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GEOTECHNICAL REPORT
LANDSLIDE ON US 101 AT MP ~~322~~ 322
LILLIWAUP, WASHINGTON

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February 8, 2000

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DOT-50000049

EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation of the landslide at MP 322 along US 101 on the Olympic Peninsula. The work included an extensive, multi-phased exploration program, laboratory testing, geologic interpretations, hydrogeologic characterization, remote monitoring of the landslide, stability analyses, and development of engineering recommendations to stabilize the landslide.

In general, the subsurface conditions include a glaciofluvial unit, a finer grain granular transition layer and a deep glaciolacustrine silt/clay unit. The materials above the slide plane are very loose/compact or firm. The inferred failure plane occurred generally within the glaciolacustrine clay in the lower part of the slide and through the granular soils above the clay in the headscarp area. The toe of the landslide occurred at or above the road with the road itself only impacted by debris flowing on the roadway. In areas, 20 to 40 feet of ancient landslide debris underlie the roadway. Groundwater occurs at a maximum of only about 5 to 15 feet above the landslide plane. The inferred elevation of the top of the glaciolacustrine clay appears to form a deep depression just upslope of the central area of the landslide. The soils overlying the glaciolacustrine clay in the depression are saturated and constitute a buried groundwater "reservoir".

In essence the recommended remediation involve combination of drainage, slope surface treatment, and a toe treatment consisting of a fill buttress and/or deep soldier pile tieback retaining wall. The design criteria presented in the report are intended to be flexible since the optimum design configuration selected by WSDOT must consider numerous constraints beyond the scope of this study. This includes the current slope and roadway grades, constructibility related to minimizing impacts on traffic, the final desired roadway alignment and grades, and costs. The proposed remediation is not intended to eliminate possible seismically induced slope movements during major design earthquake events.

Section 9.7 addresses design issues along specific sections of the roadway. Once WSDOT has finalized the selected options and developed current cross-sections, a series of stability analyses should be performed at each major change in geometry and/or remediation option. The results of the section specific analysis would be used to finalize the required size of the buttress, loads and \heights of wall, and fill reinforcement requirements.

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APPENDICES

1. INTRODUCTION

This report presents the results of the geotechnical investigation of the landslide at MP 322 along US 101 on the Olympic Peninsula (Figure 1). The work was completed under WSDOT Consultant Agreement Y-6895 and was authorized as Task Assignment AF. The work included an extensive, multi-phased exploration program, laboratory testing, geologic interpretations, hydrogeologic characterization, remote monitoring of the landslide, stability analyses, and development of engineering recommendations to stabilize the landslide. The primary purposes of the work were: 1) Determine the subsurface conditions, 2) Evaluate the landslide mechanism, 3) Develop short-term stabilization recommendations, and 4) Develop permanent, long-term stabilization recommendations.

As shown on Figure 1, the landslide is located along US 101 at MP 322 just north of Eldon, Washington on the Olympic Peninsula adjacent to the Hood Canal. Through this area, US 101 is located just above the Hood Canal along the toe of a steep hillside rising several hundred feet to the west. As shown on Figure 2, the landslide extends along US 101 about 1,100 feet and upslope a horizontal distance of about 500 feet with a vertical rise of about 250 feet. The majority of the landslide movements occurred starting about mid-February and continuing through March 1999. At this time US 101 was closed and local traffic was re-routed around the slide over existing paved and gravel roads located inland to the west. The southern portion of the slide continued to move through about mid-May 1999 at which time it appeared to stop. In about late-April and early-May 1999, attempts were made to remove the landslide debris blocking US 101 at the toe of the slide. This activity was ceased when further landslide movement was observed. In late May 1999, a re-route detour was constructed over the slide debris covering US 101 forming about a 20 foot high toe buttress. In late-October through November 1999, the southern portion of the slide, essentially up-slope of the re-route, began moving again along with portions of the landslide toe area adjacent to US 101 to the north. In December 1999, the detour buttress was raised an additional 6 feet and appears to have stabilized the slide.

Sections 2 through 5 summarize the investigation program, evaluation of the subsurface conditions, and assessment of the landslide mechanism. Sections 6 through 8 present a discussion of remediation objectives and options. Section 9 presents specific design recommendations. The attached Figures and Appendices contain the site exploration plan, interpreted geologic cross-sections, boring logs, several stratigraphic contour plots, laboratory test results, results of the geophysical survey, piezometer data, data on installed horizontal drains, inclinometer data, and results of hydrogeologic testing.

2. SUBSURFACE INFORMATION

2.1 General

This subsurface investigation included a review of available published geologic maps and review of available aerial photographs. A list of the references is contained in Section 12.0. The field investigation included surface geologic reconnaissance, borings, installation of piezometers and inclinometers, laboratory testing, surface geophysics, and hydrogeologic testing.

Figure 2 shows the locations of the explorations and installed instrumentation, and the major mapped slide features. The locations of the emergency horizontal drains to date by WSDOT are shown on Figures 3 and 18. The subsections below summarize the information with the detailed data presented in Appendices A through F.

2.2 Subsurface Mapping and Aerial Photograph Interpretation

During the course of the investigation from April to November 1999, Golder staff geologists performed a site reconnaissance of the overall landslide area. The purpose was to identify and map the major scarps and ground ruptures, areas of seepage, document exposed soil conditions, and reconnoiter surrounding areas for evidence of instability. In addition to this work, post-slide aerial photos flown by WSDOT were reviewed.

The results of this work are summarized on Figure 2 showing the mapped scarps with the direction of movement. The figure also shows locations of observed seeps. The information depicted on Figure 2 represents the approximate conditions in November 1999.

2.3 Field Exploration Program

2.3.1 Geotechnical Borings

2.3.1.1 <u>General</u>

The boring program consisted of explorations at fourteen locations by Golder and six locations by WSDOT for a total of 20 locations as shown on Figure 2.

Golder's exploration program was performed in three phases. Explorations at nine of the locations were performed during the first phase of the investigation between April 28, 1999, and June 6, 1999. Boring locations drilled during the first phase of the investigation were located in three lines oriented generally northwest-southeast in the direction of landslide movement. The uppermost borings in each line were located behind the active landslide headscarp in order to determine the in-place soil and groundwater conditions outside the active landslide mass. The second phase of the investigation included explorations at five additional locations between August 30, 1999,

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and September 21, 1999. The purpose of the second phase of the drilling program was to further investigate the subsurface conditions in areas where geologic and hydrogeologic relationships needed to be further defined, and to provide additional piezometers and inclinometers for monitoring through the 1999/2000-winter season. At ten of the fourteen locations, the boreholes were completed as inclinometers (including two "poor boy" inclinometers) with a piezometer installed in an adjacent separate drillhole. Borings at the other four locations were completed with only piezometers. The third phase of our field investigation included drilling and installation of a hydrogeologic test well located west of the landslide in the area of the "reservoir" discussed in more detail in Section 2.32 and 4.1.

Geotechnical drilling was performed by Crux Subsurface, Inc. Spokane, Washington under contract to WSDOT.. Drilling of the inclinometers and piezometers utilized a combination of HQ (3.5 inch) and HWT (4.5 inch) casing advancer, and HQ (2.5 inch) coring techniques. The drills consisted of a Crux-built 2500 drill and a Burley 4500. The drills were easily assembled and disassembled and were transported to the drill sites in pieces using a Bell Jet Ranger helicopter provided by Aero-Copters, Inc. based at Boeing Field in Seattle, Washington. During the second phase of the drilling investigation, a knuckle-boom was used to lift the drill onto the drill site (GA-14) located on the outboard side of the re-route over the toe of the slide due to concerns with flying in close proximity to power lines in the area.

Tacoma Pump and Drill, under contract to WSDOT, drilled and installed the test well for the third phase of the field investigation.

Golder field personnel were not present during drilling activities at the six WSDOT borings (H-1-99, H-1R-99, H-2R-99, TH-1-99, TH-2-99, and TH-3-99) located along US 101 and above (west of) the landslide headscarp. The boring logs for the WSDOT borings are contained in Appendix A

2.3.1.2 <u>Borings</u>

A Golder geologist was present during all drilling activities to observe and document the drilling activities, record the soil and groundwater conditions encountered, the engineering characteristics of the soil units encountered, and collect samples of the soil materials at all of the fourteen borings drilled by Crux.

At individual drill sites where multiple boring completions were performed (shallow/deep piezometers or inclinometer/piezometer) the boreholes were drilled within about 5 feet (1.5 m) of each other. One of the borings at each location (typically the inclinometer boring or the deeper of the two-piezometer borings) was sampled and represents the geotechnical data borings. The adjacent, shallower boring was typically speed drilled without sampling over the upper portions of the hole. The locations of the borings are shown on the Site Plan (Figure 2).

Soil samples were generally collected using Standard Penetration Tests (SPT's) where a 2-inch-diameter split-spoon sampler was driven 18-inches (5.5 cm) using a 140-pound

(63.5-kg) hammer in accordance with the ASTM D-1586 test method. A 24-inch (61-cm) sampler was used in GA-10 during the second phase of our investigation to continuously sample through the landslide failure surface. The number of blows of the hammer required to drive the sampler every 6 inches (15.2 cm) was recorded, and the number of blows needed to drive the last 12-inches (30.5 cm) are used to determine the SPT "N" values (blow counts). The collected soil samples were placed in plastic containers and shipped to Golder's Redmond, Washington facility for storage, additional classification, and selected laboratory testing. SPT's were the most common sampling method utilized during both phases of the investigation. During the first phase of the investigation, soil cores and Shelby tubes were also collected at selected intervals.

When difficult drilling conditions were encountered (poor recovery or difficulty in advancing the hole), the material was cored continuously using HQ-size coring equipment. HQ coring, in some cases, provided a more continuous column of sample for inspection. In other cases, where core recovery was poor, or density confirmation was desired, SPT samples were collected in conjunction with the coring. Typically, the core was drilled in 5-foot (1.5 m) runs, and the material was logged in general accordance with Golder's standard core logging procedures. The majority of the core samples were retained in core boxes and shipped to Golder's Redmond, Washington facility for storage. Selected portions of the core samples were stored in plastic ziplock bags to limit moisture loss.

Shelby tubes were also pushed to collect relatively undisturbed samples near or across the anticipated landslide planes. These 2.5-inch (6.4-cm) ID thin wall samplers were collected in general accordance with ASTM D-1587. The Shelby tubes were pushed to their full 18 (45.7 cm) or 24-inch (61 cm) length or until they met refusal. The Shelby tubes were carefully withdrawn from the borings, capped immediately, and kept upright during transport to minimize disturbance of the samples.

Detailed field logs of the soil materials encountered in the boreholes were completed in the field. These borehole logs were edited, finalized, and are included in Appendix A. A summary of the piezometers and inclinometers is presented in Table 1.

2.3.1.3 Inclinometer Completions

The inclinometer boreholes were drilled to depths ranging from about 71 to 127-feet (21.6 to 38.7 m) below the existing ground surface (bgs) in the toe area of the active landslide, from about 86 to 128-feet (26.2 to 39 m) bgs in the middle portion of the slide, and from about 208 to 235-feet (63.4 to 71.6 m) bgs above the active landslide headscarp.

Slope Indicator Company located in Bothell, Washington manufactured the inclinometer casing used during the first phase of the investigation. Inclinometer casing manufactured by RST of Coquitlam, British Columbia, Canada was used in GA-10 during the second phase of the investigation. The inclinometer casing came in 10-foot sections. Slope Indicator brand casing sections were fastened together with snap joints with O-rings. The RST brand slope inclinometer casing joints were glued and also contained O-rings. The casing was assembled in the borehole, charged with water, and clean SPT sampling rods were lowered to the bottom of the casing before grouting (cementing) the casing in place. The casing was cemented in place using a lime/cement mixture. Where grout loss was anticipated, powdered bentonite was added to the mix. The grout batches were pumped down the steel drill casing to the bottom of the boring. The drill casing was then withdrawn from the boring. WSDOT field personnel collected baseline inclinometer readings and subsequent readings after allowing the grout to set for at least a 10-hour period. The collected data was then processed by WSDOT and forwarded to Golder for review.

Plots of the inclinometer data through November 7, 1999 are contained in Appendix B. Since the inclinometers were installed after the landslide had ceased movement, the data does not reflect the total magnitude of the slope movements. In general, where the readings give a high degree of confidence, the depth of the landslide failure surface indicated by the inclinometer readings correspond to within about nine feet of the base of the landslide as interpreted in the borings.

2.3.1.4 Piezometer Completions

The piezometer boreholes were drilled to depths ranging from about 37 to 76-feet (11.3 to 23.2 m) bgs in the toe area of the active landslide, from about 86 to 108-feet (26.2 to 32.9 m) bgs in the middle portion of the slide, and from about 65 to 143-feet (19.8 to 43.6 m) bgs in the upper portions of the slide. Above the active landslide headscarp, the depth of the piezometer borings ranges from 155 to 235-feet (47.2 to 71.6 m) bgs. An additional shallow piezometer was installed at the GA-1 boring cluster to a depth of about 26 feet (7.9 m) bgs as directed by WSDOT. The deep piezometer in boring H-1-99 (GA-3A) above the headscarp on the middle line was installed by WSDOT prior to mobilizing to the site. Piezometers were also installed by WSDOT in borings TH-1-99 and TH-3-99 located on US 101 below the north toe area of the slide.

The piezometers were constructed using 2-inch (5.1 cm) outside diameter (OD) Schedule 40 PVC. The screens were generally 0.010 machine slotted Schedule 40 PVC. The slotted section was backfilled with 10/20-silica sand. The screens were set at the desired depths to monitor the groundwater conditions. Seals were constructed above the monitored interval up to ground surface using bentonite granules and/or bentonite grout sealing materials. Details of the piezometer construction for each borehole are included on the borehole logs presented in Appendix A.

A summary of available groundwater levels measured through mid November is presented on Table 2. Groundwater hydrographs for each piezometer are presented in Appendix C. In piezometers GA-4A, GA-7A, and GA-10A, slug tests were performed to estimate the permeability. The results of these tests are summarized on Table 3. As discussed in Section 2.3.4 and shown on Figure 2, WSDOT has installed horizontal drains during May and June 1999, and again in September to early December 1999. These drains have likely impacted the groundwater levels measured in the piezometers near the drains.

2.3.1.5 Instrumentation and Remote Data Access

The MP 322 landslide area was instrumented from the onset of the site investigation as described in Section 2.3.1.3 and 2.3.1.4. In November 1999 some of this instrumentation was replaced and upgraded with a set of sensors that were configured to be accessible by remote telemetry. The instrumentation program included the following sensors:

- three slope indicators positioned to span the failure plane in Boreholes GA-1C, GA-5, and GA-7
- five piezometers installed in Boreholes GA-1A, GA-1B, GA-3, GA-5A and GA-7A
- a rain gauge located at the site of GA-5.

These sensors were linked in the field to automatic data logging equipment and also were connected through radio links to a telephone modem that supported direct linkage with the Golder offices in Portland and Redmond. A downlink at WSDOT facilities is planned. The field instrumentation is powered by a solar energy system.

Data can be obtained from the Instrumentation and Remote Data Access by several means. The field data loggers collect information that is stored and can be downloaded. The remote telemetry system can be used to call up the field data loggers at any time and obtain data. Finally, the Data Access system can be configured to call automatically, typically once per day, and to download data to a remote data base.

Data have been collected since November from the MP 322 instrumentation and these data have been used in the assessment presented in this report. The major objective of the Instrumentation and Remote Data Access system is to provide a long term data monitoring capability for the slide area. These data can be used both for monitoring of the landslide and any remedial measures that are constructed and also management of the landslide risk.

2.3.2 Seismic Refraction Survey

A seismic refraction survey was performed as part of the subsurface investigation of the MP 322 landslide. The seismic refraction survey consisted of shot lines oriented approximately north-south across the width of the landslide and approximately east-west across the landslide. Two additional shot lines oriented north-south and east-west were located west of the landslide headscarp to investigate the subsurface extent of a stratigraphic depression that forms a "reservoir" in the erosional upper surface in the top of the glaciolacustrine deposits suggested by borings performed during the first phase of the investigation. The locations of the seismic lines are shown on Figures 2 and 3. Results of the refraction survey are presented in Appendix D.

2.3.3 Hydrogeologic Testing

A hydrogeologic test well was drilled west of the landslide headscarp and WSDOT boring H-1-99 in order to characterize the soil and groundwater conditions in the area of

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the "reservoir" suggested by the seismic refraction survey and a previously drilled boring (H-1-99). The test well was anticipated to be about 300 feet (91.4 m) deep. A Golder field geologist was present to observe and document the drilling activities, record the soil and groundwater conditions encountered, collect grab samples of the soil materials, document well installation and development activities, and perform a step drawdown pump test.

Great West Drilling (Great West) out of Fontana, California, under contract to WSDOT, was on site from November 8 to November 11, 1999. Great West used a truck-mounted AP 1000 Becker drill to advance 10-foot (3.1 m) long sections of 8-inch (20.3-cm) I.D. (inner diameter) steel well casing. The Becker drill utilizes a Becker hammer to advance 6 5/8-inch (16.8 cm) OD (outer diameter) dual walled drill casing. The 8-inch (20.3-cm) I.D. steel well casing is advanced down the boring immediately behind the drill casing. The soil cuttings are transported directly from the bottom of the advancing borehole up the inside of the dual-walled drill casing to the ground surface. Great West was able to advance the boring to about 110 feet (33.5 m) bgs (below ground surface) before difficult drilling was encountered and the well casing separated near one of the welded joints in the boring. Great West was able to retrieve all the casing from the boring before leaving the site. WSDOT contracted Tacoma Pump and Drill (Tacoma Pump) of Graham, Washington to finish drilling, installation, and development of the test well using a Barber DR 24 air rotary drill. Tacoma Pump was on site from November 16 to November 22, 1999. The Barber drill uses air to transport the soil cuttings up the annulus between the single walled drill casing and the 8-inch (20.3 cm) I.D. steel well casing. The Barber drill uses a lower drive unit to advance the 8-inch (20.3-cm) I.D. well casing behind the drill casing. Rather than re-drilling down the existing boring, on site personnel from Golder, WSDOT, and Tacoma Pump decided to offset about 17 feet (5.2 m) to the north and drill another boring. A 7 5/8-inch (19.4 cm) tricone button bit was used to drill the boring ahead of the advancing 8-inch (20.3 cm) well casing. Tacoma Pump assembled the 8-inch (20.3-cm) well casing in 20-foot lengths. All the 8-inch (20.3 cm) I.D. well casing joints were welded.

During drilling, grab samples were collected from the discharge hose every five feet of drill depth. The grab samples were placed in one gallon ziplock baggies and shipped to Golder's Redmond, Washington office for additional classification. Two grab samples from within the anticipated well screen depth interval were delivered to the WSDOT soils laboratory in Tumwater, Washington for grain size analysis.

At the conclusion of drilling, the screen and sump were assembled at the top of the well. A K-packer was welded to the top of the screen assembly to create an annular seal between the 8-inch (20.3 cm) I.D. well casing and the screen assembly. The 8-inch (20.3 cm) I.D. well casing was pulled back to the desired bottom elevation for the screen/sump assembly. The bottom of the boring was backfilled with bentonite chips and clean gravel. The screen and sump assembly was lowered into the boring and the 8-inch (20.3 cm) I.D. well casing was again pulled back to expose the well screen and sump. The well was air developed for about 2 hours until the sediment load within the developed water decreased and appeared to stabilize.

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The pump assembly installed by the WSDOT consisted of a 7.5 horse power submersible pump connected to a 2.5-inch (6.4-cm) diameter riser. The pump test was performed on December 8, 1999.The test pump well was GA-15 and was 297 feet (90.5 m) deep and screened from between 190 feet (57.9m) to 225 feet (68.6m). The pump was set about 207 feet (63.m) below the ground surface. The well was pumped for a total period of about 8 hours at successive rates of 25, 35, 45, and 53 gallons per minute (95,132.5,170, 200.6 liters per minute). At a pumping rate of 53 gpm (200.6 l/min.), the groundwater level was located at the pump intake level.

Water levels at each pumping step stabilized quickly. The specific capacity of the well ranged from 2.8 to 55 gpm (10.6 to 208.2 lit/min) per foot (.305 m) of drawdown. Some development (removal of fines and consolidation of material around the well bore) appears to have occurred during pumping, since the specific capacity is not linear with increasing pumping rate.

Results of the pump test and a detailed boring log for the tests well are contained in Appendix E.

2.4 WSDOT Emergency Horizontal Drains

In June/July 1999 WSDOT installed a series of 300 to 400 foot (91.4 to 121.9 m) long horizontal drains from four array locations above the road identified as Arrays A through D. In September through December 1999 a second series of horizontal drains was installed under the direction of WSDOT. These are identified as Drain Arrays E through N. Figures 3 and 18 show the approximate locations of the installed drains. The locations and orientations, particularly Arrays E through N, should be considered very approximate since as built data were not provided to Golder. In addition, the inclinations are not known although it was understood that WSDOT did obtain inclination data from the December 1999 installations.

The combined flows of the three initial arrays A though C decreased from about 206 gpm in early June to about 100 gpm (378 lit/min) in September 1999. Of the 35 drains in these initial three arrays, about 80 percent of the flow comes from three drains (A5, A6, A7) in array A and drain B8 in array B. In fact drain A7 by itself seems to discharge about 35 percent of the total flow. The discharge data for drains in arrays A, B, C, and D are summarized in Table 4 with representative plots of discharge versus time shown on Figure 4. Only limited drain discharge data have been collected from drains in Arrays E through N as many of the drains were covered by soil debris resulting from the recent wet weather of November and December 1999. The limited data collected from these drains are presented in Table 5.

2.5 Laboratory Data

Laboratory testing was performed consisting of grain size analyses, water contents, and Atterberg Limits on representative samples from the glaciolacustrine landslide debris, landslide debris near the failure surface of the slide, and on samples of the glaciolacustrine deposits. Direct shear testing under drained conditions (ASTM D-3080) was done on selected samples of the material at the landslide failure zone.

The laboratory test results are contained in Appendix F.

3. SITE CONDITIONS

3.1 Geologic Setting

The recent geologic history of the Puget Sound Lowland region has been dominated by several glacial episodes. The most recent, the Vashon stade of the Fraser glaciation, is responsible for most of the present day geologic and topographic conditions. The Puget lobe of the Cordilleran ice sheet deposited a heterogeneous assemblage of proglacial lacustrine deposits, advance outwash, lodgment till, and recessional outwash upon either bedrock or older pre-Vashon sediments and bedrock. As the glacier retreated northward, it uncovered a sculpted landscape of elongate uplands and intervening valleys. Post glacial deposits include: alluvium deposited within active stream channels, modern lacustrine deposits, organic silt and local peat deposits within kettle depressions, drainages, and outwash channels; volcanic mudflow deposits and landslide deposits.

The most recent landslide activity at MP 322 appears to be located within a larger area of ancient landslide deposits, probably associated with the withdrawal of the Vashon lobe of the Cordilleran ice sheet approximately 10,000 years ago.

3.2 Seismic Setting

3.2.1 General

The project site is located within an active convergent plate margin that has been termed the Cascadia Subduction zone. Along the Cascadia Subduction Zone, the oceanic Juan de Fuca Plate is actively subducting beneath the continental North American plate off shore from the Washington Coast. This general tectonic setting has resulted in three sesimogenic sources:

- Intraplate earthquakes that are located within the subducted Juan de Fuca plate,
- Earthquakes that occur along the interface between the actively subducting Juan de Fuca plate and the North American plate, and
- Earthquakes located within the overriding North American plate.

The best documented of these seismic sources are the intraplate earthquakes originating within the subducting Juan de Fuca plate. This seismic source is responsible for the two largest historic earthquake to have occurred in the Puget Sound Lowland, the 1949 earthquake with a M 7.1 located near Olympia, Washington, and the magnitude 6.5 Seattle earthquake in 1965. These earthquakes typically occur at depths ranging from 50 to 60 km.

The second seismic source area along the subduction zone between the Juan de Fuca plate and the North American plate has not exhibited historic activity. However, research that began in the mid-1980s (Atwater, B., 1987, 1992; and Heaton, T.H. and

Hartzell, S.H., 1992) and others has suggested that prehistoric earthquakes have occurred along the Cascadia Subduction zone producing earthquakes with magnitudes as large as M =8 or 9.

The third source of earthquakes located within the overriding North American plate are thought by some (Bucknam, R.C. and others, 1992) to be seismic sources in response to localized uplift in the North American plate. Bucknam and others (1992) conclude these shallow North American plate earthquakes can produce earthquakes of magnitude 7 or larger in the Puget Sound region.

3.2.2 1999 Satsop Earthquake

An earthquake occurred on July 2, 1999 in the Satsop area of Washington State. According to the U.S. Geological Survey National Earthquake Information Center, the earthquake had a moment magnitude (Mm) 5.7 to 5.9 and was located approximately 8.2 km north of Satsop at a epicentral depth of 40 km. The fault plane solution indicated a normal displacement along a fault with a strike of 355 degrees and dipping 60 degrees to the east. The hypocenter is approximately 40-km distance from the US 101 landslide sites. Golder calculated an attenuated acceleration from the earthquake source to the site as around 0.07g.

Inclinometer data collected during the ongoing monthly instrumentation monitoring by WSDOT at the MP 322 landslide indicated that an unstable portion of the landslide might have moved about an inch due to the event. A published nomograph by Keefer (1984) based on 40 historic earthquakes shows the relationship between epicentral distance as a function of earthquake magnitude for three general landslide types. In addition, a simple Newmark analysis was completed to assess the movement and inferred static FS at the time of the event. Based on the nomograph and the Newmark analysis, it is credible that the seismic event caused the sudden movement. The inferred static FS would have been on the order of 1.05.

3.2.3 Recommended Project Design Event

Based on the USGS criteria for the site area, the design event (10 percent exceedence in 50 years) is about 0.30g increasing to as high as 0.55 for a maximum event (2 percent exceedence in 50 years).

3.3 Surface Conditions

The site is located along and upslope of US 101 as shown on Figures 1 and 2. In general, the area is heavily vegetated with second growth coniferous trees and brush. US 101 is located at the toe of the hillside adjacent to Hood Canal. In general, the highway is at about elevation 50 to 60 feet (15.2 to 18.3 m) MSL with the hillside rising at about 2H: 1V to 3H:1V up to about elevation 470 feet (143.3 m) above Hood Canal.

In general the slide is about 1,000 feet (304.8 m) long and extends horizontally upslope about 300 to 400 feet (91.4 to 121.9 m). The total relief ranges from about 250 feet (76.2 m) in the south to 150 feet (45.7 m) in the north. Gross overall slope from the toe of the landslide to the upper scarp steepens from about 24 degrees at the northern end to about 30 degrees in the southern area. The lower 100 to 150 feet (30.5 to 45.7 m) toe area of the landslide generally has a steeper topography with slopes on the order of 28 to 32 degrees except the very northern area. The toe of the landslide appears to occur at or above the road. The detour involves about a maximum 25 ft (7.6 m) thick fill/debris flow buttress. The current topography implies that the original ground in the upper half of the slide has dropped 15 to 30 feet (4.6 to 9 m) resulting in an overall slope reduction of about 2 to 3 degrees. Ground scarps have been observed trending south of the headscarps of the known active landslide. These scarps may be indicative of future growth of the main slide to the south.

In the southern third of the landslide the slopes above the highway have been generally cleared of vegetation. In the northern two-thirds of the landslide, the slopes immediately above the highway are much steeper. Due to the significant slope movements, the southern half of the landslide area has numerous scarps, cracks, and areas of disturbed material. There are several areas of grabens forming between scarplets within the landslide mass. In the general toe area where the material flowed onto the highway, the surface is particularly disturbed with areas of entangled trees and very soft, wet ground.

3.4 Landslide History

The slide started moving in February/March 1999 and reportedly initiated in the central area with scarps noted to the north that eventually connected with the southern scarps to form the single landslide mass. We understand that the slide appeared to initiate near the road and then progressed upslope. The initial failure reportedly occurred in the central portion of the side near Section B-B'. Debris from the slide eventually covered the road. The landslide seemed to stabilize in April/May when debris removal operations were begun from the north side of the debris lobe in an attempt to reopen the road. In May as the clearing moved toward the south, the slope above the debris lobe began moving again with the movement extending upslope to the headscarp. A detour road was constructed by early June by regrading and placing the detour road up and over the debris lobe in the area. The inclinometers in the detour area indicate continued movement of 2 to 4 inches (5 to 10.2 cm) from June to August.

An earthquake on July 2, 1999 occurred some 25 miles 40.2 km) from the site. The inclinometer data implies that the earthquake caused the slide in the detour area to move an additional 1/2 to 1 inch (1.3 to 2.5 cm). Although there was a rain event at the end of June, the piezometers show no increase (unless it was a rapid rise and fall). Thus it appeared that the seismic event cause the movement.

Once the rains started in the fall of 1999, a portion of the slide uphill of high point in the detour began moving with total movements in excess of 3 to 4 feet (0.9 to 1.2 m). The

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movement was relatively shallow with the movement toeing out at about the level of the detour route. In addition shallow debris flows occurred at several places along the slope. In mid December, the buttress was raised about 6 feet (1.8 m) and the steep toe areas drained and covered with rock. In addition rock fill was placed along unstable toe portions of the slope with finger drains installed. Since then the areas appears to have stabilized.

3.5 Rainfall

The Hood Canal area experienced record setting rainfall during the winter of 1998/1999. The nearest reporting rainfall gauge is located at the Cushman Powerhouse, located about 9 miles (14.5 km) to the south of the MP 322-landslide site.

Figure 5 is a plot comparing the monthly precipitation totals since September 1998 with the monthly average from 1984 through 1997. Figure 6 is a plot of daily precipitation totals from September 1998 through early December 1999. Table 6 is a tabulation of the historic monthly precipitation totals averaged from 1984 through 1997.

The period of particularly heavy precipitation began in November 1998 culminating in a monthly total of 32 inches (81.3 cm) and continuing through the end of February. The total cumulative rainfall for the four-month period (November 1998 through February 1999) was 107.6 inches (273.3 cm). The average rainfall for the Hood Canal is approximately 88 inches (223.5 cm) per year.

During the 1999 spring and summer months (March through September), the Hood Canal area received relatively little rainfall. The total rainfall through that period was about 16.9 inches with an average daily precipitation of generally less than 0.2 inches per day. Thus far in late October and November 1999, the Hood Canal area has received a total of about 27.7 inches (70.4 cm) of precipitation with a daily average of about 0.7 inches (1.8 cm) per day.

4. SUBSURFACE CONDITION

4.1 General

In general, the subsurface conditions include a glaciofluvial outwash unit (ranges from fine to medium sand to sand and gravel), a finer grain granular transition layer (ranges from silty sand to sandy silt) and a deep glaciolacustrine silt/clay unit (clayey silt to silty clay, with Plastic Indices from 5-50). In the southern area, a permeable granular glacial drift layer underlies or is incorporated in the glaciolacustrine unit. In general, the materials above the landslide plane are very loose/compact or firm. Many of the coarse sands had SPT values less than 10 b/ft and as low as 2 to 4 b/ft. These low values are indicative of a very loose, disturbed soils with a very low relative density. Theoretically the SPT values imply the transition and glaciofluvial soils have a relative density of about 30 to 40 percent.

Based on the sample descriptions and the inclinometer data, the inferred failure plane occurred generally within the glaciolacustrine clay in the lower part of the landslide and through the granular soils above the clay in headscarp area. Only in boring GA-4 does it appear to occur at the transition-clay contact. In several borings, there was evidence of ancient landslide planes below the currently active rupture. There was as much as 10 to 30 feet (3 to 9 m) of glaciolacustrine clay landslide debris above the current landslide plane in the lower areas of the slide. This explains why it was possible for a shallower slide to occur in the detour area with the new failure toeing out at level of the detour fill buttress even though the overall slide was stabilized.

The inferred elevation of the top of the glaciolacustrine clay appears to form a deep depression just upslope of the slide in the vicinity of borings GA-3 and Section B-B'. As implied by the geophysics, the glaciolacustrine clay-transition contact forms a depression that drops to about elevation 40 feet (12.2 m) some 300 feet (91.4m) upslope of the landslide headscarp with a "spillway" near GA-6 and GA-13 at about elevation 95 feet (29 m). The transition/fluvial contact at the spillway is at about elevation 130 to 140 feet (39.6-42.7 m). A pump test implies that the water levels in the reservoir can be effectively lowered with pumping.

Several borings encountered loose sand underlying the existing roadway. The material has the appearance of debris flow deposited by ancient landslides or simply colluvial processes. The soils are about 20 to 40 feet (6.1-12.2 m) thick with N values in the range of 4 to 10 b/ft. Based on the borings, the loose soils below US 101 extend about 400 feet (122 m) from the central area to within about 150 feet (45.7 m) of the northern end of the landslide. Section F-F' on Figure 12 shows these conditions.

4.2 Stratigraphy

The mapped limits of the landslide mass are shown on Figure 2. The thickness of the landslide mass ranges from 0 to 25 feet (7.6m) (around the perimeter of the landslide to a maximum of about 50 to 75 feet (15.2 to 22.9 m) thick in the central area of the landslide.

The general geometry of the basal landslide plane appears to include a relatively flat lower section within about 75 feet (22.9 m) of the toe, a central section where the slide plane is roughly parallel with the ground surface, a steep upper section leading to the head scarp.

Four primary stratigraphic units were encountered at the MP 322 site. From youngest to oldest these are: coarse grained glaciofluvial advance outwash, finer grained transition beds, hard glaciolacustrine deposits and a very dense older till-like deposit termed glaciofluvial drift in this report. Detailed discussion of these stratigraphic units is presented below. The approximate limits of the landslide as well as the drilling and cross section locations are shown on Figure 2. Figures 7 through 13 show interpreted Cross Sections.

- **Landslide Deposits** – The composition of the landslide deposits are quite variable and generally reflect the vertical distribution of the original in-place strata. The upper portion of the landslide deposits are generally coarse grained reflecting the remobilized nature of the glaciofluvial deposits while the lower portion of the landslide deposits are generally finer grained reflecting the finer grain sediments of the transition beds and glaciolacustrine deposits. Most of the landslide debris consists of very loose to compact or firm disturbed soils. The coarser grained landslide deposits range from very loose to compact, sandy gravel to gravely sand with a trace to little silt. The finer grained landslide deposits generally range from fine to medium sand with a trace to little silt and clayey silt to silty clay. Figure 14 is a contour map of the base of the landslide deposits.

  Boring GA-13, located between GA-4 and the active landslide headscarp, encountered what appears to be in-place dense to very dense glaciofluvial deposits between about 45 and 60 feet bgs. However, these are underlain by generally compact to dense and stiff to hard transitional and glaciolacustrine deposits. The transitional beds and glaciolacustrine deposits show lower than expected N-values to a depth of about 126 feet (38.4 m) bgs and fractures observed within the glaciolacustrine deposit at about 122 feet 37.2 m) bgs. This evidence, coupled with tension cracks observed west of the headscarp in the area up slope of GA-13, suggests a possible wedge of strain softened soils related to the recent movement of the MP 322 landslide extends below and immediately west of the head area of the active landslide in this area. Alternatively, the zone of anomolously low blow counts may be associated with an older pre-historic failure surface.

- **Older Landslide Deposits** - This unit was observed in borings GA-1 and GA-10 below the active landslide plane in the southern portion of the landslide and in borings GA-14, H-1R-99, H-2R-99, TH-1-99, TH-2-99, and TH-3-99 below US 101. Below the active landslide plane the unit generally consists of firm to hard, olive gray to dark gray, massive to laminated, jointed, polished silty clay to clay with thin fine sand laminae. Hard, angular, clasts in a disturbed matrix were also observed. Below US 101 the older landslide debris consists of very loose to dense, greenish gray to olive brown, mottled, iron oxide stained, stratified to

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homogenous, fissured, sandy silt ranging to silty sand with gravel and organics. The interpreted older landslide debris located below US 101 was likely deposited at the base of the pre-US 101 slope by a combination of landslide and debris flow processes. The interpreted subsurface distribution of the older landslide debris is shown on Figures 7, through 13.

- **Glaciofluvial Outwash** – These deposits are clearly exposed in the head scarp of the landslide and were encountered in borings GA-8, GA-9, H-1-99, and GA-15 to the west of the head scarp. The unit is generally compact to very dense, thickly interbedded, and varies from fine to coarse sand with a trace to little silt and a trace of rounded gravel to sandy fine to coarse gravel with a little silt. This unit contains occasional interbeds of finer grained soils ranging from fine sand to sandy silt. Iron oxide staining is common. Figure 15 shows elevation contours at the base of the glaciofluvial deposits (top of the transitional deposits) generally west of borings GA-4 and GA-6, and at the base of the glaciofluvial landslide debris (generally east of borings GA-4 and GA-6).
- **Transition Beds** – The Transition Beds represents a general fining downward sequence from the glaciofluvial deposits to the glaciolacustrine deposits. This unit was observed underlying the glaciofluvial deposits in the southern lateral scarp of the landslide and was encountered in borings GA-6, GA-8, GA-9, GA-13, GA-15, and H-1-99. This unit overlies the hard glaciolacustrine deposits and ranges in thickness between generally 35 and 45 feet 10.7 to 13.7 m). The Transition Beds generally range from dense to very dense, light olive gray to light olive brown, massive to stratified, silty fine sand with a trace to little fine rounded gravel to fine to coarse sand with a trace to little silt and a trace to some rounded fine to coarse gravel. The unit contains occasional finer grained interbeds of silty clay ranging to sandy silt. Iron oxide staining was observed. Figure 16 shows elevation contours at the top of the disturbed glaciolacustrine deposits or base of the disturbed transitional beds within the landslide debris. Figure 17 shows elevation contours at the top of the in-place glaciolacustrine deposits or base of the transitional beds west of the headscarp..
- **Glaciolacustrine Deposits** – The glaciolacustrine deposits were observed underlying the transitional deposits in borings GA-8, GA-9, GA-15 and H-1-99 west of the head scarp, in borings GA-1, GA-4, GA-5, GA-6, GA-7, GA-10, GA-11, GA-12, and GA-13 below the active landslide, and in GA-14, H-1R-99, H-2R-99, TH-1-99, TH-2-99, and TH-3-99 beneath US 101. The glaciolacustrine deposits are generally hard, massive to laminated, locally jointed sediments ranging from silty clay to clayey silt with a trace of sand and rounded gravel sized dropstones. Figure 17 shows elevation contours at the top of the in-place glaciolacustrine deposits.
- **Glaciofluvial Drift** – This unit was observed within the glaciolacustrine deposits in borings GA-2, GA-5, GA-10, GA-11, and GA-12 primarily below the eastern toe area of the landslide. The unit typically exhibits an overall till-like appearance and consists of very dense and hard, nonstratified to crudely or thickly bedded, silty clay ranging to silty fine to coarse sand with a little to some fine to coarse

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gravel and a trace of cobbles and boulders throughout. The interpreted subsurface distribution of the glaciofluvial drift is shown on Figures 7, 11, and 12.

Zones of disturbed glaciolacustrine clay below the current basal landslide plane and the unusual character of the topography upslope of the head scarp implies that this overall hillside was part of an ancient landslide mass. The current active section has probably moved multiple times resulting in the completely disturbed, loose nature of the landslide debris.

Figures 15 clearly show that the top of the glaciolacustrine deposits is an undulating surface with stratigraphic highs and lows forming ridges and troughs. Of particular significance to the project is the apparent depression located behind (west) of the main head scarp in the vicinity of GA-3 and GA-15. In this area, the glaciolacustrine clay appears to form a deep, infilled stratigraphic depression. Several possible origins of the depression exist; 1) an ancient graben formed within ancient landslide deposits or 2) it is an erosional surface. The deposits overlying the glaciolacustrine clay in the depression are composed of partially saturated granular outwash and transitional bed sediments, which form a localized groundwater basin with groundwater perched on the low permeability glaciolacustrine deposits. A distinct narrow, east-opening trough developed within the surface of the glaciolacustrine deposits connects the basin with the east-dipping glaciolacustrine surface located beneath the landslide mass. When groundwater levels are high enough within the basin, the narrow trough acts as a spillway providing a direct path for groundwater to flow into the landslide mass. Based on the seismic refraction survey, the elevation of the top of the glaciolacustrine deposits in the narrow trough and thus the "spillway invert elevation", is approximately 95 feet (29 m).

4.3 Failure Plane Geometry

Superimposing all of the landslide cross-sections indicate that the slide plane geometry is essentially the same. The landslide mass has a maximum landslide thickness of about 40 to 60 feet (12.2 to 18.3 m) with a relatively flat slide plane in the toe area, steepening to about 20 degrees through the main slide area. In the headscarp area, the failure plane trends upward at about 50 to 60 degrees. The main differences in the sections correspond to the surface slopes, which flatten from south to north.

The geometry of the shortest section A-A' in the southern area implies that it could progress further upslope and develop a similar geometry to the other sections.

4.4 Hydrogeology

It is understood that during the active period of landslide activity, heavy seepage was observed in the toe area of the landslide. Currently seeps are still occurring in these areas. Elsewhere on the landslide away from the toe area, groundwater seeps were not observed.

In the main central area of the slide, the groundwater (in September 1999) appears to occur 5 to 15 feet (1.5 to 4.6m) above the landslide plane. This corresponds to being within about 5 feet (1.5 m) (above or below) the clay/transition contact. In the northern area where the toe of the slide occurs in the transition or drift units, the groundwater drops below the slide. The overall current average groundwater gradients range from about 50 percent in the northern area where the ground is steeper to 30 percent in the flatter northern sections.

In general, the groundwater levels in the initial set of borings have dropped about 5 to 10 feet (1.5 to 3 m) from April/May through September 1999. There does not seem to be a clear relationship between the drop and the flow from the horizontal drains. This lack of correlation may be due to the uncertainties about the drain orientation and the limited number of piezometers near effective drains. During the fall and early winter of 1999, the piezometer levels exhibited little if any increase except for the area upslope of the detour. In fact in some areas, the groundwater appears to be continuing to fall. These observations imply that emergency horizontal drains have had a significant impact. Additional data throughout the winter will confirm this initial impression. Deeper piezometers in the glaciolacustrine clay indicate a deeper groundwater level with pressure heads lower than the overlying groundwater levels. These lower levels may not have any real significance due to the low permeability in the hard clays. However, in the southern area, there is a continuous deeper watertable within the Drift unit below the clays.

The water levels in the reservoir as measured in GA-3 ranged from about elevation 142 feet (43.3 m) in April 1999 to elevation 130 feet (39.6 m) in September 99 or a drop of 12 feet (3.7 m). Estimated top of clay at spillway is about elevation 95 feet (29 m) with base of fluvial unit at about elevation 130 to 140 feet (39.6 to 42.7 m). With the groundwater at elevation 142 feet (43.3 m), there would be about 40 to 50 feet (12.2 to 15.2 m) of saturated transition soils and possibly up to 12 feet (3.7 m) of saturated fluvial sands. Based on the trend from April through September 1999, it is possible that the water could have been as high as elevation 150 to160 feet (45.7 to 48.8 m) at failure in February 1999. The recent pump test results imply that these levels can be controlled and lowered with pumping.

To evaluate the potential of controlling a source of groundwater entering the landslide mass through the spillway, a pump test was performed in order to characterize the hydrogeologic conditions in basin. Details of the pump test were previously discussed in Section 2.5.

An analysis of the water-level recovery indicates that the transmissivity of the well is about 2,500 ft^2/day ($232.3m^2$/day). The aquifer thickness is estimated at about 20 feet (6.1 m), for a hydraulic conductivity of about 2 x 10-2 cm/sec. Well GA-3, located approximately 165 feet (51.2 m) to the east was used as an observation well to monitor drawdown effects from GA-15. No drawdown was observed in well GA-3 during the eight hour duration pump test. However, since the material is highly permeable, it is likely that a longer pumping time is required before drawdown should be observed at this distance. Based on an estimate of the storage coefficient of 0.02, we estimated that it

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would take about 7 days to achieve a drawdown of 1.5 feet, and recommended that WDOT initiate a longer pumping test. During a meeting between Golder and WSDOT on December 17, 1999, it was agreed that pumping from GA-15 would be resumed and continued indefinitely.

Pumping was resumed on December 22, 1999. Water levels have declined about 3 feet (.9 M) in GA-3 since the initiation of pumping at GA-15. The response to pumping is shown clearly on the hydrograph, with drawdown starting on December 27, 1999. Fluctuations in water level are likely the result of changes in the pumping rate and/or precipitation events. However, these responses are small and it appears that pumping of well GA-15 is effectively dewatering the aquifer. The results of the pump test and hydrographs are contained in Appendix E. Specific sections for dewatering the reservoir are presented in Section 9.2.3.

The interpreted groundwater elevation contours as of July 1999 are shown on Figure 18.

5. LANDSLIDE MECHANISM AND STABILITY EVALUATION

5.1 Slide Mechanism

The data imply that the landslide was a progressive block slide with the landslide debris failing on a weak zone near the top of the glaciolacustrine clays. The recent landslide is believed to have occurred within a larger ancient landslide mass that extends further north and south along the hillside above US 101. Elevated groundwater levels are considered to be the trigger causing the landslide. As discussed in Section 3.5, the area had experienced record rainfalls that likely resulted in water levels that were higher than had occurred for many years. The original cuts made to construct US 101 may have also contributed to the failure.

It is not possible to determine the precise sequence of the landslide development. However, based on the available data and experience on similar slides, it is postulated that the landslide sequence likely involved the following:

1. The landslide involved re-activation of an ancient landslide mass. The landslide plane is generally located within a disturbed, softened zone in the glaciolacustrine soils. Since the material had failed previously, it had been strain softened and likely occurred at the material's residual angle.

2. Due to heavy prolonged rain, high seepage pressures in the toe area caused an initial block landslide extending about 100 to 150 feet (30.5 to 45.7 m) upslope of toe.

3. As this block failed, it moved outward leaving a headscarp with ground cracks extending some depth below grade. As it moved, the ground cracked and released large volumes of trapped water. This released seepage pressures and "pockets" of trapped water within the block causing numerous "debris flows" to occur.

4. The movement of the initial block unloaded the passive zone supporting the upslope ground. This reduced the stability of the upslope ground resulting in another second block landslide. As the second block landslide occurred, it pushed the lower block and unloaded the next upper block. This caused the next block to fail and push additional material out at the overall toe.

It is significant that in most areas, the glaciolacustrine slide unit extends above the active slide plane in the toe area. This material likely has a low strength similar to the slide plane itself. Thus remediation methods which stabilize the original slide may not prevent a shallow slide from occurring. This was observed in the detour buttress area as discussed in Section 5.2 below. Figure 15 shows the areas where this condition occurs.

5.2 Back-Analysis Main Slide Area

By assuming that the factor of safety (FS) was 1.0 at failure, it is possible to back-analyze the soil strength parameters with slope stability calculations. Stability analyses using the computer code XSTABLE was completed on three stability sections (Section A-A' and B-B', and G'G') within the main landslide mass. Judgment was required to assess the relative strengths of the units and the location of the groundwater table at failure. In general, it was assumed that the maximum groundwater table at the time of failure was on the order of 5 to 10 feet (1.5 to 3 m) higher than shown on Figure 18 in the toe area and about 10 to 15 feet (1.5 to 3 m) higher at the back of the landslide. This resulted in steep gradients with near surface seepage in the toe area.

The analysis implies that the lower 100 to 150 feet (30.5 to 45.7 m) of the slide mass failed first with the movement progressing upslope as each successive block lost toe support. In general, if the initiation block had a computed FS of about 1.0 with an elevated groundwater line, the entire slide mass had a computed FS of about 1.05 to 1.15 depending on slope geometry. These results, combined with the observations, imply that the landslide was a progressive failure with two or three main events. Reasonably consistent results were obtained with granular landslide units having $\phi' = 28$ to 30 degrees, $c' = 0$ psf. For a granular soil, this is about as low a ϕ' as is considered credible. The implied strength of the slide plane through the glaciolacustrine unit was $\phi' = 24$ to 26 degrees, $c' = 0$ psf. The analysis for the steep southern section, upslope of the current detour buttress, implies that there may have been some strain softening with the pre-slide strengths being about 2 degrees higher to be consistent with the observations. The range in ϕ' of 24 to 26 degrees is reasonable for the residual angle of a low PI clay. Direct shear residual angle testing on these materials are consistent with these assumptions.

Section G-G' was analyzed to assess the observed slope movements in the vicinity of the detour buttress. The results indicated:

- NEED FOR DETOUR BUTTRESS: Due to the relatively steep topography in the area, the XSTABL results were consistent with the slope continuing to fail when removal of the debris along US 101 was attempted in May 1999. With the geometry of the emergency buttress as shown on G-G', the FS would have been marginal over the summer of 1999.

- SLOPE MOVEMENT DURING SATSOP EVENT: Estimates of seismically induced slope movements are based on the ratio of the yield acceleration (Ay) to the peak applied acceleration Am. Ay is defined as the calculated horizontal acceleration required to reduce the FS to 1.0. The yield acceleration (Ay) was computed to be about 0.035g for Section G-G' prior to raising the roadway in December 1999 based on the groundwater conditions at the time of the 1999 Satsop event. As discussed in Section 3.2.2, the likely acceleration at the site was on the order of 0.07g. Using published normalized curves based on the Newmark method, the estimated slope movement for an Ay/Am of 0.5 would be

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on the order of about an inch (2.5 cm). This is consistent with the measured movement of about ½-inch (1.3 cm) over the period of the event.

- ADDITIONAL MOVEMENT IN THE FALL 1999: Once the rains began in the fall of 1999, the area in the vicinity of G-G' began moving with a total slope movement likely exceeding several feet. The toe of the new movement appeared to occur at the edge of the new detour buttress some 20 feet above the original toe of the slide during the original failure. The XSTABL runs indicate that once the detour buttress was placed, the critical failure surface became a shallower slide toeing out at the road consistent with the observed failure once the rains started. The analyses also shows that raising the buttress fill six feet (1.8 m) as done in December 1999 would stabilize the slide.

5.3 Back-Analyses US 101 Embankment

As discussed in Section 4, about a 400-foot (122 m) section of the roadway is underlain by loose sands believed to be ancient debris flow material. The current embankment slope from US 101 down to Hood Canal is on the order of 30 to 40 degrees. The limited data imply that the groundwater table drops in the debris but still may result in a moderate groundwater gradient flowing out to sea level.

Stability calculations for the slopes between US 101 and Hood Canal indicate that the near face slopes must be in soils that are dense and/or exhibit an apparent cohesion. Below the assumed near face conditions, loose soils underlying the main roadway are weak and imply that the current factor of safety for circular failure surfaces through the roadway down to Hood Canal is marginal, probably on the order of 1.05 to 1.15.

6. STABILIZATION CRITERIA FOR 1999 CONSTRUCTION SEASON

6.1 General

It was not the intent nor was it practical to implement the final stabilization options prior to the 1999-2000 wet winter season. The intent was to complete installation of the emergency horizontal drains and then perform additional emergency work as needed to maintain the one lane detour road open over the winter until the permanent work could be completed in the summer of 2000.

Once the fall rains started in November 1999, several problems developed including slope failure in the high area of the detour route and mud flowing onto the highway particularly in the northern area of the slide.

6.2 Slope Problems Fall/Winter 1999

The slide movements first occurred above the high area of the detour resulting in the shearing of inclinometers at GA-2, GA-10, and GA-11, visual surface cracks and ruptures, measured surface movements and soil squeezing onto the roadway resulting in decreased detour road width. The measured surface movements included over 2 feet (.6 m) of relative vertical displacement at one scarp above GA-10 (absolute movement likely over 3 feet (1 m)) and settlement between the surface casing and piezometers at several locations. Based on the inclinometer data, the slide plane occurred at a depth of 15 to 25 feet (4.6 to 7.6 m) and appeared to be about 10 to 20 feet (3 to 6.1 m) shallower than the original failure plane in the winter of 1999 which toed out at about the level of the old roadway surface. The fall/winter 1999 slide depth seemed consistent with the detour buttress forcing the slide plane above the original toe in order to daylight at about the level of the current detour roadway.

In addition to the slide movement, the near surface soils in part of the northern half of the detour route softened to a slurry consistency and spilled onto the roadway. This required constant maintenance to keep the roadway clear of debris. In general, the area where the soil is flowing onto to the roadway appears to be underlain by silts and clays at the surface. It is postulated that as the slide moves, the near surface soils softened due to being distorted and subjected to surface infiltration and groundwater seepage. The silts and clays rapidly deteriorated under these conditions to a slurry and flowed on to the roadway. This results in a loss of toe support for the near surface soils above the slurry causing additional soils to deteriorate to a slurry and flow onto the roadway. These silt and clay soils appear to extend some 20 to 30 feet (6.1 to 9.1 m) above the roadway in the northern section of the detour. The near surface soils in the southern section of the detour appear to be sandy and do not as readily deteriorate.

In the northern several hundred feet of the slide, there are areas where the soil has flowed out onto to the roadway. These failures are similar to the shallow debris flows occurring in the detour area although there is no evidence that the overall landslide has been reactivated. These debris flows are associated with steep topography near the toe area, rainfall infiltration, surface runoff and seepage. The soils appear to involve both silts/clays and sands. In this area the traffic had been using two lanes with the beginning of the one lane detour route occurring further to the south. Due to the debris flows, WSDOT closed the southbound lane adjacent to the slope placing a jersey barrier along the original roadway center line, moving the detour to the north of the MP 322 slide, and using the abandoned lane as a catchment area. This resulted in 20 to 30 foot catchment area between the toe of the slope and the jersey barrier on the western side of the one lane detour roadway. According to WSDOT, this catchment area was sufficient to allow periodic removal of debris and maintain the one lane of traffic to the east of the jersey barrier.

6.3 Remediation and Maintenance Winter 1999/2000

Working with WSDOT, Golder developed the remediation criterion, which was implemented in December 1999. This included raising the roadway about six feet through the northern 100 feet (30.5 m) of the detour area where slide movement had occurred to increase the size of the toe buttress.

Other remediation north of the high point in the detour route where debris flows were impacting traffic is recommended. The recommendations include:

- EXCAVATION OF SOFT SOILS: To a maximum depth of about 2 feet, any soft, disturbed soils on the slope in the toe area should be removed down to firmer, more intact material. This excavation should extend about 6 feet upslope or to firmer soils.

- FINGER DRAINS AND TOE DRAINS: The finger drains would consist of excavating narrow trenches at about 10 foot (3.1 m) centers and some 10 feet (3.1 m) above the roadway. In addition, a 12-inch (30.5-cm) deep trench should be cut along the base of the slope and graded to drain by gravity to the north and south along the detour route.

- ROCKFILL: *Once the upper soft soils have been removed* and the finger/toe drains excavated, the entire toe area of the slope should be covered with a minimum of 2 feet (0.6 m) of rockfill. The rockfill should extend about 6-feet (1.8 m) above the toe of the slope and meet the project specifications for quarry spalls or an approved equal.

The slopes and instrumentation data will be monitored throughout the winter. As necessary, debris flow material will be removed. If slope movement and/or debris flows become a problem, additional emergency remediation work will be required.

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7. REMEDIATION OBJECTIVES

7.1 Main Objectives

The assessment of long term landslide risks is not an exact science. Even with the level of investigation completed, there are major uncertainties related to soil stratigraphy, slide mechanism, and groundwater behavior. In addition, there are uncertainties related to future seismic events, longevity of the horizontal drains, and potential impacts of future manmade changes. A detailed uncertainty analysis could have been performed to develop a probability of failure and assess the cost effectiveness of various levels of risk reduction versus cost and consequence of failure. Such an evaluation would have to consider funding issues, public opinion and public impacts. These are difficult issues well beyond the scope of this geotechnical study.

Given the current situation at MP 322, it is understood that WSDOT's main objectives for landslide remediation are:

- A very low risk that any major road closures will occur due to future landslides or debris flows.
- Minimal construction impacts to the public which would involve limiting any road closures.
- Although cost is a consideration, stability and public impacts should not be compromised to minimize costs.
- Since the goal is to protect the road, alternatives that protect the road but do not necessarily stabilize the slide should be considered.

These objectives were defined based on a combination of the theoretical results, constructibility considerations, and judgment with the general intent being any remediation option result in a calculated static factor of safety (FS) of at least 1.25 using conservative assumptions about the long term effectiveness of drains. These criteria are consistent with normal engineering practices for slopes when the primary objective is maintaining trafficability on the roadway and costs are a secondary concern.

7.2 Seismic Risks Main Slide Area

With a remediated static FS on the order of 1.25, the computed yield accelerations (Ay) for the various cross sections analyzed was on the order of 0.1g. Ay is defined as the calculated horizontal acceleration required to reduce the psuedostatic FS to 1.0. Provided the anticipated maximum acceleration (Am) is on the order of only twice Ay (or about 0.2g), the theoretical slope movements caused by the earthquake should be small, on the order of a few inches. With the USGS design event of Am = 0.3g, the theoretical slope movement may exceed a foot. At the maximum USGS levels of over 0.5g, the theoretical slope movements would be many feet. All of these calculations and estimates are considered very approximate since the behavior of large landslide masses during seismic events is not well understood. It was noteworthy that the July 1999

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seismic event appeared to have caused slope movements consistent with the theoretical calculations as discusses in Section 2.2.

The slide remediation design could be based on eliminating large theoretical slope movements during the USGS site design and maximum levels of shaking. However, this would have a very significant impact on the cost of the work and the construction impacts to the public. It would require much large toe buttresses and/or much larger walls. For purposes of this report it was assumed that the risk of seismically induced slope movements are acceptable to WSDOT and not cost effective to remediate. Thus the seismic criteria should not control the design. This approach is believed to be consistent with WSDOT's normal practices for roadways.

The saturated granular soils in the slide mass are loose and prone to liquefaction. However, based on minimum depth of saturation of the granular soils and the extent of fine grain soils in the slide plane, liquefaction does not represent a significant risk to the overall slide mass. Thus liquefaction mitigation was not part of the remediation objectives.

7.3 Seismic Risks US 101 Embankment

As discussed in Section 4.1 and 5.3, 20 to 40 feet (6.1 to 12.2 m) of loose granular soils with N values in the range of 4 to 10 b/ft underlie US 101 for about 400 feet (121.9 m) from the central area to within about 150 feet (45.7 m) of the northern end of the slide. Although the groundwater table appears relatively deep, there is likely to be 10 to 20 feet (3.05 to 6.1 m) of saturated loose granular soils underlying portions of the US 101 roadway. Liquefaction analyses imply that these soils have a moderate risk of liquefaction for major events located far away from the site (Am=0.15g). However the design event (Am=.3g) would have a high risk of liquefaction. The likely consequence of liquefaction would be a general slumping and settlement of the roadway and any buttress placed on the roadway. Even without liquefaction, the US 101 roadway areas underlain by loose soils have a static FS only marginally above 1.0 and not equal to the 1.25 objective of WSDOT. Calculations indicate that a strong seismic event would result in slope movements possibly in excess of several feet for these areas.

Mitigation of these seismic risks would involve a major ground improvement program in areas of US 101 underlain by loose soils. This would be a costly program and have a significant impact on construction traffic which may require extended road closures. It is understood that WSDOT has not had stability problems associated with the roadway embankment through this area even with the current upslope landslide activity. In addition, there are likely many areas with similar conditions along other areas of US 101 north and south of the MP 322 landslide. For the purposes of this report is was assumed that the objective of the landslide remediation work related to the loose soils under the US 101 roadway is to not increase the current seismic and liquefaction risks. Ground improvement would only be required if the proposed remediation work would significantly increase the seismic risks.

8. STABILIZATION OPTION EVALUATION

8.1 Available Stabilization Elements

The main difficulties with stabilizing the MP 322 slide (compared to the MP 326 slide) is related to the fact that the groundwater table occurs at or just above the failure plane. With a desired calculated static FS on the order of 1.25, the analyses indicate that drainage alone will not meet the design criteria. Thus the stabilization options need to include more than just drainage improvement.

The available options are composed of one or more of the following elements:

- RELOCATE THE ROAD: We have assumed that this is not a feasible option.
- COMPLETION OF EMERGENCY WORK: This work was discussed in Section 6.3 and has been successfully completed.
- ADDITIONAL HORIZONTAL DRAINS MAIN SLIDE AREA: This would involve installation of additional horizontal drains to supplement the emergency drains in selected areas.
- HORIZONAL DRAINS BELOW US 101: Lowering the groundwater levels in the loose soils underlying portions of the US 101 roadway will improve stability and reduce liquefaction risks.
- DRAINING UNDERGROUND RESERVOIR: This would involve draining the underground "reservoir" with wells or horizontal drains which are tight lined through the landslide itself. Horizontal drains pose the risk that water could be discharged water directly into the headscarp area if slide movement rupture the drains due to future extreme rain events and/or earthquakes.
- EXCAVATE LANDSLIDE MATERIAL: Portions of the landslide could be excavated to reduce the average slope and improve stability. Although this is considered theoretically viable, there is a risk that any significant excavations could destabilize areas of the slope further upslope from the excavated areas.
- TOE BUTTRESS: A toe buttress could be placed by raising the roadway or placing fill to the west of the roadway.
- STRUCTURAL WALLS: Structural stabilization would involve a deep solder pile tieback wall. The wall would develop both lateral and vertical support from below the slide plane within the intact soils. Consideration was given to a micopile wall but it was considered less efficient and more costly due to the specific geometry and requirements at this site.
- DEBRIS WALL/CATCHMENT AREAS: This would involve debris walls, embankments, and/or catchment areas to reduce risk that debris impacts traffic. This options will reduce risks but will likely require long term maintenance to clean out debris.
- GROUND IMPROVEMENT: This could include deep soils mixing, stone columns, or other methods and would mainly apply to the areas of US 101 underlain by loose soils as discussed in Section 4.1.

8.2 Stability Analyses for Stabilization Elements

The general theoretical impacts of the various stabilization elements were evaluated using both XSTABL and simple parametric spreadsheet wedge analyses. In general, these analyses indicated:

- DRAINAGE: If feasible, lowering the seepage pressures within the landslide mass with drainage is almost always the most cost effective way to improve stability. However, it is unlikely that the horizontal drains will be able to lower the groundwater levels much below the top of the clay layers. In addition, since the maximum groundwater levels were unlikely to have been much more than 10 to 20 feet (3.01 to 6.1 m) above the clays, even in early winter 1999 when the slope failed, drainage by itself will not increase the calculated FS much above 1.05 to 1.15.

- TOE BUTTRESS: In general, due to the shape of the failure plane and the implied size of the critical initiation block, a fill toe buttress was very effective in increasing the computed FS. Thus a toe buttress in the range of 20 to 30 feet 6.1 to 9.1 m) produces a significant increase in the computed FS (on the order of 20 to 30 percent).

- EFFECTS OF LOOSE SOILS UNDER US 101: Stability calculations indicate that a high MSE buttress placed too close to the edge of the current highway embankment could result in embankment failure into Hood Canal in areas where the roadway is underlain by loose soils. Based on the subsurface information, the soils will behave as loose granular materials, not soft clays. Stability analyses indicates that the current stability from the embankment down to Hood Canal can be maintained if the MSE fill is off set at least 25 feet (7.6 m) from the edge of the embankment.

- DEEP WALL WITH FILL: By installing a deep solder pile tieback wall near the toe of the current slope along the road, a wedge of fill can be placed behind the wall. Thus the stability is increased by both the weight of the new fill and the capacity of the deep wall to transmit lateral loads below the slide plane. Thus 20 to 30 foot (6.1 to 9.1 m) high walls with a wedge of fill placed behind the wall feet had a significant increase in the computed FS (on the order of 20 to 30 percent) with the wall being designed for only moderate loads above that required to meet normal earthpressure criteria. Typical wall loads required were on the order of 40 to 60 k/ft (178 to 876 kN/m).

- WALL IN CUT: A wall could be placed upslope of the toe with the soil in front of the wall excavated to allow lower tiebacks to be installed and to widen the roadway section. This wall location would also minimize construction traffic due to its distance from the current one lane detour route. The stability analysis indicated that removal of soil had a significant destabilizing effect which required relatively high design wall pressures well in excess of normal earthpressures. Typical wall loads required were on the order of 60 to 120 k/ft

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(876 to 1780 kN/m) to meet an appropriate FS depending on the topography and depth of cut. These are high loads since a normal 25 foot (7.6 m) wall would be designed to resist earthpressure loads on the order of 25 k/lf (370.8 kN/m).

- CREATION OF SHALLOWER SLIDES: In may areas, particularly in the southern area of the landslide, the material overlying the initial failure plane in the winter of 1999 is clay landslide debris as shown on Figure 15. This material can have a strength as low as the actual failure plane. Thus placement of a wall or buttress may stabilize the original slide but not increase the stability of a potential shallower failure occurring within the overlying clay landslide debris. This appeared to have occurred at the high point in the detour route where the emergency buttress stabilized the original slide mass. However, in the fall of 1999, a shallower landslide developed that toed out at the top of the buttress. It was necessary to raise the buttress an additional 6 feet (1.8 m) to stabilize the shallow slide. Thus the final remediation walls or buttress must be designed to address these shallower landslides.

8.3 Recommended Options

Based on discussions with WSDOT, constructibility and construction impacts to public, long term reliability, and judgement two main options for remediation of the landslide are recommended. These involve several common elements. All options are based on a toe treatment which would consist of either a wall or a buttress fill. The intent of the toe treatment is to increase the FS against failure of an initiation block by increasing the toe resistance. In general the toe of the initial 1999 failure was at the elevation of the original SR101 roadway except in the extreme southern section where the landslide toe was above the roadway. As discussed in Section 5.2, shallow slides can occur within the current landslide mass as observed when the roadway was raised in the detour area. These shallower slide risks also need to be remediated.

The elements of the recommended options include:

- DRAINAGE (all options): We recommend the maximum benefit from drainage be realized through additional horizontal drains and lowering the water in the underground "reservoir". With an adequate off set from the buttress to the edge of the US 101 embankment fill the current static and seismic stability of the roadway underlain by loose soils will be maintained and ground modification is not required as discussed in Section 8.2. However, since the costs and construction impacts are minimal, it would be prudent to install horizontal drains in the slope below US 101 to lower the groundwater table in the loose soils. Pending the results of additional piezometer data to define the current levels, these drains should be installed for all remediation plans.

- SURFACE REGRADING (all options): Along much of the landslide area, the slope immediately above the roadway is steep and underlain by soils disturbed by the overall slope movement and the exposure to the elements. At the MP 326

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slide, a similar area was regraded to remove the very soft/loose near surface soils and covered with rock fill. This is recommended in the steeper areas of MP 322.

- CATCHMENT AREA/DEBRIS WALL (all options): It is recommended that protection be provided to minimize impact of minor debris flows. This could include a catchment area between the toe of the slope and the edge of the road or a wall between the toe and the roadway. Surface regrading and rockfill will reduce the need for a catchment.

- TOE BUTTRESS: This would involve raising US 101 with an MSE fill buttress. A raise in grade on the order of 20 to 30 feet (6.1 to 9.1 m) will provide an adequate stability improvement.

- SOLDIER PILE TIEBACK WALL COMBINED WITH FILL: This would involve installing a retaining wall 20 to 30 feet (6.1 to 9.1 m) high near or just above the current toe of slope. If installed above the toe, a temporary excavated bench will be required for installation of the wall. The wall will be backfilled to add weight and act as a small buttress in combination with the wall. Due to concerns about deeper weak zones in the clays below the current slide plane, the tiebacks should extend into very hard intact glaciolacustrine clays or the underlying dense granular units and not just below the current slide plane. Based on the geometry of the wall and ground surface, a micropile wall does not seem appropriate.

- EXTENSION SOUTH OF SLIDE AREA: As discussed in Section 3.3, there is evidence that the landslide may "grow" further south based on observations of recent ground cracks in the headscarp area extending south of the currently active landslide along US 101. Thus it seems prudent to extend the slope remediation work at least 200 feet (61 m) south of the current southern extreme of the mapped slide above US 101.

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9. REMEDIATION DESIGN CRITERIA

9.1 General

This section presents specific geotechnical design criteria for the stabilization of the landslide. In essence the recommended remediation involves combination of drainage, slope surface treatment, and a toe treatment consisting of a fill buttress and/or deep soldier pile tieback retaining wall. The design criteria are intended to be flexible since the optimum design configuration selected by WSDOT must consider numerous constraints beyond the scope of this study. This includes the current slope and roadway grades, constructibility related to minimizing impacts on traffic, the final desired roadway alignment and grades, and costs. The general intent of the proposed stabilization work is to provide a calculated static factor of safety of at least 1.25 based on a conservative assumption about the long term effectiveness of drainage provisions. As discussed in Section 7, the proposed remediation is not intended to eliminate possible seismically induced slope movements during major design earthquake events.

Sections 9.2 through 9.6 provide general design criteria while Section 9.7 addresses design issues along specific sections of the roadway. Once WSDOT has finalized the selected options and developed current cross-sections, a series of stability analyses should be performed at each major change in geometry and/or remediation option. The results of the section specific analyses would be used to finalize the required size of the buttress, loads and \heights of wall, and fill reinforcement requirements.

9.2 Drainage Main Slide Area

9.2.1 General

The general intent of the horizontal drains is to lower the groundwater table as low as possible within the landslide mass to reduce seepage pressures and increase stability. As discussed in Section 2.4, WSDOT has already installed a significant number of drains. Golder was generally not involved with the design or installation of these drains. In addition, accurate as-built information including elevations, orientations and inclinations have not been provided to Golder. This Section provides recommended drain locations and inclinations for the entire landslide as if no emergency drains had been installed. The assumption is that WSDOT will compare these recommendations with the as built drains and add selective new drains as deemed appropriate. It is likely that only a limited number of additional drains will be required due to the large number of existing drains.

The recommended ideal drain design involves installation of closely spaced short horizontal drains installed just above the exposed toe of the landslide and inclined upward to approximately follow the top of the slide plane. Since these drains will be in the lower permeability glaciolacustrine soils, an upper set of longer drains are also recommended which would be placed in the granular landslide debris soils overlying the glaciolacustrine unit and extend upslope to the back of the slide.

Figure 19 shows the general plan layout of the idealized drains while Figure 20 shows an idealized section.

9.2.2 Horizontal Drain Design criteria

The general design criteria for the short, lower drains include:

- SPACING: The intent is to cover the landslide area with drains at about a maximum spacing of 25 feet (7.6 m).
- LENGTH: The intent is to install the drains into the glaciolacustrine soils above the slide plane in the inferred initiation block. The drain length should be about 150 feet (45.7 m).
- DIAMETER: Minimum inside diameter 1.5 inches (3.8 cm).
- LOCATIONS: The intent is to install the drains at about the location where the landslide plane "daylights" on the slope. For constructibility reasons, the drains may have to penetrate the ground at locations other than those implied on Figure 19 particularly in the existing detour buttress area where the toe of the original slide is buried.
- INCLINATIONS: The intent is to have the drains located just above the slide plane.
- DRAIN GEOMETRY: The drains can be installed from a series of arrays or simply placed perpendicular to the slopes at a uniform spacing. A series of shorter arrays are required if arrays are used to avoid any undrained areas between the main arrays. The choice of drain geometry and the specific drain locations should be based on constructibility, cost and maintenance considerations. Special geometries may be required in the area of the existing detour buttress.

The upper drains should be located near the base of the granular landslide debris and just above the top of the glaciolacustrine slide unit. The maximum spacing of these drains should be 40 feet (12.2 m) and extend back to the estimated western end of the landslide plane as shown on Figure 19. Thus the drain lengths will range from 200 (61 m) to almost 400 feet (121.9 m).

9.2.3 Draining "Reservoir" Area

It is recommended that the groundwater levels in the underground "reservoir" be controlled by pumping and/or horizontal drains. The on-going pump test has shown that wells can be used to effectively lower the groundwater levels as was discussed in Section 4.4.

Two approaches to draining of the "Reservoir" area are feasible; 1) an active system that will require pumping from installed wells, (essentially an expanded version of the pump test well) and 2) a passive system of gravity drains.

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The on going pumping in the test well (GA-15) has shown that the groundwater is being lowered in the vicinity of the spillway and that the local groundwater gradient has been reversed, away from the spillway and toward GA-15. Therefore, we recommend that the existing well (GA-15) be maintained as a means of limiting groundwater inflow into the landslide mass when action levels in G-3 are reached.

The active pumping system could be set up with a permanently installed pump that is turned on manually or triggered by float switches that are activated when the groundwater level in the reservoir reaches a predetermined elevation. Alternatively, the well could be installed without a dedicated pump and the groundwater levels monitored in GA-3 during the winter rain season. When groundwater levels reach a predetermined action level, the pump is installed and active dewatering begun. Discharge from the pumping well should be directed down slope in a suitable tight line pipe to be discharged into the surface water drainage system along US 101. We recommend that a sounding tube be installed adjacent to the pump/riser assembly to allow sounding of the well bottom in order to monitor sediment buildup in the sump portion of the well. When sediment build up becomes excessive (i.e. approaching the pump intake level), the pump should be removed and the sump cleaned by bailing or airlift techniques. Annual maintenance and testing of the system will be essential prior to the onset of the rainy season.

Alternatively, horizontal drains could be installed to penetrate through the "spillway" and tap into the permeable soils in the "reservoir" area. These drains should include a perforated section installed within the "reservoir" with a tight lightlined section through the spillway and landslide mass itself. The intent of the tightline section is to avoid infiltrating the drainage into the landslide material. Figure 19 shows the approximate location of these drains. A drawback to this approach is there is a risk that future landslide movement could rupture these drains resulting in direct discharge of the reservoir groundwater into the headscarp area of the landslide. WSDOT will need to evaluate this approach to determine whether this risk is acceptable.

9.2.4 Horizontal Drains in US 101 Embankment

If a buttress fill is used in areas underlain by loose soils as discussed in Section 5.3 and 8.3, we recommend installation of horizontal drains through the bottom of the existing roadway embankment to improve stability and reduce seismic risks. Additional information about the soil conditions and groundwater levels below the roadway in these areas is required to assess the need for and design of these drains.

Based on the current limited data, the drain spacing would be on the order of 40 feet (12.2 m), installed near the toe of the slope just above sea level with lengths of about 75 feet (22.9 m).

9.2.5 Construction Monitoring and Field Modifications

The drain installation should include the following procedures:

- At 50-foot (15.2 m) intervals during installation, the driller should take a water pressure measurement in the casing to determine the tip elevation and actual average inclination of the pipe. The operator has some ability to increase or decrease the inclination by varying the drill speed and pressure. Drains that are installed significantly above or below the intended target may have to be replaced and/or abandoned before completion.

- The drilling conditions should be monitored by an experienced WSDOT geotechnical inspector to allow a general assessment of the soils encountered.

- The discharge rates from each drain should be monitored after installation and periodically after.

- Some of the drains may produce no flow or large flows. In addition, based on past experience, drains may meet refusal before reaching their design lengths. Based on the actual conditions encountered, it may be appropriate to add more drains and/or modify the inclinations. The discharge rate, measured tip elevations, and drilling behavior will be vital in assessing the need for and type of field design changes.

- After installation, the as-built drain plan should be prepared. The general vertical alignment can be determined based on the tip elevations measured every 50 feet (15.2 m) during installation. The horizontal alignment can be determined with geophysical methods by inserting a wire with a low current into each drain and using surface geophysical instruments. The as-built data are considered essential in interpreting the piezometer information and effectiveness of the drains.

The monitoring data and field assessments are an essential part of the overall remediation work. Due to the nature of horizontal drain installations and the complex site conditions, without the monitoring and field adjustments, the effectiveness of the entire remediation work will be compromised.

9.2.6 Long Term Drain Performance and Maintenance

Horizontal drains require long term monitoring, periodic flushing, and possible replacement. With time horizontal drain effectiveness tends to decrease and individual drains can become completely ineffective. This can be due to mechanical and/or biological clogging, slope movement that brakes the pipe, and/or other effects. Regardless of the reasons, the drain installation must be considered a permanent requirement that forms an essential part of the overall remediation work. Without a continuous maintenance program, the drains may eventually become ineffective and the slope susceptible to additional failure and road closure.

Based on the results of the monitoring program, drains will require flushing to remove biologic and/or soil clogging material. It is possible that flushing will not be totally effective in re-establishing the drain. If this becomes a significant problem involving several drains in critical areas, new horizontal drains would have to be installed. Section 10 presents recommendations for long term monitoring which should include sensors to assess the effectiveness of the drains.

9.3 Surface Regrading

This work will involve minor regrading in selected areas on the site to facilitate drainage and eliminate any significant surficially unstable areas. In general, we believe that the details of the work should be based on field conditions using judgment to minimize impacts and costs. The general intent is to:

- Regrade the obvious depressions to promote drainage. This earthwork can likely be completed with simple regrading without the need to import or export material.
- Remove unstable debris and soils from the slopes just above US 101 that may develop into debris flows in the fall/winter rains. Localized placement of rockfill and/or geotextiles may be warranted. This may result in some import or export of materials.
- Localized regrading on the main landslide mass. Based on the lack of observed surface runoff and erosion, the general regrading on the main landslide mass can be minimized to a few selected areas which are readily accessible or present a high risk of failing in the fall rains.

At MP 326, there was about a 150-foot (45.7 m) wide section above the roadway that appeared to be over-steepened, underlain by loose landslide debris, and was considered unstable. This area was regraded and covered by rockfill to stabilize the shallow slope conditions. We recommend that much of the steep areas along and above the current roadway at MP 322 also be treated in this manner. This would include removing loose unstable soils, flattening localized oversteepened areas to the extent practical, and covering with rockfill. The extent of the treatment depends on the toe treatment option selected (wall or buttress fill) and the actual field conditions at the time of construction.

In addition to the regrading discussed above, areas where steep slopes occur in the toe area underlain by clay should be regraded with fill to form a flatter slope and remediate the risk of a shallow slide occurring in the clay. In general with either structural walls or an MSE buttress, it should be possible to place rockfill over the clay slopes to form a moderate 2H:1V to 3H:1V slope.

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9.4 Toe Buttress

The general intent is for the buttress to provide a fill buttress that extends about 20 to 30 feet (6.1 to 9.1 m) above the toe of the landslide with a width equal to at least 1.5 times the height of the buttress. It is assumed that the outside face will be an MSE wall. An MSE wall is preferred due to cost and wall flexibility. An MSE fill/wall system maintains its integrity even if subjected to large movements (such as possible associated with seismic events). The MSE reinforcement also provides overall slope reinforcement in areas where US 101 is underlain by loose soils.

Specific wall heights and geometric constraints are included in Section 9.7. Once the final geometry is developed at each section, a stability and MSE wall analysis should be performed to determine the fill reinforcement requirements. To maintain the stability of the overall US 101 embankment where it is underlain by loose soils, the reinforcement may have to be longer and/or stronger than needed for a normal MSE wall.

Section 9.5.3 discusses solder pile-tieback wall ductility related to theoretical slope movements associated with major seismic events. With respect to ductility, an MSE buttress option is superior to the solder pile wall since MSE fills are considered very ductile and capable of experiencing significant movement and distortion without losing overall integrity.

9.5 Soldier Pile Wall

9.5.1 Soldier Pile At Edge of Roadway With Backfill

This would involve a soldier pile wall placed essentially at the toe of the current slope above US 101. This configuration allows for the benefit of additional fill to be placed behind the wall. In addition, the lowest tieback can be installed essentially at the toe of the slide resulting in a wall that develops virtually all of its lateral restraint from tieback anchors. This minimizes the moments in the wall below the lowest tieback which is important in minimizing the soldier pile section in areas where the roadway is underlain by loose soils.

The wall should be designed to meet normal earthpressure criteria to support the backfill behind the wall and to transfer the required additional lateral resistance below the slide plane. For walls in the range of 20 to 30 feet (6.1 to 9.1 m) high, the slope stability calculations indicate that the required load transfer is always greater than the loads based on normal earthpressures. In general, the load transfer forces specified in Section 7 range from 40 to 80 kips/lf (108.5 kN/m). Although there is no specific pressure distribution associated with this load, we recommend that the load be distributed as a normal apparent earthpressure distribution on the wall. Table 7 presents the applied earthpressures related to various slope geometries and transfer loads.

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The tieback anchors should be installed at about 20 to 30 degrees to the horizontal. Flatter angles will provide more horizontal resistance and less vertical load imposed on the solder piles. However a steeper angle will reduce the distance to the anchor zone. The anchor zone must extend below both the current slide plane and any weak or disturbed zones in the underlying soils. Section 9.7 provides criteria for this geometry at specific locations. The tiebacks will be permanent and must be provided with full double corrosion protection. The allowable design anchor adhesion depends on the installation methods and the results of field proof and production testing. Before ordering the anchors, we recommend that an anchor test program be completed to establish the design adhesions and required anchor lengths. It is essential that the test program use the same installation equipment that will be used for the production anchors. For preliminary design, an allowable adhesion of 1,500 psf (75 kPa) can be assumed for normal, non-pressure grouted gravity anchors. With pressure grouting, allowable adhesions two to three times this can likely be achieved. Based on preliminary calculations assuming reasonable pile and tieback spacings of 5 to 6 feet (1.5 to 1.8 m), anchor lengths on the order of 20 to 30 feet (6.1 to 9.1 m) should develop the required capacities. The final lock off tieback loads should be based on 100 percent of the normal earthpressure loads as shown on Table 7, not the full computed transfer loads.

The tieback loads will impose a significant vertical compression load on the soldier piles. For design purposes, the piles can be designed to develop 24 ksf (1149 kPa) end bearing and 1.5 ksf (71.8 kPa) adhesion in the dense/hard intact soils below the slide plane and any loose soils below US 101. It is conservatively recommended that resistance to the composed vertical loads due to adhesion in the fill above the roadway and any loose soils below the roadway be ignored. Regardless of the calculations, the soldier piles should extend at least 5 feet (1.5 m) into dense/hard intact soils. Based on preliminary calculations assuming reasonable pile spacings, solder pile penetrations on the order of 10 to 20 feet (3.1 to 6.1 m) should be adequate.

Since the piles will be installed with the backfill placed afterwards, normal pile spacing which considers soil stand up conditions do not apply. Thus the spacing should be based on the required tieback loads and spacing and the stresses on the final facing. The final facing could consist of treated wood lagging, concrete lagging, cast in place concrete structurally tied to the solder piles, and/or other designs. Since the slope may be subjected to long term creep, it may be unconservative to design the wall for reduced pressures assuming soil arching between the tiebacks. Thus we recommend that the permanent wall/lagging be designed for the full design wall pressures.

Normal WSDOT design standards for permanent wall drainage and construction anchor testing should be implemented.

9.5.2 Cut Walls Placed West/Above Roadway

In some areas, it may be an advantage to place the solder pile wall west and above the roadway level. This has the advantage of moving the wall further away from existing traffic and may facilitate construction sequencing and reduce construction impacts to the public. However, due to the removal of soil at the toe of the slide, there is a significant increase in the required wall transfer load to meet the stability requirements. Thus at a section requiring a transfer load of about 40 k/lf (54.3 kN/m) new fill added behind the wall will increase transfer load to as much as 80 k/lf (108.5 kN/m) if the wall is moved to the west and soil is removed in front of the wall instead of being added behind the wall. Although not addressed specifically in this report, it would be possible to install a cut wall and then place fill in front of the wall to reduce the required wall loads.

In general, the recommendations presented in Section 9.7.2 apply to this section.

9.5.3 Ductility

Calculations indicate that a major design seismic event (producing maximum accelerations over 0.3 g) may induce slope movements in excess of several feet. The calculated wall forces necessary to provide a yield acceleration (Ay) high enough to minimize theoretical movements to less than a few inches becomes excessive as the Am rises much above 0.15g. Thus the wall would have to be designed for lateral loads in excess of 100 to 200 k/lf (135.6 to 271.3 kN/m) to meet the theoretical criteria for very large events. In our opinion this is not appropriate to protect a roadway and may not be required due to the large uncertainties associated with these types of seismically induced slope movements. However, to the extent feasible, some ductility should be built into the wall. As a minimum, this should include reducing the tieback lock off loads from the design load to the load required to meet normal earthpressure forces. These will normally be 1/4-1/2 of the full design loads to meet the slide transfer load criteria.

Consideration should also be given to using mild steel bars for the tiebacks. Normal design and construction practices would use high strength steel strands for the tiebacks. However high strength steel exhibits brittle behavior resulting in relatively low strains to rupture the strands. Mild steel has a much more ductile stress-strain behavior which would tolerate considerably more wall movement before failing. Walls constructed of mild steel bars would be more costly and may not be warranted considering the small risk of a design seismic event. WSDOT will need to consider the costs and risk reduction in making a decision.

9.6 Catchment Area/Debris Wall

Depending on the final wall geometry and slope treatment, there may still be a risk that small debris flows could occur that might impact the roadway. Providing a catchment area and/or catchment wall between the toe of the slope and the roadway can mitigate this risk. The main disadvantage is that maintenance will be required to remove material that collects in the catchment areas. Catchment walls can be readily formed by installing soldier piles that extend above the final ground surface behind the wall. Catchment areas can be formed by placing the roadway as far to the east as possible and by providing a catchment ditch between the toe of the slope (or wall) and the edge of the roadway. The catchment area could be graded to serve as a wide catchment ditch or a small wall could be placed to provide catchment volume. The wall could be inexpensive barriers or a short gravity wall.

If the full slope rockfill treatment as recommended in Section 9.3 is implemented, a catchment wall/ditch will likely not be required.

9.7 Design At Specific Sections

9.7.1 Southern Area With Slide Toe Above Roadway

In about the southern 200 feet (61 m) of the landslide, the toe of the active slide is located 10 (3.1 m) to as much as 30 feet (9.1 m) above the roadway. Section A-A' shown on Figure 7 is typical of this area with the mapped toe of the active slide occurring about 20 feet (6.1 m) above the roadway. Calculations indicate that a 20 foot (6.1 m) high toe buttress above the toe of the slide is required at Section A-A'. Thus a toe buttress placed at the roadway would have to be about 40 feet (12.2 m) high. Accordingly, two other options are proposed:

- SOLDER PILE FILL WALL: This would involve placing a soldier pile tieback wall on a construction bench located near the toe of the active landslide. After the piles have been installed, the area behind the wall would be backfilled as the tiebacks are installed to provide stabilization weight. The wall should be designed for a transfer load of 40 k/lf (54.3 kN/m) through this area assuming a wall height of about 20 feet (6.1 m). Figure 21 shows the general geometry of the wall and backfill.

- CATCHMENT AREA: Another option would be to place the roadway on an embankment fill to create a large catchment area as shown on Figure 22. Thus even if the slide continues to fail, it will likely not impact the roadway. However the catchment area will require maintenance to remove debris and maintain the required catchment volume. This option may be cost effective if the area to the north is stabilized with a large buttress, which would result in a raising of the roadway in this area to match the buttress grades to the north. Since the current roadway grades are rising to the south of the slide anyway, the catchment fill embankment may be cost effective.

9.7.2 Detour Fill Area

The current buttress fill in the southern, high area of the detour consists of new fill underlain by buried recent slide debris as depicted on Section G'G' on Figure 13. The current ground configuration at G-G' is only an approximation as we were never provided with an as-built section. The current geometry complicates the remediation particularly as related to maintaining traffic during construction.

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Stability calculations indicate that a 30 foot (9.1 m) buttress (with a width averaging at least 1.5 times the height) above the original toe of slide is required. A soldier pile wall with fill placed behind the wall will require a transfer load of about 75 k/lf (101.7 kN/m). If a cut wall is installed to allow removal of the existing buttress fill (which includes loose slide debris) to re-establish the original roadway grades, the required transfer loads are significantly increased to 125 to 150 k/lf (169.6 to 203.5 kN/m). These design loads could be decreased if the excavation is done in the summer just to remove the old landslide debris with compacted fill replaced to add buttress fill weight.

Based on the current conditions and our assessment of maintaining at least one lane of traffic during construction, the following options are proposed:

- SOLDER PILE WALL ABOVE ROADWAY, NO EXCAVATION: This would involve installing a solder pile tieback wall just upslope of the current edge of the detour route as shown on Figure 23. The wall should extend 20 feet (6.1 m) above the current ground surface and be designed for a transfer load of 75 k/lf (101.7 kN/m). The tiebacks and solder piles must extend through the active slide debris as depicted on Figure 23. Once the wall is installed, the existing roadway bench could be widened by placing an MSE fill out over the existing edge of the embankment. If this is required, the stability of the existing embankment fill must be evaluated since the area is underlain by loose landslide debris from the 1999 failure.

- SOLDER PILE WALL ABOVE ROADWAY, PARTIAL EXCAVATION AND BACKFILL: This would be similar to the above option but would involve partial excavation of the existing roadway fill to widen the roadway section and allow removal of some of the loose underlying landslide debris. The design loads on the wall would be on the order of 125 to 150 k/lf (169.6 to 203.5 kN/m) depending on the depth of the required excavation, the final roadway elevation, and the time of year the temporary cuts were made. Figure 24 shows this option.

- MASSIVE FILL BUTTRESS RETAINED WITH COMPOSITE MSE/SOIL NAILS: This option would involve placing a large 30 foot (9.1 m) high buttress with an MSE wall which would encapsulate the current fills as shown on Figure 25. The MSE wall would be a composite wall with some soil nails tied to soil reinforcement in the base of the fill with soil reinforcement only near the top.

9.7.3 Area North Of Detour Fill Underlain By Loose Soils

About a 400-foot (121.9 m) section of US 101 north of the detour buttress is underlain by 20 to 40 feet (6.1 to 12.2 m) of loose soils. Section B-B' on Figure 8 is typical of this area. Two options are proposed for this area:

- BUTTRESS FILL: Figure 26 shows the general design for an MSE fill at Section B-B'. The fill should extend 25 feet (7.6 m) above the toe of the slide and be at least 37.5 feet (11.4 m) wide. To maintain at least the current stability of the US 101 embankment, the face of the MSE wall should be located at least 30 feet (9.1 m) from the top of the slope. Depending on the width of the bench along US 101, some temporary cutting may be required into the toe of the slope above the roadway to fit the required MSE fill width. Alternatively, the wall could be raised to 30 feet (9.1 m) and reduced in width to 32 feet (9.8 m). Once the design configuration is determined, slope stability analyses should be used to assess the requirements for the MSE fill reinforcement. To maintain the stability of the embankment, the soil reinforcing elements may have to be longer and stronger than required for a simple MSE fill. We also recommend that horizontal drains be installed near the toe of the US 101 embankment to lower the seepage pressures in the loose embankment soils pending additional subsurface data.

- SOLDER PILE WALL: Figure 27 shows a solder pile tieback wall at about the toe of the existing slide. The wall should be at least 20 feet high and develop a transfer load of 50 k/lf 67.8 kN/m) combined with a sloping fill behind the wall. The tiebacks and soldier piles must extend into the intact soils below the slide debris and loose soils below the roadway.

Due to the uncertainties in the lateral limits, depths, and groundwater levels of the loose soils under US 101, we recommend additional borings along this section of US 101. This information is needed to design and install the solder piles and tiebacks and assess the need for horizontal drains if a buttress is used. The number, location, and need for piezometers depends on whether a buttress or solder pile wall is planned.

9.7.4 Area North Of Detour Fill Underlain By Competent Soils

US 101 along about the northern 100 to 200 feet (30.5 to 61.0 m) of the landslide is underlain by dense soils. Thus either a buttress fill or solder pile wall would be feasible. Due to the moderation in the topography, the required buttress height can decrease from 25 feet 7.6 m) at the southern limit to 15 feet (4.6 m) at the northern limit. The soldier pile wall height should be 25 feet (7.6 m) but the transfer load can decrease from 50 k/lf (67.8 kN/m) at the southern end to 25 kips (33.9 kN/m) at the northern end.

9.7.5 Area South Of The Current Active Landslide

As discussed in Section 8.3, it is recommended that toe stabilization work is implemented south of the current active landslide area. This would involve extending the stabilization work as outlined in Section 9.7.1 some 200 feet (61 m) south of the current landslide.

10. INSTRUMENTATION AND REMOTE DATA ACCESS SYSTEM

10.1 Long term Monitoring Program

To properly assess the effectiveness of the drains and to monitor the long term slope stability conditions, an effective monitoring program must be put in place and monitored indefinitely. Golder has installed an automated, remote telemetry monitoring system to facilitate gathering data and reduce the reaction time when action levels are exceeded. Some additional sensors should be added to this system of full time monitoring. In addition, other monitoring should be done periodically.

The monitoring program should include:

- ADDITIONAL PIEZOMETERS: Additional piezometers may be required depending on the drainage design of the upslope reservoir and the need to assess horizontal drains in loose areas of the US 101 embankment. Some of these piezometers should be linked to the remote monitoring system.

- SURFACE SURVEY POINTS AND OBSERVATIONS: This involves establishing surface monitoring points at key locations on the slide. These can be surveyed yearly and/or after other data implies slope movements. In addition, the general slide area should be inspected yearly for any evidence of movement. No part of this survey needs to be in the remote monitoring system.

- WALL AND BUTTRESS: In areas where a solder pile wall has been installed, the top of the walls should be monitored for any evidence of movement. The toe buttress should also be monitored for movement. In addition, inclinometers should be installed in selected solder piles to monitor the movement with depth. Consideration should also be given to placing load cells on selected tiebacks to monitor the long term loads on the anchors and assess if there is a build up in load due to landslide creep. This data will also be valuable to assess wall integrity should a major seismic event cause wall/landslide movement. No part of this instrumentation is in the remote monitoring system.

- PIEZOMETER DATA: All of the piezometers should be monitored periodically with the data evaluated to assess drain effectiveness. As a minimum the piezometers should be read three times a year for the first five years with additional data obtained if unusual precipitation events occur, the remote data implies significant changes and/or other data implies slope movements. These readings should be taken in the early fall when the levels should be low, once in late November or early December, and once in late February or early March. The automated, remote telemetry monitoring system will provide data throughout the year. After five years, the frequency of readings and the number of piezometers read should be re evaluated.

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- INCLINOMETER DATA: At least four inclinometers should be included in the remote monitoring system. For the first five years, all of the other inclinometers should be read yearly with additional readings taken in the vicinity of any suspected movements. In addition, if the remote data or other information implies that the slope is moving, inclinometers located within suspected areas should be read as soon as practical. The automated, remote telemetry monitoring system will provide data throughout the year. After five years, the frequency of readings and the number of inclinometers read should be re-evaluated.

- HORIZONTAL DRAIN DISCHARGE RATES: A few selected drains should be connected to the automated, remote telemetry monitoring system to provide data throughout the year. In addition, for the initial two years the discharge rates from each drain should be measured twice a year. This would include once in late November or early December and once in late February or early March. These data will be used to develop an understanding of the pattern of the flow rates and assist in determining if drains are becoming clogged in the future. After this initial period, the frequency of readings and the need to measure individual drains should be re evaluated. It may be possible to simply measure the cumulative flow of each array to identify if clogging is occurring with individual drain only measured if a problem is indicated. If the measurements of specific drains are automated, data will be obtained throughout the year. Although the cumulative rates are important, a decrease in a drain with limited flow production can be important since it is seepage heads, not flow rates that cause landslides. Thus the discharge rates need to be evaluated in conjunction with the other slope data.

- DATA EVALUATION: An all too common problem with long term monitoring programs is that the data are collected but not evaluated in a timely manner. WSDOT should develop a protocol for the timely review and evaluation of the data.

11. USE OF REPORT

This report has been prepared exclusively for the use of WSDOT and their consultants for specific application to this project. The Golder field borings were performed in general accordance with locally accepted geotechnical engineering practice to provide information for the areas explored. There are possible variations in the subsurface conditions between the borings and variations with in the groundwater conditions with time. We recommend that a contingency for unanticipated conditions be included in the construction schedule and budget. In addition, Golder relied on data provided by WSDOT which included borings logs for several of the borings and information on horizontal drain installations.

It is anticipated that WSDOT will develop a design for the landslide remediation based on the general criteria presented in this report. Golder should have the opportunity to review geotechnical aspects of the final design.

