

Technical Report

2023 Iso-Settlement Survey

Operable Unit 2 Landfills

Former Fort Ord, California

Prepared for:



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On behalf of:



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Acronyms and Abbreviations

27CCR	Title 27 California Code of Regulations
Ahtna	Ahtna Global, LLC
Army	U.S. Department of the Army
CAD	computer-aided design
LLDPE	linear low-density polyethylene
OU2	Operable Unit 2
Polaris	Polaris Consulting
USACE	U.S. Army Corps of Engineers

1.0 Introduction

The former Fort Ord, located in northern Monterey County, California (Figure 1) was an active U.S. Army base from 1917 to 1994 encompassing approximately 28,000 acres. The U.S. Environmental Protection Agency added Fort Ord to the National Priorities List primarily on the basis of groundwater contamination discovered in 1990 beneath the Fort Ord Landfills area, which was subsequently designated as Operable Unit 2 (OU2). Fort Ord was placed on the Base Realignment and Closure list in 1991. As the lead agency, the U.S. Department of the Army (Army) manages the cleanup of the former Fort Ord in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund.

1.1 Purpose of this Report

Ahtna Global, LLC (Ahtna) prepared this technical report on behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, per Contract W91238-19-C-0027. This technical report presents the results of the iso-settlement survey conducted at the OU2 Landfills by Polaris Consulting (Polaris) per Title 27 of the California Code of Regulations (27CCR) Section 21090(e)(2). In accordance with 27CCR Section 21090(e)(2), the Army produces iso-settlement maps every five years to accurately depict the estimated total change in elevation of each portion of the OU2 Landfills engineered cover system. Therefore, for each area of the OU2 Landfills, these maps show changes in the surface elevation of the engineered cover system relative to the baseline topographic maps. The maps show the current topography of the engineered cover system and feature overprinted isopleths indicating the total settlement to-date.

1.2 Brief Summary of the Conceptual Site Model

The OU2 Landfills were active from 1955 to 1987 and were used for residential and on-base waste disposal typical of municipal landfills during that time. Waste was placed in parallel trenches 10 to 30 feet deep and then covered over with the native dune sand excavated during trenching operations. Detailed disposal records are not available; however, information gathered during field activities and from other sources indicates that household and on-base commercial refuse, dried sewage sludge, construction debris, and small amounts of chemical waste (paint, oil, pesticides, electrical equipment, ink and epoxy adhesive) were placed in the OU2 Landfills (Shaw, 2005).

The OU2 Landfills formerly included six landfill areas, one area north and five areas south of Imjin Parkway, covering approximately 150 acres, including the immediate surrounding area (Figure 2). The former Area A Landfill, north of Imjin Parkway, was approximately 33 acres separated from the Areas B through F Landfills to the south of Imjin Parkway. The Areas B through F Landfills encompass approximately 120 acres of undeveloped land. The former Area A was used from 1956 to 1966. Areas B through F were operated from 1960 until 1987, when interim closure of the facility began which effectively terminated waste disposal activities at the OU2 Landfills (Shaw, 2008b).

Additional conceptual site model details are found in the *Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Final Revision 7, Operable Unit 2 Landfills* (Ahtna, 2023a).

1.3 Brief Summary of the OU2 Landfills Remedy

Closure of the OU2 Landfills is being completed as a remedial action in accordance with:

- *Record of Decision, Operable Unit 2, Fort Ord Landfills, Fort Ord, California* (OU2 ROD; Army, 1994)
- *Explanation of Significant Differences, Operable Unit 2, Fort Ord Landfills, Fort Ord, CA* (OU2 ESD No. 1; Army, 1995)
- *Explanation of Significant Differences, Area A, Operable Unit 2 Landfill* (OU2 ESD No. 2; Army, 1996).
- *Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill* (OU2 ESD No. 3; Army, 1997).
- *Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), Operable Unit 2, Fort Ord Landfills* (OU2 ESD No. 4; Army, 2006).
- *Record of Decision Amendment, Site 39 Inland Ranges, Former Fort Ord, California* (Army, 2009)

The remedy includes placing an engineered cover system over Areas B through F that is intended to restrict rainfall infiltration and prevent leaching of chemicals remaining in buried waste materials to underlying soil and groundwater (Army, 1994). The engineered cover system for the OU2 Landfills Areas B through F overlies general fill material and includes (from bottom to top) a foundation layer, geomembrane, and a vegetative cover. Additional details about the construction and components of the engineered cover system are in the *Operation and Maintenance Plan Revision 3, Operable Unit 2 Landfills* (AEI, 2019).

- From 1996 to 1998, waste from Area A, an approximately 33-acre area north of Imjin Parkway, was excavated, transferred, and consolidated into Areas B through F south of Imjin Parkway, which allowed for clean closure of Area A (IT, 2001).
- General fill consisted of refuse, concrete and asphalt rubble from Area A, and soil from other remediation sites at the former Fort Ord. Per OU2 ESD No. 3 (Army, 1997), “remediation waste” is soil and debris excavated from remediation areas at the former Fort Ord and consolidated in the OU2 Landfills. For example, this includes soil and debris from the Site 39 Inland Ranges that may be contaminated with metals or munitions constituents.
- The foundation layer is a minimum 2-foot thick base layer over the general fill and buried waste materials, and is designed to support the geomembrane and the vegetative cover. The foundation layer includes soil from Area A, clean soil from clearing and grubbing operations, and soil from other Fort Ord remediation sites. Compactive effort is applied to the foundation layer to achieve 90 percent relative compaction (Shaw, 2005 and Gilbane, 2014).¹

¹ Relative compaction – the ratio of the field dry density to the maximum dry density determined in the laboratory, expressed as a percentage of the maximum dry density.

- The geomembrane is a 60-mil (60 thousandths of an inch) linear low-density polyethylene (LLDPE) low hydraulic conductivity barrier layer installed over the foundation layer.
- The vegetative cover is a minimum of 2 feet of clean dune sand sourced from the former Fort Ord. It protects the geomembrane, supports growth of vegetation, and acts as a drainage layer. Compactive effort is applied to the vegetative cover to achieve approximately 85 percent relative compaction (Shaw, 2005 and Gilbane, 2014).
- The engineered cover system was completed on Areas B through F in 2002.
- Vertical expansion of Area E is being completed in two phases (Gilbane, 2012). Phase I placement of remediation waste and vertical expansion was completed in 2013 (Gilbane, 2014). Phase 2 placement of remediation waste and vertical expansion will be completed in the future after soil remediation at the Site 39 Inland Ranges has been accomplished.

2.0 Mapping Methodology

Polaris's methodology for developing the iso-settlement maps is summarized in Attachment A. The 2023 aerial survey mapping meets or exceeds National Map Accuracy Standards. The vertical accuracy standard applied to elevation maps is that not more than 10 percent of the elevations tested can be in error of more than one-half the contour interval. For both the base topography and the 2023 topography, the contour interval is one foot. Spot elevations shown in the 2023 mapping (Attachment B) are within 0.1 foot of actual elevations. Given that the previous mapping events were prepared by a licensed land surveyor, it can be assumed that they also meet National Map Accuracy Standards. Thus, it can be concluded that the iso-settlement mapping also meets National Map Accuracy Standards.

2.1 Base Topography

Ahtna performed a review of OU2 Landfills related reports to determine a historical landfill survey chronology (Table 1), and provide Polaris with accurate base topography to use for comparison to the photogrammetric survey data collected on February 6, 2023 for generating the iso-settlement maps. The following reports were found to contain the most relevant information:

- *Draft Final Remedial Action Construction Completion Report, Operable Unit 2 Landfills, Areas A through F* (Shaw, 2005)
- *Final Construction Quality Control and Quality Assurance Report, Area E, Phase I, Operable Unit 2 Landfills* (Gilbane, 2014)

Base topography for Areas B, C, D and F was obtained from the computer-aided design (CAD) file named BCDEF-Asblt.dwg, which was determined to be representative of the final cover in 1999 as depicted in the construction drawings, Sheet C80, File No. 1966E274 and Sheet C82, File No. 1966E276 (Attachment C).

Base topography for Area E differs from Areas B, C, D and F in that the northwestern portion of Area E (Interim Area E) was left open until December 2002 to accept waste from other Fort Ord remediation sites (Figure 2). The base topography data for Area E was obtained from the CAD file named 783751SJ-e33.dwg which was determined to be representative of the post-interim closure surface in 2003 as depicted in the construction drawings, Sheet C81, File No. 1966E275 (Attachment C).

Since 2002, other construction activities have occurred at Area E. Construction of the Area E vertical expansion involved placing additional remediation waste above the existing LLDPE geomembrane and providing a new cover consisting of a foundation layer, LLDPE geomembrane, and vegetative layer over the remediation waste. Remediation waste from the Site 39 Inland Ranges is placed over an approximately 17-acre area of Area E as part of the foundation layer; vertical expansion Phase 1 and Phase 2 areas were prepared in 2012 and 2013 to accept this remediation waste. Phase 1 was completed in 2013 with approximately 147,000 cubic yards of remediation waste placed at Area E and sealed above and below by an LLDPE geomembrane (Gilbane, 2014). The 2013 Phase 1 area topography is depicted in the record drawings, Sheet C-11 (Attachment C).

During Site 39 remediation activities in 2013, approximately 8,300 cubic yards of remediation waste were placed in the Phase 2 area on top of approximately 12 inches of the pre-existing vegetative soil

layer that covered the original Area E LLDPE geomembrane.² In 2015, the remediation waste was temporarily covered with approximately 12 inches of clean soil obtained from the OU2 Landfills borrow source area (Figure 2).³ Until the vertical expansion is complete, the remediation waste in the Phase 2 area will remain sealed below by an LLDPE geomembrane and covered by 12 inches of clean soil, which is being managed to prevent exposure of remediation waste to the environment. Details of the Area E vertical expansion design are provided in *the Final Design Report, Revised OU2 Landfill Area E Expansion Construction, Former Fort Ord, California* (Gilbane, 2012). Details of the Area E Phase 1 vertical expansion construction are provided in the *Final Quality Control and Quality Assurance Report, Area E Phase I, Operable Unit 2 Landfills, Former Fort Ord, California* (Gilbane, 2014).

2.2 Measurement Error

The relative measurement error of a surface volume calculation is a function of the error of the base surface (1999 for Areas B, C, D and F; 2003 for Area E) and the error of the comparison surface (2023). Three main factors that will impact the absolute error of any surface are terrain irregularity, data density and deviation within the individual measurements.

