

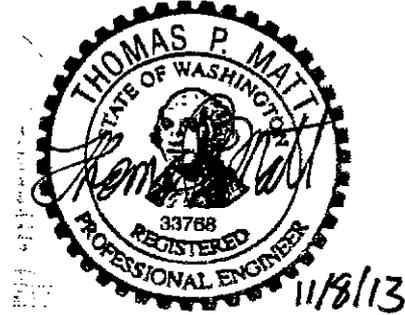
3g.

Preliminary Plat Phase 2 – Plat C, Preliminary Drainage  
Analysis, Triad Associates  
November 8, 2013



## MEMO

Date: November 8, 2013  
To: Colin Lund, Project Manager  
From: Thomas P. Matt, P.E.  
RE: The Villages MPD Preliminary Plat Phase 2 Plat C  
Preliminary Drainage Analysis  
Triad Job No.: 05-336  
Copies To: File



### The Villages MPD Preliminary Plat Phase 2 Plat C

The purpose of this memo is to provide an overview and background information related to the proposed stormwater mitigation measures for The Villages MPD Preliminary Plat Phase 2 Plat C. This preliminary plat is a portion of The Villages Master Planned Development (The Villages MPD) which proposes to develop a mix of uses including residential, commercial, office, retail, educational, civic, recreational uses, trails and open spaces on 1196 acres (assembled parcels).

The Villages is comprised of two primary development areas; Parcel B and the Main Property (consisting of Parcels C, D, E, F, the Guidetti Parcel and the BDA Parcel). Parcel B is approximately 82 acres in size and lies approximately 2 miles north of the Main Property, to the west of State Route 169 (SR 169) and north of SE 312<sup>th</sup> Street (if it were extended) in Section 11, Township 21 North, Range 6 East, W.M., King County, Washington. The Main Property is approximately 1,114 acres in size and lies west of SR 169 and south of Roberts Drive (approximately 55 acres lies to the north of this road) in Sections 15, 22, 23, and 27, Township 21 North, Range 6 East, W.M., King County, Washington. See The Villages Parcel Map attached for reference.



The Villages MPD Phase 2 Plat C Preliminary Plat consists of approximately 136.4 acres of The Villages MPD to the south of Roberts Drive, primarily within Parcel E, along with portions of Parcel D and BDA Parcel of the Main Property, in Sections 15 and 22, Township 21 North, Range 6 East, W.M., King County, Washington. The Villages MPD Phase 2 Plat C Preliminary Plat proposes a mix of uses including: residential, recreational uses, trails, open space and stormwater facilities to provide wetland recharge. The Villages MPD Phase 2 Plat C Preliminary Plat is located to the southeast of the preliminary plat of The Villages Phase 1A. See the vicinity map (attached) which shows the general location of The Villages MPD as well as the boundary for the Phase 2 Plat C Preliminary Plat. This figure also has a key map of The Villages MPD showing the location of the Phase 2 Plat C Preliminary Plat within The Villages MPD site.

In its existing condition the preliminary plat site is undeveloped and forested. There are some existing logging roads on the site from past timber harvest operations. The majority of the Phase 2 Plat C Preliminary Plat site is underlain by till soils as shown on the attached “*Geology Map*” of The Villages MPD site prepared by Associated Earth Sciences, Inc. A topographical ridge runs southeast to northwest, roughly along the border between The Villages MPD Development Parcels V28 and V29 as identified in Exhibit U to The Villages MPD Development Agreement dated December 12, 2011 (The Villages DA). This ridge corresponds to the boundary between Stormwater Management Zones 1 and 2 discussed below. Runoff generated south of the ridge currently flows south to a delineated wetland (Wetland E1). Runoff from Wetland E1 flows to the northwest and infiltrates into existing outwash soils. Runoff generated north of the ridge flows north towards Wetland TOS, which is tributary to Rock Creek and eventually to Lake Sawyer, a phosphorus sensitive lake. There are approximately 5.2 acres at the northwest end of this preliminary plat site that contain highly infiltrative outwash soils and an additional 1.1 acres of land over till soils in Stormwater Management Zone 1 that are not tributary to any wetlands.

The Villages Final Environmental Impact Statement dated December 2009 (FEIS) as well as The Villages MPD Permit Approval set forth in Black Diamond Ordinance No. 10-946 contain

stormwater management requirements for The Villages MPD. These documents require The Villages MPD to comply with the 2005 Stormwater Management Manual for Western Washington (2005 DOE Manual) as adopted by the City of Black Diamond and discuss various options for such compliance.

The Villages MPD site is split into five Stormwater Management Zones (some of which have been further divided into sub-basins) based on similar proposed stormwater management techniques. These Stormwater Management Zones are described in *The Villages MPD Development Agreement* dated December 12, 2011 at pages 59 -71 including Figure 7.4 entitled "*Conceptual Stormwater Plan*" showing the Stormwater Management Zones for The Villages MPD. A copy of this Figure 7.4 is attached at the end of this memo. The Villages MPD Phase 2 Plat C Preliminary Plat falls within Stormwater Management Zones 1 and 2. Please refer to Chapter 6 of *The Villages Master Planned Development* application revised December 31, 2009 for additional discussion of Stormwater Management Zones in The Villages MPD.

The Villages MPD's Stormwater Management Zone 1 is divided into three subzones. Zone 1A is all the area within one-quarter mile of Horseshoe Lake. The break line between Zones 1B and 1C, on the other hand, is along a subsurface till ridge that is discussed in the *Results of Subsurface Exploration and Laboratory Testing, Stormwater Infiltration Evaluation, Villages Phase I, Black Diamond, Washington* dated April 21, 2010, prepared by Golder Associates Inc., a copy of which is attached hereto. A figure from the Golder Associates report entitled "*Surface of Till*" showing the location of said till ridge is attached to the back of this memo. This break line has been refined since the publication of Figure 7.4 based on the results of the aforementioned more indepth geotechnical exploration. Zones 1A and 1B are both tributary to Horseshoe Lake while Zone 1C is cross-gradient to Horseshoe Lake based on geotechnical findings.

Based on the aforementioned Golder Associates report *Results of Subsurface Exploration and Laboratory Testing, Stormwater Infiltration Evaluation, Villages Phase I, Black Diamond,*

Washington dated April 21, 2010, the portion of this preliminary plat site within Stormwater Management Zone 1 lies within Zone 1C. Groundwater from Zone 1C flows to the southwest and eventually ends up in the Green River. Geotechnical investigations summarized in the attached Golder Associates report show that stormwater infiltrated within Stormwater Management Zone 1C is not tributary to Horseshoe Lake or Lake Sawyer.

The stormwater management requirements for Zone 1C provide that “Stormwater from rooftops and pervious surfaces shall be used to recharge wetlands where required. All other runoff will be conveyed to the regional stormwater facility within this drainage zone (Stormwater Management 1C, see Figure 7.4) unless the runoff is needed to meet the water balance needs to Horseshoe Lake.” The stormwater runoff from the portion of the preliminary plat site within Stormwater Management Zone 1C that is not required to provide wetland recharge or is not infiltrated through LID techniques within the outwash soils portion of the site will be routed to the water quality treatment and infiltration facility located in Stormwater Management Zone 1C to the southwest of the Phase 2 Plat C Preliminary Plat site that was permitted as part of The Villages Phase 1A Preliminary Plat.

The other portion of the Phase 2 Plat C Preliminary Plat site is located in Stormwater Management Zone 2, which drains directly to Rock Creek and then flows into Lake Sawyer. Lake Sawyer is a phosphorous sensitive lake located approximately three quarters of a mile north of The Villages MPD Site. In addition to basic water quality treatment requirements per the 2005 DOE Manual, phosphorous treatment is required to be provided for all basins, including Stormwater Management Zone 2, that drain towards Lake Sawyer. As such, Triad proposed that runoff from rooftops in the Stormwater Management Zone 2 portion of the preliminary plat be used to maintain wetland hydrology to Wetland TOS and that any remaining stormwater that is not required for wetland recharge be routed to the previously discussed stormwater facility located in Stormwater Management Zone 1C, which is not tributary to Lake Sawyer, for flow control (infiltration) and water quality treatment. This proposal is an alternate means of achieving stormwater service within The Villages MPD as contemplated by MPD

Condition of Approval No. 77 and Section 7.4.2 of The Villages DA. Instead of routing such stormwater to a pond in Stormwater Management Zone 2 as provided in The Villages DA at Section 7.4.4C, Triad proposes eliminating the pond in Stormwater Management Zone 2 to further reduce phosphorus impacts to Lake Sawyer. Because this proposal includes routing water from Stormwater Management Zone 2 to Stormwater Management Zone 1C, a stormwater deviation approval will be required.

Based on the above proposal, the majority of the developed preliminary plat site will utilize the off-site infiltration facility permitted as part of The Villages Preliminary Plat 1A and located approximately 2,500 feet to the west of the site for stormwater quality treatment and flow control. Runoff will be collected within the preliminary plat project area and will be conveyed to such off site pond, which is located in Stormwater Management Zone 1C. The infiltration facility will infiltrate water from the portions of the preliminary site that are tributary to phosphorus sensitive Lake Sawyer, however, because the infiltration facility is not within a watershed tributary to Lake Sawyer, no phosphorus treatment is required. As permitted, the Stormwater Management Zone 1C infiltration facility consists of a wet pond connected to an infiltration pond that is designed to infiltrate all of the runoff from Phase 2 Plat C Preliminary Plat as well as from several other portions of The Villages MPD. The Stormwater Management Zone 1C infiltration facility will be constructed along with construction of The Villages Phase 1A Preliminary Plat. See The Villages MPD Phase 1A Preliminary Plat Drainage Report dated January 26, 2011 and Addendum 1 to the Phase 1A Preliminary Plat Drainage Report dated June 28, 2012 prepared by Triad Associates for further discussion on the stormwater facility in Stormwater Management 1C. In total the Stormwater Management 1C infiltration facility will serve a tributary area of approximately 162 acres. Approximately 27.7 acres of the Phase 2 Plat C Preliminary Plat site is tributary to the infiltration facility; however, when the 10.6 acres of impervious area required for wetland recharge (discussed below) is removed, only an approximate 17.1 acres of the developed preliminary plat site will be routed to the infiltration facility. The infiltration facility has been designed to accommodate this area. A conveyance pipe will route runoff collected within the Phase 2 Plat C Preliminary Plat to the

off-site Stormwater Management Zone 1C infiltration facility. The conveyance pipe system connecting this preliminary plat to the Stormwater Management Zone 1C infiltration facility was sized during the design of SE Dogwood Street and Willow Ave SE Road Construction plans. Please refer to the associated drainage report for SE Dogwood Street and Willow Ave SE Road (submitted separately) for a description of the conveyance pipe and its sizing methodology.

Per the requirements of The Villages DA at Section 7.4.3, the hydrology of the wetlands within and bordering the preliminary plat site will be maintained. Runoff from roof tops will be routed to the Wetland TOS and Wetland E1 to approximately match the annual average volume of runoff that is generated by the existing forested site condition. For the portion of the preliminary plat site draining to Wetland TOS, in Stormwater Management Zone 2, only runoff from roofs will be used for wetland recharge to maintain hydrology. In Stormwater Management Zone 1C runoff from pervious areas can be used along with roof top runoff as required to maintain the wetland hydrology of Wetland E1 since Wetland E1 is not tributary to Lake Sawyer. Stormwater will be discharged into the wetland buffers via a flow dispersal trench per City of Black Diamond standard drawing SD-15 in City of Black Diamond Engineering Design and Construction Standards dated 2009.

For the purposes of wetland hydrology calculations, average annual rainfall along with runoff, evapotranspiration and recharge volumes from various land coverage types were taken from Appendix D of the FEIS the *Environmental Impact Statement Technical Report on Geology, Soils, and Ground Water for The Villages* dated September 26, 2008, prepared by Associated Earth Sciences, Inc. (See the Table 1 below).

TABLE 1: AVERAGE ANNUAL VOLUMES BY LAND COVER

	Precipitation (FT)	Evapotranspiration (ACFT/AC)	Recharge (ACFT/AC)	Runoff (ACFT/AC)
Outwash Forest	4.50	1.59	2.92	0.00
Till Forest	4.50	1.59	1.39	1.52
Outwash Grass	4.50	1.41	2.91	0.18
Till Grass	4.50	1.41	1.39	1.70
Impervious	4.50	0.69	0.00	3.81

Wetland recharge calculations seek to match the annual average runoff volume for developed areas tributary to wetlands between the existing forested condition and the developed condition. The average annual volume to the wetlands is assumed to consist of runoff from the existing till forest area to be developed. Recharge from the till forest areas are assumed to reach the lower aquifer and not the wetland and are therefore not included in the wetland recharge calculation. Using AESI's table, the volume of runoff that these areas would produce in the forested condition were calculated for the area to be developed. The developed areas tributary to the wetlands were delineated, and are shown in the Wetland Tributary Basins Exhibit attached hereto.

The Phase 2 Plat C Preliminary Plat site was divided into three watersheds: (1) the portion of the site located in Stormwater Management Zone 2, draining to a wetland called 'Wetland TOS'; (2) a watershed located in Stormwater Management Zone 1C that drains towards 'Wetland E1'; and (3) a watershed that is not tributary to a wetland and also infiltrates into outwash soils, and does not contribute to the existing wetland hydrology. The wetland recharge calculations showing the average annual runoff volume for areas tributary to Wetland 'TOS' are presented in Table 2 below. The wetland recharge calculations showing the average annual runoff volume for areas tributary to Wetland 'E1' are presented in Table 3 below. An



equivalent impervious area that would create the same average annual volume of runoff as the existing forested condition, based on the AESI table, was calculated and is presented in Table 4 below.

TABLE 2: EXISTING CONDITIONS TRIBUTARY TO WETLAND TOS

	Area To be Developed (AC)	Recharge (ACFT)	Runoff (ACFT)	Total Volume (ACFT)
Outwash Forest	0	0	0.00	0
Till Forest	14.9	0	22.65	22.65
<b>Total</b>	<b>14.9</b>	<b>0</b>	<b>22.65</b>	<b>22.65</b>

TABLE 3: EXISTING CONDITIONS TRIBUTARY TO WETLAND E1

	Area To be Developed (AC)	Recharge (ACFT)	Runoff (ACFT)	Total Volume (ACFT)
Outwash Forest	0	0	0.00	0
Till Forest	11.7	0	17.78	17.78
<b>Total</b>	<b>11.7</b>	<b>0</b>	<b>17.78</b>	<b>17.78</b>

Table 4: Equivalent Impervious Area

Basin	Basin Area acres	Forested Runoff Volume ac-ft	Equivalent Impervious Area ac	Stormwater Management Zone
Wetland TOS	14.9	22.65	5.95	2
Wetland E1	11.7	17.78	4.67	1C

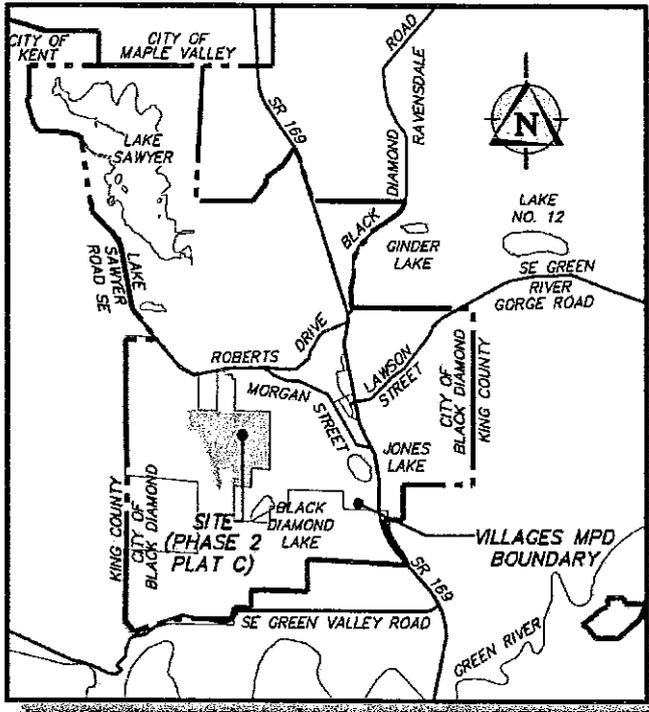
Runoff will be routed to the wetlands via flow dispersal trenches connected to roof tops. The wetland recharge calculations determined an equivalent area of impervious surfaces that would be required to match the annual average runoff volume entering tributary wetlands. Per the City of Black Diamond Engineering Design and Construction Standards, detail SD-15 for flow dispersal trenches, a single trench can disperse a maximum of 0.5 cfs. The number of trenches required was determined based on the peak flow of the areas routed to each wetland.

According to StormSHED, an SBUH hydrologic modeling program, 1 acre of impervious surfaces produces 1.0 cfs of flow during a 100-year rainfall event, the output from this model is attached to the end of this memo. Therefore 2 trenches will be required for every equivalent acre of impervious area being routed to the wetlands. At least 12 trenches will be provided for the basin draining to Wetland TOS and at least 10 trenches will be provided for the basin draining to wetland E1.

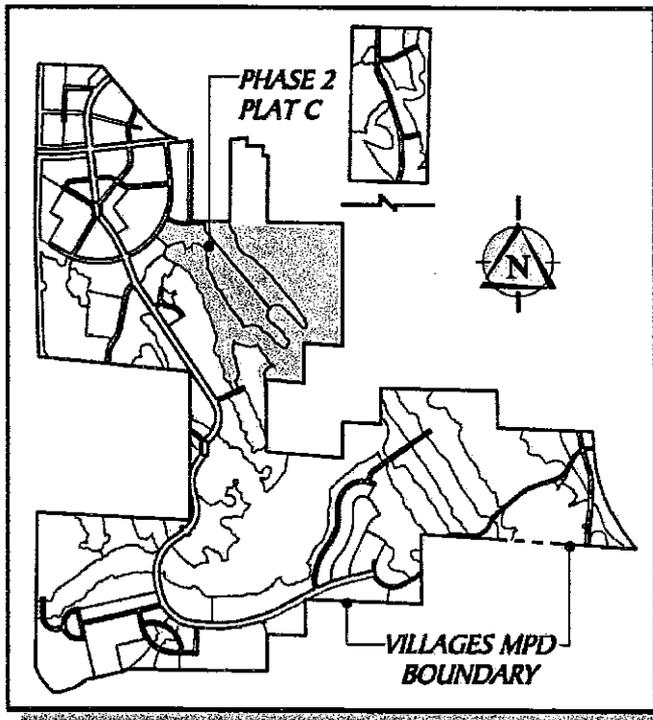
Approximately 5.2 acres at the northwest end of the preliminary plat site contains highly infiltrative outwash soils. In this area, a majority of stormwater will be infiltrated on-site rather than being conveyed off-site to the Stormwater Management Zone 1C stormwater facility. Runoff generated from roof tops and pervious areas are proposed to be infiltrated in this portion of the preliminary plat site. Runoff from roadways in this area will be routed to the bioretention cells for treatment and infiltration or routed to the offsite stormwater facility. Bioretention cells will provide basic and enhanced water quality treatment and will treat and infiltrate 91% of the total runoff volume as required by the Department of Ecology 2005 Stormwater Manual. The remaining 9% of the total runoff volume will be routed to an underground gravel infiltration gallery via an overflow riser. The gravel infiltration trenches will be sized to infiltrate 100% of the runoff from the areas tributary to it, thereby acting as an emergency measure should the bioretention cell fail to infiltrate any runoff. Per the 2005 Department of Ecology Stormwater Manual, bioretention facilities provide basic and enhanced water quality treatment.



THE VILLAGES  
REVISED 12-31-09



**VICINTY MAP**



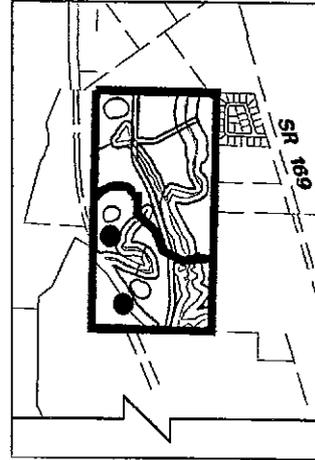
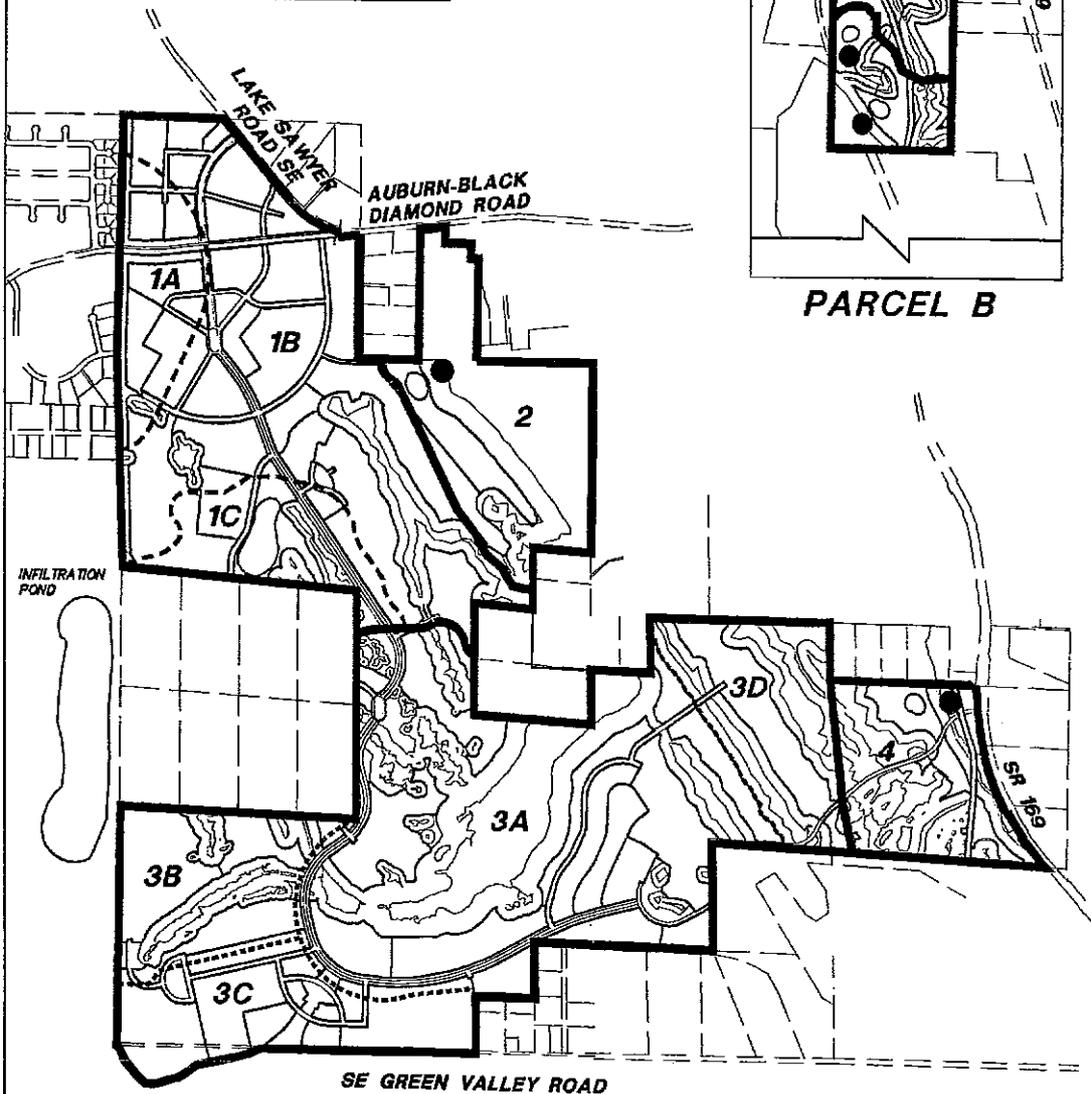
**KEY MAP-VILLAGES MPD**

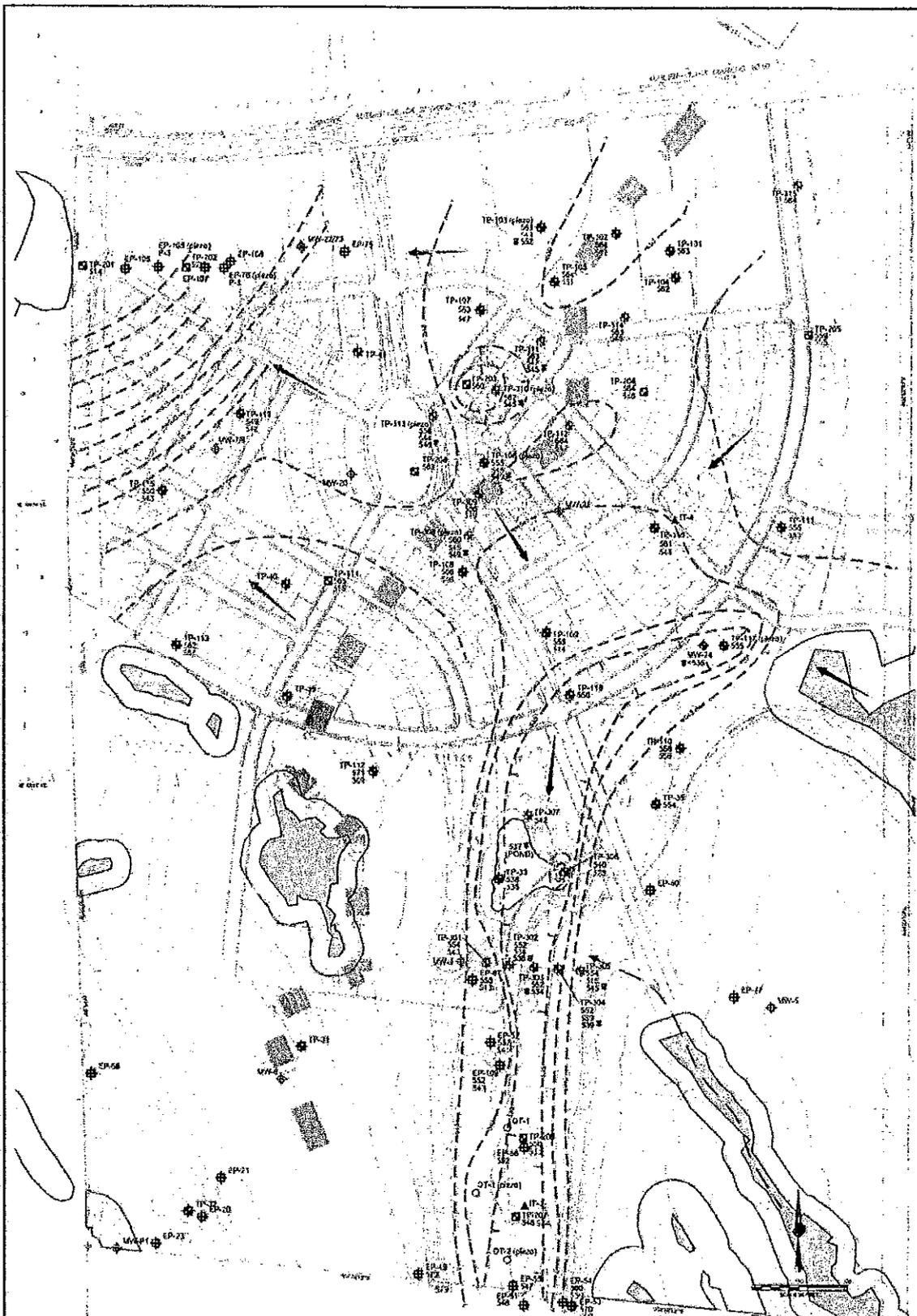


**The Villages  
Development Agreement**

**FIGURE 7.4:  
CONCEPTUAL STORMWATER PLAN**

LEGEND	
	STORMWATER MANAGEMENT ZONE
	SUB-ZONE LINES
	SUB-ZONE LINES (DEPENDANT ON FINAL LAND COVERAGES)
	PROPOSED POND
	DISCHARGE POINT



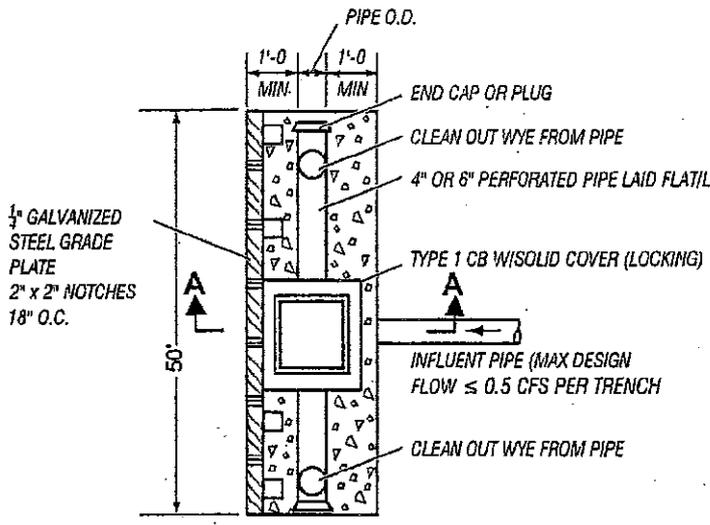


LEGEND					
	APPROXIMATE LOCATION OF TEST PIT #1 BY GOLDNER, MARCH 2006		INDICATES PIEZOMETER INSTALLED		APPROXIMATE TILL SURFACE CONTOURS BY GOLDER, RECORDED AND OBTAINED BY GOLDER, APPROXIMATE, QUOTED WHEN INTERFERED.
	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT #2 BY GOLDNER, DECEMBER 2006		APPROXIMATE LOCATION OF INFILTRATION TEST BY GOLDNER/ENR, 2007		ELEVATION OF TILL SURFACE AT TEST PIT FOR ASSESS, WHERE INDICATED/TESTS.
	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT #1 BY AUSA, 2008		APPROXIMATE LOCATION OF SOBRENDACTING WELL, 17' DIA., 2006		APPROXIMATE GROUNDWATER ELEVATION (APRIL, 2009)
	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT #1 BY GOLDNER, JANUARY 2010		APPROXIMATE LOCATION OF DRAIN TEST BY J&M, INC., 2006		GENERAL DIRECTION OF GROUNDWATER FLOW IN RECREATIONAL OUTFALL
	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT #1 BY GOLDNER, FEBRUARY 2010		APPROXIMATE LOCATION OF TELL HOUSE		OBSERVED SURFACE RUN OFF (APRIL, 2009)
	APPROXIMATE LOCATION OF (20' DIA.) SOBRENDACTING WELL, BY GOLDER (MARCH 2010)				METERS

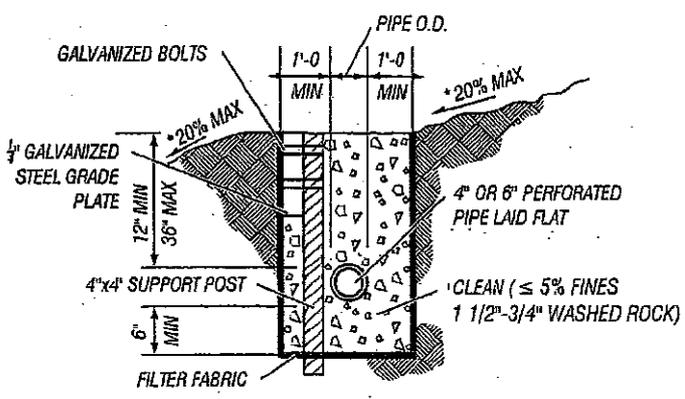
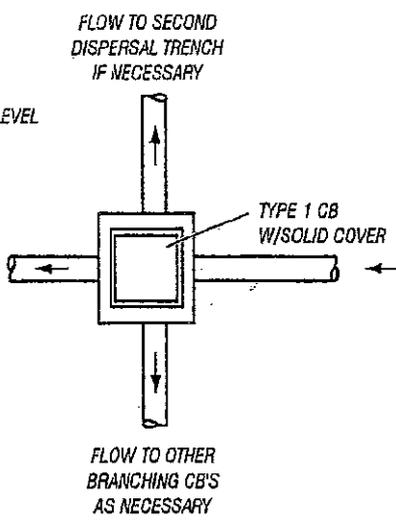
DATE: 04/20/10 AND YEAR: 2010. PREPARED BY: GOLDER ASSOCIATES, DECEMBER 2006

**FIGURE 2**  
**SURFACE OF TILL**  
 307 THE VILLAGES PS & CONSULTING SA  
 Golder Associates

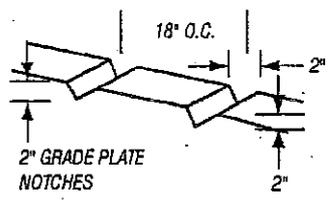




**PLAN  
NTS**

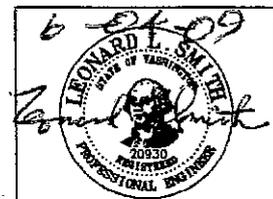


**SECTION A-A  
NTS**



- NOTES:**
1. THIS TRENCH SHALL BE CONSTRUCTED SO AS TO PREVENT POINT DISCHARGE AND/OR EROSION.
  2. TRENCHES MAY BE PLACED NO CLOSER THAN 50 FEET TO ONE ANOTHER. (100 FEET ALONG FLOWLINE)
  3. TRENCH AND GRADE PLATE MUST BE LEVEL. ALIGN TO FOLLOW CONTOURS OF SITE.
  4. SUPPORT POST SPACING AS REQUIRED BY SOIL CONDITIONS TO ENSURE GRADE BOARD REMAINS LEVEL.

15% MAX FOR FLOW CONTROL/WATER QUALITY TREATMENT IN RURAL AREAS.



**CITY OF  
BLACK DIAMOND**

**FLOW DISPERSAL TRENCH**

STANDARD DWG SD-15 NOT TO SCALE 01/01/08



Appended on: 09:37:11 Friday, November 01, 2013

Warning, History file is now 0.54 MB in size

### 1 Acre Impervious Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
100 year	1.0315	8.00	0.3553	1.0000	SBUH	TYPE1A

### Record Id: 1 Acre Impervious

<b>Design Method</b>	SBUH	<b>Rainfall type</b>	TYPE1A			
<b>Hyd Intv</b>	10.00 min	<b>Peaking Factor</b>	484.00			
		<b>Abstraction Coeff</b>	0.20			
<b>Pervious Area (AMC 2)</b>	0.00 ac	<b>DCIA</b>	1.00 ac			
<b>Pervious CN</b>	0.00	<b>DC CN</b>	98.00			
<b>Pervious TC</b>	5.00 min	<b>DC TC</b>	5.00 min			
<b>Pervious TC Calc</b>						
<b>Type</b>	<b>Description</b>	<b>Length</b>	<b>Slope</b>	<b>Coeff</b>	<b>Misc</b>	<b>TT</b>
Fixed	Min Tc of 5 min					5.00 min
Pervious TC						5.00 min
<b>Directly Connected CN Calc</b>						
<b>Description</b>					<b>SubArea</b>	<b>Sub cn</b>
Impervious surfaces (pavements, roofs, etc)					1.00 ac	98.00
DC Compositied CN (AMC 2)					98.00	
<b>Directly Connected TC Calc</b>						
<b>Type</b>	<b>Description</b>	<b>Length</b>	<b>Slope</b>	<b>Coeff</b>	<b>Misc</b>	<b>TT</b>
Fixed	Min Tc of 5 min					5.00 min
Directly Connected TC						5.00min

Licensed to: TRIAD Associates



**RESULTS OF SUBSURFACE EXPLORATION AND  
LABORATORY TESTING  
STORMWATER INFILTRATION EVALUATION  
VILLAGES PHASE I  
BLACK DIAMOND, WASHINGTON**

**REPORT**

**Submitted To:** Mr. Ryan Kemp  
BD Villages Partners L.P.  
10220 NE Points Drive Suite 120  
Kirkland, Washington 98033

**Submitted By:** Golder Associates Inc.  
18300 NE Union Hill Road, Suite 200  
Redmond, WA 98052 USA

**Distribution:**  
3 copies BD Villages Partners L.P.

**April 21, 2010**

**Project No. 063-1076-001.202**

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## INTRODUCTION

Golder Associates Inc. (Golder) is pleased to present this report summarizing the results of explorations, laboratory testing and analysis of groundwater data completed to provide input for the stormwater design for Phase I of the Villages being completed by Triad Associates.

The initial purpose of this investigation task was to evaluate the thickness and extent of recessional outwash deposits (Qvr) underlying Phase I that might be suitable for stormwater infiltration. After the results of our initial test pits, completed in December 2009 were analyzed, additional questions were raised regarding the continuity and elevation of the till unit below the recessional outwash in Phase I and in the location of the proposed stormwater pond planned just south of the existing pond at the south end of Phase I. Additional explorations were completed in January and February 2010 to provide information in those areas. A borehole was also drilled in March 2010 and completed as a monitoring well to provide additional subsurface information in an area where a thick section of recessional outwash was present in the southeast corner of Phase I. This report, describes our field exploration methods, soil and groundwater conditions, significant findings of the field investigation, and specific conditions on Phase I and hydrogeology of Horseshoe Lake. We conclude with recommendations for future work.

## 1.0 BACKGROUND

Golder prepared a preliminary geotechnical investigation for the Villages that included the Phase I area dated May 10, 2006. In preparing this memo, we reviewed the previous explorations from our geotechnical investigation and the following information from other sources:

- Associated Earth Sciences, Inc., "Environmental Impact Statement Technical Report on Geology, Soils, and Groundwater", Dated September 11, 2008.
- Associated Earth Sciences, Inc., Technical Memorandum "The Villages Water Level Monitoring Data", dated January 29, 2010
- Triad Associates, Inc. – Preliminary Road, Storm Drainage and Grading Plan, undated.

Explorations completed for the previous Golder and AESI reports have been included on Figures 1 and 2, and were used in the interpretations contained in this memorandum. Logs of the explorations are included in Appendix A.

Phase I of The Villages comprises about 95 acres. The development plans include a 336 unit single and multi-family residential development and a 14 building commercial development along with associated stormwater infiltration and detention facilities, underground utilities and access roads.

Site grades will be modified to achieve uniform construction subgrade elevations and to provide for surface water drainage. Cuts and fills across most of the site will be on the order of ten feet or less except in the southeast portion (cuts of up to 14 feet deep) and northwest corner (fills up to 30 feet thick).

Low-impact design (LID) is being implemented for disposal of surface water. At the time of this report, the LID stormwater control methods being considered include pervious pavements, rain gardens and roof downspout infiltration systems. The stormwater system will be designed in accordance with the Washington Department of Ecology Stormwater Management Manual for Western Washington (Ecology Manual). The rain gardens will consist of shallow depressions containing amended soils that will infiltrate stormwater at a design rate of 1 inch per hour. The rain gardens will include an emergency overflow that will discharge into a perforated pipe located below the rain gardens.

For the purposes of evaluating the feasibility of infiltrating stormwater at the site, we have assumed the rain gardens will be constructed in shallow depressions approximately 18 inches below final grades shown on the preliminary grading plans. We have also assumed the rain garden overflow will be discharge another 18 inches below the bottom of the rain garden, or three feet below final grade.

## 2.0 FIELD INVESTIGATIONS

### 2.1 Previous Field Investigation

Approximately 46 previous explorations (borings and test pits) were completed by Golder and AESI in the Phase I area and the outwash channel to the south. The approximate locations of the previous explorations are shown on Figure 1. Logs of these test pits are included in Appendix A (Golder logs) and Appendix B (AESI logs).

### 2.2 December 2009 Exploration

Golder excavated and logged 19 test pits (Test Pits TP-101 through TP-119) between December 8, 2009 and December 10, 2009. The approximate locations of our December 2009 test pits are shown on Figure 1, Exploration Plan. The test pits were excavated by Cascade Utilities using a Komatsu 308 track-mounted excavator, under the direction of a Golder field representative. The test pit locations shown on Figure 1 were estimated using a Trimble GeoXT handheld global positioning system (GPS). The 100-series test pits were excavated to delineate the thickness of Qvr materials for siting LID stormwater management facilities. Logs of these test pits are included in Appendix A.

### 2.3 January 2010 Exploration

On January 11 and 12, 2010 we returned to the site to excavate an additional eight test pits (TP-201 through TP-208). These explorations were completed in the northwest portion of the site and at the proposed infiltration pond located in the outwash channel to the south of Phase I. These test pits were also excavated by Cascade Utilities using a Komatsu 308 track-mounted excavator. The test pits were located using GPS. The 200-series test pits were excavated to delineate the elevation of the till surface following review of the 100 series test pits which suggested a northeast-trending till ridge occurred underlying Phase I which divided shallow groundwater flow at the site. Logs of these test pits are included in Appendix A.

### 2.4 February 2010 Exploration

On February 22 and 23, 2010, we returned to the site to excavate an additional 15 test pits (TP-301 through TP-315). These explorations were completed in the northwest portion of the site and at the proposed infiltration pond located in the outwash channel to the south of Phase I. These test pits were also excavated by Cascade Utilities using a Komatsu 308 track-mounted excavator. The test pits were located using GPS. The 300-series test pits were excavated to further delineate the till ridge location and to evaluate subsurface conditions in the outwash channel south of Phase I at the location of the proposed stormwater infiltration pond. Logs of these test pits are included in Appendix A.

### 2.5 March 2010 Borehole – MW-24

A borehole (MW-24) was installed on March 10, 2010. The borehole location is shown on Figures 1 and 2. The borehole was drilled by Boart-Longyear using a mini-sonic rig. The borehole was drilled to a

depth of 50 feet below ground surface and completed as a monitoring well. The borehole was drilled to evaluate the potential occurrence of a window through the till into underlying Qpog<sub>1c</sub> materials on the southeast portion of Phase I where a significant thickness of Qvr was encountered in TP-117. The geologic units encountered in the borehole are:

- 0 to 27 feet: Damp sand and gravel, with thin till lenses from 9 to 11 feet and 20 to 22 feet (Qvr).
- 27 to 42 feet: Damp to moist silt, clay, sand and gravel, interbedded (pre-Vashon deposits?)
- 42 to 46 feet: Wet silty to clayey sand (pre-Vashon deposits?) 46 to 50 feet: Damp clayey sand and weathered bedrock, coal fragments (locally-derived pre-Vashon till, possibly the top of the Qpog<sub>1c</sub> or Qpog<sub>1e</sub>)

Following completion of drilling, a monitoring well was installed with the screen set from 36 to 46 feet below ground. A log of boring B-24 is presented at the end of Appendix A.

### 3.0 SUBSURFACE CONDITIONS

#### 3.1 Soils

Please refer to the test pit logs contained in Appendix A and B for a detailed description of the subsurface conditions encountered at each exploration location. The following is a generalized summary of the soil units encountered on Parcel 1.

- Topsoil/Forest Duff – Where not disturbed by previous site grading, our explorations encountered a layer of topsoil and forest duff that ranged from 1 to 2 feet thick. The topsoil and vegetation layer was characterized by its dark brown color and the presence of roots and scattered organics. This unit is absent from some areas of the site such as the abandoned gravel pit area and the many gravel roads.
- Vashon Recessional Outwash (Map Unit Qvr) – The recessional outwash deposit was encountered at the surface (below topsoil) in the flat low lying areas between the till ridges in the Phase I area. It consisted of fine to coarse gravel and fine to coarse sand with some cobbles and boulders and trace amounts of silt. This material was identified as recessional outwash from the Vashon Stade of the Fraser Glaciation, deposited in broad meltwater channels that generally flowed to the southwest across the Phase I site. The outwash deposit was generally loose to compact and caved excessively, limiting our ability to reach greater depths. The outwash deposit was typically thickest in the northwest and southeast portions of the site. 27 feet of outwash was encountered in MW-24. It thinned to the east and terminated against till uplands in the southwest and southeast.
- Following grading of the site, the thickness of the Qvr in areas of the southeastern portion of the site will be reduced to less than six feet. These areas may not be suitable for the development of rain gardens because of the reduced thickness of Qvr. Stormwater runoff in these areas may need to be routed to other portions of the site.
- Vashon Till (Map Unit Qvt) – Till was encountered below the recessional outwash in many of the test pits completed for this study (TP-102, TP-103, TP-105, TP-106, TP-108, TP-109, TP-113 through TP-116, TP-119, TP-204 through TP-206, and TP-207 and immediately below the topsoil in test pits TP-111, and TP-112). Till was also identified on logs of several previous explorations. The till encountered in our test pits consisted of a silty, fine to coarse sand with varying amounts of gravel. The till unit was typically compact at the surface but quickly graded to dense to very dense. Groundwater was commonly found perched on the top of the till when encountered in our test pits. Test pits TP-111 and TP-112, where till was encountered immediately below the topsoil horizon, are located on the southern margin of the Phase I development area at the toe of a till ridge.

The surface of the till unit, in low lying areas, was scoured as the Vashon age glacier melted and water flowed across its surface. River channels carved and scoured the till surface, leaving it uneven. The flow direction of the meltwater appears to have been approximately from the northeast to the southwest across the general area of Phase I. The surface of the till in the meltwater channels was subsequently buried by recessional sand and gravel, masking its irregular surface. Others have argued (AESI, September 2008) that the till may have been scoured away completely in certain areas exposing a permeable Qpog1c outwash unit, thus leaving it in direct contact with the overlying Qvr outwash unit. This was supported principally by explorations in some of the narrow outwash channels on the Villages site. We did not observe direct evidence to support this conclusion.

- Pre-Olympia Glacial Outwash (Qpog1c) - We interpreted that this unit was encountered underlying a thin till unit in test pits TP-206 and TP-207 (proposed stormwater pond

area). The unit was described as medium to coarse sand with some fine to coarse gravel and cobbles with trace amounts of silt, wood, sandstone, and coal fragments. This material appears to match the unit description for Qpog<sub>1c</sub> identified by AESI in their September 2008 report. It was encountered at a depth of 17feet and the test pit was terminated due to caving in this deposit at 22 feet.

- Ice Contact Deposits (Qvic) – Test pit TP-110, encountered a stratified silty, fine to coarse sand and gravel below the recessional outwash deposit. Based primarily on the stratification and silt content of this material, it was identified as an ice contact deposit. This material type was not found in any of the other explorations completed for this study.

The stratification contacts indicated on the test pit logs represent the approximate depth to boundaries between soil units. Actual transitions between soil units may be more gradual. Soil conditions between exploration locations may vary from those encountered and groundwater levels fluctuate with the seasons. The nature and extent of soil variations between exploratory locations may not become evident until construction. If significant variations occur, Golder should be requested to reevaluate the recommendations of this report and to modify or verify them in writing prior to proceeding with construction.

### 3.2 Groundwater

Groundwater seepage was encountered at most of our test pit locations and in the borehole. The following table summarizes the groundwater conditions that were encountered at the time of our field exploration:

**TABLE 1**  
**Groundwater Seepage Summary**

Location	Seepage Depth (feet below grade)	Notes
TP-103	--	No seepage was encountered during excavation. A piezometer was installed at this location. Groundwater was measured at 15.5 feet below existing ground surface on January 4, 2009.
TP-104	14	No notes, till not encountered
TP-106	10.5	Piezometer installed. Groundwater was measured at 9.6 feet below existing ground surface on January 4, 2010.
TP-110	19 to 20	Perched in coarse sediment lenses in ice contact deposits.
TP-111	2.5	Perched on till.
TP-112	0.5	Perched on till.
TP-113	5	Perched on till.
TP-114	7 to 9	Perched on till.
TP-116	17	Perched on till.
TP-117	None	Piezometer installed to bottom of hole. No groundwater measured on January 4, 2010.
TP-119	14.5	Perched on till.
TP-201	12	Seepage rate noted as heavy.
TP-203	15.5	Water seepage observed within the Qvr, till was not encountered
TP-204	16	Perched on till.
TP-207	12	Perched on till.
TP-301	18	Seepage from till seams
TP-302	13 to 16	Perched on till
TP-303	16 to 18	Seepage in Qvr, till not encountered
TP-304	13	Perched on till
TP-305	9	Perched on till
TP-306	15	Perched on till
TP-309	10 to 12	Seepage observed in till
TP-310	15	Seepage in Qvr, till not encountered, piezometer installed
TP-311	20	Seepage observed in till
TP-312	15 to 16	Seepage observed in till
TP-313	12.5	Perched on till
MW-24	46	No seepage observed in Qvr. Seepage observed in sand layer within pre-Vashon units below Qvr.

**Note:**

Pressure transducers and dataloggers were installed in selected test pits completed with standpipes and in the borehole to monitor groundwater elevations. Groundwater elevation hydrographs for wells and test pits completed in the Qvr and pre-Vashon materials are included in Appendix D.

#### 4.0 LABORATORY TEST RESULTS

Grain size analyses were performed on 21 representative samples of recessional outwash collected from test pits in the Phase I project area. The grain size analyses were performed in general accordance with ASTM D-421, D-422, and D-4318. The purpose of the tests was to verify or modify the field soil classification and to evaluate the general physical properties and the consistency of likely infiltration characteristics of the soil encountered.

We also performed one Modified Proctor test in general accordance with ASTM D-1557, Modified Proctor. We anticipate that the material tested will be excavated and used for structural fill in the west portion of Phase I.

The results of laboratory tests performed on specific samples are provided either at the appropriate sample depth on the individual test pit logs or on a separate data sheet contained in Appendix C. It is important to note that these test results may not accurately represent all the soil types observed in our explorations; for example, no till samples were tested.

## 5.0 SUMMARY OF SIGNIFICANT FINDINGS

- Most of the proposed Phase I area is underlain by recessional outwash (Qvr) of suitable thickness and permeability to support the planned rain garden infiltration storm system. In some parts of the southeast portion of the site, rain gardens may need to be relocated because the Qvr thickness will be insufficient to support infiltration following site construction grading. Measured groundwater levels to date in the Qvr do not appear to adversely impact anticipated rain garden infiltration plans.
- There appears to be a northeast-southwest trending, low ridge of till below the Qvr that may act as an east/west groundwater divide in the shallow Qvr aquifer in Phase I. The approximate location of the ridge is illustrated on Figure 2. The elevation of the low point along the top of the ridge is about 545 feet. The presence of the till ridge has implications for the stormwater water balance because the east portion of the Phase I Qvr aquifer does not appear to drain toward Horseshoe Lake.
- TP-117, in the southeast corner of Phase I was terminated in Qvr at elevation 534 feet. No till was encountered. The depth of Qvr in this area was significantly lower in elevation than areas just to the north and west. Based on TP-117, the till may be present at a lower elevation (below the reach of our test pit) or there might be a window in the till to the underlying Qpog<sub>1c</sub> aquifer. No groundwater was encountered in TP-117 despite observing that significant surface water was infiltrating into the Qvr just southeast of this test pit from till uplands to the southeast. A boring was completed in this area (MW-24) to confirm the stratigraphy below the Qvr. The boring indicated about 27 feet of Qvr with thin till lenses overlying what is interpreted to be low-permeability silty to clayey sand and gravels. These materials are not lodgment till but may be ice-contact deposits, ablation tills, or the top of the Qpog<sub>1c</sub>. These materials were damp to wet but free water has not been measured in the well. The boring was completed as a monitoring well in the materials below the Qvr at a depth of 36 to 46 feet below ground.
- Test pits excavated in the proposed location of the Phase I stormwater pond (TP-206 and TP-207 and TP-301, TP-302, TP-304, and TP-305) confirmed the presence of a thin (3 to 4 foot thick) till layer separating the Qvr from permeable Qpog<sub>1c</sub> deposits. The top of permeable Qpog<sub>1c</sub> was at approximately elevation 534 to 535 feet (not surveyed). Golder test pits TP-206 and TP-207 were excavated nearby Associated Earth Sciences Inc. (AESI) test pits EP-56, IT-3, DT-1 and DT-2, also excavated in the proposed stormwater pond. The AESI test pits did not identify a till layer and described the Qvr to be in direct contact with the Qpog<sub>1c</sub>. Several of the AESI logs describe the top of the Qpog<sub>1c</sub> as being silty and clayey. The description seems to have more in common with a till than a coarse outwash (as the Qpog<sub>1c</sub> is described by AESI). The till contours in the outwash channel south of the existing pond are estimated based on explorations completed for this report and some re-interpretation of exploration logs completed by AESI. While there might be some direct contact between the Qvr and permeable Qpog<sub>1c</sub>, we recommend that planners anticipate having to excavate and remove a till layer in order to expose the permeable Qpog<sub>1c</sub> in the proposed Phase I infiltration pond. The infiltration test data reported in the AESI 2009 report from test pit IT-3 in the Qpog<sub>1c</sub> was 10 to 31 inches per hour (field measured rate). This would yield design rates in the range of about 2 to 8 inches per hour. Sieve analysis results (Appendix B) from two samples of the Qpog<sub>1c</sub> collected in TP-206 and TP-207 indicate the material may have a higher design infiltration rate based on the D<sub>10</sub> values. Therefore, we recommend that additional infiltration tests be completed.
- The stratigraphic contact between the Qvr and till shown on AESI boring logs (MW-7 and MW-8) was different than that observed in adjacent test pits TP-115 and TP-119 excavated by Golder. The Golder test pits encountered till at a depth of 7 feet and boring logs MW-7 and MW-8 identified till at a depth of 27 feet. A discrepancy of 20 feet to the top of the till unit is not easily explained in this location. We believe this discrepancy is likely related to the difficulty of interpreting drill cuttings from the air rotary drilling

methods used in drilling MW-7 and 8. The till contour elevations shown on Figure 2 for the Phase I project were drawn using information from test pits completed for this report.

- The stratigraphy in AESI boring log MW-9 appears to be different than that observed in nearby test pits TP-301 excavated by Golder and EP-81 excavated by AESI. TP-301 encountered till at a depth of 11 feet, and till was encountered in EP-81 at a depth of about 12 feet. The boring log for MW-9 identified till at a depth of about 27 feet. We think the till in MW-9 is shallower and was likely miss-identified due to the difficulty of interpreting drill cuttings from air rotary drilling methods. Additionally, the groundwater elevation in MW-9 is significantly higher during the winter months, reaching an elevation of up to 552 feet, than the groundwater elevation in the nearby pond and test pits completed in the Qvr, where groundwater elevations of 534 to 537 feet are observed. The groundwater elevation in MW-9 fluctuates over about 20 feet seasonally, whereas the water surface in the pond does not appear to fluctuate significantly over the same time period (less than about five feet). The groundwater elevation in other wells completed in Qvr in the Phase I parcel (MW-21 and MW-23) fluctuate about 6 to 16 feet annually. MW-9 appears to be completed in till or weathered till rather than Qvr and the water level in MW-9 appears to reflect shallow interflow.

## 6.0 PHASE I PARCEL

Groundwater in the Phase I parcel occurs as a thin saturated zone in the Qvr above the till contact. Within the Qvr, the groundwater elevation fluctuates about 6 to 16 feet seasonally (Figure D-1), based on groundwater elevation data collected in MW-21 and MW-23 by AESI (January 2010). In MW-21 located on the east side of the till ridge, the seasonal high groundwater elevation is about 545 feet except following large storm events when a groundwater elevation of 548 feet was observed. The groundwater elevation of about 545 feet is similar to the groundwater elevation observed in test pits TP-308 and TP-313 (Figure D-2). This suggests that there is a saturated thickness of about 1 to 6 feet in the Qvr above the till on the east side of the ridge.

A groundwater elevation of 548 feet was observed in MW-21 in the winter of 2009. In MW-23, located on the west side of the till ridge, the seasonal high groundwater elevation is about 536 feet. Thus, some shallow groundwater may flow westward across the till ridge which is at an elevation of about 545 feet when groundwater elevations in MW-21 exceed 545 feet. Based on the available groundwater elevation data in MW-21, this occurs only over short periods of time (i.e. 1 to 2 weeks per year; Figure D-1).

Based on the observed groundwater elevations, groundwater flow in the Qvr on the west side of the till ridge is towards Horseshoe Lake. On the east side of the till ridge, groundwater flow in the Qvr is towards the south to the area of the proposed stormwater infiltration pond (Figure 2). Some groundwater may flow to the west across the till ridge towards Horseshoe Lake when the groundwater elevation is greater than about 545 feet on the east side of the till ridge. Groundwater flow across the till ridge under these conditions is estimated to be less than 20 gpm.

Some moist to wet materials were observed in the pre-Vashon materials below the Qvr in MW-24. However, no water has entered the well as of March 2010.

The groundwater elevation in MW-7 and MW-22 completed in Qpog1<sub>c</sub> materials has varied between about 481 and 502 feet since September 2006 (Figure D-3). Figure D-4 shows the hydrograph of these wells since December 2009.

### 6.1 Phase I Parcel Infiltration

The infiltration rate in the Qvr that covers nearly all of Phase I was tested by AESI (AESI 2009) using a Pilot Infiltration Test (PIT) in accordance with the 2005 Ecology Stormwater Manual. The test labeled as IT-4 was performed in the southeast portion of the Phase I (Figure 2). The field measured test results of >200 inches per hour are not surprising given the coarse, clean nature of the Qvr deposit. A grain size distribution of the material that the infiltration test was conducted in is included at the end of Appendix C (AESI grain size analysis for IT-4). The 2005 Ecology Manual allows for the use of grain size distribution curves to estimate infiltration rates for rain gardens.

Design requirements for rain gardens are covered in Appendix III "Low Impact Development" section of the 2005 WSDOE Stormwater Manual (Ecology Manual). Infiltration requirements are covered under section 7.7.4 and include determination of the infiltration rate for the imported soil medium (Section 7.7.4.1) at the surface of the rain garden, as well as the rate for the underlying soil (Section 7.7.4.2).

The imported soil medium to be use in the rain gardens for this project has not been specified. However, we understand that the design is being based on a medium with an infiltration rate of about 1 in/hr. Once the material has been specified, the infiltration rate of the actual soil medium will have to be tested in accordance with the DOE Manual Section 7.7.4.1.

The infiltration rate of the underlying soil is required to be greater than the imported medium. The infiltration rate of the underlying soil is determined by using the "short term" infiltration rate contained on Table 3.7 in Volume III of the Ecology Manual. The soil conditions in the Qvr on Phase I, as determined by laboratory soil gradation testing, meet the requirements of "sand" in Table 3.7 with a "short term infiltration rate" of 8 in/hr. The short term rate is used in this case, without factoring, because the overlying imported soil protects it.

If a minimum of 10,000 ft<sup>2</sup> of impervious area is tributary to a rain garden then there must be a minimum of 3 feet between the lowest elevation of the bioretention soil and the seasonal high groundwater elevation. Based on the preliminary grading and groundwater monitoring performed to date for Phase I, this should be achievable in all areas with the possible exception of a localized area in the southeast portion of the site. The depth to till contours shown on Figure 2 along with the water level data presented in this report will allow Triad Associates to demonstrate that this condition is met in all proposed rain garden locations.

## 7.0 PHASE I STORMWATER POND

Although not depicted on Figure 2, the proposed location of the Phase I stormwater treatment and infiltration pond will be in the outwash channel just south of the existing pond. The dimensions of the pond are preliminary but will be in the range of 600 to 800 feet long (north to south) and 150 to 200 feet wide (east to west). The water quality portion of the pond will be in the north end and infiltration in the south end.

### 7.1 Groundwater and Infiltration

Groundwater in the area of the proposed Phase I stormwater pond occurs in the Qvr and in the underlying Qpog1<sub>c</sub>. Test pits suggest the thickness of the Qvr is about 8 to over 22 feet in the vicinity of test pits TP-301 to 305, inclusive. In this area, the Qvr is underlain by till. AESI well MW-9, adjacent to TP-301 suggests that there is about 27 feet of outwash overlying till. This appears to be erroneous based on the adjacent test pits and the groundwater elevations observed in MW-9 and the adjacent test pits.

