PEBBLE PROJECT
ENVIRONMENTAL BASELINE DOCUMENT
2004 through 2008

CHAPTER 6.
GEOTECHNICAL STUDIES, SEISMICITY, AND VOLCANISM
Bristol Bay Drainages

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ACRONYMS AND ABBREVIATIONS

ASTM	American Standard Test Method
Frontier	Frontier Geosciences, Inc.
GSI	geological strength index
HQ3	nominal size of Boart Longyear Triple Tube Diamond drilling bit
HW	nominal size of Boart Longyear casing
KP	Knight Piésold Ltd.
M	magnitude of earthquake
‘N’ value	number of blows necessary to advance a sampler a specified distance
NDM	Northern Dynasty Mines Inc./Northern Dynasty Minerals Ltd.
NQ3	nominal size of Boart Longyear Diamond drilling bit
PQ3	nominal size of Boart Longyear Triple Tube Diamond drilling bit
PVC	polyvinyl chloride
PW	nominal size of Boart Longyear casing
RMR	rock mass rating
RMR89	rock mass rating classification system from Bieniawski, 1989
RQD	rock quality designation
SL	seismic line
SLR	SLR International Corp.
SPT	standard penetration test
SWS	Schlumberger Water Services
UCS	unconfined compressive strength
USGS	U.S. Geological Survey
WMC	Water Management Consultants

6. GEOTECHNICAL STUDIES, SEISMICITY, AND VOLCANISM

6.1 Introduction

This chapter describes the baseline geotechnical characteristics for the mine study area and the seismicity characteristics of the Bristol Bay drainages study area.. There are no active volcanoes located within the Bristol Bay drainages study area which encompasses the mine study area and the transportation corridor study area as shown on Figure 6-1, but the study area could be affected by volcanoes located near Cook Inlet. Regional volcanism associated with the Cook Inlet volcanoes is presented in Chapter 30.

The description of geotechnical conditions within the mine study area is based on geotechnical site investigations up to the end of 2008. No geotechnical information has been collected on the transportation corridor study area to date. The description of seismicity characteristics is based on a desktop overview study of available regional information. To avoid confusion, it should be noted that the geotechnical site investigations conducted within the mine study area have included seismic geophysical techniques. The results of these seismic site investigations should not be confused with the overview study of regional seismicity.

Geotechnical characteristics comprise aspects of surficial geology, overburden and bedrock geology, hydrogeology, physiography, topography, and soils as they pertain to engineering design. Geotechnical information of interest includes rock mass characterization and classification of bedrock; the depth, composition, and characteristics of overburden (surficial materials and organic soils); and the presence and movement of water within these materials. Related overview studies are presented in Chapters 3, 4, 5, and 8.

6.2 Study Objectives

The objective of this study is to provide baseline geotechnical and seismicity information to characterize the mine study area and the transportation corridor study area.

6.3 Study Area

The Bristol Bay drainages study area lies on the north side of Iliamna Lake and extends from the North Fork Koktuli River in the west to the Cook Inlet drainage divide in the east. The northern boundary is defined by the Lake Clark National Park and Preserve, while Iliamna Lake defines the southern boundary. The extent of the study area is shown on Figure 6-1. The mine study area encompasses the Pebble Deposit Area in the western part of the Bristol Bay drainages study area. The transportation corridor study area runs eastward from the mine study area toward Cook Inlet.

The mine study area was subdivided into 10 smaller reference areas based on geographical locations, including the Pebble West and Pebble East Areas that comprise the Pebble Deposit Area. The approximate boundaries of these reference areas are shown on Figure 6-2a. The reference area boundaries have been updated; the boundaries and area names shown on Figure 6-2a supersede previous reference areas presented in the Knight Piésold Ltd. (KP) 2004, 2005, 2006, and 2007 site investigation reports. The 10 reference areas are described below:

- Pebble West Area—occupies part of the topographic saddle between the watersheds of Upper Talarik Creek and the South Fork Koktuli River.
- Pebble East Area—occupies part of the topographic saddle between the watersheds of Upper Talarik Creek and the South Fork Koktuli River.
- Area J—tributary valley to the South Fork Koktuli River.
- Area L—tributary valley to the South Fork Koktuli River.
- Area E—tributary valley to the North Fork Koktuli River.
- Area G—tributary valley to the North Fork Koktuli River.
- Upper Talarik Creek Area—residual area within the Upper Talarik Creek drainage.
- North Fork Koktuli River Area—residual area within the North Fork Koktuli drainage.
- South Fork Koktuli River Area—residual area within the South Fork Koktuli River drainage.
- Area A—the upper valley of the South Fork Koktuli River including Frying Pan Lake.

Area A is further broken down into four geomorphic subareas that are shown on Figure 6-2b and are described below:

- Valley Bottom—lowlands extending south from the Deposit Area, including Frying Pan Lake and adjacent low terrain.
- Lower/Mid Side Slopes—lower slopes on either side of the main valley.
- Upper Side Slopes—upper slopes on either side of the main valley.
- Southern Upland—to the south of Frying Pan Lake and north of the South Fork Koktuli River Area.

The regional geology of the study area is discussed in detail in Chapter 3, but in general terms the study area is located in a small basin that was infilled by Jurassic to Cretaceous sedimentary rocks that were intruded by the Cretaceous Kaskanak Batholith. The eastern portion of the batholith was, in turn, intruded by a north-northeast trending swarm of stocks, dikes, and irregular bodies that host the mineralization of the Pebble Deposit. Tertiary to Recent volcanic rocks and associated sedimentary rocks were deposited and the region was deformed along a series of thrust and transverse faults, including the Lake Clark structure. The Pebble region was then eroded by Quaternary to Recent glaciers, and the valleys were filled with glacial deposits during glacial advance and retreat phases.

6.4 Scope of Work

This chapter of the environmental baseline document presents baseline geotechnical information collected in the study area from 2004 to the end of 2008 and regional seismicity information based on desktop studies and reviews of current published information. Detailed geotechnical information for the mine study area is based on site investigations carried out by KP, hydrogeological investigations by Water Management Consultants Inc./Schlumberger Water Services (WMC/SWS), and geophysical investigations by Frontier Geosciences, Inc. (Frontier). The discussion of regional seismicity was prepared by KP.

6.5 Methods

The 2004 to 2008 geotechnical site investigation programs involved test pitting, overburden and bedrock drilling, piezometer/well installations, in situ testing, and geophysical surveys throughout the study area. The results of the site investigations were related to surficial geology and physiography to develop linkages between landscape features and subsurface characteristics. Field methods are described in this section with a more detailed description found in the following KP documents:

- *2008 Geotechnical Site Investigation Data Report, Ref. No VA101-176/23-4* (KP, 2009).
- *2007 Geotechnical Site Investigation Data Report, Ref. No. VA101-00176/20-4* (KP, 2008a).
- *2006 Geotechnical Site Investigation Data Report, Ref. No. VA101-00176/8-9* (KP, 2008b).
- *2005 Geotechnical Site Investigation Data Report, Ref. No. VA101-00176/8-6* (KP, 2007).
- *2005 Open Pit Geotechnical Investigations, Ref. No. VA101-00176/8-5* (KP, 2005a).
- *2004 Geotechnical Site Investigation Data Report, Ref. No. VA101-00176/8-3* (KP, 2005b).
- *2004 Open Pit Geotechnical Investigations, Ref. No. VA101-00176/8-2* (KP, 2005c).

The 2004, 2005, and 2006 geophysical investigation reports prepared by Frontier are also appended to the respective KP site investigation reports. Hydrogeology studies were completed by WMC/SWS and SLR International Corp. (SLR) and summaries of the hydrogeological site investigations are appended to the respective KP site investigation reports. The 2004 to 2008 WMC/SWS/SLR hydrogeology studies are discussed in Chapter 8.

6.5.1 Test Pit Investigations

Test pits provide information on the characteristics of near-surface overburden materials. Three hundred and seventeen (317) test pits were excavated during the 2004, 2005, and 2008 geotechnical site investigation programs. There were no test pits excavated in 2006 or 2007. The locations of the test pits are shown on Figures 6-3 and 6-4, and a test pit summary is provided in Appendix 6A.

The test pits were excavated using a Digger 50 helicopter-portable excavator in 2004 and a lightweight, helicopter-portable bobcat excavator in 2005. A larger, helicopter-portable bobcat excavator was used for the excavation of test pits in 2008. Test pit depths generally ranged between 5 and 10 feet. The test pit locations were accessed using helicopters and care was taken to minimize environmental disturbance during the investigations. Wherever possible, the surface organic material and vegetation were stripped prior to the excavation of the test pit and stockpiled separately. The exposed soils in the test pit walls and spoil piles were logged for their geotechnical characteristics and samples were collected and sealed in bags for laboratory testing. The test pits were backfilled and the ground surfaces were re-contoured at the completion of each test pit. The final activity at each site involved the replacement of the surface material and vegetation to re-establish, as much as possible, the pre-investigation conditions.

6.5.2 Drilling Investigations

Geotechnical drilling was carried out to characterize the overburden (materials above bedrock) and the upper portion of the bedrock. The drillholes were vertical in most cases and were typically advanced approximately 100 feet into bedrock or until more competent bedrock was reached. However, some drillholes were completed solely for overburden characterization and in these cases bedrock was confirmed by drilling 10 to 15 feet past the contact. A separate set of deeper, oriented drillholes were completed in the Pebble East Area and Pebble West Area to characterize bedrock discontinuities in the deposit area.

6.5.2.1 Overburden/Bedrock Drilling

Two hundred and ten (210) KP geotechnical drillholes, not including redrills, were drilled throughout the study area from 2004 to 2008. The locations of the geotechnical drillholes are shown on Figure 6-5. The locations of the geotechnical drillholes in and around the general deposit area are shown on Figure 6-6. A summary of the geotechnical drillholes is provided in Appendix 6B.

The site investigation drilling was completed as follows:

- 2004 and 2005 drilling was completed using a helicopter portable Boart Longyear LF70 mud rotary diamond drill modified to conduct standard penetration tests (SPTs) in overburden and packer hydraulic conductivity testing in bedrock. Drilling, in situ testing, and the installation of standpipe piezometers were carried out by Quest America Drilling Inc./American Recon Drilling, with the assistance of, and under the technical supervision of, KP. The overburden portion of each drillhole was cored using HW size casing and HQ3 size core. Bentonite Quik-Gel or a biodegradable drilling mud additive, WDS-120, was used to help keep the drillholes open.
- 2006 and 2007 drilling was completed using a helicopter portable HT-700 mud rotary diamond drill rig. The drilling, in situ testing, and installation of standpipe piezometers were carried out by Foundex Pacific Inc., with the assistance of, and under the technical supervision of, KP. HW size casing and HQ3/NQ3 size core was used in these investigations. Bentonite Quik-Gel or a biodegradable drilling polymer, Poly-Drill 133X was used in 2006 and 2007 to keep drillholes open in the overburden or in highly faulted or fractured zones in the bedrock.
- 2008 drilling was completed by Foundex Pacific Inc. under the supervision of KP field personnel and helicopter transportable HT-700 and HT-750 mud rotary diamond drill rigs were used. PW and HW casing was used in 2008 to try to increase recovery of the overburden. Bedrock was drilled with PQ3, HQ3, and NQ3 size core barrels. Bentonite Quik-Gel or a biodegradable drilling polymer, Poly-Drill 133X was used in 2008 to keep drillholes open in the overburden or in highly faulted or fractured zones in the bedrock.

The drills were moved to each location by helicopter in all investigation programs. Samples of disturbed soil were collected from the core barrel and placed into core boxes. Core recovery from the overburden was generally poor, because the fines were typically washed away during the drilling process. Core recovery was substantially improved when using the larger PQ3 size core but sandier materials were still easily washed away. All of the overburden was logged at the drill site by KP field personnel. Selected samples were sent to the KP geotechnical laboratory in Denver, Colorado, for further analysis.

Bedrock was mostly drilled using water as circulation fluid; drilling mud or biodegradable polymers were used as required in highly faulted or fractured zones. Packer hydraulic conductivity testing was completed in most drillholes. Any intervals where drilling mud or biodegradable polymers were used were flushed with water prior to packer testing. KP field personnel geotechnically logged the bedrock drill core and boxed it at the drill site. The geological logging of the drillhole core was conducted in Iliamna by geologists from Northern Dynasty Mines Inc./Northern Dynasty Minerals Ltd. (NDM) or by geologists from the Pebble Partnership. The drillhole sites were reclaimed by either NDM or Pebble Partnership personnel.

6.5.2.2 Oriented Bedrock Drilling

Fifteen (15) oriented geotechnical drillholes were completed by KP in the Pebble West Area from 2004 to 2005 to provide geotechnical information for the rock mass in this area. SRK completed 12 oriented geotechnical drillholes in the Pebble West Area and Pebble East Area in 2006, 2007, and 2008. The locations and azimuths of the drillholes are shown on Figure 6-7 and a summary of the oriented drilling programs are provided in Appendix 6C. The depth of the drillholes ranged from around 500 feet to over 5,000 feet. Core orientation was measured in these geotechnical drillholes to characterize the rock mass discontinuities within the deposit area. Drilling was completed using American Recon Drilling LF70 or Boart Longyear LF90 rigs using HQ3 and NQ3 triple-tube coring methods and the core was oriented using the Ballmark system or the Reflex ACT orientation system (formerly known as the ACE tool). Joint orientations and the geotechnical characteristics of the discontinuities were logged. Good core recovery allowed a high percentage of the core to be oriented. Acoustic logging and some borehole camera surveys were also completed in selected drillholes in 2006 to 2008.

Two oriented drillholes were completed in Area G in 2008 using a HT-750 rig to try to characterize a fault that had been encountered during 2007 drilling. These oriented drillholes were completed using the Reflex ACT orientation system and joint orientations and geotechnical characteristics were collected for the core in these drillholes.

6.5.2.3 Overburden and Bedrock Characterization

SPT samples were collected from those vertical geotechnical drillholes where an appreciable amount of overburden was present. The SPT samples provided material for soil characterization laboratory testwork. SPTs were typically conducted at 5 to 10 foot intervals where ground conditions permitted, until bedrock was reached. The number of blows required to advance the sampler was recorded for three 6-inch intervals of advancement up to 18 inches. The SPT ‘N’ value is the total number of blows required to advance the sampler the last two 6-inch increments (between 6 and 18 inches). The number of blows, depth interval, recovery length, photo documentation, and a soil description were routinely recorded for each SPT. Samples were sealed and double-bagged for subsequent laboratory analysis.

Representative samples were chosen from the SPT samples and sent to the KP geotechnical lab in Denver for testing. The SPT samples were analyzed for the following:

- Natural moisture content (American Standard Test Method (ASTM) D2216-90).
- Particle size distributions (ASTM D422-63).
- Hydrometer analysis (ASTM D422-63).

- Atterberg limits (ASTM D4318-84).

Detailed geotechnical logging of the bedrock core was carried out to characterize the rock mass quality. The following information for the bedrock was routinely collected:

- Depth interval.
- Core recovery length.
- Rock quality designation (RQD).
- Lithological description.
- Estimate of unconfined compressive strength (UCS).
- Number of discontinuities.
- Discontinuity/joint condition (roughness, aperture, alteration, infilling, etc.).
- Discontinuity type (joint, bedding, etc.).
- Discontinuity alpha and beta angles (collected for oriented drillholes).
- Orientation quality (collected for oriented drillholes).

The overburden was described by the combination of logging the recovered samples from the core tubes, monitoring of drilling characteristics and return fluid, and by comparison and calibration of these observations to physical samples recovered in the SPT sampler.

6.5.2.4 Rock Mass Classification

The rock mass characteristics observed during core logging were summarized for each core run and used to estimate the quality of the rock mass using the rock mass rating classification system (RMR89) (Bieniawski, 1989), as presented in Appendix 6D. The RMR89 system is based on determining values for the following five key rock mass parameters:

- Intact rock hardness or UCS—intact rock strength is estimated in the field.
- RQD—the RQD value was determined for each core run by summing the lengths of all core pieces greater than 4 inches in length and presenting this as a percentage of the actual drill run length.
- Fracture (joint) spacing—an estimate of fracture spacing was determined by counting the number of natural fractures encountered per length of drill run.
- Fracture (joint) condition—the fracture condition is based on an evaluation of fracture persistence, roughness, infilling, aperture, and weathering. The persistence has been conservatively assumed to have a rating of 0, consistent with high persistence. The roughness, infilling, aperture, and weathering are determined by evaluation of the drill core.
- Groundwater condition—a constant groundwater rating of 15, which corresponds to dry conditions, was used to calculate the rock mass rating (RMR). This allows the RMR to be consistent with the geological strength index (GSI) values (Hoek et al., 1995) that have also been used to estimate rock mass strengths.

There are five major RMR classes, from I—VERY GOOD to V—VERY POOR, associated with ranges of estimated RMR values between 100 (I) AND 0 (V), as summarized in Appendix 6D (adapted from Bieniawski, 1989).

6.5.3 Piezometer Installation and Hydraulic Conductivity Testing

6.5.3.1 Piezometer Installation

Two hundred and fourteen (214) standpipe piezometers were installed in the geotechnical drillholes during the 2004 to 2008 field seasons. A number of the drillholes had two piezometers installed into different completion zones in 2006, 2007, and 2008. Vibrating wire piezometers were installed in 2005 in some drillholes in the Deposit Area and in two drillholes in Area G and Area L in 2008.

The piezometer installation procedure involved:

- The depth of the piezometer completion zones were governed by several factors. A zone of interest was identified in the overburden, bedrock, or at the overburden/bedrock interface during drilling and this was used as a target for the completion zone. The depth to groundwater was also taken into consideration to ensure that the completion zone was installed below the observed water table.
- A bottom bentonite pellet seal was installed at the base of the completion zone. The bottom bentonite seal was usually 5 feet thick.
- A layer of coarse filter sand approximately 2 to 5 feet thick was then placed above the bottom bentonite seal.
- The bottom end cap of the slotted 1 or 2-inch diameter polyvinyl chloride (PVC) screen and PVC riser pipe assembly was placed upon the coarse filter sand layer which separates the well screen from the lower bentonite seal..
- A sufficient volume of filter sand was poured down the drillhole to fully encompass the screened section plus approximately 3 to 5 feet of the riser pipe above the well screen.
- A layer of bentonite pellets approximately 5 feet thick was then placed above the filter sand to form the top bentonite seal of the well completion zone.
- The open annulus above the completion zone was backfilled with either cement grout or another piezometer installation.
- Piezometers were completed by installing PVC top caps and a steel protective casing over the exposed pipe or pipes. A surface cement cap was used to seat the steel protective cover.

The vibrating wire piezometer installation method was very similar except that no bentonite or sand was used and the vibrating wire was grouted up to surface. The vibrating wire was attached to the PVC riser pipe by taping it at regular intervals until the desired depth was reached.

The groundwater levels in the standpipe and vibrating wire piezometers were monitored by WMC/SWS/SLR.

Well completion details for the piezometers are included in the KP site investigation reports (KP 2005a, 2005b, 2005c, 2007, 2008a, 2008b, 2009).

6.5.3.2 Hydraulic Conductivity Testing

Packer hydraulic conductivity testing (Lugeon method) was completed at selected depths in the majority of the geotechnical drillholes to estimate the hydraulic conductivity of the bedrock. These tests are frequently referred to as ‘packer tests’ and consist of seating an inflatable bladder (packer) in the drill bit to seal off an open hole interval for testing. Water was then pumped down the drill rods into the isolated test zone at varying controlled test pressures. The water flows were typically measured for three ascending and two descending pressure stages for each packer test.

Rising and falling head tests (Hvorslev method) were also conducted in most of the standpipe piezometers installed in the overburden and bedrock. These tests involve the addition or removal of water from the piezometer and recording subsequent changes in the water level against time until the water level returns to static equilibrium.

Hydraulic conductivity results for soil and rock typically vary with material type but results can be generally categorized into the following ranges (modified after Terzaghi and Peck, 1967):

- High 10^{-1} to 10 centimeters per second
- Medium 10^{-3} to 10^{-1} centimeters per second
- Low 10^{-5} to 10^{-3} centimeters per second
- Very low 10^{-7} to 10^{-5} centimeters per second
- Extremely low 10^{-10} to 10^{-7} centimeters per second

6.5.4 Geophysical Investigations

Geophysical investigations were completed by Frontier as part of the 2004, 2005, and 2006 geotechnical investigations. Thirty-six (36) seismic refraction traverses were completed in the study. The locations of the seismic lines are shown on Figures 6-5 and 6-6.

The seismic refraction method used in these investigations was proposed by Frontier to be the most effective means of differentiating and classifying the unsaturated materials, saturated materials, glacial drift, and bedrock of the mine study area. Survey methods involved placing a geophone array (e.g., geophone cables and implanted geophones) along the survey lines, with several shot points located along and off the ends of each cable. Geophone intervals were adjusted to produce high-resolution data on subsurface layering and to ensure adequate coverage of the overburden/bedrock interface. Small, remotely detonated, explosive charges buried in shallow hand-excavated shot holes provided the source of seismic energy that was recorded by the geophone array.

The seismic-refraction investigation was carried out using a Geometrics, Geode, 24-channel, signal-enhancement seismograph and Mark Products Ltd., 48 Hertz geophones. The results of the geophysical investigations are included in the appendices of the 2004, 2005, and 2006 KP site investigation reports.

6.5.5 Seismicity

Existing information and historical data, including earthquake catalogues and technical publications on the tectonics and seismicity of the region were collected and reviewed by KP for a detailed study on the regional seismicity of the Bristol Bay drainages. The study was completed using a revised seismic hazard map for Alaska which was published by the USGS (Wesson, 2007).

An unpublished draft report *Pebble Project – Report on Seismicity Assessment (Ref. No. VA101-00176/20-1)* (KP, 2008c) was completed by KP in 2008 and presents the results of the detailed seismic hazard analyses for the mine study area. Technical publications published up to 2011 were also used in the evaluation of the regional seismicity.

6.6 Results and Discussion

6.6.1 Geotechnical Investigations in the Mine Study Area

Geotechnical site investigations have been completed between 2004 and 2008, and the findings are summarized in this section. Appendix 6A provides a summary of the test pits. The test pit locations are shown on Figures 6-3 and 6-4. Appendix 6B provides a summary of the geotechnical drillholes through the overburden and upper bedrock. Drillhole locations are shown on Figures 6-5 and 6-6. The piezometer completion zones, hydraulic conductivity test results, and static water levels are also presented in Appendix 6B. The test pit and geotechnical drillhole logs are included in the appendices of the corresponding KP site investigation reports.

A summary of the deeper oriented drillholes completed is presented in Appendix 6C. The locations and azimuths of these drillholes are shown on Figure 6-7, and drillhole logs for the oriented geotechnical drillholes are included as appendices in the *KP 2004* and *2005 Open Pit Site Investigation Reports* (KP, 2005c, 2005a) and in the *SRK 2006 Preliminary Geotechnical Evaluation of the East Zone – 2006 Interim Report* (SRK, 2007) and in the *2007* and *2008 Geotechnical Data Acquisition Program – Pebble East Zone Data Reports* (SRK, 2008, 2009).

The depth to bedrock in each of the drillholes is shown on Figures 6-8 and 6-9. A geologic cross-section through the Deposit Area is shown on Figure 6-10. Geologic cross-sections were interpreted for most seismic lines and other areas of interest in the majority of the 10 reference areas. The section plans are presented on Figures 6-11 and 6-12 and the section profiles are presented on Figures 6-13a through 6-50.

6.6.1.1 Pebble West Area

The Pebble West Area comprises the western part of the Pebble Deposit Area, located on the drainage divide between the South Fork Koktuli River and Upper Talarik Creek, as shown on Figure 6-2a. Four vertical geotechnical drillholes, 34 test pits, and one seismic line (SL) have been completed in the Pebble West Area. The bedrock geology of the Pebble West Area is based on NDM/Pebble Partnership exploration drill core data and is illustrated on Figure 6-10. The geological section (Figure 6-13a) extending southward through the eastern half of the Pebble West Area is based on geotechnical drilling. This section provides an overview of the subsurface conditions encountered in the Pebble West Area.

The Pebble West Area is terraced with many small ponds and kettled moraine features resulting from the Brooks Lake glaciation (Detterman and Reed, 1973). A layer of topsoil less than 1 foot thick was encountered at surface over most of the Pebble West Area. The topsoil is typically dark brown, moist, and contains varying quantities of silt, sand, and gravel. The overburden in the Pebble West Area ranges in thickness from 10 to 250 feet in the western portion and generally consists of glaciofluvial, glaciolacustrine, and glacial drift deposits.

The Pebble West Area has been roughly subdivided into the western, central, and eastern portions. These portions have not been specifically delineated as subareas, but their general locations and topographic characteristics can be described with respect to Figure 6-12. The greatest contrast in elevation within the Pebble West Area is found within the western portion, with the ground surface elevation varying from 1,000 to 1,475 feet. Surficial materials in the western portion are composed of glacial drift, predominantly silty sand with some gravel, along the gently sloping hills and ridges. The central portion of the Pebble West Area has moderate slopes and is generally characterized by well-drained glaciofluvial materials. The eastern portion of the Pebble West Area covers the upstream end of the wide valley to the north of Frying Pan Lake and generally consists of glacial drift, glaciolacustrine, and glaciofluvial materials. The topography in the eastern portion of the Pebble West Area varies from 900 to 1,075 feet. Overburden materials observed in the drillholes of the eastern portion contain varying amounts of gravel, sand, silt, and clay.

Tertiary basalt, basalt breccia, volcaniclastic matrix-supported breccia/conglomerate, and mudstone/siltstone/wackes were encountered in the Pebble West Area. The drillholes in this area had average RMR values ranging from 45 to 55 (FAIR) (Bieniawski, 1989). Bedrock conditions in the Deposit Area are described in greater detail in the *KP 2004 and 2005 Open Pit Geotechnical Investigation Reports (Ref. Nos. VA101-00176/8-2 and 8-5)* (KP, 2005c, 2005a) and in the *SRK 2006 Preliminary Geotechnical Evaluation of the East Zone – 2006 Interim Report* (SRK, 2007) and *2008 Geotechnical Data Acquisition Program – Pebble East Zone Data Report* (SRK, 2009).

The piezometric surface in this area was variable, ranging from above ground level to a water level of approximately 50 feet below grade. This range represents aquifers at different elevations and variation of the topography Some vertical drillholes were advanced 300 feet into bedrock to provide additional information on the hydraulic conductivity in the bedrock of the Pebble West Area. Packer hydraulic conductivity test results were in the low to very low range, generally decreasing with increasing depth. Falling/rising head hydraulic conductivity testing in the overburden also gave hydraulic conductivity results in the low range.

6.6.1.2 Pebble East Area

The Pebble East Area comprises the eastern part of the Pebble Deposit Area, located on the drainage divide between the South Fork Koktuli River and Upper Talarik Creek, as shown on Figure 6-2a. Work completed in this area included 21 geotechnical drillholes, 17 test pits, and six seismic lines to evaluate the subsurface overburden materials and to try to delineate a potential paleochannel north of Koktuli Mountain. Figures 6-14, 6-15, 6-16, and 6-17 represent cross sections along SL-25, SL-26, SL-34, and SL-38, respectively.

Surface topsoil ranges from zero to approximately 4 feet thick over most of the Pebble East Area with some areas of peat deposits up to 2.5 feet thick. The topsoil is typically dark brown, moist, and contains varying quantities of silt, sand, and gravel. The thickness of overburden in the Pebble East Area ranges from approximately 10 feet to greater than 200 feet in the eastern portion. Seismic refraction data have revealed that there is a buried paleochannel in the eastern portion of the Pebble East Area that runs in a northeast to southwest direction along Koktuli Mountain. Several of the drillholes along this alignment did not reach bedrock. The subsurface overburden materials in the Pebble East Area consist of glaciofluvial, glaciolacustrine, and glacial drift materials composed of sand and silt with varying amounts of gravel, silt, and clay. Core recovery was generally good in the glaciolacustrine and siltier units. Several of the SPT samples in these units had a higher percentage of fines, ranging from 55 to 98 percent. Some lower SPT ‘N’ values were found near the surface and are likely attributed to peat, heaving sand, or slough in the drillholes. Several of the SPTs were refused in drillholes in the Pebble East Area; this is attributed to the abundant gravel and cobbles found in the materials of the area.

The bedrock encountered in the vertical drillholes in the Pebble East Area consisted of weathered Tertiary rhyolite, Tertiary basalt and basalt breccia, bedded andesites, and Tertiary volcaniclastic breccia/conglomerate. Some of the drillholes were terminated in the overburden or the weathered bedrock, because the primary purpose of these drillholes was for overburden characterization. Average RMR values of the drillholes in the Pebble East Area ranged from 32 to 56 (POOR to FAIR) (Bieniawski, 1989). Bedrock conditions of the Pebble East Area are described in greater detail in the *SRK 2006 Preliminary Geotechnical Evaluation of the East Zone – 2006 Interim Report* (SRK, 2007) and in the *2007* and *2008 Geotechnical Data Acquisition Program – Pebble East Zone Data Reports* (SRK, 2008, 2009).

The piezometric surface in this area ranged from above or very near the ground surface to depths of 63 feet below surface. This range represents aquifers at different elevations and topographic variation in this area. Falling head tests were completed in the overburden materials and hydraulic conductivity results were in the low to very low range. Falling head tests completed at the overburden/bedrock contact had hydraulic conductivity results from very low to the medium range, pointing to the higher permeability material that is often encountered at the bedrock contact.

6.6.1.3 Upper Talarik Creek Area

The Upper Talarik Creek Area is located north of the Pebble Deposit Area, as shown on Figure 6-2a. The Upper Talarik Creek Area is a wide, relatively flat valley containing many streams and small, seasonal lakes that feed into the upper reaches of Upper Talarik Creek. Eleven (11) geotechnical drillholes, 29 test pits, and an extension of a seismic line from the Pebble Deposit Area were completed in this area. Figure 6-18 presents a cross section through this area based on drilling from 2008.

A surficial layer of topsoil approximately 0 to 4 feet thick was typically encountered at surface in this area. The topsoil is typically dark brown, moist to wet; consisting of silt, sand, gravel, and/or peat. The overburden of the Upper Talarik Creek Area is predominantly composed of sand with varying amounts of silt and gravel. Fine-grained sediments, primarily sand, silt, and clay, were encountered in the lower-lying area in the center of the Upper Talarik Creek valley These materials are typically found in low-energy depositional environments, such as glaciolacustrine or very low-gradient stream reaches such as oxbows. The soil in the center of the valley contained only trace amounts of gravel to at least 8.5 feet deep. Overburden in the upland area bordering Area E was largely composed of sand and gravel materials. These coarser grained gravel and sand combinations are interpreted as glacial drift deposits.

The bedrock encountered in the Upper Talarik Creek Area consists of Tertiary sandstone/wacke/conglomerate, Tertiary volcaniclastic breccia/conglomerate, Tertiary basalt, Cretaceous siltstone (bedded andesite), granodiorite, and diorite. The rocks in this area had average RMR values ranging from 29 to 54 (POOR to FAIR).

The piezometric surface throughout the Upper Talarik Creek Area ranged from above ground to a depth of approximately 40 feet below ground surface. This range represents aquifers at different elevations and topographic variation throughout this area. Falling head hydraulic conductivity testing results of the overburden/bedrock contact were in the low range.

6.6.1.4 Area E

Area E consists of a broad valley located immediately west of the Pebble Deposit Area, as shown on Figure 6-2a. Site investigations in Area E included 18 geotechnical drillholes, 66 test pits, and 10 seismic lines. Work completed from 2004 to 2006 largely concentrated on a knoll in the eastern portion of Area E. Geologic sections corresponding to the SL-13 (which also extends into Area A) to SL-15 (2004) , SL-27 to 33 (2006) are presented on Figures 6-19, 6-20, 6-21, 6-22, 6-23, 6-24, 6-25, 6-26, 6-27, and 6-28, respectively. A geologic section through the northwestern part of Area E is shown on Figure 6-29.

A layer of topsoil, 0 to 1 foot thick, was encountered at surface over most of Area E. The topsoil was typically medium to dark brown, moist, and contained varying quantities of organic material, sand, and gravel. The overburden consists of a veneer of glacial drift, predominantly sands and gravels with varying amounts of silt. Frost shattered bedrock (felsenmeer) is present on the hill tops.

Bedrock was encountered at depths of 0 to 8 feet in the drillholes on top of the knoll in the eastern part of Area E. Overburden thicknesses ranging from 6 to 111 feet were found in the drillholes in the valley and on the valley side slopes in the central part of Area E. The bedrock in Area E varied from Cretaceous monzonite/granodiorite and siltstone to Tertiary sediments and intrusives. Tertiary rocks found in Area E include Tertiary volcaniclastic breccia/conglomerate, basalt, brecciated basalt, and siltstone. The average RMR values ranged from 30 to 58 (POOR to FAIR) (Bieniawski, 1989). POOR bedrock encountered in Area E was generally more fractured, or the bedrock was weathered to a considerable depth.

The piezometric surface in Area E ranged from above ground to 84 feet below surface and was usually coincident with, or close to the top of the fractured bedrock unit. This range represents aquifers at different elevations and variation of the topography throughout this area. Packer hydraulic conductivity tests were conducted in the more competent bedrock and results were in the low to very low range. Hydraulic conductivities obtained for the piezometer completion zones using rising/falling head tests were also in the low to very low range. Hydraulic conductivity values are typically higher in the overburden or at the overburden/bedrock contact where the bedrock is usually more broken.

6.6.1.5 North Fork Koktuli River Area

The North Fork Koktuli River Area is a wide, relatively flat valley located approximately four miles northwest of the Pebble Deposit Area, as shown on Figure 6-2a. The area has many streams and small, seasonal lakes that feed into the upper reaches of the North Fork Koktuli River. Four geotechnical drillholes and the excavation of nine test pits were completed in the area.

A 0.5 to 2 foot thick layer of organic topsoil was found in this area. The topsoil is typically dark brown, moist, and consists of silt, sand, and gravel. The overburden was 148 feet deep in the north, which sharply contrasted with the overburden thicknesses of 22 to 40 feet encountered farther to the south and closer to the edge of the valley. The overburden materials encountered throughout the North Fork Koktuli River Area are generally compact, with gravel and cobbles present. Material variations are the result of the numerous glaciations and localized depositional environments.

The bedrock types encountered in the North Fork Koktuli River Area were Tertiary andesite, Tertiary basalt, and Tertiary mudstone/siltstone/wacke. The bedrock in the North Fork Koktuli River Area demonstrated average RMR values ranging from 36 to 60 (POOR to FAIR) (Bieniawski, 1989). The bedrock in the northern portion of the area was comprised of Tertiary andesite and was highly fractured, weak to medium strong rock. The Tertiary basalt was generally strong, though the Tertiary basalt in a drillhole near the southern edge of the area was weaker and was fractured to approximately 130 feet deep. Tertiary mudstone/siltstone/wacke encountered in this area was medium strong and highly fractured to the depth of the drillhole (133 feet).

The ground was generally frozen near the surface in the North Fork Koktuli River Area during the excavation of the test pits in 2004 because they were completed in the early months of the summer. Aside from this frozen moisture there was no other noted groundwater present in any of the test pits. Site reconnaissance conducted in late August 2004, encountered a number of dry, rocky depressions (several feet deep) that had obvious high water lines from earlier in the season, indicating that the area is fairly well drained from spring to fall. The piezometric surface ranged from approximately 14 to 31 feet below ground surface. The range is a result of aquifers encountered at different elevations and topographic variation. A falling head test was completed in the overburden materials with a resulting hydraulic conductivity in the low range. Falling head tests were also completed at the overburden/bedrock contact with hydraulic conductivities in the very low range. Hydraulic conductivities were in the very low range for falling head tests and packer tests completed in the more competent bedrock. Packer tests could not be performed in a drillhole in the southwestern part of the North Fork Koktuli River Area where highly fractured rock was encountered because of the risk of the inflatable bladder being damaged; this rock is expected to have hydraulic conductivity in the low to medium range.

6.6.1.6 Area G

Area G is a valley surrounding a northward-draining tributary of the North Fork Koktuli River, located approximately five miles west of the Pebble Deposit Area, as shown on Figure 6-2a. Site investigation programs included 45 geotechnical drillholes, 42 test pits, and two seismic lines in this area. Geologic sections for the north, upstream north, northwest, southwest, south, and east parts of the valley are shown on Figures 6-30, 6-31, 6-32, 6-33, 6-34, and 6-35. SL-23 and SL-24 correspond to the sections on Figures 6-30 and 6-34, respectively.

The topsoil in Area G varies from a thin veneer at higher elevations, where it is often mixed with felsenmeer, to approximately 4 feet thick at lower elevations. There are frost-heaved bedrock blocks with interstitial topsoil between the blocks; this surficial portion of felsenmeer is often classed as overburden. Relict felsenmeer is encountered at depth and can be coincident with the zone of altered and fractured rock at the bedrock contact but is very difficult to distinguish. Felsenmeer exists on the ridges, valley slopes, and hill tops in the east and west of Area G with many large boulder-size fragments at the higher elevations. The topsoil in Area G is typically dark brown, moist, and consists of silt, sand, and gravel. Peat up to 10 feet thick is found in the bottom of the valley with thinner peat found in some poorly drained areas on the valley slopes.

Overburden materials in Area G are complex with rapidly changing composition and numerous layers that are not easily extrapolated between drillholes. The overburden is largely composed of sand and gravel with varying proportions of silt and is largely felsenmeer, glacial drift, and colluvium deposits. The geotechnical drillholes in northern Area G encountered bedrock at 2 to 51 feet below surface. In lower elevation areas, the overburden generally had a higher amount of fines, and was predominantly composed of silty sand. Overburden in the valley bottom was up to 15 feet of combined peat, sands, and gravels. Deeper overburden, in the northern part of the valley, was encountered on the eastern and western mid-valley slopes.

The overburden along the western ridges is generally thin with less than 5 feet present in the saddles. In contrast, the depth of overburden in the east saddle, north of Kaskanak Mountain, was approximately 50 feet deep. The depth of overburden on the eastern side slopes is typically less than 15 feet. Volcaniclastic fragmented breccia has been identified in drillholes in this area and the degree of weathering may make it difficult to distinguish this rock type from bedrock. The overburden on the eastern slopes is largely composed of sand with varying amounts of gravel and fines.

Bedrock in the northern part of Area G is primarily of volcanic origin and mostly composed of monzonite/granodiorite of the Kaskanak Batholith with some basalt, gabbro, pyroxenite, and Tertiary sediments. Bedrock in the southern and eastern part of Area G includes Cretaceous granodiorite/monzonite, Tertiary rhyolite, basalt, volcaniclastic fragmented rocks, and brecciated Tertiary sediments and volcanics. Weathered bedrock was encountered up to 80 feet deep in some of the drillholes in the southern portion of Area G. The average RMR values of the bedrock in Area G ranged from 35 to 66 (POOR to GOOD) (Bieniawski, 1989). The drillholes in Area G encountered zones of highly weathered, fractured bedrock. Some fault zones were encountered in drillholes in the northwest part of Area G.

The groundwater conditions of Area G are variable and the groundwater table varies seasonally throughout the area. The piezometric surface in the northern portion of Area G is either at or close to the ground surface, ranging from above ground to 41 feet below surface at 1700 feet elevation. The piezometric surface was observed to be close to or above the ground surface in most drillholes in the southern portion of Area G with a few drillholes at higher elevations exhibiting lower piezometric levels up to 85 feet below ground surface. The range is a result of the variation in topography and aquifers encountered at different elevations throughout Area G.

A number of falling head tests (Hvorslev method) were conducted in piezometers installed at the overburden/bedrock contact. A fractured/weathered bedrock zone is generally observed at the overburden/bedrock contact throughout Area G. This zone has a generally low to medium hydraulic conductivity. The hydraulic conductivity in the bedrock in the northern and northwestern parts of Area G is medium to low. A number of small fault zones and zones of heavily fractured rock with clay in the joints were encountered; these zones have low hydraulic conductivity in the same order of magnitude as the surrounding bedrock. The bedrock of the southern portion of Area G exhibited generally low hydraulic conductivity, however, occasional intervals of medium hydraulic conductivity ranging from were identified near the valley bottom and in the eastern saddle slopes.

6.6.1.7 Area L

Area L is a southward-draining tributary valley to the South Fork Koktuli River, located approximately six miles southwest of the Pebble Deposit Area, as shown on Figure 6-2a. The site investigation programs included 32 geotechnical drillholes and the excavation of 43 test pits in this area. Geologic sections through Area L are shown on Figures 6-36, 6-37a, and 6-37b.

The topsoil in Area L ranges from 0 to 5 feet thick and consists of dark brown silt, sand, gravel, and cobbles. The overburden varies from 0 to 105 feet with the thicker overburden in the valley bottom areas. Most overburden deposits are within 30 feet of surface. The overburden deposits consist of sand and/or gravel with varying amounts of finer materials. Glacial drift, colluvium, felsenmeer, and bedrock are found at surface in this area.

The bedrock encountered in Area L is of igneous and volcanosedimentary origin. Bedrock types encountered include granodiorite, monzonite, and monzodiorite of the Kaskanak Batholith; and Tertiary siltstone, rhyolite, andesite, dacite, volcaniclastic breccia, basalt, and brecciated basalt. The bedrock was strong, with average RMR values of 39 to 66 (POOR to GOOD) (Bieniawski, 198 Hydraulic conductivity testing was conducted in the bedrock and the results ranged from low to medium values. 9).

Groundwater was observed to be seeping into many of the test pits excavated in the northern and eastern regions of the valley. Numerous groundwater seeps were noted in these same areas during site reconnaissance in late August 2004. The piezometric level varies from above ground to approximately 200 feet below ground surface. The range is largely due to topographic variation in this area and is also attributed to encountering aquifers at different elevations.

6.6.1.8 South Fork Koktuli River Area

The South Fork Koktuli Area is located approximately six miles south to southwest of the Pebble Deposit Area, as shown on Figure 6-2a. It consists of the main valley of the South Fork Koktuli River, downstream of the Pebble Deposit Area and Area A, and also receives drainage from the tributary valleys of Areas J and L. Site investigations included the excavation of 22 test pits and 23 geotechnical drillholes in this area. Seven seismic survey lines were also completed in this area. Figures 6-38a, 6-38b, 6-39, 6-40, and 6-41 represent geologic sections along SL-6, SL-7, SL-8, and SL-19, respectively.

A surficial layer of topsoil up to 4 feet thick covers most of the area. The topsoil is typically dark brown and consists of silt, sand, gravel, and cobbles. There were also some areas of peat encountered. The overburden thickness is highly variable in the South Fork Koktuli River Area, with recorded thickness ranging from 12 feet to greater than 390 feet. The shallower overburden tends to occur in elevated areas along the sides of the valley. The overburden composition is predominantly sand and gravel, with greater proportions of sand interbedded in the east, and greater quantities of silt in the west. The materials consist of glacial drift, alluvial, and colluvial deposits. Multiple glaciations with ice sheets of varying thicknesses affected the area and resulted in a complex depositional history with numerous glacial advances and retreats reworking the glacially derived sediments and resulting in the burial of old stream channels and ponds.

The bedrock composition is variable in the South Fork Koktuli River Area. The bedrock types encountered were granodiorite, monzonite, basalt, sandstone, siltstone/mudstone, dacite, and andesite.

The rock strength was highly variable between drillholes. The average RMR values ranged from 39 to 64 (POOR to GOOD) (Bieniawski, 1989).

The presence of groundwater was not noted in any of the test pits excavated in the South Fork Koktuli River Area; however, the ground was frozen in March and April when these test pits were excavated. The groundwater levels measured in the piezometers ranged from 5 to 136 feet below ground surface. The range represents aquifers at different elevations and topographic variation throughout this area. The area is underlain by predominantly sand and gravel with high hydraulic conductivity. Portions of the South Fork Koktuli River flow subsurface through the more permeable strata during dry periods.

A limited number of hydraulic conductivity packer (Lugeon) tests were conducted in the bedrock of the area and hydraulic conductivity values were in the low range. Rising head hydraulic conductivity tests were conducted in some of the piezometers with completion zones located in overburden material; however, the groundwater recovery was too rapid to obtain accurate results, which is indicative of medium to high hydraulic conductivity. Additional information has been collected on the hydrogeology of this area by WMC/SWS/SLR and is presented in Chapter 8.

6.6.1.9 Area J

Area J is a long, narrow, steeply incised valley that drains southward into the South Fork Koktuli River, southwest of the Pebble Deposit Area, as shown on Figure 6-2a. The site investigation of Area J included 15 geotechnical drillholes, 13 test pits, and three seismic lines distributed along the valley. A geologic section through Area J is presented on Figure 6-42.

Topsoil covers much of the surface of the valley and is up to 4 feet thick. The topsoil is composed of silt, sand, and gravel. Felsenmeer is prevalent at higher elevations and ranges from 0 to approximately 15 feet depth in the drillholes throughout Area J. Overburden thickness in Area J ranged from approximately 0 to 70 feet. The overburden in Area J is predominantly composed of sand, grading to sandy gravel, with varying proportions of silt. Gradational layering and particle orientation, consistent with fluvial deposition, was noted in some coarser-grained deposits. The bedrock most commonly encountered in this area is Cretaceous granodiorite/diorite of the Kaskanak Batholith, Tertiary basalt and minor Cretaceous siltstone. The bedrock is strong with average RMR values of 40 to 65 (FAIR to GOOD) (Bieniawski, 1989).

Groundwater was encountered at depths ranging from above ground to approximately 40 feet below surface, but was mostly less than 25 feet below ground surface. The depth of groundwater ranges as a result of varying topography and aquifers at different elevations. Hydraulic conductivity values of the bedrock were in the low range.

6.6.1.10 Area A

Area A is located directly to the south of the Pebble Deposit Area, as shown on Figure 6-2a. Area A has been subdivided into four geomorphic subareas, as shown on Figure 6-2b, each of which is described in the following sections. A north to south geological cross section through Area A is shown on Figures 6-13a and 6-13b.

Valley Bottom

The Valley Bottom of Area A consists of the valley south of the Pebble Deposit Area extending to the southern end of Frying Pan Lake, as shown on Figure 6-2b. The eastern and western extents of the Valley Bottom are governed by the elevation on the side slopes. Six geotechnical drillholes, 10 test pits, and one seismic line were completed in this area. Cross sections along SL-2 and across the northern portion of the valley are shown on Figures 6-43 and 6-44, respectively.

The Valley Bottom is characterized by relatively flat topography with extensive swamp/wetlands present. Based on relict beaches evident along the valley sides, the water elevation of the glacial lake in this area was approximately 1,000 feet. The thickness of the overburden across the Valley Bottom varied between approximately 100 and 185 feet, with the thickest deposits found along the western side of the valley. The peat thickness varied between 1 and 15 feet, while the thickness of the more recent glaciofluvial deposits varied between 15 and 30 feet. A glaciolacustrine silt layer was encountered approximately 30 to 40 feet below the existing ground elevation and was variable in thickness. Glacial drift, including some relatively thin, discontinuous glaciolacustrine and glaciofluvial layers, extends from the bottom of the glaciolacustrine layer to the bedrock. The materials encountered in the drillholes in the Valley Bottom consist primarily of sand and gravel with varying amounts of silt, clay, and cobbles.

The bedrock in the Valley Bottom is primarily igneous in origin, varying from granodiorite/diorite to Tertiary rhyolite and Tertiary dacite/latite. Bedded andesites were also encountered in this area. The bedrock ranged from medium to very strong rock and average RMR values ranged from 44 to 63 (FAIR to GOOD) but generally were in the FAIR range (Bieniawski, 1989).

The piezometric surface in the Valley Bottom was encountered above or within 10 feet of the ground surface, evidenced by the numerous swamp/wetland areas in this area. The range is a result of encountering aquifers at different elevations and varying topography. The wet, boggy composition of this area is indicative of a groundwater discharge zone.

Southern Upland

The Southern Upland of Area A lies to the south of Frying Pan Lake, as shown on Figure 6-2b, and is distinguished from the Valley Bottom by elevated topography. Seventeen geotechnical drillholes, 10 test pits, and three seismic lines were completed in this area. Cross sections along SL-3, SL-4, SL-5, and a transverse section through this area are shown on Figures 6-45, 6-46, 6-47, and 6-48, respectively.

The Southern Upland is kettled and characterized by deep deposits of moraine and outwash of the Brooks Lake glaciation (Detterman and Reed, 1973). The overburden is predominantly composed of glacial drift and glaciofluvial deposits, with some sorting consistent with reworking by water. Materials encountered include sand and gravel, with varying cobble and silt content. Some thin, discontinuous silt and/or clay layers were also encountered. This material is anticipated to be moderately to highly permeable based on results of grain size analyses and observed difficulties in maintaining circulation of the drilling fluid during drilling. The overburden depth ranged between approximately 7 and 390 feet below existing grade, increasing southward.

The bedrock encountered in the Southern Upland was comprised of both sedimentary and volcanic units. The sedimentary units varied from mudstone/siltstone to breccia. Andesite, monzodiorite, latite, granodiorite, diorite, and basalt dikes are the volcanic units encountered in this part of Area A. The bedrock ranged from weak to very strong rock, though most of the drillholes encountered medium to strong rock. The drillholes in this area had average RMR values ranging from 42 to 63 (FAIR to GOOD) (Bieniawski, 1989), with most bedrock in the area in the FAIR range.

The groundwater levels in the piezometers installed in this area ranged from approximately 30 to 140 feet below surface. The range of groundwater depth is a result of encountering aquifers at different elevations and topographic variation. Hydraulic conductivity (Lugeon) tests were conducted in the bedrock, and the results for the bedrock are generally low. Falling head tests (Hvorslev method) were also conducted, and the hydraulic conductivity values for the overburden were also in the low range. Some of the overburden materials have medium to high hydraulic conductivities as indicated by recovery rates that were too fast for accurate measurements to be made with a water level meter.

Lower/Mid Side Slopes

The Lower/Mid Side Slopes of Area A refer to the lower and middle elevations of the side slopes along the Frying Pan Lake valley, and part of the South Fork Koktuli River valley downstream of Frying Pan Lake, as shown on Figure 6-2b. Site investigations in this area include one seismic line, 12 geotechnical drillholes and 19 test pits that were completed in this area. Cross sections through SL-20 and through the north valley are shown on Figures 6-49 and 6-44, respectively.

The thickness of the overburden on the Lower/Mid Side Slopes varied from 18 to 91 feet. Overburden materials encountered in the drillholes typically consisted of sand and gravel with varying amounts of silt.

The bedrock of the Lower/Mid Side Slopes was primarily diorite and granodiorite. However, dacite, andesite, Tertiary basalt, volcaniclastic breccia, siltstone/mudstone, and wackes were also encountered. The bedrock varied from a medium strong to strong rock including altered, highly fractured rock near the top of the drillholes. The bedrock in this area had average RMR values of 44 to 63 (FAIR) (Bieniawski, 1989).

The piezometric surface of this area was variable, ranging from above ground to depths of approximately 38 feet below surface. The variability of the piezometric surface is a result of topographic variation over the area and aquifers encountered at differing elevations.

Packer hydraulic conductivity (Lugeon) tests were conducted in the bedrock, and the hydraulic conductivity values determined for the bedrock were in the low range. Falling head tests (Hvorslev method) were conducted in some of the piezometers, and the hydraulic conductivity values ranged from low to medium for tests conducted in completion zones at the overburden/bedrock contact and in the bedrock.

Upper Side Slopes

The Upper Side Slopes of Area A are situated at upper elevations along the Frying Pan Lake valley, and part of the South Fork Koktuli River valley downstream of Frying Pan Lake, as shown on Figure 6-2b. Seven geotechnical drillholes, three test pits, and one seismic line have been completed in this area. A cross section through SL-21 is shown on Figure 6-50.

The subsurface conditions in this area can be summarized as a veneer of colluvium or glacial drift over shattered bedrock. Overburden thickness varied between 10 and 130 feet, but was mostly within 50 feet of ground surface. Minor frost sorting of the loose colluvium on the surface has produced thin solifluction lobes across much of this area.

The bedrock along the Upper Side Slopes consists of granodiorite/diorite/monzonite, and bedded andesites. The bedrock ranged from strong to very strong rock and average RMR values ranged from 44 to 68 (FAIR to GOOD) (Bieniawski, 1989).

The piezometric surface was typically found within the weathered bedrock in the Upper Side Slopes, approximately 0 to 92 feet below the ground surface. The range is a result of aquifers at different elevations and topographic variation. Packer testing was performed in the bedrock and the values ranged from extremely low to medium hydraulic conductivity. Falling head hydraulic conductivity testing results in the bedrock tests were in the low to medium range.

6.6.2 Regional Seismicity and Faulting

Alaska is the most seismically active state in the United States, and in 1964 it experienced the second largest earthquake recorded worldwide. The seismicity of southern Alaska is associated with interplate subduction earthquakes, intraplate earthquakes in the subducted oceanic plate, and shallow crustal earthquakes within the North American continental plate. The historical seismicity, regional tectonics, and related fault systems of southern Alaska are shown on Figure 6-51.

6.6.2.1 Alaska-Aleutian Megathrust Subduction Zone

Historically, the level of seismic activity is highest offshore along the south coast of Alaska, where earthquakes are generated by the Pacific (oceanic) plate subducting under the North American plate at an average rate of approximately 2 to 3 inches per year. Evidence suggests that these tectonic plates are locking as they pass each other, building up pressure that can sometimes be released as large Magnitude 8 to 9+ earthquakes. These large interplate subduction (thrust) earthquakes typically occur at relatively shallow depths of 10 to 25 miles. This seismic source region, known as the Alaska-Aleutian Megathrust (shown on Figure 6-51), has been responsible for several of the largest earthquakes recorded globally, including the 1964 Prince William Sound Magnitude 9.2 (M9.2) earthquake. There is potential for future large interplate subduction earthquakes (M8 to M9+) along the southern coast of Alaska. The recurrence period for these great megathrust earthquakes along the subduction zone is estimated to be about 650 years (Wesson et al., 2007). Unlike shallow crustal earthquakes or deeper intraplate subduction earthquakes that typically produce shaking for a minute or less, interplate subduction zone earthquakes produce shaking that can last for several minutes.

The distribution of recorded earthquakes by focal depth (depth to earthquake source) is shown on Figure 6-51. Several deeper earthquakes (focal depth > 25 miles) have been recorded along the south coast of Alaska and northwards in addition to the shallow earthquakes associated with the subducting plate boundary and crustal faulting. Many of these events correspond to the greater depth of the northwestward dipping Pacific plate beneath the North American plate. Very few of the recorded earthquakes are deeper than 130 miles, indicating that the subducting plate does not penetrate deeply into the mantle. This suggests that the Pacific plate is subducting at a relatively shallow angle beneath the overriding North

American plate, causing these two tectonic plates to be strongly coupled. This results in the potential for large magnitude earthquakes.

Intraplate (in subducting slab) subduction earthquakes are typically generated by a normal faulting mechanism in the subducted oceanic lithosphere, often occurring deep within the subducting Pacific plate as it moves northward beneath the North American plate. These deep earthquakes have potential to cause large ground motion, typically affecting a large area and producing a distinctive rolling motion, in contrast to the sharper jolts from shallower earthquakes on near-surface crustal faults. Several moderate to large magnitude intraplate subduction earthquakes have been recorded in southern Alaska over the last century, including M7 earthquakes in 1999 and 2001 and a M6.5 earthquake in 2000. These three events were located on or close to Kodiak Island. There is potential for future large magnitude (M7+) intraplate subduction earthquakes in the region.

A schematic section through the Alaska subduction zone is presented on Figure 6-52. The section includes all earthquakes within a zone along Section A-A, which is delineated on Figure 6-51. The section illustrates the approximate location of potential interplate subduction (megathrust) and intraplate subduction earthquakes relative to the Pebble Deposit Area.

6.6.2.2 Active Fault Systems

A fault is defined as a planar fracture or discontinuity in a volume of rock that can range from less than an inch in length to many miles long as is often found along the boundaries of tectonic plates. Active faults are moving over time due to building stresses. Inactive faults had movement along them at one time with no evidence of movement or associated seismic activity within the Holocene epoch. There are a number of active and potentially active fault systems in southern Alaska related to the tectonic pressures and crustal flexure caused by the subducting Pacific plate. Several of the active faults have generated large crustal earthquakes within the last century. The most important active and potentially active fault systems in the Bristol Bay and Cook Inlet drainages are shown on Figure 6-51 and are discussed below. Cook Inlet faults are included in this chapter because their seismicity may affect the Bristol Bay drainages study area. However, the effect of an earthquake dissipates with increasing distance from the epicenter.

A M7.9 earthquake occurred along a part of the Denali fault in 2002, with the epicenter located approximately 44 miles south of Fairbanks. This event was the largest inland earthquake in North America in almost 150 years. The western portion of the Denali fault trends in a northeast-southwest direction, approximately 125 miles north of the mine study area. The western portion of the Denali fault system is capable of generating large earthquakes of up to about M8.0.

The western end of the northeast-southwest trending Lake Clark-Castle Mountain fault system is located northeast of the mine study area. Published information indicates that the Lake Clark fault terminates at the western end of Lake Clark, over 15 miles from the eastern edge of the mine study area. This distance is based on a recent study by Haeussler and Saltus (2004) who used aeromagnetic data to refine the position of the western end of the fault. The study implies that the fault previously was mismapped in the remote and mountainous region. Recently, Haeussler (via personal communication with KP, April 2007) indicated that the reason for terminating the Lake Clark fault at the western end of Lake Clark was because of the lack of bedrock exposures southwest of the lake. Bedrock exposures are required for conventional fault mapping techniques. Haeussler suggested that the fault may extend farther to the southwest, based on a preliminary review of regional aeromagnetic data developed by the USGS.

Haeussler also indicated that there may be a southerly splay of the fault along the Newhalen River valley (east of the mine study area) toward Iliamna Lake.

A detailed study of the surficial geology and geomorphology at the mine study area was carried out in 2007 by consulting geologist Thomas Hamilton, formerly with the USGS in Anchorage, at the request of the Pebble Partnership. The findings of this study did not demonstrate anysurficial evidence of fault activity (e.g., linear features or disturbance of surficial deposits) in the vicinity of the mine study area. The mine study area is located on plutonic outcrops (some of batholithic scale) that likely provide resistance to crustal fracture. The surficial study indicated that large glaciers during the Pleistocene glacial advance followed zones of crustal fracture (weakness) associated with the Lake Clark fault (Hamilton et al, 2010). The mapped direction of primary glacial advance, shown on Figure 6-53, suggests that any potential extension of the Lake Clark fault may pass north and/or east of the mine study area, and would not cross the mine study area.