12. REFERENCES

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TABLES

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TABLE 1

SUMMARY OF EXPLORATORY BOREHOLES

Borehole Number	Ground Surface Elevation (feet MSL)	Depth to Bottom of Hole (feet bgs)	Elevation of Bottom of Hole (feet MSL)	Piezometer Sand Pack Depth Range (feet bgs)	Piezometer Sand Pack Elevation Range (feet MSL)	Comments
GA-1	145.0	86.2	58.8	66 to 86.2	79 to 58.8	Poor Boy Inclinometer
GA-1A	145.0	25.8	119.2	5 to 25.8	140 to 119.2	
GA-1B	145.0	85.0	60.0	NA	NA	Inclinometer
GA-2	98.3	61.5	36.8	17 to 61.5	81.3 to 36.5	Poor Boy Inclinometer, PVC closed off at about 15 feet bgs (11/12/99)
GA-3	289.1	235.0	54.1	NA	NA	Inclinometer, Adjacent to H-1-99
GA-3A (WSDOT H-1-99)	289.1	235.0	54.1	20 to 220	269.1 to 69.1	Piezometer borehole logged and installed by WSDOT
GA-4	175.0	127.5	47.5	NA	NA	Inclinometer
GA-4A	175.0	107.6	67.4	52.5 to 106.5	122.5 to 68.5	
GA-5	126.9	100.3	26.7	NA	NA	Inclinometer
GA-5A	126.5	46.9	79.6	21.5 to 47	105.4 to 79.9	
GA-6	191.4	116.5	74.9	NA	NA	Inclinometer
GA-6A	191.4	65.0	126.4	50 to 65	141.4 to 126.4	
GA-7	106.1	85.8	20.3	NA	NA	Inclinometer
GA-7A	106.1	47.0	59.1	31 to 47	75.1 to 59.1	
GA-8	290.9	207.5	83.4	NA	NA	Inclinometer
GA-8A	290.9	155.0	135.9	99 to 134.5	191.1 to 155.6	
GA-9	287.6	211.5	76.1	NA	NA	Inclinometer
GA-9A	287.6	170.0	117.6	123 to 170	164.6 to 117.6	
GA-10	137.3	70.4	66.9	NA	NA	Inclinometer, PVC closed off at about 25 feet bgs (11/12/99)
GA-10A	137.3	37.0	100.3	18 to 37	119.3 to 100.3	PVC closed off at about 25 feet bgs (11/12/99)
GA-11	122.0	70.4	51.6	58 to 70.4	64 to 51.6	PVC closed off at about 20 feet bgs (11/12/99)
GA-11A	122.0	45.0	77.0	33 to 45	89 to 77	PVC closed off at about 20 feet bgs (11/12/99)
GA-12	118.0	76.1	41.9	60.5 to 76.1	57.5 to 41.9	Surface monument damaged by debris flows in area.
GA-12A	118.0	49.0	69.0	25 to 49	93 to 69	Surface monument damaged by debris flows in area.
GA-13	232.0	142.5	89.5	85 to 128	147 to 104	
GA-14	67.3	61.5	5.8	25 to 39.5	42.3 to 27.8	Outboard edge of re-route
GA-15	315.0	297.0	18.0	(screen) 184.8 to 206.8	(screen) 130.2 to 108.2	Pump Test Well
WSDOT H-1R-99	52.0	59.5	-7.5	NF	NF	Located on US 101, No Installations
WSDOT H-2R-99	49.0	60.5	-11.5	NF	NF	Located on US 101, No Installations
WSDOT TH-1-99	45.0	70.0	-25.0	8 to 50	37 to -5	Located on US 101
WSDOT TH-2-99	40.0	70.0	-30.0	NF	NF	Located on US 101, No Installations
WSDOT TH-3-99	35.0	69.5	-34.5	58 to 68	-23 to -33	Located on US 101

Notes:
MSL = Mean Sea Level
bgs = Below Ground Surface
NF = Not Found
NA = Not Applicable

TABLE 2

SUMMARY OF WATER LEVELS (elev. In feet)

	Date																								
Piezometer Number	5/20/99	5/23/99	5/24/99	6/5/99	6/7/99	6/9/99	6/11/99	6/15/99	7/1/99	9/2/99	9/3/99	9/7/99	9/8/99	9/9/99	9/10/99	9/14/99	9/15/99	9/20/99	9/22/99	11/1/99	11/5/99	11/6/99	11/10/99	11/11/99	11/12/99
GA-1	67.2	65.95	70.12	71.78	71.96	72.51	72.72	70.77	70.22	N/A	N/A	N/A	N/A	69.58	N/A	N/A	N/A	N/A	N/A	68.44	68.7	N/A	68.44	68.7	N/A
GA-1A	N/A	129.05	129.68	N/A	127.93	127.79	127.68	127.41	123.64	N/A	N/A	N/A	N/A	119.7	N/A	N/A	N/A	N/A	N/A	Dry	N/A	N/A	120.1	Dry	N/A
GA-2	64.95	65.38	65.4	64.33	64.25	64.12	63.95	63.69	62.9	N/A	N/A	N/A	N/A	60.95	N/A	N/A	N/A	N/A	N/A	57.85	57.2	N/A	57.54	57.45	Damaged
GA-3A	N/A	N/A	N/A	N/A	N/A	137.1	136.88	136.32	135.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	130.74	N/A	N/A	128.72	128.7	N/A	N/A	128.34	N/A
GA-4A	N/A	N/A	N/A	N/A	N/A	N/A	113.45	111.55	109.61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	102.33	N/A	N/A	100.51	N/A	N/A	N/A	100.42	N/A
GA-5A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	82.79	81.5	N/A	N/A	N/A	N/A	DRY	N/A	N/A	N/A	N/A	N/A	Dry	Dry	N/A	N/A	Dry	N/A
GA-6A	N/A	136.7	N/A	N/A	134.87	134.72	134.57	134.13	132.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	129.1	N/A	N/A	127.95	N/A	N/A	N/A	127.81	N/A
GA-7A	N/A	73.87	N/A	71.8	71.61	71.58	74.75	71.32	70.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	68.22	N/A	N/A	64.19	63.6	N/A	N/A	63.44	N/A
GA-8A	N/A	N/A	N/A	N/A	N/A	DRY	DRY	DRY	DRY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Dry	N/A	Dry	N/A	Dry	N/A
GA-9A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	141.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	136.21	N/A	136.2	N/A	136.03	N/A
GA-10A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	112.9	112.7	N/A	N/A	112.35	N/A	N/A	112.36	112.1	N/A	N/A	N/A	111.7	112.36	112.44	Damaged
GA-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	DRY	N/A	DRY	N/A	N/A	N/A	DRY	N/A	Dry	54.6	N/A	N/A	Damaged	N/A
GA-11A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	80.7	N/A	N/A	N/A	N/A	80.1	N/A	80.14	80.6	N/A	N/A	80.54	Damaged
GA-12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	64.88	53.43	N/A	N/A	45.24	N/A	43.5	N/A	N/A	43.46	43.45	N/A
GA-12A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	76.42	N/A	N/A	75.82	N/A	75.7	75.7	N/A	75.91	75.94	N/A
GA-13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	130.1	N/A	128.72	N/A	127.87	127.7	N/A	N/A	127.74	N/A
GA-14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31.13	30.97	30.9	N/A	31.22	31.28	N/A

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SLUG TEST RESULTS

Well ID	Screened Unit	Water Level (ft bgs)	Sand Pack	Test Type	Solution	Hydraulic Conductivity (ft/s)	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (m/s)
GA-4									
	GLACIOLACUSTRINE LANDSLIDE DEBRIS laminated SILTY CLAY with thin interbeds of fractured CLAY, fine sand	74.92	52 - 107 ft bgs 55 ft	rising head (test 1)	Unconfined - Hvorslev	3.88E-08	5.59E-05	1.18E-06	1.18E-08
					Unconfined - Bouwer-Rice	2.21E-08	3.18E-05	6.73E-07	6.73E-09
				rising head (test 2)	Unconfined - Hvorslev	3.82E-08	5.50E-05	1.16E-06	1.16E-08
					Unconfined - Bouwer-Rice	1.13E-08	1.63E-05	3.44E-07	3.44E-09
				rising head (test 3)	Unconfined - Hvorslev	3.54E-08	5.10E-05	1.08E-06	1.08E-08
					Unconfined - Bouwer-Rice	1.06E-08	1.53E-05	3.24E-07	3.24E-09
					min	1.06E-08	1.53E-05	3.24E-07	3.24E-09
					max	3.88E-08	5.59E-05	1.18E-06	1.18E-08
					average	2.61E-08	3.76E-05	7.95E-07	7.95E-09
GA-7	GLACIOLACUSTRINE LANDSLIDE DEBRIS SILTY CLAY with interbedded silty sand lenses	41.33	31 - 47 ft bgs 16 ft	rising head (test 1)	Unconfined - Hvorslev	1.74E-06	2.50E-03	5.29E-05	5.29E-07
					Unconfined - Bouwer-Rice	2.89E-07	4.15E-04	8.79E-06	8.79E-08
				rising head (test 2)	Unconfined - Hvorslev	1.35E-06	1.95E-03	4.13E-05	4.13E-07
					Unconfined - Bouwer-Rice	3.79E-07	5.45E-04	1.15E-05	1.15E-07
				rising head (test 3)	Unconfined - Hvorslev	1.69E-06	2.44E-03	5.16E-05	5.16E-07
					Unconfined - Bouwer-Rice	4.54E-07	6.53E-04	1.38E-05	1.38E-07
					min	2.89E-07	4.15E-04	8.79E-06	8.79E-08
					max	1.74E-06	2.50E-03	5.29E-05	5.29E-07
					average	9.84E-07	1.42E-03	3.00E-05	3.00E-07
GA-10	GLACIOLACUSTRINE LANDSLIDE DEBRIS laminated SILTY CLAY with thin interbeds of fractured CLAY, fine sand	27.64	18 - 37 ft bgs 19 ft	rising head (test 1)	Unconfined - Hvorslev	3.76E-07	5.42E-04	1.15E-05	1.15E-07
					Unconfined - Bouwer-Rice	9.69E-08	1.40E-04	2.95E-06	2.95E-08
				rising head (test 2)	Unconfined - Hvorslev	1.88E-07	2.71E-04	5.73E-06	5.73E-08
					Unconfined - Bouwer-Rice	4.64E-08	6.68E-05	1.41E-06	1.41E-08
				rising head (test 3)	Unconfined - Hvorslev	1.78E-07	2.57E-04	5.43E-06	5.43E-08
					Unconfined - Bouwer-Rice	4.42E-08	6.37E-05	1.35E-06	1.35E-08
					min	4.42E-08	6.37E-05	1.35E-06	1.35E-08
					max	3.76E-07	5.42E-04	1.15E-05	1.15E-07
					average	1.55E-07	2.23E-04	4.72E-06	4.72E-08

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TABLE 4

SUMMARY OF HORIZONTAL DRAIN FLOWS
(Primary Drains installed by May 1, 1999)

	FLOW RATES (GPM)										
Drain #	**6/4/99**	**6/7/99**	**6/9/99**	**6/11/99**	**6/15/99**	**7/1/99**	**8/30/99**	**9/22/99**	**11/1/99**	**11/10/99**	**11/18/99**
A1-4, 9-13	2.9	6.8	6.8	6.1	6.4	5.9	3.2	3.2	3.5	4.3	4
A5	33.8	22.5	27	22.5	22.5	19.3	13	13.3	12	10	12
A6	33.8	19.3	22.5	22.5	22.5	16.9	20	24	20	24	20
A7	67.5	33.8	45	45	45	45	40	40	40	40	40
A8	27	19.3	22.5	22.5	19.3	7.9	1	0.7	Dry	Dry	0.25
Total A	165	101.7	123.8	118.6	115.7	95	77.2	81.2	75.5	78.3	76.25
B1	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
B2	0.25	0.24	0.28	0.25	0.23	0.1	0.2	0.1	0.1	0.1	0.1
B3	0.25	0.23	0.23	0.25	0.22	0.09	0.2	0.1	0.1	0.1	0.1
B4	1.5	1.5	1.6	1.4	1.4	1.05	0.5	0.4	0.3	0.3	0.5
B5	1.9	2	2	1.8	1.7	1.23	0.5	0.3	0.15	0.25	1
B6	4.5	4.2	4.7	4.4	4	3.8	2.2	1.9	1.4	1.25	1.4
B7	Drip	Drip	Drip	Drip	Drip	Drip	Drip	Dry	Drip	Drip	Drip
B8	22.5	22.5	22.5	27	19.3	19.3	10	10	9.2	8.6	10
B9	5.6	6.1	5.9	5.9	4.7	3.3	2	1.7	1.7	1.75	2.5
B10	Dry	Dry	Dry	Dry	Dry	Drip	Dry	Dry	Dry	Dry	Dry
B11	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Total B	36.5	36.77	37.21	41	31.55	28.87	15.6	14.5	12.95	12.35	15.6
C1-5	4	3.9	3.9	3.6	3.5	2.9	2	2.6	1.2	NF	
C6	NA	Drip	Drip	Drip	Drip	Trickle	Trickle	Trickle	Trickle	NF	
Total C	4	3.9	3.9	3.6	3.5	2.9	2	2.6	1.2	0	4.8
D1-14	NF	NF	NF	NF	NF	40	3.4	4.3	0.8	0.5	2.3
Total D	NF	NF	NF	NF	NF	40	3.4	4.3	0.8	0.5	2.3
Cummulative Totals	205.5	142.37	164.91	163.2	150.75	126.77	94.8	98.3	89.65	90.65	94.25

Note: The cummulative totals do not include flows from the "D" drains

TABLE 5

SUMMARY OF HORIZONTAL DRAIN FLOWS
(Arrays E through N installed September through December 1999)

	Flow Rates (GPM)			
Drain #	**11/1/99**	**11/2/99**	**11/10/99**	**11/18/99**
E1			0.25	Dry
E2			0.25	1
E3			0.25	0.25
E4			0.25	0.25
E5			0.25	0.25
E6			0.25	Dry
F1		Flow	0.25	0.5
F2		Flow	0.25	0.5
F3		Dry	0.25	0.25
F4		Dry	0.25	Dry
F5		Dry	0.25	Dry
G1		Dry	Dry	Dry
G2		Dry	Dry	Dry
G3		Dry	NF	NF
G4		Dry	NF	NF
G5		Dry	NF	NF
H1	Dry	Dry	NF	NF
H2	Dry	Dry	NF	NF
H3	Dry	Dry	NF	NF
H4	Dry	Trickle	NF	NF
H5		Dry	NF	NF
I1	Dry	Dry	Dry	Dry
I2	Dry	Dry	Dry	0.25
I3	Dry	Trickle	0.8	Dry
I4		Dry	0.8	NF
J1	Dry	Trickle	0.25	0.25
J2	Dry	Dry	Dry	Dry
J3	Dry	Dry	Dry	Dry
J4		Dry	Dry	Dry
K1	Drip	Dry	Dry	Dry
K2	Dry	Dry	Dry	Dry
K3	Drip	Dry	Dry	Dry
K4	Dry	Drip	Dry	Drip
L1	Drip	Dry	Dry	Dry
L2	Dry	Dry	Dry	Dry
L3	Drip	Dry	Dry	Dry
L4	Dry	Dry	Dry	Dry
M drains			1.5	1.3
N1				Dry
N2				Trickle
N3				Dry
N4	"N" Drains still being installed in mid to late November			Trickle
N5				Drip
N6				Dry
N7				Drip
N8				Drip

NF: Drains covered by debris from slope and therefore not accessible

DOT-50000104

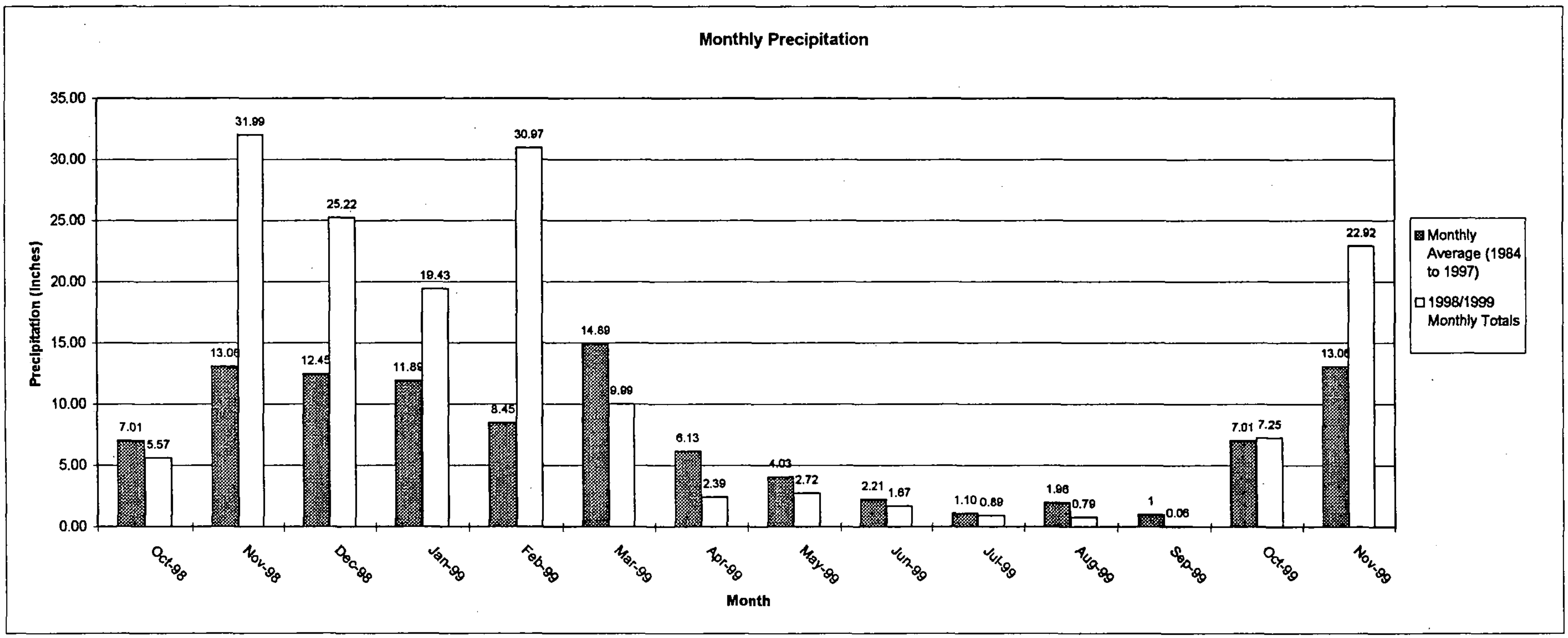
0201tabs.xls

TABLE 6

AVERAGE MONTHLY PRECIPITATION
(1984 THROUGH 1997)

	Year														
Month	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Average
January	8.8	1.01	22.21	16.66	11.13	7.75	23.46	10.59	24.74	9.78	10.59	NF	7.81	NF	11.89
February	10.72	6.91	11.51	8.72	3.37	8.34	12.81	12.45	10.04	0.49	13.56	NF	9.96	1	8.45
March	10.36	8.24	7.32	14.65	10.41	13.62	6.79	7.69	1.64	10.43	9.16	NF	2.31	91	14.89
April	8.23	3.99	3.84	3.71	6.64	6.22	2.74	11.1	8.86	11.33	5.51	NF	7.57	NF	6.13
May	8.07	1.62	4.11	6.32	5.4	2.95	2.61	3.11	0.04	5.1	3.78	NF	3.81	5.46	4.03
June	2.87	3.09	1	0.49	1.91	1.6	4.09	1.32	2.08	3.61	2.36	NF	0.41	3.92	2.21
July	0.001	0.02	0.8	0.77	0.92	3.51	0.27	0.83	0.81	2.93	0.15	NF	0.74	3.41	1.17
August	0.09	0.87	0.007	0.2	0.35	1.03	1.53	4.94	0.74	0.49	0.34	NF	1.6	2.14	1.10
September	3.28	2.57	2.62	0.84	4.2	0.3	0.01	0.001	2.83	0	1.54	NF	2.47	4.77	1.96
October	7.37	14.24	7.56	0.66	3.91	7.3	9.26	2.14	6.47	3.03	10	NF	6.33	12.91	7.01
November	21.53	5.37	17.43	7.36	20.97	10.19	25.79	16.35	10.01	5.75	17.39	NF	4.96	6.69	13.06
December	8.85	4.42	12.85	18.63	9.24	9.39	12.31	10.85	9.22	18.98	29.06	NF	12.73	5.37	12.45

Notes: Precipitation data provided by City of Tacoma and summarized by NOAA NRDC
1984 through 1994 precipitation data is for Cushman Powerhouse #2. 1996 and 1996 data is for Bremerton.



DOT-50000105

Design Wall Earthpressures

Table 7A - Required Wall Loads for Normal Earthpressures

Average Slope	Ka	P - psf/f	Total Load - k/lf			
			Total Load - k/lf			
			15	20	25	30
0	0.33	27	6.1	10.8	16.9	24.3
10	0.37	30	6.8	12.1	18.9	27.3
20	0.44	36	8.0	14.3	22.4	32.2
25	0.50	41	9.2	16.4	25.6	36.8
30	0.75	61	13.7	24.4	38.0	54.8

NOTES:
1. Normal earthpressures are required to support the proposed wall height considering the retained soil and slopes in the normal "active" zone.
2. The value of P represents the apparent earthpressure imposed as a rectangular pressure with the pressure equal to the wall height times P in psf. Thus the total load would be the height squared times P.
3. In most cases the required transfer load to stabilize the landslide will exceed these values and control the design.
4. The average slope should be calculated as the imaginary slope defined by the top of the slope against the wall to the slope at a distance along the slope equal to 1.5 times the wall height.

Table 7B - EARTHPRESSURES FOR TRANSFER LOADS

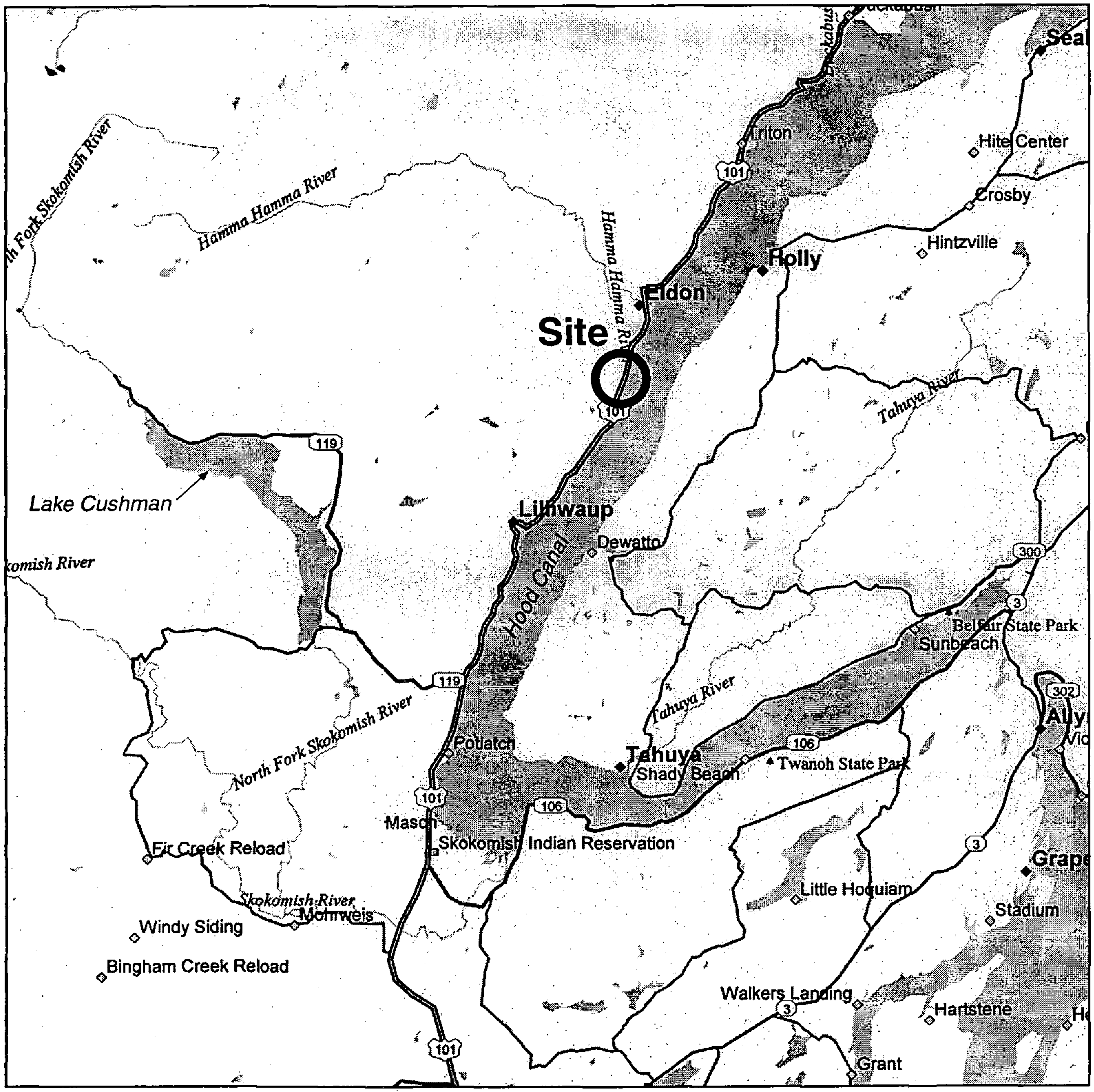
Design Load-klf	Apparent Earthpressure - P			
	Wall Height			
	15	20	25	30
0	0	0	0	0
25	111	63	40	28
50	222	125	80	56
75	333	188	120	83
100	444	250	160	111
150	667	375	240	167

Note:
1. Design load in k/lf represents the required transfer load for slope stability criteria.
2. P is in psf/ft and is applied as a rectangular pressure equal to P times the wall height.
3. The larger value from Table 7A and 7B should be used to design the wall.

DOT-50000106

FIGURES

DOT-50000107

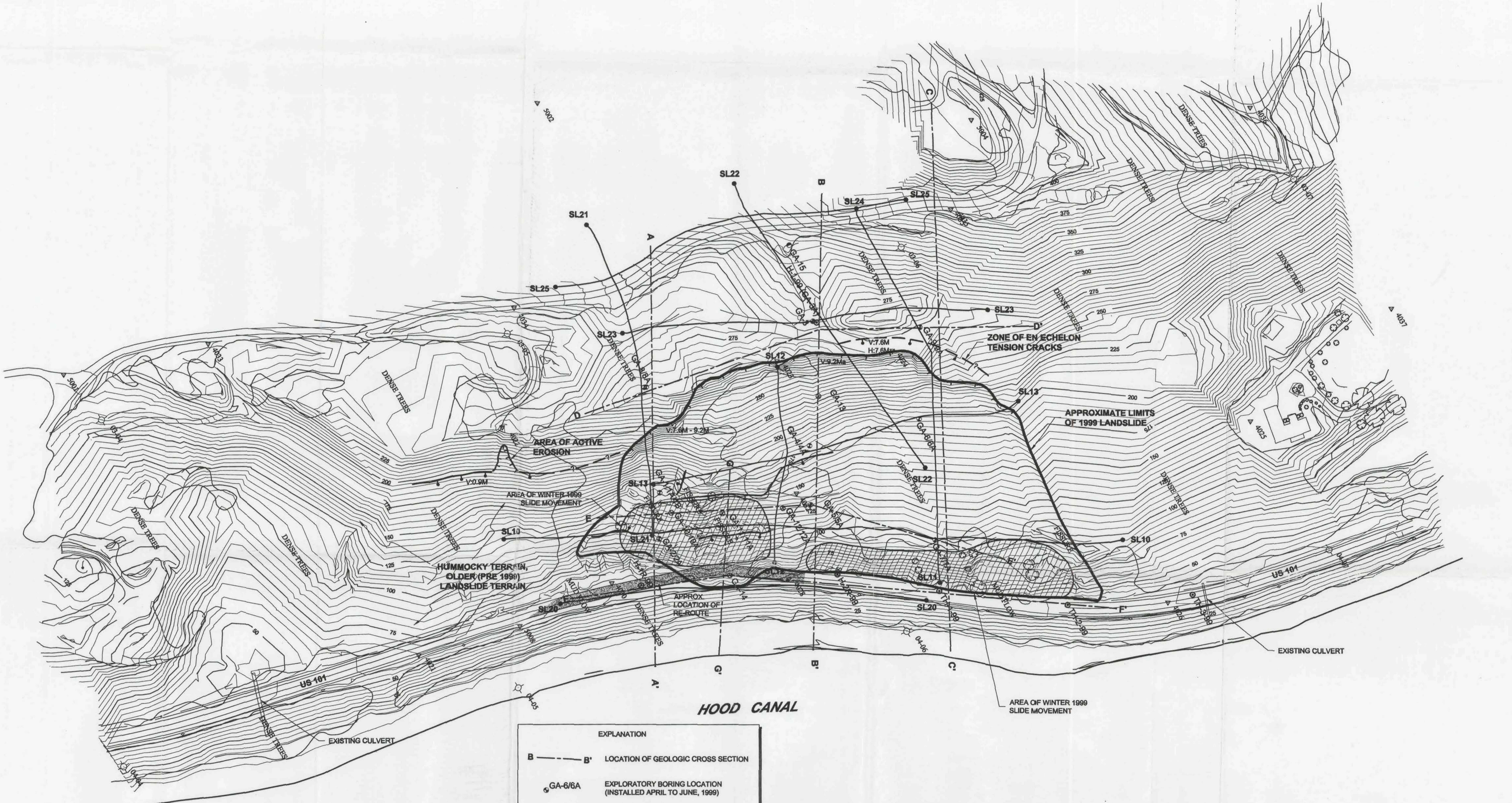


DOT-50000108

FIGURE 1
SITE LOCATION MAP
WSDOT/MP 322/WA

PROJECT NO. 993 1466.300 DRAWING NO. 84861 DATE 8/19/99 DRAWN BY EA

Golder Associates



EXPLANATION

B —·—·— B' LOCATION OF GEOLOGIC CROSS SECTION

GA-6/6A EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)

GA-14 EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)

GA-15 HYDROGEOLOGIC TEST WELL

H-1-99 WSDOT BORING

V:0.9M LANDSLIDE HEAD SCARP
V: VERTICAL DISPLACEMENT IN METERS
H: HORIZONTAL DISPLACEMENT IN METERS

SECONDARY SCARP
BALL ON DOWNTHROWN SIDE

SL-25 SL-25 SEISMIC REFRACTION SURVEY LINE

0 100 200 FEET

0 30 60 METERS

NOTE: ELEVATION CONTOURS ARE IN FEET.

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

FIGURE 2
SITE PLAN
WSDOT/MP 322/WA

Golder Associates

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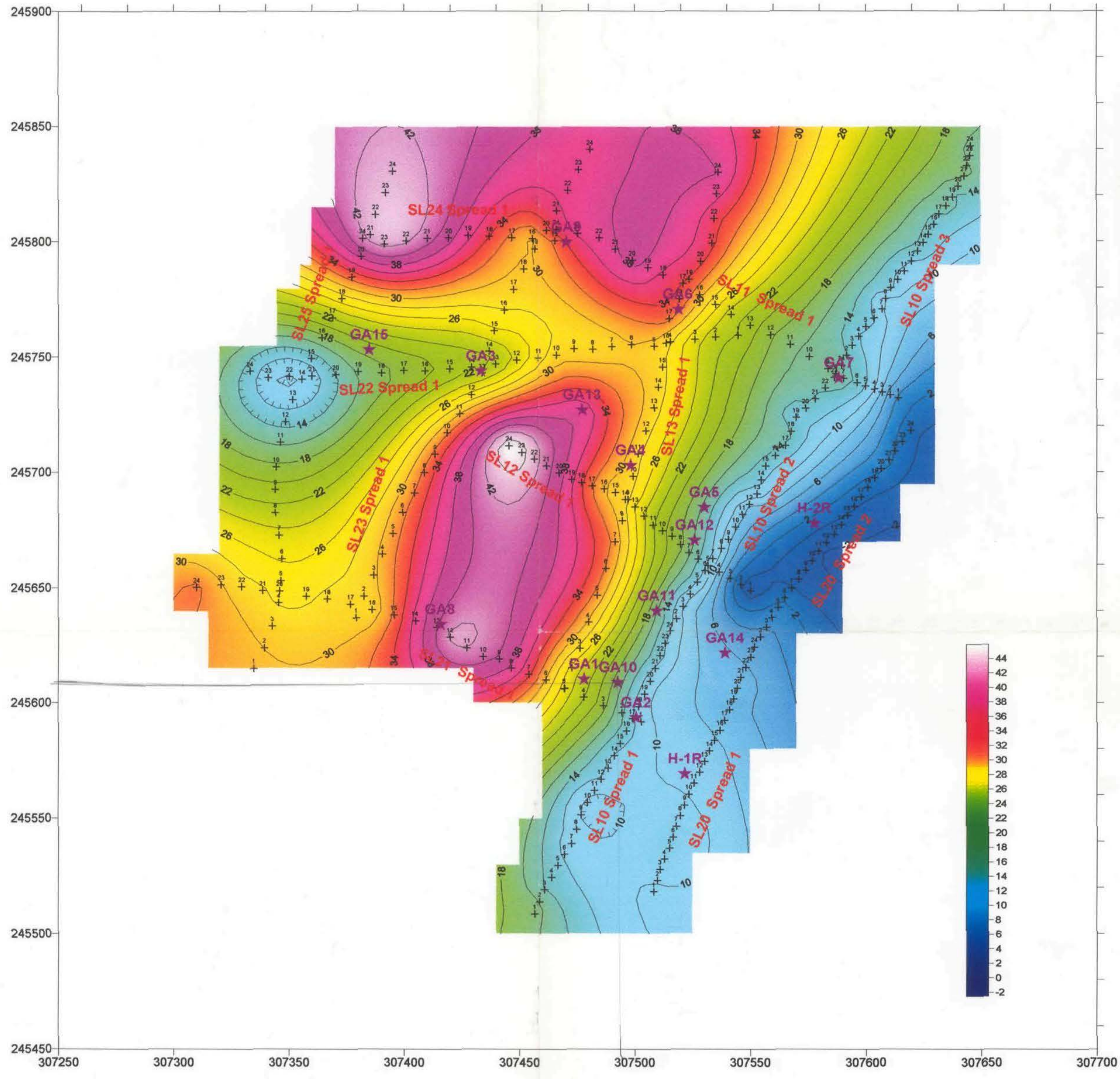


SEISMIC REFRACTION SURVEY
WSDOT/MP322 WA

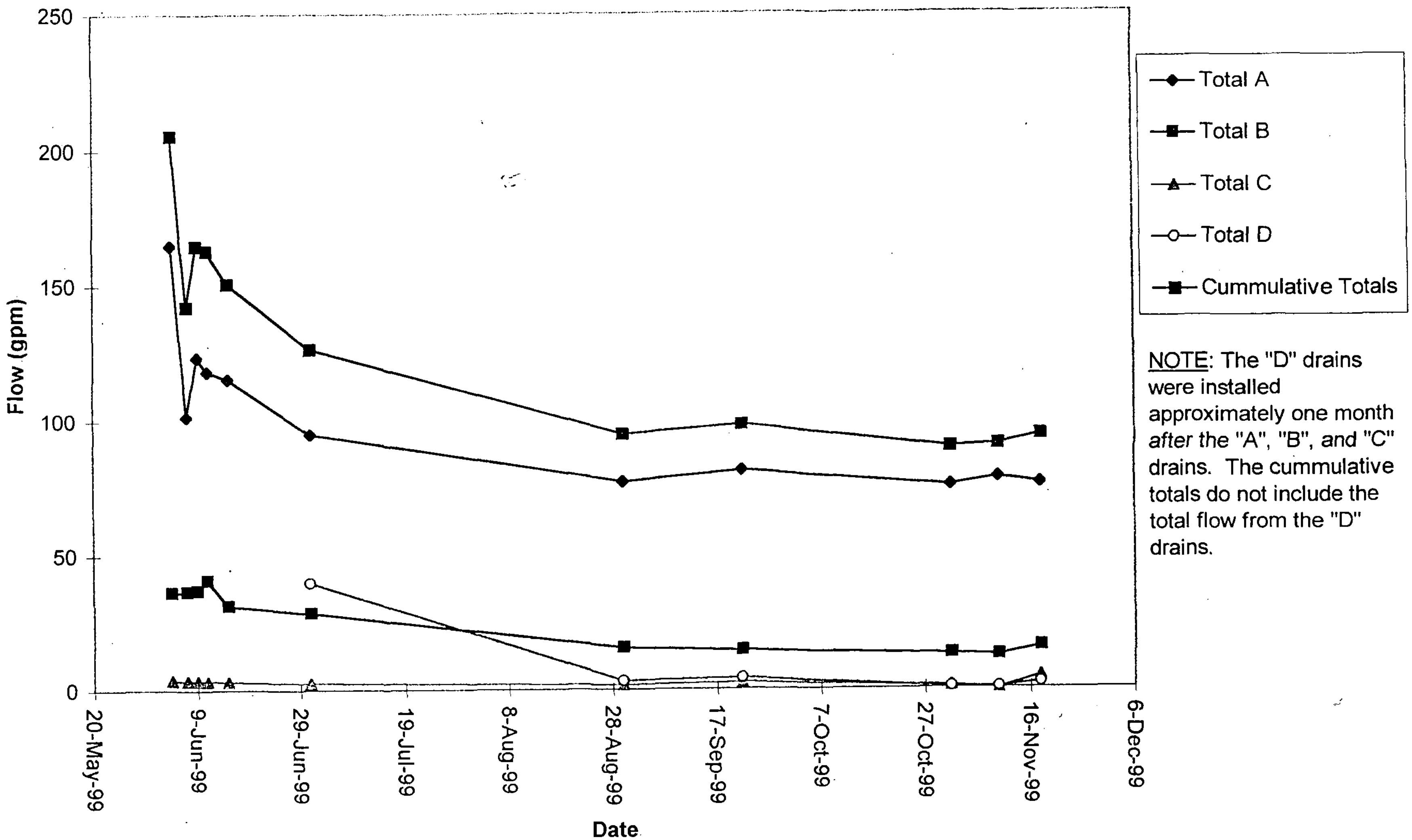
ELEVATION CONTOUR PLAN OF
THE TOP SURFACE OF GLACIOLACUSTRINE DEPOSIT

GOLDER ASSOCIATES INC.
REDMOND, WA

DATE: SEPTEMBER 1999	FIG. 3

DOT-50000110

HORIZONTAL DRAIN DISCHARGES
(Drain Arrays A through D)



NOTE: The "D" drains were installed approximately one month *after* the "A", "B", and "C" drains. The cummulative totals do not include the total flow from the "D" drains.

DOT-50000111

FIGURE 4
GRAPH OF HORIZONTAL DRAIN DISCHARGES
WSDOT/MP322/WA

C:\ACAD\BORDERS\BORDAH

Golder Associates

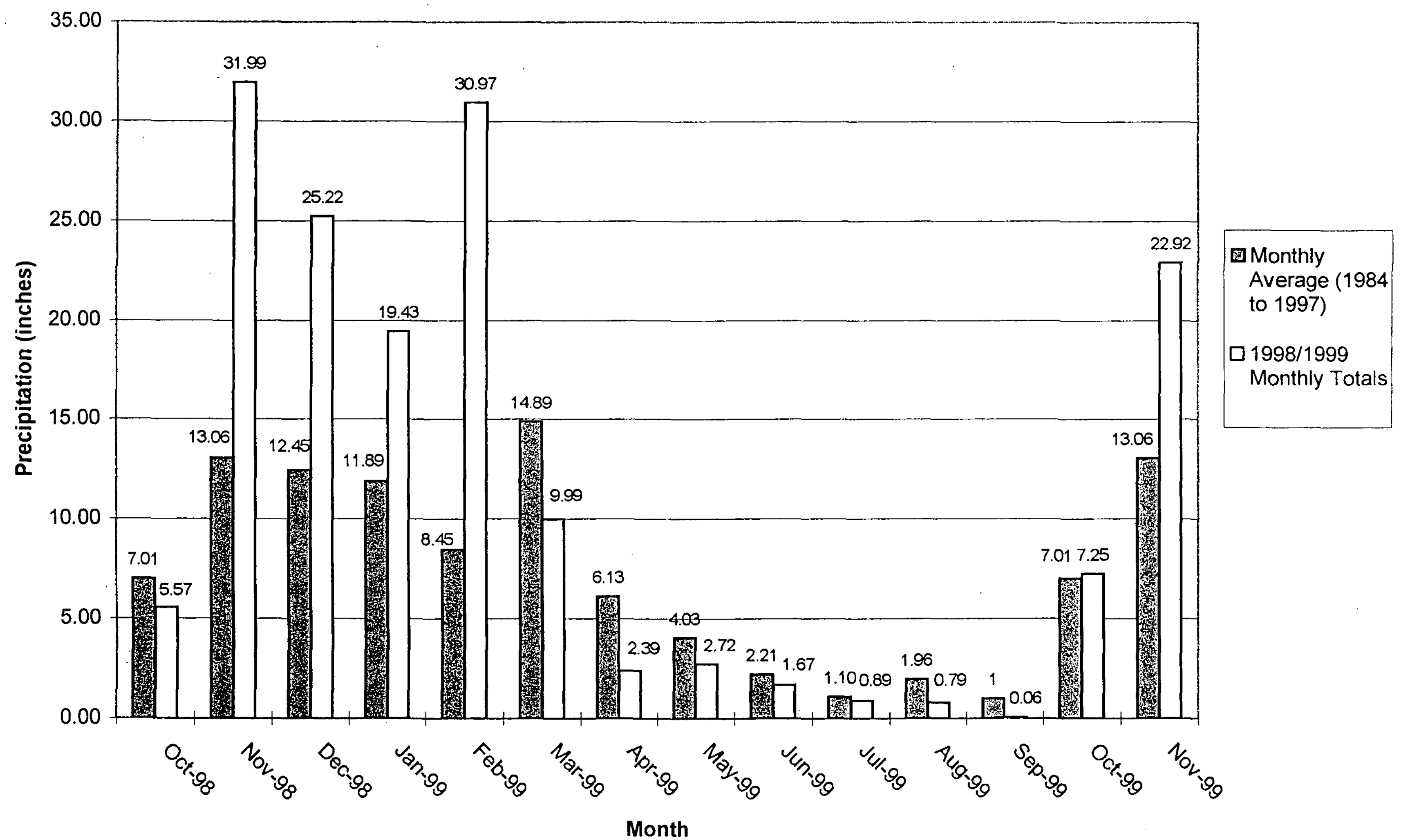


FIGURE **5**

1998/1999 MONTHLY PRECIPITATION

WSDOT/MP322/WA

DOT-50000112

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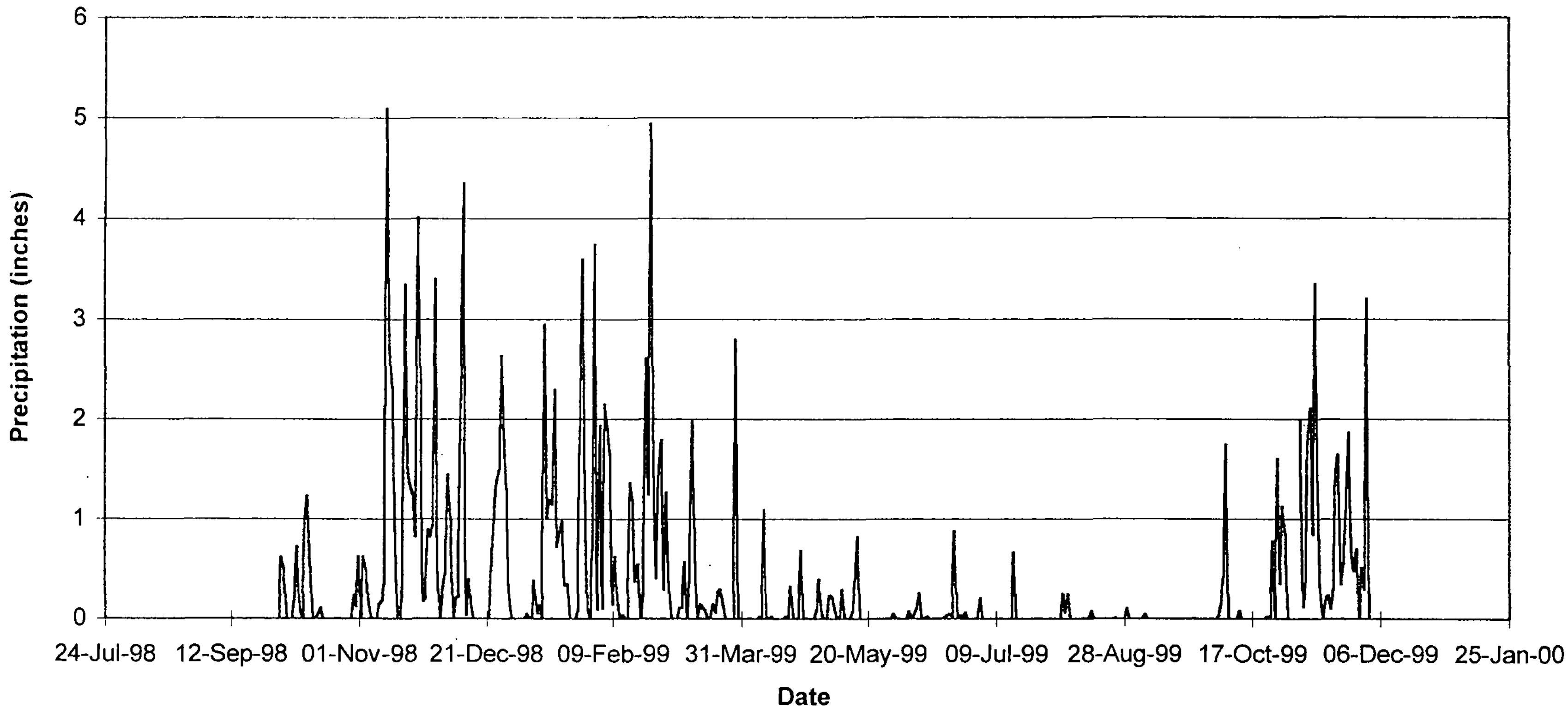
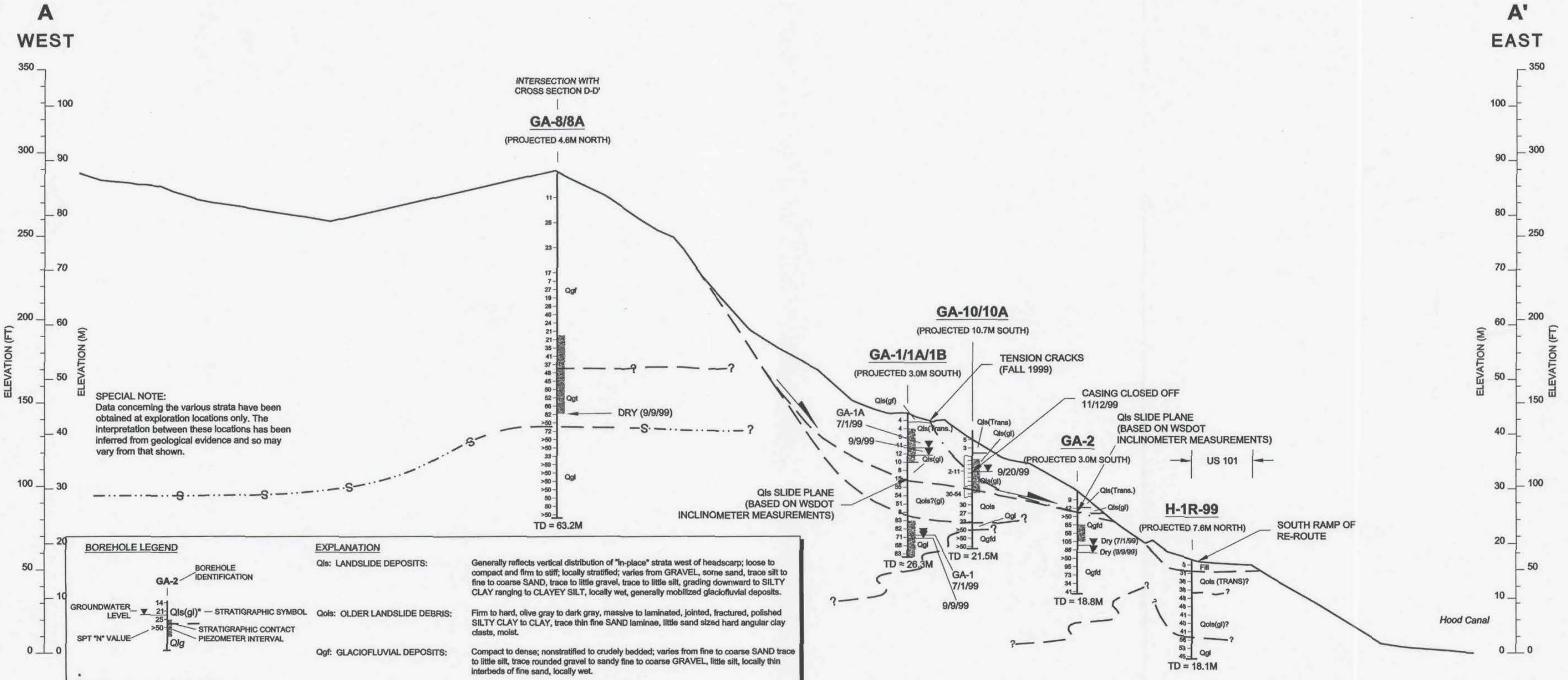


FIGURE 6
DAILY PRECIPITATION
CUSHMAN POWERHOUSE 2
WSDOT/MP322/WA

DOT-50000113

C:\ACAD\BORDERS\BORDAH

Golder Associates



BOREHOLE LEGEND

- GA-2 — BOREHOLE IDENTIFICATION
- GROUNDWATER LEVEL
- Qls(gl)* — STRATIGRAPHIC SYMBOL
- STRATIGRAPHIC CONTACT
- PIEZOMETER INTERVAL
- SPT "N" VALUE

* (gf) indicates derived from Glaciofluvial Deposit.
(gl) indicates derived from Glaciolacustrine Deposit.
(trans.) indicates derived from Transitional Beds.

- — — ? GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN
- S—··— APPROXIMATE LOCATION OF GEOLOGIC CONTACT BASED ON SEISMIC SURVEY
- — · — RENEWED LANDSLIDE MOVEMENT, FALL 1999

EXPLANATION

Qls: LANDSLIDE DEPOSITS:	Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.
Qols: OLDER LANDSLIDE DEBRIS:	Firm to hard, olive gray to dark gray, massive to laminated, jointed, fractured, polished SILTY CLAY to CLAY, trace thin fine SAND laminae, little sand sized hard angular clay clasts, moist.
Qgf: GLACIOFLUVIAL DEPOSITS:	Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, little silt, locally thin interbeds of fine sand, locally wet.
Qgt: TRANSITIONAL DEPOSITS:	Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.
Qgl: GLACIOLACUSTRINE DEPOSITS:	*Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.*
Qgfd: GLACIOFLUVIAL DRIFT:	Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.

FIGURE 7
GEOLOGIC CROSS-SECTION A-A'
US 101 MP 322
WSDOT/MP 322/WA

DOT-50000114

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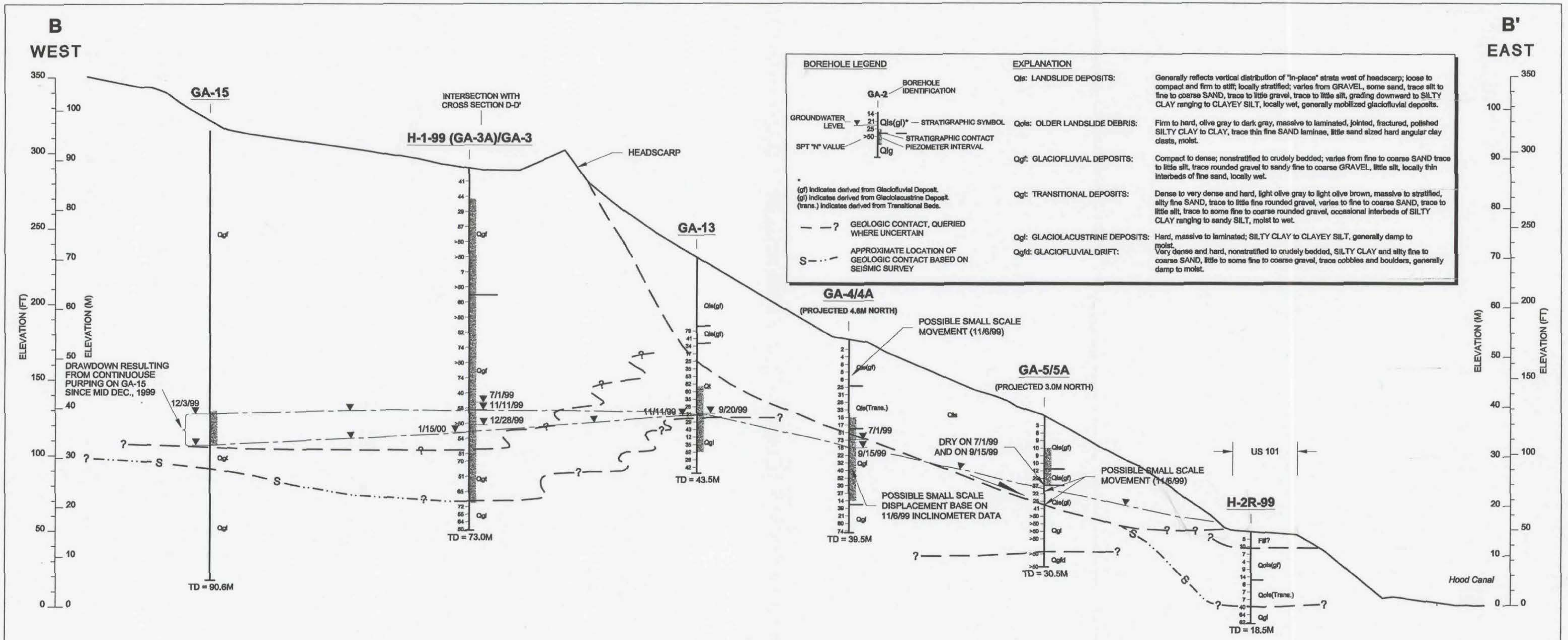

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

FEET H:V (0, 50, 100)

METERS (0, 10, 20, 30)

FIGURE 8
GEOLOGIC CROSS-SECTION B-B'
US 101 MP 322
WSDOT/MP 322/WA

DOT-50000115

Golder Associates

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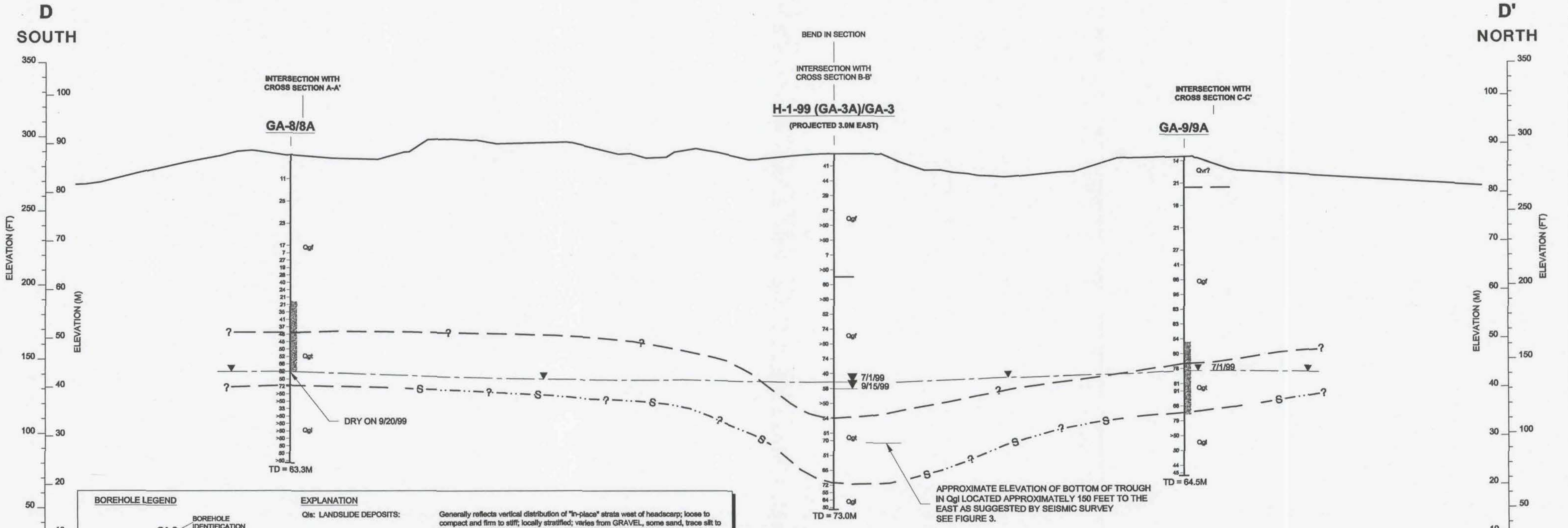
FIGURE 9
GEOLOGIC CROSS-SECTION C-C'
US 101 MP 322
WSDOT/MP 322/WA

DOT-50000116

Golder Associates



BOREHOLE LEGEND

GA-2 — BOREHOLE IDENTIFICATION

GROUNDWATER LEVEL

Qls(gl)* — STRATIGRAPHIC SYMBOL

STRATIGRAPHIC CONTACT

PIEZOMETER INTERVAL

SPT "N" VALUE

Qlg

*

(gf) indicates derived from Glaciofluvial Deposit.
(gl) indicates derived from Glaciolacustrine Deposit.
(trans.) indicates derived from Transitional Beds.

— —? GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

S—··— APPROXIMATE LOCATION OF GEOLOGIC CONTACT BASED ON SEISMIC SURVEY

EXPLANATION

Qls: LANDSLIDE DEPOSITS:	Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.
Qols: OLDER LANDSLIDE DEBRIS:	Firm to hard, olive gray to dark gray, massive to laminated, jointed, fractured, polished SILTY CLAY to CLAY, trace thin fine SAND laminae, little sand sized hard angular clay clasts, moist.
Qgf: GLACIOFLUVIAL DEPOSITS:	Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, little silt, locally thin interbeds of fine sand, locally wet.
Qgt: TRANSITIONAL DEPOSITS:	Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.
Qgl: GLACIOLACUSTRINE DEPOSITS:	Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.
Qgfd: GLACIOFLUVIAL DRIFT:	Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.

0 50 100
FEET
H:V
0 10 20 30
METERS

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

FIGURE 10
GEOLOGIC CROSS-SECTION D-D'
US 101 MP 322
WSDOT/MP 322/WA

DOT-50000117

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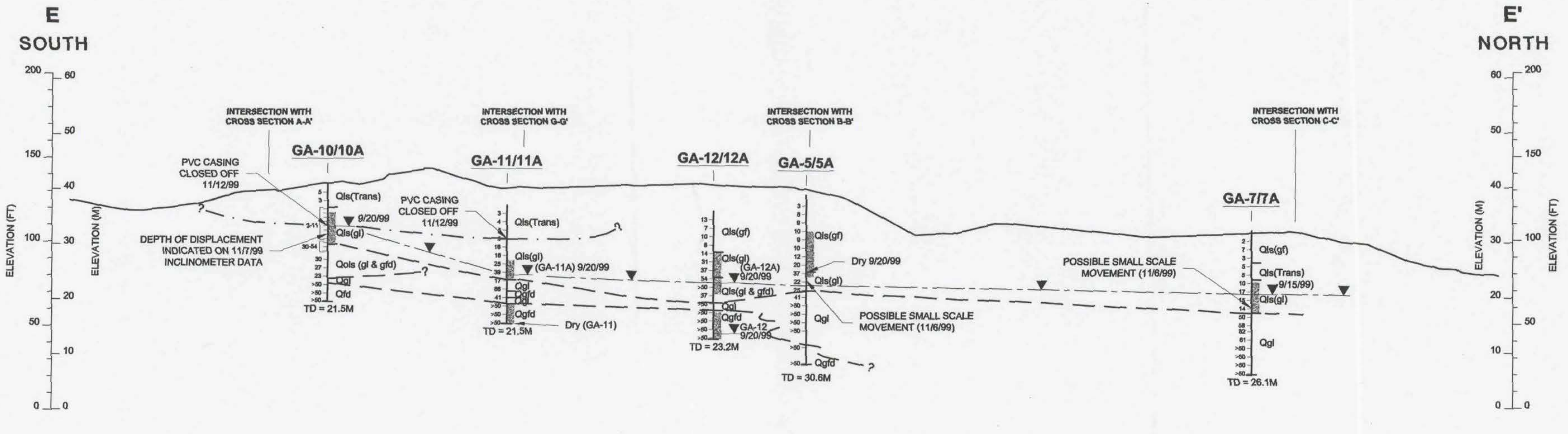
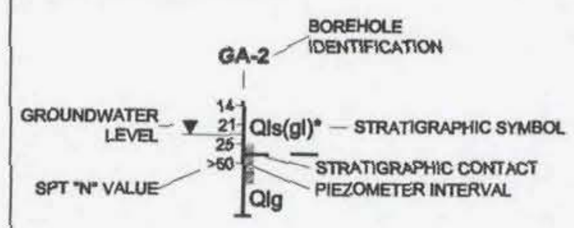
Golder Associates



SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

BOREHOLE LEGEND



* (gf) indicates derived from Glaciofluvial Deposit.
(gl) indicates derived from Glaciolacustrine Deposit.
(trans.) indicates derived from Transitional Beds.

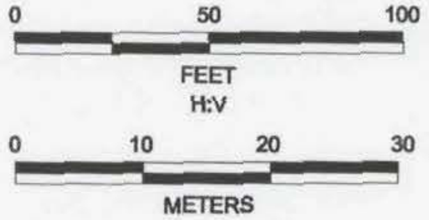
— —? GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

S—··— APPROXIMATE LOCATION OF GEOLOGIC CONTACT BASED ON SEISMIC SURVEY

— · — RENEWED LANDSLIDE MOVEMENT, FALL 1999

EXPLANATION

Qls: LANDSLIDE DEPOSITS:	Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.
Qols: OLDER LANDSLIDE DEBRIS:	Firm to hard, olive gray to dark gray, massive to laminated, jointed, fractured, polished SILTY CLAY to CLAY, trace thin fine SAND laminae, little sand sized hard angular clay clasts, moist.
Qgf: GLACIOFLUVIAL DEPOSITS:	Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, little silt, locally thin interbeds of fine sand, locally wet.
Qgt: TRANSITIONAL DEPOSITS:	Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.
Qgl: GLACIOLACUSTRINE DEPOSITS:	Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.
Qgfd: GLACIOFLUVIAL DRIFT:	Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.



DOT-50000118

FIGURE 11
GEOLOGIC CROSS-SECTION E-E'
US 101 MP 322
WSDOT/MP 322/WA

Golder Associates

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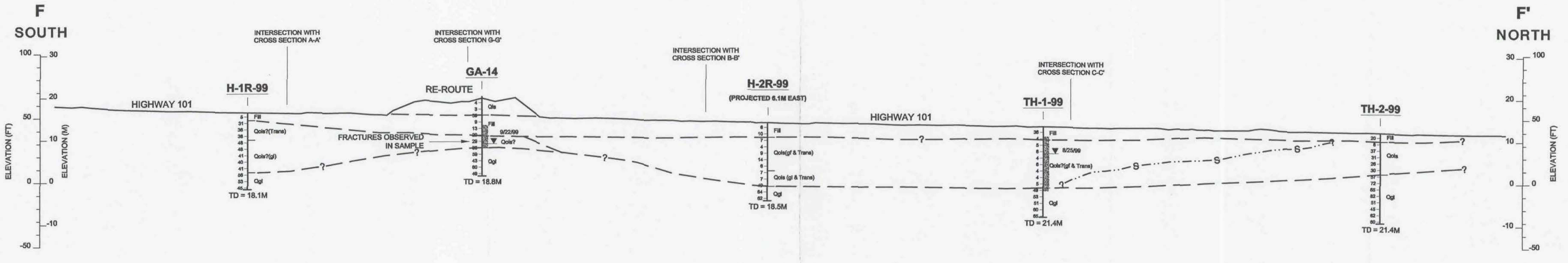
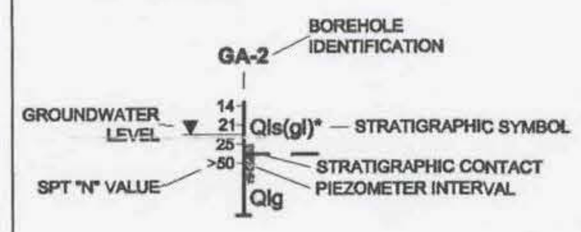


SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

BOREHOLE LEGEND



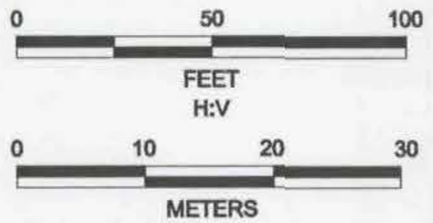
*
(gf) Indicates derived from Glaciofluvial Deposit.
(gl) Indicates derived from Glaciolacustrine Deposit.
(trans.) Indicates derived from Transitional Beds.

— —? GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

S—··— APPROXIMATE LOCATION OF GEOLOGIC CONTACT BASED ON SEISMIC SURVEY

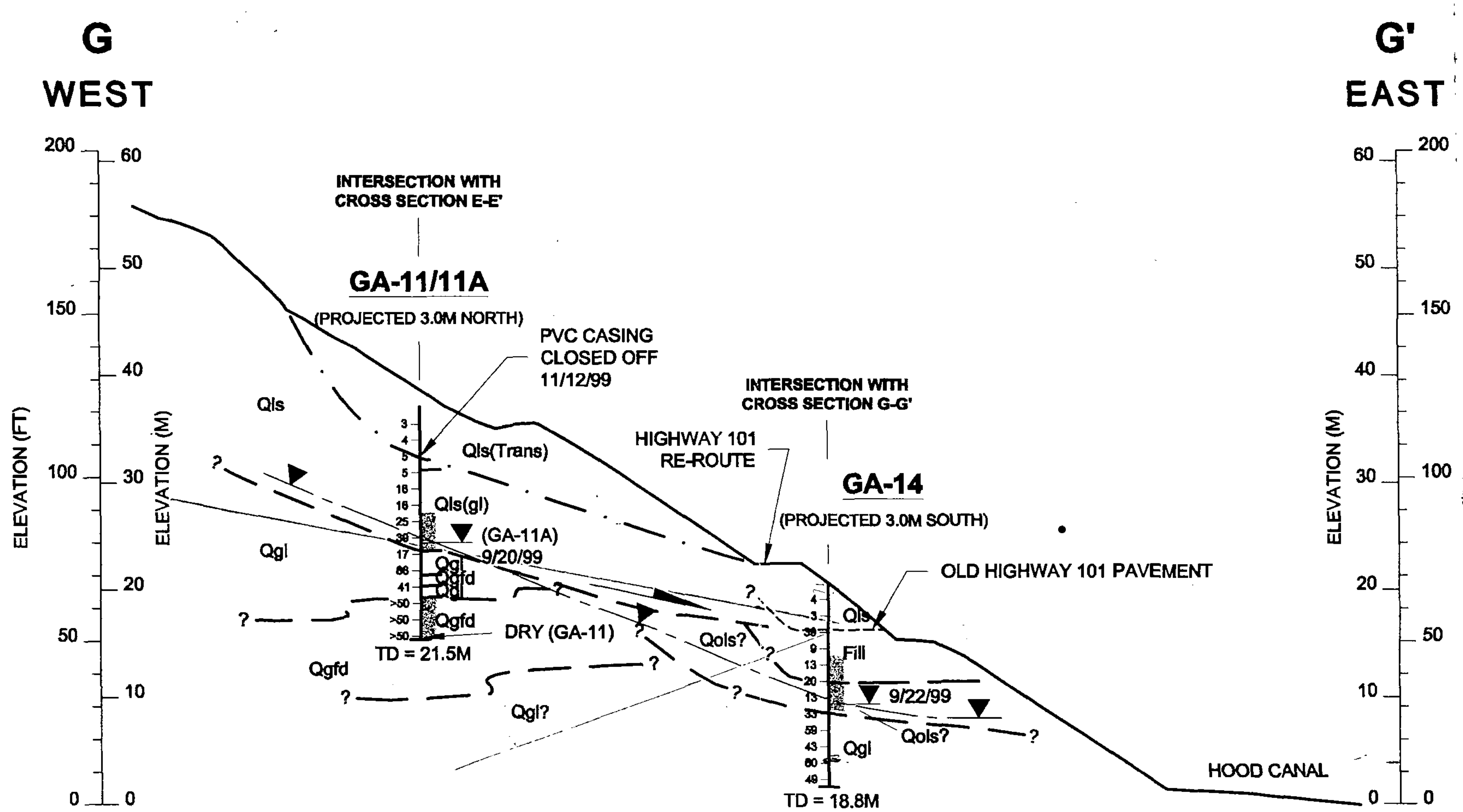
EXPLANATION

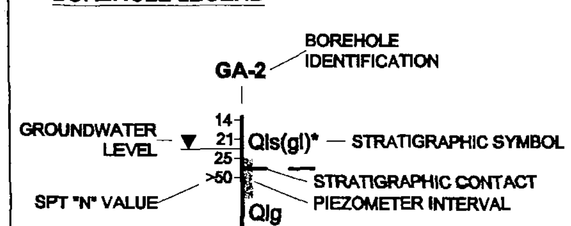
Qls: LANDSLIDE DEPOSITS:	Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.
Qols: OLDER LANDSLIDE DEBRIS:	Firm to hard, olive gray to dark gray, massive to laminated, jointed, fractured, polished SILTY CLAY to CLAY, trace thin fine SAND laminae, little sand sized hard angular clay clasts, moist.
Qgf: GLACIOFLUVIAL DEPOSITS:	Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, little silt, locally thin interbeds of fine sand, locally wet.
Qgt: TRANSITIONAL DEPOSITS:	Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.
Qgl: GLACIOLACUSTRINE DEPOSITS:	Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.
Qgfd: GLACIOFLUVIAL DRIFT:	Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.



DOT-50000119

FIGURE **12**
GEOLOGIC CROSS-SECTION F-F'
US 101 MP 322
WSDOT/MP 322/WA





* (gf) indicates derived from Glaciofluvial Deposit.
(gl) indicates derived from Glaciolacustrine Deposit.
(trans.) indicates derived from Transitional Beds.

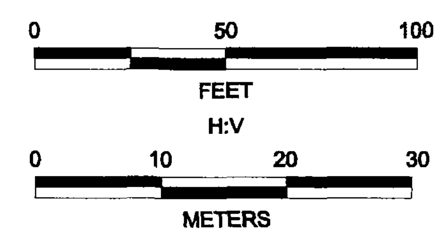
— —? GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

S— · · — APPROXIMATE LOCATION OF GEOLOGIC CONTACT BASED ON SEISMIC SURVEY

— · — RENEWED LANDSLIDE MOVEMENT, FALL 1999

EXPLANATION

Qls: LANDSLIDE DEPOSITS:	Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.
Qols: OLDER LANDSLIDE DEBRIS:	Firm to hard, olive gray to dark gray, massive to laminated, jointed, fractured, polished SILTY CLAY to CLAY, trace thin fine SAND laminae, little sand sized hard angular clay clasts, moist.
Qgf: GLACIOFLUVIAL DEPOSITS:	Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, *little silt, locally thin* interbeds of fine sand, locally wet.
Qgt: TRANSITIONAL DEPOSITS:	Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.
Qgl: GLACIOLACUSTRINE DEPOSITS:	Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.
Qgfd: GLACIOFLUVIAL DRIFT:	Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.



SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

DOT-50000120

FIGURE **13**
GEOLOGIC CROSS-SECTION G-G'
US 101 MP 322
WSDOT/MP 322/WA

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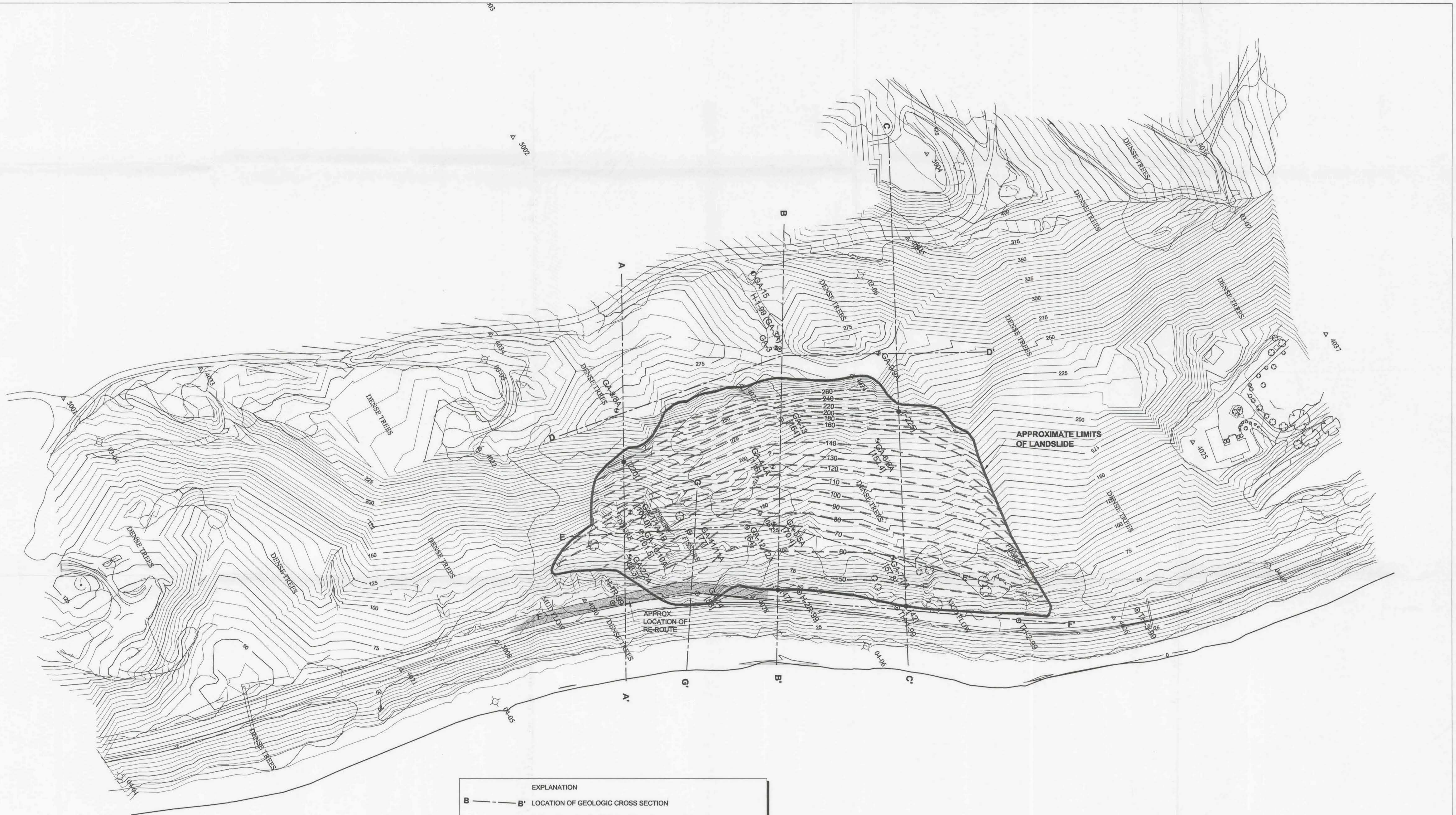
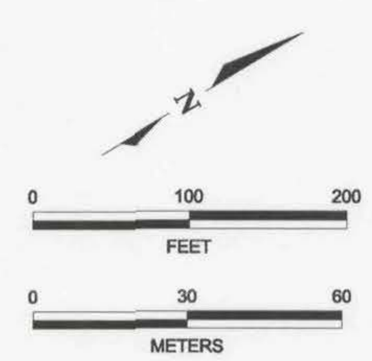
Golder Associates



	EXPLANATION
B — - — B'	LOCATION OF GEOLOGIC CROSS SECTION
— 50 —	ELEVATION CONTOUR AT BOTTOM OF LANDSLIDE DEBRIS (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)
GA-15	HYDROGEOLOGIC TEST WELL
H-1-99	WSDOT BORING
[88.3]	ELEVATION OF STRATIGRAPHIC HORIZON AT LOCATION SHOWN (FEET)

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

NOTE:
The elevation of the bottom of the landslide is based on observed geologic evidence from borings. Inclinometer data was not used due to the very limited data available at the time of preparation of this figure.



NOTE: ELEVATION CONTOURS ARE IN FEET.

FIGURE 14
ELEVATION OF BOTTOM OF RECENT LANDSLIDE DEPOSITS
WSDOT/MP 322/WA

Golder Associates

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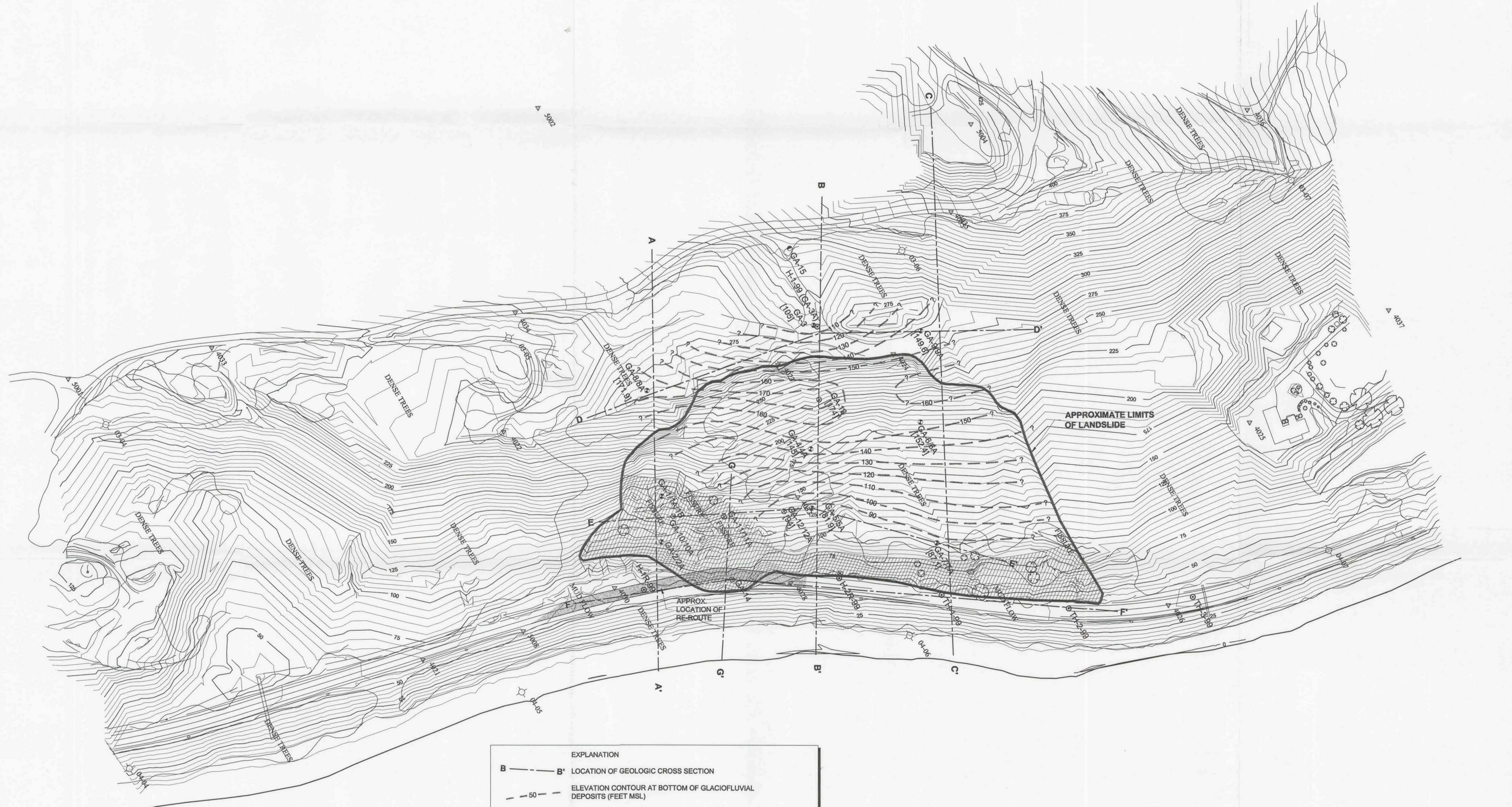

EXPLANATION

B ——·—— B'	LOCATION OF GEOLOGIC CROSS SECTION
— —50— —	ELEVATION CONTOUR AT BOTTOM OF GLACIOFLUVIAL DEPOSITS (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)
GA-15	HYDROGEOLOGIC TEST WELL
H-1-99	WSDOT BORING
[94]	ELEVATION OF STRATIGRAPHIC HORIZON AT LOCATION SHOWN (FEET)
(hatched)	Qgf NOT OBSERVED WITHIN LANDSLIDE DEBRIS

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

0 100 200
FEET

0 30 60
METERS

NOTE: ELEVATION CONTOURS ARE IN FEET.

FIGURE 15
ELEVATION OF BOTTOM OF GLACIOFLUVIAL DEPOSITS (BOTH "IN PLACE" AND WITHIN LANDSLIDE)

WSDOT/MP 322/WA

Golder Associates

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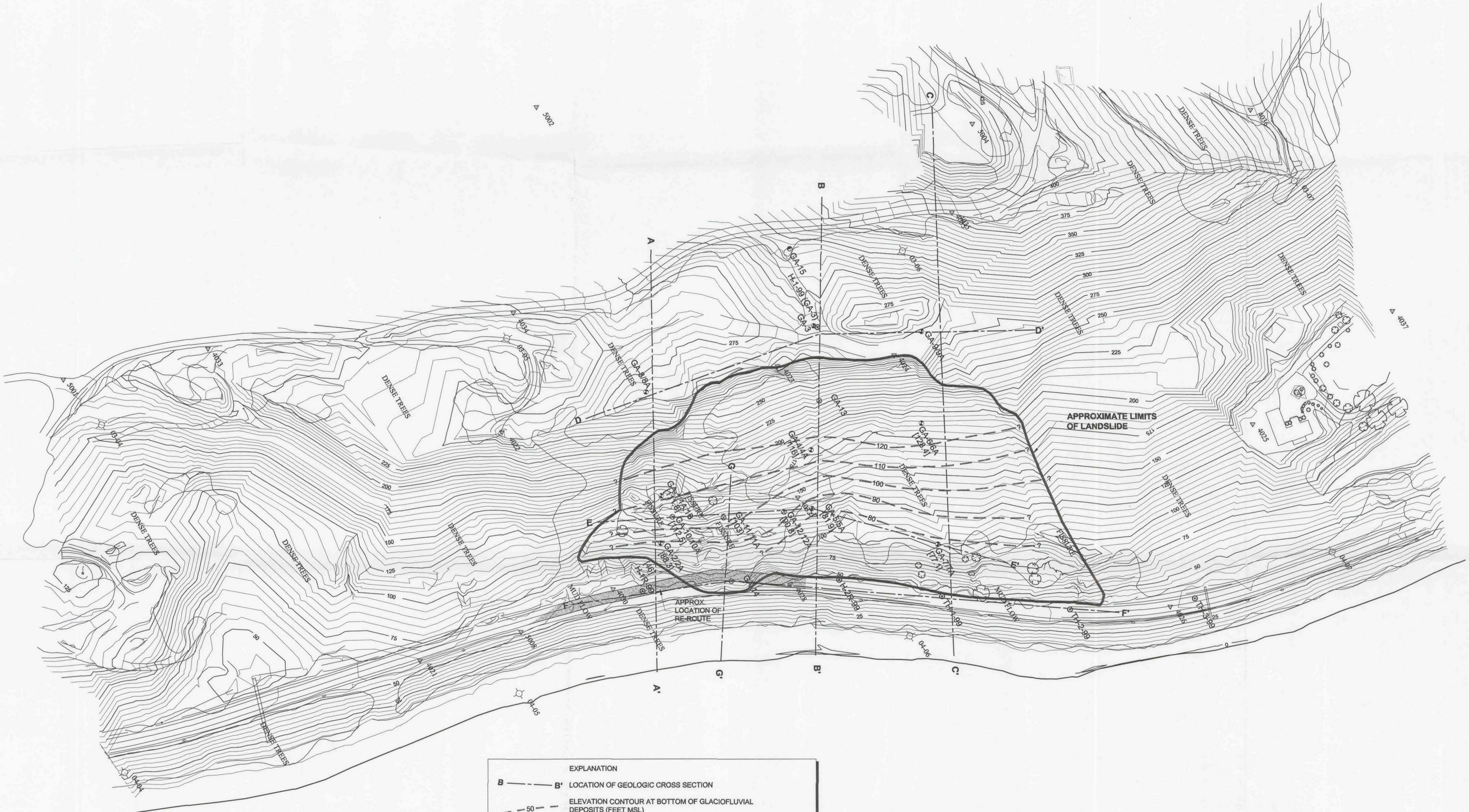
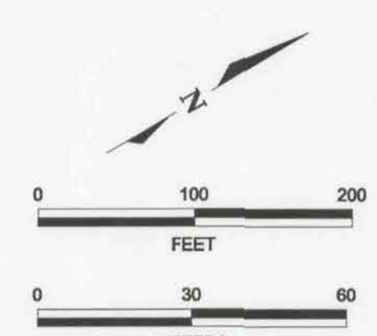
DOT-50000122



EXPLANATION

B — - — B'	LOCATION OF GEOLOGIC CROSS SECTION
— 50 —	ELEVATION CONTOUR AT BOTTOM OF GLACIOFLUVIAL DEPOSITS (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)
GA-15	HYDROGEOLOGIC TEST WELL
H-1-99	WSDOT BORING
[88.3]	ELEVATION OF STARTIGRAPHIC HORIZON AT LOCATION SHOWN (FEET)

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The *interpretation between these locations has been* inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.



NOTE: ELEVATION CONTOURS ARE IN FEET.

FIGURE **16**

ELEVATION OF TOP OF DISTURBED GLACIOLACUSTRINE DEPOSITS WITHIN LANDSLIDE DEBRIS (BASE OF TRANSITIONAL LANDSLIDE DEBRIS)

WSDOT/MP 322/WA

Golder Associates

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DOT-50000123

EXPLANATION

B ——-·—— B'	LOCATION OF GEOLOGIC CROSS SECTION
– – 50 – –	ELEVATION CONTOUR AT BOTTOM OF GLACIOFLUVIAL DEPOSITS (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)
GA-15	HYDROGEOLOGIC TEST WELL
H-1-99	WSDOT BORING
[81.3]	ELEVATION OF STRATIGRAPHIC HORIZON AT LOCATION SHOWN (FEET)

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

N

0 100 200
FEET

0 30 60
METERS

NOTE: ELEVATION CONTOURS ARE IN FEET.

FIGURE **17**

ELEVATION OF TOP OF "IN PLACE" GLACIOLACUSTRINE DEPOSITS

WSDOT/MP 322/WA

Golder Associates

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DOT-50000124

EXPLANATION

B — B'	LOCATION OF GEOLOGIC CROSS SECTION
50	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION *(INSTALLED APRIL TO JUNE, 1999)*
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)
H-1-99	WSDOT BORING
[80.1]	ELEVATION OF GROUNDWATER AT LOCATION SHOWN (FEET)
GA-15	HYDROGEOLOGIC TEST WELL
D14	HORIZONTAL DRAIN ARRAY SHOWING APPROXIMATE DRAIN ARRAY LIMITS. NUMBER INDICATES DRAINS IN ARRAY, LETTER *INDICATES DRAIN ARRAY DESIGNATION*

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

NOTES:

1) Water level contours are based on piezometer data collected in September, 1999.
2) Elevation contours are in feet.

N

0 100 200
FEET

0 30 60
METERS

FIGURE 18
GROUNDWATER ELEVATION CONTOURS WITHIN LANDSLIDE MASS
WSDOT/MP 322/WA

Golder Associates

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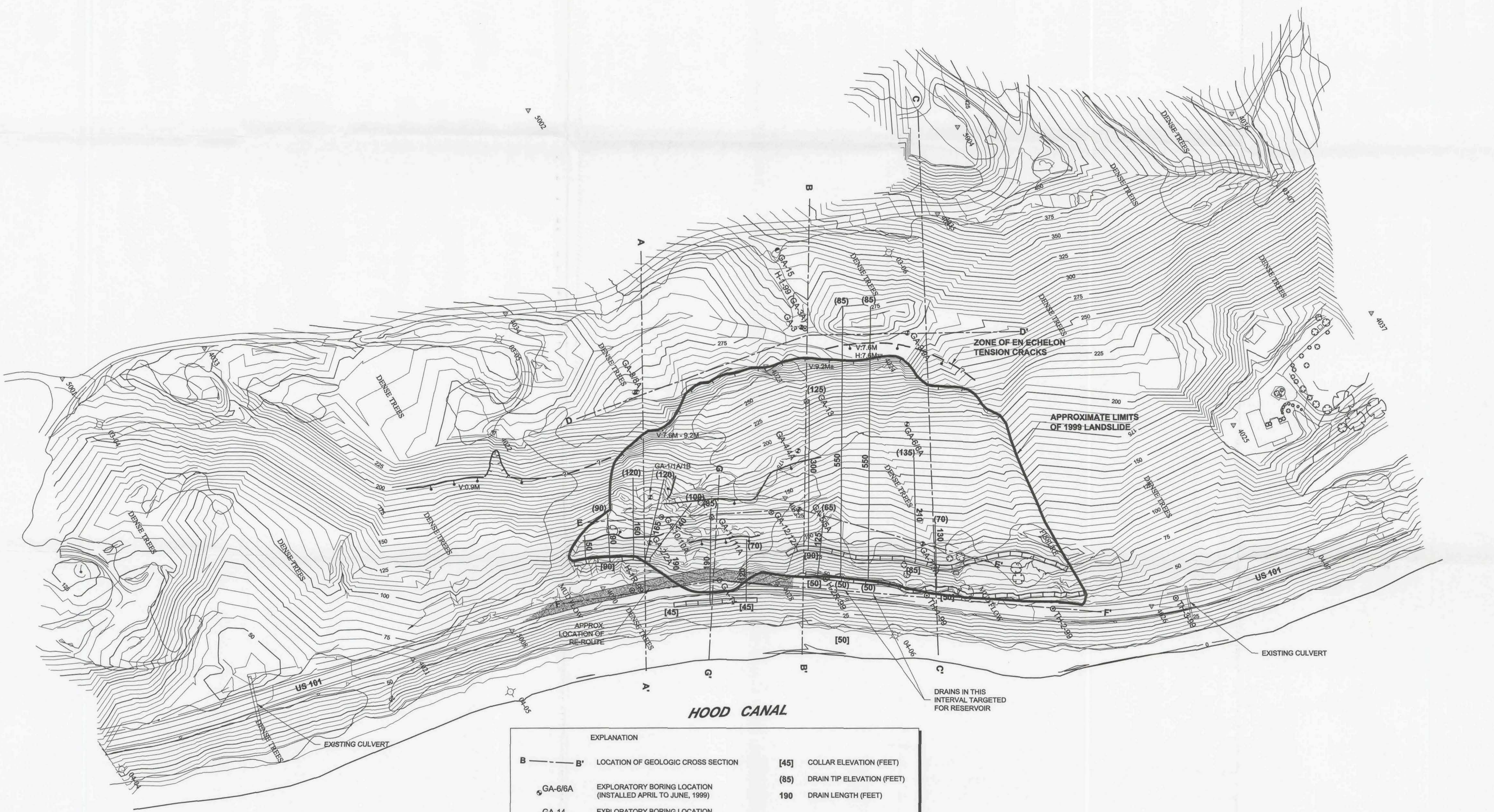

EXPLANATION

B —·—·— B'	LOCATION OF GEOLOGIC CROSS SECTION	[45]	COLLAR ELEVATION (FEET)
GA-6/6A	EXPLORATORY BORING LOCATION (INSTALLED APRIL TO JUNE, 1999)	(85)	DRAIN TIP ELEVATION (FEET)
GA-14	EXPLORATORY BORING LOCATION (INSTALLED SEPTEMBER, 1999)	190	DRAIN LENGTH (FEET)
GA-15	HYDROGEOLOGIC TEST WELL		
H-1-99	WSDOT BORING		
V:0.9M	LANDSLIDE HEAD SCARP V: VERTICAL DISPLACEMENT IN METERS H: HORIZONTAL DISPLACEMENT IN METERS		
	SECONDARY SCARP BALL ON DOWNTHROWN SIDE		

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown. Base survey supplied by WSDOT.

N

0 100 200
FEET

0 30 60
METERS

NOTE: ELEVATION CONTOURS ARE IN FEET.

FIGURE **19**

PLAN LAYOUT OF IDEALIZED DRAIN LOCATIONS

WSDOT/MP 322/WA

Golder Associates

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DOT-50000126

EXPLANATION

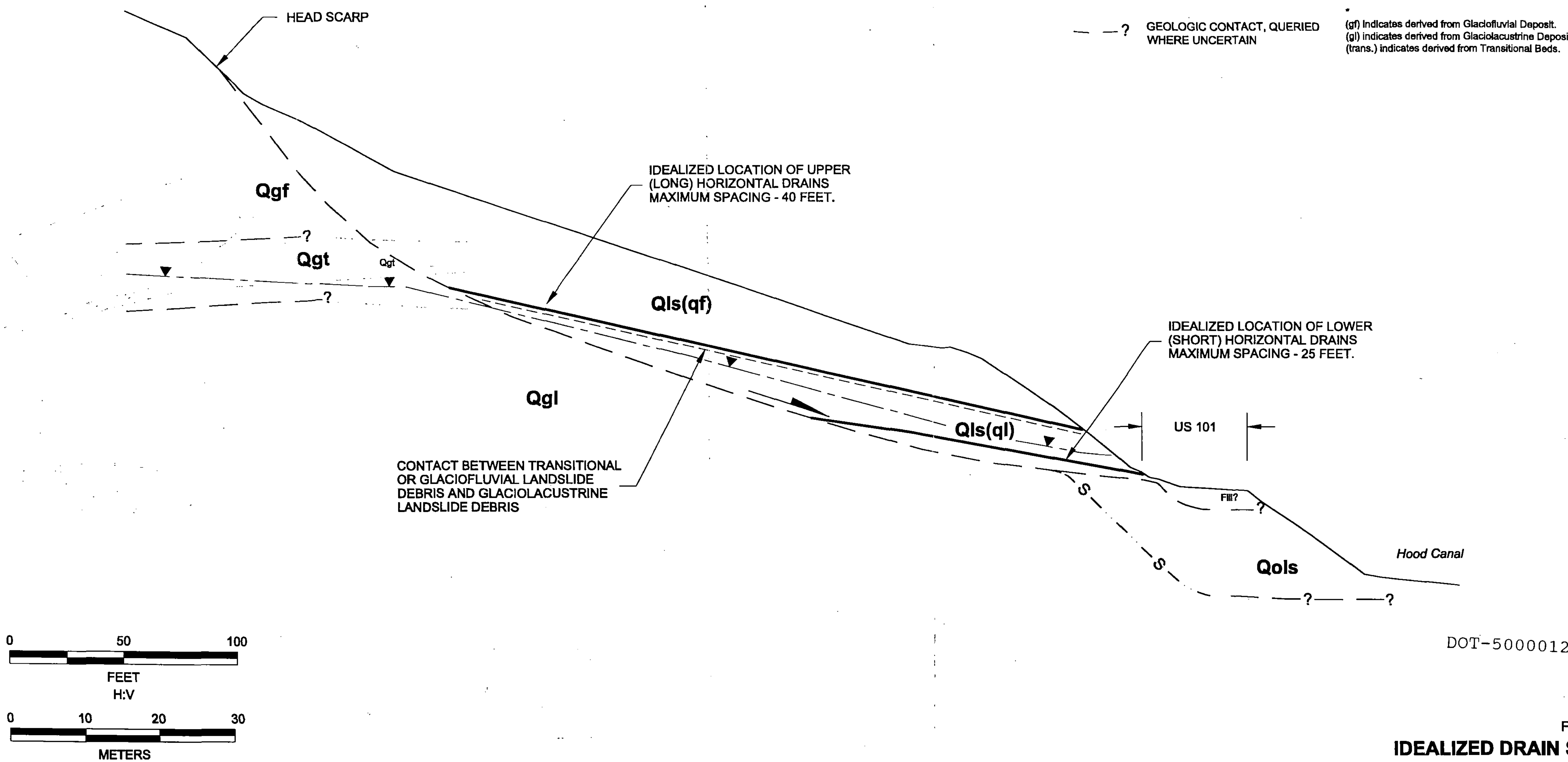
Qls: LANDSLIDE DEPOSITS: Generally reflects vertical distribution of "in-place" strata west of headscarp; loose to compact and firm to stiff; locally stratified; varies from GRAVEL, some sand, trace silt to fine to coarse SAND, trace to little gravel, trace to little silt, grading downward to SILTY CLAY ranging to CLAYEY SILT, locally wet, generally mobilized glaciofluvial deposits.