The groundwater elevation in MW-9 reaches a maximum of about 550 feet, or about two feet below ground surface based on data collected by AESI. The groundwater elevations in adjacent test pits TP-302 and TP-304 in the Qvr are around 534 to 536 feet (March 2010). Groundwater in these test pits occurs in the Qvr, above the till contact. This is similar to the elevation of the water surface in the nearby pond of about 539 feet. A review of historic aerial photographs indicates the surface area of the pond has not varied significantly between 2002 and 2007, suggesting the water surface elevation of the pond does not vary significantly since the area around the pond is flat.

If the seasonal high groundwater elevation of 550 feet observed in MW-9 reflected groundwater elevations in the Qvr, the groundwater elevation would be at or near the ground surface in the vicinity of test pits TP-301 through TP-305, inclusive. This has not been observed. The groundwater elevation difference between MW-9 and the adjacent test pits and pond suggests that MW-9 may be completed in weathered till and till rather than Qvr, and may be measuring the elevation of the interflow in the till.

In the southern part of the pond (vicinity of EP-56, EP-55 and DT-1, 2, and 3), the Qvr is about 5 to 17 feet thick. The Qvr is underlain by till or a sticky, silty to clayey sand and gravel that is logged by AESI as Qpog1<sub>c</sub>. This material appears to be relatively low permeability based on the description in the AESI test pit logs. The thickness of these fine-grained dense materials was not indicated on the AESI logs as they terminated their test pits in this deposit. Golder excavated test pits TP-206 and TP-207 between the AESI pits to confirm their results and found a similar low permeability layer but it was only 2 to 3 feet thick from about 14 to 17 feet below ground. Below that layer was a clean coarse sand and gravel outwash to a depth of 22 feet. This coarse sand and gravel outwash appears to be a potential receiving media for infiltrated storm water. However, the thickness and extent of the deposit and therefore its suitability for handling infiltration will need to be determined by further exploration.

Groundwater in the Qvr in the area of the pond appears to flow to the south based on groundwater elevations in the test pits. Overall, it appears that Qvr groundwater on the east side of the till ridge flows south through the pond area. The north/south groundwater divide in the Qvr aquifer in the vicinity of MW-9 shown on Figure 26 of the AESI report appears to be based on the groundwater level in MW-9, which appears to be completed in till or weathered till materials, rather than outwash. Thus, there does not appear to be a north/south groundwater divide in the Qvr in the area of the pond

The groundwater elevation in the underlying Qpog<sub>1c</sub> aquifer is at an elevation of about 480 to 495 feet based on AESI well MW-17. If this elevation reflects a water level within permeable outwash deposits that we observed in the bottom of test pits TP-206 and TP-207, then there appears to be adequate unsaturated thickness of Qpog<sub>1c</sub> for infiltration purposes. This assumption will need to be verified by field investigation.

## 7.2 Surface Water

The phase I stormwater pond will be situated in a shallow north-south channel between uplands on the east and west. Surface water runoff and interflow from the uplands drains from the adjacent uplands to the area of the proposed pond. Surface runoff was observed flowing down the till upland area on the east side of the proposed pond on April 6, 2010. The approximate location is depicted on Figure 2. Approximately 20 gpm was observed flowing down an old road used by ORV's. This water is likely shallow interflow discharging from the upland wetland where it intersected the eroded trace of the road. The runoff flowed over the till upland area until it reached the Qvr materials at the base of the slope near test pit TP-305. Some minor ponding of the runoff was observed where the water infiltrated into the Qvr. The stormwater pond design will need to incorporate means to intercept, collect and convey the surface flows from adjacent uplands such that these flows do not enter the pond by overland flow or shallow seepage on the pond slopes. A temporary collection system of trenches or ditches may be employed initially until such time as development infrastructure is constructed on the uplands adjacent to the pond and permanent collection and conveyance can be installed.

## 7.3 Existing Infiltration Test Results

AESI performed infiltration tests in test pit IT-3 and drain tests in test pits DT-2 and DT-3. The infiltration test in IT-3 was conducted at a depth of 19 feet. The test was performed in materials logged as dense silty gravel with fine to coarse sand. One test was performed with a head of approximately 1.5 feet; the second was performed with a head of 7.5 feet. The infiltration rate with a head of 1.5 feet was about 1.3 gpm or about 10 inches per hour. With a head of 7.5 feet, the infiltration rate was about 8 gpm, equivalent to an infiltration rate of about 31 inches per hour.

Pits DT-2 and DT-3 were excavated as test drains. The pits were excavated to depth and then backfilled with clean washed pea gravel. Water was then introduced into the pit at a known rate and the water level buildup monitored.

The drain test in DT-2 was conducted at a pit floor depth of 17.5 feet in materials logged as dense silty to clayey gravel. These materials were intersected at a depth of 10 feet below ground. During the test, water was added to the pit at a rate of 23 gpm. The water level rose to about 7.2 feet above the base of the drain. This corresponds to a specific capacity (rate of water added divided by buildup) of about 3.3 gpm/ft.

The drain test in DT-3 was conducted at a pit floor depth of 16 feet in materials logged as dense silty to clayey gravel. These materials were intersected at a depth of five feet below ground. A 0.5-foot thick sand lens was present at a depth of about 15 feet. During the test, water was added to the pit at a rate of 3.1 gpm. The water level rose to about 10.6 feet above the base of the drain. This corresponds to a specific capacity (rate of water added divided by buildup) of about 0.3 gpm/ft. The water level was then increased to about 13.6 feet above the base of the drain. The flow rate was about 7.5 gpm, for a specific capacity of about 0.5 gpm/ft. During the second phase of the test with the water level raised to 13.6 feet above the pit floor, the water level in the pit is within the Qvr materials and some of the water may be discharging to the Qvr.

Additional exploration and infiltration testing in the area of the proposed stormwater infiltration pond is recommended. At a minimum we recommend that three borings be advanced in the area of the infiltration pond to explore the thickness of the clean sand and gravel layer observed at about 17 feet in depth in TP-206 and 207, and that infiltration tests be performed in this layer if it appears to be suitable based on thickness and other factors.

## 8.0 HORSESHOE LAKE

Horseshoe Lake is a shallow lake located immediately west of the Phase I parcel. Horseshoe Lake has a history of dramatic water level fluctuations that were brought to public attention after the lake shore was developed with housing in 1990. Several newly constructed homes were flooded during construction in 1991, and have been threatened several times since the early 1990's. In response to the flooding events, King County has pumped water from the lake on several occasions to lower lake levels. The following discussion of the lake hydrogeology is based on Golder's interpretation of historical and recently acquired data.

Lake levels in Horseshoe Lake have been measured by King County (1990 through 2007); Golder (2007 through 2009) and by local lakeside resident Barbara Rush (2008 to 2010). Precipitation has been measured by King County at Horseshoe Lake from 1999 through 2007 and at another gage in Black Diamond from 2000 through 2010. Groundwater elevation data are available for the Qpog<sub>1c</sub> aquifer from 2006 through 2010 for MW-7, and 2008 through 2010 for MW-22. Groundwater elevation data are available for MW-23 completed in the Qvr from 2008 through 2010.

Horseshoe Lake elevations are shown on Figure 3, along with daily precipitation data. Hydrographs for Horseshoe Lake, along with precipitation and groundwater elevations for nearby wells, are included in Appendix E. The elevation of Horseshoe Lake fluctuated between about 498 and 513 feet between 1999 and 2010. Historic information suggests that the lake elevation may have been as high as 516 to 517 feet in 1991. The highest lake elevations are typically observed in the spring during the months of March, April, and May, but levels sufficient to cause flooding have also been observed in January and February.

Inflows to Horseshoe Lake include surface water runoff within the surface water catchment of the lake, and groundwater discharge to the lake from the groundwater catchment of the lake. Groundwater elevations in nearby wells completed in the Qvr (MW-23) are about 20 to 25 higher than the lake elevation, while groundwater elevations in nearby wells in the Qpog<sub>1c</sub> (MW-7 and MW-22) are about 5 to 15 lower than the lake elevation (Figures D-4 through D-7). This suggests that groundwater in the Qvr discharges to the lake. The groundwater catchment of the lake is controlled by the topography of the low permeability layer (till and other units) that directly underlie the Qvr. The topography of the low permeability layer in Phase I is depicted on Figure 2 based on shallow explorations and indicates that only a portion of Phase I normally contributes groundwater flows to Horseshoe Lake. The lake level hydrograph indicates that the lake elevation responds quickly to significant precipitation events in the fall and winter indicating a significant contribution from the localized groundwater catchment area.

### 8.1 Horseshoe Lake Flooding

We looked more closely at the annual water year precipitation records for the years that the lake level rose over elevation 511 feet (elevation of flooding concern for lakeside residents) and compared them to non-flood years to see if there were any trends. The data set is shown on Table 2. Based on the limited

data set, there does not appear to be a correlation between total water year (October 1 to September 30) precipitation and maximum lake level (Table 2). In other words, years with the highest total water year precipitation did not necessarily produce the highest lake water levels. However, it does appear that water year precipitation of 60 inches or more nearly always produces lake levels above 511 feet (with the exception of WY 2000). Since WY 2000 had one of the higher rainfall totals we compared it with WY 2007 which had a lower annual rainfall and higher lake level to see if the difference in lake level could be explained. In water year 2000 the total precipitation was approximately 65 inches and the maximum lake level was only 507.5 feet. In water year 2007 the precipitation was 58 inches (7 inches less than 2000) yet the maximum lake level was 512.5 (5 feet higher).

One of the differences between the years 2000 and 2007 was the pattern of the rainfall. Even though the total rainfall was lower in water year 2007 it was dominated by a number of severe events (> 3 inches per storm) which resulted in significant elevation jumps in the lake level. Water year 2000 lacked the number of intense events of 2007. One possible explanation is that severe precipitation events cause changes in the normal drainage patterns within the Qvr aquifer causing temporary pulses of groundwater from outside the normal lake groundwater basin to drain toward Horseshoe Lake. This might be caused by localized groundwater mounding and flow across topographic spillways within the till surface that only activate above certain groundwater level elevations triggered by large precipitation events. A spillway in the till surface occurs on the Phase I parcel. Based on the available groundwater elevations, groundwater may flow across this spillway when the groundwater elevation on the east side of the spillway exceeds about 545 feet which periodically occurs for short periods (up to about three weeks) following large precipitation events such as in January 2009.

Another hypothesis for the flooding is that the seasonal low lake level immediately preceding a flooding year might be significantly elevated and therefore reduce the storage capacity of the lake for the following year, thus increasing the risk of flood elevations being reached. We do not have sufficient data to analyze this hypothesis.

Groundwater elevations in the Qvr are about 15 to 20 feet higher than the lake elevation (Figures E-5 through E-7, inclusive). The groundwater elevations in the Qpog<sub>1c</sub> aquifer are about 5 to 10 feet lower than the elevation of Horseshoe Lake. The difference in lake elevation and the groundwater elevation in the Qpog<sub>1c</sub> suggests that the lake is not in direct hydraulic continuity with the Qpog<sub>1c</sub>. Discharge from the lake to the underlying Qpog<sub>1c</sub> aquifer appears to be restricted by low-permeability materials in the lake bottom. The low-permeability materials below the lake could be till, low-permeability materials in the upper part of the Qpog<sub>1c</sub>, or bentonite that was reportedly spread across the bottom of part of the lake.

## 9.0 RECOMMENDATIONS

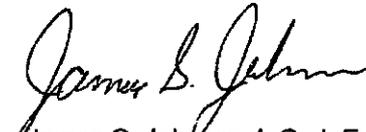
Design of the Phase I infiltration pond will require additional information on the geologic conditions, hydrogeology, infiltration capacity of the materials below the Qvr, and thickness of permeable materials below the Qvr, including confirmation of permeable Qpog1<sub>c</sub> materials. We recommend the following explorations in the infiltration pond footprint:

- Excavation of a minimum of three test pits along the length of the pond to evaluate the depth to permeable Qpog1<sub>c</sub> materials and provide locations to perform infiltration testing. The pits should be excavated below the base of the lower permeability silty to clayey gravels and sands to confirm the depth needed to develop a window into permeable Qpog1<sub>c</sub> materials
- Completion of at least three infiltration tests at the base of the test pits completed in permeable Qpog1<sub>c</sub> materials to confirm the infiltration capacity of these materials. These tests will require the test pits be excavated using setbacks and slopes appropriate for entry.
- Completion of three borings to 10 feet below the water table in the Qpog1<sub>c</sub> materials to confirm the geologic conditions below the pond, the depth to water in the Qpog1<sub>c</sub> aquifer below the pond, the thickness of unsaturated materials below the pond base, and the hydraulic conductivity of the Qpog1<sub>c</sub> aquifer. The borings should be located around the pond so that they can be saved during construction and used for post construction monitoring.

## 10.0 CLOSURE

This report was completed in substantial accordance with the scope of services outlined in Work Order V-01 and V-03 for the Villages project and approved changes. The information contained in this report is suitable for use in design level planning for the stormwater drainage design for Phase I of Villages. Additional information and analysis discussed in this report will be needed for final design. We trust the information presented in this report meets your needs. If you have any questions, please do not hesitate to contact us at (425) 883-0777.

### GOLDER ASSOCIATES INC.



James G. Johnson, L.G., L.E.G.  
Principal



Michael Klisch, L.G., L.H.G.  
Senior Project Hydrogeologist



Michael P. Klisch

TABLE

**TABLE 2**  
**Horseshoe Lake Information**

Water Year	Maximum Lake Level (feet)	Month of Maximum Lake Level	Preceding WY Minimum Lake Level (feet)	Water Year Precipitation (inches)	Water Year Precipitation to 12/31	Water Year Precipitation to 3/31	Notes
1990				58.43	16.42	39.14	
1991	514.77	April		66.97	29.02	50.69	Pumped 4/21-5/1/91 - Level may have been 2 feet higher
1992				46.23	16.37	30.68	Water damage started 2/16, pumping 2/27 to 3/6
1993				49.66	18.05	29.49	
1994				44.59	13.19	28.77	
1995				51.72	21.51	38.30	
1996	513	February		68.20	26.55	49.67	Water damage started on 2/17, Pumping started on 2/27 continuously to 3/16
1997	512	January, March		68.94	30.83	45.16	Pumping started 1/22 sporadically to 2/6. Hit 512' sporadic pumping 3/24 to 4/1
1998				38.61	17.81	27.80	
1999	512.2	April		68.99	29.22	50.28	No pumping
2000	507.5			65.63	26.15	44.14	
2001			500	38.13	10.79	20.13	
2002			497	51.47	24.72	38.58	
2003				40.82	10.79	29.58	
2004				44.31	19.90	34.63	
2005				46.72	14.91	26.92	
2006	510.35	March		51.69	17.39	38.49	
2007	512.5	March	502.83	38.32	24.50	30.63	Pumping started 3/26 sporadically to 4/4, then 4/26 and 4/27
2008	504	March	501.5	49.82	15.67	29.93	
2009	511	May	499	47.59	18.38	24.28	Test pumping 5/5 to 5/7 continuous, 5/8 to 5/11 days only, then intermittent to 5/18
2010	507	March	502 (est)		17.99	26.99	Precipitation through February 16, lake level through 3/23

Blank = no information

Landsburg Data (<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?va4486>)

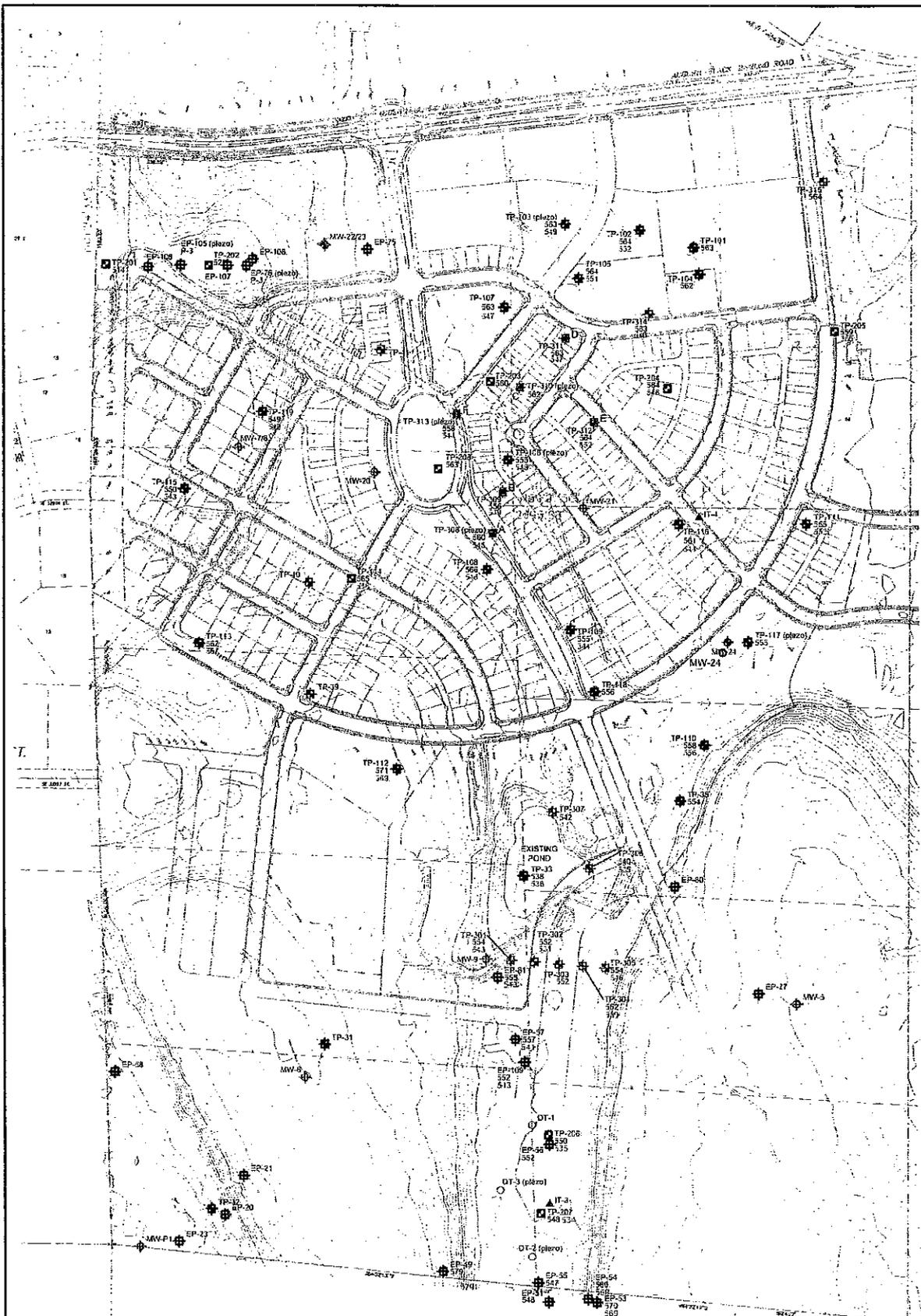
Blackstone Data ([http://green.kingcounty.gov/WaterResources/hydrology/DataDownload.aspx?G\\_ID=984](http://green.kingcounty.gov/WaterResources/hydrology/DataDownload.aspx?G_ID=984))

Enumclaw Data ([http://green.kingcounty.gov/WaterResources/hydrology/DataDownload.aspx?G\\_ID=155](http://green.kingcounty.gov/WaterResources/hydrology/DataDownload.aspx?G_ID=155))

Lake level data from Golder Associates Inc., Barbara Rush, and King County (<http://your.kingcounty.gov/dnrp/wr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>)



## FIGURES



LEGEND			
TP-10	APPROXIMATE LOCATION OF TEST PITS BY GOLDER, MARCH, 2006	IT-1	APPROXIMATE LOCATION OF INFILTRATION TEST BY AESI, NOVEMBER, 2007
TP-101 562	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT BY GOLDER, DECEMBER, 2009	MW-21	APPROXIMATE LOCATION OF BOREHOLE MONITORING WELL BY AESI, 2006
EP-19 579	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT BY AESI, 2005	DT-2	APPROXIMATE LOCATION OF DRAIN TEST BY AESI, INC. 2009
TP-201 493	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT BY GOLDER, JANUARY, 2010	379	ELEVATION OF GROUND SURFACE AT TEST PIT, WHERE INDICATED.
TP-315 564	APPROXIMATE LOCATION AND ELEVATION OF TEST PIT BY GOLDER, FEBRUARY, 2010		
(P)	INDICATES PIEZOMETER INSTALLED		

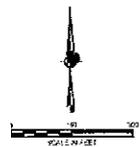
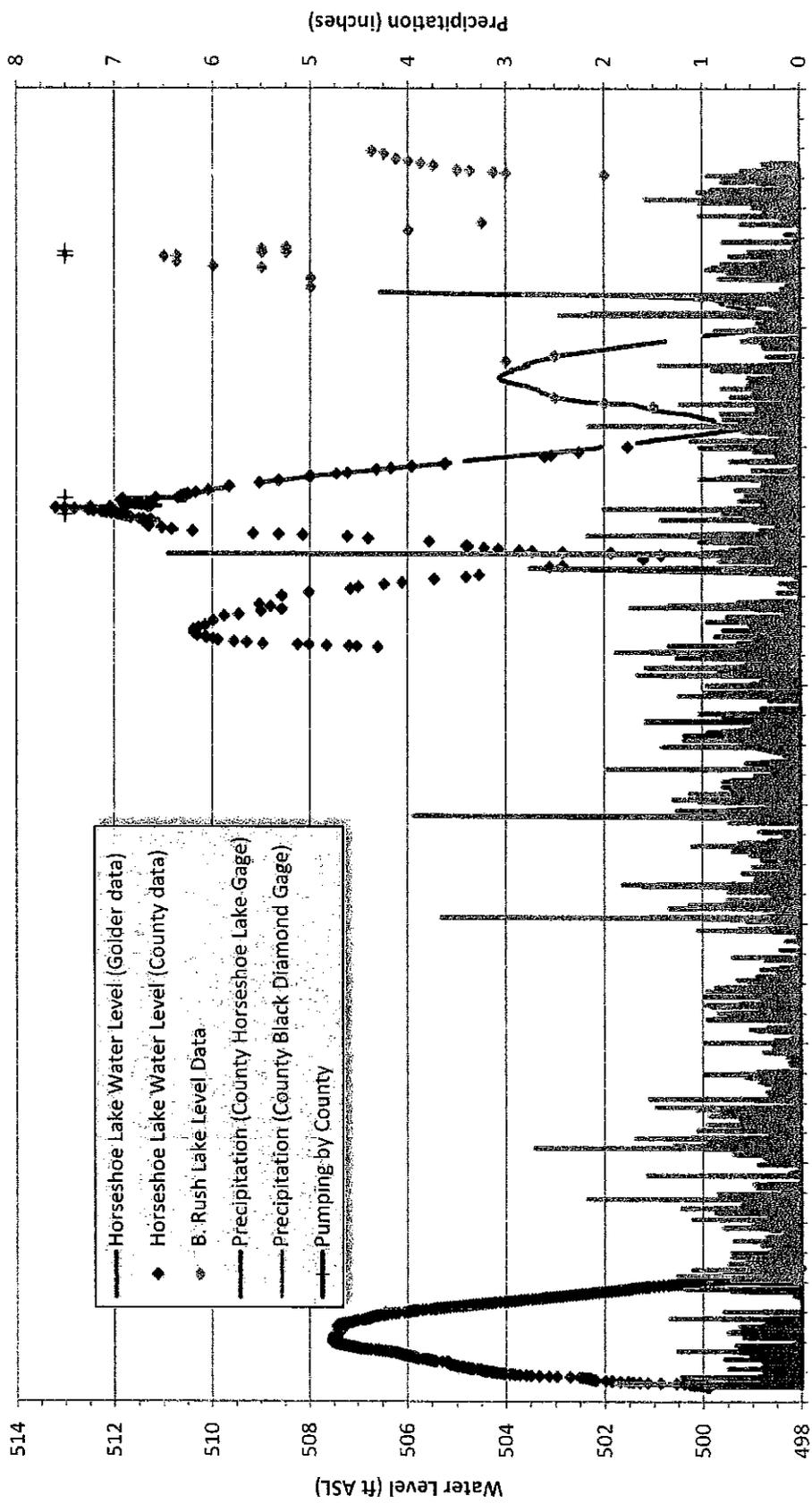


FIGURE 1  
**EXPLORATION PLAN**  
 BDP/THE VILLAGES PS & CONSULTING/WA  
 Golder Associates

SOURCE: BASE MAP AND LIDAR TOPOGRAPHY PROVIDED BY DMJM ASSOCIATES, DECEMBER, 2009  
 A:\C:\Projects\2004\21-55-150\_1P\_21-591.dwg | T:\1\Map\2010\21-55-150\_1P\_21-591.dwg | 10/1/2010 10:15:11 AM





Source: [http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?C\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?C_ID=664)  
<http://your.kingcounty.gov/dnmp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>

Title		Horseshoe Lake Stage and Precipitation	
Project Name	Villages Phase I	Project No.	063-1076.001.202
Client Name	BD Lawson Partners	Date	April 20, 2010

Drawn	EA
Checked	MPK
Reviewed	JGJ
FIGURE 3	

**APPENDIX A**  
**LEGEND / GOLDBER TEST PIT AND BORING LOGS**

## Unified Soil Classification System (USCS)

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 Sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded gravels
		GRAVELS WITH FINES More than 12% fines	GM	Gravel and Silt Mixtures
			GC	Gravel and Clay Mixtures
	SANDS 50% or more of coarse fraction passes No. 4 Sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Non-plastic and Low-Poorly-graded Sands
		SANDS WITH FINES More than 12% fines	SM	Sand and Silt Mixtures
			SC	Sand and Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50	INORGANIC	CL	Low-plasticity Clays
			ML	Non-plastic and Low-Plasticity Silts
		ORGANIC	OL	Non-plastic and Low-Plasticity Organic Clays Non-plastic and Low-Plasticity Organic Silts
			CH	High-plasticity Clays
	SILTS AND CLAYS Liquid limit greater than 50	INORGANIC	MH	High-plasticity Silts
			OH	High-plasticity Organic Clays High-plasticity Organic Silts
		ORGANIC		
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Based on ASTM D2487-00

## Component Definitions by Gradation

Component	Size Range
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76mm)
Sand	No. 4 (4.76mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.76mm) to No. 10 (2.0mm)
Medium sand	No. 10 (2.0mm) to No. 40 (0.42mm)
Fine sand	No. 40 (0.42mm) to No. 200 (0.074mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

### Sample Types

Symbol	Description
SS	SPT Sampler (2.0' OD)
HD	Heavy Duty Split Spoon
SH	Shelby Tube
CA	California Sampler
B	Bulk
C	Cored
G	Grab
P	Pitcher Sampler

### Laboratory Tests

Test	Designation
Moisture	(1)
Density	D
Grain Size	G
Hydrometer	H
Atterberg Limits	(1)
Consolidation	C
Unconfined	U
UU Triax	UU
CU Triax	CU
CD Triax	CD
Permeability	P

(1) Moisture and Atterberg Limits plotted on log.

Cohesionless Soils (a)		
Density	N, blows/ft. (c)	Relative Density (%)
Very loose	0 to 4	0 - 15
Loose	4 to 10	15 - 35
Compact	10 to 30	35 - 65
Dense	30 to 50	65 - 85
Very Dense	over 50	>85

Cohesive Soils (b)		
Consistency	N, blows/ft. (c)	Undrained Shear Strength (psf) (d)
Very soft	0 to 2	<250
Soft	2 to 4	250-500
Firm	4 to 8	500-1000
Stiff	8 to 15	1000-2000
Very Stiff	15 to 30	2000-4000
Hard	over 30	>4000

- (a) Soils consisting of gravel, sand, and silt, either separately or in combination, possessing no characteristics of plasticity, and exhibiting drained behavior.  
 (b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.  
 (c) Refer to text of ASTM D 1586-84 for a definition of N; in normally consolidated cohesionless soils, Relative Density terms are based on N values corrected for overburden pressures.  
 (d) Undrained shear strength = 1/2 unconfined compression strength.

### Silt and Clay Descriptions

Description	Typical Unified Designation
Silt	ML (non-plastic)
Clayey Silt	CL-ML (low plasticity)
Silty Clay	CL
Clay	CH
Plastic Silt	MH
Organic Soils	OL, OH, Pt

### Qualitative Descriptive Terminology for Moisture Content

Dry	No discernible moisture present
Damp	Enough moisture present to darken the appearance but no moisture on materials adheres to the hand
Moist	Will moisten the hand
Wet	Visible water present on materials

### Descriptive Terminology Denoting Component Proportions

Descriptive Terms	Range of Proportion
Trace	0-5%
Little	5-12%
Some or Adjective (a)	12-30%
And	30-50%

(a) Use Gravelly, Sandy or Silty as appropriate.

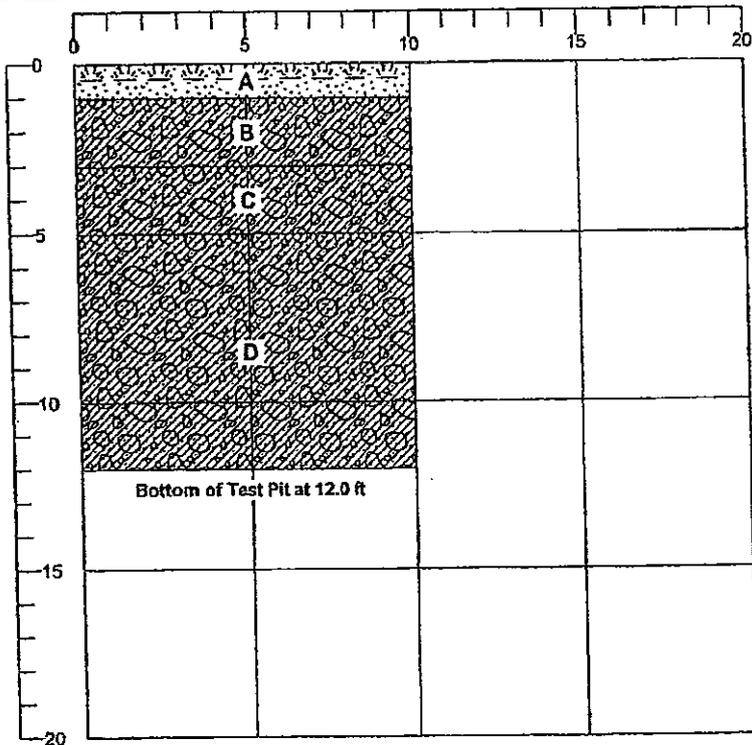
## SOIL CLASSIFICATION LEGEND





# LOG OF TEST PIT TP-31

Temp 50 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 21, 2006  
 Elevation 588.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	1.0	
2	4.0	13.3
3	11.5	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A 0.0 - 1.0 ft:** Loose, dark brown, non-stratified, silty fine to medium SAND with some organics, moist (SM) (TOPSOIL/FOREST DUFF)
- B 1.0 - 3.0 ft:** Loose to compact, orange-brown, non-stratified, silty fine to medium SAND with little, subrounded, fine to coarse gravel, moist (SM) (WEATHERED LODGEMENT TILL)
- C 3.0 - 5.0 ft:** Compact, brown-gray, non-stratified, iron-oxide stained, silty fine to coarse SAND with little to some, socketed, subrounded, fine to coarse gravel, trace cobbles, and trace boulders, moist (SM) (SLIGHTLY WEATHERED LODGEMENT TILL)
- D 5.0 - 12.0 ft:** Dense, brown-gray, non-stratified, silty fine to coarse SAND with little to some, socketed, subrounded, fine to coarse gravel, trace cobbles, and trace boulders, moist (SM) (LODGEMENT TILL)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:55	0.0		
11:45	12.0		

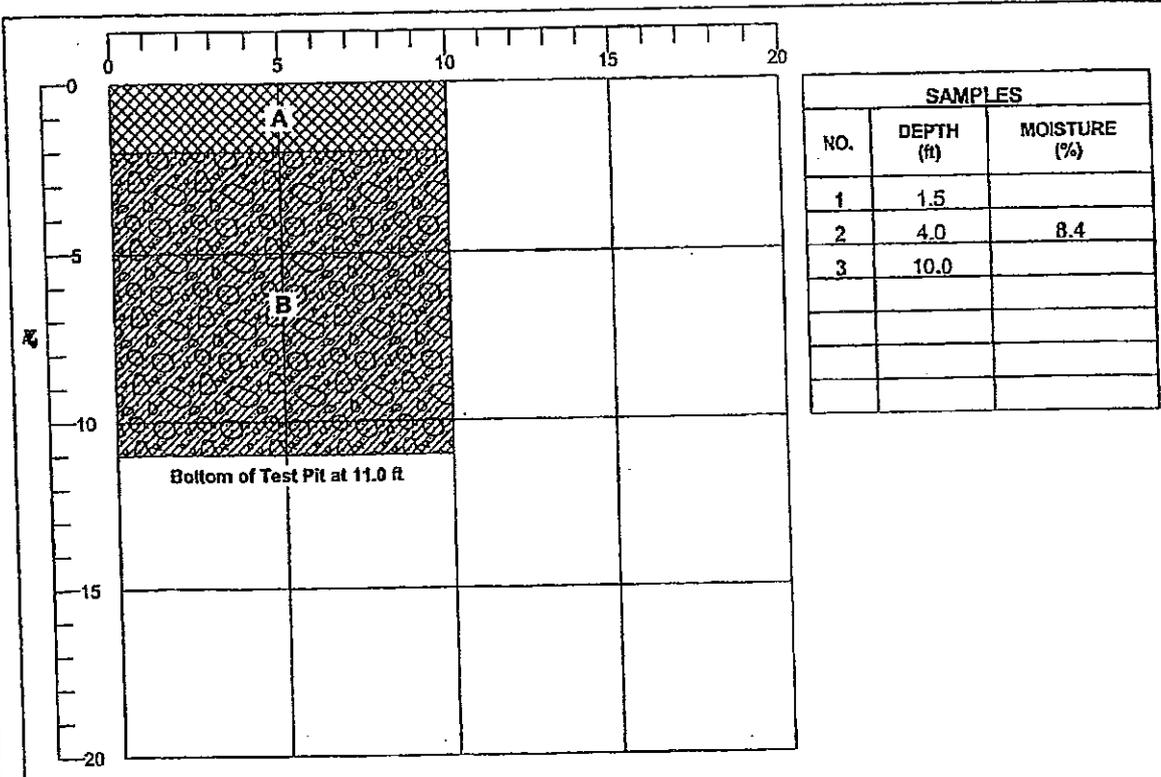
**SPECIAL NOTES:**  
 No caving was observed.  
 No water seepage was observed.

LOG OF TEST PIT 063-1076.200, VILLAGES, TFS, GPJ, GLDR, WA, GDT 4/20/06



# LOG OF TEST PIT TP-33

Temp 50 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 21, 2006  
 Elevation 538.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	1.5	
2	4.0	8.4
3	10.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 2.0 ft: Loose to compact, gray, non-stratified, fine to coarse SAND and fine to coarse GRAVEL with little silt and trace cobbles, moist to wet (SW-GW) (FILL)
- B** 2.0 - 11.0 ft: Dense to very dense, gray, non-stratified, silty fine to coarse SAND with some, subrounded, fine to coarse gravel, trace cobbles, and trace boulders, moist (SM) (LODGEMENT TILL)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
12:45	0.0		
13:00			7.5
13:15	11.0		

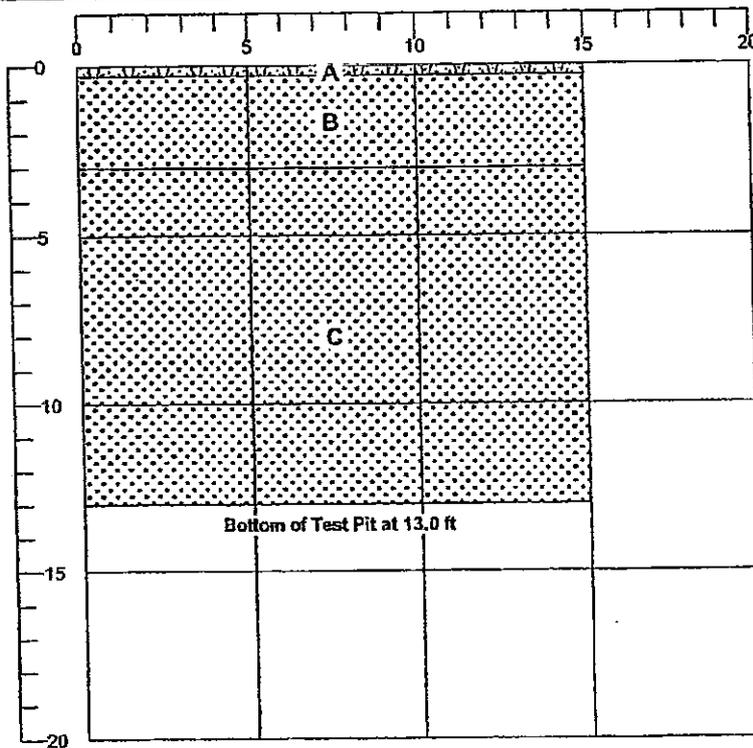
**SPECIAL NOTES:**  
 No caving was observed.  
 Minor water seepage was observed at 7.5 feet.

LOG OF TEST PIT 063-1076.200, VILLAGES, TFS.GPJ, GLDR, WA.GDT, 4/20/06



# LOG OF TEST PIT TP-35

Temp 45 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 21, 2006  
 Elevation 554.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	12.0	4.2

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 0.3 ft: Loose, dark brown, non-stratified, silty fine to coarse SAND with some organics, moist (SM) (TOPSOIL)
- B** 0.3 - 3.0 ft: Loose, orange-brown, non-stratified, silty fine to coarse SAND with trace, subrounded, fine gravel, moist (SM) (WEATHERED RECESSIONAL OUTWASH)
- C** 3.0 - 13.0 ft: Compact, brown-gray, non-stratified, fine to coarse SAND and subrounded, fine to coarse gravel with some cobbles, and trace silt, damp (SW-GW) (RECESSIONAL OUTWASH)

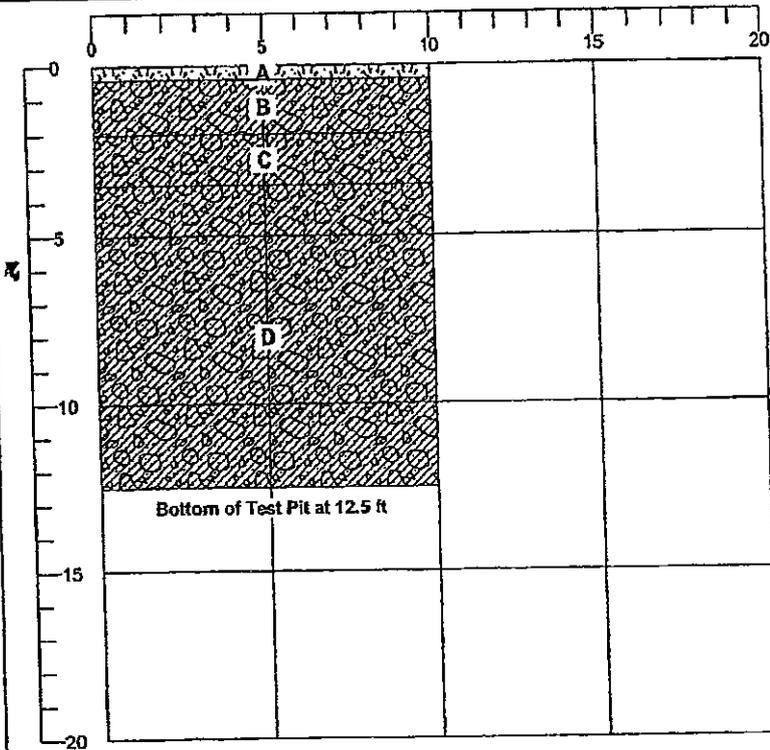
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
14:15	0.0		
14:45	13.0		

**SPECIAL NOTES:**  
 Moderate caving was observed between 2 to 13 feet.  
 No water seepage was observed.



# LOG OF TEST PIT TP-39

Temp 50 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 22, 2006  
 Elevation 568.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	12.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A 0.0 - 0.4 ft: Loose, dark brown, non-stratified, silty fine to medium SAND with some organics, moist (SM) (TOPSOIL/FOREST DUFF)
- B 0.4 - 2.0 ft: Compact, orange-brown, non-stratified, silty fine to coarse SAND with some, subrounded, fine to coarse gravel and trace cobbles, moist (SM) (WEATHERED LODGEMENT TILL)
- C 2.0 - 3.5 ft: Dense, gray, non-stratified, iron-oxide stained, silty fine to coarse SAND with some, socketed, subrounded, fine to coarse gravel and trace cobbles, moist (SM) (SLIGHTLY WEATHERED LODGEMENT TILL)
- D 3.5 - 12.5 ft: Dense to very dense, gray, non-stratified, silty fine to coarse SAND with some, socketed, subrounded, fine to coarse gravel, trace cobbles, and trace boulders, moist (SM) (LODGEMENT TILL)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
12:20	0.0		
12:40			6.0
13:00	12.5		

### SPECIAL NOTES:

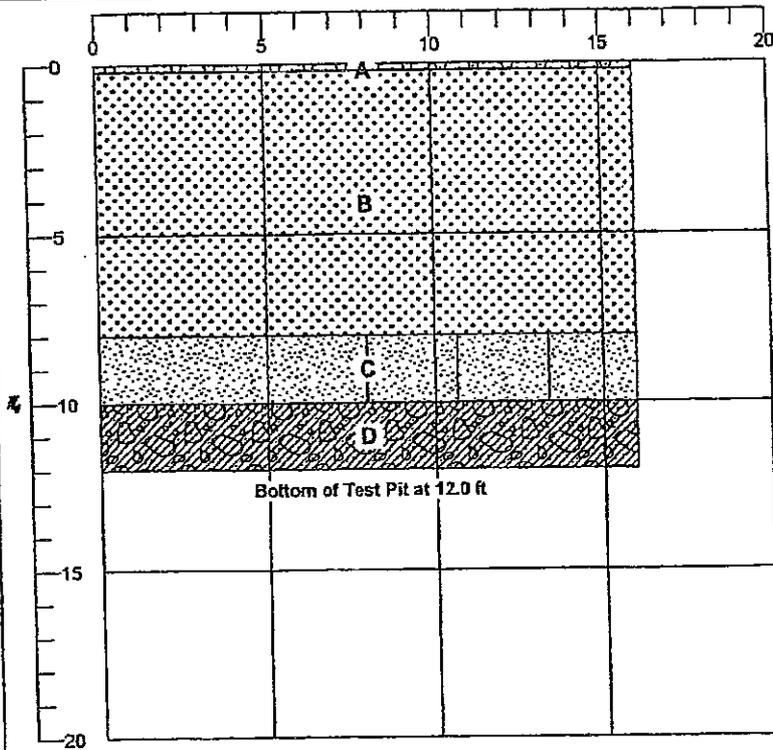
No caving was observed.  
 Minor water seepage was observed at 6 feet.

LOG OF TEST PIT: 063-1076.200 VILLAGES TFS.GPJ GLDR, WA.GDT 4/20/06



# LOG OF TEST PIT TP-40

Temp 50 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 22, 2006  
 Elevation 561.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	11.0	8.7

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 0.2 ft: Loose, dark brown, non-stratified, silty fine to coarse SAND with some organics, moist (SM) (TOPSOIL)
- B** 0.2 - 8.0 ft: Compact, brown-gray, non-stratified, fine to coarse SAND with some, subrounded, fine to coarse gravel, trace cobbles, and trace silt, moist (SW) (RECESSIONAL OUTWASH)
- C** 8.0 - 10.0 ft: Compact, gray, non-stratified, fine to coarse SAND with little silt and little fine to coarse gravel, moist (SW-SM) (RECESSIONAL OUTWASH)
- D** 10.0 - 12.0 ft: Dense, gray-brown, non-stratified, silty fine to coarse SAND with some, subrounded, fine to coarse gravel and trace cobbles, moist (SM) (LODGE MENT TILL)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:05	0.0		
13:45			10.0
14:00	12.0		

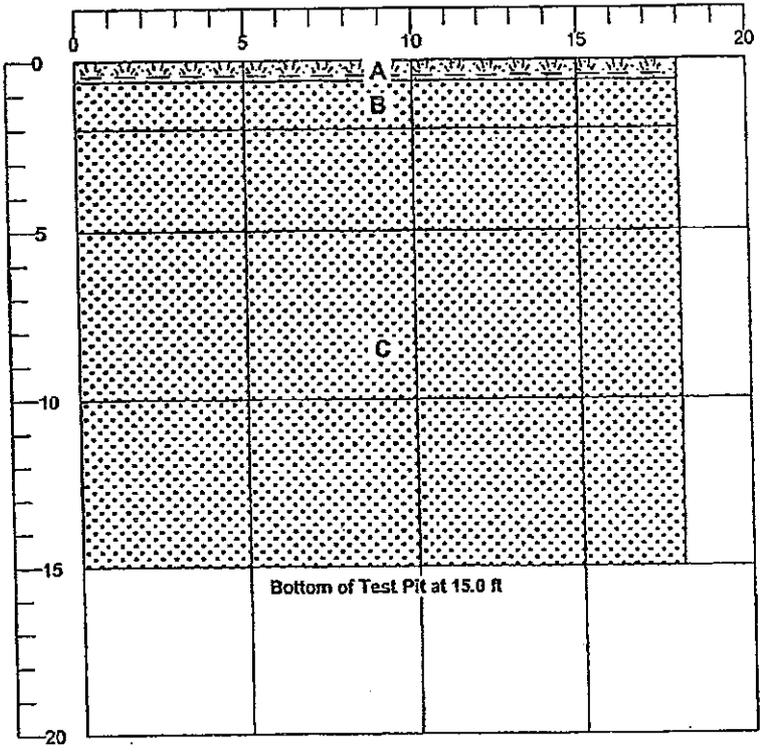
### SPECIAL NOTES:

Moderate to major caving was observed between 0 to 8 feet.  
 Minor water seepage was observed at 10 feet.



# LOG OF TEST PIT TP-41

Temp 50 °F Weather Overcast Engineer A. Dennison Operator Tim  
 Equipment 312 C Cat Trackhoe Contractor MidMountain Contractors Date March 22, 2006  
 Elevation 561.0 ft Datum MSL Job 063-1076.200  
 Location Black Diamond, WA



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	1.5	
2	3.0	
3	3.1	
4	7.0	
5	10.0	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 0.6 ft: Loose, dark brown, non-stratified, silty fine to coarse SAND with some organics, moist (SM) (TOPSOIL)

**B** 0.6 - 2.0 ft: Loose, orange-brown, non-stratified, silty fine to coarse SAND with some, subrounded, fine to coarse gravel and trace cobbles, moist (SM) (WEATHERED RECESSIONAL OUTWASH)

**C** 2.0 - 15.0 ft: Compact, brown-gray, non-stratified, subrounded, fine to coarse GRAVEL with some fine to coarse sand, some cobbles, trace boulders, and trace silt, damp (GW) (RECESSIONAL OUTWASH)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:45	0.0		
14:15	15.0		

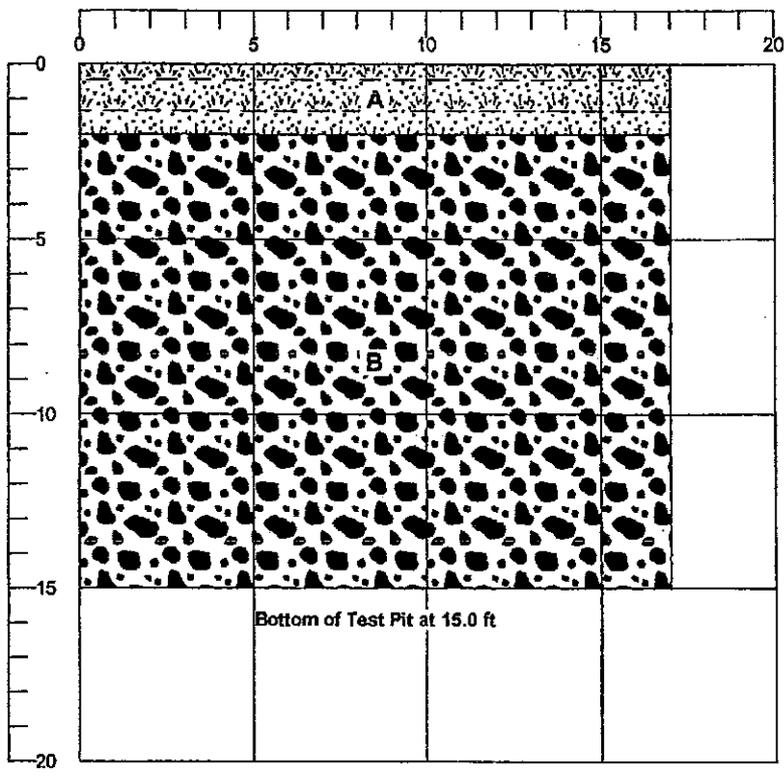
**SPECIAL NOTES:**  
 Major caving was observed between 2 to 15 feet.  
 No water seepage was observed.

LOG OF TEST PIT 063-1076.200\_VILLAGES\_TFS.GPJ GLDR\_WA.GDT 4/20/06



# LOG OF TEST PIT TP-101

Temp 40 °F Weather Cloudy Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 563.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	1.5	
2	4.0	3.77

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 2.0 ft: Loose, reddish brown, stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (TOPSOIL)
- B** 2.0 - 15.0 ft: Compact, light olive gray, fine to coarse GRAVEL and fine to coarse SAND, some cobbles and boulders, trace silt, damp (GW) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
08:50	0.0		
09:20	15.0		

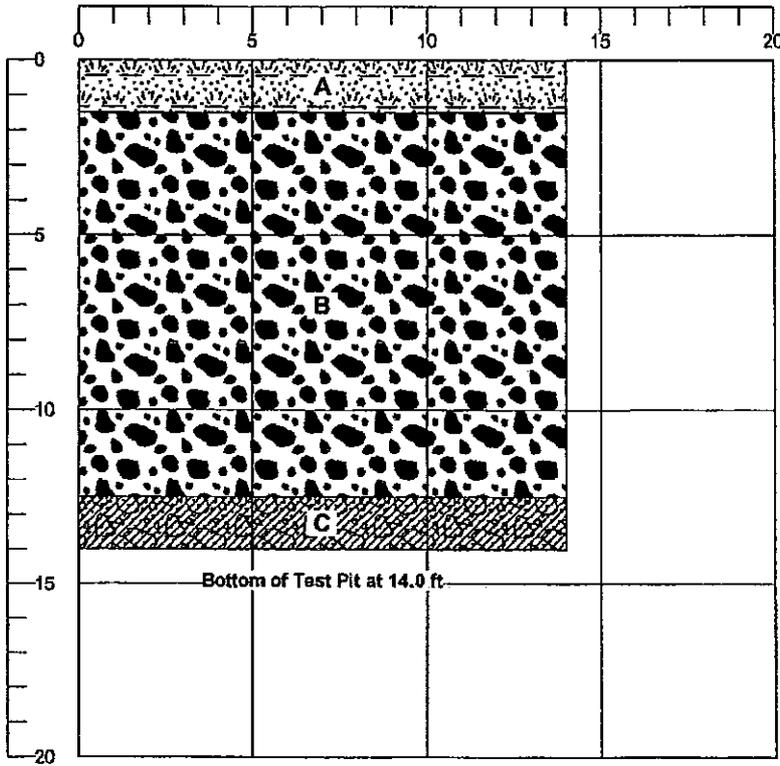
**SPECIAL NOTES:**  
 Caving at 4' to 8' bgs. No groundwater observed.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-102

Temp 40 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 564.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	6.0	5.12
2	13.5	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 1.5 ft: Loose, reddish brown, stratified, silty fine to coarse SAND, some fine to coarse gravel, trace organics and roots, moist (TOPSOIL )
- B** 1.5 - 12.5 ft: Compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders, trace silt, damp (GW) [Qvr]
- C** 12.5 - 14.0 ft: Dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
09:27	0.0		
09:55	14.0		

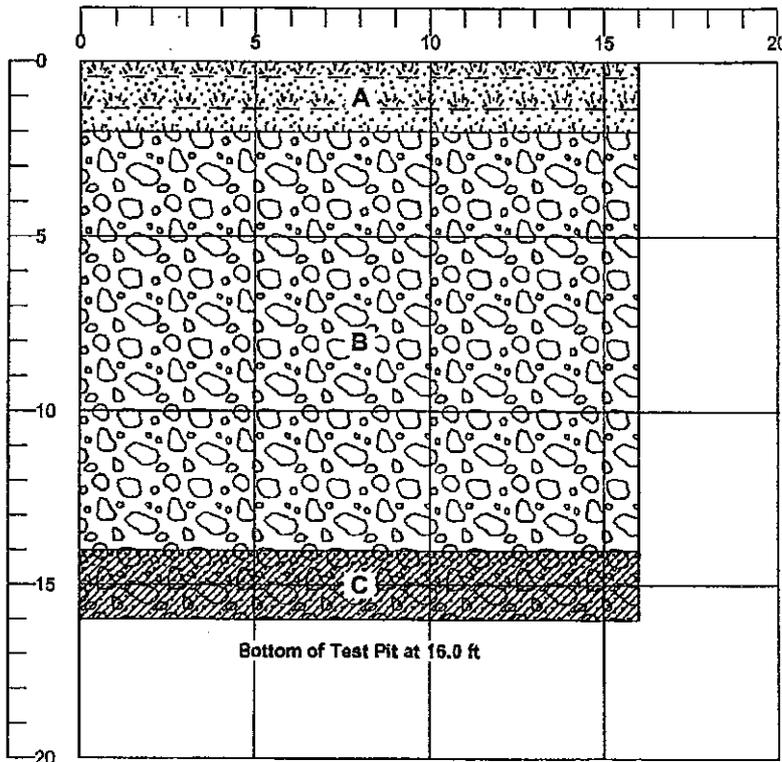
**SPECIAL NOTES:**  
 Caving at 4' to 8' bgs. No groundwater observed.

LOG OF TEST PIT: BD INFILTRATION TEST PITS.GPJ GUDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-103

Temp 45 °F Weather Clear Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/17/09  
 Elevation 563.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	7.0	5.16
2	15.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 2.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, trace organics and roots, damp (TOPSOIL)
- B** 2.0 - 14.0 ft: Loose to compact, yellowish gray to olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND, some cobbles and boulders up to 18", trace silt, damp (GP) [Qvr]
- C** 14.0 - 16.0 ft: Very dense, light olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (SM) [Qvt]

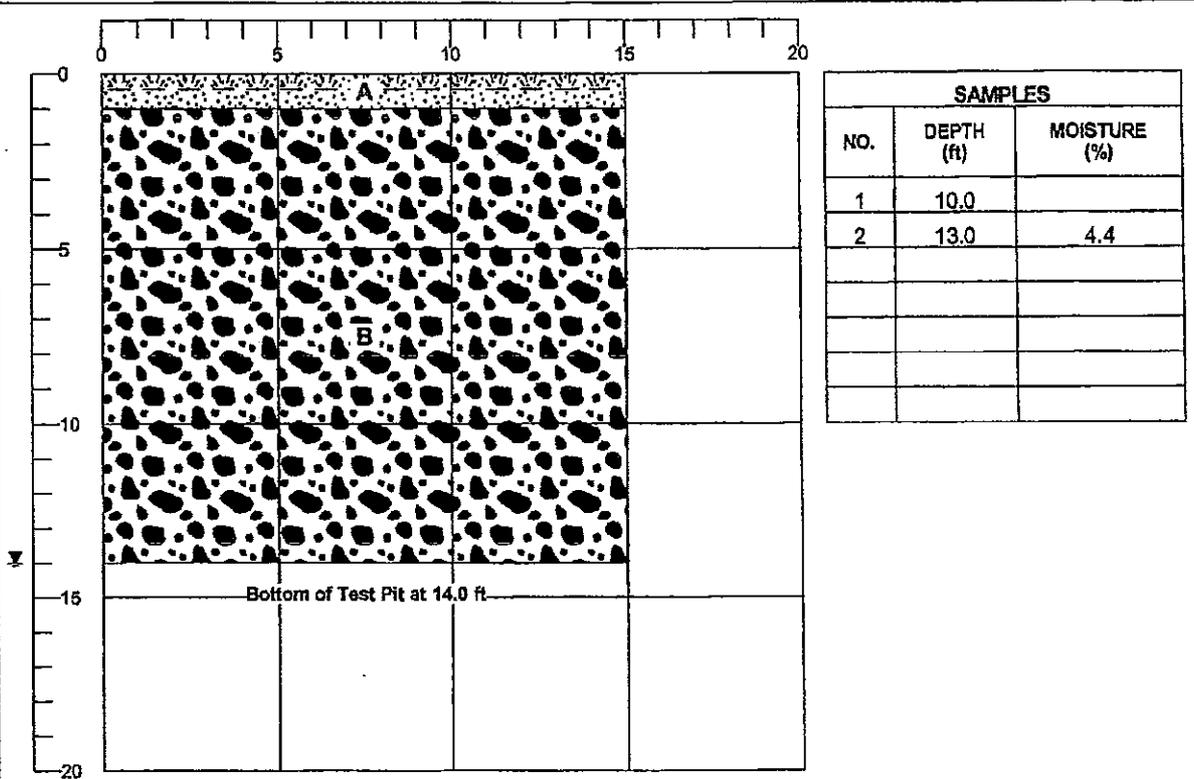
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
08:45	0.0		
09:10	16.0		

**SPECIAL NOTES:**  
 Caving at 4' to 10' bgs. No groundwater observed. Set wellpoint at 16' bgs. 22' well, top of pipe at 5.5' above grade.



