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6/3/2022

Cleanup Action Plan

Ridgetop Golf Construction Headquarters
3134 14th Avenue Northwest
Gig Harbor, WA 98335

Shawn Lombardini LHG RG
PRINCIPAL HYDROGEOLOGIST

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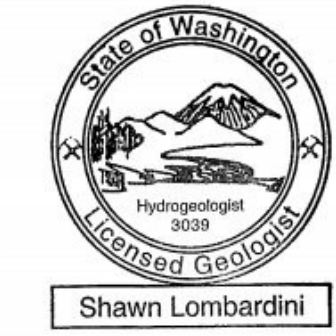
Cleanup Action Plan

Provided For:
Ridgetop Golf Construction Headquarters
3134 14th Avenue Northwest
Gig Harbor, WA 98335

Prepared for:
Ridgetop Golf
Kip Kalbrener
kip@ridgetopgolf.com

Prepared & Reviewed by:



Shawn Lombardini LHG RG
Principal Hydrogeologist

Date of Report:
June 3, 2022

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EXECUTIVE SUMMARY

This document presents the Cleanup Action Plan (CAP) for the properties located at 3134 14th Ave NW in Gig Harbor, Washington (Site). This CAP was prepared by Lombardini Geological Services, LLC (LGS) and is intended to meet the requirements of the Model Toxics Control Act (MTCA) administered by the Washington State Department of Ecology (Ecology) under Chapter 173-340 of the Washington Administrative Code (WAC). This CAP describes the proposed cleanup action for the Site and sets forth the requirements that the cleanup must meet for regulatory opinions and Site Closure with a No Further Action Letter (NFA) with Environmental Covenant.

- The Soils Investigation Report by GeoResources from June of 2021 showed Property wide arsenic contamination.
- Ridgetop Golf intends to meet with the Department of Ecology on June 16, 2022 so they can perform a Preliminary Habitat Assessment for the evaluation of the surrounding proposed undeveloped forest, specifically 50' perimeter setback areas and wetland-like area on the south of the property. Additional sampling locations were needed to fully evaluate the depth weighted average for the Site as a whole, at the time of this report these deeper samples up to 36" deep are pending results.
- A Net Environmental Benefit Analysis (NEBA) will be performed by a biologist after the assessment for areas proposed not to be remediated. The NEBA will be evaluated by Ecology in conjunction with their final determination.
- Additional samples were taken in April of 2022 by LGS to further support the habitat value vs the remediation benefit, again pending results.
- Soil samples have been tested for the following constituents of concern; Arsenic and Lead by Protocol Prep SW 6010D. Multiple areas have been detected for arsenic in soil above cleanup levels. Lead was not detected above cleanup levels.
- The primary conceptual release model for the Site is a release inferred from the Tacoma Smelter Plume. The majority of the contamination is at the surface within the uppermost foot of the Site in soil.
- Cleanup Action Overview – **Soil Tilling with Soil Confirmation Sampling**
  LGS is planning to oversee the tilling of approximately 1.9 acres, centralized in the property for the purpose of mixing lower horizons up to 18" with the upper horizons to dilute the overall soil matrix below cleanup levels for Arsenic. LGS intends to collect soil confirmation samples at 6", 12", and 18" which are lower than, or non-detectable, or less than cleanup levels for the constituent of concern. This includes creating an evenly distributed grid over the approximately 1.9 acres.

These constituents of concern will be compared to MTCA Method A cleanup levels. A list of samples locations, depths to sample, and constituents of concern is included below.

Specific tasks associated with cleanup activities are as follows;

- Request public and private Utility Locates prior to the subsurface investigation.
- Provide consulting services related to tilling logistics, scheduling, and project coordination with the client, and contractors.
- Provide oversight during the tilling of these 20 broad sample location areas to mix in soils of lesser concentrations to the maximum extent possible. The work will be performed by ANGdirt over the course of one-two days.
- The blade of the dozer will be pitched down on one corner to approximately 18" to turn over and mix (till) the soil in windrow looking soils. LGS will be onsite to observe the mixing to assess its performance for remedial action proposed of diluting.
- The total depth of 18" is the target for dilution.
- LGS will sample the 20 borings in an evenly distributed grid over the approximately 1.9 acres and perform confirmation soil sampling at 6", 12", and 18".
- LGS is employing a Limited Access Drill rig with dedicated Acetate sleeve for duplicating sample locations for arsenic at the above-mentioned depths to assess the performance of the cleanup action.
- Samples will be taken to an accredited laboratory to be run for arsenic only. (Previous lead analytical results were all below cleanup levels) with EPA Method 6020B, equivalent to Tacoma Smelter Plume Prep protocols by method SW846 6010D.
- LGS will continuously log the subsurface media during the advancement of all borings. Soil samples will be observed to document soil lithology, color, and moisture content.
- The containers will be labeled and placed in a portable chilled ice chest and transported to the laboratory following standard chain-of-custody procedures.
- LGS will compile the analytical results and draft a report summarizing the data collected from the Site. The report will include figures illustrating the location of the samples, flag maps showing sample concentration comparisons to MTCA cleanup up levels, soil methodologies used for sample collection will be described, boring logs illustrating the geology and groundwater elevations (if encountered),

and tables summarizing the data collected. The report will include conclusions and recommendations.

- As a contingency, if confirmation soil samples remain above MTCA Method A cleanup levels, additional tilling efforts may be needed to further dilute the identified contaminated soils above cleanup level to non-detectable, or less than clean up levels before proceeding to regulatory submissions.
- All data generated during the subsurface investigation will be uploaded to Ecology's EIM database for consideration prior to requesting an opinion for No Further Action with Environmental Covenant for the Site.

1.0 INTRODUCTION

1.1 *Purpose*

This document is the Cleanup Action Plan (CAP) for the Ridgetop Golf Construction Headquarters located at 3134 14th Ave NW Gig Harbor, Washington 98335. The general location of the Site is shown in Figure 1, *Proposed Tilling and Sampling Map.* A CAP is required as part of the Site cleanup process under Chapter 173-340 WAC, Model Toxics Control Act (MTCA) Cleanup Regulations. The purpose of the CAP is to identify the proposed cleanup action for the Site and to provide an explanatory document for review. More specifically, this plan:

- Describes the Site.
- Summarizes current site conditions.
- Summarizes the cleanup action alternative considered in the remedy selection process.
- Describes the selected cleanup action for the Site and the rational for selecting this alternative.
- Identifies site-specific cleanup levels and points of compliance for each hazardous substance and medium of concern for the proposed cleanup action.
- Discusses compliance requirements.
- Presents the schedule for implementing the CAP.

1.2 *Previous Studies*

1.2.1 GeoResources Soils Investigation June 2021

GeoResources performed a subsurface investigation on September 23, 2020 due to the Pierce County site development process in accordance with the Tacoma Smelter Plume guidance from the Department of Ecology. GeoResources collected 32 soil samples for arsenic and lead from 0-6", 9 soil samples for arsenic and lead from 6-12", and 4 composite soil samples for analysis. Multiple arsenic samples were shown to be above MTCA Method A Cleanup Levels. The analytical results that showed that the Site would need additional cleanup action prior to being developed. See GeoResources report in attached in Appendix A, *Supporting Documents* Summary of the analytical results to date is found in the attached Table 1, *Summary of Soil Analytical Results.*

1.2.2 LGS additional Soil Investigation April 26, 2022

In anticipation of the Preliminary Habitat Assessment requirement, LGS sampled at approximately GeoResources locations HA-6, HA-25, and HA-26, within the future Environmental Covenant

Area, to obtain laboratory analysis for a depth weighted average for review by Ecology and NEBA analysis. These results are pending results at the time of this report.

2.0 SITE DESCIPTION

2.1 *Site History*

Work by GeoResources was reviewed by LGS and this showed that the property has not been developed to the knowledge of LGS. Pierce county assessors' information also shows that it is undeveloped vacant land, as well as the Site visit to obtain the NEBA analysis samples discussed above.

2.2 *Human Health and Environmental Concerns*

As defined in WAC 173-340-200, an exposure pathway describes the mechanism by which a hazardous substance takes or could take a pathway from a source or contaminated medium to an exposed receptor.

2.2.1 Potential Soil/Sediment Exposure Pathways

- Contact (dermal contact, incidental ingestion) with hazardous substances in soil/sediments by visitors, residents, and workers (including excavation workers). Direct ingestion of, or dermal contact with, soil containing arsenic is considered a potential exposure pathway. Impacted areas are not covered currently and the risk of exposure is viable for potential direct contact or ingestion. Soil impacts have been documented at the surface up to 12" deep by GeoResources.
- Groundwater Leaching Pathway. The groundwater leaching pathway is considered incomplete at this Site. Groundwater is commonly found at much deeper depths within the recessional outwash that is typically on top of glacial till. It is also shown through analytical testing that the bottom of the contamination is above the groundwater table.

2.2.2 Potential Groundwater Exposure Pathways

Potentially complete groundwater exposure pathways at the Site include:

- Groundwater Pathway. The groundwater pathway is considered incomplete pathway at the Site. The depth of groundwater is anticipated to be deep and the analytical results show that the bottom of the contamination is above the groundwater table.

2.2.3 Potential Surface Water Exposure Pathways

Potentially complete surface water exposure pathways at the Site include:

- Surface Water Exposure Pathway. The surface water is considered incomplete at the Site. Due to the nature of the arsenic insolubility in water the surface water itself would not be affected, not carrying the constituent of concern in solution to receptors.

2.2.4 Potential Air Exposure Pathways

Potentially complete Air Exposure Pathways at the Site include:

- Vapor Intrusion/Air Exposure Pathways. Vapor intrusion/air exposure pathways are considered an incomplete pathway at the Site. Arsenic will be tilled into deeper soil horizons and only when performing the cleanup action should refuge dust be of any concern to potential receptors.

2.2.5 Terrestrial Ecological Evaluation

A NEBA is being performed in lieu of a Terrestrial Ecological Evaluation.

2.3 *Cleanup Standards*

Cleanup standards include levels and points of compliance as described in WAC 173-340-700 through WAC 173-340-760.

2.3.1 Contaminants of Concern

Contaminants of Concern (COCs) at the Site consist of Arsenic in Site soil.

The primary conceptual release model for the Site is the Tacoma Smelter Plume emissions.

2.3.2 Cleanup Levels

MTCA Method A cleanup levels for the soil exposure pathway is appropriate for this Site. MTCA Method B cleanup levels are appropriate for the air exposure pathway, and for constituents where MTCA Method A cleanup levels are not promulgated. These cleanup levels are based on the most stringent values for each exposure pathway and are considered appropriate for the Site COCs. The MTCA Method A cleanup level for arsenic is 20 mg/kg.

3.0 DESCRIPTION OF SELECTED REMEDY

This CAP and the information presented below is limited to an overview of the preferred remedy, will be submitted to the Department of Ecology. After the cleanup action is performed the Soil Confirmation Subsurface Investigation, and Cleanup Action Report will be submitted to Ecology for an Opinion for No Further Action with Environmental Covenant.

3.1 *Site Description*

The boundaries of the Site that the CAP applies to are illustrated in Figure 1, *Proposed Tilling and Sampling Map,* which illustrate the anticipated extents of soil to be tilled and perform confirmation soil sampling, at the Site, in plan view.

3.2 *Description of the Cleanup Action*

Impacts to soil will be remediated using tilling methods to dilute the upper soil horizons into the lower, less contaminated, soil horizons. The strategy and approach for the remedial action specific to the Site were designed by LGS, based on the Site COCs; Site-specific soil data, and the vertical and aerial extent of the impacted area.

Specific tasks associated with sampling activities are as follows;

- Request public and private Utility Locates prior to the subsurface investigation.
- Provide consulting services related to tilling logistics, scheduling, and project coordination with the client, and contractors.
- Provide oversight during the tilling of these 20 broad sample location areas to mix in soils of lesser concentrations to the maximum extent possible. The work will be performed by ANGdirt over the course of one-two days.
- The blade of the dozer will be pitched down on one corner to approximately 18” to turn over and mix (till) the soil in windrow looking soils. LGS will be onsite to observe the mixing to assess its performance for remedial action proposed of diluting.
- The total depth of 18” is the target for dilution.
- LGS will sample the 20 borings in an evenly distributed grid over the approximately 1.9 acres and perform confirmation soil sampling at 6”, 12”, and 18”.
- LGS is employing a Limited Access Drill rig with dedicated Acetate sleeve for duplicating sample locations for arsenic at the above-mentioned depths to assess the performance of the cleanup action.

- Samples will be taken to an accredited laboratory to be run for arsenic only. (Previous lead analytical results were all below cleanup levels) with EPA Method 6020B, equivalent to Tacoma Smelter Plume Prep protocols by method SW846 6010D.
- LGS will continuously log the subsurface media during the advancement of all borings. Soil samples will be observed to document soil lithology, color, and moisture content.
- The containers will be labeled and placed in a portable chilled ice chest and transported to the laboratory following standard chain-of-custody procedures.
- LGS will compile the analytical results and draft a report summarizing the data collected from the Site. The report will include figures illustrating the location of the samples, flag maps showing sample concentration comparisons to MTCA cleanup up levels, soil methodologies used for sample collection will be described, boring logs illustrating the geology and groundwater elevations (if encountered), and tables summarizing the data collected. The report will include conclusions and recommendations.
- As a contingency, if confirmation soil samples remain above MTCA Method A cleanup levels, additional tilling efforts may be needed to further dilute the identified contaminated soils above cleanup level to non-detectable, or less than clean up levels before proceeding to regulatory submissions.
- All data generated during the subsurface investigation will be uploaded to Ecology's EIM database for consideration prior to requesting an opinion for No Further Action with Environmental Covenant for the Site.

3.3 *Field Methodology*

LGS will implement the following during soil sample collection.

3.3.1 Soil Sampling Procedures

Soil sampling methods for this work will follow protocols established by Ecology and EPA Method 5035A. Soil samples collected by but not limited to; hand grab, auger, and drill rig acetate sleeves, which will follow the same guidance. Soils will be observed to document soil lithology, color, and moisture content. Descriptions of soil and sampling depths will be carefully logged in the field, and the drillers and field geologist will confirm sample depths as soil samples are collected. To document sampling locations, boring location maps will be completed prior to leaving the Site.

It is expected that tilling depths will be approximately 18" deep. One sample for arsenic will be taken from each soil horizon, 0-6", 6-12", and 12-18".

Soil samples will be collected from each boring acetate sleeve using either a dedicated stainless-steel spoon or spatula. Sample material will be homogenized in dedicated stainless-steel bowls and then placed into 4-oz laboratory-supplied sample jars. All confirmation soil samples will be analyzed for arsenic using EPA Method 6020B, equivalent to protocol prep SW846 6010D.

