HDR

# City of Palmer

PALMER, ALASKA

## Wastewater Treatment Facility Improvements Project - Phase II

## Bid Documents
## Volume 2 of 4

## Geotechnical Report

**May 25, 2021**

HDR Project No. 10022766

**Palmer Waste Water Treatment Plant**
**Facility Improvements**
**Palmer, Alaska**

October 2016

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32-1-02475-003

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# FACILITY IMPROVEMENTS
# ANCHORAGE, ALASKA

## 1.0 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, and engineering evaluations conducted by Shannon & Wilson, Inc. at the Waste Water Treatment Plant (WWTP) in Palmer, Alaska. The purpose of this work was to observe and document subsurface conditions and provide engineering recommendations for the construction of Moving Bed Biofilm Reactor (MBBR) Basins, Secondary Clarifiers, and a control building. To accomplish this, we advanced five geotechnical borings within the project area. The borings were advanced to between 25 and 30 feet below ground surface (bgs) for the purpose of exploring subsurface conditions. Selected soil samples recovered from the borings were tested in our Anchorage laboratory. Presented in this report are descriptions of the site and project, subsurface explorations, laboratory test results, an interpretation of subsurface conditions, and engineering conditions.

Authorization to proceed with this work was received in the form of signed contract by Mr. Tim Gallagher of HDR Alaska, Inc. on September 9, 2016. Our work was conducted in general accordance with our April 19, 2016 proposal.

## 2.0 SITE AND PROJECT DESCRIPTION

The project is located in Palmer, Alaska, at the Palmer WWTP which is located approximately 330 feet south of the intersection of East Icy Lane and South Brooks Road. A vicinity map indicating the general project location is presented as Figure 1. A site plan, included as Figure 2, shows prominent site features and the approximate boring locations.

The site is generally level and currently developed with the Palmer WWTP. The planned locations of the control building and MBBR Basins is generally in a grass covered area. The planned location of the Secondary Clarifiers is generally similar, although one of the planned locations is partially within a gravel driving surface. The control building is about 1,800 square feet and will be heated to at least 50 degrees Fahrenheit throughout the year. Each MBBR has a rectangular footprint of about 75 feet by 60 feet and a depth of about 25 feet bgs. Each Secondary Clarifier has a diameter of 55 feet and a depth of about 20 feet.

## 3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for this study consisted of drilling and sampling five borings to depths ranging between 25 and 30 feet bgs, designated Borings B-1 through B-5, on September 22, 2016. The general boring locations were selected prior to mobilizing to the site. The final boring locations shown on Figure 2 were recorded by CRW during their site survey.

Drilling services for this project were provided by Discovery Drilling using a truck mounted CME 75 drill rig. An experienced representative from our firm was present during drilling to locate the holes, observe drill action, collect samples, log subsurface conditions, and observe groundwater conditions. Prior to mobilizing to the site we contacted the Call Locate Center to locate buried utilities in the project area.

The borings were advanced with 3¼-inch inner diameter (ID), continuous flight, hollow-stem augers to a depth of approximately 25 or 30 feet bgs. As the borings were advanced, samples were typically recovered using Modified Penetration Test (MPT) methods at 2.5-foot intervals to 10 feet bgs and 5-foot intervals thereafter. In the MPT method, samples are recovered by driving a 3-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 340-pound hammer free falling 30 inches onto the drill rod. The number of blows required to advance the sampler the final 12 inches of an 18-inch penetration is termed the penetration resistance. Blow counts are shown graphically on the boring log figures as "penetration resistance" and are displayed adjacent to sample depth. The penetration resistance values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. In addition to the split-spoon samples, a grab sample of the near-surface soils was collected from the auger cuttings in the upper 1.5 to 2 feet of each boring.

The soils were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2488. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with the Unified Soil Classification System, which is described in Appendix A, Figure A-1. The frost classifications included on the logs are followed by "P-200" to indicate that the classification was based on P-200 data. The frost classification system is presented in Appendix A, Figure A-2. Summary logs of the borings are presented in Appendix A, Figures A-3 through A-7.

The borings were backfilled with the cuttings generated during drilling. Excess cuttings were spread in non-vegetated areas and outside of the site roads. Prior to backfill, a 1-inch diameter PVC piezometer was placed in Boring B-1 to allow future observations of water level.

## 4.0 LABORATORY TESTING

Laboratory tests were performed on selected soil samples recovered from the borings to support our soil descriptions and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining gradation properties, natural water content, and frost characteristics.

Water content tests were performed on the samples returned to our laboratory. Water content tests were performed in general accordance with ASTM D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A, Figures A-3 through A-7.

Grain size classification (gradation) testing was performed on select soil samples to estimate the particle size distribution. The gradation testing generally followed the procedures described in ASTM C117/C136. The test results are presented in Appendix A, Figure A-8 and summarized on the boring log as percent gravel, percent sand, and percent fines. Percent fines on the boring log are equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve.

## 5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in Borings B-1 through B-5 are presented graphically on the boring logs included as Appendix A, Figures A-3 through A-7. With the exception of Boring B-5 which was advanced in a gravel access road, the borings were advanced through a thin organic mat and 2 to 4.5 feet of fine grained soil. The predominately fine grained surficial soils were medium dense. The fines content of these surficial soils, based on our laboratory testing, ranged from approximately 27 to 74 percent. Based on our laboratory testing, the moisture contents ranged from 12 to 19 percent.

Below the predominately fine grained surficial soils, the underlying soils consisted of poorly to well-graded sands and gravels with varying amounts of fines to the bottom of the borings. The sands and gravels were medium dense to very dense with blow counts ranging from 20 to 76 blows per foot (bpf). The fines content of these sands and gravels, based on our laboratory testing, ranged from approximately 5 to 10 percent. Based on our laboratory testing, the moisture contents ranged from 1 to 5 percent. Groundwater was not encountered during drilling.

## 6.0 SEISMIC CONDITIONS

The site class most representative of the project area according to the 2012 International Building Code (IBC) will be Site Class D for a stiff soil profile. This is based on the blow count (N) method with typical blow counts in the 15 to over 50 blows per foot range. Based on the ground motions in Figures 1613.3.1(4) and 1613.3.1(5) contained in IBC 2012, $S_s$ and $S_1$ for the Maximum Considered Earthquake (return period of 2,475 years) were estimated at 1.500 and 0.701, respectively. The site specific modifying coefficients for the spectral response accelerations are $F_A = 1.0$ and $F_v = 1.5$ for the short and long periods, respectively. The $S_{MS}$ and $S_{M1}$ were calculated to be 1.500 and 1.051 respectively. The computed $S_{DS}$ and $S_{D1}$ are 1.000 and 0.701.

Based on the ground motions in Figure 12 contained in *Revision of Time-Independent Probabilistic Seismic Hazard Maps for Alaska* by the United States Geological Survey (USGS), the peak ground acceleration (PGA) was found to be 0.59 times the gravitational coefficient (g). This value is roughly equivalent to what would be calculated using probabilistic estimates of ground motions with a 2 percent probability of exceedance in 50 years (2,475-year return period).

## 7.0 FOUNDATION RECOMMENDATIONS

The design of the proposed treatment tanks and control building must consider the bearing support capabilities of the soils, expected settlements, and the effects of seasonal frost action. We understand that the control building and treatment tanks will be heated to at least 50 degrees Fahrenheit. Based on the subsurface conditions encountered and our engineering analyses, it is our opinion that the existing site soil, below the fine-grained material in the upper 2.5 to 4.5 feet bgs, is suitable for the support and backfill of the treatment tanks and control building.

### 7.1 Site Grading and Preparation

Given that the project area is relatively flat, we assume that the proposed treatment building will be constructed at or near the existing grade. Within the building footprint, organic soils and silt will need to be removed and replaced to provide sufficient support for the footings and floor slab. We assume that the existing site soils will be salvaged for re-use as much as possible. The organic soils and silt should not be used in structural areas; however the silt may be used as a low permeability fill soil at the ground surface around the building and tanks. The native sand and gravel material removed from the treatment tank excavations may be used as fill beneath the control building's slab as long as the contractor is able to meet compaction requirements described in Section 7.8, the fill contains less than approximately 20 percent fines, and contains no organics or deleterious material.

### 7.2 Foundation Design

Based on the information obtained from our field explorations, we recommend that the proposed control building and treatment tanks be supported on spread or continuous strip footings bearing directly on compacted structural fill placed over firm, unyielding native soils that are free from organics (control building) or firm, unyielding native soil (treatment tanks). The organics and silt soil should be excavated from beneath the footprint of the control building on a line running out from the bottom of the footing at a one horizontal to one vertical (1:1) slope. The exposed grade and structural fill placed beneath footings should be placed and compacted in accordance with the recommendations included in Section 7.8.

We recommend that continuous footings are sized such that the width is between 16 and 48 inches, and that spread footings should be between 2 and 5 feet to limit potential settlements. The footings should be buried sufficiently to prevent structural damage resulting from frost action. We recommend that perimeter footings in the heated building be placed a minimum of 42 inches bgs. For interior footings in heated areas, footings may be placed directly below the floor slab such that embedment is 18 inches or more below the finished floor elevation. If portions of the proposed building are to be unheated, the minimum burial depth for footings should be increased to 5 feet bgs for frost protection.

