

**REVISED GEOTECHNICAL EXPLORATION REPORT AND  
CORROSION POTENTIAL SURVEY  
PROPOSED EAST KAPOLEI RESERVOIR  
20- TO 30-INCH WATER TRANSMISSION MAIN  
AND 30- TO 42-INCH TRUNK SEWER  
EAST KAPOLEI, EWA, OAHU, HAWAII**

For

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March 10, 2006  
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**SUMMARY OF FINDINGS AND RECOMMENDATIONS**

Our field exploration along the proposed pipeline alignment from Boring Nos. B-1 to B-16 encountered overburden materials generally consisting of stiff to hard silty-clays from the ground surface down to 16.5 feet below ground surface (fbgs), the maximum depth of drilling for the water main and at 21.5 in Boring Nos. B-10, B-12, B-19, and B-20 along the proposed sewer main. Buried boulders and cobbles are anticipated at the northern most segment of the alignment (Mauka side) between Boring Nos. B-1 to B-4. The thickness of the silty-clay overburden was observed to recede at the southern end of the proposed sewer pipeline alignment, where it overlays a coral formation which was encountered at depths of 1, 8, 3.5, and 0 fbgs in Boring Nos. B-17, B-18, B-19, and B-20, respectively. A coral sand deposit was also encountered at 13 fbgs in Boring No. B-13. In terms of the geotechnical subsurface soil conditions encountered at the site, it is feasible to construct the water transmission and sewer mains along the proposed alignments using conventional equipment.

The resistivity survey and chemical tests conducted along the water transmission main alignment indicate that the corrosion activity of the brown clayey soils ranges from corrosive to extremely corrosive. The coral formation at the southern end of the pipeline alignment indicated a mild to moderate corrosion activity.

The results of our geotechnical exploration and resistivity survey including geotechnical design recommendations are contained in the text of this report.

**INTRODUCTION**

This report presents the results of our geotechnical engineering exploration and resistivity survey for the proposed 20- to 30-inch water transmission main and 30- to 42-inch trunk sewer pipe alignment for the Parcel B Subdivision Development in East Kapolei, Ewa, Oahu, Hawaii. Our work was performed in general accordance with the scope of work as outlined in our fee proposal dated June 18, 2004, the plan and profile of the East Kapolei Offsite Trunk Sewer received by PSC on September 13, 2006, and the plan and profile of the East Kapolei Water Transmission Mains dated June 15, 2006. The general location and vicinity of the project site are shown on the Project Location Map, Plate No. 1. The planned routes of the alignments are shown on the Boring Location Plan, Plate No. 2.



## **PROJECT CONSIDERATIONS**

The proposed project will consist of the construction of a 20- to 30-inch water pipeline about 18,540 feet long. The pipeline originates from the 4 MG East Kapolei Reservoir near the H-1 Freeway, about 1,160 feet west-southwest from the H-1 and Palehua Road intersection. The water main runs south along the 50-foot wide utility corridor parallel to the 75-foot wide (north to south) electrical easement of the HECO high-tension power lines along the proposed North-South Road alignment, all the way down to the proposed Kapolei Parkway intersection immediately south of Parcel B. The 30-inch water pipeline is proposed from the reservoir to Sta. 90+50. The pipeline reduces to 24 inches in diameter from Sta. 90+50 to Sta. 39+30. The pipeline again reduces to 20 inches in diameter thereafter to Sta. 0+00 of the water main plans dated June 15, 2006. This project is part of the offsite improvements designed to provide the water supply requirements of the Department of Hawaiian Homelands East Kapolei Subdivision Development (Parcel B). The project also includes the construction of a 30-inch trunk sewer pipe parallel to the water main alignment along the eastern side of Parcel B.

Based on the plans and profile of the trunk sewer main received by PSC on September 13, 2006, the 30-inch sewer pipeline runs from Sta. 59+00 to Sta. 32+83. The trunk sewer increases to 42 inches in diameter from Sta. 32+83 to Sta. 0+00, where it connects with the Kapolei interceptor sewer near Renton Road. There is also a 36-inch trunk sewer pipe perpendicular to the alignment of the 30-inch to 42-inch sewer pipe at the interception of the 30-inch to 42-inch (that is Sta. 32+83). The 36-inch trunk sewer pipe continues its alignment easterly and end at Mango Tree Road (Boring No. 15 covered this section). The location of the project site is shown on the Project Location Map, Plate No. 1. The planned routes of the water mains, the sewer pipe, and the approximate locations of the borings are shown on the Site Location Plan, Plate No. 2. The field resistivity survey points are shown on the Resistivity Test Location Plan, Plate No. 2-A.

Based on the plans and profiles for the water main and trunk sewer, we understand that the water main will be embedded at a depth of between 5 to 7 feet and the sewer pipe between 10 to 20 feet below ground surface (20 to 26 feet for the 36-inch trunk sewer). Our borings were drilled to about 16.5 feet along the water main and four (4) 21.5-foot borings were drilled along the proposed sewer pipe alignment.

A plan on the water transmission main dated June 15, 2006 was provided for us to review on June 16, 2006 and a plan on the sewer main was provided to us via email on September 13, 2006.

## **PURPOSE AND SCOPE**

The purpose of this survey is to obtain information on the engineering and chemical properties of the subsurface soil/rock along the proposed pipeline alignments to develop conclusions and recommendations for the geotechnical design and corrosion protection. The recommendations and



geotechnical design parameters for the pipelines provided in this report are based on the data and information obtained from our field exploration and laboratory test results. Our scope of work for the current study consisted of the following:

1. Planning and scheduling the investigation;
2. Coordinating the drilling operations and soil resistivity survey;
3. Drilling 16 borings to a depth of about 16.5 feet and 4 borings to 21.5 feet;
4. Providing a field engineer to monitor the drilling and sampling operations and to prepare the log of the borings;
5. Providing a field engineer to conduct field resistivity surveys and to encode and interpret the results;
6. Reviewing available soils information of nearby sites;
7. Performing appropriate laboratory tests on selected soil samples to determine the relevant engineering properties of the soils encountered;
8. Selected soil samples were sent to an EPA approved testing laboratory for pH, chloride, and sulphate tests for corrosion design;
9. Analyzing the field and laboratory data and performing engineering analyses; and
10. Submitting a written report summarizing our findings, conclusions, and recommendations for the geotechnical design and construction of the water transmission main and sewage facilities including parameters for the design of corrosion protection for the metallic components of these underground water transmission lines.

## **FIELD EXPLORATION**

### **Drilling and Soil Sampling**

Subsurface conditions along the water main and sewage alignments were explored by drilling 20 borings to depths of 16.5 to 21.5 feet. The approximate boring locations are shown on the Site and Boring Location Plan, Plate No. 2. The borings were advanced using a Diedrich D-25 drill rig equipped with 4-inch solid-stem augers and rotary drilling equipment. Samples were obtained at selected depths using a 1 1/2-inch by 24.0-inch Standard Penetration Test (SPT) sampler driven with a 140-pound hammer falling 30 inches.

During the drilling operations, our Project Geologist maintained a log of the soils encountered, obtained samples of the soils at selected depths, classified the soils by visual/manual methods, and recorded the number of blows required to drive the sampler for each 6 inches of an 18-inch drive.



The number of blows required to drive the sampler for the last 12-inches are presented on the Log of Borings, Plate Nos. 3 through 22. Sampling efforts were terminated when practical refusal was encountered. Soils and Rocks were classified in accordance with the Unified Soil Classification System and Rock Classification System as shown on Plate Nos. 23 and 24, respectively.

## **GEOLOGY**

### **Regional Geology**

Oahu was formed by the buildup and coalescence of 2 large shield volcanoes (Waianae and Koolau Mountains) erupting from 2 sub-parallel rift zones in the Pacific Ocean sea floor. Waianae first formed an isolated island and was joined by, and later to, the Koolau Island by lava flows issuing from the Koolau Volcano. The island building was roughly similar to that of the Big Island today with the added complication of explosive volcanism generated by volcanic magma contacting sea and groundwater, exploding, and forming tuff cones. These mountains weathered and eroded for a period as the island subsided as much as 1,200 feet. Valleys were eroded into the shield volcanoes and were filled by both erosional debris and growing coral-algal reefs.

The project site is located just south (Makai) of the southern end of the deeply eroded Waianae Range on the Ewa Coastal Plain. The coastal plain is composed of a sediment wedge over 1,000 feet thick of land derived sediments (clay to boulder size) and reef (coralline algae, coral, shells and other carbonate) debris. These wedges accumulated and moved on and offshore depending upon changing rainfall patterns and sea level changes caused by water alternately being stored in, and released by, continental glaciers during the Ice Ages (Pleistocene Epoch). During the formation of the Waianae, a cluster of about 6 volcanic fire fountains erupted just Mauka of the site, according to published geologic literature.

### **Site (Route) Geology**

The site's subsurface reflects the area's relatively long, and somewhat complex, geologic history. There are hard, 'fresh', basalt gravel, cobbles and boulders deposited in alluvial fans at the mouths of canyons close to the mountain range. Stream, wave, and current transport have removed most sand-sized particles from the area leaving brown, silty, clay alluvium and lagoon deposits. The fire fountains blanketed the site repeatedly with hot basaltic glass lava droplets. When the eruptions were small, and a strong wind blew, the droplets cooled in the wind and near shore water and did not fuse. However, large eruptions produced deposits of welded glass known as welded tuff. During the entire period, coral-algal reefs and associated carbonate sediments continued to deposit somewhat offshore away from the near-shore muddy water.



## **SITE AND SUBSURFACE CONDITIONS**

### **Site Description**

The first 1,000-foot segment of the pipeline alignment, between Boring Nos. B-1 and B-2, lies along a dirt road bordering a farm plot north of Farrington Highway. It runs parallel to a levee alongside the west bound lane of Farrington Highway. The alignment between Boring Nos. B-2 to B-8 traverses an agricultural field presently cultivated for corn and a variety of vegetable crops at the time of the survey. The mid-southern segment of the survey between Boring Nos. B-9 and B-19 are located in grassy plains with occasional bushes. The southernmost segment of the survey line, between Boring Nos. B-18 through B-20, is part of the 42-inch trunk sewer alignment from Kapolei Parkway extension to Renton Road. The survey terminated in the vicinity of Boring No. B-20, a clear area immediately west of the Kapolei Train Station on the west bound side of Renton Road. This zone is distinctively covered at the surface with sandy, gravelly, coralline materials.

### **Subsurface Conditions**

Based on our borings, the subsurface soils along the pipeline alignment may be classified into 3 geotechnical zones. Zone-1 would be the northern segment of the water main alignment stretching about 4,000 feet between Boring Nos. B-1 and B-4, where boulders and cobbles were encountered within the silty-clay, soil matrix. The resistivity survey indicates that the soil in this region is generally very corrosive. The second geotechnical zone is located along the middle 8,000-foot segment between Boring Nos. B-4 to B-16, which is comprised of similar silty, clay soils, characterized by the absence of boulders/cobbles encountered and has a generally high corrosion potential (except in the stretch from B-6 to B-8, where resistivity test results indicate extremely corrosive potential). The third zone is the southern most segment of the alignment where the soil overburden thins out towards the south as it overlays the Kapolei coral formation. The resistivity survey also indicates that the corrosion activity of the soil over this zone is from moderate to mildly corrosive.

Subsurface conditions that may impact the proposed project are:

- ❖ Surface and subsurface basalt gravel, cobbles, and boulders may be encountered along the route from Boring No. B-1 to approximately Boring Nos. B-3 or B-4.
- ❖ Stiff to hard, brown, silty-clay is common from the surface to about 15 to 20 feet in Boring Nos. B-1 through B-15.



- ❖ Hard to very hard, silty, sandy clay (very weathered volcanic tuff), was encountered in a number of borings between Boring Nos. B-1 through B-15.
- ❖ Surface silty-clay thins to less than 5 feet in Boring Nos. B-16 through B-20.
- ❖ Boring Nos. B-16 through B-20 are underlain by coralline sediments from less than 5 feet below the surface to at least the depth of the bottom of the water transmission main.

Boring No. B-12 had anomalously soft soil that may be uncompacted fill.

The detailed descriptions of the subsurface materials encountered are presented on the Log of Borings, Plate Nos. 3 through 22.

### **LABORATORY TESTING**

The field classifications of the samples were verified in the laboratory. These classifications are presented on the Log of Borings, Plate Nos. 3 through 22.

#### **Moisture Content**

Moisture content determinations are used as an aid in soil classifications and evaluating certain properties such as relative saturation. The moisture content is expressed as a percentage of the dry weight of the tested sample. The results are shown at the appropriate depths on the Logs of Borings, Plate Nos. 3 through 22.

#### **Atterberg Limits**

The Atterberg Limits were determined on selected samples for soil classification and to obtain an indication of the expansion and shrinkage potential of the soil with changes in moisture content. Results of these tests are shown on Plate No. 25.

#### **Moisture and Density Relation/Compaction**

Compaction tests were performed in accordance with ASTM D-1557 to determine the maximum dry density and optimum moisture content of the soils to be compacted or used as backfill for the pipes. Test results are presented on Plate Nos. 26 and 27.





## **Chemical Tests**

Chemical Tests related to the potential corrosion activity of the soils, such as pH, sulfates, and chlorides, were conducted by an EPA approved independent analytical laboratory to confirm the results of our resistivity data. A summary of these tests are shown in the Summary of Chemical Test Data, Plate No. 58, and the test data is presented in Appendix A of this report.

## **FIELD RESISTIVITY TESTS**

Soil resistivity was tested at 63 locations along the proposed pipeline routes with a Nilsson 400 Soil Resistivity Meter. The Wenner 4-Pin Method of conducting soil resistivity was employed for the survey. The approximate test locations are shown on the Resistivity Test Location Plan, Plate No. 2-A. In conformance with the Water System External Corrosion Control Standards of the Board of Water Supply, City and County of Honolulu, the distances between the test locations along their respective routes are approximately 300 feet or less.

We anticipate that the depth of the water main invert below the finished grade will be between 5 to 6 feet below present grade with a minimum soil cover of 3 feet over the pipe. Soil samples for chemical tests (i.e., pH, chloride, and sulfate contents) were generally taken at this depth. Field soil resistivity measurements were taken at pin spacings of 4, 8, and 12 feet corresponding to the resistivity of the soils in Ohm-cm at these respective depths.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **General**

From a geotechnical engineering standpoint, the surveyed utility corridor may be used for the construction of the proposed water transmission main and sewer pipe alignments. Our conclusions and recommendations are based upon the assumption that the soil conditions are relatively consistent with the conditions observed and/or described in this report. Therefore, this report does not reflect variations in the subsurface conditions in the areas that were not explored. Should such variations be revealed during construction, the recommendations contained in this report would need to be re-evaluated by PSC Consultants, LLC (PSC). PSC should be advised of any alterations of the proposed development so that we may review such changes and, if necessary, provide additional recommendations.



## **Site Preparation**

At the on-set of earthwork, all areas within the contract grading limits of the utility corridor should be cleared and grubbed. All vegetation, debris, and other deleterious materials should be removed and disposed of offsite. We anticipate the surface materials at the site to contain significant amounts of organics and debris from surface vegetation. Onsite soils containing such materials are unsuitable for use as trench backfill.

## **Excavations**

The soils along the pipeline alignment surveyed may be excavated utilizing conventional equipment. Basalt boulders may be encountered in the region between Boring Nos. B-1 through B-4 and may require special consideration where these are encountered. Excavation contractors digging the utility trenches should satisfy themselves as to the hardness of deposits and select the most appropriate type of equipment required.

The width of the trench excavation should be at least 48 inches for the 30-inch diameter water main and at least 36 inches for the 20-inch diameter pipe. For the trunk sewer, the widths of the trenches should be at least 57 and 76 inches for the 30- and 42-inch diameter pipes respectively, as specified in Item 624.03B and 625.03A of the Hawaii Standard Specifications for Road, Bridges, and Public Works Construction.

For temporary un-surcharged construction excavations, the excavations should be sloped or shored. Temporary slopes should not be steeper than 1H: 1V in granular soils, and 1/2H: 1V in fine-grained soils. If there is insufficient space for sloped excavations, shoring should be used. Traffic and surcharge loads should be kept back at least 10 feet from the top of the excavations. Slopes should be inspected during construction/excavation to determine if they need to be flattened based on exposed conditions. Exposed slopes should be kept moist (but not saturated) during construction. The bottom of the trench should be inspected by the geotechnical engineer and if the material is found unsuitable, the contractor shall excavate below grade to at least 1.5 feet or as directed by the engineer. The excavated area below grade shall be filled with 3B Fine aggregate in 6-inch compacted layers and brought up to the bottom of the crushed rock cradle (Section 11.4B Additional Excavation, Hawaii Standard Specifications for Public Works Construction, September 1986) and wrapped in non-woven filter fabric and brought up to within 6 inches of the invert grade or to the bottom of the concrete jacket or cradle.



Waterlines and Sewer lines should be bedded in at least 6 inches of clean granular material, such as sand or fine gravel that extends to at least 12 inches above the pipe or conduit. In the southern segment of the 42-inch diameter trunk sewer from Kapolei Parkway Extension to Renton Road, we anticipate to encounter coralline formation at the bottom of the 76-inch wide trench. We recommend a 6-inch layer of pipe bedding material at the bottom of the trench within the coral formation. Hand-operated mechanical compactors should be used for compaction of bedding and backfill material, including under and around the utility pipes. Thereafter, the trenches should be backfilled with approved materials. Trench backfill should be placed in loose lifts of not more than 8 inches in loose thickness; moisture-conditioned to about 2 percent wet of optimum moisture content, and compacted to at least 90 percent of maximum dry density. The top of the trenches shall be restored to match the original ground surface conditions prior to excavation.

### **Sheathing Recommendations**

If necessary, the contractor shall sheath and brace excavation to render the excavation secure. The sheathing and bracing should be removed before completing the backfill. When sheathing is necessary, the width of the trenches should be wider than the above- specified widths.

### **Trench Backfills**

For the first lift from the bottom of the pipe to 12 inches above the pipe barrel, either sandy or granular material such as black sand, beach sand, crushed fine aggregates, finely graded coral passing through a 1-inch sieve should be used. Native material that does not contain lumps greater than 1 inch in diameter, organic debris, or adobe may also be used. The trench backfill material shall conform to Item No. 703.21 of the Hawaii Standard Specifications for Road, Bridge and Public Works Construction.

For the succeeding lifts from 12 inches above the pipe to the original ground surface, the native materials excavated from the trench may be used to backfill the trench. The finished surface shall match the original ground surface prior to trenching in material composition and in thickness. The finished product shall be equal to or better than the original.

These materials should not contain more than 50 percent rock, hard lumps of earth greater than 6 inches, rocks larger than 6 inches in their largest diameter, adobe or other deleterious material. The granular borrow, or non-expansive native material may also be used for backfill in excavations for appurtenant structures.



Fill and backfill material should be placed in level lifts of not more than 8 inches in loose thickness and moisture-conditioned to within 2 percent wet of optimum moisture content. Fine-grained soils should be compacted to at least 90 percent relative compaction and granular soils should be compacted to at least 95 percent relative compaction, determined in accordance with ASTM D1557, as indicated above. We believe that if the native soils of silty clay are used as trench backfill from 12 inches above the pipe to the original ground surface, and prepared according to the above methods of placement, moisture condition and compaction, this will act as an impermeable layer inhibiting runoff from entering into the pipe trench.