Confirmation soil samples will immediately be placed into chilled ice chests recommended 2-8 degrees Celsius (6 degrees +/-2 degrees) for transport. Following industry standard chain-of-custody procedures, confirmation soil samples will be transported for analysis to a Washington State-accredited analytical laboratory.

TABLE 1		
Ridgetop Golf Construction Headquarters		
3134 14th Ave NW Gig Harbor, WA (22-113)		
CLEANUP ACTION PLAN		
SAMPLE AND ANALYSIS BY PROPOSED BORING LOCATION		
PROPOSED GRID BORING LOCATION	APPROXIMATE SAMPLE INTERVALS	ANALYSIS
For all proposed locations	*6", 12", 18"*	Arsenic

3.4 *Cleanup Standards and Point of Compliance*

As defined in section *2.3.2 Cleanup Levels*, MTCA Method A cleanup levels are appropriate for soil at this Site. It is assumed that standard points of compliance will be used as defined below:

- Soil – Direct Contact: For soil cleanup levels based on human exposure via direct contact, the point of compliance is throughout the Site from the ground surface to 15 feet bgs.
- Soil – Leaching: For soil cleanup levels based on protection of groundwater, the point of compliance is throughout the Site.

3.5 *Applicable, Relevant, and Appropriate Requirements (ARARs)*

All cleanup actions conducted under MTCA shall comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as ARARs. The primary ARAR is the MTCA regulation (WAC 173-340), especially with regard to the development of cleanup levels and procedures for development and implementation of a cleanup under MTCA. ARARs for the Site cleanup also include the following:

- Washington Solid and Hazardous Waste Management (RCW 70.105); Chapter 173-303 WAC; 40 CFR 241, 257; Chapter 173-350 and 173-351 WAC) and Land Disposal Restrictions (40 CFR 268; WAC 173-303-340).
- Washington Industrial Safety and Health Act (RCW 49.17) and other Federal Occupational Safety and Health Act (29 CFR 1910, 1926).

3.6 *Restoration Timeframe*

The Cleanup Action will take approximately one week if confirmation samples are obtained. The Cleanup Action report and opinion for No Further Action with an Environmental Covenant is estimated to take approximately 3-4 months to Site closure.

3.7 *Compliance Monitoring*

MTCA identifies three types of compliance monitoring to be performed during and/or after a remedial action, protection, performance, and confirmational monitoring. According to MTCA:

Protection monitoring confirms:

> *"…that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action…"*

Performance monitoring confirms:

> "*…that the interim action or cleanup action has attained cleanup standards and, if appropriate, remediation levels…*"

Confirmational monitoring confirms:

> "*…the long-term effectiveness of the interim action or cleanup action once cleanup standards and, if appropriate, remediation levels or other performance standards have been attained.*"

Due to the minimal impacts to the Site and relatively shallow nature of the identified contamination this cleanup action will eliminate the need for any of these three monitoring types of compliance monitoring and qualify the Site for regulatory closure with an Environmental Covenant for the buffer areas.

All data generated will be submitted to Ecology in accordance with WAC 173-340-840(5) in both written and electronic format.

3.8 *Schedule for Implementation*

Upon Ecology approval of the CAP, the cleanup action field event, can be expected to take place within 4 to 6 weeks. These activities are expected to take about 1-2 days to complete, and one day of confirmation drilling and confirmation sample collection. The Cleanup Action Report will take 3 to 4 weeks from the receipt of laboratory data. As described above, Confirmation Soil sampling will be used to ensure soils remaining after cleanup are below cleanup levels for Site closure with an Environmental Covenant.

3.9 *Institutional/Engineering Controls*

Since residual contamination will remain at the Site above MTCA Method A cleanup levels around the perimeter of the property, institutional controls in the form of an Environmental Covenant will be required to be put into place on the property (WAC 173-340-440). An Environmental Covenant would:

- Prohibit activities on the Site that may interfere with a cleanup action, operation and maintenance, monitoring, or other measures necessary to assure the integrity of the cleanup action and continued protection of human health and the environment.
- Prohibit activities that may result in the release of a hazardous substance that was contained as part of the cleanup action.
- Require notice to Ecology of the owner's intent to convey any interest in the Site.
- Require the land owner to restrict leases to uses and activities consistent with the restrictive covenant and notify all lessees of the restrictions on the use of the property.
- Require the land owner to include in any instrument conveying any interest in any portion of the property, notice of the restrictive covenant.
- Require notice and approval by Ecology of any proposal to use the site in a manner that is inconsistent with the restrictive covenant.
- Grant Ecology and its designated representatives the right to enter the property at reasonable times for the purpose of evaluating compliance with the cleanup action plan and other required plans, including the right to take samples, inspect any remedial actions taken at the Site, and to inspect records.

An environmental covenant on the perimeter of the property would require coordination with Pierce County/City of Gig Harbor. It is anticipated to increase the timeframe for Site closure 1 month with filing title documents however this was built in the timeframe to closure estimate above.

4.0 LIMITATIONS

This report summarizes the findings of the services authorized under our agreement with Ridgetop Golf – Mr. Kip Kalbrener. It has been prepared using generally accepted professional practices, related to the nature of the work accomplished. This report was prepared for the exclusive use of Ridgetop Golf – Mr. Kip Kalbrener and his designated representatives for the specific application to the project purpose.

Recommendations, opinions, site history, and proposed actions contained in this report apply to conditions and information available at the time this report was completed. Since conditions and regulations beyond our control can change at any time after completion of this report, or our proposed work, we are not responsible for any impacts of any changes in conditions, standards, practices, and/or regulations subsequent to our performance of services. We cannot warrant or validate the accuracy of information supplied by others, in whole or part.

LOMBARDINI GEOLOGICAL SERVICES LLC

5.0 REFERENCES

GeoResources Soils Investigation Report XXX-14th Ave NW Gig Harbor, June 25, 2021

https://ngmdb.usgs.gov/mapview/?center=-122.556,47.289&zoom=15Accessed 06.02.2022

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Hydrogeologic Framework, Groundwater Movement, and Water Budget of the Kitsap Peninsula West-Central Washington; USGS 2014

American Society for Testing and Materials (ASTM) Standard E 1903-11. *Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process.*

Washington State Department of Ecology, 2004, *Collecting and Preparing Soil Samples for VOC Analysis*, Implementation Memorandum #5.
?
Washington State Department of Ecology, 2013, *Model Toxic Control Act Statute and Regulation – Chapter 173-340 WAC*, Publication number 94-06 (Revised 2013)

Washington State Department of Ecology, 2019, *Tacoma Smelter Plume Model Remedies Guidance* Publication #19-09-101

FIGURES

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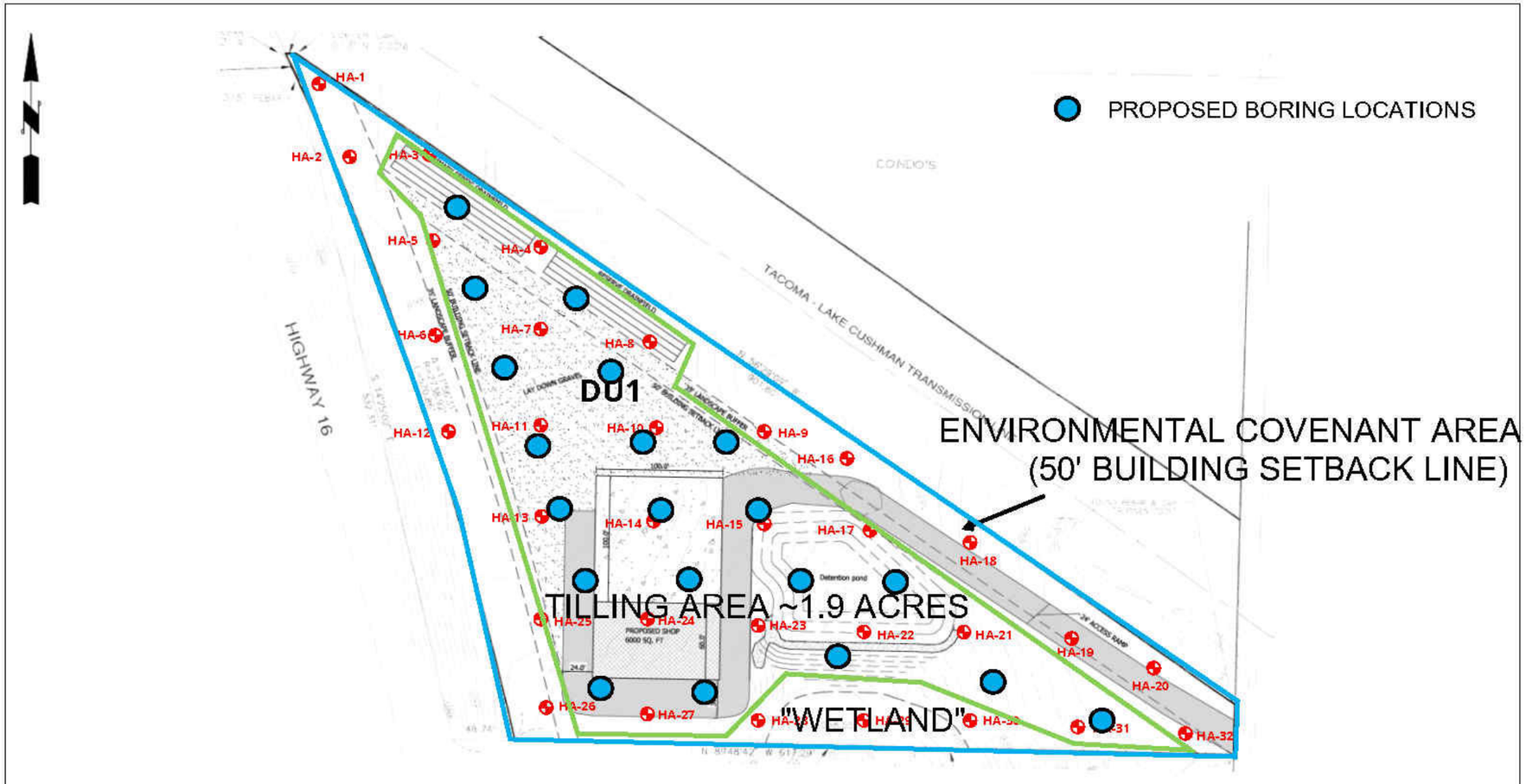
FILENAME	DRAWN BY	CHECKED BY	APPROVED BY	PROJECT NUMBER
BLANK TEMPLATE.DWG	ICD 5/23/2022	SL 5/23/2022	SL 5/23/2022	22-113



Site Plan Provided by Contour dated

Approximate Hand Auger Number and Location

Decision Unit 1 (DU1)

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www.georesources.rocks

Site and Exploration Plan
Soils Investigation and Report
xxx – 14th Avenue Northwest
Pierce County, Washington
PN: 0221213045

Doc: RidgetopGolf.14thAveNW.F2	September 2020	Figure 2a

LGS LOMBARDINI GEOLOGICAL SERVICES LLC

FIGURE 1
PROPOSED TILLING AND SAMPLE MAP

RIDGETOP GOLF CONSTRUCTION HEADQUARTERS
3134 14TH AVENUE NORTHWEST
GIG HARBOR, WA

TABLES

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Table 1 - Summary of Soil Analytical Results
3134 14th Ave NW
Gig Harbor, Washington

Sample Number	Depth Collected (feet)	Date Collected	CONSTITUENTS OF CONCERN	
			Arsenic	Lead
GeoResources September 2020				
HA 1	0-6"	9/23/2020	**49.8**	**90**
HA 1	6-12"	9/23/2020	**18.3**	**30.3**
HA 2	0-6"	9/23/2020	**34.2**	**71**
HA 3	0-6"	9/23/2020	**18.7**	**30.1**
HA 4	0-6"	9/23/2020	**22.9**	**90.1**
HA 4	6-12"	9/23/2020	**21.1**	**41.2**
HA 5	0-6"	9/23/2020	**15.3**	**9.3**
HA 6	0-6"	9/23/2020	**44**	**22.6**
HA 7	0-6"	9/23/2020	**73.1**	**73.2**
HA 8	0-6"	9/23/2020	**54.6**	**61.7**
HA 8	6-12"	9/23/2020	**13.2**	**14.7**
HA 9	0-6"	9/23/2020	**37.9**	**56**
HA 10	0-6"	9/23/2020	**117**	**78.4**
HA 11	0-6"	9/23/2020	**21.8**	**42.8**
HA 12	0-6"	9/23/2020	**11.8**	**18.7**
HA 12	6-12"	9/23/2020	**21.9**	**23.2**
HA 13	0-6"	9/23/2020	**64.1**	**126**
HA 14	0-6"	9/23/2020	**34.4**	**61.8**
HA 15	0-6"	9/23/2020	**32.4**	**44.4**
HA 16	0-6"	9/23/2020	**16**	**25**
HA 16	6-12"	9/23/2020	**15.9**	**21.6**
HA 17	0-6"	9/23/2020	**12.8**	**21**
HA 18	0-6"	9/23/2020	**9.1**	**18.3**
HA 19	0-6"	9/23/2020	**24.5**	**51.7**

Sample Number	Depth Collected (feet)	Date Collected	CONSTITUENTS OF CONCERN	
			Arsenic	Lead
GeoResources September 2020				
HA 20	0-6"	9/23/2020	**34.3**	**51.8**
HA 20	6-12"	9/23/2020	**29**	**31.5**
HA 21	0-6"	9/23/2020	**7.8**	**13.5**
HA 22	0-6"	9/23/2020	**11.3**	**22.8**
HA 23	0-6"	9/23/2020	**22.3**	**20.4**
HA 24	0-6"	9/23/2020	**18.8**	**35**
HA 24	6-12"	9/23/2020	**27**	**28.1**
HA 25	0-6"	9/23/2020	**48.7**	**97**
HA 26	0-6"	9/23/2020	**21.1**	**41**
HA 27	0-6"	9/23/2020	**52.5**	**40.8**
HA 28	0-6"	9/23/2020	**4.4**	**6.3**
HA 28	6-12"	9/23/2020	**11.7**	**13.3**
HA 29	0-6"	9/23/2020	**21.1**	**29.3**
HA 30	0-6"	9/23/2020	**9.6**	**21**
HA 31	0-6"	9/23/2020	**15.5**	**19.6**
HA 32	0-6"	9/23/2020	**30.3**	**44.4**
HA 32	6-12"	9/23/2020	**23.2**	**43.6**
Composite 1	--	9/23/2020	**10.3**	**50.9**
Composite 2	--	9/23/2020	**32.1**	**42.6**
Composite 3	--	9/23/2020	**30**	**45.1**
Composite 4	--	9/23/2020	**28.6**	**43**
PQL			2.5	2.5
MTCA Method A Cleanup Levels			20	250

