West Bay Drive Sidewalk Project

90% Design STORMWATER SITE PLAN

Prepared for:

City of Olympia PO Box 1967 Olympia, WA 19507-1967

Prepared by:

Craig Andersen, PE, City of Olympia, 360-753-8709

April 2014

Project Engineer's Certification

"I hereby certify that this Drainage and Erosion Control Plan for West Bay Drive Sidewalk Project has been prepa
by me or under my supervision and meets minimum standards of the City of Olympia and normal standards o
engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability
the sufficiency, suitability, or performance of drainage facilities designed by me."

Final report is to be stamped by a professional engineer

Table of Contents

1.0 Project Overview

This project site is approximately .5 acres in size, and is located in Olympia, Washington on the west side of Budd Inlet. Please see the vicinity map (Exhibit 1) provided in Appendix A.

The project will improve West Bay Drive from Brawne Avenue NW to Smyth Landing, a combined office space/condominium building located at 1801 West Bay Drive NW. The design will accommodate northbound and southbound 11-foot vehicle lane and a future 5-foot bicycle lane. New sidewalk, curb, ADA ramps, and planter strips will be constructed along the west side o West Bay Drive from 1115 West Bay Drive to 1801 West Bay Drive (Smyth Landing). Retaining walls will also be constructec where necessary to keep the sidewalk within right-of-way as much as possible. Stormwater collection and conveyance will be revised to accommodate the new curb alignment.

Post development, the stormwater will be collected from the west side of the street along a curb, and be directed to Budd Inle via a closed conveyance system. Please see the plan sheets provided in Appendix A for the proposed stormwater runoff conveyance.

The project adds approximately 12000 square feet (S.F.) of new impervious surface and contributes to 6 different outfalls to Budd Inlet along West Bay Drive. The project is exempt from the detention requirement, because it discharges directly into Budd Inlet. The project is also exempt from the quality treatment requirement, because there is 2442 S.F. new effective pollution generating impervious surface which does not exceed the allowable 5,000 S.F.. The minimum requirements are described in more detail in the sections below.

2.0 Existing Conditions

2.1 Existing Storm System

The existing stormwater runoff is conveyed to Budd Inlet via ditches and a closed conveyance system. Please see the existir hydraulic features map (Exhibit 2) provided in Appendix A for an overview of the existing stormwater runoff conveyance.

2.2 Existing Soils

Per the NRCS web soil survey website, soils at the project site are primarily Xerorthents, 0 to 5% slopes, which are describe as tidal flats, with a parent material of "sandy and loamy cut and fill material". Other soil types shown at the site all have low (-0.06 in/hr) infiltration rates (Ksat) from their most limiting layer. The depth to the restrictive feature is 20 to 72 inches, and the depth to the water table is more than 80 inches. (USDA, 2011)

A geotechnical report specific to the project corridor was drafted in 2010 by Landau Associates. Please see this geotechnical report, provided in Appendix B, for more specific soils information. The data from the NRCS web soil survey website is also provided in Appendix B.

calculations provided in Appendix C.

4.1 Utility Conflicts

During design finalization, the areas with potential conflicts will need to be addressed. Possible solutions include designing s pipe depth to miss the utilities, moving the existing utilities, or moving the CB to miss the existing utility. Where abandoned catch basins are within 5'+/- of the new catch basin, a 6' diameter manhole is being considered so the solid lid to the abando catch basin can be eliminated because these solid lids can create an unsmooth ride for bicycles.

5.0 Summary of Minimum Requirements

The ten minimum requirements (MRs) and two additional requirements (ARs) outlined in the Olympia Manual were evaluated for applicability for this project. The project-wide areas used for determining the applicability of the minimum requirements are as follows:

- New Impervious Surfaces: (approximately12,000 S.F.)*(See Exhibit 3, Appendix C)*
- Replaced Impervious Surfaces: (approximately 12,800 S.F *(See Exhibit 4, Appendix C)*

Existing Driving Lanes, Curbs, Sidewalks, Bike Paths, and Shoulders (Existing Impervious Surfaces): approximately 61,000 S.F. *(See Exhibit 5, Appendix C)*

- Preliminary Estimated Cost of the Road Project: Presently the 60% engineer's estimate is at $990,000.

The areas above were calculated using AutoCAD 2012 software, utilizing survey information provided by the city, as well as aerial photography for parts of the existing impervious areas. Please see the Area Exhibits provided in Appendix C.

With the above areas, the ((Flow Chart for Determining Requirements for Road Redevelopment", taken from the Olympia Manual, was used to determine the minimum requirement applicability for the project site. The results from the flow chart wer that MRs #1-5 apply to the new and replaced impervious surfaces and the land disturbed, and MRs #6-10 apply to the new impervious surfaces only. ARs #1 and #2 also apply to the new impervious surfaces.

Please see the ((Flow Chart for Determining Requirements for Road Redevelopment" provided in Appendix C.

5.5 MR #5: Onsite Storm water Management, including Easements and Setbacks

This MR asks that Best Management Practices (BMPs) be used to the maximum extent practicable to convey, infiltrate, disperse, and retain stormwater runoff onsite, without causing flooding or erosion impacts. Infiltration rates onsite are not amenable to infiltration BMPs, and therefore stormwater runoff is simply being conveyed offsite through a closed conveyance system.

5.6 MR #6: Runoff Treatment

As discussed above, MR #6 applies to the new impervious surfaces. Areas were then checked at the Threshold Discharge A (TDA) level, to determine the applicability of MR #6 for each TDA. TDAs must apply M R #6 if either of the following threshol are met:

Although MR #6 is applicable to new impervious as determined at the project level, the numbers shown above show that no runoff treatment is needed because the thresholds are not tripped at the TDA level.

5.7 #7:

- Projects in which the total of effective, pollution-generating impervious surface (PGIS) is 5,000 square feet or more in a TDA of the project.
  The total effective PGIS is 2,442 S.F. *for the entire project site, and therefore will not trip the threshold within any TDA mapped on the project site. (See Exhibit* 6, *Appendix* C)
- Projects in which the total of pollution-generating pervious surfaces (PGPS) is three-quarters of an acre or more in a TDA, and from which there is a surface discharge in a natural or man-made conveyance system from the site.
  The total PGPS is 8,775 *S.F. for the entire project site, and therefore will not trip the threshold within any TDA mapped on the project site. (See Exhibit* 7, *Appendix* C)

Control

This project discharges via conveyance systems that are comprised entirely of manmade conveyance elements into the salt water of Budd Inlet, and is therefore exempt from the flow control requirement per section 2.5.7 of the Olympia Manual.

This exemption requires that the discharge be at or below the ordinary high water mark (the mean higher high water line). Th ordinary high water mark is at 5.8 feet NGVD and all discharges are above elevation 15.0. There were no issues seen durir site visits downstream of the project site, between the project site discharge and Budd Inlet that would indicate a need for flo control.

This exemption also requires that the hydraulic capacity of the downstream conveyance system be checked, to verify that it c handle the flows from future built-out conditions of the project area, and the existing condition from all non-project areas from which runoff is collected. Calculations provided in Appendix C show the amount of flow being added to each discharge poin a result of this project, and the City can use this information to complete the downstream analysis.

6.0 Special Reports and Studies

Include any special reports and studies conducted to prepare the Stormwater Site Plan.

A list of any special reports and studies for the project site will need to be added prior to report finalization.

7.0 Other Permits

Include a list of other necessary permits and approvals as required by other regulatory agencies, if those permits or approval include conditions that affect the drainage plan, or contain more restrictive drainage-related requirements.

A list of permits will need to be added/updated prior to report finalization.

8.0 Bond Quantities Worksheet

This section of the report normally asks the designer to provide documentation to establish the appropriate bond amount for AR #1. However, the bond discussed in AR #1 is not applicable to a City Capital Improvement Project, and this section of the report therefore does not apply to this project.

9.0 References

USDA, 2011. United States Department of Agriculture, Natural Resources Conservation Service. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov. Accessed February 2012.

Olympia, 2009. City of Olympia. Drainage Design and Erosion Control Manual for Olympia. October 2009.

WSDOT, 2007. Washington State Department of Transportation, Hydraulics Office. M23-03.01 Hydraulics Manual. March 2007.

WSDOT, 2012a. Washington State Department of Transportation. Inlet Spacing with Side Flow. http://www.wsdot.wa.gov/Design/Hydraulics/ProgramDownloads.htm. Accessed February 2012.

WSDOT, 2012b. Washington State Department of Transportation. Sag Worksheet. http://www.wsdot.wa.gov/Design/Hydraulics/ProgramDownloads.htm. Accessed Februa ry 2012.

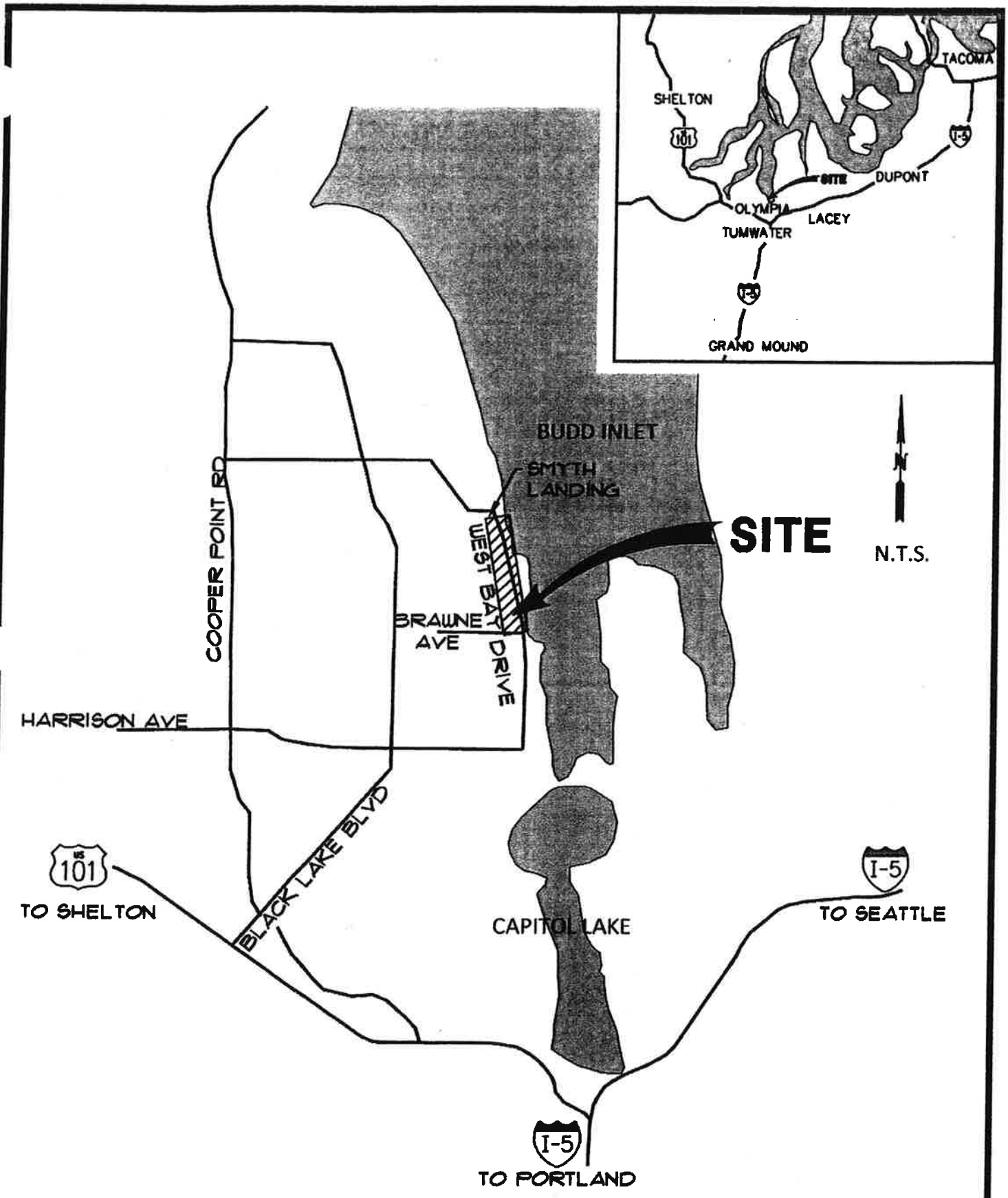
Personal Communication, 2-10-2012. Eric Christensen, City of Olympia. Personal Communication. February 10, 2012.