# LOG OF TEST PIT TP-104

Temp 40 °F Weather Cloudy, showers Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 562.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 1.0 ft: Loose, reddish brown, stratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, trace organics and roots, moist (TOPSOIL)
- B** 1.0 - 14.0 ft: Compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders, trace silt, damp (GW) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
11:15	0.0		
11:35		14.0	
11:40	14.0		

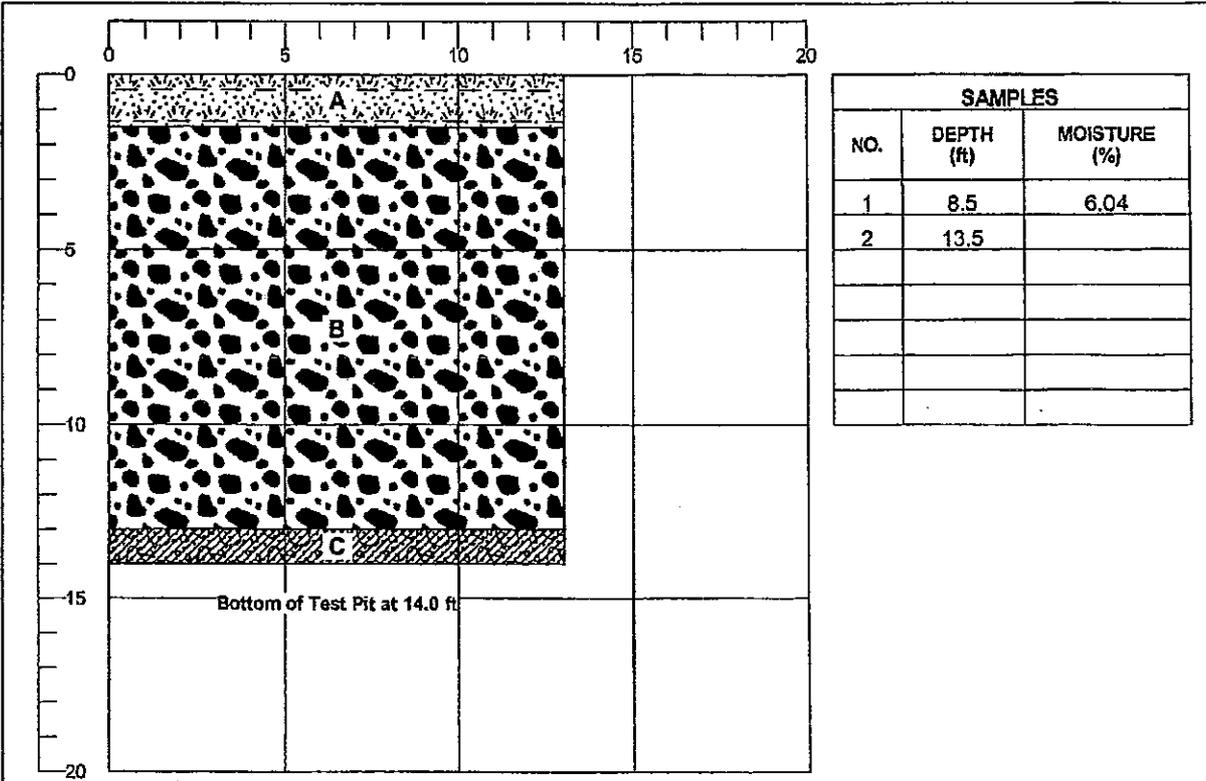
**SPECIAL NOTES:**  
 Caving at 4' to 10' bgs. Groundwater observed at 14' bgs.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-105

Temp 40 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 564.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.5 ft: Loose, reddish brown, stratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, trace organics and roots, moist (TOPSOIL)

**B** 1.5 - 13.0 ft: Compact, light olive brown, stratified, fine to coarse GRAVEL and fine to coarse SAND, some cobbles, trace silt, moist (GW) [QVR]

**C** 13.0 - 14.0 ft: Dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
11:45	0.0		
12:10	14.0		

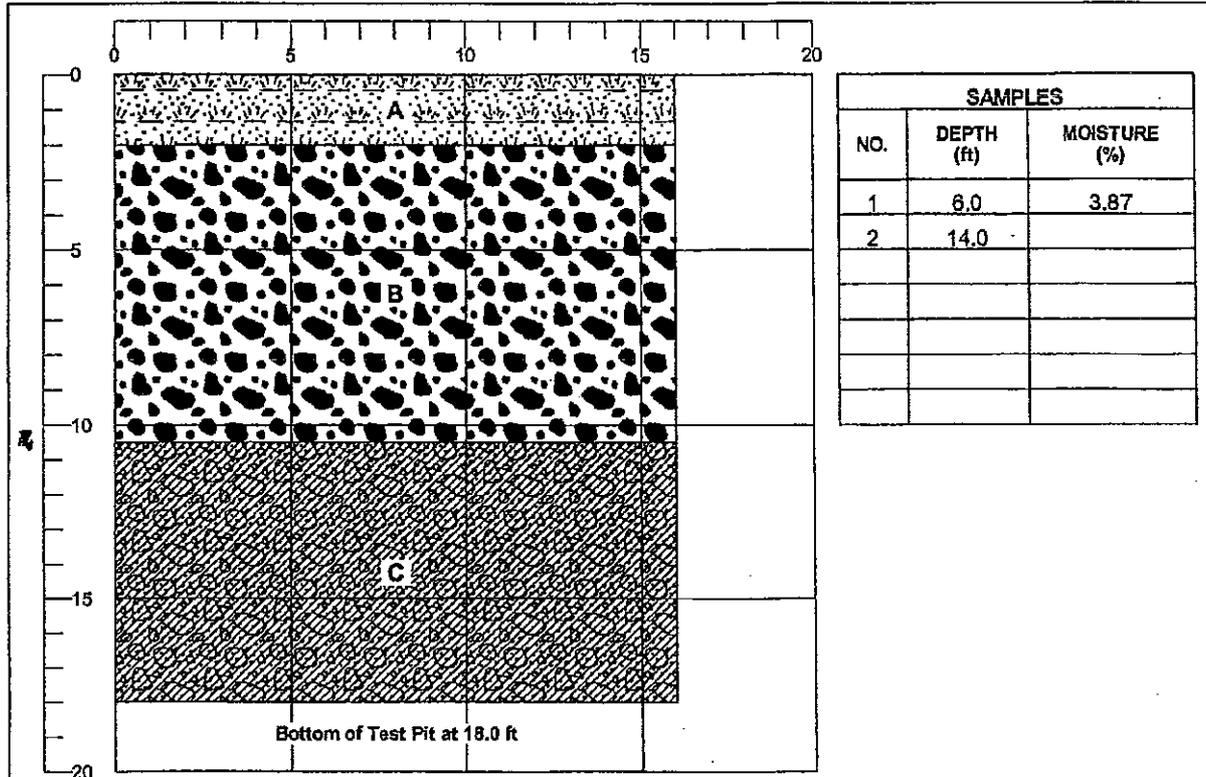
**SPECIAL NOTES:**  
 Caving at 4' to 12' bgs. No groundwater observed.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-106

Temp 45 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 555.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 2.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, trace organics and roots, damp (TOPSOIL)

**B** 2.0 - 10.5 ft: Loose to compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders, trace silt, damp (GW) [Qvr]

**C** 10.5 - 18.0 ft: Dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, damp (SM) [Qvt]

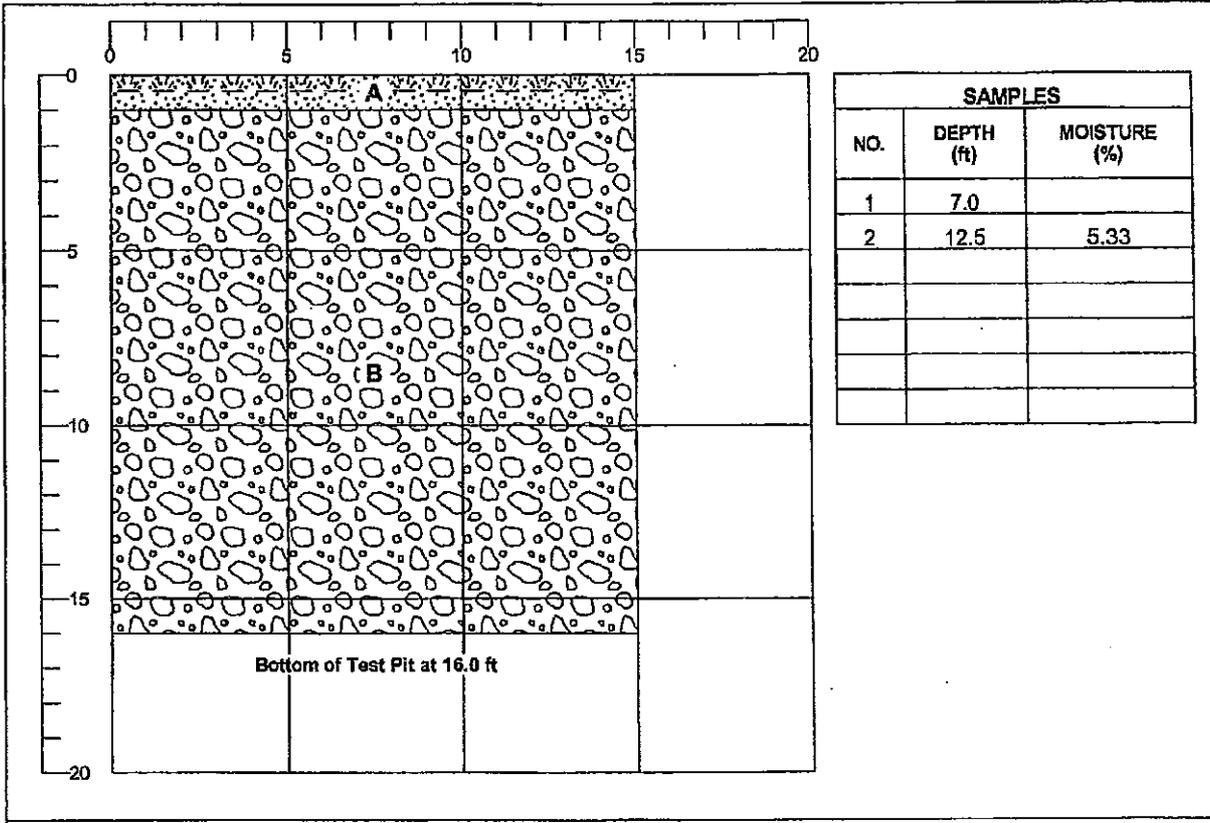
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
02:20			10.5
14:00	0.0		
14:30	18.0		

**SPECIAL NOTES:**  
 Caving at 4' to 9' bgs. Approximately 1 gpm seepage observed at 10.5' bgs at time of excavation. Set 22' wellpoint, 6.5' stick up above ground level.



# LOG OF TEST PIT TP-107

Temp 45 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 563.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, trace organics and roots, moist (TOPSOIL)

**B** 1.0 - 16.0 ft: Compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders, trace silt with interbed from 12' to 13' bgs of fine to coarse SAND and fine gravel, moist to wet (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
12:19	0.0		
12:30	16.0		

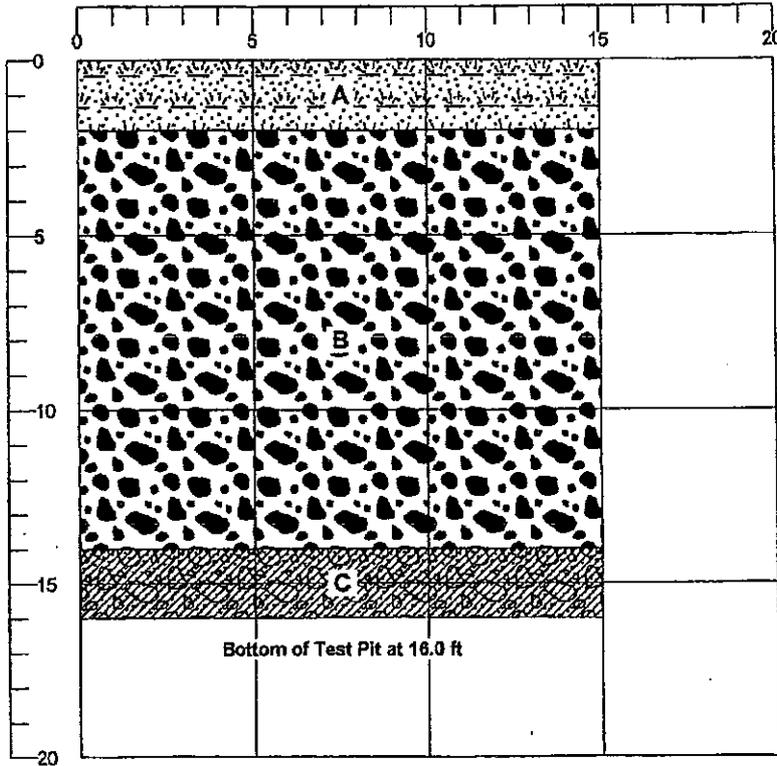
**SPECIAL NOTES:**  
 Caving at 4' to 12' bgs. No groundwater observed.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/1/10



# LOG OF TEST PIT TP-108

Temp 45 °F Weather Cloudy, showers Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 566.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	8.0	4.44
2	15.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 2.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles, trace organics and roots, damp (TOPSOIL)
- B** 2.0 - 14.0 ft: Loose to compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders up to 18", trace silt, damp (GW) [Qvr]
- C** 14.0 - 16.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles, damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
14:45	0.0		
15:20	16.0		

### SPECIAL NOTES:

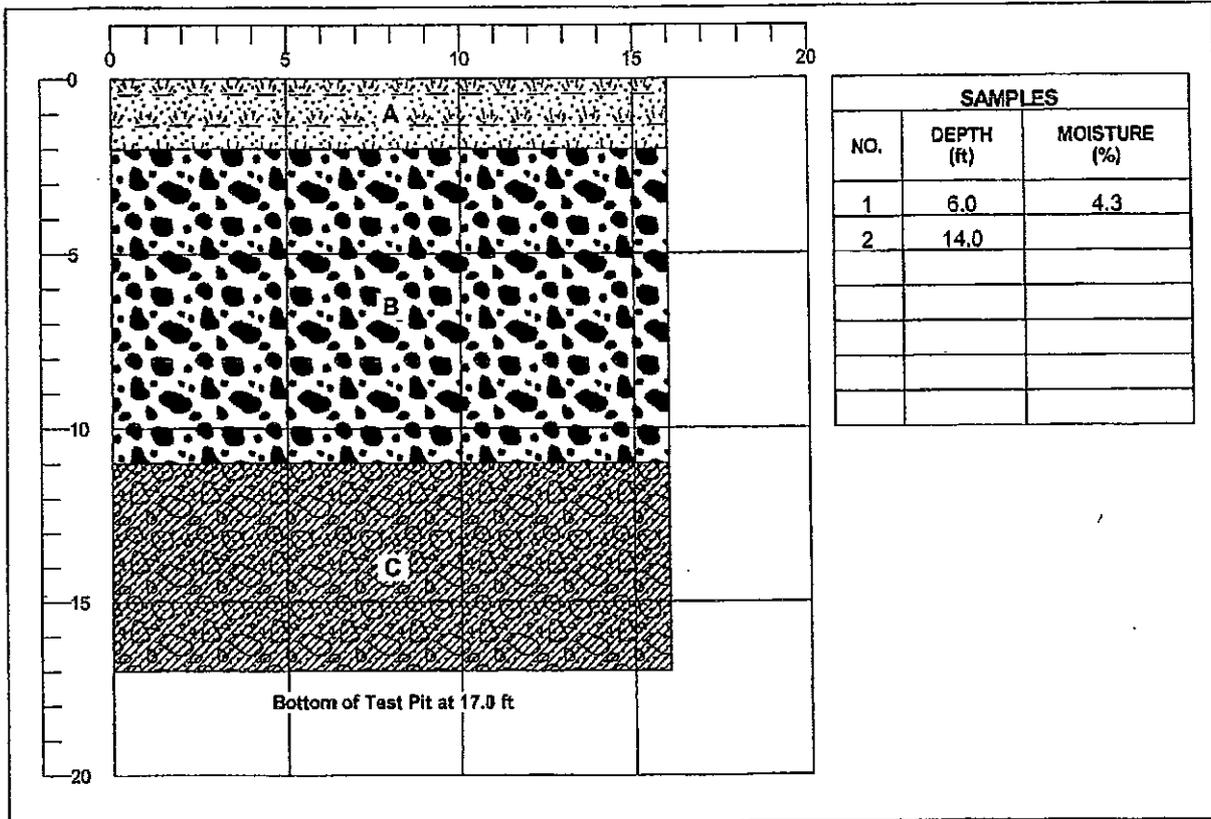
Caving at 5' to 14' bgs. No groundwater observed.

LOG OF TEST PIT: BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-109

Temp 45 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/15/09  
 Elevation 555.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	6.0	4.3
2	14.0	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 2.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles, trace organics and roots, damp (TOPSOIL)
- B** 2.0 - 11.0 ft: Loose to compact, light olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles, trace silt, damp (GW) [Qvr]
- C** 11.0 - 17.0 ft: Dense, light olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles and boulders, damp (SM) [Qvt]

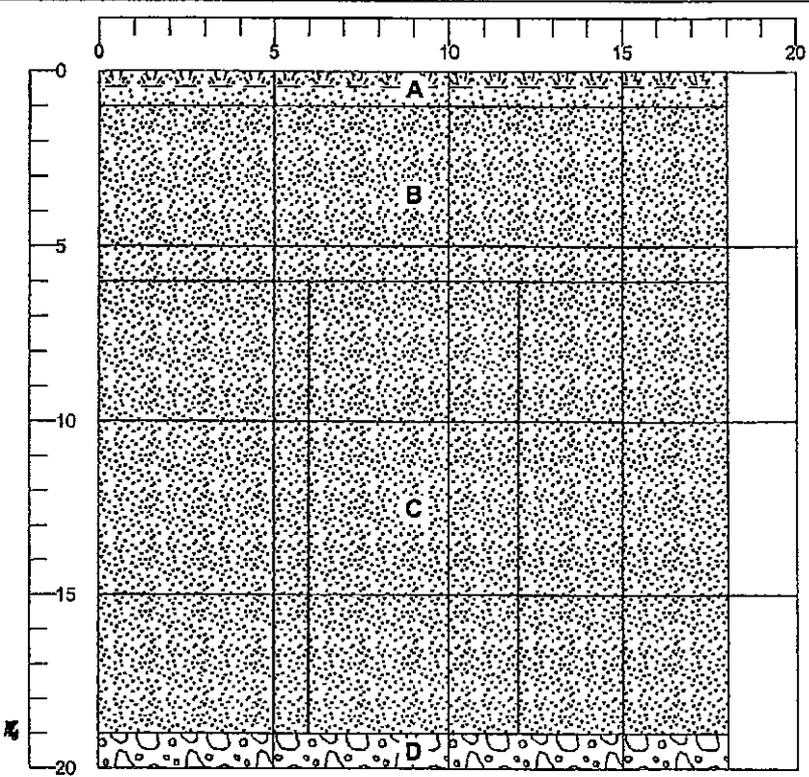
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
15:45	0.0		
16:20	17.0		

**SPECIAL NOTES:**  
 Caving at 4' to 8' bgs. No groundwater observed.



# LOG OF TEST PIT TP-110

Temp 50 °F Weather Cloudy, show Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 558.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	2.5	
2	12.5	
3	17.0	
4	20.0	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 1.0 ft: Loose, brown to reddish brown, non-stratified, silty fine to medium SAND, some silt, little cobbles, trace organics and roots, damp (TOPSOIL)
- B** 1.0 - 6.0 ft: Loose, yellowish gray to olive gray, stratified, fine to medium SAND with Fe oxide staining, some silt, damp (SP) [Qvr]
- C** 6.0 - 19.0 ft: Dense, yellowish brown to olive gray, stratified, silty fine to coarse SAND and GRAVEL, some cobbles and boulders and lenses of yellowish brown clayey silt 6" to 1' thick, damp to moist (SM) [Qvic]
- D** 19.0 - 21.0 ft: Dense, light grayish brown, non-stratified, sandy fine to coarse GRAVEL and cobbles, little silt, wet (GP) [Qvic]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:15	0.0		
10:45			19.0
10:55	21.0		

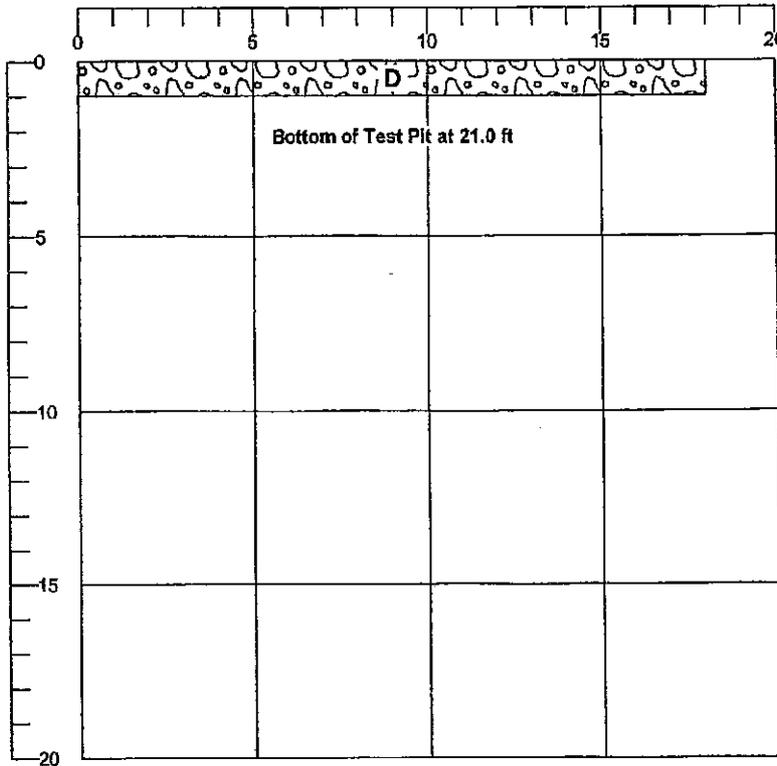
**SPECIAL NOTES:**  
 Caving at 1' to 6' bgs. Approximately 0.5 gpm seepage observed at 19' to 20' bgs, at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GOLDER.WA.GDT 2/11/10



# LOG OF TEST PIT TP-110

Temp 50 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 558.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	2.5	
2	12.5	
3	17.0	
4	20.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 1.0 ft: Loose, brown to reddish brown, non-stratified, silty fine to medium SAND, some silt, little cobbles, trace organics and roots, damp (TOPSOIL)
- B** 1.0 - 6.0 ft: Loose, yellowish gray to olive gray, stratified, fine to medium SAND with Fe oxide staining, some silt, damp (SP) [Qvr]
- C** 6.0 - 19.0 ft: Dense, yellowish brown to olive gray, stratified, silty fine to coarse SAND and GRAVEL, some cobbles and boulders and lenses of yellowish brown clayey silt 6" to 1' thick, damp to moist (SM) [Qvic]
- D** 19.0 - 21.0 ft: Dense, light grayish brown, non-stratified, sandy fine to coarse GRAVEL and cobbles, little silt, wet (GP) [Qvic]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:15	0.0		
10:45			19.0
10:55	21.0		

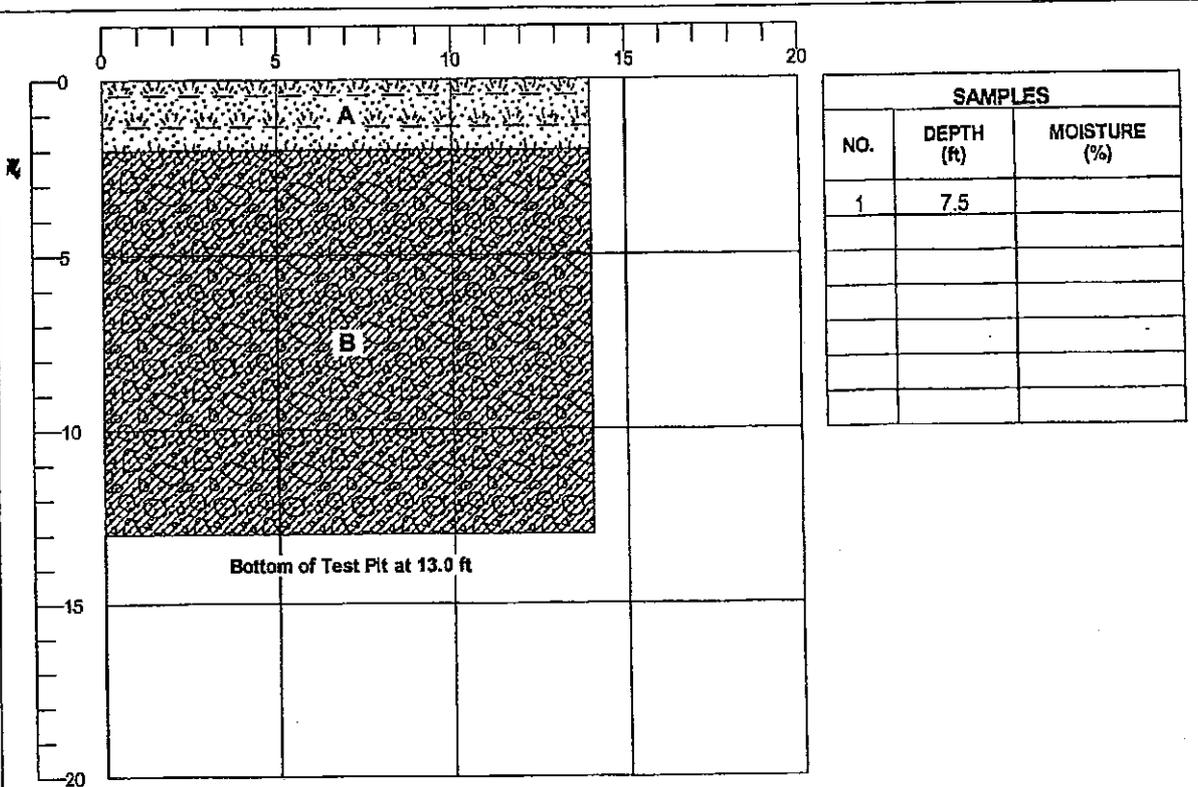
**SPECIAL NOTES:**  
 Caving at 1' to 6' bgs. Approximately 0.5 gpm seepage observed at 19' to 20' bgs, at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR WA.GDT 2/11/10



# LOG OF TEST PIT TP-111

Temp 50 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 555.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 2.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, roots and organics, damp (TOPSOIL)

**B** 2.0 - 13.0 ft: Dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, and boulders up to 18", damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
11:07	0.0		
11:15			2.5
11:30	13.0		

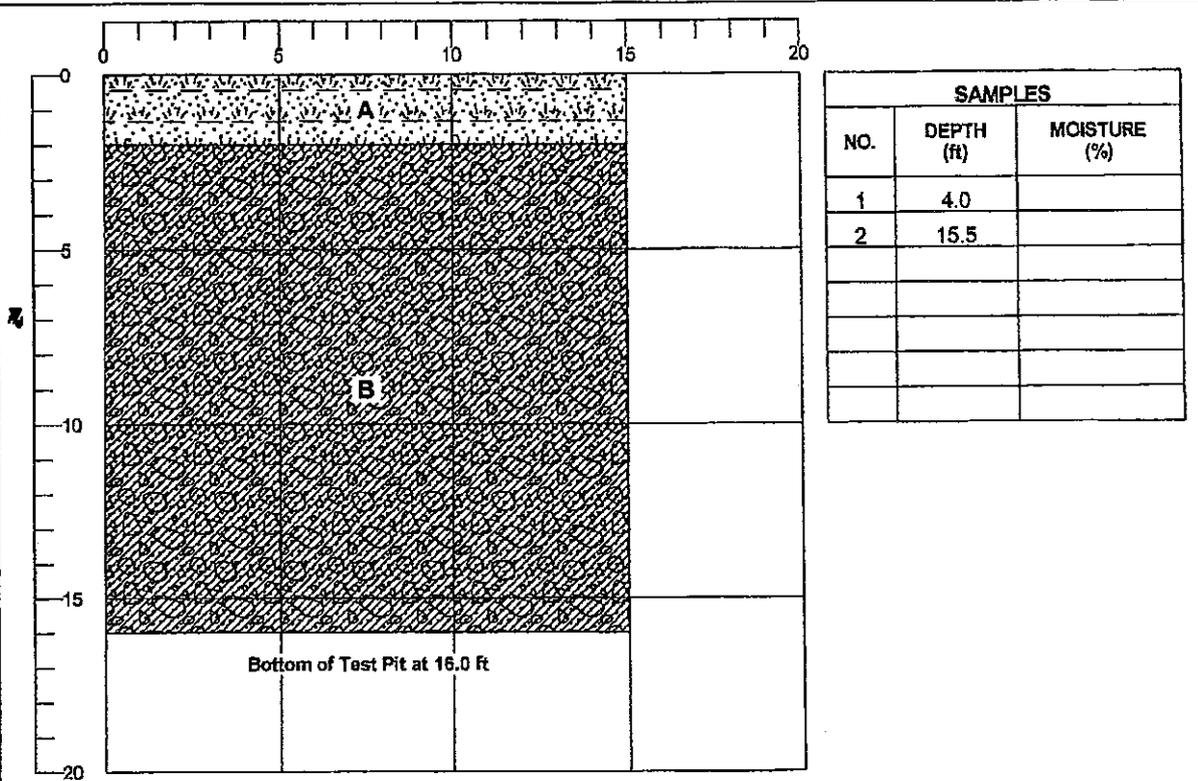
**SPECIAL NOTES:**  
 No caving observed. Slight seepage observed at 2.5' bgs, at time of excavation.

LOG OF TEST PIT, BD, INFILTRATION TEST PITS, GRJ, GLDR, WA, GDT, 2/11/10



# LOG OF TEST PIT TP-112

Temp 50 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 571.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 2.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, roots and organics, damp (TOPSOIL)

**B** 2.0 - 16.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, and boulders up to 2', damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
12:30	0.0		
12:40			7.0
12:50	16.0		

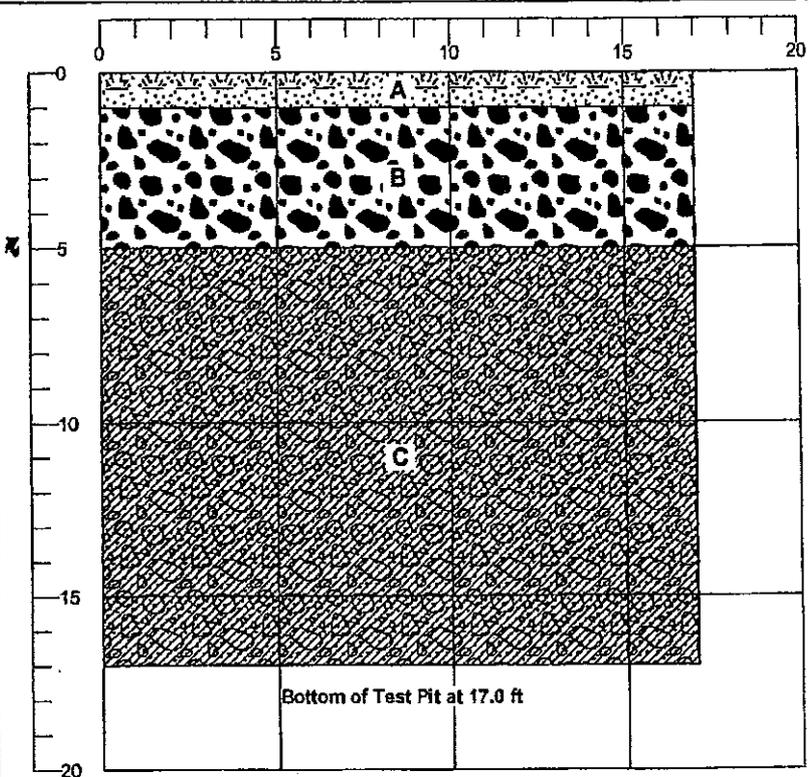
**SPECIAL NOTES:**  
 No caving observed. Approximately 0.5 gpm seepage observed at 7' to 8.5' bgs. at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ\_GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-113

Temp 50 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 562.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	2.5	6.6
2	11.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 1.0 ft: Loose, dark brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles, organics and roots, damp (TOPSOIL)
- B** 1.0 - 5.0 ft: Loose, yellowish gray to olive gray, stratified, fine to coarse GRAVEL, and fine to coarse SAND, some cobbles and boulders up to 1', trace silt, damp to wet (GW) [Qvr]
- C** 5.0 - 17.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little cobbles and boulders up to 1', damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:28	0.0		
14:00	17.0		
14:40			5.0

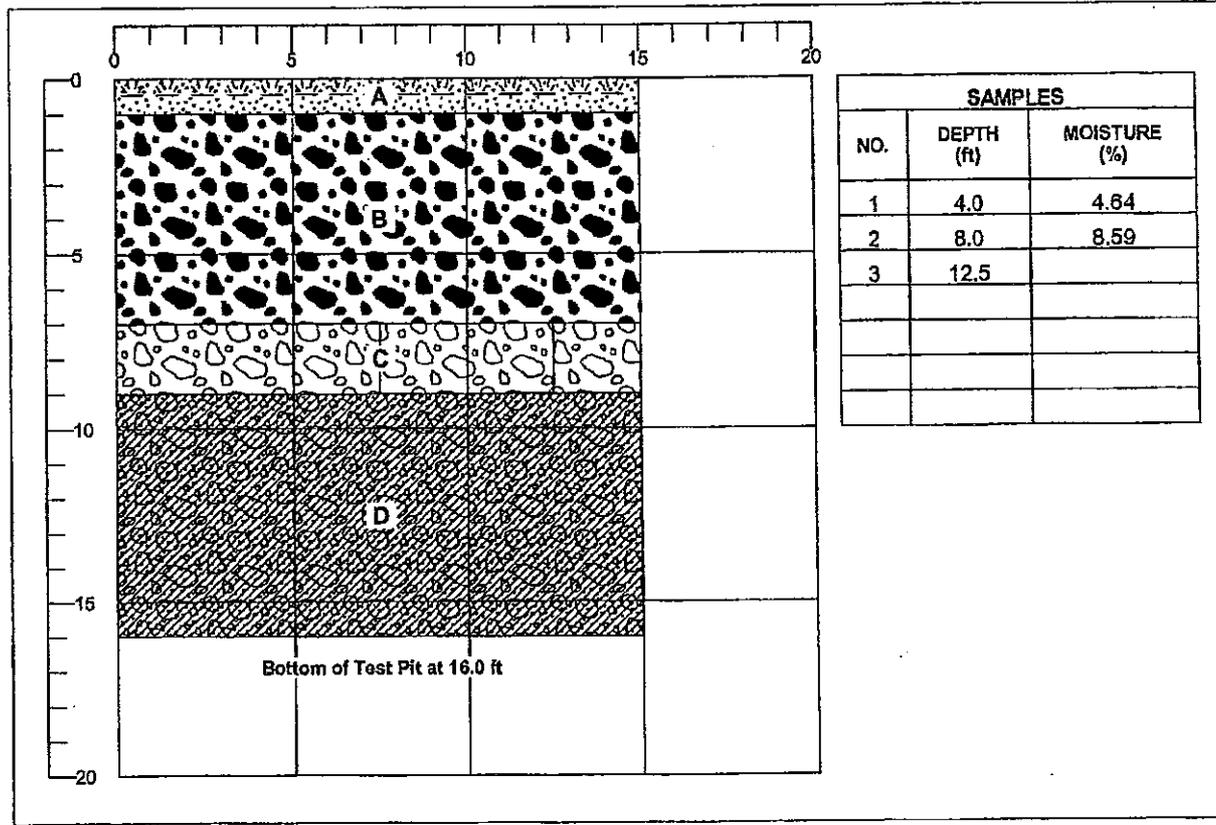
**SPECIAL NOTES:**  
 Slight caving at 2' to 3' bgs.  
 Approximately 0.5 gpm seepage observed at 5' bgs, at time of excavation.

LOG OF TEST PIT: BQ INFILTRATION TEST PITS.GPJ QILDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-114

Temp 50 °F Weather Cloudy, snow Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 565.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, dark brown to yellowish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (TOPSOIL)

**B** 1.0 - 7.0 ft: Loose to compact, yellowish brown to olive gray, stratified, fine to coarse GRAVEL, some fine to coarse sand, some cobbles and boulders up to 1', trace silt, damp (GW) [Qvr]

**C** 7.0 - 9.0 ft: Compact, olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND, little silt, wet (GP/GM) [Qvr]

**D** 9.0 - 16.0 ft: Very dense, light olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles and boulders up to 1', damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
14:20	0.0		
14:30			7-9
14:40	16.0		

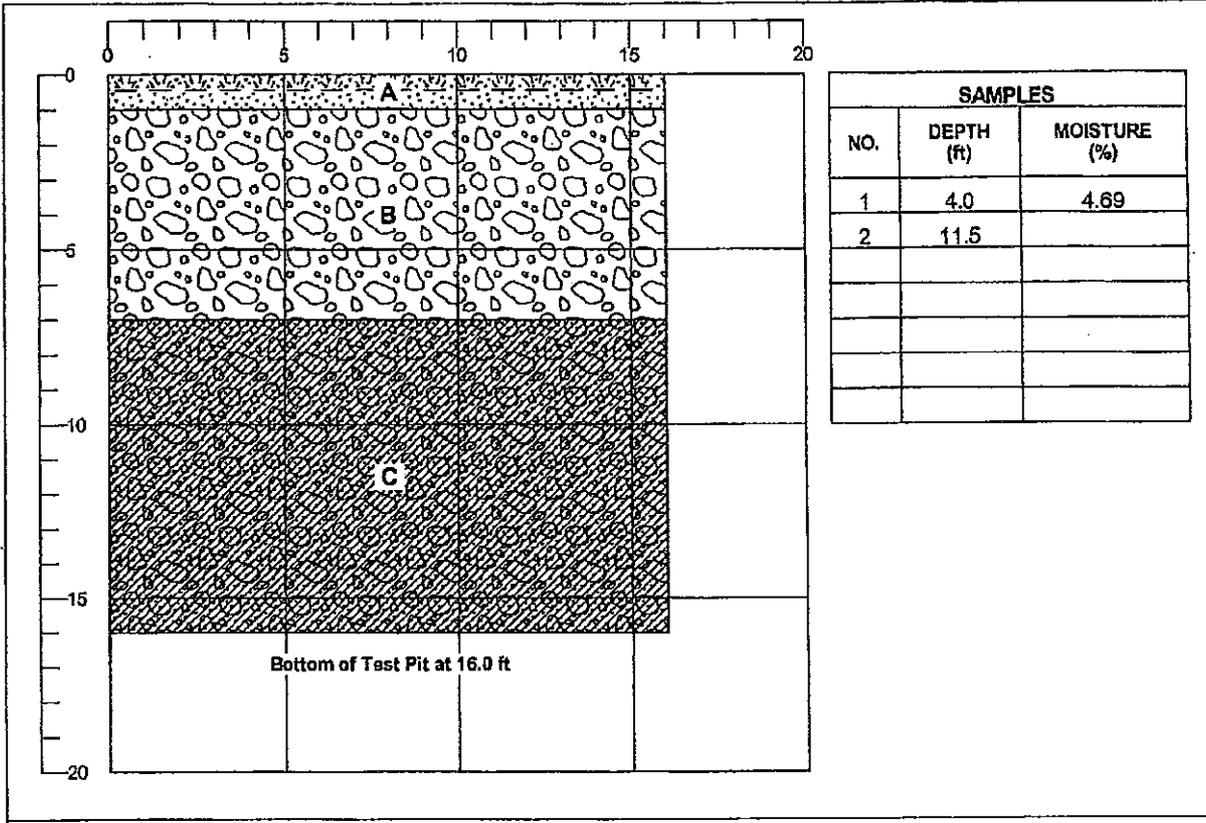
**SPECIAL NOTES:**  
 Slight caving observed. Approximately 0.5 gpm seepage observed at 7' to 9' bgs, at time of excavation.

LOG OF TEST PIT: BD INFILTRATION TEST PITS.GPJ GLDR WA.GDT 2/11/10



# LOG OF TEST PIT TP-115

Temp 50 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/16/09  
 Elevation 550.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little roots, damp (TOPSOIL)

**B** 1.0 - 7.0 ft: Loose to compact, yellowish gray to olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND, some cobbles and boulders up to 1.5', trace silt, damp (GP) [Qvr]

**C** 7.0 - 16.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, and boulders, damp to moist (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
15:04	0.0		
15:25	16.0		

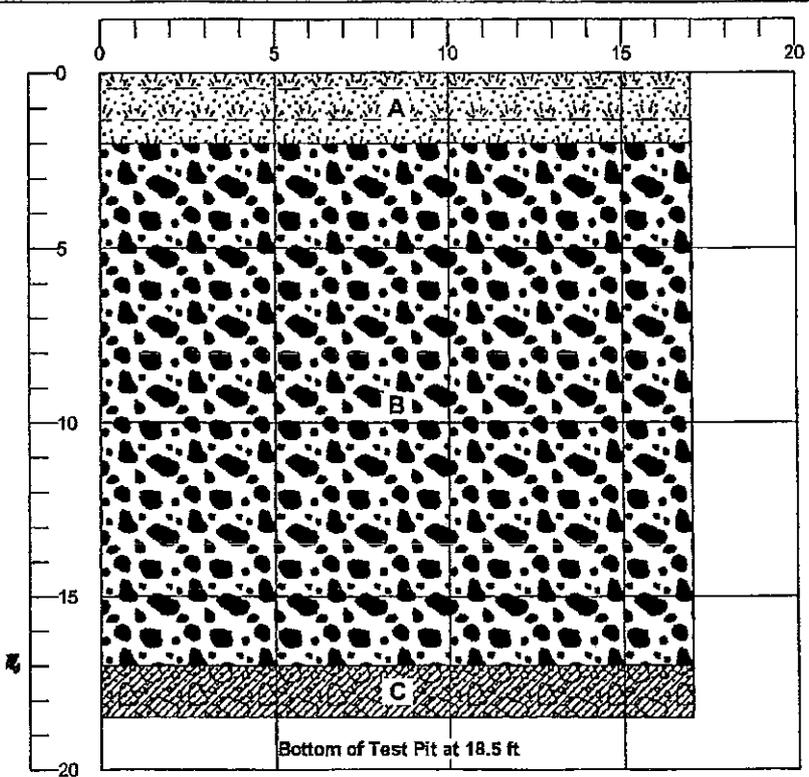
**SPECIAL NOTES:**  
 Caving at 1' to 7' bgs. No groundwater observed.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR.WA.GDT 2/11/10



# LOG OF TEST PIT TP-116

Temp 45 °F Weather Clear Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/17/09  
 Elevation 561.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	8.5	3.17
2	17.5	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 2.0 ft: Loose, yellowish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, roots and organics, damp (TOPSOIL)
- B** 2.0 - 17.0 ft: Loose to compact, yellowish gray to olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND, some cobbles and boulders up to 1', trace silt, interbed of coarse SAND and fine GRAVEL at 5' to 8' bgs, 1.5' to 2' boulders at 15' bgs, damp (GW) [Qvr]
- C** 17.0 - 18.5 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, and boulders up to 8", damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:00	0.0		
10:20			17.0
10:25	18.5		

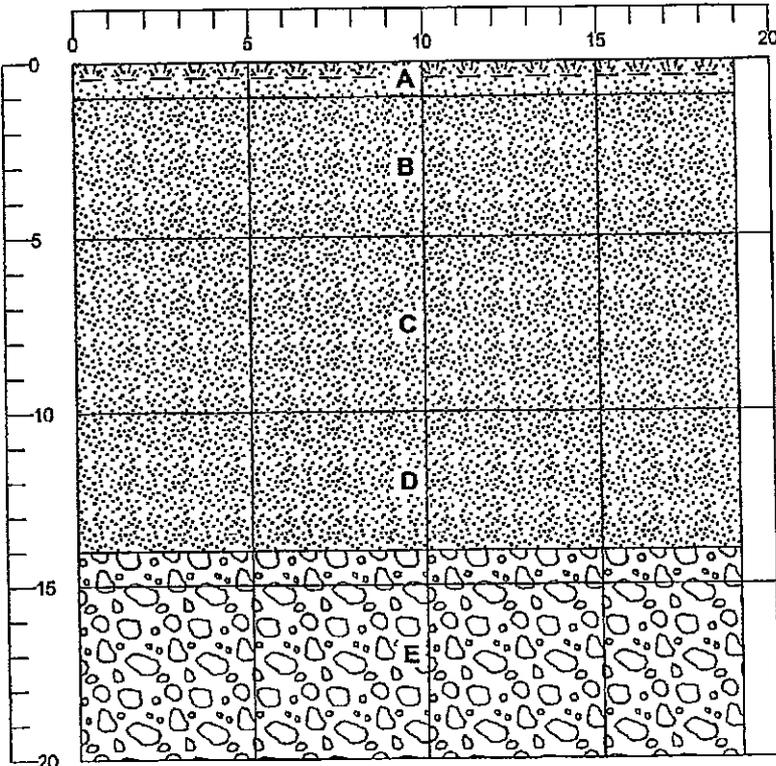
**SPECIAL NOTES:**  
 Caving at 4' to 8' bgs. Slight seepage observed at 17' bgs, at time of excavation.

LOG OF TEST PIT - SB INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-117

Temp 50 °F Weather Overcast Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/17/09  
 Elevation 555.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	7.5	20.1
2	12.0	3.56
3	16.0	

Bottom of Test Pit at 20.0 ft

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
<b>A</b>	0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little roots, damp (TOPSOIL)
<b>B</b>	1.0 - 5.0 ft: Loose, reddish brown to olive gray, stratified, gravelly fine to coarse SAND, little cobbles, trace silt, roots damp (SP) [Qvr]
<b>C</b>	5.0 - 10.0 ft: Loose, olive gray, stratified, fine to coarse SAND, little fine gravel, trace silt, damp (SP) [Qvr]
<b>D</b>	10.0 - 14.0 ft: Loose to compact, mottled light gray, olive gray, and reddish brown, stratified, fine to coarse SAND, some silt, roots, damp (SP) [Qvr]
<b>E</b>	14.0 - 20.0 ft: Compact, olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND, some cobbles, trace silt, damp (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:40	0.0		
11:20	20.0		

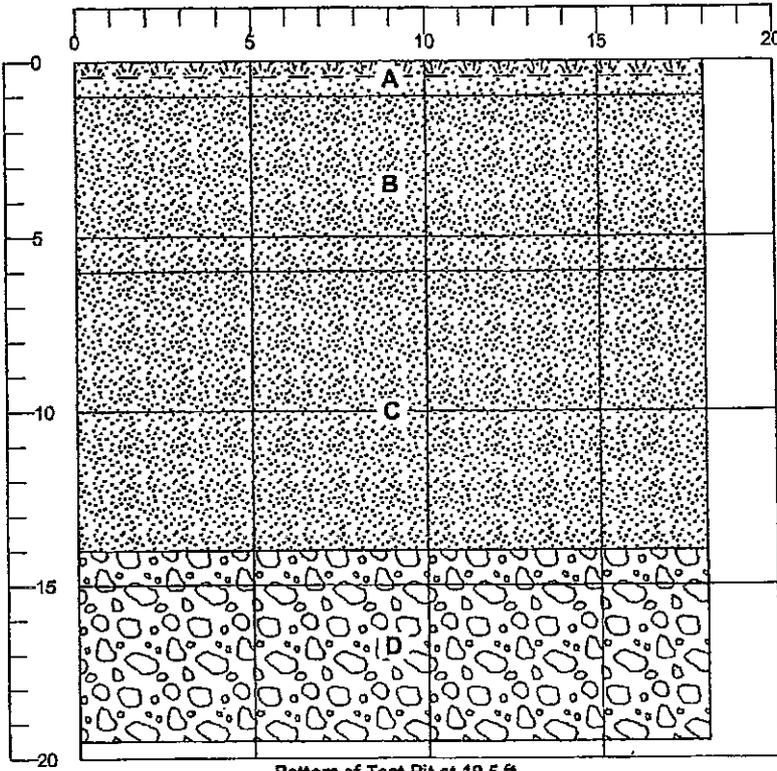
**SPECIAL NOTES:**  
 Some caving at 2' to 10' bgs, heavy caving at 14' to 20' bgs. No groundwater observed. Set well at 21' bgs. 22' well with 1.3' above ground surface.

LOG OF TEST PIT, BD INFILTRATION TEST PITS, GPJ\_GIDR\_WA.GDT, 2/11/10



# LOG OF TEST PIT TP-118

Temp 50 °F Weather Overcast Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/17/09  
 Elevation 556.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	10.0	
2	16.5	4.09

Bottom of Test Pit at 19.5 ft

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little roots and organics, damp (TOPSOIL)
- B** 1.0 - 6.0 ft: Loose to compact, yellowish gray, stratified, fine to coarse SAND and fine to coarse GRAVEL, some cobbles and boulders up to 1.5', trace silt, roots, damp (SP) [Qvr]
- C** 6.0 - 14.0 ft: Compact, olive gray, stratified, gravelly fine to coarse SAND, some cobbles and boulders, trace silt, damp (SP) [Qvr]
- D** 14.0 - 19.5 ft: Compact, olive gray, stratified, fine to coarse GRAVEL and fine to coarse SAND and COBBLES, some boulders up to 1.5', some fine to coarse sand, trace silt, damp (OUTWASH)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
12:20	0.0		
12:35	19.5		

### SPECIAL NOTES:

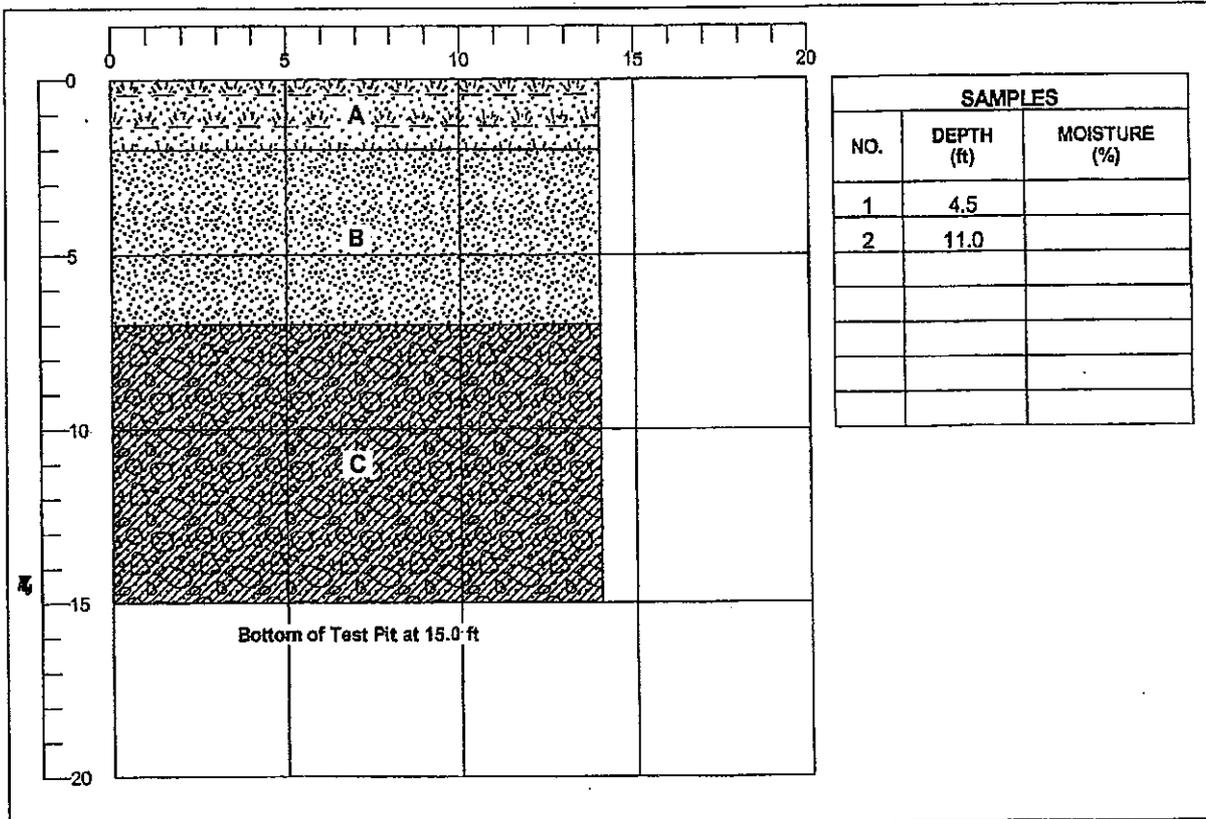
Caving at 4' to 10' bgs. No groundwater observed.

LOG OF TEST PIT - BD INFILTRATION TEST PITS.GPJ GLDR.WAGDT 2/11/10



# LOG OF TEST PIT TP-119

Temp 50 °F Weather Overcast Engineer T. Marshall Operator Matt  
 Equipment Komatsu PC 200 Contractor Cascade Date 12/17/09  
 Elevation 550.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 2.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, organics and roots, damp (TOPSOIL)

**B** 2.0 - 7.0 ft: Loose, yellowish gray to olive gray, stratified, gravelly fine to coarse SAND, some cobbles and boulders up to 1', trace silt, damp (SP) [Qvr]

**C** 7.0 - 15.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles and boulders up to 1', damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
01:15			14.5
13:00	0.0		
13:20	15.0		

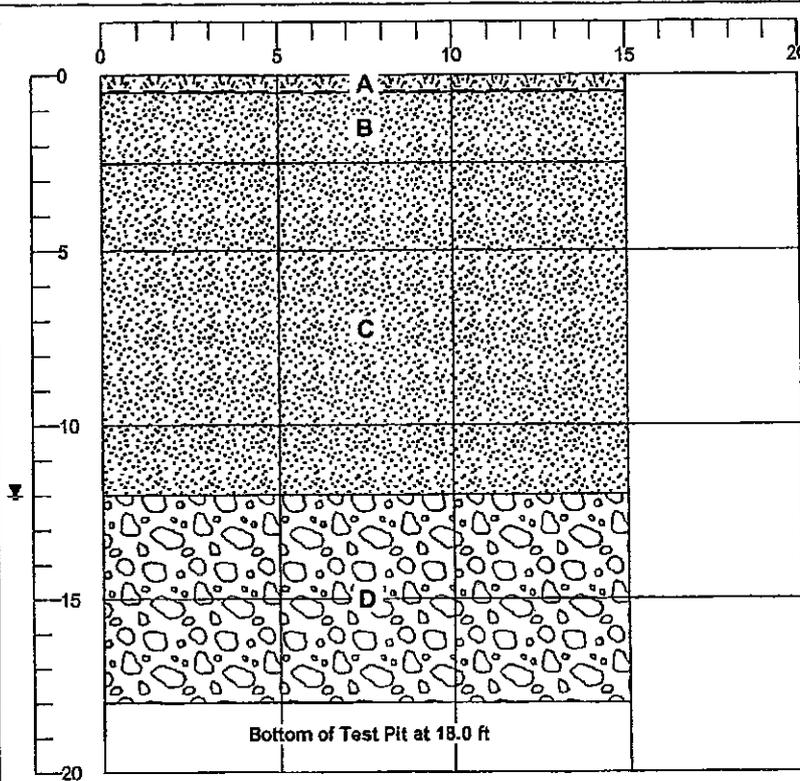
**SPECIAL NOTES:**  
 Slight caving at 2' to 5' bgs. Slight seepage observed at 14.5' bgs, at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR.WASDOT 2/11/10



# LOG OF TEST PIT TP-201

Temp 50 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/12/10  
 Elevation 514.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	7.5	
2	12.0	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 0.5 ft: Very loose, organics, leaf duff, moist (TOPSOIL)
- B** 0.5 - 2.5 ft: Loose, light olive gray to dark brown, stratified, silty fine to medium SAND, some roots and organics, damp (SM)
- C** 2.5 - 12.0 ft: Loose, light gray to yellowish brown, stratified, fine to medium SAND, little silt, damp (SP) [Qvr]
- D** 12.0 - 18.0 ft: Compact to dense, orangish brown, stratified, fine to coarse GRAVEL, COBBLES, and BOULDERS to 12", some fine to coarse sand, wet (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
08:45	0.0		
08:55		12.0	
09:07	18.0		

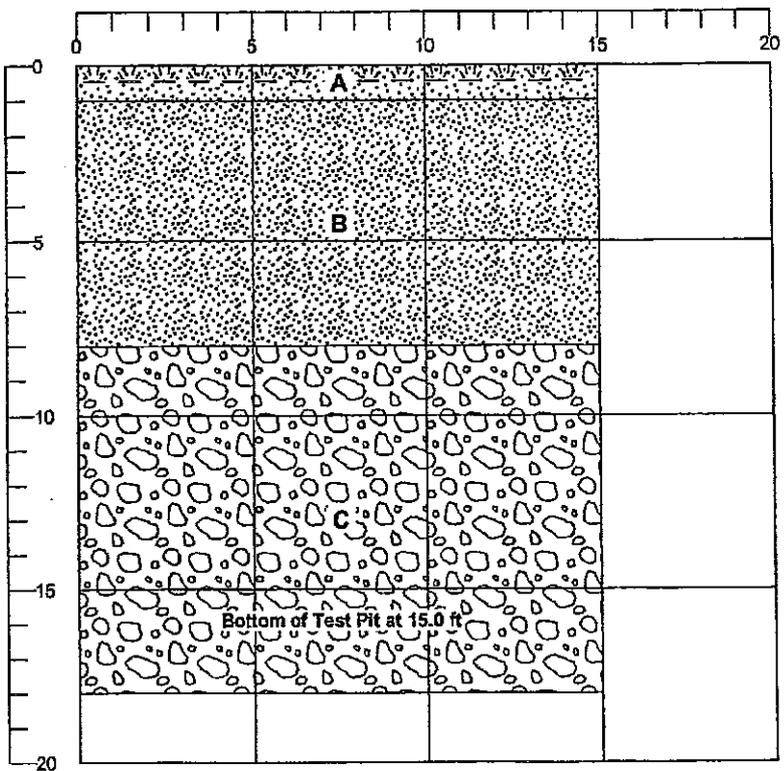
### SPECIAL NOTES:

Heavy caving at 4' to 14' bgs. Heavy groundwater inflow at 12' bgs at time of excavation.



