outwash-maybe
Qp. peat
Ø exploration PTS

AERIAL VIEW

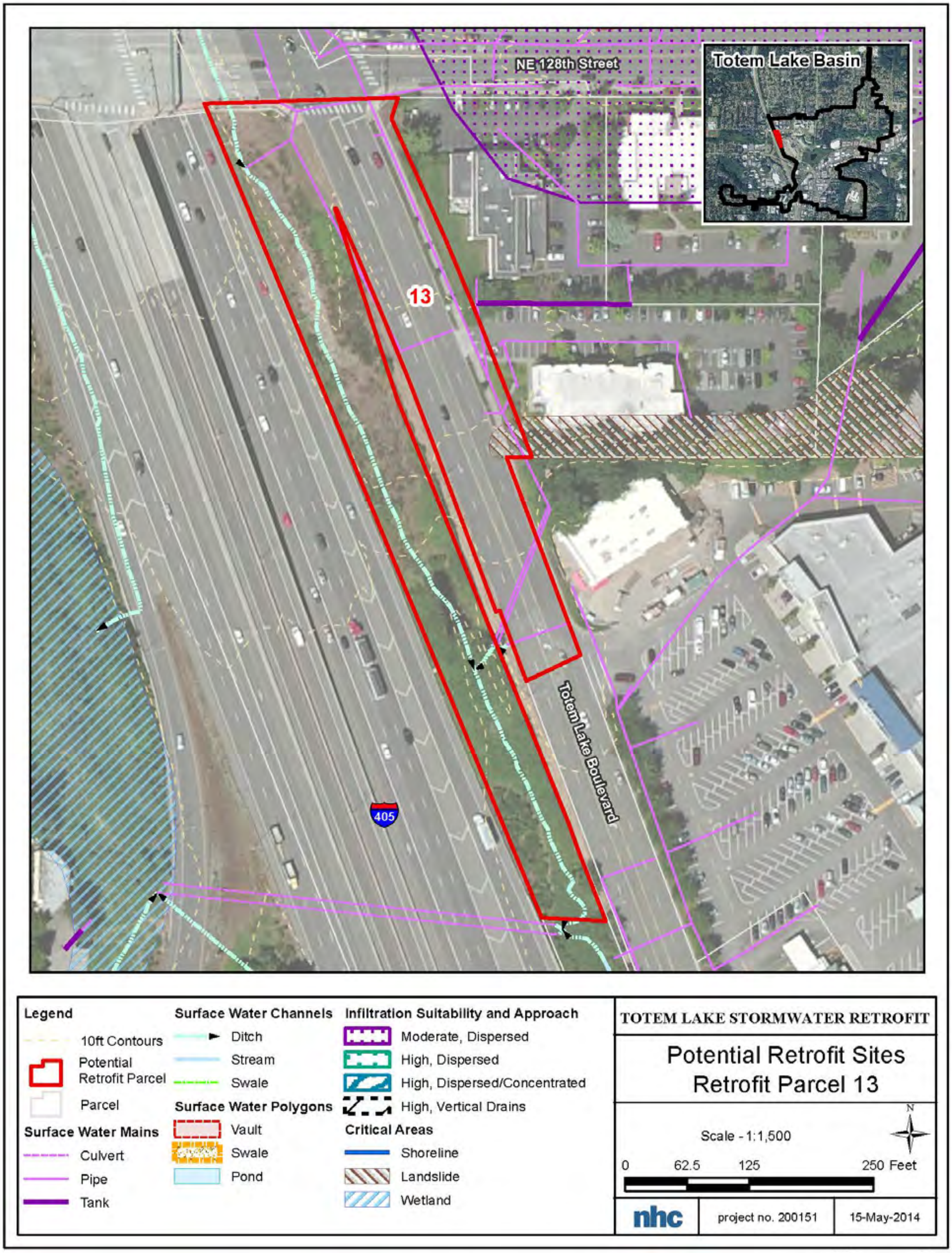


Figure 5

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:______________________________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Slopes difficult to see because of heavy brambles
Right-of-way - WSDOT
Potential for swale for street runoff at north going to combined detention wetpond at south.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):______________________________

	UNIQUE SITE ID: 14		
DATE: May 10, 2014	ASSESSED BY: LG	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Totem Lake Mall - West
Address:

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Piped conveyance. Small pond at southwest side.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Covered mall amid large parking. Piped conveyance outlets to Totem Lake Boulevard.
West parking slopes west.

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:______

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Raingardens in large LS strip at west.
Likely requires some regrading of west quarter of parking lot.
Potentially locate underground F.C. under R.G. - especially if water level drops 4'.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☑ Commercial ☐ Institutional
☐ Industrial ☑ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:______
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☑ Property Ownership
☐ Other:______

Conflicts with Existing Utilities:
☐ None
☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:______

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?______
Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qp. peat
6-10 exploration points

AERIAL VIEW

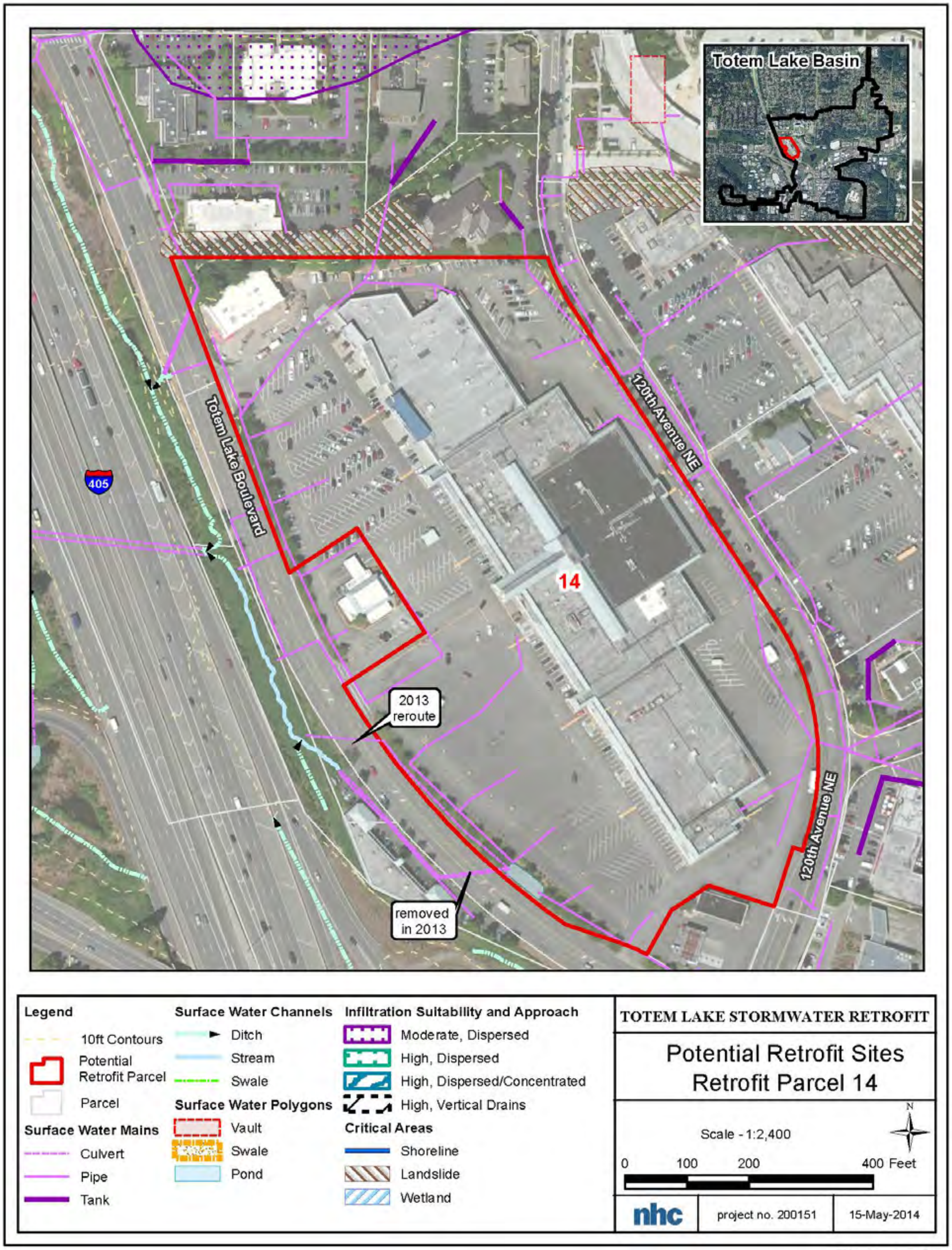


Figure 6

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- [x] Confirm property ownership -ROW
- [ ] Confirm drainage area
- [ ] Confirm drainage area impervious cover
- [ ] Confirm volume computations
- [ ] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [ ] Obtain detailed topography
- [ ] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other:

Initial Feasibility and Construction Considerations

W.Q. need/impact.
Easy to get runoff from parking - either surface or intercept pipe.

Private ownership
No infiltration

Site Candidate for Further Investigation:	☑ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☑ Maybe
If No, Site Candidate for Other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s):

	UNIQUE SITE ID: 15		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Totem Lake Mall East and Yuppie Pawn

Address:

Ownership: ☐ Public ☑ Private ☐ Unknown

If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☑ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈

Imperviousness ≈ %

Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible

If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

Two-lane commercial street W/C/G/5W.
East Totem Lake Mall - large parking lot with covered mall.
Slopes to west and south to a depression to east of Bank.

Yuppie Pawn adjacent to Totem Lake with appx 10' fall.

PROPOSED RETROFIT

Purpose of Retrofit:

- [x] Water Quality
- [ ] Recharge
- [ ] Channel Protection
- [x] Flood Control
- [ ] Demonstration / Education
- [ ] Repair
- [ ] Other:____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:

- [ ] Extended Detention
- [ ] Wet Pond
- [ ] Created Wetland
- [ ] Bioretention
- [ ] Filtering Practice
- [ ] Infiltration
- [ ] Swale
- [ ] Other:____

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Use south or southwest end of mall as underground F.C. + W.Q.

Yuppie Pawn constrained by size - with WA vault, limited area for building/trees in parking, etc., unless entire lot given over to stormwater treatment

SITE CONSTRAINTS

Adjacent Land Use:

- [ ] Residential
- [x] Commercial
- [ ] Institutional
- [ ] Industrial
- [ ] Transport-Related
- [x] Park
- [ ] Undeveloped
- [ ] Other:____

Possible Conflicts Due to Adjacent Land Use? [ ] Yes [ ] No

If Yes, Describe:

Access:

- [ ] No Constraints

Constrained due to

- [ ] Slope
- [ ] Space
- [ ] Utilities
- [ ] Tree Impacts
- [ ] Structures
- [x] Property Ownership
- [ ] Other:____

Conflicts with Existing Utilities:

- [x] None
- [ ] Unknown

Yes	Possible	
[ ]	[ ]	Sewer
[ ]	[ ]	Water
[ ]	[ ]	Gas
[ ]	[ ]	Cable
[ ]	[ ]	Electric
[ ]	[ ]	Electric to Streetlights
[ ]		Overhead Wires
[ ]	[ ]	Other:____

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[ ] Probable	[x] Not Probable
Impacts to a Stream	[ ] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[x] Not Probable

How many?____

Approx. DBH____

Other factors:____

Soils:

Soil auger test holes:	[ ] Yes	[ ] No
Evidence of poor infiltration (clays, fines):	[ ] Yes	[ ] No
Evidence of shallow bedrock:	[ ] Yes	[ ] No
Evidence of high water table (gleying, saturation):	[ ] Yes	[ ] No

Qp. peat
Qvr. outwash to northeast
HGW
3-6 exploration points

AERIAL VIEW

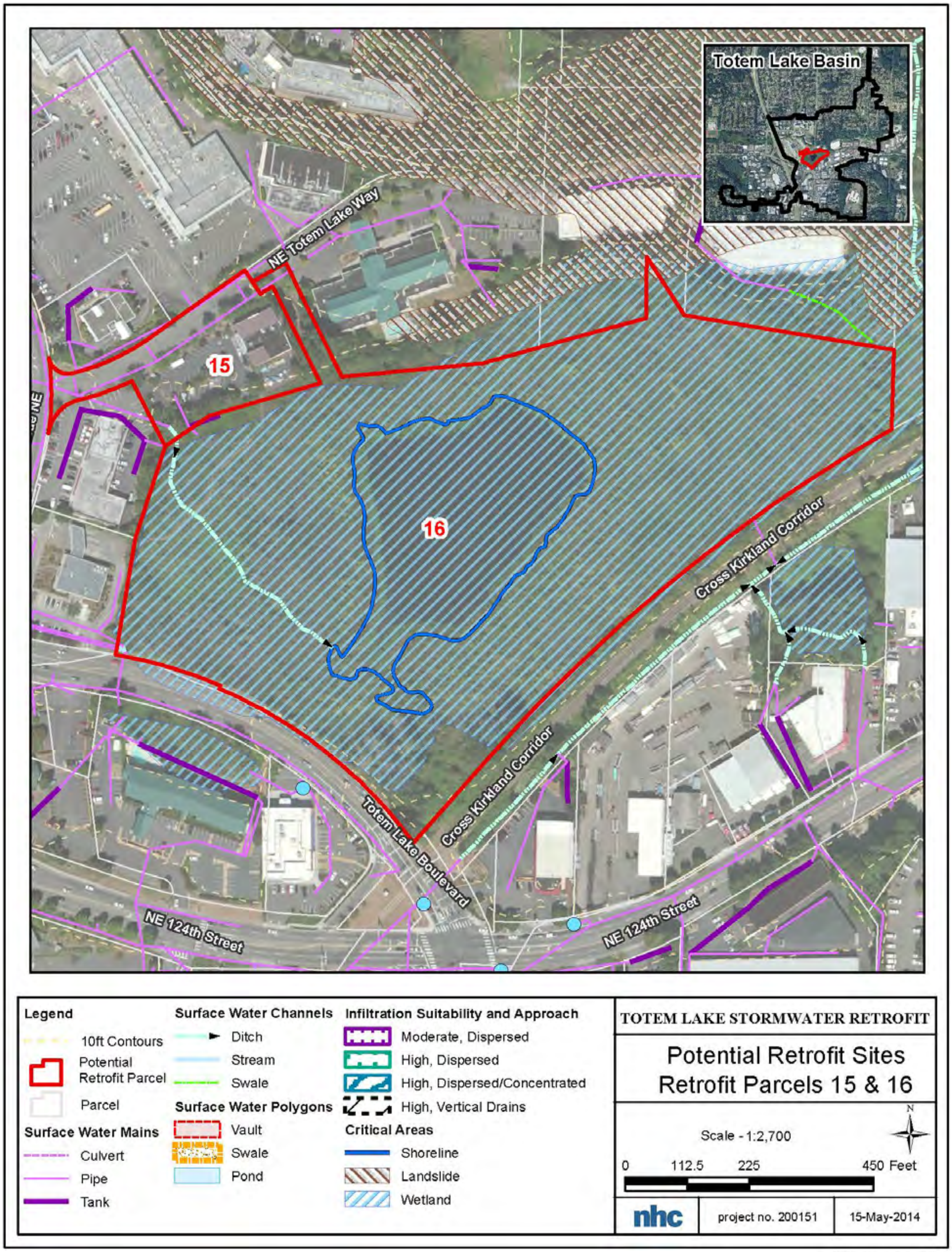


Figure 7

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- ☐ Confirm property ownership
- ☑ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other: ______

Initial Feasibility and Construction Considerations

Site Candidate for Further Investigation:	☑ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☑ Maybe
If No, Site Candidate for Other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s): ______

Retrofit Reconnaissance Investigation **RRI**

		UNIQUE SITE ID: 16	
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Totem Lake

Address:

Ownership: ☑ Public ☐ Private ☐ Unknown

If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage

☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site

☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈

Imperviousness ≈ %

Impervious Area ≈

Notes:

Drainage Area Land Use:

☐ Residential
- ☐ SFH (< 1 ac lots)
- ☐ SFH (> 1 ac lots)
- ☐ Townhouses
- ☐ Multi-Family

☐ Commercial

☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible

If Yes, Describe:

No engineered practice, but provides treatment and flow control naturally.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

Lake, wetlands, and floodplain.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:____

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Increase volume of lake?
If lake drops 4-5' W/D.S. project, can some of that volume be used for a regional F.C. facility?

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☑ Commercial ☐ Institutional
☐ Industrial ☑ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property Ownership
☐ Other:____

Conflicts with Existing Utilities:
☑ None
☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream	☑ Probable	☐ Not Probable
Floodplain Fill	☑ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?____
Approx. DBH____

Other factors:____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☑ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☑ Yes	☐ No

Qp. peat
HGW
Ø exploration points

AERIAL VIEW

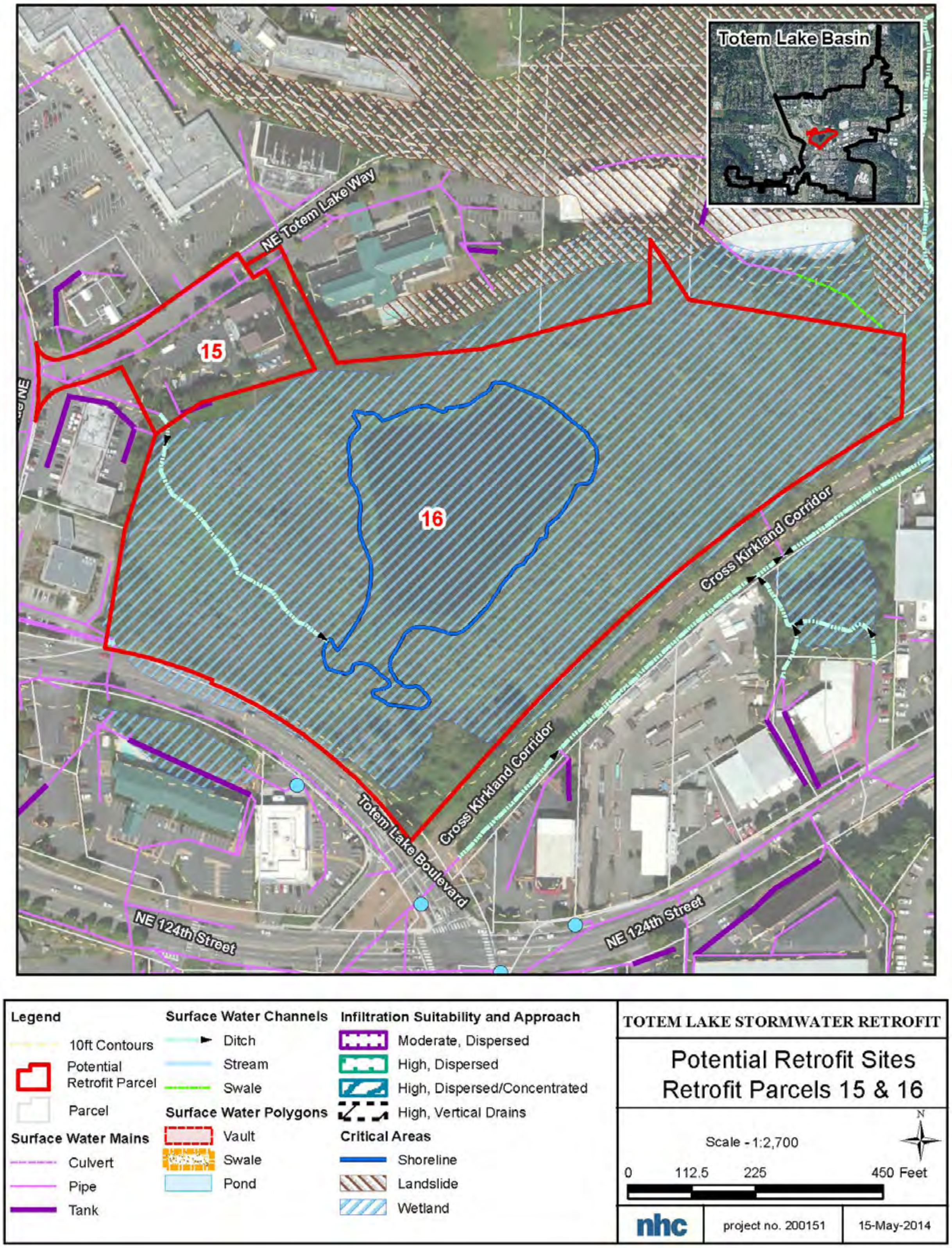


Figure 7

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:__________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Use additional depth provided when lake is lowered for regional F.C. - adds back water for wetland ecology, but maybe wrong timing?

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):__________

	UNIQUE SITE ID: 17

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Cross Kirkland Corridor between Totem Lake Boulevard and NE 128th

Address:

Ownership: ☑ Public ☐ Private ☐ Unknown

If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage

☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site

☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈

Imperviousness ≈ %

Impervious Area ≈

Notes:

Drainage Area Land Use:

☐ Residential
- ☐ SFH (< 1 ac lots)
- ☐ SFH (> 1 ac lots)
- ☐ Townhouses
- ☐ Multi-Family

☐ Commercial

☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible

If Yes, Describe:

Ditch at south side conveys large basin to Totem Lake.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

Gravel elevated trail with vegetated ditch at south and Totem Lake wetlands at north.
Lake side drops right into lake.
South half of private property side - adjacent property appears to be close to existing level of water.
From Site 18 to northeast appears to be more room and depth for deepening, widening, and putting F.C.

PROPOSED RETROFIT

Purpose of Retrofit:
- [ ] Water Quality
- [ ] Demonstration / Education
- [ ] Recharge
- [ ] Repair
- [ ] Channel Protection
- [ ] Other:
- [x] Flood Control

Retrofit Volume Computations - Target Storage:	**Retrofit Volume Computations - Available Storage:**

Proposed Treatment Option:
- [x] Extended Detention
- [ ] Filtering Practice
- [ ] Wet Pond
- [ ] Infiltration
- [ ] Created Wetland
- [ ] Swale
- [ ] Bioretention
- [ ] Other:

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Widen, deepen ditch and north area of 18 for F.C.

SITE CONSTRAINTS

Adjacent Land Use:
- [ ] Residential
- [ ] Industrial
- [ ] Undeveloped
- [x] Commercial
- [ ] Transport-Related
- [x] Other: W.G.
- [ ] Institutional
- [x] Park

Possible Conflicts Due to Adjacent Land Use? [ ] Yes [ ] No
If Yes, Describe:

Access:
- [ ] No Constraints

Constrained due to
- [ ] Slope
- [ ] Utilities
- [ ] Structures
- [ ] Other:
- [x] Space
- [ ] Tree Impacts
- [ ] Property Ownership

Conflicts with Existing Utilities:
- [ ] None
- [x] Unknown

Yes	**Possible**	
[ ]	[ ]	Sewer
[ ]	[ ]	Water
[ ]	[ ]	Gas
[ ]	[ ]	Cable
[ ]	[ ]	Electric
[ ]	[ ]	Electric to Streetlights
[ ]		Overhead Wires
[ ]	[ ]	Other:

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[x] Probable	[ ] Not Probable
Impacts to a Stream	[x] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[x] Not Probable

How many?
Approx. DBH

Other factors:

Soils:

Soil auger test holes:	[x] Yes	[ ] No	6
Evidence of poor infiltration (clays, fines):	[x] Yes	[ ] No	Qp. peat
Evidence of shallow bedrock:	[ ] Yes	[x] No	W.L.
Evidence of high water table (gleying, saturation):	[x] Yes	[ ] No	

AERIAL VIEW

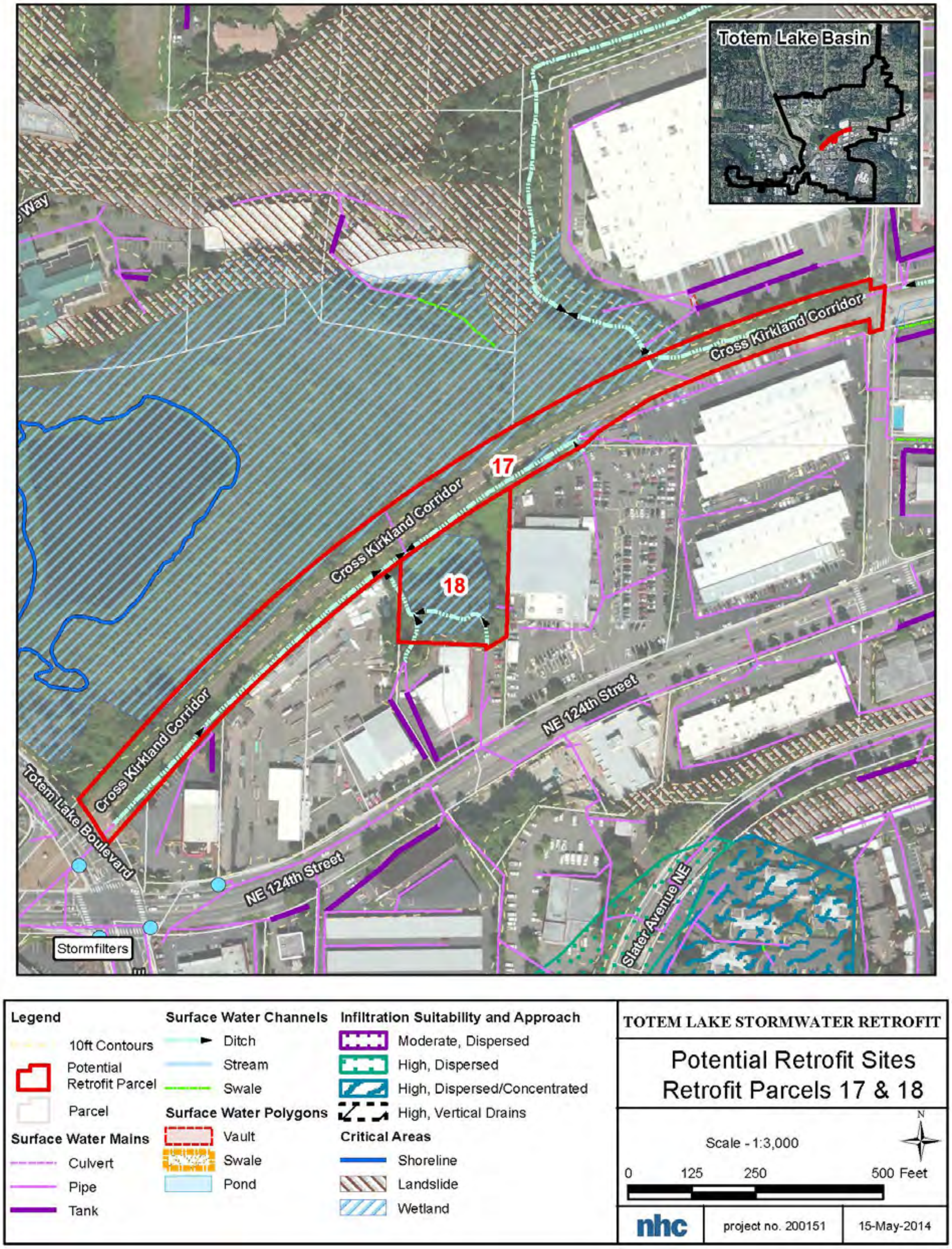


Figure 8

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:__________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Drains large basin to constricted area.
Southeast area - private, and used for parking
Combine with 18.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):__________

 Unique Site ID: 17

		UNIQUE SITE ID: 18	
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: King County Waste Water
Address: 129th and Cross Kirkland Corridor

Ownership: ☑ Public ☐ Private ☐ Unknown King Co.
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other: ______

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other: ______

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other: ______

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ ______
Imperviousness ≈ ______%
Impervious Area ≈ ______

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other: ______

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Ditches drain upstream basin through site to Cross Kirkland Corridor and then Totem Lake.
Trees, possible W.L.
Appears to be elevated above ditch at Site 17 (Cross Kirkland Corridor). Too vegetated to tell. Combine north side with ditch at site and make into F.C.? What is effect of lower lake?