Qgf: GLACIOFLUVIAL DEPOSITS: Compact to dense; nonstratified to crudely bedded; varies from fine to coarse SAND trace to little silt, trace rounded gravel to sandy fine to coarse GRAVEL, little silt, locally thin interbeds of fine sand, locally wet.

Qgt: TRANSITIONAL DEPOSITS: Dense to very dense and hard, light olive gray to light olive brown, massive to stratified, silty fine SAND, trace to little fine rounded gravel, varies to fine to coarse SAND, trace to little silt, trace to some fine to coarse rounded gravel, occasional interbeds of SILTY CLAY ranging to sandy SILT, moist to wet.

Qgl: GLACIOLACUSTRINE DEPOSITS: Hard, massive to laminated; SILTY CLAY to CLAYEY SILT, generally damp to moist.

Qgfd: GLACIOFLUVIAL DRIFT: Very dense and hard, nonstratified to crudely bedded, SILTY CLAY and silty fine to coarse SAND, little to some fine to coarse gravel, trace cobbles and boulders, generally damp to moist.



DOT-50000127

FIGURE 20
IDEALIZED DRAIN SECTION
US 101 MP 322
WSDOT/MP 322/WA

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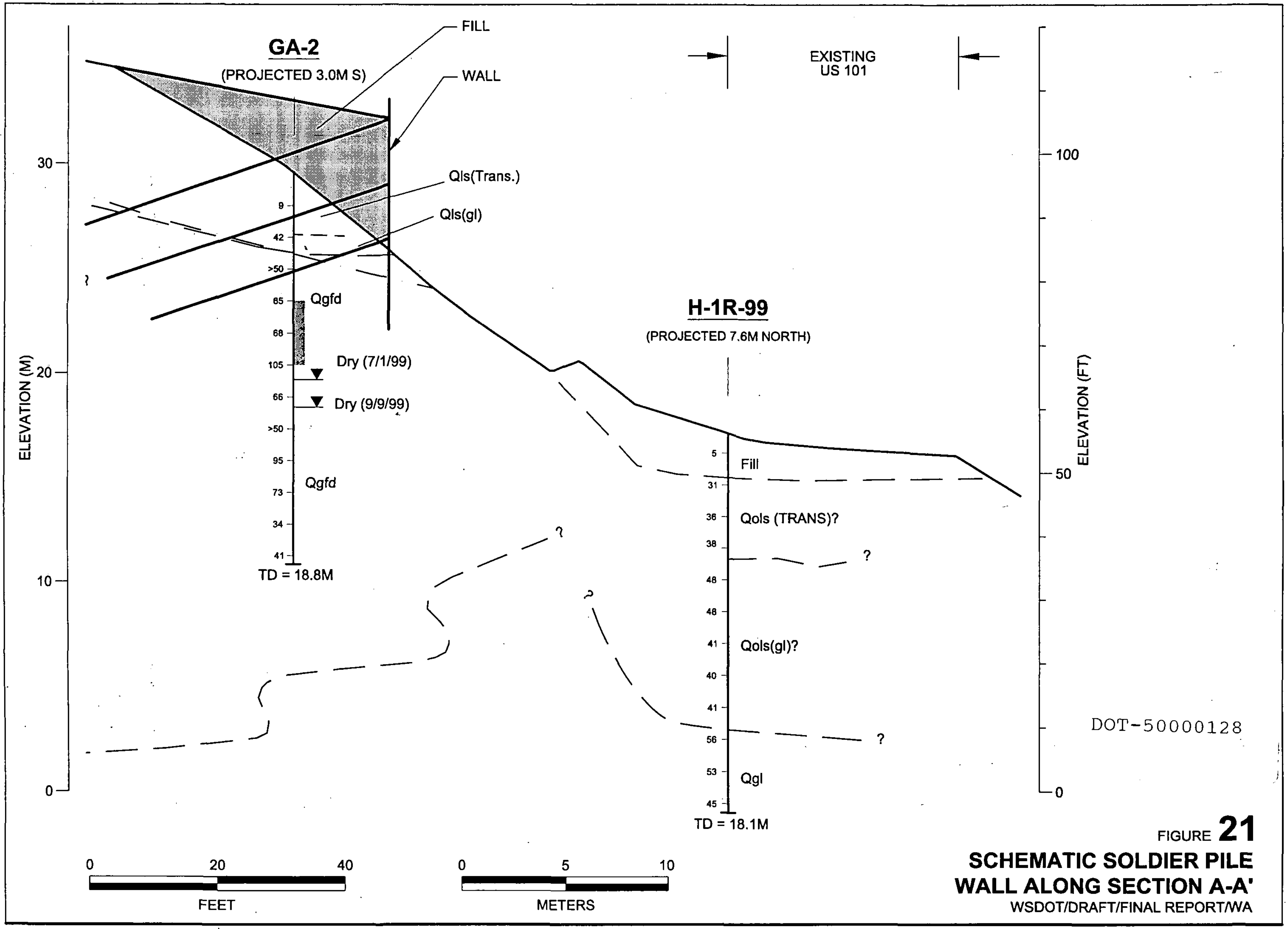
Golder Associates



DOT-50000128

FIGURE **21**

SCHEMATIC SOLDIER PILE WALL ALONG SECTION A-A'

WSDOT/DRAFT/FINAL REPORT/WA

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Golder Associates

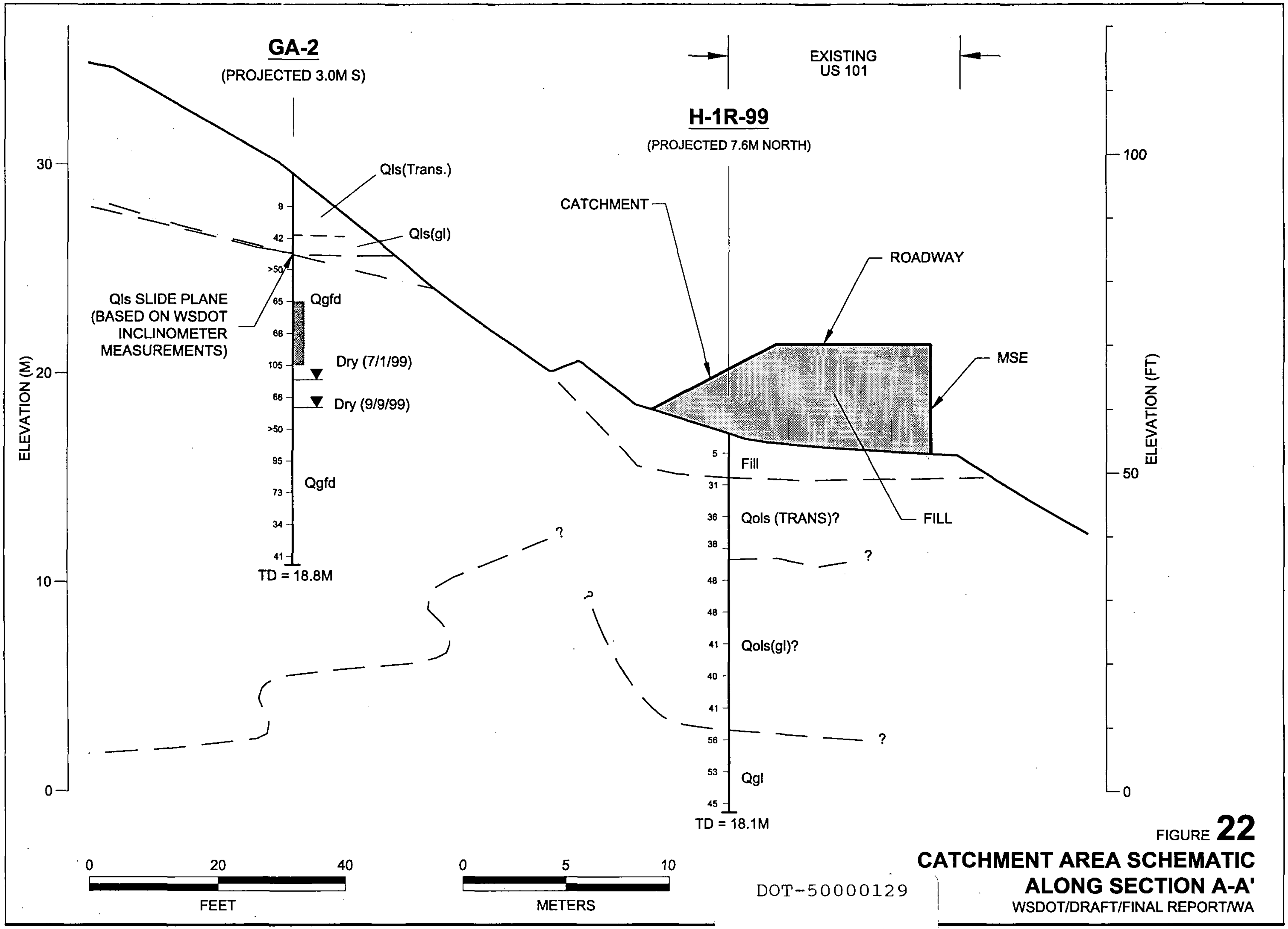

FIGURE **22**

CATCHMENT AREA SCHEMATIC ALONG SECTION A-A'

WSDOT/DRAFT/FINAL REPORT/WA

DOT-50000129

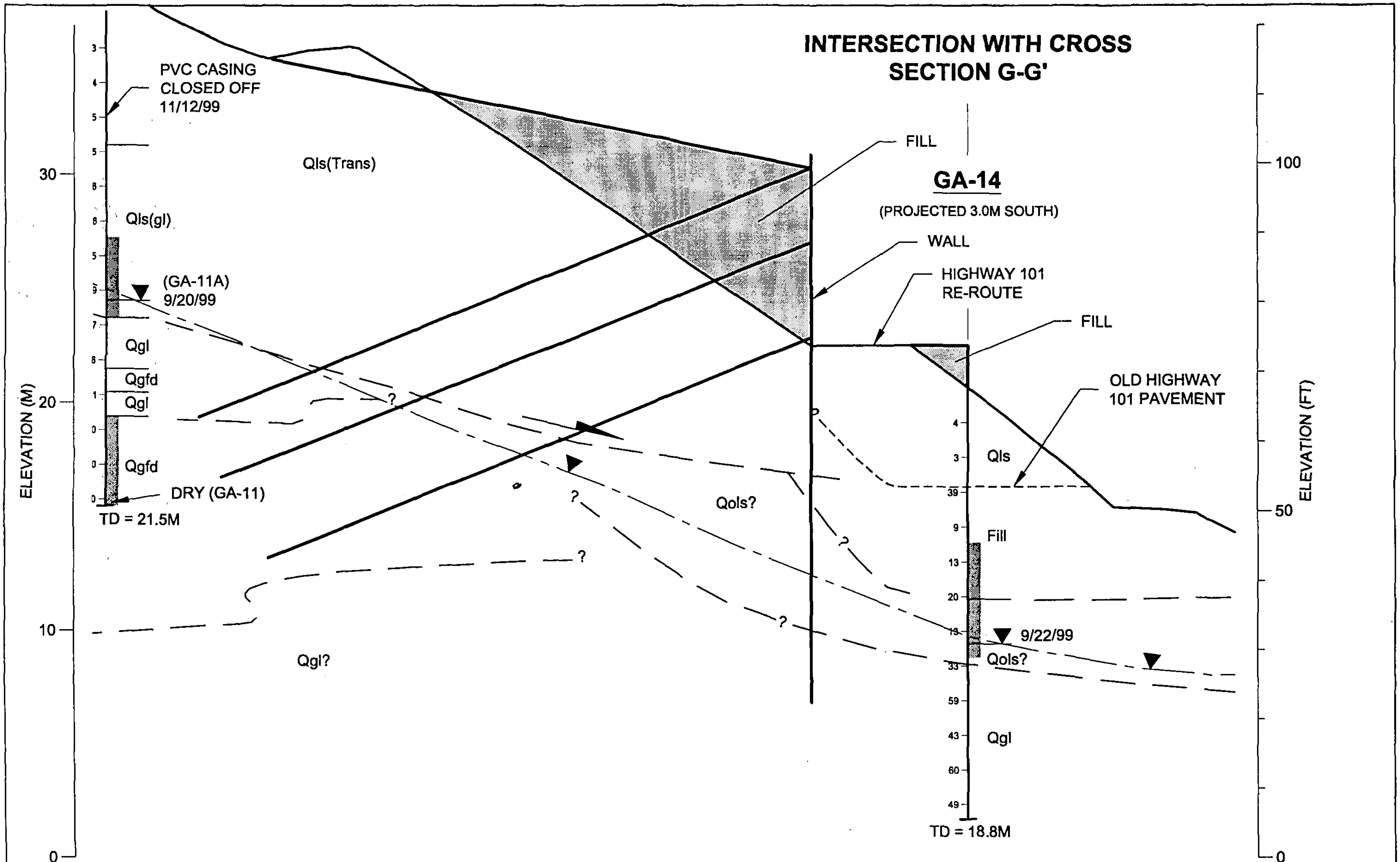

FIGURE **23**

SOLDIER PILE WALL SCHEMATIC ALONG SECTION G-G'

WSDOT/DRAFT/FINAL REPORT/WA

DOT-50000130

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Golder Associates

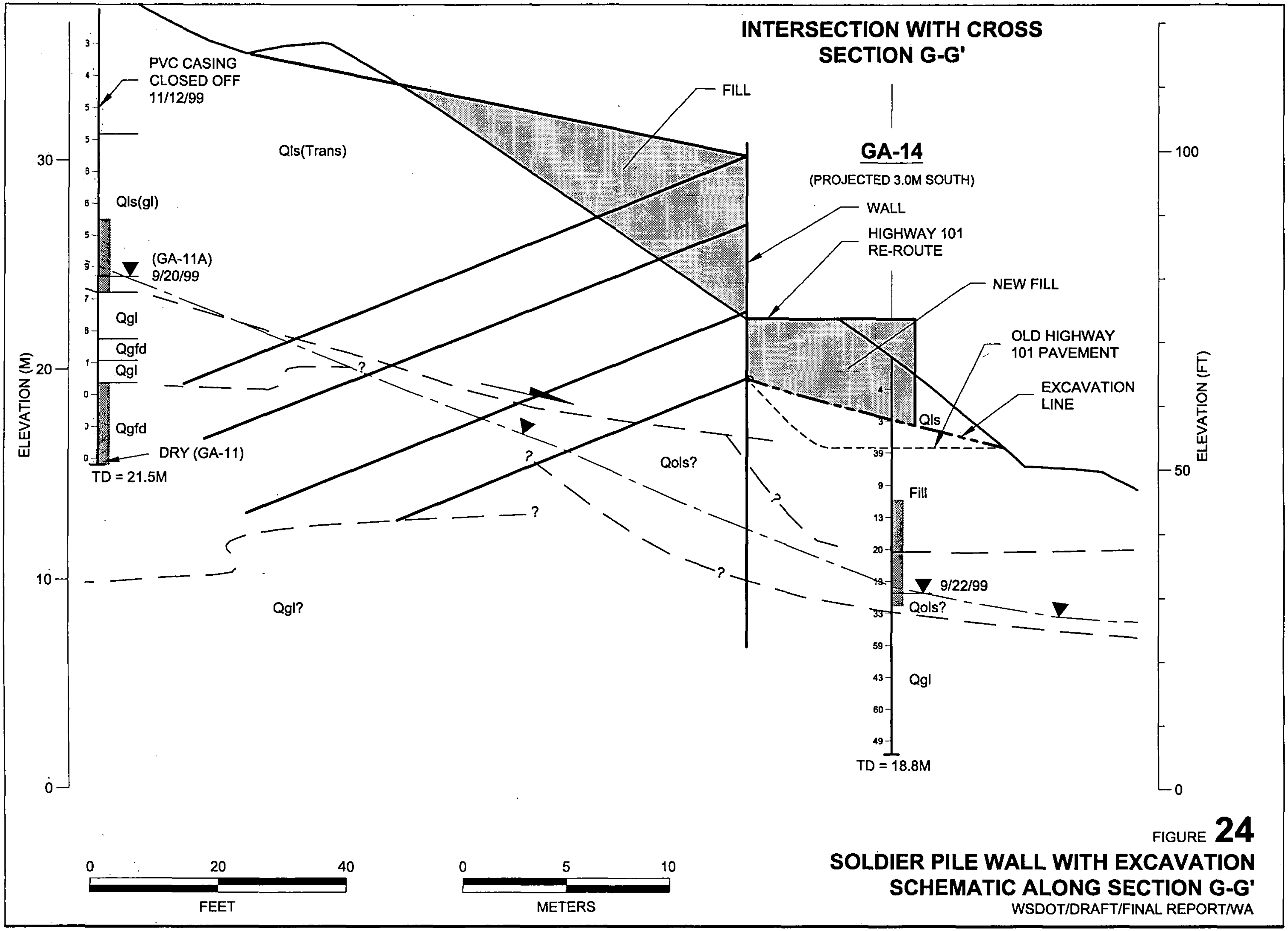

FIGURE **24**

SOLDIER PILE WALL WITH EXCAVATION SCHEMATIC ALONG SECTION G-G'

WSDOT/DRAFT/FINAL REPORT/WA

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Golder Associates

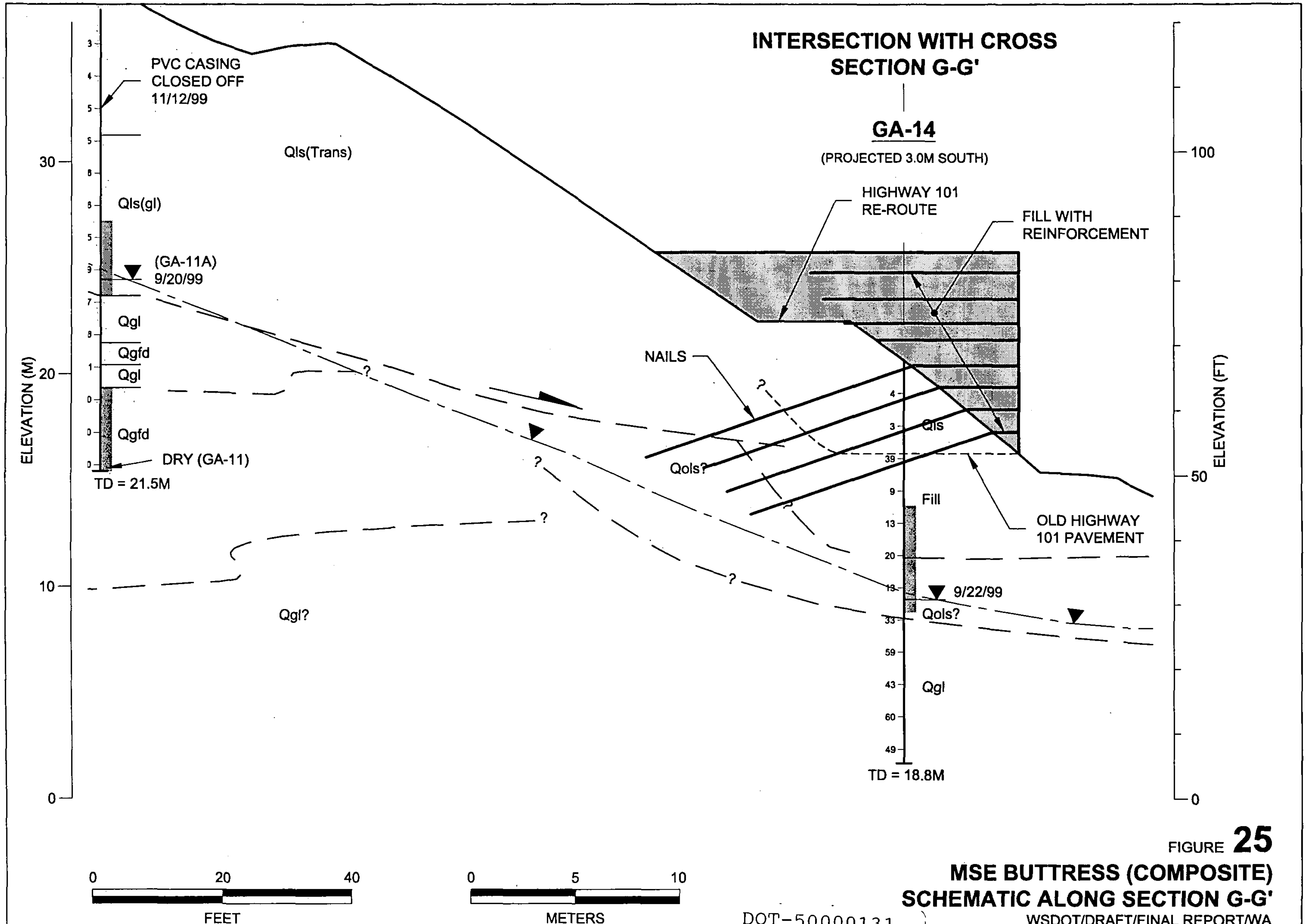

FIGURE **25**

MSE BUTTRESS (COMPOSITE) SCHEMATIC ALONG SECTION G-G'

WSDOT/DRAFT/FINAL REPORT/WA

DOT-50000131

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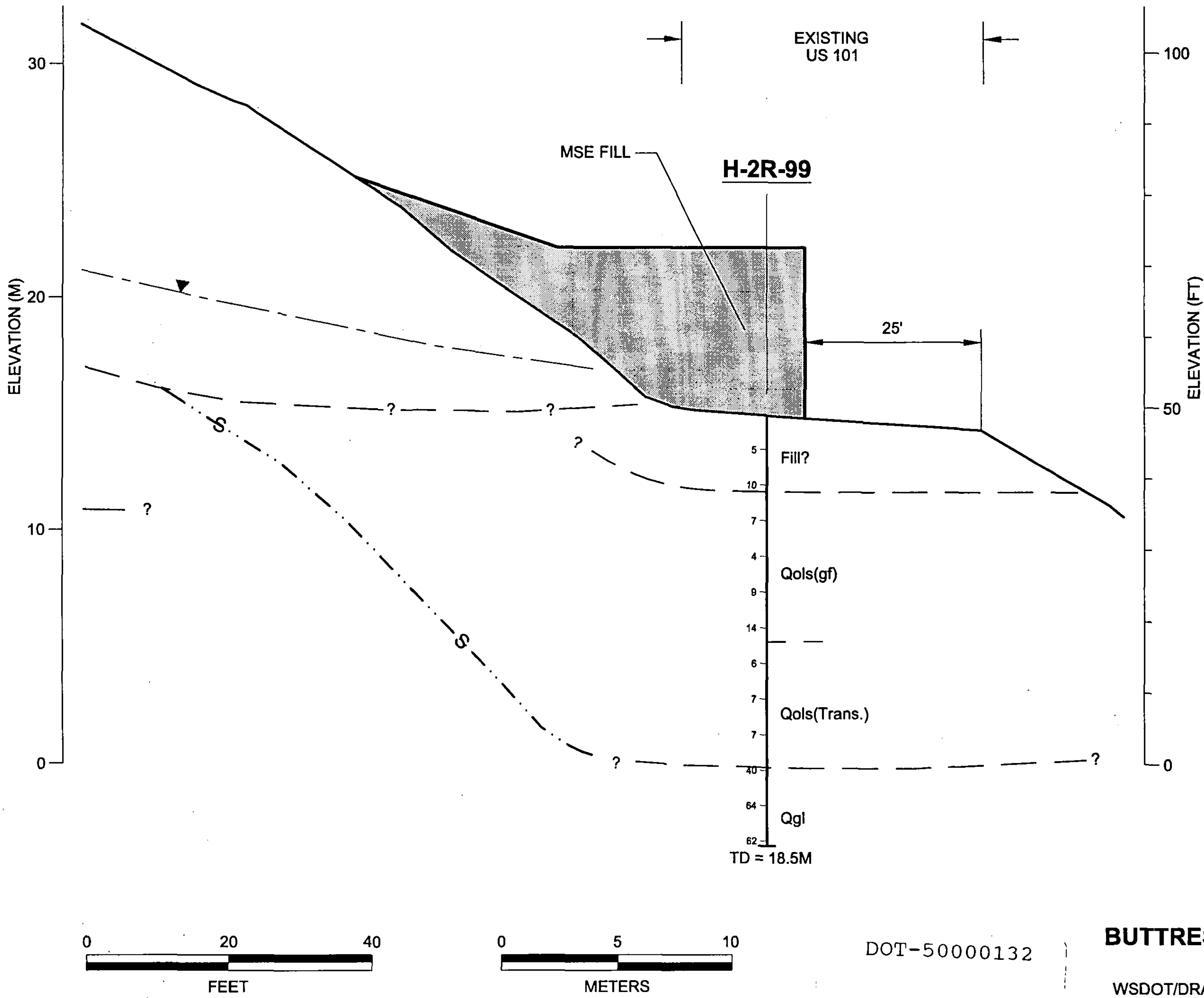
Golder Associates



DOT-50000132

FIGURE **26**

BUTTRESS SCHEMATIC
SECTION B-B'

WSDOT/DRAFT/FINAL REPORT/WA

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Golder Associates

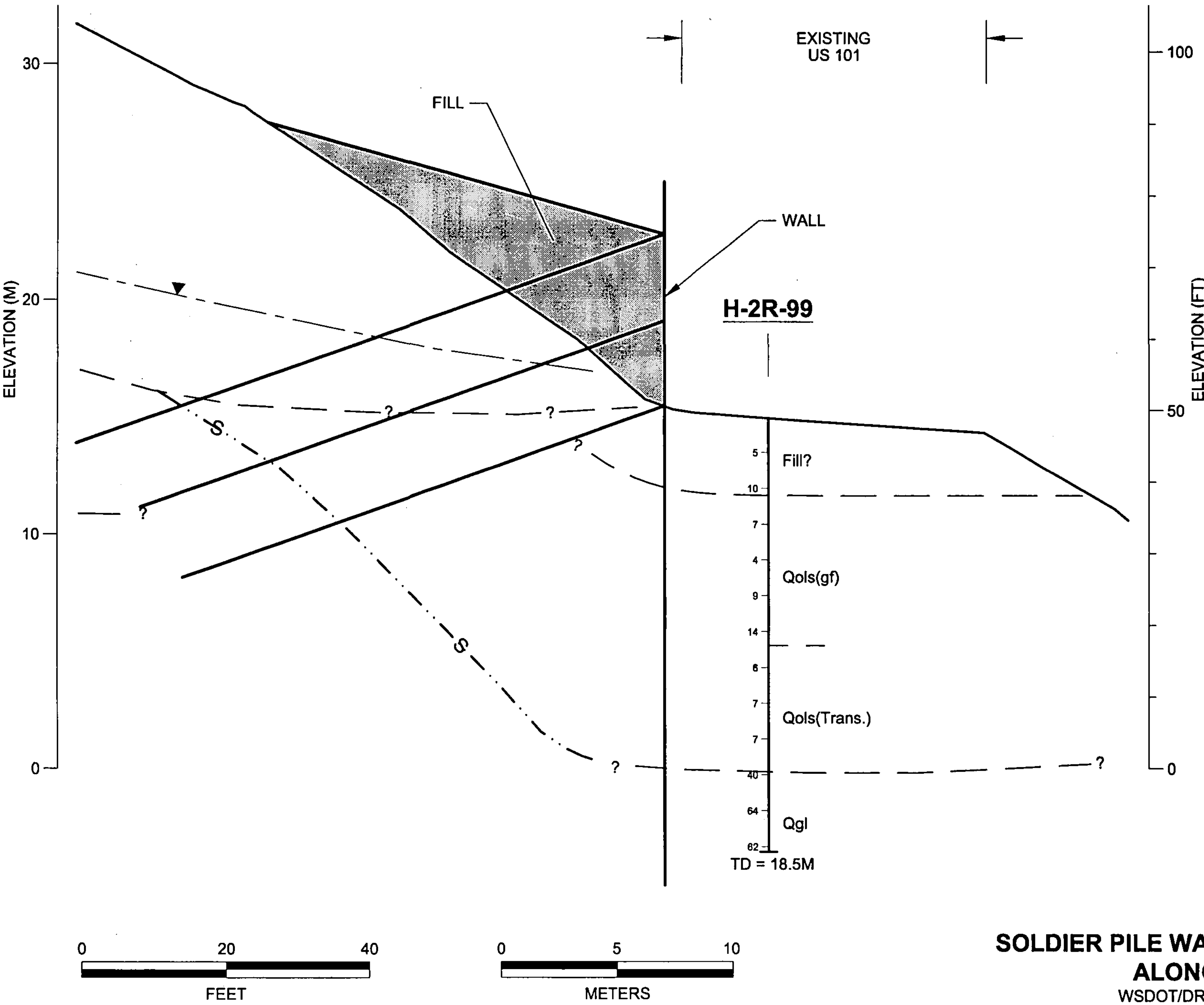


FIGURE **27**

SOLDIER PILE WALL SCHEMATIC ALONG SECTION B-B'

WSDOT/DRAFT/FINAL REPORT/WA

APPENDIX A

BOREHOLE LOGS
(Golder and WSDOT)

DOT-50000133

H. F. 26.00 (Rev. 5-67)

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Engineer
Copy to

LOG OF TEST BORING

S.H. ______ S.R. 101 Section MP 322 Slide Job No. DMC-021
Hole No. H-1-99 Sub Section ______ Cont. Sec. 2303
Station In middle of Y Offset 22' from bluff Ground El. ______
Type of Boring wet rotary Casing 238' x HQ 118' x HWT W.T. El. 4-17-99 43.5' 4-18-99 79'
Inspector J. Hicks Date 4-18-99 Sheet 1 of 10

Post-it® Fax Note 7671 | Date 4/17 | # of pages 10
To Dave Findley | From Steve Lowell
Co./Dept. Golder | Co. WSDOT
Phone # (425) 883-0777 | Phone # (360) 709-5460
Fax # (425) 882-5498 | Fax #

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
9'	9 16 25 - 41		D-1	(8'-9') Gravelly SAND with silt, subangular, dense, brown, wet, and homogeneous. 1' recovered on drive.
				Note: Piezometer completed in boring as follows.
				0-20': Bentonite Surface Seal
				20-220': Screen and Sandpack
				220-240': Bentonite
19.5'	18 21 23 = 44		D-2	(18'-19.5') Gravelly SAND with silt, rounded, dense, olive, wet, and homogeneous. 1.5' recovered on drive.

DOT-50000134

Hole No. H-1-99 Sub Section M.P. 322 Slide Sheet 3 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
-29'	10 14 15 - 29		D-3	(28'-29') Gravelly SAND, subangular, dense, olive grey, wet, and homogeneous. 1' recovered on drive.
-39.5'	21 31 26 - 57		D-4	(38'-39.5') SAND with gravel, subrounded, very dense, olive grey, wet, + homogeneous. 1.5' recovered on drive.

DOT-50000135

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 3 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
49'	30 50 for 6"		D-5	(48'-49') Gravelly SAND with silt, angular, very dense, olive grey, wet, and homogeneous. 1' recovered on drive.
58.3'	50 for 3"		D-6	(58'-58.3') Sandy GRAVEL, angular, very dense, olive grey wet, and homogeneous. .3" recovered on drive.
-69.5'			D-7	(68'-69.5') SAND with gravel, angular, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.

DOT-50000136

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 4 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
'-79'	46 50 for 4"		D-8	(78'-79') Gravelly SAND with silt, subangular, very dense, dark grey, wet, and homogeneous. 1' recovered on drive.
-89.5'	28 27 33-60		D-9	(88'-89.5') SAND with gravel, subrounded, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.

DOT-50000137

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 5 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
-99'	23 50 for 6"		D-10	(98'-99') SAND with gravel, subangular, very dense, dark olive grey, wet, and homogeneous. 1' recovered on drive.
8'-109.5'	26 24 28 - 52		D-11	(108'-109.5') SAND with gravel, subrounded, very dense, dark olive grey, wet, and homogeneous. 1.5' recovered on drive
8'-119.5'	23 33 41 - 74		D-12	(118'-119.5') SAND, rounded, very dense, olive grey, wet, and homogeneous 1.5' recovered on drive.

DOT-50000138

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 6 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
-129'	38 50 for 6"		D-13	(128'-129') SAND with gravel, subrounded, very dense, olive grey, wet, and homogeneous. 1' recovered on drive.
-139.5'	28 36 38 - 74		D-14	(138'-139.5') SAND, subrounded, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.

DOT FORM 351-003A REVISED 4/80

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 7 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
-149'	14 17 23-40		D-15	(148'-149') Gravelly SAND, rounded, dense, dark olive grey, wet, and homogeneous. 1' recovered on drive.
-159.5'	19 28 30-56		D-16	(158'-159.5') Gravelly SAND, subrounded, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.
-169'	28 50 for 6"		D-17	(168'-169') SAND with gravel, cobbles, and silt, subrounded, very dense, olive grey, wet, and homogeneous. 1' recovered on drive.

DOT-50000140

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 8 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
				Qgf?
				Qgf/Qgl Transitional Deposit?
-179.5'	24 28 26 -54		D-18	(178'-179.5') SAND, rounded, very dense, greyish brown, wet, and homogeneous. 1.5' recovered on drive.
			El 105	
-189.5'	15 21 30 -51		D-19	(188'-189.5') Sandy SILT, hard, olive grey, wet, and homogeneous. 1.5' recovered on drive.
-194.5'	18 28 42 -70		D-20	(193'-194.5') Silty SAND, rounded, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.

DOT-50000141

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 9 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
-204.5'	18 21 30 -51		D-21	(203'-204.5') SAND with silt, rounded, very dense, olive grey, wet, and homogeneous. 1.5' recovered on drive.
				Qgf/Qgl Transitional Deposit?
-214.5'	18 26 39 -65		D-22	(213'-214.5') Silty SAND, rounded, very dense, dark greenish grey, wet, and homogeneous. 1.5' recovered on drive.
				Qgf/Qgl Transitional Deposit?

DOT-50000142

Qgl

Hole No. H-1-99 Sub Section MP 322 Slide Sheet 10 of 10

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
				(220) SILT
3-224.5'	15 22 50 72		D-23	(223'-224.5') SILT, very hard, grey, wet, and laminated.
				1.5' recovered on drive.
				Qg
-229.5'	13 18 37 -55		D-24	(228'-229.5') SILT, very hard, dark grey, wet, and
				homogeneous / laminated 1.5' recovered on drive.
-234.5'	18 25 39 -64		D-25	(233'-234.5') SILT, very hard, dark grey, moist, and
				homogeneous / laminated 1.5' recovered on drive.
-239.5'	14 31 29 -50		D-26	(238'-239.5') SILT, hard, dark grey, moist, and
				homogeneous / stratified at 238.2' with very soft zone
				of (lighter color) silt. 1.5' recovered on drive.

DOT-50000143

South

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1R-99

PROJECT M.P. 322 Slide Highway Holes

Job No. DMC-021

S.R. 101

Station ______ Offset ______

C.S. 2303

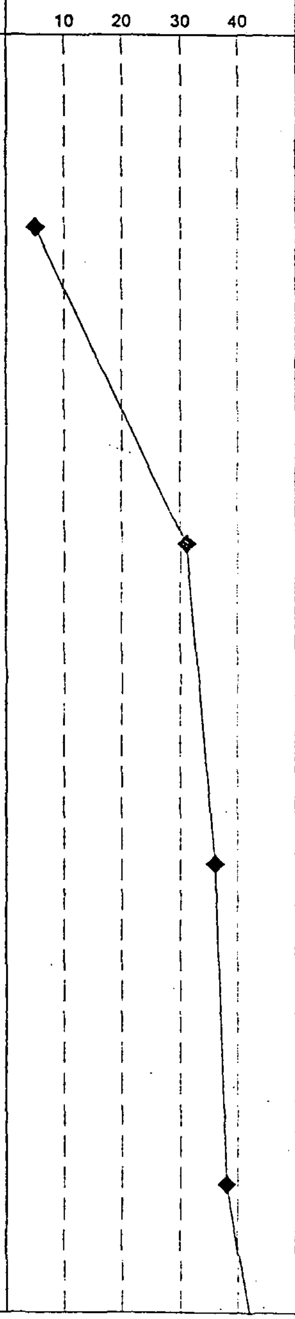
Equipment CME 850 w/ autohammer

Casing HQx62

Ground El 252'

Method of Boring Wet Rotary

Start Date May 20, 1999 Completion Date May 20, 1999 Sheet 1 of 3



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Description of Material
	1	4 2 3 (5)	D-1	Poorly graded GRAVEL with sand, subrounded, loose, black, wet, Homogeneous, no HCl reaction Length Recovered 0.2 ft
5	2			
		8 14 17 (31)	D-2	SILT, dense, dark greenish grey, wet, Homogeneous, no HCl reaction, Zones of FeO2 staining Length Recovered 1.5 ft
10	3			
	4	10 15 21 (36)	D-3	Silty SAND, dense, dark greenish grey, wet, Homogeneous, no HCl reaction, FeO2 stains present Length Recovered 1.5 ft
15	5			
		11 17 21 (38)	D-4	Silty SAND, dense, dark olive grey, wet, Homogeneous, no HCl reaction, FeO2 stains present Length Recovered 1.5 ft
20	6			

DOT-50000144

SOIL DMC021-1.GPJ SOIL.GDT 5/21/99 12:07:27 PS

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1R-99

PROJECT M.P. 322 Slide Highway Holes

Job No. DMC-021

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Description of Material
	7	9, 20, 28 (48)	D-5	SILT, dense, dark greenish grey, moist, Laminated,Fissured, no HCl reaction, FeO2 stains present Length Recovered 1.5 ft
25	8			
		11, 18, 30 (48)	D-6	SILT, dense, dark greenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft
30	9			
	10	9, 17, 24 (41)	D-7	SILT, medium dense, dark greenish grey, dry, Stratified,Laminated,Fissured, no HCl reaction Length Recovered 1.5 ft
35	11			
		10, 16, 24 (40)	D-8	SILT, dense, dark greenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft
40	12			
	13	11, 18, 23 (41)	D-9	SILT, dense, dark greenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft
45				

Standard Penetration Blows/ft: 10 20 30 40

DOT-50000145

SOIL DMC021~1.GPJ SOIL.GDT 5/21/99 02:07:28 P5

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1R-99

PROJECT M.P. 322 Slide Highway Holes

Sheet 3 of 3

Job No. DMC-021

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14									
	15		>>	12 24 32 (56)		D-10		SILT, very dense, dark greenish grey, moist, Blocky,Homogeneous, no HCl reaction Length Recovered 1.5 ft		
50	16		>>	15 22 31 (53)		D-11		SILT, very dense, darkgreenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
55	17									
	18			12 19 26 (45)		D-12		SILT, dense, dark greenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
60								End of test hole boring at 59.5 ft below ground elevation.		
	19							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
65	20									
70	21									

DOT-50000146

North

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2R-99

PROJECT M.P. 322 Slide Highway Holes

Job No. DMC-021

S.R. 101

Station

Offset

C.S. 2303

Equipment CME 850 w/ autohammer

Casing HQx62

Ground El ~49

Method of Boring Wet Rotary

Start Date May 20, 1999

Completion Date May 20, 1999

Sheet 1 of 3

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	1									
5				2 3 3 (6)		D-1		Silty SAND with gravel, loose, olive/moddled with FeO2, wet, Disrupted, no HCl reaction, FeO2 stains present Length Recovered 1.5 ft		
	2									
10	3			1 3 7 (10)		D-2		SILT with sand, with Organics and gravel, loose, olive moddled with Feo2 stains, wet, Homogeneous, no HCl reaction, Feo2 stains present Wood in bottom 6" of sampler Length Recovered 1.5 ft		
	4									
15				3 4 3 (7)		D-3		Well graded SAND with gravel, and silt, loose, very dark greyish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft		
	5									
20	6			1 2		D-4		Sandy Elastic SILT with gravel, soft, olive grey moddled with FeO2, wet, Disrupted, no HCl reaction, FeO2 stains		

DOT-50000147

SOIL DMC021-1.GPJ SOIL.GDT 5/21/99 12:07:35 P5

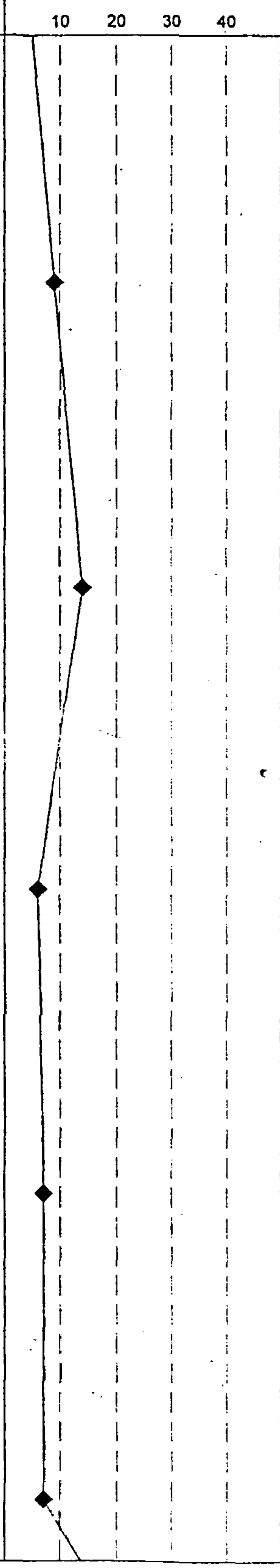
Washington State Department of Transportation

HOLE No. H-2R-99

PROJECT M.P. 322 Slide Highway Holes

Job No. DMC-021

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				2 (4)				Length Recovered 1.5 ft		
	7									
25				4 4 5 (9)		D-5		Poorly graded SAND, loose, olive brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	8									
	9									
30				4 8 6 (14)		D-6		Well graded SAND with gravel, medium dense, dark olive, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	10									
35				4 4 2 (6)		D-7		No Recovery		
	11									
	12									
40				1 3 4 (7)		D-8		SILT with sand, loose, olive grey moddled with FeO2, wet, Stratified, no HCl reaction Length Recovered 1.5 ft		
	13									
45				2 3		D-9		SILT with gravel, loose, olive, wet, Homogeneous, no HCl reaction		



DOT-50000148

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2R-99

PROJECT M.P. 322 Slide Highway Holes

Job No. DMC-021

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 (7)				Length Recovered 1.0 ft		
	14									
	15			10 17 23 (40)		D-10		SILT, dense, olive grey, moist, Laminated,Fissured, no HCl reaction, FeO2 stains present Length Recovered 1.5 ft		
50										
	16									
			>>	13 23 41 (64)		D-11		Elastic SILT, very hard, grey and dark grey, wet, Stratified, no HCl reaction Length Recovered 1.5 ft		
55	17									
	18		>>	13 25 37 (62)		D-12		SILT, very dense, dark greenish grey, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
60										
	19							End of test hole boring at 60.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
65	20									
	21									
70										

DOT-50000149

SOIL DMC021-1.GPJ SOIL.GDT 5/21/99 2:07:37 P5

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-1-99

PROJECT Eldon Slide MP322

Job No. XL-0749

S.R. 101

Station

Offset

C.S. 2303

Equipment BK-81 w/ autohammer

Casing HQx17.5 HW73.5

Ground El 30.0 (9.14 m)

Method of Boring Wet Rotary

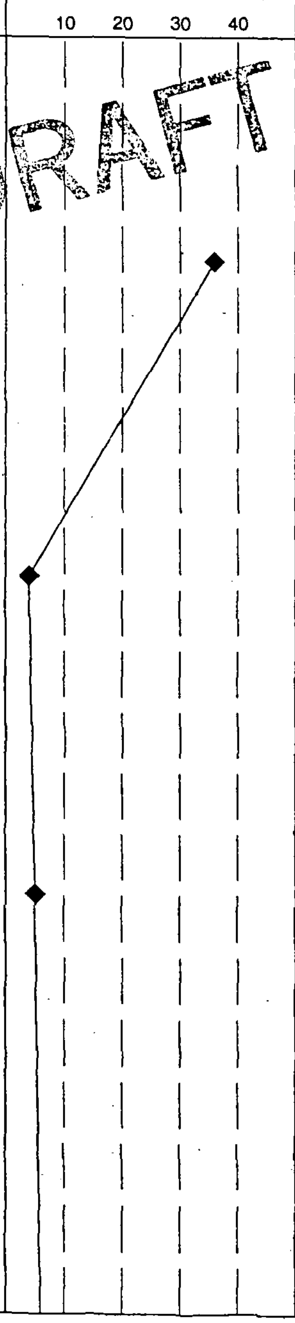
Start Date August 25, 1999

Completion Date August 25, 1999

Sheet 1 of 4

DRAFT

Standard Penetration Blows/ft



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material
					1 ft.=0.3048 m.
	1	17 16 20 (36)	D-1		Silty SAND with gravel, dense, light brown, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.4 ft
5	2				
		3 1 3 (4)	D-2		Well graded SAND with gravel, very loose, light gray, wet, Stratified, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.0 ft
10	3				
	4	2 2 3 (5)	D-3		SILT, medium dense, light gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft
15	5				
	6		U-4 A B		Silty SAND with gravel, medium dense, light gray, wet, Homogeneous, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft
20					

Groundwater

Instrument

DOT-50000150

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:30:44 P10

LOG OF TEST BORING

Washington State Department of Transportation

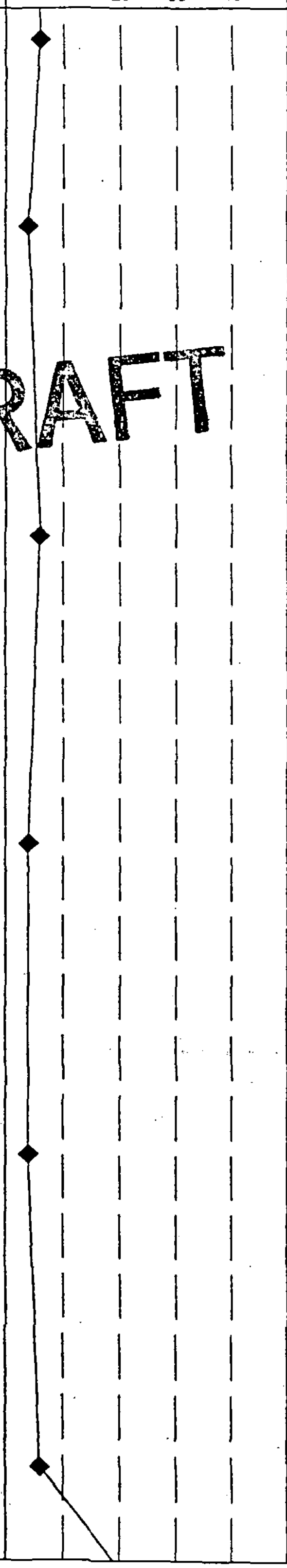
HOLE No. TH-1-99

PROJECT Eldon Slide MP322

Sheet 2 of 4

Job No. XL-0749

Standard Penetration Blows/ft (10, 20, 30, 40)



DRAFT

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater
		5, 3, 3 (6)	D-5		Silty SAND with gravel, loose, light gray, wet, Homogeneous, no HCl reaction. Length Recovered 0.7 ft, Length Retained 0.5 ft. 08/25/1999	∇
	7					
		1, 2, 2 (4)	D-6		Silty SAND, very loose, light gray, wet, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.4 ft	
25						
		2, 2, 3 (6)	D-7		Silty SAND, loose, olive brown, wet, Stratified, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.4 ft	
	9					
30						
	10					
		1, 1, 3 (4)	D-8		Silty SAND with gravel, very loose, olive brown, wet, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.4 ft	
35						
	11					
		1, 1, 3 (4)	D-9		Silty SAND with gravel, with FeO2 staining, very loose, olive brown, wet, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.4 ft	
	12					
40						
	13					
		2, 2, 3	D-10		Sandy SILT with gravel, medium dense, olive brown, wet, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.4 ft	
45						

DOT-50000151

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:30:44 P10

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-1-99

PROJECT Eldon Slide MP322

Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(6)						
	14									
	15			10 23 26 (49)		D-11		Sandy SILT, dense, greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
50										
	16		>>	11 20 33 (53)		D-12		Sandy SILT, dense, greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
55	17									
	18		>>	12 19 32 (51)		D-13		Sandy SILT, dense, greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
60	19									
			>>	11 20 40 (60)		D-14		Sandy SILT, very dense, greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
65	20									
	21		>>	15 28 37		D-15		Sandy SILT, very dense, greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
70										

DRAFT

DOT-50000152

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:30:45 P10

LOG OF TEST BORING

Washington State
Department of Transportation

HOLE No. TH-1-99

PROJECT Eldon Slide MP322

Sheet 4 of 4
Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft 10 20 30 40	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(65)				End of test hole boring at 70 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	22									
75	23									
	24									
80										
	25									
85	26									
	27									
90										
	28									
95										

DRAFT

DOT-50000153

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:30:46 P10

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-2-99

PROJECT Eldon Slide MP322

Job No. XL-0749

S.R. 101

Station ______ Offset ______

C.S. 2303

Equipment BK-81 w/ autohammer

Casing HQx17.5 HW73.5

Ground El 30.0 (9.14 m)

Method of Boring Wet Rotary

Start Date August 26, 1999

Completion Date August 27, 1999

Sheet 1 of 4

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1		20	11 10 10 (20)		D-1		Silty SAND with gravel, medium dense, wet, greenish brown, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.		
5										
	2									
			8	3 4 4 (8)		D-2		SILT with gravel and organics, medium stiff, wet, light gray, homogeneous. Recovered: 1.0 ft. Retained: 0.6 ft.		
10	3									
	4					U-3		Recovered A,B,C		
15			37	9 15 22 (37)		D-4		SILT, hard, wet, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.		
	5									
				9 12 19		D-5		SILT, hard, wet, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.		
20	6									

DRAFT

DOT-50000154

LOG OF TEST BORING

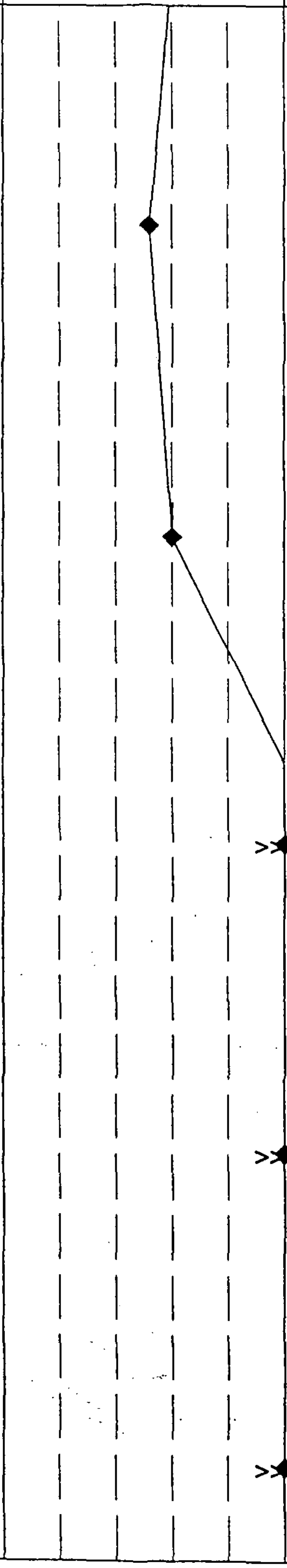
Washington State Department of Transportation

HOLE No. TH-2-99

PROJECT Eldon Slide MP322

Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(31)						
	7									
25				9 11 15 (26)		D-6		SAND with gravel, dense, wet, olive brown, homogeneous. Recovered: 1.0 ft. Retained: 0.9 ft.		
	8									
30	9			19 15 15 (30)		D-7		SAND with gravel, dense, wet, olive brown, homogeneous. Recovered: 1.0 ft. Retained: 0.9 ft.		
	10		>>	18 27 30 (57)		D-8		SILT, hard, wet, light gray, laminated. Recovered: 1.0 ft. Retained: 0.9 ft.		
35	11									
	12		>>	13 29 43 (72)		D-9		SILT, very hard, wet, light gray, homogeneous. Recovered: 1.25 ft. Retained: 1.0 ft.		
40	13									
45			>>	16 32 33		D-10		SILT, very hard, wet, light gray, homogeneous. Recovered: 1.25 ft. Retained: 1.0 ft.		



DRAFT

DOT-50000155

LOG OF TEST BORING

Washington State
Department of Transportation

HOLE No. TH-2-99

PROJECT Eldon Slide MP322

Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(65)						
	14									
	15		>>	13 26 56 (82)		D-11		SILT, very hard, wet, light gray, homogeneous. Recovered: 1.25 ft. Retained: 1.0 ft.		
50										
	16									
			>>	18 26 25 (51)		D-12		SILT, hard, wet, light gray, homogeneous. Recovered: 1.25 ft. Retained: 1.4 ft.		
55	17									
	18			11 15 30 (45)		D-13		SILT, hard, wet, light gray, homogeneous. Recovered: 1.0 ft. Retained: 0.9 ft.		
60										
	19		>>	15.28 34 (62)		D-14		SILT, very hard, wet, light gray, homogeneous. Recovered: 1.3 ft. Retained: 1.25 ft.		
65	20									
	21		>>	13 24 36		D-15		SILT, very hard, wet, light gray, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.		
70										

DRAFT

DOT-50000156

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-2-99

PROJECT Eldon Slide MP322

Sheet 4 of 4

Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(60)				End of Test Hole Boring at 70 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	22									
75	23									
	24									
80								DRAFT		
	25									
85	26									
	27									
90										
	28							DOT-50000157		
95										

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:31:07 P10

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-3-99

PROJECT Eldon Slide MP322

Job No. XL-0749

S.R. 101

Station

Offset

C.S. 2303

Equipment BK-81 w/ autohammer

Casing HQx17.5 HW73.5

Ground El 30.0 (9.14 m)

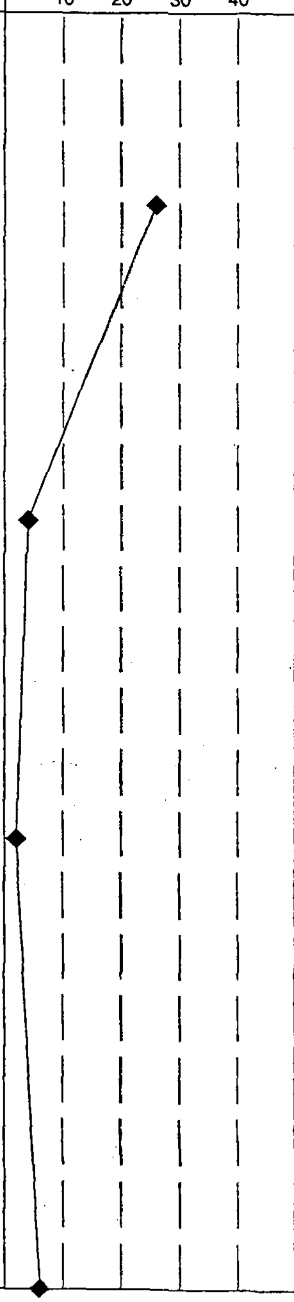
Method of Boring Wet Rotary

Start Date August 23, 1999

Completion Date August 26, 1999

Sheet 1 of 4

Standard Penetration Blows/ft (10, 20, 30, 40)



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Description of Material
				1 ft.=0.3048 m.
	1	21 15 11 (26)	D-1	Silty SAND with gravel, dense, moist, light brown, homogeneous. Recovered: 0.1 ft. Retained: 0.1 ft.
5	2			DRAFT
		7 2 2 (4)	D-2	GRAVEL with sand and silt, subangular, very loose, moist, light brown, homogeneous. Recovered: 0.1 ft. Retained: 0.1 ft.
10	3			
	4	1 1 1 (2)	D-3	SILT with organics, soft, moist, light gray, homogeneous. Recovered: 1.0 ft. Retained: 0.9 ft.
15	5			
			U-4	Recovered: A,B,C,D
20	6			

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:31:26 P10

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-3-99

PROJECT Eldon Slide MP322

Job No. XL-0749

Sample No. (Tube No.)	SPT Blows/6" (N)	Lab Tests	Description of Material
D-5	2, 3, 3 (6)		(20'-21'3") SILT with organics, medium stiff, light gray, homogeneous. (21'3"-21'6") Silty SAND, loose, greenish gray, homogeneous. Recovered: 1.5 ft. Retained: 1.5 ft.
D-6	5, 7, 7 (14)		Silty SAND with organics, medium dense, greenish gray, homogeneous. Recovered: 0.1 ft. Retained: 0.1 ft.
U-7			Recovered: A,B,C,D,E
D-8	6, 11, 14 (25)		SILT, very stiff, moist, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.
D-9	8, 11, 16 (27)		SILT, very stiff, moist, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.
D-10	8, 11, 14 (25)		SILT, very stiff, moist, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.
D-11	10, 14, 20 (34)		SILT, hard, moist, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.

Depth (ft): 25, 30, 35, 40, 45 — Meters (m): 7, 8, 9, 10, 11, 12, 13

Standard Penetration Blows/ft: 10, 20, 30, 40

DRAFT

DOT-50000159

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:31:27 P10

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-3-99

PROJECT Eldon Slide MP322

Job No. XL-0749

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
	14					
		10 16 22 (38)		D-12		SILT, hard, moist, light gray, laminated. Recovered: 1.5 ft. Retained: 1.4 ft.
	15					
50						
	16					
		13 20 24 (44)		D-13		SILT, hard, moist, light gray, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.
55						
	17					
		13 19 32 (61)		D-14		SILT, very hard, moist, light gray, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.
	18					
60						
	19					
		11 20 39 (59)		D-15		SILT, hard, moist, light gray, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.
65						
	20					
		14 31 42 (73)		D-16		SILT, very hard, moist, light gray, homogeneous. Recovered: 1.5 ft. Retained: 1.4 ft.
	21					
70						

Standard Penetration Blows/ft: 10 20 30 40

DRAFT

DOT-50000160

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. TH-3-99

PROJECT Eldon Slide MP322

Sheet 4 of 4

Job No. XL-0749

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								End of Test Hole Boring at 69.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	22									
75	23									
	24									
80	25									
85	26									
	27									
90	28									
95										

DRAFT

DOT-50000161

SOIL XL0749-1.GPJ SOIL.GDT 10/1/99 2:31:28 P10

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466

RECORD OF BOREHOLE GA-1

BORING LOCATION: South Line, Middle Hole

DATUM: MSL

BORING DATE: 5/17-18/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Loose to very loose, light olive brown, nonstsratified, silty fine to medium SAND, trace to little gravel, trace organics (rootlets), moist (TRANSITIONAL LANDSLIDE DEBRIS)	SM		44.2m / 0.0m						PVC Stickup 36.6cm	Bentonite Chips; 3.8cm I.D. Sch. 40 PVC Casing
1						1	SS	1-2-2	4	30.5cm/45.8cm		
2		Very loose to loose, light olive, laminated to massive, fractured, SILT to CLAYEY SILT, trace organics, grades downward to fine sandy SILT, moist to wet (TRANSITIONAL LANDSLIDE DEBRIS)	CL-ML		42.4m / 1.8m							
3						2	SS	2-2-2	4	30.5cm/45.8cm		
4		Loose to compact, light olive, massive to faintly laminated, fractured, fine SAND, little to some silt, trace organics, with interbeds of SILT, some fine sand, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM/ML		40.2m / 4.0m	3	SS	3-3-2	5	27.5cm/45.8cm		
5												
6						4	SS	3-6-5	11	27.5cm/45.8cm		
7												
8						5	SS	4-5-7	12	30.5cm/45.8cm		
9		See description on next page			35.4m / 8.8m							
		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000162

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466

RECORD OF BOREHOLE GA-1

BORING LOCATION: South Line, Middle Hole

DATUM: MSL

BORING DATE: 5/17-18/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLE NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 70.2cm drop)	N	REC/ATT
	HWT Casing Advancer	Stiff, light olive, nonstratified to faintly laminated, mottled in places, slightly FeOx stained, SILT, ranging to CLAYEY SILT, wet (TRANSITIONAL LANDSLIDE DEBRIS)	CL-ML		6	SS	3-4-6	10	33.6cm/45.8cm
10				34.1m / 10.1m					
		Firm to stiff, olive gray, massive, fractured, mottled, CLAY ranging to SILTY CLAY, moist to wet, contains hard, angular clasts of clay to 1 cm diameter, contains polished planar surfaces oriented approximately perpendicular to sampler axis (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL						
11					7	SS	3-3-5	8	33.6cm/45.8cm
12		12.2m: Becomes stiff to very stiff			8	SS	3-6-9	15	33.6cm/45.8cm
13				31.3m / 12.9m					
		Hard, olive gray to dark gray, massive to laminated, jointed, SILTY CLAY to CLAY, trace thin (<2 mm) fine SAND laminae, moist to wet at 13.7m becoming damp to moist by 16.8m (GLACIOLACUSTRINE OLDER LANDSLIDE DEBRIS) ppen: >4.5 tsf	CL						
14					9	SS	13-25-30	55	45.8cm/45.8cm
15		15.3m: Observed a 2 cm thick zone of polished angular hard clay clasts tightly arranged in sample			10	SS	13-23-31	54	45.8cm/45.8cm
16									
17					11	SS	12-22-29	51	45.8cm/45.8cm
				26.4m / 17.8m					
18		See description on next page	MH						

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50

WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC / WATER LEVEL: Bentonite Chips; 3.8cm I.D. Sch. 40 PVC Casing

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000163

Golder Associates

RECORD OF BOREHOLE GA-1

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466

BORING LOCATION: South Line, Middle Hole

SHEET 3 **OF** 3

DATUM: MSL

BORING DATE: 5/17-18/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. / WATER CONTENT, PERCENT (Wp – W – Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Firm, dark gray, weakly stratified, fractured, polished SILT, little sand sized hard angular clay clasts, soft and disturbed from 18.6m to 18.8m, moist to wet (GLACIOLACUSTRINE OLDER LANDSLIDE DEBRIS)	MH			12	SS	3-4-4	8	42.7cm/45.8cm	23 39.6 52	Bentonite Chips
19					25.0m / 19.2m							3.8cm I.D. Sch. 40 PVC Casing
		Hard, medium gray, weakly laminated, CLAY, trace to little fine to coarse subrounded sand, trace fine subrounded gravel, occasional thin (~2.5cm) SAND interbeds, moist (GLACIOLACUSTRINE DEPOSIT) ppen: >4.5 tsf	CH									
20						13	SS	13-45-38	83	45.8cm/45.8cm	26 29.1 59	10-20 Silica Sand
21						14	SS	13-27-55	82	45.8cm/45.8cm		
22												22.6m 6/15/99
23						15	SS	12-29-42	71	45.8cm/45.8cm		3.8cm I.D. Sch. 40 PVC Screen - Hand Slotted
24						16	SS	32-35-33	68	0.0cm/45.8cm		
25												
26					17.9m / 26.3m	17	SS	21-33-50	83	45.8cm/45.8cm		
		Total depth 86.2 ft bgs Note: Poor boys inclinometer installed in boring.										
27												

Penetration resistance scale: 0 10 20 30 40 50. Water content scale: 0 20 40 60 80 100.

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000164

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-1A

SHEET 1 **OF** 1

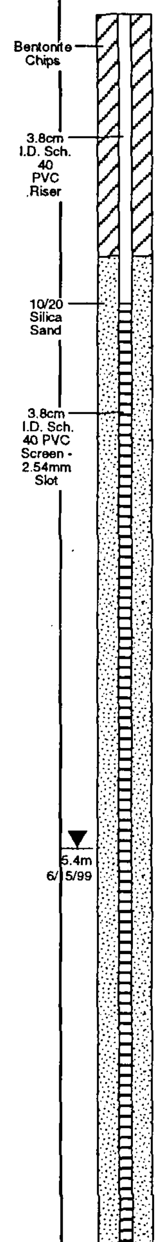
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Middle Hole

BORING DATE: 5/22/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp ⊢ W ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					14.2m							
0	HWT Casing Advancer	Speed drilled to 7.9m to install shallow piezometer. See GA-1 for detailed soil descriptions.			0.0						PVC Stickup 42.7cm	
1												
2												
3												
4												
5												5.4m 6/15/99
6												
7					36.4m							
8		Boring termnated at 25.8' below the surface			7.9m							
9												



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury

LOGGED: JDC

CHECKED:

DATE: 7/15/99

DOT-50000165

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-1B

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Middle Hole

BORING DATE: 5/23-24/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HQ Casing Advancer				44.2m							
		Speed drilled to 18.3m to install inclinometer. See log of GA-1 for stratigraphy.			0.0						PVC Stickup 36.6cm A+ A- Slots at N86°W	Lime/Cement Grout 5.7cm Slope Inclinometer Casing
1–9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: JDC

CHECKED:

DATE: 7/16/99

DOT-50000166

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-1B

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Middle Hole

BORING DATE: 5/23-24/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kb hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (10 20 30 40 50); WATER CONTENT, PERCENT (Wp ⊢ W ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HQ Casing Advancer											Lime/Cement Grout
10												5.7cm Slope Inclinometer Casing
11		11.3m: Drill action indicates clays - fluid color changes to gray										
12		11.9m: Fluid return drops off										
		12.5m: No fluid return										
13												
14												
15												
16												
17												
18												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: JDC

CHECKED:

DATE: 7/15/99

DOT-50000167

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-1B

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Middle Hole

BORING DATE: 5/23-24/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
19	HQ Casing Advancer											Lime/Cement Grout; 5.7cm Slope Inclinometer Casing
20												
21												
22												
23												
24												
25					18.3m / 25.9m							
26		Boring temnated at 25.9m below the surface										
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: JDC

CHECKED:

DATE: 7/15/99

DOT-50000168

Golder Associates

RECORD OF BOREHOLE GA-2

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: South Line, Lower Hole

BORING DATE: 5/17/99

Boring method: HWT Casing Advancer

DEPTH (METERS)	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT
0	Loose and stiff, gray, SILTY CLAY and silty fine to medium SAND, moist to wet (LANDSLIDE DEBRIS)	CL/SM	30.0m / 0.0					
2				1	SS	2-3-6	9	21.4cm/45.8cm
3	Hard, mottled gray and brown, stratified to nonstratified, SILTY CLAY, some gravel, damp to moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL	26.9m / 3.1m					
				2	SS	10-17-25	42	45.8cm/45.8cm
5				3	SS	50/3	>50	7.6cm/7.6cm
	Very dense and hard, tan to brown, interbedded, SILTY CLAY and fine to medium SAND, some silt, some gravel, damp to moist (GLACIOFLUVIAL DRIFT)	SM/CL	24.8m / 5.2m					
6				4	SS	16-16-49	65	24.4cm/45.8cm
	Very dense, brown, nonstratified, silty fine to coarse SAND, little to some fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	SM	23.3m / 6.7m					
8				5	SS	15-30-38	68	45.8cm/45.8cm
9								

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp —— W —— Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 68.6cm

Bentonite Chips

3.8cm I.D. Sch. 40 PVC Casing

10/20 Silica Sand

3.8cm I.D. Sch. 40 PVC Screen - 2.54mm Slot

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/15/99

DOT-50000169

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-2

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: South Line, Lower Hole

BORING DATE: 5/17/99

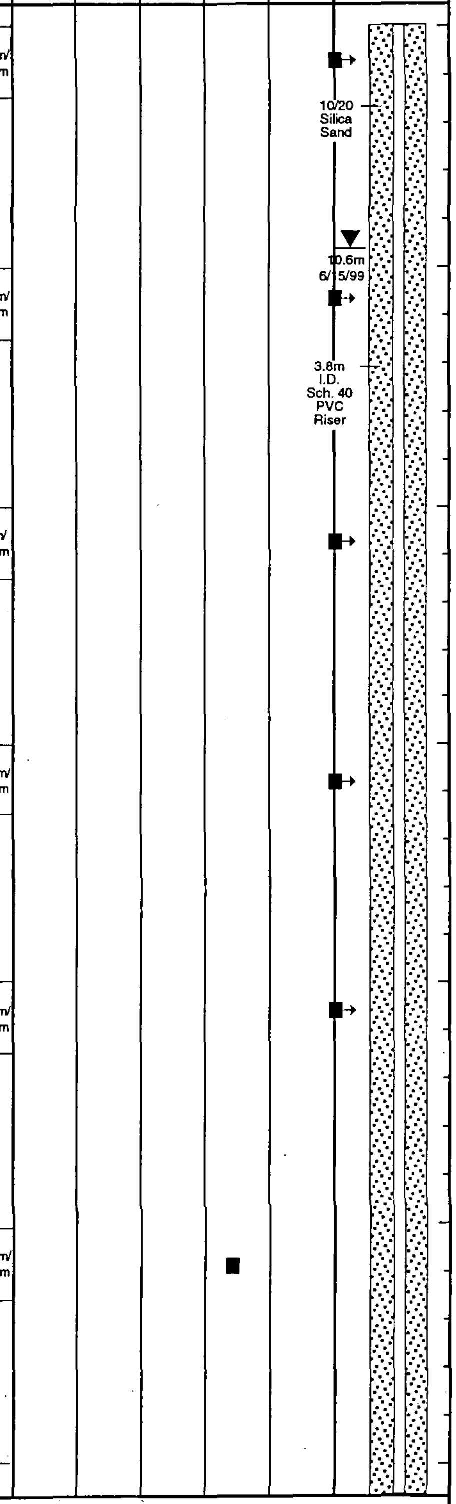
Boring method: HWT Casing Advancer

DEPTH (METERS)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT
	Very dense, brown, nonstratified, silty fine to coarse SAND, little to some fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	SM		6	SS	36-45-60	105	39.7cm/45.8cm
10								
11				7	SS	20/29/37	66	24.4cm/45.8cm
12				8	SS	31-50/3	>50	6.1cm/22.9cm
13								
14				9	SS	40-45-50	95	24.4cm/45.8cm
15				10	SS	26-40-33	73	30.5cm/45.8cm
16								
17				11	SS	14-15-19	34	21.4cm/45.8cm
18								

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50

WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC / WATER LEVEL



Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/16/99

DOT-50000170

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-2

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: South Line, Lower Hole

BORING DATE: 5/17/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very dense, brown, nonstratified, silty fine to coarse SAND, little to some fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	SM		11.2m	12	SS	20-21-20	41	8/18		10/20 Silica Sand
		Total depth 18.8m bgs Note: Poor boy inclinometer installed in boring.			18.8m							
19												
20												
21												
22												
23												
24												
25												
26												
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/15/99

DOT-50000171

Golder Associates

RECORD OF BOREHOLE GA-3

PROJECT: WSDOT/MP 322 Landslide/WA

SHEET 1 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp ─o W ─ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					88.2m							
0	HWT Casing Advancer	Speed drilled to 71.7m No samples taken. See WSDOT Log H-1-99 for stratigraphy.	GM		0.0						PVC Stickup 86.9cm A+ A- Slots at N81°E	5.7cm Slope Inclinometer Casing; Lime/ Cement Grout
1												
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: Burley 4500 **LOGGED:** CAV

DOT-50000172

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: **DATE:** 7/15/99

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-3

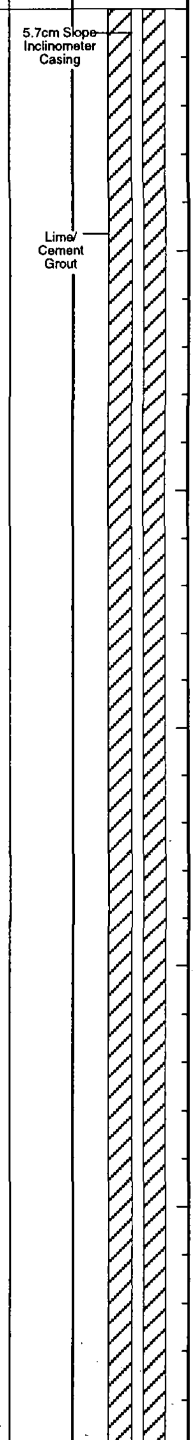
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Upper Hole

BORING DATE: 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp ⊢ W ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											
11												
12												
13												
14												
15												
16												
17												
18												



Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

- 9

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000173

Golder Associates

RECORD OF BOREHOLE GA-3

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Upper Hole

BORING DATE: 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢ W ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer											5.6cm Slope Inclinometer Casing
19	HQ Casing Advancer											
20												Lime/ Cement Grout
21												
22												
23												
24												
25												
26												
27												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000174

Golder Associates

RECORD OF BOREHOLE GA-3

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp ⊢ W ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
28	HQ Casing Advancer											5.7cm Slope Inclinometer Casing
29												Lime/ Cement Grout
30												
31												
32												
33												
34												
35												
36												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000175

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-3

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
37	HQ Casing Advancer											5.7cm Slope Inclinometer Casing
38												Lime/ Cement Grout
39												
40												
41												
42												
43												
44												
45												

Log continued on next page

DRILL RIG: Burley 4500 **LOGGED:** CAV

DOT-50000176

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: **DATE:** 7/15/99

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-3

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Upper Hole

BORING DATE: 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
46	HQ Casing Advancer											5.7cm Slope Inclinometer Casing
47												Lime/ Cement Grout
48												
49												
50												
51												
52												
53												
54												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000177

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-3

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Upper Hole

BORING DATE: 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
55												5.7cm Slope Inclinometer Casing
56												Lime/ Cement Grout
57												
58												
59	HQ Casing Advancer											
60												
61												
62												
63												
64		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000178

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-3

SHEET 8 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Upper Hole

BORING DATE: 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
64	HQ Casing Advancer											5.7cm Slope Inclinometer Casing
65												Lime/ Cement Grout
66												
67												
68												
69												
70												
71												
		Bottom of hole 235.0 ft bgs			16.5m / 71.7m							
72												
73												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER:

LOGGED: CAV

CHECKED:

DATE: 7/15/99

DOT-50000179

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer			53.4m						PVC Stickup 85.7cm A+A- Slots at N60°E	5.7cm Slope Inclinometer Casing
		Loose, light brown, nonstratified, silty fine to coarse SAND, some rounded gravel, little organics, dry to damp (LANDSLIDE DEBRIS)		0.0							
		Very loose to loose, light olive brown, massive to crudely bedded, fine to medium SAND, little subrounded fine to coarse gravel, trace silt, trace organics at 1.8m, varies to fine to coarse SAND, little to some subrounded to rounded fine to coarse gravel, trace silt, gravel clasts are multilithologic in composition, wet (moisture likely affected by drill fluids) (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SP	52.8m / 0.0							Bentonite Cement Grout
2					1	SS	1-1-1	2	15.3cm/45.8cm	■	
3				51.5m / 2.75m							
					2	SS	4-2-2	4	15.3cm/45.8cm	■	
4			SW								
5					3	SS	6-2-3	5	15.3cm/45.8cm	■	
6					4	SS	4-3-2	5	15.3cm/45.8cm	■	
8					5	SS	3-3-3	6	18.3cm/45.8cm	■	
9											

Water content, percent: Wp —— W —— Wl (scale 0, 10, 20, 30, 40, 50)

Log continued on next page

DRILL RIG: 2500 **LOGGED:** FSM/MS

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

DOT-50000180

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4

SHEET 2 **OF** 5

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT.	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer			44.2m / 9.2m							5.7cm Slope Inclinometer Casing
		Compact to dense, light grayish olive, faintly laminated, silty fine SAND, varies to SILT and fine SAND, damp to moist, micaceous (TRANSITIONAL LANDSLIDE DEBRIS)	SM		6	SS	10-11-14	25	33.6cm/45.8cm	25	
10											Bentonite Cement Grout
11					7	SS	9-15-16	31	36.6cm/45.8cm	31	
		11.9m: Lost drill fluid returns to surface									
12				41.3m / 12.0m							
		Compact to dense, light olive brown, massive to faintly laminated, silty fine SAND, ranging to SILT and fine SAND, moist to wet, observed on one planar, rough fracture at 12.5m oriented ~30° wrt sample axis cutting across faint laminae (TRANSITIONAL LANDSLIDE DEBRIS)	SM/ML		8	SS	9-13-15	28	39.7cm/45.8cm	28	
13	HQ Casing Advancer										
14					9	SS	12-13-20	33	21.4cm/45.8cm	33	
15				38.3m / 15.1m							
		Compact, olive gray and moderate bluish gray, laminated to massive, fractured, SILT, little to some fine sand, ranging to SILT and fine SAND, grades downward in hole to SILT, trace to little fine sand, damp to moist becoming moist to wet below 17.2m (TRANSITIONAL LANDSLIDE DEBRIS)	ML		10	SS	5-7-8	15	33.6cm/45.8cm	15	
16											
17					11	SS	7-6-11	17	36.6cm/45.8cm	17	
18				35.4m / 18.0m							
		See description on next page	ML								

Log continued on next page

DRILL RIG: 2500 **LOGGED:** FSM/MS

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

DOT-50000181

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/7-9/99

BORING METHOD: HQ Casing Advancer

DEPTH (METERS)	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
	Very stiff to hard, olive gray to gray, massive to faintly laminated, CLAYEY SILT with hard CLAY interbeds <2.5cm, possible fracture zone at 18.9m, moist becoming damp with depth (GLACIOLACUSTRINE DEPOSIT?) ppen >4.5 tsf	CL-ML		12	SS	10-17-34	51	45.8cm/45.8cm
19								
20				13	SS	12-23-50	73	45.8cm/45.8cm
21								
22				14	SS	6-8-10	18	45.8cm/45.8cm
23				15	SS	5-10-12	22	45.8cm/45.8cm
24	Very stiff to hard, gray, massive to faintly laminated, SILTY CLAY (CL) with thin (<2.5cm) interbeds of dark gray, laminated, fractured CLAY (CH), moist (GLACIOLACUSTRINE DEPOSIT)	CL	29.1m / 24.2m					
25				16	SS	7-11-21	32	45.8cm/45.8cm
26				17	SS	8-15-25	40	36.6cm/45.8cm
27								

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT Wp — W — Wl

PIEZOMETER GRAPHIC / WATER LEVEL: 5.7cm Slope Inclinometer Casing; Bentonite Cement Grout

DRILL RIG: 2500 **LOGGED:** FSM/MS

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

DOT-50000182

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/7-9/99

Boring method: HQ Casing Advancer

DEPTH (METERS)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLE NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT
	Very stiff to hard, gray, massive to faintly laminated, SILTY CLAY (CL) with thin (<2.5cm) interbeds of dark gray, laminated, fractured CLAY (CH), moist (GLACIOLACUSTRINE DEPOSIT)	CL						
28				18	SS	10-19-33	52	39.7cm/45.8cm
29–30				19	SS	8-14-16	30	39.7cm/45.8cm
31				20	SS	6-11-16	27	24.4cm/45.8cm
32–33				21	SS	4-7-7	14	0.0cm/45.8cm
34				22	SS	1-18-21	39	36.6cm/45.8cm
			18.6m / 34.8m					
35	Very stiff to hard, gray to dark gray, laminated, SILTY CLAY with thin laminae of CLAY and fine SAND, moist (GLACIOLACUSTRINE DEPOSIT)	CL/ CH						
35–36				23	SS	6-9-12	21	9.2cm/45.8cm

Log continued on next page

Penetration resistance blows/ft. scale 0–50; Water content, percent (Wp — w — Wl).

Piezometer graphic / water level: 5.7cm Slope Inclinometer Casing; Bentonite Cement Grout

DRILL RIG: 2500 **LOGGED:** FSM/MS

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

DOT-50000183

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4

SHEET 5 **OF** 5

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/7-9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp —o W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
37	HQ Casing Advancer	Very stiff to hard, gray to dark gray, laminated, SILTY CLAY with thin laminae of CLAY and fine SAND, moist (GLACIOLACUSTRINE DEPOSIT)	CL/CH			24	SS	16-27-33	60	30.5cm/45.8cm		5.7cm Slope Inclinometer Casing; Bentonite Cement Grout
38					14.5m	25	SS	15-25-49	74	45.8cm/45.8cm		Slough
39		Total depth 38.9m bgs			38.9m							
40												
41												
42												
43												
44												
45												

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: S. Walker/N. Salisbury

LOGGED: FSM/MS
CHECKED:
DATE: 7/15/99

DOT-50000184

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Middle Hole

BORING DATE: 6/9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Speed drilled to 32.8m. See Log GA-4 for stratigraphy.			53.4m / 0.0						PVC Stickup 68.6cm	3.8cm Sch. 40 PVC Riser with Flush-Threaded Joints and O-Rings; Bentonite Cement Grout
1												
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury

LOGGED: MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000185

Golder Associates

RECORD OF BOREHOLE GA-4A

PROJECT: WSDOT/MP 322 Landslide/WA

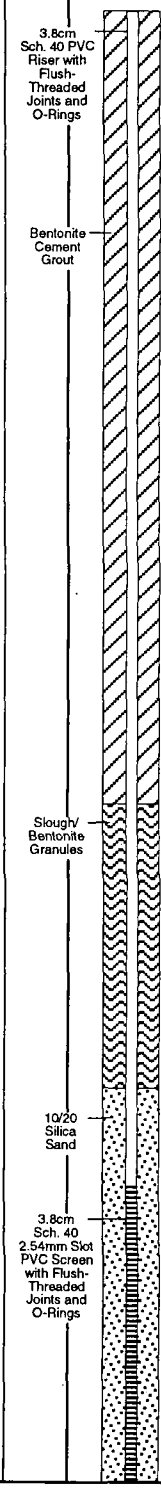
PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Middle Hole

DATUM: MSL

BORING DATE: 6/9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											
11												
12												
13												
14												
15												
16	HQ Casing Advancer											
17												
18		Log continued on next page										



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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury

LOGGED: MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000186

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Middle Hole

BORING DATE: 6/9/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
19	HQ Casing Advancer											10/20 Silica Sand; ▼ 19.4m 6/15/99
20												
21												3.8cm Sch. 40 2.54mm Slot PVC Screen with Flush-Threaded Joints and O-Rings
22												
23												
24												
25												
26												
27												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury

LOGGED: MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000187

Golder Associates

RECORD OF BOREHOLE GA-4A

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 6/9/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
28–32	HQ Casing Advancer											10/20 Silica Sand; 3.8cm Sch. 40 2.54mm Slot PVC Screen with Flush-Threaded Joints and O-Rings
32						1	SH	Push 58.4cm	NA	51.9cm/ 58.0cm		3.8cm Sch. 40 PVC Riser with End Cap
					20.6m	2	SH	Push 17.8cm	NA	18.3cm/ 18.3cm		Slough
33		Total depth 32.8m bgs			32.8m							
34												
35												
36												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury

LOGGED: MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000188

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

RECORD OF BOREHOLE GA-5

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Lower Hole

BORING DATE: 6/10-11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50); WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					38.7cm							
0	HWT Casing Advancer	Very loose to loose, grayish brown, nonstratified to thickly bedded, fine to coarse GRAVEL and fine to coarse SAND, trace silt, varies to fine to coarse GRAVEL, little to some sand, trace silt, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS) NOTE: Moisture likely affected by drill fluids	GW		0.0						PVC Stickup 79.6cm A+A- Slots at N75°E	5.7cm Inclinometer Casing; Lime Cement Grout
2						1	SS	3-2-1	3	7.6cm/45.8cm		
3.5						2	SS	4-5-3	8	7.6cm/45.8cm		
5						3	SS	4-6-3	9	9.2cm/45.8cm		
6.5						4	SS	5-5-5	10	7.6cm/45.8cm		
8						5	SS	2-5-4	9	15.3cm/45.8cm		
9		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/15/99

DOT-50000189

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-5

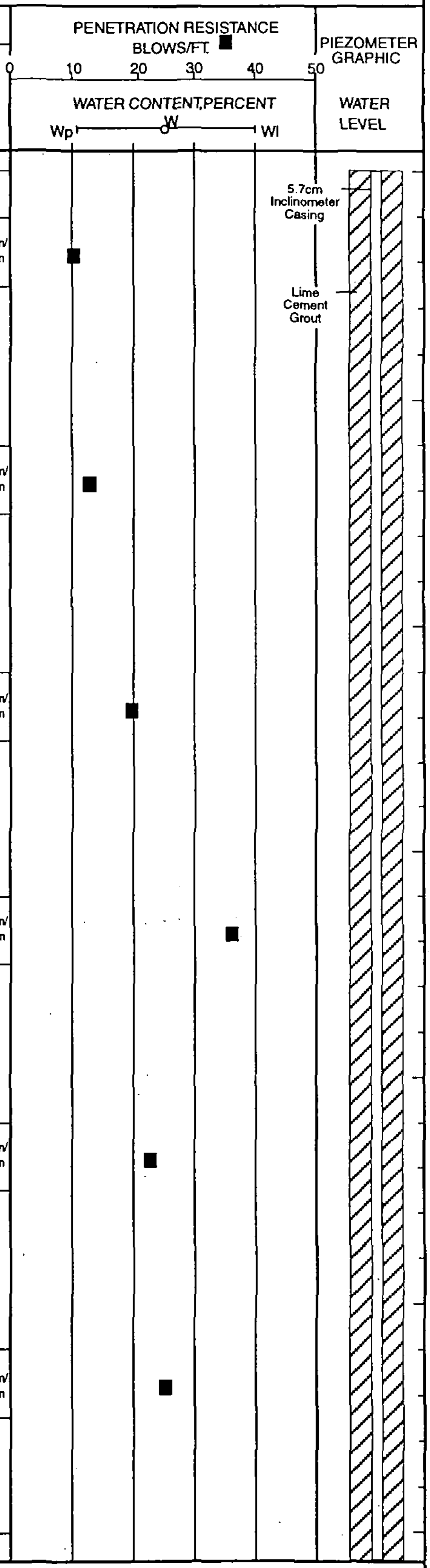
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Lower Hole

BORING DATE: 6/10-11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
	HWT Casing Advancer	Loose to compact, grayish brown, massive to crudely bedded, fine to medium SAND, trace to some fine rounded gravel, trace silt, varies to fine to coarse subrounded to rounded GRAVEL and fine to coarse SAND, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW		29.4m / 9.3m					
						6	SS	4-5-5	10	15.3cm/45.8cm
10										
11						7	SS	5-5-7	12	15.3cm/45.8cm
12										
						8	SS	8-9-11	20	12.2cm/45.8cm
13										
		Very stiff to hard, greenish gray and dark gray with very light gray mottling, massive to faintly laminated, jointed, fractured in places, CLAY to SILTY CLAY with occasional interbeds of clayey fine to medium SAND, trace fine faceted gravel in sand, trace rounded gravel dropstones (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH		25.0m / 13.7m					
14						9	SS	8-14-23	37	45.8cm/45.8cm
15	HQ Casing Advancer									
						10	SS	3-7-15	22	30.5cm/45.8cm
16										
17										
		Hard, greenish gray and dark gray, varies to olive brown, laminated to massive, jointed, CLAY withthin (<1cm) interbeds of fine SAND observed below 20.7m, damp to moist (GLACIOLACUSTRINE DEPOSIT)	CH		21.5m / 17.2m	11	SS	5-8-17	25	45.8cm/45.8cm
18										



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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 2/7/2000

DOT-50000190

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-5

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Lower Hole **BORING DATE:** 6/10-11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. / WATER CONTENT, PERCENT (Wp – W – Wl; 0 10 20 30 40 50)	PIEZOMETER GRAPHIC / WATER LEVEL
	HQ Casing Advancer	Hard, greenish gray and dark gray, varies to olive brown, laminated to massive, jointed, CLAY withthin (<1cm) interbeds of fine SAND observed below 20.7m, damp to moist (GLACIOLACUSTRINE DEPOSIT))	CH			12	SS	11-18-23	41	45.8cm/45.8cm		5.7cm Inclinometer Casing
19												Lime Cement Grout
20						13	SS	17-29-50/4	>50	45.8cm/45.8cm		
21						14	SS	42-50/2	>50	15.3cm/21.4cm		
22												
23						15	SS	30-50/3	>50	15.3cm/22.9cm		
24						16	SS	50/2	>50	3.1cm/6.1cm		
25												
26												
27												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/15/99

DOT-50000191

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-5

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Lower Hole **BORING DATE:** 6/10-11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HQ Casing Advancer	Hard, greenish gray and dark gray, varies to olive brown, laminated to massive, jointed, CLAY withthin (<1cm) interbeds of fine SAND observed below 20.7m, damp to moist (GLACIOLACUSTRINE DEPOSIT)	SM/ SC			17	SS	50/3.5	>50	6.1cm/ 9.2cm	■→	
28		27.5m: Possible change to very dense, brownish gray, nonstratified, clayey silty fine to coarse SAND, withlittle fine gravel, wet (NOTE: moisture likely affected by drill fluids)										Lime Cement Grout
29												5.7cm Inclinometer Casing
30					8.1m	18	SS	50/3	>50	0cm/ 7.6cm	■→	
		Total depth 30.6m bgs			30.6m							
31												
32												
33												
34												
35												
36												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 2/7/2000

DOT-50000192

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-5A

SHEET 1 OF 2

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Lower Hole

BORING DATE: 6/11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	For detailed soil profile description, see log for GA-5, drilled 1.5m to the south			38.7m / 0.0						PVC Stickup 61.0cm	3.8cm ID Sch. 40 PVC Riser with Flush Threaded Joints and O-Rings
1												Bentonite
2												
3												
4												
5												
6												
7												10/20 Silica Sand
8												3.8cm ID Sch. 40 PVC Screen, 2.54mm Slots, with Flush Threaded Joints and O-Rings
9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: FSM

CHECKED:

DATE: 7/15/99

DOT-50000193

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-5A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Lower Hole

BORING DATE: 6/11/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer											10/20 Silica Sand
10												3.8cm ID Sch. 40 PVC Screen, 2.54mm Slots, with Flush Threaded Joints and O-Rings
11												Caved Soil
12												10/20 Silica Sand
13					25.3m / 13.4m							13.3m 6/15/99
		Gray, laminated to massive, fractured, CLAY ranging to CLAY, little to some fine to medium SAND, moist, wet in fractures (Qls?)										
14						1	SH	Push 27.9cm	NA	10.2cm/ 27.9cm		3.8cm ID Sch. 40 PVC Riser with End Cap
		Total Depth 14.3m bgs (sampled)			24.4m / 14.3m							
15												
16												
17												
18												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: FSM

CHECKED:

DATE: 2/7/2000

DOT-50000194

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-6

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: North Line, Middle Hole

BORING DATE: 5/20-21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLE NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
0	HWT Casing Advancer	Very loose to compact, light olive brown and light olive gray, nonstratified to weakly stratified, fine to coarse SAND, trace to little fine subrounded gravel, trace to little silt, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM	58.4m / 0.0					
2					1	SS	1-1-1	2	30.5cm/45.8cm
3.5					2	SS	3-4-5	9	30.5cm/45.8cm
5					3	SS	3-2-3	5	15.3cm/45.8cm
6.5					4	SS	10-9-11	20	30.5cm/45.8cm
8					5	SS	5-10-13	23	30.5cm/45.8cm

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50)

WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 80.8vm
A+A- Slots at N65°E

Lime Cement Grout

5.7cm Inclinometer Casing

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/15/99

DOT-50000195

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466

RECORD OF BOREHOLE GA-6

BORING LOCATION: North Line, Middle Hole

DATUM: MSL

BORING DATE: 5/20-21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ / WATER CONTENT, PERCENT	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very loose to compact, light olive brown and light olive gray, nonstratified to weakly stratified, fine to coarse SAND, trace to little fine subrounded gravel, trace to little silt, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM			6	SS	4-4-3	7	9.2cm/ 45.8cm		Lime Cement Grout
10												5.7cm Inclinometer Casing
		Compact to dense, light olive brown to light gray, nonstratified, silty fine SAND, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		47.7m / 10.7m							
11						7	SS	5-6-8	14	30.5cm/ 45.8cm		
12		Dense, light olive brown, nonstratified, silty fine SAND, moist to wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM		46.5m / 11.9m							
						8	SS	8-13-20	33	36.6cm/ 45.8cm		
13												
14						9	SS	13-15-21	36	39.7cm/ 45.8cm		
15												
						10	SS	8-15-16	31	30.5cm/ 45.8cm		
16												
17						11	SS	12-17-20	37	39.7cm/ 45.8cm		
18												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 2/7/2000

DOT-50000196

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-6

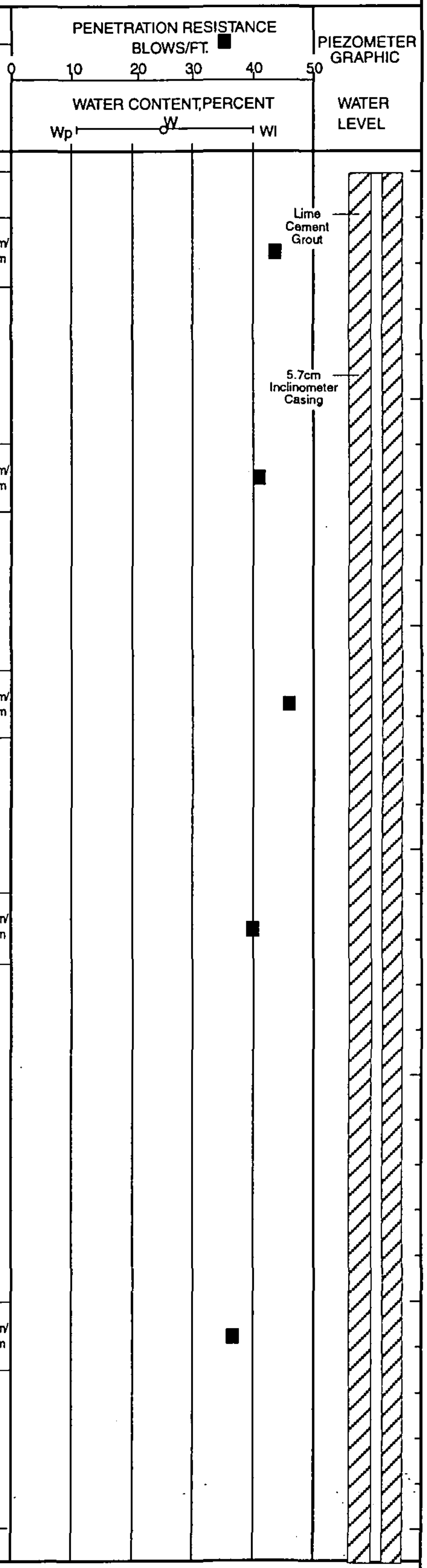
DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: North Line, Middle Hole

BORING DATE: 5/20-21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
	HWT Casing Advancer	Dense, light olive brown, nonstratified, silty fine SAND, moist to wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM		12	SS	15-22-21	43	39.7cm/ 45.8cm
19		Hard to dense, light gray, CLAYEY SILT, some fine sand, moist (GLACIOLACUSTRINE DEPOSIT)	ML	39.2m / 19.2m					
20					13	SS	7-17-21	41	45.8cm/ 45.8cm
21									
22					14	SS	11-21-25	46	39.7cm/ 45.8cm
		Hard, light gray, massive to stratified, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	CL	36.1m / 22.3m					
23	HQ Casing Advancer				15	SS	11-15-25	40	39.7cm/ 45.8cm
24									
25									
26					16	SS	11-14-23	37	36.6cm/ 45.8cm
27									
		Log continued on next page							



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/15/99

DOT-50000197

Golder Associates

RECORD OF BOREHOLE GA-6

PROJECT: WSDOT/MP 322 Landslide/WA

SHEET 4 **OF** 4

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: North Line, Middle Hole

BORING DATE: 5/20-21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0–50); WATER CONTENT, PERCENT Wp—W—Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HQ Casing Advancer	Hard, light gray, massive to stratified, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	CL		58.4m 0.0m							Lime Cement Grout
28												
29												5.7 Inclinometer Casing
						17	SS	10-16-24	40	45.8cm/45.8cm	■ 40	
30												
31												
32						18	SS	11-17-28	45	45.8cm/45.8cm	■ 45	
33												
34												
35					22.8m	19	SS	13-19-31	50	24.4cm/45.8cm	■ 50	
		Total depth 35.5m bgs			35.5m							
36												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: N. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 2/7/2000

DOT-50000198

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-6A

SHEET 1 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: MP322, North Line, Middle Hole

BORING DATE: 5/21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					58.4m							
0	HWT Casing Advancer	Speed drilled to 18.3m to install piezometer. See log of GA-6 for detailed stratigraphy.			0.0						PVC Stickup 91.5cm	Bentonite Chips
1												3.8cm I.D. Sch. 40 PVC Casing
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/Buck