# LOG OF TEST PIT TP-202

Temp 45 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/11/10  
 Elevation 523.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	4.5	
2	13.0	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel and organics, moist (TOPSOIL)

**B** 1.0 - 8.0 ft: Loose to compact, olive gray, stratified, fine to coarse SAND, little silt and fine to coarse gravel with iron oxide staining, moist (SP) [Qvr]

**C** 8.0 - 18.0 ft: Compact, olive gray to yellowish gray, stratified, gravelly fine to coarse SAND, some cobbles and boulders, damp (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO WIL (ft)	DEPTH TO SEEPAGE (ft)
11:22	0.0		
11:50	18.0		

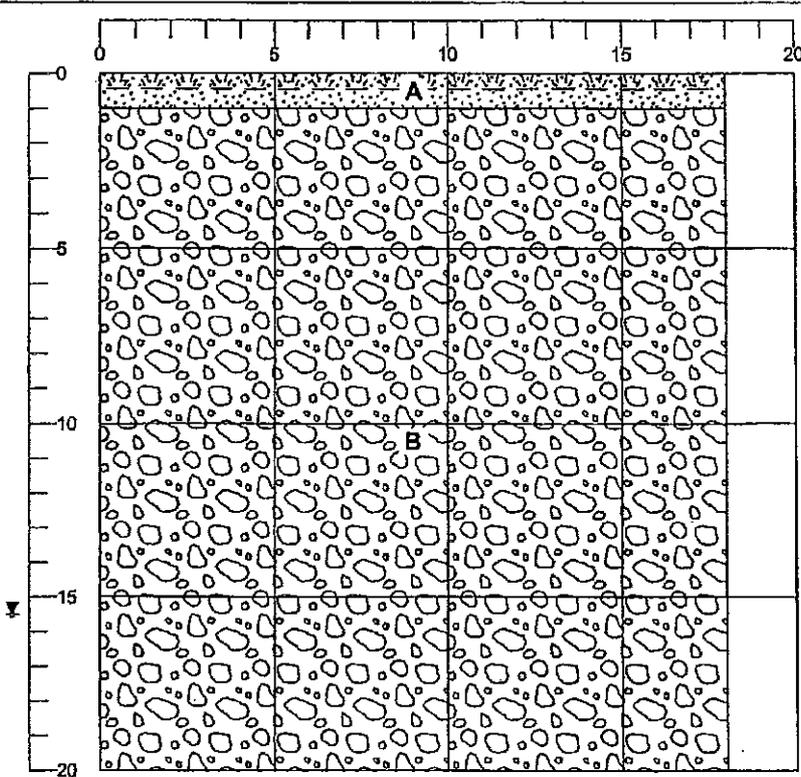
**SPECIAL NOTES:**  
 Some caving from 3' to 10' bgs. Heavy caving at 18' bgs.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-203

Temp 50 °F Weather Cloudy, shower Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/12/10  
 Elevation 561.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	16.5	

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 1.0 ft: Loose, dark brown, to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (TOPSOIL)
- B** 1.0 - 22.0 ft: Compact to dense, yellowish brown to olive gray, stratified, sandy fine to coarse GRAVEL, COBBLES, and BOULDERS to 12", trace silt, wet (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
09:40	0.0		
09:50		15.5	
09:55	22.0		

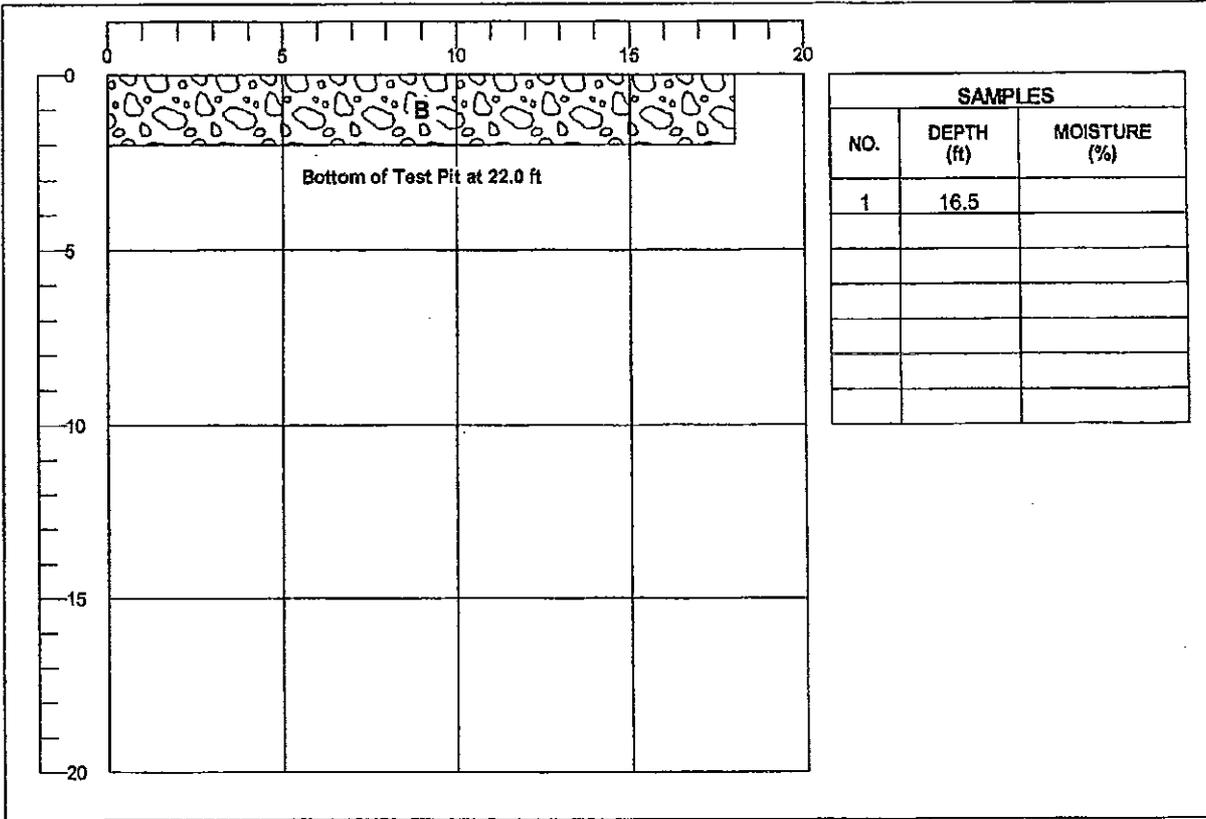
### SPECIAL NOTES:

Heavy caving at 14' bgs. Groundwater observed at 15.5' bgs at time of excavation.



# LOG OF TEST PIT TP-203

Temp 50 °F Weather Cloudy, showe Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/12/10  
 Elevation 561.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, dark brown, to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, damp (TOPSOIL)

**B** 1.0 - 22.0 ft: Compact to dense, yellowish brown to olive gray, stratified, sandy fine to coarse GRAVEL, COBBLES, and BOULDERS to 12", trace silt, wet (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
09:40	0.0		
09:50		15.5	
09:55	22.0		

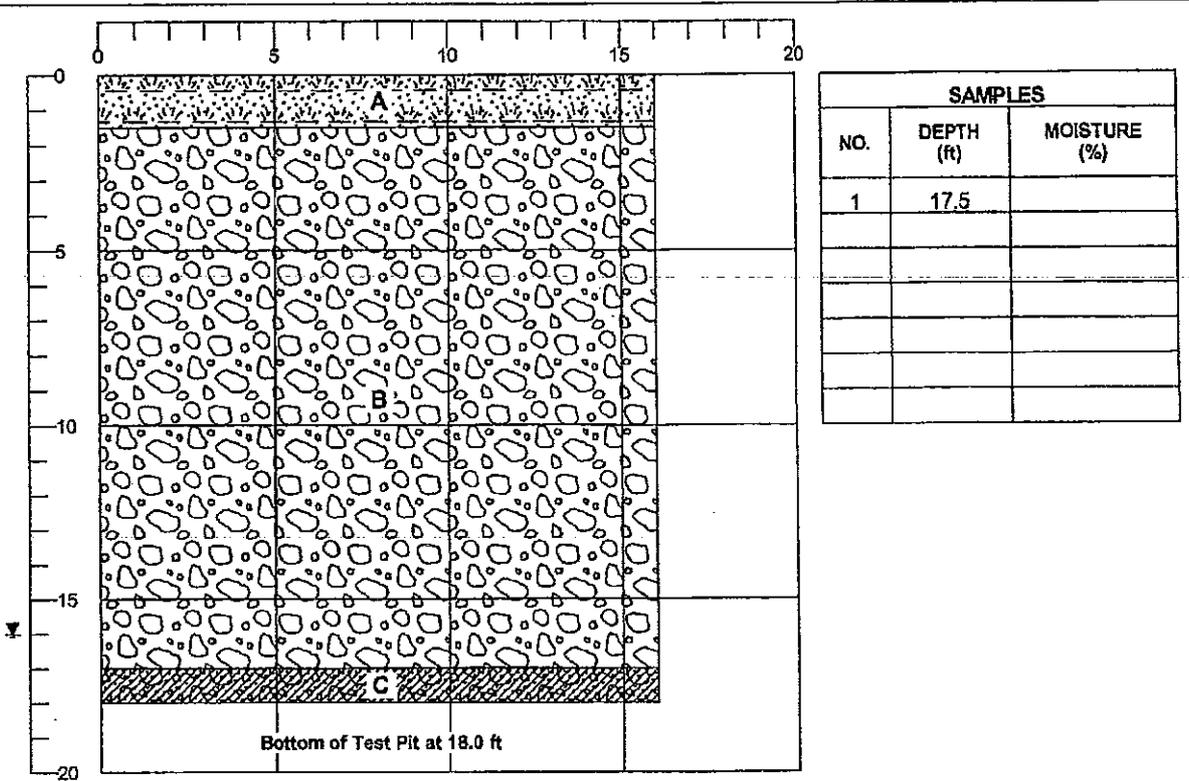
**SPECIAL NOTES:**  
 Heavy caving at 14' bgs. Groundwater observed at 15.5' bgs at time of excavation.

LOG OF TEST PIT: BD INFILTRATION TEST PITS.GPJ GLDR, WA.GDT 2/11/10



# LOG OF TEST PIT TP-204

Temp 55 °F Weather Cloudy, showers Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/11/10  
 Elevation 564.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.5 ft: Loose, dark brown, to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, organics, roots, moist (TOPSOIL)

**B** 1.5 - 17.0 ft: Compact to dense, yellowish brown to olive gray, stratified, sandy fine to coarse GRAVEL, some cobbles and boulders, trace silt (GP) [Qvr]

**C** 17.0 - 18.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, moist (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
10:20	0.0		
10:30		16.0	
10:40	18.0		

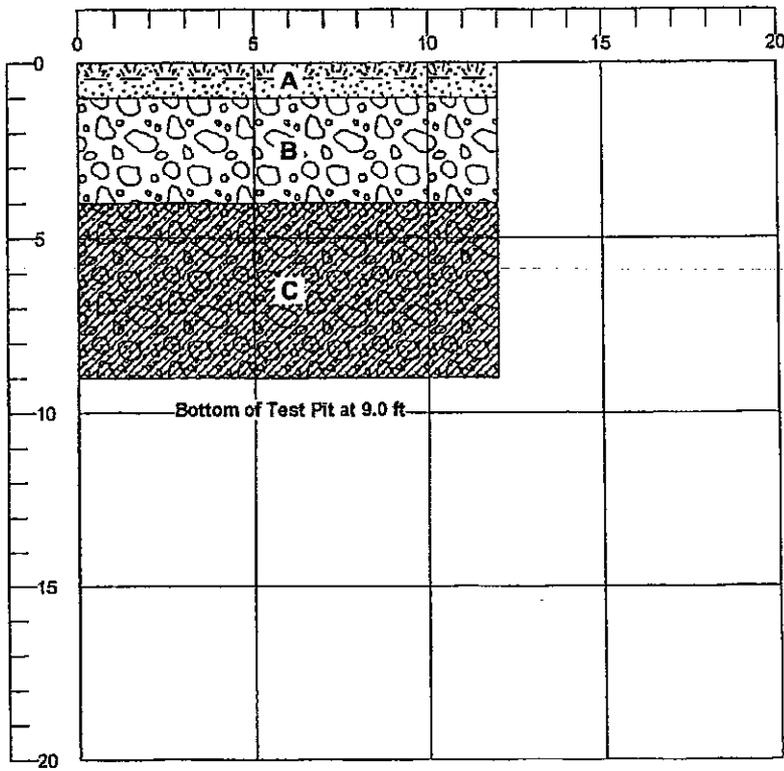
**SPECIAL NOTES:**  
 Some caving at 4' to 9' bgs. Groundwater observed at 16' bgs at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-205

Temp 55 °F Weather Cloudy, showers Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/12/10  
 Elevation 560.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	6.5	

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, roots, organics, moist (TOPSOIL)

**B** 1.0 - 4.0 ft: Compact, stratified, yellowish gray to olive gray, gravelly fine to coarse SAND, some cobbles and boulders up to 12", trace silt, damp (GP) [Qvr]

**C** 4.0 - 9.0 ft: Very dense, olive gray, non-stratified, silty fine to coarse gravel, some cobbles, damp (SM) [Qvt]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:28	0.0		
13:40	9.0		

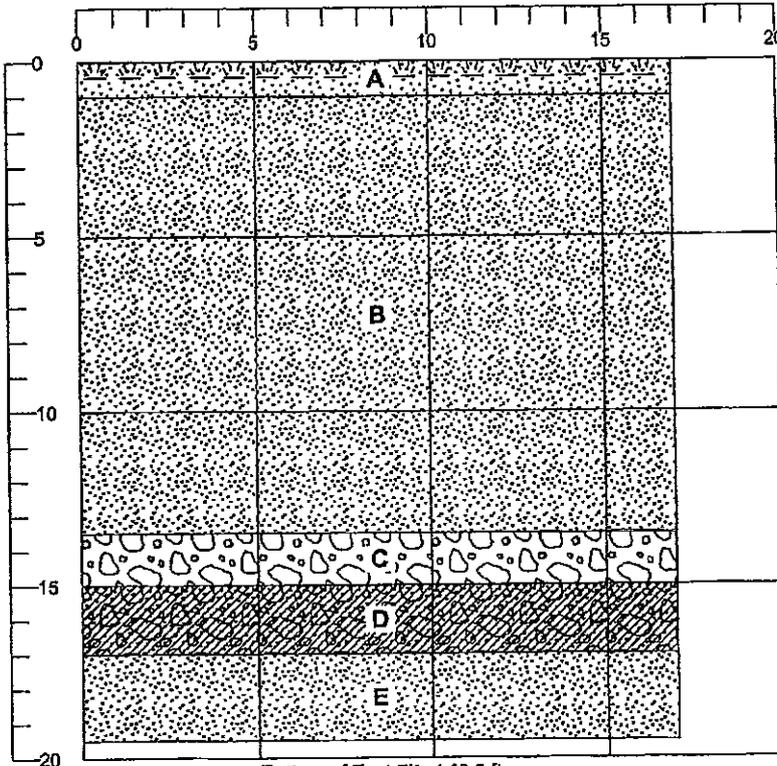
**SPECIAL NOTES:**  
 Little caving at 1' to 4' bgs. No groundwater observed at time of excavation.

LOG OF TEST PIT, BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/1/10



# LOG OF TEST PIT TP-206

Temp 55 °F Weather Cloudy Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/11/10  
 Elevation 550.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	18.0	4.61

Bottom of Test Pit at 19.5 ft

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, some organics and roots, moist (TOPSOIL)
- B** 1.0 - 13.5 ft: Loose, olive gray with oxide staining, stratified, fine to coarse SAND, little silt and fine to coarse gravel, roots, damp (SP) [Qvr]
- C** 13.5 - 15.0 ft: Dense, light yellowish brown to olive gray, non-stratified, gravelly fine to coarse SAND, some cobbles and boulders, trace silt, moist (GP) [Qvr]
- D** 15.0 - 17.0 ft: Dense, light yellowish brown, silty fine to coarse SAND, some fine to coarse gravel, cobbles, moist (SM) [Qvt]
- E** 17.0 - 19.5 ft: Dense, brownish gray to olive gray, non-stratified, fine to coarse poorly graded SAND, some fine to coarse gravel and cobbles, trace silt, wood, and sandstone fragments, moist (SP) (PRE-OLYMPIA GLACIAL OUTWASH)

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
14:17	0.0		
14:45	19.5		

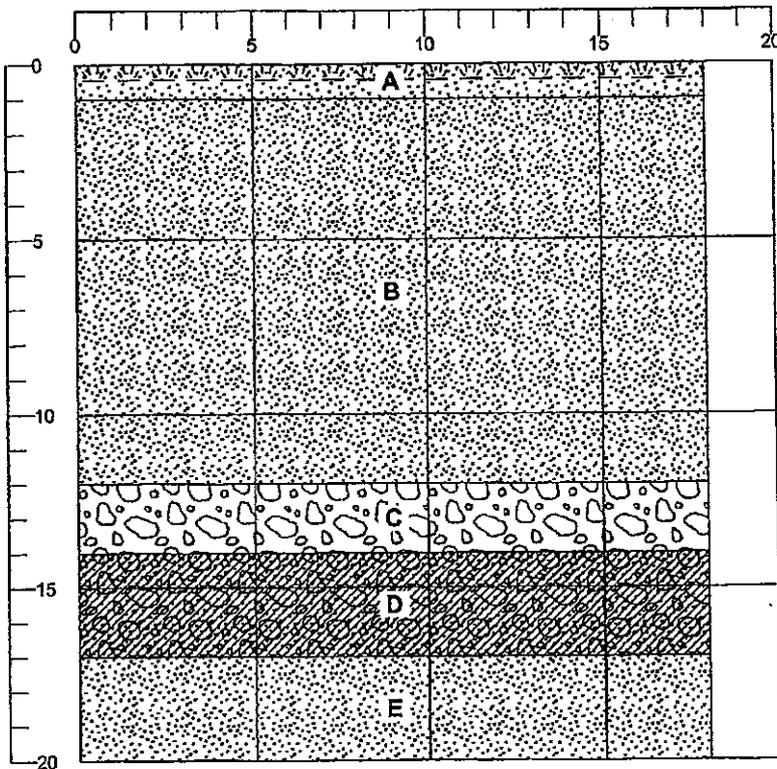
**SPECIAL NOTES:**  
 Some caving. No groundwater observed at time of excavation.

LOG OF TEST PIT, BD INFILTRATION TEST PITS.GPJ GLDR, WA.GDT 2/11/10



# LOG OF TEST PIT TP-207

Temp 55 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/11/10  
 Elevation 548.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	6.5	
2	13.0	
3	18.5	11.36
4	21.0	8.74

### LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

- A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little organics, moist (TOPSOIL)
- B** 1.0 - 12.0 ft: Loose, olive gray, stratified, fine to medium SAND, little silt, trace fine gravel, moist (SP) [Qvr]
- C** 12.0 - 14.0 ft: Compact to dense, olive gray, stratified, gravelly fine to coarse SAND, some cobbles and boulders to 18", trace silt, moist (GP) [Qvt]
- D** 14.0 - 17.0 ft: Dense, light yellowish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, moist (SM) [Qvt]
- E** 17.0 - 22.0 ft: Dense, brownish gray, non-stratified, gravelly fine to coarse SAND, trace to little silt, moist (SP) (PRE-OLYMPIA GLACIAL OUTWASH) [Qpog<sub>1c</sub>]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:35	0.0		
14:04	22.0		

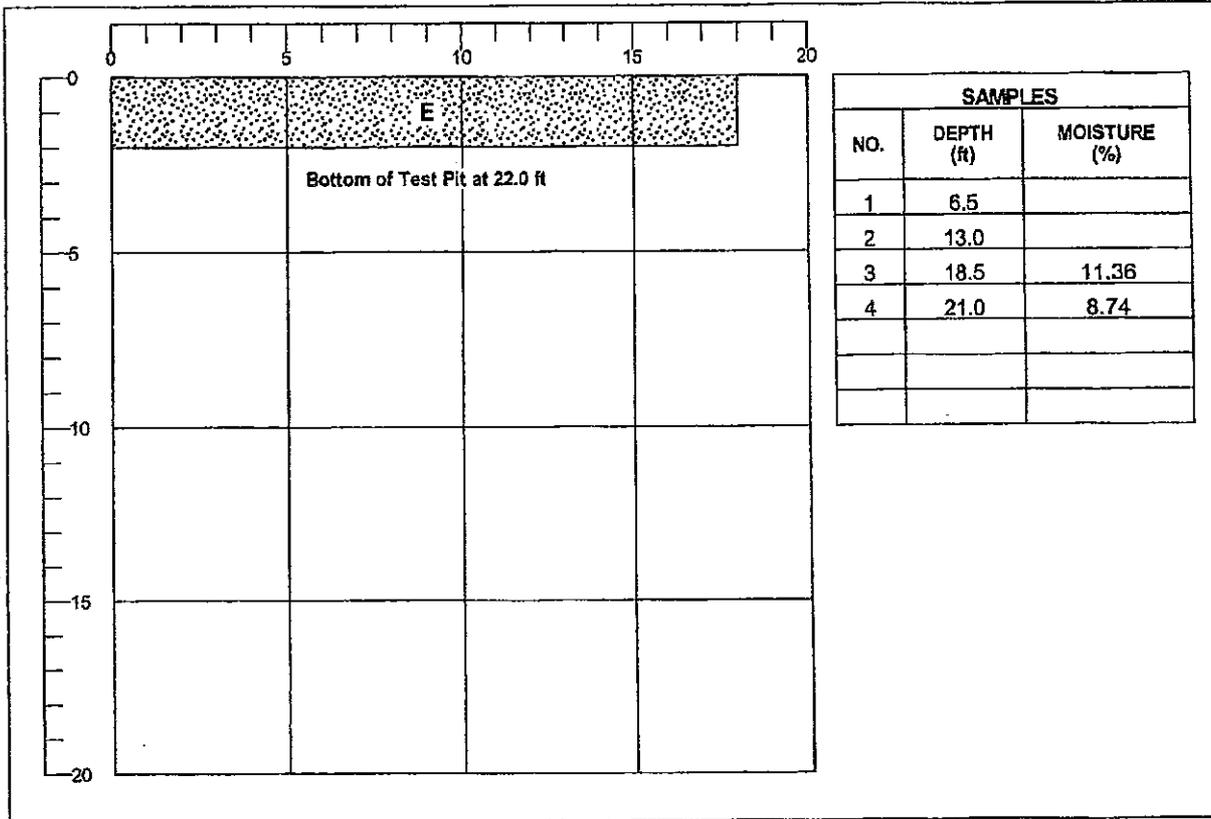
### SPECIAL NOTES:

Some caving at 2' to 10' bgs. Slight seepage at top of till at 12' bgs at time of excavation.



# LOG OF TEST PIT TP-207

Temp 55 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/11/10  
 Elevation 548.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, little organics, moist (TOPSOIL)

**B** 1.0 - 12.0 ft: Loose, olive gray, stratified, fine to medium SAND, little silt, trace fine gravel, moist (SP) [Qvr]

**C** 12.0 - 14.0 ft: Compact to dense, olive gray, stratified, gravelly fine to coarse SAND, some cobbles and boulders to 18", trace silt, moist (GP) [Qvr]

**D** 14.0 - 17.0 ft: Dense, light yellowish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, cobbles, moist (SM) [Qvt]

**E** 17.0 - 22.0 ft: Dense, brownish gray, non-stratified, gravelly fine to coarse SAND, trace to little silt, moist (SP) (PRE-OLYMPIA GLACIAL OUTWASH) [Qpog<sub>1</sub>]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
13:35	0.0		
14:04	22.0		

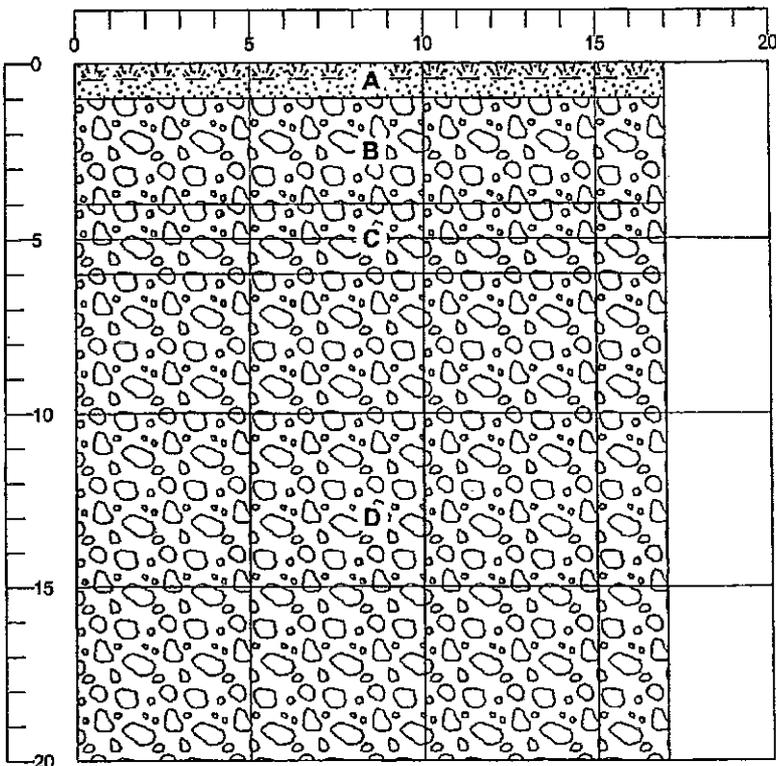
**SPECIAL NOTES:**  
 Some caving at 2' to 10' bgs. Slight seepage at top of till at 12' bgs at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-208

Temp 55 °F Weather Cloudy, rain Engineer T. Marshall Operator Matt  
 Equipment Komatsu 308 Contractor Cascade Date 1/12/10  
 Elevation 563.0 ft Datum Local Job 063-1076.201  
 Location Black Diamond



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
1	5.0	

Bottom of Test Pit at 20.0 ft

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

- A** 0.0 - 1.0 ft: Loose, dark brown to reddish brown, non-stratified, silty fine to coarse SAND, some fine to coarse gravel, organics, damp (TOPSOIL)
- B** 1.0 - 4.0 ft: Compact, yellowish gray, stratified, sandy fine to coarse GRAVEL, some cobbles, trace silt, damp (GP) [Qvr]
- C** 4.0 - 6.0 ft: Compact yellowish brown, non-stratified, fine to coarse GRAVEL, little medium to coarse SAND and cobbles, trace silt, damp (GP) [Qvr]
- D** 6.0 - 20.0 ft: Dense, yellowish gray to olive gray, stratified, gravelly fine to coarse SAND, some fine to coarse cobbles, trace silt, with 0.4" silt lense at 18' bgs, damp (GP) [Qvr]

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)
14:00	0.0		
14:20	20.0		

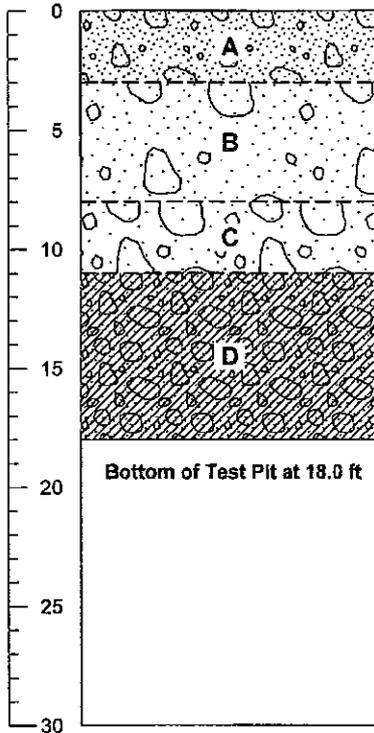
**SPECIAL NOTES:**  
 Some caving at 4' to 8' bgs and 17' to 20' bgs. No groundwater observed at time of excavation.

LOG OF TEST PIT BD INFILTRATION TEST PITS.GPJ GLDR\_WA.GDT 2/11/10



# LOG OF TEST PIT TP-301

Name BD Villages Job 063-1076-001.201  
 Location 75'E of MW-9 Elevation approx. 554 Datum N/A  
 Temp 45 °F Weather Sunny, clear Date 02/22/2010 Logged by T. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
301-1	12.5	

TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
<b>A</b>	0.0 - 3.0 ft: Compact, reddish-brown to olive-grey, stratified, gravelly SAND, trace cobbles and silt, damp. (SP) (OUTWASH)
<b>B</b>	3.0 - 8.0 ft: Compact, olive-grey, stratified, fine to medium SAND, some fine to coarse gravel, trace silt, damp. (SP) (OUTWASH)
<b>C</b>	8.0 - 11.0 ft: Dense, dark olive-grey, stratified, sandy GRAVEL, COBBLES, and BOULDERS, little silt, lenses of fine, sandy silt, damp. (GP) (OUTWASH)
<b>D</b>	11.0 - 18.0 ft: Very dense, light olive-grey, non-stratified, silty, fine to medium SAND, some fine to coarse gravel and cobbles, damp to wet. (SM) (TILL)

TIME	DEPTH TO W/L (FT)	NOTES
	13.0	
<b>SPECIAL NOTES:</b>		
Severe caving at 2 to 8 ft. Moderate seepage in till seams (approximately 1/2 GPM) at 18 ft.		

LOG OF TEST PIT-2, BD VILLAGES.GPJ BRENDAGDT 4/20/10





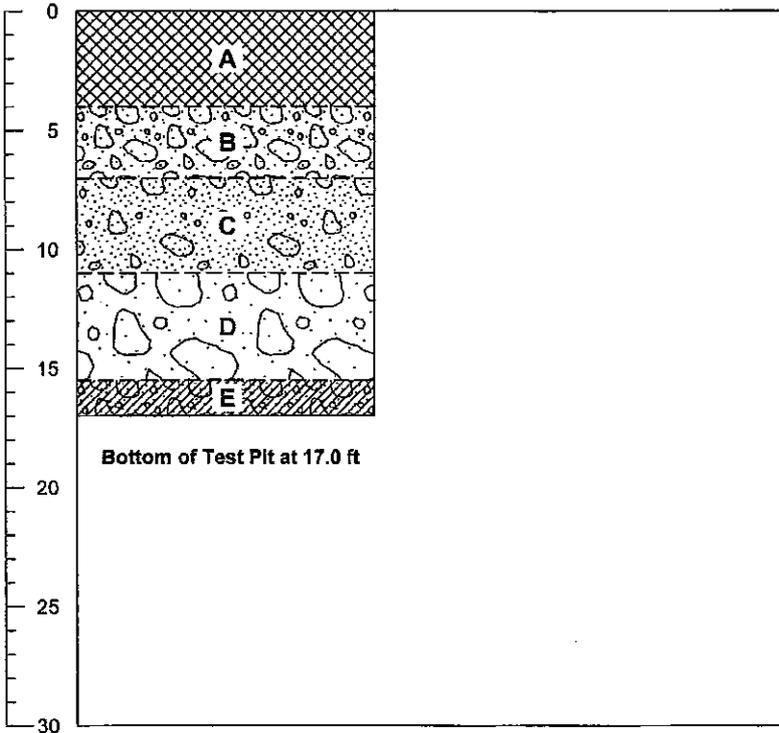






# LOG OF TEST PIT TP-306

Name BD Villages Job 063-1076-001.201  
 Location Black Diamond Elevation approx. 540 Datum N/A  
 Temp 50 °F Weather Sunny, clear. Date 02/22/2010 Logged by T. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES			
NO.	DEPTH (ft)	MOISTURE (%)	
306-1	2.0		
306-2	16.5		
TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
<b>A</b>	0.0 - 4.0 ft: Loose to compact, yellow-brown to blue-grey, non-stratified, silty, fine to medium SAND, some fine to coarse gravel, cobbles, and wood, moist to wet. (SM) (FILL)
<b>B</b>	4.0 - 7.0 ft: Compact, brown, stratified, sandy, fine to coarse GRAVEL, trace silt, moist. (GP) (OUTWASH)
<b>C</b>	7.0 - 11.0 ft: Compact, dark olive-grey, stratified, gravelly, fine to coarse SAND, trace silt, wet. (SP) (OUTWASH)
<b>D</b>	11.0 - 15.5 ft: Dense, dark olive-grey, stratified, sandy, fine to coarse GRAVEL and COBBLES, trace silt, wet. (GP) (OUTWASH)
<b>E</b>	15.5 - 17.0 ft: Very dense, light olive-grey, non-stratified, silty, fine to medium SAND, some fine to coarse gravel and cobbles, wet. (SM) (TILL)

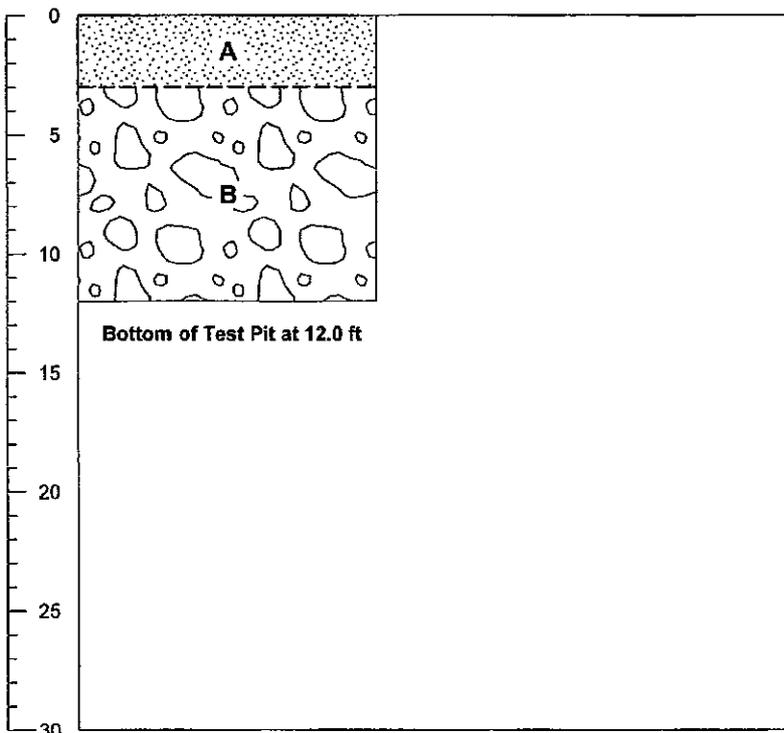
TIME	DEPTH TO W/L (FT)	NOTES
	15.0	
<b>SPECIAL NOTES:</b>		
Severe caving at 4 to 11 ft.		
Groundwater (approximately 5 GPM) at 15 ft.		

LOG OF TEST PIT-2, BD VILLAGES.GPJ BRENDIA.GDT 4/20/10



# LOG OF TEST PIT TP-307

Name BD Villages Job 063-1076-001.201  
 Location Black Diamond Elevation approx. 542 Datum N/A  
 Temp 50 °F Weather Sunny, clear Date 02/22/2010 Logged by T. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 3.0 ft: Loose, olive-grey, stratified, gravelly fine to coarse SAND, trace silt, damp. (SP) (OUTWASH)

**B** 3.0 - 12.0 ft: Loose to compact, olive-grey, stratified, sandy, fine to coarse GRAVEL and COBBLES, trace silt, damp. (GP) (OUTWASH)

TIME	DEPTH TO W/L (FT)	NOTES

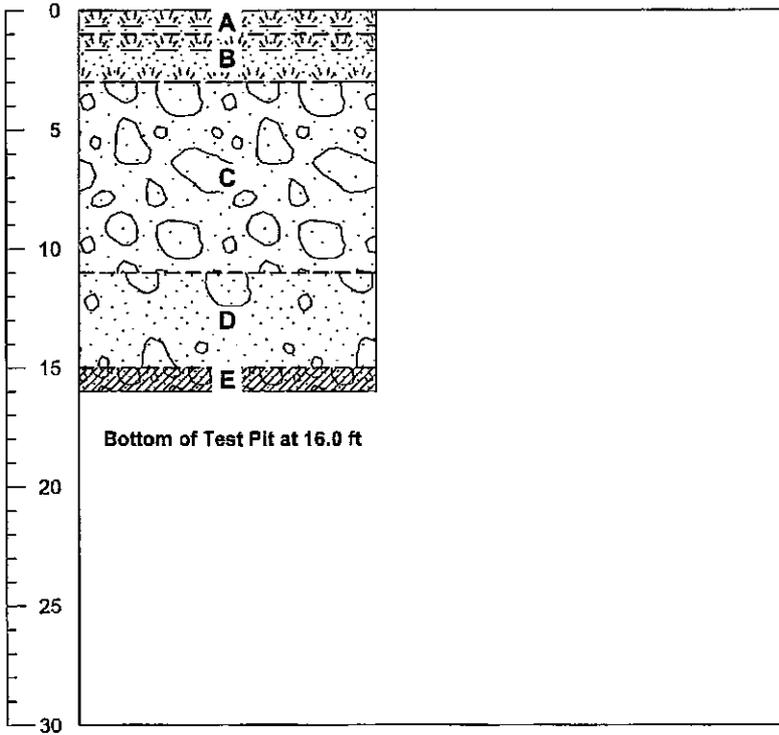
**SPECIAL NOTES:**  
 Severe caving at 0 to 11 ft. (Test pit 25 ft. across.)  
 No groundwater observed.

LOG OF TEST PIT-2 BD VILLAGES.GPJ BRENDAGDT 4/20/10



# LOG OF TEST PIT TP-308

Name BD Villages Job 063-1076-001.201  
 Location Black Diamond Elevation approx. 560 Datum N/A  
 Temp 40 °F Weather Sunny, clear. Date 02/23/2010 Logged by J. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)
308-1	15.0	

TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
<b>A</b>	0.0 - 1.0 ft: Loose, dark brown, non-stratified, silty fine to medium SAND, some fine to coarse gravel, roots and organics, moist. (SM) (DUFF/TOPSOIL)
<b>B</b>	1.0 - 3.0 ft: Loose to compact, reddish-brown to yellow-brown, non-stratified, silty, fine to medium SAND, some fine to coarse gravel, cobbles and roots, damp. (SM) (OUTWASH)
<b>C</b>	3.0 - 11.0 ft: Compact, yellow-brown to olive-grey, stratified, sandy, fine to coarse GRAVEL, COBBLES, and BOULDERS to 12 in., trace silt, damp. (GP) (OUTWASH)
<b>D</b>	11.0 - 15.0 ft: Compact, dark olive-grey, stratified, gravelly fine to coarse SAND, COBBLES and BOULDERS to 12", trace silt, damp. (SP) (OUTWASH)
<b>E</b>	15.0 - 16.0 ft: Very dense, light olive-grey, non-stratified, silty, fine SAND, some fine to coarse gravel and cobbles, damp. (SM) (TILL)

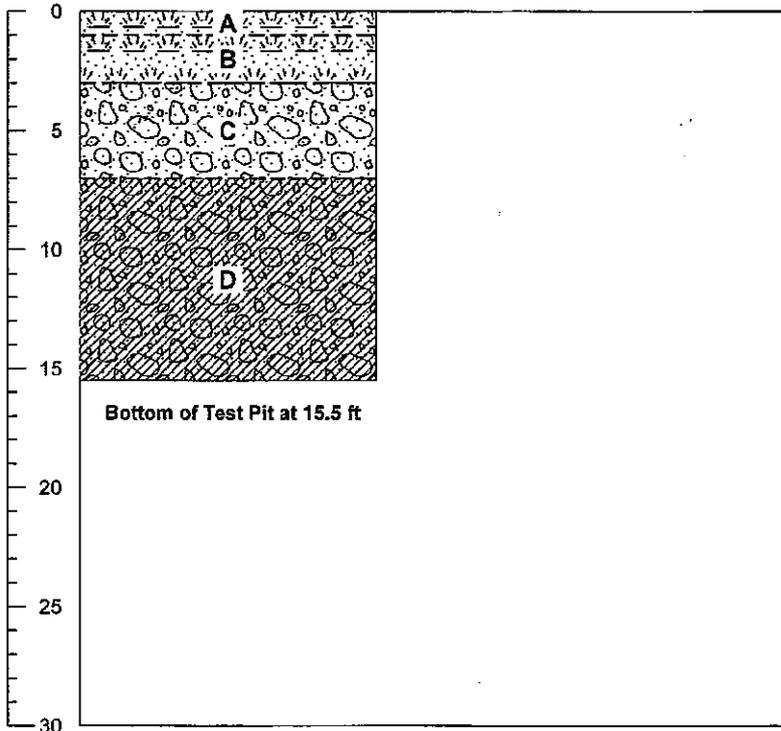
TIME	DEPTH TO W/L (FT)	NOTES
<b>SPECIAL NOTES:</b>		
Slight caving at 2 to 11 ft.		
No seepage observed after 10 minutes.		
Piezometer installed.		

LOG OF TEST PIT-2, BD VILLAGES.GPJ, BRENDA.GDT, 4/20/10



# LOG OF TEST PIT TP-309

Name BD Villages Job 063-1076-001.201  
 Location Black Diamond Elevation approx. 556 Datum N/A  
 Temp 45 °F Weather Sunny, clear. Date 02/23/2010 Logged by T. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES			
NO.	DEPTH (ft)	MOISTURE (%)	
309-1	8.0		
TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
<b>A</b>	0.0 - 1.0 ft: Loose, dark brown, non-stratified, silty fine to medium SAND, some fine to coarse gravel, roots and organics, moist. (SM) (DUFF/TOPSOIL)
<b>B</b>	1.0 - 3.0 ft: Loose to compact, reddish-brown to yellow-brown, non-stratified, silty, fine to medium SAND, some fine to coarse gravel, cobbles and roots, damp. (SM) (OUTWASH)
<b>C</b>	3.0 - 7.0 ft: Compact, yellow-brown to olive-grey, stratified, sandy, fine to coarse GRAVEL and COBBLES, trace silt, damp. (GP) (OUTWASH)
<b>D</b>	7.0 - 15.5 ft: Very dense, light olive-grey, non-stratified, silty, fine SAND, some fine to medium SAND, some fine to coarse gravel and cobbles, damp to moist. (SM) (TILL)

TIME	DEPTH TO W/L (FT)	NOTES
	10.0	
<b>SPECIAL NOTES:</b>		
Moderate caving at 2 to 6 ft. Slight seepage due to perched groundwater (approximately < 1/4 GPM) at 10 ft and 12 ft.		

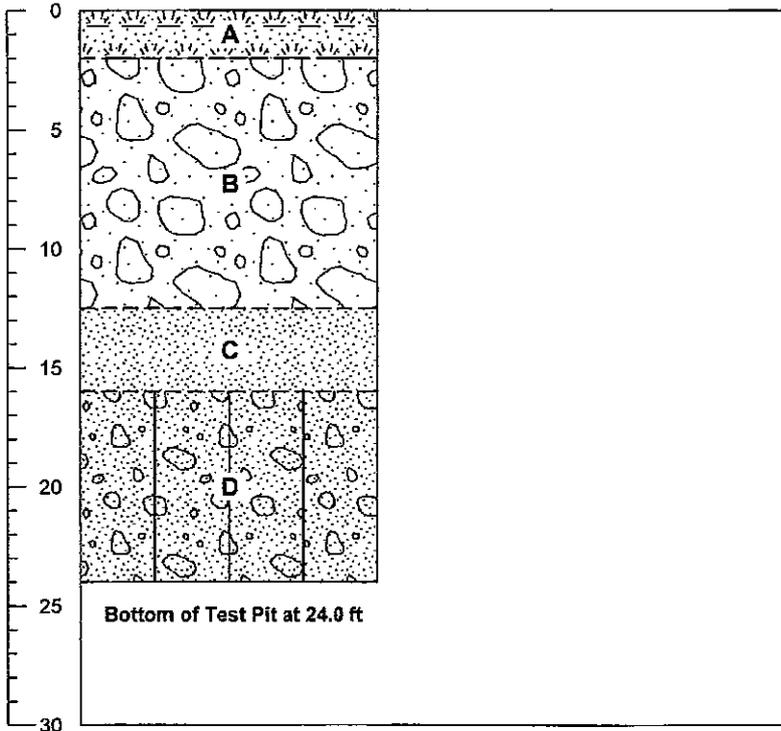
LOG OF TEST PIT-2 BD VILLAGES.GPJ BRENDAGDT 4/20/10





# LOG OF TEST PIT TP-311

Name BD Villages Job 063-1076-001.201  
 Location Black Diamond Elevation approx. 563 Datum N/A  
 Temp 45 °F Weather Sunny, clear. Date 02/23/2010 Logged by T. Marshall  
 Equipment Komatsu 308 Contractor Cascade Operator Matt



SAMPLES			
NO.	DEPTH (ft)	MOISTURE (%)	
311-1	12.5		
311-2	16.0		
TEST RESULTS			
DEPTH	WD	DD	% PASSING #200

**LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES**

**A** 0.0 - 2.0 ft: Loose, dark brown to reddish-brown, non-stratified, silty fine to medium SAND, some fine to coarse gravel, roots and organics, damp. (SM) (DUFF/TOPSOIL)

**B** 2.0 - 12.5 ft: Loose to compact, yellow-brown to olive-grey, stratified, sandy, fine to coarse GRAVEL, COBBLES, and BOULDERS to 12 in., trace silt, damp. (GP) (OUTWASH)

**C** 12.5 - 16.0 ft: Compact, olive-grey, stratified, fine to medium SAND, trace silt, damp. (SP) (OUTWASH)

**D** 16.0 - 24.0 ft: Very dense, olive-grey, non-stratified, silty, fine SAND, some fine to coarse gravel and cobbles, damp. (SM) (TILL)

Cobble content increases below 23 ft.

TIME	DEPTH TO W/L (FT)	NOTES
	20.0	
<b>SPECIAL NOTES:</b>		
Moderate caving at 2 to 8 ft.		
Groundwater at 20 ft.		

LOG OF TEST PIT-2 BD VILLAGES.GPJ BRENDIA.GDT 4/20/10









# RECORD OF BOREHOLE MW-24

SHEET 1 of 3

PROJECT: Black Diamond Villages  
 PROJECT NUMBER: 063-1076-01.201  
 LOCATION: 56 feet West of TP#117

DRILLING METHOD: RotoSonic  
 DRILLING DATE: 03/10/2010  
 DRILL RIG: Mini-Sonic

DATUM:  
 AZIMUTH: N/A  
 COORDINATES: not surveyed

ELEVATION: 557  
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / FT				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	WATER CONTENT (PERCENT)				GRAPHIC	
											W <sub>p</sub> W <sub>L</sub>					
0	Continuous Core	0.0 - 2.5 Brown to red brown, silty fine to coarse SAND, some fine to coarse gravel, moist. (Outwash)	SM		554.5											2" SCH 40 PVC riser pipe, in cement seal with 4-foot stainless steel above ground monument
		2.5 - 6.0 Yellow gray to olive gray, fine to coarse SAND, trace silt, damp. (Outwash)	SP		2.5	1	GRAB									
5			6.0 - 9.0 Yellow gray to olive gray, fine to medium SAND, some fine to coarse gravel, little silt, damp. (Outwash)	SP		551.0	2	GRAB								
			9.0 - 11.0 Olive gray, silty SAND, some fine to coarse gravel, damp. (Till lense?)	SM		548.0	3	GRAB								
10			11.0 - 20.0 Olive gray, fine to coarse SAND and fine to coarse GRAVEL, trace silt, damp. (Outwash)	SP/GP		546.0										
15		Interbeds of olive gray with iron-oxide staining, silty SAND, some fine to coarse gravel, damp. (3.0 feet)	SM			4	GRAB								2" SCH 40 PVC riser pipe with bentonite backfill	
20		Log continued on next page			537.0											

BOREHOLE RECORD BD\_THEVILLAGES\_MW-24\_DRAFT.GPJ GLDR.WA.GDT 4/21/10

1 in to 3 ft  
 DRILLING CONTRACTOR: Boart/Longyear  
 DRILLER: Brian

LOGGED: TPM  
 CHECKED: JGJ  
 DATE: 4/1/2010



# RECORD OF BOREHOLE MW-24

SHEET 2 of 3

PROJECT: Black Diamond Villages  
 PROJECT NUMBER: 063-1076-01.201  
 LOCATION: 56 feet West of TP#117

DRILLING METHOD: RotoSonic  
 DRILLING DATE: 03/10/2010  
 DRILL RIG: Mini-Sonic

DATUM:  
 AZIMUTH: N/A  
 COORDINATES: not surveyed

ELEVATION: 557  
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	WATER CONTENT (PERCENT)						
											W <sub>p</sub> W <sub>L</sub> W <sub>p</sub> W <sub>L</sub>						
20	Continuous Core	20.0 - 22.0 Olive gray, sandy fine to coarse GRAVEL, some silt, damp. (Till)	GP		20.0	5	GRAB										
		22.0 - 26.0 Gray to olive gray with iron-oxide staining, fine to coarse GRAVEL and COBBLES, little silt, damp. (Outwash)	GW		535.0 22.0												
		26.0 - 27.0 Gray to brown, fine to medium SAND, some fine to coarse gravel, little silt, damp. (Outwash)	SP		531.0 26.0												
		27.0 - 27.5 Brown SILT, thinly bedded with dark brown SILT, moist.	ML		530.0 27.0	6	GRAB										
		27.5 - 42.0 Olive gray, sandy fine to coarse GRAVEL, little silt, damp. (Outwash - Till transition)	GM		529.5 27.5												
		Interbed of light orange brown with iron-oxide staining, SILT and fine to coarse GRAVEL, moist. (6.0 inches)						7	GRAB								
		Interbed of light orange brown, clayey SILT and fine to coarse GRAVEL, little fine to medium sand, moist. (1.0 foot)	GM			8	GRAB										
		Interbed of dark red brown SILT, some fine gravel, little fine to medium sand, moist. (1.0 foot)	GP/GW			9	GRAB										
		Interbed of light brown, silty fine to coarse GRAVEL, little fine to medium sand, moist to wet. (1.0 foot)	ML			10	GRAB										
			GM														
						11	GRAB										
						12	GRAB										
40		Log continued on next page															

2" SCH 40  
PVC riser  
pipe with  
filter sand  
backfill

BOREHOLE RECORD BD THEVILLAGES\_MW-24 DRAFT.GPJ GLDR\_WA.GDT 4/21/10

1 in to 3 ft  
 DRILLING CONTRACTOR: Boart/Longyear  
 DRILLER: Brian

LOGGED: TPM  
 CHECKED: JGJ  
 DATE: 4/1/2010



# RECORD OF BOREHOLE MW-24

SHEET 3 of 3

PROJECT: Black Diamond Villages  
 PROJECT NUMBER: 063-1076-01.201  
 LOCATION: 56 feet West of TP#117

DRILLING METHOD: RotoSonic  
 DRILLING DATE: 03/10/2010  
 DRILL RIG: Mini-Sonic

DATUM:  
 AZIMUTH: N/A  
 COORDINATES: not surveyed

ELEVATION: 557  
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in <small>140 lb hammer 30 inch drop</small>	N	REC / ATT	WATER CONTENT (PERCENT)				WATER LEVELS	GRAPHIC	
					DEPTH (ft)						W <sub>1</sub>  -----  W <sub>2</sub> <small>20 40 60 80</small>						
40	Continuous Core	27.5 - 42.0 Olive gray, sandy fine to coarse GRAVEL, little silt, damp. (Outwash - Till transition) (Continued)	GP/GW		515.0	13	GRAB			1.0 10.0					2" SCH 40 PVC slotted screen with filler sand backfill		
		42.0			14						GRAB						
45		42.0 - 46.0 Olive brown, fine to coarse SAND, little to some silt, little fine gravel, scattered coal fragments, wet. (Outwash)										SP		511.0			
	48.0	15	GRAB														
50	46.0 - 50.0 Dark olive brown, silty fine to coarse SAND, some fine to coarse gravel, scattered coal fragments, moist. (Till)			SP/SM		507.0					Filler sand backfill, no pipe						
	50.0					Bentonite chip backfill											
55	Boring completed at 50.0 ft.																
60																	

0855 on 03/11/2010, well observed to be dry and no water level measurement recorded.

BOREHOLE RECORD, BD, THE VILLAGES, MW-24, DRAFT, GPJ, GLDR, WA, GDT, 4/21/10

1 in to 3 ft  
 DRILLING CONTRACTOR: Boart/Longyear  
 DRILLER: Brian

LOGGED: TPM  
 CHECKED: JGJ  
 DATE: 4/1/2010



**APPENDIX B**  
**LEGEND / AESI TEST PIT AND BORING LOGS**

Soil Classification		Terms Describing Relative Density and Consistency		
		Density	SPT <sup>(2)</sup> blows/foot	
Coarse-Grained Soils - More than 50% <sup>(1)</sup> Retained on No. 200 Sieve	Gravels - More than 50% <sup>(1)</sup> of Coarse Fraction Retained on No. 4 Sieve	GW	Well-graded gravel and gravel with sand, little to no fines	Coarse-Grained Soils Very Loose 0 to 4 Loose 4 to 10 Medium Dense 10 to 30 Dense 30 to 50 Very Dense >50 Consistency SPT <sup>(2)</sup> blows/foot Very Soft 0 to 2 Soft 2 to 4 Medium Stiff 4 to 8 Stiff 8 to 15 Very Stiff 15 to 30 Hard >30
		GP	Poorly-graded gravel and gravel with sand, little to no fines	
		GM	Silty gravel and silty gravel with sand	
	Sands - 50% <sup>(1)</sup> or More of Coarse Fraction Passes No. 4 Sieve	GC	Clayey gravel and clayey gravel with sand	
		SW	Well-graded sand and sand with gravel, little to no fines	
		SP	Poorly-graded sand and sand with gravel, little to no fines	
Fine-Grained Soils - 50% <sup>(1)</sup> or More Passes No. 200 Sieve	Sands - 50% <sup>(1)</sup> or More of Coarse Fraction Passes No. 4 Sieve	SM	Silty sand and silty sand with gravel	<b>Component Definitions</b> <b>Descriptive Term</b> <b>Size Range and Sieve Number</b> Boulders            Larger than 12" Cobbles            3" to 12" Gravel              3" to No. 4 (4.75 mm) Coarse Gravel    3" to 3/4" Fine Gravel       3/4" to No. 4 (4.75 mm) Sand                No. 4 (4.75 mm) to No. 200 (0.075 mm) Coarse Sand      No. 4 (4.75 mm) to No. 10 (2.00 mm) Medium Sand     No. 10 (2.00 mm) to No. 40 (0.425 mm) Fine Sand         No. 40 (0.425 mm) to No. 200 (0.075 mm) Silt and Clay      Smaller than No. 200 (0.075 mm)
		SC	Clayey sand and clayey sand with gravel	
		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel	
	Sils and Clays	CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay	
		OL	Organic clay or silt of low plasticity	
		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt	
Sils and Clays	CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel		
	DH	Organic clay or silt of medium to high plasticity		
	PT	Peat, muck and other highly organic soils		
		<b>(3) Estimated Percentage</b> <b>Moisture Content</b> <b>Component</b> <b>Percentage by Weight</b> Trace            <5 Few              5 to 10 Little            15 to 25 With            - Non-primary coarse constituents: ≥ 15% - Fines content between 5% and 15% Dry - Absence of moisture, dusty, dry to the touch Slightly Moist - Perceptible moisture Moist - Damp but no visible water Very Moist - Water visible but not free draining Wet - Visible free water, usually from below water table		
		<b>Symbols</b> 		
		<b>(1)</b> Percentage by dry weight <b>(2)</b> (SPT) Standard Penetration Test (ASTM D-1586) <b>(3)</b> In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488) <b>(4)</b> Depth of ground water ▾ ATD = At time of drilling ▽ Static water level (date) <b>(5)</b> Combined USCS symbols used for fines between 5% and 15%		

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

blockstation\_key.dwg LAYOUT: Layout2

Associated Earth Sciences, Inc.