### **Foundations**

Footings located adjacent to below-grade structures or utilities should be deepened such that the structures or utilities will be above a plane extending downward at 45 degrees from the bottom edge of the nearest footing. This will mitigate the potential of surcharging adjacent below-grade structures or utilities with additional structural loads and reduce the potential for foundation settlement.

### **Excavation for Appurtenant Structures**

The bottom of the foundation excavations for appurtenant structures, such as manholes or reaction blocks, should be firm and unyielding. If soft and/or loose soils are encountered at the bottom of the foundation excavations, these should be over-excavated to expose competent insitu material or to a minimum of 20 inches and replaced with select granular material such as 3B Fine Gravel, wrapped in a non-woven filter fabric such as Mirafi 180 N and overlain with 6 inches of bedding material. For Sewer Manhole structures in coralline formation, we recommend 6 inches of bedding material.

### **Allowable Bearing Capacity**

An allowable bearing capacity in the order of about 2,000 psf is estimated in the undisturbed silty clay materials along the pipeline alignments. If the manholes such as; A-11 to A-23 are made to rest directly on this silty clay soils we believe these insitu materials can adequately support the anticipated manhole loads. For the native coral formation, an allowable bearing capacity in the order of about 3,000 psf is estimated.

### **Lateral Resistance for Earth Retaining Walls**

Lateral loads acting on the structure may be resisted by frictional resistance between the footing and the bearing material and by passive earth pressure developed against the nearest vertical faces of the embedded portion of the foundations. A coefficient of friction of 0.20 may be used for the friction between the foundation and the clayey bearing subgrade soils and up to 0.4 if bearing on coral formation. Resistance due to passive pressure may be calculated using an equivalent fluid pressure



of 250 pounds per cubic foot (pcf). These values assume that the concrete for the foundations is cast directly against the foundation excavations or, for formed foundations, the space between the wall of the foundation excavation and the foundation pad is backfilled with approved engineered fill. Lateral resistance in the upper 12 inches below the finished grade should be neglected unless confined by pavements of slabs.

### **Existing Utility Lines**

It is anticipated that several existing utility lines may be encountered during construction particularly along Farrington Highway and along Renton Road by the Train Station. Underground utilities may include gas and petroleum pipes. Therefore, we recommend that all existing utility lines along the proposed water transmission main and trunk sewer line especially within the above-specified areas be located accurately prior to construction and that an adequate program be developed to reduce potential damage to the existing utility lines during construction. The contractor has the sole responsibility to develop and implement an effective program to protect the utilities during construction.

### **Highway Crossing**

The conventional trench and backfill method of underground pipe installation across Farrington Highway may cause unwanted traffic interruption. To avoid traffic disruption, if necessary, micro tunneling may be considered. Micro-tunneling is discussed in the following section, for general information only, as our scope of work does not include trench less construction for this project.

## **MICRO-TUNNELING PROCEDURES FOR PIPE INSTALLATION**

Micro-tunneling is a construction technology which installs underground utility lines without excavating trenches on the surface. Depending on the size of the bore and construction methodology, this method can be performed by remote control to mechanically advance the drill head (Tunnel Boring Machine, TBM). The method can also maintain a balanced earth pressure. A backhoe-type digger at the tunneling face has also been used for larger diameter pipelines. Micro-tunneling construction is particularly favorable in installing underground utility lines in urban and areas of heavy traffic and where very hard subsurface soil conditions are not present. Compared to the conventional cut-and-cover method, micro-tunneling considerably reduces the amount of excavated material produced. Since only the jacking and receiving pits and the tunnel bore are excavated, no trenching is required. Disturbance to existing utilities is also reduced by mitigating the potential of ground settlements often associated with large excavations and extensive dewatering operations.



During a micro-tunneling operation, jacking and receiving pits are first constructed. Typically, the pits are selected at the proposed manhole locations. The pit excavations generally require bracing systems such as soldier piles and lagging or interlocking sheet pile cofferdam. Dewatering would be required for pit construction to provide a relatively dry working environment. Adequate depth of penetration of the sheets would be necessary for the stability of the bottom of excavation in sandy materials. The size and shape of the jacking pits are usually based on the length of the tunneling shield, the length of the fully extended jacks, the length of each section of pipe and constraints imposed by the traffic conditions at the site. The jacking pit will require construction of a thrust wall, installation of main jacks, floor beams and guide rails. A working platform and a sump pump are typically required in excavations extending below the groundwater level. The working platform may consist of a layer of gravel fill topped with a layer of concrete to provide a stable base from which to work. The gravel layer will also facilitate dewatering by sump pumps to maintain a dry working area within the excavation.

For pipe installation, the tunneling shield is advanced first, followed by a string of pipe sections. Alignment is usually controlled by a laser system. Cuttings are removed by a circulating slurry system, or a muck or auger system, depending on the specific type of micro-tunneling equipment. Systems utilizing mechanical earth pressure balance devices and a circulating slurry system do not require dewatering along the alignment during construction.

Disruption can occur during micro-tunneling operations as a result of unforeseen obstacles, loss of slurry, problems with the circulating system, problems of pipe quality control, prolonged work stoppage, inadequate equipment maintenance, etc. If the tunneling shield has to be "rescued" between jacking and receiving pits, a recovery shaft will have to be excavated, which may result in requiring an additional manhole or structure along the route of the pipe. Micro-tunneling construction methods should be performed only by a qualified, experienced, specialty contractor with adequately trained personnel, and under "Design Build" system. To mitigate the potential of any problems occurring during micro-tunneling operations, the contractor's personnel should be present at the site throughout the construction. It is advisable that the specialty contractor should have contingency plans to deal with unanticipated conditions. The contractors should independently evaluate the existing soil conditions prior to bidding by drilling additional borings or retain geotechnical professionals to assist in the design build process.

### **Design Parameters for Corrosion Protection System**

In general, results of the field resistivity survey and chemical tests indicate that the areas surveyed have corrosion ratings that range from 1 to 5. This indicates that the subsurface soils surveyed are mildly corrosive (4, 5) (coralline rocks) to moderately (2, 3) and (1) corrosive (brown, alluvial soils).



Resistivity tests, located between Boring Nos. B-1 to B-18 (Test Numbers 1 through 52), showed subsurface soils with corrosion ratings from 1 to 3 corresponding to a corrosion potential rating categorized as highly to moderately corrosive. Since the tests were done during the hot, dry month of August, the near-surface soils were generally dry and cracked. The soils may be even more corrosive when wetted by rain or irrigation. Results of the tests are shown on the Summary of Soil Resistivity Test Results, Plate Nos. 28 through 57. The corrosion activity potential, as indicated by the tests, tend to increase with depth as the natural moisture content of the soils are less affected by surface evaporation.

Resistivity tests conducted near the end of the water transmission main between Boring Nos. B-17 and B-18, where the coral formation was observed to occur near the surface, indicate anticipated corrosion activity of corrosive to moderately corrosive. Resistivity tests conducted along the sewer line, from Boring Nos. B-18 to B-20, where the coral formation appears very close to the surface indicate the anticipated corrosion activity to be generally mildly corrosive. These results are consistent with coralline rock and sediments above the general water table.

The chemical tests were conducted on samples generally taken from a depth of about 5 to 6.5 feet, the anticipated water pipe invert. The results of the chemical tests generally conform to the resistivity test results.

The design for corrosion protection for metallic pipes or metallic components of composite pipes may be designed using these parameters.

### **Plan Review**

Preliminary and final drawings and specifications for the proposed water transmission mains should be reviewed by PSC Consultants, LLC (PSC) prior to advertising for bidding. This is to evaluate conformance with the intent of the geotechnical engineering recommendations presented in this report, under a separate authorization. Unless this review is made, PSC cannot be responsible for misinterpretation of our recommendations.

### **Construction Monitoring**

It is recommended that PSC Consultants, LLC (PSC) be retained to provide geotechnical engineering services during construction of the proposed water line installation. The items of construction monitoring that are critical include observation of the water line placement or trench excavation, fill placement, and compaction. Other aspects of earthwork construction should also be observed by a representative from PSC. This is to observe compliance with the intent of the design concepts, specifications, or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report



was prepared. The recommendations provided in this report are contingent upon such observations. If actual exposed subsurface conditions encountered during construction are different from those assumed or considered in this report, then appropriate modifications to the design should be made.

## **LIMITATIONS**

The analyses and recommendations submitted in this report are based, in part, upon information obtained from field borings. Variations of subsoil conditions between the borings may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations provided in this report.

The field locations and elevations for the borings drilled were estimated from the plans provided by Community Planning and Engineering, Inc. and by measuring from existing features and structures shown on the plans. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification lines shown on graphic representations of the borings depict the approximate boundaries between soil/rock types and, as such, may denote a gradual transition. This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., their client, the Board of Water Supply, and their consultants for specific application to the proposed 20- to 30-inch East Kapolei Reservoir Water Transmission Main and 30-inch to 42-inch Sewer Pipe in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the engineer in the design evaluation of the proposed project. Therefore, it may not contain sufficient data, or proper information to serve as the basis for preparation of construction cost estimates. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes. The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil conditions may require further evaluations and may result in additional cost or construction delays. Therefore, a sufficient contingency fund is recommended to accommodate these possible extra costs.


In addition, this report is subject to revision if the structural information or its planned development is different than those assumed in this preliminary report.



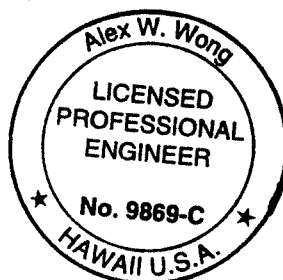


The findings in this report are valid as of the present date. However, change in the soil conditions can occur with the passage of time, whether they may be due to natural processes, or due to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation, or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period if 2 years.

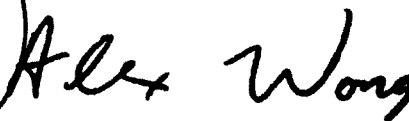
Respectfully submitted,  
**PSC CONSULTANTS, LLC**

  
Melchor G. Nolasco  
Office Engineer

MGN/ASW:ch



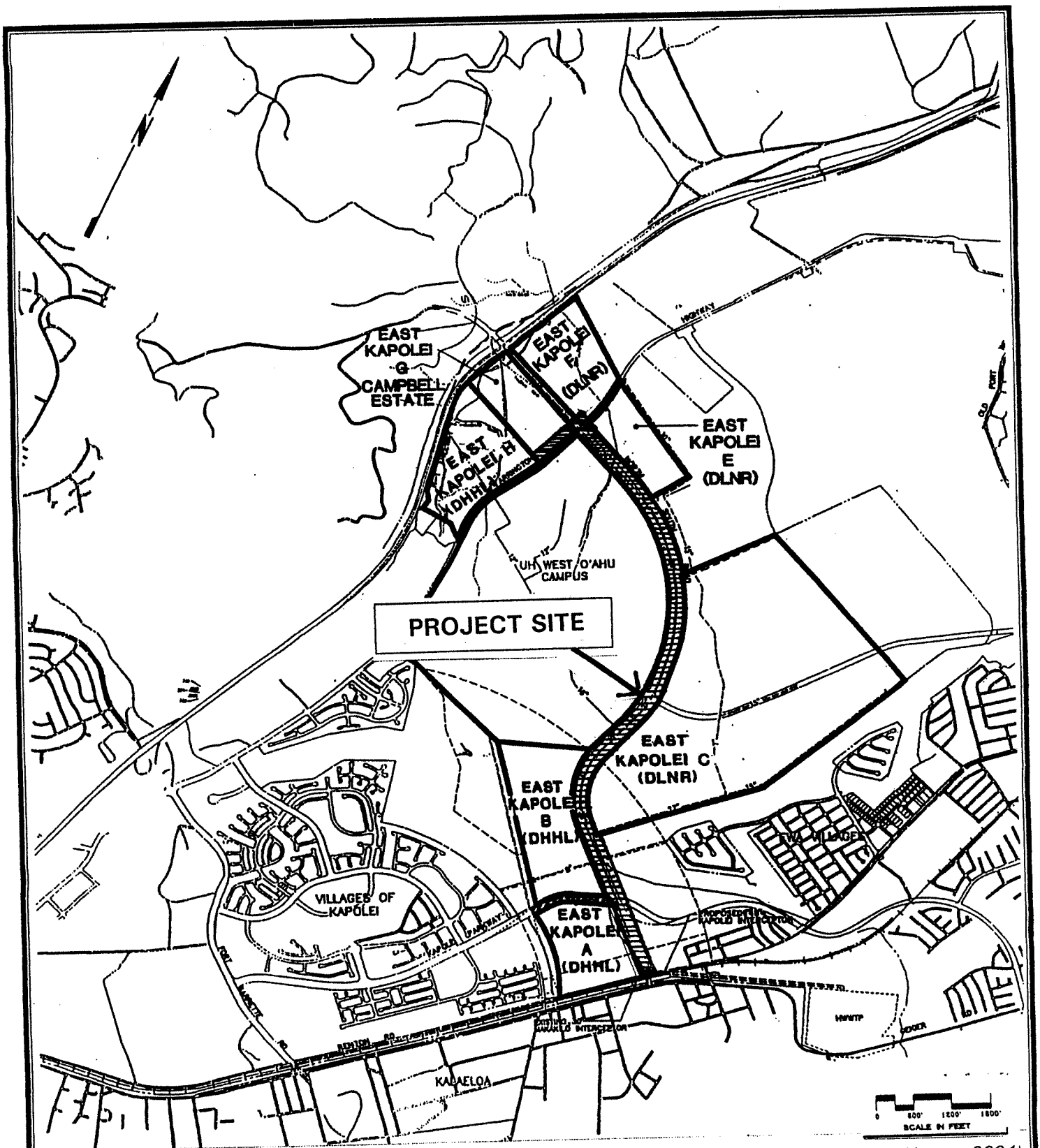
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Alex W. Wong, P.E.  
Senior Engineer

Enc.: Plate No. 1	Project Location Map
Plate No. 2	Site Plan with Boring Locations
Plate No. 2-A	Site Plan with Resistivity Test Locations
Plate Nos. 3 through 22	Log of Borings
Plate No. 23	Unified Soil Classification System
Plate No. 24	Rock Classification Chart
Plate No. 25	Atterberg Limits Test Data
Plate No. 26 through 27	Compaction Test Results
Plate No. 28 through 42	Resistivity Survey Test Data
Plate No. 43 through 57	Plots of Resistivity Survey Test Data
Plate No. 58	Summary of Chemical Test Results
Appendix A	Analytical Laboratory Test Data





Reference: East Kapolei Schematic Development Plan from Community Planning & Engineering, Inc. (August 2004)

## SITE PLAN

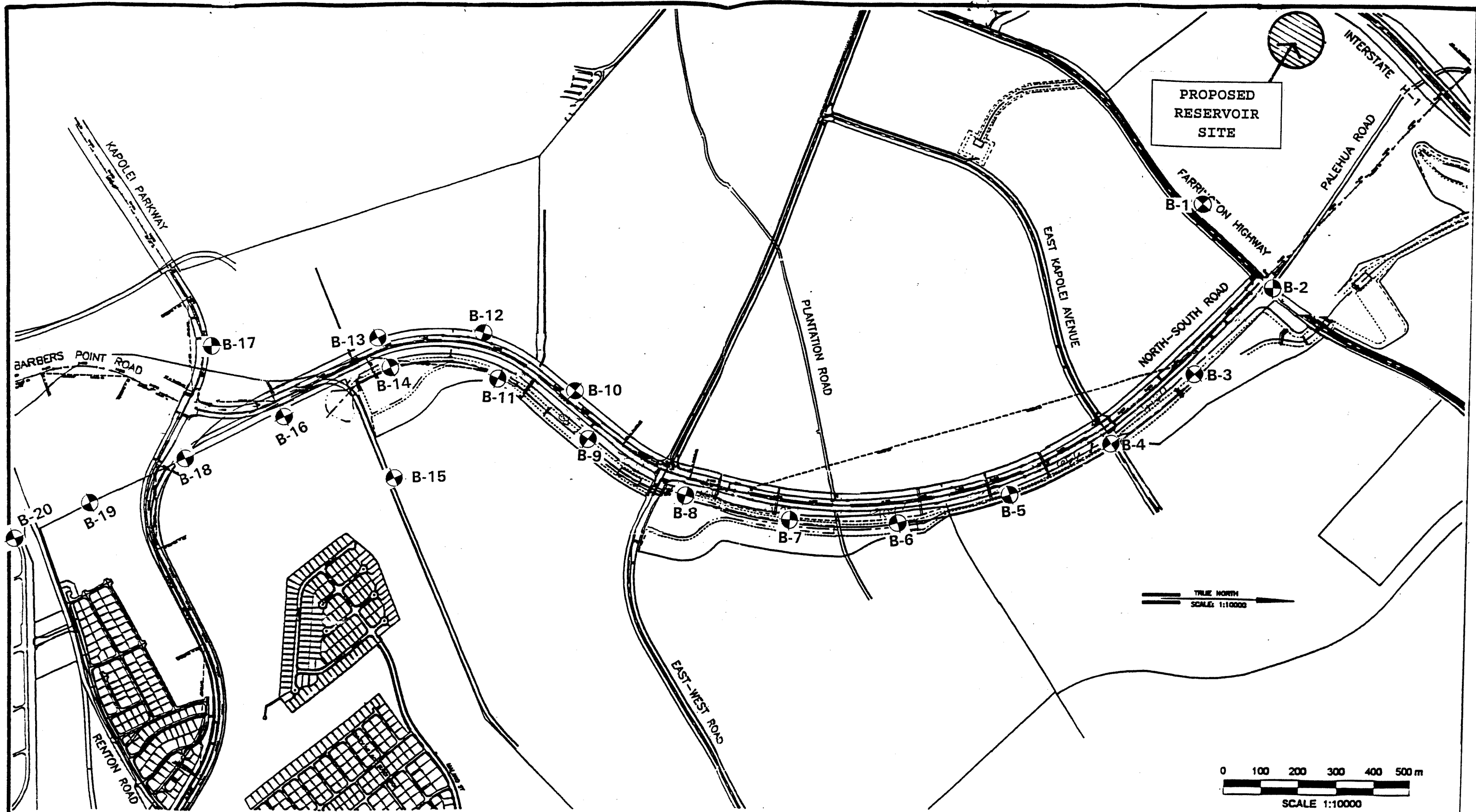


**CONSULTANTS, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

East Kapolei Parcel "B" Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11



LEGEND:

● APPROXIMATE PSC BORING LOCATIONS

REFERENCE: CAD FILE PROVIDED BY R. M. TOWILL CORPORATION ON OCTOBER 21, 1997.