Notes:

All values reported in milligrams per kilogram (mg/kg)

-- = Not analyzed for constituent

< = Not detected at the listed laboratory detection limits

PQL = Practical Quantification Limit (laboratory detection limit) -

Red Bold indicates the detected concentration exceeds MTCA Method A cleanup levels

Bold indicates detections

APPENDIX A

Supporting Documents

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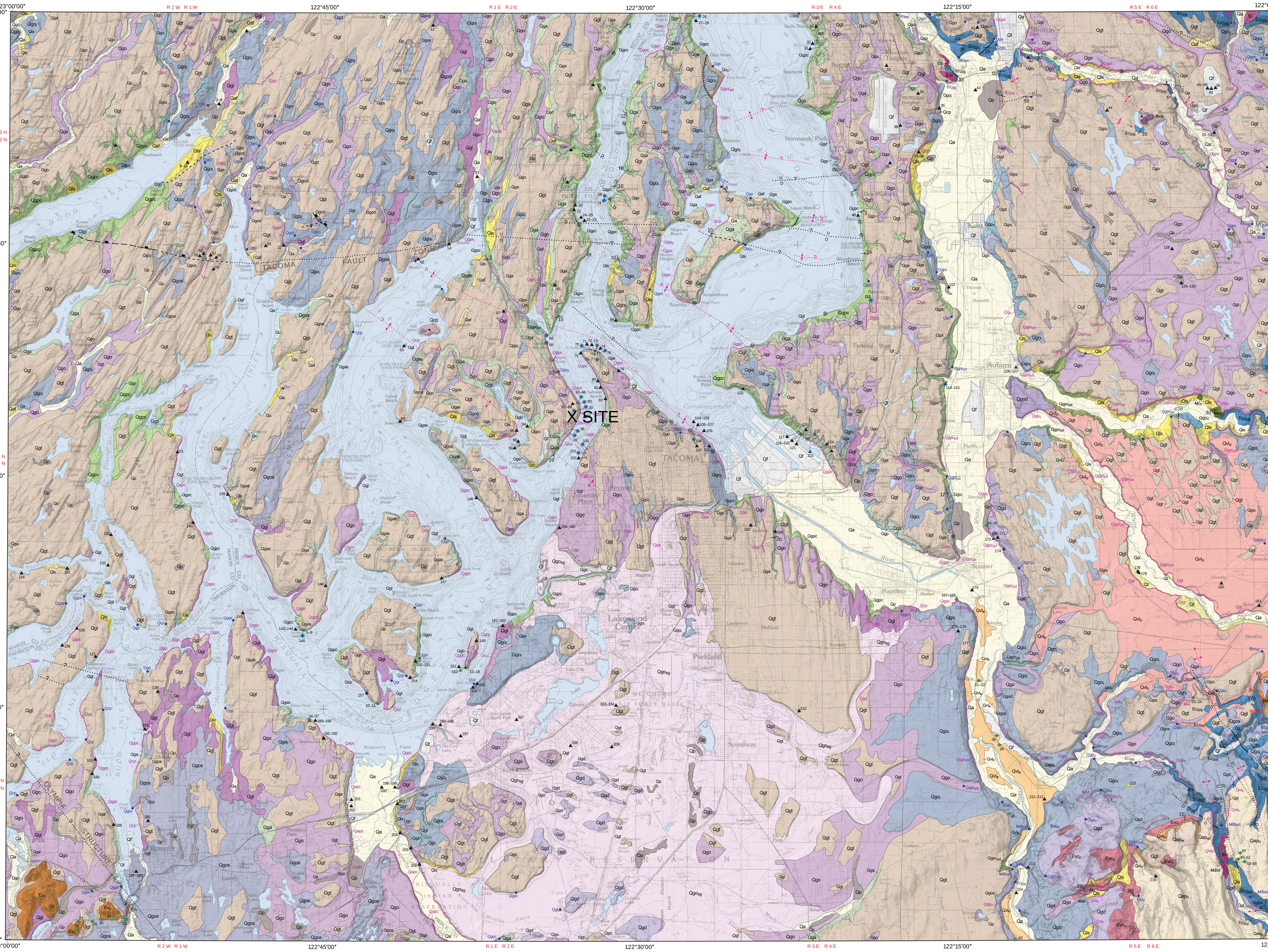
WASHINGTON STATE DEPARTMENT OF Natural Resources
Peter Goldmark - Commissioner of Public Lands
Division of Geology and Earth Resources
David K. Norman - State Geologist

WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES
MAP SERIES 2015-03
Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington
Pamphlet accompanies map

Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington

Compiled by J. Eric Schuster, Ashley A. Cabibbo, Joseph F. Schilter, and Ian J. Hubert

November 2015

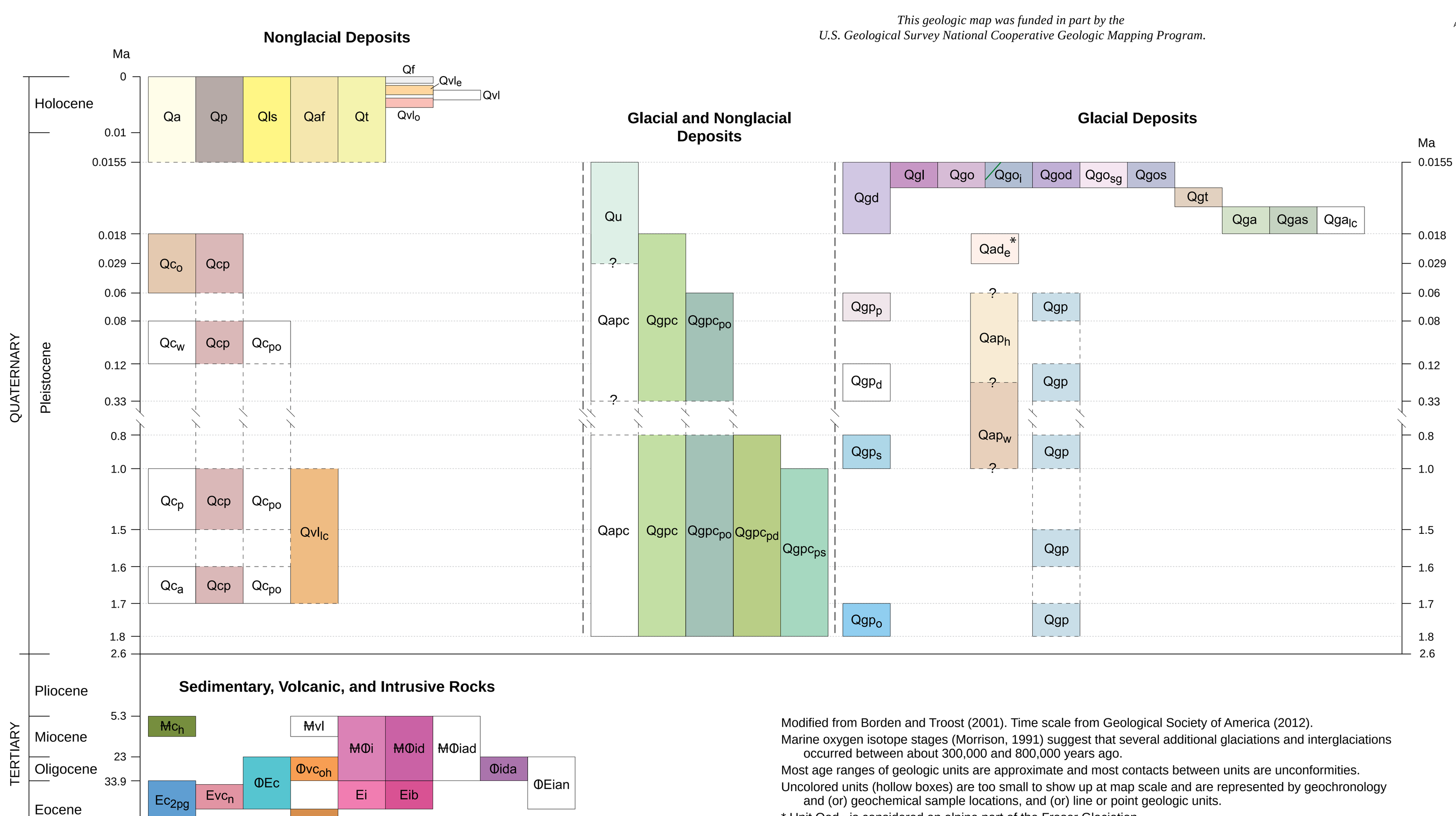


Lambert conformal conic projection
North American Datum of 1927; to place on North American Datum of 1983, move the projection lines approximately 23 meters north and 94 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey Tacoma 1:100,000-scale quadrangle, 1991
Shaded relief generated from a lidar bare-earth digital elevation model (available from Puget Sound Lidar Consortium, http://pugetsoundlidar.ess.washington.edu/)
GIS by J. Eric Schuster
Digital cartography by by Anne C. Olson and J. Eric Schuster
Editing and production by Jessica L. Czajkowski, Alexander N. Steely, and Jaretta M. Roloff

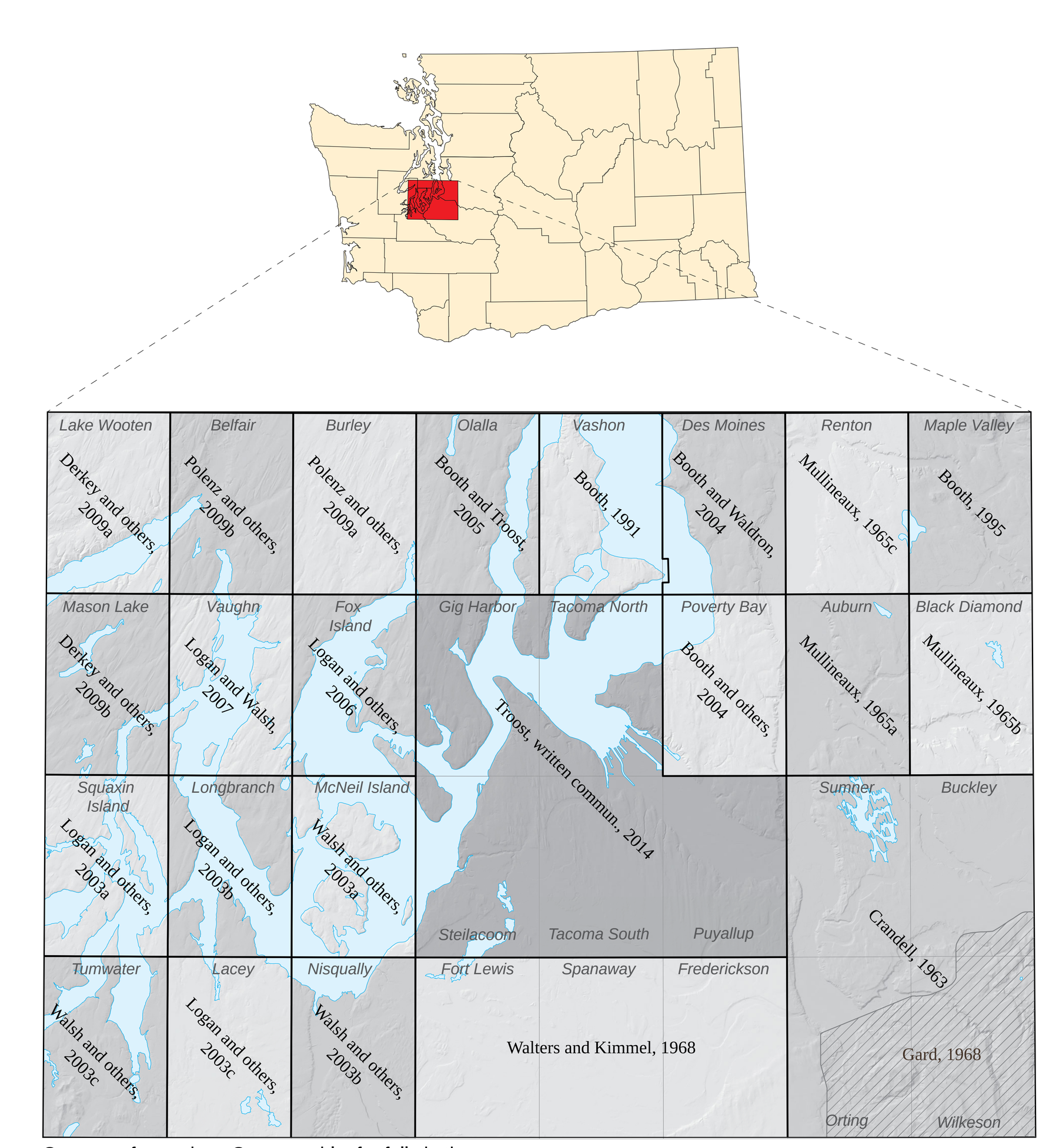
SCALE 1:100,000
0 5 10 MILES
0 5 10 KILOMETERS
contour interval 20 meters

This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program.

16° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2015



Modified from Borden and Troost (2001). Time scale from Geological Society of America (2012).
Marine oxygen isotope stages (Morrison, 1991) suggest that several additional glaciations and interglaciations occurred between about 300,000 and 800,000 years ago.
Most age ranges of geologic units are approximate and most contacts between units are unconformities.
Uncolored units (hollow boxes) are too small to show up at map scale and are represented by geochronology and (or) geochemical sample locations, and (or) line or point geologic units.
* Unit Qad_e is considered an alpine part of the Fraser Glaciation.
# The Double Bluff Glaciation may also include parts of the Hamm Creek interglaciation and Defiance Glaciation.



Sources of map data. See pamphlet for full citations.

DESCRIPTION OF MAP UNITS

See pamphlet for detailed unit descriptions. Uncolored units (hollow boxes) are too small to show at map scale and are represented solely by geochronology and (or) geochemical sample locations, and (or) line or point geologic units. See Tables 1–4 for supporting analytical data.

Quaternary Unconsolidated Deposits

HOLOCENE TO LATE PLEISTOCENE NONGLACIAL DEPOSITS

Qf **Artificial fill (Holocene)**—Modified land and engineered and unengineered fill that obscure or substantially alter the original geologic deposit.

Qa **Alluvium (Holocene)**—Loose, stratified to massively bedded fluvial silt, sand, and gravel; typically well rounded and moderately to well sorted; locally includes sandy to silty estuarine deposits.