The Castle Mountain fault system is capable of generating large earthquakes with magnitudes of about M7.0+. There is surficial geologic evidence of Holocene movement along this fault (Haeussler et al., 2000). There have been two instrument-recorded earthquakes on the Castle Mountain fault zone, a M5.7 earthquake in 1984 and a M4.6 earthquake in 1996. An earthquake of approximately M7 that was likely associated with the Castle Mountain Fault also occurred in 1933. Research studies by the USGS (Haeussler et al., 2002) indicated that major earthquakes have occurred along this fault about every 700 years, on average, over the last 2,700 years, and that a major (M6 to M7) earthquake may occur on the fault in the next 50 to 100 years. A recent study indicates that there is potential for a M6.9 to M7.3 earthquake on the western segment of the fault, based on geologic findings relating to fault slip rates. The USGS has adopted a maximum earthquake magnitude of M7.1 for the Castle Mountain fault in the recently revised seismic hazard model (Wesson et al., 2007). The potential for earthquakes of similar magnitude may also exist along the Lake Clark fault. However, unlike the Castle Mountain fault, Haeussler and Waythomas (2011) have found no known evidence of movement along the currently mapped Lake Clark fault since the last glaciation (the Holocene epoch) and no evidence of historical seismicity during the last 1.8 million years, indicating that the Lake Clark fault is not active. The Lake Clark fault is now classified by the USGS as inactive. (Haeussler et al., 2011).

The findings of Haeussler and Saltus (2004) also imply the presence of another fault northwest and parallel to the Lake Clark fault and name it the Telaquana fault. The Mulchatna fault is farther north, trending parallel to the Lake Clark fault. The maximum potential magnitude for earthquakes generated on these two faults would likely be similar or smaller (in the range of M6 to M7) compared to the longer Lake Clark and Castle Mountain fault system.

The Bruin Bay fault runs northeast-southwest along the west shore of Cook Inlet starting from Mt. Susitna, near Anchorage, to the south shore of Becharof Lake. The fault is a major reverse (thrust) fault, dipping to the northwest and is predominantly buried under Quaternary deposits. It is thought to have been active during the late Jurassic period (around 150 million years ago) and again about 25 million years ago in the middle to late Tertiary. A source characterization study conducted by Woodland-Clyde Consultants in 1978 indicated that the Bruin Bay fault has experienced a small number of earthquakes, the largest of which was a M7.3 event in 1943 (Stevens and Craw, 2003).

The Border Ranges fault is a major, but currently inactive, north-northwest trending fault system that crosses the Kenai Peninsula and continues southwest through Afognak Island. The last movement on this fault occurred during the Cretaceous or early Tertiary, about 65 million years ago, producing a strike-slip system that can be traced as a continuous structure for over 400 miles, from southeast Alaska to south-central Alaska. The Border Ranges fault system consists of a 3 to 6-mile-wide zone of ductile shear zones and brittle faults, known as the Border Ranges shear zone. This fault system likely has the potential for generating future large earthquakes greater than M7.0.

The Kodiak Island and Narrow Cape faults are part of a series of northeast-trending strike-slip faults (subparallel to the megathrust subduction zone) that extend across southeastern Kodiak Island and into the northwestern Gulf of Alaska. The geomorphic expression of these faults suggests that displacement occurred during Holocene time. These faults are considered to be active and capable of producing earthquakes of up to M7.5 (Wesson et al., 2007).

6.6.3 Regional Volcanism

There are no active volcanoes located within the Bristol Bay drainages study area, but the study area could be affected by volcanoes located near Cook Inlet. Regional volcanism associated with the Cook Inlet volcanoes is presented in Chapter 30.

6.7 Summary

The study area for the geotechnical studies in the Bristol Bay drainages is limited to the vicinity of the mine study area. No geotechnical information has been collected in the transportation corridor study area to date. The geotechnical information presented here is based on site investigations completed in 2004 to 2008, which consisted of test pitting, drilling, piezometer/well installations, hydraulic conductivity testing, and geophysical investigations. The site investigations were completed to assess the subsurface conditions of the mine study area, including the rock mass characterization and classification of bedrock; the depth, composition and characteristics of overburden (surficial materials and organic soils); and the presence and movement of groundwater within these materials.

Alaska is the most seismically active state in the United States, with earthquakes generated by the Pacific plate subducting under the North American plate. Historically, the level of seismic activity is highest offshore along the south coast of Alaska where the Pacific (oceanic) plate is subducting under the North American plate at an average rate of approximately 2 to 3 inches per year. Several moderate to large magnitude intraplate subduction earthquakes have been recorded over the last century. There is potential for future large magnitude (M8 to M9+) interplate subduction earthquakes and (M7+) intraplate subduction earthquakes in the region. The western end of the northeast-southwest trending Lake Clark-Castle Mountain Fault system is located east of the mine study area at the end of Lake Clark. The Castle Mountain Fault system is capable of generating large earthquakes with magnitudes in the range of 7 that could affect the Bristol Bay drainages study area. The Lake Clark fault is considered inactive by the USGS. The seismic hazard associated with crustal faults in the mine study area is not considered to be significant as the ground accelerations generated by earthquakes decrease the farther the distance from the epicenter.

6.8 References

Bieniawski, Z.T. 1989. Engineering Rock Mass Classifications. John Wiley and Sons, New York.

Detterman, R.L., and B.L. Reed. 1973. Surficial Geology of the Iliamna Quadrangle, Alaska. U.S. Department of the Interior. Geological Survey Bulletin # 1368-A.

Haeussler, P.J. 2007. U.S. Geological Survey, Anchorage, Alaska. Personal communication by email with Graham Greenaway, P.E., of Knight Piésold Ltd.

Haeussler, P.J., T.C. Best, and C.F. Waythomas. 2002. "Paleoseismology at High Latitudes: Seismic Disturbance of Upper Quaternary Deposits along the Castle Mountain Fault near Houston, Alaska." Geological Survey of America Bulletin; Vol. 114, Issue 10, Pp.1,296-1,310.

Haeussler, P.J., R.L. Bruhn, and T.L. Pratt. 2000. "Potential Seismic Hazard and Tectonics of the Upper Cook Inlet Basin, Alaska, Based on Analysis of Pliocene and Younger Deformation." Geological Survey of America Bulletin, Vol. 112, Issue 9, Pp. 1,414-1,429.

Haeussler, P.J., and R.W. Saltus. 2004. 26 Kilometers of Offset on the Lake Clark Fault since Late Eocene Time. U.S. Geological Survey, Professional Paper 1709-A.

Haeussler, P.J., and C.F. Waythomas. 2011. "Review of the Origin of the Braid Scarp near the Pebble Prospect, Southwestern Alaska. U.S. Geological Survey Open File Report 2011-1028.

Hamilton, T.D., and R.F. Klieforth. 2010. Surficial geologic map of parts of the Iliamna D-6 and D-7 quadrangles, Pebble Project area, southwestern Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2009-4, 19 p., 1 sheet, scale 1:50,000. (reproduced with permission from David Szumigala, Apr. 21, 2010).

Hoek, E., P.K. Kaiser, and W.F. Bawden. 1995. Support of Underground Excavations in Hard Rock. Taylor & Francis.

Knight Piésold Ltd. (KP). 2009. Pebble Project — 2008 Geotechnical Site Investigation Data Report. 3 Volumes. Ref. No. VA101-176/23-4. October.

———. 2008a. Pebble Project — 2007 Geotechnical Site Investigation Data Report. Ref. No. VA101-176/20-4. November.

———. 2008b. Pebble Project — 2006 Geotechnical Site Investigation Data Report. 2 Volumes. Ref. No. VA101-176/8-9. March.

———. 2008c. Pebble Project — Report on Seismicity Assessment (unpublished draft report). Ref. No. VA101-176/20-1. November.

———. 2007. Pebble Project — 2005 Geotechnical Site Investigation Data Report. Ref. No. VA101-176/8-6. March.

———. 2005a. Pebble Project—2005 Open Pit Geotechnical Investigations. Ref. No. VA101-176/8-5. December.

———. 2005b. Pebble Project — Geotechnical Site Investigation Data Report. 2 Volumes. Ref. No. VA101-176/8-3. March.

———. 2005c. Pebble Project—2004 Open Pit Geotechnical Investigations. Ref. No. VA101-176/8-2. January.

SRK Consulting (SRK). 2009. Pebble Project 2008 Geotechnical Data Acquisition Program – Pebble East Zone – Data Report. October.

———. 2008. Pebble Project 2007 Geotechnical Data Acquisition Program – Pebble East Zone – Data Report. March.

———. 2007. Pebble Project Preliminary Geotechnical Evaluation of the East Zone – 2006 Interim Report. August.

Stevens, D.S.P., and P.A. Craw. 2003. Geologic Hazards in and near the Northern Portion of the Bristol Bay Basin. Misc. Publication 132, State of Alaska, Department of Natural Resources, Alaska Division of Geological and Geophysical Surveys. December.

Terzaghi, K., and R.B. Peck. 1967. Soil Mechanics in Engineering Practice, 2nd Edition. John Wiley and Sons, New York.

Wesson, R.L., O.S. Boyd, C.S. Mueller, C.G. Bufe, A.D. Frankel, and M.D. Petersen. 2007. Revision of Time-Independent Probabilistic Seismic Hazard Maps for Alaska, U.S. Geological Survey Open-File Report 2007-1043.

6.9 Glossary

Aeromagnetic survey—a geophysical survey of the earth’s magnetic field carried out using a magnetometer either onboard or towed behind an aircraft in a grid-like pattern.

Alluvium— sediment and detritus transported by a stream or river and deposited as the river floodplain.

Alpha angle—the maximum dip vector of a fracture plane with respect to the core axis.

Andesite—a type of fine-grained volcanic rock.

Annulus—the space between the drill string and sides of the drillhole or surface casing.

Aperture—measurement of the size of the opening on a fracture surface that would allow water to pass through.

Asthenosphere—A zone of the earth's mantle that lies beneath the lithosphere and consists of several hundred kilometers of deformable rock.

Atterberg limits—series of thresholds which are observed when the water content of a soil is steadily changed.

Azimuth—the angle measured between a reference vector and the plane of the meridian, measured clockwise to 360 degrees.

Basalt—a dark-colored, fine-grained, extrusive igneous rock containing no more than 53 percent by weight of quartz.

Batholith—a large (more than 100 square kilometers) igneous intrusion; most are granitic in composition, and their genesis is linked with plate tectonics; batholiths are generally discordant with the surrounding rocks.

Bedding—layering of sheet like units, called beds or strata.

Bentonite—montmorillonite rich clay formed by the breakdown and alteration of volcanic ash and volcanic tuffs.

Beta angle—the angle between the maximum dip vector of a fracture plane with respect to a core reference line in a clockwise direction.

Breccia—a coarse, clastic sedimentary or volcanosedimentary rock with angular constituent clasts.

Brittle behavior—the manner in which competent rocks lose their internal cohesion along certain surfaces when the elastic limit is exceeded under an applied stress, gives rise to fractures, faults or joints.

Clast—fragment of sediment or rock that was formed by the deterioration of larger rocks.

Clastic—sediment composed of fragments of pre-existing rocks.

Colluvium—material transported by gravity, typically deposited and accumulated on lower slopes and/or at the base of slopes.

Competent—a measure of the amount of intact rock and the strength of the rock in a rock mass.

Completion zone—the zone of filter sand surrounding the screened section of a piezometer.

Cretaceous—approximately 145.6 to 65 million years ago, the third of the three periods included in the Mesozoic Era.

Crustal—term applied to the thin outermost solid layer of the earth.

Dacite—a light colored, fine-grained, igneous rock containing 63 to 70 weight percent of silicon dioxide.

Dike—discordant or cross cutting, tabular intrusion, most are vertical or near vertical, having pushed their way through the overlying rock.

Diorite—an intermediate, coarse-grained igneous rock with up to 10 percent quartz.

Discontinuity—a boundary or layer marked by substantial change or break in sedimentation, or a joint (fracture), vein, etc., in rock mechanics.

Ductile behavior—response to stress where permanent deformation occurs without fracturing.

Epicenter—the point on the earth’s surface immediately overlying an earthquake focus.

Fault slip rate—the rate of relative displacement that occurs between the blocks along a fault zone.

Felsenmeer—coarse, angular, frost-shattered rock debris in environments that are or were formerly at the immediate margins of glaciers.

Flexure—the lateral deflection from a datum line of a planar feature as it is shortened.

Fluvial—term applied to material transported by moving water, typically deposited in a stream channel, along a stream bank, or on a floodplain.

Gabbro—a type of coarse-grained, basic igneous rock that results from slow crystallization of basaltic magmas.

Geological cross-section—a diagram which displays a vertical section of the earth's subsurface.

Geological strength index—an estimate of the average strength of a rock mass taking lithology, structure, and discontinuity surface conditions into consideration.

Geomorphology—the scientific study of the landforms on the earth's surface and of the processes that have fashioned them.

Geophone—a rugged device employed during seismic surveys to measure ground displacement by detecting the arrival of seismic waves by transforming the ground motion into an electric voltage.

Geotechnical— of or pertaining to practical applications of geological science in civil engineering, mining, etc.

Glacial wasting—erosion and/or melting of glacier ice.

Glacial drift— any sediment laid down by, or in association with, glacial ice activity.

Glacial outwash—the stratified sands and gravels deposited at or near ice margins.

Glacial till—collective term for the group of sediments laid down by the direct action of glacial ice without the intervention of water.

Glaciofluvial sediments—material transported and deposited by meltwater streams flowing from glaciers.

Glaciolacustrine—term for materials produced by or involving a lake which received meltwater from glacial ice.

Granodiorite—a type of coarse-grained igneous rock.

Heaving sand—term for sand that pushes up inside the drill string during drilling because of greater pressure conditions within the formation outside the drill string than those pressures inside the drill string.

Holocene—epoch that covers the last 10,000 years, often referred to as Recent or post-glacial.

Hydraulic conductivity—a measurement of the flow rate of water, by volume, through a cross-sectional unit of a porous subsurface medium.

Hydrogeology—the study of the occurrence and movement of groundwater and its effects on earth materials.

Hydrometer—a device used to measure specific gravity or relative density of a liquid.

Igneous rocks—rocks or minerals that were formed when molten material (magma) solidified; one of three main classifications of rock.

Interplate—relating to or occurring between two tectonic plates.

Intraplate—relating to or occurring within the interior of a tectonic plate.

Intrusive—applied to a body of rock, usually igneous, that is intrudes into pre-existing rocks; intrusions are classified according to size, shape, and geometrical relationship to the surrounding rock.

Jurassic—from 208 to 145.6 million years ago, the Mesozoic period following the Triassic and preceding the Cretaceous.

Kettle depression—a depression that forms in the surface of glacial sediment as a result of the melting of an included ice mass; a depression may fill with water, forming a small lake.

Latite—a type of porphyritic extrusive igneous rock.

Lithology—physical characteristics of a rock such as color and texture.

Lithosphere—the outermost layer of the solid earth, comprising all crustal rocks and the brittle part of the uppermost mantle.

Magnitude—the magnitude of an earthquake based on the amplitude of seismic waves.

Mantle—the zone lying between the earth’s crust and core.

Monzodiorite—a type of coarse-grained igneous rock.

Monzonite—a type of coarse-grained igneous rock.

Moraine—an accumulation of material that has been transported on the surface of ice, within ice, or beneath ice.

Oriented drilling—drilling of a hole with a known azimuth and inclination in order to collect orientation measurements of the discontinuities in the rock mass.

Outcrop—exposed bedrock.

Overburden—the material that lies above the bedrock.

Oxbow—a crescent-shaped body of water formed when a wide meander from the main stream of a river is cut off to create a lake.

Packer or Lugeon test—a pressure test of a sealed zone, used to determine hydraulic conductivity.

Paleochannel—unconsolidated sediments deposited in ancient currently inactive river or stream bed.

Permeability—the ability of a rock, sediment, or soil to permit fluids to flow through it.

Persistence—the continuation of a discontinuity beyond the limits of the drill core.

Physiography—the study of the physical features of the earth's surface.

Piezometer—an observation or monitoring well designed to measure the hydraulic head of the groundwater at a particular depth below the ground.

Piezometric level—the elevation representing the static hydraulic head of groundwater at a site.

Plate—a segment of the lithosphere with little volcanic or seismic activity that is bounded by continuous belts of earthquakes and volcanic activity.

Pleistocene—from 1.64 million years ago to about 10,000 years ago, the first of two epochs of the Quaternary sub-era.

Plutonic—a loosely defined term to describe igneous rock bodies which have crystallized at great depth, or to describe a large intrusion, also used to describe the origin of magmas and gas derived from near the base of the crust or in the upper mantle.

Porphyry—medium-grained rock containing large, well-formed grains of any mineral.

Pyroxenite—a type of igneous rock with a silica content of less than about 45 percent.

Quaternary—a sub-era of the Cenozoic Era that covers the past 1.64 million years and comprises the Pleistocene and Holocene epochs.

Relict—used to describe a feature that has persisted through time.

Response test—a particular type of aquifer test where water is quickly added or removed from a piezometer, and the change in hydraulic head is monitored through time, to determine the near-well aquifer characteristics.

Reverse fault—a low-angle fault in which the relative displacement of the hanging wall is upwards; thrust faults are a type of reverse fault.

Rhyolite—a type of fine-grained extrusive igneous rock.

Rock mass rating system (RMR89)—system developed by Bieniawski to classify a rock mass.

Rock quality designation (RQD)—core recovery percentage which incorporates only solid core pieces that are greater than four inches in length.

Seismicity—the frequency or magnitude of earthquake activity in a given area.

Seismic refraction—a geophysical survey method that uses the refraction of seismic waves on soil and rock units to characterize subsurface geologic conditions and structure.

Seismograph—a device which records seismic information.

Shear zone—a narrow region in which rocks have undergone intense deformation.

Shot point—the point from which a source of seismic shock waves is produced for experimental purposes.

Slough—material that sheds from the sides of an excavation and falls down to the bottom of the hole.

Solifluction—the slow creeping of fragmented material down a slope as a result of the alternate freezing and thawing of the water contained in the material.

Splay—one of a series of branching faults near the termination of a major fault which spread the displacement over a large area.

Spoil pile—earth and rock removed when excavating.

Standard penetration test—an in situ dynamic penetration test designed to provide data regarding soil properties.

Static equilibrium—the point at which the water level becomes static during a response test.

Strata—lithological term applied to materials that form layers or beds.

Strike—the compass direction of a horizontal line on an inclined plane.

Strike-slip fault—also known as a transverse fault, a fault where the major displacement is horizontal and parallel to the strike of a vertical or subvertical fault plane.

Stock—an igneous intrusion, approximately circular in plan with steep contacts to the country rock and a surface area of 20 square kilometers or less.

Subduction—the action of a tectonic plate descending below another plate at a convergent margin.

Tertiary— from 65 million years ago until 1.64 million years ago, the first sub-era of the Cenozoic Era; the Tertiary comprises five epochs: Paleocene, Eocene, Oligocene, Miocene, and Pliocene.

Test pit—a shallow excavation dug either by hand or a mechanical device to observe and sample shallow subsurface materials.

Thrust fault—a low-angle (commonly less than 45 degrees) reverse fault where the hanging wall overhangs the footwall.

Transverse fault—also known as a strike-slip fault, a fault where the major displacement is horizontal and parallel to the strike of a vertical or subvertical fault plane.

Triconed—drilling that is completed with a tricone bit.

Unconfined compressive strength—the strength of a rock or soil sample when crushed in one direction (uniaxial) without lateral restraint.

Vibrating wire piezometer—a piezometer that converts water pressure to a frequency signal via a diaphragm, a tensioned steel wire, and an electromagnetic coil. The piezometer is designed so that a change in pressure on the diaphragm causes a change in tension of the wire. When excited by the electromagnetic coil, the wire vibrates at its natural frequency. The vibration of the wire in the proximity of the coil generates a frequency signal that is transmitted to a readout device.

Volcaniclastic—a sedimentary rock composed of pre-existing fragments, particles or clasts of volcanic origin.

Wacke—a sandstone which contains between 15 and 75 percent mud matrix.

Weathering—the breakdown of rocks and minerals at and below the earth's surface by the action of physical and chemical processes.

FIGURES

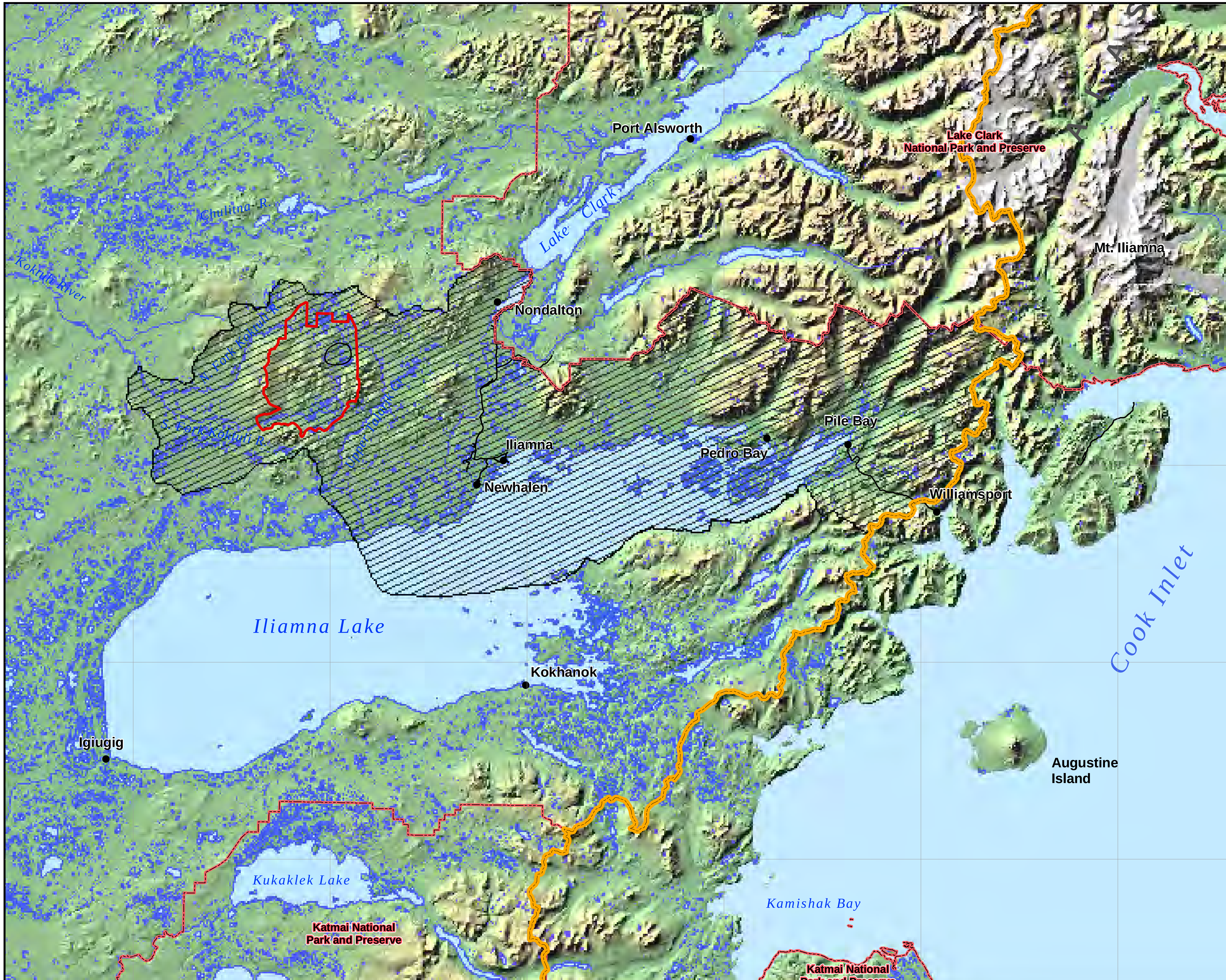

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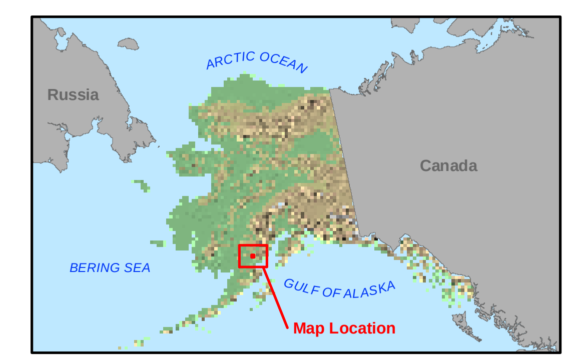
Figure 6-1
Geotechnical, Seismicity, and Volcanism Study Area
Bristol Bay Drainages

Legend

- General Deposit Location
- Bristol Bay Study Area
- Geotechnical Study Area
- Population Centers
- National Park and Preserve Boundary
- BB / CI Drainages Boundary
- Existing Roads

Notes

1. BB/CI refers to Bristol Bay/Cook Inlet drainages.



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Kilometers: 5 0 5 10 15 20 25

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Scale 1:600,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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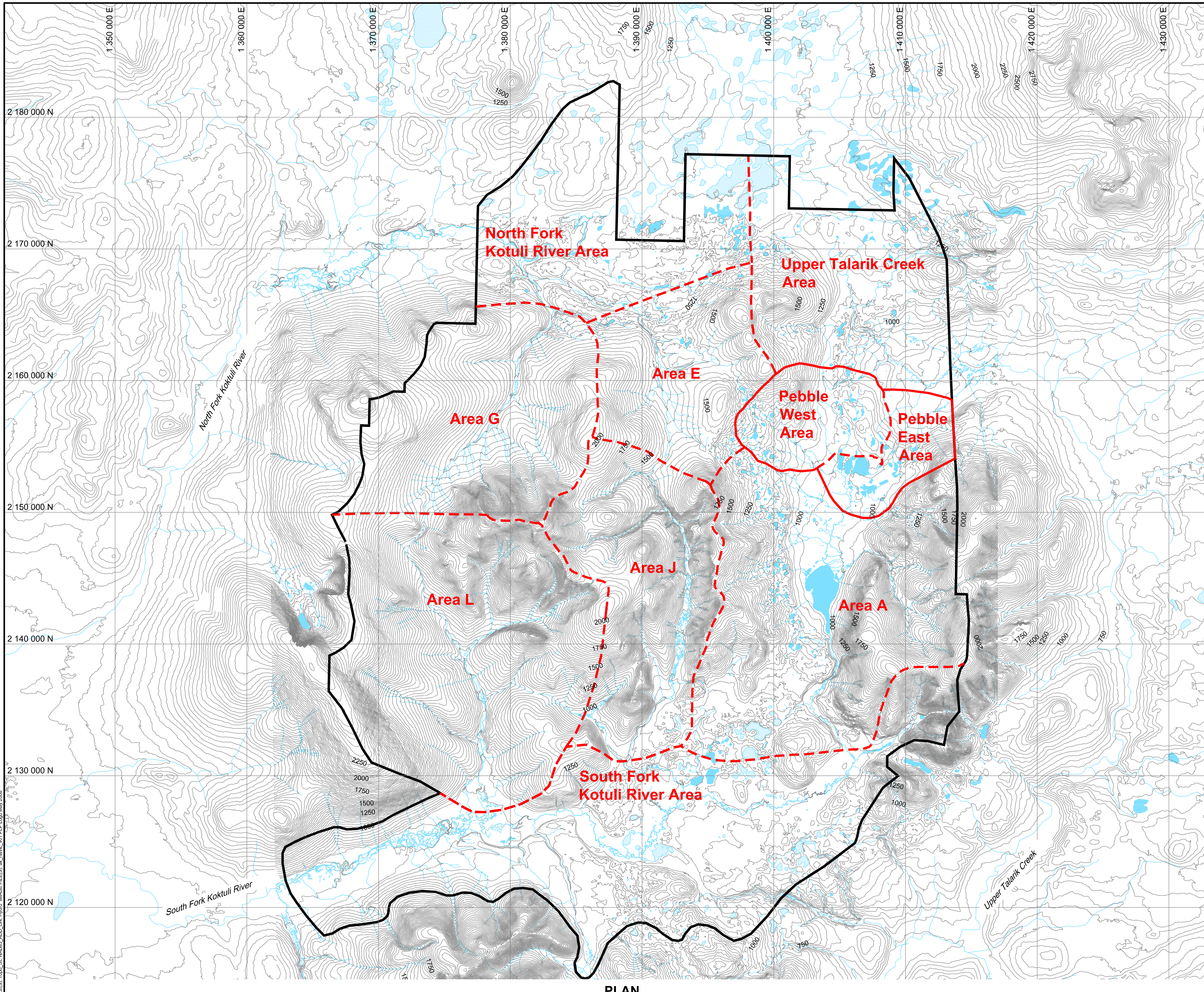

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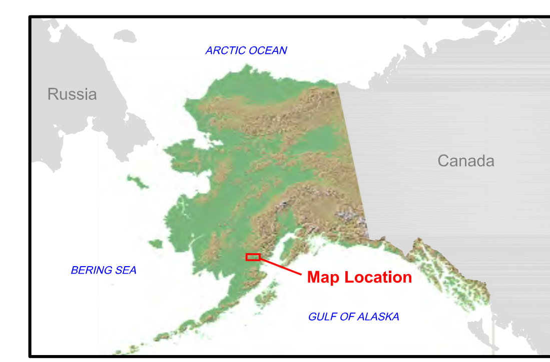
Figure 6-2a
Mine Study Area and 10 Reference Areas

Legend

- Mine Study Area Boundary
- Reference Area Boundaries
- General Deposit Location

Notes

The reference areas defined in this figure are based on KP, 2009.



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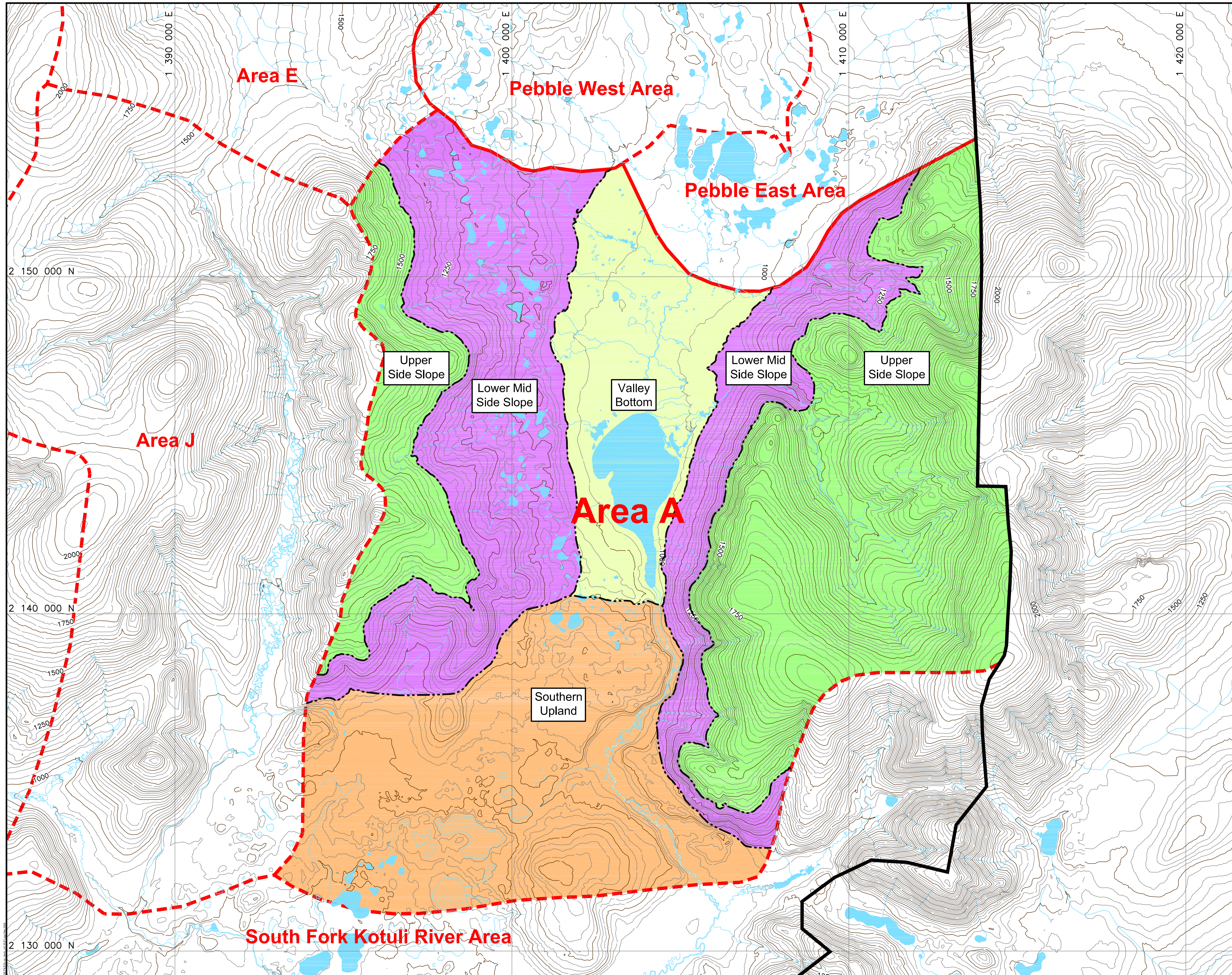

PLAN

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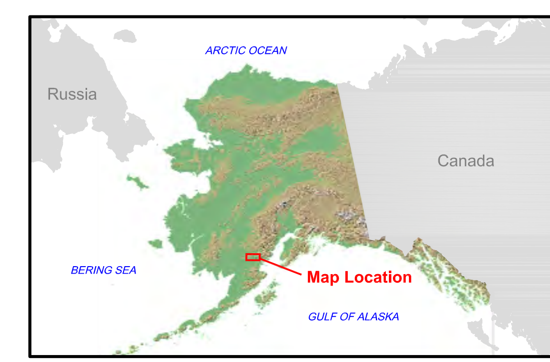
Figure 6-2b
Four Geomorphic Subareas of Reference Area A Mine Study Area

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- Boundary of Sub Areas within Area A
- General Deposit Location
- Valley Bottom
- Lower Mid Side Slopes
- Upper Side Slopes
- Southern Upland

Notes

The reference areas in this figure are based on KP, 2009.



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Alaska State Plane Zone 5 (units feet)
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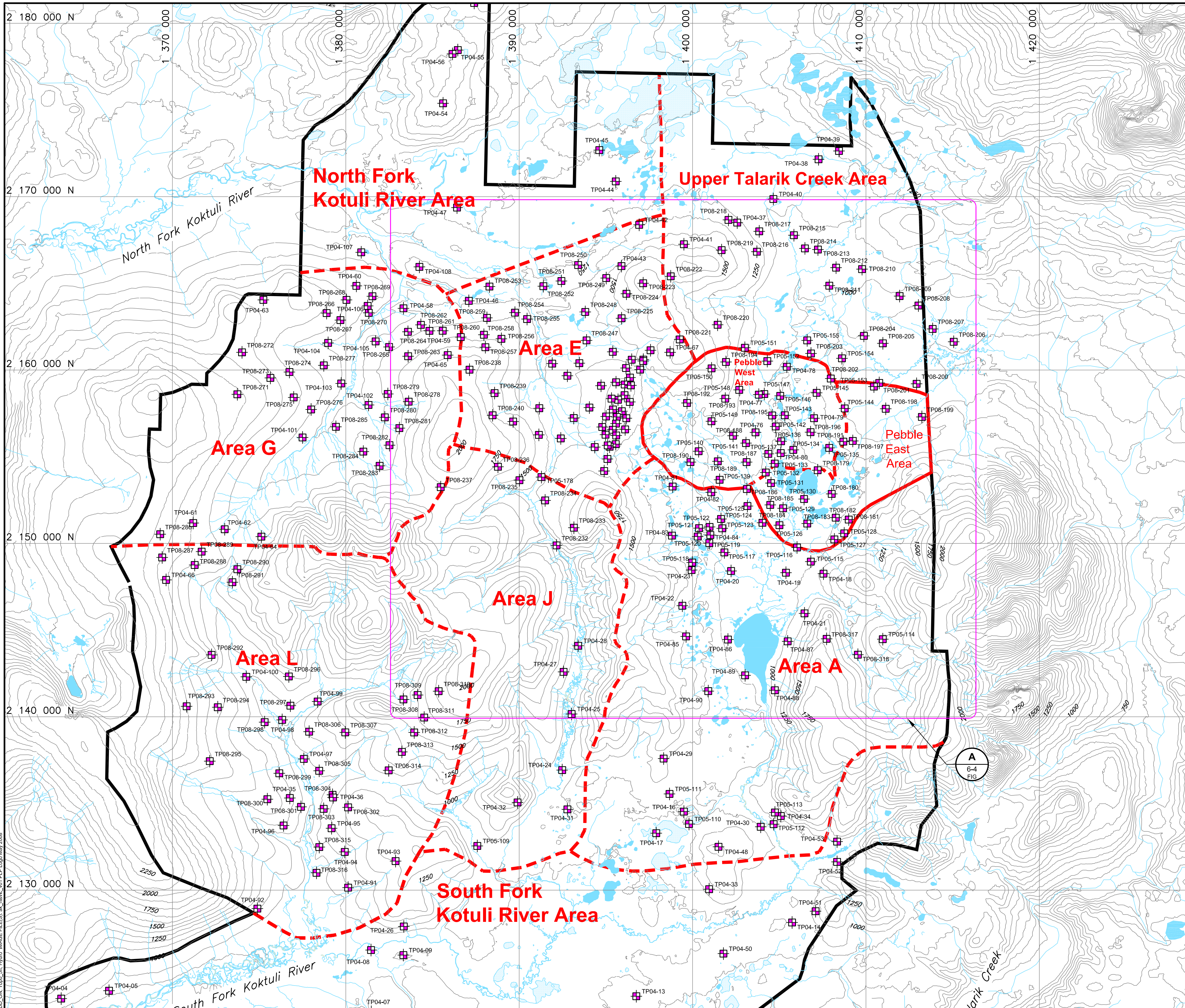

Figure 6-3
Test Pit Locations
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- Test Pit

Notes

1. See Figure 6-4 for Detail.

Meter: 500 0 500 1000 1500 2000 2500
Feet: 2000 0 2000 4000 6000 8000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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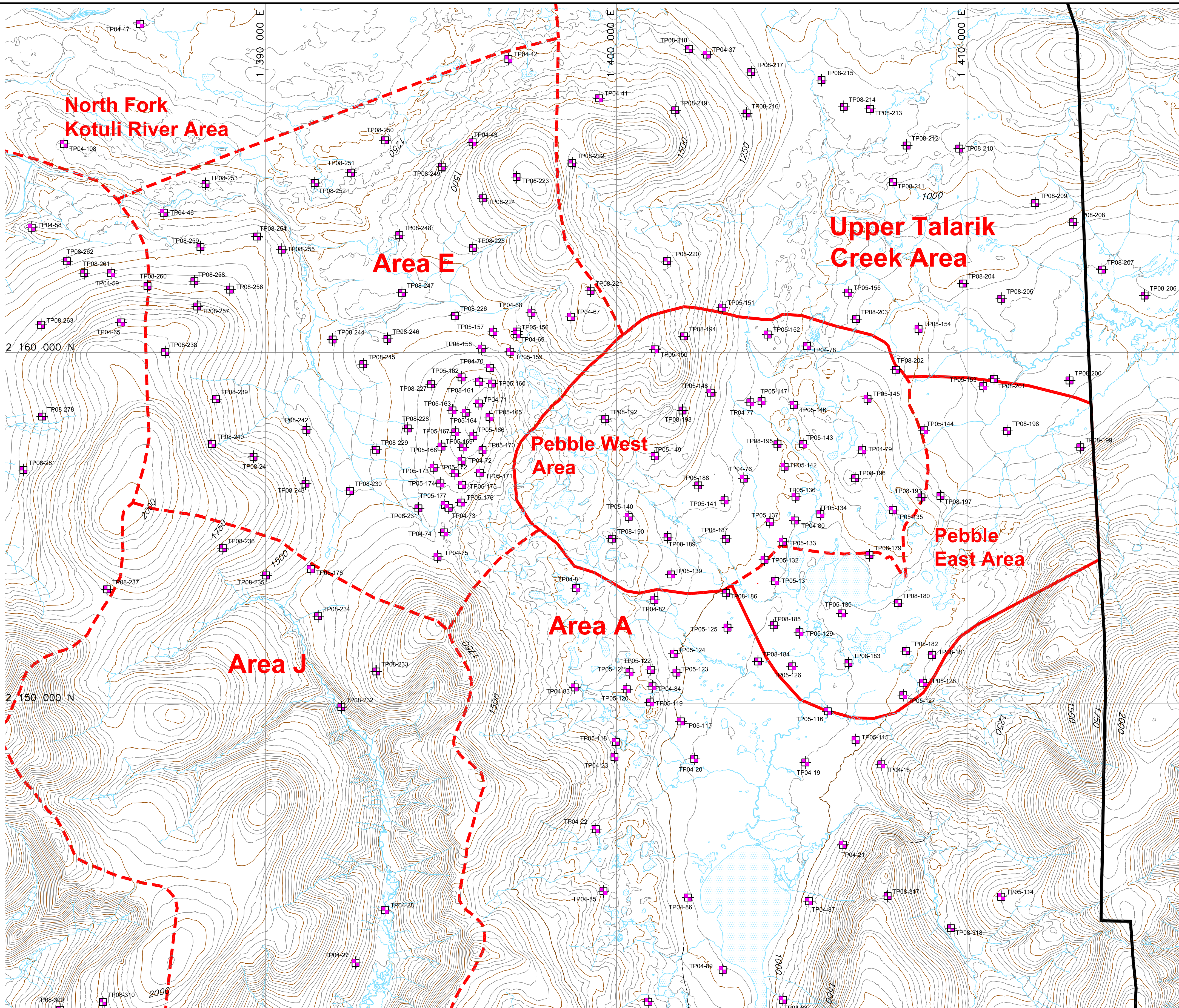
Version: 2008-1	Author: Knight Piesold Ltd.



A DETAIL 6-3 FIG

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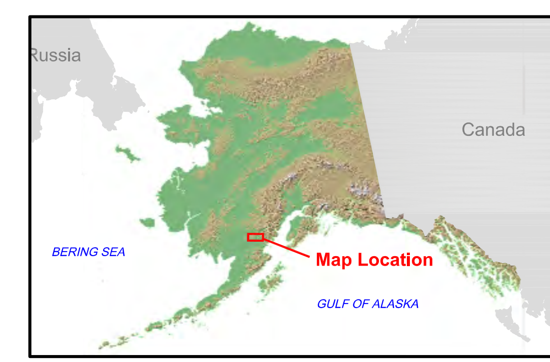
Figure 6-4
Detail Test Pit Locations
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- Test Pit

Notes

1. See Figure 6-3 for Detail Inset Location.



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1000 0 1000 2000 3000 4000 Feet
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Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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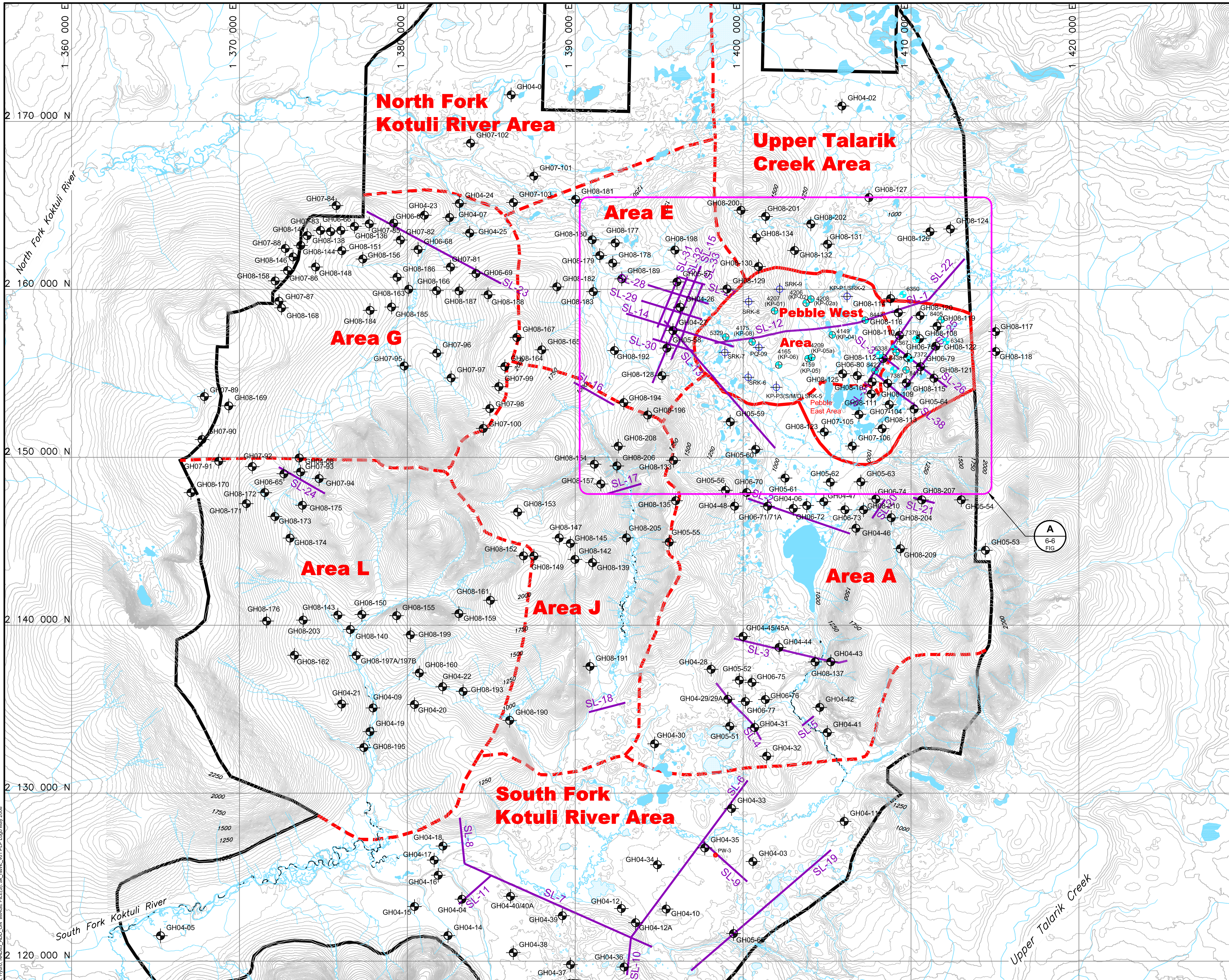

THE pebble PARTNERSHIP

Figure 6-5
Geotechnical Drillhole
and Seismic Line Locations
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH07-94 2004 to 2008 Geotechnical Drillholes
- 4206 (KP-02) Oriented Geotechnical Drillhole
- SL-17 Seismic Line
- SKK-1 Other Geotechnical Drillhole

Notes

1. See Figure 6-6 for Detail.

Meter: 500 0 500 1000 1500 2000 2500
Feet: 2000 0 2000 4000 6000 8000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: B04.dwg	Date: October 15, 2010
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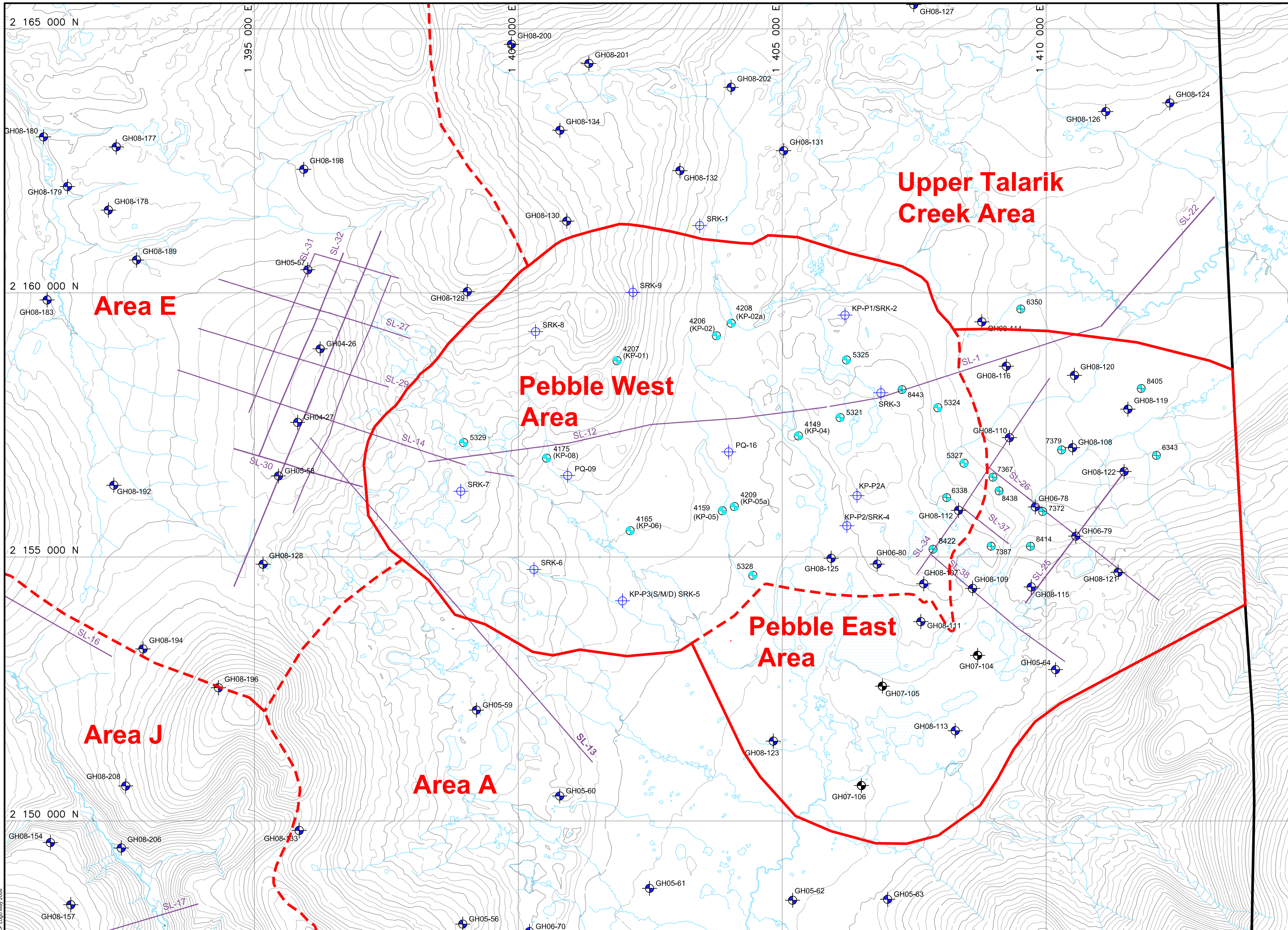


A
6-5
FIG
DETAIL

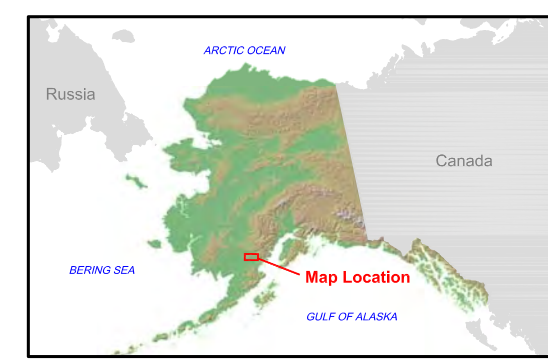
Figure 6-6
Detail Geotechnical Drillhole and Seismic Line Locations
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH08-119 — 2004 to 2008 Geotechnical Drillholes
- 4207 (KP-01) — Oriented Geotechnical Drillhole
- SL-1 — Seismic Line
- SRK-1 — Other Geotechnical Drillhole

Notes

1. See Figure 6-5 for Detail Inset Location



Meter: 200 0 200 400 600 800 1000
Feet: 1000 0 1000 2000 3000
N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: B05.dwg	Date: September 14, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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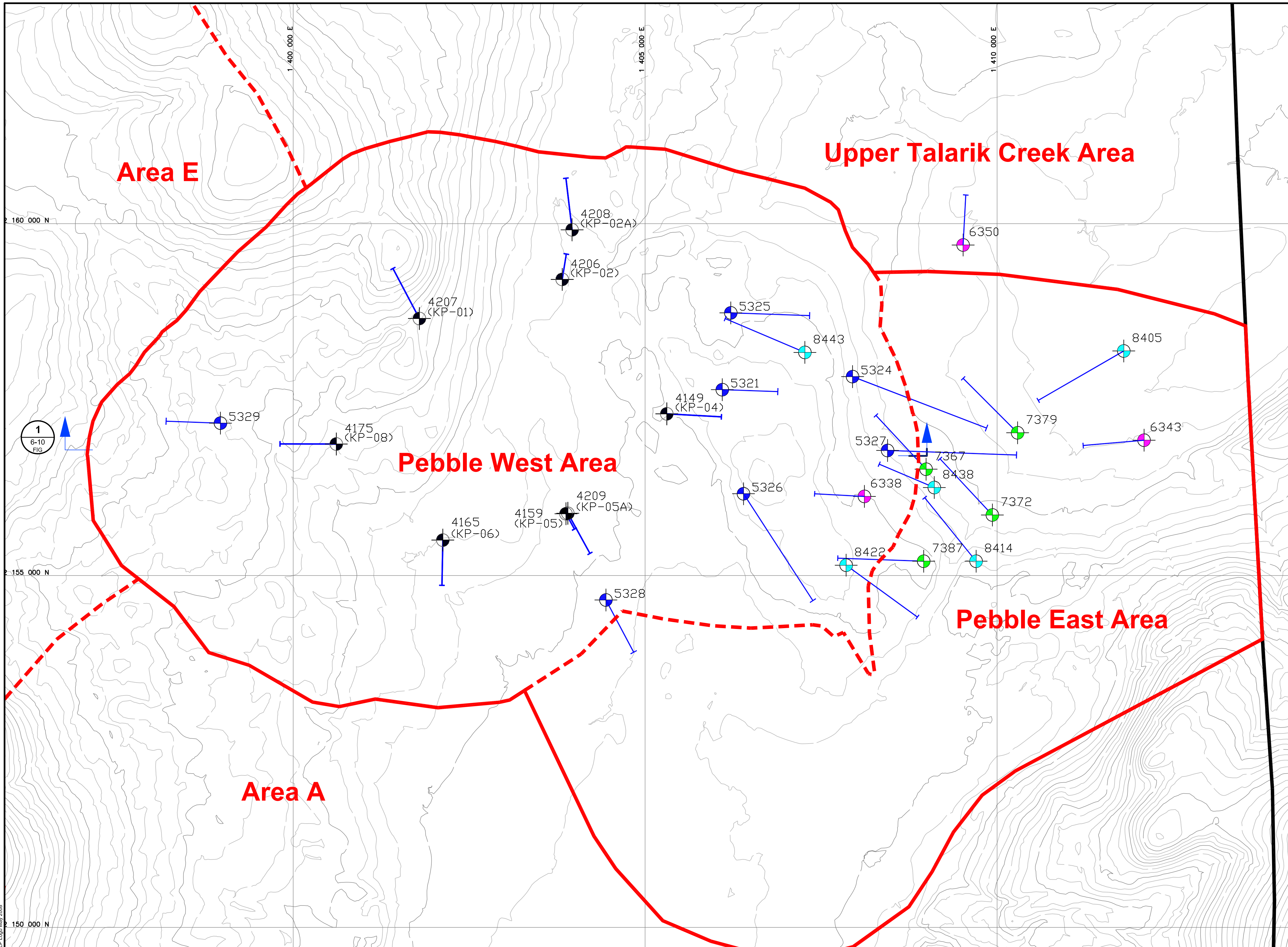
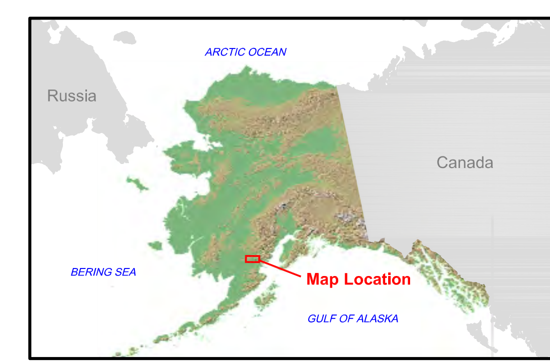
Figure 6-7
Oriented Geotechnical Drillhole Locations
General Deposit Location



Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- 4207 (KP-01) 2004 Oriented Geotechnical Drillholes
- 5324 2005 Oriented Geotechnical Drillholes
- 6350 2006 Oriented Geotechnical Drillholes
- 7379 2007 Oriented Geotechnical Drillholes
- 8405 2008 Oriented Geotechnical Drillholes
- 1 6-10 FIG Location and Direction of Geological Section.



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Feet: 500 0 500 1000 1500 2000 2500
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1983 North American Datum

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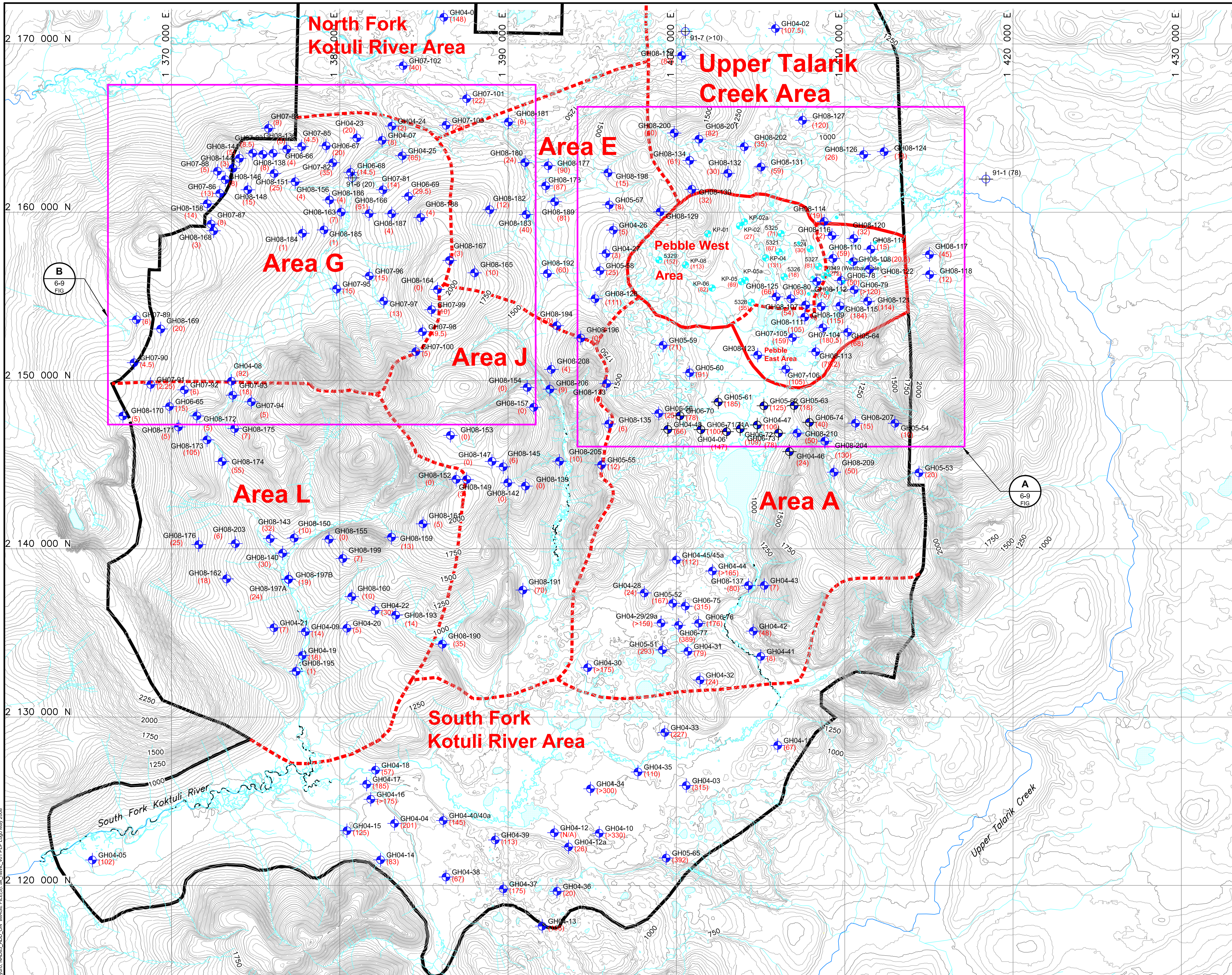
Version: 2008-1	Author: Knight Piesold Ltd.



