GEOLABS, INC.
Geotechnical Engineering and Drilling Services

October 5, 2005
W.O. 5411-00

Mr. Merle D. Grimes
MDG, Inc.
1042 Broken Arrow Circle
Elizabeth, CO 80107

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
AHUKINI-LYDGATE BIKE/PEDESTRIAN PATH
FEDERAL-AID PROJECT NO. STP-0700(51)
LIHUE, KAUAI, HAWAII

Dear **Mr. Grimes:**

This report describes the findings from our literature research performed and presents our preliminary geotechnical considerations for the proposed Ahukini-Lydgate Bike/Pedestrian Path project between Ahukini Landing and Lydgate Park on the Island of Kauai, Hawaii. This report is intended to provide preliminary geotechnical considerations for planning and for the development of the Environmental Assessment only. Our work was performed in general accordance with the scope of services outlined in our revised fee proposal of June 9, 2005. The general location and vicinity of the project site are shown on the Project Location Map, Plate 1.

SUMMARY OF FINDINGS

Based on our literature research performed for the proposed Ahukini-Lydgate Bike/Pedestrian Path project, we anticipate that the proposed path alignments will traverse beach and dune sand deposits, alluvial soils and volcanic rock. The beach and dune sand deposits generally consist of poorly-graded sands. Portions of the project site are underlain by recent alluvial deposits that are typically soft and compressible. One of the path alignments travels close to an estimated wetland area. In addition, portions of the proposed alignments are underlain by basalt formations. We anticipate that the areas with basalt formations are covered by stiff residual and saprolitic soils, to basalt rock formation.

Several geotechnical considerations that may have a significant impact on project cost and construction time were identified during our literature research. In addition, the geotechnical considerations may have adverse impacts to the project during construction. These geotechnical considerations include settlement due to soft soil deposits, slope raveling, potential rockfall hazards, seepage of groundwater, and flooding associated with high rainfall storms. Special attention should be given to soft ground stabilization, cut slope design, subgrade stabilization, drainage design, and erosion control measures during the design and construction of the bike/pedestrian path project.

We anticipate that the proposed path alignments will traverse soft, loose, and/or unstable ground, such as gullies and stream crossings underlain by recent alluvial soils. Methods to reduce the anticipated path settlements and increase the path stability include removal of the soft and/or loose soil deposits and replacement with compacted fill materials, installation of a working platform or drainage blanket prior to fill placement, and utilizing soil stabilization methods, such as vibro-replacement or jet-grouting to improve the soft and/or loose soil deposits for construction.

In addition, a settlement waiting period likely will be required for embankment construction over the soft ground areas to reduce the potential for shear failure in the soft material and to reduce post construction settlements of the embankment. In addition, a surcharge program with settlement monitoring may be required to reduce the settlement waiting period.

It is proposed to place the new path on the existing Hanamaulu River Bridge structure. The load capacity of the existing bridge foundation will need to be determined for the additional loads of the new bridge deck structure. New bridge structures will be required for the drainageway crossing near the Radisson Hotel and for the roadway crossing near the Kamalani Bridge. Since poor subsoil conditions may be encountered at the crossing sites, a deep foundation system such as drilled shafts or driven piles may be required to support the new bridge structures. In areas subjected to scour, the new bridge structure should be designed for scour. We understand that the use of viaduct bridge structures is being considered for crossing the soft ground areas. Because of the soft subsoil conditions, we anticipate that a deep foundation system will likely be required to support the viaduct bridge structures.

It should be noted that the findings and preliminary recommendations provided in this report are intended for planning and development of the Environmental Assessment only. The text of this report should be referred to for detailed discussion of our findings and preliminary recommendations.

PROJECT CONSIDERATIONS

The proposed Bike/Pedestrian Path project is located between Ahukini Landing and the existing Lydgate Park on the Island of Kauai, Hawaii. The project involves completion of the planning phase, including obtaining approval of the environmental assessment. The study corridor is located between Ahukini Landing and a point near the existing Lydgate Park, and from the shoreline to the Kuhio Highway.

