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VINTERRA

Preliminary Technical Information Report

prepared for:
DR Horton

date:
August 27, 2013

RECEIVED
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CITY OF WOODINVILLE
DEVELOPMENT SERVICES

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Vinterra

City of Woodinville, Washington

Preliminary Technical Information Report

Prepared for
DR Horton
12931 NE 126th Place
Kirkland, WA 98034

Date: **December 18, 2012**
Revised: **April 5, 2013, August 27, 2013**

GINA R. BROOKS
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REGISTERED
PROFESSIONAL ENGINEER
8/27/13

Blueline Job No. 12-132

Prepared by: Gina Brooks, PE
Reviewed by: Todd Oberg, PE

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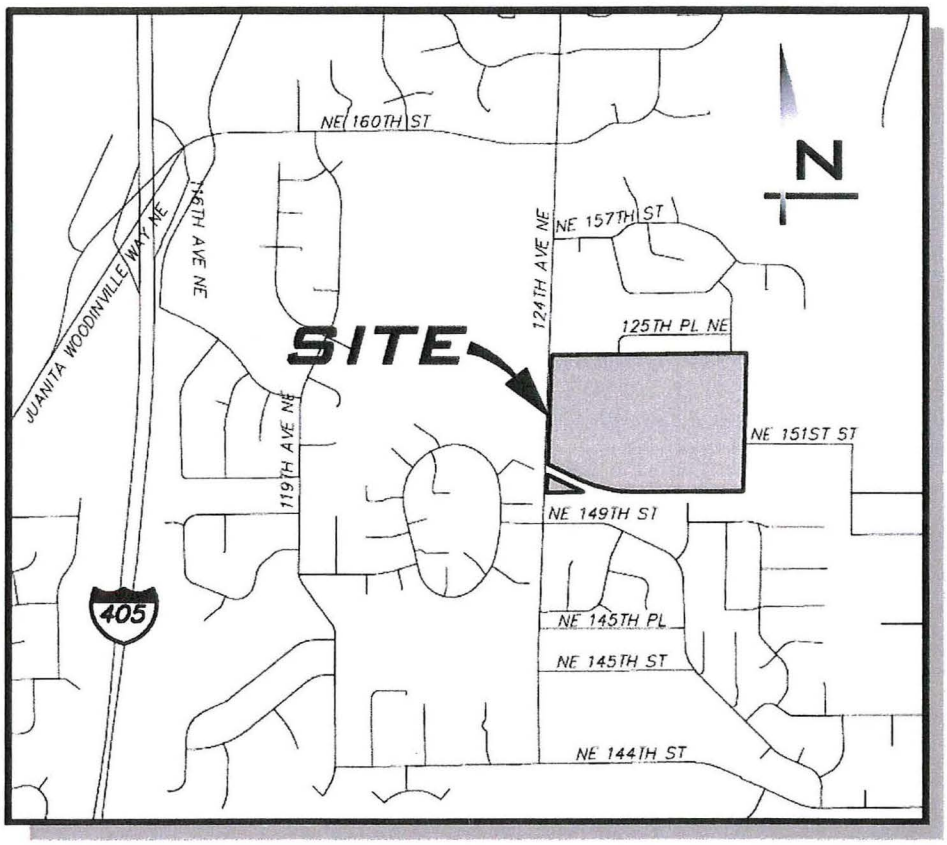
SECTION 1 PROJECT OVERVIEW

The Vinterra proposed development is located at 15025 124th Avenue NE in Woodinville, WA. within Section 16, Township 26N, Range 5E W.M. See Vicinity Map below.



Vicinity Map
Not to Scale

The site is composed of two parcels (16206059017, 1626059077) totaling approximately 33.35 acres. The parcel is segmented into two separate areas by City of Seattle Water Property. The large portion of the property measuring 32.97 acres will be the location of the development whereas, the small portion of the property measuring 0.38 acre will include frontage improvements along 124th Avenue NE.

In the existing condition, the largest parcel is being used as a commercial nursery and contains a gravel parking lot and drive aisles, irrigation pond and several buildings. The smaller parcel is an existing large single family residence lot. There is a small wetland located along the southern border within the eastern portion of the site. Ground slopes generally range from 1 to 10 percent with small

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isolated areas exceeding 50%. The site has a drainage ridge that generally runs north-south creating two basins referred to as West Basin and East Basin. Approximately 1.09 acres of upstream area is tributary to the site. This area is located east of the project site and consists of portions of existing residential lots plus a portion of existing NE 151st Street ROW. The site is surrounded by residential properties to the north and east, 124th Avenue NE ROW to the west, and City of Seattle Water Property to the south.

Proposed development will include the demolition of the existing buildings outbuildings and the creation of 157 lots with associated roadway, utilities, drainage tracts, recreation tracts, open space tract, and a sensitive area tract.

The subject project's drainage facilities were designed using the guidelines and requirements established in the 2009 King County Surface Water Design Manual (2009 KCSWDM) as adopted by the City of Woodinville. The project discharges to two different basins. The West Basin is located within the Juanita Creek Sub Basin. The East Basin is located within the Sammamish River West Sub Basin. The site requires "Level 2 Flow Control" and.water quality treatment complying with the "Basic Water Quality Menu".

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SECTION 2 CONDITIONS AND REQUIREMENTS SUMMARY

Compliance with the 2009 KCSWDM Core and Special Requirements are listed below.

Core Requirement #1: Discharge at the Natural Location: Discharge from the site is to the existing natural discharge locations. See Section 3 of this Report for the Downstream Analysis.

Core Requirement #2: Offsite Analysis: See Section 3 of this Report for the offsite analysis.

Core Requirement #3: Flow Control: Design of the flow control facilities are described in Section 4 of this Report. Placement of the flow control facilities is shown on the Preliminary Civil Plans under separate cover.

Core Requirement #4: Conveyance System: Sizing of the proposed conveyance system will be completed during final design. A preliminary layout of the conveyance system is shown on the Preliminary Civil Plans under separate cover.

Core Requirement #5: Erosion and Sediment Control: This Core Requirement will be address during final design.

Core Requirement #6: Maintenance and Operations: This Core Requirement will be address during final design.

Core Requirement #7: Financial Guarantees and Liability: This Core Requirement will be address during final design.

Core Requirement #8: Water Quality: Design of the water quality facilities are described in Section 4 of this Report. Placement of the water quality facilities is shown on the Preliminary Civil Plans under separate cover.

Special Requirement #1: Other Adopted Area-Specific Requirements: There are no known additional requirements for the subject project.

Special Requirement #2: Flood Hazard Area Delineation: The site does not contain or is adjacent to a flood hazard area. This Special Requirement, therefore, is not applicable.

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Special Requirement #3: Flood Protection Facilities: The site does not rely on or will modify an existing flood protection facility or construct a new flood protection facility. This Special Requirement, therefore, is not applicable.

Special Requirement #4: Source Control: The subject project is a single family development and not a commercial development. This Special Requirement, therefore, is not applicable.

Special Requirement #5: Oil Control: The subject project is a single family development and not a high-use development. This Special Requirement, therefore, is not applicable.

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SECTION 3 OFFSITE ANALYSIS

A site visit was conducted on July 26, 2012 on a sunny day.

ONSITE DRAINAGE

The site is split into two separate drainage basins; east and west. The East Basin is approximately two-thirds of the site and is tributary to a 24-inch storm system located central and at the north end of the site. The West Basin is approximately one-third of the site and discharges into the 124th Avenue NE conveyance system.

UPSTREAM BASIN

Approximately 1.09 acres of upstream area is tributary to the site. This area is located east of the project site and consists of portions of existing residential lots plus a portion of existing NE 151st Street ROW. See Section 4 of this Report for an exhibit delineating the upstream area.

DOWNSTREAM DRAINAGE FIELD INSPECTION

The downstream drainage paths were determined from the site to the ¼ mile point downstream. Please reference the Downstream Drainage Exhibits and Downstream Drainage Inventory Tables included on the following pages.

East Basin

The east portion of the site generally slopes east to west and west to east concentrating at an irrigation pond located along the north central boundary of the subject property. Flow leaves the pond (Point A) and is conveyed through a series of catch basins and 24-inch corrugated metal pipes until it is discharged into a channel via a 24-inch outlet (Point B). Approximately 170 feet downstream in the channel represents the ¼ mile point from the project. Flow continues through the channel eventually crossing below Woodinville Duvall Road until it reaches the Sammamish River approximately 1 mile downstream.

There was some minor erosion and sedimentation noted in the open channel along the downstream route. There are no existing drainage complaints within the City of Woodinville limits along the downstream path from the site. The City of Woodinville Stormwater Management Plan- Section 5.2 "Problem Ranking and CIP Development" was reviewed. A copy of the drainage complaint map is included on the following pages. Additionally, King County does not show a record of any drainage complaints along the downstream route within the last ten years.

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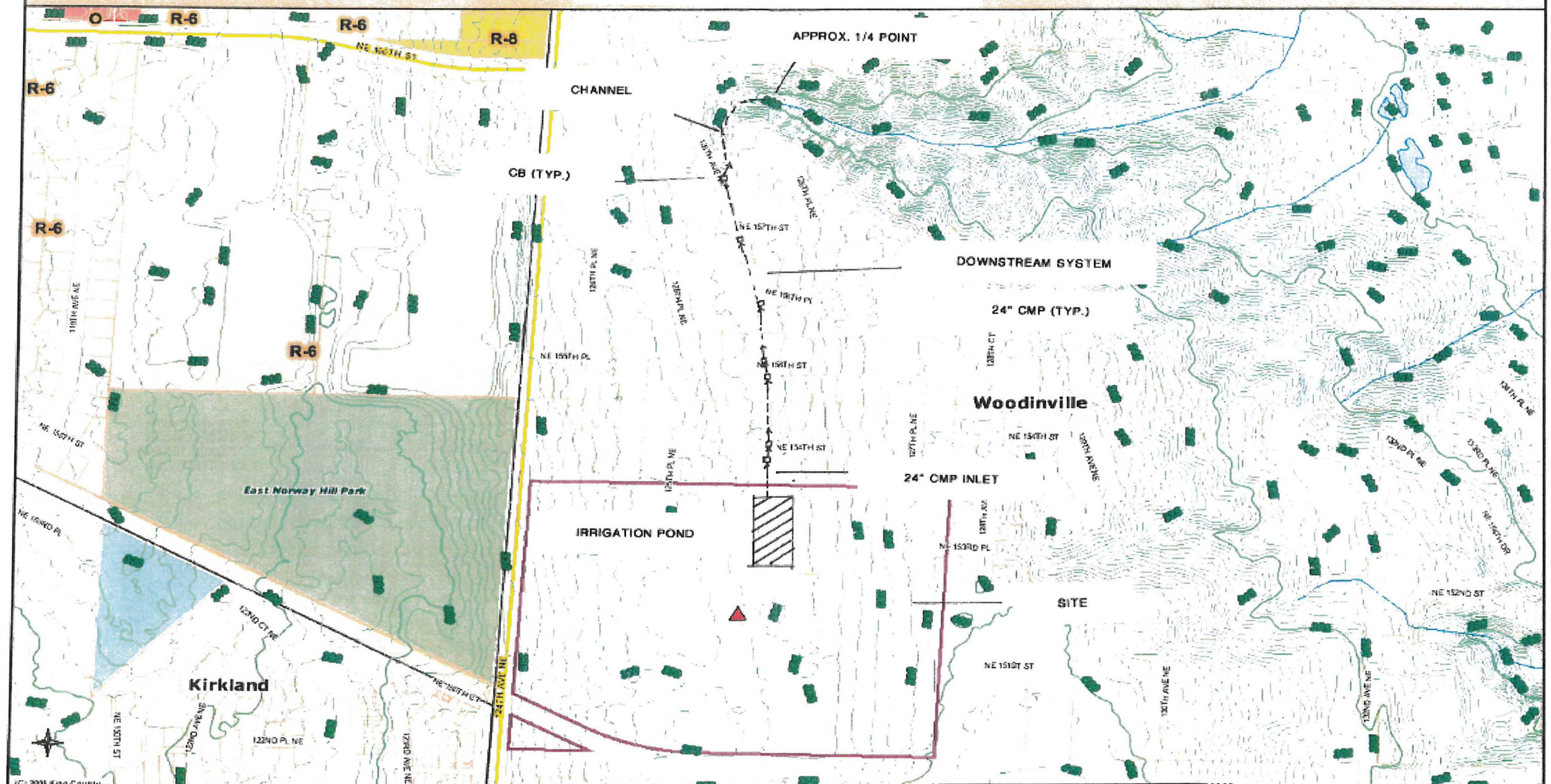
EAST BASIN DOWNSTREAM



The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

Date: 7/18/2012 Source: King County iMAP - Property Information (http://www.metrokc.gov/GIS/iMAP)

King County

Off-site Analysis Drainage System Table
Surface Water Design Manual, Core Requirement #2

Basin: Sammamish River **Subbasin Name:** Sammamish River West **Subbasin Number:**

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector, resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	¼ mi = 1,320 ft.	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A	24-inch CMP	North through Kingswood Development	0.5 - 2%	0 - 1,170 ft (Approximately)	None observed	None	No problems observed.
B	Open Channel	2-3 feet wide at outlet, up to 3 feet deep, 6-8 wide at end of analysis	5 - 30%	1,170 - 1,340 ft.	Some cutting of channel sidewalls.	None	Some debris in channel.

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DRAINAGE PHOTOS

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East Basin

Outlet from Irrigation Pond.

Upstream catch basin from outlet.

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24-inch CMP outlet to channel.

Approximately 50 feet downstream of outlet.

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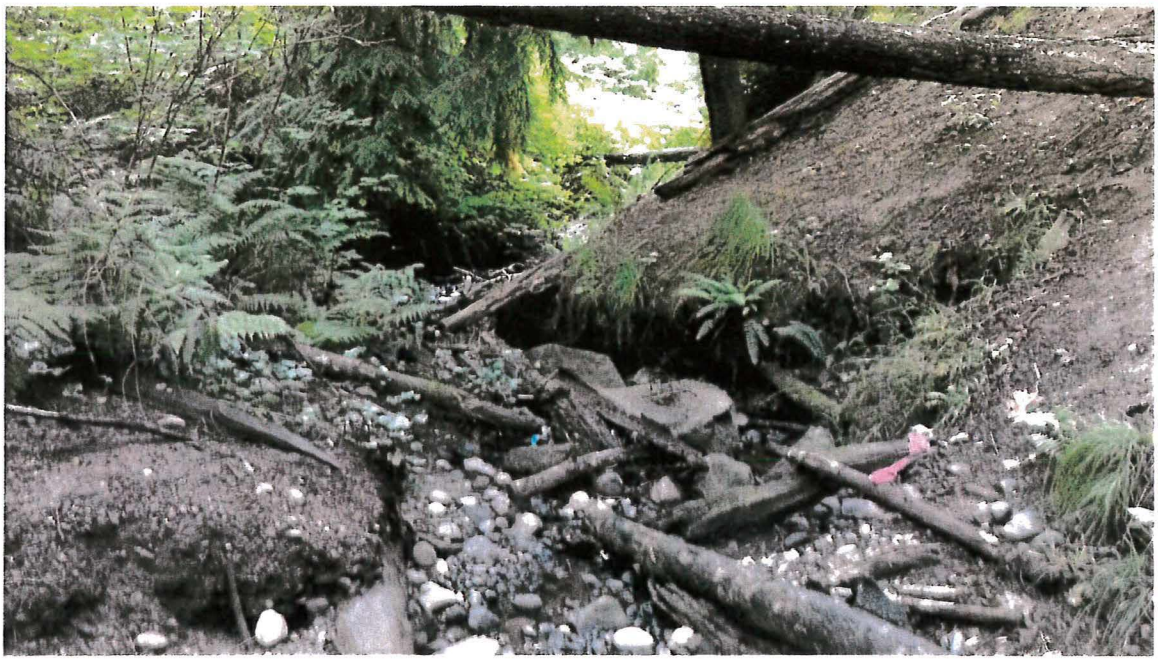

Approximately ¼ mile point from site, some erosion of channel sidewalls.

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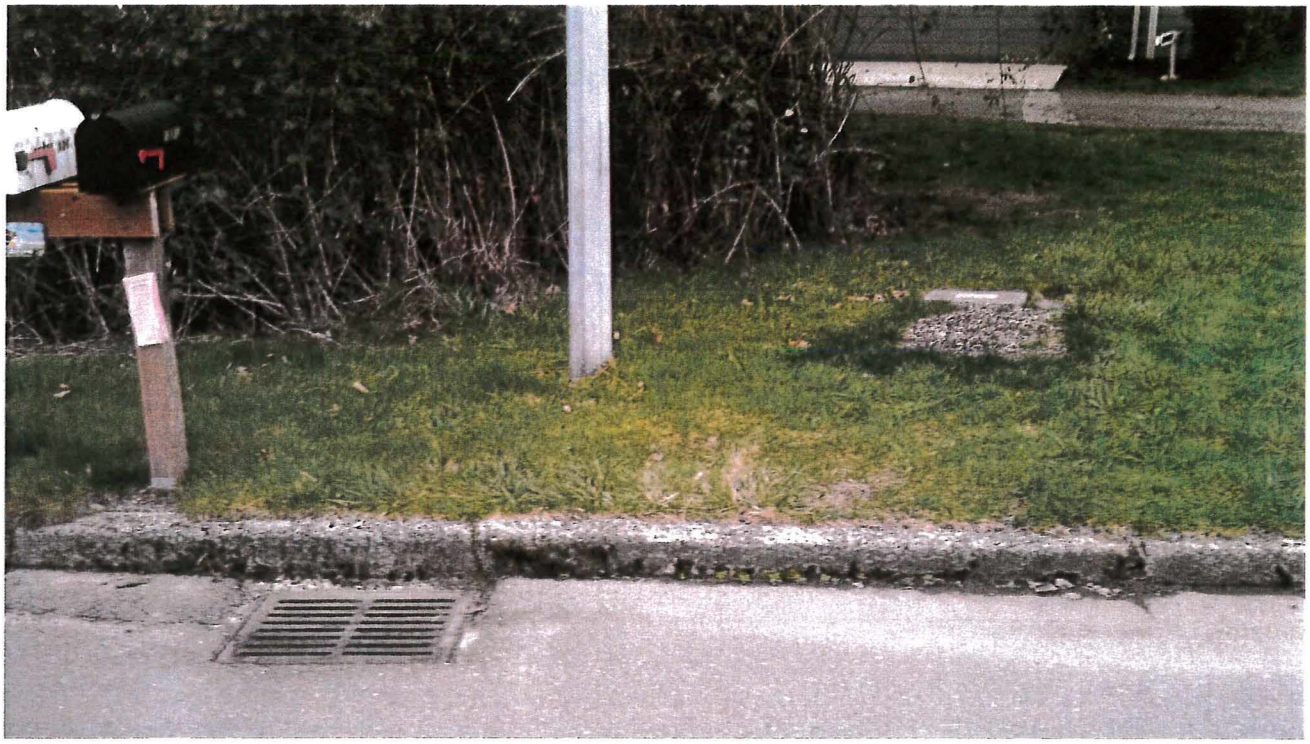

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West Basin

The west portion of the site generally slopes east to west to 124th Avenue NE. Catch basins along 124th Avenue NE capture the site's drainage and convey the drainage south along 124th Avenue NE. The downstream path was delineated starting from City of Kirkland catch basin #24817 located just south of the Seattle Public Utility easement (Point A). From this point, flow is conveyed south to a catch basin north of NE 149th Street. At this point the conveyance system changes from 12-inch ductile iron to 24-inch concrete pipe (Point B). Flow continues south to a manhole before heading west across 124th Avenue NE via a 36-inch concrete pipe (Point C). Flow continues westerly via 36-inch concrete pipes whereupon it discharges to an open channel approximately 1,180 feet downstream (Point D). Flow continues through the open channel for approximately 265 feet whereupon it reaches twin 36-inch concrete culverts at 122nd Avenue NE (Point E). This represents the ¼ mile point downstream from the property. Following this point, flow continues through a series of open channels and pipes eventually reaching Lake Washington approximately 3 miles downstream.