Appendix A

Exhibit 1 - Vicinity Map

Plan Sheets

Exhibit 2 - Existing Hydraulic Features



SKILLINGS CONNOLLY

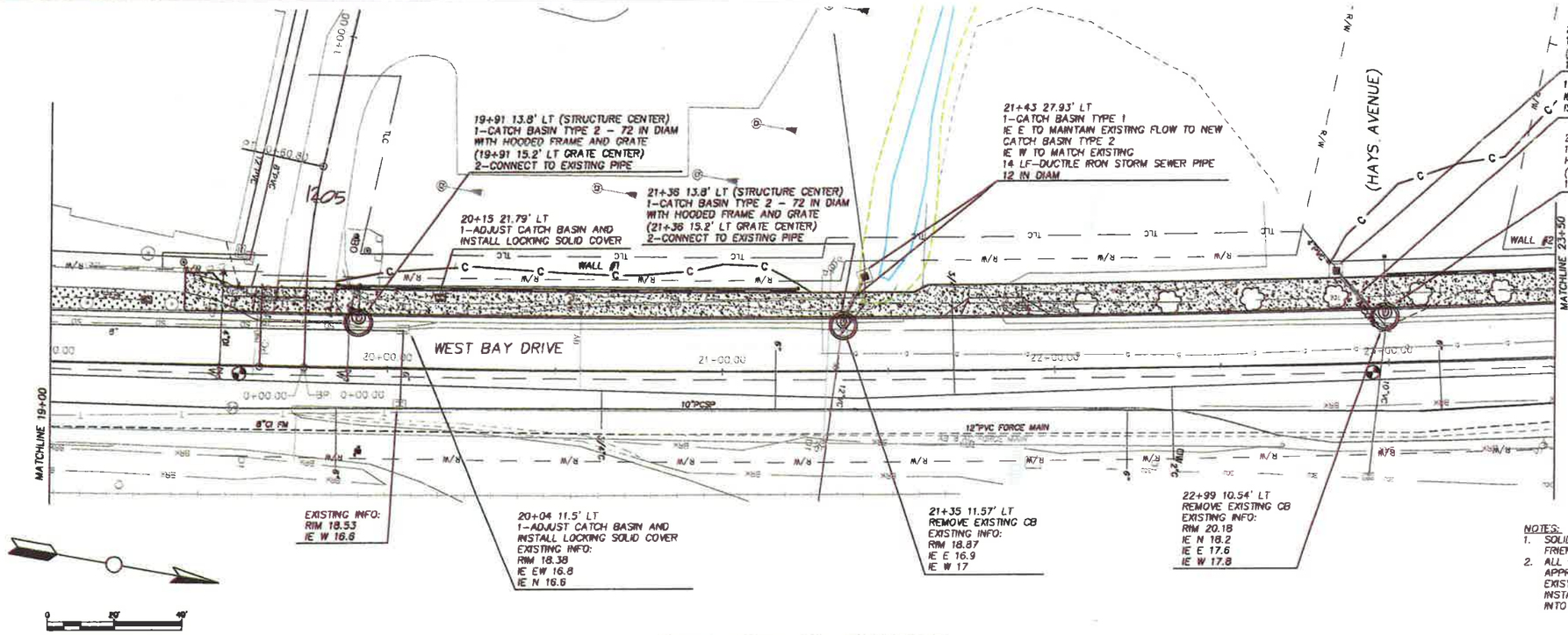
EXHIBIT 1

VICINITY MAP

WEST BAY DRIVE SIDEWALK PROJECT

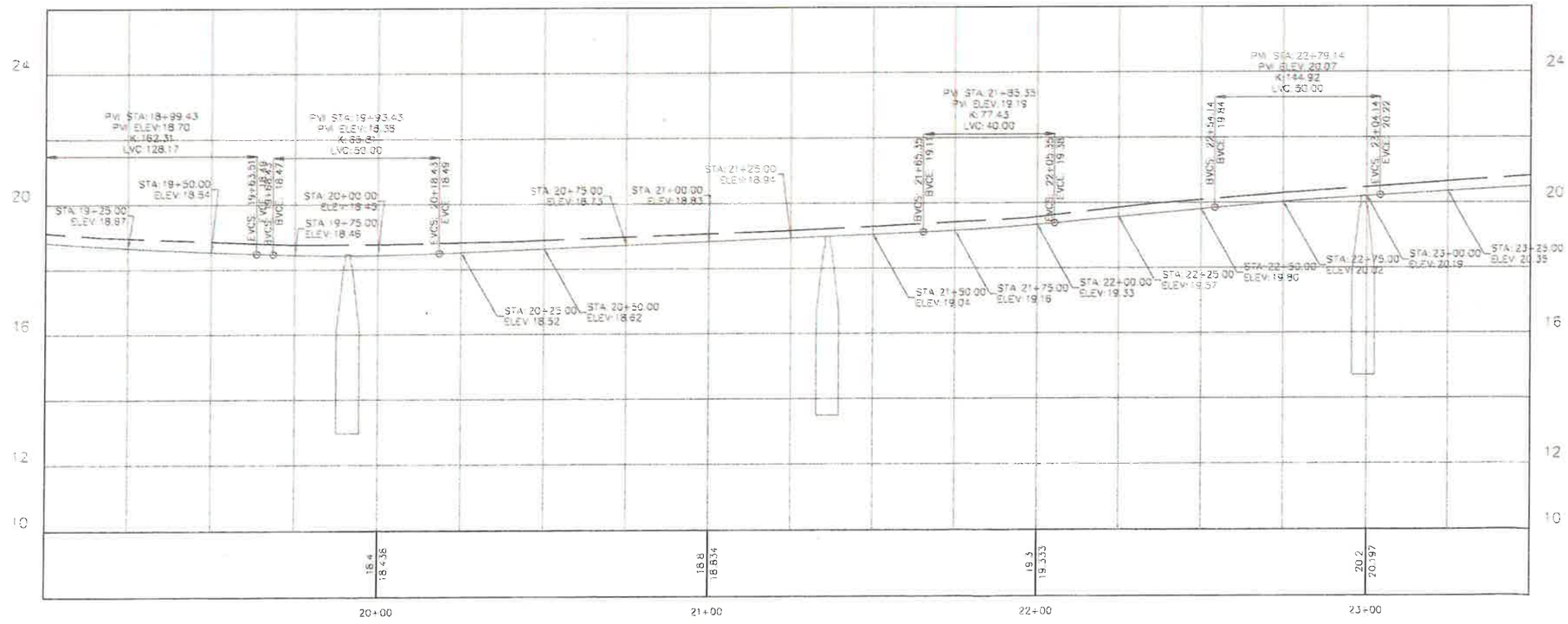
Plotted By: Tyrell Bradley, EIT on 2/22/12 9:47 AM

G:\Project\2010\10005 Olympia Engineering On-Call\Task Order 4 - West Bay Drive Sidewalks\Hydraulic Design\Hydraulic Report Exhibits CAD\Vicinity Map.dwg Tbradley 2/22/12 9:48 AM



NOTES:
1. SOLID COVERS SHALL BE PEDESTRIAN FRIENDLY WITH NON-SLIP SURFACE.
2. ALL ELEVATIONS SHOWN ARE APPROXIMATE. CONTRACTOR VERIFY EXISTING SYSTEM ELEVATIONS AND INSTALL NEW STRUCTURES TO MATCH INTO EXISTING STORM SYSTEM.