PROPOSED RETROFIT

Purpose of Retrofit:

- ☐ Water Quality
- ☐ Demonstration / Education
- ☐ Recharge
- ☐ Repair
- ☐ Channel Protection
- ☐ Other:
- ☐ Flood Control

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:

- ☐ Extended Detention
- ☐ Filtering Practice
- ☐ Wet Pond
- ☐ Infiltration
- ☐ Created Wetland
- ☐ Swale
- ☐ Bioretention
- ☐ Other:

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:

- ☐ Residential
- ☐ Industrial
- ☐ Undeveloped
- ☑ Commercial
- ☐ Transport-Related
- ☐ Other:
- ☐ Institutional
- ☑ Park Cross Kirkland Corridor

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No

If Yes, Describe:

Access:

☐ No Constraints

Constrained due to

- ☐ Slope
- ☐ Utilities
- ☐ Structures
- ☐ Other:
- ☐ Space
- ☐ Tree Impacts
- ☑ Property Ownership

Conflicts with Existing Utilities:

- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☑ Probable	☐ Not Probable
Impacts to a Stream	☑ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☑ Probable	☐ Not Probable
Impacts to Specimen Trees	☑ Probable	☐ Not Probable

How many?______

Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	☑ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☑ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☑ Yes	☐ No

Qp. peat / Qvr. outwash

AERIAL VIEW

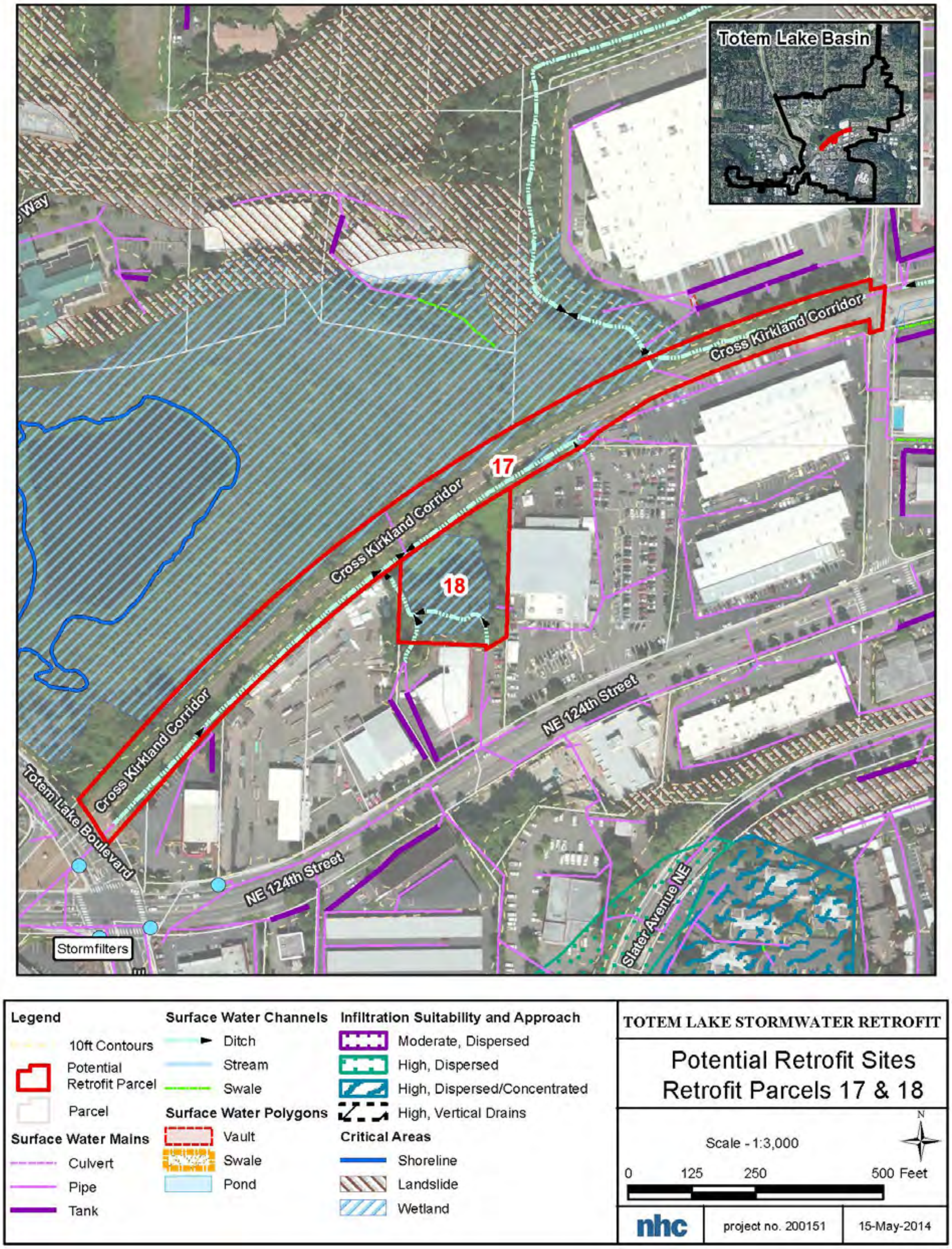


Figure 8

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:__________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

If north portion is not a wetland, could provide some F.C. and W.Q. through a detention wetpond. Split flows coming in or take flows from neighboring property.
Could north area combined with south 17 provide significant F.C.?

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):__________

	UNIQUE SITE ID: 19		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Comfort Inn
Address:

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☑ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible

If Yes, Describe:
underground tank at north
Small detention (?) pond at northwest corner.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Motel with parking.
Off-site flows channeled through underground tank.
Wetland up/over north walk in back of motel (stagnant).
Water near road level but running at lowest level - must be a blockage.
Too vegetated to see. Clear and deepen and install a C.S.

PROPOSED RETROFIT

Purpose of Retrofit:
- [ ] Water Quality
- [ ] Demonstration / Education
- [ ] Recharge
- [ ] Repair
- [ ] Channel Protection
- [ ] Other:
- [x] Flood Control

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- [x] Extended Detention
- [ ] Filtering Practice
- [x] Wet Pond
- [ ] Infiltration
- [x] Created Wetland
- [ ] Swale
- [ ] Bioretention
- [ ] Other:

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Clear and deepen to east and install F.C. structure.
If lake is lowered 4', will additional storage be available?

SITE CONSTRAINTS

Adjacent Land Use:
- [ ] Residential
- [ ] Industrial
- [ ] Undeveloped
- [x] Commercial
- [x] Transport-Related
- [ ] Other:
- [ ] Institutional
- [ ] Park

Possible Conflicts Due to Adjacent Land Use? [x] Yes [ ] No
If Yes, Describe: Inn customers adversely affected?

Access:
- [ ] No Constraints

Constrained due to
- [ ] Slope
- [ ] Utilities
- [ ] Structures
- [ ] Other:
- [ ] Space
- [ ] Tree Impacts
- [x] Property Ownership

Conflicts with Existing Utilities:
- [x] None
- [ ] Unknown

Yes	Possible	
[ ]	[ ]	Sewer
[ ]	[ ]	Water
[ ]	[ ]	Gas
[ ]	[ ]	Cable
[ ]	[ ]	Electric
[ ]	[ ]	Electric to Streetlights
[ ]		Overhead Wires
[ ]	[ ]	Other:

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[x] Probable	[ ] Not Probable
Impacts to a Stream	[ ] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[ ] Not Probable

How many?________
Approx. DBH________

Other factors:

Soils:

Soil auger test holes:	[x] Yes	[ ] No	
Evidence of poor infiltration (clays, fines):	[ ] Yes	[ ] No	
Evidence of shallow bedrock:	[ ] Yes	[x] No	
Evidence of high water table (gleying, saturation):	[x] Yes	[ ] No	Qvr. outwash

AERIAL VIEW

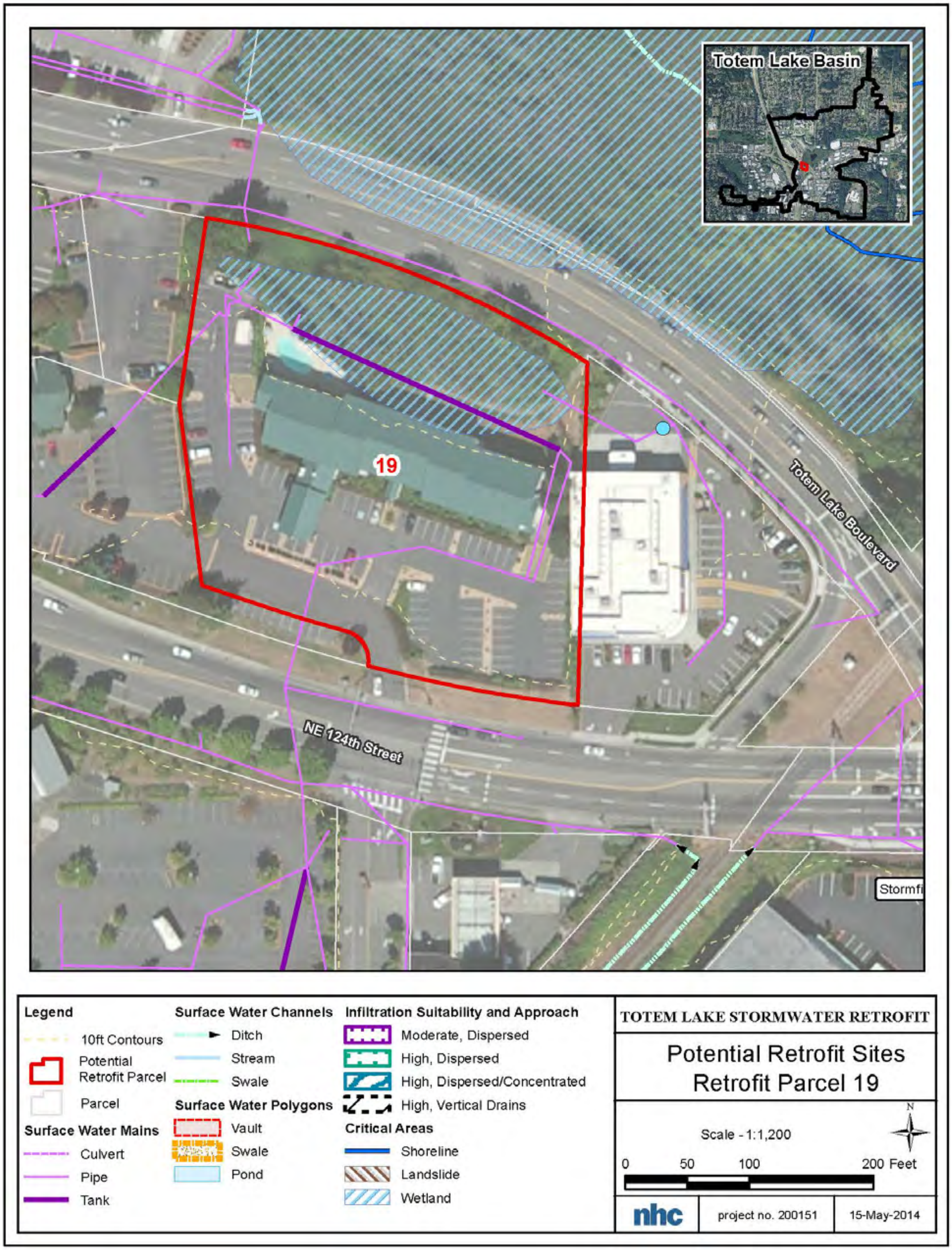


Figure 9

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- [ ] Confirm property ownership
- [ ] Confirm drainage area
- [ ] Confirm drainage area impervious cover
- [ ] Confirm volume computations
- [ ] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [x] Obtain detailed topography
- [ ] Obtain utility mapping
- [x] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other:

Initial Feasibility and Construction Considerations

Needs survey to determine if any volume available for storage. Is it a jurisdictional wetland.?

Site Candidate for Further Investigation:	[x] Yes	[ ] No	[ ] Maybe
Is Site Candidate for Early Action Project(s):	[ ] Yes	[ ] No	[x] Maybe
If No, Site Candidate for Other Restoration Project(s):	[ ] Yes	[ ] No	[ ] Maybe

If yes, type(s):

	UNIQUE SITE ID: 20		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Cross Kirkland Corridor west of I-405
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Ditches

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Elevated, gravel trail with ditches both sides.
Cross Kirkland Corridor right-of-way appears narrower south of 116th.
What is tributaryarea?
Cross Kirkland Corridor side slopes flatter at this stretch.

Existing Head Available and Points Where Measured:
Little to none.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Re-align trail to one side.
Re-grade for W.Q. - not enough head for F.C.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☑ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property Ownership
☐ Other:

Conflicts with Existing Utilities:
☐ None
☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☑	☐	Other: F / O

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☐ Not Probable
Impacts to a Stream ?	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☑ Probable	☐ Not Probable

How many? 1 Fir
Approx. DBH 24"

Other factors:

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☑ Yes	☐ No

Qvr.
HGW

AERIAL VIEW

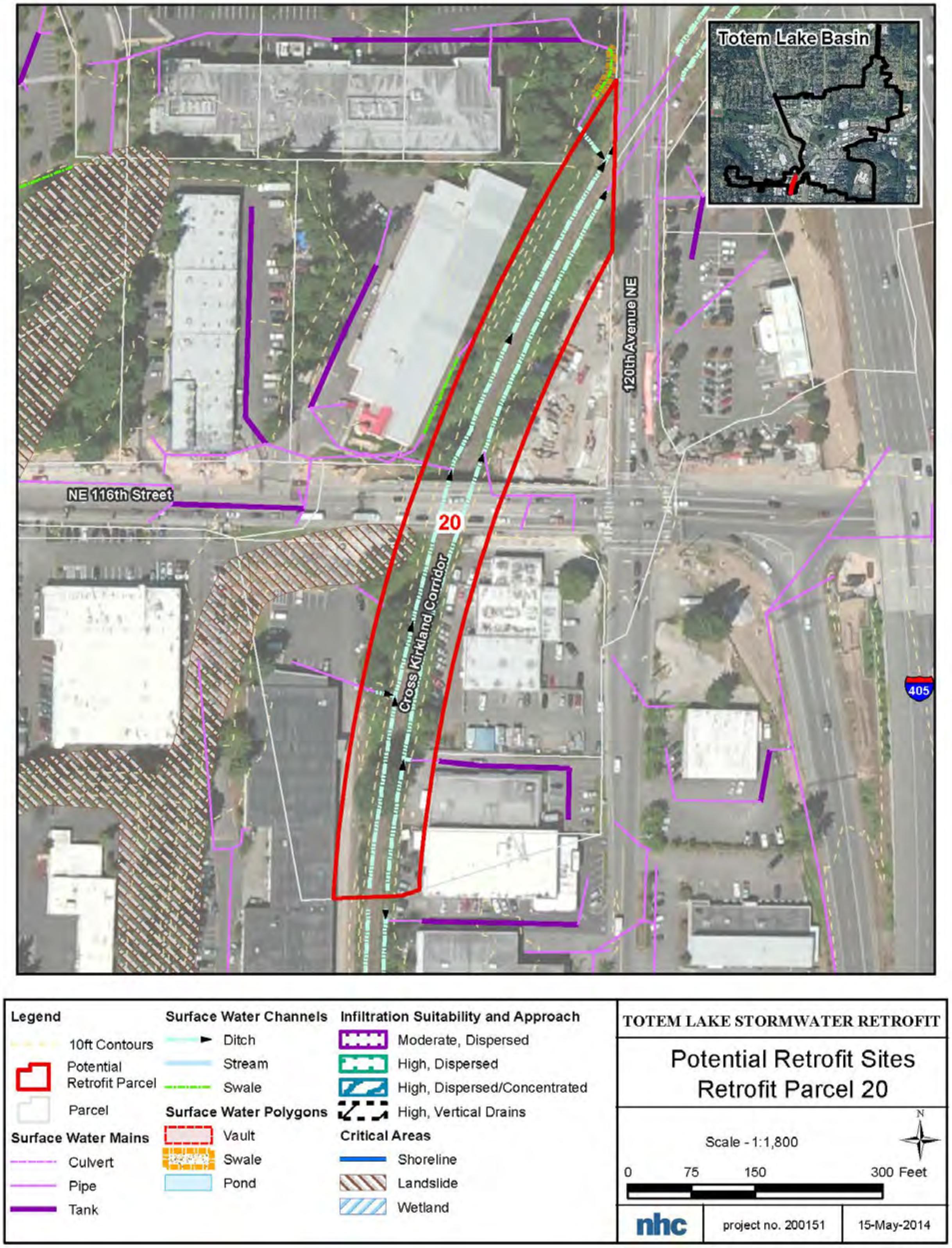


Figure 10

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- [ ] Confirm property ownership
- [x] Confirm drainage area
- [ ] Confirm drainage area impervious cover
- [ ] Confirm volume computations
- [ ] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [ ] Obtain detailed topography
- [ ] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other:______

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Too high in basin?
Where is F/O?
Encroachments at south end, or is right-of-way narrower?

	Yes	No	Maybe
SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑	☐	☐
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐	☑	☐
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐	☑	☐

IF YES, TYPE(S):______

Unique Site ID: 20

	UNIQUE SITE ID: 21

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Cross Kirkland Corridor under I-405 to NE 124th Street

Address:

Ownership: ☑ Public ☐ Private ☐ Unknown

If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage

☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site

☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:

☐ Residential
- ☐ SFH (< 1 ac lots)
- ☐ SFH (> 1 ac lots)
- ☐ Townhouses
- ☐ Multi-Family

☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible

If Yes, Describe:

Ditches both sides.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

Elevated gravel trail with ditches both sides.

≈ 20' below Site 22 ≈ 2:1 slope

Existing Head Available and Points Where Measured:

No head longitudinally

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality
- ☐ Demonstration / Education
- ☐ Recharge
- ☐ Repair
- ☐ Channel Protection
- ☐ Other:______
- ☐ Flood Control

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- ☐ Extended Detention
- ☐ Filtering Practice
- ☐ Wet Pond
- ☐ Infiltration
- ☐ Created Wetland
- ☐ Swale
- ☐ Bioretention
- ☐ Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
- ☐ Residential
- ☐ Industrial
- ☐ Undeveloped
- ☑ Commercial
- ☑ Transport-Related
- ☐ Other:______
- ☐ Institutional
- ☐ Park

Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☐ No

If Yes, Describe: Does WSDOT own under I-405?

Access:
- ☑ No Constraints

Constrained due to
- ☐ Slope
- ☐ Utilities
- ☐ Structures
- ☐ Other:______
- ☐ Space
- ☐ Tree Impacts
- ☐ Property Ownership

Conflicts with Existing Utilities:
- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☑	☐	Other: F/O

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?______

Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	☑ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☑ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☑ Yes	☐ No

Qvt. till Qvr outwash

AERIAL VIEW

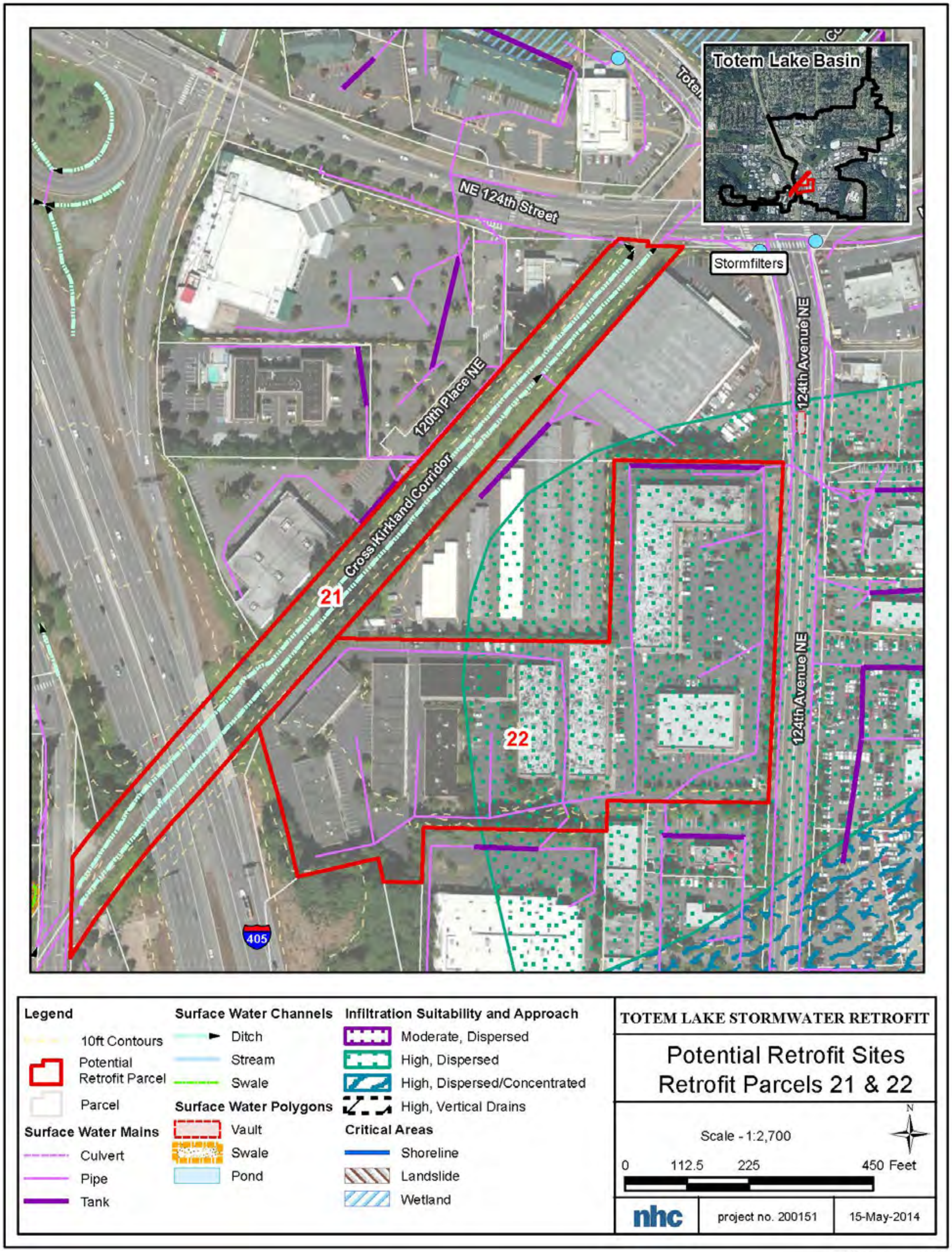


Figure 11

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

No head or area available under I-405 because of abutments/pillars.
Gravel area at southwest end?
Vegetated ditches for more filtering? Concerned about conveyance.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☑ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE

IF YES, TYPE(S):

		UNIQUE SITE ID: 22	
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Totem Square
Address: 11961 - 124th Avenue Ne

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Underground tank at northeast end.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Strip mall and parking.
Very flat, graded to drain.

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality
- ☐ Recharge
- ☐ Channel Protection
- ☐ Flood Control
- ☐ Demonstration / Education
- ☐ Repair
- ☐ Other:________________

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- ☐ Extended Detention
- ☐ Wet Pond
- ☐ Created Wetland
- ☐ Bioretention
- ☐ Filtering Practice
- ☐ Infiltration
- ☐ Swale
- ☐ Other:________________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
- ☐ Residential
- ☑ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:________________

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
- ☐ No Constraints

Constrained due to
- ☐ Slope
- ☐ Space
- ☐ Utilities
- ☐ Tree Impacts
- ☐ Structures
- ☑ Property Ownership
- ☐ Other:________________

Conflicts with Existing Utilities:
- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:________________

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?________________
Approx. DBH________________

Other factors:________________

Soils:

Soil auger test holes:	☑ Yes	☐ No	1
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No	
Evidence of shallow bedrock:	☐ Yes	☐ No	
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No	Qvr. high dispersed

AERIAL VIEW

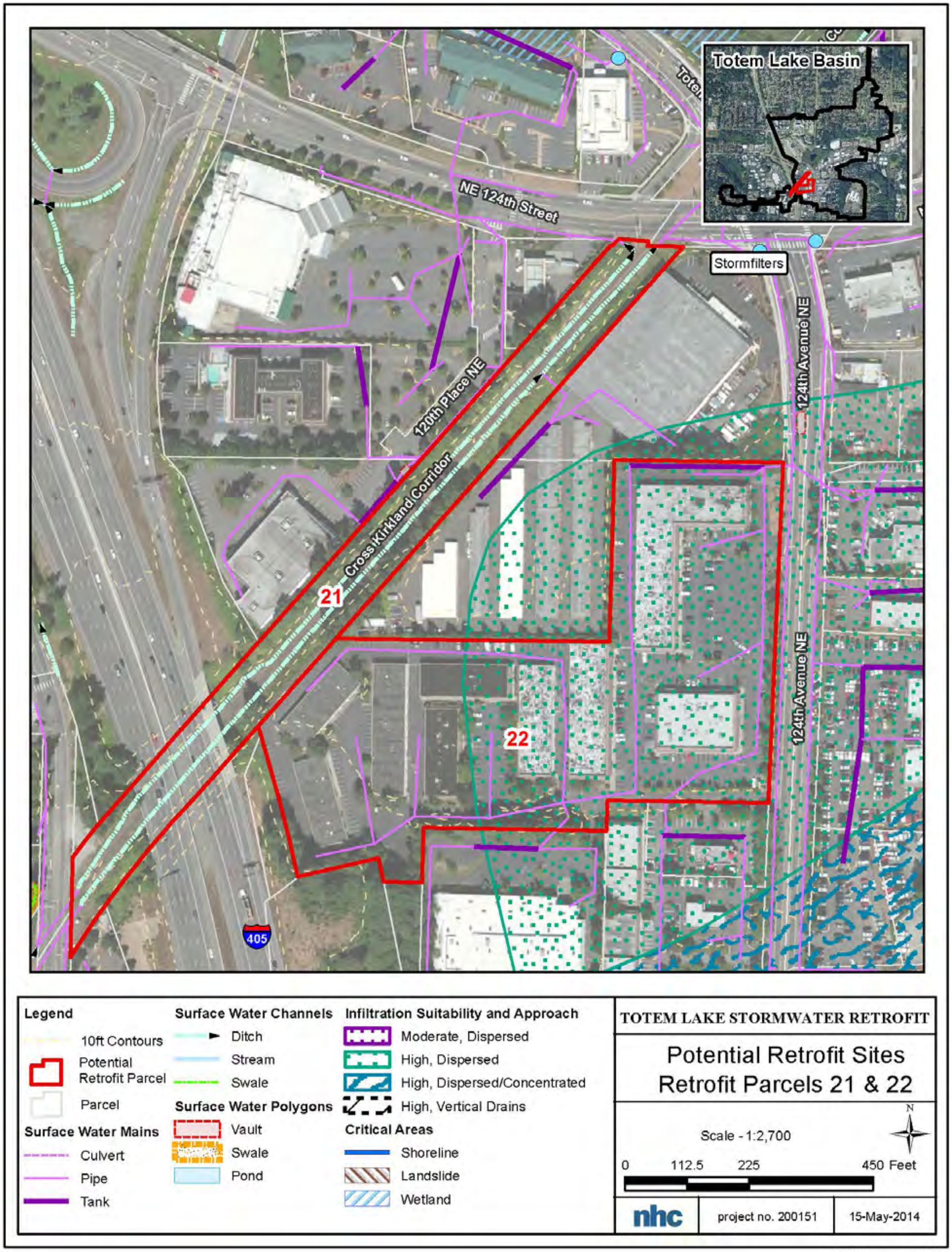


Figure 11

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- [ ] Confirm property ownership
- [x] Confirm drainage area
- [x] Confirm drainage area impervious cover
- [x] Confirm volume computations
- [ ] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [ ] Obtain detailed topography
- [ ] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other:

Initial Feasibility and Construction Considerations

When redevelops, partner to use for regional F.C.
Check volumes and approximate size needed.

