FINAL REPORT

FOR REFERENCE ONLY

GEOTECHNICAL CONSULTATION

PGE Job No. 7790-018

for

THE LIMTIACO CONSULTING GROUP, INC.

MANA DRAG STRIP
REHABILITATION OF PAVEMENT
KAUAI RACEWAY PARK
KEKAHA, KAUAI, HAWAII

THIS IS NOT THE SOILS REPORT
FOR THE "MANA DRAG RACING STRIP
IMPROVEMENTS PH. 2" PROJECT

September 24, 2012

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SUMMARY

Our main geotechnical findings and recommendations include:

1. The existing pavement at the Mana Drag Strip was observed to be old and in poor condition. Main types of pavement distress observed consisted primarily of severe pavement weathering; moderate to high severity raveling; moderate to high severity block cracking; concrete patches; and weeds in cracks. Pacific Geotechnical Engineers, Inc. (PGE) understands that pavement rehabilitation is planned for this project.

2. Subsurface conditions at select locations of the Mana Drag Strip were explored by drilling five (5) soil test borings and performing (16) pavement cores. Dynamic cone penetrometer (DCP) tests were performed below the pavement at select core locations.

3. Subsurface conditions encountered in the borings generally consisted of about 2 inches of asphaltic concrete (AC) on the surface, except in Boring B-3, where the AC thickness was about 3 inches. The AC was underlain by fill material of medium dense coralline gravel and very stiff fat clay. Below the fill, subsurface conditions generally consisted of medium dense to very dense poorly graded beach/dune sand to the maximum depths explored in the borings at 6.1 to 10.5 feet.

   Ground water was encountered in the borings at depths of about 7 to 8 feet below existing grades at the time of the field exploration.

4. Based on PGE's field exploration and analysis, a milling and resurfacing concept does not appear to be feasible for the drag strip due to insufficient thickness of existing AC and deteriorated condition of the pavement. As the pavement was constructed sometime in the 1970s, it is probably well beyond its original design life. A full-depth pavement reconstruction consisting of the following minimum rigid and flexible pavement sections is recommended. It is estimated that the design life for the reconstructed pavement with maintenance is on the order of 35 years.

Rigid Pavement (launch pad)

- 6 inches of Portland cement concrete (PCC)
- 6 inches of aggregate base course
- compacted subgrade

Flexible Pavement (launch pad to 1,320 feet)

- 2 inches of AC
- 6 inches of untreated aggregate base course
- 6 inches of aggregate subbase
- compacted subgrade

5. Alternate pavement sections to a full-depth reconstruction were developed. Although the alternate pavement section would have lower initial cost, the thinner section is anticipated to have a shorter pavement design life and would probably require a greater amount and more frequent pavement maintenance and repairs compared to full pavement reconstruction.

   Alternate Pavement Section

   a. Remove the existing AC, recompact the existing coralline gravel to a relative compaction of at least 95 percent, and place 2 inches of new AC. A design life of about 10 years on average is estimated for this pavement section.

   b. Remove the existing AC, recompact the existing coralline gravel to a relative compaction of at least 95 percent, and place 3 inches of new AC. A design life of about 25 years on average is estimated for this pavement section.

   More detailed discussion and recommendations are presented in the main text of this report.

1.0 INTRODUCTION

This report presents the results of the geotechnical consultation services that Pacific Geotechnical Engineers, Inc. (PGE) provided for the pavement rehabilitation of the Mana Drag Strip at Kekaha, Kauai, Hawaii. The approximate location of the site is shown on the Map of Area, Plate 1.

2.0 PROJECT CONSIDERATIONS

This project includes the rehabilitation of approximately 1,320 feet of the raceway at Mana Drag Strip. For ease of reference, the starting line is assigned a station of 0+00 with increasing stationing toward the east. The drag strip consists of a 56 feet wide two lane raceway. It includes 80 feet of burn out area, 1,320 feet of raceway, and 2,670 feet of shutdown area. The raceway is primarily paved with asphaltic concrete (AC) except for a 100 feet long launch pad that is paved with concrete. Pavement rehabilitation is being considered for 1,320 feet of the raceway between the starting and finishing lines. PGE understands that if project funds allow, additional improvements may include extending the launch pad to a length of 280 feet and rehabilitating the pavement at the shut down and burn out areas. A general layout of the site is shown on the Plot Plans, Plates 2.1 through 2.3.

PGE understand that the rehabilitation being considered may include full-depth repair/reconstruction of severely distressed areas and resurfacing the remaining areas. PGE further understand that grading consisting of one inch of cut is planned for the rehabilitated raceway.

Because little to no previous subsurface information and as-built plans were available for the Mana Drag Strip, a subsurface exploration program consisting of drilling soil test borings, performing in situ testing, and pavement coring was undertaken for this project. Consultation regarding the raceway design, raceway geometry, and other civil aspects of the project is not included in PGE's scope of services.

3.0 SCOPE OF SERVICES

Based on the above considerations, PGE performed the following scope of services:

1. *Review of Readily Available Information* - Readily available information on general geologic and subsurface conditions in the vicinity of the project site was researched and reviewed. The sources of the review included information in PGE's files, and other readily available subsurface and geologic information.

2. *Coordination with TLCG, HOCC Consultation, and Utility Checking* - Prior to the start of the field work, PGE coordinated its work with The Limtiaco Consulting Group (TLCG) and Department of Land and Natural Resources (DLNR). The Hawaii One Call Center (HOCC) was consulted to review the proposed boring and core locations with regard to potential underground utilities. Readily available underground utility plans were reviewed to check for possible underground lines. Each boring and core location was toned using a metal detector to check for possible underground utilities.

3. *Site Visits* - PGE's engineering personnel conducted site visits to observe general site surface conditions and general conditions of the existing pavement. Detailed mapping of pavement distress was not included. Possible boring and core locations were selected based on the site observation of the existing pavement conditions.

4. *Field Exploration* - Subsurface conditions along the drag strip were explored by performing the following soil test borings and pavement cores:

    - Five (5) soil test borings, designated B-1 through B-5, to depths of about 6 to 10 feet below existing grades; and

    - Sixteen (16) pavement cores, with five (5) cores taken at the boring locations, and eleven (11) cores, designated C-1 through C-11, at select locations along the raceway.

    The borings were drilled using a truck mounted Mobile B-55G drill rig with continuous flight augers. The pavement cores were excavated with a portable coring machine. The approximate locations of the borings and pavement cores are shown on the Plot Plans, Plates 2.1 through 2.3. The locations and elevations of the borings and pavement cores were surveyed by Esaki Surveying and Mapping, Inc.

    Eleven (11) dynamic cone penetrometer (DCP) tests were performed below the AC pavement at select core locations.

    The drilling, sampling, and pavement coring were performed under the technical observation of PGE's engineering personnel, who logged the soils encountered, and obtained relatively undisturbed and disturbed soil samples and pavement cores. The logs of the borings and a more detailed description of the field exploration program are presented in Appendix A of this report.

5. *Laboratory Testing* - Soil samples obtained from the field exploration were shipped to PGE's laboratory on Oahu for further examination and testing. The testing included moisture content and dry density determinations, Atterberg Limits, gradation analysis, moisture-density relations tests, laboratory single point California Bearing Ratio (CBR) tests, strength tests, and R-value tests.

    A more detailed description of the laboratory testing and the test results are presented in Appendix B of this report.

6. *Engineering Analysis and Report Preparation* - Based on the results of the information review, field exploration and laboratory testing, engineering analysis was performed and recommendations developed for pavement rehabilitation.

   The results of this geotechnical consultation, complete with field and laboratory test data, are summarized in this report. PGE's findings and preliminary recommendations were discussed with TLCG during the course of the design through e-mails, and telephone conversations.

4.0 REVIEW OF READILY AVAILABLE INFORMATION

PGE understands that the raceway at Mana Drag Strip was constructed sometime in the 1970s. As-built conditions of the original raceway were not available at the time of this consultation.

The drag strip consists of a 2-lane raceway of approximately 56 feet in width. Based on information provided by members of the Garden Isle Racing Association (GIRA) during a March 3, 2012 site meeting, PGE understands that the raceway has performed well over the years. The only rehabilitation to the raceway was performed in the 1980s to repair three areas of settled AC pavement between stations 4+50 and 7+50. The distressed AC pavements at these locations were replaced with new concrete pavement. The concrete pavement section consisted of 6 inches of Portland cement concrete (PCC) placed on recompacted existing coralline gravel material. PGE understands that since the pavement repair, there have been no major problems with the raceway pavements.

5.0 SITE CONDITIONS

5.1 GENERAL GEOLOGY

The Mana coastal plain is located in western Kauai and lies at the foot of an ancient sea cliff composed of lava flows of the Waimea Canyon Volcanic series. The plain stretches from Waimea in the south to Polihale in the north. It is mainly composed of thick deposits of alluvium composed of clay, silt, and other detritus derived from weathered basalt. Seaward portions of the plain are generally overlain by beach and dune deposits largely composed of sand-size calcareous sediments. Lagoonal deposits composed of a mixture of calcareous and alluvial sediments are generally present in low-lying areas of the plain, just inland of the beach and dune deposits. As a

result of agricultural development of the Mana plain, the lagoonal deposits have been largely covered by fill.

Based on geologic maps of Kauai by Macdonald and others (1960) and Sherrod and others (2007), the project site is located inland of a beach berm crest in an area composed of calcareous dune and older beach sand deposits. A characteristic of the calcareous deposits in this portion of the coast is the common presence of weakly cemented sand at or near the water table. Development of the site has resulted in the placement of fill over the sand deposits.

According to the United States Department of Agriculture, Natural Resources Conservation Service (NRCS), the surface soil at the site is classified as Jaucas loamy fine sand (JfB), 0 to 8 percent slopes. JfB soil is a calcareous soil that developed in wind and water-deposited calcareous sand derived from coral and marine shells.

5.2 SURFACE CONDITIONS

The Mana Drag Strip consists of a two-lane raceway starting from Station 0+00 at the launch pad to about Station 13+20 at the end of the quarter mile finish line. According to topographic information shown on the project plans, the site is relatively level with an average ground surface elevation of about +10 feet. All elevations in this report are referenced to Mean Sea Level datum.

The existing pavement conditions along the raceway were observed during PGE's site visits. Select photographs taken during PGE's site visits are presented on Plates 3.1 through 3.6. The approximate location and direction of each photograph is shown on Plates 2.1 through 2.3.

In general, the pavement at the drag strip is old and worn. Main types of pavement distress observed consisted primarily of the following:

- severe pavement weathering;
- moderate to high severity raveling;
- moderate to high severity block cracking,
- concrete patches; and
- weeds in pavement cracks.

5.3 ANTICIPATED SUBSURFACE CONDITIONS

Subsurface conditions encountered in Borings B-1 through B-5 are illustrated on the Log of Borings on Plates A-1.1 through A-1.5 in Appendix A. Because the borings are widely spaced, the actual field occurrences of geological units, subsurface and groundwater conditions between the borings, and pavement sections may differ from those indicated on the logs.

Subsurface conditions encountered in the borings generally consisted of about 2 inches of AC on the surface, except in Boring B-3, where the AC thickness was about 3 inches. The AC was underlain by fill material consisting of about 5 to 7 inches of medium dense coralline gravel and 5 to 7 inches of very stiff fat clay. The fill material was underlain by beach/dune deposits consisting of medium dense to very dense poorly graded sand to the maximum depths explored in the borings at 6.1 to 10.5 feet.

Ground water was encountered in the borings at depths of about 7 to 8 feet below existing grades at the time of the field exploration. Based on available topographic information, these depths correspond to elevations ranging from about +2 to +3 feet. Due to the proximity of the site to the ocean, groundwater levels at the site are anticipated to fluctuate with the tides and rainfall landward of the site.

A summary of the AC and fill layer thicknesses at the boring and core locations is presented in Table 1. Photographs of the cores are presented on Plates A-3.1 through A-3.16 in Appendix A of this report. The cores revealed that AC thickness across the site is relatively uniform at about 2 inches. Pavement cracks generally extended the entire depth of the cores that were sited over cracks.

5.4 DCP TESTS

Eleven (11) DCP tests were performed at select core locations directly beneath the existing pavement surface. The tests were performed in general accordance with ASTM D 6951 test method. Plots of the DCP test results with correlated CBR values are presented on Plates A-4.1 through A-4.11 in Appendix A. The correlated CBR values are based on data collected by the Waterways Experiment Station, a U.S. Army Corps of Engineers research and development laboratory.

The DCP test results indicate minimum correlated CBR values of about 7 for the sandy subgrade material, 4 for the fat clay fill material, and 15 for the coralline gravel fill material.

6.0 DISCUSSION

The existing pavement is in poor condition and exhibited moderate to high severity raveling and block cracking. As the pavement was constructed sometime in the 1970s, it is probably well beyond its original design life. A milling and resurfacing concept for pavement rehabilitation was initially considered for this project. Based on the results of the field exploration and PGE's analysis, milling and resurfacing does not appear to be feasible for the Mana Drag Strip due to insufficient thickness of the existing pavement and the deteriorated pavement condition. Based on the above considerations, it is recommended that a full-depth pavement reconstruction be performed.

Laboratory test results indicate the near surface fat clay is highly plastic with high shrink and swell tendencies. This material will tend to swell and soften upon wetting and shrink upon drying. The fat clay should be completely removed for the pavement reconstruction.

More detailed discussions and recommendations are presented in the following report sections.

7.0 RECOMMENDATIONS

7.1 SITE PREPARATION

1. Prior to grading, the areas where the pavement is to be rehabilitated should be prepared by saw-cutting and removing existing pavement, and stripping off all vegetation. All old pavement and stripped-off and demolished materials should be taken to a suitable disposal site off of DLNR's property.

2. Existing underground utility lines within the pavement repairs limits and any underground structures and utilities that may interfere with the construction should be completely removed, relocated, deepened, and/or jacketed with concrete if still in use. The remaining portions of any lines to be left in-place should be properly cut and plugged.

3. After removal of the existing AC and fat clay fill material, the sandy subgrade beneath new pavements should be scarified to a depth of at least 6 inches, thoroughly moisture conditioned to within 2 percent of the optimum moisture content for this material, and compacted to a relative compaction of at least 95 percent. Due to the poorly graded nature of the on-site sand, compaction of this material may be difficult. A thin layer of structural fill may be placed on the sand to assist in the compaction.

   Relative compaction in this report is defined as the dry unit weight of the compacted material expressed as a percentage of the maximum dry unit weight of the same material based on ASTM D 1557 test method.

Any soft, loose, or yielding subgrade areas detected during the subgrade compaction should be treated by removing the soft or loose materials to firm soils and replacing with properly compacted structural fill.

7.2 ANTICIPATED EXCAVATION CONDITIONS

1. Excavations to the depths required to construct the new pavements are anticipated to encounter concrete slabs, and fill material consisting of gravel, silt and clays. It is anticipated that the soil materials can generally be excavated with conventional earthwork equipment. Excavation of concrete slabs will likely require special handling equipment such as a hydraulic hoe ram or other suitable rock excavating equipment.

2. Groundwater is not anticipated to be encountered within the depths of the new pavements.

7.3 FILL MATERIALS, PLACEMENT, AND COMPACTION

1. Fill that may be needed to backfill any yielding subgrade areas that has been removed should consist of structural fill material consisting of granular, generally well-graded material, with particles ranging from coarse to fine and classified as GW, GW-GM, GP-GM, SW, SW-SM, or SP-SM according to the Unified Soil Classification System (USCS). Materials classified as GM or SM may be used provided their fines are non-plastic. It should be free of organic matter, vegetation, trash, debris, clayey soil, concrete, and particles larger than 3 inches in maximum dimension. It should be non-expansive with less than 15 percent fines passing a No. 200 standard sieve. It should have a CBR value of at least 30, a CBR swell of less than one percent when compacted at optimum moisture content and after 4 days of soaking, a liquid limit of 25 or less, and a plasticity index of 10 or less.

2. Structural fill material should be placed in not more than 8-inch thick horizontal loose lifts, moisture conditioned to within 2 percent of the optimum moisture content for this material, and compacted to a relative compaction of at least 95 percent.

3. All on-site and imported materials should be checked, and if appropriate, tested and approved by a qualified testing laboratory prior to their use in fills at the site.

4. An adequate number of field density tests should be performed by a quality control testing firm to check that the required degree of compaction has been achieved. It is recommended that PGE be retained to perform this checking.

7.4 GUIDELINES FOR PAVEMENT RECONSTRUCTION

1. Flexible and rigid pavement analysis was performed based on the guidelines and procedures outlined in American Association of State Highway and Transportation

   Officials (AASHTO)'s Guide for Design of Pavement Structures (1993). The analysis was performed using the pavement design program DARWin® version 3.1.

   The following was assumed in PGE's analysis:

   - Traffic types consisting of mostly passenger vehicles.
   - Twelve (12) races on average per year.
   - A subgrade resilient modulus of 6,200 psi.
   - A design life of 35 years.
   - A plain concrete flexural strength of 650 pounds per square inch (psi).

2. Based on the results of PGE's analysis, the following minimum pavement sections are recommended:

   Rigid Pavement (launch pad)

   - 6 inches of Portland cement concrete (PCC)
   - 6 inches of untreated aggregate base course
   - compacted subgrade

   Flexible Pavement (launch pad to 1,320 feet)

   - 2 inches of AC
   - 6 inches of untreated aggregate base course
   - 6 inches of aggregate subbase
   - compacted subgrade

   The new flexible pavement at the site will likely weather and oxidize with time. Some amount of maintenance will be required during the life of the pavement. The estimated design life for a reconstructed pavement with maintenance is about 35 years.

3. The pavement sections presented above will require complete removal of the fat clay fill material. The subgrade under areas to be paved should be prepared as described in Section 7.1 of this report.

4. The untreated aggregate base course should conform to the requirements of Section 703.06 of the Hawaii Standard Specifications for Road, Bridge and Public Works Construction (HSS), dated 2005. It should have a nominal size of 1-1/2 inch. The subbase course should conform to the structural fill requirements presented in subsection 7.3 of this report.

5. The base course and subbase course should be placed in not more than 8-inch thick loose lifts, moisture conditioned to within 2 percent of the optimum moisture content for these materials, and compacted to a relative compaction of at least 95 percent.

6. The limits of the base course and subbase course should extend at least 12 inches beyond the edges of the AC or concrete limits.

7. It is recommended that an allowance be included in the project for potential additional over excavation that may be needed in areas where soft subgrade soils are encountered.

8. To reduce the potential for distress at the transition between rigid and flexible pavement, a ledger should be provided to support the AC pavement. Alternatively, a thicker AC pavement section of at least 10 feet in length could be provided at the transition.

7.5 ALTERNATE PAVEMENT SECTIONS

Alternate pavement sections to full-depth reconstruction were developed for the Mana Drag Strip. Although the alternate pavement section would have lower initial cost, the thinner section is anticipated to have a shorter pavement design life and would probably require a greater amount and more frequent pavement maintenance and repairs compared to full-depth pavement reconstruction. As discussed in Section 6.0, full-depth pavement reconstruction is recommended for the Mana Drag Strip due to poor existing pavement conditions.

The alternate pavement sections include the following:

1. Remove the existing AC, recompact the existing coralline gravel to a relative compaction of at least 95 percent, and place 2 inches of new AC. A design life of about 10 years on average is estimated for this pavement section.

2. Remove the existing AC, recompact the existing coralline gravel to a relative compaction of at least 95 percent, and place 3 inches of new AC. A design life of about 25 years on average is estimated for this pavement section.

PGE understands that cutting of site grade by about one inch is planned to provide a flatter site grade. This will result in thinning of the existing coralline gravel material below the AC and thinner pavement section for the alternate pavement sections. It is estimated that the average design life of a pavement section consisting of 2 inches of new AC over about 5 inches of recompacted coralline gravel may be on the order of 7 to 10 years.

8.0 PLANS/SPECS REVIEW AND SERVICES DURING CONSTRUCTION

During the design, PGE intends to review the geotechnical related sections of the pre-final plans and specifications to check the intent of its recommendations are properly reflected in the contract documents.

During construction, PGE should be retained to periodically observe the pavement subgrade conditions and preparation, and to review the laboratory and earthwork compaction data obtained by the Contractor on earthwork operations. PGE's involvement during pavement subgrade preparation and construction will allow it to develop modifications to its recommendations, if necessary, should subsurface conditions differ from those presented in this report.

9.0 LIMITATIONS

This geotechnical consultation report has been prepared specifically for the use of The Limtiaco Consulting Group in accordance with generally accepted soils and foundation engineering practices for the Mana Drag Strip, Rehabilitation of Pavement project as described herein. No warranty or guarantee, expressed or implied, or other representation, is made as to the professional advice included in this report and none should be inferred.