There was no evidence of erosion or inadequate capacity at any point along the downstream drainage course. An inquiry was placed with both King County and the City of Kirkland in regards to drainage complaints along the downstream path. King County records indicate no drainage complaints within the last ten years. According to the City of Kirkland, since annexing this area in June of 2011, there have been no complaints since that time. There are no existing drainage complaints within the City of Woodinville limits along the downstream path from the site.

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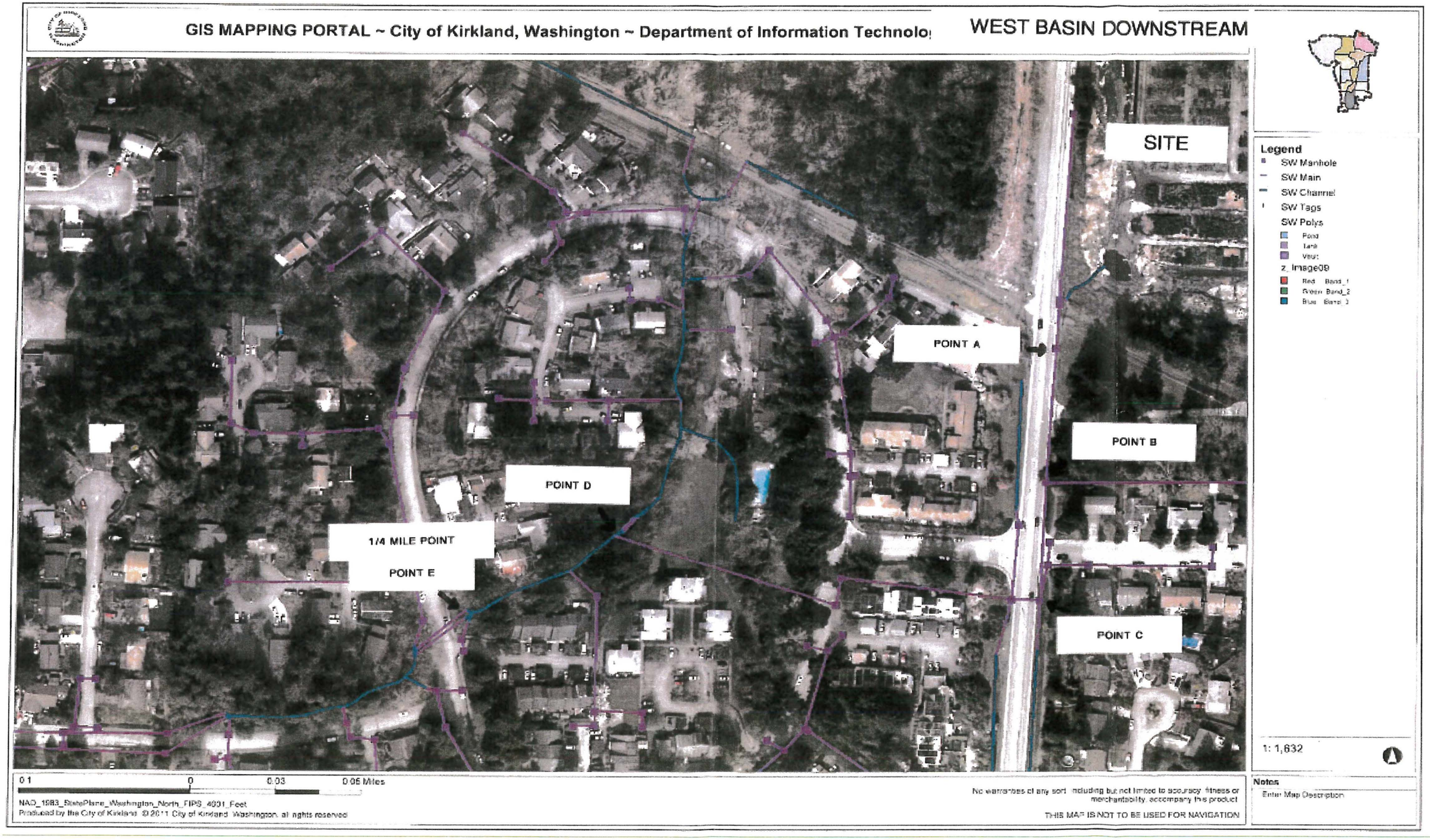

Off-site Analysis Drainage System Table
Surface Water Design Manual, Core Requirement #2

Basin: Lake Washington **Subbasin Name:** Juanita Creek **Subbasin Number:**

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector, resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	¼ mi = 1,320 ft.	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A	12-inch Ductile Iron	Along the east side of 124th Avenue NE	0.5 - 2%	0 - 234 ft.	None observed	None	No problems observed.
B	24- inch Concrete	Along the east side of 124th Avenue NE	0.5 - 2%	234 - 437 ft.	None observed	None	No problems observed.
C	36-inch Concrete	Westerly along NE 149th PL and Breakthrough development	2 - 15%	437 - 1,177 ft.	None observed	None	No problems observed.
D	Open Channel	Westerly through Breakthrough development	0.5 - 3%	1,177 - 1,456 ft.	None observed	None	Channel 4 - 5 feet wide typical, 10' wide at outlet from 36-inch, water in channel approx. 2 inches deep.

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DRAINAGE PHOTOS

West Basin

Point A – City of Kirkland catch basin # 24817, looking South.

Point B, looking north.

B

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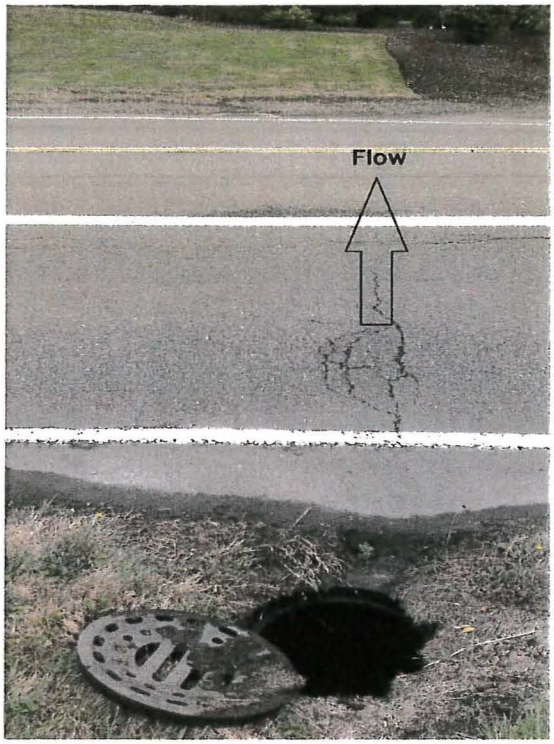

Point C, Looking west across 124th Avenue NE.

Across 124th Avenue from Point C.

Intermediate manhole between points C and D.

Point D, Top of outlet covered in heavy brush.

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Immediately downstream of Point D.

Point E, twin 36" culverts.

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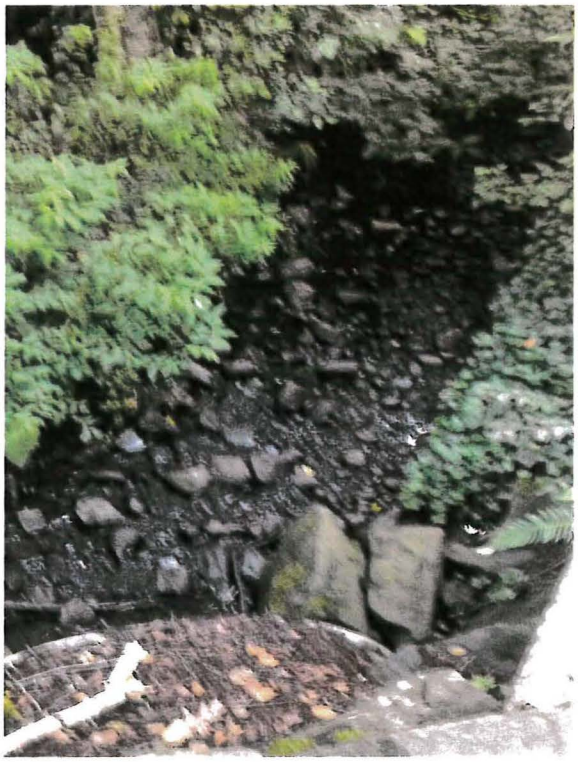

Immediately upstream of twin culverts.

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Resource Review

The best available resource information was reviewed for existing or potential problems. The following is a summary of the findings.

- The east portion of the site is located within the Sammamish River West Sub Basin. The west portion of the site is located within the Juanita Creek Sub Basin.
- There is a small wetland located along the southern border within the eastern portion of the site. The wetland delineated on the King County iMap on the following page is not a wetland but, is an existing irrigation pond.
- The site does not contain any streams and is not located within a floodplain.
- The site is not located in an Erosion Hazard Area.
- The site is not located in a Landslide Hazard Area.
- The site is not located in a Seismic Hazard Area.

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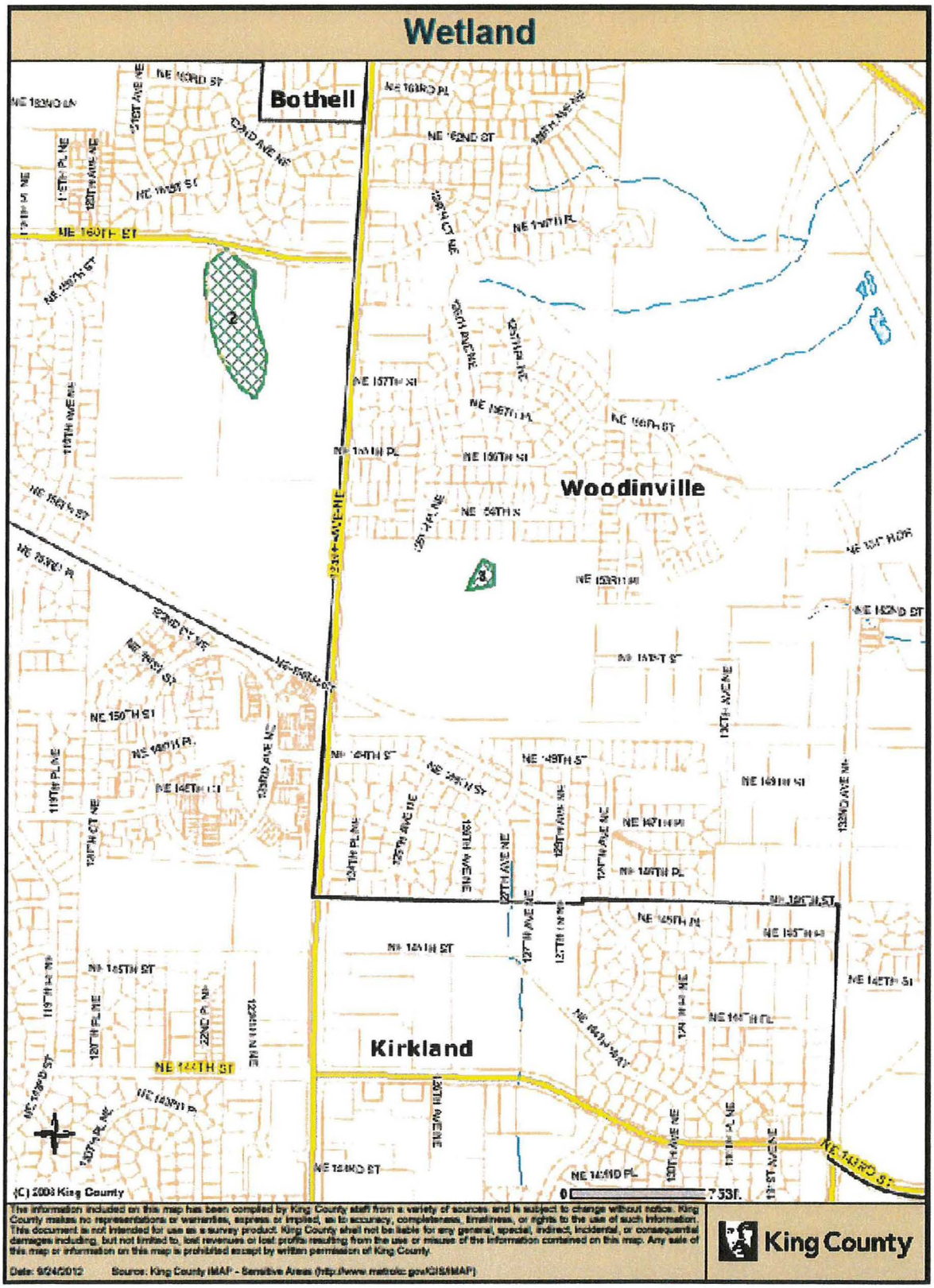

Streams
Bothell
Woodinville
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Date: 9/24/2012 Source: King County IMAP - Sensitive Areas (http://www.metrokc.gov/GIS/IMAP)
King County

EXHIBIT 14
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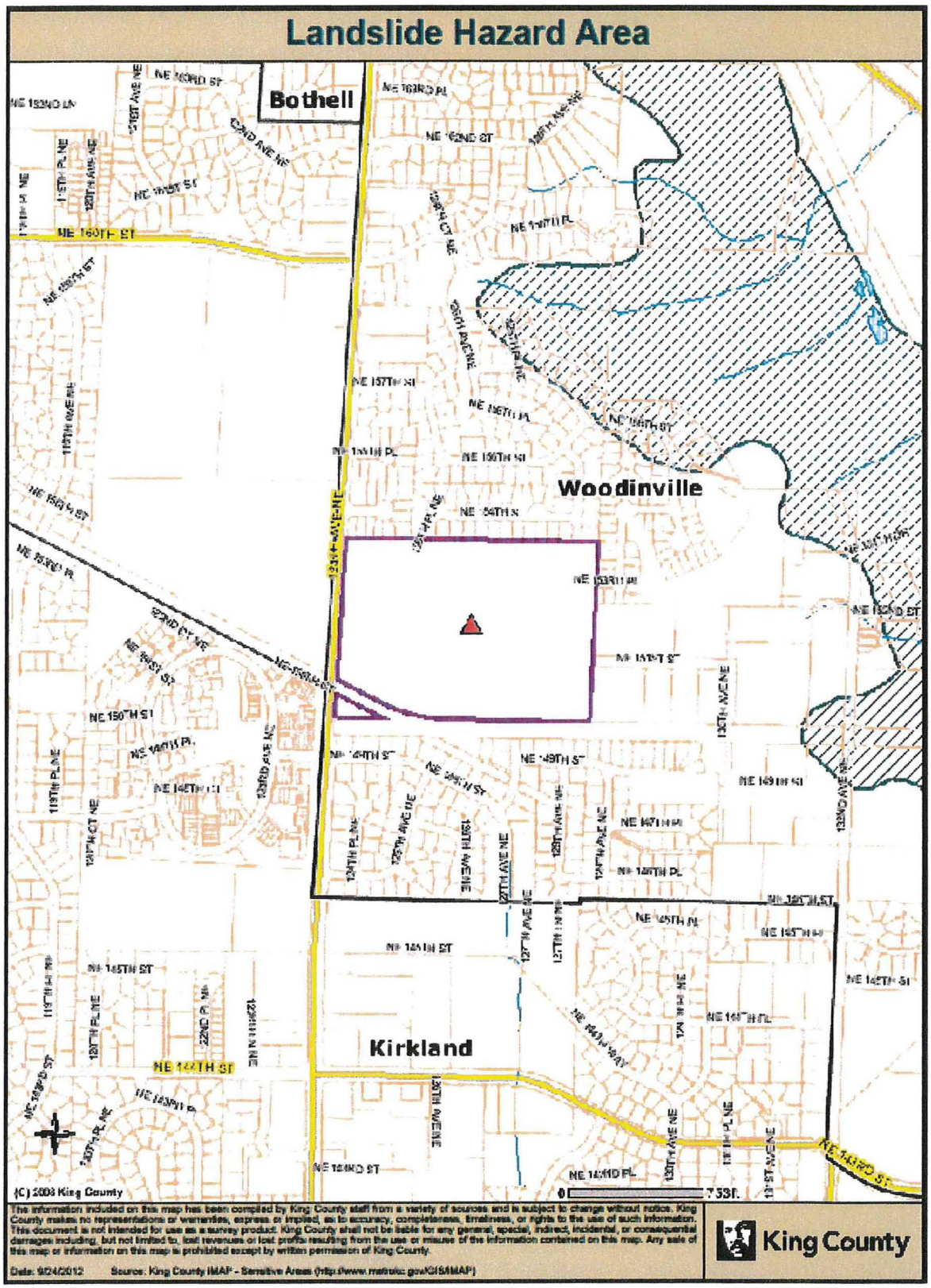
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NE 167TH PL
NE 168TH PL
NE 169TH PL
NE 170TH PL
NE 171ST PL
NE 172ND PL
NE 173RD PL
NE 174TH PL
NE 175TH PL
NE 176TH PL
NE 177TH PL
NE 178TH PL
NE 179TH PL
NE 180TH PL
NE 181ST PL
NE

