FULL DRAINAGE REPORT

(FDR)

for

HARMS ESTATE

3601 Seattle Hill Road, Mill Creek, Washington

JONATHAN SAMUEL MURRAY
STATE OF WASHINGTON
50096
REGISTERED
PROFESSIONAL ENGINEER

8/21/2015

DRS Project No. 14087
City of Mill Creek Project No. PP 15-67

Owner/Applicant

Harbour Homes, Inc.
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Report Prepared by

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JANUARY 28, 2015

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AUGUST 21, 2015

DRAINAGE INFORMATION SUMMARY FORM

Project Name: **Harms Estate PRD**

Project Engineer: D.R. STRONG Consulting Engineers Inc.

Project Applicant: Harbour Homes, Inc.

Project Site Area: 7.13 acres

Project Development Area: 5.88 acres

Number of Lots (if applies): 28

Summary Table

Drainage Basin Information	**Individual Basin Information**			
	TDA 1	TDA 2	C	D
On-Site Sub-Basin Area (acres)	2.398	4.536		
Type of Storage Proposed	Vault	Vault		
Approx. Live Storage Volume (cu. ft.)	29,400	29,808		
Approx. Dead Storage Volume (cu. ft.)	7,280	9,000		
Soil Type(s) (Natural Resource Conservation Service)	Alderwood (0-8%)	Alderwood (0-8%)		
Pre-developed Runoff Rates				
Q (cfs.) 2 yr.	0.0473	0.0876		
10 yr.	0.0914	0.1693		
50 yr.	0.1697	0.3142		
Re-development Area	N/A	N/A		
Post-development Runoff Rates (without quantity controls)				
Q (cfs.) 2 yr.	0.4536	0.5346		
10 yr.	0.7614	0.9037		
50 yr.	1.2187	1.4562		
Post-development Runoff Rates (with quantity controls)				
Q (cfs.) 2 yr.	0.0250	0.0522		
10 yr.	0.0576	0.1369		
50 yr.	0.1359	0.3798		
Bypass Area (bypass)				
Number of acres (subtracted from runoff analysis)	0	0		
.				
Offsite Upstream Area				
Number of acres (Upstream of Site)	0.0	0.0		
Number of acres (Upstream of Road)	0.0	0.0		
Offsite Downstream Flow				
Q (cfs) 50 yr.	0.0	0.0		

FULL DRAINAGE REPORT

HARMS ESTATE PRD

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MR 1 - Stormwater Site Plan Narrative

Project Narrative

The project Site (Site) is located on the north side of Seattle Hill Road near the intersection with 35th Ave SE in the City of Mill Creek. The Site is in the northwest quarter of Section 4, Township 27 North, Range 5 East, W.M. The Site includes 7.13 acres on two parcels, 2705040020-1600 and 2705040020-1602. The Site and vicinity is shown in Figure 1. The project (Project) involves the development of 28 dwelling units. The project will be developed as a Planned Residential Development under the City of Mill Creek Code Chapter 16.12.

Existing Site Conditions

The existing Site is developed with a single family home, a mobile home, detached garages, outbuildings, landscaping, and dirt roads. A paved driveway provides access to both residences from Seattle Hill Road. The remainder of the Site is consists of, pasture, forest and wetlands. The western portion of the Site slopes from northwest to southeast at grades ranging from 2 to 6% and contains Wetland ñAò. The eastern portion of the Site slopes from west and east at slopes ranging from 2 to 16%. Offsite wetlands B and C are located to the northeast of the Site. Existing Site conditions and wetland locations are shown in Figure 5.

Post-Developed Conditions

The developed Site will contain 28 unit single family residences, plat road, storm drainage facilities and utilities. Lots and drainage tracts will be landscaped, and both sides of the plat road will have planters. There will be one stormwater detention vault. The sensitive areas and their buffers onsite will be placed in Native Growth Protection Areas (NGPA). Sensitive areas and their buffers will remain undisturbed where possible. Buffer area that is reduced will be replaced with expanded buffer areas elsewhere. Areas proposed to be set aside as NGPAôs which are disturbed during construction will be revegetated to near undisturbed condition. A 50-foot landscape buffer is proposed along Seattle Hill Road.

Upstream Analysis

In examining relevant topographic surveys and conducting a Site visit on December 4th, 2014. The Site is bordered to the west by recently developed single family parcels with storm drainage directed towards the public conveyance systems in the adjacent roads. The southern boundary of the Site is Seattle Hill Road, which only has curb, gutter, and catch basins on the portion of the road from the southwest property corner to the intersection of 36th Dr. SE, which is a high point in Seattle Hill Road. The northern half of Seattle Hill Road east of 36th Dr. SE sheet flows directly onto the Site. The parcel adjacent to the southwest corner of the site appears to direct roof runoff to the public conveyance systems in Seattle Hill Road while the northern portion of the gravel parking area flows onto the Site toward Wetland òAò and the eastern portion of the gravel parking area flows onto the Site toward a shallow depression. A 6ò LCPE pipe was observed at the bottom of the depression but no outfall could be located on the south

side of Seattle Hill Road. The northern portion of the Site is bordered by a recently constructed subdivision with a private detention vault which drains to the wetland northeast of the Site. The westerly portion of the parcel to the east of the Site contains an existing residence, driveway, and lawn which appear to drain onto the southeast corner of the Site.

Downstream Analysis

Based on field reconnaissance, review of available topographic data, review of available aerial photography, wetland delineations, and a Site visit conducted on December 4th, 2014, the Site is divided into two Threshold Discharge Areas (TDA).

Runoff from the northern portion of the Site in TDA 1 sheet flows off the Site from the northeast corner and continues as sheet flow over an existing sewer easement and to a wetland approximately 50 feet from the Site. Runoff continues northerly through the wetland and dense vegetation. No defined flow path was observed although there were several areas of standing water greater than 2 feet deep. At approximately 1,068 feet from the Site runoff flows under 146th St SE through three 42ò diameter LCPE culverts. The culvertsôinlets and outfalls were mostly clear of vegetation but had some sediment accumulation. Runoff then continues northerly through another series of small ponds and dense vegetation (Webster's Pond). The Pond has a channelized outfall that runs parallel to 35th Ave SE. The confluence of the Webster's Pond channel and that from Thomas Lake, approximately 1,590 feet from the Site, drains westerly under 35th Ave SE into Penny Creek, which continues southwesterly for greater than one mile from the Site.

Runoff from the southern portion of the Site in TDA 2 leaves the Site via a 12ò concrete pipe located in the southeast corner of the Site and continues southerly under Seattle Hill Road. The 12ò concrete pipe increases to an 18ò concrete pipe at a Type 1 catch basin located on the southern side of Seattle Hill Road and continues southerly through another Type 1 catch basin. Runoff daylights from the pipe system into a wetland area approximately 160 feet from the Site and continues southerly into Tambark Creek. Tambark Creek has a defined channel that ranges in width from 1-2 feet wide and 1-3 feet deep to over 20 feet wide and several feet deep. At approximately 1,590 feet from the Site Tambark Creek passes under 154th Place SE via a 36ò LCPE culvert and continues southerly. The culvert inlet and outfall was mostly clear of vegetation and had some sediment accumulation. Tambark Creek continues southerly for greater than 1 mile from the Site.

There was no indication of flooding or any apparent downstream issues. The downstream path is shown in Figure 2 and photos from the Downstream Analysis are included in Appendix D.

Conveyance Design Analysis

A backwater analysis for the proposed conveyance system will be performed during the final engineering phase of the project.

