Appendix F  Geotechnical Conditions Memo
Appendices

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**Subject:**  
*Summary of Geotechnical Conditions for the Southeast Area Specific Plan (SEASP), City of Long Beach, California*

**Introduction**

In accordance with your request, LGC Geotechnical, Inc. has prepared this summary of geotechnical conditions for the Southeast Area Specific Plan (SEASP) in the City of Long Beach, California. The purpose of our study was to evaluate the general site geotechnical conditions and provide a summary of potential geotechnical issues regarding future redevelopment. No subsurface work, laboratory testing or onsite geologic mapping was performed as part of our review, therefore the geotechnical information contained in this section has been developed by the review of previous geotechnical reports and readily available geotechnical data.

**Site Description**

It is our understanding that the City of Long Beach is seeking to replace the existing 1,481-acre Southeast Area Development and Improvement Plan (SEADIP) with a new Specific plan and conventional zoning. The new Southeast Area Specific Plan (SEASP) is intended to provide comprehensive direction for the future development of an approximately 1,472-acre area and provide conventional zoning for a 9-acre area (PlaceWorks, 2015). The new SEASP site is generally located in the southeast corner of Long Beach within the County of Los Angeles and bordering the County of Orange. In general, the subject site is bounded by the county border to the east and southeast, State Route 22 Freeway/7th Street to the north, Bellflower Boulevard to the west, and Marine Stadium/Alamitos Bay to the southwest (Figure 1 – Site Location Map). The new SEASP Proposed Zoning map prepared by Fuscoe Engineering (2015) has been provided for reference (Figure 2 – SEASP Proposed Zoning).

Current land uses consist primarily of residential dwellings, commercial, office space, industrial, open space/wetlands, active oil operations and undeveloped parcels (PlaceWorks, 2015). The area also, includes a golf course, Marina Vista Park, a public school, and a Los Angeles Water and Power facility. The San Gabriel and Los Cerritos Channels traverse the subject site approximately from the northeast corner southwest to Alamitos Bay and the Pacific Ocean. Topographically, the subject site is relatively flat-lying with some elevation gain in the northern portion of the area near State Route 22/7th Street.
Geologic Background

Regionally the site is located in the Los Angeles Basin within the coastal section of the Peninsular Ranges Geomorphic Province of California. Based on our review of regional geologic maps, the site is underlain primarily by artificial fill with lesser amounts of Quaternary Young Alluvial Fan Deposits and Quaternary Old Paralic Deposits. Artificial fill, consisting of engineered and non-engineered fill materials, is the result of man-made activities including mining, quarrying, land development and construction operations. It is anticipated that these artificial fill materials are relatively shallow (less than ten feet in thickness). Quaternary Young Alluvium is located in the northeastern corner of the subject site and most likely underlies the majority of the mapped artificial fill. These materials generally consist of poorly consolidated clay and silt. Quaternary Old Paralic Deposits overlie the wave cut platforms which have been preserved by regional uplift (CGS, 2003) and are located in the northern portion of the site. These deposits generally consist of poorly sorted, interfingered deposits of siltstone, sandstone, and conglomerate. A portion of the regional geologic map with the approximate SEASP boundary has been provided (Figure 3 – Regional Geologic Map).

Regional geologic mapping and local topographic expressions do not indicate the presence of large-scale landslides within the area of the subject site. Review of the Seismic Hazard Zone Maps and the Seismic Hazard Zone Reports for the Long Beach, Los Alamitos and Seal Beach 7.5 Minute Quadrangle indicates that the site is not located within a mapped area considered potentially susceptible to seismically-induced slope instability.

Groundwater

Historical high groundwater maps indicate groundwater levels generally ranging from approximately 3 feet to 20 feet below the existing ground surface (see References). Due to the proximity to the ocean, existing ground elevation relative to mean sea level (msl), and presence of waterways/channels through the SEASP site, shallow groundwater conditions should be anticipated for the majority of the site.