EXHIBIT 14
PAGE 29 OF 73

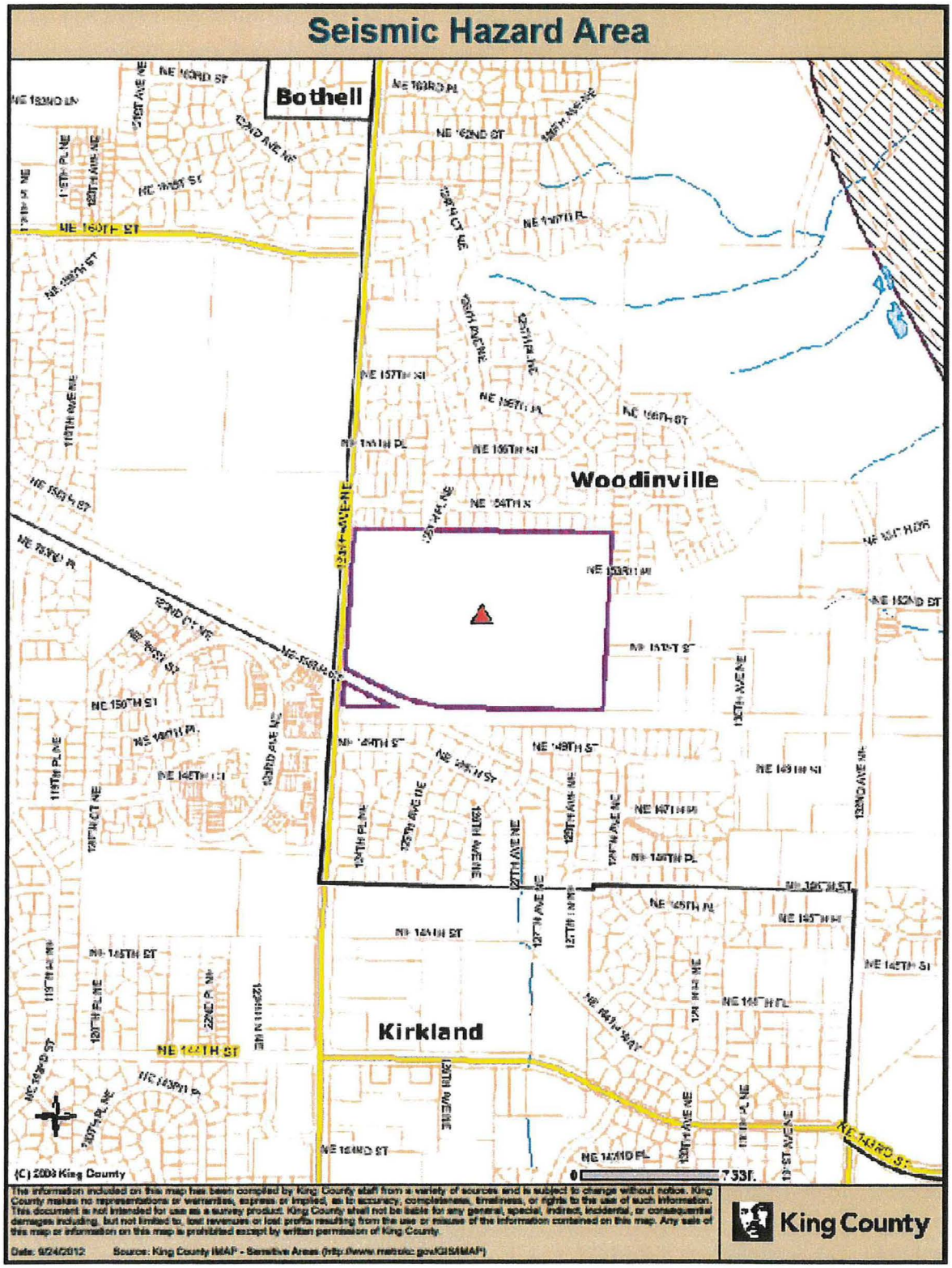

EXHIBIT 14
PAGE 30 OF 73

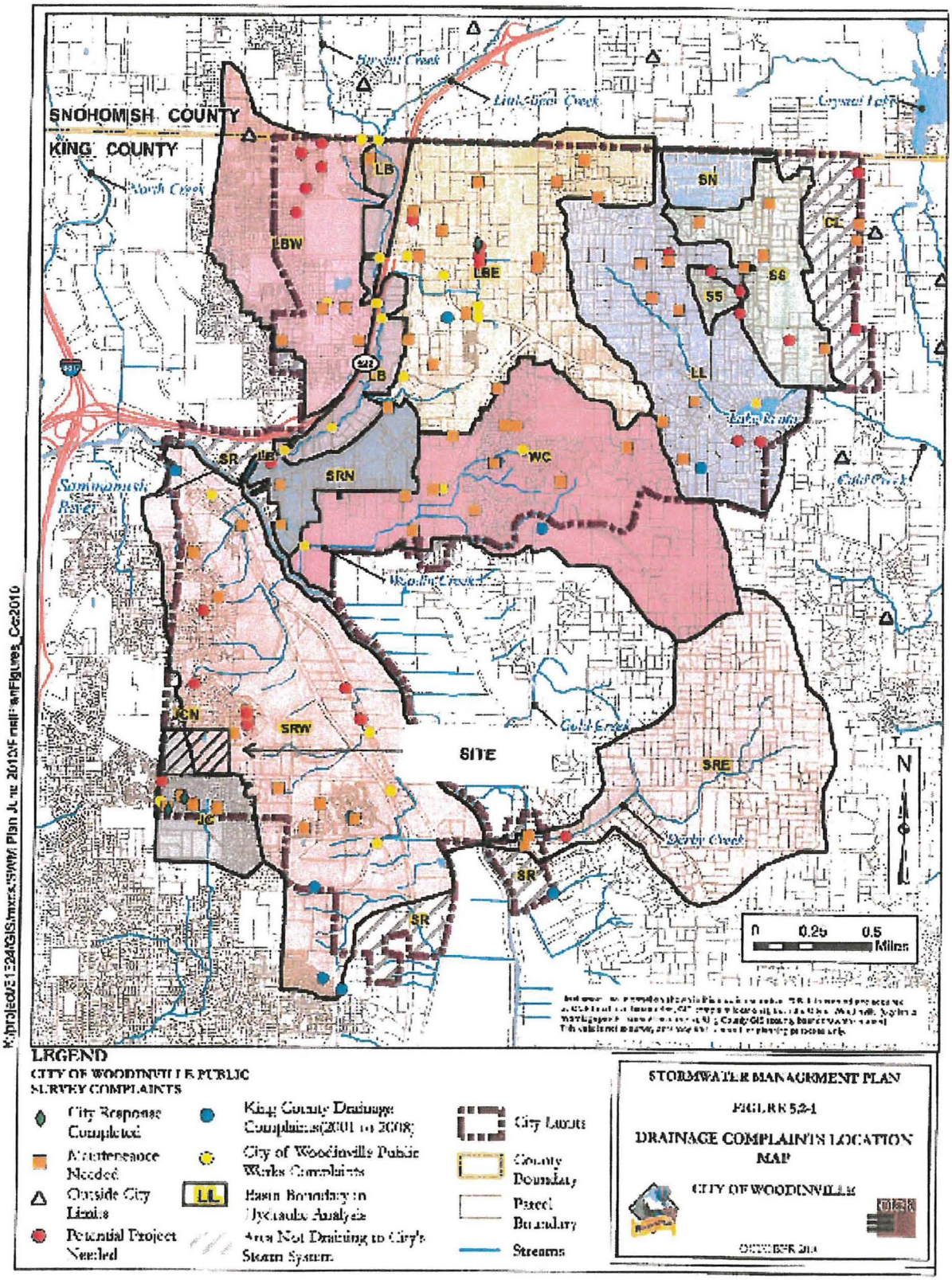

EXHIBIT 14
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SECTION 4 FLOW CONTROL & WATER QUALITY ANALYSIS AND DESIGN

Flow control and water quality treatment will be accommodated for in two combined detention/water quality facilities. The West Basin will utilize a wetvault. The East Basin will utilize a wetpond. Live storage within the vault/pond will be designed according to Level 2 Flow Control. Dead storage within the vault/pond will be designed according to the Basic Water Quality Treatment Menu.

A. Hydraulic Analysis

The drainage analysis was modeled using the King County Runoff Time Series software. The site soils are Alderwood (AgC) and Norma (No), KCRTS group Till. See Soils Map on the following pages. The site is located in the Seatac rainfall region with a location scale factor of 1.0.

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Custom Soil Resource Report
Soil Map

EXHIBIT 14
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TABLE 3.2.2.B EQUIVALENCE BETWEEN SCS SOIL TYPES AND KCRTS SOIL TYPES

SCS Soil Type	SCS Hydrologic Soil Group	KCRTS Soil Group	Notes
* Alderwood (AgB, AgC, AgD)	C	Till	
Arents, Alderwood Material (AmB, AmC)	C	Till	
Arents, Everett Material (An)	B	Outwash	1
Beausite (BeC, BeD, BeF)	C	Till	2
Bellingham (Bh)	D	Till	3
Briscot (Br)	D	Till	3
Buckley (Bu)	D	Till	4
Earlmont (Ea)	D	Till	3
Edgewick (Ed)	C	Till	3
Everett (EvB, EvC, EvD, EwC)	A/B	Outwash	1
Indianola (InC, InA, InD)	A	Outwash	1
Kitsap (KpB, KpC, KpD)	C	Till	
Klaus (KsC)	C	Outwash	1
Neilton (NeC)	A	Outwash	1
Newberg (Ng)	B	Till	3
Nooksack (Nk)	C	Till	3
* Norma (No)	D	Till	3
Orcas (Or)	D	Wetland	
Oridia (Os)	D	Till	3
Ovall (OvC, OvD, OvF)	C	Till	2
Pilchuck (Pc)	C	Till	3
Puget (Pu)	D	Till	3
Puyallup (Py)	B	Till	3
Ragnar (RaC, RaD, RaC, RaE)	B	Outwash	1
Renton (Re)	D	Till	3
Salal (Sa)	C	Till	3
Sammamish (Sh)	D	Till	3
Seattle (Sk)	D	Wetland	
Shalcar (Sm)	D	Till	3
Si (Sn)	C	Till	3
Snohomish (So, Sr)	D	Till	3
Sultan (Su)	C	Till	3
Tukwila (Tu)	D	Till	3
Woodinville (Wo)	D	Till	3

Notes:

1. Where outwash soils are saturated or underlain at shallow depth (<5 feet) by glacial till, they should be treated as till soils.
2. These are bedrock soils, but calibration of HSPF by King County DNRP shows bedrock soils to have similar hydrologic response to till soils.
3. These are alluvial soils, some of which are underlain by glacial till or have a seasonally high water table. In the absence of detailed study, these soils should be treated as till soils.
4. Buckley soils are formed on the low-permeability Osceola mudflow. Hydrologic response is assumed to be similar to that of till soils.

B

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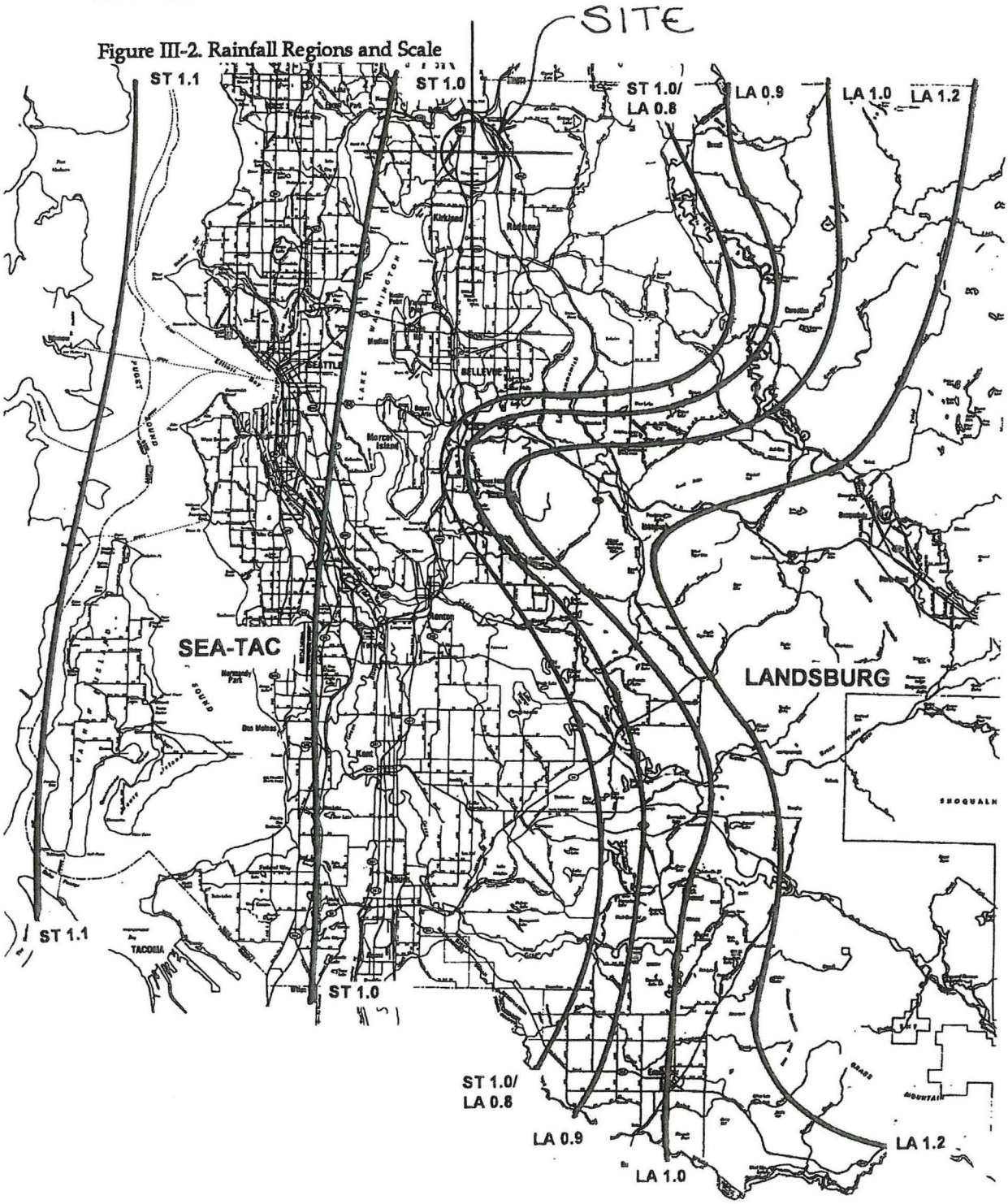
SECTION III

Figure III-2. Rainfall Regions and Scale



B

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EXISTING CONDITIONS

The existing conditions were analyzed as forested. The existing basin boundary area, 33.05 acres is defined as that area that will be improved through development of the subject property. The existing basin boundary will include the property area, 33.35 acres, less wetland Tract 991, 0.11 acre, less preserved Tract 999, 0.35 acre, less dedicated ROW along 124th Avenue NE, 0.27 acre, plus the frontage improvement area between the dedicated ROW/proposed back of sidewalk and the existing edge of pavement, 0.43 acre. As stated previously, the site is divided into two basins, West Basin and East Basin. The basins are delineated below. See Existing Conditions Exhibit on the following page.

WEST BASIN

The West Basin is 11.12 acres. The following information was used for generating time series and flow frequencies.

WEST BASIN **EXISTING CONDITIONS** (12132exw.tsf)	Total Area = 11.12 acres
GROUND COVER	AREA(acre)
Till-Forest	11.12

```
  Flow Frequency Analysis
  Time Series File:12132exw.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---        -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak         - - Peaks - -  Rank  Return  Prob
   (CFS)                                 (CFS)              Period
   0.701      2   2/09/01 18:00         0.897          1  100.00   0.990
   0.190      7   1/06/02  3:00         0.701          2   25.00   0.960
   0.520      4   2/28/03  3:00         0.538          3   10.00   0.900
   0.018      8   3/24/04 20:00         0.520          4    5.00   0.800
   0.309      6   1/05/05  8:00         0.454          5    3.00   0.667
   0.538      3   1/18/06 21:00         0.309          6    2.00   0.500
   0.454      5  11/24/06  4:00         0.190          7    1.30   0.231
   0.897      1   1/09/08  9:00         0.018          8    1.10   0.091
Computed Peaks                          0.832             50.00   0.980
```


B

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EAST BASIN

The East Basin is 21.93 acres. The following information was used for generating time series and flow frequencies.

EAST BASIN **EXISTING CONDITIONS** (12132exe.tsf)	Total Area = 21.93 acres
GROUND COVER	AREA(acre)
Till-Forest	21.93

Flow Frequency Analysis
Time Series File:12132exe.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
1.38	2	2/09/01 18:00	1.77	1	100.00	0.990
0.375	7	1/06/02 3:00	1.38	2	25.00	0.960
1.03	4	2/28/03 3:00	1.06	3	10.00	0.900
0.036	8	3/24/04 20:00	1.03	4	5.00	0.800
0.609	6	1/05/05 8:00	0.896	5	3.00	0.667
1.06	3	1/18/06 21:00	0.609	6	2.00	0.500
0.896	5	11/24/06 4:00	0.375	7	1.30	0.231
1.77	1	1/09/08 9:00	0.036	8	1.10	0.091
Computed Peaks			1.64		50.00	0.980

EXISTING CONDITIONS

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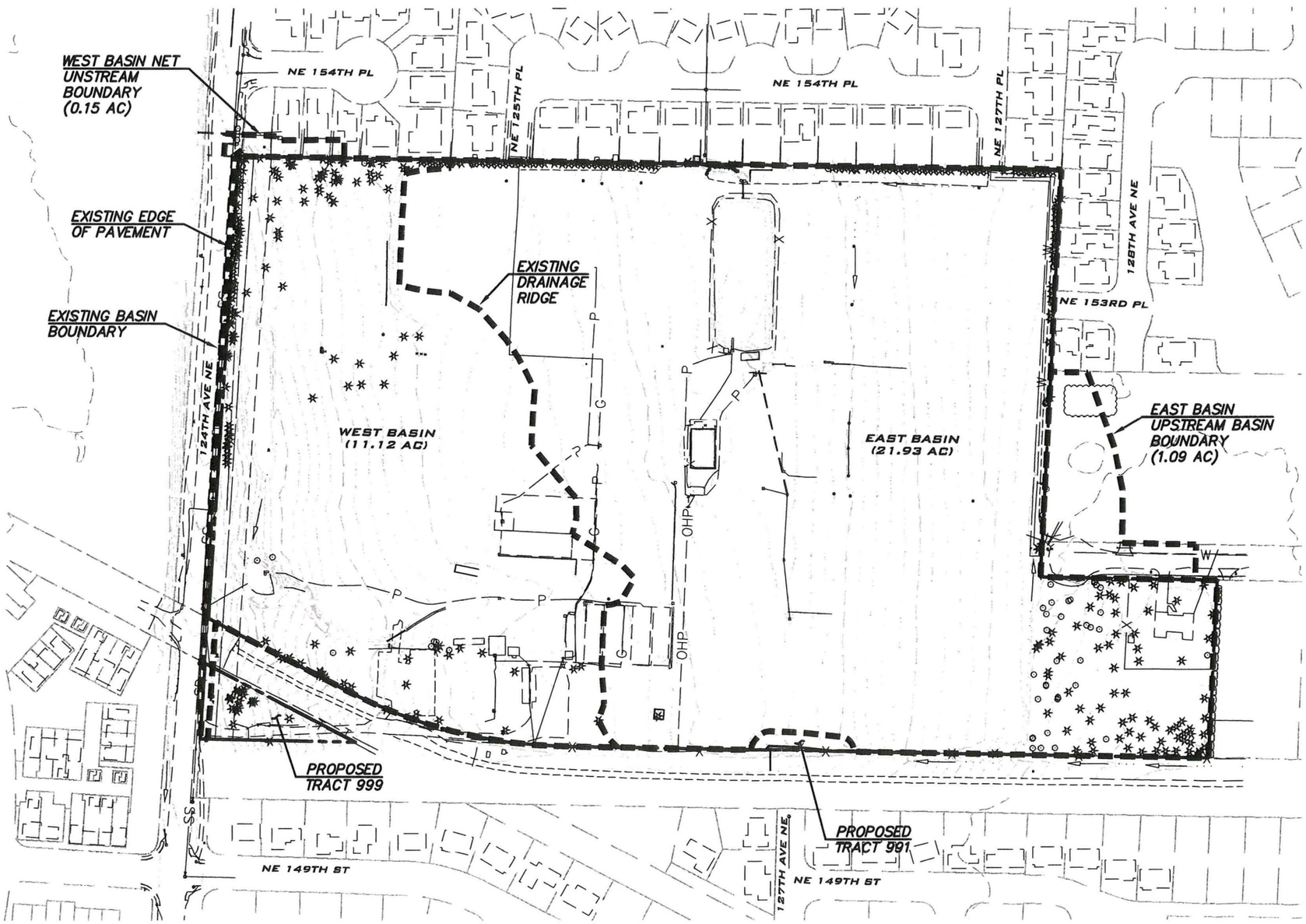

BLUELINE

EXISTING CONDITIONS MAP
VINTERRA

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SCALE	AS NOTED
PROJECT MANAGER	TODD A. OBERG, PE
DESIGNED BY	GINA BROOKS, PE
DRAWN BY	CAROL DOGGETT
PLOT DATE	August 12, 2013

JOB NUMBER: 12-132

FIGURE: EC

Aug 12, 2013 – 4:23pm – User gbrooks
E:\Projects\12132\dwg\Exhibits\12132EC.dwg

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UPSTREAM CONDITIONS

WEST BASIN

Approximately 0.39 acres of upstream area is tributary to the proposed conveyance system that will be tributary to the proposed vault. This area consists of existing pavement, sidewalk, and the backyards of properties located north of the site. A portion of the proposed improvements along 124th Avenue NE, 0.24 acre, will not be conveyed to the proposed vault. A portion of this upstream area will be used as compensation and incorporated into the developed basin boundary for the area that will not be conveyed to the proposed vault. The net upstream area will simply flow through the vault.

The total upstream area consists of 0.20 acre of landscaping and 0.19 acre of impervious surfaces. The area of improvements that will not be tributary to the proposed vault include 0.07 acre of landscaping and 0.17 acre of impervious surfaces. The net upstream area therefore consists of 0.20 acre – 0.07 acre = 0.13 acre landscaping and 0.19 acre – 0.17 acre = 0.02 acre of impervious surfaces.

The following information was used for generating time series and flow frequencies.

