

Geologic Resource Evaluation Scoping Summary

Eugene O'Neill National Historic Site
Port Chicago Naval Magazine National Memorial
Rosie the Riveter World War II Home Front National
Historical Park

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The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park System units with a geologic scoping meeting and summary (this document), a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity to discuss park-specific geologic management issues, and if possible include a site visit with local experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and monitoring and research needs.

Eugene O'Neill National Historic Site, Port Chicago Naval Magazine National Memorial, and Rosie the Riveter World War II Home Front National Historical Park are not "natural area" parks. Nevertheless, on September 24, 2008, during the geologic scoping meeting for John Muir National Historic Site, scoping participants identified some geologic features, processes, and associated issues for Eugene O'Neill, Port Chicago, and Rosie the Riveter. The GRE Program will not provide a digital geologic map for these three units, but this summary provides some citations and Internet links to geologic-map data (see "Geologic Mapping" section).

Resource Manager Lucy Lawliss started the scoping meeting with a welcome, and Russ Graymer (U.S. Geological Survey) outlined the regional geology for these National Park System units. Tim Connors (Geologic Resources Division) facilitated the discussion of map coverage, and Bruce Heise (Geologic Resources Division) led the discussion regarding geologic processes, features, and related management issues. Participants at the meeting included NPS staff from John Muir National Historic Site, Golden Gate National Recreation Area, San Francisco Bay Area Network, Columbia Cascades Support Office, Pacific West Region, and Geologic Resources Division, and cooperators from the California Geological Survey, U.S. Geological Survey, and Colorado State University (table 1).

Park and Geologic Settings

Two words sum up the geologic settings for Eugene O'Neill National Historic Site, Port Chicago Naval Magazine National Memorial, and Rosie the Riveter World War II Home Front National Historical Park: "landslide" for Eugene O'Neill and "bay fill" for Port Chicago and Rosie the Riveter. No bedrock is exposed at any of the sites. Port Chicago Naval Magazine National Memorial and Rosie the Riveter World War II Home Front National Historical Park are situated along coasts in tidal flats.

Eugene O'Neill National Historic Site

Tao House near Danville, California, became Eugene O'Neill's home. Considered "America's greatest playwright," O'Neill won the Pulitzer Prize four times and the Nobel Prize for Literature in 1936. A wanderer by nature and plagued with health problems, O'Neill made Tao House his refuge from 1937 to 1944. Here he wrote the last of his plays, including "The Iceman Cometh" and "Long Day's Journey into Night." While O'Neill wrote, his wife Carlotta channeled her own creative energy into Tao House. Combining a Spanish colonial exterior of adobe-like blocks with an interior of deep blue ceilings and red doors, tiled or black-stained floors, and Chinese furniture, she called it her "pseudo-Chinese house." The structure and

surrounding land (5.3 ha [13 ac]) became part of the National Park System in 1976. It is open to the public by reservation only. The house was built on a large landslide deposit.

Port Chicago Naval Magazine National Memorial

The naval magazine Port Chicago was established in 1942 as an ammunition trans-shipment facility at Suisun Bay, California. During the first part of World War II, Port Chicago was rapidly built up to support the heavy demand for explosives in the Pacific. Port Chicago served as the main facility for the Pacific Theater, and the national memorial recognizes its critical role in World War II. This affiliated area of the National Park System also commemorates the explosion that occurred here on July 17, 1944, which resulted in the largest domestic loss of life during World War II.

The national memorial is situated at the Concord Naval Weapons Station, which is an active military base near Concord, California. It is open to the public through reservation only and requires at least two weeks notice for military clearance. The memorial covers 0.2 ha (0.5 ac) of a tidal mudflat. Port Chicago was filled with bay mud to provide docking for ships.

Rosie the Riveter World War II Home Front National Historical Park

Located in the wartime boomtown of Richmond, California, Rosie the Riveter World War II Home Front National Historical Park commemorates the contributions of the women and men on the “home front” who supported World War II. Fully engaged in winning the war, Americans of every race worked together toward a common goal in a manner not equaled since. The park includes examples of industrial production facilities and social institutions (e.g., child care and medical insurance) that arose as a result of the war-time effort. Authorized in 2000, the park is presently under development, working with the City of Richmond, Contra Costa County, and other partners to preserve the stories and physical evidence of World War II in Richmond. Like Port Chicago, Rosie the Riveter World War II Home Front National Historical Park is situated on a mudflat, which is exposed at low tide. Built as a shipping yard, its physical foundation is artificial fill (e.g., trash and dredge piles).

Geologic Mapping Data

During the scoping meeting, Tim Connors showed some of the main features of the GRE Program’s digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of being GIS compatible. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation for the GRE Program and allows for rigorous quality control. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format; layer files; FGDC-compliant metadata; and a Windows HelpFile that captures ancillary map data. These data are posted at <http://science.nature.nps.gov/nrdata/>. The data model is available at <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>.

