

GEOLOGY, SOILS, AND SEISMICITY

This chapter describes the regional geologic environment as well as local geologic considerations that may affect development proposed under the Specific Plan. Standards of significance related to geologic impacts are provided, followed by the description of potential impacts and recommended mitigation measures.

14.1 SETTING

Regional/Local Geology

The Specific Plan area is located in northeastern Contra Costa County, on the northern flank of the Diablo Range at the southern edge of the Pittsburg-Antioch Plain. The Pittsburg-Antioch Plain is essentially a floodplain of Suisun Bay, which is itself a flooded estuary of the Sacramento River. The river channel was carved through the area during the Pleistocene, a geologic epoch of much lower sea level. The northern half of the plain is currently dominated by salt water marshes. The southern half of the plain is covered by alluvial materials eroded from the Diablo Range to the south. Alluvial materials were deposited along the length of its base in a series of fans that spread outward across the plain toward Suisun Bay.¹

The area covered by the Specific Plan is lowland, with elevations of less than 200 feet above sea level. The topography is gentle with minimal areas of steep slopes which could present hazards. High slope areas are found in the extreme southern part of the plan area within drainages immediately east and west of Bailey Road between State Route 4 and West Leland Road.

The majority of the plan area consists of surficial deposits of alluvium, alluvial fan, and terrace deposits consisting of clay, silt, sand, and gravel. The high slope areas cited above correspond roughly with the northern extension of Tulare formation surface materials in the plan area. Materials of this formation are described as poorly consolidated, non-marine sandstone, siltstone and conglomerate, with some tuff (volcanic ash deposits) included.

Soils

Soils within the plan area are flatland soils, which dominate the alluvial slope from the base of the hills to the south to the Suisun Bay margin estuaries. Most of the plan area overlies Antioch Loam soil of flat to moderate slopes. This soil consists of well-drained soils overlying older mixed alluvial terrace and fan materials. Runoff is slow to medium and presents a slight to

moderate erosion hazard where exposed. Loam portions of this soil demonstrate low shrink-swell potential, while clay portions may present high to moderate shrink-swell potential.

Other portions of the plan area overlie moderately well-drained Capay Clay on gentle slopes. Runoff in such soils is generally very slow and there is little hazard of erosion where soil is exposed. Soils of this type present high shrink-swell and subsidence potential.

Faults and Seismicity

No known active faults, or those which have had surface displacement within the last 11,000 years, are located within the plan area. However, several major active faults are sufficiently close to cause intense ground shaking during earthquake events. The main trace of the San Andreas fault is located approximately 40 miles west of the plan area. In addition, the Hayward fault is located approximately 20 miles west, while the Calaveras fault is 10 miles southwest of the Specific Plan area. The Concord fault is approximately 6.5 miles southwest, the Clayton-Greenville fault is approximately 3 miles southwest, and the Antioch fault is located approximately 6.5 miles east of the project location.

The San Andreas fault is considered capable of producing a maximum credible earthquake (MCE) of magnitude 8.0. Both the Hayward and Calaveras faults could produce MCEs of magnitude 7.5, while the Concord-Green Valley, the Clayton-Greenville, and the Antioch faults are classified as capable of producing MCEs between magnitude 6.3 and 6.9.² The Hayward fault currently is considered to have the highest regional potential of producing a major earthquake. The probability of a magnitude 7 or larger earthquake occurring on the Hayward fault was determined in 1990 to be about 28 percent for the subsequent 30 years.³

Several potentially active faults, or faults that have experienced displacement within the last two million years, occur near the plan area. These include the Kirker Pass and the Black Diamond Area faults. Evidence exists that there has been extensive differential movement along a series of northwest-trending splays of the Kirker Pass and Clayton faults, which are centered within the Mount Diablo foothills and extend northward. These faults currently are considered to be inactive, and earthquakes they could generate likely would be of lesser magnitude than other regional faults and would not be expected to produce surface faulting in the Specific Plan area.⁴

Geologic Hazards

No active faults are mapped within the Specific Plan area and hazards associated with fault rupture would not be expected. There are no Alquist-Priolo Earthquake Fault Zones in the Specific Plan area. (The Alquist-Priolo Act is intended to reduce the loss of life from earthquakes by prohibiting buildings for human occupation from being constructed across an active fault. Under the act, zones have been established along active faults in California.)

Ground Shaking

Ground shaking is the most widespread hazard in the planning area. Damage to structures in the planning area resulting from an earthquake would depend on the length of the fault break, distance from the fault, the nature of the underlying ground materials, and the type of structures, their materials, and construction quality.