This report has been developed specifically for the use of The Limtiaco Consulting Group for the Mana Drag Strip Rehabilitation project in Kekaha, Kauai, Hawaii. This report is not intended for construction and does not contain sufficient information for the purposes of other parties or for other uses. PGE is not responsible for any claims, damages, or liability associated with the use of the information presented in this report by any other parties without PGE's expressed written consent. No third party may rely upon this report or any other document prepared by PGE unless PGE has agreed to such reliance in advance and in writing.

This report does not reflect variations which may occur in the subsurface and groundwater conditions between the boring locations. The nature and extent of variations of the subsurface conditions may not become evident until construction. This report does not reflect the presence or absence of debris and/or obstructions that may be encountered at or below the ground surface. Because of the wide spacing between borings and pavement cores, the actual pavement sections may vary significantly between the boring and test locations. This report does not reflect any changes in the pavement conditions subsequent to PGE's April 2012 field exploration. The

pavement may continue to deteriorate with time. PGE should be contacted and retained to perform follow-on checking of the pavement if long delay before construction is anticipated.

Ground water was encountered in all of the borings at the time of the field exploration. Fluctuations in the groundwater levels may occur due to variations in tides, rainfall, irrigation, seepage, and other factors that may be different from the conditions that existed at the time of PGE's field work.

The comments and recommendations presented in this report are based on the anticipated construction described herein. Should the actual construction differ from that described in this report, PGE should be notified and retained to check if any modifications to the recommendations presented in this report are needed. The comments and recommendations presented in this report shall not be considered valid unless the changes are reviewed by PGE and the recommendations of this report verified or modified in writing.

The field exploration portion of this consultation may not have disclosed the presence of underground structures such as landfills, cesspools, buried debris, abandoned utilities, drywells, storage tanks, sumps, cavities, voids, and pits, etc., that may be present at the site. Should these items be encountered during construction, PGE should be notified and retained to provide appropriate recommendations for their disposal and/or treatment. Assessment of the presence or absence of these structures was not included in the scope of this consultation.

The scope of PGE's services for this project was limited to conventional geotechnical engineering services and did not include any environmental assessment or evaluations of potential subsurface and groundwater contamination. Silence in this report regarding any environmental aspects of the site does not indicate the absence of potential environmental problems.

Detailed mapping and surveying of pavement distress areas was not included in the scope of PGE's services. This report assumes that appropriate contingencies will be included in the contract documents to account for uncertainties in the location of distressed areas during the design and areas requiring more extensive pavement rehabilitation during construction.

PGE's scope of services specifically excluded the investigation, detection, or assessment of the presence of Biological Pollutants in or around any existing or planned structures. Accordingly, this draft report includes no interpretations, recommendations, findings, or conclusions for the purpose of detecting, preventing, assessing, or abating Biological Pollutants. The term "Biological Pollutants" includes, but is not limited to molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

The following plates, table, references, and appendices are attached and complete this report:

Plate 1	-	Map of Area
Plates 2.1 through 2.3	-	Plot Plans
Plates 3.1 through 3.6	-	Site Photographs
Table 1	-	Summary of Existing Pavement Section
References		
Appendix A	-	Field Exploration
Appendix B	-	Laboratory Testing

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

Kenneth Fan

EXP. April 30, 2014

Yours very truly,

PACIFIC GEOTECHNICAL ENGINEERS, INC.

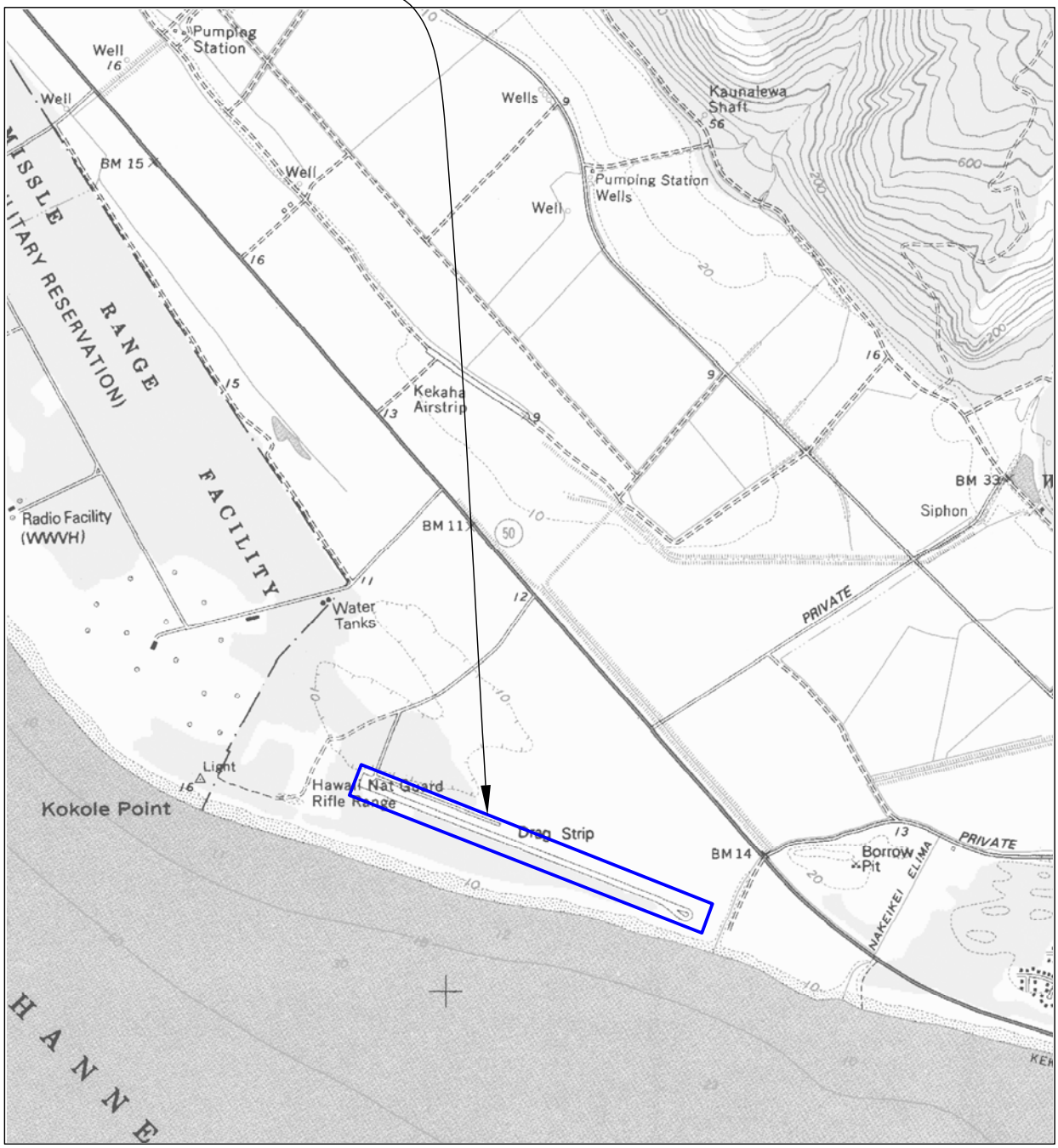
Kenneth Fan

Kenneth K. Fan, P.E.
Project Manager

KKF/TR (7790-018 Final Report)
(Four copies submitted)

7790-018 moa.dwg (05-03-12)

General Location of Project Site



0 1000 2000 4000 6000 FEET

0 0.5 1 2 KILOMETER

N

Contour Interval 40 Feet
Datum is Mean Sea Level
Depth Curves in Feet - Datum is Mean Lower Low Water

MAP OF AREA

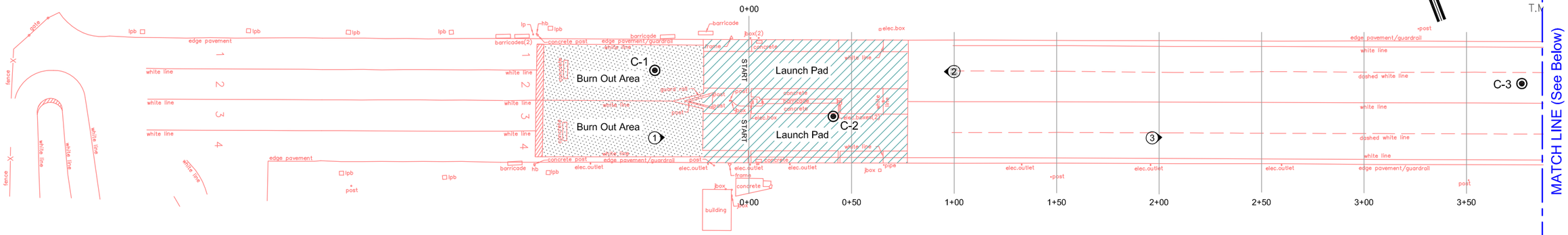
Mana Drag Strip
Kekaha, Kauai, Hawaii

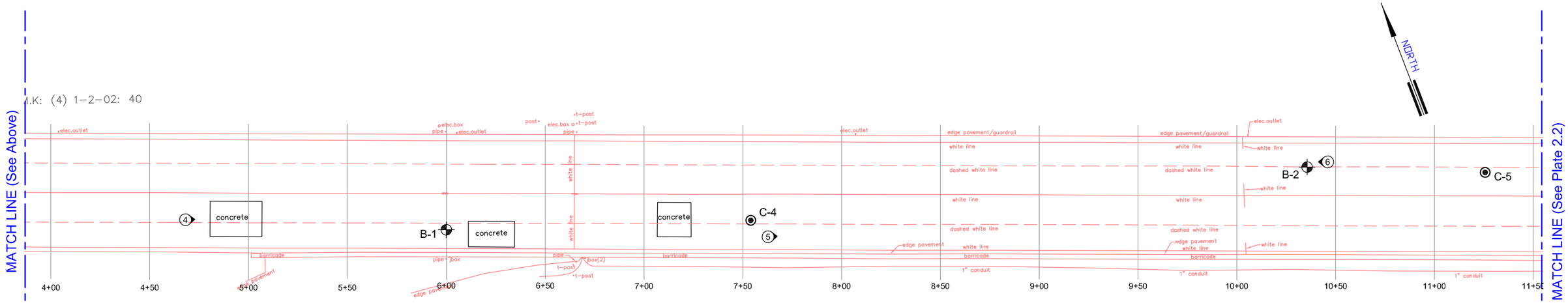
Reference:
U.S.G.S. Topographic Map
Kekaha, Kauai, Hawaii
Dated: 1983

Pacific Geotechnical Engineers, Inc.

PLATE 1

7790-018 plot plan 2012may25_12-40.dwg (05-29-12)





Legend:

B-1 — PGE Boring Location and Number

C-1 — PGE Core Location and Number

① — Approximate PGE Photo Location, Number, and Direction

Scale 1"= 50' Feet (0, 25, 50, 100)

Reference:
Topographic Map
Mana Drag Strip Impovements
By: Esaki Surveying & Mapping, Inc.
Prepared For: The Limtiaco Consulting Group
Dated: April 16, 2012

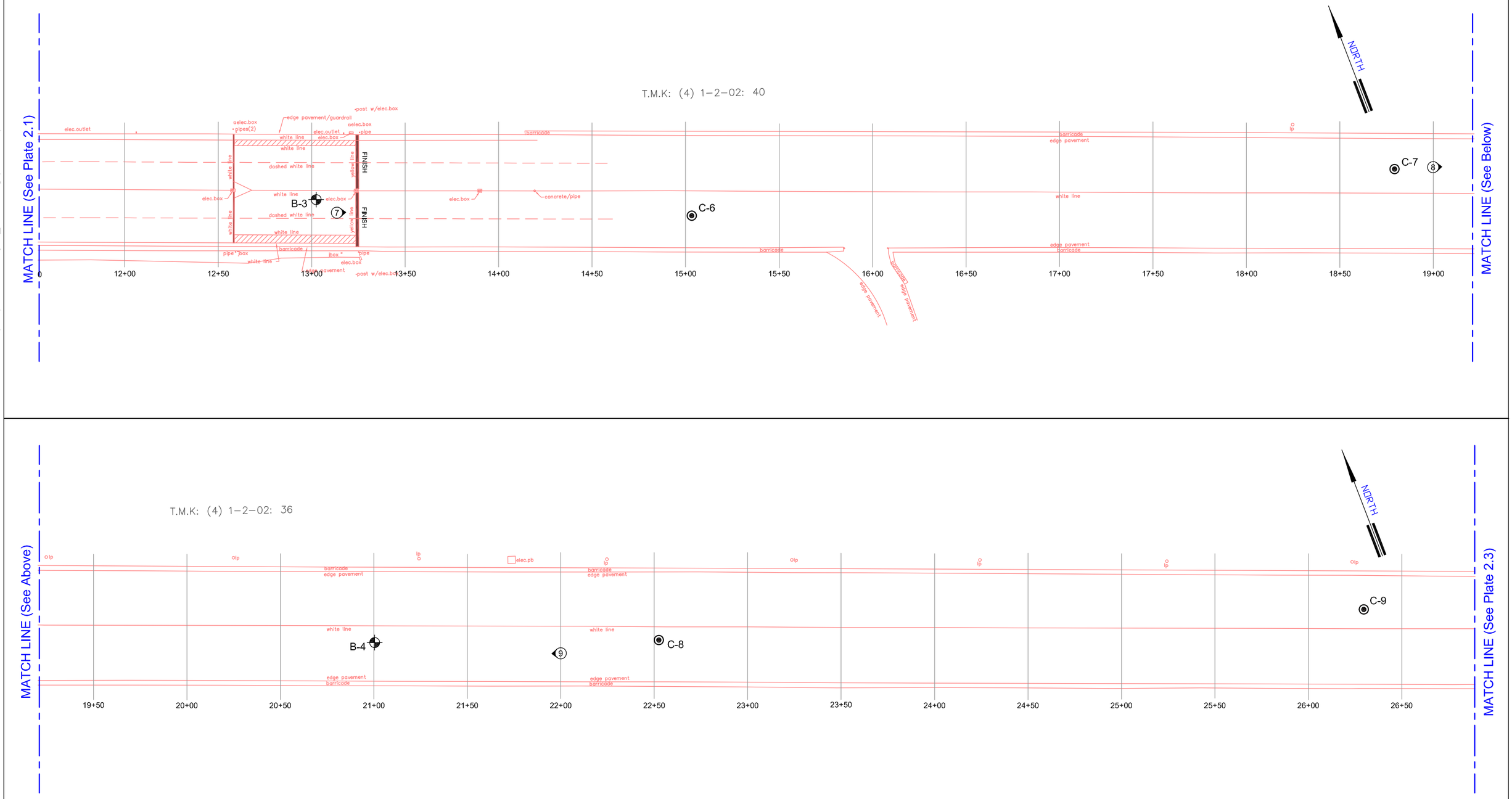
PLOT PLAN

Mana Drag Strip
Kauai Raceway Park
Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 2.1

7790-018 plot plan 2012may25_12-40.dwg (05-30-12)



Legend:

B-3 PGE Boring Location and Number

C-6 PGE Core Location and Number

⑦ Approximate PGE Photo Location, Number, and Direction

0 25 50 100
Scale 1"= 50' Feet

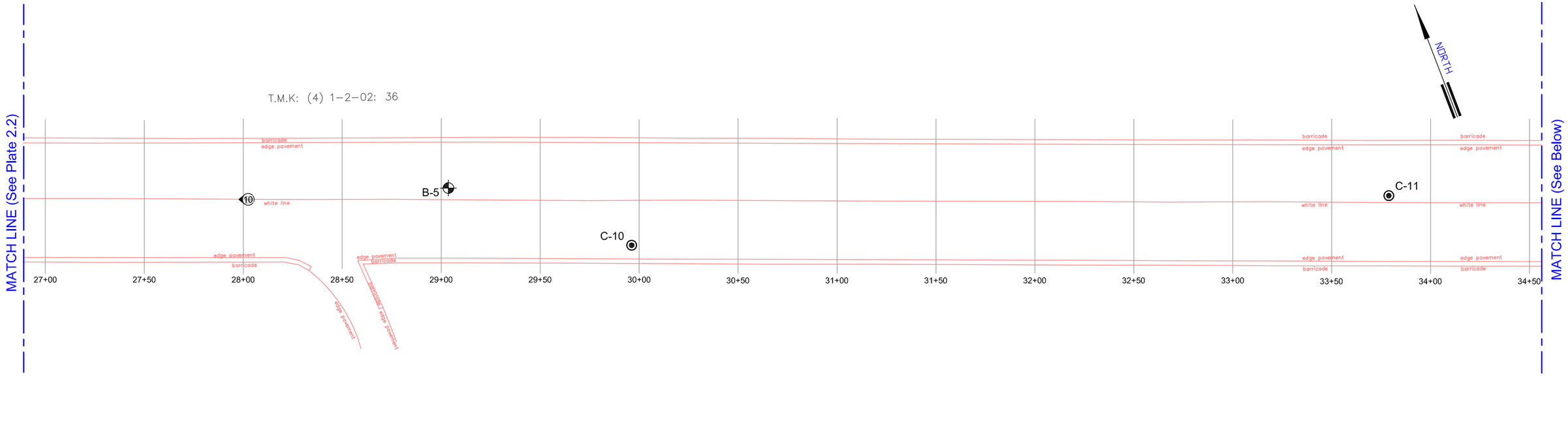
Reference:
Topographic Map
Mana Drag Strip Impovements
By: Esaki Surveying & Mapping, Inc.
Prepared For: The Limtiaco Consulting Group
Dated: April 16, 2012

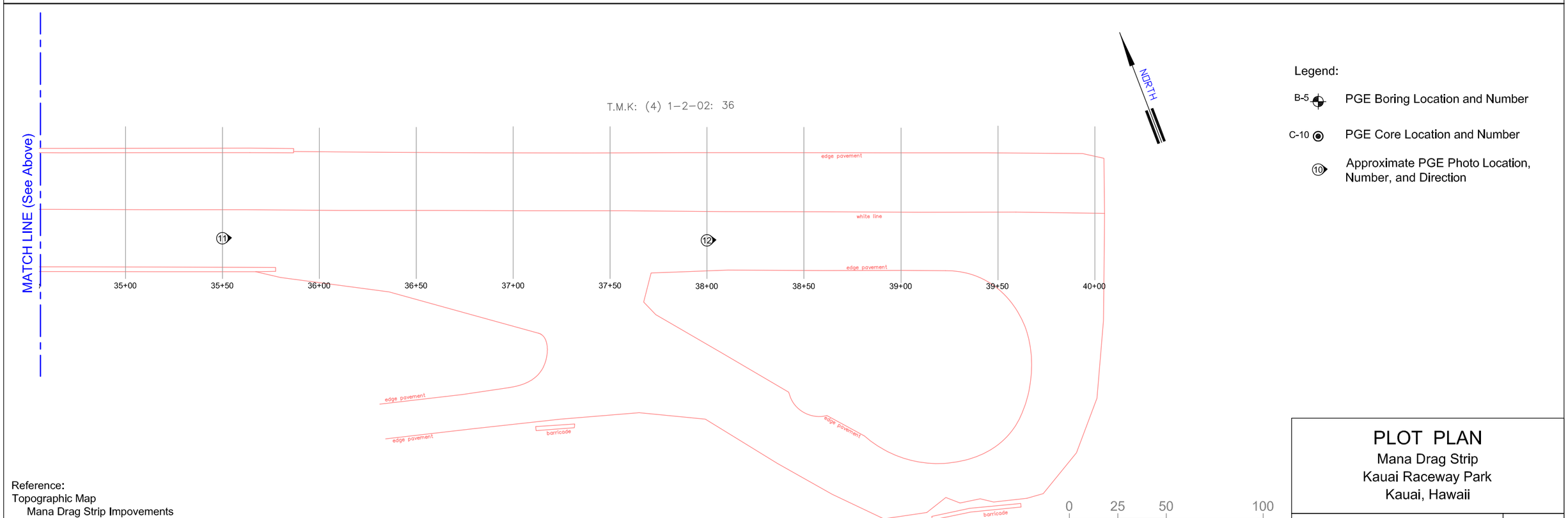
PLOT PLAN

Mana Drag Strip
Kauai Raceway Park
Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 2.2





Legend:

- B-5 — PGE Boring Location and Number
- C-10 — PGE Core Location and Number
- 10 — Approximate PGE Photo Location, Number, and Direction

Reference:
Topographic Map
Mana Drag Strip Impovements
By: Esaki Surveying & Mapping, Inc.
Prepared For: The Limtiaco Consulting Group
Dated: April 16, 2012

0 25 50 100
Scale 1"= 50' Feet

PLOT PLAN

Mana Drag Strip
Kauai Raceway Park
Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 2.3

PHOTO 1 – Launch pad, looking east.

