Applied
Geotechnical
Engineering
& Geologic Consulting

April 23, 2016

KAS & Associates, Inc.
Attention: Scott Pingle, P.E.
304 S. Holly Street
Medford, OR 97501

SUBJECT: GEOTECHNICAL INVESTIGATION, KARUK RESIDENT CENTER, HAPPY CAMP, CALIFORNIA

At your request, Applied Geotechnical Engineering and Geologic Consulting LLC (AGEGC) has conducted a geotechnical investigation for the proposed Resident Center for the Karuk Tribe in Happy Camp, California. Our investigation consisted of subsurface explorations, laboratory testing, and engineering analyses. This report summarizes our work and provides our conclusions and recommendations for suitably founding the proposed building on the site.

SITE DESCRIPTION

The proposed building site is located on the south (downhill) side of Jacobs Way in Happy Camp. The site is currently used for the facilities group for the tribe. It has the facilities office in a house on the north side of the site. The remainder of the site is used for storage of materials. The building site footprint gently slopes down to the south/southwest; however, the area southwest of the new building (outside the existing fence line) slopes down to the southwest at about 2.5H:1V. The slope is relatively uniform with no indications of slope instability. Indications of groundwater seeps or springs (damp/wet areas and/or water-loving vegetation) were not observed on the slope at the time of our fieldwork.

PROJECT DESCRIPTION

We understand the new metal building will include a large sports court, small rooms and associated facilities. A retaining wall (up to 8 ft high) will be required along the downhill side to provide support for the first floor slab-on-grade. The retaining wall will be constructed of concrete block. We estimate foundation wall loads and column loads will be up to 3 kips/ft and 20 kips, respectively. Site development work will include removal of the existing building.

GEOLOGY

Based on our review of geologic information for the site and vicinity and our previous work in this area, the site is underlain by severely weathered metasedimentary rock. The rock has typically weathered to the consistency of a hard, reddish-brown silt soil. The depth of weathering is typically greater than 20 ft thick.

SUBSURFACE CONDITIONS

Subsurface materials and conditions for the proposed building were investigated by AGEGC on March 23, 2016, with two test pits. The approximate locations of the test pits are shown on the Site Plan, Figure 1. Due to the material stored at the site and the existing building, the potential locations for test pits were limited. The test pits were completed using a John Deere 110 rubber-tired backhoe provided by the tribe. All field operations were observed by a geotechnical engineer/geologist provided by our firm, who maintained a detailed log of the materials and conditions encountered in the test pits.

Logs of the test pits are provided at the end of the report, in Appendix A. The terms used to describe the materials encountered in the test pits are defined in Table 1A.

Soils. The test pits encountered surficial silt soil that grades with depth to decomposed metasedimentary rock.

Both test pit excavations encountered a surficial layer of imported fill consisting of crushed (angular) rock. The rock is used as surfacing in the storage yard and is typically about 12 in. thick.

Below the fill is typically a dark red, clayey silt soil. The dark red soil is slightly to moderately expansive, highly compressible, and low strength. This silt soil is typically less than 12 in. thick.

The majority of the soils encountered in the two test pits consist of stiff, reddish-brown and mottled silt. The color of the silt indicates it is typically not saturated. The silt is the result of in situ weathering of the metasedimentary rock that underlies the site at depth. The silt has a variable clay content with local remnant rock structure. In general, the silt becomes more rock-like with depth with increasing stiffness and shear strength. These silt soils are typically slightly compressible in the overconsolidated range and moderately compressible at higher stresses (normally consolidated range). Both test pits were terminated in this silt at a depth of 4 ft.

Groundwater. Groundwater was not observed in the test pits. Based on our experience in the area, we anticipate that groundwater typically occurs at depths of greater than 20 ft below existing grades.

CONCLUSIONS AND RECOMENDATIONS

General. The subsurface explorations indicate the site is mantled with silt that is underlain at depth by decomposed metasedimentary rock. In our opinion, subgrade materials and conditions at the site are suitable for construction of the proposed new building. Foundation support for the proposed building can be provided by conventional spread footings. The following sections of this report provide our conclusions and recommendations for design and construction of the proposed new community center building.

