HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering · Hydrogeology · Geoenvironmental · Inspection & Testing

March 8, 2007
HWA Project No. 2006-172-300

Art O'Neal & Associates
127 17th Avenue SW
Olympia, WA 98501

Attention: Art O'Neal

Subject: **INFILTRATION EVALUATION**
WATER QUALITY PROJECT PLANNING
POTLATCH "BUBBLE" AND CORE RESERVATION PLANNING AREAS
MASON COUNTY, WASHINGTON

Dear Mr. O'Neal:

HWA GeoSciences Inc. (HWA) is pleased to submit this effluent disposal/infiltration feasibility review at the Potlatch "Bubble" and Core Reservation planning areas in Mason County, Washington.

INTRODUCTION

HWA's soils and hydrogeologic evaluation dated January 30, 2007 provides a general evaluation of soil septic treatment capability and infiltration potential based on geologic, soils, and physiographic criteria in the planning area, based on review of existing geologic and hydrogeologic data (HWA, 2007). The report contained herein summarizes site specific explorations conducted at selected sites within the Potlatch and Reservation planning areas, for evaluation of infiltration potential.

Goals and Objectives

The goals and objectives of this study were to evaluate the infiltration potential and site suitability of selected sites. Figures 1, 2 and 3 show the location of the areas investigated, which included:

- Potlatch State Park Campground (TP-11, TP-12, and TP-13)
- Potlatch State Park Drainfield (TP-14 and TP-15)
- New Skokomish Tribal Housing Area (TP-2, TP-8, TP-9, and TP-10)
- North Reservation Area (TP-3, TP-4, TP-6, and TP-7)

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SITE EXPLORATIONS

HWA monitored the excavation of five test pits on January 23, 2007, and eight test pits on February 21, 2007. Excavation services were provided by the Skokomish Tribe Natural Resources Department. We also observed soils exposed at several existing excavations. Figures 1, 2 and 3 show the test pit locations. Test pit logs are included in Appendix A. The objective of this study was to determine soil types and shallow ground water depths at the sites to identify potentially suitable infiltration receptor soils. The four general areas are discussed below.

Potlatch State Park Campground

The State Park campground area west of Highway 101 is mapped as recessional outwash (Logan, 2003, Carson, 1976, and Shannon & Wilson, 1978) and Grove soil (Ness and Fowler, 1960). Refer to the HWA January 30, 2007 report for geologic and soils maps of this area (HWA, 2007). Accessible areas within the campground include an approximately 200 foot long strip adjacent to the parking area near the entrance, and areas at the west end of the site, near the Park's water well.

Most of the campground area is relatively flat, with uplands to the west rising over 250 feet, starting at the west part of the campground area. The campground area slopes and drains to the east, towards Hood Canal. A creek runs through the campground area, which originates from springs at the base of the steep slope west of the site, and flows via culverts under Highway 101.

HWA monitored the excavation of three test pits in this area, designated TP-11, TP-12, and TP-13. Figure 2 shows the test pit locations. A Washington State Parks archaeologist observed all excavations, and we understand no cultural resource issues were identified during excavation at the campground area.

Soils encountered in the test pits included dense silty sand (glacial till) in TP-11, and loose sand (recessional outwash) in TP-12 and TP-13. Shallow ground water was encountered in all three test pits, ranging from three to four feet below grade in TP-12 and TP-13, and 6 feet below grade in TP-11. Ground water, where encountered, is noted on the test pit logs. HWA conducted this study in winter, during a period of high seasonal ground water. Soil moisture/ground water conditions will likely change in response to rainfall, time of year, creek stage, and other factors. Shallow ground water gradient in this area is likely to the east, following topography.

Although this area contains permeable soils with high infiltration rates, the presence of shallow ground water may limit the feasibility of rapid infiltration at this site. Most of the infiltrated water will reach shallow ground water and travel horizontally to the creek, and/or daylight in the roadside ditch along Highway 101. Site and highway stormwater

systems (culverts, ditches, outfalls, etc.) would need to be evaluated to accommodate the added flow from a wastewater effluent infiltration system.

Potlatch State Park Drainfield

The State Parks drainfield is located west and uphill from the campground area, reportedly due to the high ground water at the campground and beachfront Park sites. The site is a cleared, grassy area surrounded by forested land, and slopes to the east. The drainfield area is mapped near the contact between glacial till and outwash by Logan (2003) and Carson (1976) and as glacial till by Shannon & Wilson (1978). The soils map indicates Hoodsport (till-derived) soils in this area (Ness and Fowler, 1960).

HWA monitored the excavation of two test pits, designated TP-14 and TP-15, one at either end of the drainfield, at the edge of the cleared area. Figures 2 and 3 show the test pit locations. Soils encountered in both test pits included approximately three feet of topsoil and silty sands (weathered outwash) over relatively clean sands and gravels (outwash) to depths of up to nine feet below grade. Ground water was not encountered in the two test pits at this location, and is likely deep, based on the topography (i.e., upland location, approximate elevation of 200 feet). Ground water gradient at the site is likely to the east, or downslope. We observed numerous ground water springs at the base of the hillside along the western side of Highway 101 in the general area south of the State Park. This seepage is likely occurring along the advance outwash exposure at the base of the hill.

This site appears favorable for rapid infiltration, and presumably could be expanded by additional clearing. A preliminary northeast-southwest slope profile constructed through the drainfield commencing uphill of the drainfield area and extending towards the flat ground in the campground area shows that the slope is approximately 25 to 30 percent. According to the geologic maps described earlier and HWA test pit explorations, the site is underlain by glacial advance outwash deposits. These deposits formed within proglacial stream channels and braided plains that developed in front of the advancing glacial ice sheet and were subsequently over-ridden, and are dense to very dense. Typically, this soil is stable and has high shear strength (internal friction angle of up to 45 degrees). According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section E, Geotechnical Report, Category D, "*Areas with slopes between 15 and 40 percent will require a geological assessment, and may further require a geotechnical report...* ". Therefore, HWA recommends additional soil exploration in the vicinity of the drainfield prior to addition of any new flows to the drainfield area to characterize the soil unit underlying the advance outwash deposits and evaluate the stability of the slope, which extends from the existing drainfield area to the campground area.

New Skokomish Tribal Housing area

The New Skokomish Tribal Housing area is mapped as glacial till by Logan (2003) and Shannon & Wilson (1978) and as Till with a small pocket of recessional outwash by Carson (1976). The soils map indicates Hoodsport (till-derived) soils, with a large swath of Grove soils (outwash-derived) in the central portion of the proposed development (Ness and Fowler, 1960).

HWA monitored the excavation of four test pits in this area, designated TP-2 , TP-8, TP-9, and TP-10. Figures 1 and 3 show the test pit locations. Explorations in this area were limited by access, as the area is currently heavily timbered, and new roads were being created at the time of our explorations. Soils encountered included:

TP-2 - This test pit encountered stratified silty sands with silt layers to a depth of eight feet, and clean sands (outwash) from eight feet to the maximum excavated depth of nine feet. Deeper soils appeared more permeable, although additional exploration in this area would be required to assess the feasibility of rapid infiltration. Infiltration facilities in these conditions would require overexcavation of surficial lower permeability soils, or installation of subsurface infiltration facilities (trenches, galleries, etc.) to a sufficient depth to access suitable soils.

TP-8 - This test pit encountered sandy and gravelly, silts (glacial till) and is not likely suitable for rapid infiltration.

TP-9 – This test pit encountered silt and silty sands, and is not likely suitable for rapid infiltration.

TP10 – This test pit encountered a six foot thick veneer of glacial till over gravel (outwash) to the maximum excavated depth of eight feet. As in TP-2, this area may be suitable for rapid infiltration provided surficial low permeability soils are removed, or the facility is constructed below them. Additional exploration in this area would be required to assess the feasibility of rapid infiltration.

North Reservation Area

HWA monitored the excavation of four test pits in this area designated TP-3, TP-4, TP-6, and TP-7. Figure 1 shows the test pit locations. These locations were suggested by Cascade Design Professionals, Inc., and are discussed below.

TP-3 - This test pit was located east of Highway 101, at the edge of a mapped wetland area. Soils encountered included silty sands with gravel, with a high ground water table (1.5 feet below grade). Ground water, where encountered, is noted on the test pit logs. HWA conducted this study in winter, during a period of high seasonal ground water. Soil moisture/ground water conditions will likely change in response to rainfall, time of year, creek stage, and other factors. Shallow ground water in this area likely drains to Hood

Canal, to the east. This area is unsuitable for rapid infiltration due to low permeability soils, high ground water, and the presence of wetlands. This area may be suitable for discharge of reclaimed water to wetlands.