PHOTO 2 – Moderate to high severity longitudinal and block cracking.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.1

PHOTO 3 – Moderately severe block cracking.

PHOTO 4 – Concrete pavement patch.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.2

PHOTO 5 – Highly to moderately severe block cracking.

PHOTO 6 – High severity block cracking.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.3

PHOTO 7 – Finish line at quarter mile.

PHOTO 8 – Grass in cracks.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.4

PHOTO 9 – Raveling and loss of aggregate.

PHOTO 10 – Pavement crack at paving joint.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.5

PHOTO 11 – Vegetation in cracks.

PHOTO 12 – Near end of raceway, looking east.

SITE PHOTOGRAPHS
Mana Drag Strip
Kauai Raceway Park, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE 3.6

TABLE 1

SUMMARY OF EXISTING PAVEMENT SECTION

Location	Assumed Station	Approximate Pavement Section [1] (inch)		Fat Clay (inch)
		AC	Coralline Gravel	
C-1	0+-50	1-5/8	6-7/8	3 [2]
C-2	0+37	Concrete 4-1/2	2-1/2	6 [2]
C-3	3+75	2	4-1/2	8-1/2 [2]
C-4	7+50	2	5-1/2	3 [2]
C-5	11+22	2	5	6 [2]
C-6	15+00	1-7/8	5-1/8	6-1/2 [2]
C-7	18+75	1-1/2	5	6-1/2 [2]
C-8	22+50	1-7/8	6-1/8	5-1/2 [2]
C-9	26+25	1-3/8	6-5/8	5-1/2 [2]
C-10	29+93	1-1/2	5-3/4	5-1/2 [2]
C-11	33+75	2-1/2	6	6 [2]
B-1	6+05	2	6	10
B-2	10+32	1-7/8	6	7
B-3	13+00	3	6	9
B-4	21+00	1-7/8	6	6
B-5	29+00	2	7	7

Notes: (1) Pavement section estimated from core and borehole measurements.
(2) Fat clay thickness estimated based on DCP results.

REFERENCES

1. Macdonald, Gordon A., Stearns, H.T., Cox, D.C., and Davis, D.A., Geologic and Topographic Map of the Island of Kauai, Hawaii, United States Geological Survey, colored geologic map, 1960.

2. Sherrod, David R., Sinton, J.M., Watkins, S.E., and Brunt, K.M., Geologic Map of the State of Hawaii: U.S. Geological Survey, Open-file Report 2007-1089, Version 1.0, Plate 2, geologic map of the island of Kauai, 2007.

3. AASHTO Guide for Design of Pavement Structures, American Association of State Highway and Transportation Officials, 1993.

4. United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey, Island of Oahu, Hawaii (HI990), Soil Maps Version 1, February 28, 2008 and Soil Data Version 6, December 31, 2006.

5. AASHTOWare, DARWin, version 3.1, Pavement Design, Analysis & Rehabilitation for Windows.

6. Kauai Raceway Park, New Concrete Starting Line Pads and Track Asphalt, Preliminary Specifications, June 13, 2011.

APPENDIX A

FIELD EXPLORATION

The field exploration program for this project consisted of drilling five (5) soil test borings to depths ranging from 6.1 to 10.5 feet below existing grades and performing sixteen (16) pavement cores. The approximate locations of the borings and core samples are shown on the Plot Plans, Plates 2.1 through 2.4 in the main text. The locations and elevations of the borings and pavement cores were surveyed by Esaki Surveying and Mapping, Inc.

Prior to the start of field work, readily available underground utility plans were reviewed to check for possible underground utility lines. The Hawaii One Call Center (HOCC) was contacted to review the proposed boring, pavement cores, and bulk sample locations for possible underground utility lines. AT&T HITS was also contacted to check the boring, pavement cores and bulk sample locations for possible underground communication lines. As a final check, the boring, pavement cores, and bulk sample locations were toned using a metal detector.

The borings were drilled by PGE's subcontracted driller, Geolabs, Inc. using a Mobile B-55G truck mounted drill rig with 4-inch diameter continuous flight augers. The pavement cores were excavated by PGE's subcontractor, Cushnie Construction Company, Inc., using a coring machine. The drilling and coring was conducted under the technical observation of PGE's engineering personnel who maintained a log of the materials encountered in each boring and core location, and obtained relatively undisturbed and disturbed soil samples for further examination and laboratory testing.

Relatively undisturbed and disturbed soil samples were obtained in the borings using a stainless steel split barrel sampler with an outside diameter (O.D.) of 3.3 inches and an inside diameter (I.D.) of 2.4 inches and a Standard Penetration Test (SPT) split spoon sampler with an O.D. and I.D. of 2 and 1.4 inches, respectively. The sampler was driven with blows from a 140 pounds hammer falling 30 inches. Each sampling attempt consisted of driving the sampler for a total distance of approximately 18 inches, and recording the blow counts for each 6 inches of penetration. The blow counts for the last 12 inches of penetration were recorded. The blow counts for the 3.3 inches diameter split barrel sampler represent actual blow count and have not been corrected to equivalent SPT-N values.

After the completion of the field work, the soil samples retrieved from the borings, pavement cores, and bulk samples were shipped to PGE's laboratory on Oahu for further examination and testing.

Graphical representations of the soils encountered in the borings are presented on the Log of Borings, Plates A-1.1 through A-1.5. The soils encountered in the boring were initially classified in the field in general accordance with ASTM D 2488 test procedures and the Unified Soil Classification System presented on Plates A-2.1 and A-2.2. Additional field data from PGE's observations of the drilling process, soil cuttings, drilling rate, and soil sampling were used to supplement the field classifications of the soils. The field classifications were later refined according to ASTM D 2487 based on the results of laboratory tests performed on selected soil samples.

Ground water was encountered in the borings at the time of drilling. The measured water levels are indicated on the boring logs. Because of the proximity of the site to the ocean, the groundwater level at the site is anticipated to fluctuate with the tides, seasonal variations, and rainfall landward of the site.

The pavement at the boring and core locations was cored using a coring machine to obtain cores of approximately 4 inches in diameter. Photographs of the pavement cores are presented on Plates A-3.1 through A-3.16.

Eleven (11) DCP tests were performed below the pavement at select pavement coring locations. The test consisted of driving a conical rod with blows from a 17.6 pounds drop hammer falling 22.6 inches. The penetration resistance provides correlation of the soil CBR values. The DCP test results are presented on Plates A-4.1 through A-4.11.

At the completion of drilling, the borings were backfilled with gravel and capped with AC. The core holes were backfilled with gravel and capped with cold mix AC or concrete.

- o0o -

The following plates are attached and complete this appendix.

Plates A-1.1 through A-1.5	-	Log of Borings, B-1 through B-5
Plates A-2.1 and A-2.2	-	Unified Soil Classification System
Plates A-3.1 through A-3.16	-	Photograph of Pavement Cores
Plates A-4.1 through A-4.11	-	Dynamic Cone Penetrometer Test Data

Project *Mana Drag Strip, Rehabilitation of Pavement* Job No. *7790-018*

Location *Kekaha, Kauai* Drawn By *LML*

Date Started *4/10/2012* Date Ended *4/10/2012*

Drilling Method *4-inch Augers, Rotary Wash* Drilling Equipment *Mobile B-55G*

Logged By *L. Oshiro* Water Level (depth) *7.0 ft*

BORING B-1 (Page 1 of 1)

Surface Elevation *+9.7* ± feet

Datum *Mean Sea Level*

Northing *N/A*

Easting *N/A*

Lab Data		Core Info							
Moisture Content (%)	Dry Density (pcf)	Core Type	Recovery (%)	RQD (%)	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class
									SURFACE
									AC
40	81				61				GM
									CH
6					52				SP
					22	4			
6	97				26				
					42				
18	107				66/5"	8			
					79				

Description

SURFACE

2 inches of asphaltic concrete

Yellowish brown silty coralline gravel, medium dense, with coralline sand, mosit (fill)

Light reddish brown fat clay, very stiff, with coralline sand, moist (fill)

Light yellowish brown poorly graded coralline sand, medium dense, with silt, moist (beach/dune deposit)

grades weakly cemented and saturated

(Water level at 1100 hours on 4/10/2012)

grades very dense

Boring completed at 10.5 feet on 4/10/2012.

Notes:

- ☒ 3.3-inch O.D. split barrel sampler
- ◪ 2-inch O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.1

Project *Mana Drag Strip, Rehabilitation of Pavement* Job No. *7790-018*

Location *Kekaha, Kauai* Drawn By *LML*

Date Started *4/10/2012* Date Ended *4/10/2012*

Drilling Method *4-inch Augers, Rotary Wash* Drilling Equipment *Mobile B-55G*

Logged By *L. Oshiro* Water Level (depth) *7.2 ft*

BORING B-2 (Page 1 of 1)

Surface Elevation *+9.6* ± feet

Datum *Mean Sea Level*

Northing *N/A*

Easting *N/A*

Lab Data		Core Info							
Moisture Content (%)	Dry Density (pcf)	Core Type	Recovery (%)	RQD (%)	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class
									SURFACE
5	103				48				AC
									GM
					28				CH
									SP
5	101				31	4			
					23				
23	104				64/4"	8			
20					65				

Description

SURFACE

1-7/8 inches of asphaltic concrete

Yellowish brown silty coralline gravel, medium dense, with coralline sand, moist (fill)

Light reddish brown fat clay, very stiff, with coralline sand, moist (fill)

Light yellowish brown poorly graded coralline sand, medium dense, with silt, moist (beach/dune deposit)

grades weakly cemented

(Water level at 1155 hours on 4/10/2012)

grades very dense and saturated

Boring completed at 10.5 feet on 4/10/2012.

Notes:

- ☒ 3.3-inch O.D. split barrel sampler
- ◪ 2-inch O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.2

Project *Mana Drag Strip, Rehabilitation of Pavement* Job No. *7790-018*

Location *Kekaha, Kauai* Drawn By *LML*

Date Started *4/10/2012* Date Ended *4/10/2012*

Drilling Method *4-inch Augers, Rotary Wash* Drilling Equipment *Mobile B-55G*

Logged By *L. Oshiro* Water Level (depth) *7.3 ft*

BORING B-3 (Page 1 of 1)

Surface Elevation *+10.0* ± feet

Datum *Mean Sea Level*

Northing *N/A*

Easting *N/A*

Lab Data		Core Info							
Moisture Content (%)	Dry Density (pcf)	Core Type	Recovery (%)	RQD (%)	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class
38	88				36				AC
									GM
					41				CH
									SP
15					26	4			
					33				
					83	8			
23					70				

Description

SURFACE

3 inches of asphaltic concrete

Yellowish brown silty coralline gravel, medium dense, with coralline sand, moist (fill)

Light reddish brown fat clay, very stiff, with coralline sand, moist (fill)

Light yellowish brown poorly graded coralline sand, dense, with silt, moist (beach/dune deposit)

grades medium dense

grades dense and weakly cemented

grades very dense and saturated

(Water level at 1239 hours on 4/10/2012)

Boring completed at 10.5 feet on 4/10/2012.

Notes:

- ☒ 3.3-inch O.D. split barrel sampler
- ◪ 2-inch O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.3

Project *Mana Drag Strip, Rehabilitation of Pavement* Job No. *7790-018*

Location *Kekaha, Kauai* Drawn By *LML*

Date Started *4/10/2012* Date Ended *4/10/2012*

Drilling Method *4-inch Augers, Rotary Wash* Drilling Equipment *Mobile B-55G*

Logged By *L. Oshiro* Water Level (depth) *N/A*

BORING B-4 (Page 1 of 1)

Surface Elevation *+9.8* ± feet

Datum *Mean Sea Level*

Northing *N/A*

Easting *N/A*

Lab Data		Core Info							
Moisture Content (%)	Dry Density (pcf)	Core Type	Recovery (%)	RQD (%)	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class
									AC
43	72				45				GM
					31				CH
									SP
7	94				28	4			
					30				

Description

SURFACE

1.8 inches of asphaltic concrete

Yellowish brown silty coralline gravel, medium dense, with coralline sand, moist (fill)

Light reddish brown fat clay, very stiff, with coralline sand, moist (fill)

Light yellowish brown poorly graded coralline sand, dense, with silt, moist (beach/dune deposit)

grades medium dense

grades medium dense to dense

Boring completed at 6.1 feet on 4/10/2012.

Ground water not encountered.

Notes:

- ☒ 3.3-inch O.D. split barrel sampler
- ◪ 2-inch O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.4

Project *Mana Drag Strip, Rehabilitation of Pavement* Job No. *7790-018*

Location *Kekaha, Kauai* Drawn By *LML*

Date Started *4/10/2012* Date Ended *4/10/2012*

Drilling Method *4-inch Augers, Rotary Wash* Drilling Equipment *Mobile B-55G*

Logged By *L. Oshiro* Water Level (depth) *N/A*

BORING B-5 (Page 1 of 1)

Surface Elevation *+9.5* ± feet

Datum *Mean Sea Level*

Northing *N/A*

Easting *N/A*

Lab Data		Core Info							
Moisture Content (%)	Dry Density (pcf)	Core Type	Recovery (%)	RQD (%)	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class
									AC
					43				GM
					12				CH
									SP
5	96				16	4			
					27				

Description

SURFACE

2 inches of asphaltic concrete

Yellowish brown silty coralline gravel, medium dense, with coralline sand, moist (fill)

Light reddish brown fat clay, very stiff, with coralline sand, moist (fill)

Light yellowish brown poorly graded coralline sand, medium dense, with silt, moist (beach/dune deposit)

Boring completed at 6.1 feet on 4/10/2012.

Ground water not encountered.

Notes:

☒ 3.3-inch O.D. split barrel sampler ◪ 2-inch O.D. SPT (split-spoon sampler)

☒ Disturbed sample ⌶ Core run ⌶ Piston sample

☐ Sample lost during extraction DRIVING ENERGY: 140 lb dropping 30 inches

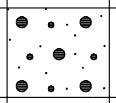
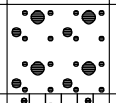
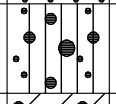
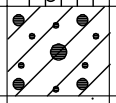
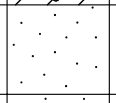
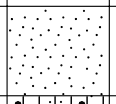
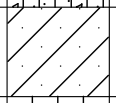
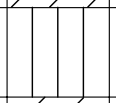
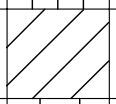
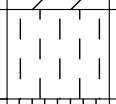
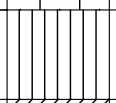
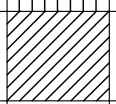
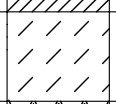
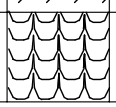
LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.5

UNIFIED SOIL CLASSIFICATION SYSTEM – (ASTM D2487)

MAJOR DIVISIONS			LETTER SYMBOL	GRAPHIC SYMBOL	GROUP NAMES
COARSE–GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW		WELL–GRADED GRAVEL, WELL–GRADED GRAVEL WITH SAND
			GP		POORLY–GRADED GRAVEL, POORLY–GRADED GRAVEL WITH SAND
		GRAVELS WITH MORE THAN 12% FINES	GM		SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC		CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND LESS THAN 5% FINES	SW		WELL–GRADED SAND, WELL–GRADED SAND WITH GRAVEL
			SP		POORLY–GRADED SAND, POORLY–GRADED SAND WITH GRAVEL
		SANDS WITH MORE THAN 12% FINES	SM		SILTY SAND, SILTY SAND WITH GRAVEL
			SC		CLAYEY SAND, CLAYEY SAND WITH GRAVEL
FINE–GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		SILT, SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY SILT
			CL		LEAN CLAY, LEAN CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY LEAN CLAY
			OL		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH		ELASTIC SILT, ELASTIC SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY ELASTIC SILT
			CH		FAT CLAY, FAT CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY FAT CLAY
			OH		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
HIGHLY ORGANIC SOILS			PT		PEAT

NOTE:
DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS. REFER TO ASTM D2487 FOR BORDERLINE CLASSIFICATIONS GW–GM, GW–GC, GP–GM, GP–GC, SW–SM, SW–SC, SP–SM, AND SP–SC.

UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 1 OF 2)

Pacific Geotechnical Engineers, Inc.

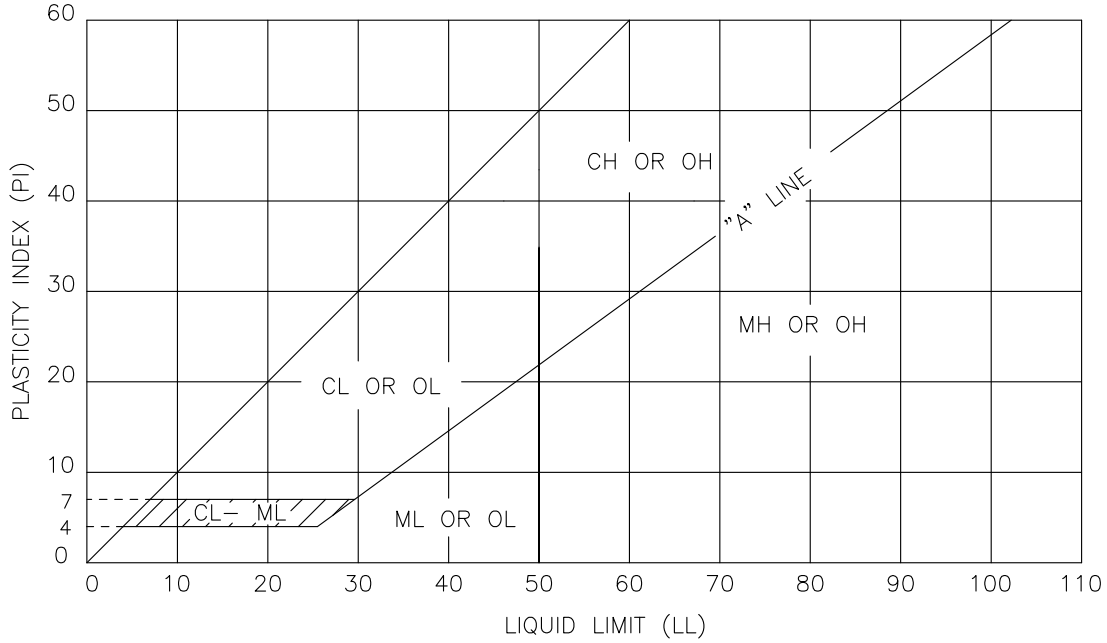
PLATE A-2.1

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE **	MILLIMETERS	SIEVE SIZE **
SAND				
FINE	0.075	#200 **	0.425	#40 **
MEDIUM	0.425	#40 **	2.00	#10 **
COARSE	2.00	#10 **	4.75	#4 **
GRAVEL				
FINE	4.75	#4 **	19.0	3/4" *
COARSE	19.0	3/4" *	75.0	3" *
COBBLES	75.0	3" *	300	12" *
BOULDERS	300	12" *	---	---

** U.S. STANDARD SIEVE * SQUARE OPENINGS

PLASTICITY CHART



FOR CLASSIFICATION OF FINE-GRAINED SOILS AND FINE-GRAINED FRACTION OF COARSE-GRAINED SOILS

NOTE:
WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF FINE-GRAINED SOILS AND COARSE-GRAINED SOILS.

FINE-GRAINED SOILS

APPROXIMATE SHEAR STRENGTH IN KSF

VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
MEDIUM STIFF	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

COARSE-GRAINED SOILS

VERY LOOSE	THESE ARE USUALLY
LOOSE	BASED ON AN EXAMINATION
MEDIUM DENSE	OF SOIL SAMPLES, AND
DENSE	PENETRATION RESISTANCE.
VERY DENSE	

UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 2 OF 2)

Pacific Geotechnical Engineers, Inc.