Alternative path alignments were developed during the initial phase of the planning study for the project. These path alignments were reduced to two main alternative path alignments for engineering evaluation to quantify potential costs for grading and major structures. Geotechnical input will be required to identify potential hazards, such as soft ground conditions, rockfall, and other conditions that may have a large impact on project costs and construction time.

We understand that the bike and pedestrian path will be about 10 to 12 feet wide and will consist of a 6-inch thick concrete path. One of the path alignment alternatives travels primarily along the existing shoreline from Ahukini Landing to Lydgate Park. The other path alignment alternative travels further inland along Kuhio Highway.

One of the path alignment alternatives will traverse one existing major structure, the Hanamaulu River Bridge. Since the Hanamaulu River Bridge is historic, construction of a replacement bridge structure may not be possible. Therefore, the Hanamaulu River Bridge structure will probably require modifications. In addition, two new bridge structures and a tunnel structure are proposed along the alignments.

Based on the relatively flat site topography along most of the path alignments, we anticipate that the majority of the cuts and fills will be on the order of less than 10 feet. However, major cuts and fills on the order of up to about 20 to 30 feet are anticipated for the construction of the proposed path alignment located between Hanamaulu Bridge and Ahukini Landing.

PATH ALIGNMENT ALTERNATIVES

We understand that two main path alignment alternatives were developed for the project. These selected path alignment alternatives were studied for this report and are described below. The different paths and segments for the path alignment alternatives are shown on the Site Plans, Plates 2.1 through 2.6.

Alternative No. 1

Path Alternative No. 1 generally runs along the existing shoreline. The path starts from Ahukini Landing, circles around Hanamaulu Bay, and travels near the shoreline to Lydgate Park. At the back of Hanamaulu Bay, the path alignment is located away from the shoreline and within a low-lying area. In addition, the path crosses over the existing historic Hanamaulu Bridge in this area.

An alternative segment that connects the shoreline path up to Kuhio Highway is proposed near the Wailua Golf Course driving range. This alternative segment includes a tunnel section that crosses an existing pathway. In addition, new bridge structures are proposed near the Radisson Hotel and the Kamalani Play Bridge at Lydgate Park.

Alternative No. 2

Path Alternative No. 2 connects with Path Alternative No. 1 near the northern portion of Hanamaulu Bay. This alternative path alignment follows existing cane haul roads and runs along the eastern side of Kuhio Highway to Lydgate Park. This path alternative also includes alternative path segments that travels from Kuhio Highway down to the shoreline near the Radisson Hotel.

GEOLOGIC CONDITIONS

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lava of the Waimea Canyon Volcanic Series during the late Pliocene Epoch (more than 2¼ million years before present). Following the cessation of this main shield building phase, there was renewed volcanic activity with the extrusion of basaltic lava of the post-erosional Koloa Volcanic Series and the concurrent deposition of the alluvial sediments of the Palikea Formation.

The majority of the Island of Kauai is covered by lava of the Waimea Canyon Volcanic Series. These lavas consist of four distinct formations: Napali, Olokele, Haupu, and Makaweli. These formations are comprised of thin-bedded a'a and pahoehoe flows to massive basalt flows that ponded in calderas and graben.

Rocks of the Koloa Volcanic Series cover most of the eastern half of the Island of Kauai. These rocks are generally characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales. Associated with the vents are pyroclastic materials, which usually form low cinder cones at the vent.

During the Pleistocene Epoch (Ice Age), there were many sea level changes as a result of widespread glaciation in the continental areas of the world. As the great continental glaciers accumulated, the level of the ocean fell since there was less water available to fill the oceanic basins. Conversely, as the glaciers receded, or melted, global sea levels rose because more water was available. The land mass of Kauai remained essentially stable during these changes, and the fluctuations were eustatic in nature. These glacio-eustatic fluctuations resulted in stands of the sea that were both higher and lower relative to the present sea level of Kauai.

The basaltic rock built by the extrusion of lavas of the Koloa Volcanic Series are generally characterized by flows of jointed dense vesicular basalt inter-bedded with thin clinker layers. The weathering process has formed a mantle of residual soils which grade to saprolite with depth. In general, saprolite is composed of mainly silty material and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with depth.