TP-4 - This area is mapped as recessional outwash (Logan, 2003, Shannon & Wilson, 1978). Soils are mapped as Grove soils (outwash-derived) (Ness and Fowler, 1960). Test pit TP-4 encountered fill soils and debris to a depth of seven feet, with outwash sands from seven to ten feet. Ground water was not encountered to a maximum depth of 10 feet. Shallow ground water in this area likely drains to Hood Canal, to the east.

This site contained abundant debris at the surface, including demolition debris, automobiles, and other refuse. It is possible that outwash soils exist at shallower depths in other parts of this site unaffected by local grading and filling. Rapid infiltration may be feasible at this site, provided the extent of fill and potential soil or ground water contamination from historic site use are addressed (i.e., phase I-II environmental site assessment).

Two test pits conducted in this general area by HWA in 1994 indicate the presence of clean and silty sands to depths of six feet, suggesting the presence of outwash (HWA, 1994).

TP-6 - This area is also mapped as recessional outwash and Grove soils similar to TP-4 above. This site was formerly owned by WSDOT, and was the subject of several previous investigations, including:

- Pacific Groundwater Group (PGG), September 8, 2005 *WSDOT-Potlatch Maintenance Yard Environmental Assessment,* Draft Report and soil logs.
- A Hydrogeologic Study and ground water mounding analysis conducted in 1999-2000 (mentioned in the PGG report, but no information on authors). Monitoring well records on file at Department of Ecology indicate the driller was employed by Ecology. This study, if it could be obtained from WSDOT, might provide design level information for rapid infiltration at this site, depending on the report contents and quality.

HWA test pit TP-6 encountered four feet of fill soils over sandy outwash soils, with no ground water encountered to a depth of 10 feet. Shallow ground water in this area likely drains to Hood Canal, to the east.

Other boring and test pit logs obtained indicate variable thickness of fill and glacial till at the site. Ground water is reported at 17 feet depth on one boring log, which also indicates approximately 15 feet of recessional outwash over five feet of glacial till, over saturated advance outwash at 25 feet (PGG, 2005).

Rapid infiltration may be feasible at this site, provided the extent of fill and potential soil or ground water contamination from historic site use are addressed.

TP-7 - This area, located at the edge of a steep (40 percent slope) bluff, is mapped as Alpine or Advance Outwash by Logan (2003), and Advance Outwash by Shannon & Wilson (1978). The soils map indicates Hoodsport (till-derived) soils in this area (Ness and Fowler, 1960). Areas uphill of TP-7, on flatter ground, are generally mapped as glacial till. Test pit TP-7 encountered clean, sandy outwash soils. Ground water was not encountered to a maximum depth of eight feet. Shallow ground water in this area likely follows the steep topography to the east, towards Hood Canal. Water infiltrated in this area will likely surface along the slope, or at the base of the slope, impacting downslope areas. Although this area has permeable outwash soils, rapid infiltration may not be feasible due to slope stability issues. According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section A and E, *"Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of consolidated rock is classified as a landslide hazard area and will require a geotechnical report."* Therefore, HWA recommends additional soil exploration and slope stability evaluation in this area in order to establish feasibility of infiltration.

LABORATORY TESTING

Laboratory tests were conducted on selected soil samples to characterize relevant properties of the on-site soils. Laboratory testing included determination of moisture content and grain size distribution. All testing was conducted in accordance with appropriate ASTM standards. The test results and a discussion of laboratory test methodology are presented in Appendix B.

INFILTRATION ESTIMATES

The Washington State Department of Ecology (Ecology) 2005 *Stormwater Management Manual for Western Washington* recommends utilizing one of three methods for determining infiltration rates: USDA textural analysis, ASTM grain size distribution from soil samples, and in-situ field measurements.

This guidance document is intended primarily for stormwater, and therefore does not apply at this site, but contains results of recent research and principles of hydrogeology which can be used to estimate infiltration rates from other sources (e.g., treated waste water effluent). HWA utilized USDA textural analysis and ASTM grain size distribution to estimate infiltration rates for this project.

USDA Soil Textural Classification

Infiltration rates can be estimated from grain size distribution data using the USDA textural analysis approach. HWA analyzed 11 soil samples collected from test pits for grain size distribution and textural classification in accordance with ASTM test procedures, corrected to approximate the USDA procedures. Table 2 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

To determine long-term infiltration rates based on the USDA method, Ecology recommends that the short-term infiltration rates be reduced by a correction factor based on the soil textural classification, average degree of long-term facility maintenance, TSS (total suspended solids) reduction through pretreatment, and site subsurface variability.

Based on the USDA grain size method, laboratory test results indicate estimated long-term infiltration rates of two in/hr for most of the sandy soils encountered in our explorations at the Parks campground, Parks drainfield, and at TP-4 and TP-6 in the north Reservation area. USDA infiltration rates at the new housing area range from 0.25 to 0.5 in/hr at TP-10 and TP2, respectively.

ASTM Grain Size Distribution

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). Because this method compares data from existing full-scale infiltration facilities, the estimated infiltration rates are presented as estimated long-term infiltration rates. The estimated long-term infiltration rates assume an average degree of long-term facility maintenance, TSS control, and site variability in the subsurface conditions. Table 2 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

Based on the ASTM grain size method, our laboratory test results indicate estimated infiltration rates of up to 9 in/hr for sandy soils encountered at the Parks campground, TP-2, TP-4,and TP-6; ranging from 2 to 6 in/hr at the Parks Drainfield; and 2.4 in/hr at TP-10.

Table 2
Long-Term Infiltration Rates*
Based On USDA and ASTM Soil Textural Classification

				Ecology Long Term rates	
Test Pit	Depth	ASTM description	USDA Classification	ASTM (in/hr)	USDA (in/hr)
	Campground				
TP-12	4	Well graded SAND with gravel	Sand	9	2
TP13	4.5	Well graded SAND with gravel	Sand	9	2
	Drainfield				
TP-14	22.5	Poorly graded SAND with gravel	Sand	6.5	2
TP-14	8.5	Well graded GRAVEL with sand	Sand	4.2	2
TP-15	3.5	Poorly graded SAND with gravel	Sand	1.8	2
TP-15	5.3	Well graded GRAVEL with sand	Sand	5.5	2
TP-15	6.5	Poorly graded GRAVEL w/ sand	Sand	5	2
	New Housing area				
TP-2	6	Poorly graded GRAVEL w/ sand	Loamy Sand	9	0.5
TP-10	7.6	Poorly graded GRAVEL w/ silt and sand	Sandy Loam	2.4	0.25
	North Reservation Area				
TP-4	8	Poorly graded SAND with gravel	Sand	9	2
TP-6	8	Well graded GRAVEL with sand	Sand	9	2

* based on *Stormwater Management Manual for Western Washington*, Ecology, 2005.

Infiltration Estimates

Based on HWA's grain size testing, long term infiltration rates for soils encountered at the site range from 0.25 to 2 in/hr using the USDA method, and up to 9 in/hr using the ASTM method.

These estimates should be considered preliminary, with no factor of safety, unknown ground water depths, no accounting for ground water mounding (see below) and subject to additional testing and design data as outlined below. Vertical infiltration is limited by the least permeable layer in the soil profile. HWA did not analyze the fine grained soils (e.g., silts and silty sands) encountered in our explorations. The infiltration rates provided herein should therefore be used in conjunction with the test pit logs (Appendix A) to evaluate infiltration feasibility.

GROUND WATER MOUNDING

Ground water mounding is a local raising of the ground water table due to infiltrating water from the surface. If a ground water mound reaches the infiltration facility, infiltration rates are greatly reduced, and facility failure may occur, depending on flow rates and storage volume.

Evaluation of ground water mounding is best accomplished by understanding ground water levels, gradient, and aquifer characteristics. Because ground water levels were deeper than most of the test pits, the infiltration receptor soils at the selected site should be evaluated by installing ground water monitoring wells and measuring ground water levels. For areas with shallow ground water, aquifer properties should be evaluated by conducting pumping or slug tests. Mounding potential can then be predicted by 1) analytical solutions using infiltration rates and ground water levels, 2) measuring shallow ground water levels during pilot infiltration testing, or 3) performing predictive ground water flow modeling.