PLATE A-2.2

C-1

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.1

C-2

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.2

C-3

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.3

C-4

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.4

C-5

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.5

C-6

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.6

C-7

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.7

C-8

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.8

C-9

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.9

C-10

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.10

C-11

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.11

B-1

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.12

B-2

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.13

B-3

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.14

B-4

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

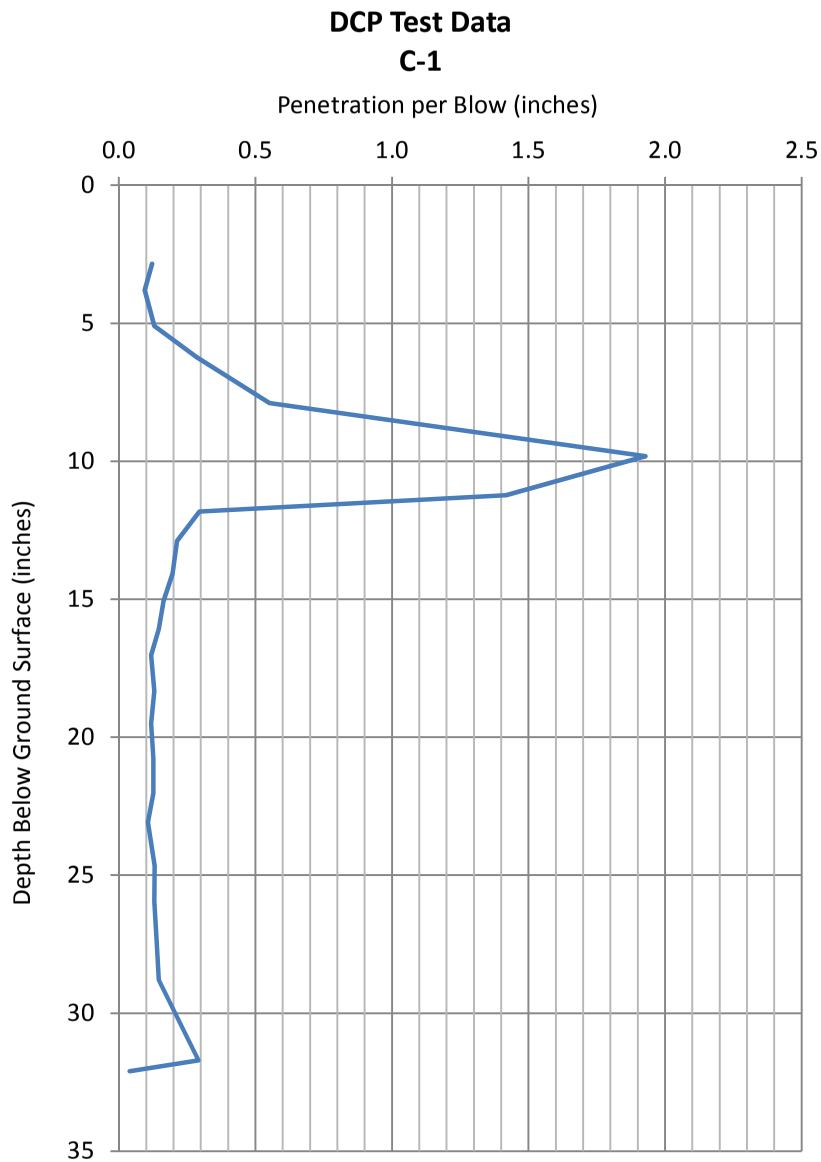
PLATE
A-3.15

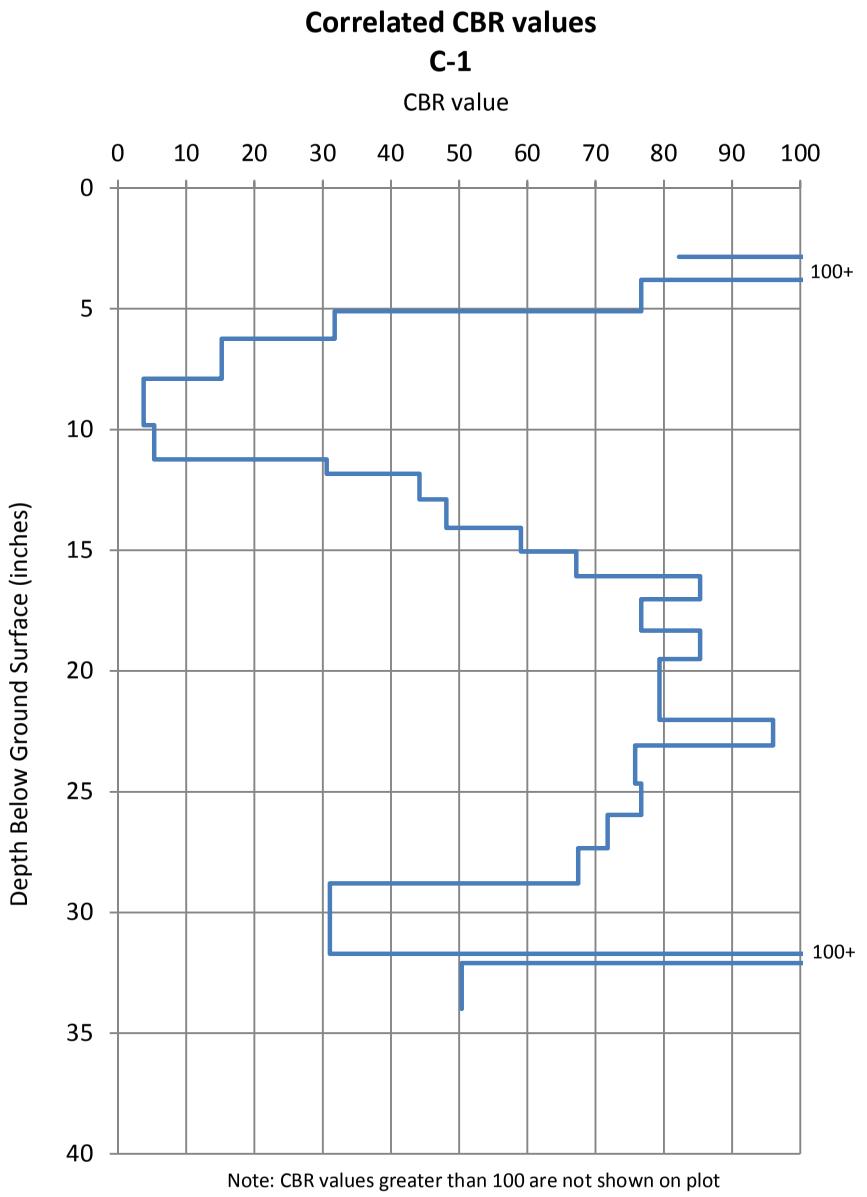
B-5

PHOTOGRAPHS OF PAVEMENT CORES
Pavement Rehabilitation, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE
A-3.16





Note: CBR values greater than 100 are not shown on plot

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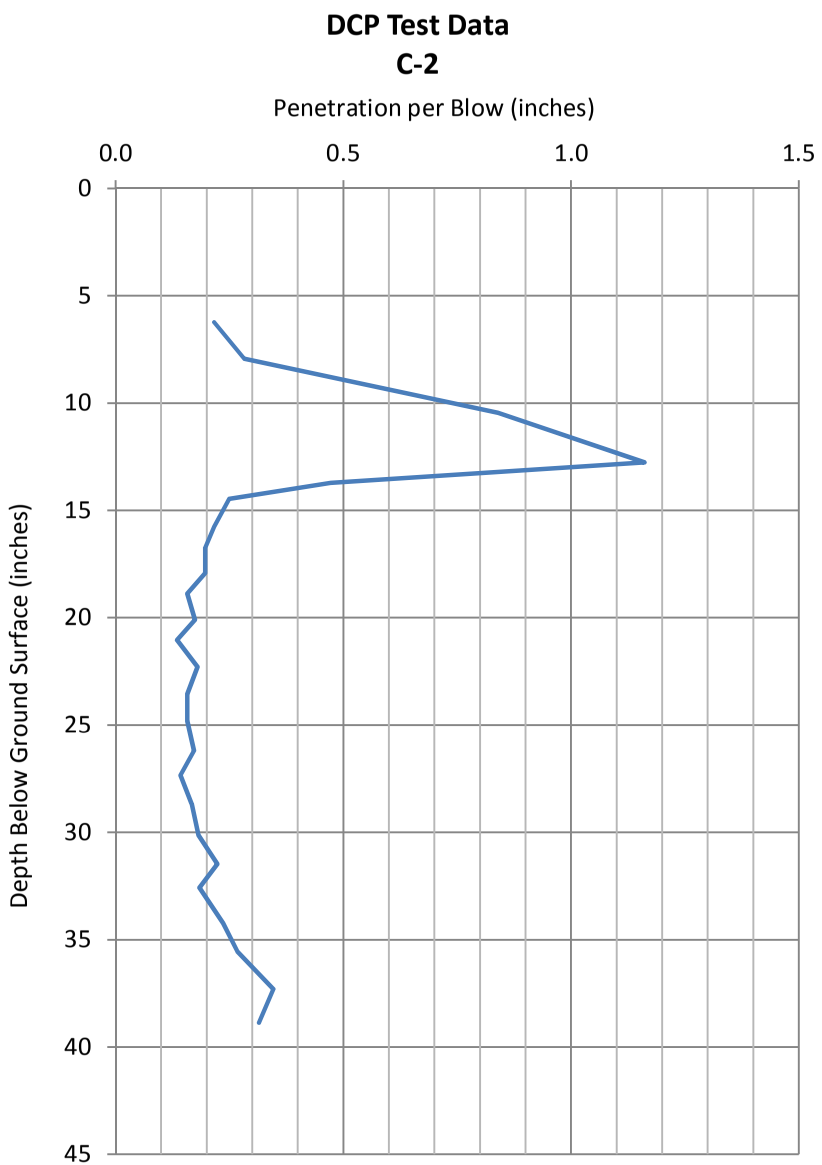
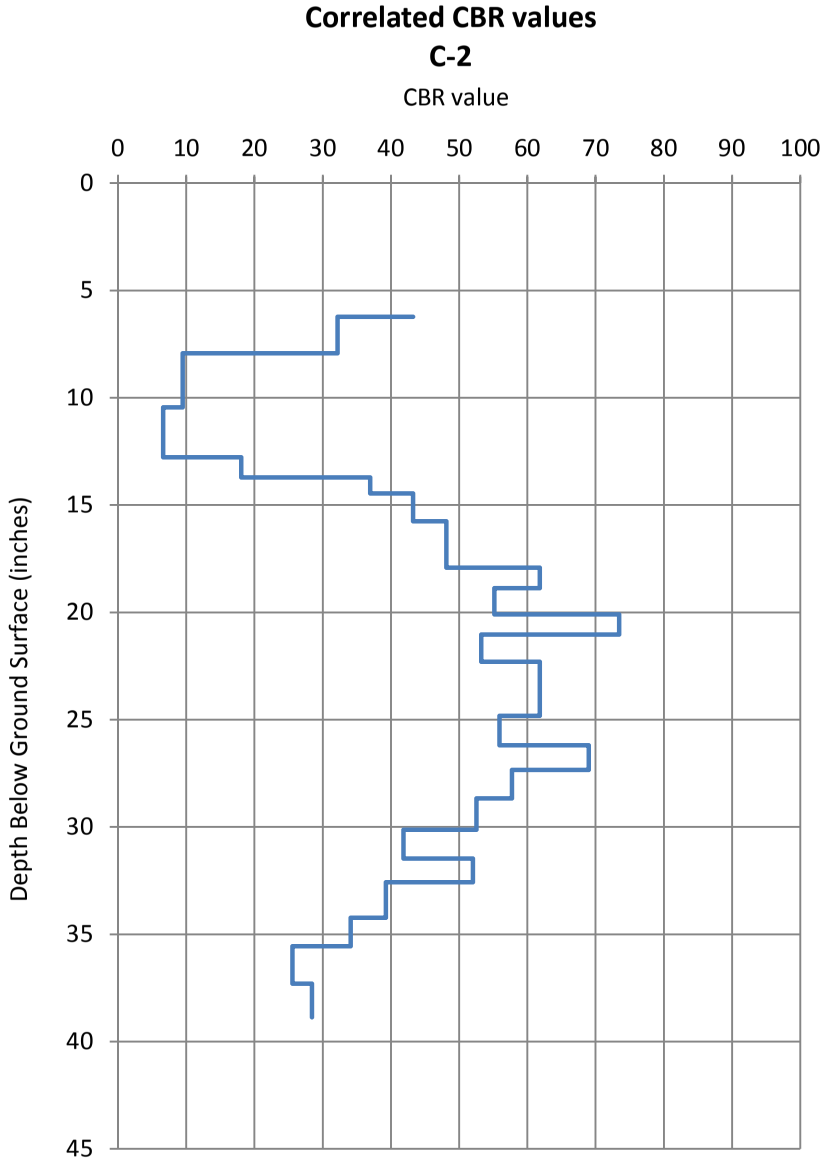
PLATE A-4.1

Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii





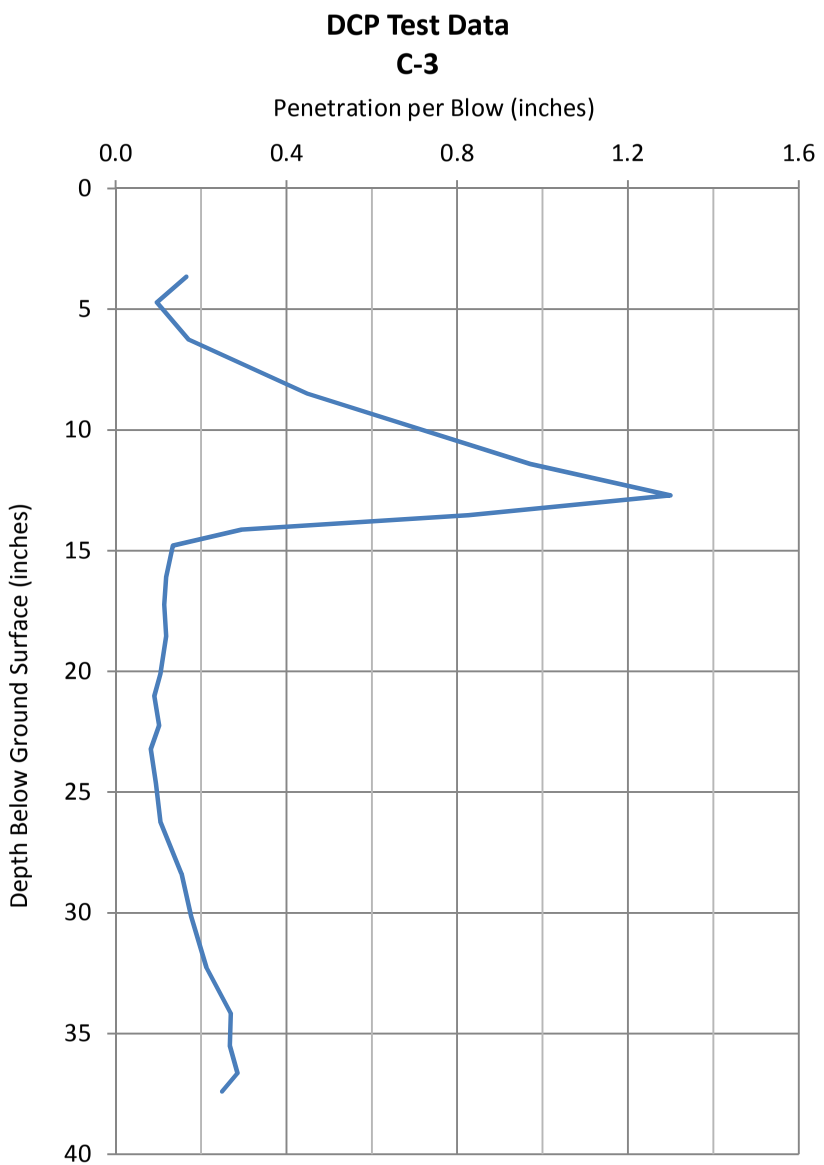
Dynamic Cone Penetrometer Test Data

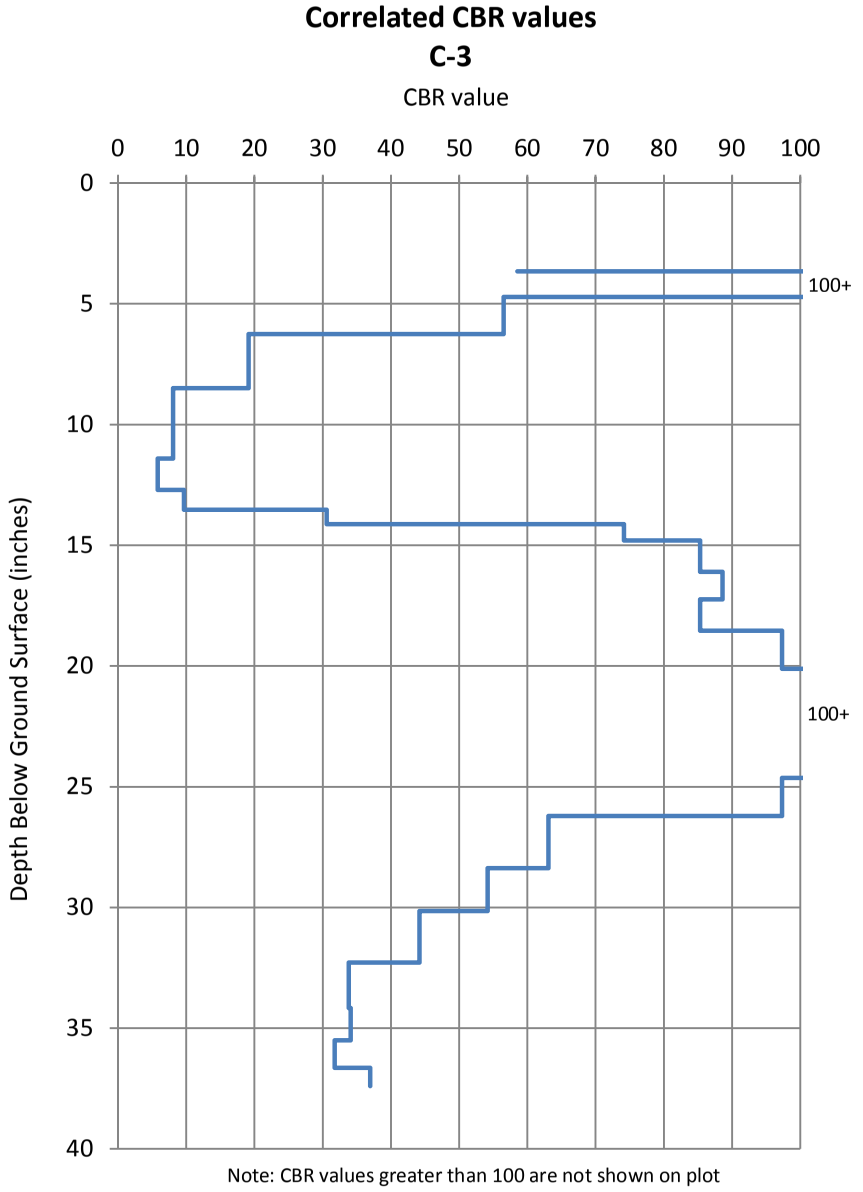
Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.2