Erosion of the upper Koloa and Waimea Canyon Volcanic Series has deposited alluvial sediments along streams, drainageways, and low-lying areas. These sediments are generally unconsolidated to moderately consolidated, non-calcareous soil deposits. Agricultural and commercial developments within the last century have brought the project site to its present conditions.

The geology for the proposed path alignments were developed based on geologic references. The site geology for the two path alternatives is described in the following subsections.

Alternative No. 1

The proposed path alignment for Alternative No. 1 is mainly underlain by beach and dune sand deposits. The beach and dune sand deposits are characterized as unconsolidated calcareous deposits. These deposits are poorly graded and uniform in particle size. Recent alluvial deposits may be encountered further inland from the shoreline near the Kawailoa area and within the Hanamaulu Stream area. The recent alluvial deposits are characterized as unconsolidated, non-calcareous soils. These recent alluvial deposits tend to be soft in consistency and compressible. In addition, basalt rock formation of the Koloa Volcanic Series may be encountered along the southern portion of the path alignment at the sides of Hanamaulu Bay.

Alternative No. 2

This alternative alignment is mainly underlain by alluvial deposits consisting of recent and older alluvium. Characteristics of the recent alluvium are described above. The older alluvial deposits are more consolidated and stiffer in consistency compared to the recent alluvial deposits. The southern portion of path alignment is underlain by basalt rock formation of the Koloa Volcanic Series. We anticipate the presence of residual and saprolitic soils near the ground surface. These soils are developed from the in-situ weathering of the basalt formation. In addition, the northern portion of the path alignment near Lydgate Park is underlain by a dune sand deposit.

SURFACE TERRAIN

The terrain along the bike/pedestrian path project limits varies significantly from level, low-lying areas to sloping hillside areas. A brief description of the topography along the proposed alignments is presented below. These descriptions are based on United States Geological Survey (USGS) topographic maps.

Alternative No. 1

The initial roadway alignment from Ahukini Landing travels around Hanamaulu Bay with the ground surface varying from low-lying near the mouth of the bay to sloping hillsides along the sides of the bay with ground surface elevations up to about +80 feet Mean Sea Level (MSL). The remaining portion of the alignment travels along the shoreline with ground surface elevations from about +5 to +20 feet MSL.

Alternative No. 2

Since this alternative path alignment is further inland, the ground elevations along Alternative No. 2 are generally higher compared to Alternative No. 1. The existing ground surface near Hanamaulu Bay is about Elevation +80 feet MSL and generally slopes downwards as the alignment travels along Kuhio Highway to Lydgate Park to about Elevation +5 to +20 feet MSL.

EXISTING/NEW BRIDGE STRUCTURES AND TUNNEL

The proposed path alignments will traverse existing and new bridge structures and a new tunnel structure. Description of the bridge and tunnel structures is provided in the subsequent subsections.

Existing Hanamaulu River Bridge

The Hanamaulu River Bridge is a 2-span concrete arch bridge with 53 and 79-foot long spans. The bridge was built in the 1920's with a bridge deck about 10 feet wide. The bridge piers and abutments are supported on a pile foundation except for the Kapaa-side abutment that is supported on spread footings bearing on rock. The type of pile and other details of the pile foundation were not shown on the available drawings. In addition, subsurface soil information was not provided on the drawings. We anticipate that the existing bridge structure is underlain by recent alluvial deposits.

We understand that the existing bridge will be renovated with a new bridge deck on the existing bridge. The bridge deck will consist of precast concrete planks with stainless steel cable railings and concrete railing posts. In addition, new concrete end post structures will be constructed.

The load capacity of the existing bridge foundation will need to be determined for the additional loads of the new bridge deck structure. We understand that bridge scour need not be considered in the bridge design.

New Bridge Near Radisson Hotel

A new one-span bridge structure is proposed to cross an existing drainageway near the Radisson Hotel. The new bridge will be supported at it ends by concrete abutment structures and will be about 90 feet in length. The use of prestressed planks or girders is being considered with stainless steel cable railings. Based on the geologic maps, the new bridge site is generally underlain by recent alluvial and beach sand deposits.