West_Bay_CL PROFILE



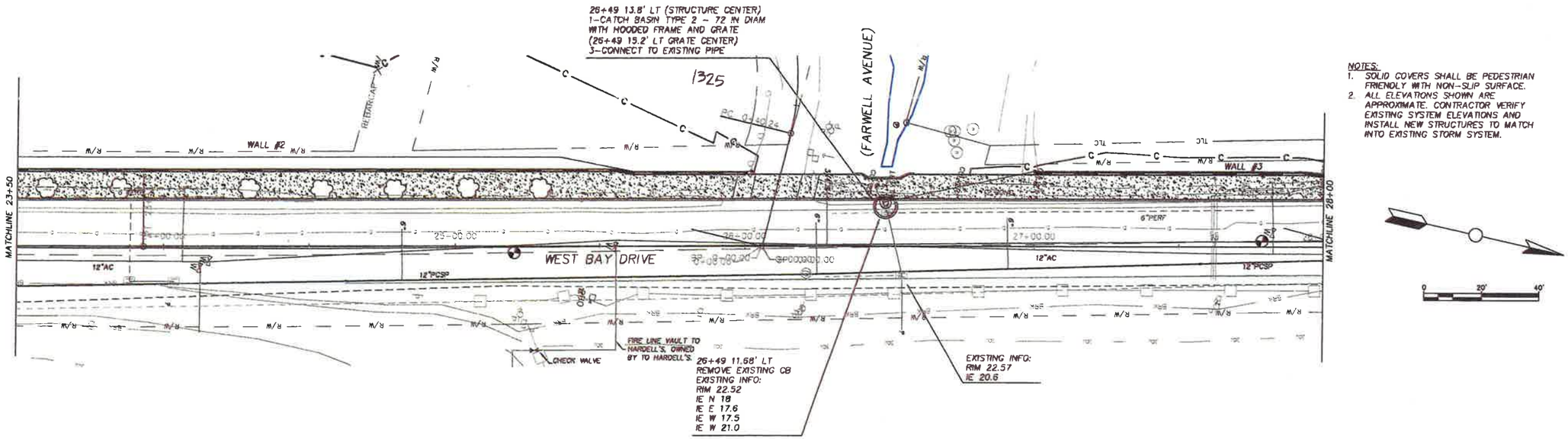
NO.	DATE	BY	APPR

REVISIONS

CITY OF OLYMPIA

WEST BAY SIDEWALK
STORM SHEET

ENGINEER	CWA
DESIGNED	CWA/JDE
DRAWN	JDE
APPROVED	SPS
PROJECT NO.	1034G
DATE	03/2014
DRAWING NAME	1034G Storm
SHEET	OF



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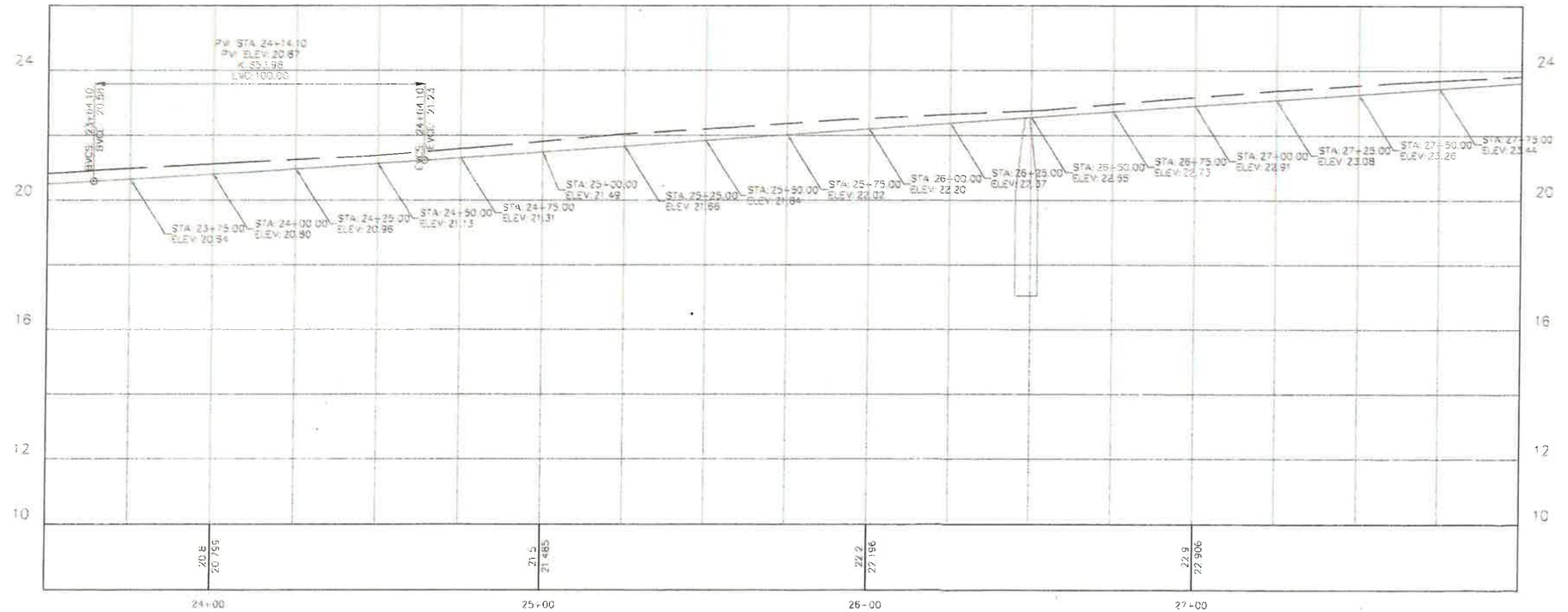


CITY OF OLYMPIA

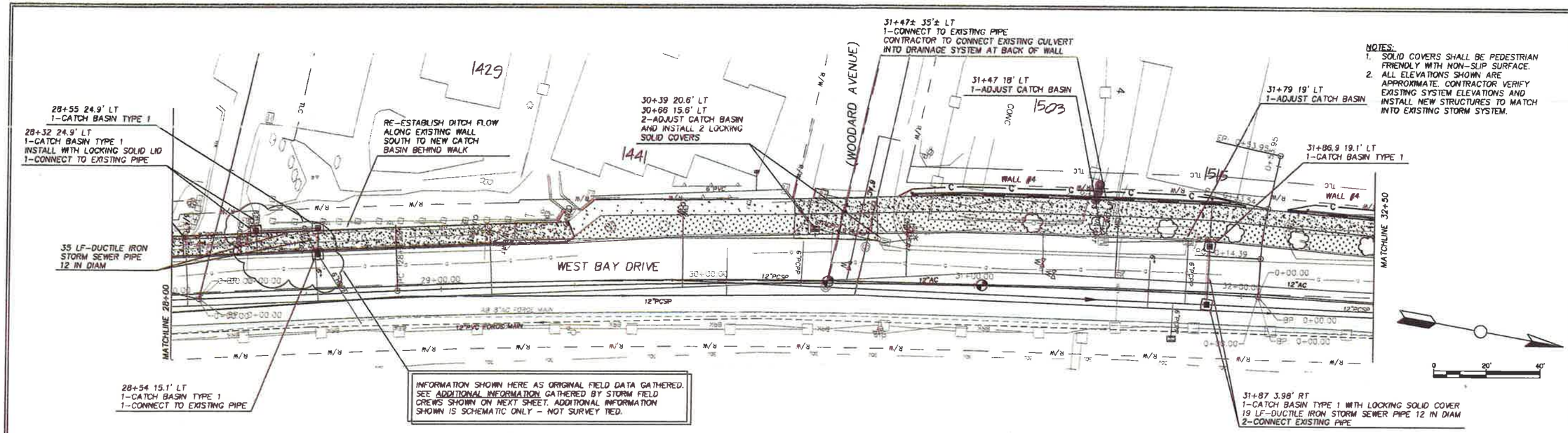
WEST BAY SIDEWALK

STORM SHEET 1

REVISIONS

NO.	DATE	BY	APPR

ENGINEER	CWA
DESIGNED	CWA/JDE
DRAWN	JDE
APPROVED	SPS
PROJECT NO.	
1034G	
DATE	
03/2014	
DRAWING NAME	
1034G Storm	
SHEET	OF



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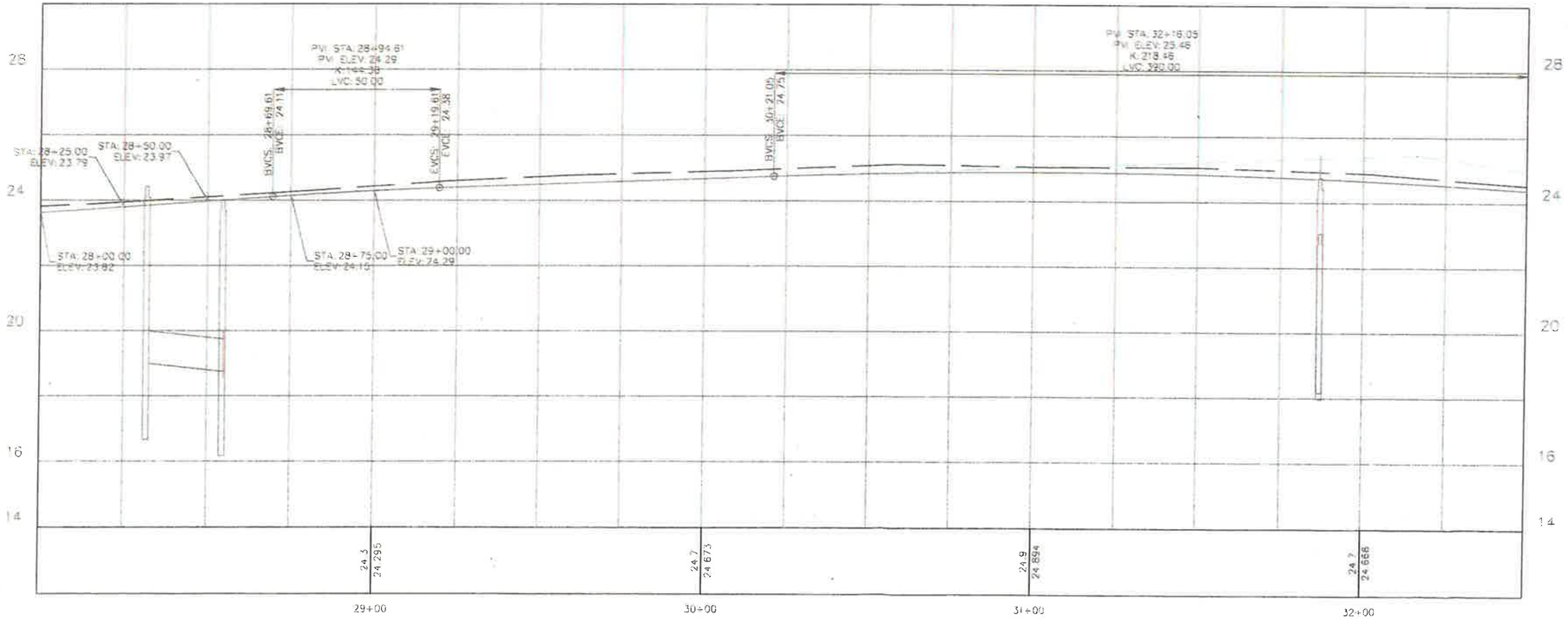

CITY OF OLYMPIA

WEST BAY SIDEWALK

STORM SHEET

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NO.	DATE	BY	APPR

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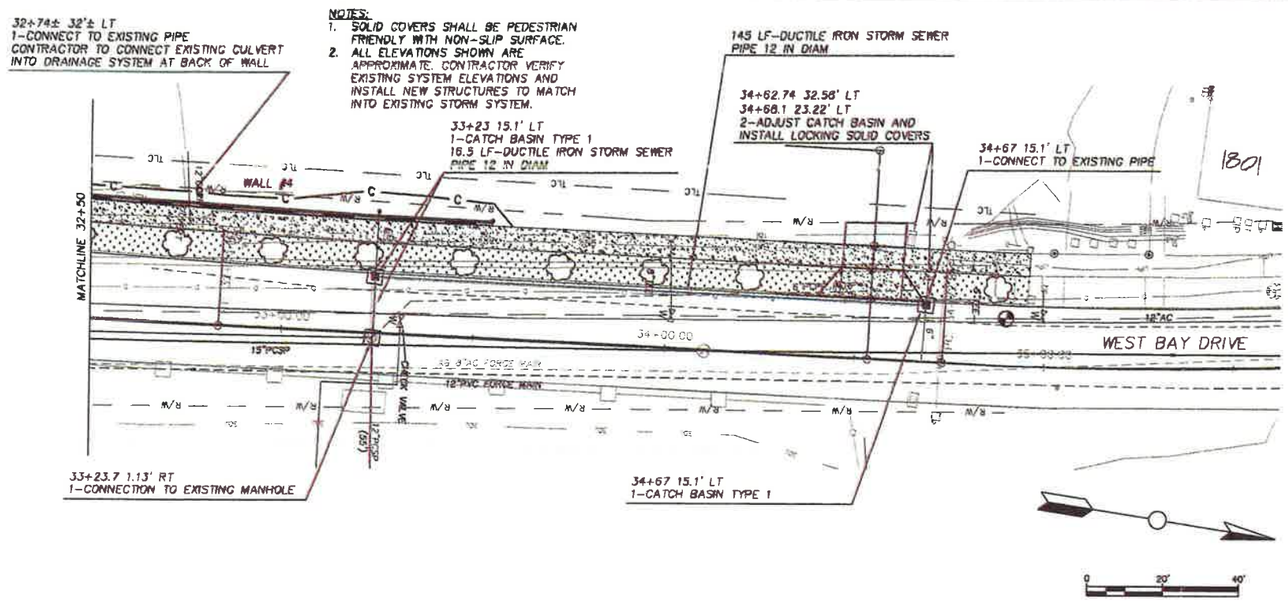