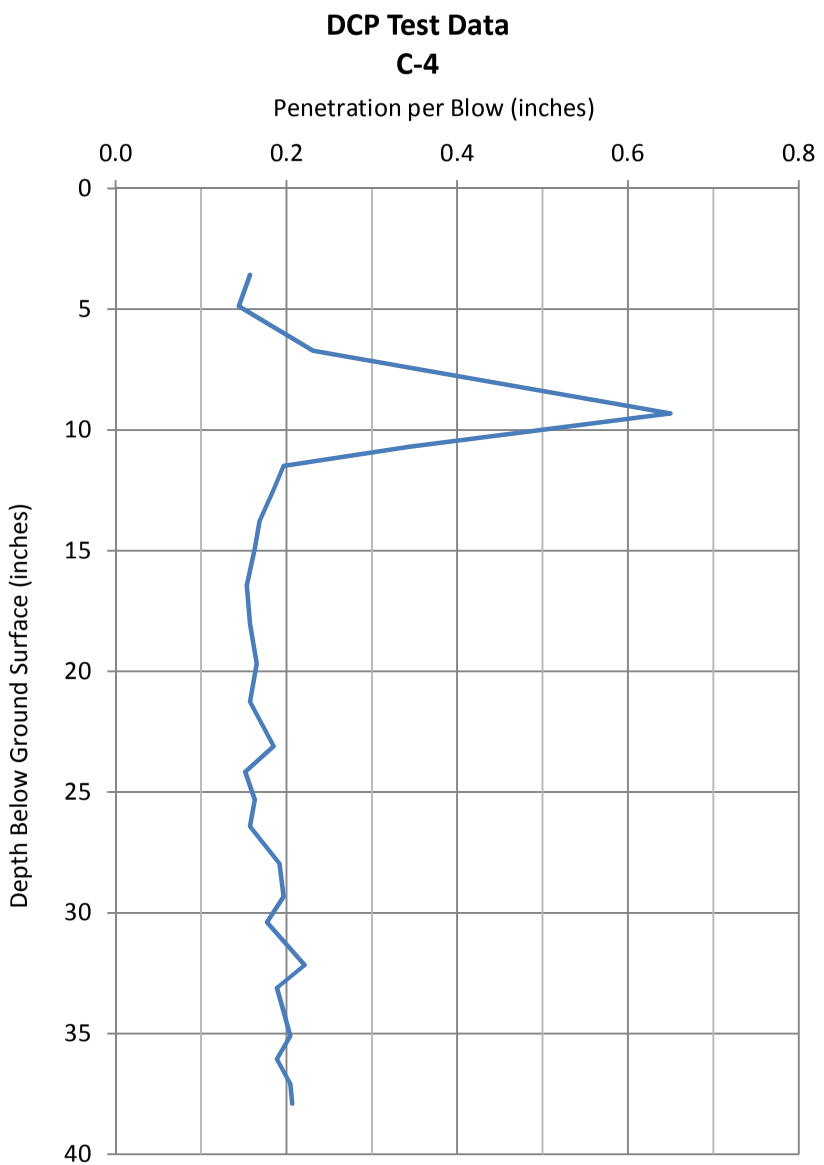
Dynamic Cone Penetrometer Test Data

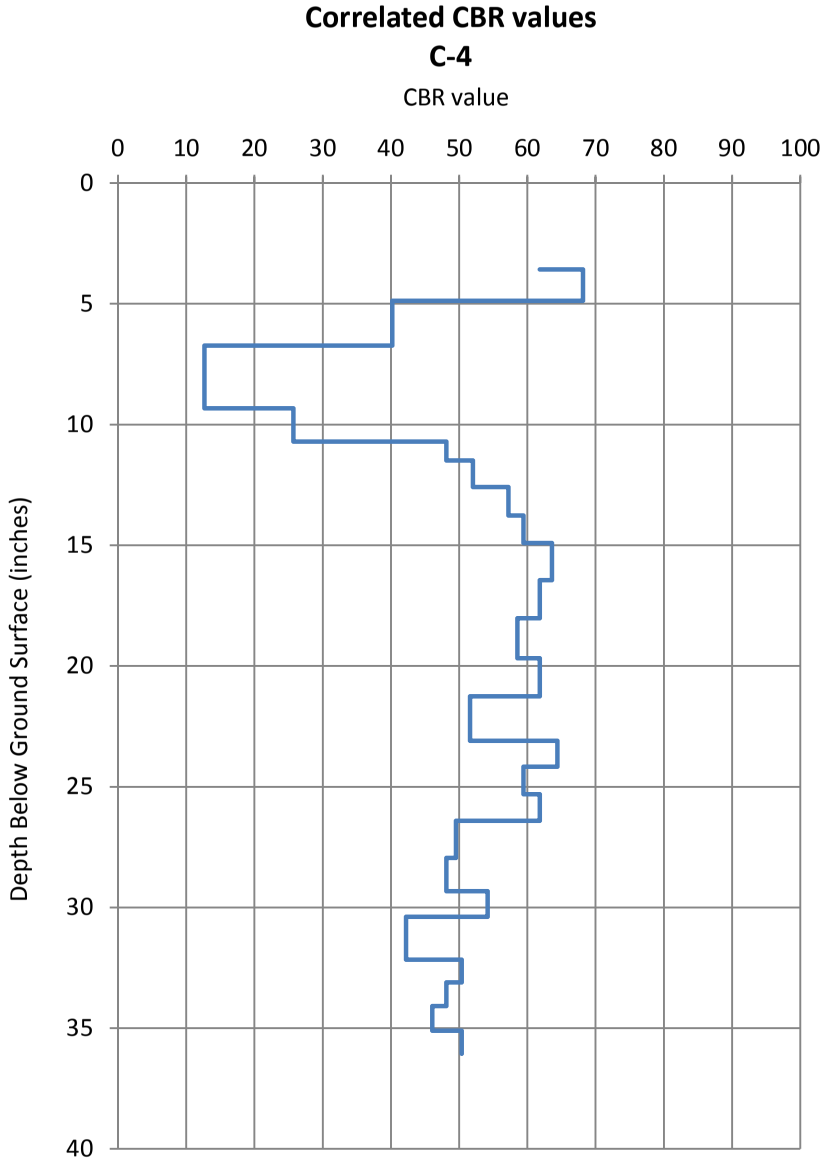
Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.3





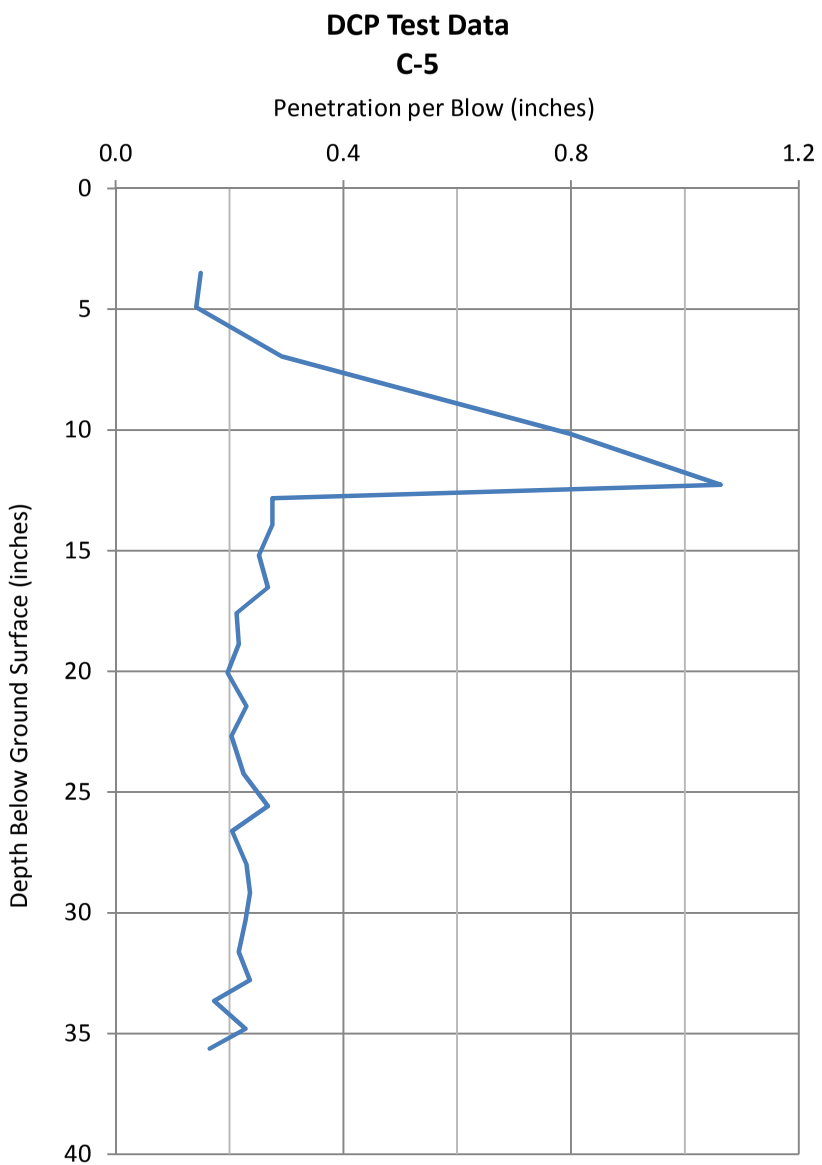
Dynamic Cone Penetrometer Test Data

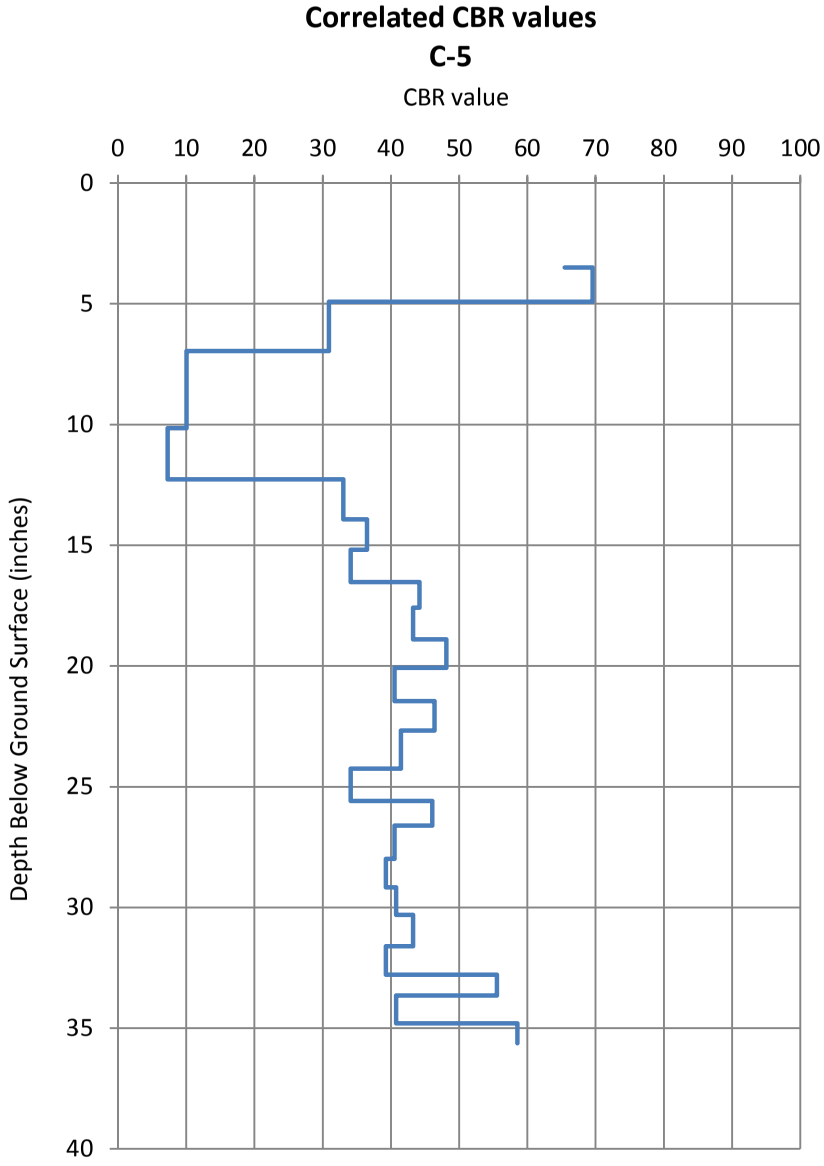
Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.4





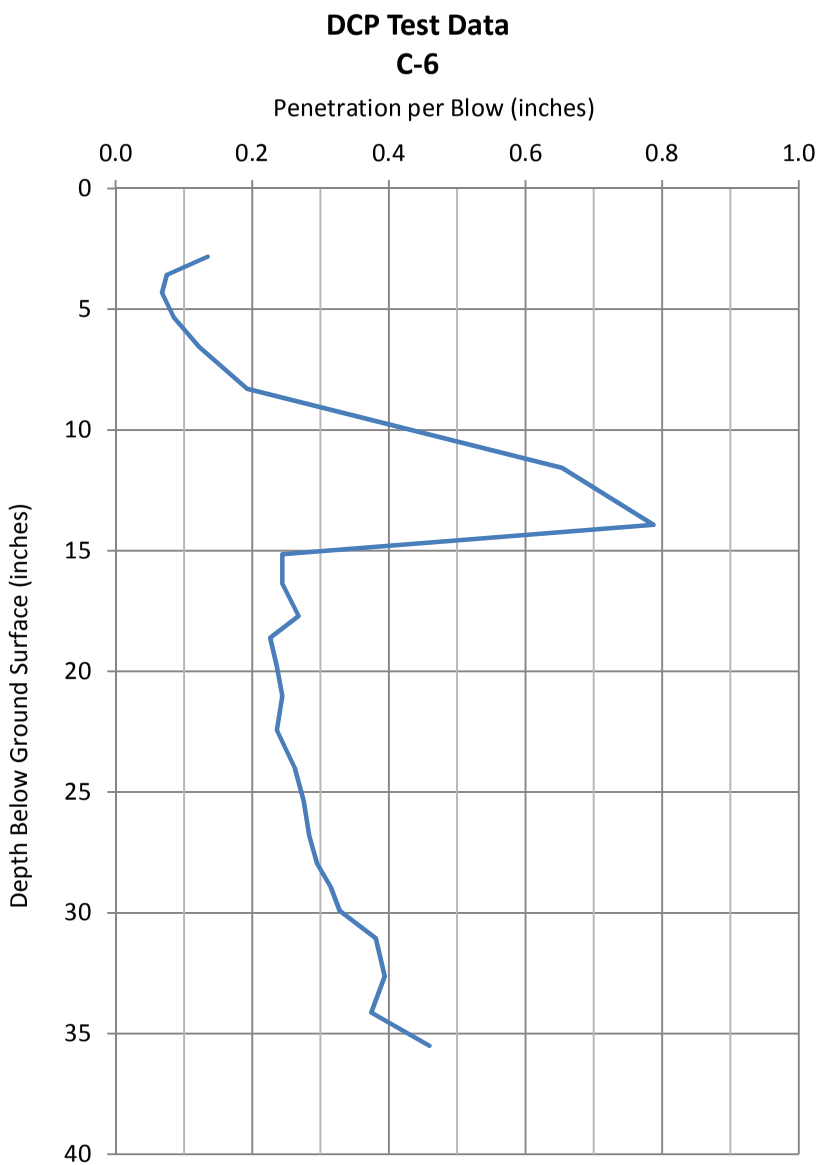
Pacific Geotechnical Engineers, Inc.

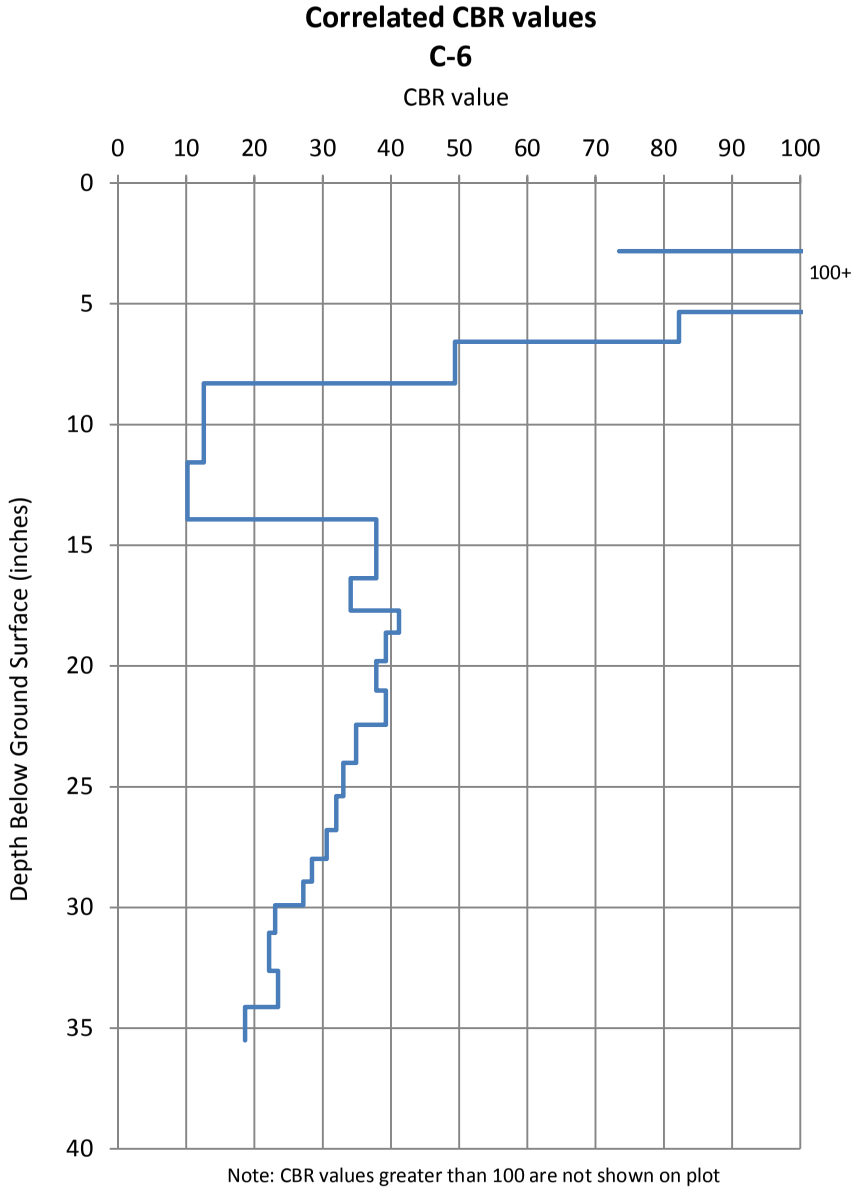
PLATE A-4.5

Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii





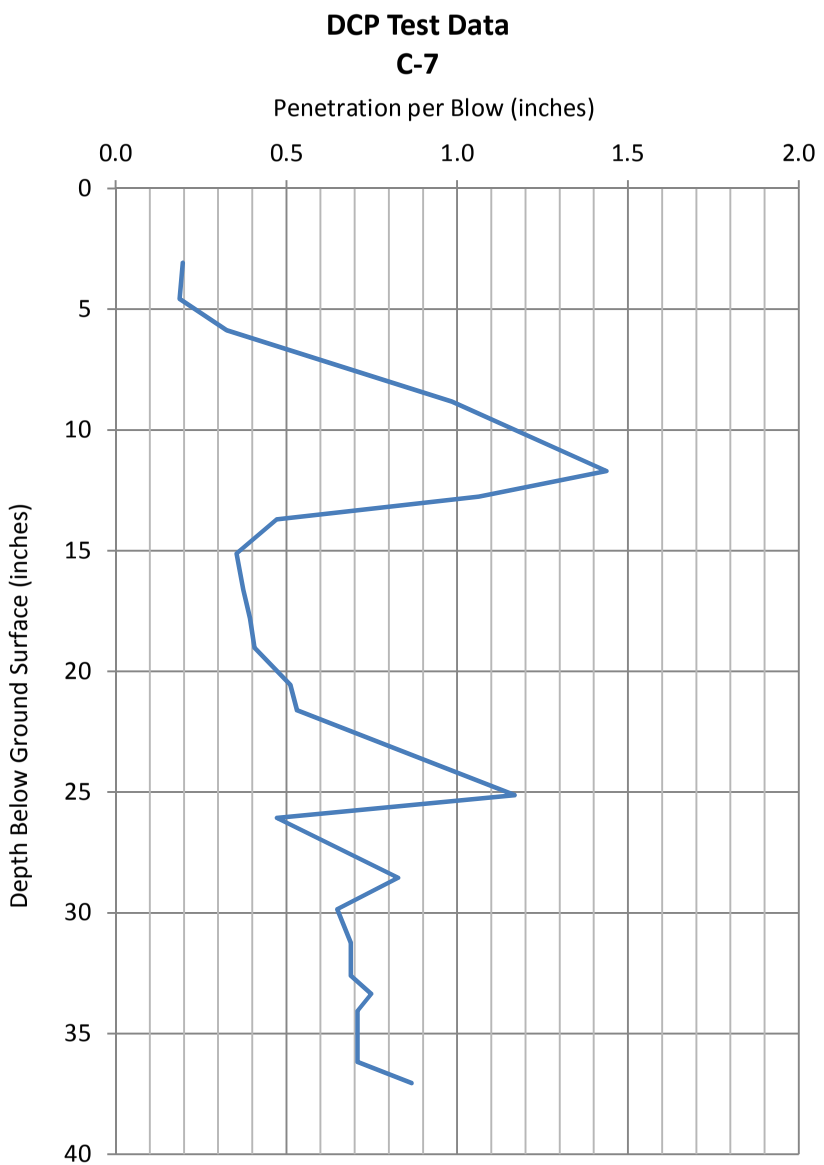
Dynamic Cone Penetrometer Test Data

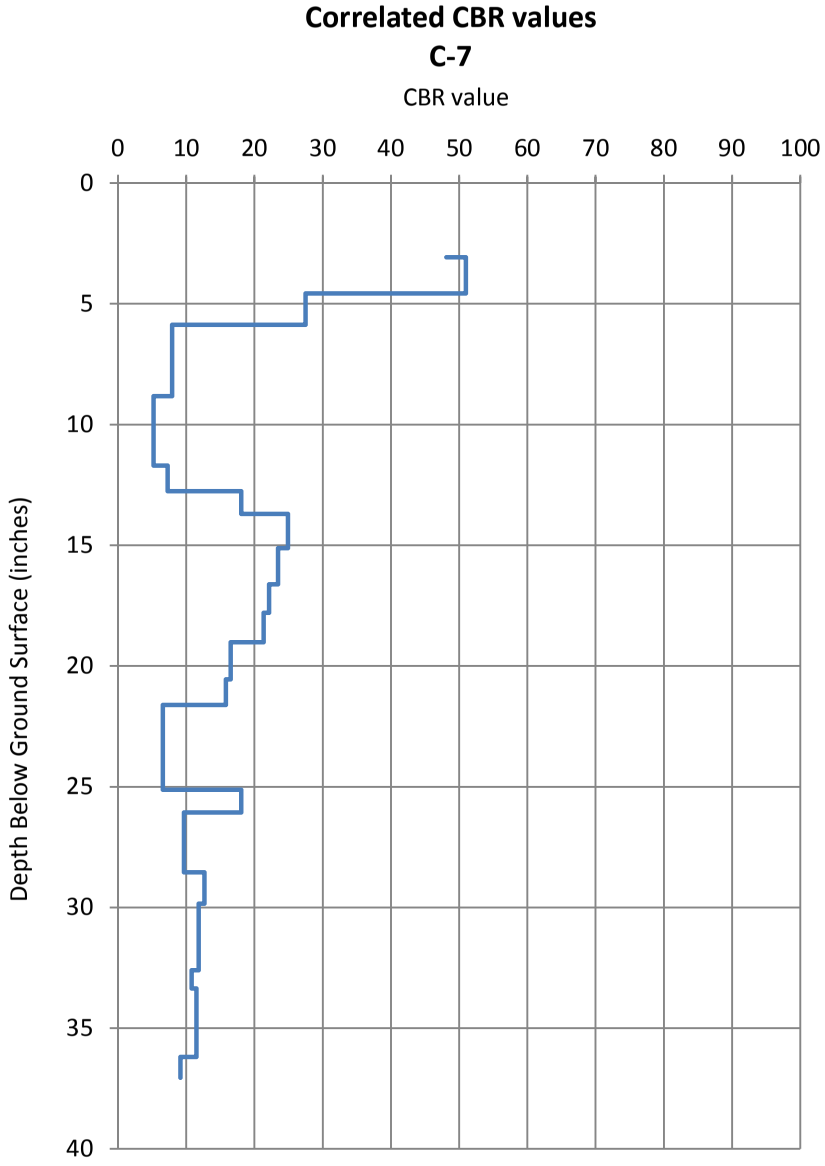
Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.6