PLAN

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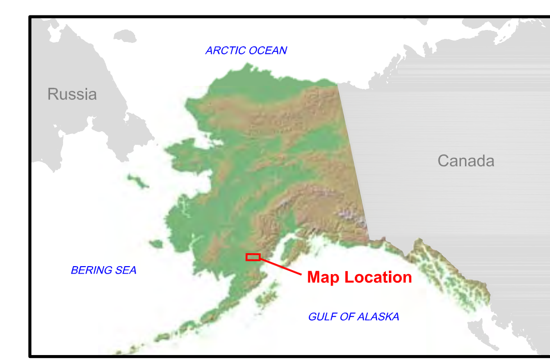
Figure 6-8
Geotechnical Drillholes Depth to Bedrock Mine Study Area 2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH04-1 (10) — 2004 to 2008 Geotechnical Drillhole
- 4165 (KP-06) (82) — Oriented Geotechnical Drillhole

Notes

1. Numbers in parentheses denote the depth of the overburden in feet.
2. See Figure 6-9 for Detail



Meter: 500 0 500 1000 1500 2000 2500 3000

Feet: 2000 0 2000 4000 6000 8000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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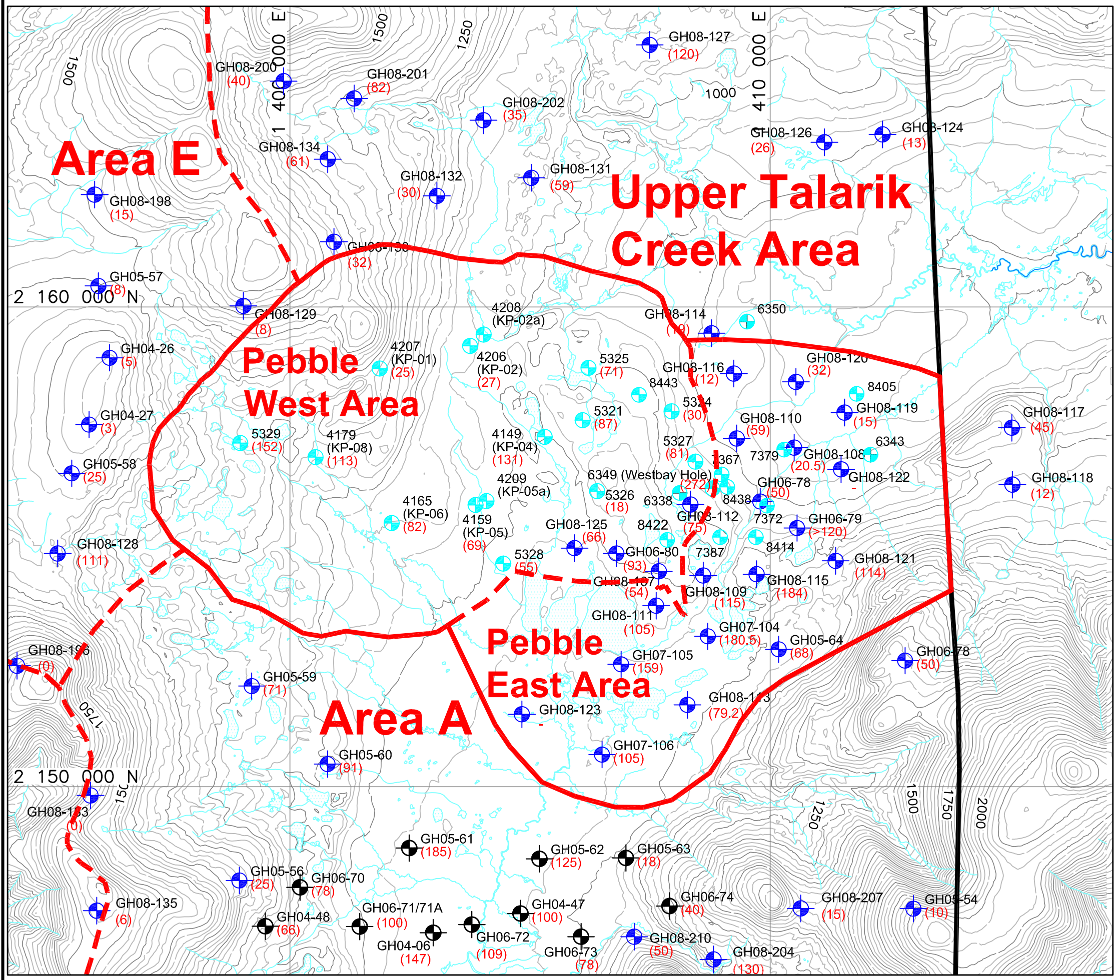
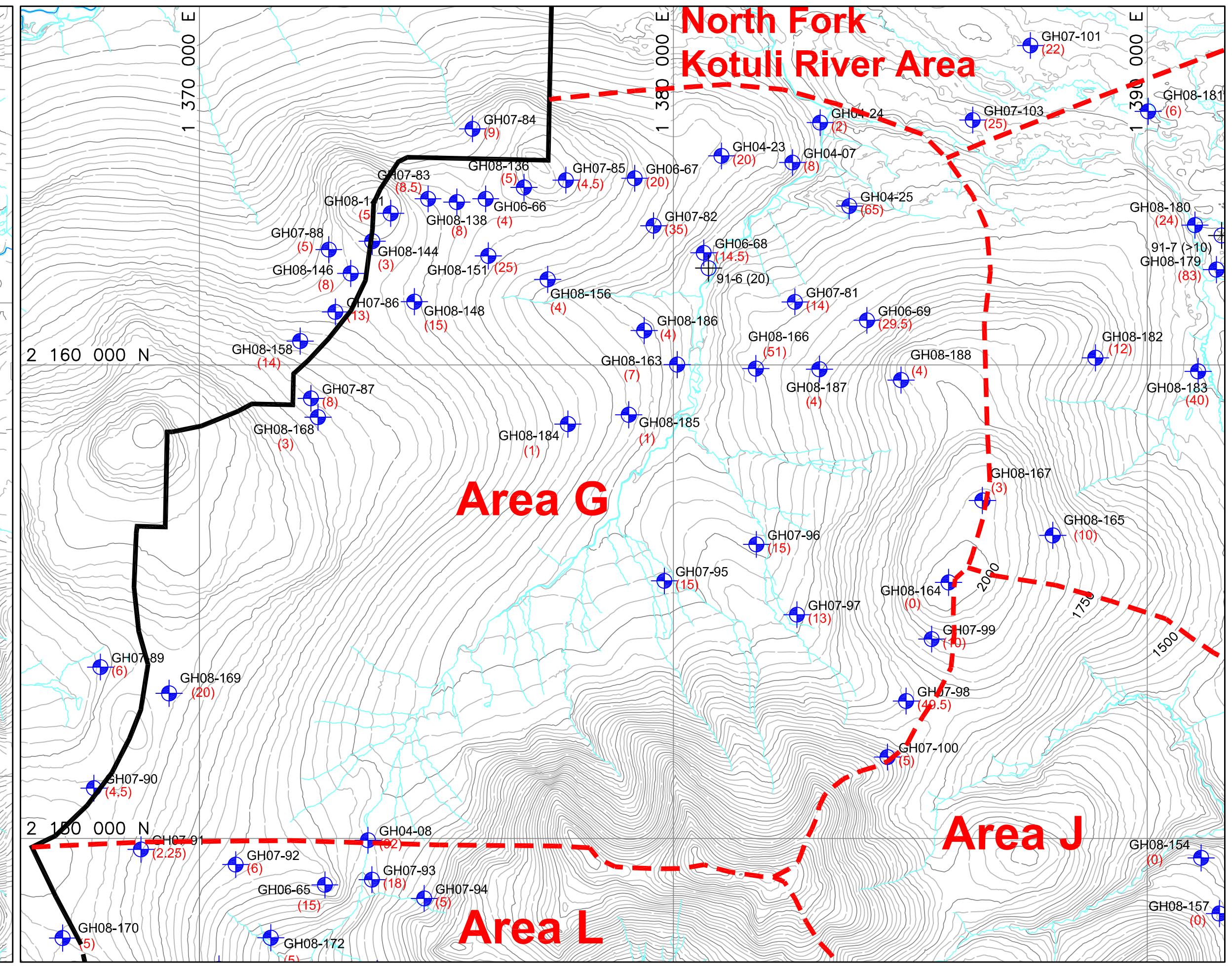
Version: 2008-1	Author: Knight Piesold Ltd.



A DETAIL 6-8 FIG



B DETAIL 6-8 FIG

THE pebble PARTNERSHIP

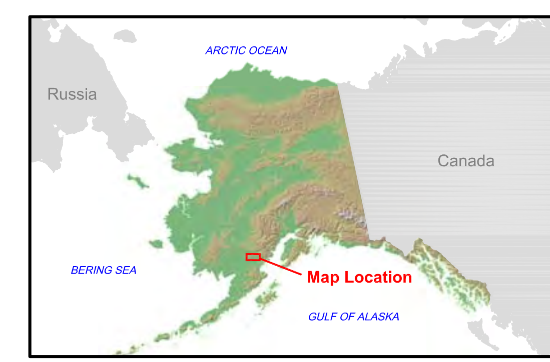
Figure 6-9
Detail Geotechnical Drillholes
Depth to Bedrock
Mine Study Area
2004 - 2008

Legend

- Nine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH04-1 (10) 2004 to 2008 Geotechnical Drillhole
- 5321 (82) Oriented Geotechnical Drillhole.

Notes

1. Numbers in parentheses denote the depth of the overburden in feet.
2. See Figure 6-8 for Detail inset location.



Meter: 500 0 500 1000 2000 2000

Feet: 2000 0 2000 4000 6000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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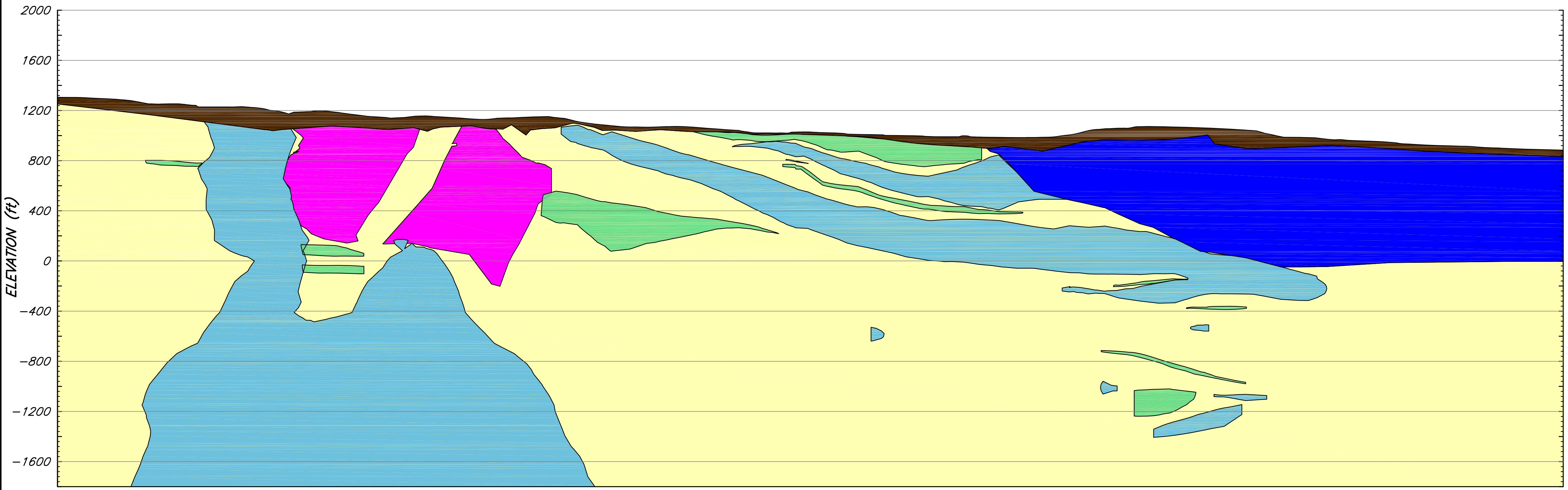
Version: 2008-1	Author: Knight Piesold Ltd.

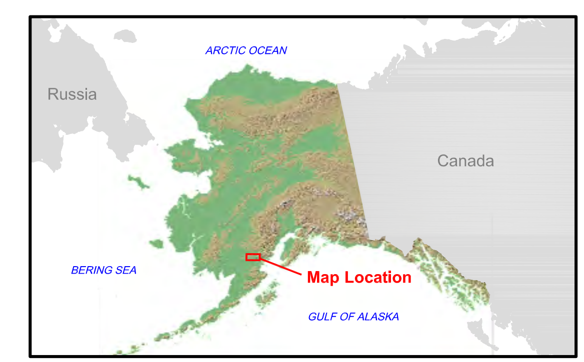


1 6-7 FIG **SECTION**

Figure 6-10
Geologic Cross Section
Pebble West Area

Legend

- Overburden
- Tertiary Sediments
- Megabreccia (Intrusives)
- Granodiorite (Intrusives)
- Diorite
- Extrusives



Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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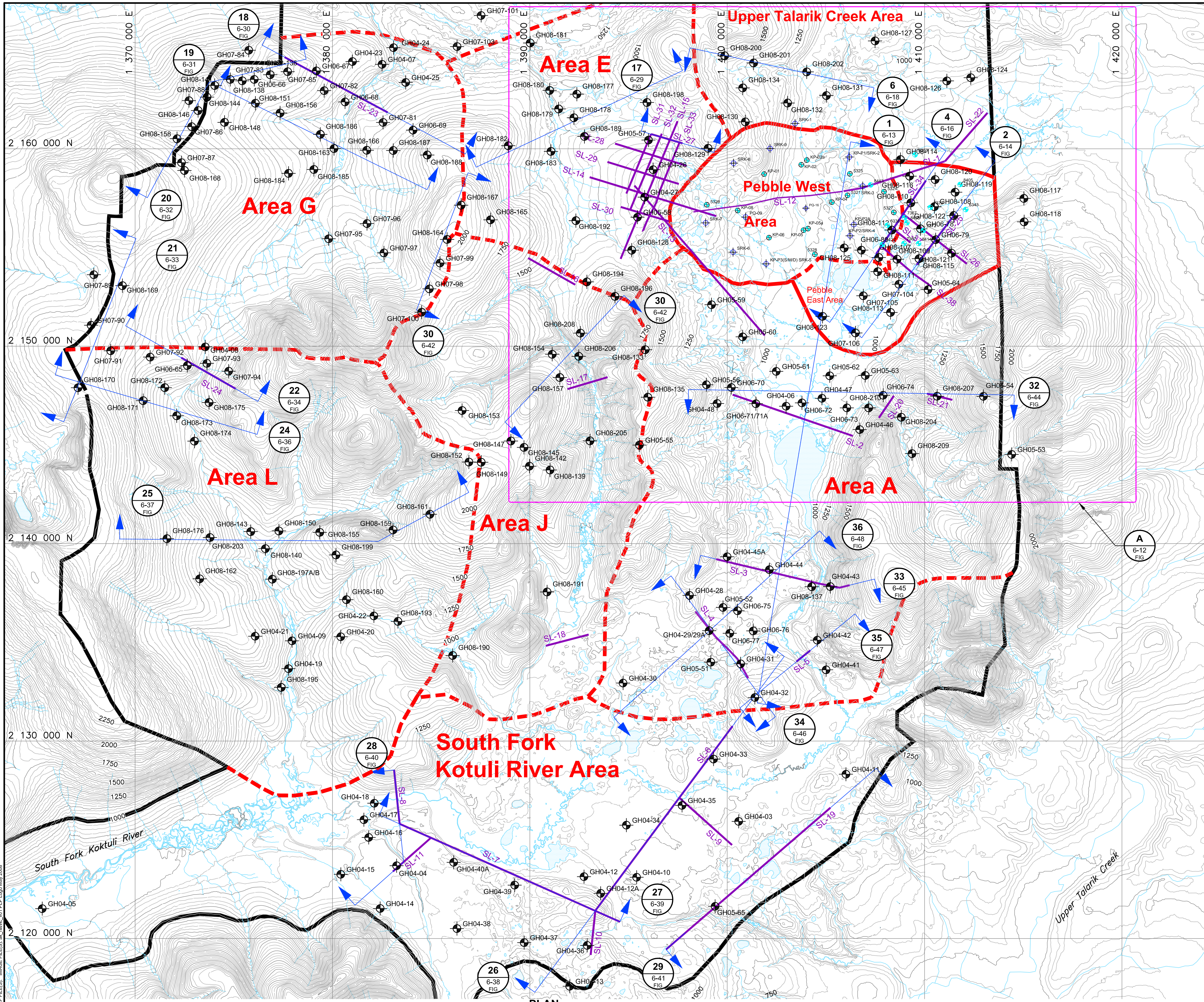


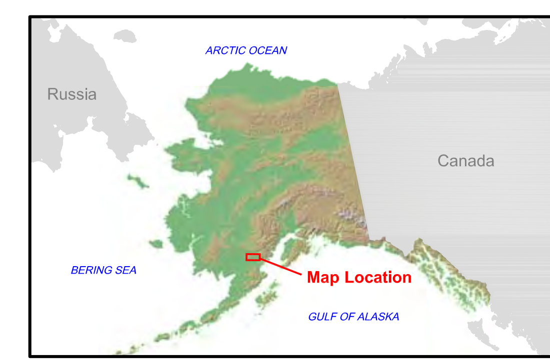
Figure 6-11
Geologic Section Plan
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH04-1 — 2004 to 2008 Geotechnical Drillholes
- 5321 — Oriented Geotechnical Drillhole
- SL-1 — Seismic Line
- SRK-1 — Other Geotechnical Drillhole
- 32 6-44 FIG — Location and Direction of Geological Sections

Notes

1. See Figure 6-12 for Detail.



Meter: 500 0 500 1000 1500 2000 2500
Feet: 2000 0 2000 4000 6000 8000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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Version: 2008-1	Author: Knight Piesold Ltd.

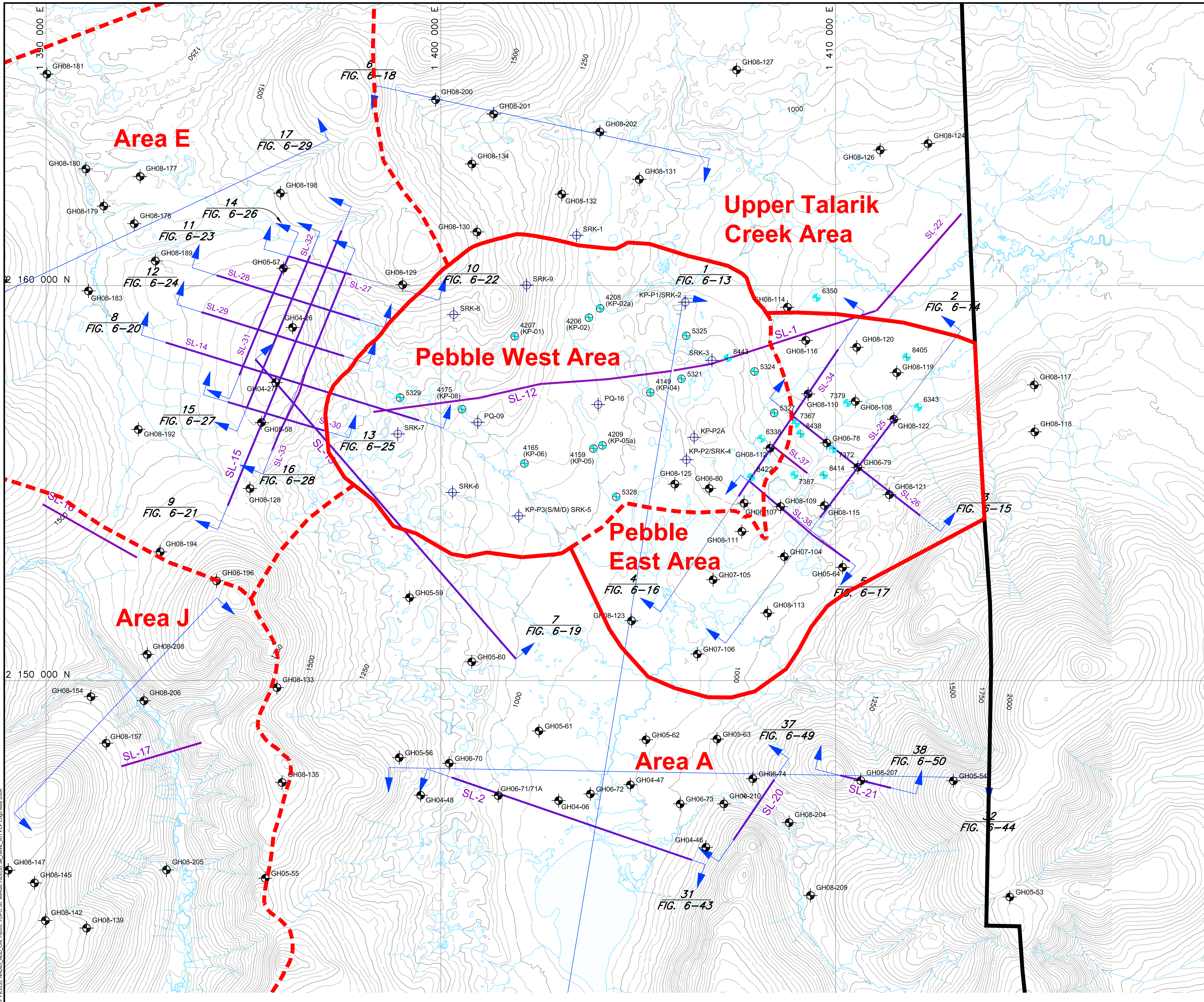


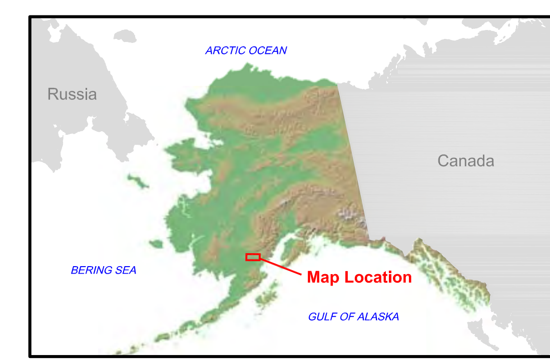
Figure 6-12
Detail Geologic Section Plan
Mine Study Area
2004 - 2008

Legend

- Mine Study Area Boundary
- Reference Area Boundary
- General Deposit Location
- GH04-1 — 2004 to 2008 Geotechnical Drillholes
- 4206 (KP-02) — Oriented Geotechnical Drillhole
- SL-1 — Seismic Line
- SRK-1 — Other Geotechnical Drillhole
- 32 / 6-44 FIG — Location and Direction of Geological Sections

Notes

1. See Figure 6-11 for Detail Inset Location.



Meter: 250 0 250 500 750 1000 1250

Feet: 1000 0 1000 2000 3000 4000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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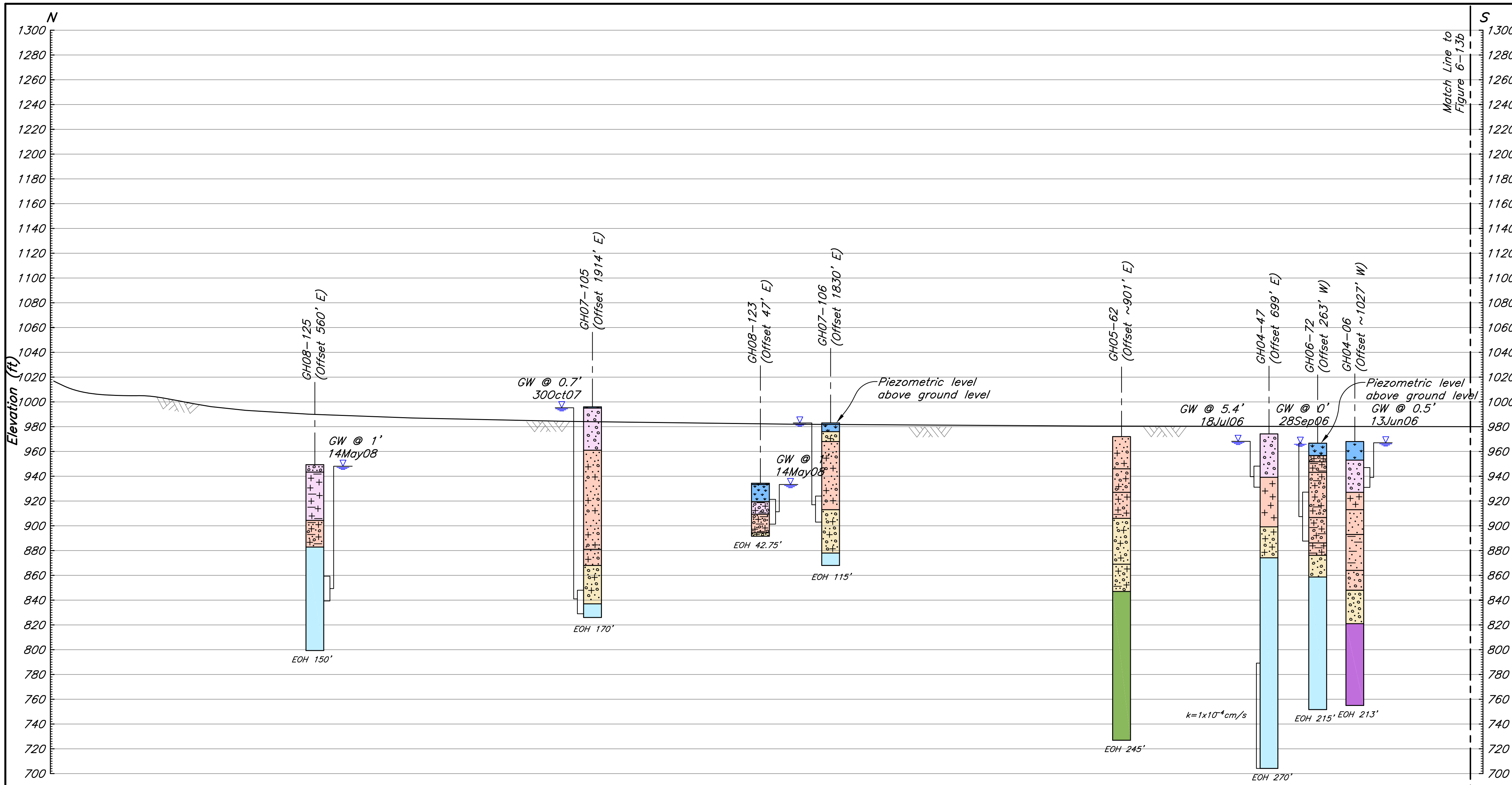

SECTION 1/FIGURE 6-11

SECTION ALONG FRYING PAN VALLEY

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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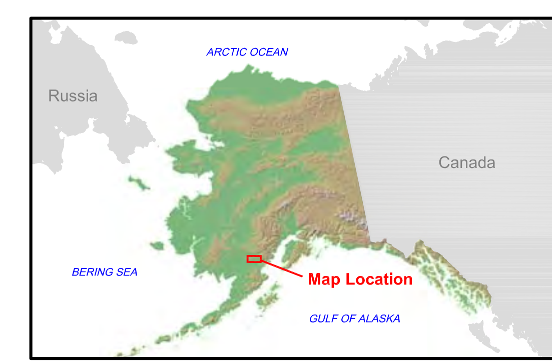
Figure 6-13a
Geologic Section
Frying Pan Valley
Sheet 1 of 2

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

N

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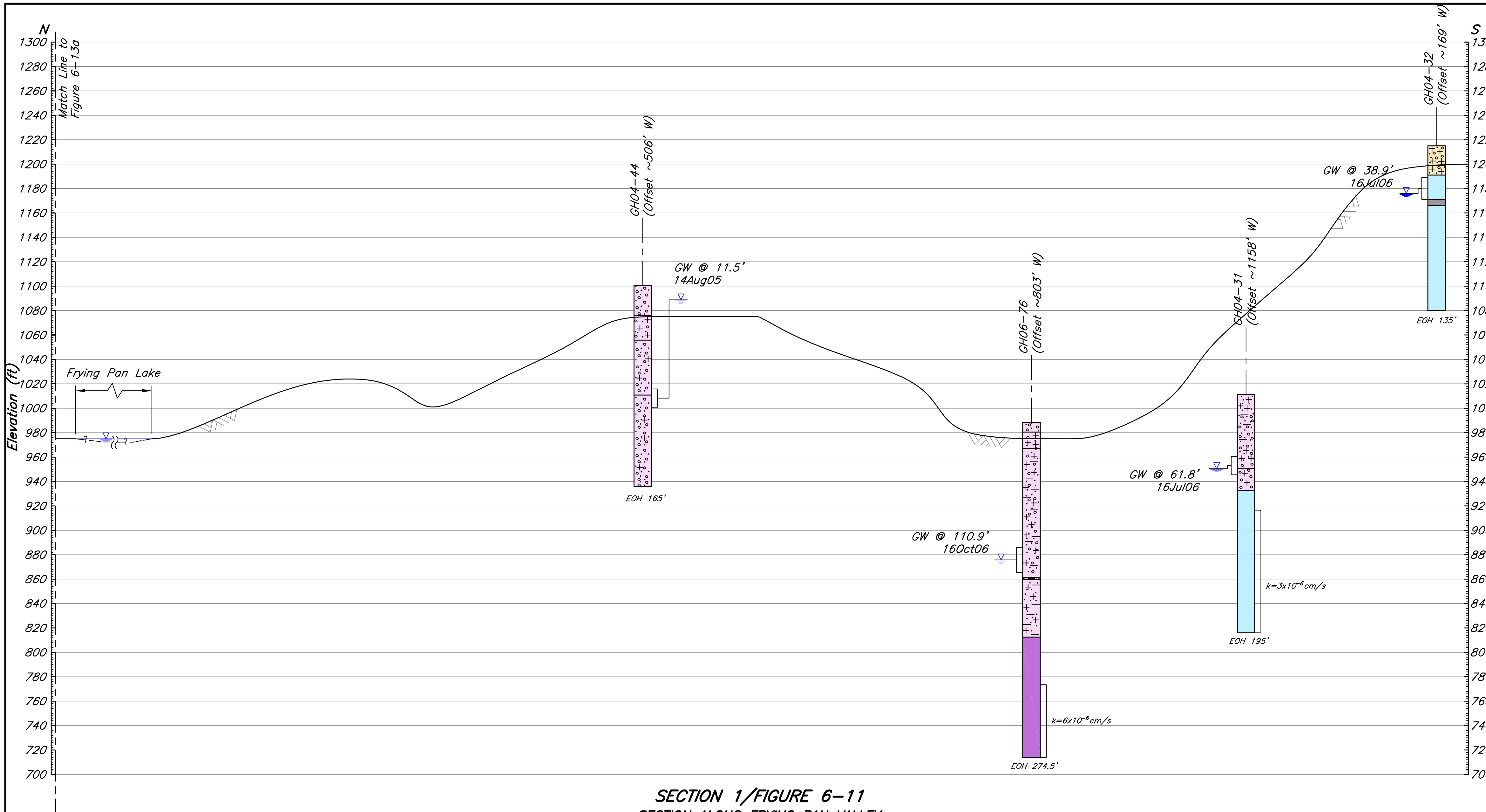
VANCOUVER B.C.



SECTION 1/FIGURE 6-11
SECTION ALONG FRYING PAN VALLEY
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10^{-4}cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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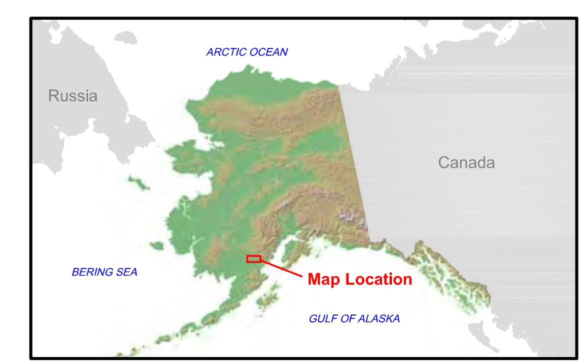
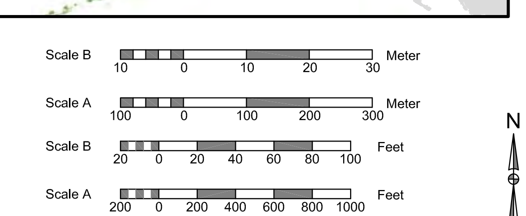
Figure 6-13b Geologic Section Frying Pan Valley Sheet 2 of 2

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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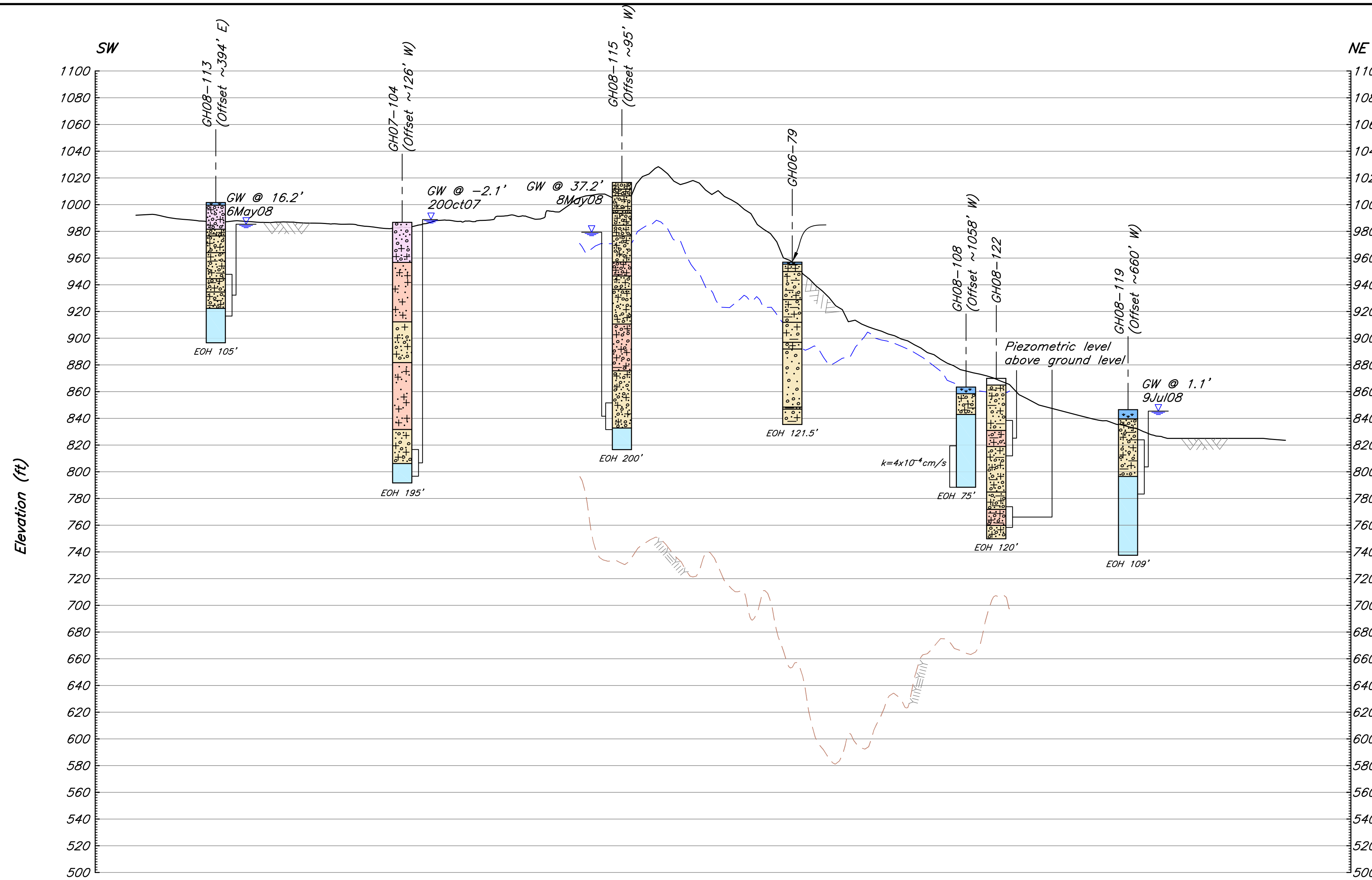


SECTION 2/FIGURE 6-12

SECTION ALONG SEISMIC LINE – 25

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium

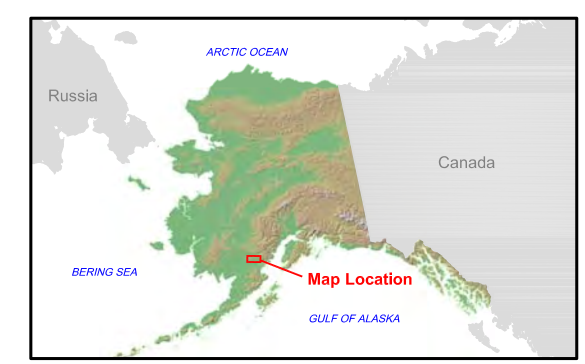
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

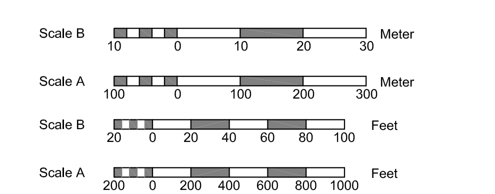
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2\times10^{-4}$cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Figure 6-14
Geologic Section
Seismic Line-25
Pebble East Area

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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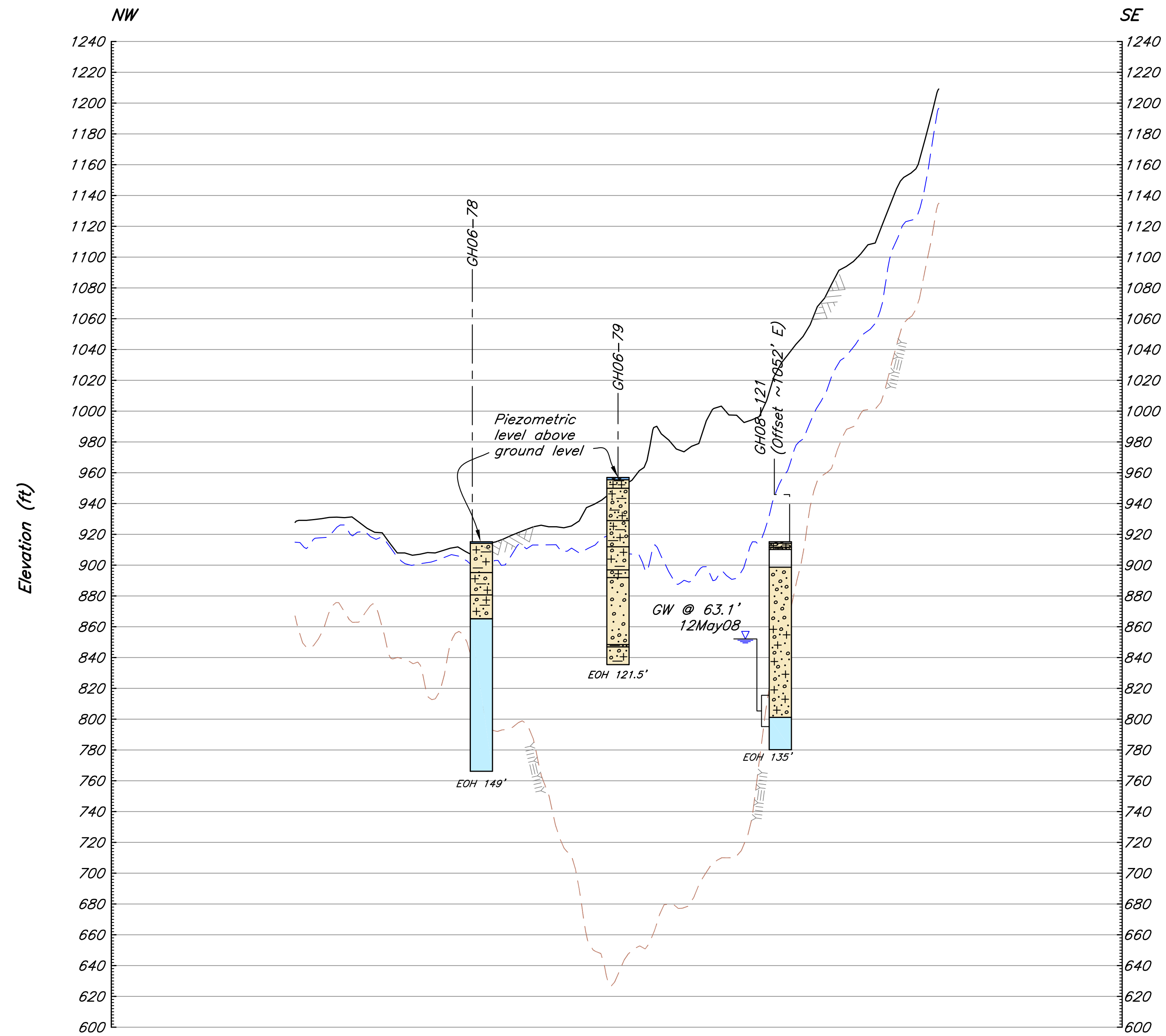


SECTION 2/FIGURE 6-12
SECTION ALONG SEISMIC LINE – 26
Horizontal Scale A, Vertical Scale B

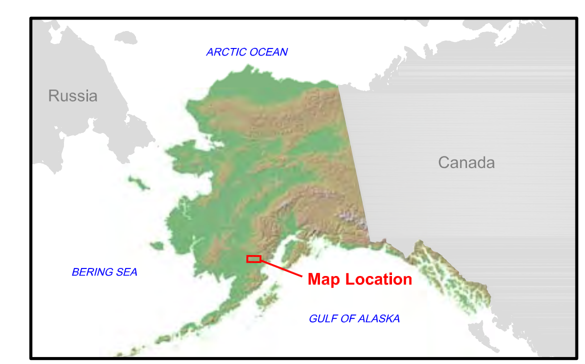
Legend

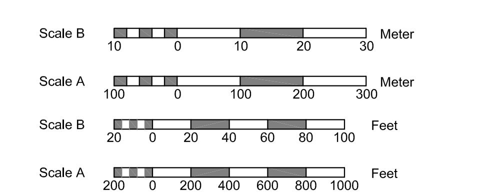
- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

Figure 6-15
Geologic Section
Seismic Line-26
Pebble East Area

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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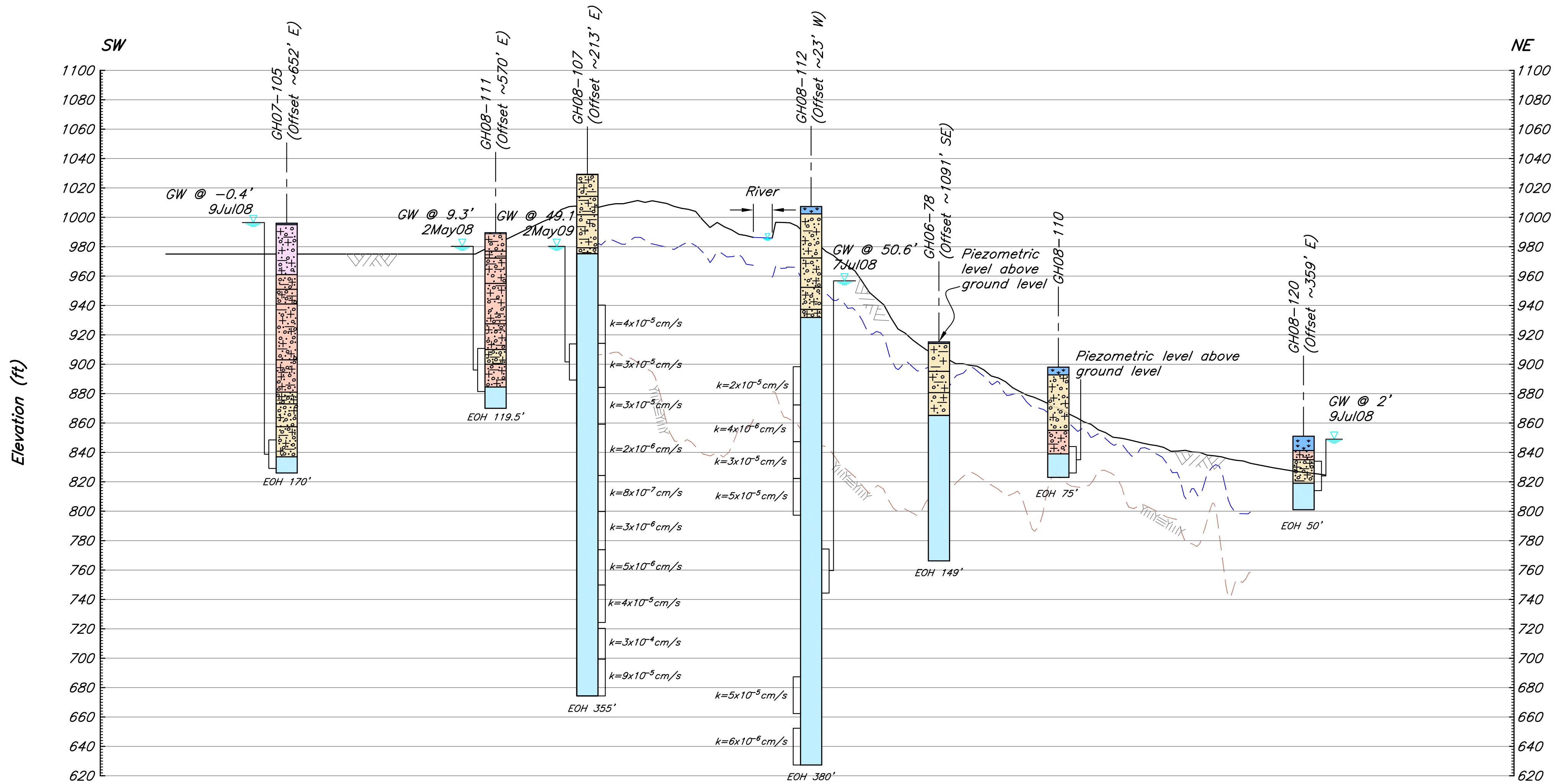


SECTION 4/FIGURE. 6-12

SECTION ALONG SEISMIC LINE – 34

Horizontal Scale A, Vertical Scale B

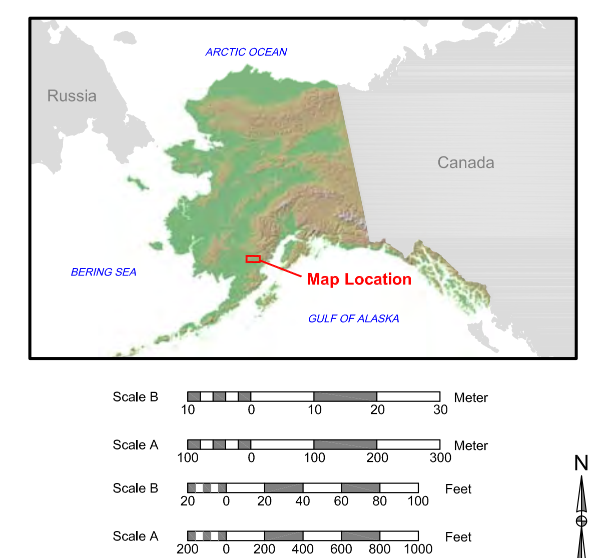
Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Figure 6-16
Geologic Section
Seismic Line-34
Pebble East Area

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



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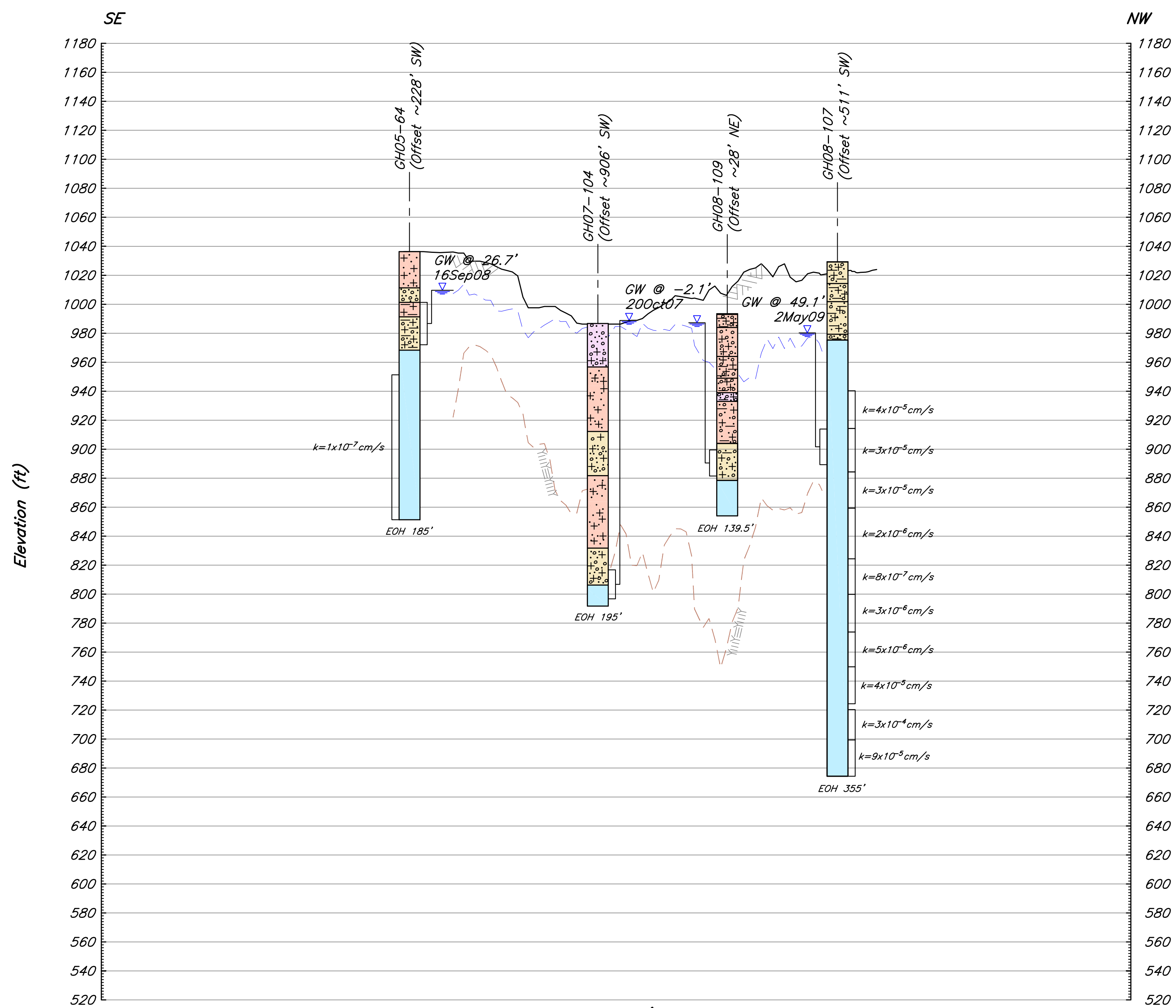


SECTION 5/FIGURE 6-12

SECTION ALONG SEISMIC LINE – 24

Horizontal Scale A, Vertical Scale B

Legend

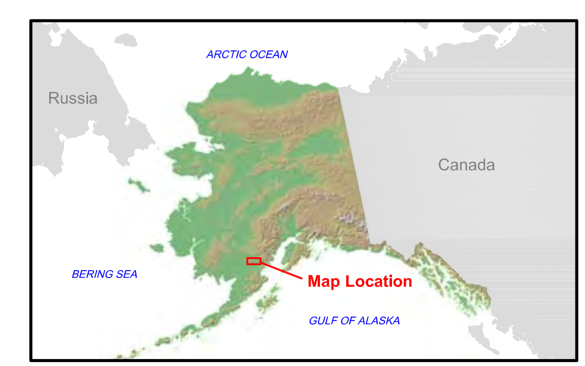
- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

THE pebble PARTNERSHIP

Figure 6-17
Geologic Section
Seismic Line-38
Pebble East Area

Notes

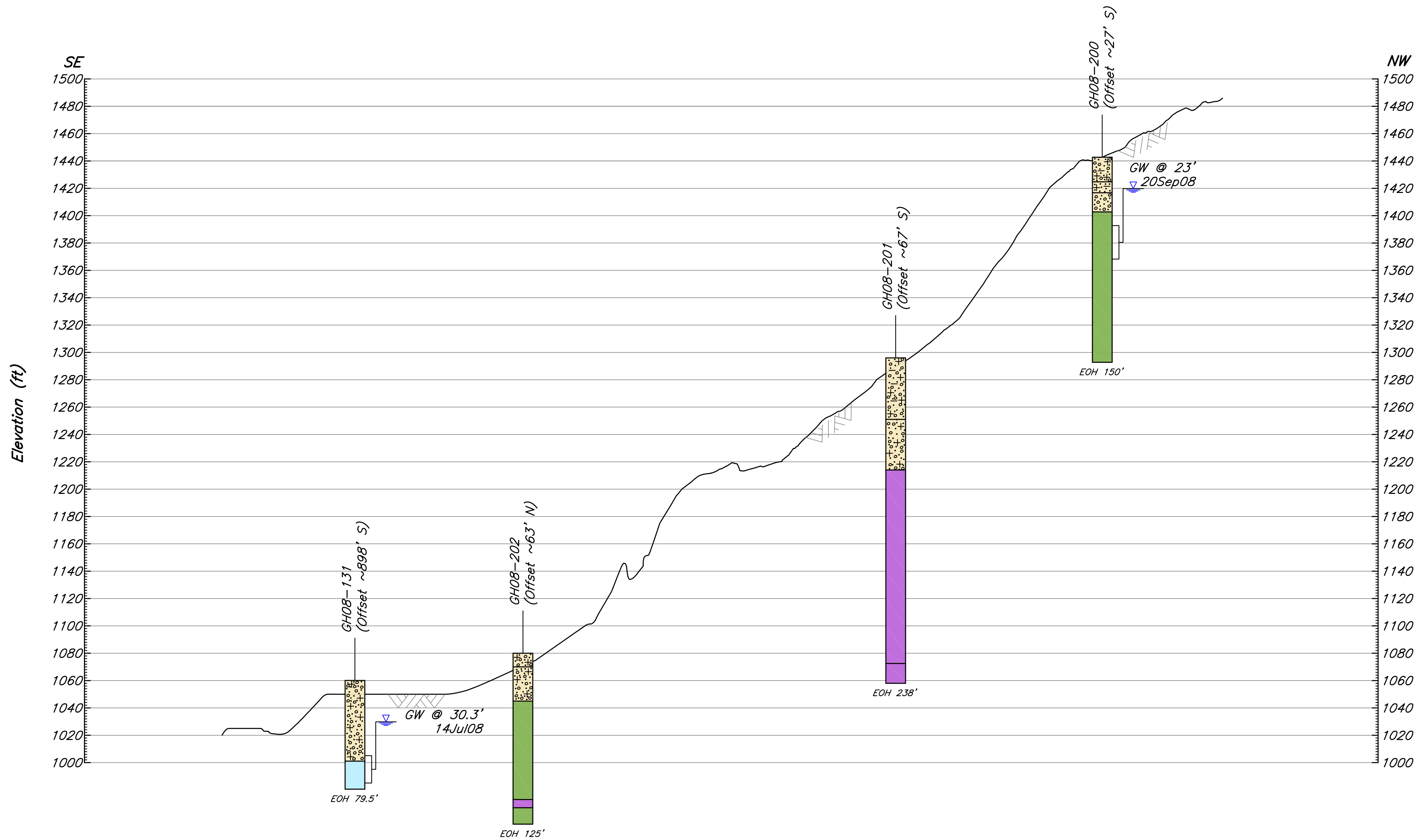
1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

File: B17.dwg	Date: September 17, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