New Tunnel Structure Near Driving Range

A new path tunnel structure is proposed near the Wailua Golf Course Facility. The 160-foot long tunnel will be composed of concrete construction and will be about 12 feet wide by 10 feet high. The tunnel structure is situated on a path connecting the Alternative No. 1 Coastal Path with the Alternative No. 2 Highway Path. Based on the geologic maps, the tunnel site is generally underlain by dune sand deposits.

New Bridge Structure Near Kamalani Bridge

A new three-span bridge structure is proposed near the existing Kamalani Bridge within the Lydgate Park area. The new bridge will be about 140 feet in length with span

lengths of 35 and 70 feet. The proposed bridge will consist of wooden deck and railings, concrete pier columns, and concrete abutment structures. The wooden deck will be supported by stainless steel cables. We anticipate that the new bridge site is underlain by a dune sand deposit.

WETLAND AREA

We estimate that the proposed Alternative No. 2 path alignment will travel close to an estimated wetland area. In general, these areas are characterized by swamp or marsh-like environment with possible presence of standing water. Wetland sites may contain various forms of unique wildlife, which may require preservation. The approximate location of the estimated wetland site is shown on Plates 2.4 and 2.5.

From a geotechnical engineering point-of-view, swamps and marshlands often imply the presence of soft soils. It should be noted that areas not designated as a "Wetland Site" may also contain deposits of soft soils. These areas are further discussed in the Geotechnical Considerations section.

GEOTECHNICAL CONSIDERATIONS

Based on our desk-top study of the project site, several types of geotechnical considerations may have the potential for adverse impacts on the stability of the planned structures as well as the future maintenance of the proposed path. The geotechnical considerations may include, but are not limited to, the following:

- Settlement Due to Soft Soils
- Slope Raveling or Failure
- Rockfall Hazard
- Seepage of Groundwater
- Flooding by Rainfall

Settlement Due to Soft Soils

Areas underlain by recent alluvium are susceptible to consolidation and settlement over time as man-made fills are placed over these soft ground areas. Based on our literature research, soft soils are likely to be encountered at stream crossings, drainageways, wetland areas and other localized areas. A thorough field exploration should be performed at these locations where soft soil deposits are suspected in order to determine the lateral extent, thickness, and consolidation characteristics under the proposed fill loading conditions. The soft soil areas should be further evaluated to provide recommendations for design and construction of embankments and/or bridge viaduct structures over these areas. The estimated soft ground areas are shown on the Plates 2.1 through 2.6.

Slope Raveling or Failure

Based on the aerial photographs and available topographic maps of the project site, we anticipate that earthwork for the proposed bike and pedestrian path project will involve cuts at various locations throughout the site. We anticipate that substantial cuts of up to about 20 feet in the saprolite and/or weathered rock may be required. Therefore, some slope raveling and localized slope failures may occur on very steep cut slopes. Most of these slope raveling and failures tend to occur in steeply cut slopes with slope inclinations of about 1H:1V or steeper. Because of these existing conditions, cut slope inclinations for the larger cut slopes will need to be evaluated on a case-by-case basis when the vertical profile of the alignment is established.

Rockfall Hazard

It should be noted that areas adjacent to relatively steep hillsides are susceptible to rockfall. Rockfall involves the detachment and fall of rock material from the slope face that can present dangerous conditions for bike and pedestrian traffic. Because of these potential issues, cut slope inclinations for the larger cut slopes will need to be evaluated on a case-by-case basis when the vertical profile of the alignment is established.

Seepage of Groundwater

We anticipate that the soils encountered during path construction may have relatively high water contents due to the high rainfall and high groundwater levels. In addition, perched groundwater tables may exist in some areas. Because of the high moisture anticipated in the weathered materials, earthwork cuts may expose permeable layers responsible for transmitting seepage of subsurface groundwater, which in turn may cause potentially unstable cut faces.

Flooding by Rainfall

Based on a review of available topographic maps of the site, the Island of Kauai contains numerous rivers, streams, and drainage paths as a result of the high volume of tropical rainfall. Extended periods of heavy rainfall may swell drainage pathways to their capacity and flood low-lying areas. We wish to emphasize that adequate modeling of scour potential and storm water runoff should be performed for the design of new bridge structures.