The Uniform Building Code (UBC) in California incorporates standard response spectra (i.e., the response of structures with different frequencies to specific ground motions) as a basis for structural design. The response spectra establish the minimum strength for which a building must be designed. The UBC considers primary lateral seismic forces and general soil type. Incorporation of vertical forces into code design is being considered currently.⁵ The objective of the UBC is to protect the life safety of building occupants and the public. For large earthquakes, the UBC primarily ensures that the building will not collapse, but some structural and non-structural damage may be expected.

Buildings constructed prior to code revisions in the 1970s generally would not meet current design provisions for earthquake forces of the UBC. Expected damage to different types of buildings is described below:

- The most severe hazards are presented by unreinforced masonry buildings constructed of brick or concrete block. Under strong intensity ground shaking, many of these structures may be expected to collapse or require demolition. The City of Pittsburg has developed a list of unreinforced masonry buildings to assess their potential to meet Uniform Code for Building Conservation (UCBC) requirements through retrofit.
- Other types of buildings that may also be severely damaged are older buildings of steel and concrete framing that were not designed to resist earthquake vibrations, and older reinforced brick and masonry structures.
- Light wood-frame, such as most residential structures, and sheet metal buildings would be expected to have moderate damage in most conditions.
- Steel-frame structures designed to resist earthquake vibrations have an excellent record in earthquakes.

New construction in the Specific Plan area would be required to conform to the UBC. Table 14-1 identifies the expected damage levels to newly constructed buildings from ground shaking of moderate and large earthquakes. These estimates represent general conditions in UBC Seismic Zone 4, and specifically apply to buildings constructed to the requirements of all UBC editions between 1976 and 1994. Buildings of special occupancy are required by the State to meet more stringent design requirements than the UBC. Special occupancy buildings include hospitals, schools, and other structures that are important to protecting health and safety in the community.

TABLE 14-1

Damage Expected for Buildings Designed Under the 1994 UBC

Distance to Fault		Expected MMI ^a	Standardized Damage Status ^b				
Mag. 6.0-6.5	Mag. 7.5-8.0		None	Slight	Moderate	Extensive	Complete
30 mi.	50 mi.	VII	60-90%	10-40%	1-5%	<1%	0
5 mi.	40 mi.	VIII	35-60%	35-45%	10-30%	<5%	<1%
1 mi.	30 mi.	IX	25-40%	25-40%	20-40%	3-10%	<2%
--	3 mi.	X	5-25%	5-25%	40-70%	10-30%	<5%

Notes:

^a MMI=Modified Mercalli Scale Intensity

^b Standardized Damage States:

None and Slight—No damage or minor damage to non-structural elements; only incidental hazard

Moderate—Primarily non-structural damage; also could be minor non-threatening structural damage; remote chance of life-threatening situation from structural elements

Extensive—Extensive structural and non-structural damage; localized life-threatening situations could be common

Complete—Complete collapse or damage that is not economically repairable; life-threatening situations in every building of this category

Source: City of Pittsburg 1998 After Earthquake Engineering Research Institute.

The Association of Bay Area Governments (ABAG) has released maps showing estimated ground shaking intensities for communities throughout the San Francisco Bay Region. These maps are used for depicting the general risk within neighborhoods. For the Specific Plan area, the worst-case scenario is a magnitude 7.1 earthquake on the Concord-Green Valley fault. The Concord fault has been projected to be capable of producing ground shaking intensity of VIII on the Modified Mercalli Intensity Scale.⁶ Peak horizontal ground acceleration from a severe earthquake on the Concord fault could reach 0.45 g, where “g” equals the acceleration of gravity.⁷

Unstable Surface Materials

According to the *City of Pittsburg General Plan Seismic Safety Element*, the vicinity of the Specific Plan area is considered moderately to generally stable. Relatively small areas in the southwestern portion of the plan area have been mapped as “moderately unstable.”⁸ These areas are located between State Route 4 and West Leland Road west of Bailey Road.

Alluvial strata underlying portions of the plan area are not considered particularly susceptible to liquefaction. The Specific Plan area is deemed to have ‘generally moderate to low’ liquefaction potential.

City of Pittsburg Policies Related to Geology, Soils, and Seismicity

The *City of Pittsburg General Plan* Safety Element policies apply to development proposed under the Specific Plan.⁹ These policies include:

- Require geotechnical studies prior to approval of rezoning, specific plans, or subdivision maps in areas of low damage susceptibility designated B through D and areas of high damage susceptibility as shown on the Geologic and Seismic Hazards map. Require comprehensive geologic and engineering studies of critical structures regardless of location.
- Require preparation of a soils report prior to issuing a building permit, except where the Building Inspector determines that a report is not needed.
- Limit cut slopes to 3:1 (33 percent slope) except where an engineering geologist can establish that a steeper slope would perform satisfactorily over the long term. Encourage use of retaining walls or rock-filled crib walls as alternatives to high cut slopes.
- Require contour rounding and revegetation. Require blending of cut-and-fill slopes with existing contours, and provision of horizontal variation, in order to mitigate the artificial appearance of engineered slopes. Require revegetation to control erosion.