Figure 1
Vicinity Map

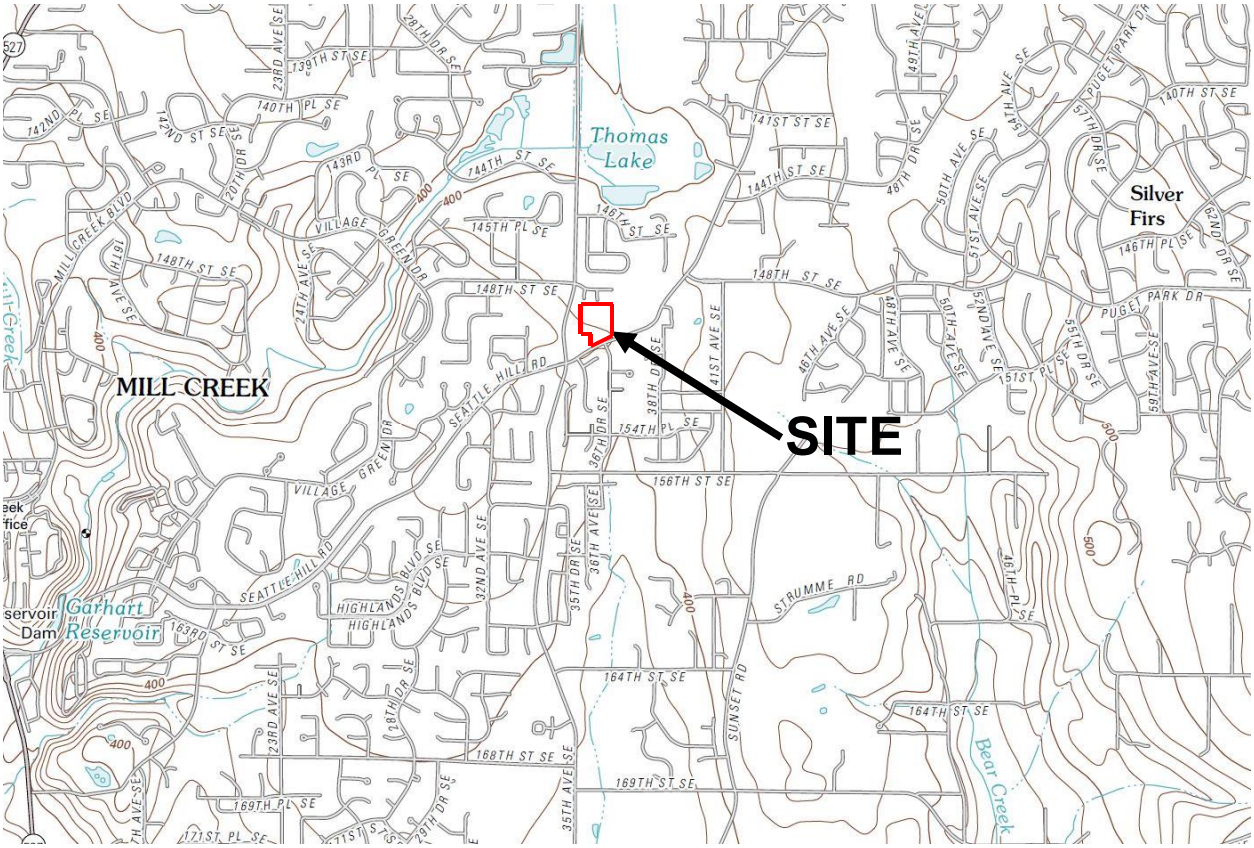
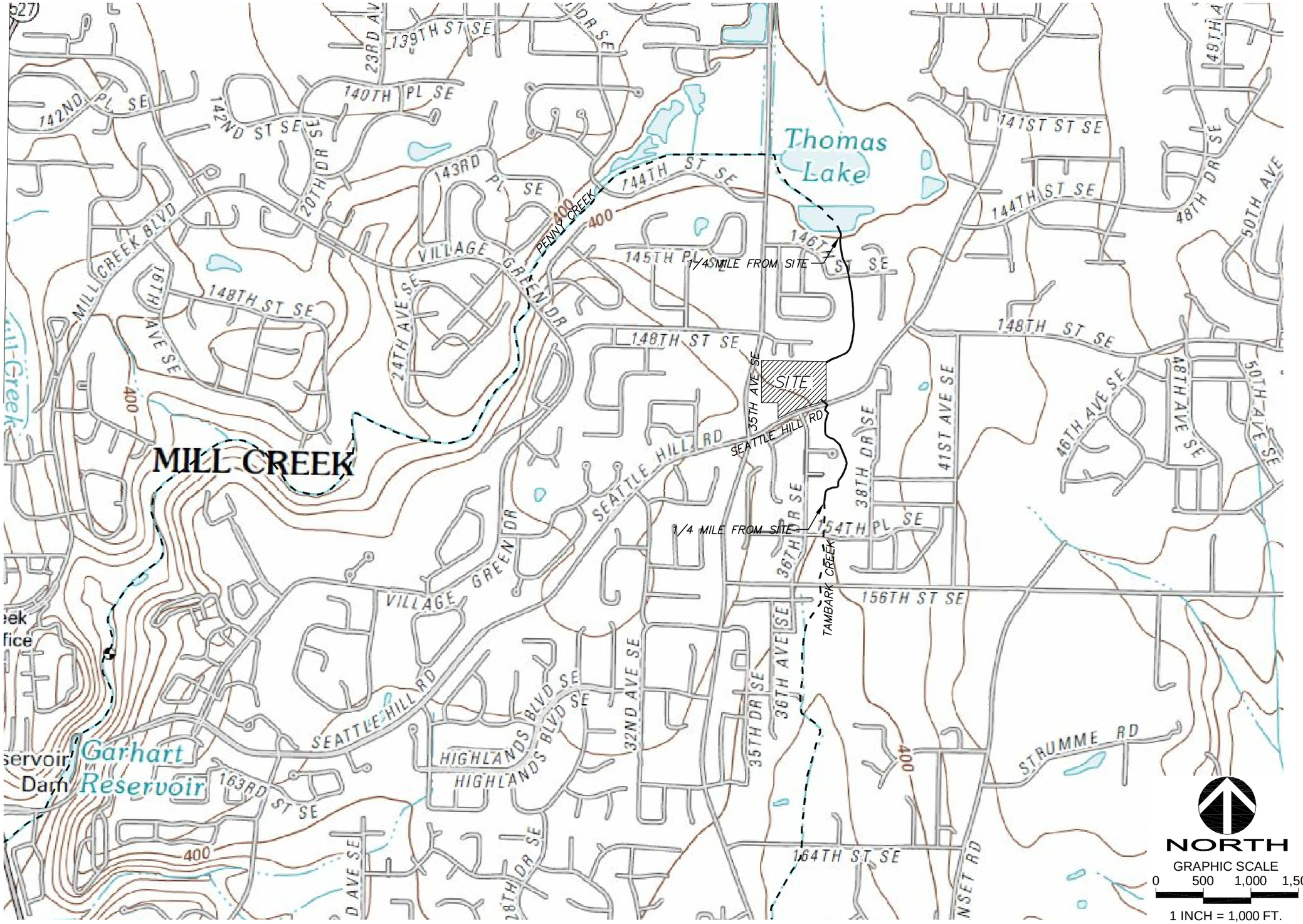


FIGURE 2
USGS TOPOGRAPHIC MAP AND DOWNSTREAM MAP



R:\2014\0\14087\3\Drawings\Plots\PP\Figs\FIG 2 DS MAP 14087.dwg 1/28/2015 3:35:40 PM PST COPYRIGHT © 2014, D.R. STRONG CONSULTING ENGINEERS INC.

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FIGURE 2
DOWNSTREAM MAP
HARMS

DRAFTED BY: DLR
DESIGNED BY:
PROJECT ENGINEER: JSM
DATE: 12.8.14
PROJECT NO.: 14087

FIGURE: 2

FIGURE 3
USDA SOILS MAP

Map Unit Legend

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Alderwood gravelly sandy loam, 0 to 8 percent slopes	6.4	100.0%
Totals for Area of Interest		**6.4**	**100.0%**

1— Alderwood Gravelly Sandy Loam, 0 to 8 percent slopes

Map Unit Setting

- *National map unit symbol:* 2t625
- *Elevation:* 50 to 800 feet
- *Mean annual precipitation:* 25 to 60 inches
- *Mean annual air temperature:* 48 to 52 degrees F
- *Frost-free period:* 160 to 240 days
- *Farmland classification:* Prime farmland if irrigated

Map Unit Composition

- *Alderwood and similar soils:* 85 percent
- *Minor components:* 15 percent

Setting

- *Landform:* Ridges, hills
- *Landform position (two-dimensional):* Summit
- *Landform position (three-dimensional):* Crest, talf
- *Down-slope shape:* Linear, convex
- *Across-slope shape:* Convex
- *Parent material:* Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical Profile

A - 0 to 7 inches: gravelly sandy loam
Bw1 - 7 to 21 inches: very gravelly sandy loam
Bw2 - 21 to 30 inches: very gravelly sandy loam
Bg - 30 to 35 inches: very gravelly sandy loam
2Cd1 - 35 to 43 inches: very gravelly sandy loam
2Cd2 - 43 to 59 inches: very gravelly sandy loam

Properties and qualities

- *Slope:* 0 to 8 percent
- *Depth to restrictive feature:* 20 to 39 inches to densic material
- *Natural 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 37 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Very low (about 2.7 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Other vegetative classification:* Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XS301WA)

Minor Components

Everett

- *Percent of map unit:* 5 percent
- *Landform:* Kames, eskers, moraines
- *Landform position (two-dimensional):* Summit
- *Landform position (three-dimensional):* Crest
- *Down-slope shape:* Convex
- *Across-slope shape:* Convex
- *Other vegetative classification:* Droughty Soils (G002XN402WA)

Mckenna

- *Percent of map unit:* 5 percent
- *Landform:* Depressions, drainageways
- *Down-slope shape:* Concave, linear
- *Across-slope shape:* Concave
- *Other vegetative classification:* Wet Soils (G002XF103WA)

Shalcar

- *Percent of map unit:* 3 percent
- *Landform:* Depressions
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave
- *Across-slope shape:* Concave
- *Other vegetative classification:* Wet Soils (G002XN102WA)

Norma

- *Percent of map unit:* 2 percent
- *Landform:* Depressions, drainageways
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave, linear
- *Across-slope shape:* Concave
- *Other vegetative classification:* Wet Soils (G002XS101WA)

MR 2 - SWPPP Narrative

SWPPP Document

A detailed SWPPP document will be prepared during the final engineering phase of the project.

MR 3 - Water Pollution Source Control for New Development

To be prepared as a part of the SWPPP document during the final engineering phase of the project.

MR 4 - Preservation of natural drainage systems and outfalls, and provisions of offsite mitigation

The Site consists of two Threshold Discharge Areas (TDA) TDA 1 and TDA 2. The Site basins are shown in Figure 4. TDA 1 drains to the northeast corner of the site and TDA 2 drains to the southeast corner of the site. Existing runoff from TDA 1 drains to the offsite wetlands B and C which connects to Webster's Pond and eventually Penny Creek. TDA 2 drains to the conveyance system along Seattle Hill Road and eventually into Tambark Creek.

