

SECTION 1

Introduction

This report presents the results of a Methane Remedial Measures Study that was conducted to evaluate alternatives to remediate methane found to be migrating from Landfill 26 located at Hamilton Army Air Field (HAAF). This report was prepared by CH2M HILL on behalf of the United States Army Corps of Engineers (USACE), Sacramento District. This report was prepared under Contract Number DACA 05-99-D-2001, Delivery Order Number 0012.

1.1 Project Background

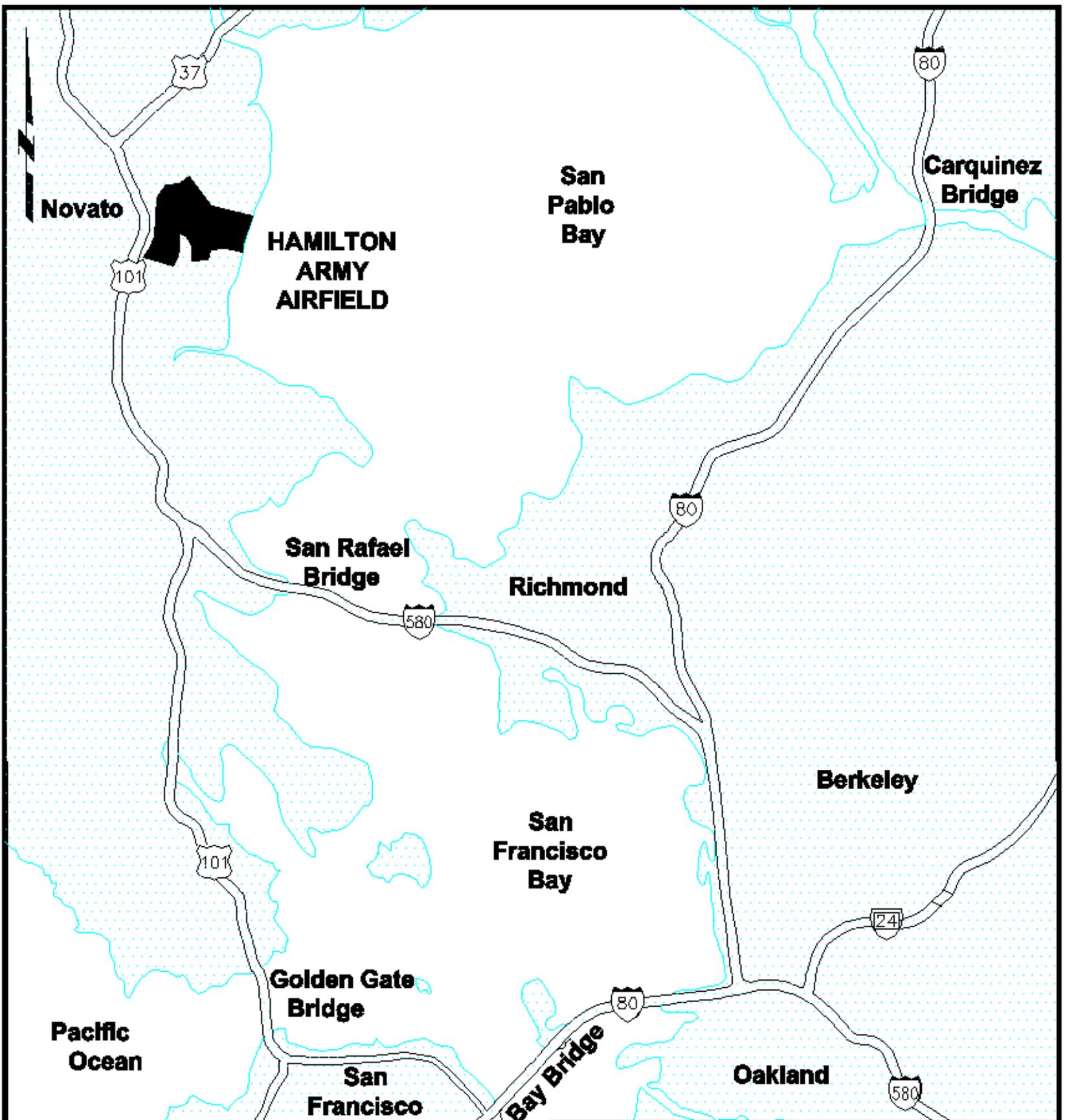
Landfill 26 is located at HAAF, a former military installation located within the city limits of Novato, California, in Marin County, approximately 22 miles north of San Francisco. The site is bounded by U.S. Highway 101 on the west and San Pablo Bay on the east (Figure 1-1). Figure 1-2 depicts a vicinity map. HAAF is currently inactive and parts of the property have been transferred to real estate developers.