The GRE Program will not be creating digital geologic maps for Eugene O’Neill National Historic Site, Port Chicago Naval Magazine National Memorial, or Rosie the Riveter World War II Home Front National Historical Park because these units are not slated for inventories through the Inventory and Monitoring (I & M) Program. In some cases the GRE Program has created maps for non-I & M parks when geologic data at a useful scale from a single source exists; however, these type of data are not available for Eugene O’Neill National Historic Site, Port Chicago Naval Magazine National Memorial, and Rosie the Riveter World War II Home Front National Historical Park.

The following maps, which may be of use for resource management at Eugene O’Neill National Historic Site, are available from the California Geological Survey and U.S. Geological Survey. “GMAP” numbers included in the following citations are unique identification numbers for the GRE Program’s database.

Graymer, R. W. 2000. Las Trampas Ridge, California, 7.5' quadrangle [GMAP 74805]. In *Geologic map and map database of the Oakland metropolitan area, Alameda, Contra Costa, and San Francisco counties, California*. Scale 1:50,000. Miscellaneous Field Studies Map MF-2342. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/mf/2000/2342/>.

Graymer, R. W., D. L. Jones, and E. E. Brabb. 1994. *Preliminary geologic map emphasizing bedrock formations in Contra Costa County, California: A digital database* [GMAP 1345]. Scale 1:75,000. Open-File Report OFR 94-622. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/of/1994/of94-622/>

Majmundar, H. H. 1995. *Landslides and related features map in the Las Trampas Ridge quadrangle and parts of the Diablo quadrangle, Alameda and Contra Costa counties, California* [GMAP 46635]. Scale 1:24,000. Landslide Hazards Identification Map 38. Open-File Report OFR 95-15, Plate A. Sacramento, CA: California Geological Survey.

Majmundar, H. H. 1995. *Landslides and related features map in the Las Trampas Ridge quadrangle and parts of the Diablo quadrangle, Alameda and Contra Costa counties, California* [GMAP 63933]. Scale 1:24,000. Landslide Hazards Identification Map 38. Open-File Report OFR 95-15, Plate B. Sacramento, CA: California Geological Survey.

The following maps may provide sources of information for resource management at Port Chicago Naval Magazine National Memorial:

Graymer, R. W., D. L. Jones, and E. E. Brabb. 1994. *Preliminary geologic map emphasizing bedrock formation in Contra Costa County, California* [GMAP 1345]. Scale 1:75,000. Open-File Report OFR 94-622. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/of/1994/of94-622/>.

Graymer, R. W., D. L. Jones, and E. E. Brabb. 2002. *Geologic map and map database of northeastern San Francisco Bay region, California, [including] most of Solano County and parts of Napa, Marin, Contra Costa, San Joaquin, Sacramento, Yolo, and Sonoma counties* [GMAP 54992]. Scale 1:100,000. Miscellaneous Field Studies Map MF-2403. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/mf/2002/2403/>.

Wagner, D. L., C. I. Gutierrez, and K. B. Clahan. 2006. *Geologic map of the south half of the Napa 30 × 60 quadrangle, California* [GMAP 74823]. Scale 1:100,000. Sacramento, CA: California Department of Conservation, California Geological Survey. ftp://ftp.consrv.ca.gov/pub/dmg/rgmp/Prelim_geo_pdf/Napa100ksouth_prelim.pdf.

The following maps may be useful for resource management at Rosie the Riveter World War II Home Front National Historical Park:

Blake, M. C., R. W. Graymer, D. L. Jones, and A. Soule. 2000. *Geologic map and map database of parts of Marin, San Francisco, Alameda, Contra Costa, and Sonoma counties, California* [GMAP 2526]. Scale 1:75,000. Miscellaneous Field Investigations Map MF-2337. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/mf/2000/2337/>.

Graymer, R. W. 2000. Richmond, California, 7.5' quadrangle [GMAP 74804]. In *Geologic map and map database of the Oakland metropolitan area, Alameda, Contra Costa, and San Francisco counties, California*. Scale 1:50,000. Miscellaneous Field Studies Map MF-2342. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/mf/2000/2342/>.

Graymer, R. W., D. L. Jones, and E. E. Brabb. 1994. *Preliminary geologic map emphasizing bedrock formation in Contra Costa County, California* [GMAP 1345]. Scale 1:75,000. Open-File Report OF-94-622. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/of/1994/of94-622/>.