Site Candidate for Further Investigation:	☑ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☑ No	☐ Maybe
If no, site candidate for other Restoration Project(s):	☐ Yes	☑ No	☐ Maybe

If yes, type(s):

	UNIQUE SITE ID: 23

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Intersection NE 124th Street and 124th Avenue NE
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Four (4) storm filters.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Intersection of two main arterials - 6 and 7 lanes.
Busy intersection. Aaron McDonald of City of Kirkland Public Works says construction has to be night work.
Treatment occurring.
Basin at map appears to be incorrect - smaller than map.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:___________________

Retrofit Volume Computations - Target Storage:	**Retrofit Volume Computations - Available Storage:**

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:___________________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:___________________
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property Ownership
☐ Other:___________________

Conflicts with Existing Utilities:
☐ None
☐ Unknown

Yes	**Possible**	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:_______________

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☐ Not Probable
Impacts to Wetlands	☐ Probable	☐ Not Probable
Impacts to a Stream	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☐ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

How many?_______________
Approx. DBH_______________

Other factors:___________________________________

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

AERIAL VIEW

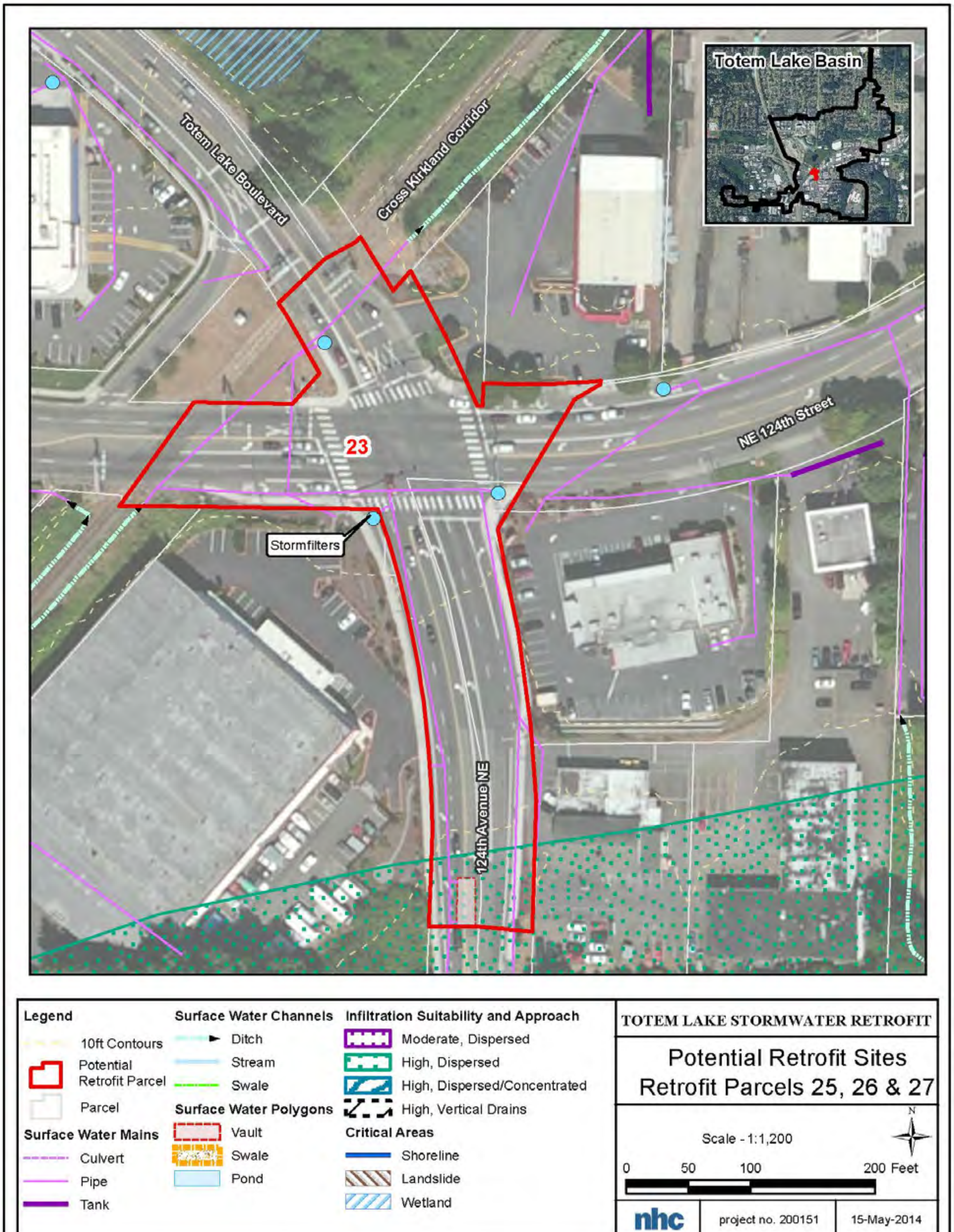


Figure 12

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:______

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

PGIS may already be fully treated - check basins.
F.C?
Too busy to construct or maintain facilities.

	YES	NO	MAYBE
SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐	☑	☐
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐	☑	☐
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐	☑	☐

IF YES, TYPE(S):______

	UNIQUE SITE ID: 24

DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: GTE Telephone Ops
Address: 12055 Slater Avenue

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:______

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:______

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:______

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ ______
Imperviousness ≈ ______%
Impervious Area ≈ ______

Notes:

Drainage Area Land Use:
☐ Residential
- ☑ SFH (< 1 ac lots)
- ☐ SFH (> 1 ac lots)
- ☑ Townhouses
- ☐ Multi-Family

☑ Commercial
☑ Institutional
☐ Industrial
☑ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:______

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible

If Yes, Describe:
Conveyance pipes for parking lot and building.
Ditch at existing northeast 120th Street - will be changed.
Underground tank in Slater Avenue

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Commerical building with large parking lot.
10-20' below Slater Avenue.

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:______

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☑ Commercial ☐ Institutional
☐ Industrial ☑ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:______

Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☑ Property Ownership
☐ Other:______

Conflicts with Existing Utilities:
☐ None
☑ Unknown

Yes	**Possible**	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:______

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?______
Approx. DBH______

Other factors:______

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvr. outwash - high disperse, infiltration

AERIAL VIEW

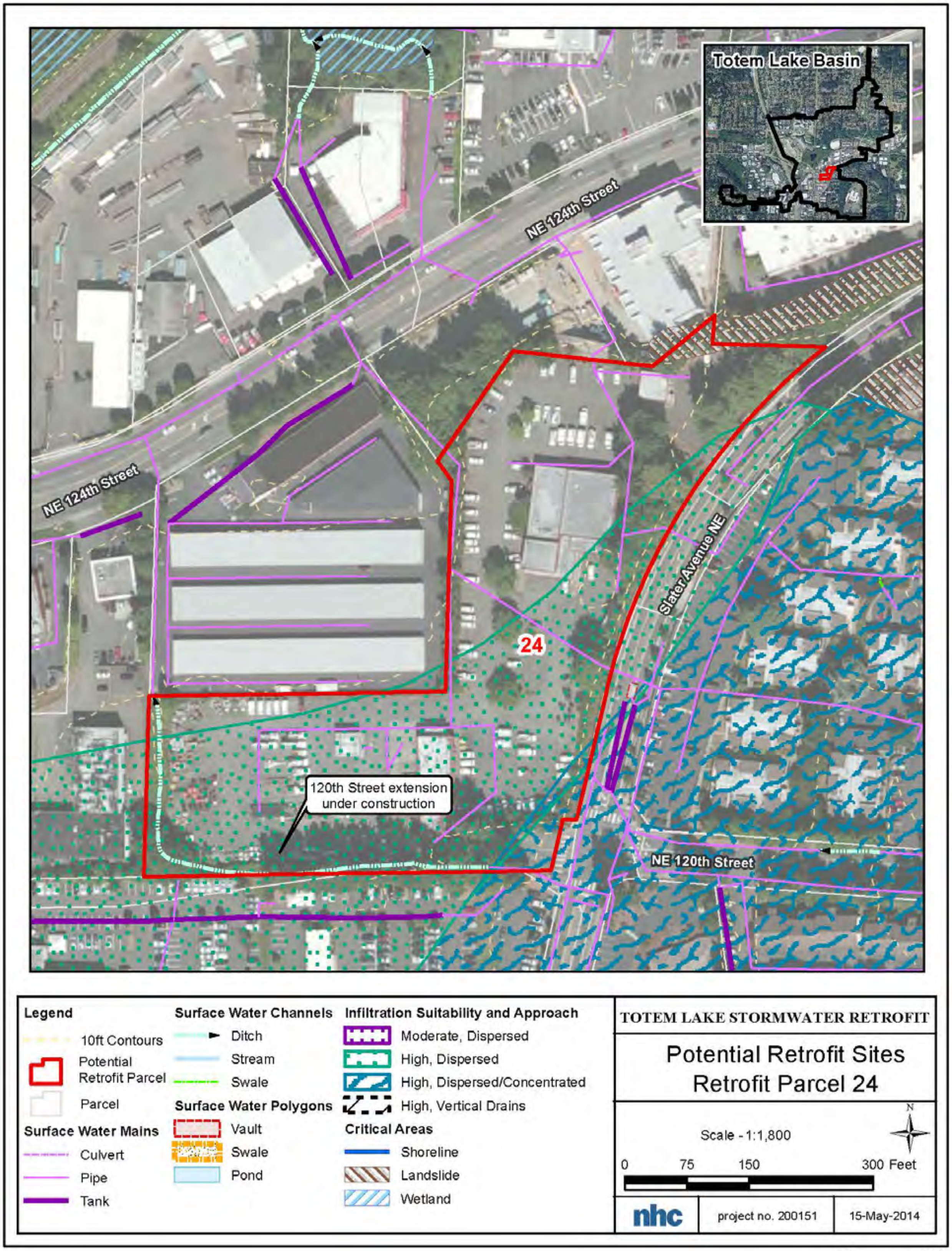


Figure 13

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:__________

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

If redevelops, possible W.Q. and F.C. addition.
Need model to assess impacts.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):__________

	UNIQUE SITE ID: 25		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: NE 120th from Slater to 132nd
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:
Piped conveyance.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Fully developed right-of-way - C/G/SW/OHP
Rockeries or embankments either side.
Catch Basin/Pipes

Existing Head Available and Points Where Measured:
10% ± slope

PROPOSED RETROFIT

Purpose of Retrofit:

- [x] Water Quality
- [ ] Recharge
- [ ] Channel Protection
- [ ] Flood Control
- [ ] Demonstration / Education
- [ ] Repair
- [ ] Other:________________

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:

- [ ] Extended Detention
- [ ] Wet Pond
- [ ] Created Wetland
- [ ] Bioretention
- [x] Filtering Practice
- [ ] Infiltration
- [ ] Swale
- [ ] Other:________________

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Catch Basin SF in ROW
Replace street trees with Filterra as existing trees need to be removed.
Small area for B.F. (good infiltration) at north side of far west end, but underground utilitues.
Filters then UIC? W.Q. vault and underground tank in Slater downstream.

SITE CONSTRAINTS

Adjacent Land Use:

- [x] Residential
- [x] Commercial
- [x] Institutional
- [ ] Industrial
- [ ] Transport-Related
- [ ] Park
- [ ] Undeveloped
- [ ] Other:________________

Possible Conflicts Due to Adjacent Land Use? [ ] Yes [x] No

If Yes, Describe:

Access:

- [ ] No Constraints

Constrained due to

- [ ] Slope
- [ ] Space
- [x] Utilities
- [ ] Tree Impacts
- [ ] Structures
- [x] Property Ownership
- [ ] Other:________________

Conflicts with Existing Utilities:

- [ ] None
- [ ] Unknown

Yes	Possible	
[ ]	[ ]	Sewer
[ ]	[x]	Water
[ ]	[ ]	Gas
[x]	[ ]	Cable
[x]	[ ]	Electric
[x]	[ ]	Electric to Streetlights
[x]		Overhead Wires
[ ]	[ ]	Other:__________

Potential Permitting Factors:

Dam Safety Permits Necessary	[ ] Probable	[x] Not Probable
Impacts to Wetlands	[ ] Probable	[x] Not Probable
Impacts to a Stream	[ ] Probable	[x] Not Probable
Floodplain Fill	[ ] Probable	[x] Not Probable
Impacts to Forests	[ ] Probable	[x] Not Probable
Impacts to Specimen Trees	[ ] Probable	[x] Not Probable

How many?__________

Approx. DBH__________

Other factors:________________

Soils:

Soil auger test holes:	[ ] Yes	[ ] No
Evidence of poor infiltration (clays, fines):	[ ] Yes	[ ] No
Evidence of shallow bedrock:	[ ] Yes	[ ] No
Evidence of high water table (gleying, saturation):	[ ] Yes	[ ] No

Qvr. outwash east
Qvt. till west

AERIAL VIEW

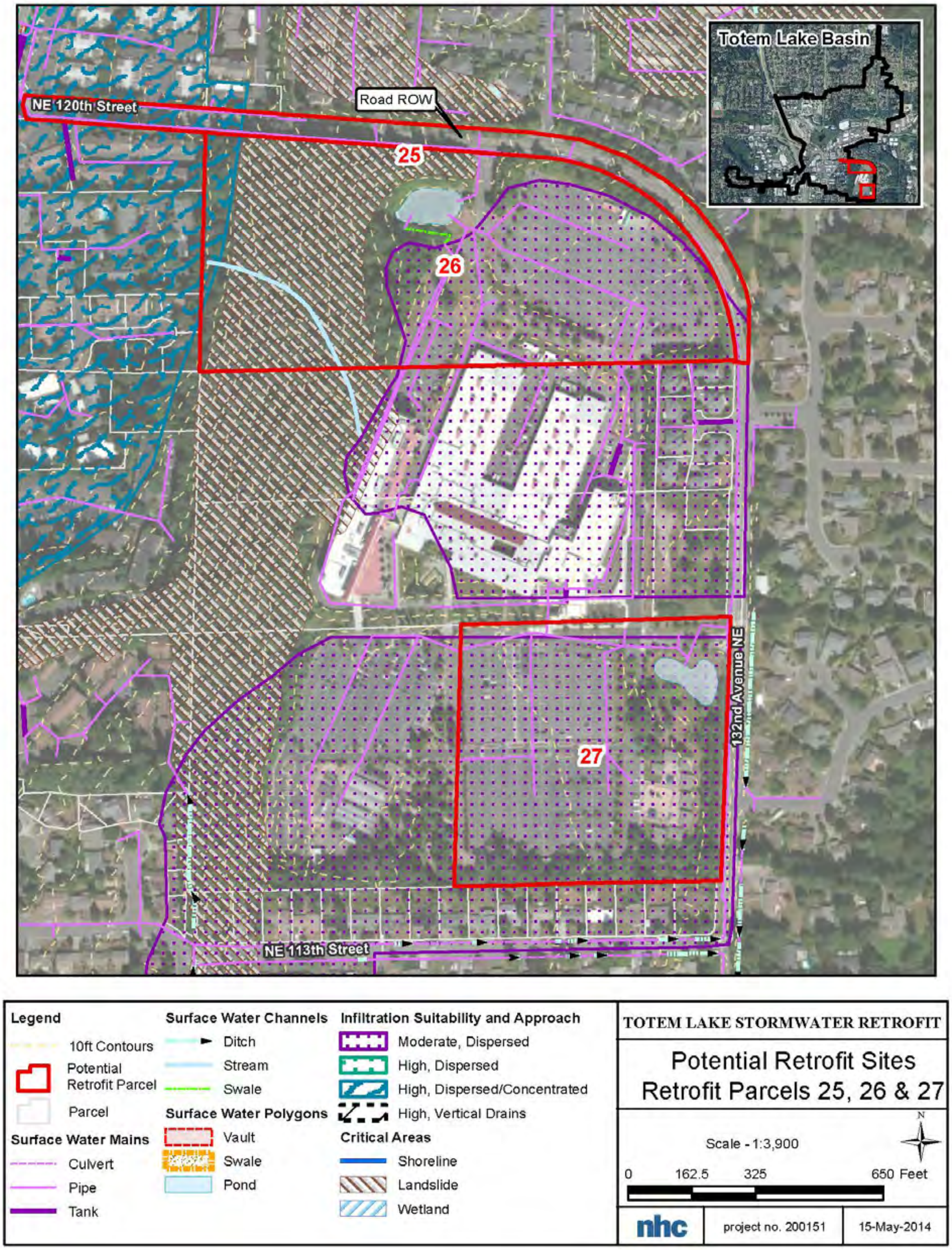


Figure 14

Design or Delivery Notes

Follow-up Needed to Complete Field Concept

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

Initial Feasibility and Construction Considerations

Try UICs near intersection with Slater Avenue NE.
what standard do underground tanks in Slater provide FC to?
What is tributary area?

Site Candidate for Further Investigation:	☑ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☑ Maybe
If no, site candidate for other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s): ______

	UNIQUE SITE ID: 26		
DATE: May 10, 2014	**ASSESSED BY:** LG	**CAMERA ID:**	**PICTURES:**
GPS ID:	**LMK ID:**	**LAT:**	**LONG:**

SITE DESCRIPTION

Name: Lake Washington Institute of Technology - north parking lot
Address:

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other: Large parking lot

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☑ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Wetpond/detention pond, swale.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Lot slopes to west to pond.
Pond with standing water plus C.S.
Unclear how much area available - Brambles and greenbelt.

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality
- ☐ Recharge
- ☐ Channel Protection
- ☐ Flood Control
- ☐ Demonstration / Education
- ☐ Repair
- ☐ Other: ______

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
- ☐ Extended Detention
- ☐ Wet Pond
- ☐ Created Wetland
- ☐ Bioretention
- ☐ Filtering Practice
- ☐ Infiltration
- ☐ Swale
- ☐ Other: ______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

SITE CONSTRAINTS

Adjacent Land Use:
- ☐ Residential
- ☐ Commercial
- ☑ Institutional
- ☑ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: ______

Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☐ No

If Yes, Describe: Greenbelt.

Access:
- ☐ No Constraints

Constrained due to
- ☑ Slope
- ☐ Space
- ☐ Utilities
- ☐ Tree Impacts
- ☐ Structures
- ☑ Property Ownership
- ☑ Other: Greenbelt

Conflicts with Existing Utilities:
- ☑ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other: ______

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many? Unknown

Approx. DBH Overgrown

Other factors: Slopes at west side

Soils:

Soil auger test holes:	☐ Yes	☐ No	Qvr. outwash?
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No	Qvt. till - both moderate, dispersed
Evidence of shallow bedrock:	☐ Yes	☐ No	
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No	

AERIAL VIEW

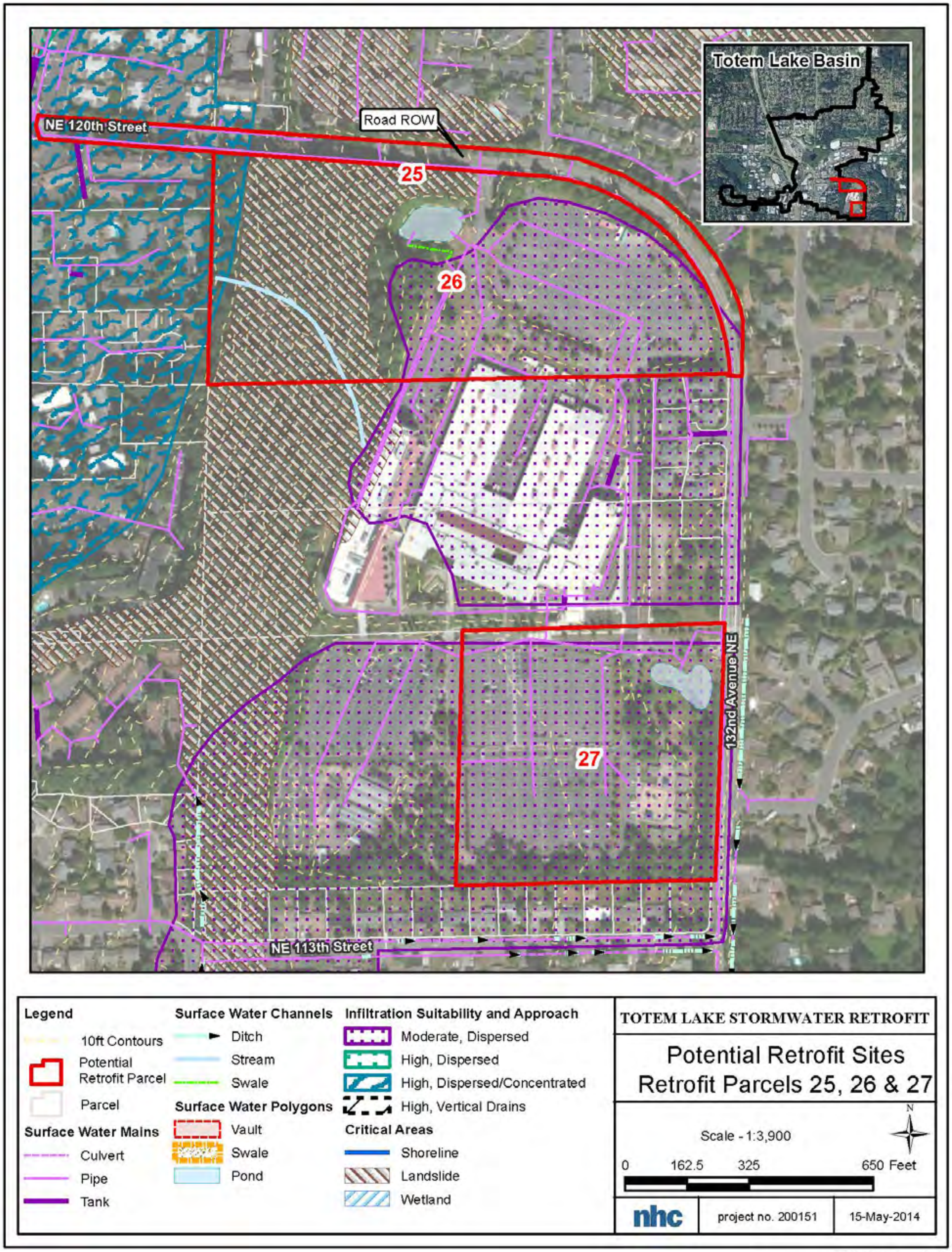


Figure 14

Design or Delivery Notes

Alternatives to existing pond expansion are underground tanks and filter in parking lot.
Parking lot has no planter islands - cut in raingardens.

Follow-up Needed to Complete Field Concept

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☑ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☑ Other: Slopes, Greenbelt

Initial Feasibility and Construction Considerations

Extent of greenbelt - does greenbelt limit pond expansion?

Site Candidate for Further Investigation:	☑ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☑ Maybe
If No, Site Candidate for Other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s): __________

	UNIQUE SITE ID: 27		
DATE: May 10, 2014	ASSESSED BY: LG	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Lake Washington Institute of Technology - Southeast
Address:

Ownership: ☐ Public ☑ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other: Large Parking Lot

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ ______
Imperviousness ≈ ______ %
Impervious Area ≈ ______

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☑ Yes ☐ No ☐ Possible
If Yes, Describe:
Detention pond

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Parking lot, detention pond, small institutional building (childcare).

PROPOSED RETROFIT

Purpose of Retrofit:
- ☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
- ☐ Demonstration / Education ☐ Repair ☐ Other:______

Retrofit Volume Computations - Target Storage:	**Retrofit Volume Computations - Available Storage:**

Proposed Treatment Option:
- ☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
- ☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:______

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Increase size of F.C. pond.
Increase depth of F.C. pond?
Add W.Q. wetpond.
Cut in raingardens into parking lot?

SITE CONSTRAINTS

Adjacent Land Use:
- ☑ Residential ☐ Commercial ☑ Institutional
- ☐ Industrial ☐ Transport-Related ☐ Park
- ☐ Undeveloped ☐ Other:______

Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☑ No
If Yes, Describe: College plan for site.

Access:
- ☐ No Constraints
- Constrained due to
  - ☐ Slope ☐ Space
  - ☐ Utilities ☑ Tree Impacts
  - ☐ Structures ☑ Property Ownership
  - ☐ Other:______

Conflicts with Existing Utilities:
- ☐ None
- ☐ Unknown

Yes	Possible	
☐	☐	Sewer
☐	☐	Water
☐	☐	Gas
☐	☐	Cable
☐	☐	Electric
☐	☐	Electric to Streetlights
☐		Overhead Wires
☐	☐	Other:______

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many? 3-5
Approx. DBH 3'
Cedar, doug fir, elm

Other factors:______

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

Qvt. till moderate dispersed

AERIAL VIEW

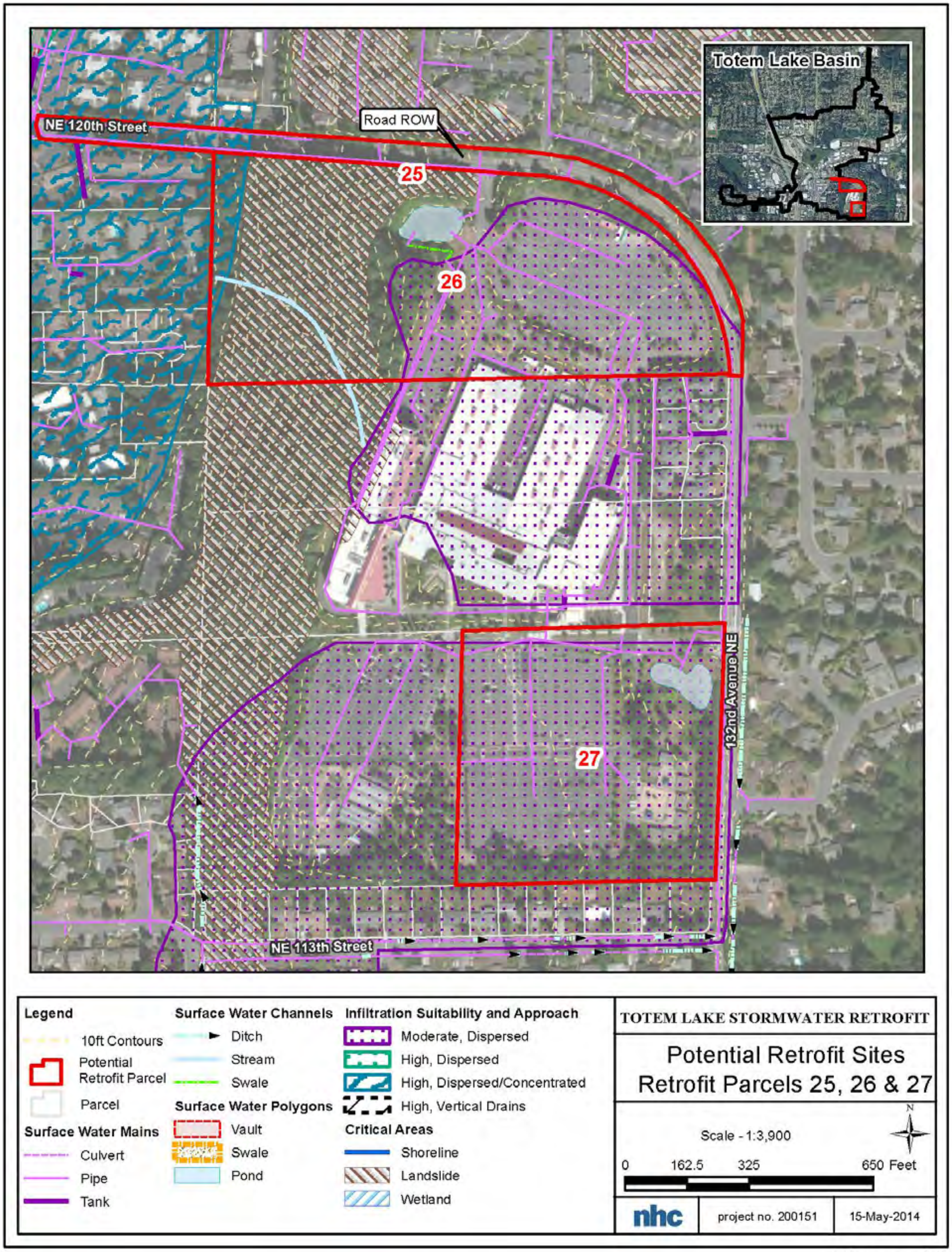


Figure 14

DESIGN OR DELIVERY NOTES

Alternate ideas:
-Regrade parking to drain across media filter drains and/or to RG within parking.
-Underground vaults, filters in parking lot

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☑ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☑ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Area available to ↑ F.C. and W.Q., if acceptable to college.
↑ F.C. size would impact trees.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☑ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #1

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: 132nd Ave NE

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.5	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints					X		
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS			X				
F3.2 Infiltration Potential (High = 1, Low = 5)			X				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)			X				
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	2.46	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)		X					
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #2

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: 132nd Square Park

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	1.7	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT: x | PINK BOX=CALCULATED VALUE: x.x

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits		x					1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	x						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	x						
F2.2 Access for Construction and Maintenance	x						
F3.1 Upstream PGIS		x					
F3.2 Infiltration Potential (High = 1, Low = 5)			x				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			x				
F4.1 Project Impact on Site Uses & Operations (Long-term)		x					
F4.2 Sufficiency of Space Given Setback Requirements, etc.	x					1.69	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	x						
F5.2 Drainage Infrastructure Can be Reasonably Modified	x						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	x						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			x				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #3

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: WSDOT Ponds - SE Corner of Slater Avenue and NE 126th Place

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.7	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits				X			1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints			X				
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)		X					
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS		X					
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)	X						
F4.2 Sufficiency of Space Given Setback Requirements, etc.				X		2.62	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)				X			
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #4

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: United Rentals on Slater Ave.