The Project proposed to discharge mitigated flows at the natural discharge points of TDA 1 and TDA 2. This will be done with a separate vault for each TDA. Developed target surfaces have been routed such that the total areas tributary to each vault matches preexisting conditions.

The roof areas of three lots adjacent to On-Site Wetland A will be fully dispersed into the wetland buffer.

In pre-developed condition, see Figure 5, the entire Site is modeled as "Forest." In the developed condition, see Figure 6, project surfaces will be as shown. The onsite wetland and wetland buffers will remain undeveloped and have been included as forested in both predeveloped and developed runoff calculations. In addition the proposed landscape buffer in Tract 996 will be planted to a forested condition and will be modeled as such. Dispersed roof areas will also be modeled as forested. The proposed detention facilities will match developed conditions' durations to the pre-developed durations of the Site less ranging from 50% of the two-year peak flow up to the full 50-year peak flow. Maintaining this rate, the proposed development does not create or aggravate a "severe flooding problem" or "severe erosion problem." No drainage impacts are anticipated as a result of the proposed Project improvements.

FIGURE 4
DRAINAGE BASINS, SUBBASINS AND SITE CHARACTERISTICS

NORTH

GRAPHIC SCALE

0 40 80 160

1 INCH = 80 FT.

R:\2014\0\14087\3\Drawings\Plots\PP\Figs\FIG 4 BASINS 14087.dwg 1/28/2015 3:54:53 PM PST

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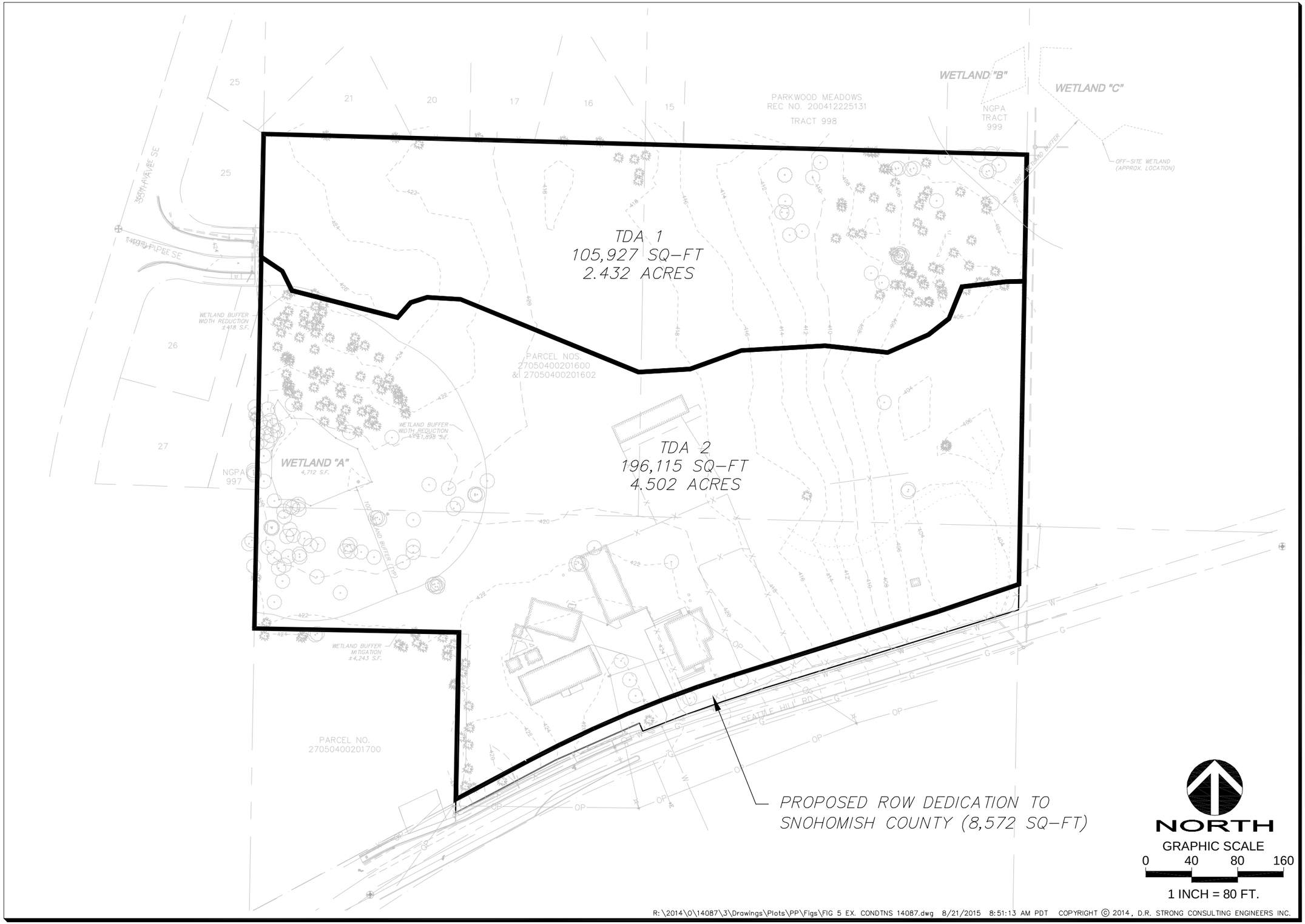
FIGURE 4

DRAINAGE BASINS, SUBBASINS, AND SITE CHARACTERISTICS
HARMS PRELIMINARY PLAT/ PRD
HARBOUR HOMES

DRAFTED BY: DLR
DESIGNED BY:
PROJECT ENGINEER:
DATE: 12-9-14
PROJECT NO.: 14087

FIGURE: 4

FIGURE 5
EXISTING SITE CONDITIONS



R:\2014\0\14087\3\Drawings\Plots\PP\Figs\FIG 5 EX. CONDTNS 14087.dwg 8/21/2015 8:51:13 AM PDT

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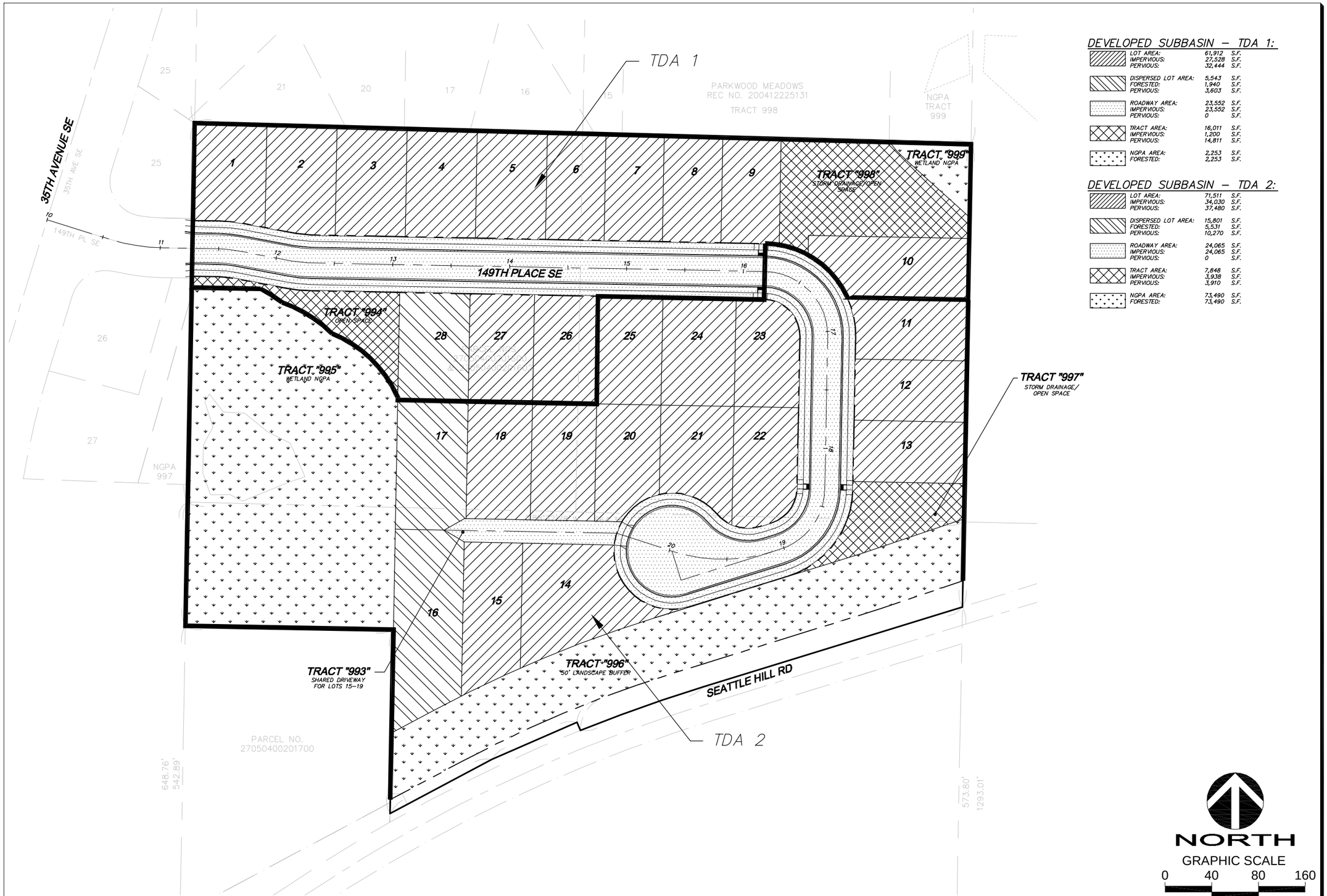
FIGURE 5