Metadata were not available for the base topography (1999 and 2003) that was used, so an error uncertainty cannot be reported for the base topography. Uncertainties or absolute error can be estimated based on ties to stable control from prior surveys, which held one point vertically (#81, 92L-16-WEST); however, this disk was no longer available for use. Subsequent mapping has reported elevations on two benchmark disks at the perimeter of the OU2 Landfills: BM-D and BM-F (Attachment B). Polaris was able to tie into both disks, holding one and using the second as validation of the adjustment; however, there are insufficient sample points to make an inference about absolute error. Due to the lack of metadata on the base topography, relative error on the surface comparison also cannot be determined.

² This volume is based on 2 feet of soil being placed on an approximately 2.6-acre area, which is the uncapped Phase 2 portion of the Area E vertical expansion.

³ Chemical characterization of the clean borrow source area soils are documented in the *Draft Chemical Characterization Report, Vegetative Cover and Backfill Soil, Operable Unit 2 Landfills and Basewide Remediation Sites* (Shaw, 2003).

3.0 Differential Settlement Findings

Comparison of 1999 base topography with 2023 photogrammetric survey data indicated no significant changes in surface elevations at Areas B, C, D, and F as shown on the iso-settlement maps for each area (Attachment B). Comparison of historical elevation data for settlement monuments on all the OU2 Landfills areas also demonstrates no significant changes in surface elevations (Table 2). This is likely due to the age of the waste in these areas, with waste last received at the OU2 Landfills in the western half of Area F in 1987 (Dames & Moore, 1993). Typically 20 percent of waste settlement occurs in the first 5 years after disposal as decomposition reduces the waste volume; therefore, most of the long-term settlement in the waste trenches in Areas B, C, D, and F had already occurred prior to construction of the engineered cover system in 1997 and 1998. Despite this, field methane measurements at passive vents indicate some waste decomposition is still occurring in each area of the OU2 Landfills (Ahtna, 2023b).

Overall surface settlement in each of the OU2 Landfills areas may be attributed to continuing waste decomposition and the geotechnical properties of the soils used for general fill and in construction of the engineered cover system (i.e., primarily dune sand). The foundation layer and general fill are undergoing consolidation settlement due to overburden loads applied by the soils placed above (i.e., the foundation layers and vegetative cover on Areas B through F and additional vertical expansions on Area E). Over time, as pore fluid is squeezed out of the voids between soil grains, the soil grains rearrange themselves into a more stable and denser configuration, and a decrease in volume and surface settlement results (Holtz and Kovacs, 1981).

The vegetative cover is undergoing hydrocompaction, which produces ground surface collapse when the soil is saturated for sustained periods (e.g., during the winter months when the vegetative cover becomes saturated down to the geomembrane), but the water is subsequently removed (e.g., through drainage and evapotranspiration in the summer months). Infiltrating water enters the porous structure of the sandy soil reducing capillary tension between coarser soil particles. Removal of these structural bonds causes overall consolidation and is manifested by subsidence at the ground surface (Stumpf, 2013). The design thickness of the vegetative cover is a minimum of 2 feet (Shaw, 2005) and, per 27CCR Section 21090, the vegetative cover thickness must be not less than one foot. Annual inspections and intermittent repairs to the vegetative cover indicate these requirements continue to be met (Ahtna, 2023b and AEI, 2018).

Comparison of 2003 base topography with 2023 photogrammetric survey data for Area E indicated significant changes in surface elevations related to the Phase 1 vertical expansion in 2013 and disposal of range-related debris in the Phase 1 area in 2019, as shown on the iso-settlement map for Area E (Attachment B).

The following sections provide more detail on the findings of the iso-settlement survey for each area of the OU2 Landfills, with a focus on changes in surface topography that are greater than ± 1 foot.

3.1 Area B

Area B accepted waste from 1966 to 1975 (Dames & Moore, 1993). Minor sloughing of the vegetative cover has occurred in isolated locations around the perimeter of Area B resulting in decreases in

elevation of 1 foot to 2 feet relative to the 1999 base topography. The location with the most significant change in elevation is on the southeastern side of Area B where perimeter road improvements created a depression between Areas B and C as shown in Sheet C80 (Attachment C); however, this has not had an adverse effect on the engineered cover system, as shown in Photograph 1, and there is no evidence of ponding in this area requiring repairs to the engineered cover system (Ahtna, 2023b).

Settlement monument SM-B1 is in the middle of Area B (Attachment C, Sheet C80). In the 25-year period following placement of waste and the engineered cover system in Area B, the elevation of SM-B1 has declined 0.21 of a foot (2.5 inches) (Table 2). As shown on the iso-settlement map for Area B in Attachment B, elevation differentials between 1999 and 2023 over most of Area B have been less than 1 foot, with a maximum differential of -4 to -5 feet in the area of the perimeter road improvements noted above.

Based on site history and the results of the iso-settlement mapping and settlement monument survey, elevation changes in Area B appear to be the result of consolidation settlement, hydrocompaction, historical slope stability issues, and construction activities. Continued methane generation at Area B indicates ongoing decomposition of the underlying waste; however, this is not likely to be a significant factor due to the age of the waste.

3.2 Area C

Area C accepted waste from 1966 to 1975 (Dames & Moore, 1993). The location with the most significant decrease in elevation is on the western side of Area C where perimeter road improvements created a depression between Areas B and C as shown in Sheet C80 (Attachment C); however, this has not had an adverse effect on the engineered cover system, as shown in Photograph 1, and there is no evidence of ponding in this area requiring repairs to the engineered cover system (Ahtna, 2023b). In addition, the northeastern corner of Area C exhibits increases in surface elevation of up to 4 feet when compared to the 1999 base topography that were likely the result of road construction and maintenance.

Settlement monument SM-C1 is in the middle of Area C (Attachment C, Sheet C80). In the 25-year period following placement of waste and the engineered cover system in Area C, the elevation of SM-C1 has declined 0.22 of a foot (2.6 inches) (Table 2). As shown on the iso-settlement map for Area C in Attachment B, elevation differentials between 1999 and 2023 over most of Area C have been less than 1 foot, with a maximum differential of 3 to 4 feet in the area of the road maintenance noted above.

Based on site history and the results of the iso-settlement mapping and settlement monument survey, elevation changes in parts of Area C appear to be the result of consolidation settlement, hydrocompaction, and construction activities. Continued methane generation at Area C indicates ongoing decomposition of the underlying waste; however, this is not likely to be a significant factor due to the age of the waste.

3.3 Area D

Area D accepted waste from 1966 to 1975 (Dames & Moore, 1993). Minor to moderate sloughing of the vegetative cover has occurred on the northwestern and southeastern slopes of Area D resulting in

decreases in elevation of 1 foot to 3 feet relative to the 1999 base topography. Repair of the vegetative cover on the northwestern slope included the placement of a concrete-lined drainage ditch to mitigate erosion (Photograph 2).

Settlement monument SM-D1 is in the middle of Area D (Attachment C, Sheet C80). In the 25-year period following placement of waste and the engineered cover system in Area D, the elevation of SM-D1 has declined 0.33 of a foot (4.0 inches) (Table 2). As shown on the iso-settlement map for Area D in Attachment B, elevation differentials between 1999 and 2023 over most of Area D have been less than 1 foot, with a maximum differential of -5 to -6 feet in an isolated area of the northwestern slope; however, there is no evidence of ponding in this area requiring repairs to the engineered cover system (Ahtna, 2023b). The iso-settlement map also shows increasing elevation differential of 1 to 4 feet that represents the top deck berm on the north side of Area D constructed after 1998 to manage storm water runoff and mitigate erosion of the northern slope.

Based on site history and the results of the iso-settlement mapping and settlement monument survey, elevation changes in parts of Area D appear to be primarily the result of consolidation settlement, hydrocompaction, historical slope stability issues, and construction activities. Area D stopped receiving waste at the same time as Areas B and C; however, this area continues to generate methane at concentrations high enough to justify use of Area D as a fuel source for the onsite landfill gas extraction and treatment system. This indicates ongoing decomposition of the underlying waste that could be contributing to overall elevation differentials at Area D.

3.4 Area E

Area E accepted waste from 1960 to 1987, though from 1975 to 1987 only the northwest portion of Area E was actively receiving waste characterized as “demolition” debris and not household refuse (Dames & Moore, 1993). Area E continues to generate methane at concentrations high enough to justify use of the area as a fuel source for the onsite landfill gas extraction and treatment system and indicates ongoing decomposition of the underlying waste. The base topography for Area E is from 2003 because closure of Interim Area E was completed in December 2002 (Shaw, 2005). Minor to moderate sloughing of the vegetative cover has occurred on the western slopes of Interim Area E resulting in decreases in elevation of 1 foot to 3 feet relative to the 2003 base topography. Repair of the vegetative cover on the western slope included the placement of a concrete-lined drainage ditch in 2015 and a subdrain system in 2017 to mitigate erosion. There is no evidence of ponding in this area requiring additional repairs to the engineered cover system (Ahtna, 2023b).

The larger blue shaded area on the Area E iso-settlement map represents the increase in elevation associated with the Phase 1 vertical expansion completed in 2013, as depicted on Sheet C-11 in Attachment C, and an expansion of the area to the southwest when range-related debris from the Site 39 Inland Ranges and Bureau of Land Management Area B were placed in the Phase 1 area (KEMRON, 2020) (Photograph 3). The smaller blue-shaded and dark green-shaded areas west of the Phase 1 area represent placement of soils from construction and well installation projects at the former Fort Ord. These soils will be encapsulated by the future engineered cover system when additional remediation waste is placed in the Phase 2 area.

At the western extent of the Phase 2 area, a trench was left in place so a new LLDPE geomembrane may be secured to the existing LLDPE geomembrane to cover additional remediation waste from the Site 39 Inland Ranges to be brought to Area E in the future. This “tie-in” trench is indicated by the narrow “open bracket” shape with surface elevations that are 1 foot to 3 feet lower than the 2003 base topography. Inspections of the OU2 Landfills after major storm events have found the subdrain system installed on the western slope of Area E is performing per design and no ponded water has been observed in the tie-in trench on the western side of Area E (Ahtna, 2023b).