CLOSURE

We appreciate the opportunity to provide geotechnical services to you on this project. If you have questions or need additional information, please contact our office.

Respectfully submitted,

GEOLABS, INC.

By _____
Gerald Y. Seki, P.E.
Senior Geotechnical Engineer

By _____
Clayton S. Mimura, P.E.
President

CSM:GS:as

CLAYTON S. MIMURA
LICENSED PROFESSIONAL ENGINEER
No. 4176-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

_____ 4-30-06
SIGNATURE EXPIRATION DATE OF THE LICENSE

Attachments: Project Location Map, Plate 1
Site Plans, Plates 2.1 thru 2.6

(4 Copies to Addressee)

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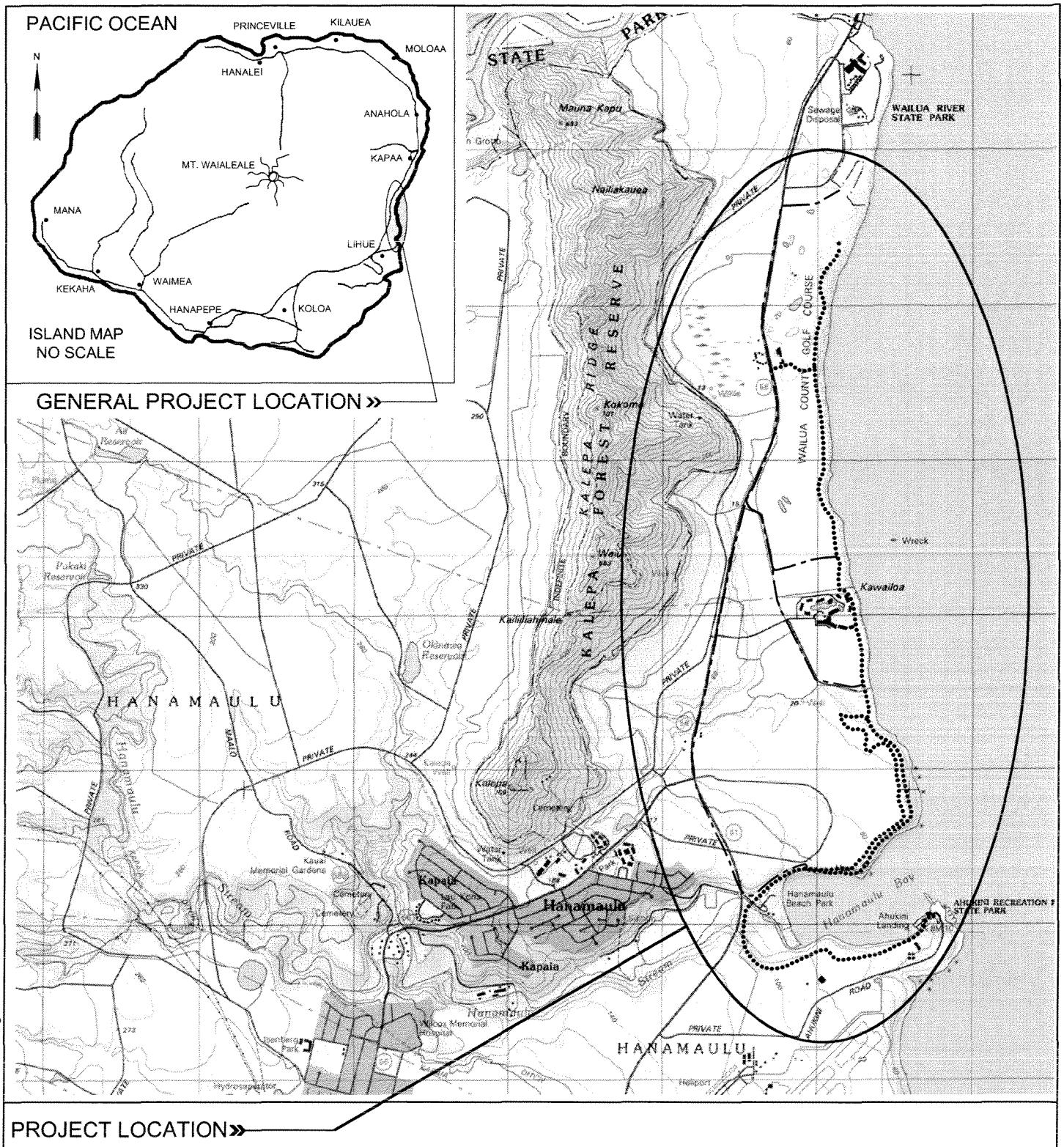