Figure 6-18
Geologic Section
Upper Talarik Creek Area



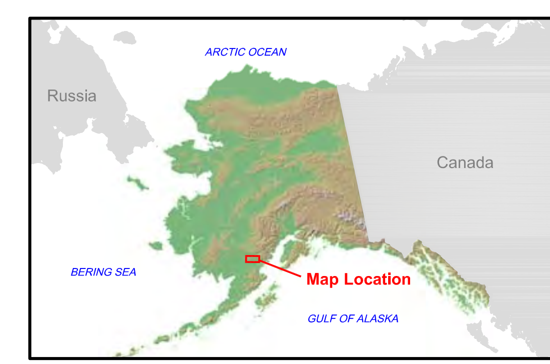
SECTION 6/FIGURE 6–12
SECTION IN UPPER TALARIK CREEK AREA
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
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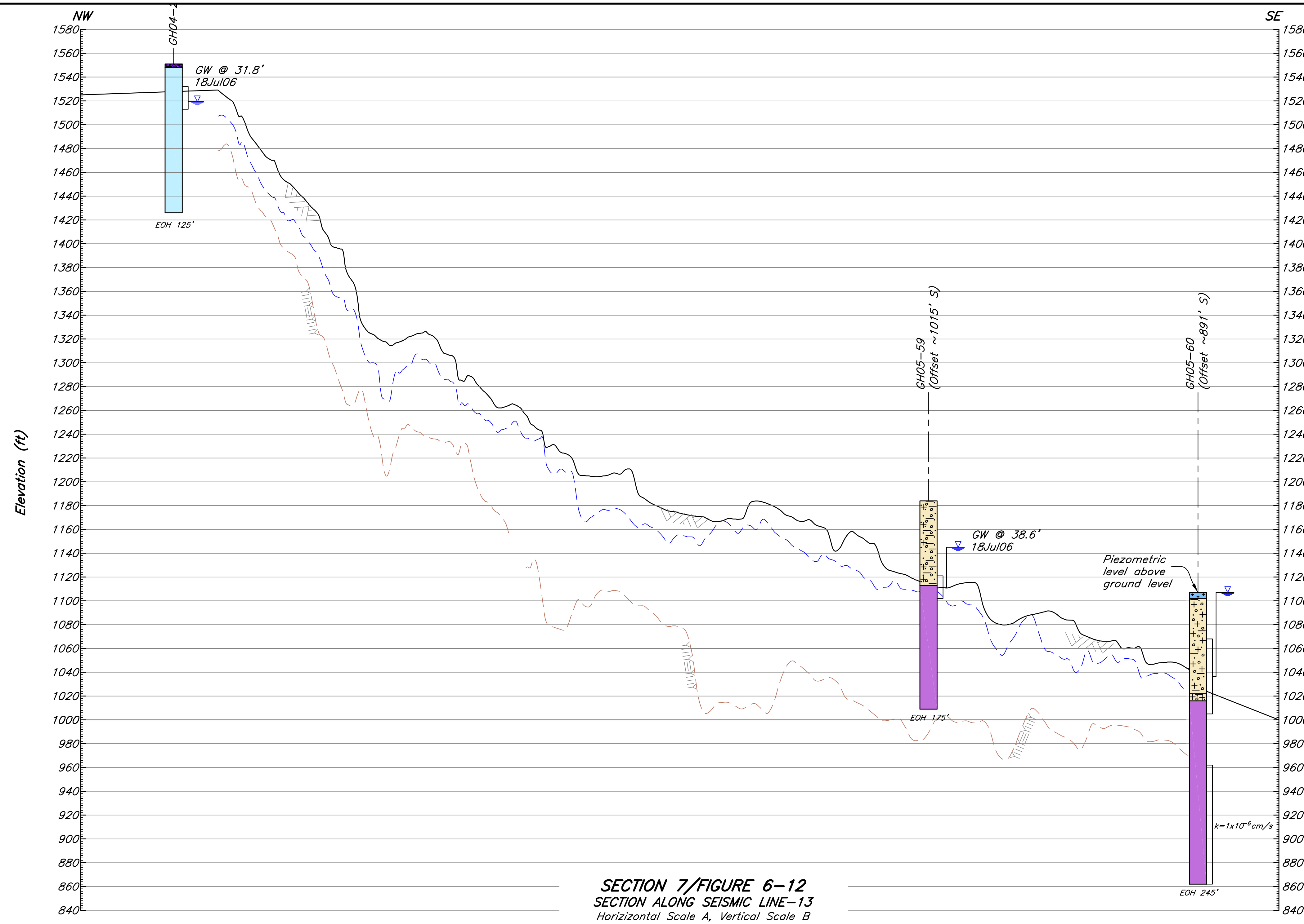
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 7/FIGURE 6–12
SECTION ALONG SEISMIC LINE–13
Horizizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Glacial Deposits:
  - Alluvium
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}$ cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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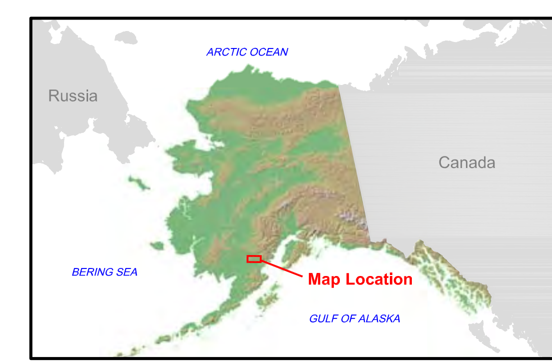
Figure 6-19
Geologic Section Seismic Line-13 Area E / Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
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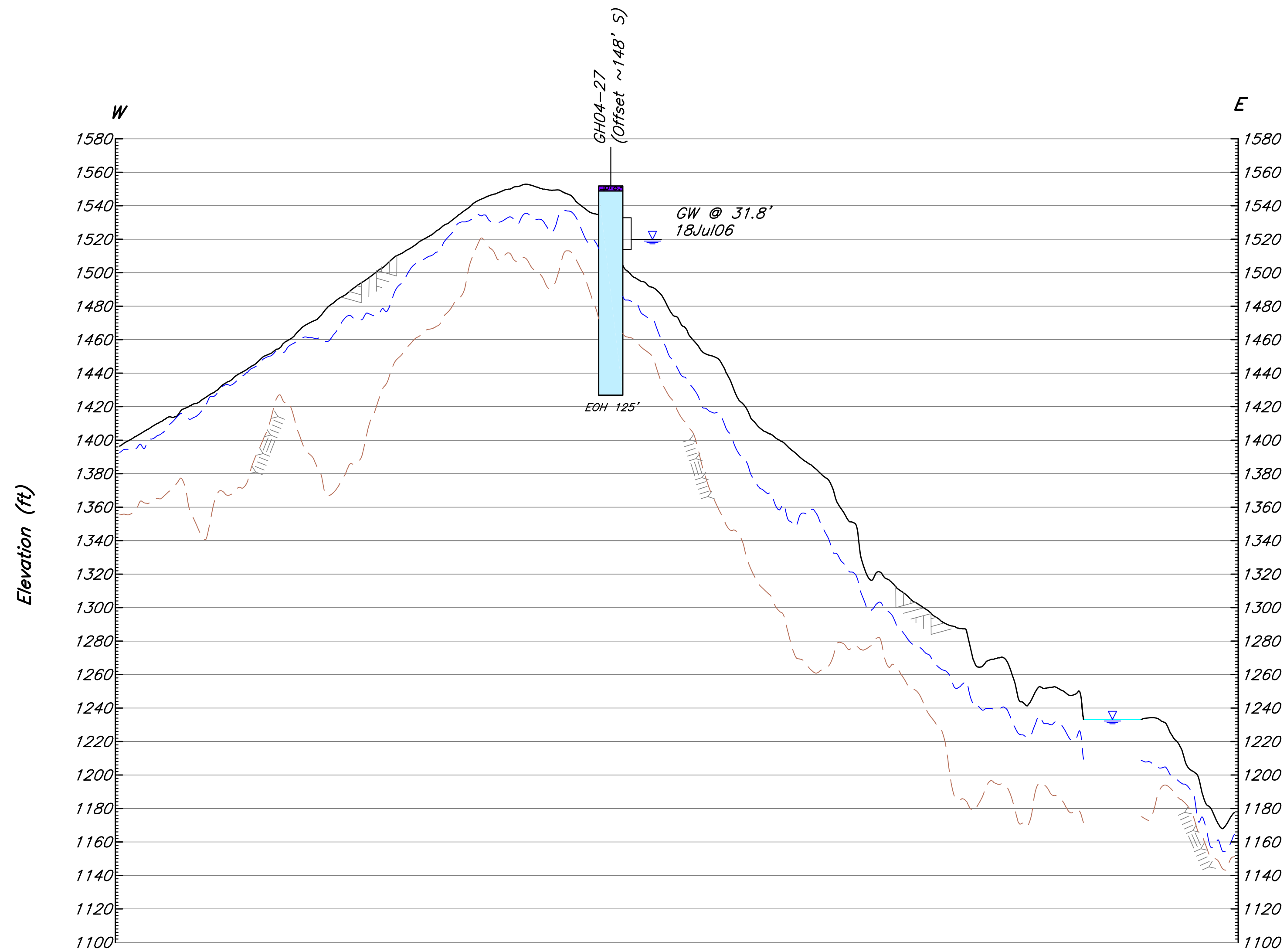
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 8/FIGURE 6–11

SECTION ALONG SEISMIC LINE–14

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:

- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

GW @ 75' 12Apr06	Piezometer completion zone, measured groundwater level (GW) and date of measurement
$k=1.2x10^{-4}cm/s$	Hydraulic conductivity from packer tests in centimeters per second (cm/s)
	Ground surface
	Interpreted groundwater level from seismic data
	Interpreted bedrock surface from seismic and drillhole data
EOH	Depth to end of drillhole

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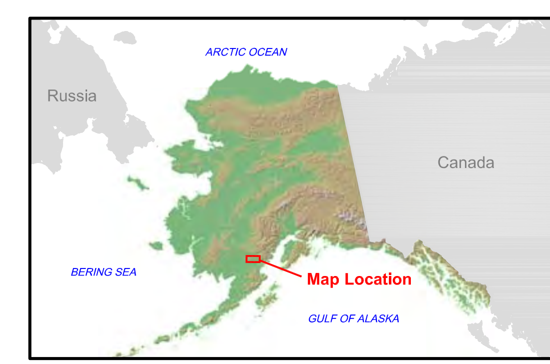
Figure 6-20
Geologic Section
Seismic Line-14
Area E / General Deposit Location

Notes

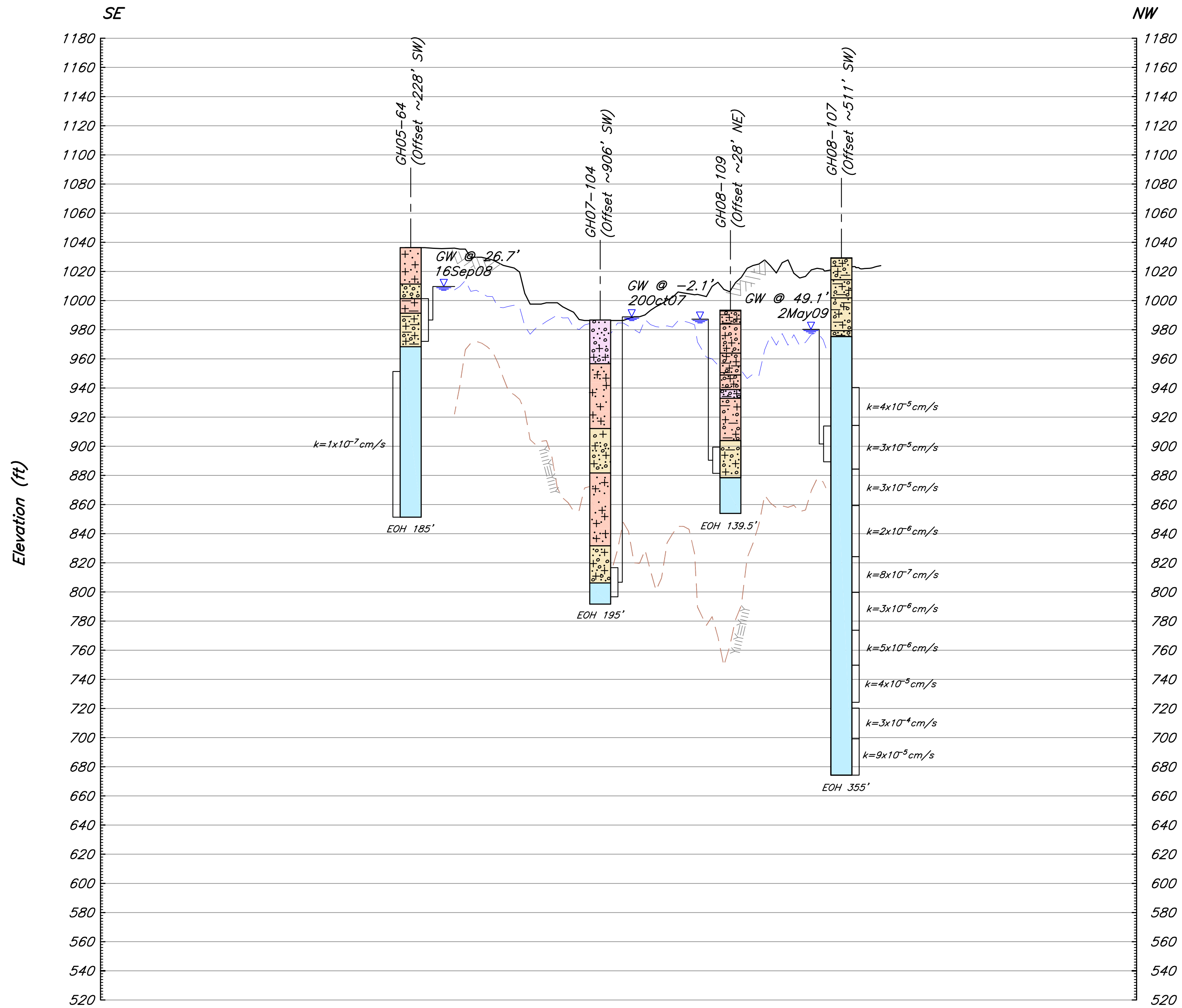
1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B: 10 0 10 20 30 Meter
Scale A: 100 0 100 200 300 Meter
Scale B: 20 0 20 40 60 80 100 Feet
Scale A: 200 0 200 400 600 800 1000 Feet

N

File: B20.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 9/FIGURE 6–21

SECTION ALONG SEISMIC LINE–24

Horizontal Scale A, Vertical Scale B

Legend

Glacial Deposits

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

GW @ 75' 12Apr06	Piezometer completion zone, measured groundwater level (GW) and date of measurement
k=1.2x10⁻⁴cm/s	Hydraulic conductivity from packer tests in centimeters per second (cm/s)
	Ground surface
	Interpreted groundwater level from seismic data
	Interpreted bedrock surface from seismic and drillhole data
EOH	Depth to end of drillhole

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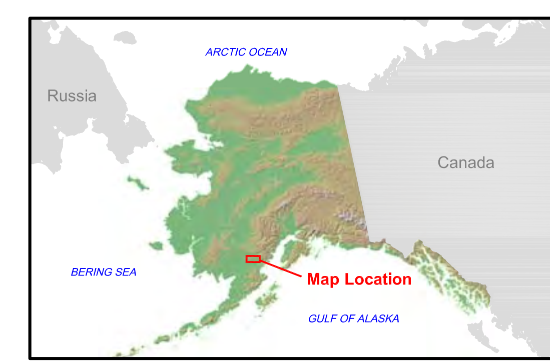
Figure 6-21
Geologic Section
Seismic Line-15
Area E

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

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File: B21.dwg	Date: September 17, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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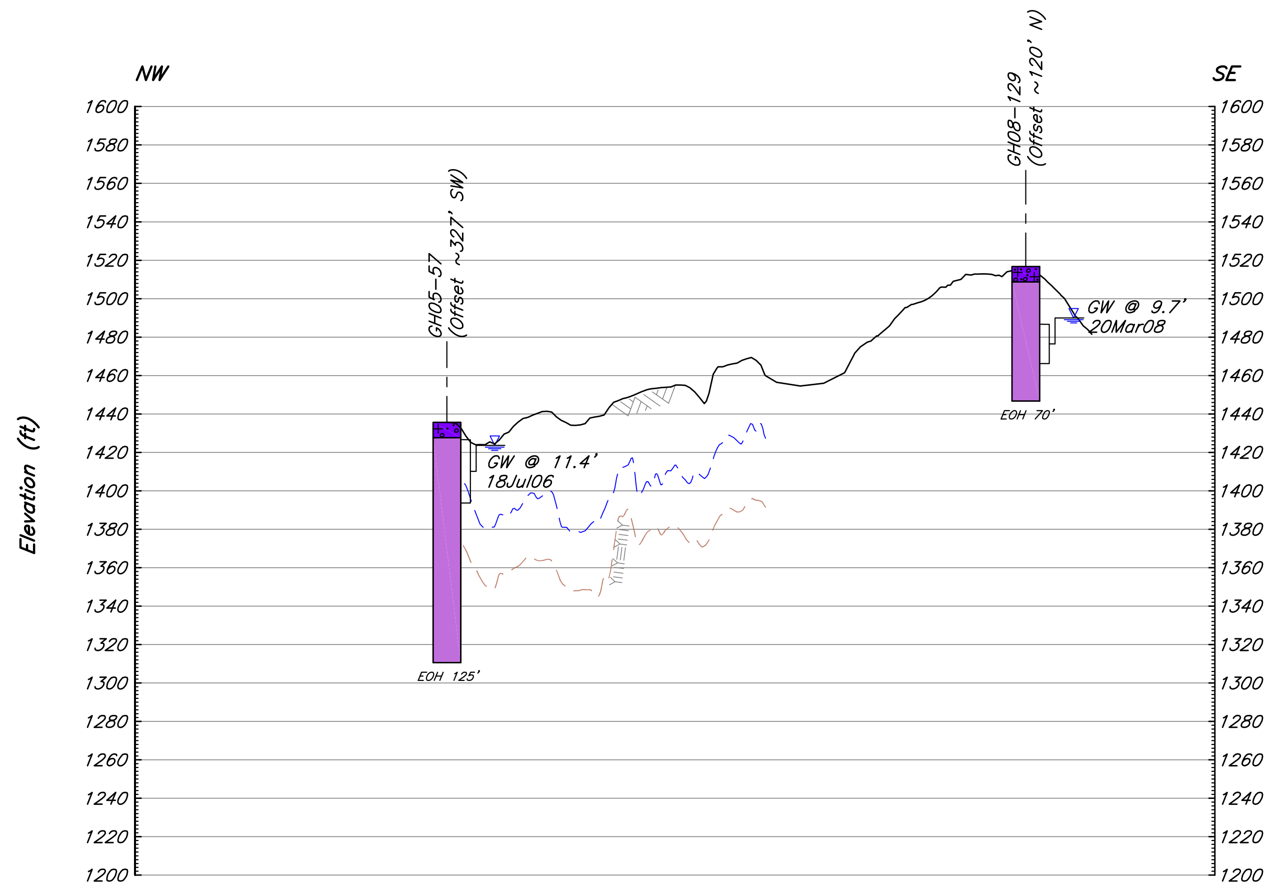
VANCOUVER B.C.



SECTION 10/FIGURE 6.12

SECTION ALONG SEISMIC LINE-27

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

Glacial Deposits

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

GW @ 75' 12Apr06	Piezometer completion zone, measured groundwater level (GW) and date of measurement
$k=1.2x10^{-4}cm/s$	Hydraulic conductivity from packer tests in centimeters per second (cm/s)
	Ground surface
	Interpreted groundwater level from seismic data
	Interpreted bedrock surface from seismic and drillhole data
EOH	Depth to end of drillhole

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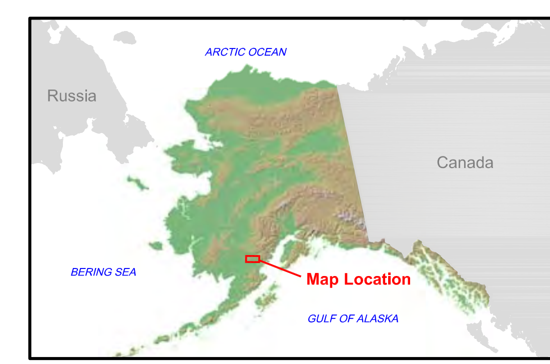
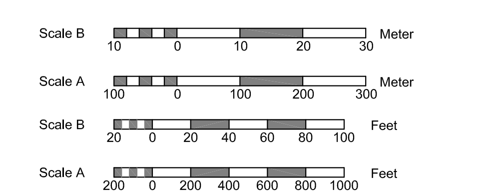
Figure 6-22
Geologic Section
Seismic Line-27 Area E

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





File: B22.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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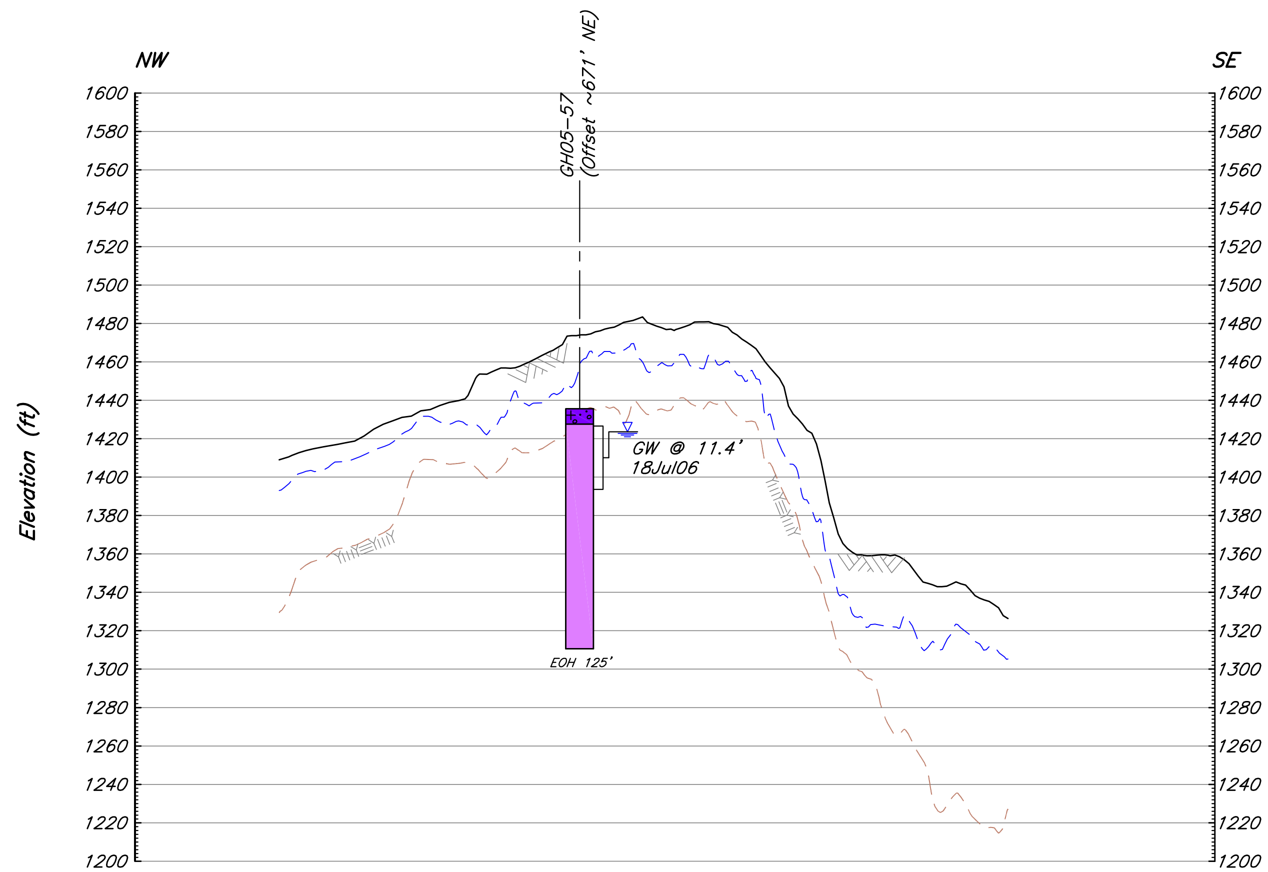
Figure 6-23
Geologic Section
Seismic Line-28 Area E



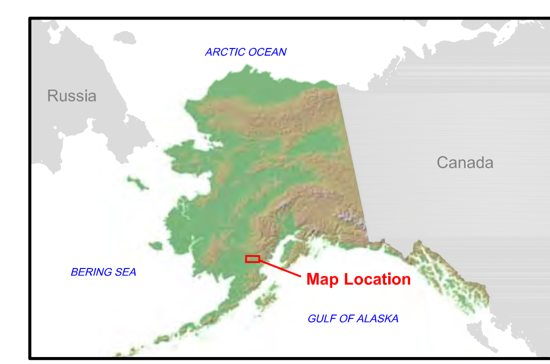
SECTION 11/FIGURE 6-12

SECTION ALONG SEISMIC LINE-28

Horizontal Scale A, Vertical Scale B

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

File: B23.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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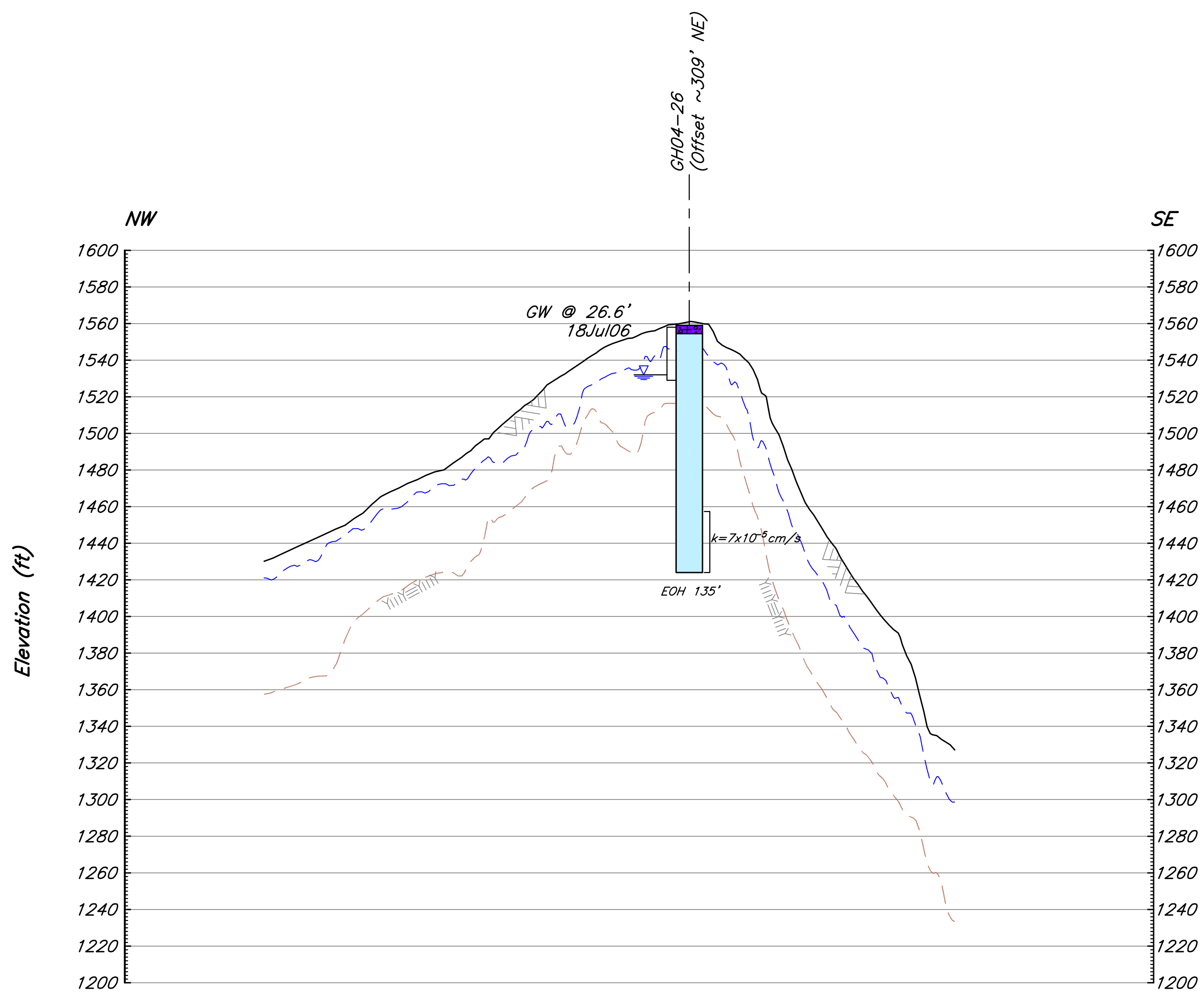
Figure 6-24
Geologic Section
Seismic Line-29 Area E



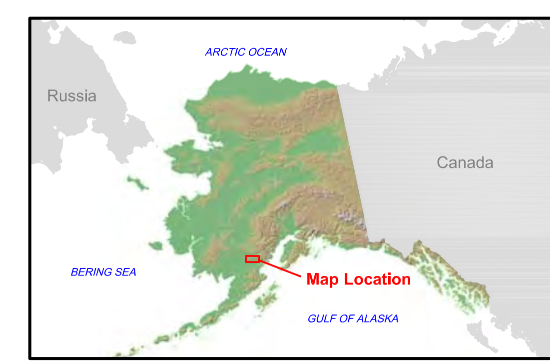
SECTION 12/FIGURE 6–12

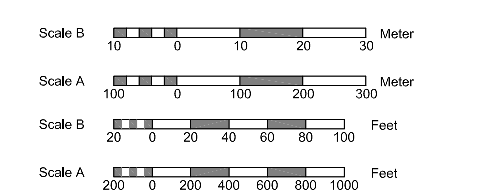
SECTION ALONG SEISMIC LINE–29

Horizontal Scale A, Vertical Scale B

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



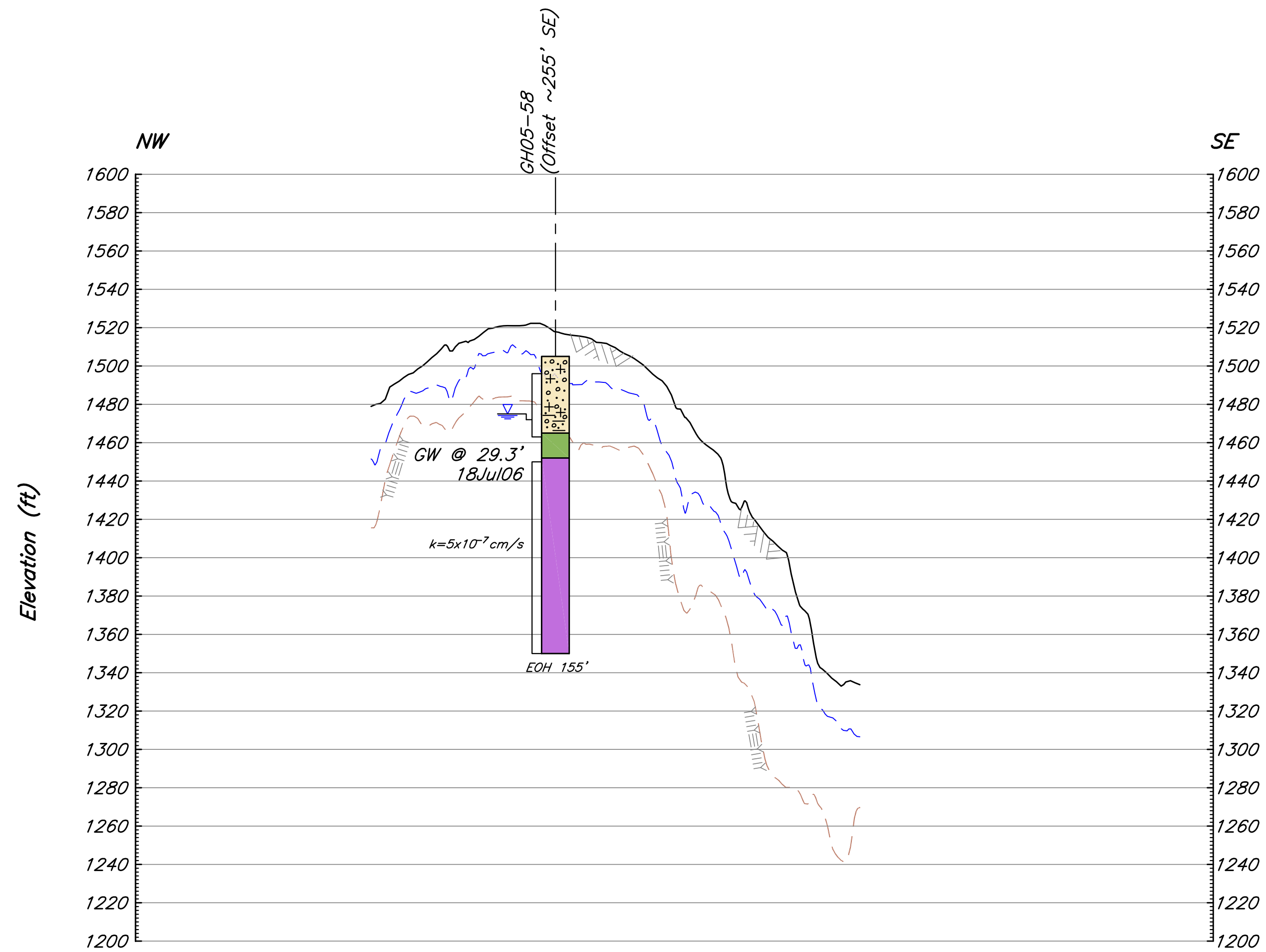


Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

File: B24.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

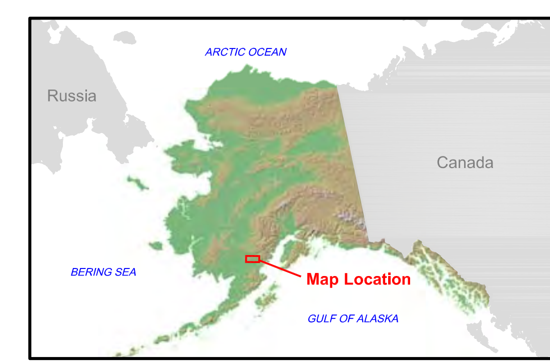
Figure 6-25
Geologic Section
Seismic Line-30 Area E

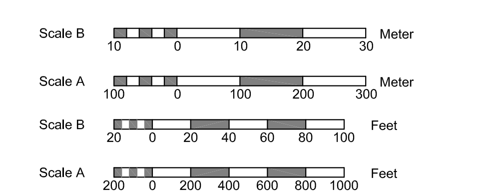


SECTION 13/FIGURE 6–12
SECTION ALONG SEISMIC LINE–30
Horizontal Scale A, Vertical Scale B

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



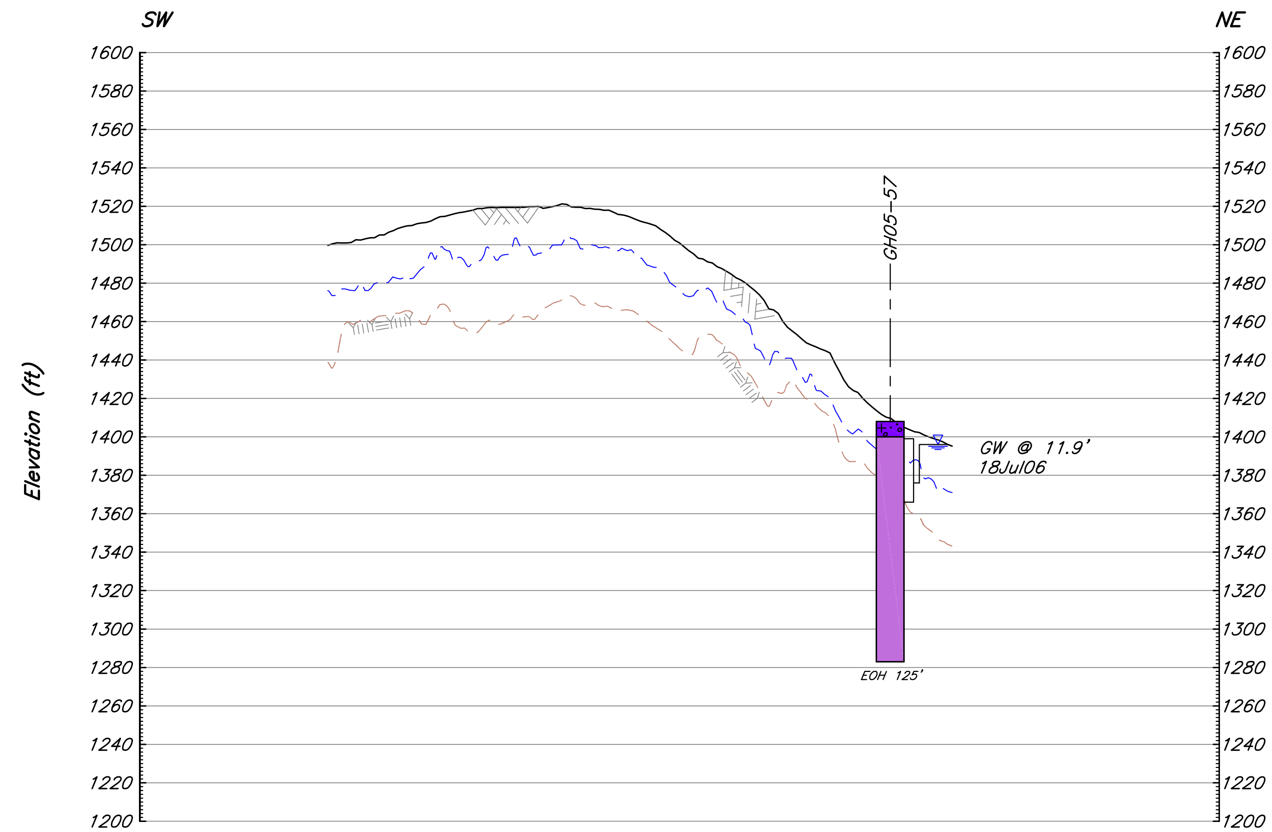


Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10^-4 cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

File: B25.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

Figure 6-26
Geologic Section
Seismic Line-31 Area E



SECTION 14/FIGURE 6-12
SECTION ALONG SEISMIC LINE-31
Horizontal Scale A, Vertical Scale B

Legend

Glacial Deposits

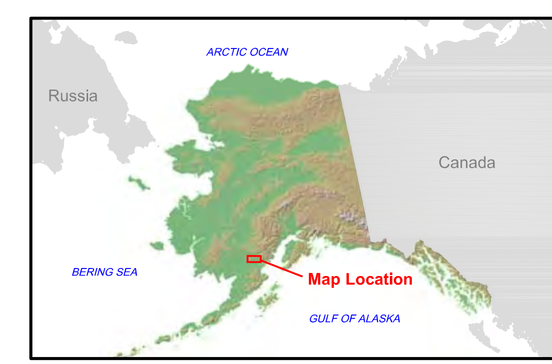
- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

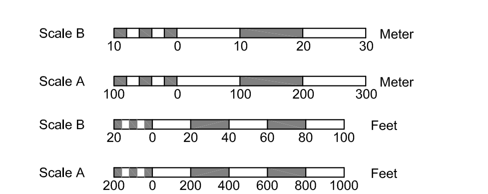
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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Version: 2008-1	Author: Knight Piesold Ltd.

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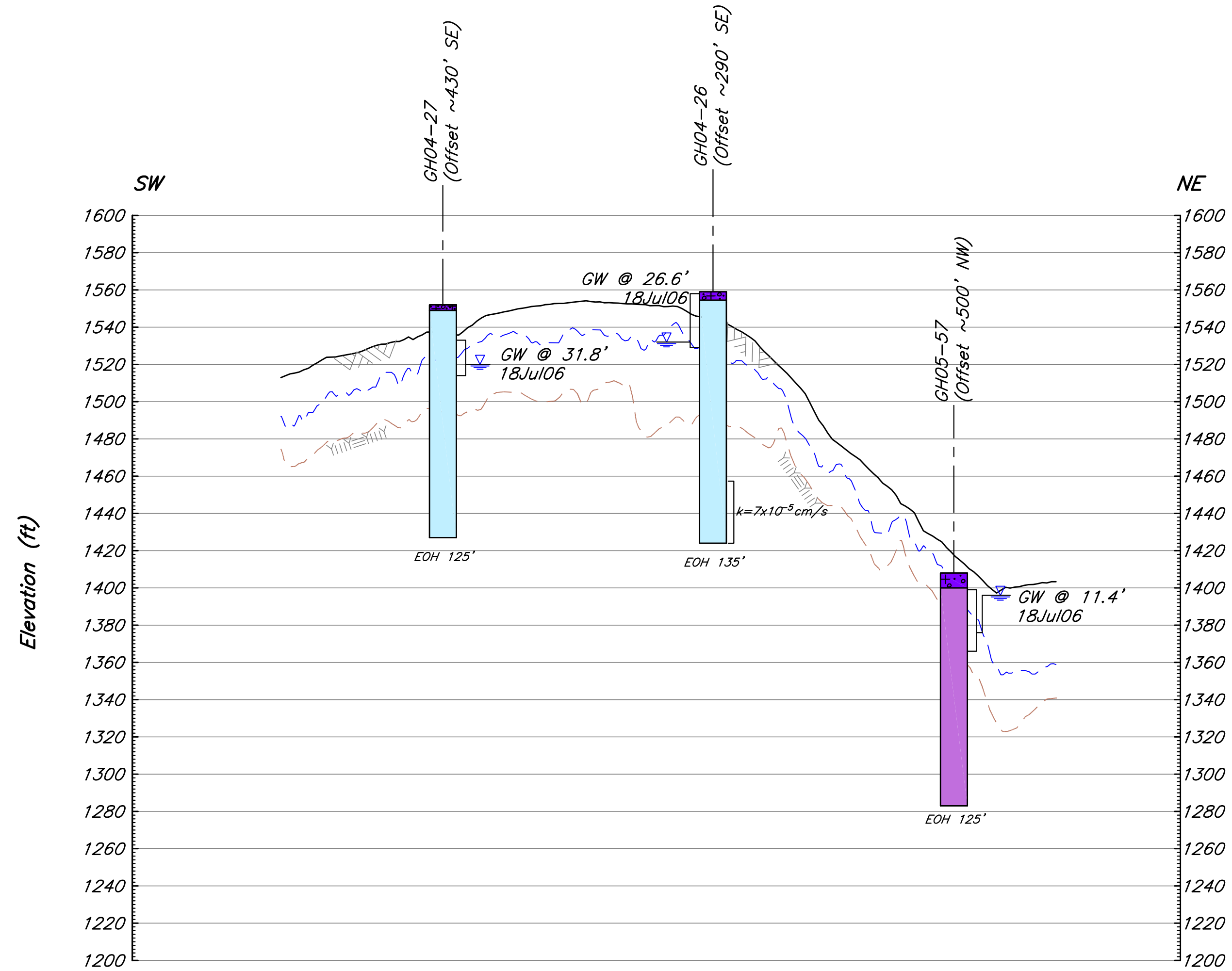
Figure 6-27
Geologic Section
Seismic Line-32 Area E



SECTION 15/FIGURE 6–12

SECTION ALONG SEISMIC LINE–32

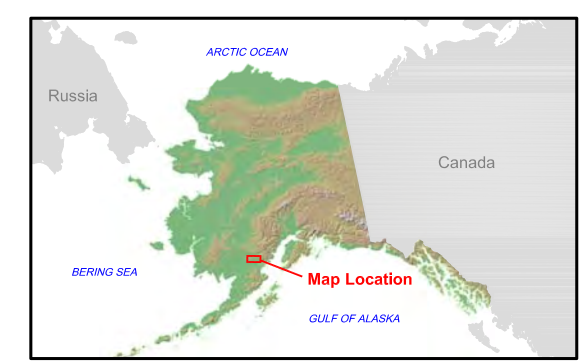
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



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Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

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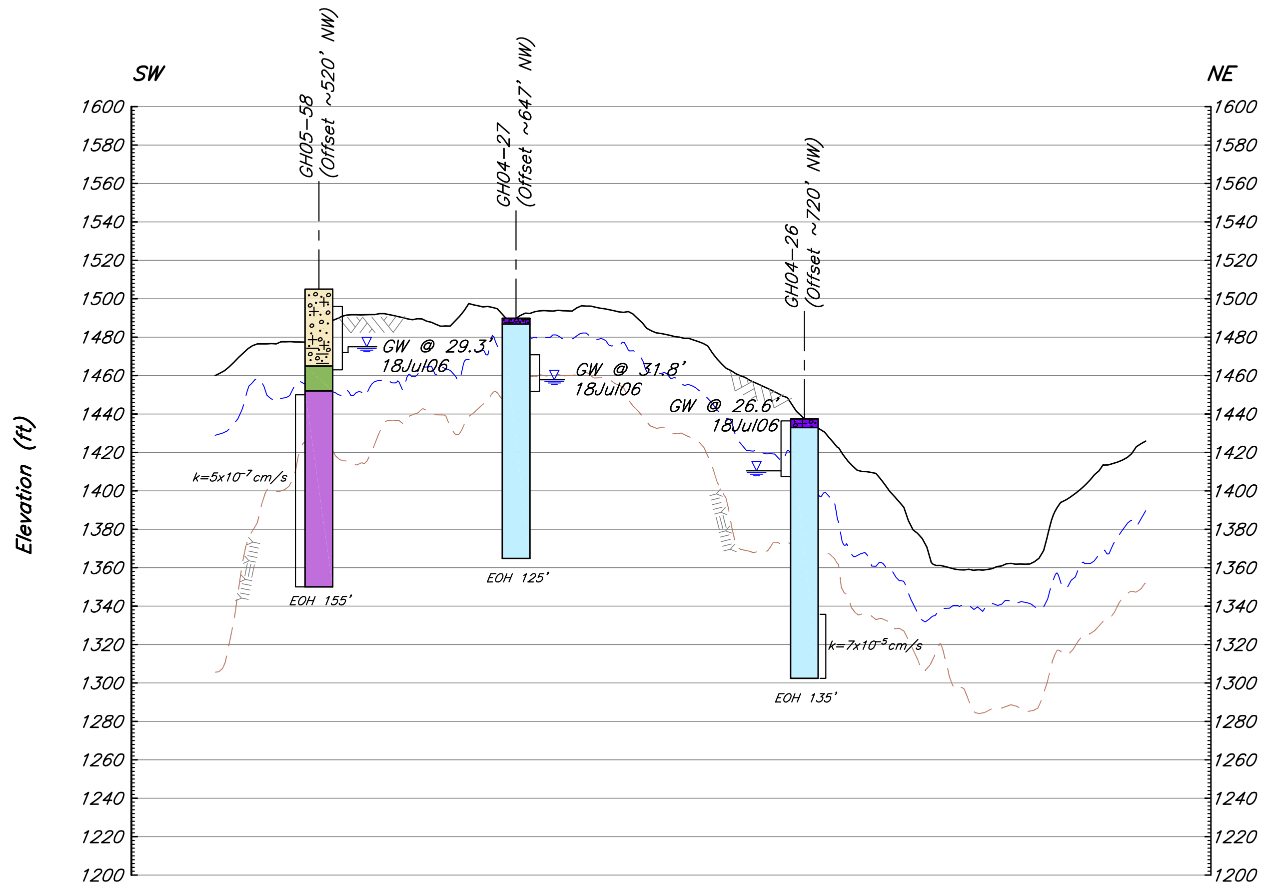

SECTION 16/FIGURE 6–12

SECTION ALONG SEISMIC LINE–33

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Glacial Deposits:
  - Alluvium
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}$ cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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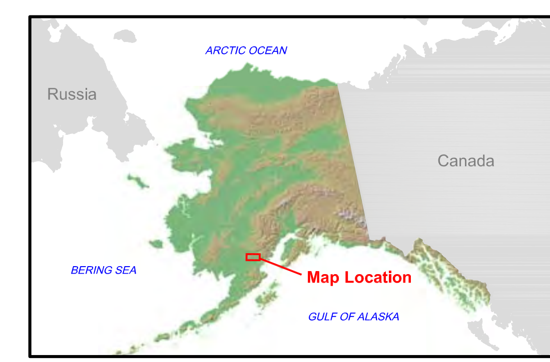
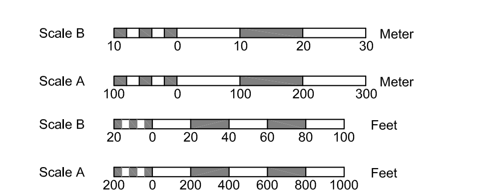
Figure 6-28
Geologic Section
Seismic Line-33 Area E

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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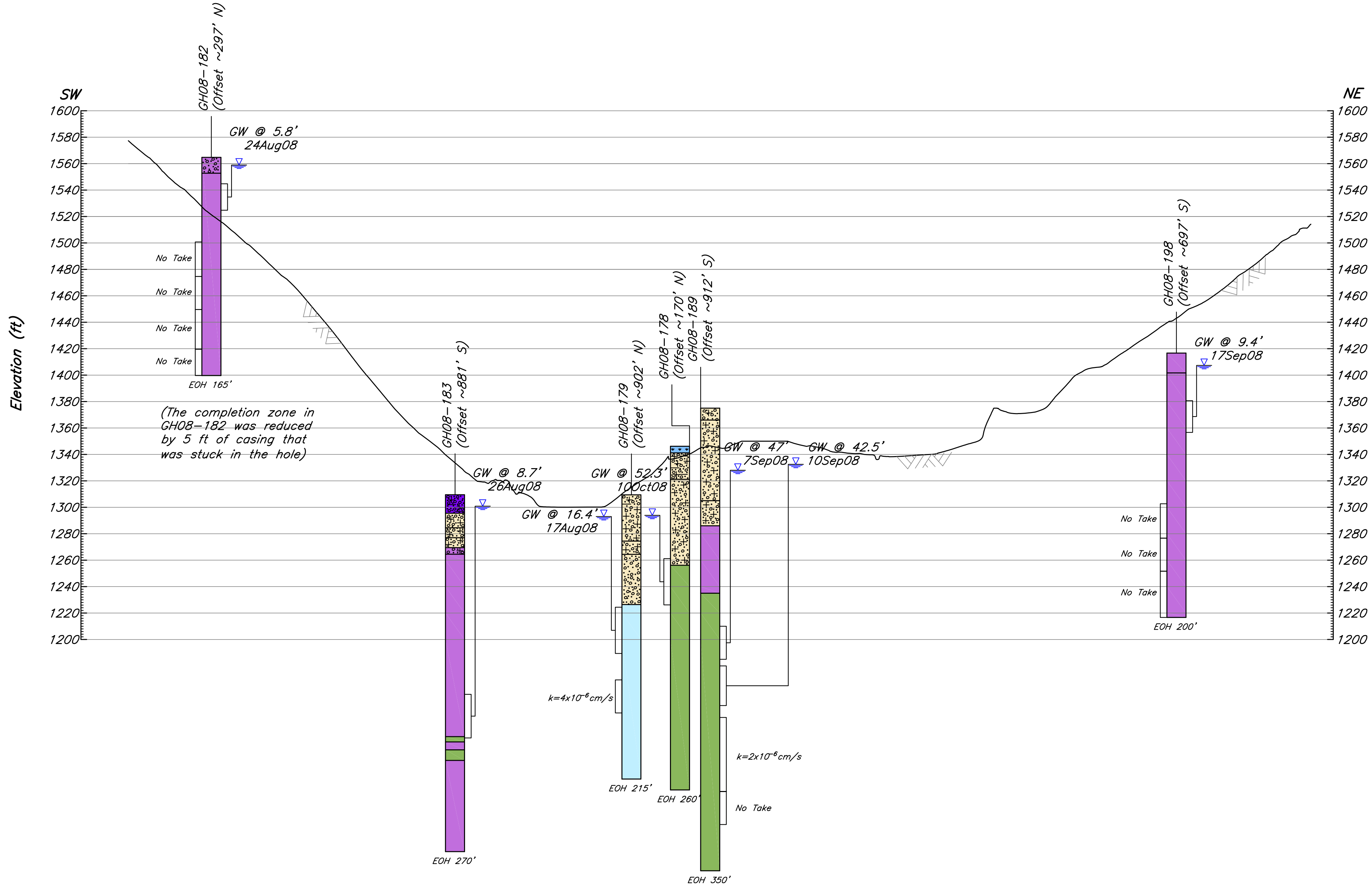
Version: 2008-1	Author: Knight Piesold Ltd.

VANCOUVER B.C.



SECTION 17/FIGURE 6-12

SECTION NORTHWEST AREA E

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:

- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit

- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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Figure 6-29
Geologic Section
Northwest Area E

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
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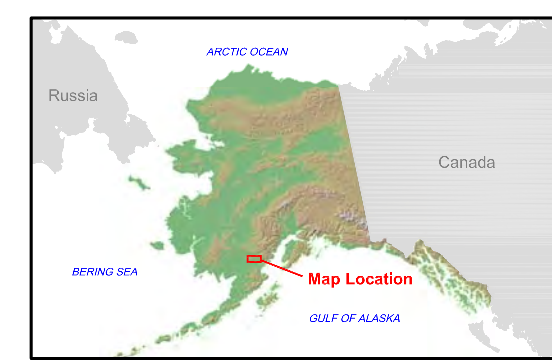
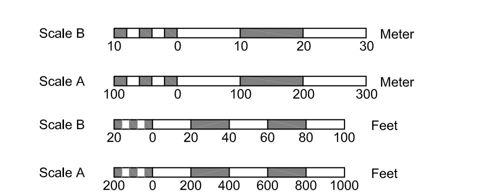
8. Bedrock geology defined by Pebble Partnership geologists.





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Version: 2008-1	Author: Knight Piesold Ltd.

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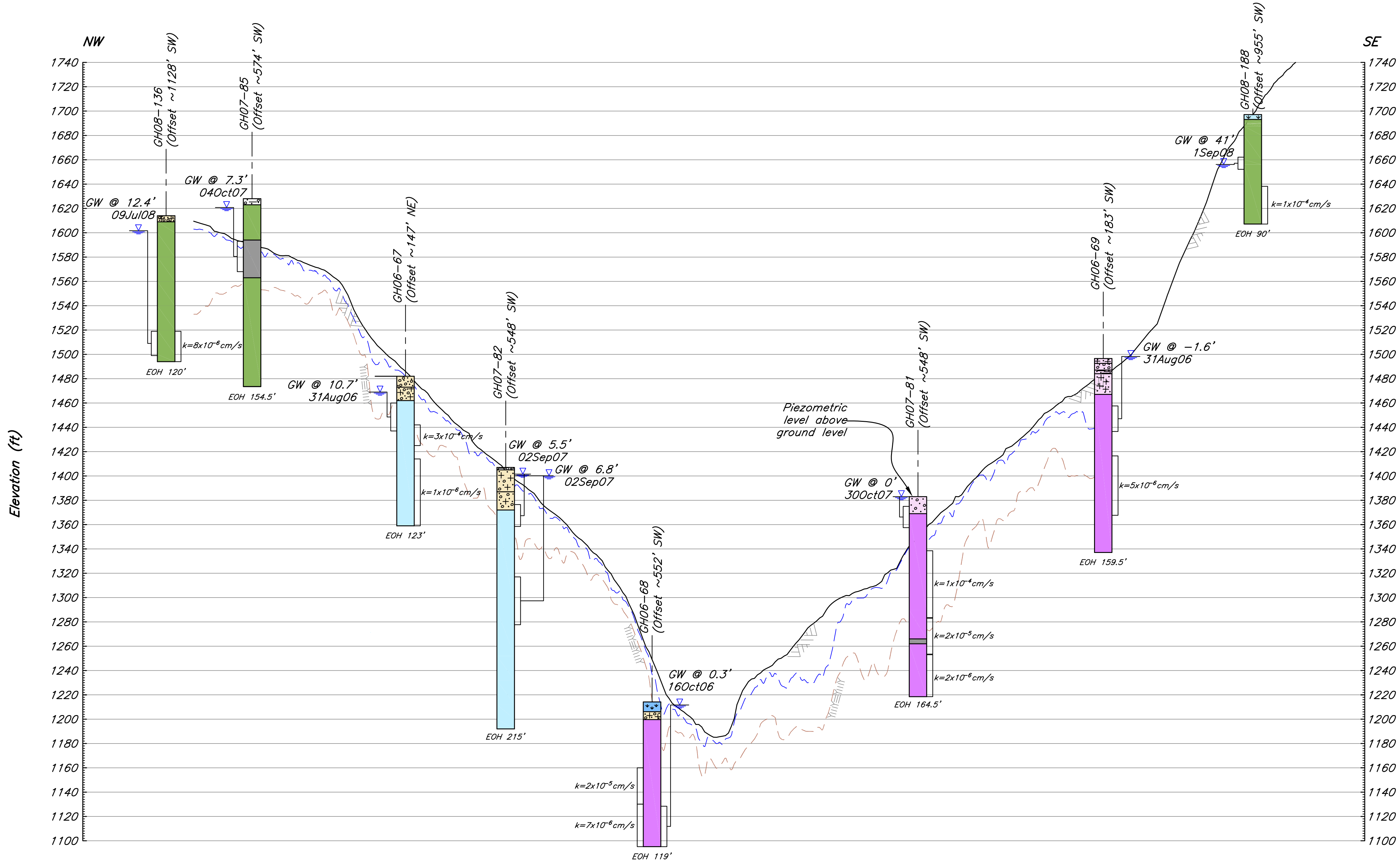
Figure 6-30
Geologic Section
Seismic Line-23 Area G



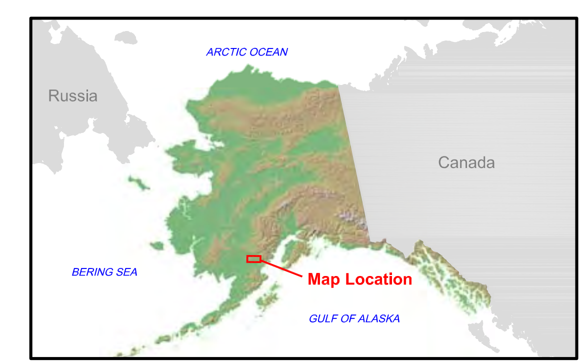
SECTION 18/FIGURE 6–11
SECTION ALONG SEISMIC LINE–23
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

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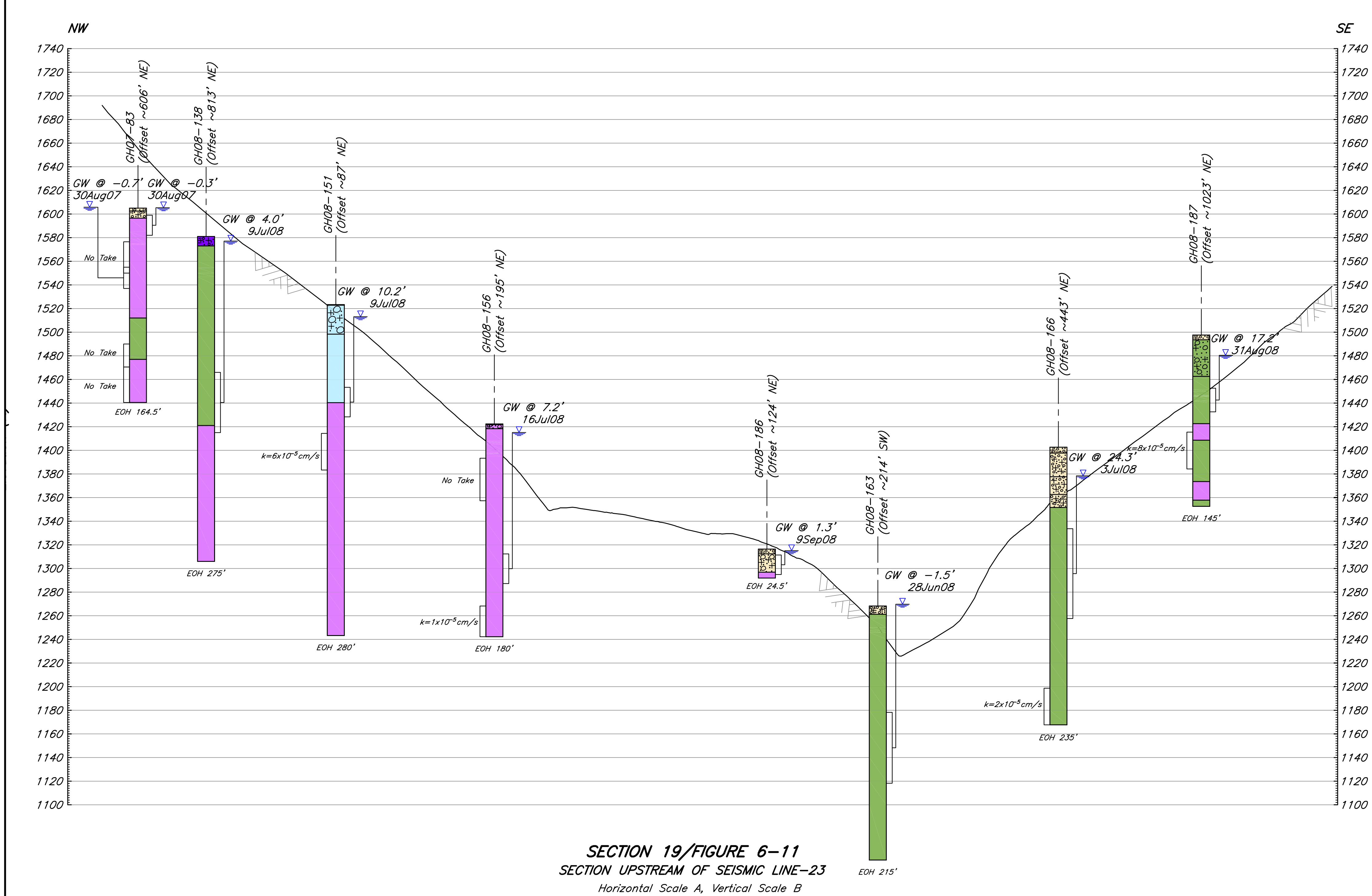

SECTION 19/FIGURE 6-11

SECTION UPSTREAM OF SEISMIC LINE-23

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits

- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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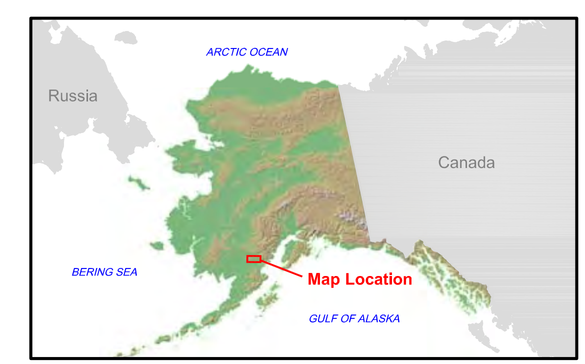
Figure 6-31
Geologic Section
Upstream of Seismic Line-23
Area G

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

N

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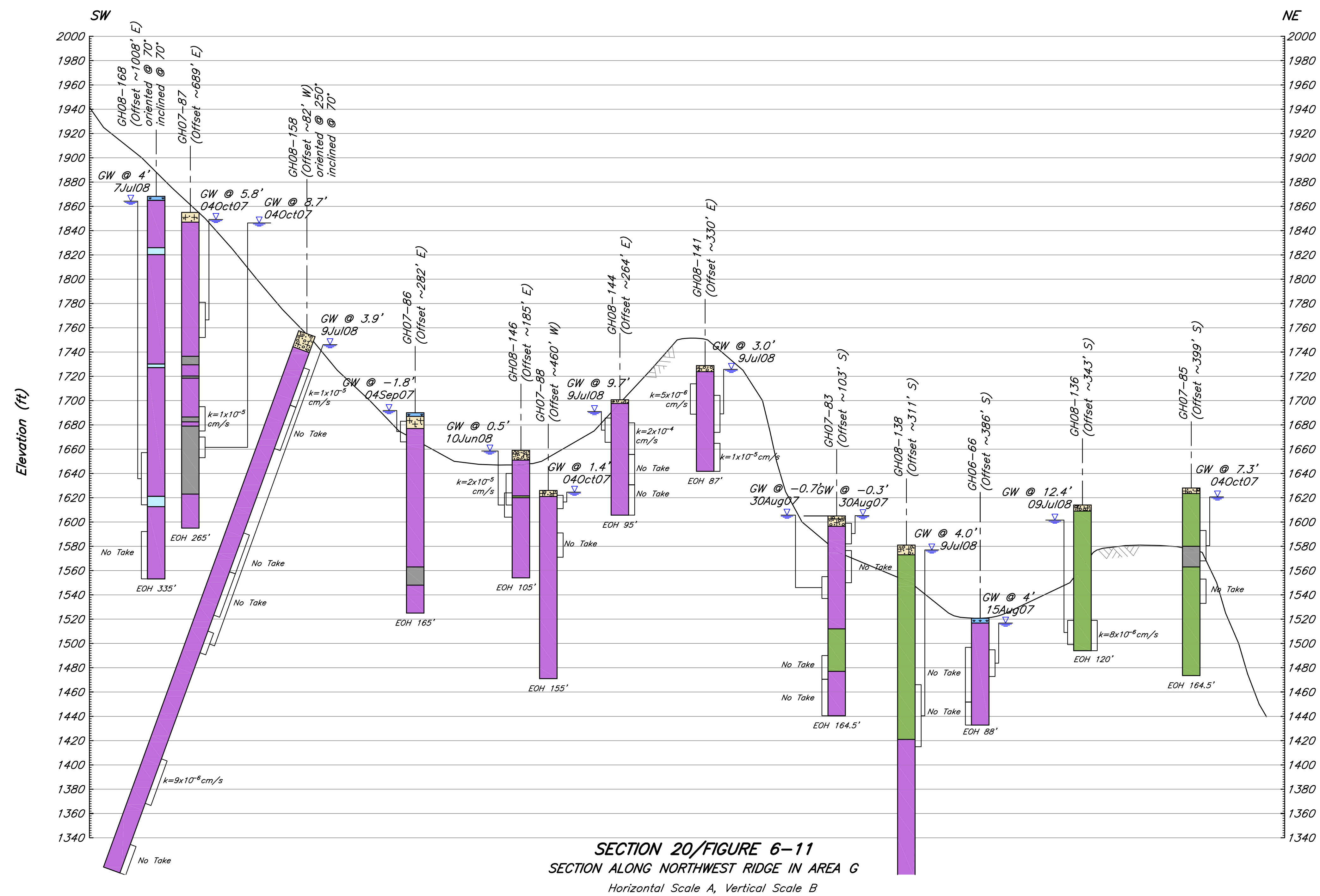

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

Glacial Deposits

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement

$k=1.2x10^{-4}$cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)

Ground surface

Interpreted groundwater level from seismic data

Interpreted bedrock surface from seismic and drillhole data

EOH — Depth to end of drillhole

THE pebble PARTNERSHIP

Figure 6-32
Geologic Section
Northwest Ridge Area G

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
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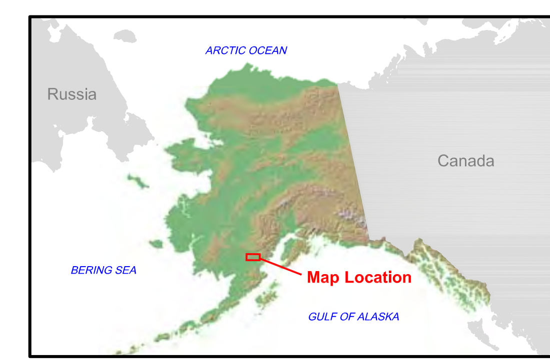

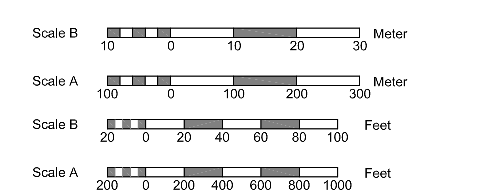

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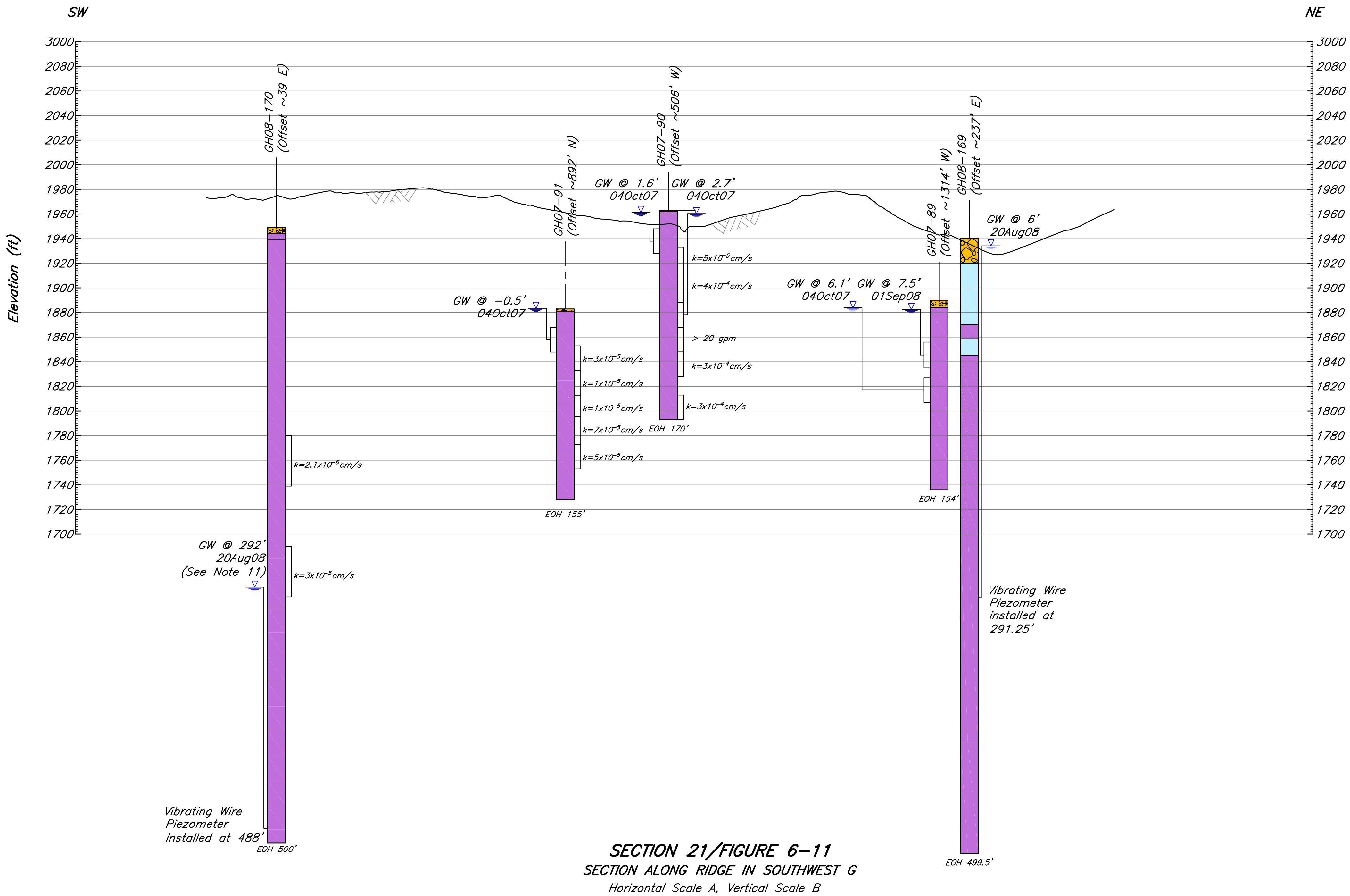

SECTION 21/FIGURE 6–11

SECTION ALONG RIDGE IN SOUTHWEST G

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Figure 6-33
Geologic Section Southwest Ridge Area G

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
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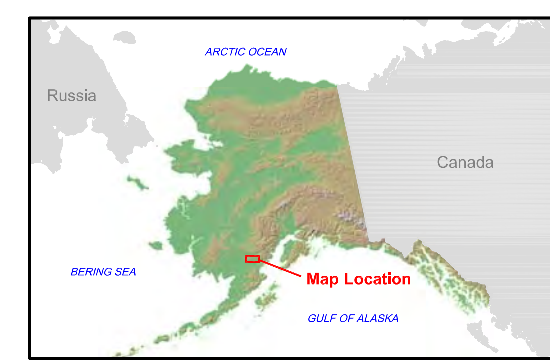

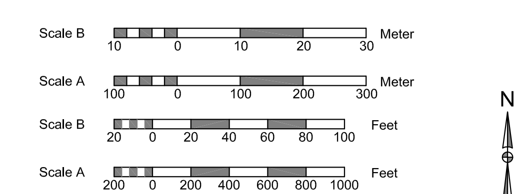

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Version: 2008-1	Author: Knight Piesold Ltd.

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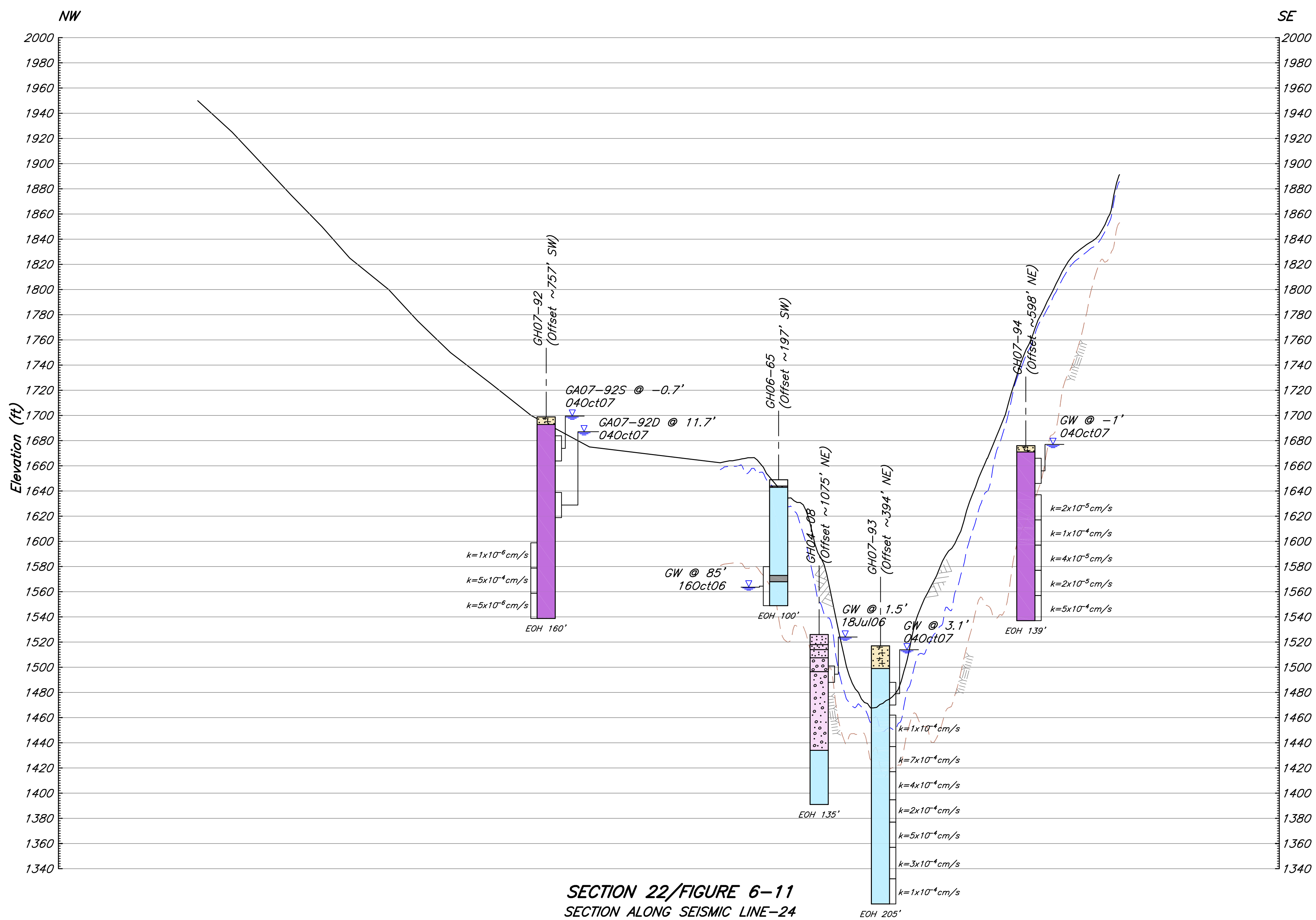
Figure 6-34
2008 Geologic Section Along Seismic Line-24 Area G



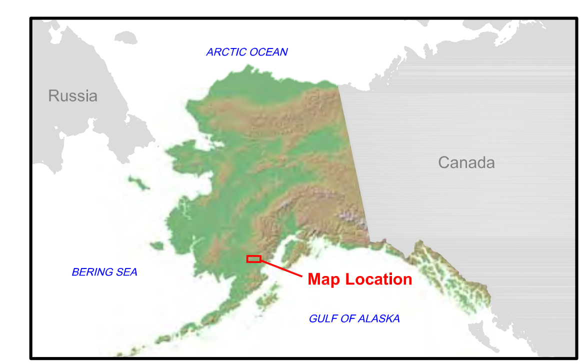
SECTION 22/FIGURE 6-11
SECTION ALONG SEISMIC LINE-24
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Glacial Deposits:
  - Alluvium
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

File: B34.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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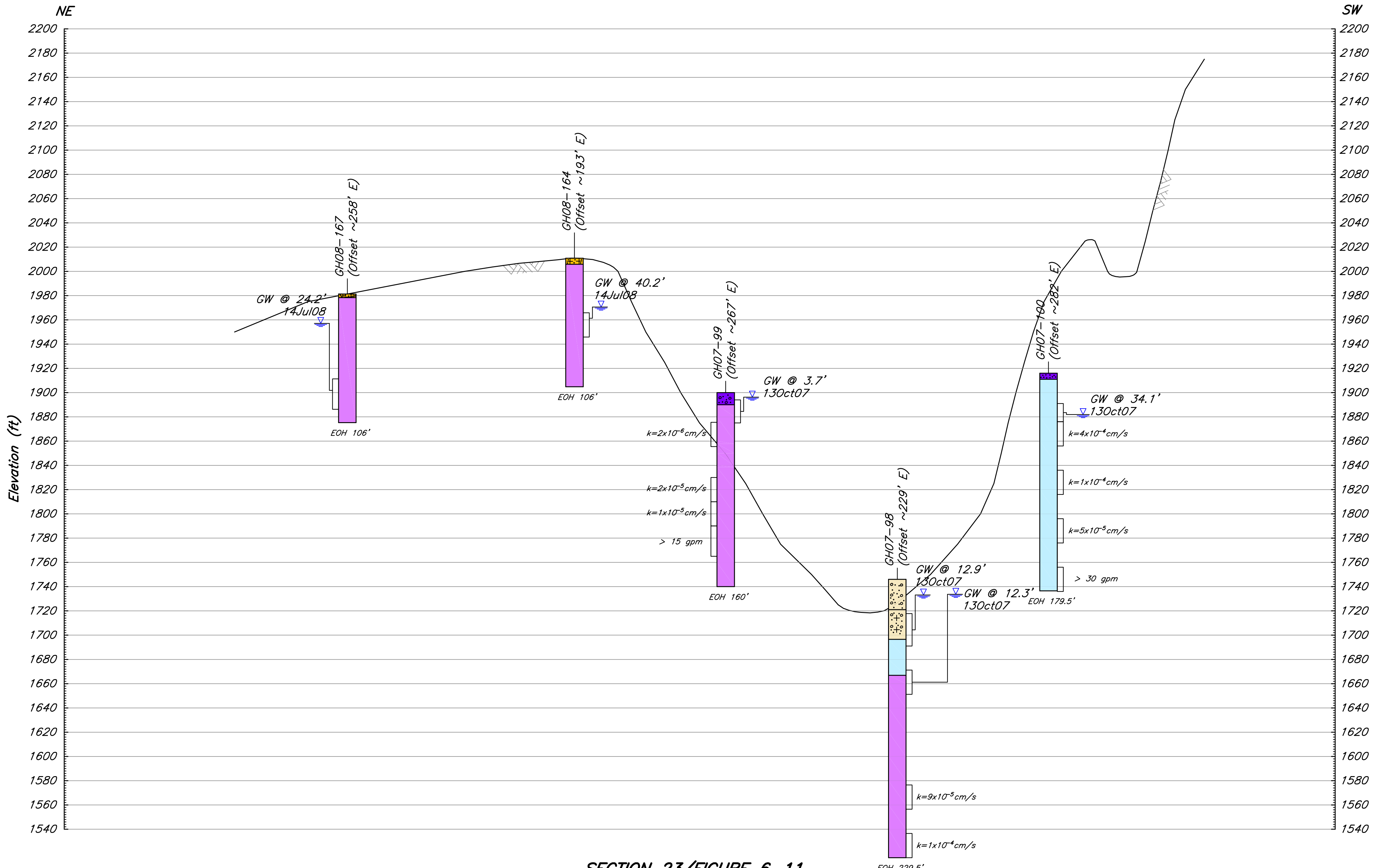
Figure 6-35
Geologic Section
East Ridge Area G



SECTION 23/FIGURE 6-11
EAST GEOLOGIC SECTION
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

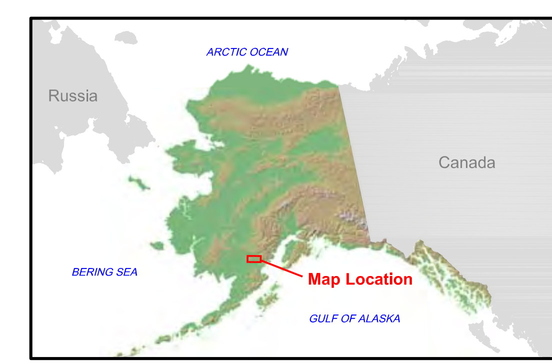
Glacial Deposits

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



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Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
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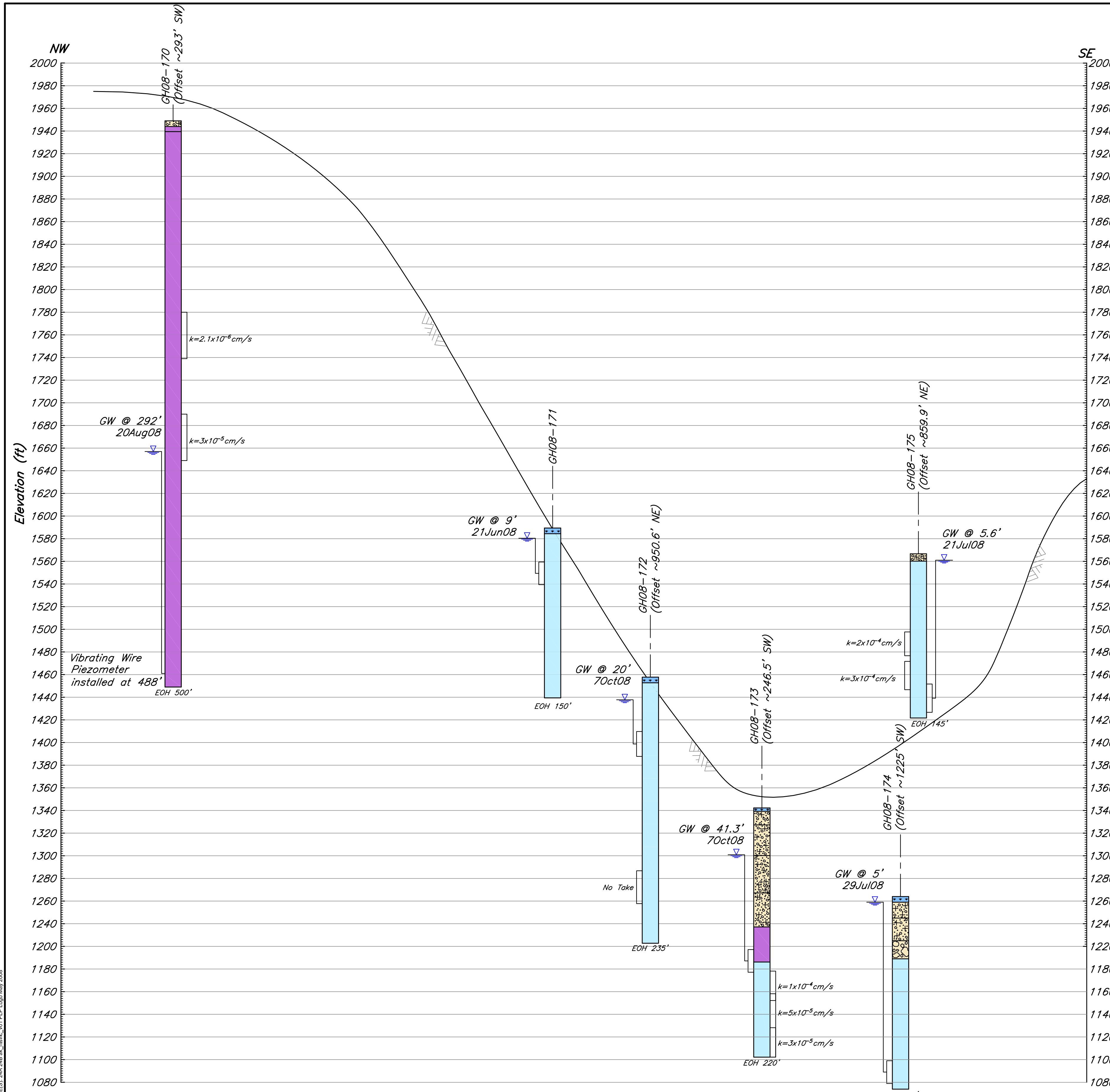
File: B35.dwg	Date: September 17, 2010
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 24/FIGURE 6-11

SECTION ACROSS NORTH AREA L

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10-4cm/s — Hydraulic conductivity from packer tests in centimeters per second (cw/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

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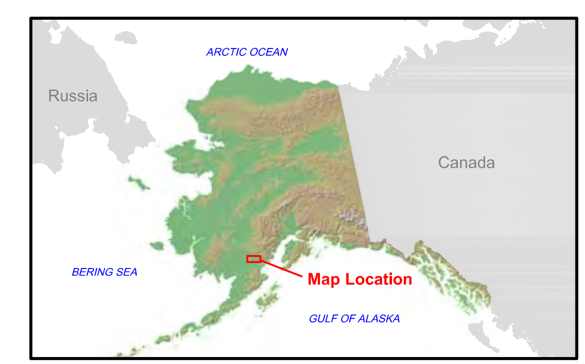
Figure 6-36 Geologic Section North Area L

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

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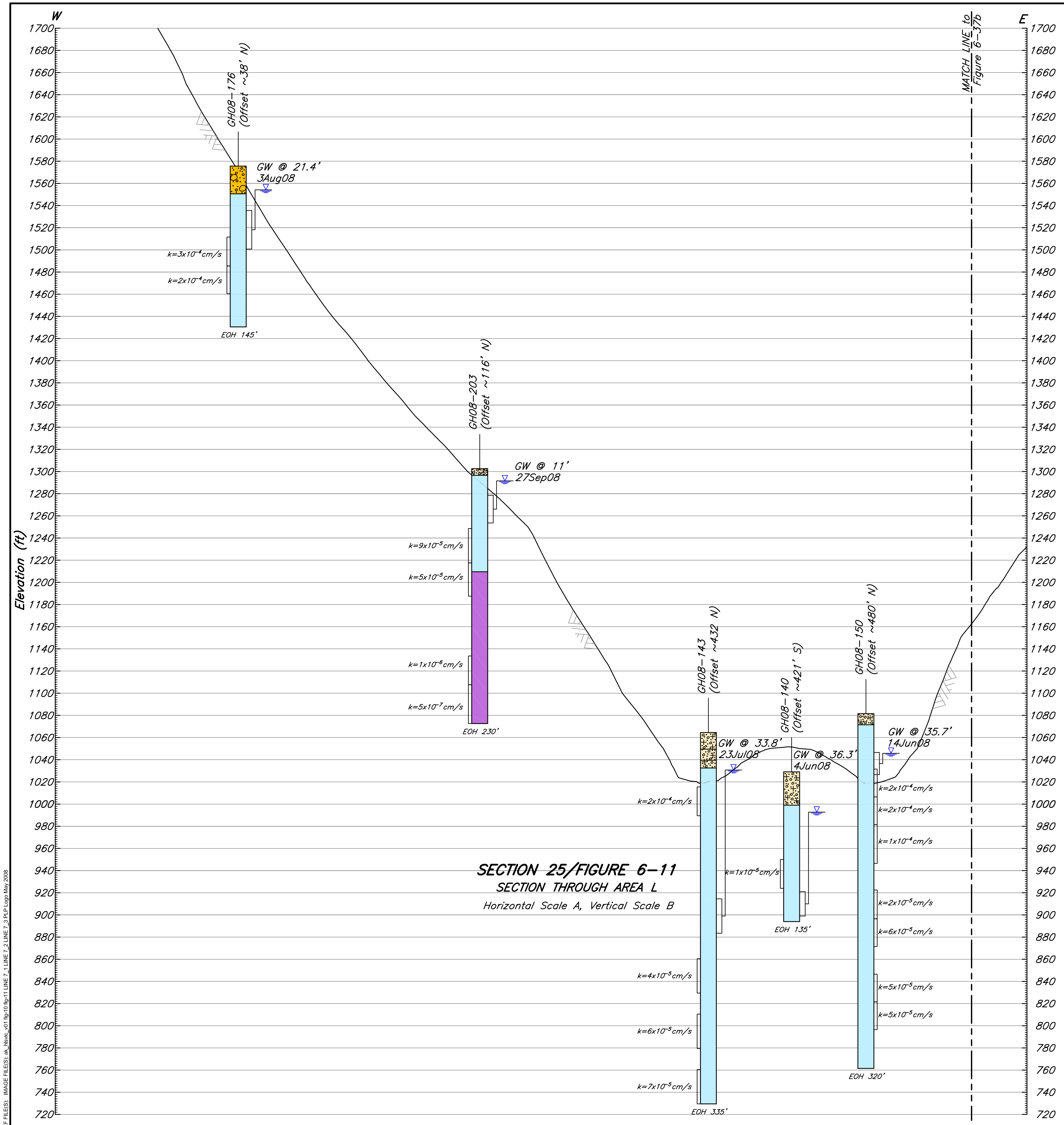
Version: 2008-1	Author: Knight Piesold Ltd.



Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit

- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cw/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

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Figure 6-37a
Geologic Section
Area L Sheet 1 of 2

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
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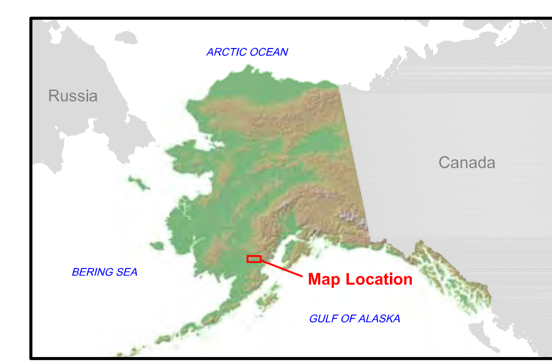
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B: 10 0 10 20 30 Meter
Scale A: 100 0 100 200 300 Meter
Scale B: 20 0 20 40 60 80 100 Feet
Scale A: 200 0 200 400 600 800 1000 Feet
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Version: 2008-1	Author: Knight Piesold Ltd.

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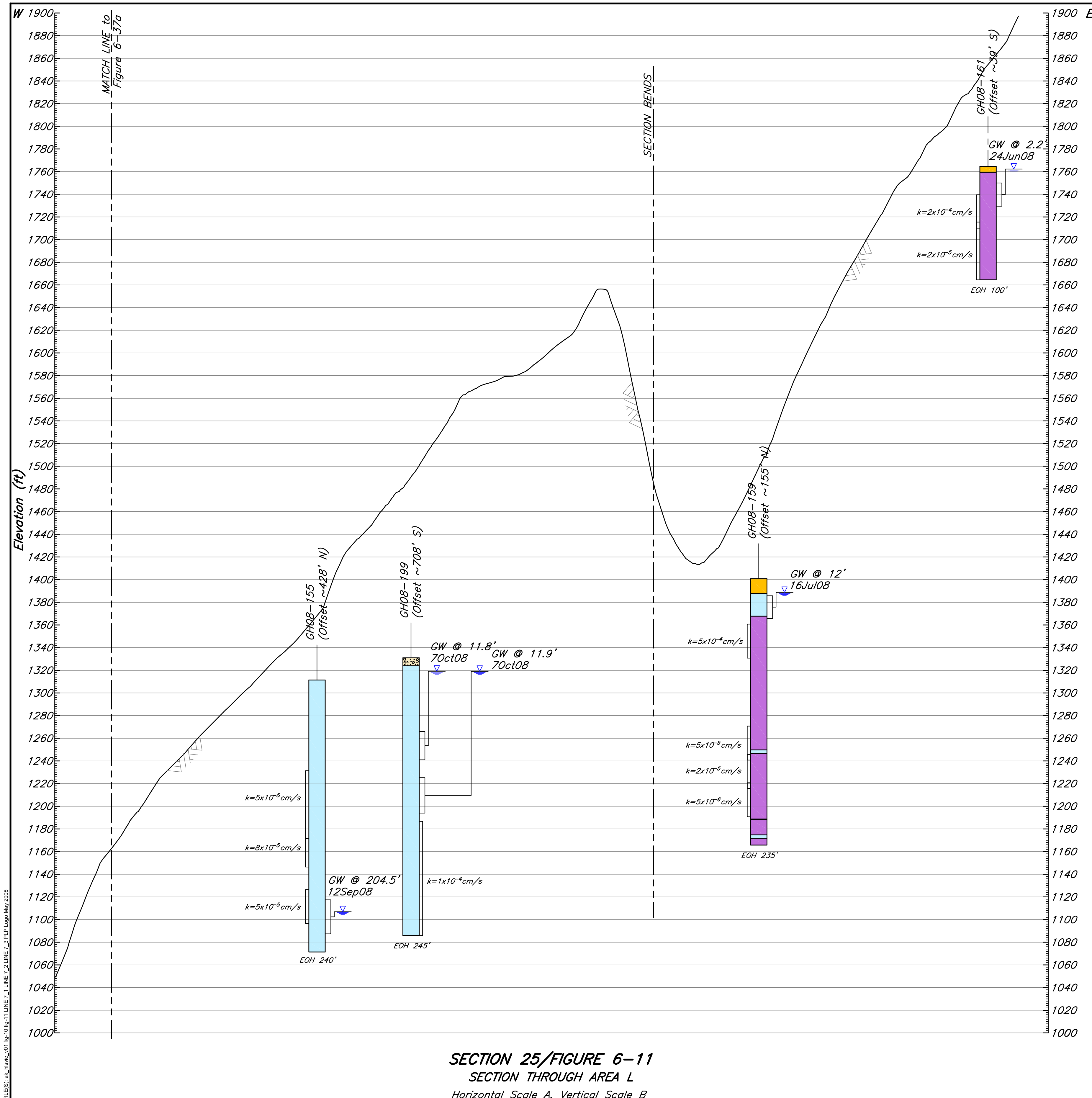

SECTION 25/FIGURE 6–11

SECTION THROUGH AREA L

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Glacial Deposits:
  - Alluvium
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cw/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

Figure 6-37b
Geologic Section
Area L Sheet 2 of 2

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
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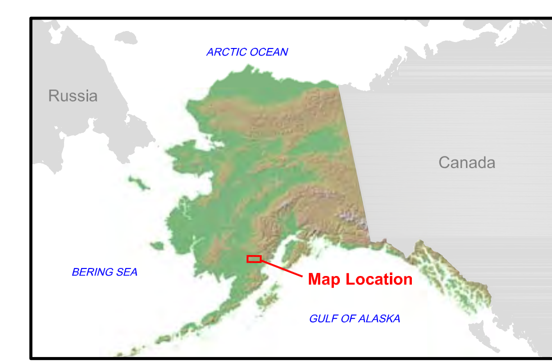
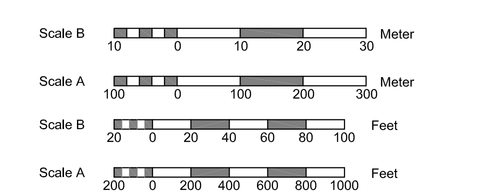
8. Bedrock geology defined by Pebble Partnership geologists.





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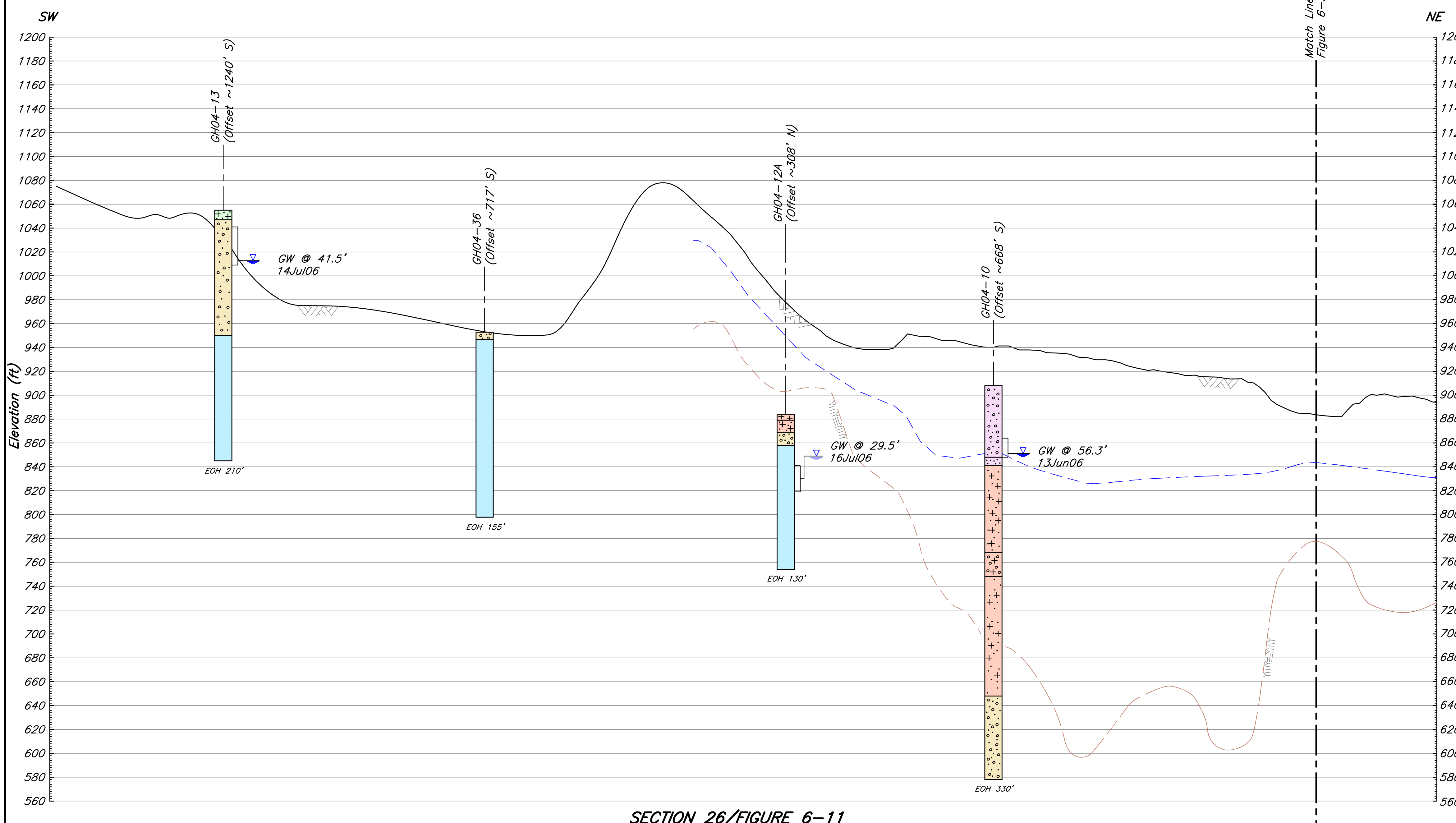
Version: 2008-1	Author: Knight Piesold Ltd.

Figure 6-38a
Geologic Section
Seismic Line-6
South Fork Koktuli River Area
Sheet 1 of 2



SECTION 26/FIGURE 6-11
SECTION ALONG SEISMIC LINE-6
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
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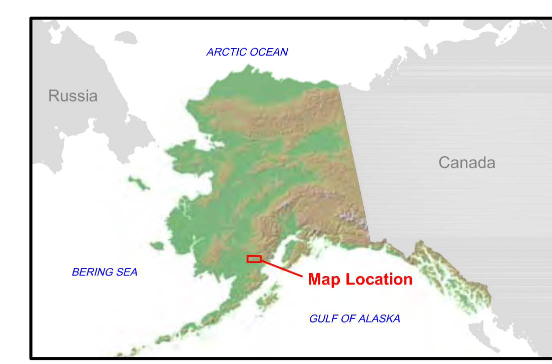
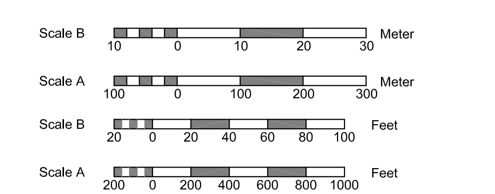
8. Bedrock geology defined by Pebble Partnership geologists.





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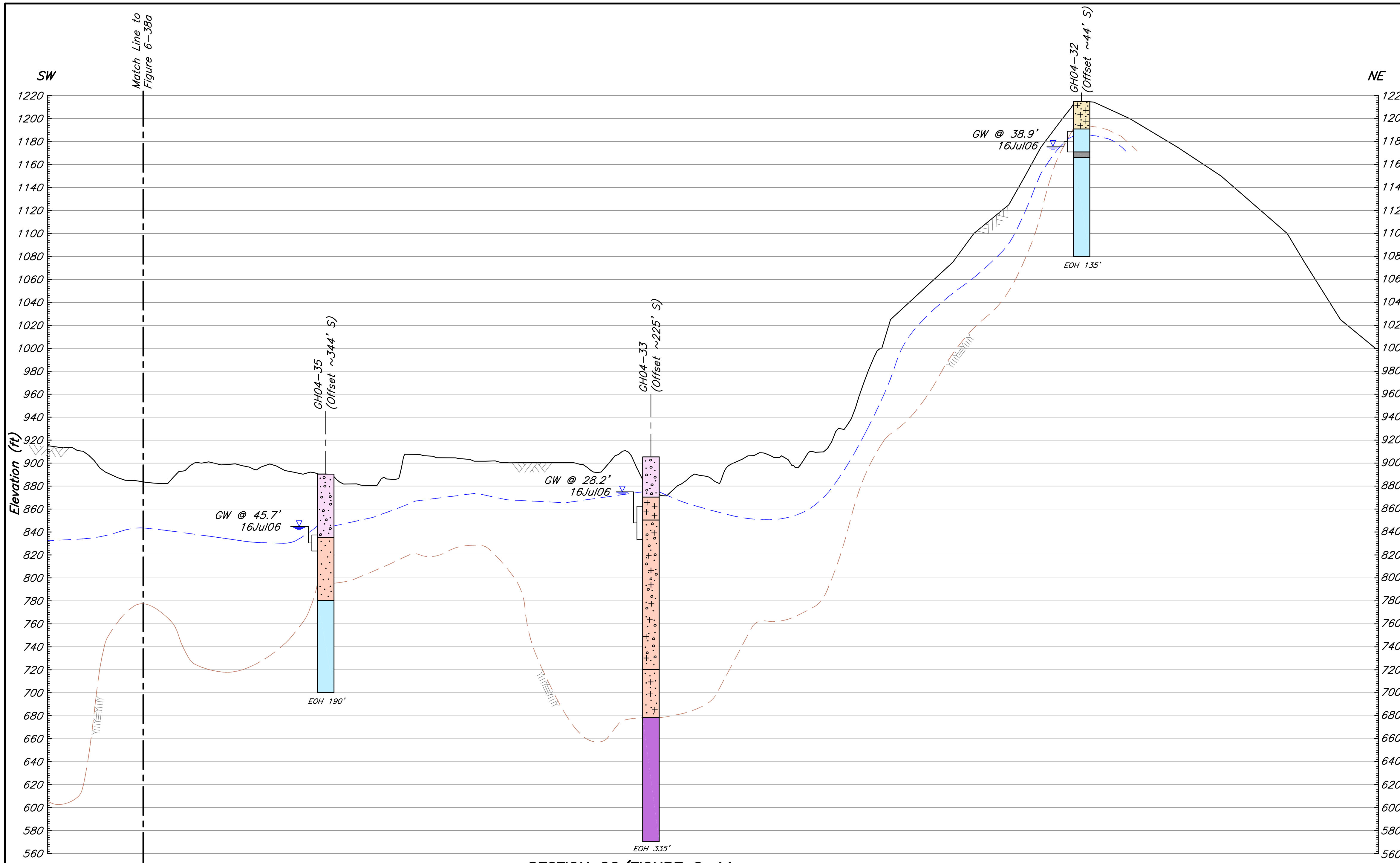
Version: 2008-1	Author: Knight Piesold Ltd.

Figure 6-38b
Geologic Section
Seismic Line-6
South Fork Koktuli River Area
Sheet 2 of 2



SECTION 26/FIGURE 6-11
SECTION ALONG SEISMIC LINE-6
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit

- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
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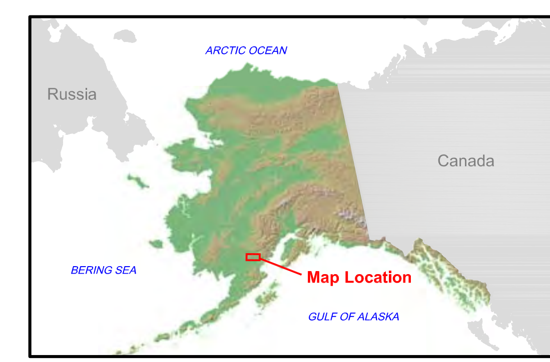

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Scale A 200 0 200 400 600 800 1000 Feet
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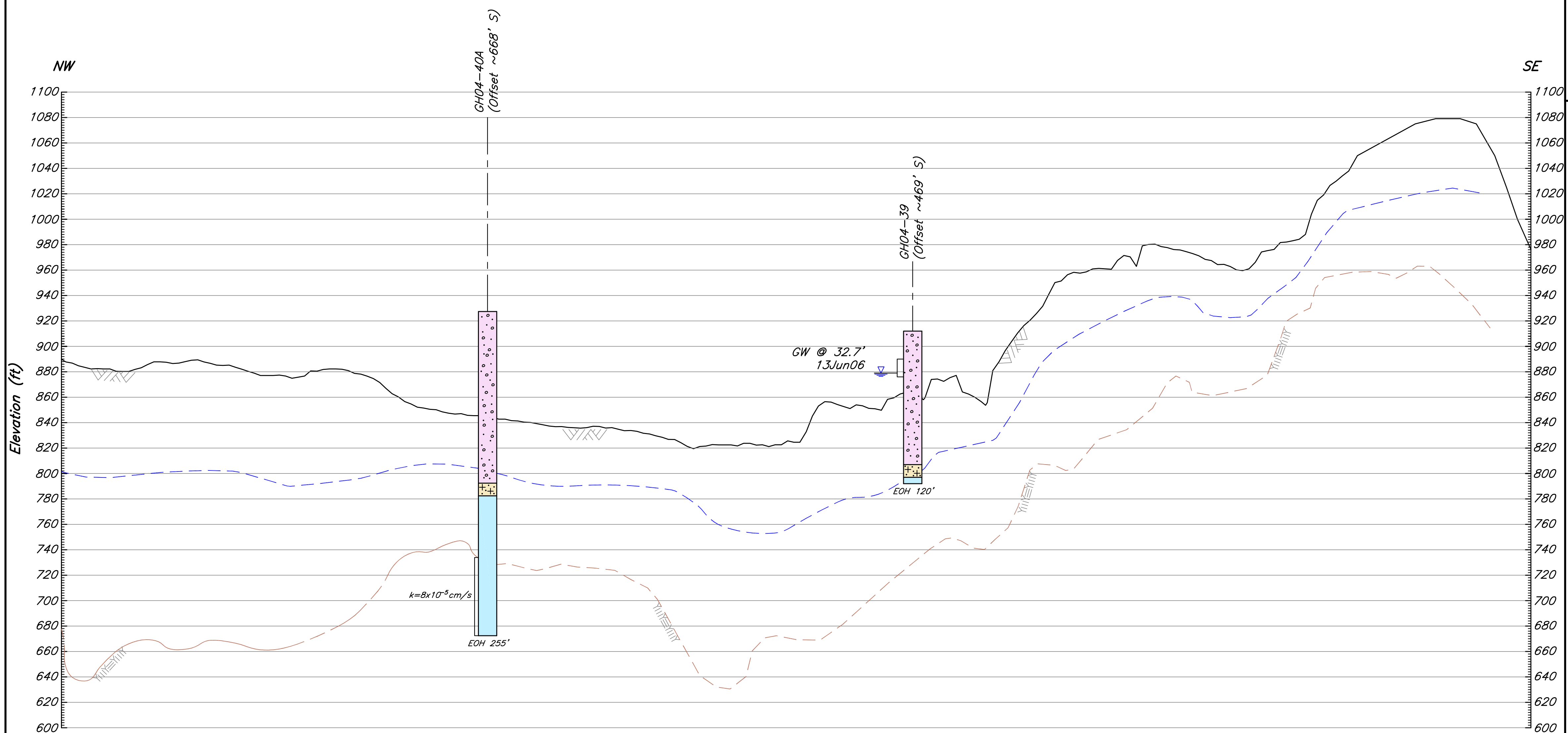

SECTION 27/FIGURE 6–11

SECTION ALONG SEISMIC LINE–7

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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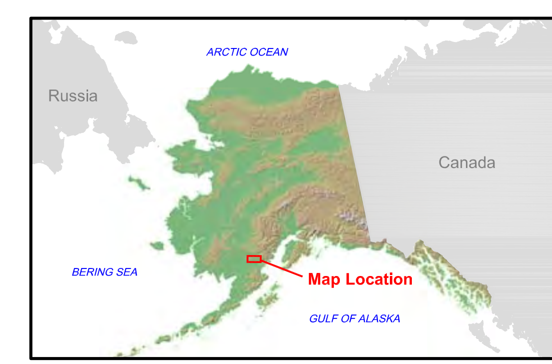
Figure 6-39
Geologic Section
Seismic Line-7
South Fork Koktuli River Area

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



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Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet

N

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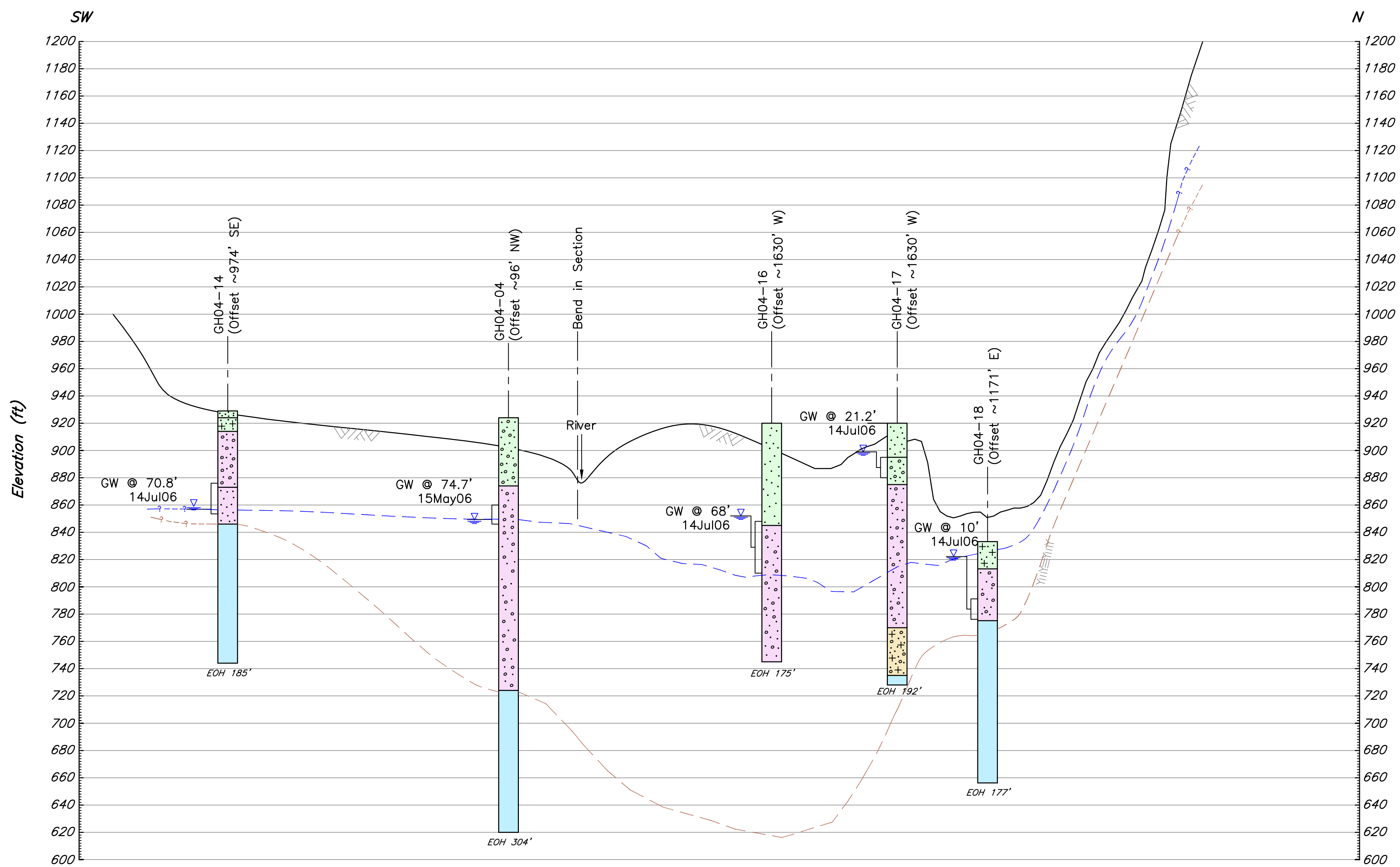

SECTION 28/FIGURE 6-11

SECTION ALONG SEISMIC LINE-8

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:

- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

GW @ 75' 12Apr06	Piezometer completion zone, measured groundwater level (GW) and date of measurement
$k=1.2\times10^{-4}$cm/s	Hydraulic conductivity from packer tests in centimeters per second (cm/s)
	Ground surface
	Interpreted groundwater level from seismic data
	Interpreted bedrock surface from seismic and drillhole data
EOH	Depth to end of drillhole

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Figure 6-40
Geologic Section
Seismic Line-8
South Fork Koktuli River Area

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
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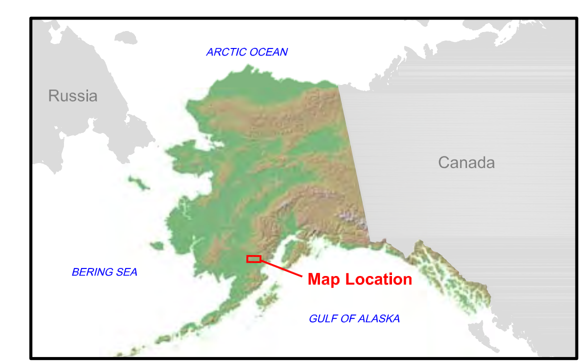

Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

N

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Version: 2008-1	Author: Knight Piesold Ltd.

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VANCOUVER B.C.