WEST BASIN NET UPSTREAM CONDITIONS (12132wup.tsf)	Total Area = 0.15 acre
GROUND COVER	AREA(acre)
Till-Grass	0.13
Impervious	0.02

```
  Flow Frequency Analysis
  Time Series File:12132wup.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---        -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak         - - Peaks - -  Rank  Return  Prob
   (CFS)                                 (CFS)              Period
   0.017      4   2/09/01  2:00         0.037          1  100.00   0.990
   0.010      6   1/05/02 16:00         0.021          2   25.00   0.960
   0.021      2   2/27/03  7:00         0.017          3   10.00   0.900
   0.007      8   8/26/04  2:00         0.017          4    5.00   0.800
   0.010      7  10/28/04 16:00         0.016          5    3.00   0.667
   0.017      3   1/18/06 16:00         0.010          6    2.00   0.500
   0.016      5  11/24/06  3:00         0.010          7    1.30   0.231
   0.037      1   1/09/08  6:00         0.007          8    1.10   0.091
Computed Peaks                           0.032              50.00   0.980
```


B

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EAST BASIN

Approximately 1.09 acres of upstream area is tributary to the site. This area is located east of the project site and consists of portions of existing residential lots plus a portion of existing NE 151st Street ROW.

The effective impervious area was estimated using Table 3.2.2.D and Table 3.2.2.E in the 2009 KCSWDM. Since the percent impervious table does not extend below 1 DU/GA, the percent impervious was extrapolated to be equal to 7.8% for 0.28 DU/GA. The effective impervious fraction for Rural is 0.40. The effective impervious area is therefore, 1.09 acres * 7.8% * 0.40 = 0.03 acre.

The following information was used for generating time series and flow frequencies.

EAST BASIN UPSTREAM CONDITIONS (12132eup.tsf)	Total Area = 1.09 acres
GROUND COVER	AREA(acre)
Till-Grass	1.06
Impervious	0.03

```
Flow Frequency Analysis
Time Series File:12132eup.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---          -----Flow Frequency Analysis-------
Flow Rate  Rank  Time of Peak          - - Peaks - -  Rank  Return  Prob
  (CFS)                                  (CFS)              Period
  0.102      4   2/09/01  2:00          0.238          1  100.00   0.990
  0.055      7   1/05/02 16:00          0.129          2   25.00   0.960
  0.129      2   2/27/03  7:00          0.105          3   10.00   0.900
  0.027      8   8/26/04  2:00          0.102          4    5.00   0.800
  0.057      6   1/05/05  8:00          0.095          5    3.00   0.667
  0.105      3   1/18/06 16:00          0.057          6    2.00   0.500
  0.095      5  11/24/06  3:00          0.055          7    1.30   0.231
  0.238      1   1/09/08  6:00          0.027          8    1.10   0.091
Computed Peaks                           0.202              50.00   0.980
```


B

DEVELOPED CONDITIONS

The developed basin boundary area is equal to the existing basin boundary area, 33.05 acres. The basin ridge between the West Basin and East Basin will be located to maintain existing basin areas. The developed boundary will vary along the 124th Avenue NE and will extend into a portion of the north backyards upstream of the plat to compensate for improvement area along 124th Avenue NE that will not be conveyed to the proposed vault. See Upstream Conditions above for a description of the upstream area, the portion that will be incorporated into the developed conditions, and the net upstream area. The same ground cover within the upstream area will be swapped with that portion of the same ground cover that will not be tributary to the proposed vault. See attached Developed Conditions Exhibit on the following pages.

The improvements within the existing basin boundary, 33.05 acres, will include 0.43 acre of existing/dedicated right-of-way and Seattle Water Line property, 8.30 acres of proposed right-of-way, 0.26 acre of access tracts, 2.25 acres of drainage tracts, 0.66 acre of recreational space tracts, 19.47 acres of R-6 zoned lot area, and 1.68 acres of R-4 zoned lot area. As stated previously, the site is divided into two basins, West Basin and East Basin, delineated below.

The impervious coverage for the development is delineated below.

Impervious Coverage for the Existing/Dedicated 124TH Avenue NE ROW and Seattle Water Line Property

The impervious coverage within the existing/dedicated 124th Avenue NE ROW and Seattle Water Line Property is 0.31 acre.

The developed boundary will vary along the 124th Avenue NE and will extend into a portion of the north backyards upstream of the plat as mentioned above. Since the same ground cover that will be used for compensation will be the same as the 124th Avenue NE improvement area's ground cover that will bypass the vault, the developed ground cover conditions will remain the same as delineated above. The impervious cover will remain as 0.31 acre.

Impervious Coverage for the Proposed ROW

The impervious coverage within the proposed right-of-way is 7.44 acres.

Impervious Coverage for the Proposed Access Tracts

The impervious coverage within the proposed access tracts was assumed to be 100% or 0.26 acre.

Impervious Coverage for the Lots

The maximum impervious coverage per lot is 70% for R-6 zoning and 45% for R-4 zoning per WMC Section 21.24.085.

Per Section 1.2.3.3 in the 2009 KCSWDM, projects subject to Core Requirement #3 must apply flow control BMPs to impervious surfaces as directed by this section to either supplement the flow mitigation provided by required flow control facilities or provide flow mitigation where flow control facilities are not required. Flow control BMPs must be selected and applied according to the basic requirements, procedures, and provisions detailed in Section 5.2 and the design specifications for each BMP in Appendix C, Section C.2. Since approval will be required for the subdivision as well as the building permits for the newly created lots, both kinds of flow control BMP implementation are required as described in Section 5.2.

Per Section 5.2, for individual lots, implementation shall be in accordance with the "Individual Lot BMP Requirements" in Section 5.2.1. The individual lots on the subject project are smaller than 22,000 square feet and therefore, fall under the Section 5.2.1.1 "Small Lot BMP Requirements". Since full dispersion and full infiltration are not feasible, one or more of the following BMPs listed under Section 5.2.1.1 (3.) must be applied to an impervious area equal to at least 10% of the lot for lot areas up to 11,000 square feet.

For the R-6 zoned lots, this required BMP treatment area is equal to 10%*19.47 acres = 1.95 acres. For the R-4 zoned lots, this required BMP treatment area is equal to 10%*1.68 acres = 0.17 acres.

A combination of "Reduced Impervious Surface Credit" via a "Restricted Footprint" per Appendix C, Section C.2.9 and other optional BMP measures will be applied to the lots to fulfill the BMP treatment requirement. For the R-6 zoned lots, an impervious area of 1.95 acres (10% of the lot areas) will be treated utilizing the "Restricted Footprint". This area fulfills the BMP requirement for the R-6 zoned lots and equates to an allowable average coverage of 60% impervious coverage on the R-6 lots. The adjusted impervious area for the R-6 lots is therefore; 19.47 acres*70% - 1.95 acres = 11.68 acres or 19.47 acres*60% = 11.68 acres.

For the R-4 zoned lots, an impervious area of 0.03 acre (2% of the lot areas) will be treated utilizing the "Restricted Footprint" and 0.14 acre (8% of the lot areas) will be treated by other BMP measures. This total area fulfills the BMP requirement for the R-4 zoned lots and equates to an allowable average coverage of 43% impervious coverage on the R-4 lots of which a total area of 0.14 acre over all the R-4 lots will be treated by other BMP measures that will be determined at building

permit. Per Table 1.2.3.C in the 2005 KCSWDM, the worst case credit received for BMP measures is conversion of the impervious area to 50% impervious and 50% grass. This conversion will be applied to the 0.14 acre that will be treated by other BMP measures. The adjusted impervious area for the R-4 zoned lots is therefore, 1.68 acres*45% - 0.03 acre – 0.14 acre*50% = 0.66 acre.

The adjusted impervious coverage for all the lots is therefore, 11.68 acres + 0.66 acre = 12.34 acres. The distribution of impervious area per lot will be delineated on the final plat documents.

WEST BASIN

The West Basin is 11.12 acres. The West Basin will include 0.43 acre of existing/dedicated right-of-way, 2.62 acres of proposed right-of-way, 0.13 acre of access tracts, 0.85 acre of drainage tract, 0.05 acre of recreation space tract, and 7.04 acres of R-6 zoned lot area.

The impervious coverage for the developed West Basin is delineated below.

Impervious Coverage for the Existing/Dedicated 124TH Avenue NE ROW and Seattle Water Line Property

The impervious coverage within the existing/dedicated 124th Avenue NE ROW and Seattle Water Line Property is 0.31 acre.

Impervious Coverage for the Proposed ROW

The impervious coverage within the proposed ROW is 2.35 acres.

Impervious Coverage for the Proposed Access Tracts

The impervious coverage within the proposed access tracts was assumed to be 100% or 0.13 acre.

Impervious Coverage for the Lots

The impervious coverage within the proposed lots is 60% * 7.04 acres = 4.23 acres.

The following information was used for generating time series and flow frequencies.

WEST BASIN DEVELOPED CONDITIONS (12132dw.tsf)	Total Area = 11.12 acres
GROUND COVER	AREA(acre)
Till-Grass	4.10
Impervious	7.02

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Flow Frequency Analysis
Time Series File:12132dw.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
2.07	6	2/09/01 2:00	4.18	1	100.00	0.990
1.69	8	1/05/02 16:00	2.65	2	25.00	0.960
2.49	3	2/27/03 7:00	2.49	3	10.00	0.900
1.83	7	8/26/04 2:00	2.20	4	5.00	0.800
2.20	4	10/28/04 16:00	2.19	5	3.00	0.667
2.19	5	1/18/06 16:00	2.07	6	2.00	0.500
2.65	2	10/26/06 0:00	1.83	7	1.30	0.231
4.18	1	1/09/08 6:00	1.69	8	1.10	0.091
Computed Peaks			3.67		50.00	0.980

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EAST BASIN

The East Basin is 21.93 acres. The East Basin will include 5.68 acres of proposed right-of-way, 0.13 acre of access tracts, 1.40 acres of drainage tract, 0.61 acre of recreation space tracts, 12.43 acres of R-6 zoned lot area, and 1.68 acres of R-4 zoned lot area.

The impervious coverage for the developed East Basin is delineated below.

Impervious Coverage for the Proposed ROW

The impervious coverage within the proposed ROW is 5.09 acres.

Impervious Coverage for the Proposed Access Tracts

The impervious coverage within the proposed access tracts was assumed to be 100% or 0.13 acre.

Impervious Coverage for the Lots

The impervious coverage within the proposed lots is 60% * 12.43 acres + 0.66 acre = 8.11 acres.

The following information was used for generating time series and flow frequencies.

EAST BASIN DEVELOPED CONDITIONS (12132de.tsf)	Total Area = 21.93 acres
GROUND COVER	AREA(acre)
Till-Grass	8.60
Impervious	13.33

Flow Frequency Analysis
Time Series File:12132de.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
4.00	6	2/09/01 2:00	8.12	1	100.00	0.990
3.24	8	1/05/02 16:00	5.06	2	25.00	0.960
4.81	3	2/27/03 7:00	4.81	3	10.00	0.900
3.48	7	8/26/04 2:00	4.24	4	5.00	0.800
4.20	5	10/28/04 16:00	4.20	5	3.00	0.667
4.24	4	1/18/06 16:00	4.00	6	2.00	0.500
5.06	2	10/26/06 0:00	3.48	7	1.30	0.231
8.12	1	1/09/08 6:00	3.24	8	1.10	0.091
Computed Peaks			7.10		50.00	0.980

DEVELOPED CONDITIONS

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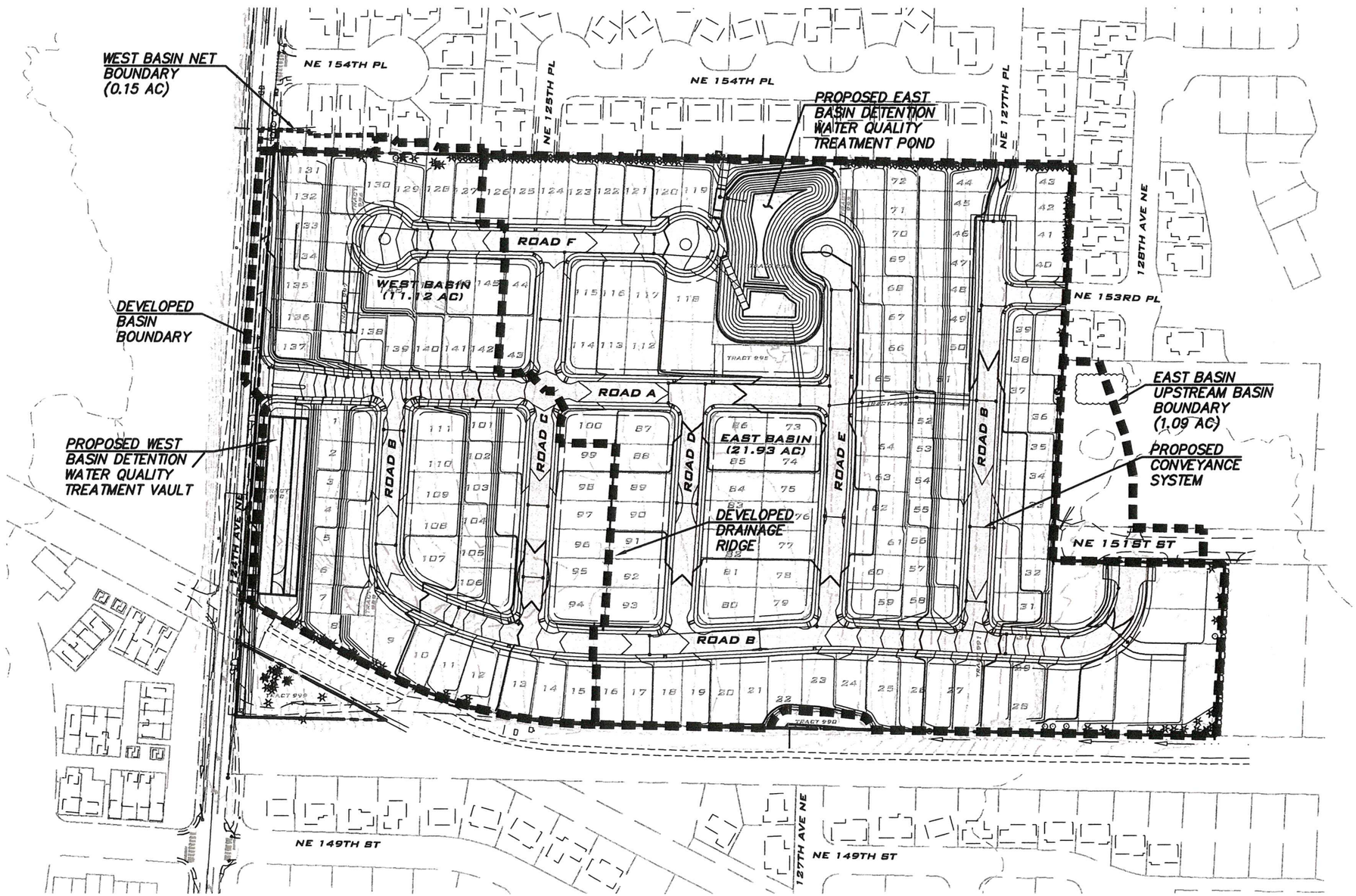

N

SCALE: 1" = 200'
0 50 100 200

BLUELINE

DEVELOPED CONDITIONS
MAP
VINTERRA

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SCALE	AS NOTED
PROJECT MANAGER	TODD A. OBERG, PE
DESIGNED BY	GINA BROOKS, PE
DRAWN BY	CAROL DOGGETT
PLOT DATE	August 13, 2013

JOB NUMBER:
12-132

FIGURE:
DC

Aug 13, 2013 - 10:34am - User gbrooks
E:\Projects\12132\dwg\Exhibits\12132DC.dwg

EXHIBIT 14
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B. Flow Control Analysis and Design

Flow control will be accommodated for in two combined detention/water quality facilities. The West Basin will utilize a wetvault. The East Basin will utilize a wetpond. Live storage within the vault/pond will be designed according to Level 2 Flow Control.

WEST BASIN

Since the West Basin receives upstream drainage, the existing condition peak flows required to meet flow control are established based on the sum of the existing condition (12132exw.tsf) and the upstream condition (12132wup.tsf) peak flows. The sum of these time series is stored as 12132wpre.tsf. The developed condition peak flows tributary to the pond also, incorporates the upstream peak flows. The sum of the developed condition tributary to the proposed pond (12132dw.tsf) and the upstream condition (12132wup.tsf) peak flows is stored as 12132wpost.tsf. See KCRTS Printouts below.

Flow Frequency Analysis
Time Series File:12132wpre.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.715	2	2/09/01 18:00	0.925	1	100.00	0.990
0.196	7	1/06/02 3:00	0.715	2	25.00	0.960
0.538	4	2/28/03 3:00	0.550	3	10.00	0.900
0.020	8	3/24/04 19:00	0.538	4	5.00	0.800
0.319	6	1/05/05 8:00	0.469	5	3.00	0.667
0.550	3	1/18/06 20:00	0.319	6	2.00	0.500
0.469	5	11/24/06 4:00	0.196	7	1.30	0.231
0.925	1	1/09/08 9:00	0.020	8	1.10	0.091
Computed Peaks			0.855		50.00	0.980

Flow Frequency Analysis
Time Series File:12132wpost.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
2.08	6	2/09/01 2:00	4.22	1	100.00	0.990
1.70	8	1/05/02 16:00	2.67	2	25.00	0.960
2.51	3	2/27/03 7:00	2.51	3	10.00	0.900
1.83	7	8/26/04 2:00	2.21	4	5.00	0.800
2.21	5	10/28/04 16:00	2.21	5	3.00	0.667
2.21	4	1/18/06 16:00	2.08	6	2.00	0.500

2.67	2	10/26/06	0:00	1.83	7	1.30	0.231
4.22	1	1/09/08	6:00	1.70	8	1.10	0.091
Computed Peaks				3.70		50.00	0.980

Per the KCRTS printout below, the vault surface area required is 20,020 square feet with 7.06 feet of live storage at the 100-year peak stage, elevation 332.06. The provided vault depth and surface area will match the minimum required. The proposed vault is therefore, adequately sized to accommodate for the required flow control.