Qp **Peat (Holocene to late Pleistocene)**—Loose, locally very soft and wet, organic and organic-rich sediment, including muck, silt, and clay.

Qls **Landslide deposits (Holocene)**—Loose, unsorted, and unstratified clay, silt, soil, and organic matter and angular to rounded sand, gravel, and boulders. Absence of a mapped slide does not imply absence of sliding or hazard.

Qaf **Alluvial fan deposits (Holocene)**—Stratified and typically poorly sorted silt, sand, gravel, and boulders forming concentric lobes where streams emerge from confining valleys and reduced gradients cause sediment load to be deposited.

Qvl_e **Electron Mudflow (Holocene)**—Unsorted mixture of subangular andesitic rock fragments in a purplish-gray, clayey sand matrix; from Mount Rainier.

Qvl **Lahar deposits (Holocene to late Pleistocene)**—Unsorted mixtures of andesitic rock fragments in a clayey sand matrix; post-glacial; Lahar runout and overbank deposits of three lahars from Mount Rainier Summerland eruptive period. Unit Qvl is represented on the map by geochronology sample sites no. 178–179 (Table 1).

Qvl_o **Osceola Mudflow (Holocene)**—Unstratified mixture of subrounded to subangular andesitic rock fragments in a plastic clayey sand matrix; grayish purple to medium or light gray, oxidizes to mottled yellowish brown; originated as a volcanic mudflow from Mount Rainier.

Qt **Terrace deposits (Holocene to late Pleistocene)**—Well-sorted, loose, fluvial sand and pebble to boulder gravel along the White and Green Rivers.

PLEISTOCENE GLACIAL DEPOSITS

Deposits of the Vashon Stade of the Fraser Glaciation

Qgd **Vashon Drift**—Stratified and unstratified sand, silt, clay, gravel, and diamicton; deposited during glacial advance and retreat; includes undifferentiated advance outwash, recessional outwash, ice-dammed-lake sediment, and ice-contact features.

Qgo **Recessional outwash**—Silt, clay, sand, and gravel deposited by glacial meltwater; variably sorted; loose to compact; massive to well stratified; horizontal to steeply dipping beds; includes drumlins, eskers, kettles, kames, and deltas. Divided into:

- Qgl **Recessional glaciolacustrine deposits**—Very fine grained sand, silt, and clay deposited in small ice-enclosed, ice-marginal, and ice-dammed lakes; stratified sand with scattered dropstones and occasional lenses of till or silt.
- Qgo_i **Recessional outwash, ice-contact deposits**—Sand, gravel, silt, and clay; tan to gray; loose; moderately to well sorted and rounded; good porosity and permeability; contains a mixture of dynamic-ice and stagnant-ice features, including drumlins, eskers (green lines), kettles, kames, and less-orderly hummocky topography.
- Qgod **Recessional outwash, delta deposits**—Sand and pebble to cobble gravel, minimal silty sand, and rare boulders; well sorted; predominantly unweathered; deposited beyond retreating ice front by meltwater streams.
- Qgo_{sg} **Recessional outwash, Steilacoom Gravel**—Pebbles with boulders; local crossbedding; kettles and other ice-contact depressions.
- Qgos **Recessional outwash, sand**—Sand with lenses and beds of pebble gravel and silt; gray to brown; moderate to well sorted; matrix free; loose; moderate to well rounded; commonly associated with eskers and kettles.

Qgt **Vashon Till**—Clay, silt, sand, and gravel; gray to brown and yellowish brown where oxidized; unstratified and highly compact; angular to subrounded; low permeability and porosity; includes moraines, drumlins, striations, and flutes.

Qga **Advance outwash**—Sand and pebble to cobble gravel; light gray to light brown; poorly to well sorted; very compact. Divided into:

- Qgas **Advance outwash, sand**—Fine- to medium-grained sand with lenses of silt or gravel; fluvial and lacustrine facies; typically well rounded and well sorted; prone to deep-seated landslides; locally called Colvos or Esperance Sand.
- Qga_{lc} **Lawton Clay**—Laminated to massive silt, clayey silt, and silty clay interbedded with layers of crossbedded sand; light gray to dark blue-gray; local ripple marks.

Qad_e **Evans Creek Drift (Fraser Glaciation, Evans Creek Stade)**—Till, poorly sorted sand and gravel, and boulders; complexly interbedded; forms moraines and terraces.

Qu **Fraser-age continental glacial and nonglacial deposits**—Undifferentiated glacial and nonglacial deposits of the Fraser Glaciation.

Pre-Vashon Glacial and Nonglacial Deposits

Qc_o **Sediments of the Olympia nonglacial interval**—Thin to thick interbedded sand and silt, with localized gravel and some laminated silt and clay sequences; abundant plant material, wood fragments, and shells.

Qcp **Pre-Fraser continental sedimentary deposits, nonglacial**—Silt interbedded with fine sand; blue-gray to yellow-brown; massive to laminated; abundant peat and organic debris and pumice layers.

Qapc **Pre-Vashon alpine glacial drift and nonglacial deposits**—Undifferentiated alpine glacial and nonglacial deposits.

Qgpc **Pre-Vashon continental glacial drift and nonglacial deposits**—Composite geologic unit that includes combinations of all of the continental glacial and nonglacial deposits . Unit Qgpc is widespread in bluffs near Puget Sound and Hood Canal and in valley walls of major rivers.

$Qgpc_{po}$ **Pre-Olympia continental glacial and nonglacial deposits**—Composite geologic unit that includes combinations from among all of the continental glacial and nonglacial geologic units older than Olympia nonglacial interval (Olympia beds, unit Qc_o).

Qgp_p **Possession Drift**—Sand, gravel, compact sandy till, and glaciomarine drift, with lenses of sand and gravel; gray and oxidized near top of unit; locally contains shells and shell fragments.

Qgp **Pre-Fraser continental glacial drift**—Clay, silt, sand, and gravel; moderately rounded; laminated to poorly bedded; compact to loose; locally oxidized; gravel clasts of northern provenance deposited by glacial ice.

Qc_w **Whidbey Formation**—Fluvial sands and gravels and massive to laminated marine and lacustrine silt and clay; wide range of oxidation levels; contains organic material.

Qc_{po} **Pre-Olympia continental sedimentary deposits, nonglacial**—Silt, clay, gravel, sand, and peat; coarse to fine grained; massive to laminated; predominately volcanic; abundant organic debris and pumiceous deposits.

Qap_h **Hayden Creek Drift**—Alpine glacial till and outwash sand and gravel; yellowish to dark brown and oxidized.

Qap_w **Wingate Hill Drift**—Alpine glacial till and outwash gravel; dark brown and oxidized, with weathering rinds; very compact; weathering rinds on clasts average 0.2 in. thick.

Qgp_d **Double Bluff Drift**—Till, glaciomarine drift, glaciofluvial sand and gravel, and glaciolacustrine silt; wood and shells abundant.

Qgp_s **Salmon Springs Drift**—Medium to coarse sand, pebble to cobble gravel, and till, with thin beds and lenses of silt and clay; locally contains peat and volcanic ash; clasts covered with iron-oxide stain, some strongly weathered and decomposed; well sorted.

Qvl_{lc} **Lily Creek Formation**—Unconsolidated lahar deposits; sand and gravel interbedded with compact mudflows; mudflows interbedded with ash and silt to very fine sand and white pumice; wholly or partly altered to clay.

$Qgpc_{pd}$ **Pre–Double Bluff continental glacial and nonglacial deposits**— Composite geologic unit that includes combinations from among all of the continental glacial and nonglacial geologic units older than the Double Bluff (unit Qgp_d). Includes portions of Stuck Drift.

$Qgpc_{ps}$ **Pre–Salmon Springs continental glacial and nonglacial deposits**— Composite geologic unit that includes some combination of Puyallup Formation (unit Qc_p), Alderton Formation (unit Qc_a), Stuck Drift , and Orting Drift (unit Qgp_o).

Qc_p **Puyallup Formation**—Alluvial and lacustrine silt, sand, and gravel; compact peat beds common; weathered to clay to a depth of ~10 in.; silt is laminated and pinkish-gray; sand is gray and medium to coarse; yellowish-gray pumice common.

Qc_a **Alderton Formation**—Alluvial sand, pebble to boulder gravel, mudflows, and peat, with pumice and tuff. Ash deposition is estimated from an Ar-Ar analysis to be 1.6 Ma (Table 1).

Qgp_o **Orting Drift**—Deeply oxidized sand and gravel and minor amounts of till; reversely magnetized; very compact, unsorted, and unstratified.

Tertiary Sedimentary, Volcanic, and Intrusive Rocks

Mc_h **Hammer Bluff Formation (late Miocene)**—Clayey fluvial sand and gravel, with thin silt and clay lenses, wood fragments, volcanic ash and lignite, and lacustrine sand and clay; cohesive and compact.

Mvl **Volcanic lahars (middle to late Miocene)**—Pumice gravel, several ash layers, and three lahars containing carbonized wood.

MΦi **Intrusive latite (Miocene to Oligocene)**—Light gray to creamy tan latite; well jointed and breaks into platy fragments; contorted flow banding, drag folding, and many xenoliths.

MΦid **Quartz diabase (Miocene to Oligocene)**—Sill of dark gray quartz diabase (diorite), weathered to light greenish gray in places; appears chalky where feldspars have been strongly weathered; holocrystalline and medium grained.

MΦiad **Intrusive andesite and dacite (Miocene to Oligocene)**—Light-gray massive hornblende dacite porphyry and porphyritic pyroxene andesite sills and dikes; porphyry is deeply weathered in places; irregularly shaped cavities common.

ΦEc **Continental sedimentary rocks (Oligocene to Eocene)**—Tuffaceous sandstone and conglomerate, mudstone, and shale; generally poorly indurated; locally cemented by calcite and zeolites; strongly iron-stained; partly weathered to clay.

$Φvc_{oh}$ **Ohanapecosh Formation (late Eocene to Oligocene)**—Volcaniclastic conglomerate, sandstone, siltstone, and shale; typically greenish gray, though may be black, brown, red, or white; lower volcanic sandstones are poorly sorted.

Φida **Intrusive dacite (upper Oligocene)**—Basaltic, andesitic, or dacitic rocks; medium dark gray to dark greenish gray; porphyritic.

ΦEian **Intrusive porphyritic andesite (Oligocene to Eocene)**—Irregularly shaped intrusive bodies and a sill of porphyritic andesite, probably emplaced at shallow depth.

Ec_{2pg} **Continental sedimentary rocks of the Puget Group (early Eocene to early Oligocene)**—Sandstone, siltstone, shale, carbonaceous shale, claystone, and coal; massive to crossbedded. Divided into:

- Evc_n **Northcraft Formation (Eocene)**—Andesite breccia; generally brownish or yellowish black, but may be brick red, dark gray, greenish gray, or black; includes tuff and lesser amounts of volcanic conglomerate and volcanic sandstone interbedded with mudflow breccia.

Ei **Porphyritic intrusive igneous rocks (Eocene)**—Greenish-gray rocks composed of zoned and altered plagioclase and hornblende phenocrysts.

Eib **Intrusive porphyritic basalt and andesite (late Eocene)**—Irregular masses of phaneritic igneous rock containing plagioclase and small crystals of mafic minerals; black to varying shades of brown.

Ev_c **Crescent Formation (Eocene)**—Plagioclase-pyroxene tholeiitic basalt with local diabase and gabbro; dark gray with a greenish tint, brown where weathered, and reddish and variegated along altered contact zones.

GEOLOGIC SYMBOLS

- Contact—Approximately located
- Fault—Dotted where concealed; short-dashed where inferred; queried where identity or existence questionable
- Reverse fault—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; queried where identity or existence questionable; rectangles on upthrown block
- High-angle dip-slip fault—Solid where location approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; U, upthrown block; D, downthrown block
- Normal fault—Solid where location approximate; short-dashed where inferred; dotted where concealed; bar and ball on downthrown block
- Anticline—Solid where location approximate; short-dashed where inferred; dotted where concealed; arrow indicates plunge direction
- Syncline—Solid where location approximate; dotted where concealed
- Monocline, synclinal bend—Location concealed; queried where identity or existence questionable; arrows show direction of dip; shorter arrow on steeper limb
- Monocline, anticlinal bend—Location concealed; queried where identity or existence questionable; arrows show direction of dip; shorter arrow on steeper limb
- Qcp, Qc_o Geologic unit too thin to show as polygon—Location approximate; tic separates units
- Landslide scarp—Location accurate; identity and existence certain; hatchures point downslope
- 80 Inclined bedding—showing strike and dip
- Vertical bedding—showing strike
- 6 Inclined bedding in unconsolidated deposits—showing strike and dip
- 51 Geochronology sample, fossil
- 123 Geochronology sample, argon-argon ($^{40}Ar/^{39}Ar$)
- 215 Geochronology sample, U-Pb, uranium-lead
- 121 Geochronology sample, radiocarbon (^{14}C)
- 126 Geochronology sample, fission-track
- 122 Geochronology sample, luminescence
- 5 Geochemistry sample
- Qgp_o Geologic unit too small to be shown as a polygon or line
- Paleomagnetic sample, transitional magnetization
- Paleomagnetic sample, normal magnetization
- Paleomagnetic sample, reversed magnetization

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G14AC00212. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Table 4. Hydrogeologic unit labels and terminology used in groundwater studies of the Kitsap Peninsula, west-central Washington.

