

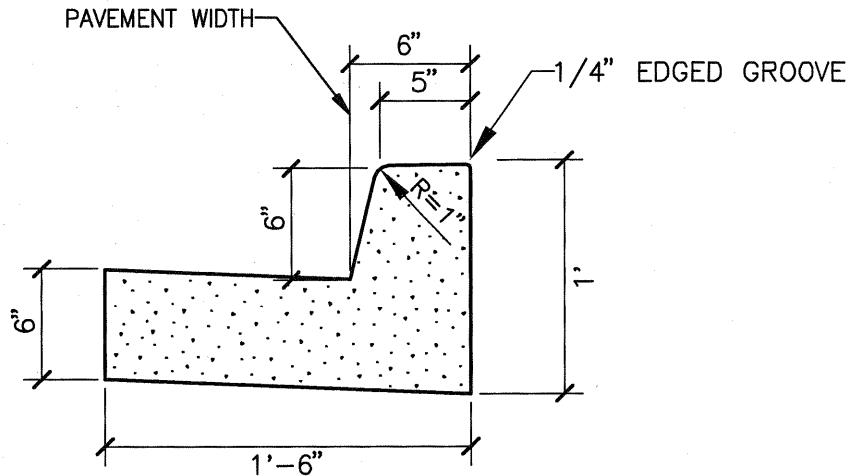
# **APPENDICES**

Appendix A – City Standard Details

Appendix B – Engineering Geology Report

**APPENDIX A**  
**CITY STANDARDS DETAILS**

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**NOTES:**

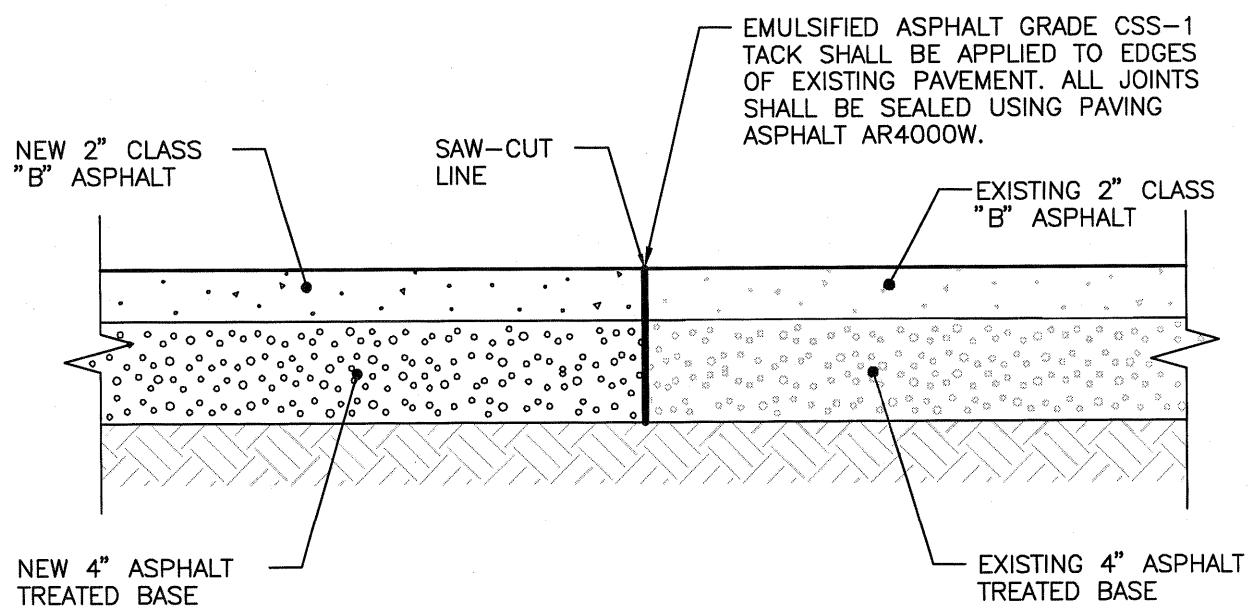
1. CONSTRUCTION OF CURB DETAILS SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION AS PUBLISHED BY THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND THE AMERICAN PUBLIC WORKS ASSOCIATION. (WSDOT/APWA SPECIFICATIONS) UNLESS OTHERWISE MODIFIED BELOW.
2. ALL CONCRETE SHALL BE AIR ENTRAINED CONCRETE CLASS 3000.
3. FORMS SHALL BE TRUE TO LINE AND GRADE AND SECURELY STAKED. STEEL FORMS ONLY SHALL BE USED ON TANGENT SECTIONS. WOOD FORMS MAY BE USED ON CURVED SECTIONS. AS AN ALTERNATIVE EXTRUDED CEMENT CONCRETE CURB AND GUTTER MAY BE USED PER WSDOT SECTION 8-04.3(1)A.
4. FULL DEPTH EXPANSION JOINTS CONSISTING OF 3/8" INCH MINIMUM PRE-MOLDED JOINT MATERIAL SHALL BE PLACED ADJACENT TO CATCH BASINS, INLETS AND AT POINTS OF TANGENCY ON STREETS AND DRIVEWAY RETURNS. MAXIMUM SPACING SHALL BE 15 FEET.
5. CONTRACTION JOINTS (DUMMY JOINTS) CONSISTING OF 3/8" INCH MINIMUM x 2" OF PRE-MOLDED JOINT MATERIAL SHALL BE CONSTRUCTED AT INTERVALS OF 15 FEET.
6. ALL JOINTS SHALL BE CLEAN AND EDGED.
7. FINISH SHALL BE A LIGHT BROOM FINISH.
8. FINISHED CURBS AND GUTTERS SHALL BE SPRAYED WITH A CLEAR CURING COMPOUND.
9. MINIMUM REPLACEMENT SECTION LENGTH FOR DAMAGED CURB BEING REMOVED AND REPLACED SHALL BE 5 FEET.

**SNOQUALMIE RIDGE II****CEMENT CONCRETE  
CURB AND GUTTER**

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## STREETS



SNOQUALMIE RIDGE II

ASPHALT PATCH  
DETAIL

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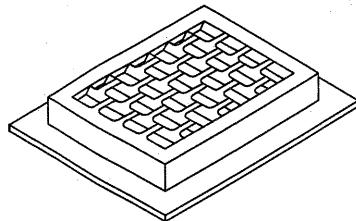
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Approved AB#04-172 11/8/04

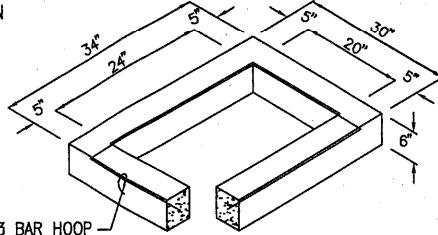
Attest: *J.W.* Jodi Warren/CMC City Clerk

# STORM DRAINAGE

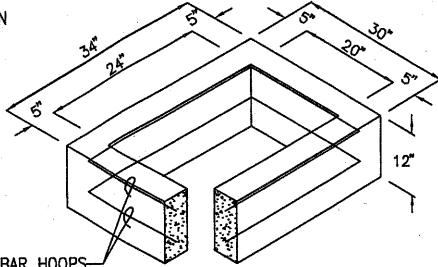
FRAME AND LOCKING  
VANED GRATE



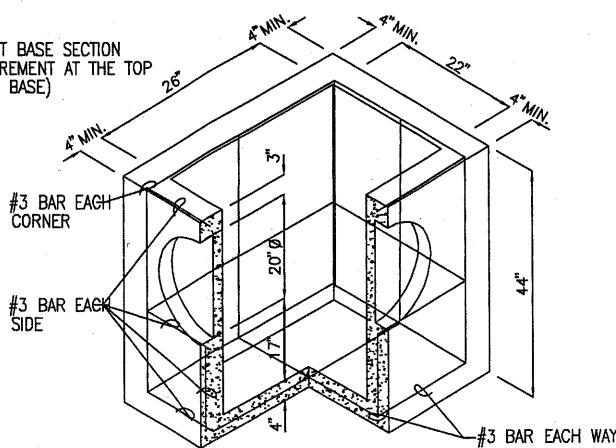
6" RISER SECTION



12" RISER SECTION



PRECAST BASE SECTION  
(MEASUREMENT AT THE TOP  
OF THE BASE)



## NOTES:

1. CATCH BASINS SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C478 (AASHTO M 199) & C890 UNLESS OTHERWISE SHOWN ON PLANS.
2. AS AN ACCEPTABLE ALTERNATIVE TO REBAR, WELDED WIRE FABRIC HAVING A MIN. AREA OF 0.12 SQUARE INCHES PER FOOT MAY BE USED. WELDED WIRE FABRIC SHALL COMPLY TO ASTM A497 (AASHTO M 221). WIRE FABRIC SHALL NOT BE PLACED IN KNOCKOUTS.
3. ALL REINFORCED CAST-IN-PLACE CONCRETE SHALL BE CLASS 4000.
4. PRECAST BASES SHALL BE FURNISHED WITH CUTOUTS OR KNOCKOUTS. KNOCKOUTS SHALL HAVE A WALL THICKNESS OF 2" MIN. ALL PIPE SHALL BE INSTALLED IN FACTORY PROVIDED KNOCKOUTS.
5. KNOCKOUT OR CUTOUT HOLE SIZE IS EQUAL TO PIPE OUTER DIAM. PLUS CATCH BASIN WALL THICKNESS.
6. ROUND KNOCKOUTS MAY BE ON ALL 4 SIDES, WITH MAX. DIAM. OF 20". KNOCKOUTS MAY BE EITHER ROUND OR "D" SHAPE.
7. THE MAX. DEPTH FROM THE FINISHED GRADE TO THE PIPE INVERT IS 5'-0".
8. THE TAPER ON THE SIDES OF THE PRECAST BASE SECTION AND RISER SECTION SHALL NOT EXCEED 1/2"/FT.
9. CATCH BASIN FRAME AND GRATE SHALL BE IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND MEET THE STRENGTH REQUIREMENTS OF FEDERAL SPECIFICATION RR-F-621D. MATING SURFACES SHALL BE FINISHED TO ASSURE NON-ROCKING FIT WITH ANY COVER POSITION.
10. FRAME AND GRATE MAY BE INSTALLED WITH FLANGE DOWN OR CAST INTO RISER.
11. EDGE OF RISER OR BRICK SHALL NOT BE MORE THAN 2" FROM VERTICAL EDGE OF CATCH BASIN WALL.
12. GROUT IN BETWEEN ALL JOINTS AND ADJUSTMENT SECTIONS.