The landfill occupies a former marshland and floodplain area along the margin of San Pablo Bay. The military used the landfill as a refuse disposal area from the 1940s to the 1970s. Although there are no records of disposal at the landfill, primary contents have been verified to include primarily construction debris, and also scrap metal, airplane parts, and buried culverts. Between 1994 and 1995, a Resource Conservation and Recovery Act (RCRA)-type landfill cap was installed. A 150- to 200-foot buffer zone was subsequently established around the landfill, as shown on Figure 1-3.

Prior to design of the RCRA cap, several methane studies were conducted:

- In 1986, Woodward-Clyde Consultants (WCC) conducted the first methane study as part of a preliminary investigation. The investigation concluded that Landfill 26 was non-methanogenic.
- In 1992, before closure of the landfill, Quadrel Services conducted a methane study. During this study soil gas was monitored at 40 locations in and around the landfill. During the study, not only was methane not detected above 5 percent, it was not detected above 0.1 percent, by volume, at any location.
- In 1993 the USACE Omaha District installed and sampled six landfill gas monitoring probes in and around the landfill. Only one sample detected methane above 5percent. This sample was from a probe located within the landfill.

Based on these studies, the design for the landfill cap did not include a landfill gas venting system. However, in 1994 as part of the landfill closure, 23 gas monitoring probes (GMP-1 to GMP-23) were placed around the perimeter of the final cover in a proactive measure to monitor any landfill gas that might be present. The locations of the GMPs are shown in Figure 1-4. Landfill gas monitoring has been ongoing periodically at the landfill since the gas monitoring probes were installed. Initial sampling and analysis indicated that methane

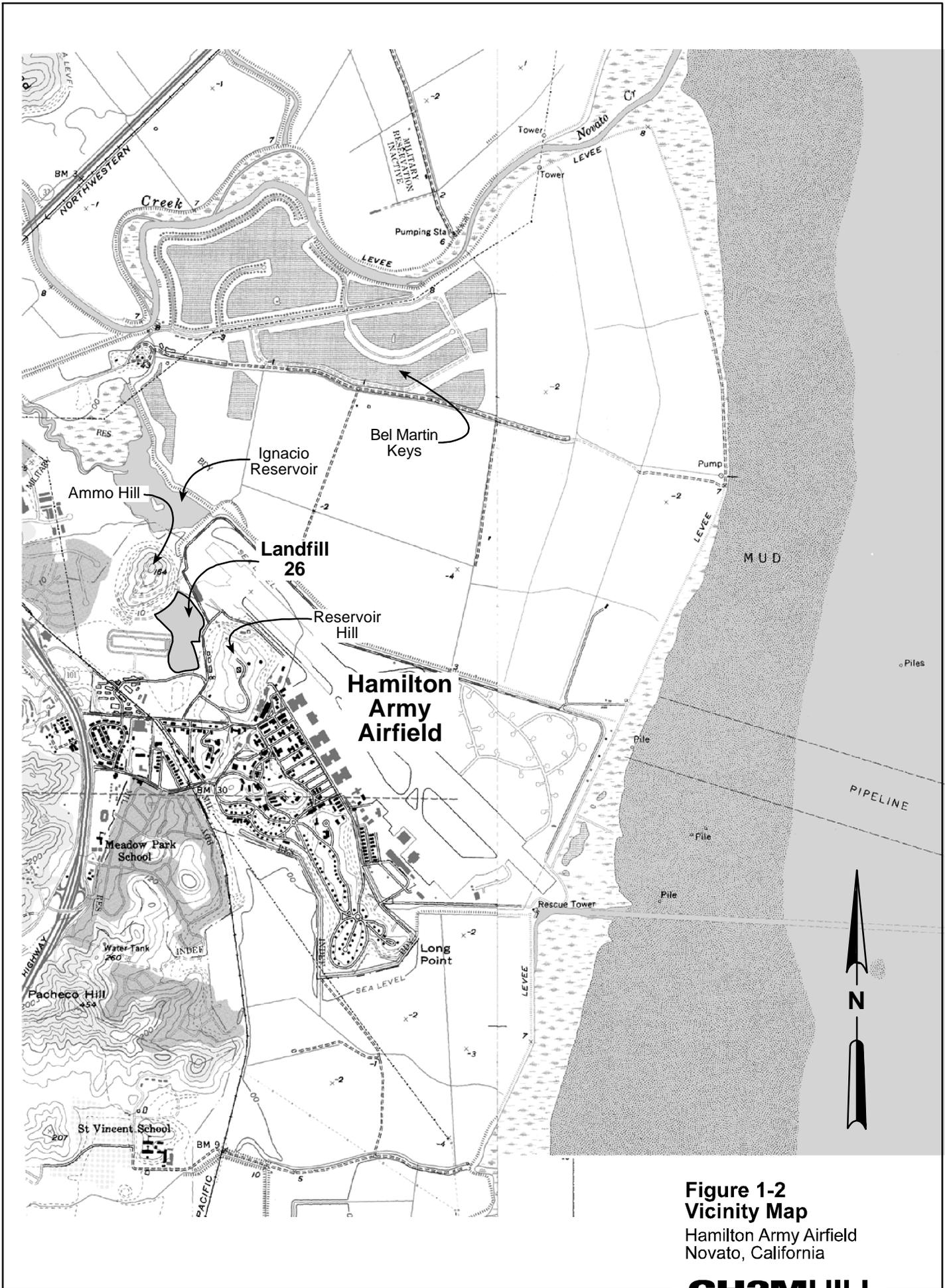


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**FIGURE 1-1:
SITE LOCATION MAP**

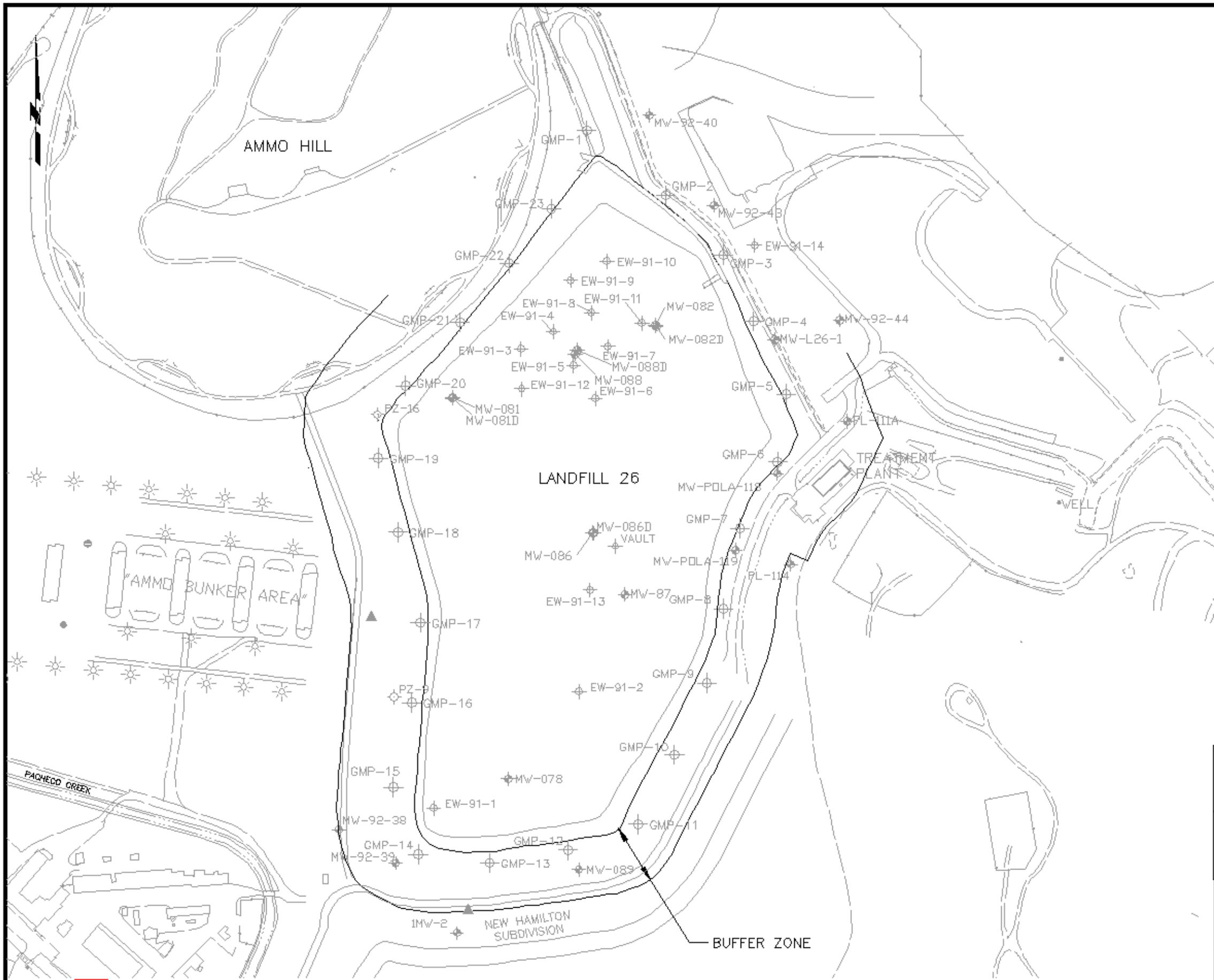
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 SACRAMENTO DISTRICT*