### EXPLORATION LOG KEY

FIGURE A1

## LOG OF EXPLORATION PIT NO. EP-20

Depth (ft)	DESCRIPTION	
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.	
	<b>Forest Duff/Topsoil</b>	Approximate Elev. 539 feet
1		
2	<b>Qvr - Vashon Recessional Outwash</b>	
3	Loose to medium dense, moist, brown, medium to coarse SAND, few fine gravel; massive.	
4		
5	Medium dense, moist, brown-gray, medium to coarse SAND, with gravel, trace cobbles; roughly	
6	horizontal bedding.	
7		
8		
9		
10	Medium dense, moist, brown-gray, medium to coarse SAND, few gravel, few cobbles and boulders.	
11		
12	Oxidized.	
13	<b>Qvt - Vashon Lodgement Till</b>	
14	Dense, moist, gray, silty fine SAND, few gravel, trace cobbles.	
15	Bottom of exploration pit at depth 14 feet No seepage. Moderate caving 0 to 5 feet.	
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: JHS

Approved by: JHS

Project No. KG060601A

9/15/06

## LOG OF EXPLORATION PIT NO. EP-21

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 570 feet</p>	
1	Forest Duff/Topsoil	
2	Qvt - Vashon Lodgement Till	
3	Medium dense, tan, silty fine SAND, few gravel, few cobbles; oxidized (weathered till).	
4	Dense, tan, oxidized till, few cobbles.	
5		
6		
7		
8		
9		
10	Bottom of exploration pit at depth 9.5 feet	
11	No seepage. No caving.	
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

KCTP3 060601A (EP-20 THRU EP-95, EP-104, IT-1 THRU IT-4).GFSJ June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: JHS  
Approved by: JHS



9/15/06

## LOG OF EXPLORATION PIT NO. EP-23

Depth (ft)	DESCRIPTION	Approximate Elev. 550 feet
	Forest Duff	
1	<b>Qvr - Vashon Recessional Outwash</b>	
2	Loose, moist, tan to oxidized brown, GRAVEL, with fine to coarse sand and cobbles.	
3		
4	Loose to medium dense, gray-brown, as above; roughly stratified.	
5		
6		
7		
8		
9		
10	Medium dense, moist, gray-brown, GRAVEL, with fine to medium sand, few silt and cobbles. Medium dense, moist, gray-brown, fine to medium SAND, with gravel and cobbles.	
11		
12	Seepage.	
13	<b>Qvt - Vashon Lodgement Till</b>	
14	Dense, moist, gray-brown, silty fine SAND, few gravel.	
15	Bottom of exploration pit at depth 14 feet Heavy seepage at 12 feet. Moderate caving 0 to 4 feet and 10 to 12.5 feet.	
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

KCTP3 060601A (EP-20 THRU EP-25, EP-104, IT-1 THRU IT-4) GFL June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: JHS

Approved by: JHS



9/15/06

## LOG OF EXPLORATION PIT NO. EP-32

Depth (ft)	DESCRIPTION	Approximate Elev. 668 feet
	Forest Duff/Topsoil	
1	Qvt - Vashon Lodgement Till	
2	Medium dense, slightly moist, orangish brown, silty fine SAND, little gravel, few medium to coarse sand; heavy oxidation, abundant roots (weathered till).	
3		
4	Dense, moist, grayish orangish brown (mottled), silty fine SAND, little subangular to subrounded gravels, few medium to coarse sand; moderate oxidation.	
5	Becomes grayish brown at 5 feet and very dense (very hard digging).	
6		
7		
8		
9	Color change at ~9.5 feet.	
10	Very dense, moist, gray, silty fine SAND, little gravel, few medium to coarse sand.	
11	Bottom of exploration pit at depth 10.2 feet Exploration terminated due to refusal from boulders and density of formation. No seepage. No caving.	
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

KCTP3 060601A (EP-30 THRU EP-95, EP-104, IT-1 THRU IT-4), GP-1, June 9, 2009

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

10/11/06

## LOG OF EXPLORATION PIT NO. EP-49

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 579 feet</b></p>
1	<b>Forest Duff/Topsoil</b>
1	<b>Qvt - Vashon Lodgement Till</b>
2	Loose, moist, red-brown, silty fine SAND, few gravel and medium to coarse sand; heavy oxidation, abundant roots (weathered till).
3	
4	Dense, slightly moist, light brown (tan), silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders; minor oxidation, trace roots to 5 feet.
5	Becomes grayish brown.
6	
7	
8	As above (till).
9	Operator notes very hard digging.
10	Very dense, moist, grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace boulders and cobbles.
11	Bottom of exploration pit at depth 10 feet No seepage. No caving.
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

KCTP3 060601A (EP-20 THRU EP-55, EP-104, IT-1 THRU IT-4) GPJ June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: BAA  
Approved by: JHS



10/18/06

# LOG OF EXPLORATION PIT NO. EP-51

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 548 feet</b></p>
1	<b>Forest Duff/Topsoil</b>
2	<b>Qvr - Vashon Recessional Outwash</b>
3	Loose, moist, red-brown, silty fine SAND, trace gravel; abundant roots, heavy oxidation (weathered outwash).
4	Loose, tan, moist, fine SAND, trace gravel, trace silt; trace roots, minor oxidation, massive.
5	
6	
7	Becomes fine to coarse SAND with gravel, trace silt; minor oxidation, trace organics (charcoal)
8	(heavy oxidation in places, gray).
9	<b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>
10	Heavy oxidation at contact.
11	Medium dense, moist, blue-gray, silty/clayey fine SAND, little gravel, few medium to coarse sand, non-stratified, trace cobbles and boulders, light brown in places, oxidized in places, some gravels very weathered.
12	
13	Finer, fine to coarse, medium SAND, trace gravel, charcoal.
14	(Looks like lower in EP-50 with less boulders and cobbles) Medium dense, very moist, light brown, silty/clayey, fine to coarse SAND, little gravel; trace charcoal/organics, glued with clay/silt.
15	
16	Wetter, more silt/clay, gravels very weathered, coarser.
17	
18	Cleans up. Medium dense to dense, moist, brownish gray, medium SAND, trace gravel scattered throughout, trace silt, coarse sand, non-stratified, very minor oxidation.
19	
20	As above, less gravel.
21	
22	Bottom of exploration pit at depth 21 feet Very minor seepage 13.5 to 18 feet. Minor caving 7 to 9 feet.
23	
24	
25	

KCTPS 050601A (EP-20 THRU EP-25, EP-104, IT-1 THRU IT-4), GPJ June 9, 2006

## The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: BAA  
Approved by: JHS



10/18/06

## LOG OF EXPLORATION PIT NO. EP-53

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 570 feet</b></p>
1	Forest Duff/Topsoil
2	Qvt - Vashon Lodgement Till
3	Medium dense to dense, slightly moist, tan, silty fine SAND, little gravel; moderate oxidation, few roots to 5 feet (weathered till).
4	
5	
6	Very dense, slightly moist, brownish gray, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders, minor oxidation.
7	
8	
9	Very dense, as above, slightly sandier.
10	
11	
12	Bottom of exploration pit at depth 12 feet No seepage. No caving.
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KCTP3 060601A (EP-20 THRU EP-55, EP-104, IT-1, T-HRU (T-4), GP, J, June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

10/18/06

## LOG OF EXPLORATION PIT NO. EP-54

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 560 feet</p>	
	Forest Duff/Topsoil	
1	Qvt - Vashon Lodgement Till	
2	Loose, moist, orange-brown, silty fine SAND, few gravel, trace cobbles/boulders; moderately tight, few roots/organics, heavy oxidation (weathered till).	
3		
4		
5		
6	Very dense, slightly moist, brownish gray to grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders; minor oxidation (very dense, gray, till contact appears to be dipping parallel to slope surface).	
7		
8		
9		
10	As above - no oxidation.	
11		
12	Bottom of exploration pit at depth 11 feet No seepage. No caving.	
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KCTP3 00001A (EP-20 THRU EP-35, EP-10A, IT-1 THRU IT-4) GPJ, June 9, 2006

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

10/18/06

# LOG OF EXPLORATION PIT NO. EP-55

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 547 feet</p>	
	<b>Forest Duff/Topsoil</b>	
1	<b>Qvr - Vashon Recessional Outwash</b>	
2	Loose, moist, red-brown, silty fine SAND, trace gravel; heavy oxidation, abundant roots/organics (weathered outwash).	
3	As above, tan, less silt, trace gravel.	
4	Loose to medium dense, moist, gray, medium to coarse SAND with gravel, stratified, minor oxidation (like EP-51 at 7 feet), trace boulders (layer sands and gravels), caving.	
5		
6		
7		
8		
9		
10	Boulder layer with medium sand, few gravel and coarse sand.	
11	<b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>	
12	Medium dense, very moist, tan, silty/clayey GRAVEL with fine to coarse sand; very sticky, glued with clay, trace charcoal/organics, non-stratified.	
13	As above, very moist to wet, sticky.	
14	Bottom of exploration pit at depth 13 feet Very minor to no seepage 11 to 13 feet. Severe caving 0 to 11 feet.	
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24		
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KCTP3 060601A (EP-20 THRU EP-95, EP-104, IT-1 THRU IT-4) GP1 June 5, 2008

## The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: BAA  
Approved by: JHS



10/18/06

## LOG OF EXPLORATION PIT NO. EP-56

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 552 feet</p>
	Forest Duff/Topsoil
1	<b>Qvr - Vashon Recessional Outwash</b>
2	Loose, moist, red-orange-brown, silty fine SAND, trace gravel; heavy oxidation, few roots. As above, orange-brown, few silt.
3	
4	Loose, slightly moist, gray-brown, fine to medium SAND, trace coarse sand, trace gravel, scattered, trace silt; minor oxidation, well sorted, massive.
5	
6	
7	Increased gravel and moisture, severe caving.
8	
9	
10	
11	
12	
13	Loose, moist, brownish gray, medium SAND, trace gravel scattered, few coarse sand, trace silt; minor oxidation, severe caving, stratified.
14	Boulder layer.
15	<b>Qpog<sub>16</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>
15	Medium dense to dense, very moist, tan, silty/clayey GRAVEL, with sand.
16	Exploration terminated due to severe caving. No seepage. Severe caving 0 to 13 feet.
17	
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KCTP3 060601A (EP-50 THRU EP-95, EP-104, IT-1 THRU IT-4), G.P.J. June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

10/18/06

## LOG OF EXPLORATION PIT NO. EP-57

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 551 feet</b></p>
1	Forest Duff/Topsoil
2	Qvr - Vashon Recessional Outwash
3	Loose, moist, red-brown, silty fine to coarse SAND with gravel; abundant roots, heavy oxidation.
4	Loose, slightly moist, gray-orange, fine to medium SAND with gravel, stratified; minor oxidation, trace roots.
5	
6	
7	
8	
9	Predominantly fine to medium SAND, trace scattered gravels.
10	
11	Qvt - Vashon Lodgement Till
12	Dense, moist, brown-gray, silty fine SAND, little gravel.
13	
14	As above, gray-brown.
15	Bottom of exploration pit at depth 14 feet No seepage. No caving.
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KCTP3 060601A (EP-20 THRU EP-35, EP-104, IT-1 THRU IT-4) GP1 June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

10/18/06

## LOG OF EXPLORATION PIT NO. EP-58

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 550 feet</b></p>	
	<b>Forest Duff/Topsoil</b>	
1	<b>Qvr - Vashon Recessional Outwash</b>	
2	Loose, moist, dark brown, silty fine to coarse SAND, little gravel; abundant organics/roots (weathered outwash).	
3	As above, brown, moderate oxidation (weathered outwash).	
4	Loose, slightly moist, fine to coarse SAND with gravel, few cobbles, trace silt, trace roots; minor oxidation, stratified, brown to gray in layers.	
5	SAND with gravel to GRAVEL with sand.	
6		
7		
8		
9		
10	Increase in moisture to moist.	
11		
12		
13	Moderate oxidation, few silt, may produce water.	
14	Loose, wet, orange-brown, fine to coarse SAND with gravel, little silt, trace cobbles; moderate oxidation.	
15	Seepage on top of till - moderate pooling on bottom of pit.	
	<b>Qvt - Vashon Lodgement Till</b>	
16	Dense, moist, grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles.	
17	Bottom of exploration pit at depth 16 feet Moderate seepage 13.5 to 14 feet on top of till. No caving.	
18		
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KCTP3 050601A (EP-20 THRU EP-65, EP-104, IT-1 THRU IT-4) GPJ June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601A

Logged by: BAA  
Approved by: JHS



10/19/06

## LOG OF EXPLORATION PIT NO. EP-77

Depth (ft)	DESCRIPTION	Approximate Elev. 600 feet
	Forest Duff/Topsoil	
1	Qvt - Vashon Lodgement Till	
2	Medium dense, moist, orangish brown, silty fine SAND, little gravel, few medium to coarse sand; few roots/organics, moderate oxidation, unsorted (minor seepage) (weathered till).	
3	Very dense, moist, grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders.	
4		
5	Minor seepage within till.	
6		
7	Minor seepage within till. (2.5 feet to BOH minor seepage in places)	
8		
9	Very dense, moist, grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders.	
10		
11	Bottom of exploration pit at depth 10 feet No caving. Minor seepage at 2.5 feet (on top of till) and from 3 feet to BOH in places.	
12		
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24		
25		

KCTP3 060601A (EP-20 THRU EP-95, EP-104, IT-1 THRU IT-4), GPJ, June 9, 2006

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

11/20/06

## LOG OF EXPLORATION PIT NO. EP-80

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 562 feet</b></p>	
	<b>Forest Duff/Topsoil</b>	
1	<b>Qvt - Vashon Lodgement Till</b>	
2	Loose, moist, brown, silty fine SAND, little gravel; few roots/organics (weathered till).	
3	Turns medium dense, orange-brown, trace cobbles and boulders, unsorted; trace roots (weathered till).	
4	Turns tan, as above; trace roots.	
5		
6		
7	Dense, moist, grayish brown, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders.	
8	Seepage in places 5 feet to BOH.	
9		
10	As above.	
11	Bottom of exploration pit at depth 10 feet No caving. Minor seepage in places 5 to 10 feet.	
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KCTPS 060601A (EP-20 THRU EP-66, EP-104, IT-1 THRU IT-4) GPJ June B, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA

Approved by: JHS

Project No. KG060601A

11/20/06

## LOG OF EXPLORATION PIT NO. EP-81

Depth (ft)	DESCRIPTION	Approximate Elev. 555 feet
	<p>This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>	
	<p><b>Topsoil</b></p>	
1	<p><b>Tailings/Fill</b></p>	
2	<p>Loose, moist, dark brown, silty fine SAND, few gravel and medium to coarse sand; few roots, unsorted.</p>	
3		
4	<p><b>Qvr - Vashon Recessional Outwash</b></p>	
5	<p>(backwall - digging on slope) Medium dense, moist, gray-brown, rounded GRAVEL with fine sand, minor oxidation, well sorted, weakly stratified.</p>	
6		
7		
8	<p>Seepage.</p>	
9	<p>Medium dense, wet, gray-brown, fine to coarse SAND with gravel.</p>	
10	<p>Stratified - gravel and sand layers.</p>	
11		
12	<p><b>Qvt - Vashon Lodgement Till</b></p>	
13	<p>Dense, moist, grayish brown, brown-gray, silty fine SAND, little gravel, few medium to coarse sand, trace cobbles and boulders.</p>	
14		
15	<p>As above.</p>	
16	<p>Bottom of exploration pit at depth 15.5 feet</p>	
17	<p>No caving. Moderate seepage 8 to 11.5 feet.</p>	
18		
19		
20		
21		
22		
23		
24		
25		

KCTP3 060801A (EP-20 THRU EP-68 EP-104, IT-1 THRU IT-4) GPJ June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA

Approved by: JHS

Project No. KG060601A

11/20/06

## LOG OF EXPLORATION PIT NO. EP-105

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>	
	DESCRIPTION	Approximate Elev. 523 feet
	<b>Forest Duff/Topsoil</b>	
1	Moist, dark brown, fine to coarse SAND, little silt, little fine to coarse gravel; organic-rich, highly oxidized, abundant roots.	
2	<b>Qvr - Vashon Recessional Outwash</b>	
3	Loose, moist, yellowish-brown, fine to medium SAND, little silt, little coarse sand, few fine to coarse gravel; oxidized, roots present (weathered outwash).	
4	At 3.5': Loose to medium dense, moist, brown, medium coarse SAND, with fine to coarse gravel, little fine sand, few silt, few cobbles; stratified with ~1' sandier horizons.	
5		
6		
7		
8		
9	At 9': Moisture content increases to very moist.	
10		
11	<b>Qpog<sub>16</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>	
12	Dense, very moist, orange to tan brown, silty fine to coarse GRAVEL, little medium coarse sand, few to little cobbles, few fine sand, clay present; highly oxidized, clay/silt in interstitial spaces, occasional pieces of charcoal.	
13		
14	At 14': Becomes primarily silty fine to coarse GRAVEL.	
15	At 15': Dense, very moist, brown, medium coarse SAND, little fine to coarse gravel, few fine sand, few cobbles.	
16		
17	At 17': Dense, very moist, orange to tan brown, silty fine to coarse GRAVEL, little cobbles, little medium to coarse sand, few fine sand; stratified with ~1' siltier cobblier horizons that are more oxidized, silt/clay in interstitial spaces, occasional pieces of charcoal encountered.	
18		
19		
20		
21		
22	At 22': Heavy seepage (>10 gpm) that probably represents the ground water table.	
23		
24	Bottom of exploration pit at depth 23 feet Minor caving 0 to 9 feet, moderate caving 9 to 23 feet. Heavy seepage (>10 gpm) at 22 feet.	
25		

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601D

Logged by: ALD

Approved by:



6/5/08

## LOG OF EXPLORATION PIT NO. EP-106

Depth (ft)		Approximate Elev. 525 feet
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.	
	<b>DESCRIPTION</b>	
	<b>Forest Duff/Topsoil</b>	
1	Loose, moist, dark brown, silty fine to coarse SAND, few fine to coarse gravel; organic-rich, abundant roots.	
2	<b>Qvr - Vashon Recessional Outwash</b>	
3	Loose to medium dense, moist, yellowish-brown, silty fine to medium SAND, little coarse sand, few fine to coarse gravel; oxidized, roots present (weathered outwash).	
4	At 3.5': Medium dense, moist, brown, medium to coarse SAND, with fine to coarse gravel, little coarse sand, few cobbles.	
5		
6	<b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>	
7	Dense, moist, orange, silty medium coarse SAND, with fine to coarse gravel, little cobbles, few fine sand, clay present; highly oxidized, clay/silt in interstitial spaces.	
8		
9	At 9': Dense, very moist, gray-brown, medium to coarse SAND, with fine to coarse gravel, few fine sand, few cobbles, few silt; stratified with graveller/siltier horizons ~1' thick.	
10		
11		
12		
13		
14		
15		
16	At 15.5': Becomes very moist to saturated.	
17	At 17': Dense, very moist, tan brown, silty fine to coarse GRAVEL, little medium to coarse sand, few cobbles, few fine sand; stratified with horizons of primarily silty fine to coarse gravel ~1' thick, slightly oxidized, silt in interstitial spaces.	
18		
19		
20	Bottom of exploration pit at depth 19.5 feet	
21	Minor caving 0 to 15.5 feet, moderate caving 15.5 to 19.5 feet. Minor seepage (<1 gpm) at 15.5 feet.	
22		
23		
24		
25		

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601D

Logged by: ALD

Approved by:



6/5/08

## LOG OF EXPLORATION PIT NO. EP-107

Depth (ft)	DESCRIPTION	Approximate Elev. 522 feet
	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>	
	<b>Forest Duff/Topsoil</b>	
1	Loose, moist, dark brown, silty fine SAND, trace medium sand; organic-rich, roots present.	
	<b>Qvr - Vashon Recessional Outwash</b>	
2	Loose, moist, yellow-brown, silty fine SAND, trace medium sand; roots present, oxidized (weathered outwash).	
3	At 3': Loose, moist, brown, fine SAND, trace medium sand, trace silt; slightly stratified with ~1"	
4	siltier horizons.	
5		
6	At 5.5': Loose, moist, brown, fine to coarse GRAVEL, with medium to coarse sand, few fine sand, few cobbles, trace silt; slightly stratified with ~1' sandier horizons.	
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21	Bottom of exploration pit at depth 20 feet Moderate caving 3 to 20 feet. No seepage.	
22		
23		
24		
25		

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Project No. KG060601D

6/5/08

Logged by: ALD

Approved by:

## LOG OF EXPLORATION PIT NO. EP-108

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>	
	DESCRIPTION	Approximate Elev. 524 feet
	<b>Topsoil/Forest Duff</b>	
1	Loose, moist, dark brown, silty fine SAND, trace medium sand; organic-rich, abundant roots.	
	<b>Qvr - Vashon Recessional Outwash</b>	
2	Loose, moist, yellow-brown, fine SAND, little silt, trace medium sand; oxidized, roots present, slightly mottled texture (weathered outwash).	
3	At 3': Becomes brown and trace silt.	
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14	At 14': Loose, moist, brown, fine to coarse GRAVEL, with medium to coarse sand, few fine sand, few cobbles, trace silt.	
15		
16		
17		
18		
19	Bottom of exploration pit at depth 18 feet Moderate caving 3 to 18 feet. No seepage.	
20		
21		
22		
23		
24		
25		

KCTP3 060601D.GPJ July 3, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.

Project No. KG060601D

Logged by: ALD

Approved by:



6/5/08

# LOG OF EXPLORATION PIT NO. EP-109

Depth (ft)	DESCRIPTION	Approximate Elev. 552 feet
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.	
	<b>Forest Duff/Topsoil</b>	
1	Loose, moist, dark brown, silty fine to coarse SAND, few fine to coarse gravel; organic rich, roots present.	
	<b>Qvr - Vashon Recessional Outwash</b>	
2	Medium dense, moist, orange-brown, fine to coarse SAND, little silt, few fine to coarse gravel; highly oxidized, roots present.	
3	Medium dense, moist, brown, medium to coarse SAND, little fine to coarse gravel, few fine sand, trace silt; slightly stratified with ~0.5' more gravelly horizons.	
4		
5		
6		
7		
8		
	<b>Qvt - Vashon Lodgement Till</b>	
9	Very dense, very moist, brown-gray, silty fine to medium SAND, little fine to coarse gravel, trace to few cobbles, trace coarse sand; unsorted.	
10		
11		
12		
13	Becomes more gravel and cobble rich and ~6 to 8 gpm of seepage from this interval.	
14	Very dense, very moist, gray-brown, silty fine to medium SAND, little fine to coarse gravel, few to trace cobbles, trace coarse sand; unsorted, water level rose to 12.5' with BOH at 15' from seepage at 12.5' to 13.5'.	
15		
16		
	<b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b>	
17	Very dense, very moist, tan-gray, medium to coarse SAND, with fine to coarse gravel, few cobbles, few silt, trace fine sand; dark rind around several gravels.	
18	With the bottom of the pit at 18', the water level has risen to 17.5' in ~10 min due to seepage from the zone at 12.5' to 13.5', flowing at a rate of ~6 to 8 gpm.	
19		
20		
21	Bottom of exploration pit at depth 18 feet Seepage (<1 gpm) at 9'. ~6 to 8 gpm of seepage at 12.5' to 13.5'. Moderate caving 0 to 9'.	
22		
23		
24		
25		

KCTPS 060601B (EP-109 & EP-110, DT-1, THRU DT-3), GP-1, July 3, 2008

## The Villages King County, WA

Associated Earth Sciences, Inc.



Logged by: ALD  
Approved by:

Project No. KG060601E

6/23/08

## LOG OF EXPLORATION PIT NO. IT-3

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;"><b>Approximate Elev. 555 feet</b></p>	
1	<p style="text-align: center;"><b>Forest Duff/Topsoil</b></p> <p>Loose, moist, dark brown, silty fine SAND, organics/roots.</p>	
2	<p style="text-align: center;"><b>Qvr - Vashon Recessional Outwash</b></p> <p>Loose, moist, brown, fine to medium SAND, trace silt, trace gravel, trace roots, moderate oxidation.</p>	
3	Transitions to gray-brown at 3 feet.	
4		
5		
6	Severe caving 0 to 8 feet.	
7	<p style="text-align: center;"><b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b></p>	
8	Boulder layer up to 1 foot in diameter.	
9	Slight seepage at ~8.5 feet.	
10	Dense, moist, tan, silty/clayey fine to coarse SAND, with gravel, trace cobbles and boulders (gravel and cobbles are rounded).	
11		
12		
13	Dense, very moist, tan, silty fine to coarse SAND, with gravel, trace charcoal (gravels are very weathered).	
14		
15		
16	Dense, very moist, tan, silty GRAVEL, with fine to coarse sand, trace cobbles.	
17		
18	Dense, moist, tan, silty GRAVEL, with fine to coarse sand, trace cobbles, trace charcoal (weathered gravels).	
19		
20	Bottom of exploration pit at depth 19 feet Minor seepage at 8.5 feet. Severe caving 0 to 8 feet. Infiltration test performed at 19 feet.	
21		
22		
23		
24		
25		

KCTP3 060601A (EP-20 THRU EP-95, EP-104, IT-1 THRU IT-4), GP-1, June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA

Approved by: JHS

Project No. KG060601A

12/11/07

## LOG OF EXPLORATION PIT NO. IT-4

Depth (ft)	DESCRIPTION	Approximate Elev. 560 feet
	Forest Duff/Topsoil	
1	Loose, moist, dark brown, silty SAND, with gravel, organics/roots.	
	Qvr - Vashon Recessional Outwash	
2	Loose, moist, brown, fine to coarse SAND, with gravel, few silt, trace roots (weathered outwash).	
3		
4	Loose, moist, gray-brown, medium to coarse SAND, with gravel up to 3 inches (rounded), trace silt, weakly stratified, trace roots.	
5		
6		
7		
8	Increased moisture, caving, cleaner, loose, very moist, gray-brown, GRAVEL, with medium to coarse sand, weakly stratified.	
9		
10		
11	Severe caving, having trouble staying ahead of caving.	
12		
13	Loose, very moist, gray-brown, GRAVEL, with medium to coarse sand, weakly stratified, severe caving.	
14		
15	Bottom of exploration pit at depth 14 feet Exploration terminated due to severe caving. No seepage. Severe caving 7.5 to 14 feet. Infiltration test performed at 8 feet.	
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

KCTP3\_060601A (EP-20 THRU EP-95, EP-104, IT-1 THRU IT-4), GPJ, June 9, 2008

### The Villages Black Diamond, WA

Associated Earth Sciences, Inc.



Logged by: BAA  
Approved by: JHS

Project No. KG060601A

12/17/07

## LOG OF EXPLORATION PIT NO. DT-1

Depth (ft)	DESCRIPTION	Approximate Elev. 551 feet
	Forest Duff/Topsoil	
1	Loose, moist, dark brown, silty fine to medium SAND, organic rich, abundant roots.	
	Qvr - Vashon Recessional Outwash	
2	Loose, moist, orange-brown, fine to medium SAND, few silt, few coarse sand, occasional fine gravel; highly oxidized, minor roots present.	
3		
4	Loose to medium dense, moist, gray-brown, medium to coarse SAND, few fine sand, trace fine gravel; slightly stratified with 1" to 2" siltier horizons.	
5		
6		
7		
8		
9		
10		
11		
12	Cobble rich horizon.	
	Qpog <sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained	
13	Very dense, moist, tan-brown, silty/clayey fine to coarse GRAVEL, little fine to coarse sand, trace cobble; silt/clay in interstitial spaces, slightly oxidized, black (charcoal) fragments encountered, dark rind around some gravels.	
14		
15	Becomes very moist at 15'.	
16		
17		
18		
19	Bottom of exploration pit at depth 18 feet No seepage. Moderate caving 0 to 12.5'.	
20		

KCTP3 0506018 (EP-109 & EP-110, DT-1 THRU DT-3) GP-J July 3, 2008

### The Villages King County, WA

Associated Earth Sciences, Inc.



Logged by: ALD  
Approved by:

Project No. KG060601E

6/23/08

## LOG OF EXPLORATION PIT NO. DT-2

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 545 feet</p>
1	<p style="text-align: center;"><b>Forest Duff/Topsoil</b></p> <p>Loose, moist, dark brown, fine to medium SAND, few coarse sand, trace fine to coarse gravels; organic rich, abundant roots.</p>
2	<p style="text-align: center;"><b>Qvr - Vashon Recessional Outwash</b></p> <p>Loose to medium dense, moist, orange-brown, fine to medium SAND, few silt, trace coarse sand; oxidized, roots present.</p>
3	<p>Medium dense, moist, brown, fine to coarse SAND, few fine to coarse gravel, trace silt.</p>
4	
5	
6	<p>Becomes predominantly sand.</p>
7	
8	
9	<p>Gravel content increases.</p>
10	<p style="text-align: center;"><b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b></p>
11	<p>Very dense, very moist, tan-brown, silty/clayey fine to coarse GRAVEL, little to few fine to coarse sand, trace cobbles; silt/clay in interstitial spaces, slightly stratified with ~1' horizons with less silt/clay, dark rind around some gravels.</p>
12	
13	
14	
15	
16	
17	
18	<p>Bottom of exploration pit at depth 17.5 feet                      Minor seepage (&lt;1 gpm) at 11.5 to 12'. Minor caving 0 to 10'.</p>
19	
20	

KCTPS 060618 (EP-109 & EP-110, DT-1 THRU DT-3), GPS July 3, 2008

### The Villages King County, WA

Associated Earth Sciences, Inc.

Project No. KG060601E

Logged by: ALD

Approved by:



6/24/08

## LOG OF EXPLORATION PIT NO. DT-3

Depth (ft)	<p style="font-size: small;">This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;"><b>DESCRIPTION</b></p> <p style="text-align: right;">Approximate Elev. 547 feet</p>
1	<p style="text-align: center;"><b>Forest Duff/Topsoil</b></p> <p>Loose, moist, dark brown, silty fine to medium SAND, few coarse sand, trace fine gravel; organic rich, abundant roots.</p>
2	<p style="text-align: center;"><b>Qvr - Vashon Recessional Outwash</b></p> <p>Medium dense, moist, orange-brown, fine to medium SAND, few silt, few coarse sand; oxidized, roots present.</p>
3	
4	
5	<p style="text-align: center;"><b>Qpog<sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained</b></p> <p>Very dense, very moist, tan-brown, silty/clayey fine to coarse GRAVEL, little fine to coarse sand, trace cobbles; dark rind around some gravels, silt/clay in interstitial spaces, black (charcoal) fragments encountered.</p>
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	A 0.5' horizon of gray, medium SAND, few fine gravel, few fine and coarse sand, trace silt.
16	
17	<p>Bottom of exploration pit at depth 16 feet</p> <p>Minor seepage (&lt;1 gpm) at 5'. Minor caving 0 to 5'.</p>
18	
19	
20	

KCTPS 0606018 (EP-108 & EP-110, DT-1 THRU DT-3), GPJ, July 3, 2008

### The Villages King County, WA

Associated Earth Sciences, Inc.



Logged by: ALD

Approved by:

Project No. KG060601E

6/24/08

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



Project Number  
KG060601A

Well Number  
MW-5

Sheet  
1 of 3

Project Name The Villages

Location Black Diamond, WA

Elevation (Top of Well Casing) 603.74'

Surface Elevation (ft) 601.59'

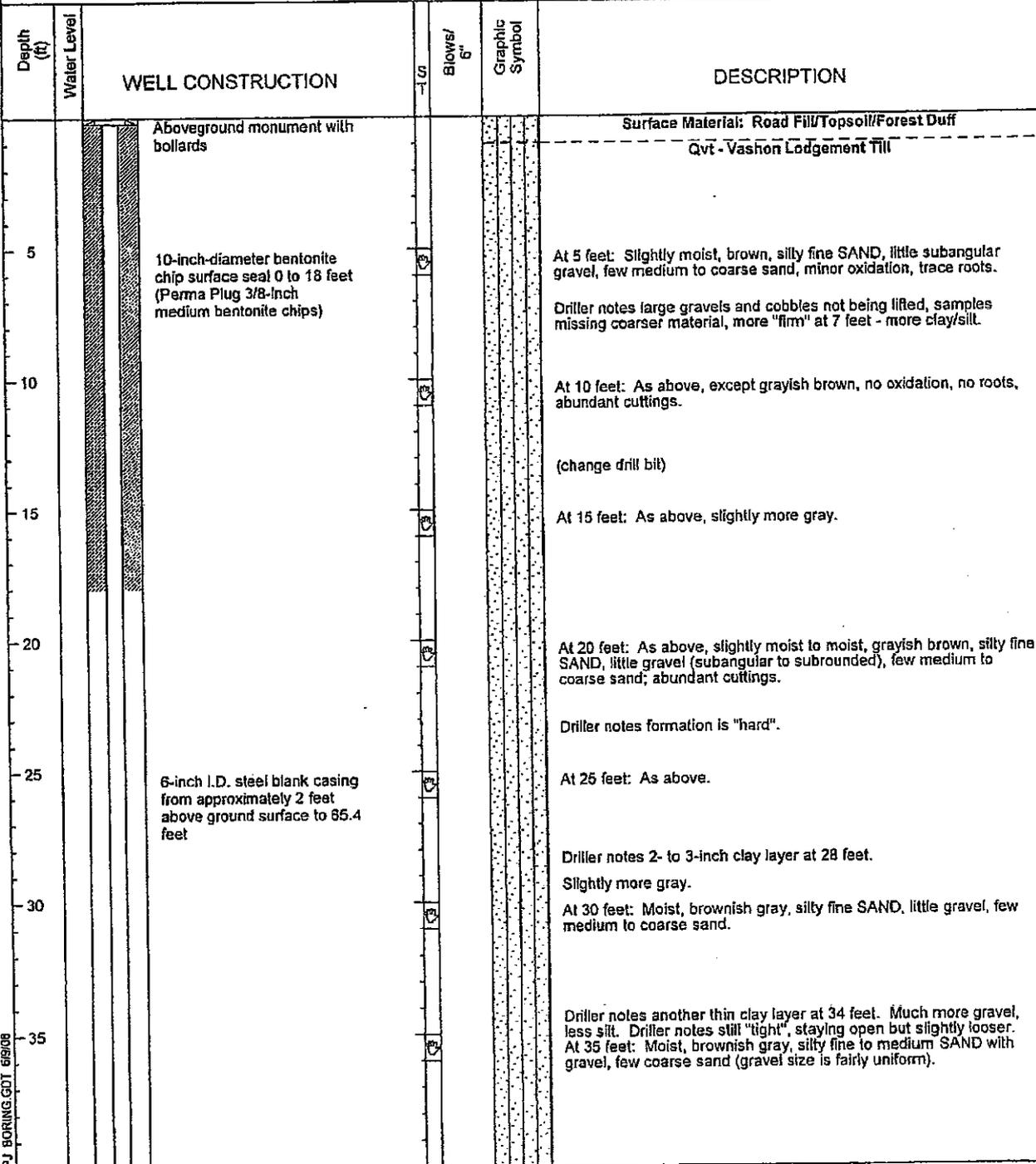
Water Level Elevation 535.86'

Date Start/Finish 9/18/06, 9/19/06

Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary

Hole Diameter (in) 10" to 18 5/8" to TD

Hammer Weight/Drop N/A



NW060601A.GPJ BORING.GDT 6/9/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)     No Recovery
- 3" OD Split Spoon Sampler (D & M)     Ring Sample
- Grab Sample     Shelby Tube Sample

- M - Moisture
- ∇ Water Level (12/14/06)
- ▼ Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log

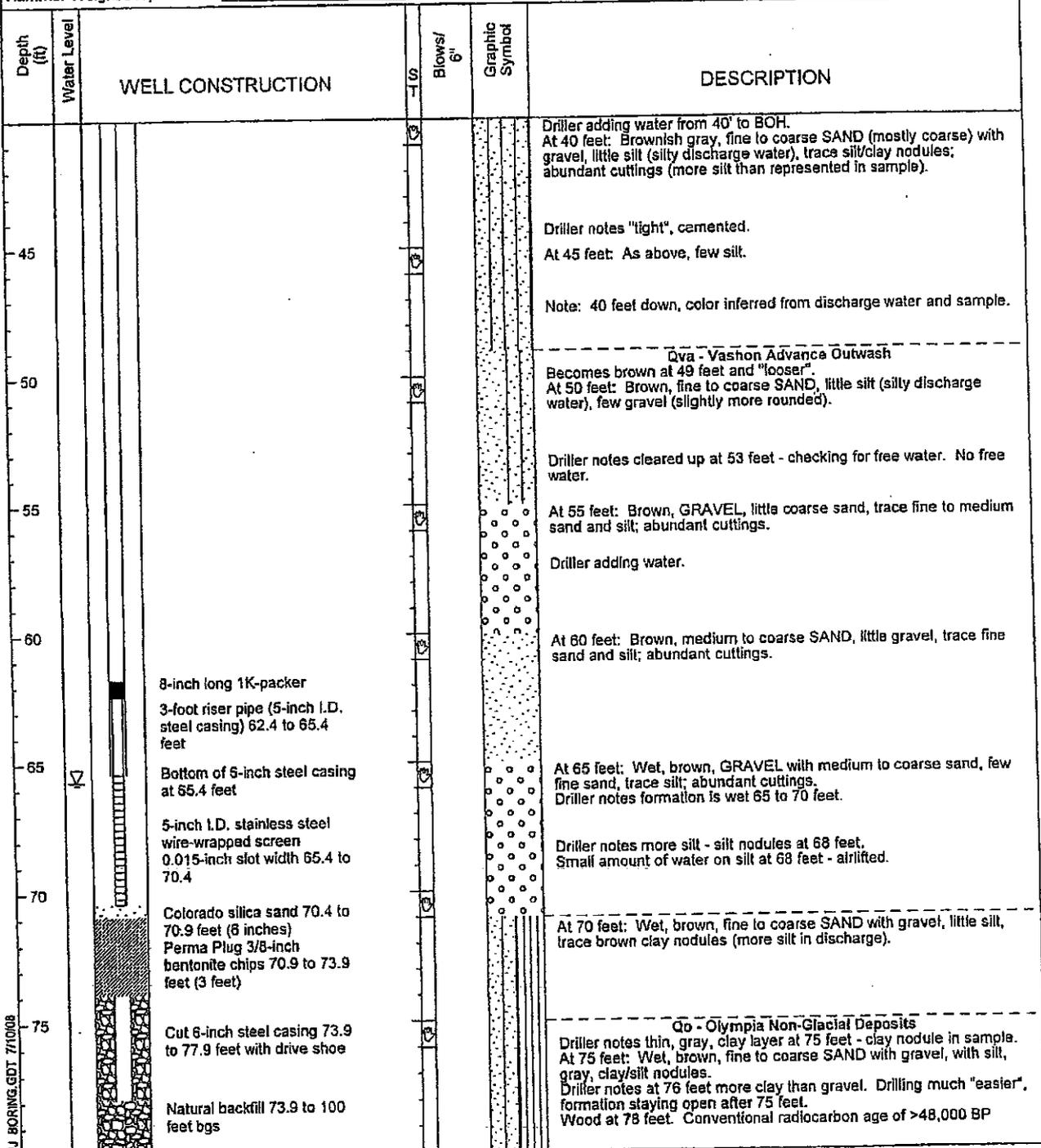
Project Number  
KG060601A

Well Number  
MW-5

Sheet  
2 of 3

Project Name The Villages  
 Elevation (Top of Well Casing) 603.74'  
 Water Level Elevation 535.86'  
 Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 601.59'  
 Date Start/Finish 9/18/06, 9/19/06  
 Hole Diameter (in) 10" to 18 1/8" to TD



NWELL 060601A.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Project Number KG060601A	Well Number MW-5	Sheet 3 of 3
Project Name <b>The Villages</b>	Location Black Diamond, WA	
Elevation (Top of Well Casing) 603.74'	Surface Elevation (ft) 601.59'	
Water Level Elevation 535.86'	Date Start/Finish 9/18/06 9/19/06	
Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary	Hole Diameter (in) 10" to 18 1/6" to TD	
Hammer Weight/Drop N/A		

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6'	Graphic Symbol	DESCRIPTION
85		Natural backfill 73.9 to 100 feet bgs			At 79.5 feet: Wet, gray, silty fine to coarse SAND with gravel. Becomes wet, gray, SILT, few sand and gravel at 80 to 85 feet.
90					Driller notes turned brownish gray and into sand and gravel again at 85 feet (staying open, "tight") (till-like). Qpog <sub>12</sub> - Pra-Olympia Glacial Deposits, Coarse-Grained At 85 feet: Wet, brownish gray, GRAVEL with fine to coarse sand, little silt (angular to subangular gravels) (gravels mostly green and orange, oxidized outer coating). (Silty discharge - more silt than in samples 85 to 100 feet)
95					At 90 feet: Wet, brownish gray, GRAVEL with fine to coarse sand, little silt (silty discharge water). Angular gravels, abundant cuttings.
100					At 95 feet: As above, except brown.  Formation has more silt than is seen in samples. Very murky discharge. Driller notes "tight" and hole staying open. Drilled open hole 80 to 100 feet. At 100 feet: As above, slightly more orangish brown.
105					Boring terminated at 100 feet on 9/19/06
110					
115					

NW0601A.GPJ BORING.GDT 7/10/06

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: BAA
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (12/14/06)	Approved by:
Grab Sample	Shelby Tube Sample	Water Level at time of drilling (ATD)	

# Geologic & Monitoring Well Construction Log



Project Number  
KG060601A

Well Number  
MW-6

Sheet  
1 of 5

Project Name **The Villages**

Location **Black Diamond, WA**

Elevation (Top of Well Casing) **591.69'**

Surface Elevation (ft) **589.71'**

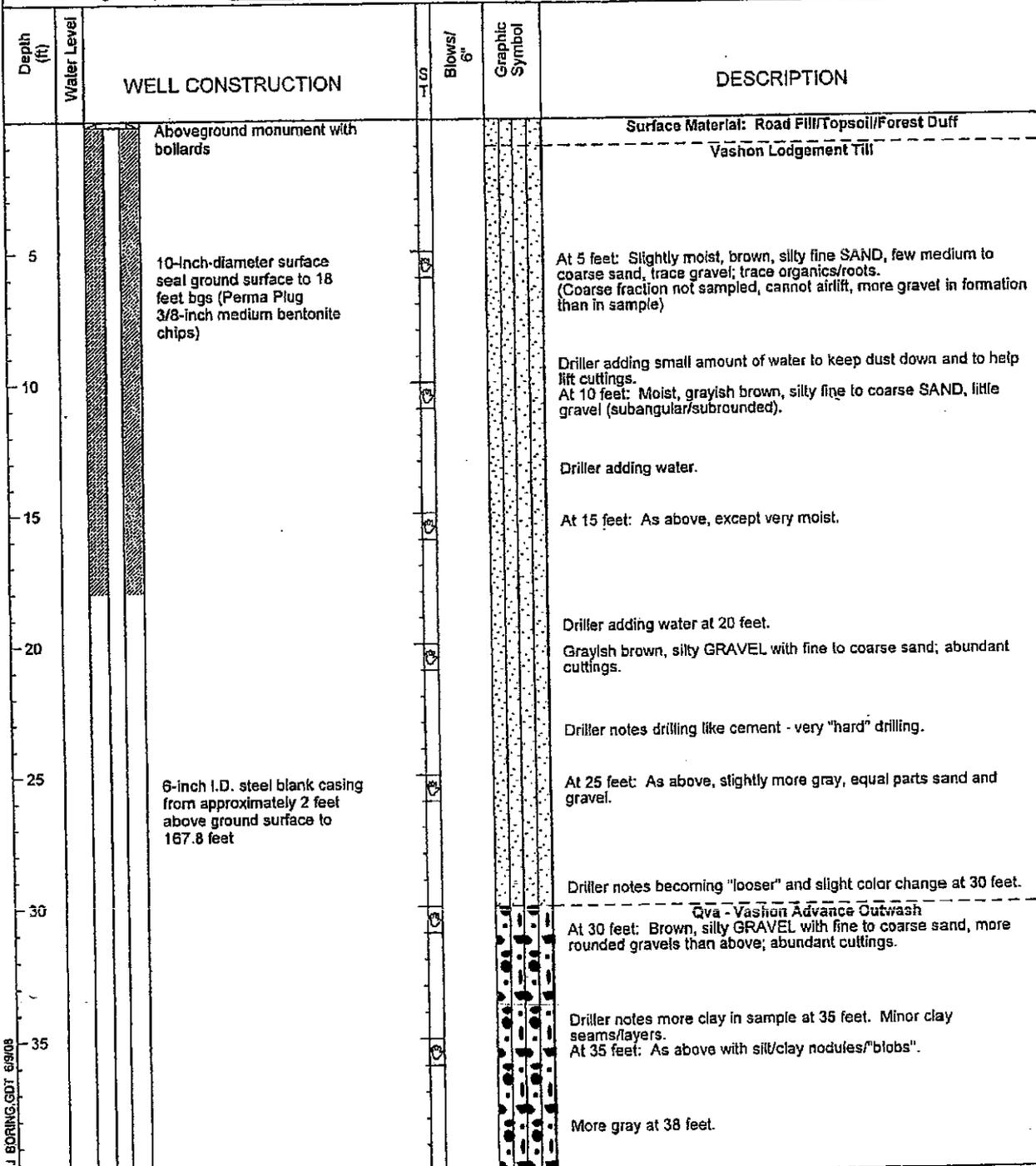
Water Level Elevation **491.25'**

Date Start/Finish **9/19/06 9/20/06**

Drilling/Equipment **Aquatech Well Drilling and Pump/Air Rotary**

Hole Diameter (in) **10" to 18 1/8" to TD**

Hammer Weight/Drop **N/A**



NWELL\_060601A.GPJ BORING.GDT 6/9/06

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Associated Earth Sciences, Inc.

### Geologic & Monitoring Well Construction Log

Project Number  
KG060601A

Well Number  
MW-6

Sheet  
2 of 5

Project Name The Villages

Location Black Diamond, WA

Elevation (Top of Well Casing) 591.69'

Surface Elevation (ft) 589.71'

Water Level Elevation 491.25'

Date Start/Finish 9/19/06 9/20/06

Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary

Hole Diameter (in) 10" to 18 1/8" to TD

Hammer Weigh/Drop N/A

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
					At 40 feet: Brownish gray, silty fine to coarse SAND, little gravel.
					Driller notes thin (~1 foot) clay layer at ~45 feet.
45					Qpog, - Pre-Olympia Glacial Till At 45 feet: Gray, fine to coarse sandy SILT, little gravel, effervesces with HCL. Dark gray/black film in discharge water.
50		6" I.D. steel blank casing from approximately 2 feet above ground surface to 167.8 feet			At 50 feet: Gray, silty fine to coarse SAND with gravel (subangular to rounded gravels, predominantly volcanic), few silt/clay nodules with sand inside, effervesces with HCL.
55					At 55 feet: As above.  HCL reaction from 45 feet to BOH, including Qpog, and Qpog,
60					At 60 feet: Brownish gray, silty fine to coarse SAND, little gravel; abundant cuttings. Qpog <sub>ss</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained Becomes more brown at 61'.
65					At 65 feet: Brown, silty medium to coarse SAND with gravel, few fine sand, effervesces with HCL. Driller notes formation "loose" - sand and gravel at 66 feet, decrease in silt but formation staying open.
70					At 70 feet: Grayish brown, fine to coarse SAND with gravel, few silt (mostly medium to coarse sand), effervesces with HCL.
75					At 75 feet: As above, slightly more gray, more gravel, coal flecks in sample; mostly volcanic gravels, effervesces with HCL.  Driller notes becoming more coarse last 6 to 7 feet of run ~73 to 78 feet. No free draining water.

NWELL\_060601A.GPJ BORING.GDT 6/9/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)     No Recovery
- 3" OD Split Spoon Sampler (D & M)     Ring Sample
- Grab Sample     Shelby Tube Sample

- M - Moisture
- ▽ Water Level (12/14/06)
- ▽ Water Level at time of drilling (ATD)

Logged by: BAA  
Approved by:

Associated Earth Sciences, Inc.

## Geologic & Monitoring Well Construction Log

Project Number  
KG060601A

Well Number  
MW-6

Sheet  
3 of 5

Project Name The Villages  
 Elevation (Top of Well Casing) 591.69'  
 Water Level Elevation 491.25'  
 Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 589.71'  
 Date Start/Finish 9/19/06 9/20/06  
 Hole Diameter (in) 10" to 18 5/8" to TD

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
85			1	[Symbol]	At 80 feet: Brownish gray, medium to coarse SAND, little gravel, little silt, effervesces with HCL.  Color change at 82 feet. Driller still adding water.
90		6" I.D. steel blank casing from approximately 2 feet above ground surface to 167.8 feet	1	[Symbol]	At 85 feet: Brown, medium to coarse SAND with gravel, little silt, effervesces with HCL.  Driller notes discharge "cleaned up" at 88 feet. Gravels become more oxidized starting at 85 feet.  At 90 feet: As above, few silt.
95			1	[Symbol]	At 95 feet: Brown, medium to coarse SAND, few gravel, few silt, effervesces with HCL.
100	▽		1	[Symbol]	At 100 feet: Brown, GRAVEL with coarse sand, trace silt, effervesces with HCL. Increased silt in discharge - 101 to 103 feet - silty lens.
105			1	[Symbol]	At 105 feet: Wet, brown, medium to coarse SAND, little gravel, few silt, effervesces with HCL. Driller notes feels like water at 105 feet. Clean, wet sand and gravel below 103 feet.
110			1	[Symbol]	At 110 feet: As above (rounded gravels).
115			1	[Symbol]	At 115 feet: Wet, brown, GRAVEL with medium to coarse sand, few silt, effervesces with HCL.  Formation producing more water.

NW1/4 SEC06N14E01J BORING GDT 6/5/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)     No Recovery
- 3" OD Split Spoon Sampler (D & M)     Ring Sample
- Grab Sample     Shelby Tube Sample

- M - Moisture
- ▽ Water Level (12/14/06)
- ▽ Water Level at time of drilling (ATD)

Logged by: BAA  
 Approved by:

Project Name <b>The Villages</b>	Location <b>Black Diamond, WA</b>
Elevation (Top of Well Casing) <b>591.69'</b>	Surface Elevation (ft) <b>589.71'</b>
Water Level Elevation <b>491.25'</b>	Date Start/Finish <b>9/19/06 9/20/06</b>
Drilling/Equipment <b>Aquatech Well Drilling and Pump/Air Rotary</b>	Hole Diameter (in) <b>10" to 18/16" to TD</b>
Hammer Weight/Drop <b>N/A</b>	

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/ 6"	Graphic Symbol	DESCRIPTION
		6" I.D. steel blank casing from approximately 2 feet above ground surface to 167.8 feet			At 120 feet: Wet, brown, medium to coarse SAND with gravel, few silt (subangular to rounded gravel), effervesces with HCL. Driller notes silty lens at ~121 to 123 feet.
125					At 125 feet: As above.
130					At 130 feet: As above.
135					At 135 feet: As above.
140					At 140 feet: As above.
145					At 145 feet: As above.
150					At 150 feet: As above.
152					Silty lens ~152 feet, driller notes large gravels and cobbles.
155					At 155 feet: As above. Driller notes formation is producing ~75 gpm.

NW WELL 060601A.GPJ BORING.GDT 06/06

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: BAA
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (12/14/06)	Approved by:
Grab Sample	Sheby Tube Sample	Water Level at time of drilling (ATD)	

Associated Earth Sciences, Inc.

### Geologic & Monitoring Well Construction Log



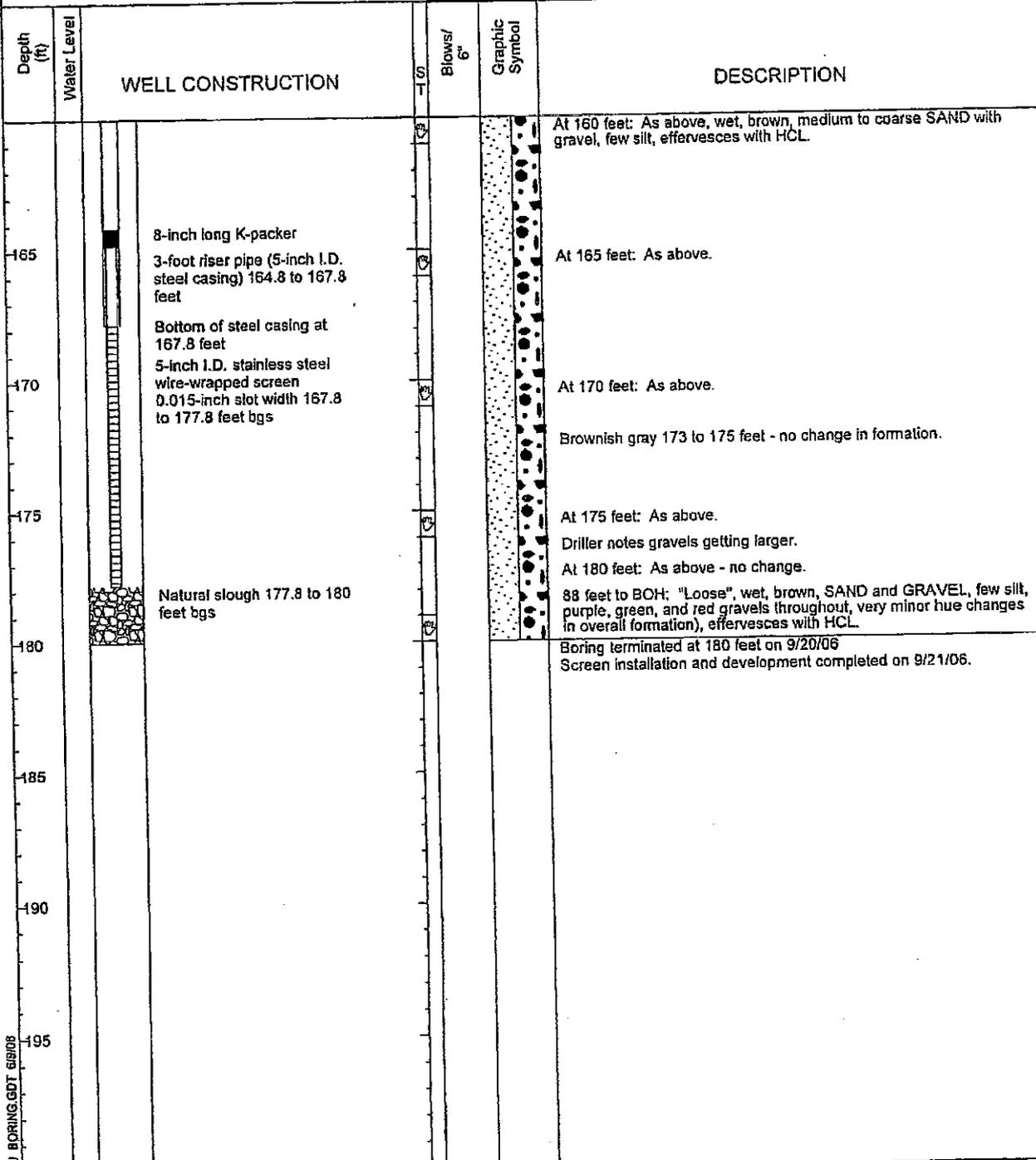
Project Number  
KG060601A

Well Number  
MW-6

Sheet  
5 of 5

Project Name The Villages  
 Elevation (Top of Well Casing) 591.69'  
 Water Level Elevation 491.25'  
 Drilling/Equipment Aquatech Well Drilling and Pump/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 589.71'  
 Date Start/Finish 9/19/06 9/20/06  
 Hole Diameter (in) 10" to 18 1/8" to TD



MWELL 060601A.GPJ BORING.GDT 6/10/06

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

### Geologic & Monitoring Well Construction Log



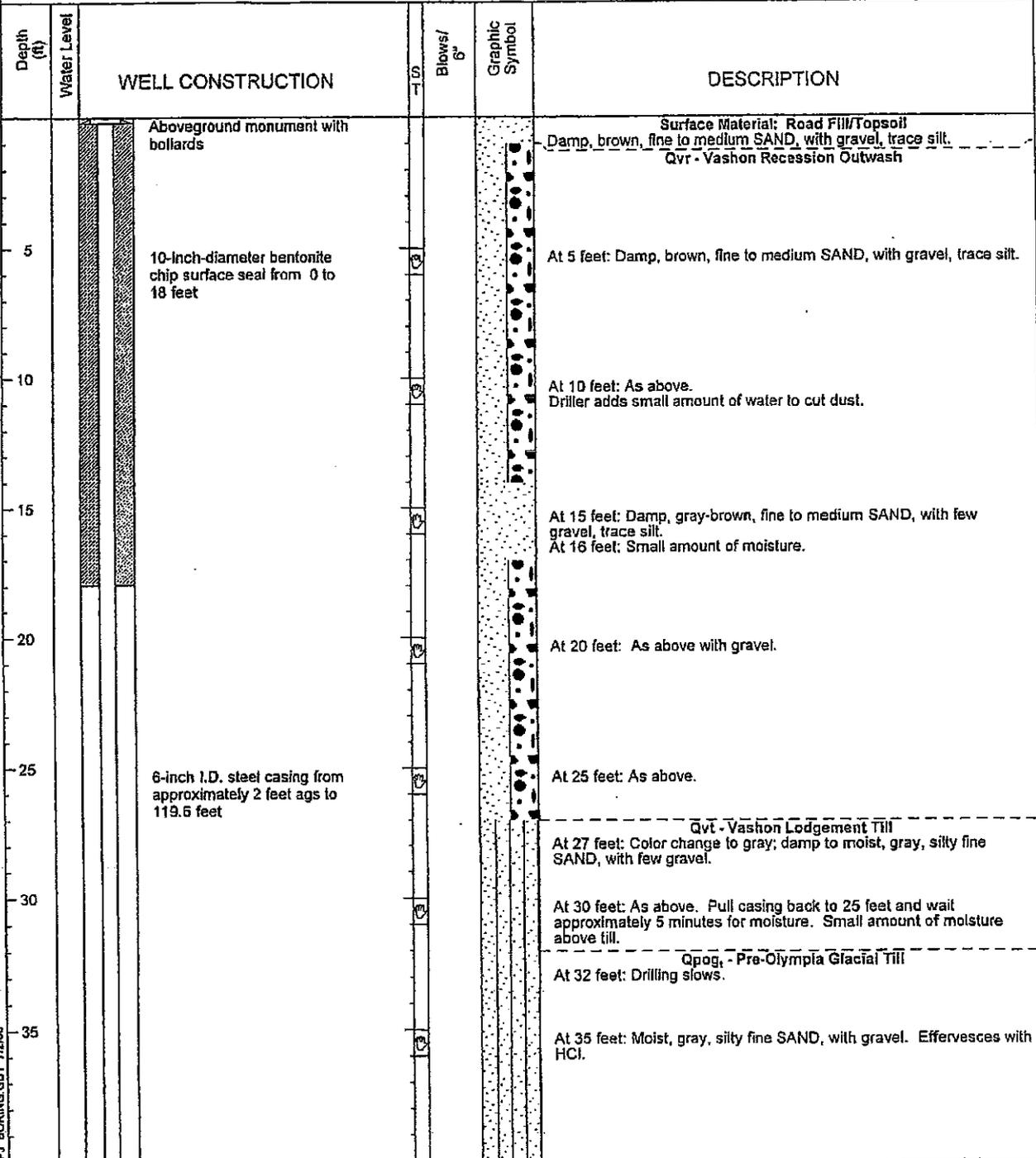
Project Number  
KG060601A

Well Number  
MW-7

Sheet  
1 of 4

Project Name The Villages  
 Elevation (Top of Well Casing) 553.36'  
 Water Level Elevation 492.56'  
 Drilling/Equipment Tacoma Pump & Drilling/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 550.70'  
 Date Start/Finish 9/25/06 9/26/06  
 Hole Diameter (in) 10" to 18 1/6" to TD



NHWELL\_060601A.GPJ BORINGS.GDT 7/2/08

**Sampler Type (ST):**

- |  |  |   |                |
|--|--|---|----------------|
| <input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)   | <input type="checkbox"/> No Recovery                   | M - Moisture  | Logged by: JHS |
| <input type="checkbox"/> 3" OD Split Spoon Sampler (D & M) | <input type="checkbox"/> Ring Sample                   | <input checked="" type="checkbox"/> Water Level (12/14/06)                | Approved by:   |
| <input checked="" type="checkbox"/> Grab Sample            | <input checked="" type="checkbox"/> Shelby Tube Sample | <input checked="" type="checkbox"/> Water Level at time of drilling (ATD) |                |

Associated Earth Sciences, Inc.

**Geologic & Monitoring Well Construction Log**

Project Number  
KG060601A

Well Number  
MW-7

Sheet  
2 of 4

Project Name The Villages  
 Elevation (Top of Well Casing) 553.36'  
 Water Level Elevation 492.56'  
 Drilling/Equipment Tacoma Pump & Drilling/Air Rotary  
 Hammer Weigh/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 550.70'  
 Date Start/Finish 9/25/06 9/26/06  
 Hole Diameter (in) 10" to 18/6" to TD

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/ 6"	Graphic Symbol	DESCRIPTION
					At 40 feet: As above, abundant cuttings. Note: no free water after casing weld.
					----- Opog <sub>10</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained
45					At 45 feet: Moist, grayish brown, silty fine to coarse SAND, with gravel.
					At 47 feet: Driller notes losing air into formation.
50		6-inch I.D. steel casing from approximately 2 feet ags to 119.6 feet			At 50 feet: As above.
55					At 55 feet: As above.
	▽				No free water after casing weld.
60					At 60 feet: Moist, gray-brown, silty GRAVEL, with few sand.
65					At 65 feet: As above, moist to wet.
					Driller notes cobble/boulder at 68 feet (granite clasts in sample return).
70	▽				At 70 feet: As above.
					At 71 feet: Driller producing turbid water, gray-brown in color.
75					At 75 feet: As above.
					*WL with BOH approximately 77 feet and BOC approximately 76 feet: 59.6 feet bgs after sitting overnight.
					Making less water than at 71 feet bgs.

NANWELL DEGBN.A.G.P.J. BORING.GDT. 7/2/06

Sampler Type (ST):

-  2" OD Split Spoon Sampler (SPT)
-  3" OD Split Spoon Sampler (D & M)
-  Grab Sample
-  No Recovery
-  Ring Sample
-  Shelby Tube Sample

- M - Moisture
- ▽ Water Level (12/14/06)
- ▽ Water Level at time of drilling (ATD)

Logged by: JHS  
 Approved by:

Project Name <b>The Villages</b>	Location <b>Black Diamond, WA</b>
Elevation (Top of Well Casing) <b>553.36'</b>	Surface Elevation (ft) <b>550.70'</b>
Water Level Elevation <b>492.56'</b>	Date Start/Finish <b>9/25/06 9/26/06</b>
Drilling/Equipment <b>Tacoma Pump &amp; Drilling/Air Rotary</b>	Hole Diameter (in) <b>10" to 18 1/6" to TD</b>
Hammer Weight/Drop <b>N/A</b>	

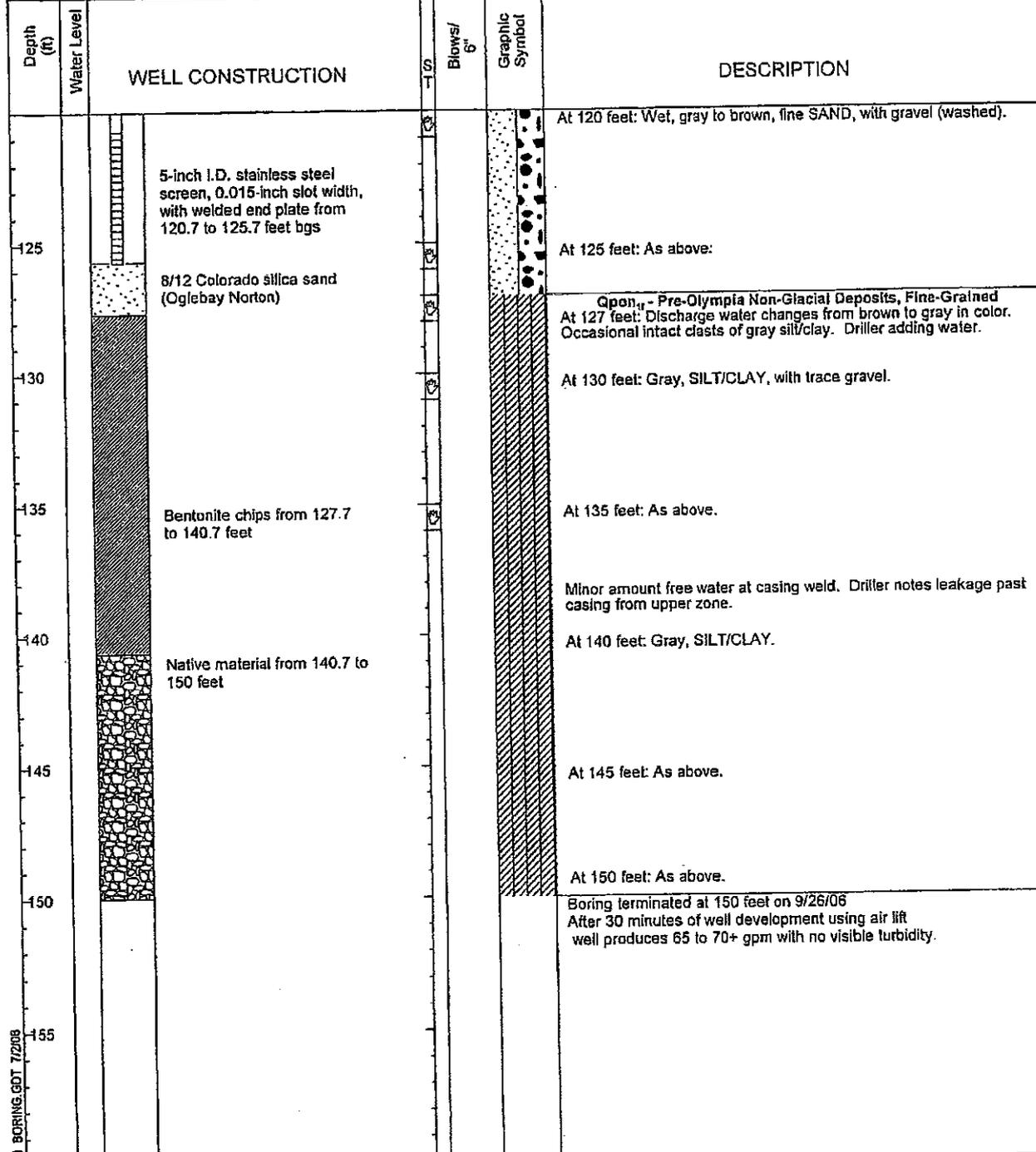
Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
85					At 80 feet: Wet, brown, medium to coarse SAND, with gravel, few silt. Gravels are mostly fine in size.  Drill speed slows, increase in gravel content.
90		6-inch I.D. steel casing from approximately 2 feet ags to 119.6 feet			At 85 feet: Wet, brown, GRAVEL with sand, silt. Gravels are mostly broken.  At 90 feet: As above, few silt. Gravels are mostly fine to medium in size.  At 92 feet: Increase in free water.
95					At 95 feet: Wet, brown to gray, fine to coarse SAND, with gravel, few silt. Silt content under-represented in sample due to free water.  Driller estimates airlifting approximately 15 to 20 gpm with drillstem at 97 feet bgs.
100					At 100 feet: Wet, gray to brown (brown discharge water), fine to coarse SAND, with gravel (washed by discharge).
105					At 105 feet: As above.
110					At 110 feet: As above.
115		K-packer from 117.7 to 118.2 feet 5-inch I.D. steel casing from 118.2 to 120.7 feet			At 115 feet: As above.  Driller notes flow rate increased with depth; discharge water is brown in color.