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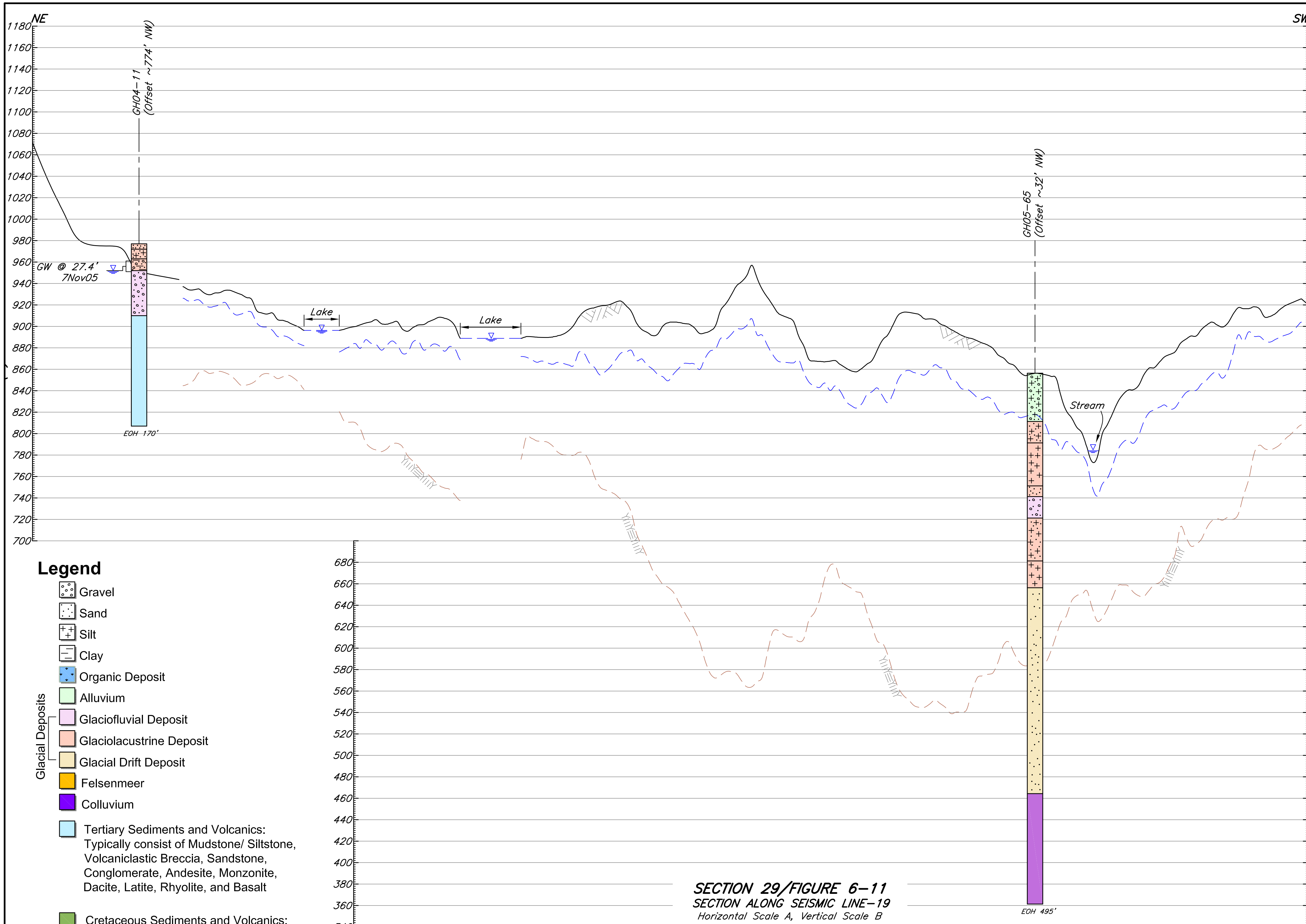
Figure 6-41
Geologic Section
Seismic Line-19
South Fork Koktuli River Area



Legend

Glacial Deposits
- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
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- Fault Zone

GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement

$k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cw/s)

Ground surface

Interpreted groundwater level from seismic data

Interpreted bedrock surface from seismic and drillhole data

EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
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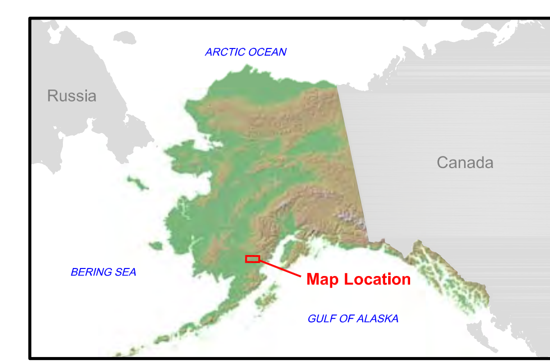
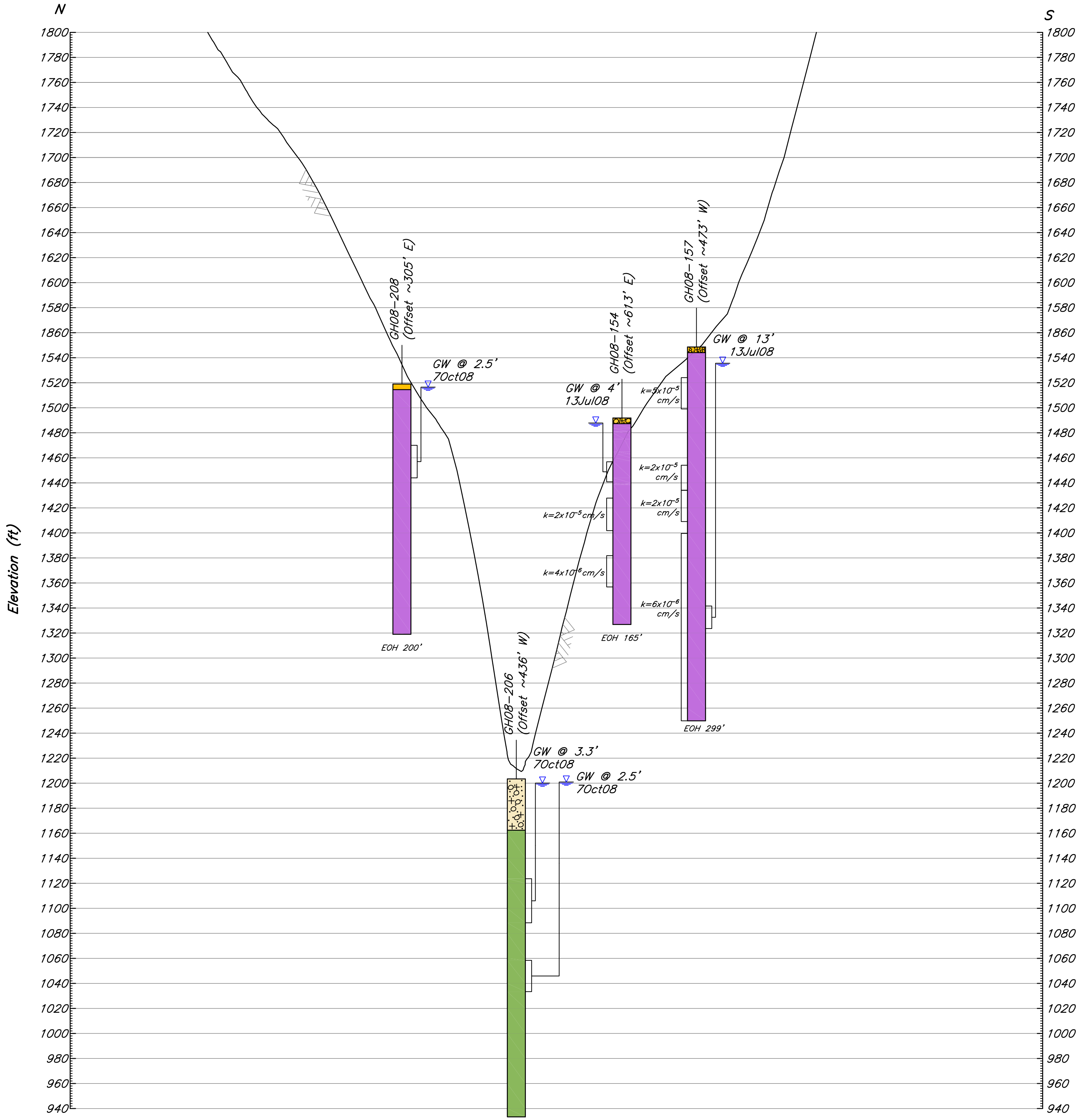
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B — Meter
Scale A — Meter
Scale B — Feet
Scale A — Feet

N

File: B43.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 30/FIGURE 6-11

SECTION ACROSS NORTH AREA J

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

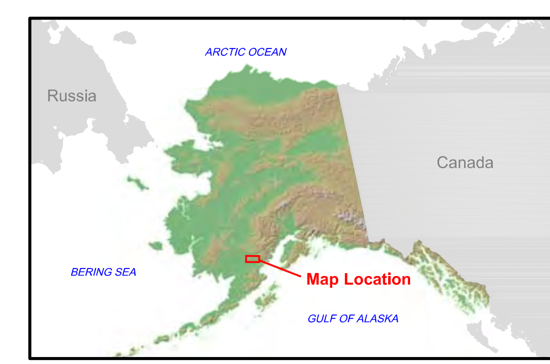
Glacial Deposits:
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}$cm/s — Hydraulic conductivity from packer tests in centimeters per second (cw/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

Figure 6-42
Geologic Section
Area J

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B — Meter; Scale A — Meter; Scale B — Feet; Scale A — Feet

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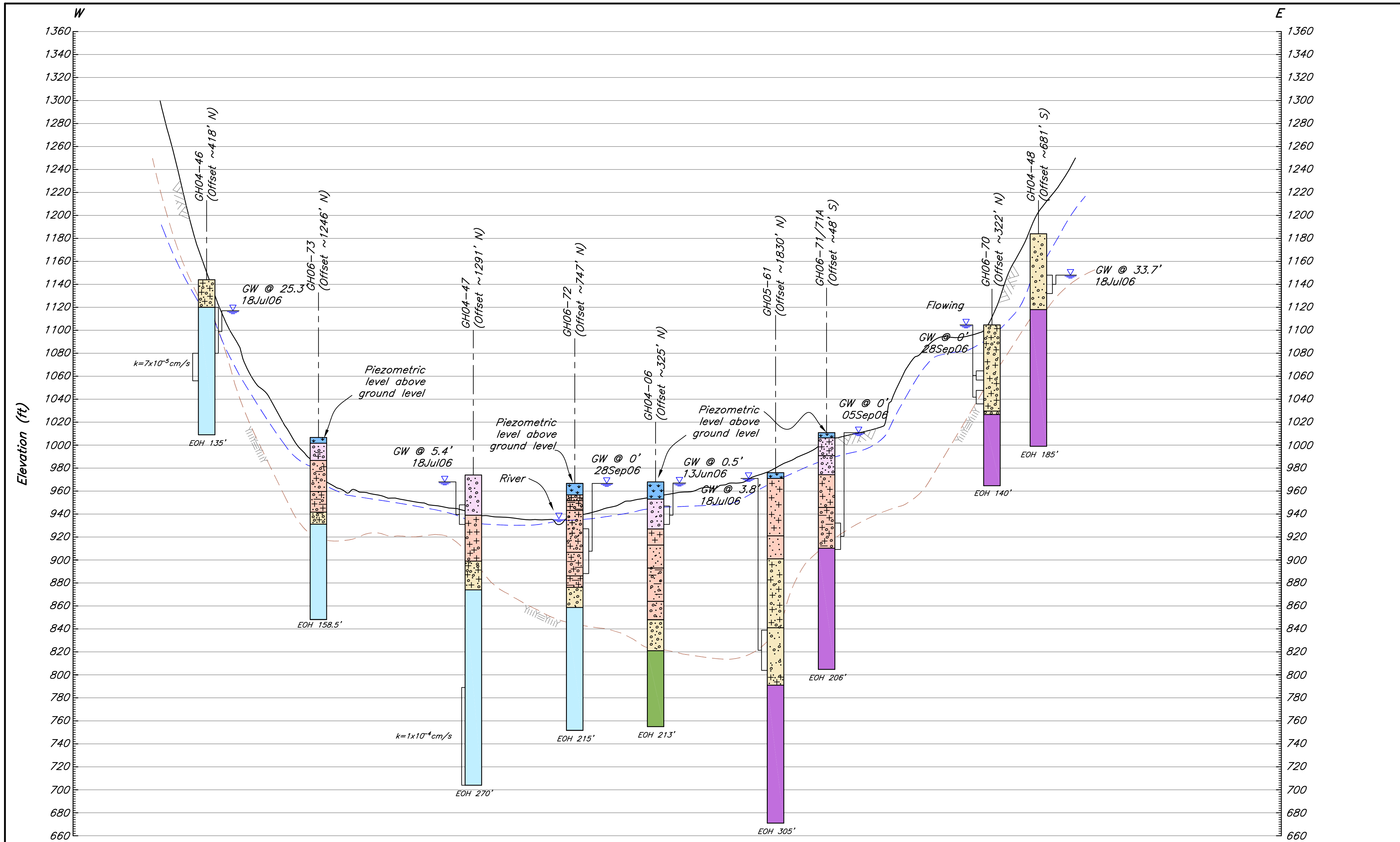
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 31/FIGURE 6-12

SECTION ALONG SEISMIC LINE-2

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Glacial Deposits:
  - Alluvium
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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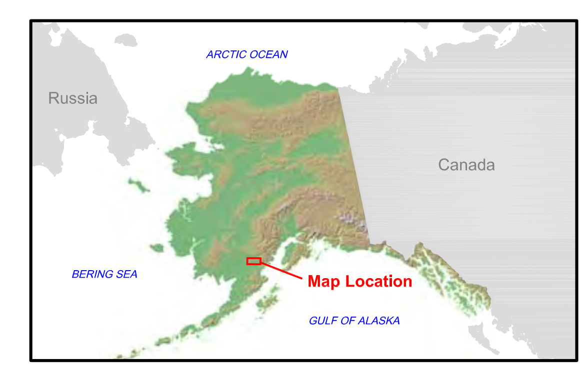
Figure 6-43
Geologic Section Seismic Line-2 Valley Bottom Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

N

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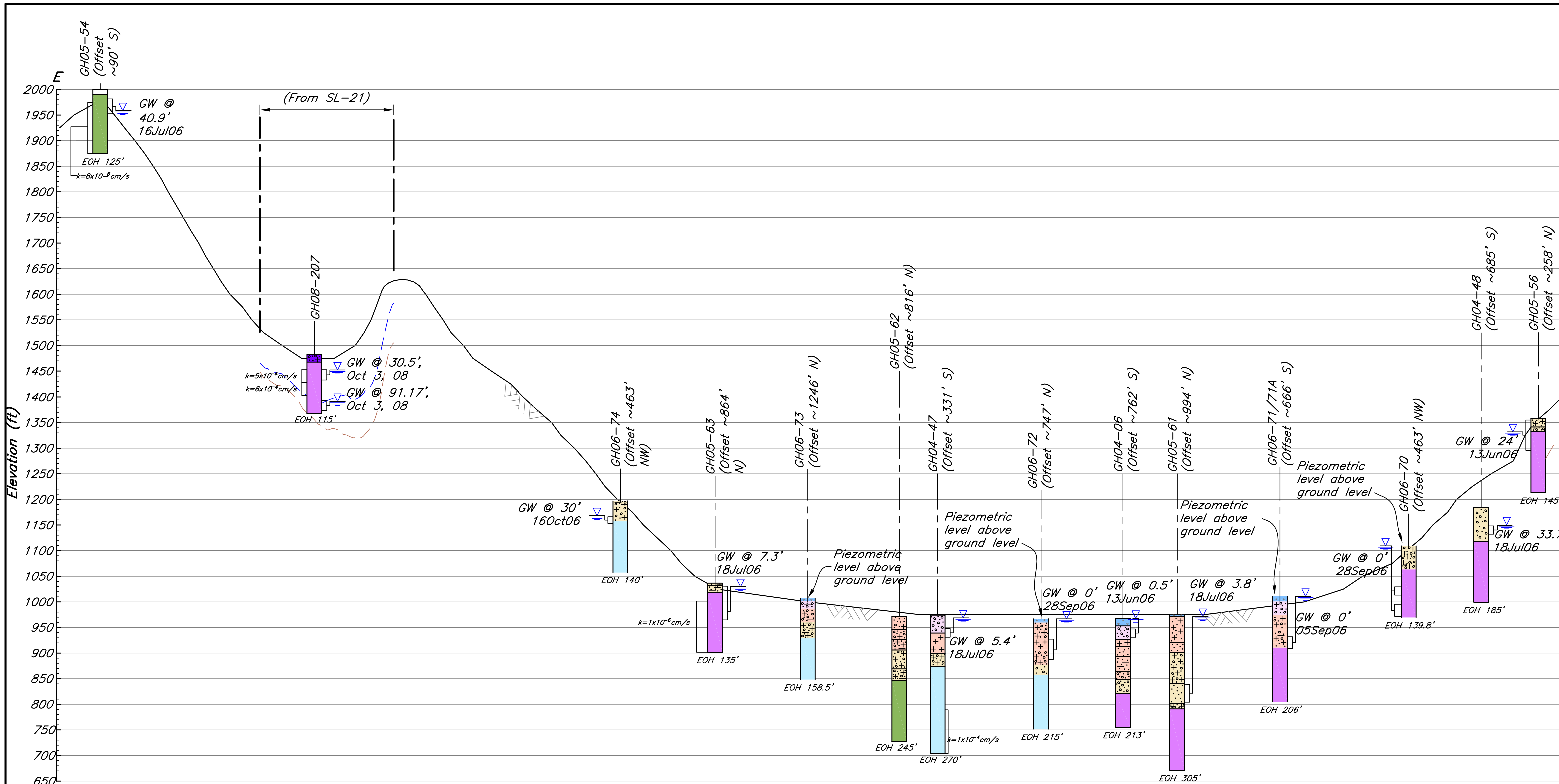
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 32/FIGURE 6–12

NORTH VALLEY BOTTOM GEOLOGIC SECTION

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits:
- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit

- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

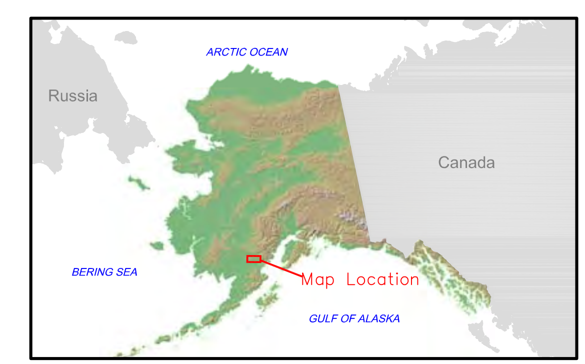
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

THE pebble PARTNERSHIP

Figure 6-44
Geologic Section
North Valley Bottom
Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B: 20 0 20 40 60 80 Meter
Scale A: 100 0 100 200 300 400 Meter
Scale B: 50 0 50 100 150 200 250 Feet
Scale A: 250 0 250 500 750 1000 1250 Feet

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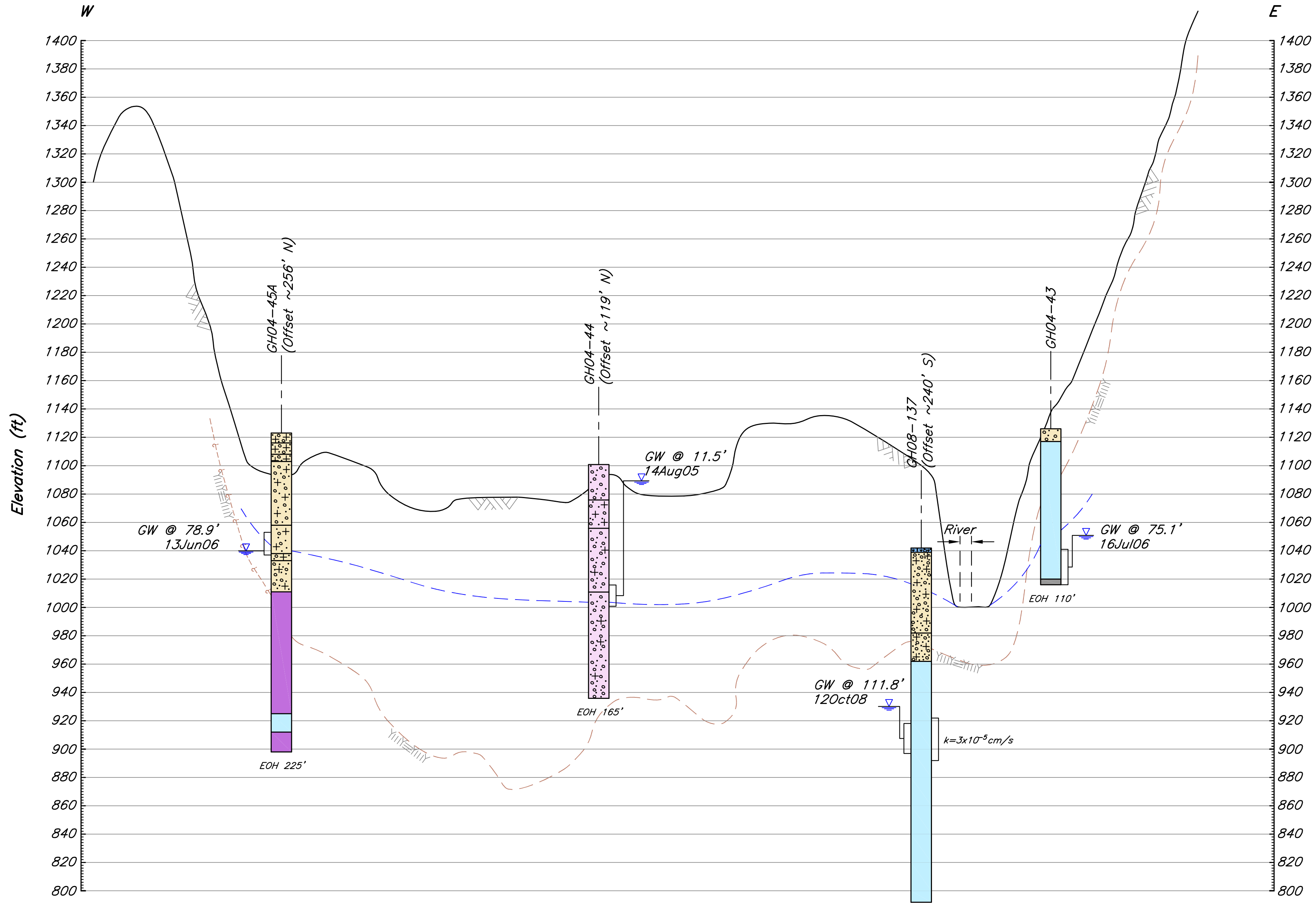
Figure 6-45
Geologic Section
Seismic Line-3
Southern Upland Area
Area A



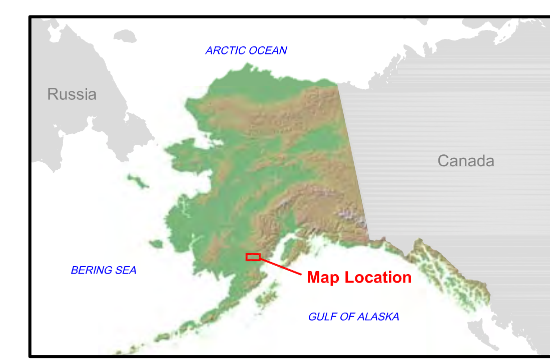
SECTION 33/FIGURE 6.11
SECTION ALONG SEISMIC LINE-3
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet
N

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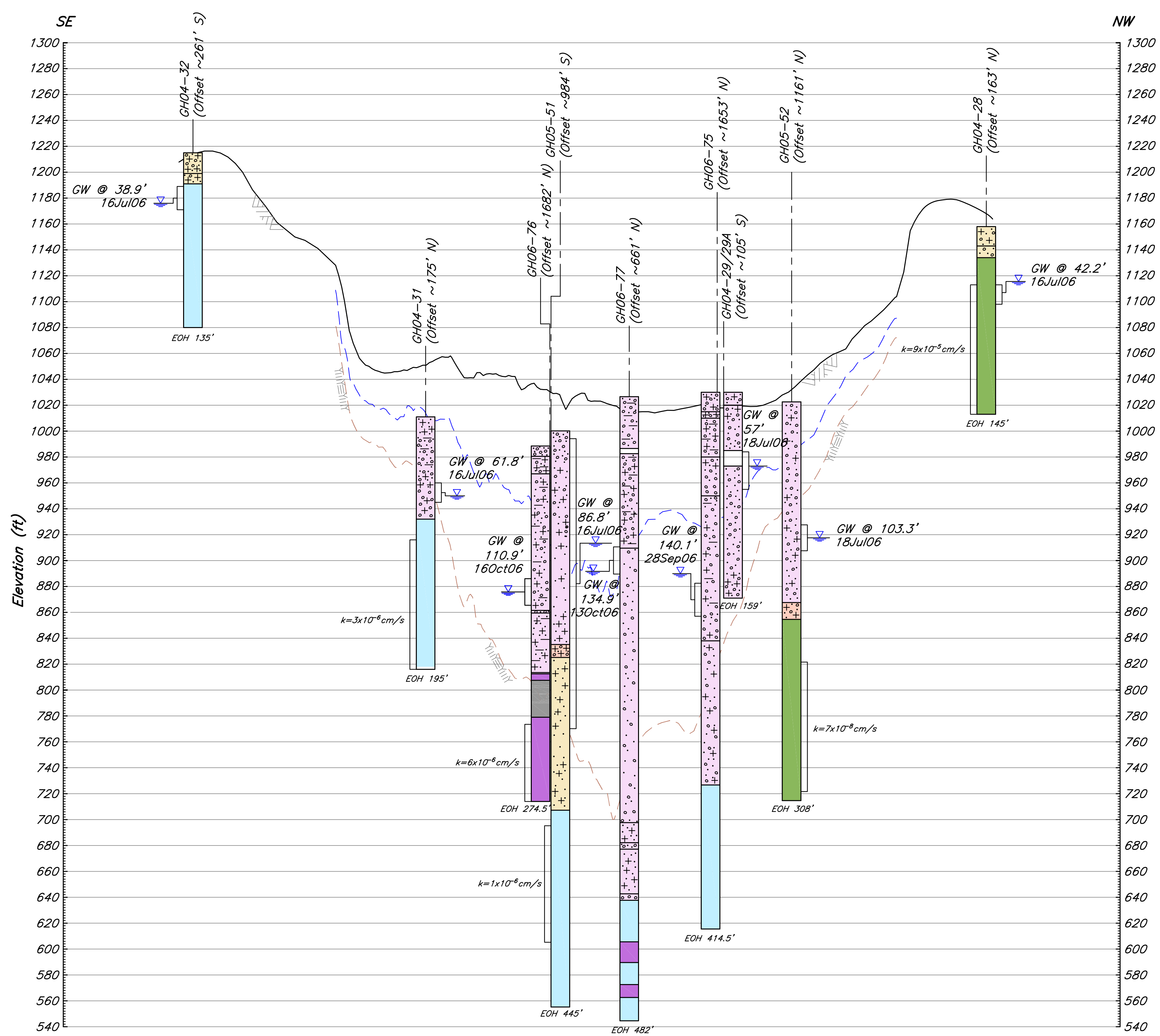
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 34/FIGURE 6–11

SECTION ALONG SEISMIC LINE–4

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium

Glacial Deposits

- Glaciofluvial Deposit
- Glaciolacustrine Deposit
- Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/ Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cw/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data

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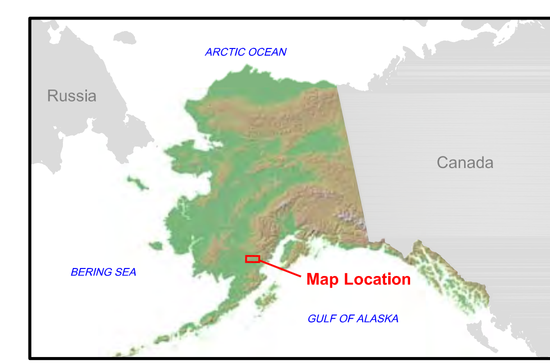
Figure 6-46
Geologic Section
Seismic Line-4
Southern Upland Area
Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter

Scale A 100 0 100 200 300 Meter

Scale B 20 0 20 40 60 80 100 Feet

Scale A 200 0 200 400 600 800 1000 Feet

N

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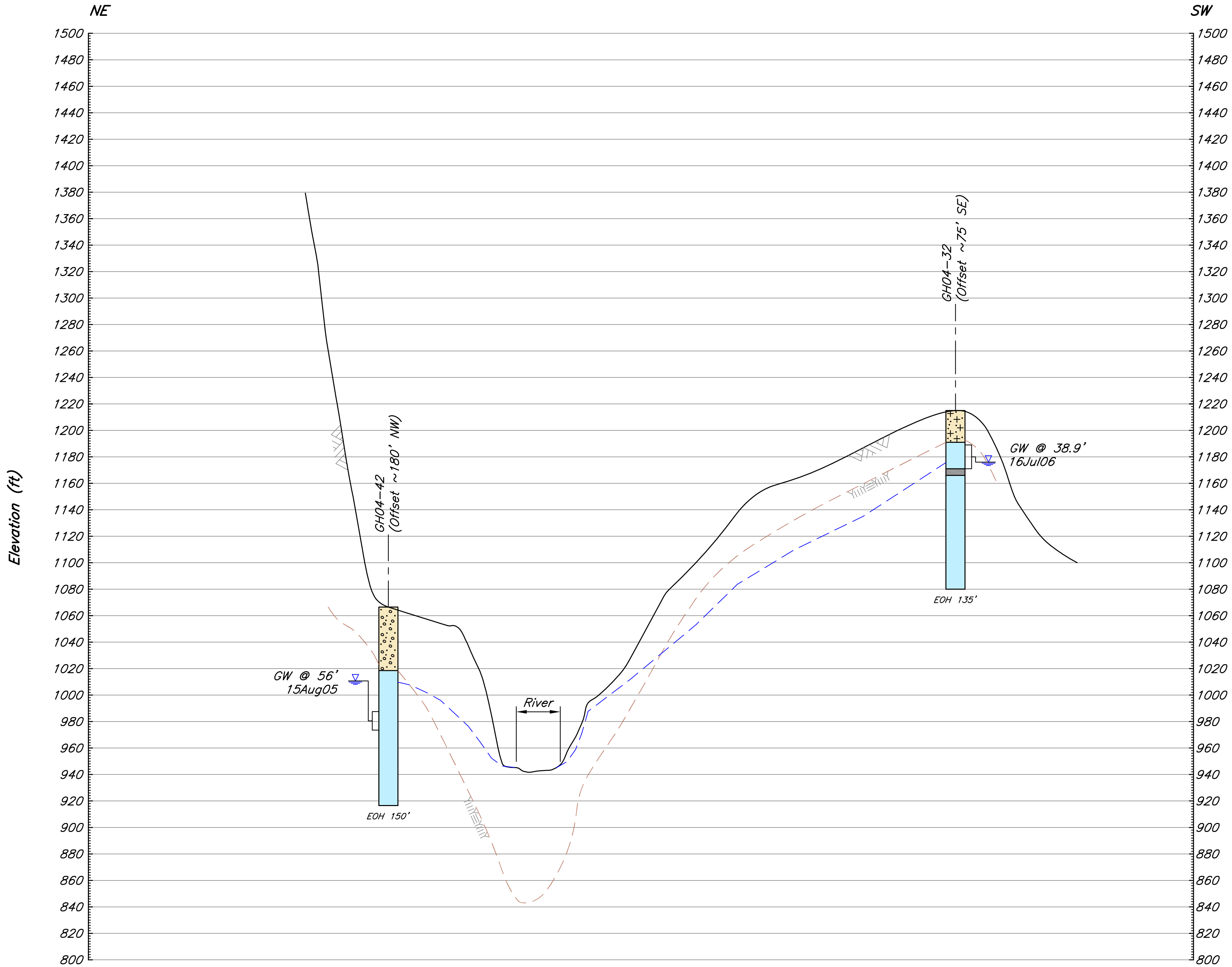
Version: 2008-1	Author: Knight Piesold Ltd.

Figure 6-47
Geologic Section
Seismic Line-5
Southern Upland Area
Area A



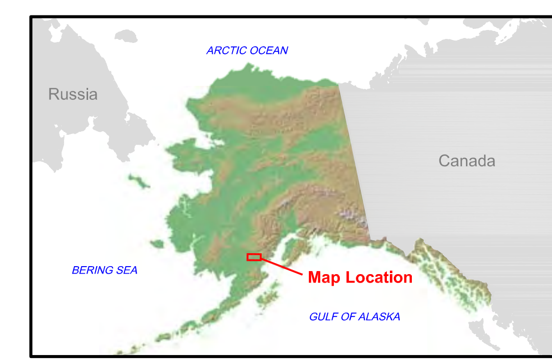
SECTION 35/FIGURE 6–11
SECTION ALONG SEISMIC LINE–5
Horizontal Scale A, Vertical Scale B

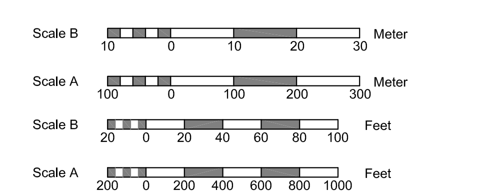
Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.





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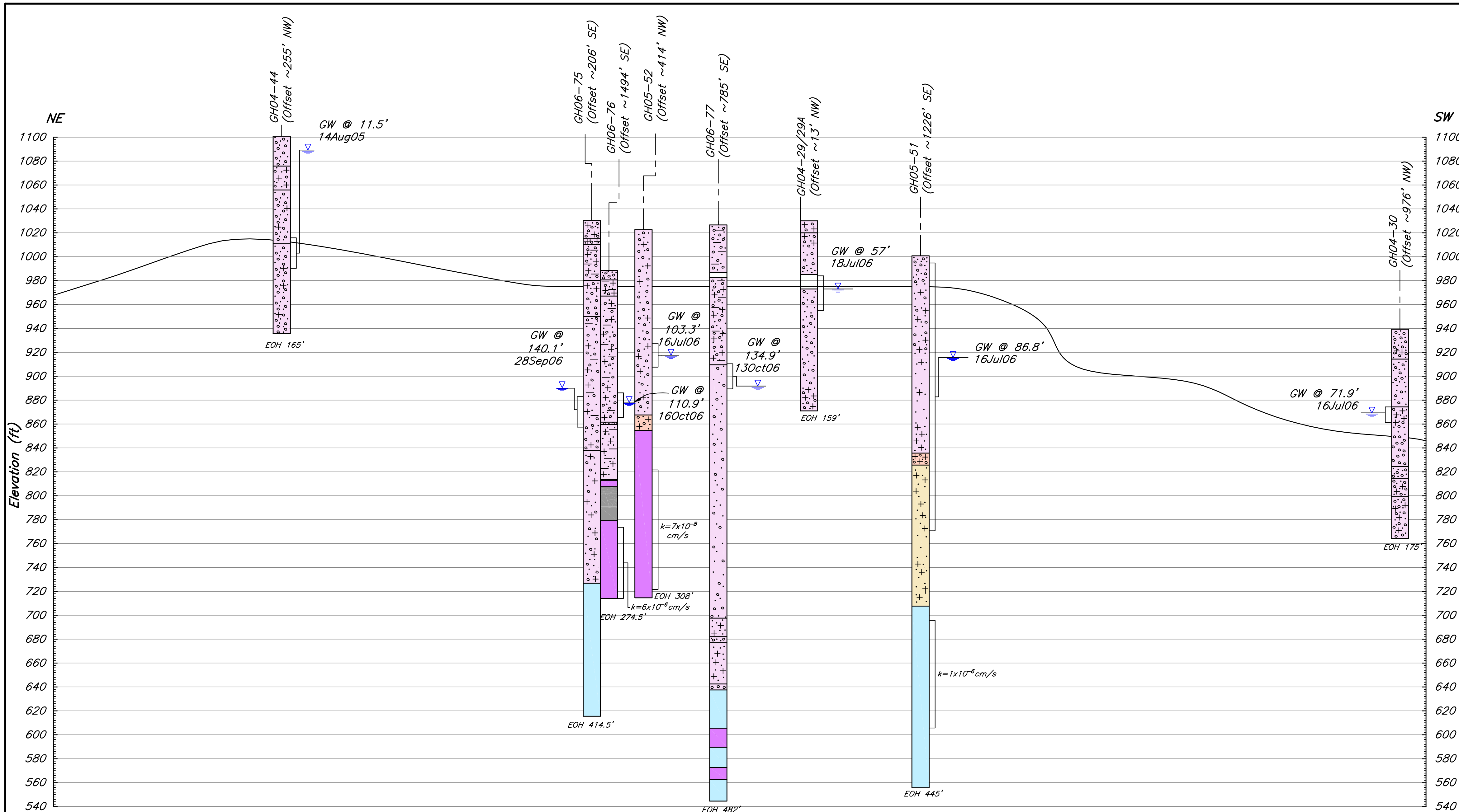

SECTION 36/FIGURE 6–11

SOUTHWEST TRANSVERSE GEOLOGIC SECTION

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium
- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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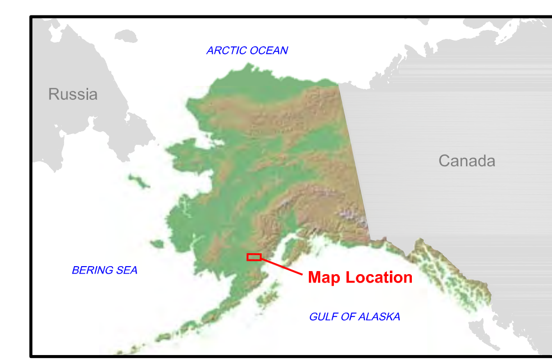
Figure 6-48
Geologic Section Southwest Transverse Southern Upland Area Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B 10 0 10 20 30 Meter
Scale A 100 0 100 200 300 Meter
Scale B 20 0 20 40 60 80 100 Feet
Scale A 200 0 200 400 600 800 1000 Feet

N

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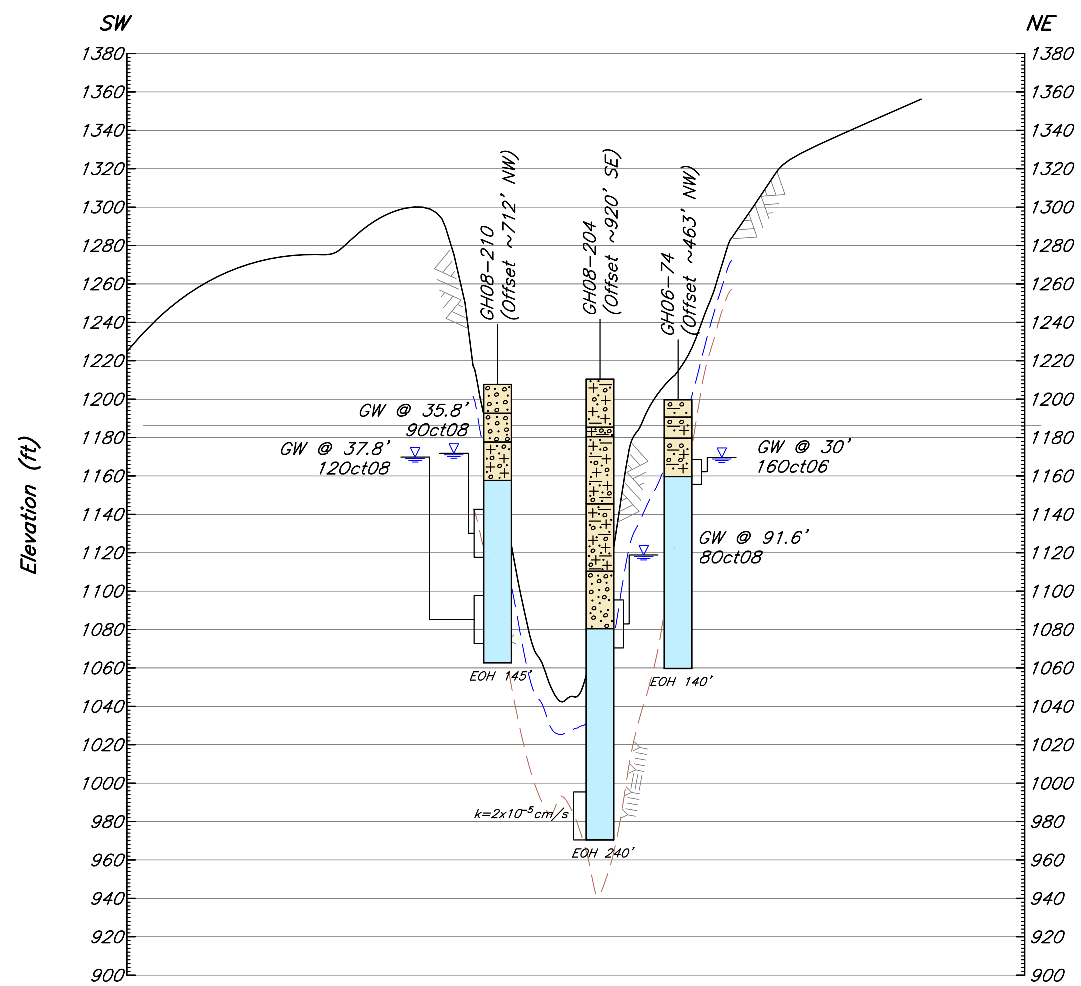
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 31/FIGURE 6-12
SECTION ALONG SEISMIC LINE-20
Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

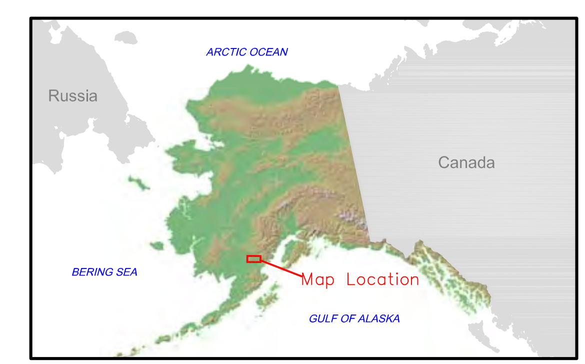
- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- k=1.2x10⁻⁴cm/s — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

THE pebble PARTNERSHIP

Figure 6-49
Geologic Section
Seismic Line-20
Lower/Mid Side Slopes
Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



Scale B: 10 0 10 20 30 Meter
Scale A: 100 0 100 200 300 Meter
Scale B: 20 0 20 40 60 80 100 Feet
Scale A: 200 0 200 400 600 800 1000 Feet
N

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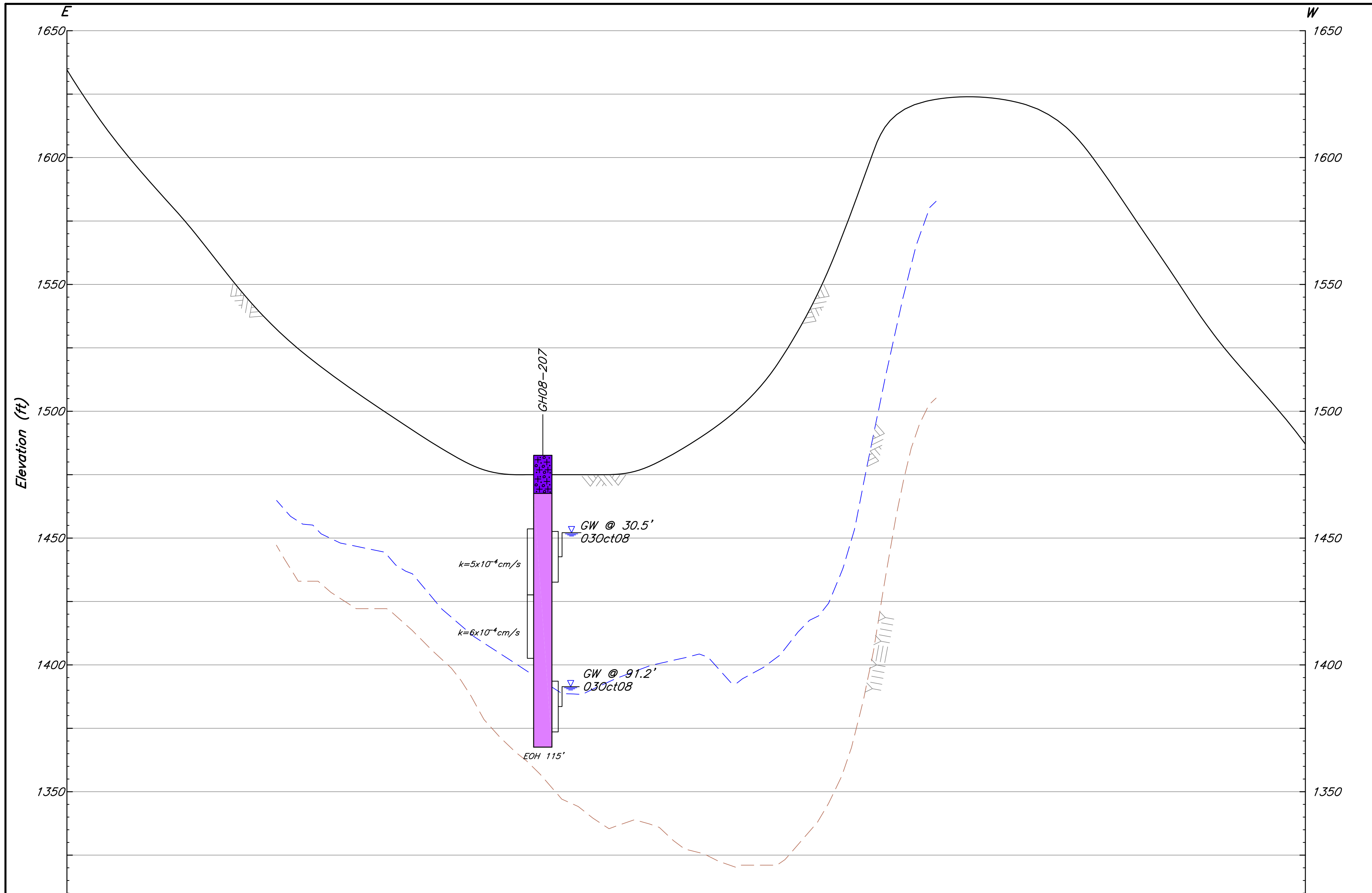
Version: 2008-1	Author: Knight Piesold Ltd.



SECTION 38/FIGURE 6-12

SECTION ALONG SEISMIC LINE-21

Horizontal Scale A, Vertical Scale B

Legend

- Gravel
- Sand
- Silt
- Clay
- Organic Deposit
- Alluvium
- Glacial Deposits:
  - Glaciofluvial Deposit
  - Glaciolacustrine Deposit
  - Glacial Drift Deposit
- Felsenmeer
- Colluvium

- Tertiary Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Volcaniclastic Breccia, Sandstone, Conglomerate, Andesite, Monzonite, Dacite, Latite, Rhyolite, and Basalt
- Cretaceous Sediments and Volcanics: Typically consist of Mudstone/Siltstone, Conglomerate, Sandstone, and Basalt
- Cretaceous Intrusive: Typically consist of Granodiorite, Monzonite, Monzodiorite, Porphyritic Monzodiorite, Diorite, and Gabbro
- Fault Zone

- GW @ 75' 12Apr06 — Piezometer completion zone, measured groundwater level (GW) and date of measurement
- $k=1.2x10^{-4}cm/s$ — Hydraulic conductivity from packer tests in centimeters per second (cm/s)
- Ground surface
- Interpreted groundwater level from seismic data
- Interpreted bedrock surface from seismic and drillhole data
- EOH — Depth to end of drillhole

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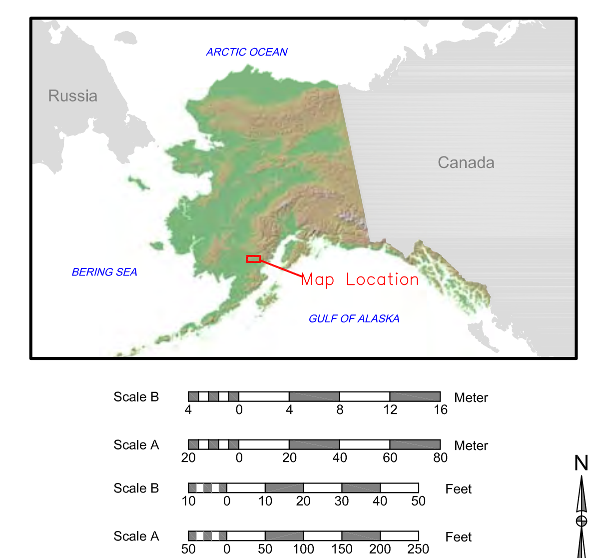
Figure 6-50
Geologic Section
Seismic Line-21
Upper Side Slopes
Area A

Notes

1. For section locations, see Figure 6-11 and FIgure 6-12.
2. Groundwater levels may vary seasonally. Measurements are from ground surface, unless otherwise indicated.
3. The strata indicated represent the major deposit types/particle sizes encountered in the drillholes. The gradation of the soils is anticipated to vary. The contact between deposit types is approximate; the transition may be gradual.
4. The stratigraphy between drillholes may vary.
5. Detailed drillhole data for 2004, 2005, 2006, 2007 and 2008 are found in KP, 2005b, 2007, 2008b, 2008a and 2009 respectively .
6. Seismic data provided by Frontier Geosciences Inc.
7. Drillhole intervals with no color were triconed and have minimal to no data available from cuttings or standard penetration test samples; therefore, the deposit type is unknown.
8. Bedrock geology defined by Pebble Partnership geologists.



File: B52.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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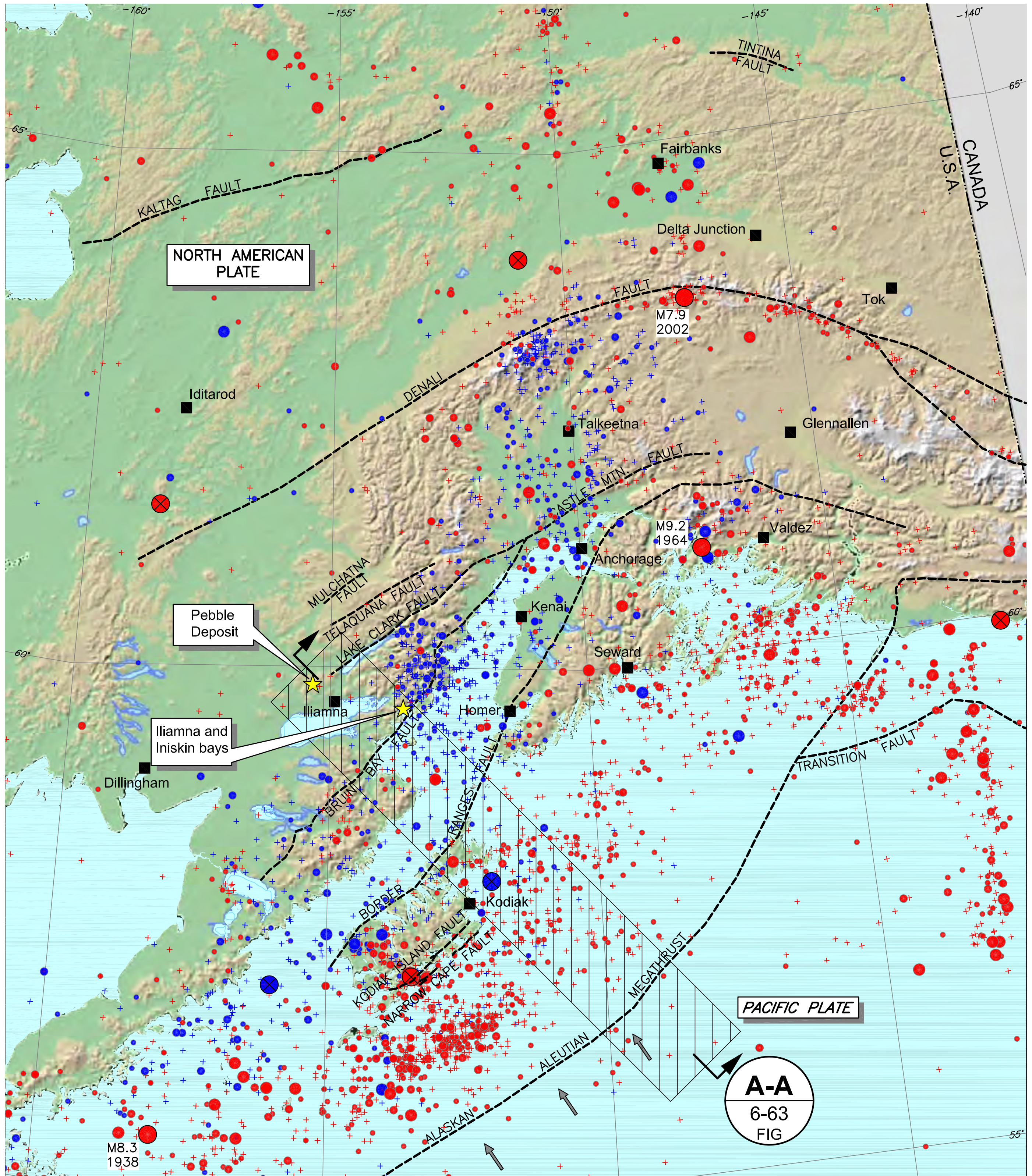
Figure 6-51
Seismicity of Southern Alaska Showing Distribution of Earthquakes by Depth



Legend

Active and potentially active faults

Zone of recorded earthquakes included on SECTION A-A

EARTHQUAKE FOCAL DEPTH

- Depth ≤ 25 miles
- Depth > 25 miles

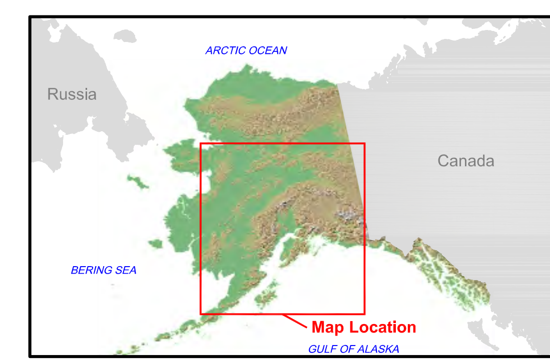
EARTHQUAKE MAGNITUDE

- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 +
- Large magnitude earthquakes recorded between 1899 & 1904

Location and direction of view for Geological Section

Notes

1. Historical seismicity data supplied by geoForecaster Inc., California.



Kilometers 50 0 50 100 150 200 250

Miles 50 0 50 100 150

N

File: B54.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

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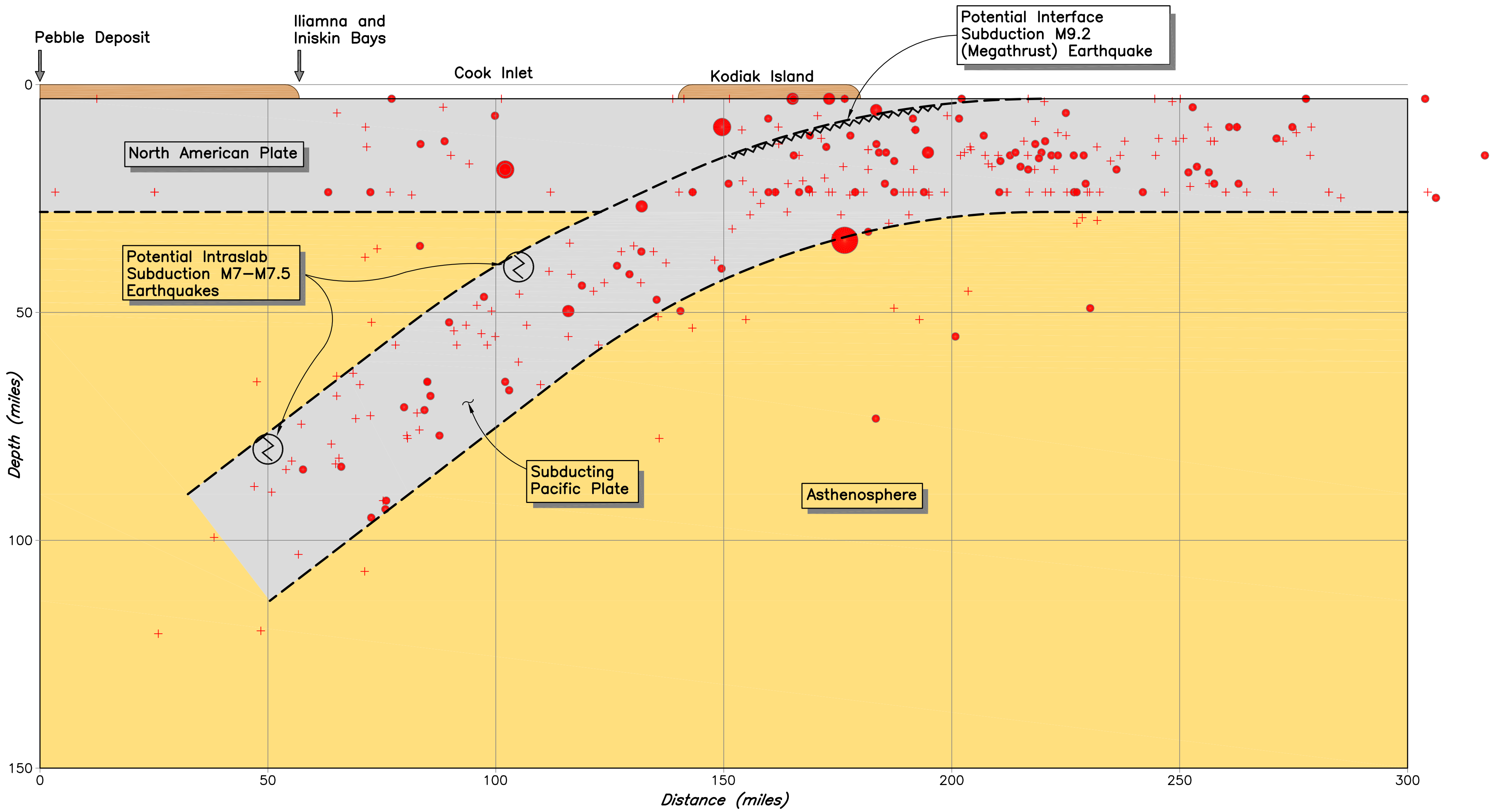
Figure 6-52
Schematic Section A-A through
Southern Alaska Subduction Zone



Legend

Earthquake Magnitude

- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 +

Lithosphere

Asthenosphere

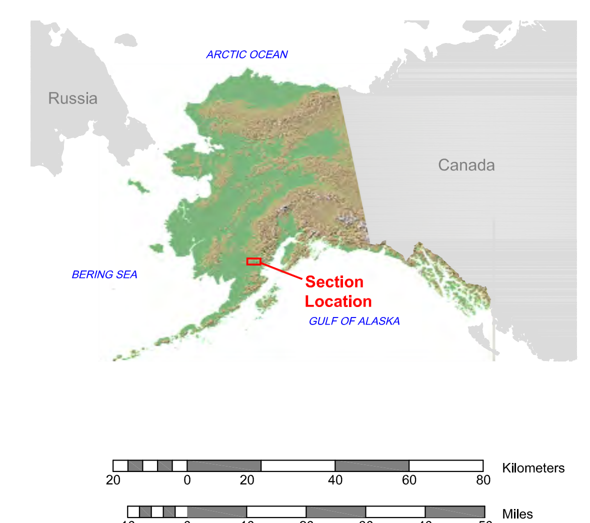
Plate Boundaries

Potential Interface Subduction Earthquake Site

Potential Intraslab Subduction Earthquake Site

Notes

1. Section shows recorded earthquakes within shaded zone for SECTION A-A on FIGURE 6-51.



File: B55.dwg	Date: September 20, 2010
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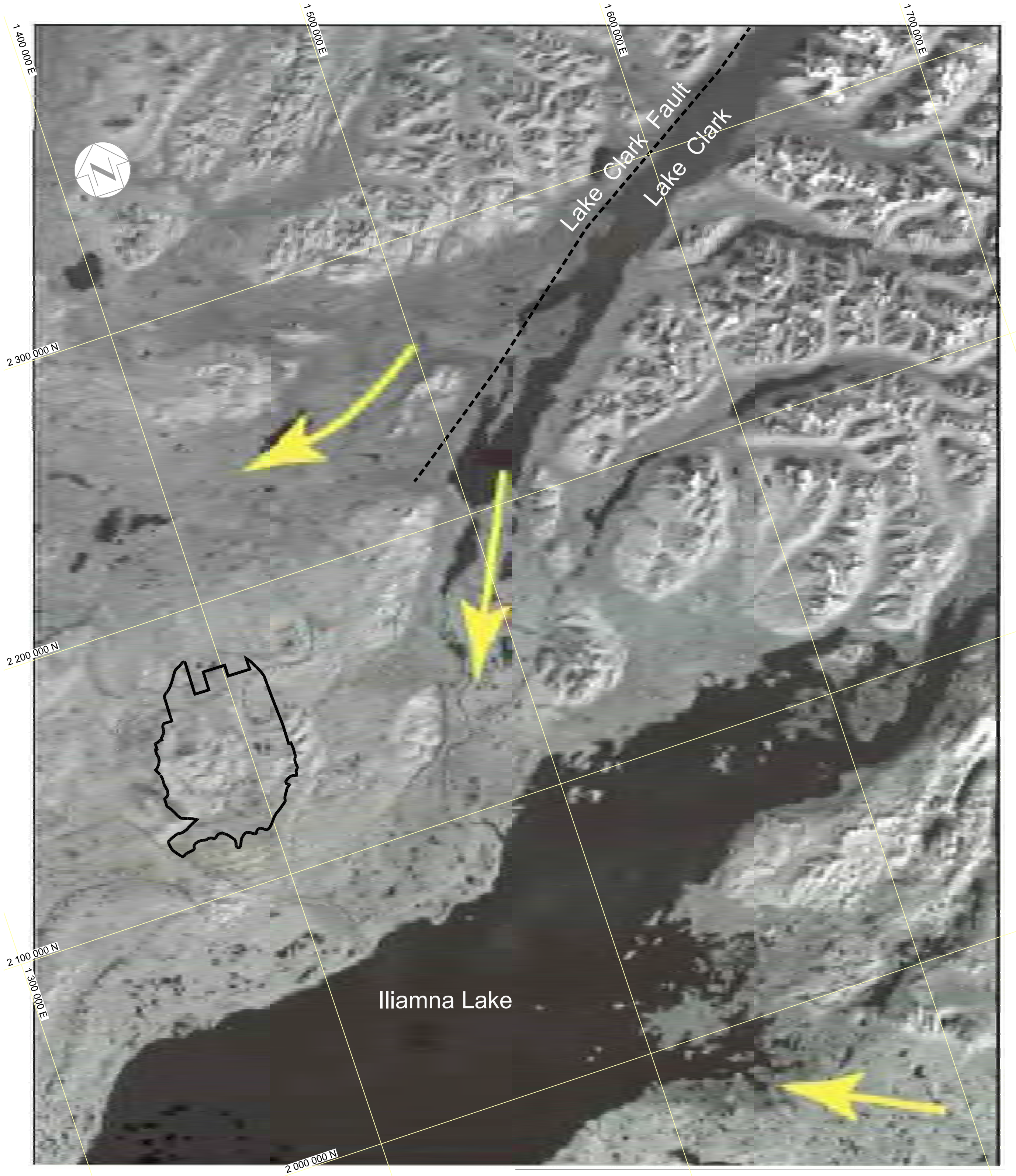


Figure 6-53
Mapped Location of Lake Clark Fault and Direction of Glacial Advance

Legend

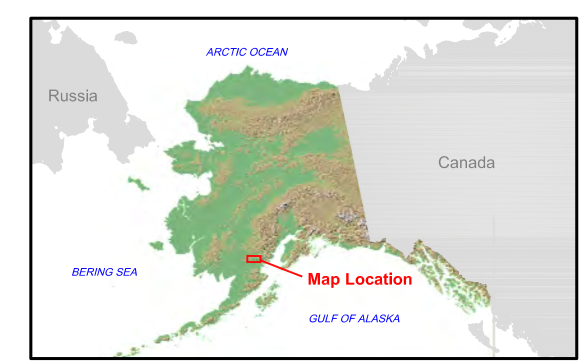
- - - - - Potentially active fault

——— Mine Study Area

Figure shows satellite image of Lake Clark-Iliamna Lake area. Large yellow arrows show principal routes followed by glaciers issuing from Lake Clark trough and flowing westward from Cook Inlet into Iliamna Lake basin.
Source: Surficial Geologic Map of the Pebble Limited Partnership's Pebble Project.