Graymer, R. W., D. L. Jones, and E. E. Brabb. 1998. *Geologic map of the Hayward fault zone, Contra Costa, Alameda, and Santa Clara counties, California: A digital database* [GMAP 1338]. Scale 1:50,000. Open-File Report OFR 95-597. Reston, VA: U. S. Geological Survey. <http://wrgis.wr.usgs.gov/open-file/of95-597/>.

Pike, R. J., R. W. Graymer, S. Roberts, N. B. Kalman, S. Sobieszcyk. 2001. *Map and map database of susceptibility to slope failure by sliding and earthflow in the Oakland area, California* [GMAP 50173]. Scale 1:50,000. Miscellaneous Field Studies Map MF-2385. Reston, VA: U.S. Geological Survey. <http://pubs.usgs.gov/mf/2002/2385/>.

Geologic Features, Processes, and Resource Management Issues

The scoping session at John Muir National Historic Site provided an opportunity to develop a list of geologic features, processes, and related resource management issues for Eugene O'Neill National Historic Site, Port Chicago Naval Magazine National Memorial, and Rosie the Riveter World War II Home Front National Historical Park. During scoping, participants did not prioritize geologic issues, but discussion made it clear that seismicity has primary management significance for all three units. Furthermore, hillslope movement is a very real hazard at Eugene O'Neill National Historic Site. These issues are listed first, followed in alphabetical order by other features and processes of interest.

Seismicity

In central California today, the Pacific and North American plates are sliding past each other at an annual average rate of 4.1 cm (1.6 in) (Sloan 2006). The boundary between the Pacific and North American plates is not a sharp one, although the San Andreas Fault is identified with it. Movement between the plates affects a broad zone of faulting and folding that extends over the entire San Francisco Bay Area. Earthquakes and associated hazards lessen from west to east.

The San Andreas Fault system consists of two major branches in the Bay Area: the San Andreas and San Gregorio faults comprise the western branch; and the eastern branch, known as the East Bay Fault system, includes the Hayward, Calaveras, Greenville, and Concord faults. The East Bay Fault system is the branch that affects Eugene O'Neill National Historic Site, Port Chicago Naval Magazine National Memorial, and Rosie the Riveter World War II Home Front National Historical Park. Eugene O'Neill National Historic Site lies on the northern Calaveras Fault, but the Hayward and San Andreas faults also affect the site. Every 200 years or so, a large earthquake can be expected on the Calaveras Fault. The adobe-like blocks of Tao House will be susceptible to damage during such an event, as will the interior ornaments. The landslide deposit on which the house is built is a product of seismic activity and is likely to move during a large earthquake.

The Green Valley Fault, an extension of the Concord Fault to the north, is the closest fault to Port Chicago Naval Magazine National Memorial. As a result of earthquake activity, Los Medonas thrust has uplifted the hills in the area. Though shaking is a factor for safety and infrastructure, the memorial is less likely to experience damage from direct shaking than from liquefaction (loose, saturated sediments decreasing in volume like quicksand). The soft material (e.g., fill over bay mud) on which the memorial lies is highly susceptible to this hazard.

Rosie the Riveter World War II Home Front National Historical Park is also susceptible to liquefaction because it too is built on soft bay fill. Additionally inundation by a seiche in San Pablo Bay is a possible hazard; one such event is recorded from the late 1890s. The Hayward Fault is the closest to the national

historical park. The California Geological Survey has conducted a seismic-hazard study for Richmond and San Pablo and produced maps that show shaking susceptibility, which may be of use for resource management at the park.

Hillslope Features and Processes

Landslides are widespread, naturally occurring geologic events. Only when such phenomena conflict with development or other human activities do they constitute a serious problem or hazard. According to Rogers et al. (1979), the severity of such a problem is directly related to the extent of human activity in the affected area. Adverse effects can be mitigated by early recognition and avoidance or by corrective engineering. Actual losses can range from mere inconvenience where very slow or small-scale nondestructive slides occur to severe losses with high maintenance costs where large-scale, destructive slides are involved. Large, rapidly moving slides have the capacity to completely destroy buildings, roads, bridges, and other costly structures (Rogers et al. 1979). Tao House at Eugene O’Neill National Historic Site was built on a landslide deposit. Reactivation as a result of seismic activity, particularly during a wet period, would affect Tao House, an adobe-like, block structure. Moreover, the slide could lurch downhill and damage roads and other structures.

Climate Change

“A climate disrupted by human activities poses such sweeping threats to the scenery, natural and cultural resources, and wildlife of the West’s national parks that it dwarfs all previous risks to these American treasures,” so states *Losing Ground: Western National Parks Endangered by Climate Disruption* (Saunders et al. 2006). The authors contend that “a disrupted climate is the single greatest threat to ever face western national parks.” Because of the potential disruption that climate change could cause to park resources, including geologic features and processes, the GRE Program has begun to include a discussion during scoping meetings of the effects of climate change to park resources. Both Rosie and Riveter and Port Chicago are at sea level and have been since Tertiary time. Therefore any rise in sea level as a result of climate change would affect the resources, including infrastructure, at these two units. Both Port Chicago and Rosie the Riveter need an assessment of sea-level rise along their shorelines. Intensification of winter storms and El Niño events could lubricate landslide deposits at Eugene O’Neill National Historic Site, causing reactivation.