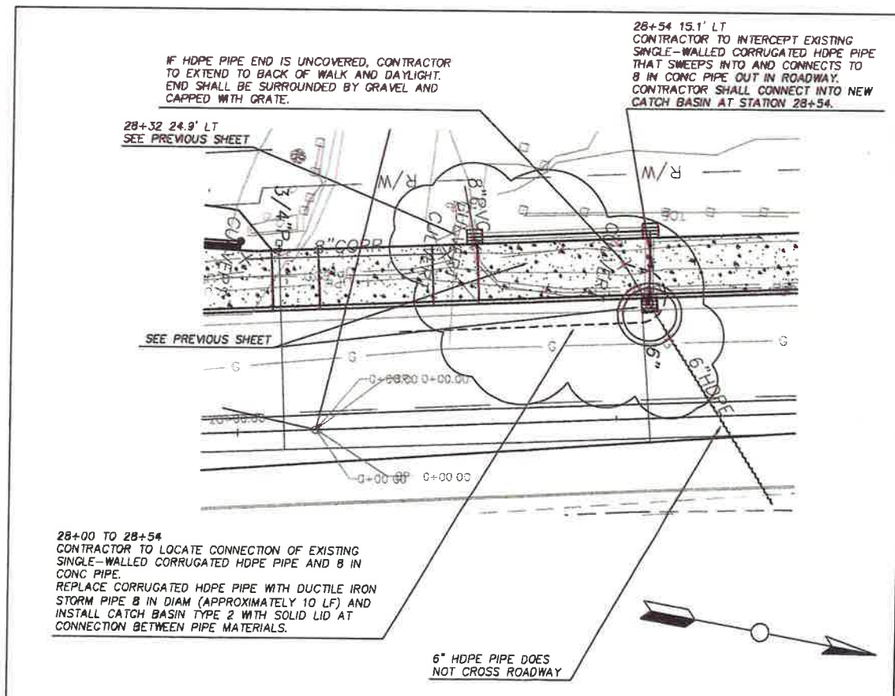

ADDITIONAL INFORMATION SCHEMATIC
(FROM PREVIOUS SHEET)

Olympia

CITY OF OLYMPIA

WEST BAY SIDEWALK

STORM SHEET 1

REVISIONS

NO.	DATE	BY	APPR

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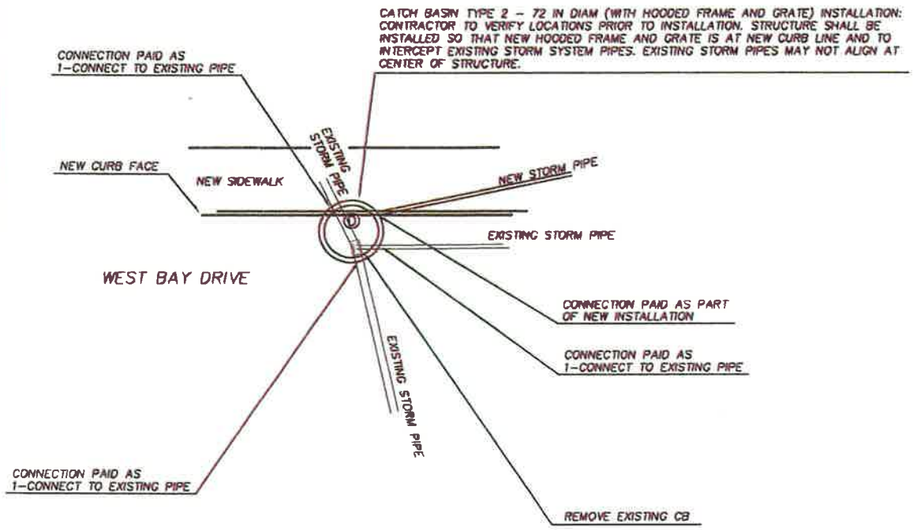
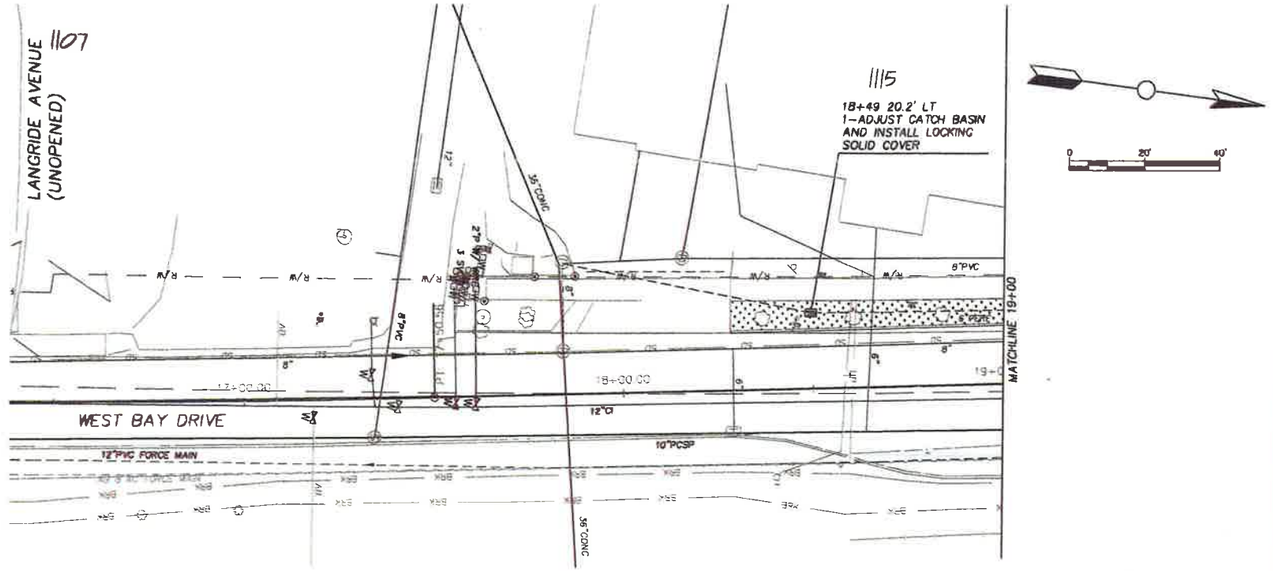


INSTALLATION DETAIL
CATCH BASIN TYPE 2 – 72 IN DIAM



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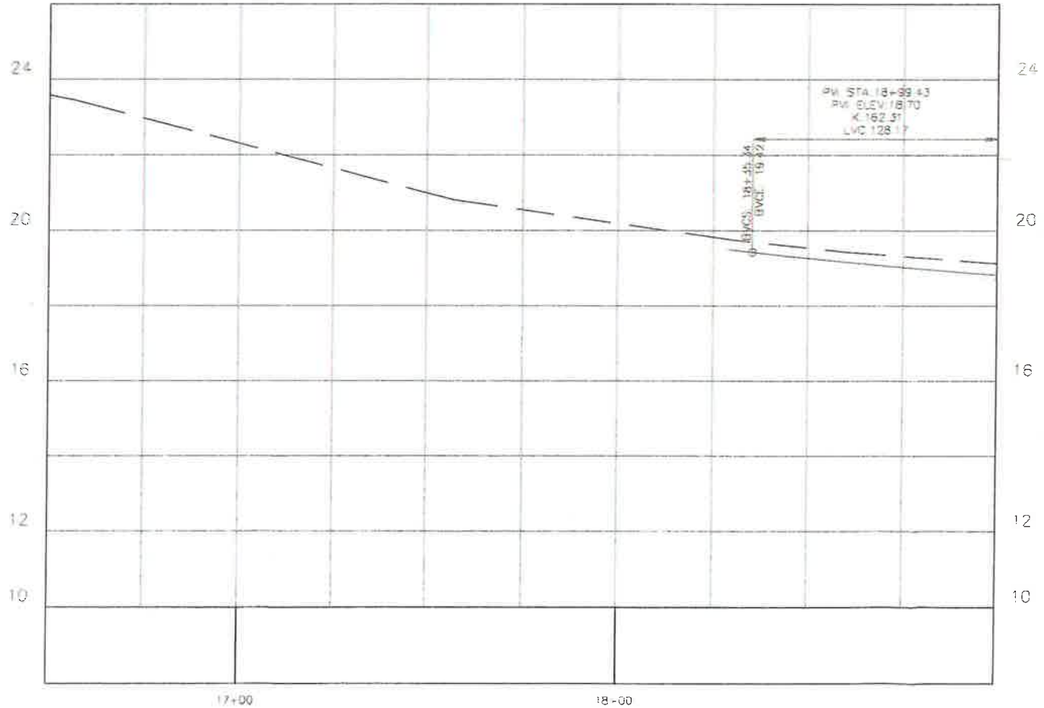

CITY OF OLYMPIA
WEST BAY SIDEWALK
STORM SHEET
-

REVISIONS

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DATE	03/2014
DRAWING NAME	1034G Storm
SHEET	OF

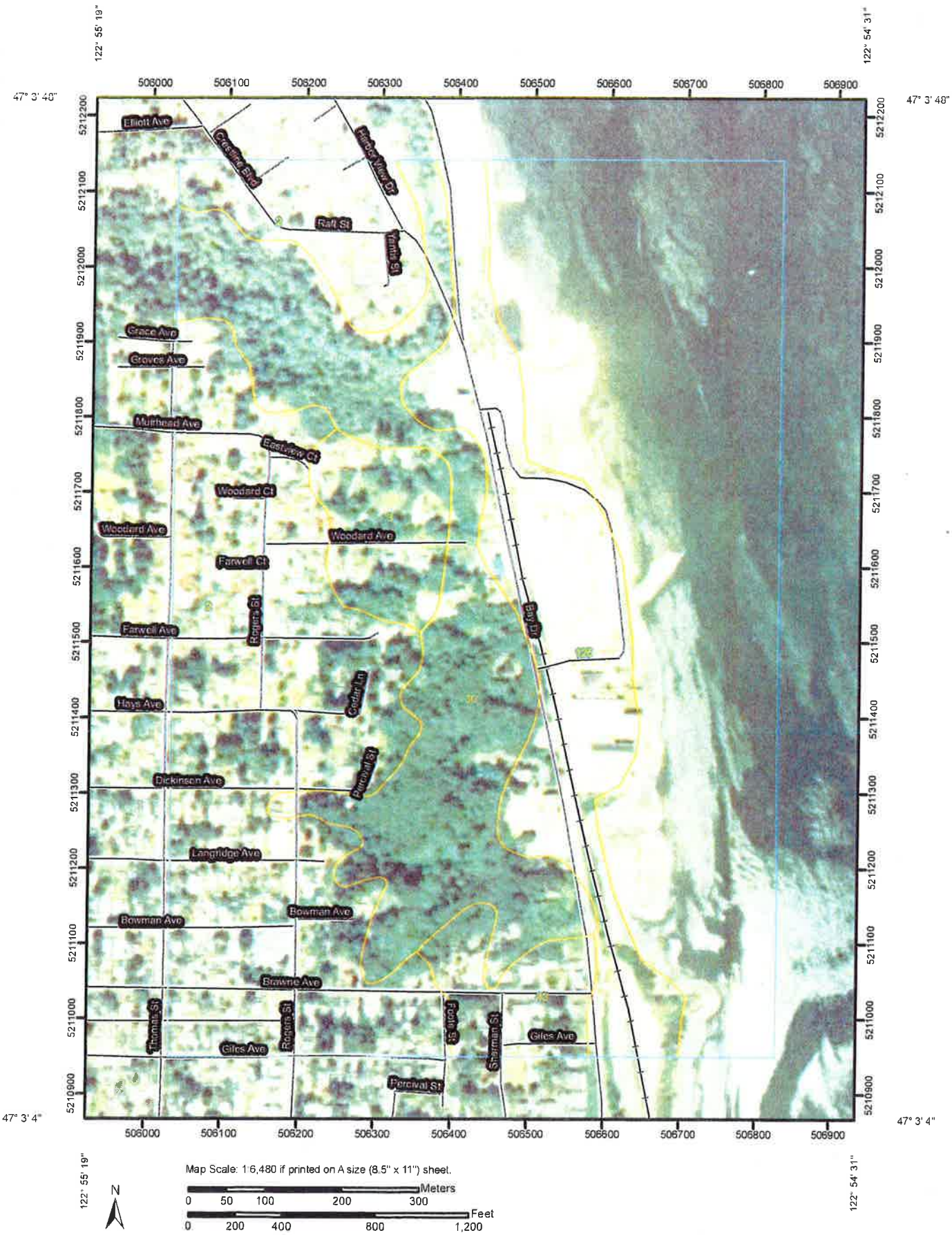
SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 2