[–, not defined]

Sceva, 1957 (Kitsap County)	Garling and others, 1965 (Kitsap Peninsula)	Dion and others, 1988 (Bainbridge Island)	Kitsap County Groundwater Advisory Committee and others, 1991 (Kitsap County)	Kato and Warren, Inc., and Robinson and Noble, Inc., 2000 (Bainbridge Island)	This study	Number of wells used to determine extent and thickness of unit
Alluvium	Alluvium	1	Qn1, alluvium and recessional deposits	Qvr, Shallow aquifer	Qvr, Vashon recessional aquifer	215
A, recessional outwash	Qvr, recessional outwash					
B, till	Qvt, till	2	Qg1, till	Qvt	Qvt, Vashon till confining unit	1,568
C, advance outwash	Qva, advance outwash	3	Qg1a, advance outwash/shallow aquifer	PA, perched aquifer system	Qva, Vashon advance aquifer	1,480
D, Puyallup sand	Qc, Colvos sand					
–	–	4	Qn2, 1st nonglacial deposits	C1, upper confining unit	QC1, Upper confining unit	1,368
			Qg2, 2nd glacial deposits	SPA, semi-perched aquifer system	QC1pi, Permeable interbeds	143
E, Kitsap Clay member	Qg/Qk, unnamed gravel/Kitsap formation		Qn3, 2nd nonglacial deposits	C2, lower confining unit	QC1, Upper confining unit	78
F, Orting gravel member	Qss, Salmon Springs (?) Drift	5	Qg3, 3rd glacial deposits/sea-level aquifer	SLA, sea level aquifer	QA1, Sea-level aquifer	1,109
–	Qpu, pre-Salmon Springs (?) deposits	6	Qn4, 3rd nonglacial deposits	C3, confining unit	QC2, Middle confining unit	387
		Pleistocene deposits (undifferentiated)	Qg4, 4th glacial deposits/deep aquifer; Qg4m marine glaciomarine deposits	GMA, glaciomarine aquifer system	QA2, Glacio-marine aquifer	289
G, Admiralty drift			Qn5, 4th nonglacial deposits	C4, confining unit	QC3, Lower confining unit	115
Pre-Orting deposits, undifferentiated			Qg5, 5th glacial deposits	FBA, Fletcher Bay Aquifer	QA3, Deep aquifer	69
			Qn6, ancient nonglacial deposits	C5, confining unit	QC4, Basal confining unit	29
Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Tertiary Blakeley Formation of Weaver, 1916	Blakeley Harbor Formation of Fulmer, 1975	BR, Bedrock	46
				Blakeley Formation of Fulmer, 1975		

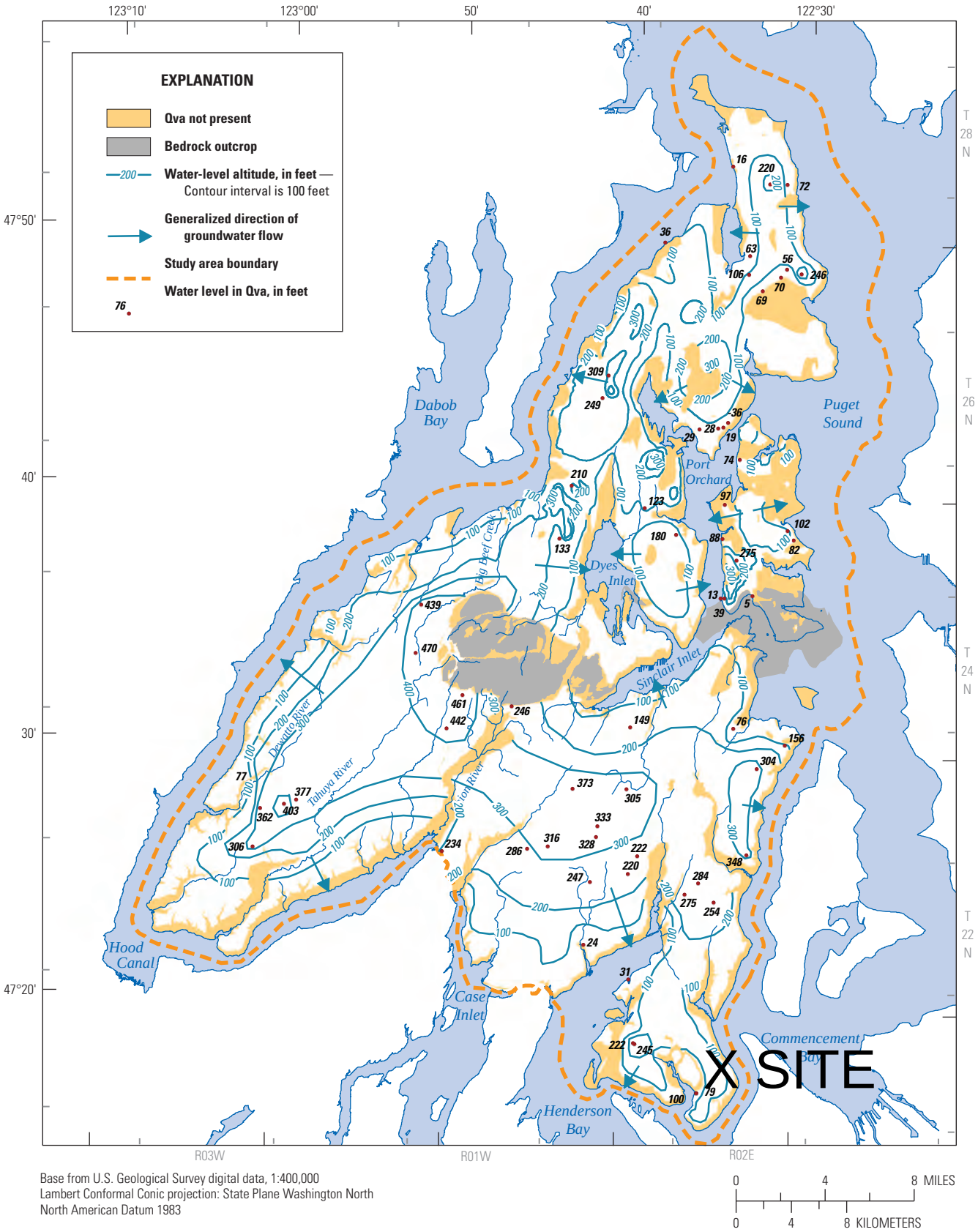
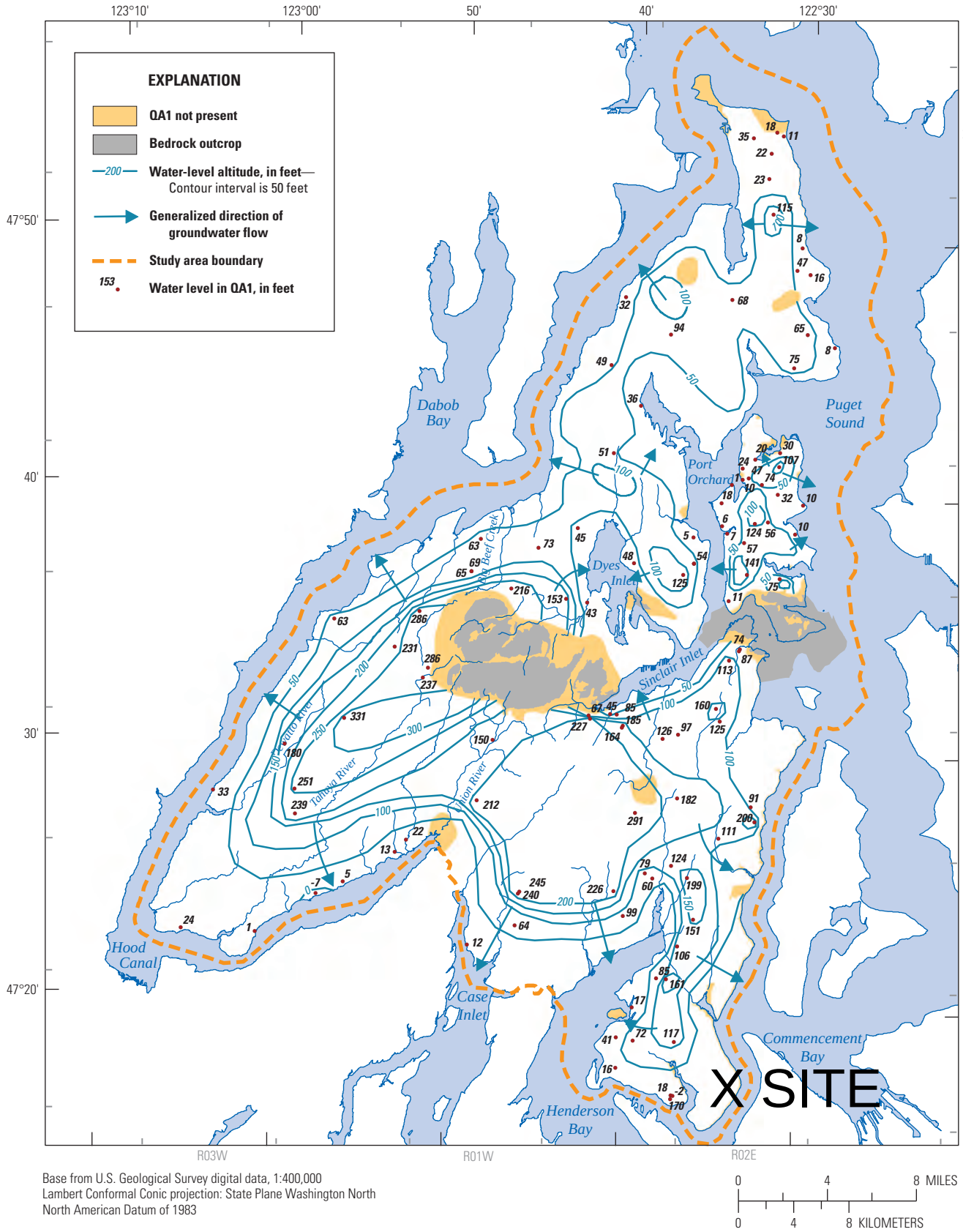


Figure 20. Water-level altitudes and generalized direction of groundwater flow in the Vashon advance aquifer (Qva), Kitsap Peninsula, west-central Washington, autumn 2010.



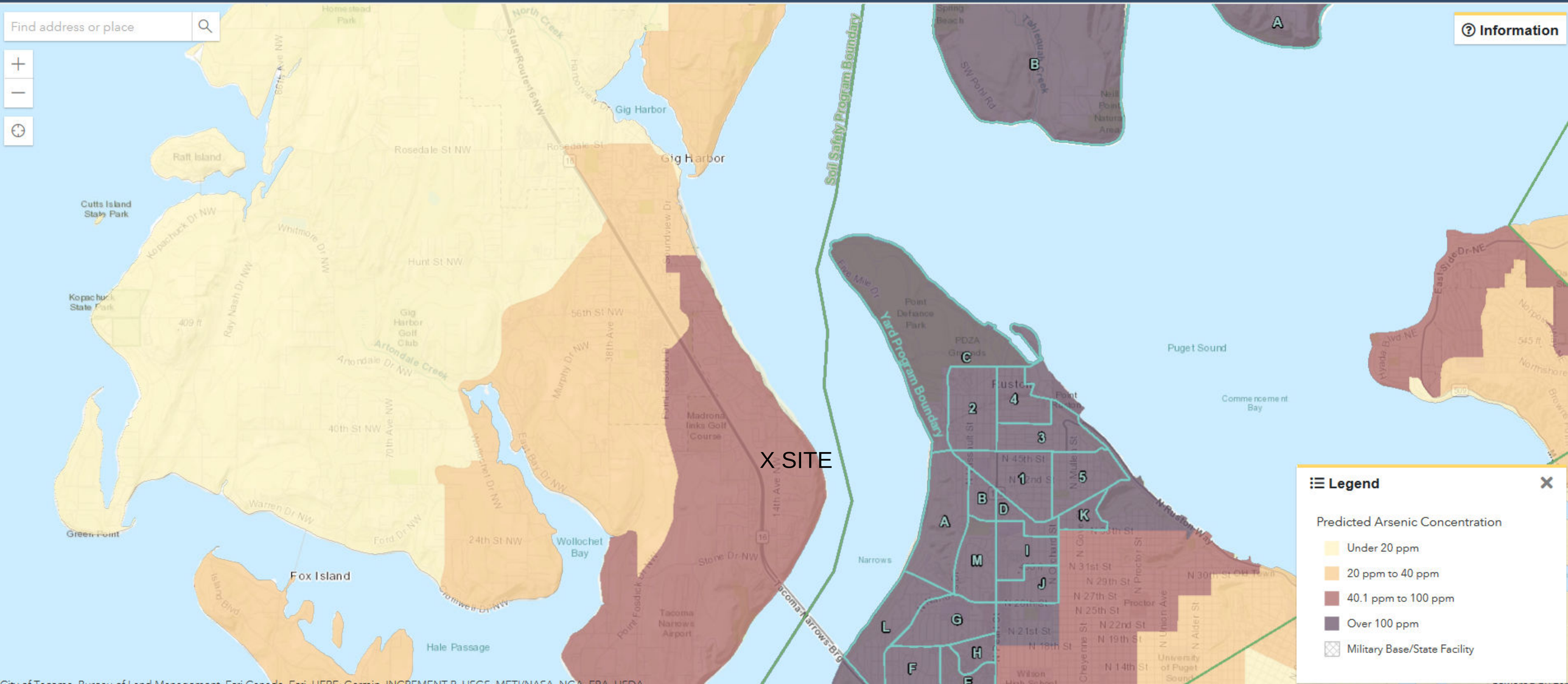
Base from U.S. Geological Survey digital data, 1:400,000
Lambert Conformal Conic projection: State Plane Washington North
North American Datum of 1983

Figure 21. Water-level altitudes and generalized direction of groundwater flow in the sea level aquifer (QA1), Kitsap Peninsula, west-central Washington, autumn 2010.

DEPARTMENT OF ECOLOGY
State of Washington

Dirt Alert

Tacoma Smelter Plume | Orchard Lands | Everett Smelter Plume | Upper Columbia River



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June 25, 2021

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Soils Investigation and Report
Proposed Contractor Yard
xxx – 14th Avenue Northwest
Pierce County, Washington
PN: 0221213045
Doc ID: RidgetopGolf.14thAveNW.SIR

INTRODUCTION

This report presents the data from our subsurface explorations and third-party laboratory testing regarding the arsenic and lead determinations for the soil at the site located on 14th Avenue Northwest adjacent to the Cushman Trail in the Gig Harbor area of Pierce County, Washington.

Our understanding of the project is based on email and telephone correspondences with Mr. Carl Halsan, our past work at the site, our review of the Department of Ecology (DOE) Environmental Checklist Review for the project dated November 27, 2018, our understanding of the DOE *Tacoma Smelter Plume Model Remedies Guidance* (2019) and our past experience in the project area.

We understand that DOE has indicated the project site is within the old Asarco Tacoma Smelter Plume as determined by prior mapping. DOE's Tacoma Smelter Plume map search tool shows the site is located in an area mapped as containing 40.1 to 100 parts per million (ppm) Arsenic. As such, DOE is requesting sampling the soil and analyzing for arsenic and lead following the 2019 Tacoma Smelter Plume Guidance as a condition of the permit.

SCOPE

Based on our discussion with Eva Barber at the DOE Tacoma Smelter Plume Department, we propose a scope of work that conforms to the performance standards as outlined in the DOE's *Tacoma Smelter Plume Model Remedies Guidance* and includes the following:

1. Reviewing existing geological and geotechnical literature for the site area;
2. Visiting the site and collecting a series of samples at 32 locations from the upper 6 to 24 inches of soils;
3. Submitting soils to an approved third-party laboratory for arsenic and lead determinations;
4. Providing a data report detailing exploration locations, methods, and analytical results.