BORING LOCATION PLAN

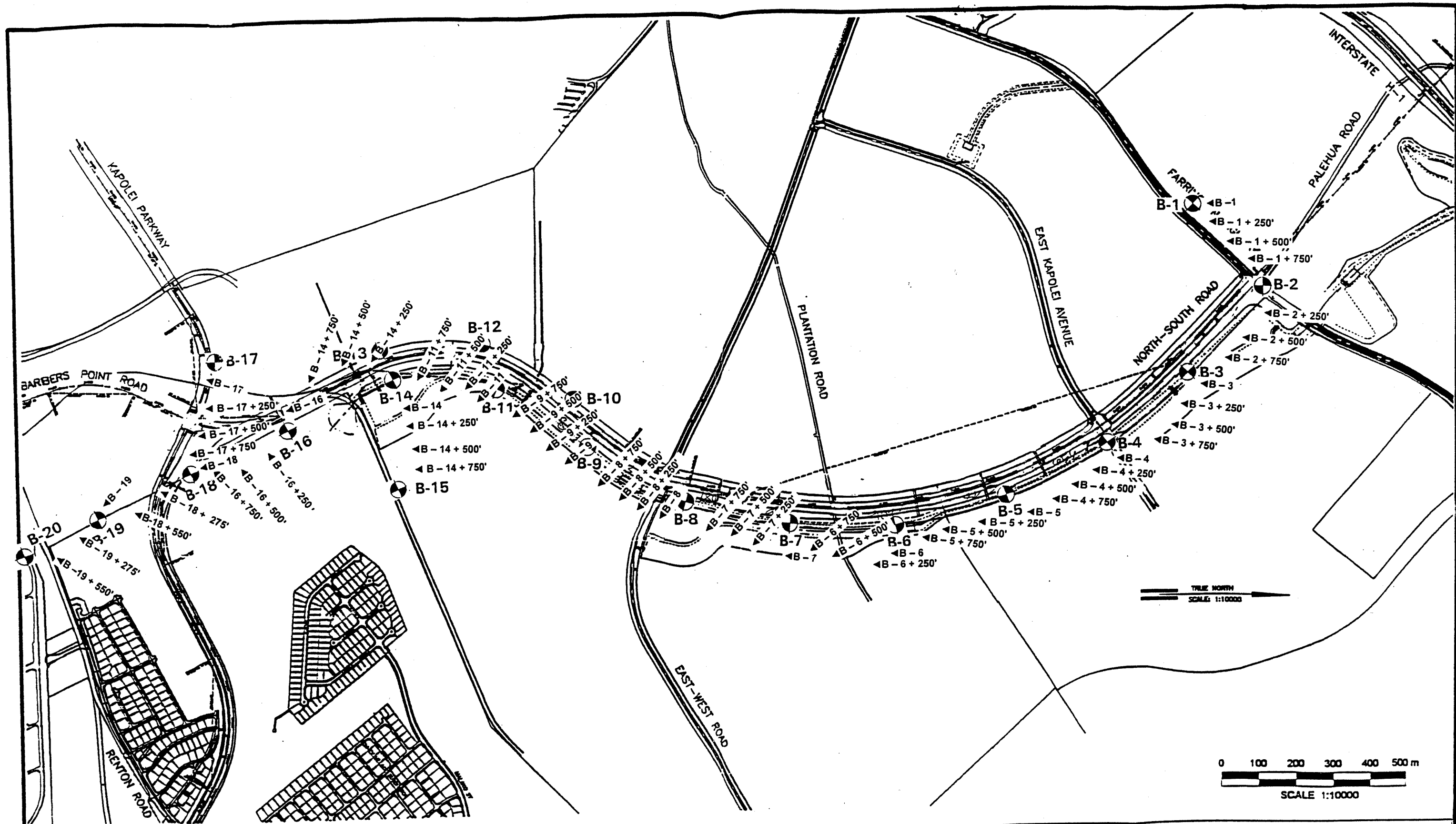


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East Kapolei Reservoir Water Transmission Main  
& Parcel B Sewer Main  
North South Road, Kapolei, Oahu, Hawaii

DATE: March 2006

PSC JOB NO. 24307.11



LEGEND:

△ APPROXIMATE RESISTIVITY TEST LOCATION

REFERENCE: CAD FILE PROVIDED BY R. M. TOWILL  
CORPORATION ON OCTOBER 21, 1997

## RESISTIVITY TESTS LOCATION PLAN



**CONSULTANTS, LLC**  
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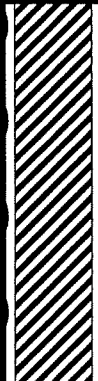
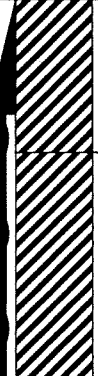

East Kapolei Parcel "B" Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

BORING LOCATION: See Site Plan					DRILLER: PSC					<b>BORING NO. B-1</b>
BORING ELEVATION: 150 FEET					LOGGED BY: B. Anderson					
DATE (S) DRILLED: 8/20/05					TYPE RIG: Diedrich (D-25)					

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, with a tr. of gravel, brown, dry, v. stiff
						2				
						3				
						4				
		23.7			21	SPT-1	5			145.0 Silty CLAY, brown, damp, v. stiff
		0.2				Aug-2	6		CH	Silty CLAY, brown, damp, tr. gravel, v. stiff
						7				
						8				
						9				
						Aug-3	10		CH	Boulders in Silty CLAY (Could not SPT sample because of boulders)
		18.0				11				
		11.6				12				
						13				
							14			Boring Terminated at about 13.0 feet. No groundwater encountered.
							15			


  

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	CON - Consolidation Test
AUG - Auger Cuttings	PI - Atterberg Limits
SH - Shelby Tube	UC - Unconfined Compression
D&M - Dames & Moore	SG - Specific Gravity
	SA - Sieve Analysis

LOG OF BORING

 <div style="display: inline-block; vertical-align: middle;"> <b>Geotechnical &amp; Environmental Consultants</b>  <b>Construction Management, Testing &amp; Inspection</b> </div>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
	DATE: March 2006	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-2
BORING ELEVATION: 156.3 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/27/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
LL=45 PL=22 PI=33						Aug-1				Gravelly, Silty, CLAY, with cobbles and boulders, dry, loose (prob. fill)
							1			
							2			
							3		CL	
							4			
		21.7			21	SPT-1	5			151.3 Silty CLAY, brown, damp, v. stiff
							6			
						Aug-2	7		CH	
							8			148.8 Silty CLAY, tr. sand (v. weathered volcanic tuff), brown, damp, v. hard
							9			
		20.0			>50	SPT-2	10			
							11			
						Aug-3	12		CH	
							13			
							14			
		19.9			>50	SPT-3	15			
							16			139.8
							17			Boring terminated at about 16.5 feet Groundwater not encountered
						18				

SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression			
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity			
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

## LOG OF BORING



Geotechnical & Environmental  
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Construction Management,  
Testing & Inspection

E. Kapolei Parcel "B", Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-3
BORING ELEVATION: 137.2 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/27/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Gravelly, Silty, CLAY, with cobbles and boulders, dry, soft to stiff, (fill, in part)
							2			
							3			
							4			
		20.3			34	SPT-1	5		CH	Silty CLAY, tr. of sand (v. weathered volcanic tuff), brown, damp, hard, grading downward to v. hard
						Aug-2	6			
							7			
							8			
							9		CH	Silty CLAY, tr. of sand (v. weathered volcanic tuff), damp, very hard
		22.5			48	SPT-2	10			
						Aug-3	11			
							12			
							13		CH	Silty CLAY, tr. of sand (v. weathered volcanic tuff), damp, very hard
							14			
		18.7			>50	SPT-3	15			
							16			
							17			Terminated boring at approximately 16.5 feet Groundwater not encountered
							18			

SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression			
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity			
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

## LOG OF BORING









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E. Kapolei Parcel "B", Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan	DRILLER: PSC	<b>BORING NO. B-4</b>
BORING ELEVATION: 136.20 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/27/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, brown, dry, soft (plowed field) grades downward to v. stiff at about 3 ft.
							2			
							3			
							4			
LL=56 PL=21 PI=35		23.5			28	SPT-1	5			
							6			
						Aug-2	7			128.7 Silty CLAY, brown, damp, v. hard
							8			
							9			
							10			
		21.7			54	SPT-2	11			
							12			
						Aug-3	13		CH	
							14			
							15			
							16			
		22.2			39	SPT-3	17			119.7 Terminated boring at about 16.5 feet Groundwater not encountered
							18			

#### SAMPLE TYPE

MC - Modified California SPT - Standard Penetration  
 CB - Core Barrel SH - Shelby Tube  
 AUG - Auger Cuttings D&M - Dames & Moore

#### OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression  
 CON - Consolidation Test SG - Specific Gravity  
 PI - Atterberg Limits SA - Sieve Analysis

## LOG OF BORING



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E. Kapolei Parcel "B", Offsite Improvements  
 Water and Sewage Transmission Mains  
 Kapolei, Ewa, Oahu, Hawaii



DATE: March 2006

PROJECT NO.: 24307.11




BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-5
BORING ELEVATION: 122.9 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/20/05	TYPE RIG: Diedrich (D-25)	

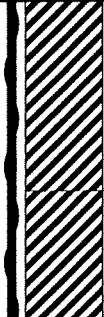


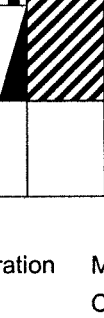
OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		15.4				Aug-1	1		CH	Silty CLAY, tr. of gravel, brown, dry, v. stiff
							2			
							3			
							4			
		19.2			27	SPT-1	5		CH	Silty CLAY, tr. of sand (v. weathered volcanic tuff), damp, brown, hard
							6			
						Aug-2	7			
							8			
							9			
		22.8			30	SPT-2	10			
							11			
						Aug-3	12			
							13			
							14			
		22.8			32	SPT-3	15			
							16			
							17			Boring Terminated at about 16.5 feet Groundwater not encountered
							18			

SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

LOG OF BORING

 <b>Geotechnical &amp; Environmental Consultants</b> Construction Management, Testing & Inspection	<b>E. Kapolei Parcel "B", Offsite Improvements</b> Water and Sewage Transmission Mains Kapolei, Ewa, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-6
BORING ELEVATION: 110.8 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/20/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, brown, dry, stiff
							2			
							3			107.8
							4			Silty CLAY, tr. of sand (v. weathered volcanic tuff), brown, damp, v. stiff
		25.2			27	SPT-1	5		CH	
							6			
						Aug-2	7			
							8			
							9		CH	
		23.6			30	SPT-2	10			
							11			
						Aug-3	12			
							13		CH	
							14			
		22.5			32	SPT-3	15			
							16			94.3
							17			Boring terminated at about 16.5 feet Groundwater was not encountered
							18			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration		MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

## LOG OF BORING



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E. Kapolei Parcel "B", Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan						DRILLER: PSC				<b>BORING NO. B-7</b>
BORING ELEVATION: 94.7 FEET						LOGGED BY: B. Anderson				
DATE (S) DRILLED: 8/20/05						TYPE RIG: Diedrich (D-25)				

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1	CH		Silty CLAY, brown, damp, stiff
							2			
							3			
							4			
		22.5			12	SPT-1	5			
							6			
						Aug-2	7			
							8			Silty CLAY, brown, damp, hard
							9			
							10			
							11			
		22.9			39	SPT-2	12			
							13			
						Aug-3	14			
							15			CH
							16			
							17			
							18			
		22.0			43	SPT-3	15			
							16			
							17			
							18			
										Boring terminated at 16.5 feet No groundwater encountered

<b>SAMPLE TYPE</b> MC - Modified California SPT - Standard Penetration CB - Core Barrel      SH - Shelby Tube AUG - Auger Cuttings      D&M - Dames & Moore	<b>OTHER LABORATORY TESTS</b> MD - Moisture/Density      UC - Unconfined Compression CON - Consolidation Test      SG - Specific Gravity PI - Atterberg Limits      SA - Sieve Analysis
--	--

LOG OF BORING

 <b>Geotechnical &amp; Environmental Consultants</b> Construction Management, Testing & Inspection	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
	DATE: March 2006	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-8
BORING ELEVATION: 83.4 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/21/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1			Silty CLAY, brown, dry, v. stiff, with roots
							2		CH	
							3			
							4			Silty CLAY, brown, damp, v. stiff
							5			
							6		CH	
		19.0			31	SPT-1	7			Silty CLAY, tr. of sand (v. weathered volcanic tuff), brown, damp, v. hard
						Aug-2	8			
							9			
							10			Boring terminated at about 16.5 feet Groundwater was not encountered
		22.5			82	SPT-2	11			
						Aug-3	12		CH	
							13			
							14			
		21.8			84	SPT-3	15			
							16			
							17			
							18			

SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression			
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity			
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

## LOG OF BORING



Geotechnical & Environmental  
Consultants  
Construction Management,  
Testing & Inspection

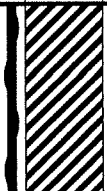
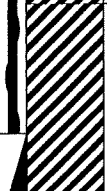
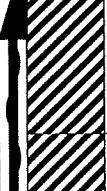



E. Kapolei Parcel "B", Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan					DRILLER: PSC					<b>BORING NO. B-9</b>
BORING ELEVATION: 79.8 FEET					LOGGED BY: B. Anderson					
DATE (S) DRILLED: 8/21/05					TYPE RIG: Diedrich (D-25)					


  

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, (v. weathered volcanic tuff), brown, dry, v. stiff, with roots
						2				
						3				
							4		CH	Silty CLAY, tr. sand (v. weathered volcanic tuff), brown, damp, hard
						5				
						6				
		18.4			34	SPT-1	7		CH	Silty CLAY, tr. sand (v. weathered volcanic tuff), brown with black, orange spots, damp, v. hard
						8				
						9				
							10		CH	Boring terminated at about 16.5 feet Groundwater was not encountered
						11				
						12				
		21.4			52	SPT-2	13		CH	
						14				
						15				
							16		CH	
						17				
						18				







SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	CON - Consolidation Test
AUG - Auger Cuttings	PI - Atterberg Limits
SH - Shelby Tube	UC - Unconfined Compression
D&M - Dames & Moore	SG - Specific Gravity
	SA - Sieve Analysis

<b>LOG OF BORING</b>	
 <div style="clear: both;"></div> <p style="margin: 0;">Geotechnical &amp; Environmental Consultants Construction Management, Testing &amp; Inspection</p>	<b>E. Kapolei Parcel "B", Offsite Improvements Water and Sewage Transmission Mains Kapolei, Ewa, Oahu, Hawaii</b>
DATE: March 2006	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-10
BORING ELEVATION: 79 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/27/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
-LL=52 -PL=21 -PI=31						Auger-1	1		CH	Silty CLAY, brown, dry grades downward to damp, v. stiff, with roots	
						2					
						3					
						4					
						32	SPT-1	5		CH	Silty CLAY, tr. sand (v. weathered volcanic tuff), brown with white stains in fissures (agricultural chemicals?), damp, hard
						6					
						Auger-2	7				
						8					
								9		CH	Silty CLAY, tr. sand (v. weathered volcanic tuff), damp, stiff
		23.3			21	SPT-2	10				
						Auger-3	11				
						12					
								13		CH	Silty CLAY, tr. sand (v. weathered volcanic tuff),brown and white specks, damp, v.stiff
							14				
		20.9			26	SPT-3	15				
						Auger-4	16				
								17		CH	
							18				
							19				
							20				
			22.6			25	SPT-4	21			
							22				
							23				
							24				
										Terminated boring at about 21.5 feet Groundwater not encountered	

#### SAMPLE TYPE

MC - Modified California SPT - Standard Penetration  
CB - Core Barrel SH - Shelby Tube  
AUG - Auger Cuttings D&M - Dames & Moore

#### OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression  
CON - Consolidation Test SG - Specific Gravity  
PI - Atterberg Limits SA - Sieve Analysis

## LOG OF BORING



Geotechnical & Environmental  
Consultants  
Construction Management,  
Testing & Inspection

E. Kapolei Parcel "B", Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan					DRILLER: PSC					<b>BORING NO. B-11</b>
BORING ELEVATION: 74.6 FEET					LOGGED BY: B. Anderson					
DATE (S) DRILLED: 8/21/05					TYPE RIG: Diedrich (D-25)					

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, brown, dry, v. stiff, with roots
						2				
						3				
						4				
		17.3			36	SPT-1	5		CH	71.6 Silty CLAY, tr. sand (v. weathered volcanic tuff), brown, damp, hard
						6				
						Aug-2	7		CH	66.6 Silty CLAY, tr. sand (v. weathered volcanic tuff), brown with black and orange specks, damp, v. hard
						8				
						9				
		19.4			42	SPT-2	10			
						Aug-3	11		CH	61.6 Silty CLAY, tr. sand (v. weathered volcanic tuff with sand-size coral fragments), brown with black and white specks, damp, v. hard
						12				
						13				
		20.6			42	SPT-3	15			
							16		CH	58.1
						17				
							18			Terminated boring at about 16.5 feet Groundwater not encountered

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	CON - Consolidation Test
AUG - Auger Cuttings	PI - Atterberg Limits
SH - Shelby Tube	UC - Unconfined Compression
D&M - Dames & Moore	SG - Specific Gravity
	SA - Sieve Analysis

LOG OF BORING

<b>Geotechnical &amp; Environmental Consultants</b> <b>Construction Management, Testing &amp; Inspection</b>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>
	<div style="width: 45%;">DATE: March 2006</div> <div style="width: 45%;">PROJECT NO.: 24307.11</div>

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan		DRILLER: PSC	BORING NO. B-12
BORING ELEVATION: 72 FEET		LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/21/05		TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
						Aug-1	1		CH	Silty CLAY, brown, dry, soft (fill?), with roots	
							2				
							3				69.0
							4				Silty CLAY, brown, damp, soft (fill?)
		15.9			9	SPT-1	5		CH		
							6				
						Aug-2	7				
							8				
					4	SPT-2	10		CH		
							11				
						Aug-3	12				
							13				59.0
							14			Silty CLAY, with a tr. of coral and tuffaceous sand, lt. brown, damp, soft, (fill?)	
		20.6			9	SPT-3	15		CH		
							16				
						Aug-4	17				
							18				
		19.3			>50	SPT-4	20		CH		
							21				51.6
							22				51.6
							23				
							24			Coralline rock in tip (1") of sampler Boring terminated at about 20.5 feet. Groundwater not encountered.	