Based on the recommended footing dimensions, depths, and site preparation recommendations, we recommend that foundations for the proposed controlled building be designed with an allowable soil bearing pressure of 3,000 pounds per square foot (psf). The foundations for the treatment tanks, based on the recommended footing dimensions and site preparation recommendations, can be designed for an allowable bearing capacity of 10,000 psf. Localized loose or soft areas, whether resulting from existing conditions or disturbance during construction must be corrected prior to casting footings, or damaging differential settlements could occur. In our opinion, the above bearing value may be increased by one-third for short-term wind or seismic loading. Figure 3 presents a typical floor slab and footing detail.

### 7.3 Excavation Slopes and Utility Trenches

Buried pipes and cables will be needed to connect the control building and treatment tanks to the existing WWTP. Also, deep excavations will be required to install the treatment tanks. Excavations for installation of new utilities should be constructed as presented in Figure 4. Based on the explorations conducted for this project we do not expect groundwater to be encountered during excavation. Unsupported excavations should not penetrate a 1 horizontal to 1 vertical plane from the edge of exiting ponds or footings.

Excavation side slopes could stand near vertical initially but should be expected to slough and slump over time to flatter slopes (i.e., to about 1.4H to 1V). The slope and excavation bottom conditions should be made the responsibility of the contractor who will be present on a day to day basis and can adjust their efforts to obtain the needed stability. The contractor should be prepared to use shoring or a trench box as necessary to protect their workers in accordance with state and federal safety regulations (including OSHA) which require slope protection for trenches deeper than 4 feet bgs.

Trench backfill should be placed in maximum 6 to 8-inch loose lifts and compacted as discussed in Section 7.8. The lift thickness may be increased to up to 12 inches if it can be shown that the lift is adequately compacted at depth. The bedding and fill material around the pipe should also be compacted as described in Section 7.8 or per manufacturer recommendations to support and hold the pipe firmly in place. Unless specified by the manufacturer the bedding should meet the requirements for Class E Bedding on Figure 5. Utility trenches should be backfilled with existing inorganic soils as much as practical between the top of the pipe bedding and the bottom of the structural section or the original ground surface. This procedure limits the contrast between trench backfill and the surrounding soil conditions that can lead to adverse settlement or frost heave behavior. Bulking of backfill into trenches should be discouraged as this can cause voids and lead to large future surface settlements.

### 7.4 Settlements

Assuming that the organic and other unsuitable soils are removed from the control building and treatment tank footprint, the total settlements that will develop are dependent upon the actual loads that are applied, the footing sizes, and the care with which structural fills are placed and compacted beneath foundations. Based on the allowable bearing pressures, and assuming locally loose or compressible soils are excavated and replaced and adequate compaction of fill materials is achieved (per Section 7.8), we estimate total settlements of about 1-inch could occur and that differential settlements will be about one-half of the total over a horizontal distance of about 50 feet. The greatest amount of settlement should occur during construction, essentially as fast as the building loads are applied, such that long term differential settlements of the building will be relatively small and well within tolerable limits. It is estimated that long term differential settlements of the building should be about 1/4 inch or less.

### 7.5 Floor Slab Support

Concrete floor slabs are anticipated on the interior of the proposed treatment building. We recommend that the exposed foundation soils be probed to locate materials that may be naturally loose or have become loosened or disturbed due to demolition activities and/or the filling and grading process. If loose areas are encountered, we recommend that they be re-compacted or removed and replaced with compacted structural fill. The structural fill placed beneath the floor slab should be placed and compacted in accordance with the recommendations included in Section 7.8. We recommend pouring the concrete slab over compacted Type IIA structural fill. Provided the recommendations discussed above are adhered to by the contractor, a subgrade reaction modulus of at least 150 pounds per square inch per inch (psi/in) should be attainable on the recommended support soils. In areas to receive floor coverings, we recommend installing a vapor retarder directly beneath the concrete slab.

### 7.6 Lateral Earth Pressures

Tank walls and footing stem walls below ground that support earth fills should be designed to resist horizontal earth pressures. The magnitude of the pressure is dependent on the method of backfill placement, the type of backfill material, drainage provisions, and whether the wall is permitted to deflect after or during placement of backfill.

If the walls are allowed to deflect laterally or rotate an amount equal to about 0.001 times the height of the wall, an active earth pressure condition under static loading would prevail and an equivalent fluid weight of 35 pounds per cubic foot (pcf) is recommended for design of the walls. For rigid walls that are restrained from deflecting at the top, an at-rest earth pressure condition would prevail and an equivalent fluid weight of 55 pcf is recommended. To simulate seismic loading (from soils adjacent to the tank wall) a rectangular pressure prism with a magnitude of 14 psf per foot of wall height should be applied to the below-grade walls. Note that these values reflect free-draining, compact, granular backfill with no hydrostatic forces acting on the wall, and also assume that the soils within the zone of frost penetration (about 8 to 10 feet vertical) are non-frost-susceptible. These values do not include a factor of safety.

Lateral forces from wind or seismic loading may be resisted by passive earth pressures against the sides of footings and stem walls. These resisting pressures can be estimated using an equivalent fluid weight of 240 pcf. This value includes a factor of safety of two on the full passive earth pressure and assumes that backfill around the footings is densely compacted.

Lateral resistance may also be developed in friction against sliding along the base of foundations. These forces may be computed using a coefficient of 0.4 between concrete and soil.

### 7.7 Drainage and Groundwater

Groundwater was not encountered during our exploration. Based on work conducted on other portions of the WWTP, groundwater is expected to be deeper than 50 feet bgs.

To minimize ponding of excess surface waters during periods of rainfall or rapid snow melting, we recommend that areas around the excavations be contoured to drain surface waters away from the excavations and off the site. Roof down spouts on the control building should likewise carry rainwater in tight lines away from the addition and existing building foundations.

### 7.8 Structural Fill

Backfill will be required in the sub-cut excavation, beneath and around the foundation walls, and below the concrete floor slabs. Classified structural fill placed in these areas should be clean, granular soil to provide drainage and frost protection. These soils should contain less than about six percent (by weight, based on the minus 3-inch portion) passing the No. 200 sieve. In general, we recommend that Type II/IIA material, as defined by the Municipality of Anchorage Standard Specifications (MASS), be utilized to meet these requirements. Generally, both Type II and IIA material may be placed using moisture density control in both wet and dry conditions. Type IIA should be used when backfilling within 12 inches of walls or beneath slabs.

Laboratory testing of the existing sand and gravel soils in the project area typically contain between 5 and 9 percent fines. Provided the material is placed beneath the heated structure, or below the expected frost depth (10 feet), soil with more than six percent fines may be used as structural fill as long as the contract can meet the compaction requirements.

Fills beneath footings and floor slabs, as well as utility trenches, should be placed in lifts not to exceed 6 to 8 inches loose thickness and compacted to 95 percent of the maximum density as determined by the Modified Proctor compaction procedure (ASTM D 1557). The lift thickness may be increased to up to 12 inches if it can be shown that the lift is adequately compacted at depth.

When backfilling within 18 inches of the building stem walls where the wall is not supported on both sides, material should be placed in layers not to exceed six inches loose thickness and densely compacted with hand operated equipment.  Heavy equipment should not be used as it could cause increased lateral pressures and damage walls.  When backfilling around the treatment tanks, the zone of hand operated equipment should be extended from 18 inches at the base of the excavation to an additional six inches for every foot of wall height from the base of the excavation.  The fill level should be uniform around the tank and heavy equipment should be run perpendicular to the tank walls during compaction.  We recommend that our services be retained to observe or test the quality of fill compaction during construction.

## 8.0 CLOSURE AND LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein.  The conclusions contained in this report are based on site conditions as they presently exist.  It is assumed that the exploratory borings and piezometers are representative of the subsurface conditions throughout the site and aquifer, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse.  Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings.  Shannon & Wilson has prepared the attachments in Appendix B *Important Information About Your Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature.  Files provided in electronic media format are furnished solely for the convenience of the client.  Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact the undersigned.

