CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

GEOTECHNICAL ENGINEERING DIVISION (GED)

REPORT
GEOTECHNICAL EVALUATION
ECIS ODOR CONTROL FACILITY
Mission Road and Jesse Street
Los Angeles, CA
FOR: Baron Miya

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GEOTECHNICAL EVALUATION
ECIS ODOR CONTROL FACILITY
MISSION ROAD AND JESSE STREET

WO E2001442 **FILE #01-139**

1 INTRODUCTION

This report presents the results of the geotechnical evaluation conducted for the proposed East Central Interceptor Sewer (ECIS) Odor Control Facility to be located west of the intersection of Mission Drive and Jesse Street, along the ECIS alignment, within the City of Los Angeles (See Figure 1). This evaluation was conducted to provide geotechnical recommendations for design and construction of the proposed facility. The Geotechnical Engineering Division (GED) prepared this report in response to a request on September 5, 2001 from Baron Miya.

This report is based on a visual observation of site conditions by GED, two ECIS exploratory borings drilled in the site area, and results of laboratory tests performed on samples obtained from these exploratory borings. Logs of these exploratory borings and laboratory test results are included in Appendices A and B, respectively, of this report. Figure 2 depicts the locations of the proposed structures and exploratory borings.

2 PROJECT SCOPE

2.1 Proposed Construction

The Odor Control Facility will include a biotrickling filter building and an adjacent biofilter. The biotickling building will have plan dimensions of approximately 13.1 meters by 19.5 meters (43 feet by 64 feet) with a maximum building height of about 6 meters (20 feet). This building will include a subterranean level extending to a depth of 4.3 to 6.1 meters (14 to 20 feet) below existing grade. Three biotrickling filters (approximately 3.66 meters (12 feet) in diameter and 8.84 meters (29 feet) in height), a temporary recirculation tank with a diameter of approximately 2.3 meters (7.5 feet), a control room, control panel, and piping will be located within this building. A partial mezzanine level will be constructed along one side of the building.

The biofilter is expected to have plan dimensions of approximately 7.3 meters by 20.1 meters (24 feet by 66 feet) with a maximum height of approximately 6.2 meters (20 feet). This building will be subdivided into three independent biofilter cells. This structure is not planned to have a subterranean level. However, the floor of this structure will be located on the order of one meter (3 feet) below the adjacent site grade.

Odor Control Facility structures at this site will be located away from the ECIS tunneling access shaft. The existing site is relatively flat. Site grading is expected to consist of cuts and fills of 0.3 to 0.6 meters (one to two feet) or less.

2.2 Structural Considerations

As currently proposed, the biotrickling filter building will be founded on a concrete mat foundation with an estimated loading of approximately 96 KN/m^2 (approximately 2,000 pounds per square foot). The biofilter will have a maximum operating weight of approximately 9,790 KN corresponding to a uniform foundation pressure of approximately 66 KN/m^2 (approximately 1,400 pounds per square foot). A concrete mat foundation is planned for support of the biofilter.

3 SUBSURFACE CONDITIONS

Two exploratory borings drilled for the ECIS project are located near the proposed Odor Control Facility. The borings were drilled to depths of approximately 29.3 meters (96 feet) below the existing ground surface. Standard Penetration Tests and relatively undisturbed samples were collected from each of the borings. Logs of the borings are presented in Appendix A. Approximate locations of the borings in relation to the proposed Odor Control structure locations are shown on Figure 2.

4 EXISTING SITE CONDITIONS

4.1 Surface Conditions

The subject site is an irregular shaped parcel located west of the intersection of Mission Road and Jesse Street. The area of the proposed structures currently exists as concrete paved parking area with a perimeter fence. The proposed Odor Control Facility site is bounded by unpaved ground to the north, Mission Road to the east, a paved parking area to the south, and Southern Pacific railroad tracks to the west. The site and site area is relatively flat with ground surface elevations on the order of 76 meters (250 feet) above sea level.