RECOMMENDATIONS

If a site is selected, HWA recommends more detailed on-site hydrogeologic, geotechnical, and in some cases environmental investigations. The investigation would likely consist of additional test pit explorations and soil laboratory testing in areas not previously accessible. Borings and monitoring wells should also be installed and tested to establish ground water levels, gradients, quality, and aquifer parameters. Seasonal ground water changes should be evaluated. Monitoring during one wet season at a minimum is recommended. A ground water mounding analysis and modeling to predict flow rates and impacts to nearby surface water features should also be performed as described above. Some of the sites will require a slope stability evaluation. A Phase I (and possibly II) Environmental Site Assessment should also be conducted prior to any property purchase, or to evaluate impacts of infiltration over potentially contaminated soils or ground water.

Pilot infiltration testing would be needed to size the facility for design flows. The pilot test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter steel ring excavated to the receptor soils. Discharge and water levels are monitored and long term infiltration rates can be approximated.

REFERENCES

Carson, R. J., 1976. *Geologic Map of North Central Mason County, Washington*, 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Ecology, Washington State Department of, 2005, *Stormwater Management Manual for Western Washington*, Publications Numbers 05-10-029 through 05-10-033, Water Quality Program, Washington State Department of Ecology

Ecology, Washington State Department of, 2006a. Well logs http://apps.ecy.wa.gov/welllog/MapSearch/viewer.htm?&FASTSTART=YES&SESSIONID=71197128

HWA GeoSciences, Inc., September 19, 1994. *Preliminary Hydrogeologic Evaluation, Skokomish Wastewater Facility Report*, prepared for KCM Portland.

HWA January 30, 2007. *Soils and Hydrogeologic Evaluation , Potlatch "Bubble" Planning Area, Mason County, Washington*

Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15 http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

Ness, A.0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington,* Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations. http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

Pacific Groundwater Group (PGG), September 8, 2005. *WSDOT-Potlatch Maintenance Yard Environmental Assessment,* Draft Report and soil logs.

Shannon & Wilson, Inc. 1978. *Generalized Geologic Map, Skokomish Indian Reservation, Mason County, Washington*, Report #W-3302-01.

LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the area at the time the report was prepared. No warranty, express or implied, is made. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. It is always possible that contamination may exist in areas that were not sampled. HWA's findings and conclusions must not be considered as scientific or engineering certainties, but rather as our professional opinion concerning the significance of the limited data gathered and interpreted during the course of the assessment.

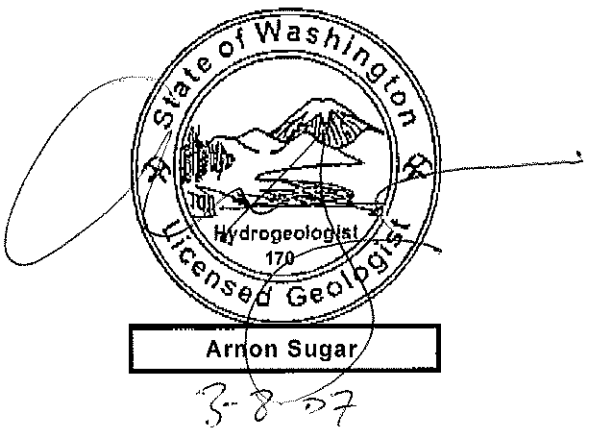
We recommend that HWA be retained to review the plans and specifications to verify that our recommendations have been interpreted and implemented as intended. Sufficient field monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to provide recommendations should conditions revealed during construction differ from those anticipated. HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for the safety of personnel other than our own on the site.

This study and report have been prepared on behalf of Art O'Neal Associates and Mason County, for the specific application to the subject property. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

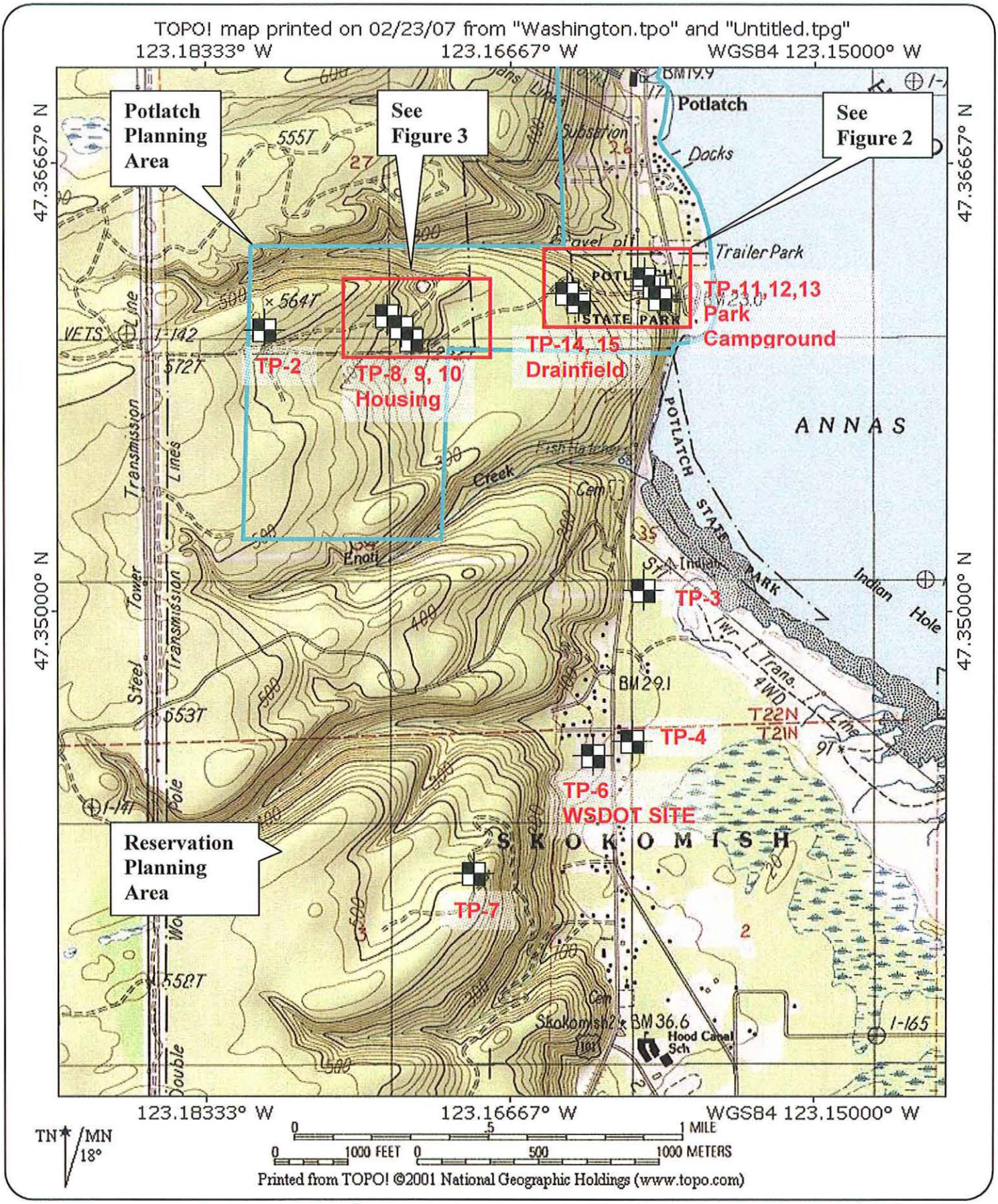
We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

Sincerely,

HWA GEOSCIENCES INC.



