# 3.5 GEOLOGY AND SOILS

## 3.5.1 INTRODUCTION

This section presents existing geologic conditions in the Updated 2009 Redevelopment Plan Area and analyzes the potential for development under the project to be affected by those conditions. Information presented in the discussion and analysis presented below was drawn from site visits, the *Hercules General Plan* and *General Plan EIR*, and environmental documents associated with previous projects in Hercules.

## 3.5.2 ENVIRONMENTAL SETTING

The sections below present a detailed description of the environmental setting of the Updated 2009 Redevelopment Plan Area, including the Added Area, related to geology and soils, concentrating primarily on aspects that are specific to the Added Area.

### 3.5.2.1 Geology and Soils

Hercules is located within the California Coast Ranges geomorphic province that parallels the boundary between two major tectonic plates—the Pacific and North American plates. The predominant rock types within this province are marine sedimentary and volcanic rocks that were originally part of the intact, overriding (North American) plate. The units were uplifted after the plate margin changed from a subduction zone to a transform fault, approximately 25 million years ago (Alt and Hyndman 2000).

Geology in the Redevelopment Plan Area consists of alluvial (stream-related) deposits of Quaternary age (less than two million years old) on the floor of the Refugio Valley, which includes the Sycamore Crossing site, surrounded by marine sedimentary rocks of Miocene age (between 5 and 23 million years old) in adjacent uplands, including the Hill Town site. Alluvium in Refugio Valley varies from about 12 feet in thickness in the southeast portion of the valley to about 80 feet in thickness near the valley mouth. Much of the older valley floor deposits are covered by loose, artificial fill. Clear Lake clay lies on top of the alluvial deposits on the valley floor. The clay is a poorly drained soil with low erosion potential, low strength, high shrink-swell potential, and high corrosivity. Soils in the upland areas primarily consist of Tierra Loam, a moderately well-drained soil with moderate to high erosion potential, low strength, high shrink-swell potential, and high corrosivity. Other soils in the upland areas consist of Los Osos clay Loam and Sehorn clay, both of which are well-drained soils with moderate to high erosion potential, low strength, high shrink-swell potential, and high corrosivity (RBF 2008).

### 3.5.2.2 Topographic Setting

The Sycamore Crossing project site is located within the Refugio Creek watershed, south of the main stem of the creek, and is bisected by the West Branch tributary of Refugio Creek, at an elevation between about 30 feet (at the bottom of the ravine just west of San Pablo Avenue) and 54 feet above mean sea level (msl). The existing land surface at the site consists of a low-lying area along the east side of the site, including a ravine through which the West Branch of Refugio Creek flows, and a steep-sided, flat, elevated mound of soil on the western half of the site. This soil was excavated from nearby properties and placed on the Sycamore Crossing site during development of the surrounding areas.

The Hill Town project site is located in a hilly upland area along the northeast side of Refugio Valley. Overall, the site slopes downward from northeast to southwest toward the Refugio Valley, with elevations varying from approximately 30 to 240 feet msl. The topography of the site is characterized by a relatively level low-lying area in the southern portion of the site and another relatively level elevated portion in the northern portion of the site, separated by a steep north-to-south trending slope. A drainage swale traverses the southern boundary of the site from east to west at an elevation of approximately 30 feet msl.

### 3.5.2.3 Mineral Resources

No significant mineral deposits have been identified by the California Department of Conservation, Division of Mines and Geology for the Hercules area. However, Hercules does have areas that have been identified as containing mineral deposits with a significance that cannot be evaluated from available data known as "MRZ-3 zones."

MRZ-3 zones have been mapped for the hills to the north and south of SR-4, east of I-80 (approximately 2 to 3 miles east of the proposed Added Area), and the hilly area north of John Muir Parkway to the west of I-80 in the general vicinity of the Hill Town site. However, according to the *Hercules General Plan*, there is no information to suggest that these areas have extractable minerals of commercial value such that existing and planned land uses would reduce their benefit to the community and region (California Public Utility Commission 2005; City of Hercules 1998). See **Section 5.0, Other CEQA Considerations**, for additional discussion of this issue.