EXISTING HYDRAULIC FEATURES

Appendix B
NRCS Web Soil Survey Data
Geotechnical Report


122° 55' 19"
122° 54' 31"
47° 3' 48"
47° 3' 4"
506000
506100
506200
506300
506400
506500
506600
506700
506800
506900
5212200
5212100
5212000
5211900
5211800
5211700
5211600
5211500
5211400
5211300
5211200
5211100
5211000
5210900
Elliott Ave
Crestland Blvd
Hidden View Ct
Raft St
Tumtum St
Grace Ave
Groves Ave
Muirhead Ave
Eastview Ct
Woodard Ct
Woodard Ave
Farwell Ct
Farwell Ave
Rogers St
Bay Dr
Hays Ave
Cedar Ln
Dickinson Ave
Purcell St
Langridge Ave
Bowman Ave
Brawne Ave
Thomas St
Giles Ave
Percival St
Sherman St
Foote St
Map Scale: 1:6,480 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 200 400 800 1,200

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,480 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Thurston County, Washington
Survey Area Data: Version 7, Jul 1, 2010

Date(s) aerial images were photographed: 7/23/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Thurston County, Washington (WA067)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2	Alderwood gravelly sandy loam, 3 to 15 percent slopes	68.8	29.3%
3	Alderwood gravelly sandy loam, 15 to 30 percent slopes	9.1	3.9%
30	Dystric Xerochrepts, 60 to 90 percent slopes	42.0	17.9%
43	Hoogdal silt loam, 15 to 30 percent slopes	7.7	3.3%
125	Xerorthents, 0 to 5 percent slopes	31.6	13.5%
Subtotals for Soil Survey Area		**159.2**	**67.9%**
Totals for Area of Interest		**234.5**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Thurston County, Washington

2—Alderwood gravelly sandy loam, 3 to 15 percent slopes

Map Unit Setting

Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 220 days

Map Unit Composition

Alderwood and similar soils: 100 percent

Description of Alderwood

Setting

Landform: Till plains
Parent material: Basal till

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 40 inches to dense material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability (nonirrigated): 4s

Typical profile

0 to 15 inches: Gravelly sandy loam
15 to 30 inches: Very gravelly sandy loam
30 to 34 inches: Very gravelly loamy sand

Minor Components

Norma

Percent of map unit:
Landform: Drainageways

3—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
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Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.8 inches)

Interpretive groups
Land capability (nonirrigated): 4e

Typical profile
0 to 15 inches: Gravelly sandy loam
15 to 30 inches: Very gravelly sandy loam
30 to 34 inches: Very gravelly loamy sand

30—Dystric Xerochrepts, 60 to 90 percent slopes

Map Unit Setting
Mean annual precipitation: 50 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 180 days

Map Unit Composition
Dystric xerochrepts and similar soils: 85 percent
Minor components: 5 percent

Description of Dystric Xerochrepts

Setting
Landform: Escarpments
Parent material: Colluvium and glacial till

Properties and qualities
Slope: 60 to 90 percent
Depth to restrictive feature: 20 to 72 inches to dense material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.1 inches)

Interpretive groups
Land capability (nonirrigated): 7e

Typical profile
0 to 4 inches: Very gravelly sandy loam
4 to 30 inches: Very gravelly sandy loam
30 to 34 inches: Very gravelly sandy loam

Minor Components

Skipopa
Percent of map unit: 5 percent

43—Hoogdal silt loam, 15 to 30 percent slopes

Map Unit Setting

Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 160 to 200 days

Map Unit Composition

Hoogdal and similar soils: 85 percent
Minor components: 5 percent

Description of Hoogdal

Setting

Landform: Escarpments
Parent material: Loess and glaciolucustrine deposits

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 17 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 10.4 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 5 inches: Silt loam
5 to 10 inches: Silty clay loam
10 to 25 inches: Silty clay
25 to 60 inches: Silty clay

Minor Components

Skipopa

Percent of map unit: 3 percent

Yelm

Percent of map unit: 2 percent

125—Xerorthents, 0 to 5 percent slopes

Map Unit Setting

Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 39 to 50 degrees F
Frost-free period: 150 to 200 days

Map Unit Composition
Xerorthents and similar soils: 100 percent

Description of Xerorthents

Setting
Landform: Tidal flats
Parent material: Sandy and loamy cut and fill material

Properties and qualities
Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Depth to water table: About 24 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups
Land capability (nonirrigated): 7s

Typical profile
0 to 60 inches: Variable

Data Source Information

Soil Survey Area: Thurston County, Washington
Survey Area Data: Version 7, Jul 1, 2010

Water Features

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Report—Water Features

Water Features– Thurston County, Washington											
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
2—Alderwood gravelly sandy loam, 3 to 15 percent slopes										
Alderwood	C	—	January	1.5-3.0	1.7-3.3	—	—	None	—	None
	C	—	February	1.5-3.0	1.7-3.3	—	—	None	—	None
	C	—	March	1.5-3.0	1.7-3.3	—	—	None	—	None
3—Alderwood gravelly sandy loam, 15 to 30 percent slopes										
Alderwood	C	—	January	1.5-3.0	1.7-3.3	—	—	None	—	None
	C	—	February	1.5-3.0	1.7-3.3	—	—	None	—	None
	C	—	March	1.5-3.0	1.7-3.3	—	—	None	—	None
30—Dystric Xerochrepts, 60 to 90 percent slopes										
Dystric xerochrepts	C	—	Jan-Dec	—	—	—	—	None	—	—
43—Hoogdal silt loam, 15 to 30 percent slopes										
Hoogdal	C	—	January	1.4-2.0	1.4-2.9	—	—	None	—	None
	C	—	February	1.4-2.0	1.4-2.9	—	—	None	—	None
	C	—	March	1.4-2.0	1.4-2.9	—	—	None	—	None
	C	—	December	1.4-2.0	1.4-2.9	—	—	None	—	None

Water Features– Thurston County, Washington										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
125—Xerorthents, 0 to 5 percent slopes										
Xerorthents	C	—	January	2.0	>6.0	—	—	None	—	None
	C	—	February	2.0	>6.0	—	—	None	—	None
	C	—	March	2.0	>6.0	—	—	None	—	None
	C	—	November	2.0	>6.0	—	—	None	—	None
	C	—	December	2.0	>6.0	—	—	None	—	None

Data Source Information

Soil Survey Area: Thurston County, Washington
Survey Area Data: Version 7, Jul 1, 2010

Appendix C

Area Exhibits used for MR Applicability

Exhibit 3 - New Impervious Surfaces

Exhibit 4 - Replaced Impervious Surfaces

Exhibit 5 - Existing Impervious Surfaces

Exhibit 6 - Effective, Pollution-Generating Impervious Surfaces

Exhibit 7 - Pollution-Generating Pervious Surfaces

Flow Chart for Determining Requirements for Road Redevelopment

Rainfall Intensity Data

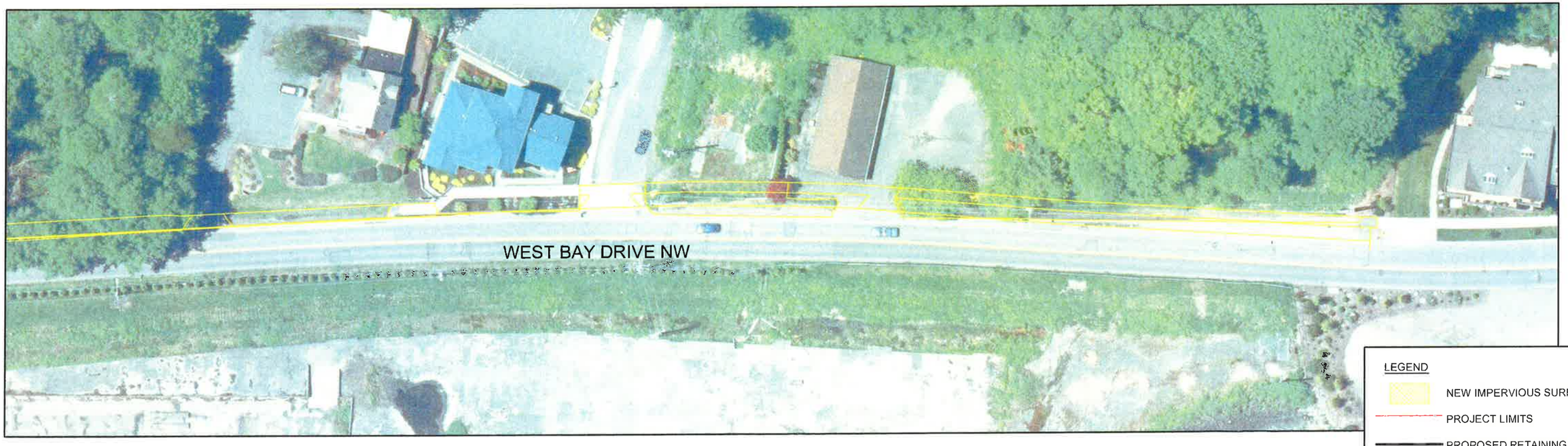
Inlet Spacing and Sag Analysis Spreadsheets