LOCATION:
 HAMILTON ARMY AIRFIELD
 NOVATO, CALIFORNIA



**Figure 1-2
Vicinity Map**

Hamilton Army Airfield
Novato, California



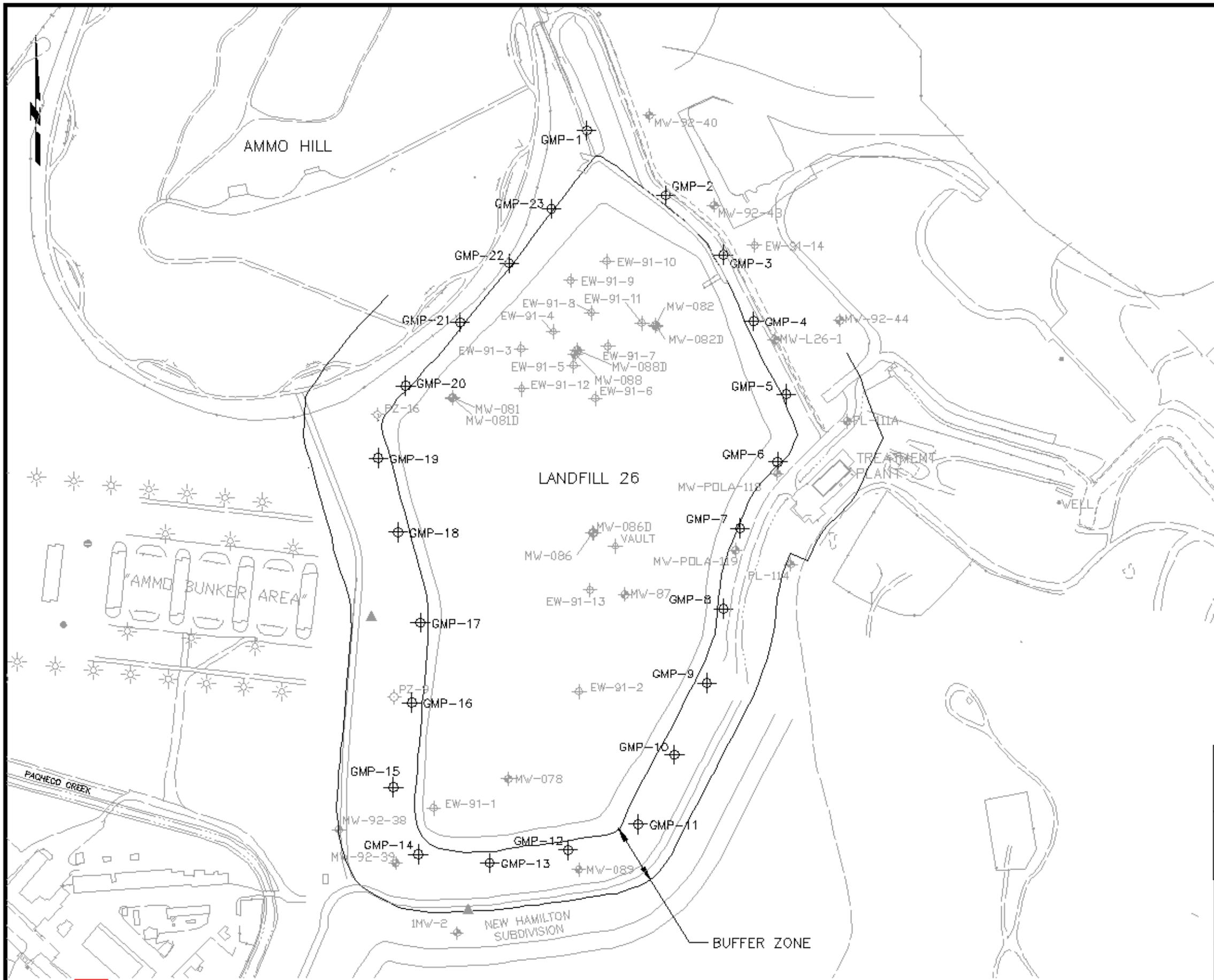
- LEGEND:**
- ◆ MW-82 MONITORING WELL
 - ⊕ EW-91-1 EXTRACTION WELL
 - ⊕ GMP-22 GAS MONITORING PROBE
 - ⊙ PIEZOMETER
 - ▲ APPROXIMATE LOCATION OF NEW NAVY MONITORING WELL, NOT MONITORED DURING SUPPLEMENTAL MONITORING PROGRAM

 CH2MHILL	SCALE
	

**FIGURE 1-3:
SITE LAYOUT
LANDFILL 26**

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SACRAMENTO DISTRICT**

LOCATION:
**HAMILTON ARMY AIRFIELD
NOVATO, CALIFORNIA**



- LEGEND:**
- ◆ MW-082 MONITORING WELL
 - ⊕ EW-91-1 EXTRACTION WELL
 - ⊕ GMP-22 GAS MONITORING PROBE
 - ⊙ PIEZOMETER
 - ▲ APPROXIMATE LOCATION OF NEW NAVY MONITORING WELL, NOT MONITORED DURING SUPPLEMENTAL MONITORING PROGRAM

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**FIGURE 1-4:
GAS MONITORING
PROBE LOCATIONS**

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LOCATION:
**HAMILTON ARMY AIRFIELD
NOVATO, CALIFORNIA**

concentrations were generally well below the regulatory limit of 5 percent methane by volume. However, in September 1999, methane was detected above the 5 percent criteria in two of the probes (GMP-5 and GMP-9). Subsequent sampling was conducted in 2000 to evaluate the increases in methane concentrations. The results of this sampling suggest that methane is accumulating under the landfill cap and migrates along the edges of the cap in the vicinity of GMP-5, GMP-8, GMP-9 and GMP-13.