LOGGED: MS/JDC

CHECKED:

DATE: 7/15/99

DOT-50000199

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-6A

SHEET 2 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: MP322, North Line, Middle Hole

BORING DATE: 5/21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											Bentonite Chips
11												3.8cm I.D. Sch. 40 PVC Casing
12												
13												
14												
15												10/20 Silica Sand
16												3.8cm I.D. Sch. 40 PVC Screen - 2.54mm Slot
17												17.5m 6/15/99
18												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/Buck

LOGGED: MS/JDC

CHECKED:

DATE: 7/15/99

DOT-50000200

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-6A

DATUM: MSL

PROJECT NUMBER: 993 1466

BORING LOCATION: MP322, North Line, Middle Hole

BORING DATE: 5/21/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
19	HWT Casing Advancer											3.8cm I.D. Sch. 40 PVC Screen - 2.54mm Slot; 10/20 Silica Sand
					38.6m	1	SS	11-17-20-28	37	50.8cm / 61.0cm	■ (37)	3.8cm I.D. Sch. 40 PVC Riser
20	HWT Casing Advancer	Boring terminated at 19.8 bgs			19.8m							
21												
22												
23												
24												
25												
26												
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/Buck

LOGGED: MS/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000201

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-7

SHEET 1 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Lower Hole **BORING DATE:** 5/18-19/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
0	HWT Casing Advancer			32.3m					
		Very loose, dark reddish brown, silty fine to medium SAND with some coarse sand and fine to coarse gravel, damp (TOPSOIL)	SM	0.0					
		Very loose, orange brown, silty fine to medium SAND with some coarse sand and fine to coarse gravel, damp (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM	15.3cm					
1		Very loose, brown, nonstratified, fine to coarse SAND, some fine to coarse gravel, trace silt, damp (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW	31.4m / 91.5cm					
2					1	SS	2-1-1	2	24.4cm/ 45.8cm
3		3.1m: Becomes moist to wet, loose							
					2	SS	5-3-4	7	21.4cm/ 45.8cm
4									
5		4.9m: Decrease in coarse sand and gravel, increase in silt			3	SS	3-1-2	3	9.2cm/ 45.8cm
6		Loose, tan, nonstratified, silty very fine SAND to fine SAND with some silt, moist (TRANSITIONAL LANDSLIDE DEBRIS)	SM	26.6m / 5.8m					
					4	SS	2-2-3	5	45.8cm/ 45.8cm
7									
8		7.9m: Becomes grayish brown with increase in silt			5	SS	2-3-2	5	39.7cm/ 45.8cm
		Firm, brownish gray, nonstratified, fine sandy SILT, moist (TRANSITIONAL LANDSLIDE DEBRIS)	ML	24.1m / 8.2m					
9		Stiff, gray, massive, SILTY CLAY, moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL/ CH	23.5m / 8.8m					
		Log continued on next page							

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT Wp — W — Wl

PVC Stickup 89.1cm
A+A- Slots at N79°E

PIEZOMETER GRAPHIC / WATER LEVEL

5.7cm Slope Inclinometer Casing

Lime Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 2/7/2000

DOT-50000202

Golder Associates

RECORD OF BOREHOLE GA-7

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Lower Hole

BORING DATE: 5/18-19/99

Soil Profile

Depth (m)	Boring Method	Description	USCS	Elev. / Depth
9.0–11.7	HWT Casing Advancer	Stiff, gray, massive, SILTY CLAY, moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS). 9.9m: Becomes very moist to wet. 10.7m: Becomes very stiff. 11.0m: Possible 2.54cm thick shear zone	CL/ CH	
11.7–13.1	HQ Casing Advancer	Compact, brown, nonstratified, silty fine SAND, wet ("pudding-llike consistency") (LANDSLIDE DEBRIS)	SM	20.6m / 11.7m
13.1–14.8	HQ Casing Advancer	Stiff, gray, massive, SILTY CLAY, moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH/ CL	19.2m / 13.1m
14.8–	HQ Casing Advancer	Hard, gray, massive, SILT ranging to SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT). 16.8m: Clay is weakly stratified. 17.1m: Trace fine gravel	CL- ML	17.6m / 14.8m

Log continued on next page

Samples

Number	Type	Blows / 15.2cm (63.5kg hammer, 70.2cm drop)	N	Rec/Att	Water Content, Percent (Wp / W / Wl)
6	SS	3-5-5	10	39.7cm/ 45.8cm	
7	SS	7-8-9	17	39.7cm/ 45.8cm	
8	SS	6-7-8	15	24.4cm/ 45.8cm	
9	SS	2-4-10	14	39.7cm/ 45.8cm	26 / 34.4 / 65
10	SS	12-19-31	50	39.7cm/ 45.8cm	24 / 25.1 / 33
11	SS	12-22-36	58	45.8cm/ 45.8cm	

Penetration Resistance Blows/Ft. (0–50); Water Content, Percent (0–100)

Piezometer Graphic / Water Level: 5.7cm Slope Inclinometer Casing; Lime Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 2/7/2000

DOT-50000203

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-7

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Lower Hole

BORING DATE: 5/18-19/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT Wp—W—Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					14.1m / 18.3m							
	HQ Casing Advancer	Hard, gray, stratified, SILTY CLAY, trace gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CH			12	SS	15-32-50	82	39.7cm/ 45.8cm		
		18.5m: Thin layer (<3.2mm) of fine to medium SAND										
		18.6m: 1.3cm thick layer of medium to coarse SAND and fine GRAVEL										
19												2.25-inch Slope Inclinometer Casing
		19.8m: Thinly laminated										
20						13	SS	15-25-36	61	39.7cm/ 45.8cm		
												Lime Cement Grout
21												
		21.4m: Trace fine sand in a 1.3cm thick lense and trace dark gray polished clay in a 6.4mm thick lense				14	SS	15-28-50/5	>50	45.8cm/ 45.8cm		
22												
23		22.9m: Trace fine to medium sand in a 6.4mm lense and trace dark gray clay in a 1.3cm lense				15	SS	13-26-50/5	>50	45.8cm/ 45.8cm		
24		23.9m-24.2m: Gravel/cobbles present based on drill action			8.0m / 24.4m							
		Hard, gray, weakly laminated, SILTY CLAY, trace dark gray clay lenses, trace fine sand in laminae, trace fine subrounded gravel (dropstone), moist (GLACIOLACUSTRINE DEPOSIT)	CH			16	SS	14-33-50/6	>50	45.8cm/ 45.8cm		
25												
		25.8m: Presence of gravels										
26		25.9m: Well laminated, with trace fine to medium sand and clay in 1.6mm lenses			6.2m / 26.2m	17	SS	25-50/4	>50	45.8cm/ 45.8cm		
		Boring terminated at 26.1m bgs, slope inclinometer installed at 26.2m										
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 8/19/99

DOT-50000204

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

RECORD OF BOREHOLE GA-7A

SHEET 1 **OF** 2

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Lower Hole **BORING DATE:** 5/19/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Boring speed drilled to install piezometer. See log GA-7, located approximately 91.5cm north, for detailed soil description.			32.4m / 0.0						PVC Stickup 1.1m	3.8cm I.D. Sch. 40 PVC Casing; Bentonite Chips
1												
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: S. Walker

LOGGED: MS
CHECKED:
DATE: 7/15/99

DOT-50000205

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

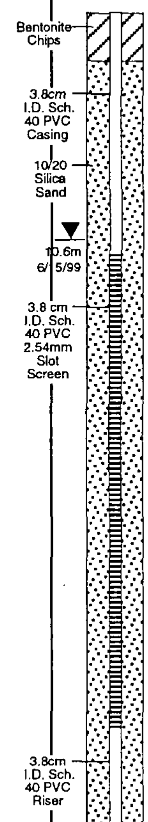
RECORD OF BOREHOLE GA-7A

SHEET 2 **OF** 2

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Lower Hole **BORING DATE:** 5/19/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT,PERCENT (Wp ⊢ W ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											
11												
12												
13												
14					18.0m							
		Total depth 14.3m			14.3m							
15												
16												
17												
18												



DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: S. Walker

LOGGED: MS
CHECKED:
DATE: 7/15/99

DOT-50000206

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Middle Line, Middle Hole

BORING DATE: 5/24-27/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer. 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp ⊢ W ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer				88.7m						PVC Stickup 46.4cm A+A- Slots at N74°E	5.7cm Slope Inclinometer Casing
		Loose, dark brown to brown, nonstratified, silty fine to coarse SAND, some fine to coarse gravel, organics to 15.2cm (GLACIOFLUVIAL DEPOSIT)	SM		0.0							
1												Lime Cement Grout
		Compact, light olive brown, nonstratified, fine to coarse SAND, some fine to coarse subrounded gravel, little silt, wet (GLACIOFLUVIAL DEPOSIT)	SM		87.2m / 5.0							
2												
3												
4												
5						1	SS	6-7-4	11	9.2cm/45.8cm	■ (11)	
6												
7												
8												
9												

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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/ MS

CHECKED:

DATE: 7/15/99

DOT-50000207

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Middle Line, Middle Hole **BORING DATE:** 5/24-27/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Compact, light olive brown, nonstratified, fine to coarse SAND, some fine to coarse subrounded gravel, little silt, wet (GLACIOFLUVIAL DEPOSIT)	SM									5.7cm Slope Inclinometer Casing
						2	SS	11-14-11	25	15.3cm/45.8cm	■	
10												Lime Cement Grout
11												
12												
13												
14						3	SS	10-11-12	23	15.3cm/45.8cm	■	
15												
16												
17	HQ Casing Advancer											
18												
		Log continued on next page										

DRILL RIG: 2500 **LOGGED:** JDC/MS DOT-50000208

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

Golder Associates

RECORD OF BOREHOLE GA-8

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

DATUM: MSL

BORING DATE: 5/24-27/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HQ Casing Advancer	Compact, light olive brown, nonstratified, fine to coarse SAND, some fine to coarse subrounded gravel, little silt, wet (GLACIOFLUVIAL DEPOSIT)	SM								5.7cm Slope Inclinometer Casing
					4	SS	10-9-8	17	21.4cm/45.8cm		
19				69.5m / 19.2m							Lime Cement Grout
		Compact to dense, tan and gray, nonstratified to crudely or thickly bedded, fine to medium SAND, little to some fine to coarse subrounded gravel, trace ranging to some silt, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM								
20											
					5	SS	3-1-6	7	12.2cm/45.8cm		
21											
22					6	SS	10-12-15	27	12.2cm/45.8cm	19	
23					7	SS	7-9-10	19	15.3cm/45.8cm		
24											
25					8	SS	12-13-15	28	39.7cm/45.8cm		
26					9	SS	6-24-16	40	0.0cm/45.8cm		
27											

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS

CHECKED:

DATE: 2/7/2000

DOT-50000209

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 5/24-27/99

BORING METHOD: HQ Casing Advancer

SOIL PROFILE: Compact to dense, tan and gray, nonstratified to crudely or thickly bedded, fine to medium SAND, little to some fine to coarse subrounded gravel, trace ranging to some silt, moist to wet (GLACIOFLUVIAL DEPOSIT) — USCS: SM

NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
10	SS	9-11-13	24	30.5cm/45.8cm
11	SS	6-12-9	21	7.6cm/45.8cm
12	SS	5-9-12	21	0.0cm/45.8cm
13	SS	12-16-19	35	7.6cm/45.8cm
14	SS	19-16-25	41	6.1cm/45.8cm
15	SS	13-18-19	37	0.0cm/45.8cm

ELEV. / DEPTH: 52.4m / 36.3m

See description on Sheet 5

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50

WATER CONTENT, PERCENT Wp W Wl 0 20 40 60 80 100

o24

PIEZOMETER GRAPHIC / WATER LEVEL: 5.7cm Slope Inclinometer Casing; Lime Cement Grout

DEPTH (METERS): 28, 29, 30, 31, 32, 33, 34, 35, 36

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS

CHECKED:

DATE: 2/7/2000

DOT-50000210

Golder Associates

RECORD OF BOREHOLE GA-8

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

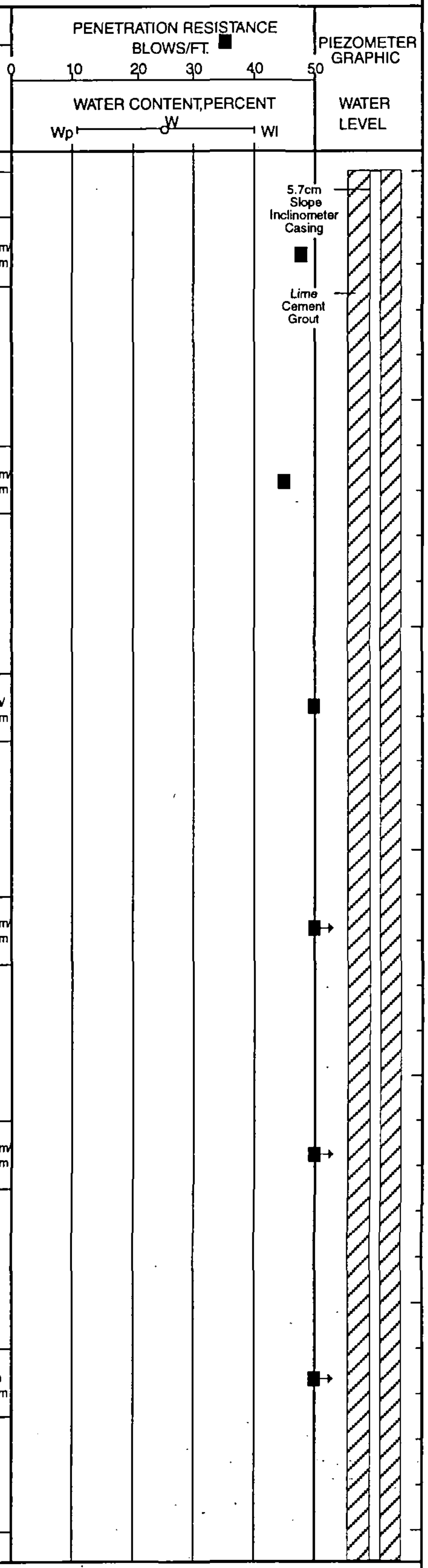
DATUM: MSL

BORING DATE: 5/24-27/99

Boring method: HQ Casing Advancer

Soil profile (37–45 m depth): Dense to very dense, light olive gray to light olive brown, massive to weakly stratified, silty fine SAND and sandy SILT, wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT) — USCS: SM/ ML

NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
16	SS	19-28-20	48	30.5cm/ 45.8cm
17	SS	15-20-25	45	30.5cm/ 45.8cm
18	SS	19-23-27	50	6.1cm/ 45.8cm
19	SS	16-21-31	52	30.5cm/ 45.8cm
20	SS	24-26-40	66	30.5cm/ 45.8cm
21	SS	20-42-40	82	7.6cm 45.8cm



Depth (meters): 37, 38, 39, 40, 41, 42, 43, 44, 45

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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS

CHECKED:

DATE: 7/15/99

DOT-50000211

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8

DATUM: MSL

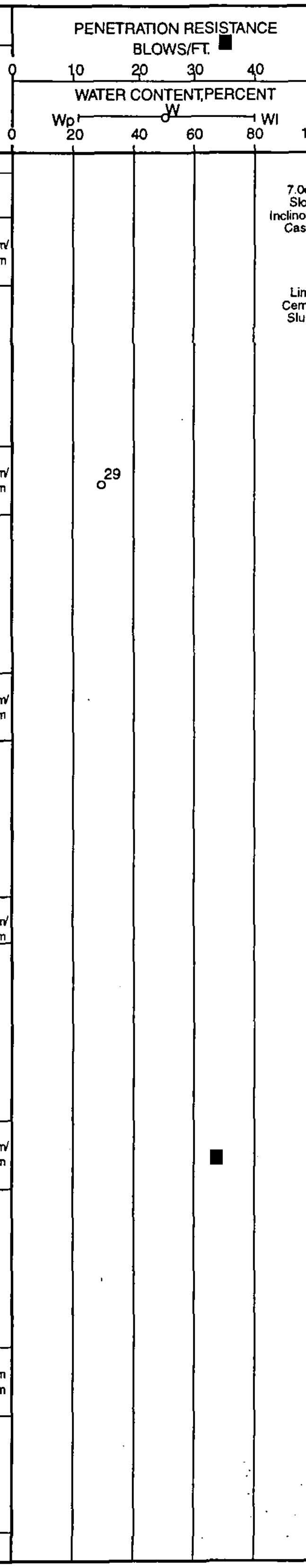
PROJECT NUMBER: 993 1466.300

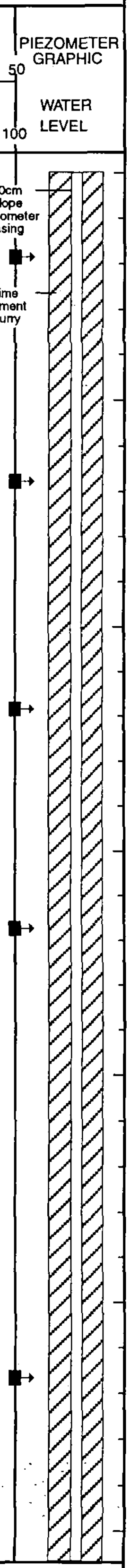
BORING LOCATION: South Line, Upper Hole

BORING DATE: 5/24/99

Boring method: HQ Casing Advancer

DEPTH (METERS)	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
46	Dense to very dense, light olive gray to light olive brown, massive to weakly stratified, silty fine SAND and sandy SILT, wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM/ ML		22	SS	21-38-50	88	30.5cm/ 45.8cm
47	Very dense and hard, light olive gray to gray, massive to laminated, SILT, ranging to CLAYEY SILT, trace to some sand, wet (GLACIOLACUSTRINE DEPOST)	CL- ML	41.8m / 47.0m					
48				23	SS	18-30-42	72	30.5cm/ 45.8cm
49				24	SS	12-40-50/5	>50	45.8cm/ 45.8cm
50–51				25	SS	37-50/6	>50	30.5cm/ 30.5cm
52	Hard, gray, massive to faintly laminated, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT) 52.3m: Observed a zone <15.3cm thick containing hard angular clasts	CL- ML	36.6m / 52.2m	26	SS	6-11-22	33	36.6cm/ 45.8cm
54				27	SS	14-30-50/3	>50	30.5cm 38.1cm





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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS

CHECKED:

DATE: 7/15/99

DOT-50000212

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 5/24-27/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	WATER CONTENT, PERCENT	PIEZOMETER GRAPHIC / WATER LEVEL
55	HQ Casing Advancer	Hard, gray, massive to faintly laminated, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	CL								5.7cm Slope Inclinometer Casing
					28	SS	15-27-50/3		15.3cm/ 38.1cm		Lime Cement Grout
56											
57					29	SS	15-32-50/3		30.5cm/ 38.1cm	31	
58		58.3m-58.7m: Observed polished surfaces									
					30	SS	15-25-50	75	42.7cm/ 45.8cm		
59											
60		59.8m-60.1m: Observed vertical fractures with a light gray SILT infilling trace angular CLAY clasts in a disturbed looking SILTY CLAY matrix 60.1m-60.4m: Very dense, light olive gray interbed of medium SAND, trace silt			31	SS	10-17-33	50	45.8cm/ 45.8cm		
61		61.3m-61.8m: Observed several polished joint surfaces oriented approximately perpendicular to sampler axis			32	SS	17-19-31	50	45.8cm/ 45.8cm		
62											
63				25.1m	33	SS	19-37-50	87	45.8cm/ 45.8cm		
		Boring terminated 63.3m bgs		63.3m							
64											

PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50)

WATER CONTENT, PERCENT Wp W Wl (0 20 40 60 80 100)

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS

CHECKED:

DATE: 7/15/99

DOT-50000213

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

RECORD OF BOREHOLE GA-8A

SHEET 1 **OF** 6

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** South Line, Upper Hole **BORING DATE:** 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50; WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Speed drilled to 47.3m to install piezometer. See log of GA-8 for detailed stratigraphy.			88.5m / 0.0						PVC Stickup 45.8cm	3.8cm I.D. Sch. 40 PVC Riser; Bentonite
1												
2												
3												
4												
5												
6												
7												
8												
9												

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DRILL RIG: 2500 **LOGGED:** JDC/MS/FSM

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: S. Walker/N. Salisbury **DATE:** 7/15/99

DOT-50000214

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

RECORD OF BOREHOLE GA-8A

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** South Line, Upper Hole **BORING DATE:** 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp ⊢ W ○ ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer											3.8cm I.D. Sch. 40 PVC Riser
10												Bentonite
11												
12												
13												
14												
15												
16												
17												
18												
		Log continued on next page										

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS/FSM
CHECKED:
DATE: 7/15/99

DOT-50000215

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8A

SHEET 3 **OF** 6

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp —o W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer											3.8cm I.D. Sch. 40 PVC Riser
19												Bentonite
20												
21												
22												
23												
24												
25												
26												
27												
		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000216

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: USCS	SOIL PROFILE: GRAPHIC LOG	SOIL PROFILE: ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 15.2cm, 63.5kg hammer, 76.2cm drop	SAMPLES: N	SAMPLES: REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT Wp ⊢ W ⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
28	HWT Casing Advancer											
29												
30												
31												
32												
33												
34												
35												
36												
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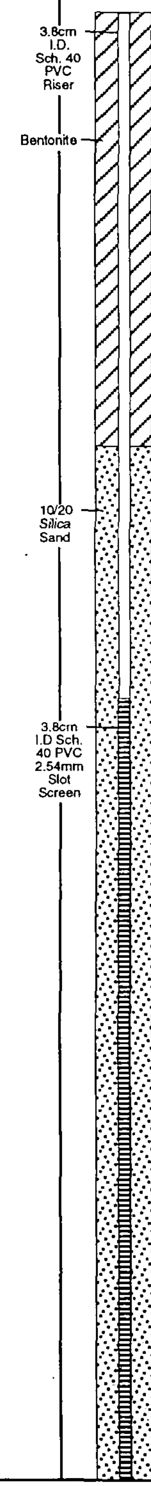


DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS/FSM

CHECKED:

DATE: 2/7/2000

DOT-50000217

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8A

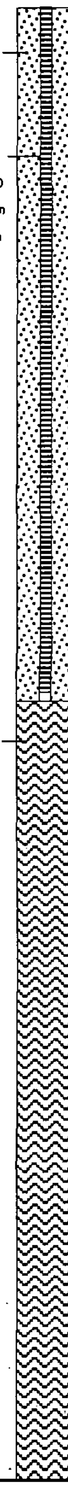
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
37	HWT Casing Advancer											10/20 Silica Sand
38												3.8cm I.D. Sch. 40 PVC 2.54mm Slot Screen
39												
40												
41		Note: Unable to install screen down to 47.3m due to adverse drilling conditions (heaving sand, loss of circulation)										Dry on 6/15/99; Slough/ Caved Soil
42												
43												
44												
45												



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DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000218

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-8A

SHEET 6 **OF** 6

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: South Line, Upper Hole

BORING DATE: 6/1-7/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
46	HWT Casing Advancer											Slough/ Caved Soil
47					41.2m							
		Boring terminated at 47.3m bgs			47.3m							
48												
49												
50												
51												
52												
53												
54												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker/N. Salisbury

LOGGED: JDC/MS/FSM

CHECKED:

DATE: 7/15/99

DOT-50000219

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/11-14/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer				87.7m							
		Loose, brown, silty SAND, little gravel, trace organics, dry (GLACIOFLUVIAL DEPOSIT)	SM		0.0	1	SS	7-7-7	14	15.3cm/ 45.8cm	■ (14); PVC Stickup 69.5cm A+A- Slots at N86°W	5.7cm Slope Inclinometer Casing
1		Compact to dense, light olive brown, nonstratified to crudely bedded, silty fine to coarse SAND, some fine subrounded gravel, moist to wet (RECESSIONAL OUTWASH)	SM		87.0m / 76.3cm							Lime Cement Grout
5						2	SS	2-8-13	21	9.2cm/ 45.8cm	■ (21)	
6		Compact to dense, light olive gray, massive to thickly beded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM		81.6m / 6.1m							
9												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000220

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

SHEET 2 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Compact to dense, light olive gray, massive to thickly beded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM			3	SS	3-8-8	16	9.2cm/ 45.8cm		5.7cm Slope Inclinometer Casing
10												Lime Cement Grout
11												
12												
13												
14						4	SS	5-13-18	21	21.4cm/ 45.8cm		
15												
16												
17												
18												

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DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 7/15/99

DOT-50000221

Golder Associates

RECORD OF BOREHOLE GA-9

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

DATUM: MSL

BORING DATE: 6/11-14/99

DEPTH (METERS)	BORING METHOD	DESCRIPTION	USCS	ELEV. DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT
	HWT Casing Advancer	Compact to dense, light olive gray, massive to thickly beded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM		5	SS	9-14-13	27	12.2cm/45.8cm
19									
20									
21					6	SS	6-12-29	41	12.2cm/45.8cm
22									
23									
24					7	SS	4-26-40	66	9.2cm/45.8cm
25									
26									
27									

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC / WATER LEVEL: 5.7cm Slope Inclinometer Casing; Lime Cement Grout

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 7/15/99

DOT-50000222

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Upper Hole **BORING DATE:** 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC WATER LEVEL
	HWT Casing Advancer	Compact to dense, light olive gray, massive to thickly beded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM			8	SS	18-50-45	95	9.2cm/ 45.8cm		
28		27.5m: Becomes very dense										Lime Cement Grout
29												5.7cm Slope Inclinometer Casing
30												
						9	SS	31-38-45	83	12.2cm/ 45.8cm		
31												
32	HQ Casing Advancer											
33												
						10	SS	17-27-36	63	45.8cm/ 45.8cm		
34												
35												
36												

Log continued on next page

DRILL RIG: Burley 4500
DRILLING CONTRACTOR: Crux
DRILLER: Hundahl/Buck

LOGGED: CAV/JDC
CHECKED:
DATE: 7/15/99

DOT-50000223

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

SHEET 5 OF 8

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
37	HQ Casing Advancer	Very dense, light olive gray, massive to thickly bedded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM			11	SS	18-26-28	54	21.4cm/ 45.8cm		Lime Cement Grout
38												5.7cm Slope Inclinometer Casing
39												
40						12	SS	22-28-32	60	9.2cm/ 45.8cm		
41												
42		Hard and very dense, light olive brown, stratified to massive, silty fine SAND, trace to little fine gravel, with interbeds of SILTY CLAY, trace sand, moist to wet (GLACIOFLUVIAL / GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM/ CL		45.6m / 42.1m							
43						13	SS	24-28-50	78	39.7cm/ 45.8cm		
44												
45												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000224

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Upper Hole **BORING DATE:** 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0–50); WATER CONTENT, PERCENT Wp–W–Wl	PIEZOMETER GRAPHIC / WATER LEVEL
46	HQ Casing Advancer	Hard and very dense, light olive brown, stratified to massive, silty fine SAND, trace to little fine gravel, with interbeds of SILTY CLAY, trace sand, moist to wet (GLACIOFLUVIAL / GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM/ CL			14	SS	21-31-50	81	30.5cm/ 45.8cm	■→	
					41.1m / 46.7m							Lime Cement Grout
47		Very dense, light olive gray, massive to thickly beded, fine to coarse SAND, trace to little silt, trace ranging to some subrounded fine to coarse gravel, varies to fine SAND, trace to little silt, trace fine subrounded gravel, moist to wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM			15	SS	20-36-45	91	30.5cm/ 45.8cm	■→	
48												5.7cm Slope Inclinometer Casing
49												
50						16	SS	28-33-35	68	45.8cm/ 45.8cm	■→	
51												
					35.9m / 51.9m							
52		Very dense and hard, light olive gray, massive to weakly stratified, SILT, little to some sand, and CLAYEY SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	ML- CL									
53						17	SS	19-29-50	79	45.8cm/ 45.8cm	■→	
54												

Log continued on next page

DRILL RIG: Burley 4500 **LOGGED:** CAV/JDC

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: Hundahl/Buck **DATE:** 8/19/99

DOT-50000225

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT,PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
55	HQ Casing Advancer	Very dense and hard, light olive gray, massive to weakly stratified, SILT, little to some sand, and CLAYEY SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	ML-CL									
56												Lime Cement Grout
						18	SS	17-34-50/4	>50	45.8cm/ 45.8cm		
57												5.7m Slope Inclinometer Casing
58												
59												
		59.5m-60.0m: Fractured and disturbed, containing hard angular CLAY clasts and polished fractures oriented 0-90° wrt sampler axis				19	SS	13-24-26	50	45.8cm/ 45.8cm		
		59.8m: ppen 3.5-4.0 tsf										
60		60.18,-60.21m: Observd a 2.5cm thick lense of fine to coarse SAND										
61												
62												
						20	SS	11-18-26	44	30.5cm/ 45.8cm		
63												
64												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 7/15/99

DOT-50000226

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Upper Hole **BORING DATE:** 6/11-14/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp —○W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
64	HQ Casing Advancer	Very dense and hard, light olive gray, massive to weakly stratified, SILT, little to some sand, and CLAYEY SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CL-ML		23.2m	21	SS	12-20-25	45	45.8cm/45.8cm	■	
		Boring terminated 64.5m bgs			64.5m							
65												
66												
67												
68												
69												
70												
71												
72												
73												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/Buck

LOGGED: CAV/JDC

CHECKED:

DATE: 2/7/2000

DOT-50000227

Golder Associates

RECORD OF BOREHOLE GA-9A

PROJECT: WSDOT/MP 322 Landslide/WA

SHEET 1 **OF** 6

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Boring speed drilled to install piezometer. For detailed soil profile description, see log for GA-9.			87.7m / 0.0							3.8cm I.D. Sch. 40 PVC Riser; Bentonite
1												
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/J. Salisbury

LOGGED: CAV/FSM

CHECKED:

DATE: 7/15/99

DOT-50000228

Golder Associates

RECORD OF BOREHOLE GA-9A

PROJECT: WSDOT/MP 322 Landslide/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

SHEET 2 **OF** 6

DATUM: MSL

BORING DATE: 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											3.8cm I.D. Sch. 40 PVC Riser
11												Bentonite
12												
13												
14												
15												
16												
17												
18												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/ J. Salisbury

LOGGED: CAV/FSM

CHECKED:

DATE: 7/15/99

DOT-50000229

Golder Associates

RECORD OF BOREHOLE GA-9A

PROJECT: WSDOT/MP 322 Landslide/WA

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp ⊢—o W—⊣ Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer											3.8cm I.D. Sch. 40 PVC Riser
19												Bentonite
20												
21												
22												
23												
24												
25												
26												
27												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/ J. Salisbury

LOGGED: CAV/FSM

CHECKED:

DATE: 7/15/99

DOT-50000230

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp —o W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
												3.8cm I.D. Sch. 40 PVC Riser
28												
												Bentonite
29												
30												
31												
32	HQ Casing Advancer											
33												
34												
35												
36												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/J. Salisbury

LOGGED: CAV/.FSM

CHECKED:

DATE: 7/15/99

DOT-50000231

Golder Associates

PROJECT: WSDOT/MP 322
Landslide/WA

RECORD OF BOREHOLE GA-9A

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** North Line, Upper Hole **BORING DATE:** 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer, 76.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
37	HQ Casing Advancer											
38												
39												
40												
41												
42												
43												
44												44.0m 7/1/99
45												

Log continued on next page

DRILL RIG: Burley 4500
DRILLING CONTRACTOR: Crux
DRILLER: Buck/J. Salisbury

LOGGED: CAV/FSM
CHECKED:
DATE: 2/7/2000

DOT-50000232

Golder Associates

PROJECT: WSDOT/MP 322 Landslide/WA

RECORD OF BOREHOLE GA-9A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: North Line, Upper Hole

BORING DATE: 6/15-16/99

DEPTH (METERS)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 76.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
46	HQ Casing Advancer											10/20 Silica Sand
47												3.8cm I.D. Machine Slotted PVC 2.54mm Slot Screen
48												
49												
50												
51					35.9m							3.8cm I.D. Sch. 40 PVC Riser
52		Bottom of hole at 51.9m bgs			51.9m							
53												
54												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/J. Salisbury

LOGGED: CAV/FSM

CHECKED:

DATE: 7/15/99

DOT-50000233

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-10

SHEET 1 **OF** 3

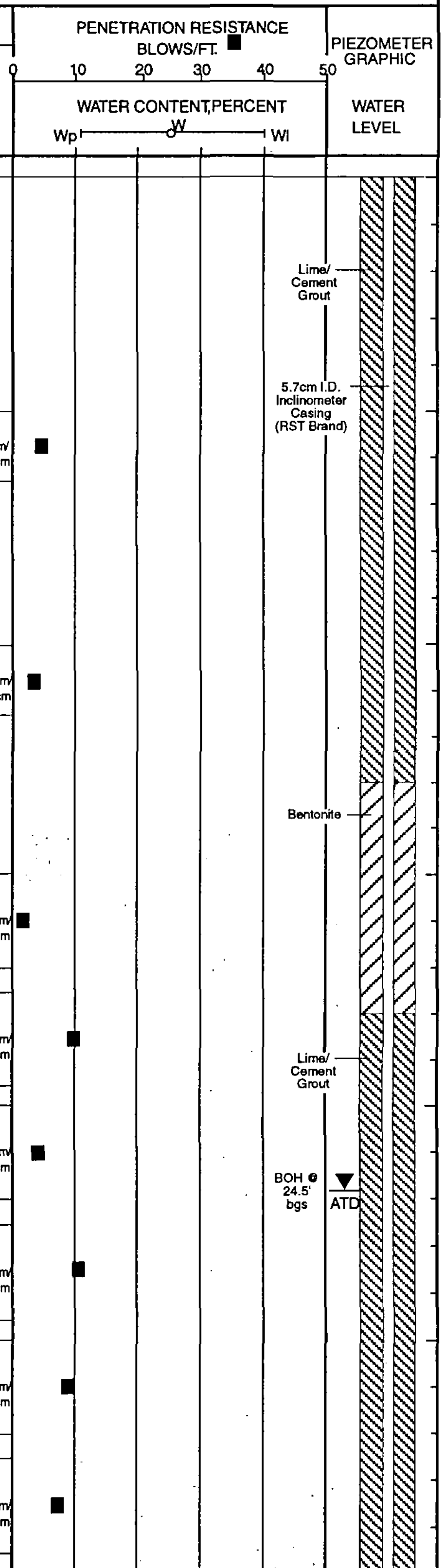
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 8/30-31/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT
0	HWT Casing Advancer			41.8m					
		Loose to very loose, olive, massive to faintly laminated, fractured, SILT, trace fine sand, trace rounded fine to coarse gravel, moist, contains harder SILT clasts in a loose matrix of silt (TRANSITIONAL LANDSLIDE DEBRIS)	ML	0.0m					
1									
					1	SS	1-2-3	5	6.1cm/45.8cm
2									
3									
					2	SS	1-1-2	3	33.6cm/45.8cm
4				37.7m					
		Very loose to compact and very soft to stiff, nonstratified, mottled, fractured, SILT ranging to SILTY CLAY, moist, contains hard angular clasts in a more loose matrix (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL-ML	4.1m					
					3	SS	1-1-1-1	2	39.7cm/61.0cm
5									
		5.5m: Grout loss during installation							
					4	SS	2-5-5-4	10	39.7cm/61.0cm
6									
					5	SS	1-2-2-4	4	45.8cm/61.0cm
7									
					6	SS	3-4-7-8	11	54.9cm/61.0cm
				34.3m					
		Firm to stiff, light bluish gray and olive brown to light olive, nonstratified, mottled, fractured, CLAYEY SILT to SILTY CLAY with harder subrounded to angular polished clasts, moist to wet (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL	7.5m					
8					7	SS	5-4-5-5	9	39.7cm/61.0cm
					8	SS	3-3-5-9	8	48.8cm/61.0cm
9									



Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000234

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-10

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 8/30-31/99

DEPTH METERS	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT
	HWT Casing Advancer	Firm to stiff, light bluish gray and olive brown to light olive, nonstratified, mottled, fractured, CLAYEY SILT to SILTY CLAY with harder subrounded to angular polished clasts, moist to wet (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL		9	SS	3-4-5-7	9	39.7cm/ 61.0cm
10					10	SS	2-4-5-7	9	33.6cm/ 61.0cm
11		Hard, olive gray to light olive gray, laminated, SILTY CLAY to CLAYEY SILT with thin (~2.5cm) interbeds of dark gray CLAY, moist, contains scattered joints(Qgl BLOCK IN OLDER SLIDE DEBRIS)	CL/ CH	31.0m / 10.8m	11	SS	2-8-22-28	30	51.9cm/ 61.0cm
					12	SS	8-16-24	40	30.5cm/ 45.8cm
12		Very dense, light bluish gray to light olive brown, faintly bedded, fine to coarse SAND, little subrounded to subangular fine to coarse gravel, trace silt/clay, moist (Qgfd BLOCK IN OLDER SLIDE DEBRIS)	SW	29.7m / 12.0m	13	SS	7-30-24	54	33.6cm/ 45.8cm
13		Very stiff to hard, dark bluish gray, nonstratified to faintly laminated, fractured, SILTY CLAY to CLAY, moist, contains hard angular clasts in a softer matrix (OLDER SLIDE DEBRIS)	CL/ CH	28.5m / 13.3m					
14					14	SS	5-12-18	30	45.8cm/ 45.8cm
15		Compact, light olive, mottled, fine to coarse SAND and fine to coarse subrounded to rounded GRAVEL, trace silt/clay, moist to wet, occasional bluish gray CLAY to SILTY CLAY, little sand, little gravel mottling (OLDER SLIDE DEBRIS)	SW	27.0m / 14.8m	15	SS	16-15-12	27	18.3cm/ 45.8cm
16									
17		Very stiff to hard, bluish gray, laminated, SILTY CLAY to CLAY with thin (<1mm) very light gray laminae (ash?), damp to moist (GLACIOLACUSTRINE DEPOSIT) ppen - >4.5 tsf	CL/ CH	24.8m / 17.0m	16	SS	6-8-15	23	12.2cm/ 45.8cm
18		See description on next page		23.9m / 17.8m					

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 — WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC — WATER LEVEL: Lime/ Cement Grout; 5.7cm ID Inclinometer Casing (RST Brand)

Log continued on next page

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: Shawn Walker

LOGGED: F. Mocker
CHECKED:
DATE: 2/7/2000

DOT-50000235

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-10

SHEET 3 OF 3

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 8/30-31/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very dense, light olive gray to light olive brown, crudely stratified, fine to coarse SAND, trace to some fine to coarse subrounded to rounded gravel, trace silt/clay, occasional silt interbeds, slight iron oxide staining throughout, moist to wet (GLACIOFLUVIAL DRIFT)	SW			17	SS	36-50/6	>50	15.3cm/ 30.5cm	■→	
19											BOH @ 19.0m bgs	ATD
											5.7cm ID Inclinometer Casing (RST Brand)	
20						18	SS	40-50/6	>50	24.4cm/ 30.5cm	■→	
											Lime/ Cement Grout	
21					20.3m	19	SS	50/5	>50	12.2cm/ 12.2cm	■→	
		Total depth 21.5m bgs (sampled)			21.5m							
22												
23												
24												
25												
26												
27												

DOT-50000236

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-10A

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 9/1/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. See log for GA-10 for detailed soil description.			41.8m / 0.0m							Stand-up Monument and Concrete; Bentonite Chips; 5.1cm OD Sch.40 PVC Casing
1												
2												
3												Bentonite Granules
4												
5												10/20 Silical Sand
6		Note: Turbid water observed from "D" drains located near GA-2/2A while drilling down from 6.1m bgs										
7												7.7m 9/20/99
8												5.1cm OD Sch.40 PVC 2.54mm Slot Screen
9												

Log continued on next page

DRILL RIG: .2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000237

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-10A

SHEET 2 **OF** 2

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/1/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 70.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											5.1cm OD Sch.40 PVC 2.54mm Slot Screen; 10/20 Silica Sand
11					30.5m							5.1cm OD Sch.40 PVC Casing
		Total depth 11.3m bgs			11.3m							
12												
13												
14												
15												
16												
17												
18												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000238

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-11

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/2-3/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ / WATER CONTENT, PERCENT	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Loose to very loose, olive to dark olive, faintly laminated to massive, fractured, SILT, trace fine sand, moist (TRANSITIONAL LANDSLIDE DEBRIS)	ML		37.2m / 0.0m							Standup Monument and Concrete
1												5.1cm OD Sch.40 PVC Casing
						1	SS	1-2-1	3	33.6cm/45.8cm		
2												Bentonite Chips
3						2	SS	1-2-2	4	42.7cm/45.8cm		
4		4.6m: Iron oxide stained, wet, iron oxide staining is concentrated along fractures, contains harder angular clasts in a loose matrix										
5						3	SS	1-2-3	5	30.5cm/45.8cm		
		Firm, greenish gray, nonstratified, fractured, CLAYEY SILT, wet, contains harder angular clasts in a softer matrix (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL/ML		31.4m / 5.8m							
6						4	SS	2-2-3	5	36.6cm/45.8cm		
7		Very stiff, medium gray, massive to interbedded, fractured, CLAYEY SILT to SILTY CLAY with thin (~2.5cm) interbeds of dark gray, CLAY to SILTY CLAY, moist, contains hard angular clasts in a soft matrix (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL/CH		30.0m / 7.2m							
8						5	SS	4-6-10	16	36.6cm/45.8cm	Wp 23, W 32.6, Wl 37	
9												
		Log continued on next page										

Log continued on next page

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: Shawn Walker

LOGGED: F. Mocker
CHECKED:
DATE: 2/7/2000

DOT-50000239

Golder Associates

RECORD OF BOREHOLE GA-11

PROJECT: WSDOT/MP322/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

DATUM: MSL

BORING DATE: 9/2-3/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT.	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very stiff, medium gray, massive to interbedded, fractured, CLAEY SILT to SILTY CLAY with thin (~2.5cm) interbeds of dark gray, CLAY to SILTY CLAY, moist, contains hard angular clasts in a soft matrix (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL/ CH		6	SS	4-7-9	16	33.6cm/ 45.8cm		Bentonite Chips
10		Very stiff to hard, dark gray and medium gray to greenish gray, interbedded and laminated, CLAY and CLAYEY SILT to SILTY CLAY, moist (LANDSLIDE DEBRIS-BLOCK?)	CL/ CH	27.0m / 10.2m							5.1cm OD Sch.40 PVC Casing
11					7	SS	7-11-14	25	42.7cm/ 45.8cm		
12											BOH @ 12.2m bgs ATD
					8	SS	7-15-24	39	45.8cm/ 45.8cm		
13											
14		Very stiff to hard, greenish gray, massive to faintly laminated, jointed, SILTY CLAY to CLAY with faint fine SAND laminae, moist to wet, some hard angular clasts in a soft matrix observed at ~13.7m in sample (GLACIOLACUSTRINE DEPOSIT)	CL/ CH	23.5m / 13.7m	9	SS	5-7-10	17	36.6cm/ 45.8cm		
15					10	SS	11-36-50	86	39.7cm/ 45.8cm		
16		Very dense, greenish gray, nonstratified, clayey fine to coarse subrounded to rounded GRAVEL, some medium to coarse sand, moist (GLACIOFLUVIAL DRIFT)	GC	21.7m / 15.6m							
17		Hard, light gray to dark gray and pale brown, laminated, jointed, CLAY, ranging to SILTY CLAY with fine to medium SAND interbeds, damp to moist (GLACIOLACUSTRINE DEPOSIT)	CH	20.6m / 16.6m	11	SS	7-14-27	41	45.8cm/ 45.8cm		
18		Very dense, olive to dark olive brown, stratified, fine to coarse SAND, trace fine to coarse subrounded gravel, trace silt, varies to fine to coarse SAND and fine rounded GRAVEL, trace silt, wet (GLACIOFLUVIAL DRIFT)	SW	19.5m / 17.7m							10/20 Silica Sand

Log continued on next page

Penetration resistance scale: 0 10 20 30 40 50. WATER CONTENT, PERCENT: Wp W Wl

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000240

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-11

SHEET 3 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/2-3/99

DEPTH METERS	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50); WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very dense, olive to dark olive brown, stratified, fine to coarse SAND, trace fine to coarse subrounded gravel, trace silt, varies to fine to coarse SAND and fine rounded GRAVEL, trace silt, wet (GLACIOFLUVIAL DRIFT)	SW			12	SS	50/4	>50	3.1cm/ 9.2cm		10/20 Silica Sand
19												5.1cm OD Sch.40 PVC 2.54mm Slot Screen
20						13	SS	50-50/3	>50	15.3cm/ 22.9cm		
21												5.1cm OD Sch.40 PVC Casing
					15.7m	14	SS	50/5	>50	9.2cm/ 12.2cm		
		Total depth 21.5m bgs (sampled)			21.5m							
		Piezometer dry on 9/20/99										
22												
23												
24												
25												
26												
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000241

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-11A

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/7/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 70.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					37.2m							
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. See log for GA-11 for detailed soil description			0.0m						Stand-up Monument and Concrete; Bentonite Chips; 5.1cm OD Sch.40 PVC Casing	
1												
2												
3												
4												
5												
6												
7												
8												
9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000242

Golder Associates

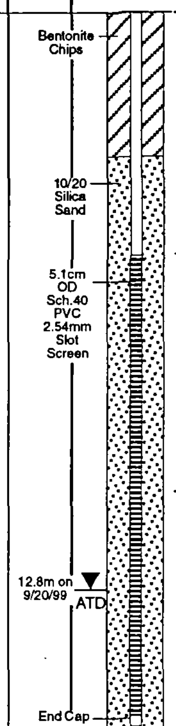
PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-11A

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/7/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 70.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC WATER LEVEL
10	HWT Casing Advancer											
11												
12												
13					23.5m							
		Total depth 13.7m bgs			13.7m							
14												
15												
16												
17												
18												



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000243

Golder Associates

RECORD OF BOREHOLE GA-12

PROJECT: WSDOT/MP322/WA

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

SHEET 1 **OF** 3

DATUM: MSL

BORING DATE: 9/8/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT,PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Loose to compact, light olive brown, stratified, fine to medium SAND, little fine to coarse subrounded to rounded gravel, trace silt with interbeds of fine SAND, trace to little silt, trace fine subrounded to rounded gravel, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SP		36.0m / 0.0m							Stand-up Monument; Concrete
1												5.1cm OD Sch.40 PVC Casing
2						1	SS	5-9-4	13	15.3cm/45.8cm		Bentonite Chips
3						2	SS	6-3-4	7	12.2cm/45.8cm		
4												Caved Soil
5						3	SS	8-6-4	10	18.3cm/45.8cm		
6						4	SS	5-4-4	8	15.3cm/45.8cm		Bentonite Chips
7		Compact and stiff, olive and medium bluish gray, stratified, SILT ranging to CLAYEY SILT and fine SAND, trace silt, moist, minor fractures, mottling and iron oxide staining (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CL/CH		28.7m / 7.3m							
8						5	SS	3-6-18	24	36.6cm/45.8cm		
		Very stiff to hard, medium bluish gray to light olive gray and greenish gray, interbedded, laminated, fractured, mottled in places, SILTY CLAY and CLAY, moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS-BLOCK)	CL/CH		27.7m / 8.3m							
9												

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000244

Golder Associates

RECORD OF BOREHOLE GA-12

PROJECT: WSDOT/MP322/WA

SHEET 2 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/8/99

BORING METHOD: HWT Casing Advancer

DEPTH METERS	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH	SAMPLE NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE / WATER CONTENT	PIEZOMETER GRAPHIC / WATER LEVEL
	Very stiff to hard, medium bluish gray to light olive gray and greenish gray, interbedded, laminated, fractured, mottled in places, SILTY CLAY and CLAY, moist (GLACIOLACUSTRINE LANDSLIDE DEBRIS-BLOCK)	CL/ CH		6	SS	6-13-18	31	30.5cm/ 45.8cm		Bentonite Chips
10										5.1cm OD Sch.40 PVC Casing
11	11.0m: Hard angular clasts of CLAY observed in a softer matrix of CLAY			7	SS	9-14-23	37	45.8cm/ 45.8cm		
12	Hard, medium gray, massive to faintly laminated or interbedded, jointed, CLAY ranging to SILTY CLAY, with discontinuous laminae and pockets of fine SAND, little fine to coarse rounded gravel, dropstones at 12.8m, damp to moist, contains occasional polished slickensided surfaces at 12.7m (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH	24.1m / 11.9m	8	SS	11-23-32	54	45.8cm/ 45.8cm		
13–14	Very dense, light olive, nonstratified, fine to coarse SAND, some fine to coarse subrounded to rounded gravel, trace silt, becomes clayey at 14.3m, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW	22.6m / 13.4m	9	SS	17-36-50/4	>50	24.4cm/ 45.8cm		
15	Hard, medium gray to dark gray, stratified, jointed, CLAY, some joints and laminae are polished and lined with softer clay, looks fractured in places, moist to wet (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH	21.0m / 14.9m	10	SS	5-15-22	37	30.5cm/ 45.8cm	Wp 26, W 30.6, Wl 66	
16–17	Hard and very dense, light gray to light olive brown, stratified, SILT ranging to SILTY CLAY, with dark gray CLAY interbeds to 1 cm thick, moist to wet (GLACIOLACUSTRINE DEPOSIT)	ML/ CL	19.5m / 16.5m	11	SS	22-50/5	>50	27.5cm/ 27.5cm		Caved Soil
18	See description on next page	SW	18.1m / 17.8m							

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000245

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-12

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/8/99

DEPTH METERS	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Very dense and hard, light olive brown, stratified, fine to medium SAND and fine to coarse subrounded to rounded GRAVEL, trace to little silt,varies to fine to medium SAND, little rounded gravel, trace silt, contains minor interbeds of CLAYEY SILT, moist to wet (GLACIOFLUVIAL DRIFT)	SW			12	SS	75/3	>50	0.0cm/ 7.6cm	Caved Soil; 10/20 Silica Sand; 5.1cm OD Sch.40 PVC Casing
19											
20						13	SS	50/4	>50	9.2cm/ 9.2cm	
21											5.1cm OD Sch.40 PVC 2.54mm Slot Screen
						14	SS	92/6	>50	15.3cm/ 15.3cm	
22											22.2m on 9/20/99
23					12.8m / 23.2m	15	SS	50/1	>50	3.1cm/ 3.1cm	End Cap
		Total depth 23.2m bgs (sampled)									
24											
25											
26											
27											

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50

WATER CONTENT,PERCENT Wp W Wl

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: Shawn Walker

LOGGED: F. Mocker
CHECKED:
DATE: 10/6/99

DOT-50000246

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-12A

SHEET 1 OF 2

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 9/9/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm 63.5kg hammer 70.2cm drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
					36.0m							
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. See log for GA-12 for detailed soil description			0.0m							Stand-up Monument and Concrete
1												Bentonite Chips; 5.1cm OD Sch.40 PVC Casing
2												
3												
4												
5												
6												
7												
8												10/20 Silica Sand
9												5.1cm OD Sch.40 PVC 2.54mm Slot Screen

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000247

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-12A

SHEET 2 OF 2

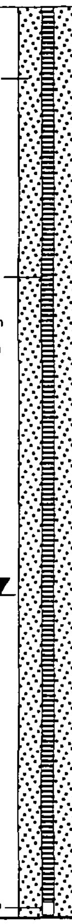
DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 9/9/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT,PERCENT Wp —o W— Wl	PIEZOMETER GRAPHIC / WATER LEVEL
10	HWT Casing Advancer											10/20 Silica Sand
11												5.1cm OD Sch.40 PVC 2.54mm Slot Screen
12												
13												12.9m on 9/20/99 ▼
14												
15		Total depth 14.9m bgs			21.0m / 14.9m							End Cap
16												
17												
18												



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000248

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-13

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/10-13/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Loose to compact, light brown, fine to medium SAND, with trace gravel, trace silt, may contain more gravelly interbeds (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SP		70.8m / 0.0m							Standup Monument and Concrete
1												5.1cm OD Sch.40 PVC Casing
2		Note: Upper 15.3m of boring was speed drilled before beginning to split spoonsample. Soil descriptions from 0-15.3m are based on drill action and inspection of cuttings in drill fluid.										
3												Bentonite Chips
4												
5												
6												
7												
8		Loose to compact, light brown, fine to coarse SAND with little to some gravel (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW		62.4m / 8.4m							
9												
		Log continued on next page										

Log continued on next page

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000249

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-13

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/10-13/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT Wp—W—Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Loose to compact, light brown, fine to coarse SAND with little to some gravel (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW									Bentonite Chips
10												5.1cm OD Sch.40 PVC Casing
11												
12												
13												
14		14.0m-14.6m: Drill action suggests dense soils										
		Dense to very dense, light olive brown to light greenish gray, crudely bedded, fine to coarse SAND, trace to little fine to coarse subrounded to rounded gravel, trace silt, moist to wet (GLACIOFLUVIAL DEPOSIT?/LANDSLIDE BLOCK?)	SW		56.4m / 14.3m							
15						1	SS	19-33-46	79	30.5cm/ 45.8cm		
16												
17						2	SS	16-19-22	41	18.3cm/ 45.8cm		
18		Compact to dense, light olive, massive to faintly bedded, fine to medium SAND, trace silt, wet (TRANSITIONAL BEDS?/LANDSLIDE DEBRIS BLOCK?)	SP		53.1m / 17.7m							

Log continued on next page

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: Shawn Walker

LOGGED: F. Mocker
CHECKED:
DATE: 2/7/2000

DOT-50000250

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-13

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/10-13/99

DEPTH METERS	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50); WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Compact to dense, light olive, massive to faintly bedded, fine to medium SAND, trace silt, wet (TRANSITIONAL BEDS?/LANDSLIDE DEBRIS BLOCK?)	SP			3	SS	13-16-18	34	12.2cm/45.8cm		Bentonite Chips
19												5.1cm OD Sch.40 PVC Casing
20						4	SS	7-8-9	17	18.3cm/45.8cm		
		Compact, olive, massive, SILT, little to some fine sand, wet (TRANSITIONAL BEDS?/LANDSLIDE DEBRIS?)	ML		50.0m / 20.7m							
21												Caved Soil
						5	SS	9-11-14	25	27.5cm/45.8cm		
22												
		Dense to very dense, olive, massive to faintly laminated, fine SAND, trace to little silt, wet (TRANSITIONAL BEDS?/Qols BLOCK?)	SP-SM		48.5m / 22.3m							
23						6	SS	9-14-21	35	21.4cm/45.8cm		Caved Soil
24												Bentonite Chips
						7	SS	15-24-29	53	30.5cm/45.8cm	■→	
25	HQ Casing Advancer											
26						8	SS	24-34-48	82	18.3cm/45.8cm	■→	10/20 Silica Sand
27												5.1cm OD Sch.40 PVC 2.54mm Slot Screen
		27.5m: Color change in drill fluids			43.3m / 27.5m							
		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000251

Golder Associates

RECORD OF BOREHOLE GA-13

PROJECT: WSDOT/MP322/WA
DATUM: MSL
PROJECT NUMBER: 993 1466.300
BORING LOCATION: Highway 101 at MP 322
BORING DATE: 9/10-13/99

BORING METHOD: HQ Casing Advancer

DEPTH METERS	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE / WATER CONTENT	PIEZOMETER GRAPHIC / WATER LEVEL
	Very dense, greenish gray, massive to faintly laminated or bedded, silty fine SAND ranging to SILT, trace fine sand, moist to wet (TRANSITIONAL BEDS?/Qols BLOCK?)	SM/ ML	43.3m / 27.5m							10/20 Silica Sand
28				9	SS	15-24-36	60	12.2cm/ 45.8cm		
29										5.1cm OD Sch.40 PVC 2.54mm Slot Screen
				10	SS	12-17-18	35	27.5cm/ 45.8cm		
30										
31				11	SS	10-12-14	26	36.6cm/ 45.8cm		
										31.5m on 9/20/99
32				12	SS	8-10-11	21	33.6cm/ 45.8cm		
33	Stiff to hard, dark greenish gray, massive to faintly bedded, SILTY CLAY ranging to CLAY, damp to moist (GLACIOLACUSTRINE DEPOSIT?/OLDER SLIDE DEBRIS?)	CL	37.7m / 33.1m							
34				13	SS	6-10-19	29	45.8cm/ 45.8cm	Wp 25, W 27.1, Wl 40	
35				14	SS	9-17-26	43	45.8cm/ 45.8cm		
36										

Log continued on next page

DRILL RIG: 2500
DRILLING CONTRACTOR: Crux
DRILLER: Shawn Walker
LOGGED: F. Mocker
CHECKED:
DATE: 2/7/2000

DOT-50000252

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-13

SHEET 5 **OF** 5

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

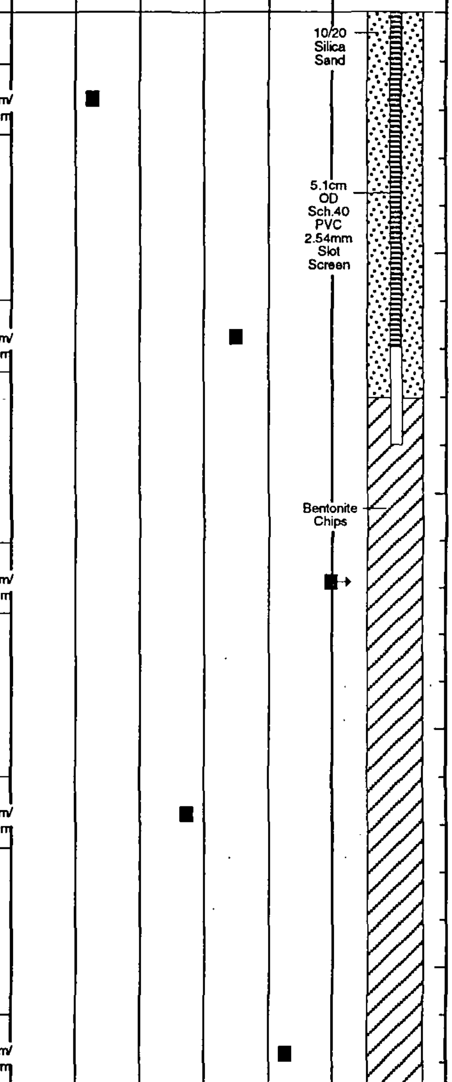
BORING DATE: 9/10-13/99

DEPTH METERS	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT
37	HQ Casing Advancer	Stiff to hard, dark greenish gray, massive to faintly bedded, SILTY CLAY ranging to CLAY, damp to moist (GLACIOLACUSTRINE DEPOSIT?/OLDER SLIDE DEBRIS?) @37.2m: Fractures observed	CL		15	SS	4-6-6	12	45.8cm/45.8cm
38				32.3m / 38.4m					
39		Very stiff to hard, dark greenish gray, massive to fainky laminated or bedded, CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	CL		16	SS	8-14-21	35	45.8cm/45.8cm
40					17	SS	13-25-27	52	45.8cm/45.8cm
41					18	SS	6-12-16	28	18.3cm/45.8cm
42									
43				27.3m / 43.5m	19	SS	10-17-25	42	45.8cm/45.8cm
		Total depth 45.3m bgs (sampled)							
44									
45									

PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50

WATER CONTENT, PERCENT Wp W Wl

PIEZOMETER GRAPHIC / WATER LEVEL



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Shawn Walker

LOGGED: F. Mocke

CHECKED:

DATE: 2/7/2000

DOT-50000253

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-14

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/20-21/99

BORING METHOD: HWT Casing Advancer

SOIL PROFILE

DEPTH (m)	DESCRIPTION	USCS	ELEV. / DEPTH
0			20.4m
0.0	Very loose and soft, light olive brown and light bluish gray, nonstratified, fractured, fine to medium SAND, little to some rounded fine to coarse gravel, trace silt with angular clasts of SILTY CLAY, moist (LANDSLIDE DEBRIS) 4.3m: Harder drilling suggesting old Highway 101 asphalt	SP	0.0m
4.3	Dense, dark olive brown, nonstratified, subangular fine to coarse GRAVEL, some fine to coarse sand, trace silt, moist (FILL)	GW	16.2m / 4.3m
5.6	Loose to compact, light olive brown, nonstratified, fine to coarse subrounded to rounded GRAVEL, some fine to coarse sand, trace silt, varies to fine to coarse SAND, little fine to coarse subrounded to rounded gravel, trace silt, moist (FILL?)	GW	14.8m / 5.6m

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SAMPLES

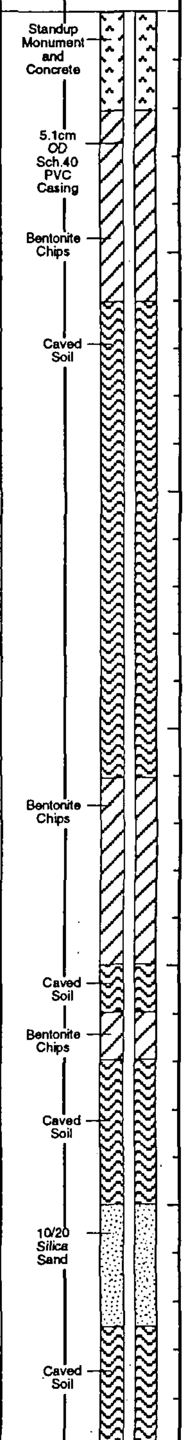
BLOWS / 15.2cm — 63.5kg hammer, 70.2cm drop

NUMBER	TYPE	BLOWS / 15.2cm	N	REC/ATT
1	SS	1-2-2	4	18.3cm/45.8cm
2	SS	2-2-1	3	18.3cm/45.8cm
3	SS	14-19-20	39	24.4cm/45.8cm
4	SS	6-4-5	9	3.1cm/45.8cm
5	SS	8-7-6	13	12.2cm/45.8cm

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT Wp — W — Wl

PIEZOMETER GRAPHIC / WATER LEVEL



DRILL RIG: ' 2500

DRILLING CONTRACTOR: Crux

DRILLER: Scott Tunison

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000254

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-14

DATUM: MSL

PROJECT NUMBER: 993 1466.300 **BORING LOCATION:** Highway 101 at MP 322 **BORING DATE:** 9/20-21/99

DEPTH METERS	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer		GW		11.1m /							Caved Soil
		Compact, light olive brown, stratified, jointed, SILT, moist (OLDER SLIDE DEBRIS)	ML		9.3m	6	SS	9-9-11	20	12.2cm/45.8cm		5.1cm OD Sch.40 PVC Casing
10		Very stiff to hard, light olive brown, laminated to massive, SILTY CLAY with CLAY interbeds to 2.5cm thick, moist to wet at 10.7m becoming moist below, iron oxide stained joints observed, appears fractured above approximately 10.8m (OLDER SLIDE DEBRIS)	CL-CH		10.7m / 9.8m							10/20 Silica Sand; 5.1cm OD Sch.40 PVC 2.54mm Slot Screen
11						7	SS	7-11-18	29	45.8cm/45.8cm		Caved Soil
12												10/20 Silica Sand
					7.9m	8	SS	6-11-22	33	45.8cm/45.8cm		Caved Soil
13		Hard, light olive gray to light bluish gray, laminated to massive, SILTY CLAY with interbeds of CLAY, damp to moist (GLACIOLACUSTRINE DEPOSIT)	CH		12.5m							Bentonite Chips
14						9	SS	10-22-37	59	45.8cm/45.8cm		
15						10	SS	10-16-27	43	45.8cm/45.8cm		
16												Caved Soil
17						11	SS	11-20-40	60	45.8cm/45.8cm		
18												

Log continued on next page

DRILL RIG: 2500 **LOGGED:** F. Mocker

DRILLING CONTRACTOR: Crux **CHECKED:**

DRILLER: Scott Tunison **DATE:** 2/7/2000

DOT-50000255

Golder Associates

PROJECT: WSDOT/MP322/WA

RECORD OF BOREHOLE GA-14

SHEET 3 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1466.300

BORING LOCATION: Highway 101 at MP 322

BORING DATE: 9/20-21/99

DEPTH METERS	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 15.2cm (63.5kg hammer 70.2cm drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
	HWT Casing Advancer	Hard, light olive gray to light bluish gray, laminated to massive, SILTY CLAY with interbeds of CLAY, damp to moist (GLACIOLACUSTRINE DEPOSIT)	CH		1.7m	12	SS	12-19-30	49	45.8cm/45.8cm	■	Sample Hole
		Total depth 18.8m bgs (sampled)			18.8m							
19		NOTE: Caved soil in screened interval is likely sand and gravel from above 9.2m or from top of hole.										
20												
21												
22												
23												
24												
25												
26												
27												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Scott Tunison

LOGGED: F. Mocker

CHECKED:

DATE: 2/7/2000

DOT-50000256

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA
PROJECT NO: 993 1466.300
LOCATION: Approximately 51.9m west of H-1-99

DRILLING DATE: 11/9-18/99
DRILL RIG: AP1000
ADDITIVES: NA

DATUM: MSL
COORDINATES N: 806275
AZIMUTH: NA

COLLAR ELEV: ~96.1m
E: 1008470
INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH 96.1m	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
0	Brown(7.5YR 4/4), fine to coarse SAND, some fine to coarse rounded gravel, little silt to clayey silt, varies to GRAVEL, some fine to coarse sand, little to some silt, slight iron oxide staining, moist (GLACIOFLUVIAL DEPOSIT)		1	G	0.0m	21.9cm / 20.3cm ID / 16.8cm Becker Hammer Bit	Moist	1230	NOTE: Becker Drill AP1000 hit refusal at 33.6m bgs. 20.3cm casing broke in hole. Great West fished casing out. Offset ~5.2m to north and drilled with Barber DR 24 owned by Tacoma Pump & Drill down to 33.6m before continuing with soil descriptions.	Surface Seal (Bentonite Chips)
2			2	G					0-6.1m: Drilled 30.5cm boring, set surface seal with 13 bags bentonite	
	Brown (7.5YR 4/4), fine to coarse subrounded to rounded GRAVEL, trace cobbles, some fine to coarse sand, trace to little silt, slight iron oxide, moist. Driller indicates dense soils (hard drilling) (GLACIOFLUVIAL DEPOSIT)				93.6m / 2.4m					20.3cm ID Steel Casing
4			3	G						
5	5.3m: Becomes brown (7.5YR 4/2)		4	G				1420 1514		
7			5	G						
8			6	G						
9	Brown (7.5YR 4/3), fine to coarse SAND, some subrounded to rounded fine to coarse gravel, trace silt, varies to SAND and GRAVEL, trace silt, moist (GLACIOFLUVIAL DEPOSIT)		7	G	86.9m / 9.2m					
11			8	G					11/9/99 / 11/10/99	
12	Dense to very dense, brown (7.5YR 4/3), stratified?, fine to coarse SAND and fine to coarse subrounded to rounded GRAVEL, trace silt, moist (lots of rock fragments suggest gravel content may be higher) (GLACIOFLUVIAL DEPOSIT)		9	G	83.9m / 12.2m			0843 15.3c m/min		
14	13.7m: Varies to brown (7.5YR 4/3), fine to coarse SAND, some fine to coarse subrounded to rounded gravel, trace silt, moist		10	G				0855 0957	1 hour to add casing	
15										

Log continued on next page

DOT-50000257

SCALE: NTS
DRILLING CONTRACTOR: Great West Drilling
DRILLER: Jim Benson

LOGGED: F.S. Mocker
CHECKED:
DATE: 2/7/2000

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA
PROJECT NO: 993 1466.300
LOCATION: Approximately 51.9m west of H-1-99

DRILLING DATE: 11/9-18/99
DRILL RIG: AP1000
ADDITIVES: NA

DATUM: MSL
COORDINATES N: 806275
AZIMUTH: NA

COLLAR ELEV: ~96.1m
E: 1008470
INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
16	Dense to very dense, brown (7.5YR 4/3), stratified?, fine to coarse SAND and fine to coarse subrounded to rounded GRAVEL, trace silt, moist (lots of rock fragments suggest gravel content may be higher) (GLACIOFLUVIAL DEPOSIT)		11	G			Moist	21.4 cm/min		
17	Dense to very dense, brown (10YR 5/3), crudely stratified, fine to coarse SAND, little to some fine to coarse subrounded to rounded gravel, trace silt, varies to SAND and GRAVEL, trace silt, moist, sand component appears to be mostly fine to medium grained, gravel component is also generally finer (GLACIOFLUVIAL DEPOSIT)		12	G	79.3m 16.8m			1012 1114	1 hour to add casing	
18			13	G				>15.3 cm/min		20.3cm ID Steel Casing
19										
20	19.8m-21.4m: Mostly SAND and GRAVEL, varying to sandy fine to coarse subrounded to rounded GRAVEL, trace silt, moist		14	G				1134		
21										
22			15	G		21.9cm / 20.3cm ID / 16.8cm Becker Hammer Bit				
23	23.2m-26.2m: May contain interbeds of sandy SILT to silty SAND as suggested by cuttings		16	G				1357		
24								24.4 cm/min		
25			17	G						
26			18	G				1409 1506		
27								9.2 cm/min		
28	Driller noted harder drilling. Dense to very dense, light olive brown (2.5Y 5/3), sandy fine to coarse subrounded to rounded GRAVEL, trace to little silt, trace rounded cobbles, damp to moist (TILL?)		19	G	67.7m 28.4m		Damp			
29	Varies to fine to coarse SAND and fine to coarse subrounded to rounded GRAVEL, trace to little silt, damp							1535 1638	Advanced 5.2m off-set boring from 0 - 29.3m bgs with Barber DR24 Drill on 11/16/99	
30			20	G					~340 Becker Hammer blows for 3.1m	

Log continued on next page

DOT-50000258

SCALE: NTS
DRILLING CONTRACTOR: Great West Drilling
DRILLER: Jim Benson

LOGGED: F.S. Mocker
CHECKED:
DATE: 2/7/2000

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA
PROJECT NO: 993 1466.300
LOCATION: Approximately 51.9m west of H-1-99

DRILLING DATE: 11/9-18/99
DRILL RIG: AP1000/Barber DR 24
ADDITIVES: NA

DATUM: MSL
COORDINATES N: 806275
AZIMUTH: NA

COLLAR ELEV: -96.1m
E: 1008470
INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
	Driller noted harder drilling. Dense to very dense, light olive brown (2.5Y 5/3), sandy fine to coarse subrounded to rounded GRAVEL, trace to little silt, trace rounded cobbles, *damp to moist (TILL?)*					16.8cm Becker Hammer Bit	Moist	9.2 cm/min		
31			21	G						
					64.1m 32.0m					
32	Dense to very dense, light olive brown (2.5Y 5/3), fine to coarse SAND, little to some fine to coarse subrounded to rounded gravel, trace silt, moist (GLACIOFLUVIAL DEPOSIT)						Moist	1714 0904	11/10/99 11/17/99	
	Note: Description of soil may be skewed towards sand due to drilling process. Grab samples are collected from discharge during drilling. Mostly sand is discharged during drilling. Gravels are flushed out of boring at end of 6.1m drill run.		22	G						
33								42.7 cm/min	@33.6m Casing broke Great West fished out casing. Tacoma Pump and Drill on site with Barber drill to advance new hole offset ~5.2m to North of Great West boring.	20.3cm ID Steel Casing
34			23	G		21.9cm / 20.3cm ID / 19.4cm Tricone Button Bit				
35								0911 0954		
			24	G						
36										
37			25	G						
38								51.9 cm/min		
			26	G						
39										
40			27	G						
41								1006 1044		
42			No Sample Collected							
	@~42.7m: Sand fraction appears to be finer (fine to medium grained)									
43			28	G						
44	@~44.2m: Driller noted drill action suggests larger gravels							76.3 cm/min		
45			29	G						

Log continued on next page

DOT-50000259

SCALE: NTS
DRILLING CONTRACTOR: Great West Drilling/Tacoma Pump and Drill
DRILLER: Jim Benson/Mark Weise

LOGGED: F.S. Mocker
CHECKED:
DATE: 2/7/2000

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA
PROJECT NO: 993 1466.300
LOCATION: Approximately 51.9m west of H-1-99

DRILLING DATE: 11/9-18/99
DRILL RIG: Barber DR 24
ADDITIVES: NA

DATUM: MSL
COORDINATES N: 806275
AZIMUTH: NA

COLLAR ELEV: ~96.1m
E: 1008470
INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
46	Dense to very dense, light olive brown (2.5Y 5/3), fine to coarse SAND, little to some fine to coarse subrounded to rounded grave, trace silt, moist (GLACIOFLUVIAL DEPOSIT)		30	G			Moist	76.3 cm/min		
47	@ 47.3m-53.4m: Gravel content appears to increase, may contain fine to medium SAND interbeds							1052 1130		
48			31	G						20.3cm ID Steel Casing
49			32	G				61.0 cm/min		
50										
51			33	G						
52			34	G						
53						21.9cm / 20.3cm ID / 19.4cm Tricone Button Bit		1140 1218		
54			No Sample Collected							
55			35	G				61.0 cm/min		
56										K-Packer
57			36	G						Bottom of 20.3cm casing shoe
58							Wet		58.0m logs 11/22/99 pre-installation	Screen Assembly; 2 mm Slot
59			37	G	36.6m					
60	Dense to very dense, olive brown (2.5Y 4/3) fine to medium SAND and fine rounded GRAVEL, varies to fine GRAVEL, some fine to medium sand, trace silt, wet (GLACIOFLUVIAL DEPOSIT)		No Sample Collected		59.5m			1228 1256	59.5m-65.6m: Began injecting water to help cuttings out of hole	2 mm Slot

Log continued on next page

SCALE: NTS
DRILLING CONTRACTOR: Tacoma Pump and Drill
DRILLER: Mark Weise

LOGGED: F.S. Mocker
CHECKED:
DATE: 2/7/2000

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA	DRILLING DATE: 11/9-18/99	DATUM: MSL	COLLAR ELEV: ~96.1m
PROJECT NO: 993 1466.300	DRILL RIG: Barber DR 24	COORDINATES N: 806275	E: 1008470
LOCATION: Approximately 51.9m west of H-1-99	ADDITIVES: NA	AZIMUTH: NA	INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
61	Dense to very dense, olive brown (2.5Y 4/3) fine to medium SAND and fine rounded GRAVEL, some fine to medium sand, trace silt					Wet			
62		38	G			▽	@1341	WL ATD 61.9m and rising after letting sit ~25 minutes	Screen Assembly; 1 mm Slot
							61.0 cm/min		
63		39	G						
				(32.3m) 63.7m					
64	Dense, to very dense and hard, light brownish gray (2.5Y 6/2), interbedded, fine SAND, trace silt and SILT ranging to CLAYEY SILT, wet (TRANSITION BEDS)								0.4 mm Slot
65		40	G			Air lifted ~0.25 gpm	1306 1402		
66		No Sample Collected						65.6m-68.6m: No sample recovery, likely fine SAND with SILT interbeds as in G#40.	Sump
67								65.6m-71.7m: Injected water	
68		No Sample Collected					33.6 cm/min	68.0m-68.6m: Driller noted harder drilling, CLAY cuttings begin appearing (Qgl)	0.5 mm Slot
				(27.5m) 68.6m	~21.9cm / ~20.3cm ID / 19.4cm Tricone Button Bit				
69	Hard, dark greenish gray (1G 4/1), laminated to massive SILTY CLAY to CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	41	G			Moist			
70									Gravel Backfill
71		42	G				1420 1534		
72		43	G					72.6m-75.0m: 6 bags bentonite	
73							67.1 cm/min		Bentonite Chips
74		44	G						
75		45	G					75.0m-82.4m: Gravel backfill	Gravel Backfill
76									

Log continued on next page

SCALE: NTS	LOGGED: F.S. Mocker
DRILLING CONTRACTOR: Tacoma Pump and Drill	CHECKED:
DRILLER: Mark Weise	DATE: 2/7/2000

DOT-50000261

Golder Associates

RECORD OF DRILLHOLE GA-15

PROJECT: WSDOT/MP322/WA
PROJECT NO: 993 1466.300
LOCATION: Approximately 51.9m west of H-1-99

DRILLING DATE: 11/9-18/99
DRILL RIG: Barber DR 24
ADDITIVES: NA

DATUM: MSL
COORDINATES N: 806275
AZIMUTH: NA

COLLAR ELEV: ~96.1m
E: 1008470
INCLINATION: -90°

DEPTH SCALE (METERS)	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	(ELEVATION) DEPTH	HOLE DIAMETER/ CASING DIAMETER/ BIT TYPE	MOISTURE WATER LEVELS YIELD (GPM)	TIME/ RATE OF ADVANCE	NOTES DRILLING METHOD INSTRUMENTATION	WELL COMPLETION
	Hard, dark greenish gray (1G 4/1), laminated to massive SILTY CLAY to CLAY, moist (GLACIOLACUSTRINE DEPOSIT)				~21.9cm; 20.3cm ID; 19.4cm Tricone Button Bit	Moist	67.1 cm/min		Gravel Backfill
77		46	G						
78		No Sample Collected					1543 1633		
80		47	G				54.9 cm/min		
81		48	G						
82								82.4m-85.4m: 8 bags holeplug bentonite chips	Bentonite Chips
83		49	G						
84		50	G				1644 0840		
85								85.4m-90.6m: Caved soil during well installation 20.3cm CSG @ 71.1m	Caved Soil
86		51	G						
87		52	G				67.1 cm/min		
89	Very dense, sandy fine to coarse GRAVEL with CLAY interbeds below approx. 90.0m (GLACIOFLUVIAL DRIFT)	53	G	7.0m 89.1m		~0.25 gpm			
90				5.5m			0850		
91	Total Depth 90.6m bgs			90.6m					

DOT-50000262

SCALE: NTS
DRILLING CONTRACTOR: Tacoma Pump and Drill
DRILLER: Mark Weise

LOGGED: F.S. Mocker
CHECKED:
DATE: 2/7/2000

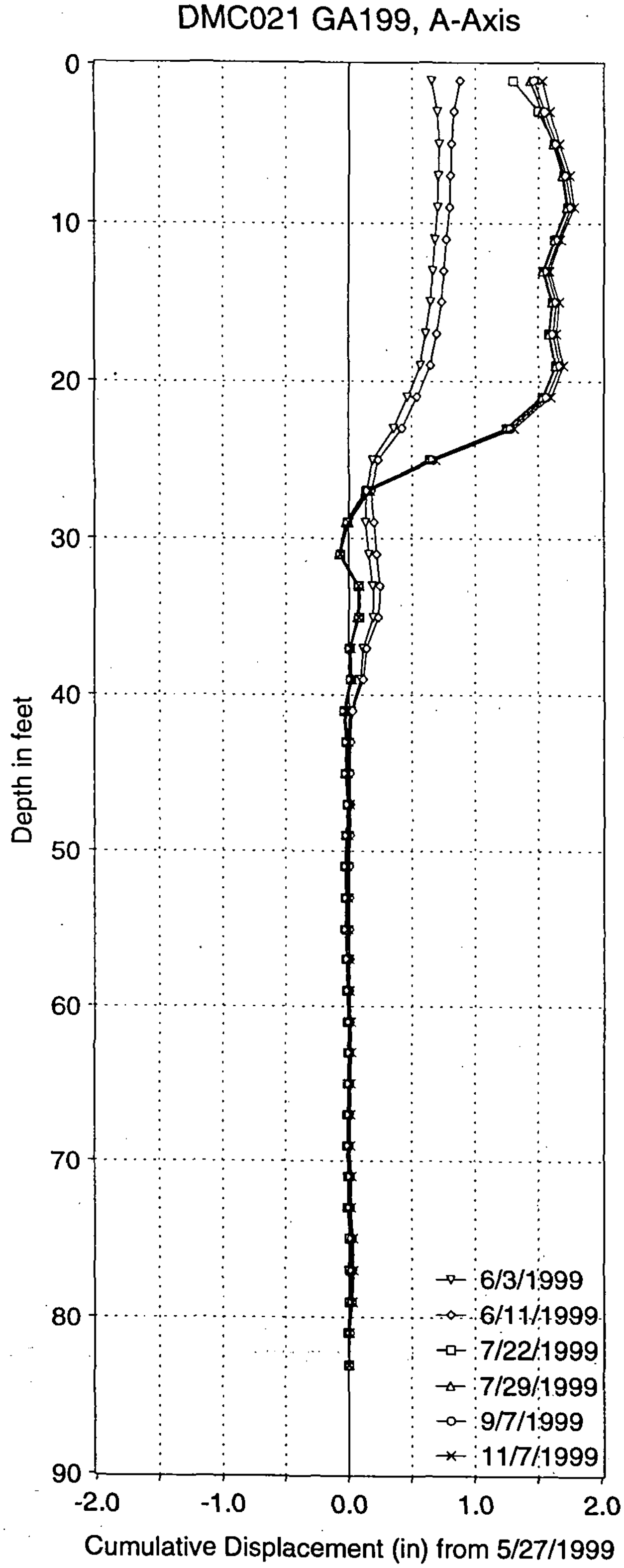
Golder Associates

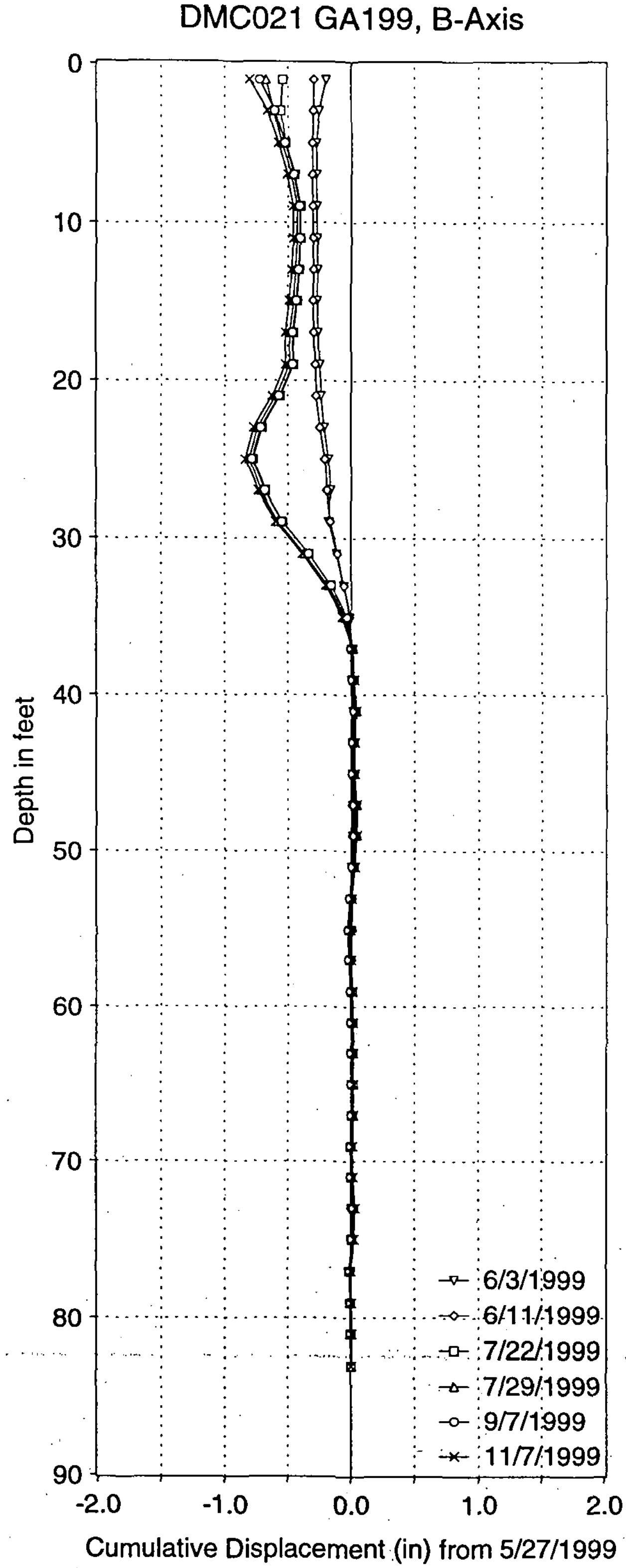
APPENDIX B

INCLINOMETER DATA

Note: Depth and displacement on the output sheets are in S.I. units

DOT-50000263





WSDOT	XL-0749 SR 101
MATERIALS LAB	MP 322 SLIDE
GEOTECH SECTION	A+ = N132 deg.
OLYMPIA, WA	GA1-99

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA199
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	7
SENSOR #	26087	26087
DATE	05/27/99 11:59	11/07/99 08:14
READINGS PER DIRECTION	41	41

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-253	235	-488	-299	287	-586	-98	1.5330
4.000	-210	191	-401	-266	258	-524	-123	1.5918
6.000	-41	27	-68	-103	104	-207	-139	1.6656
8.000	75	-87	162	53	-53	106	-56	1.7490
10.000	134	-147	281	229	-230	459	178	1.7826
12.000	233	-246	479	314	-313	627	148	1.6758
14.000	278	-293	571	215	-219	434	-137	1.5870
16.000	173	-187	360	197	-199	396	36	1.6692
18.000	155	-169	324	119	-120	239	-85	1.6476
20.000	116	-130	246	206	-208	414	168	1.6986
22.000	-19	9	-28	224	-225	449	477	1.5978
24.000	31	-47	78	557	-558	1115	1037	1.3116
26.000	66	-87	153	514	-516	1030	877	0.6894
28.000	59	-58	117	191	-199	390	273	0.1632
30.000	11	-26	37	74	-72	146	109	-0.0006
32.000	41	-54	95	-72	70	-142	-237	-0.0660
34.000	121	-131	252	111	-141	252	0	0.0762
36.000	98	-134	232	177	-157	334	102	0.0762
38.000	75	-89	164	74	-73	147	-17	0.0150
40.000	40	-53	93	93	-91	184	91	0.0252
42.000	4	-17	21	-11	9	-20	-41	-0.0294
44.000	-17	2	-19	-6	5	-11	8	-0.0048
46.000	-80	67	-147	-87	89	-176	-29	-0.0096
48.000	-43	29	-72	-27	25	-52	20	0.0078
50.000	39	-53	92	52	-53	105	13	-0.0042
52.000	65	-79	144	67	-69	136	-8	-0.0120
54.000	65	-79	144	73	-75	148	4	-0.0072
56.000	61	-74	135	58	-57	115	-20	-0.0096
58.000	48	-60	108	52	-53	105	-3	0.0024
60.000	17	-29	46	15	-14	29	-17	0.0042
62.000	-23	9	-32	-22	23	-45	-13	0.0144
64.000	-34	22	-56	-25	23	-48	8	0.0222
66.000	-9	-3	-6	-2	2	-4	2	0.0174
68.000	22	-35	57	31	-31	62	5	0.0162
70.000	2	-14	16	1	2	-1	-17	0.0132
72.000	-10	-2	-8	1	-1	2	10	0.0234
74.000	-26	13	-39	-31	32	-63	-24	0.0174
76.000	-111	98	-209	-111	111	-222	-13	0.0318
78.000	-78	66	-144	-58	66	-124	20	0.0396
80.000	-22	9	-31	10	5	5	36	0.0276
82.000	11	-23	34	29	-15	44	10	0.0060

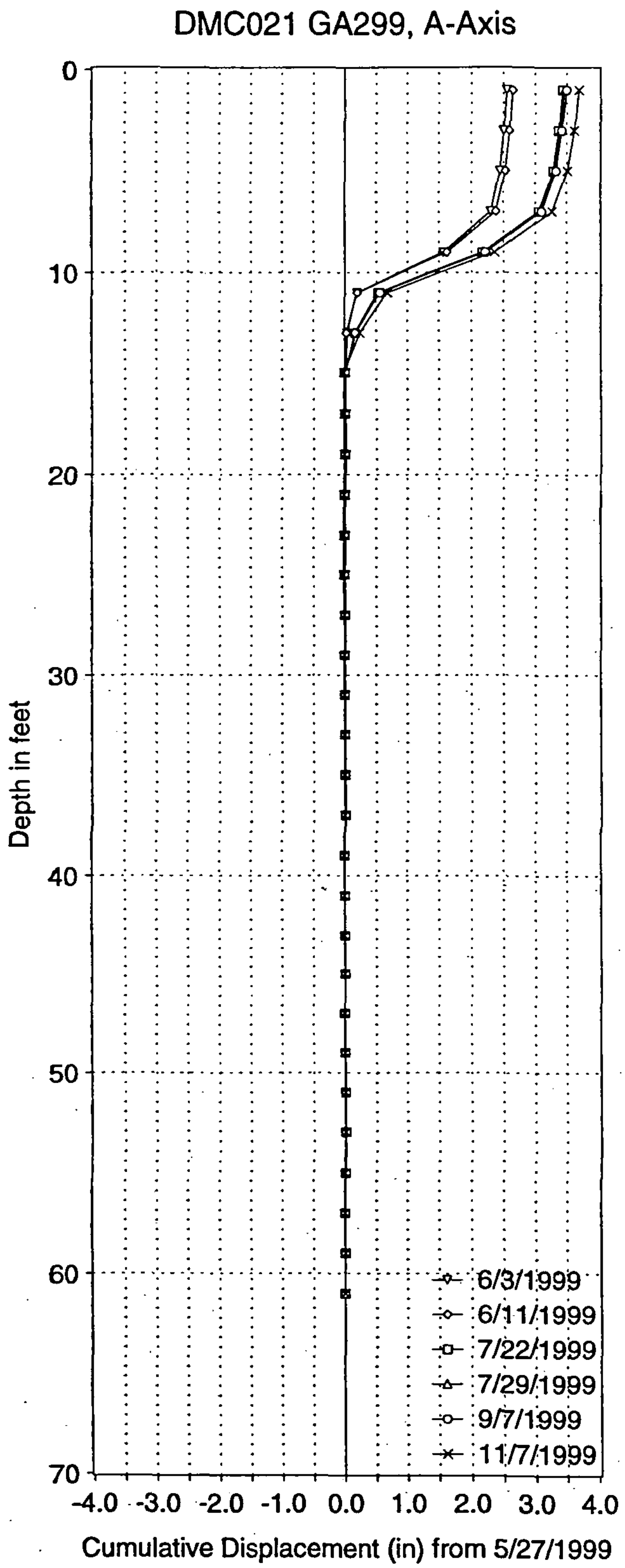
END OF RECORDS

SENSOR: 26087

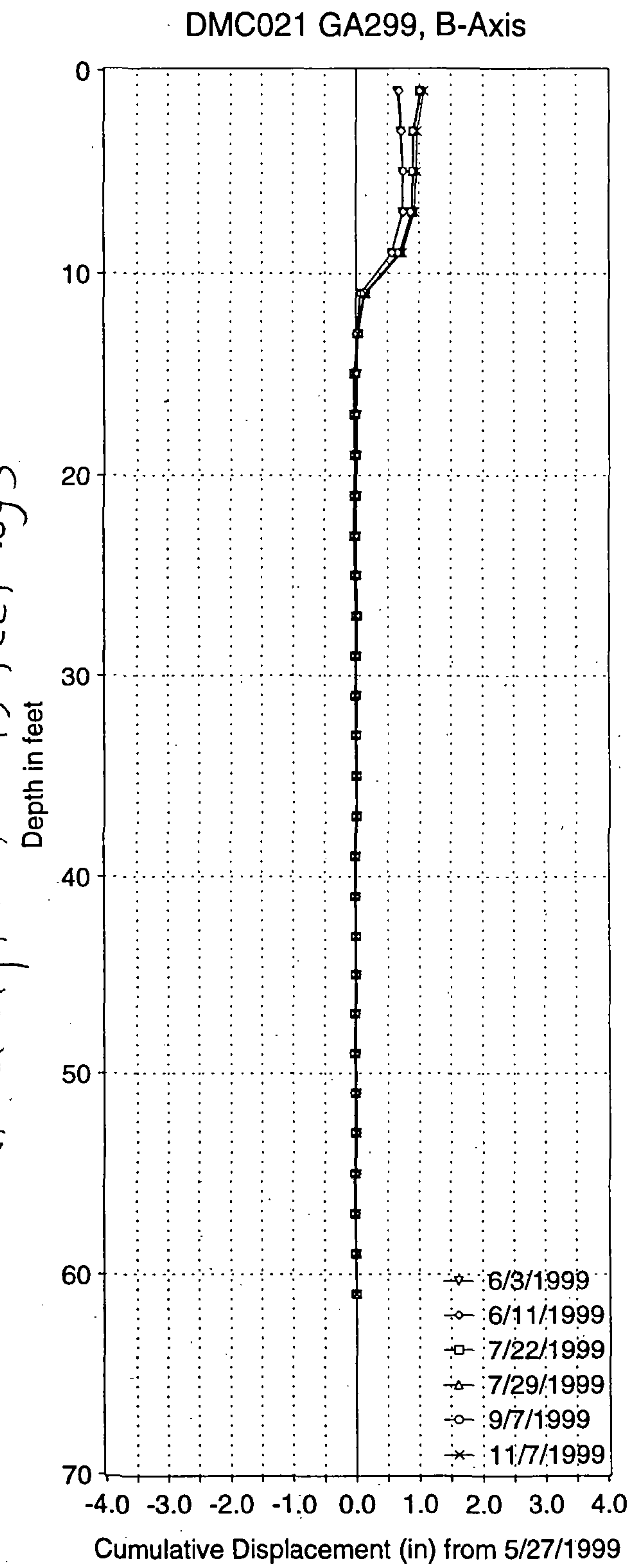
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	443	-472	915	329	-352	681	-234	-0.8010
4.000	332	-363	695	266	-293	559	-136	-0.6606
6.000	119	-142	261	52	-87	139	-122	-0.5790
8.000	17	-70	87	-17	-26	9	-78	-0.5058
10.000	42	-92	134	38	-95	133	-1	-0.4590
12.000	55	-103	158	63	-118	181	23	-0.4584
14.000	41	-91	132	55	-101	156	24	-0.4722
16.000	28	-63	91	49	-91	140	49	-0.4866
18.000	-20	-29	9	-12	-32	20	11	-0.5160
20.000	-11	-37	26	74	-120	194	168	-0.5226
22.000	-23	-6	-17	89	-136	225	242	-0.6234
24.000	-66	35	-101	-10	-21	11	112	-0.7686
26.000	23	-54	77	-67	21	-88	-165	-0.8358
28.000	128	-155	283	7	-39	46	-237	-0.7368
30.000	189	-235	424	14	-57	71	-353	-0.5946
32.000	143	-184	327	-20	-48	28	-299	-0.3828
34.000	97	-140	237	-59	-71	12	-225	-0.2034
36.000	-23	-70	47	-31	57	-88	-135	-0.0684
38.000	10	-58	68	-2	-46	44	-24	0.0126
40.000	42	-91	133	35	-75	110	-23	0.0270
42.000	78	-127	205	83	-134	217	12	0.0408
44.000	113	-158	271	119	-156	275	4	0.0336
46.000	111	-129	240	94	-122	216	-24	0.0312
48.000	47	-96	143	44	-96	140	-3	0.0456
50.000	58	-104	162	77	-114	191	29	0.0474
52.000	122	-169	291	147	-184	331	40	0.0300
54.000	179	-223	402	194	-233	427	25	0.0060
56.000	224	-261	485	217	-254	471	-14	-0.0090
58.000	188	-235	423	179	-226	405	-18	-0.0006
60.000	150	-196	346	144	-198	342	-4	0.0102
62.000	135	-183	318	126	-180	306	-12	0.0126
64.000	122	-171	293	117	-174	291	-2	0.0198
66.000	121	-168	289	119	-170	289	0	0.0210
68.000	149	-201	350	156	-210	366	16	0.0210
70.000	184	-233	417	186	-226	412	-5	0.0114
72.000	171	-209	380	158	-190	348	-32	0.0144
74.000	115	-154	269	126	-163	289	20	0.0336
76.000	205	-238	443	222	-257	479	36	0.0216
78.000	200	-241	441	198	-239	437	-4	0.0000
80.000	235	-281	516	238	-273	511	-5	0.0024
82.000	220	-223	443	227	-225	452	9	0.0054

END OF RECORDS

DOT-50000266



Note: Casing closed off on 11/12/99 at a depth of ~15 feet bgs



WSDOT	XL-0749 SR 101
MATERIALS LAB	MP 322 SLIDE
GEOTECH SECTION	A+ = N112 deg.
OLYMPIA, WA	GA2-99

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA299
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	7
SENSOR #	26087	26087
DATE	05/27/99 13:32	11/07/99 07:55
READINGS PER DIRECTION	30	30

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-263	243	-506	-198	191	-389	117	3.6936
4.000	-225	208	-433	-121	118	-239	194	3.6234
6.000	-130	112	-242	81	-86	167	409	3.5070
8.000	-46	29	-75	717	-717	1434	1509	3.2616
10.000	56	-70	126	1463	-1476	2939	2813	2.3562
12.000	2	-17	19	366	-370	736	717	0.6684
14.000	-68	54	-122	147	-151	298	420	0.2382
16.000	-123	107	-230	-116	113	-229	1	-0.0138
18.000	-115	99	-214	-107	103	-210	4	-0.0144
20.000	-83	67	-150	-78	73	-151	-1	-0.0168
22.000	-189	177	-366	-185	186	-371	-5	-0.0162
24.000	-116	98	-214	-105	100	-205	9	-0.0132
26.000	-107	93	-200	-109	105	-214	-14	-0.0186
28.000	-221	204	-425	-218	212	-430	-5	-0.0102
30.000	-228	212	-440	-223	218	-441	-1	-0.0072
32.000	-217	202	-419	-209	210	-419	0	-0.0066
34.000	-272	257	-529	-268	265	-533	-4	-0.0066
36.000	-265	249	-514	-260	254	-514	0	-0.0042
38.000	-230	214	-444	-224	217	-441	3	-0.0042
40.000	-242	227	-469	-240	233	-473	-4	-0.0060
42.000	-274	261	-535	-268	266	-534	1	-0.0036
44.000	-251	237	-488	-247	245	-492	-4	-0.0042
46.000	-238	223	-461	-233	227	-460	1	-0.0018
48.000	-275	262	-537	-271	267	-538	-1	-0.0024
50.000	-260	244	-504	-259	254	-513	-9	-0.0018
52.000	-428	417	-845	-425	422	-847	-2	0.0036
54.000	-298	284	-582	-291	287	-578	4	0.0048
56.000	-154	141	-295	-149	143	-292	3	0.0024
58.000	-113	97	-210	-109	105	-214	-4	0.0006
60.000	-80	63	-143	-72	66	-138	5	0.0030

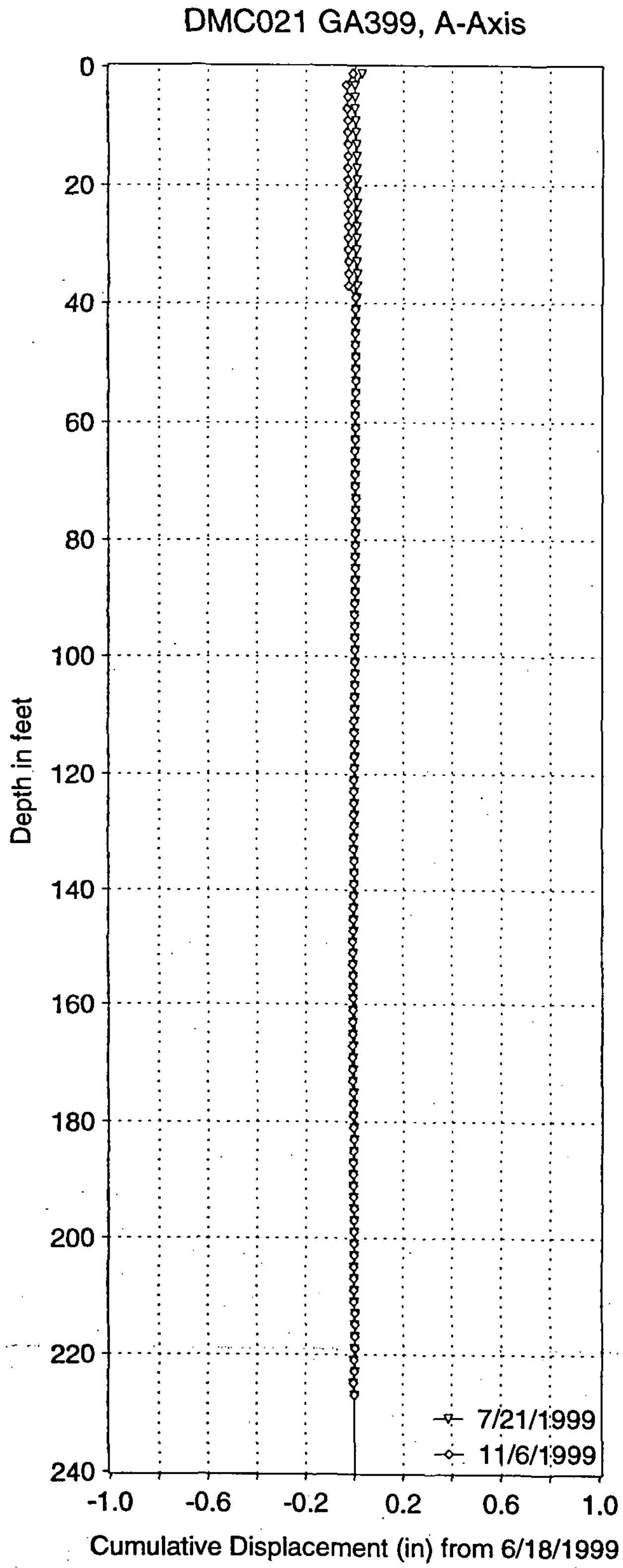
END OF RECORDS

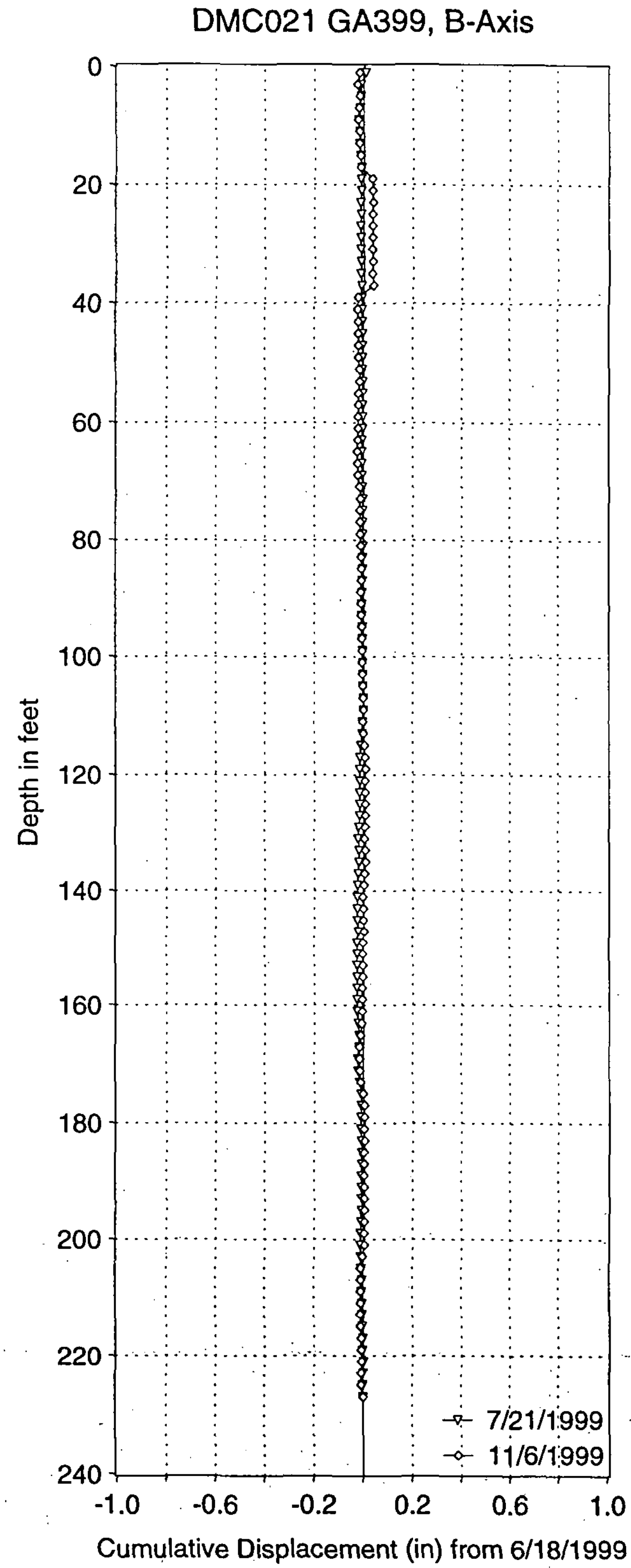
SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	319	-350	669	404	-431	835	166	1.0626
4.000	259	-289	548	270	-304	574	26	0.9630
6.000	151	-193	344	174	-203	377	33	0.9474
8.000	110	-157	267	287	-319	606	339	0.9276
10.000	111	-159	270	634	-598	1232	962	0.7242
12.000	146	-163	309	235	-259	494	185	0.1470
14.000	105	-134	239	169	-198	367	128	0.0360
16.000	59	-94	153	57	-94	151	-2	-0.0408
18.000	23	-56	79	18	-55	73	-6	-0.0396
20.000	-41	5	-46	-47	9	-56	-10	-0.0360
22.000	18	-34	52	18	-41	59	7	-0.0300
24.000	31	-71	102	24	-59	83	-19	-0.0342
26.000	-29	-16	-13	-36	-13	-23	-10	-0.0228
28.000	-59	13	-72	-65	11	-76	-4	-0.0168
30.000	-51	5	-56	-53	0	-53	3	-0.0144
32.000	-34	-5	-29	-39	2	-41	-12	-0.0162
34.000	-85	45	-130	-91	46	-137	-7	-0.0090
36.000	-83	54	-137	-88	47	-135	2	-0.0048
38.000	47	-75	122	45	-85	130	8	-0.0060
40.000	131	-166	297	137	-169	306	9	-0.0108
42.000	50	-54	104	38	-54	92	-12	-0.0162
44.000	-73	31	-104	-71	29	-100	4	-0.0090
46.000	-4	-30	26	-7	-38	31	5	-0.0114
48.000	-8	-35	27	-5	-39	34	7	-0.0144
50.000	13	-46	59	6	-49	55	-4	-0.0186
52.000	-84	75	-159	-89	76	-165	-6	-0.0162
54.000	-112	83	-195	-114	79	-193	2	-0.0126
56.000	-53	8	-61	-57	13	-70	-9	-0.0138
58.000	-74	31	-105	-80	39	-119	-14	-0.0084
60.000	-107	93	-200	-107	93	-200	0	0.0000

END OF RECORDS

DOT-50000269





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

XL-0749 SR 101
MP 322 SLIDE
GA3-99 A+ = N134 deg.