## PIPE ALLOWANCES

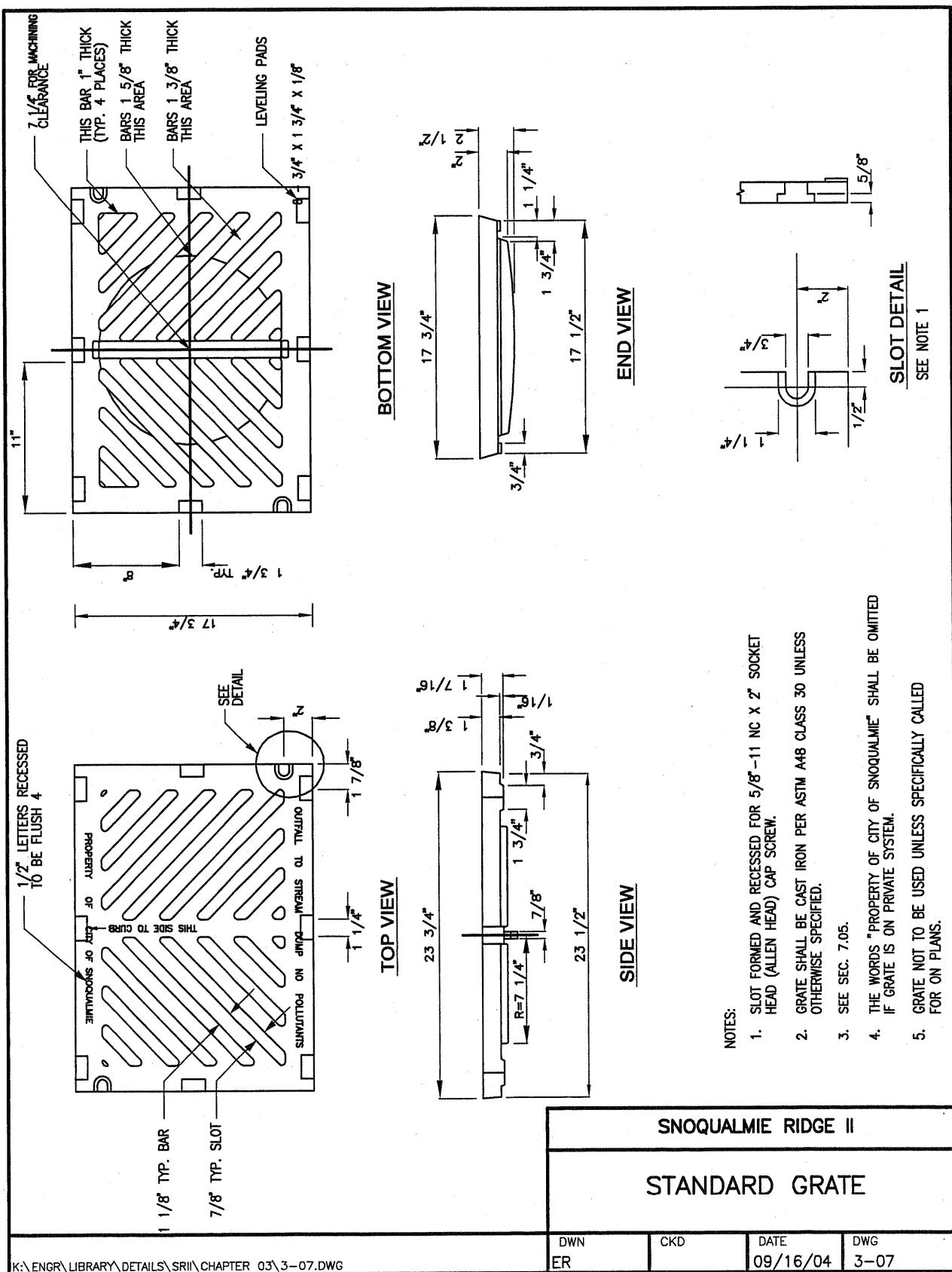
PIPE MATERIAL	MAXIMUM INSIDE DIAMETER
REINFORCED OR PLAIN CONCRETE	12"
ALL METAL PIPE	15"
CPSSP * (STD. SPEC. 9-05.20)	12"
SOLID WALL PVC (STD. SPEC. 9-05.12(1))	15"
PROFILE WALL PVC (STD. SPEC. 9-05.12(2))	15"

\* CORRUGATED POLYETHYLENE  
STORM SEWER PIPE

## SNOQUALMIE RIDGE II

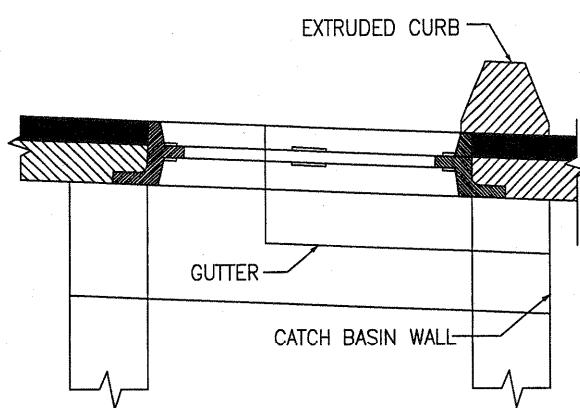
### CATCH BASIN TYPE 1

## **STORM DRAINAGE**

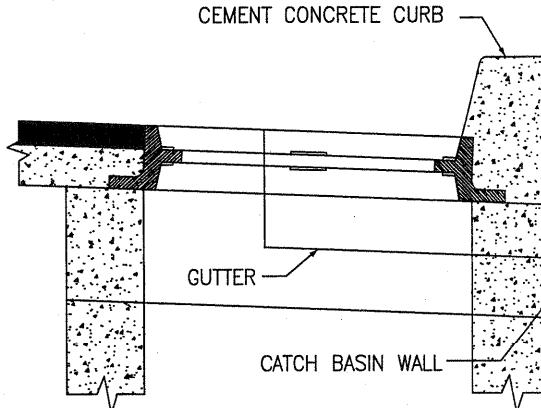


Approved: AB#04-172 11/8/04  
Attest: *J.W.* Jodi Warren/CMC City Clerk

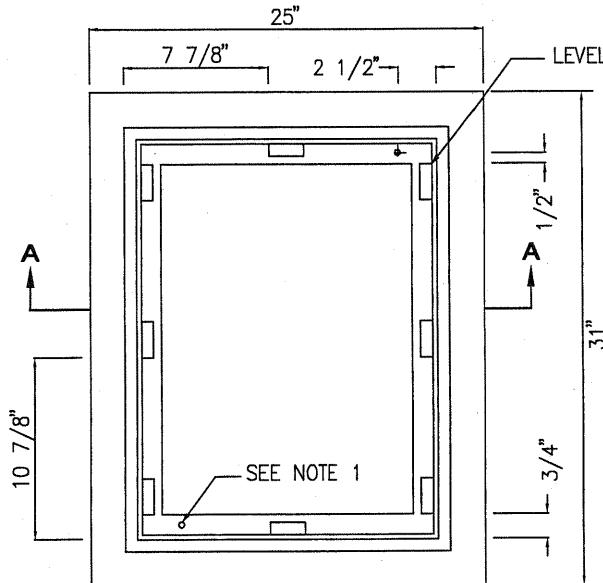
# STORM DRAINAGE



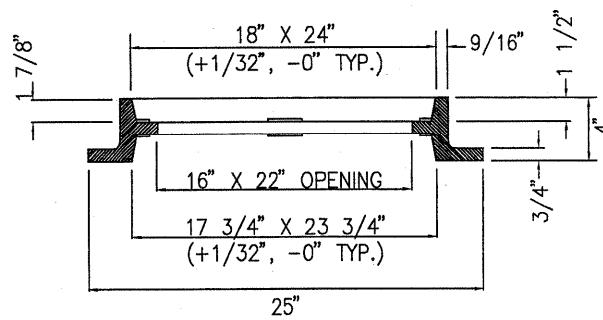
**EXTRUDED CURB**  
SEE NOTE 4



**VERTICAL CURB**  
SEE NOTE 4



**PLAN**



**SECTION A-A**

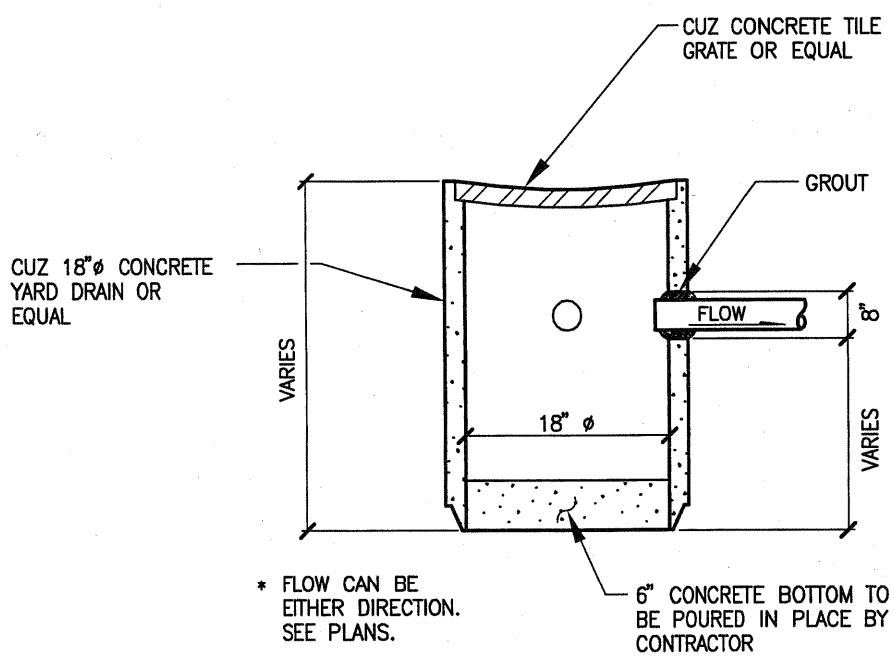
**NOTES:**

1. DRILL AND TAP FOR, AND PROVIDE, TWO LOCKING BOLTS 5/8"-11 NC STAINLESS TYPE 304 STEEL SOCKET HEAD (ALLEN HEAD) CAP SCREWS 2" LONG WHEN USED WITH SOLID COVER (DWG. NO. 2-015) OR WHEN SPECIFIED BY ENGINEER.
2. FRAME MATERIAL IS DUCTILE IRON PER ASTM A48 CLASS 30.
3. SET FRAME TO GRADE AND CONSTRUCT ROAD AND GUTTER TO BE FLUSH WITH FRAME.
4. SEE SEC. 7.05.