MWELL 060601A.GPJ BORING.GDT 7/2/08

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> No Recovery	M - Moisture	Logged by: JHS
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (12/14/06)	Approved by:
Grab Sample	Shelby Tube Sample	Water Level at time of drilling (ATD)	

Project Name: **The Villages** Location: **Black Diamond, WA**  
 Elevation (Top of Well Casing): **553.36'** Surface Elevation (ft): **550.70'**  
 Water Level Elevation: **492.56'** Date Start/Finish: **9/25/06 9/26/06**  
 Drilling/Equipment: **Tacoma Pump & Drilling/Air Rotary** Hole Diameter (in): **10" to 18/8" to TD**  
 Hammer Weigh/Drop: **N/A**



Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: JHS  
 Approved by:

MW060601A.GPJ BORING.GDT 7/2/08

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



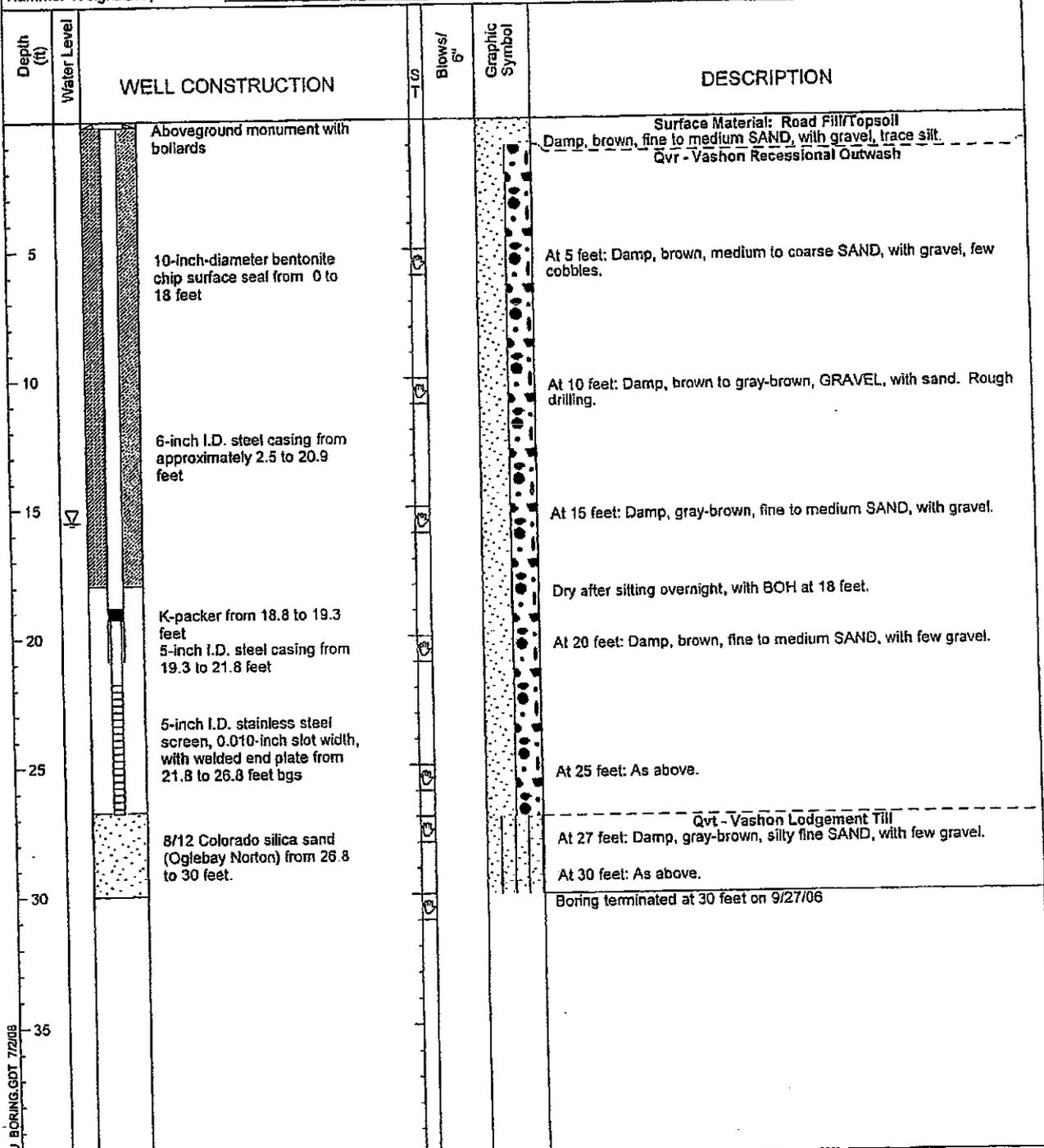
Project Number  
KG060601A

Well Number  
MW-8

Sheet  
1 of 1

Project Name The Villages  
 Elevation (Top of Well Casing) 553.35'  
 Water Level Elevation 535.20'  
 Drilling/Equipment Tacoma Pump & Drilling/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 550.72'  
 Date Start/Finish 9/28/06 9/27/06  
 Hole Diameter (in) 10" to 18 1/8" to TD



NWELL 060601A.GPJ BORING.GDT 7/2/06

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: JHS

Approved by:

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



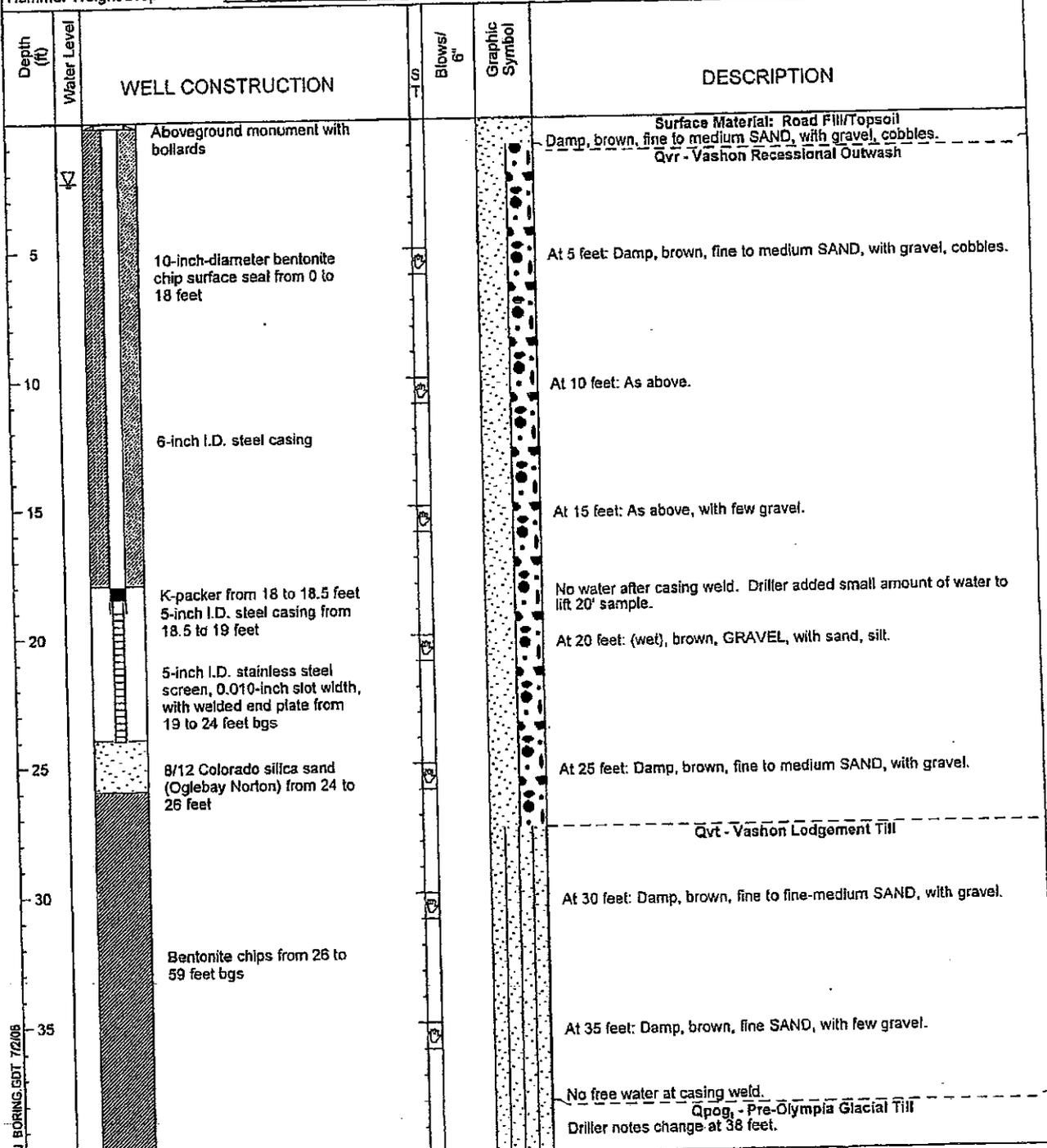
Project Number  
KG060601A

Well Number  
MW-9

Sheet  
1 of 2

Project Name The Villages  
 Elevation (Top of Well Casing) 555.04'  
 Water Level Elevation 550.17'  
 Drilling/Equipment Tacoma Pump & Drilling/Air Rotary  
 Hammer Weigh/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 552.41'  
 Date Start/Finish 9/27/06 9/27/06  
 Hole Diameter (In) 10" to 18 5/8" to TD



NWELL 060601A.GPJ BORING.GDT 7/2/06

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (12/14/06)
- Water Level at time of drilling (ATD)

Logged by: JHS

Approved by:

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



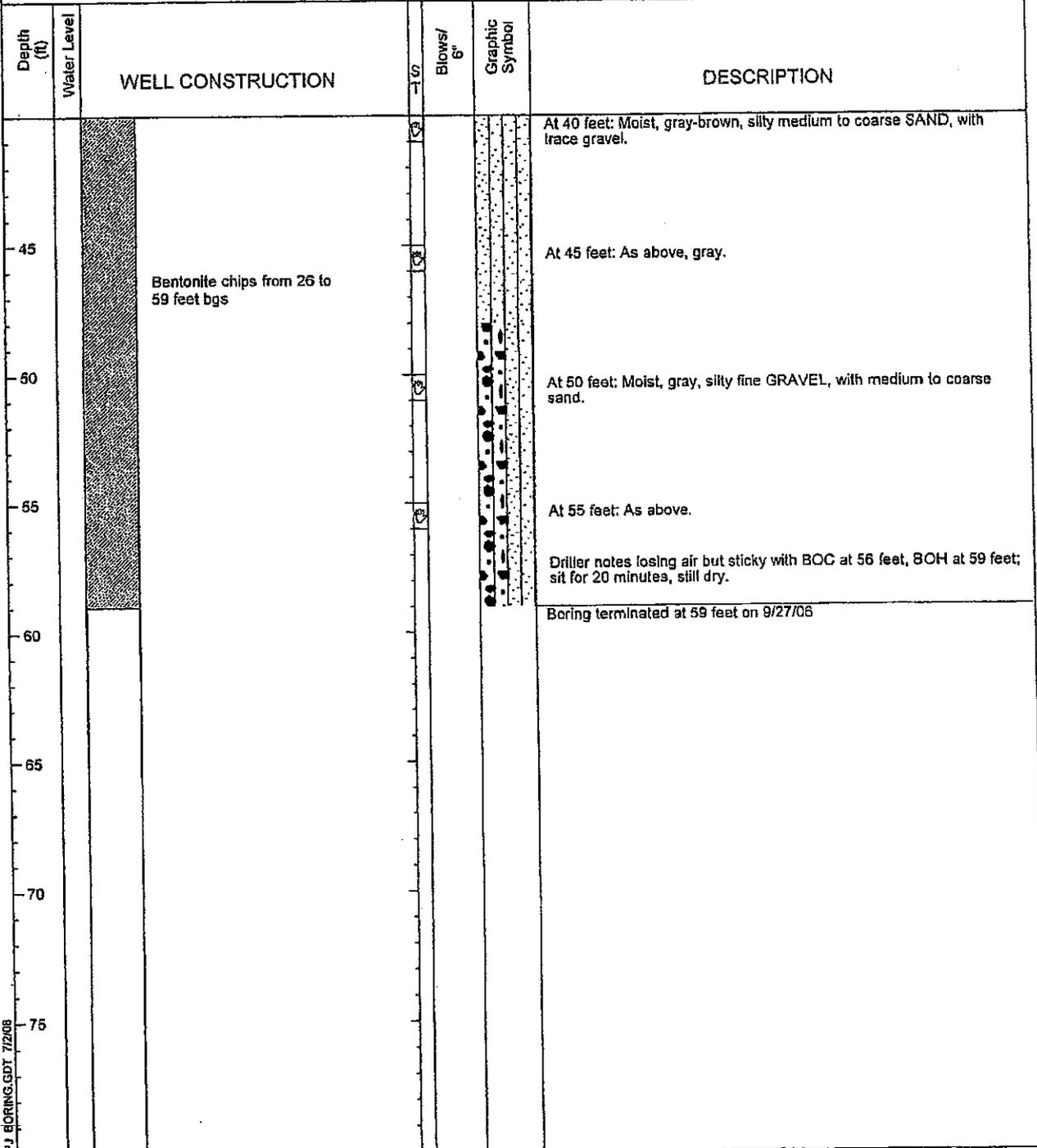
Project Number  
KG060601A

Well Number  
MW-9

Sheet  
2 of 2

Project Name The Villages  
 Elevation (Top of Well Casing) 555.04'  
 Water Level Elevation 550.17'  
 Drilling/Equipment Tacoma Pump & Drilling/Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 552.41'  
 Date Start/Finish 9/27/06 9/27/06  
 Hole Diameter (in) 10" to 18'6" to TD



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: JHS



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level (12/14/06)

Approved by:



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)

MW9WELL\_060601A.GPJ BORING.GDT 7/2/08

# Geologic & Monitoring Well Construction Log



Project Number  
KG060601D

Well Number  
MW-20

Sheet  
1 of 3

Project Name The Villages

Elevation (Top of Well Casing) 566.20'

Water Level Elevation 491.60'

Drilling/Equipment Tacoma Pump-Drilling/Dual Air Rotary

Hammer Weight/Drop N/A

Location Black Diamond, WA

Surface Elevation (ft) 564.00'

Date Start/Finish 6/4/08, 6/4/08

Hole Diameter (in) 10" to 18", 6" to TD

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Aboveground monument with bollards				Surface Material: Road Material/Drill Pad Qvr - Vashon Recessional Outwash
5		10-inch-diameter bentonite chip surface seal from 0 to 18 feet				Moist, brown, fine to coarse SAND, with gravel, few silt, abundant cuttings, trace roots, minor oxidation.
10						Slightly moist, brown, GRAVEL, little fine to coarse sand, trace silt.
15						Moist, brown, GRAVEL, few fine to coarse sand, trace silt.
20						Transition to fine to medium SAND at 18 feet. No free water after casing weld at 18 feet.
25		6-inch I.D. steel blank casing from approximately 2.5 feet above ground surface to 115 feet				Very moist, brown, fine to medium SAND, trace coarse sand, gravel, and silt.
30						Qvt - Vashon Lodgement Till Driller notes change at ~22 feet - increased density, drills like till.
35						Moist, grayish-brown, silty fine SAND, few gravel. As above. Driller notes formation seems looser for till and gravelly. Moist, brownish-gray, silty fine SAND, little gravel, few coarse sand.

NW WELL 060601D.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Project Name <b>The Villages</b>	Location <b>Black Diamond, WA</b>
Elevation (Top of Well Casing) <b>566.20'</b>	Surface Elevation (ft) <b>564.00'</b>
Water Level Elevation <b>491.60'</b>	Date Start/Finish <b>6/4/08, 6/4/08</b>
Drilling/Equipment <b>Tacoma Pump-Drilling/Dual Air Rotary</b>	Hole Diameter (in) <b>10' to 18', 6" to TD</b>
Hammer Weight/Drop <b>N/A</b>	

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
					Moist, brownish-gray, silty fine SAND, little gravel, few coarse sand.
45					As above except few gravel.
					Driller notes coarse material; cobbles, small boulders
50					As above.
		6-inch I.D. steel blank casing from approximately 2.5 feet above ground surface to 115 feet			
55					Moist, brownish-gray, silty fine SAND, few gravel, trace coarse sand.
60					Moist, brownish-gray, silty fine SAND, few gravel.
					----- Qpog <sub>1c</sub> Pre-Olympia Glacial Deposits, Coarse-Grained -----
65					Moist, gray, silty fine to medium SAND, little gravel, trace silty nodules.
70					Moist, gray, silty GRAVEL, with medium to coarse sand.
					Increased moisture, driller notes free water at ~71 to 72 feet.
75					Very moist, silty coarse SAND, with gravel, few fine to medium sand.
					Airlifted small amount of water after casing weld at ~78 feet. Not free draining yet.

NWELL 060601D.GPJ BDRING.GDT 7/1/08

**Sampler Type (ST):**

- |                                   |                    |
|-----------------------------------|--------------------|
| 2" OD Split Spoon Sampler (SPT)   | No Recovery        |
| 3" OD Split Spoon Sampler (D & M) | Ring Sample        |
| Grab Sample                       | Shelby Tube Sample |

- |                                       |
|---------------------------------------|
| M - Moisture                          |
| Water Level (6/19/08)                 |
| Water Level at time of drilling (ATD) |

Logged by: BAA

Approved by:

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



Project Number  
KG060601D

Well Number  
MW-20

Sheet  
3 of 3

Project Name **The Villages**

Location **Black Diamond, WA**

Elevation (Top of Well Casing) **566.20'**

Surface Elevation (ft) **564.00'**

Water Level Elevation **491.60'**

Date Start/Finish **6/4/08 6/4/08**

Drilling/Equipment **Tacoma Pump-Drilling/Dual Air Rotary**

Hole Diameter (in) **10' to 18', 6" to TD**

Hammer Weight/Drop **N/A**

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
85					Wet, gray, silty GRAVEL, with medium to coarse sand (sample wet due to accumulated water after casing weld).
					Very moist, as above (effervesces with HCl).
90		6-inch I.D. steel blank casing from approximately 2.5 feet above ground surface to 115 feet			As above (effervesces with HCl).
					Becoming finer-grained.
95					Very moist, gray, silty fine to coarse sand, with gravel (effervesces with HCl). Driller using water to clean out casing. Notes formation producing water at ~96 feet.
100					Wet, grayish-brown, fine to coarse SAND, few gravel (abundant orange sand), trace silt and silt nodules. Free draining water after casing weld at ~98 feet, producing ~5 gpm (airlift).
105					As above. Driller notes formation producing ~15 gpm (airlift). Increased gravel and possible trace organics at 108 feet (black film on discharge pile).
110					Wet, gray-brown, fine to coarse SAND, little gravel, trace to few silt. Increased gravels up to 1.5-inch diameter. As above with abundant orange, green, and red sands and gravels Driller notes formation producing ~30 gpm (airlift).
115		Bottom of casing left open, no well screen installed			Boring terminated at 115 feet on 6/4/08 Leaving open bottom - no screen installed.

NW WELL 060601D.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)     No Recovery
- 3" OD Split Spoon Sampler (D & M)     Ring Sample
- Grab Sample     Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA  
Approved by:

Associated Earth Sciences, Inc.		Geologic & Monitoring Well Construction Log			
		Project Number KG060601D	Well Number MW-21	Sheet 1 of 1	
Project Name <b>The Villages</b>		Location <b>Black Diamond, WA</b>			
Elevation (Top of Well Casing) <b>565.64'</b>		Surface Elevation (ft) <b>563.40'</b>			
Water Level Elevation <b>544.08'</b>		Date Start/Finish <b>6/4/08, 6/5/08</b>			
Drilling/Equipment <b>Tacoma Pump-Drilling/Dual Air Rotary</b>		Hole Diameter (in) <b>10" to 18", 6" to TD</b>			
Hammer Weight/Drop <b>N/A</b>					
Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6" SPT	Graphic Symbol	DESCRIPTION
		Aboveground monument with bollards			Surface Material: Road/Drill Pad Material Qvr - Vashon Recessional Outwash
5		10-inch-diameter bentonite chip surface seal from 0 to 18'			Dry, brown, GRAVEL, few fine to coarse sand, trace silt; abundant cuttings.
10		6-inch I.D. steel casing from approximately 2' above ground surface to 16.8'			Slightly moist, GRAVEL, little fine to coarse sand, trace silt.
15		K-packer and riser from approximately 14.8' to 16.8'			As above.
20		5-inch I.D. stainless steel screen, 0.015-inch slot with welded end plate from 16.8' to 21.8'			At 18 feet transitions to fine to medium SAND, trace gravel. No free water after casing weld at 18 feet.
25		Pea gravel 21.8' to 23.2'			Qvt - Vashon Lodgement Till Moist, brown, silty fine to coarse SAND, little gravel.
30		Bentonite chips 23.2' to 37'			Moist, brown, silty fine SAND, few gravel and coarse sand.
35					Moist, brownish-gray, silty fine SAND, few to little gravel. Driller notes cobbly zone, looser at ~32 feet.
					As above.
					Boring terminated at 37 feet on 6/5/08 Well installed 6/5/08.

NWELL\_060601D.GPJ BORING.GDT 7/1/08

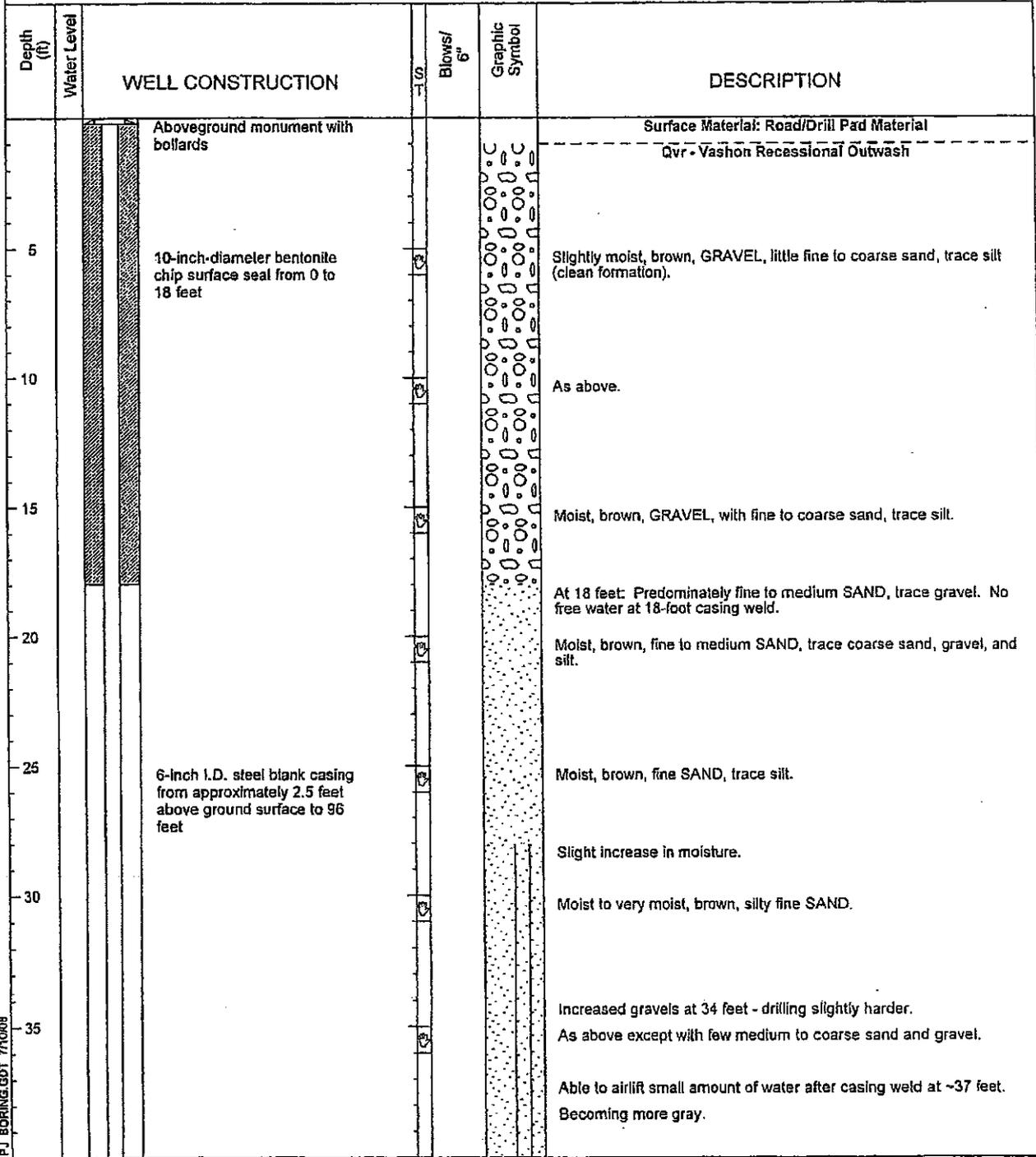
**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA  
Approved by:

Project Name <b>The Villages</b>	Location Black Diamond, WA
Elevation (Top of Well Casing) 557.75'	Surface Elevation (ft) 555.15'
Water Level Elevation 492.43'	Date Start/Finish 6/5/08, 6/5/08
Drilling/Equipment Tacoma Pump-Drilling/Dual Air Rotary	Hole Diameter (in) 10' to 18', 6" to TD
Hammer Weight/Drop N/A	



NWELL\_060601D.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: BAA
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (6/19/08)	Approved by:
Grab Sample	Shelby Tube Sample	Water Level at time of drilling (ATD)	

### Geologic & Monitoring Well Construction Log



Project Number  
KG060601D

Well Number  
MW-22

Sheet  
2 of 3

Project Name The Villages  
 Elevation (Top of Well Casing) 557.75'  
 Water Level Elevation 492.43'  
 Drilling/Equipment Tacoma Pump-Drilling/Dual Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 555.15'  
 Date Start/Finish 6/5/08 6/5/08  
 Hole Diameter (In) 10" to 18", 6" to TD

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
45					Moist to very moist, brownish-gray, silty fine to medium SAND, little coarse sand and gravel. Qvt - Vashon Lodgement Till Driller notes becoming more dense and "bill-like" at ~41 feet.
50					Moist, brownish-gray, silty fine SAND, few coarse sand and gravel.  As above except gray.
55		6-inch I.D. steel blank casing from approximately 2.5 feet above ground surface to 96 feet			As above.
60					Qpog <sub>1c</sub> - Pre-Olympia Glacial Deposits, Coarse-Grained Becoming coarse and increased moisture at ~58 feet.  Moist, brownish-gray, silty medium to coarse SAND, few to little gravel.  Water level came up to 62.41 feet bgs with BOH/BOL at 95 feet after 10 minutes.
65					As above.
70					As above.
75					Increased moisture.  Very moist, brown-gray, silty coarse SAND, few medium sand and gravel.  Airlifted small amount of water after casing weld at 77 feet.

NW WELL 060601D.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)     No Recovery
- 3" OD Split Spoon Sampler (D & M)     Ring Sample
- Grab Sample     Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Associated Earth Sciences, Inc.

### Geologic & Monitoring Well Construction Log



Project Number  
KG060601D

Well Number  
MW-22

Sheet  
3 of 3

Project Name The Villages  
 Elevation (Top of Well Casing) 557.75'  
 Water Level Elevation 492.43'  
 Drilling/Equipment Tacoma Pump-Drilling/Dual Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 555.15'  
 Date Start/Finish 6/5/08, 6/5/08  
 Hole Diameter (in) 10' to 18', 6" to TD

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/ 6" SPT	Graphic Symbol	DESCRIPTION
					Wet, gray-brown, silty fine to coarse SAND, few gravel.
85		6-inch I.D. steel blank casing from approximately 2.5 feet above ground surface to 96 feet			Very moist to wet, gray-brown, silty fine to coarse SAND, few gravel.
90			Wet, gray-brown, fine to coarse SAND, little gravel, trace silt (washed). Driller estimates airlifting ~5 gpm. Trace organic black film on discharge pile.		
95			Bottom of casing left open, no well screen installed		As above. Driller notes coarse gravel from ~90 to 96 feet.
100					Boring terminated at 96 feet on 6/5/08 Leaving open bottom - no screen installed.
105					
110					
115					

NWELL\_060610.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

- 2" OD Split Spoon Sampler (SPT)    No Recovery
- 3" OD Split Spoon Sampler (D & M)    Ring Sample
- Grab Sample    Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Associated Earth Sciences, Inc.

# Geologic & Monitoring Well Construction Log



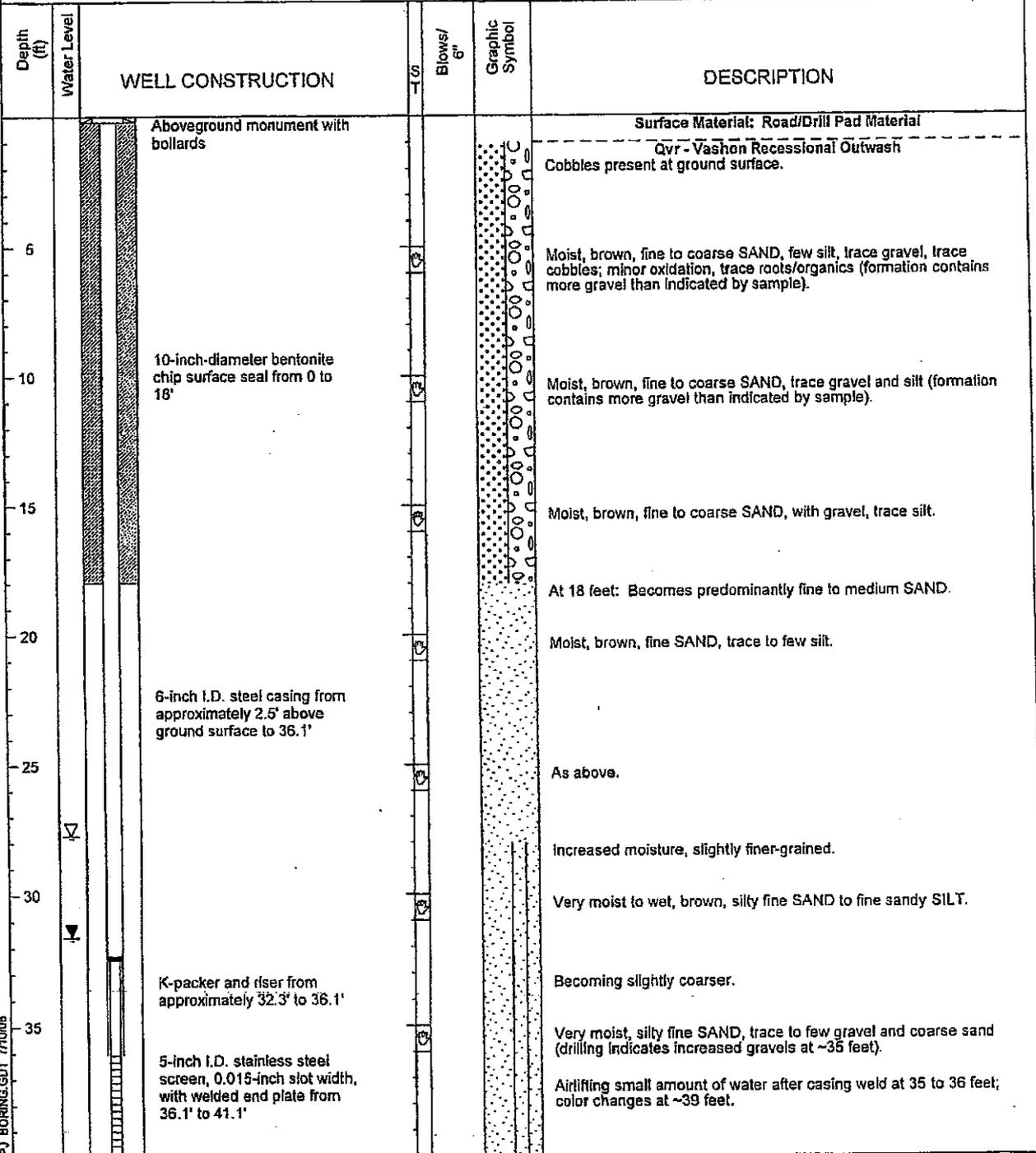
Project Number  
KG060601D

Well Number  
MW-23

Sheet  
1 of 2

Project Name The Villages  
 Elevation (Top of Well Casing) 558.00'  
 Water Level Elevation 527.67'  
 Drilling/Equipment Tacoma Pump-Drilling/Dual Air Rotary  
 Hammer Weight/Drop N/A

Location Black Diamond, WA  
 Surface Elevation (ft) 555.40'  
 Date Start/Finish 8/6/08, 6/6/08  
 Hole Diameter (in) 10' to 18', 6" to TD



NWELL\_060601D.GPJ BORING.GDT 7/10/08

**Sampler Type (ST):**

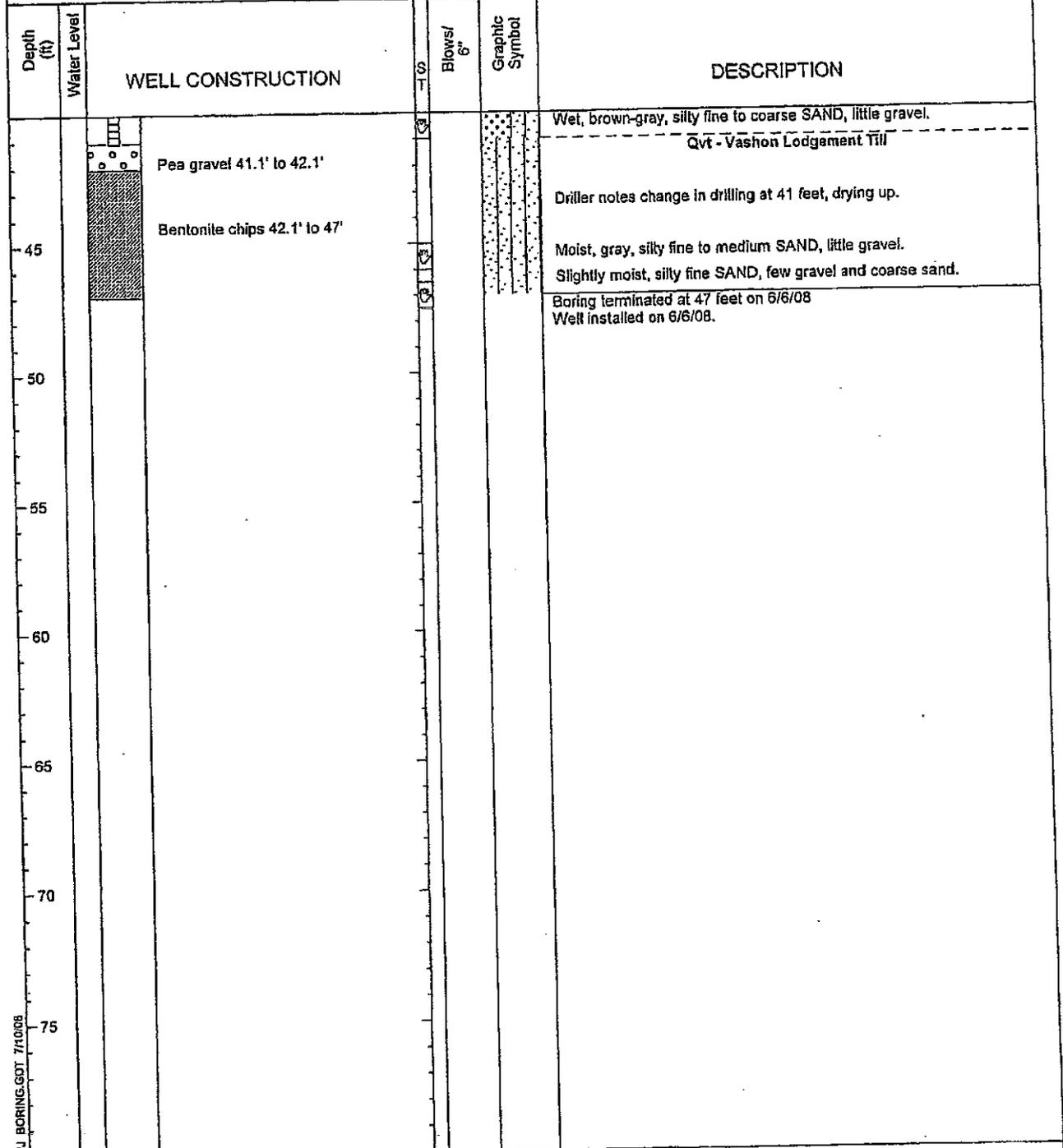
- 2" OD Split Spoon Sampler (SPT)    No Recovery
- 3" OD Split Spoon Sampler (D & M)    Ring Sample
- Grab Sample    Shelby Tube Sample

- M - Moisture
- Water Level (6/19/08)
- Water Level at time of drilling (ATD)

Logged by: BAA

Approved by:

Project Name <b>The Villages</b>	Location <b>Black Diamond, WA</b>
Elevation (Top of Well Casing) <b>558.00'</b>	Surface Elevation (ft) <b>555.40'</b>
Water Level Elevation <b>527.67'</b>	Date Start/Finish <b>6/6/08, 6/6/08</b>
Drilling/Equipment <b>Tacoma Pump-Drilling/Dual Air Rotary</b>	Hole Diameter (in) <b>10" to 18", 6" to TD</b>
Hammer Weight/Drop <b>N/A</b>	



NW WELL 060601D.GPJ BORING.GDT 7/10/08

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: BAA
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (6/19/08)	Approved by:
Grab Sample	Shelby Tube Sample	Water Level at time of drilling (ATD)	

**APPENDIX C**  
**LABORATORY TEST RESULTS**



# PARTICLE SIZE DISTRIBUTION

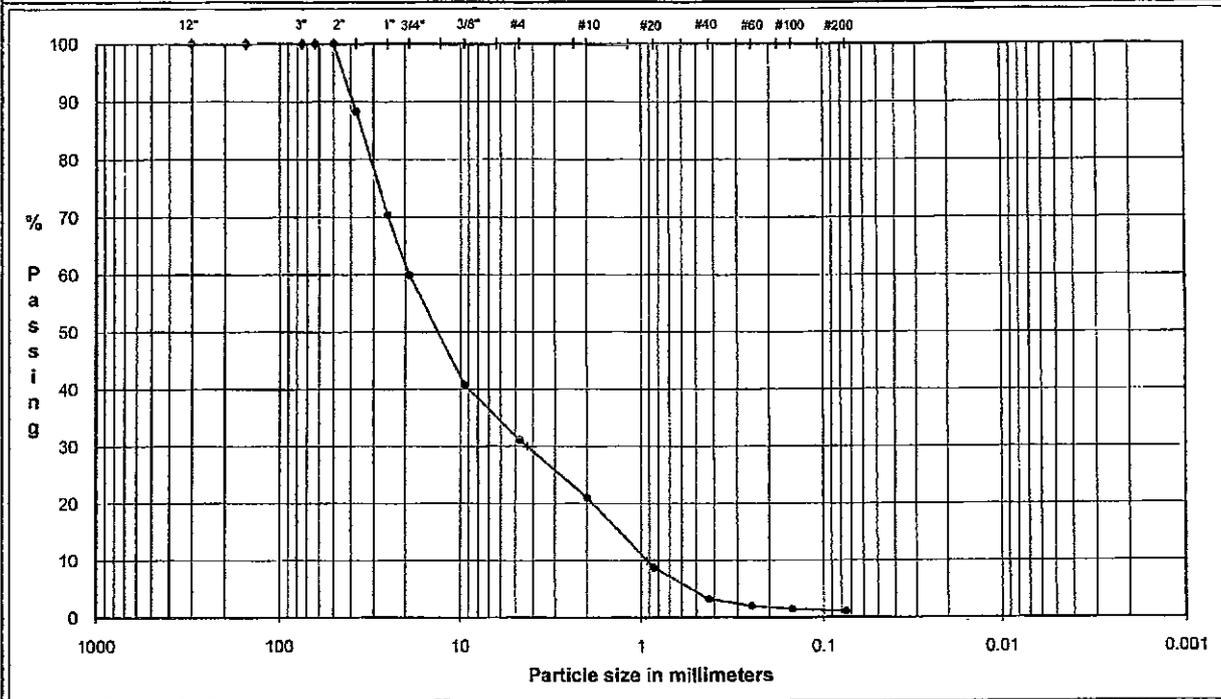
ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA

SAMPLE ID: TP-101

0 Depth: 2-15ft

TYPE: -



COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	3.77
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	88.4	Coarse Gravel	40.0	
1.0"	25	70.4			
0.75"	19	60.0			
0.375"	9.5	40.8	Fine Gravel	28.8	
#4	4.75	31.2			
#10	2.00	21.0	Coarse Sand	10.1	
#20	0.85	8.7	Medium Sand	17.8	
#40	0.43	3.2			
#60	0.25	2.0			
#100	0.15	1.5	Fine Sand	2.1	
#200	0.075	1.1			
				Fines	1.1

$D_{80} = 19.01$	$D_{30} = 4.30$	$D_{10} = 0.93$
$C_u = D_{60}/D_{10} =$	20.5	> 4
$C_c = D_{30}^2/(D_{10} \cdot D_{60}) =$	1.1	> 1

DESCRIPTION: C-F GRAVEL and C-F SAND  
trace silt

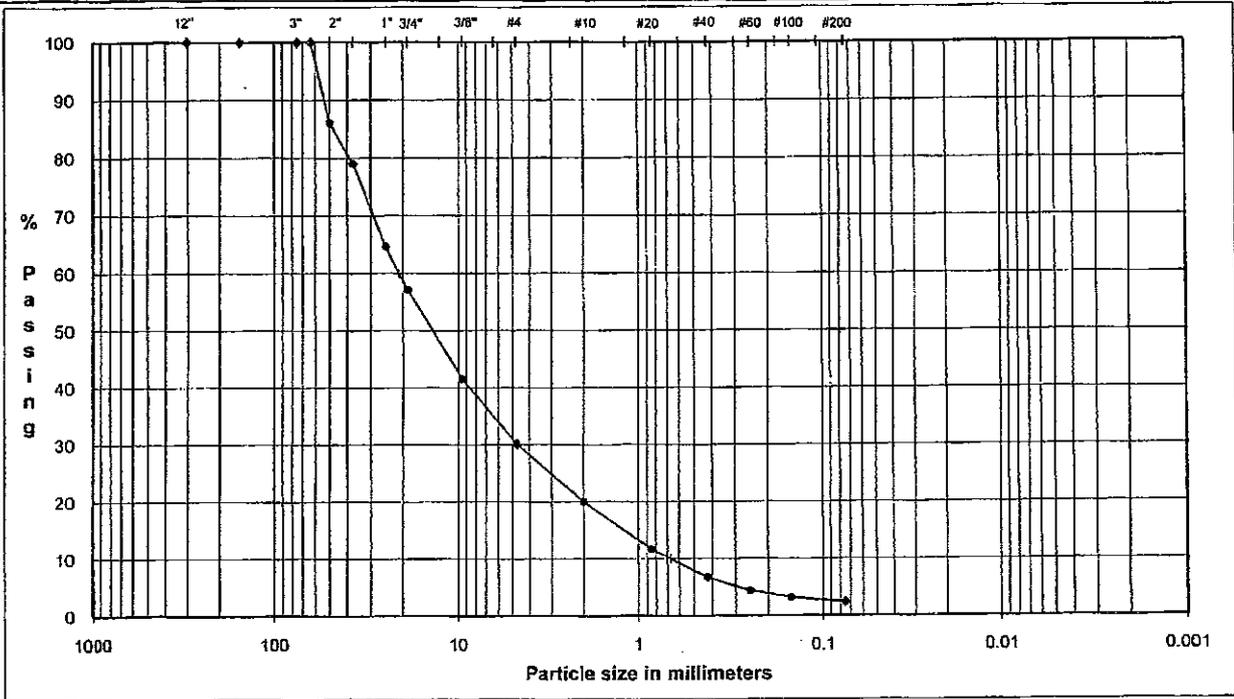
USCS: GW

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-102**      0 Depth: **1.5-12ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage	Moisture Content
	(mm)	% Passing			
	12.0"	304.8	100.0		5.12
	6.0"	154.2	100.0		
	3.0"	75	100.0	Cobbles	0.0
	2.5"	63.5	100.0		
	2.0"	50	86.1		
	1.5"	37.5	79.0		
	1.0"	25	64.7		
	0.75"	19	57.1	Coarse Gravel	42.9
	0.375"	9.5	41.5		
	#4	4.75	30.2	Fine Gravel	26.9
	#10	2.00	20.0	Coarse Sand	10.2
	#20	0.85	11.7		
	#40	0.43	6.7	Medium Sand	13.3
	#60	0.25	4.4		
	#100	0.15	3.2		
	#200	0.075	2.4	Fine Sand	4.3
				Fines	2.4

$D_{60} = 21.08$	$D_{30} = 4.86$	$D_{10} = 0.67$
$C_u = D_{60}/D_{10} = 31.3$		$> 4$
$C_c = D_{30}^2 / (D_{10} \cdot D_{60}) = 1.5$		$> 1$

DESCRIPTION: **C-F GRAVEL**  
 some c-f sand, trace silt

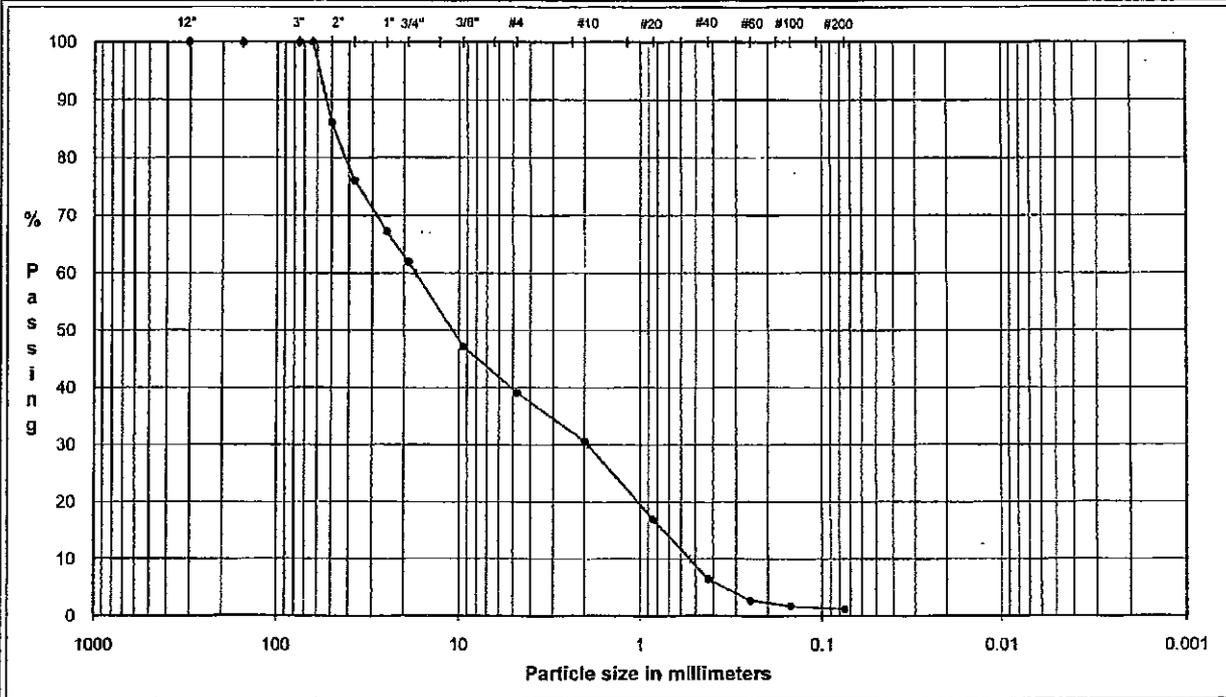
USCS: **GW**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-103**      0 Depth: **2-14ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	5.16
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	100.0			
2.0"	50	86.1			
1.5"	37.5	76.1	Coarse Gravel	38.0	
1.0"	25	67.3			
0.75"	19	62.0	Fine Gravel	22.9	
0.375"	9.5	47.2			
#4	4.75	39.1	Coarse Sand	8.6	
#10	2.00	30.6			
#20	0.85	16.9	Medium Sand	24.1	
#40	0.43	6.4			
#60	0.25	2.7	Fine Sand	5.2	
#100	0.15	1.7			
#200	0.075	1.2			
Fines				1.2	

$D_{60} = 17.30$	$D_{30} = 1.93$	$D_{10} = 0.54$
$C_u = D_{60}/D_{10} = 32.2$		$> 4$
$C_c = D_{30}^2 / (D_{10} * D_{60}) = 0.4$		$< 1$

DESCRIPTION: **C-F GRAVEL and C-F SAND**  
 trace silt

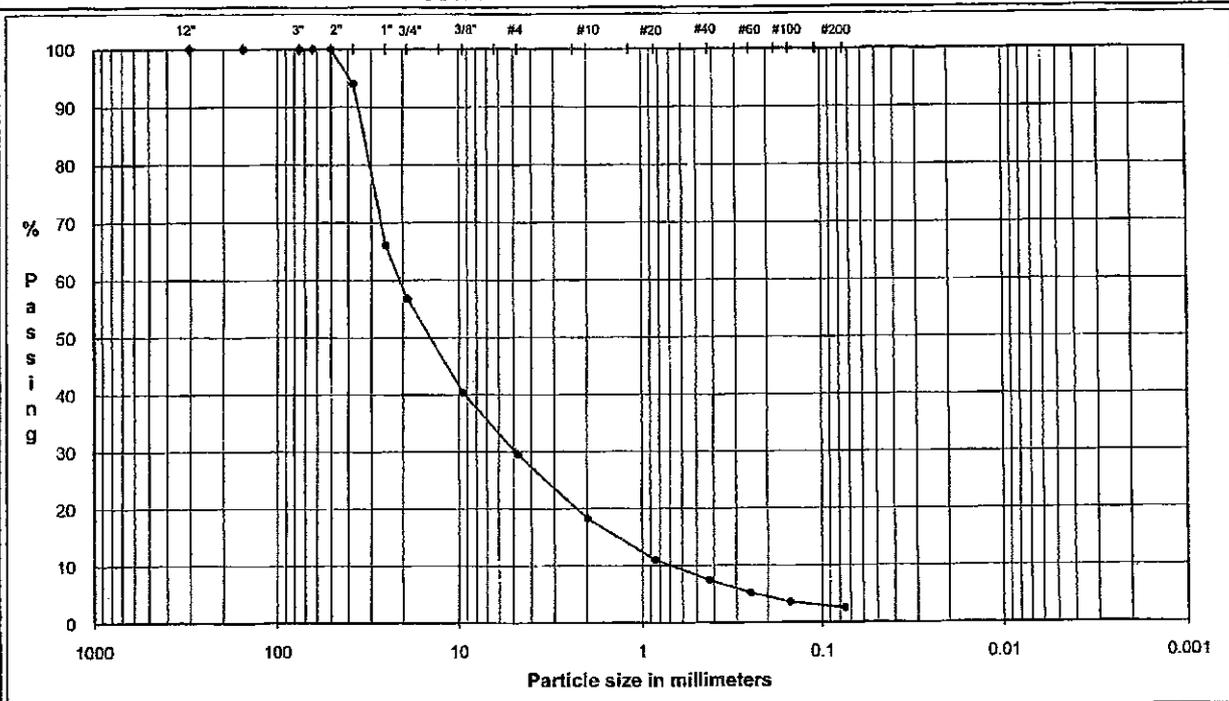
USCS: **GP**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-104**      0 Depth: **1-14ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size		Particle Size		Moisture Content
	(mm)	% Passing	Classification	Percentage	
12.0"	304.8	100.0			4.40
6.0"	154.2	100.0			
3.0"	75	100.0	Cobbles	0.0	
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	94.0			
1.0"	25	66.1			
0.75"	19	56.8	Coarse Gravel	43.2	
0.375"	9.5	40.4			
#4	4.75	29.5	Fine Gravel	27.3	
#10	2.00	18.3	Coarse Sand	11.2	
#20	0.85	11.0			
#40	0.43	7.5	Medium Sand	10.9	
#60	0.25	5.2			
#100	0.15	3.6			
#200	0.075	2.5	Fine Sand	5.0	
			Finest	2.5	

$D_{60} = 20.88$	$D_{30} = 4.90$	$D_{10} = 0.70$
$C_u = D_{60}/D_{10} = 29.9$		> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) = 1.6$		> 1

DESCRIPTION: **C-F GRAVEL**  
 some c-f sand, trace silt

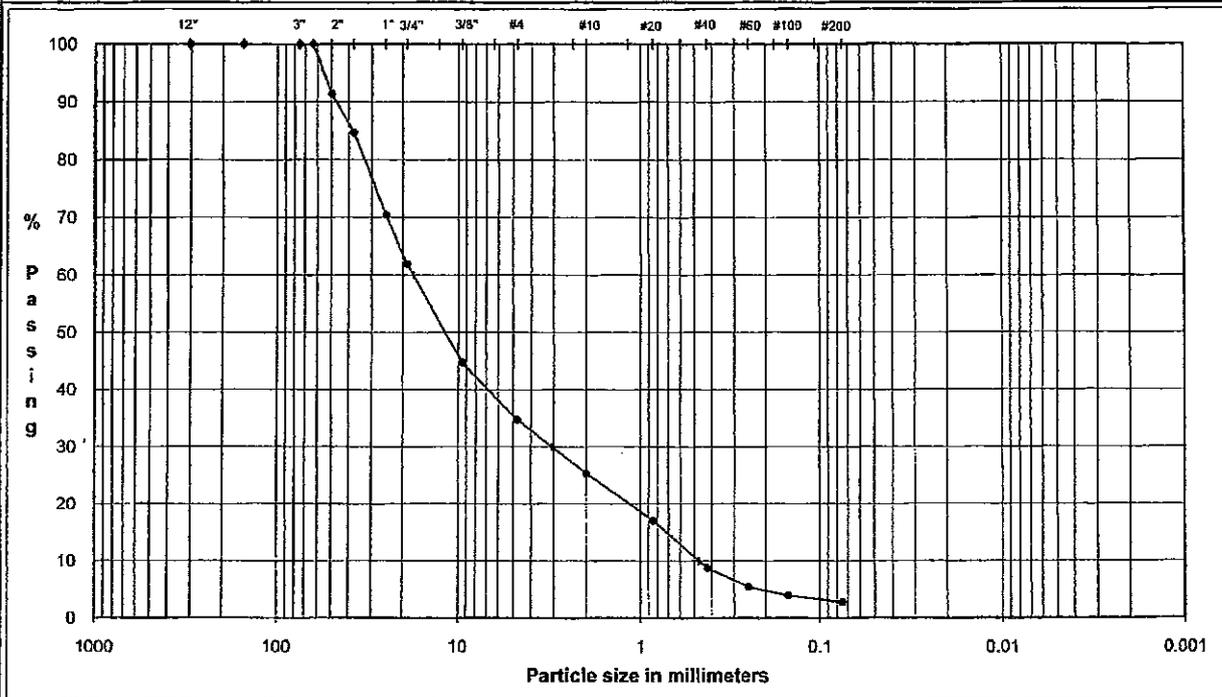
USCS: **GW**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA  
 SAMPLE ID: TP-105      0 Depth: 1.5-13ft  
 TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage	Moisture Content 6.04
	(mm)	% Passing			
12.0"	304.8	100.0			
6.0"	154.2	100.0			
3.0"	75	100.0	Cobbles	0.0	
2.5"	63.5	100.0			
2.0"	50	91.4			
1.5"	37.5	84.8			
1.0"	25	70.5			
0.75"	19	61.9	Coarse Gravel	38.1	
0.375"	9.5	44.7			
#4	4.75	34.7	Fine Gravel	27.2	
#10	2.00	25.3	Coarse Sand	9.4	
#20	0.85	17.1			
#40	0.43	8.8	Medium Sand	16.6	
#60	0.25	5.4			
#100	0.15	3.9			
#200	0.075	2.8	Fine Sand	6.0	
			Fines	2.8	

D <sub>60</sub> = 17.59	D <sub>30</sub> = 3.07	D <sub>10</sub> = 0.47
Cu = D <sub>60</sub> /D <sub>10</sub> = 37.3		> 4
Cc = D <sub>30</sub> <sup>2</sup> /(D <sub>10</sub> *D <sub>60</sub> ) = 1.1		> 1