SITE CONDITIONS

Surface Conditions

The proposed Cushman Trail Contractors Yard is located on the east margin of the Gig Harbor glacial upland area. The site is situated in an area of historical commercial, multifamily and rural single family development. According to the Pierce County Assessor website, the site is triangular in shape, measures about 345 feet wide (northeast to southwest) by about 900 feet deep (northwest to southeast), and encompasses approximately 3.77 acres. The site is bounded by commercial development on the south, 14th Avenue NW on the east, SR 16 on the west and the Cushman Trail on the north. The site is currently undeveloped and forested, but was previously graded some time ago. Access is currently provided by a crushed rock trail/driveway that extends west from 14th Avenue NW.

The ground surface at the site is gently to moderately sloping towards the center of the property. The ground surface at the site slopes at between 5 and 20 percent, the steeper areas to the south and east. Localized areas of 20 to 35 percent slope occur in the extreme south portion of the site, adjacent to a localized wetland area south of the site. We expect that the steeper slope areas are related to historic grading, i.e. cut slopes, at the site. The vertical height of the steeper slopes range from approximately 10 feet to 16 feet in height. No areas steeper than 40 percent are present at the site or the immediate adjacent areas.

We observed no evidence of significant erosion, surficial sloughing and soil movement at the site at the time of our site observations. The site is vegetated with grass, brush and scattered trees. Minor surface water was observed in the extreme south portion of the site and the adjacent area at the time of our previous reconnaissance. No groundwater seepage was observed in the explorations the site. The general topography of the site area indicates that the site drains towards the south.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey indicates that the site is underlain by Harstine gravelly ashy sandy loam (16C). The Harstine soils are derived from sandy glacial till and form on slopes of 6 to 15 percent. These soils have a “moderate” erosion hazard when exposed and are included in hydrologic soils group C. A copy of the soils map for this area is illustrated on Figure 3.

Site Geology

According to the draft *Geologic Map of the Gig Harbor 7.5-minute Quadrangle Pierce County, Washington* by Troost, K.G., Booth, D.B., and Wells, R.E. (in review), the site is in an area underlain by recessional outwash (Qvr) and glacial till (Qvt). These soils were generally deposited during the most recent Vashon Stade of the Fraser Glaciation, some 12,000 to 15,000 years ago. Recessional outwash typically consists of poorly stratified mixtures of sand and gravel that were deposited by meltwaters emanating from the retreating ice mass. Glacial till typically consists of a heterogeneous mixture of clay, silt, sand and gravel that was deposited at the base of the continental ice mass and is typically encountered overridden by the ice mass. As such, it is considered overconsolidated and in a very dense condition, and exhibits high strength and low compressibility characteristics where undisturbed. Recessional outwash is considered normally consolidated. An excerpt of the above reference geologic map is attached as Figure 4.

Arsenic and Lead Sampling

On September 23, 2020, two GeoResources, LLC (GeoResources) representatives arrived onsite and sampled the soils in general accordance with the *2019 DOE Tacoma Smelter Plume Model Remedies Guidance (*MRG*)*. Based on the information obtained from the MRG, we used a single decision unit (DU1) for the project site. Based on procedures outlined in the guidance document, 32 explorations were completed within DU1. We collected samples from 0 to 6, and 6 to 12 inches below existing grade at each exploration location. Four composite samples were also collected from the site. Samples were taken from the site in sealed glass jars and transported to Spectra Laboratories, an approved third-party laboratory, for testing. The number and locations of the explorations were selected by GeoResources based on MRG and our understanding of the proposed development, consideration for underground utilities, existing site conditions, and current site usage.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun.

The approximate locations of our explorations are indicated on the attached Site and Exploration Plan, Figure 2. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our test pits are included as Figures A-2 to A-23.

ARSENIC AND LEAD DETERMINATIONS

According to the Washington Department of Ecology – Tacoma Smelter Plume Model Remedies Guidance, "elevated" arsenic or lead levels are measured in parts per million (ppm) and are defined in Table 1, below.

TABLE 1:
"ELEVATED" ARSENIC AND LEAD LEVELS

Contaminant	Average Concentration	Maximum Concentration (any one sample)
Arsenic (As)	>20 ppm	>40 ppm
Lead (Pb)	>250 ppm	>500 ppm

The laboratory used test method 6010(D) in accordance with the guidance document. The average arsenic level for the site was approximately 29 ppm and the average lead level for the site was about 41.4 ppm. The maximum arsenic level was about 117 ppm, encountered at the 0"-6" depth in HA-10, and the maximum lead level was about 126 ppm, encountered at the 0"-6" depth in HA-13. Both the maximum arsenic level and maximum lead level samples were collected near the central portion of the site as shown in Figure 2a. The maximum arsenic level of 117 ppm meets the Department of Ecology's definition of "elevated"; however, samples collected from the 6 inch to 12 inch and the 12 inch to 24 inch depths at the same location were found to be below "elevated" levels. The Laboratory Analyses and Chain of Custody is included in Appendix B.

Based on previous discussions with the Washington Department of Ecology, we anticipate that the site could be enrolled into the Voluntary Cleanup Program (VCP) sponsored by Ecology. The program will provide technical guidance on cleanup efforts and provide documentation of the completed cleanup for the record, including issuing a No Further Action (NFA) for the property.

Typically, site earthwork activities are sufficient to dilute contamination to below cleanup levels. However, per Table 2 of the Ecology guidance manual (below), since the site is within the 40.1 to 100 ppm arsenic zone, mix and dilute in place is not allowed. Instead, shallow excavation and removal is required.

TABLE 2
MODEL REMEDIES BY ARSENIC AND LEAD SOIL LEVEL

Soil sampling results in parts per million (ppm)	Permanent		Non-Permanent			
Average	Excavate & Remove	Mix	Cap in place/Consolidate and cap			
Arsenic 20-40 Lead 250-500	Yes	Yes	Yes			
Arsenic 40-100 Lead 250-500	Yes	No	Max <200 Max <1000	Type 1 or 2*cap	Max >200 Max >1000	Type 2 cap
Arsenic 100-200 Lead 500-1000	Yes	No	Type 2 cap			
Arsenic >200 Lead > 1000	Yes	No	Type 2 cap **(only for capping in place)**			

*Type 1 and 2 caps are described in Chapter 5.

We consulted with Shawn Lombardini of Lombardini Geological Services LLC (LGS) to review the results. We recommended engaging with LGS to work with Ecology staff to prepare a Cleanup Action Plan and submit to DOE prior to beginning of site work. LGS should be retained to observe the clean up, provide technical reports, verification of the cleanup, and submit paperwork to the support the NFA review.

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LIMITATIONS

We have prepared this report for use by Ridgetop Golf, Mr. Carl Halsan, and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

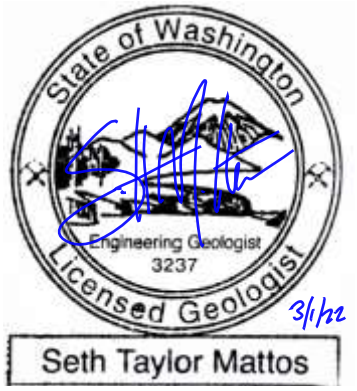
If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

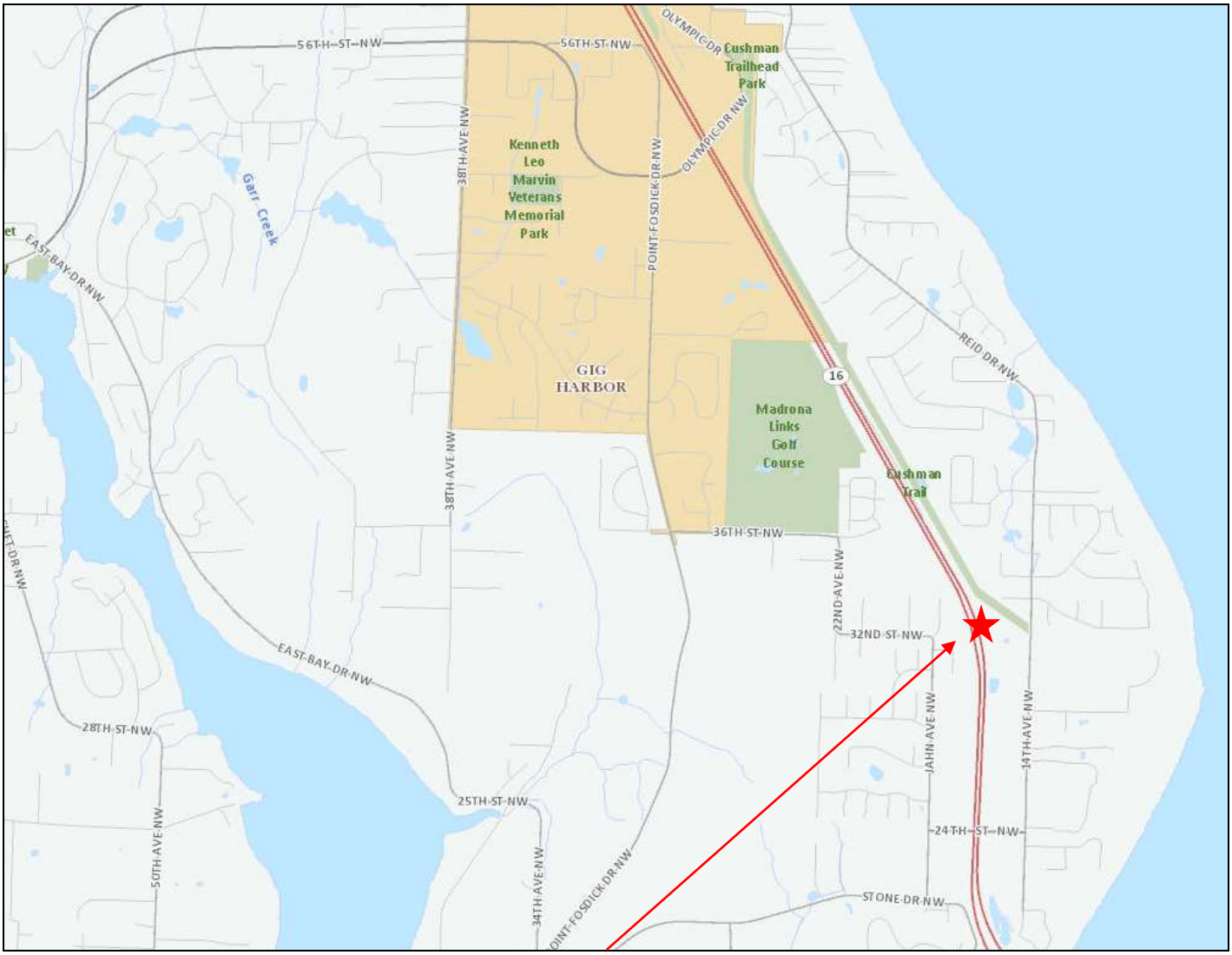
Andrew Schnitger, EIT
Staff Engineer in Training



Keith S. Schembs, LEG
Principal

Seth Mattos, LG
Associate

AES:STM:KSS/aes
DocID: RidgetopGolf.14thAveNW.SIR
Attachments: Figure 1: Site Location Map
Figure 2: Site and Exploration Plan
Figure 3: NRCS Soils Map
Figure 4: USGS Geologic Map
Appendix A – Subsurface Explorations
Appendix B – Laboratory Test Results



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

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Not to Scale

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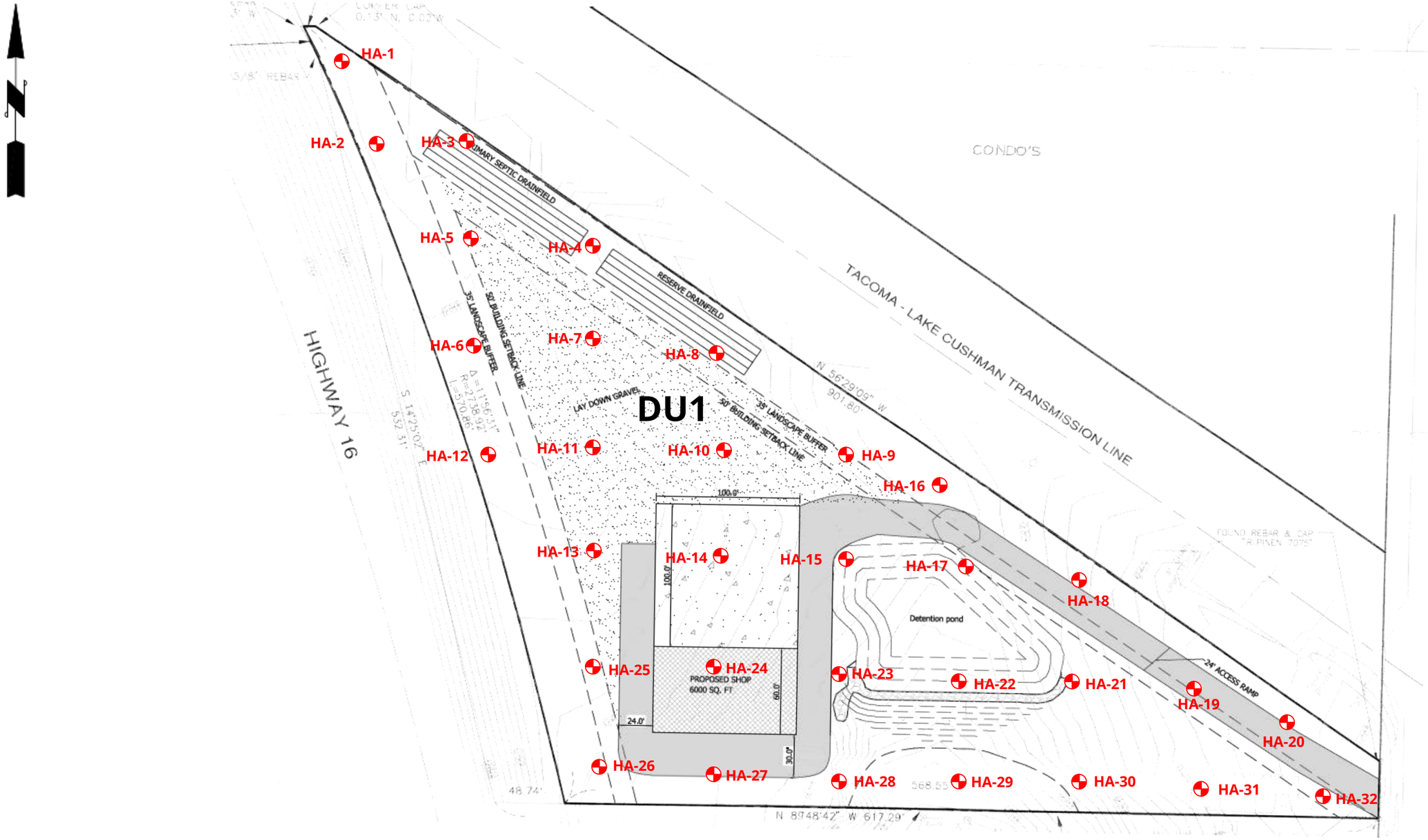
Site Location Map