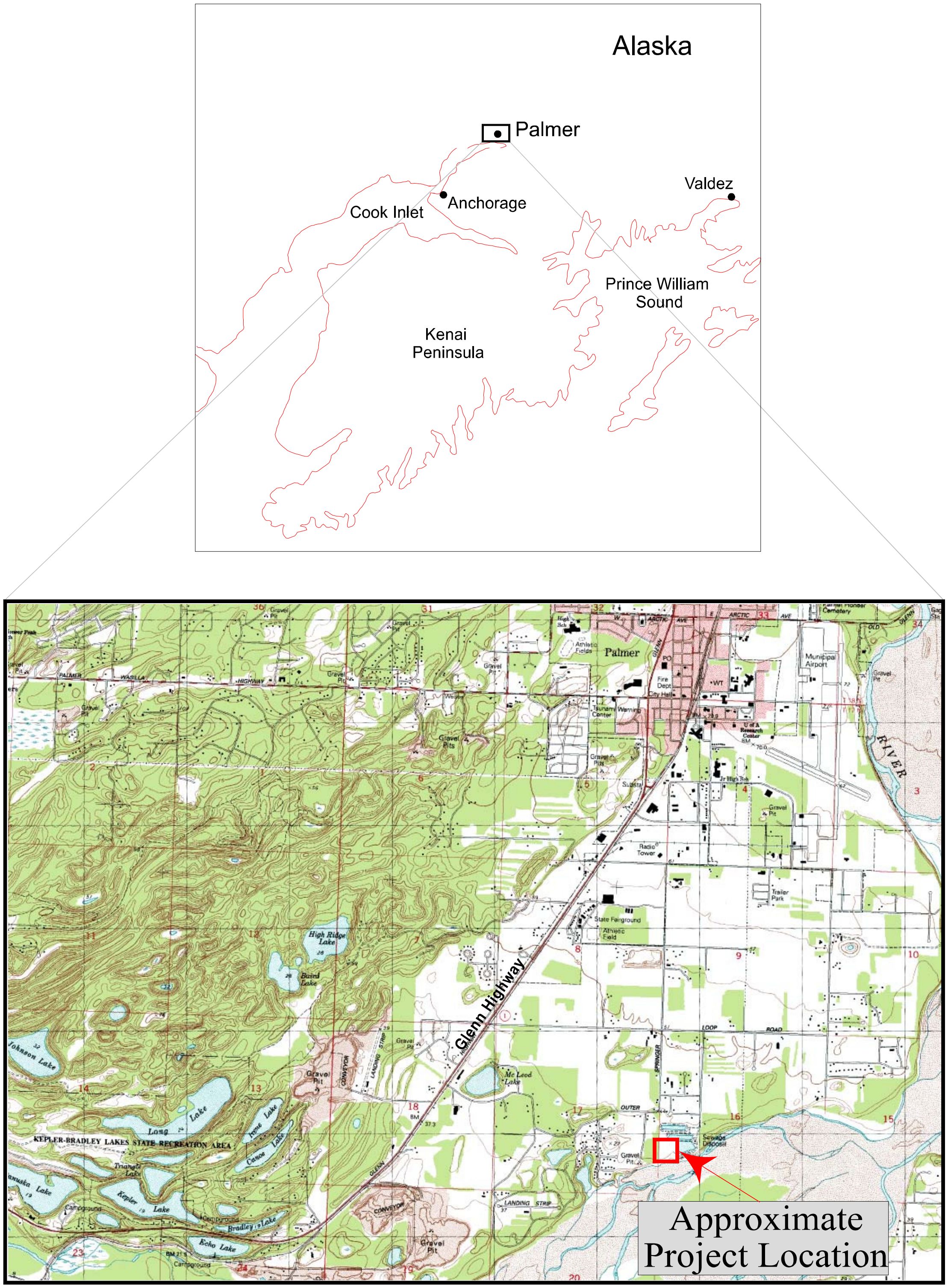
We appreciate this opportunity to be of service. Please contact the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

**SHANNON & WILSON, INC.**

For: Brenton Leeper, EIT
Geotechnical Engineer II

BAL/SJG:KLB

Stafford Glashan, PE
Senior Engineer III




Adapted from AllTopo Maps USGS Anchorage C-6 SW 25K Quadrangle

0 1 2

APPROXIMATE SCALE IN MILES

N

Palmer Waste Water Treatment Plant
Facility Improvements
Palmer, Alaska

**VICINITY MAP**

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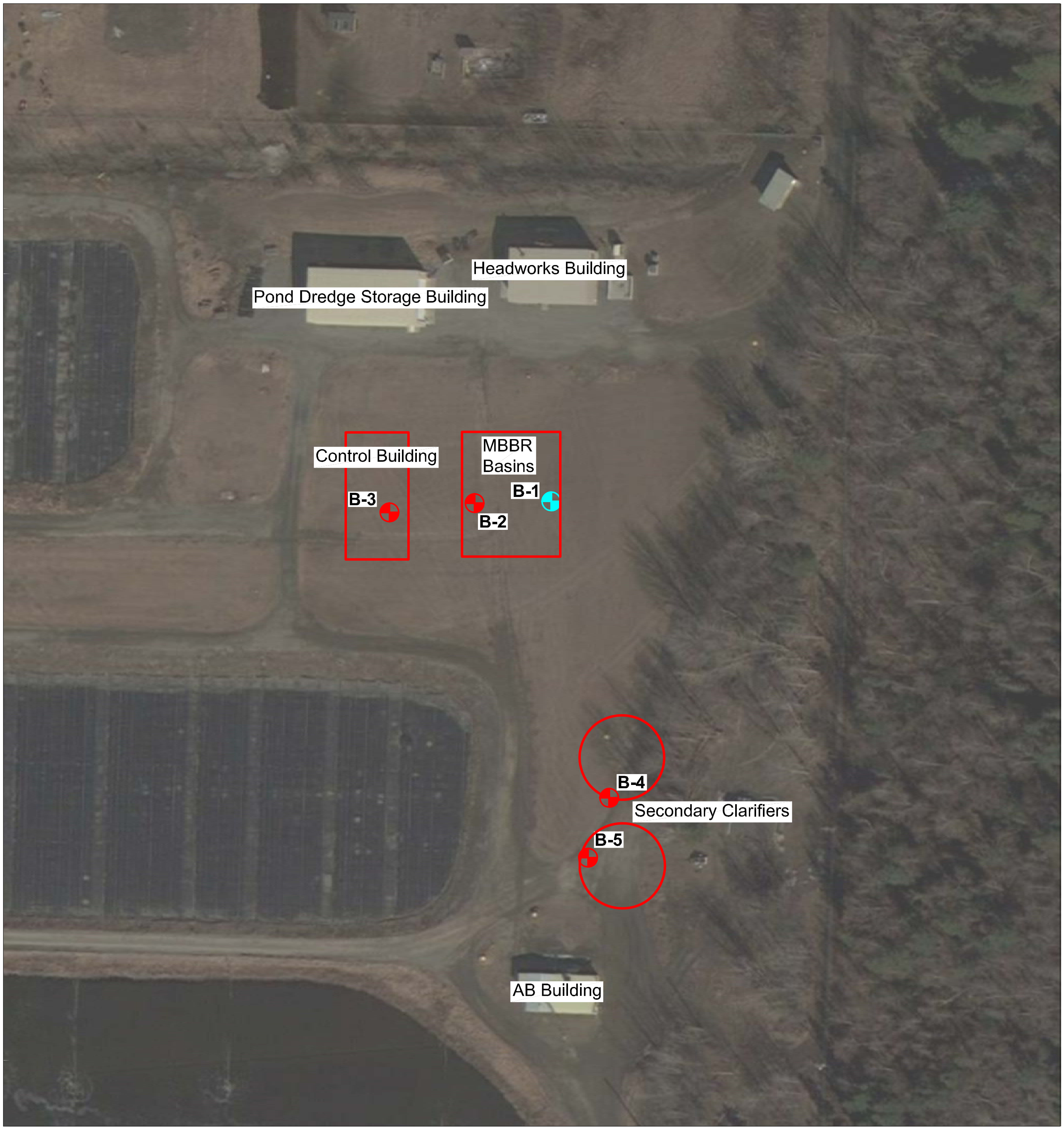
**FIG. 1**




## NOTES

1. Basemap imagery (April 2011) provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.

## LEGEND

B-2 Approximate Location of Boring B-1, Advanced by Shannon & Wilson, September 2016

B-1 Blue symbol indicates boring was completed with a piezometer.

Proposed structure

0 50 100 200
APPROXIMATE SCALE IN FEET

N

Palmer Waste Water Treatment Plant
Facility Improvements
Palmer, Alaska

**SITE PLAN**

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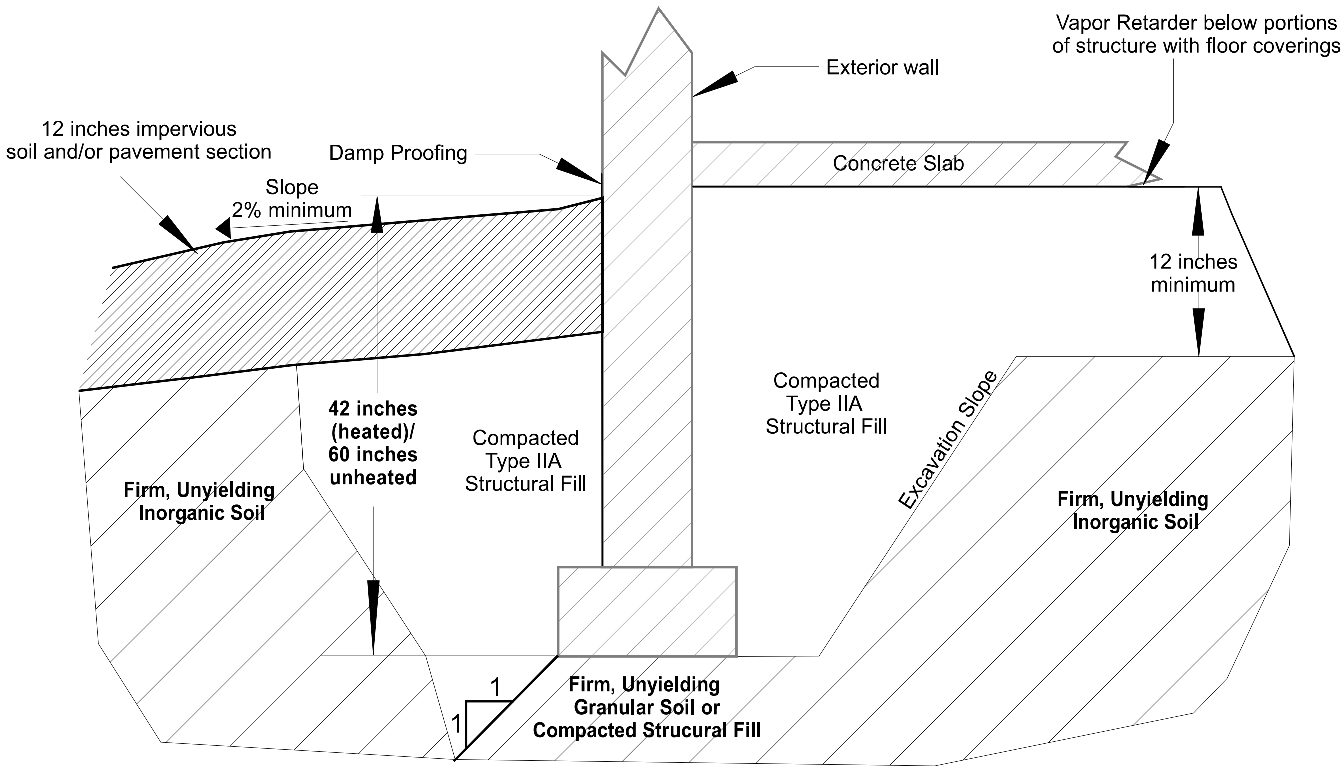
**FIG. 2**




**NOTES:**

1. If conditions render on-site soil unsuitable for compaction and drainage, backfill the footing excavation with free-draining granular soil with not more than 6% passing No. 200 sieve (by wet sieving) with no plastic fines. MOA Type II/IIA classified fill generally meets these requirements.