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.2	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT x — **PINK BOX=CALCULATED VALUE** x.x

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits			x				1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints			x				
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			x				
F2.2 Access for Construction and Maintenance	x						
F3.1 Upstream PGIS		x					
F3.2 Infiltration Potential (High = 1, Low = 5)					x		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			x				
F4.1 Project Impact on Site Uses & Operations (Long-term)					x		
F4.2 Sufficiency of Space Given Setback Requirements, etc.				x		3.15	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					x		
F5.2 Drainage Infrastructure Can be Reasonably Modified			x				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			x				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	x						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #8

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: OB Kirkland Properties - NE 126th Place

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.4	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

	FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1	Ease of Permitting & Number of Environmental Permits		x					1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2	Potential Utility or Site Constraints		x					
F2.1	Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			x				
F2.2	Access for Construction and Maintenance	x						
F3.1	Upstream PGIS			x				
F3.2	Infiltration Potential (High = 1, Low = 5)					x		
F3.3	Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			x				
F4.1	Project Impact on Site Uses & Operations (Long-term)				x			
F4.2	Sufficiency of Space Given Setback Requirements, etc.	x					2.38	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1	Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			x				
F5.2	Drainage Infrastructure Can be Reasonably Modified	x						
F5.3	Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)		x					
F5.4	Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	x						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #10

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: CKC Between 128th Lane and Slater Ave

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.0	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT	X	**PINK BOX=CALCULATED VALUE**	X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits				X			1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints				X			
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS	X						
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)		X					
F4.1 Project Impact on Site Uses & Operations (Long-term)					X		
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	2.92	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					X		
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	X						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #11

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Dodge Dealership - NE 124th Street

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.0	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits		X					1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	X						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS					X		
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)					X		
F4.1 Project Impact on Site Uses & Operations (Long-term)		X					
F4.2 Sufficiency of Space Given Setback Requirements, etc.	X					2.92	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					X		
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)		X					
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)					X		

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #13

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Vegetated Area between 405 and Totem Lake

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.6	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits			X				1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints			X				
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS	X						
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)	X						
F4.2 Sufficiency of Space Given Setback Requirements, etc.			X			2.54	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #14

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Totem Lake Mall

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.2	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

	FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1	Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2	Potential Utility or Site Constraints	X						
F2.1	Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2	Access for Construction and Maintenance	X						
F3.1	Upstream PGIS		X					
F3.2	Infiltration Potential (High = 1, Low = 5)					X		
F3.3	Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)		X					
F4.1	Project Impact on Site Uses & Operations (Long-term)		X					
F4.2	Sufficiency of Space Given Setback Requirements, etc.	X					2.15	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1	Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2	Drainage Infrastructure Can be Reasonably Modified			X				
F5.3	Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4	Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #15

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Yuppie Pawn at NE Totem Lake Way

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.6	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT X **PINK BOX=CALCULATED VALUE** X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

	FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1	Ease of Permitting & Number of Environmental Permits			X				1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2	Potential Utility or Site Constraints		X					
F2.1	Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2	Access for Construction and Maintenance	X						
F3.1	Upstream PGIS	X						
F3.2	Infiltration Potential (High = 1, Low = 5)					X		
F3.3	Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)				X			
F4.1	Project Impact on Site Uses & Operations (Long-term)					X		
F4.2	Sufficiency of Space Given Setback Requirements, etc.			X			2.54	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1	Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2	Drainage Infrastructure Can be Reasonably Modified	X						
F5.3	Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4	Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #16

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Totem Lake

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.5	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT | X | PINK BOX=CALCULATED VALUE | X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits					X		1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	X						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5) (Owned by Conservation District)		X					
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS	X						
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3	X						
F4.1 Project Impact on Site Uses & Operations (Long-term)	X						
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	2.46	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	X						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #17

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: CKC between Totem Lake Blvd and NE 128th

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.1	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE	X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits					X		1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints			X				
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS			X				
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)	X						
F4.1 Project Impact on Site Uses & Operations (Long-term)				X			
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	3.08	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					X		
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	X						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #18

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: King County Wastewater Parcel

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.7	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT: X — PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits				X			1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints			X				
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)		X					
F2.2 Access for Construction and Maintenance		X					
F3.1 Upstream PGIS		X					
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)		X					
F4.2 Sufficiency of Space Given Setback Requirements, etc.			X			2.62	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #19

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Comfort Inn

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.9	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT x **PINK BOX=CALCULATED VALUE** x.x

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

	FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1	Ease of Permitting & Number of Environmental Permits			x				1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2	Potential Utility or Site Constraints			x				
F2.1	Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			x				
F2.2	Access for Construction and Maintenance	x						
F3.1	Upstream PGIS		x					
F3.2	Infiltration Potential (High = 1, Low = 5)					x		
F3.3	Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			x				
F4.1	Project Impact on Site Uses & Operations (Long-term)					x		
F4.2	Sufficiency of Space Given Setback Requirements, etc.				x		2.85	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1	Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			x				
F5.2	Drainage Infrastructure Can be Reasonably Modified			x				
F5.3	Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	x						
F5.4	Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	x						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #20

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.	Location: CKC west of 405 Date:		**PROJECT DESCRIPTION**
FEASIBILITY RATING (1-5):	3.4	1=HIGHEST; 5=LOWEST FEASIBILITY	
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)	
ESTIMATED PROJECT COST:	$		

NOTE: GRAY BOX = DATA INPUT: x — PINK BOX=CALCULATED VALUE: x.x

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits					x		1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints					x		
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	x						
F2.2 Access for Construction and Maintenance	x						
F3.1 Upstream PGIS			x				
F3.2 Infiltration Potential (High = 1, Low = 5)					x		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			x				
F4.1 Project Impact on Site Uses & Operations (Long-term)					x		
F4.2 Sufficiency of Space Given Setback Requirements, etc.					x	3.31	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					x		
F5.2 Drainage Infrastructure Can be Reasonably Modified			x				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	x						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	x						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #21

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: CKC under 405 to NE 124th St.

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.4	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits					X		1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints					X		
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS			X				
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)					X		
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	3.31	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)					X		
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	X						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #22

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Totem Square 11961 124th Ave NE

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	1.9	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	X						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS		X					
F3.2 Infiltration Potential (High = 1, Low = 5)			X				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)			X				
F4.2 Sufficiency of Space Given Setback Requirements, etc.		X				1.85	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)		X					
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)	X						

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #23

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: Intersection of 124th and 124th

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	3.2	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT X **PINK BOX=CALCULATED VALUE** X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints					X		
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance					X		
F3.1 Upstream PGIS		X					
F3.2 Infiltration Potential (High = 1, Low = 5)					X		
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)		X					
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	3.15	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #24

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: GTE Telephone Ops 12055 Slater Ave

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.6	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE	X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

	FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1	Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2	Potential Utility or Site Constraints		X					
F2.1	Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2	Access for Construction and Maintenance	X						
F3.1	Upstream PGIS			X				
F3.2	Infiltration Potential (High = 1, Low = 5)			X				
F3.3	Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)				X			
F4.1	Project Impact on Site Uses & Operations (Long-term)				X			
F4.2	Sufficiency of Space Given Setback Requirements, etc.		X				2.54	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1	Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2	Drainage Infrastructure Can be Reasonably Modified	X						
F5.3	Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4	Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)					X		

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #25

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: NE 120th from Slater Ave to 132nd Ave NE

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.4	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT	X	**PINK BOX=CALCULATED VALUE**	X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints					X		
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)	X						
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS		X					
F3.2 Infiltration Potential (High = 1, Low = 5)			X				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)			X				
F4.1 Project Impact on Site Uses & Operations (Long-term)			X				
F4.2 Sufficiency of Space Given Setback Requirements, etc.					X	2.31	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified	X						
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)	X						
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)			X				

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #26

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: LWIT - North Parking Lot

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.4	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	

NOTE: GRAY BOX = DATA INPUT X | **PINK BOX=CALCULATED VALUE** X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	X						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS			X				
F3.2 Infiltration Potential (High = 1, Low = 5)			X				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)				X			
F4.1 Project Impact on Site Uses & Operations (Long-term)		X					
F4.2 Sufficiency of Space Given Setback Requirements, etc.	X					2.38	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)	X						
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)					X		

TOTEM LAKE STORMWATER RETROFIT RATING FORM

SUMMARY

PROJECT: Retrofit Site #27

THIS FORM SHOULD BE USED WITH IN CONJUNCTION WITH THE TOTEM LAKE STORMWATER RETROFIT PROJECT RATING FORM INSTRUCTIONS AND WORKSHEETS DOCUMENT TO SCORE PROJECTS FOR PLACEMENT ON THE CAPITAL FACILITIES PLAN.

Location: LWIT SE Parking Lot

Date:

PROJECT DESCRIPTION

FEASIBILITY RATING (1-5):	2.8	1=HIGHEST; 5=LOWEST FEASIBILITY
PROJECT SCORE (0-100)		100 = HIGHEST (FROM STEP 2)
ESTIMATED PROJECT COST:	$	
NOTE: GRAY BOX = DATA INPUT	X	PINK BOX=CALCULATED VALUE: X.X

STEP 1

PREPARE FEASIBILITY ANALYSIS PRIOR TO RANKING SITE FOR FEASIBILITY

SITE FEASIBILITY RATING (1 TO 5)

FEASIBILITY CRITERIA - RATE CRITERIA 1 TO 5	1 (Best)	2	3	4	5 (Worst)	RATING	NOTES & INSTRUCTIONS
F1.1 Ease of Permitting & Number of Environmental Permits	X						1 = BEST, 5 WORST Assess each criteria and check applicable box. If not applicable, leave blank.
F1.2 Potential Utility or Site Constraints	X						
F2.1 Parcel Ownership (City of Kirkland =1 ---> multiple private owners =5)			X				
F2.2 Access for Construction and Maintenance	X						
F3.1 Upstream PGIS					X		
F3.2 Infiltration Potential (High = 1, Low = 5)			X				
F3.3 Upstream Impervious Surface (100+ ac. = 1, 50-100 ac. = 2, 20-50 ac. = 3, 10-20 ac. = 4, <10 ac. = 5)					X		
F4.1 Project Impact on Site Uses & Operations (Long-term)		X					
F4.2 Sufficiency of Space Given Setback Requirements, etc.	X					2.77	Give Project a Score of 1 to 5 based on best overall judgment of all factors. Ranks 1 & 2 for Top 6 projects. Move to Step 2 - Project Score
F5.1 Sufficient Head for Treatment/Flow Control Options (yes = 1, neutral = 3, no = 5)			X				
F5.2 Drainage Infrastructure Can be Reasonably Modified			X				
F5.3 Level of Existing Treatment & Flow Control for Stormwater (none=1 - mostly meets current stds = 5)			X				
F5.4 Redevelopment Potential (planned=1, public/no plans = 3, private/no plans = 5)					X		

Appendix E

Retrofit Concept
Summary Sheets

PROJECT SUMMARY SHEET

Project Title: **132nd Square Park Regional Detention with UICs**

Project Description:

Construct regional stormwater facility that would provide infiltration, flow control, and water quality treatment. Construct underground injection control (UIC) wells at southeast corner of park. Stormwater would be captured from the park and area north of NE 132nd Street.

Pre-Treatment Pond:

- 14,400 square feet top area
- 6 feet deep
- 3H:1V side slopes
- Lined

Detention Pond:

- 73,200 square feet top area
- 8 feet deep live storage (Approx. El. 276-284')
- 3H:1V side slopes
- Lined, adjacent landslide hazard area

UIC Wells:

- 33 UIC casings to 100' depth
- 40' spacing between wells
- Assumed 15 gpm capacity

Major Site Impacts and Challenges:

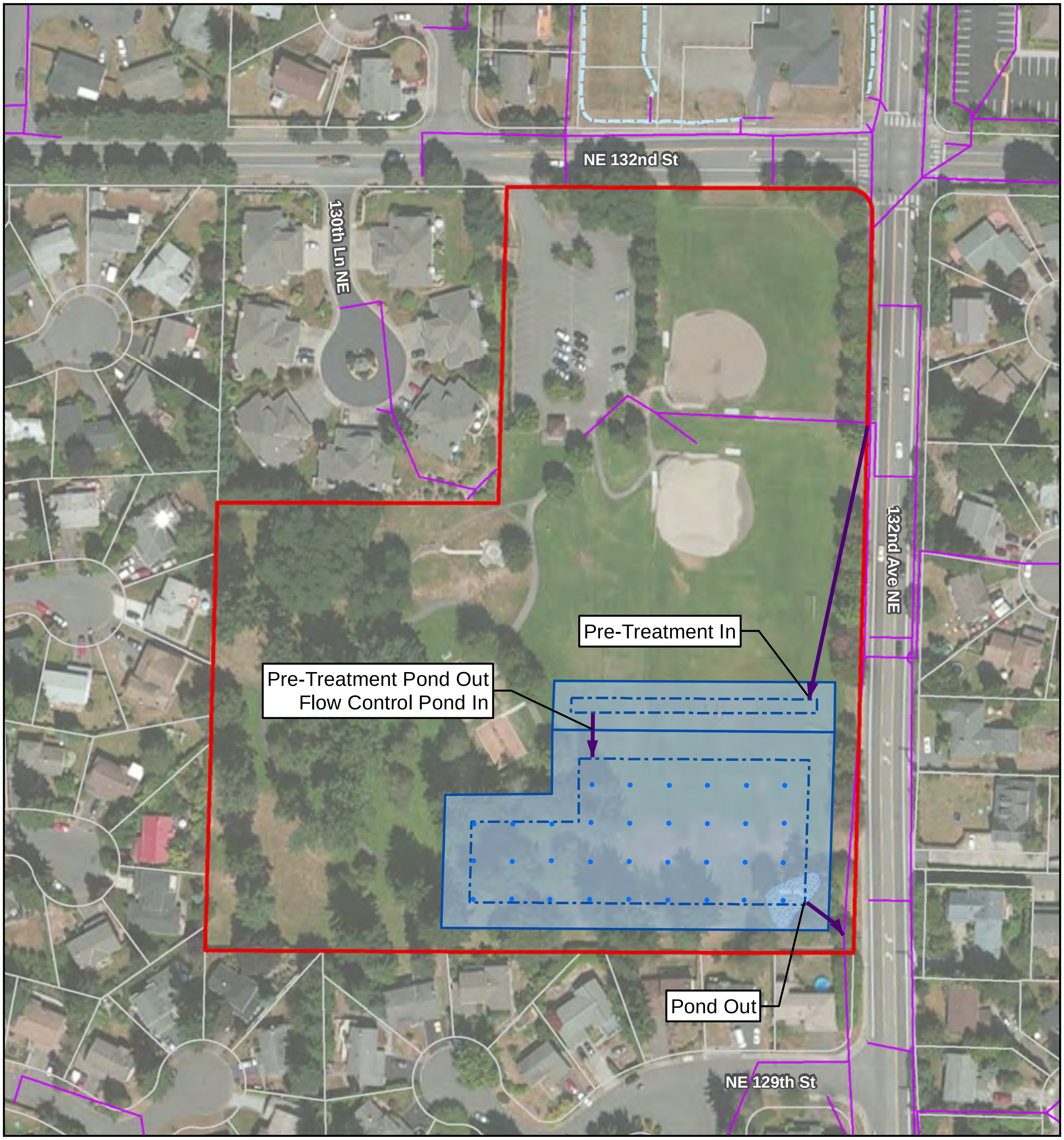
- Landslide hazard area extends to corner of park.
- Significant tree removal.

Stormwater Compliance: Meets flow duration control standard and water quality standard for 48.5 acres. Meets LID standard.

Other Project Benefits: Infiltration would reduce downstream flow volumes to Totem Lake. Would significantly reduce stormwater flooding at 126th Pl and along CKC west of 132nd Ave.

Estimated Project Costs: $2,000,000

Associated Projects/Analysis: Coordination with City of Kirkland Parks Department.
On-site geologic and groundwater analysis required prior to further design. Drill to depths up to 100', install test UIC and monitoring wells. Mapping and analysis to evaluate potential geologic hazards and estimate potential impacts of groundwater injection on slope stability.



Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Ditch

Conduit

Pond

Proposed Retrofit

Pond

Pipe

Proposed UIC Well

TOTEM LAKE STORMWATER RETROFIT

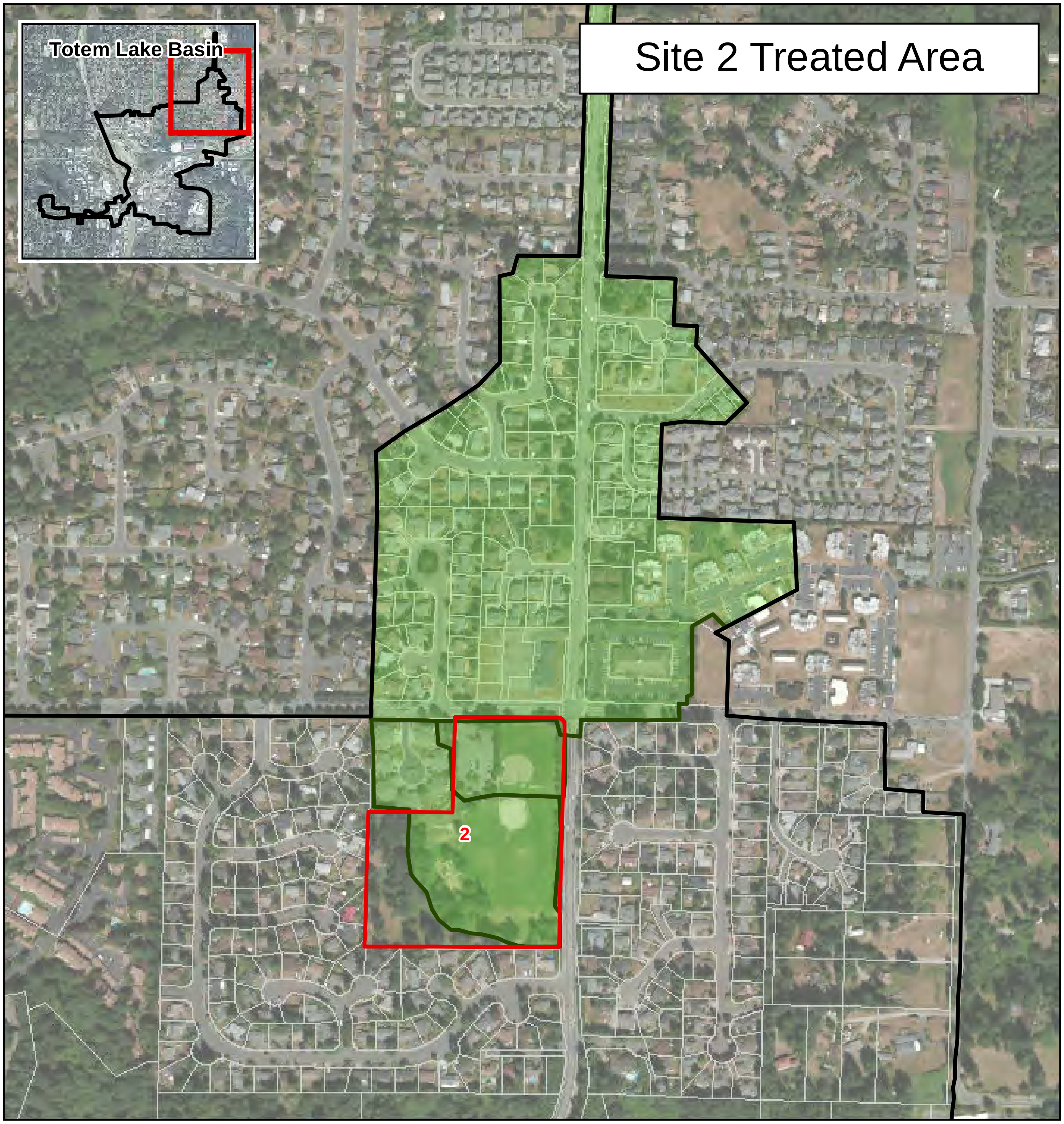
Site 2A 132nd Square Park

Scale - 1:1,800

0 75 150 300 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-July-2015



Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:6,000

0 250 500 1,000 Feet

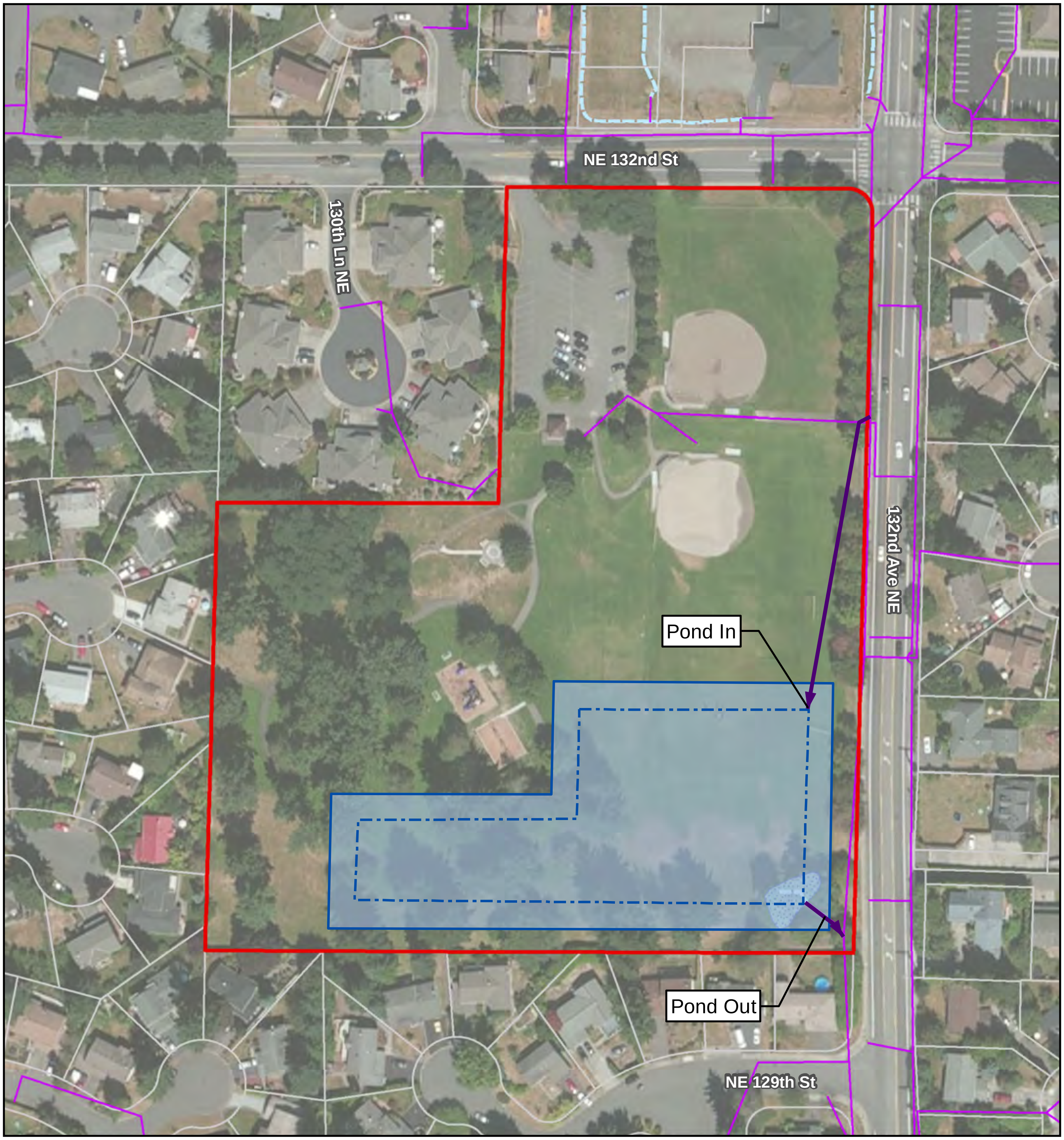
N

Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 2

PROJECT SUMMARY SHEET

Project Title:	**132nd Square Park Regional Detention**
Project Description:	Construct regional detention facility at southeast corner of park. Stormwater would be captured from the park and area north of NE 132nd Street. Detention Pond: • 103,500 square feet top area • 8 feet deep live storage (Approx. El. 276-284') • 3H:1V side slopes • Lined, adjacent landslide hazard area
Major Site Impacts and Challenges:	• Landslide hazard area extends to corner of park. • Significant tree removal.
Stormwater Compliance:	Provides significant flow control but does not meet stormwater standards for 48.5-acre contributing area.
Other Project Benefits:	Would significantly reduce stormwater flooding at 126th Pl and along CKC west of 132nd Ave.
Estimated Project Costs:	$1,400,000
Associated Projects/Analysis:	Coordination with City of Kirkland Parks Department.



Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Ditch

Conduit

Pond

Proposed Retrofit

Pond

Pipe

TOTEM LAKE STORMWATER RETROFIT

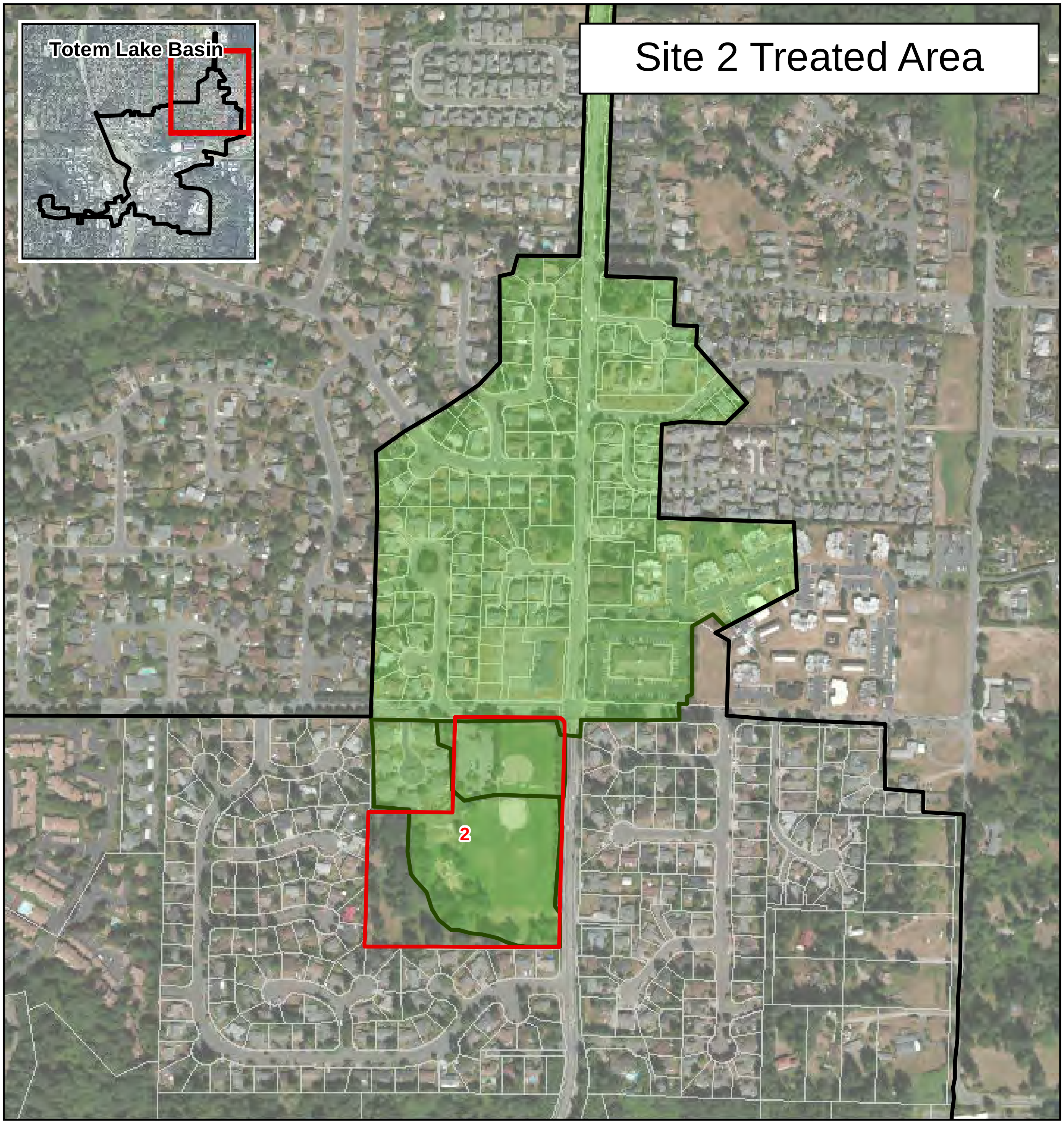
Site 2B 132nd Square Park

Scale - 1:1,800

0 75 150 300 Feet

N

Northwest Hydraulic Consultants | project no. 200151 | 08-July-2015



Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:6,000

0 250 500 1,000 Feet

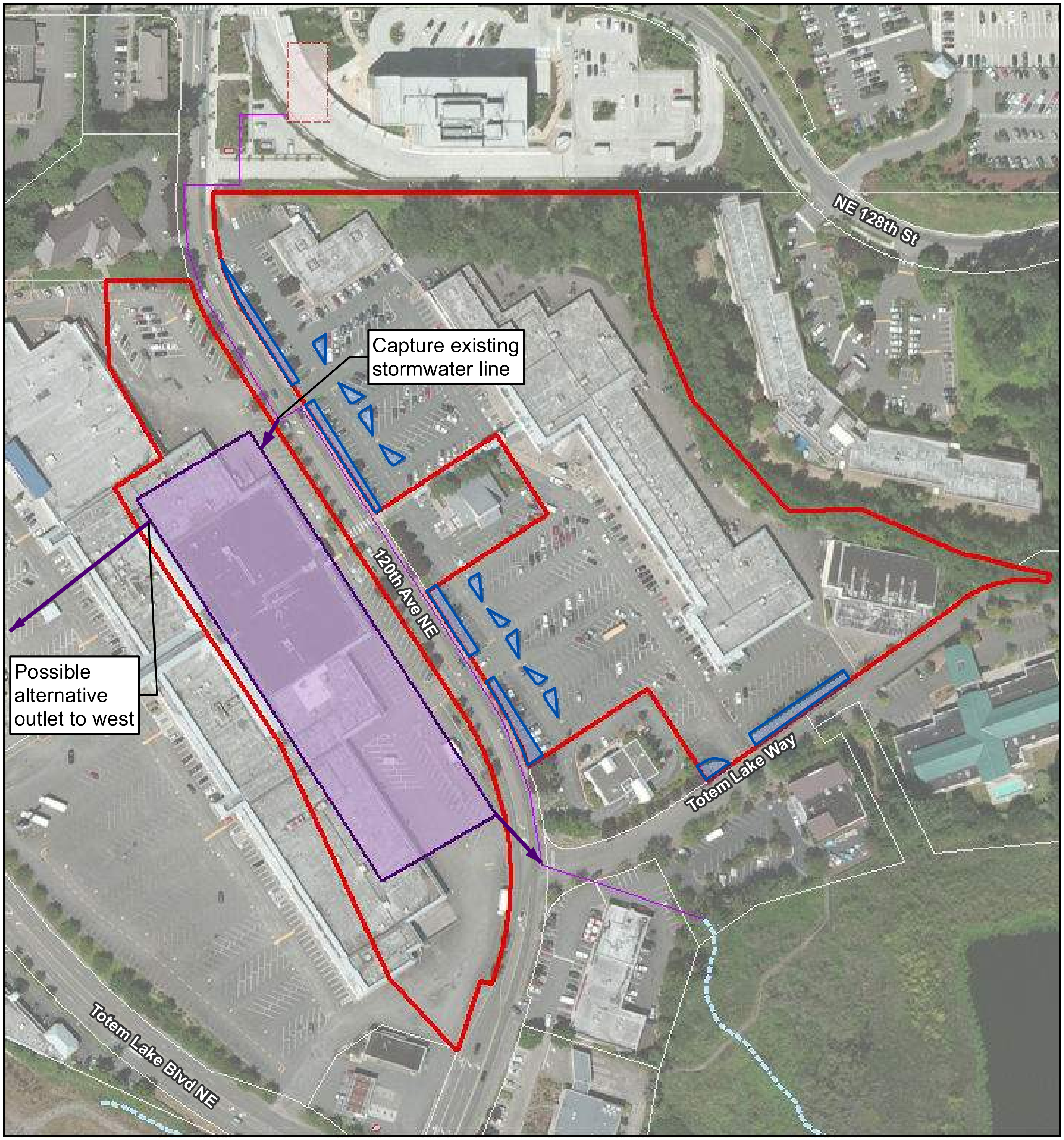
N

Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 2

PROJECT SUMMARY SHEET

Project Title:	**Totem Lake Mall East Detention and Water Quality Treatment**
Project Description:	Construct regional stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from the large parcel and from the existing 120th Ave stormwater line. Vault: • 108,000 square feet top area • 8 feet deep total storage • 4 feet deep live storage (Approx. El. 124-128') • 4 feet deep dead storage for water quality • Assumed outlet to Totem Lake via 120th Ave; vault could be adjusted to start live storage at El. 125' and outlet to the west. Bioretention (Optional) for Enhanced Water Quality: • 13,300 square feet top area proposed as concept • Provides Enhanced Water Quality treatment for 25% of parcel • 9 in. deep (3 in. ponding + 6 in. freeboard) • 3H:1V side slopes • Lined, no infiltration due to saturated soils • Bypasses flow control vault due to elevation limitations
Major Site Impacts and Challenges:	• Low ground and high water level in Totem Lake or Totem Lake Creek to west. Existing ground elevations range from 128 to 130 feet, while typical lake elevations are 122 to 124 feet and may be higher during floods. • Size of vault limits potential site development. • Deeper vault with pumps may be more economical, however emergency power would be required.
Stormwater Compliance:	Does not meet flow duration control standard for 24.7 ac basin, however it would be a significant improvement. Meets basic water quality standard. Option to meet enhanced water quality for 25% of mall parcel. Does not meet LID standard.
Other Project Benefits:	Would improve stormwater conditions downstream of Totem Lake, though the lake naturally attenuates some of these effects.
Estimated Project Costs:	$14,300,000 for Vault and Basic Water Quality ($640,000 additional for Enhanced Water Quality)
Associated Projects/Analysis:	Additional analysis and design will be needed to locate a system that works with redevelopment; may combine with TL Mall West.



Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Conduit

Ditch

Vault

Proposed Retrofit

Bioretention

Vault

Pipe

TOTEM LAKE STORMWATER RETROFIT

Totem Lake Mall East

Scale - 1:2,400

0 100 200 400 Feet

N

Northwest Hydraulic Consultants	project no. 200151	12-Jan-2015

Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:6,000

0 250 500 1,000 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 14E

PROJECT SUMMARY SHEET

Project Title: **Totem Lake Mall West Detention and Water Quality Treatment**

Project Description: Construct stormwater facility that would provide flow control and water quality treatment.

Vault:
- 65,500 square feet top area
- 8 feet deep total storage
- 4 feet deep live storage (Approx. El. 124-128')
- 4 feet deep dead storage for water quality

Bioretention (Optional) for Enhanced Water Quality:
- 15,350 square feet top area proposed as concept
- Provides Enhanced Water Quality treatment for 40% of parcel
- 9 in. deep (3 in. ponding + 6 in. freeboard)
- 3H:1V side slopes
- Lined, no infiltration due to saturated soils
- Bypasses flow control vault due to elevation limitations

Major Site Impacts and Challenges:
- Low ground and high water level in Totem Lake Creek. Existing ground elevations range from 127 to 129 feet, while typical ditch elevations are 120 to 124 feet and may be higher during floods.
- Size of vault limits site development.
- Deeper vault with pumps may be more economical, however emergency power would be required.

Stormwater Compliance: Does not meet flow duration control standard for 14.0 ac basin, however it would be a significant improvement. Meets basic water quality standard. Option to meet enhanced water quality for 40% of mall parcel. Does not meet LID standard.

Other Project Benefits: Would improve stormwater conditions downstream of Totem Lake.

Estimated Project Costs: $8,700,000 for Vault and Basic Water Quality
($730,000 additional for Enhanced Water Quality)

Associated Projects/Analysis: Additional analysis and design will be needed to locate a system that works with redevelopment. This may be done in conjunction with a new street layout or stormwater system layout that includes Totem Lake Mall East.

Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Conduit

Ditch

Vault

Proposed Retrofit

Bioretention

Vault

Pipe

TOTEM LAKE STORMWATER RETROFIT

Totem Lake Mall West

Scale - 1:2,400

0 100 200 400 Feet

N

Northwest Hydraulic Consultants	project no. 200151	12-Jan-2015

Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:6,000

0 250 500 1,000 Feet

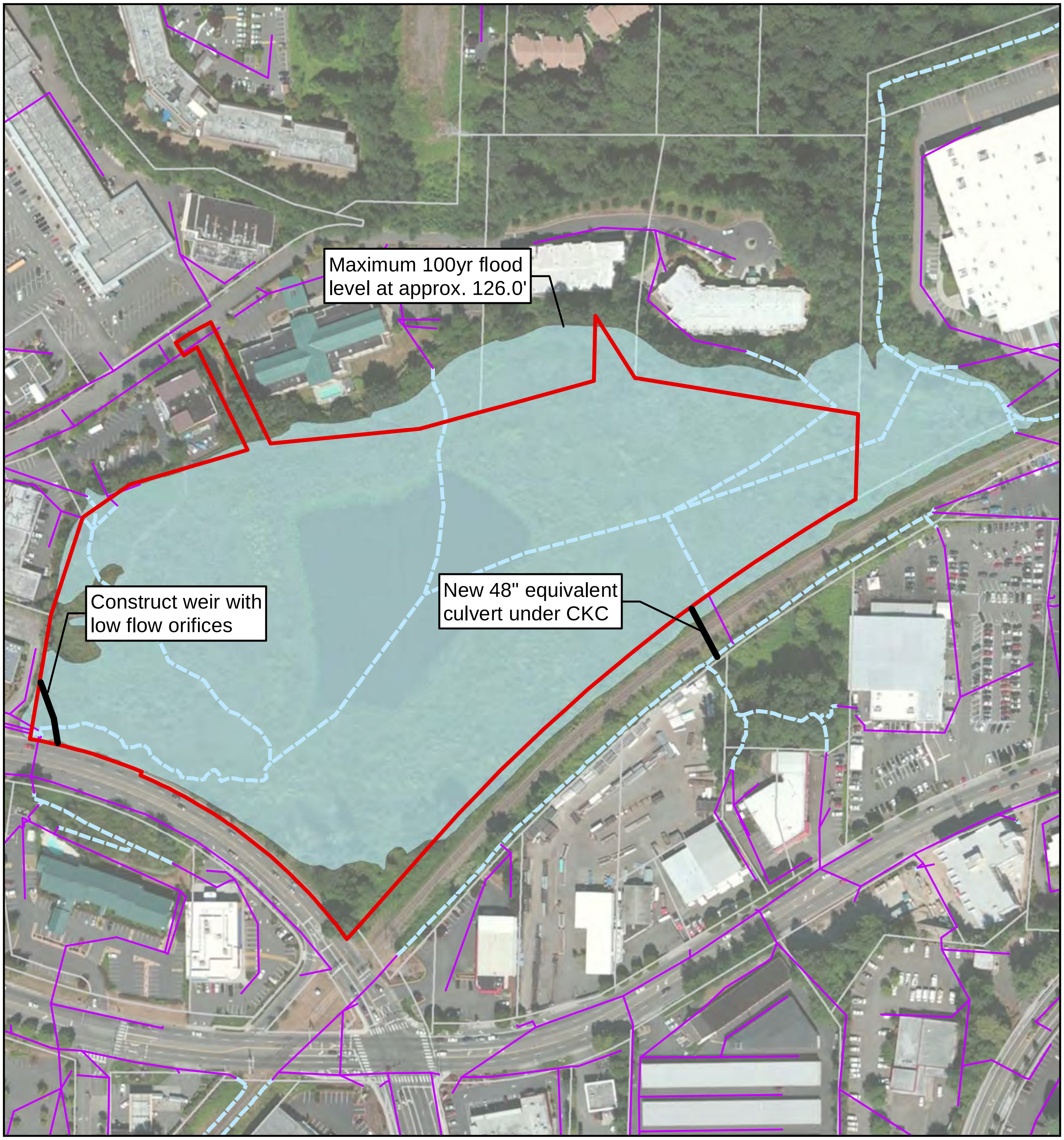
N

Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 14W

PROJECT SUMMARY SHEET

Project Title:	**Totem Lake Outlet Modification**
Project Description:	Construct a weir upstream of the Totem Lake outlet to enhance flow control and regulate storage in the lake. Construct new 48-inch equivalent culvert under CKC to replace existing buried culvert. • Weir crest elevation 125.5’ • 2 low flow openings or active gate structure
Major Site Impacts and Challenges:	• Project would modify existing wetland water levels • Backwater from I-405 culverts and downstream affects discharge • Significant permitting challenges
Stormwater Compliance:	Provides significant detention and flow control. Does not meet flow control standard for entire contributing area.
Other Project Benefits:	Reduces flooding of Totem Lake Blvd and along the CKC.
Estimated Project Costs:	$400,000
Associated Projects/Analysis:	Project will require wetland analysis and coordination with Ecology and permitting agencies regarding feasibility.



Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Ditch

Conduit

TOTEM LAKE STORMWATER RETROFIT

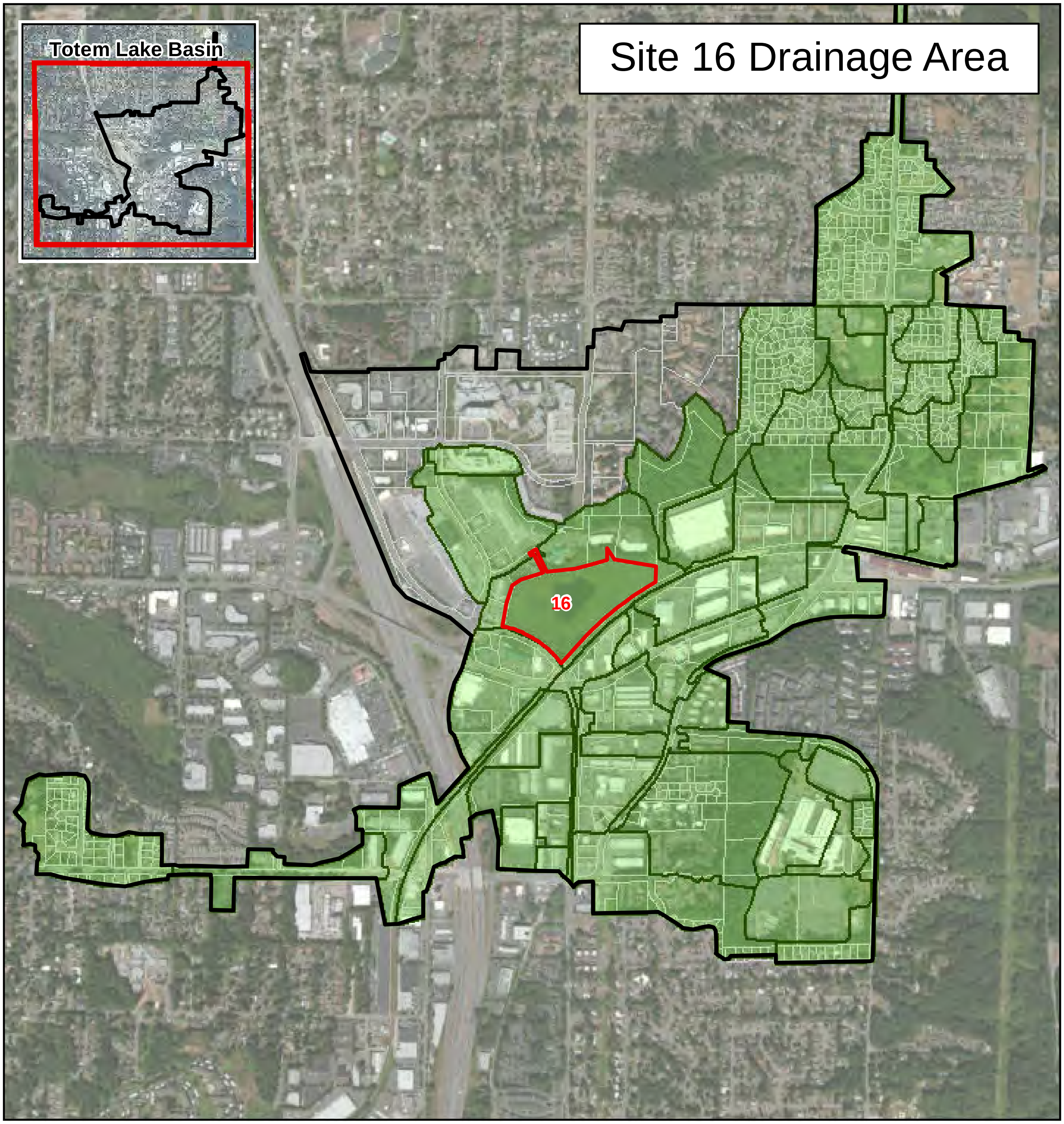
Site 16 Totem Lake Park

Scale - 1:3,000

0 125 250 500 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-July-2015



Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:16,200

0 650 1,300 2,600 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 16

PROJECT SUMMARY SHEET

Project Title:	**Totem Square Regional Detention and Water Quality Treatment**
Project Description:	Construct regional stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from two locations along the west side of 124th Ave, and one location from the private property to the south (same as existing drainage). Vault: • 24,000 square feet top area • 16.5 feet deep total storage • 12.5 feet deep live storage • 4 feet deep dead storage for water quality Bioretention (Optional) for Enhanced Water Quality: • 9,400 square feet top area • 9 in. deep (3 in. ponding + 6 in. freeboard) • 3H:1V side slopes • Lined, no infiltration • Flow control compliance assumes outflow directed to vault
Major Site Impacts and Challenges:	• Restriction of other utility locations within right of way. • East half of parcel has soils with "high dispersed" infiltration capacity. Further study and/or a modified site layout would be required to take advantage of these soils. • Utility covers/grates within bike path. • Bioretention siting is challenging due to the ability to convey pollution-generating impervious surface to the bioretention cell. Also, steep slopes between parcel and CKC (to west) will likely restrict the cell's ability to infiltrate and instead require the cell to be lined.
Stormwater Compliance:	Meets flow duration control standard and basic water quality standard for 20.3 acres. Option to meet enhanced water quality for 3.5 acres. Does not meet LID standard.
Other Project Benefits:	Would significantly reduce stormwater flooding in the vicinity of 124th and 124th, which is a major intersection.
Estimated Project Costs:	$6,400,000 for Vault and Basic Water Quality ($140,000 additional for Enhanced Water Quality)
Associated Projects/Analysis:	Potential geotechnical review of site soil infiltration and adjacent slope stability.

Legend

Parcel
Potential Retrofit Parcel

Existing Stormwater System

Conduit
Ditch
Vault

Proposed Retrofit

Bioretention
Vault
Pipe

Proposed Development

Building
Roadway

TOTEM LAKE STORMWATER RETROFIT

Totem Square

Scale - 1:2,400

0 100 200 400 Feet

N

Northwest Hydraulic Consultants	project no. 200151	12-Jan-2015

Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:3,600

0 150 300 600 Feet

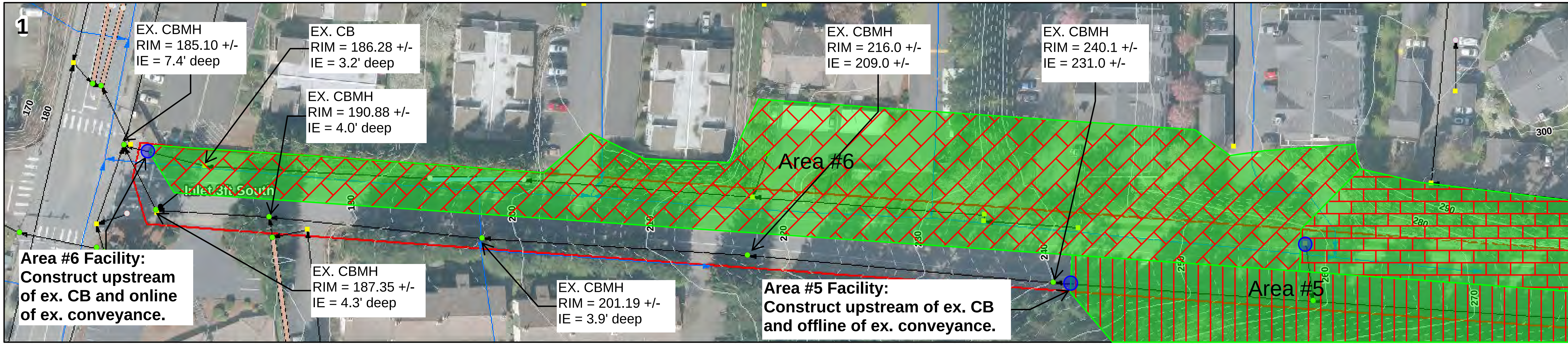
N

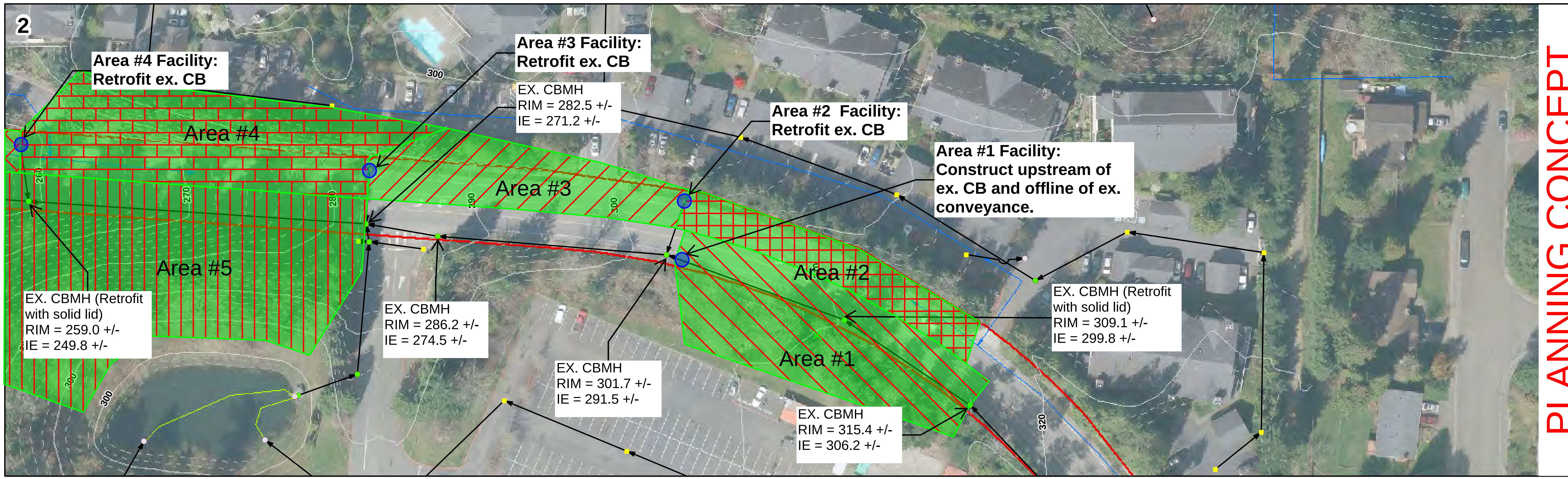
Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 22

PROJECT SUMMARY SHEET

Project Title:	**NE 120th Street Water Quality Treatment**
Project Description:	Construct stormwater facilities that would provide enhanced water quality treatment for the 120th Avenue NE ROW east of Slater Avenue. Stormwater would be captured from approximately 4 acres of ROW. • StormFilter CB or Filterra Units at 4 catchbasins • StormFilter MH units at two locations • Bottomless StormFilter MH at intersection with Slater Ave
Major Site Impacts and Challenges:	• Use of Filterra units would require sidewalk modifications or rebuild at two catch basin locations
Stormwater Compliance:	Meets enhanced water quality standard for 4.0 acres.
Other Project Benefits:	Potential infiltration at bottomless StormFilter at NE 120th and Slater Avenue.
Estimated Project Costs:	$310,000
Associated Projects/Analysis:	None.





Legend

- 2ft Contours
- 10ft Contours
- Potential Retrofit Site
- Catch Basin (Type I/Inlet)
- Catch Basin (Type II)
- Catch Basin (Other)

Main

- Pipe
- Tank
- Water Main

Channel

- Ditch
- Swale

WATER QUALITY FACILITIES:

Area #1: StormFilter CB or Filterra
Area treated = 18,300 SF
(Filterra requires sidewalk re-build)

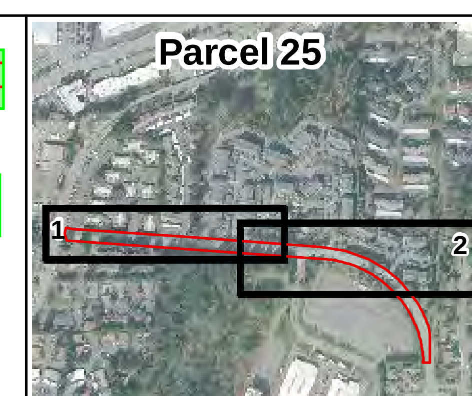
Area #2: StormFilter CB or Filterra
Area Treated = 7,500 SF

Area #3: StormFilter CB or Filterra
Area Treated = 10,900 SF

Area #4: StormFilter CB
Area Treated =19,600 SF
Poor location for Filterra - at intersection

Area #5: StormFilter MH
Area Treated = 54,500 SF
Use of Filterra requires a retaining wall to extend sidewalk behind Filterra unit.

Area #6: StormFilter MH - Area Treated = 62,000 SF
Bottomless to promote infiltration
Use of Filterra requires extensive relocation of Telecom and traffic signal infrastructure.



TOTEM LAKE STORMWATER RETROFIT

SITE 25 NE 120TH STREET Concept

1 inch = 75 feet

0 37.5 75 150 Feet

N

NHC | project no. 200151 | January 15, 2015

PROJECT SUMMARY SHEET

Project Title:	**LWIT Water Quality and Detention Vault**
Project Description:	Construct stormwater facility that would provide flow control and water quality treatment. Stormwater would be captured from 23.4 acres of the LWIT campus. Vault: • 25,000 square feet top area • 4 feet deep dead storage • 6 feet deep live storage
Major Site Impacts and Challenges:	• Preserves parking on top of vault.
Stormwater Compliance:	Meets basic water quality standard, provides significant flow control but does not meet flow control standard for 23.4-acre contributing area.
Other Project Benefits:	None.
Estimated Project Costs:	$5,300,000
Associated Projects/Analysis:	Coordination with LWIT required.

Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Ditch

Conduit

Pond

Proposed Retrofit

Vault

Pipe

TOTEM LAKE STORMWATER RETROFIT

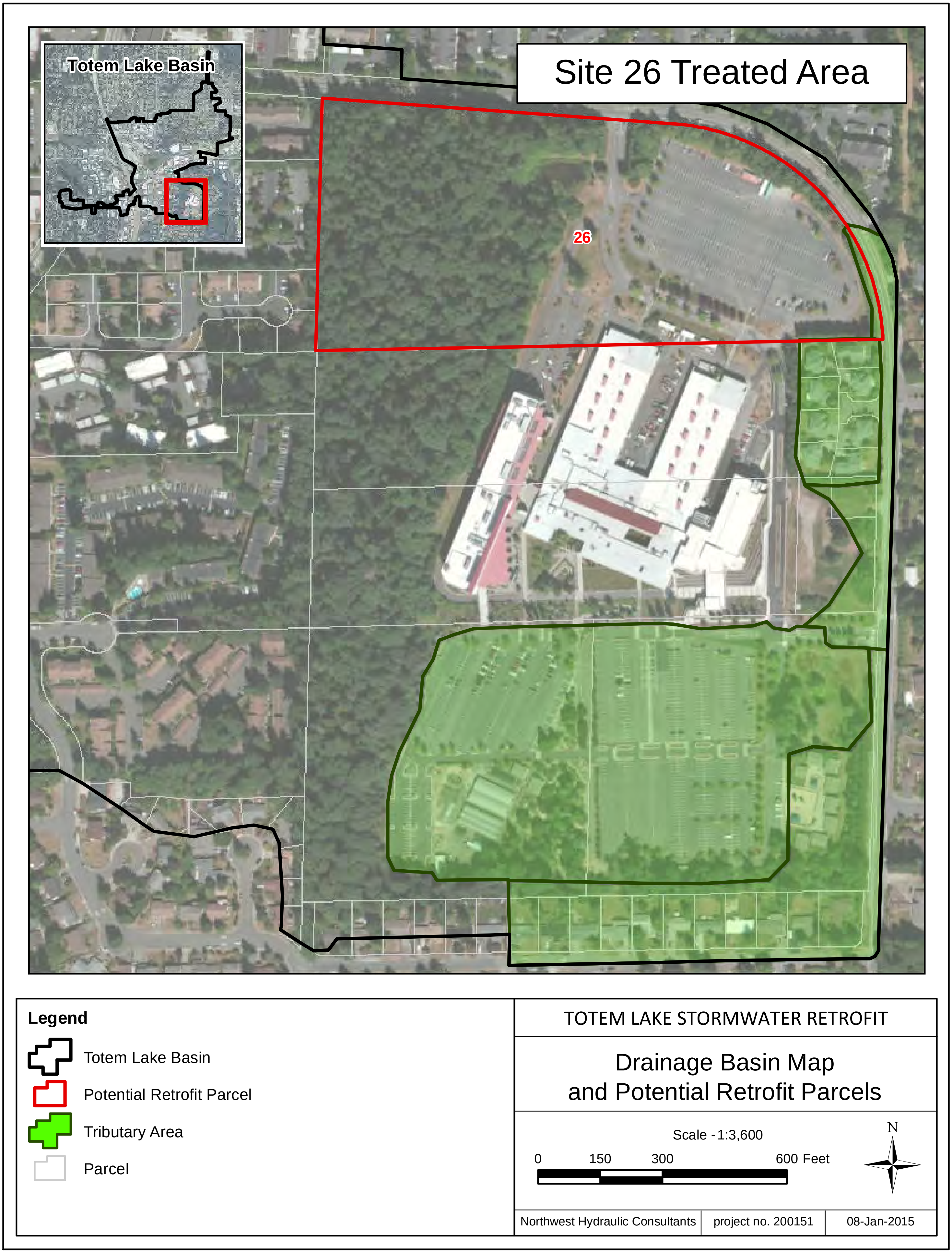
Site 26A LWIT

Scale - 1:2,400

0 100 200 400 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-July-2015


Site 26 Treated Area
Totem Lake Basin
26
Legend
Totem Lake Basin
Potential Retrofit Parcel
Tributary Area
Parcel
TOTEM LAKE STORMWATER RETROFIT
Drainage Basin Map
and Potential Retrofit Parcels
Scale - 1:3,600
0
150
300
600 Feet
N
Northwest Hydraulic Consultants
project no. 200151
08-Jan-2015

SITE 26

PROJECT SUMMARY SHEET

Project Title:	**LWIT Infiltration Vault**
Project Description:	Construct stormwater facility that would provide infiltration, flow control and water quality treatment. Stormwater would be captured from 23.4 acres of the LWIT campus. Pre-Treatment Vault: • 5,000 square feet top area • 6 feet deep Infiltration Vault: • 15,000 square feet top area • 10.5 feet deep live storage • Assumed 2" per hour infiltration rate
Major Site Impacts and Challenges:	• Preserves parking on top of vault.
Stormwater Compliance:	Meets flow duration control standard and water quality standard for 23.4 acres. Meets LID standard.
Other Project Benefits:	Infiltration would reduce downstream flow volumes to Totem Lake.
Estimated Project Costs:	$2,500,000
Associated Projects/Analysis:	Coordination with LWIT required.