Four settlement monuments have been installed over time at Area E:

- SM-E1 is on the south side of Area E and is the oldest existing monument that represents changes in elevation since the original engineered cover system was constructed in 1998. In the 25-year period following construction of the original engineered cover system at Area E, the elevation of SM-E1 has declined by 0.67 of a foot (8.0 inches). This part of Area E has not been disturbed by erosion or construction activities; therefore, the elevation change is likely the result of consolidation settlement, hydrocompaction, and decomposition of the underlying waste.
- SM-E2 was on the north side of Area E but was removed or buried during Area E vertical expansion construction in 2013; however, in the 10-year period following construction of the original engineered cover system at Area E, the elevation of SM-E2 declined by 0.42 of a foot (5 inches). This part of Area E had not been disturbed by erosion or construction activities prior to the 2013 vertical expansion; therefore, the elevation change is likely the result of consolidation settlement, hydrocompaction, and decomposition of the underlying waste.
- SM-E3 is on the north side of Area E and was installed sometime after closure of Interim Area E in 2003 and first surveyed in 2008. In the 15-year period following the first survey event, the elevation of SM-E3 declined by 0.18 of a foot (2.2 inches). This part of Area E has not been disturbed by erosion or construction activities since 2008 and the decline in elevation is relatively small; therefore, the elevation change is likely primarily the result of consolidation settlement and hydrocompaction, and decomposition of the underlying waste to a lesser extent.
- SM-E4 is in the middle of Area E and is the newest monument that represents changes in elevation since the Phase 1 vertical expansion was completed in 2013. In the 10-year period following construction of the Phase 1 vertical expansion at Area E, the elevation of SM-E has declined by 0.47 of a foot (5.6 inches). Because this part of Area E has not been disturbed by erosion or construction activities since completion of the Phase 1 vertical expansion, the elevation change is likely the result of consolidation settlement, hydrocompaction, and decomposition of the underlying waste.

Based on site history and the results of the iso-settlement mapping and settlement monument survey, elevation changes in Area E appear to be the result of consolidation settlement, hydrocompaction, slope stability issues, construction activities, and to some extent decomposition of the underlying waste in some areas.

3.5 Area F

Area F accepted waste from 1966 to 1987 (Dames & Moore, 1993). Waste was placed primarily in north-south oriented trenches then covered with the native soil that was excavated to create the trench. Due to the more recent placement of waste in this part of the OU2 Landfills, settlement related to waste decomposition in the trenches is indicated by areas with elevation loss of 1 foot to 2 feet in the Area F iso-settlement map. It is also apparent that, on the northern side of Area F, some east-west oriented trenches were used for waste disposal. Photograph 4 shows the differential settlement that has occurred since the placement of the engineered cover in 1998.

Minor to significant sloughing of the vegetative cover has occurred on the northern slope of Area F resulting in decreases in elevation of 1 foot to 2 feet relative to the 1999 base topography. Repair of the vegetative cover on the northern slope included the placement of a subdrain system in 2017 to mitigate erosion (Ahtna, 2023b). An erosion channel in the vegetative cover on the northern slope of Area F, resulting from higher than average precipitation during the 2023 water year, is shown in Photograph 5 and is observable on the iso-settlement map in Attachment B. Repair of the vegetative cover in this area was completed in September 2023. There is no evidence of ponding in this area requiring additional repairs to the engineered cover system (Ahtna, 2023b).

Settlement monument SM-F1 is near the western edge of Area F (Attachment C, Sheet C82). In the 25-year period following placement of waste and the engineered cover system in Area F, the elevation of SM-F1 has declined 0.41 of a foot (4.9 inches) (Table 2). Settlement monument SM-F2 is in the central eastern part of Area F (Attachment C, Sheet C82). In the 25-year period following placement of waste and the engineered cover system in Area F, the elevation of SM-F2 has declined 0.76 of a foot (9.1 inches) (Table 2). As shown on the iso-settlement map for Area F in Attachment B, elevation differentials between 1999 and 2023 over most of Area F have been less than 1 foot, with isolated settlement areas of -2 to -3 feet in the waste disposal trenches on the south side of Area F. Temporary ponding has been observed in these isolated areas after higher than average precipitation events; however, this is resolved through drainage and evapotranspiration from the vegetative cover and there is no evidence of damage to the engineered cover system. A maximum differential of 3 to 4 feet is observed at the western extent of Area F in an area of access road improvements.

Based on site history and the results of the iso-settlement mapping and settlement monument survey, differential settlement in Area F appears to be the result of slope stability issues, particularly on the northern slope, consolidation settlement, hydrocompaction, and decomposition of the underlying waste in the parallel disposal trenches.

4.0 Conclusions and Recommendations

The majority of settlement related to waste decomposition had already occurred in Areas B, C, and D prior to the placement of the engineered cover system in 1997 because these areas had stopped receiving waste by 1975. Other than differential settlement of the vegetative cover related to consolidation settlement, hydrocompaction, construction, and minor erosion, no significant changes were observed in these areas when the 2023 surface elevations were compared to 1999 surface elevations.

Because Area F continued to receive decomposable waste until interim closure of the OU2 Landfills in 1987, this area showed evidence of settlement related to waste decomposition in areas that correspond to the locations of waste disposal trenches. However, no significant changes were observed in Area F when the 2023 surface elevations were compared to 1999 surface elevations.

Monuments were installed at the OU2 Landfills after placement of remediation waste and construction of the engineered cover system to monitor landfill settlement. Surveyors have measured monument elevations four times since construction of the engineered cover system for Areas B, C, D, and F was completed in 1998 (Table 2). In the 25-year period following placement of waste and the engineered cover system in these areas at the OU2 Landfills, settlement of the monuments has ranged from 0.18 of a foot (2.2 inches) at Area E to 0.76 of a foot (9.1 inches) at Area F, with an average settlement of 0.41 of a foot (4.9 inches) in these areas. This amount of settlement is consistent with expected long-term waste decomposition and consolidation settlement of the general fill and foundation layer combined with intermittent hydrocompaction due to wetting and drying of the vegetative cover.

Differential settlement related to waste decomposition could not be assessed for all of Area E because of the amount of construction changes that have occurred there since 1999; however, the change in elevation of less than one foot at the current and historical Area E settlement monuments is also consistent with expected long term consolidation settlement of the general fill and foundation layers combined with intermittent hydrocompaction due to wetting and drying of the vegetative cover, and indicates minimal settlement since 1999. Differential settlement at Area E may continue to be a challenge to assess because more remediation waste from the Site 39 Inland Ranges will be placed in the Phase 2 vertical expansion area within the next few years.

Continuing methane generation in all areas of the OU2 Landfills indicates ongoing waste decomposition that could contribute to future settlement; however, this is expected to be limited due to the age of the waste. The limited amount of differential settlement demonstrates the design and construction of the OU2 Landfills engineered cover system is sufficient because no adverse impacts related to settlement have occurred and none are expected.

It is recommended iso-settlement mapping be completed again in 2028 in accordance with 27CCR Section 21090(e)(2).

5.0 References⁴

- Ahtna Environmental, Inc. (AEI), 2018. *Final Annual Report 2017, Operations and Maintenance, Operable Unit 2 Landfills*. May 18. AR# [OU2-712](#).
- AEI, 2019. *Operation and Maintenance Plan Revision 3, Operable Unit 2 Landfills*. September 16. AR# [OU2-593J](#).
- Ahtna Global, LLC (Ahtna), 2023a. *Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Final Revision 7, Operable Unit 2 Landfills*. May 25. AR# [OU2-702S](#).
- Ahtna, 2023b. *Final Operable Unit 2 Remedy and Monitoring and Operations and Maintenance, Fourth Quarter 2021 through Third Quarter 2022, Former Fort Ord, California*. June 6. AR# [OU2-738B](#).
- California Code of Regulations, Title 27, Section 21090(e)(2) (27CCR).
- Dames & Moore, 1993. *Final Remedial Investigation Report, Remedial Investigation/Feasibility Study, Fort Ord Landfills, Fort Ord, California*. June 8. AR# [OU2-222](#).
- Holtz, Robert D. and Kovacs, William D., 1981. *An Introduction to Geotechnical Engineering*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.
- IT, 2001. *Draft Final Remedial Action Confirmation Report and Post-Remediation Screening Risk Assessment Area A, Operable Unit 2 Landfills, Former Fort Ord, CA*. April. AR# [OU2-599A](#).
- ITSI Gilbane Company (Gilbane), 2012. *Final Design Report, Revised OU2 Landfill Area E Expansion Construction, Former Fort Ord, California*. August 10. AR# [OU2-683B](#).
- Gilbane, 2014. *Final Quality Control and Quality Assurance Report, Area E Phase I, Operable Unit 2 Landfills, Former Fort Ord, California*. October 8. AR# [OU2-687B](#).
- KEMRON Environmental Services (KEMRON), 2020. *Impact Area MRA and BLM Area B Structure Demolition and Removal, Technical Information Paper, Former Fort Ord, California*. May. AR# [OE-0983A](#).
- Shaw Environmental, Inc. (Shaw), 2003. *Draft Chemical Characterization Report, Vegetative Cover and Backfill Soil, Operable Unit 2 Landfills and Basewide Remediation Sites, Former Fort Ord, California*. February. AR# [OU2-629](#).
- Shaw, 2005. *Draft Final Remedial Action Construction Completion Report, Operable Unit 2 Landfills, Areas A through F, Former Fort Ord, California*. January 31. AR# [OU2-630B](#).
- Shaw, 2008a. *Operation and Maintenance Plan, Operable Unit 2 Landfills, Former Fort Ord, California, Revision 2*. September 4. AR# [OU2-593F](#).

⁴ At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g. BW-1234). To find the referenced document, this number may be typed into the Online Search tool at: <http://www.fortordcleanup.com/documents/search/>. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn.

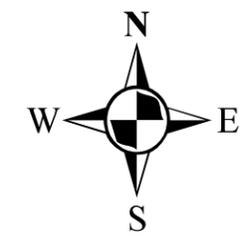
- Shaw, 2008b. *Final Construction Completion Report, Landfill Gas System Expansion, Operable Unit 2 Landfills, Former Fort Ord, California, Revision 0*. September 11. AR# [OU2-662F](#).
- Shaw, 2009. *Final Remedial Design/Remedial Action Work Plan, Site 39 Inland Ranges Remediation and OU2 Landfills, Area E Construction, Former Fort Ord, California, Revision 0*. December 7. AR# [RI-044D](#).
- Stumpf, A.J., 2013. *Hydrocompaction Subsidence*. In: Bobrowsky P.T. (eds) *Encyclopedia of Natural Hazards*. Encyclopedia of Earth Sciences Series. Springer, Dordrecht.
- U.S. Department of the Army (Army), 1994. *Record of Decision, Operable Unit 2, Fort Ord Landfills, Fort Ord, California*. July. AR# [OU2-480](#).
- Army, 1995. *Explanation of Significant Differences, Operable Unit 2, Fort Ord Landfills, Fort Ord, CA*. August. AR# [OU2-406](#).
- Army, 1996. *Explanation of Significant Differences, Area A, Operable Unit 2 Landfill*. August. AR# [OU2-458](#).
- Army, 1997. *Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill*. January. AR# [OU2-523](#).
- Army, 2006. *Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), Operable Unit 2, Fort Ord Landfills*. August. AR# [OU2-656](#).
- Army, 2009. *Record of Decision Amendment, Site 39 Inland Ranges, Former Fort Ord, California*. September. AR# [RI-041E](#).