Subsidence

Subsidence is generally defined as the sinking or lowering of earth’s surface due to natural geologic and/or man-made causes. Regional subsidence associated with oil and gas withdrawal began in the Long Beach area in 1938 and 1939 (Mayuga, 1968). Over approximately 20 square miles have been affected by the regional subsidence due to the extraction of oil and gas from subsurface layers. The withdrawal of oil and gas from subsurface layers from the Wilmington Oil Field created a “subsidence bowl” up to approximately 29 feet deep in the Port of Long Beach and extended eastward under the City of Long Beach coastline including the new SEASP site. Regional mapping of the subsidence indicates that the SEASP site experienced approximately 1.2 feet to 1.6 feet of subsidence (LBGO, 2016). Water injection to maintain pressure in the oil reservoirs began in 1953, which eventually stopped further subsidence in the region (Mayuga, 1968). Although subsidence has been arrested, constant monitoring and control by the Long Beach Oil and Gas Department is ongoing and will continue in the future. Stable land surfaces are critical for continued regional economic growth and cannot be jeopardized by the effects of oil and gas production (LBGO, 2016).
Potential Geotechnical Issues

Based upon the results of our limited document review (see References), it is our opinion that redevelopment of portions of the subject site appear generally feasible from a geotechnical standpoint. At a minimum, the following geotechnical items should be evaluated and addressed on a site by site basis with regards to specific improvement plans for future redevelopment. Geotechnical evaluations should be performed during the design phase of proposed redevelopment in order to provide recommendations in accordance with the currently adopted California Building Code (CBC) and/or the applicable sections of the City of Long Beach Municipal Code.

Active Faulting

Prompted by damaging earthquakes in Northern and Southern California, State legislation and policies concerning the classification and land-use criteria associated with faults have been developed. Their purpose was to prevent the construction of urban developments across the trace of active faults. The result was the Alquist-Priolo Earthquake Fault Zoning Act, which was most recently revised in 2007 (CGS, 2007). According to the State Geologist, an active fault is defined as one which has had surface displacement within the Holocene Epoch (roughly the last 11,000 years). A potentially active fault is defined as any fault which has had surface displacement during Quaternary time (last 1,600,000 years), but not within the Holocene. Earthquake Fault Zones have been delineated along the traces of active faults within California.

Portions of the SEASP site are located within a State of California Earthquake Fault Zone (aka Alquist-Priolo Special Studies Zone) associated with the Newport-Inglewood Fault which traverses the site in a northwesterly direction (Figure 4 – State Earthquake Fault Zone Map). Where developments for human occupation are proposed within the delineated Earthquake Fault Zones, the state requires detailed fault evaluations be performed so that engineering-geologists can mitigate the hazards associated with active faulting by identifying the location of active faults and allowing for a setback from the zone of previous ground rupture. The approximate location of the State Earthquake Fault Zone has been superimposed on the SEASP Proposed Zoning map for reference (Figure 5 – SEASP Zoning Map with Fault Zone).

There is a potential for significant ground shaking across the entire site during a strong seismic event. New improvements will need to be designed for seismic forces in accordance with current building codes and regulations.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include but are not limited to ground lurching and shallow ground rupture, soil liquefaction, dynamic settlement, and seiches and tsunamis. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependant on the distance between the site and causative fault and the onsite geotechnical conditions.
**Liquefaction and Dynamic Settlement**

Liquefaction induced settlement is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that loose, saturated, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction, depending on their plasticity and moisture content (Bray & Sancio, 2006). Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Based on our review of the regional seismic hazard maps and reports (see References), a large majority of the site is located within a liquefaction seismic hazard zone (Figure 6 – Seismic Hazard Map). The potential for liquefaction and dynamic settlement will need to be addressed prior to the redevelopment of any site within the liquefaction seismic hazard zone.

**Lateral Spreading**

Lateral spreading is a type of liquefaction induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures. The potential for lateral spreading will need to be addressed prior to the redevelopment of any site within the liquefaction seismic hazard zone.