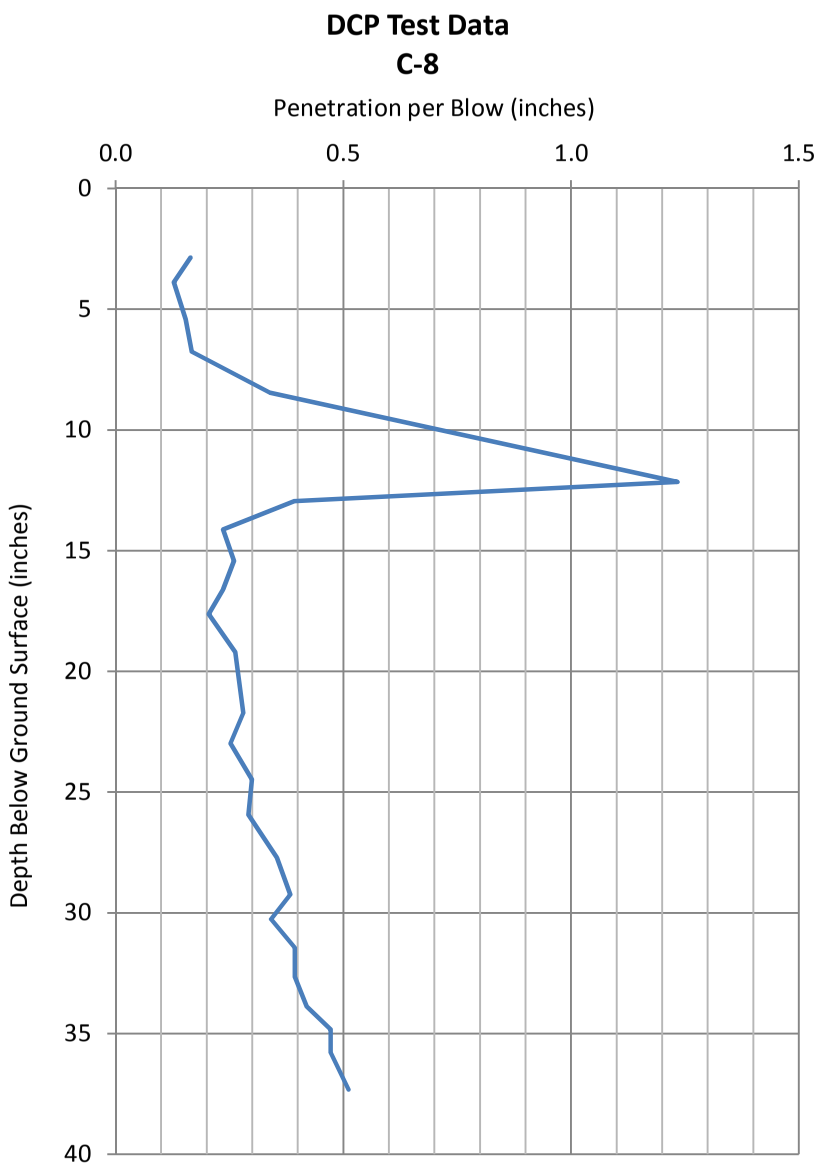
Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.7



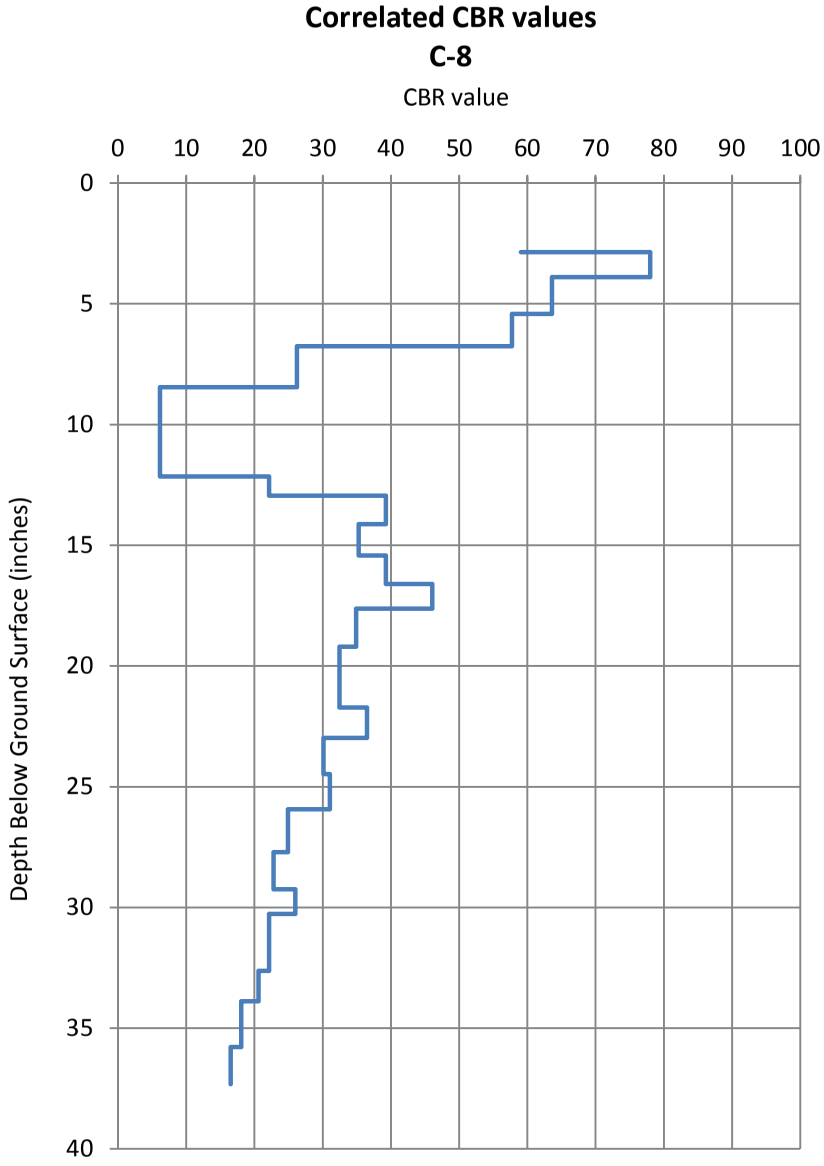


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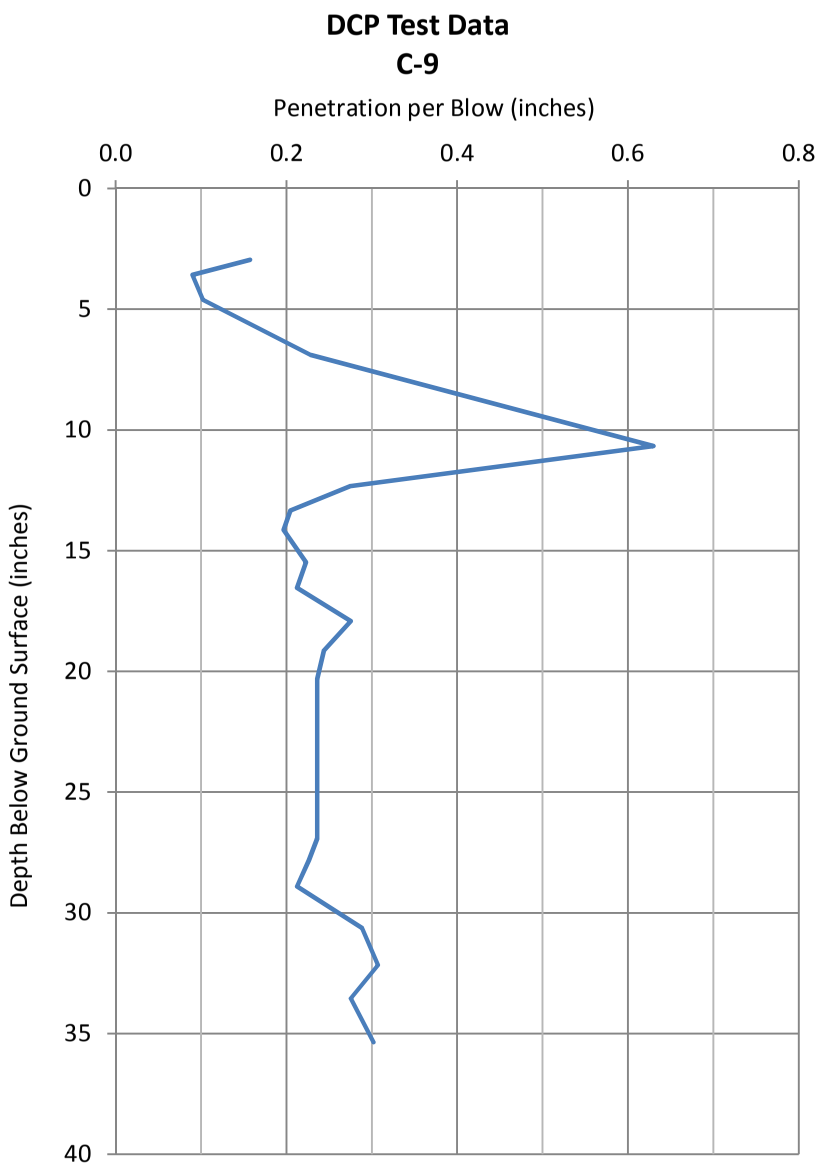
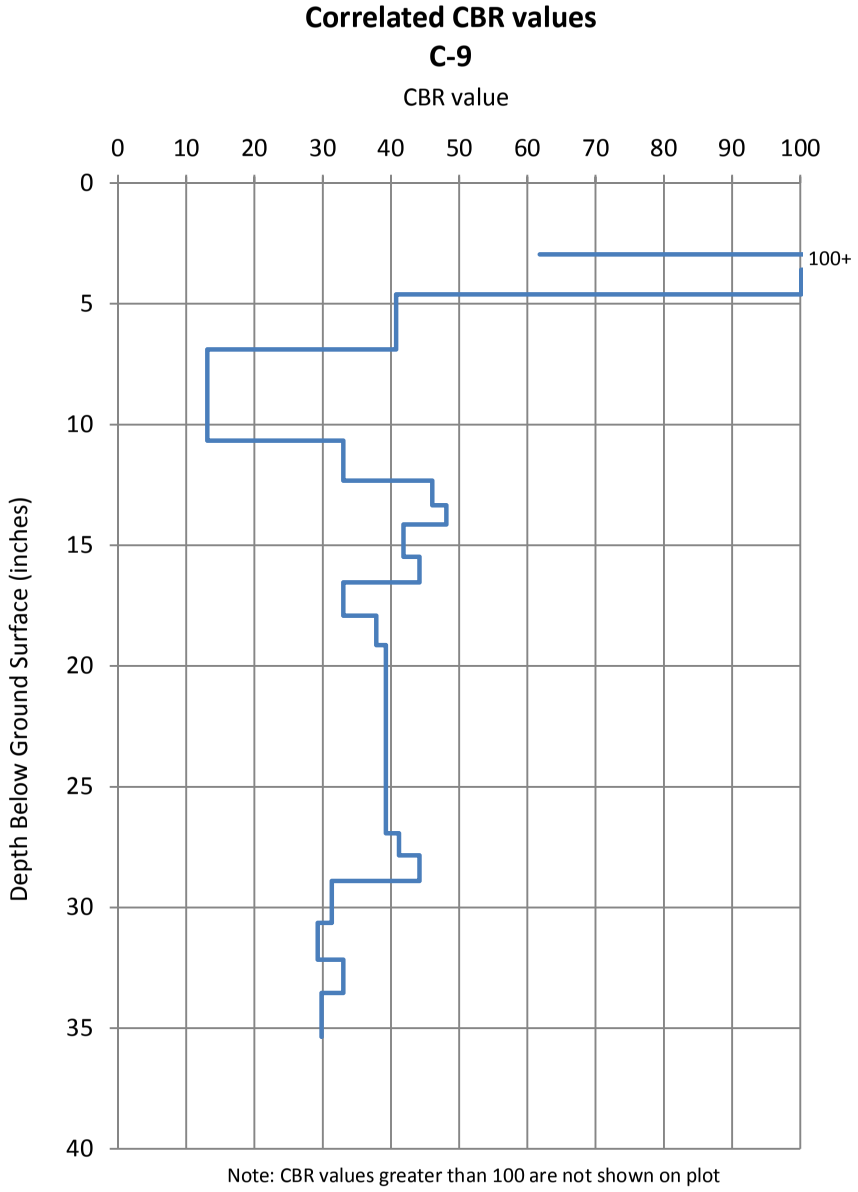
PLATE A-4.8

Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip
Kekaha, Kauai, Hawaii



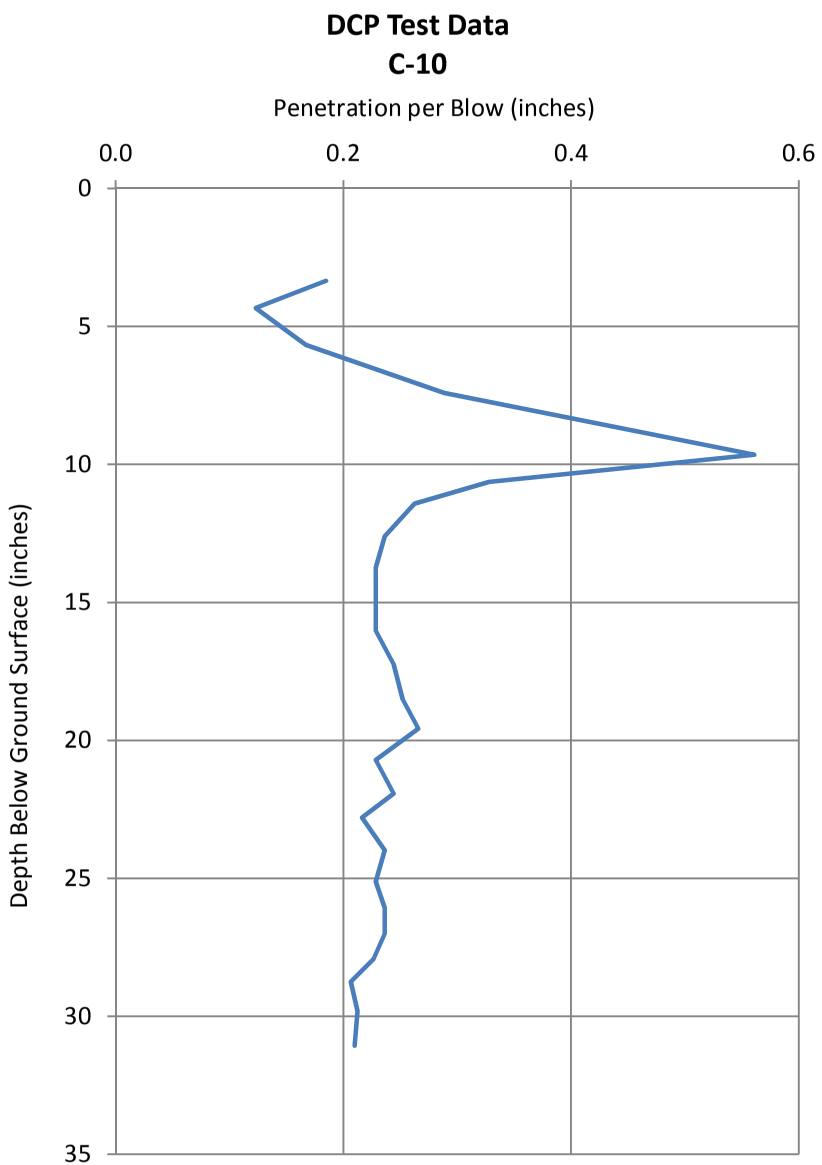


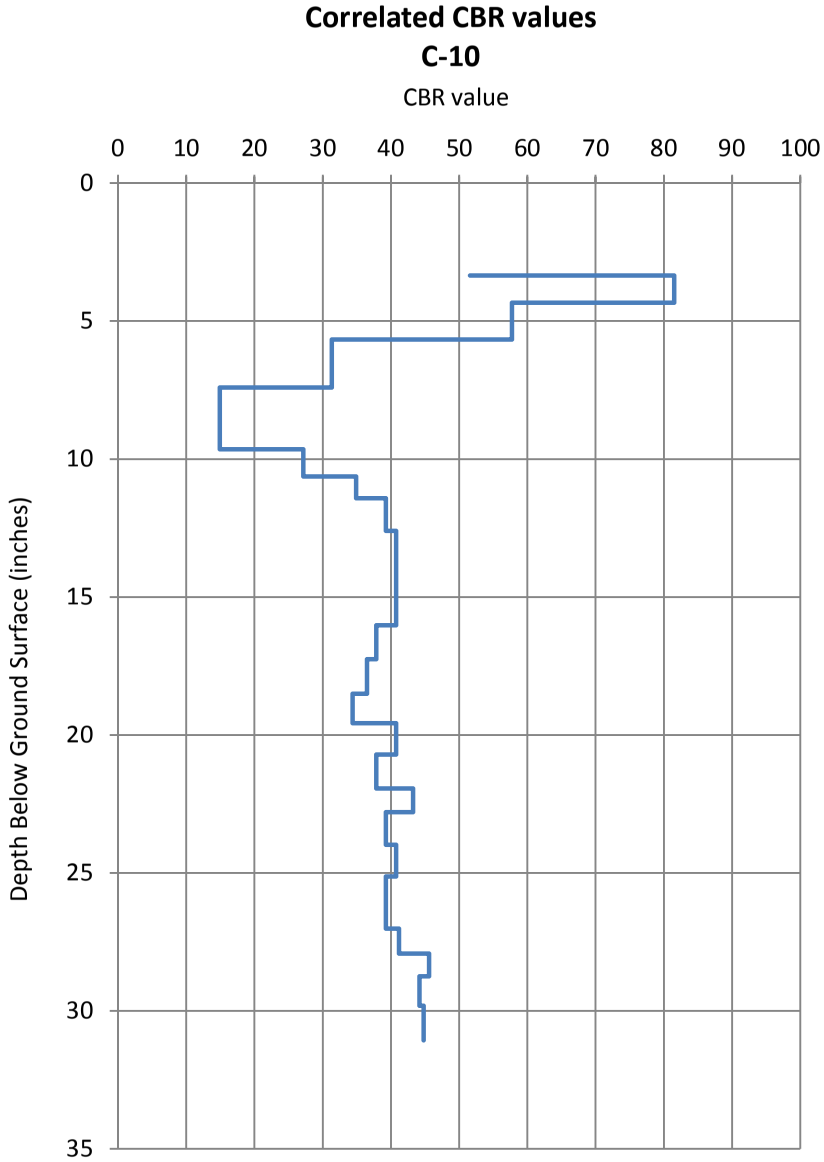
Pacific Geotechnical Engineers, Inc.