2. All backfill should be placed in layers not exceeding 10 to 12 inches loose thickness and densely compacted. Structural fill should be compacted to 95% minimum of ASTM D-1557.

3. Backfill within 18 inches of the wall should be placed in layers not exceeding 6 inches and densely compacted with hand-operated equipment. Heavy equipment should not be used for backfill, as such equipment operated near the wall could increase lateral earth pressures and possibly damage the wall.

4. OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible or compliance to these regulations as he/she is at the project on a day to day basis and is aware of changing conditions.

5. Where unsuitable fill soils (loose, compressible, organic, or debris) are encountered beneath footings, the footing trenches should be over-excavated and the unsuitable material should be removed and replaced with compacted structural fill. Excavations should extend inward as needed to remove material from beneath the slab. At a minimum, excavations should extend inward and outward at a distance equal to the depth of the excavation below footing grade.

Palmer Waste Water Treatment Pland
Facility Improvments
Palmer, Alaska

**FLOOR SLAB AND FOOTING DETAIL**

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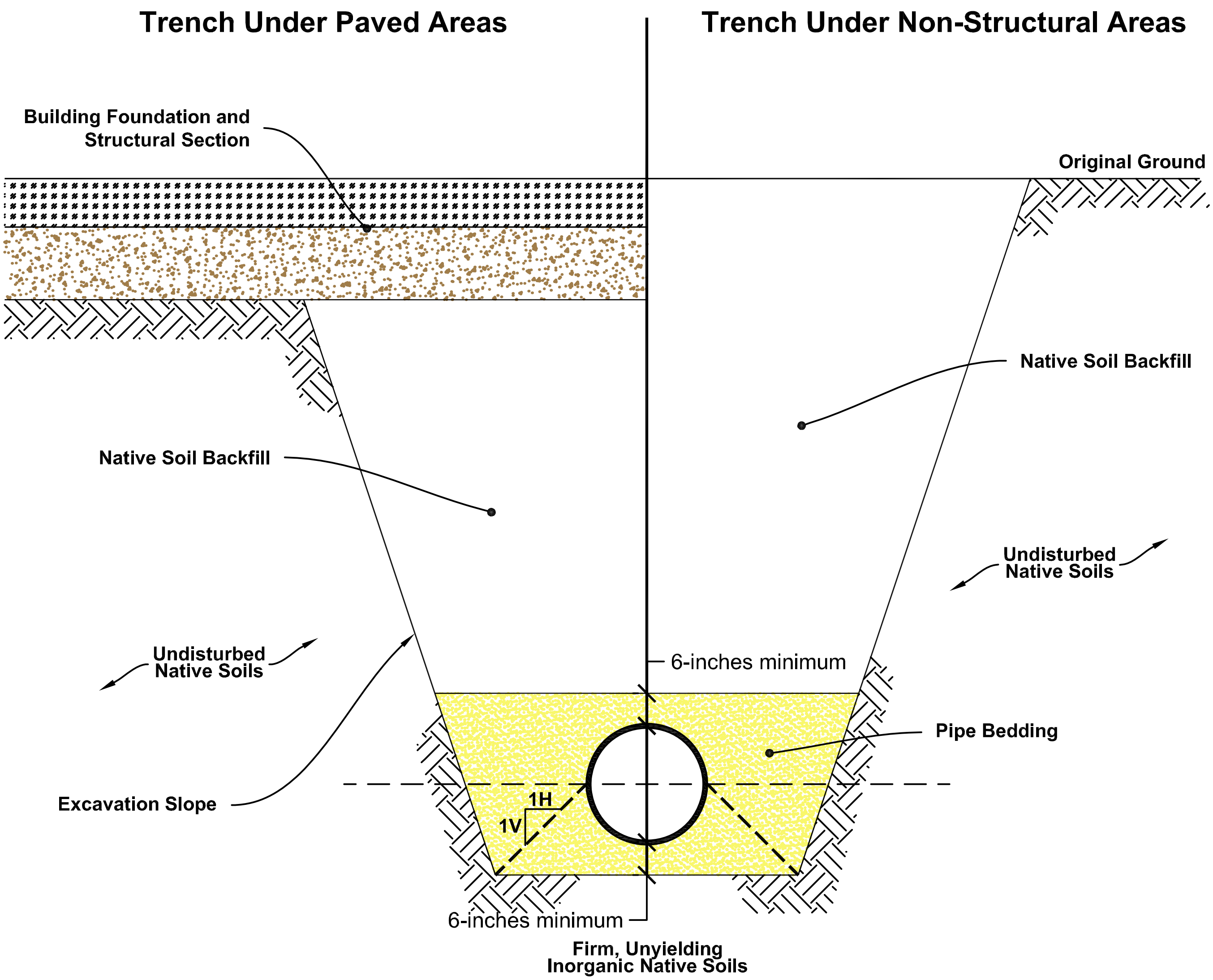
**FIG. 3**




## NOTES

1. Trench backfill under structural areas should be placed in loose lifts not to exceed 6-8 inches and compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557.
2. Trench backfill under non-structural areas should be placed in loose lifts not to exceed 18 inches and compacted to at least 90 percent of its maximum dry density as determined by ASTM D-1557.
3. Pipe bedding should conform to MOA Class E bedding material or as recommended by pipe manufacturer.
4. Pipe bedding and cover thickness shown above should be used absent pipe manufacturer requirements.
5. OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible for compliance to these regulations as he/she is at the project on a day to day basis, is aware of the changing conditions, and has authority to direct work.

Palmer Waste Water Treatment Plant
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**UTILITY TRENCH DETAIL**

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**FIG. 4**

# GRADATION REQUIREMENTS

(Adapted from Municipality of Anchorage Standard Specifications, 2015)

## LEVELING COURSE

| U.S. STANDARD SIEVE SIZE English | Metric | PERCENT PASSING BY WEIGHT |
|---|---|---|
| 1 in. | 25.0 mm | 100 |
| 3/4 in. | 19.0 mm | 70 - 100 |
| 3/8 in. | 9.5 mm | 50 - 80 |
| No. 4 | 4.75 mm | 35 - 65 |
| No. 8 | 2.36 mm | 20 - 50 |
| No. 50 | 0.30 mm | 8 - 28 |
| No. 200 | 0.075 mm | 0 - 6* |

## TYPE II-A CLASSIFIED FILL

| U.S. STANDARD SIEVE SIZE | | PERCENT PASSING BY WEIGHT |
|---|---|---|
| 3 in. | 75 mm | 100 |
| 3/4 in. | 19.0 mm | 50 - 100 |
| No. 4 | 4.75 mm | 25 - 60 |
| No. 10 | 2.00 mm | 15 - 50 |
| No. 40 | 0.425 mm | 4 - 30 |
| No. 200 | 0.075 mm | 2 - 6*** |

## TYPE II CLASSIFIED FILL

| U.S. STANDARD SIEVE SIZE | | PERCENT PASSING BY WEIGHT |
|---|---|---|
| 8 in. | - | 100 |
| 3 in. | 75 mm | 70 - 100 |
| 1-1/2 in. | 37.5 mm | 55 - 100 |
| 3/4 in. | 19.0 mm | 45 - 85 |
| No. 4 | 4.75 mm | 20 - 60 |
| No. 10 | 2.00 mm | 12 - 50 |
| No. 40 | 0.425 mm | 4 - 30 |
| No. 200 | 0.075 mm | 2 - 6** |

## CLASS E BEDDING

| U.S. STANDARD SIEVE SIZE | | PERCENT PASSING BY WEIGHT |
|---|---|---|
| 1/2 in. | 12.5 mm | 100 |
| 3/8 in. | 9.5 mm | 100-80 |
| No. 4 | 4.75 mm | 20 - 75 |
| No. 10 | 2.00 mm | 12 - 60 |
| No. 40 | 0.425 mm | 2 - 30 |
| No. 200 | 0.075 mm | 0 - 6 |

* The fraction passing the No. 200 sieve shall not exceed 75 percent of the fraction passing the No. 50 sieve.