SNOQUALMIE RIDGE II

STANDARD FRAME DETAILS

## STORM DRAINAGE



SNOQUALMIE RIDGE II

YARD DRAIN

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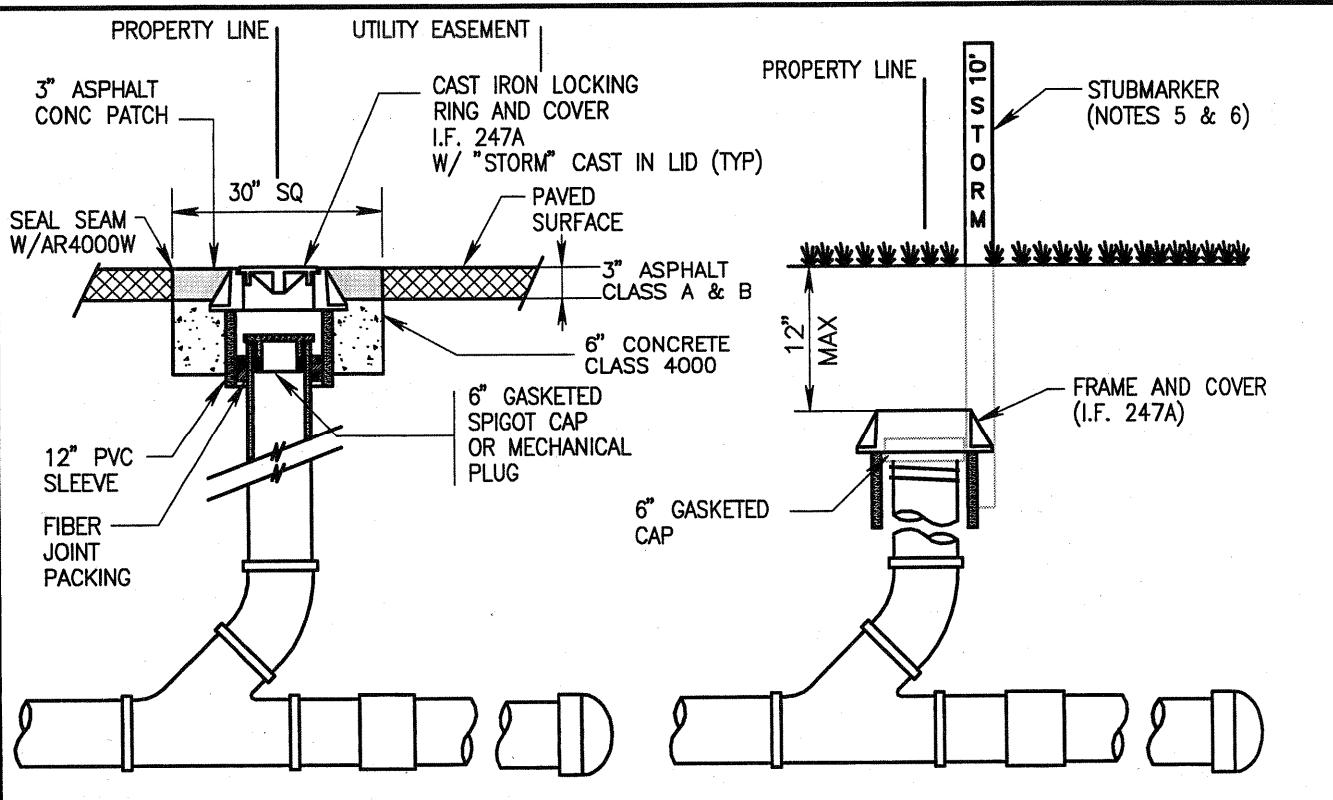
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Approved: AB#04-172 11/8/04  
Attest: *Jodi Warren/CMC* City Clerk

# STORM DRAINAGE



## PAVED AREAS TRAFFIC AREAS

## UNPAVED AREAS NON-TRAFFIC AREAS

### NOTES

1. CLEAN-OUT PIPE AND FITTINGS SHALL BE PVC.
2. A STORM TEE OR SWEEP MAY BE INSTALLED IN LIEU OF A WYE AS SHOWN. STRAIGHT TEES ARE NOT ACCEPTABLE.
3. FOR NEW PLATS THE VERTICAL RISER PORTION OF THE CLEAN-OUT WILL BE CONSTRUCTED AT TIME OF CONNECTION TO BUILDING TO MINIMIZE DAMAGE, THE 6" WYE AND 6" PVC PIPE W/GASKETED CAPS WILL BE INSTALLED PRIOR TO BUILDING CONNECTION.
4. STORM STUB WILL BE EXTENDED 10' BEYOND PROPERTY LINE TO PREVENT DAMAGE TO CLEAN-OUT AND MINIMIZE CONFLICTS WITH OTHER UTILITIES WHEN SERVICE TO BUILDING IS ACCOMPLISHED.
5. A PRESSURE TREATED 2"x4" STUBMARKER SHALL EXTEND DOWN TO THE BOTTOM OF THE STORM PIPE. A MINIMUM OF 3 FEET SHALL EXTEND ABOVE GROUND.
6. THE STUBMARKER SHALL BE PAINTED WITH WHITE TRAFFIC PAINT AND THE WORD "STORM" AND THE LENGTH OF THE 2"x4" SHALL BE PAINTED ON THE MARKER WITH HIGH BLACK PAINTED LETTERS

SNOQUALMIE RIDGE II

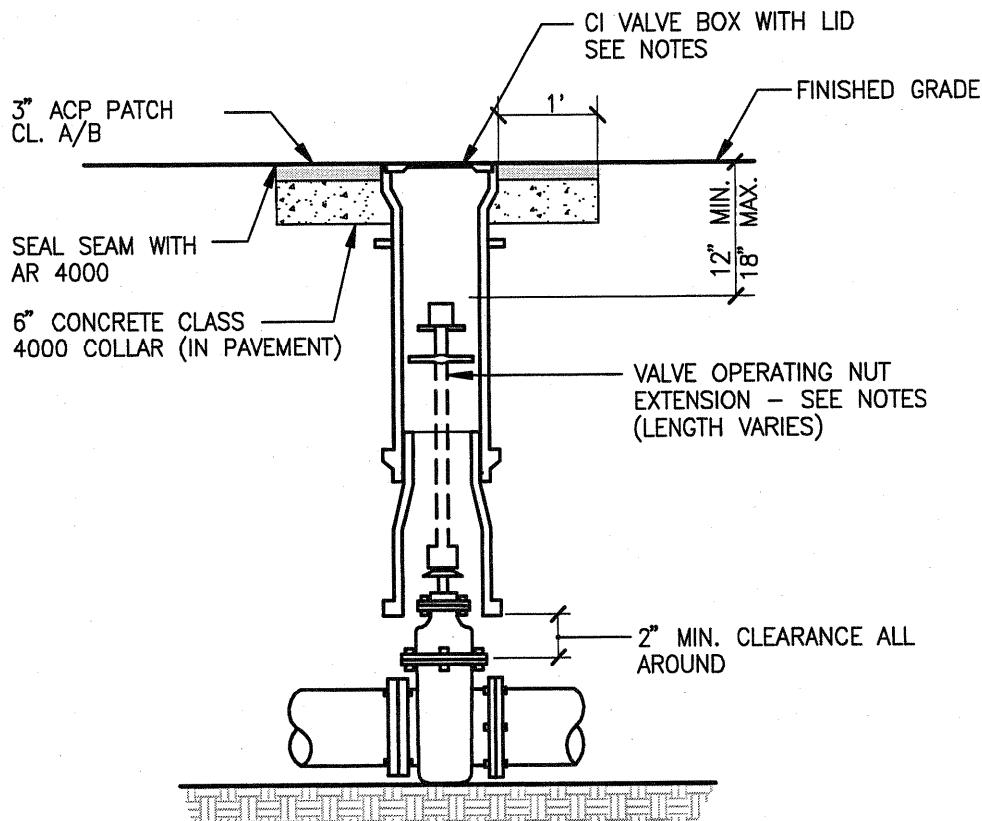
STORM CLEAN-OUT

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Approved: AB#04-172 11/8/04.