### 3.5.2.4 Groundwater

The City of Hercules lies within the San Francisco Bay Hydric Region. However, due to low elevations, proximity to San Pablo Bay, and the underlying bedrock, Hercules and the surrounding communities are not within a groundwater basin identified by the California Department of Water Resources.

Groundwater in the Refugio Valley, including the Sycamore Crossing site, occurs at shallow depths and is not a source of potable water. Groundwater was not encountered in the geotechnical borings placed the Hill Town site.

### 3.5.2.5 Seismicity and Faults

#### *Ground Rupture*

Ground rupture or displacement along surface faults can cause damage to structures on or near faults, especially during major earthquakes. No known faults cross either property, and there are no Alquist-Priolo Special Studies Zones in the City of Hercules.

#### *Ground Shaking*

Strong earthquake ground shaking is probably the most significant seismic hazard that can be expected anywhere in the San Francisco Bay Area. The amount of earthquake shaking at a site is a function of earthquake magnitude, the type of earthquake source (i.e., type of fault), the distance between the site and the earthquake source, the geology of the site, and how the earthquake waves decrease or attenuate as they travel from their source to the site in question. The larger the earthquake and the shorter the distance between the earthquake source and the site, the greater the amount of shaking. The geologic materials through which the earthquake energy travels toward the site act to decrease, or attenuate, the amount of shaking. The San Francisco Bay Area has experienced a number of large, damaging earthquakes during historical time (Water Transit Authority 2003).

**Figure 3.5-1, Major Faults and Earthquake Epicenters in the San Francisco Bay Region**, shows the locations of major faults relative to the proposed Added Area. The Added Area is located approximately 2 miles east of the eastern trace of the Hayward fault, one of several major fault zones present within the San Francisco Bay Area. The most recent major earthquake on the Hayward fault occurred in 1868 (on the southern portion of the fault, near Mills College). The United States Geological Survey (USGS) Working Group on California Earthquake Probabilities estimates that there is a 27 percent chance that the Hayward–Rodgers Creek fault system[1] will experience an earthquake of magnitude 6.7 or greater by 2032 (USGS 2003). A major earthquake on the Hayward fault is anticipated to produce strong ground shaking within the Redevelopment Plan Area, including the Added Area.

Additionally, the San Andreas Fault parallels the Hayward fault approximately 17 miles west of Hercules, and the Great Valley-Concord-Calaveras fault zone is located about 13 miles to the east. Taken

[1] The Hayward fault is associated with the Rogers Creek fault, located north of San Pablo Bay, and the two faults are often combined into one shear zone when discussing regional tectonics.