Site Preparation. As part of site development, the existing building will be demolished. Debris from demolition of the existing building (including foundations and existing utilities) must be removed from the site and disposed of properly. Care should be taken during demolition of the building to not substantially damage/disturb the subgrade soils. Soils disturbed/damaged during demolition of the building will need to be overexcavated and replaced with structural fill to design subgrade elevations.

During relatively wet winter and spring months, the native, fine-grained surficial soils can be significantly wet of the optimum moisture content. Soils that are wet of optimum are easily disturbed and remolded by construction equipment. Disturbed soils are not suitable for support of building foundations or pavement sections.

The building pad, areas to be paved, and cut and fill areas should be stripped of surficial organics and the dark red silt soil. We anticipate that stripping to a depth of about 12 to 18 in. will be required to remove most organics. Locally deeper stripping will be required in areas of existing fill. These materials (strippings and the dark red silt) cannot be used as structural fill and must be removed from the site.

Care must be taken by the contractor to minimize disturbance of the subgrade soils by using appropriate equipment and methods. We recommend use of trackhoes equipped with smooth-lip buckets for all excavations to minimize disturbance to the subgrade soils. If the subgrade is disturbed during construction, soft, disturbed soils should be overexcavated to firm soil and backfilled with structural fill.

Abandoned utilities should be overexcavated and the trenches backfilled with compacted, granular structural fill.

Areas of soft subgrade encountered during site preparation should be removed and replaced with compacted structural fill. The subgrade should be evaluated by the project geotechnical engineer prior to placement of any structural fill. The evaluation may include a proof-roll of the site with a fully-loaded dump truck.

Structural Fill. All fill placed within 3 ft of the building and paved areas should consist of structural fill. Structural fills should be compacted to at least 95% of the maximum dry density as determined by ASTM D 698.

On-site silt soils are not suitable for use as structural fills and will need to be removed from the site where excavated as part of construction.

In our opinion, ¾-in.-minus crushed rock would be appropriate for use as structural fill for foundation support, under concrete slab-on-grade, in utility trenches, and in paved area. All imported structural fill material should be hard, durable crushed rock.

Foundation Support Recommendations. Based on the results of our investigation and our understanding of the proposed new building, it is our opinion that foundation support for the new building can be provided by conventional wall-type (continuous) and column-type spread footing foundations founded on structural fill over competent (stiff) silt soils. The dark red clayey silt soils are not suitable for support of foundations.

Footings should be established at a minimum depth of 18 in. below the lowest adjacent finished grade for exterior footings. The width of footings should not be less than 12 in. for continuous wall footings and 30 in. for column footings. All footing excavations should be observed by a qualified geotechnical engineer prior to placement of rebar and concrete.

For foundations founded on structural fill over competent (stiff) silt, we estimate that the total, long-term settlement of spread footings designed in accordance with the above recommendations and imposing a real bearing pressure of up to 1,500 psf will be less than 0.5 in.

For design purposes, the real bearing value refers to the total of dead load plus frequently and/or permanently applied live loads, and can be increased by one-third for the total of all loads; dead, live, and wind or seismic.

If construction is completed during wet weather conditions, a minimum of 4 in. of imported crushed rock should be placed and compacted on the subgrade soils to protect the native soils from softening due to ponding water.

Lateral Earth Pressures. We understand that the new building will require a cantilevered retaining wall constructed of concrete block. Design lateral earth pressures for retaining walls depend on the type of construction, i.e., the ability of the wall to yield and whether the wall is drained. Possible conditions are: 1) a conventional cantilevered retaining wall that yields by tilting about its base, and 2) a wall which is laterally supported at its base and top and therefore is unable to yield.

Assuming granular wall backfill will be used behind the retaining walls, we have assumed an angle of internal friction of 37° and a moist unit weight of 135 pcf for the backfill.

For design purposes, cantilevered retaining walls are typically assumed to be yielding. Assuming drained and yielding retaining wall conditions, the retaining walls for the building can be designed based on an equivalent fluid pressure of 35 pcf.