Figures

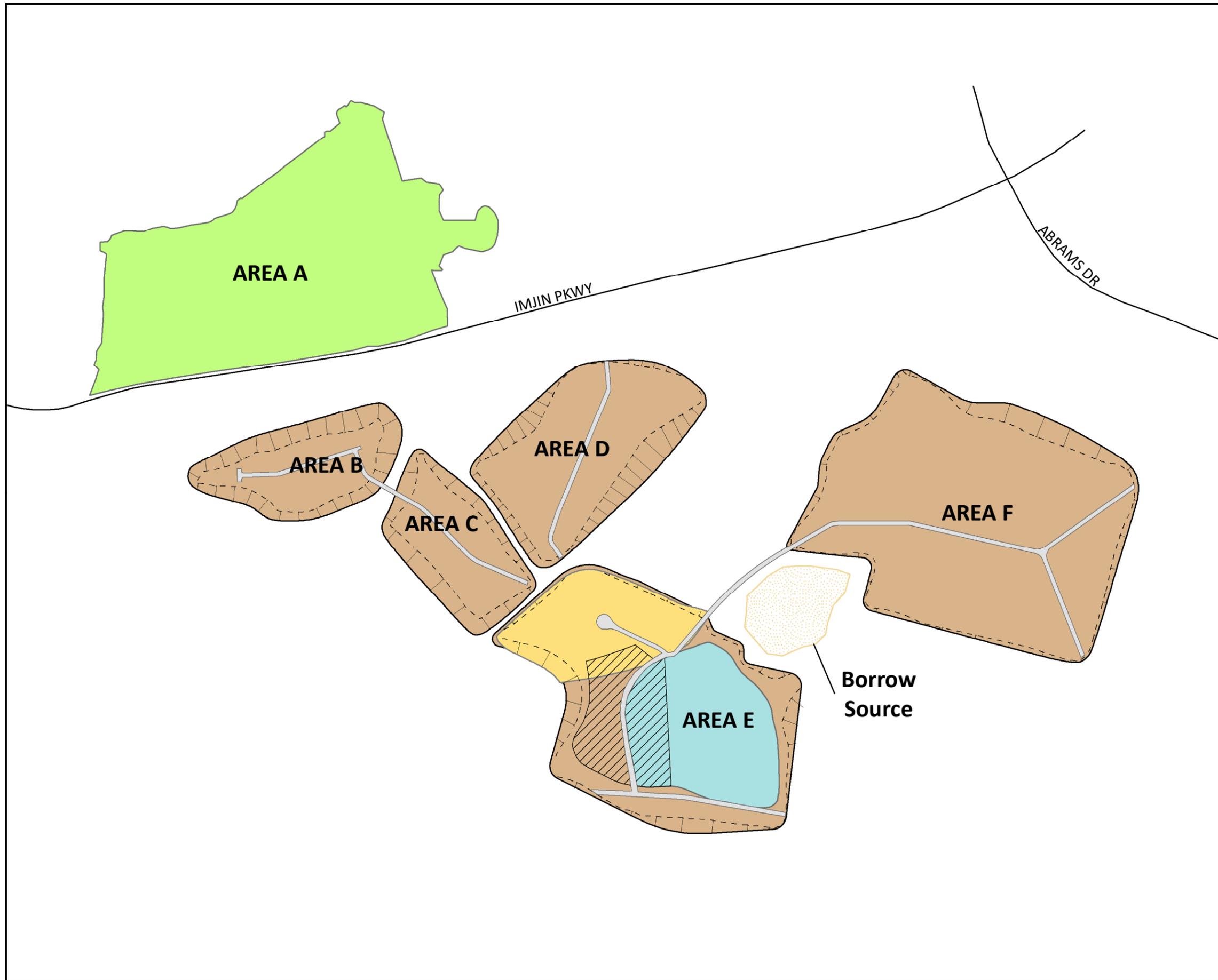


EXPLANATION

- Roads
-  Approximate extent of landfill areas (Areas B through F)
-  Former Fort Ord boundary

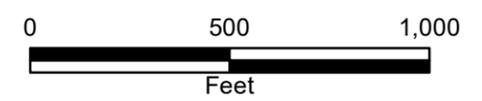
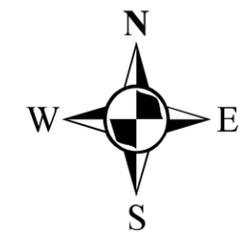


LOCATION MAP
 Technical Report 2023 Iso-Settlement Survey
 Operable Unit 2 Landfills
 Former Fort Ord, California



EXPLANATION

-  Access Road
-  Areas Covered 1997 to 1998
-  Area A clean closed 2001
-  Area E covered December 2002
-  Area E vertical expansion (Phase I) 2013
-  Area E phase II TBD
-  Borrow Source Area



LANDFILLS SITE PLAN
 Technical Report 2023 Iso-Settlement Survey
 Operable Unit 2 Landfills
 Former Fort Ord, California

Tables

Table 1. Chronology of Surveys and Related Events

Dates	Event
15-Sep-94	Fort Ord Military Reservation topographic maps prepared photogrammetrically by Hammon, Jensen, Wallen and Associates using aerial photography from June 6, 1994 (Shaw, 2008a).
Dec-97	Vegetative cover installation and hydroseeding in Areas B, C, and D completed (Shaw, 2005).
Aug-98	Vegetative cover installation on Area F completed (Shaw, 2005).
Aug-98	Vegetative cover installation on a portion of Area E completed (Shaw, 2005).
Nov-98	Hydroseeding on portions of Areas E and F completed (Shaw, 2005).
29-Oct-99	Survey of location and elevation of OU2 Landfills settlement monitoring points (Record Drawing Sheet C1; Shaw, 2005).
Dec-02	LLDPE geomembrane and vegetative cover at Interim Area E, as-built survey of Interim Area E completed (Shaw, 2005).
Jan-03	Hydroseeding on Interim Area E completed (Shaw, 2005).
3-Mar-03	Record Drawing Sheet C81, Final Cover Topography, Area E updated Interim Area E topography (Shaw, 2005).
3-Jun-08	Survey of location and elevation of OU2 Landfills settlement monitoring points (Shaw, 2009).
17-May-11	Survey of Area E existing topography in Phase 1 and Phase 2 vertical expansion areas to estimate volume of remediation waste placed at Area E in late 2010 and early 2011 (Gilbane, 2012).
Jul-13	Survey of Area E Phase 1 topography (Gilbane, 2014).
Aug-13	Area E vertical expansion Phase 1 completed (Gilbane, 2014).
6-Nov-13	Survey of location and elevation of Area E settlement monitoring points (Gilbane, 2014).
24-Jul-18	Survey of location and elevation of OU2 Landfills settlement monitoring points.
26-Oct-18	OU2 Landfills topographic maps prepared photogrammetrically by Polaris Consulting using aerial photography from August 6, 2018.
6-Feb-23	Survey of location and elevation of OU2 Landfills settlement monitoring points.
16-Mar-23	OU2 Landfills topographic maps prepared photogrammetrically by Polaris Consulting using aerial photography from February 6, 2023.

Table 2. Settlement Evaluation

Settlement Monument	Coordinates (NAD 1983, State Plane, California Zone 4)		Settlement Monument Elevations (feet MSL NGVD 1929)					Change in Elevation 2018-2023	Change in Elevation 1999-2023*
	Northing	Easting	10/29/1999	6/3/2008	11/6/2013	7/24/2018	2/6/2023		
SM-B1	2135608.561	5744527.897	197.61	197.29	NM	197.41	197.40	0.01	-0.21
SM-C1	2135215.617	5745255.639	221.47	221.22	NM	221.30	221.25	0.05	-0.22
SM-D1	2135682.304	5745804.664	237.74	237.55	NM	237.49	237.41	0.08	-0.33
SM-E1	2134079.443	5746245.577	254.54	253.93	NM	253.94	253.87	0.07	-0.67
SM-E2	2134687.315	5746193.998	248.05	247.63	NA	NA	NA	NA	NA
SM-E3	2134867.429	5746005.352	NA	253.39	NM	253.28	253.21	0.07	-0.18
SM-E4	2134397.730	5746295.800	NA	NA	264.18	263.81	263.71	0.10	-0.47
SM-F1	2135361.418	5747027.801	218.09	217.86	NM	217.69	217.68	0.01	-0.41
SM-F2	2135224.354	5747981.878	207.76	207.06	NM	207.07	207.00	0.07	-0.76
Minimum:								0.01	-0.76
Maximum:								0.10	-0.18
Average:								0.06	-0.41

Notes:

*Where 1999 data are not available for SM-E3 and SM-E4, 2008 and 2013 data were used, respectively.

NA: not available (settlement monument not yet constructed or destroyed).

NAD: North American Datum

NGVD: National Geodetic Vertical Datum

NM: not measured.

SM-E2 was removed or buried during Area E vertical expansion construction in 2012.

SM-E3 was installed sometime between closure of Interim Area E in 2003 and June 2008.

SM-E4 was installed after the Area E Phase 1 vertical expansion was completed in 2013.