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

## LOG OF BORING

<b>Geotechnical &amp; Environmental Consultants</b> <b>Construction Management, Testing &amp; Inspection</b>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
	DATE: March 2006	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06




BORING LOCATION: See Site Plan		DRILLER: PSC	BORING NO. B-13
BORING ELEVATION: 66.2 FEET		LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/28/05		TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1				Silty CLAY, brown, damp, stiff, with roots
							1		CH	
							2			
							3			63.2 Silty CLAY, brown, damp, v. stiff
							4			
		19.8			13	SPT-1	5			
							6			
						Aug-2	7			
							8		CH	
							9			
		23.9			20	SPT-2	10			
							11			
						Aug-3	12			
							13			53.2 CORALLINE FORMATION, weakly cemented, cream colored, damp, some silty clay layers near top
							14			
		10.9			27	SPT-3	15			
							16			49.7
							17			Terminated boring at about 16.5 feet Groundwater not encountered
							18			





SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression			
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity			
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

LOG OF BORING

 <div>Geotechnical &amp; Environmental Consultants Construction Management, Testing &amp; Inspection</div>	<div>E. Kapolei Parcel "B", Offsite Improvements Water and Sewage Transmission Mains Kapolei, Ewa, Oahu, Hawaii</div>	
	DATE: March 2006	PROJECT NO.: 24307.11


BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-14
BORING ELEVATION: 67 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/28/05	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
LL=52 PL=20 PI=32		21.2			18	Aug-1	1		CH	Silty CLAY, brown, dry, stiff with roots
							2			
							3			
							4			
						SPT-1	5			
		22.3			45	Aug-2	6		CH	59.5 Silty CLAY, tr. sand (v. weathered volcanic tuff with tr. coralline sand), damp, hard
							7			
							8			
							9			
						SPT-2	10			
		21.9			50+	Aug-3	11		CH	53.5 Silty CLAY, tr. sand (v. weathered volcanic tuff with tr. of coralline sand), brown with black stains, damp, v. hard
							12			
							13			
							14			
						SPT-3	15			
							16		CH	50.5 Terminated boring at about 16.5 feet Groundwater not encountered
							17			
							18			

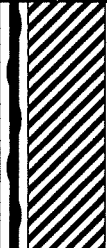


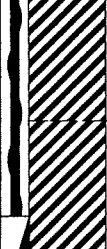
SAMPLE TYPE				OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression			
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity			
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis			

## LOG OF BORING

 <b>Geotechnical &amp; Environmental Consultants</b> <b>Construction Management, Testing &amp; Inspection</b>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
	DATE: March 2006.	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan	DRILLER: PSC	<b>BORING NO. B-15</b>
BORING ELEVATION: 62.4 FEET	LOGGED BY: B. Anderson	
DATE (S) DRILLED: 8/21/04	TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, brown, dry, stiff, with roots
							2			
							3			
							4			58.4
		20.5			23	SPT-1	5		CH	Silty CLAY, brown, damp, v. stiff
							6			
						Aug-2	7			
							8			
							9		CH	
		21.3			31	SPT-2	10			
							11			
						Aug-3	12			
							13		CH	48.9
							14			Silty CLAY, tr. of sand (v. weathered volcanic tuff), brown, damp, v. hard
		19.1			58	SPT-3	15			
							16			45.9
							17			Terminated boring at about 16.5 feet Groundwater not encountered
							18			

**SAMPLE TYPE**

MC - Modified California SPT - Standard Penetration  
 CB - Core Barrel SH - Shelby Tube  
 AUG - Auger Cuttings D&M - Dames & Moore

**OTHER LABORATORY TESTS**

MD - Moisture/Density UC - Unconfined Compression  
 CON - Consolidation Test SG - Specific Gravity  
 PI - Atterberg Limits SA - Sieve Analysis

**LOG OF BORING**

Geotechnical & Environmental  
 Consultants  
 Construction Management,  
 Testing & Inspection





E. Kapolei Parcel "B", Offsite Improvements  
 Water and Sewage Transmission Mains  
 Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan						DRILLER: PSC		<b>BORING NO. B-16</b>
BORING ELEVATION: 63.4 FEET						LOGGED BY: B. Anderson		
DATE (S) DRILLED: 9/4/05						TYPE RIG: Diedrich (D-25)		

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
						Aug-1	1		CH	Silty CLAY, brown, dry, stiff, with roots	
							2			61.4	Silty CLAY, brown, damp, v. stiff
							3				
							4				
		23.9			21	SPT-1	5				
						Aug-2	6				
							7				
							8		CH		
							9				
		22.9			25	SPT-2	10				
						Aug-3	11				
							12				
							13				
							14			49.9	Silty CLAY, tr.sand (v. weathered volcanic tuff), brown, damp, v. hard
		23.0			>50	SPT-3	15		CH		
							16				
							17			46.9	Terminated boring at about 16.5 feet Groundwater not encountered
							18				


  

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	UC - Unconfined Compression
SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	SG - Specific Gravity
D&M - Dames & Moore	SA - Sieve Analysis
PI - Atterberg Limits	

LOG OF BORING

	<b>Geotechnical &amp; Environmental Consultants</b> <b>Construction Management,</b> <b>Testing &amp; Inspection</b>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
		DATE: March 2006	PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan						DRILLER: PSC		<b>BORING NO. B-17</b>
BORING ELEVATION: 59.9 FEET						LOGGED BY: B. Anderson		
DATE (S) DRILLED: 9/4/05						TYPE RIG: Diedrich (D-25)		

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1	[Diagonal Hatching]	CH	Silty CLAY, brown, dry, stiff, w. roots
							2	[Star Pattern]		CORALLINE FORMATION, weakly cemented, cream colored, dry
							3	[Star Pattern]		
							4	[Star Pattern]		
							5	[Diagonal Hatching]	CH	Silty CLAY, brown, damp, v. stiff
		17.2			38	SPT-1	6	[Diagonal Hatching]		
						Aug-2	7	[Diagonal Hatching]		
							8	[Star Pattern]		CORALLINE FORMATION, weakly cemented, cream colored, dry
							9	[Star Pattern]		
		10.8			23	SPT-2	10	[Star Pattern]		
						Aug-3	11	[Star Pattern]		
							12	[Star Pattern]		
							13	[Star Pattern]		
							14	[Star Pattern]		
		9.3			>50	SPT-3	15	[Star Pattern]		
							16	[Star Pattern]		
							17	[Star Pattern]		Terminated boring at about 16.5 feet Groundwater not encountered
							18	[Star Pattern]		





<b>SAMPLE TYPE</b> MC - Modified California SPT - Standard Penetration CB - Core Barrel      SH - Shelby Tube AUG - Auger Cuttings      D&M - Dames & Moore	<b>OTHER LABORATORY TESTS</b> MD - Moisture/Density      UC - Unconfined Compression CON - Consolidation Test      SG - Specific Gravity PI - Atterberg Limits      SA - Sieve Analysis
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<b>LOG OF BORING</b>	
<b>Geotechnical &amp; Environmental Consultants</b> Construction Management, Testing & Inspection	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>
DATE: March 2006	PROJECT NO.: 24307.11

BORING LOCATION: See Site Plan										DRILLER: PSC		<b>BORING NO. B-18</b>
BORING ELEVATION: 57.7 FEET										LOGGED BY: B. Anderson		
DATE (S) DRILLED: 9/4/05										TYPE RIG: Diedrich (D-25)		


  

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						Aug-1	1		CH	Silty CLAY, brown, dry, stiff, with roots
						2	55.7			Silty CLAY, brown, damp, v. stiff
						3				
						4				
		20.8			24	SPT-1	5		CH	
						6				
						Aug-2	7			
						8	49.7			
							9			CORALLINE FORMATION, weakly cemented, cream colored, dry
		21.7			27	SPT-2	10			
						Aug-3	11			
						12				
						13				
						14				
		9.1			30	SPT-3	15			
						16	41.2			
						17				Terminated boring at about 16.5 feet Groundwater not encountered
							18			

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	UC - Unconfined Compression
SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	SG - Specific Gravity
D&M - Dames & Moore	PI - Atterberg Limits
	SA - Sieve Analysis

<b>LOG OF BORING</b>	
 <b>Geotechnical &amp; Environmental Consultants</b> <b>Construction Management,</b> <b>Testing &amp; Inspection</b>	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>
	<div style="display: flex; justify-content: space-between;"> <div>DATE: March 2006</div> <div>PROJECT NO.: 24307.11</div> </div>

BORING LOCATION: See Site Plan					DRILLER: PSC					<b>BORING NO. B-19</b>
BORING ELEVATION: 52 FEET					LOGGED BY: B. Anderson					
DATE (S) DRILLED: 9/4/05					TYPE RIG: Diedrich (D-25)					

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
						Aug-1	1		CH	Silty CLAY, with coralline sand and gravel (fill),  48.5	
						2					
						3					
		11.5			22	SPT-1	4			CORALLINE FORMATION, weakly cemented, cream colored, dry  34.5	
						5					
						6					
						Aug-2	7				
						8					
						9					
		10.1			11	SPT-2	10				
						Aug-3	11				
						12					
						13					
		4.5			5	SPT-3	15				
						Aug-4	16				
						17				30.5	
						18				CORALLINE FORMATION, with gravel-sized coral fragments, it also contains brown silty CLAY auger cuttings, and brown silty, clayey drilling water. This mixture may be due to infiltration of drilling cuttings and water into solution cavities before the SPT sample was taken.  30.5	
		29.5			13	SPT-4	20				
						21					
							22			Terminated boring at about 21.5 feet	
							23			Groundwater not encountered	
							24				

<b>SAMPLE TYPE</b>	<b>OTHER LABORATORY TESTS</b>
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	UC - Unconfined Compression
SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	SG - Specific Gravity
D&M - Dames & Moore	PI - Atterberg Limits
	SA - Sieve Analysis

LOG OF BORING

<b>Geotechnical &amp; Environmental Consultants</b> Construction Management, Testing & Inspection	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>
	<div style="display: flex; justify-content: space-between;"> <div>DATE: March 2006</div> <div>PROJECT NO.: 24307.11</div> </div>


BORING 24307WRT.GPJ BORING.GDT 9/11/06

BORING LOCATION: See Site Plan		DRILLER: PSC	BORING NO. B-20
BORING ELEVATION: 51.2 FEET		LOGGED BY: B. Anderson	
DATE (S) DRILLED: 9/4/05		TYPE RIG: Diedrich (D-25)	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		13.3			27	SPT-1	1			CORALLINE FORMATION, weakly cemented, cream colored, dry
							2			
							3			
							4			
							5			
							6			
							7			
							8			
							9			
		14.1			7	SPT-2	10			
							11			
							12			
							13			
							14			
		10.8			6	SPT-3	15			
							16			
							17			
							18			
							19			
		13.0			13	SPT-4	20			
							21			
							22			
							23			
							24			
29.7										Terminated boring at about 21.5 feet Groundwater not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

## LOG OF BORING

 <b>Geotechnical &amp; Environmental Consultants</b> Construction Management, Testing & Inspection	<b>E. Kapolei Parcel "B", Offsite Improvements</b> <b>Water and Sewage Transmission Mains</b> <b>Kapolei, Ewa, Oahu, Hawaii</b>	
	DATE: March 2006	PROJECT NO.: 24307.11

BORING 24307WRT.GPJ BORING.GDT 9/11/06



# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS		
			GRAPH	LETTER			
COARSE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS  (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES		
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES		
		SAND AND SANDY SOILS  50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS  (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
			SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES	
	SAND AND SANDY SOILS  50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES		
		SAND AND SANDY SOILS  50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES	
			SAND AND SANDY SOILS  50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS  50 % OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY		
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
	SILTS AND CLAYS  LIQUID LIMIT GREATER THAN OR EQUAL TO 60	SILTS AND CLAYS  LIQUID LIMIT GREATER THAN OR EQUAL TO 60		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS		
				CH	INORGANIC CLAYS OF HIGH PLASTICITY		
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS		
	HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

## UNIFIED SOIL CLASSIFICATION SYSTEM

**PSC CONSULTANTS, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

East Kapolei Parcel "B" Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

- I **CONSOLIDATION OF SEDIMENTARY ROCKS**; usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated  
P = poorly consolidated  
M = moderately consolidated  
W = well consolidated

II **BEDDING OF SEDIMENTARY ROCKS**

Splitting Property	Thickness	Stratification
Massive ...	Greater than 4.0 ft.	very thick bedded
Blocky	2.0 to 4.0 ft.	thick-bedded
Slabby	0.2 to 2.0 ft.	thin-bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01 ft.	thinly laminated

III **FRACTURING**

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

IV **HARDNESS**

1. **Soft** – reserved for plastic material alone.
2. **Low hardness** – can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** – can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** – can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. **Very hard** – cannot be scratched with a knife blade; leaves a metallic streak.

V **STRENGTH**

1. **Plastic** or very low strength.
2. **Friable** - Crumbles easily by rubbing with fingers.
3. **Weak** – An unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** – Specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** – Specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** – Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

- VI **WEATHERING** – The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation and freezing and thawing.

- D. **Deep** – Moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
- M. **Moderate** – Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
- L. **Little** - No megascopic decomposition of minerals; little or no affect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
- F. **Fresh** – Unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints,

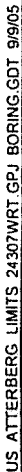
**ROCK CLASSIFICATION SYSTEM**

**PSC** CONSULTANTS, LLC  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

East Kapolei Parcel "B" Offsite Improvements  
Water and Sewage Transmission Mains  
Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11



## ATTERBERG LIMITS DATA



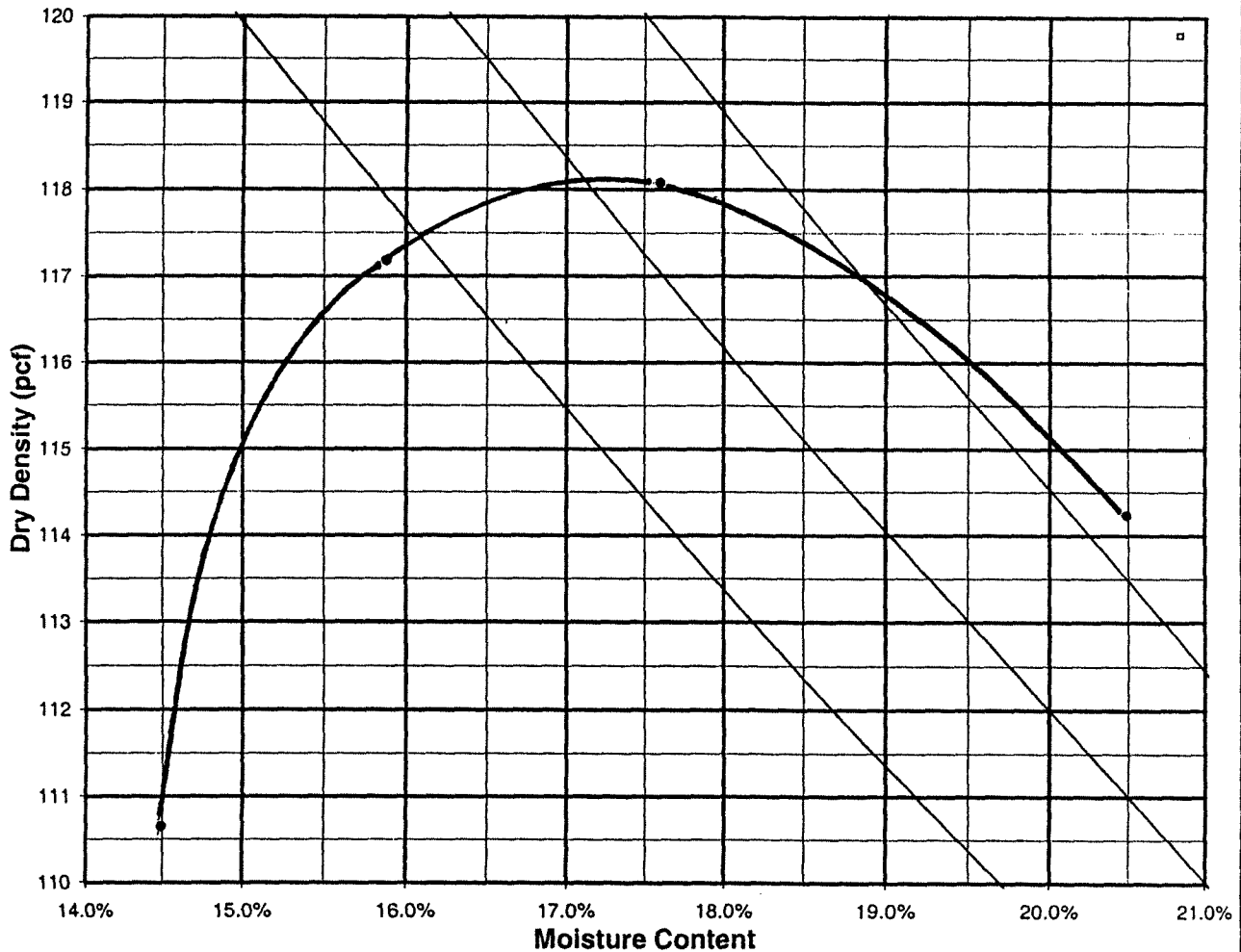
East Kapolei Parcel "B" Offsite Improvements  
Water & Sewage Transmission Mains  
East Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

Project No.: 24307.11

PLATE NO.25

### MOISTURE-DENSITY RELATIONSHIP



Sample Source: BS-2 Agricultural Area

Description: Brown Silty Clay

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	126.68	135.78	138.85	137.64
Moisture Content	14.49%	15.88%	17.60%	20.49%
Dry Density (pcf)	110.65	117.18	118.07	114.24

Maximum Dry Density (pcf): 118.1  
 Optimum Moisture Content (%): 17.6  
 Test Method: ASTM D-1557

Atterberg Limits

LL

PL

PI

### COMPACTION TEST RESULTS

ASTM D-1557



**PSC Consultants, LLC**

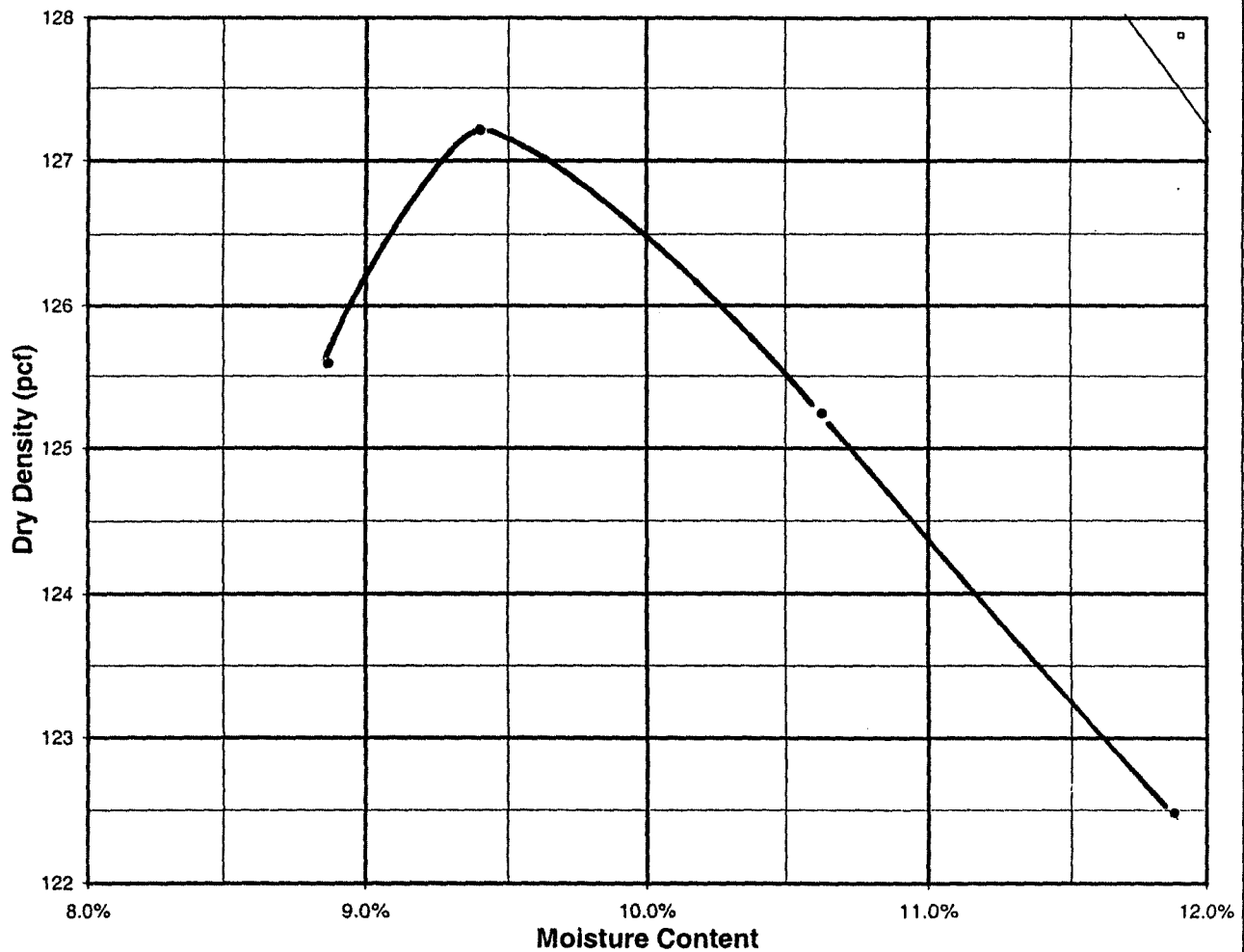
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Parcel "B" Off-Site Improvements  
 Water & Sewage Transmission Main Alignments  
 East Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