These design criteria assume the wall will be backfilled within 2 ft of the back of the wall with relatively clean (less than 10% passing the No. 200 sieve – washed analysis) granular fill. A non-woven geotextile (minimum 5 oz weight per ASTM D 5261 and 200 lb tensile strength per ASTM D 4632) should be placed between any drain material and any soil classified as sand or finer. The backfill should be placed in horizontal lifts not to exceed 12 in. (loose) and compacted to about 93% of the maximum dry density as determined by ASTM D 698. Overcompaction of the backfill should be avoided, and heavy compactors and large pieces of construction equipment should not operate within 10 ft of embedded walls. Compaction within 10 ft of the walls should be accomplished using hand-operated vibratory compactors.

We also recommend an additional lateral earth pressure of 15 pcf for seismic loading. For design purposes, the resultant of the seismic force should be assumed to act at a point two-thirds from the base of the wall (inverted triangular distribution).

Lateral Load Resistance. Horizontal shear forces can be resisted by frictional forces developed between the base of spread footings and the underlying soil and by passive soil resistance. The total frictional resistance between the footing and the soil is the normal force times the coefficient of friction between the soil and the base of the footing. We recommend an ultimate value of 0.35 for the coefficient of friction; the normal force is the sum of the vertical forces (dead load plus real live load). If additional lateral resistance is required, passive earth resistance against embedded footings or walls can be computed using a pressure based on an equivalent fluid with a unit weight of 300 pcf. This design passive earth pressure is appropriate only if granular structural fill is to be used for the backfill around footings.

Slab-on-Grade Floor Support and Drainage. We anticipate the finished first floor elevation of the building will be founded above adjacent final grades and that a subslab drainage system will not be required. To provide uniform floor support, the slab-on-grade should be underlain by a minimum 12-in.-thick granular base course placed as structural fill. The granular base should consist of angular crushed rock up to ¾ in. in size.

We recommend installation of a vapor barrier membrane (such as a Stego Wrap Class A vapor retarder) beneath the slab-on-grade floor. Vapor barriers should be installed in accordance with the manufacturer's recommendations. Waterproofing on retaining walls should extend at least 12 in. beyond the cold joint at the base of the wall.

The ground surface around the exterior of the building should be sloped to drain away from the building for a distance of at least 10 ft. A perimeter foundation drain should be installed adjacent to the exterior spread footing foundation. Downspouts from the roof should be discharged into a storm water sewer or at least a distance of 30 ft from the building, and not on the slope below the building.

Pavement Sections. We anticipate that the majority of the vehicle traffic will consist of relatively lightly loaded automobiles and passenger trucks. Based on the results of our fieldwork for the site, subgrade for the pavement sections will consist of stiff silt or better. A field determination of the CBR was not completed as part of this study; however, based on our experience with similar soils, we anticipate that the silt has a CBR value of about 5. For design purposes, we have assumed a 20-year design life for the pavement section.

The asphaltic concrete (A.C.) pavement section should consist of 3 in. of A.C. over 12 in. of ¾-in.–minus crushed rock. The A.C. should be placed and compacted in a single lift. For concrete parking areas, we recommend a minimum section of 4 in. of reinforced concrete (3,000 psi minimum) over 12 in. of ¾-in.-minus crushed rock. The concrete should be reinforced with a wire mesh.

The pavement sections should be underlain by a woven geotextile (minimum 5 ounce weight).

Subgrade for paved areas should be prepared as recommended in our report, including a proof-roll of the subgrade observed by the project geotechnical engineer. The pavement section should be underlain by a woven geotextile (minimum tensile strength of 200 lbs per ASTM D 4632) placed on the subgrade soils.

The above recommended sections assume the aggregate base rock is well drained. Drainage of the base course rock is critical for longevity of the roadway section. Saturated subgrade and base course sections can reduce the life of the pavement by more than half. Where practical, the ground surface should be sloped to provide drainage. The pavement should have a minimum 2% transverse grade to promote surface water runoff and drainage.

The recommended roadway sections assume the pavement is constructed in accordance with current Caltrans' standard specifications for highway construction, including paving and aggregate base rock. The above sections also assume the pavements will be constructed during dry weather. Additional rock would be required if the sections are constructed during wet weather conditions. The sections are not intended to provide support for construction equipment.