Conveyance Sizing for Proposed Pipes

Downstream Conveyance Sizing Information

SCALE IN FEET
0 15 30 60

MATCH LINE 27+00
SEE BELOW



MATCH LINE 27+00
SEE ABOVE

LEGEND
NEW IMPERVIOUS SURFACES
PROJECT LIMITS
PROPOSED RETAINING WALL

SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 3

NEW IMPERVIOUS SURFACES

SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

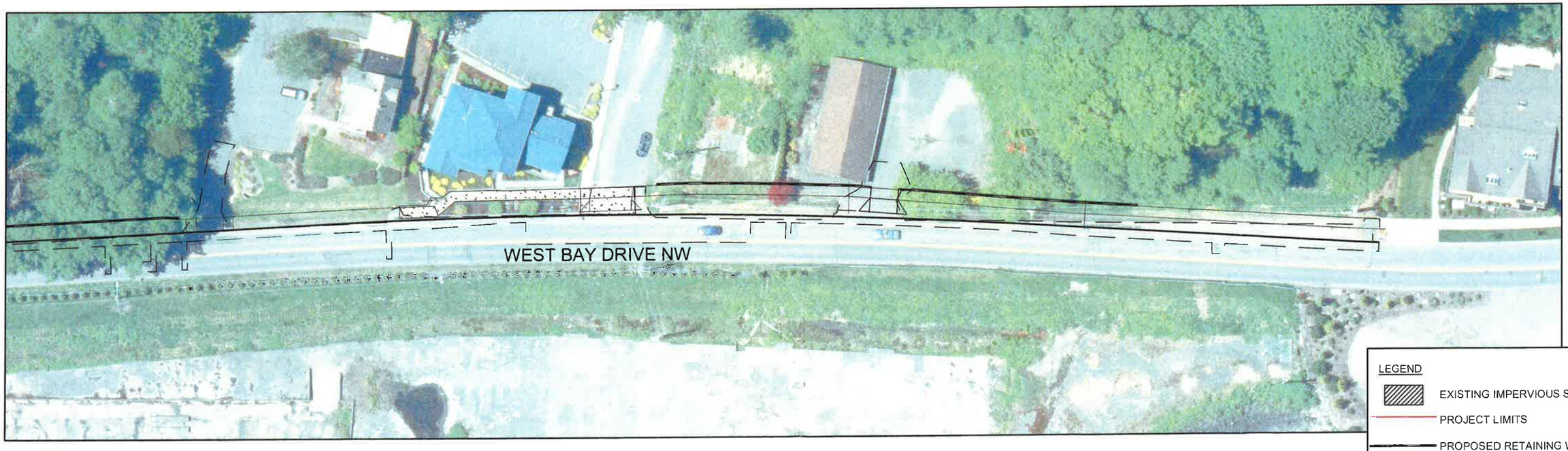
WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 4

REPLACED IMPERVIOUS SURFACES

SCALE IN FEET
0 15 30 60

MATCH LINE 27+00
SEE BELOW



MATCH LINE 27+00
SEE ABOVE

LEGEND
- EXISTING IMPERVIOUS SURFACES
- PROJECT LIMITS
- PROPOSED RETAINING WALL

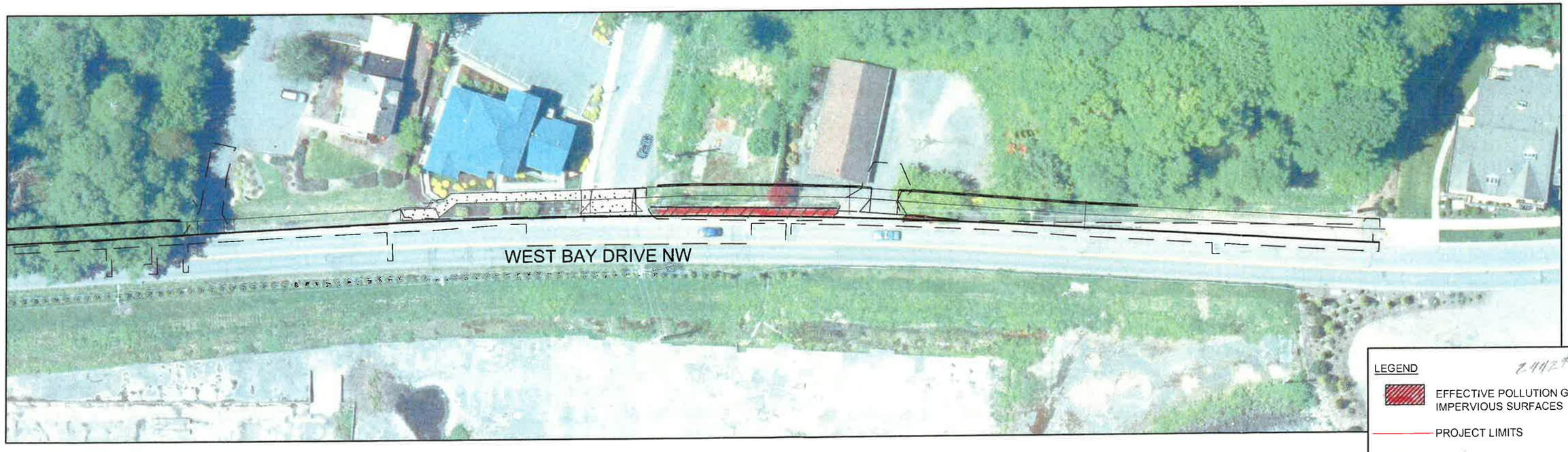
SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 5
EXISTING IMPERVIOUS SURFACES

SCALE IN FEET
0 15 30 60

MATCH LINE 27+00
SEE BELOW



MATCH LINE 27+00
SEE ABOVE

LEGEND

2442 ft

EFFECTIVE POLLUTION GENERATING IMPERVIOUS SURFACES (NEW)