### MOISTURE-DENSITY RELATIONSHIP



Sample Source: BS-1 Coral Area

Description: Coralline Sand

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	136.72	139.16	138.55	137.03
Moisture Content	8.87%	9.40%	10.63%	11.88%
Dry Density (pcf)	125.59	127.21	125.24	122.48

Maximum Dry Density (pcf): 127.2  
 Optimum Moisture Content (%): 9.4  
 Test Method: ASTM D-1557

Atterberg Limits

LL

PL

PI

### COMPACTION TEST RESULTS

ASTM D-1557



**PSC Consultants, LLC**

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Parcel "B" Off-Site Improvements  
 Water & Sewage Transmission Main Alignments  
 East Kapolei, Ewa, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

Pipe Size: 30-Inch Water Transmission Mains  
Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

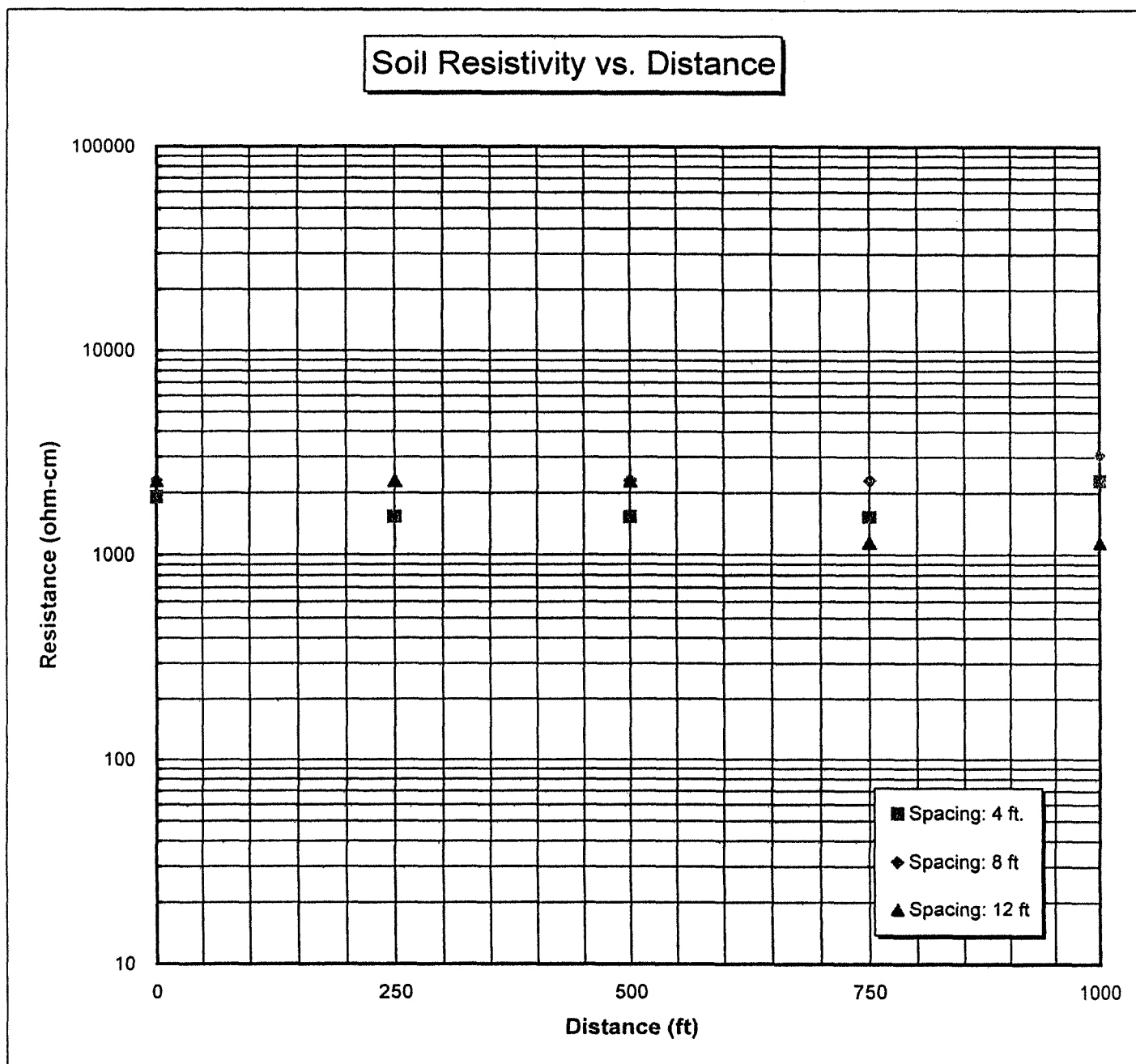
**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: E. Kapolei Reservoir Water Transmission Main Alignment  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-1 to Boring B-2 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From BH-2 to BH-3 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

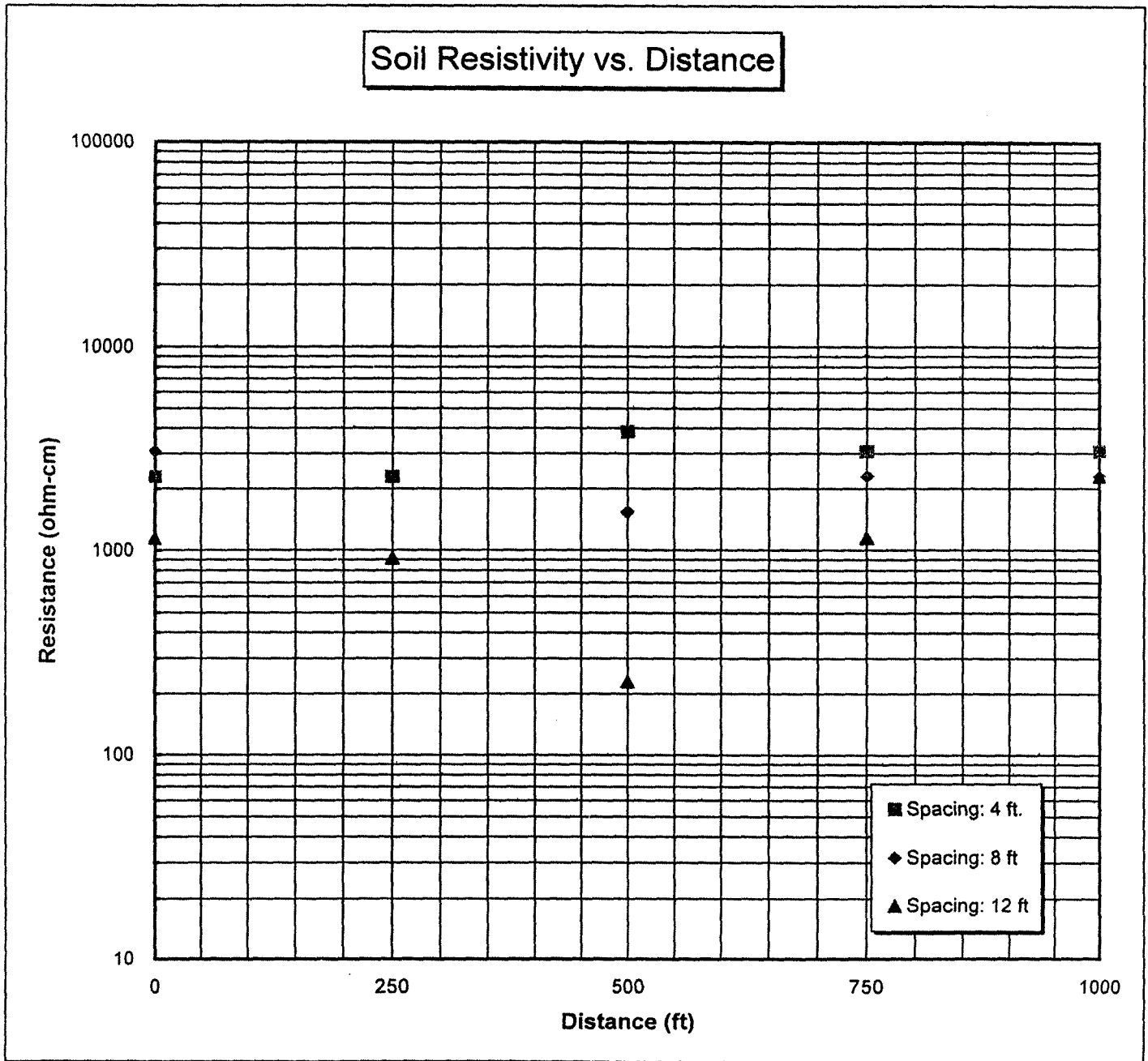
**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

Date: August 2005

Project No. 24307.11



Pipeline Location: E. Kapolei Reservoir Water Transmission Main Alignment  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-2 to Boring B-3 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From BH-3 to BH-4 East Kapolei Reservoir Water Transmission Main  
See Site Plan

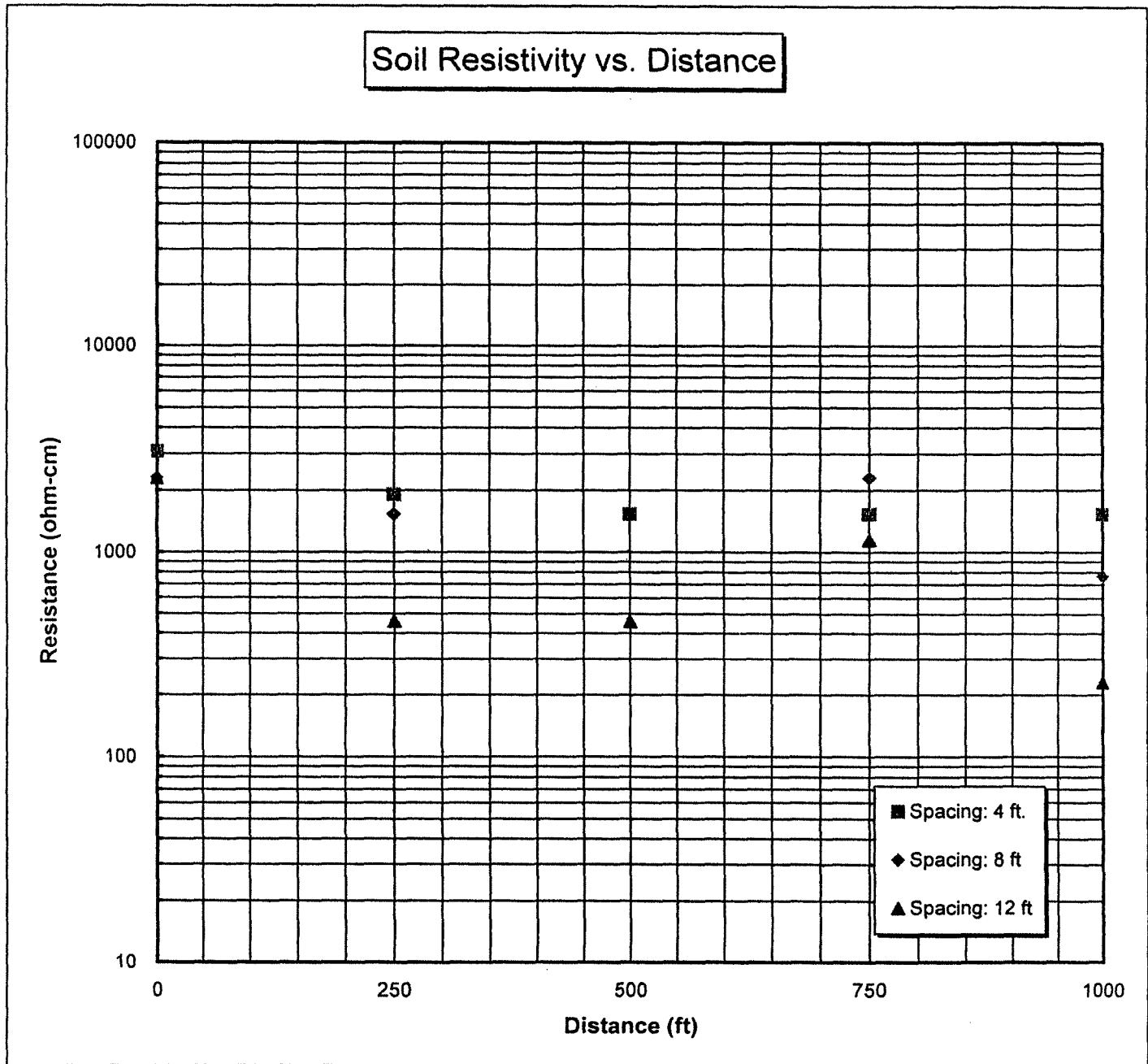
Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

[illegible]

<p align="center"><b>SUMMARY OF SOIL RESISTIVITY TEST RESULTS</b>  <b>(Wenner 4-Pin Method ASTM G-57)</b></p>		
<p align="center"><b>PSC Consultants, LLC</b>  SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS</p>	<p align="center"><b>BWS: Proposed Corrosion Protection System</b>  <b>East Kapolei Reservoir Water Transmission Main</b>  <b>Kapolei, Oahu, Hawaii</b></p>	
	<p align="center"><b>DATE: March 2006</b></p>	<p align="center"><b>Project No. 24307.11</b></p>

Pipeline Location: E. Kapolei Reservoir Water Transmission Main Alignment  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-3 to Boring B-4 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-4 to B-5 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

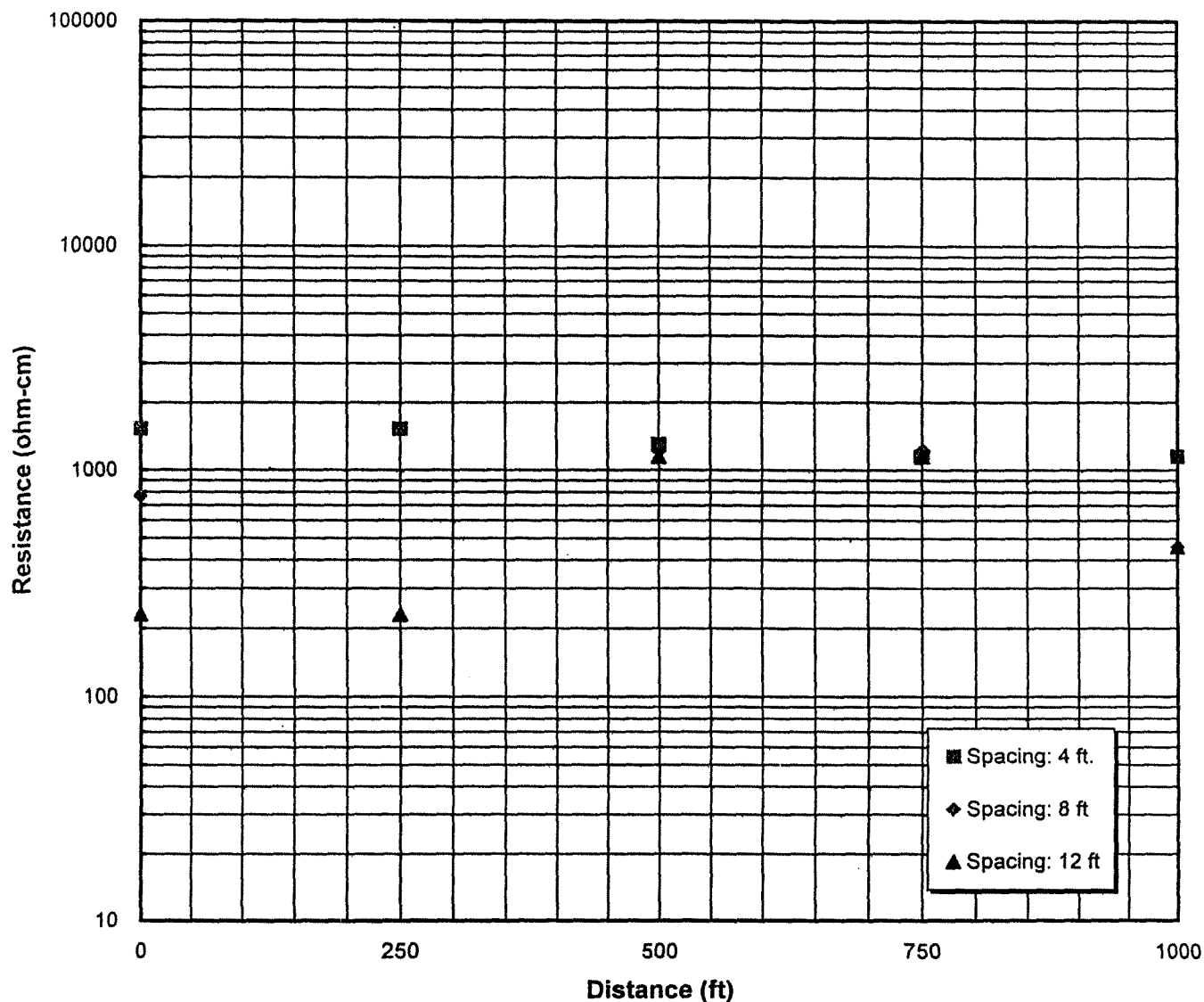
Test Date: August-05

[illegible]

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005

### Soil Resistivity vs. Distance



Note: Distance is Pipe Alignment from Boring B-4 to Boring B-5 (See Site Plan)

#### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
 Proposed East Kapolei Reservoir Water Transmission Main  
 Kapolei, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

Pipeline Locations: From Boring B-5 to B-6 East Kapolei Reservoir Water Transmission Main  
See Site Plan  
Pipe Size: 20-30-Inch Water Transmission Mains  
Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