DOT-50000270

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA399
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	3
SENSOR #	26087	26087
DATE	06/18/99 07:39	11/06/99 10:10
READINGS PER DIRECTION	113	113

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		N.
2.000	201	-228	429	233	-240	473	44	-0.0768
4.000	0	7	-7	-9	9	-18	-11	-0.1032
6.000	-474	481	-955	-475	475	-950	5	-0.0966
8.000	-455	464	-919	-463	463	-926	-7	-0.0996
10.000	-408	414	-822	-411	411	-822	0	-0.0954
12.000	-326	334	-660	-330	331	-661	-1	-0.0954
14.000	-227	233	-460	-230	230	-460	0	-0.0948
16.000	-234	240	-474	-236	237	-473	1	-0.0948
18.000	-171	233	-404	-180	230	-410	-6	-0.0954
20.000	-155	162	-317	-160	159	-319	-2	-0.0918
22.000	-186	191	-377	-190	189	-379	-2	-0.0906
24.000	-195	202	-397	-199	199	-398	-1	-0.0894
26.000	-190	200	-390	-194	198	-392	-2	-0.0888
28.000	-194	201	-395	-197	197	-394	1	-0.0876
30.000	-205	210	-415	-209	207	-416	-1	-0.0882
32.000	-246	254	-500	-250	251	-501	-1	-0.0876
34.000	-235	241	-476	-239	238	-477	-1	-0.0870
36.000	-335	344	-679	-341	342	-683	-4	-0.0864
38.000	-333	391	-724	-387	387	-774	-50	-0.0840
40.000	-439	441	-880	-445	438	-883	-3	-0.0540
42.000	-416	417	-833	-422	411	-833	0	-0.0522
44.000	-389	395	-784	-393	392	-785	-1	-0.0522
46.000	-465	471	-936	-469	468	-937	-1	-0.0516
48.000	-482	492	-974	-489	489	-978	-4	-0.0510
50.000	-466	475	-941	-470	470	-940	1	-0.0486
52.000	-450	458	-908	-454	454	-908	0	-0.0492
54.000	-409	415	-824	-413	412	-825	-1	-0.0492
56.000	-389	398	-787	-394	394	-788	-1	-0.0486
58.000	-421	427	-848	-425	422	-847	1	-0.0480
60.000	-427	439	-866	-435	435	-870	-4	-0.0486
62.000	-501	509	-1010	-505	505	-1010	0	-0.0462
64.000	-449	456	-905	-452	450	-902	3	-0.0462
66.000	-363	373	-736	-369	369	-738	-2	-0.0480
68.000	-299	308	-607	-304	303	-607	0	-0.0468
70.000	-295	306	-601	-301	303	-604	-3	-0.0468
72.000	-338	347	-685	-344	343	-687	-2	-0.0450
74.000	-360	367	-727	-365	364	-729	-2	-0.0438
76.000	-430	441	-871	-434	437	-871	0	-0.0426
78.000	-449	453	-902	-453	449	-902	0	-0.0426
80.000	-397	410	-807	-401	407	-808	-1	-0.0426
82.000	-467	478	-945	-471	473	-944	1	-0.0420
84.000	-438	449	-887	-444	445	-889	-2	-0.0426
86.000	-368	376	-744	-372	371	-743	1	-0.0414
88.000	-428	439	-867	-432	435	-867	0	-0.0420
90.000	-446	459	-905	-450	455	-905	0	-0.0420

DOT-50000271

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		N.
92.000	-424	434	-858	-428	430	-858	0	-0.0420
94.000	-445	453	-898	-450	449	-899	-1	-0.0420
96.000	-429	438	-867	-433	435	-868	-1	-0.0414
98.000	-377	386	-763	-382	382	-764	-1	-0.0408
100.000	-388	401	-789	-393	398	-791	-2	-0.0402
102.000	-453	465	-918	-457	461	-918	0	-0.0390
104.000	-509	520	-1029	-514	517	-1031	-2	-0.0390
106.000	-558	567	-1125	-561	563	-1124	1	-0.0378
108.000	-509	518	-1027	-514	514	-1028	-1	-0.0384
110.000	-477	487	-964	-481	484	-965	-1	-0.0378
112.000	-490	500	-990	-494	497	-991	-1	-0.0372
114.000	-477	486	-963	-480	483	-963	0	-0.0366
116.000	-515	525	-1040	-519	521	-1040	0	-0.0366
118.000	-488	501	-989	-491	498	-989	0	-0.0366
120.000	-473	481	-954	-476	478	-954	0	-0.0366
122.000	-475	486	-961	-479	483	-962	-1	-0.0366
124.000	-485	497	-982	-489	493	-982	0	-0.0360
126.000	-519	530	-1049	-523	526	-1049	0	-0.0360
128.000	-549	559	-1108	-554	558	-1112	-4	-0.0360
130.000	-536	555	-1091	-540	552	-1092	-1	-0.0336
132.000	-497	506	-1003	-501	502	-1003	0	-0.0330
134.000	-437	443	-880	-442	440	-882	-2	-0.0330
136.000	-410	426	-836	-414	423	-837	-1	-0.0318
138.000	-436	445	-881	-439	442	-881	0	-0.0312
140.000	-498	513	-1011	-502	507	-1009	2	-0.0312
142.000	-517	531	-1048	-521	526	-1047	1	-0.0324
144.000	-495	502	-997	-498	499	-997	0	-0.0330
146.000	-528	544	-1072	-533	542	-1075	-3	-0.0330
148.000	-531	542	-1073	-536	538	-1074	-1	-0.0312
150.000	-615	628	-1243	-621	625	-1246	-3	-0.0306
152.000	-523	532	-1055	-526	528	-1054	1	-0.0288
154.000	-509	524	-1033	-513	521	-1034	-1	-0.0294
156.000	-551	557	-1108	-555	553	-1108	0	-0.0288
158.000	-537	554	-1091	-542	551	-1093	-2	-0.0288
160.000	-554	569	-1123	-557	565	-1122	1	-0.0276
162.000	-554	565	-1119	-558	560	-1118	1	-0.0282
164.000	-549	562	-1111	-554	559	-1113	-2	-0.0288
166.000	-601	615	-1216	-607	612	-1219	-3	-0.0276
168.000	-655	667	-1322	-659	664	-1323	-1	-0.0258
170.000	-702	715	-1417	-706	713	-1419	-2	-0.0252
172.000	-622	632	-1254	-626	629	-1255	-1	-0.0240
174.000	-596	609	-1205	-600	606	-1206	-1	-0.0234
176.000	-625	637	-1262	-629	634	-1263	-1	-0.0228
178.000	-579	592	-1171	-583	589	-1172	-1	-0.0222
180.000	-613	625	-1238	-619	622	-1241	-3	-0.0216
182.000	-613	627	-1240	-618	625	-1243	-3	-0.0198
184.000	-602	615	-1217	-606	611	-1217	0	-0.0180
186.000	-543	556	-1099	-547	553	-1100	-1	-0.0180
188.000	-582	593	-1175	-586	590	-1176	-1	-0.0174
190.000	-510	523	-1033	-515	520	-1035	-2	-0.0168
192.000	-493	503	-996	-498	501	-999	-3	-0.0156
194.000	-497	510	-1007	-501	507	-1008	-1	-0.0138
196.000	-543	555	-1098	-547	554	-1101	-3	-0.0132
198.000	-559	572	-1131	-562	569	-1131	0	-0.0114

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		N.
200.000	-599	613	-1212	-604	609	-1213	-1	-0.0114
202.000	-609	622	-1231	-614	618	-1232	-1	-0.0108
204.000	-607	622	-1229	-613	619	-1232	-3	-0.0102
206.000	-641	653	-1294	-645	650	-1295	-1	-0.0084
208.000	-670	683	-1353	-675	680	-1355	-2	-0.0078
210.000	-640	658	-1298	-645	654	-1299	-1	-0.0066
212.000	-727	743	-1470	-734	743	-1477	-7	-0.0060
214.000	-772	779	-1551	-775	775	-1550	1	-0.0018
216.000	-698	707	-1405	-702	703	-1405	0	-0.0024
218.000	-675	689	-1364	-678	685	-1363	1	-0.0024
220.000	-505	516	-1021	-507	510	-1017	4	-0.0030
222.000	-548	570	-1118	-555	570	-1125	-7	-0.0054
224.000	-565	569	-1134	-566	563	-1129	5	-0.0012
226.000	-574	590	-1164	-581	590	-1171	-7	-0.0042

END OF RECORDS

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		N.
2.000	-326	269	-595	-314	266	-580	15	-0.0174
4.000	-343	279	-622	-342	298	-640	-18	-0.0264
6.000	-313	250	-563	-297	259	-556	7	-0.0156
8.000	-242	192	-434	-228	199	-427	7	-0.0198
10.000	-238	182	-420	-226	203	-429	-9	-0.0240
12.000	-231	177	-408	-217	187	-404	4	-0.0186
14.000	-192	140	-332	-185	155	-340	-8	-0.0210
16.000	-173	131	-304	-168	140	-308	-4	-0.0162
18.000	-72	-1	-71	-143	10	-153	-82	-0.0138
20.000	-75	23	-98	-63	37	-100	-2	0.0354
22.000	-45	-17	-28	-31	2	-33	-5	0.0366
24.000	-50	-4	-46	-34	7	-41	5	0.0396
26.000	-38	-13	-25	-26	-2	-24	1	0.0366
28.000	-58	24	-82	-48	35	-83	-1	0.0360
30.000	39	-93	132	54	-81	135	3	0.0366
32.000	237	-295	532	250	-282	532	0	0.0348
34.000	122	-170	292	137	-158	295	3	0.0348
36.000	103	-158	261	107	-145	252	-9	0.0330
38.000	70	-198	268	183	-188	371	103	0.0384
40.000	262	-316	578	276	-301	577	-1	-0.0234
42.000	20	-79	99	30	-65	95	-4	-0.0228
44.000	-105	45	-150	-91	59	-150	0	-0.0204
46.000	-67	5	-72	-53	18	-71	1	-0.0204
48.000	-2	-58	56	12	-44	56	0	-0.0210
50.000	45	-115	160	55	-99	154	-6	-0.0210
52.000	58	-123	181	69	-114	183	2	-0.0174
54.000	66	-125	191	78	-118	196	5	-0.0186
56.000	50	-111	161	62	-98	160	-1	-0.0216
58.000	54	-117	171	68	-105	173	2	-0.0210
60.000	26	-78	104	38	-66	104	0	-0.0222
62.000	-10	-57	47	7	-43	50	3	-0.0222
64.000	-6	-53	47	8	-42	50	3	-0.0240
66.000	44	-106	150	55	-93	148	-2	-0.0258
68.000	99	-156	255	110	-142	252	-3	-0.0246
70.000	130	-193	323	133	-180	313	-10	-0.0228
72.000	141	-210	351	151	-198	349	-2	-0.0168
74.000	134	-197	331	147	-184	331	0	-0.0156
76.000	63	-131	194	76	-116	192	-2	-0.0156
78.000	74	-135	209	86	-122	208	-1	-0.0144
80.000	33	-106	139	45	-91	136	-3	-0.0138
82.000	55	-123	178	66	-109	175	-3	-0.0120
84.000	77	-144	221	89	-131	220	-1	-0.0102
86.000	125	-193	318	139	-179	318	0	-0.0096
88.000	118	-180	298	133	-168	301	3	-0.0096
90.000	143	-206	349	155	-193	348	-1	-0.0114
92.000	229	-281	510	241	-268	509	-1	-0.0108
94.000	145	-215	360	156	-201	357	-3	-0.0102
96.000	169	-233	402	182	-218	400	-2	-0.0084
98.000	195	-262	457	209	-247	456	-1	-0.0072
100.000	171	-238	409	185	-223	408	-1	-0.0066
102.000	190	-251	441	202	-237	439	-2	-0.0060
104.000	132	-210	342	145	-195	340	-2	-0.0048
106.000	127	-193	320	139	-179	318	-2	-0.0036
108.000	120	-183	303	132	-170	302	-1	-0.0024

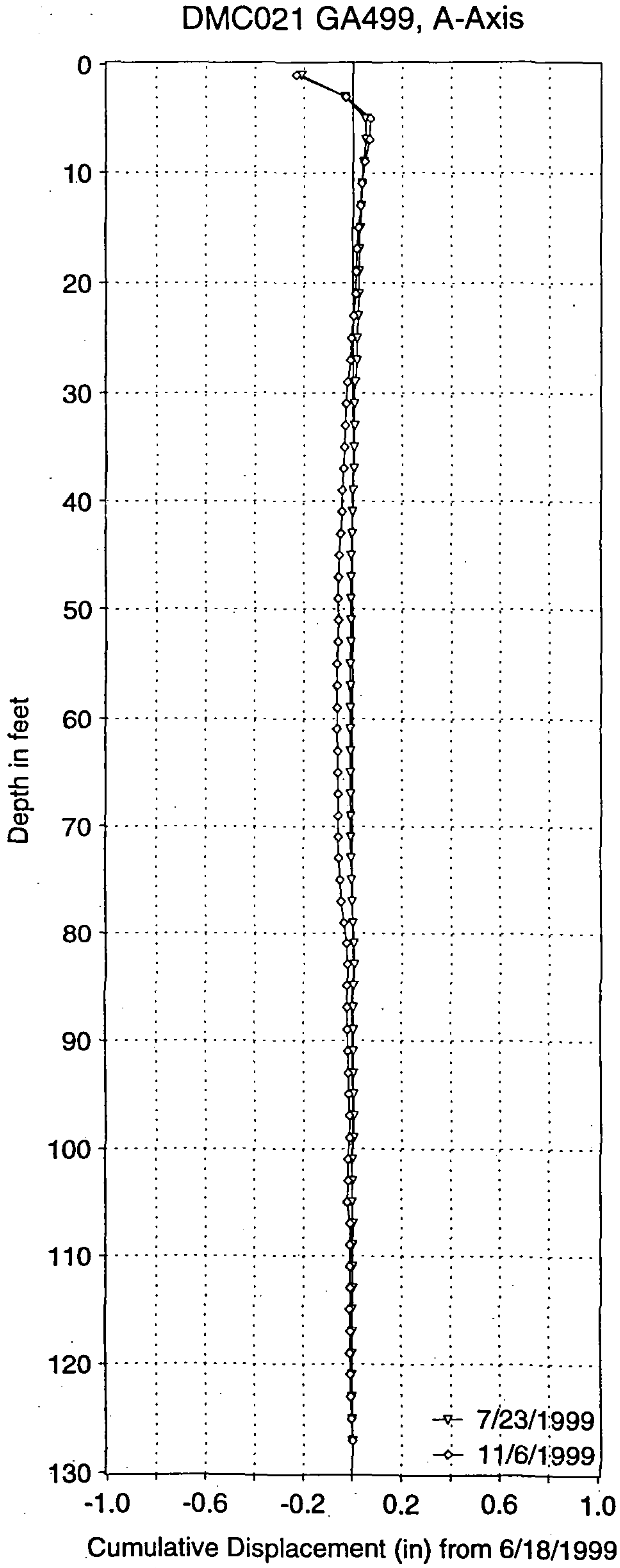
SENSOR: 26087

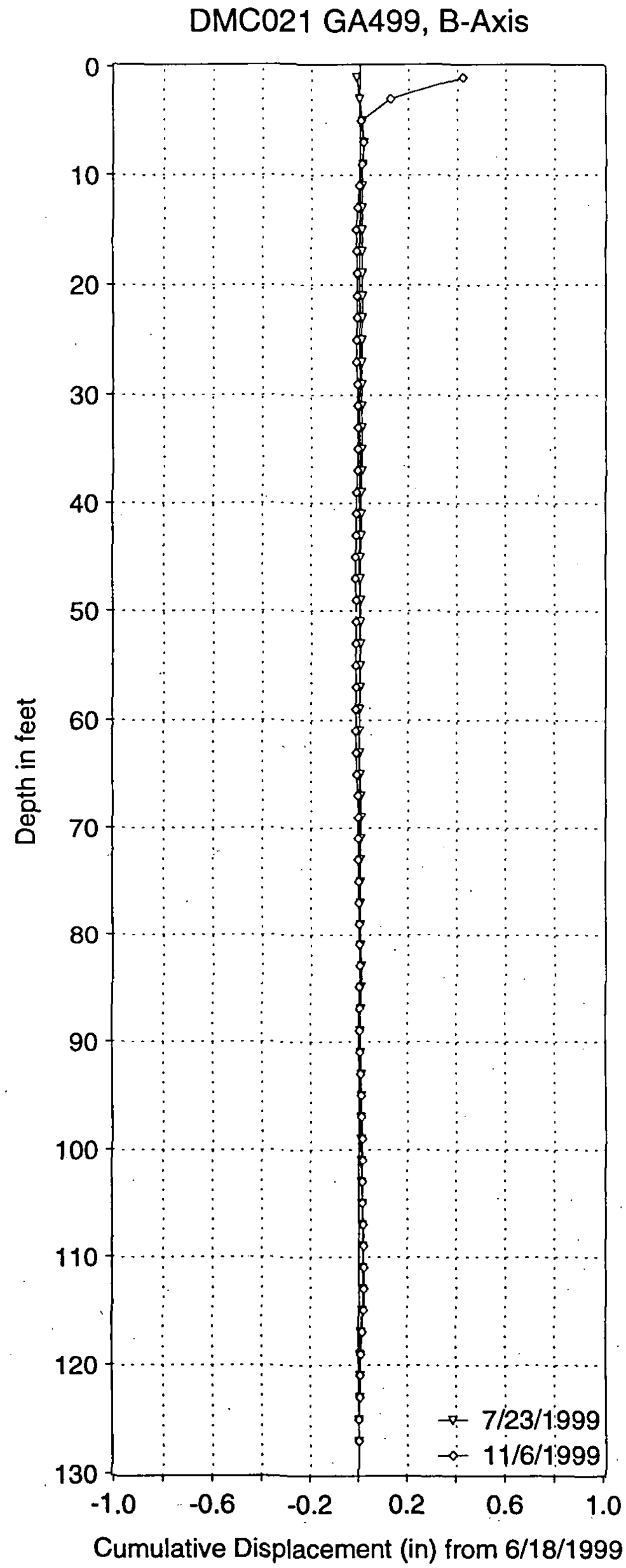
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		N.
110.000	131	-202	333	146	-187	333	0	-0.0018
112.000	142	-210	352	157	-194	351	-1	-0.0018
114.000	173	-250	423	187	-229	416	-7	-0.0012
116.000	155	-227	382	167	-211	378	-4	0.0030
118.000	176	-221	397	187	-207	394	-3	0.0054
120.000	130	-197	327	145	-185	330	3	0.0072
122.000	132	-207	339	144	-194	338	-1	0.0054
124.000	75	-137	212	88	-123	211	-1	0.0060
126.000	99	-169	268	114	-154	268	0	0.0066
128.000	122	-177	299	135	-164	299	0	0.0066
130.000	-8	-31	23	7	-18	25	2	0.0066
132.000	102	-155	257	113	-143	256	-1	0.0054
134.000	187	-227	414	197	-215	412	-2	0.0060
136.000	287	-329	616	304	-317	621	5	0.0072
138.000	361	-401	762	377	-389	766	4	0.0042
140.000	297	-345	642	313	-339	652	10	0.0018
142.000	187	-253	440	198	-238	436	-4	-0.0042
144.000	185	-248	433	197	-235	432	-1	-0.0018
146.000	165	-232	397	174	-219	393	-4	-0.0012
148.000	189	-242	431	201	-235	436	5	0.0012
150.000	164	-233	397	178	-220	398	1	-0.0018
152.000	187	-255	442	203	-241	444	2	-0.0024
154.000	231	-292	523	245	-278	523	0	-0.0036
156.000	213	-274	487	229	-263	492	5	-0.0036
158.000	207	-268	475	219	-256	475	0	-0.0066
160.000	173	-239	412	185	-227	412	0	-0.0066
162.000	187	-247	434	194	-245	439	5	-0.0066
164.000	153	-221	374	165	-214	379	5	-0.0096
166.000	122	-194	316	135	-185	320	4	-0.0126
168.000	138	-202	340	151	-189	340	0	-0.0150
170.000	190	-249	439	201	-236	437	-2	-0.0150
172.000	146	-211	357	158	-197	355	-2	-0.0138
174.000	188	-246	434	185	-233	418	-16	-0.0126
176.000	195	-270	465	199	-256	455	-10	-0.0030
178.000	199	-264	463	215	-249	464	1	0.0030
180.000	247	-303	550	263	-289	552	2	0.0024
182.000	197	-253	450	208	-238	446	-4	0.0012
184.000	229	-291	520	242	-281	523	3	0.0036
186.000	186	-257	443	199	-241	440	-3	0.0018
188.000	243	-303	546	256	-291	547	1	0.0036
190.000	263	-335	598	275	-322	597	-1	0.0030
192.000	288	-353	641	304	-339	643	2	0.0036
194.000	305	-363	668	318	-350	668	0	0.0024
196.000	357	-412	769	363	-404	767	-2	0.0024
198.000	357	-414	771	371	-402	773	2	0.0036
200.000	337	-417	754	348	-403	751	-3	0.0024
202.000	354	-419	773	367	-421	788	15	0.0042
204.000	337	-405	742	351	-401	752	10	-0.0048
206.000	324	-394	718	339	-379	718	0	-0.0108
208.000	312	-372	684	325	-359	684	0	-0.0108
210.000	254	-313	567	265	-301	566	-1	-0.0108
212.000	295	-349	644	309	-337	646	2	-0.0102
214.000	417	-486	903	431	-475	906	3	-0.0114
216.000	417	-487	904	426	-472	898	-6	-0.0132

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		N.
218.000	394	-452	846	408	-438	846	0	-0.0096
220.000	452	-502	954	463	-487	950	-4	-0.0096
222.000	345	-406	751	360	-392	752	1	-0.0072
224.000	389	-445	834	399	-436	835	1	-0.0078
226.000	309	-357	666	311	-341	652	-14	-0.0084

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

XL-0749 SR 101
MP 322 SLIDE
GA4-99 A+ = N100 deg.

DOT-50000277

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA499
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	3
SENSOR #	26087	26087
DATE	06/18/99 09:11	11/06/99 13:30
READINGS PER DIRECTION	63	63

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	338	-330	668	122	-209	331	-337	-0.2676
4.000	194	-187	381	94	-123	217	-164	-0.0654
6.000	105	-98	203	105	-103	208	5	0.0330
8.000	54	-47	101	66	-65	131	30	0.0300
10.000	205	-197	402	212	-210	422	20	0.0120
12.000	294	-287	581	297	-294	591	10	0.0000
14.000	221	-212	433	222	-219	441	8	-0.0060
16.000	225	-216	441	227	-222	449	8	-0.0108
18.000	165	-157	322	166	-162	328	6	-0.0156
20.000	105	-97	202	106	-100	206	4	-0.0192
22.000	97	-91	188	103	-99	202	14	-0.0216
24.000	111	-103	214	114	-109	223	9	-0.0300
26.000	98	-91	189	101	-96	197	8	-0.0354
28.000	97	-88	185	103	-98	201	16	-0.0402
30.000	147	-138	285	151	-145	296	11	-0.0498
32.000	165	-157	322	166	-161	327	5	-0.0564
34.000	183	-175	358	185	-179	364	6	-0.0594
36.000	170	-161	331	171	-164	335	4	-0.0630
38.000	85	-78	163	85	-82	167	4	-0.0654
40.000	25	-17	42	25	-19	44	2	-0.0678
42.000	46	-38	84	48	-43	91	7	-0.0690
44.000	75	-66	141	78	-71	149	8	-0.0732
46.000	111	-102	213	113	-106	219	6	-0.0780
48.000	111	-103	214	111	-105	216	2	-0.0816
50.000	-9	17	-26	-11	17	-28	-2	-0.0828
52.000	-60	68	-128	-60	66	-126	2	-0.0816
54.000	22	-11	33	21	-15	36	3	-0.0828
56.000	91	-82	173	89	-83	172	-1	-0.0846
58.000	110	-101	211	107	-101	208	-3	-0.0840
60.000	103	-94	197	102	-95	197	0	-0.0822
62.000	105	-97	202	101	-96	197	-5	-0.0822
64.000	83	-73	156	81	-74	155	-1	-0.0792
66.000	49	-39	88	46	-40	86	-2	-0.0786
68.000	37	-27	64	34	-28	62	-2	-0.0774
70.000	75	-64	139	73	-65	138	-1	-0.0762
72.000	94	-86	180	89	-83	172	-8	-0.0756
74.000	102	-90	192	96	-89	185	-7	-0.0708
76.000	82	-73	155	76	-70	146	-9	-0.0666
78.000	89	-78	167	78	-72	150	-17	-0.0612
80.000	70	-59	129	59	-52	111	-18	-0.0510
82.000	34	-24	58	29	-23	52	-6	-0.0402
84.000	71	-60	131	68	-59	127	-4	-0.0366
86.000	86	-77	163	82	-77	159	-4	-0.0342
88.000	65	-55	120	62	-57	119	-1	-0.0318
90.000	62	-50	112	58	-51	109	-3	-0.0312

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	70	-60	130	65	-61	126	-4	-0.0294
94.000	42	-30	72	38	-30	68	-4	-0.0270
96.000	61	-49	110	57	-48	105	-5	-0.0246
98.000	35	-25	60	33	-27	60	0	-0.0216
100.000	73	-61	134	73	-64	137	3	-0.0216
102.000	126	-117	243	123	-119	242	-1	-0.0234
104.000	168	-157	325	170	-162	332	7	-0.0228
106.000	24	-13	37	13	-7	20	-17	-0.0270
108.000	10	3	7	6	2	4	-3	-0.0168
110.000	93	-82	175	91	-84	175	0	-0.0150
112.000	83	-73	156	81	-74	155	-1	-0.0150
114.000	52	-41	93	48	-42	90	-3	-0.0144
116.000	54	-43	97	49	-43	92	-5	-0.0126
118.000	87	-75	162	87	-79	166	4	-0.0096
120.000	167	-153	320	162	-155	317	-3	-0.0120
122.000	190	-178	368	185	-178	363	-5	-0.0102
124.000	146	-134	280	141	-135	276	-4	-0.0072
126.000	113	-101	214	106	-100	206	-8	-0.0048

END OF RECORDS

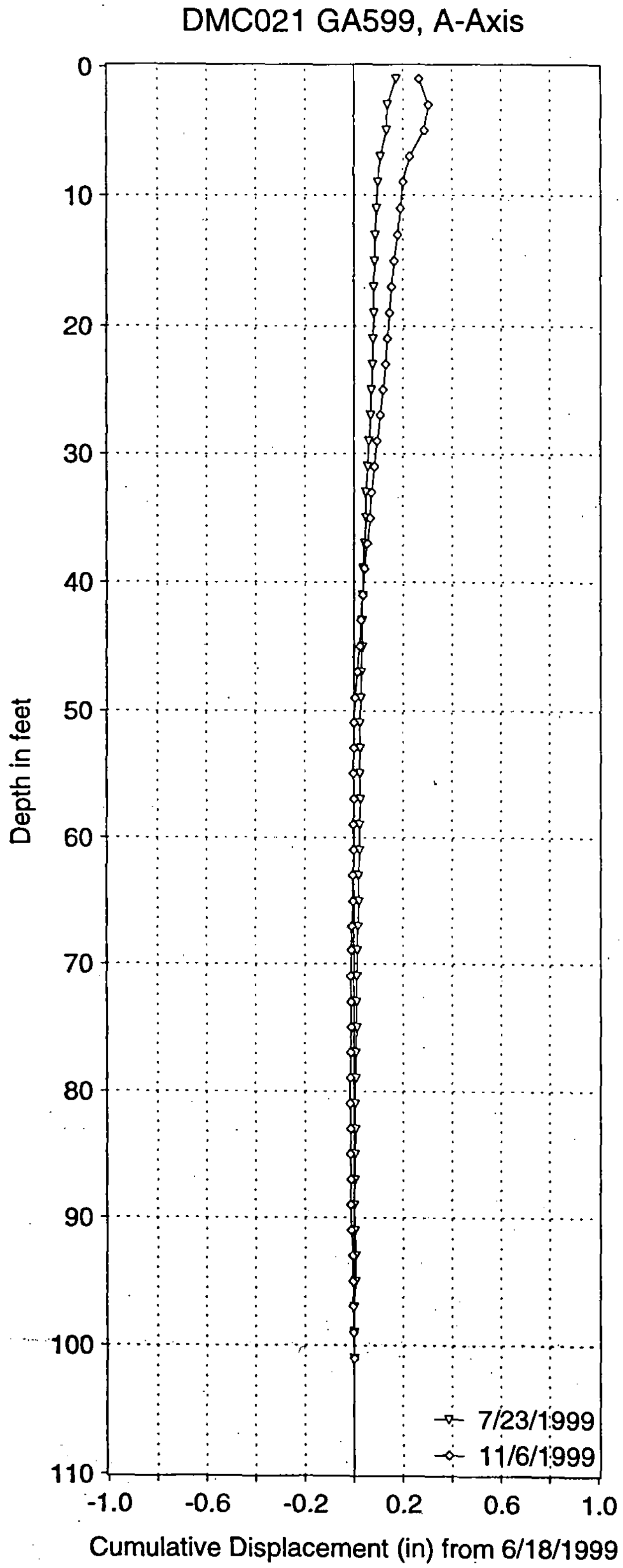
ENSOR: 26087

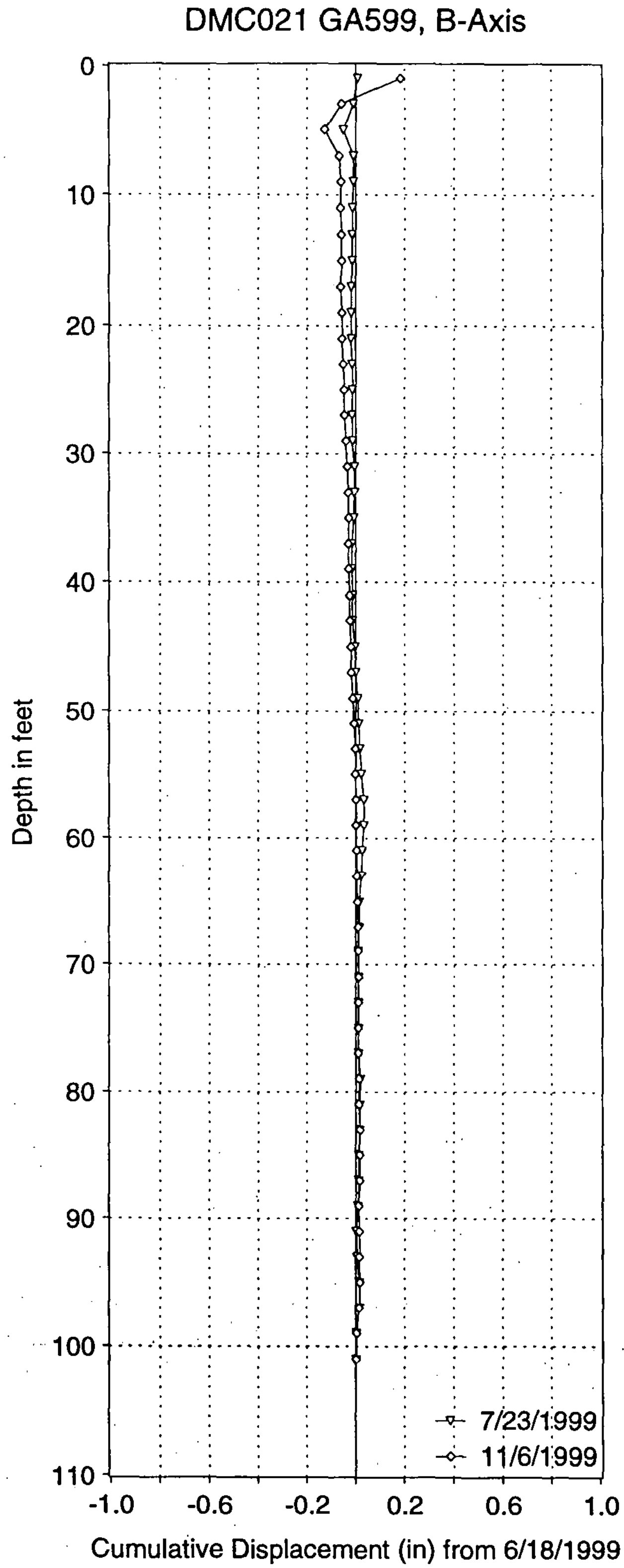
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-243	183	-426	-2	-70	68	494	0.4218
4.000	-77	34	-111	21	-71	92	203	0.1254
6.000	104	-170	274	111	-145	256	-18	0.0036
8.000	152	-226	378	170	-219	389	11	0.0144
10.000	185	-250	435	197	-255	452	17	0.0078
12.000	189	-255	444	203	-255	458	14	-0.0024
14.000	187	-254	441	201	-247	448	7	-0.0108
16.000	185	-246	431	191	-235	426	-5	-0.0150
18.000	171	-238	409	183	-224	407	-2	-0.0120
20.000	147	-211	358	161	-198	359	1	-0.0108
22.000	84	-162	246	97	-149	246	0	-0.0114
24.000	98	-163	261	113	-151	264	3	-0.0114
26.000	151	-210	361	161	-201	362	1	-0.0132
28.000	134	-206	340	146	-189	335	-5	-0.0138
30.000	124	-197	321	134	-182	316	-5	-0.0108
32.000	141	-206	347	155	-191	346	-1	-0.0078
34.000	213	-278	491	229	-265	494	3	-0.0072
36.000	217	-283	500	233	-270	503	3	-0.0090
38.000	151	-214	365	165	-201	366	1	-0.0108
40.000	209	-291	500	223	-279	502	2	-0.0114
42.000	187	-270	457	202	-258	460	3	-0.0126
44.000	170	-253	423	185	-241	426	3	-0.0144
46.000	169	-241	410	183	-229	412	2	-0.0162
48.000	138	-209	347	151	-191	342	-5	-0.0174
50.000	84	-150	234	99	-137	236	2	-0.0144
52.000	89	-162	251	103	-150	253	2	-0.0156
54.000	106	-182	288	118	-167	285	-3	-0.0168
56.000	109	-179	288	122	-166	288	0	-0.0150
58.000	87	-164	251	101	-150	251	0	-0.0150
60.000	106	-187	293	119	-173	292	-1	-0.0150
62.000	118	-202	320	131	-186	317	-3	-0.0144
64.000	108	-185	293	119	-172	291	-2	-0.0126
66.000	95	-171	266	104	-155	259	-7	-0.0114
68.000	87	-160	247	98	-146	244	-3	-0.0072
70.000	111	-194	305	126	-178	304	-1	-0.0054
72.000	130	-211	341	142	-197	339	-2	-0.0048
74.000	134	-206	340	145	-193	338	-2	-0.0036
76.000	181	-233	414	194	-221	415	1	-0.0024
78.000	131	-193	324	143	-178	321	-3	-0.0030
80.000	160	-228	388	173	-216	389	1	-0.0012
82.000	126	-197	323	137	-183	320	-3	-0.0018
84.000	162	-228	390	173	-214	387	-3	0.0000
86.000	147	-210	357	159	-197	356	-1	0.0018
88.000	120	-183	303	131	-171	302	-1	0.0024
90.000	143	-225	368	156	-211	367	-1	0.0030
92.000	153	-231	384	162	-217	379	-5	0.0036
94.000	179	-255	434	189	-241	430	-4	0.0066
96.000	185	-241	426	195	-230	425	-1	0.0090
98.000	170	-233	403	180	-218	398	-5	0.0096
100.000	171	-250	421	181	-235	416	-5	0.0126
102.000	194	-259	453	207	-246	453	0	0.0156
104.000	157	-222	379	171	-211	382	3	0.0156
106.000	144	-207	351	153	-193	346	-5	0.0138
108.000	57	-121	178	66	-105	171	-7	0.0168

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
110.000	-38	-8	-30	-23	6	-29	1	0.0210
112.000	-139	77	-216	-125	90	-215	1	0.0204
114.000	-97	37	-134	-83	50	-133	1	0.0198
116.000	-38	-13	-25	-22	-3	-19	6	0.0192
118.000	119	-183	302	138	-175	313	11	0.0156
120.000	94	-165	259	106	-157	263	4	0.0090
122.000	97	-162	259	113	-149	262	3	0.0066
124.000	188	-248	436	205	-238	443	7	0.0048
126.000	306	-345	651	321	-331	652	1	0.0006

END OF RECORDS





WSDOT	XL-0749 SR 101
MATERIALS LAB	MP 322 SLIDE
GEOTECH SECTION	GA5-99 A+ = N112 deg.
OLYMPIA, WA	

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA599
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	3
SENSOR #	26087	26087
DATE	06/18/99 10:01	11/06/99 14:04
READINGS PER DIRECTION	50	50

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	242	-223	465	199	-209	408	-57	0.2904
4.000	188	-186	374	201	-206	407	33	0.3246
6.000	359	-354	713	409	-407	816	103	0.3048
8.000	446	-442	888	464	-464	928	40	0.2430
10.000	471	-469	940	479	-479	958	18	0.2190
12.000	431	-427	858	439	-437	876	18	0.2082
14.000	418	-414	832	430	-429	859	27	0.1974
16.000	401	-395	796	409	-407	816	20	0.1812
18.000	376	-373	749	384	-383	767	18	0.1692
20.000	380	-377	757	387	-385	772	15	0.1584
22.000	344	-339	683	351	-346	697	14	0.1494
24.000	306	-302	608	313	-310	623	15	0.1410
26.000	236	-229	465	245	-240	485	20	0.1320
28.000	267	-263	530	274	-273	547	17	0.1200
30.000	278	-273	551	283	-282	565	14	0.1098
32.000	375	-371	746	381	-381	762	16	0.1014
34.000	222	-216	438	227	-220	447	9	0.0918
36.000	276	-270	546	285	-279	564	18	0.0864
38.000	457	-451	908	466	-462	928	20	0.0756
40.000	517	-512	1029	522	-519	1041	12	0.0636
42.000	544	-539	1083	550	-546	1096	13	0.0564
44.000	490	-485	975	494	-490	984	9	0.0486
46.000	401	-398	799	410	-406	816	17	0.0432
48.000	359	-357	716	369	-365	734	18	0.0330
50.000	351	-347	698	354	-350	704	6	0.0222
52.000	350	-343	693	352	-345	697	4	0.0186
54.000	352	-347	699	353	-349	702	3	0.0162
56.000	352	-346	698	352	-346	698	0	0.0144
58.000	309	-306	615	311	-307	618	3	0.0144
60.000	291	-287	578	291	-287	578	0	0.0126
62.000	314	-309	623	317	-310	627	4	0.0126
64.000	361	-356	717	361	-357	718	1	0.0102
66.000	370	-364	734	375	-369	744	10	0.0096
68.000	336	-330	666	338	-333	671	5	0.0036
70.000	419	-414	833	419	-417	836	3	0.0006
72.000	397	-391	788	397	-390	787	-1	-0.0012
74.000	343	-337	680	343	-337	680	0	-0.0006
76.000	391	-385	776	393	-386	779	3	-0.0006
78.000	496	-490	986	497	-492	989	3	-0.0024
80.000	492	-486	978	492	-487	979	1	-0.0042
82.000	435	-428	863	433	-426	859	-4	-0.0048
84.000	411	-403	814	411	-402	813	-1	-0.0024
86.000	391	-383	774	390	-383	773	-1	-0.0018
88.000	384	-378	762	385	-378	763	1	-0.0012
90.000	358	-351	709	358	-351	709	0	-0.0018

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	229	-221	450	225	-218	443	-7	-0.0018
94.000	205	-198	403	205	-200	405	2	0.0024
96.000	367	-361	728	368	-361	729	1	0.0012
98.000	595	-590	1185	597	-590	1187	2	0.0006
100.000	510	-502	1012	509	-502	1011	-1	-0.0006

END OF RECORDS

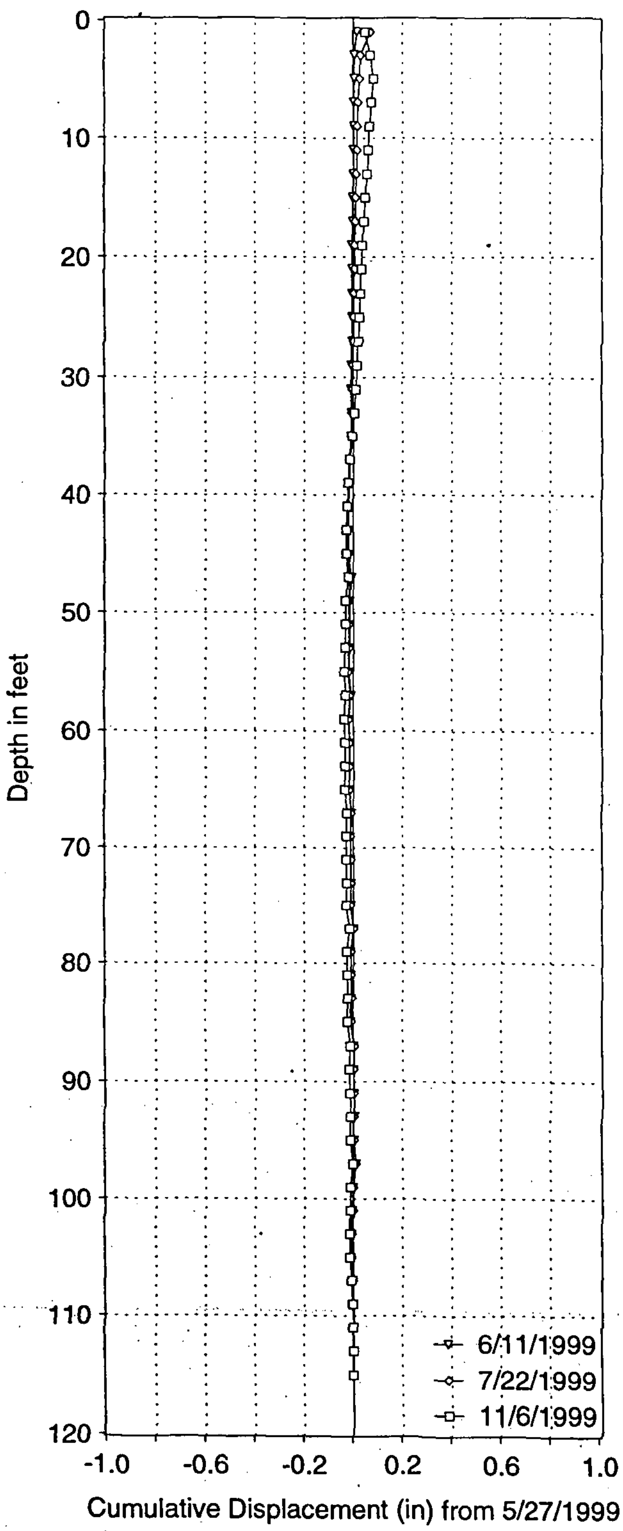
SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-23	-32	9	187	-227	414	405	0.1830
4.000	86	-138	224	166	-171	337	113	-0.0600
6.000	-89	33	-122	-126	95	-221	-99	-0.1278
8.000	-259	194	-453	-253	215	-468	-15	-0.0684
10.000	-280	209	-489	-262	219	-481	8	-0.0594
12.000	-171	102	-273	-163	120	-283	-10	-0.0642
14.000	-92	26	-118	-77	40	-117	1	-0.0582
16.000	-41	-37	-4	-24	-24	0	4	-0.0588
18.000	-26	-41	15	-15	-24	9	-6	-0.0612
20.000	-87	21	-108	-74	38	-112	-4	-0.0576
22.000	-120	47	-167	-108	65	-173	-6	-0.0552
24.000	-190	129	-319	-178	148	-326	-7	-0.0516
26.000	-244	184	-428	-231	199	-430	-2	-0.0474
28.000	-330	262	-592	-318	282	-600	-8	-0.0462
30.000	-355	282	-637	-347	301	-648	-11	-0.0414
32.000	-349	290	-639	-337	309	-646	-7	-0.0348
34.000	-266	207	-473	-255	221	-476	-3	-0.0306
36.000	-173	99	-272	-154	113	-267	5	-0.0288
38.000	-160	95	-255	-147	113	-260	-5	-0.0318
40.000	-214	156	-370	-201	173	-374	-4	-0.0288
42.000	-139	81	-220	-126	100	-226	-6	-0.0264
44.000	-125	38	-163	-110	57	-167	-4	-0.0228
46.000	-127	41	-168	-114	58	-172	-4	-0.0204
48.000	-128	39	-167	-116	59	-175	-8	-0.0180
50.000	-129	58	-187	-123	76	-199	-12	-0.0132
52.000	-100	27	-127	-89	43	-132	-5	-0.0060
54.000	-109	25	-134	-94	42	-136	-2	-0.0030
56.000	-123	38	-161	-106	57	-163	-2	-0.0018
58.000	-155	67	-222	-139	86	-225	-3	-0.0006
60.000	-173	89	-262	-159	106	-265	-3	0.0012
62.000	-161	83	-244	-147	99	-246	-2	0.0030
64.000	-141	58	-199	-129	73	-202	-3	0.0042
66.000	-106	36	-142	-93	54	-147	-5	0.0060
68.000	-116	49	-165	-101	66	-167	-2	0.0090
70.000	-173	106	-279	-157	122	-279	0	0.0102
72.000	-207	136	-343	-191	153	-344	-1	0.0102
74.000	-141	67	-208	-126	79	-205	3	0.0108
76.000	-157	95	-252	-144	111	-255	-3	0.0090
78.000	-215	129	-344	-202	146	-348	-4	0.0108
80.000	-223	134	-357	-207	150	-357	0	0.0132
82.000	-229	150	-379	-215	170	-385	-6	0.0132
84.000	-199	118	-317	-184	134	-318	-1	0.0168
86.000	-175	111	-286	-158	125	-283	3	0.0174
88.000	-127	61	-188	-107	76	-183	5	0.0156
90.000	-65	-9	-56	-51	7	-58	-2	0.0126
92.000	-53	-22	-31	-38	-4	-34	-3	0.0138
94.000	-64	-10	-54	-48	8	-56	-2	0.0156
96.000	-26	-31	5	-6	-15	9	4	0.0168
98.000	64	-110	174	82	-111	193	19	0.0144
100.000	-36	-24	-12	-12	-5	-7	5	0.0030

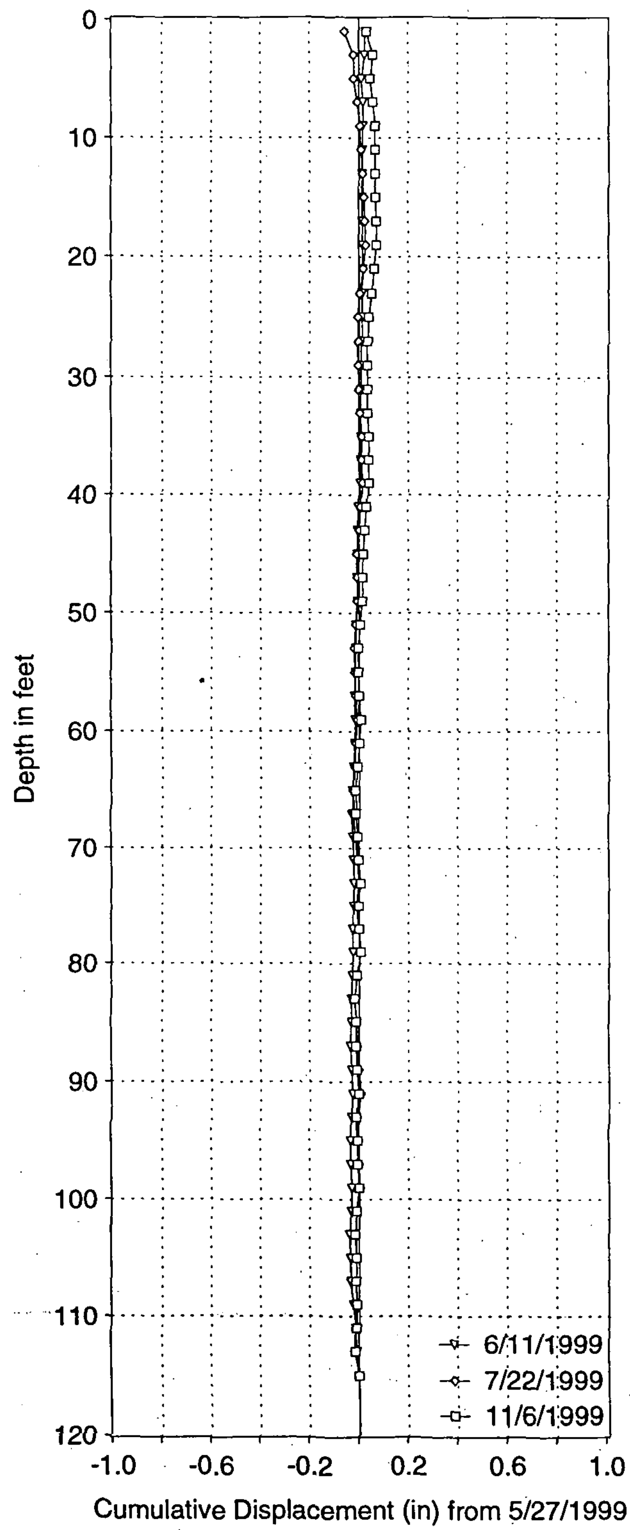
END OF RECORDS

DOT-50000285

DMC021 GA699, A-Axis



DMC021 GA699, B-Axis



WSDOT *MATERIALS LAB* *GEOTECH SECTION* *OLYMPIA, WA*	XL-0749 SR 101 MP 322 SLIDE A+ = N113 deg. GA6-99

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA699
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	4
SENSOR #	26087	26087
DATE	05/27/99 09:46	11/06/99 13:01
READINGS PER DIRECTION	57	57

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	26	-42	68	20	-15	35	-33	0.0822
4.000	11	-27	38	9	-5	14	-24	0.1020
6.000	110	-120	230	125	-123	248	18	0.1164
8.000	138	-148	286	151	-149	300	14	0.1056
10.000	177	-188	365	188	-187	375	10	0.0972
12.000	166	-176	342	177	-174	351	9	0.0912
14.000	139	-149	288	151	-148	299	11	0.0858
16.000	181	-191	372	194	-190	384	12	0.0792
18.000	230	-241	471	242	-240	482	11	0.0720
20.000	259	-270	529	269	-267	536	7	0.0654
22.000	234	-244	478	244	-242	486	8	0.0612
24.000	231	-241	472	242	-239	481	9	0.0564
26.000	219	-229	448	230	-226	456	8	0.0510
28.000	199	-211	410	210	-209	419	9	0.0462
30.000	182	-194	376	193	-190	383	7	0.0408
32.000	145	-154	299	157	-154	311	12	0.0366
34.000	154	-164	318	169	-166	335	17	0.0294
36.000	250	-257	507	264	-260	524	17	0.0192
38.000	405	-418	823	418	-418	836	13	0.0090
40.000	239	-251	490	249	-246	495	5	0.0012
42.000	263	-274	537	274	-271	545	8	-0.0018
44.000	194	-205	399	203	-199	402	3	-0.0066
46.000	171	-181	352	168	-170	338	-14	-0.0084
48.000	97	-107	204	113	-109	222	18	0.0000
50.000	171	-181	352	179	-178	357	5	-0.0108
52.000	243	-254	497	253	-250	503	6	-0.0138
54.000	263	-270	533	270	-266	536	3	-0.0174
56.000	310	-319	629	308	-311	619	-10	-0.0192
58.000	306	-316	622	321	-313	634	12	-0.0132
60.000	182	-194	376	187	-186	373	-3	-0.0204
62.000	210	-218	428	217	-214	431	3	-0.0186
64.000	232	-240	472	238	-235	473	1	-0.0204
66.000	195	-205	400	191	-192	383	-17	-0.0210
68.000	20	-30	50	34	-23	57	7	-0.0108
70.000	14	-25	39	23	-18	41	2	-0.0150
72.000	58	-66	124	65	-61	126	2	-0.0162
74.000	94	-103	197	99	-97	196	-1	-0.0174
76.000	111	-118	229	105	-103	208	-21	-0.0168
78.000	183	-193	376	203	-196	399	23	-0.0042
80.000	213	-222	435	217	-214	431	-4	-0.0180
82.000	171	-178	349	177	-171	348	-1	-0.0156
84.000	167	-177	344	173	-170	343	-1	-0.0150
86.000	136	-143	279	133	-130	263	-16	-0.0144
88.000	21	-29	50	35	-24	59	9	-0.0048
90.000	67	-76	143	73	-70	143	0	-0.0102

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	18	-25	43	20	-15	35	-8	-0.0102
94.000	-75	68	-143	-70	75	-145	-2	-0.0054
96.000	-34	26	-60	-35	37	-72	-12	-0.0042
98.000	111	-119	230	127	-122	249	19	0.0030
100.000	222	-230	452	230	-226	456	4	-0.0084
102.000	275	-283	558	280	-277	557	-1	-0.0108
104.000	299	-306	605	307	-303	610	5	-0.0102
106.000	344	-350	694	341	-339	680	-14	-0.0132
108.000	226	-234	460	231	-225	456	-4	-0.0048
110.000	129	-137	266	133	-128	261	-5	-0.0024
112.000	64	-71	135	67	-63	130	-5	0.0006
114.000	18	-26	44	26	-24	50	6	0.0036

END OF RECORDS

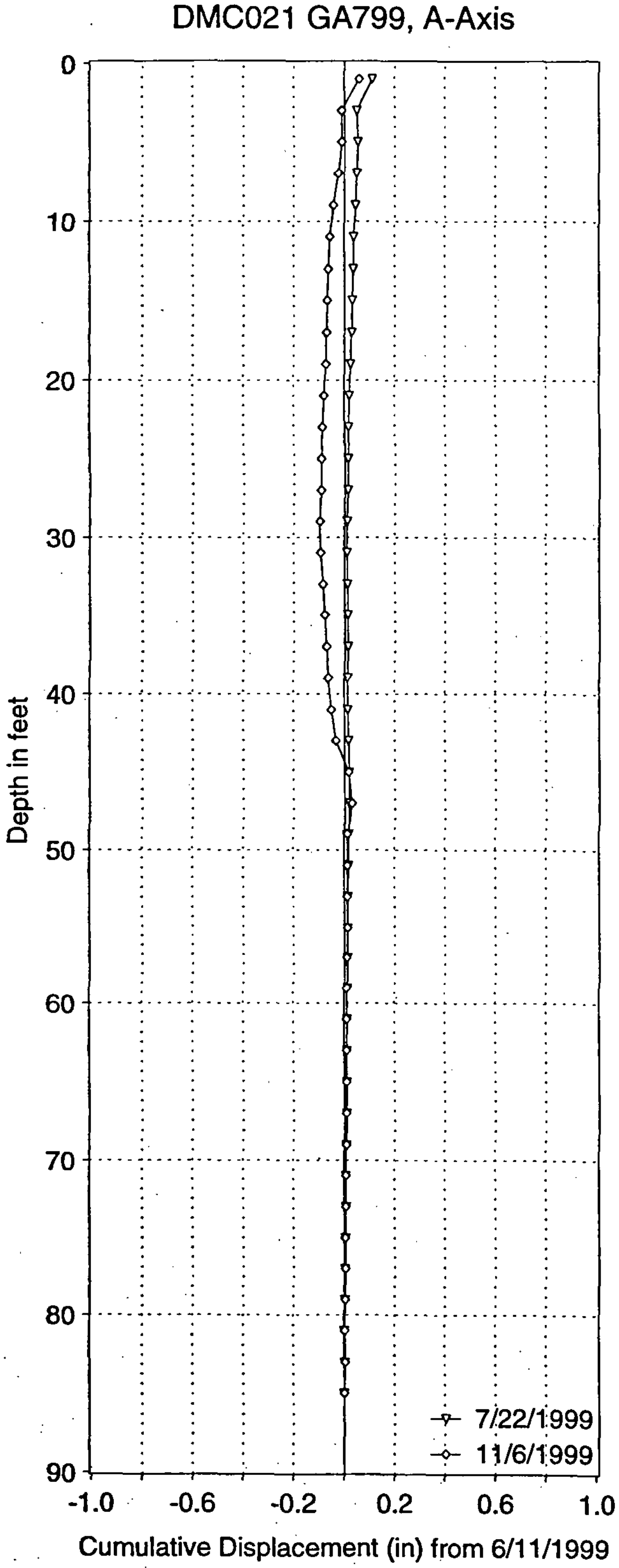
ENSOR: 26087

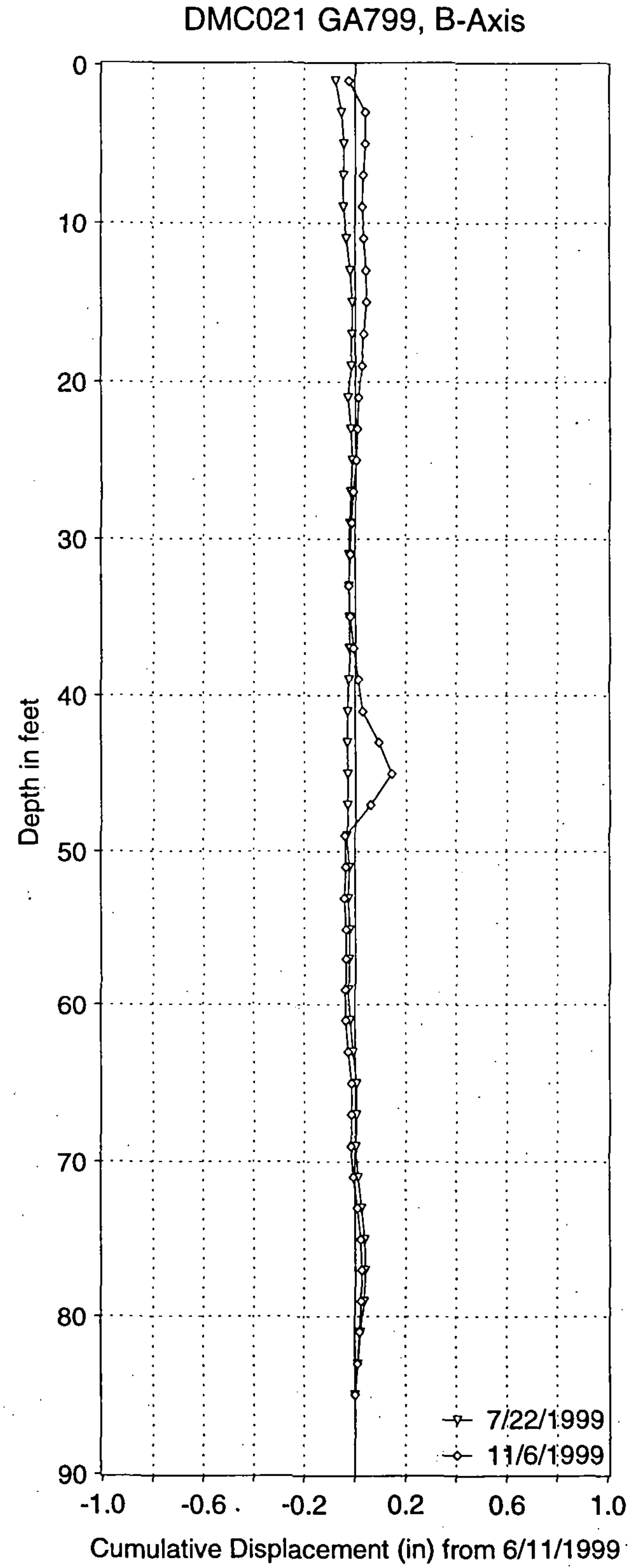
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	226	-267	493	203	-248	451	-42	0.0306
4.000	203	-228	431	209	-239	448	17	0.0558
6.000	106	-149	255	94	-145	239	-16	0.0456
8.000	109	-150	259	101	-141	242	-17	0.0552
10.000	55	-99	154	51	-104	155	1	0.0654
12.000	44	-93	137	41	-99	140	3	0.0648
14.000	60	-99	159	56	-94	150	-9	0.0630
16.000	20	-43	63	18	-43	61	-2	0.0684
18.000	-21	5	-26	-29	0	-29	-3	0.0696
20.000	-18	-24	6	-9	-32	23	17	0.0714
22.000	44	-87	131	52	-95	147	16	0.0612
24.000	37	-85	122	53	-90	143	21	0.0516
26.000	73	-102	175	75	-106	181	6	0.0390
28.000	15	-36	51	11	-40	51	0	0.0354
30.000	-5	-42	37	-10	-48	38	1	0.0354
32.000	15	-56	71	10	-60	70	-1	0.0348
34.000	22	-55	77	16	-54	70	-7	0.0354
36.000	-67	54	-121	-69	52	-121	0	0.0396
38.000	-229	204	-433	-233	199	-432	1	0.0396
40.000	-171	135	-306	-166	128	-294	12	0.0390
42.000	-102	70	-172	-96	62	-158	14	0.0318
44.000	-23	-25	2	-18	-32	14	12	0.0234
46.000	-21	-2	-19	-22	-6	-16	3	0.0162
48.000	-17	-18	1	-17	-21	4	3	0.0144
50.000	-48	0	-48	-37	-4	-33	15	0.0126
52.000	55	-82	137	60	-92	152	15	0.0036
54.000	63	-103	166	55	-107	162	-4	-0.0054
56.000	65	-102	167	63	-99	162	-5	-0.0030
58.000	-55	22	-77	-67	25	-92	-15	0.0000
60.000	-103	77	-180	-98	69	-167	13	0.0090
62.000	69	-86	155	70	-99	169	14	0.0012
64.000	197	-234	431	205	-239	444	13	-0.0072
66.000	277	-304	581	273	-302	575	-6	-0.0150
68.000	185	-212	397	175	-211	386	-11	-0.0114
70.000	63	-82	145	57	-84	141	-4	-0.0048
72.000	-61	22	-83	-69	24	-93	-10	-0.0024
74.000	-59	15	-74	-53	10	-63	11	0.0036
76.000	-11	-30	19	-15	-29	14	-5	-0.0030
78.000	-47	15	-62	-58	12	-70	-8	0.0000
80.000	-82	35	-117	-67	27	-94	23	0.0048
82.000	-18	-23	5	-9	-31	22	17	-0.0090
84.000	50	-84	134	43	-79	122	-12	-0.0192
86.000	-31	9	-40	-29	9	-38	2	-0.0120
88.000	-54	22	-76	-63	18	-81	-5	-0.0132
90.000	-157	131	-288	-167	132	-299	-11	-0.0102
92.000	-199	158	-357	-190	150	-340	17	-0.0036
94.000	-156	117	-273	-163	125	-288	-15	-0.0138
96.000	-195	186	-381	-197	182	-379	2	-0.0048
98.000	-189	167	-356	-205	158	-363	-7	-0.0060
100.000	-154	110	-264	-143	103	-246	18	-0.0018
102.000	-91	46	-137	-93	39	-132	5	-0.0126
104.000	-99	73	-172	-108	71	-179	-7	-0.0156
106.000	-197	182	-379	-200	177	-377	2	-0.0114
108.000	-210	190	-400	-224	182	-406	-6	-0.0126

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
110.000	-170	139	-309	-171	134	-305	4	-0.0090
112.000	-113	88	-201	-118	79	-197	4	-0.0114
114.000	-52	29	-81	-55	49	-104	-23	-0.0138

END OF RECORDS





WSDOT	XL-0749 SR 101
MATERIALS LAB	MP 322 SLIDE
GEOTECH SECTION	A+ = N115 deg.
OLYMPIA, WA	GA7-99

DOT-50000291

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA799
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	2	4
SENSOR #	26087	26087
DATE	06/11/99 09:42	11/06/99 12:32
READINGS PER DIRECTION	42	42

SENSOR: 26087

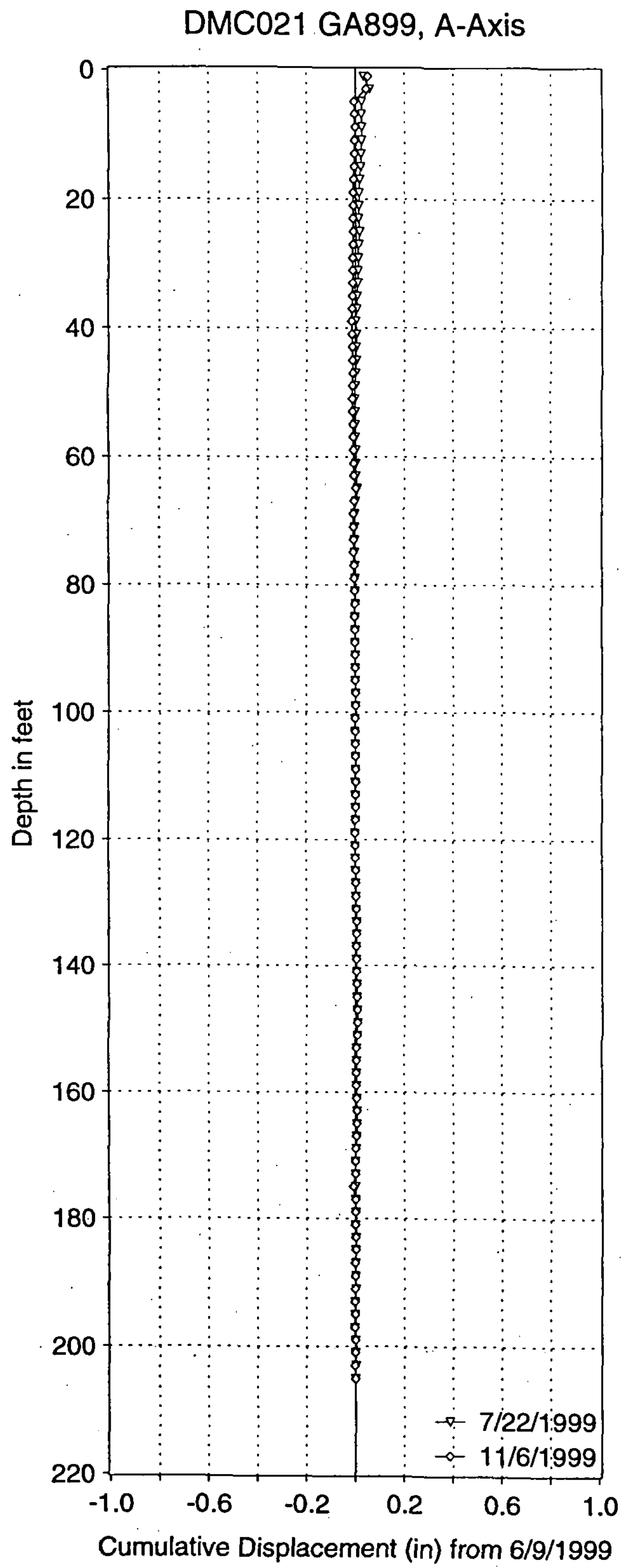
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	197	-227	424	262	-277	539	115	-0.0162
4.000	58	-66	124	62	-59	121	-3	-0.0852
6.000	154	-166	320	169	-168	337	17	-0.0834
8.000	86	-95	181	107	-105	212	31	-0.0936
10.000	102	-113	215	117	-117	234	19	-0.1122
12.000	83	-94	177	94	-93	187	10	-0.1236
14.000	73	-83	156	82	-79	161	5	-0.1296
16.000	73	-84	157	79	-78	157	0	-0.1326
18.000	99	-110	209	106	-106	212	3	-0.1326
20.000	128	-139	267	137	-136	273	6	-0.1344
22.000	111	-121	232	121	-120	241	9	-0.1380
24.000	95	-105	200	104	-103	207	7	-0.1434
26.000	70	-81	151	76	-74	150	-1	-0.1476
28.000	17	-27	44	25	-21	46	2	-0.1470
30.000	25	-37	62	27	-26	53	-9	-0.1482
32.000	30	-40	70	27	-26	53	-17	-0.1428
34.000	46	-56	102	45	-43	88	-14	-0.1326
36.000	59	-70	129	58	-57	115	-14	-0.1242
38.000	111	-123	234	109	-108	217	-17	-0.1158
40.000	95	-105	200	88	-88	176	-24	-0.1056
42.000	165	-178	343	156	-154	310	-33	-0.0912
44.000	137	-145	282	99	-96	195	-87	-0.0714
46.000	208	-217	425	203	-199	402	-23	-0.0192
48.000	157	-167	324	173	-172	345	21	-0.0054
50.000	171	-182	353	178	-176	354	1	-0.0180
52.000	198	-207	405	203	-200	403	-2	-0.0186
54.000	226	-237	463	232	-227	459	-4	-0.0174
56.000	242	-251	493	250	-245	495	2	-0.0150
58.000	182	-192	374	186	-183	369	-5	-0.0162
60.000	183	-193	376	189	-185	374	-2	-0.0132
62.000	181	-190	371	186	-183	369	-2	-0.0120
64.000	162	-171	333	167	-163	330	-3	-0.0108
66.000	124	-133	257	131	-125	256	-1	-0.0090
68.000	79	-88	167	83	-80	163	-4	-0.0084
70.000	111	-121	232	117	-114	231	-1	-0.0060
72.000	118	-125	243	123	-118	241	-2	-0.0054
74.000	119	-128	247	126	-122	248	1	-0.0042
76.000	177	-185	362	182	-177	359	-3	-0.0048
78.000	155	-165	320	160	-158	318	-2	-0.0030
80.000	204	-213	417	210	-206	416	-1	-0.0018
82.000	178	-189	367	182	-179	361	-6	-0.0012
84.000	198	-207	405	206	-203	409	4	0.0024

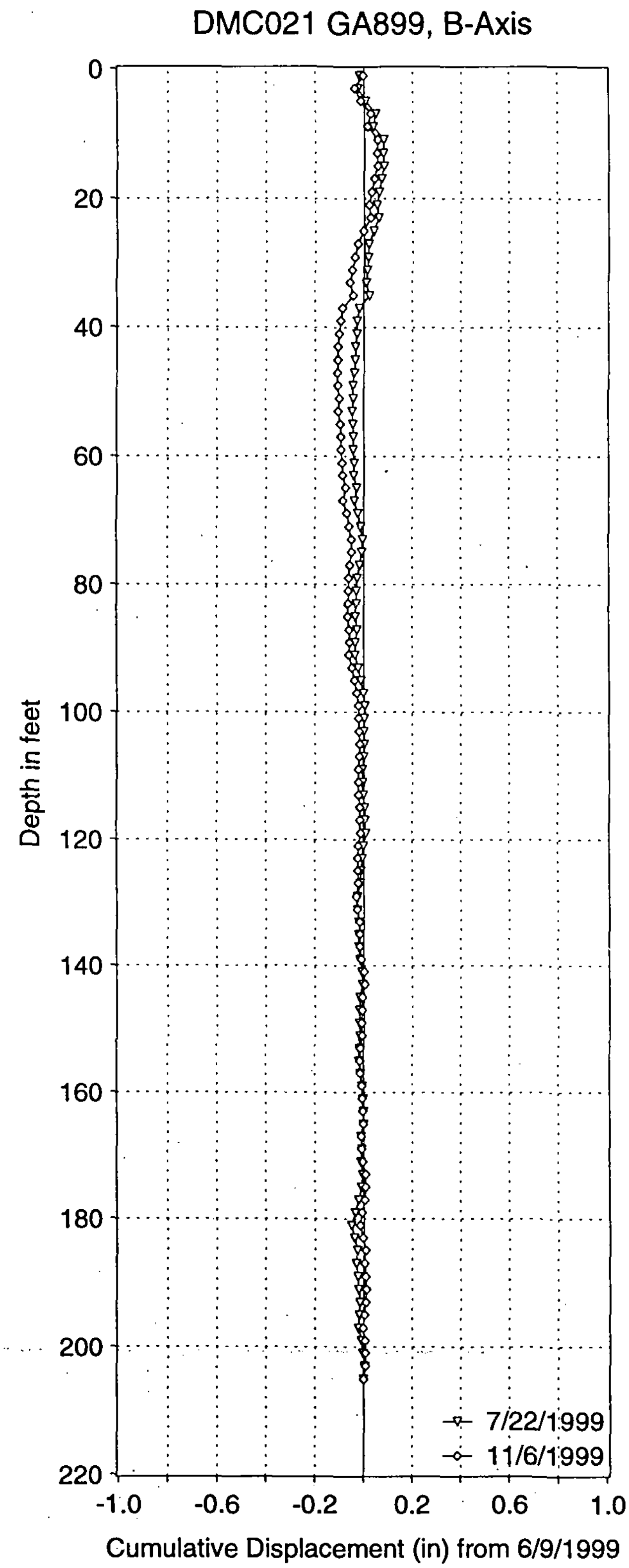
END OF RECORDS

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	486	-473	959	422	-431	853	-106	-0.0234
4.000	249	-281	530	249	-282	531	1	0.0402
6.000	206	-226	432	212	-234	446	14	0.0396
8.000	192	-216	408	191	-222	413	5	0.0312
10.000	149	-202	351	149	-190	339	-12	0.0282
12.000	89	-138	227	90	-124	214	-13	0.0354
14.000	48	-91	139	51	-86	137	-2	0.0432
16.000	-24	-9	-15	-11	-16	5	20	0.0444
18.000	62	-98	160	65	-107	172	12	0.0324
20.000	119	-173	292	130	-183	313	21	0.0252
22.000	155	-203	358	155	-211	366	8	0.0126
24.000	137	-189	326	138	-197	335	9	0.0078
26.000	139	-164	303	150	-173	323	20	0.0024
28.000	113	-145	258	116	-152	268	10	-0.0096
30.000	169	-204	373	169	-209	378	5	-0.0156
32.000	235	-265	500	238	-275	513	13	-0.0186
34.000	322	-372	694	323	-363	686	-8	-0.0264
36.000	243	-271	514	230	-262	492	-22	-0.0216
38.000	161	-196	357	142	-181	323	-34	-0.0084
40.000	145	-181	326	128	-167	295	-31	0.0120
42.000	285	-307	592	226	-261	487	-105	0.0306
44.000	179	-195	374	123	-168	291	-83	0.0936
46.000	133	-164	297	207	-230	437	140	0.1434
48.000	150	-184	334	231	-267	498	164	0.0594
50.000	130	-182	312	131	-177	308	-4	-0.0390
52.000	140	-172	312	145	-178	323	11	-0.0366
54.000	202	-251	453	198	-244	442	-11	-0.0432
56.000	195	-213	408	197	-214	411	3	-0.0366
58.000	175	-203	378	171	-206	377	-1	-0.0384
60.000	151	-204	355	148	-206	354	-1	-0.0378
62.000	158	-207	365	155	-194	349	-16	-0.0372
64.000	135	-186	321	130	-170	300	-21	-0.0276
66.000	122	-139	261	123	-141	264	3	-0.0150
68.000	120	-143	263	116	-147	263	0	-0.0168
70.000	105	-152	257	101	-138	239	-18	-0.0168
72.000	99	-149	248	95	-129	224	-24	-0.0060
74.000	78	-128	206	75	-109	184	-22	0.0084
76.000	66	-97	163	69	-88	157	-6	0.0216
78.000	35	-69	104	35	-71	106	2	0.0252
80.000	94	-143	237	97	-149	246	9	0.0240
82.000	102	-147	249	112	-151	263	14	0.0186
84.000	194	-217	411	206	-222	428	17	0.0102

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

XL-0749 SR 101
MP 322 SLIDE
GA8-99 A+ = N110 deg.

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA899
Site description SR 101 MP 322 SLIDE

	PREVIOUS		CURRENT	
DATA SET #	1		3	
SENSOR #	26087		26087	
DATE	06/09/99	10:45	11/06/99	11:07
READINGS PER DIRECTION	102		102	

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-45	-140	95	53	-55	108	13	0.0510
4.000	129	-127	256	167	-171	338	82	0.0432
6.000	117	-110	227	113	-113	226	-1	-0.0060
8.000	-67	55	-122	-64	62	-126	-4	-0.0054
10.000	-46	40	-86	-42	41	-83	3	-0.0030
12.000	-59	56	-115	-56	57	-113	2	-0.0048
14.000	-98	90	-188	-95	91	-186	2	-0.0060
16.000	-114	108	-222	-111	109	-220	2	-0.0072
18.000	-117	112	-229	-114	112	-226	3	-0.0084
20.000	-84	77	-161	-81	80	-161	0	-0.0102
22.000	-164	160	-324	-160	161	-321	3	-0.0102
24.000	-269	254	-523	-264	262	-526	-3	-0.0120
26.000	-263	257	-520	-259	258	-517	3	-0.0102
28.000	-166	158	-324	-163	162	-325	-1	-0.0120
30.000	-167	159	-326	-163	162	-325	1	-0.0114
32.000	-165	157	-322	-161	163	-324	-2	-0.0120
34.000	-212	205	-417	-209	206	-415	2	-0.0108
36.000	-310	305	-615	-307	307	-614	1	-0.0120
38.000	-142	136	-278	-137	135	-272	6	-0.0126
40.000	-61	50	-111	-57	57	-114	-3	-0.0162
42.000	-4	-3	-1	-2	1	-3	-2	-0.0144
44.000	-101	91	-192	-97	96	-193	-1	-0.0132
46.000	35	-44	79	38	-39	77	-2	-0.0126
48.000	178	-187	365	182	-183	365	0	-0.0114
50.000	173	-182	355	177	-177	354	-1	-0.0114
52.000	-20	13	-33	-17	17	-34	-1	-0.0108
54.000	-41	29	-70	-37	34	-71	-1	-0.0102
56.000	13	-22	35	16	-18	34	-1	-0.0096
58.000	-43	35	-78	-41	39	-80	-2	-0.0090
60.000	-101	93	-194	-98	96	-194	0	-0.0078
62.000	-44	37	-81	-41	41	-82	-1	-0.0078
64.000	-40	38	-78	-45	44	-89	-11	-0.0072
66.000	-100	81	-181	-87	86	-173	8	-0.0006
68.000	-113	102	-215	-108	106	-214	1	-0.0054
70.000	-114	106	-220	-111	109	-220	0	-0.0060
72.000	-98	92	-190	-95	95	-190	0	-0.0060
74.000	-87	77	-164	-83	79	-162	2	-0.0060
76.000	-82	73	-155	-81	78	-159	-4	-0.0072
78.000	-111	101	-212	-107	105	-212	0	-0.0048
80.000	-125	117	-242	-122	121	-243	-1	-0.0048
82.000	-130	124	-254	-128	129	-257	-3	-0.0042
84.000	-126	117	-243	-123	120	-243	0	-0.0024
86.000	-115	108	-223	-113	111	-224	-1	-0.0024
88.000	-125	116	-241	-122	119	-241	0	-0.0018
90.000	-139	131	-270	-136	134	-270	0	-0.0018

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	-121	115	-236	-118	119	-237	-1	-0.0018
94.000	-133	124	-257	-130	127	-257	0	-0.0012
96.000	-148	140	-288	-146	143	-289	-1	-0.0012
98.000	-79	71	-150	-77	74	-151	-1	-0.0006
100.000	-49	42	-91	-46	44	-90	1	0.0000
102.000	-27	21	-48	-24	25	-49	-1	-0.0006
104.000	-37	28	-65	-34	31	-65	0	0.0000
106.000	-37	29	-66	-34	33	-67	-1	0.0000
108.000	-98	90	-188	-96	95	-191	-3	0.0006
110.000	-155	149	-304	-153	152	-305	-1	0.0024
112.000	-189	186	-375	-186	187	-373	2	0.0030
114.000	-210	203	-413	-207	205	-412	1	0.0018
116.000	-169	165	-334	-166	166	-332	2	0.0012
118.000	-55	47	-102	-52	51	-103	-1	0.0000
120.000	-6	1	-7	-4	3	-7	0	0.0006
122.000	63	-66	129	65	-65	130	1	0.0006
124.000	72	-78	150	73	-75	148	-2	0.0000
126.000	103	-107	210	104	-105	209	-1	0.0012
128.000	67	-73	140	69	-71	140	0	0.0018
130.000	31	-36	67	33	-33	66	-1	0.0018
132.000	-11	9	-20	-10	13	-23	-3	0.0024
134.000	-37	31	-68	-35	34	-69	-1	0.0042
136.000	-44	41	-85	-42	42	-84	1	0.0048
138.000	-58	55	-113	-57	56	-113	0	0.0042
140.000	-121	117	-238	-119	119	-238	0	0.0042
142.000	-83	79	-162	-81	82	-163	-1	0.0042
144.000	-71	64	-135	-68	67	-135	0	0.0048
146.000	-100	96	-196	-99	99	-198	-2	0.0048
148.000	-89	83	-172	-87	86	-173	-1	0.0060
150.000	-155	151	-306	-153	154	-307	-1	0.0066
152.000	-233	230	-463	-229	230	-459	4	0.0072
154.000	-202	195	-397	-199	198	-397	0	0.0048
156.000	-309	306	-615	-306	307	-613	2	0.0048
158.000	-89	86	-175	-87	88	-175	0	0.0036
160.000	-186	182	-368	-185	185	-370	-2	0.0036
162.000	-151	150	-301	-150	153	-303	-2	0.0048
164.000	-74	70	-144	-71	71	-142	2	0.0060
166.000	-71	65	-136	-67	66	-133	3	0.0048
168.000	26	-31	57	30	-30	60	3	0.0030
170.000	204	-209	413	209	-207	416	3	0.0012
172.000	271	-273	544	274	-270	544	0	-0.0006
174.000	266	-271	537	277	-275	552	15	-0.0006
176.000	195	-199	394	190	-189	379	-15	-0.0096
178.000	91	-95	186	95	-93	188	2	-0.0006
180.000	3	-7	10	6	-5	11	1	-0.0018
182.000	-103	101	-204	-100	105	-205	-1	-0.0024
184.000	-98	94	-192	-95	97	-192	0	-0.0018
186.000	-67	63	-130	-64	65	-129	1	-0.0018
188.000	-103	99	-202	-99	103	-202	0	-0.0024
190.000	-127	124	-251	-125	127	-252	-1	-0.0024
192.000	-120	120	-240	-117	122	-239	1	-0.0018
194.000	-113	107	-220	-110	111	-221	-1	-0.0024
196.000	-81	77	-158	-77	78	-155	3	-0.0018
198.000	-99	96	-195	-98	100	-198	-3	-0.0036

SENSOR: 26087

DEPTH	PREVIOUS DATA A0	PREVIOUS DATA A180	PREVIOUS DATA DIFF	CURRENT DATA A0	CURRENT DATA A180	CURRENT DATA DIFF	CHANGE	CUM.DISP. IN.
200.000	-107	103	-210	-103	106	-209	1	-0.0018
202.000	-107	103	-210	-103	107	-210	0	-0.0024
204.000	-109	104	-213	-107	110	-217	-4	-0.0024

END OF RECORDS

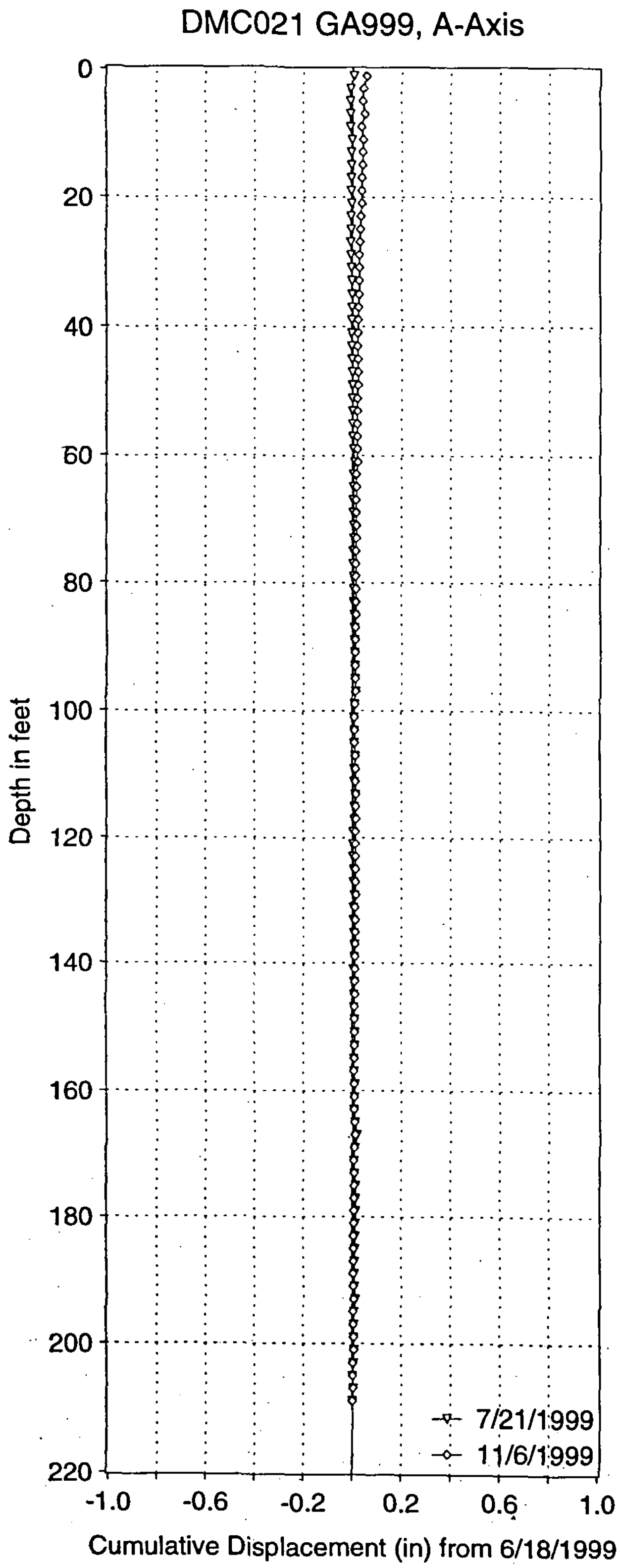
ENSOR: 26087

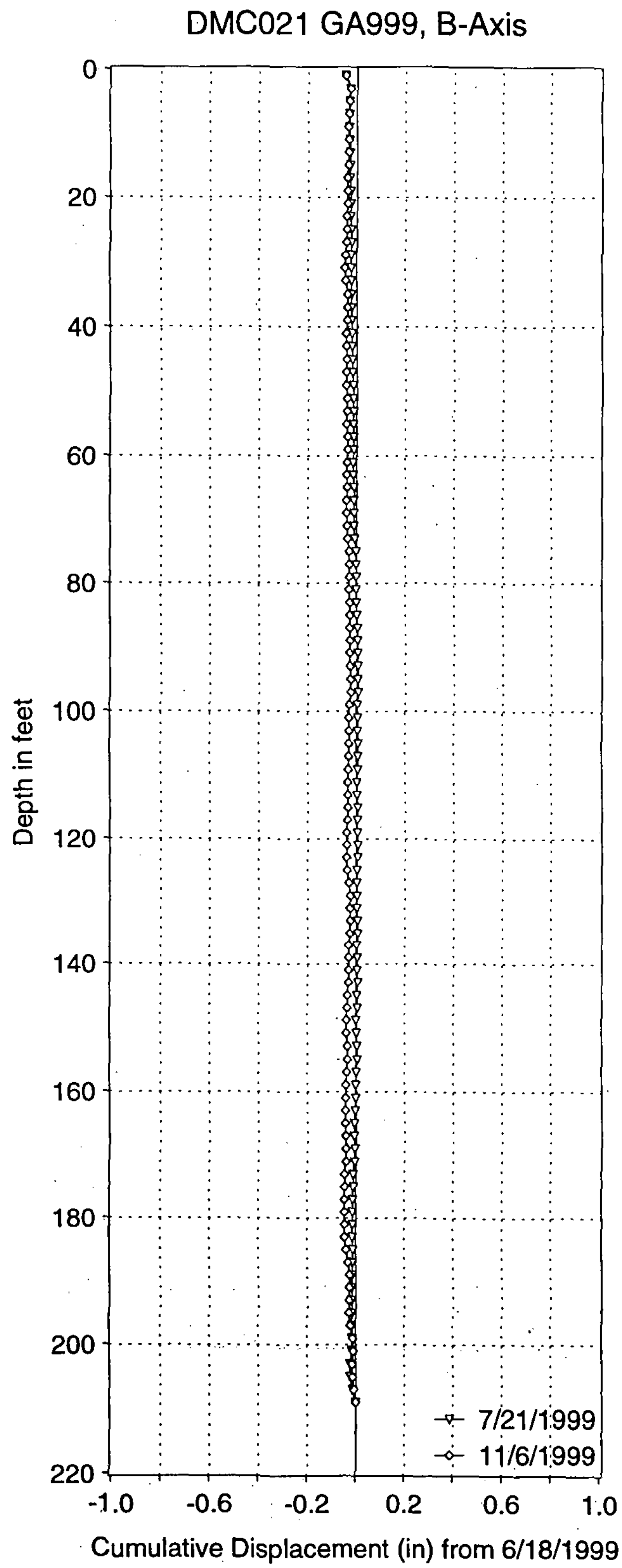
DEPTH	PREVIOUS DATA B0	PREVIOUS DATA B180	PREVIOUS DATA DIFF	CURRENT DATA B0	CURRENT DATA B180	CURRENT DATA DIFF	CHANGE	CUM.DISP. IN.
2.000	-247	226	-473	-222	192	-414	59	-0.0036
4.000	-267	214	-481	-283	239	-522	-41	-0.0390
6.000	-237	105	-342	-220	189	-409	-67	-0.0144
8.000	-153	127	-280	-157	102	-259	21	0.0258
10.000	-165	53	-218	-164	122	-286	-68	0.0132
12.000	-71	53	-124	-73	47	-120	4	0.0540
14.000	62	-120	182	59	-119	178	-4	0.0516
16.000	109	-133	242	109	-151	260	18	0.0540
18.000	94	-100	194	89	-124	213	19	0.0432
20.000	37	-40	77	30	-66	96	19	0.0318
22.000	-41	5	-46	-49	7	-56	-10	0.0204
24.000	-53	58	-111	-55	7	-62	49	0.0264
26.000	-91	96	-187	-94	55	-149	38	-0.0030
28.000	-145	101	-246	-133	91	-224	22	-0.0258
30.000	-147	103	-250	-137	97	-234	16	-0.0390
32.000	-150	98	-248	-137	99	-236	12	-0.0486
34.000	-126	77	-203	-133	92	-225	-22	-0.0558
36.000	-96	159	-255	-111	71	-182	73	-0.0426
38.000	-183	177	-360	-190	157	-347	13	-0.0864
40.000	-219	175	-394	-211	171	-382	12	-0.0942
42.000	-213	175	-388	-210	169	-379	9	-0.1014
44.000	-115	93	-208	-121	85	-206	2	-0.1068
46.000	5	-40	45	1	-45	46	1	-0.1080
48.000	5	-23	28	-4	-29	25	-3	-0.1086
50.000	-111	82	-193	-119	87	-206	-13	-0.1068
52.000	-120	83	-203	-118	77	-195	8	-0.0990
54.000	-89	45	-134	-98	49	-147	-13	-0.1038
56.000	-78	50	-128	-81	51	-132	-4	-0.0960
58.000	-177	141	-318	-178	140	-318	0	-0.0936
60.000	-86	64	-150	-92	65	-157	-7	-0.0936
62.000	-204	165	-369	-205	165	-370	-1	-0.0894
64.000	-161	132	-293	-178	135	-313	-20	-0.0888
66.000	-219	175	-394	-210	170	-380	14	-0.0768
68.000	-162	118	-280	-171	134	-305	-25	-0.0852
70.000	-189	141	-330	-193	155	-348	-18	-0.0702
72.000	-254	210	-464	-260	221	-481	-17	-0.0594
74.000	-295	246	-541	-297	243	-540	1	-0.0492
76.000	-302	254	-556	-293	250	-543	13	-0.0498
78.000	-243	195	-438	-239	191	-430	8	-0.0576
80.000	-202	153	-355	-205	147	-352	3	-0.0624
82.000	-174	125	-299	-178	119	-297	2	-0.0642
84.000	-169	118	-287	-173	115	-288	-1	-0.0654
86.000	-153	107	-260	-156	113	-269	-9	-0.0648
88.000	-167	117	-284	-173	112	-285	-1	-0.0594
90.000	-145	94	-239	-147	89	-236	3	-0.0588
92.000	-122	74	-196	-127	87	-214	-18	-0.0606
94.000	-157	112	-269	-162	124	-286	-17	-0.0498
96.000	-186	140	-326	-191	152	-343	-17	-0.0396
98.000	-219	171	-390	-226	175	-401	-11	-0.0294
100.000	-242	193	-435	-248	190	-438	-3	-0.0228
102.000	-250	203	-453	-256	199	-455	-2	-0.0210
104.000	-234	186	-420	-239	185	-424	-4	-0.0198
106.000	-233	202	-435	-233	198	-431	4	-0.0174
108.000	-157	107	-264	-154	103	-257	7	-0.0198

ENSOR: 26087

DEPTH	PREVIOUS DATA B0	B180	DIFF	CURRENT DATA B0	B180	DIFF	CHANGE	CUM.DISP. IN.
110.000	-137	107	-244	-142	103	-245	-1	-0.0240
112.000	-221	195	-416	-227	193	-420	-4	-0.0234
114.000	-325	294	-619	-332	293	-625	-6	-0.0210
116.000	-377	345	-722	-381	341	-722	0	-0.0174
118.000	-429	385	-814	-434	390	-824	-10	-0.0174
120.000	-448	402	-850	-436	397	-833	17	-0.0114
122.000	-389	360	-749	-390	354	-744	5	-0.0216
124.000	-263	231	-494	-267	226	-493	1	-0.0246
126.000	-211	171	-382	-214	170	-384	-2	-0.0252
128.000	-141	99	-240	-134	93	-227	13	-0.0240
130.000	-87	46	-133	-99	41	-140	-7	-0.0318
132.000	-85	38	-123	-91	47	-138	-15	-0.0276
134.000	-121	73	-194	-124	75	-199	-5	-0.0186
136.000	-113	88	-201	-119	82	-201	0	-0.0156
138.000	-159	124	-283	-165	126	-291	-8	-0.0156
140.000	-214	165	-379	-221	178	-399	-20	-0.0108
142.000	-249	204	-453	-253	205	-458	-5	0.0012
144.000	-265	217	-482	-253	211	-464	18	0.0042
146.000	-235	208	-443	-238	202	-440	3	-0.0066
148.000	-172	152	-324	-175	146	-321	3	-0.0084
150.000	-164	143	-307	-169	139	-308	-1	-0.0102
152.000	-133	103	-236	-133	97	-230	6	-0.0096
154.000	11	-46	57	11	-50	61	4	-0.0132
156.000	-78	45	-123	-83	43	-126	-3	-0.0156
158.000	0	-38	38	-3	-30	27	-11	-0.0138
160.000	-63	20	-83	-67	18	-85	-2	-0.0072
162.000	-66	28	-94	-71	26	-97	-3	-0.0060
164.000	-96	54	-150	-98	55	-153	-3	-0.0042
166.000	-90	42	-132	-79	38	-117	15	-0.0024
168.000	-43	11	-54	-49	12	-61	-7	-0.0114
170.000	-98	72	-170	-104	72	-176	-6	-0.0072
172.000	-192	149	-341	-196	163	-359	-18	-0.0036
174.000	-244	198	-442	-245	197	-442	0	0.0072
176.000	-254	222	-476	-252	218	-470	6	0.0072
178.000	-161	112	-273	-146	109	-255	18	0.0036
180.000	-107	57	-164	-96	53	-149	15	-0.0072
182.000	-62	19	-81	-68	34	-102	-21	-0.0162
184.000	-107	70	-177	-113	81	-194	-17	-0.0036
186.000	-138	111	-249	-139	106	-245	4	0.0066
188.000	-118	73	-191	-122	76	-198	-7	0.0042
190.000	-157	110	-267	-163	107	-270	-3	0.0084
192.000	-164	115	-279	-162	112	-274	5	0.0102
194.000	-143	94	-237	-140	91	-231	6	0.0072
196.000	-134	89	-223	-127	86	-213	10	0.0036
198.000	-103	69	-172	-107	78	-185	-13	-0.0024
200.000	-120	94	-214	-122	91	-213	1	0.0054
202.000	-157	129	-286	-160	132	-292	-6	0.0048
204.000	-215	198	-413	-206	193	-399	14	0.0084

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

XL-0749 SR 101
MP 322 SLIDE
GA9-99 A+ = N63 deg.