4.2 Subsurface Conditions

Fill material consisting primarily of sand with silt was encountered in one boring to a depth of approximately 2.7 meters (9 feet) below the ground surface. Natural materials encountered in the two borings consisted primarily of medium dense to very dense sandy soils with varying percentages of silt and/or clay (Unified Soil Classifications of SP-SM, SM, and SM-SC) to depths of approximately 10.1 meters (33 feet). Dense to very dense sands and gravels (Unified Soil Classifications of SP, SP-SM, GP, and GP-GM) were encountered between depths of approximately 10.1 meters and 16.1 meters (33 feet to 53 feet). These materials were underlain with very dense sands with varying percentages of silt (Unified Soil Classifications of SP, SP-SM, SM, SW, and SW-SM) to the explored depths of approximately 29.3 meters (96 feet).

4.3 Groundwater

Perched groundwater was encountered at depths of approximately 6.0 and 17.7 meters (20 and 58 feet) in the two borings. Groundwater data obtained from CDMG (1998) indicates that the shallowest reported depth to groundwater in the site area is more than 45 meters (150 feet) below the ground surface.

5 LABORATORY TESTING

Numerous in-situ moisture and density tests, seven direct shear tests, 11 mechanical analyses, 12 percent passing the number 200 sieve, and one Atterberg Limits test were conducted on samples obtained at various depths from the borings.

In-situ moisture content and dry density tests were performed on a large number of relatively undisturbed ring samples. The percent of moisture as a function of dry weight, and the measured dry density in units of Kilonewton per cubic meter (KN/m^3) are presented on the exploration logs (see Appendix A).

Percent passing the No. 200 sieve was determined for 12 samples. Results are presented on the exploration logs (see Appendix A).

Atterberg Limits testing was performed on one soil sample collected from a depth of approximately 7.6 meters (25 feet). The liquid limit (LL) and plasticity index (PI) of the sample is shown on the exploration log (see Appendix A).

Consolidated drained three-point direct shear tests were performed on seven relatively undisturbed samples of the subsurface earth materials. Individual specimens were prepared and different vertical normal stresses were applied. Specimens were soaked prior to shearing. Samples were sheared at a constant rate of strain. Based upon the range of normal loads applied, the shear strength envelope was determined. Results of the test are presented on the Figures C-56 through C-62 in Appendix B. Test results indicate friction angles of 36 to 49 degrees with cohesion intercepts of 0 to 26.72 KN/m^2 (170 psf).

Sieve analyses were performed on 11 samples to assist in soil classification and to determine the distribution of soil particle sizes. Results of the tests are presented on Figures C-244 through C-254 of Appendix B.

6 REGIONAL GEOLOGY/FAULTING

The proposed Odor Control Facility site is an area where the bedrock is overlain by thick alluvium deposits. The alluvium consists primarily of sands and gravels with varying percentages of silt and/or clay. These materials are generally medium dense to very dense.

The proposed site is within the seismically active Southern California Area. There are a number of hazards that earthquakes typically present to structures. These hazards are discussed below.

6.1 Ground Surface Rupture

Ground surface rupture is typically considered to occur along active faults. Active faults are faults that have had displacement within the past 11,000 years. Since there are no known active faults beneath this site, or in close proximity to it, the potential for ground surface rupture is very low.

6.2 Liquefaction

The site is shown on the State of California Seismic Hazard Zones Map as not being within an area that has a potential for liquefaction. Liquefaction typically occurs when near surface (usually the upper 15 meters (50 feet)), saturated, clean, fine-grained loose sands are subjected to intense ground shaking.

The soils at this site consist primarily of sands and gravels with varying percentages of silt and/or clay. The natural granular materials were generally dense to very dense below a depth of approximately 4 meters (13 feet). In one of the nearby borings, perched groundwater was encountered at a depth of approximately 6 meters (20 feet) below the ground surface. Based on the subsurface data of the area, we do not expect groundwater to rise a significant amount above the perched level. Considering the denseness of the earth materials below a depth of 4 meters (13 feet), it is our opinion that liquefaction at the site is unlikely.

6.3 Ground Shaking

During an earthquake, ground shaking impacts structures throughout the area. Faults capable of generating a major earthquake that are within 25 kilometers (15 miles) of the proposed site are listed in Table 1 below (the San Andreas fault is also listed since it is the largest fault in Southern California).