Seismic Considerations. The new building will be founded on stiff silt soils over weathered rock at depth. In our opinion, based on the current International Building Code, the subsurface conditions at this site may be classified as a Site Class C for seismic design purposes.

Based on the results of our investigation, the location of the site, and the nature of the underlying soil/rock, we anticipate that the potential for earthquake-induced fault displacement, subsidence, liquefaction-induced settlement and/or lateral displacement, or seiches at this site is low.

Design Review and Construction Services. We welcome the opportunity to review and discuss construction plans and specifications as they are being developed. In addition, AGEGC should be retained to review all geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in our report. Additionally, to observe compliance with the intent of recommendations, design concepts, and the plans and specifications, we are of the opinion that all construction operations dealing with earthwork and foundations should be observed by an AGEGC representative. Our construction-phase services will allow for timely design changes if site conditions are encountered that are different from those described in this report. If we do not have the opportunity to confirm our interpretations, assumptions, and analyses during construction, we cannot be responsible for the application of our recommendations to subsurface conditions that are different from those described in this report.

LIMITATIONS

This report has been prepared to aid the design team in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the community center building. In the event that any changes in the design and location of the building as outlined in this report are planned, we should be given the opportunity to review the changes and to modify or reaffirm the conclusions and recommendations of this report in writing.

The conclusions and recommendations submitted in this report are based on the data obtained from the test pit explorations, and from other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil conditions may exist between test pit locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions different from those encountered in the explorations are observed or encountered, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Sincerely,
Applied Geotechnical Engineering and Geologic Consulting, LLC

Robin L. Warren, G.E., R.G.
Principal

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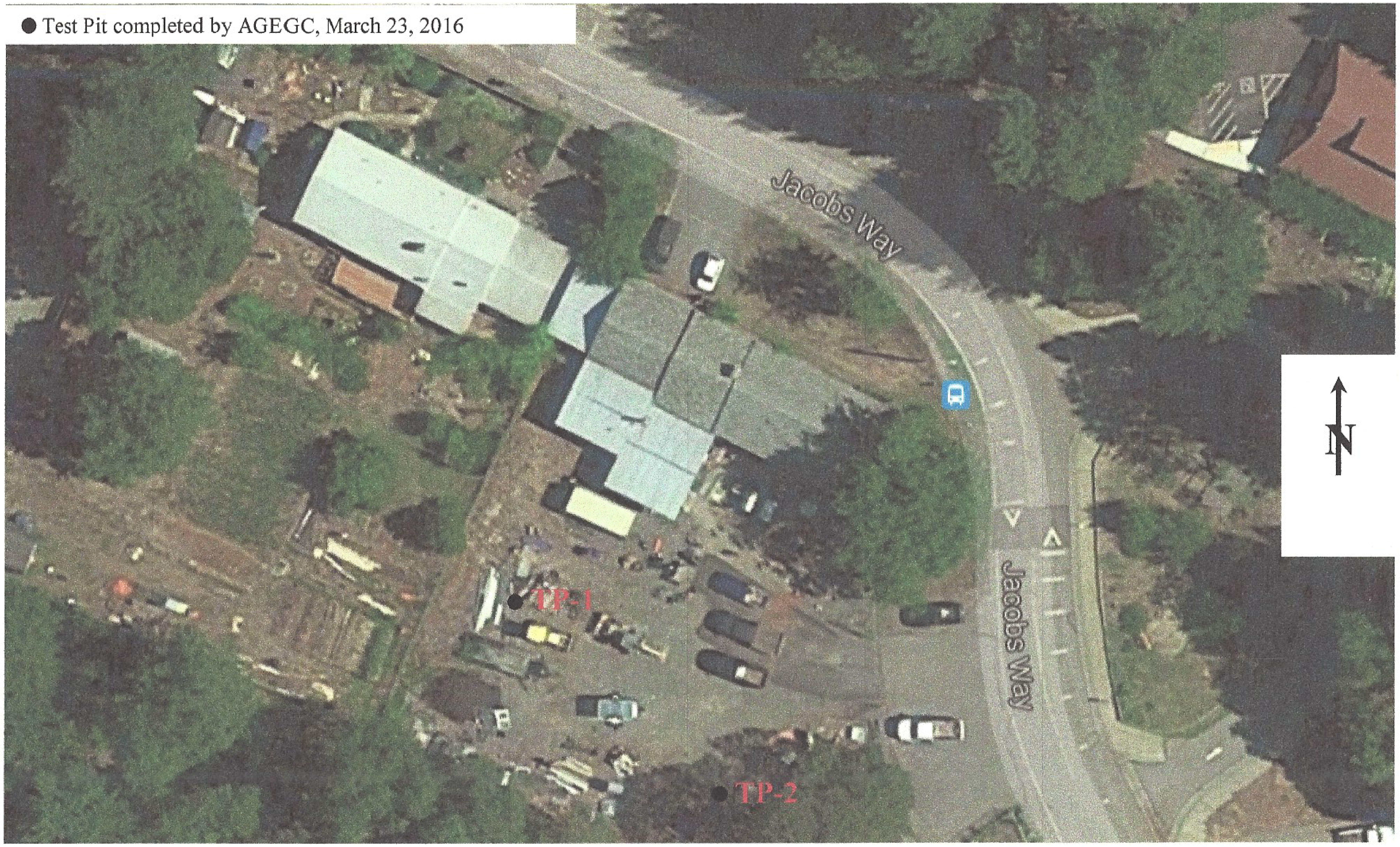