Photographs

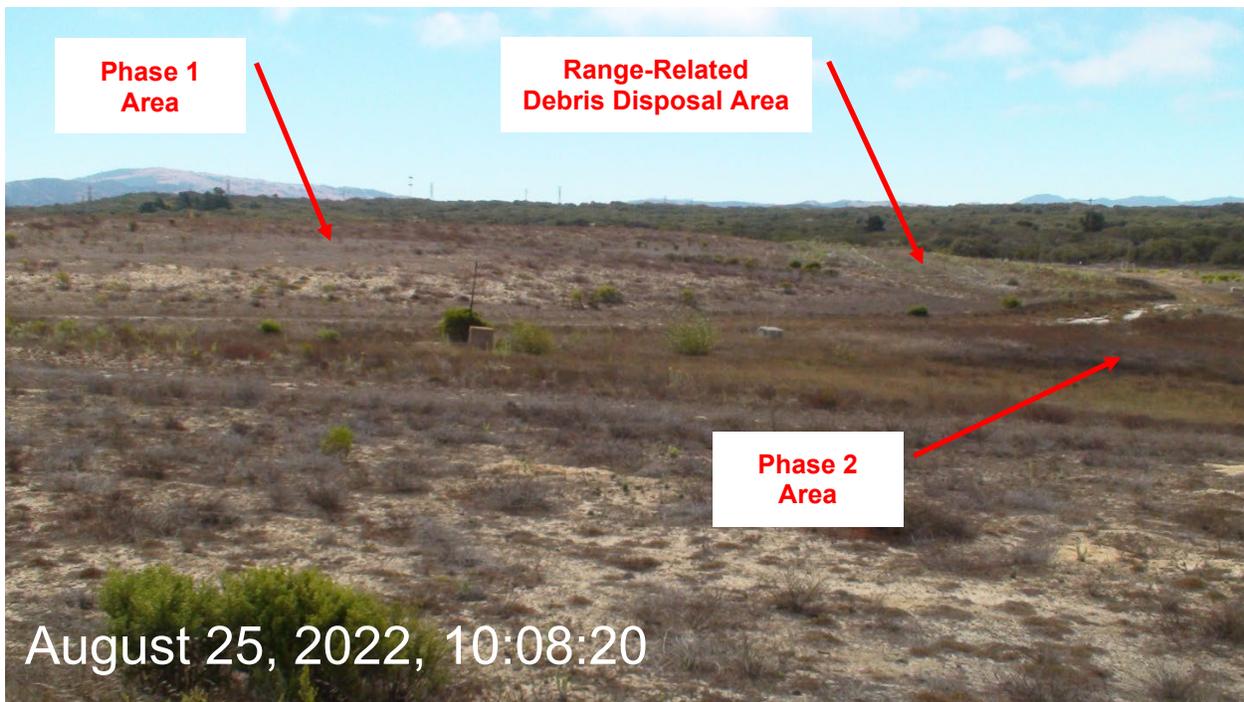
Photograph 1. Areas B/C Road Crossing



Photograph 2. Western Area D Concrete V-Ditch



Photograph 3. Area E Phase 1 and Phase 2 Vertical Expansion Areas



Photograph 4. Area F Waste Trench Settlement



Photograph 5. Area F Vegetative Cover Erosion



Attachments

Attachment A

Professional Land Surveyor's Statement of Mapping Methods



Polaris Land Surveying, Inc.

Professional Land Surveying Services

P. O. Box 1378, Carmel Valley, CA 93924 (831) 659-9564

E-mail: Lynn@PolarisLandSurveying.net

March 16, 2023

Eric Schmidt

Via email: eschmidt@ahtna.net

Re: OU2 Landfill Iso-Settlement Mapping
Ahtna Global, LLC
110 W 38th Avenue, Suite 200B
Anchorage, Alaska 99503

Dear Mr. Schmidt:

We've completed the Iso-Settlement mapping of the OU2 Landfills south of Imjin Parkway. We mapped the existing site features and existing elevations on the OU2 Landfill property based on ties to existing landfill control and referenced to California State Plane Coordinates, Zone 4 NAD83 (1992), NGVD 1929, using an aerial survey.

We prepared the enclosed Iso-Settlement map that shows 2023 contours and their relationship to the 1999 baseline mapping for Areas B, C, D and F. Area E's baseline mapping is from 2003. The Iso-Settlement map indicates all areas where differential settlement has been noted since the baseline mapping.

We created the Fort Ord 2023 Compilation X.dwg to perform the surface analysis. This drawing has the baseline surfaces and the 2023 existing conditions surface. Volume surfaces were built for each OU2 cell using the baseline surface as the Base Surface and the 2023 surface as the Comparison Surface. The volume surface is modeled by elevation banding on a 1 foot interval. 2023 Iso-settlement mapping is enclosed for your review. The 2023 Compilation drawing and all associated drawings will be provided electronically via download link and CD. Hard copies will follow in the mail.

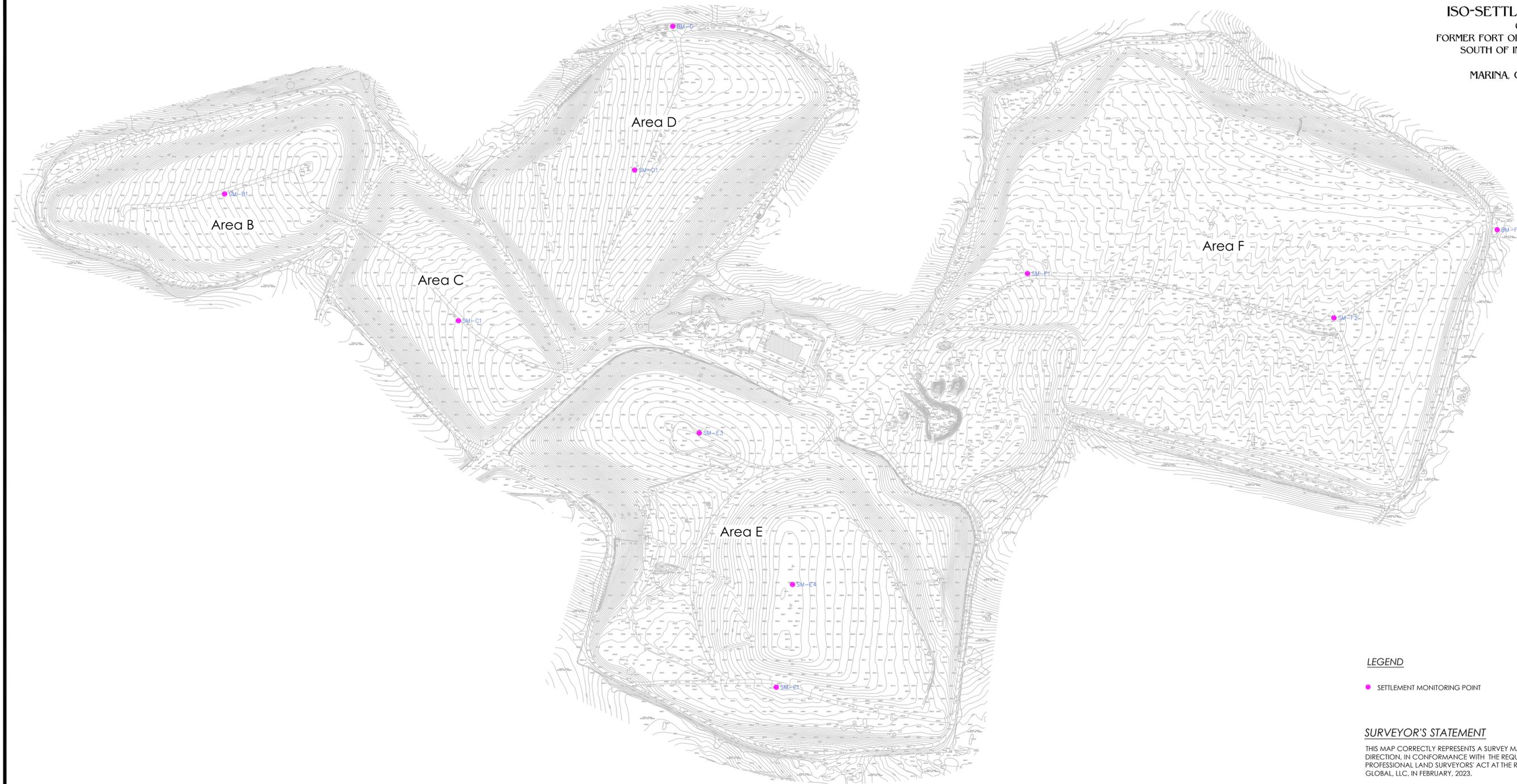
Sincerely,

Kathy Nitayangkul, L.S. 8512
Principal
Polaris Land Surveying, Inc.

Attachment B

Iso-Settlement Maps

ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA



Existing Conditions

NOTES

1. CONTOURS SHOWN HEREON ARE BASED ON EXISTING SITE CONDITIONS.
2. EXISTING SITE TOPOGRAPHY IS BASED ON AN AERIAL PHOTOGRAMMETRIC SURVEY PROVIDED BY POLARIS LAND SURVEYING, INC. DATE OF PHOTOGRAPHY 2-4-23. DATA ARE BASED ON CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 4, NAD 83. HORIZONTAL CONTROL WAS DERIVED FROM FOUND MONUMENTS PER RECORD OF SURVEY FILED WITH THE COUNTY OF MONTEREY IN VOLUME 19 OF SURVEYS AT PAGE 20, SHOWN AS POINTS 58 AND 59 THEREON. POINTS ARE IRON PIPES AND PLASTIC PLUG STAMPED BESTOR RCE 15310. PRIOR ISOSETTLEMENT MAPPING HELD BM-F FOR VERTICAL CONTROL, VERTICAL DATUM IS NGVD 1929 BASED ON BM-F SHOWN HEREON, ELEVATION = 199.47'. TABLE A LISTS THE SURVEY CONTROL MONUMENTS.
3. SETTLEMENT MONITORING PLATES WERE MEASURED AS PART OF THIS SURVEY. TABLE B SUMMARIZES THE MEASURED CHANGES IN ELEVATION.
4. INDIVIDUAL OU-2 LANDFILL AREAS ARE DEPICTED ON SHEETS 2-6. TABLE C SUMMARIZES THE SURFACE ELEVATION DIFFERENCES BETWEEN THE 2018 MAPPING AND EXISTING CONDITIONS.

Table A. OU-2 Landfill Survey Control

Point #	Northing	Easting	Elevation (ft)	Designation/Description
58	2135523.39	5742608.27	183.32	1" IRON PIPE, TAG ILLEGIBLE
59	2135839.97	5743605.00	176.78	1" IRON PIPE, TAGGED BESTOR RCE 15310
100	2136128.43	5745923.34	235.46	BM-D
101	2135497.71	5748490.84	199.47	BM-F