Attest: *Jodi Warren/CMC City Clerk*



NOTES:

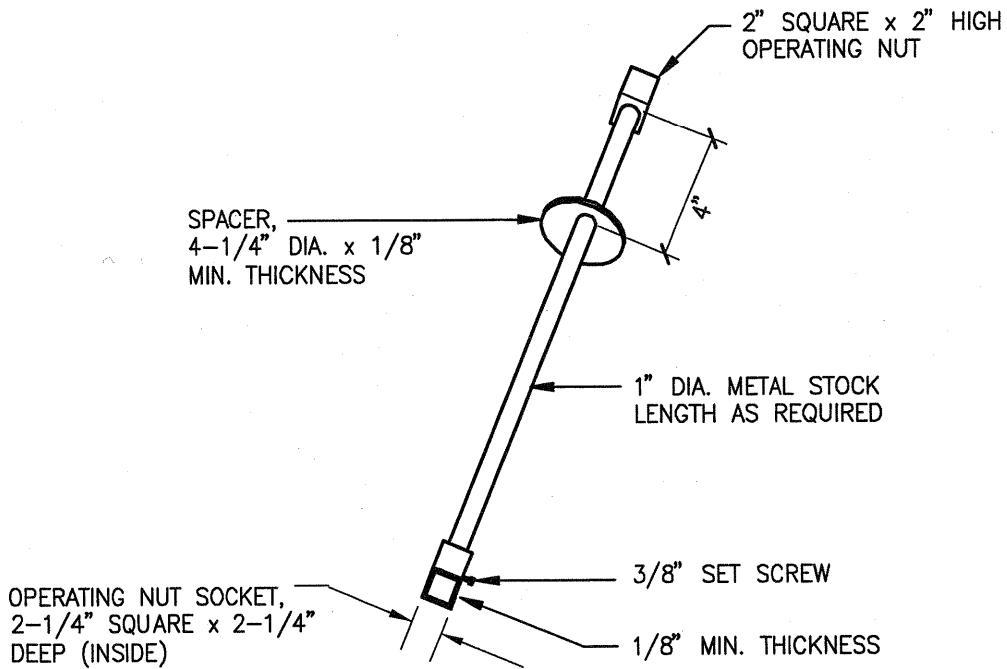
1. 5" DIAMETER HUBBED CAST IRON SOIL PIPE MAY BE USED FOR VALVE BOX EXTENSION.
2. ONLY ONE VALVE BOX EXTENSION TO BE USED PER VALVE.
3. ONLY ONE OPERATING NUT EXTENSION TO BE USED PER VALVE. (SEE DETAIL 4-08)
4. OPERATING NUT EXTENSION REQUIRED WHEN VALVE NUT IS OVER 4 FEET DEEP.
5. VALVE BOX SHALL BE RICH 940B WITH 18" SEATTLE STYLE TOP SECTION.
6. SET VALVE BOX LID 2 INCHES BELOW UNPAVED ROADWAY SHOULDER SURFACE.
7. VALVE LID MARKED "WATER".
8. 2" SKIRT ON LID.

SNOQUALMIE RIDGE II

VALVE BOX AND  
OPERATING NUT EXTENSION

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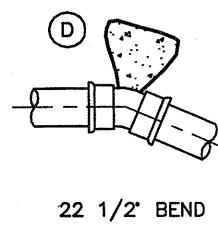
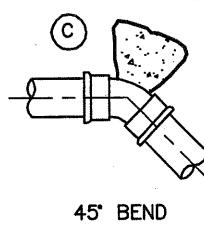
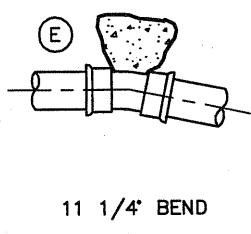
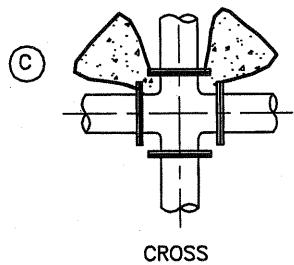
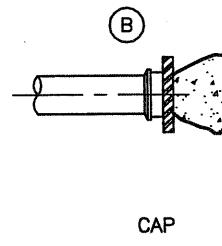
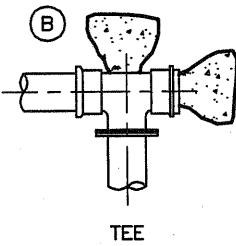
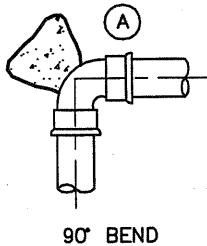
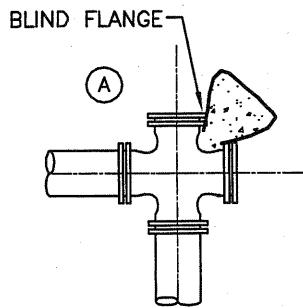
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**NOTES:**

1. EXTENSIONS ARE TO BE A MIN. OF ONE (1) FOOT LONG WITH ONLY ONE EXTENSION TO BE USED PER VALVE.
2. FILLET WELD ALL COMPONENTS.
3. ALL EXTENSIONS ARE TO BE MADE OF STEEL SIZED AS NOTED, AND PAINTED WITH TWO COATS OF INDUSTRIAL ALKYD GLOSS PAINT. COLOR TO BE WHITE.

SNOQUALMIE RIDGE II			
VALVE OPERATING EXTENSION FABRICATION DETAILS			
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### NOTES:

1. BEARING AREA OF CONCRETE THRUST-BLOCK BASED ON 200 PSI PRESSURE AND SAFE SOIL-BEARING LOAD OF 2,000 POUNDS PER SQUARE FOOT.
2. BEARING AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZES, PRESSURES, AND SOIL CONDITIONS.
3. CONCRETE BLOCKING (CLASS 3000) SHALL BE CAST IN PLACE AND HAVE A MINIMUM OF 1/4 SQUARE FOOT BEARING AGAINST THE FITTING.
4. BLOCK SHALL BEAR AGAINST FITTINGS ONLY AND SHALL BE CLEAR OF JOINTS TO PERMIT TAKING UP OR DISMANTLING OF JOINT.
5. CONTRACTOR SHALL INSTALL BLOCKING ADEQUATE TO WITHSTAND FULL TEST PRESSURE UNDER ALL CONDITIONS OF SERVICE.
6. MINIMUM ROD DIAMETER SHALL BE 3/4" ASTM A-307 WITH 36KSI YIELD STRENGTH, GALV.
7. ALL BLOCKS SHALL BE FORMED WITH PLYWOOD & SHALL BE INSPECTED AND APPROVED PRIOR TO PLACING CONCRETE. FORM LUMBER SHALL BE SUBSTANTIAL IN DIMENSION (WIDTH, LENGTH, THK). FORMING SHALL BE COMPLETE AND SUFFICIENT SO AS TO KEEP THE CONCRETE FROM OVERFLOWING ONTO THE FITTINGS BEYOND THE FORMED LIMITS.
8. FITTINGS AND BOLTS SHALL BE COVERED WITH VISQUEEN PRIOR TO CONCRETE PLACEMENT.

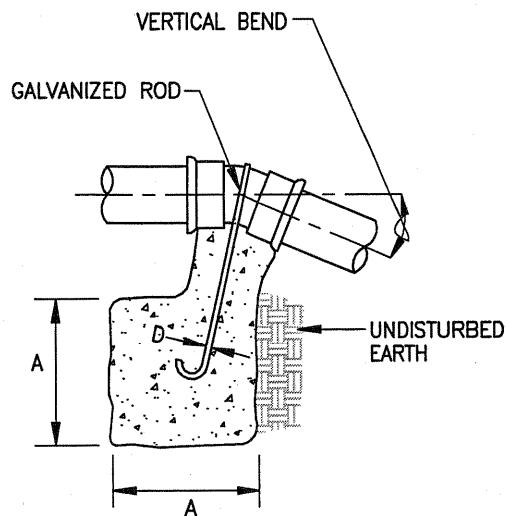
### THRUST BLOCK TABLE

MINIMUM BEARING AREA AGAINST UNDISTURBED SOIL

PIPE SIZE	(A) SQ. FT.	(B) SQ. FT.	(C) SQ. FT.	(D) SQ. FT.	(E) SQ. FT.
4"	3	1	1	1	1
6	4	4	2	1	1
8"	7	6	4	2	1
10"	11	10	6	3	2
12"	16	14	9	5	3
14"	22	19	12	6	3
16"	29	25	16	8	4
18"	36	31	20	10	5
20"	45	39	24	13	6
22"	54	47	29	15	8
24"	64	56	35	18	9
28"	87	76	48	24	12
30"	101	87	55	28	14
36"	145	125	78	40	20
42"	197	171	107	55	27
48"	257	223	140	71	36

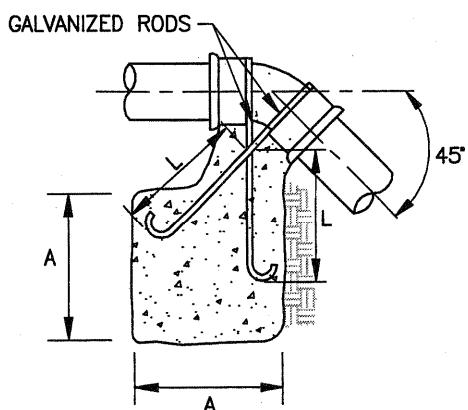
### SNOQUALMIE RIDGE II

### STANDARD HORIZONTAL BLOCKING DETAILS



**VERTICAL BLOCKING**  
FOR 11-1/4", 22 1/2" & 30° BENDS

VERTICAL BLOCKING FOR 11-1/4", 22 1/2" & 30° BENDS					
PIPE SIZE	V B	CU. FT.	A	D	L
4"	22-1/2"	8	2.0'	3/4"	1.5'
	11-1/4"	11	2.2'		2.0'
	30°	17	2.6'		
6"	11-1/4"	11	2.2'	3/4"	2.0'
	22-1/2"	25	2.9'		
	30°	41	3.5'		
8"	11-1/4"	16	2.5'	3/4"	2.0'
	22-1/2"	47	3.6'		
	30°	70	4.1'	3/4"	2.5'
12"	11-1/4"	32	3.2'	3/4"	2.0'
	22-1/2"	88	4.5'	7/8"	3.0'
	30°	132	5.1'		
16"	11-1/4"	70	4.1'	7/8"	3.0'
	22-1/2"	184	5.7'	1-1/8"	4.0'
	30°	275	6.5'	1-1/4"	
20"	11-1/4"	91	4.5'	7/8"	3.0'
	22-1/2"	225	6.1'	1-1/4"	4.0'
	30°	330	6.9'	1-3/8"	4.5'
24"	11-1/4"	128	5.0'	1"	3.5'
	22-1/2"	320	6.8'	1-3/8"	4.5'
	30°	480	7.9'	1-5/8"	5.5'



**VERTICAL BLOCKING**  
45° BEND

**NOTE:**

1. CONCRETE BLOCKING BASED ON 200 PSI PRESSURE & CLASS 3000 CONCRETE.
2. FITTINGS AND BOLTS SHALL BE COVERED WITH VISQUEEN PRIOR TO CONCRETE PLACEMENT.
3. PROVIDE MIN 3" COVER OVER GALVANIZED RODS.
4. RODS SHALL BE GALV. A307 OR STAINLESS STEEL. MIN. 36 KSI YIELD STRENGTH, SIZE AS SHOWN.
5. BEARING AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZES, PRESSURES AND SOIL CONDITIONS.