Arnie Sugar, LG, LHG
Vice President



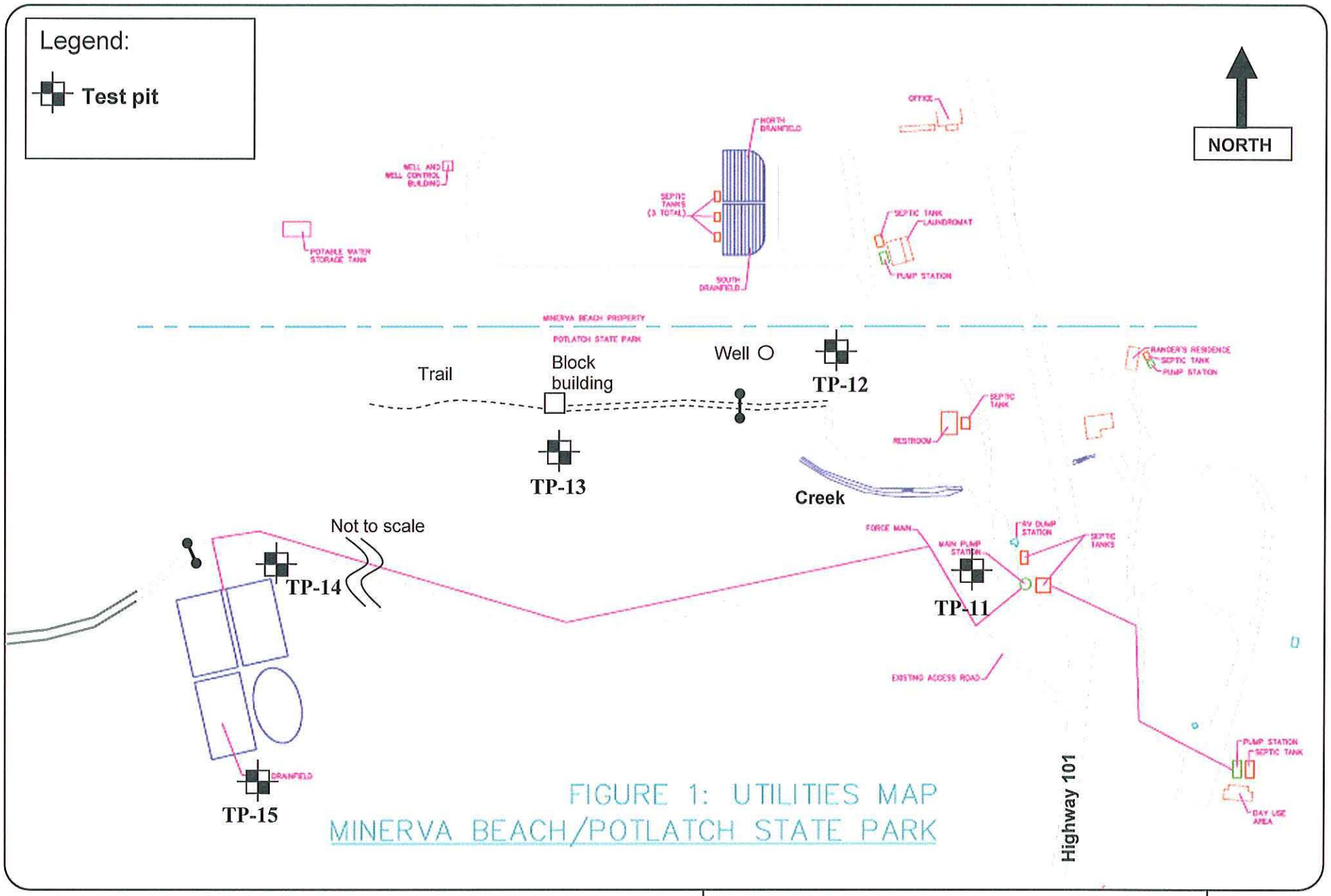
HWA GEOSCIENCES INC.

EXPLORATION LOCATIONS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE & RESERVATION AREAS

FIGURE NO. **1**

PROJECT NO. **2006-172-300**



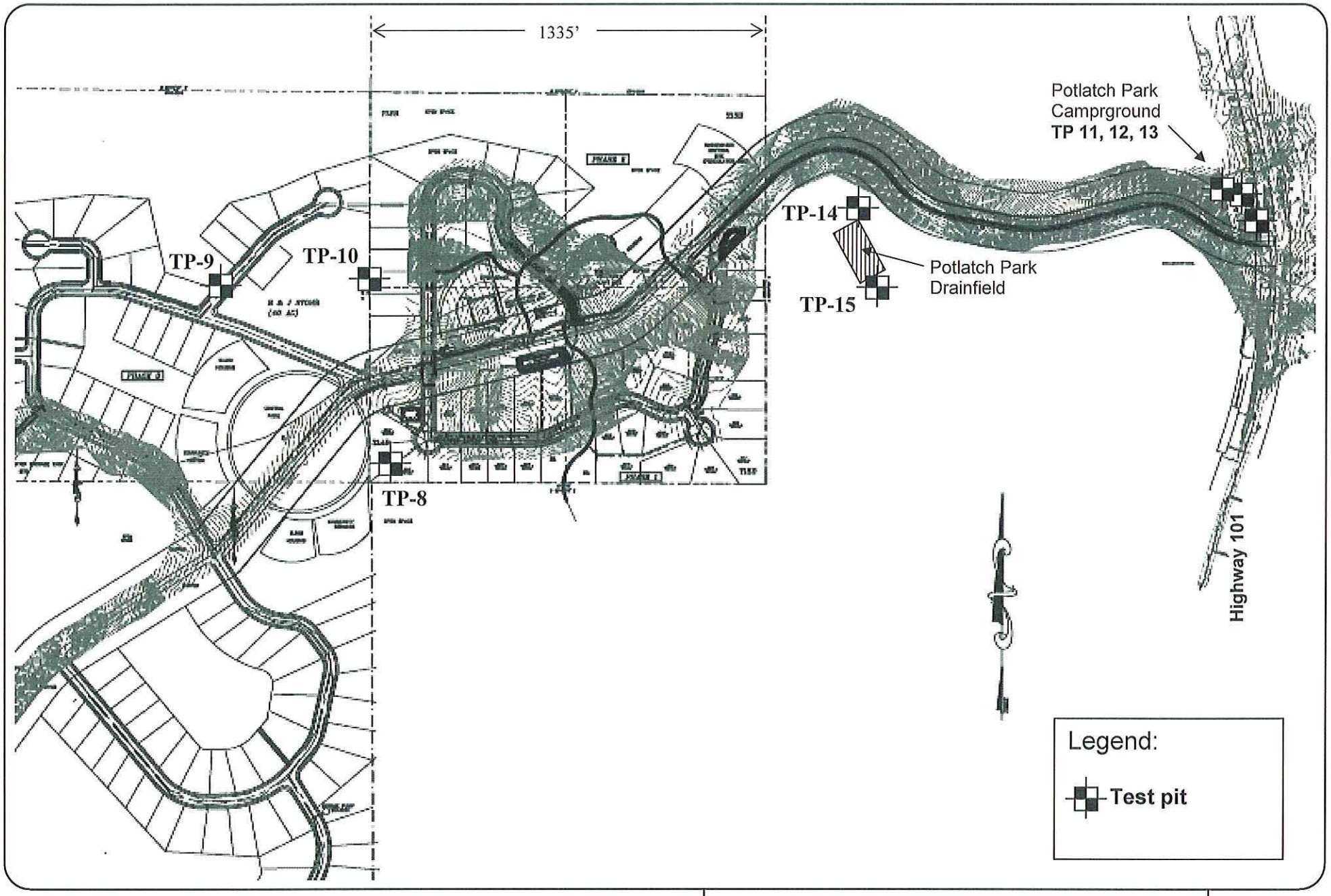
HWA GEOSCIENCES INC.

EXPLORATION LOCATIONS – POTLATCH STATE PARK CAMPGROUND AREA

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO. 2

PROJECT NO. 2006172-300



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EXPLORATION LOCATIONS – NEW HOUSING AREA

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE AREA

FIGURE NO. 3

PROJECT NO. 2006172-300

APPENDIX A

TEST PIT AND WELL LOGS

NOTE: THERE IS NO TP-1 OR TP-5

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
More than 50% Retained on No. 200 Sieve Size	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve	Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines
AL	Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
CBR	California Bearing Ratio
CN	Consolidation
DD	Dry Density (pcf)
DS	Direct Shear
GS	Grain Size Distribution
K	Permeability
MD	Moisture/Density Relationship (Proctor)
MR	Resilient Modulus
PID	Photoionization Device Reading
PP	Pocket Penetrometer Approx. Compressive Strength (tsf)
SG	Specific Gravity
TC	Triaxial Compression
TV	Torvane Approx. Shear Strength (tsf)
UC	Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- 3-1/4" OD Split Spoon with Brass Rings
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- Non-standard Penetration Test (3.0" OD split spoon)

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

HWA GEOSCIENCES INC.