TABLE 1 - Summary of Nearby Faults

Fault	Distance, Km (miles)	Magnitude
Elysian Park Zone	1 (0.5)	6.7
Newport-Inglewood	14 (9)	6.9
Raymond	8 (5)	6.5
San Andreas(Mojave)	56 (35)	7.8
San Gabriel	20 (12)	7.0
Santa Monica	9 (6)	6.6
Sierra Madre	20 (12)	7.0
Verdugo	11 (7)	6.7
Whittier	8 (5)	6.8

Note that these distances will vary slightly from distances obtained using the California Department of Conservation, Division of Mines and Geology “Active Fault Near Source Zones” map due to difference in measuring the surface location and subsurface projections. According to the state map the closest fault is the Raymond Fault at a distance of approximately 8 km (5 miles) and is a type “B” fault. The 8-km (5 mile) distance shall be used when computing near source factors according to the 1999 Los Angeles Building Code.

6.4 Earthquake Induced Landslide

Due to the relatively flat nature of the subject site, as well as the surrounding area, the potential for an earthquake-induced landslide to affect the proposed structures is considered very low.

6.5 Earthquake Induced Flooding

Earthquakes can cause the flooding of a site due to structure failure of an upstream dam, seiches (sloshing of water in large inland bodies of water) and tsunamis (large waves caused by seismic events in the ocean). Due to the distance from the site to the ocean, tsunamis are not considered to pose any danger. No large inland bodies of water are located in close proximity to the site and the general area is predominately flat. Therefore, the potential for seiches or dam failure affecting the site is considered very low because any releases of large quantities of water from great distances would be dispersed before reaching the site.

6.6 Seismic Settlement

The on-site surfical soils are generally cohesionless in nature. The shallow granular soils within approximately 4 meters (13 feet) of the ground surface could be potentially susceptible to seismically induced settlement. Earth materials below a depth of approximately 4 meters (13 feet) are dense to very dense and not subject to significant seismically induced settlement. Since the biotrickling filter building will be founded in the dense granular materials at a depth of approximately 5 meters (20 feet) below the ground surface the potential for seismically induced settlement impacting this building is considered very low.

To mitigate the possibility of seismic settlement in the near surface bearing soils, the upper 1.5 meters (5 feet) of material beneath the biofilter foundation should be removed and replaced with properly compacted fill materials. Fill materials should be compacted to a minimum of 95% of the maximum dry density obtained by the ASTM D1557 Method.

7 FINDINGS

Based on the two borings, fill materials and shallow unsuitable natural soils may be encountered at the site. Natural materials beneath the site consist primarily of medium dense to very dense sandy soils with varying percentages of silt and/or clay to depths of approximately 10.1 meters (33 feet). Dense to very dense sands and gravels with some silt underlie these materials to a depth of approximately 16.1 meters (53 feet). These materials were underlain with very dense sand with varying percentages of silt to the explored depths of approximately 29.3 meters (96 feet).

Secondary seismic effects such as ground rupture, liquefaction, landslides, and inundation are not considered a problem at this site. Existing fill soils and any unsuitable natural soils will require removal and replacement for support of the biofilter foundation. However, the site is less than 25 kilometers (15 miles) from eight faults that are classified as Type B Faults, and 47 kilometers from the San Andreas Fault, which is a Type A Fault. Therefore, this site like much of Southern California is subject to strong ground shaking from nearby earthquakes.

8 CONCLUSIONS

The following conclusions are based on the results the materials encountered in the nearby borings, laboratory test results and our understanding of the project.

- The site is suitable for the construction of an Odor Control Facility as proposed; however, the site would require grading for support of the near surface biofilter.

- Mat foundations may be used for support of the structures as planned. The biotrickling filter building can be founded on undisturbed natural soils at a depth of 4.3 meters (14 feet) or more below the ground surface. Support of the biofilter will require a 1.5 meter (5-foot) minimum removal of any existing fill materials and unsuitable natural soils. The removal may exceed 1.5 meters (5 feet) in some areas. The actual depth of removal will be determined by a GED representative at the time of construction.

- According to the 1999 Los Angeles Building Code, fill shall be placed on natural undisturbed material or approved compacted fill. All required fill and backfill shall be placed in loose level lifts not exceeding 0.2 meters (8 inches) in thickness. It should also be moisture conditioned to near optimum moisture, and mechanically compacted to at least 95% of the maximum density obtained by the ASTM D1557 Method. For fill soils with more than 15% clay, the required relative compaction may be decreased to 90% in accordance with the requirements of the Los Angeles Department of Building and Safety Grading Code. However, test results indicate that this is not the case for the on-site soil, which will be used for fill and backfill. Therefore, the minimum compaction shall be 95% of the maximum density for the on-site soil. GED's representative shall test all fill soils for adequacy, under the supervision of the Geotechnical Engineer. Compaction by jetting or by flooding shall not be allowed.

- There are no known active faults crossing the site. The site may be subjected to heavy shaking from any of the nearby faults listed in Table 1, however the 1999 Los Angeles Building Code static design method should be adequate for the proposed Odor Control Facility.

- Imported fill shall be tested to ensure that the new soils have similar characteristics to the on-site soils. All imported fill soil shall be approved by the Geotechnical Engineering Division, prior to importing.

- Perched groundwater was encountered at a depth of approximately 6 meters (20 feet) below the ground surface. Groundwater is not expected to impact the construction with the possible exception of the biotrickling filter foundation and installation of any shoring.

9 SITE GRADING

9.1 Site Grading

The site will require grading for the support of the foundation of the proposed biofilter. It has been our experience that in urban areas that have been developed, it is not possible, or economical to find all the pockets of fill or disturbed soil with exploratory borings. Therefore, it is recommended that as a minimum the upper 1.5 meters (5 feet) of foundation soil be removed from the biofilter building and replaced with properly compacted fill. Prior to placing any new fill, a GED representative shall observe the bottom of the over-excavation to determine if additional removals are required. If additional fill or unsuitable soils are found, these materials will have to be removed to suitable natural material.

9.2 Site Preparation

The proposed structural areas of the site (building areas plus 1.5 meters (5 feet) beyond the building limits) shall be cleared of all trash, deleterious materials, vegetation, roots, irrigation lines, and utility lines (if any). All deleterious materials shall be disposed of off-site. In addition, any existing foundations, slabs, retaining walls, and other obstructions below the existing grade shall be removed and wasted from the site.

The biofilter area should be over-excavated a minimum of 1.5 meters (5 feet) below the bearing elevation of the mat foundation and replaced with either clean on-site soil, or imported fill material similar to the on-site soils. The removal limits should extend a minimum of 1.5 meters (5 feet) beyond the plan dimensions of the structure. The bottom shall be observed by a GED representative, scarified, moisture conditioned to between optimum moisture content and a few percent above optimum and compacted to a minimum of 95 percent relative compaction.

All fill shall be free of organic material, hazardous waste contamination, deleterious debris, and brick and concrete rubble larger than 0.15 meters (6 inches) in size. Fill and backfill shall be placed in loose level lifts not exceeding 0.2 meters (8 inches) in thickness, moisture conditioned to between optimum moisture and a few percent above optimum, and mechanically compacted to at least 95% of the maximum density obtained by the ASTM D1557 Method. For fill soils with more than 15% clay, the required relative compaction may be decreased to 90% in accordance with the requirements of the Los Angeles Department of Building and Safety Grading Code. This is not the case and the required relative compaction shall be 95% of the maximum density. A representative from GED shall test all fill soils for adequacy, under the supervision of the Geotechnical Engineer. Compaction by jetting or by flooding shall not be allowed.

10 DESIGN RECOMMENDATIONS

10.1 General

Mat foundations can be used for support of the proposed structures. Foundations of the biotrickling filter building, with a subterranean level extending approximately 4.3 meters (14 feet) below grade, can be supported on undisturbed natural soils. The foundation of the biofilter can be supported on a minimum of 1.5 meters (five feet) of properly compacted fill material. Fill materials may consist of either on-site soils or approved imported soils. Design recommendations for seismicity, earthwork, foundations, and retaining walls are provided. Construction considerations, such as temporary excavations, are discussed in the “Construction Considerations” section later in this report.

The recommendations of this report are based on limited information regarding the proposed construction. Further recommendations, in the form of a supplemental report, may be provided, if desired. If a supplemental report is desired, please submit a written request to our office.

The foundation and grading plans shall be reviewed by our office to ensure that the recommendations contained in this report and any supplemental reports are appropriate to the project as designed.

10.2 Seismicity

This site, along with all of Southern California, is located within a seismically active area (UBC Zone 4), however the site is not within a special studies zone. The provisions of the 1999 Los Angeles Building Code (LABC) are considered appropriate minimums for the design of the proposed structures, provided the appropriate site parameters are included as discussed below.

Section 1636 of the 1999 LABC defines six different soil profile types ($S_A – S_F$). These soil profile types are used to lookup values of the seismic coefficients Ca and Cv in tables 16-Q and 16-R respectively. These coefficients, together with the near source factors to be discussed a little later, are used in the formulas to determine the static base shear force that the structure must be designed to withstand.

Soil Profile Types are based on the average properties of the upper 30 meters (100 feet) of soil. The appropriate soil profile type is chosen by referencing the average shear wave velocity, average Standard Penetration Test (SPT) blowcounts, and/or the undrained shear strength of the soil.

The site is shown on the State of California Seismic Hazard Zones Map as not being within an area that has a potential for liquefaction. During the subsurface investigation, ground water was encountered at depths of approximately 6 and 17.7 meters (approximately 20 feet and 58 feet) below the ground surface. The shallow ground water depth was perched on a clayey sand layer. The boring logs indicate that the soils are generally dense to very dense below a depth of approximately 4 meters (13 feet). Based on this information, it is our opinion that liquefaction at the site is unlikely.

As previously mentioned, near source factors are also used to determine the seismic coefficients Ca and Cv. The near source factors Na and Nv can be determined from 1999 LABC Tables 16-S and 16-T respectively. In order to use the tables it is necessary to know the distance to the nearest fault and the corresponding fault type as found in the State of California Department of Conservation “Active Fault Near-Source Zones” maps. According to this map, the nearest fault is the Raymond Fault (type“B”fault) at a distance of approximately 8 km (5 miles).

Using the above information and the appropriate tables within the 1999 LABC, the near source factors and seismic coefficient can be determined. These values are summarized in Table 2 below.

TABLE 2 – Seismic Design Data

Seismic Zone Factor (Z)	0.4
Soil Profile Type	S_C
Near Source Factor Na	1.0
Near Source Factor Nv	1.08
Seismic Coefficient Ca	0.40
Seismic Coefficient Cv	0.60

10.3 Seismic Settlement

Since the biotrickling filter building will be founded in the dense granular materials at a depth of approximately 5 meters (16 feet) below the ground surface the potential for seismically induced settlement impacting this building is considered very low. To mitigate the possibility of seismic settlement in the near surface bearing soils, the upper 1.5 meters (5 feet) of material beneath the biofilter foundation should be removed and replaced with properly compacted fill materials. Fill materials shall be placed and compacted in accordance with the recommendations of Section 10.4 Earthwork of this report.

10.4 Earthwork

10.4.1 Removals

Proper site preparation will require the removal of the existing vegetation, and any interfering substructures. All disturbed soil containing debris, or other undesirable material, and all debris resulting from any demolition shall be removed and wasted from the site. Disturbed soils such as those derived from demolition shall be properly removed.

The area of the biofilter foundation should be over-excavated to remove any existing fill materials or other unsuitable materials to a uniform depth below the bottom of foundations and replaced with compacted fill. Based on the data obtained during previous investigation of the site area, overexcavation depths on the order of 1.5 meters (5 feet) below the bearing elevation of the biofilter foundation is recommended. Removal excavations should extend a horizontal distance beyond the edges of the foundations equal to the depth of overexcavation below the footings or a minimum of 1.5 meters (5 feet), whichever is greater.

Slab-on-grade and pavement areas should be over-excavated to a depth of at least 0.6 meters (2 feet) below existing grade or the finish subgrade elevation, whichever is lower, and replaced with properly compacted fill. Removal excavations should extend a horizontal distance of at least 1 meter (3 feet) beyond the plan dimensions of pavements.