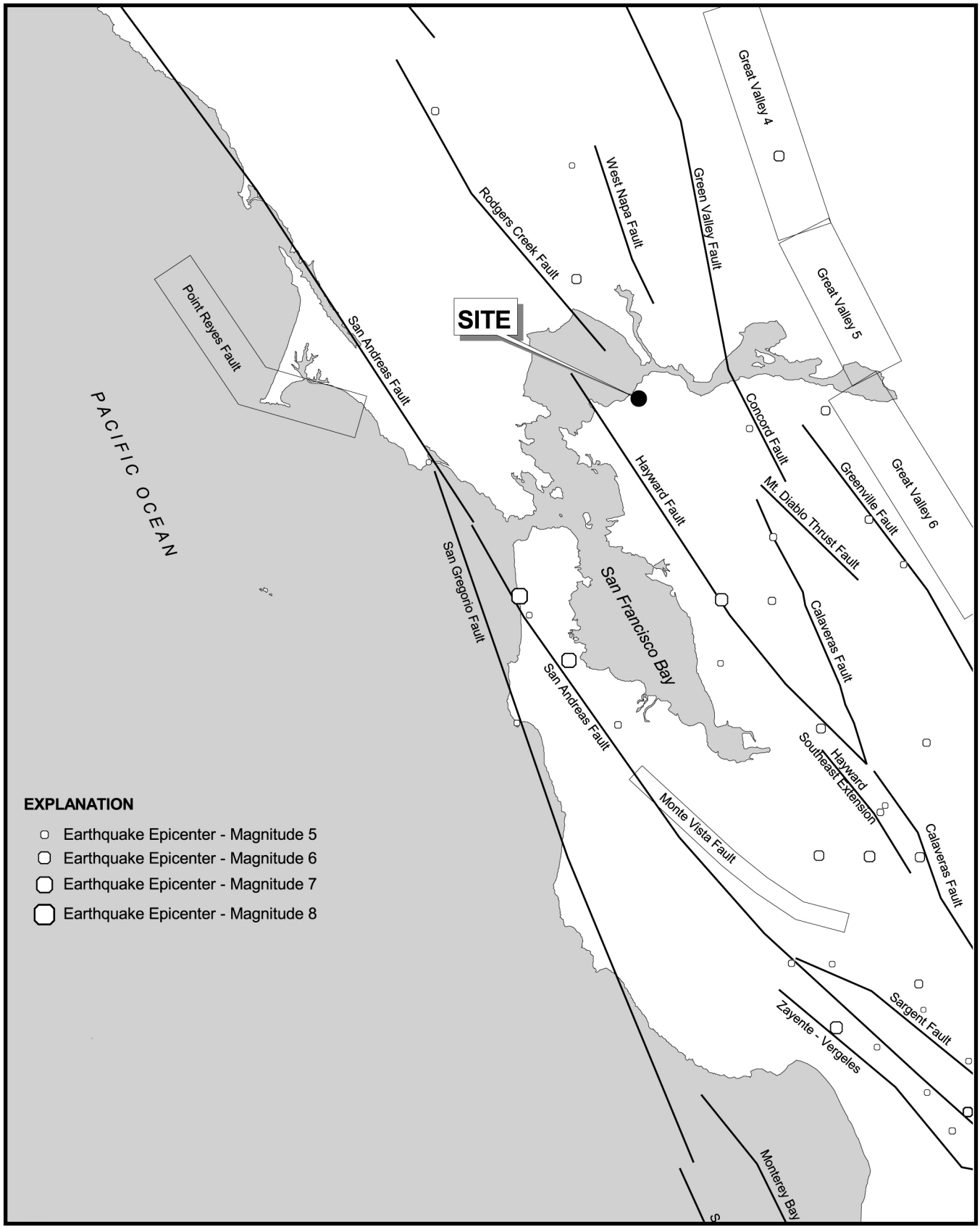
together, along with other faults in the area, there is a 62 percent probability of at least one magnitude 6.7 or greater earthquake striking the San Francisco Bay Area before 2032 (USGS 2003). The intensity of ground shaking within the Redevelopment Plan Area would be reduced as the distance from the epicenter of the earthquake increases; however, a major earthquake on any of the active Bay Area faults could still produce strong shaking in the project vicinity.

### *Lurching*

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to occur in water-saturated sediments, soils, and alluvium at distances of up to 75 miles from the earthquake epicenter. The potential for the formation of these cracks is considered greater at contacts between deep alluvium and bedrock. Lurch cracking is likely to occur in areas of bay mud and fill in moderate to large earthquakes. According to the *Hercules General Plan*, the probability of lurching in the valley floor areas (including the Sycamore Crossing site) is unknown, but its occurrence is possible. The Hill Town site is expected to be less susceptible to lurch cracking because such contacts are not present at the site.

### *Subsidence*

Another potential seismic hazard is that of earthquake-induced subsidence or settlement. Buildings constructed on compressible sediment may be subject to differential settlement of soils during an earthquake, depending on the distribution of the building weight, the type and condition of the underlying sediment, and the intensity or style of ground shaking experienced at the site. Primary areas of concern regarding differential settlement include the bay mud present near San Francisco Bay and other areas of deep sediment deposits, as well as areas of poorly engineered fill. The Sycamore Crossing site is underlain by alluvial soils and artificial fill; these soils may be subject to settlement during a strong earthquake. The Hill Town project site is located on relatively thin soils underlain by bedrock material, and most, if not all, of the unconsolidated sediment under building construction areas is expected to be removed or compacted during construction, so earthquake-induced settlement is not expected to be a hazard in this location.