SIZE OF DEAD  
WEIGHT BLOCK  
C.Y. CONCRETE

VERTICAL BLOCKING FOR 45° BENDS					
PIPE SIZE	V B	CU. FT.	A	D	L
4"	45	30	3.1'	3/4"	2.0'
6"		68	4.1'		
8"		123	5.0'		
12"		232	6.1'	3/4"	2.5'
16"		478	7.8'	1-1/8"	4.0'
20"		560	8.2'	1-1/4"	
24"		820	9.4'	1-3/8"	4.5'

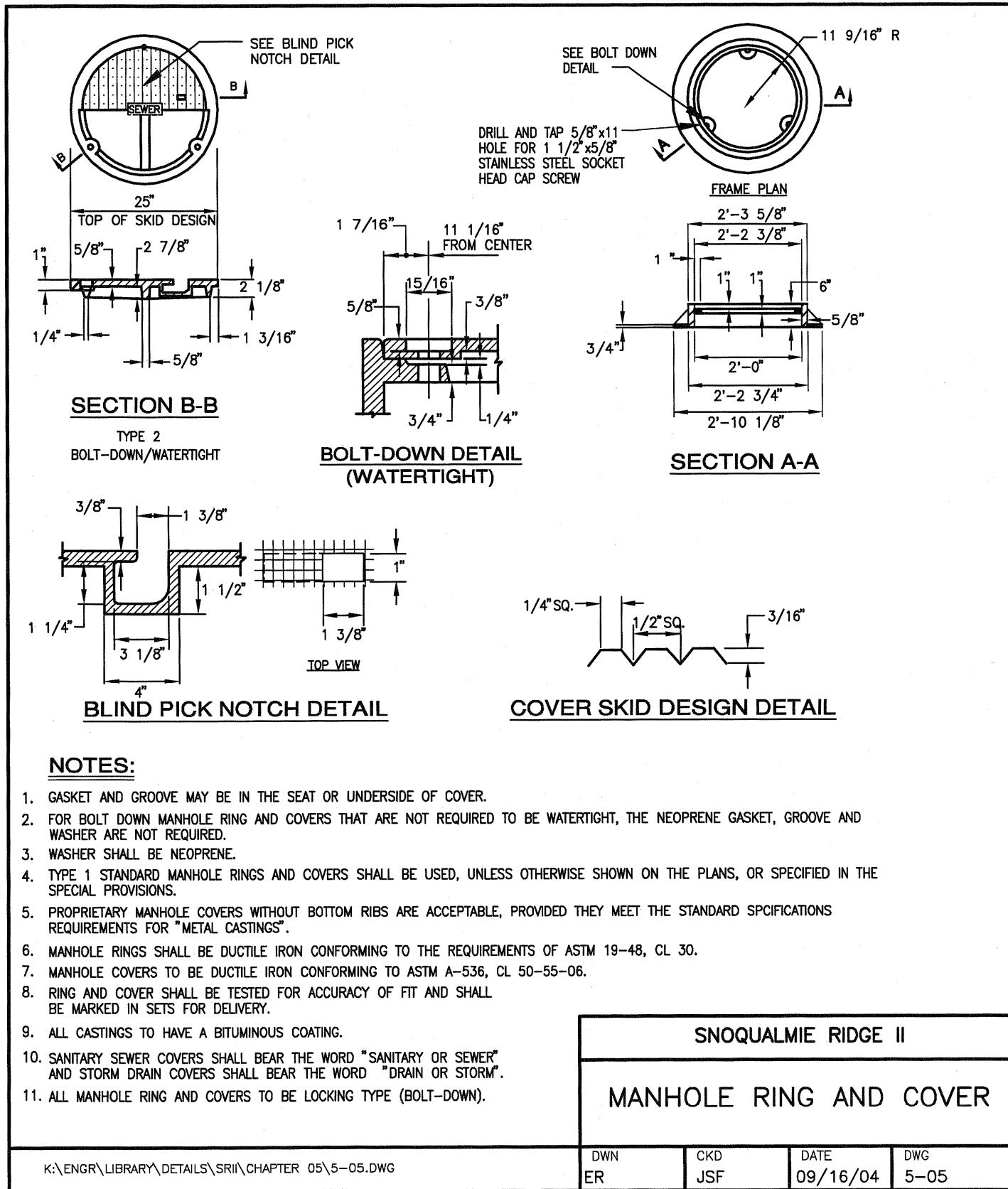
PIPE SIZE	PIPE AREA SQ. IN.	++	+	++	++
		22.5°	45°	60°	90°
4"	12.5	0.3	0.6	0.7	1.1
6"	28.3	0.5	1.1	1.4	2.1
8"	50.3	0.9	1.9	2.5	3.8
12"	113	2.1	4.2	5.6	8.4
16"	201	3.7	7.5	9.9	15
18"	254	3.7	10	13	20
20"	314	4.9	12	16	24
24"	432	6.0	16	21	32

TYPE OF  
FITTING

**SNOQUALMIE RIDGE II**  
**STANDARD VERTICAL  
BLOCKING DETAILS**

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**NOTES:**

1. GASKET AND GROOVE MAY BE IN THE SEAT OR UNDERSIDE OF COVER.
2. FOR BOLT DOWN MANHOLE RING AND COVERS THAT ARE NOT REQUIRED TO BE WATERTIGHT, THE NEOPRENE GASKET, GROOVE AND WASHER ARE NOT REQUIRED.
3. WASHER SHALL BE NEOPRENE.
4. TYPE 1 STANDARD MANHOLE RINGS AND COVERS SHALL BE USED, UNLESS OTHERWISE SHOWN ON THE PLANS, OR SPECIFIED IN THE SPECIAL PROVISIONS.
5. PROPRIETARY MANHOLE COVERS WITHOUT BOTTOM RIBS ARE ACCEPTABLE, PROVIDED THEY MEET THE STANDARD SPECIFICATIONS REQUIREMENTS FOR "METAL CASTINGS".
6. MANHOLE RINGS SHALL BE DUCTILE IRON CONFORMING TO THE REQUIREMENTS OF ASTM A-48, CL 30.
7. MANHOLE COVERS TO BE DUCTILE IRON CONFORMING TO ASTM A-536, CL 50-55-06.
8. RING AND COVER SHALL BE TESTED FOR ACCURACY OF FIT AND SHALL BE MARKED IN SETS FOR DELIVERY.
9. ALL CASTINGS TO HAVE A BITUMINOUS COATING.
10. SANITARY SEWER COVERS SHALL BEAR THE WORD "SANITARY OR SEWER" AND STORM DRAIN COVERS SHALL BEAR THE WORD "DRAIN OR STORM".
11. ALL MANHOLE RING AND COVERS TO BE LOCKING TYPE (BOLT-DOWN).

SNOQUALMIE RIDGE II

MANHOLE RING AND COVER

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**APPENDIX B**  
**ENGINEERING GEOLOGY REPORT**

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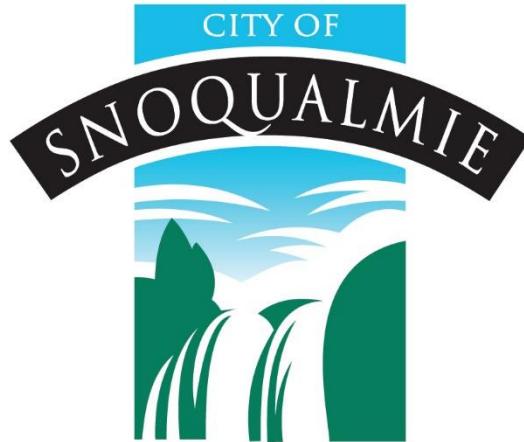
# ENGINEERING GEOLOGY REPORT

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## **WATER RECLAMATION AND WATER TREATMENT FACILITY IMPROVEMENTS**

### **PHASE 2, 4, AND 5**

*Prepared by RH2 Engineering, Inc.,  
for the City of Snoqualmie*



**July 2016**

*This report is based on site investigations completed in April and May 2016, and subsequent analysis, interpretation, and evaluation of site geology, geologic hazards, and geotechnical conditions of the site.*

*RH2 Project: SNQ 116.028.02.201*



22722 29<sup>th</sup> Drive SE  
Suite 210  
Bothell, WA 98021

***City of Snoqualmie***  
**Water Reclamation and Water Treatment Facility Improvements – Phase 2, 4, and 5**  
**REPORT ON SITE GEOLOGY, GEOLOGICAL HAZARDS, AND**  
**GEOTECHNICAL CONDITIONS**

July 2016

*Report based on a Site Investigation Completed in April and May 2016*

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RH2 Engineering, Inc., (RH2) has prepared this Engineering Geology Report (Report) for exclusive use by the City of Snoqualmie (City). RH2 conducted an engineering geology site assessment for the water reclamation facilities (the site). The assessment reviewed available soil, geologic, geotechnical, groundwater, and geohazard information, and conducted a limited geologic/geotechnical investigation that consisted of collection and field identification analysis of site soil.