Overexcavation depths may have to be greater in some areas to completely remove unsuitable soils. Thus, we recommend that unit costs for site earthwork be obtained during the initial bidding process. Unit pricing should be obtained for site overexcavation, soil moisture conditioning, fill import, and fill placement and compaction.

10.4.2 Subgrade Preparation and Compaction

Prior to placing any fill, the exposed natural subgrade shall be inspected and approved by the Geotechnical Engineer. If soft, yielding, or unsuitable soils such as old fill are exposed at the subgrade surface, then the unsuitable soils shall be removed and replaced with properly compacted fill soils in accordance with the following section.

10.4.3 Fill Compaction

All required fill and backfill shall be placed in loose level lifts not exceeding 0.2 meters (8 inches) in thickness, moisture conditioned to near optimum moisture, and mechanically compacted to at least 95% of the maximum density obtained by the ASTM D1557 Method. The GED's representative shall test all fill soils for adequacy, under the supervision of the Geotechnical Engineer. Compaction by jetting or by flooding shall not be allowed.

10.4.4 Control of Moisture Content

Soils shall be compacted between optimum moisture content and a few percent above the optimum moisture.

10.4.5 Fill Materials

All existing soils at the site may be used for fill, or backfill provided they are free of organic material, hazardous waste contamination, deleterious debris, and brick or concrete rubble larger than 0.15 meters (6 inches) in size. Such unsuitable material shall be removed and wasted from the site.

The 1.5 meter (5 foot) over-excavated area beneath the future foundation of the biofilter and over-excavated slab-on-grade and pavement areas shall be replaced with either clean on-site soil, or soil that is similar in properties to the on site soil. All fill shall be free of organic material, hazardous waste contamination, deleterious debris, and brick and concrete rubble larger than 0.15 meters (6 inches) in size. All fill shall be placed in thin loose lifts not more than 0.2 meters (8 inches) thick, and compacted too at least 95% relative compaction. The Building Code requires that structural fill that is granular in nature, that is having less than 15% passing 0.005 mm, be compacted to 95% relative compaction. Relative compaction shall be defined as the ratio of field dry density to the maximum dry density as determined by the latest version of ASTM Standard Method D1557.

All imported soils shall be approved at the borrow site by the geotechnical engineer prior to its import. The geotechnical engineer shall be notified at least 3 working days prior to import to allow time to conduct the appropriate tests and calculations which will verify the required bearing capacity.

10.5 Mat Foundations

10.5.1 Vertical Capacity

Based on our understanding of the anticipated structure types and the characteristics of the on-site soils, the proposed structures may be supported on mat foundations. The biotrickling filter building shall be founded on undisturbed natural soil and the biofilter on at least 1.5 meters (5 feet) of properly compacted fill. Foundations shall be founded at least 0.5 meters (18 inches) below the lowest adjacent grade and shall be designed to impose a dead load plus live load bearing pressure not to exceed 140 KN/m^2 (2,900 pounds per square foot). A 1/3 increase may be used when considering transient loading conditions such as wind or seismic forces.

A coefficient of vertical subgrade reaction, for a 0.3-meter-square loaded area, of 31.4 KN/m^3 may be used for design. Vertical subgrade modulus, k, can be calculated as $k = 31.4\ (B+1/2B)^2$, where B is the mat width in meters.

All loose and disturbed soil at the bottom of the proposed foundation excavations shall be excavated and replaced with structural concrete or properly compacted fill. All fill placed adjacent to foundations shall be mechanically compacted to the same standards as outlined in the fill placement section of this report.

The bearing capacity shall be verified by remolding samples of the fill soil at or below the bottom of the footing elevation. The remolded samples shall be tested to determine their shear strength and compressibility. These tests will be reported in the compaction report.

10.5.2 Lateral Capacity

Foundations may be utilized to resist temporary lateral forces such as those developed by wind or seismic forces. The allowable passive resistance of the native soil or properly compacted fill may be assumed 47 KN/m^3 (300 pounds per square foot per foot of depth), with a maximum of 470 KN/m^2 (3,000 psf). The coefficient of friction between the bottom of the footing and native soil may be assumed to be 0.35 and may be used without reduction of the lateral bearing resistance.