EXISTING SITE CONDITIONS
HARMS PRELIMINARY PLAT/ PRD
HARBOUR HOMES

DRAFTED BY: DLR
DESIGNED BY:
PROJECT ENGINEER:
DATE: 12-9-14
PROJECT NO.: 14087

FIGURE: 5

FIGURE 6
DEVELOPED SITE CONDITIONS



DEVELOPED SUBBASIN – TDA 1:

LOT AREA:	61,912	S.F.
IMPERVIOUS:	27,528	S.F.
PERVIOUS:	32,444	S.F.
DISPERSED LOT AREA:	5,543	S.F.
FORESTED:	1,940	S.F.
PERVIOUS:	3,603	S.F.
ROADWAY AREA:	23,552	S.F.
IMPERVIOUS:	23,552	S.F.
PERVIOUS:	0	S.F.
TRACT AREA:	16,011	S.F.
IMPERVIOUS:	1,200	S.F.
PERVIOUS:	14,811	S.F.
NGPA AREA:	2,253	S.F.
FORESTED:	2,253	S.F.

DEVELOPED SUBBASIN – TDA 2:

LOT AREA:	71,511	S.F.
IMPERVIOUS:	34,030	S.F.
PERVIOUS:	37,480	S.F.
DISPERSED LOT AREA:	15,801	S.F.
FORESTED:	5,531	S.F.
PERVIOUS:	10,270	S.F.
ROADWAY AREA:	24,065	S.F.
IMPERVIOUS:	24,065	S.F.
PERVIOUS:	0	S.F.
TRACT AREA:	7,848	S.F.
IMPERVIOUS:	3,938	S.F.
PERVIOUS:	3,910	S.F.
NGPA AREA:	73,490	S.F.
FORESTED:	73,490	S.F.

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FIGURE 6
DEVELOPED SITE CONDITIONS
HARMS PRELIMINARY PLAT/ PRD
HARBOUR HOMES

DRAFTED BY: DLR
DESIGNED BY:
PROJECT ENGINEER:
DATE: 12-9-14
PROJECT NO.: 14087

FIGURE: 6

R:\2014\0\14087\3\Drawings\Plots\PP\Figs\FIG 6 DEV CONDTNS 14087.dwg 8/17/2015 2:12:23 PM PDT COPYRIGHT © 2014, D.R. STRONG CONSULTING ENGINEERS INC.

MR 5 - On-site Stormwater Management

Two combination stormwater detention and water quality vaults are proposed to provide flow control and basic water treatment for Project runoff. Per the provided geotechnical report, soil conditions on the Site are not conducive to infiltration or other Low Impact Development (LID) Best Management Practices (BMPs). The Project proposes to disperse the roof runoff from three lots adjacent to Tract 995. The Project will implement BMP T5.13 Post-Construction Soil Quality and Depth. No other BMPõs are proposed at this time.

Soil Management Plan

Within the limits of Site disturbance, duff and topsoil will be retained in an undisturbed state and stockpiled for later use to stabilize and amend soils throughout the Site. Post-construction soil amendment will meet the requirements of BMP T5.13 Post-Construction Soil Quality and Depth

MR 6 - Run-off Treatment Requirements

Two combined detention and water quality vault are proposed per Ecology BMP T10.40.

TDA 1

The required water quality volume is 0.1526 ac-ft (6,647 cu-ft) and the proposed water quality volume is 7,280 cu-ft.

TDA 2

The required water quality volume is 0.2040 ac-ft (8,886 cu-ft) and the proposed water quality volume is 9,000 cu-ft.

MR 7 - Flow Control

The continuous simulation model, the Western Washington Hydrology Model, WWHM, version 3 was used to analyze the pre and post developed runoff rates. The soil type is modeled as hydrologic soil group C for the Alderwood Series SCS classification as shown in Figure 3, Soils. In the pre-developed conditions the entire Site is modeled as ñTill Forestò In post-development conditions, the soil types are unchanged from the pre-developed conditions. The portions of the Site within the proposed clearing limits tributary to the proposed detention vault were modeled as ñTill Forestò, ñTill Grassò or ñImperviousò as appropriate. Results of the WWHM analysis are included in this Appendix A.

Two storm detention vaults will provide flow control for Project runoff. Vault #1 will serve TDA 1 and will discharge at the natural discharge point of TDA 1. Vault #2 will served TDA 2 and will discharge at the natural discharge point of TDA 2. Roof runoff from three lots will be dispersed into Tract 995 to maintain predeveloped flow patterns. The vault detention volumes are provided in the following table.

Vault Design Volumes

Facility	TDA	Tributary Area (AC)	Required Volume (cu-ft)	Provided Volume (cu-ft)
Vault #1	1	2.398	28,152	33,840
Vault #2	2	4.536	29,018	29,808

Site Area Analysis

The following tables represent the Site areas breakdown for existing and design input in WWHM. Tributary areas for the vault is presented in the following table.

Area Breakdown

	TDA 1		TDA 2	
Predeveloped	**(Sq-Ft)**	**(Acres)**	**(Sq-Ft)**	**(Acres)**
Forest	105,927	2.432	196,115	4.502
Developed				
ROW Area				
Impervious	24,752	0.568	28,003	0.643
Pervious	0	0	0	0
Total	24,752	0.568	28,003	0.643

Area Breakdown (con't)

	TDA 1		TDA 2	
Lot Area	**(Sq-Ft)**	**(Acres)**	**(Sq-Ft)**	**(Acres)**
Impervious - Roof	21,668	0.497	25,030	0.575
Impervious ï Misc	2,600	0.060	3,000	0.069
Impervious - Driveways	5,200	0.119	6,000	0.138
Pervious - Lawn	36,047	0.828	47,751	1.096
Forested - Dispersed Roofs	1,940	0.045	5,531	0.127
Total	67,455	1.549	87,312	2.004
Tract Area				
Impervious	1,200	0.028	3,984	0.091
Pervious	10,034	0.230	3,910	0.090
Forested	2,253	0.052	78,282	1.797
Total	18,264	0.419	81,338	1.867
Totals				
Impervious	54,220	1.245	62,033	1.425
Pervious	50,858	1.168	51,661	1.186
Forested	4,193	0.096	79,021	1.814
Total	**109,271**	**2.509**	**192,715**	**4.424**

WWHM Input

	TDA 1		TDA 2	
Predeveloped	**(Sq-Ft)**	**(Acres)**	**(Sq-Ft)**	**(Acres)**
Forest	105,927	2.432	196,115	4.502
Developed				
Roads, Mod.	24,752	0.568	28,003	0.643
Roof Tops, Flat	21,668	0.497	25,030	0.575
Driveways, Mod.	7,800	0.179	9,000	0.207
C, Lawn, Mod.	50,858	1.168	51,661	1.186
C, Forest, Mod.	4,193	0.096	79,021	1.814

Performance Standards

The detention facility has been designed to meet the requirements of Section 15.14 MCMC and the 2005 DOE Manual. The facility will match developed conditions durations to the pre-developed durations ranging from 50% of the two-year peak flow up to the full 50-year peak flow. Maintaining this rate, the proposed development does not

create or aggravate a ñsevere flooding problemò or ñsevere erosion problemò. No drainage impacts are anticipated as a result of the proposed Project improvements.

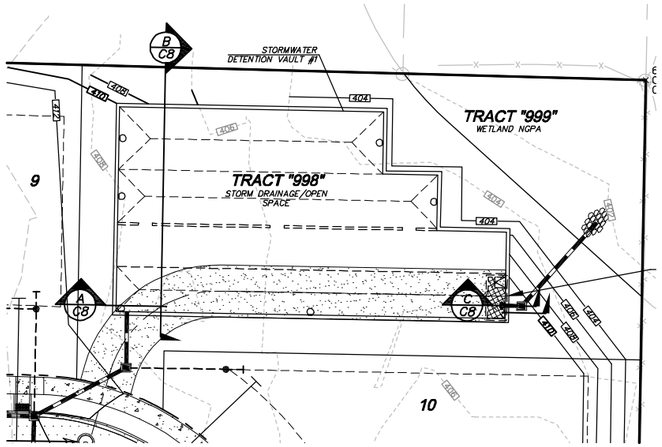
Low Impact Design (LID) Feasibility Analysis

The use of Low Impact Design Facilities including infiltration and dispersal were evaluated for this Project. Infiltration facilities meeting the requirements of Chapter 3 of Volume III of the 2005 Ecology Manual were found to be infeasible for this Site due to soil conditions. Per the Geotechnical Report prepared by Earth Solutions NW (January 15, 2015) soils on the Site are dense cemented glacial till which exhibit poor infiltration characteristics with shallow groundwater seepage. Infiltration was not recommended by the Geotech. The project proposes to disperse the roof area of some lots adjacent to the wetland buffer areas using dispersal trenches. However, on most lots dispersion will not be feasible due to the lack of a vegetated flow path.