NOT TO SCALE

**SOURCE:** RBF Consulting – 2007

FIGURE **3.5-1**

Major Faults and Earthquake Epicenters in the San Francisco Bay Area

359-011•12/08

### *Landslides*

The Sycamore Crossing site lies on the valley floor and does not contain any steep natural slopes; landslides are therefore not expected to occur on the Sycamore Crossing site. The Hill Town site, however, lies on a south-facing ridge, with slopes in the center of the site approaching 3:1 (horizontal to vertical). A geotechnical investigation conducted by Terrasearch for the proposed Hill Town development concluded that in its current condition, the central sloping portion of the Hill Town site may be susceptible to landslides if a strong earthquake occurred when the soils on site are saturated, such as after a heavy rainfall.

### *Liquefaction*

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking. It occurs in loose, saturated materials (predominantly sands) during an earthquake, and results in the temporary fluid-like behavior of those materials. Liquefaction typically occurs in areas where groundwater is shallow, and materials consist of clean, poorly consolidated, fine sands. According to the *Hercules General Plan* and investigations performed for past development projects in the Hercules area, the upland areas surrounding the Refugio Valley floor (including the Hill Town site) are underlain by bedrock and would not be subject to liquefaction. The liquefaction potential in the valley floor generally is not known, although there is no indication that materials susceptible to liquefaction are present (City of Hercules 1998).

Preliminary geotechnical investigations have been prepared for both the Sycamore Crossing and Hill Town sites by Treadwell & Rollo and Terrasearch respectively. Treadwell & Rollo concluded that the potential for liquefaction at the Sycamore Crossing site is low due to a lack of loose sand or silt below groundwater. Likewise, Terrasearch concluded that liquefaction hazards on the Hill Town site are not significant due to the site's subsurface materials, which consist of silts and clays in the upper 0 to 6 feet underlain by sandstone/siltstone bedrock.

## 3.5.2.6 Soil Corrosivity Potential

Soils in both the Refugio Valley and the surrounding upland areas are know to have high corrosion potential. The corrosion potential of the fill material that covers much of the Sycamore Crossing site is unknown; however, much of this material was imported from the surrounding areas within Refugio Valley and may share characteristics of the native soil in the valley, including high corrosivity.

### 3.5.2.7 Expansive Soils

Expansive soils contain mixed-layer clay minerals that swell or shrink upon wetting and drying, respectively. Expansive soils are common throughout California and can cause damage to foundations and slabs unless properly treated during construction. Most fine-grained deposits along the margins of San Francisco Bay contain mixed clay layers and exhibit expansive or potentially expansive behavior. The soils underlying both the Sycamore Crossing and Hill Town sites are considered to have high shrink-swell potential.

### 3.5.2.8 Erosion

The Sycamore Crossing site lies on the valley floor and does not contain any steep natural slopes. There are no slope/runoff or wind conditions on the Sycamore Crossing site that indicate that either construction or commercial/residential use of the site would cause substantial erosion. The Hill Town site lies on a south-facing ridge with slopes in the center of the site approaching 3:1 (horizontal to vertical) and is, therefore, more susceptible to water erosion. Future construction activities on site could expose unvegetated soils, which could be eroded during storm events.

### 3.5.2.9 Other Geologic and Seismic Hazards

Other types of geologic and seismic hazards include tsunamis and seiches. The *Hercules General Plan* and previous environmental studies have concluded that the City of Hercules is highly unlikely to be affected by these hazards because of its distance from the Pacific Ocean and from enclosed water bodies subject to seiches. These hazards are, therefore, not discussed in this EIR.

## 3.5.3 REGULATORY CONSIDERATIONS

This section briefly summarizes the regulatory requirements that govern proposed projects within the City of Hercules, including those specifically affecting the proposed Updated 2009 Redevelopment Plan.

### 3.5.3.1 State Regulations

#### *Alquist-Priolo Earthquake Fault Zoning Act*

The Alquist-Priolo Earthquake Fault Zoning Act (originally enacted in 1972) is intended to regulate development on or near active fault traces to reduce the hazardous effects of fault rupture. The act prohibits the construction of most buildings intended for human occupancy across active fault traces, and requires that site-specific fault-trace studies be conducted for projects within delineated fault zones to

identify potential active fault traces. The Added Area is not located within an Alquist-Priolo Zone associated with the Hayward fault, and therefore no fault trace study is required.