Notes

1. Reproduced from Hamilton and Klieforth, 2010.
2. Mapped location of Lake Clark fault based on Haessler, 2004.



10 0 10 20 30 Kilometers
5 0 5 10 15 Miles
N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: B56.dwg	Date: September 20, 2010
Version: 2008-1	Author: Knight Piesold Ltd.

APPENDICES

APPENDIX 6A

Test Pit Investigations Summary, 2004 through 2008

APPENDIX 6A

Test Pit Investigations Summary, 2004 through 2008

Test Pit #	Coordinates[A] Northing (ft)	Coordinates[A] Easting (ft)	Elevation (ft)	Location of Test Pit	Total Depth (ft)	From (ft)	To (ft)	Material[B]	Geomorphology
TP04-01	2,119,517	1,366,560	915	South Fork Koktuli River Area	7.9	0.7	7.9	SILT - some sand, some gravel, frequent cobbles.	Colluvium/Till
TP04-02	2,120,853	1,365,680	824	South Fork Koktuli River Area	10.8	0.2	1.1	SAND and GRAVEL - trace silt occasional cobbles.	Glaciofluvial
						1.1	10.8	sandy GRAVEL - trace silt, frequent cobbles.	
TP04-03	2,120,232	1,369,126	945	South Fork Koktuli River Area	9.2	0.3	7.2	clayey SILT - some sand, some gravel, occasional cobbles.	Glacial Drift/Till
						7.2	9.2	clayey, gravelly SAND - trace silt, occasional cobbles.	
TP04-04	2,123,748	1,363,586	974	South Fork Koktuli River Area	9.2	0.5	4.3	PEAT - some silt, some sand, trace clay.	
						4.3	9.2	silty SAND - some gravel, frequent cobbles.	
TP04-05	2,124,204	1,366,349	840	South Fork Koktuli River Area	8.2	0.6	2.8	PEAT - some silt, some sand, some gravel.	Glaciofluvial
						2.8	8.2	SAND and GRAVEL - some silt, occasional cobbles.	
TP04-06	2,122,931	1,364,202	801	South Fork Koktuli River Area	10.5	1.2	6.9	SILT - some sand, some gravel, trace clay.	Glacial Drift/Till, Glaciofluvial
						6.9	10.5	silty SAND and GRAVEL - occasional cobbles.	
TP04-07	2,122,981	1,381,469	896	South Fork Koktuli River Area	8.5	1.5	8.5	SAND and GRAVEL - trace silt, occasional cobbles.	Glaciofluvial/Outwash
TP04-08	2,119,602	1,383,670	833	South Fork Koktuli River Area	9.5	2.0	7.9	SAND and GRAVEL - occasional cobbles.	Glaciofluvial
						7.9	9.5	SILT - some clay, trace gravel.	
TP04-09	2,126,255	1,383,320	889	South Fork Koktuli River Area	8.9	2.6	8.9	SAND and GRAVEL - trace silt, frequent cobble.	Glaciofluvial
TP04-10	2,119,966	1,391,944	1,004	South Fork Koktuli River Area	9.2	0.0	9.2	SILT and CLAY - some sand, some gravel.	Glacial Till
TP04-11	2,122,026	1,383,630	965	South Fork Koktuli River Area	10.5	2.0	10.5	sandy GRAVEL - trace silt, well graded.	Glaciofluvial/Outwash
TP04-12	2,122,133	1,393,523	906	South Fork Koktuli River Area	7.9	1.0	3.6	GRAVEL - trace sand, trace silt, trace clay, well graded.	Glacial Drift/Till, Glaciofluvial
						3.6	7.2	SAND and GRAVEL - some silt.	
						7.2	7.9	BEDROCK - volcanic, purplish-brown, highly weathered.	Bedrock
TP04-13	2,123,882	1,396,758	919	South Fork Koktuli River Area	9.2	1.6	4.3	SILT - trace sand, trace gravel.	Outwash Plain/Till
						4.3	9.2	sandy GRAVEL - trace silt, well graded.	
TP04-14	2,128,136	1,405,742	958	South Fork Koktuli River Area	8.5	0.3	8.5	GRAVEL - some clay, some sand, some silt, poorly graded.	Glacial Drift/Till
TP04-15	2,126,548	1,381,458	1,017	South Fork Koktuli River Area	6.4	1.0	3.9	sandy GRAVEL - some clay, trace silt, well graded.	Glaciofluvial
						3.9	5.9	SILT and GRAVEL - some sand, well graded.	
						5.9	6.4	BEDROCK - volcanic, grey, highly weathered.	Bedrock
TP04-16	2,134,533	1,399,499	1,014	Area A, Southern Upland Area	9.5	1.1	5.6	SILT and SAND - some gravel, poorly graded.	Glacial Drift/Till, Glaciofluvial
						5.6	9.5	SAND and GRAVEL - trace silt.	
TP04-17	2,133,285	1,397,906	951	Area A, Southern Upland Area	8.9	1.3	4.6	SILT - some sand, some gravel, trace clay.	Glacial Drift/Till
TP04-18	2,148,254	1,407,551	1,178	Area A, Lower/Mid Side Slopes	4.6	2.3	4.6	COBBLES and GRAVEL - some silt.	Solifluction/Glacial Drift/Bedrock
TP04-19	2,148,310	1,405,388	948	Area A, Valley Bottom	9.8	2.6	9.8	SAND and GRAVEL - some silt, gradational layering.	Glaciofluvial/Glaciolacustrine
TP04-20	2,148,410	1,402,220	988	Area A, Valley Bottom	8.9	4.6	8.9	CLAY - some silt, trace sand, organic peat lenses.	Glaciolacustrine
TP04-21	2,145,963	1,406,457	1,079	Area A, Lower/Mid Side Slopes	8.9	1.3	8.9	clayey SAND and GRAVEL - trace silt, well graded.	Glacial Drift/Till
TP04-22	2,146,405	1,399,411	1,139	Area A, Lower/Mid Side Slopes	5.2	1.6	5.2	GRAVEL and SAND - some silt, trace clay, well graded.	Solifluction/Glacial Drift
TP04-23	2,148,464	1,399,945	1,093	Area A, Lower/Mid Side Slopes	9.5	1.3	9.5	silty SAND and GRAVEL - trace clay.	Glacial Drift/Till
TP04-24	2,136,927	1,392,479	988	Area J	8.5	2.0	5.6	SAND and GRAVEL - gradational layering and particle orientation.	Glaciofluvial/Glacial Drift
						5.6	8.5	SAND - some silt, visible layering.	
TP04-25	2,140,162	1,393,027	965	Area J	5.6	1.3	4.6	Sandy GRAVEL - trace silt, well graded, gradational layering.	Glaciofluvial
						4.6	5.6	SAND and GRAVEL - some silt.	
TP04-26	2,127,906	1,383,348	988	South Fork Koktuli River Area	9.2	0.5	6.6	SILT - some sand, some gravel, trace clay.	Glacial Drift/Till
						6.6	8.5	GRAVEL and SAND - some silt, well graded.	
						8.5	9.2	COBBLES - some sand, some gravel.	
TP04-27	2,142,593	1,392,561	1,188	Area J	9.2	3.8	9.2	gravelly SAND - some clay, trace silt, poorly graded.	Glacial Drift/Till
TP04-28	2,144,095	1,393,401	1,060	Area J	5.2	2.0	4.9	SAND - some gravel, occasional cobble.	Fluvial/Glaciofluvial
						4.9	5.2	COBBLES - 0.1-0.4m in diameter.	

Test Pit #	Coordinates[A] Northing (ft)	Easting (ft)	Elevation (ft)	Location of Test Pit	Total Depth (ft)	From (ft)	To (ft)	Material[B]	Geomorphology
TP04-29	2,137,590	1,398,330	1,132	Area A, Southern Upland Area	7.9	1.1	7.9	GRAVEL - some sand, trace silt, well graded, angular particles.	Glacial Drift
TP04-30	2,133,658	1,403,932	1,096	Area A, Southern Upland Area	8.2	2.0	4.9	SILT and SAND - trace gravel, trace clay.	Glacial Drift/Till
						4.9	8.2	SAND and GRAVEL - trace silt, occasional cobbles.	
TP04-31	2,134,661	1,392,782	984	Area J	8.9	0.7	8.9	sandy GRAVEL - some silt, occasional cobbles, well graded.	Glacial Drift/Till
TP04-32	2,135,064	1,389,905	1,106	Area J	8.9	2.0	3.0	SILT and SAND - trace gravel, poorly graded.	Colluvium
						3.0	6.2	sandy GRAVEL - some silt, angular particles.	
						6.2	8.9	GRAVEL - some sand, trace silt, angular particles.	
TP04-33	2,130,059	1,400,958	1,070	South Fork Koktuli River Area	9.8	1.3	5.9	sandy GRAVEL - some silt, occasional cobble, well graded.	Outwash /Glacial Drift
						5.9	7.5	SAND - trace silt, trace gravel, well graded.	
						7.5	9.8	SAND and GRAVEL - trace silt, occasional cobbles, well graded.	
TP04-34	2,134,276	1,405,091	955	Area A, Southern Upland Area	8.2	0.2	8.2	SAND and GRAVEL - some silt, angular particles.	Glacial Drift
TP04-35	2,135,318	1,376,771	1,030	Area L	8.2	1.6	8.2	gravelly SAND - some clay, some silt, occasional cobble.	Glacial Drift/Till
TP04-36	2,135,346	1,379,264	1,066	Area L	8.5	2.3	8.5	SAND - some gravel, some silt, trace clay.	Glacial Drift/Till
TP04-37	2,168,502	1,402,576	1,358	Upper Talarik Creek Area	9.8	1.6	9.8	GRAVEL and SAND - some silt, well graded.	Glacial Drift/Till
TP04-38	2,172,154	1,407,266	1,184	Upper Talarik Creek Area	8.9	4.3	8.9	silty SAND - some gravel, trace clay.	Outwash
TP04-39	2,172,631	1,408,447	1,198	Upper Talarik Creek Area	7.2	0.3	7.2	SAND and GRAVEL - some clay, trace silt, well graded.	Glacial Drift/Till
TP04-40	2,169,863	1,404,662	1,102	Upper Talarik Creek Area	8.5	1.6	8.5	trace gravel, trace silt, some gradational layering.	Outwash
TP04-41	2,167,255	1,399,503	1,463	Upper Talarik Creek Area	9.2	1.3	9.2	SAND and GRAVEL - some silt, trace clay, occasional cobbles.	Glacial Drift/Till
TP04-42	2,168,374	1,396,920	1,319	Area E	9.2	1.3	5.9	SAND - some silt, trace gravel, well graded.	Glaciofluvial/Drift/Till
						5.9	9.2	sandy GRAVEL - some clay, trace silt, well graded.	
TP04-43	2,165,996	1,395,899	1,463	Area E	9.2	1.6	9.2	SAND and GRAVEL - some silt, coarsening with depth.	Outwash
TP04-44	2,170,881	1,395,573	1,188	North Fork Koktuli River Area	8.5	0.2	3.0	SAND - trace silt, trace gravel, well graded.	Glaciofluvial/Lacustrine
						3.0	3.8	silty CLAY - some sand, very hard.	
						3.8	5.9	SAND - fine grained, some silt, poorly graded.	
						5.9	8.5	SAND and CLAY - fine grained, some silt, poorly graded.	
TP04-45	2,172,685	1,394,620	1,145	North Fork Koktuli River Area	7.9	0.3	7.9	SAND - some silt, trace gravel, poorly graded.	Outwash
TP04-46	2,163,989	1,387,095	1,319	Area E	7.9	1.6	7.9	SAND - medium grained, some gravel, poorly graded.	Outwash
TP04-47	2,169,371	1,386,416	1,119	North Fork Koktuli River Area	7.9	0.3	0.6	silty SAND and GRAVEL - well graded.	Glaciofluvial
						0.6	7.9	GRAVEL - some sand, trace silt, well graded.	
TP04-48	2,132,502	1,401,495	1,227	Area A, Southern Upland Area	7.9	0.3	7.2	sandy silty GRAVEL - trace clay, well graded.	Glacial Drift/Till
						7.2	7.9	BEDROCK - highly weathered.	Bedrock
TP04-49	2,121,260	1,397,664	929	South Fork Koktuli River Area	8.2	0.6	2.3	silty SAND and GRAVEL - some cobbles.	Outwash/Glacial Drift
						2.3	6.9	SAND and GRAVEL - some cobbles.	
						6.9	8.2	SAND - medium grained, some gravel, poorly graded.	
TP04-50	2,126,340	1,401,778	925	South Fork Koktuli River Area	7.9	0.3	1.6	gravelly SAND - poorly graded.	Glacial Drift/Till
						1.6	7.9	silty SAND - fine grained, trace clay, poorly graded.	
TP04-51	2,128,786	1,407,094	1,037	South Fork Koktuli River Area	6.9	0.3	6.9	SAND - some gravel, trace silt.	Glacial Drift
TP04-52	2,131,634	1,408,334	1,030	South Fork Koktuli River Area	7.9	0.3	7.9	SAND and GRAVEL - some silt, some cobbles.	Glaciofluvial
TP04-53	2,132,802	1,408,336	919	South Fork Koktuli River Area	7.9	0.3	1.6	SAND - medium to fine grained, some silt.	Glaciofluvial
						1.6	3.0	SAND and GRAVEL - frequent cobble, well graded.	
						3.0	3.3	SAND - medium grained, poorly graded.	
						3.3	4.6	SAND and GRAVEL - poorly graded.	
						4.6	4.9	SAND - medium grained, poorly graded.	
						4.9	7.9	SAND and GRAVEL - medium to coarse grained sand, well graded.	
TP04-54	2,175,384	1,385,610	1,312	North Fork Koktuli River Area	7.9	0.3	0.6	SAND - fine grained, some gravel, some silt, poorly graded.	Glacial Drift/Till
						0.6	7.9	gravelly SAND - trace fines, gravel content decreases with depth.	
TP04-55	2,178,455	1,386,460	1,342	North Fork Koktuli River Area	3			ABANDONED TEST PIT.	Abandoned location - water

Test Pit #	Coordinates[A] Northing (ft)	Easting (ft)	Elevation (ft)	Location of Test Pit	Total Depth (ft)	From (ft)	To (ft)	Material[B]	Geomorphology
TP04-56	2,178,234	1,386,158	1,339	North Fork Koktuli River Area	7.9	0.3	0.6	SAND - medium grained, some gravel, some silt, poorly graded.	Glacial Drift/Till
						0.6	7.9	SAND - some clay, some silt, well graded.	
TP04-57	2,181,170	1,387,406	1,368	North Fork Koktuli River Area	6.9	0.3	6.9	SAND - medium grained, some gravel, poorly graded.	Glacial Drift
TP04-58	2,163,561	1,383,328	1,312	Area G	7.9	0.3	0.6	SAND - medium grained, some silt, poorly graded.	Glacial Drift
						0.6	7.9	SAND and GRAVEL - trace fines, well graded.	
TP04-59	2,162,266	1,385,592	1,430	Area G	7.9	0.5	0.8	SAND and SILT - fine grained, poorly graded.	Glacial Drift
						0.8	2.3	SAND - medium and coarse grained, some gravel, poorly graded.	
						2.3	7.9	sandy GRAVEL - some silt, trace clay, well graded.	
TP04-60	2,164,853	1,380,614	1,378	Area G	7.9	0.3	7.9	GRAVEL - some silt, some sand, well graded.	Colluvium/Drift
TP04-61	2,151,177	1,371,202	1,700	Area G	5.2	1.3	5.2	sandy GRAVEL - trace silt, well graded.	Glacial Drift/Till
TP04-62	2,150,814	1,373,019	1,549	Area G	7.2	0.5	7.2	SAND and GRAVEL - some silt, frequent cobbles, well graded.	Glacial Drift/Till
TP04-63	2,164,043	1,375,247	1,526	Area G	5.9	1.3	5.9	SAND - medium grained, some gravel, poorly graded.	Glacial Drift
TP04-64	2,150,389	1,375,132	1,585	Area G	8.9	1.0	2.3	SAND - some silt, well graded.	Glacial Drift
						2.3	6.9	SAND - fine to medium grained, poorly graded.	
						6.9	8.9	gravelly SAND - some clay, trace silt, well graded.	
TP04-65	2,160,860	1,385,876	1,709	Area G	5.6	0.3	5.6	SAND - some gravel, well graded becoming poorly graded.	Glacial Drift
TP04-66	2,147,898	1,369,637	1,795	Area L	7.9	0.5	7.9	SAND - some gravel, trace silt.	Glacial Drift
TP04-67	2,161,021	1,398,705	1,581	Area E	7.5	1.0	7.5	SAND - some gravel, some to trace silt, well graded.	Glacial Drift/Till
TP04-68	2,161,138	1,397,577	1,421	Area E	8.2	0.6	7.9	SAND - medium to fine grained, some angular gravel.	Glaciofluvial
						7.9	8.2	COBBLE and GRAVEL - angular.	
TP04-69	2,160,521	1,397,157	1,430	Area E	7.9	0.3	0.8	GRAVEL - clean, poorly graded, rounded.	Glaciofluvial
						0.8	7.9	SAND and GRAVEL - trace silt, well graded.	
TP04-70	2,159,565	1,396,393	1,480	Area E	7.9	0.3	7.9	SAND - some silt, some gravel.	Glacial Drift/Till
TP04-71	2,158,549	1,396,077	1,578	Area E	7.9	0.3	0.5	GRAVEL - clean, poorly graded, angular to subrounded.	Glacial Drift/Till
						0.5	7.2	clayey SAND - fine grained, some silt, trace gravel, poorly graded.	
						7.2	7.9	SAND - fine grained, some silt, poorly graded.	
TP04-72	2,156,911	1,395,583	1,509	Area E	7.9	0.8	7.9	clayey SAND - some silt, trace gravel, poorly graded.	Glacial Drift/Till
TP04-73	2,155,573	1,395,216	1,490	Area E	7.9	0.6	7.9	SAND - some silt, trace clay.	Glacial Drift/Till
TP04-74	2,154,872	1,395,089	1,493	Area E	8.4	0.3	0.8	GRAVEL - clean, poorly graded, rounded.	Glaciofluvial
						0.8	3.6	SAND - some silt.	
						3.6	8.4	gravelly clayey SAND - medium to fine grained, some silt.	
TP04-75	2,154,177	1,394,900	1,424	Area E	8.2	0.3	8.2	SAND - some silt, some gravel, poorly graded.	Glacial Drift
TP04-76	2,156,402	1,403,631	1,014	Mineral Deposit Area	9.5	0.5	7.5	sand SILT - some gravel, some clay.	Glacial alluvial
						7.5	9.5	silty, sandy GRAVEL - trace clay, occasional cobbles.	
TP04-77	2,158,581	1,403,818	1,023	Mineral Deposit Area	9.2	0.3	2.3	sandy SILT - trace clay, trace gravel.	Glacial alluvial
						2.3	9.2	sandy GRAVEL - trace silt, frequent cobbles.	
TP04-78	2,160,187	1,405,435	996	Mineral Deposit Area	9.2	0.3	5.9	silty SAND and GRAVEL - trace clay, well graded.	Glacial alluvial
						5.9	9.2	gravelly SAND - trace silt, trace clay.	
TP04-79	2,157,221	1,407,006	1,009	Mineral Deposit Area	6.2	0.3	6.2	SAND and GRAVEL some silt, trace clay, well graded.	Ablation till
TP04-80	2,155,210	1,405,084	1,001	Mineral Deposit Area	9.2	0.2	7.9	SAND and GRAVEL - occasional cobbles, well graded.	Glaciofluvial - esker/braided stream
						7.9	9.2	sandy GRAVEL - trace silt, poorly graded.	
TP04-81	2,153,281	1,398,851	1,189	Area A, Lower/Mid Side Slopes	7.5	0.3	6.9	GRAVEL and SAND - some silt, trace clay, occasional cobbles.	Glaciofluvial
						6.9	7.5	gravelly SAND - some silt, trace clay.	
TP04-82	2,152,947	1,401,081	1,069	Area A, Lower/Mid Side Slopes	7.9	0.3	6.9	gravelly SAND - some silt, isolated cobbles.	Glacial alluvial
						6.9	7.9	silty, gravelly SAND - trace clay, well graded.	
TP04-83	2,150,449	1,398,809	1,188	Area A, Lower/Mid Side Slopes	7.5	0.6	2.3	silty SAND - some gravel, some clay.	Glacial alluvial
						2.3	7.5	GRAVEL and SAND - some silt, trace clay, frequent cobbles.	

Test Pit #	Coordinates[A] Northing (ft)	Easting (ft)	Elevation (ft)	Location of Test Pit	Total Depth (ft)	From (ft)	To (ft)	Material[B]	Geomorphology
TP04-84	2,150,479	1,401,027	1,096	Area A, Lower/Mid Side Slopes	9.8	0.3	9.8	silty, gravelly SAND - some clay, well graded.	Recessional/lateral moraine - till
TP04-85	2,144,636	1,399,628	1,216	Area A, Lower/Mid Side Slopes	8.9	0.3	5.9	gravelly SAND - some silt, trace clay, well graded.	Colluvial
						5.9	8.9	clayey SILT - trace sand, trace gravel with depth, poorly graded.	Alluvial fan/outwash
TP04-86	2,144,456	1,402,040	999	Area A, Valley Bottom	6.9	0.4	3.9	silty SAND - Topsoil.	Alluvial
						3.9	6.9	silty, gravelly SAND - some clay.	Glaciolacustrine
TP04-87	2,144,350	1,405,487	1,077	Area A, Lower/Mid Side Slopes	9.2	1.6	9.2	sandy, silty GRAVEL - trace clay, well graded.	Lateral moraine
TP04-88	2,141,533	1,404,745	1,076	Area A, Lower/Mid Side Slopes	8.9	1.1	8.9	silty SAND and GRAVEL - some clay.	Glacial alluvial
TP04-89	2,142,390	1,403,029	996	Area A, Valley Bottom	6.1	2.7	4.3	silty SAND - Organic soil.	Alluvial
						4.3	6.1	SILT and CLAY - some sand, trace gravel.	Glaciolacustrine
TP04-90	2,141,482	1,400,907	1,124	Area A, Lower/Mid Side Slopes	8.2	0.6	7.2	silty SAND - some gravel, well graded.	Glacial alluvial
						7.2	8.2	sandy GRAVEL - trace silt, poorly graded.	
TP04-91	2,130,145	1,380,137	973	Area L	9.2	2.0	9.2	silty, gravelly SAND - trace clay, occasional cobble.	Ablation till/lateral moraine
TP04-92	2,128,937	1,374,901	1,018	Area L	7.5	2.6	5.6	silty, gravelly SAND - trace clay.	Glaciolacustrine
						5.6	7.5	sandy, silty GRAVEL - trace clay, frequent cobbles.	
TP04-93	2,131,676	1,382,874	1,012	Area L	9.2	1.6	9.2	gravelly, silty SAND - trace clay, occasional cobbles.	Recessional/lateral moraine - till
TP04-94	2,132,206	1,379,942	1,042	Area L	8.2	2.0	8.2	gravelly SAND - some silt, trace clay.	Glaciolacustrine/colluvial
TP04-95	2,133,570	1,379,183	1,100	Area L	8.9	1.4	5.4	silty, sandy GRAVEL - trace clay.	Alluvial
						5.4	8.9	sandy GRAVEL - some silt, trace clay.	
TP04-96	2,133,731	1,376,411	1,107	Area L	9.2	0.2	9.2	sandy GRAVEL - some silt.	Colluvial
TP04-97	2,137,572	1,377,580	993	Area L	8.8	1.3	8.2	silty SAND - fine grained, trace clay, trace gravel.	Ablation till
						8.2	8.8	gravelly, silty SAND - trace clay, well graded.	
TP04-98	2,139,821	1,376,332	1,007	Area L	7.8	0.8	7.8	GRAVEL and SAND - trace silt, occasional cobble.	Glacial alluvial
TP04-99	2,140,882	1,378,377	1,035	Area L	8	0.8	7.5	GRAVEL and SAND - some silt, frequent cobble.	Glacial alluvial
						7.2	8.0	sandy GRAVEL - some silt, trace clay, well graded.	
TP04-100	2,142,307	1,374,263	1,118	Area L	7.9	0.6	7.9	gravelly SAND - some silt, isolated cobble.	Glacial alluvial
TP04-101	2,156,109	1,377,507	1,360	Area G	9.2	3.6	9.2	silty SAND - some gravel, trace clay, well graded.	Glaciolacustrine
TP04-102	2,157,985	1,381,312	1,333	Area G	8.9	1.3	8.9	gravelly SAND - some silt, trace clay, occasional cobbles.	Colluvial
TP04-103	2,159,224	1,379,737	1,290	Area G	8.2	0.4	8.2	silty SAND - some gravel, some clay.	Alluvial
TP04-104	2,161,563	1,378,980	1,306	Area G	8.2	2.2	7.2	silty SAND - some gravel, trace clay, few cobbles.	Glacial alluvial
						7.2	8.2	sandy SILT - some gravel, trace clay.	
TP04-105	2,161,650	1,381,722	1,326	Area G	9.2	0.6	8.2	sandy GRAVEL - some silt, trace clay, well graded.	Alluvial fan/outwash
						8.2	9.2	sandy SILT - some clay, some gravel.	
TP04-106	2,163,697	1,381,261	1,302	Area G	6.6	1.5	5.9	silty SAND - some gravel, trace clay, occasional cobbles.	Ablation till
						5.9	6.6	GRAVEL - some silt, some sand, occasional cobble.	
TP04-107	2,166,787	1,380,893	1,155	North Fork Koktuli River Area	6.9	0.3	6.2	sandy GRAVEL -fine sand, some silt, isolated cobbles.	Glacial alluvial
						6.2	6.9	GRAVEL - some sand, trace silt, poorly graded.	
TP04-108	2,165,951	1,384,246	1,177	North Fork Koktuli River Area	9.2	0.6	8.2	SAND - some gravel, some silt, occasional cobbles.	Ablation till/moraine
						8.2	9.2	sandy GRAVEL - some silt, some clay, well graded.	
TP05-109	2,132,551	1,387,586	948	Area J	5.0	0.0	1.5	SILT - some sand, trace gravel.	Glaciofluvial
						1.5	5.0	SAND - some gravel, occasional cobbles, trace silt, well graded.	
TP05-110	2,133,819	1,399,795	907	Area A, Southern Upland Area	4.5	0.0	4.5	SAND - some gravel, occasional cobbles, well graded.	Kettled Moraine
TP05-111	2,135,551	1,398,669	1,038	Area A, Southern Upland Area	5.0	0.0	5.0	SILT and SAND - some gravel, occasional cobbles, trace clay, well graded, subrounded to rounded.	Kettled Moraine
TP05-112	2,133,807	1,404,678	953	Area A, Southern Upland Area	5.0	0.5	2.0	SILT and SAND - some gravel, occasional cobbles, well graded.	Outwash Sands and Gravels
						2.0	5.0	SAND and GRAVEL - isolated cobbles, well graded.	
TP05-113	2,134,481	1,404,750	1,065	Area A, Southern Upland Area	5.0	0.0	2.0	silty SAND - some gravel and cobbles, subangular to rounded.	Moraine
						2.0	5.0	gravelly SAND, occasional cobbles, subangular to rounded.	
TP05-114	2,144,476	1,410,972	1,526	Area A, Upper Side Slopes	4.0	0.5	4.0	SAND and GRAVEL - some silt, occasional boulders, subangular, well graded.	Blockfield
TP05-115	2,148,948	1,406,819	1,003	Area A, Valley Bottom	5.0	0.3	5.0	SAND and GRAVEL - occasional cobbles & boulders, well graded, subangular to subrounded.	Moraine

APPENDIX 6B

Vertical Overburden/Bedrock Drillhole Investigations Summary, 2004 through 2008

APPENDIX 6B

Overburden/Bedrock Geotechnical Drillhole Investigations Summary, 2004 through 2008

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH04-01	North Fork Koktuli River Area	2,171,584	1,386,180	1,067	HQ3 to EOH	197.0	148.0	---	---	---	0.49	2	15.5	30	13.9	22-Aug-04	---	TA	Tertiary Andesite	46	18	41
GH04-02	Upper Talarik Creek Area	2,170,918	1,405,882	1,151	HQ3 to EOH	125.0	107.5	---	---	---	0.92	2	13.2	26.2	6.0	17-Jul-08	---	TW/TC	Tertiary Sediments - Sandstone Conglomerate	13	8	29
GH04-03	South Fork Koktuli River Area	2,125,932	1,400,583	936	HQ3 to EOH	405.0	315.0	---	---	---	0.00	2	45	61	56.9	20-Aug-04	---	G	Granodiorite	49	13	39
GH04-04	South Fork Koktuli River Area	2,123,686	1,383,250	924	HQ3 to EOH	304.0	201.0	---	---	---	0.23	2	64	78	74.8	19-Aug-08	---	TY	Tertiary Sediments - Siltstone	37	24	44
GH04-05	South Fork Koktuli River Area	2,121,512	1,365,296	772	HQ3 to EOH	210.0	102.0	---	---	---	0.33	2	24.6	40	4.3	15-Jul-08	---	G	Granodiorite	49	55	53
GH04-06	Area A, Valley Bottom	2,146,959	1,402,986	968	HQ3 to EOH	213.0	147.0	---	---	---	0.82	2	20.7	37	0.6	18-Jul-08	---	D	Diorite	31	75	46
GH04-07	Area G	2,164,276	1,382,513	1,241	HQ3 to EOH	110.0	8.0	---	---	---		NO PIEZOMETER			---	---	---	TB	Tertiary Basalt/Fault or Shear Zone @70.25'	60	77	52
GH04-08	Area G	2,149,963	1,373,556	1,526	HQ3 to EOH	135.0	92.0	---	---	---	0.26	2	25	38	Flowing	12-Jul-08	---	TF/TY/TC	Tertiary Sediments - Sandstone/Siltstone/Siltstone Conglomerate	40	36	46
GH04-09	Area L	2,135,078	1,377,955	910	HQ3 to EOH	115.0	14.0	---	---	---		NO PIEZOMETER			---	---	---	N/TBd	Monzodiorite/Tertiary Basalt Dyke @ 84.5-99'	59	43	50
GH04-10	South Fork Koktuli River Area	2,123,101	1,395,412	908	HQ3 to EOH	330.0	330+	---	---	---	0.89	2	44	60	56.8	20-Aug-04	---		Bedrock was not reached	---	---	---
GH04-11	South Fork Koktuli River Area	2,128,321	1,406,017	977	HQ3 to EOH	170.0	67.0	---	---	---	0.10	2	15	28	25.3	21-Aug-04	---	TY	Tertiary Sediments, Brecciated	48	44	47
GH04-12	South Fork Koktuli River Area	2,123,133	1,392,745	875	HQ3 to EOH	---	---	---	---	---		NO PIEZOMETER			---	---	---		Bedrock was not reached	---	---	---
GH04-12A	South Fork Koktuli River Area	2,122,286	1,393,590	884	HQ3 to EOH	130.0	26.0	---	---	---	0.23	2	43	65	35.2	15-Jul-08	Highly Permeable	TA	Andesite	69	42	55
GH04-13	South Fork Koktuli River Area	2,117,580	1,392,021	1,055	HQ3 to EOH	210.0	105.0	---	---	---	0.82	2	14	46	41.9	23-Aug-04	---	TB	Basalt	49	50	51
GH04-14	South Fork Koktuli River Area	2,121,520	1,382,419	929	HQ3 to EOH	185.0	83.0	---	---	---	0.33	2	53	75.5	72.0	15-Jul-08	---	TY/X.Y	Andesitic Mud/Siltstone	51	40	46
GH04-15	South Fork Koktuli River Area	2,123,251	1,380,425	903	HQ3 to EOH	135.0	125.0	---	---	---		NO PIEZOMETER			---	---	---	G	Granodiorite	Weathered Bedrock for 10ft, not geotechnically logged		
GH04-16	South Fork Koktuli River Area	2,125,117	1,381,837	889	HQ3 to EOH	175.0	175+	---	---	---	0.23	2	72	110	65.1	15-Jul-08	---		Bedrock was not reached	---	---	---
GH04-17	South Fork Koktuli River Area	2,126,017	1,381,594	843	HQ3 to EOH	195.0	185.0	---	---	---	0.30	2	25	40	19.5	15-Jul-08	Highly Permeable	TA	Andesitic Mud/Siltstone	Weathered Bedrock for 10ft, not geotechnically logged		
GH04-18	South Fork Koktuli River Area	2,126,850	1,382,120	833	HQ3 to EOH	177.0	57.0	---	---	---	0.38	2	42	57	8.2	15-Jul-08	Highly Permeable	TY	Andesitic Mud/Siltstone	26	30	45
GH04-19	Area L	2,133,668	1,377,773	882	HQ3 to EOH	120.0	18.0	---	---	---	0.49	2	4	28	2.8	16-Jul-08	---	G	Granodiorite	50	100	57
GH04-20	Area L	2,135,284	1,380,421	1,226	HQ3 to EOH	105.0	5.0	---	---	---	1.15	2	1	24	0.0	7-Aug-08	1.4E-04	G/TBd	Granodiorite/Tertiary Basalt Dykes	31	100	53
GH04-21	Area L	2,135,310	1,376,085	1,218	HQ3 to EOH	105.0	7.0	---	---	---		NO PIEZOMETER			---	---	---	G	Granodiorite	55	93	56
GH04-22	Area L	2,136,338	1,382,100	1,134	HQ3 to EOH	150.0	30.0	---	---	---	1.38	2	7	17	6.5	7-Aug-08		G	Granodiorite	49	75	52
GH04-23	Area G	2,164,417	1,381,015	1,367	HQ3 to EOH	155.0	20.0	---	---	---	0.56	2	6	22	DRY	17-Jul-08	Highly Permeable	TR	Gabbro	57	164	60

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH04-24	Area G	2,165,120	1,383,096	1,122	HQ3 to EOH	120.0	2.0	---	---	---		NO PIEZOMETER			---	---	---	TB	Basalt (Gabbroic texture)	70	185	65
GH04-25	Area G	2,163,357	1,383,712	1,316	HQ3 to EOH	185.0	65.0	125	185	1.2E-04	0.49	2	30	76	48.6	22-Aug-04	Highly Permeable	TB	Basalt	11	152	43
GH04-26	Area E	2,158,941	1,396,246	1,559	HQ3 to EOH	135.0	4.5	35	135	2.1E-04	0.33	2	1	30	27.2	22-Aug-04	---	TY/TW	Tertiary Siltstone/Wacke	28	115	49
GH04-27	Area E	2,157,549	1,395,818	1,553	HQ3 to EOH	125.0	3.0	54.7	125	8.6E-05	1.80	2	19	38	31.3	13-Jul-08	---	TY	Tertiary Siltstone	28	61	47
GH04-28	Area A, Southern Upland	2,137,379	1,398,091	1,158	HQ3 to EOH	145.0	24.0	45	145	3.1E-04	0.03	2	45	60	42.5	22-Aug-08	5.4E-05	TD/M	Latite to Fine-grained Monzodiorite	63	152	63
GH04-29	Area A, Southern Upland	2,135,591	1,399,085	1,072	HQ3 to EOH	45.0	---	---	---	---		NO PIEZOMETER			---	---	---		Bedrock was not reached	---	---	---
GH04-29A	Area A, Southern Upland	2,135,590	1,399,086	1,030	HQ3 to EOH	152.0	152+	---	---	---	0.49	1	46	75	57.5	19-Aug-08	---		Bedrock was not reached	---	---	---
GH04-30	Area A, Southern Upland	2,132,937	1,394,724	939	HQ3 to EOH	175.0	175+	---	---	---	0.39	1	65	78	69.3	22-Aug-08	---		Bedrock was not reached	---	---	---
GH04-31	Area A, Southern Upland	2,133,911	1,400,682	1,012	HQ3 to EOH	195.0	79.0	95	195	9.7E-06	0.23	1	51	65.5	DRY	22-Aug-08	---	TD	Latite	50	50	51
GH04-32	Area A, Southern Upland	2,132,207	1,401,402	1,215	HQ3 to EOH	135.0	24.0	---	---	---	0.07	2	26	44	37.9	22-Aug-08	---	TD/TA	Latite/Andesite (fault zone @ 44-49')	31	80	49
GH04-33	South Fork Koktuli River Area	2,129,087	1,399,309	905	HQ3 to EOH	335.0	227.0	---	---	---	0.13	1	43	60	28.1	22-Aug-08	---	M	Monzonite	32	56	45
GH04-34	South Fork Koktuli River Area	2,125,740	1,394,893	897	HQ3 to EOH	300.0	300+	---	---	---		NO PIEZOMETER			---	---	---		Bedrock was not reached.	---	---	---
GH04-35	South Fork Koktuli River Area	2,126,742	1,397,715	890	HQ3 to EOH	190.0	110.0	---	---	---	0.85	1	53	67	41.2	22-Aug-08	---	TF	Tertiary Sediments - Breccia	33	61	44
GH04-36	South Fork Koktuli River Area	2,119,650	1,392,907	953	HQ3 to EOH	155.0	20.0	---	---	---		NO PIEZOMETER			---	---	---	TD	Dacite	37	53	46
GH04-37	South Fork Koktuli River Area	2,119,791	1,389,715	978	HQ3 to EOH	295.0	175.0	---	---	---	0.33	1	125	152	124.1	15-Jul-08	---	TF/TA/TF	Tertiary Sediments (175-212',280-295') Andesite (212-280')	37	33	46
GH04-38	South Fork Koktuli River Area	2,120,503	1,386,308	944	HQ3 to EOH	190.0	67.0	95	190	3.5E-04	0.16	1	47	65	38.1	15-Jul-08	---	TY/G	Andesitic Mud/Siltstone Granodiorite Dykes @ 135', 152.5'	25	47	48
GH04-39	South Fork Koktuli River Area	2,122,703	1,389,233	912	HQ3 to EOH	120.0	113.0	---	---	---	0.39	1	22	36	30.5	20-Aug-04	---	TA	Andesite	11	50	45
GH04-40	South Fork Koktuli River Area	2,123,808	1,386,101	929	HQ3 to EOH	105.0	---	---	---	---		NO PIEZOMETER			---	---	---		Bedrock was not reached	---	---	---
GH04-40A	South Fork Koktuli River Area	2,123,858	1,386,142	927	HQ3 to EOH	255.0	145.0	193.5	255	1.1E-04		NO PIEZOMETER			---	---	---	TA	Andesite	27	53	45
GH04-41	Area A, Southern Upland	2,133,609	1,405,013	944	HQ3 to EOH	125.0	8.0	25	125	4.5E-04	0.30	1	80	95	41.1	23-Aug-04	---	TY/TW	Tertiary Sediment Breccia Latite Dyke/Fault Zone @ 104-105'	22	62	44
GH04-42	Area A, Southern Upland	2,135,111	1,404,563	1,067	HQ3 to EOH	150.0	48.0	---	---	---	0.00	1	79	93	58.8	23-Aug-04	---	TY/TB/TF	Mudstone Basalt Dyke (113-115')	17	36	42
GH04-43	Area A, Lower/Mid Side Slopes	2,137,825	1,405,221	1,123	HQ3 to EOH	110.0	7.0	---	---	---	0.49	2	85	110	75.2	17-Jul-08	Highly Permeable	TD	Dacite (possible open fault 106-110')	7	29	41
GH04-44	Area A, Southern Upland	2,138,681	1,402,137	1,100	HQ3 to EOH	165.0	165+	---	---	---	0.49	1	85	100	DRY	22-Aug-08	---		Bedrock was not reached.	---	---	---
GH04-45	Area A, Southern Upland	2,139,335	1,399,997	1,123	HQ3 to EOH	40.0	---	---	---	---		NO PIEZOMETER			---	---	---		Bedrock was not reached	---	---	---
GH04-45A	Area A, Southern Upland	2,139,335	1,399,997	1,124	HQ3 to EOH	225.0	112.0	125	225	9.4E-05	0.49	1	70	86	81.8	22-Aug-08	---	D.d/TB/D.b	Diorite/Basalt Dyke @ 198-211'	59	69	56

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH04-46	Area A, Lower/Mid Side Slopes	2,145,777	1,406,716	1,144	HQ3 to EOH	135.0	24.0	35	135	2.1E-04	0.49	2	64	87.5	24.2	23-Jul-08	3.6E-05	TD/TY/TA	Dacite/Mudstone Andesite Tertiary Basalt Dykes @ 100', 127'	57	80	57
GH04-47	Area A, Valley Bottom	2,147,359	1,404,802	974	HQ3 to EOH	270.0	100.0	185	270	2.9E-04	0.62	1	26	43	5.1	18-Jul-08	---	TD/TY/TA	Latite or Dacite Pyroclastic Flow	44	57	48
GH04-48	Area A, Lower/Mid Side Slopes	2,147,095	1,399,489	1,185	HQ3 to EOH	185.0	66.0	---	---	---	0.49	1	36	52	33.1	18-Jul-08	---	Gs	Granodiorite	31	77	50
GH05-51	Area A, Southern Upland	2,133,987	1,399,202	1,001	HQ3 to EOH	445.0	293.0	305	395	2.2E-06	1.18	2	6	230	73.8	19-Aug-08	---	TA	Tertiary Andesite	71	59	58
GH05-52	Area A, Southern Upland	2,136,732	1,399,774	1,023	HQ3 to EOH	308.0	167.0	207	307	1.0E-07	0.69	2	95	115	102.9	16-Jul-08	1.9E-05	Y	Bedded Andesites	49	113	57
GH05-53	Area A, Upper Side Slopes	2,144,466	1,414,428	1,944	HQ3 to EOH	135.0	20.0	35	135	1.8E-06	1.21	2	4	42	27.8	18-Jul-08	---	Y	Bedded Andesites	45	93	55
GH05-54	Area A, Upper Side Slopes	2,147,466	1,412,991	2,000	HQ3 to EOH	125.0	10.0	25	125	1.3E-05	0.66	2	18	47	25.9	11-Oct-06	1.3E-04	Y	Bedded Andesites	55	96	57
GH05-55	Area A, Upper Side Slopes	2,144,949	1,395,597	1,591	HQ3 to EOH	125.0	12.0	25	125	1.9E-06	0.75	2	3	30	2.0	21-Oct-06	3.5E-06	D	Diorite	92	97	68
GH05-56	Area A, Lower/Mid Side Slopes	2,148,039	1,398,947	1,358	HQ3 to EOH	145.0	25.0	45	145	1.2E-06	0.82	2	3	62	34.8	21-Oct-06	1.6E-06	D/G	Diorite/Granodiorite	58	72	55
GH05-57	Area E	2,160,442	1,396,058	1,408	HQ3 to EOH	125.0	8.0	25	125	2.0E-06	1.51	2	9	42	0.7	13-Jul-08	1.5E-04	G	Granodiorite	23	89	51
GH05-58	Area E	2,156,505	1,395,455	1,505	HQ3 to EOH	155.0	25.0	55	155	6.3E-07	1.05	2	9	42	28.1	13-Jul-08	1.6E-04	Y/G	Bedded Andesites Granodiorite	26	83	49
GH05-59	Area A, Lower/Mid Side Slopes	2,152,112	1,399,230	1,184	HQ3 to EOH	175.0	71.0	95	175	7.4E-06	0.98	2	63	82	38.7	18-Jul-08	9.6E-04	G	Granodiorite	23	49	48
GH05-60	Area A, Lower/Mid Side Slopes	2,150,475	1,400,744	1,107	HQ3 to EOH	245.0	91.0	145	245	9.0E-07	0.66	2	39	102	Flowing	---	---	G	Granodiorite	18	39	42
GH05-61	Area A, Valley Bottom	2,148,765	1,402,496	976	HQ3 to EOH	305.0	185.0	205	305	1.6E-07	1.67	2	137	172	-0.1	23-Jul-08	---	G	Granodiorite	47	28	49
GH05-62	Area A, Valley Bottom	2,148,520	1,405,188	972	HQ3 to EOH	245.0	125.0	---	---	---	NO PIEZOMETER				---	---	---	Y	Bedded Andesites, weathered	32	47	46
GH05-63	Area A, Lower/Mid Side Slopes	2,148,541	1,407,009	1,041	HQ3 to EOH	135.0	18.0	35	135	1.2E-06	1.80	2	6	72	9.7	23-Jul-08	---	D	Diorite	41	64	50
GH05-64	Pebble East Area	2,152,872	1,410,183	1,020	HQ3 to EOH	185.0	68.0	85	185	9.1E-08	0.46	2	35	67	14.5	18-Jul-08	1.1E-04	Y	Bedded Andesites	58	84	54
GH05-65	South Fork Koktuli River Area	2,121,641	1,399,424	835	HQ3 to EOH	495.0	392.0	---	---	---	NO PIEZOMETER				---	---	---	G	Granodiorite	77	100	64
GH06-65	Area L	2,149,020	1,372,647	1,649	HQ3 to 23', NQ3 to 40', HQ3 to EOH	100.0	5.8	---	---	---	1.25	1	69	100	85.0	31-Aug-06	1.4E-05	TW/TR	Tertiary Wacke/Rhyolite	27	55	48
GH06-66	Area G	2,163,510	1,376,039	1,565	HQ3 to 19', NQ3 to EOH	88.0	4.0	24	69	no take	1.97	1	26	48	5.2	17-Jul-08	2.2E-06	R	Tertiary Basalt/Gabbro	48	110	55
								69	88	no take												
GH06-67	Area G	2,163,945	1,379,185	1,482	HQ3 to 35', NQ3 to EOH	123.0	20.0	68	123	1.6E-07	1.64	1	23	45	10.7	31-Aug-06	7.8E-06	TB	Tertiary Basalt	27	89	48
GH06-68	Area G	2,162,370	1,380,641	1,214	HQ3 to 42', NQ3 to EOH	119.0	14.5	54	84	2.3E-06	1.15	1	96	116	4.3	17-Jul-08	5.5E-05	R	Gabbro	40	45	48
								84	119	6.8E-07												
GH06-69	Area G	2,160,944	1,384,085	1,497	HQ3 to 80', NQ3 to EOH	159.5	29.6	80	129	5.8E-07	2.76	1	39.5	60	3.1	17-Jul-08	1.0E-04	R	Gabbro	39	46	45
								129	160	5.6E-08												
GH06-70S	Area A, Lower/Mid Side Slopes	2,147,906	1,400,211	1,109	HQ3 to EOH	139.8	78.0	---	---	---	2.33	1	80	96	Flowing	---	---	G	Granodiorite	9	60	40
GH06-70D											2.27	1	114	138	Flowing	---	---					

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH06-71	Area A, Lower/Mid Side Slopes	2,147,080	1,401,484	1,011	HQ3 to EOH	90.0	N/A	---	---	---	NO PIEZOMETER				Artesian	---	---	---	Bedrock was not reached	---	---	---
GH06-71A	Area A, Lower/Mid Side Slopes	2,147,087	1,401,454	1,011	HQ3 to 127.5', NQ3 to EOH	206.0	100.5	---	---	---	1.44	2	79	102	Flowing	---	---	G	Granodiorite	15	54	40
GH06-72	Area A, Valley Bottom	2,147,129	1,403,789	967	HQ3 to 130', NQ3 to EOH	215.0	108.0	---	---	---	1.71	2	39.5	79	Flowing	---	---	TR	Tertiary Rhyolite	24	80	44
GH06-73	Area A, Valley Bottom	2,146,876	1,406,063	1,007	HQ3 to 79.5', NQ3 to EOH	158.5	75.5	---	---	---	NO PIEZOMETER				Artesian	---	---	TD	Tertiary Dacite/Latite	42	75	49
GH06-74	Area A, Lower/Mid Side Slopes	2,147,514	1,407,904	1,197	HQ3 to 48.5', NQ3 to EOH	140.0	40.0	85	140	2.2E-06	4.56	1	31	44	26.0	18-Jul-08	6.1E-06	TB	Tertiary Basalt	77	74	57
GH06-75	Area A, Southern Upland	2,136,598	1,400,526	1,026	HQ3 to 315', NQ3 to EOH	414.5	315.0	369.5	399.5	---	2.72	1	148	173	141.0	19-Aug-08	---	TB/TY/TA	Tertiary Basalt/Mudstone/ Siltstone/Andesite	65	84	59
GH06-76	Area A, Southern Upland	2,135,578	1,401,319	989	HQ3 to 176', NQ3 to EOH	274.5	176.0	215	274.5	1.1E-06	2.36	1	102.5	123	104.8	16-Jul-08	7.1E-06	G/TA	Granodiorite/Tertiary Andesite	46	61	52
GH06-77	Area A, Southern Upland	2,135,459	1,400,130	1,027	HQ3 to 326', NQ3 to EOH	482.0	389.0	---	---	---	2.79	1	116	137	137.6	18-Aug-08	---	TY/TA/P/TB	Porphyritic Monzodiorite/ Tertiary Mudstone/Siltstone/ Andesite/Basalt	59	82	56
GH06-78	Pebble East Area	2,155,947	1,409,794	915	HQ3 to EOH	149.0	50.0	---	---	---	GROUTED IN TO STOP ARTESIAN FLOW				Artesian	---	---	TF/TX	Volcaniclastic Matrix supported Conglomerate/Clast dominant Conglomerate	66	65	53
GH06-79	Pebble East Area	2,155,394	1,410,562	957	HQ3 to EOH	121.5	---	---	---	---	NO PIEZOMETER				Artesian	---	---	---	Bedrock Not Reached	---	---	---
GH06-80	Pebble West Area	2,154,864	1,406,799	1,017	HQ3 to 149.5', NQ3 to EOH	217.0	93.0	188.5	217	4.8E-06	1.80	1	36	50	42.4	18-Jul-08	5.1E-06	TB/TF	Tertiary Basalt/Volcaniclastic Matrix supported Conglomerate	22	72	49
GH07-81	Area G	2,161,333	1,382,565	1,383	HQ3 to 33', NQ3 to EOH	164.5	14.0	44.5	99.5	1.6E-05	3.18	2	8	25.5	Flowing	---	Flowing ~1gpm	M	Cretaceous Porphyritic Monzonite, Shear Zone 117-121'	52	62	50
								100	129.5	2.1E-06												
								130	164.5	1.9E-07												
GH07-82S	Area G	2,162,943	1,379,583	1,407	HQ3 to 87.5', NQ3 to EOH	215.0	35.0	130	155	---	3.28	1	30.5	48.5	5.5	2-Sep-07	5.2E-06	TB	Tertiary Basalt	18	81	44
								155	175	---												
								175	195	---												
GH07-82D								195	215	---	3.18	1	90.0	129.3	6.8	2-Sep-07	1.4E-05					
GH07-83S	Area G	2,163,510	1,374,824	1,605	HQ3 to 23.5', NQ3 to EOH	164.5	8.5	28.5	55	No take	2.79	1	6	23	-0.3	30-Aug-07	6.5E-05	M/Y/G	Cretaceous Monzonite to 93', Siltstone to 128', Granodiorite to 215'	47	71	51
								55	75	---												
								75	95	---												
GH07-83D								95	115	---	3.02	1	50	68	-0.7	30-Aug-07	2.1E-05					
								115	134.5	No take												
								134.5	164.5	No take												
GH07-84	Area G	2,164,989	1,375,761	1,481	HQ3 to EOH	165.0	9	20.5	44.5	1.9E-06	3.08	2	16	33	11.2	4-Oct-07	9.1E-05	Y	Cretaceous Sandstone	56	100	53
								44.5	65.5	---												
								65.5	85.5	---												
								85.5	105	---												
								105	135	---												
								135	165	---												
GH07-85	Area G	2,163,904	1,377,732	1,628	HQ3 to 13.5', NQ3 to 55', HQ3 to 70', NQ3 to EOH	154.5	4.5	25	50	6.4E-06	2.99	2	35	60	7.3	4-Oct-07	4.5E-06	YW	Cretaceous Mudstone to Sandstone, Fault Zone 48-65'	42	101	49
								75	95	---												
								95	125	---												
								125	154.5	---												

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH07-86	Area G	2,161,121	1,372,867	1,690	HQ3 to 28', NQ3 to EOH	165.0	13	30	60	---	2.89	2	7	24	-1.8	4-Sep-07	5.1E-04	M	Cretaceous Monzonite, Fault Zone 127-142'	50	80	53
								60	100	3.7E-06												
								100	130	2.8E-07												
								125	165	---												
GH07-87S	Area G	2,159,296	1,372,353	1,855	HQ3 to EOH	260.0	8	100	140	4.0E-06	2.33	1	74	103	5.8	4-Oct-07	1.1E-05	G	Cretaceous Granodiorite, Minor Fault Zones 118.5-125.5, 134.75-136.5', and 168.5-172.5', Major Fault Zone 176-232'	19	40	36
								140	160	1.9E-05												
GH07-87D								160	180	9.5E-07	2.13	1	185	202	8.7	4-Oct-07	3.3E-06					
								240	260	1.5E-06												
GH07-88	Area G	2,162,438	1,372,730	1,626	HQ3 to 55', NQ3 to EOH	155.0	5	15	35	8.9E-06	2.44	2	4	15	1.4	4-Oct-07	2.6E-04	R	Cretaceous Gabbro	75	117	63
								35	55	no take												
								62	85	---												
								85	115	---												
								115	155	5.3E-07												
GH07-89S	Area G	2,153,620	1,367,910	1,890	HQ3 to EOH	154.1	6	130	147.6	---	2.69	1	34	55	7.5	1-Sep-08	1.6E-06	M/G	Cretaceous Monzonite-Granodiorite	33	72	44
GH07-89D											2.69	1	63	83	6.4	4-Oct-07	1.9E-06					
GH07-90S	Area G	2,151,062	1,367,772	1,963	HQ3 to EOH	170.0	4.5	30	50	4.6E-06	3.28	1	15	35	1.6	4-Oct-07	9.5E-05	M	Cretaceous Monzonite	53	73	46
								50	75	4.7E-05												
								95	115	>20 gal/ min over interval												
GH07-90D											3.28	1	75	95	2.7	4-Oct-07	3.8E-04					
								115	135	2.7E-05												
								150	170	3.4E-05												
GH07-91	Area L	2,149,768	1,368,765	1,889	HQ3 to EOH	155.0	2.25	30	50	2.6E-06	2.92	2	15	35	-0.5	4-Oct-07	2.7E-04	M/TB	Cretaceous Monzonite, Tertiary Basalt 87 to 90.25', 92.75 to 108'	50	84	49
								50	70	1.5E-06												
								70	90	1.3E-06												
								85	110	8.7E-06												
								110	130	6.1E-06												
								130	155	6.0E-06												
GH07-92S	Area L	2,149,448	1,370,764	1,699	HQ3 to EOH	160.0	6	80	100	1.2E-08	2.13	1	15	35	-0.7	4-Oct-07	2.5E-04	Mx	Brecciated Monzonite	41	55	44
								100	120	2.1E-07												
GH07-92D								120	140	---	2.13	1	60	80	11.7	4-Oct-07	2.0E-05					
								140	160	4.8E-07												
GH07-93	Area L	2,149,129	1,373,640	1,517	HQ3 to EOH	205.0	18	55	80	1.3E-05	2.66	2	29	47	3.1	4-Oct-07	3.0E-04	TA/TX/TD	Tertiary Andesite to 30', Tertiary Volcaniclastic Breccia to 125', Tertiary Dacite to 205'	45	78	46
								80	100	5.8E-05												
								100	124.5	4.7E-05												
								120	140	1.2E-05												
								140	160	6.7E-05												
								160	185	---												
								185	205	1.4E-05												
GH07-94	Area L	2,148,734	1,374,743	1,676	HQ3 to EOH	139.0	5	39	59	3.2E-06	2.95	2	10	30	-1.0	4-Oct-07	9.2E-05	M	Cretaceous Porphyritic Monzonite	52	83	49
								59	79	2.8E-05												
								79	99	7.7E-06												
								99	119	3.4E-06												
								119	139	---												
GH07-95	Area G	2,155,440	1,379,810	1,368	HQ3 to EOH	129.8	15	30	50	1.3E-04	2.99	2	15	30	1.6	24-Sep-07	3.6E-04	TX	Tertiary Breccia	54	77	47
								50	70	1.2E-04												
								70	90	1.0E-04												
								90	110	4.5E-05												
								110	130	6.7E-05												
GH07-96S	Area G	2,156,211	1,381,752	1,394	HQ3 to EOH	195.0	15	115	135	8.2E-07	2.56	1	23.6	45	3.2	4-Oct-07	1.4E-05	TX	Tertiary Breccia	31	49	38
								135	155	7.9E-07												
GH07-96D								155	175	1.7E-05	2.62	1	65	85	2.9	4-Oct-07	2.9E-05					
								175	195	1.5E-05												