Mason County Wastewater Infiltration Evaluation
Mason County
Washington

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2006-172-22 FIGURE: 1

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0			Topsoil + gravel	
		SM	Dense or very dense gray and brown silty SAND with gravel and cobbles, slightly stratified, diamict texture, moist **[SANDY TILL/DRIFT]**	
3		SP SM	Brown & gray silty fine to coarse SAND with gravel and cobbles to 1', moist. Some silt seams. **[OUTWASH, SILTY]**	○
6			Dense brown & gray silty SAND with gravel and cobbles, moist. Some 1-2" brown silt seams, non plastic.	○
9		SP	Gray fine to coarse SAND, moist. Angular, clean sand.	
12			Test pit terminated at about 10 feet below the ground surface. No ground water encountered during this exploration.	
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-2

PROJECT NO.: 2006-172-22 FIGURE: 2

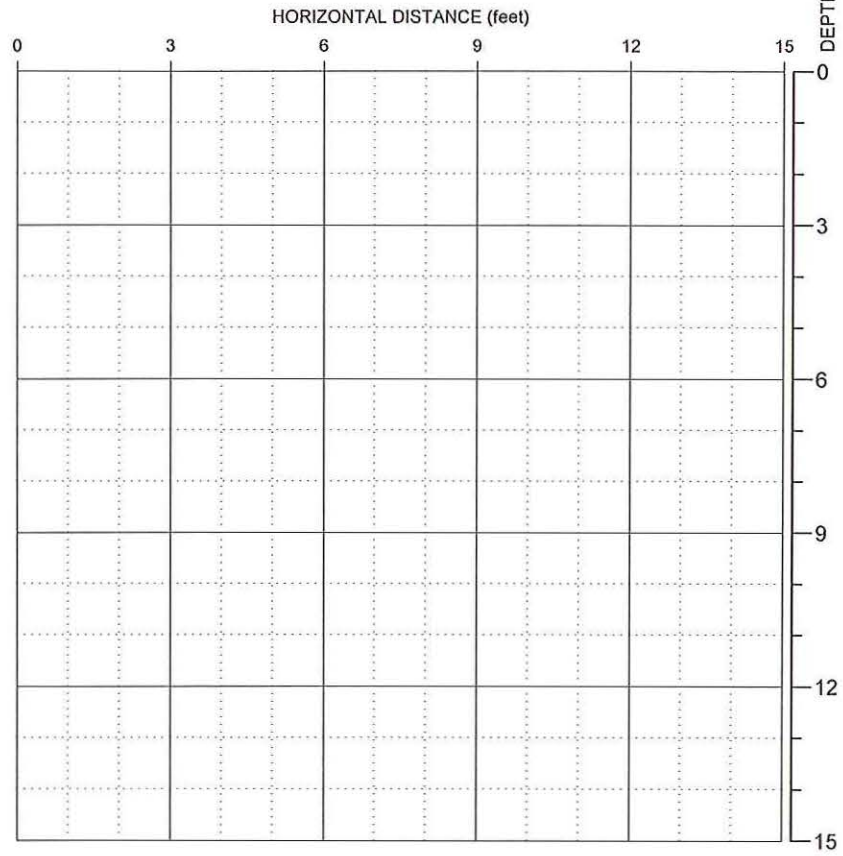
EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Brown, silty SAND with gravel, roots, moist to wet.					
3		SM	Blue-gray, silty SAND with gravel and cobbles, wet. Some silt seams.					
6								
9								
12								
15								

Test pit terminated at about 5 feet below the ground surface.
Ground water observed at about 1.5 feet depth.
Caving noted below 3 feet.

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

LOG OF TEST PIT
TP-3

PROJECT NO.: 2006-172-22 FIGURE: 3

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Brown, silty SAND with gravel, moist	
3		SP	Seam of gray fine to coarse SAND with gravel.	
		ML SM	Brown, SILT, silty SAND, and large woody debris [fill] Reddish brown, silty SAND with gravel and silt, moist	
6		ML	Brown SILT	○
		ML		
		SM SP	Reddish brown, fine to coarse SAND, few gravel, moist	○
9				
12				
15				

Test pit terminated at about 10 feet below the ground surface.
No ground water encountered during this exploration.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-4

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 4

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SP	Gray, fine to medium SAND with gravel and cobbles, moist. [FILL?]	
3		ML SM	Reddish brown, silty SAND with gravel and silt lenses, moist.	
		GP	Lens of brown GRAVEL with sand (one sidewall only)	
		SM	Brown, silty fine to coarse SAND with gravel, moist, some silt lenses. [FILL?]	
6		SP	Brown, fine to coarse SAND with gravel and cobbles, moist.	
9		GW	Gray, well graded GRAVEL with fine to coarse sand and cobbles, moist.	
12			Test pit terminated at about 10 feet below the ground surface. No ground water encountered during this exploration.	
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-6

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: 5

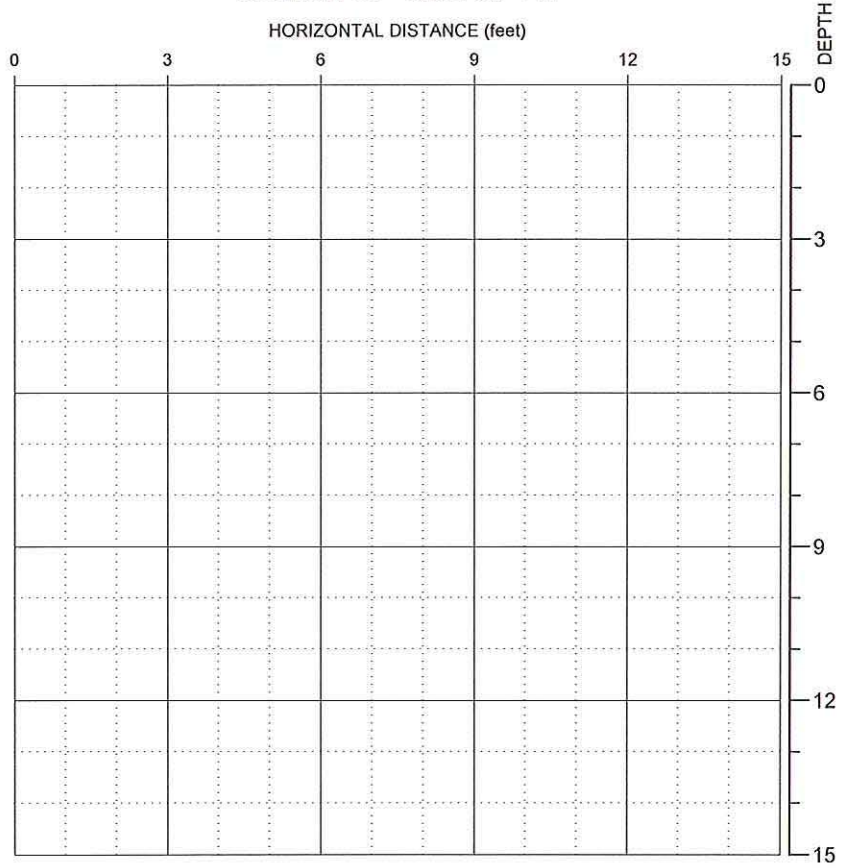
EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Forest duff, roots to 3 feet.					
		SP	Loose gray and brown fine to medium SAND, moist. Slighlly stratified, but no silt layers. **(OUTWASH)**					
3								
6			Loose, gray fine to mediuam SAND, some gravel and cobbles, moist.					
9								
12								
15								

Test pit terminated at about 8 feet below the ground surface.
No ground water encountered during this exploration.
No caving observed.

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

LOG OF TEST PIT
TP-7

PROJECT NO.: 2006-172-22 FIGURE: 6

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		ML	Soft, yellow brown to reddish brown, fine to coarse sandy, fine to coarse gravelly, SILT, roots and rootlets. Cobbles noted, organics. **(TOPSOIL/WEATHERED TILL)**	
3		ML	Hard, olive gray, fine to coarse sandy, fine to coarse gravelly, SILT, moist. **(GLACIAL TILL)**	
6			Test pit terminated at about 5.65 feet below the ground surface. No ground water observed during this exploration.	
9				
12				
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-8