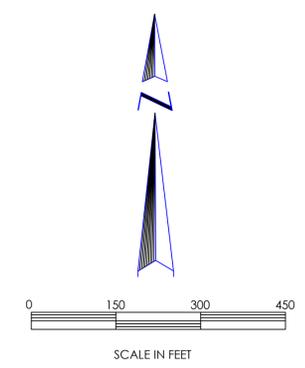
LEGEND

- SETTLEMENT MONITORING POINT

SURVEYOR'S STATEMENT

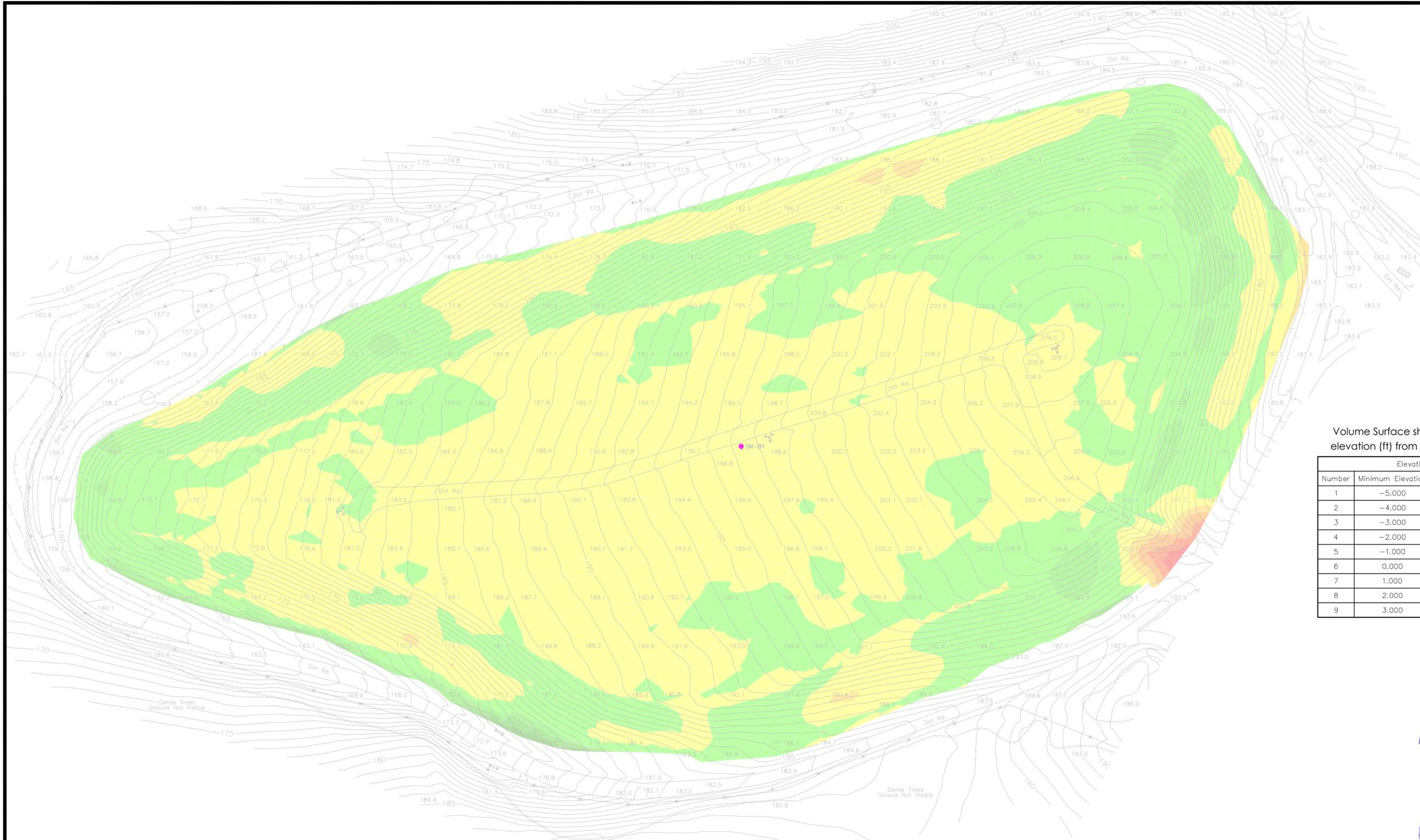
THIS MAP CORRECTLY REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECTION, IN CONFORMANCE WITH THE REQUIREMENTS OF THE PROFESSIONAL LAND SURVEYORS' ACT AT THE REQUEST OF AHTNA GLOBAL, LLC, IN FEBRUARY, 2023.

DATED _____
LYNN A. KOVACH
P.L.S. 5321



PREPARED FOR: AHTNA GLOBAL, LLC
 SURVEYED BY: POLARIS LAND SURVEYING
 P. O. BOX 1378
 CARMEL VALLEY, CA 93924
 831-659-9564
 SCALE: 1" = 150' VIEW: EXISTING DATE: March 14, 2023
 FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 1 of 6

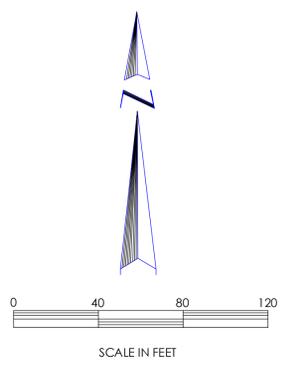
**ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA**



Volume Surface showing the change in elevation (ft) from 1999 to 2023 at Area B

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-5.000	-4.000	Red
2	-4.000	-3.000	Orange
3	-3.000	-2.000	Yellow
4	-2.000	-1.000	Light Green
5	-1.000	0.000	Yellow-Green
6	0.000	1.000	Green
7	1.000	2.000	Light Green
8	2.000	3.000	Green
9	3.000	4.000	Dark Green

OU2 Landfill Area B



NOTES

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- EXISTING SITE TOPOGRAPHY IS BASED ON AN AERIAL PHOTOGRAMMETRIC SURVEY PROVIDED BY POLARIS LAND SURVEYING, INC. DATE OF PHOTOGRAPHY 2-6-23. DATA ARE BASED ON CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 4, NAD 83. HORIZONTAL CONTROL WAS DERIVED FROM FOUND MONUMENTS PER RECORD OF SURVEY FILED WITH THE COUNTY OF MONTEREY IN VOLUME 19 OF SURVEYS AT PAGE 20, SHOWN AS POINTS 58 AND 59 THEREON. POINTS ARE IRON PIPES AND PLASTIC PLUG STAMPED BESTOR RCE 15310. PRIOR ISOSETTLEMENT MAPPING HELD BM-F FOR VERTICAL CONTROL. VERTICAL DATUM IS NGVD 1929 BASED ON BM-F SHOWN HEREON. ELEVATION = 199.47. TABLE A LISTS THE SURVEY CONTROL MONUMENTS.
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Table B. Settlement Monitoring Plate Data

Point #	Designation	2023 Measured Elevation (ft)	1999 Published Elevation (ft)	Difference (ft)
102	SM-B1	197.40	197.61	-0.21
103	SM-C1	221.25	221.47	-0.22
104	SM-D1	237.41	237.74	-0.33
105	SM-F1	217.68	218.09	-0.41
106	SM-F2	207.00	207.76	-0.76
107	SM-E1	253.87	254.54	-0.67
206	SM-E4	263.71	264.18B	-0.47
207	SM-E3	253.21	253.39A	-0.18

^A SM-E3 elevation published 6/3/2008
^B SM-E4 elevation published 11/6/2013

Table C. OU-2 Landfill Area 2023 Settlement Data

Volume Surface Area Designation	Minimum Elevation (ft)	Maximum Elevation (ft)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)	Cut/Fill
B	-4.95	3.81	2,014	2,232	218	Fill
C	-2.76	4.13	783	2,837	2,054	Fill
D	-5.66	3.28	1,680	6,651	4,971	Fill
E	2.71	16.79	5,256	155,446	150,190	Fill
F	-2.89	3.01	14,377	4,212	10,165	Cut

PREPARED FOR: AHTNA GLOBAL, LLC
 SURVEYED BY: POLARIS LAND SURVEYING
 P. O. BOX 1378
 CARMEL VALLEY, CA 93924
 831-659-9564

SCALE: 1" = 40' VIEW: AREA B DATE: March 14, 2023
 FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 2 of 6

**ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA**



Table B. Settlement Monitoring Plate Data

Point #	Designation	2023 Measured Elevation (ft)	1999 Published Elevation (ft)	Difference (ft)
102	SM-B1	197.40	197.61	-0.21
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^A SM-E3 elevation published 6/3/2008
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E	2.71	16.79	5,256	155,446	150,190	Fill
F	-2.89	3.01	14,377	4,212	10,165	Cut

Volume Surface showing the change in elevation (ft) from 1999 to 2023 at Area C

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-3.000	-2.000	Orange
2	-2.000	-1.000	Yellow
3	-1.000	0.000	Light Green
4	0.000	1.000	Green
5	1.000	2.000	Dark Green
6	2.000	3.000	Forest Green
7	3.000	4.000	Dark Forest Green
8	4.000	5.000	Very Dark Green

