MESOPOTAMIA GEOTECHNICAL CONSULTANTS

GEOTECHNICAL INVESTIGATION REPORT& INFILTRATION FEASIBILITY STUDY

Proposed New Shopping Center
21419 & 21425 Cajalco Road
Perris, CA 92570

Prepared For:

Mr. Sameh Abdelmalek
3343 Deputy Evans Drive
Norco, CA. 92860

Project Number MGC-2018-064
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To: Mr. Sameh Abdelmalek
3343 Deputy Evans Drive
Norco, CA. 92860

Subject: Geotechnical Investigation Report & Infiltration Feasibility Study
Proposed New Shopping Center
21419 & 21425 Cajalco Road
Perris, CA 92570

References: Eurocon, Proposed New Shopping Center (Service Gas Station, Drive Thru-Restaurant and Retails), Site Plan Proposal, 21419 & 21425 Cajalco Road, Perris, CA 92570.

Foresight Engineering, Inc., Topographic Survey, 21419 & 21425 Cajalco Road, Perris, CA 92570. Project No. 404-101, dated 11/14/2017.

JK Associates, Grading & Drainage, 21419 & 21425 Cajalco Road, Perris, CA 92570. Job No. 2017.39.

INTRODUCTION

Dear Mr. Abdelmalek,

As per your request and authorization, Mesopotamia Geotechnical Consultants (MGC) performed a geotechnical investigation and infiltration feasibility study for a proposed shopping center located at 21419 & 21425 in the City of Perris, Riverside County, California. The purpose of MGC's geotechnical investigation was to provide geotechnical recommendations for use in design, construction, and cost estimate of the proposed project. The findings, conclusions, and recommendations contained in this report are based on limited subsurface field exploration, laboratory testing and relevant geotechnical analyses. At the time this report was prepared, the referenced Site Plan, by Eurocon, the Topographic Survey, by Foresight Engineering, Inc., and the Grading & Drainage Plan, by JK Associates, were made available by the client to MGC, and were used as the basis of this report; Eurocon's Site Plan was used to depict MGC's boreholes locations as shown in Appendix 2. Once the development plans are finalized, they should be forwarded to this office, prior to commencing construction, to review, revise and update this report; if deemed necessary, with respect to the structural components of the proposed project; this process may require additional field explorations.

SITE LOCATION AND DESCRIPTION

The APN numbers of the subject property is 318-140-028 & 318-140-029. The legal description of the subject property is Lots/Parcels 1 & 2 of Subdivision PM 10833, Recorded Book/Page 10833 in the Mead Valley Area of the City of Perris, Riverside County, California, which currently encompasses two addresses: 21419 & 21425 Cajalco Road. The subject property is located at some 400 feet west of the intersection of Cajalco Road and Clark Street. The property is bound from the east by vacant land, from the south by what appears to be single family property, from the west 1-story church, while it is bound by, and accessed from, Cajalco Street on the north.

At the time of MGC's field exploration, the subject property was vacant, and covered by brushes and trees as well as remnants of previous developments. The subject property is relatively flat and gently sloping in the southwest direction with an elevation difference of approximately 8 feet between the northeast and southwest corners. The subject property is rectangular in shape with an approximate dimension of 276 feet in the north-south direction and 165 feet dimension in the east-west direction; it has an approximate plan area of a little over one acre.

PROJECT CONSIDERATIONS

It is MGC's understanding that the proposed new construction will mostly occupy the north half of the property, while the south half will be mostly used as a parking lot since it is mapped within a 100-year Flood Plain Plan by the Federal Emergency Management Administration (FEMA). The construction on the north part will consist of a 1-story restaurant and a mini-mart at the northwest and northeast corners; respectively, and a fuel island, with its affiliated underground fuel tanks, between them as shown on the Boring Location Map in Appendix 2. No earth-retaining and/or subterranean structures were proposed at the time this report was prepared. Structural loading was not available; nevertheless, MGC anticipates that the uniform loads will be on the order of approximately 3 to 5 kips/foot (k/ft) while concentrated loads will be approximately 50 to 75 k.

Once the structural plans are finalized, they should be forwarded to this office to re-evaluate this report. Additional subsurface exploration may be required, and based on that the preliminary recommendations may be revised and/or supplemented.