Coastal Features and Processes

The National Park Service is steward to 97 coastal park units, including national seashores, lakeshores, recreational areas, memorials, and monuments. These coastal parks contain more than 11,750 km (7,300 mi) of shoreline and a wide diversity of geological, biological, and cultural resources. Coastal environments include beaches, estuaries, lagoons, marshes, tidal flats, bluffs, and sea cliffs. The coastal environment at Port Chicago Naval Magazine National Memorial and Rosie the Riveter World War II Home Front National Historical Park is tidal flat. Port Chicago was built on the coast of Suisun Bay, and Rosie the Riveter is situated on the shoreline of San Pablo Bay.

The water/land interface is a dynamic zone often extending inland to encompass erosion, deposition, and transport of material (i.e., mud, silt, sand, cobbles, and boulders), and extending seaward to encompass tidal flats, mangrove swamps, and other low-profile landforms. Meteorological, hydrologic, and oceanic processes working in concert with surface and bedrock geology shape the shoreline within this zone. Shoreline processes may occur gradually over time, as with the movement of sandbars, spits, and deltas, or catastrophically such as during landslides and storm-induced sediment transport (<http://www2.nature.nps.gov/geology/coastal/index.cfm>).

Human activity can modify dynamic coastal processes and habitats. Typical examples of human activities that interfere with natural shoreline processes include dredging and filling, beach nourishment, construction of seawalls and jetties, garbage and sewage disposal, fuel and chemical spills, construction of harbor facilities, housing developments, destruction of estuaries, draining of coastal marshes, and mineral extraction

(<http://www2.nature.nps.gov/geology/coastal/index.cfm>). Scoping participants identified seawall and riprap as a human modification at Rosie the Riveter. In actuality the entire shoreline has been modified as a result of the redevelopment of Richmond Shipyard 3. Historically the naval magazine had four shipyards, but only Shipyard 3 was built to survive the war years. This site is listed in the Natural Register of Historic Places and represents the surviving remnant of the World War II-era Kaiser shipyards. It includes six historic buildings, five structures, and associated land base (Lucy Lawliss, Rosie the Riveter World War II Home Front National Historical Park, e-mail communication, January 29, 2008).

Disturbed Lands and Paleontology

Modern human activities have disturbed more than 127,480 ha (315,000 ac) in 195 National Park System units have been disturbed. Some of these features may be of historical significance, but most are not in keeping with the mandates of the National Park Service. Disturbed lands are those park lands where the natural conditions and processes have been directly impacted by mining activities, development (e.g., facilities, roads, dams, abandoned campgrounds, and user trails), agricultural practices (e.g., farming, grazing, timber harvest, and abandoned irrigation ditches), overuse, or inappropriate use. Usually lands disturbed by natural phenomena such as landslides, earthquakes, floods, and hurricanes are not considered for restoration unless influenced by human activities. For more information about disturbed lands restoration, contact Dave Steensen (Geologic Resources Division) at dave_steensen@nps.gov or 303-969-2014.

Disturbed lands near Port Chicago Naval Magazine National Memorial include a clay mine; this mine is not associated with the national memorial, however (Lucy Lawliss, Rosie the Riveter WWII Home Front National Historical Park, e-mail communication, January 29, 2008) and probably lies on the still extant military reservation (Will Elder, Golden Gate National Recreation Area, e-mail communication, April 8, 2008). Interestingly, the clay sediments at the mine have yielded vertebrate fossils (Will Elder, Golden Gate National Recreation Area, personal communication during scoping, September 24, 2007).

Because of the high likelihood of fossils in the bedrock (probably Miocene Hombre Sandstone) at Eugene O'Neill National Historic Site, Elder et al. (2007) recommends that park staff monitor bedrock excavations for paleontological material such as invertebrates, foraminifera, diatoms, and fish scales and bones.

References

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- Saunders, S., T. Easley, J. A. Logan, and T. Spencer. 2006. *Losing ground: Western national parks endangered by climate disruption*. Louisville, CO: The Rocky Mountain Climate Organization; New York, NY: Natural Resources Defense Council. <http://www.nrdc.org/land/parks/gw/gw.pdf>.
- Sloan, D. 2006. *Geology of the San Francisco Bay region*. California Natural History Guides. Berkeley, CA: University of California Press.

Table 1. Scoping Meeting Participants

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