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA999
Site description SR 101 MP 322 SLIDE

	PREVIOUS		CURRENT	
DATA SET #	1		3	
SENSOR #	26087		26087	
DATE	06/18/99	06:34	11/06/99	09:24
READINGS PER DIRECTION	104		104	

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	78	-66	144	86	-76	162	18	0.0564
4.000	-147	145	-292	-146	142	-288	4	0.0456
6.000	-209	213	-422	-218	216	-434	-12	0.0432
8.000	-210	218	-428	-203	202	-405	23	0.0504
10.000	-209	215	-424	-217	217	-434	-10	0.0366
12.000	-165	173	-338	-166	168	-334	4	0.0426
14.000	-220	225	-445	-223	221	-444	1	0.0402
16.000	-225	232	-457	-227	227	-454	3	0.0396
18.000	-242	247	-489	-245	242	-487	2	0.0378
20.000	-272	271	-543	-274	268	-542	1	0.0366
22.000	-245	252	-497	-247	246	-493	4	0.0360
24.000	-218	224	-442	-218	221	-439	3	0.0336
26.000	-223	230	-453	-225	227	-452	1	0.0318
28.000	-223	230	-453	-224	227	-451	2	0.0312
30.000	-190	192	-382	-193	189	-382	0	0.0300
32.000	-186	193	-379	-186	191	-377	2	0.0300
34.000	-179	185	-364	-179	182	-361	3	0.0288
36.000	-191	193	-384	-192	189	-381	3	0.0270
38.000	-186	196	-382	-186	191	-377	5	0.0252
40.000	-210	211	-421	-213	207	-420	1	0.0222
42.000	-166	176	-342	-166	175	-341	1	0.0216
44.000	-203	211	-414	-206	210	-416	-2	0.0210
46.000	-187	193	-380	-189	191	-380	0	0.0222
48.000	-189	196	-385	-190	194	-384	1	0.0222
50.000	-190	197	-387	-189	194	-383	4	0.0216
52.000	-159	171	-330	-162	169	-331	-1	0.0192
54.000	-137	145	-282	-138	143	-281	1	0.0198
56.000	-148	150	-298	-149	149	-298	0	0.0192
58.000	-135	145	-280	-137	143	-280	0	0.0192
60.000	-148	164	-312	-154	165	-319	-7	0.0192
62.000	-163	166	-329	-159	158	-317	12	0.0234
64.000	-138	146	-284	-139	144	-283	1	0.0162
66.000	-147	160	-307	-149	158	-307	0	0.0156
68.000	-197	203	-400	-198	201	-399	1	0.0156
70.000	-221	230	-451	-223	229	-452	-1	0.0150
72.000	-239	242	-481	-241	240	-481	0	0.0156
74.000	-285	295	-580	-285	293	-578	2	0.0156
76.000	-310	322	-632	-310	320	-630	2	0.0144
78.000	-350	358	-708	-351	358	-709	-1	0.0132
80.000	-327	326	-653	-330	327	-657	-4	0.0138
82.000	-259	269	-528	-261	263	-524	4	0.0162
84.000	-288	296	-584	-290	294	-584	0	0.0138
86.000	-310	318	-628	-310	315	-625	3	0.0138
88.000	-344	358	-702	-345	355	-700	2	0.0120
90.000	-355	367	-722	-357	363	-720	2	0.0108

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	-291	297	-588	-294	296	-590	-2	0.0096
94.000	-266	277	-543	-267	275	-542	1	0.0108
96.000	-218	236	-454	-222	234	-456	-2	0.0102
98.000	-172	171	-343	-175	168	-343	0	0.0114
100.000	-121	137	-258	-121	134	-255	3	0.0114
102.000	-194	213	-407	-197	210	-407	0	0.0096
104.000	-173	171	-344	-175	170	-345	-1	0.0096
106.000	-10	18	-28	-15	17	-32	-4	0.0102
108.000	-255	258	-513	-255	258	-513	0	0.0126
110.000	-308	321	-629	-311	317	-628	1	0.0126
112.000	-265	278	-543	-269	276	-545	-2	0.0120
114.000	-222	230	-452	-222	228	-450	2	0.0132
116.000	-226	233	-459	-229	231	-460	-1	0.0120
118.000	-225	231	-456	-225	230	-455	1	0.0126
120.000	-241	251	-492	-243	248	-491	1	0.0120
122.000	-252	258	-510	-255	257	-512	-2	0.0114
124.000	-227	238	-465	-231	235	-466	-1	0.0126
126.000	-264	275	-539	-263	273	-536	3	0.0132
128.000	-266	276	-542	-270	274	-544	-2	0.0114
130.000	-245	253	-498	-246	249	-495	3	0.0126
132.000	-317	324	-641	-318	324	-642	-1	0.0108
134.000	-324	334	-658	-326	331	-657	1	0.0114
136.000	-232	237	-469	-236	234	-470	-1	0.0108
138.000	-224	235	-459	-226	231	-457	2	0.0114
140.000	-237	245	-482	-238	242	-480	2	0.0102
142.000	-293	303	-596	-295	302	-597	-1	0.0090
144.000	-208	223	-431	-211	221	-432	-1	0.0096
146.000	-225	223	-448	-227	221	-448	0	0.0102
148.000	-100	113	-213	-102	109	-211	2	0.0102
150.000	-79	85	-164	-82	82	-164	0	0.0090
152.000	-171	181	-352	-171	180	-351	1	0.0090
154.000	-249	257	-506	-247	255	-502	4	0.0084
156.000	-355	363	-718	-357	361	-718	0	0.0060
158.000	-181	185	-366	-186	183	-369	-3	0.0060
160.000	-125	136	-261	-126	134	-260	1	0.0078
162.000	-310	322	-632	-312	318	-630	2	0.0072
164.000	-254	272	-526	-258	270	-528	-2	0.0060
166.000	-103	115	-218	-109	113	-222	-4	0.0072
168.000	-67	69	-136	-66	66	-132	4	0.0096
170.000	-185	201	-386	-186	199	-385	1	0.0072
172.000	-198	210	-408	-201	208	-409	-1	0.0066
174.000	-117	126	-243	-121	123	-244	-1	0.0072
176.000	-71	78	-149	-74	74	-148	1	0.0078
178.000	-40	51	-91	-42	47	-89	2	0.0072
180.000	-64	69	-133	-66	66	-132	1	0.0060
182.000	-69	81	-150	-71	79	-150	0	0.0054
184.000	-118	127	-245	-119	125	-244	1	0.0054
186.000	-228	237	-465	-230	234	-464	1	0.0048
188.000	-271	282	-553	-273	278	-551	2	0.0042
190.000	-258	271	-529	-261	267	-528	1	0.0030
192.000	-207	218	-425	-210	218	-428	-3	0.0024
194.000	-231	240	-471	-234	238	-472	-1	0.0042
196.000	-311	318	-629	-312	317	-629	0	0.0048
198.000	-318	325	-643	-323	323	-646	-3	0.0048

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
200.000	-247	256	-503	-251	251	-502	1	0.0066
202.000	-174	185	-359	-177	175	-352	7	0.0060
204.000	-185	194	-379	-186	190	-376	3	0.0018
206.000	-135	143	-278	-141	142	-283	-5	0.0000
208.000	61	-57	118	65	-58	123	5	0.0030

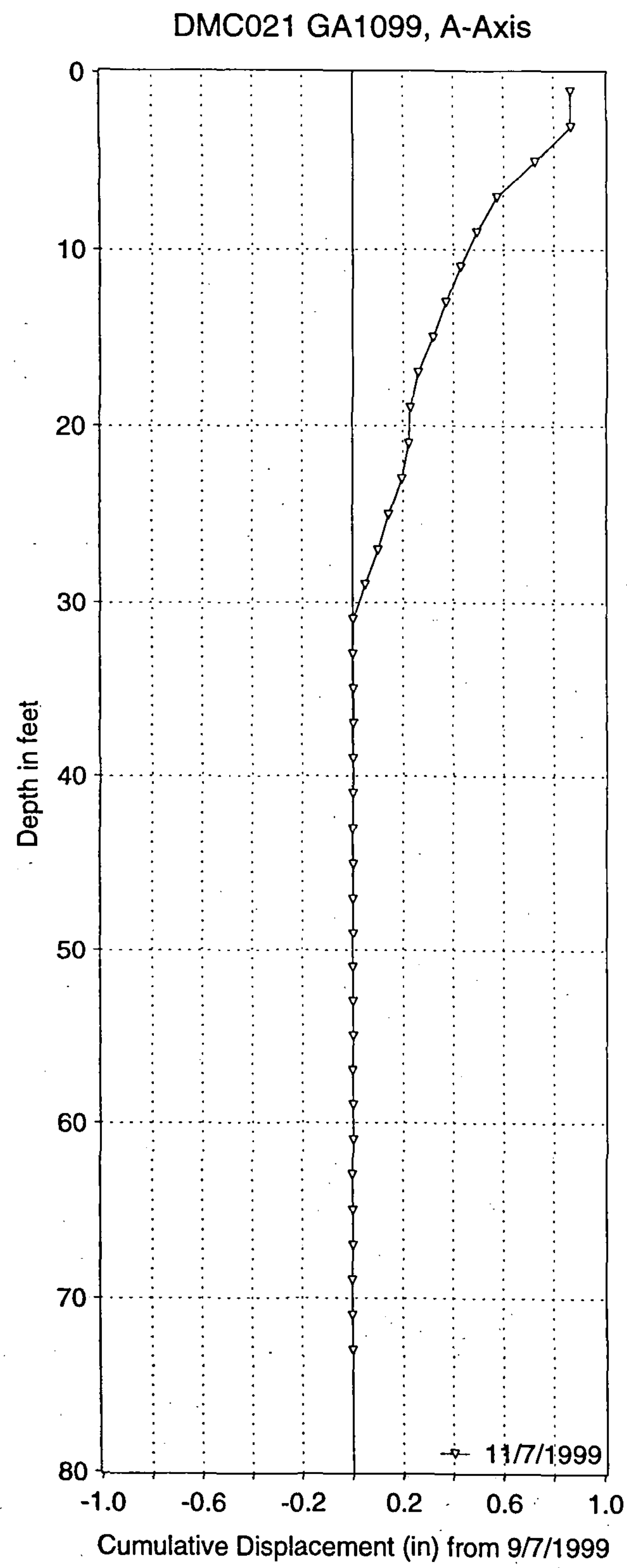
END OF RECORDS

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	929	-1013	1942	923	-985	1908	-34	-0.1098
4.000	1041	-1099	2140	1051	-1089	2140	0	-0.0894
6.000	1110	-1173	2283	1123	-1163	2286	3	-0.0894
8.000	1144	-1205	2349	1158	-1197	2355	6	-0.0912
10.000	1186	-1248	2434	1197	-1235	2432	-2	-0.0948
12.000	1211	-1283	2494	1222	-1272	2494	0	-0.0936
14.000	1169	-1234	2403	1181	-1224	2405	2	-0.0936
16.000	1085	-1149	2234	1097	-1139	2236	2	-0.0948
18.000	1015	-1085	2100	1029	-1070	2099	-1	-0.0960
20.000	986	-1034	2020	998	-1023	2021	1	-0.0954
22.000	903	-973	1876	917	-962	1879	3	-0.0960
24.000	913	-973	1886	925	-959	1884	-2	-0.0978
26.000	959	-1025	1984	973	-1014	1987	3	-0.0966
28.000	975	-1051	2026	988	-1038	2026	0	-0.0984
30.000	960	-1026	1986	974	-1017	1991	5	-0.0984
32.000	1019	-1081	2100	1028	-1067	2095	-5	-0.1014
34.000	1039	-1106	2145	1040	-1091	2131	-14	-0.0984
36.000	1046	-1109	2155	1059	-1098	2157	2	-0.0900
38.000	1016	-1075	2091	1029	-1063	2092	1	-0.0912
40.000	1021	-1086	2107	1034	-1078	2112	5	-0.0918
42.000	978	-1049	2027	989	-1035	2024	-3	-0.0948
44.000	1012	-1089	2101	1023	-1075	2098	-3	-0.0930
46.000	988	-1057	2045	1003	-1045	2048	3	-0.0912
48.000	996	-1059	2055	1009	-1046	2055	0	-0.0930
50.000	1026	-1091	2117	1034	-1077	2111	-6	-0.0930
52.000	1042	-1124	2166	1054	-1109	2163	-3	-0.0894
54.000	1026	-1095	2121	1038	-1083	2121	0	-0.0876
56.000	1061	-1131	2192	1066	-1118	2184	-8	-0.0876
58.000	1047	-1109	2156	1061	-1095	2156	0	-0.0828
60.000	1054	-1108	2162	1068	-1095	2163	1	-0.0828
62.000	1086	-1150	2236	1100	-1139	2239	3	-0.0834
64.000	1083	-1150	2233	1094	-1136	2230	-3	-0.0852
66.000	1054	-1123	2177	1067	-1111	2178	1	-0.0834
68.000	1042	-1121	2163	1055	-1108	2163	0	-0.0840
70.000	1030	-1086	2116	1038	-1074	2112	-4	-0.0840
72.000	1038	-1109	2147	1049	-1094	2143	-4	-0.0816
74.000	1006	-1077	2083	1009	-1063	2072	-11	-0.0792
76.000	991	-1053	2044	999	-1039	2038	-6	-0.0726
78.000	962	-1031	1993	975	-1017	1992	-1	-0.0690
80.000	1049	-1112	2161	1064	-1098	2162	1	-0.0684
82.000	1069	-1122	2191	1079	-1108	2187	-4	-0.0690
84.000	968	-1033	2001	981	-1019	2000	-1	-0.0666
86.000	1045	-1102	2147	1057	-1090	2147	0	-0.0660
88.000	1041	-1113	2154	1052	-1099	2151	-3	-0.0660
90.000	1028	-1097	2125	1042	-1087	2129	4	-0.0642
92.000	1050	-1117	2167	1058	-1101	2159	-8	-0.0666
94.000	1051	-1116	2167	1063	-1102	2165	-2	-0.0618
96.000	1130	-1179	2309	1143	-1165	2308	-1	-0.0606
98.000	1232	-1290	2522	1246	-1281	2527	5	-0.0600
100.000	1151	-1194	2345	1163	-1183	2346	1	-0.0630
102.000	1019	-1069	2088	1033	-1054	2087	-1	-0.0636
104.000	1111	-1157	2268	1122	-1143	2265	-3	-0.0630
106.000	1234	-1283	2517	1247	-1271	2518	1	-0.0612
108.000	1153	-1215	2368	1168	-1203	2371	3	-0.0618

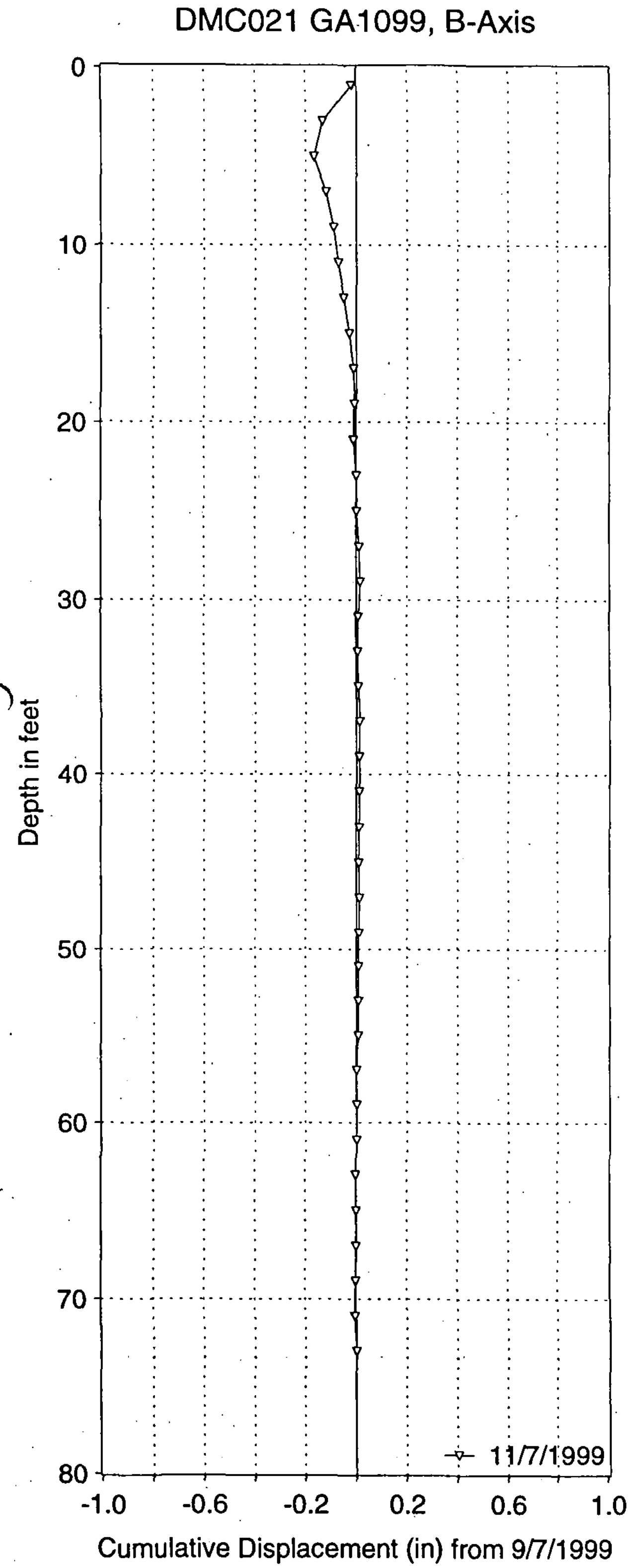
SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
110.000	1068	-1125	2193	1083	-1113	2196	3	-0.0636
112.000	1009	-1076	2085	1023	-1062	2085	0	-0.0654
114.000	1063	-1125	2188	1076	-1111	2187	-1	-0.0654
116.000	1051	-1128	2179	1065	-1114	2179	0	-0.0648
118.000	1019	-1095	2114	1033	-1085	2118	4	-0.0648
120.000	1028	-1077	2105	1041	-1063	2104	-1	-0.0672
122.000	983	-1046	2029	998	-1033	2031	2	-0.0666
124.000	956	-1023	1979	961	-1010	1971	-8	-0.0678
126.000	950	-1018	1968	953	-1004	1957	-11	-0.0630
128.000	961	-1034	1995	963	-1021	1984	-11	-0.0564
130.000	958	-1029	1987	972	-1014	1986	-1	-0.0498
132.000	941	-1007	1948	953	-993	1946	-2	-0.0492
134.000	899	-971	1870	913	-960	1873	3	-0.0480
136.000	962	-1014	1976	976	-1005	1981	5	-0.0498
138.000	903	-959	1862	914	-946	1860	-2	-0.0528
140.000	1002	-1060	2062	1014	-1050	2064	2	-0.0516
142.000	944	-1007	1951	958	-993	1951	0	-0.0528
144.000	886	-941	1827	902	-929	1831	4	-0.0528
146.000	970	-1025	1995	982	-1015	1997	2	-0.0552
148.000	844	-905	1749	859	-892	1751	2	-0.0564
150.000	899	-958	1857	913	-945	1858	1	-0.0576
152.000	925	-985	1910	933	-969	1902	-8	-0.0582
154.000	965	-1030	1995	977	-1016	1993	-2	-0.0534
156.000	862	-930	1792	877	-917	1794	2	-0.0522
158.000	867	-927	1794	881	-918	1799	5	-0.0534
160.000	786	-834	1620	799	-823	1622	2	-0.0564
162.000	726	-770	1496	741	-756	1497	1	-0.0576
164.000	777	-838	1615	791	-824	1615	0	-0.0582
166.000	725	-783	1508	737	-769	1506	-2	-0.0582
168.000	860	-916	1776	870	-900	1770	-6	-0.0570
170.000	857	-906	1763	869	-893	1762	-1	-0.0534
172.000	811	-867	1678	829	-857	1686	8	-0.0528
174.000	714	-783	1497	723	-770	1493	-4	-0.0576
176.000	676	-741	1417	691	-727	1418	1	-0.0552
178.000	603	-673	1276	618	-659	1277	1	-0.0558
180.000	568	-633	1201	581	-618	1199	-2	-0.0564
182.000	471	-530	1001	480	-517	997	-4	-0.0552
184.000	501	-571	1072	506	-558	1064	-8	-0.0528
186.000	461	-519	980	459	-506	965	-15	-0.0480
188.000	467	-531	998	466	-520	986	-12	-0.0390
190.000	489	-543	1032	503	-530	1033	1	-0.0318
192.000	521	-587	1108	535	-574	1109	1	-0.0324
194.000	605	-672	1277	618	-658	1276	-1	-0.0330
196.000	704	-762	1466	701	-751	1452	-14	-0.0324
198.000	723	-779	1502	718	-769	1487	-15	-0.0240
200.000	718	-777	1495	729	-762	1491	-4	-0.0150
202.000	667	-718	1385	683	-709	1392	7	-0.0126
204.000	533	-597	1130	548	-579	1127	-3	-0.0168
206.000	609	-649	1258	615	-631	1246	-12	-0.0150
208.000	869	-916	1785	872	-900	1772	-13	-0.0078

END OF RECORDS



Note: Casing Closed off on 11/12/99 at a depth of ~25 feet bgs



WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

XL-0749 SR 101
MP 322 SLIDE
GA-10-99
A+ = N114 deg.

DOT-50000306

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on November 8,1999
SITE: DMC021 HOLE NUMBER GA1099
Site description SR 101 MP 322 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	2
SENSOR #	26087	26087
DATE	09/07/99 08:43	11/07/99 08:34
READINGS PER DIRECTION	36	36

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	426	-432	858	425	-434	859	1	0.8688
4.000	288	-295	583	410	-415	825	242	0.8682
6.000	165	-169	334	289	-291	580	246	0.7230
8.000	159	-163	322	229	-229	458	136	0.5754
10.000	226	-228	454	281	-281	562	108	0.4938
12.000	293	-295	588	342	-342	684	96	0.4290
14.000	141	-146	287	183	-189	372	85	0.3714
16.000	158	-161	319	211	-210	421	102	0.3204
18.000	251	-254	505	277	-277	554	49	0.2592
20.000	316	-321	637	321	-324	645	8	0.2298
22.000	285	-286	571	312	-309	621	50	0.2250
24.000	131	-127	258	175	-168	343	85	0.1950
26.000	101	-108	209	139	-142	281	72	0.1440
28.000	113	-118	231	157	-160	317	86	0.1008
30.000	143	-147	290	183	-185	368	78	0.0492
32.000	74	-78	152	77	-77	154	2	0.0024
34.000	50	-53	103	50	-50	100	-3	0.0012
36.000	45	-47	92	46	-45	91	-1	0.0030
38.000	38	-40	78	41	-42	83	5	0.0036
40.000	-15	11	-26	-14	13	-27	-1	0.0006
42.000	-7	1	-8	-3	3	-6	2	0.0012
44.000	-18	15	-33	-20	17	-37	-4	0.0000
46.000	15	-21	36	19	-22	41	5	0.0024
48.000	71	-73	144	71	-71	142	-2	-0.0006
50.000	86	-92	178	89	-90	179	1	0.0006
52.000	82	-84	166	83	-83	166	0	0.0000
54.000	18	-23	41	19	-21	40	-1	0.0000
56.000	118	-121	239	122	-120	242	3	0.0006
58.000	161	-167	328	162	-165	327	-1	-0.0012
60.000	127	-130	257	128	-129	257	0	-0.0006
62.000	129	-132	261	131	-131	262	1	-0.0006
64.000	110	-107	217	109	-105	214	-3	-0.0012
66.000	139	-142	281	139	-142	281	0	0.0006
68.000	187	-193	380	191	-193	384	4	0.0006
70.000	236	-241	477	237	-239	476	-1	-0.0018
72.000	321	-322	643	322	-319	641	-2	-0.0012

END OF RECORDS

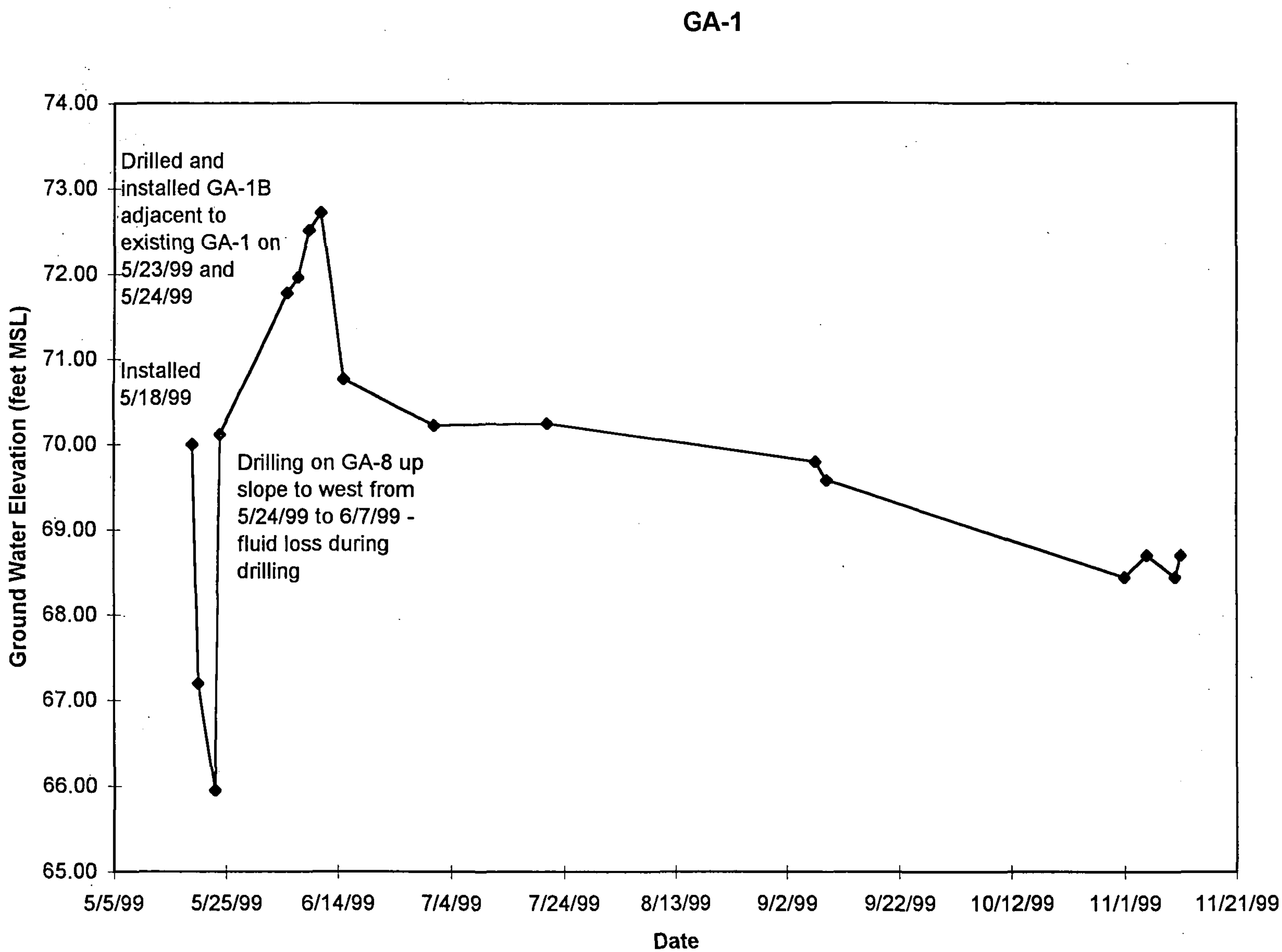
ENSOR: 26087

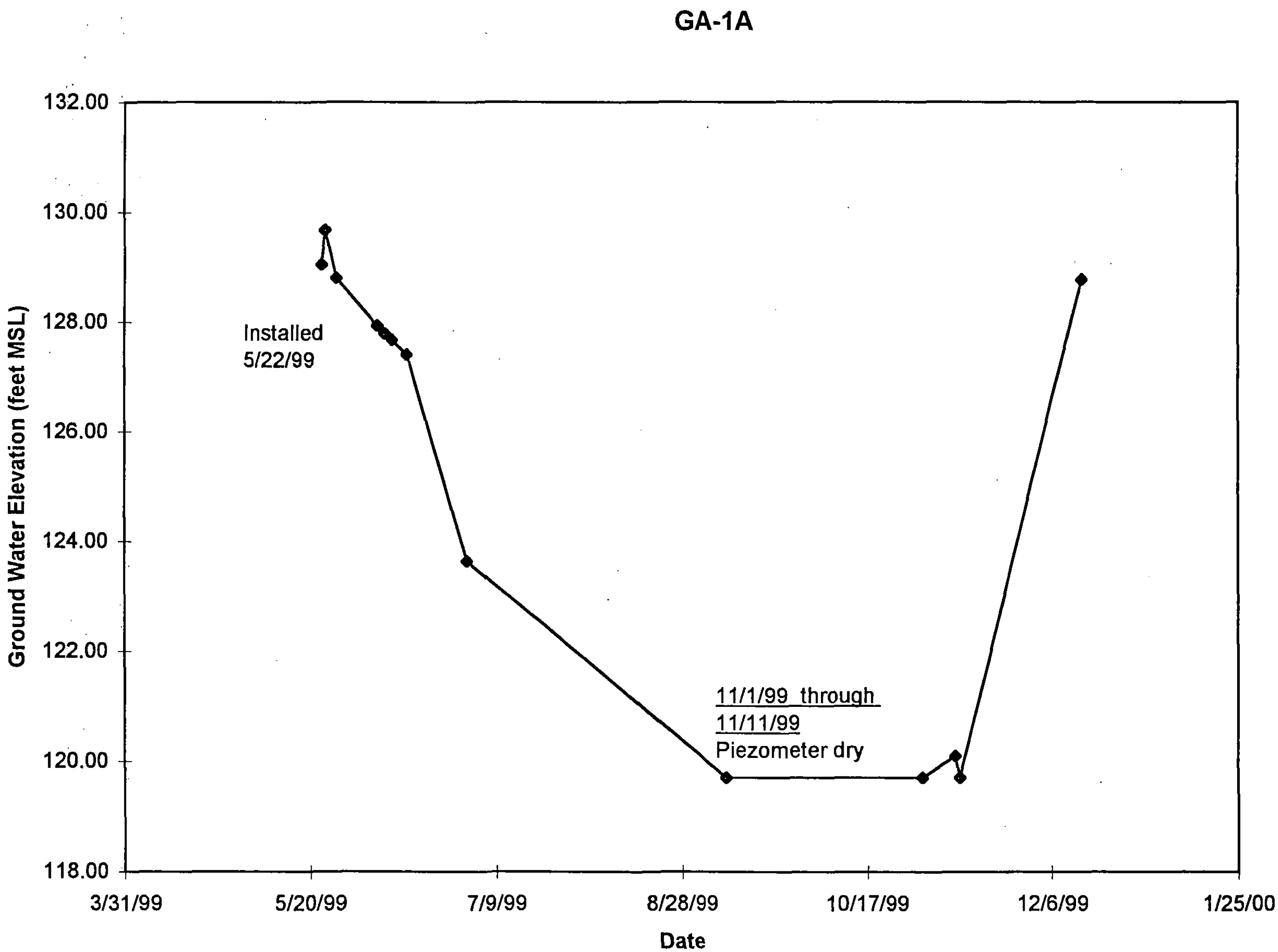
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	437	-485	922	539	-574	1113	191	-0.0186
4.000	453	-487	940	485	-513	998	58	-0.1332
6.000	504	-540	1044	465	-497	962	-82	-0.1680
8.000	523	-575	1098	499	-551	1050	-48	-0.1188
10.000	539	-584	1123	520	-573	1093	-30	-0.0900
12.000	532	-561	1093	513	-542	1055	-38	-0.0720
14.000	655	-683	1338	641	-662	1303	-35	-0.0492
16.000	711	-746	1457	698	-733	1431	-26	-0.0282
18.000	724	-771	1495	721	-766	1487	-8	-0.0126
20.000	722	-762	1484	724	-763	1487	3	-0.0078
22.000	625	-662	1287	617	-655	1272	-15	-0.0096
24.000	618	-644	1262	615	-642	1257	-5	-0.0006
26.000	793	-823	1616	787	-815	1602	-14	0.0024
28.000	834	-869	1703	831	-864	1695	-8	0.0108
30.000	684	-719	1403	692	-722	1414	11	0.0156
32.000	574	-608	1182	576	-611	1187	5	0.0090
34.000	474	-499	973	474	-495	969	-4	0.0060
36.000	437	-479	916	429	-480	909	-7	0.0084
38.000	451	-489	940	455	-487	942	2	0.0126
40.000	526	-565	1091	527	-563	1090	-1	0.0114
42.000	547	-583	1130	546	-585	1131	1	0.0120
44.000	573	-592	1165	574	-594	1168	3	0.0114
46.000	694	-732	1426	693	-730	1423	-3	0.0096
48.000	683	-725	1408	684	-729	1413	5	0.0114
50.000	655	-698	1353	655	-698	1353	0	0.0084
52.000	619	-661	1280	619	-663	1282	2	0.0084
54.000	626	-661	1287	630	-659	1289	2	0.0072
56.000	738	-771	1509	743	-774	1517	8	0.0060
58.000	827	-872	1699	825	-873	1698	-1	0.0012
60.000	839	-878	1717	843	-878	1721	4	0.0018
62.000	894	-926	1820	895	-927	1822	2	-0.0006
64.000	732	-757	1489	734	-753	1487	-2	-0.0018
66.000	701	-734	1435	702	-735	1437	2	-0.0006
68.000	727	-762	1489	727	-761	1488	-1	-0.0018
70.000	801	-839	1640	806	-842	1648	8	-0.0012
72.000	871	-894	1765	868	-887	1755	-10	-0.0060

END OF RECORDS

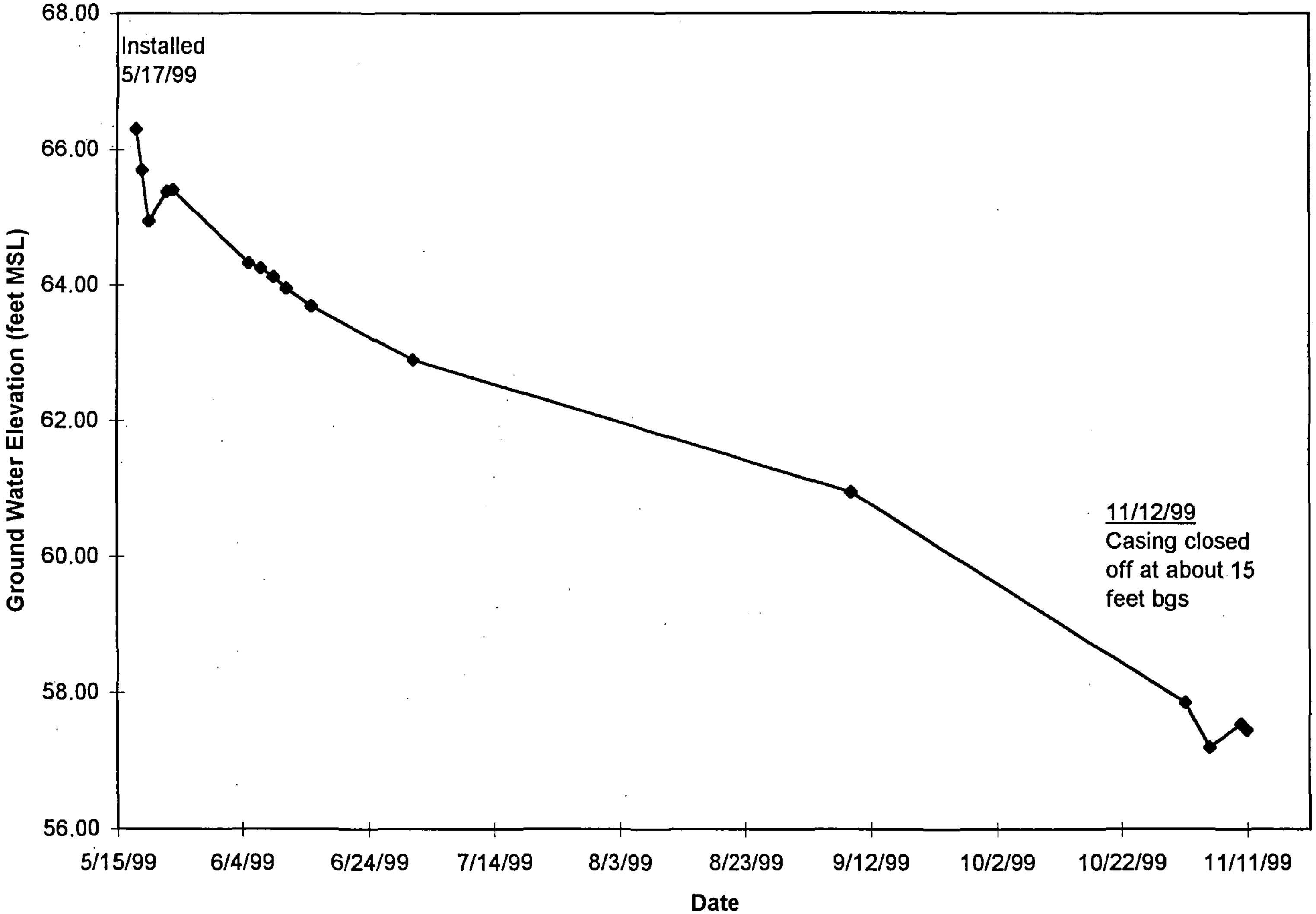
APPENDIX C

GROUNDWATER HYDROGRAPHS

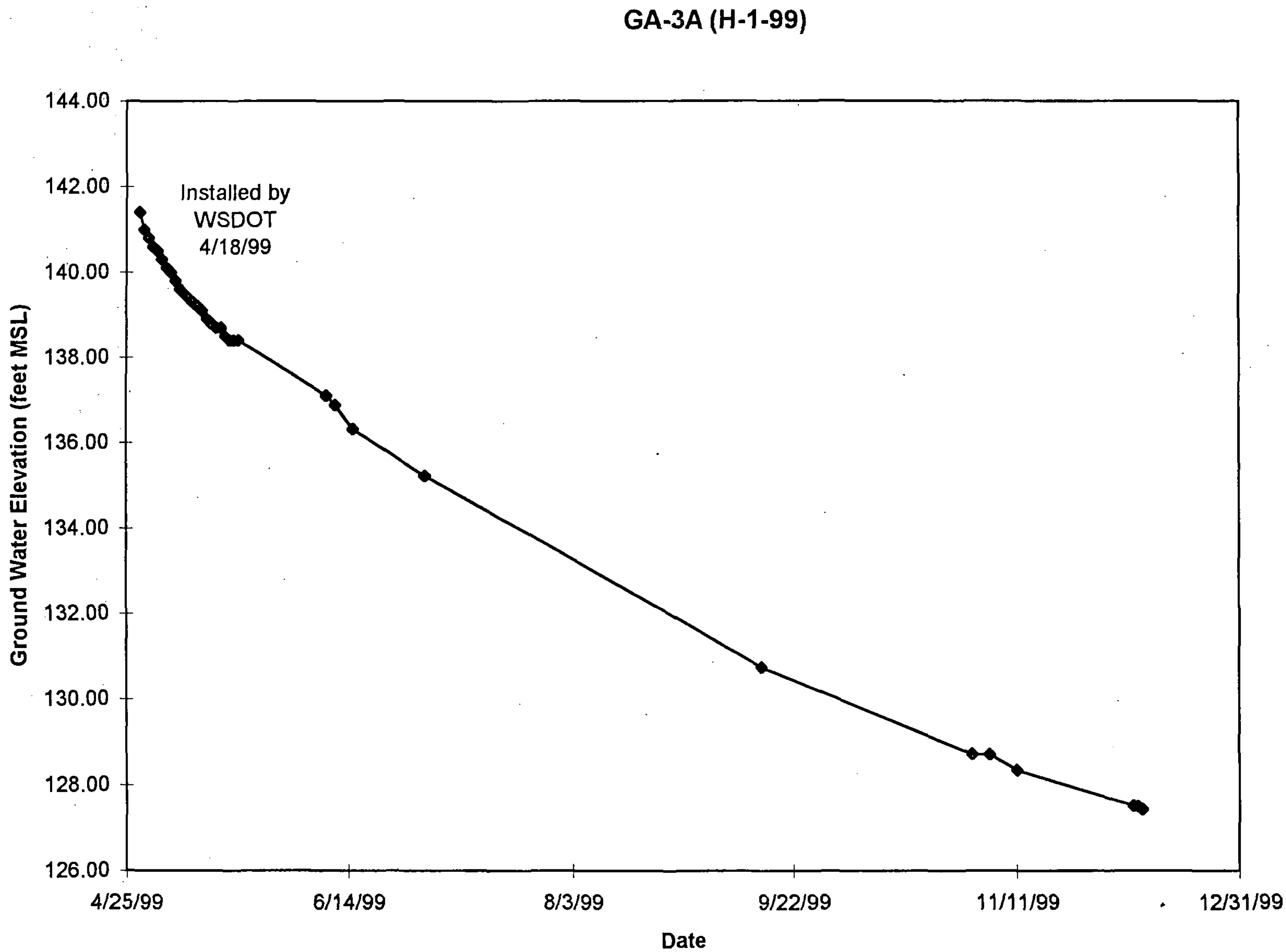

GA-1
Ground Water Elevation (feet MSL)
74.00
73.00
72.00
71.00
70.00
69.00
68.00
67.00
66.00
65.00
Drilled and installed GA-1B adjacent to existing GA-1 on 5/23/99 and 5/24/99
Installed 5/18/99
Drilling on GA-8 up slope to west from 5/24/99 to 6/7/99 - fluid loss during drilling
5/5/99
5/25/99
6/14/99
7/4/99
7/24/99
8/13/99
9/2/99
9/22/99
10/12/99
11/1/99
11/21/99
Date


GA-1A
Ground Water Elevation (feet MSL)
132.00
130.00
128.00
126.00
124.00
122.00
120.00
118.00
Installed
5/22/99
11/1/99 through
11/11/99
Piezometer dry
3/31/99
5/20/99
7/9/99
8/28/99
10/17/99
12/6/99
1/25/00
Date

GA-2

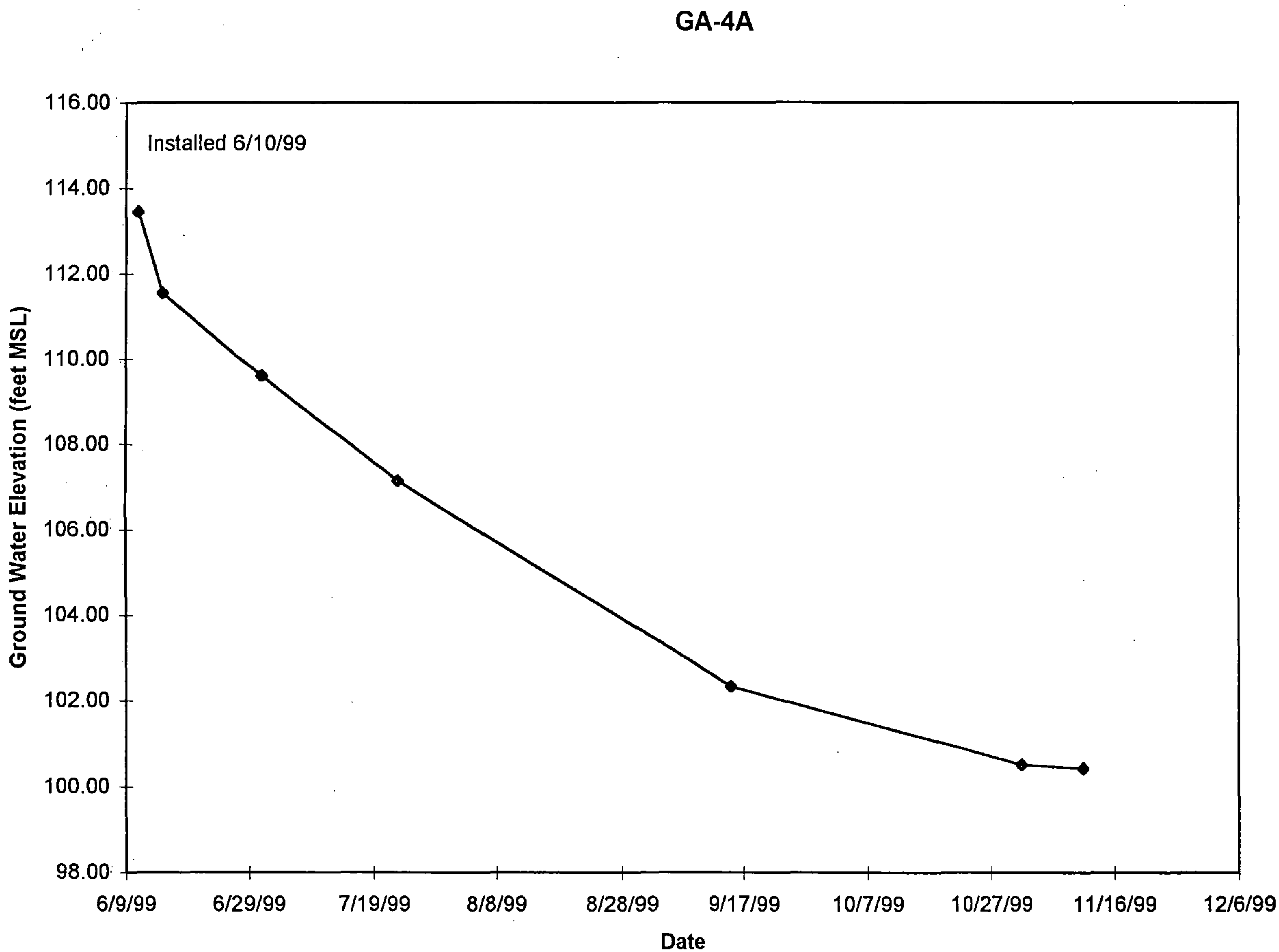


DOT-50000312



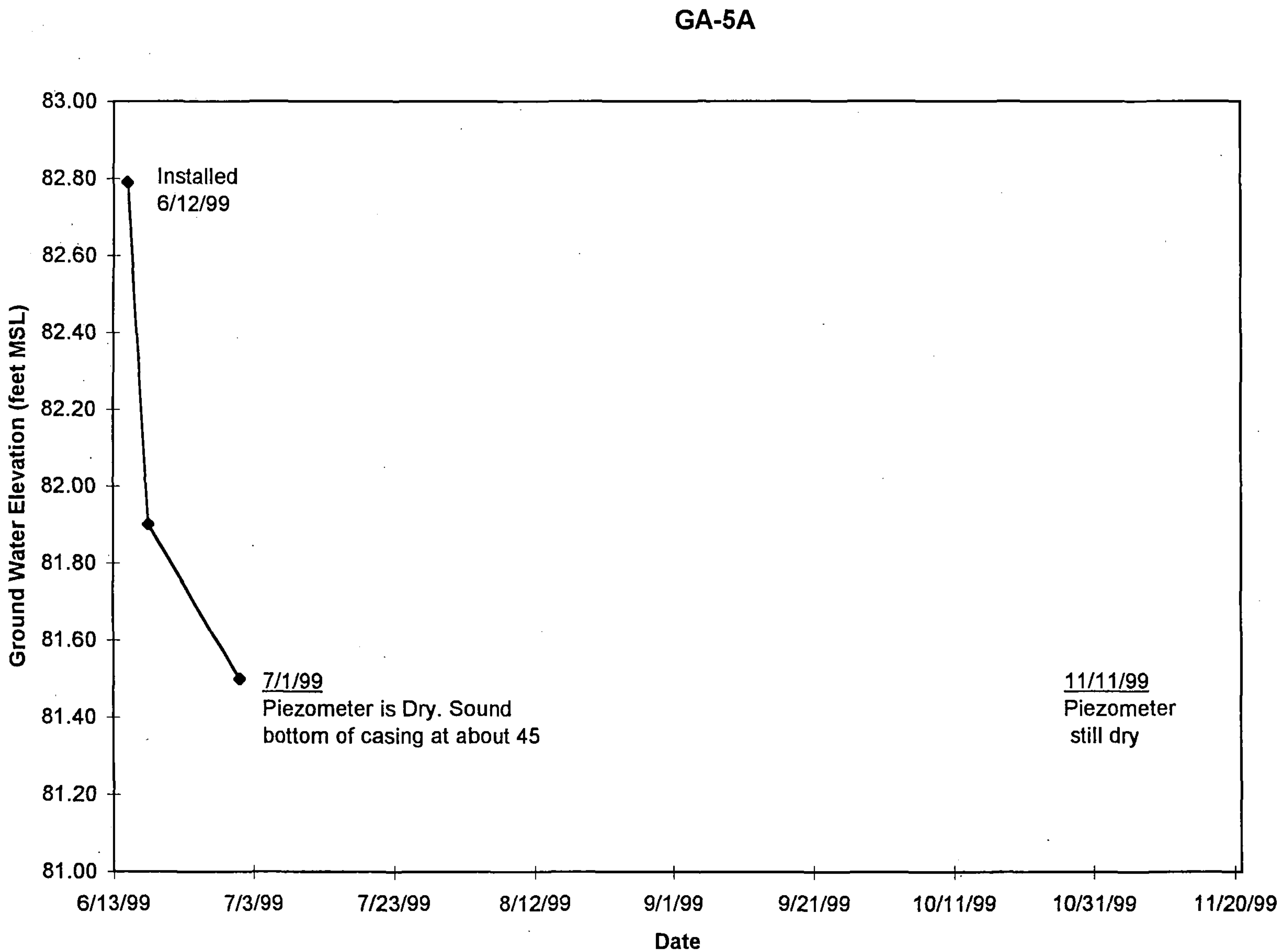
DOT-50000313

0201appc.xls



Golder Associates

DOT-50000314



DOT-50000315

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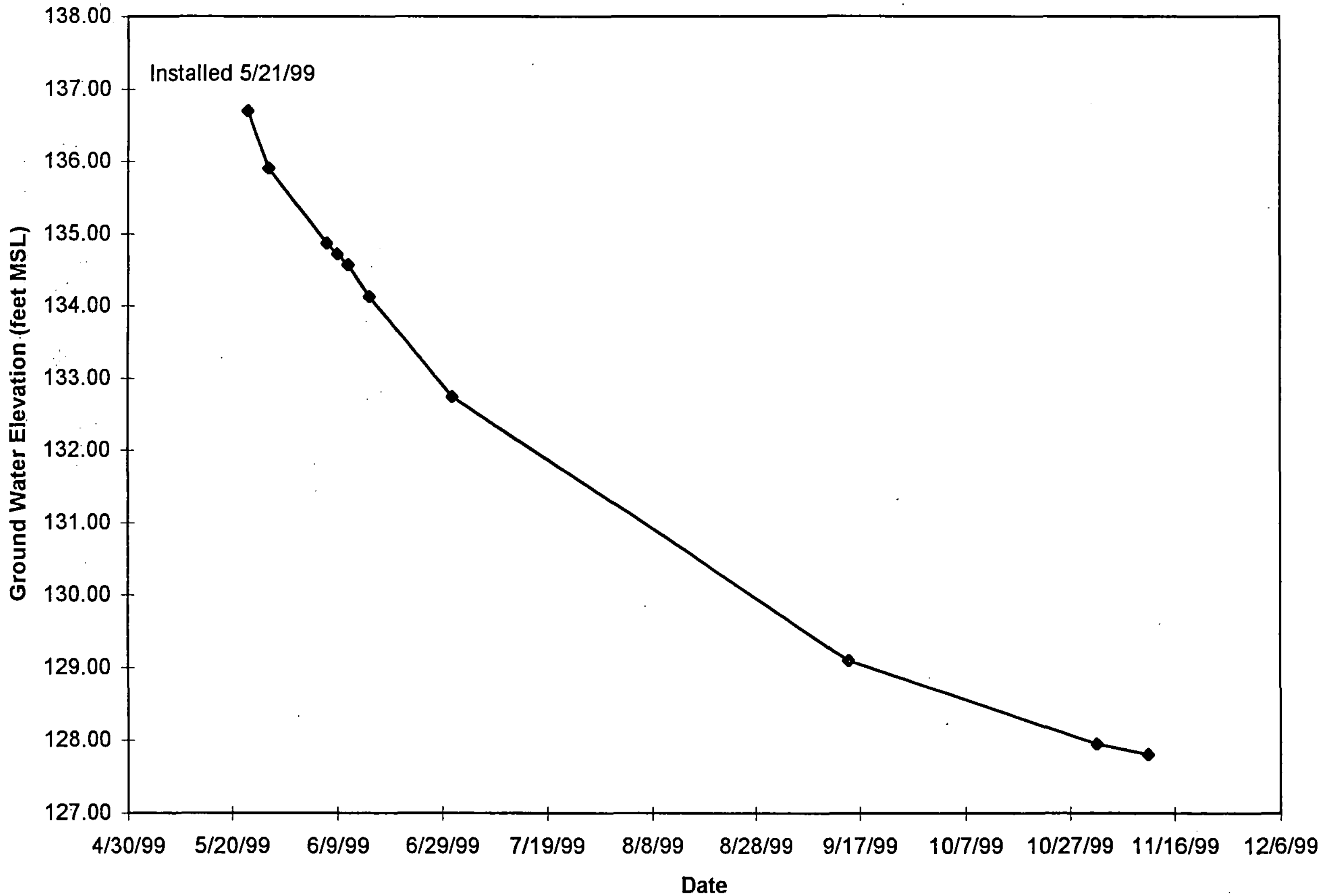
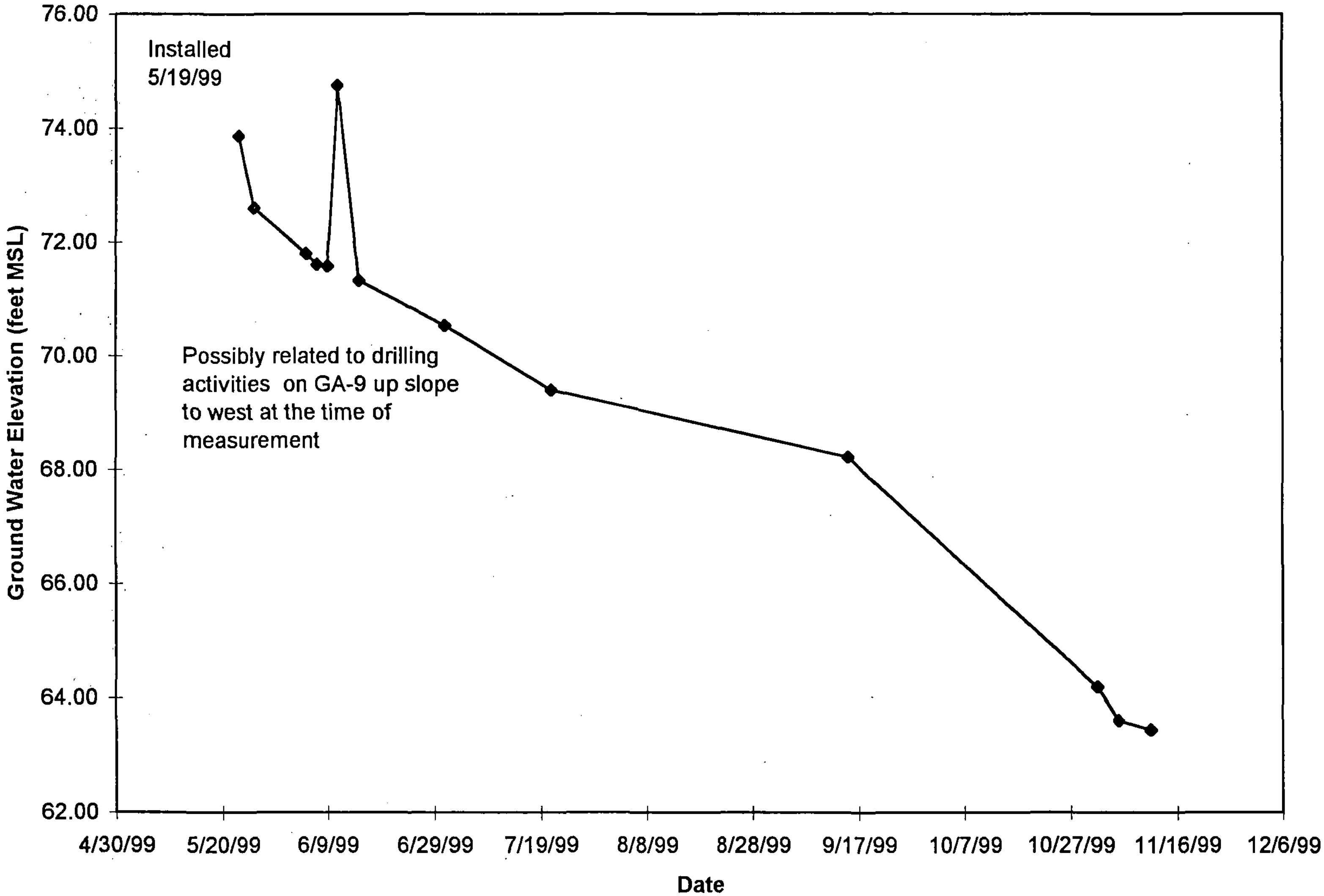
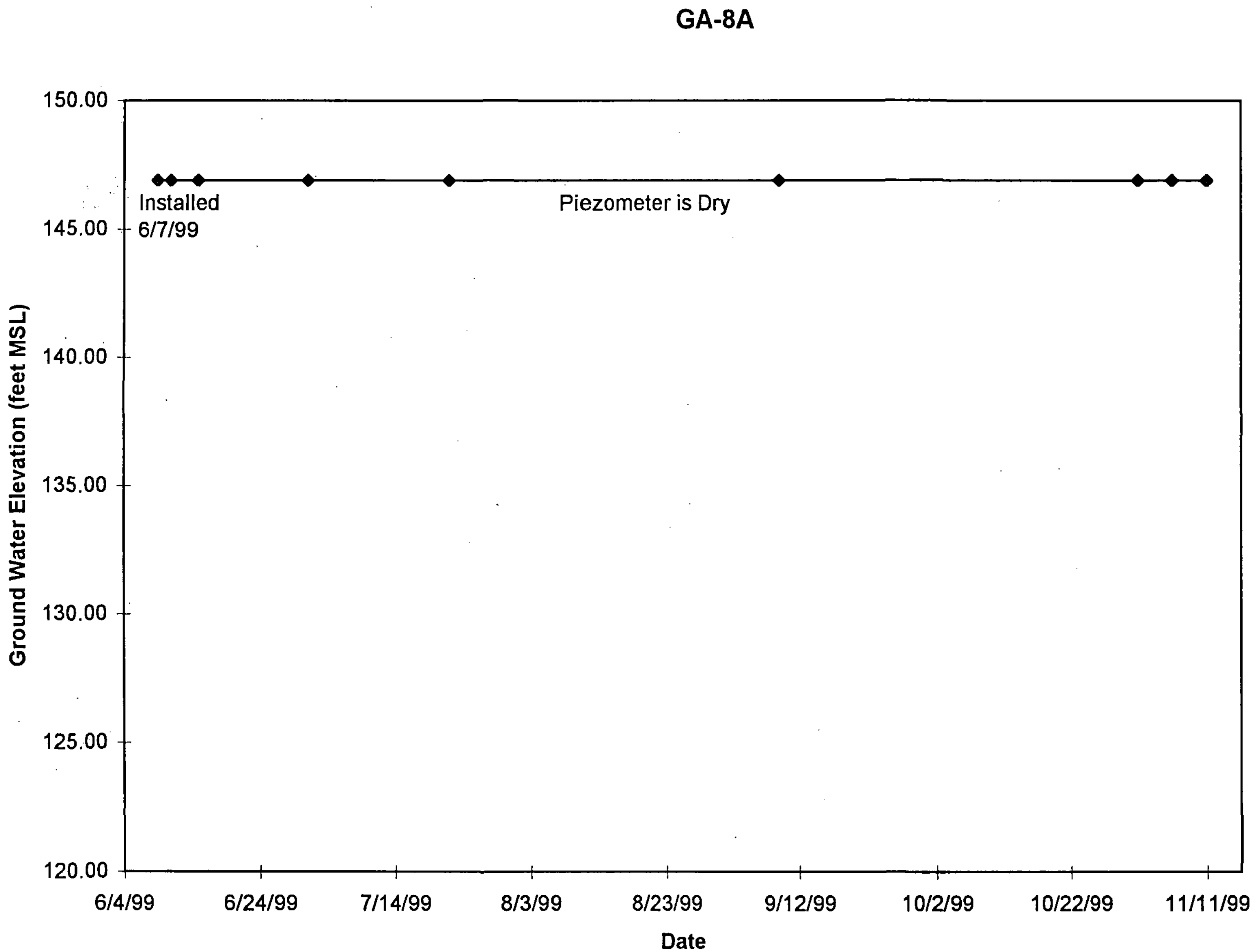
GA-6A

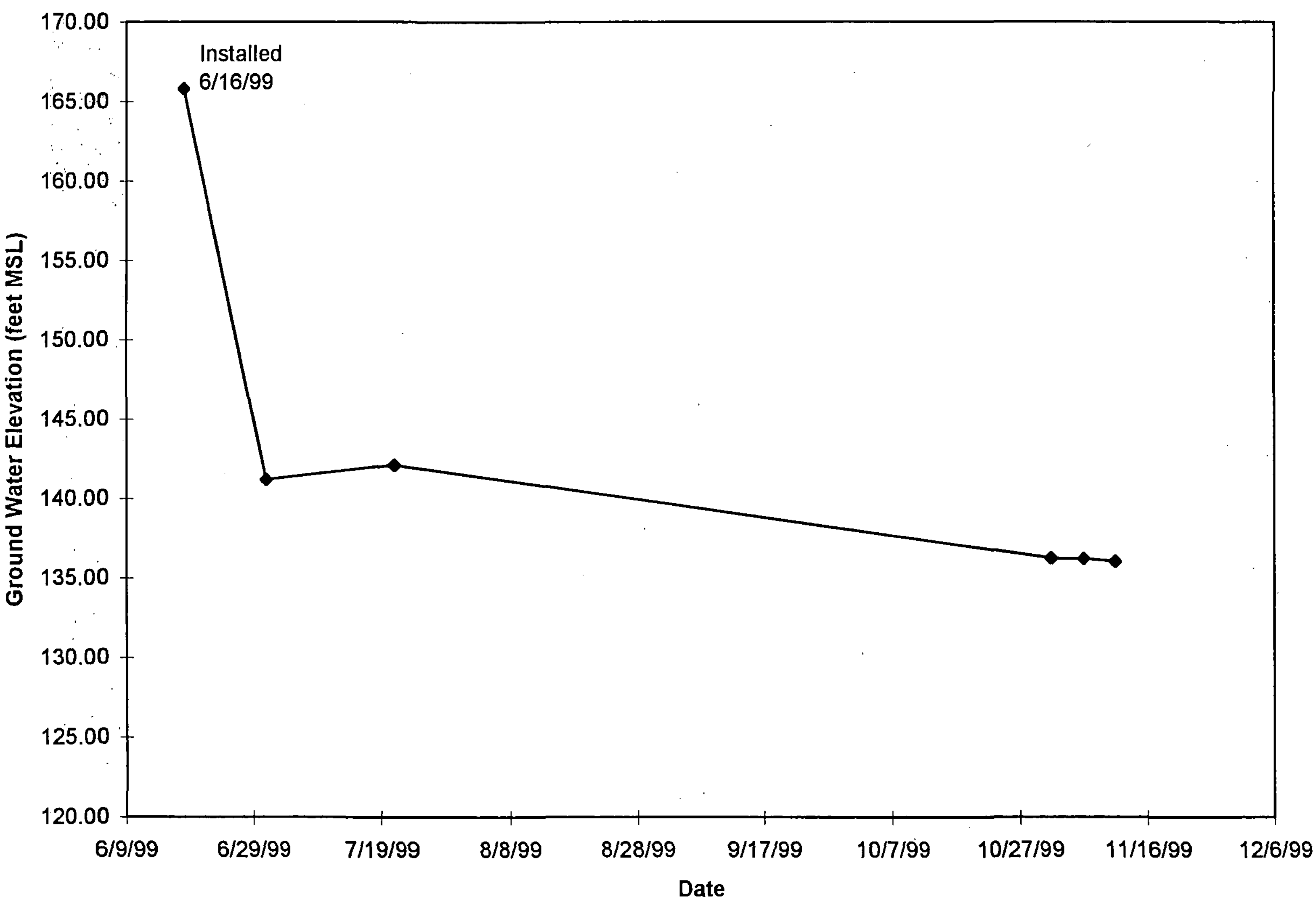

Installed 5/21/99
Ground Water Elevation (feet MSL)
138.00
137.00
136.00
135.00
134.00
133.00
132.00
131.00
130.00
129.00
128.00
127.00
4/30/99
5/20/99
6/9/99
6/29/99
7/19/99
8/8/99
8/28/99
9/17/99
10/7/99
10/27/99
11/16/99
12/6/99
Date

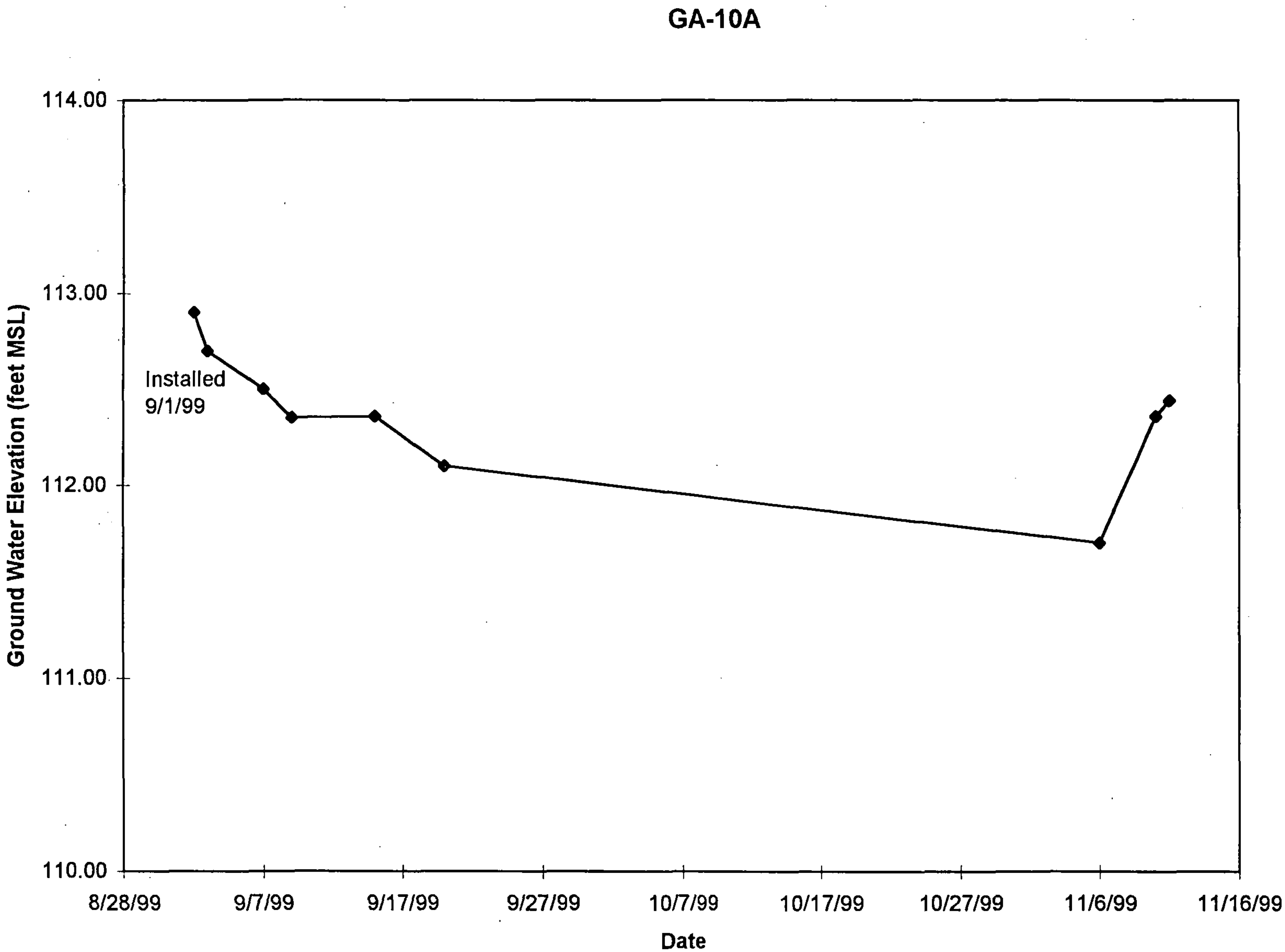
GA-7A


Installed
5/19/99
Possibly related to drilling activities on GA-9 up slope to west at the time of measurement
Ground Water Elevation (feet MSL)
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
4/30/99
5/20/99
6/9/99
6/29/99
7/19/99
8/8/99
8/28/99
9/17/99
10/7/99
10/27/99
11/16/99
12/6/99
Date


GA-8A
150.00
145.00
140.00
135.00
130.00
125.00
120.00
Ground Water Elevation (feet MSL)
Installed
6/7/99
Piezometer is Dry
6/4/99
6/24/99
7/14/99
8/3/99
8/23/99
9/12/99
10/2/99
10/22/99
11/11/99
Date

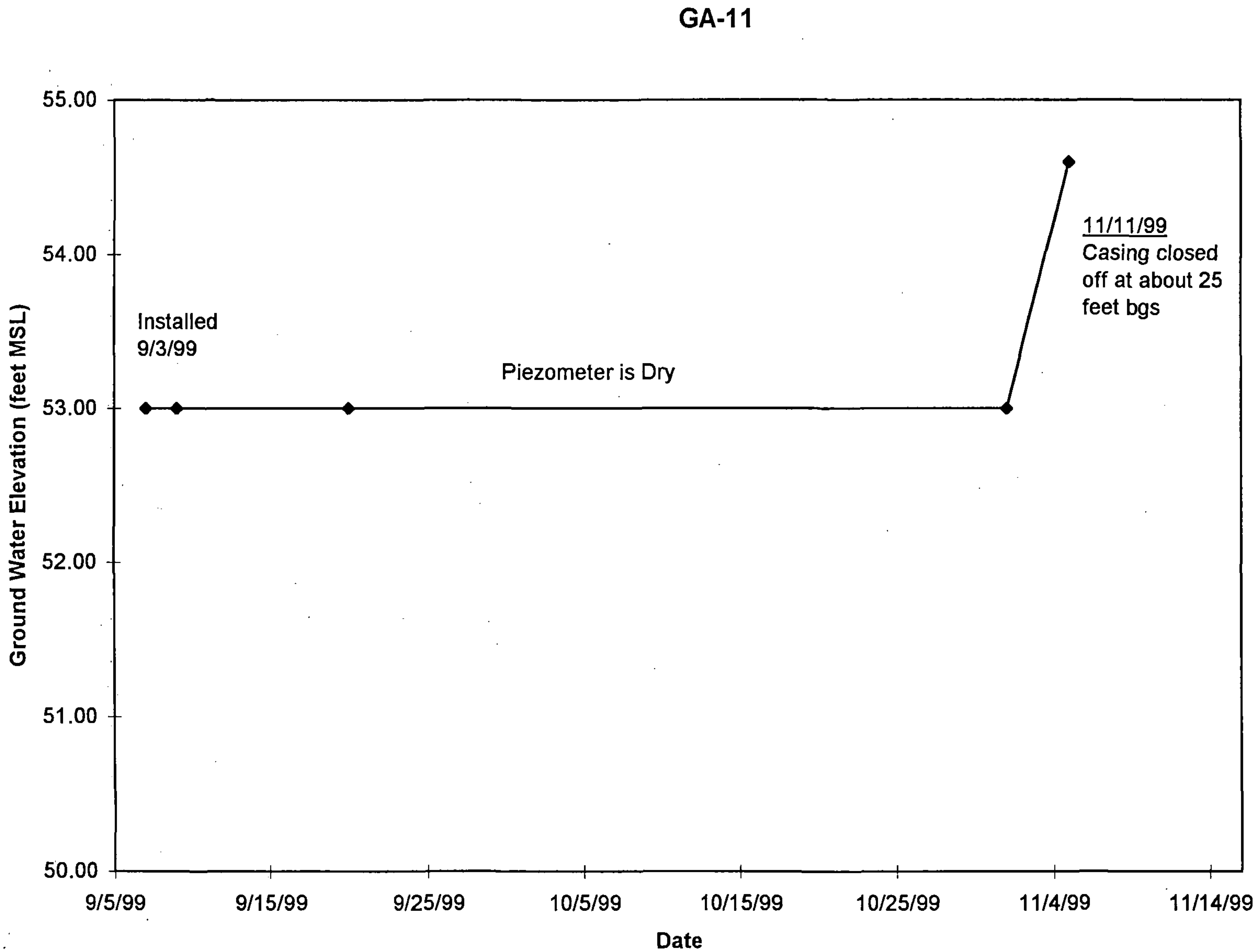
GA-9A (322)


Installed
6/16/99
Ground Water Elevation (feet MSL)
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
6/9/99
6/29/99
7/19/99
8/8/99
8/28/99
9/17/99
10/7/99
10/27/99
11/16/99
12/6/99
Date



Golder Associates

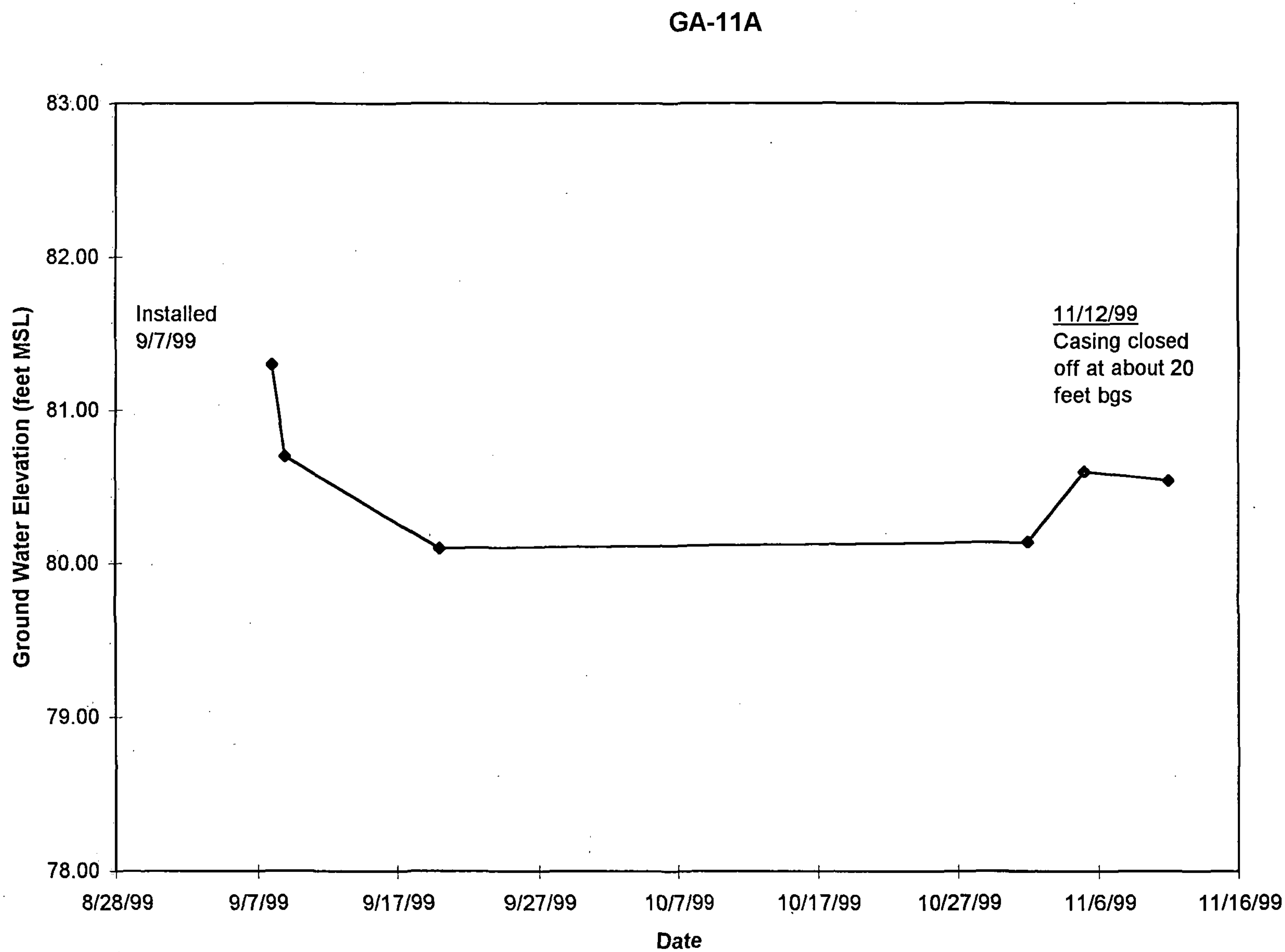
DOT-50000320

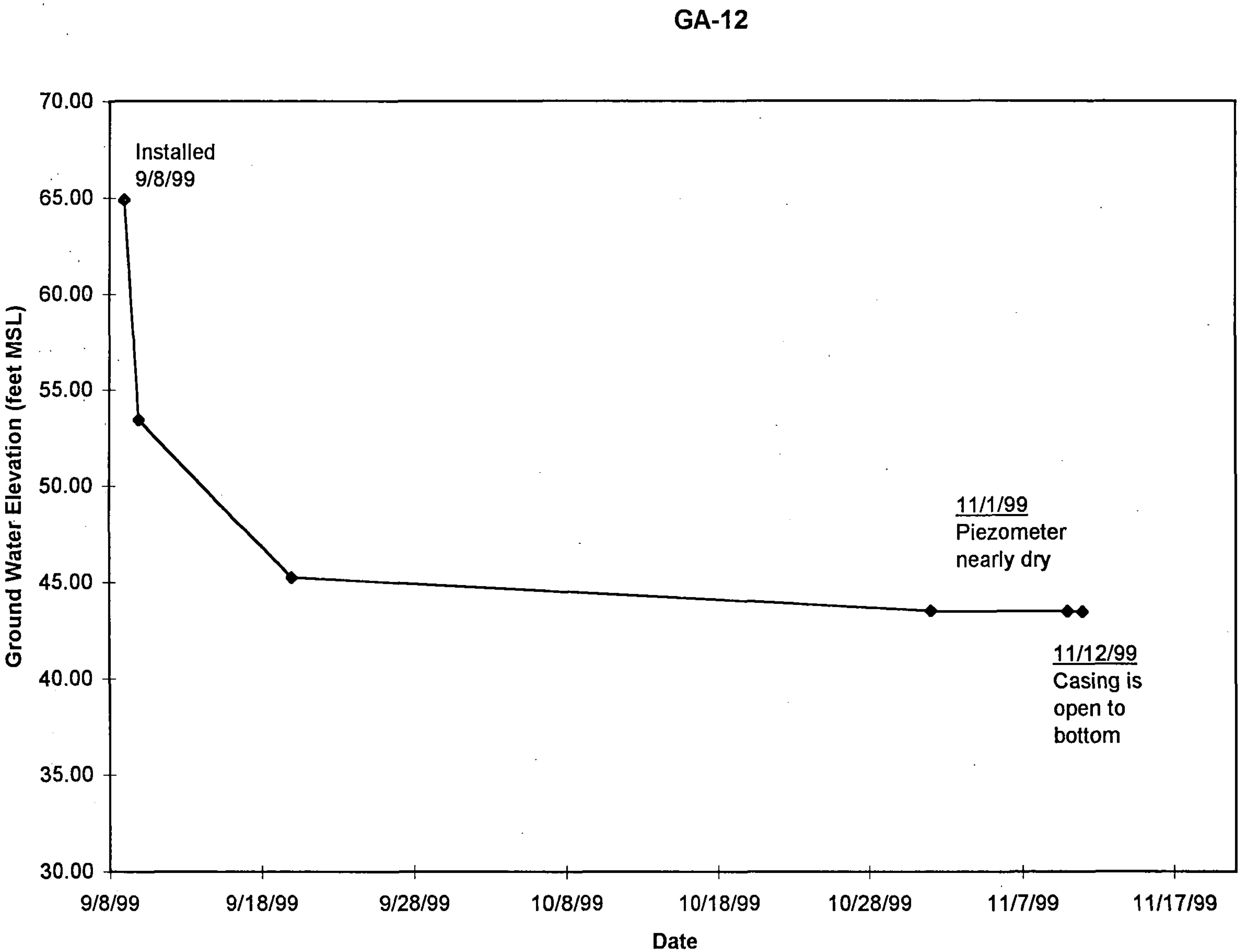


DOT-50000321

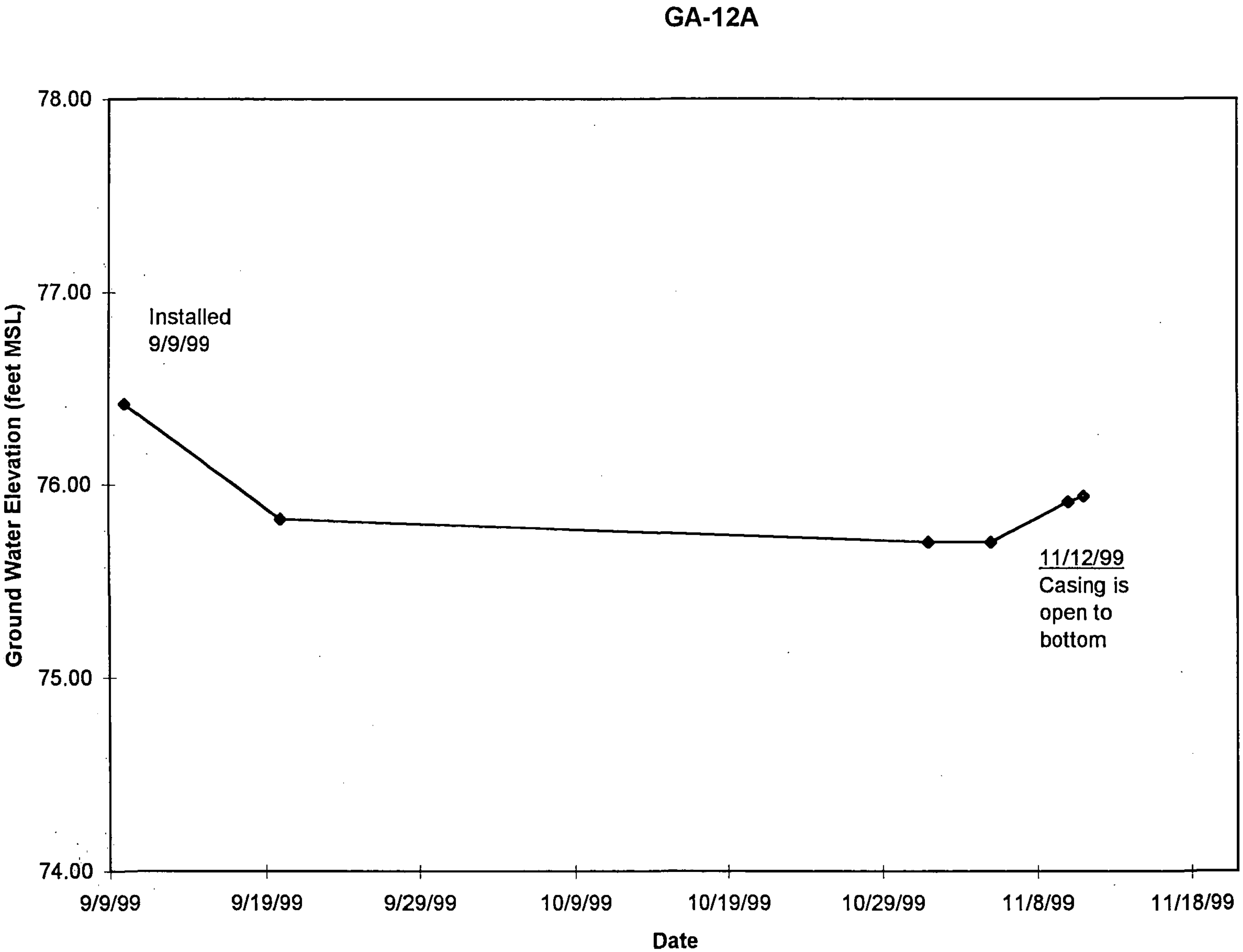
0201appc.xls

Golder Associates





DOT-50000323



DOT-50000324

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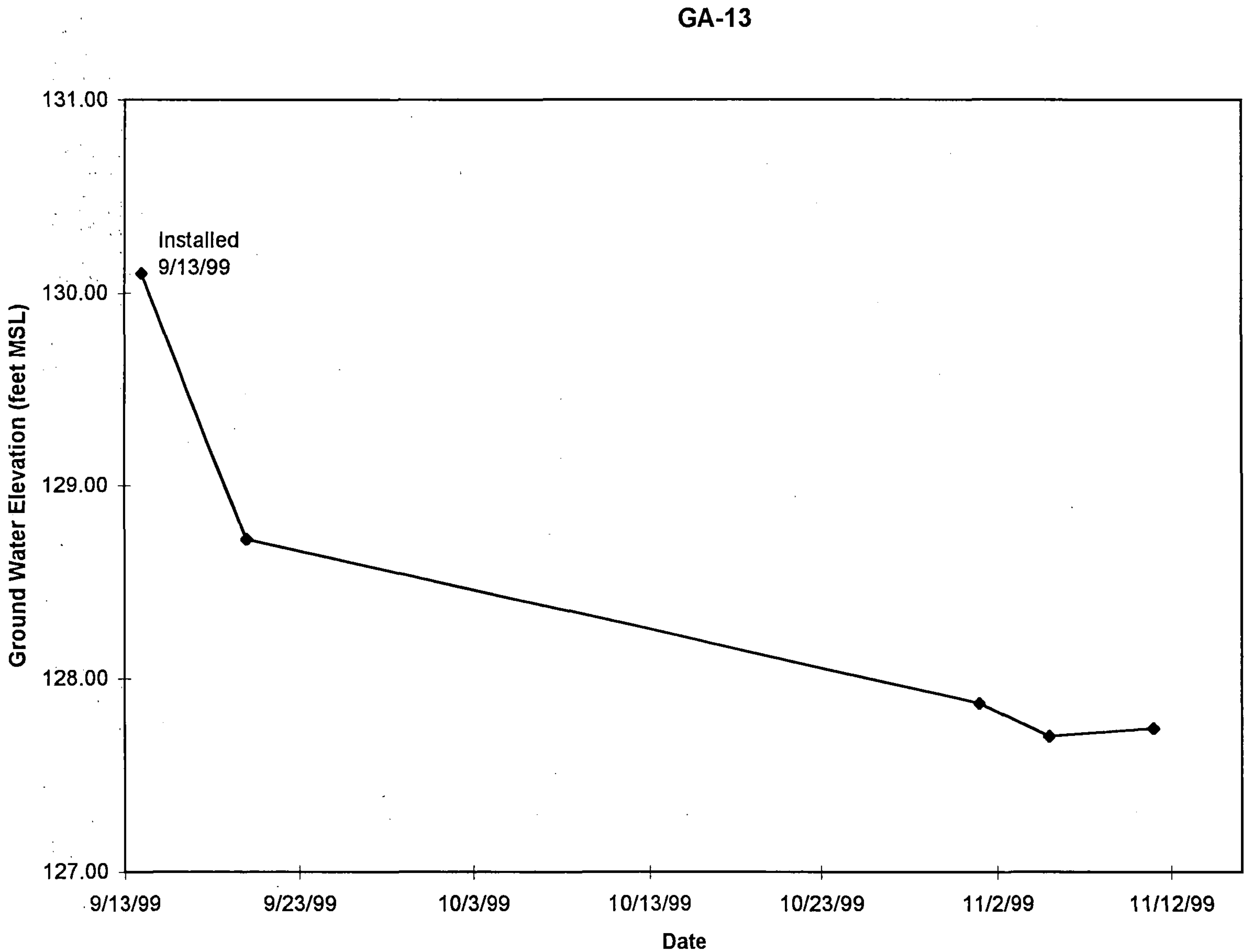
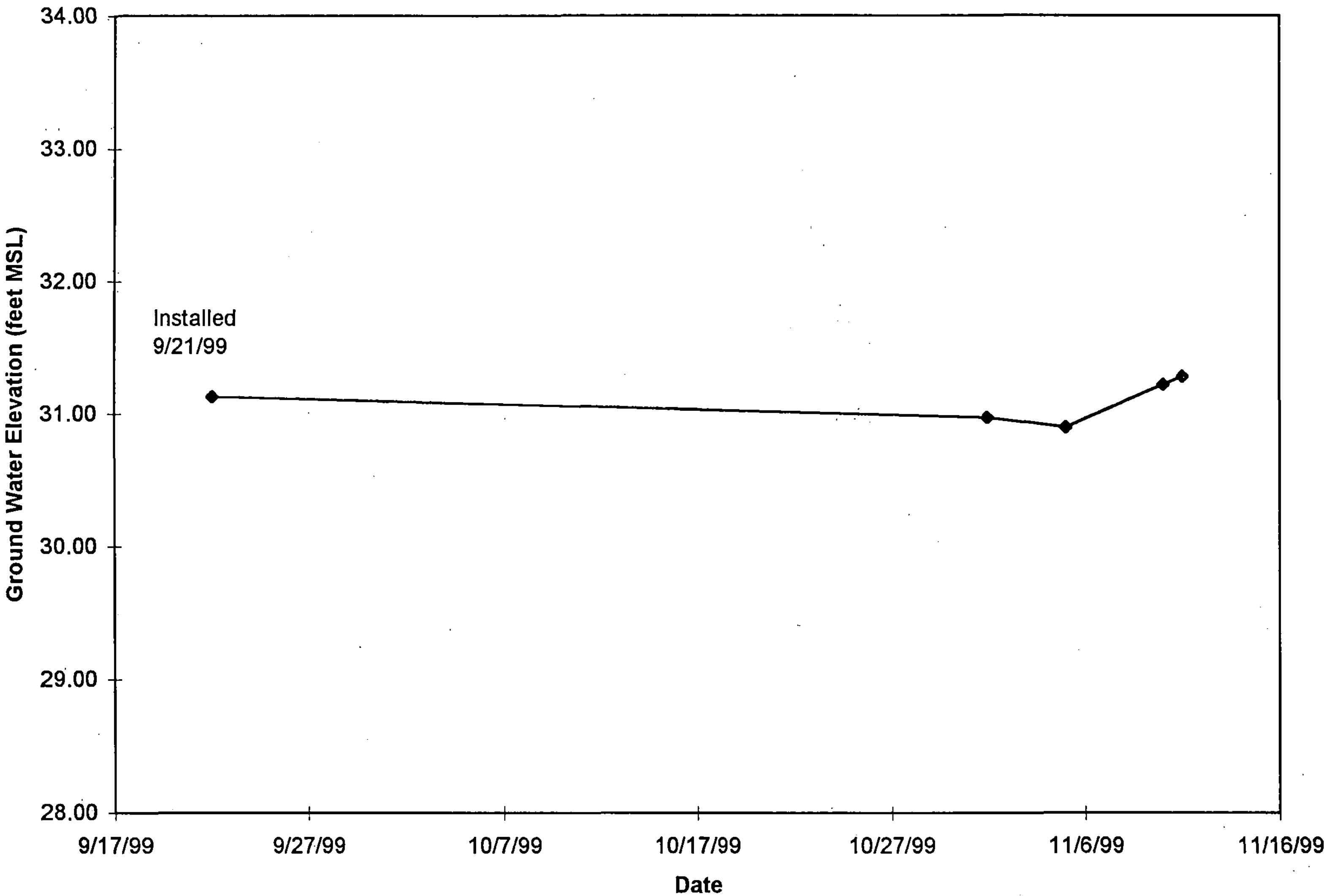


Golder Associates

DOT-50000325

GA-14


Ground Water Elevation (feet MSL)
34.00
33.00
32.00
31.00
30.00
29.00
28.00
Installed
9/21/99
9/17/99
9/27/99
10/7/99
10/17/99
10/27/99
11/6/99
11/16/99
Date

APPENDIX D

SEISMIC REFRACTION SURVEY

REPORT

ON

SEISMIC REFRACTION SURVEY
WSDOT US 101 MP 322 LANDSLIDE INVESTIGATION, WA

Prepared for:

Golder Associates Inc.
Redmond, Washington

Submitted by:

Golder Associates Inc.
Redmond, Washington

January 25, 2000

993-1466 task 400
9931466.doc

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

During the period of June 17 to June 19 of 1999, Golder Associates Inc. carried out a program of seismic refraction survey at MP 322 of Highway 101, Washington. Line 10 through 13 with six spreads in total were completed. The survey was extended toward further east and west, line 20 through 25 with seven spreads were completed during the period of August 9 to August 12, 1999. The purpose of the geophysical survey was to map the top surface of the Glaciolacustrine Deposit (hard clay and silty clay). The survey line locations are shown in Figure 1.