### *Seismic Hazards Mapping Act*

The Seismic Hazards Mapping Act is intended to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other types of ground failure, and from other earthquake-related hazards. The state geologist has delineated various seismic hazard zones related to ground shaking, liquefaction, landslides, and other ground failure to better regulate development in hazard-prone areas. Geotechnical investigations conducted within Seismic Hazard Zones must incorporate standards specified by CGS Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards* (CGS 1997c). Before a development permit is approved for a site within a seismic hazard zone, a site-specific geotechnical study must be conducted to address potential seismic hazards and appropriate mitigation must be incorporated into the project design. The proposed Added Area is located within a Seismic Hazardous Zone (Terrasearch 2005).

### *California Building Code*

The *California Building Code* requires extensive geotechnical analysis and engineering for grading, foundations, retaining walls, and other structures, including criteria for seismic design. The San Francisco Bay Area is located within Zone 4, which is expected to experience the greatest effects from earthquakes, and requires the most stringent requirements for seismic design. Any projects within the proposed Updated 2009 Redevelopment Plan Area must be designed according to the latest seismic design standards, and would be required to meet all relevant *California Building Code* requirements for seismic safety.

## 3.5.3.2 Local Plans and Policies

### *Hercules General Plan*

The *General Plan* includes policies and implementing actions to ensure safety from seismic and geologic hazards. The following policies are relevant to the proposed project. The City conditions approval of individual development proposals on the following implementation programs:

**Policy 2A.1:** For each proposal, require a feasibility study to determine whether any proposed critical facilities (emergency response centers, police stations, and hospitals) and schools could be sited in areas with lesser earthquake hazards. An alternative site

feasibility assessment should include a consideration of sites in areas with lesser earthquake (and flood) hazards in addition to considerations of service area, accessibility, and economic considerations.

**Policy 2B:** Projects proposed for all critical facilities including schools, high-population facilities (such as shopping malls) and industries using or generating significant amounts of hazardous materials within areas subject to very strong earthquake ground shaking or ground failure shall conduct geotechnical studies and structural design evaluations.

**Program 2B.1:** If the alternative site feasibility study for a critical facility or school were to indicate that other less hazardous sites are not available for the critical facility, then geotechnical studies and structural design processes for the facility would be conducted in compliance with State of California requirements and recommendations of the Seismic Safety Commission. These should include detailed studies of the geologic materials at the site, seismic event response evaluations to identify design criteria, foundation design criteria, and dynamic method analyses of proposed structures.

**Program 2B.2:** For the other types of facilities, the alternative site feasibility assessment would be an optional requirement of the City (an alternatives site evaluation may be required under CEQA). A rigorous geotechnical evaluation and structural design process would be required to ensure that the proposed structures would perform in major earthquakes without creating a life safety hazard to occupants or people in surrounding areas.

**Policy 2C:** The City will update an Earthquake Preparedness and Emergency Response Plan as necessary to establish emergency access points to evaluate the comprehensiveness of the City's evacuation routes in relation to the specific effects of seismic-induced ground shaking, liquefaction, and lurching within the community.

**Policy 2D:** The administration of subdivision and grading ordinances shall allow for flexibility in the review and approval of construction plans to permit sound engineering design in the solution of specific geological problems. Site-specific geotechnical investigations shall be required for every new development.

**Program 2D.1:** Applications for subdivision and development projects shall include site-specific geotechnical investigations prepared by a California-certified engineering geologist documenting the geotechnical suitability of the site for the proposed development based on soil and underlying substrate conditions; and the measures required to ensure public safety and protection of the property. The following shall be implemented through adoption as conditions of approval for the project.

- Loose or improperly compacted existing fills and backfills should be excavated from areas to be filled
- All areas to be graded should be stripped of vegetation and the top few inches of highly organic topsoil.
- Organic soil should be stripped and stockpiled and used for landscaping
- Lower valley areas where bay mud deposits are exposed or are blanketed by shallow thicknesses or poorly compacted fill will require detailed studies prior to site grading.
- Side hill "sliver" cuts and fills should be avoided.
- Special consideration should be given to slope stability in the steep hillside areas. Site new structures away from steep hillsides and the toes of existing landslide surfaces, reducing the potential for damage from landslide movement or burial.
- Steep sideslopes should be left in their natural condition where possible.
- Minimize the potential for creating new landslides or reactivating old ones. Set backs should be determined based on detailed soils investigations in individual cases opposite landslide prone slopes to reduce the potential for slide damage to improvements.