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Figure 1
Site Plan

Project No. 4206-16
Karuk Resident Center
Happy Camp, California
April 2016

APPENDIX A
Subsurface Explorations

Test Pit TP-1

00 to 12 in.	FILL: Dense, gray GRAVEL, crushed/angular, up to 4 in. in size.
12 to 48 in.	Stiff, reddish brown mottled yellow SILT; some clay.

Groundwater seepage not observed.
No significant caving of test pit sidewalls.
Completed March 23, 2016.

Test Pit TP-2

00 to 12 in.	FILL: Dense, gray GRAVEL, crushed/angular, up to 4 in. in size.
12 to 24 in.	Soft to medium stiff, dark reddish brown clayey SILT; low density, low strength.
24 to 48 in.	Stiff, reddish brown mottled yellow SILT; some clay, scattered subrounded cobble and gravel.

Groundwater seepage not observed.
No significant caving of test pit sidewalls.
Completed March 23, 2016.

TABLE 1A: SOIL DESCRIPTION TERMINOLOGY

Coarse-Grained Soils (Sand Size and Larger)

Relative Density	Standard Penetration Resistance (N-Values)
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Fine-Grained (Cohesive) Soils

Consistency	Standard Penetration Resistance (N-Value)	Torvane Undrained Shear Strength, tsf	Field Identification
Very Soft	2	Less than 0.125	• Easily penetrated by fist.
Soft	2-4	0.125-0.25	• Easily penetrated by thumb.
Medium Stiff	5-8	0.25-0.50	• Penetrated by thumb with moderate effort.
Stiff	9-15	0.50-1.0	• Readily indented by thumb but penetrated only with great effort.
Very Stiff	16-30	1.0-2.0	• Readily indented by thumbnail.
Hard	Over 30	Over 2.0	• Indented with difficulty by thumbnail.

Grain Shape

Term	Description
Angular	Corners and edges sharp.
Subangular	Corners worn off, angles not worn off
Subrounded	Corners and angles worn off, flat surfaces remain.
Rounded	Worn to almost spherical shape.

Grain Size Classification

Boulders	6 to 36 inches
Cobbles	3 to 6 inches
Gravel	¼-¾ inch (fine)
	¾-3 inches (coarse)
Sand	No. 200-No. 40 sieve (fine)
	No. 40-No. 10 sieve (medium)
	No. 10-No. 4 sieve (coarse)
Silt/Clay	Pass No. 200 sieve

Modifier for Subclassification

Adjective	Percentage of Other Material in Total Sample
Clean	0 – 1.5
Trace	1.5 - 10
Some	10 - 30
Sandy, Silty, or Clayey	30 - 50