This report was prepared in accordance with the requirements of the current governing building code of the State of California (CBC). Thus, if this report is not submitted promptly for review and approval by the pertinent reviewing agency, and if construction does not follow shortly, additional geotechnical services may be required in the future to address more conservative requirements of more recent codes.

SCOPE OF INVESTIGATION

MGC performed the following tasks as part of their scope of work:

1. Researched electronically geotechnical and seismic literature, available in public domain and relevant to the immediate area of the subject project, to define the scope of services in terms of field exploration requirements, site accessibility, laboratory testing, calculations and engineering analyses.
2. Reviewed geotechnical reports, available in MGC's archives, for similar projects in the immediate area of the subject project.
3. Marked 7 borings locations and notified Underground Service Alert (USA) a minimum of 48-business hours before start of construction.
2. Performed a field subsurface exploration, which included drilling seven boreholes to an approximate maximum depth of 16 feet below existing ground surface (bgs).
3. Obtained bulk and ring samples for laboratory testing.
4. Performed percolation testing, to develop infiltration rates, in accordance with Appendix A of the "*Design Handbook for Low Impact Development Best Management Practices*" prepared by the Conservation District of Riverside County in 2011.

4. Performed laboratory testing in the laboratories of Sassan Geoscinces, Inc. to assess properties of selected samples taken from the two boreholes.
5. Performed seismic and geologic hazards assessment.
5. Collated data, analyzed field and laboratory data, and performed relevant engineering calculations and geotechnical engineering analyses.
6. Prepared this report presenting compiled field and laboratory data, analyses, and MGC's findings, conclusions and recommendations for design and construction of the proposed development.

FIELD EXPLORATION PROGRAM

Seven boreholes were drilled on the subject property on October 22, 2018. Boring Nos. 1 through 4 were drilled, in the area between the proposed locations of the restaurant and the fuel island, to an approximate depth of 5 feet bgs. Boring No. 5 was drilled at the proposed location of the Mini-Mart to an approximate depth of 11 feet, Boring No. 6 was drilled in the proximity of underground fuel tanks to an approximate depth of 16 feet bgs, and Boring No. 7 was drilled at the proposed location of the Restaurant to an approximate depth of 11 feet; approximate locations of the borings are depicted on the referenced Boring Location Map in Appendix 2. No utilities were damaged during MGC's fieldwork. Representative ring and bulk samples were obtained for laboratory testing. Logs of borings are included in Appendix 3. Boreholes were backfilled with drill cuttings and were tamped; however, backfill should not be considered as structural fill. No groundwater was encountered during MGC's field exploration.

LABORATORY TESTS RESULTS

Moisture Content/Dry Density tests, Consolidation test, Expansion Index test, Maximum Dry Density/Optimum Moisture Content test, and Direct Shear test were performed in the laboratory of Sassan Geosciences, Inc. A copy of the tests results is included in Appendix 4. Moisture content/dry density tests results are shown on the boring logs. MGC reviewed the laboratory tests procedures and results, and concur with them; additionally, MGC accepts the responsibility for using the data.

Based on the laboratory test results onsite soils appear to exhibit low expansion index. To evaluate the corrosion potential of the subsurface soils at the site, a soil sample was collected during MGC's subsurface exploration, and was tested for soluble sulfate, chloride content, pH and resistivity testing. Results of these tests are summarized in the table below.

Test-Pit Number	Sample Depth (feet)	Sulfate (mg/kg)	Chloride (mg/kg)	pH	Minimum Resistivity (ohm-cm)
Boring No. 5	**0 to 5**	**39**	**41**	**8.9**	**1223**

In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor. Based on the approximate relationship between soil resistivity and soil corrosiveness shown in the table below, onsite soils appear to have ***"severely corrosive"*** potential to buried steel pipes.

Soil Resistivity (ohm-cm)	Classification of Soil Corrosiveness
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Acidity is an important factor of soil corrosivity. The lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to buried metallic structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films, which form on steel in high pH environments. Accordingly, onsite soils appear to have "***low corrosive potential***" to buried structural steel.

Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. A potentially high sulfate content could also cause corrosion of the reinforcing steel in concrete. Based on the table below, sulfate exposure may be considered "***negligible***" for subsurface materials sampled at the subject site; therefore, no special requirements for buried concrete appear to be warranted.