PLATE A-4.9

Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip
Kekaha, Kauai, Hawaii





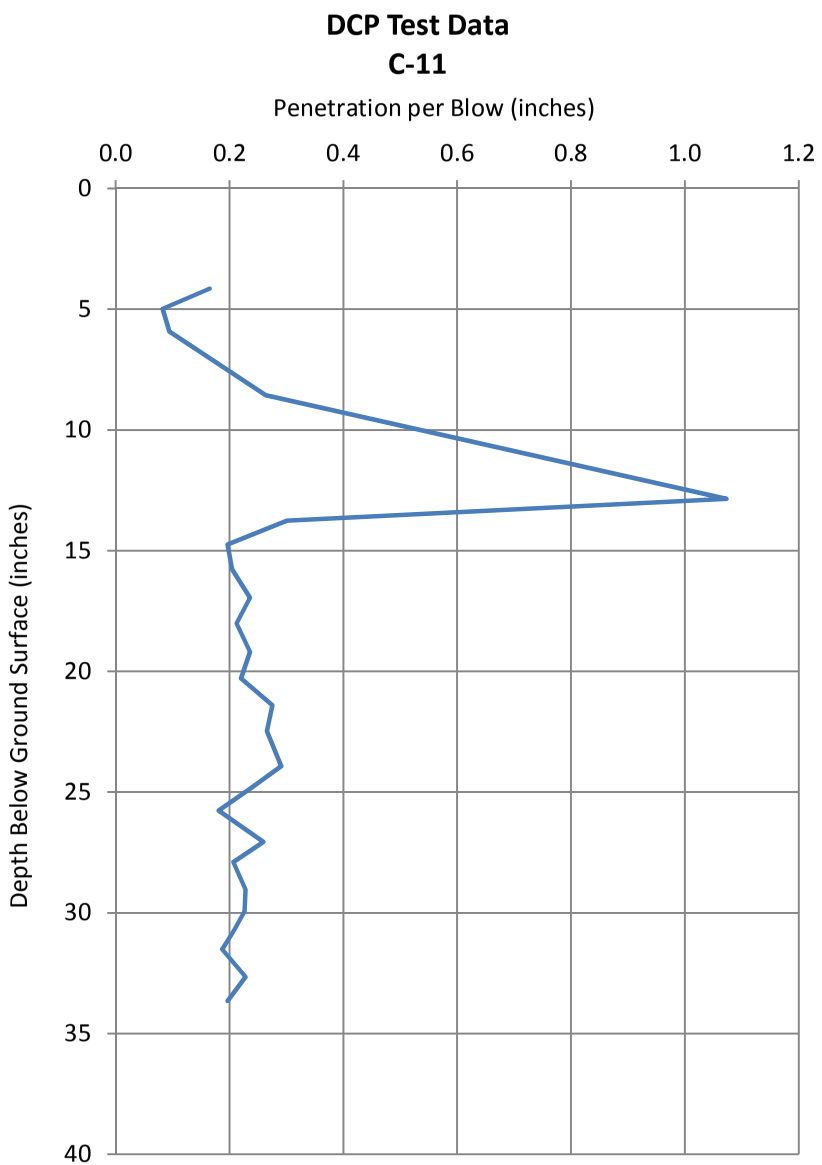
Pacific Geotechnical Engineers, Inc.

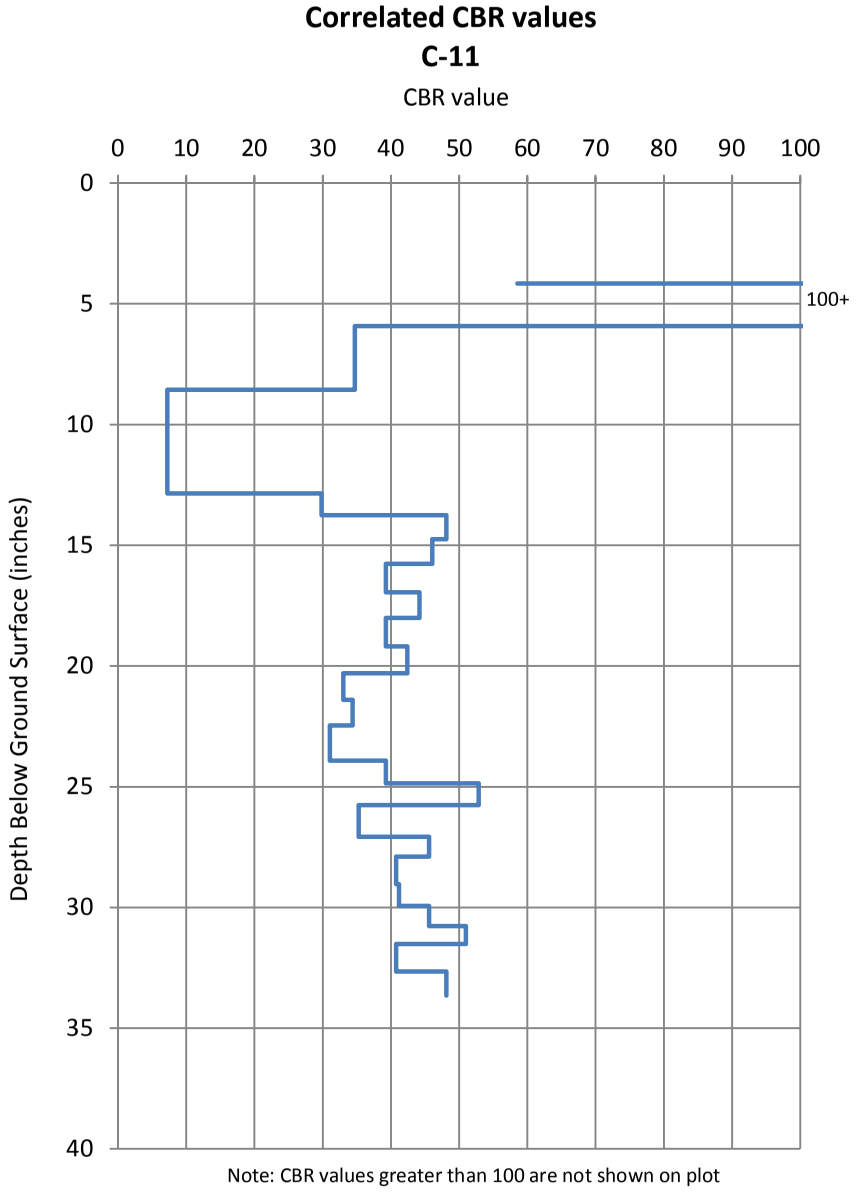
PLATE A-4.10

Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip

Kekaha, Kauai, Hawaii





Dynamic Cone Penetrometer Test Data

Rehabilitation of Pavement, Mana Drag Strip
Kekaha, Kauai, Hawaii

Pacific Geotechnical Engineers, Inc.

PLATE A-4.11

APPENDIX B

LABORATORY TESTING

GENERAL - To evaluate their engineering properties, selected soil samples obtained during the field exploration were subjected to laboratory moisture content and dry density determinations, Atterberg Limits, gradation analysis, moisture-density relations tests, laboratory single point CBR tests, strength tests, and R-value tests. The tests and their results are described in the following paragraphs.

MOISTURE CONTENT AND DRY DENSITY - Relatively undisturbed selected soil samples were tested to measure their in-situ moisture contents and dry densities. The tests were performed in general accordance with ASTM D 2216 test method. Results of the moisture content and dry density determinations are presented on the Logs of Borings, Plates A-1.1 through A-1.5 at the respective sample depths.

ATTERBERG LIMITS - Three (3) Atterberg Limits tests were performed on select samples in general accordance with ASTM D 4318 test method. The test results are presented on Plate B-1.

GRADATION ANALYSIS - Four (4) gradation analysis tests were performed in general accordance with ASTM D 422 to evaluate grain size distribution. The test results are presented on Plates B-2.1 and B-2.2.

MOISTURE-DENSITY RELATIONS - Two (2) moisture-density relations tests were performed on bulk samples of near surface soils in general accordance with ASTM D 1557 test method. The test results are presented on Plates B-3.1 and B-3.2.

CALIFORNIA BEARING RATIO (CBR) - Two (2) single point laboratory CBR tests were performed on the bulk samples used in the moisture-density relations tests in general accordance with ASTM D 1883 test method. The results of the CBR tests are presented on Plates B-4.1 and B-4.2.

SHEAR STRENGTH - Two (2) shear strength tests were performed on relatively undisturbed soil samples to evaluate their shear strength properties. The triaxial tests were performed under unconsolidated, undrained (TX/UU) conditions in general accordance with ASTM D 2850 test method. The tests were performed on soil samples at their field moisture contents. Total stress properties were measured in these tests. The results of the strength tests are summarized in Table B-1.

R-VALUE – R-value tests were performed on the bulk samples to measure their strength for potential use in road pavements. The tests were performed in general accordance with ASTM D 2844 test method by PGE's subcontracted testing laboratory, Advanced Terra Testing, Inc. (ATT). The test results are presented in Table B-2.

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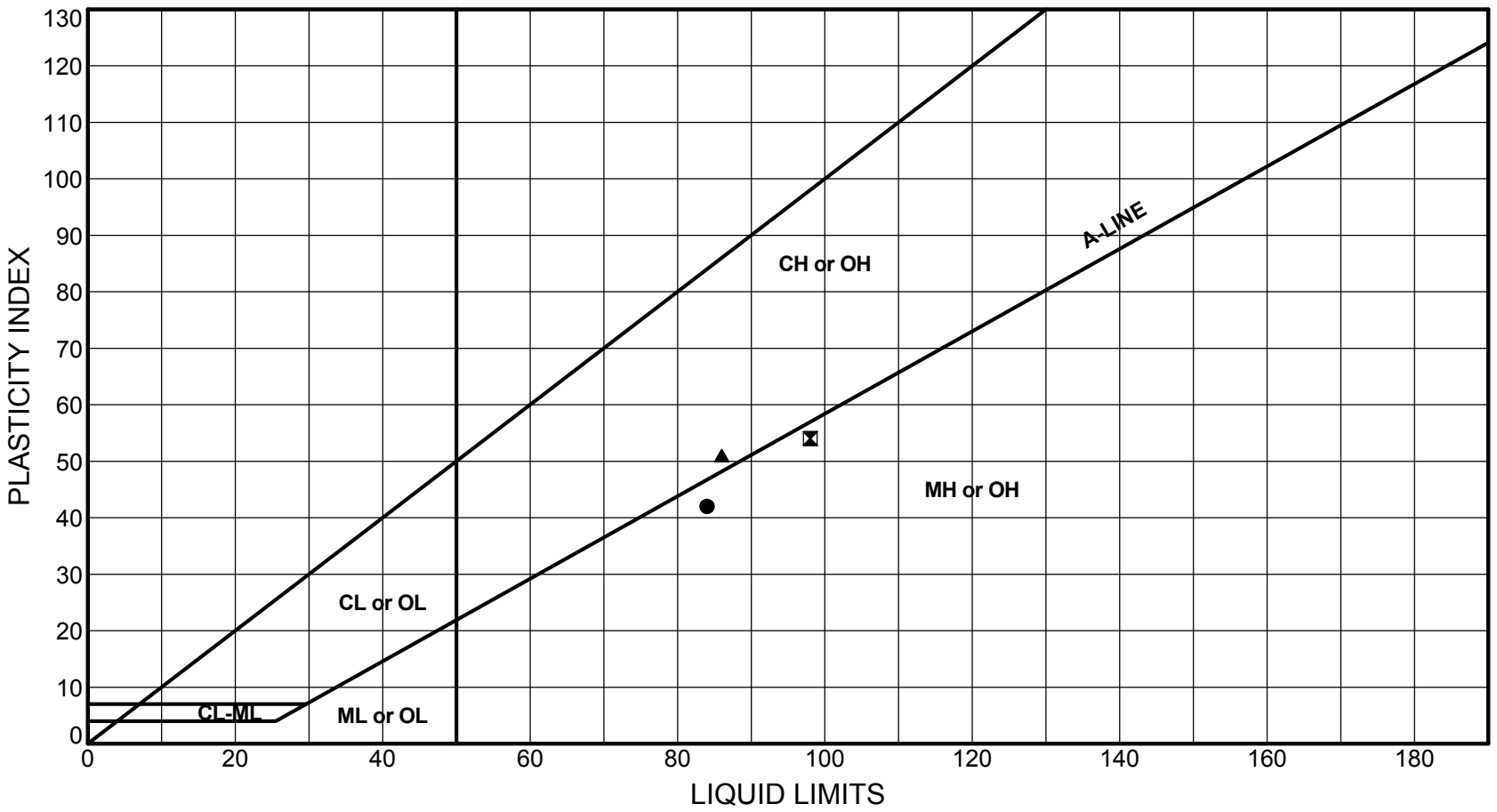
The following plates and tables are attached and complete this appendix.

Plate B-1	-	Atterberg Limits
Plates B-2.1 and B-2.2	-	Gradation Curves
Plates B-3.1 and B-3.2	-	Laboratory Compaction Test Data
Plates B-4.1 and B-4.2	-	Laboratory California Bearing Ratio (CBR) Test Results
Table B-1	-	Shear Strength Test Results
Table B-2	-	R-Value Test Results

PROJECT *Mana Drag Strip, Rehabilitation of Pavement* JOB NUMBER *7790-018*

LOCATION *Kekaha, Kauai* DATE *5/30/2012* DRAWN BY *LML*



ATTERBERG LIMITS

KEY	LOCATION	SAMPLE DEPTH (ft)	LIQUID LIMIT	PLASTICITY INDEX
●	B-1	0.7	84	42
⊠	B-5	0.9	98	54
▲	Bulk 1	0.5 - 1.0	86	51

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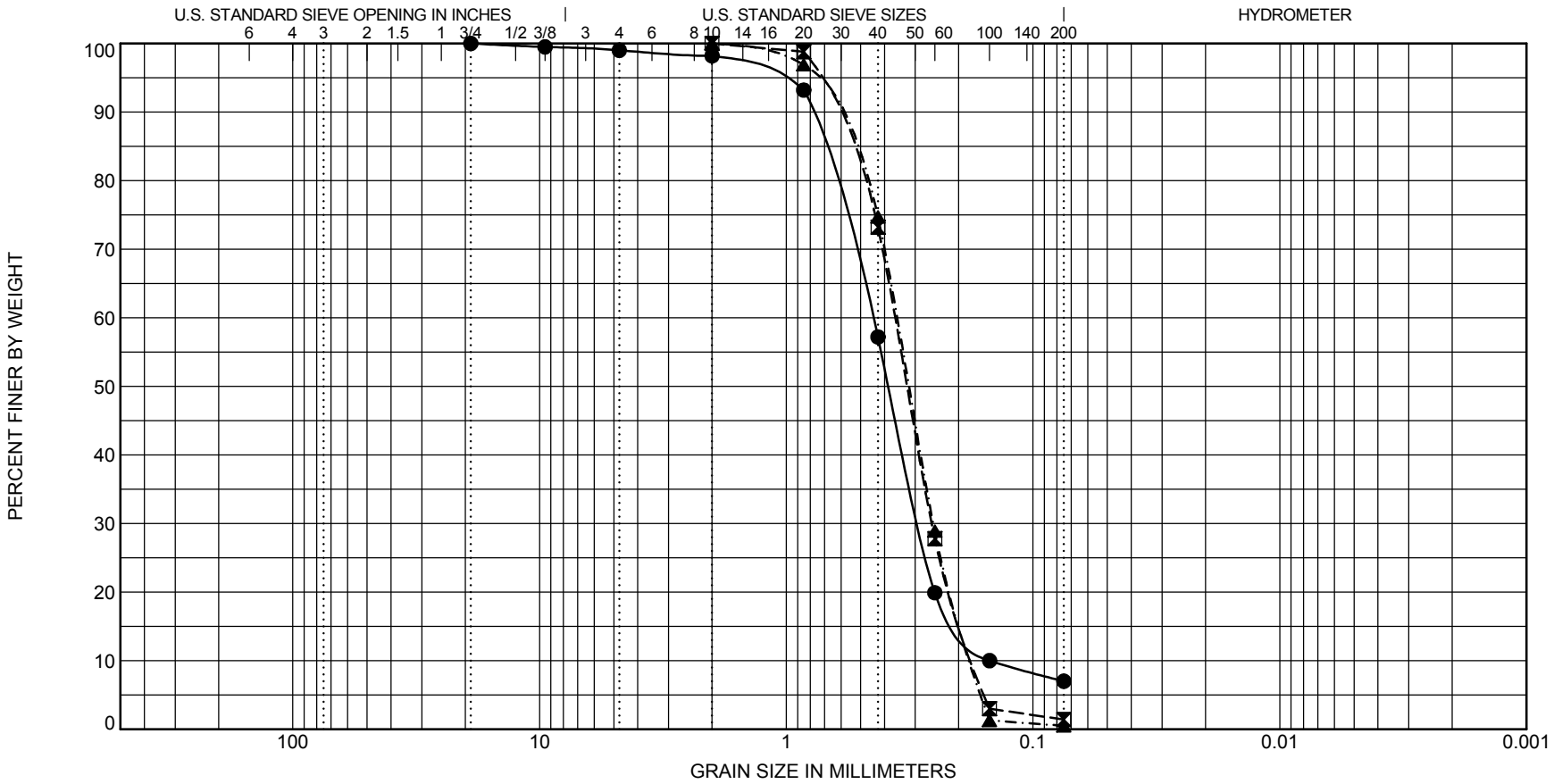
PLATE B-1

PROJECT *Mana Drag Strip, Rehabilitation of Pavement* JOB NUMBER *7790-018*

LOCATION *Kekaha, Kauai* DATE *5/30/2012* DRAWN BY *LML*



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LOCATION	DEPTH (ft)		CLASSIFICATION	NAT. WC	LL	PL	PI	SYMBOL
B-1	2.3	SP-SM	Light yellowish brown poorly graded coralline sand with silt	6				●
B-2	7.6	SP	Light yellowish brown poorly graded coralline sand with silt	23				⊠
B-4	3.5	SP	Light yellowish brown poorly graded coralline sand with silt	7				▲

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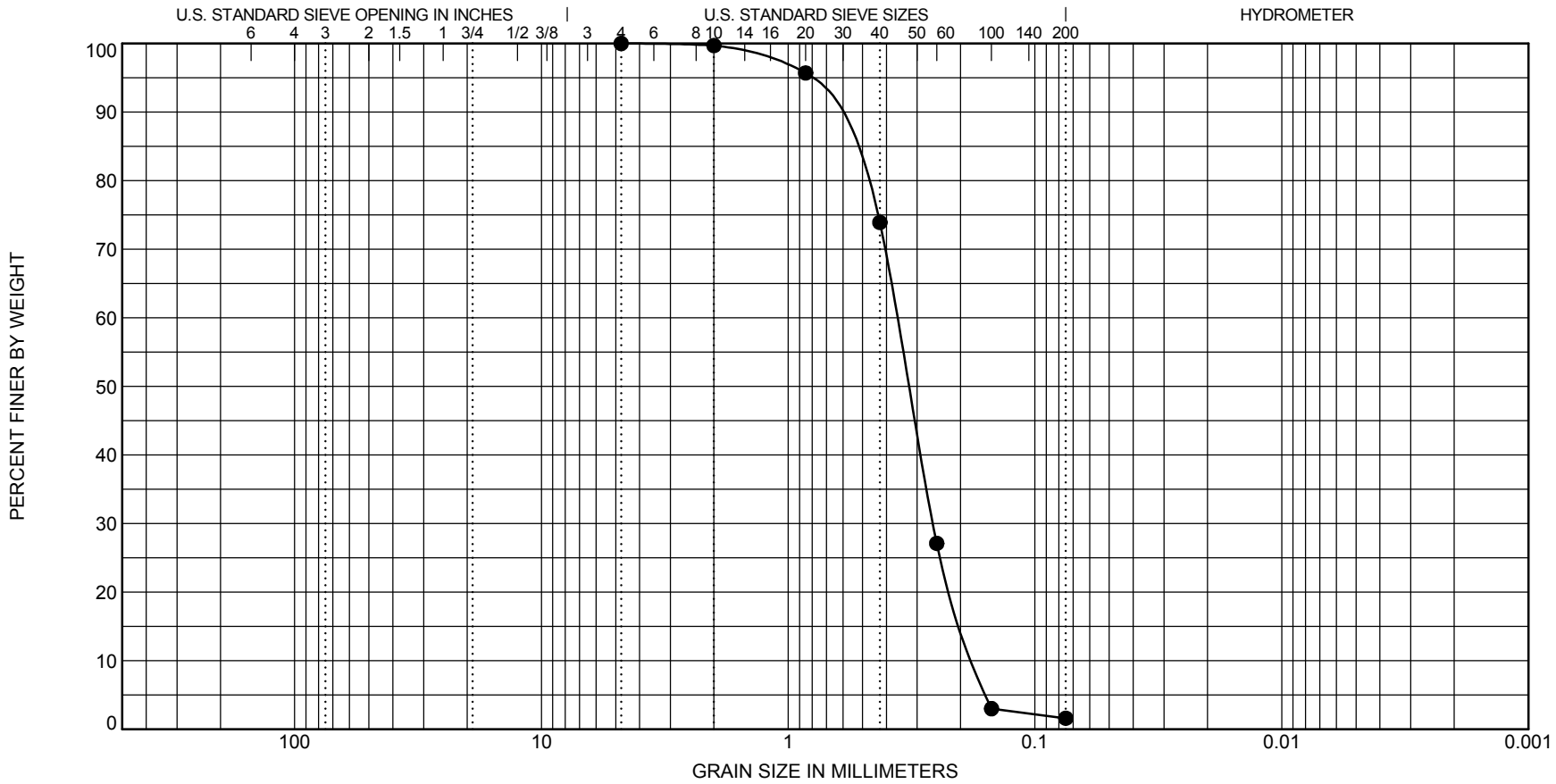
PLATE B-2.1