Live Storage Volume

Required = 141,295 cubic feet

Provided = 141,295 cubic feet

Retention/Detention Facility

```
        Type of Facility: Detention Vault
        Facility Length:      308.00  ft
         Facility Width:       65.00  ft
          Facility Area:    20020.    sq. ft
Effective Storage Depth:        6.84  ft
      Stage 0 Elevation:      325.00  ft
         Storage Volume:   136937.    cu. ft
             Riser Head:        6.84  ft
         Riser Diameter:       24.00  inches
    Number of orifices:        2
                                     Full Head    Pipe
   Orifice #      Height  Diameter  Discharge  Diameter
                   (ft)     (in)      (CFS)      (in)
      1            0.00     1.69       0.202
      2            4.40     3.00       0.381     6.0
        Top Notch Weir: None
   Outflow Rating Curve: None
```

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	325.00	0.	0.000	0.000	0.00
0.02	325.02	400.	0.009	0.010	0.00
0.04	325.04	801.	0.018	0.014	0.00
0.05	325.05	1001.	0.023	0.018	0.00
0.07	325.07	1401.	0.032	0.020	0.00
0.09	325.09	1802.	0.041	0.023	0.00
0.11	325.11	2202.	0.051	0.025	0.00
0.12	325.12	2402.	0.055	0.027	0.00
0.14	325.14	2803.	0.064	0.029	0.00

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0.26	325.26	5205.	0.119	0.039	0.00
0.37	325.37	7407.	0.170	0.047	0.00
0.49	325.49	9810.	0.225	0.054	0.00
0.60	325.60	12012.	0.276	0.060	0.00
0.72	325.72	14414.	0.331	0.066	0.00
0.84	325.84	16817.	0.386	0.071	0.00
0.95	325.95	19019.	0.437	0.075	0.00
1.07	326.07	21421.	0.492	0.080	0.00
1.18	326.18	23624.	0.542	0.084	0.00
1.30	326.30	26026.	0.597	0.088	0.00
1.42	326.42	28428.	0.653	0.092	0.00
1.53	326.53	30631.	0.703	0.096	0.00
1.65	326.65	33033.	0.758	0.099	0.00
1.76	326.76	35235.	0.809	0.103	0.00
1.88	326.88	37638.	0.864	0.106	0.00
2.00	327.00	40040.	0.919	0.109	0.00
2.11	327.11	42242.	0.970	0.112	0.00
2.23	327.23	44645.	1.025	0.115	0.00
2.34	327.34	46847.	1.075	0.118	0.00
2.46	327.46	49249.	1.131	0.121	0.00
2.58	327.58	51652.	1.186	0.124	0.00
2.69	327.69	53854.	1.236	0.127	0.00
2.81	327.81	56256.	1.291	0.129	0.00
2.92	327.92	58458.	1.342	0.132	0.00
3.04	328.04	60861.	1.397	0.135	0.00
3.15	328.15	63063.	1.448	0.137	0.00
3.27	328.27	65465.	1.503	0.140	0.00
3.39	328.39	67868.	1.558	0.142	0.00
3.50	328.50	70070.	1.609	0.145	0.00
3.62	328.62	72472.	1.664	0.147	0.00
3.73	328.73	74675.	1.714	0.149	0.00
3.85	328.85	77077.	1.769	0.152	0.00
3.97	328.97	79479.	1.825	0.154	0.00
4.08	329.08	81682.	1.875	0.156	0.00
4.20	329.20	84084.	1.930	0.158	0.00
4.31	329.31	86286.	1.981	0.160	0.00
4.40	329.40	88088.	2.022	0.162	0.00
4.43	329.43	88689.	2.036	0.165	0.00
4.46	329.46	89289.	2.050	0.172	0.00
4.49	329.49	89890.	2.064	0.184	0.00
4.53	329.53	90691.	2.082	0.200	0.00
4.56	329.56	91291.	2.096	0.220	0.00
4.59	329.59	91892.	2.110	0.244	0.00
4.62	329.62	92492.	2.123	0.270	0.00
4.65	329.65	93093.	2.137	0.289	0.00
4.77	329.77	95495.	2.192	0.316	0.00
4.88	329.88	97698.	2.243	0.340	0.00
5.00	330.00	100100.	2.298	0.361	0.00
5.11	330.11	102302.	2.349	0.381	0.00
5.23	330.23	104705.	2.404	0.399	0.00
5.35	330.35	107107.	2.459	0.416	0.00
5.46	330.46	109309.	2.509	0.432	0.00
5.58	330.58	111712.	2.565	0.447	0.00
5.69	330.69	113914.	2.615	0.462	0.00

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5.81	330.81	116316.	2.670	0.476	0.00
5.93	330.93	118719.	2.725	0.490	0.00
6.04	331.04	120921.	2.776	0.503	0.00
6.16	331.16	123323.	2.831	0.515	0.00
6.27	331.27	125525.	2.882	0.528	0.00
6.39	331.39	127928.	2.937	0.540	0.00
6.50	331.50	130130.	2.987	0.551	0.00
6.62	331.62	132532.	3.043	0.563	0.00
6.74	331.74	134935.	3.098	0.574	0.00
6.84	331.84	136937.	3.144	0.583	0.00
6.94	331.94	138939.	3.190	1.210	0.00
7.04	332.04	140941.	3.236	2.340	0.00
7.14	332.14	142943.	3.282	3.810	0.00
7.24	332.24	144945.	3.327	5.550	0.00
7.34	332.34	146947.	3.373	7.510	0.00
7.44	332.44	148949.	3.419	9.690	0.00
7.54	332.54	150951.	3.465	12.050	0.00
7.64	332.64	152953.	3.511	14.180	0.00
7.74	332.74	154955.	3.557	15.010	0.00
7.84	332.84	156957.	3.603	15.800	0.00
7.94	332.94	158959.	3.649	16.540	0.00
8.04	333.04	160961.	3.695	17.260	0.00
8.14	333.14	162963.	3.741	17.940	0.00
8.24	333.24	164965.	3.787	18.600	0.00
8.34	333.34	166967.	3.833	19.240	0.00
8.44	333.44	168969.	3.879	19.850	0.00
8.54	333.54	170971.	3.925	20.450	0.00
8.64	333.64	172973.	3.971	21.030	0.00
8.74	333.74	174975.	4.017	21.590	0.00

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	4.22	0.93	2.60	7.06	332.06	141295.	3.244
2	2.08	*******	0.70	6.86	331.86	137301.	3.152
3	2.51	*******	0.49	5.94	330.94	118938.	2.730
4	2.67	*******	0.48	5.89	330.89	117846.	2.705
5	2.21	*******	0.33	4.84	329.84	96915.	2.225
6	2.21	*******	0.16	4.26	329.26	85362.	1.960
7	1.70	*******	0.15	3.85	328.85	77113.	1.770
8	1.83	*******	0.12	2.61	327.61	52326.	1.201

```
----------------------------------
Route Time Series through Facility
  Inflow Time Series File:12132wpost.tsf
 Outflow Time Series File:wout

Inflow/Outflow Analysis
   Peak Inflow Discharge:        4.22 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:        2.60 CFS at 10:00 on Jan  9 in Year 8
    Peak Reservoir Stage:        7.06  Ft
     Peak Reservoir Elev:      332.06  Ft
  Peak Reservoir Storage:   141295.    Cu-Ft
                        :        3.244 Ac-Ft
```

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Flow Duration from Time Series File:wout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence %	Probability
0.010	30384	49.550	49.550	50.450	0.505E+00
0.030	7016	11.442	60.992	39.008	0.390E+00
0.049	6346	10.349	71.341	28.659	0.287E+00
0.069	5487	8.948	80.289	19.711	0.197E+00
0.088	4776	7.789	88.077	11.923	0.119E+00
0.108	2922	4.765	92.842	7.158	0.716E-01
0.128	1807	2.947	95.789	4.211	0.421E-01
0.147	1421	2.317	98.107	1.893	0.189E-01
0.167	810	1.321	99.428	0.572	0.572E-02
0.186	39	0.064	99.491	0.509	0.509E-02
0.206	25	0.041	99.532	0.468	0.468E-02
0.225	24	0.039	99.571	0.429	0.429E-02
0.245	16	0.026	99.597	0.403	0.403E-02
0.265	11	0.018	99.615	0.385	0.385E-02
0.284	13	0.021	99.636	0.364	0.364E-02
0.304	23	0.038	99.674	0.326	0.326E-02
0.323	37	0.060	99.734	0.266	0.266E-02
0.343	24	0.039	99.773	0.227	0.227E-02
0.363	17	0.028	99.801	0.199	0.199E-02
0.382	12	0.020	99.821	0.179	0.179E-02
0.402	12	0.020	99.840	0.160	0.160E-02
0.421	13	0.021	99.861	0.139	0.139E-02
0.441	14	0.023	99.884	0.116	0.116E-02
0.461	11	0.018	99.902	0.098	0.978E-03
0.480	13	0.021	99.923	0.077	0.766E-03
0.500	14	0.023	99.946	0.054	0.538E-03
0.519	10	0.016	99.962	0.038	0.375E-03
0.539	8	0.013	99.976	0.024	0.245E-03
0.559	5	0.008	99.984	0.016	0.163E-03
0.578	5	0.008	99.992	0.008	0.815E-04
0.598	3	0.005	99.997	0.003	0.326E-04
0.617	0	0.000	99.997	0.003	0.326E-04
0.637	1	0.002	99.998	0.002	0.163E-04
0.657	0	0.000	99.998	0.002	0.163E-04
0.676	0	0.000	99.998	0.002	0.163E-04
0.696	0	0.000	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: 12132wpre.tsf
New File: wout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.159	0.92E-02	0.77E-02	-15.6	0.92E-02	0.159	0.156	-1.5
0.202	0.62E-02	0.47E-02	-24.6	0.62E-02	0.202	0.162	-19.6
0.244	0.49E-02	0.40E-02	-17.9	0.49E-02	0.244	0.192	-21.4
0.287	0.37E-02	0.36E-02	-2.2	0.37E-02	0.287	0.278	-3.3
0.330	0.28E-02	0.25E-02	-10.9	0.28E-02	0.330	0.318	-3.4
0.372	0.22E-02	0.19E-02	-14.8	0.22E-02	0.372	0.347	-6.8

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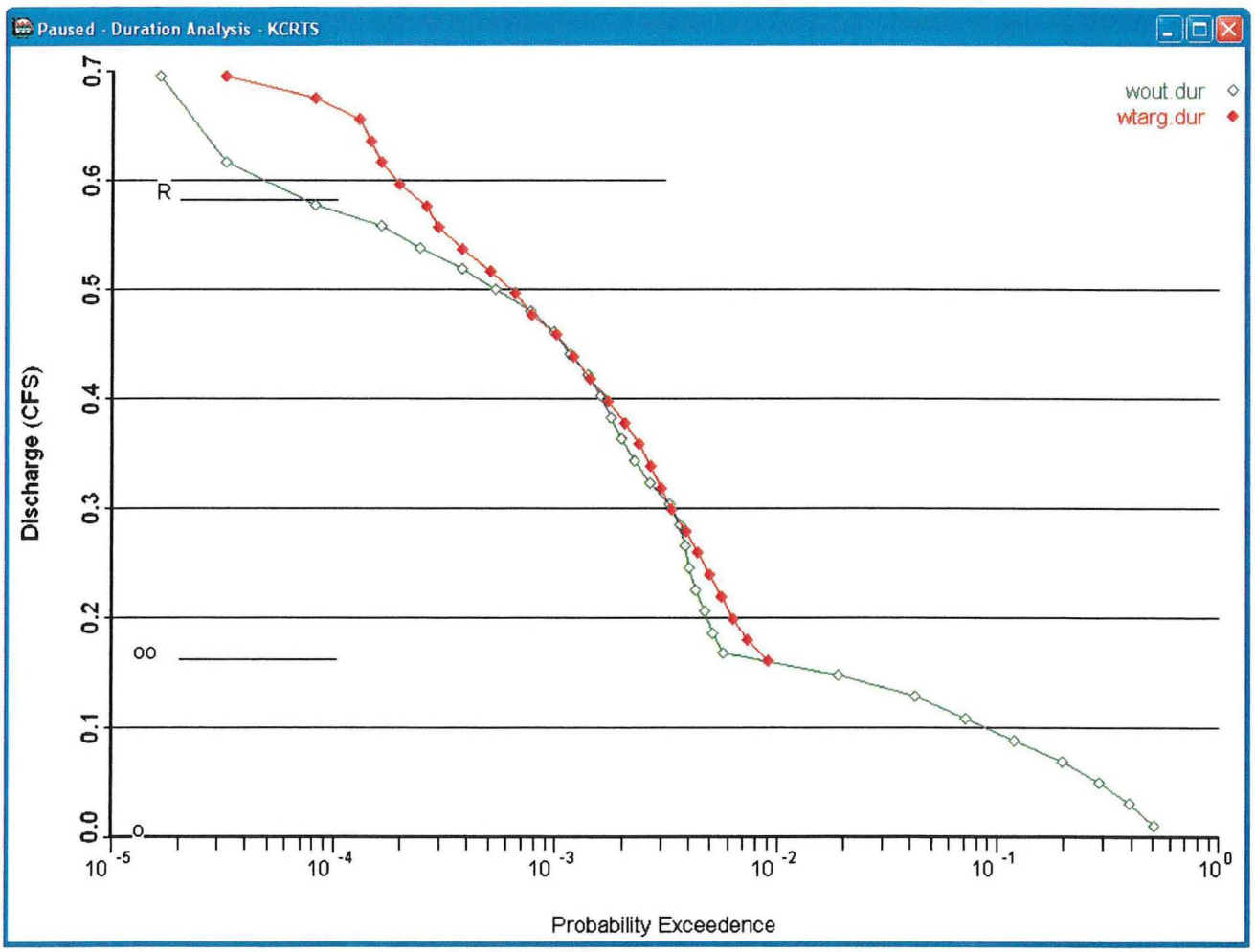
0.415	0.15E-02	0.14E-02	-1.1	0.15E-02	0.415	0.414	-0.3
0.458	0.99E-03	0.10E-02	1.6	0.99E-03	0.458	0.459	0.3
0.501	0.62E-03	0.52E-03	-15.8	0.62E-03	0.501	0.487	-2.7
0.543	0.34E-03	0.23E-03	-33.3	0.34E-03	0.543	0.522	-3.9
0.586	0.21E-03	0.33E-04	-84.6	0.21E-03	0.586	0.549	-6.4
0.629	0.16E-03	0.33E-04	-80.0	0.16E-03	0.629	0.559	-11.0
0.672	0.82E-04	0.16E-04	-80.0	0.82E-04	0.672	0.578	-13.9
0.714	0.16E-04	0.00E+00	-100.0	0.16E-04	0.714	0.696	-2.6

Maximum positive excursion = 0.005 cfs (1.3%)
occurring at 0.425 cfs on the Base Data:12132wpre.tsf
and at 0.430 cfs on the New Data:wout.tsf

Maximum negative excursion = 0.052 cfs (-23.6%)
occurring at 0.220 cfs on the Base Data:12132wpre.tsf
and at 0.168 cfs on the New Data:wout.tsf



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Flow Frequency Analysis
Time Series File:wout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.697	2	2/09/01 20:00	2.60	7.06	1	100.00	0.990
0.152	7	1/07/02 3:00	0.697	6.86	2	25.00	0.960
0.491	3	3/06/03 22:00	0.491	5.94	3	10.00	0.900
0.125	8	8/26/04 8:00	0.485	5.89	4	5.00	0.800
0.159	6	1/08/05 6:00	0.331	4.84	5	3.00	0.667
0.331	5	1/19/06 0:00	0.159	4.27	6	2.00	0.500
0.485	4	11/24/06 8:00	0.152	3.85	7	1.30	0.231
2.60	1	1/09/08 10:00	0.125	2.62	8	1.10	0.091
Computed Peaks			1.97	7.01		50.00	0.980

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EAST BASIN

Since the East Basin receives upstream drainage, the existing condition peak flows required to meet flow control are established based on the sum of the existing condition (12132exe.tsf) and the upstream condition (12132eup.tsf) peak flows. The sum of these time series is stored as 12132epre.tsf. The developed condition peak flows tributary to the pond also, incorporates the upstream peak flows. The sum of the developed condition tributary to the proposed pond (12132de.tsf) and the upstream condition (12132eup.tsf) peak flows is stored as 12132epost.tsf. See KCRTS Printouts below.

Flow Frequency Analysis
Time Series File:12132epre.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
1.47	2	2/09/01 18:00	1.95	1	100.00	0.990
0.412	7	1/05/02 16:00	1.47	2	25.00	0.960
1.14	3	2/28/03 3:00	1.14	3	10.00	0.900
0.054	8	3/24/04 19:00	1.14	4	5.00	0.800
0.666	6	1/05/05 8:00	0.987	5	3.00	0.667
1.14	4	1/18/06 20:00	0.666	6	2.00	0.500
0.987	5	11/24/06 4:00	0.412	7	1.30	0.231
1.95	1	1/09/08 9:00	0.054	8	1.10	0.091
Computed Peaks			1.79		50.00	0.980

Flow Frequency Analysis
Time Series File:12132epost.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
4.10	6	2/09/01 2:00	8.36	1	100.00	0.990
3.29	8	1/05/02 16:00	5.10	2	25.00	0.960
4.94	3	2/27/03 7:00	4.94	3	10.00	0.900
3.51	7	8/26/04 2:00	4.35	4	5.00	0.800
4.23	5	10/28/04 16:00	4.23	5	3.00	0.667
4.35	4	1/18/06 16:00	4.10	6	2.00	0.500
5.10	2	10/26/06 0:00	3.51	7	1.30	0.231
8.36	1	1/09/08 6:00	3.29	8	1.10	0.091
Computed Peaks			7.27		50.00	0.980

Per the KCRTS printout below, the pond live volume required at the maximum stage of 8.24 feet, elevation 365.24, is 260,435 cubic feet. The provided pond live volume is 266,884 cubic feet. See East Pond Volume Calculations spreadsheet on the following pages.

Live Storage Volume

Required = 260,435 cubic feet

Provided = 266,884 cubic feet

Retention/Detention Facility

```
         Type of Facility: Detention Pond
              Side Slope:        4.50  H:1V
      Pond Bottom Length:      254.00  ft
       Pond Bottom Width:       70.00  ft
        Pond Bottom Area:    17780.    sq. ft
    Top Area at 1 ft. FB:    50323.    sq. ft
                                1.155 acres
 Effective Storage Depth:        7.94  ft
       Stage 0 Elevation:      357.00  ft
          Storage Volume:   246606.    cu. ft
                                5.661 ac-ft
              Riser Head:        7.94  ft
          Riser Diameter:       30.00  inches
      Number of orifices:        3
                                     Full Head    Pipe
    Orifice #      Height  Diameter  Discharge  Diameter
                    (ft)     (in)      (CFS)      (in)
       1            0.00     2.25       0.381
       2            5.60     3.75       0.553     6.0
       3            6.30     3.00       0.289     6.0
          Top Notch Weir: None
    Outflow Rating Curve: None
```

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	357.00	0.	0.000	0.000	0.00	17780.
0.02	357.02	356.	0.008	0.021	0.00	17838.
0.05	357.05	893.	0.020	0.030	0.00	17926.
0.07	357.07	1252.	0.029	0.036	0.00	17985.
0.09	357.09	1612.	0.037	0.042	0.00	18043.
0.12	357.12	2155.	0.049	0.047	0.00	18131.
0.14	357.14	2518.	0.058	0.051	0.00	18190.
0.16	357.16	2882.	0.066	0.056	0.00	18249.
0.19	357.19	3431.	0.079	0.059	0.00	18337.
0.34	357.34	6215.	0.143	0.080	0.00	18781.
0.50	357.50	9258.	0.213	0.097	0.00	19258.

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0.65	357.65	12180.	0.280	0.111	0.00	19710.
0.81	357.81	15373.	0.353	0.124	0.00	20195.
0.97	357.97	18643.	0.428	0.135	0.00	20685.
1.12	358.12	21780.	0.500	0.145	0.00	21148.
1.28	358.28	25204.	0.579	0.155	0.00	21645.
1.43	358.43	28486.	0.654	0.164	0.00	22116.
1.59	358.59	32065.	0.736	0.173	0.00	22621.
1.74	358.74	35494.	0.815	0.181	0.00	23099.
1.90	358.90	39231.	0.901	0.189	0.00	23613.
2.06	359.06	43050.	0.988	0.197	0.00	24131.
2.21	359.21	46706.	1.072	0.204	0.00	24620.
2.37	359.37	50687.	1.164	0.211	0.00	25146.
2.52	359.52	54497.	1.251	0.218	0.00	25643.
2.68	359.68	58642.	1.346	0.225	0.00	26177.
2.83	359.83	62606.	1.437	0.231	0.00	26681.
2.99	359.99	66919.	1.536	0.237	0.00	27223.
3.15	360.15	71318.	1.637	0.244	0.00	27769.
3.30	360.30	75522.	1.734	0.249	0.00	28285.
3.46	360.46	80092.	1.839	0.255	0.00	28839.
3.61	360.61	84457.	1.939	0.261	0.00	29362.
3.77	360.77	89200.	2.048	0.267	0.00	29925.
3.92	360.92	93728.	2.152	0.272	0.00	30455.
4.08	361.08	98647.	2.265	0.277	0.00	31026.
4.24	361.24	103657.	2.380	0.283	0.00	31600.
4.39	361.39	108437.	2.489	0.288	0.00	32142.
4.55	361.55	113627.	2.609	0.293	0.00	32725.
4.70	361.70	118576.	2.722	0.298	0.00	33274.
4.86	361.86	123948.	2.845	0.303	0.00	33865.
5.01	362.01	129069.	2.963	0.307	0.00	34422.
5.17	362.17	134624.	3.091	0.312	0.00	35021.
5.33	362.33	140276.	3.220	0.317	0.00	35623.
5.48	362.48	145662.	3.344	0.321	0.00	36192.
5.60	362.60	150033.	3.444	0.325	0.00	36650.
5.64	362.64	151502.	3.478	0.330	0.00	36803.
5.68	362.68	152977.	3.512	0.342	0.00	36956.
5.72	362.72	154458.	3.546	0.360	0.00	37110.
5.76	362.76	155946.	3.580	0.385	0.00	37264.
5.80	362.80	157439.	3.614	0.416	0.00	37418.
5.83	362.83	158563.	3.640	0.451	0.00	37533.
5.87	362.87	160068.	3.675	0.532	0.00	37688.
5.91	362.91	161578.	3.709	0.547	0.00	37843.
6.07	363.07	167683.	3.849	0.599	0.00	38465.
6.22	363.22	173497.	3.983	0.644	0.00	39051.
6.30	363.30	176633.	4.055	0.664	0.00	39366.
6.33	363.33	177816.	4.082	0.674	0.00	39484.
6.36	363.36	179002.	4.109	0.688	0.00	39602.
6.39	363.39	180192.	4.137	0.708	0.00	39721.
6.43	363.43	181784.	4.173	0.731	0.00	39879.
6.46	363.46	182982.	4.201	0.757	0.00	39998.
6.49	363.49	184184.	4.228	0.788	0.00	40117.
6.52	363.52	185389.	4.256	0.821	0.00	40236.
6.55	363.55	186598.	4.284	0.845	0.00	40355.
6.71	363.71	193106.	4.433	0.912	0.00	40993.
6.86	363.86	199300.	4.575	0.971	0.00	41596.