** The fraction passing the No. 200 sieve shall not exceed 15 percent of the fraction passing the No. 4 sieve.

*** The fraction passing the No. 200 sieve shall not exceed 20 percent of the fraction passing the No. 4 sieve.

Palmer Waste Water Treatment Plan
Facility Improvements
Palmer, Alaska

**GRADATION REQUIREMENTS**

March 2016 32-1-02504

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**FIG. 5**

## APPENDIX A

## SOIL BORINGS AND TEST RESULTS

*Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.*

## S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

| CONSTITUENT[2] | FINE-GRAINED SOILS (50% or more fines)[1] | COARSE-GRAINED SOILS (less than 50% fines)[1] |
|---|---|---|
| **Major** | ***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3] | ***Sand*** or ***Gravel***[4] |
| **Modifying (Secondary)** Precedes major constituent | 30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4] | More than 12% fine-grained: ***Silty*** or ***Clayey***[3] |
| **Minor** Follows major constituent | 15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4] | 5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3] |
| | 30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5] | 15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5] |

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor.*
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

## MOISTURE CONTENT TERMS

| | |
|---|---|
| Dry | Absence of moisture, dusty, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible free water, from below water table |

## STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

| | |
|---|---|
| Hammer: | 140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm<br><br>NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer. |
| Sampler: | 10 to 30 inches long<br>Shoe I.D. = 1.375 inches<br>Barrel I.D. = 1.5 inches<br>Barrel O.D. = 2 inches |
| N-Value: | Sum blow counts for second and third 6-inch increments.<br>Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches. |

*NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.*

## PARTICLE SIZE DEFINITIONS

| DESCRIPTION | SIEVE NUMBER AND/OR APPROXIMATE SIZE |
|---|---|
| FINES | < #200 (0.075 mm = 0.003 in.) |
| SAND | |
| Fine | #200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.) |
| Medium | #40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.) |
| Coarse | #10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.) |
| GRAVEL | |
| Fine | #4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.) |
| Coarse | 3/4 to 3 in. (19 to 76 mm) |
| COBBLES | 3 to 12 in. (76 to 305 mm) |
| BOULDERS | > 12 in. (305 mm) |

## RELATIVE DENSITY / CONSISTENCY

| COHESIONLESS SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| N, SPT, BLOWS/FT. | RELATIVE DENSITY | N, SPT, BLOWS/FT. | RELATIVE CONSISTENCY |
| < 4 | Very loose | < 2 | Very soft |
| 4 - 10 | Loose | 2 - 4 | Soft |
| 10 - 30 | Medium dense | 4 - 8 | Medium stiff |
| 30 - 50 | Dense | 8 - 15 | Stiff |
| > 50 | Very dense | 15 - 30 | Very stiff |
| | | > 30 | Hard |

## WELL AND BACKFILL SYMBOLS

| | |
|---|---|
| Bentonite Cement Grout | Surface Cement Seal |
| Bentonite Grout | Asphalt or Cap |
| Bentonite Chips | Slough |
| Silica Sand | Inclinometer or Non-perforated Casing |
| Perforated or Screened Casing | Vibrating Wire Piezometer |

## PERCENTAGES TERMS [1, 2]

| | |
|---|---|
| Trace | < 5% |
| Few | 5 to 10% |
| Little | 15 to 25% |
| Some | 30 to 45% |
| Mostly | 50 to 100% |

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Palmer Waste Water Treatment Plant
Facility Improvements
Palmer, AK

# SOIL DESCRIPTION AND LOG KEY

October 2016 32-1-02475-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

**FIG. A-1**
Sheet 1 of 3

# UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
## (Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

| MAJOR DIVISIONS | | | GROUP/GRAPHIC SYMBOL | TYPICAL IDENTIFICATIONS |
|---|---|---|---|---|
| COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)* | Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)* | Gravel *(less than 5% fines)* | GW | Well-Graded Gravel; Well-Graded Gravel with Sand |
| | | | GP | Poorly Graded Gravel; Poorly Graded Gravel with Sand |
| | | Silty or Clayey Gravel *(more than 12% fines)* | GM | Silty Gravel; Silty Gravel with Sand |
| | | | GC | Clayey Gravel; Clayey Gravel with Sand |
| | Sands *(50% or more of coarse fraction passes the No. 4 sieve)* | Sand *(less than 5% fines)* | SW | Well-Graded Sand; Well-Graded Sand with Gravel |
| | | | SP | Poorly Graded Sand; Poorly Graded Sand with Gravel |
| | | Silty or Clayey Sand *(more than 12% fines)* | SM | Silty Sand; Silty Sand with Gravel |
| | | | SC | Clayey Sand; Clayey Sand with Gravel |
| FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)* | Silts and Clays *(liquid limit less than 50)* | Inorganic | ML | Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt |
| | | | CL | Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay |
| | | Organic | OL | Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay |
| | Silts and Clays *(liquid limit 50 or more)* | Inorganic | MH | Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt |
| | | | CH | Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay |
| | | Organic | OH | Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay |
| HIGHLY-ORGANIC SOILS | Primarily organic matter, dark in color, and organic odor | | PT | Peat or other highly organic soils (see ASTM D4427) |

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).
2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

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**SOIL DESCRIPTION AND LOG KEY**

October 2016 32-1-02475-003

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**FIG. A-1**
Sheet 2 of 3

## GRADATION TERMS

| | |
|---|---|
| Poorly Graded | Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested. |
| Well-Graded | Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested. |

## CEMENTATION TERMS[1]

| | |
|---|---|
| Weak | Crumbles or breaks with handling or slight finger pressure |
| Moderate | Crumbles or breaks with considerable finger pressure |
| Strong | Will not crumble or break with finger pressure |

## PLASTICITY[2]

| DESCRIPTION | VISUAL-MANUAL CRITERIA | APPROX. PLASITICTY INDEX RANGE |
|---|---|---|
| Nonplastic | A 1/8-in. thread cannot be rolled at any water content. | < 4 |
| Low | A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit. | 4 to 10 |
| Medium | A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit. | 10 to 20 |
| High | It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit. | > 20 |

## ADDITIONAL TERMS

| | |
|---|---|
| Mottled | Irregular patches of different colors. |
| Bioturbated | Soil disturbance or mixing by plants or animals. |
| Diamict | Nonsorted sediment; sand and gravel in silt and/or clay matrix. |
| Cuttings | Material brought to surface by drilling. |
| Slough | Material that caved from sides of borehole. |
| Sheared | Disturbed texture, mix of strengths. |

## PARTICLE ANGULARITY AND SHAPE TERMS[1]

| | |
|---|---|
| Angular | Sharp edges and unpolished planar surfaces. |
| Subangular | Similar to angular, but with rounded edges. |
| Subrounded | Nearly planar sides with well-rounded edges. |
| Rounded | Smoothly curved sides with no edges. |
| Flat | Width/thickness ratio > 3. |
| Elongated | Length/width ratio > 3. |

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ATD | At Time of Drilling |
| Diam. | Diameter |
| Elev. | Elevation |
| ft. | Feet |
| FeO | Iron Oxide |
| gal. | Gallons |
| Horiz. | Horizontal |
| HSA | Hollow Stem Auger |
| I.D. | Inside Diameter |
| in. | Inches |
| lbs. | Pounds |
| MgO | Magnesium Oxide |
| mm | Millimeter |
| MnO | Manganese Oxide |
| NA | Not Applicable or Not Available |
| NP | Nonplastic |
| O.D. | Outside Diameter |
| OW | Observation Well |
| pcf | Pounds per Cubic Foot |
| PID | Photo-Ionization Detector |
| PMT | Pressuremeter Test |
| ppm | Parts per Million |
| psi | Pounds per Square Inch |
| PVC | Polyvinyl Chloride |
| rpm | Rotations per Minute |
| SPT | Standard Penetration Test |
| USCS | Unified Soil Classification System |
| $q_u$ | Unconfined Compressive Strength |
| VWP | Vibrating Wire Piezometer |
| Vert. | Vertical |
| WOH | Weight of Hammer |
| WOR | Weight of Rods |
| Wt. | Weight |

## STRUCTURE TERMS[1]

| | |
|---|---|
| Interbedded | Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed. |
| Laminated | Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination. |
| Fissured | Breaks along definite planes or fractures with little resistance. |
| Slickensided | Fracture planes appear polished or glossy; sometimes striated. |
| Blocky | Cohesive soil that can be broken down into small angular lumps that resist further breakdown. |
| Lensed | Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay. |
| Homogeneous | Same color and appearance throughout. |

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Facility Improvements
Palmer, AK

# SOIL DESCRIPTION AND LOG KEY

October 2016 32-1-02475-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

**FIG. A-1**
Sheet 3 of 3

2013 BORING CLASS3 02475-003 GINT.GPJ SWNEW7.GDT 10/12/16

SHANNON & WILSON, INC.