Sulfate In Water (parts-per-million)	Water-Soluble Sulfate (SO_4) in soil (percentage by weight)	Sulfate Exposure
0-150	0.00 - 0.10	Negligible
150-1,500	0.10 - 0.20	Moderate
1,500-10,000	0.20 - 2.00	Severe
>10,000	Over 2.00	Very Severe

It should be noted that corrosivity tests should be performed after completion of earthworks, before start of buried concrete and/or metal works, to verify if the current corrosivity test results remain applicable; otherwise, this office should be contacted to provide additional recommendations to provide mitigations for adverse conditions, if any are encountered.

SUBSURFACE CONDITIONS

Onsite visual classifications, during the subsurface field exploration, indicated that the soil layers in the seven boreholes, at the corresponding depths, are relatively correlated. The results of our field subsurface exploration indicated that thickness of existing fill, which consisted of sandy silt soils, at the locations of our boreholes ranged between 1 foot to 2 feet bgs; deeper fill however, may be found at other locations within the same site at old buried utility lines or other abandoned subterranean structures. No documents were made available for MGC that show the existing fill, which appears to have been placed during previous developments on the subject property, to be certified. Therefore, the existing fill is considered unsuitable for the support of structures and should be removed. The removed fill may be incorporated in the engineered fill after being cleaned from debris and other deleterious materials.

Competent alluvial native soils beneath existing fill consisted predominantly of intermittent layers of firm-in-place fine-grained soils and medium dense-in-place granular soils layers.

Subsurface groundwater was not encountered during MGC's subsurface exploration to the maximum drilled depth of 16 feet. Historic high groundwater level appears to be deeper than 50 feet bgs per geologic maps available electronically in public domain. Fluctuations in groundwater levels may occur due to variations in rainfall and other factors not in evidence at the time measurements were made.

INFILTRATION TESTING

It is MGC's understanding that the intent is to construct relatively 5-feet deep shallow infiltration trenches, in the area between the proposed locations of the restaurant and the fuel island, as the proposed Best Management Practices (BMP) devices. Accordingly, MGC performed a *Shallow Percolation Test*, during the above-mentioned field exploration, in substantial conformance with the pertinent procedure presented in ***Appendix A "INFILTRATION TESTING"*** of the "***Design Handbook for Low Impact Development Best Management Practices***" published by the Water Conservation District, of the Riverside County Flood Control, in September 2011. Subsequently, drilled four boreholes; Borings 1 through 4, at the proposed location of the shallow infiltration trench, as stipulated by ***Option 2*** in ***Table 1*** of the above-mentioned ***Appendix A***. The four boreholes were converted into percolation testing pits to calculate the infiltration rates, and to provide the civil engineer with data necessary for selecting and designing the Best Management Practices (BMP) facility.

The four 5-foot deep boreholes had a diameter of approximately 8 inches, and their bottoms filled with 2 inches of gravel. After presoaking the four boreholes, percolation test started by refilling the boreholes with water, and measuring the drops during 25 minutes for two consecutive measurements. Since the measurements showed that 6 inches of water seeps away in less than 25 minutes for all four boreholes, it was determined to run the percolation test for ***sandy soils*** as per the above-mentioned ***Appendix A***. Measurements were taken every 10 minutes, for 60 minutes, with a precision of 0.25 inch.

Based on percolation test data sheets in Appendix 7, an average infiltration rate (I_t) of 1.12 inch/hour was calculated, which should be divided by a factor of safety of 3, per the provisions of the above-mentioned ***Option 2***, to yield a design infiltration rate (I_d) of ***0.37 inch/hour***.

SEISMIC AND GEOLOGIC HAZARDS ASSESSMENT

Faults & Surface Rupture: The subject site is located within the Steele Peak Quadrangle that is not currently evaluated by the California Geological Survey (CGS); however, the CGS Map for Earthquake Zones of Required Investigation indicate that the subject site is not currently mapped within a known earthquake fault zone. Furthermore, no evidence was apparent that may suggest existence of active and/or potentially active faults at the subject site, and neither current geologic publications, available electronically in public domain, suggest otherwise. The subject site appears to be equidistance from Lake Mathews Fault Zone to the southwest, and from Lakeview Fault Zone to the northeast; more than 10 kilometers from both fault zones.

Landslides: The subject site is located in a relatively flat area, and is not mapped within landslide hazards zones according to the above-mentioned CGS Map.