In accordance with the Scope of Work, agreed to by the City, RH2 has completed a geologic exploration to gain information for characterizing the soil, geologic, groundwater, and geotechnical conditions of the site in anticipation of Phase 2, 4, and 5 Water Reclamation Facility site development that could require a general understanding of the site conditions that could affect design and construction of building foundations, roads, and underground utilities. The geologic services were conducted in accordance with the locally-accepted practices of a licensed engineering geologist, and per the elements of the Revised Code of Washington (RCW) Chapter 18.220, and the Washington Administrative Code (WAC) Chapter 308-15.

The City provided a backhoe and operator to assist with the site investigation to excavate test pits, and a licensed well driller was contracted by the City to provide drilling services. The excavation and sampling of five test pits and the drilling of two soil borings were completed under the direction of an RH2 Washington State licensed engineering geologist. The conclusions and recommendations contained in this Report are based upon surface and subsurface geologic exploration of the earth materials (granular fill, native soil, and sediment) and groundwater conditions at the site, and review of previous studies and maps of the project area. Use of this Report by others, or for another project, is at the user's sole risk.

Based on the explorations completed under the Scope of Work, RH2 predicts that the types of earth materials that may be encountered during excavation and construction of structure foundations, pavement, and underground utilities will consist primarily of layers of native dense gravelly sand and fine sand, and silty gravelly sand granular fill. Bedrock was not encountered during site exploration but likely underlies the site at depths greater than 50 feet. Groundwater was not encountered during site exploration.

The earth materials and groundwater conditions at the site do not present unusual risks requiring mitigation for design or construction, and should therefore accommodate design and construction of new buildings, pavement, and utilities that are similar to those currently on the site. This Report provides general recommendations for design and construction of buildings, pavement, and utilities.

RH2 looks forward to assisting and supporting the City with future site development plans.

Sincerely,

**RH2 Engineering, Inc.**



Steve Nelson, LG, LHG, LEG  
Licensed Geologist, Hydrogeologist, and Engineering Geologist

This engineering geology report is a final and complete response to elements in the Scope of Work and Contract agreement between the City of Snoqualmie and RH2 Engineering, Inc.

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# **ENGINEERING GEOLOGY REPORT**

## **INTRODUCTION**

### **Project Description**

The City of Snoqualmie (City) desires to construct improvements at the City's water reclamation facilities (the site). The proposed improvements will consist of a 70-diameter concrete clarifier tank constructed partially below grade at a depth of approximately 23 feet, and four buildings (solid handling facility, aerobic digesters, wastewater and stormwater decant stations) constructed with a continuous foundation and slab on grade. The information developed in this Engineering Geology Report (Report) would be used for design and construction that may require foundation design, shoring, groundwater control, and mitigation for geologic hazards, such as seismic-induced ground acceleration, liquefaction, erosion, and landslides.

### **Location and Existing Conditions**

The site is in the NW  $\frac{1}{4}$   $\frac{1}{4}$  of NE  $\frac{1}{4}$  Section 30 Township 24N, Range 08E, centered at latitude 47.54 N, longitude 121.83 W. The site is located on both sloping and flat terrain at approximately 430 feet in elevation above mean sea level. The general layout of the site is shown in **Figure 1**.

The areas of the proposed site improvements are undeveloped but disturbed. The clarifier will be constructed by cut and fill into the slope on the north perimeter of the site, and the buildings will be constructed on a flat, recently-filled area.

### **Purpose of the Engineering Geology Report**

This Report is a public document. It is specific to this project and has been prepared to support the planning, permitting, design, and bid documents for this project. This Report was prepared consistent with the Revised Code of Washington (RCW) Chapter 18.220, and the Washington Administrative Code (WAC) Chapter 308-15, which regulates the licensed practice of geology.

This Report, with the attached test pit logs and boring logs from the investigation, may be used to support the evaluation of potential design and construction of the proposed structures, and related pavement and utilities. This Report includes recommendations for enhancing the constructability of site development projects based on site-specific characterizations of the earth materials and preparation of the subgrade for site development. This Report does not dictate the means or methods for site development activities, but is intended to provide information that could be useful to plan site development activities and prepare planning-level costs for excavation, grading, geohazard mitigation, and water management that would arise from specific conditions of the project area.

### **Previous Work**

RH2 Engineering, Inc., (RH2) reviewed the following documents and websites.

- Associated Earth Sciences, Inc., (AESI). 1995. *Final Geotechnical Report, Snoqualmie WWTP, Proposed Waste Treatment Plant Expansion*. Report prepared for KCM, Inc.

- Dragovich, Joe D., et al. 2009. Geologic map of the Snoqualmie 7.5-Minute Quadrangle, Washington: Washington Division of Geology and Earth Resources Geologic Map GM-75, 2 plates.
- United States Department of Agriculture Natural Resource Conservation Service (NRCS) Web Soil Survey. Accessed November 18, 2015. <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>
- Washington State Department of Natural Resources (DNR) Washington Interactive Geologic Map. Accessed November 18, 2015. <http://wigm.dnr.wa.gov/>
- Washington State Department of Ecology (Ecology); Well Log Viewer. Assessed November 18, 2015. <https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx>

## ***REGIONAL GEOLOGY***

### **Geologic Units**

RH2 reviewed geologic maps and descriptions of regional geologic conditions by Dragovich et al. (2009). RH2 reviewed the driller's logs for borings and wells completed within 1 mile of the site and recorded at the Ecology well log website.

The surficial geologic units mapped at the site consist of glacial deltaic outwash, and lacustrine sediment and artificial fill. The glacial deposits consist of sandy gravel and pebbly sand underlain by lacustrine (lakebed) sand and silt. These deposits are likely underlain by glacial till (AESI, 1995). The artificial fill consists of variable amounts of sand, gravel, and silt, with some organic and woody debris.

### **Regional Seismic and Liquefaction Risk**

The DNR Interactive Geologic Map, based on the United States Geological Survey (USGS) National Earthquake Hazards Reduction Program (NEHRP), assigns a Seismic Site Class C, Very Dense Soil.

## ***SITE GEOLOGY***

### **Exploration Methods and Strategy**

Before site exploration, RH2 reviewed available geologic maps, soil maps, and exploration boring logs for the local area. On April 18, 2016, Holocene Drilling of Puyallup, Washington, used a hollow stem auger drilling rig to advance a soil boring (B-1) at the clarifier site to a depth of 31 feet and completed the boring as a monitoring well. On May 24, 2016, Holocene Drilling advanced a soil boring (B-2) located on the access road, 15 feet in elevation above the clarifier site to a depth of 46 feet and decommissioned the boring.

The City provided a Case 580 backhoe to excavate four test pits to depths of 6 to 11 feet below ground surface (bgs) on May 25, 2016. Upon completion of the geological investigation, the test pits were backfilled with excavated material that was compacted with the backhoe bucket.

Soil boring and test pit locations are shown on **Figure 1**.

RH2 inspected soil samples retrieved from the excavations and borings to identify stratigraphy, composition, texture, structure, and cohesion of native earth materials encountered in the excavations and borings. **Appendix A** contains copies of the soil test pit logs and **Appendix B** contains the soil boring logs.

Explorations at the site encountered granular fill at the building sites, and native sandy gravel, gravelly sand, and fine sand at the clarifier site.

Glacial till and bedrock were not encountered and likely underlie the site at a depth of more than 50 feet.

### **Hydrogeology**

A review of existing well logs obtained from Ecology for a 1-mile area surrounding the site indicates that groundwater may exist at a depth of more than 40 feet beneath the surface within deeper unconsolidated sediments. No groundwater was encountered at any exploration site; the lowest elevation boring, B-1, was 31 feet bgs at the clarifier site.

### **Geologic Laboratory Tests**

Representative soil samples were described using the Unified Soil Classification System. No laboratory analysis was conducted on site soil; information regarding geotechnical properties of the soil was obtained through field inspection.

## ***PROJECT SUMMARY***

### **Geologic and Groundwater Conditions**

The building sites are underlain by silty gravelly sand fill. The clarifier site is underlain by gravelly sand and fine sand. The local groundwater table is likely below a depth of 40 feet bgs.

### **Risks, Hazards, and Mitigation**

- Risks from landslides, mass wasting, and flooding are negligible.
- The risk of earthquakes of magnitude (M) 5 to 6 during the next 50 years is high (80 percent).
- Liquefaction risk is mapped as low; the soil is compact, well sorted, and well drained.
- The risk of persistent groundwater seepage from surrounding native soil into excavations during site development is negligible, unless construction would occur following a period of sustained rainfall creating saturated shallow soil.

### **Allowable Bearing Capacity and Earth Pressure**

Based on the observed soil composition and density, the compacted granular fill (gravelly sand) at the four building sites and the dense gravelly sand and fine sand at the clarifier site may support a structure with an appropriately designed foundation that spreads a load that does not exceed a net allowable bearing capacity of 3,000 pounds per square foot (psf).

The following earth pressures are estimated for the moderately dense fine sand, assuming a friction angle of 32 degrees and a unit weight of 110 pounds per cubic foot (pcf):

- At rest – 52 pcf

- Active – 34pcf
- Passive – 358pcf

## **CONCLUSIONS AND RECOMMENDATIONS**

### **Site Excavation for Foundations and Underground Utilities**

- Shallow, continuous foundations and underground utilities for the four buildings would be founded on dense, silty gravelly sand fill. The clarifier would be founded on moderately dense fine sand. Excavations to the subgrade at all sites should be reviewed by a Licensed Engineering Geologist (LEG) or Professional Engineer with a geotechnical background (PEG), at the lowest design subgrade elevation, prior to any subgrade improvements.