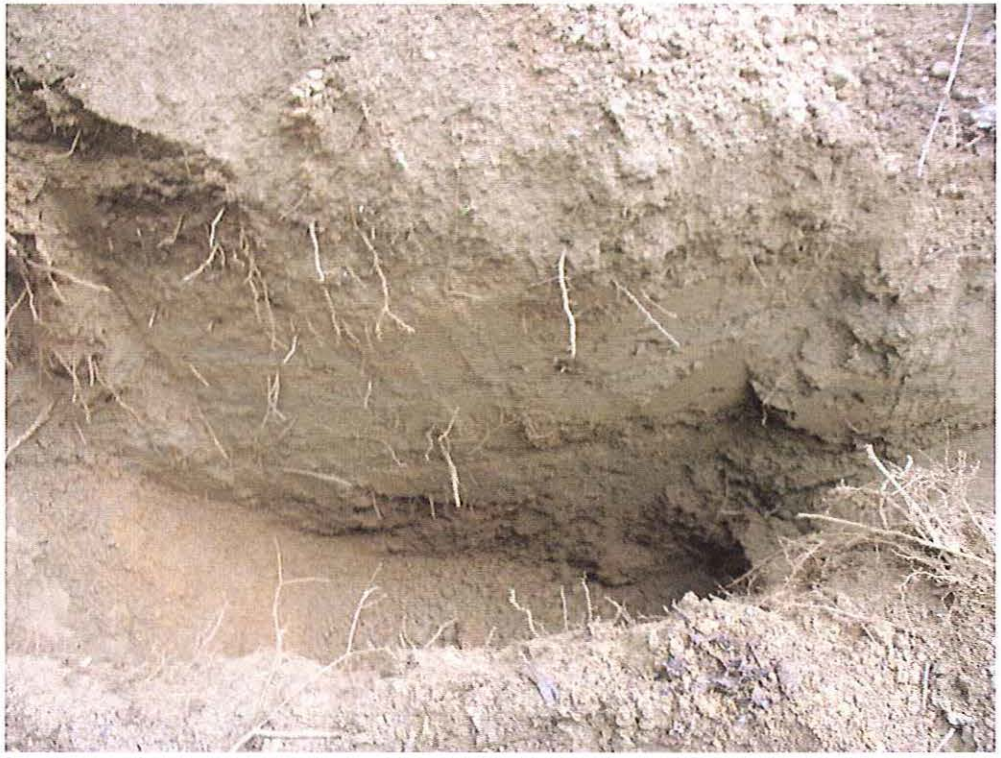
PROJECT NO.: 2006-172-300 FIGURE: 7

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, brown, silty, fine gravelly, fine to coarse SAND, roots and rootlets, moist, organics. **(TOPSOIL)**	
		ML	Soft to medium stiff, brown, fine sandy, SILT, scattered gravel, moist, roots and rootlets. Fine to medium sandy seams noted.	
3		ML SM	**(MASS WASTING DEPOSITS/WEATHERED NATIVE?)** Alternating layers of medium stiff, brown to reddish, fine to coarse sandy, coarse gravely, clayey, SILT with brown, silty, fine to coarse gravelly, fine to coarse SAND, moist.	
6		SM	Medium dense, reddish brown, silty, fine to coarse gravelly, fine to coarse, SAND. **(WEATHERED NATIVE?)**	
9			Test pit terminated at about 7.6 feet below the ground surface. No ground water observed during this exploration. Minor caving observed from about 5.5 to 6 feet below the ground surface.	
12				
15				

PHOTOGRAPH OF TEST PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-9

PROJECT NO.: 2006-172-300 FIGURE: 8

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, black to dark brown, silty, fine to coarse gravelly, SAND, moist, roots and rootlets. **(TOPSOIL)**	
		SM	Loose, dark brown, silty, fine to coarse gravelly, SAND, moist, roots and rootlets. **(WEATHERED TILL)**	
3		ML SM	Soft to medium stiff, reddish brown, fine to coarse gravelly, sandy SILT to silty, SAND, moist to wet. Roots noted.	
6		GM	Very dense, gray, silty, fine to coarse sandy, fine to coarse GRAVEL, moist. **(GLACIAL TILL)**	
9		GP GM	Very dense, gray, olive gray, slightly silty, fine to coarse, sandy, fine to coarse GRAVEL. **(ADVANCE OUTWASH)**	
12			Test pit terminated at about 8.3 feet below the ground surface. No ground water seepage observed during this exploration.	
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-10

PROJECT NO.: 2006-172-300 FIGURE: 9

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		ML	Soft, dark brown, fine to coarse sandy, fine to coarse gravelly, SILT, roots and rootlets, moist. **(TOPSOIL)**	
		SM	Loose to medium dense, yellow brown, silty, fine to coarse gravelly, fine to coarse SAND, moist, roots and rootlets. **(WEATHERED TILL)** Big boulder noted at about 2.5 feet below the ground surface.	
3		GM	Very dense, gray, fine to coarse sandy, silty, fine to coarse GRAVEL. Cobbles noted. **(GLACIAL TILL)**	
6				
9				
12				
15				

Test pit terminated at about 6.9 feet below the ground surface.
Minor to moderate seepage observed at about 5.8 feet during this exploration.
Minor cavings observed from about 2 to 3.5 feet and from 6 to 6.7 feet below the ground surface.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-11

PROJECT NO.: 2006-172-300 FIGURE: 10

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		ML	Soft, dark brown, fine to coarse gravelly, fine to coarse sandy, SILT, organics, roots and rootlets, moist. **(TOPSOIL)**	
		SM	Loose, brown, silty, fine to coarse gravelly, fine to coarse SAND, organics, moist, roots and rootlets. **(WEATHERED OUTWASH)**	
3		SW	Loose, olive gray, fine to coarse gravelly, fine to coarse well graded SAND with cobbles, wet. **(RECESSIONAL OUTWASH)**	
6			Test pit terminated at about 5 feet below the ground surface. Moderate to heavy seepage observed at about 4.3 feet during this exploration.	
9				
12				
15				

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-12

PROJECT NO.: 2006-172-300 FIGURE: 11

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, dark brown, silty, fine to coarse gravelly, fine to coarse SAND, roots and rootlets, moist. **(TOPSOIL)**	
		SM	Loose, reddish brown, silty, fine to coarse SAND, scattered gravel, moist to wet. **(WEATHERED OUTWASH)**	
3				
		SW	Loose, olive gray, fine gravelly, fine to coarse well graded SAND, wet. **(RECESSIONAL OUTWASH)**	
6				
9				
12				
15				

Test pit terminated at about 5 feet below the ground surface.
Heavy seepage observed at about 3.75 feet during this exploration.
Moderate caving observed from about 2 to 2.8 feet below the ground surface.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-13

PROJECT NO.: 2006-172-300 FIGURE: 12

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, olive gray, silty, fine gravelly, fine to coarse SAND, organics, moist.	
		ML	**(TOPSOIL)**	
		SM	Soft, reddish brown, fine to coarse gravelly, fine to coarse sandy, SILT to fine to coarse SAND, roots and rootlets. Cobbles, boulders noted.	
3		SP	**(WEATHERED OUTWASH)** Medium dense, olive gray, slightly silty, fine to coarse gravelly, fine to coarse SAND. **(ADVANCE OUTWASH?)** Sand becoming coarse.	
6		GP	Medium dense, brown to olive brown, slightly silty, fine to coarse sandy, fine to coarse GRAVEL, moist.	
9		GW	Medium dense, olive gray, slightly silty, fine to coarse, well graded GRAVEL with fine to medium SAND, moist.	
12				
15				

Test pit terminated at about 9.25 feet below the ground surface.
No ground water encountered during this exploration.
Moderate caving observed from about 4.5 to 8 feet.

PHOTOGRAPH OF TEST PIT

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HWA GEOSCIENCES INC.

LOG OF TEST PIT
TP-14

PROJECT NO.: 2006-172-300 FIGURE: 13

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: CASE 580 Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 1
DATE COMPLETED: 2/21/07
LOGGED BY: T. Taddese

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE
0		SM	Loose, brown, silty, fine gravelly, fine to medium SAND, organics, moist, roots and rootlets.	
		SM	**(TOPSOIL)**	
			Loose to medium dense, laminated, olive gray and olive brown, slightly silty, fine to coarse gravelly, fine to coarse SAND, moist, roots and rootlets. **(WEATHERED OUTWASH)**	
3		SP	Loose to med. dense, olive gray, sl. silty, fine to med. SAND, moist. Scattered fine to coarse gravel.	
		SP SM	**(ADVANCE OUTWASH?)**	
		GW	Loose to medium dense, olive gray, slightly silty, fine to coarse gravelly, fine to medium SAND, moist. Traces of till noted.	
6		GP	Loose to medium dense, olive gray, slightly silty, well graded GRAVEL with fine to medium SAND, moist. Traces of till noted.	
			Medium dense, olive brown, fine to medium sandy, fine to coarse GRAVEL, moist. Cobbles noted.	
9				
12				
15				

Test pit terminated at about 8.75 feet below the ground surface.
No ground water encountered during this exploration.
Moderate caving observed from about 1.5 to 3.0 feet.