7.02	364.02	206007.	4.729	1.020	0.00	42242.
7.17	364.17	212389.	4.876	1.070	0.00	42852.
7.33	364.33	219298.	5.034	1.120	0.00	43506.
7.48	364.48	225870.	5.185	1.160	0.00	44124.
7.64	364.64	232983.	5.349	1.210	0.00	44786.
7.80	364.80	240202.	5.514	1.250	0.00	45453.
7.94	364.94	246606.	5.661	1.280	0.00	46040.
8.04	365.04	251231.	5.767	2.080	0.00	46461.
8.14	365.14	255898.	5.875	3.510	0.00	46883.
8.24	365.24	260608.	5.983	5.350	0.00	47308.
8.34	365.34	265360.	6.092	7.540	0.00	47733.
8.44	365.44	270154.	6.202	10.010	0.00	48161.
8.54	365.54	274992.	6.313	12.740	0.00	48590.
8.64	365.64	279873.	6.425	15.700	0.00	49021.
8.74	365.74	284796.	6.538	18.880	0.00	49453.
8.84	365.84	289763.	6.652	22.270	0.00	49887.
8.94	365.94	294774.	6.767	25.140	0.00	50323.
9.04	366.04	299828.	6.883	26.320	0.00	50760.
9.14	366.14	304926.	7.000	27.440	0.00	51199.
9.24	366.24	310068.	7.118	28.510	0.00	51639.
9.34	366.34	315254.	7.237	29.550	0.00	52082.
9.44	366.44	320484.	7.357	30.550	0.00	52525.
9.54	366.54	325759.	7.478	31.520	0.00	52971.
9.64	366.64	331078.	7.601	32.460	0.00	53418.
9.74	366.74	336442.	7.724	33.370	0.00	53866.
9.84	366.84	341852.	7.848	34.260	0.00	54316.

Hyd	Inflow	Outflow Target	Outflow Calc	Peak Stage	Peak Elev	Storage (Cu-Ft)	Storage (Ac-Ft)
1	8.36	2.09	5.28	8.24	365.24	260435.	5.979
2	5.10	*******	0.31	5.23	362.23	136858.	3.142
3	4.94	*******	1.07	7.16	364.16	211889.	4.864
4	4.35	*******	0.73	6.42	363.42	181540.	4.168
5	4.23	*******	0.24	2.97	359.97	66454.	1.526
6	4.10	*******	1.35	7.95	364.95	246993.	5.670
7	3.51	*******	0.27	3.84	360.84	91363.	2.097
8	3.29	*******	0.31	5.05	362.05	130419.	2.994

```
----------------------------------
Route Time Series through Facility
  Inflow Time Series File:12132epost.tsf
 Outflow Time Series File:epndout

Inflow/Outflow Analysis
   Peak Inflow Discharge:        8.36 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:        5.28 CFS at 10:00 on Jan  9 in Year 8
    Peak Reservoir Stage:        8.24  Ft
     Peak Reservoir Elev:      365.24  Ft
  Peak Reservoir Storage:   260435.    Cu-Ft
                        :        5.979 Ac-Ft


  Flow Duration from Time Series File:epndout.tsf
 Cutoff     Count  Frequency   CDF    Exceedence_Probability
```

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CFS		%	%	%	
0.021	33593	54.783	54.783	45.217	0.452E+00
0.061	5805	9.467	64.250	35.750	0.358E+00
0.101	5004	8.160	72.410	27.590	0.276E+00
0.142	4757	7.758	80.168	19.832	0.198E+00
0.182	4212	6.869	87.037	12.963	0.130E+00
0.223	3212	5.238	92.275	7.725	0.773E-01
0.263	1946	3.174	95.448	4.552	0.455E-01
0.304	1478	2.410	97.859	2.141	0.214E-01
0.344	902	1.471	99.330	0.670	0.670E-02
0.385	59	0.096	99.426	0.574	0.574E-02
0.425	31	0.051	99.477	0.523	0.523E-02
0.466	18	0.029	99.506	0.494	0.494E-02
0.506	12	0.020	99.525	0.475	0.475E-02
0.546	23	0.038	99.563	0.437	0.437E-02
0.587	41	0.067	99.630	0.370	0.370E-02
0.627	42	0.068	99.698	0.302	0.302E-02
0.668	32	0.052	99.750	0.250	0.250E-02
0.708	23	0.038	99.788	0.212	0.212E-02
0.749	18	0.029	99.817	0.183	0.183E-02
0.789	6	0.010	99.827	0.173	0.173E-02
0.830	7	0.011	99.839	0.161	0.161E-02
0.870	11	0.018	99.856	0.144	0.144E-02
0.911	10	0.016	99.873	0.127	0.127E-02
0.951	9	0.015	99.887	0.113	0.113E-02
0.991	7	0.011	99.899	0.101	0.101E-02
1.03	12	0.020	99.918	0.082	0.815E-03
1.07	16	0.026	99.945	0.055	0.554E-03
1.11	12	0.020	99.964	0.036	0.359E-03
1.15	5	0.008	99.972	0.028	0.277E-03
1.19	3	0.005	99.977	0.023	0.228E-03
1.23	5	0.008	99.985	0.015	0.147E-03
1.27	6	0.010	99.995	0.005	0.489E-04
1.32	1	0.002	99.997	0.003	0.326E-04
1.36	0	0.000	99.997	0.003	0.326E-04
1.40	1	0.002	99.998	0.002	0.163E-04
1.44	0	0.000	99.998	0.002	0.163E-04

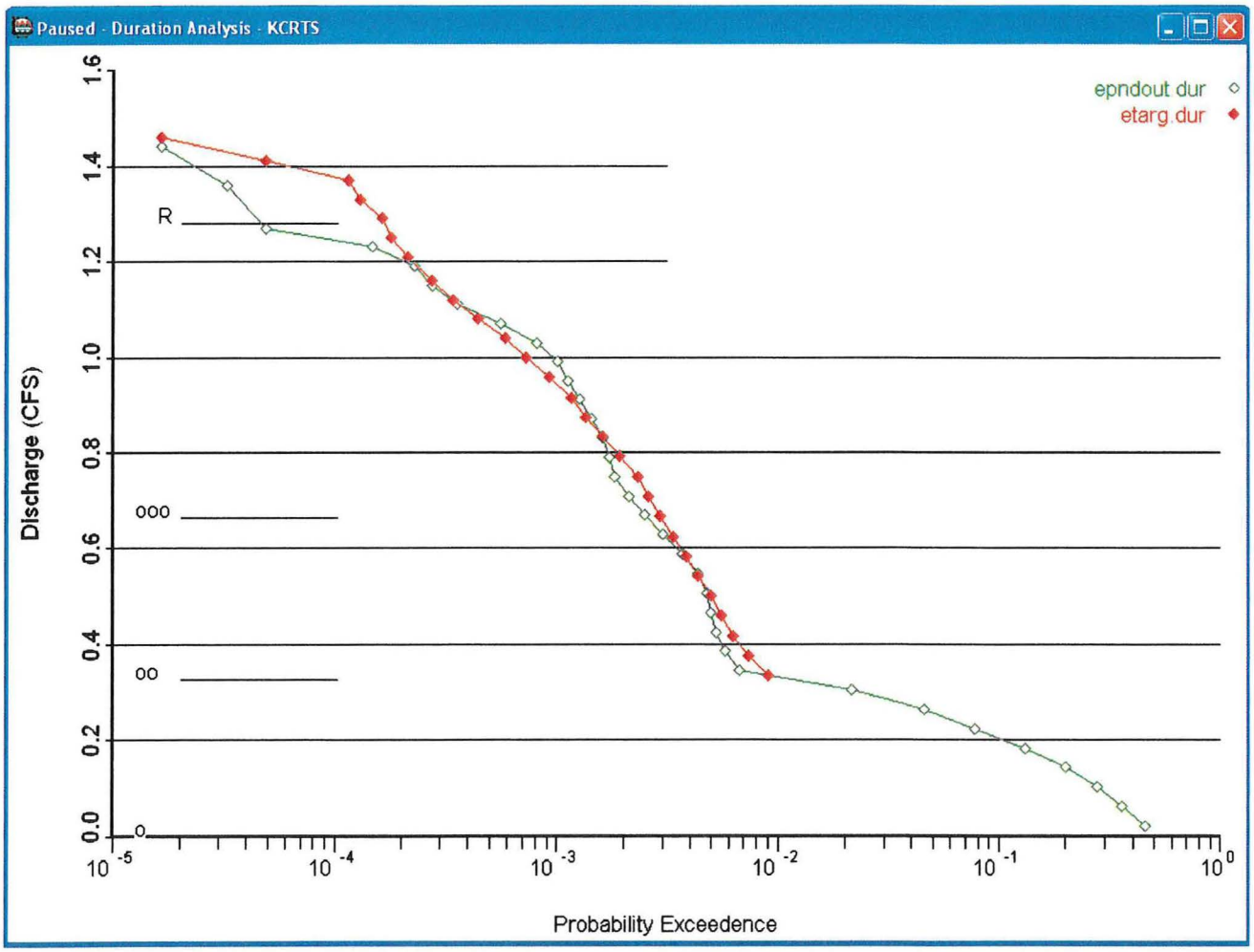
Duration Comparison Anaylsis
Base File: 12132epre.tsf
New File: epndout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.332	0.92E-02	0.72E-02	-21.7	0.92E-02	0.332	0.321	-3.2
0.420	0.62E-02	0.53E-02	-14.8	0.62E-02	0.420	0.360	-14.2
0.508	0.49E-02	0.47E-02	-2.3	0.49E-02	0.508	0.485	-4.5
0.595	0.37E-02	0.35E-02	-4.9	0.37E-02	0.595	0.589	-1.2
0.683	0.28E-02	0.23E-02	-16.9	0.28E-02	0.683	0.642	-6.0
0.771	0.22E-02	0.18E-02	-18.2	0.22E-02	0.771	0.704	-8.7
0.859	0.15E-02	0.15E-02	0.0	0.15E-02	0.859	0.859	0.0
0.947	0.10E-02	0.11E-02	11.1	0.10E-02	0.947	0.982	3.8
1.03	0.59E-03	0.80E-03	36.1	0.59E-03	1.03	1.07	3.2
1.12	0.34E-03	0.31E-03	-9.5	0.34E-03	1.12	1.12	-0.2

1.21	0.21E-03	0.20E-03	-7.7	0.21E-03	1.21	1.20	-0.7
1.30	0.15E-03	0.33E-04	-77.8	0.15E-03	1.30	1.24	-4.4
1.39	0.82E-04	0.16E-04	-80.0	0.82E-04	1.39	1.27	-8.5
1.47	0.16E-04	0.00E+00	-100.0	0.16E-04	1.47	1.45	-1.9

Maximum positive excursion = 0.049 cfs (5.2%)
occurring at 0.955 cfs on the Base Data:12132epre.tsf
and at 1.00 cfs on the New Data:epndout.tsf

Maximum negative excursion = 0.060 cfs (-14.4%)
occurring at 0.414 cfs on the Base Data:12132epre.tsf
and at 0.355 cfs on the New Data:epndout.tsf



Flow Frequency Analysis
Time Series File:epndout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
1.45	2	2/09/01 20:00	5.28	8.24	1	100.00	0.990

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0.308	7	1/07/02 4:00	1.45	7.96	2	25.00	0.960
1.07	4	3/06/03 22:00	1.09	7.24	3	10.00	0.900
0.269	8	8/26/04 7:00	1.07	7.16	4	5.00	0.800
0.435	6	1/08/05 3:00	0.727	6.42	5	3.00	0.667
0.727	5	1/19/06 0:00	0.435	5.82	6	2.00	0.500
1.09	3	11/24/06 8:00	0.308	5.05	7	1.30	0.231
5.28	1	1/09/08 10:00	0.269	3.84	8	1.10	0.091
Computed Peaks			4.00	8.17		50.00	0.980

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EAST POND
VOLUME CALCULATIONS
BLUELINE PROJECT NO. 12-132
PROJECT NAME: VINTERRA

ELEVATION		INCREMENTAL VOLUME	TOTAL VOLUME	LIVE VOLUME
	SF	CF	CF	CF
352.0	6986		0	
		7,687		
353.0	8388		7,687	
		0		
353.0	12612		7,687	
		13,726		
354.0	14839		21,413	
		34,530		
356.0	19691		55,943	
		0		
356.0	20075		55,943	
		21,215		
357.0	22355		77,158	0
		23,519		
358.0	24683		100,677	23,519
		54,162		
360.0	29479		154,839	77,681
		63,940		
362.0	34461		218,779	141,621
		74,087		
364.0	39626		292,866	215,708
		40,952		
365.0	42277		333,817	256,660
		10,225		
365.24	42930		344,042	266,884
		79,768		
367.0	47716		423,810	346,653

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C. Water Quality Analysis and Design

Water quality treatment will be accommodated for in two combined detention/water quality facilities. The West Basin will utilize a wetvault. The East Basin will utilize a wetpond. Dead storage within the vault/pond will be designed according to the Basic Water Quality Treatment Menu.

WETPOND (DEAD STORAGE)

The required dead storage within the vault/pond was determined using procedures provided in Section 6.4.1.1 of the 2009 KCSWDM. Areas tabulated below are the subject site's developed areas tributary to the each pond.

$V_B = f\ V_r$

where: f = volume correction factor = 3 (Basic)

V_r = volume of runoff from mean annual storm, ft^3

$V_r = (0.9A_i + 0.25A_{tg} + 0.10A_{tf} + 0.01A_o) \times R$

where: A_i = area of impervious surface, ft^2

A_{tg} = area of till grass and pasture, ft^2

A_{tf} = area of till forest, ft^2

A_o = area of outwash soils, ft^2

R = rainfall from mean annual storm = 0.039 feet

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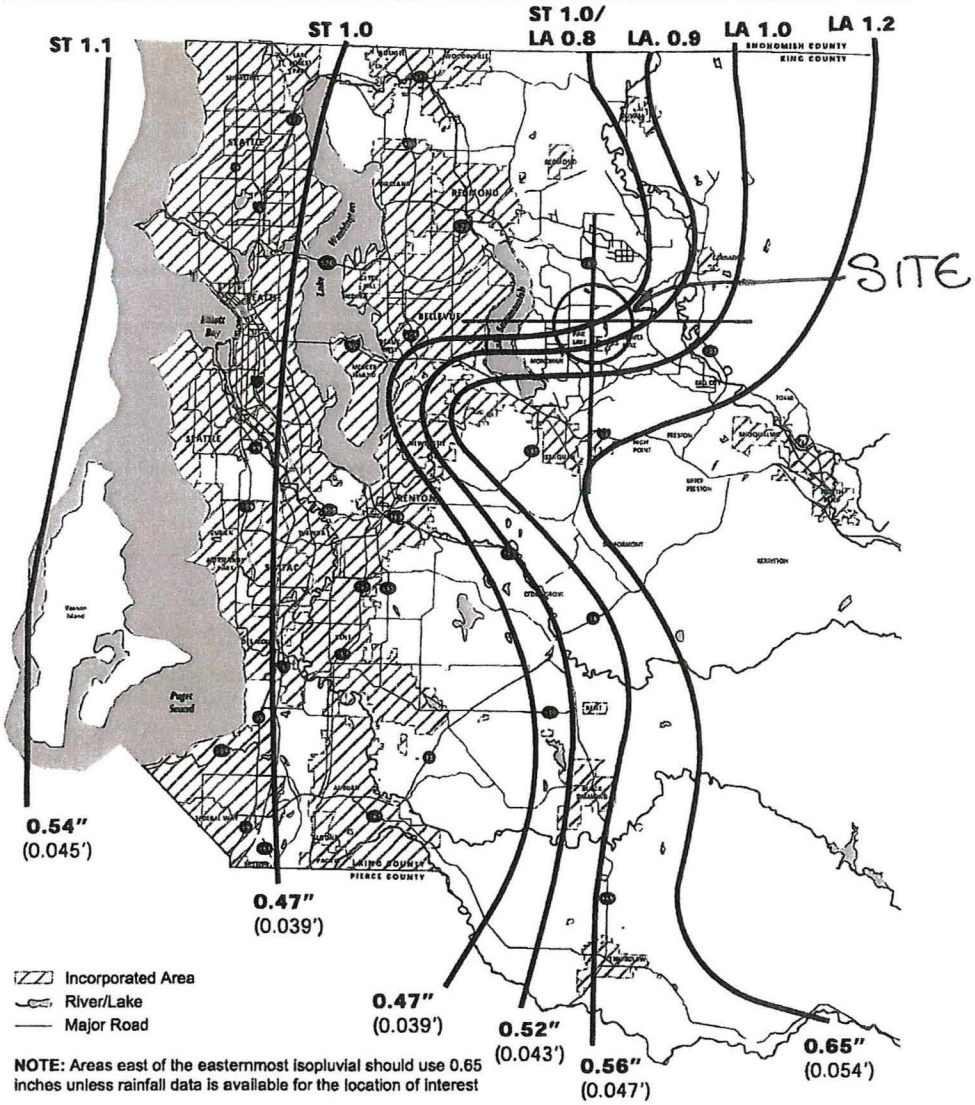
FIGURE 6.4.1.A PRECIPITATION FOR MEAN ANNUAL STORM IN INCHES (FEET)



NOTE: Areas east of the easternmost isopluvial should use 0.65 inches unless rainfall data is available for the location of interest

result, generates large amounts of runoff. For this application, till soil types include Buckley and bedrock soils, and alluvial and outwash soils that have a seasonally high water table or are underlain at a shallow depth (less than 5 feet) by glacial till. U.S. Soil Conservation Service (SCS) hydrologic soil groups that are classified as till soils include a few B, most C, and all D soils. See Chapter 3 for classification of specific SCS soil types.

B

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WEST BASIN

V_B = 3[(0.9(7.02+0.02) + 0.25(4.10+0.13)]*43,560*0.039 = 37,681 cubic feet

Dead storage within the West Basin vault will be located within the two most west cells of the vault. The cells will be 4 feet deep and 308 feet long. The cells will be 22 feet and 21 feet wide. The total dead storage provided is (22 feet + 21 feet)*308 feet*4 feet = 52,976 cubic feet which exceeds the minimum required.