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH07-97S	Area G	2,154,727	1,382,608	1,497	HQ3 to EOH	185.0	13	95	115	4.2E-05	2.23	1	24	45	11.9	4-Oct-07	3.6E-05	TX	Tertiary Breccia	44	67	44
								115	135	1.1E-06												
GH07-97D								135	155	1.5E-06	2.20	1	64.2	84.5	12.1	4-Oct-07	9.4E-05					
								155	175	>20 gal/ min over interval												
GH07-98S	Area G	2,152,902	1,384,912	1,746	HQ3 to EOH	229.5	49.5	129.5	149.5	---	3.05	1	28.2	55	12.9	13-Oct-07	2.8E-04	TX/M	Tertiary Breccia to 79', then Cretaceous Monzonite	48	57	43
								149.5	169.5	---												
								169.5	189.5	1.2E-05												
GH07-98D								189.5	209.5	1.9E-06	2.89	1	74.8	94.8	12.3	13-Oct-07	5.7E-04					
								209.5	229.5	1.6E-05												
GH07-99	Area G	2,154,211	1,385,450	1,900	HQ3 to EOH	160.0	10	24.5	44.5	4.4E-07	3.08	2	6	25	3.7	13-Oct-07	4.8E-04	M	Cretaceous Monzonite	79	98	57
								44.5	70	---												
								70	90	3.3E-06												
								90	110	1.3E-06												
								110	135	>15 gal/ min over interval												
								135	160	---												
GH07-100	Area G	2,151,719	1,384,518	1,916	HQ3 to EOH	179.5	5	40	60	8.0E-05	3.12	2	25	40	34.1	13-Oct-07	1.1E-04	TX	Tertiary Breccia	60	89	51
								60	80	3.9E-05												
								80	100	1.6E-05												
								100	120	---												
								120	140	6.6E-06												
								140	160	7.4E-06												
								160	180	> 30 gal/ min over interval												
GH07-101	North Fork Koktuli River Area	2,166,749	1,387,533	1,169	HQ3 to EOH	119.5	22	39.5	69.5	3.6E-06	3.20	2	10	30	20.3	31-Oct-07	1.5E-05	TB	Tertiary Basalt	68	155	60
								69.5	99.5	2.6E-06												
								99.5	119.5	3.0E-06												
GH07-102S	North Fork Koktuli River Area	2,168,708	1,383,762	1,146	HQ3 to EOH	133.0	40	N/A			2.53	1	25	45	26.8	31-Oct-07	3.8E-06	TYTWf	Tertiary Mudstone/Siltstone/ Wacke	1	49	36
GH07-102D											2.49	1	85	105	27.6	31-Oct-07	7.8E-07					
GH07-103S	North Fork Koktuli River Area	2,165,175	1,386,316	1,241	HQ3 to EOH	130.0	25	95	135	1.4E-06	2.72	1	8	31	25.6	31-Oct-07	9.0E-06	TB	Tertiary Basalt	16	50	38
GH07-103D											2.79	1	70	90	31.2	31-Oct-07	9.4E-07					
GH07-104	Pebble East Area	2,153,137	1,408,702	1,003	HQ3 to EOH	195.0	180.5	N/A			3.38	2	170	190	-2.1	20-Oct-07	7.1E-06	TR	Tertiary Rhyolite	20	43	36
GH07-105	Pebble East Area	2,152,553	1,406,897	996	HQ3 to EOH	170.0	159	N/A			2.99	1	148	167	0.7	26-Oct-07	2.7E-03	TR	Tertiary Rhyolite	3	40	31
GH07-106	Pebble East Area	2,150,671	1,406,499	983	HQ3 to EOH	115.0	105	N/A			2.40	2	59	80	Flowing	---	Flowing, ~2gpm	TR	Tertiary Rhyolite	0	43	33
GH08-107	Pebble West Area	2,154,630	1,407,556	1,029	PQ3 to 59' HQ3 to 355'	355	58	64	90	-	2.53	2	115.4	140	49.05	2-May-08	6.6E-06	TB-TBx	Tertiary Basalt/Tertiary Basalt Breccia	66	73	55
								89	115	3.8E-05												
								114	145	2.7E-05												
								144	170	3.3E-05												
								169	205	1.6E-06								TX	Tertiary Volcaniclastic Breccia			
								204	229.5	7.7E-07												
								229	255.5	2.6E-06												
								254	279.5	4.7E-06												
								279	305	3.7E-05								TB	Tertiary Basalt			
								309	330	2.9E-04												
								329	355	9.0E-05												
GH08-108	Pebble East Area	2,157,070	1,410,500	863	PQ3 to 37' HQ3 to 75'	75	20.5	44	75	3.9E-04	Piezometer could not be installed, HWT drill casing stuck over completion zone.							TB	Tertiary Basalt	46	106	53
GH08-109	Pebble East Area	2,154,404	1,408,606	993	PQ3 to 139.5'	139.5	122	No Packer Tests Performed			1.97	2	94	112	13.06	2-May-08	2.50E-05	TX	Tertiary Volcaniclastic Breccia	61	71	51
GH08-110	Pebble East Area	2,157,260	1,409,305	898	PQ3 to 75'	75	62	No Packer Tests Performed			2.53	1	54	72	Flowing, ~0.5gpm	25-Apr-08	Not Tested	TX	Tertiary Volcaniclastic Breccia	20	40	38
GH08-111	Pebble East Area	2,153,775	1,407,626	990	PQ3 to 119.5'	119.5	105	No Packer Tests Performed			3.81	1	78.8	107	9.32	2-May-08	3.50E-06	TBx	Tertiary Basalt Breccia	63	58	51

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-112	Pebble West Area	2,155,883	1,408,340	1,007	PQ3 to 103.5' HQ3 to 380'	380	86	109	135	1.8E-05	2.82	1	233	263	50.59	7-Jul-08	5.10E-05	TX	Tertiary Volcaniclastic Breccia Conglomerate	55	59	50
								134	160	3.7E-06												
								159	185	3.1E-05								TB	Tertiary Basalt			
								189	210	4.6E-05												
								205	235	-								TX	Tertiary Volcaniclastic Breccia Conglomerate			
								259	285	-												
								294	320	-												
								319	345	4.8E-05								TB-TBx	Tertiary Basalt/Tertiary Basalt Breccia			
								355	380	6.0E-06												
GH08-113	Pebble East Area	2,151,709	1,408,277	1,002	PQ3 to 105'	105	85.6	No Packer Tests Performed			2.40	1	53.7	85	16.24	6-May-08	6.70E-06	TR	Tertiary Rhyolite	17	10	32
GH08-114	Pebble East Area	2,159,452	1,408,780	886	PQ3 to 34.7'	34.7	19	No Packer Tests Performed			2.82	2	7.5	27	Dry	4-May-08	Dry Well	TX	Tertiary Volcaniclastic Breccia Conglomerate	68	35	55
GH08-115	Pebble East Area	2,154,432	1,409,718	1,017	PQ3 to 115' HQ3 to 200'	200	Bedrock Not Reached	No Packer Tests Performed			2.13	1	165	185	37.24	8-May-08	1.60E-04	TX	Tertiary Volcaniclastic Breccia Conglomerate	39	8	34
GH08-116	Pebble East Area	2,158,613	1,409,244	890	PQ3 to 15' HQ3 to 30'	30	12	No Packer Tests Performed			3.05	2	8	27	7.74	7-Jul-08	3.30E-05	TX	Tertiary Volcaniclastic Breccia Conglomerate	80	18	56
GH08-117	Pebble East Area	2,157,485	1,415,033	1,044	PQ3 to 48.5' HQ3 to 75'	75	45	No Packer Tests Performed			2.56	2	30	50	34.58	17-Jul-08	Water Level in Completion Zone	TX	Tertiary Volcaniclastic Breccia Conglomerate	79	36	49
GH08-118	Pebble East Area	2,156,298	1,415,045	1,036	PQ3 to 37.5' HQ3 to 85'	85	12	No Packer Tests Performed			3.96	2	6.8	35	0.49	19-Jul-08	6.50E-04	TB	Tertiary Basalt	30	69	51
GH08-119	Pebble East Area	2,157,799	1,411,549	847	PQ3 to 28.5' HQ3 to 105'	105	21	No Packer Tests Performed			3.31	2	9.2	30	1.12	9-Jul-08	5.90E-05	TB	Tertiary Basalt	40	62	44
GH08-120	Pebble East Area	2,158,439	1,410,536	851	PQ3 to 50'	50	34	No Packer Tests Performed			3.51	1	17	37	-2	9-Jul-08	6.70E-05	TR	Tertiary Rhyolite	35	28	38
GH08-121	Pebble East Area	2,154,709	1,411,364	1,042	PQ3 to 90' HQ3 to 135'	135	116	No Packer Tests Performed			3.67	1	99.7	120	63.12	12-May-08	6.80E-06	TBx	Tertiary Basalt Breccia	56	63	52
GH08-122S	Pebble East Area	2,156,617	1,411,477	870	PQ3 to 120'	120	Bedrock Not Reached	No Packer Tests Performed			1.83	1	31.5	58	Flowing, ~1gpm	13-May-08	Not Tested		Did Not Reach Bedrock			
GH08-122D											2	2	96	112	Flowing, ~13gpm	13-May-08	Not Tested					
GH08-123	Pebble East Area	2,151,513	1,404,831	973	PQ3 to 42.7'	42.7	Bedrock Not Reached	No Packer Tests Performed			2.00	1	13	33	1.01	14-May-08	3.20E-04		Did Not Reach Bedrock			
GH08-124	Upper Talarik Creek Area	2,163,598	1,412,342	906	PQ3 to 23.5' HQ3 to 155'	155	12.5	No Packer Tests Performed			3.22	1	101	150	0.15	23-Jul-08	5.90E-06	TX	Tertiary Volcaniclastic Breccia	57	47	48
																		TW/TT	Tertiary Wacke and Siltstone			
GH08-125	Pebble West Area	2,154,975	1,405,927	981	PQ3 to 100' HQ3 to 150'	150	74	No Packer Tests Performed			2.53	1	90	110	1.31	17-May-08	2.30E-05	TY/TW	Tertiary Mudstone/Siltstone/Wacke	43	48	45
																		TY	Tertiary Mudstone/Siltstone			
																		TB	Tertiary Basalt			
GH08-126	Upper Talarik Creek Area	2,163,434	1,411,129	925	PQ3 to 38.5' HQ3 to 65'	65	48	No Packer Tests Performed			3.18	2	20	40	6.00	18-Jul-08	3.10E-05	TX	Tertiary Volcaniclastic Breccia	62	44	52
GH08-127	Upper Talarik Creek Area	2,165,462	1,407,492	1,068	PQ3 to 52' HQ3 to 155'	155	145	No Packer Tests Performed			2.53	1	104	126	40.49	18-May-08	1.00E-05	TX	Tertiary Volcaniclastic Breccia	8	15	29
GH08-128	Area E	2,154,863	1,395,164	1,463	PQ3 to 120' HQ3 to 285'	285	190	154	180	-	2.89	1	88.7	110	83.73	23-May-08	2.80E-06	TX	Tertiary Volcaniclastic Breccia/Conglomerate	46	42	42
								204	230	-												
								229	255	-								G	Granodiorite			
GH08-129	Area E	2,160,024	1,399,033	1,549	PQ3 to 15' HQ3 to 70'	70	8	No Packer Tests Performed			2.76	1	30	51	9.71	20-May-08	1.00E-05	R or TB	Gabbro or Tertiary Basalt	71	79	58
GH08-130	Upper Talarik Creek Area	2,161,360	1,400,918	1,464	PQ3 to 50' HQ3 to 240'	240	43	No Packer Tests Performed			2.92	2	29	49	39.73	22-May-08	Water Level in Completion Zone	R or TB	Gabbro or Tertiary Basalt	56	48	49
GH08-131	Upper Talarik Creek Area	2,162,693	1,405,027	1,060	HQ3 to 79.5'	79.5	59	No Packer Tests Performed			3.18	1	54.5	75	30.25	14-Jul-08	3.70E-05	TB	Tertiary Basalt	77	75	54
																		TX	Tertiary Volcaniclastic Breccia/Conglomerate			
GH08-132	Upper Talarik Creek Area	2,162,316	1,403,062	1,160	PQ3 to 40' HQ3 to 172.5'	172.5	45	No Packer Tests Performed			2.56	2	24	45	13.52	14-Jul-08	4.70E-05	Y	Andesitic Bedded Siltstone	30	65	41
GH08-133	Area A, Upper Side Slopes	2,149,820	1,395,849	1,667	PQ3 to 15' HQ3 to 115'	115	16	15	45	2.4E-04	3.48	1	9	29	9.81	26-May-08	Water Level in Completion Zone	M	Monzonite	55	63	50
								44	70	No Take												
								69	95	No Take												
GH08-134	Upper Talarik Creek Area	2,163,081	1,400,788	1,353	PQ3 to 77' HQ3 to 160'	160	113	No Packer Tests Performed			2.99	2	56	78	Flowing ~2 gpm	19-Jul-08	Not Tested	D	Diorite	17	48	36
GH08-135	Area J	2,147,418	1,395,978	1,766	PQ3 to 10' HQ3 to 110'	110	11	19	45	No Take	3.64	1	85	105	20.11	27-May-08	Test incomplete after 24 hours, low hydraulic conductivity	B	Basalt	84	128	65
								30	70	No Take												
								69	95	No Take												

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-136	Area G	2,163,750	1,376,848	1,614	PQ3 to 12' HQ3 to 120'	120	5	19	45	-	2.62	1	95	115	12.37	9-Jul-08	1.60E-05	B	Basalt	74	81	55
								49	70	-												
								69	95	-												
								94	120	7.9E-06												
GH08-137	Area A, Southern Upland	2,137,818	1,404,282	1,042	PQ3 to 92.5' HQ3 to 250'	250	113	120	150	3.3E-05	2.82	1	123.8	145	111.77	12-Oct-08	In the order of 10-2 to 10-3 cm/s, could not fill piezometer	TB	Tertiary Basalt	53	88	49
								204	230	-								TBx	Tertiary Basalt Breccia			
GH08-138	Area G	2,163,442	1,375,431	1,581	PQ3 to 10' HQ3 to 275'	275	12	29	105	-	2.4	1	115	166	3.97	9-Jul-08	4.10E-06	B	Basalt/Pyroxenite	15	26	35
								99	170	-								B	Basalt/Pyroxenite			
								169	275	-								G	Granodiorite			
GH08-139	Area J	2,143,731	1,391,026	1,715	HQ3 to 125'	125	10	19	45	-	2.85	1	98	120	24.7	13-Jul-08	2.00E-06	G	Granodiorite	47	70	47
								49	75	No Take												
								74	125	No Take												
GH08-140	Area L	2,139,747	1,376,604	1,029	PQ3 to 35' HQ3 to 135'	135	48	50	80	-	3.77	1	108	130	36.27	4-Jun-08	7.10E-05	TX	Tertiary Volcaniclastic Breccia	55	119	54
								79	105	1.3E-05								TBd	Tertiary Basalt			
								104	135	-								TX	Tertiary Volcaniclastic Breccia			
																		TB	Tertiary Basalt			
GH08-141	Area G	2,163,204	1,374,035	1,729	PQ3 to 11' HQ3 to 87'	87	5	15	40	4.9E-06	2.92	1	24.5	55	30.35	9-Jul-08	5.70E-06	G	Granodiorite	86	130	66
								39	65	-												
								64	87	1.4E-05												
GH08-142	Area J	2,143,922	1,389,982	1,806	HQ3 to 164.5'	164.5	80	140	164.5	-	2.69	1	135	155	24.3	13-Jul-08	1.60E-05	G	Granodiorite	36	42	40
																		TB	Tertiary Basalt			
																		G	Granodiorite			
																		TB	Tertiary Basalt			
																		G	Granodiorite			
GH08-143	Area L	2,140,607	1,375,861	1,065	PQ3 to 45' HQ3 to 197' NQ3 to 335'	335	40	49	75	2.1E-04	3.41	1	149.8	181	33.79	23-Jul-08	In the order of 10-2 to 10-4 cm/s, falling too fast to get accurate results	TX	Tertiary Volcaniclastic Breccia	66	129	60
								100	125	-								TBx	Tertiary Basalt Breccia			
								125	150	-								TX	Tertiary Volcaniclastic Breccia			
								204	230	4.4E-05												
								229	255	-								TB/TA	Tertiary Basalt/Andesite			
								254	280	6.0E-05												
								314	335	7.9E-06								TBx	Tertiary Basalt Breccia			
								304	335	7.2E-05												
GH08-144	Area G	2,162,615	1,373,646	1,701	PQ3 to 7' HQ3 to 95'	95	3	19	45	1.7E-04	2.4	1	15	35	9.68	9-Jul-08	7.60E-05	G	Granodiorite	77	119	60
								44	70	No Take												
								69	95	No Take												
GH08-145	Area J	2,144,875	1,389,707	1,880	HQ to 110'	110	7	25	50	2.1E-05	2.69	1	35	55	21.67	8-Jun-08	2.10E-04	G	Granodiorite	56	123	53
								35	60	1.3E-05												
								60	85	3.5E-06												
								85	110	-												
GH08-146	Area G	2,161,935	1,373,192	1,659	PQ3 to 15' HQ3 to 105'	105	8	19	45	2.0E-05	3.15	1	35	55	0.52	10-Jun-08	Test incomplete after being attempted on two separate occasions, low hydraulic conductivity	G	Granodiorite	70	127	56
								44	70	-								B	Basalt			
								64	105	-								G	Granodiorite			
GH08-147	Area J	2,145,198	1,389,042	1,903	HQ3 to 104.5'	104.5	7	24.5	49.5	-	2.69	1	79	99	2.05	9-Jun-08	1.70E-04	G	Granodiorite	52	90	53
								49.5	74.5	5.0E-06												
								73.2	104.7	1.8E-05												
GH08-148	Area G	2,161,337	1,374,534	1,616	PQ3 to 27' HQ3 to 243'	243	20	34	60	-	2.62	1	169.5	230	7.61	12-Jun-08	3.20E-06	G	Granodiorite	51	92	48
								59	85	No Take												
								84	110	2.2E-06								TB	Tertiary Basalt			
								109	135	-												
								134	175	-								G	Granodiorite			
								164	243	3.4E-06												
GH08-149	Area J	2,144,121	1,387,538	1,974	HQ3 to 119.5'	119.5	3	34.5	59.5	1.6E-05	3.22	1	55	75	3.28	11-Jun-08	3.0E-06	G	Granodiorite	33	86	46
								79.5	104.5	-												
GH08-150	Area L	2,140,642	1,377,288	1,082	PQ3 to 25.5' HQ3 to 100' NQ3 to 320'	320	30	50	75	1.8E-04	4.4	1	35	55	35.7	14-Jun-08	Water Level in Completion Zone	TXf	Tertiary Volcaniclastic Breccia Flow	76	116	60
								74	100	2.4E-04												
								105	135	1.1E-04												
								135	160	-								TX	Tertiary Volcaniclastic Breccia			
								159	185	2.0E-05								TX	Tertiary Volcaniclastic Breccia			
								184	210	5.7E-05												
								210	235	-												
								235	260	4.7E-05								TB	Tertiary Basalt			
								259	285	4.9E-05												
								284	320	-												

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-151	Area G	2,162,305	1,376,095	1,523	PQ3 to 65',	280	68	89	115	-	2.23	1	70	95	10.24	9-Jul-08	8.10E-05	TB	Tertiary Basalt	25	84	43
					HQ3 to 280'			109	140	6.3E-05												
								129	170	-								G	Granodiorite			
								164	215	-												
								199	280	-												
GH08-152	Area L	2,144,132	1,386,914	1,952	HQ3 to 104.5'	104.5	7	23	50	2.2E-05	3.12	1	80	100	15.94	14-Jun-08	4.6E-05	G	Granodiorite	44	107	50
								49	74.5	2.5E-04												
								74.5	104.5	6.9E-05												
GH08-153	Area J	2,146,742	1,386,570	1,823	HQ3 to 59.5'	59.5	5	No Packer Tests Performed			3.01	1	15	35	1.87	12-Jul-08	4.6E-05	G	Granodiorite	44	80	46
GH08-154	Area J	2,149,452	1,391,260	1,492	HQ3 to 165'	165	15	64	90	1.5E-05	3.05	1	35	57	4.00	13-Jul-08	2.70E-05	G	Granodiorite	40	135	52
								85	110	-												
								110	135	3.8E-06												
								145	165	-												
GH08-155	Area L	2,140,571	1,379,360	1,311	HQ3 to 55,	240	8	80	140	4.7E-05	3.35	1	194	224	204.45	12-Sep-08	Water Level in Completion	TX	Teriary Volcaniclastic Breccia	54	56	45
					NQ3 to 240'			139	165	7.8E-05							Zone					
								185	215	5.1E-05												
								214	240	-												
GH08-156	Area G	2,161,810	1,377,347	1,422	PQ3 to 20' ,	180	4	29	65	No Take	2.43	1	110	135	7.23	16-Jul-08	Test unable to be	R	Gabbro	48	94	51
					HQ3 to 180'			64	95	-							completed					
								94	155	-												
								154	180	1.4E-05												
GH08-157	Area J	2,148,413	1,391,522	1,549	HQ3 to 79.5',	299	5	24.5	49.5	5.3E-05	3.71	1	207	225	13	13-Jul-08	7.40E-06	D	Diorite	26	114	43
					NQ3 to 298.75'			94.5	114.5	2.2E-05												
								114.5	139.5	2.0E-05								G	Granodiorite			
								149	298.75	5.9E-06												
GH08-158	Area G	2,160,506	1,372,125	1,755	PQ3 to 19',	470	14	29	64	1.3E-05	2.53	1	258	277	3.85	9-Jul-08	9.50E-05	G	Granodiorite	72	134	61
					HQ3 to 347',			64	105	No Take												
					NQ3 to 500'			104	145	-												
					***downhole			144	185	-												
					depths***			185	220	No Take												
								219	260	No Take												
								259	300	-												
								299	340	-												
								339	395	-												
								394	435	8.7E-06												
								434	475	-												
								474	500	No Take												
GH08-159	Area L	2,140,694	1,383,070	1,401	PQ3 to 20',	235	28.5	40	70	4.50E-04	3.12	1	15	35	11.97	16-Jul-08	3.40E-06	TX	Tertiary Volcaniclastic Breccia	34	71	42
					HQ3 to 235'			84	110	-								TB	Tertiary Basalt			
								99	135	-								G	Granodiorite			
								130	160	4.90E-05								TB	Tertiary Basalt			
								155	185	2.20E-05								G	Granodiorite			
								180	210	5.20E-06								TB	Tertiary Basalt			
								205	235	-								G	Granodiorite			
																		TB	Tertiary Basalt			
																		G	Granodiorite			
GH08-160	Area L	2,137,161	1,380,710	1,098	HQ3 to 194.5',	329.5	35	44.5	69.5	8.90E-06	3.18	1	15	35	12.43	25-Jun-08	1.30E-05	TX	Tertiary Volcaniclastic Breccia	47	79	49
					NQ3 to 329.5			69.5	94.5	-												
								94.5	119.5	-								TB	Tertiary Basalt			
								119.5	144.5	1.70E-06												
								144.5	169.5	2.50E-07												
								169.5	194.5	-								TX	Tertiary Volcaniclastic Breccia			
								274.5	329.5	4.10E-07												
GH08-161	Area L	2,141,487	1,384,942	1,765	PQ3 to 15',	100	11	28	55	1.60E-04	3.77	1	14.5	35	2.2	24-Jun-08	4.10E-05	G	Granodiorite	16	69	39
					HQ3 to 100'			49	101	2.30E-05												
GH08-162	Area L	2,138,217	1,373,274	1,340	HQ3 to 20',	200	20	70	95	-	2.82	1	20	40	-1.07	20-Jul-08	3.60E-04	G	Granodiorite	77	181	61
					NQ3 to 200'			95	120	-												
								120	145	9.00E-06								TB?	Possible Tertiary Basalt			
								145	170	1.40E-05												
								170	200	9.90E-06								G	Granodiorite			
GH08-163	Area G	2,160,010	1,380,080	1,268	PQ3 to12.5',	215	7	34	60	-	1.96	1	90	150	-1.5	28-Jun-08	1.40E-04	B	Basalt	39	117	47
					HQ3 to 215'			55	90	-												
								154	190	-												
								184	215	-												
GH08-164	Area G	2,155,408	1,385,809	2,027	PQ3 to 10',	106	4	No Packer Tests Performed			3.77	1	45	65	40.19	14-Jul-08	2.30E-07	G	Granodiorite	60	105	53
					HQ3 to 106'																	
GH08-165	Area E	2,156,401	1,388,006	1,830	HQ3 to 130'	130	75	No Packer Tests Performed			2.72	1	55	75	13.06	30-Jun-08	6.40E-06	G	Granodiorite	25	62	41

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-166	Area G	2,159,924	1,381,441	1,403	PQ3 to 65', HQ3 to 235'	235	135	204	235	1.50E-05	1.8	1	69	145	24.31	3-Jul-08	3.80E-05	B	Basalt	30	100	46
GH08-167	Area G	2,157,140	1,386,522	1,987	PQ3 to 9.7', HQ3 to 106	106	4	No Packer Tests Performed			2.89	1	70	95	24.16	14-Jul-08	2.70E-06	G	Granodiorite	73	144	60
GH08-168	Area G	2,158,898	1,372,501	1,868	PQ3 to 34' HQ3 to 282.9' NQ3 to 335' ***downhole depths***	335	12	294	335	No Take	3.24	1	211	254	4	7-Jul-08	1.20E-06	G	Granodiorite	41	80	49
																		TB	Tertiary Basalt			
																		G	Granodiorite			
																		TB	Tertiary Basalt			
																		G	Granodiorite			
																		TB	Tertiary Basalt			
																		G	Granodiorite			
GH08-169	Area G	2,153,064	1,369,359	1,940	PQ3 to 65', HQ3 to 245', NQ3 to 499.5'	499.5	78.5	109	160	-	2.76	1	N/A	291	6	20-Aug-08	N/A	TX	Tertiary Volcaniclastic Breccia	67	136	58
								159	225	-								G	Granodiorite			
								230	300	-												
								305	350	-								TB	Tertiary Basalt			
								449.5	499.5	-								G	Granodiorite			
GH08-170	Area L	2,147,896	1,367,111	1,949	PQ3 to 30' HQ3 to 135' NQ3 to 500'	500	9.5	169	210	2.10E-06	3.97	1	N/A	488	292	20-Aug-08	N/A	G	Granodiorite	64	132	57
								209	250	-												
								259	300	2.80E-05												
								334	375	-												
								374	415	-												
								414	460	-												
								459	500	-												
GH08-171	Area L	2,147,241	1,370,411	1,589	PQ3 to 43' HQ3 to 150'	150	65	74	100	-	2.95	1	30	50	8.89	21-Jul-08	4.20E-06	TX	Teriary Volcaniclastic Breccia	45	68	46
								130	150	-												
GH08-172	Area L	2,147,901	1,371,504	1,458	PQ3 to 21' HQ3 to 150' NQ3 to 235'	235	30	94	125	-	3.02	1	48	70	20.07	7-Oct-08	1.40E-04	TX	Teriary Volcaniclastic Breccia	59	99	55
								124	155	-												
								174	200	No Take								TBx	Tertiary Basalt Breccia			
								199	235	-												
GH08-173	Area L	2,146,475	1,372,111	1,342	PQ3 to 118' HQ3 to 220'	220	105	144	175	1.00E-04	2.75	1	125	145	41.27	7-Oct-08	In the order to 10-2 to 10-3, falling too fast to get accurate results	G	Granodiorite	70	114	55
								194	220	2.90E-05												
								164	220	4.60E-05								TX	Tertiary Volcaniclastic Breccia			
GH08-174	Area L	2,145,191	1,373,009	1,264	PQ3 to 66.5' HQ3 to 170'	170	161.5	104	160	-	2.72	1	145	165	5.25	29-Jul-08	2.50E-04	TX	Tertiary Volcaniclastic Breccia	29	54	39
																		TB	Tertiary Basalt			
GH08-175	Area L	2,147,147	1,373,749	1,567	PQ3 to 10' HQ3 to 145'	145	8	69	95	2.40E-04	2.99	1	115	140	5.64	31-Jul-08	1.00E-04	TX	Tertiary Volcaniclastic Breccia	48	96	51
								89	120	2.80E-04												
GH08-176	Area L	2,140,251	1,371,642	1,576	PQ3 to 40' HQ3 to 145'	145	25	64	90	3.00E-04	2.99	1	40	75	21.42	3-Aug-08	1.10E-04	TX	Tertiary Volcaniclastic Breccia	62	105	54
								89	115	1.70E-04												
								114	145	-												
GH08-177	Area E	2,162,766	1,392,383	1,337	PQ3 to 127.5' HQ3 to 260' NQ3 to 300'	300	Not Reached	None performed due to heavily fractured rock			2.99	1	178	210	47.31	10-Oct-08	5.20E-07	TBx	Tertiary Basalt Breccia	2	27	30
GH08-178	Area E	2,161,569	1,392,234	1,346	PQ3 to 95' HQ3 to 110' NQ3 to 260'	260	101	154	260	-	2.3	1	85	120	52.3	10-Oct-08	1.20E-06	TB	Tertiary Basalt	20	71	39

		Alaska State Plane Coordinates[A,B]						Packer Test (Lugeon)[F]			Piezometer Information											
Drillhole #	Location of Drillhole	Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Zone From (ft)	Packer Zone To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Stickup (ft)	Size (in)	Completion Zone From (ft)	Completion Zone To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-179	Area E	2,162,015	1,391,461	1,309	PQ3 to 85'	215	89	140	165	3.70E-06	2.89	1	85	120	16.4	17-Aug-08	1.10E-04	TB	Tertiary Basalt	54	103	51
					HQ3 to 100'			165	190	-												
					NQ3 to 215			190	215	-												
GH08-180	Area E	2,162,955	1,391,006	1,273	PQ3 to 25'	240	25	89	135	No Take	3.02	1	40	72	-0.36	20-Aug-08	8.00E-05	TBx	Tertiary Basalt Breccia	18	85	45
					HQ3 to 190'			125	190	-								TB	Tertiary Basalt			
					NQ3 to 240'			199	240	-												
GH08-181S	Area E	2,165,358	1,390,019	1,201	PQ3 to 5.25'	120	10	32	85	No Take	3.25	1	10	30	14.24	22-Aug-08	Water Level in Completion Zone	TB	Tertiary Basalt	42	96	51
					HQ3 to 85'																	
					NQ3 to 120'																	
GH08-181D								94	120	No Take	3.31	1	45	65	15.11	23-Aug-08	8.10E-07					
GH08-182	Area E	2,160,152	1,388,906	1,565	PQ3 to 25,	165	12	64	90	No Take	3.44	1	25	40	5.81	24-Aug-08	Casing stuck in completion zone	M	Monzonite	53	101	52
					HQ3 to 55,			89	115	No Take												
					NQ3 to 165'			115	140	No Take												
								139	165	No Take												
GH08-183	Area E	2,159,867	1,391,073	1,310	PQ3 to 50'	270	255	44	70	-	2.85	1	151	184	8.7	26-Aug-08	2.40E-05	G	Granodiorite	15	40	36
					HQ3 to 180'													TB	Tertiary Basalt			
					NQ3 to 270'													G	Granodiorite			
																		TB	Tertiary Basalt			
																		G	Granodiorite			
GH08-184	Area G	2,158,753	1,377,776	1,468	PQ3 to 25'	50	21	No Packer Tests Performed			3.03	1	25	45	0.9	27-Aug-08	5.30E-07	G	Granodiorite	53	61	47
					HQ3 to 50'																	
GH08-185	Area G	2,158,949	1,379,058	1,374	PQ3 to 15'	60	45	No Packer Tests Performed			3.28	1	35	55	2.36	29-Aug-08	4.80E-05	G	Granodiorite	36	65	44
					HQ3 to 60'																	
GH08-186	Area G	2,160,728	1,379,386	1,316	PQ3 to 15'	24.5	19.5	No Packer Tests Performed			3.41	1	5	22	1.33	9-Sep-08	In the order to 10-2 to 10-3, falling too fast to get accurate results	R	Gabbro	12	105	42
					HQ3 to 24.5'																	
GH08-187	Area G	2,159,911	1,383,083	1,498	PQ3 to 40'	145	81	84	105	8.30E-05	3.38	1	45	65	17.24	31-Aug-08	2.40E-04	B	Basalt	24	79	43
					HQ3 to 145'													G	Granodiorite			
																		B	Basalt			
								104	135	-								G	Granodiorite			
																		B	Basalt			
GH08-188	Area G	2,159,683	138,404	1,765	PQ3 to 10'	90	5	19	55	-	3.18	1	30	50	41	1-Sep-08	Water Level in Completion Zone	B	Basalt	47	93	50
					HQ3 to 90'			59	85	1.20E-04												
GH08-189S	Area E	2,160,625	1,392,769	1,375	PQ to 85'	350	89	234	260	-	3.02	1	165	190	47.18	7-Sep-08	7.40E-06	G	Granodiorite	20	58	39
					HQ to 185'			234	290	2.00E-06								FZ	Fault Zone			
GH08-189D					NQ to 350'			289	315	No Take	2.95	1	195	225	42.45	10-Sep-08	2.10E-06	B	Basalt			
								304	350	-												
GH08-190	Area J	2,134,336	1,386,093	963	PQ3 to 40'	160	40	64	85	-	2.4	1	50	70	-0.10	3-Sep-08	8.20E-06	G	Granodiorite	47	85	48
					HQ3 to 160'			89	115	-												
								119	145	-												
GH08-191	Area J	2,137,551	1,390,876	1,008	PQ3 to 55'	180	88	104	130	No Take	3.51	1	67	90	40.98	9-Sep-08	1.40E-06	Y	Andesitic Bedded Siltstone	56	65	47
					HQ3 to 180'			129	155	No Take												
								154	180	No Take												
GH08-192	Area E	2,156,358	1,392,336	1,375	PQ3 to 85'	255	85	89	115	-	3.94	1	150	170	10.33	9-Sep-08	6.10E-06	G	Granodiorite	35	80	45
					HQ3 to 255'			119	145	No Take												
								149	170	No Take												
								169	195	No Take												
								194	220	No Take												
								219	255	No Take												
GH08-193	Area L	2,136,061	1,383,319	1,106	PQ3 to 16.5'	150	15	44	70	2.80E-05	3.38	1	24.7	45	5.48	12-Sep-08	4.30E-05	TX	Tertiary Volcaniclastic Breccia	49	60	46
					HQ3 to 150'			74	100	No Take												
								99	125	No Take								G	Granodiorite			
								124	150	No Take												
GH08-194	Area E	2,153,258	1,392,891	1,512	PQ3 to 75'	225	86.8	104	130	9.30E-05	2.79	1	55.5	75	0.2	14-Sep-08	3.30E-06	G	Granodiorite	11	66	41
					HQ3 to 225'			129	155	3.60E-05												
								154	180	No Take												
								179	205	8.70E-05												
								189	225	7.80E-05												
GH08-195	Area L	2,132,179	1,377,408	887	PQ3 to 10.5'	165.5	12	44	69.75	No Take	3.67	1	15	40	1.87	16-Sep-08	4.40E-06	G	Granodiorite	51	81	49
					HQ3 to 165.5'			74	99.5	-												
								94	125	No Take												
								124	165.5	No Take												
GH08-196	Area J	2,152,344	1,394,473	1,907	PQ3 to 10'	105	21	24	105	-	3.87	1	47	67	26.57	15-Sep-08	1.60E-06	Y	Andesitic Bedded Siltstone	15	71	45
					HQ3 to 105'																	
GH08-197A	Area L	2,138,199	1,376,956	969	PQ3 to 34.7'	45	24.25	No Packer Tests Performed			2.66	1	26.25	43	0.52	17-Sep-08	6.00E-04	TX	Tertiary Volcaniclastic Breccia	64	67	53
					HQ3 to 45'																	

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-197B	Area L	2,138,185	1,376,947	969	PQ3 to 25'	400	19	44	70	-	2.65	1	129	154	Flowing, ~1gpm	24-Sep-08	Not Tested	TF(TX)	Tertiary Volcaniclastic Breccia	85	120	66
					HQ3 to 156'			69	100	-								TX	Tertiary Volcaniclastic Breccia			
					NQ3 to 400'			99	130	1.10E-04								TF(TX)	Tertiary Volcaniclastic Breccia			
								199	225	1.50E-04								TB	Tertiary Basalt			
								224	250	3.50E-05								TX	Tertiary Volcaniclastic Breccia			
								249	275	6.70E-05								TB	Tertiary Basalt			
								274	300	1.10E-04								TF(TX)	Tertiary Volcaniclastic Breccia			
								299	325	9.70E-07								TB	Tertiary Basalt			
								324	350	-												
								349	375	-								TF	Tertiary Volcaniclastic Breccia			
								374	400	8.50E-07												
GH08-198	Area E	2,162,343	1,395,936	1,417	PQ3 to 35'	200	45	64	90	-	3.38	1	36	60	9.40	17-Sep-08	2.80E-05	G	Granodiorite	48	85	53
					HQ3 to 200'			89	115	-												
								114	140	No Take												
								139	165	No Take												
								164	200	No Take												
GH08-199S	Area L	2,139,428	1,380,179	1,331	PQ3 to 15'	245'	33	219	245	7.10E-06	2.92	1	65	90	11.8	7-Oct-08	2.30E-04	TX	Tertiary Volcaniclastic Breccia	70	61	54
					HQ3 to 90'													TBx	Tertiary Basalt Breccia			
					NQ3 to 245'			189	245	8.30E-05								TF	Tertiary Volcaniclastic Breccia			
GH08-199D											2.59	1	105.7	137	11.9	7-Oct-08	In the order of 10-2 to 10-3 cm/s, falling too fast to get accurate results	TBx	Tertiary Basalt Breccia			
								159	245	1.40E-04								TF	Tertiary Volcaniclastic Breccia			
GH08-200	Upper Talarik Creek Area	2,164,708	1,399,869	1,443	PQ3 to 50' HQ3 to 150'	150	95	No Packer Tests Performed			3.54	1	56	75	23.14	20-Sep-08	1.40E-05	TB	Tertiary Basalt	38	88	51
GH08-201	Upper Talarik Creek Area	2,164,347	1,401,337	1,296	PQ3 to 74' HQ3 to 135', NQ3 to 153.8', HQ3 to 164.8, NQ3 to 238'	238	96.6	No Packer Tests Performed			NA	1	54.5	74	No longer flowing, piezometer was grouted in	23-Sep-08	Not Tested	TB	Tertiary Basalt	38	67	46
																		FZ	Fault Zone			
GH08-202	Upper Talarik Creek Area	2,163,894	1,404,030	1,073	PQ3 to 40' NQ3 to 125'	125	35	No Packer Tests Performed			No Piezometer Installed							Y	Cretaceous Andesitic Siltstone	43	83	51
																		G	Granodiorite			
																		Y	Cretaceous Andesitic Siltstone			
GH08-203	Area L	2,140,309	1,373,795	1,303	PQ3 to 20'	230	30	54	85	9.40E-05	3.28	1	24	49	11.1	27-Sep-08	2.60E-04	TX	Tertiary Volcaniclastic Breccia	74	90	53
					HQ3 to 140'			84	115	4.70E-05								TB	Tertiary Basalt			
					NQ3 to 230'			114	140	-								TX	Tertiary Volcaniclastic Breccia			
								149	170	-								TBx	Tertiary Basalt Breccia			
								169	195	1.10E-06								G	Granodiorite			
								194	230	5.10E-07												
GH08-204	Area A, Upper Side Slopes	2,146,402	1,408,822	1,209	PQ3 to 65' HQ3 to 239.75'	239.75	130	189	215	2.00E-04	3.94	1	115	140	91.57	8-Oct-08	In the order of 10^{-3} to 10^{-4} cm/s, Water level dropped too fast during falling head test to measure by hand	G	Granodiorite	45	71	46
								214	240	2.20E-05												
GH08-205S	Area J	2,145,205	1,393,051	1,112	PQ3 to 20' HQ3 to 155'	155	15	109	135	-	3.22	1	23	59	3.8	30-Sep-08	1.20E-05	TB	Tertiary Basalt	49	113	47
																		G	Granodiorite			
GH08-205D											3.08	1	66.5	105	6.6	2-Oct-08	2.70E-05	G/FZ	Fault Zone (Granodiorite)			
																		G	Granodiorite			
GH08-206S	Area J	2,149,489	1,392,479	1,203	PQ3 to 15'	270	30	179	205	-	2.53	1	79.7	115	3.3	7-Oct-08	3.10E-05	TB	Tertiary Basalt	36	116	46
GH08-206D					HQ3 to 155'			204	230	-	2.66	1	145	170	2.5	7-Oct-08	9.40E-05					
					NQ3 to 270'			224	270	-												
GH08-207S	Area A, Upper Side Slopes	2,147,466	1,410,638	1,483	PQ3 to 25' HQ3 to 115'	115	15	29	55	5.2E-04	3.84	1	30	50	30.5	3-Oct-08	In the order of 10-2 to 10-3 cm/s, Would not hold water, even at maximum pump flow.	M	Monzonite	56	84	51
								54	80	5.8E-04												
GH08-207D								79	115	-	3.84	1	89	109	91.17	3-Oct-08	3.8E-05					
GH08-208	Area J	2,150,663	1,392,562	1,519	PQ3 to 25' HQ3 to 200'	200	15.5	69	95	-	3.08	1	49	75	2.5	7-Oct-08	8.20E-05	G	Granodiorite	42	99	47
								94	135	-												
								134	165	-												
								164	200	-												
GH08-209	Area A, Upper Side Slopes	2,144,557	1,409,363	1,226	PQ3 to 75' NQ3 to 165'	165	63	94	120	4.50E-04	3.18	1	54	78	6.43	5-Oct-08	7.40E-06	M	Monzonite	41	70	44
								119	145	-												

Drillhole #	Location of Drillhole	Alaska State Plane Coordinates[A,B] Northing (ft)	Easting (ft)	Elevation (ft)	Nominal Hole Size	Total Depth[H] (ft)	Depth to Bedrock[H] (ft)	Packer Test (Lugeon)[F] Packer Zone From (ft)	To (ft)	Hydraulic Conductivity (Lugeon)[F] (cm/s)	Piezometer Information Stickup (ft)	Size (in)	Completion Zone From (ft)	To (ft)	Depth to Water[G,H] (ft)	Date Measured[G]	Hydraulic Conductivity (Rising/Falling Head)[F] (cm/s)	Lithocode[C]	Bedrock Type	Average Est. RQD[J] (%)	Average Est. UCS[E,J] (Mpa)	Average Estimated RMR89[D,J]
GH08-210S	Area A, Lower/Mid Side Slopes	2,146,875	1,407,171	1,096	PQ3 to 55' HQ3 to 145'	145	50	94	120	-	4.92	1	65	90	35.76	9-Oct-08	1.30E-04	TB	Tertiary Basalt	56	103	51
																		TX	Tertiary Volcaniclastic Breccia			
																		TBx	Tertiary Basalt Breccia			
GH08-210D								119	145	-	4.33	1	110	135	37.795	12-Oct-08	1.30E-04	TY	Tertiary Siltstone/Mudstone			
																		TX	Tertiary Siltstone/Mudstone			
																		TW	Tertiary Wacke			

Notes:
A. NAD 83, Alaska State Plane - Zone 5 (ft).
B. Coordinates surveyed by PLP personnel.
C. Lithocodes were determined by PLP.
D. RMR89 = Rock Mass Rating Classification System (Bieniawski, 1989).
E. Unconfined compressive strength (UCS) values were estimated in the field.
F. Packer Hydraulic Conductivity Tests (Lugeon Method) were completed in the bedrock and Rising/Falling Head Tests (Hvorslev Method) were conducted in either the bedrock or overburden depending on the location of the completion zone of the piezometer.
G. Static water levels can vary dramatically seasonally.
H. All depth measurements are with respect to ground surface level, including water level measurements.
I. Artesian flow is defined as sustained water flow >50gpm, <50gpm is termed flowing.
J. Average RQD, UCS and RMR is for all of the bedrock per drillhole, the values have not been separated out for different rock types.

APPENDIX 6C

Oriented Geotechnical Drillhole Investigation Summary, 2004 through 2008

APPENDIX 6C
Pebble Deposit Area Oriented Geotechnical Drillhole Investigation Summary, 2004 through 2008

Year Drilled	KP/SRK Nomenclature	Drillhole No. (NDM/PLP Nomenclature)	Coordinates[1] Northing (ft)	Coordinates[1] Easting (ft)	Collar Elevation (ft)	Azimuth (°)	Inclination (°)	Total Depth[2] (ft)	Lithocode[3]	Bedrock Types Encountered
2004	KP-01	4207	2,158,718	1,401,871	1,259	333	60	1,607	Y/M/P/D	Bedded Andesites / Monzonite / Porphyritic Monzodiorite / Diorite
	KP-02	4206	2,159,189	1,403,753	1,036	10	60	731	TF/TC/D/TBd	Tertiary Sediments / Tertiary Basalt / Diorite / Dyke
	KP-02a	4208	2,159,426	1,404,035	1,026	354	60	1,477	Gs/D/Y	Granodiorite / Diorite / Bedded Andesites
	KP-04	4149	2,157,294	1,405,306	1,006	94	60	1,554	TC/Y/D	Tertiary Sediments / Bedded Andesites / Diorite
	KP-05	4159	2,155,875	1,403,866	1,010	152	60	497	TY/TF/TBd/Gs/D	Tertiary Sediments / Tertiary Basalt / Granodiorite / Diorite
	KP-05a	4209	2,155,955	1,404,093	1,008	152	60	1,302	TY/TW/TBd/D/Y/Gs	Tertiary Sediments / Tertiary Basalt / Diorite / Bedded Andesites / Granodiorite
	KP-06	4165	2,155,498	1,402,119	1,051	182	60	1,285	N/Y/TBd	Monzodiorite / Bedded Andesites / Tertiary Basalt
	KP-08	4175	2,156,871	1,400,535	1,160	271	60	1,599	N/TBd/Y/M/D	Monzodiorite / Tertiary Basalt / Bedded Andesites / Monzonite / Diorite
2005	N/A	5321	2,157,640	1,406,096	1,046	92	65	1,868	TY/TBd/TC/TF/Gs/Y	Tertiary Sediments / Tertiary Basalt / Granodiorite / Bedded Andesites
	N/A	5324	2,157,825	1,407,947	961	111	60	4,077	TW/TY/TC/TD/TF/TA/Gp/TBd	Tertiary Sediments / Granodiorite Quartz Monzodiorite / Tertiary Basalt
	N/A	5325	2,158,733	1,406,217	999	92	65	2,651	TY/TA/TW/TC/TF/G/Y/D/Gs/GZ	Tertiary Sediments / Granodiorite / Bedded Andesites / Diorite / Fault Zone @2,208-2,238'
	N/A	5326	2,156,163	1,406,398	1,047	147	65	4,283	TA/TW/TF/TC/TY/Gs/Y/D/Gp	Tertiary Sediments / Granodiorite / Bedded Andesites / Diorite / Granodiorite Quartz Monzodiorite
	N/A	5327	2,156,775	1,408,445	950	92	65	4,338	TF/TA/TY/TW/TC/TD	Tertiary Sediments - Not oriented to bottom
	N/A	5328	2,154,653	1,404,443	1,000	152	65	1,988	TW/TA/TC/TY/Gs/Y	Tertiary Sediments / Granodiorite / Bedded Andesites
	N/A	5329	2,157,166	1,398,966	1,235	272	65	1,828	N	Monzodiorite
2006	N/A	6338	2,156,124	1,408,116	1,044	273	80	4,082	TX/TB/TF/TY/TW/TC/Y/W/Gp	Tertiary Sediments / Tertiary Basalt / Bedded Andesites / Granodiorite
	N/A	6343	2,156,923	1,412,089	858	265	80	5,002	TX/TB/TW/TT/TA/TY/TM/TD/Y/G	Tertiary Sediments / Tertiary Basalt / Tertiary Andesite / Tertiary Monzonite / Tertiary Dacite / Bedded Andesites / Granodiorite / Fault Zone @ 2,312-2,322'
	N/A	6350	2,159,696	1,409,518	866	3	80	4,098	TX/TB/TY/TW/TC/TT/TF/G/Y	Tertiary Sediments / Tertiary Basalt / Granodiorite / Bedded Andesites
2007	N/A	7367	2,156,511	1,408,992	932	317	75	4,036	TX/TB/TY/TC/TF/Y/W/G	Tertiary Sediments / Tertiary Basalt / Bedded Andesite / Granodiorite
	N/A	7372	2,155,860	1,409,934	918	317	75	4,217	TX/TB/TD/TF/TW/TM/TY/TC/TT/G/X	Tertiary Sediments / Tertiary Basalt / Tertiary Dacite / Tertiary Monzonite / Granodiorite / Fault Breccia
	N/A	7379	2,157,028	1,410,292	870	315	75	4,228	TD/TA/TX/TF/TB/TW/TC/G/Y	Tertiary Sediments / Tertiary Dacite / Tertiary Andesite / Tertiary Basalt / Granodiorite / Bedded Andesites
	N/A	7387	2,155,203	1,408,958	1,017	272	75	4,722	TD/TX/TF/TB/TW/TA/TY/TT/TC/Y/Gp/Q	Tertiary Sediments / Tertiary Dacite / Tertiary Basalt / Tertiary Andesite / Bedded Andesites / Granodiorite / Quartz

Year Drilled	KP/SRK Nomenclature	Drillhole No. (NDM/PLP Nomenclature)	Coordinates[1] Northing (ft)	Easting (ft)	Collar Elevation (ft)	Azimuth (°)	Inclination (°)	Total Depth[2] (ft)	Lithocode[3]	Bedrock Types Encountered
2008	N/A	8405	2,158,190	1,411,801	848	240	74	5,091	TX/TB/TW/Gs/TBd/Y/Gp	Tertiary Sediments / Tertiary Basalt / Granodiorite / Bedded Andesites / Fault Zones @4,398-4,643'
	N/A	8414	2,155,203	1,409,703	979	321	75	4,489	TX/TR/TD/TB/TW/TY/TF/TC/Q/Gp	Tertiary Sediments / Tertiary Rhyolite / Tertiary Dacite / Tertiary Basalt / Quartz / Granodiorite / Fault Zone @1,443-1,493'
	N/A	8422	2,155,147	1,407,856	1,034	126	75	4,839	TX/TB/TW/TY/TF/TT/TC/TD/Gs/Gp/Q	Tertiary Sediments / Tertiary Basalt / Tertiary Dacite / Granodiorite / Quartz
	N/A	8438	2,156,250	1,409,108	937	173	75	3,184	TB/TX/TW/TY/TC/TT/TF/Q/G	Tertiary Basalt / Tertiary Sediments / Quartz / Granodiorite / Fault Zones @2,424-2,690'
	N/A	8443	2,158,170	1,407,270	1,000	293	65	2,911	TW/TC/TBd/TY/TC/TF/Gs/TD/Y	Tertiary Sediments / Tertiary Basalt / Granodiorite / Tertiary Dacite / Bedded Andesites / Fault Zones @1,040-1,080', 2,736-2,833'

Notes:
1. NAD 83, Alaska State Planes, Zone 5.
2. All depth measurements are downhole.
3. Lithocodes were determined by NDM/Pebble Partnership.
4. Oriented Geotechnical Drillholes were completed by KP in 2004 and 2005 and SRK in 2006, 2007, and 2008.

APPENDIX 6D

Rock Mass Rating Classification System

APPENDIX 6D

Rock Mass Rating Classification System[A]

												VALUE	RATING
Intact Rock Strength	**PLST (MPa)**	10	8	6.5	5.5	5	4.5	3	2	1	< 1		
	UCS (MPa)	250	200	160	140	125	110	75	50	25	< 25		
	Field Est.	chipped by hammer		many blows by hammer to break				single blow		pocket knife			
	RATING	**15**	**14**	**13**	**12**	**11**	**10**	**8**	**6**	**4**	**< 3**		
RQD	**RQD (%)**	100	90	80	70	60	50	40	30	20	0		
	RATING	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**5**	**4**	**3**		
Joint Spacing (Js)	**Js (centimeters)**	> 200	160	130	90	60	40	20	15	10	< 6		
	RATING	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**8**	**7**	**5**		

								Set 1	Set 2	Set 3		
							Orientation					
							J Spacing					
Joint Condition	**Persistence (meters)**	< 1	1-3	3-10	10-20	> 20						
	RATING	**6**	**4**	**2**	**1**	**0**						
	Aperture (millimeters)	None	<0.1	0.1-1.0	1-5	5-10						
	RATING	**6**	**5**	**4**	**1**	**0**						
	Roughness	V Rough	Rough	SL Rough	Smooth	Slicks						
	RATING	**6**	**5**	**3**	**1**	**0**						
	Infilling (millimeters)	None	Hard Infilling		Soft Infilling							
			< 5	> 5	< 5	> 5						
	RATING	**6**	**4**	**3**	**2**	**0**						
	Weathering	FRESH	SW	MW	HW	CW						
	RATING	**6**	**5**	**3**	**1**	**0**						
							Sub-Total					

Groundwater Condition	**Inflow (l/min/10m)**	None	< 10	10-25	25-125	> 125		
	General	Dry	Damp	Wet	Dripping	Flowing		
	RATING	**15**	**10**	**7**	**4**	**0**		

Adjustment for Joint Orientation	DIP OF ADVERSE JOINT SET				
	0-20	20-45	45-90		
Strike Perpendicular to Tunnel Axis Drive with Dip	Unfavorable -10	Favorable -2	Very Favorable 0		
Strike Perpendicular to Tunnel Axis Drive against Dip	Unfavorable -10	Unfavorable -10	Fair -5		
Strike Parallel to Tunnel	Unfavorable -10	Fair -5	Very Unfavorable -12		

ROCK MASS RATING	80 - 100	60 - 80	40 - 60	20 - 40	0 - 20
DESCRIPTION	VERY GOOD	GOOD	FAIR	POOR	VERY POOR
RMR CLASS	I	II	III	IV	V

Notes:

A. RMR89 system (Bieniawski, 1989)

CW = completely weathered

HW = highly weathered

l/min/10m = liters per minute per 10 meters

Est. = estimate

UCS = unconfined compressive strength

MW = moderately weathered

PLST = point load strength test

SW = slightly weathered

RQD = rock quality designation

APPENDIX 6D

Rock Mass Rating Classification System[A]

												VALUE	RATING
Intact Rock Strength	**PLST (MPa)**	10	8	6.5	5.5	5	4.5	3	2	1	< 1		
	UCS (MPa)	250	200	160	140	125	110	75	50	25	< 25		
	Field Est.	chipped by hammer		many blows by hammer to break				single blow		pocket knife			
	RATING	**15**	**14**	**13**	**12**	**11**	**10**	**8**	**6**	**4**	**< 3**		
RQD	**RQD (%)**	100	90	80	70	60	50	40	30	20	0		
	RATING	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**5**	**4**	**3**		
Joint Spacing (Js)	**Js (centimeters)**	> 200	160	130	90	60	40	20	15	10	< 6		
	RATING	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**8**	**7**	**5**		

								Set 1	Set 2	Set 3		
							Orientation					
							J Spacing					
Joint Condition	**Persistence (meters)**	< 1	1-3	3-10	10-20	> 20						
	RATING	**6**	**4**	**2**	**1**	**0**						
	Aperture (millimeters)	None	<0.1	0.1-1.0	1-5	5-10						
	RATING	**6**	**5**	**4**	**1**	**0**						
	Roughness	V Rough	Rough	SL Rough	Smooth	Slicks						
	RATING	**6**	**5**	**3**	**1**	**0**						
	Infilling (millimeters)	None	Hard Infilling		Soft Infilling							
			< 5	> 5	< 5	> 5						
	RATING	**6**	**4**	**3**	**2**	**0**						
	Weathering	FRESH	SW	MW	HW	CW						
	RATING	**6**	**5**	**3**	**1**	**0**						
							Sub-Total					

Groundwater Condition	**Inflow (l/min/10m)**	None	< 10	10-25	25-125	> 125		
	General	Dry	Damp	Wet	Dripping	Flowing		
	RATING	**15**	**10**	**7**	**4**	**0**		

Adjustment for Joint Orientation	DIP OF ADVERSE JOINT SET				
	0-20	20-45	45-90		
Strike Perpendicular to Tunnel Axis Drive with Dip	Unfavorable -10	Favorable -2	Very Favorable 0		
Strike Perpendicular to Tunnel Axis Drive against Dip	Unfavorable -10	Unfavorable -10	Fair -5		
Strike Parallel to Tunnel	Unfavorable -10	Fair -5	Very Unfavorable -12		

ROCK MASS RATING	80 - 100	60 - 80	40 - 60	20 - 40	0 - 20
DESCRIPTION	VERY GOOD	GOOD	FAIR	POOR	VERY POOR
RMR CLASS	I	II	III	IV	V

Notes:

A. RMR89 system (Bieniawski, 1989)

CW = completely weathered

HW = highly weathered

l/min/10m = liters per minute per 10 meters

Est. = estimate

UCS = unconfined compressive strength

MW = moderately weathered

PLST = point load strength test

SW = slightly weathered

RQD = rock quality designation