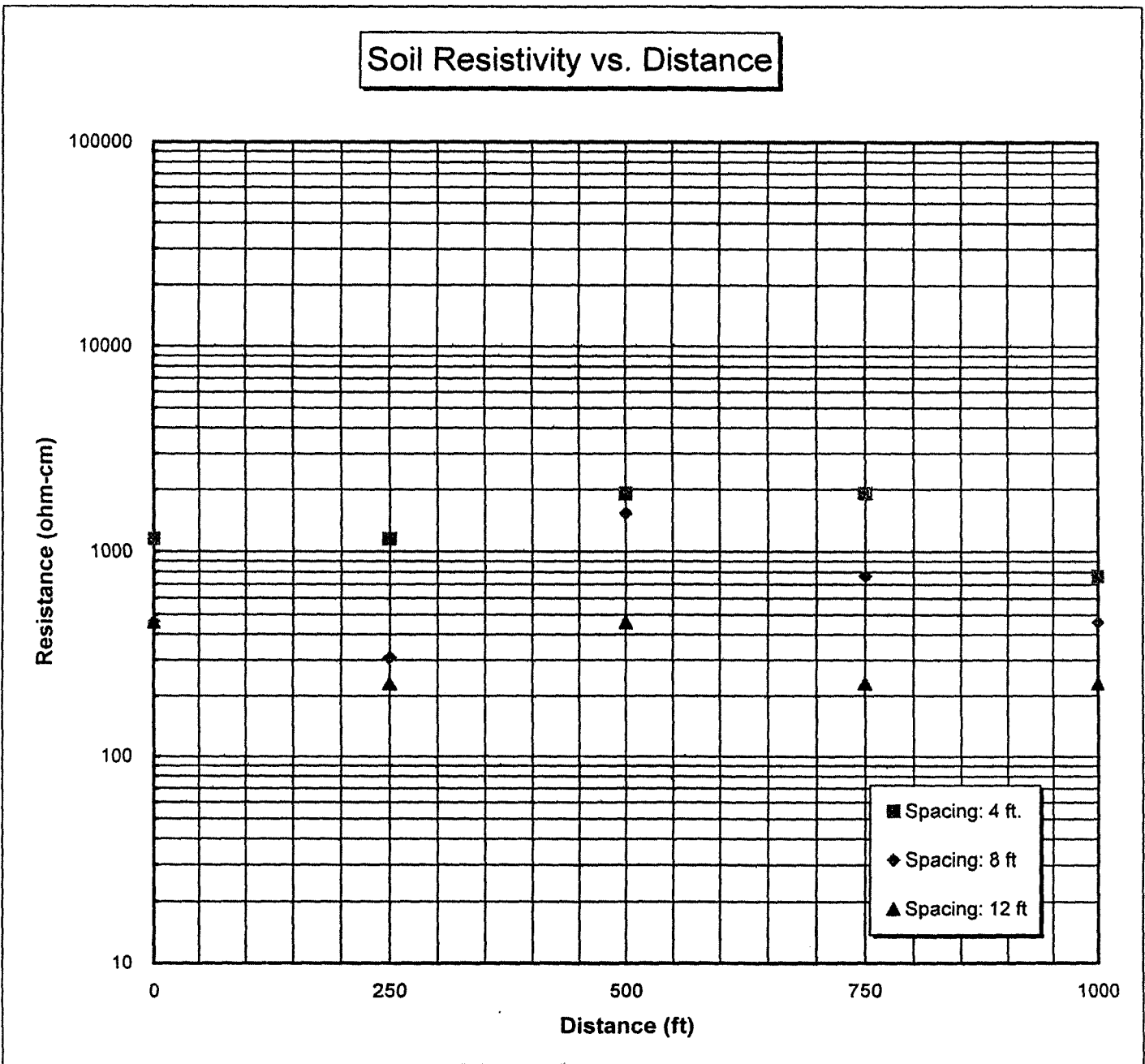
**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-5 to Boring B-6 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	I. DATE: March 2006	PROJECT NO. 24307.11

Pipe Size: 20-30-Inch Water Transmission Mains  
Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**

**SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS**

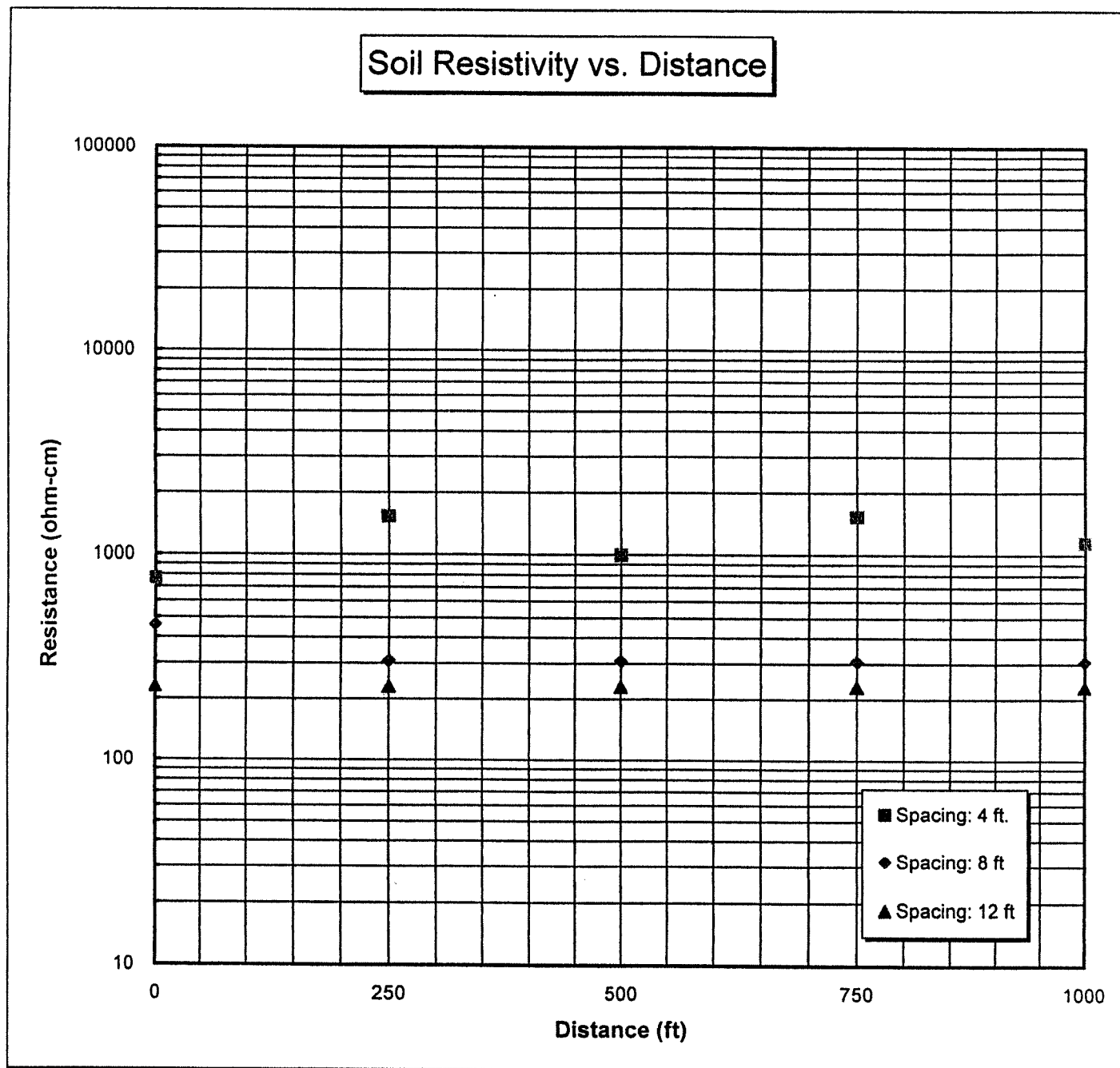
**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11



Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-6 to Boring B-7 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-7 to B-8 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

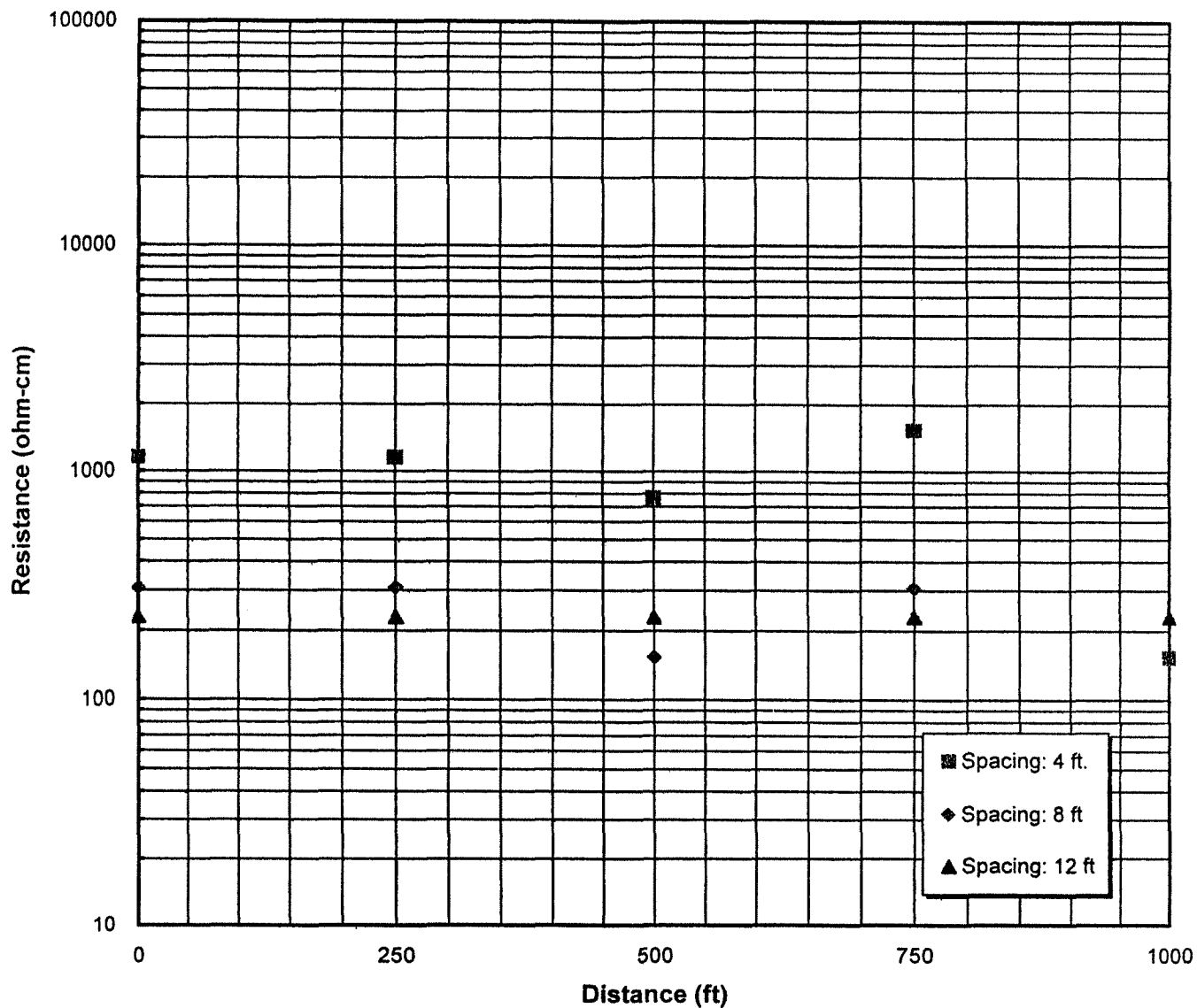
**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005

### Soil Resistivity vs. Distance



*Note: Distance is Pipe Alignment from Boring B-7 to Boring B-8 (See Site Plan)*

#### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
 Proposed East Kapolei Reservoir Water Transmission Main  
 Kapolei, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

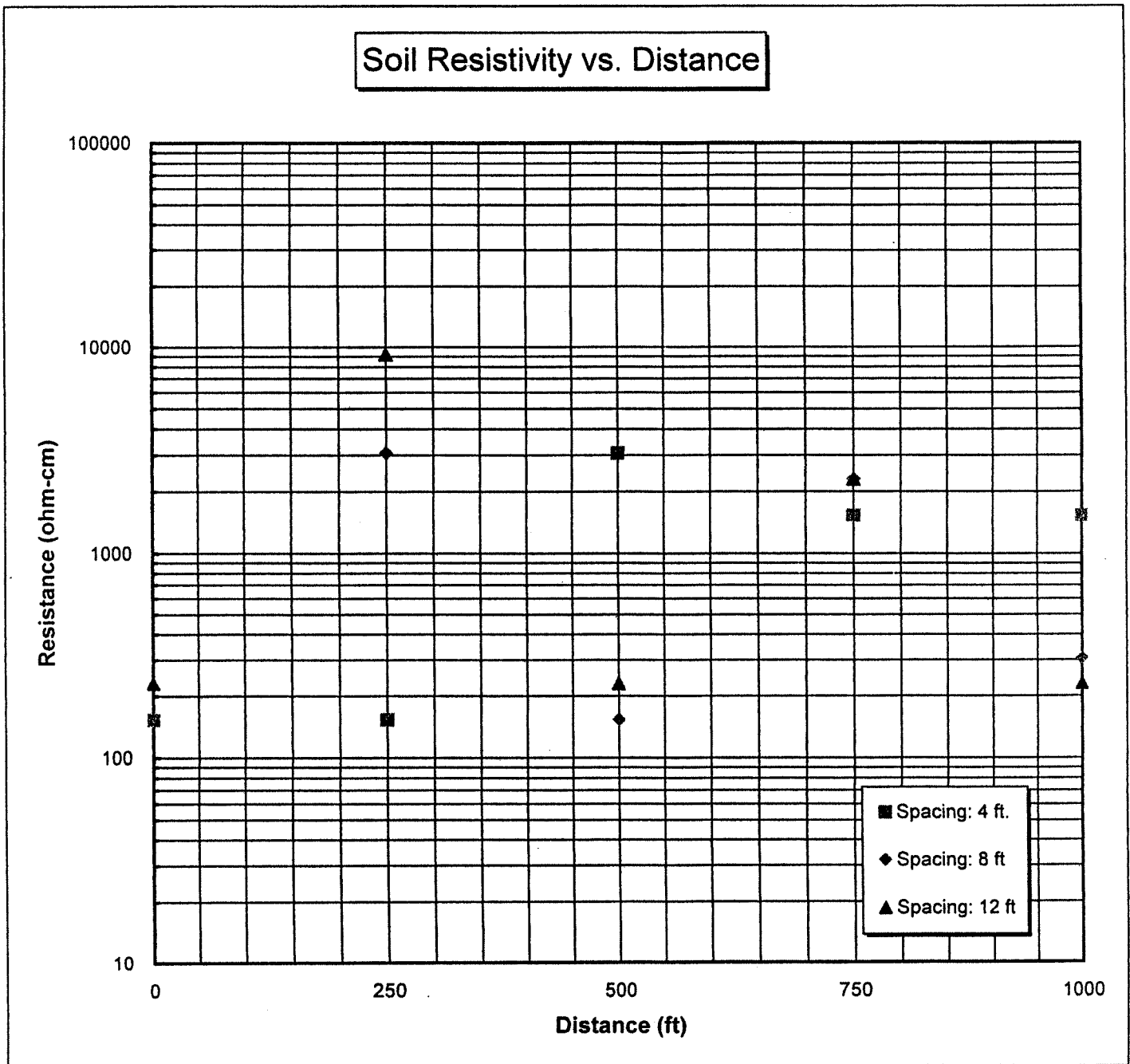
**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-8 to Boring B-9 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-9 to B-11 East Kapolei Reservoir Water Transmission Main  
See Site Plan

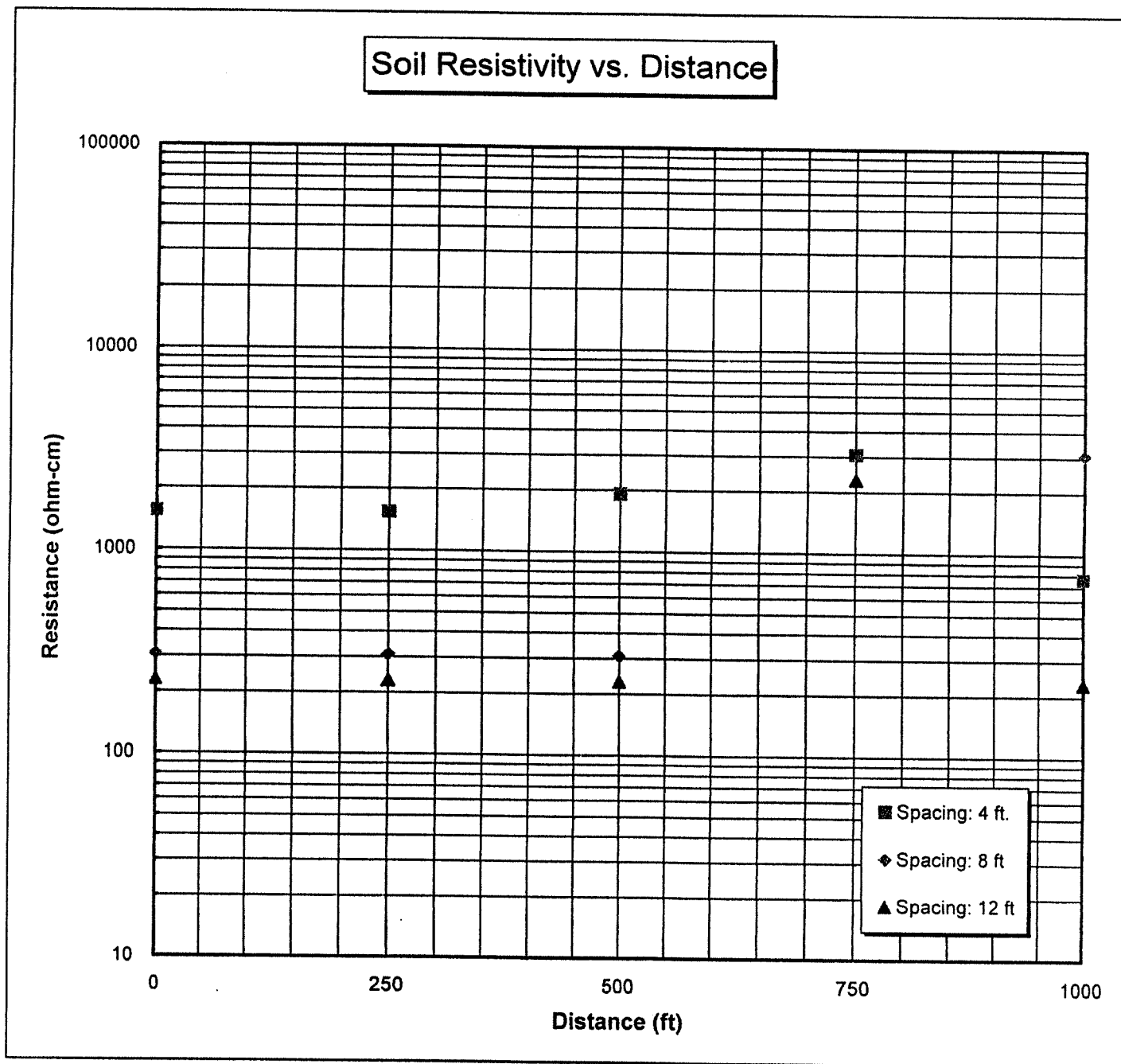
Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

[illegible]

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-9 to Boring B-11 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-11 to B-14 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