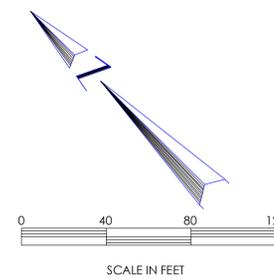
OU2 Landfill Area C

NOTES

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LEGEND

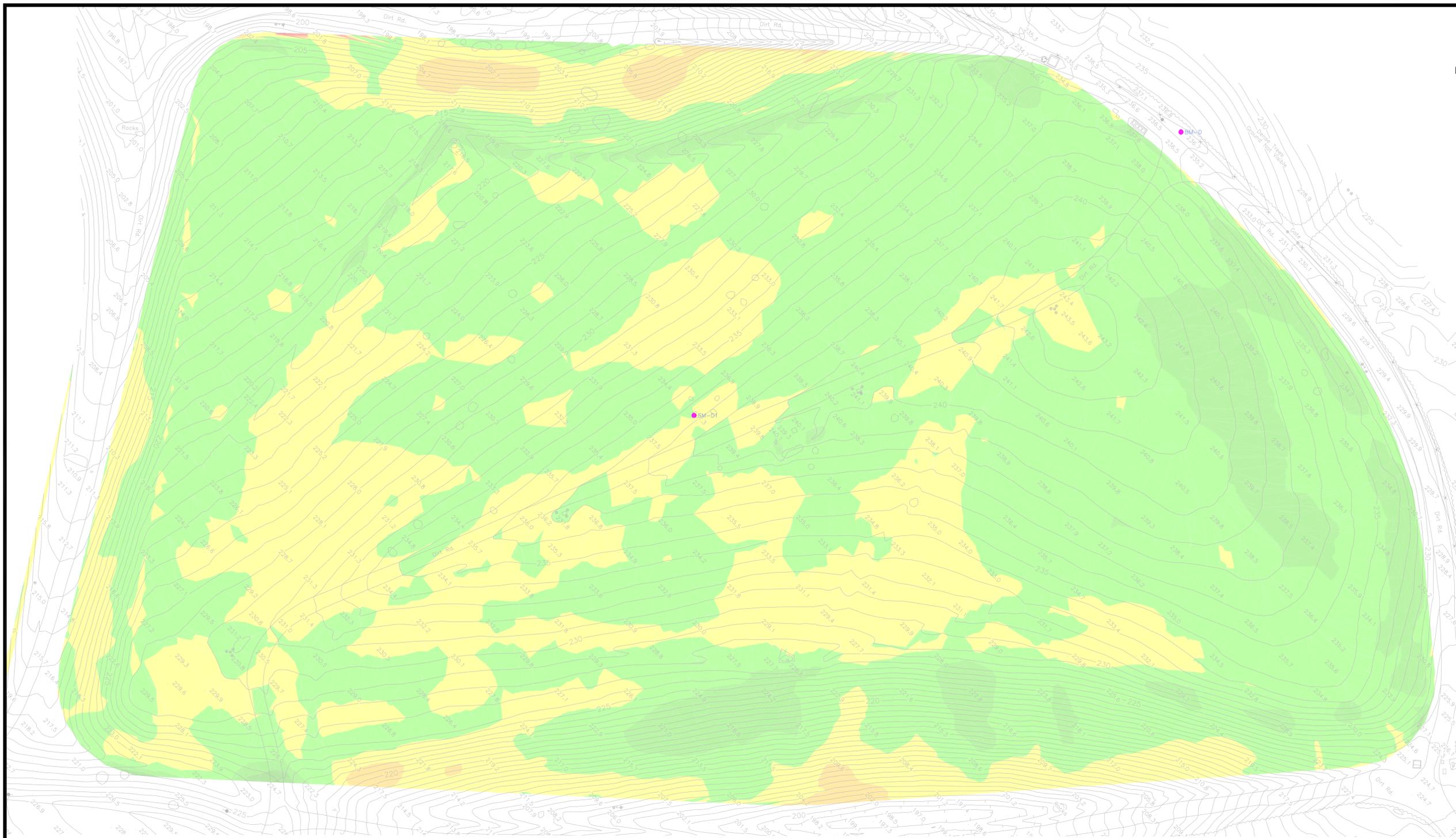
- SETTLEMENT MONITORING POINT



PREPARED FOR: AHTNA GLOBAL, LLC
SURVEYED BY: POLARIS LAND SURVEYING
P. O. BOX 1378
CARMEL VALLEY, CA 93924
831-659-9564

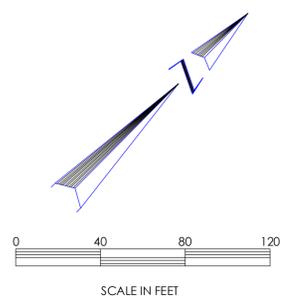
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FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 3 of 6

ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA



LEGEND

● SETTLEMENT MONITORING POINT



OU2 Landfill Area D

NOTES

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Table B. Settlement Monitoring Plate Data

Point #	Designation	2023 Measured Elevation (ft)	1999 Published Elevation (ft)	Difference (ft)
102	SM-B1	197.40	197.61	-0.21
103	SM-C1	221.25	221.47	-0.22
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106	SM-F2	207.00	207.76	-0.76
107	SM-E1	253.87	254.54	-0.67
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207	SM-E3	253.21	253.39A	-0.18

^A SM-E3 elevation published 6/3/2008
^B SM-E4 elevation published 11/6/2013

Table C. OU-2 Landfill Area 2023 Settlement Data

Volume Surface Area Designation	Minimum Elevation (ft)	Maximum Elevation (ft)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)	Cut/Fill
B	-4.95	3.81	2,014	2,232	218	Fill
C	-2.76	4.13	783	2,837	2,054	Fill
D	-5.66	3.28	1,680	6,651	4,971	Fill
E	2.71	16.79	5,256	155,446	150,190	Fill
F	-2.89	3.01	14,377	4,212	10,165	Cut

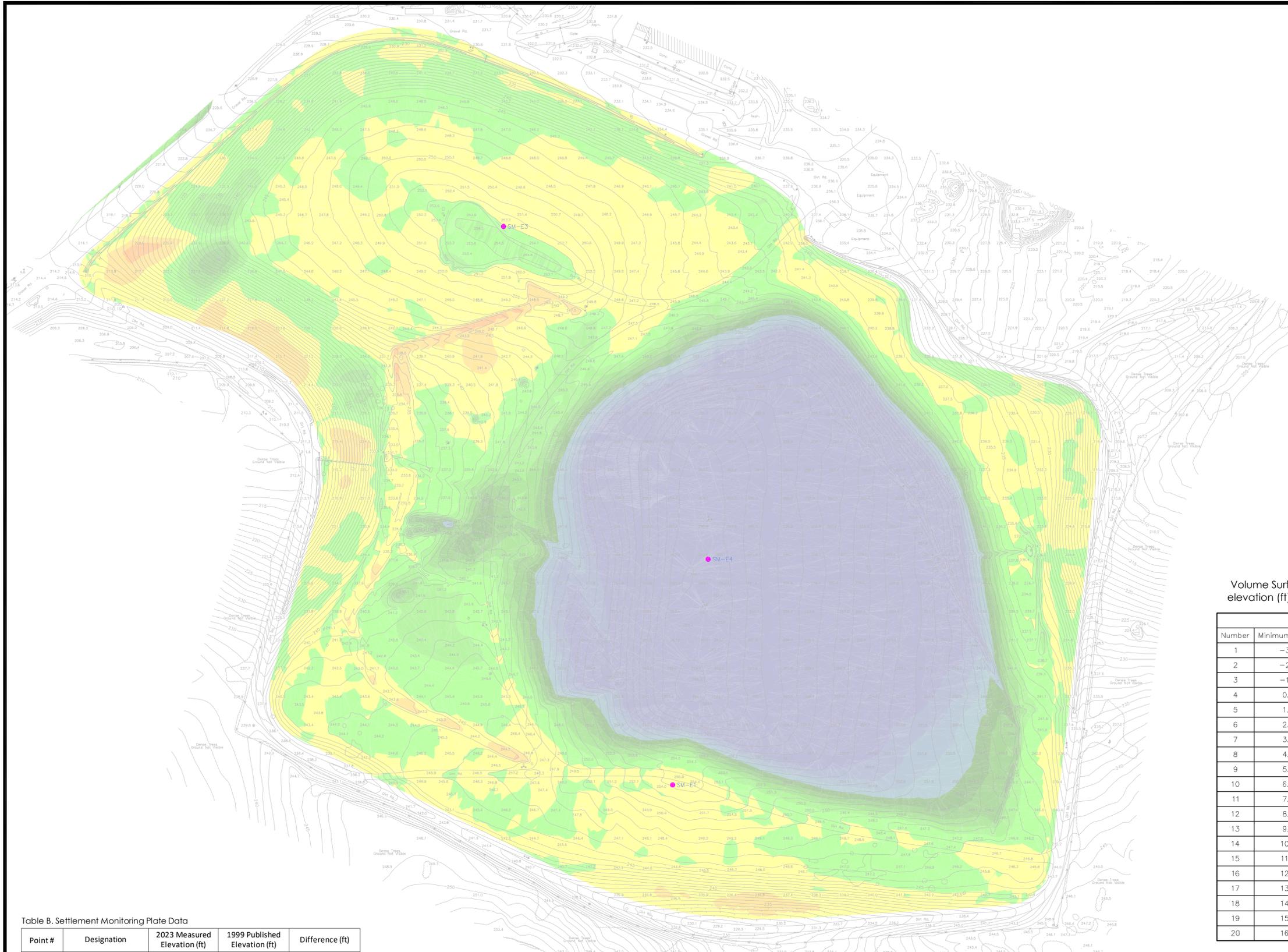
Volume Surface showing the change in elevation (ft) from 1999 to 2023 at Area D

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-6.000	-5.000	Red
2	-5.000	-4.000	Red
3	-4.000	-3.000	Orange
4	-3.000	-2.000	Orange
5	-2.000	-1.000	Yellow
6	-1.000	0.000	Yellow
7	0.000	1.000	Light Green
8	1.000	2.000	Light Green
9	2.000	3.000	Light Green
10	3.000	4.000	Light Green

PREPARED FOR: AHTNA GLOBAL, LLC
SURVEYED BY: POLARIS LAND SURVEYING
P. O. BOX 1378
CARMEL VALLEY, CA 93924
831-659-9564

SCALE: 1" = 40' VIEW: AREA D DATE: March 14, 2023
FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 4 of 6

**ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA**



NOTES

1. CONTOURS SHOWN HEREON ARE BASED ON EXISTING SITE CONDITIONS.
2. EXISTING SITE TOPOGRAPHY IS BASED ON AN AERIAL PHOTOGRAMMETRIC SURVEY PROVIDED BY POLARIS LAND SURVEYING, INC. DATE OF PHOTOGRAPHY 2-4-23. DATA ARE BASED ON CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 4, NAD 83. HORIZONTAL CONTROL WAS DERIVED FROM FOUND MONUMENTS PER RECORD OF SURVEY FILED WITH THE COUNTY OF MONTEREY IN VOLUME 19 OF SURVEYS AT PAGE 20, SHOWN AS POINTS 58 AND 59 THEREON. POINTS ARE IRON PIPES AND PLASTIC PLUG STAMPED BESTOR RCE 1 5310. PRIOR ISOSETTLEMENT MAPPING HELD BM-F FOR VERTICAL CONTROL. VERTICAL DATUM IS NGVD 1929 BASED ON BM-F SHOWN HEREON. ELEVATION = 199.47'. TABLE A LISTS THE SURVEY CONTROL MONUMENTS.
3. SETTLEMENT MONITORING PLATES WERE MEASURED AS PART OF THIS SURVEY. TABLE B SUMMARIZES THE MEASURED CHANGES IN ELEVATION.
4. INDIVIDUAL OU-2 LANDFILL AREAS ARE DEPICTED ON SHEETS 2-6. TABLE C SUMMARIZES THE SURFACE ELEVATION DIFFERENCES BETWEEN THE 2018 MAPPING AND EXISTING CONDITIONS.