Legend

Parcel

Potential Retrofit Parcel

Existing Stormwater System

Ditch

Conduit

Pond

Proposed Retrofit

Vault

Pipe

TOTEM LAKE STORMWATER RETROFIT

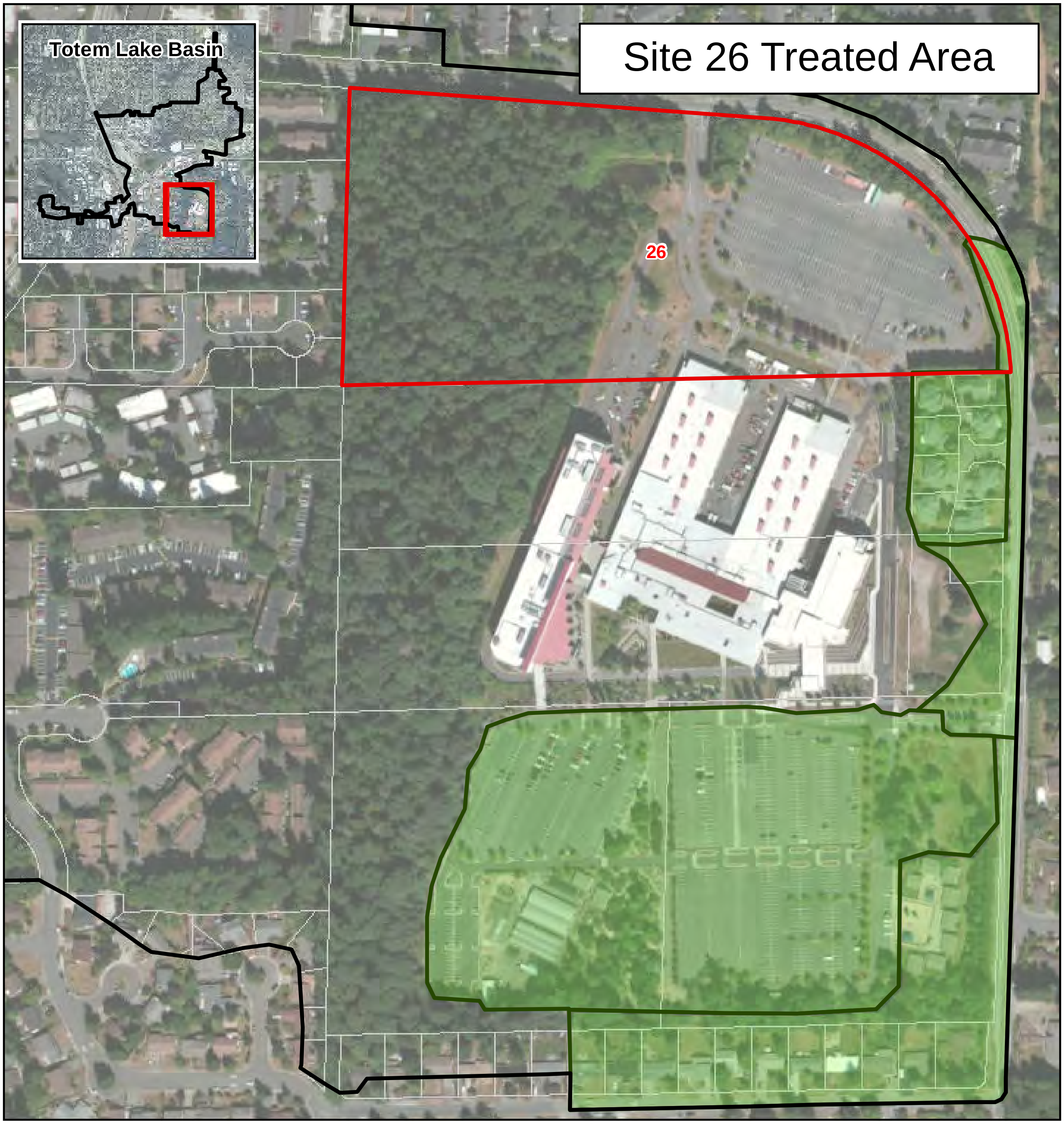
Site 26B LWIT

Scale - 1:2,400

0 100 200 400 Feet

N

Northwest Hydraulic Consultants	project no. 200151	08-July-2015



Legend

- Totem Lake Basin
- Potential Retrofit Parcel
- Tributary Area
- Parcel

TOTEM LAKE STORMWATER RETROFIT

Drainage Basin Map
and Potential Retrofit Parcels

Scale - 1:3,600

0 150 300 600 Feet

N

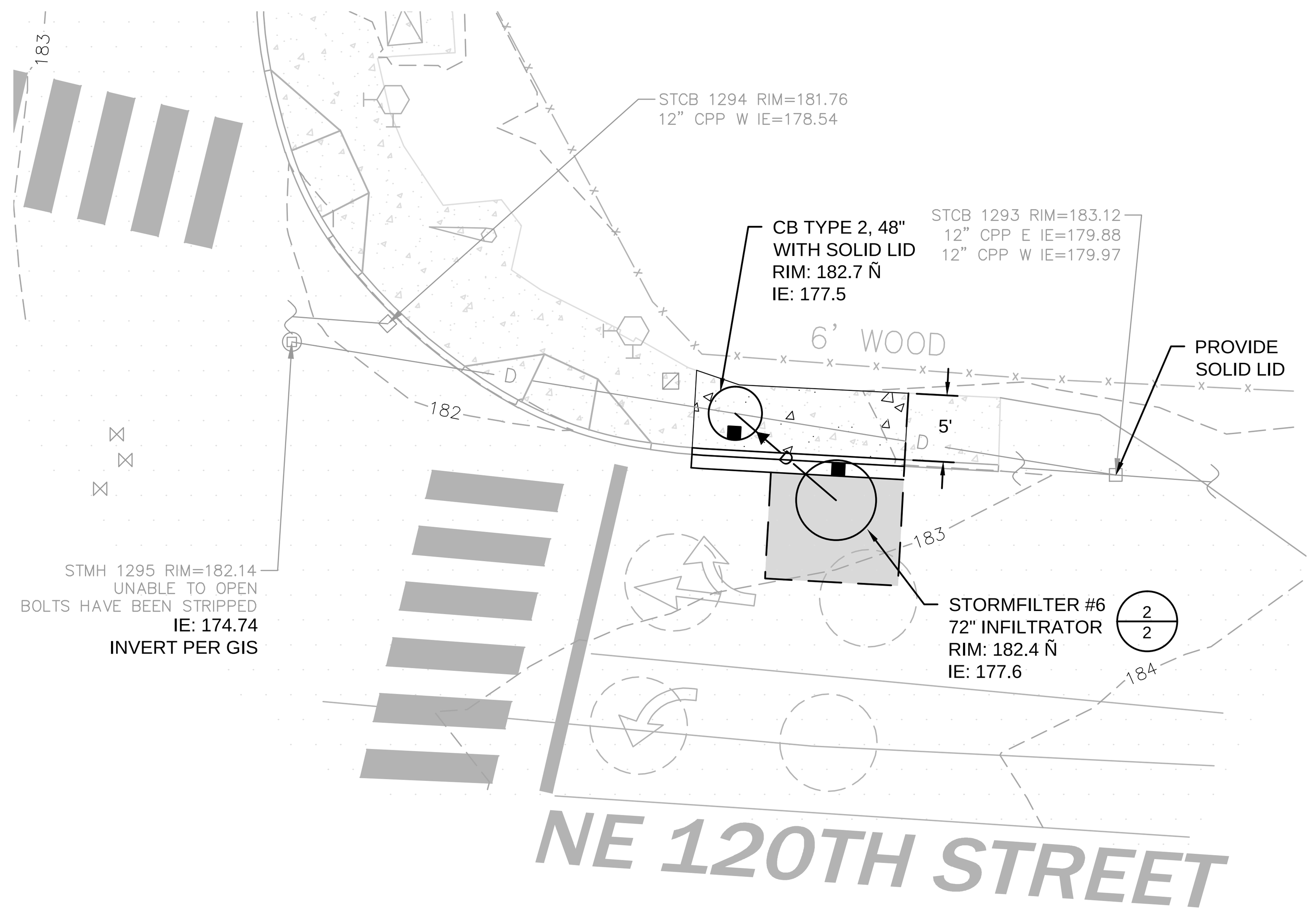
Northwest Hydraulic Consultants	project no. 200151	08-Jan-2015

SITE 26

Appendix F

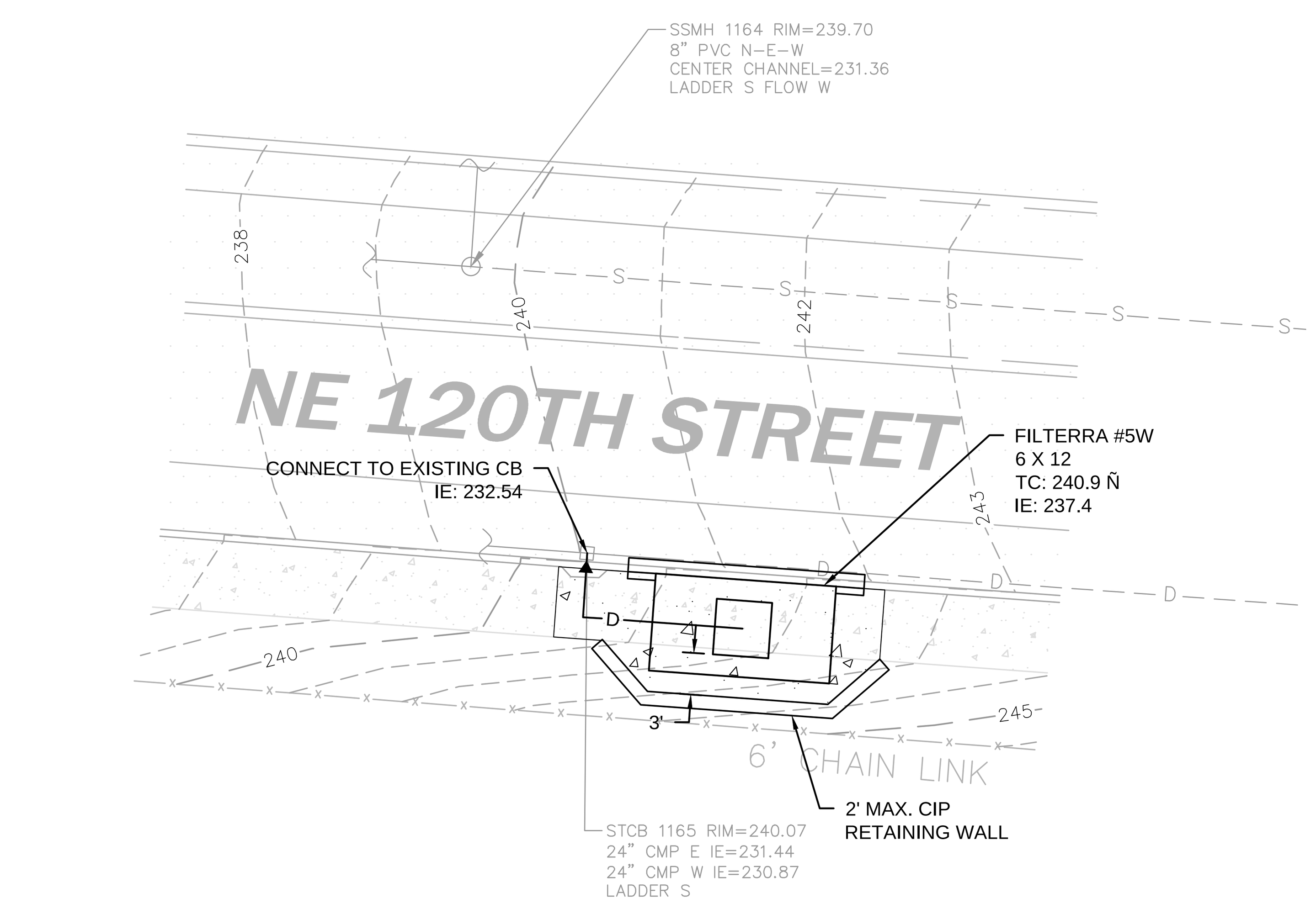
Capital Project Plans and Estimates

CALL BEFORE YOU DIG: 1-800-424-5555



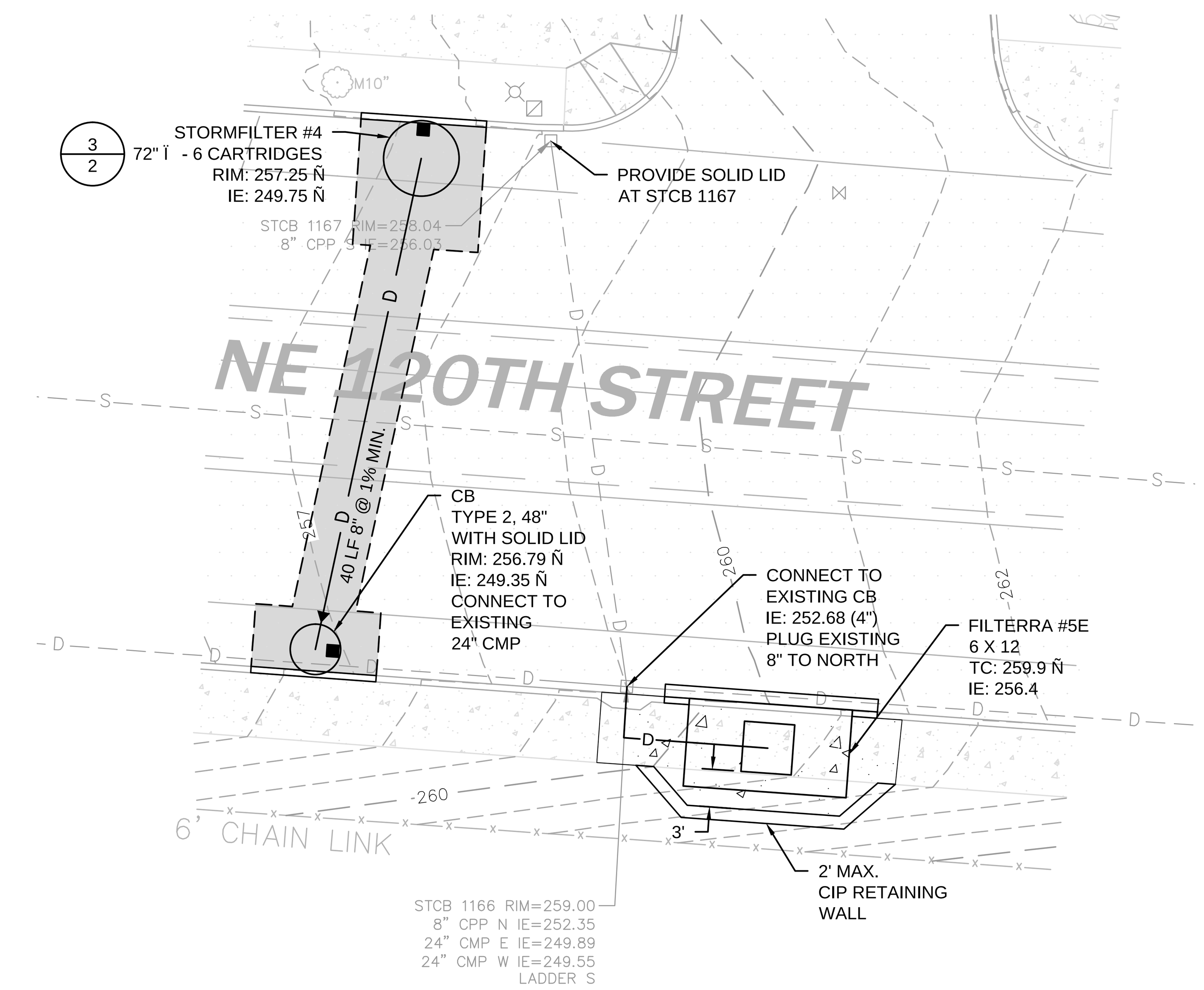
AREA #6

SCALE: 1"=10'



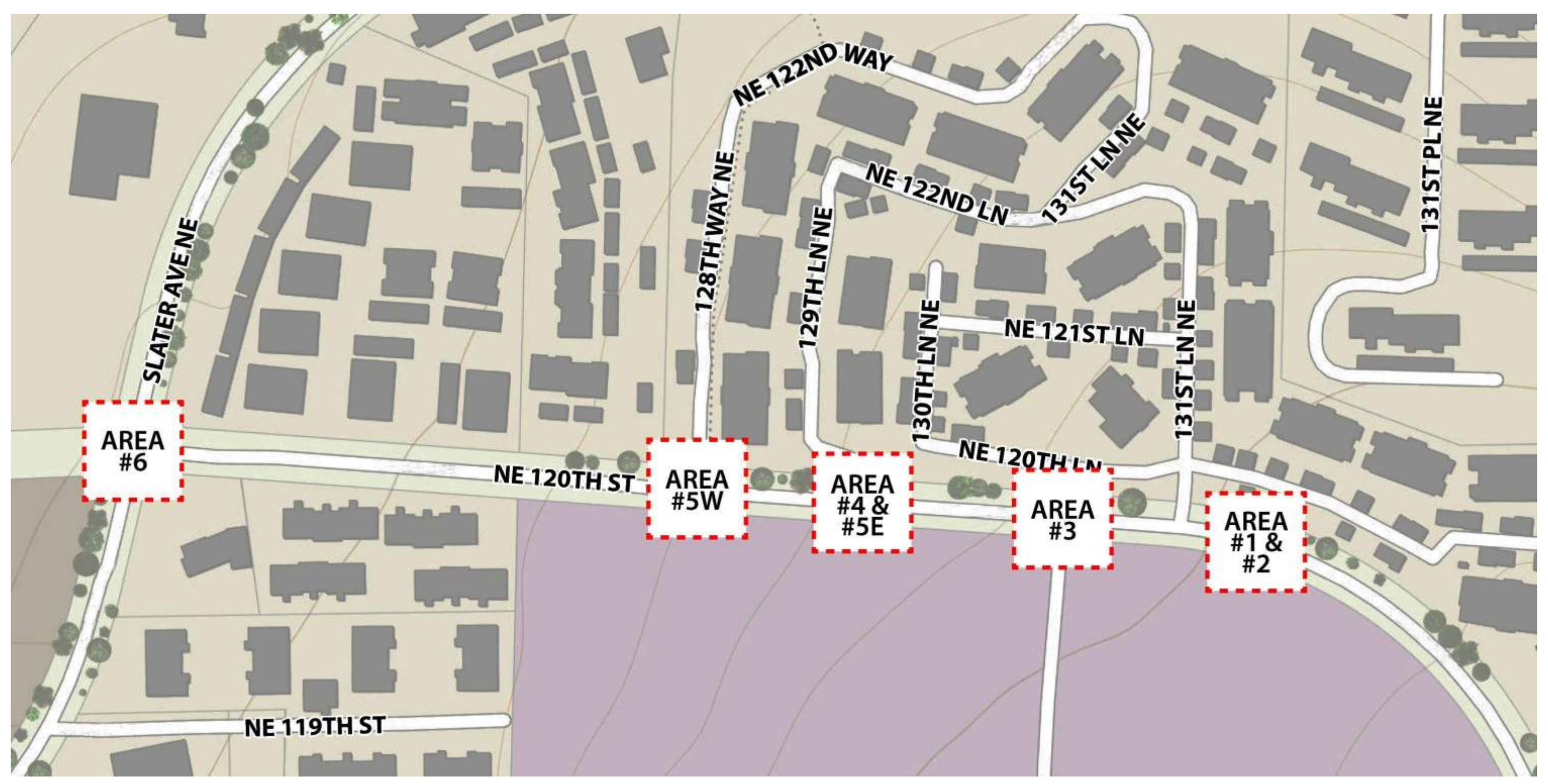
AREA #5W

SCALE: 1"=10'



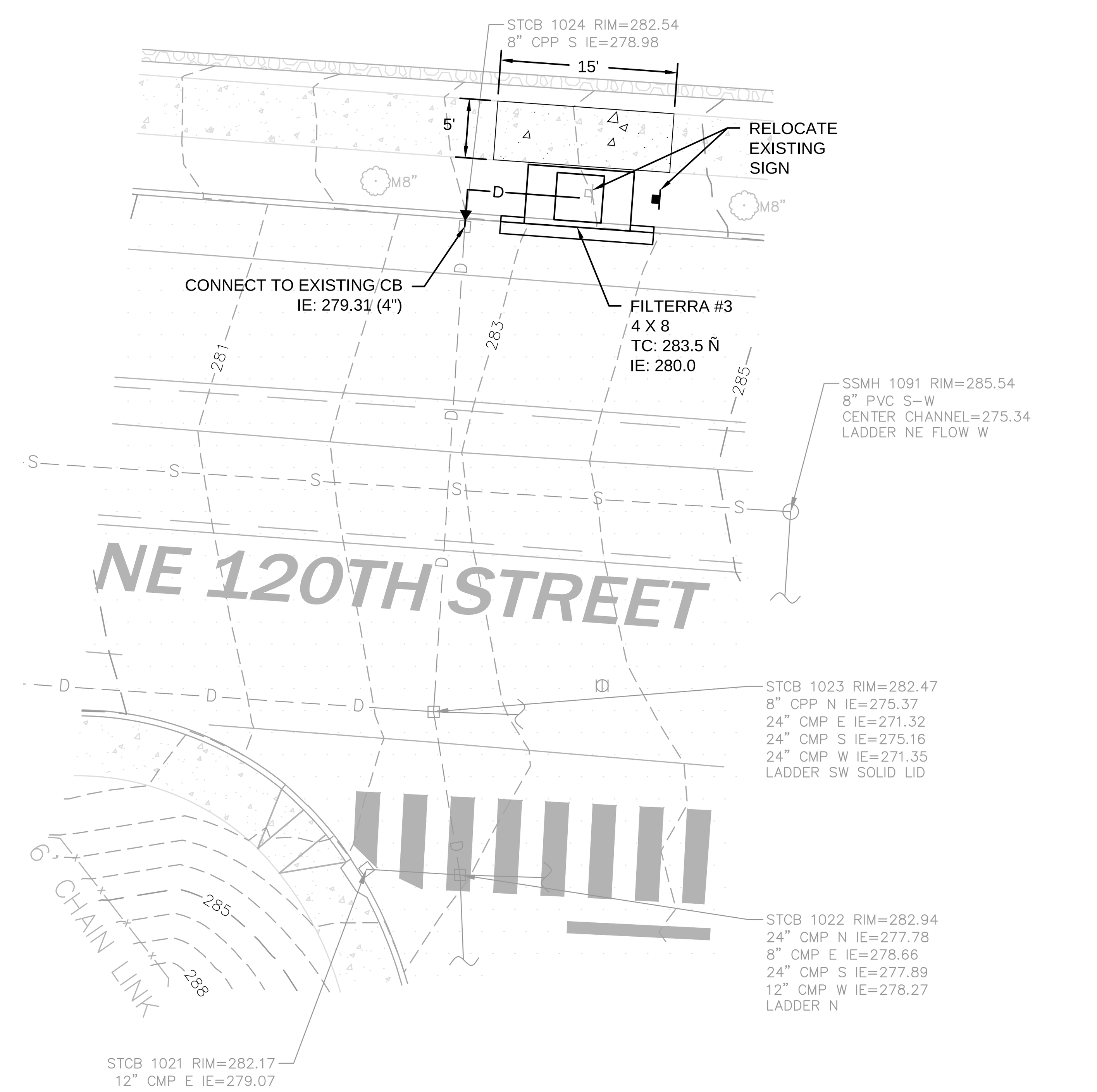
AREA #4 AND #5E

SCALE: 1"=10'



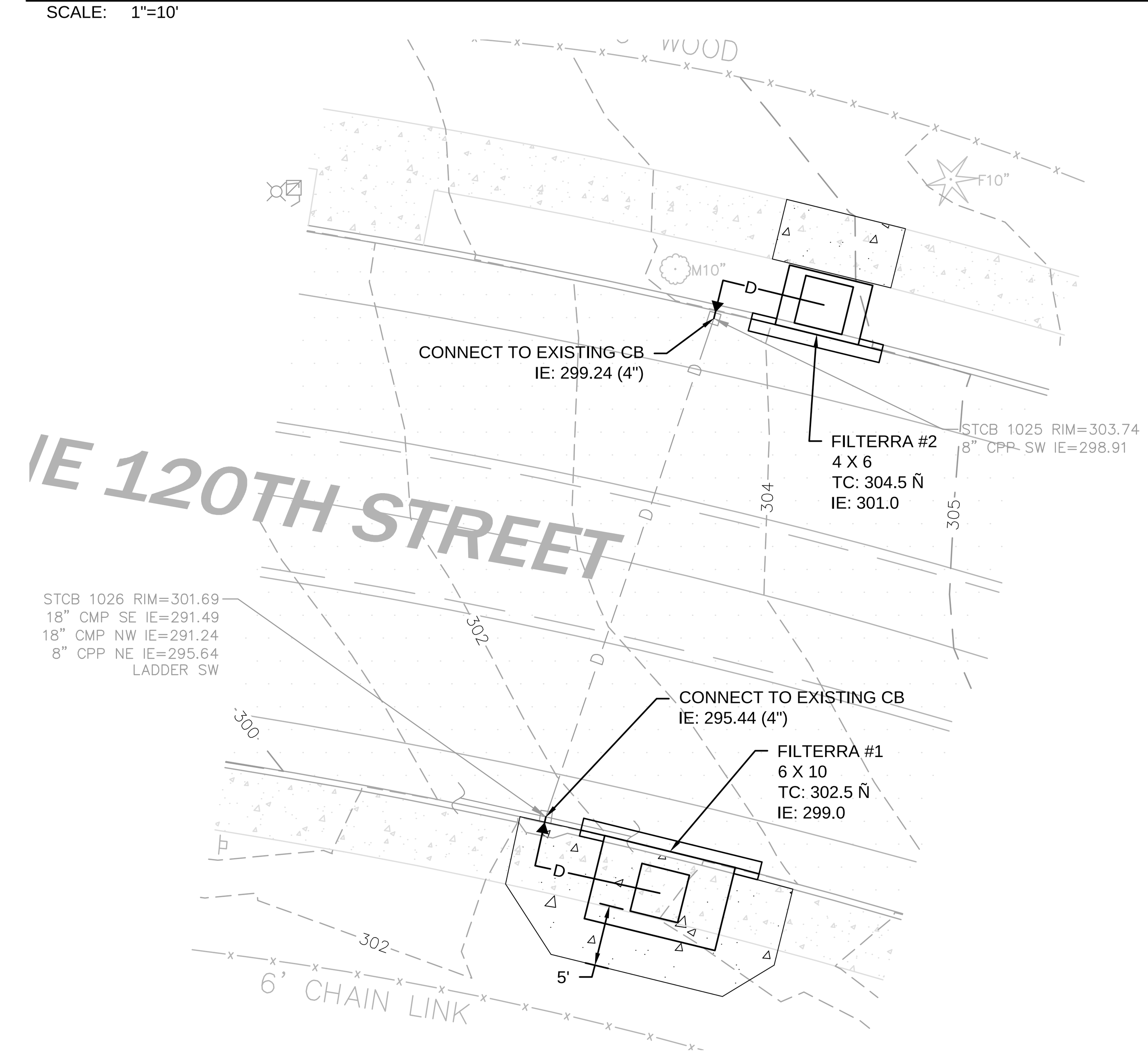
VICINITY MAP

SCALE: 1"=200'