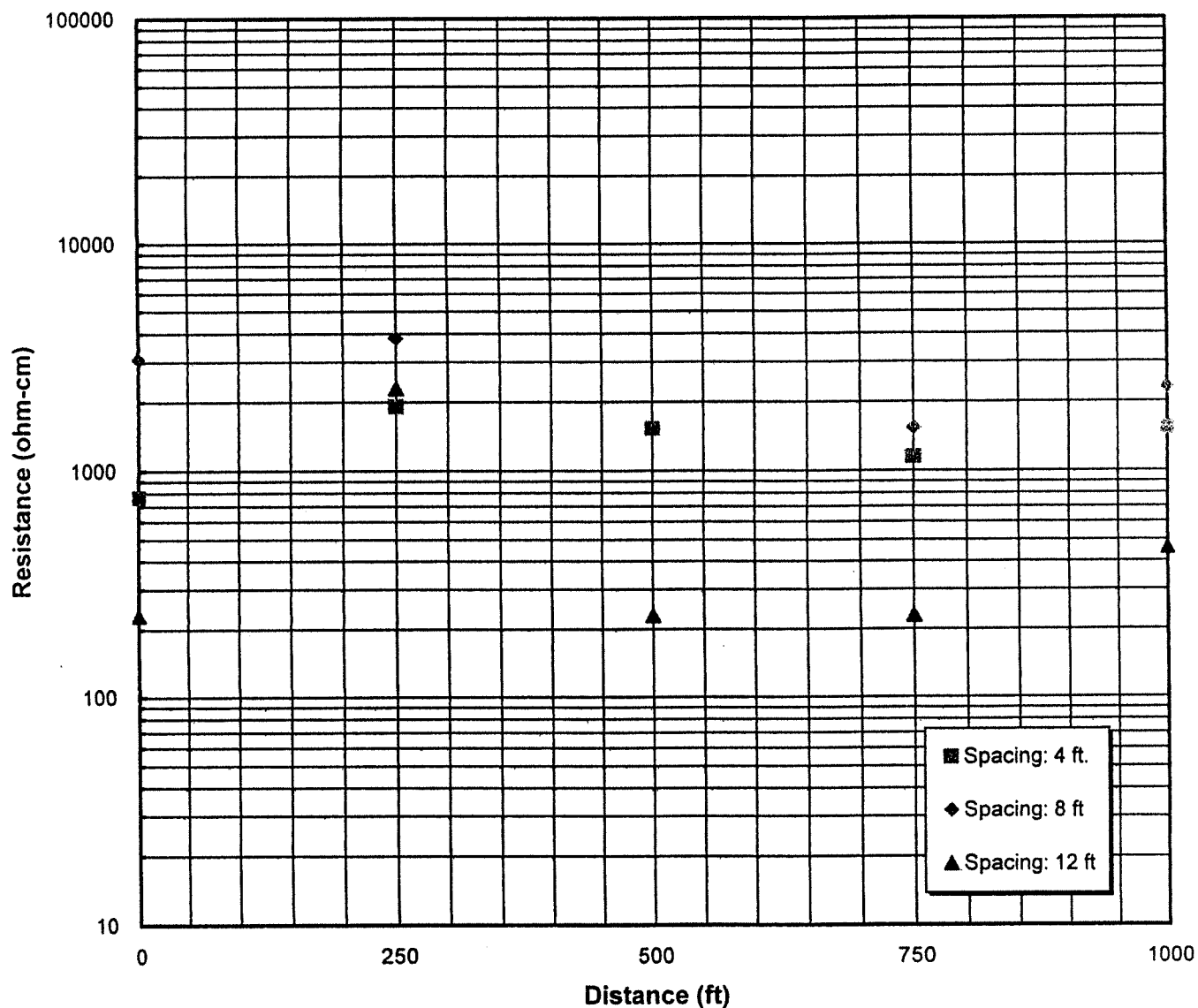
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SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	Project No. 24307.11



Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005

### Soil Resistivity vs. Distance



*Note: Distance is Pipe Alignment from Boring B-11 to Boring B-14 (See Site Plan)*

#### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
 Proposed East Kapolei Reservoir Water Transmission Main  
 Kapolei, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

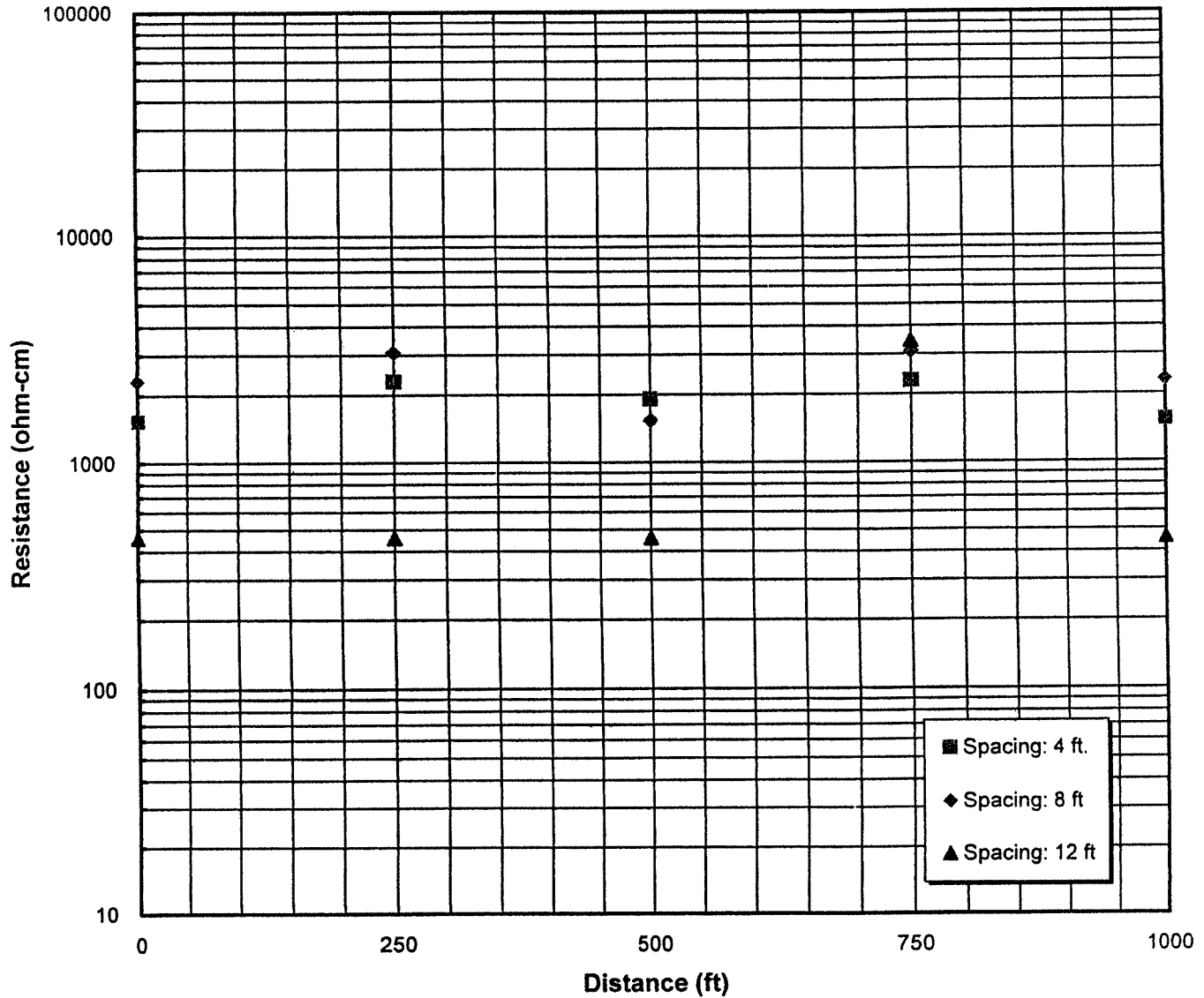
Pipeline Locations:	From Boring B-14 to B-15 East Kapolei Reservoir Water Transmission Main See Site Plan
Pipe Size:	20-30-Inch Water Transmission Mains
Test Date:	August-05

[illegible]

<p align="center"><b>SUMMARY OF SOIL RESISTIVITY TEST RESULTS</b>  <b>(Wenner 4-Pin Method ASTM G-57)</b></p>		
<p align="center"><b>PSC Consultants, LLC</b>  SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS</p>	<p align="center"><b>BWS: Proposed Corrosion Protection System</b>  East Kapolei Reservoir Water Transmission Main  <b>Kapolei, Oahu, Hawaii</b></p>	
	<p>DATE: March 2006</p>	<p>Project No. 24307.11</p>

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005

### Soil Resistivity vs. Distance



*Note: Distance is Pipe Alignment from Boring B-14 to Boring B-15 (See Site Plan)*

#### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
 Proposed East Kapolei Reservoir Water Transmission Main  
 Kapolei, Oahu, Hawaii

DATE: March 2006

PROJECT NO. 24307.11

Pipeline Locations: From Boring B-14 to B-16 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

TEST NO.	LOCATION	PIN SPACING (FT.)	RESISTANCE (OHMS)	RESISTIVITY (OHM-CM)	CORROSION RATING
41	Boring B-14	4	2.000	1532	2
		8	1.500	2298	2
		12	0.200	460	1
46	Approx. 250 feet from B-14	4	2.000	1532	2
		8	1.500	2298	2
		12	1.000	2298	2
47	Approx. 250 feet from Test Location No. 46	4	3.000	2298	2
		8	1.500	2298	2
		12	1.000	2298	2
48	Approx. 250 feet from Test Location No. 47	4	4.000	3064	3
		8	2.000	3064	3
		12	1.500	3447	3
49	Boring B-16 Approx. 250 feet from Test Location No. 48	4	4.000	3064	3
		8	2.000	3064	3
		12	1.500	3447	3
	RESISTIVITY RANGE (OHM-CM)	CORROSION RATING	ANTICIPATED CORROSION ACTIVITY		
	0 -1,000	1	Extremely Corrosive		
	1,001 - 3,000	2	Very Corrosive		
	3,001 - 5,000	3	Corrosive		
	5,001 - 10,000	4	Moderately Corrosive		
	OVER 10,000	5	Mildly Corrosive		

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

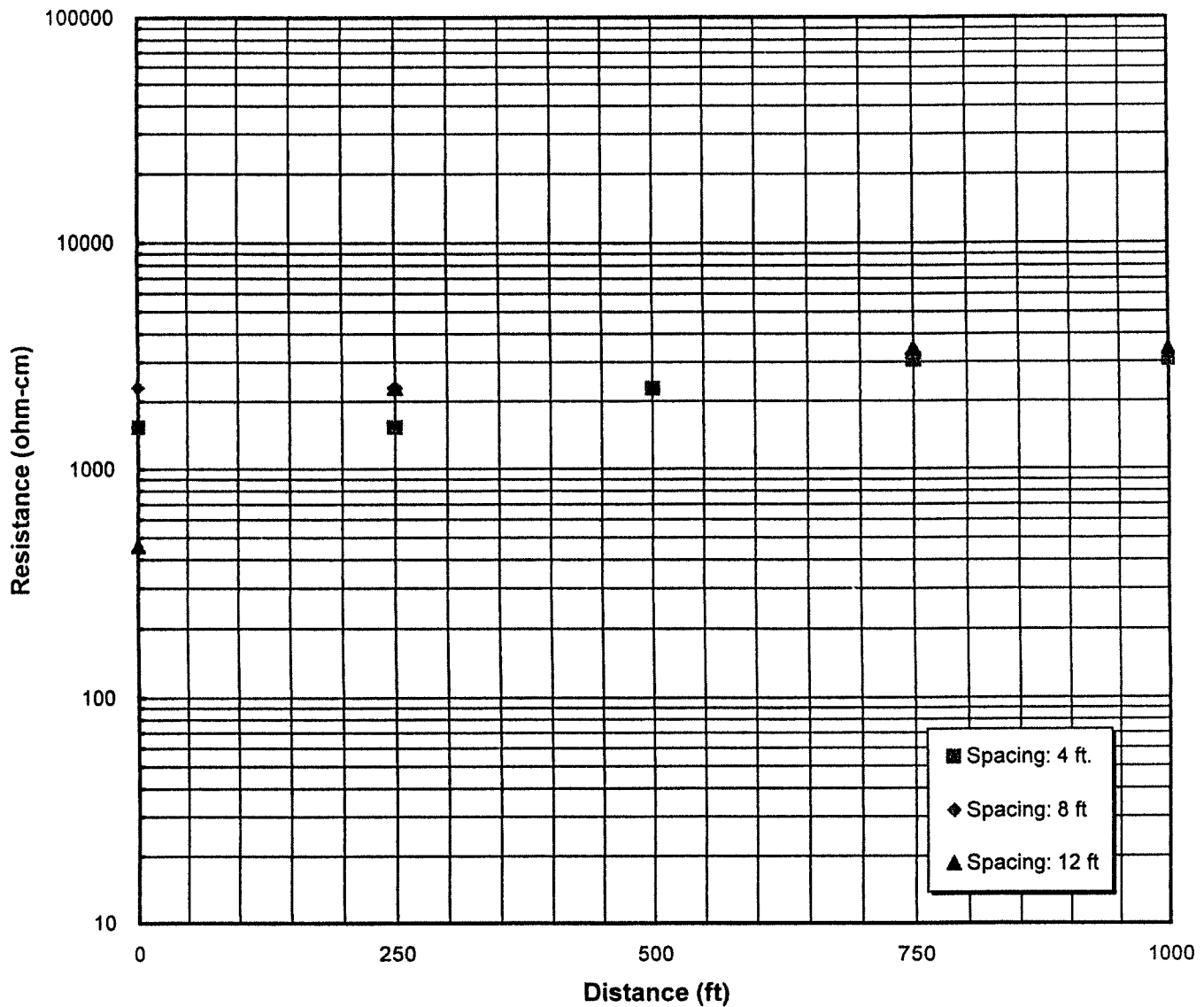
**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005

**Soil Resistivity vs. Distance**



*Note: Distance is Pipe Alignment from Boring B-14 to Boring B-16 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-16 to B-18 East Kapolei Reservoir Water Transmission Main  
See Site Plan

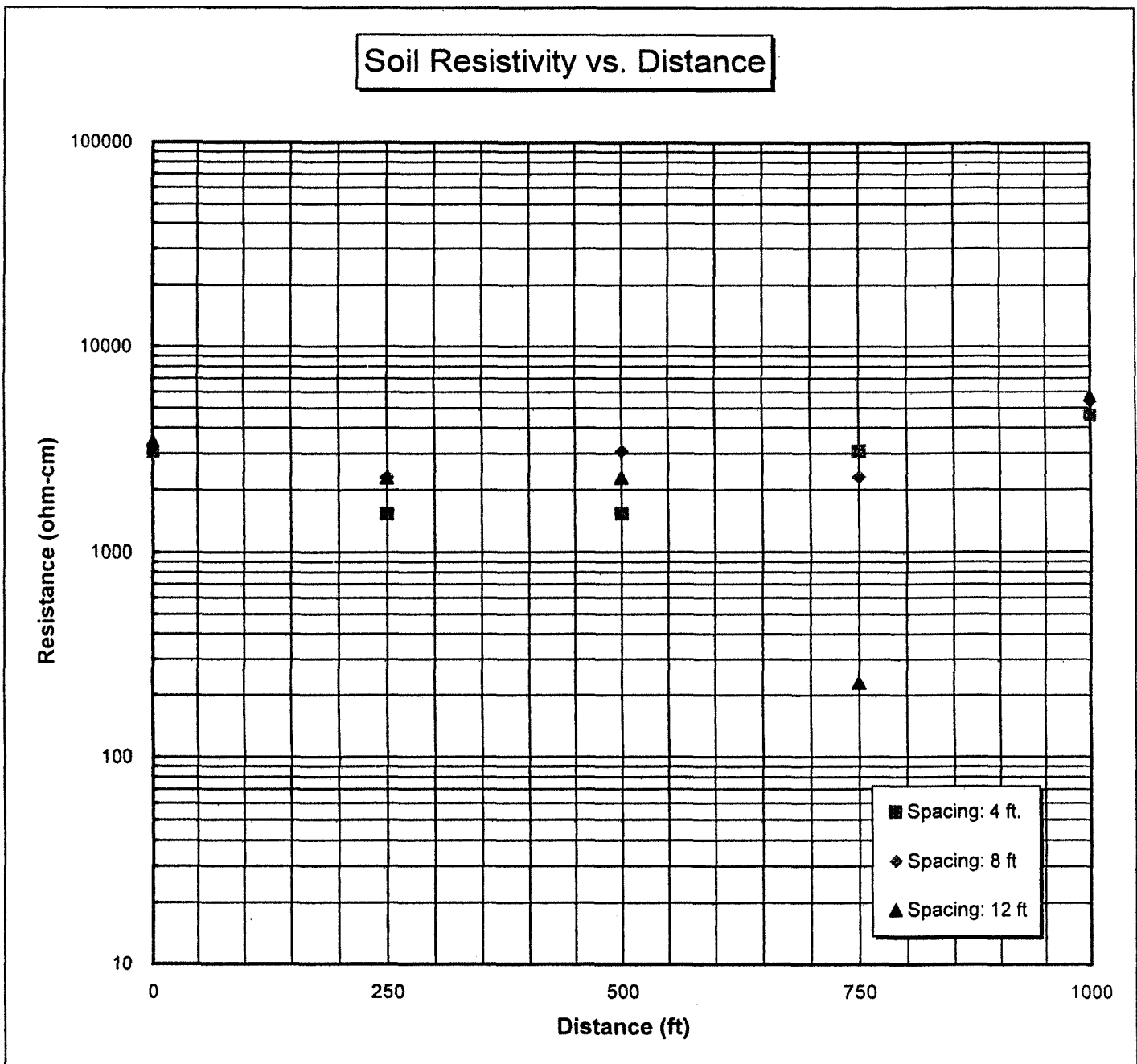
Pipe Size: 20-30-Inch Water Transmission Mains

Test Date: August-05

[illegible]

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-16 to Boring B-18 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-17 to B-18 East Kapolei Reservoir Water Transmission Main  
See Site Plan