10.6 Settlement

The magnitude of total and differential static settlements of the mat foundation will be a function of the structural design and stiffness of the mat. Based on our understanding of the proposed construction, we estimate that total settlement of the proposed structures will not exceed 12 mm (2 inch) with differential settlements of approximately 6 mm (3 inch) or less.

10.7 Retaining Walls

Plans provided to GED show that the maximum height of soil retained by the basement walls of the biotrickling filter building will be 4.3 to 6.1 meters (14 to 20 feet). The basement wall can be considered as a restrained wall (the rotation of the top of the wall is restricted by the above ground floor). A uniform lateral earth pressure of 4.3H kN/m^2 (28H psf), where H is the height of retainment in meters (feet), shall be used for the design of the basement wall. This earth pressure is for the condition of a level backfill for a horizontal distance equal to or greater than the height of the wall.

In addition to the above static soil pressures, a seismic lateral earth pressure should be used for design of subterranean walls. Evaluation of dynamic seismic lateral earth pressure was performed for a horizontal ground acceleration of 0.4g. For this level of ground motion, we recommend that an inverted dynamic equivalent fluid pressure of 4.7 kN/m^3 (30 pcf) be used in the design of the walls. This pressure should be applied as an inverted triangular pressure distribution with the base of the triangle at the top of the wall and the tip of the triangle at the wall base.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or cranes for service of the facility, should be considered for design of the retaining walls. Loads applied within a 1H:1V projection behind the heel (or back) of the wall footing should be considered as lateral surcharge.

The calculated lateral earth pressure is based on the assumption that hydrostatic pressure will not develop behind the back of the basement wall. However, as provided in the plans, basement walls need to be waterproofed to ensure that no water from landscaping or other sources can seep through the basement walls that are in contact with soil. A minimum of 0.1 meter (4-inch) diameter perforated pipe shall be provided at the bottom and behind the basement wall to collect water. Inside the basement, a sump pump with a sump pump pit shall be provided to collect and dispose water of water seepage from behind the back of the wall or other unforeseen conditions.

Backfills for retaining walls should be compacted to a minimum of 90 percent relative compaction (based on ASTM Test Method D1557). During construction of retaining walls, the backcut should be made in accordance with the requirements of Cal/OSHA Construction Safety Orders. Relatively light construction equipment should be used to backfill retaining walls.

10.8 Slabs-on-Grade

Slabs-on-grade should be placed on properly compacted fill soils as described in the earthwork section of this report. Prior to placing concrete, the exposed subgrade should be scarified to at least 0.15 meters (6 inches), moisture-conditioned, and then compacted to 95 percent of the ASTM Test Method D1557-91 laboratory maximum density. The subgrade should not be allowed to dry out prior to concrete placement.

Care should be taken to avoid slab curling if slabs are poured in hot weather. Slabs should be designed and constructed as promulgated by the Portland Cement Association (PCA). Prior to the slab pour, all utility trenches should be properly backfilled and compacted.

In areas where a moisture-sensitive floor covering (such as vinyl, tile, or carpet) is used, a polyethylene vapor barrier with a thickness of at least 6-mils should be placed between the slab and compacted subgrade. Where the barrier is used, it should be protected with 50 millimeters (2 inches) of sand placed above to prevent punctures and to aid in the concrete cure. Vapor barrier seams should be overlapped a minimum of 0.15 meters (6 inches) and taped or otherwise sealed.

10.9 Pavement Design

Prior to subgrade preparation, pavement areas should be over-excavated and replaced with properly compacted fill material in accordance with Section 10 of this report. Prior to the placement of aggregate base or asphalt concrete pavements, the upper 0.15 meters (6 inches) of subgrade soils should be scarified, moisture-conditioned, and properly compacted. Exposed subgrade soils should be moisture-conditioned to between optimum-moisture content and a few percent above the optimum-moisture content and compacted. Subgrade soils should be compacted to a minimum of 95 percent of the ASTM Test Method D1557-91 laboratory maximum density to a depth of approximately 0.15 meters (6 inches).