PROJECT LIMITS

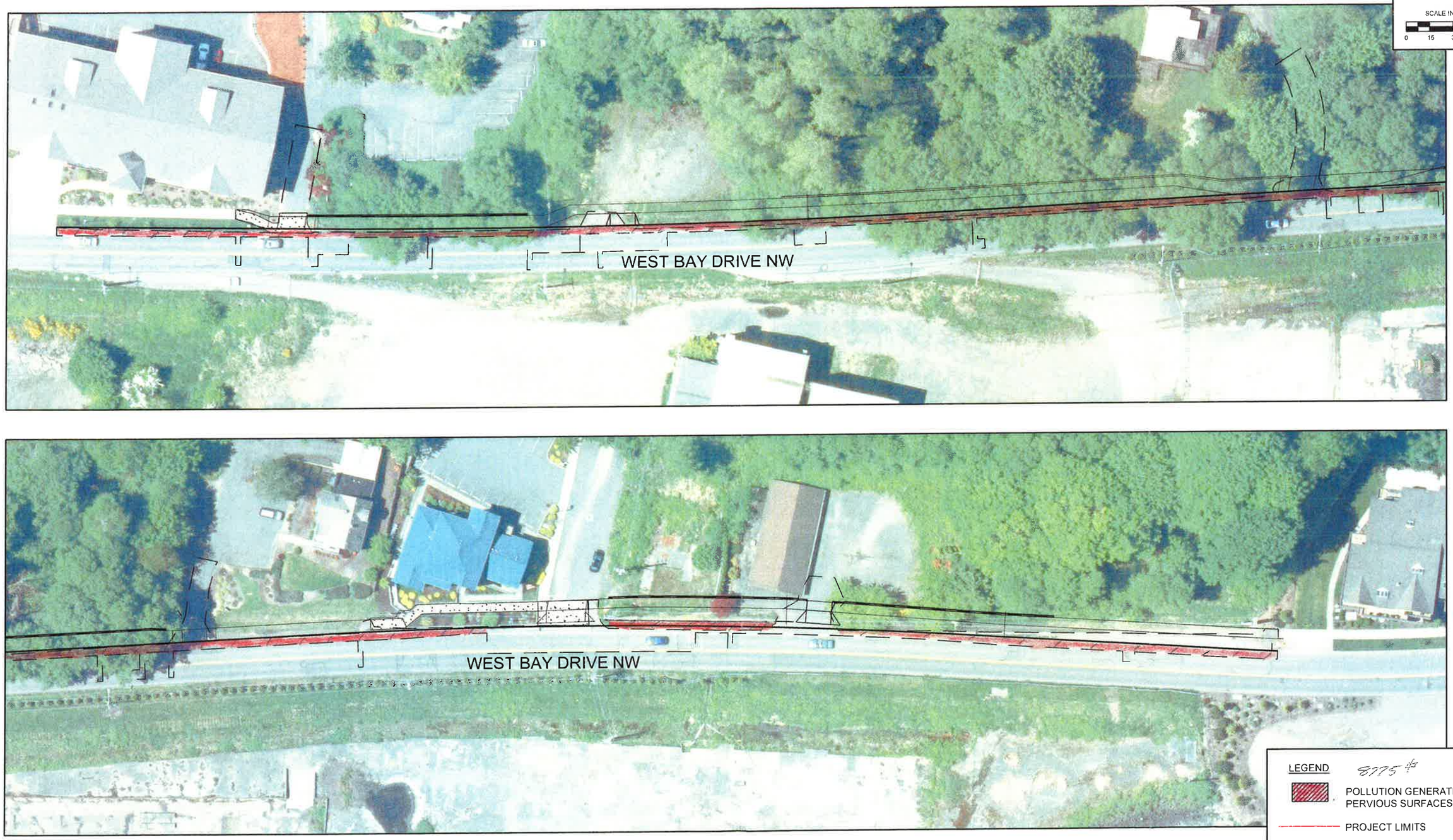
PROPOSED RETAINING WALL

SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 6

EFFECTIVE POLLUTION GENERATING IMPERVIOUS SURFACES



SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

WEST BAY DRIVE SIDEWALK PROJECT

EXHIBIT 7

POLLUTION GENERATING PERVIOUS SURFACES

West Bay Drive
Sidewalk Project

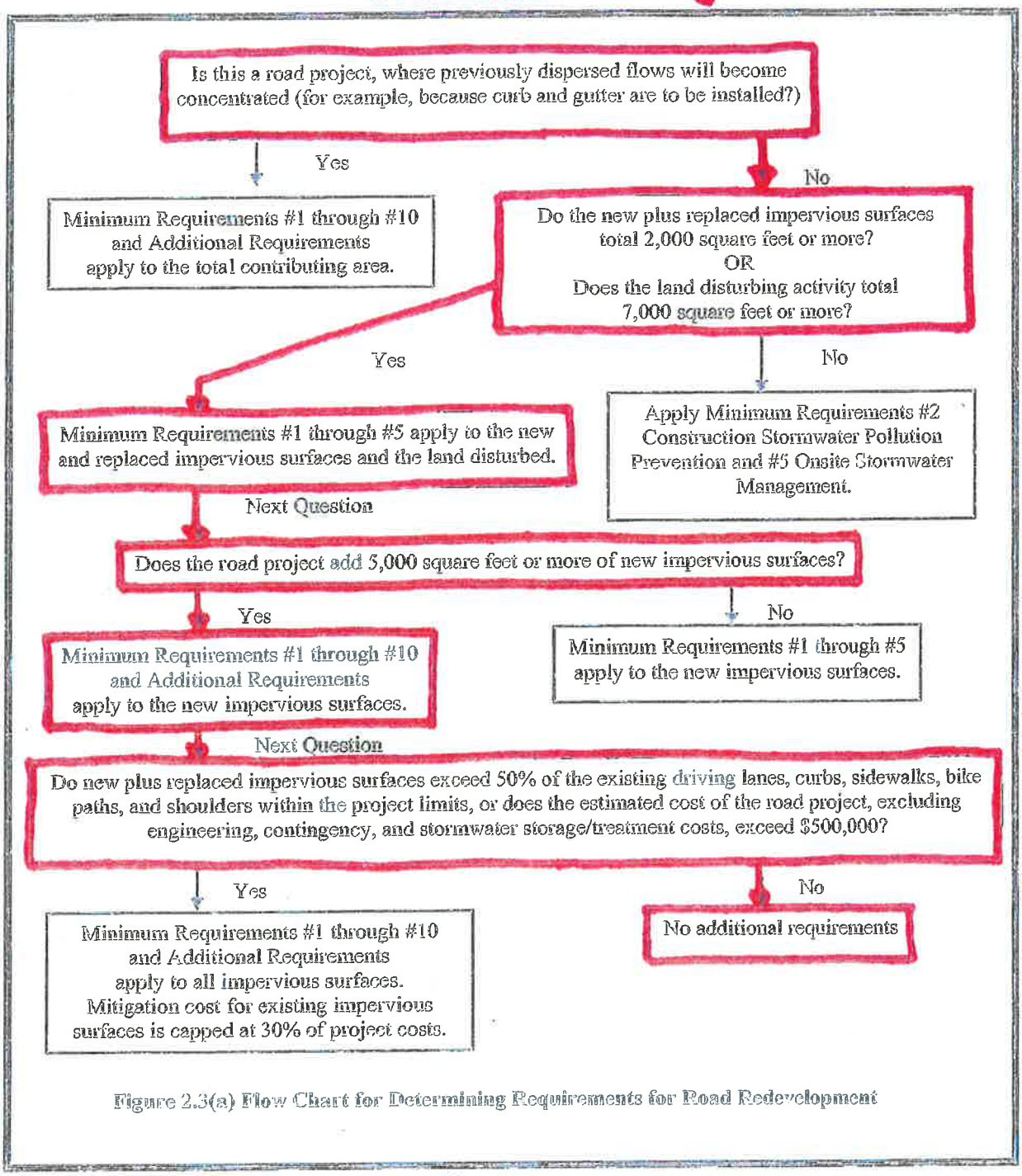


Figure 2.3(a) Flow Chart for Determining Requirements for Road Redevelopment

West Bay Drive
Sidewalk Project

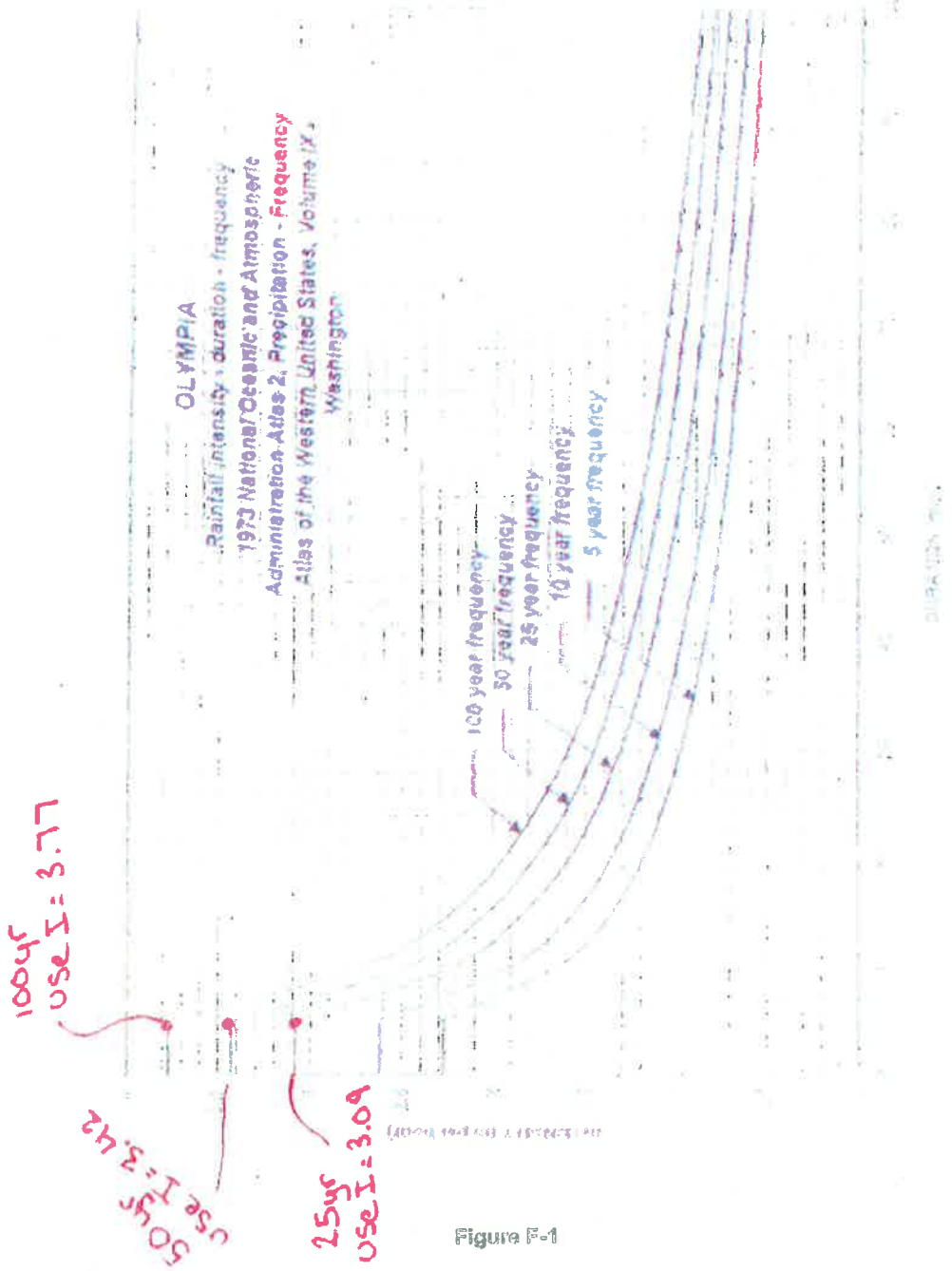


Figure F-1

West Bay Sidewalk
10005 Task 5

HIGHWAY DRAINAGE (English Units)

T =	5
m =	N/A
n =	N/A
C =	0.9
i =	3.09
GW =	1.67

** Use 25 yr storm, and 2% cross slope

25-year
Inlet Spacing Analysis

Sta.	Pavement Drainage Area (S.F.)	Delta Q	Sum Q	Slope	Super	G.W.	d	Zd	V	Q bp	Comments (L/R)
----	----	----	----	----	----	---	---	---	---	----	
31+87	2081	0.133	0.133	0.0040	0.0200	1.67	0.08	3.93	0.99	0.030	
33+24	3857	0.246	0.277	0.0102	0.0200	1.67	0.09	4.34	1.71	0.076	
34+25	3047	0.195	0.270	0.0142	0.0200	1.67	0.08	4.05	1.91	0.065	
34+90	1942	0.124	0.200	0.0139	0.0200	1.67	0.07	3.63	1.73	0.039	bypass goes offsite
		0.000	0.076			0.00				0.000	
						0.00				0.000	
		0.000	0.000			0.00				0.000	
28+54	6492	0.414	0.414	0.0078	0.0200	1.67	0.11	5.32	1.76	0.152	
26+49	4915	0.314	0.465	0.0045	0.0200	1.67	0.12	6.16	1.49	0.200	
22+99	8413	0.537	0.737	0.0068	0.0200	1.67	0.14	6.77	1.97	0.346	
21+39	4631	0.296	0.642	0.0034	0.0200	1.67	0.15	7.32	1.48	0.322	bypass goes to sag
		0.000	0.322			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
15+33	6393	0.408	0.408	0.0174	0.0200	1.67	0.09	4.55	2.32	0.120	
16+28	1700	0.109	0.229	0.0191	0.0200	1.67	0.07	3.60	2.01	0.043	
17+84	4151	0.265	0.308	0.0141	0.0200	1.67	0.09	4.26	1.98	0.082	
19+00	3443	0.220	0.302	0.0078	0.0200	1.67	0.09	4.72	1.60	0.094	bypass goes to sag
		0.000	0.094			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	

West Bay Sidewalk
10005 Task 5

HIGHWAY DRAINAGE (English Units)

T =	5
m =	N/A
n =	N/A
C =	0.9
I =	3.42
GW =	1.67

50-year
Inlet Spacing Analysis

Sta.	Pavement Drainage Area (S.F.)	Delta Q	Sum Q	Slope	Super	G.W.	d	Zd	V	Q bp	Comments (L/R)
----	----	----	----	----	----	---	---	---	---	----	
31+87	2081	0.147	0.147	0.0040	0.0200	1.67	0.08	4.08	1.02	0.036	
33+24	3857	0.273	0.309	0.0102	0.0200	1.67	0.09	4.53	1.77	0.090	
34+25	3047	0.215	0.306	0.0142	0.0200	1.67	0.08	4.24	1.98	0.080	
34+90	1942	0.137	0.228	0.0139	0.0200	1.67	0.08	3.81	1.80	0.049	bypass goes offsite
		0.000	0.090			0.00				0.000	
						0.00				0.000	
		0.000	0.000			0.00				0.000	
28+54	6492	0.459	0.459	0.0078	0.0200	1.67	0.11	5.52	1.81	0.176	
26+49	4915	0.347	0.523	0.0045	0.0200	1.67	0.13	6.43	1.54	0.234	
22+99	8413	0.594	0.829	0.0068	0.0200	1.67	0.14	7.07	2.04	0.404	
21+39	4631	0.327	0.731	0.0034	0.0200	1.67	0.15	7.69	1.53	0.381	bypass goes to sag
		0.000	0.381			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
15+33	6393	0.452	0.452	0.0174	0.0200	1.67	0.09	4.72	2.39	0.141	
16+28	1700	0.120	0.261	0.0191	0.0200	1.67	0.08	3.78	2.10	0.055	
17+84	4151	0.293	0.349	0.0141	0.0200	1.67	0.09	4.46	2.06	0.100	
19+00	3443	0.243	0.343	0.0078	0.0200	1.67	0.10	4.95	1.66	0.114	bypass goes to sag
		0.000	0.114			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
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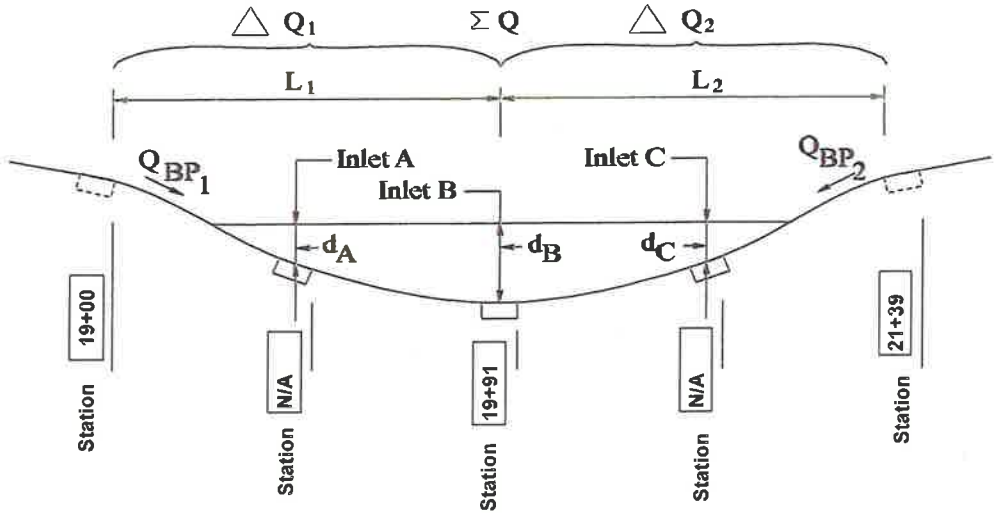
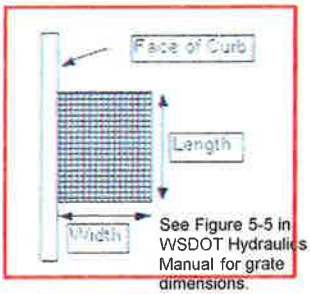
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	
		0.000	0.000			0.00				0.000	