LEGEND:

····· ALTERNATE NO. 1

— - — ALTERNATE NO. 2

3000 1500 0 3000 FT.

GRAPHIC SCALE

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REFERENCE: MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).

PROJECT LOCATION MAP

AHUKINI-LYDGATE BIKE/PEDESTRIAN PATH
FEDERAL AID PROJECT NO. STP-0700(51)
LIHUE, KAUAI, HAWAII

GEOLABS, INC.

Geotechnical Engineering

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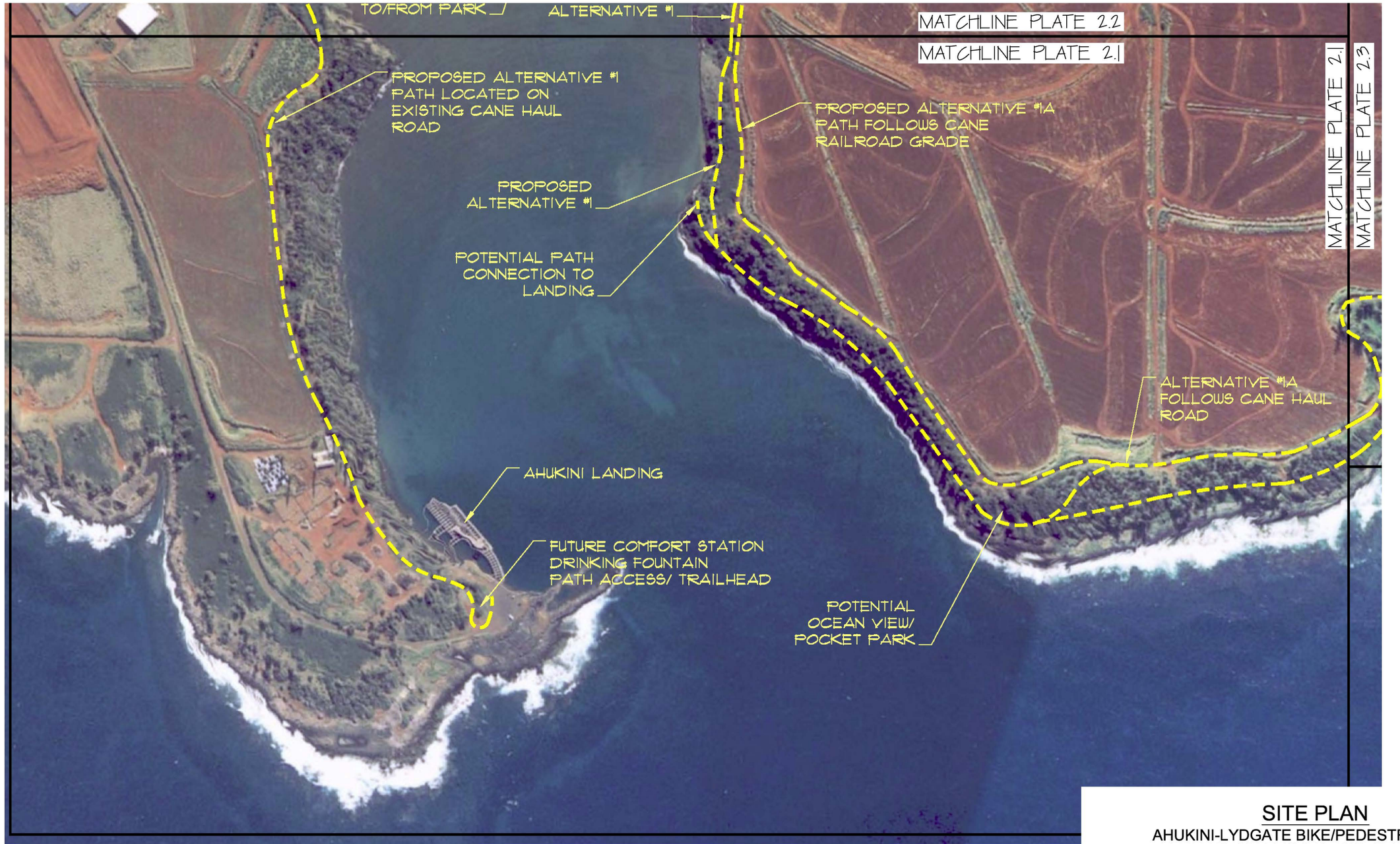