Soils Investigation and Report
xxx – 14th Avenue Northwest
Pierce County, Washington
PN: 0221213045

DocID: RidgetopGolf.14thAveNW.F	June 2021	Figure 1



Site Plan Provided by Contour

Exploratoin Number and Approximate Location HA-24

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Site and Exploration Plan

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Doc: RidgetopGolf.14thAveNW.F2	June 2021	Figure 2

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
16C	Harstine gravelly sandy loam	Sandy glacial drift with an influence of volcanic ash over dense glaciomarine deposits	6 to 15	Moderate	C
16D			15 to 30	Moderate to severe	

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NRCS Soils Map

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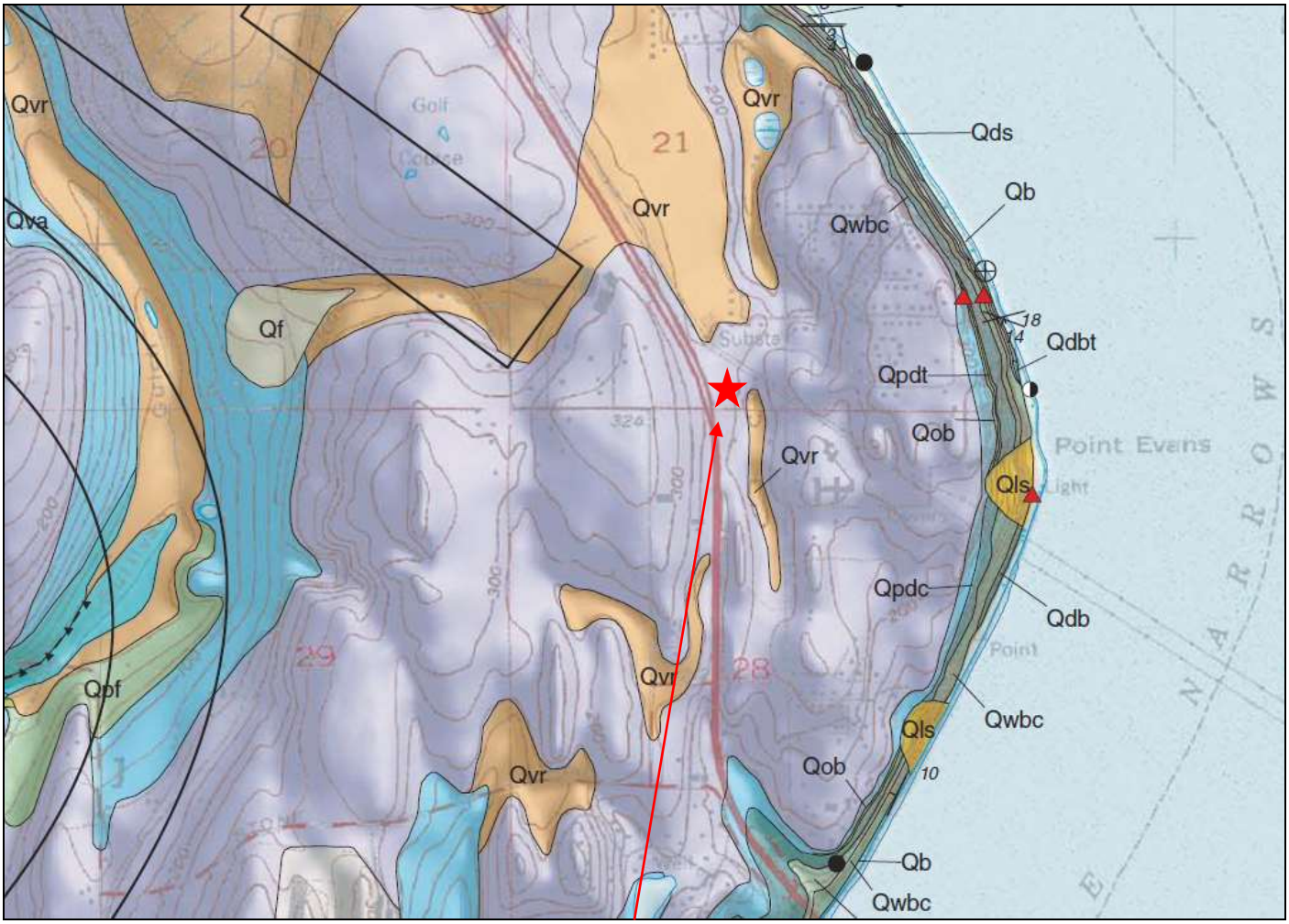

Approximate Site Location

(An excerpt from the *Geologic Map of the Gig Harbor 7.5-minute Quadrangle, Washington* by Troost, K.G., Booth, D.B., and Wells, R.E. in review)

Qvr	Recessional outwash deposits
Qvt	Glacial till

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USGS Geologic Map

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Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

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Pierce County, Washington
PN: 0221213045

Hand Auger HA-1

Location: Northernmost portion of parcel

Depth (in)	Soil Type	Soil Description
0 - 5	-	Forest duff
5 - 17	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 17 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-2

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 3	-	Forest duff
3 - 9	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 9 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-3

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

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Test Pit Logs
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Pierce County, Washington
PN: 0221213045

Hand Auger HA-4

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	14	SM	Light brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-5

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	10	SM	Light brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-6

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Light brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-7

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 8	SM	Light brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-8

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 14	SM	Light brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-9

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 1	-	Forest duff
1 - 7	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 7 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-10

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	1	-	Forest duff
1	-	7	SM	Reddish brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 7 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-11

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Reddish brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-12

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	14	SM	Light brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-13

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-14

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-15

Location: Northern half of parcel

Depth (in)	Soil Type	Soil Description
0 - 2	-	Forest duff
2 - 8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-16

Location: Northern half of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	14	SM	Brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-17

Location: Central portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-18

Location: Eastern portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Light Brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-19

Location: Southeastern portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	10	SM	Light Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-20

Location: Southeastern portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	16	SM	Light Brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 16 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-21

Location: Southeasternmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-22

Location: Central portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	10	SM	Light Brown silty SAND with gravel (loose to medium dense, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-23

Location: Central portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 2 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-24

Location: Central portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	14	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-25

Location: Westernnmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	10	SM	Reddish Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-26

Location: Southernnnmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	10	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-27

Location: Southernnnmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-28

Location: Southernnmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	15	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 15 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-29

Location: Southernnmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	10	SM	Light Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-30

Location: Southernmost portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	8	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 8 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

Hand Auger HA-31

Location: Southeastern portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	4	-	Forest duff
4	-	10	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 10 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Hand Auger HA-32

Location: Southeastern portion of parcel

Depth (in)			Soil Type	Soil Description
0	-	2	-	Forest duff
2	-	14	SM	Brown silty SAND with gravel (loose, moist) (sandy till)

Terminated at 14 inches below the existing ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.
No mottling observed.

Logged by: AES/MM **Excavated on: September 23, 2020**

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PN: 0221213045

Appendix B

Laboratory Test Results

SPECTRA Laboratories ...Where experience matters
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10/02/2020

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: HA
Sample Matrix: Soil
Date Sampled: 09/23/2020
Date Received: 09/24/2020
Spectra Project: 2020090781

Client ID	Spectra #	Analyte	Result	Units	Method
HA 1, D= 0-6"	1	Arsenic--Protocol Prep	49.8	mg/Kg Dry	SW846 6010D
HA 1, D= 0-6"	1	Lead--Protocol Prep	90.0	mg/Kg Dry	SW846 6010D
HA 2, D= 0-6"	2	Arsenic--Protocol Prep	34.2	mg/Kg Dry	SW846 6010D
HA 2, D= 0-6"	2	Lead--Protocol Prep	71.0	mg/Kg Dry	SW846 6010D
HA 3, D= 0-6"	3	Arsenic--Protocol Prep	18.7	mg/Kg Dry	SW846 6010D
HA 3, D= 0-6"	3	Lead--Protocol Prep	30.1	mg/Kg Dry	SW846 6010D
HA 4, D= 0-6"	4	Arsenic--Protocol Prep	22.9	mg/Kg Dry	SW846 6010D
HA 4, D= 0-6"	4	Lead--Protocol Prep	90.1	mg/Kg Dry	SW846 6010D
HA 5, D= 0-6"	5	Arsenic--Protocol Prep	15.3	mg/Kg Dry	SW846 6010D
HA 5, D= 0-6"	5	Lead--Protocol Prep	9.3	mg/Kg Dry	SW846 6010D
HA 6, D= 0-6"	6	Arsenic--Protocol Prep	44.0	mg/Kg Dry	SW846 6010D
HA 6, D= 0-6"	6	Lead--Protocol Prep	22.6	mg/Kg Dry	SW846 6010D
HA 7, D= 0-6"	7	Arsenic--Protocol Prep	73.1	mg/Kg Dry	SW846 6010D
HA 7, D= 0-6"	7	Lead--Protocol Prep	73.2	mg/Kg Dry	SW846 6010D
HA 8, D= 0-6"	8	Arsenic--Protocol Prep	54.6	mg/Kg Dry	SW846 6010D
HA 8, D= 0-6"	8	Lead--Protocol Prep	61.7	mg/Kg Dry	SW846 6010D
HA 9, D= 0-6"	9	Arsenic--Protocol Prep	37.9	mg/Kg Dry	SW846 6010D
HA 9, D= 0-6"	9	Lead--Protocol Prep	56.0	mg/Kg Dry	SW846 6010D
HA 10, D= 0-6"	10	Arsenic--Protocol Prep	117	mg/Kg Dry	SW846 6010D
HA 10, D= 0-6"	10	Lead--Protocol Prep	78.4	mg/Kg Dry	SW846 6010D
HA 11, D= 0-6"	11	Arsenic--Protocol Prep	21.8	mg/Kg Dry	SW846 6010D

SPECTRA LABORATORIES

Christina Frans, QA Manager
a7/scj

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10/02/2020

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: HA
Sample Matrix: Soil
Date Sampled: 09/23/2020
Date Received: 09/24/2020
Spectra Project: 2020090781

Client ID	Spectra #	Analyte	Result	Units	Method
HA 11, D= 0-6"	11	Lead--Protocol Prep	42.8	mg/Kg Dry	SW846 6010D
HA 12, D= 0-6"	12	Arsenic--Protocol Prep	11.8	mg/Kg Dry	SW846 6010D
HA 12, D= 0-6"	12	Lead--Protocol Prep	18.7	mg/Kg Dry	SW846 6010D
HA 13, D= 0-6"	13	Arsenic--Protocol Prep	64.1	mg/Kg Dry	SW846 6010D
HA 13, D= 0-6"	13	Lead--Protocol Prep	126	mg/Kg Dry	SW846 6010D
HA 14, D= 0-6"	14	Arsenic--Protocol Prep	34.4	mg/Kg Dry	SW846 6010D
HA 14, D= 0-6"	14	Lead--Protocol Prep	61.8	mg/Kg Dry	SW846 6010D
HA 15, D= 0-6"	15	Arsenic--Protocol Prep	32.4	mg/Kg Dry	SW846 6010D
HA 15, D= 0-6"	15	Lead--Protocol Prep	44.4	mg/Kg Dry	SW846 6010D
HA 16, D= 0-6"	16	Arsenic--Protocol Prep	16.0	mg/Kg Dry	SW846 6010D
HA 16, D= 0-6"	16	Lead--Protocol Prep	25.0	mg/Kg Dry	SW846 6010D
HA 17, D= 0-6"	17	Arsenic--Protocol Prep	12.8	mg/Kg Dry	SW846 6010D
HA 17, D= 0-6"	17	Lead--Protocol Prep	21.0	mg/Kg Dry	SW846 6010D
HA 18, D= 0-6"	18	Arsenic--Protocol Prep	9.1	mg/Kg Dry	SW846 6010D
HA 18, D= 0-6"	18	Lead--Protocol Prep	18.3	mg/Kg Dry	SW846 6010D
HA 19, D= 0-6"	19	Arsenic--Protocol Prep	24.5	mg/Kg Dry	SW846 6010D
HA 19, D= 0-6"	19	Lead--Protocol Prep	51.7	mg/Kg Dry	SW846 6010D
HA 20, D= 0-6"	20	Arsenic--Protocol Prep	34.3	mg/Kg Dry	SW846 6010D
HA 20, D= 0-6"	20	Lead--Protocol Prep	51.8	mg/Kg Dry	SW846 6010D
HA 21, D= 0-6"	21	Arsenic--Protocol Prep	7.8	mg/Kg Dry	SW846 6010D
HA 21, D= 0-6"	21	Lead--Protocol Prep	13.5	mg/Kg Dry	SW846 6010D

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Christina Frans, QA Manager

a7/scj

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10/02/2020

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: HA
Sample Matrix: Soil
Date Sampled: 09/23/2020
Date Received: 09/24/2020
Spectra Project: 2020090781

Client ID	Spectra #	Analyte	Result	Units	Method
HA 22, D= 0-6"	22	Arsenic--Protocol Prep	11.3	mg/Kg Dry	SW846 6010D
HA 22, D= 0-6"	22	Lead--Protocol Prep	22.8	mg/Kg Dry	SW846 6010D
HA 23, D= 0-6"	23	Arsenic--Protocol Prep	22.3	mg/Kg Dry	SW846 6010D
HA 23, D= 0-6"	23	Lead--Protocol Prep	20.4	mg/Kg Dry	SW846 6010D
HA 24, D= 0-6"	24	Arsenic--Protocol Prep	18.8	mg/Kg Dry	SW846 6010D
HA 24, D= 0-6"	24	Lead--Protocol Prep	35.0	mg/Kg Dry	SW846 6010D
HA 25, D= 0-6"	25	Arsenic--Protocol Prep	48.7	mg/Kg Dry	SW846 6010D
HA 25, D= 0-6"	25	Lead--Protocol Prep	97.0	mg/Kg Dry	SW846 6010D
HA 26, D= 0-6"	26	Arsenic--Protocol Prep	21.1	mg/Kg Dry	SW846 6010D
HA 26, D= 0-6"	26	Lead--Protocol Prep	41.0	mg/Kg Dry	SW846 6010D
HA 27, D= 0-6"	27	Arsenic--Protocol Prep	52.5	mg/Kg Dry	SW846 6010D
HA 27, D= 0-6"	27	Lead--Protocol Prep	40.8	mg/Kg Dry	SW846 6010D
HA 28, D= 0-6"	28	Arsenic--Protocol Prep	4.4	mg/Kg Dry	SW846 6010D
HA 28, D= 0-6"	28	Lead--Protocol Prep	6.3	mg/Kg Dry	SW846 6010D
HA 29, D= 0-6"	29	Arsenic--Protocol Prep	21.1	mg/Kg Dry	SW846 6010D
HA 29, D= 0-6"	29	Lead--Protocol Prep	29.3	mg/Kg Dry	SW846 6010D
HA 30, D= 0-6"	30	Arsenic--Protocol Prep	9.6	mg/Kg Dry	SW846 6010D
HA 30, D= 0-6"	30	Lead--Protocol Prep	21.0	mg/Kg Dry	SW846 6010D
HA 31, D= 0-6"	31	Arsenic--Protocol Prep	15.5	mg/Kg Dry	SW846 6010D
HA 31, D= 0-6"	31	Lead--Protocol Prep	19.6	mg/Kg Dry	SW846 6010D