2. INSTRUMENTATION AND FIELD PROCEDURES

The seismic refraction survey was carried out utilizing a Geometrics 24-channel Strataview, 24 16Hz geophones and two 5 or 20 meter spacing takeout cables. Kinestick Explosives were used for seismic sources.

Field procedure consisted of laying out the cables, planting the geophones, and setting up three middle shots, two near end shots and two off-end shots. Data were collected and saved in digital format and also printed on paper.

3. GEOPHYSICAL RESULTS

3.1 Data Processing and Interpretation

The first arrivals of the seismic signals were picked using Sipik, then plotted versus geophone locations for all records for each spread. The parallelism of arrival times from different location shots and total times of reciprocal shots were carefully examined. Then the velocities of all layers and travel times to sub-surfaces of these layers under each geophone were analyzed, and in turn the depths to sub-surfaces of these layers under each geophone were calculated.

3.2 Results and Discussion

The interpreted depth sections of SL10 through SL13 and SL20 through SL25 are presented in drawings SL10 through SL13 and SL20 through Sl25, respectively in Appendix A. Four layers are interpreted. The interpreted velocity of the surficial layer varies from 260 m/s (852 ft/s) to 340 m/s (1115 ft/s). The velocity of the second layer from the surface varies from 470 m/s (1541 ft/s) to 580 m/s (1902 ft/s). This correlates with dry Glaciofluvial Deposit (dense sand and gravel). The underlying layer with velocity around 1110 m/s (3640 ft/s) correlates with wet to saturated Glaciofluvial Deposit in this area. The basal layer with velocity about 2200 m/s (7216 ft/s) correlates with Glaciolacustrine Deposit (hard clay to silty clay). The thickness of the total overburden varies from around 8 m (26 ft) in the east to about 93 m (306 ft) in the west. The water table changed during the survey.

The elevation contour of the top surface of the basal layer is shown in Figure 2. In general, the surface dips eastward with a major depression in the west side of the survey area.

4. LIMITATIONS

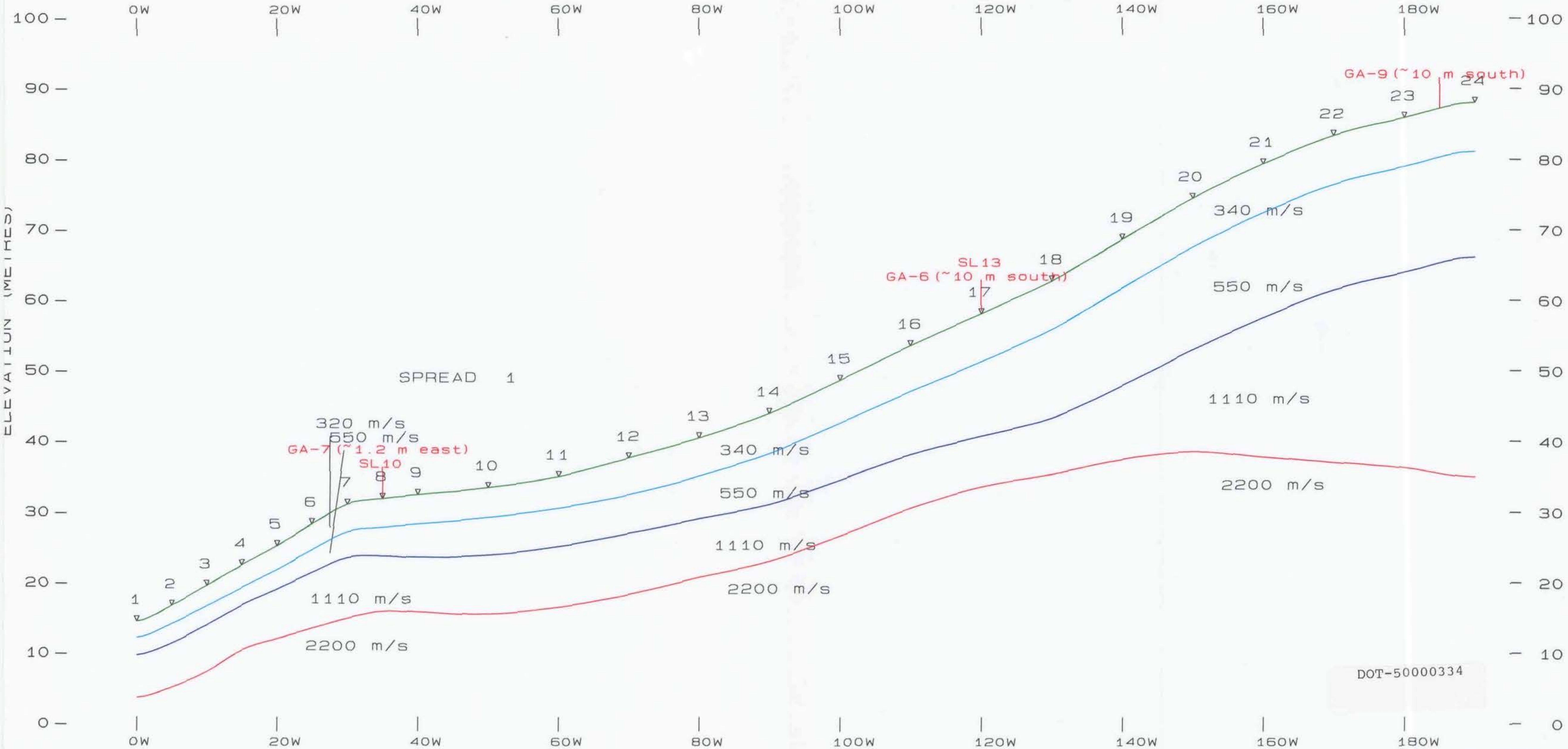
The geophysical information in this report is based on geophysical measurements obtained by generally accepted methods and procedures and our interpretation of the data. Individual values may in some instances, be erroneous due to noise occurring simultaneously with the measurements. Given the consistency of the data, however, the survey results are considered to be a reasonably accurate representation of the measured geophysical parameters at the site. In general, the errors in the interpreted depths related to the resolution of the technique is about ±15 % of the true depths.

SEISMIC LINE WSDOT/MP322 SL10

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466	
SEISMIC REFRACTION SURVEY	
INTERPRETED DEPTH SECTION	
GOLDER ASSOCIATES INC.	
DATE: JUNE 1999	SL10

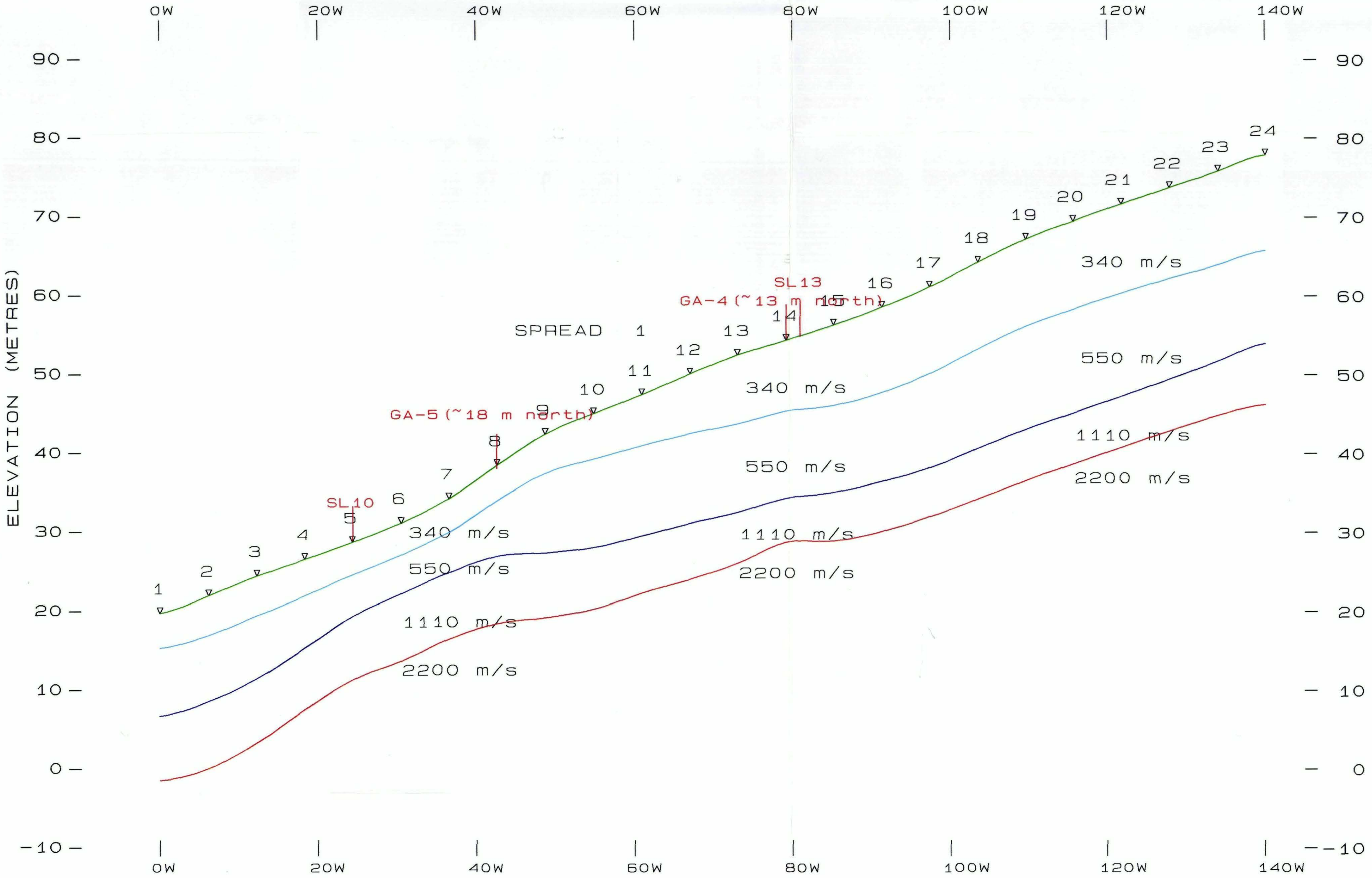
DOT-50000333



NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP322 SL11

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999		SL11

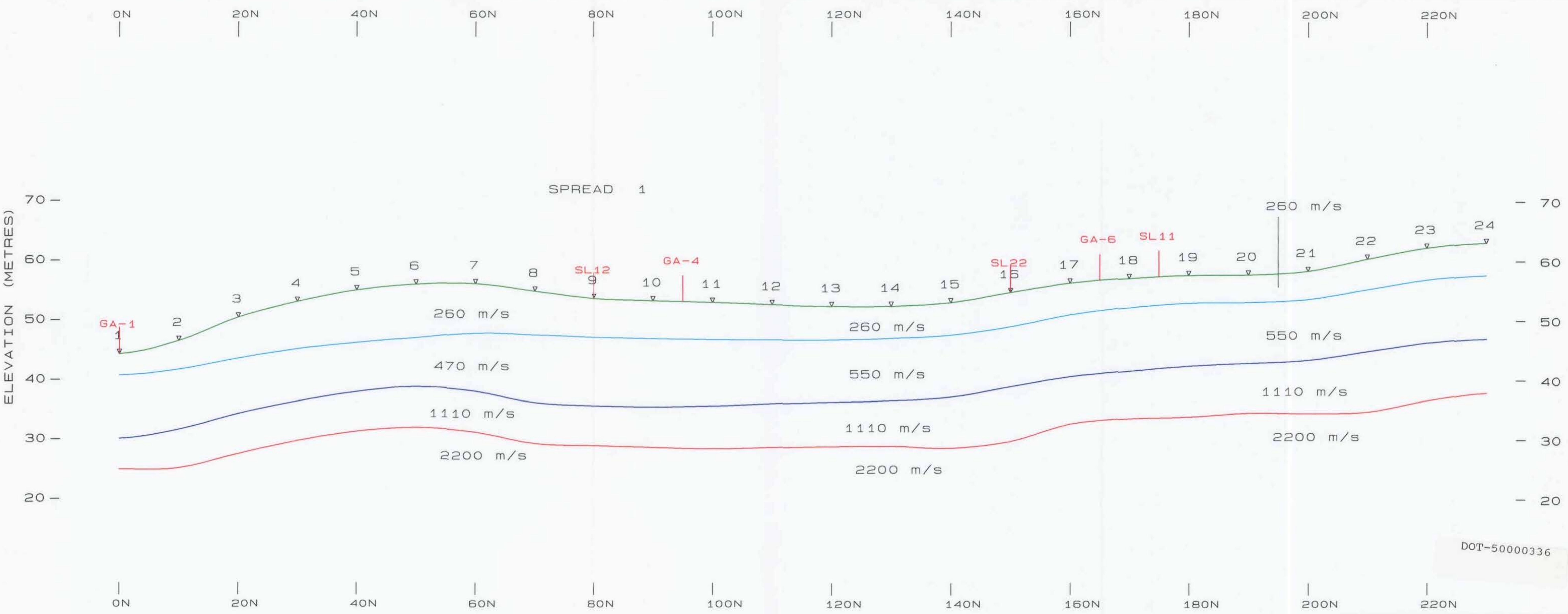


SEISMIC LINE WSDOT/MP322 SL12

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999		SL12

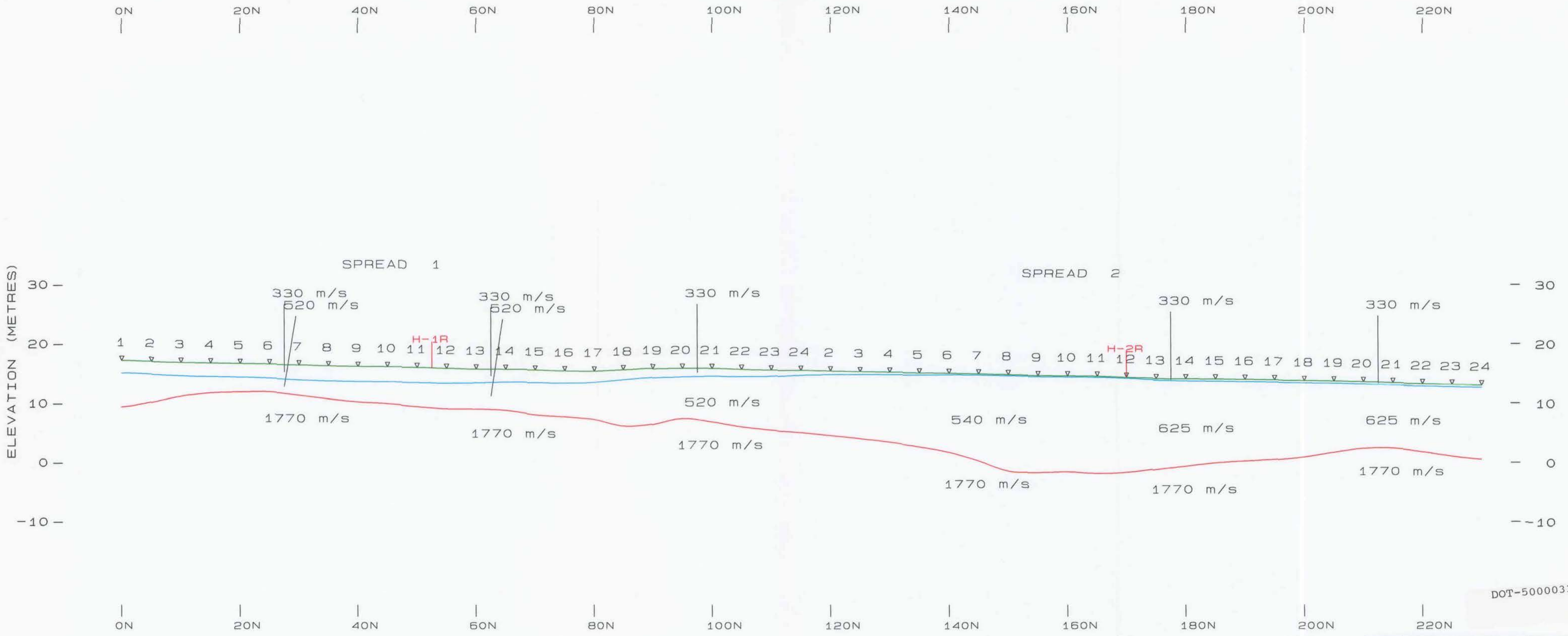
DOT-50000335



SEISMIC LINE WSDOT/MP322 SL13

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999 · SL13

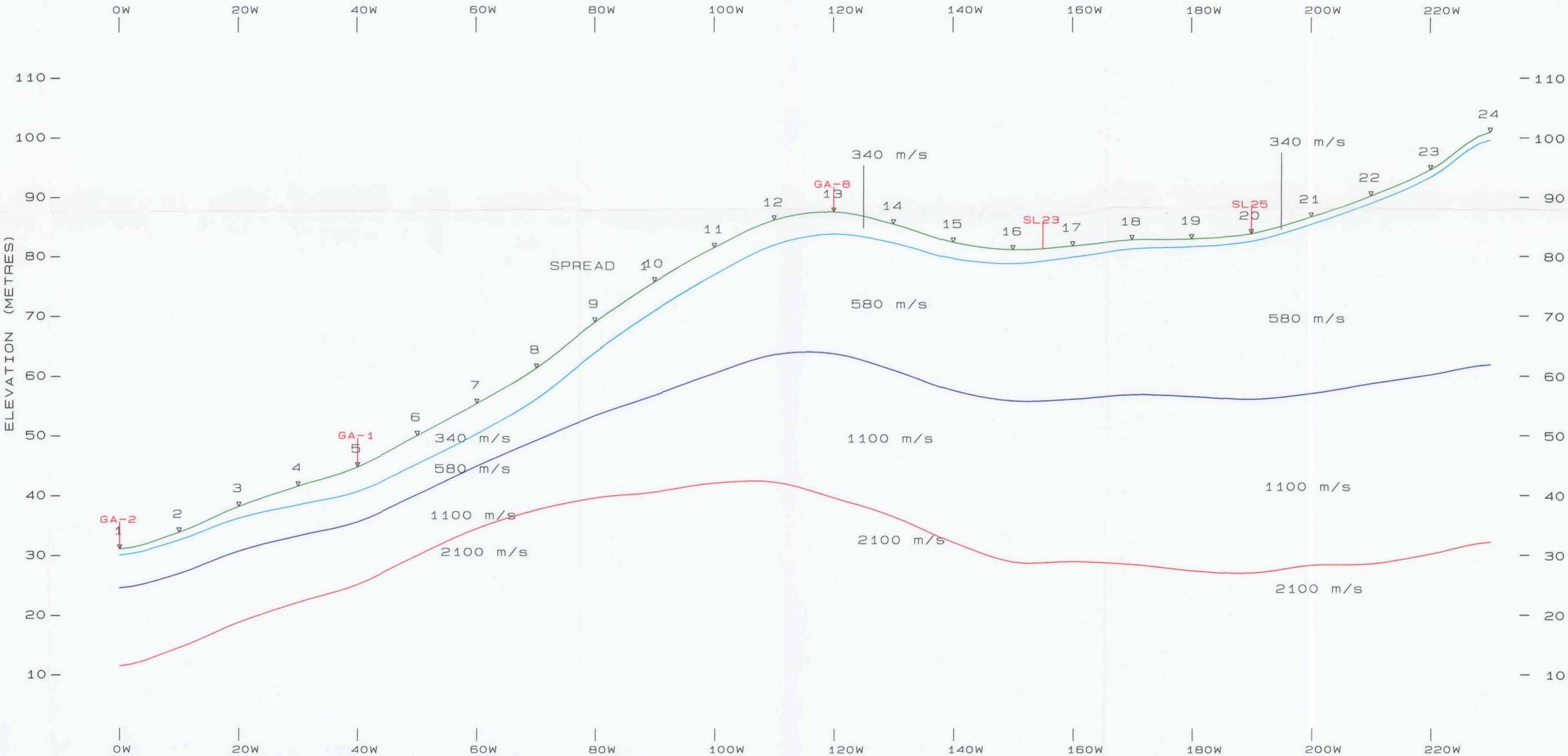


DOT-50000337

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP322 SL20

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999 SL20

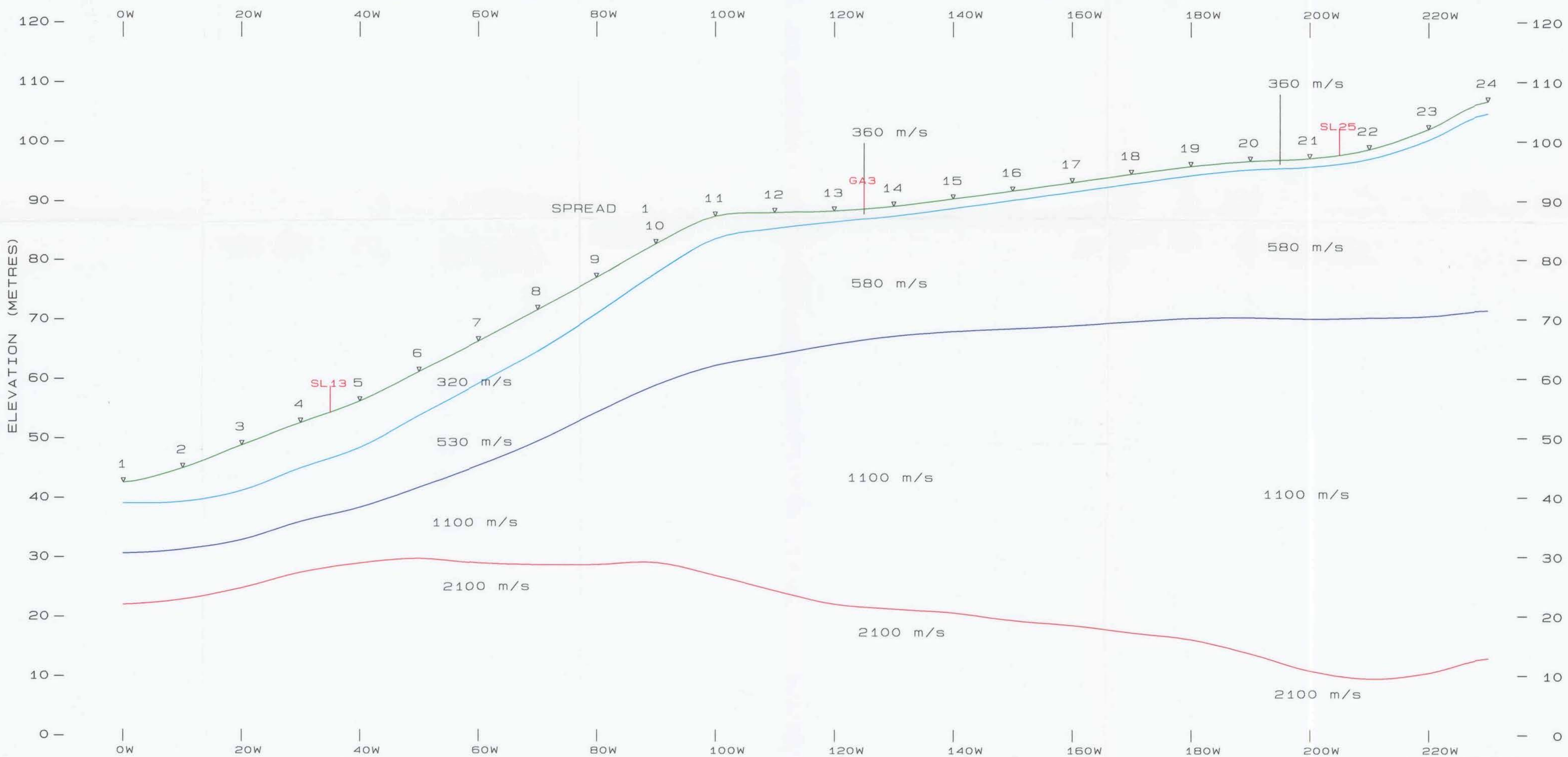


SEISMIC LINE WSDOT/MP322 SL21

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999		SL21

DOT-50000338

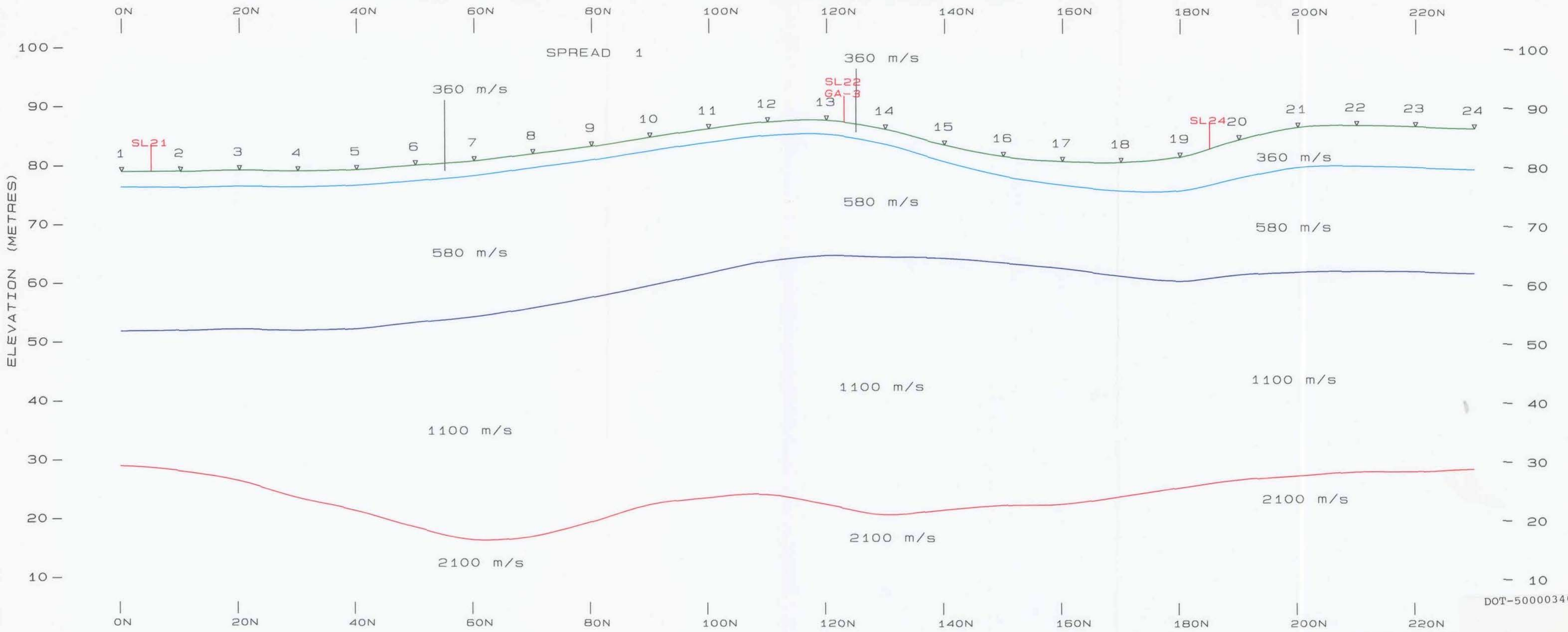


NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP322 SL22

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION		
GOLDER ASSOCIATES INC.		
DATE: JUNE 1999		SL22

DOT-50000339

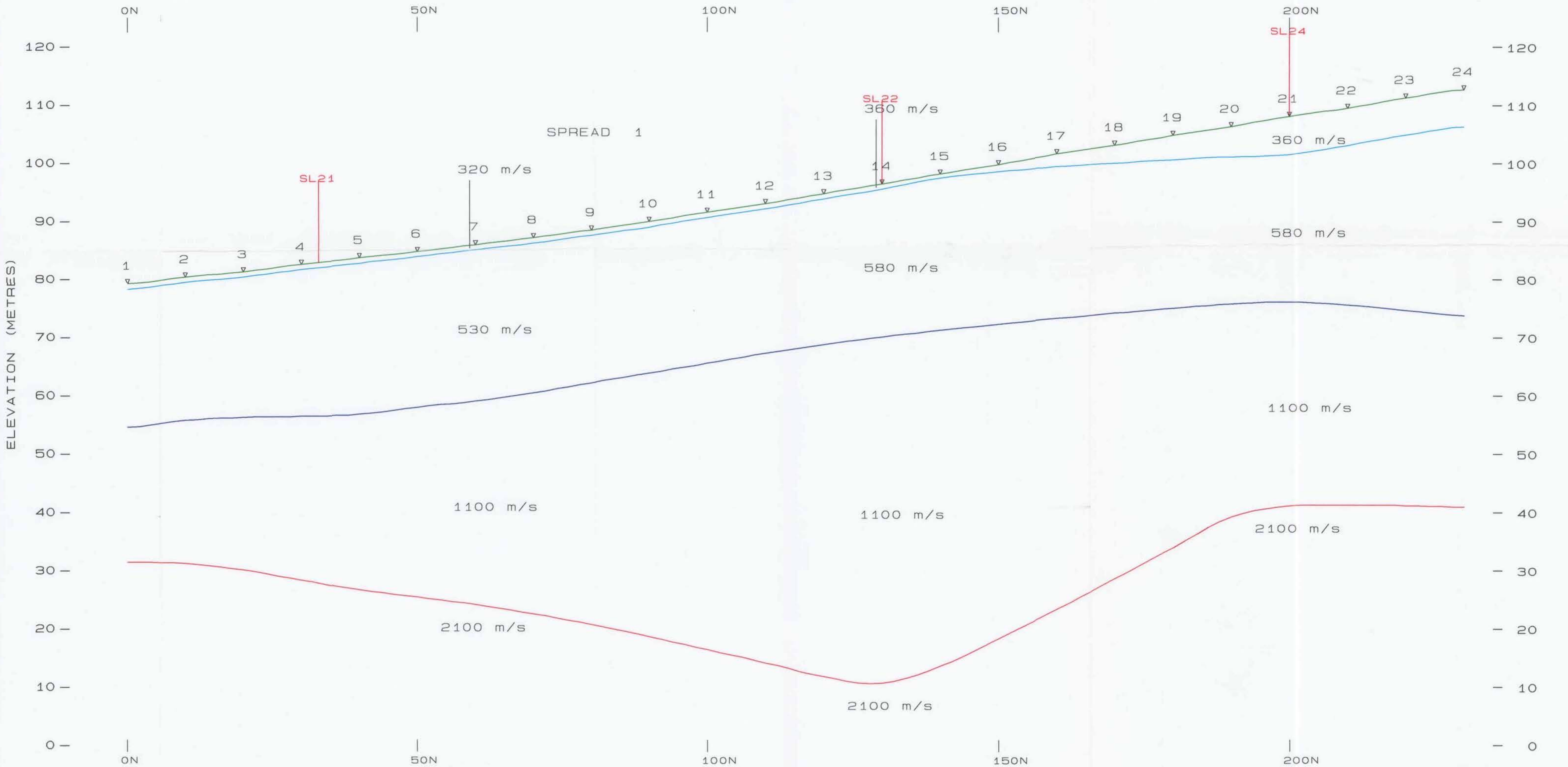


DOT-50000340

NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999   SL23

SEISMIC LINE WSDOT/MP322 SL23

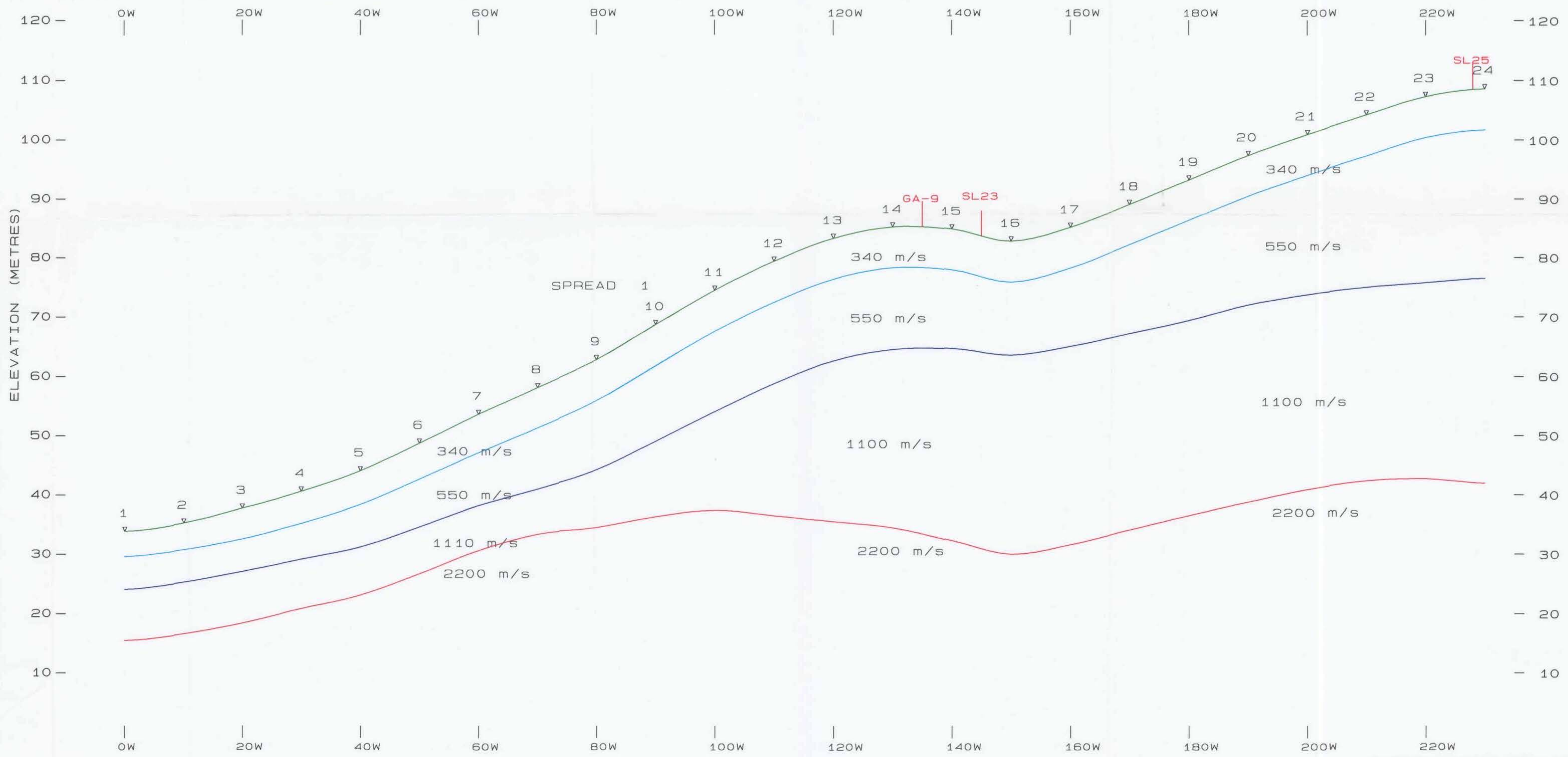


SEISMIC LINE WSDOT/MP322 SL25

NOTES:
VERTICAL SCALE: 1:500
HORIZONTAL SCALE: 1:500
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999 SL25

DOT-50000342



NOTES:
VERTICAL SCALE 1: 500
HORIZONTAL SCALE 1: 500
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP322 SL24

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP322/WA: 993-1466
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: JUNE 1999 — SL24

APPENDIX E

HYDROGEOLOGIC TEST DATA

DOT-50000343

MEMORANDUM

TO: File 993-1466 January 20, 2000

FR: Bob Anderson

RE: MP 322 WELL TESTING AND HYDROGRAPHS 993-1466

Well GA-15 Pumping Test

Well GA-15 was tested on December 8, 1999. The well is 297 feet deep, completed between 190 and 225 feet. The pump was set at about 207 feet below ground. The well was pumped for a total length of about 8 hours at rates of successive 25, 35, 45, and 53 gallons per minute. At a rate of 53 gpm, water-levels were at the pump intake.

Water-levels at each pumping step stabilized quickly. The specific capacity of the well ranged from 2.8 to 55 gpm per foot of drawdown. Some development (removal of fines and consolidation of material around the well bore) appears to have occurred during pumping, since the specific capacity is not linear with increasing pumping rate.

An analysis of the water-level recovery indicates that the transmissivity of the well is about 2,500 ft2/day. The aquifer thickness is estimated at about 20 feet, for a hydraulic conductivity of about 2 x 10-2 cm/sec. No drawdown was observed in well GA-3 during pumping. However, since the material is highly permeable, it is likely that a longer pumping time is required before drawdown soul be observed at this distance. Based on an estimate of the storage coefficient of 0.02, we estimated that it would take about 7 days to achieve a drawdown of 1.5 feet, and recommended that WDOT initiate a longer pumping test.

December 1999/January 2000 Water-Level Monitoring

Water-levels for wells GA-1a, GA-1b, GA-5a, GA-7a, and GA-3a, and one precipitation gage have been measured since Early December using automated pressure transducer/data logger equipment connected to a dial-up system that allows remote monitoring of the data. WDOT has been responsible for field maintenance. Golder is responsible for the remote monitoring equipment that sends data to our offices. Well GA-15 was equipped with a pump and has been pumping continuously at a rate of approximately 55 gpm since *December 27??? 1999*. Hydrographs for these wells are shown on the attached figures. Data are also attached.

Landslide Area Hydrographs

Well GA-1A is completed at a shallow depth of 7 to 26 feet below ground. Water-levels increased gradually about 7 during between December 3rd and 17th, and then increase sharply on December 18, rising about 10 feet in three days. Water-levels decrease after

DOT-50000344

December 24. There is a data gap between December 26 and January 4, 2000. Water-levels do not change after January 6, 2000. It appears that the transducer was pulled and re-set at a different depth. Water-levels after January 6 are not reliable. The well should be checked and all depth settings recorded.

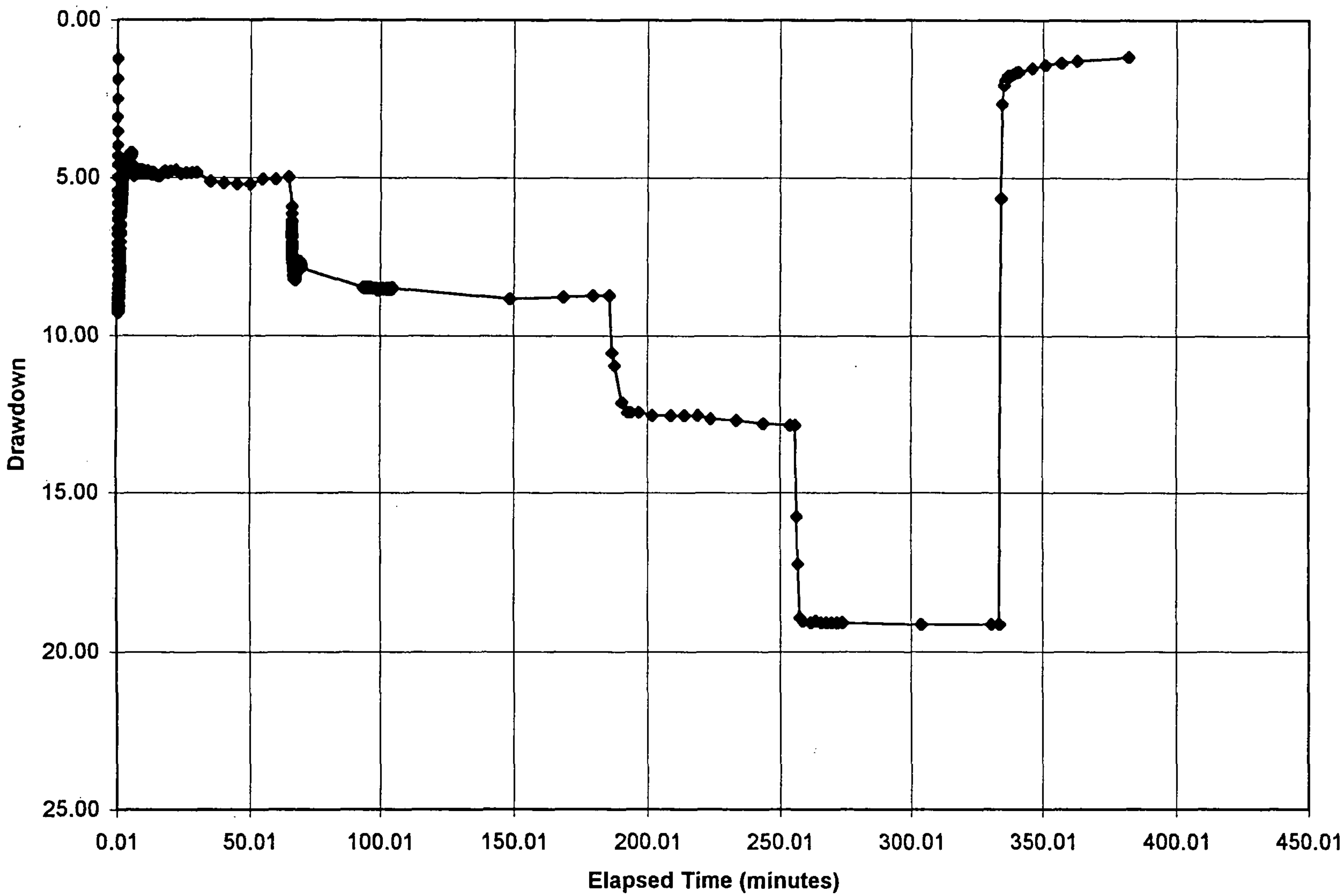
Well GA-1B is 85 feet deep with an open bottom completion. Water levels are stable at an elevation of about 71 feet. The transducer was pulled on December 23 and not re-installed.

Well GA-5a is completed from 25 to 45 feet below ground. Water-levels increase about one foot during early December and remain fairly stable during January. The December rise in water-level is consistent with observations at well 1a, and is likely related to high precipitation. Reliable precipitation data at the site are not available until January 4, 2000. Precipitation in January has not affected water-levels.

Well GA-7a is completed from 35 to 45 feet below ground. Water-levels decrease slightly in early December, then rise about 2.5 feet between December 18 and January 4, 2000. The December rise in water-level is consistent with observations at well 1a, and is likely related to high precipitation. Reliable precipitation data at the site are not available until January 4, 2000. Water-levels have been steady in January, and precipitation has not affected water-levels.

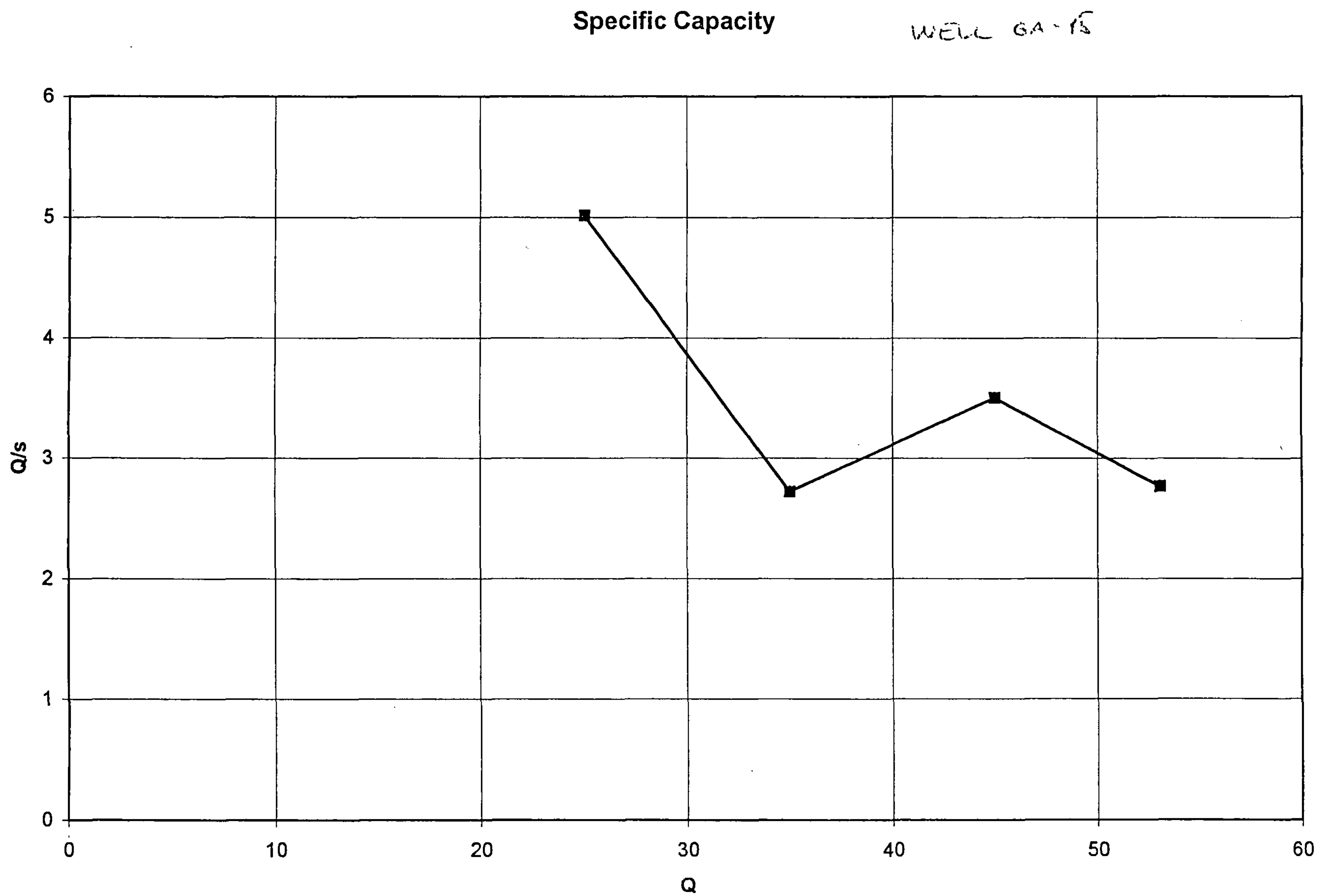
Well GA-3 is competed near the saddle at the top of the landslide. It is connected to the aquifer that is thought to have an influence on initiating the landslide. Water-levels have declined about 3 feet since the initiation of pumping at GA-15. The response to pumping is shown clearly on the hydrograph, with drawdown starting on December 27, 1999. Fluctuations in water-level are likely the result of changes in the pumping rate and/or precipitation events. However, these responses are small and it appears that pumping of well GA-15 is effectively dewatering the aquifer. Pumping and monitoring of wells should continue.

Time vs. Drawdown well GA-15

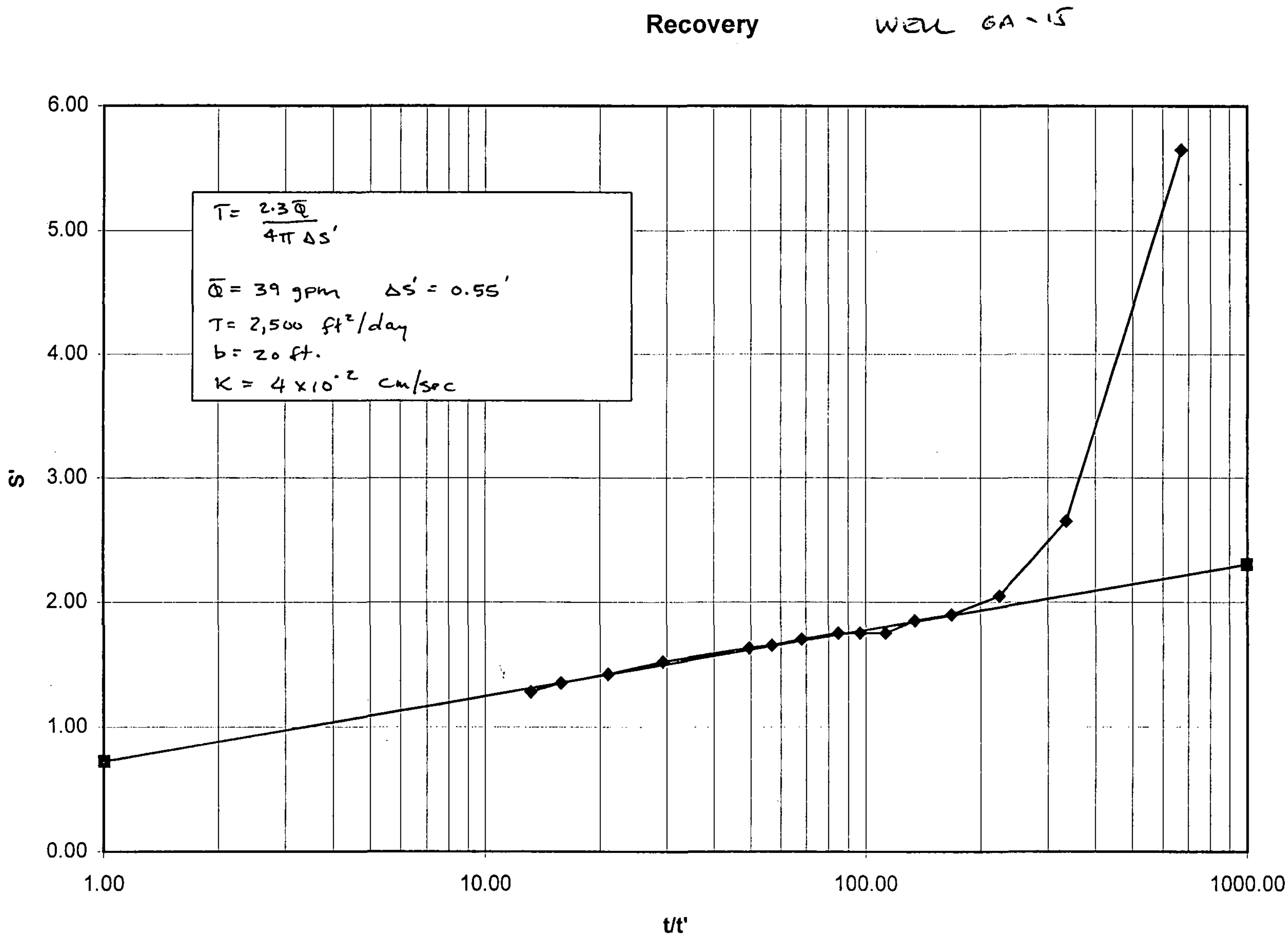


244

DOT-50000346



Specific Capacity
WELL GA-15
Q/s
6
5
4
3
2
1
0
0
10
20
30
40
50
60
Q



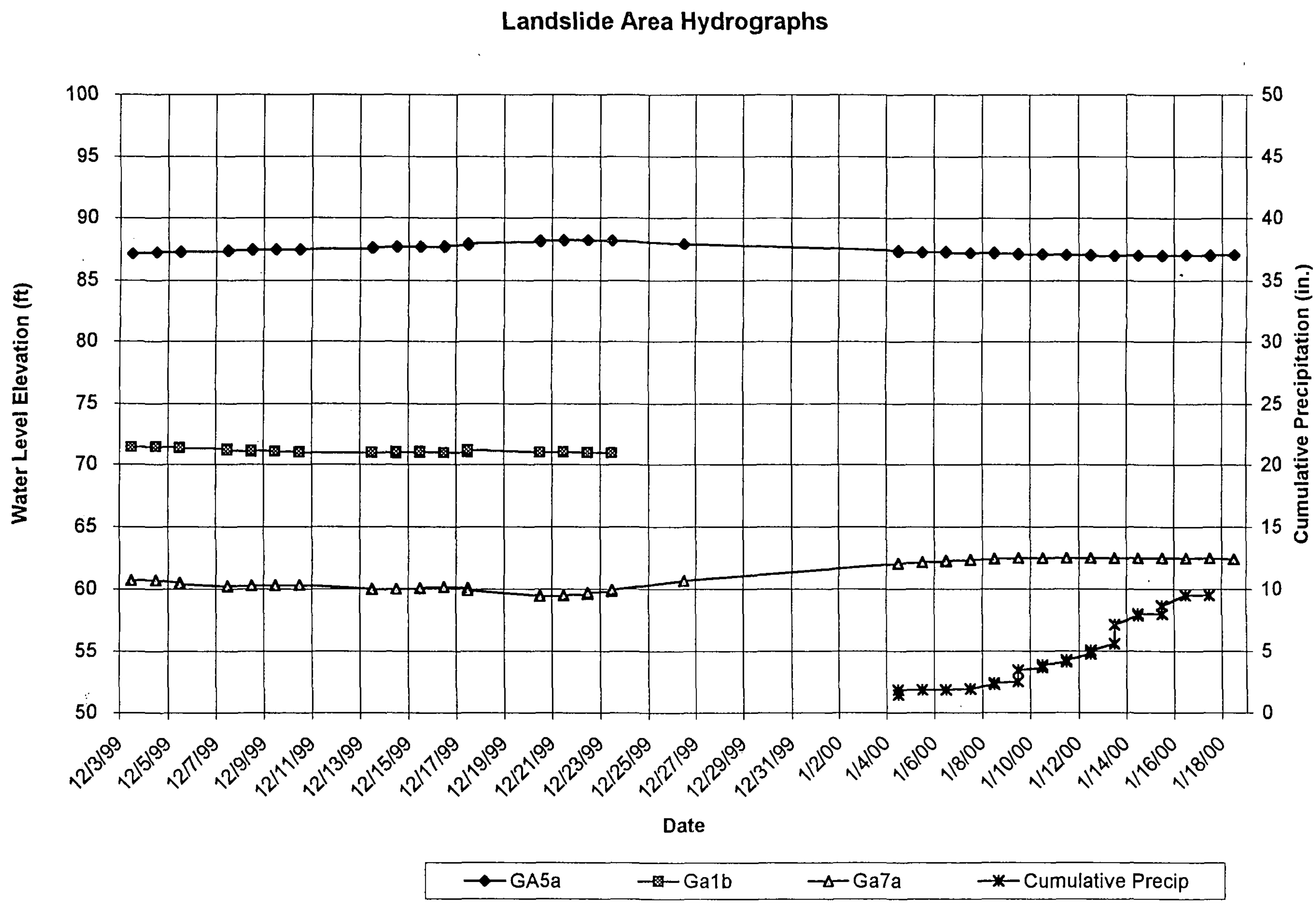
DOT-50000348

Dewatering Analysis

JACOB	76.2 m radius		
k	4.00E-04 m/s		3
b	4.096 m		
T	1.64E-03 m2/s		
S	0.02		
r	76.2 m		
t	0.5 day		43200 sec
u	4.10E-01 (Must be less than 2)		
Q (gpm)	25	50	100
Q (m3/s)	1.58E-03	3.15E-03	6.31E-03
s (m)	0.02	0.05	0.10
	0.08	0.16	0.32

JACOB	76 m radius		
k	4.00E-04 m/s		
b	4.096 m		
T	1.64E-03 m2/s		
S	0.02		
r	76 m		
t	7 day		604800 sec
u	2.91E-02		
Q (gpm)	1	50	100
Q (m3/s)	6.31E-05	3.15E-03	6.31E-03
s (m)	0.01	0.45	0.91
	0.03	1.49	2.97

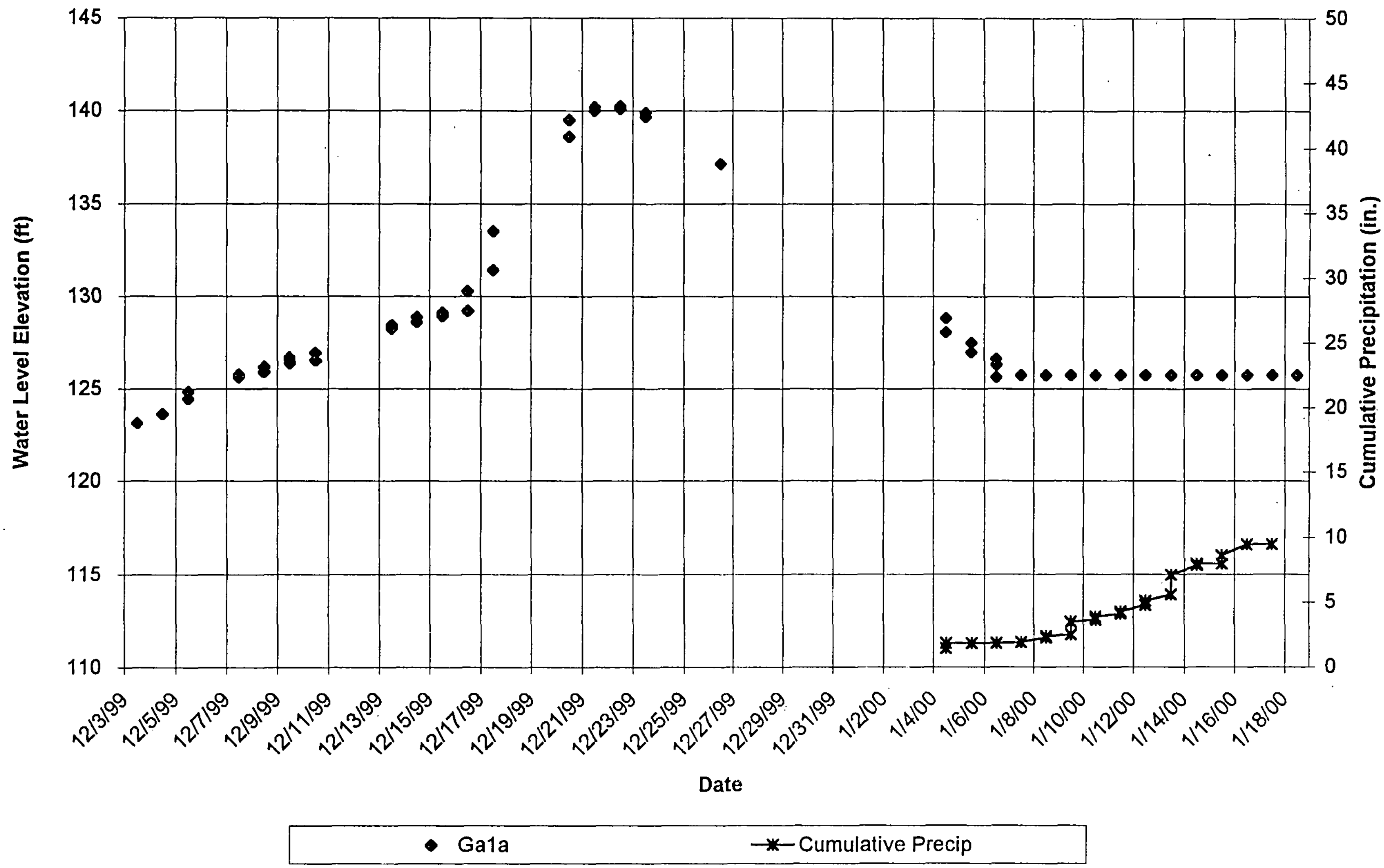
JACOB	76 m radius		
k	4.00E-04 m/s		
b	4.096 m		
T	1.64E-03 m2/s		
S	0.02		
r	76 m		
t	14 day		1209600
u	1.46E-02		
Q (gpm)	1	50	100
Q (m3/s)	6.31E-05	3.15E-03	6.31E-03
s (m)	0.01	0.56	1.12
	0.04	1.83	3.67

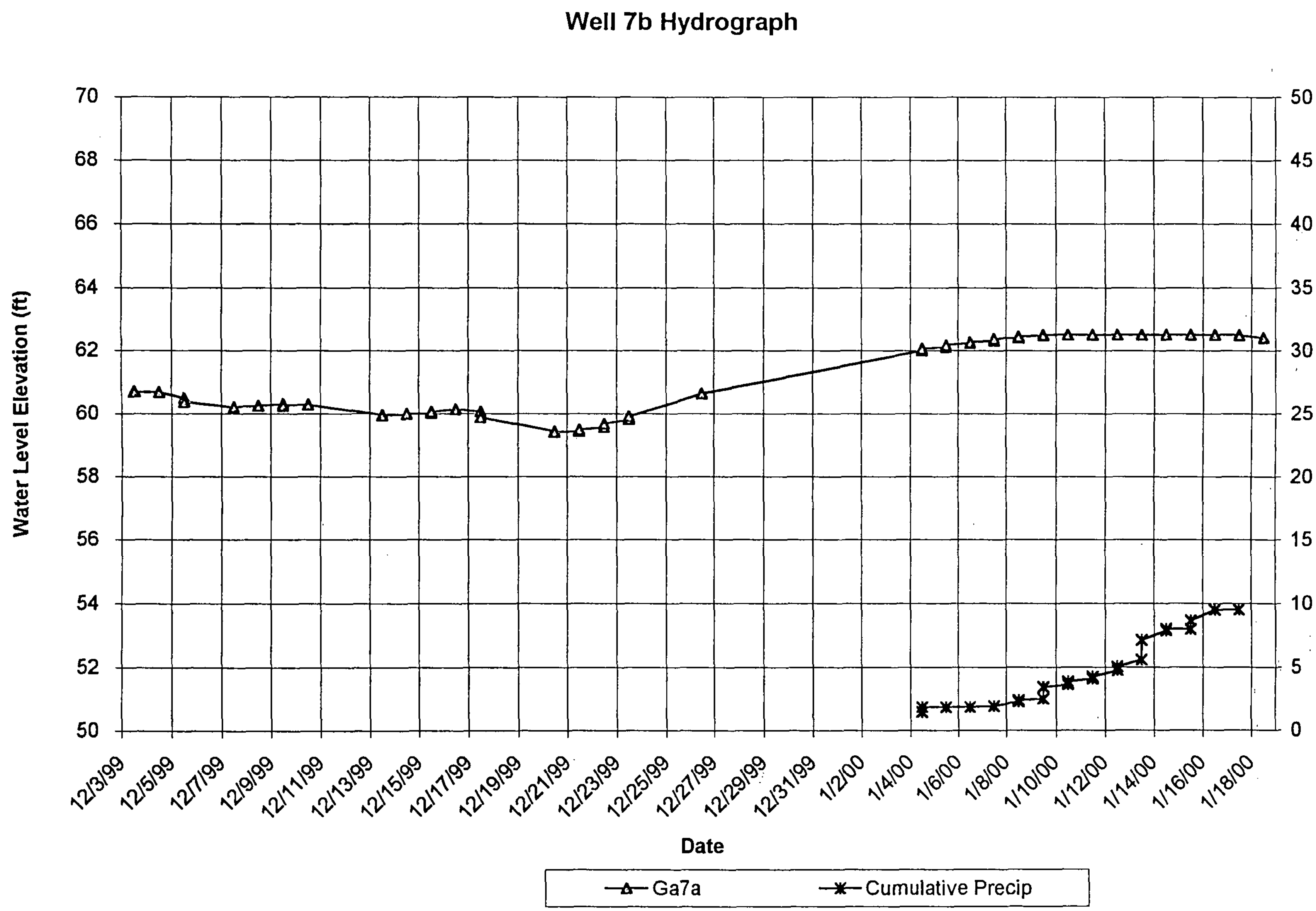


DOT-50000350

DOT-50000351

Well 1A Hydrograph

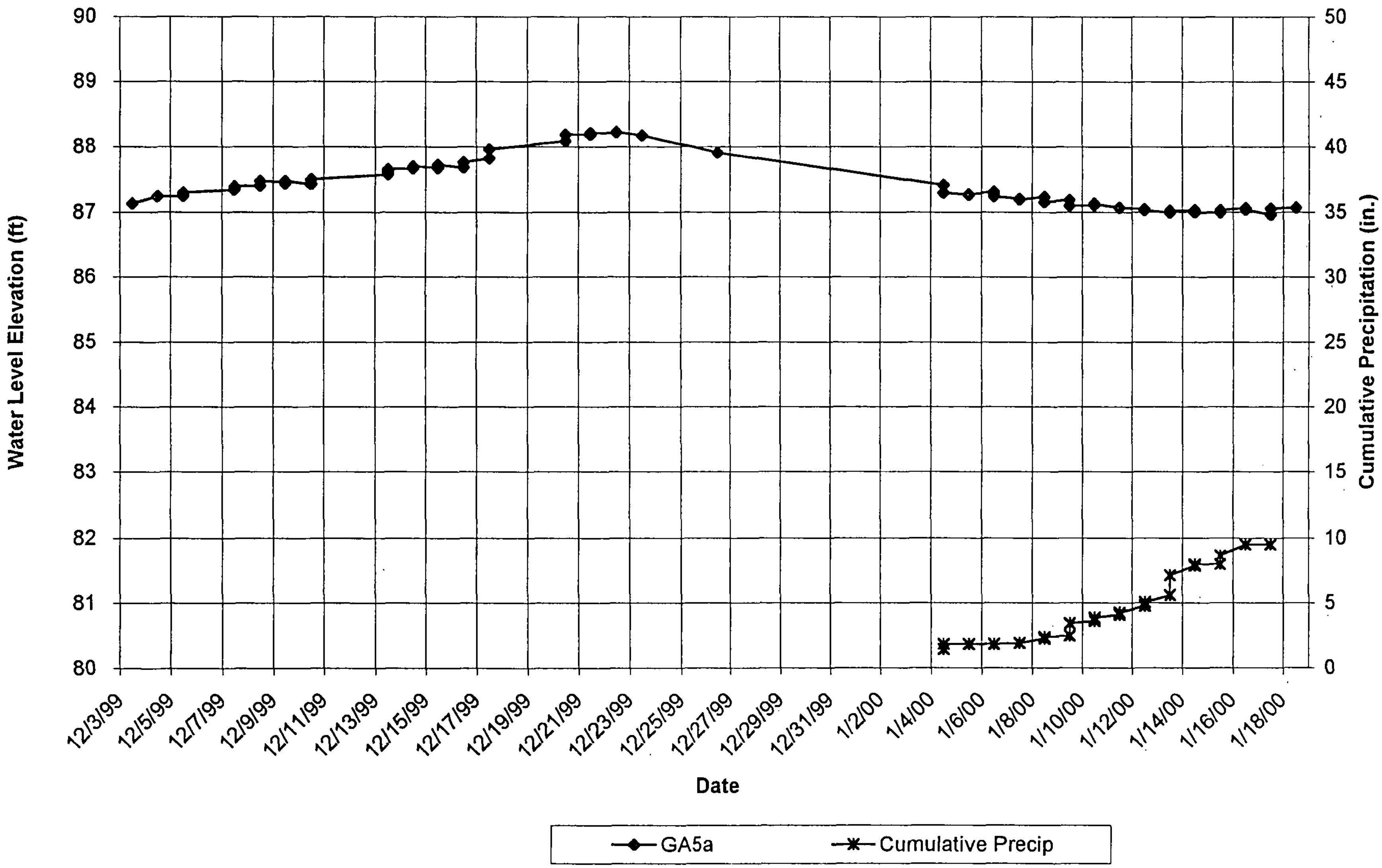


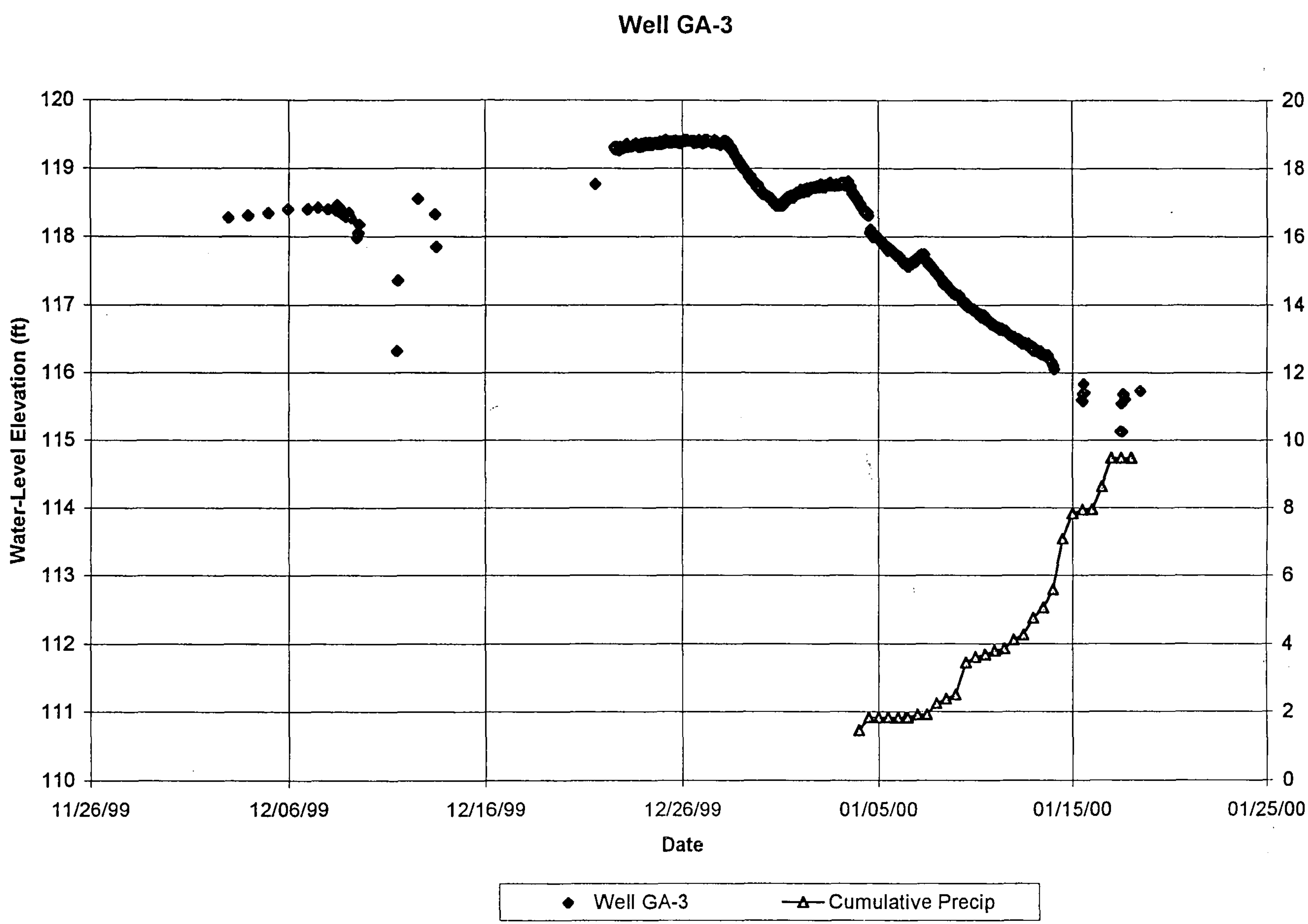


DOT-50000352

DOT-50000353

Well 5b Hydrograph




Well GA-3
Water-Level Elevation (ft)
Cumulative Precipitation (inches)
Date
11/26/99
12/06/99
12/16/99
12/26/99
01/05/00
01/15/00
01/25/00
Well GA-3
Cumulative Precip

Well	Ga7a	Ga1a
Transducer Elev	62.50	119.40
Casing Elev	106.10	145.40
Total Depth	47.00	26.00
TD Elev	59.10	119.40
Screen Interval	35-45	7-26

	Height over Tdx	WL Elev	Height over Tdx	WL Elevation
12/3/99 12:00 AM	1.81	60.70	3.74	123.14
12/4/99 12:00 AM	1.82	60.69	4.24	123.64
12/5/99 12:00 AM	2.01	60.49	5.07	124.47
12/5/99 12:00 PM	2.13	60.37	5.43	124.83
12/7/99 12:10 AM	2.30	60.20	6.24	125.64
12/7/99 12:10 PM	2.29	60.21	6.36	125.76
12/8/99 12:10 AM	2.24	60.26	6.51	125.91
12/8/99 12:10 AM	2.24	60.26	6.51	125.91
12/8/99 12:10 PM	2.26	60.25	6.78	126.18
12/8/99 12:10 PM	2.26	60.25	6.78	126.18
12/8/99 12:10 PM	2.26	60.25	6.78	126.18
12/9/99 2:36 PM	2.19	60.31	7.12	126.52
12/9/99 2:36 PM	2.19	60.31	7.12	126.52
12/9/99 2:36 PM	2.19	60.31	7.12	126.52
12/9/99 2:40 PM	2.23	60.27	7.10	126.50
12/9/99 2:40 PM	2.23	60.27	7.10	126.50
12/9/99 2:40 PM	2.23	60.27	7.10	126.50
12/9/99 2:43 PM	2.25	60.25	7.30	126.70
12/9/99 2:43 PM	2.25	60.25	7.30	126.70
12/9/99 2:43 PM	2.25	60.25	7.30	126.70
12/9/99 2:52 PM	2.25	60.25	6.98	126.38
12/9/99 2:52 PM	2.25	60.25	6.98	126.38
12/9/99 2:52 PM	2.25	60.25	6.98	126.38
12/9/99 2:54 PM	2.23	60.27	7.14	126.54
12/9/99 2:54 PM	2.23	60.27	7.14	126.54
12/9/99 2:54 PM	2.23	60.27	7.14	126.54
12/9/99 2:55 PM	2.23	60.27	7.06	126.46
12/9/99 2:55 PM	2.23	60.27	7.06	126.46
12/9/99 2:55 PM	2.23	60.27	7.06	126.46
12/10/99 12:10 AM	2.21	60.29	7.14	126.54
12/10/99 12:10 AM	2.21	60.29	7.14	126.54
12/10/99 12:10 PM	2.21	60.29	7.55	126.95
12/10/99 12:10 PM	2.21	60.29	7.55	126.95
12/13/99 12:10 AM	2.53	59.97	8.86	128.26
12/13/99 12:10 AM	2.53	59.97	8.86	128.26
12/13/99 8:09 AM	2.54	59.97	8.94	128.34
12/13/99 8:09 AM	2.54	59.97	8.94	128.34
12/13/99 12:10 PM	2.56	59.94	9.05	128.45
12/14/99 12:10 AM	2.51	59.99	9.20	128.60
12/14/99 2:46 PM	2.50	60.00	9.47	128.87
12/15/99 12:10 AM	2.48	60.02	9.53	128.93

Well	GA5a	Ga1b
Transducer Elev	84.10	67.40
Casing Elev	126.90	145.00
Total Depth	85.00	85.00
TD Elev	41.90	60.00
Screen Interval	25-45	NA

	12-Hour Precipiatation	Cumulative Precipitation	Height over Tdx	WL Elev	Height over Tdx	WL Elev
12/3/99 12:00 AM			3.03	87.13	4.03	71.43
12/4/99 12:00 AM			3.14	87.24	4.04	71.44
12/5/99 12:00 AM			3.15	87.25	3.97	71.37
12/5/99 12:00 PM			3.19	87.29	3.92	71.32
12/7/99 12:10 AM			3.24	87.34	3.85	71.25
12/7/99 12:10 PM	No Data	No Data	3.29	87.39	3.76	71.16
12/8/99 12:10 AM			3.30	87.40	3.63	71.03
12/8/99 12:10 AM			3.30	87.40	3.63	71.03
12/8/99 12:10 PM			3.38	87.48	3.74	71.14
12/8/99 12:10 PM			3.38	87.48	3.74	71.14
12/8/99 12:10 PM			3.38	87.48	3.74	71.14
12/9/99 2:36 PM			3.35	87.45	3.68	71.08
12/9/99 2:36 PM			3.35	87.45	3.68	71.08
12/9/99 2:36 PM			3.35	87.45	3.68	71.08
12/9/99 2:40 PM			3.33	87.43	3.66	71.06
12/9/99 2:40 PM			3.33	87.43	3.66	71.06
12/9/99 2:40 PM			3.33	87.43	3.66	71.06
12/9/99 2:43 PM			3.35	87.45	3.66	71.06
12/9/99 2:43 PM			3.35	87.45	3.66	71.06
12/9/99 2:43 PM			3.35	87.45	3.66	71.06
12/9/99 2:52 PM			3.35	87.45	3.66	71.06
12/9/99 2:52 PM			3.35	87.45	3.66	71.06
12/9/99 2:52 PM			3.35	87.45	3.66	71.06
12/9/99 2:54 PM			3.33	87.43	3.66	71.06
12/9/99 2:54 PM			3.33	87.43	3.66	71.06
12/9/99 2:54 PM			3.33	87.43	3.66	71.06
12/9/99 2:55 PM			3.37	87.47	3.66	71.06
12/9/99 2:55 PM			3.37	87.47	3.66	71.06
12/9/99 2:55 PM			3.37	87.47	3.66	71.06
12/10/99 12:10 AM			3.33	87.43	3.64	71.04
12/10/99 12:10 AM			3.33	87.43	3.64	71.04
12/10/99 12:10 PM			3.39	87.49	3.60	71.00
12/10/99 12:10 PM			3.39	87.49	3.60	71.00
12/13/99 12:10 AM			3.47	87.57	3.53	70.93
12/13/99 12:10 AM			3.47	87.57	3.53	70.93
12/13/99 8:09 AM			3.51	87.61	3.60	71.00
12/13/99 8:09 AM			3.51	87.61	3.60	71.00
12/13/99 12:10 PM			3.55	87.65	3.58	70.98
12/14/99 12:10 AM			3.57	87.67	3.51	70.91
12/14/99 2:46 PM			3.60	87.70	3.64	71.04
12/15/99 12:10 AM			3.58	87.68	3.56	70.96

Well	Ga7a	Ga1a
Transducer Elev	62.50	119.40
Casing Elev	106.10	145.40
Total Depth	47.00	26.00
TD Elev	59.10	119.40
Screen Interval	35-45	7-26

	Height over Tdx	WL Elev	Height over Tdx	WL Elevation
12/15/99 11:03 AM	2.44	60.07	9.73	129.13
12/15/99 12:10 PM	2.44	60.06	9.67	129.07
12/16/99 12:10 AM	2.37	60.14	9.80	129.20
12/16/99 12:10 PM	2.36	60.14	10.87	130.27
12/17/99 12:10 AM	2.44	60.06	12.02	131.42
12/17/99 12:10 PM	2.62	59.88	14.12	133.52
12/20/99 12:10 AM	3.05	59.45	19.22	138.62
12/20/99 12:10 PM	3.09	59.41	20.13	139.53
12/21/99 12:10 AM	3.07	59.43	20.62	140.02
12/21/99 12:10 PM	3.02	59.49	20.80	140.20
12/22/99 12:10 AM	2.94	59.56	20.86	140.26
12/22/99 12:10 PM	2.82	59.68	20.72	140.12
12/23/99 12:10 AM	2.69	59.81	20.49	139.89
12/23/99 12:10 PM	2.59	59.91	20.29	139.69
12/26/99 12:10 PM	1.86	60.64	17.74	137.14
12/26/99 12:10 PM	1.86	60.64	17.74	137.14
1/4/00 12:10 AM	0.50	62.00	9.41	128.81
1/4/00 12:10 PM	0.45	62.06	8.67	128.07
1/5/00 12:10 AM	0.39	62.11	8.08	127.48
1/5/00 12:10 PM	0.34	62.16	7.57	126.97
1/6/00 12:10 AM	0.28	62.23	7.21	126.61
1/6/00 9:39 AM	0.23	62.27	6.88	126.28
1/6/00 9:43 AM	0.23	62.27	6.90	126.30
1/6/00 11:01 AM	0.25	62.26	6.24	125.64
1/7/00 12:10 AM	0.18	62.32	6.34	125.74
1/7/00 12:10 PM	0.13	62.37	6.34	125.74
1/8/00 12:10 AM	0.09	62.41	6.34	125.74
1/8/00 12:10 PM	0.06	62.44	6.34	125.74
1/9/00 12:10 AM	0.03	62.47	6.34	125.74
1/9/00 12:10 PM	0.00	62.50	6.34	125.74
1/10/00 12:10 AM	(0.05)	62.50	6.34	125.74
1/10/00 10:15 AM	(0.07)	62.50	6.34	125.74
1/10/00 10:19 AM	(0.07)	62.50	6.34	125.74
1/10/00 12:10 PM	(0.06)	62.50	6.34	125.74
1/11/00 12:10 AM	(0.09)	62.50	6.34	125.74
1/11/00 12:10 PM	(0.13)	62.50	6.34	125.74
1/12/00 12:10 AM	(0.17)	62.50	6.34	125.74
1/12/00 12:10 PM	(0.17)	62.50	6.34	125.74
1/13/00 12:10 AM	(0.24)	62.50	6.34	125.74
1/13/00 12:10 PM	(0.26)	62.50	6.34	125.74
1/14/00 12:10 AM	(0.28)	62.50	6.34	125.74

Well	**GA5a**	**Ga1b**
Transducer Elev	**84.10**	**67.40**
Casing Elev	**126.90**	**145.00**
Total Depth	**85.00**	**85.00**
TD Elev	**41.90**	**60.00**
Screen Interval	**25-45**	**NA**

	12-Hour Precipiatation	**Cumulative Precipitation**	**Height over Tdx**	**WL Elev**	**Height over Tdx**	**WL Elev**
12/15/99 11:03 AM			3.62	87.72	3.66	71.06
12/15/99 12:10 PM			3.62	87.72	3.62	71.02
12/16/99 12:10 AM			3.59	87.69	3.53	70.93
12/16/99 12:10 PM	**No Data**	**No Data**	3.66	87.76	3.56	70.96
12/17/99 12:10 AM			3.72	87.82	3.58	70.98
12/17/99 12:10 PM			3.86	87.96	3.76	71.16
12/20/99 12:10 AM			3.99	88.09	3.56	70.96
12/20/99 12:10 PM			4.09	88.19	3.60	71.00
12/21/99 12:10 AM			4.09	88.19	3.58	70.98
12/21/99 12:10 PM			4.12	88.22	3.61	71.01
12/22/99 12:10 AM			4.12	88.22	3.55	70.95
12/22/99 12:10 PM			4.13	88.23	3.58	70.98
12/23/99 12:10 AM			4.08	88.18	3.53	70.93
12/23/99 12:10 PM			4.08	88.18		
12/26/99 12:10 PM			3.81	87.91	**No Data**	**No Data**
12/26/99 12:10 PM			3.81	87.91		
1/4/00 12:10 AM	1.45	1.45	3.31	87.41		
1/4/00 12:10 PM	0.38	1.83	3.19	87.29		
1/5/00 12:10 AM	-	1.83	3.16	87.26		
1/5/00 12:10 PM	-	1.83	3.17	87.27		
1/6/00 12:10 AM	-	1.83	3.21	87.31		
1/6/00 9:39 AM	-	1.83	3.17	87.27		
1/6/00 9:43 AM	-	1.83	3.15	87.25		
1/6/00 11:01 AM	-	1.83	3.14	87.24		
1/7/00 12:10 AM	0.08	1.91	3.10	87.20		
1/7/00 12:10 PM	-	1.91	3.09	87.19		
1/8/00 12:10 AM	0.34	2.25	3.13	87.23		
1/8/00 12:10 PM	0.12	2.37	3.05	87.15		
1/9/00 12:10 AM	0.14	2.51	3.09	87.19		
1/9/00 12:10 PM	0.94	3.45	3.00	87.10		
1/10/00 12:10 AM	0.16	3.61	3.01	87.11		
1/10/00 10:15 AM	0.07	3.68	3.03	87.13		
1/10/00 10:19 AM	0.11	3.79	3.03	87.13		
1/10/00 12:10 PM	0.06	3.85	3.02	87.12		
1/11/00 12:10 AM	0.26	4.11	2.97	87.07		
1/11/00 12:10 PM	0.15	4.26	2.97	87.07		
1/12/00 12:10 AM	0.48	4.74	2.95	87.05		
1/12/00 12:10 PM	0.31	5.05	2.93	87.03		
1/13/00 12:10 AM	0.54	5.59	2.89	86.99		
1/13/00 12:10 PM	1.49	7.08	2.92	87.02	**No Data**	**No Data**
1/14/00 12:10 AM	0.75	7.83	2.93	87.03		

Well	GA5a	Ga1b
Transducer Elev	84.10	67.40
Casing Elev	126.90	145.00
Total Depth	85.00	85.00
TD Elev	41.90	60.00
Screen Interval	25-45	NA

	12-Hour Precipiatation	Cumulative Precipitation	Height over Tdx	WL Elev	Height over Tdx	WL Elev
1/14/00 12:10 PM	0.11	7.94	2.90	87.00		
1/15/00 12:10 AM	0.01	7.95	2.89	86.99		
1/15/00 12:10 PM	0.67	8.62	2.93	87.03		
1/16/00 12:10 AM	0.85	9.47	2.96	87.06		
1/16/00 12:10 PM	-	9.47	2.94	87.04		
1/17/00 12:10 AM	-	9.47	2.86	86.96		
1/17/00 12:10 PM	-		2.95	87.05		
1/18/00 12:10 AM	-		2.97	87.07		

Well	Ga7a	Ga1a
Transducer Elev	62.50	119.40
Casing Elev	106.10	145.40
Total Depth	47.00	26.00
TD Elev	59.10	119.40
Screen Interval	35-45	7-26

	Height over Tdx	WL Elev	Height over Tdx	WL Elevation
1/14/00 12:10 PM	(0.22)	62.50	6.34	125.74
1/15/00 12:10 AM	(0.24)	62.50	6.34	125.74
1/15/00 12:10 PM	(0.23)	62.50	6.34	125.74
1/16/00 12:10 AM	(0.18)	62.50	6.34	125.74
1/16/00 12:10 PM	(0.08)	62.50	6.34	125.74
1/17/00 12:10 AM	(0.06)	62.50	6.34	125.74
1/17/00 12:10 PM	0.02	62.48	6.34	125.74
1/18/00 12:10 AM	0.09	62.41	6.34	125.74

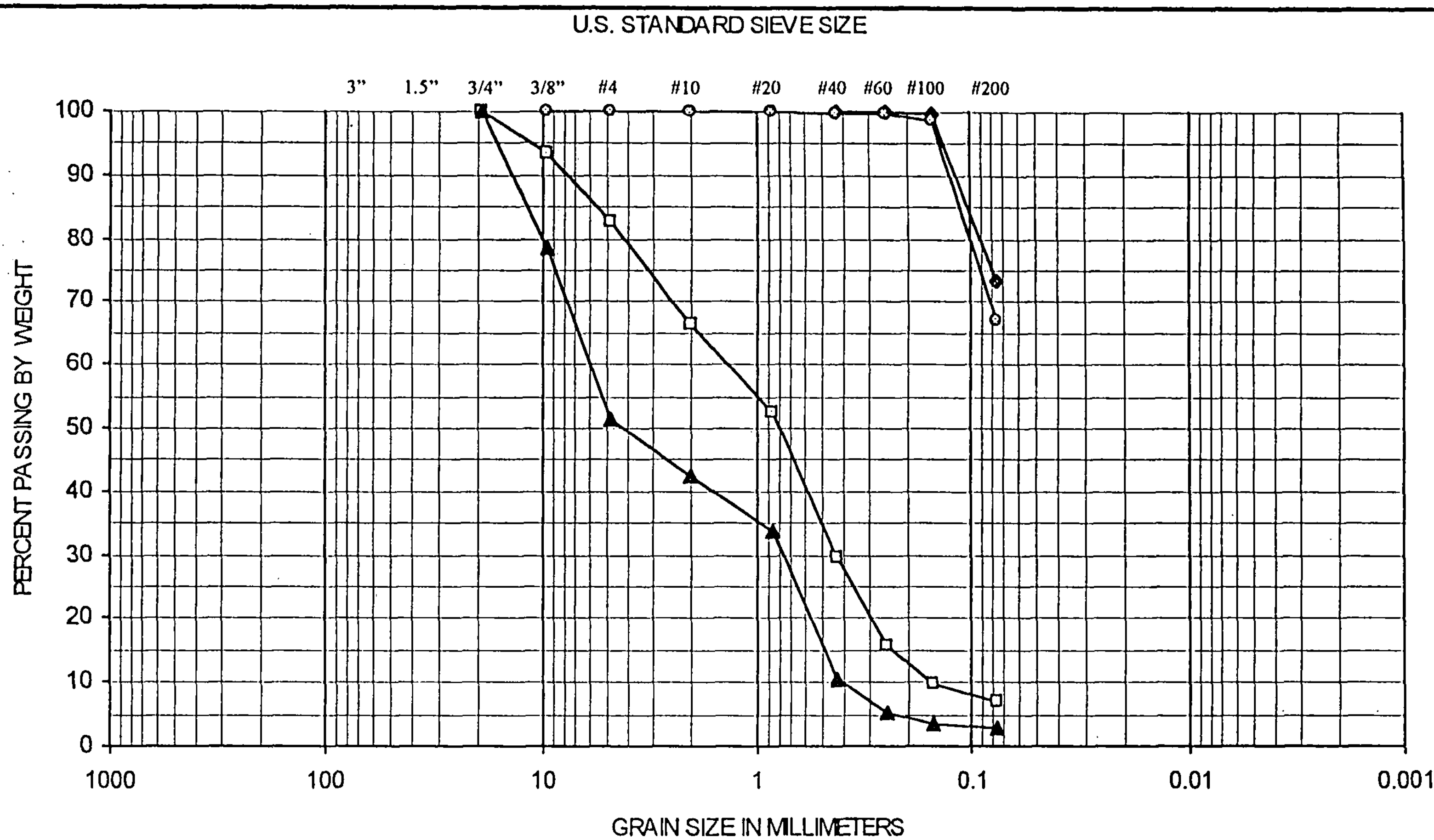
APPENDIX F

LABORATORY TEST RESULTS

DOT-50000361

0314-034-00 (993-1466.500) JRS:MBB:mbb 9/8/99 (Sieves.ppt)

Geo Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◈	GA-1	25-26.5	Gray fine sandy silt (ML)
▣	GA-2	25-26.5	Brown fine to coarse sand with silt and fine gravel (SW-SM)
◎	GA-4	41-42.5	Gray fine sandy silt (ML)
▲	GA-5	31-32.5	Gray medium sand with fine gravel (SP)