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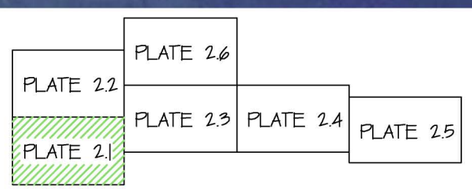
- ESTIMATED SOFT GROUND AREAS
- ESTIMATED WETLAND AREAS



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GRAPHIC SCALE

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SITE PLAN

AHUKINI-LYDGATE BIKE/PEDESTRIAN PATH
FEDERAL AID PROJECT NO. STP-0700(51)
LIHUE, KAUAI, HAWAII

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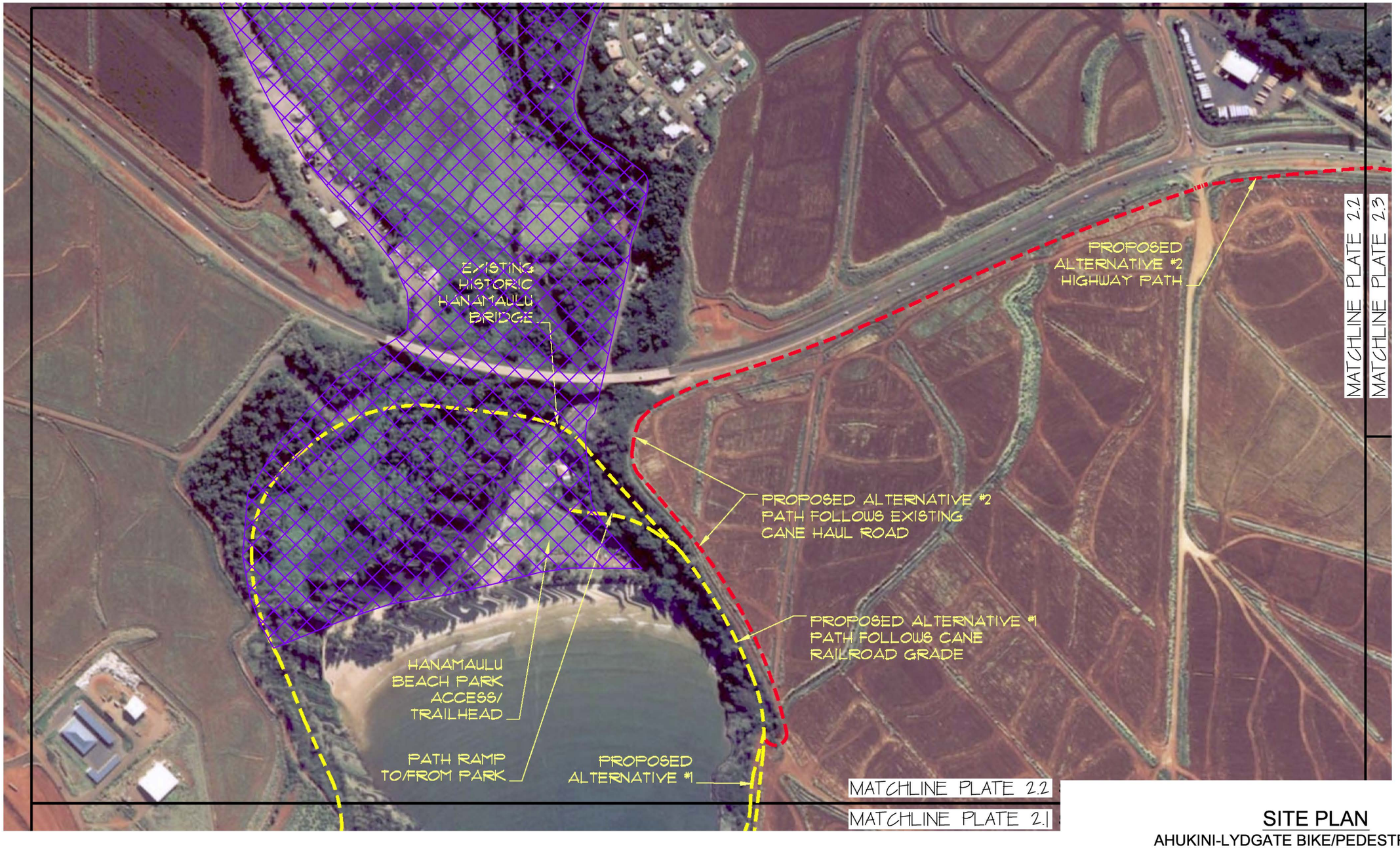