PHOTOGRAPH OF TEST PIT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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LOG OF TEST PIT
TP-15

PROJECT NO.: 2006-172-300 FIGURE: 14

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

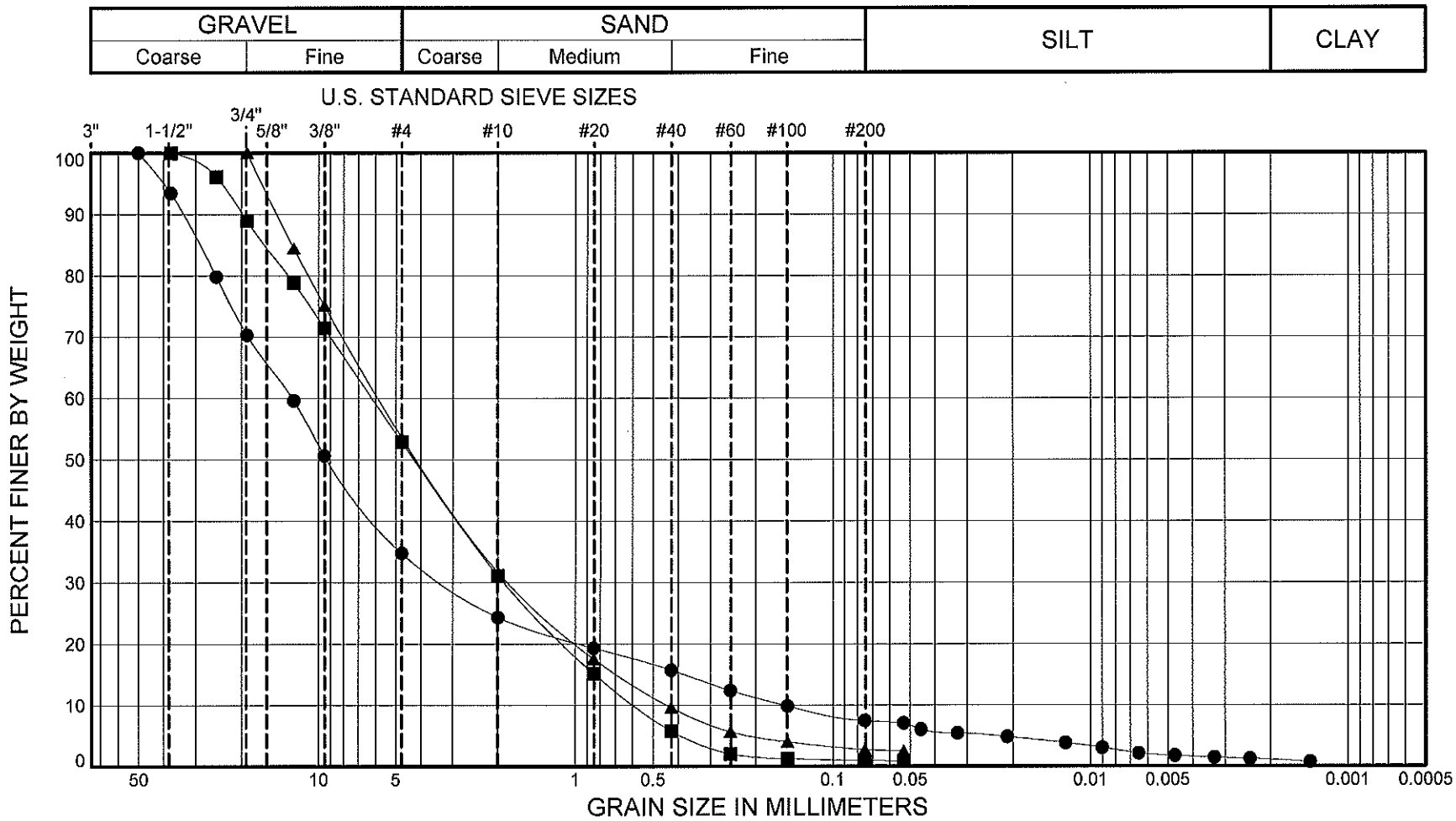
Representative soil samples obtained from the borings were returned to the HWA laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize certain properties of the on-site soils. Laboratory tests, as described below, included determination grain size distribution.

MOISTURE CONTENT

The natural moisture contents of selected samples were determined in general accordance with ASTM D 2216. The results are plotted at the sampled intervals on the exploration log as appropriate.

GRAIN SIZE ANALYSIS

The grain size distribution of selected soil samples was determined in general accordance with ASTM D 422. Grain size distribution curves for the tested samples are presented in figures B-1 through B-4.



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-10	S-7	7.6 - 8.1	(GP-GM) Brown, poorly graded GRAVEL with silt and sand	7				65.3	27.3	7.4
■	TP-12	S-3	4.0 - 4.5	(SW) Brown, well graded SAND with gravel	13				47.1	52.0	0.9
▲	TP-13	S-3	4.5 - 4.8	(SW) Brown, well graded SAND with gravel	15				46.4	50.9	2.7

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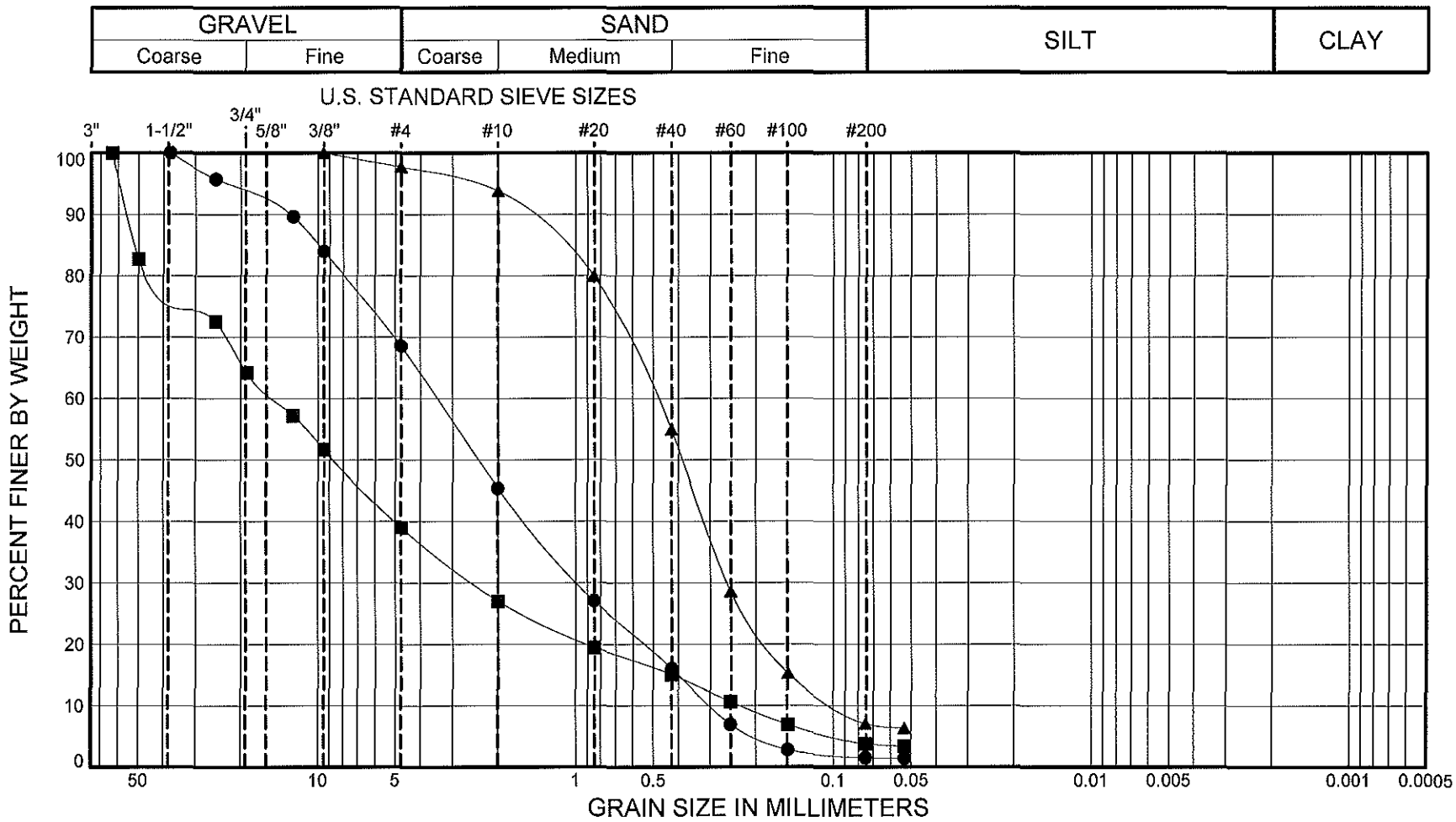
Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 1



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-14	S-2	2.5 - 3.5	(SP) Brown, poorly graded SAND with gravel	7				31.5	67.0	1.5
■	TP-14	S-5	8.5 - 9.0	(GW) Brown, well graded GRAVEL with sand	6				61.0	35.2	3.8
▲	TP-15	S-3	3.5 - 4.0	(SP-SM) Brown, poorly graded SAND with silt	14				2.3	90.7	7.0