GRADATION CURVE

PROJECT *Mana Drag Strip, Rehabilitation of Pavement* JOB NUMBER *7790-018*

LOCATION *Kekaha, Kauai* DATE *5/30/2012* DRAWN BY *LML*



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LOCATION	DEPTH (ft)		CLASSIFICATION	NAT. WC	LL	PL	PI	SYMBOL
Bulk 2 (Sta. 12+00)	1.0 - 2.0	SP	Yellowish brown poorly graded sand	2				●

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PLATE B-2.2

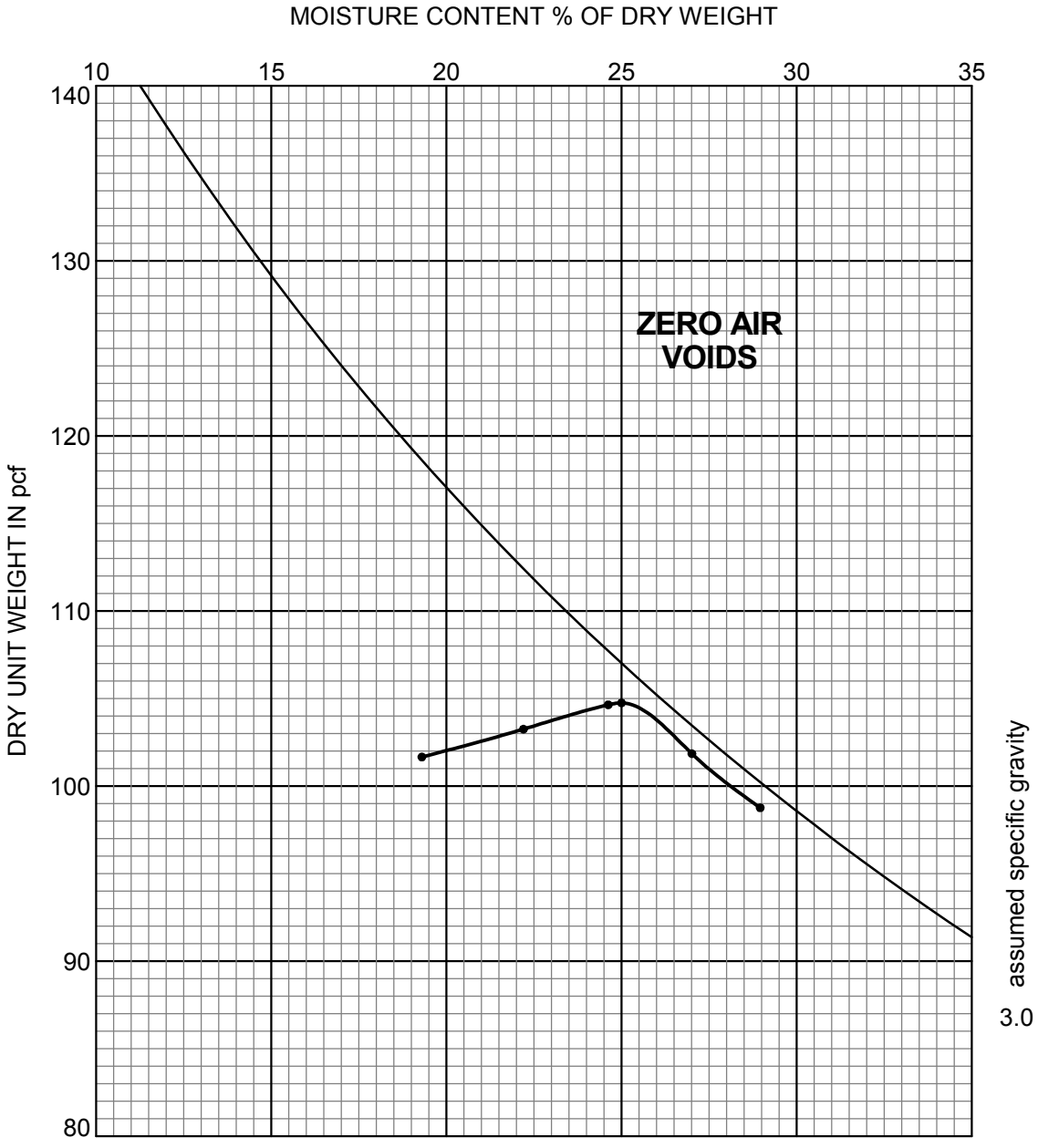
GRADATION CURVE

Sample Depth 0.5 - 1.0 ft
Elevation +9.5 ft ±
Description of Material Reddish brown fat clay (CH)

Compaction Method ASTM D 1557
Optimum Moisture Content 25.0%
Maximum Dry Unit Weight 104.8 pcf

Job Number: 7790-018
Project: Mana Drag Strip, Rehabilitation of Pavement
Kekaha, Kauai

Bulk 1
Sample Location: Station 6+00



COMPACTION TEST DATA

Pacific Geotechnical Engineers, Inc.

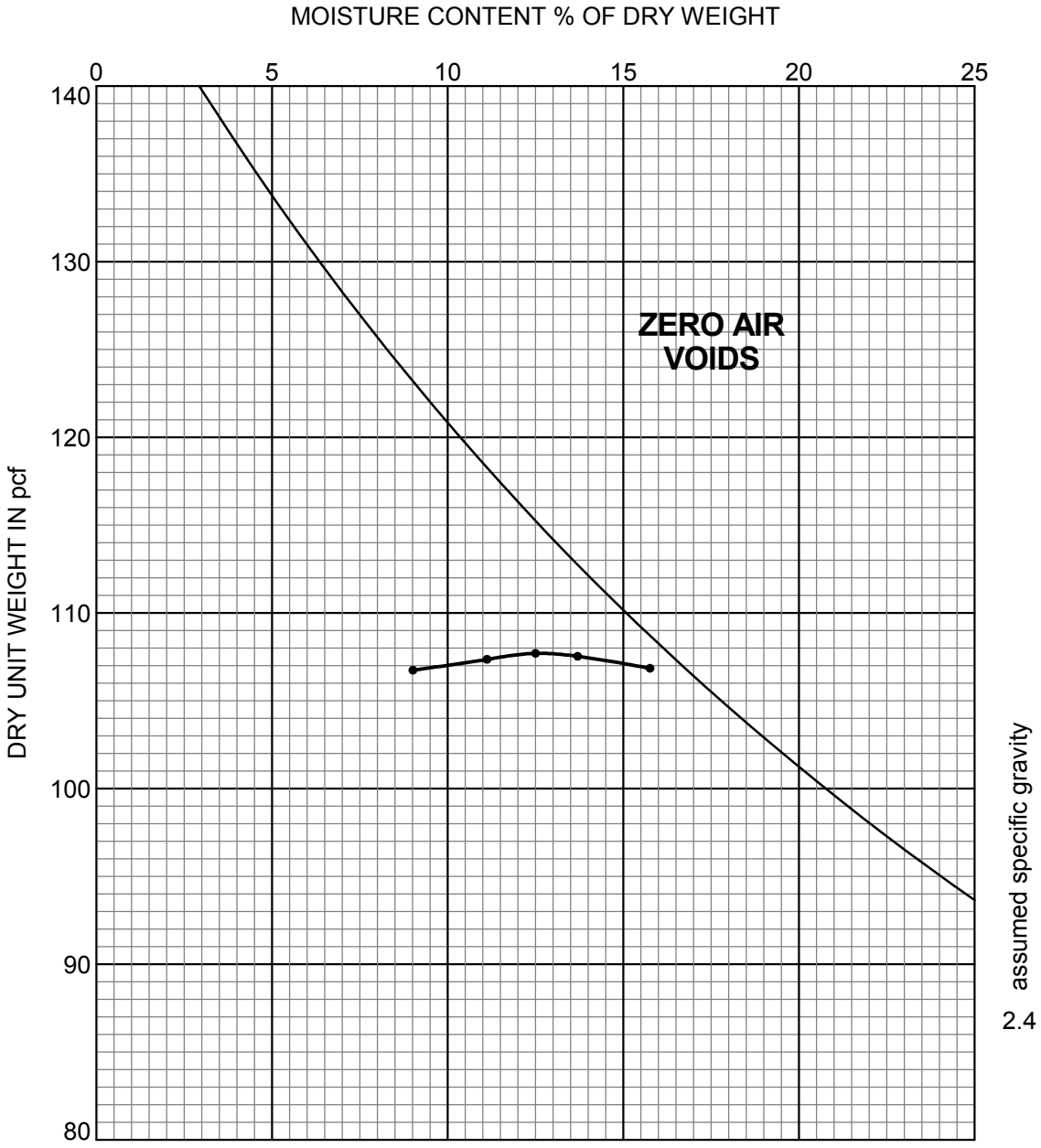
PLATE B-3.1

Sample Depth 1.0 - 2.0 ft
Elevation +9.0 ft ±
Description of Material Yellowish brown poorly graded sand (SP)
Compaction Method ASTM D 1557
Optimum Moisture Content 12.5%
Maximum Dry Unit Weight 107.7 pcf

Job Number: 7790-018
Project: Mana Drag Strip, Rehabilitation of Pavement
Kekaha, Kauai

Bulk 2

Sample Location: Station 12+00



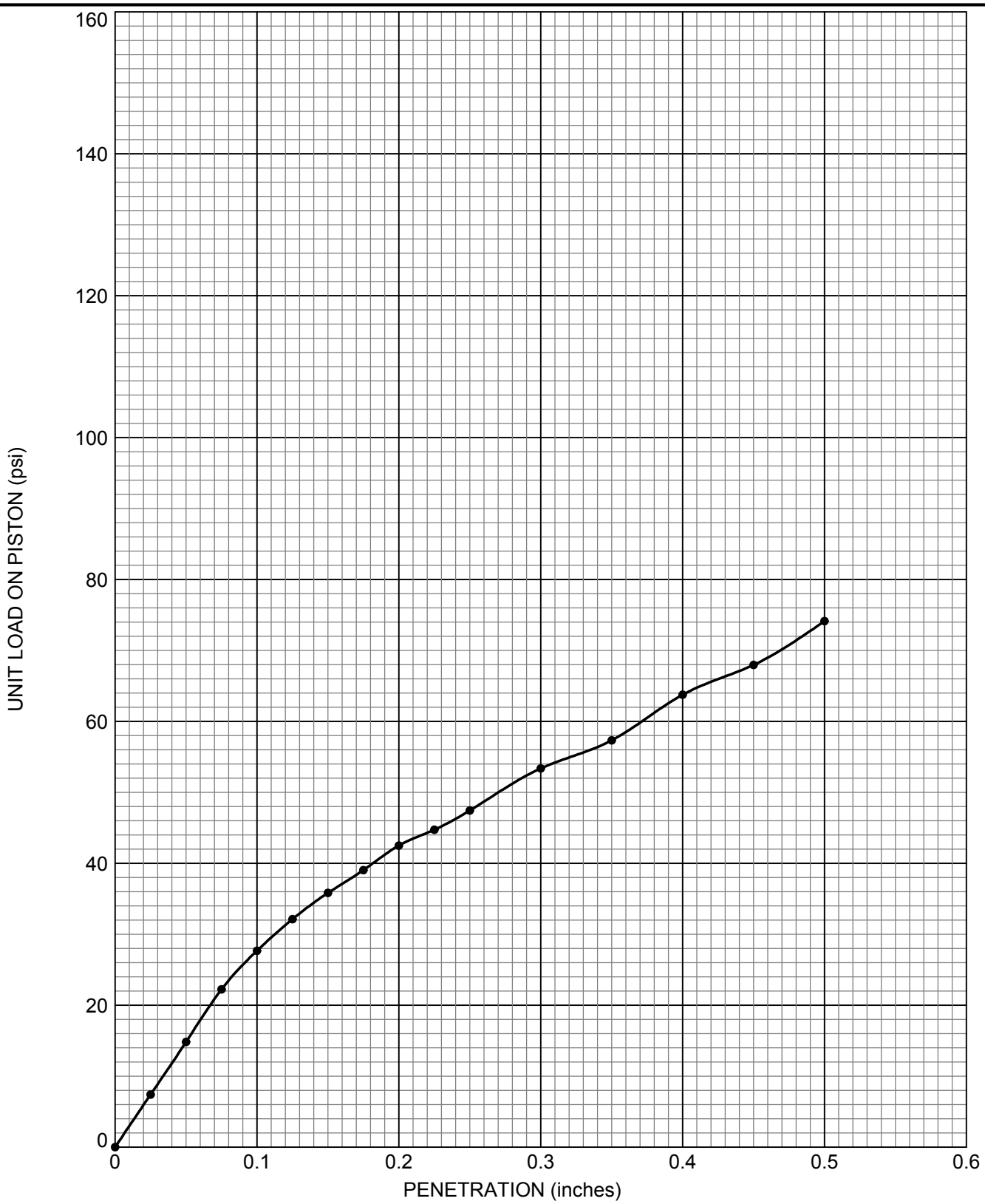
COMPACTION TEST DATA

Pacific Geotechnical Engineers, Inc.

PLATE B-3.2

PROJECT *Mana Drag Strip, Rehabilitation of Pavement* JOB NUMBER *7790-018*

LOCATION *Kekaha, Kauai* DATE *5/30/2012* DRAWN BY *LML*



LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

Location	Depth (ft)	Before Soaking		After Soaking			Laboratory CBR Value	
		Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	% Swell	@ 0.1"	@ 0.2"
Bulk 1 (Sta. 6+00)	0.5 - 1.0	24	93.7	35	87.9	6.6	3	3

Soil Description: Reddish brown fat clay (CH)

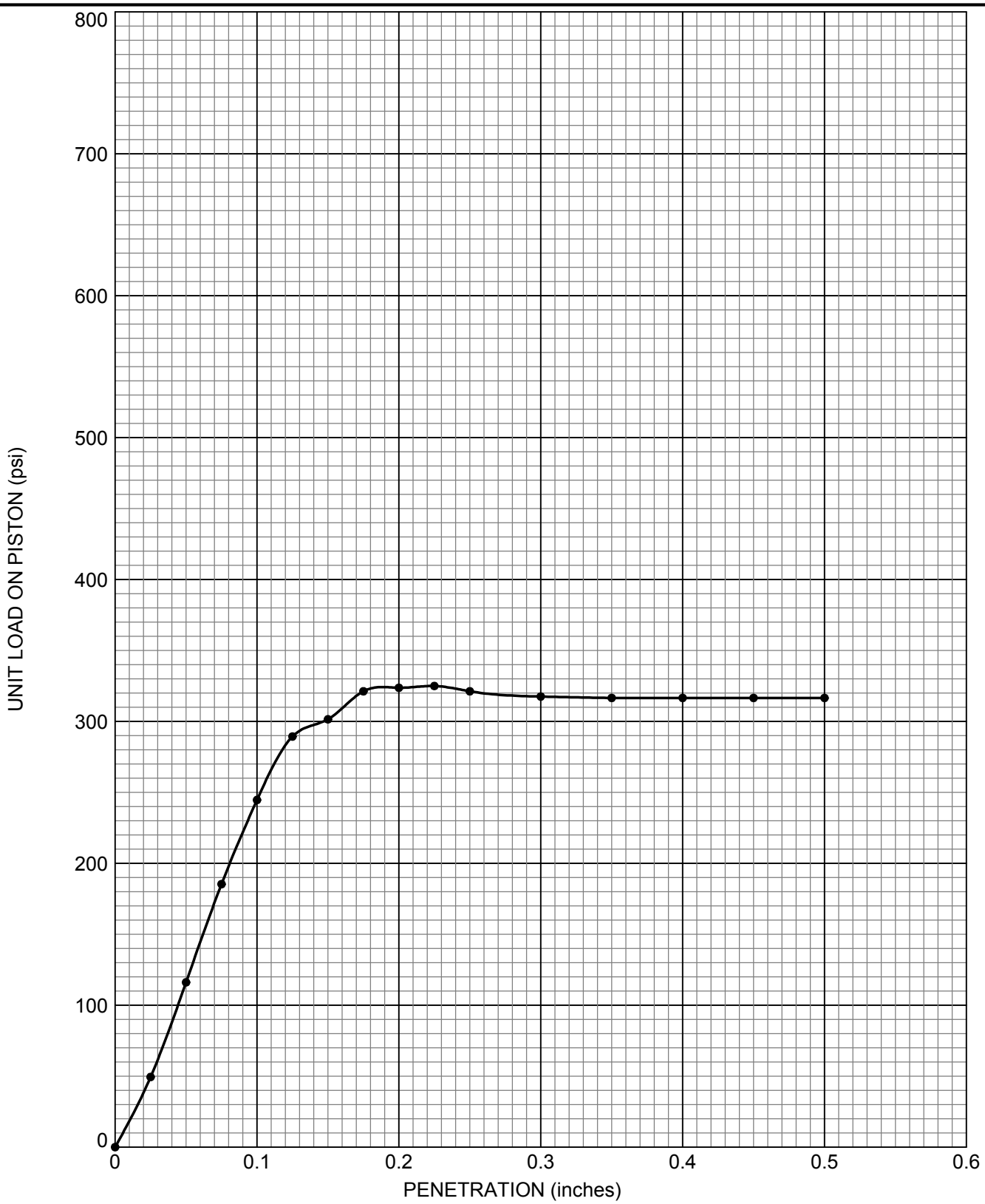
Test Method: ASTM D 1883

Pacific Geotechnical Engineers, Inc.

PLATE B-4.1

PROJECT *Mana Drag Strip, Rehabilitation of Pavement* JOB NUMBER *7790-018*

LOCATION *Kekaha, Kauai* DATE *5/30/2012* DRAWN BY *LML*



LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

Location	Depth (ft)	Before Soaking		After Soaking			Laboratory CBR Value	
		Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	% Swell	@ 0.1"	@ 0.2"
Bulk 2 (Sta. 12+00)	1.0 - 2.0	10	102.7	20	102.7	0.0	26	22

Soil Description: Yellowish brown poorly graded sand (SP)

Test Method: ASTM D 1883

Pacific Geotechnical Engineers, Inc.

PLATE B-4.2

TABLE B-1

SHEAR STRENGTH TEST RESULTS
ASTM D 2850

Boring No.	Depth (feet)	Soil Description	Moisture Content (%)	Dry Unit Weight (lb/ft^3)	Confining Pressure (lb/ft^2)	Shear Strength at Failure (lb/ft^2)
2	0.6	CH (fill)	40	78	100	1175
3	3.5	SP (beach/dune deposit)	6	99	150	690

TABLE B-2

R-VALUE TEST RESULTS
ASTM D 2844

Sample	Depth (feet)	Soil Description	R-value
Bulk 1	0.5 – 1.0	CH (fill)	9
Bulk 2	1.0 – 2.0	SP (beach/dune deposit)	75