# FROST CLASSIFICATION

(after Municipality of Anchorage, 2007)

| GROUP | | 0.02 Mil. | P-200* | USC SYSTEM (based on P-200 results) |
|---|---|---|---|---|
| NFS | Sandy Soils | 0 to 3 | 0 to 6 | SW, SP, SW-SM, SP-SM |
| | Gravelly Soils | 0 to 3 | 0 to 6 | GW, GP, GW-GM, GP-GM |
| F1 | Gravelly Soils | 3 to 10 | 6 to 13 | GM, GW-GM, GP-GM |
| F2 | Sandy Soils | 3 to 15 | 6 to 19 | SP-SM, SW-SM, SM |
| | Gravelly Soils | 10 to 20 | 13 to 25 | GM |
| F3 | Sands, except very fine silty sands** | Over 15 | Over 19 | SM, SC |
| | Gravelly Soils | Over 20 | Over 25 | GM, GC |
| | Clays, PI>12 | | | CL, CH |
| F4 | All Silts | Over 15 | Over 19 | ML, MH |
| | Very fine silty sands** | | | SM, SC |
| | Clays, PI<12 | | | CL, CL-ML |
| | Varved clays and other fined grained, banded sediments | | | CL and ML<br>CL, ML, and SM;<br>SL, SH, and ML;<br>CL, CH, ML, and SM |

PI = Plasticity Index
P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

*Approximate P-200 value equivalent for frost classification.
Value range based on typical, well-graded soil curves.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

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**FROST CLASSIFICATION LEGEND**

October 2016 32-1-02475-003

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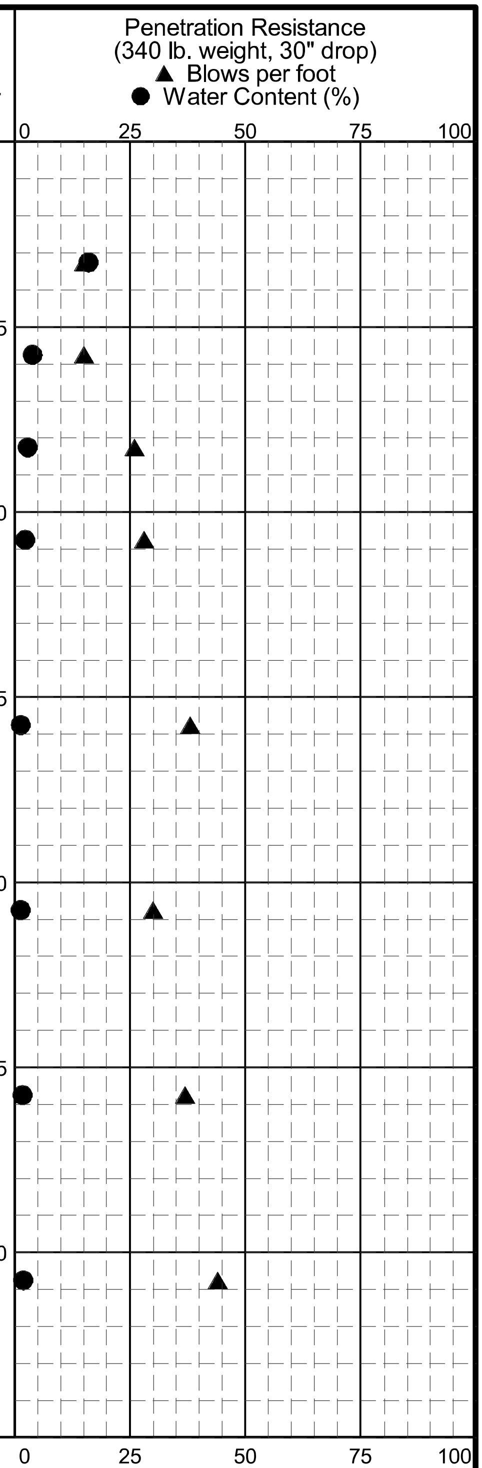
**FIG. A-2**

| MATERIAL DESCRIPTION | Depth, Ft. | Symbol | Samples | Ground Water | Depth, Ft. |
|---|---|---|---|---|---|
| Approx. Elevation: 154.6 Ft. | | | | | |
| Organic mat | 0.3 | | | | |
| Medium dense to dense, brown, *Silt with Sand (ML)*; moist | | | S1, S2 | | |
| Medium dense, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; dry to moist | 4.5 | | S3, S4 | | 5 |
| S4: 6.9% Fines (F1 (P200)) | | | S5 | | 10 |
| | | | S6 | | 15 |
| S7: 53% Gravel, 42% Sand, 6% Fines (NFS (P200)) | | | S7 | | 20 |
| | | | S8 | Groundwater not encountered during drilling on 9/22/2016 | 25 |
| | 31.5 | | S9 | | 30 |
| Bottom of Boring<br>Boring Completed 9/22/2016 | | | | | |




## LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

## NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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Palmer, AK

**LOG OF BORING B-1**

October 2016 32-1-02475-003

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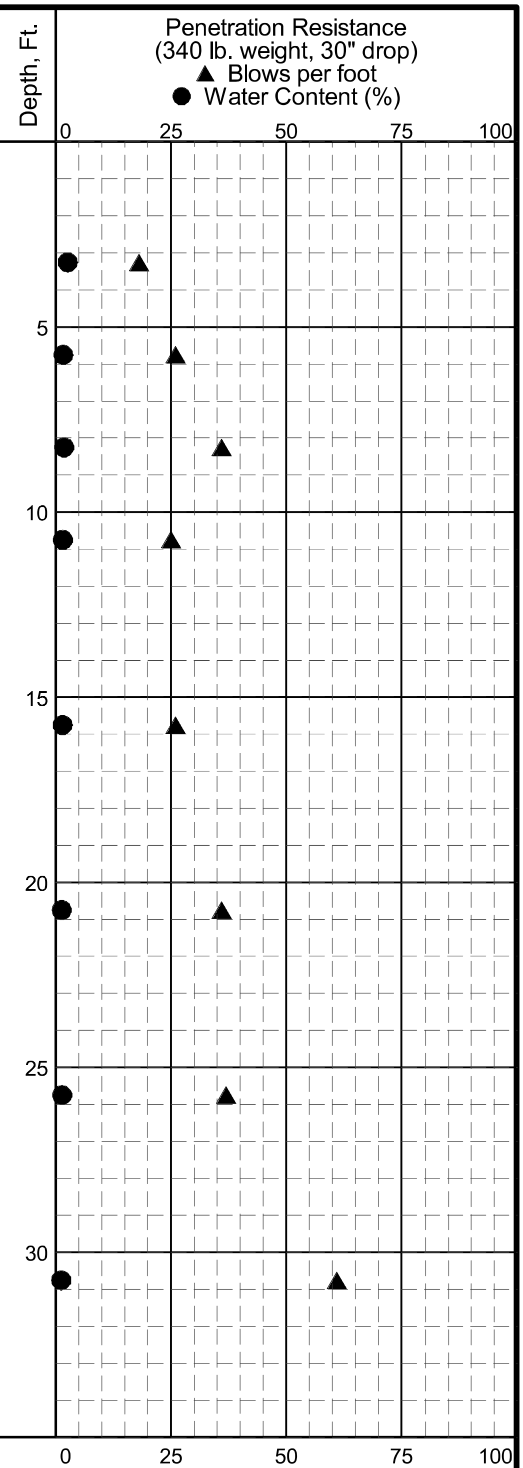
**FIG. A-3**

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 02475-003 GINT.GPJ SWNEW7.GDT 10/24/16

| MATERIAL DESCRIPTION<br>Approx. Elevation: 154.0 Ft. | Depth, Ft. | Symbol | Samples | Ground Water |
|---|---|---|---|---|
| Organic mat | 0.3 | | | |
| Medium dense, brown, *Silt with Sand (ML)*; moist | 2.5 | | S1 | |
| Medium dense to dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist<br>S3: 33% Gravel, 60% Sand, 7% Fines (F2 (P200)) | 9.0 | | S2<br>S3<br>S4 | |
| Medium dense to very dense, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; dry to moist | 31.5 | | S5<br>S6<br>S7<br>S8<br>S9 | Groundwater not encountered during drilling on 9/22/2016 |
| Bottom of Boring<br>Boring Completed 9/22/2016 | | | | |




## LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample

## NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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**LOG OF BORING B-2**

October 2016 32-1-02475-003

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**FIG. A-4**

GEOTECHNICAL LOG 02475-003 GINT.GPJ SWNEW7.GDT 10/24/16

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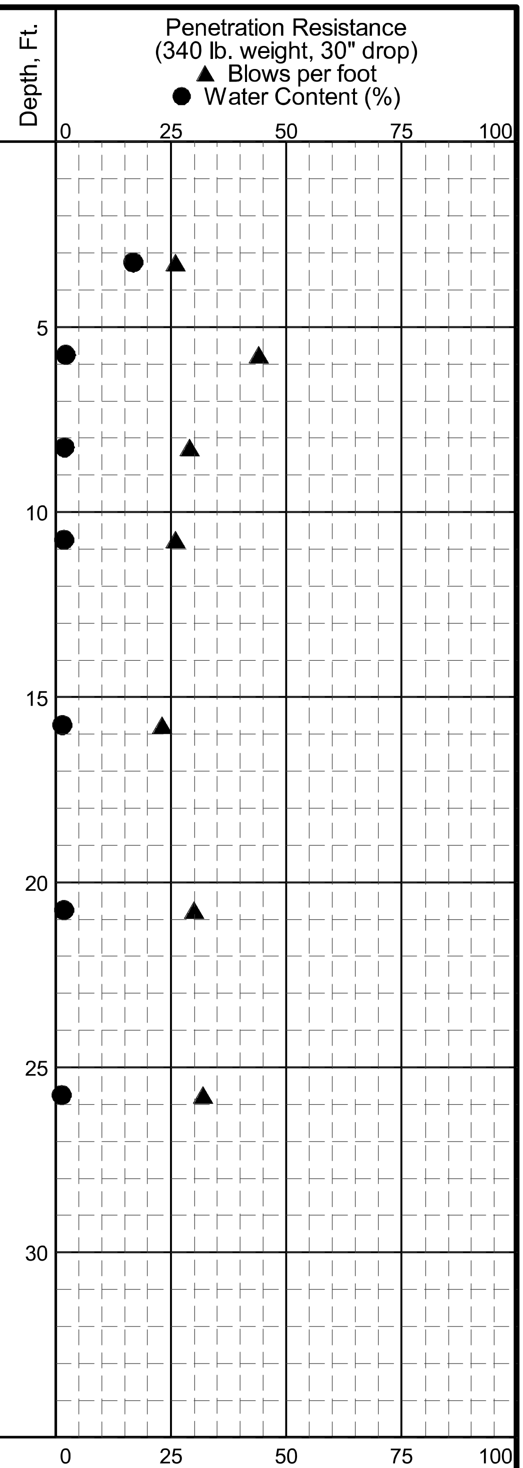
# LOG OF BORING B-3

| MATERIAL DESCRIPTION (Approx. Elevation: 153.5 Ft.) | Depth, Ft. | Samples |
|---|---|---|
| Organic mat | 0.3 | S1 |
| Medium dense, brown, *Silt with Sand (ML)*; moist<br>S2: 74.2% Fines (F4 (P200)) | 4.0 | S2 |
| Medium dense to dense, brown, *Well-Graded Gravel with Sand (GW)* to *Well-Graded Gravel with Silt and Sand (GW-GM)*; dry to moist<br>S7: 65% Gravel, 30% Sand, 5% Fines (NFS (P200)) | 26.5 | S3, S4, S5, S6, S7, S8 |
| Bottom of Boring<br>Boring Completed 9/22/2016 | | |