Liquefaction: Soil liquefaction usually results from loss of shear strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded fine-grained sands. The subject site is not mapped within potentially liquefiable zones according to the above-mentioned CGS Map. Furthermore, groundwater was not encountered during MGC's subsurface exploration to the maximum drilled depth of 15 feet, and historic groundwater levels appear to be deeper than 50 feet bgs in the proximity of the subject site per above-mentioned geologic maps. Generally speaking, it is unlikely for groundwater to rise to liquefaction-triggering levels considering that the State of California is currently facing one of the most severe droughts on record.

Seismic Design Coefficients: The following seismic coefficients were developed, in accordance with LABC, by utilizing the calculator available on the "U.S. Seismic Design Maps" on the USGS website, for a central representative location of 33.83714° north latitude and 117.28916° west longitude; calculation output is included in Appendix No. 5:

CBC Seismic Design Parameters	
Site Class Definition (Table 1613.5.2)	D
Mapped Spectral Response Acceleration at 0.2s Period, Ss (Figure 22-1)	1.500
Mapped Spectral Response Acceleration at 1s Period, S_1 (Figure 22-2)	0.600
Short Period Site Coefficient at 0.2s Period, F_a (Table 11.4-1)	1.0
Long Period Site Coefficient at1s Period, F_v (Table 11.4-2)	1.5
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS} (Eq. 11.4-1)	1.500
Adjusted Spectral Response Acceleration at 1s Period, S_{M1} (Eq. 11.4-2)	0.900
Design Spectral Response Acceleration at 0.2s Period, S_{DS} (Eq. 11.4-3)	1.000
Design Spectral Response Acceleration at 1s Period, S_{D1} (Eq. 11.4-4)	0.600
Maximum Considered Earthquake-Geometric Mean (MCE_G) adjusted for site effects, PGA_M (Eq. 11.8-1)	0.500
Seismic Design Category	D

FINDINGS & CONCLUSIONS

- The proposed development is feasible from a geotechnical standpoint provided that MGC's recommendations are implemented.
- The subject site is suitable for installing relatively shallow infiltration trenches; with their inverts located approximately at 5 feet deep bgs, in conformance with the provisions of the "***Design Handbook for Low Impact Development Best Management Practices***" prepared by the Conservation District of Riverside County in 2011.
- Uncertified fill soils are not suitable for support of proposed structures and/or engineered fill.
- The potential for liquefaction adversely affecting proposed structures is generally remote.
- The subject site is not located within an AP Zone. Therefore, the potential of adverse impact resulting from surface rupture, generated by the activation of the fault is highly unlikely.
- The potential for landslides adversely affecting the subject flat property is highly unlikely.
- Proposed structures may be supported by conventional shallow footings established in competent native soils, or engineered fill.
- Onsite soils are corrosive to buried ferrous pipes.

RECOMMENDATIONS

General

The recommendations presented in this report are subject to review and revision based upon our observation of exposed subsurface soils during construction. These recommendations are for the purposes of design and cost estimates. Safety in the field is the responsibility of the property owner and his/her retained contractor for that matter.

Site Preparation

Existing vegetation, rubble and debris should be removed, and should be hauled offsite to a proper dumpsite designated by the regulating agency.

General Excavations

No records were made available for MGC certifying the existing fill; therefore, the latter is not suitable for supporting structures. Accordingly, existing fill should be removed, from proposed buildings footprints, until competent native soils are exposed. Removed soils may be incorporated in structural fill after removing deleterious materials; such as organic materials, oversized materials, etc.

Temporary excavations for underground fuel tanks, which are not expected to be deeper than 10 feet, may be made by sloping back the temporary excavations at no steeper than 1:1. These relatively deep excavations shall be performed in a manner that should not undermine adjacent structures; otherwise, the ABC Slot Cut Method should be utilized.

Temporary excavations for removal and recompaction purposes are not expected to exceed 5 feet, which can be made by sloping these excavations at no steeper than 1:1 wherever enough space is available. If sloping the temporary excavations may undermine adjacent offsite property, or adjacent public right of way, then they can be made by excavating a 2-foot high vertical cut at the bottom, and sloping the remaining 3 feet at the top at no steeper than 1:1, provided that no surcharge is exerted on the excavations, as per the attached pertinent calculations in Appendix 6. Temporary excavations shall only be used when they are not surcharged, and when they do not remove lateral support from adjacent offsite property, or adjacent public right of way; otherwise, the ABC slot cut method below should be utilized for supporting temporary excavations.