### **Subgrade Preparation**

- Areas of subgrade that consist of loose fill, or native soil that is loose or otherwise unsuitable, should be over excavated and backfilled with at least 2 feet of structural fill. Structural backfill should meet the requirements of gravel borrow (or equivalent) per the Washington State Department of Transportation (WSDOT) Standard Specifications 2014, 9-03.14(1), and should be placed at optimal moisture in 6-inch loose lifts and compacted with a heavy vibratory roller or equivalent. Each lift should be compacted to a firm and unyielding surface to achieve at least 95 percent of maximum dry density as determined by the modified proctor test (ASTM D 1557).
- The final subgrade should be flat and free of loose earth materials or boulders larger than 4 inches in diameter. The subgrade should be probed to confirm uniform soil density and approved by a LEG or PEG.

### **Use of Excavated Earth Materials**

- Excavated native fine gravelly sand and fine sand at the clarifier site and excavated granular fill at the building sites may be stockpiled for reuse as structural fill, or as common or select borrow if the material contains less than 5 percent fines, the moisture content of the excavated soil is within plus or minus 2 percent of optimum, contains no waste debris, organic soil or woody material, and all rock materials (cobbles, boulders, and rock fragments) larger than 4 inches in diameter are removed.
- Stockpiled earth materials should be protected from wetting or drying that would make it unsuitable as fill.
- Earth materials excavated for re-use as fill, as well as all imported fill material, should be tested for moisture content just prior to placement. Structural fill should be within plus or minus 2 percent of its optimum moisture content when placed.

### **Slopes and Shoring**

- The clarifier excavation will require temporary shoring to support the adjacent access road and underlying utilities. The clarifier will be constructed of cast-in-place concrete, which would become the permanent retaining wall for the cut slope. The retaining wall design will be completed by others.

- All temporary and permanent faces in native soil should be no steeper than 2H:1V.
- All temporary slopes should be reviewed for stability several times a day, or as often as necessary to ensure slope integrity. This shall include reviewing the top of the slope for tension cracks and settlement, as well as erosion.
- The native soil is moderately erodible. All temporary slopes should be protected from erosion. During precipitation events, the surface should be covered by plastic sheeting or other techniques that prevent rain splash erosion and rilling.
- All permanent slopes and swales should be protected from erosion by hydroseeding, planting with landscape fabric, coarse bark placement, quarry spalls, or other materials that prevent rain splash erosion and rilling.

### **Seismic Design Factors**

- There is a moderate probability that the site will experience a moderate (M 5) earthquake in the next 50 years.
- The native soil should be considered as a Site Class C, Very Dense Soil, per International Building Code (IBC) (2012) Site Class definitions.

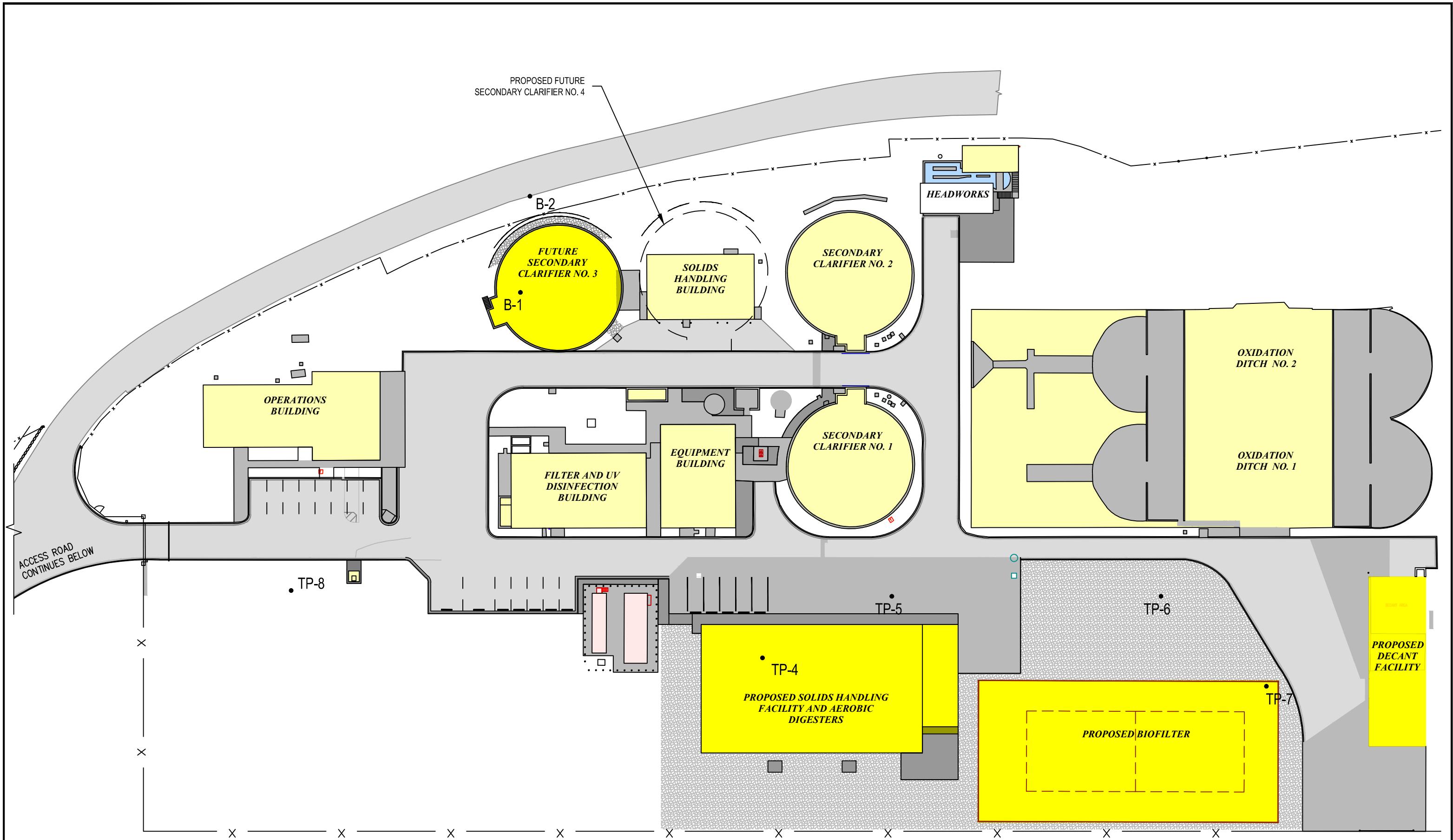
### **On-site Infiltration Capacity**

- No infiltration rate testing was conducted as part of this investigation. Layers of gravelly sand containing silt have sufficiently low permeability to cause infiltrated precipitation to perch within shallow and surficial soil at a depth of 2 to 3 feet. This perching condition suggests a low to moderate suitability for on-site infiltration. Infiltration rates should be tested at specific locations if on-site infiltration is used to manage stormwater.

# *FIGURE 1*

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## *SITE MAP AND TEST PIT LOCATIONS*



**FIGURE 1 - SITE MAP AND EXPLORATION LOCATIONS**

1" = 50'



8/21/2017

SNO\116-028\CAD\PHASE1\WRWTF-P-GEO

# APPENDIX A

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## *TEST PIT LOGS*

	<b>Test Pit/Exploration Log</b> <b>SNQ TP4</b> Exploration Name	<b>WRF Improvements</b> <b>Aerobic Digester – West Side</b> Project	<b>S of Secondary Clarifier 1</b> <b>Snoqualmie WRF, WA</b> Location	
Steve Nelson, L.E.G.	May 25, 2016	SNQ 115.041.03	<b>Case 580 backhoe, 2-foot bucket</b> <b>City of Snoqualmie</b> Backhoe and Operator	
Inspected By	Date	Project #		
Depth	<b>Description</b>		<b>Sketch/Photo</b>	
0 to 2.0 feet	Gravelly SAND (SW); brown; fine to coarse; fine to coarse subrounded gravel; few cobbles and boulders up to 18 inches; trace wood and metal debris; dense; moist. (FILL)			
2.0 to 6.0 feet	Gravelly SAND (SW); light brown; fine to coarse; fine to coarse subrounded gravel; few cobbles; some wood debris; very dense; moist. (FILL)			
6.0 to 11 feet	Gravelly Silty SAND (SM); dark brown; fine to coarse; fine to coarse subrounded gravel; few cobbles; very dense; moist. (FILL)  Sidewalls stable unless disturbed.			
Exploration backfilled with excavated material.				

	<b>Test Pit/Exploration Log</b> <b>SNQ TP5</b> <b>Exploration Name</b>	<b>WRF Improvements</b> <b>Aerobic Digester – East Side</b> <b>Project</b>	<b>S of Secondary Clarifier 1</b> <b>Snoqualmie WRF, WA</b> <b>Location</b>	
	<b>Steve Nelson, L.E.G.</b>  <b>Inspected By</b>	<b>May 25, 2016</b>  <b>Date</b>	<b>SNQ 115.041.03</b>  <b>Project #</b>	
<b>Depth</b>	<b>Description</b>		<b>Sketch/Photo</b>	
0 to 2.0 feet	Gravelly SAND (SW); brown; fine to coarse; fine to coarse subrounded gravel; few cobbles and boulders up to 18 inches; trace wood and metal debris; dense; moist. (FILL)			
2.0 to 5.0 feet	Gravelly SAND (SW); light brown; fine to coarse; fine to coarse subrounded gravel; few cobbles; some wood debris; very dense; moist. (FILL)			
5.0 to 11 feet	Gravelly Silty SAND (SM); light brown to brown; fine to coarse sand; few fine to medium subrounded gravel; stratified; very dense; moist. (alluvium)  Sidewalls stable unless disturbed.			
Exploration backfilled with excavated material.				

<b>RH2</b> ENGINEERS PLANNERS SCIENTISTS	<b>Test Pit/Exploration Log</b> <b>SNQ TP6</b> Exploration Name	<b>WRF Improvements</b> <b>Wastewater Decant Station</b> Project	<b>S of Oxidation Ditch 1</b> <b>Snoqualmie WRF, WA</b> Location
<b>Steve Nelson, L.E.G.</b>	<b>May 25, 2016</b>	<b>SNQ 115.041.03</b>	<b>Case 580 backhoe, 2-foot bucket</b> <b>City of Snoqualmie</b>
Inspected By	Date	Project #	Backhoe and Operator
Depth	<b>Description</b>		
0 to 3.0 feet	Gravelly SAND (SW); light brown; fine to coarse; fine to coarse subrounded gravel; cobbles and few boulders up to 18 inches; some wood debris; dense; moist. (FILL)		
3.0 to 6.0 feet	Gravelly Silty SAND (SM); brown; fine to medium, some coarse; non-plastic fines; fine to coarse subrounded gravel; few cobbles; some wood debris; very dense; moist. (FILL)		
6.0 to 8.0 feet	Gravelly Silty SAND (SM); brownish gray; fine to medium, some coarse; non-plastic fines; fine to coarse subrounded gravel; some wood debris; very dense; moist. (FILL)  Sidewalls stable unless disturbed.		
Exploration backfilled with excavated material.			

<b>RH2</b> ENGINEERS PLANNERS SCIENTISTS	<b>Test Pit/Exploration Log</b> <b>SNQ TP7</b> Exploration Name	<b>WRF Improvements</b> <b>Stormwater Decant Station</b> Project	<b>SW of Vactor Decant Station</b> <b>Snoqualmie WRF, WA</b> Location
<b>Steve Nelson, L.E.G.</b>	<b>May 25, 2016</b>	<b>SNQ 115.041.03</b>	<b>Case 580 backhoe, 2-foot bucket</b> <b>City of Snoqualmie</b>
Inspected By	Date	Project #	Backhoe and Operator
Depth	<b>Description</b>		
0 to 3.0 feet	Gravelly SAND with Silt (SW-SM); light brown; fine to coarse; fine to coarse subrounded gravel; few boulders up to 18 inches; some organic debris and roots; very dense; moist (FILL)		
3.0 to 8.0 feet	Gravelly Silty SAND (SM); dark brown; fine to medium; fine to medium subrounded gravel; very dense; moist. (FILL)  Sidewalls stable unless disturbed.		
Exploration backfilled with excavated material.			

<b>RH2</b> ENGINEERS PLANNERS SCIENTISTS	<b>Test Pit/Exploration Log</b> <b>SNQ TP8</b> Exploration Name	<b>WRF Improvements</b> <b>Garage Shop Facility</b> Project	<b>S of Operations Building</b> <b>Snoqualmie WRF, WA</b> Location
<b>Steve Nelson, L.E.G.</b>	<b>May 25, 2016</b>	<b>SNQ 115.041.03</b>	<b>Case 580 backhoe, 2-foot bucket</b> <b>City of Snoqualmie</b>
Inspected By	Date	Project #	Backhoe and Operator
Depth	<b>Description</b>		
0 to 2.0 feet	Gravelly SAND (SW); brown; fine to coarse; fine to coarse subrounded gravel; few cobbles and boulders up to 18 inches; trace wood and metal debris; dense; moist. (FILL)		
2.0 to 6 feet	Gravelly Silty SAND (SM); brownish gray; fine to coarse; fine to coarse subrounded to subangular gravel; few cobbles; very dense; moist. (FILL)  Sidewalls stable unless disturbed.		
Exploration backfilled with excavated material.			

# *APPENDIX B*

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## *SOIL BORING LOGS*



### Boring Exploration Log

#### B-1/MW-1

Exploration Name

**WRF Improvements**  
**City of Snoqualmie**  
**Project**

**N of Sludge Tank**  
**Snoqualmie WRF, WA**

Location

Steve Nelson, LHG

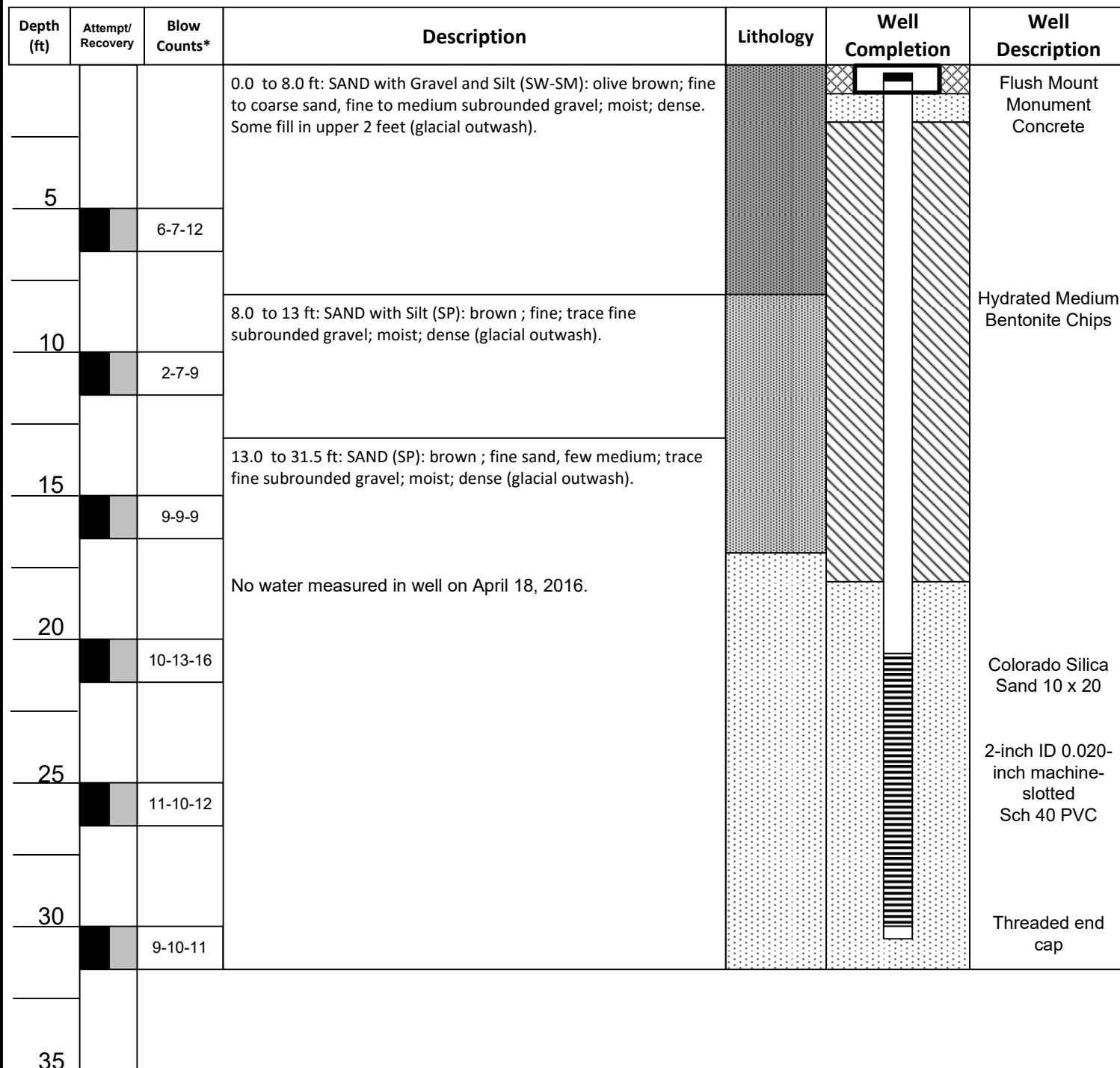
Inspected by

April 18, 2016

Date

**B-59 truck-mounted hollow stem auger - 4-in. ID**  
**Holocene Drilling**

Drilling Equipment and Contractor



\* Standard Penetration Test 150# auto hammer

Surface Elevation = 435 feet amsl

**Boring Exploration Log****B-2**

Exploration Name

**WRF Improvements  
City of Snoqualmie  
Project****N of Sludge Tank  
Snoqualmie WRF, WA  
Location****Steve Nelson, LHG**

Inspected by

**May 24, 2016**

Date

**Dietrich D-150 track-mounted hollow stem auger - 3-in. ID  
Holocene Drilling**

Drilling Equipment and Contractor

Depth (ft)	Attempt/ Recovery	Blow Counts*	Description	Lithology
			0.0 to 9.0 Gravelly SAND with Silt (SW); light brown; fine to coarse sand, fine to coarse gravel with some cobbles; moist; dense (Fill)	
5	grab			
	grab			
10	3-7-23		9.0 to 17.0 ft: SAND with Gravel (SW): brown; fine to coarse sand, fine to medium subrounded gravel; moist; dense (glacial outwash).	
15	9-15-12			
20	11-9-9		17.0 to 22 ft: SAND with Gravel (SP): brown ; fine to medium sand; few subrounded gravel; moist; dense (glacial outwash).	
25	5-8-9		22.0 to 46.5 ft: SAND (SP): brown ; fine sand, few medium; trace fine subrounded gravel; moist; dense (glacial outwash).	
30	7-8-10		Boring backfilled with bentonite chips to 6 feet and crushed gravel to surface.	
35	7-9-10			
* Standard Penetration Test 150# auto hammer		Surface Elevation = 450 feet amsl		
Page 1 of 2				

**Boring Exploration Log****B-2**

Exploration Name

**WRF Improvements  
City of Snoqualmie  
Project****N of Sludge Tank  
Snoqualmie WRF, WA  
Location****Steve Nelson, LHG**

Inspected by

**May 24, 2016**

Date

**Dietrich D-150 track-mounted hollow stem auger - 3-in. ID  
Holocene Drilling  
Drilling Equipment and Contractor**

Depth (ft)	Attempt/ Recovery	Blow Counts*	Description	Lithology
40			22.0 to 46.5 ft: SAND (SP): brown ; fine sand, few medium; trace fine subrounded gravel; moist; dense (glacial outwash).	
45		7-9-10	Boring backfilled with bentonite chips to 6 feet and crushed gravel to surface.	
50		10-14-14		
55				
60				