Shallow soils encountered within the borings consisted primarily of sand with some silt. Based on these soil descriptions we have assumed an R-value of 40 for the subgrade soils. We recommend that R-value testing be performed at the completion of site earthwork to determine the R-value of the soils exposed at the subgrade elevation. For an assumed Traffic index of 6 and an R-value of 40, we recommend a preliminary pavement section consisting of 7.6 cm (3 inches) of asphalt concrete over 10 cm (4 inches) of aggregate base.

10.10 Cement Type

No chemical test data is available to evaluate the potential for the corrosion of concrete in contact with the site soils. Lacking this information, we recommend that concrete be designed per the “severe” category of Table 19-A-4 of the 1997 UBC. If desirable, soil samples could be collected from the site and tested to determine if less restrictive concrete requirements could be used for the project.

11 CONSTRUCTION CONSIDERATIONS

11.1 Groundwater Control

Perched groundwater may be encountered during construction of the biotrickling filter building, therefore, some amount of groundwater control may be necessary to facilitate construction. Minor hydrocarbon or lead contamination is possible. The contractor should follow the May 2001 "Hazardous Waste/Soil Management Plan" prepared by Parsons Engineering Science, Inc. for the ECIS project.

It is anticipated that control of groundwater can be accomplished with portable sump pumps set in trenches excavated around the perimeter of the foundation. Prior to excavating below the water table, dewatering should be performed to lower the immediate water surface to at least 1 meter (3 feet) below the planned depth of excavation to prevent bottom heave. Groundwater should be maintained at this elevation until construction has progressed above the surrounding static groundwater level, and sufficient structural dead-load and backfill have been placed to counteract hydrostatic uplift pressures. The system should operate continuously until the construction process has progressed above the surrounding static water table surface.

The dewatering program should consider the effects on adjacent structures. To reduce the potential for impacting the performance of the adjacent building and other structures, the dewatering system should be designed and operated to prevent significant lowering of groundwater levels beneath adjacent structures. Consideration should be given to installing monitoring wells near existing structures in order to measure and document groundwater levels during excavation and construction.

11.2 Temporary Excavations

Temporary construction slopes shall not exceed 1:1 (horizontal : vertical) for slopes 2 meters (7 feet) or less in height. Temporary excavation slopes more than 2 meters (7 feet) in height to a maximum of 6 meters (20 feet) high can be cut as a compound slope with the lower 2 meters (7 feet) sloped at a 1:1 (horizontal : vertical) gradient and the portion of the slope above constructed at a 1-1/2:1 (horizontal : vertical) or flatter gradient.

11.3 Temporary Shoring

Cantilevered shoring walls up to 5 meters in height that are permitted to yield, shall be designed to withstand a lateral force equivalent to a fluid having a density of 4.7 kN/m^3 (30 pcf) for a level back slope. If a braced shoring system is used instead, it shall be designed to withstand a rectangular lateral pressure distribution equal to 4H kN/m^2 (25H psf), where H is the height of the wall in meters (feet).

11.4 Geotechnical Services During Construction

Foundation recommendations in this report are based on the assumption that all foundations will be embedded into firm, competent material. A representative from our office shall observe all foundation excavations prior to the placement of steel or concrete. The purpose of the observation is to evaluate that the foundations are founded on firm, competent material and that the excavation is free of loose and/or disturbed soils.

Structural fill and backfill shall be placed and compacted under the observation of a representative from our office. To schedule inspection call (213) 485-3805 at least two working days before inspection is required.

12 CLOSURE

12.1 Plan Review

This report has been prepared to aid in the evaluation of the proposed Odor Control Facility and to assist architects and engineers in design of the proposed structures. Our office shall be provided an opportunity to review the design drawings and specifications at 50% and 100% completion to ensure that the recommendations of this report have been properly implemented.

12.2 Closing

It shall be understood that where this report recommends inspection by the Geotechnical Engineer. The inspection may be made by either the Geotechnical Engineer or GED personnel working under the supervision of the Geotechnical Engineer.

If there are any questions regarding this report, please contact Patrick Schmidt at (213) 847-4046, or Theo Seeley at (213) 847-4044.

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Patrick J. Schmidt GE 2260
Geotechnical Engineer I

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APPENDIX A

APPENDIX B