Excavations should be kept relatively dry and firm. Water, regardless of the source, should be prevented from impacting these excavations.

ABC Slot Cut Method

This method may also be used, in combination with the requirements of the preceding sections, for temporary excavations. Basically, if it is determined during construction that surfaces exposed in vertical temporary excavations are not sufficiently stable and may undermine adjacent offsite property, or adjacent public right of way, then these excavations should be performed utilizing the ABC slot cuts having a maximum width of 5½ feet and a height of 3 feet supporting a 1:1 slope with no surcharge, as per the attached pertinent calculations in Appendix 6. The procedure to construct slot cuts is presented below:

1. From an imaginary line on the surface at the footprint of removal and recompaction, discussed in the following section, excavate inward at 1:1 down to the bottom of removal.
2. Divide the imaginary line above into no wider than 5½-foot sections, and mark them as "A, B, C" slots.

3. Excavate vertical cuts at the same imaginary line above, at the "A" slots only, all the way down to the bottom of removal.
4. Place fill and compact as discussed in the following section at the "A" slots only.
5. After completing earthworks at all the "A" slots, repeat items 3 & 4 above for "B" slots and then for "C" slots.
6. All relevant CAL-OSHA requirements should be complied with during construction. All involved contractors in the field are solely responsible for the safety of their labor.
7. Slot cuts should be performed under continuous observation of a representative of project's soils engineer to assess exposed surfaces and provide additional recommendations if deemed necessary.
8. Both sides adjacent to the slot under construction should have sufficient support (bracing, buttressing, etc.) during all phases of construction of the slot in the middle.

Fill Placement

Engineered fill that is fill placed, under continuous observation by the soils engineer of record, over competent native soils approved by the aforementioned engineer. The upper layers of soils shall be removed to allow placement of a minimum of 3 feet of engineered fill beneath footings; depth of removal shall not be less than 4 feet. The removal and recompaction should extend horizontally a minimum distance equal to the thickness of the fill beneath the footings, but not less than 3 feet, beyond the exterior face of at-grade footings.

Wherever the extension of removal and recompaction has the potential to undermine offsite property, footings in this particular case shall be established at deeper than 2 feet below existing grade in competent native soils; otherwise, the "***ABC Slot Cut Method***" above should be utilized.

Prior to placing fill, exposed bottoms of competent native soils should be scarified to a depth of about 6 inches, brought to about approximately 2% to 3% above optimum moisture content and then compacted to least 90% of the maximum dry density of the soils as determined by the ASTM Designation D1557 Method of Soil Compaction. The removed dirt, less debris or organic matter and rocks exceeding 8 inches in size, may be utilized in the engineered fill.

The fill soils should be placed in loose layers that do not exceed 8 inches in thickness per layer. Each layer should be spread evenly and thoroughly mixed during spreading to promote uniformity of the materials and moisture content. The moisture content of the fill soils should be adjusted by moistening or drying as necessary to bring the moisture content of the soils at the time of compaction to approximately 2% to 3% above optimum moisture content. The moisture content should be uniform throughout the soils. Fill soils should be mechanically compacted to at least 90% of their maximum dry density obtainable using the ASTM D 1557 method of compaction and should be firm and unyielding when compacted. An approximate shrinkage of 10% is anticipated.

Foundations

Foundations of proposed structures may be supported on conventional shallow foundations established in competent native soils, or in engineered fill placed over competent native soils, with a minimum depth and width of 18 inches.

Footings constructed in accordance with the above recommendations, would be capable of supporting an allowable bearing pressure of 3,000 psf, which may be increased by 250 psf for each foot increase in width or depth and up to a maximum allowable pressure of 4,000 psf. The allowable bearing capacity may also be increased by one-third for short-term transient loading like wind and/or seismic loading.

Lateral loads may be resisted by friction between the footings and the supporting subgrade, and passive resistance of properly compacted backfill and/or competent bedrock, in combination. A coefficient of friction of 0.40, together with a lateral passive resistance of 275 pcf not exceeding a maximum of 3,000 psf, may be used in the design of footings. These design parameters have already been reduced by a factor-of-safety of 1.5.

Structural loads were not available for our review at the time of our investigation; nevertheless, it is estimated that settlement to be less than ½ inch, and differential settlement not exceeding ¼ inch, as measured between adjacent structural elements. Based on our experience with similar granular soils in that area, the major part of settlement is expected to occur during construction.

Footing depths (embedment) should be measured from lowest adjacent finished grade, considered as the bottom of interior slab-on-grade or the finished exterior grade; excluding landscape topsoil, whichever is lower. Embedment depths should not be allowed to be affected adversely, such as through erosion, softening, digging, etc.

Planters should not be sited adjacent to foundations. Where planters cannot be avoided, measures to minimize seeping potential beneath foundations should be implemented. Such measures could include providing area drains, deepening foundations or providing sealed bottom planters.

Based on laboratory tests results, there appears to be low potential for corrosivity-induced structural damage impacting reinforced concrete foundations.

Slab-On-Grade

The concrete slabs-on-grade may be supported by competent native soils, or on a minimum thickness of 2 feet of engineered fill, prepared per the pertinent recommendations discussed above.

If it is desired to place the slab-on-grade on uncertified fill, the slab should be designed as a structural slab deriving its support entirely from foundations.

The slabs-on-grade shall be at least 4 inches thick and shall be reinforced with ½-inch-diameter deformed reinforcing bars spaced at intervals not exceeding 24 inches each way.

The soil below an interior concrete slab shall be pre-saturated prior to placing the concrete. If moisture-sensitive floor coverings are planned, the floor slabs in those areas should be constructed in a manner to reduce the potential of water vapor migration through the slabs. The floor slabs beneath areas of moisture-sensitive floor covering should be underlain by a vapor retarder consisting of a minimum of 10-mil-thick impermeable membrane. Care should be taken to avoid damage to the membrane and to seal the membrane around utilities and other penetrations.

Shallow Infiltration Trenches

Shallow infiltration trenches are long, narrow, gravel-filled trenches, often vegetated, that infiltrate stormwater runoff from small drainage areas. Infiltration trenches may include a shallow depression at the surface, but the majority of runoff is stored in the void space within the gravel and infiltrates through the sides and bottom of the trench. It is MGC's opinion from a geotechnical standpoint that the proposed 5-foot deep shallow infiltration trenches, to be constructed at the area between the proposed locations of the restaurant and the fuel island, are feasible and appear to be in substantial conformance with the applicable provisions of Section 3.2 "***Infiltration Trench***" of the "***Design Handbook for Low Impact***

Development Best Management Practices" published by the Water Conservation District, of the Riverside County Flood Control, in September 2011, based on the following:

- The subject property is relatively flat with the upper soils being predominantly granular exhibiting relatively appropriate percolation rates.
- Historic groundwater table is deeper than 50 feet per geologic maps available electronically in public domain.
- The subject site is not mapped within a potentially seismic or geologic hazardous zone as discussed in the previous sections.
- Relatively adequate infiltration rates; an average of 0.37 inch/hour, were calculated as shown in the percolation tests data sheets included in Appendix 7.

Shallow infiltration trenches shall meet the setback requirements of the above-mentioned Handbook in addition to be set back a minimum of 10 feet from buildings foundations; the bottoms of the latter shall be setback a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the infiltration trench at no steeper than 1:1 gradient.

Design, construction and maintenance of the proposed infiltration trenches shall be in substantial conformance with above-mentioned Handbook.

Pavement Design

The result of an R-value test, performed on a bulk sample obtained during MGC's exploration, was 73. However, an R-Value of 50 was incorporated in the design conservatively to develop minimum standard pavement sections. Based on the design procedures outlined in the current Caltrans Highway Design Manual, and using a design R-value of 78 for aggregate base course, preliminary flexible pavement sections may consist of the following for the Traffic Indices indicated.

Traffic Index	Asphalt Concrete (inches)	Aggregate Base (inches)
4.0	3.0	3.0
5.0	3.0	4.0
6.0	3.5	5.0
7.0	4.0	6.0

The recommended pavement sections above should be reviewed by the project's civil engineer, and revised if the reviewing agency requires thicker sections. Final pavement design should be based on at-grade laboratory testing performed near the completion of grading, and the Traffic Index determined by the project civil engineer.

Underground Utility Lines & Fuel Tanks

Utility lines trenches and fuel tanks excavations should be located so as not to impair the bearing capacity or cause settlement of foundations. Generally, trenches and excavations should be clear of a 45-degree plane extending outward and downward from the bottom edges of the foundations. The project structural engineer may require further setbacks. All work associated with temporary excavations and shoring should conform to the State of California Safety Code (CAL-OSHA). Bedding material immediately around a utility line and to a point 12 inches above the line should consist of sand, fine-grained gravel, or cement slurry to support the line and protect it.