Ground Water: Groundwater not encountered during drilling on 9/22/2016




● Water Content (%)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

## LEGEND

* Sample Not Recovered
3" O.D. Split Spoon Sample
Grab Sample

## NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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**LOG OF BORING B-3**

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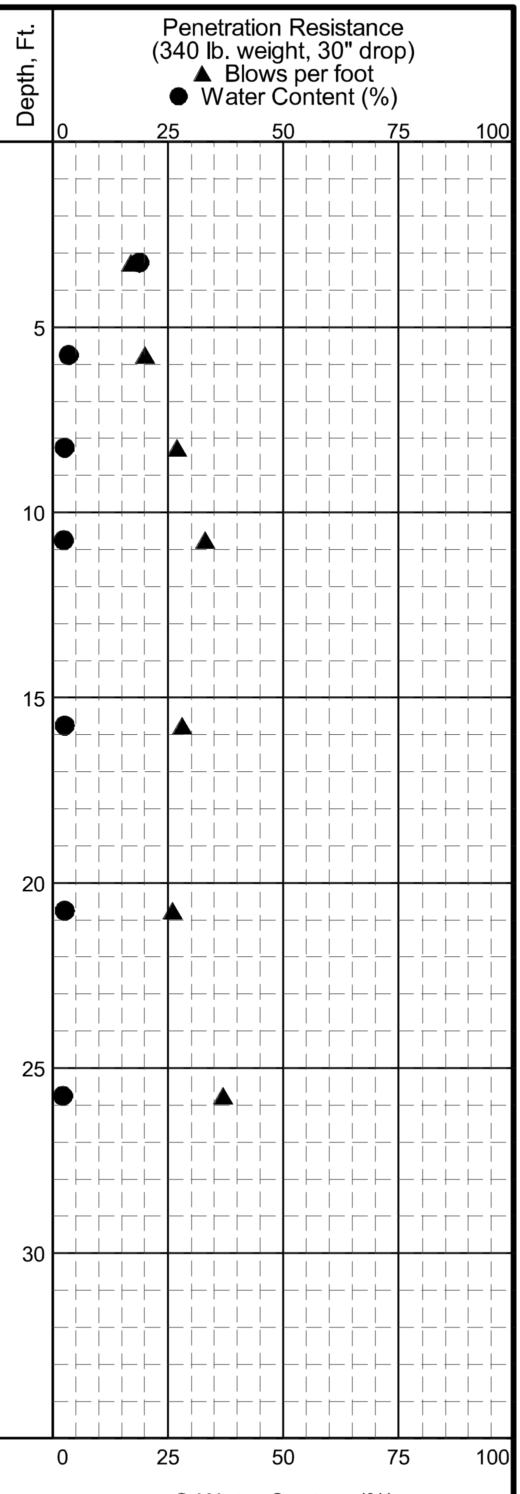
**FIG. A-5**

| MATERIAL DESCRIPTION<br>Approx. Elevation: 153.0 Ft. | Depth, Ft. | Symbol | Samples | Ground Water |
|---|---|---|---|---|
| Organic mat | 0.2 | | | |
| S1: 35% Gravel, 38% Sand, 27% Fines (F3 (P200)) | | | S1 | |
| Medium dense, brown, *Silty Sand with Gravel (SM)*; moist | 3.0 | | S2 | |
| Medium dense, brown, *Silty Gravel with Sand (GM)*; moist | 5.0 | | S3 | |
| Medium dense to dense, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; dry to moist | | | S4 | |
| S5: 48% Gravel, 42% Sand, 10% Fines (F1 (P200)) | | | S5, S6, S7, S8 | Groundwater not encountered during drilling on 9/22/2016 |
| Bottom of Boring<br>Boring Completed 9/22/2016 | 26.5 | | | |




## LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample

## NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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**LOG OF BORING B-4**

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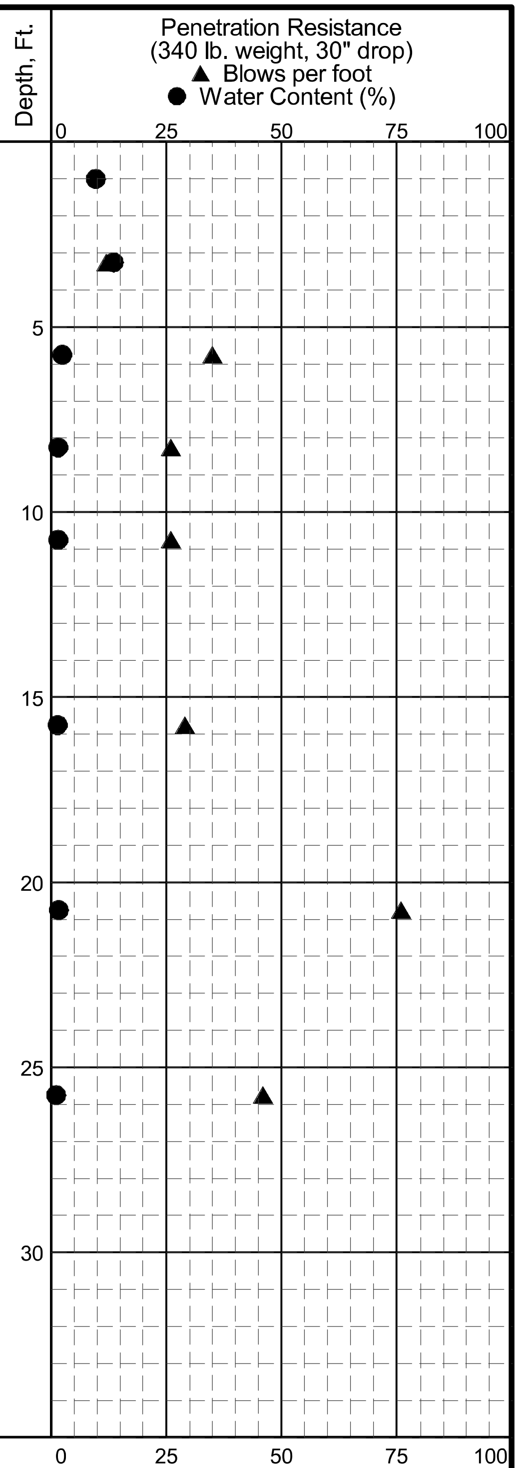
**FIG. A-6**

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 02475-003 GINT.GPJ SWNEW7.GDT 10/24/16

| MATERIAL DESCRIPTION | Depth, Ft. | Symbol | Samples | Ground Water |
|---|---|---|---|---|
| Approx. Elevation: 154.0 Ft. | | | | |
| Medium dense, brown, *Silty Sand with Gravel (SM)*; moist | | | S1 | |
| Medium dense, brown, *Silt with Sand and Gravel (ML)*; moist | 2.0 | | S2 | |
| Medium dense to very dense, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; dry to moist | 4.0 | | S3 | |
| S4: 8.8% Fines (F1 (P200)) | | | S4 | |
| | | | S5 | |
| | | | S6 | |
| | | | S7 | |
| S8: 59% Gravel, 33% Sand, 8% Fines (F1 (P200)) | | | S8 | Groundwater not encountered during drilling on 9/22/2016 |
| Bottom of Boring<br>Boring Completed 9/22/2016 | 26.5 | | | |




## LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample

● Water Content (%)

Plastic Limit —●— Liquid Limit

Natural Water Content

## NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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**LOG OF BORING B-5**