DESCRIPTION: C-F GRAVEL and C-F SAND  
 trace silt

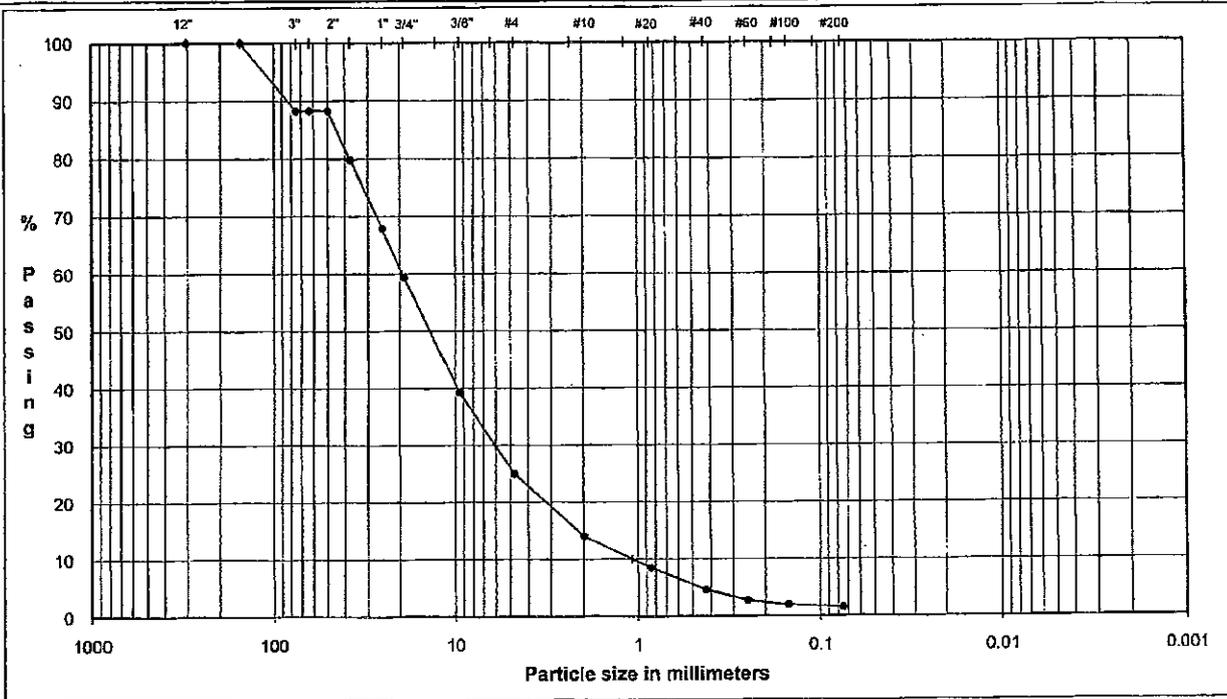
USCS: GW

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-106**      0 Depth: **2-10.5ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage
	(mm)	% Passing		
12.0"	304.8	100.0	Cobbles	11.7
6.0"	154.2	100.0		
3.0"	75	88.3		
2.5"	63.5	88.3		
2.0"	50	88.3		
1.5"	37.5	79.8		
1.0"	25	67.9		
0.75"	19	59.4	Coarse Gravel	28.9
0.375"	9.5	39.3	Fine Gravel	34.5
#4	4.75	24.9		
#10	2.00	14.0	Coarse Sand	10.9
#20	0.85	8.5	Medium Sand	9.4
#40	0.43	4.7		
#60	0.25	2.7		
#100	0.15	2.0	Fine Sand	3.1
#200	0.075	1.6		
Fines				1.6

Moisture Content  
3.87

$D_{60} = 19.37$	$D_{30} = 6.07$	$D_{10} = 1.07$
$C_u = D_{60}/D_{10} =$	18.0	> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	1.8	> 1

DESCRIPTION: **C-F GRAVEL**  
 some c-f sand, trace silt

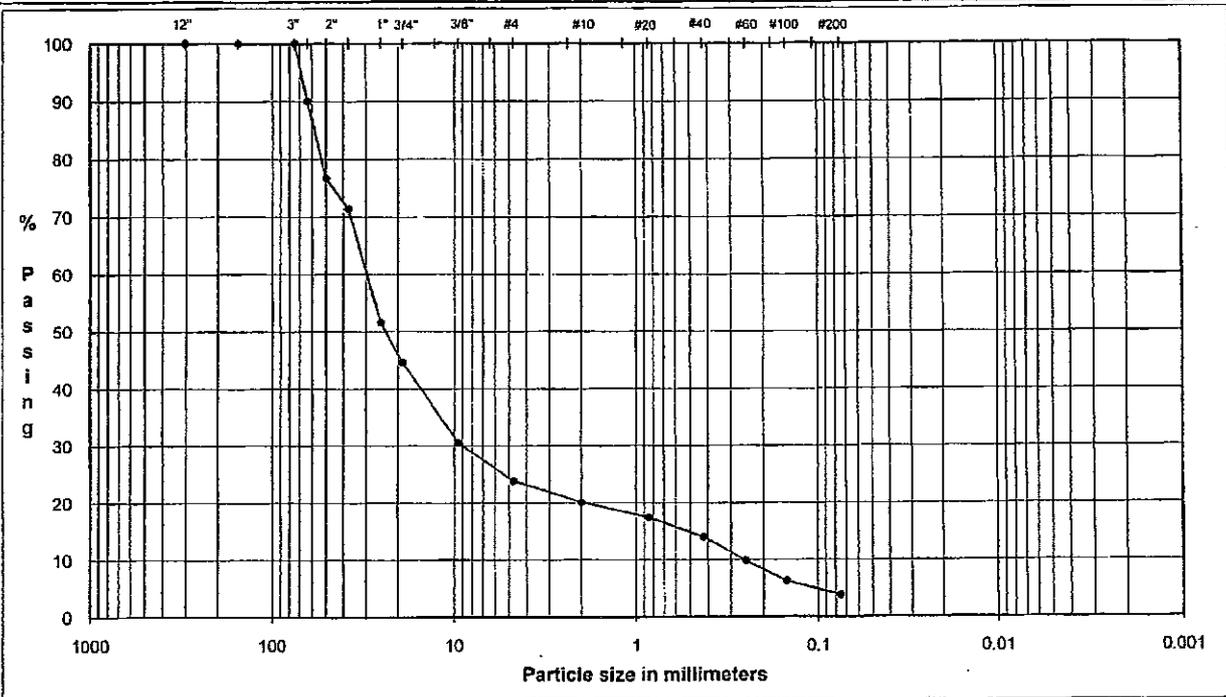
USCS: **GW**

TECH	TCM
DATE	1/7/10
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REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA  
 SAMPLE ID: TP-107      0 Depth: 1-16ft  
 TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	5.35
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	90.1			
2.0"	50	76.8			
1.5"	37.5	71.4	Coarse Gravel	55.4	
1.0"	25	51.7			
0.75"	19	44.6			
0.375"	9.5	30.5	Fine Gravel	20.7	
#4	4.75	23.9	Coarse Sand	3.8	
#10	2.00	20.1	Medium Sand	6.1	
#20	0.85	17.5			
#40	0.43	14.1	Fine Sand	10.3	
#60	0.25	9.9			
#100	0.15	6.3			
#200	0.075	3.8	Finest	3.8	

$D_{60} = 29.67$	$D_{30} = 9.00$	$D_{10} = 0.25$
$C_u = D_{60}/D_{10} = 118.6$		> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) = 10.7$		> 3

DESCRIPTION: C-F GRAVEL  
 some c-f sand, trace silt

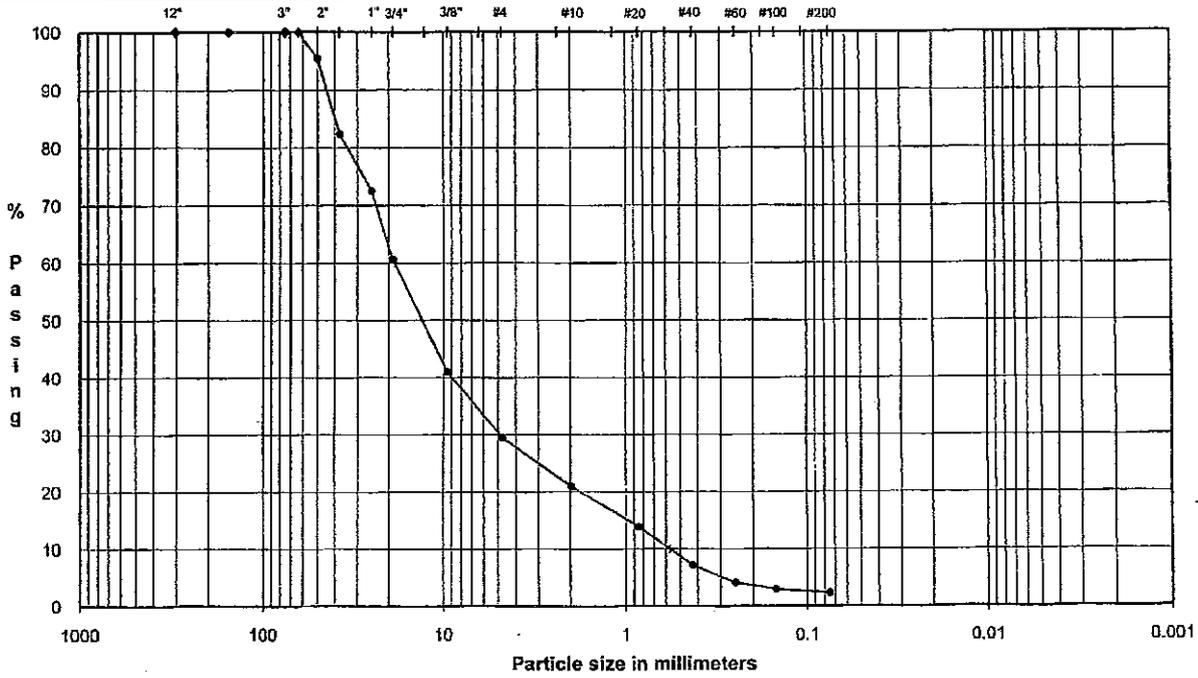
USCS: GP

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA  
 SAMPLE ID: TP-108 0 Depth: 2-14ft  
 TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content	
	(mm)	% Passing				
12.0"	304.8	100.0	Cobbles	0.0	4.44	
6.0"	154.2	100.0				
3.0"	75	100.0				
2.5"	63.5	100.0				
2.0"	50	95.5				
1.5"	37.5	82.4				
1.0"	25	72.6	Coarse Gravel	39.4		
0.75"	19	60.6				
0.375"	9.5	41.0				
#4	4.75	29.5	Fine Gravel	31.1		
#10	2.00	21.0	Coarse Sand	8.6		
#20	0.85	13.9	Medium Sand	13.9		
#40	0.43	7.1				
#60	0.25	4.1				
#100	0.15	2.9	Fine Sand	4.8		
#200	0.075	2.3				
			Fines	2.3		

$D_{60} = 18.58$	$D_{30} = 4.88$	$D_{10} = 0.57$
$C_u = D_{60}/D_{10} =$	32.6	> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	2.3	> 1

DESCRIPTION: C-F GRAVEL  
 some c-f sand, trace silt

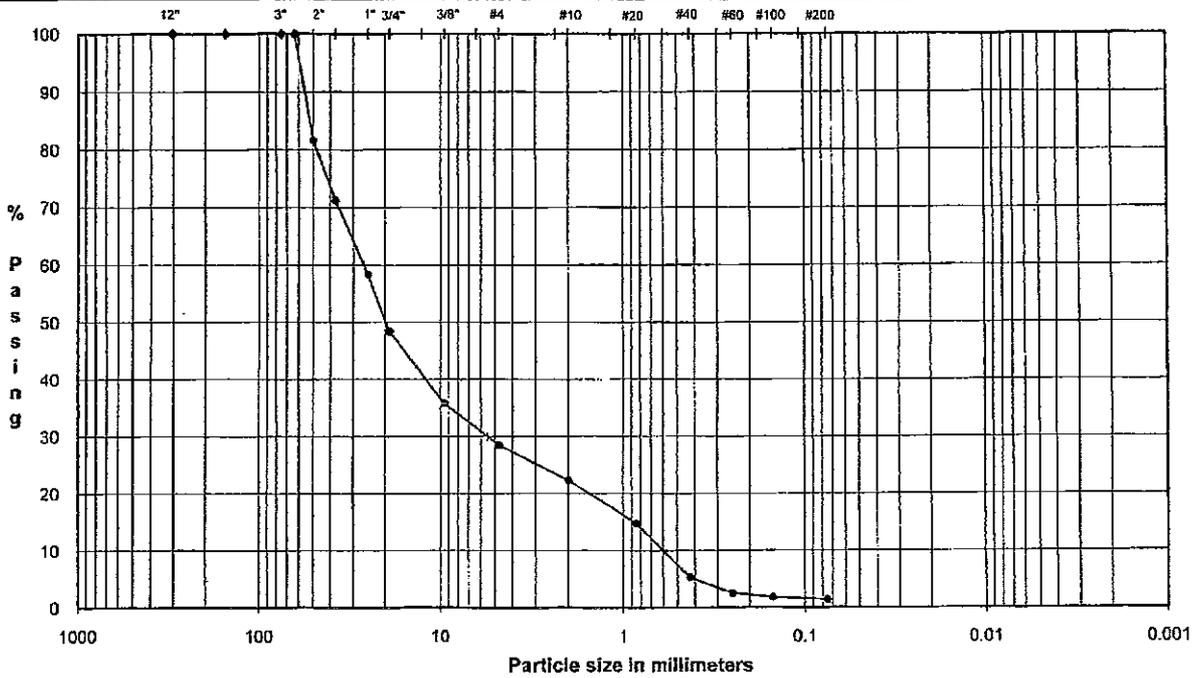
USCS: GW

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-109**      0 Depth: **2-11ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage	Moisture Content
	(mm)	% Passing			
	12.0"	304.8	100.0		4.30
	6.0"	154.2	100.0		
	3.0"	75	100.0	Cobbles	0.0
	2.5"	63.5	100.0		
	2.0"	50	81.7		
	1.5"	37.5	71.2		
	1.0"	25	58.4		
	0.75"	19	48.4	Coarse Gravel	51.6
	0.375"	9.5	35.8		
	#4	4.75	28.5	Fine Gravel	19.9
	#10	2.00	22.3	Coarse Sand	6.2
	#20	0.85	14.8		
	#40	0.43	5.3	Medium Sand	17.0
	#60	0.25	2.5		
	#100	0.15	1.8		
	#200	0.075	1.4	Fine Sand	3.9
				Fines	1.4

D <sub>60</sub> = 26.33	D <sub>30</sub> = 5.47	D <sub>10</sub> = 0.60
-------------------------	------------------------	------------------------

Cu = D <sub>60</sub> /D <sub>10</sub> =	44.0	> 4
Cc = D <sub>30</sub> <sup>2</sup> /(D <sub>10</sub> *D <sub>60</sub> ) =	1.9	> 1

DESCRIPTION: **C-F GRAVEL**  
 some c-f sand, trace silt

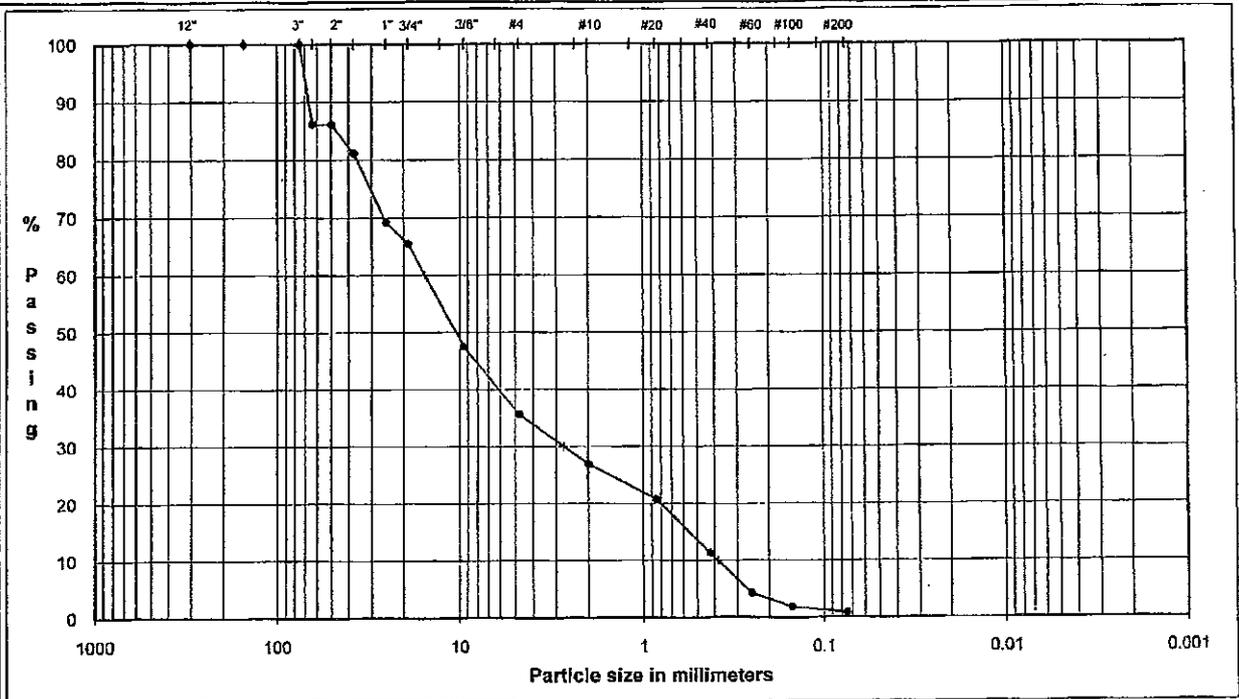
USCS: **GW**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-113**      0 Depth: **1-5ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	6.60
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	86.2			
2.0"	50	86.2	Coarse Gravel	34.5	
1.5"	37.5	81.1			
1.0"	25	69.2	Fine Gravel	29.9	
0.75"	19	65.5			
0.375"	9.5	47.5	Coarse Sand	8.7	
#4	4.75	35.6			
#10	2.00	26.9	Medium Sand	15.5	
#20	0.85	20.8			
#40	0.43	11.4	Fine Sand	10.5	
#60	0.25	4.3			
#100	0.15	1.8			
#200	0.075	0.9	Finest	0.9	

$D_{60} = 15.36$	$D_{30} = 2.72$	$D_{10} = 0.38$
$C_u = D_{60}/D_{10} = 40.1$	$> 4$	
$C_c = D_{30}^2 / (D_{10} * D_{60}) = 1.3$	$> 1$	

DESCRIPTION: **C-F GRAVEL and C-F SAND**  
 trace silt

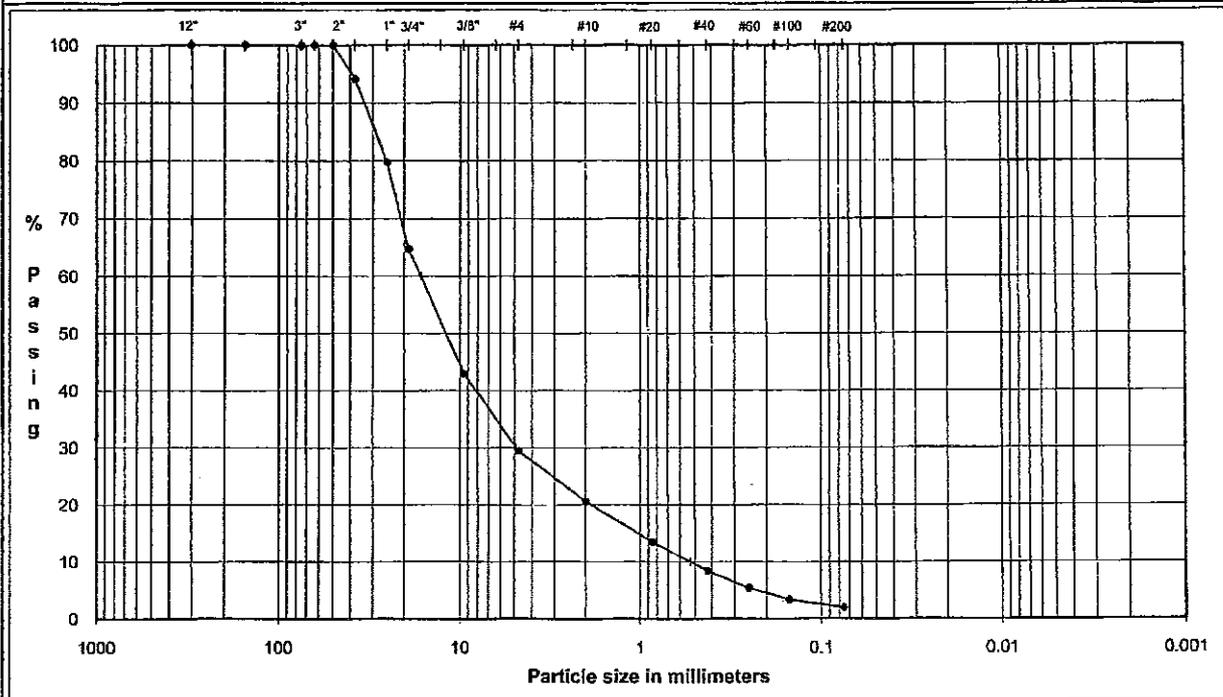
USCS: **GW**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA  
 SAMPLE ID: TP-114 0 Depth: 1-7ft  
 TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U. S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	4.64
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	94.1	Coarse Gravel	35.3	
1.0"	25	79.8			
0.75"	19	64.7	Fine Gravel	35.3	
0.375"	9.5	43.0			
#4	4.75	29.5	Coarse Sand	8.9	
#10	2.00	20.6	Medium Sand	12.1	
#20	0.85	13.5			
#40	0.43	8.4	Fine Sand	6.5	
#60	0.25	5.4			
#100	0.15	3.4			
#200	0.075	2.0	Fines	2.0	

D <sub>60</sub> = 16.34	D <sub>30</sub> = 4.88	D <sub>10</sub> = 0.53
Cu = D <sub>60</sub> /D <sub>10</sub> =	31.0	> 4
Cc = D <sub>30</sub> <sup>2</sup> /(D <sub>10</sub> *D <sub>60</sub> ) =	2.8	> 1

DESCRIPTION: C-F GRAVEL  
 some c-f sand, trace silt

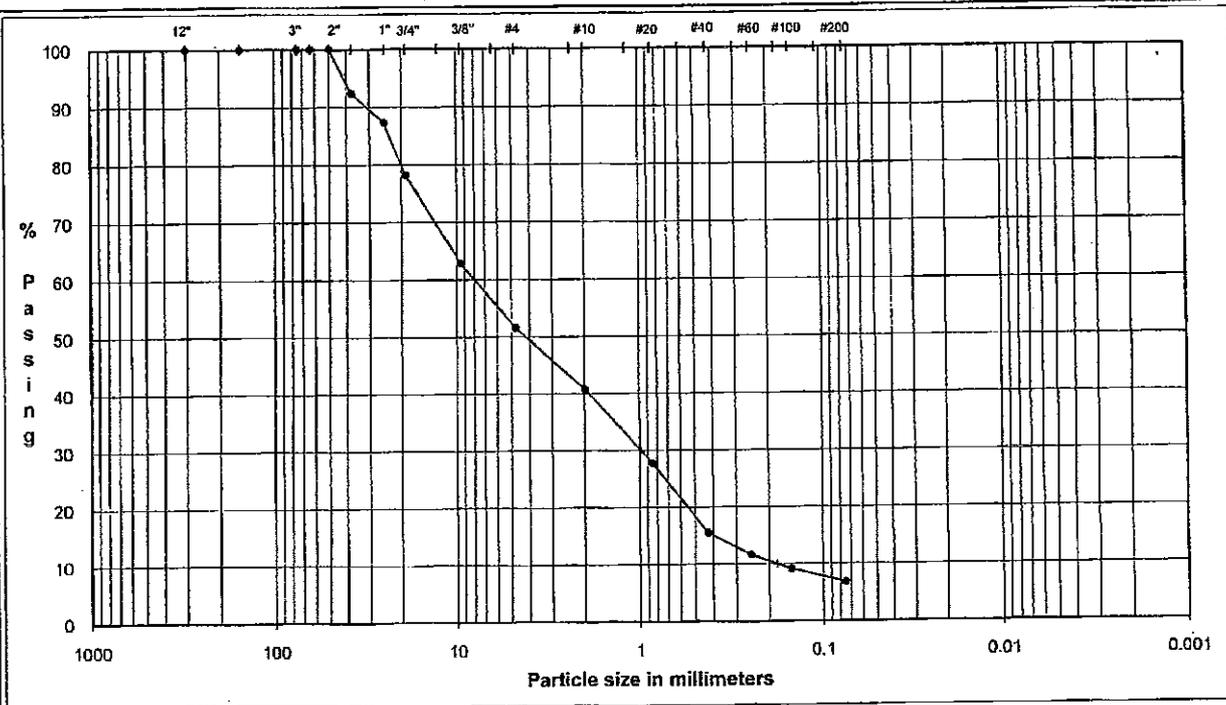
USCS: GW

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-114**      0 Depth: **7-9ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size		Particle Size	
	(mm)	% Passing	Classification	Percentage
12.0"	304.8	100.0	Cobbles	0.0
6.0"	154.2	100.0		
3.0"	75	100.0		
2.5"	63.5	100.0		
2.0"	50	100.0		
1.5"	37.5	92.4		
1.0"	25	87.3	Coarse Gravel	21.7
0.75"	19	78.3		
0.375"	9.5	62.9	Fine Gravel	26.7
#4	4.75	51.5		
#10	2.00	40.8	Coarse Sand	10.7
#20	0.85	27.8		
#40	0.43	15.5	Medium Sand	25.3
#60	0.25	11.6		
#100	0.15	9.1	Fine Sand	8.7
#200	0.075	6.8		
			Fines	6.8

Moisture Content  
8.59

$D_{60} = 7.95$	$D_{30} = 0.98$	$D_{10} = 0.18$
$C_u = D_{60}/D_{10} =$	44.3	> 6
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	0.7	< 1

DESCRIPTION: **C-F SAND and C-F GRAVEL**  
 little silt

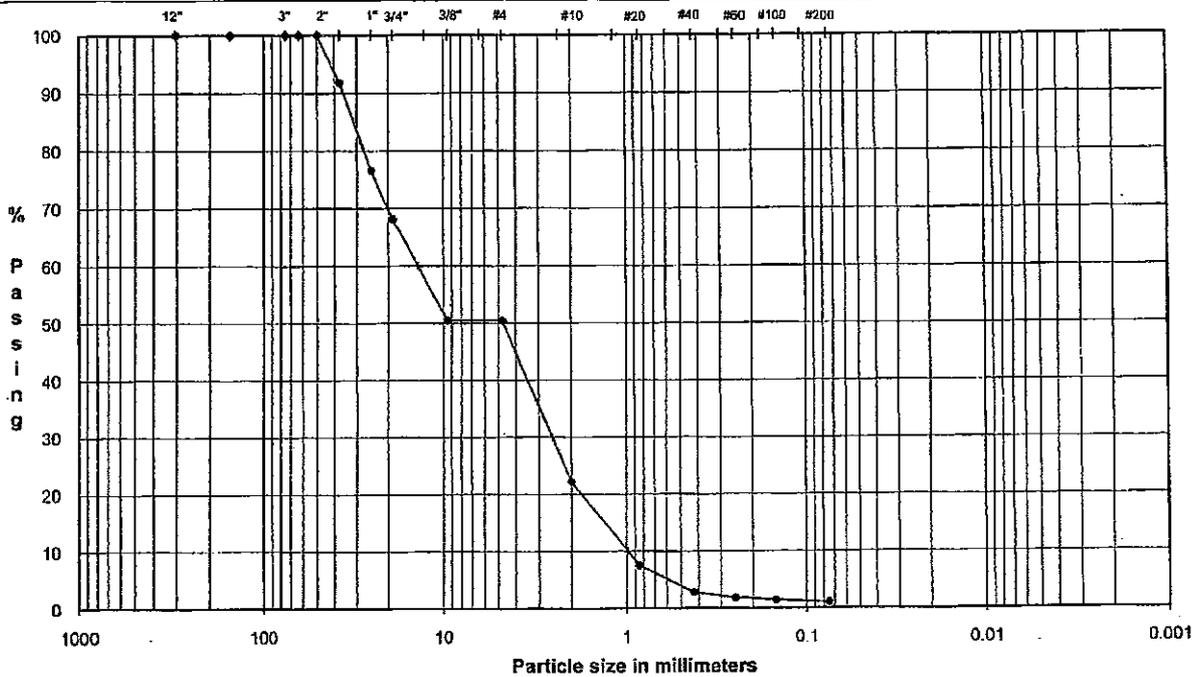
USCS: **SP/SM**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-115**      0 Depth: **1-7ft**  
 TYPE: **-**



COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Classification	Percentage	Moisture Content <b>4.69</b>
	12.0"	304.8	100.0		
6.0"	154.2	100.0			
3.0"	75	100.0	Cobbles	0.0	
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	91.8			
1.0"	25	76.6			
0.75"	19	68.1	Coarse Gravel	31.9	
0.375"	9.5	50.5			
#4	4.75	50.4	Fine Gravel	17.7	
#10	2.00	22.2	Coarse Sand	28.2	
#20	0.85	7.5			
#40	0.43	2.8	Medium Sand	19.4	
#60	0.25	1.8			
#100	0.15	1.4			
#200	0.075	1.0	Fine Sand	1.8	
			Fines	1.0	

$D_{60} = 13.81$	$D_{30} = 2.54$	$D_{10} = 0.98$
$C_u = D_{60}/D_{10} =$	14.1	> 6
$C_c = D_{30}^2 / (D_{10} \cdot D_{60}) =$	0.5	< 1

DESCRIPTION: **C-F SAND and C-F GRAVEL**  
 trace silt

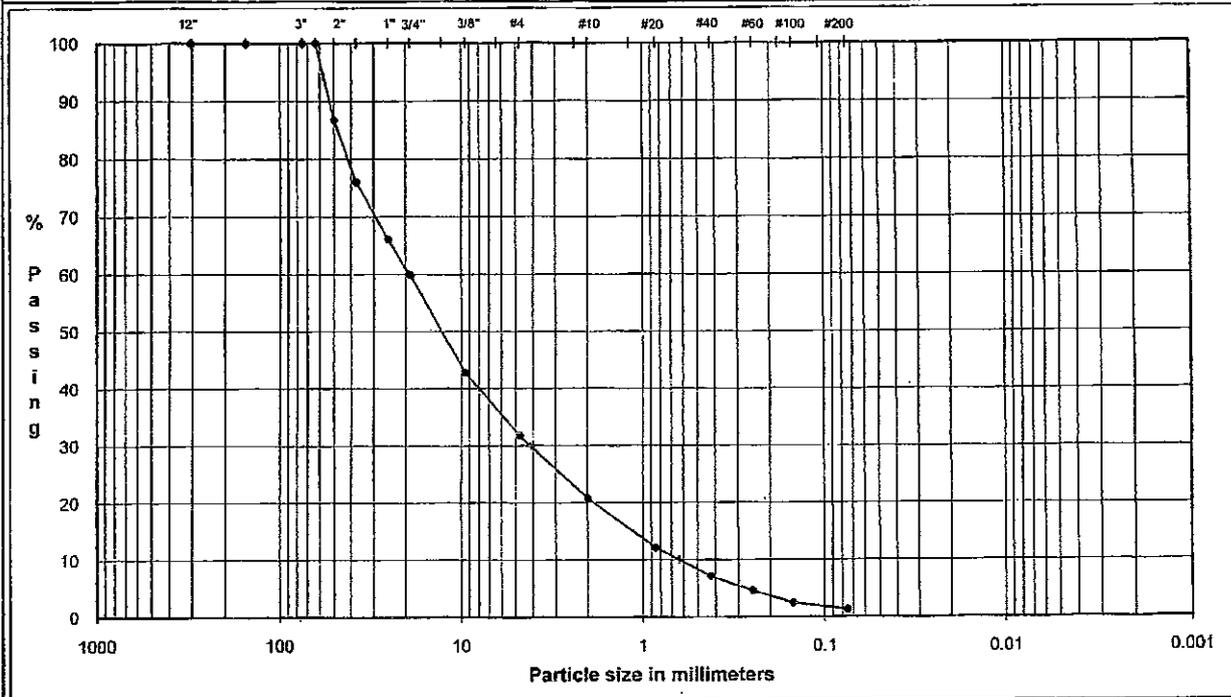
USCS: **SP**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-116**      0 Depth: **2-17ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves and Numbers	Particle Size (mm)	% Passing	Classification	Percentage	Moisture Content <b>3.17</b>
	12.0"	304.8	100.0		
6.0"	154.2	100.0			
3.0"	75	100.0	Cobbles	0.0	
2.5"	63.5	100.0			
2.0"	50	86.3			
1.5"	37.5	76.0			
1.0"	25	66.1			
0.75"	19	59.9	Coarse Gravel	40.1	
0.375"	9.5	42.8			
#4	4.75	31.8	Fine Gravel	28.1	
#10	2.00	20.8	Coarse Sand	11.0	
#20	0.85	12.1			
#40	0.43	7.1	Medium Sand	13.7	
#60	0.25	4.6			
#100	0.15	2.5			
#200	0.075	1.3	Fine Sand	5.8	
			Fines	1.3	

$D_{60} = 19.11$	$D_{30} = 4.13$	$D_{10} = 0.63$
------------------	-----------------	-----------------

$C_u = D_{60}/D_{10} =$	30.1	> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	1.4	> 1

**DESCRIPTION:** C-F GRAVEL and C-F SAND  
trace silt

**USCS:** GW

<b>TECH</b>	TCM
<b>DATE</b>	1/7/10
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<b>REVIEW</b>	<i>[Signature]</i>

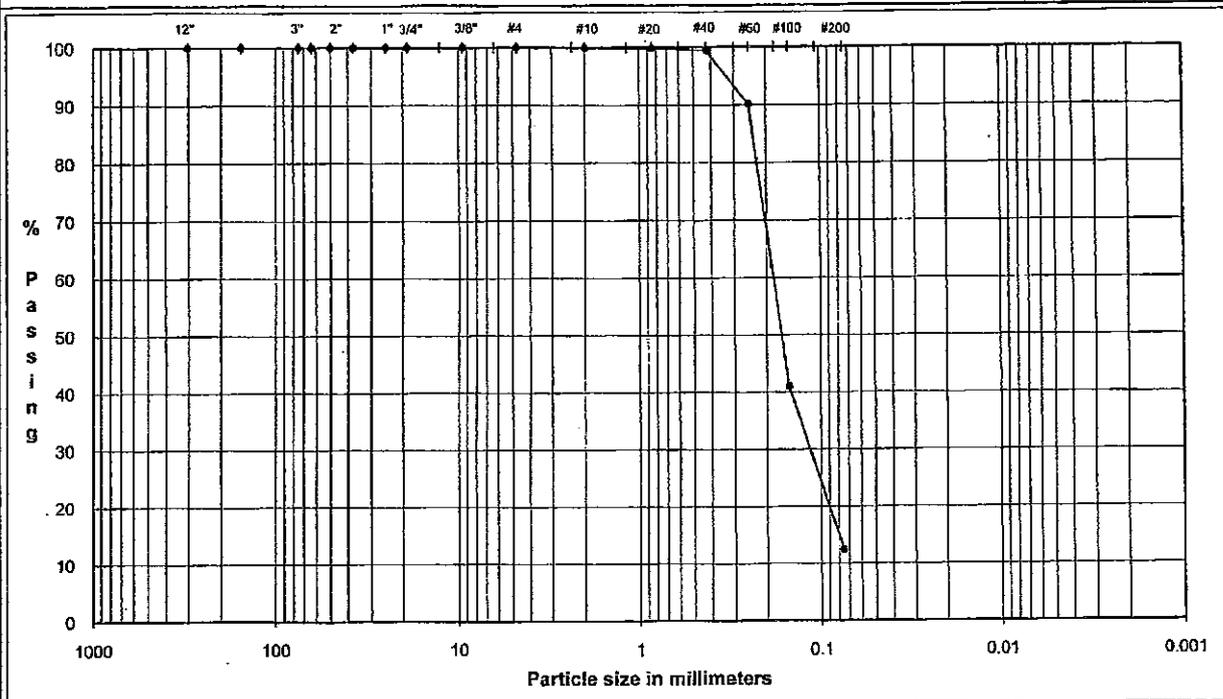
# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA

SAMPLE ID: TP-117 S-2 Depth: 10-14ft

TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content <span style="border: 1px solid black; padding: 2px;">20.10</span>
	(mm)	% Passing			
12.0"	304.8	100.0			
6.0"	154.2	100.0			
3.0"	75	100.0	Cobbles	0.0	
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	100.0			
1.0"	25	100.0			
0.75"	19	100.0	Coarse Gravel	0.0	
0.375"	9.5	100.0			
#4	4.75	100.0	Fine Gravel	0.0	
#10	2.00	99.9	Coarse Sand	0.1	
#20	0.85	99.8			
#40	0.43	99.4	Medium Sand	0.5	
#60	0.25	90.1			
#100	0.15	41.0			
#200	0.075	12.4	Fine Sand	87.0	
			Fines	12.4	

$D_{60} = 0.18$	$D_{30} = 0.11$	$D_{10} = \#N/A$
$C_u = D_{60}/D_{10} =$	#N/A	#N/A
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	#N/A	#N/A

DESCRIPTION: C-F SAND  
some silt

USCS: SM

TECH	TCM
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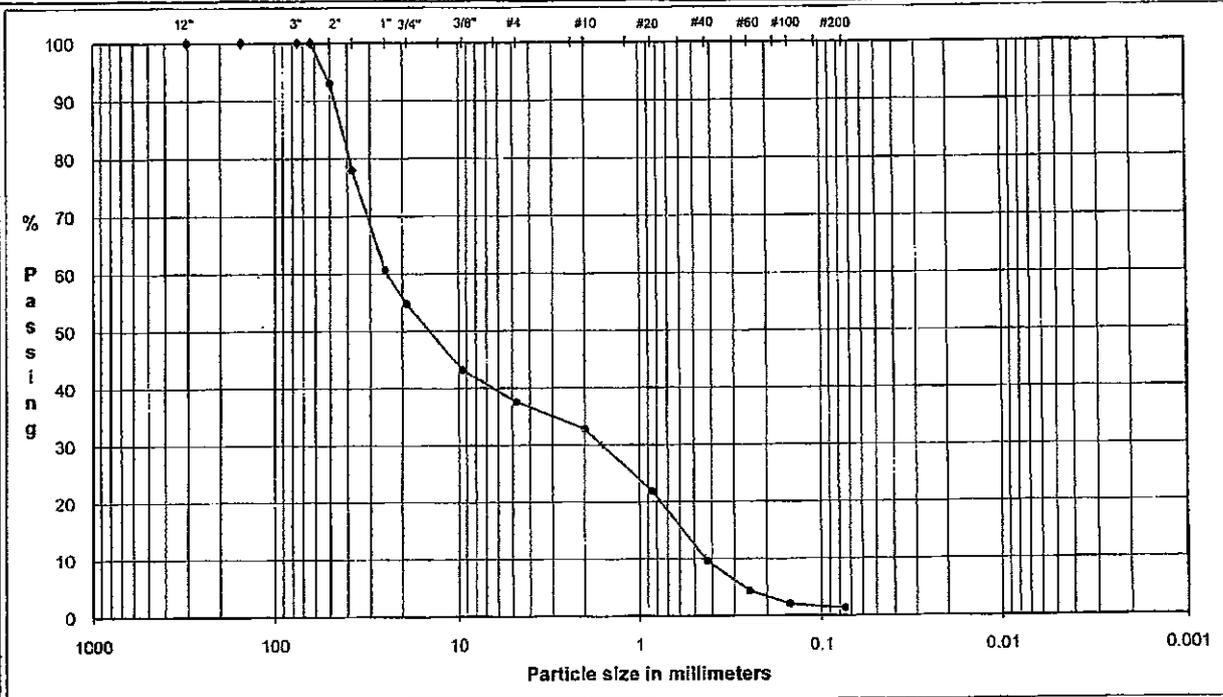
# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**

SAMPLE ID: **TP-117**                      S-3                      Depth: **14-20ft**

TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	3.56
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	100.0			
2.0"	50	93.0			
1.5"	37.5	78.0	Coarse Gravel	45.2	
1.0"	25	60.6			
0.75"	19	54.8	Fine Gravel	17.2	
0.375"	9.5	43.2			
#4	4.75	37.6			
#10	2.00	32.8	Coarse Sand	4.8	
#20	0.85	21.9	Medium Sand	23.2	
#40	0.43	9.7			
#60	0.25	4.4			
#100	0.15	2.0			
#200	0.075	1.3	Fine Sand	8.4	
				Fines	1.3

$D_{60} = 24.30$	$D_{30} = 1.60$	$D_{10} = 0.43$
$C_u = D_{60}/D_{10} =$	56.1	> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	0.2	< 1

DESCRIPTION: **C-F GRAVEL and C-F SAND**  
 trace gravel

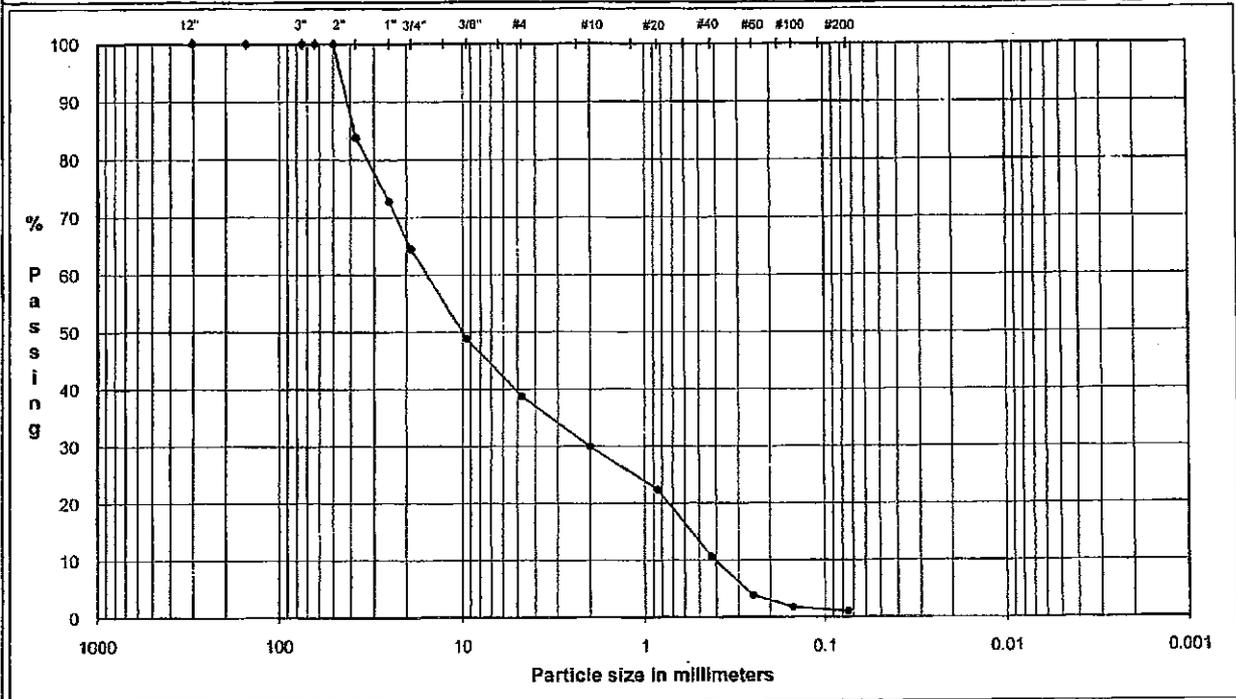
USCS: **GP**

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# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP-118**      0 Depth: **14-19.5ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size		Classification	Percentage	Moisture Content
	(mm)	% Passing			
12.0"	304.8	100.0	Cobbles	0.0	4.09
6.0"	154.2	100.0			
3.0"	75	100.0			
2.5"	63.5	100.0			
2.0"	50	100.0			
1.5"	37.5	83.8	Coarse Gravel	35.5	
1.0"	25	72.8			
0.75"	19	64.5	Fine Gravel	25.7	
0.375"	9.5	48.9			
#4	4.75	38.8	Coarse Sand	8.9	
#10	2.00	29.9			
#20	0.85	22.4	Medium Sand	19.3	
#40	0.43	10.6			
#60	0.25	3.9			
#100	0.15	1.8	Fine Sand	9.6	
#200	0.075	1.0			
				Finest	1.0

$D_{60} = 15.55$	$D_{30} = 2.01$	$D_{10} = 0.40$
$C_u = D_{60}/D_{10} =$	38.4	> 4
$C_c = D_{30}^2/(D_{10} \cdot D_{60}) =$	0.6	< 1

DESCRIPTION: **C-F GRAVEL and C-F SAND**  
 trace gravel

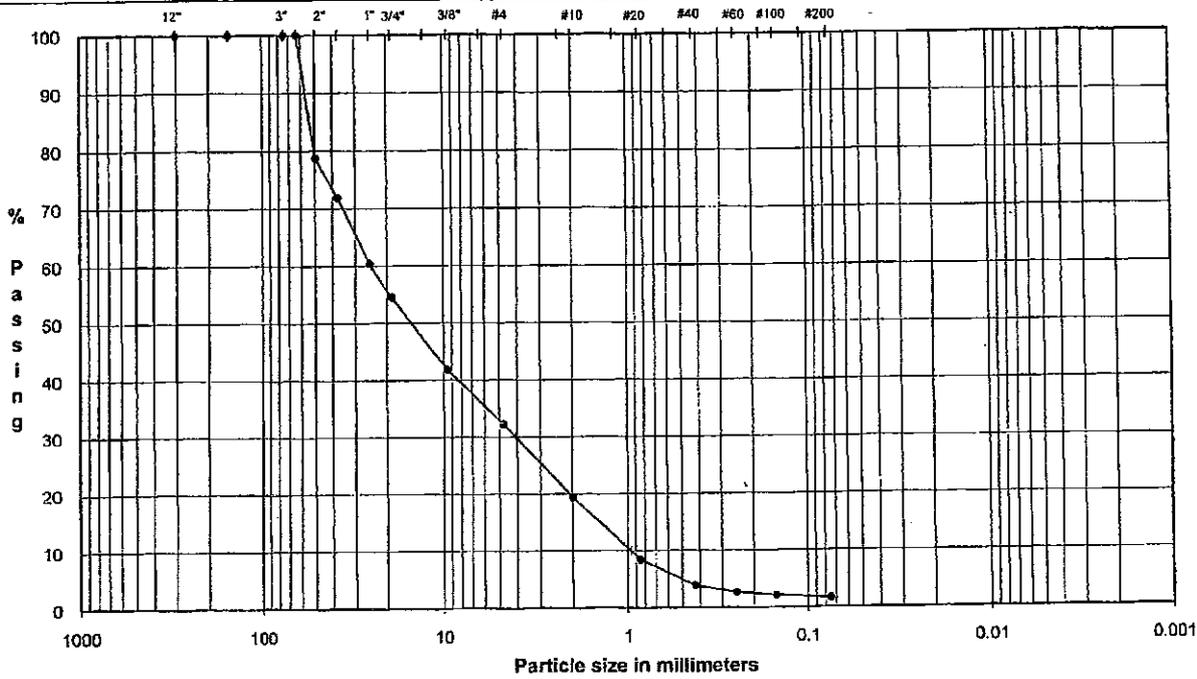
USCS: **GP**

TECH	TCM
DATE	1/7/10
CHECK	TCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: BDP / The Villages FS and Consulting / WA  
 SAMPLE ID: TP-119 0 Depth: 2-7ft  
 TYPE: -



COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Classification	Percentage
	12.0"	304.8	100.0	Cobbles
6.0"	154.2	100.0		
3.0"	75	100.0		
2.5"	63.5	100.0	Coarse Gravel	45.4
2.0"	50	78.8		
1.5"	37.5	71.9		
1.0"	25	60.4		
0.75"	19	54.6	Fine Gravel	22.3
0.375"	9.5	41.9		
#4	4.75	32.2	Coarse Sand	12.9
#10	2.00	19.4		
#20	0.85	8.4	Medium Sand	15.5
#40	0.43	3.9		
#60	0.25	2.6		
#100	0.15	2.1	Fine Sand	2.2
#200	0.075	1.7		
Fines				1.7

Moisture Content  
3.51

$D_{60} = 24.49$	$D_{30} = 4.08$	$D_{10} = 0.96$
$C_u = D_{60}/D_{10} = 25.5$		$> 4$
$C_c = D_{30}^2 / (D_{10} \cdot D_{60}) = 0.7$		$< 1$

DESCRIPTION: C-F GRAVEL and C-F SAND  
trace gravel

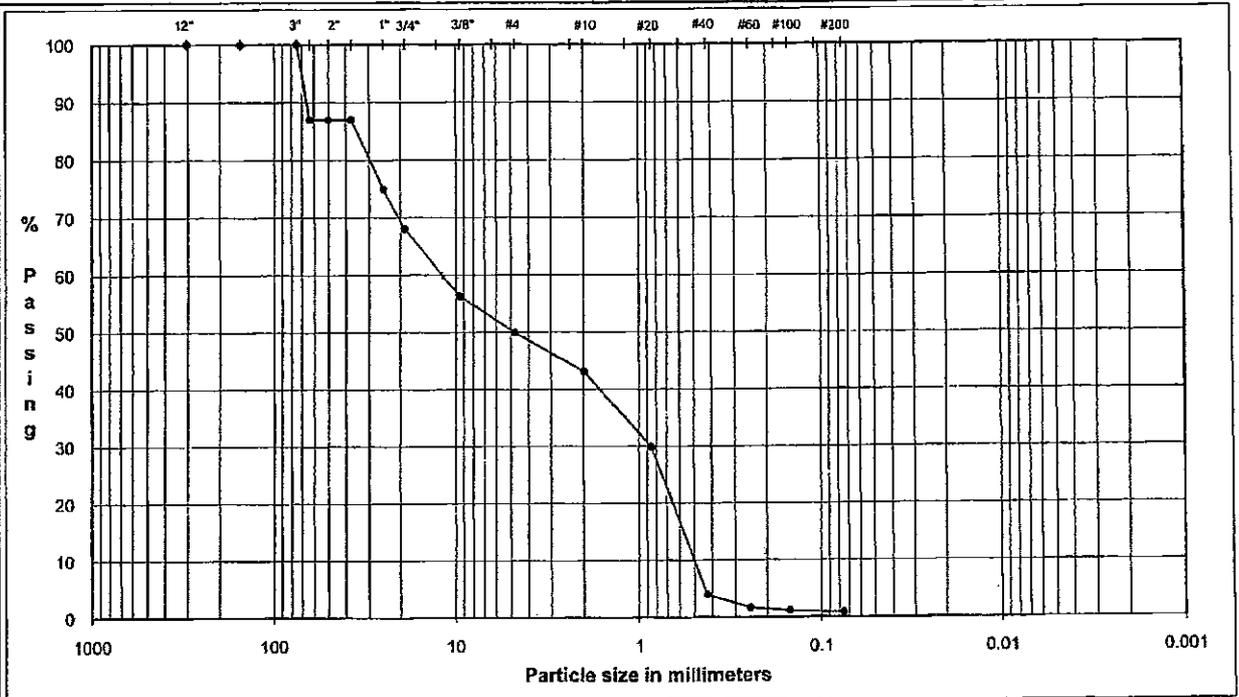
USCS: GP

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 DATE 1/7/10  
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 REVIEW *[Signature]*

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP206**      0 Depth: **18ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>FINES</b>

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage
	(mm)	% Passing		
12.0"	304.8	100.0	Cobbles	0.0
6.0"	154.2	100.0		
3.0"	75	100.0		
2.5"	63.5	87.0		
2.0"	50	87.0		
1.5"	37.5	87.0		
1.0"	25	75.0		
0.75"	19	68.0	Coarse Gravel	32.0
0.375"	9.5	56.4	Fine Gravel	18.1
#4	4.75	50.0		
#10	2.00	43.2	Coarse Sand	6.8
#20	0.85	29.8	Medium Sand	39.2
#40	0.43	3.9		
#60	0.25	1.7		
#100	0.15	1.2		
#200	0.075	0.9	Fine Sand	3.1
Fines				0.9

$D_{60} = 11.79$	$D_{30} = 0.86$	$D_{10} = 0.50$
$C_u = D_{60}/D_{10} =$		23.6 > 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$		0.1 < 1

DESCRIPTION: **C-F SAND and C-F GRAVEL**

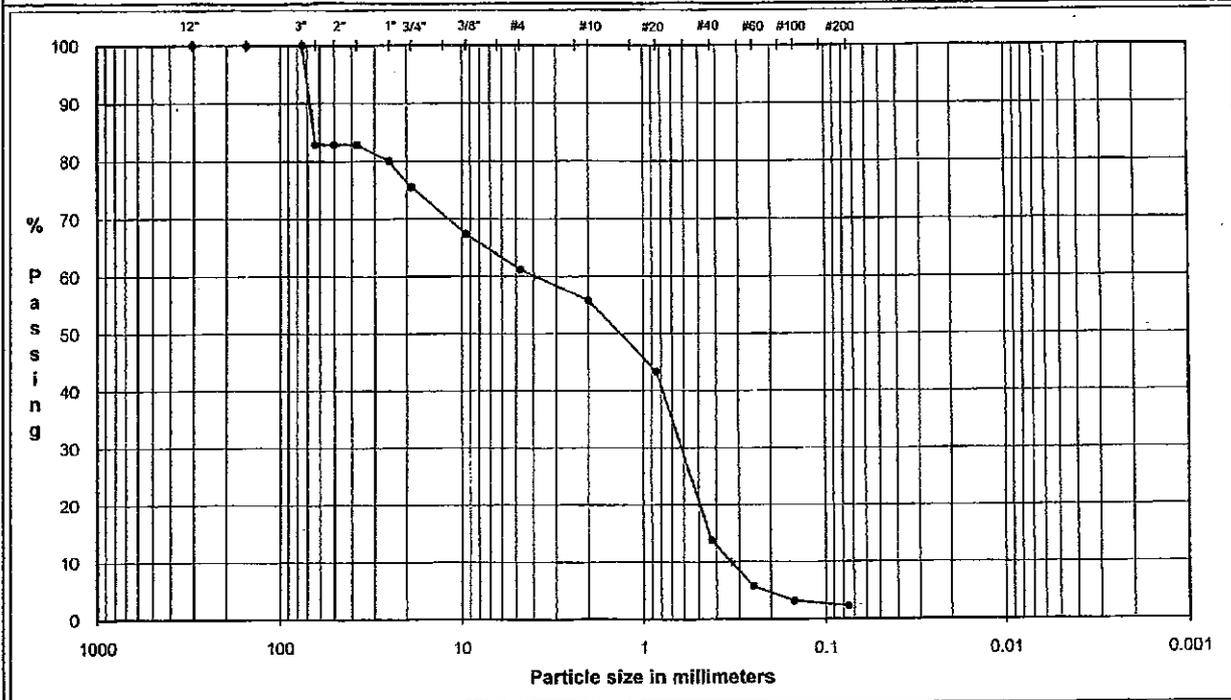
USCS: **GP**

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# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP207**                      S-3                      Depth: **18.5ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage
	(mm)	% Passing		
	12.0"	304.8	100.0	
	6.0"	154.2	100.0	
	3.0"	75	100.0	Cobbles 0.0
	2.5"	63.5	82.8	
	2.0"	50	82.8	
	1.5"	37.5	82.8	
	1.0"	25	80.0	
	0.75"	19	75.6	Coarse Gravel 24.4
	0.375"	9.5	67.4	
	#4	4.75	61.2	Fine Gravel 14.4
	#10	2.00	55.8	Coarse Sand 5.4
	#20	0.85	43.4	
	#40	0.43	13.8	Medium Sand 42.0
	#60	0.25	5.8	
	#100	0.15	3.2	
	#200	0.075	2.3	Fine Sand 11.5
				Fines 2.3

$D_{60} = 3.92$	$D_{30} = 0.62$	$D_{10} = 0.33$
$C_u = D_{60}/D_{10} =$	11.9	> 6
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	0.3	< 1

DESCRIPTION: C-F SAND and C-F GRAVEL

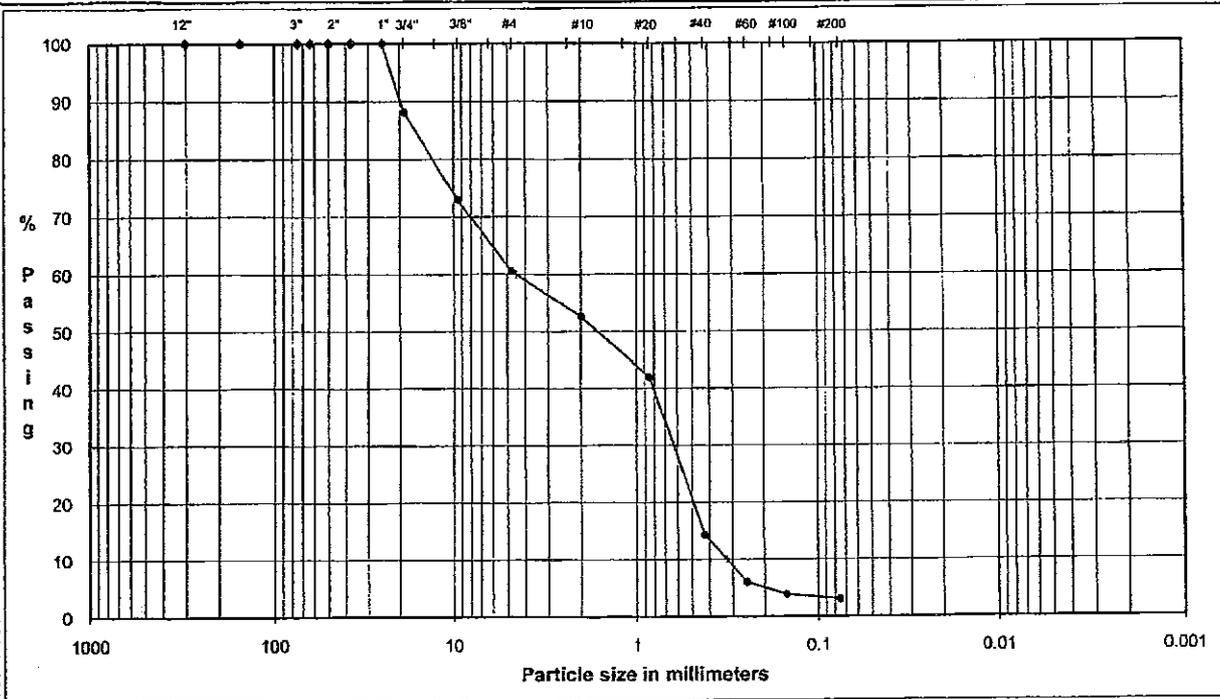
USCS: SP

TECH	TM
DATE	1/25/10
CHECK	FCM
REVIEW	<i>[Signature]</i>

# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **TP207**      S-4      Depth: **21ft**  
 TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size	Particle Size	Classification	Percentage
	(mm)	% Passing		
	12.0"	304.8	100.0	
	6.0"	154.2	100.0	
	3.0"	75	100.0	Cobbles 0.0
	2.5"	63.5	100.0	
	2.0"	50	100.0	
	1.5"	37.5	100.0	
	1.0"	25	100.0	
	0.75"	19	88.2	Coarse Gravel 11.8
	0.375"	9.5	73.0	
	#4	4.75	60.5	Fine Gravel 27.6
	#10	2.00	52.6	Coarse Sand 7.9
	#20	0.85	41.9	
	#40	0.43	14.3	Medium Sand 38.3
	#60	0.25	6.0	
	#100	0.15	3.9	
	#200	0.075	3.0	Fine Sand 11.3
				Fines 3.0

$D_{60} = 4.47$	$D_{30} = 0.63$	$D_{10} = 0.32$
$C_u = D_{60}/D_{10} =$	13.9	> 6
$C_c = D_{30}^2/(D_{10} \cdot D_{60}) =$	0.3	< 1

DESCRIPTION: C-F SAND and C-F GRAVEL

USCS: SP

TECH	TM
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## MOISTURE DENSITY CURVES ASTM D 698 & 1557

PROJECT TITLE	BDP / The Villages FS and Consulting	TEST TYPE	D 1557 or Percentage Limits for D 4718
PROJECT NUMBER	063-1076.201	PROCEDURE	METHOD C NON ASTM
SAMPLE IDENTITY	Proctor 108		
SAMPLE TYPE			
MOLD NUMBER	Labnewmold	TYPE COMPACTOR	PREPARATION
MOLD WEIGHT (gm)	5691.00	Mechanical	Wet Method
MOLD DIAMETER (in)	6.006		
MOLD HEIGHT (in)	4.587	TYPE PROCTOR	
MOLD VOLUME (cu.ft)	0.0750	MODIFIED	
		10-lbf. RAMMER WITH 18 INCH DROP	
			METHOD A: 20% OR LESS RETAINED ON #4
			METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"
			METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT	COARSE FRACTION	TOTAL SAMPLE	TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED
Wt Tare & Soil (W1)		337.50	TOTAL WEIGHT, WET ( COARSE & FINE ) 61122.00
Wt Tare & Soil (W2)		323.50	TOTAL WEIGHT, DRY ( COARSE & FINE ) 57477.59
Wt Tare (W3)		102.70	WEIGHT RETAINED ON # 4 SIEVE (WET) 0.00
Wt Moisture (W4=W1-W2)	0.00	14.00	WEIGHT RETAINED ON 3/8" SIEVE (WET)
Wt Dry Soil (W5=W2-W3)	0.00	220.80	WEIGHT RETAINED ON 3/4" SIEVE (WET) 27481.00
Water Content (dec) (wc=W4/W5)		0.0634	PERCENT RETAINED ON # 4 SIEVE (DRY) 0.00%
Water Content (%) (W4/W5)*100		6.34%	PERCENT RETAINED ON 3/8" SIEVE (DRY) 0.00%
			PERCENT RETAINED ON 3/4" SIEVE (DRY) 47.81%

POINT RESULTS (FINE)	1	2	3	4	5	6	7
Wt. Soil & Mold (W1)	10272.00	10503.00	10676.00	10708.00			
Weight of Mold (W2)	5691.00	5691.00	5691.00	5691.00			
Wt. Of Wet Soil (W3=W1-W2)	4581.00	4812.00	4985.00	5017.00			
Wet Density, wd (pcf) (W3/453.6*Vm)	134.60	141.39	146.47	147.41			

WATER CONTENTS	4	5	6	7	8	9
Wt Tare & Soil (W4)	362.90	462.40	568.50	570.80		
Wt Tare & Soil (W5)	349.60	435.30	523.90	516.50		
Wt Tare (W6)	100.50	105.10	90.50	89.20		
Wt Moisture (W7=W4-W5)	13.30	27.10	44.60	54.30		
Wt Dry Soil (W8=W5-W6)	249.10	330.20	433.40	427.30		
Water Content (%) (W7/W8)*100	5.34%	8.21%	10.29%	12.71%		
Dry Density (pcf) (wd/(1+wc))	127.8	130.7	132.8	130.8		

MAXIMUM DRY DENSITY (pcf)	132.9	DESCRIPTION
OPTIMUM MOISTURE CONTENT (%)	10.1	
Corrected Maximum Dry Density (pcf)	146.7	
Corrected Optimum Moisture (%)	5.3	USCS

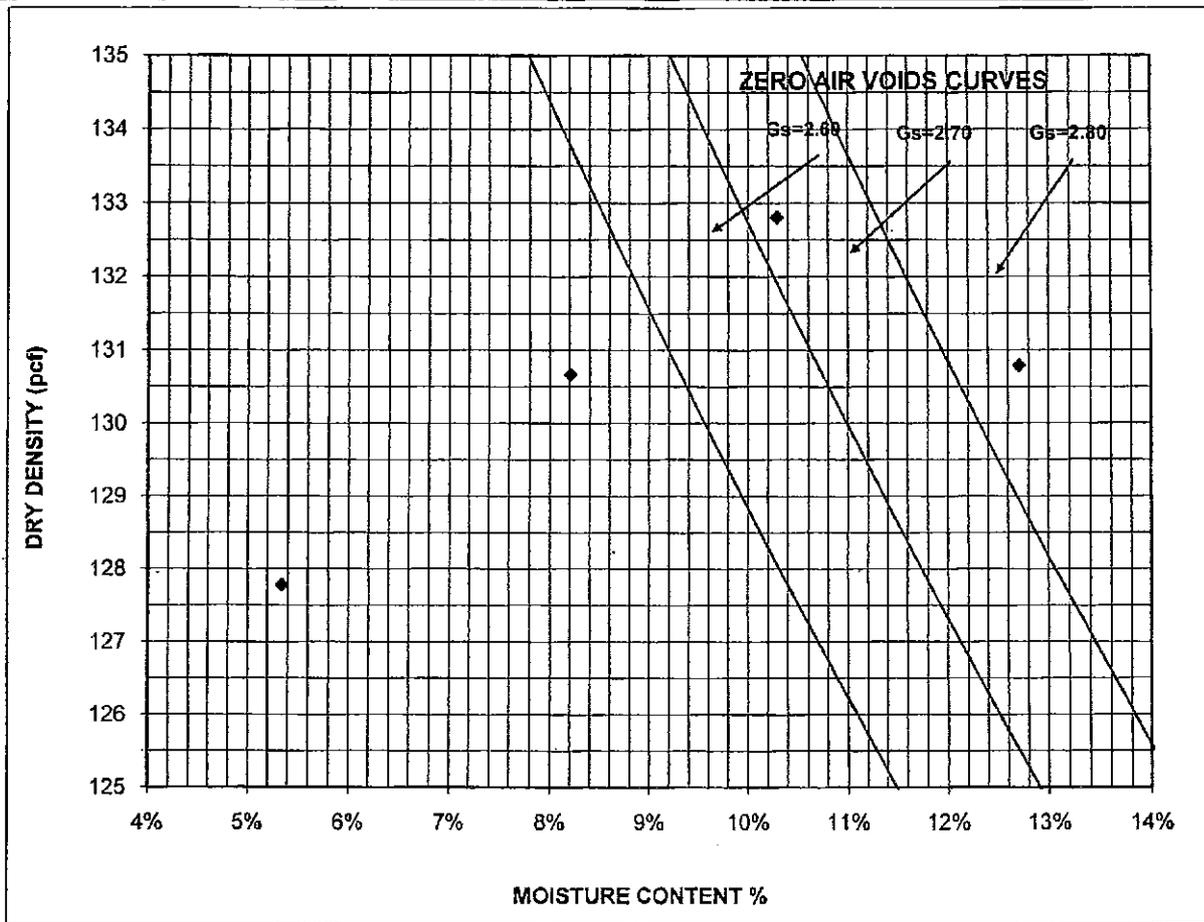
Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

Weight of Oven Dry Sample (gm)	A	[ ]	LL	-
Weight of Saturated-Surface-Dry (gm)	B	[ ]	PL	-
Weight of Saturated Sample in Water (gm)	C	[ ]	PI	-
Absorption of Oversize Particles (%) [(B-A)/A]*100		[ ]	MC	6.34%
Bulk Specific Gravity A/(B-C)		[ ]		

AVERAGE ABSORPTION	[ ]
AVERAGE BULK SPECIFIC GRAVITY	2.65

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**MOISTURE / DRY DENSITY CURVE  
D 1557 METHOD C**



MAXIMUM DRY DENSITY (pcf)	Beyond the Upper Percentage Limits for D 47
OPTIMUM MOISTURE (%)	NO CORRECTION REQUIRED

SAMPLE ID	TP-103 S-1
SAMPLE TYPE	0
SAMPLE DEPTH	0

LL	-
PL	-
PI	-

DESCRIPTION: C-F GRAVEL

USCS: GW

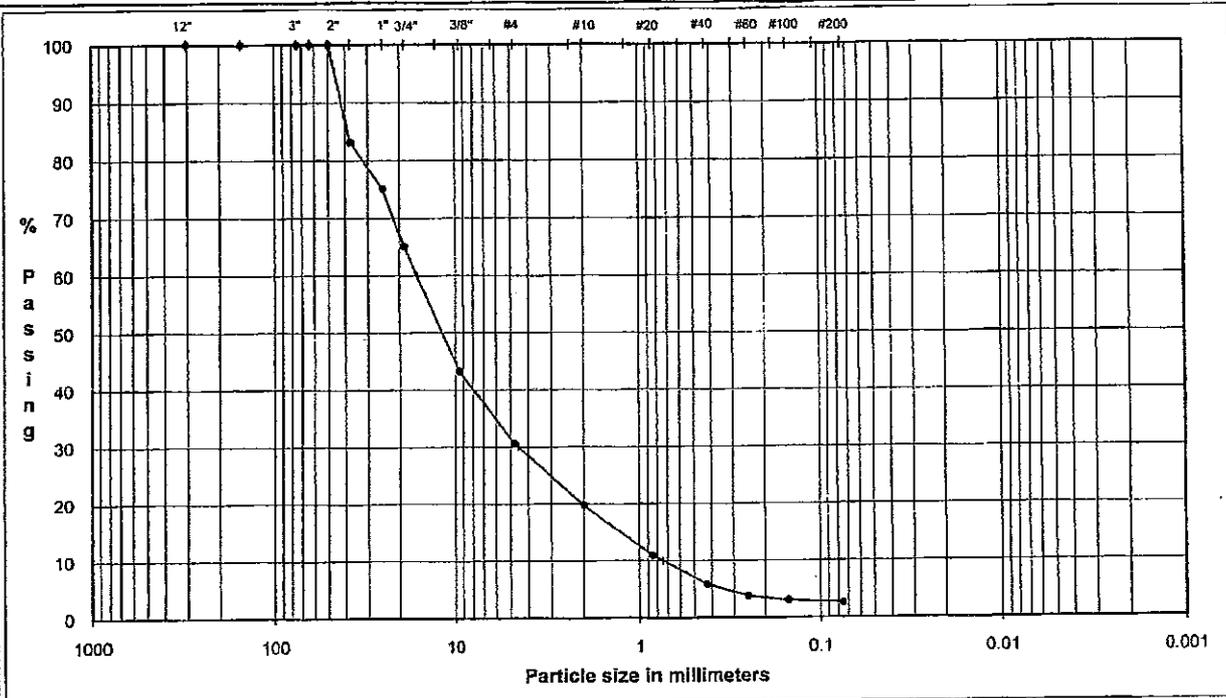
BDP / The Villages FS and Consulting  
063-1076.201

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# PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **BDP / The Villages FS and Consulting / WA**  
 SAMPLE ID: **Proctor Sample TP-108 0** Depth: **0**  
 TYPE: **-**



COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Classification	Percentage
	12.0"	304.8	100.0	Cobbles
6.0"	154.2	100.0		
3.0"	75	100.0		
2.5"	63.5	100.0		
2.0"	50	100.0		
1.5"	37.5	83.2		
1.0"	25	75.1	Coarse Gravel	34.8
0.75"	19	65.2		
0.375"	9.5	43.3	Fine Gravel	34.6
#4	4.75	30.6		
#10	2.00	19.7	Coarse Sand	10.8
#20	0.85	10.9		
#40	0.43	5.9	Medium Sand	13.9
#60	0.25	3.8		
#100	0.15	3.1	Fine Sand	3.3
#200	0.075	2.6		
			Finest	2.6

$D_{60} = 16.13$	$D_{30} = 4.53$	$D_{10} = 0.75$
$C_u = D_{60}/D_{10} =$	21.8	> 4
$C_c = D_{30}^2 / (D_{10} * D_{60}) =$	1.7	> 1

DESCRIPTION: **C-F GRAVEL**

USCS: **GW**

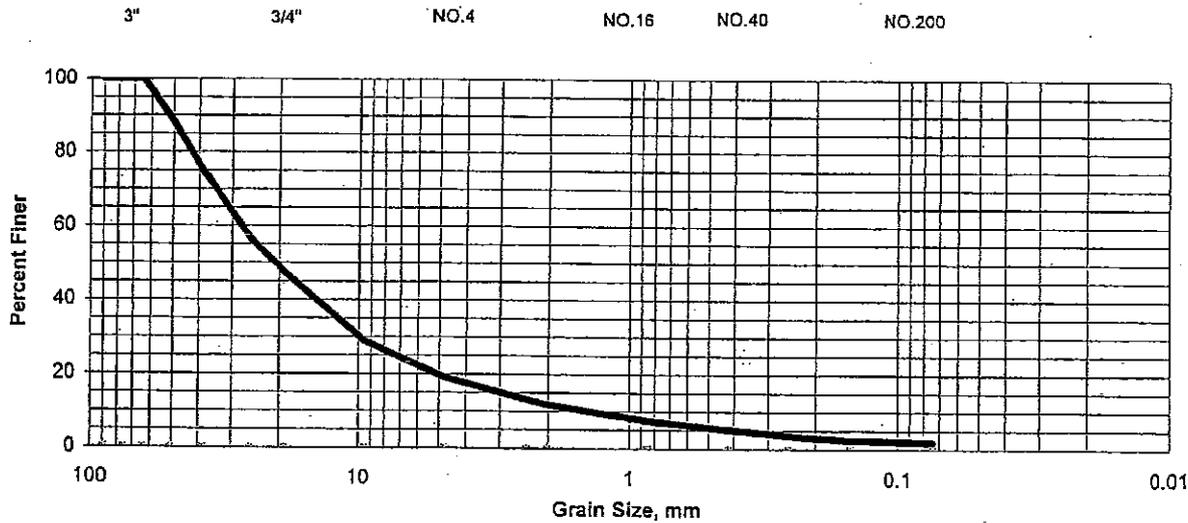
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# GRAIN SIZE ANALYSIS - MECHANICAL

Date 12/24/2007	Project Villages at Black Diamond	Project No. KG060601A	Soil Description Gravel with sand, trace silt
Tested By KME/CDF	Location Parcel D	EP No IT-4	Depth 8'
Wt. Of wet sample + Tare	10260	Moisture % 3.7	
Wt. of Dry Sample + Tare	9920		
Wt. of Tare	664.35		
Wt. of Dry Sample	9255.65		
After Wash Weight + Tare	9750		

Sieve No.	Diam. (mm)	Wt. Retained (g)	% Retained	% Passing	Specification Requirements	
					Minimum	Maximum
3.5	90	0	0.0	100.0		
3	76.1	0	0.0	100.0		
2.5	64	0	0.0	100.0		
2	50.8	989	10.7	89.3		
1.5	38.1	2368	25.6	74.4		
1	25.4	4038	43.6	56.4		
3/4	19	4870	52.6	47.4		
3/8	9.51	6574	71.0	29.0		
#4	4.76	7495	81.0	19.0		
#8	2.38	8040	86.9	13.1		
#10	2	8165	88.2	11.8		
#20	0.85	8555	92.4	7.6		
#40	0.42	8775	94.8	5.2		
#60	0.25	8925	96.4	3.6		
#100	0.149	9030	97.6	2.4		
#200	0.074	9080	98.1	1.9		

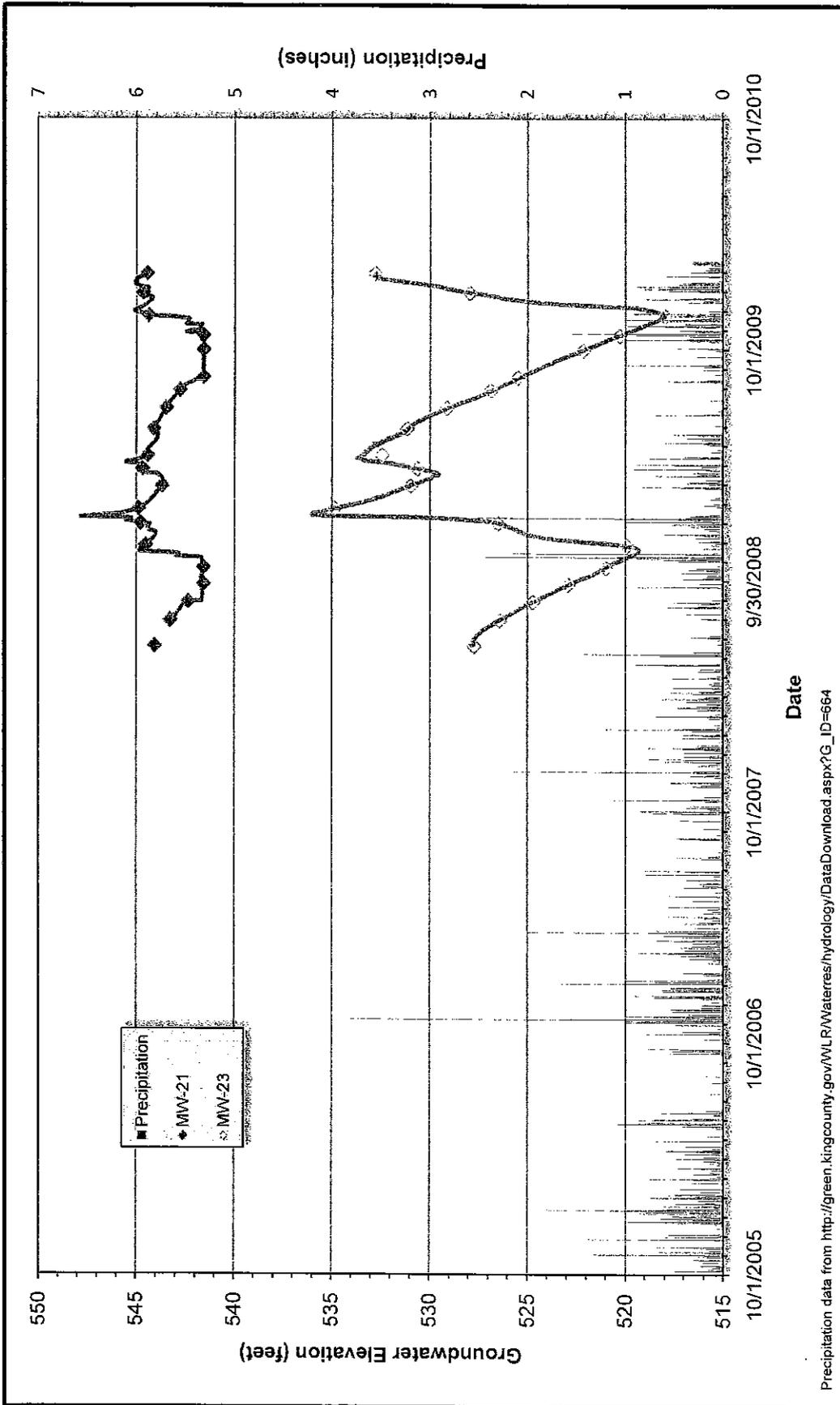
US STANDARD SIEVE NOS.



**ASSOCIATED EARTH SCIENCES, INC.**

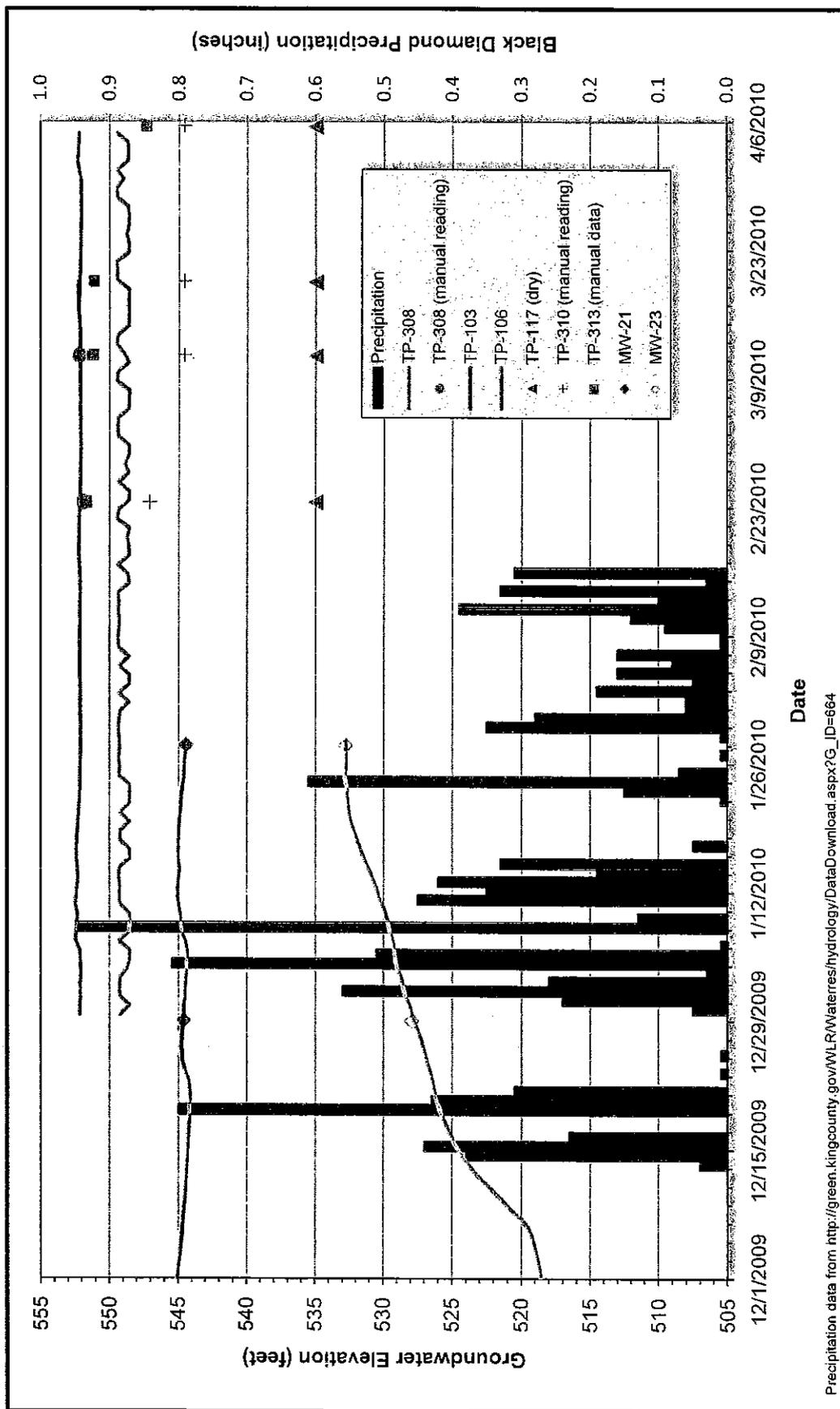
911 5th Ave., Suite 100 Kirkland, WA 98033 425-827-7701 FAX 425-827-5424

**APPENDIX D**  
**GROUNDWATER ELEVATIONS**



Precipitation data from [http://green.kingcounty.gov/WL/R/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WL/R/Waterres/hydrology/DataDownload.aspx?G_ID=664)

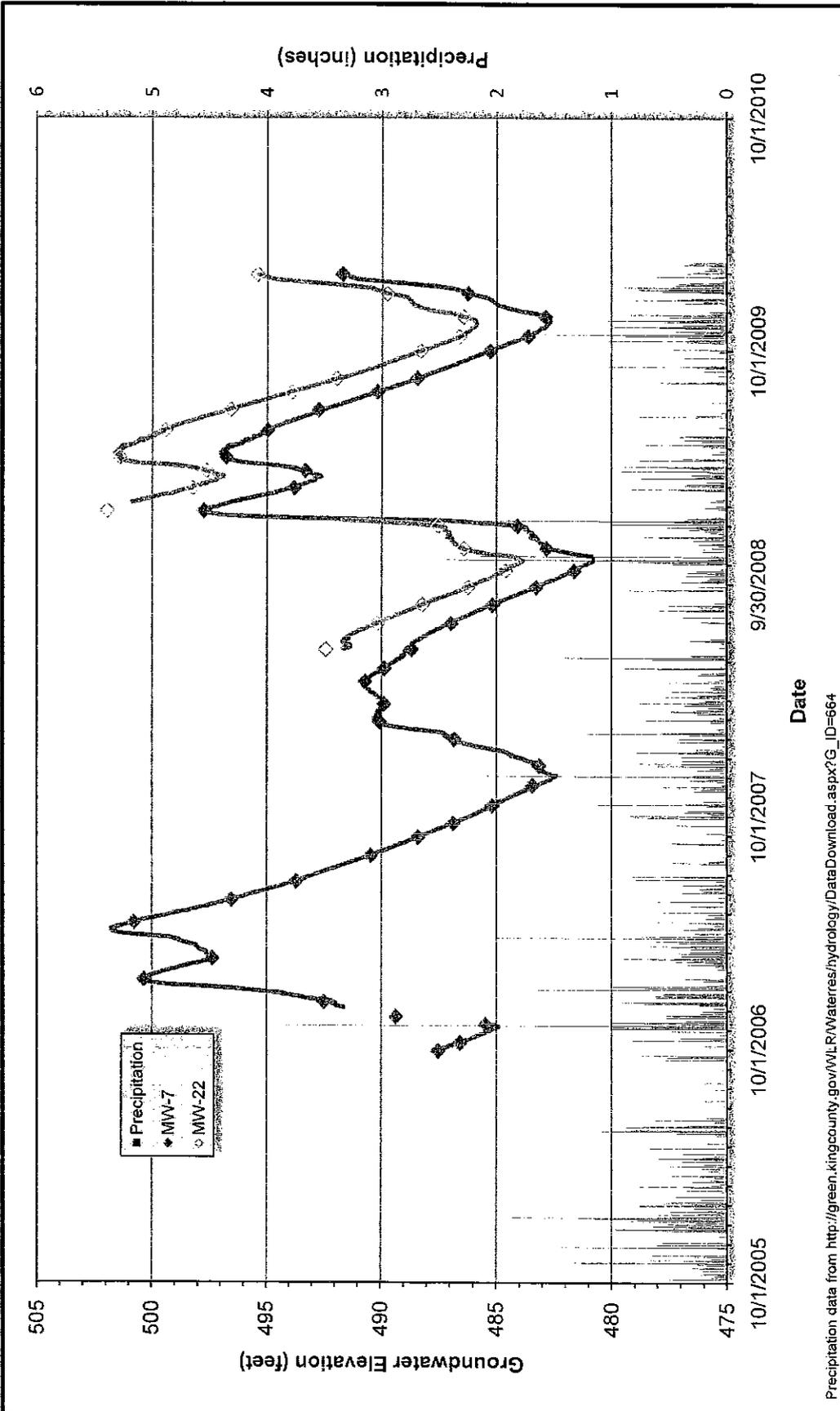
		<b>Long-Term Groundwater Elevations in Qvr Wells</b>		Drawn	EA
		Project Name Villages Phase I Client Name BD Lawson Partners	Project No. 063-1076-001.202 Date April 21, 2010	Checked	MPK
				Reviewed	JGJ
				<b>FIGURE D-1</b>	



Precipitation data from [http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)

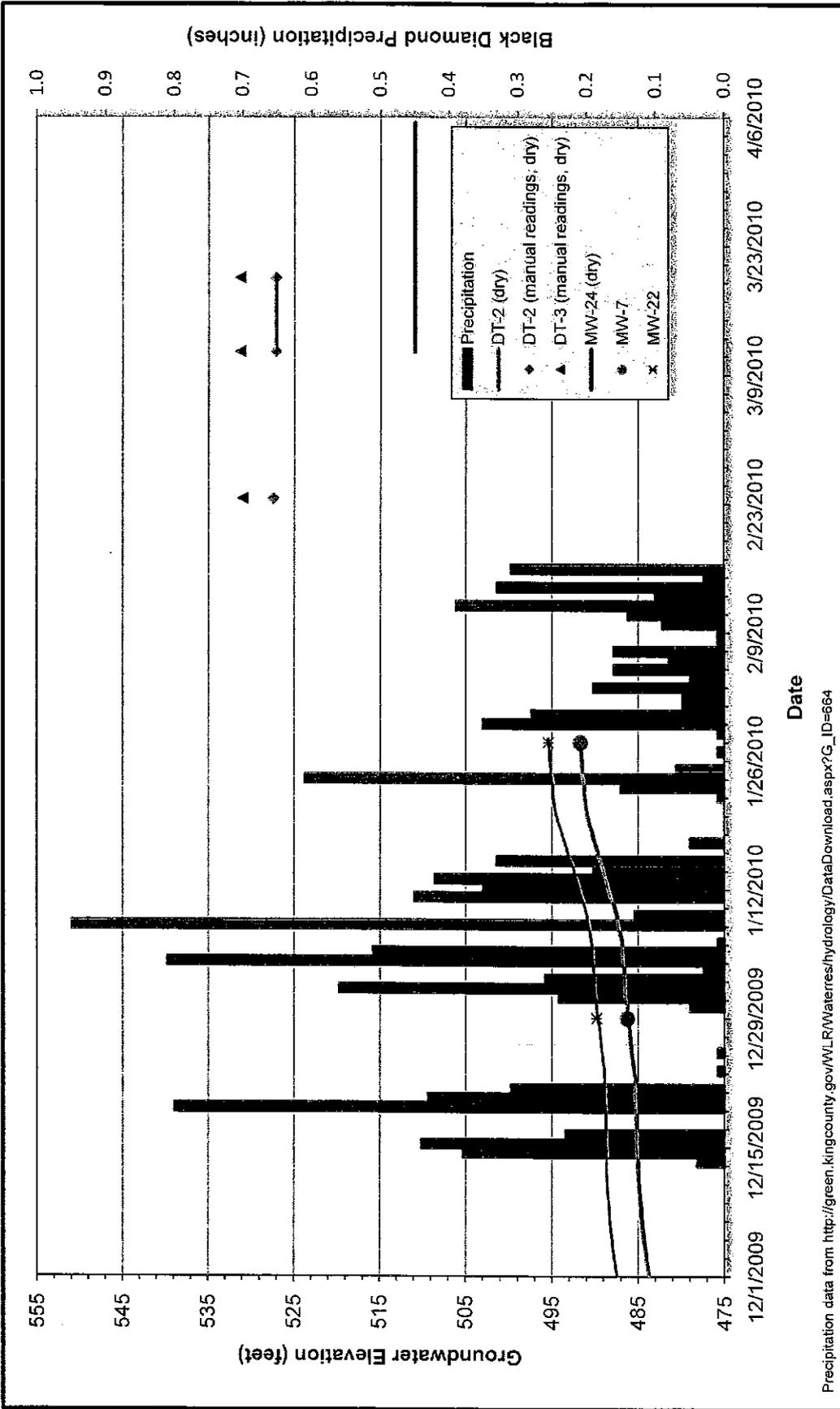
Title		Groundwater Elevations in Qvr Test Pits and Wells	
Project Name	Villages Phase I	Project No.	063-1076-001.202
Client Name	BD Lawson Partners	Date	April 21, 2010
Drawn	EA	Checked	MPK
Reviewed	JGJ	FIGURE D-2	





Precipitation data from [http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)

	<b>Title</b> Long-Term Groundwater Elevations in Pre-Vashon Wells		Drawn EA
	<b>Project Name</b> Villages Phase I		Checked MPK
	<b>Client Name</b> BD Lawson Partners		Reviewed JGJ
		<b>Project No.</b> 063-1076-001.202	<b>FIGURE</b> D-3
		<b>Date</b> April 21, 2010	

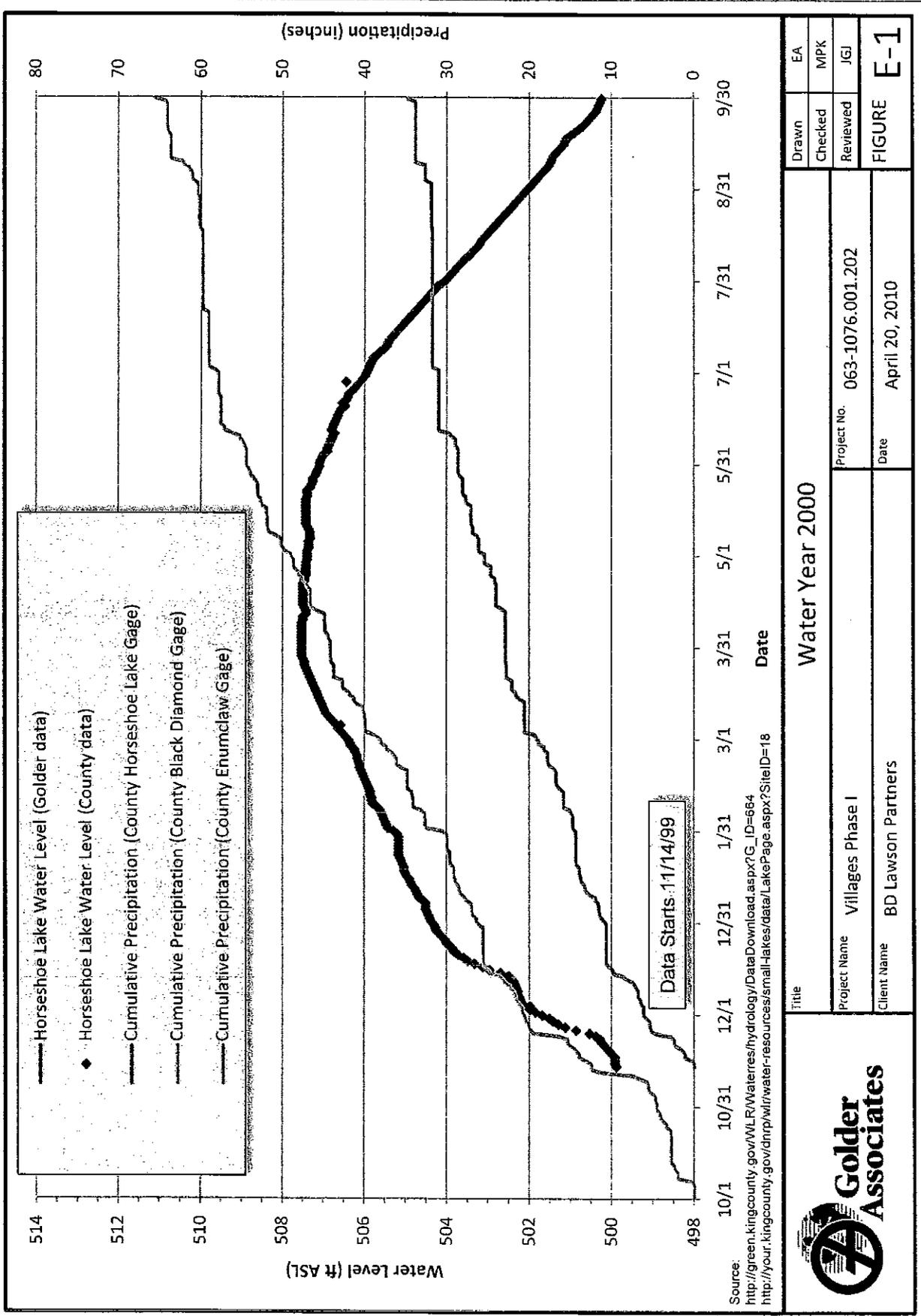


Precipitation data from [http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)

Title		Groundwater Elevations in Pre-Vashon Test Pits and Wells	
Project Name	Villages Phase I	Project No.	063-1076-001.202
Client Name	BD Lawson Partners	Date	April 21, 2010
Drawn	EA	Checked	MPK
Reviewed	JGJ	FIGURE	D-4

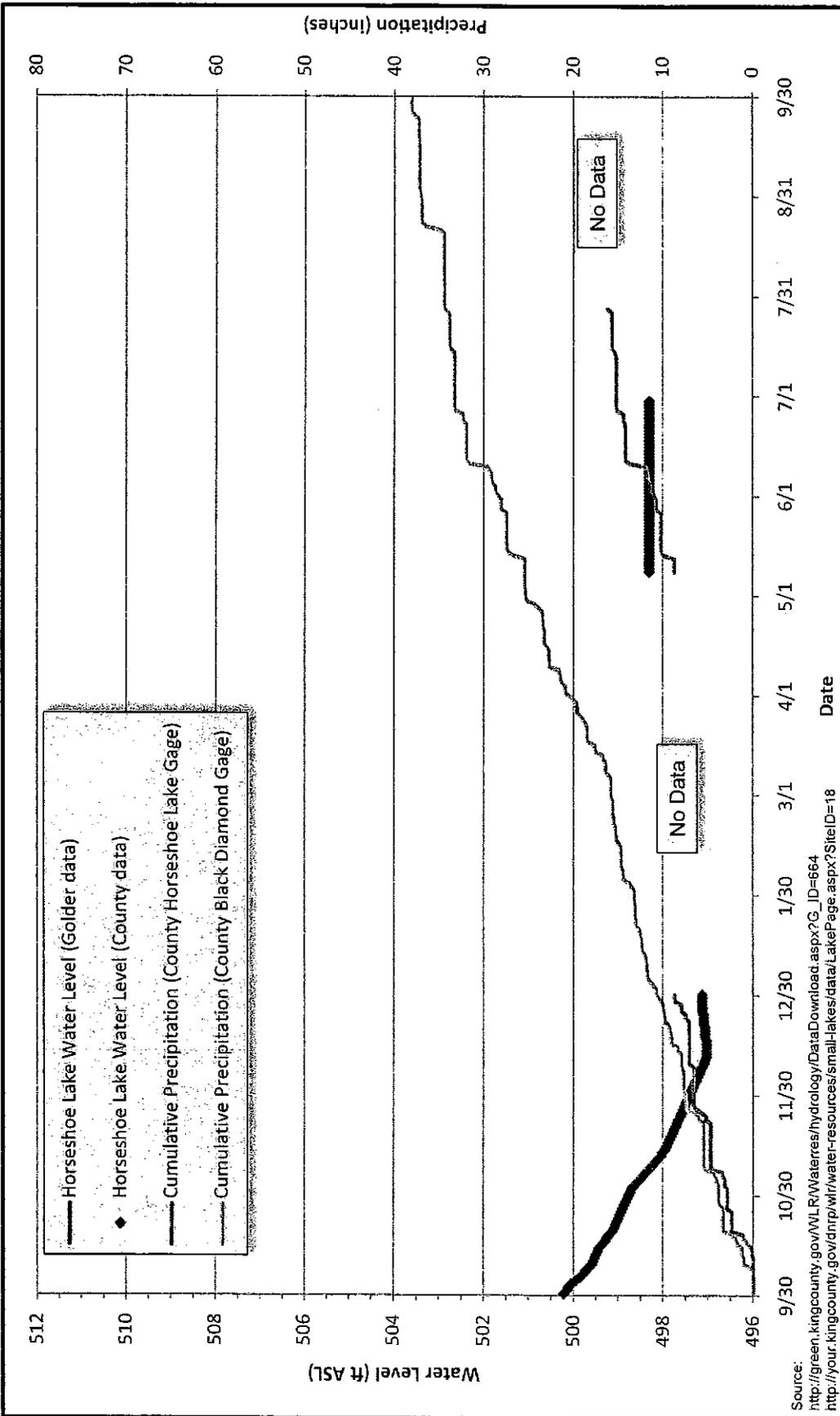


**APPENDIX E**  
**HORSESHOE LAKE INFORMATION**



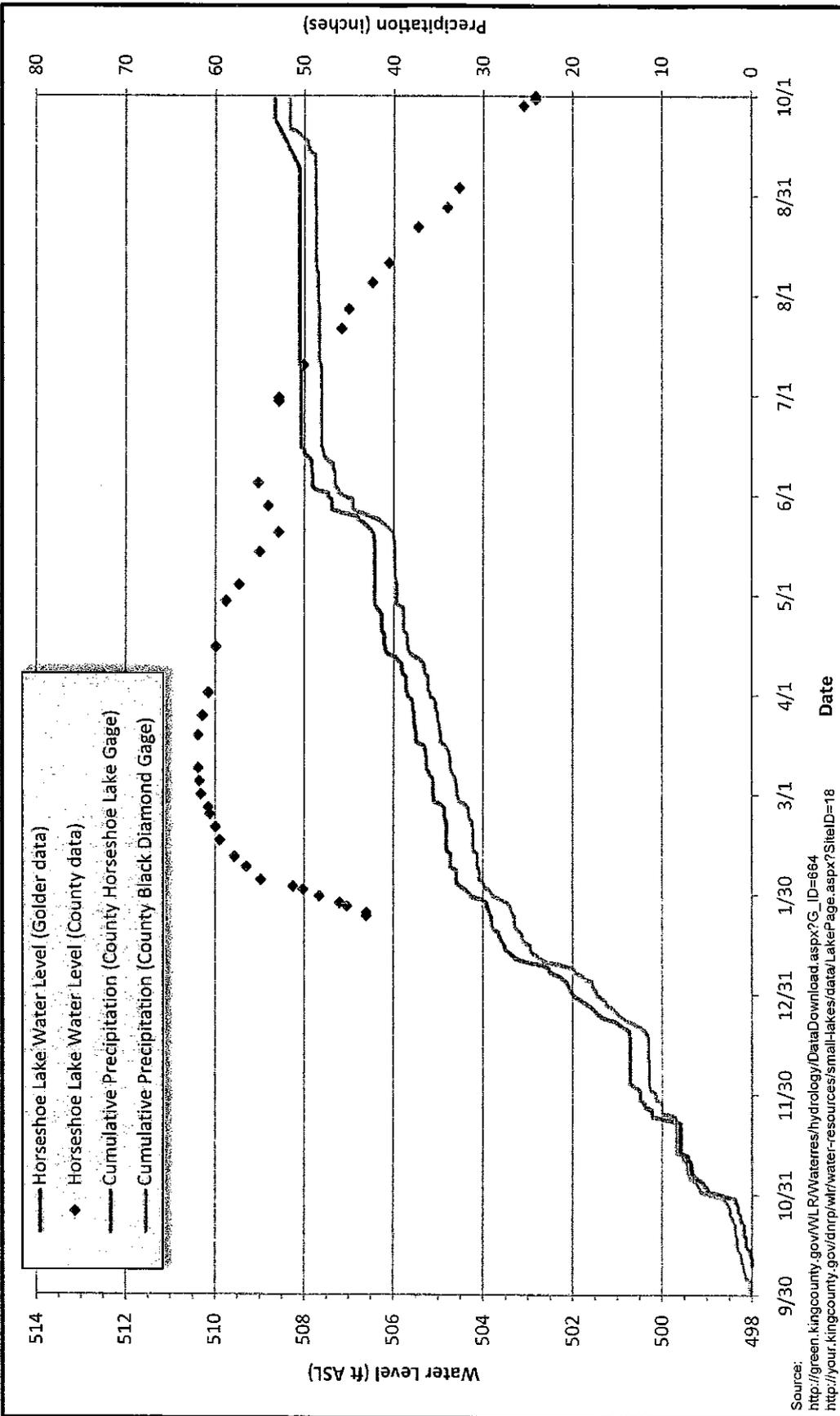
Drawn	EA
Checked	MPK
Reviewed	JGJ
FIGURE E-1	



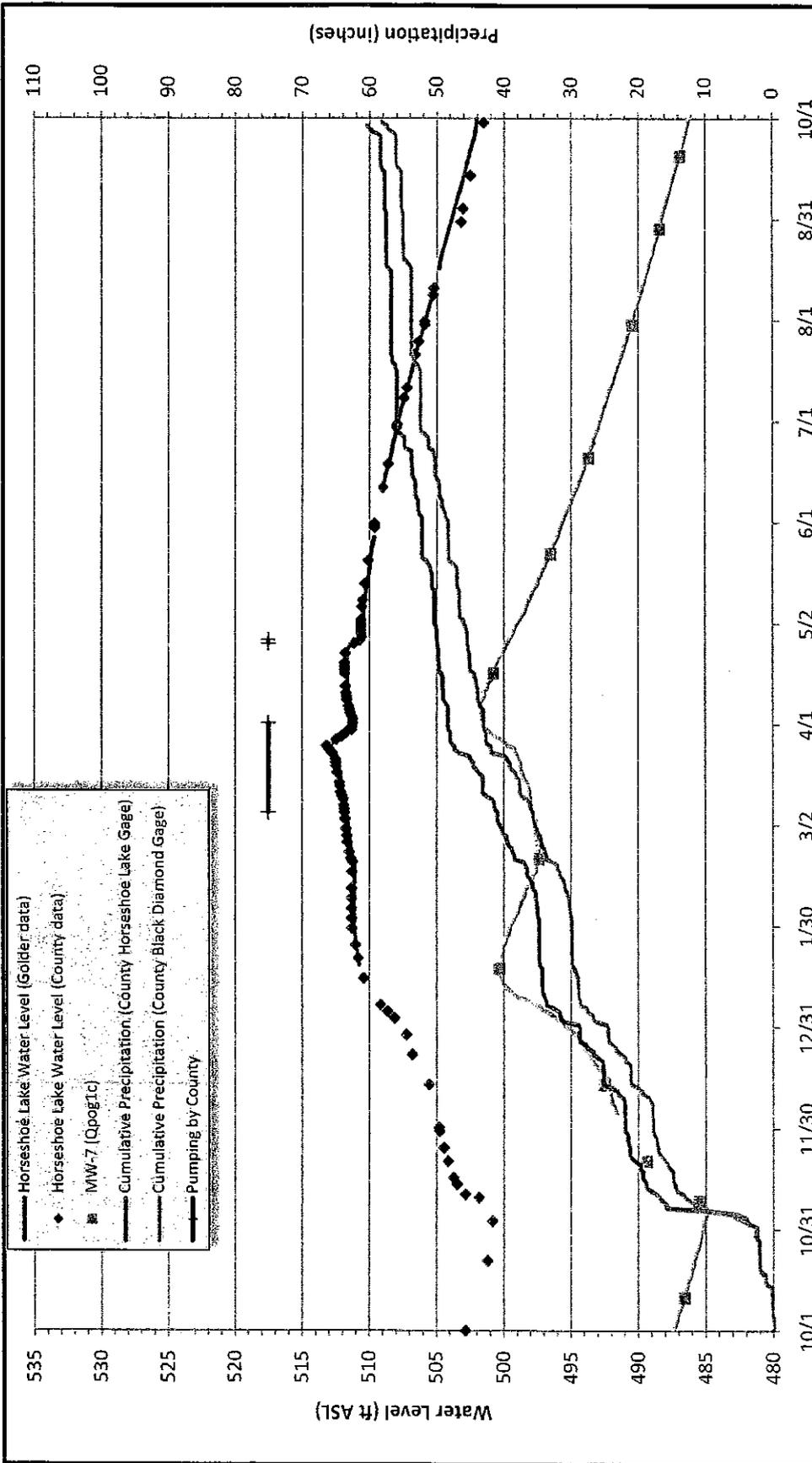


		<b>Water Year 2001</b>		Drawn EA
Project Name Villages Phase I		Project No. 063-1076.001.202		Checked MPK
Client Name BD Lawson Partners		Date April 20, 2010		Reviewed JGJ
<b>FIGURE E-2</b>				

Source:  
[http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)  
<http://your.kingcounty.gov/dntrp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>



		Title		Water Year 2006	
		Project Name		Villages Phase I	
Source:		Project No.		063-1076.001.202	
<a href="http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664">http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664</a> <a href="http://your.kingcounty.gov/dnmp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18">http://your.kingcounty.gov/dnmp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18</a>		Date		April 20, 2010	
Client Name		BD Lawson Partners		Reviewed	
Checked		MPK		Reviewed	
Drawn		EA		FIGURE	
				E-3	

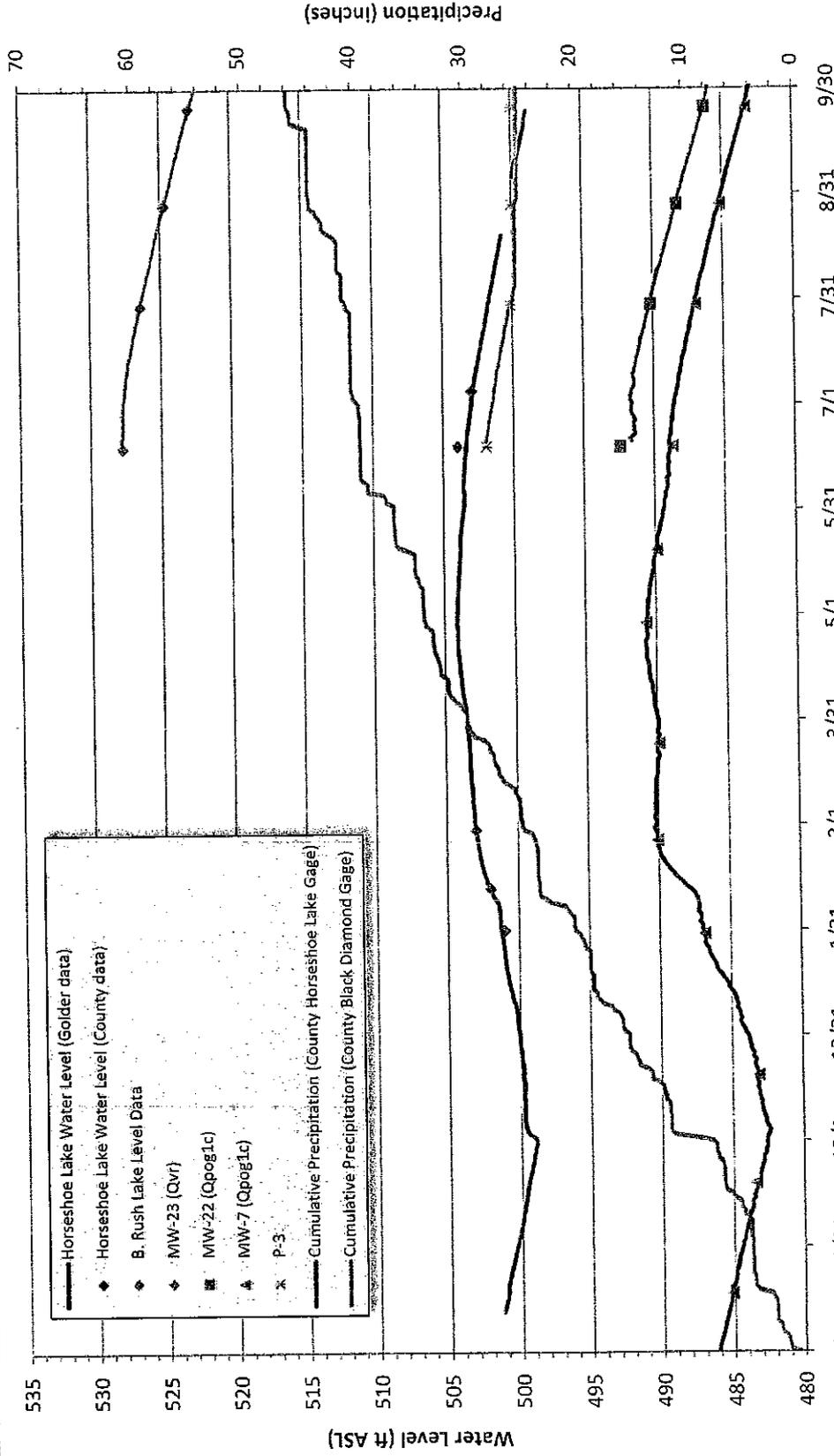


Sources:  
[http://green.kingcounty.gov/VL/R/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/VL/R/Waterres/hydrology/DataDownload.aspx?G_ID=664)  
<http://your.kingcounty.gov/dnrp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>



Title: Water Year 2007  
 Project Name: Villages Phase I  
 Client Name: BD Lawson Partners  
 Project No.: 063-1076.001.202  
 Date: April 20, 2010

Drawn	EA
Checked	MPK
Reviewed	JGJ
FIGURE E-4	

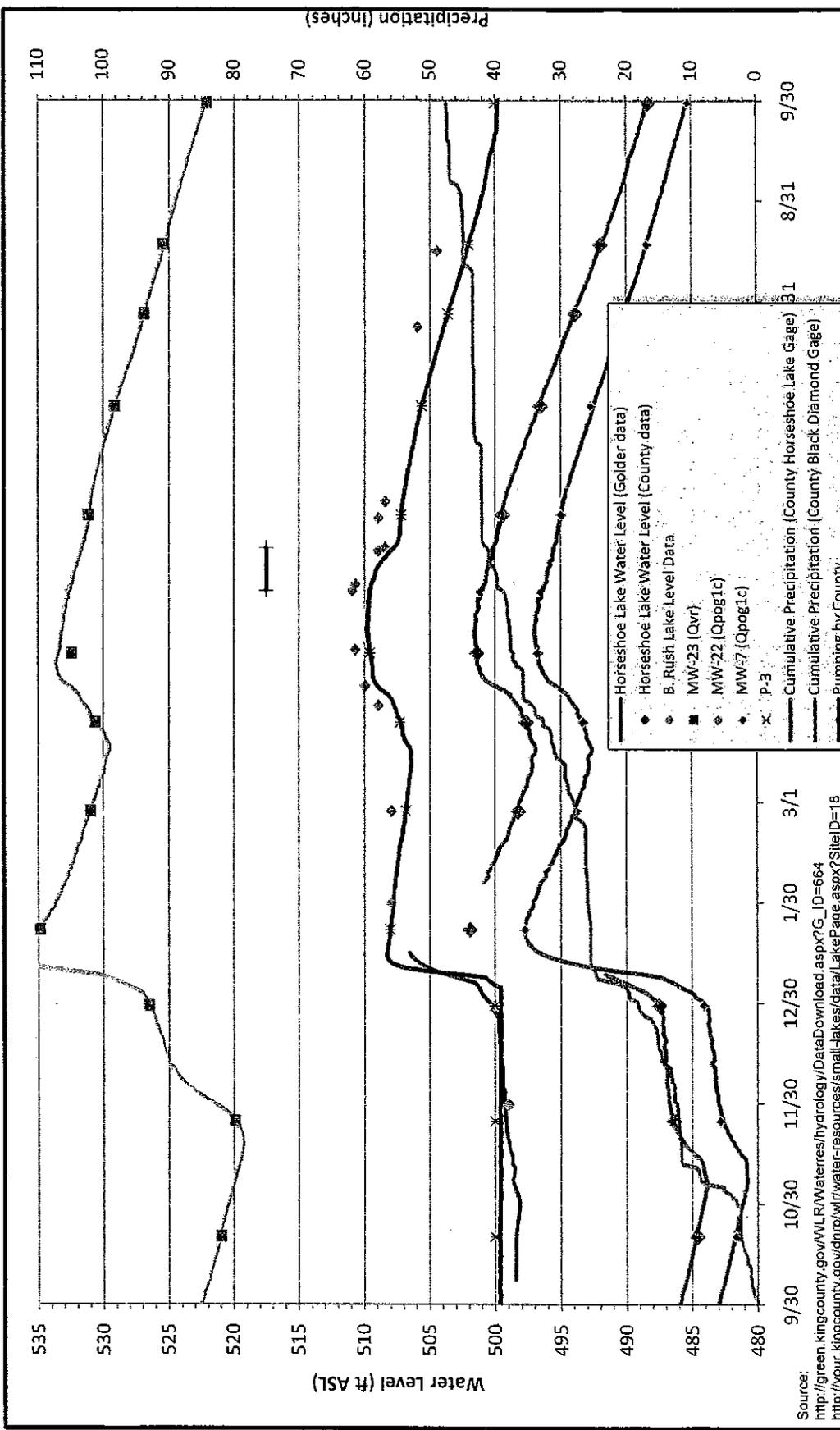


Source:  
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<http://your.kingcounty.gov/dmp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>

Drawn	EA
Checked	MPK
Reviewed	JGJ
<b>FIGURE E-5</b>	

<b>Water Year 2008</b>	
Project Name	Villages Phase I
Project No.	063-1076.001.202
Client Name	BD Lawson Partners
Date	April 20, 2010

**Golder Associates**



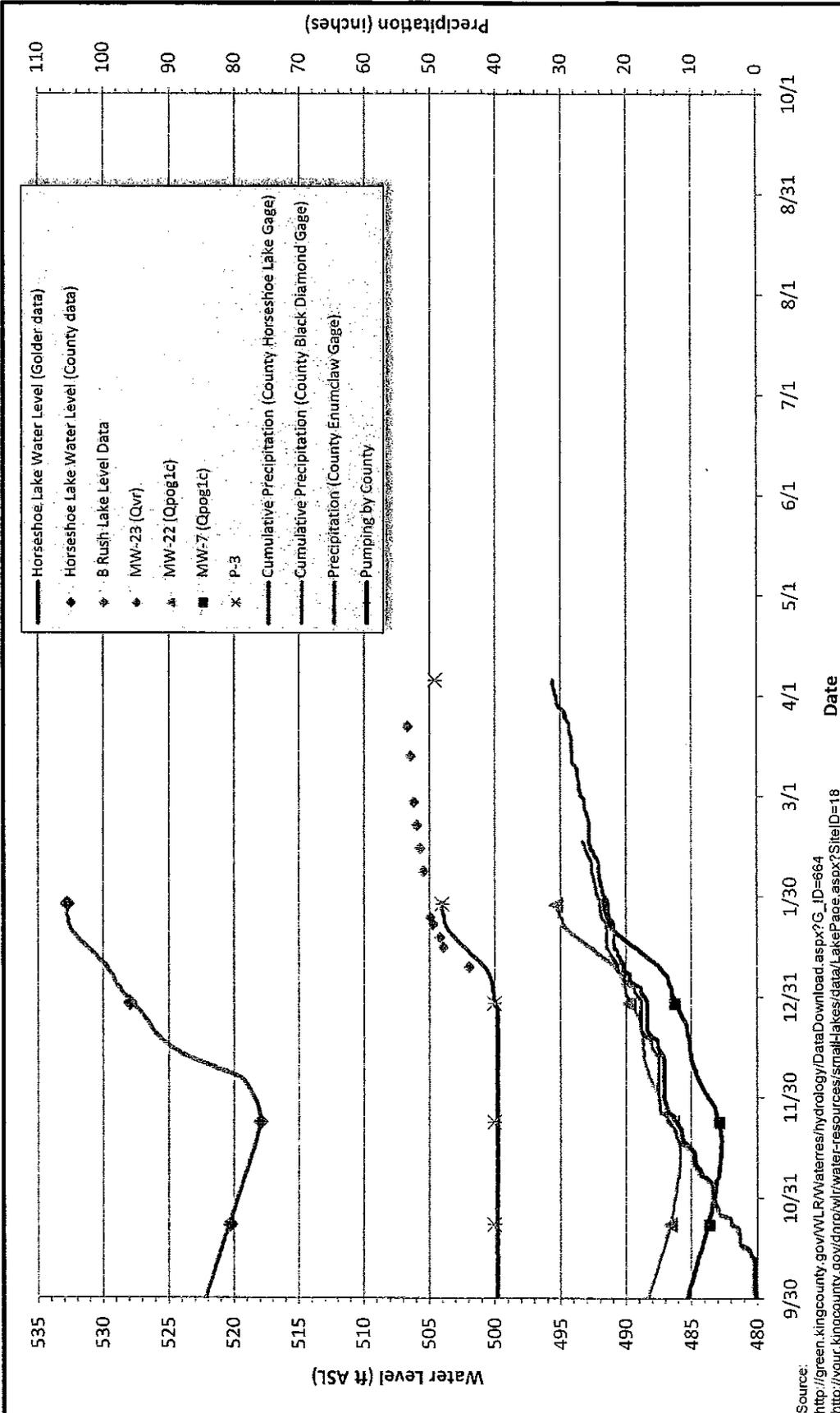
Source:  
[http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)  
<http://your.kingcounty.gov/dmp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>

**Golder Associates**

Title: Villages Phase I  
 Client Name: BD Lawson Partners

Project No. 063-1076.001.202  
 Date: April 20, 2010

Drawn	EA
Checked	MPK
Reviewed	JGJ
<b>FIGURE E-6</b>	



Source: [http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G\\_ID=664](http://green.kingcounty.gov/WLR/Waterres/hydrology/DataDownload.aspx?G_ID=664)  
<http://your.kingcounty.gov/dnrp/wlr/water-resources/small-lakes/data/LakePage.aspx?SiteID=18>

		<b>Water Year 2010</b>		Drawn EA
Title <b>Villages Phase I</b>		Project No. 063-1076.001.202		Checked MPK
Client Name BD Lawson Partners		Date April 20, 2010		Reviewed JGJ
<b>FIGURE E-7</b>				