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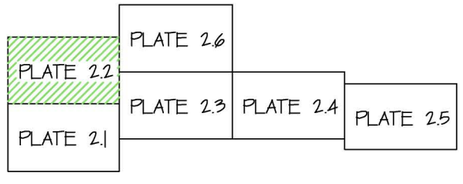
- ESTIMATED WETLAND AREAS



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SITE PLAN

AHUKINI-LYDGATE BIKE/PEDESTRIAN PATH
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MATCHLINE PLATE 2.6

MATCHLINE PLATE 2.3

FUTURE JUNIOR GOLF COURSE
-COMFORT STATION
-PARKING
-SHOWERS
-PICNIC FACILITIES
-DRINKING FOUNTAIN
-PATH ACCESS/TRAILHEAD

EXISTING MOTOCROSS PARK

PROPOSED ALTERNATIVE #2A

WAILUA GOLF COURSE

4

5

PROPOSED ALTERNATIVE #1A

ALTERNATIVE #1A FOLLOWS ALONG CANE HAUL ROAD

MATCHLINE PLATE 2.1

MATCHLINE PLATE 2.3

EXISTING COMFORT STATION

PROPOSED ALTERNATIVE #1 COASTAL PATH

MATCHLINE PLATE 2.3

MATCHLINE PLATE 2.4

LEGEND:

ALTERNATIVE NO. 1

ALTERNATIVE NO. 2

ESTIMATED SOFT GROUND AREAS

ESTIMATED WETLAND AREAS

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GRAPHIC SCALE

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SITE PLAN

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- ALTERNATIVE NO. 1
- ALTERNATIVE NO. 2
- ESTIMATED SOFT GROUND AREAS
- ESTIMATED WETLAND AREAS

PLATE 2.1 | PLATE 2.2 | PLATE 2.3 | PLATE 2.4 | PLATE 2.5 | PLATE 2.6

0 200 400 800 1200 FT.

GRAPHIC SCALE

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SITE PLAN

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SITE PLAN

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- ALTERNATIVE NO. 1
- ALTERNATIVE NO. 2
- ESTIMATED SOFT GROUND AREAS
- ESTIMATED WETLAND AREAS

PLATE 2.6
PLATE 2.2 | PLATE 2.3 | PLATE 2.4 | PLATE 2.5
PLATE 2.1

0 200 400 800 1200 FT.
GRAPHIC SCALE

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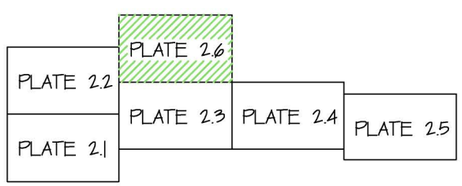

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