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.020	ft/ft	Shoulder Width	5.00	ft
Allowable	Z_d	10.5	ft	Lane Width	11.00	ft
Allowable	d_B	0.21	ft	($d_A = d_C$ = 0.105 ft allowable)		
Time of Concentration	T_c	5.0	min			
50 yr. rainfall coefficients: m	m	N/A				
50 yr. rainfall coefficients: n	n	N/A				
Rainfall Intensity	$I_{50\text{-}yr}$	3.42	in/hr	(for 5 minute duration)		
Distance between last inlet and low point	L_1	91.00	ft	L_2	148.00	ft
Width of catchment area	W_1	30.00	ft	W_2	24.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.11	cfs	Q_{BP2}[4]	0.38	cfs
Discharge of catchment area	Q_1	0.20	cfs	Q_2	0.27	cfs



See Figure 5-5 in WSDOT Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.11 + 0.20 + 0.38 + 0.27 = 0.96 la

Combination[1] or Grate Inlet for sag P_B (C/G) →		C					
Effective Perimeter of Grate Inlets (reduced by 50% for plugging)	P_A Flank	0	ft	Width	0	Length	0
	P_B	3.87	ft	Width	1.31	Length	1.25
	P_C Flank	0	ft	Width	0	Length	0

⇨

$\Sigma Q = Q_A + Q_B + Q_C$

[2] $\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 1.12 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.19 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-5.2.

[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-5 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

West Bay 12" Pipe Sizing

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	3.56	ft^3/s

Results

Discharge	3.56	ft^3/s
Normal Depth	1.00	ft
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.81	ft
Percent Full	100.0	%
Critical Slope	0.01032	ft/ft
Velocity	4.54	ft/s
Velocity Head	0.32	ft
Specific Energy	1.32	ft
Froude Number	0.00	
Maximum Discharge	3.83	ft^3/s
Discharge Full	3.56	ft^3/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

West Bay 12" Pipe Sizing

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.81	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01032	ft/ft

West Bay 6" Ex. Culvert Sizing

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01000	ft/ft
Normal Depth	0.50	ft
Diameter	0.50	ft
Discharge	0.73	ft^3/s

Results

Discharge	0.73	ft^3/s
Normal Depth	0.50	ft
Flow Area	0.20	ft^2
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.13	ft
Top Width	0.00	ft
Critical Depth	0.43	ft
Percent Full	100.0	%
Critical Slope	0.00929	ft/ft
Velocity	3.71	ft/s
Velocity Head	0.21	ft
Specific Energy	0.71	ft
Froude Number	0.00	
Maximum Discharge	0.78	ft^3/s
Discharge Full	0.73	ft^3/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

West Bay 6" Ex. Culvert Sizing

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.43	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00929	ft/ft

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: [illegible]

Project No.: [illegible]

Date: [illegible] By: [illegible]

Sheet: [illegible] Page 1 of 3

Q = CIA

$I_{25} = 3.09$, $I_{100} = 3.77$

C = 0.9

★ Proposed pipe at Sta. 14+00

Area [illegible] = 3,442 S.F. = 0.079 Ac.

$Q_{25} = (0.9)(3.09)(0.079) = 0.22$ cfs

$Q_{100} = (0.9)(3.77)(0.079) = 0.27$ cfs

★ Proposed pipe at Sta. 19+17

Area [illegible] = 5,971 S.F. = 0.137 Ac.

$Q_{25} = (0.9)(3.09)(0.137) = 0.38$ cfs

$Q_{100} = (0.9)(3.77)(0.137) = 0.46$ cfs

★ Proposed pipe at Sta. 22+94

Area [illegible] = 8,371 S.F. = 0.192 Ac.

$Q_{25} = (0.9)(3.09)(0.192) = 0.534$ cfs

$Q_{100} = (0.9)(3.77)(0.192) = 0.652$ cfs

★ Proposed pipe at Sta. 26+64

Area [illegible] = 4,915 S.F. = 0.112 Ac.

$Q_{25} = (0.9)(3.09)(0.112) = 0.31$ cfs

$Q_{100} = (0.9)(3.77)(0.112) = 0.38$ cfs

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West [illegible]

Project No.: 10005 Task 5

Date: 2-14-2012 By: ASH

Sheet: Pipe Sizing Flows Page 2 of 3

* Existing culvert at sta 28+34

Area Contributing = 6,493 S.F. = 0.149 Acres

$Q_{25} = (0.9)(3.01)(0.149) = 0.41$ cfs

$Q_{100} = (0.9)(3.77)(0.149) = 0.51$ cfs

* Proposed pipe at sta 31+37

Area Contributing = 2,081 S.F. 0.048 Acres

$Q_{25} = (0.9)(3.04)(0.048) = 0.13$ cfs

$Q_{100} = (0.9)(3.77)(0.048) = 0.16$ cfs

* Proposed pipe at sta 32+20

Area Contributing = 3,811 S.F.
3,047 S.F.
1,148 S.F.

8,984 S.F. 0.203 Acres

$Q_{25} = (0.9)(3.04)(0.203) = 0.56$ cfs

$Q_{100} = (0.9)(3.77)(0.203) = 0.70$ cfs

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West Bay Dr. Sidewalks

Project No.: 10005 Task 5

Date: 2-14-2012 By: ASF

Sheet: Pipe Sizing Flows Page 1 of 3

* Proposed pipe sta 32+24 to 34+25

Area Contributing = 3047 S.F
1,942 S.F.

4,989 S.F. = 0.115 Acre

$Q_{25} = (0.9)(3.09)(0.115) = 0.32$ cfs

$Q_{100} = (0.9)(3.77)(0.115) = 0.39$ cfs

* Proposed pipe sta 34+25 to 34+90

Area Contributing = 1,942 S.F. = 0.045 Acre

$Q_{25} = (0.9)(3.09)(0.045) = 0.13$ cfs

$Q_{100} = (0.9)(3.77)(0.045) = 0.15$ cfs

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West Bay Dr. Sidewalks
Project No.: 10005 Task 3
Date: 2-16-2012 By: ASH
Sheet: Flows added to Downstream Conveyance Page 1 of 4

New Impervious Areas Contributing to Discharge Points:

Discharge Point #1:

101 S.F.
61 S.F.
1,928 S.F.

2,090 S.F. → 0.048 Acre

Discharge Point #2:

26 S.F.
1,327 S.F.

1,353 S.F. → 0.031 Acre

Discharge Point #3:

4,109 S.F.
7 S.F.
334 S.F.

4,450 S.F. → 0.102 Acre

Discharge Point #4:

1,788 S.F.
201 S.F.

1,989 S.F. → 0.046 Acre

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West Bay Dr. Sidewalks

Project No.: 10005 Task 5

Date: 2-16-2012 By: ASH

Sheet: Flows Added to Downstream Conveyance Page 2 of 4

Discharge Point #5:

557 S.F.
621 S.F.
557 S.F.

1,186 S.F → 0.027 Acre

Discharge Point #10:

973 S.F.
1,890 S.F.

2,863 S.F. → 0.066 Acre

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West Parc Ind Subdivision
Project No.: 10005 Task 5
Date: 2-16-2012 By: ASH
Sheet: Flows Added to Downstream Conveyance Page 3 of 4

Flows Added to Discharge Point 3 Formula

$Q = CIA$

A: Area (acres)

$I_{25} = 3.09$ in/hr

$I_{100} = 3.77$ in/hr

$C_{impervious} = 0.90$

* Assigned "Eastern Meadows" C values from pre-project conditions.

$C_{preproject\ 10yr} = 0.50$

$C_{preproject\ 25yr} = (0.50)(1.10) = 0.55$

$C_{preproject\ 100yr} = (0.50)(1.25) = 0.63$

$\Delta C_{25} = 0.90 - 0.55 = 0.35$

$\Delta C_{100} = 0.90 - 0.63 = 0.27$

Flows added $(Q) = \Delta CIA$

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: West Bay Dr Stream
Project No.: 10005 Task 5
Date: 2-16-2012 By: ASH
Sheet: Flows Added to Downstream Confluences Page 4 of 4

Flows Added to Discharge Points

Discharge Point #1

25yr: Q = (0.35)(3.09)(0.043) = 0.05 cfs

100yr: Q = (0.27)(3.77)(0.043) = 0.05 cfs

Discharge Point #2

25yr: Q = (0.35)(3.09)(0.03) = 0.03 cfs

100yr: Q = (0.27)(3.77)(0.03) = 0.02 cfs

Discharge Point #3

25yr: Q = (0.35)(3.09)(0.10) = 0.11 cfs

100yr: Q = (0.27)(3.77)(0.10) = 0.10 cfs

Discharge Point #4

25yr: Q = (0.35)(3.09)(0.045) = 0.05 cfs

100yr: Q = (0.27)(3.77)(0.045) = 0.05 cfs

Discharge Point #5

25yr: Q = (0.35)(3.09)(0.027) = 0.03 cfs

100yr: Q = (0.27)(3.77)(0.027) = 0.03 cfs

Discharge Point #6

25yr: Q = (0.35)(3.09)(0.046) = 0.05 cfs

100yr: Q = (0.27)(3.77)(0.046) = 0.05 cfs

Appendix D
Utility Conflict Notes

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: [illegible]

Project No.: 10005 Task E

Date: [illegible] By: [illegible]

Sheet: Utility Conflicts Page 1 of 2

* New power/CB at sta. 19+91

- existing water service to bldg right - is within 2' (center of pipe to center of pipe)
- at this point of water service will have to be relocated

* New power/CB at sta 19+00

NO CONFLICTS

* New CB at sta 21+39

NO CONFLICTS

* New power/CB at sta 22+99

NO CONFLICTS

* New power/CB at sta 23+49

NO CONFLICTS

* New CB at sta 23+54

- "V-UL-Phone" conflicts w/ new [illegible]
- CB conflicts w/ existing [illegible]

SKILLINGS CONNOLLY

Lacey, Washington 360-491-3399

Project Name: [illegible]

Project No.: 10[illegible] Task 5

Date: 2-14-2012 By: ASH

Sheet: Utility Conflicts Page 2 of 2

* New [illegible] at sta [illegible] +87

- Conflicts

- [illegible]
- Water line

- depths need to be checked

* New manholes at sta 23+24

- CONFLICTS

- Gas line
- Water line

- depths need to be checked

* New [illegible] sta 33+[illegible] to sta 34+25 (+CB)

- Conflicts

- water [illegible]
- 10" water storm line
- Gas line
- [illegible] PHONE line

depths need to be checked
- [illegible] gas line can be moved
- Park view [illegible] to be removed

* [illegible] CB sta 34+40

- [illegible]