AREA #3

SCALE: 1"=10'

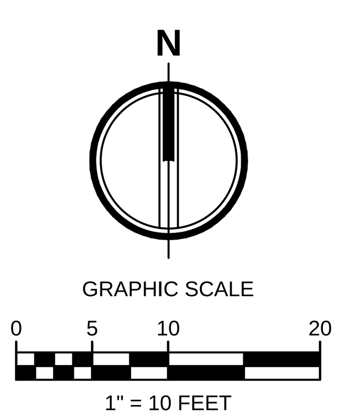


AREA #1 AND #2

SCALE: 1"=10'

LEGEND

SAWCUT AND ASPHALT PATCHING		6/2
CONCRETE WALK RESTORATION		4/2
CURB AND GUTTER RESTORATION		5/2
FILTERRA		1/2
CATCH BASIN		
STORM DRAIN	—— D ——	



AHBL
TACOMA · SEATTLE · SPOKANE · TRI-CITIES
1200 6th Avenue, Suite 1620 Seattle, WA 98101
206.267.2425 TEL 206.267.2429 FAX www.ahbl.com WEB

nhc
northwest hydraulic consultants

FILE	ENGR.	REVIEW	SCALE	DATE
			1" = 10'	6/15/15

NO.	REVISION	BY	REVIEW	DATE

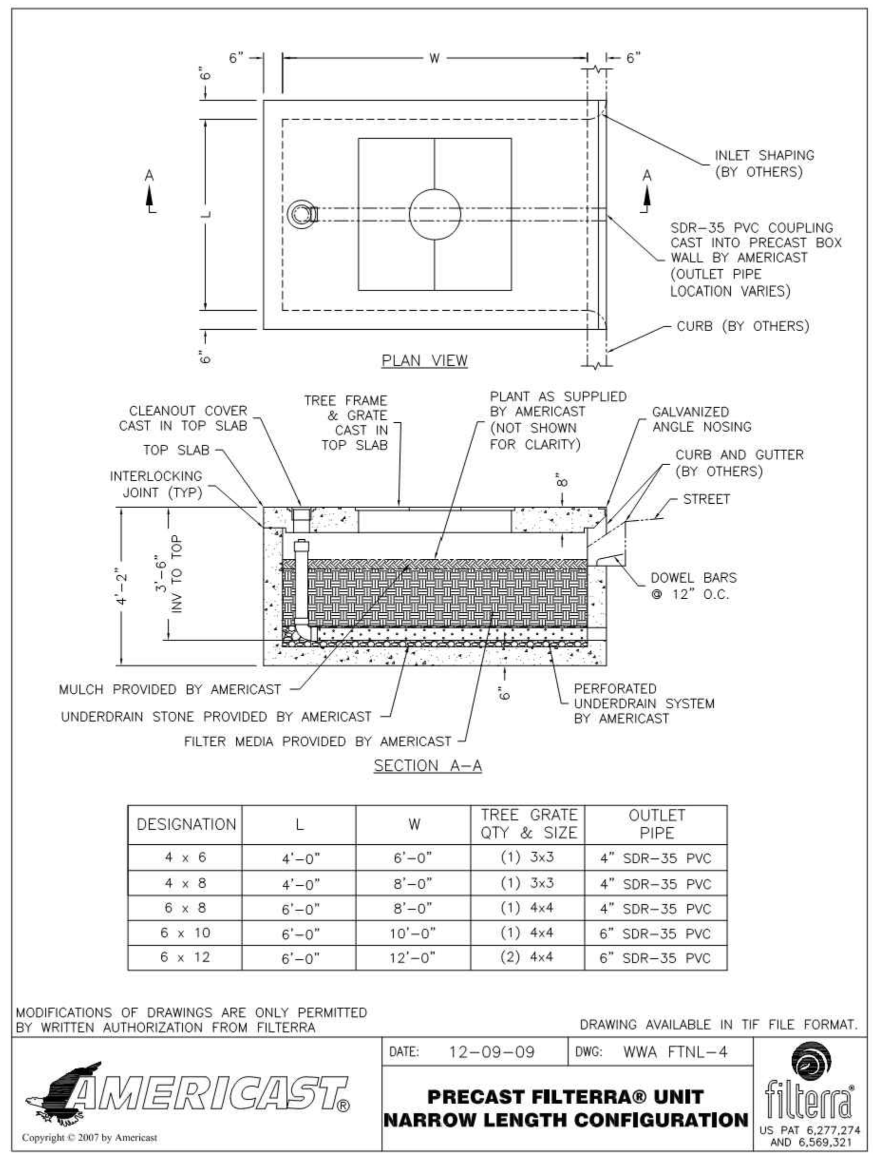
CITY OF KIRKLAND WASHINGTON

CITY OF KIRKLAND
PUBLIC WORKS DEPARTMENT
123 FIFTH AVENUE – KIRKLAND, WA 98033-6189 – (206)828-1243

N.E. 120TH STREET STORMWATER QUALITY RETROFIT CONCEPT DESIGN PLAN

SHEET 1 / 2

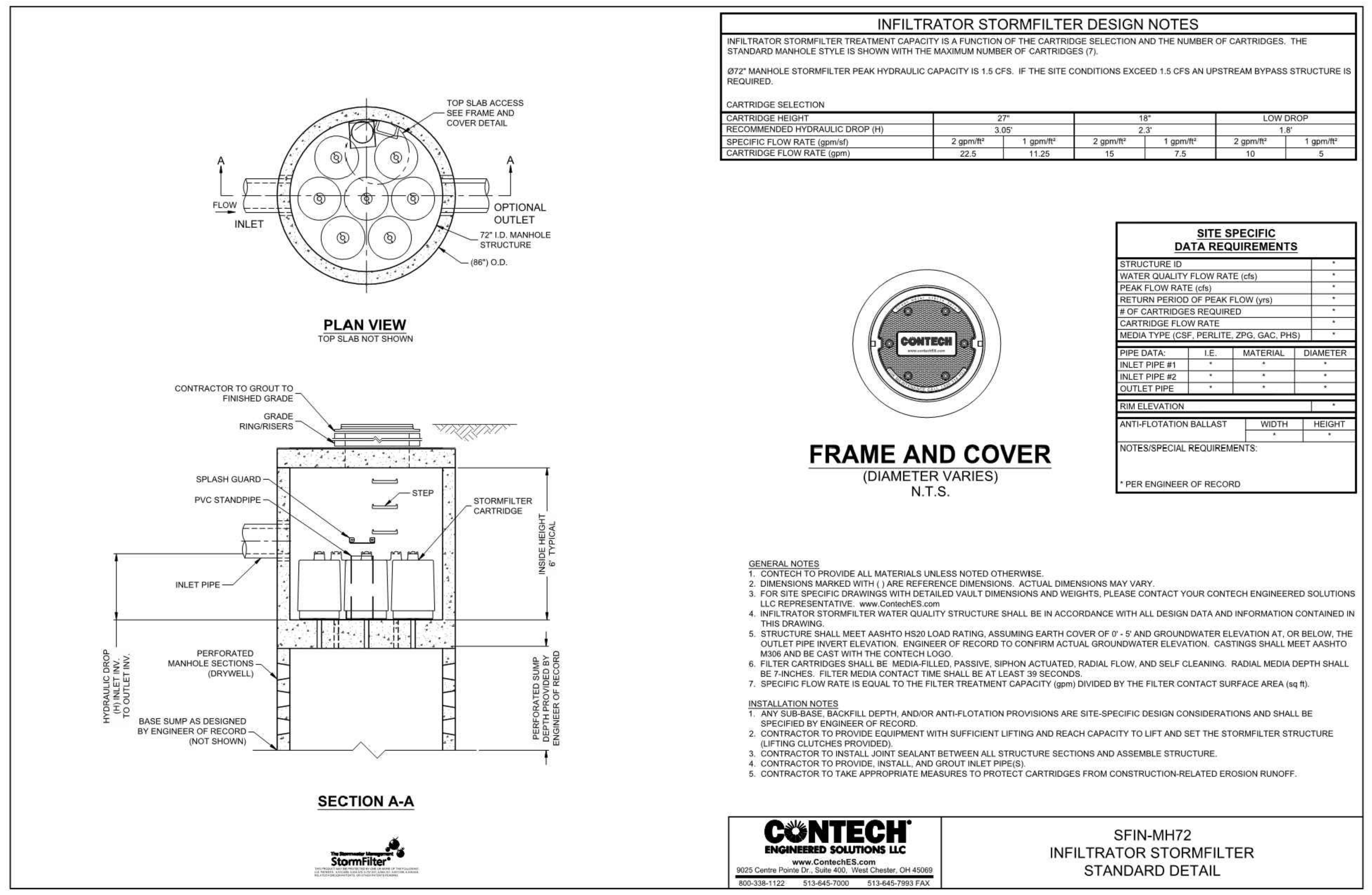
CALL BEFORE YOU DIG: 1-800-424-5555



DESIGNATION	L	W	TREE GRATE QTY & SIZE	OUTLET PIPE
4 x 6	4'-0"	6'-0"	(1) 3x3	4" SDR-35 PVC
4 x 8	4'-0"	8'-0"	(1) 3x3	4" SDR-35 PVC
6 x 8	6'-0"	8'-0"	(1) 4x4	4" SDR-35 PVC
6 x 10	6'-0"	10'-0"	(1) 4x4	6" SDR-35 PVC
6 x 12	6'-0"	12'-0"	(2) 4x4	6" SDR-35 PVC

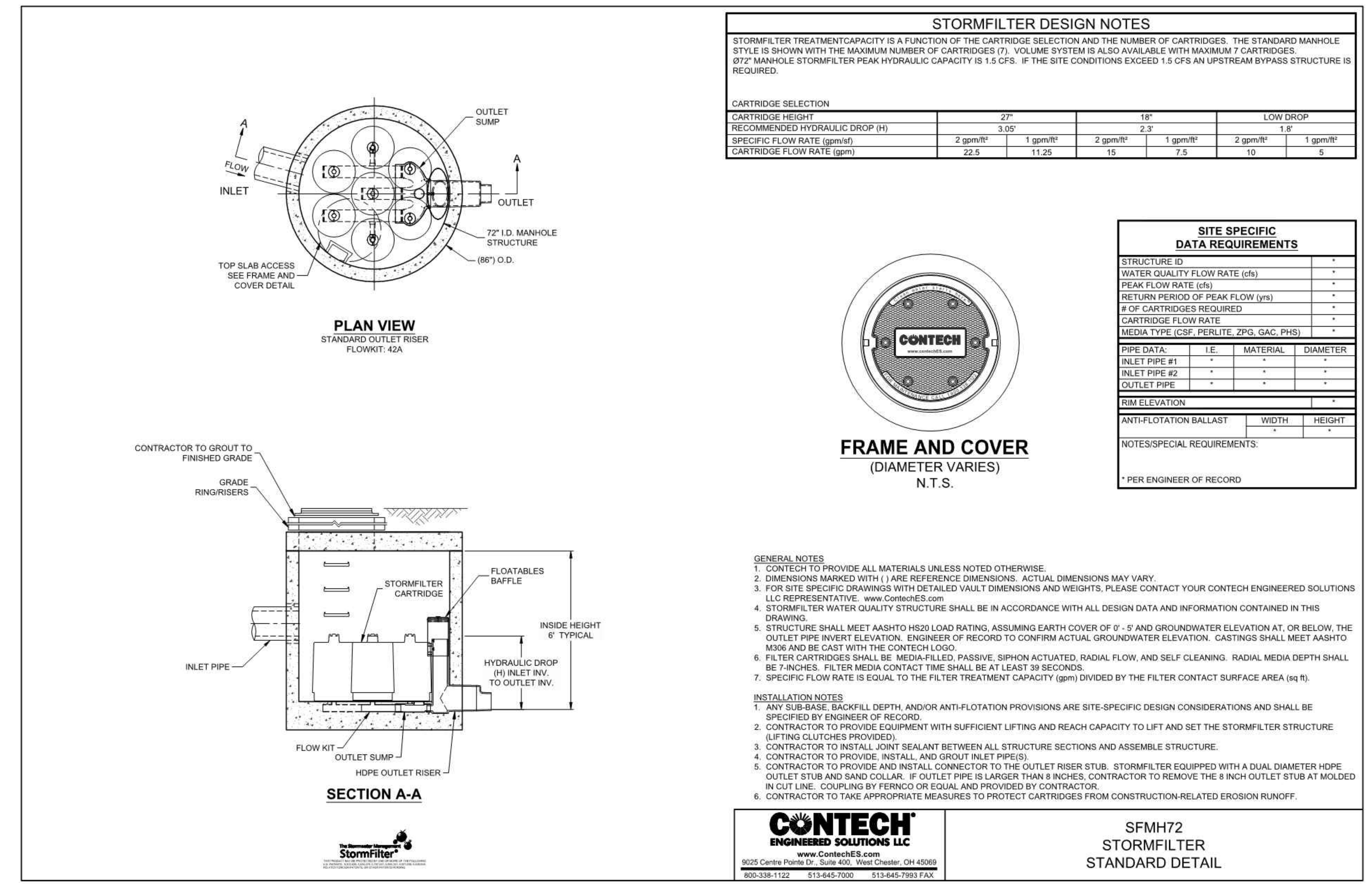
1 **FILTERA**

SCALE: NOT TO SCALE



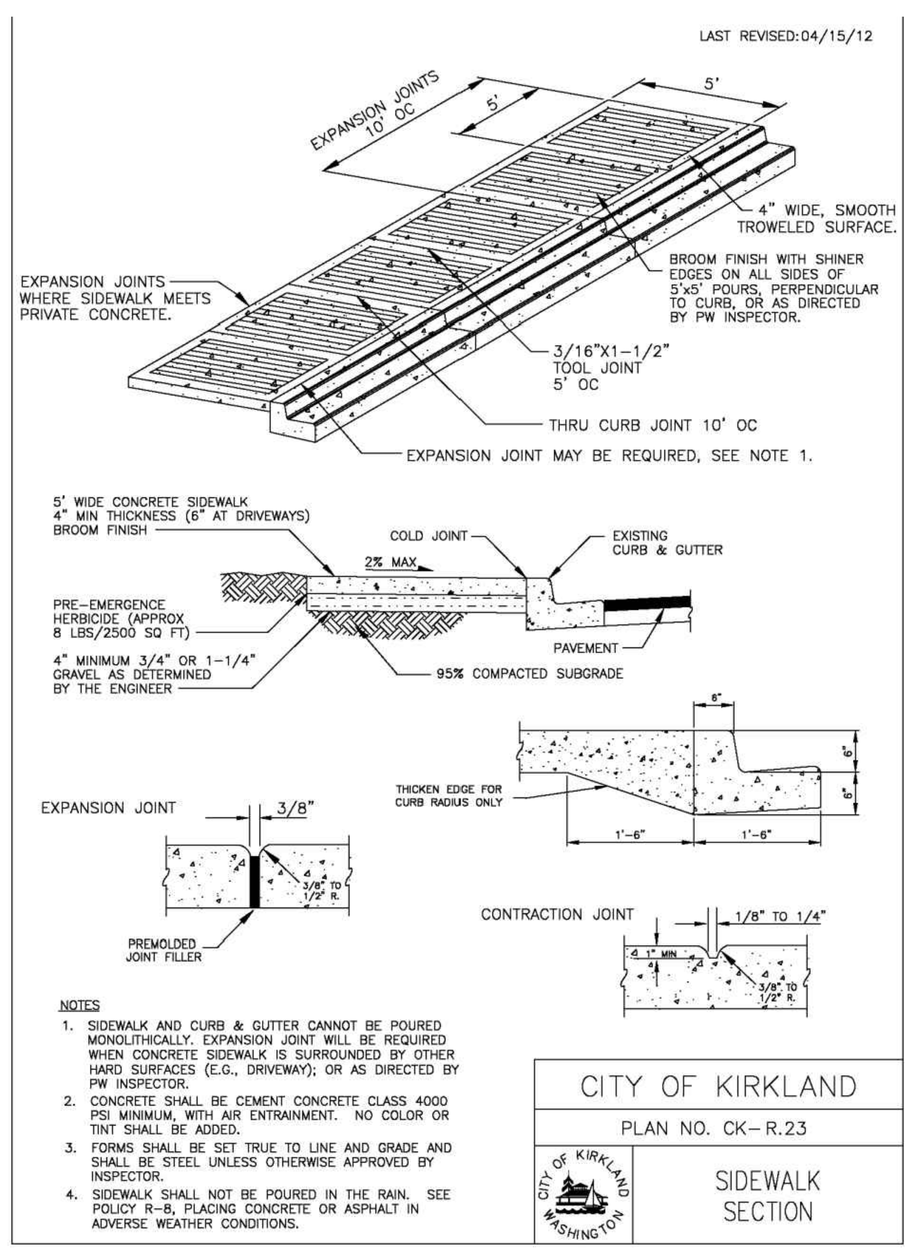
2 **STORMFILTER 72" MH INFILTRATOR**

SCALE: NOT TO SCALE



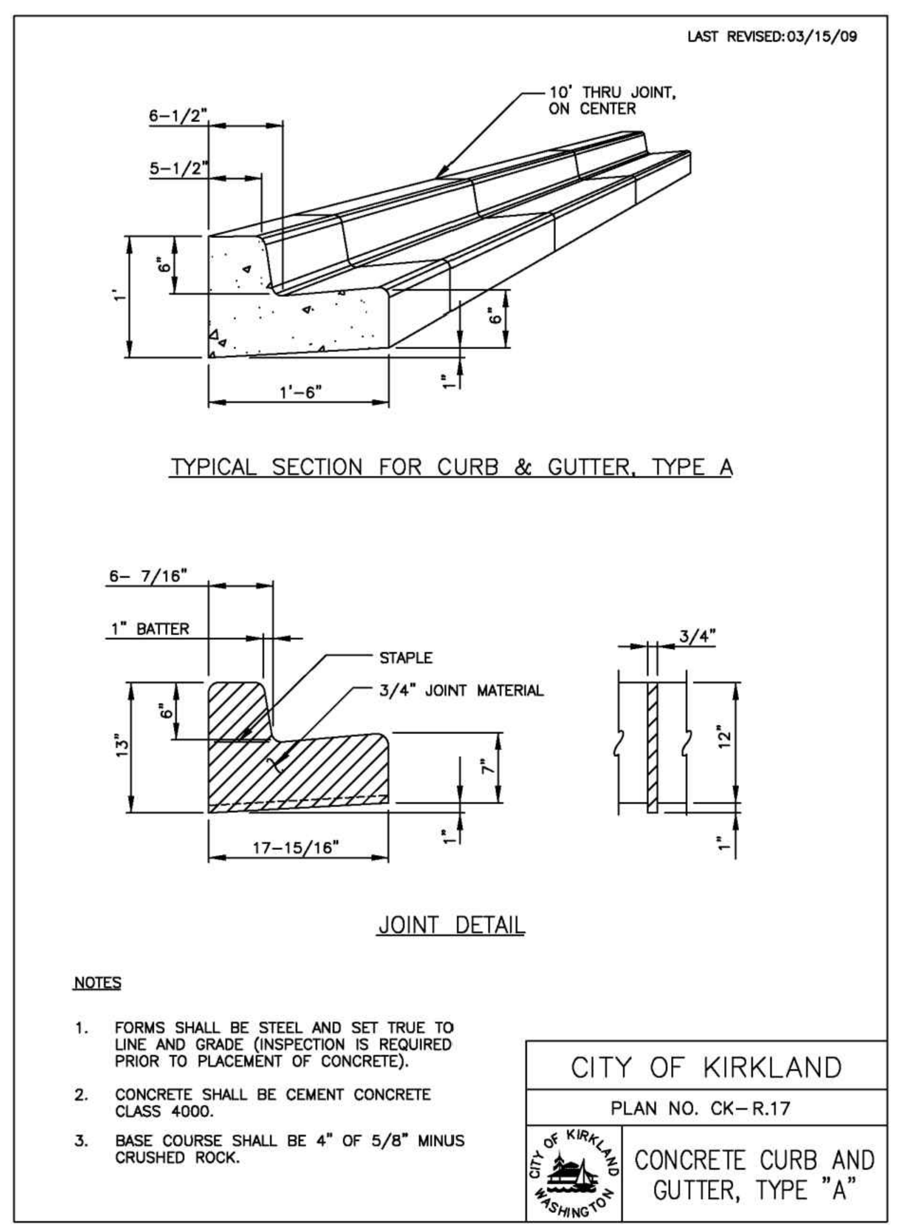
3 **STORMFILTER 72" MH**

SCALE: NOT TO SCALE



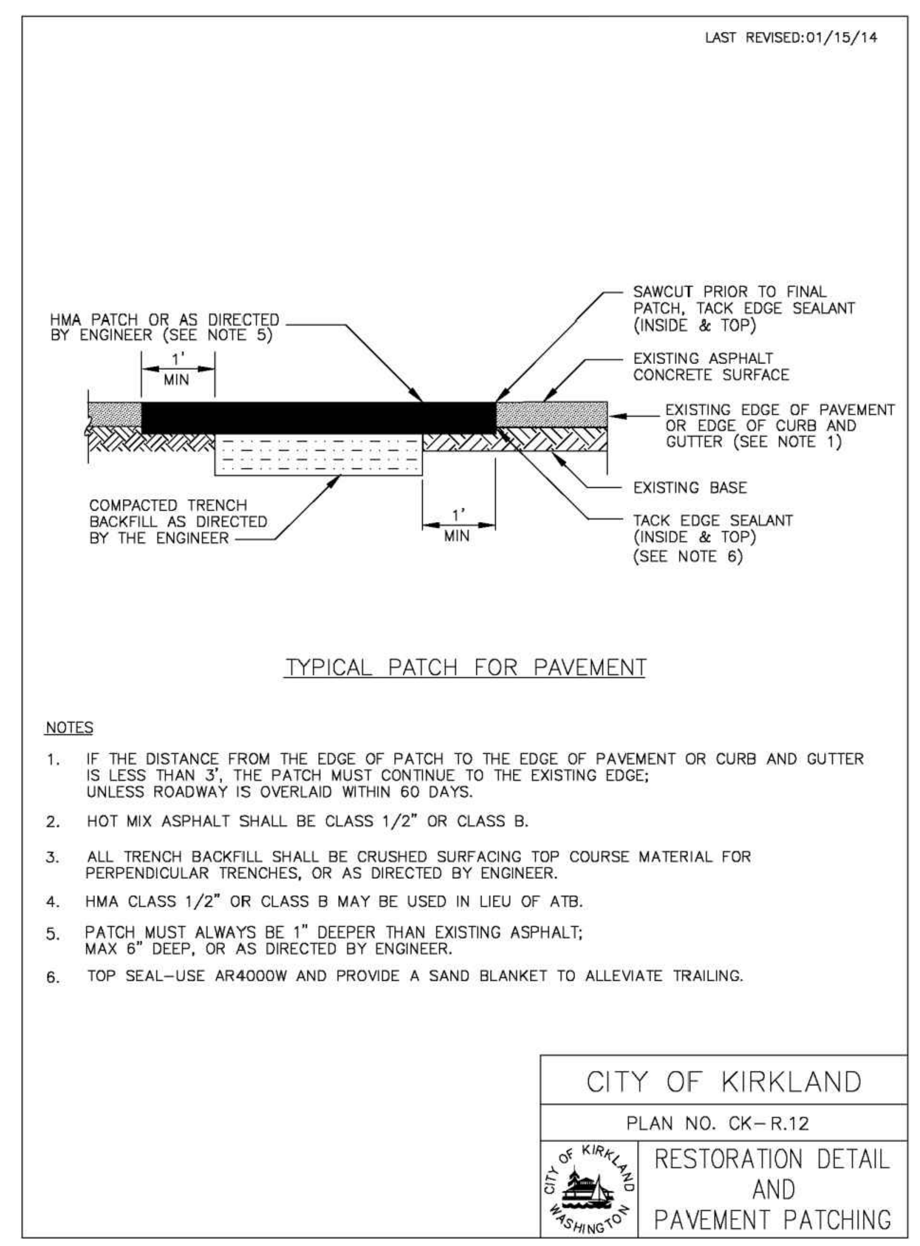
4 **SIDEWALK**

SCALE: NOT TO SCALE



5 **CURB & GUTTER**

SCALE: NOT TO SCALE



6 **PAVEMENT PATCHING**

SCALE: NOT TO SCALE

AHBL
TACOMA • SEATTLE • SPOKANE • TRI-CITIES
1200 6th Avenue, Suite 1620 Seattle, WA 98101
206.267.2425 TEL 206.267.2429 FAX www.ahbl.com WEB

nhc northwest hydraulic consultants

FILE	ENGR.	REVIEW	SCALE	DATE

NO.	REVISION	BY	REVIEW	DATE

CITY OF KIRKLAND WASHINGTON

CITY OF KIRKLAND
PUBLIC WORKS DEPARTMENT
123 FIFTH AVENUE – KIRKLAND, WA 98033-6189 – (206)828-1243

N.E. 120TH STREET STORMWATER QUALITY RETROFIT CONCEPT DESIGN PLAN

SHEET 2 / 2

CIVIL & STRUCTURAL ENGINEERS ● LAND PLANNERS ● LANDSCAPE ARCHITECTS

Opinion of Probable Cost

PROJECT: 120TH KIRKLAND TOTEM LAKE
PREPARED BY: Jared McDonald
DATE: June 18, 2015
PROJECT NO.: 2130516.10

PROBABLE CONSTRUCTION COST SUMMARY

Sect. #	Description		Estimated Cost
010	Site Preparation		5,443.50
020	Erosion Control		7,000.00
030	Storm Drainage System		183,270.00
040	Road Construction		12,245.00
050	Traffic Control		15,000.00
100	Miscellaneous Const.		11,148.00
		Subtotal	$234,107
Design Contingency		20.00%	$46,821
		Grand Total	$280,928
		Use	$290,000

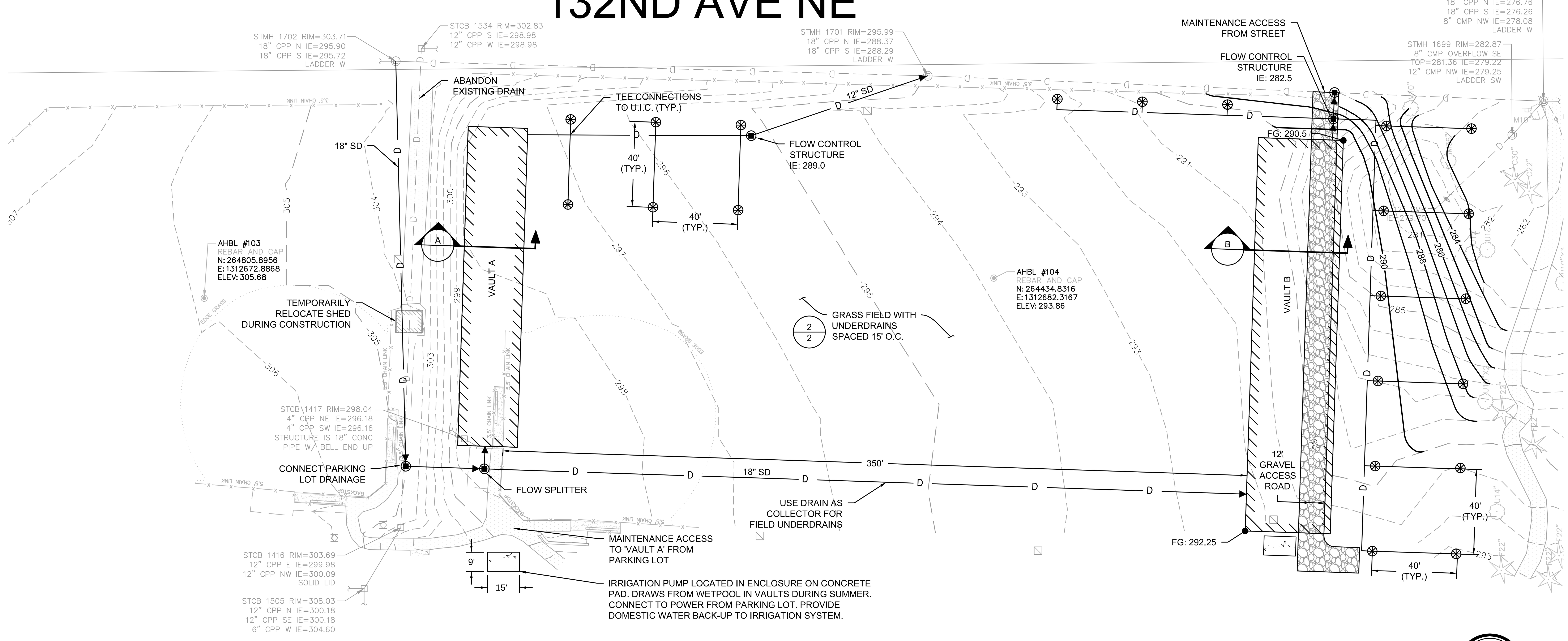
Notes:

1. Estimate excludes City, County, and Utility District Fees.
2. Estimate excludes sales tax.
3. Estimate is in 2015 dollars. Escalation beyond 2015 should be added.
4. Estimate excludes design and permitting fees expected to be approximately 20% of construction cost or $58,000.