FIGURE 7
DETENTION & WATER QUALITY FACILITY DETAILS

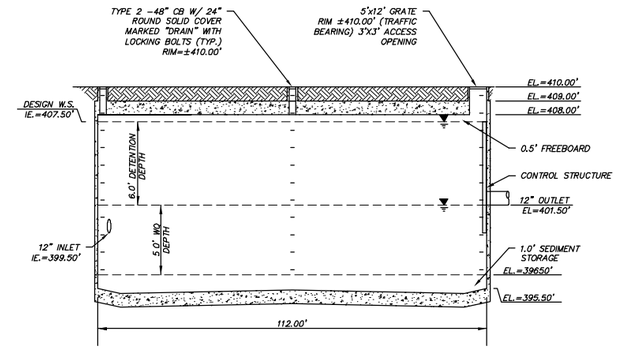
NW 1/4 SECTION 4, TOWNSHIP 27 N, RANGE 5 E, W.M.

HARMS PRELIMINARY SUBDIVISION / PRD



DETENTION VAULT PLAN

SCALE: 1"=20'

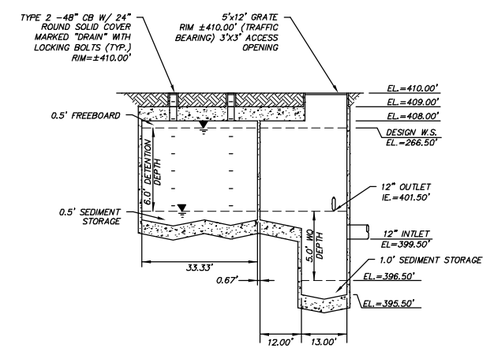


SECTION A-A

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'

A
C8



SECTION B-B

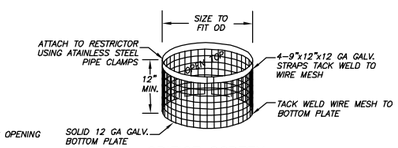
HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'

B
C8

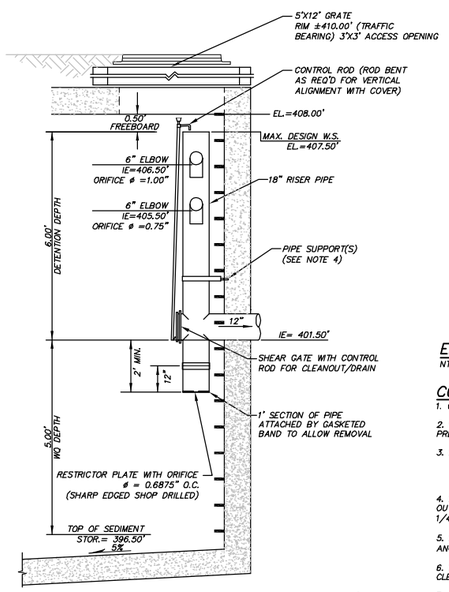
DETENTION PERFORMANCE CHART

STORM	STAGE(FT)	STORAGE VOLUME (CU FT) REQUIRED	DESIGNED	AS-BUILT
DEAD STORAGE	401.50'	6,647	7,920	
2YR	405.58'	19,157	23,028	
10 YR	406.21'	22,099	26,564	
100 YR	407.50'	28,152	33,840	
FREE BOARD	407.50'	28,152	33,840	



ORIFICE SCREEN

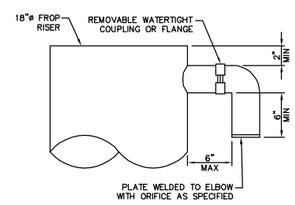
NTS



DETENTION VAULT SECTION C-C

NTS

C
C8



ELBOW RESTRICTOR DETAIL

NTS

CONTROL STRUCTURE NOTES

1. OUTLET CAPACITY: 100-YR PEAK FLOW

2. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED. GALVANIZED PIPE PARTS TO HAVE ASPHALT TREATMENT 1.

3. FRAME AND LADDER OR STEPS OFFSET SO:
   A. CLEANOUT GATE IS VISIBLE FROM TOP.
   B. CLIMB-DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE.
   C. FRAME IS CLEAR OF CURB.

4. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE: OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4"

5. PROVIDE AT LEAST ONE 3"X.090 GAUGE SUPPORT BRACKET ANCHORED TO CONCRETE WALL. (MAXIMUM 3' VERTICAL SPACING)

6. LOCATE ELBOW RESTRICTOR(S) AS NECESSARY TO PROVIDE MINIMUM CLEARANCE AS SHOWN.

7. LOCATE ADDITIONAL LADDER RUNGS IN STRUCTURES USED AS ACCESS TO TANKS OR VAULTS TO ALLOW ACCESS WHEN CATCH BASIN IS FILLED WITH WATER.

CONTROL STRUCTURE W/FROP-TEE)

NTS

Call 2 Working Days Before You Dig
811
Utilities Underground Location Center
(ID,MT,ND,OR,WA)

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O 425.827.3063 F 425.827.3423

HARMS PRELIMINARY SUBDIVISION / PRD

PRELIMINARY
VAULT #1 PLAN, SECTIONS AND DETAILS

3601 SEATTLE HILL RD
MILL CREEK WASHINGTON

HARBOUR HOMES, LLC

Harbour Homes
1441 N 34TH ST, STE 200
SEATTLE, WA 98103
206.315.8130

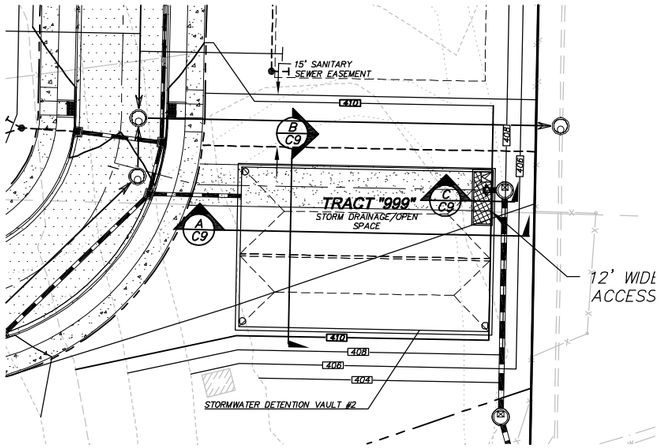
DATE	REVISION	APR
8.13.15	1ST CITY REVIEW	JSM

DRAFTED BY: CWA
DESIGNED BY: JSM
PROJECT ENGINEER: LRJ
DATE: 01.27.15
PROJECT NO.: 14087

DRAWING: C9
SHEET: 9 OF 10

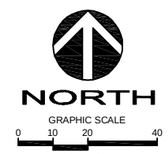
NW 1/4 SECTION 4, TOWNSHIP 27 N, RANGE 5 E, W.M.

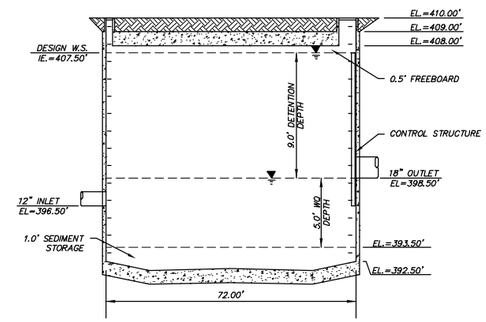
HARMS PRELIMINARY SUBDIVISION / PRD



DETENTION VAULT PLAN

SCALE: 1"=20'





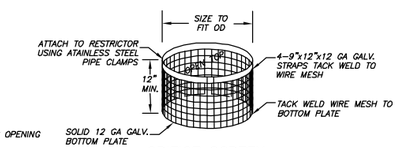
SECTION A–A

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

A C9

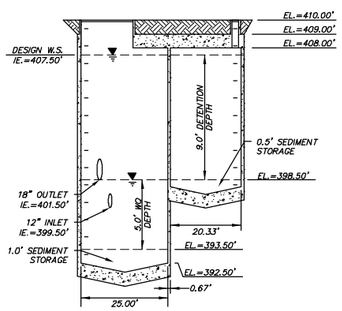
DETENTION PERFORMANCE CHART

STORM	STAGE(FT)	STORAGE VOLUME (CU FT) REQUIRED	DESIGNED	AS-BUILT
DEAD STORAGE	398.50'	8,886	9,000	
2YR	404.65'	18,829	20,369	
10 YR	406.11'	24,536	25,204	
100 YR	407.54'	29,147	29,940	
FREE BOARD	407.50'	29,018	29,808	



ORIFICE SCREEN

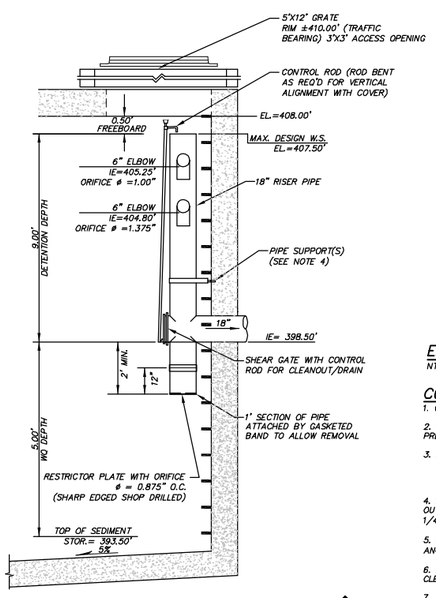
NTS



SECTION B–B

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

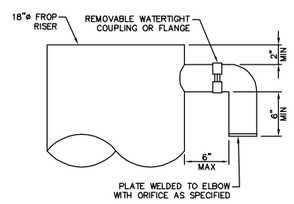
B C9



DETENTION VAULT SECTION C–C

NTS

C C9



ELBOW RESTRICTOR DETAIL

NTS

CONTROL STRUCTURE NOTES

1. OUTLET CAPACITY: 100-YR PEAK FLOW

2. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED. GALVANIZED PIPE PARTS TO HAVE ASPHALT TREATMENT 1.

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   C. FRAME IS CLEAR OF CURB.

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CONTROL STRUCTURE W/FROP-TEE)

NTS

Call 2 Working Days Before You Dig
811
Utilities Underground Location Center
(ID,MT,ND,OR,WA)

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DRS
D.R. STRONG CONSULTING ENGINEERS
ENGINEERS PLANNERS SURVEYORS
620 - 7th AVENUE KIRKLAND, WA 98033
O 425.827.3063 F 425.827.3423

HARMS PRELIMINARY SUBDIVISION / PRD

PRELIMINARY
VAULT #2 PLAN, SECTIONS AND DETAILS

3601 SEATTLE HILL RD
MILL CREEK WASHINGTON

HARBOUR HOMES, LLC

Harbour Homes
1441 N 34TH ST, STE 200
SEATTLE, WA 98103
206.315.8130

JONATHAN SAMUEL JEREMY
STATE OF WASHINGTON
PROFESSIONAL ENGINEER

DATE	REVISION	APP
8.15.15	1ST CITY REVIEW	JSM

DRAFTED BY: CWA
DESIGNED BY: JSM
PROJECT ENGINEER: LRJ
DATE: 01.27.15
PROJECT NO.: 14087

DRAWING: C10
SHEET: 10 OF 10

MR 8 - Wetlands Protection

The proposed stormwater system will be designed to minimize or eliminate entry of waste materials or pollutants to ground water resources and/or surface waters. Flow to offsite wetlands B and C will be maintained by mitigated and treated release from the vault. No drainage impacts are anticipated as a result of the proposed Project improvements.

MR 9 - Operation and Maintenance Manual

To maximize the effectiveness of the On-Site Stormwater Management BMPôs the following practices should be implemented as part of an overall Site management program:

Å Soil quality and depth should be established toward the end of construction and once established, should be protected from compaction, such as from large machinery use, and from erosion.

Å Soil should be planted and mulched after installation.

Å Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

Å An Operation and Maintenance excerpt from the 2005 DOE manual has been included in this Section for each drainage facility that is being proposed.

APPENDIX A
WWHM ANALYSIS

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 14087 Harms Estate
Site Address: 3601 Seattle Hill Road
City : Bothell, WA
Report Date : 8/17/2015
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : TDA 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	2.43

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : DEV TDA 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	1.1675
C, Forest, Mod	.0963

Impervious Land Use	Acres
ROADS MOD	0.5682
ROOF TOPS FLAT	0.4974
DRIVEWAYS MOD	0.1791

Element Flows To:

Surface	Interflow	Groundwater
Vault 1,	Vault 1,	

Name : Vault 1
Width : 69 ft.
Length : 68 ft.
Depth: 7ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.6875 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 0.75 in. **Elevation:** 4 ft.
Orifice 1 Diameter: 1 in. **Elevation:** 5 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.108	0.000	0.000	0.000
0.078	0.108	0.008	0.003	0.000
0.156	0.108	0.017	0.005	0.000
0.233	0.108	0.025	0.006	0.000
0.311	0.108	0.034	0.007	0.000
0.389	0.108	0.042	0.008	0.000
0.467	0.108	0.050	0.008	0.000
0.544	0.108	0.059	0.009	0.000
0.622	0.108	0.067	0.010	0.000
0.700	0.108	0.075	0.010	0.000
0.778	0.108	0.084	0.011	0.000
0.856	0.108	0.092	0.011	0.000
0.933	0.108	0.101	0.012	0.000
1.011	0.108	0.109	0.012	0.000
1.089	0.108	0.117	0.013	0.000
1.167	0.108	0.126	0.013	0.000
1.244	0.108	0.134	0.014	0.000
1.322	0.108	0.142	0.014	0.000
1.400	0.108	0.151	0.015	0.000
1.478	0.108	0.159	0.015	0.000
1.556	0.108	0.168	0.015	0.000
1.633	0.108	0.176	0.016	0.000
1.711	0.108	0.184	0.016	0.000
1.789	0.108	0.193	0.017	0.000
1.867	0.108	0.201	0.017	0.000
1.944	0.108	0.209	0.017	0.000
2.022	0.108	0.218	0.018	0.000
2.100	0.108	0.226	0.018	0.000
2.178	0.108	0.235	0.018	0.000
2.256	0.108	0.243	0.019	0.000
2.333	0.108	0.251	0.019	0.000
2.411	0.108	0.260	0.019	0.000
2.489	0.108	0.268	0.020	0.000
2.567	0.108	0.276	0.020	0.000
2.644	0.108	0.285	0.020	0.000
2.722	0.108	0.293	0.020	0.000
2.800	0.108	0.302	0.021	0.000

2.878	0.108	0.310	0.021	0.000
2.956	0.108	0.318	0.021	0.000
3.033	0.108	0.327	0.022	0.000
3.111	0.108	0.335	0.022	0.000
3.189	0.108	0.343	0.022	0.000
3.267	0.108	0.352	0.022	0.000
3.344	0.108	0.360	0.023	0.000
3.422	0.108	0.369	0.023	0.000
3.500	0.108	0.377	0.023	0.000
3.578	0.108	0.385	0.023	0.000
3.656	0.108	0.394	0.024	0.000
3.733	0.108	0.402	0.024	0.000
3.811	0.108	0.411	0.024	0.000
3.889	0.108	0.419	0.024	0.000
3.967	0.108	0.427	0.025	0.000
4.044	0.108	0.436	0.028	0.000
4.122	0.108	0.444	0.030	0.000
4.200	0.108	0.452	0.032	0.000
4.278	0.108	0.461	0.033	0.000
4.356	0.108	0.469	0.035	0.000
4.433	0.108	0.478	0.036	0.000
4.511	0.108	0.486	0.037	0.000
4.589	0.108	0.494	0.038	0.000
4.667	0.108	0.503	0.039	0.000
4.744	0.108	0.511	0.040	0.000
4.822	0.108	0.519	0.041	0.000
4.900	0.108	0.528	0.041	0.000
4.978	0.108	0.536	0.042	0.000
5.056	0.108	0.545	0.049	0.000
5.133	0.108	0.553	0.053	0.000
5.211	0.108	0.561	0.057	0.000
5.289	0.108	0.570	0.059	0.000
5.367	0.108	0.578	0.062	0.000
5.444	0.108	0.586	0.064	0.000
5.522	0.108	0.595	0.066	0.000
5.600	0.108	0.603	0.068	0.000
5.678	0.108	0.612	0.070	0.000
5.756	0.108	0.620	0.072	0.000
5.833	0.108	0.628	0.074	0.000
5.911	0.108	0.637	0.076	0.000
5.989	0.108	0.645	0.077	0.000
6.067	0.108	0.653	0.330	0.000
6.144	0.108	0.662	0.882	0.000
6.222	0.108	0.670	1.612	0.000
6.300	0.108	0.679	2.484	0.000
6.378	0.108	0.687	3.477	0.000
6.456	0.108	0.695	4.578	0.000
6.533	0.108	0.704	5.778	0.000
6.611	0.108	0.712	7.068	0.000
6.689	0.108	0.720	8.443	0.000
6.767	0.108	0.729	9.898	0.000
6.844	0.108	0.737	11.43	0.000
6.922	0.108	0.746	13.03	0.000
7.000	0.108	0.754	14.70	0.000
7.078	0.108	0.762	16.44	0.000
7.156	0.000	0.000	18.24	0.000

Name : TDA 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	4.5

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : DEV TDA 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	1.186
C, Forest, Mod	1.8141

Impervious Land Use	Acres
ROADS MOD	0.6429
ROOF TOPS FLAT	0.5745
DRIVEWAYS MOD	0.2066

Element Flows To:

Surface	Interflow	Groundwater
Vault 2,	Vault 2,	

Name : Vault 2
Width : 56.7821651453271 ft.
Length : 56.7821651453271 ft.
Depth: 10ft.
Discharge Structure
Riser Height: 9 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.875 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 1.375 in. **Elevation:** 6.3 ft.
Orifice 1 Diameter: 1 in. **Elevation:** 6.75 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.074	0.000	0.000	0.000
0.111	0.074	0.008	0.007	0.000
0.222	0.074	0.016	0.009	0.000
0.333	0.074	0.025	0.012	0.000
0.444	0.074	0.033	0.013	0.000
0.556	0.074	0.041	0.015	0.000
0.667	0.074	0.049	0.016	0.000
0.778	0.074	0.058	0.018	0.000
0.889	0.074	0.066	0.019	0.000
1.000	0.074	0.074	0.020	0.000
1.111	0.074	0.082	0.021	0.000
1.222	0.074	0.090	0.022	0.000
1.333	0.074	0.099	0.023	0.000
1.444	0.074	0.107	0.024	0.000
1.556	0.074	0.115	0.025	0.000
1.667	0.074	0.123	0.026	0.000
1.778	0.074	0.132	0.027	0.000
1.889	0.074	0.140	0.028	0.000
2.000	0.074	0.148	0.028	0.000
2.111	0.074	0.156	0.029	0.000
2.222	0.074	0.164	0.030	0.000
2.333	0.074	0.173	0.031	0.000
2.444	0.074	0.181	0.031	0.000
2.556	0.074	0.189	0.032	0.000
2.667	0.074	0.197	0.033	0.000
2.778	0.074	0.206	0.034	0.000
2.889	0.074	0.214	0.034	0.000
3.000	0.074	0.222	0.035	0.000
3.111	0.074	0.230	0.035	0.000
3.222	0.074	0.239	0.036	0.000
3.333	0.074	0.247	0.037	0.000
3.444	0.074	0.255	0.037	0.000
3.556	0.074	0.263	0.038	0.000
3.667	0.074	0.271	0.039	0.000
3.778	0.074	0.280	0.039	0.000
3.889	0.074	0.288	0.040	0.000
4.000	0.074	0.296	0.040	0.000
4.111	0.074	0.304	0.041	0.000
4.222	0.074	0.313	0.041	0.000
4.333	0.074	0.321	0.042	0.000
4.444	0.074	0.329	0.042	0.000
4.556	0.074	0.337	0.043	0.000
4.667	0.074	0.345	0.043	0.000
4.778	0.074	0.354	0.044	0.000
4.889	0.074	0.362	0.044	0.000
5.000	0.074	0.370	0.045	0.000
5.111	0.074	0.378	0.045	0.000
5.222	0.074	0.387	0.046	0.000
5.333	0.074	0.395	0.046	0.000
5.444	0.074	0.403	0.047	0.000
5.556	0.074	0.411	0.047	0.000
5.667	0.074	0.419	0.048	0.000
5.778	0.074	0.428	0.048	0.000

5.889	0.074	0.436	0.049	0.000
6.000	0.074	0.444	0.049	0.000
6.111	0.074	0.452	0.050	0.000
6.222	0.074	0.461	0.050	0.000
6.333	0.074	0.469	0.060	0.000
6.444	0.074	0.477	0.070	0.000
6.556	0.074	0.485	0.077	0.000
6.667	0.074	0.493	0.082	0.000
6.778	0.074	0.502	0.091	0.000
6.889	0.074	0.510	0.101	0.000
7.000	0.074	0.518	0.108	0.000
7.111	0.074	0.526	0.114	0.000
7.222	0.074	0.535	0.120	0.000
7.333	0.074	0.543	0.125	0.000
7.444	0.074	0.551	0.130	0.000
7.556	0.074	0.559	0.134	0.000
7.667	0.074	0.567	0.139	0.000
7.778	0.074	0.576	0.143	0.000
7.889	0.074	0.584	0.147	0.000
8.000	0.074	0.592	0.151	0.000
8.111	0.074	0.600	0.155	0.000
8.222	0.074	0.609	0.158	0.000
8.333	0.074	0.617	0.162	0.000
8.444	0.074	0.625	0.165	0.000
8.556	0.074	0.633	0.169	0.000
8.667	0.074	0.641	0.172	0.000
8.778	0.074	0.650	0.175	0.000
8.889	0.074	0.658	0.178	0.000
9.000	0.074	0.666	0.181	0.000
9.111	0.074	0.674	0.725	0.000
9.222	0.074	0.683	1.718	0.000
9.333	0.074	0.691	3.002	0.000
9.444	0.074	0.699	4.521	0.000
9.556	0.074	0.707	6.245	0.000
9.667	0.074	0.716	8.150	0.000
9.778	0.074	0.724	10.22	0.000
9.889	0.074	0.732	12.45	0.000
10.00	0.074	0.740	14.81	0.000
10.11	0.074	0.748	17.32	0.000
10.22	0.000	0.000	19.95	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.047307
5 year	0.07203
10 year	0.091407
25 year	0.119551
50 year	0.143328
100 year	0.16965

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.027873
5 year	0.046912
10 year	0.064458
25 year	0.093781
50 year	0.121939
100 year	0.156587

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.017	0.021
1951	0.076	0.033
1952	0.037	0.021
1953	0.035	0.021
1954	0.044	0.020
1955	0.067	0.023
1956	0.088	0.062
1957	0.060	0.063
1958	0.086	0.033
1959	0.062	0.024
1960	0.049	0.024
1961	0.046	0.024
1962	0.045	0.046
1963	0.061	0.019
1964	0.093	0.023
1965	0.045	0.018
1966	0.045	0.025
1967	0.024	0.021
1968	0.063	0.022
1969	0.066	0.025
1970	0.030	0.023
1971	0.035	0.022
1972	0.053	0.068
1973	0.047	0.021
1974	0.034	0.035
1975	0.044	0.029
1976	0.035	0.019
1977	0.036	0.023
1978	0.027	0.019
1979	0.037	0.021
1980	0.116	0.020
1981	0.039	0.021
1982	0.044	0.019
1983	0.046	0.035
1984	0.043	0.024
1985	0.044	0.068
1986	0.065	0.054
1987	0.157	0.112
1988	0.065	0.070
1989	0.035	0.032
1990	0.054	0.019
1991	0.046	0.031
1992	0.050	0.031
1993	0.039	0.030
1994	0.023	0.016

1995	0.020	0.031
1996	0.045	0.037
1997	0.089	0.038
1998	0.196	0.375

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1956	0.3755
2	0.1566	0.1117
3	0.1159	0.0702
4	0.0932	0.0677
5	0.0887	0.0676
6	0.0883	0.0631
7	0.0858	0.0623
8	0.0765	0.0537
9	0.0669	0.0456
10	0.0658	0.0379
11	0.0652	0.0374
12	0.0649	0.0352
13	0.0626	0.0346
14	0.0624	0.0332
15	0.0610	0.0329
16	0.0600	0.0321
17	0.0538	0.0311
18	0.0531	0.0310
19	0.0495	0.0309
20	0.0494	0.0298
21	0.0473	0.0287
22	0.0464	0.0247
23	0.0461	0.0246
24	0.0461	0.0241
25	0.0455	0.0240
26	0.0450	0.0239
27	0.0448	0.0237
28	0.0447	0.0234
29	0.0445	0.0230
30	0.0442	0.0229
31	0.0440	0.0226
32	0.0440	0.0221
33	0.0428	0.0220
34	0.0388	0.0214
35	0.0387	0.0211
36	0.0369	0.0211
37	0.0368	0.0210
38	0.0363	0.0208
39	0.0355	0.0206
40	0.0350	0.0205
41	0.0349	0.0196
42	0.0346	0.0195
43	0.0340	0.0195
44	0.0300	0.0190
45	0.0274	0.0190
46	0.0236	0.0189
47	0.0231	0.0188
48	0.0197	0.0177
49	0.0170	0.0164

POC #1

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0237	4325	4232	97	Pass
0.0249	3866	2531	65	Pass
0.0261	3474	2390	68	Pass
0.0273	3081	2278	73	Pass
0.0285	2731	2152	78	Pass
0.0297	2451	2004	81	Pass
0.0309	2186	1819	83	Pass
0.0321	1977	1651	83	Pass
0.0333	1751	1490	85	Pass
0.0345	1544	1361	88	Pass
0.0357	1369	1224	89	Pass
0.0370	1233	1088	88	Pass
0.0382	1115	951	85	Pass
0.0394	1006	807	80	Pass
0.0406	900	677	75	Pass
0.0418	795	530	66	Pass
0.0430	712	474	66	Pass
0.0442	631	457	72	Pass
0.0454	557	444	79	Pass
0.0466	497	422	84	Pass
0.0478	456	398	87	Pass
0.0490	418	385	92	Pass
0.0502	385	366	95	Pass
0.0515	356	347	97	Pass
0.0527	329	326	99	Pass
0.0539	303	306	100	Pass
0.0551	280	292	104	Pass
0.0563	267	275	102	Pass
0.0575	252	261	103	Pass
0.0587	236	244	103	Pass
0.0599	214	229	107	Pass
0.0611	194	210	108	Pass
0.0623	181	185	102	Pass
0.0635	165	170	103	Pass
0.0648	158	157	99	Pass
0.0660	149	145	97	Pass
0.0672	142	126	88	Pass
0.0684	135	113	83	Pass
0.0696	128	104	81	Pass
0.0708	126	97	76	Pass
0.0720	123	92	74	Pass
0.0732	118	88	74	Pass
0.0744	115	80	69	Pass
0.0756	112	65	58	Pass
0.0768	109	51	46	Pass
0.0781	108	40	37	Pass
0.0793	105	40	38	Pass
0.0805	105	39	37	Pass
0.0817	102	38	37	Pass
0.0829	100	38	38	Pass