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**FIG. A-7**

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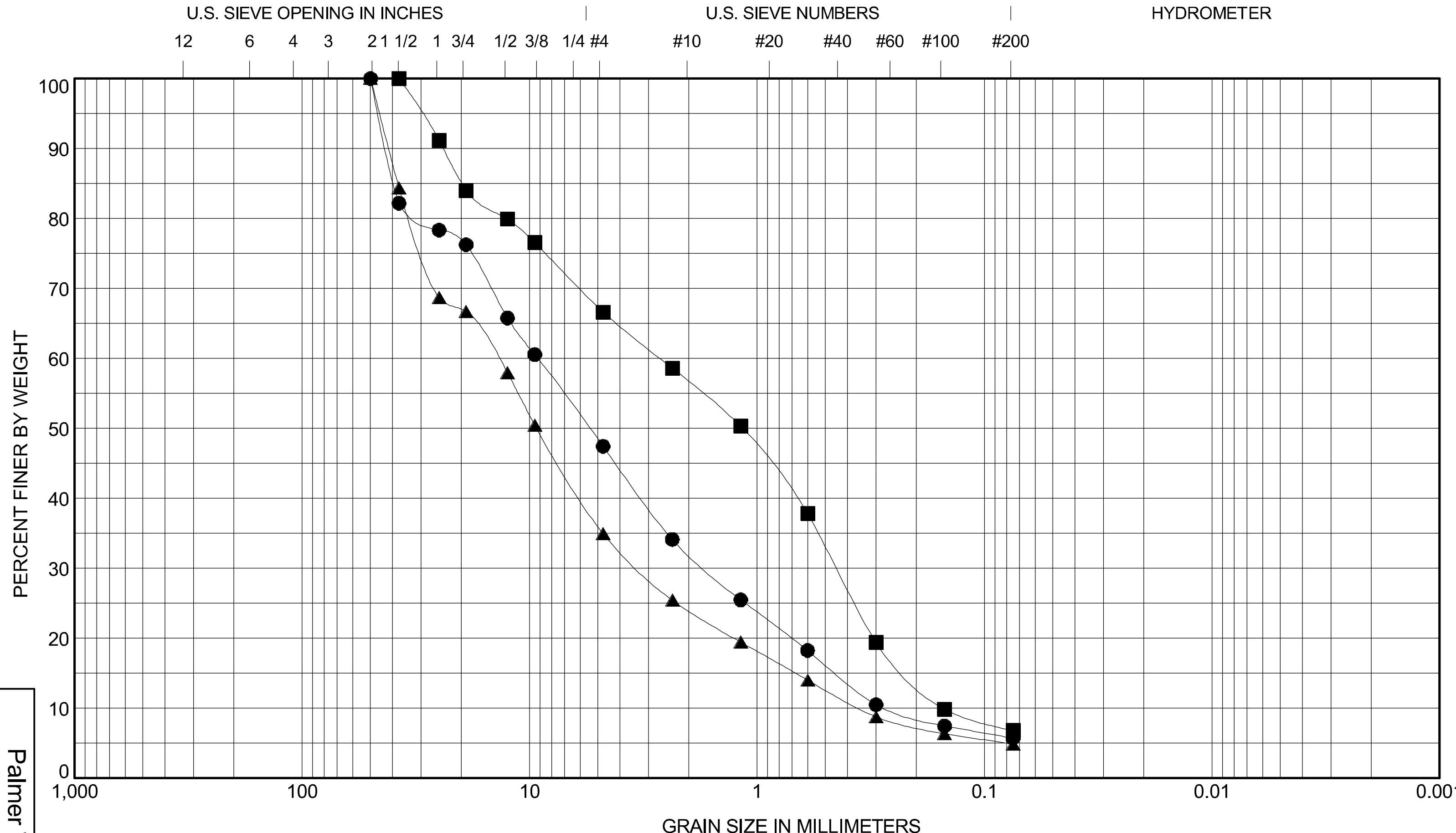


| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Sample | | Depth, Ft | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | **B-1 S7** | **20.0 - 21.5** | **Well-Graded Gravel with Silt and Sand (GW-GM)** | | | | **1.2** | **34.3** |
| ■ | **B-2 S3** | **5.0 - 6.5** | **Poorly Graded Sand with Silt and Gravel (SP-SM)** | | | | **0.5** | **17.5** |
| ▲ | **B-3 S7** | **20.0 - 21.5** | **Well-Graded Gravel with Sand (GW)** | | | | **2.2** | **39.0** |

| Sample | | Depth, Ft | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | **B-1 S7** | **20.0 - 21.5** | **50** | **9.23** | **1.7** | **0.27** | **53** | **42** | **6** | |
| ■ | **B-2 S3** | **5.0 - 6.5** | **37.5** | **2.66** | **0.45** | **0.15** | **33** | **60** | **7** | |
| ▲ | **B-3 S7** | **20.0 - 21.5** | **50** | **13.78** | **3.3** | **0.35** | **65** | **30** | **5** | |

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# GRAIN SIZE CLASSIFICATION

October 2016

32-1-02475-003

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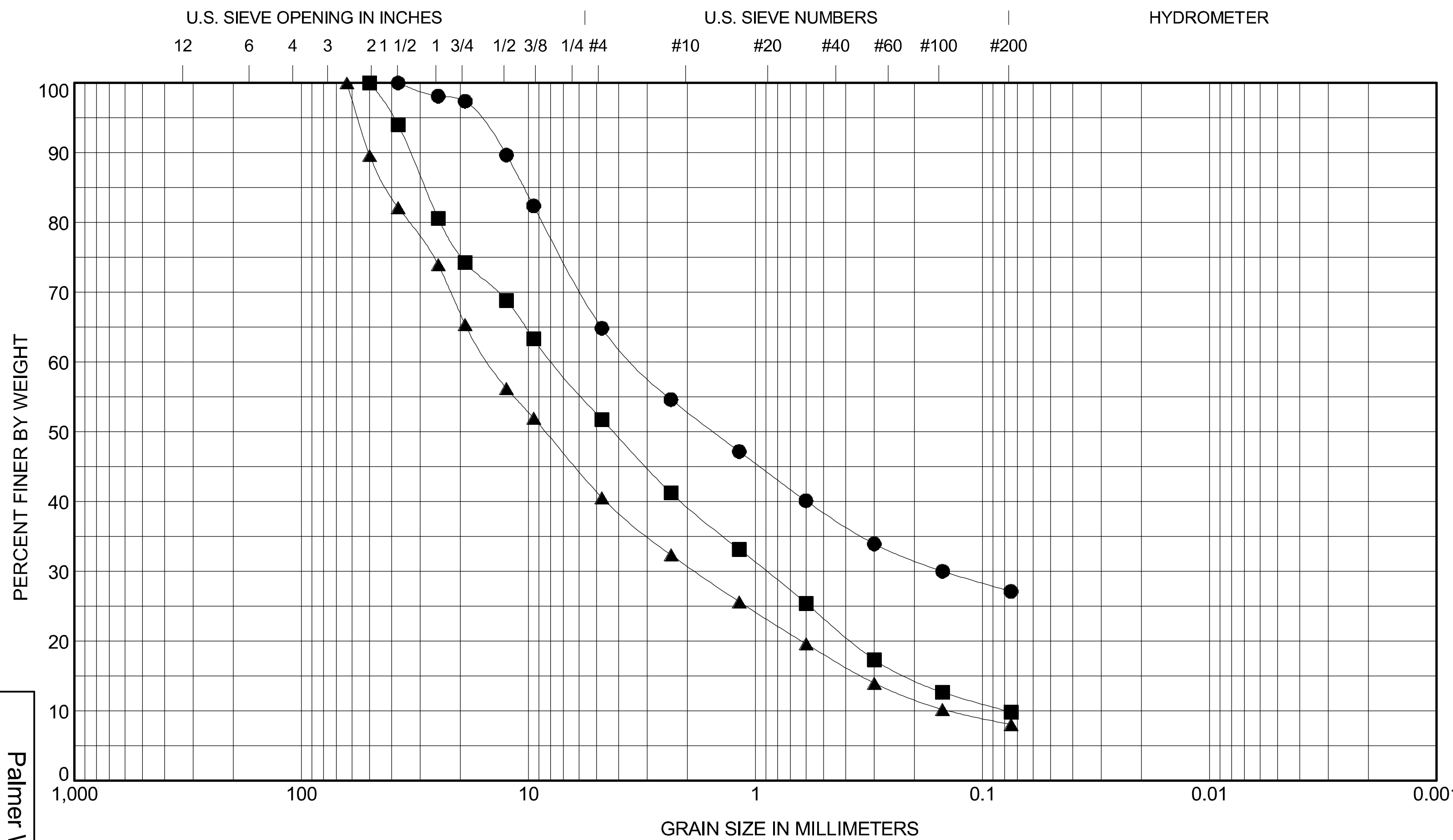
**FIG. A-8**
Sheet 1 of 2




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Sample | | Depth, Ft | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | **B-4 S1** | **0.0 - 1.5** | **Silty Sand with Gravel (SM)** | | | | | |
| ■ | **B-4 S5** | **10.0 - 11.5** | **Well-Graded Gravel with Silt and Sand (GW-GM)** | | | | **1.3** | **100.1** |
| ▲ | **B-5 S8** | **25.0 - 26.5** | **Well-Graded Gravel with Silt and Sand (GW-GM)** | | | | **1.7** | **106.4** |

| Sample | | Depth, Ft | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | **B-4 S1** | **0.0 - 1.5** | **37.5** | **3.41** | **0.15** | | **35** | **38** | **27** | |
| ■ | **B-4 S5** | **10.0 - 11.5** | **50** | **7.78** | **0.89** | **0.08** | **48** | **42** | **10** | |
| ▲ | **B-5 S8** | **25.0 - 26.5** | **63** | **14.86** | **1.85** | **0.14** | **59** | **33** | **8** | |

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# GRAIN SIZE CLASSIFICATION

October 2016

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**FIG. A-8**
**Sheet 2 of 2**

## APPENDIX B

## IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

Attachment to 32-1-02475-003

Date: October 2016
To: HDR Alaska, Inc.
Re: Palmer Waste Water Treatment Plant, Facility Improvements, Palmer, Alaska

# Important Information About Your Geotechnical/Environmental Report

## CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

## THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

## SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

## MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

**A REPORT'S CONCLUSIONS ARE PRELIMINARY.**

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

**THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.**

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

**BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.**

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

**READ RESPONSIBILITY CLAUSES CLOSELY.**

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland