



San Francisco, California **Lake Merced Pump Station**

Improvement Overview

The San Francisco Public Utilities Commission and Water Department needed to replace the existing Lake Merced Pump Station with a more modern facility, while maintaining operations of the existing station. Historical records in addition to a geotechnical investigation indicated the site was susceptible to seismic-induced lateral spreading, liquefaction, and settlement. A ground improvement solution was required to provide proper foundation for the new structures as well as protection for the inlet pipes off of Lake Merced.



Design

A 30,000 square foot area was treated with compaction grouting to depths of 30 feet below ground surface. The compaction grouting was performed in ascending stages, starting at the bottom of the hole and working upward, with individual stage lengths of two feet in height. The objective was to densify loose liquefiable soils to Cone Penetration Test (CPT) tip resistance values of 120 tsf. Specifications called for a grout pump with variable rates of 0.2 to 3.0 cubic feet per minute at pressures of up to 1,000 psi. Project design specified that the downhill perimeter of the site have compaction grouting in a 4 ft triangular arrangement. The remainder of the site was contractor designed to have compaction grouting in a 6.5 ft square pattern. A soil mixed / concrete shaft buttress wall was installed near the Lake Merced inlet pipes.



Ground Conditions

Geotechnical investigations determined that the site was overlain by 2 to 10.5 ft of sandy fill. Loose to medium dense sand and silty sand (Colma Formation) was below the fill. Groundwater was found between 9.5 and 14.5 ft below ground surface, depending on the water level of Lake Merced. In addition, during construction of the original facility, the downhill lake side of the site was backfilled with riprap including concrete rubble, rebar, and wood.

Owner

San Francisco Public Utilities Commission
San Francisco Water Department

General Contractor

Western Water Constructors

Geotechnical Engineer

URS Corporation



Malcolm Drilling Company
Ground Improvement Division

Compaction Grouting
Soil Mixing
Secant Piles

San Francisco, California
Lake Merced Pump Station



Construction

Malcolm Drilling Co. Inc. (MDCI) installed over 1,600 individual compaction grouting points at the operating Lake Merced water pump station site. MDCI batched the grout onsite and utilized twin grout pumps that have a grout pumping piston no greater than 4-inches in diameter through a 2-inch diameter delivery line. Compaction grouting points were drilled with a Klemm 807 and Bauer RG 19. MDCI also installed a soil cement secant buttress wall with a Bauer RG 23 and Bauer BG 40, providing a complete ground improvement package.

Quality Assurance

MDCI maintained an extensive QA/QC program, recording the following parameters: injection pressure at the pump, injection pressure at the hole collar, injected volume per stage, and grout termination criteria per stage (pressure, heave, or volume). Post-grouting CPT tests were performed to verify that the design criteria for densification was met.



<p>Ground Improvement Division</p> <p>3524 Breakwater Avenue, Suite 108 Hayward, California 94545 Tel: (510) 780-1167</p>	<p>San Francisco</p> <p>3503 Breakwater Court Hayward, CA 94545 Tel: (510) 780-9181</p>	<p>Seattle</p> <p>8701 South 192nd Street Kent, WA 98031 Tel: (253) 395-3300</p>	<p>San Diego</p> <p>16885 West Bernardo Drive, Suite 100 San Diego, CA 92127 Tel: (858) 753-0707</p>
<p>Corporate Office</p> <p>92 Natoma Street, Suite 400 San Francisco, CA 94105 Tel: (415) 901-4400</p>	<p>Los Angeles</p> <p>4926 North Azusa Canyon Road Irwindale, CA 91706 Tel: (626) 338-0035</p>	<p>Salt Lake City</p> <p>10 West 100 South, Suite 703 Salt Lake City, UT 84101 Tel: (801) 359- 2757</p>	<p>Las Vegas</p> <p>2365B Renaissance Drive Las Vegas, NV 89119 Tel: (702) 650-2922</p>