West Basin Dead Storage Volume
Required = 37,681 cubic feet
Provided = 52,976 cubic feet

EAST BASIN

V_B = 3[(0.9(13.33+0.03) + 0.25(8.60+1.06)]*43,560*0.039 = 73,589 cubic feet

The provided East Pond dead volume is 77,158 cubic feet at Elevation 357.00 which exceeds the required minimum. See East Pond Volume Calculations spreadsheet on the previous pages.

East Basin Dead Storage Volume
Required = 73,589 cubic feet
Provided = 77,158 cubic feet

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SECTION 5 CONVEYANCE SYSTEM ANALYSIS AND DESIGN

ONSITE CONVEYANCE SYTEM

For preliminary sizing, ratios of the total flows derived from KCRTS (15-minute time step) were used. The West Basin and East Basin characteristics including upstream areas are delineated below. See KCRTS Flow Frequencies below.

WEST BASIN CONVEYANCE CONDITIONS (12132cw15.tsf)	Total Area = 11.27 acres
GROUND COVER	AREA(acre)
Till-Grass	4.23
Impervious	7.04

```
  Flow Frequency Analysis
  Time Series File:12132cw15.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---        -----Flow Frequency Analysis-------
 Flow Rate   Rank   Time of Peak       - - Peaks - -   Rank   Return   Prob
   (CFS)                                (CFS)                Period
    3.35       6    8/27/01 18:00       10.44           1   100.00   0.990
    2.39       8    1/05/02 15:00        7.27           2    25.00   0.960
    7.27       2   12/08/02 17:15        4.69           3    10.00   0.900
    2.70       7    8/23/04 14:30        4.20           4     5.00   0.800
    4.20       4   11/17/04  5:00        4.03           5     3.00   0.667
    4.03       5   10/27/05 10:45        3.35           6     2.00   0.500
    4.69       3   10/25/06 22:45        2.70           7     1.30   0.231
   10.44       1    1/09/08  6:30        2.39           8     1.10   0.091
Computed Peaks                           9.39                 50.00   0.980
```

EAST BASIN DEVELOPED CONDITIONS (12132ce15.tsf)	Total Area = 23.02 acres
GROUND COVER	AREA(acre)
Till-Grass	9.66
Impervious	13.36

```
  Flow Frequency Analysis
  Time Series File:12132ce15.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---        -----Flow Frequency Analysis-------
 Flow Rate   Rank   Time of Peak       - - Peaks - -   Rank   Return   Prob
```


B

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(CFS)			(CFS)		Period	
6.36	6	8/27/01 18:00	20.64	1	100.00	0.990
4.62	8	1/05/02 15:00	14.17	2	25.00	0.960
14.17	2	12/08/02 17:15	8.95	3	10.00	0.900
5.12	7	8/23/04 14:30	8.47	4	5.00	0.800
8.47	4	11/17/04 5:00	7.75	5	3.00	0.667
7.75	5	10/27/05 10:45	6.36	6	2.00	0.500
8.95	3	10/25/06 22:45	5.12	7	1.30	0.231
20.64	1	1/09/08 6:30	4.62	8	1.10	0.091
Computed Peaks			18.49		50.00	0.980

Preliminary pipe sizing was based on a ratio of the total 25-year storm using a ratio of the collected area over the total basin area. The Manning's Equation, $Q(full) = (1.49/n)*A*R^{2/3}*S^{1/2}$, was used to calculate pipe capacity assuming smooth interior pipe (n = 0.012) sloped at 1% minimum. The 25-year peak flows for the West and East Basins are 7.27 cfs and 14.17 cfs consecutively as calculated above.

Subbasins A, B, C, D, E, F, G, J, K, and most of L, are end runs and only collect the areas within their subbasins. See Preliminary Catch Basin Subbasin Map on the following pages. Where basins combine, the total flow/area from the combined basins was used to determine the pipe size. The total areas within each basin that can be accommodated within different sized pipes are delineated below. It is assumed that lateral runs to single catch basins will be 12".

PIPE SIZE	CAPACITY	EQUIVALENT WEST BASIN AREA	EQUIVALENT EAST BASIN AREA
12"	3.86 CFS	5.98 AC	6.27 AC
15"	7.00 CFS	10.85 AC	11.37 AC
18"	11.38 CFS		18.49 AC
24"	24.51 CFS		

PRELIMINARY CATCH BASIN SUBBASIN

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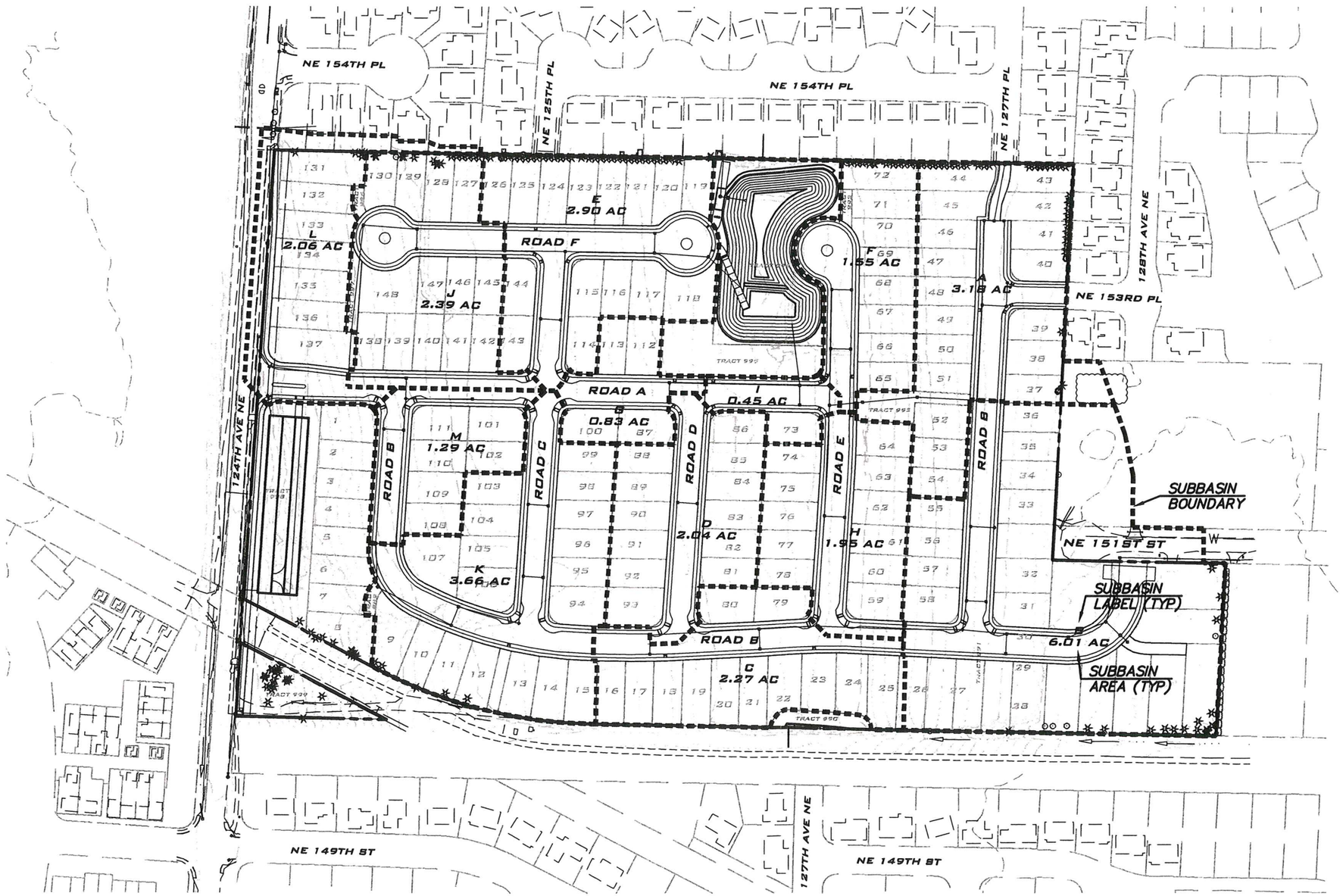

N

SCALE: 1" = 200'
0 50 100 200

BLUELINE

PRELIMINARY CATCH BASIN SUBBASIN MAP
VINTERRA

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SCALE	AS NOTED
PROJECT MANAGER	TODD A. OBERG, PE
DESIGNED BY	GINA BROOKS, PE
DRAWN BY	LISA JOHNSON
PLOT DATE	August 12, 2013

JOB NUMBER: 12-132

FIGURE: CBS

Aug 12, 2013 – 4:21pm – User gbrooks
E:\Projects\12132\dwg\Exhibits\12132CBS.dwg

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NORTH OFFSITE CONVEYANCE SYTEM

Per the City's request, a 25-year capacity analysis was completed for the existing conveyance system located north of the subject site. See downstream analysis for description. For simplicity, the entire offsite basin tributary to the existing conveyance system was conservatively assumed to enter the existing conveyance system at the upstream end. The downstream conveyance system is 24 inch pipe.

A backwater analysis was performed to ensure that during the 25-year, the headwater elevation in each structure remained within the existing conveyance system. Only the proposed condition was analyzed since the release rates from the proposed pond will be less than the existing condition as it is today. The existing nursery is predominately impervious surfaces and landscaping resulting in higher flow rates than will be the case when the site is developed and detaining to forested conditions.

North of the subject site, the existing conveyance system collects 27.14 acres of residential development. See Downstream Basin Map on the following pages. The existing residential development is zoned R-6. Per the 2009 KCSWDM, Table 3.2.2.D, the impervious percentage is 52% for 6 DU/AC. The 25-year, 15-minute flow rate calculated using KCRTS was derived using the following information. See KCRTS Flow Frequencies below.

DOWNSTREAM BASIN CONDITIONS (12132noffsite.tsf)	Total Area = 27.14 acres
GROUND COVER	AREA(acre)
Till-Grass	13.03
Impervious (52%)	14.11

```
Flow Frequency Analysis
Time Series File:12132noffsite.tsf
Project Location:Sea-Tac
```

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
6.72	6	8/27/01 18:00	23.24	1	100.00	0.990
5.02	8	1/05/02 15:00	15.59	2	25.00	0.960
15.59	2	12/08/02 17:15	9.84	3	10.00	0.900
5.41	7	8/23/04 14:30	9.54	4	5.00	0.800
9.84	3	11/17/04 5:00	8.37	5	3.00	0.667
8.37	5	10/27/05 10:45	6.72	6	2.00	0.500
9.54	4	10/25/06 22:45	5.41	7	1.30	0.231
23.24	1	1/09/08 6:30	5.02	8	1.10	0.091

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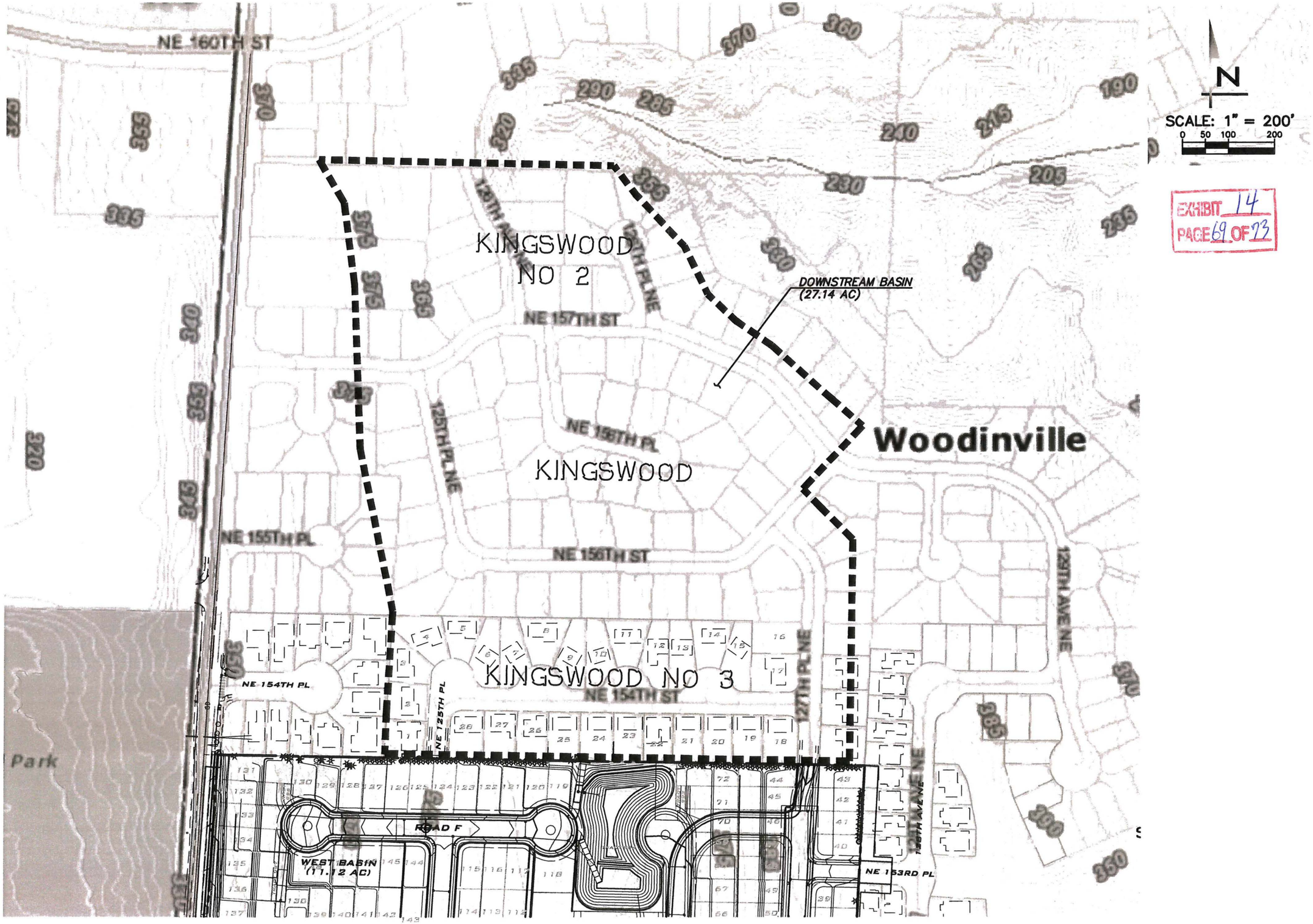
Computed Peaks	20.69	50.00	0.980

The subject site's pond 25-year release rate is 1.45 cfs. See epndout.tsf at the end of Section 4B of this Report for the flow frequency analysis. The largest total 25-year flow rate for the downstream system is therefore, 15.59 cfs + 1.45 cfs = 17.04 cfs.

For the backwater analysis, the tailwater elevation at the outfall was assumed to be equal to the crown of the pipe. The conveyance system information was derived from the Kingswood, Kingswood No. 2, and Kingswood No. 3 asbuilts. See asbuilts on the following pages. The backwater spreadsheet delineates the catch basins with the prefix of "K", "K2", and "K3" as a reference to the specific divisions. See backwater analysis on the following pages.

During the 25-year storm, all headwater elevations remained within the conveyance system. The downstream system is therefore, adequately sized and meets the requirements of the 2009 KCSWDM.



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BLUELINE

DOWNSTREAM BASIN MAP

VINTERRA

© 2013 THE BLUELINE GROUP

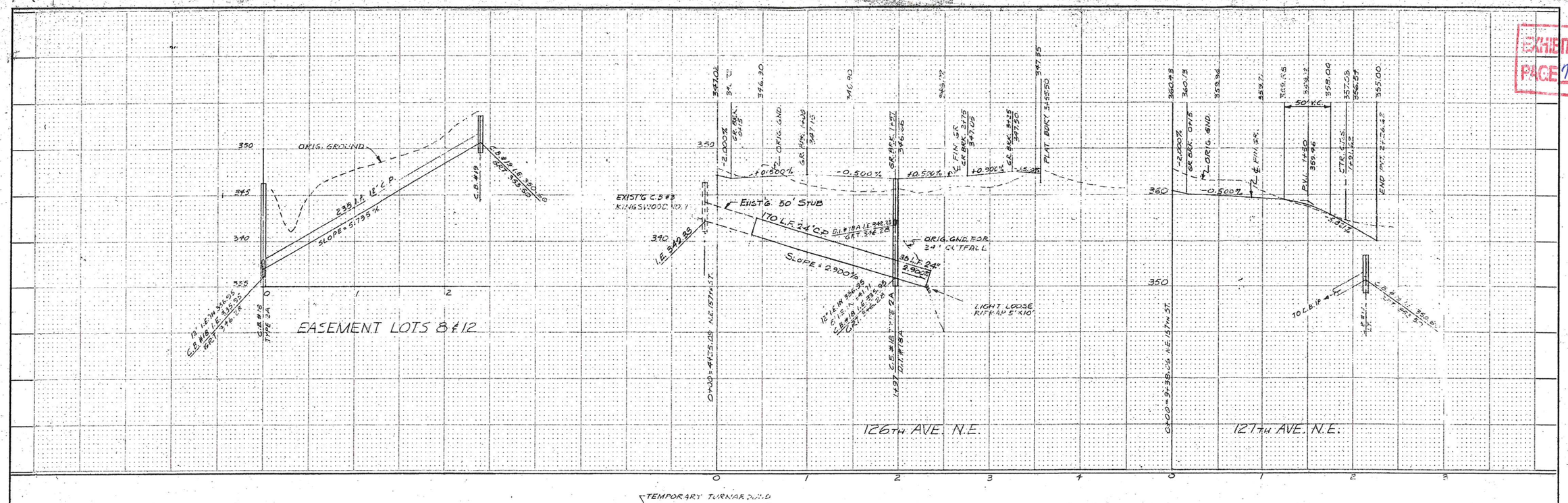
SCALE	AS NOTED
PROJECT MANAGER	TODD A. OBERG, PE
DESIGNED BY	GINA BROOKS, PE
DRAWN BY	LISA JOHNSON
PLOT DATE	July 1, 2013

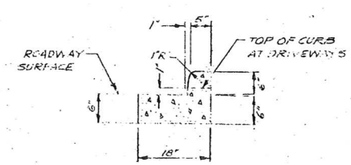
JOB NUMBER: 12-132

FIGURE: DC

Jul 01, 2013 – 2:55pm – User gbrooks
E:\Projects\12132\dwg\Exhibits\12132Vinterra DC.dwg

EXHIBIT 14
PAGE 20 OF 23

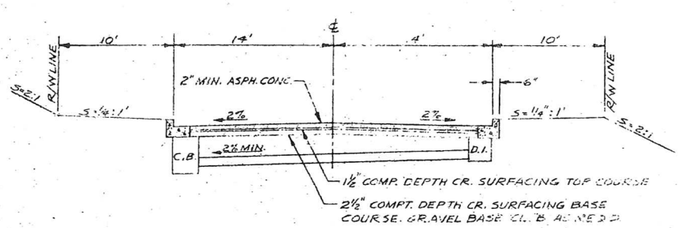




CEMENT CONCRETE CURB & GUTTER

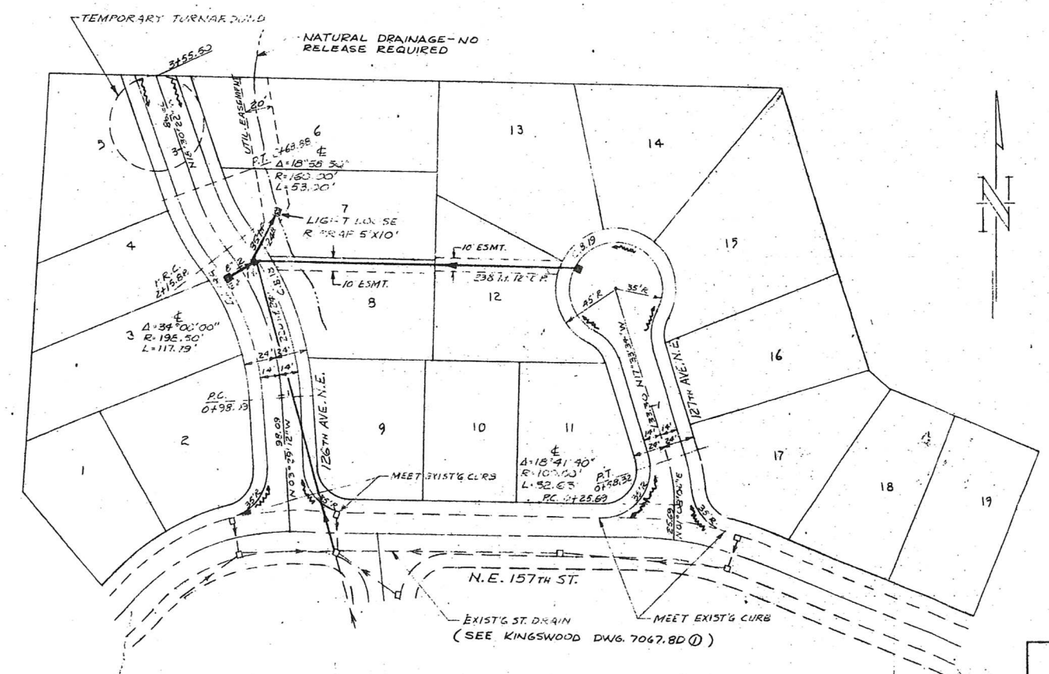
1/2" EXPANSION JOINT FILLER FOR FULL SECTION OF CURB & GUTTER AT 15' O.C.

NO SCALE



CURB AND GUTTER SECTION

NO SCALE



NOTES:

1. ALL WORKMANSHIP & MATERIALS SHALL CONFORM TO KING COUNTY ENGINEER'S SPECIFICATIONS AND TO F.H.A. STANDARDS.
2. FOR PLANS OF N.E. 157TH ST., SEE KINGSWOOD DWG. NO. 7067.8D SHEET 1.
3. 14 GA. CORR. ALUMINUM PIPE MAY BE SUBSTITUTED FOR 24" CONC. PIPE.

Aug 28 1968

REVISIONS

DATE	NO.	DESCRIPTION	BY
7/26/68	1	REV. PER KING CO. ENGR.	L.S.
7/26/68	2	REV. PER SEWER DIST.	L.S.
8/1/68	3	FILLED 126TH AVE.	L.S.
8/9/68	4	REV. PER KING CO. ENGR.	L.S.

KINGSWOOD NO. 2

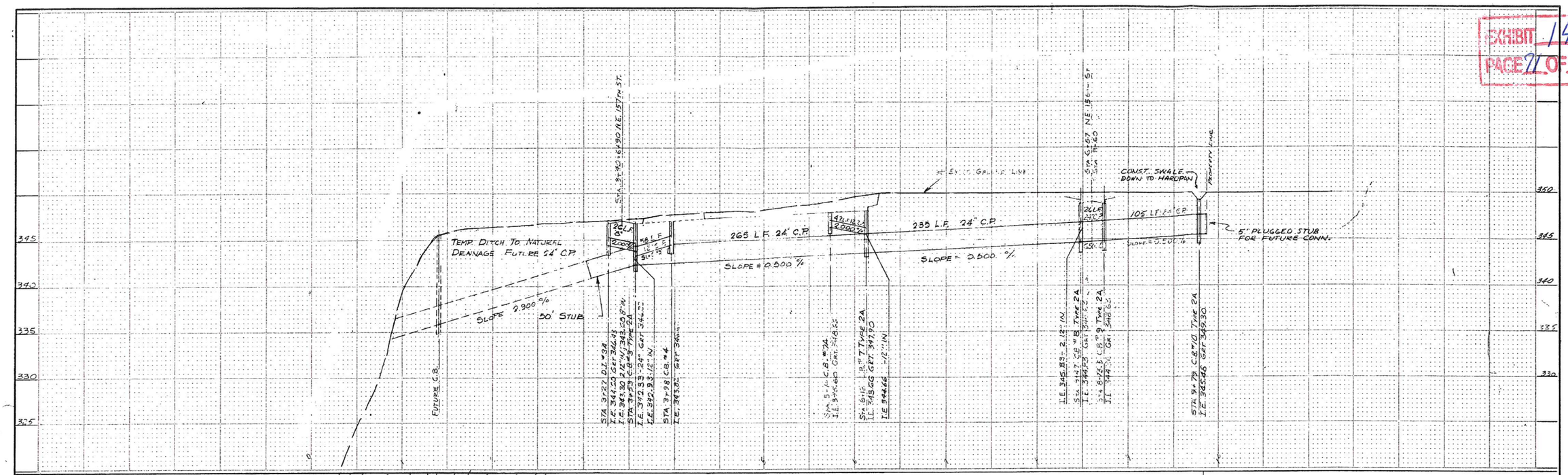
STREETS AND STORM DRAINS PLAN AND PROFILE

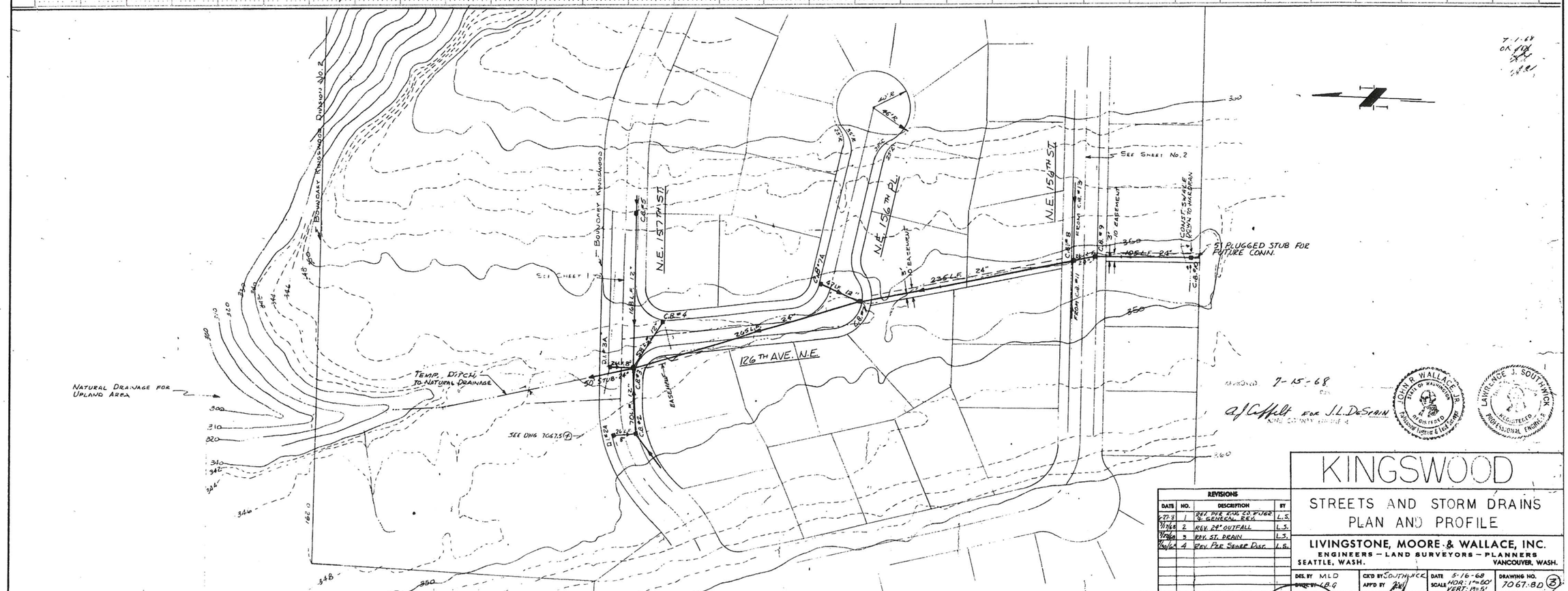
LIVINGSTONE, MOORE & WALLACE, INC.
ENGINEERS — LAND SURVEYORS — PLANNERS
SEATTLE, WASH. VANCOUVER, WASH.

DES. BY E.F.	CK'D BY	DATE JULY, 1968	DRAWING NO.
DWN. BY E.F.	APP'D BY	SCALE HORIZ. 1"=30' VERT. 1"=5'	7067.5 ④

H-123 (23196)

EXHIBIT 14
PAGE 77 OF 73





7-15-68

a/ Coffelt FOR J.L. DeStain
KING COUNTY ENGINEER

JOHN R. WALLACE JR. STATE OF WASHINGTON REGISTERED Livingstone Moore & Wallace Inc.

LAWRENCE J. SOUTHWICK STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER

REVISIONS			
DATE	NO.	DESCRIPTION	BY
6-27-68	1	REV. PER KING CO. ENGR. & GENERAL REV.	L.S.
7/17/68	2	REV. 24" OUTFALL	L.S.
7/24/68	3	REV. ST. DRAIN	L.S.
7/30/68	4	REV. PER SEWER DIST.	L.S.

KINGSWOOD

STREETS AND STORM DRAINS PLAN AND PROFILE

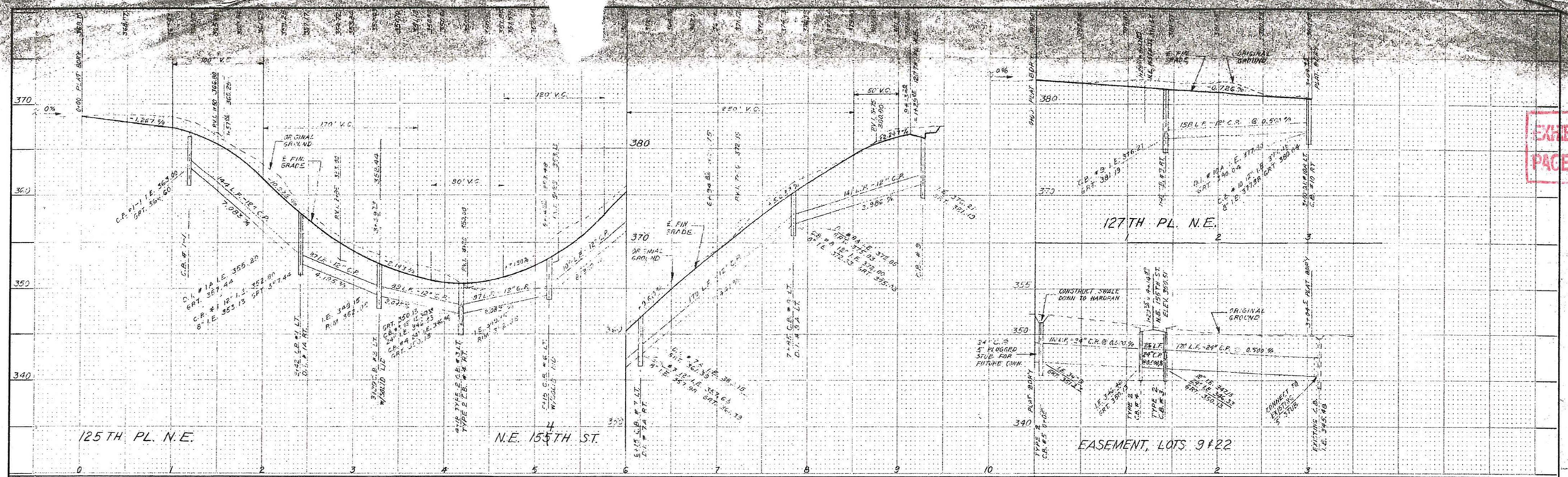
LIVINGSTONE, MOORE & WALLACE, INC.
ENGINEERS — LAND SURVEYORS — PLANNERS
SEATTLE, WASH. VANCOUVER, WASH.

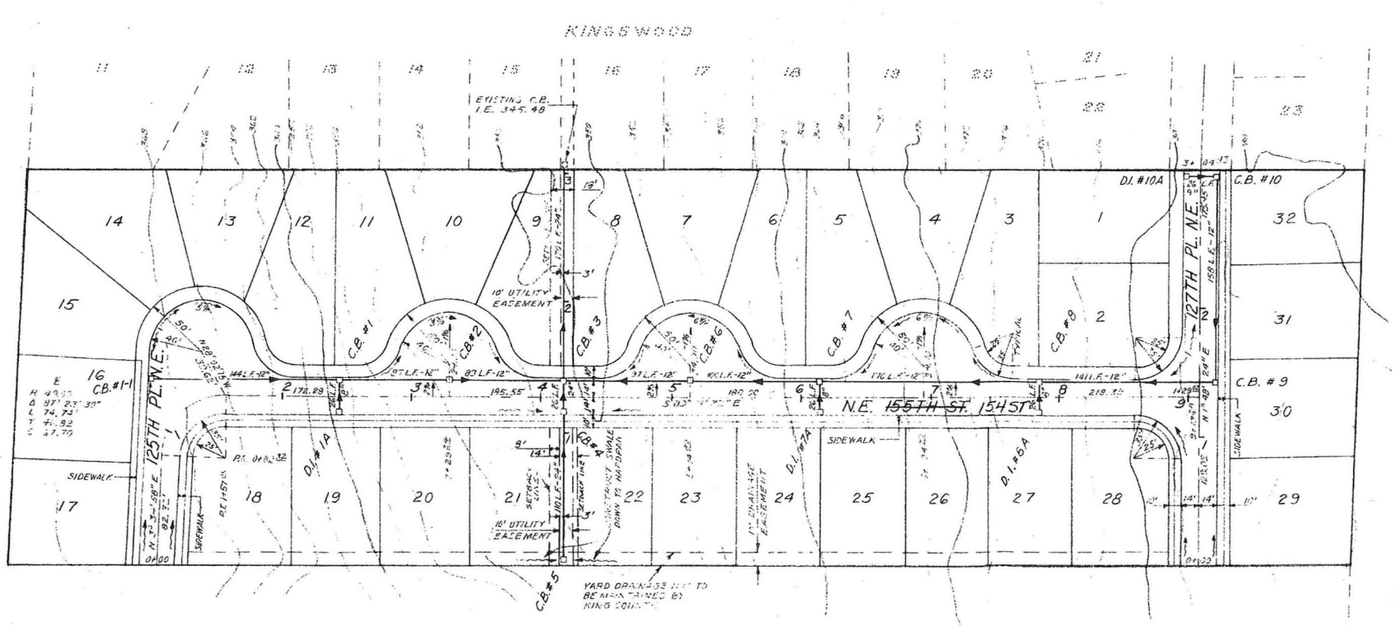
DES. BY MLD	CK'D BY SOUTHWICK	DATE 5-16-68	DRAWING NO.
DRAWN BY LB.G	APP'D BY	SCALE HOR: 1"=50' VERT: 1"=5'	7067.8D (3)

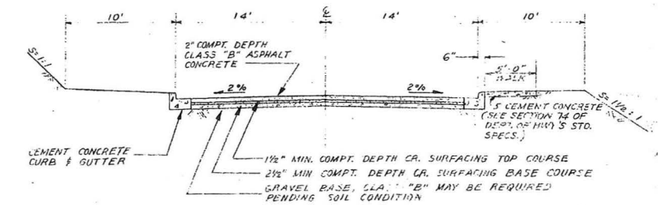
21759

G-177B

EXHIBIT 14
PAGE 22 OF 23



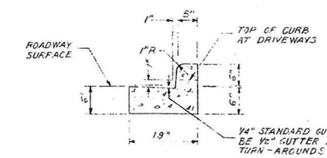




CURB AND GUTTER SECTION
NO SCALE

ATTENTION

1. ALL WORKMANSHIP & MATERIALS SHALL CONFORM TO KING COUNTY ENGINEER'S SPECIFICATIONS AND TO F.H.A. STANDARDS.



CEMENT CONCRETE CURB & GUTTER
¼" EXPANSION JOINT FILLER FOR FULL SECTION OF CURB & GUTTER AT 15' O.C.
NO SCALE

APPROVED 3-24-71
DIRECTOR OF PUBLIC WORKS

REVISIONS			
DATE	NO.	DESCRIPTION	BY
7/6/71	1	REV. PER KING CO.	L.S.
9/21/71	2	REV. PER KING CO.	L.S.

KINGSWOOD NO. 3

STREETS AND STORM DRAINS
PLAN AND PROFILE

MOORE, WALLACE & KENNEDY, INC.
— Formerly —
LIVINGSTONE, MOORE & WALLACE, INC.
ENGINEERS — LAND SURVEYORS — PLANNERS
SEATTLE, WASH. VANCOUVER, WASH.

DES. BY E.F.	CK'D BY L.S.	DATE FEB. 1971	DRAWING NO.
DWN. BY B.F.	APP'D BY	SCALE H: 1" = 50' V: 1" = 5'	7069.150 1 of 3

22938

K-143

EXHIBIT 14
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BACKWATER CALCULATIONS

PROJECT NAME: VINTERRA **PREPARED BY:** GRB

PROJECT NUMBER: 12-132 **DESIGN STORM:** 25 YEAR

PIPE SEGMENT FROM CB	PIPE SEGMENT TO CB	Q (CFS)	PIPE LENGTH (FT)	PIPE SIZE (IN)	MANNING'S "n" VALUE	OUTLET ELEVATION (FT)	INLET ELEVATION (FT)	PIPE AREA (SQ FT)	FULL VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	TAILWATER ELEVATION (FT)	FRICTION LOSS (FT)	ENTRANCE HGL ELEVATION (FT)	ENTRANCE HEAD LOSS (FT)	EXIT HEAD LOSS (FT)	OUTLET CONTROL ELEVATION (FT)	INLET CONTROL ELEVATION (FT)	APPROACH VELOCITY HEAD (FT)	BEND HEAD LOSS (FT)	JUNCTION HEAD LOSS (FT)	HEADWATER ELEVATION (FT)	RIM ELEVATION (FT)	FREEBOARD (FT)
K2 OF	K2CB 18	17.04	35	24	0.012	334.94	335.95	3.14	5.42	0.46	337.95	0.17	338.12	0.23	0.46	338.80	338.43	0.46	0.17	0.00	338.52	346.28	7.76
K2CB 18	KCB 3	17.04	220	24	0.012	335.95	342.33	3.14	5.42	0.46	338.52	1.06	344.33	0.23	0.46	345.02	344.81	0.46	0.02	0.00	344.58	346.43	1.85
KCB 3	KCB 7	17.04	265	24	0.012	342.33	343.66	3.14	5.42	0.46	344.58	1.27	345.85	0.23	0.46	346.53	346.17	0.46	0.02	0.00	346.10	347.90	1.80
KCB 7	KCB 8	17.04	235	24	0.012	343.66	344.83	3.14	5.42	0.46	346.10	1.13	347.22	0.23	0.46	347.91	347.34	0.46	0.01	0.00	347.46	348.63	1.17
KCB 8	KCB 9	17.04	26	24	0.012	344.83	344.96	3.14	5.42	0.46	347.46	0.12	347.59	0.23	0.46	348.27	347.47	0.46	0.03	0.00	347.84	348.63	0.79
KCB 9	KCB 10	17.04	105	24	0.012	344.96	345.48	3.14	5.42	0.46	347.84	0.50	348.35	0.23	0.46	349.03	347.99	0.46	0.01	0.00	348.58	349.30	0.72
KCB 10	K3CB 3	17.04	170	24	0.012	345.48	346.33	3.14	5.42	0.46	348.58	0.82	349.40	0.23	0.46	350.08	348.84	0.46	0.01	0.00	349.64	350.13	0.49
K3CB 3	K3CB 4	17.04	26	24	0.012	346.33	346.46	3.14	5.42	0.46	349.64	0.12	349.76	0.23	0.46	350.45	348.97	0.46	0.01	0.00	350.00	350.13	0.13
K3CB 4	K3CB 5	17.04	110	24	0.012	346.46	347.01	3.14	5.42	0.46	350.00	0.53	350.53	0.23	0.46	351.21	349.52	0.00	0.01	0.00	351.22	351.30	0.08