SIEVE ANALYSIS RESULTS

FIGURE #

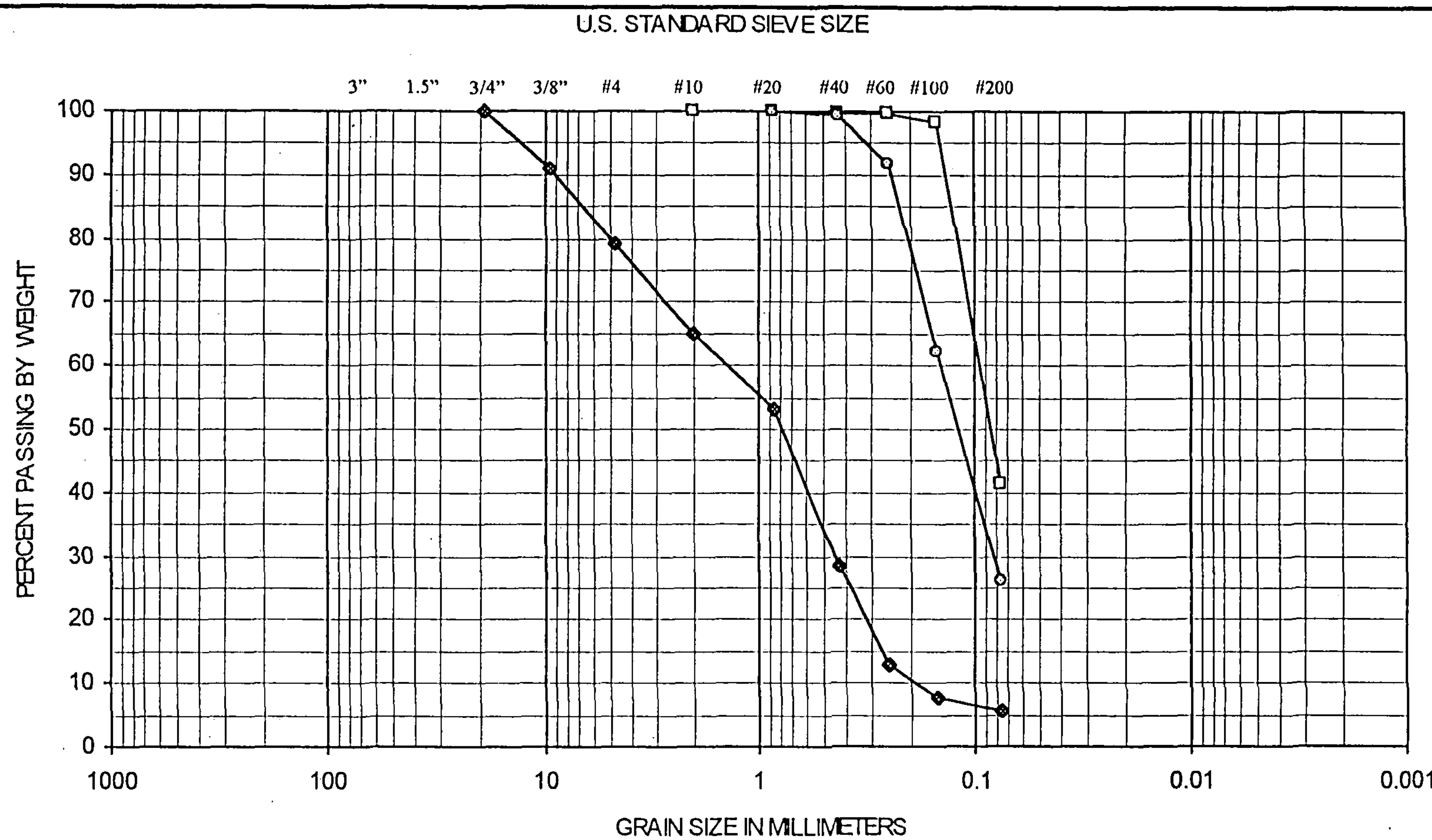
DOT-50000362

0314-034-00 (993-1466.500) JRS:MBB:mbb 9/8/99 (Sieves.ppt)

Geo Engineers

SIEVE ANALYSIS RESULTS

FIGURE #



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	GA-6	21-22.5	Gray fine to medium sand with silt and fine gravel (SP-SM)
□	GA-6	46-47.5	Gray silty fine sand (SM)
◎	GA-7	21-22.5	Gray silty fine sand (SM)

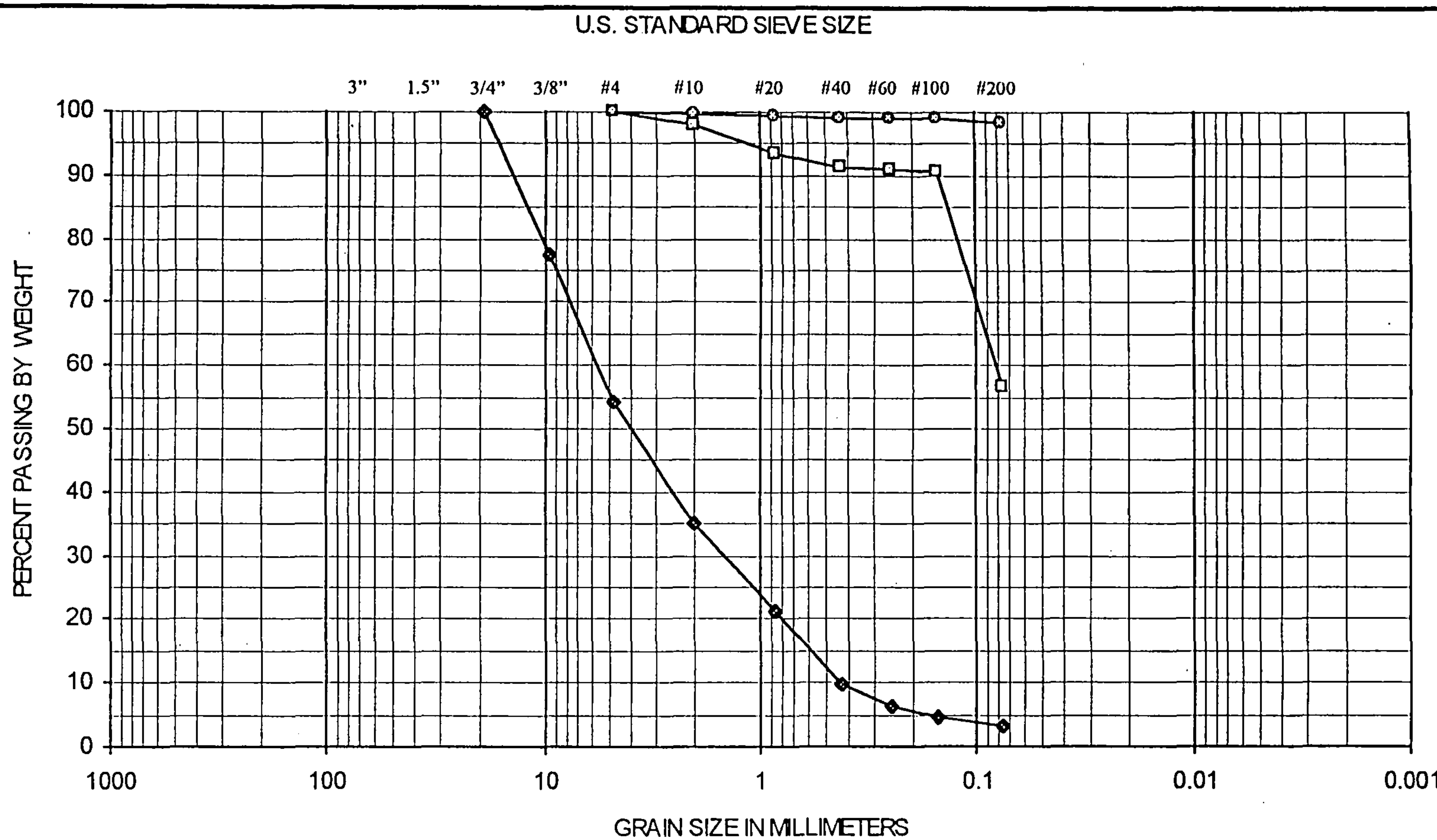
DOT-50000363

0314-034-00 (993-1466.500) JRS:MBB:mbb 9/8/99 (Sieves.ppt)

GeoEngineers

SIEVE ANALYSIS RESULTS

FIGURE #



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	GA-8	61-62.5	Gray medium to coarse sand with fine gravel (SP)
□	GA-8	141-142.5	Gray fine sandy silt (ML)
◎	GA-8	201-202.5	Gray silt (ML)

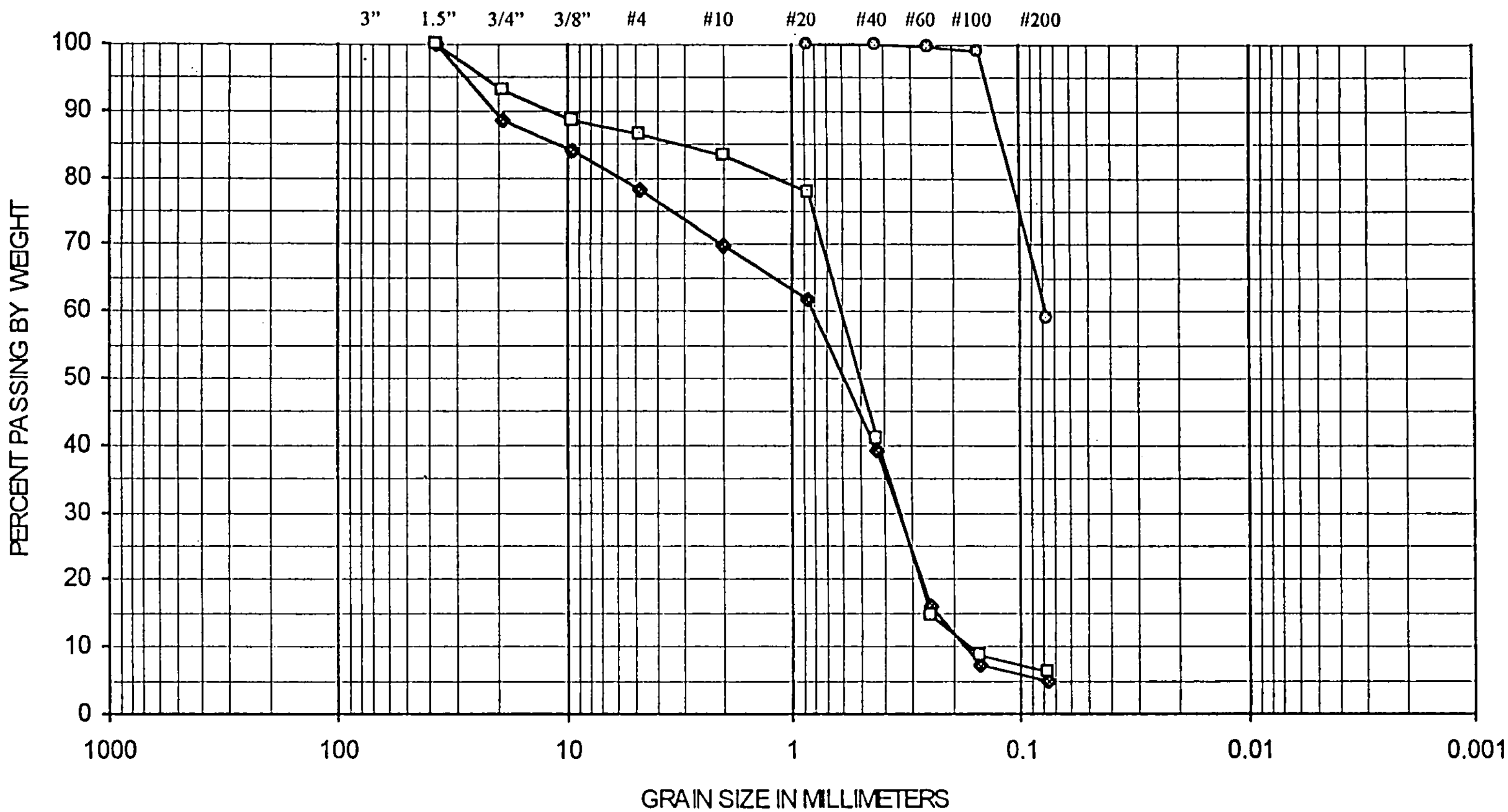
DOT-50000364

0314-034-00 (993-1466.500) JRS:MBB:mbb 9/8/99 (Sieves.ppt)

Geo Engineers

SIEVE ANALYSIS RESULTS

FIGURE #



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	GA-9	45-46.5	Gray fine to medium sand with gravel (SP)
□	GA-9	110-111.5	Gray fine to medium sand with silt (SP-SM)
◎	GA-9	165-166.5	Gray fine sandy silt (ML)

DOT-50000365

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500)   Job No: 0314-034-00

Date: 9/8/99   Tested By: MBB

Boring No: GA-1   Sample No: 5   Depth: 25-26.5'

Soil Description: Gray silty fine sand (SM)

Moisture Content		
Pan #	Z3	*
Pan + Wet Soil	665.85	*
Pan + Dry Soil	532.05	*
Moisture Loss	133.80	
Pan Wt.	87.11	*
Dry Soil Wt.	444.94	
Moisture Content	30.1	

-200 Wash		
Pan #	Z3	
Pan + Dry Soil (Before)	532.05	
Pan + Dry Soil (After)	251.94	*
-200 From Wash	280.11	
Pan Wt.	87.11	
Dry Soil Wt.	444.94	
% of -200	63.0	

Total Washed Soil Wt: 164.83

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	0.00	0.0	100.0
3/8"	************	0.00	0.0	100.0
#4	************	0.00	0.0	100.0
#10	0.00	0.00	0.0	100.0
#20	0.00	0.00	0.0	100.0
#40	0.02	0.17	0.0	100.0
#60	0.05	0.42	0.1	99.9
#100	0.23	1.95	0.4	99.6
#200	13.99	118.32	26.6	73.4
Pan	19.49	164.83		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	100.0
#40	100.0
#60	99.9
#100	99.6
#200	73.4

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.0
	Fine	26.6
-200		73.4

Soil Classification: Gray fine sandy silt (ML)

DOT-50000366

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-2 Sample No: 5 Depth: 25-26.5'

Soil Description: Brown silty fine to coarse sand with occasional gravel (SM)

Moisture Content		
Pan #	B3	*
Pan + Wet Soil	555.35	*
Pan + Dry Soil	510.13	*
Moisture Loss	45.22	
Pan Wt.	84.37	*
Dry Soil Wt.	425.76	
Moisture Content	10.6	

-200 Wash		
Pan #	B3	
Pan + Dry Soil (Before)	510.13	
Pan + Dry Soil (After)	481.38	*
-200 From Wash	28.75	
Pan Wt.	84.37	
Dry Soil Wt.	425.76	
% of -200	6.8	

Total Washed Soil Wt: 397.01

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	28.33	6.7	93.3
#4	***********	74.41	17.5	82.5
#10	9.23	143.77	33.8	66.2
#20	17.13	203.13	47.7	52.3
#40	26.54	300.33	70.5	29.5
#60	36.59	359.61	84.5	15.5
#100	40.88	384.92	90.4	9.6
#200	42.69	395.59	92.9	7.1
Pan	42.93	397.01		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	93.3
#4	82.5
#10	66.2
#20	52.3
#40	29.5
#60	15.5
#100	9.6
#200	7.1

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	17.5
Sand	Coarse	16.3
	Medium	36.8
	Fine	22.4
-200		7.1

Soil Classification: Brown fine to coarse sand with silt and fine gravel (SW-SM)

DOT-50000367

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-4 Sample No: 8 Depth: 41-42.5'

Soil Description: Gray silty fine sand (SM)

Moisture Content		
Pan #	Z8	*
Pan + Wet Soil	597.22	*
Pan + Dry Soil	480.96	*
Moisture Loss	116.26	
Pan Wt.	81.91	*
Dry Soil Wt.	399.05	
Moisture Content	29.1	

-200 Wash		
Pan #	Z8	
Pan + Dry Soil (Before)	480.96	
Pan + Dry Soil (After)	303.18	*
-200 From Wash	177.78	
Pan Wt.	81.91	
Dry Soil Wt.	399.05	
% of -200	44.6	

Total Washed Soil Wt: 221.27

Sieve Analysis

Sieve Size	Fractional Sample: Accum. Wt. Retained	Total Sample: Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	0.00	0.0	100.0
#4	***********	0.26	0.1	99.9
#10	0.00	0.26	0.1	99.9
#20	0.01	0.47	0.1	99.9
#40	0.02	0.67	0.2	99.8
#60	0.08	1.91	0.5	99.5
#100	0.23	4.99	1.3	98.7
#200	6.38	131.55	33.0	67.0
Pan	10.74	221.27		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	99.9
#10	99.9
#20	99.9
#40	99.8
#60	99.5
#100	98.7
#200	67.0

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.1
Sand	Coarse	0.0
	Medium	0.1
	Fine	32.8
-200		67.0

Soil Classification:	Gray fine sandy silt (ML)

DOT-50000368

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-5 Sample No: 6 Depth: 31'

Soil Description: Gray silty fine to coarse sand with occasional gravel (SM)

Moisture Content		
Pan #	B4	*
Pan + Wet Soil	501.39	*
Pan + Dry Soil	457.20	*
Moisture Loss	44.19	
Pan Wt.	84.25	*
Dry Soil Wt.	372.95	
Moisture Content	11.8	

-200 Wash		
Pan #	B4	
Pan + Dry Soil (Before)	457.20	
Pan + Dry Soil (After)	447.41	*
-200 From Wash	9.79	
Pan Wt.	84.25	
Dry Soil Wt.	372.95	
% of -200	2.6	

Total Washed Soil Wt: 363.16

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	0.00	0.0	100.0
3/8"	************	80.36	21.5	78.5
#4	************	180.70	48.5	51.5
#10	4.57	215.44	57.8	42.2
#20	8.77	247.37	66.3	33.7
#40	19.22	333.74	89.5	10.5
#60	22.37	353.13	94.7	5.3
#100	23.39	359.41	96.4	3.6
#200	23.95	362.85	97.3	2.7
Pan	24.00	363.16		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	78.5
#4	51.5
#10	42.2
#20	33.7
#40	10.5
#60	5.3
#100	3.6
#200	2.7

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	48.5
Sand	Coarse	9.3
	Medium	31.7
	Fine	7.8
-200		2.7

Soil Classification:	Gray medium sand with fine gravel (SP)

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-6 Sample No: 4 Depth: 21-22.5'

Soil Description: Gray silty fine to coarse sand with occasional gravel (SM)

Moisture Content		
Pan #	Z5	*
Pan + Wet Soil	502.91	*
Pan + Dry Soil	455.15	*
Moisture Loss	47.76	
Pan Wt.	86.43	*
Dry Soil Wt.	368.72	
Moisture Content	13.0	

-200 Wash		
Pan #	Z5	
Pan + Dry Soil (Before)	455.15	
Pan + Dry Soil (After)	436.15	*
-200 From Wash	19.00	
Pan Wt.	86.43	
Dry Soil Wt.	368.72	
% of -200	5.2	

Total Washed Soil Wt: 349.72

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	33.69	9.1	90.9
#4	***********	77.32	21.0	79.0
#10	7.31	129.34	35.1	64.9
#20	13.41	172.75	46.9	53.1
#40	23.27	263.31	71.4	28.6
#60	33.46	321.97	87.3	12.7
#100	36.70	340.62	92.4	7.6
#200	38.15	348.97	94.6	5.4
Pan	38.28	349.72		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	90.9
#4	79.0
#10	64.9
#20	53.1
#40	28.6
#60	12.7
#100	7.6
#200	5.4

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	21.0
Sand	Coarse	14.1
	Medium	36.3
	Fine	23.2
-200		5.4

Soil Classification: Gray fine to medium sand with silt and fine gravel (SP-SM)

DOT-50000370

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-6 Sample No: 9 Depth: 46-47.5'

Soil Description: Gray silty fine sand (SM)

Moisture Content		
Pan #	Z1	*
Pan + Wet Soil	637.19	*
Pan + Dry Soil	522.13	*
Moisture Loss	115.06	
Pan Wt.	83.88	*
Dry Soil Wt.	438.25	
Moisture Content	26.3	

-200 Wash		
Pan #	Z1	
Pan + Dry Soil (Before)	522.13	
Pan + Dry Soil (After)	411.25	*
-200 From Wash	110.88	
Pan Wt.	83.88	
Dry Soil Wt.	438.25	
% of -200	25.3	

Total Washed Soil Wt: 327.37

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	0.00	0.0	100.0
#4	***********	0.00	0.0	100.0
#10	0.00	0.00	0.0	100.0
#20	0.02	0.34	0.1	99.9
#40	0.05	0.84	0.2	99.8
#60	0.12	2.02	0.5	99.5
#100	0.47	7.90	1.8	98.2
#200	15.32	257.46	58.7	41.3
Pan	19.48	327.37		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	99.9
#40	99.8
#60	99.5
#100	98.2
#200	41.3

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.2
	Fine	58.6
-200		41.3

Soil Classification: Gray silty fine sand (SM)

DOT-50000371

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-7 Sample No: 4 Depth: 21'

Soil Description: Gray silty fine sand (SM)

Moisture Content		
Pan #	B9	*
Pan + Wet Soil	733.24	*
Pan + Dry Soil	597.26	*
Moisture Loss	135.98	
Pan Wt.	84.33	*
Dry Soil Wt.	512.93	
Moisture Content	26.5	

-200 Wash		
Pan #	B9	
Pan + Dry Soil (Before)	597.26	
Pan + Dry Soil (After)	524.02	*
-200 From Wash	73.24	
Pan Wt.	84.33	
Dry Soil Wt.	512.93	
% of -200	14.3	

Total Washed Soil Wt: 439.69

Sieve Analysis

	Fractional Sample	Total Sample		
Sieve Size	Accum. Wt. Retained	Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	0.00	0.0	100.0
#4	***********	0.00	0.0	100.0
#10	0.00	0.00	0.0	100.0
#20	0.00	0.00	0.0	100.0
#40	0.11	3.15	0.6	99.4
#60	1.49	42.68	8.3	91.7
#100	6.78	194.21	37.9	62.1
#200	13.21	378.39	73.8	26.2
Pan	15.35	439.69		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	100.0
#40	99.4
#60	91.7
#100	62.1
#200	26.2

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.6
	Fine	73.2
-200		26.2

Soil Classification: Gray silty fine sand (SM)

DOT-50000372

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-8 Sample No: 4 Depth: 61'

Soil Description: Gray fine to coarse sand with silt and occasional gravel (SW-SM)

Moisture Content		
Pan #	Z2	*
Pan + Wet Soil	467.66	*
Pan + Dry Soil	425.89	*
Moisture Loss	41.77	
Pan Wt.	84.50	*
Dry Soil Wt.	341.39	
Moisture Content	12.2	

-200 Wash		
Pan #	Z2	
Pan + Dry Soil (Before)	425.89	
Pan + Dry Soil (After)	416.39	*
-200 From Wash	9.50	
Pan Wt.	84.50	
Dry Soil Wt.	341.39	
% of -200	2.8	

Total Washed Soil Wt: 331.89

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	0.00	0.0	100.0
3/8"	************	76.76	22.5	77.5
#4	************	155.86	45.7	54.3
#10	8.86	221.75	65.0	35.0
#20	15.25	269.27	78.9	21.1
#40	18.50	307.83	90.2	9.8
#60	21.01	319.51	93.6	6.4
#100	22.51	326.49	95.6	4.4
#200	23.51	331.15	97.0	3.0
Pan	23.67	331.89		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	77.5
#4	54.3
#10	35.0
#20	21.1
#40	9.8
#60	6.4
#100	4.4
#200	3.0

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	45.7
Sand	Coarse	19.3
	Medium	25.2
	Fine	6.8
-200		3.0

Soil Classification:	Gray medium to coarse sand with fine gravel (SP)

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-8 Sample No: 20 Depth: 141-142.5'

Soil Description: Gray silty fine sand (SM)

Moisture Content		
Pan #	B10	*
Pan + Wet Soil	454.45	*
Pan + Dry Soil	370.76	*
Moisture Loss	83.69	
Pan Wt.	85.20	*
Dry Soil Wt.	285.56	
Moisture Content	29.3	

-200 Wash		
Pan #	B10	
Pan + Dry Soil (Before)	370.76	
Pan + Dry Soil (After)	247.30	*
-200 From Wash	123.46	
Pan Wt.	85.20	
Dry Soil Wt.	285.56	
% of -200	43.2	

Total Washed Soil Wt: 162.10

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	0.00	0.0	100.0
3/8"	***********	0.00	0.0	100.0
#4	***********	0.00	0.0	100.0
#10	0.78	6.01	2.1	97.9
#20	2.49	19.19	6.7	93.3
#40	2.58	25.16	8.8	91.2
#60	2.66	25.76	9.0	91.0
#100	2.83	27.02	9.5	90.5
#200	15.83	123.50	43.3	56.7
Pan	21.03	162.10		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	97.9
#20	93.3
#40	91.2
#60	91.0
#100	90.5
#200	56.7

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	2.1
	Medium	6.7
	Fine	34.4
-200		56.7

Soil Classification: Gray fine sandy silt (ML)

DOT-50000374

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-8 Sample No: 32 Depth: 201-202.5'

Soil Description: Gray silt (ML)

Moisture Content		
Pan #	Z4	*
Pan + Wet Soil	447.28	*
Pan + Dry Soil	364.46	*
Moisture Loss	82.82	
Pan Wt.	85.35	*
Dry Soil Wt.	279.11	
Moisture Content	29.7	

-200 Wash		
Pan #	Z4	
Pan + Dry Soil (Before)	364.46	
Pan + Dry Soil (After)	90.11	*
-200 From Wash	274.35	
Pan Wt.	85.35	
Dry Soil Wt.	279.11	
% of -200	98.3	

Total Washed Soil Wt: 4.76

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	Total Sample % Retained	Total Sample % Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	0.00	0.0	100.0
3/8"	************	0.00	0.0	100.0
#4	************	0.00	0.0	100.0
#10	0.45	0.44	0.2	99.8
#20	1.98	1.95	0.7	99.3
#40	2.75	2.90	1.0	99.0
#60	2.94	3.07	1.1	98.9
#100	3.15	3.26	1.2	98.8
#200	4.44	4.41	1.6	98.4
Pan	4.83	4.76		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	99.8
#20	99.3
#40	99.0
#60	98.9
#100	98.8
#200	98.4

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.2
	Medium	0.9
	Fine	0.5
-200		98.4

Soil Classification: Gray silt (ML)

DOT-50000375

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-9 Sample No: 4 Depth: 45-46.5'

Soil Description: Gray fine to medium sand with occasional coarse sand and gravel (SP)

Moisture Content		
Pan #	Z6	*
Pan + Wet Soil	685.66	*
Pan + Dry Soil	606.34	*
Moisture Loss	79.32	
Pan Wt.	87.66	*
Dry Soil Wt.	518.68	
Moisture Content	15.3	

-200 Wash		
Pan #	Z6	
Pan + Dry Soil (Before)	606.34	
Pan + Dry Soil (After)	582.88	*
-200 From Wash	23.46	
Pan Wt.	87.66	
Dry Soil Wt.	518.68	
% of -200	4.5	

Total Washed Soil Wt: 495.22

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	59.77	11.5	88.5
3/8"	************	82.63	15.9	84.1
#4	************	113.20	21.8	78.2
#10	2.82	156.60	30.2	69.8
#20	5.49	197.70	38.1	61.9
#40	11.68	315.95	60.9	39.1
#60	20.52	436.56	84.2	15.8
#100	23.78	481.03	92.7	7.3
#200	24.74	494.13	95.3	4.7
Pan	24.82	495.22		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	88.5
3/8"	84.1
#4	78.2
#10	69.8
#20	61.9
#40	39.1
#60	15.8
#100	7.3
#200	4.7

Classification Data

Description		% Total
Gravel	Coarse	11.5
	Fine	10.3
Sand	Coarse	8.4
	Medium	30.7
	Fine	34.4
-200		4.7

Soil Classification: Gray fine to medium sand with gravel (SP)

DOT-50000376

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/8/99 Tested By: MBB

Boring No: GA-9 Sample No: 10 Depth: 110-111.5'

Soil Description: Gray fine to medium sand with occasional coarse sand (SP)

Moisture Content		
Pan #	B2	*
Pan + Wet Soil	471.07	*
Pan + Dry Soil	414.03	*
Moisture Loss	57.04	
Pan Wt.	84.63	*
Dry Soil Wt.	329.40	
Moisture Content	17.3	

-200 Wash		
Pan #	B2	
Pan + Dry Soil (Before)	414.03	
Pan + Dry Soil (After)	394.94	*
-200 From Wash	19.09	
Pan Wt.	84.63	
Dry Soil Wt.	329.40	
% of -200	5.8	

Total Washed Soil Wt: 310.31

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	***********	0.00	0.0	100.0
1.5"	***********	0.00	0.0	100.0
3/4"	***********	23.09	7.0	93.0
3/8"	***********	37.71	11.4	88.6
#4	***********	44.96	13.6	86.4
#10	1.18	55.14	16.7	83.3
#20	3.32	73.59	22.3	77.7
#40	16.73	193.88	58.9	41.1
#60	27.23	280.95	85.3	14.7
#100	29.67	301.19	91.4	8.6
#200	30.66	309.40	93.9	6.1
Pan	30.77	310.31		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	93.0
3/8"	88.6
#4	86.4
#10	83.3
#20	77.7
#40	41.1
#60	14.7
#100	8.6
#200	6.1

Classification Data

Description		% Total
Gravel	Coarse	7.0
	Fine	6.6
Sand	Coarse	3.1
	Medium	42.1
	Fine	35.1
-200		6.1

Soil Classification: Gray fine to medium sand with silt (SP-SM)

DOT-50000377

Particle Size Analysis Worksheet

Job Name: Golder (993-1466.500)   Job No: 0314-034-00

Date: 9/8/99   Tested By: MBB

Boring No: GA-9   Sample No: 16   Depth: 165.0-166.5'

Soil Description: Gray silty fine sand (SM)

Moisture Content	
Pan #	B8 *
Pan + Wet Soil	606.58 *
Pan + Dry Soil	490.66 *
Moisture Loss	115.92
Pan Wt.	84.10 *
Dry Soil Wt.	406.56
Moisture Content	28.5

-200 Wash	
Pan #	B8
Pan + Dry Soil (Before)	490.66
Pan + Dry Soil (After)	329.92 *
-200 From Wash	160.74
Pan Wt.	84.10
Dry Soil Wt.	406.56
% of -200	39.5

Total Washed Soil Wt: 245.82

Sieve Analysis

Sieve Size	Fractional Sample: Accum. Wt. Retained	Total Sample: Accum. Wt. Retained	% Retained	% Passing
3.0"	************	0.00	0.0	100.0
1.5"	************	0.00	0.0	100.0
3/4"	************	0.00	0.0	100.0
3/8"	************	0.00	0.0	100.0
#4	************	0.00	0.0	100.0
#10	0.00	0.00	0.0	100.0
#20	0.02	0.16	0.0	100.0
#40	0.07	0.57	0.1	99.9
#60	0.19	1.55	0.4	99.6
#100	0.46	3.75	0.9	99.1
#200	20.44	166.43	40.9	59.1
Pan	30.19	245.82		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	100.0
#40	99.9
#60	99.6
#100	99.1
#200	59.1

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.1
	Fine	40.8
-200		59.1

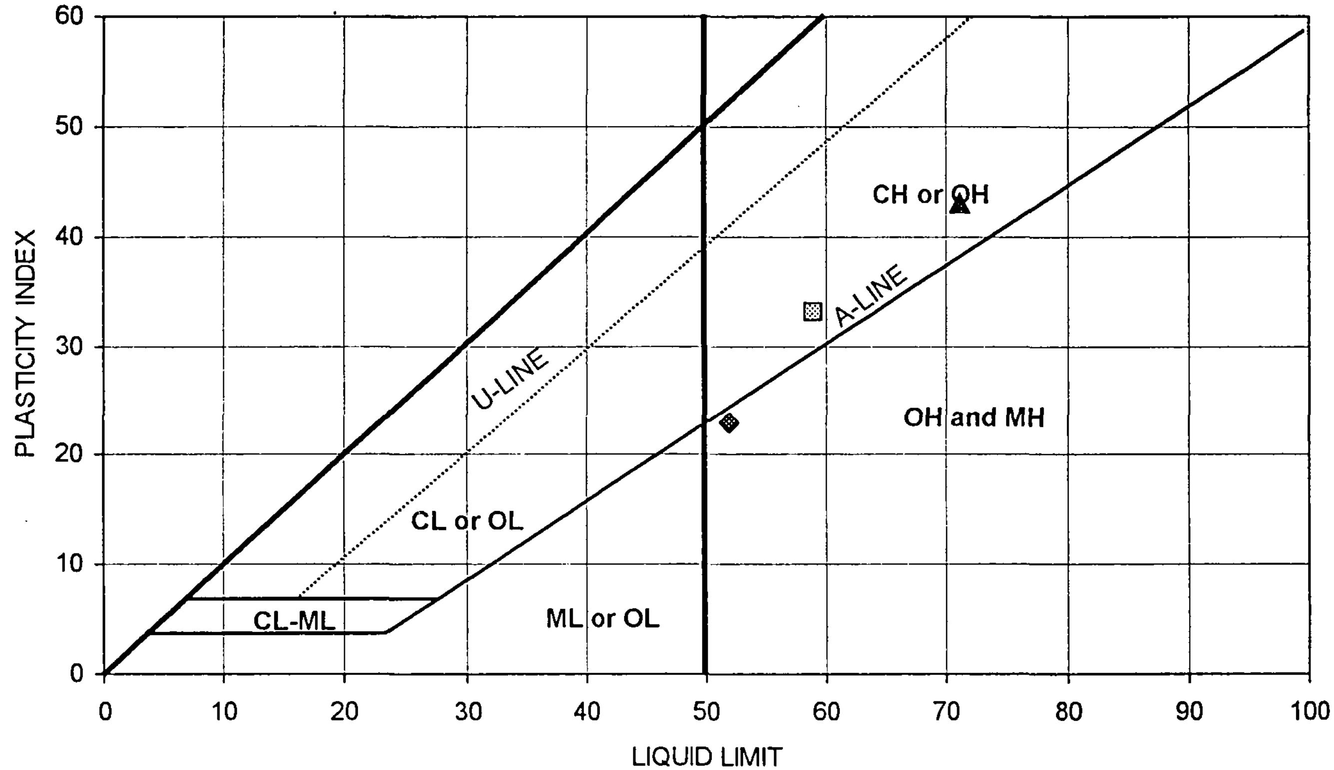
Soil Classification: Gray fine sandy silt (ML)

DOT-50000378

Geo Engineers

ATTERBERG LIMITS TEST RESULTS

FIGURE #



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	Sample #	SOIL DESCRIPTION
◆	GA-1	N/A	39.6	52	23	SS #12	Gray elastic silt (MH)
▩	GA-1	N/A	29.1	59	33	SS # 13	Gray fat clay (CH)
▲	GA-2	N/A	31.6	71	43	SS # 2	Gray fat clay (CH)

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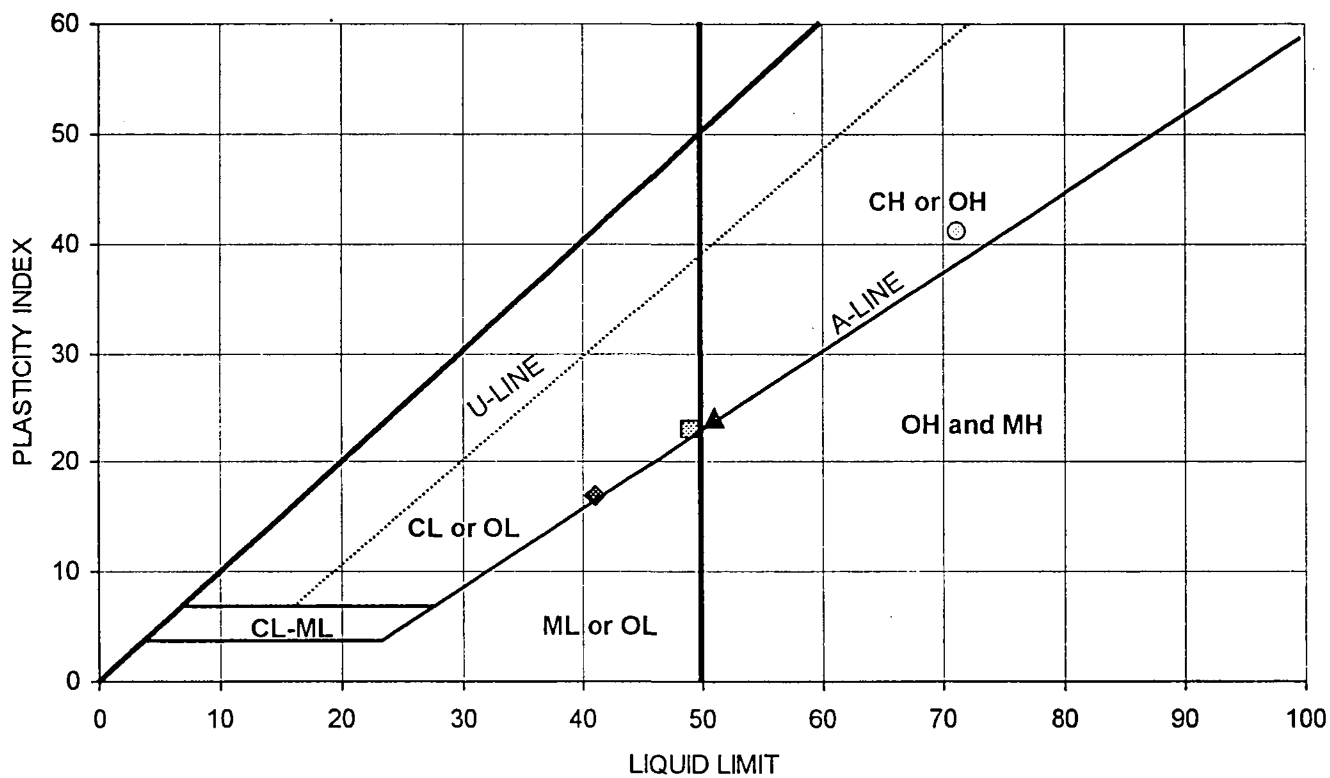
0314-034-00 (993-1466.500) JRS:MBB:mbb 9/14/99 (Atterbergs.ppt)

GeoEngineers

ATTERBERG LIMITS TEST RESULTS

FIGURE #

PLASTICITY CHART



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	sample #	SOIL DESCRIPTION
◆	GA-4	N/A	28.4	41	17	SS#14	Gray clay (CL)
■	GA-4	N/A	32.0	49	23	SS#19	Gray clay (CL)
▲	GA-5	N/A	25.7	51	24	SS#10A	Gray fat clay (CH)
○	GA-5	N/A	30.3	71	41	SS#12	Gray fat clay (CH)

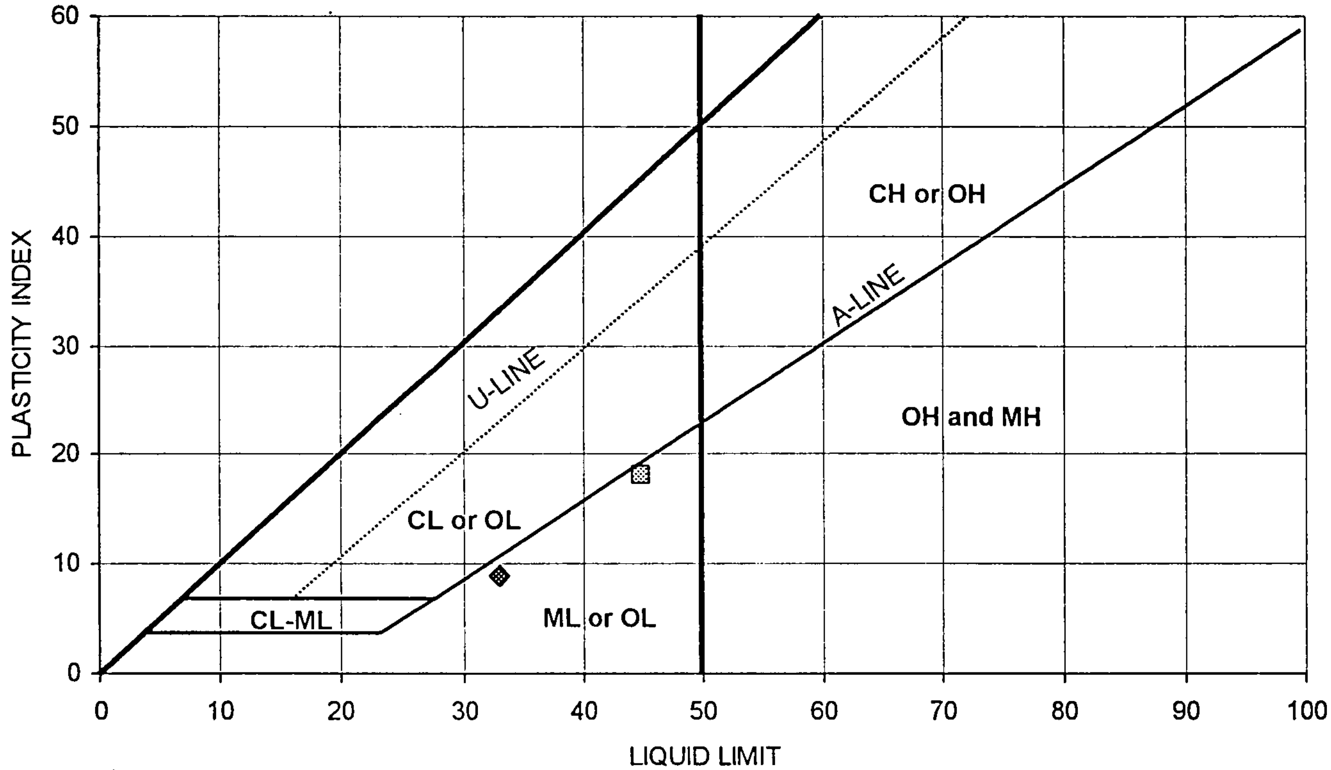
DOT-50000380

GeoEngineers

ATTERBERG LIMITS TEST RESULTS

FIGURE #

PLASTICITY CHART



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	Sample #	SOIL DESCRIPTION
◆	GA-7	N/A	25.1	33	9	SS#10	Gray silt (ML)
▩	GA-9	N/A	30.9	45	18	SS#19	Gray silt (ML)

DOT-50000381

#993-1466.500

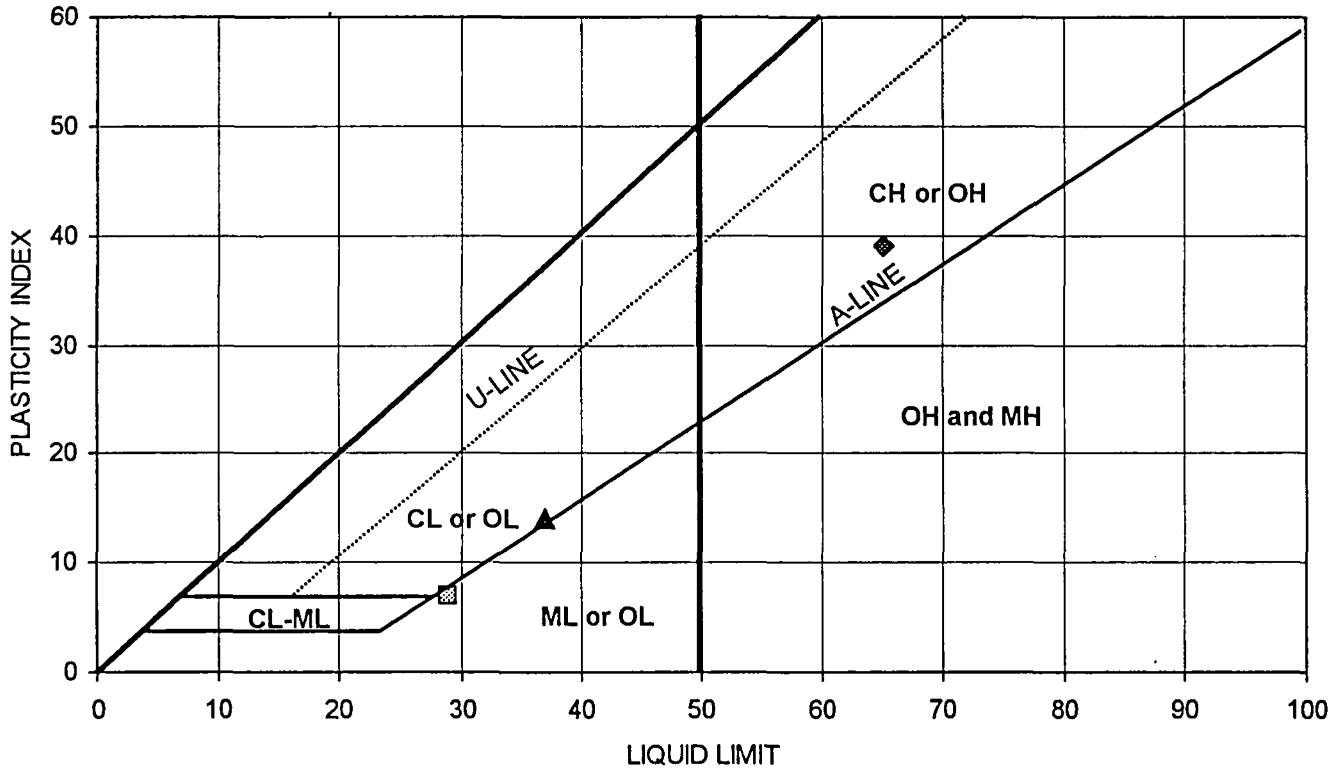
0314-034-00 JRS:ESM:jrs 10/22/99 (Atterbergs.ppt)

GeoEngineers

ATTERBERG LIMITS TEST RESULTS

FIGURE #

PLASTICITY CHART



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GA-7	45.0'	34.4	65	39	Gray fat clay (CH)
▣	GA-8	161-162.4'	25.9	29	7	Gray silt (ML)
▲	GA-11	20-21.5'	32.6	37	14	Gray clay (CL)

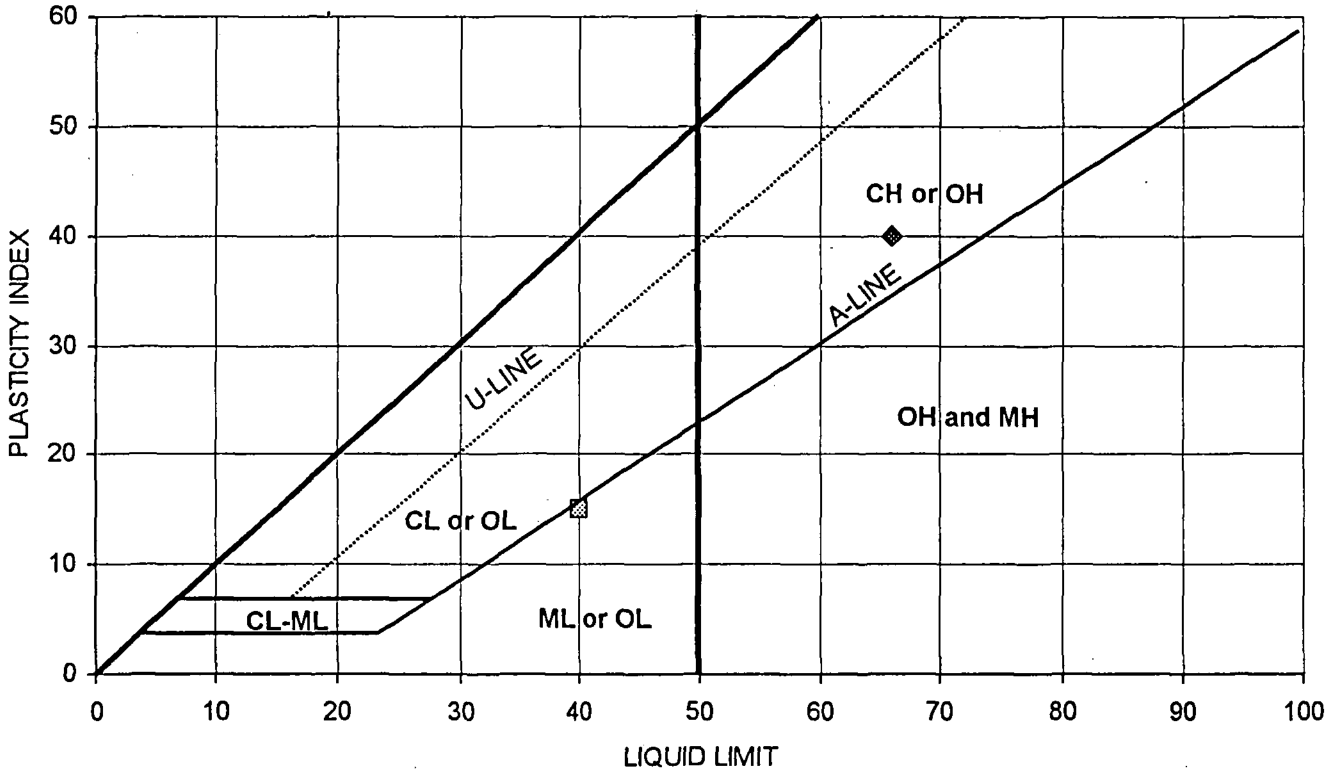
DOT-50000382

#993 - 1466.500

0314-034-00 JRS:ESM:jrs 10/22/99 (Atterbergs.ppt)

Geo Engineers

PLASTICITY CHART



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GA-12	51-52.5'	30.6	66	40	Gray fat clay (CH)
▨	GA-13	111-112.5'	27.1	40	15	Gray silt (ML)

ATTERBERG LIMITS TEST RESULTS

FIGURE #

DOT-50000383

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

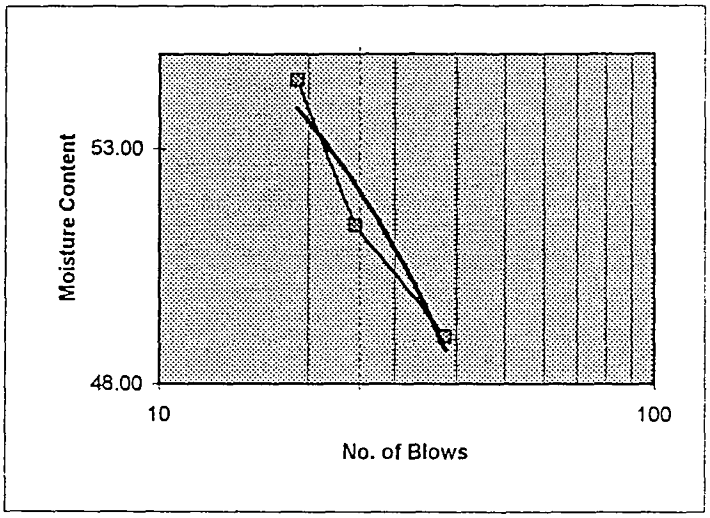
Boring No: GA-1 Sample No: SS 12 Depth: 0

Soil Description: Gray elastic silt (MH)

Natural Moisture Content: 39.6%

Liquid Limit Determination

Can No.	D31	K9	D32		
No. of Blows	38	25	19		
Moisture Content	48.99	51.36	54.46		



Liquid Limit 52

Plastic Limit 29

Plasticity Index 23

Plastic Limit Determination

Can No.	D20	K18	D98		
Moisture Content	27.17	30.77	29.41		

DOT-50000384

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

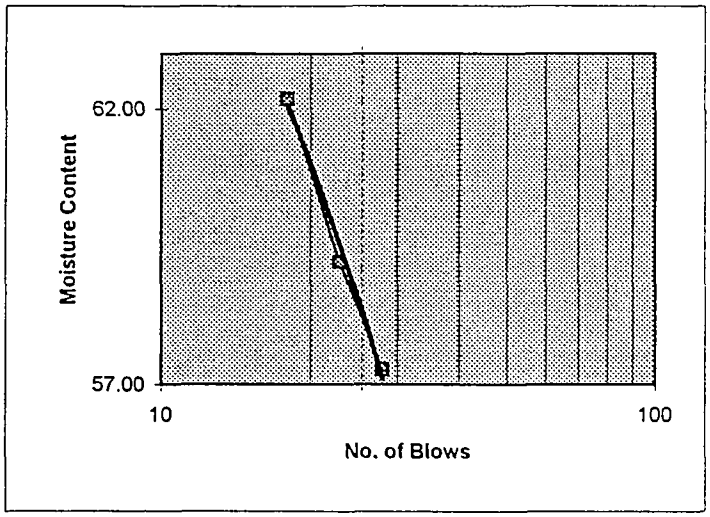
Boring No: GA-1 Sample No: SS 13 Depth: 0

Soil Description: Gray fat clay (CH)

Natural Moisture Content: 29.1%

Liquid Limit Determination

Can No.	D28	K13	K12		
No. of Blows	28	23	18		
Moisture Content	57.27	59.26	62.19		



Liquid Limit 59

Plastic Limit 26

Plasticity Index 33

Plastic Limit Determination

Can No.	K10	K16	D30		
Moisture Content	24.39	27.16	26.67		

DOT-50000385

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

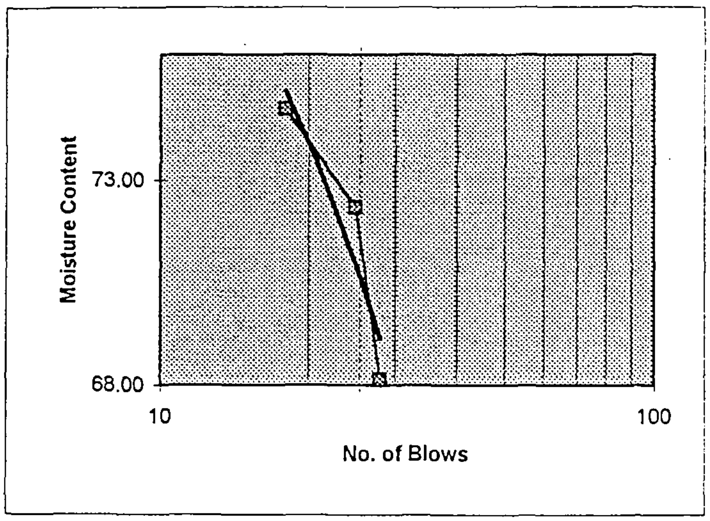
Boring No: GA-2 Sample No: SS 2 Depth: 0

Soil Description: Gray fat clay (CH)

Natural Moisture Content: 31.6%

Liquid Limit Determination

Can No.	D29	D14	T7		
No. of Blows	28	25	18		
Moisture Content	68.13	72.35	74.71		



Liquid Limit: 71

Plastic Limit: 28

Plasticity Index: 43

Plastic Limit Determination

Can No.	K17	D27			
Moisture Content	28.00	28.17			

DOT-50000386

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

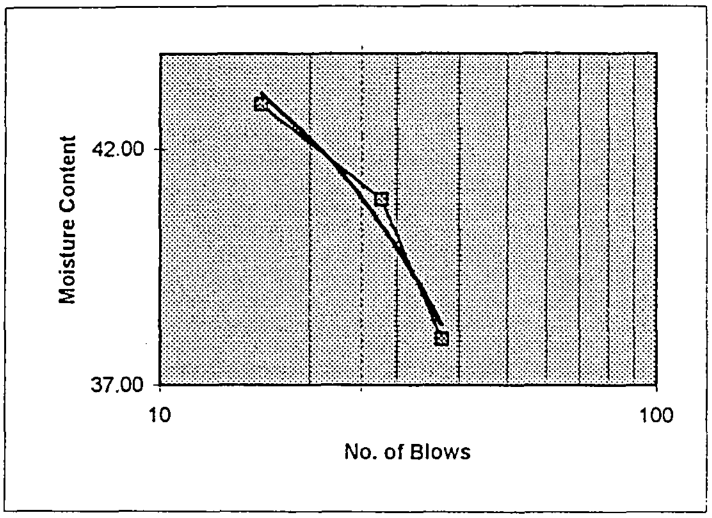
Boring No: GA-4 Sample No: SS 14 Depth: 0

Soil Description: Gray clay (CL)

Natural Moisture Content: 28.4%

Liquid Limit Determination

Can No.	D6	D8	K4		
No. of Blows	37	28	16		
Moisture Content	37.97	40.91	42.94		



Liquid Limit: 41

Plastic Limit: 24

Plasticity Index: 17

Plastic Limit Determination

Can No.	K8	K14	D5		
Moisture Content	23.93	23.53	24.75		

DOT-50000387

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

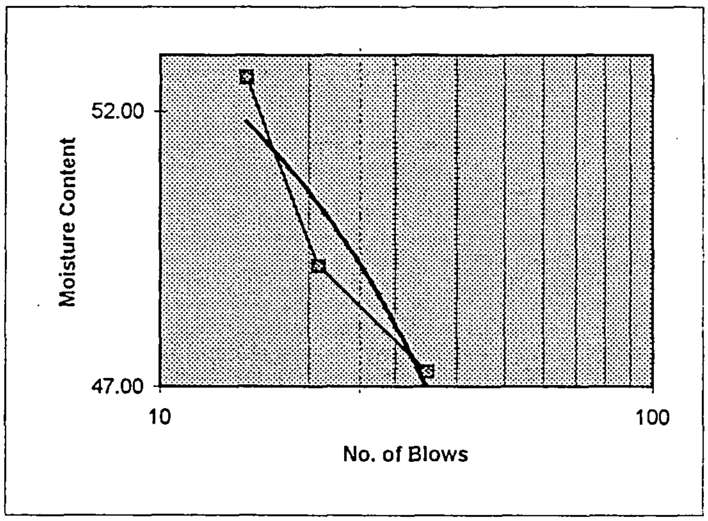
Boring No: GA-4 Sample No: SS 19 Depth: 0

Soil Description: Gray clay (CL)

Natural Moisture Content: 32.0%

Liquid Limit Determination

Can No.	K15	T6	T11		
No. of Blows	35	21	15		
Moisture Content	47.27	49.22	52.61		



Liquid Limit 49

Plastic Limit 27

Plasticity Index 23

Plastic Limit Determination

Can No.	T4	K11	T8		
Moisture Content	29.41	24.49	26.55		

DOT-50000388

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

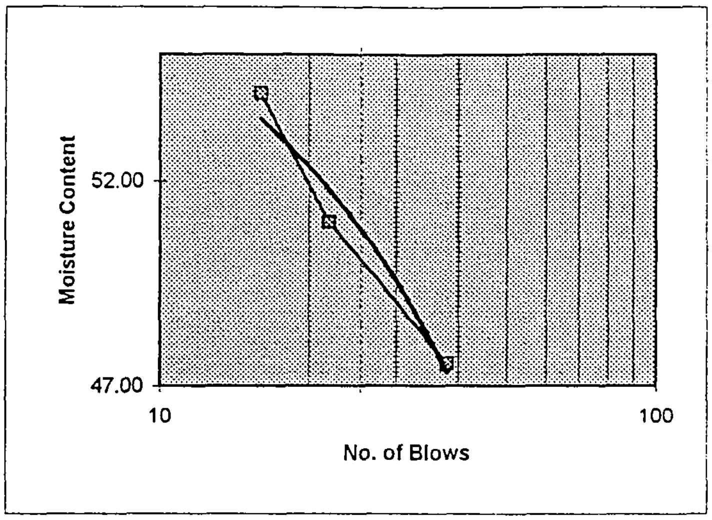
Boring No: GA-5 Sample No: SS 10A Depth: 0

Soil Description: Gray fat clay (CH)

Natural Moisture Content: 25.7%

Liquid Limit Determination

Can No.	D7	K2	T10		
No. of Blows	38	22	16		
Moisture Content	47.54	50.99	54.07		



Liquid Limit: 51

Plastic Limit: 26

Plasticity Index: 24

Plastic Limit Determination

Can No.	D12	K22	K7		
Moisture Content	26.36	26.28	26.77		

DOT-50000389

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

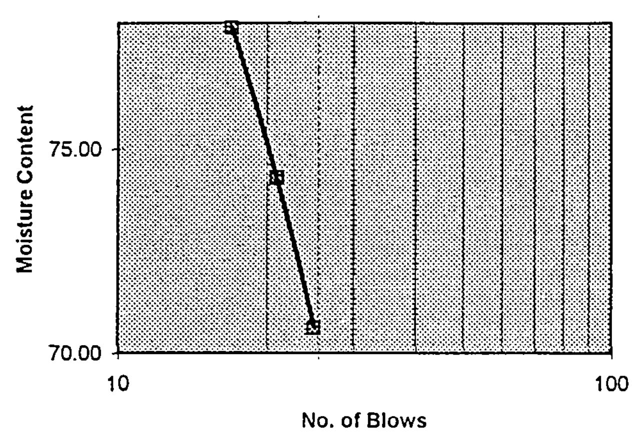
Boring No: GA-5 Sample No: SS 12 Depth: 0

Soil Description: Gray fat clay (CH)

Natural Moisture Content: 30.3%

Liquid Limit Determination

Can No.	K21	D4	D16		
No. of Blows	25	21	17		
Moisture Content	70.61	74.31	77.87		



Liquid Limit 71

Plastic Limit 29

Plasticity Index 41

Plastic Limit Determination

Can No.	D11	D99	D3		
Moisture Content	31.65	27.16	29.17		

DOT-50000390

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

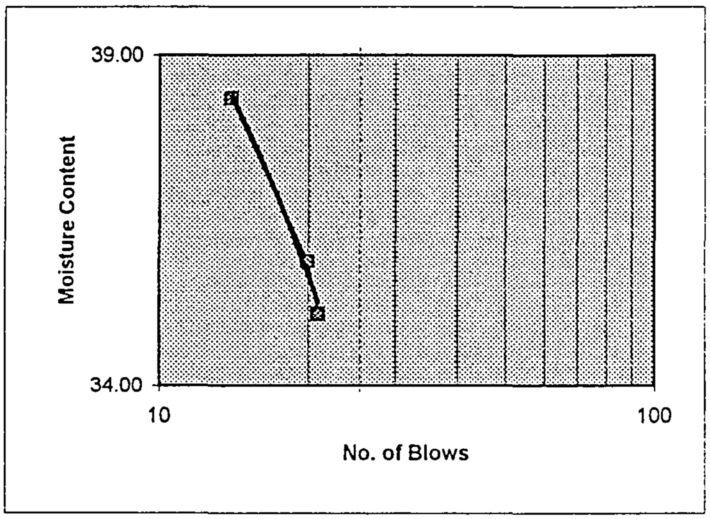
Boring No: GA-7 Sample No: SS 10 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 25.1%

Liquid Limit Determination

Can No.	D2	D26	K18		
No. of Blows	21	20	14		
Moisture Content	35.08	35.90	38.35		



Liquid Limit 33

Plastic Limit 25

Plasticity Index 9

Plastic Limit Determination

Can No.	T1	D24	T3		
Moisture Content	26.28	25.00	22.48		

DOT-50000391

Atterberg Limit Determination

Job Name: Golder (993-1466.500) Job No: 0314-034-00

Date: 9/14/99 Tested By: MBB

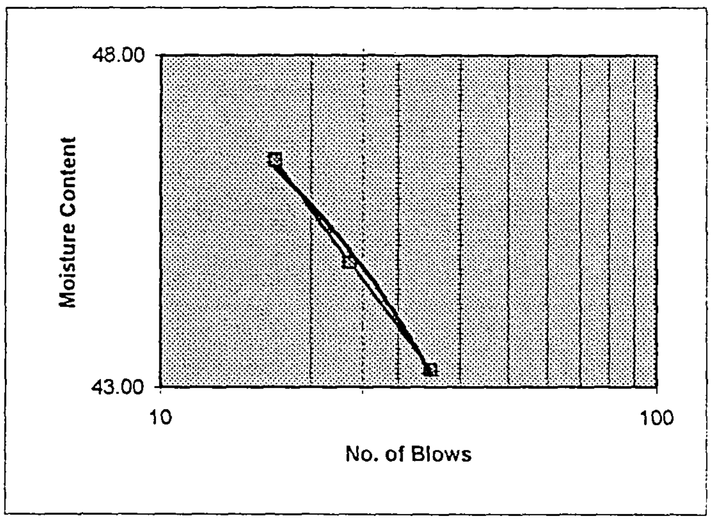
Boring No: GA-9 Sample No: SS 19 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 30.9%

Liquid Limit Determination

Can No.	K5	K19	D1		
No. of Blows	35	24	17		
Moisture Content	43.27	44.92	46.45		



Liquid Limit 45

Plastic Limit 27

Plasticity Index 18

Plastic Limit Determination

Can No.	D10	T2	D33		
Moisture Content	29.23	26.73	25.17		

DOT-50000392

Atterberg Limit Determination

#993-1466.500

Job Name: Golder #993-1466.500 Job No: 0314-034-00

Date: 10/22/99 Tested By: ESM/JRS

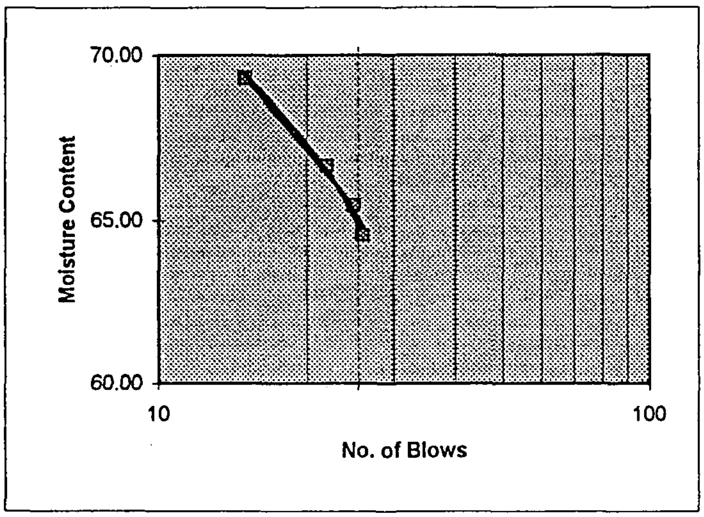
Boring No: GA-7 Sample No: SS#9 Depth: 45.0'

Soil Description: Gray fat clay (CH) (med. stiff, moist)

Natural Moisture Content: 34.4%

Liquid Limit Determination

Can No.	d14	t6	d28	d6	
No. of Blows	22	26	25	15	
Moisture Content	66.67	64.57	65.46	69.31	



Liquid Limit: 65

Plastic Limit: 26

Plasticity Index: 39

Plastic Limit Determination

Can No.	t7	k9	d4		
Moisture Content	25.73	25.58	26.62		

DOT-50000393

Atterberg Limit Determination #993 - 1466 .500

Job Name: Golder #993-1466.500 Job No: 0314-034-00

Date: 10/22/99 Tested By: ESM/JRS

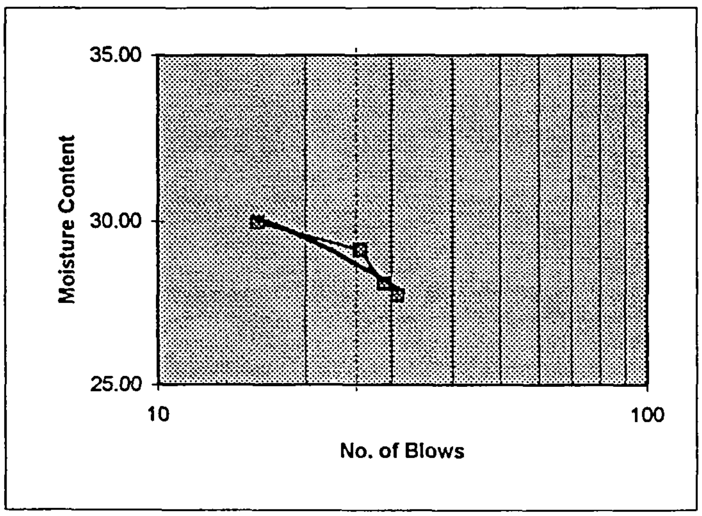
Boring No: GA-8 Sample No: SS#24 Depth: 161-162.4'

Soil Description: Gray silt (ML) (med. stiff, moist)

Natural Moisture Content: 25.9%

Liquid Limit Determination

Can No.	d2	d32	d27	d30	
No. of Blows	31	29	26	16	
Moisture Content	27.71	28.06	29.13	29.96	



Liquid Limit 29

Plastic Limit 22

Plasticity Index 7

Plastic Limit Determination

Can No.	k5	t10	t11		
Moisture Content	22.22	22.76	22.45		

DOT-50000394

Atterberg Limit Determination

993-1466.500

Job Name: Golder #993-1466.500 Job No: 0314-034-00

Date: 10/22/99 Tested By: ESM/JRS

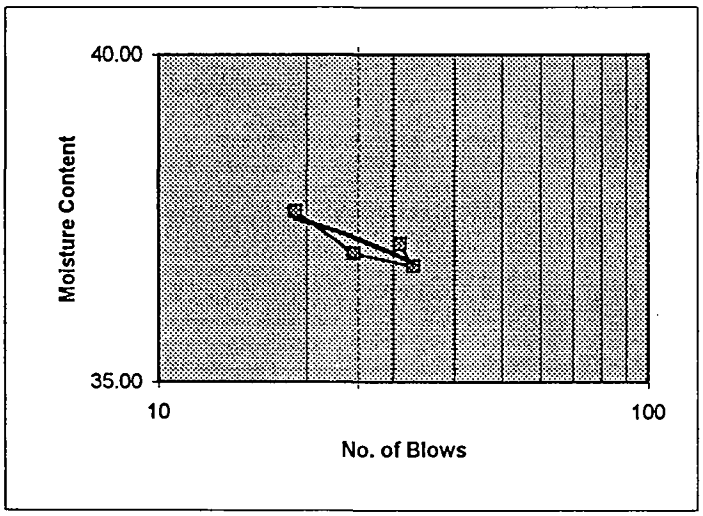
Boring No: GA-11 Sample No: SS#4 Depth: 20-21.5'

Soil Description: Gray silt (ML) (med. stiff, moist)

Natural Moisture Content: 32.6%

Liquid Limit Determination

Can No.	k8	d7	k15	T1	
No. of Blows	19	25	33	31	
Moisture Content	37.65	37.00	36.80	37.13	



Liquid Limit: 37

Plastic Limit: 24

Plasticity Index: 14

Plastic Limit Determination

Can No.	d24	d16	t5		
Moisture Content	23.01	24.83	23.15		

DOT-50000395

Atterberg Limit Determination

$993 -1466.500

Job Name: Golder #993-1466.500 Job No: 0314-034-00

Date: 10/22/99 Tested By: ESM/JRS

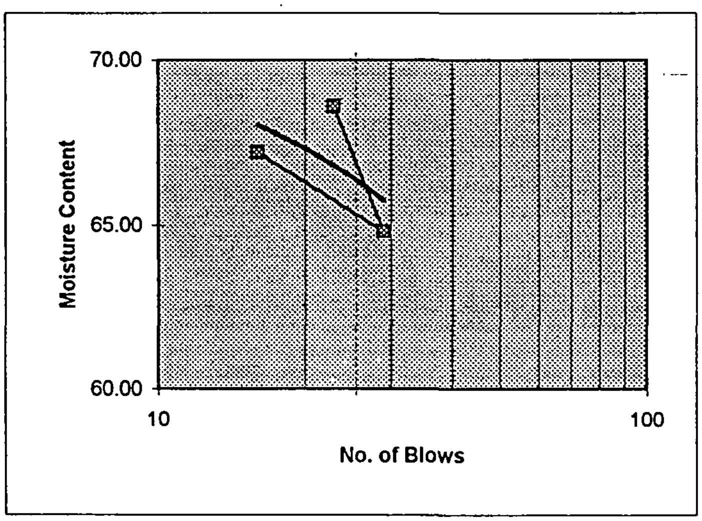
Boring No: GA-12 Sample No: SS#10 Depth: 51-52.5'

Soil Description: Gray fat clay (CH) (med. stiff, moist)

Natural Moisture Content: 30.6%

Liquid Limit Determination

Can No.	k3	t4	d17		
No. of Blows	23	29	16		
Moisture Content	68.59	64.81	67.22		



Liquid Limit 66

Plastic Limit 26

Plasticity Index 40

Plastic Limit Determination

Can No.	t9	k11	k9		
Moisture Content	26.81	26.43	25.40		

DOT-50000396

Atterberg Limit Determination

#993-1466.500

Job Name: Golder #993-1466.500 Job No: 0314-034-00

Date: 10/22/99 Tested By: ESM/JRS

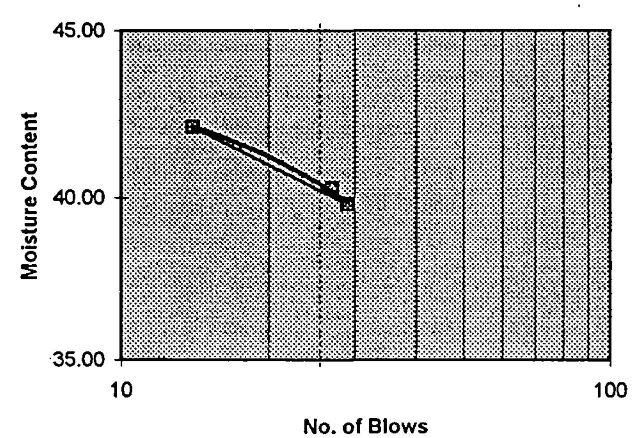
Boring No: GA-13 Sample No: SS#13 Depth: 111-112.5'

Soil Description: Gray silt (ML) (med. stiff, moist)

Natural Moisture Content: 27.1%

Liquid Limit Determination

Can No.	d25	d18	d29		
No. of Blows	27	29	14		
Moisture Content	40.29	39.81	42.14		



Liquid Limit: 40

Plastic Limit: 25

Plasticity Index: 15

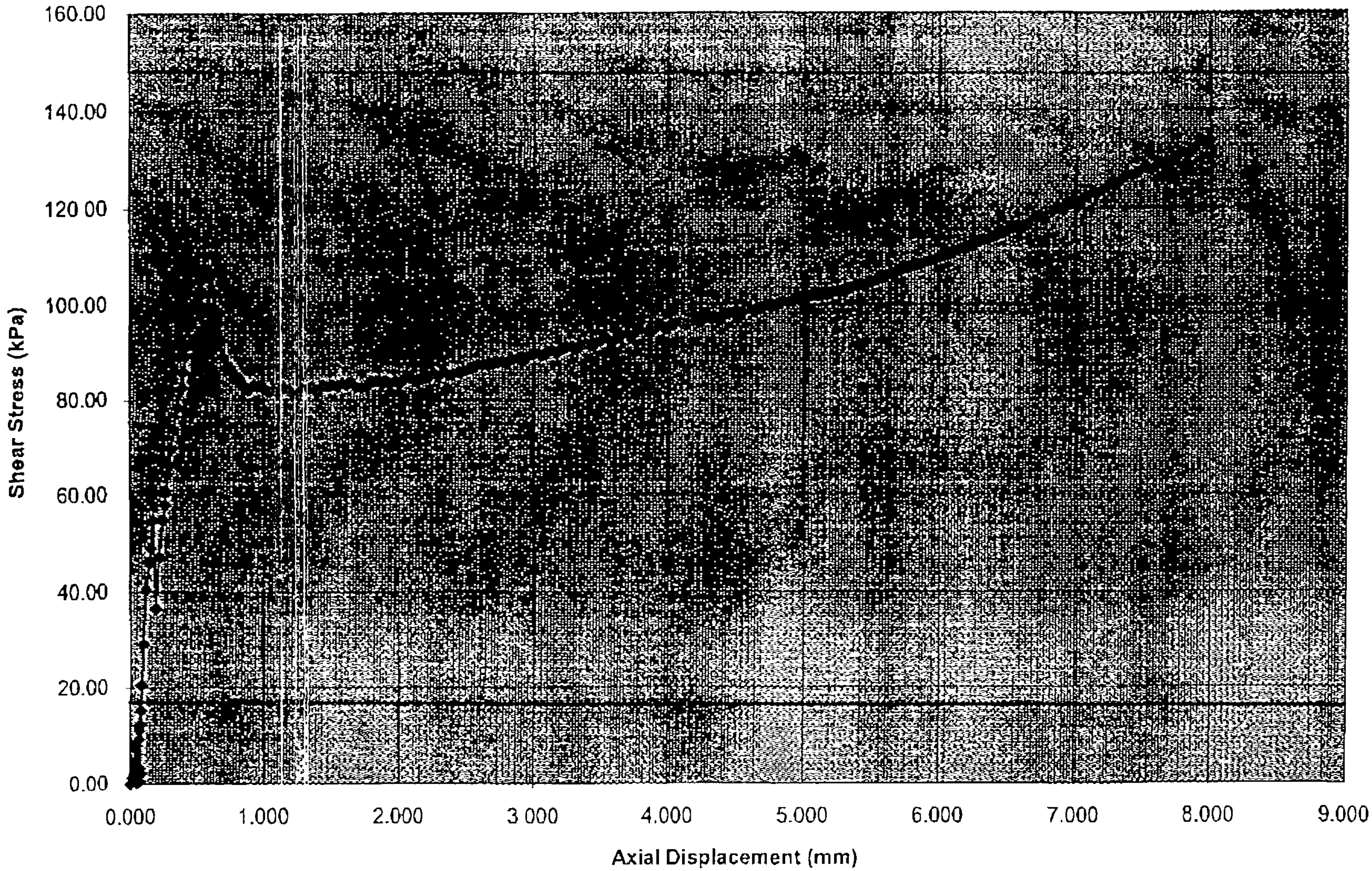
Plastic Limit Determination

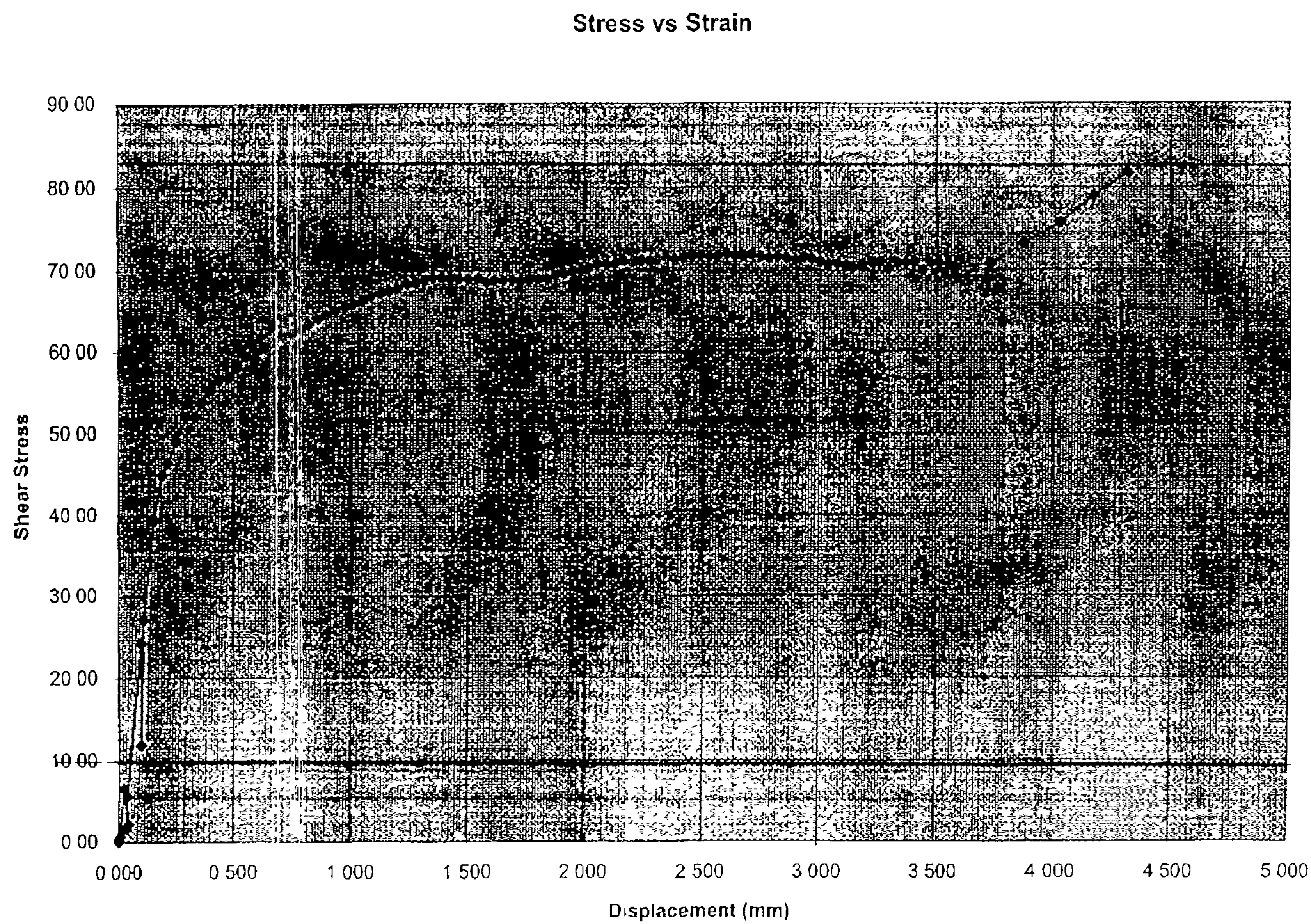
Can No.	k20	k21	t8		
Moisture Content	25.00	25.00	26.06		

DOT-50000397

G 4AR4002

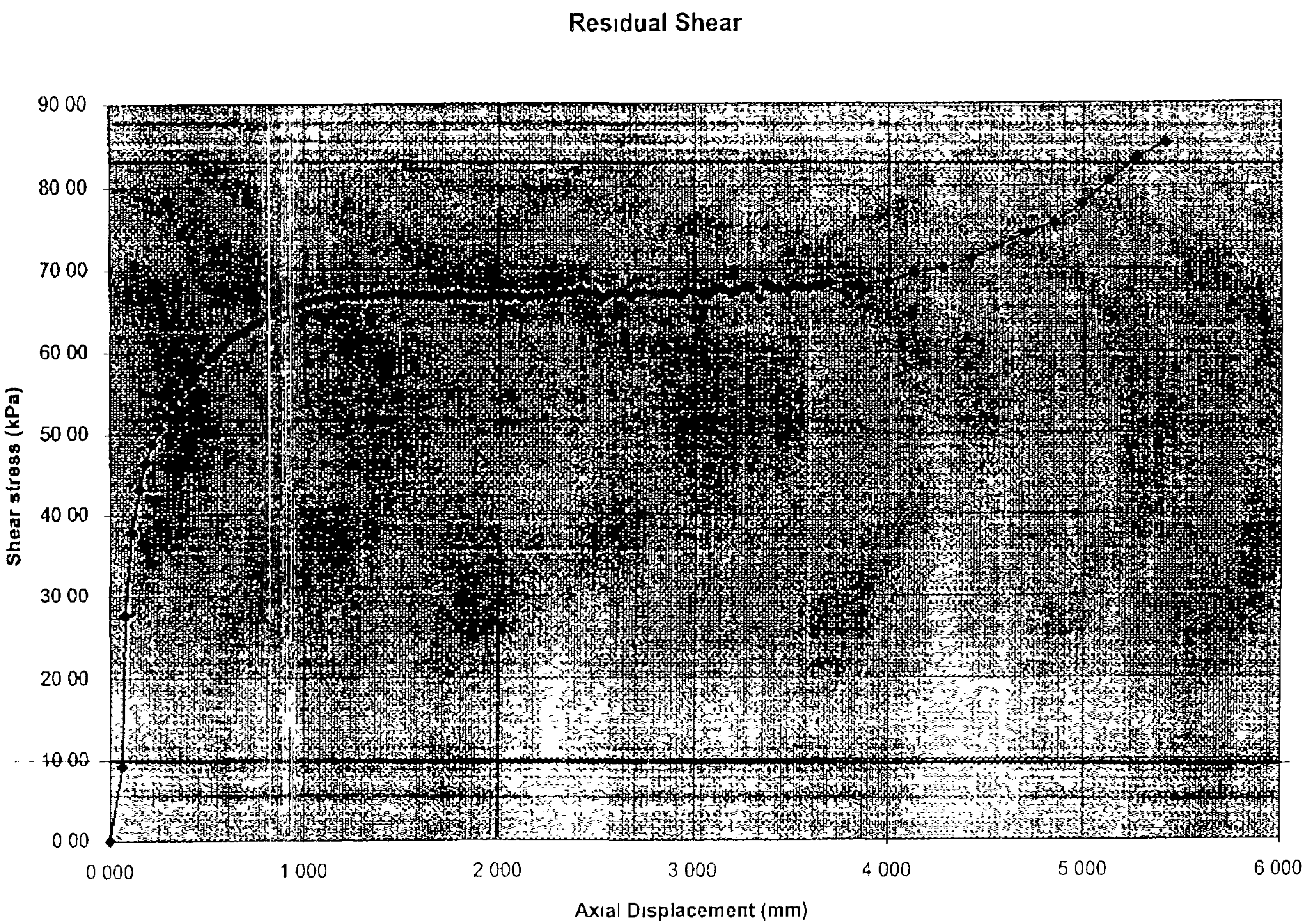
Residual Shear

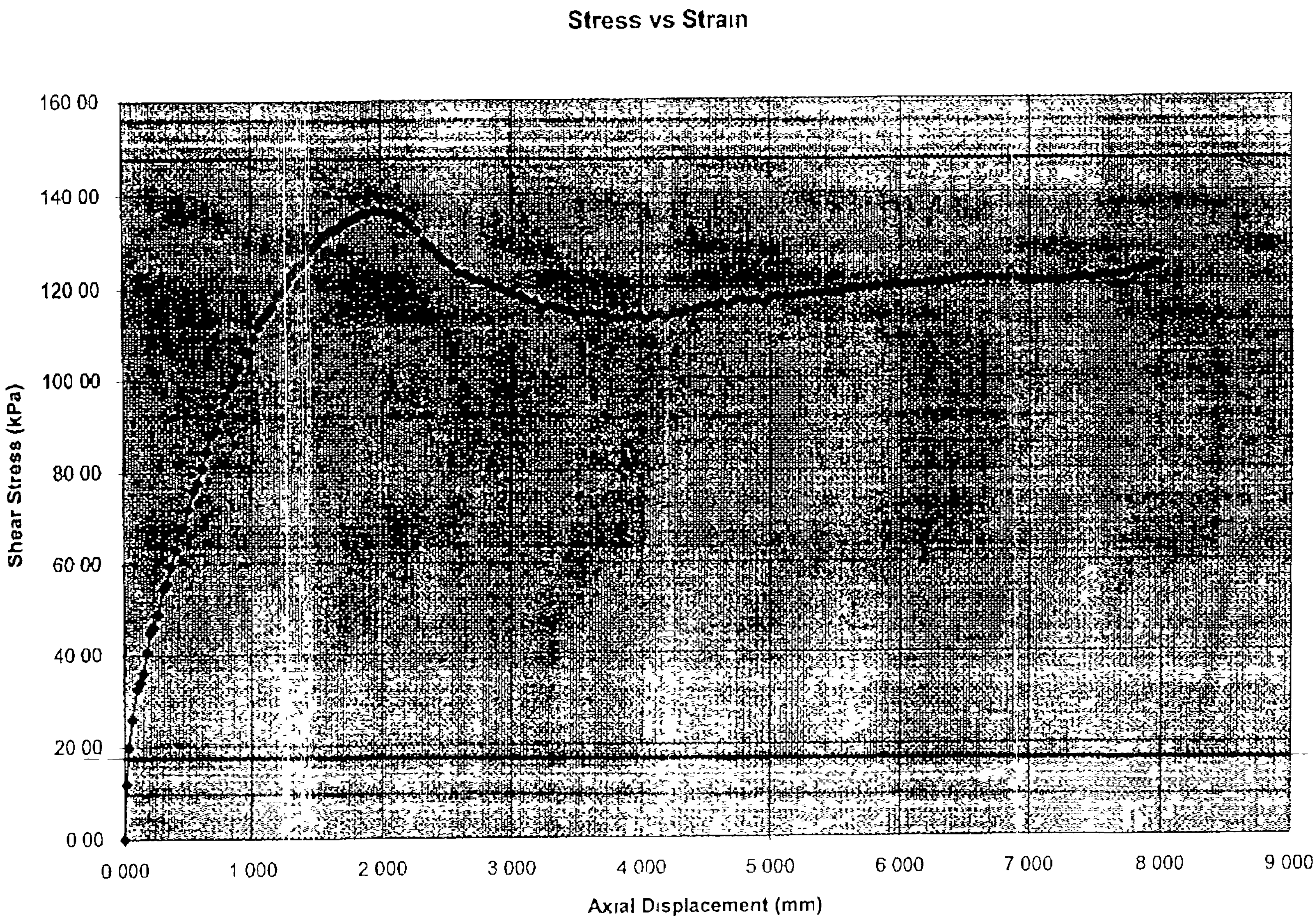




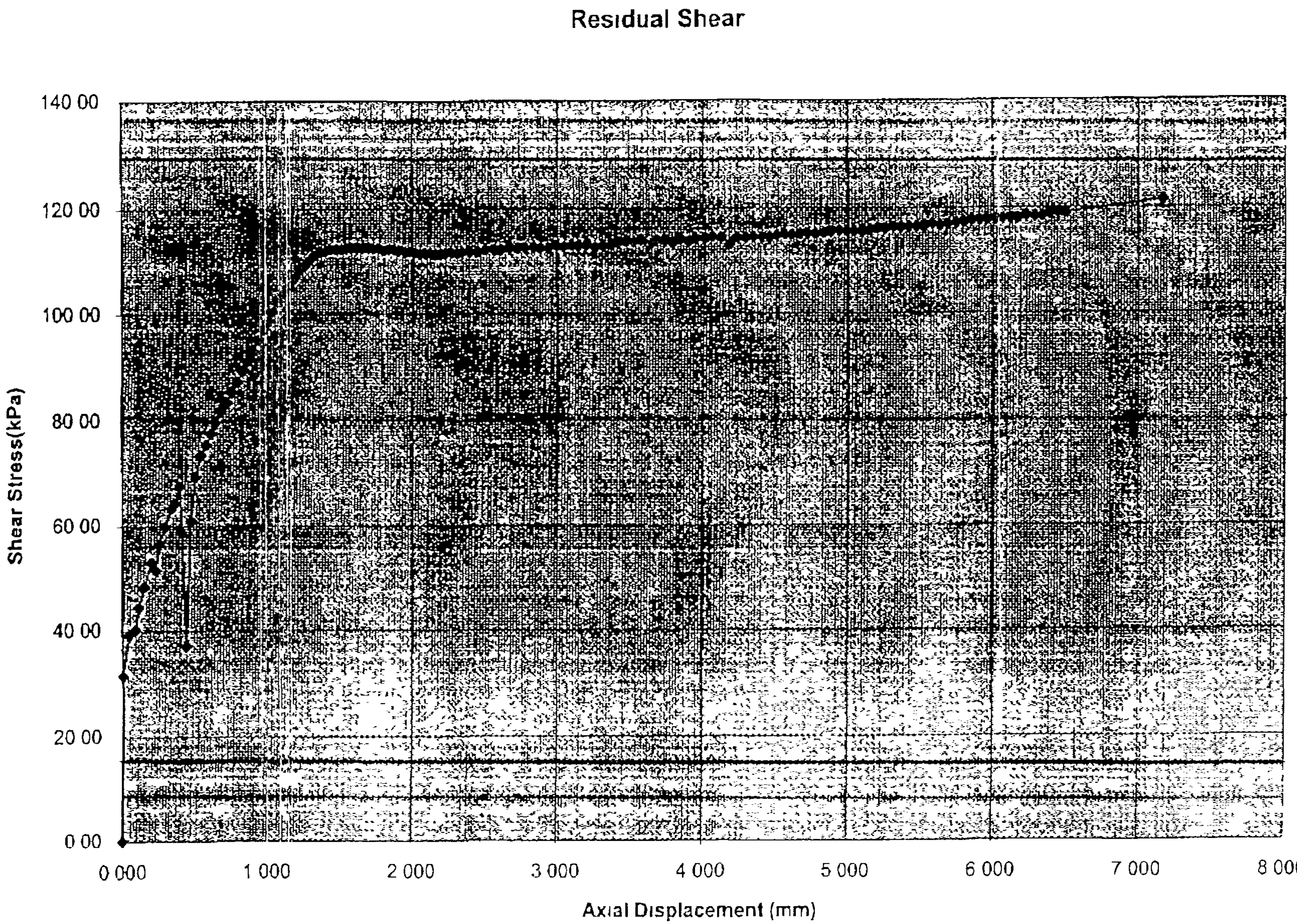
DOT-50000399

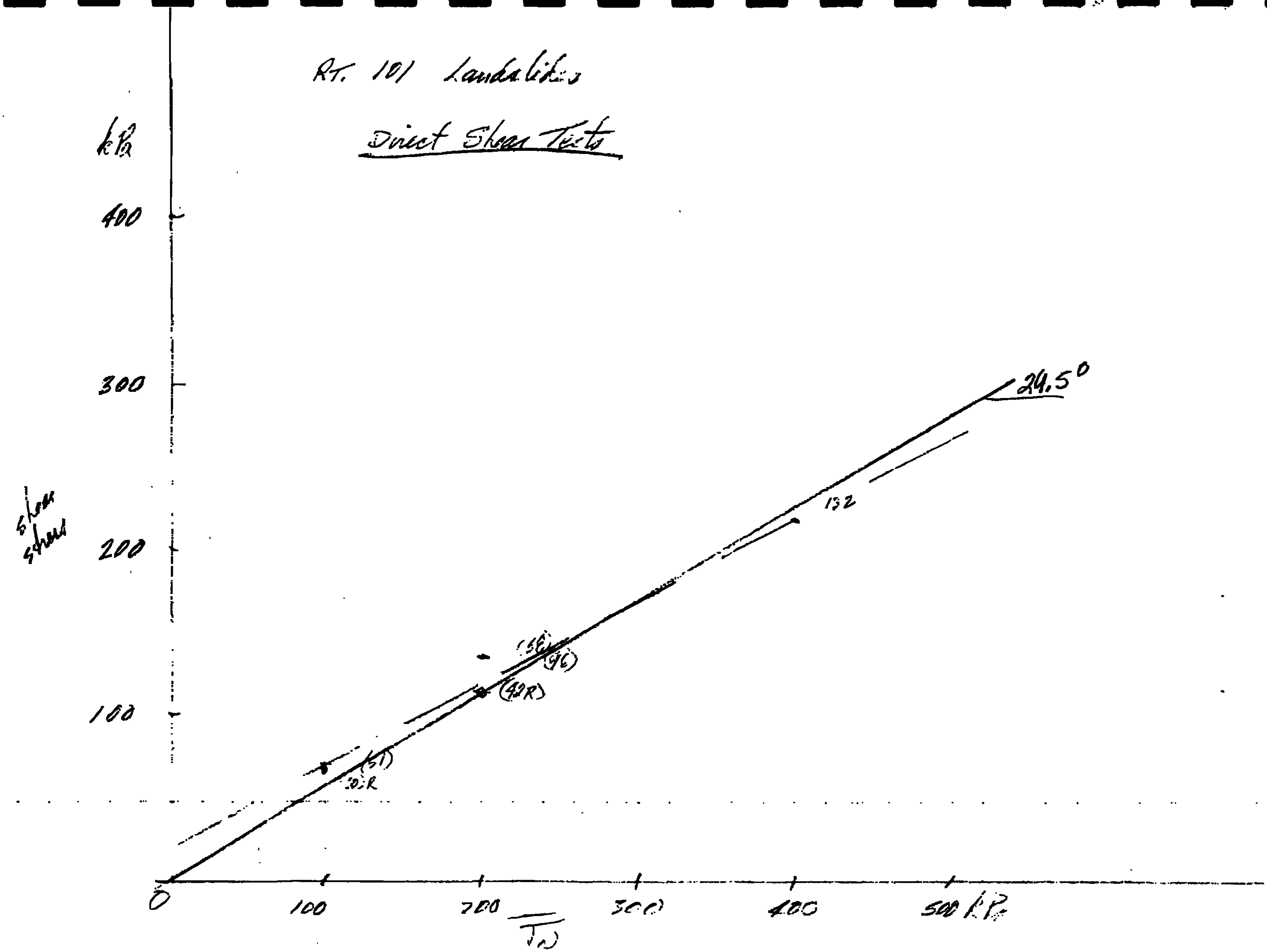
G4AK1001


Residual Shear
Shear stress (kPa)
90 00
80 00
70 00
60 00
50 00
40 00
30 00
20 00
10 00
0 00
0 000
1 000
2 000
3 000
4 000
5 000
6 000
Axial Displacement (mm)



DOT-50000401


Residual Shear
Shear Stress(kPa)
140 00
120 00
100 00
80 00
60 00
40 00
20 00
0 00
0 000
1 000
2 000
3 000
4 000
5 000
6 000
7 000
8 000
Axial Displacement (mm)



DOT-50000403