Filename: 2130516 120th Cost Est. 6/30/2015 7:01 PM

CALL BEFORE YOU DIG: 1-800-424-5555

132ND AVE NE

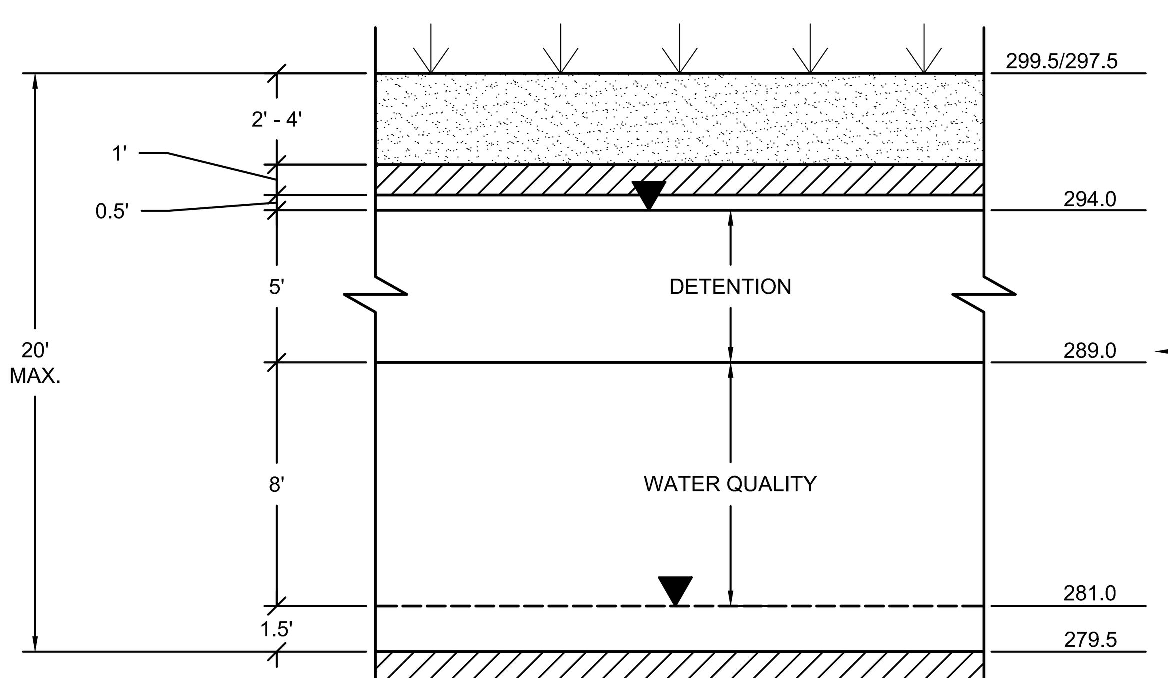


LEGEND

GRAVEL ACCESS ROAD	
U.I.C. WELL	
CONTOURS	282
CONCRETE VAULT	
CATCH BASIN, TYPE 2	
STORM DRAIN	D

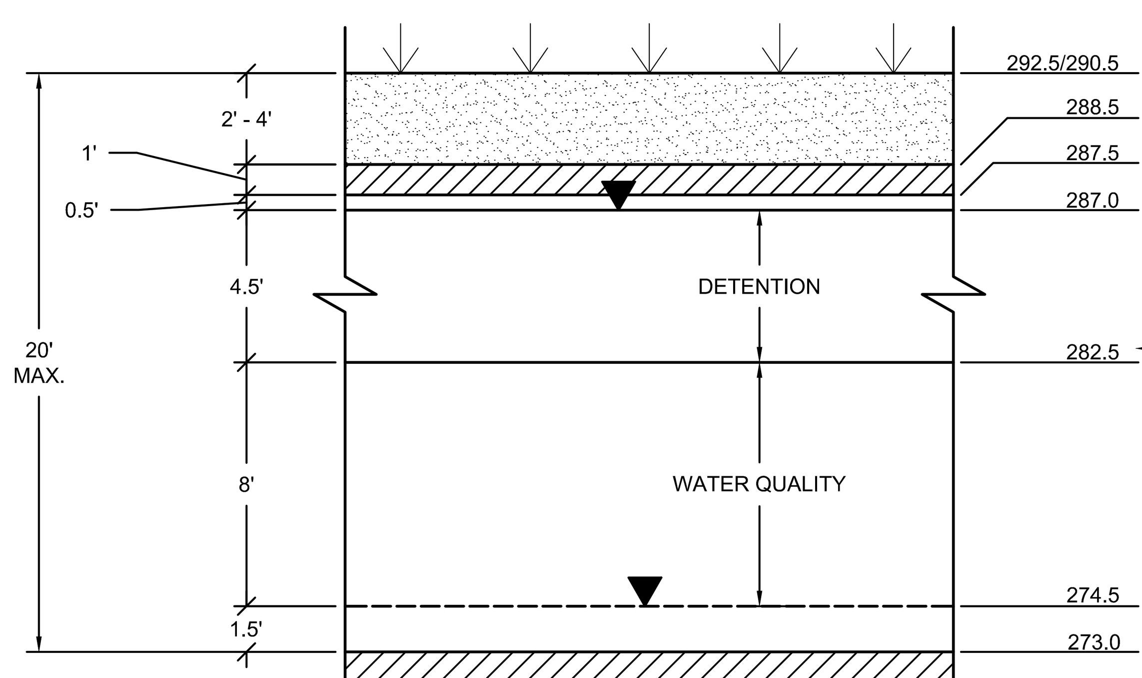
VICINITY MAP

SCALE: 1"=200'



- AREA = 4,200 SF
- DETENTION VOL. = 21,000 CF
- WQ VOL. = 33,600 CF
- OPEN GRATE AREA = 168 SF

TOTAL VOLUMES, BOTH VAULTS:
- WQ VOL. = 92,800 CF
- DETENTION VAULT VOL. = 50,600 CF



- AREA = 7,400 SF
- DETENTION VOL. = 33,300 CF
- WQ VOL. = 59,200 CF
- OPEN GRATE AREA = 296 SF

A VAULT A SECTION
NOT TO SCALE

B VAULT B SECTION
NOT TO SCALE

AHBL
TACOMA · SEATTLE · SPOKANE · TRI-CITIES
1200 6th Avenue, Suite 1620 Seattle, WA 98101
206.267.2425 TEL 206.267.2429 FAX www.ahbl.com WEB

nhc northwest hydraulic consultants

FILE	ENGR.	REVIEW	SCALE	DATE
			1" = 30'	6/15/5

NO.	REVISION	BY	REVIEW	DATE

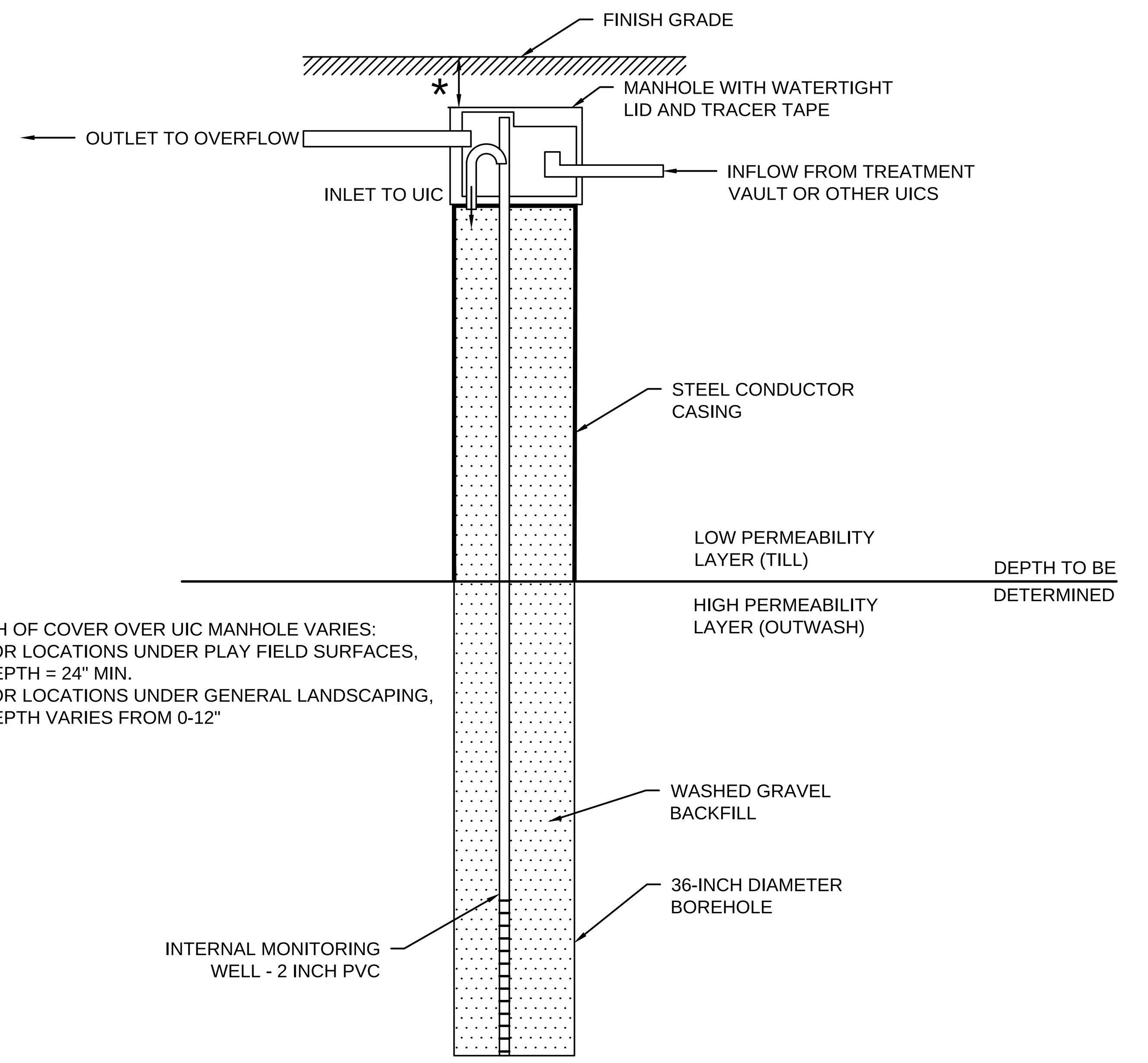
CITY OF KIRKLAND WASHINGTON

CITY OF KIRKLAND
PUBLIC WORKS DEPARTMENT
123 FIFTH AVENUE – KIRKLAND, WA 98033-6189 – (206)828-1243

132ND SQUARE PARK STORMWATER QUALITY RETROFIT CONCEPT DESIGN

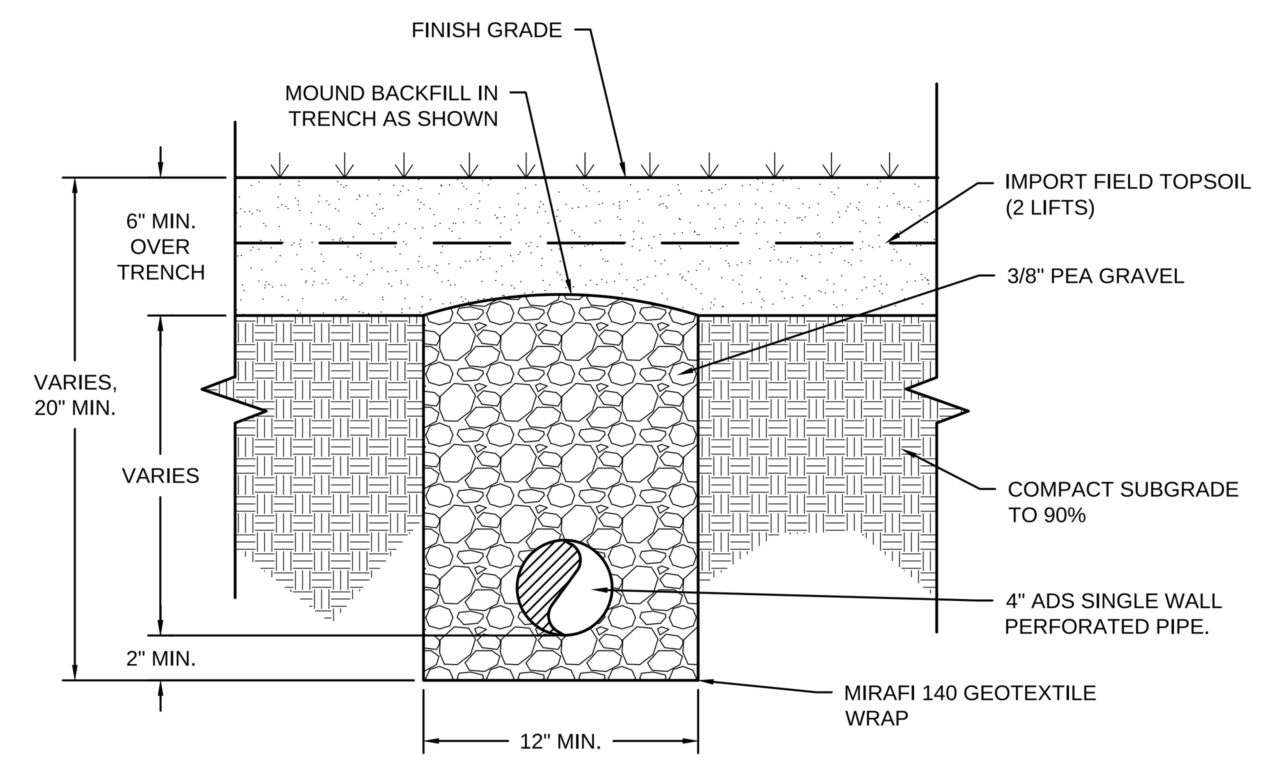
SHEET 1 / 2

CALL BEFORE YOU DIG: 1-800-424-5555



* DEPTH OF COVER OVER UIC MANHOLE VARIES:
- FOR LOCATIONS UNDER PLAY FIELD SURFACES, DEPTH = 24" MIN.
- FOR LOCATIONS UNDER GENERAL LANDSCAPING, DEPTH VARIES FROM 0-12"

1 UIC WELL SCHEMATIC
NOT TO SCALE



2 GRASS FIELD WITH UNDERDRAIN
NOT TO SCALE

AHBL
TACOMA · SEATTLE · SPOKANE · TRI-CITIES
1200 6th Avenue, Suite 1620 Seattle, WA 98101
206.267.2425 TEL 206.267.2429 FAX www.ahbl.com WEB

nhc northwest hydraulic consultants

FILE	ENGR.	REVIEW	SCALE	DATE
			1" = 30'	6/15/5

NO.	REVISION	BY	REVIEW	DATE

CITY OF KIRKLAND WASHINGTON

CITY OF KIRKLAND
PUBLIC WORKS DEPARTMENT
123 FIFTH AVENUE – KIRKLAND, WA 98033-6189 – (206)828-1243

132ND SQUARE PARK STORMWATER QUALITY RETROFIT CONCEPT DESIGN

SHEET 2 / 2

CIVIL & STRUCTURAL ENGINEERS • LAND PLANNERS • LANDSCAPE ARCHITECTS

Opinion of Probable Cost

PROJECT: 132nd Kirkland Totem Lake
PREPARED BY: Jared McDonald
DATE: June 29, 2015
PROJECT NO.: 2130516.10

PROBABLE CONSTRUCTION COST SUMMARY

	Sect. #	Description	Estimated Cost
	010	Site Preparation	135,963.25
	020	Erosion Control	23,350.00
	030	Storm Drainage System	2,156,025.00
	040	Paving and Surfacing	4,415.00
	050	Traffic Control	8,000.00
	080	Field Replacement	297,500.00
	100	Miscellaneous Const.	131,263.00
		Subtotal	$2,756,516
Design Contingency		20.00%	$551,303
		Grand Total	$3,307,819
		Use	$3,310,000

Notes:

1. Estimate excludes City, County, and Utility District Fees.
2. Estimate excludes sales tax.
3. Estimate is in 2015 dollars. Escalation beyond 2015 should be added.
4. Estimate excludes design and permitting fees expected to be approximately 15% of construction cost or $495,000.

Appendix G

132nd Square Park
UIC Suitability

RH2 ENGINEERS PLANNERS SCIENTISTS

RH2 TECHNICAL

Memorandum

Client: Northwest Hydraulic Consultants and City of Kirkland

Project: Totem Lake Stormwater Retrofit UIC

Project File: NHC 114.014.01.101 **Project Manager:** Rick Ballard, P.E.

Composed by: Steve Nelson, L.H.G.

Subject: UIC Suitability at 132nd Square Park Site

Date: May 15, 2015

State of Washington
Engineering Geologist
1402
Licensed Geologist
STEPHEN ERIC NELSON

5/15/15

INTRODUCTION

RH2 Engineering, Inc., (RH2) has prepared this memorandum summarizing the potential suitability and capacity for deep injection of stormwater using underground injection control (UIC) wells at the 132nd Square Park (the Park) at the intersection of NE 132nd Street and 132nd Avenue NE in the City of Kirkland. The site conditions affecting the suitability of UIC wells was evaluated using available geologic and geotechnical information, including the geologic and geotechnical boring data available on the Washington Department of Natural Resources (WADNR) Washington Interactive Geologic Map, King County (County) Critical Areas mapping, and a 2010 report completed by AMEC Earth and Environmental (Hydrogeologic Report: John Muir Elementary School, Kirkland, Washington).

Suitability of the Park Site

Three shallow soil borings were completed at and next to the Park. The borings extended only to a depth of 9 feet, and encountered medium-dense to very-dense, fine to medium sand, which may be fill soil, recessional outwash, or weathered till. No data indicated the thickness of this surficial layer, the presence of a glacial till layer, or the thickness and character of a sufficiently thick layer of outwash below the Park site. Several soil borings were completed within 1,000 feet of the Park to the south, southwest, and southeast. These borings encountered layers of fill, sandy soil, and glacial till overlying dense, fine to medium-grained sand, identified as glacial advance outwash. The outwash layer observed in these soil borings appears to range in thickness from approximately 15 to 30 feet. Some of the borings observed some groundwater at the base of the outwash. Outwash in these nearby borings consisted of fine to medium sand, with some thin silt layers and occasional gravel. The sand is very dense, indicating subsequent compression by overriding glacial ice. The composition and characteristics of advance outwash near the Park is similar to the advance outwash at John Muir Elementary (JME), which is the site of an active UIC facility, ½-mile north of the Park. The outwash at JME is 30 to 40 feet thick.

Infiltration Capacity of the Park Site

Without soil borings on the Park property, the estimate of the potential capacity of a UIC system at the Park is based on comparison of conditions and testing results for the JME property. The analysis at JME concluded that 50 UIC wells, spaced no closer than 40 feet apart, could accommodate a design flow of 0.5 cubic feet per second (cfs) or 230 gallons per minute (gpm) for a peak 100-year storm event. The analysis recommended operation of UIC wells with a discharge rate of 30 gpm, and with a design to overflow excess un-infiltrated water to surface discharge. In comparison, the outwash layer at the Park may be 50 percent thinner with a corresponding reduction in the ability to receive infiltrated stormwater. The area of the Park is similar to the area of the JME. Therefore, for planning purposes, it may be assumed that UIC wells at the Park could operate at a flow rate of 15 gpm with similar spacing of 40 feet between wells.

Potential Geologic Hazards at the Park Site

The area approximately 300 to 500 feet south of the Park along the slope between the upland and lowland areas is mapped by the County as a landslide-hazard area. This area is generally stable, but a significant increase in soil moisture, such as the introduction of water from UIC wells, could migrate to the south and emerge as springs. Excessive spring discharge without mitigating drainage from the slope could potentially destabilize the slope. At the JME site, a similar landslide hazard exists east of the JME. The distance between active UIC wells at the JME site and area mapped as a slope hazard is approximately 300 to 500 feet. Analysis for the JME UIC project concluded that the potential effect of the UIC wells on groundwater and soil moisture was sufficiently distant from the slope.

Additional Analyses Needed

Before any further analyses of the UIC approach is conducted, the subsurface below the Park site should be characterized by drilling to depths of up to 100 feet to characterize the layering and composition of geologic units below the Park, to install a groundwater monitoring well to observe and measure the seasonal range in depth to groundwater below the Park, and install a test UIC well for infiltrating potable water into the test UIC well and observing the response to groundwater injection. These data would be used to refine the potential capacity of the site for deep infiltration of stormwater. More detailed mapping and analyses would be required to evaluate the potential geologic hazards at and south of the Park site to estimate the potential effects of increased soil moisture on slope stability and identify the potential structures that could be affected by deep injection of stormwater.

Appendix H

HSPF Model
Readme Files

Final HSPF Models for Totem Lake Stormwater Retrofit Project
For: City of Kirkland, Jenny Gaus
Developed by: Northwest Hydraulic Consultants, 206-241-6000, Pat Flanagan & Patty Dillon

Models run in WinHSPFLt (BASINS 4.1, uses HSPF version 12.2)

Totem Lake HSPF models originated from King County's Juanita Creek basin model (King County, 2012). Subbasins and FTABLEs modified for Totem Lake portion of the basin above I-405 (including adjacent basin areas affected by redelineation of subbasins). Water quality routines turned off for Totem Lake modeling, and WQ inputs not updated for modified subbasins.

Each model scenario is set up in an independent directory with identical file structure.
Directories are associated with model scenarios as follows:
Forest - Forested land use for Totem Lake basin only (no modifications to land use in rest of Juanita Creek), no change to FTABLEs
Baseline - Existing land use, Totem Lake (426) and Totem Lake Blvd (402) FTABLEs calibrated to lake levels post-2013 culvert project
Pre-2013 - Existing land use, Totem Lake (426) and Totem Lake Blvd (402) FTABLEs calibrated to lake levels pre-2013 culvert project (used for model validation only)
AltSite2A - Existing land use, retrofit concept 2A added
AltSite2B - Existing land use, retrofit concept 2B added
AltSite14 - Existing land use, retrofit concepts for 14E/W added
AltSite16 - Existing land use, retrofit concept 16 added
AltSite22 - Existing land use, retrofit concept 22 added
AltSite26A - Existing land use, retrofit concept 26A added
AltSite26B - Existing land use, retrofit concept 26B added
RetrofitAll - Existing land use, all preliminary concepts added
Retro132 - Existing land use, 132nd Square capital project added

Within individual directories, the key files are:
prec.wdm - Data storage file containing precipitation and evaporation input timeseries
*.uci - HSPF model input file
*.wdm - Data storage file containing flow and stage output timeseries for key locations

Appendix I

SWMM Model
Readme Files

Final SWMM Models for Totem Lake Stormwater Retrofit Project
For: City of Kirkland, Jenny Gaus
Developed by: Northwest Hydraulic Consultants, 206-241-6000, Pat Flanagan & Patty Dillon

Models developed using PC-SWMM 2014 v5.7
Models run in engine version SWMM5.1.007

10year and 100year events based on Total Inflow to Totem Lake.
Inflows Generated from HSPF model (WY 1949-2015), developed by NHC.

Model Names/Scenarios:
TL_10yr_v7hfinal_Existing.inp =   10-year Event, Geometry is "existing conditions" as of spring 2015.
TL_10yr_v7hfinal_132ndPark.inp =   10-year Event, Added proposed stormwater retrofit project at 132nd Square Park (2 Vaults and Infiltration).
TL_100yr_v7hfinal_Existing.inp =   100-year Event, Geometry is "existing conditions" as of spring 2015.
TL_100yr_v7hfinal_132ndPark.inp = 100-year Event, Added proposed stormwater retrofit project at 132nd Square Park (2 Vaults and Infiltration).

G1400024 – Totem Lake/Juanita Creek Basin

Ecology comments on "Totem Lake/ Juanita Creek Basin Stormwater Retrofit Conceptual Design, Final Project Report for Grant G1400024" by City of Kirkland, dated July 15, 2015, received July 31, 2015.

1. ***Executive Summary, Introduction, Page III***, The first bullet indicates that the project objective is to "test the feasibility of the flow control standard…(ECY08)". This was not a clearly stated objective in the grant. Ecology maintains that the ECY08 standard is a feasible standard and is the basis for Minimum Requirement #5 and #8. It does not seem that Kirkland is proposing that the Minimum Requirements are infeasible. Based on further reading of the Final Report, this objective might be refined to indicate that Kirkland was attempting to satisfy the ECY08 through retrofits only and not considering the impact of New and Redevelopment. **Clarify this statement in the Final Report**.
2. ***Executive Summary, Results, Page IV,*** The discussion on "flow impacts" centers on volumes and flood peaks. Ecology's Flow Control standards, including ECY08 are based on restoring the duration regime within the targeted Flow range. **Clarify how the study ties to Ecology flow based standard.**
3. ***Introduction, Section 1.2 Project Goals, Page 1,*** The first bullet indicates that the project objective is to "test the feasibility of the flow control standard". This was not a clearly stated objective in the grant. **See Comment 1 for more details and clarify the statement regarding Flow Control.**
4. ***Introduction, Section 3.2 Gap Analysis, Treatment required to Meet Current Standards, Page 7,*** The LID scenario is a little confusing. It is unclear why the proposed Bioretention facilities were designed to capture 50 percent of the runoff from infiltrative areas. It was also unclear why permeable pavement was not considered in this scenario. This could have made the goal significantly more achievable. **Clarify why the LID capture area was limited and why permeable pavement was not considered in the LID scenario.**
5. ***Introduction, Section 1.2 Project Goals, Page 2,*** The text indicates that the construction of regional facilities will encourage redevelopment. While this is acceptable as an ancillary benefit, it was not one of the primary goals for the Grant. The purpose of the grants was to encourage Watershed health and restoration.
6. ***Retrofit Analysis, Section 4.3 Evaluation of Alternatives, pages 27-30,*** This section discusses at length the flood related impacts based on volume and return interval frequency flows. While this is ancillary and useful information for the jurisdiction, the focus of this grant was primarily Stormwater related to the Ecology's Flow Control and LID performance Standards. It is acceptable that the jurisdiction discusses these concerns, a disclaimer/explanation that the flood related information would help future readers understand that this is not directly related to Ecology's Municipal Stormwater Standards.
7. ***Outcomes and Lessons Learned, Section 6.2 Totem Lake Stormwater Retrofit Projects – Lessons Learned, Page 41,*** The focus of the outcomes seems to be on the burdens of cost that could pose a barrier to Redevelopment. While this is an understandable concern for the municipality,

this grant focusses on efforts to restore a watershed. The applicant states that the ability to restore the watershed cannot be met with retrofits alone. Ecology has long acknowledged that there are multiple approaches that must be taken to restore a watershed. The New and Redevelopment Requirements are a key portion of the permit. Kirkland indicates that they may want to explore the "area-swapping or equivalent-area treatment" to other basins where there are more opportunities for regional facilities, such as the Redmond Plan. Kirkland must understand that there remains an obligation to retrofit the Totem Lake watershed, even if they transfer some of the upcoming improvements to an identified higher priority basin. There is a possibility that the Totem Lake watershed would be identified as a high priority basin and it would not be acceptable to transfer out of this basin. This is said to emphasize that a Stormwater Transfer Program is not simply a certainty to allow "Area-swapping", the transfer must result in a more significant benefit in a higher priority watershed. **Ecology recommends that you discuss the intent to comply with the appropriate Stormwater Transfer Program requirements and acknowledge the importance of New and redevelopment requirements if a transfer is not possible.**