Pipe Size: 20-30-Inch Water Transmission Mains

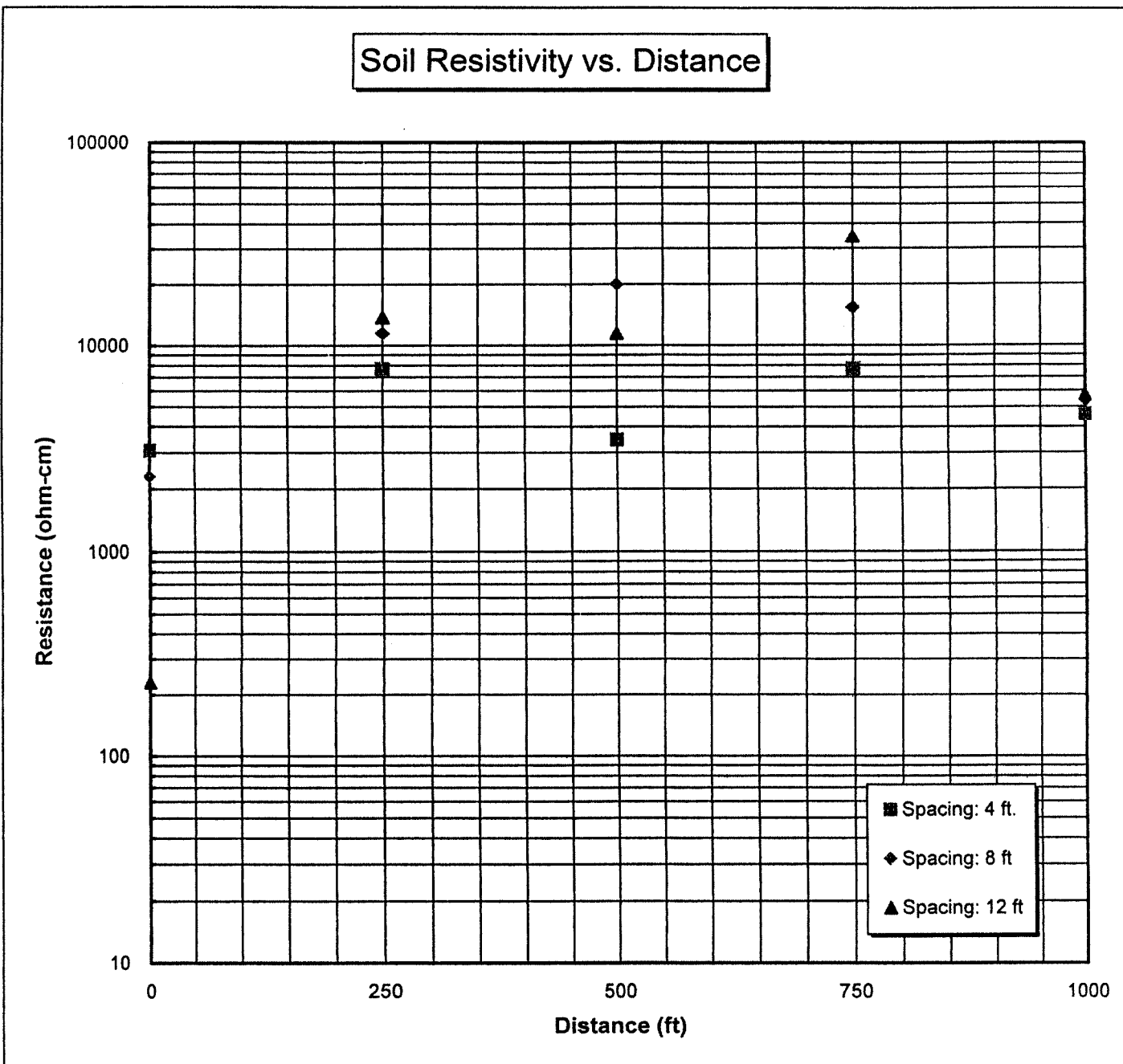
Test Date: August-05

[illegible]

<p align="center"><b>SUMMARY OF SOIL RESISTIVITY TEST RESULTS</b>  <b>(Wenner 4-Pin Method ASTM G-57)</b></p>		
<p align="center"><b>PSC Consultants, LLC</b>  SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS</p>	<p align="center"><b>BWS: Proposed Corrosion Protection System</b>  <b>East Kapolei Reservoir Water Transmission Main</b>  <b>Kapolei, Oahu, Hawaii</b></p>	
	<p>DATE: March 2006</p>	<p>Project No. 24307.11</p>



Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-17 to Boring B-18 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Locations: From Boring B-18 to B-20 East Kapolei Reservoir Water Transmission Main  
See Site Plan  
Pipe Size: 20-30-Inch Water Transmission Mains  
Test Date: August-05

[illegible]

### SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)

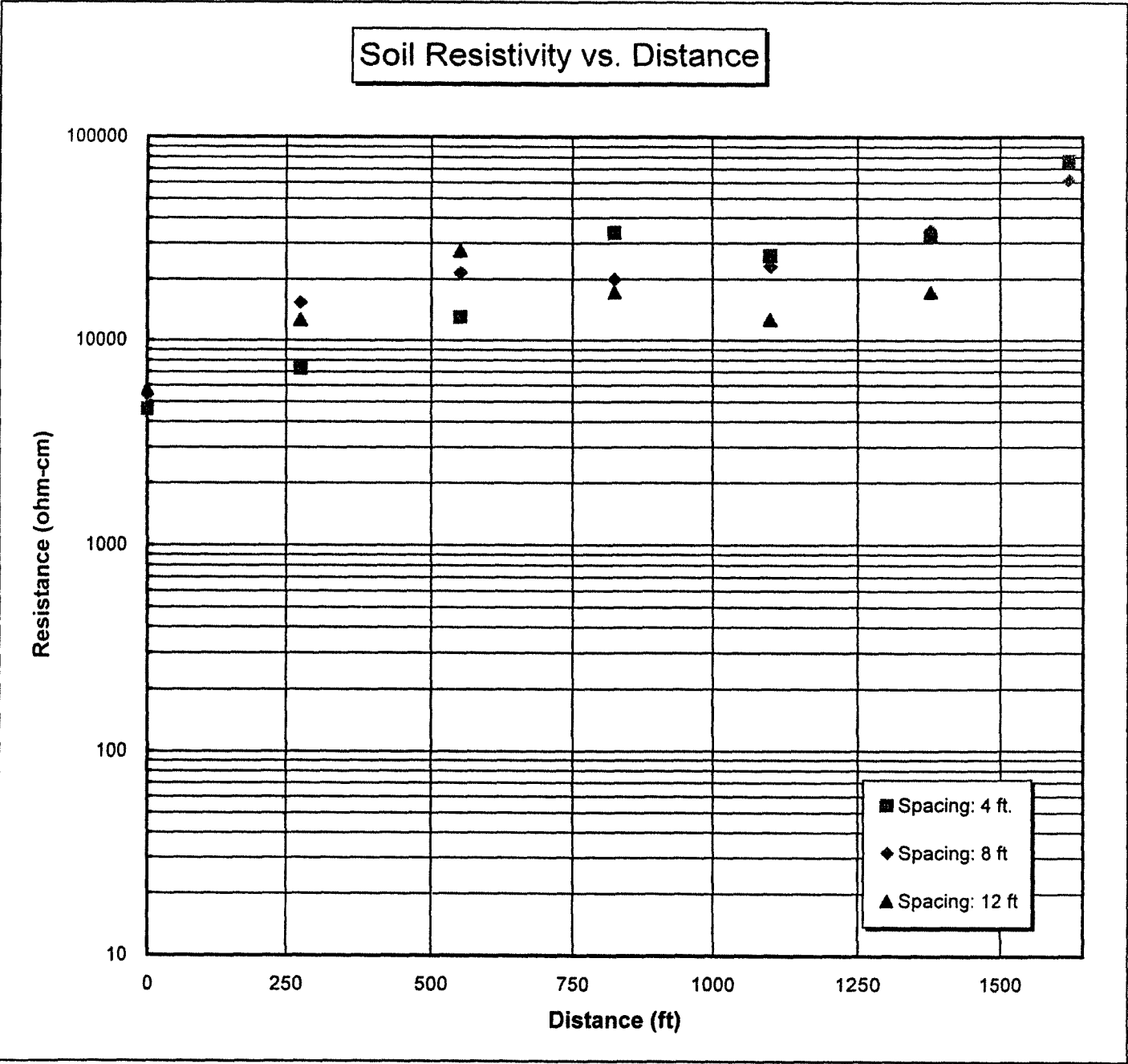
**PSC Consultants, LLC**  
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**BWS: Proposed Corrosion Protection System**  
**East Kapolei Reservoir Water Transmission Main**  
**Kapolei, Oahu, Hawaii**

DATE: March 2006

Project No. 24307.11

Pipeline Location: East Kapolei Reservoir Water Transmission Main  
 Pipe Size: 20 to 30-inch Mains  
 Test Date: August, 2005



*Note: Distance is Pipe Alignment from Boring B-18 to Boring B-20 (See Site Plan)*

SUMMARY OF SOIL RESISTIVITY TEST RESULTS (Wenner 4-Pin Method ASTM G-57)		
<b>PSC Consultants, LLC</b> SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS	<b>BWS: Proposed Corrosion Protection System</b> Proposed East Kapolei Reservoir Water Transmission Main Kapolei, Oahu, Hawaii	
	DATE: March 2006	PROJECT NO. 24307.11

Pipeline Location: East Kapolei Water Transmission Main  
Pipe Size: 20-30-Inch  
Test Date: September 2005

[illegible]

## SUMMARY OF CHEMICAL TEST RESULTS

**(Corrosion Potential)**

**PSC Consultants, LLC**

## SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

### Proposed Corrosion Protection System

### E.Kapolei 20-30-Inch Water Transmission Main

**Kapolei, Ewa, Oahu, Hawaii**

DATE: March 2006

PROJECT NO. 20304.10

PLATE NO. 58

**APPENDIX A**

**Analytical Laboratory Test Data**



**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-1
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/20/2005 0:00
<b>Lab ID:</b>	0509027-01A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>43.1</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:12:00 A	R30408	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>8.18</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:25:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

**Appendix A-1**

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-2
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/27/2005 0:00
<b>Lab ID:</b>	0509027-02A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>197</u>	40.0	mg/Kg	4	9/14/05	9/14/2005 11:49:00 A	R30408	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.59</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:29:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-2

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-3
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/27/2005 0:00
<b>Lab ID:</b>	0509027-03A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 11:12:00 A	R30408	
<b>CORROSVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.27</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:30:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-3



# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-4
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/27/2005 0:00
Lab ID:	0509027-04A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
CHLORIDE						E325.2		
<u>Chloride</u>	<u>36.1</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:31:00 A	R30408	
CORROSIVITY BY PH						SW9045B		
<u>pH</u>	<u>8.15</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:32:00 PM	R30358	

### Qualifiers

ND - Not Detected at the Reporting Limit

S - Spike Recovery outside accepted recovery limits

J - Analyte detected below quantitation limits

R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

E - Value above quantitation range

\* - Value exceeds Maximum Contaminant Level

Appendix A-4

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-5
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/20/2005 0:00
<b>Lab ID:</b>	0509027-05A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>63.9</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:31:00 A	R30408	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>8.18</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:34:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-6
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/20/2005 0:00
Lab ID:	0509027-06A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
CHLORIDE						E325.2		
<u>Chloride</u>	<u>520</u>	40.0	mg/Kg	4	9/14/05	9/14/2005 12:07:00 PM	R30410	
CORROSIVITY BY PH						SW9045B		
<u>pH</u>	<u>7.14</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:35:00 PM	R30358	

Qualifiers	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-6

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-7
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/20/2005 0:00
Lab ID:	0509027-07A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
CHLORIDE						E325.2		
<u>Chloride</u>	<u>712</u>	50.0	mg/Kg	5	9/14/05	9/14/2005 12:21:00 PM	R30410	
CORROSIVITY BY PH						SW9045B		
<u>pH</u>	<u>6.89</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:37:00 PM	R30358	

Qualifiers	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-7

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-8
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/21/2005 0:00
Lab ID:	0509027-08A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
CHLORIDE						E325.2		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
CORROSIVITY BY PH						SW9045B		
<u>pH</u>	<u>6.82</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:39:00 PM	R30358	

Qualifiers	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-8

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-9
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/21/2005 0:00
<b>Lab ID:</b>	0509027-09A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>142</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>8.00</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:43:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-9

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-10
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/27/2005 0:00
<b>Lab ID:</b>	0509027-10A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>102</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>8.14</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:46:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-10

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-11
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/21/2005 0:00
<b>Lab ID:</b>	0509027-11A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>123</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.95</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:50:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-11



# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-12
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/21/2005 0:00
Lab ID:	0509027-12A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
CHLORIDE						E325.2		
Chloride	64.7	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
CORROSIVITY BY PH						SW9045B		
pH	8.05	1.00	pH Units	1	9/7/05	9/7/2005 4:53:00 PM	R30358	

### Qualifiers

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

\* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

Appendix A-12

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-13
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/28/2005 0:00
<b>Lab ID:</b>	0509027-13A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 12:07:00 PM	R30412	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>9.00</u>	1.00	pH Units	1	9/7/05	9/7/2005 4:57:00 PM	R30358	

**Qualifiers**

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

\* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

**Appendix A-13**

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-14
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	08/27/2005 0:00
<b>Lab ID:</b>	0509027-14A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.64</u>	1.00	pH Units	1	9/7/05	9/7/2005 5:00:00 PM	R30358	

<b>Qualifiers</b>	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

Appendix A-14

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-15
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	08/21/2005 0:00
Lab ID:	0509027-15A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>122</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 11:49:00 A	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.89</u>	1.00	pH Units	1	9/7/05	9/7/2005 5:03:00 PM	R30358	

### Qualifiers

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

\* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

**Client:** PSC Consultants, LLC  
**Work Order:** 0509027  
**Project:** E. Kapolei Water Trans. Main., 24307.11  
**Lab ID:** 0509027-16A

**Client Sample ID:** B-16  
**Tag Number:**  
**Collection Date:** 09/03/2005 0:00  
**Matrix:** SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 12:07:00 PM	R30410	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.90</u>	1.00	pH Units	1	9/7/05	9/7/2005 5:08:00 PM	R30358	

**Qualifiers** ND - Not Detected at the Reporting Limit  
J - Analyte detected below quantitation limits  
B - Analyte detected in the associated Method Blank  
\* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits  
R - RPD outside accepted recovery limits  
E - Value above quantitation range

Appendix A-16

# Oceanic Analytical Laboratory, Inc.

Date: Sep 20, 2005

## Result Summary

Client:	PSC Consultants, LLC	Client Sample ID:	B-17
Work Order:	0509027	Tag Number:	
Project:	E. Kapolei Water Trans. Main., 24307.11	Collection Date:	09/03/2005 0:00
Lab ID:	0509027-17A	Matrix:	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
Chloride	ND	10.0	mg/Kg	1	9/14/05	9/14/2005 12:07:00 PM	R30412	
<b>CORROSIVITY BY PH</b>						<b>SW9045B</b>		
pH	<u>7.33</u>	1.00	pH Units	1	9/7/05	9/7/2005 5:10:00 PM	R30358	

Qualifiers	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	E - Value above quantitation range
	* - Value exceeds Maximum Contaminant Level	

**Oceanic Analytical Laboratory, Inc.**

Date: Sep 20, 2005

**Result Summary**

<b>Client:</b>	PSC Consultants, LLC	<b>Client Sample ID:</b>	B-18
<b>Work Order:</b>	0509027	<b>Tag Number:</b>	
<b>Project:</b>	E. Kapolei Water Trans. Main., 24307.11	<b>Collection Date:</b>	09/03/2005 0:00
<b>Lab ID:</b>	0509027-18A	<b>Matrix:</b>	SOLID

Analyses	Result	Reporting Limit	Units	Dilution Factor	Date Prepared	Date Analyze	Batch ID	Qual Notes
<b>CHLORIDE</b>						<b>E325.2</b>		
<u>Chloride</u>	<u>84.9</u>	10.0	mg/Kg	1	9/14/05	9/14/2005 12:07:00 PM	R30412	
<b>CORROSIIVITY BY PH</b>						<b>SW9045B</b>		
<u>pH</u>	<u>7.28</u>	1.00	pH Units	1	9/7/05	9/7/2005 5:13:00 PM	R30358	

**Qualifiers**

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

\* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

**Appendix A-18**



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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0051  
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

## LABORATORY REPORT

Prepared For: Oceanic Analytical Laboratory  
99-193 Aiea Heights Dr. #121  
Aiea, HI 96701  
Attention: Aidan Scott

Project: 0509027

Sampled: 08/20/05-09/03/05  
Received: 09/10/05  
Issued: 09/19/05 15:52

NELAP #01108CA

*The results listed within this Laboratory Report pertain only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a wet weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the sole use of Del Mar Analytical and its client. This report shall not be reproduced, except in full, without written permission from Del Mar Analytical. The Chain of Custody, 1 page, is included and is an integral part of this report.*

*This entire report was reviewed and approved for release.*

## SAMPLE CROSS REFERENCE

LABORATORY ID	CLIENT ID	MATRIX
IOI0683-01	0509027-01B	Solid
IOI0683-02	0509027-02B	Solid
IOI0683-03	0509027-03B	Solid
IOI0683-04	0509027-04B	Solid
IOI0683-05	0509027-05B	Solid
IOI0683-06	0509027-06B	Solid
IOI0683-07	0509027-07B	Solid
IOI0683-08	0509027-08B	Solid
IOI0683-09	0509027-09B	Solid
IOI0683-10	0509027-10B	Solid
IOI0683-11	0509027-11B	Solid
IOI0683-12	0509027-12B	Solid
IOI0683-13	0509027-13B	Solid
IOI0683-14	0509027-14B	Solid
IOI0683-15	0509027-15B	Solid
IOI0683-16	0509027-16B	Solid
IOI0683-17	0509027-17B	Solid
IOI0683-18	0509027-18B	Solid

Reviewed By:

Del Mar Analytical, Irvine  
Amy Windham For Kathleen A. Robb  
Project Manager

Appendix A-19





# Del Mar Analytical

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Oceanic Analytical Laboratory  
 99-193 Aiea Heights Dr. #121  
 Aiea, HI 96701  
 Attention: Aidan Scott

Project ID: 0509027

Report Number: IOI0683

Sampled: 08/20/05-09/03/05  
 Received: 09/10/05

## INORGANICS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IOI0683-01 (0509027-01B - Solid)				Sampled: 08/20/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	26	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-02 (0509027-02B - Solid)				Sampled: 08/27/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	23	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-03 (0509027-03B - Solid)				Sampled: 08/27/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	35	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-04 (0509027-04B - Solid)				Sampled: 08/27/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	57	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-05 (0509027-05B - Solid)				Sampled: 08/20/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	31	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-06 (0509027-06B - Solid)				Sampled: 08/20/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	47	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-07 (0509027-07B - Solid)				Sampled: 08/20/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	49	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-08 (0509027-08B - Solid)				Sampled: 08/21/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	40	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-09 (0509027-09B - Solid)				Sampled: 08/21/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	51	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-10 (0509027-10B - Solid)				Sampled: 08/27/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	30	1	9/12/2005	9/12/2005	

Del Mar Analytical, Irvine  
 my Windham For Kathleen A. Robb  
 Project Manager

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Oceanic Analytical Laboratory  
 99-193 Aiea Heights Dr. #121  
 Aiea, HI 96701  
 Attention: Aidan Scott

Project ID: 0509027

Report Number: IOI0683

Sampled: 08/20/05-09/03/05

Received: 09/10/05

## INORGANICS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IOI0683-11 (0509027-11B - Solid)				Sampled: 08/21/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	35	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-12 (0509027-12B - Solid)				Sampled: 08/21/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I12044	5.0	46	1	9/12/2005	9/12/2005	
Sample ID: IOI0683-13 (0509027-13B - Solid)				Sampled: 08/28/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	34	1	9/13/2005	9/13/2005	
Sample ID: IOI0683-14 (0509027-14B - Solid)				Sampled: 08/27/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	47	1	9/13/2005	9/13/2005	
Sample ID: IOI0683-15 (0509027-15B - Solid)				Sampled: 08/21/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	61	1	9/13/2005	9/13/2005	
Sample ID: IOI0683-16 (0509027-16B - Solid)				Sampled: 09/03/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	38	1	9/13/2005	9/13/2005	
Sample ID: IOI0683-17 (0509027-17B - Solid)				Sampled: 09/03/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	38	1	9/13/2005	9/13/2005	
Sample ID: IOI0683-18 (0509027-18B - Solid)				Sampled: 09/03/05				
Reporting Units: mg/kg								
Sulfate	EPA 300.0	5I13052	5.0	32	1	9/13/2005	9/13/2005	

Del Mar Analytical, Irvine  
 my Windham For Kathleen A. Robb  
 Project Manager

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