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Mason County Wastewater
Infiltration Evaluation
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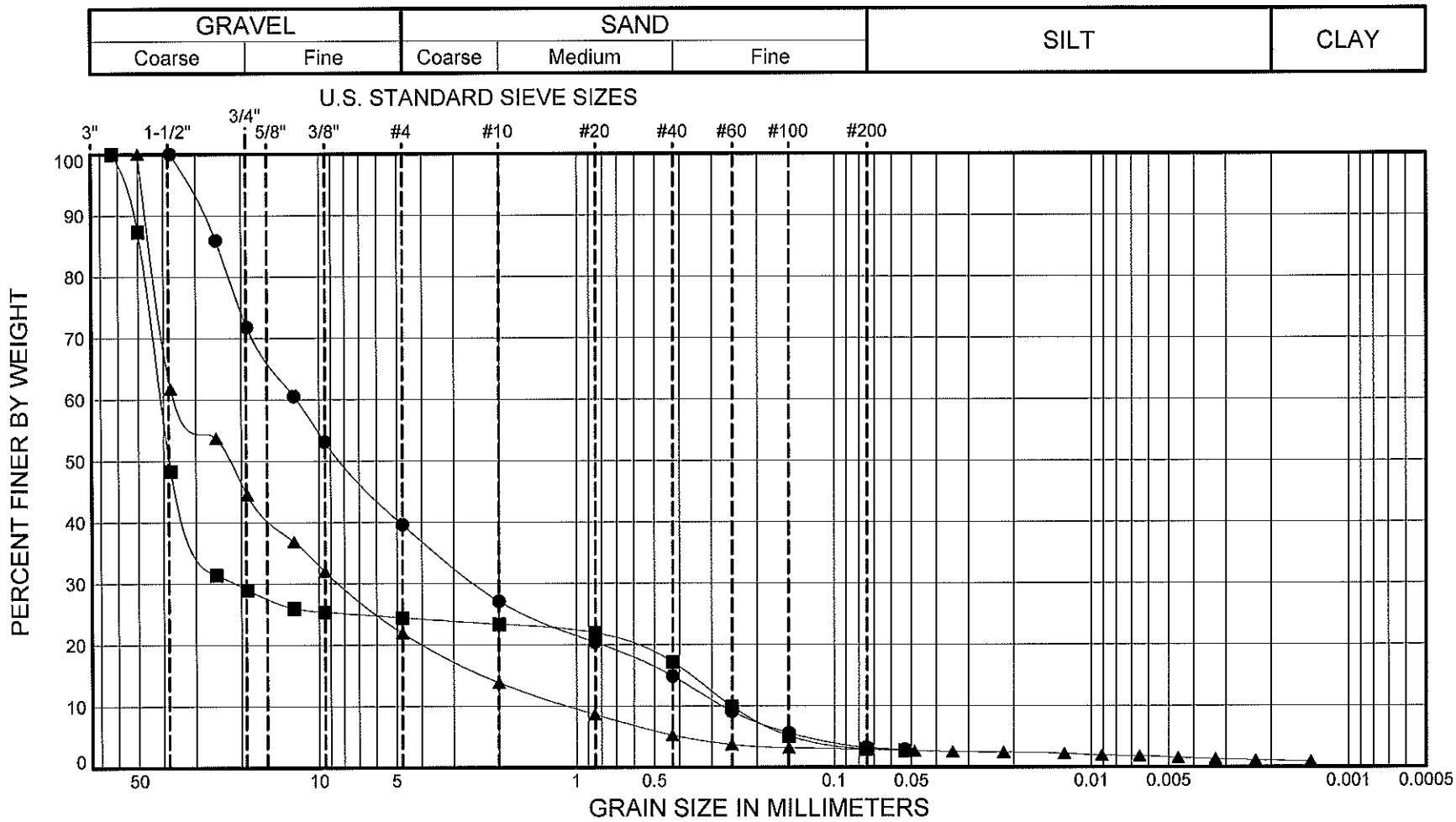
Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 2

HWAGRSZ 2006172.GPJ 3/8/07



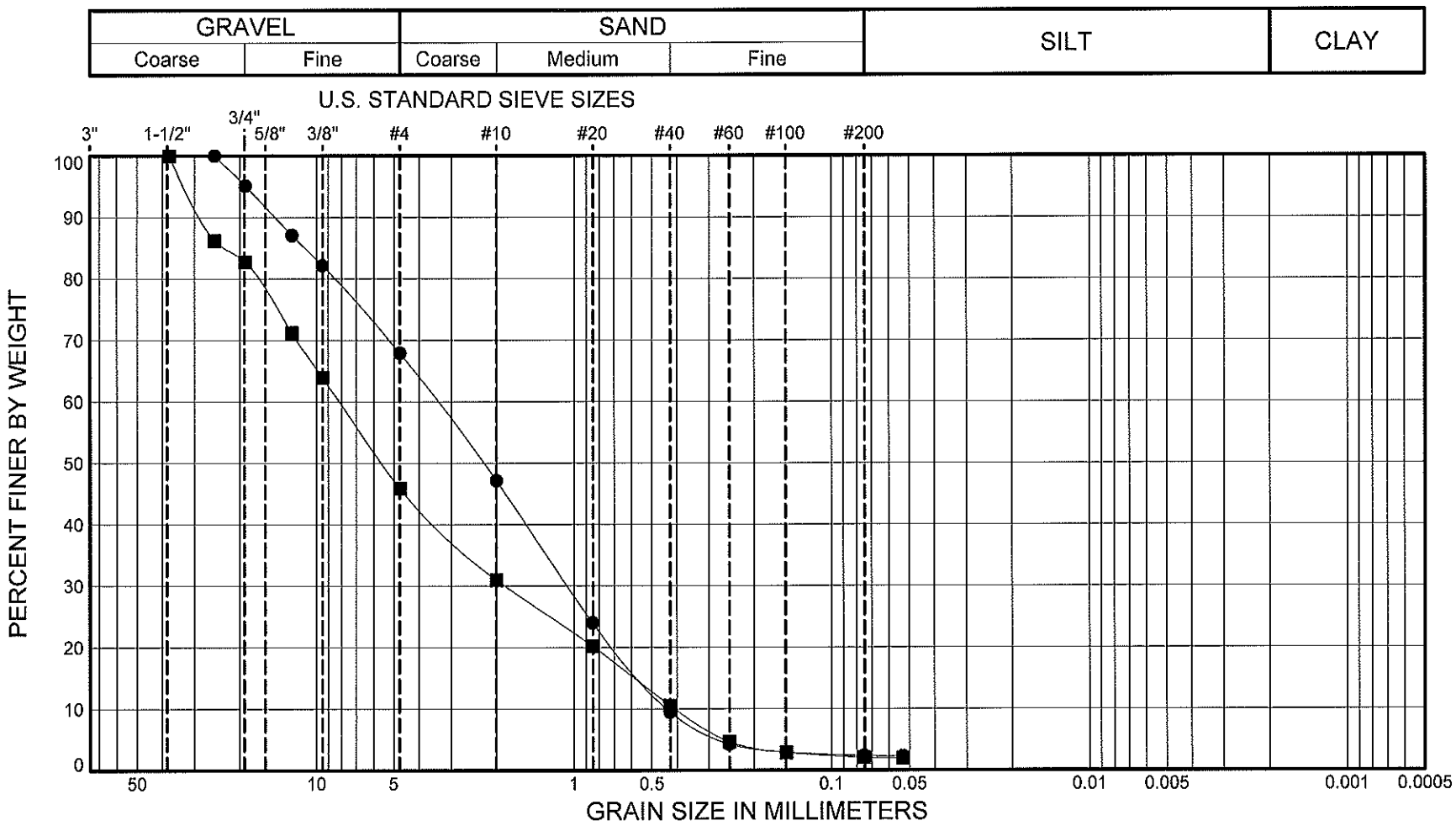
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-15	S-4	5.3 - 5.5	(GW) Brown, well graded GRAVEL with sand	6				60.4	36.4	3.2
■	TP-15	S-5	6.5 - 6.8	(GP) Brown, poorly graded GRAVEL with sand	6				75.6	21.4	2.9
▲	TP-2		6.0 - 6.5	(GP) Brown, poorly graded GRAVEL with sand	4				78.1	19.0	2.9

HWA GEOSCIENCES INC.

Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 3



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-4		8.0 - 8.5	(SP) Brown, poorly graded SAND with gravel	6				32.1	65.5	2.3
■	TP-6		8.0 - 8.5	(GW) Brown, Well-graded GRAVEL with sand	5				54.1	43.8	2.1

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Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: 4

HWAGRSZ 2006172.GPJ 3/8/07