- Expansive soils should be considered in the design of road pavement sections.

- Site planning should consider the potential of different settlement where compressible soils exist, and employ appropriate approaches to reducing the hazard to an acceptable level of risk.

- Areas underlain by soft bay mud will require further detailed soil investigations.

- Slopes should be planted as soon as possible after completion of construction to develop a protective organic mat.

- Dense pockets of brush and trees located on steep slopes should be left intact where possible to prevent potential landslides.

- The sides of the stream channel in portions of Refugio Valley should be improved to protect erosion-induced slumping. Care should be taken to maintain the natural appearance of the water course in open-space areas.

- Development of the project sites should minimize the amount of native soils compacted by construction vehicles and structures, as well as the amount of soil disturbed through grading and excavation. As much as possible, native soils should be left undisturbed and used for open space and landscaping purposes.

- Development of the project sites should also maximize the use of pervious materials, including fill, and incorporate proper drainage structures capable of handling anticipated increases in surface runoff.

- Minimize amount of grading when building on hill sides. No grading should occur on slopes steeper than 30 percent, and cut slope angles no greater than 33 percent be maintained.

**Program 2D.2:** Applications for subdivision and development projects shall include site specific erosion control and hillside drainage plans, which shall address the following standards. These standards shall be implemented through adoption as conditions of approval for the project.

- The use of silt fencing, sediment trapping basins, runoff diversion devices, and hydroseeding of barren slopes can minimize or prevent this impact.

- Grading in the City should occur with no increase in discharge of sediments to wetlands, Refugio Creek, or San Pablo Bay.

## 3.5.4 IMPACTS AND MITIGATION MEASURES

### 3.5.4.1 Significance Criteria

The impact of the proposed project on the geology and soils environment would be considered significant if it would exceed any of the following standards of significance, in accordance with Appendix G of the *2008 California Environmental Quality Act (CEQA) Statutes and Guidelines* and the *UC CEQA Handbook*:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence of a known fault (refer to CGS Special Publication 42);
  - strong seismic ground shaking;
  - seismic-related ground failure, including liquefaction; or
  - landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the *California Building Code*, creating substantial risks to life or property.
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

### 3.5.4.2 Issues Not Discussed Further

The Added Area is not crossed by any known or previously recognized active faults or earthquake fault zones (Alquist-Priolo Special Study Zones). There would therefore be no known risk related to ground surface rupture by faulting; for this reason, this issue is not discussed further in this section.

As discussed above, the City of Hercules is highly unlikely to be affected by tsunami or seiche hazards because of its distance from the Pacific Ocean and from enclosed water bodies subject to seiches. This issue is not discussed further in this section.

No septic systems or other infiltrating wastewater disposal systems are proposed as part of the potential development projects within the Redevelopment Plan Area, including the Added Area. Therefore, implementation of the project would not require the construction of septic tanks for wastewater disposal. This issue is not discussed further in this section.

### 3.5.4.3 Project Impacts and Mitigation Measures

**Impact Geo-1:** **The proposed project could expose people and structures to substantial adverse effects related to seismic ground shaking. (*Potentially Significant; Less than Significant with Mitigation*)**

The Bay Area, including Hercules, is one of the most seismically active regions in the United States. Earthquakes and ground shaking in the Bay Area are inevitable but unpredictable and will occur at some point prior to, during, or after the completion of development within the Updated 2009 Redevelopment Plan Area. An earthquake of moderate to high magnitude generated within the San Francisco Bay region, similar to that which has occurred in the past, could cause considerable ground shaking within the Added Area. Future development within this area would involve construction of facilities in a seismically active zone, and the ground shaking associated with earthquakes would pose potential threats to structures and to persons present at the time of seismic events.