**Expansion and Corrosion Potential**

During the design phase of proposed redevelopment, expansion and corrosion potential of the site soils will need to be tested in order to provide proper design recommendations for foundations, buried utilities, concrete, etc. The laboratory test results should be utilized in order to mitigate the effects of expansive and/or corrosive soils on the proposed improvements.

**Hydro Collapse**

Although the depth of groundwater is relatively shallow, the potential for hydro collapse should be evaluated during the design phase. If necessary, recommendations for mitigation of hydro collapse should be provided.
Limitations

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is based on data obtained from limited review of the referenced maps and reports which have been extrapolated to characterize the site. Variations may exist and conditions not observed or described in this report may be encountered during future redevelopment. This report was prepared in order to provide a summary of potential geotechnical issues that will need to be addressed during redevelopment of the subject site. Site specific geotechnical reports will need to be prepared on a site by site basis once proposed redevelopment plans are prepared.

The findings of this report are valid as of the present date. However, changes in the conditions of a site can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties.

We sincerely appreciate this opportunity to be of service. Should you have any questions, please do not hesitate to contact our office.

Respectfully,

LGC Geotechnical, Inc.

Dennis Boratyniec, GSE 2770
Vice President

Kevin Dyekman, CEG 2595
Project Geologist

KAD/DJB

Attachments: References
Figure 1 – Site Location Map
Figure 2 – SEASP Proposed Zoning
Figure 3 – Regional Geologic Map
Figure 4 – State Earthquake Fault Zone Map
Figure 5 – SEASP Zoning Map with Fault Zone
Figure 6 – Seismic Hazard Map

Distribution: (2) Addressee (wet-signed copies)
References


California Department of Conservation, Division of Mines and Geology, 1998a, Seismic Hazard Zone Report for the Long Beach 7.5-Minute Quadrangles, Los Angeles County, California, Open File Report 98-19.

_____, 1998b, Seismic Hazard Zone Report for the Los Alamitos 7.5-Minute Quadrangles, Los Angeles County, California, Open File Report 98-10.

_____, 1998c, Seismic Hazard Zone Report for the Seal Beach 7.5-Minute Quadrangles, Los Angeles County, California, Open File Report 98-11.


_____, 1999c, Seismic Hazard Zones, Seal Beach Quadrangle, Revised Official Map, Released March 25, 1999.


California Department of Water Resources, 2000, Historic Data Map Interface, Website Address: http://wdl.water.ca.gov


_____, 2009b, Tsunami Inundation Map for Emergency Planning, Los Alamitos/Seal Beach Quadrangles, County of Los Angeles, dated March 1, 2009.


_____, 2003, Geologic Map of the Long Beach 30’x 60’ Quadrangle, Los Angeles County, California.


Fuscoe Engineering, 2015, Figure 3, SEASP Proposed Zoning, dated November 10, 2015

Long Beach Development Services, 2008, City of Long Beach Planned Development District 1, dated February 1, 2008.
Long Beach Gas and Oil (LBGO), 2016, Subsidence, website address:  

FIGURE 2
Southeast Area Specific Plan
(SEASP)

SEASP Proposed Zoning

- Single Family Residential
- Mobile Homes
- Multi-Family Residential
- Commercial - Neighborhood
- Mixed Use Community Core
- Mixed Use Marine
- Industrial
- Public
- Coastal Habitat, Wetlands & Recreation
- Open Space/Recreation
- Designated ROW (not built)
- ROW/Cut downs
- Channel, Marina & Waterway
- Converting to Conventional Zoning
- Specific Plan Boundary
- City Boundary

1" = 1500'

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Approximate Limits of the new SEASP
Approximate Limits of Earthquake Fault Zone

Approximate Trace of Newport-Inglewood Fault

FIGURE 5
SEASP Proposed Zoning Map with Earthquake Fault Zone
Approximate Limits of the new SEASP

California Department of Conservation, Division of Mines and Geology, Seismic Hazard Zones, Long Beach, Los Alamitos, and Seal Beach Quadrangles, Revised Official Map, Released March 25, 1999

FIGURE 6
Liquefaction Hazard Zone Map

MAP EXPLANATION
Zones of Required Investigation:

Liquefaction
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.