In March 2001, Shea Homes installed 19 soil gas monitoring probes within the Hamilton Meadows subdivision adjacent to the south and southeastern portions of the buffer zone. The probes were located within the subdivision property approximately 3 to 5 feet from the property boundary. Shea Homes reports that preliminary results from field measurements collected in the soil gas probes showed detections of methane in 18 of the 19 probes but that none of the probes detected methane at or above 5percent. Shea Homes also performed sweep-type sampling in homes to look for the presence of methane. No methane was detected in any of the homes sampled. A copy of the Shea Homes data is provided in Appendix E.

1.2 Study Objective

The objectives of this Methane Remedial Measures Study were to:

- Determine if sufficient data are currently available to develop a remedial approach to addressing methane migrating from the landfill,
- Evaluate alternatives to remediate the methane found to be migrating at Landfill 26, and
- Recommend a course of action based on available data.

The study was performed as an engineering study to summarize relevant information (such as historical information about the landfill, chemical and geological information, landfill cap construction, methane and physical properties, knowledge of similar methane situations at other landfills, and adjacent land use). The study also included a qualitative evaluation of landfill gas migration risk, identification of potential courses of action, and recommendations for the best course of action, based on available data.

This report proposes and evaluates conceptual approaches for remediating methane at Landfill 26. This report does not provide design specifications for the recommended option. Following the selection and approval of a final concept/option, implementation may require permitting, design, procurement construction, and monitoring.

1.3 Ongoing Studies

As this study is being prepared, USACE is undertaking a project to install additional gas-monitoring probes in the vicinity of GMP-7 through GMP-13 and another project to evaluate groundwater upgradient of the landfill. It is expected that these studies will provide additional information regarding the presence of methane in the buffer zone, groundwater levels, groundwater quality, and other factors influencing the presence and transport of methane within the buffer zone. If the conclusions and recommendations in this report need to be updated following the additional GMP studies, an addendum will be prepared.

1.4 Organization of the Report

This report is organized in the following sections:

- **Section 1, Introduction**, provides the project background, study objectives, and organization of the report.
- **Section 2, Site Information**, provides the regulatory framework for landfill gas monitoring and control, closed landfills in California, the operational history of Landfill 26, land use surrounding Landfill 26, a summary of previous investigations and monitoring data, and the geologic and hydrogeologic setting in the vicinity of the landfill. Section 2 also assesses whether sufficient data are available to make recommendations for remediating methane at Landfill 26.
- **Section 3, Definition and Evaluation of the Problem**, describes the expected generation, duration, and fate and transport of methane in landfills; discusses the potential for natural sources to contribute to methane generation; provides general conclusions regarding generation, duration, and fate and transport of methane in Landfill 26; discusses the proximity of residential homes and subsurface utility trenches; and provides an overall qualitative assessment of risk from landfill gas migration.
- **Section 4, Identification of Remedial Options**, presents the range of conceptual options under consideration to address methane generated by Landfill 26. In this section, the components of each option, as currently envisioned, are presented and described.
- **Section 5, Evaluation of Remedial Options**, provides an evaluation of each option, including effectiveness, cost, and uncertainty.
- **Section 6, Recommended Remedial Option Conclusions**, recommends a conceptual approach for remediation based on available data, and describes additional data needs that have been identified.
- **Section 7, References**, includes a list of primary references used to complete this report.
- **Appendices A through E** include supporting data.