The bedding material should meet the specifications given in the latest edition of the "Standard Specifications for Public Works Construction" (Greenbook). Sand or gravel should be compacted in accordance with Greenbook specifications. Jetting of the bedding material in accordance with Greenbook specifications is allowed.

Above the bedding, utility trenches and excavations backfill should be compacted in accordance with the preceding compaction recommendations to 90% of its maximum dry density. Jetting and/or flooding should not be permitted. At least the upper 24 inches of the trench backfill should consist of the same soils as are adjacent to the trench.

Onsite soils appear to be severely corrosive to buried ferrous pipes and tanks; therefore, it is recommended that a qualified corrosion protection specialist be consulted to specify the measures that should be taken to protect ferrous pipes and tanks that are in direct contact with soil, or to provide other alternatives for non-ferrous pipes or tanks; if possible.

Surface Drainage

Positive surface drainage should be provided and maintained to direct surface water away, through non-erodible drainage devices, from structures and slopes and towards the street or other suitable collective drainage facilities at all times. In no case, should the surface waters be allowed to pond adjacent to buildings, behind the retaining walls or flow over the slope surfaces in an uncontrolled manner.

Inadequate control of runoff water or heavy irrigation may result in shallow groundwater conditions and seepage where, previously, none existed. Maintaining adequate surface drainage, proper disposal of runoff water and control of irrigation will minimize the potential of adverse structural impact resulting from over-moisturized soils.

Geotechnical Observation

A qualified representative of the geotechnical consultant should have at least the following duties:

- Observe excavations so that necessary modifications, if deemed necessary, based on variations in the soil conditions encountered, can be made.
- Observe exposed subgrade in areas to receive fill, if any, and in areas where excavation has resulted in the desired finished subgrade. The representative should also observe delineation of areas requiring overexcavation.
- Evaluate the suitability of on-site and import soils (if any) for fill placement.
- Test fills and backfills for field density and compaction to determine the percentage of compaction achieved during placement.
- Observe foundations prior to placing rebar for verification of compliance with minimum embedment depth and width.

The governmental agencies having jurisdiction over the project should be notified before commencement of grading so that the necessary grading permits can be obtained, and arrangements made for required inspection(s). The contractor should be familiar with the inspection requirements of the reviewing agencies.

LIMITATION

This report is prepared for the use of the client and authorized agents and should not be considered transferable. This report provides parameters for on-site earth materials, and these parameters should be utilized with the future site construction. During any site grading, we recommend staff from our office be present to review this report and to make adjustments for exposed geotechnical conditions not anticipated by the report.

It is the intent of this report to aid in the design and completion of the described project. Implementation of the advice presented in the "Conclusions and Recommendations" sections of this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual conditions will not be discovered during or after construction.

The calculations and analyses contained in this report are based on data derived from field observation during limited subsurface exploration and laboratory test results. Recommendations are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed by the MGC's limited subsurface exploration on the subject property.

If conditions encountered during construction appear to differ from those disclosed during this investigation, this office should be notified, so as to consider the need for modifications. This way any required supplemental recommendations can be made with a minimum delay to the project.

MGC has prepared this report in accordance with generally accepted engineering practices and makes no other warranties either expressed or implied as to the professional advice provided under the terms of the agreement and included in this report.

Soil samples obtained during this investigation will be secured and retained for a period of thirty days from the date of this report and will be disposed unless special arrangements are made by the client.

The opportunity to be of service on this project is highly appreciated. If you have any questions, do not hesitate to call the undersigned.

NIDHAM ARAM ALRAYES, PE, MS, QSD/P
RCE No. C65487

REGISTERED PROFESSIONAL ENGINEER
NIDHAM ARAM ALRAYES
No. 65487
Exp: 09/19
CIVIL
STATE OF CALIFORNIA

Attachments:

Appendix 1 – Vicinity Map
Appendix 2 – Boring Location Map
Appendix 3 – Logs of Borings
Appendix 4 – Laboratory Test Results prepared by Sassan Geosciences, Inc.
Appendix 5 – Seismic Design Data
Appendix 6 – Calculations
Appendix 7 – Percolation Test Data Sheet

Distribution: (5) copies to Addressee along with one CD.