Although some structural damage typically is unavoidable, building codes and local construction requirements have been established to protect against building collapse and to minimize injury during seismic events. Structures built according to code should be able to (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake. However, it is reasonable to expect that a well-designed and well-constructed structure will not collapse in a major earthquake (Water Transit Authority 2003).

Compliance with applicable regulations, such as building code requirements, and conformance with the *Hercules General Plan* Safety Element policies listed above, would be required as part of any development project. Using standard construction techniques, chosen in accordance with the results of site-specific geotechnical investigations and in compliance with codes and requirements, structures can be designed

and built to withstand the geologic hazards listed above. Furthermore, the following mitigation measure, requiring compliance with building code standards and the recommendations of project-specific geotechnical studies, would reduce potential seismic impacts to less than significant.

**MM GEO-1**: A site-specific geotechnical investigation shall be required for any new development proposed within the Updated 2009 Redevelopment Area. Development proposed within the Updated 2009 Redevelopment Area shall conform to the provisions of current building codes and to the recommendations of the geotechnical investigations performed for proposed development. Structures for human habitation shall be designed to meet or exceed *California Uniform Building Code* standards for Seismic Zone 4.

**Significance after Mitigation:** Less than significant.

**Impact Geo-2: The proposed project could expose people and structures to substantial adverse effects associated with seismic-related liquefaction or landslides.** ***(Potentially Significant; Less than Significant with Mitigation)***

Liquefaction was found not to be a risk on the Sycamore Crossing and Hill Town sites. Landslides are a possibility in portions of the Hill Town site. Future development of the Hill Town site would require substantial grading to create usable building pads and road beds. Grading in accordance with modern engineering techniques and standards, as ensured by the grading permit process, would greatly reduce the landslide potential of the site. However, the site-specific geotechnical investigation identified potential landslide hazards, including areas of soil creep and a landslide deposit. The recommendations of this report included removal of any areas of soil creep and landslide deposits on the site and replacement with engineered fill prior to construction, as well as installation of subdrains at geologic contacts that could be a source of water seepage. Without these measures, impacts related to landslides would be potentially significant.

The creation of a Geologic Hazard Abatement District (GHAD) would allow seismic risks to be managed in a way that would reduce potential impacts. GHADs are state agencies formed to address geologic hazards and related concerns. GHADs are formed and established according to the procedures and requirements set forth in Public Resources Code (PRC) section 26500 et seq. The purpose of a GHAD is to prevent, mitigate, control, and/or abate geologic hazards, and to mitigate or abate structural hazards that are partly or wholly caused by geologic hazards. A "geologic hazard" is broadly defined as an actual or threatened landslide, land subsidence, soil erosion, earthquake, fault movement, or any other natural or unnatural movement of land or earth (PRC section 26570). In establishing a GHAD, a plan of control is prepared for the site to be included in the GHAD that identifies potential geologic hazards and measures

to monitor and mitigate such hazards. Depending on the site and plan of control, GHADs may maintain open space areas, creek setbacks, drainage and storm water improvements, retaining walls, and other improvements that are necessary to be maintained and monitored so that the GHAD can carry out its functions.

**MM GEO-2a**: Development of the proposed Hill Town project shall be subject to the recommendations of the site-specific geotechnical report for site preparation, grading, retaining wall construction, and foundation design.

**MM GEO-2b**: Prior to the recordation of the first final map, the project proponent of the Hill Town project shall form a Geologic Hazard Abatement District (GHAD) or annex into an existing GHAD for the purpose of identifying potential geologic hazards and carrying out measures to monitor and mitigate such hazards. The GHAD shall be fully operational and the assessments shall be established and in place before the final map is recorded. The project proponent shall provide adequate funding through its own source and/or through the GHAD assessments to cover a major event before the GHAD will accept responsibility. The amount of this obligation will be determined at the time the Plan of Control and Engineer's Report is prepared for the GHAD. If a GHAD is determined by the City and project applicant to be infeasible, the project proponent shall assign these responsibilities to a similar entity.