0.0841	94	38	40	Pass
0.0853	90	37	41	Pass
0.0865	85	37	43	Pass
0.0877	84	36	42	Pass
0.0889	79	36	45	Pass
0.0901	78	34	43	Pass
0.0913	75	34	45	Pass
0.0926	74	33	44	Pass
0.0938	71	32	45	Pass
0.0950	70	31	44	Pass
0.0962	69	29	42	Pass
0.0974	67	28	41	Pass
0.0986	67	27	40	Pass
0.0998	64	27	42	Pass
0.1010	62	26	41	Pass
0.1022	61	26	42	Pass
0.1034	60	26	43	Pass
0.1046	60	26	43	Pass
0.1059	56	23	41	Pass
0.1071	56	23	41	Pass
0.1083	56	23	41	Pass
0.1095	53	23	43	Pass
0.1107	53	23	43	Pass
0.1119	51	22	43	Pass
0.1131	50	22	44	Pass
0.1143	49	22	44	Pass
0.1155	47	21	44	Pass
0.1167	45	21	46	Pass
0.1179	42	21	50	Pass
0.1192	41	21	51	Pass
0.1204	41	21	51	Pass
0.1216	39	21	53	Pass
0.1228	38	20	52	Pass
0.1240	37	20	54	Pass
0.1252	36	19	52	Pass
0.1264	34	19	55	Pass
0.1276	33	19	57	Pass
0.1288	33	19	57	Pass
0.1300	32	19	59	Pass
0.1312	32	19	59	Pass
0.1324	31	19	61	Pass
0.1337	29	19	65	Pass
0.1349	28	18	64	Pass
0.1361	28	18	64	Pass
0.1373	27	18	66	Pass
0.1385	26	18	69	Pass
0.1397	26	17	65	Pass
0.1409	23	17	73	Pass
0.1421	22	17	77	Pass
0.1433	21	16	76	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.1526 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.1993 **cfs.**

Off-line facility target flow: 0.1052 **cfs.**
Adjusted for 15 min: 0.1123 **cfs.**

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.087606
5 year	0.133388
10 year	0.169273
25 year	0.22139
50 year	0.265423
100 year	0.314166

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.051357
5 year	0.092319
10 year	0.132052
25 year	0.201453
50 year	0.270784
100 year	0.358899

Yearly Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1950	0.031	0.037
1951	0.142	0.050
1952	0.068	0.042
1953	0.064	0.037
1954	0.082	0.033
1955	0.124	0.046
1956	0.163	0.113
1957	0.111	0.110
1958	0.159	0.090
1959	0.116	0.046
1960	0.091	0.047
1961	0.086	0.046
1962	0.083	0.075
1963	0.113	0.039
1964	0.173	0.037
1965	0.083	0.035
1966	0.084	0.049
1967	0.044	0.034
1968	0.116	0.042
1969	0.122	0.060
1970	0.056	0.043
1971	0.065	0.041
1972	0.098	0.120
1973	0.088	0.039
1974	0.063	0.047
1975	0.082	0.047
1976	0.066	0.036
1977	0.067	0.039
1978	0.051	0.036
1979	0.068	0.038
1980	0.215	0.040
1981	0.072	0.036
1982	0.081	0.035
1983	0.085	0.046
1984	0.079	0.041
1985	0.082	0.103
1986	0.121	0.099
1987	0.290	0.456
1988	0.120	0.147
1989	0.065	0.045
1990	0.100	0.030
1991	0.085	0.061
1992	0.092	0.049
1993	0.072	0.050
1994	0.043	0.031
1995	0.036	0.043

1996	0.083	0.100
1997	0.164	0.116
1998	0.362	0.762

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.3622	0.7615
2	0.2899	0.4561
3	0.2145	0.1470
4	0.1727	0.1201
5	0.1644	0.1158
6	0.1634	0.1133
7	0.1589	0.1100
8	0.1416	0.1026
9	0.1239	0.1000
10	0.1219	0.0988
11	0.1207	0.0903
12	0.1201	0.0751
13	0.1160	0.0611
14	0.1156	0.0597
15	0.1130	0.0500
16	0.1111	0.0497
17	0.0997	0.0494
18	0.0983	0.0488
19	0.0918	0.0473
20	0.0914	0.0473
21	0.0877	0.0466
22	0.0858	0.0460
23	0.0854	0.0460
24	0.0854	0.0459
25	0.0842	0.0456
26	0.0833	0.0450
27	0.0830	0.0427
28	0.0829	0.0425
29	0.0823	0.0422
30	0.0819	0.0416
31	0.0815	0.0409
32	0.0814	0.0408
33	0.0792	0.0397
34	0.0718	0.0394
35	0.0718	0.0394
36	0.0683	0.0390
37	0.0681	0.0383
38	0.0672	0.0372
39	0.0657	0.0372
40	0.0647	0.0369
41	0.0646	0.0365
42	0.0641	0.0364
43	0.0629	0.0356
44	0.0556	0.0353
45	0.0507	0.0347
46	0.0438	0.0343
47	0.0428	0.0326
48	0.0365	0.0310
49	0.0314	0.0303

POC #2

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0438	4510	3896	86	Pass
0.0460	3880	2428	62	Pass
0.0483	3527	1755	49	Pass
0.0505	3177	991	31	Pass
0.0528	2853	902	31	Pass
0.0550	2569	865	33	Pass

0.0572	2214	807	36	Pass
0.0595	2010	765	38	Pass
0.0617	1808	729	40	Pass
0.0640	1638	697	42	Pass
0.0662	1379	660	47	Pass
0.0684	1256	624	49	Pass
0.0707	1147	600	52	Pass
0.0729	1048	563	53	Pass
0.0751	907	527	58	Pass
0.0774	811	491	60	Pass
0.0796	741	465	62	Pass
0.0819	664	440	66	Pass
0.0841	559	411	73	Pass
0.0863	507	395	77	Pass
0.0886	467	380	81	Pass
0.0908	430	358	83	Pass
0.0931	385	335	87	Pass
0.0953	359	322	89	Pass
0.0975	336	301	89	Pass
0.0998	313	268	85	Pass
0.1020	280	240	85	Pass
0.1042	268	229	85	Pass
0.1065	256	221	86	Pass
0.1087	239	211	88	Pass
0.1110	221	198	89	Pass
0.1132	198	177	89	Pass
0.1154	185	161	87	Pass
0.1177	168	153	91	Pass
0.1199	161	147	91	Pass
0.1222	149	140	93	Pass
0.1244	143	137	95	Pass
0.1266	139	136	97	Pass
0.1289	129	131	101	Pass
0.1311	126	128	101	Pass
0.1333	123	127	103	Pass
0.1356	118	122	103	Pass
0.1378	115	119	103	Pass
0.1401	112	114	101	Pass
0.1423	110	111	100	Pass
0.1445	108	107	99	Pass
0.1468	107	103	96	Pass
0.1490	105	97	92	Pass
0.1513	102	94	92	Pass
0.1535	101	91	90	Pass
0.1557	98	89	90	Pass
0.1580	92	88	95	Pass
0.1602	85	78	91	Pass
0.1624	85	76	89	Pass
0.1647	81	73	90	Pass
0.1669	78	70	89	Pass
0.1692	75	65	86	Pass
0.1714	74	62	83	Pass
0.1736	71	60	84	Pass
0.1759	70	57	81	Pass
0.1781	69	47	68	Pass
0.1804	67	39	58	Pass
0.1826	67	29	43	Pass

0.1848	65	29	44	Pass
0.1871	62	26	41	Pass
0.1893	61	26	42	Pass
0.1915	60	25	41	Pass
0.1938	60	25	41	Pass
0.1960	56	24	42	Pass
0.1983	56	24	42	Pass
0.2005	56	23	41	Pass
0.2027	53	23	43	Pass
0.2050	53	23	43	Pass
0.2072	51	21	41	Pass
0.2095	50	20	40	Pass
0.2117	50	20	40	Pass
0.2139	48	20	41	Pass
0.2162	45	20	44	Pass
0.2184	43	20	46	Pass
0.2207	41	19	46	Pass
0.2229	41	19	46	Pass
0.2251	39	18	46	Pass
0.2274	38	18	47	Pass
0.2296	38	18	47	Pass
0.2318	36	18	50	Pass
0.2341	34	18	52	Pass
0.2363	33	18	54	Pass
0.2386	33	18	54	Pass
0.2408	32	18	56	Pass
0.2430	32	18	56	Pass
0.2453	31	18	58	Pass
0.2475	30	18	60	Pass
0.2498	28	18	64	Pass
0.2520	28	18	64	Pass
0.2542	27	18	66	Pass
0.2565	26	18	69	Pass
0.2587	26	17	65	Pass
0.2609	25	17	68	Pass
0.2632	22	17	77	Pass
0.2654	21	17	80	Pass

Water Quality BMP Flow and Volume for POC 2.
On-line facility volume: 0.204 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.2255 **cfs.**
Off-line facility target flow: 0.1208 **cfs.**
Adjusted for 15 min: 0.1257 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

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APPENDIX B
BACKWATER ANALYSIS

To be prepared during final engineering stage of project.

APPENDIX C
SPECIAL REPORTS AND STUDIES

The following report and studies have been provided with this submittal.

1. Harms Estate, Traffic Impact Analysis, prepared by Gibson Traffic Consultants, Inc., January 2015.

2. Geotechnical Engineering Study, Harms Estate, prepared by Earth Solutions NW, LLC. January 15, 2015

3. Wetland Delineation and Fish and Wildlife Habitat Assessment Report, prepared by Soundview Consultants, LLC., June 24, 2015

APPENDIX D
PHOTOS

Photo 1: Culverts passing under 146th St SE

Photo 2: Looking north from 146th St SE towards Webster's Pond.