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10/02/2020

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: HA
Sample Matrix: Soil
Date Sampled: 09/23/2020
Date Received: 09/24/2020
Spectra Project: 2020090781

Client ID	Spectra #	Analyte	Result	Units	Method
HA 32, D= 0-6"	32	Arsenic--Protocol Prep	30.3	mg/Kg Dry	SW846 6010D
HA 32, D= 0-6"	32	Lead--Protocol Prep	44.4	mg/Kg Dry	SW846 6010D
HA 1, D= 6-12"	33	Arsenic--Protocol Prep	18.3	mg/Kg Dry	SW846 6010D
HA 1, D= 6-12"	33	Lead--Protocol Prep	30.3	mg/Kg Dry	SW846 6010D
HA 4, D= 6-12"	34	Arsenic--Protocol Prep	21.1	mg/Kg Dry	SW846 6010D
HA 4, D= 6-12"	34	Lead--Protocol Prep	41.2	mg/Kg Dry	SW846 6010D
HA 8, D= 6-12"	35	Arsenic--Protocol Prep	13.2	mg/Kg Dry	SW846 6010D
HA 8, D= 6-12"	35	Lead--Protocol Prep	14.7	mg/Kg Dry	SW846 6010D
HA 12, D= 6-12"	36	Arsenic--Protocol Prep	21.9	mg/Kg Dry	SW846 6010D
HA 12, D= 6-12"	36	Lead--Protocol Prep	23.2	mg/Kg Dry	SW846 6010D
HA 16, D= 6-12"	37	Arsenic--Protocol Prep	15.9	mg/Kg Dry	SW846 6010D
HA 16, D= 6-12"	37	Lead--Protocol Prep	21.6	mg/Kg Dry	SW846 6010D
HA 20, D= 6-12"	38	Arsenic--Protocol Prep	29.0	mg/Kg Dry	SW846 6010D
HA 20, D= 6-12"	38	Lead--Protocol Prep	31.5	mg/Kg Dry	SW846 6010D
HA 24, D= 6-12"	39	Arsenic--Protocol Prep	27.0	mg/Kg Dry	SW846 6010D
HA 24, D= 6-12"	39	Lead--Protocol Prep	28.1	mg/Kg Dry	SW846 6010D
HA 28, D= 6-12"	40	Arsenic--Protocol Prep	11.7	mg/Kg Dry	SW846 6010D
HA 28, D= 6-12"	40	Lead--Protocol Prep	13.3	mg/Kg Dry	SW846 6010D
HA 32, D= 6-12"	41	Arsenic--Protocol Prep	23.2	mg/Kg Dry	SW846 6010D
HA 32, D= 6-12"	41	Lead--Protocol Prep	43.6	mg/Kg Dry	SW846 6010D
Composite 1	42	Arsenic--Protocol Prep	10.3	mg/Kg Dry	SW846 6010D

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Kristie Hintz for
Christina Frans, QA Manager
a7/scj

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10/02/2020

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: HA
Sample Matrix: Soil
Date Sampled: 09/23/2020
Date Received: 09/24/2020
Spectra Project: 2020090781

Client ID	Spectra #	Analyte	Result	Units	Method
Composite 1	42	Lead--Protocol Prep	50.9	mg/Kg Dry	SW846 6010D
Composite 2	43	Arsenic--Protocol Prep	32.1	mg/Kg Dry	SW846 6010D
Composite 2	43	Lead--Protocol Prep	42.6	mg/Kg Dry	SW846 6010D
Composite 3	44	Arsenic--Protocol Prep	30.0	mg/Kg Dry	SW846 6010D
Composite 3	44	Lead--Protocol Prep	45.1	mg/Kg Dry	SW846 6010D
Composite 4	45	Arsenic--Protocol Prep	28.6	mg/Kg Dry	SW846 6010D
Composite 4	45	Lead--Protocol Prep	43.0	mg/Kg Dry	SW846 6010D

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10/1/2020

Geo Resources, LLC
5007 Pacific Hwy. E.
Suite 16
Fife, WA 98424

Units: mg/Kg
Spectra Project: 2020090781
Applies to Spectra #'s 1-20
Analyst: SCJ

QUALITY CONTROL RESULTS
ICP Metals SW846 6010D - Soil/Solid

Method Blank

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Blank Result
Arsenic	< 2.5
Lead	< 2.5

Laboratory Control Sample (LCS)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Spike Added	LCS Conc.	LCS %Rec
Arsenic	200.0	197.9	99.0
Lead	200.0	197.4	98.7

LCS Recovery limits 80-120%

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020
Sample Spiked: 2020090781-1

Element	Sample Conc.	Spike Conc.	MS Conc.	MS %Rec	MSD Conc	MSD %Rec	RPD
Arsenic	91.8	200.0	277.3	92.8	276.4	92.3	0.5
Lead	165.8	200.0	318.1	76.2	318.0	76.1	0.1

Comment:
Recovery Limits 75-125%
RPD Limit 20

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10/1/2020

Geo Resources, LLC
5007 Pacific Hwy. E.
Suite 16
Fife, WA 98424

Units: mg/Kg
Spectra Project: 2020090781
Applies to Spectra #'s 21-40
Analyst: SCJ

QUALITY CONTROL RESULTS
ICP Metals SW846 6010D - Soil/Solid

Method Blank

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Blank Result
Arsenic	< 2.5
Lead	< 2.5

Laboratory Control Sample (LCS)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Spike Added	LCS Conc.	LCS %Rec
Arsenic	200.0	196.4	98.2
Lead	200.0	194.3	97.2

LCS Recovery limits 80-120%

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020
Sample Spiked: 2020090781-21

Element	Sample Conc.	Spike Conc.	MS Conc.	MS %Rec	MSD Conc	MSD %Rec	RPD
Arsenic	14.1	200.0	202.6	94.3	198.5	92.2	2.2
Lead	24.3	200.0	195.0	85.4	192.6	84.2	1.4

Comment:
Recovery Limits 75-125%
RPD Limit 20

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10/1/2020

Geo Resources, LLC
5007 Pacific Hwy. E.
Suite 16
Fife, WA 98424

Units: mg/Kg
Spectra Project: 2020090781
Applies to Spectra #'s 41-45
Analyst: SCJ

QUALITY CONTROL RESULTS
ICP Metals SW846 6010D - Soil/Solid

Method Blank

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Blank Result
Arsenic	< 2.5
Lead	< 2.5

Laboratory Control Sample (LCS)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020

Element	Spike Added	LCS Conc.	LCS %Rec
Arsenic	200.0	194.2	97.1
Lead	200.0	193.5	96.8

LCS Recovery limits 80-120%

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Date Digested: 10/1/2020 Date Analyzed: 10/1/2020
Sample Spiked: 2020090781-41

Element	Sample Conc.	Spike Conc.	MS Conc.	MS %Rec	MSD Conc	MSD %Rec	RPD
Arsenic	40.5	200.0	233.7	96.6	228.9	94.2	2.5
Lead	76.0	200.0	249.4	86.7	251.2	87.6	1.0

Comment:
Recovery Limits 75-125%
RPD Limit 20

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CHAIN OF CUSTODY

NAME GeoResources, LLC

ADDRESS 4809 Pacific Hwy E, Fife, WA 98424

PHONE # (253) 896-1011 FAX #

E-MAIL SethM@georesources.us; KeithS@georesources.us; AndrewS@georesources.us;

SAMPLE ID:	DATE SAMPLED	TIME SAMPLED	MATRIX	Arsenic $37.00	Arsenic & Lead $44.00	Arsenic, Lead, and Cadmium $52.00		NORMAL	RUSH (50% Surcharge)
HA 1, D= 0-6"	9/23/20		Soil		X				
HA 2, D= 0-6"	9/23/20		Soil		X				
HA 3, D= 0-6"	9/23/20		Soil		X				
HA 4, D= 0-6"	9/23/20		Soil		X				
HA 5, D= 0-6"	9/23/20		Soil		X				
HA 6, D= 0-6"	9/23/20		Soil		X				
HA 7, D= 0-6"	9/23/20		Soil		X				
HA 8, D= 0-6"	9/23/20		Soil		X				
HA 9, D= 0-6"	9/23/20		Soil		X				
HA 10, D= 0-6"	9/23/20		Soil		X				

Relinquished by:	Company:	Date:	Time:
Andrew Schnitger	GeoResources, LLC	9/24/20	1:55
Received by:	**Company:**	**Date:**	**Time:**
Marie Holt	Spectra	9-24-20	1:55

Payment Terms: Net 30 days for clients with existing accounts. New clients or one time clients must pay for analysis at the time samples are delivered to the Lab. Past due accounts subject to 18% per annum interest. Customer agrees to pay all costs of collection including reasonable attorney's fees and all other associated costs of collection regardless of whether suit is filed.

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PHONE # (253) 896-1011 FAX #

E-MAIL SethM@georesources.us; KeithS@georesources.us; AndrewS@georesources.us;

SAMPLE ID:	DATE SAMPLED	TIME SAMPLED	MATRIX	Arsenic $37.00	Arsenic & Lead $44.00	Arsenic, Lead, and Cadmium $52.00		NORMAL	RUSH (50% Surcharge)
HA 11, D= 0-6"	9/23/20		Soil		X				
HA 12, D= 0-6"	9/23/20		Soil		X				
HA 13, D= 0-6"	9/23/20		Soil		X				
HA 14, D= 0-6"	9/23/20		Soil		X				
HA 15, D= 0-6"	9/23/20		Soil		X				
HA 16, D= 0-6"	9/23/20		Soil		X				
HA 17, D= 0-6"	9/23/20		Soil		X				
HA 18, D= 0-6"	9/23/20		Soil		X				
HA 19, D= 0-6"	9/23/20		Soil		X				
HA 20, D= 0-6"	9/23/20		Soil		X				

Relinquished by:	Company:	Date:	Time:
Andrew Schnitger	GeoResources, LLC	9/24/20	1:55
Received by:	**Company:**	**Date:**	**Time:**
Marie Holt	Spectra	9-24-20	1:55

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E-MAIL SethM@georesources.us; KeithS@georesources.us; AndrewS@georesources.us;

SAMPLE ID:	DATE SAMPLED	TIME SAMPLED	MATRIX	Arsenic $37.00	Arsenic & Lead $44.00	Arsenic, Lead, and Cadmium $52.00		NORMAL	RUSH (50% Surcharge)
HA 21, D= 0-6"	9/23/20		Soil		X				
HA 22, D= 0-6"	9/23/20		Soil		X				
HA 23, D= 0-6"	9/23/20		Soil		X				
HA 24, D= 0-6"	9/23/20		Soil		X				
HA 25, D= 0-6"	9/23/20		Soil		X				
HA 26, D= 0-6"	9/23/20		Soil		X				
HA 27, D= 0-6"	9/23/20		Soil		X				
HA 28, D= 0-6"	9/23/20		Soil		X				
HA 29, D= 0-6"	9/23/20		Soil		X				
HA 30, D= 0-6"	9/23/20		Soil		X				

Relinquished by:	Company:	Date:	Time:
Andrew Schnitger	GeoResources, LLC	9/24/20	1:55
Received by:	**Company:**	**Date:**	**Time:**
Marie Holt	Spectra	9-24-20	1:55

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SPECTRA LABORATORIES

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CHAIN OF CUSTODY

9
20200807 81
MAN

NAME GeoResources, LLC

ADDRESS 4809 Pacific Hwy E, Fife, WA 98424

PHONE # (253) 896-1011 FAX #

E-MAIL SethM@georesources.us; KeithS@georesources.us; AndrewS@georesources.us;

SAMPLE ID:	DATE SAMPLED	TIME SAMPLED	MATRIX	Arsenic $37.00	Arsenic & Lead $44.00	Arsenic, Lead, and Cadmium $52.00		NORMAL	RUSH (50% Surcharge)
HA 31, D= 0-6"	9/23/20		Soil		X				
HA 32, D= 0-6"	9/23/20		Soil		X				
HA 1, D= 6-12"	9/23/20		Soil		X				
HA 4, D= 6-12"	9/23/20		Soil		X				
HA 8, D= 6-12"	9/23/20		Soil		X				
HA 12, D= 6-12"	9/23/20		Soil		X				
HA 16, D= 6-12"	9/23/20		Soil		X				
HA 20, D= 6-12"	9/23/20		Soil		X				
HA 24, D= 6-12"	9/23/20		Soil		X				
HA 28, D= 6-12"	9/23/20		Soil		X				

Relinquished by:	Company:	Date:	Time:
Andrew Schnitger	GeoResources, LLC	9/24/20	1:55
Received by:	**Company:**	**Date:**	**Time:**
Marie Holt	Spectra	9-24-20	1:55

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PHONE # (253) 896-1011 FAX # _____

E-MAIL SethM@georesources.us; KeithS@georesources.us; AndrewS@georesources.us;

SAMPLE ID:	DATE SAMPLED	TIME SAMPLED	MATRIX	Arsenic $37.00	Arsenic & Lead $44.00	Arsenic, Lead, and Cadmium $52.00		NORMAL	RUSH (50% Surcharge)
HA 32, D= 6-12"	9/23/20		Soil		X				
Composite 1	9/23/20		Soil		X				
Composite 2	9/23/20		Soil		X				
Composite 3	9/23/20		Soil		X				
Composite 4	9/23/20		Soil		X				

Relinquished by:	Company:	Date:	Time:
Andrew Schnitger	GeoResources, LLC	9/24/20	1:55
Received by:	**Company:**	**Date:**	**Time:**
Marie Holt	Spectra	9-24-20	1:55

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