Contra Costa County Policies Related to Geology, Soils, and Seismicity

Contra Costa County General Plan policies relative to geologic hazards also apply to development proposed under the Specific Plan. These policies include:

- Significant land use decisions (general plan amendment, rezoning, etc.) shall be based on a thorough evaluation of geologic-seismic and soils conditions and risk.
- Because the region is seismically active, structures for human occupancy shall be designed to perform satisfactorily under earthquake conditions.
- Staff review of applications for development permits and other entitlements, and review of applications to other agencies which are referred to the County, shall include appropriate recommendations for seismic strengthening and detailing to meet the latest adopted seismic design criteria.
- Ground conditions shall be a primary consideration in the selection of land use and in the design of development projects.
- Through the environmental review process, require geologic, seismic and/or soils studies as necessary to evaluate proposed development in areas subject to ground shaking, fault displacement, or liquefaction.

14.2 STANDARDS OF SIGNIFICANCE

The Specific Plan would be considered to have a significant geologic impact if it would:

- cause substantial erosion;
- create unstable ground conditions due to disruptions, displacements, or overcovering of soil;
- substantially change topography; or
- expose substantial numbers of people or structures to major geologic or seismic hazards.

14.3 IMPACTS AND MITIGATION MEASURES

In general, geologic constraints at a project site can be mitigated by standard engineering design and construction specifications. Review of the Specific Plan area did not reveal any geologic hazard deemed beyond mitigation using standard building practices. Such hazards include steep slopes, high earth shaking amplification, or liquefaction potential.

Both the City of Pittsburg and the Contra Costa County general plans identify the need for geotechnical studies in association with land use decisions to identify geologic hazards. The lead agency for the design review of Specific Plan projects should determine the need for such studies prior to implementation of particular projects proposed under the plan.

IMPACT 14-1. Development associated with the Specific Plan would increase population and employment in the planning area and expose people to hazards associated with strong ground shaking likely to occur in the area within the lifetime of the project. This impact is considered less than significant.

Under worst-case projections, the Specific Plan area likely would be subject to mostly ‘moderate’ or lesser damage from earth shaking, assuming construction according to UBC specifications. ‘Severe’ damage is projected to be less than five percent while ‘complete’ damage is expected to be less than one percent. All Specific Plan projects (both permitted and conditional uses) would be required to conform with UBC design specifications.

MITIGATION MEASURE 14-1. None required.

IMPACT 14-2. Construction associated with the Specific Plan would increase the potential for erosion within the planning area. This impact is considered less than significant.

As noted above, geologic constraints at a project site can be mitigated by standard engineering design and construction specifications. Review of the Specific Plan area with regard to erosion potential did not reveal any areas that could not be mitigated through standard building practices and Best Management Practices to minimize erosion.

In the short term, possible construction of 380 parking spaces in the 3.45-acre parcel adjacent to the existing BART parking lot would involve construction grading and site development. The topography of the parcel is mostly flat with slight changes in elevation. No significant impacts of erosion or sedimentation would occur. The parking lot would be designed to meet City of Pittsburg design requirements to minimize erosion.

MITIGATION MEASURE 14-2. Developments associated with the Specific Plan shall include a site-specific erosion control plan. In addition, projects greater than 5 acres in area must include a Stormwater Pollution Prevention Plan (SWPPP) and implement control measures (or Best Management Practices) to control discharges of pollutants from the project sites. Implementation of project SWPPPs should be monitored by a designated monitor.

Erosion must be minimized by implementing SWPPP measures and other mitigations including, but not limited to, the following:

- perform earthmoving activities during the dry season (mid-March to mid-October);
- stabilize disturbed areas before the start of the rainy season (i.e., before October 15) using vegetation or other methods; and
- use silt fences, straw bales or similar measures to prevent sediment from being mobilized in runoff.

NOTES: Geology, Soils, and Seismicity

¹ Contra Costa County, *Environmental Impact Report on the State Route 4/Bailey Road Interchange Improvement Project*, June 1991.

² City of Pittsburg, *Pittsburg General Plan Update: Existing Conditions and Planning Issues Report*, June 1998.

³ Ibid.

⁴ Ibid.

⁵ Ibid.

⁶ Contra Costa County Community Development Department, *Contra Costa County General Plan 1995–2010*, Safety Element, July 1996.

⁷ City of Pittsburg, Pittsburg General Plan Update, op. cit.

⁸ Ibid.

⁹ City of Pittsburg, Pittsburg General Plan, Safety Element, 1988.