**Significance after Mitigation**: Less than significant.

**Impact Geo-3: The proposed project would not result in substantial soil erosion or loss of topsoil. (*Less than Significant*).**

As discussed above, the erosion potential is low on the Sycamore Crossing site because it lies on the valley floor and does not include any steep natural slopes. The Hill Town site includes steeply-sloped areas, with slopes in the center of the site near 3:1 (horizontal to vertical), and thus is more susceptible to water erosion. Future construction activities onsite could expose unvegetated soils, which could be eroded during storm events. However, stormwater erosion is regulated by the National Pollutant Discharge Elimination System (NPDES), which would require the implementation of Best Management Practices (BMPs) for future developments on both the Sycamore Crossing and Hill Town sites. Notably, construction activities on both sites would be required to develop and implement a Stormwater Pollution Prevention Program (SWPPP) in accordance with the state's General Construction Permit. The SWPPP would identify the BMPs to be implemented on the construction site. With the required compliance with

the NPDES, the proposed project would not result in substantial soil erosion or the loss of topsoil. Erosion-related impacts would therefore be less than significant.

**Mitigation Measure**: No project-level mitigation measure required.

**Impact GEO-4: The proposed project is located on a geologic unit that may be unstable or could become unstable as a result of the project. (*Less than Significant*)**

The discussion of Impact Geo-2, above, highlights potential landslide hazards at the Hill Town site. Additional instability of underlying units may be attributed to differential settlement, soil creep, or the triggering of localized slumps or landslides in response to grading at the site. The site-specific geotechnical report identified several potential conditions on site that could cause soil instability, including areas of soil creep, fill associated with past uses, and the presence of numerous pipes and other buried utilities. The site geology is also characterized by geologic contacts between sandstone and siltstone layers that could be a source of water seepage. Storm drainage systems at the project site would be designed to avoid infiltration of stormwater into subsurface soils that could potentially be destabilized by increased infiltration. However, development of the site would require extensive cuts and fills and construction of retaining walls to create building pads and roadways. In the absence of appropriate design features, potential impacts related to unstable site geology and soils would be significant.

**Mitigation Measure**: Implementation of **Mitigation Measures GEO-2a** and **GEO-2b** would reduce impacts related to unstable geologic units to a less than significant level.

**Significance after Mitigation**: Less than significant.

**Impact Geo-5: Development within the proposed Updated 2009 Redevelopment Area could be located on expansive soils. *(Less than Significant)***

As described above, the soils in the Added Area have high shrink-swell potential and therefore pose a potential risk to life or property due to expansion and contraction of the soil. However, properly designed foundations (i.e., those designed in accordance with the *Uniform Building Code* requirements for expansive soils) can withstand the additional force created by the expanding and contracting soil. Any development in the Added Area would be subject to *Uniform Building Code* requirements. Therefore, no significant impacts from expansive soils are expected.

**Mitigation Measure**: No project-level mitigation measure required.

### 3.5.4.4 Cumulative Impacts and Mitigation Measures

**Impact GEO-6:** **The proposed project, in conjunction with reasonably foreseeable near-term and long-term development, would place new structures and introduce an increased population in a seismically active region.** ***(Less than Significant)***

Development that could occur under the proposed Updated 2009 Redevelopment Plan, along with development in Hercules generally would increase both the population and employment concentration in the City of Hercules and the region. The Sycamore Crossing and Hill Town projects would add both new residents and employees to the City. In addition, other cumulative development in the surrounding area could result in long-term population growth in western Contra Costa County. Together, this cumulative growth would increase the population in the Bay Area, and particularly in proximity to the Hayward fault, that would be subject to strong groundshaking in a major earthquake and other potential seismic-related hazards.

It is not possible to eliminate the risk from construction in earthquake-prone areas, nor is it possible to fully avoid all geologic hazards. However, these hazards would be mitigated to the extent practicable through implementation of and compliance with adopted *General Plan* policies, building codes, and regulations. Building codes and local construction requirements have been established to protect against building collapse and major injury during a seismic event. Any development within the proposed Redevelopment Plan Area would be required to implement State seismic construction regulations and would implement additional measures, as described in **Impact Geo-1**. Construction in conformance with the *Uniform Building Code* and other pertinent regulations and guidelines would reduce the risks of injury and structural damage from ground shaking, earthquake-induced landslides, and other seismic and geologic hazards to a less than significant level.

**Mitigation Measure:** No project-level mitigation measure required.

## 3.5.5 REFERENCES

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