Volume Surface showing the change in elevation (ft) from 2003 to 2023 at Area E

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-3.000	-2.000	Orange
2	-2.000	-1.000	Yellow
3	-1.000	0.000	Light Green
4	0.000	1.000	Green
5	1.000	2.000	Dark Green
6	2.000	3.000	Teal
7	3.000	4.000	Blue-Teal
8	4.000	5.000	Blue
9	5.000	6.000	Dark Blue
10	6.000	7.000	Very Dark Blue
11	7.000	8.000	Black
12	8.000	9.000	Black
13	9.000	10.000	Black
14	10.000	11.000	Black
15	11.000	12.000	Black
16	12.000	13.000	Black
17	13.000	14.000	Black
18	14.000	15.000	Black
19	15.000	16.000	Black
20	16.000	17.000	Black

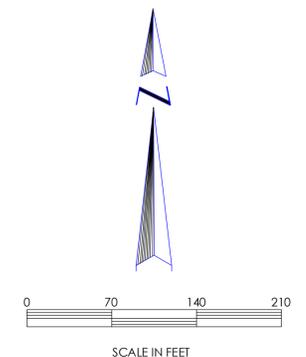


Table B. Settlement Monitoring Plate Data

Point #	Designation	2023 Measured Elevation (ft)	1999 Published Elevation (ft)	Difference (ft)
102	SM-B1	197.40	197.61	-0.21
103	SM-C1	221.25	221.47	-0.22
104	SM-D1	237.41	237.74	-0.33
105	SM-F1	217.68	218.09	-0.41
106	SM-F2	207.00	207.76	-0.76
107	SM-E1	253.87	254.54	-0.67
206	SM-E4	263.71	264.18B	-0.47
207	SM-E3	253.21	253.39A	-0.18

Table C. OU-2 Landfill Area 2023 Settlement Data

Volume Surface Area Designation	Minimum Elevation (ft)	Maximum Elevation (ft)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)	Cut/Fill
B	-4.95	3.81	2,014	2,232	218	Fill
C	-2.76	4.13	783	2,837	2,054	Fill
D	-5.66	3.28	1,680	6,651	4,971	Fill
E	2.71	16.79	5,256	155,446	150,190	Fill
F	-2.89	3.01	14,377	4,212	10,165	Cut

OU2 Landfill Area E

LEGEND

● SETTLEMENT MONITORING POINT

^A SM-E3 elevation published 6/3/2008
^B SM-E4 elevation published 11/6/2013

PREPARED FOR: AHTNA GLOBAL, LLC
SURVEYED BY: POLARIS LAND SURVEYING
P. O. BOX 1378
CARMEL VALLEY, CA 93924
831-659-9564

SCALE: 1" = 70' VIEW: AREA E DATE: March 14, 2023
FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 5 of 6

**ISO-SETTLEMENT MAP
OF
FORMER FORT ORD OU-2 LANDFILLS
SOUTH OF IMJIN PARKWAY
MARINA, CALIFORNIA**

LEGEND

● SETTLEMENT MONITORING POINT

Table B. Settlement Monitoring Plate Data

Point #	Designation	2023 Measured Elevation (ft)	1999 Published Elevation (ft)	Difference (ft)
102	SM-B1	197.40	197.61	-0.21
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104	SM-D1	237.41	237.74	-0.33
105	SM-F1	217.68	218.09	-0.41
106	SM-F2	207.00	207.76	-0.76
107	SM-E1	253.87	254.54	-0.67
206	SM-E4	263.71	264.18B	-0.47
207	SM-E3	253.21	253.39A	-0.18

^A SM-E3 elevation published 6/3/2008
^B SM-E4 elevation published 11/6/2013

Table C. OU-2 Landfill Area 2023 Settlement Data

Volume Surface Area Designation	Minimum Elevation (ft)	Maximum Elevation (ft)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)	Cut/Fill
B	-4.95	3.81	2,014	2,232	218	Fill
C	-2.76	4.13	783	2,837	2,054	Fill
D	-5.66	3.28	1,680	6,651	4,971	Fill
E	2.71	16.79	5,256	155,446	150,190	Fill
F	-2.89	3.01	14,377	4,212	10,165	Cut

NOTES

- CONTOURS SHOWN HEREON ARE BASED ON EXISTING SITE CONDITIONS.
- EXISTING SITE TOPOGRAPHY IS BASED ON AN AERIAL PHOTOGRAMMETRIC SURVEY PROVIDED BY POLARIS LAND SURVEYING, INC. DATE OF PHOTOGRAPHY 2-6-23. DATA ARE BASED ON CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 4, NAD 83. HORIZONTAL CONTROL WAS DERIVED FROM FOUND MONUMENTS PER RECORD OF SURVEY FILED WITH THE COUNTY OF MONTEREY IN VOLUME 19 OF SURVEYS AT PAGE 20. SHOWN AS POINTS 58 AND 59 THEREON. POINTS ARE IRON PIPES AND PLASTIC PLUG STAMPED BESTOR RCE 15310. PRIOR ISOSETTLEMENT MAPPING HELD BM-F FOR VERTICAL CONTROL. VERTICAL DATUM IS NGVD 1929 BASED ON BM-F SHOWN HEREON. ELEVATION = 199.47'. TABLE A LISTS THE SURVEY CONTROL MONUMENTS.
- SETTLEMENT MONITORING PLATES WERE MEASURED AS PART OF THIS SURVEY. TABLE B SUMMARIZES THE MEASURED CHANGES IN ELEVATION.
- INDIVIDUAL OU-2 LANDFILL AREAS ARE DEPICTED ON SHEETS 2-6. TABLE C SUMMARIZES THE SURFACE ELEVATION DIFFERENCES BETWEEN THE 2018 MAPPING AND EXISTING CONDITIONS.

Volume Surface showing the change in elevation (ft) from 1999 to 2023 at Area F

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-3.000	-2.000	Orange
2	-2.000	-1.000	Yellow-Orange
3	-1.000	0.000	Yellow
4	0.000	1.000	Light Green
5	1.000	2.000	Green
6	2.000	3.000	Dark Green
7	3.000	4.000	Very Dark Green

PREPARED FOR: AHTNA GLOBAL, LLC
 SURVEYED BY: POLARIS LAND SURVEYING
 P. O. BOX 1378
 CARMEL VALLEY, CA 93924
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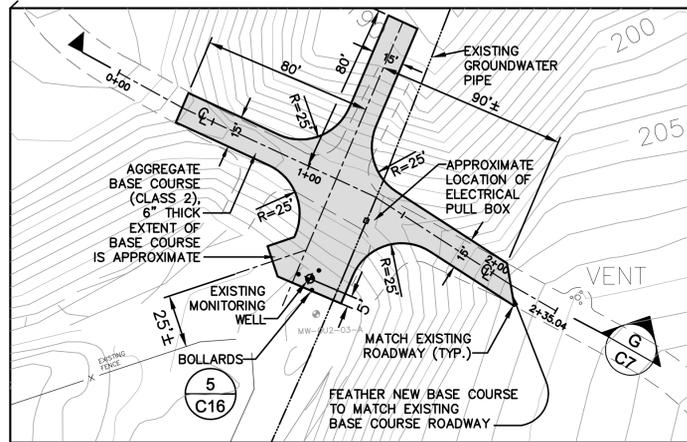
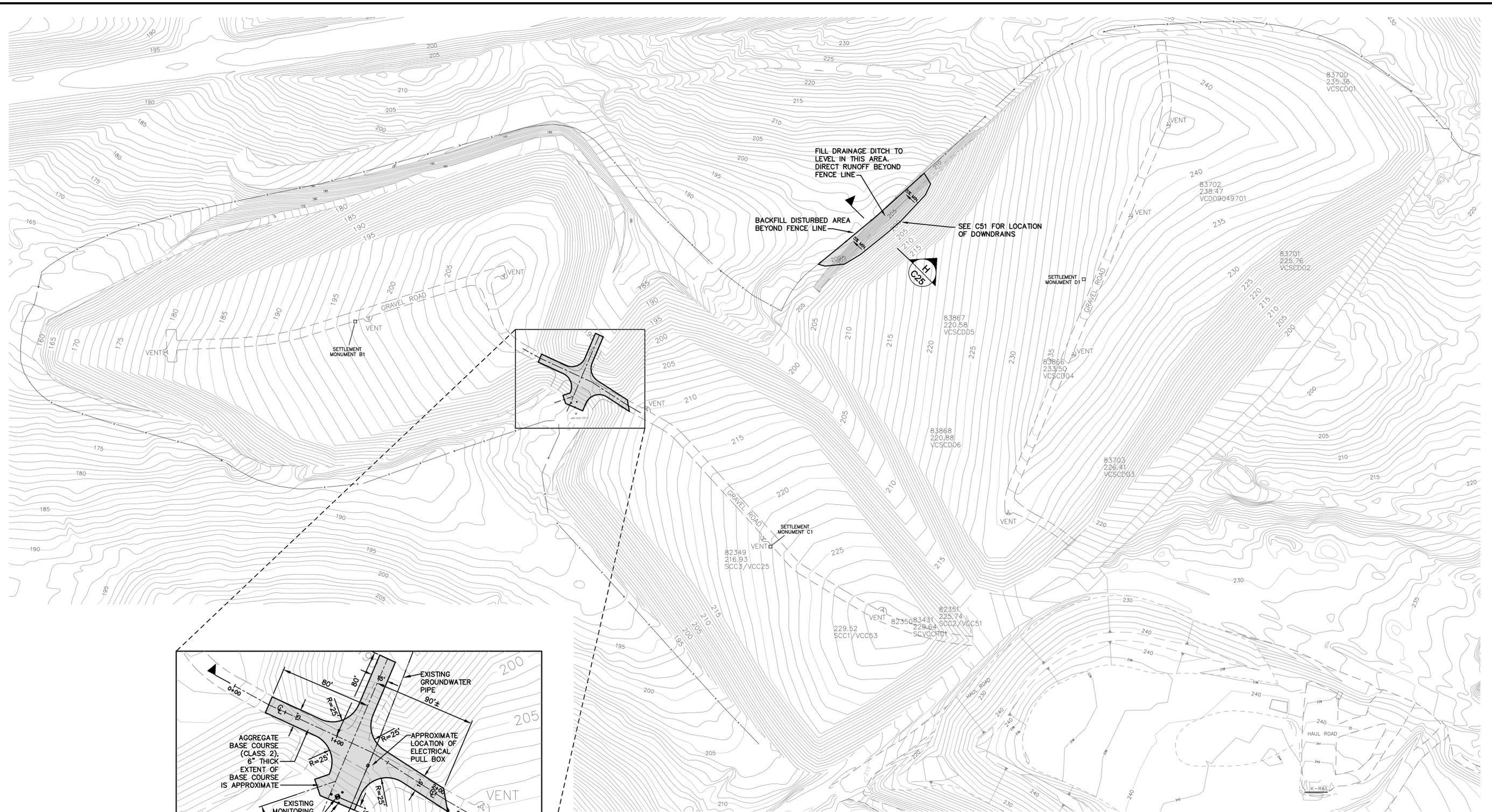
SCALE: 1" = 70' VIEW: AREA F DATE: March 14, 2023
 FILE NAME: 2023 Compilation.dwg JOB #19129 Sheet 6 of 6

OU2 Landfill Area F



Attachment C

Record Drawings



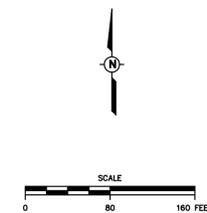
DETAIL
SCALE 1" = 40' - 80' FEET

NOTES:

1. THIS DRAWING REPRESENTS A TOPOGRAPHIC SURVEY OF THE LANDFILL AREA. DESIGN INFORMATION IS SHOWN ON SHEET C7.

Reference:
Drawing "BCD_FGR0" from Bestor Engineers.

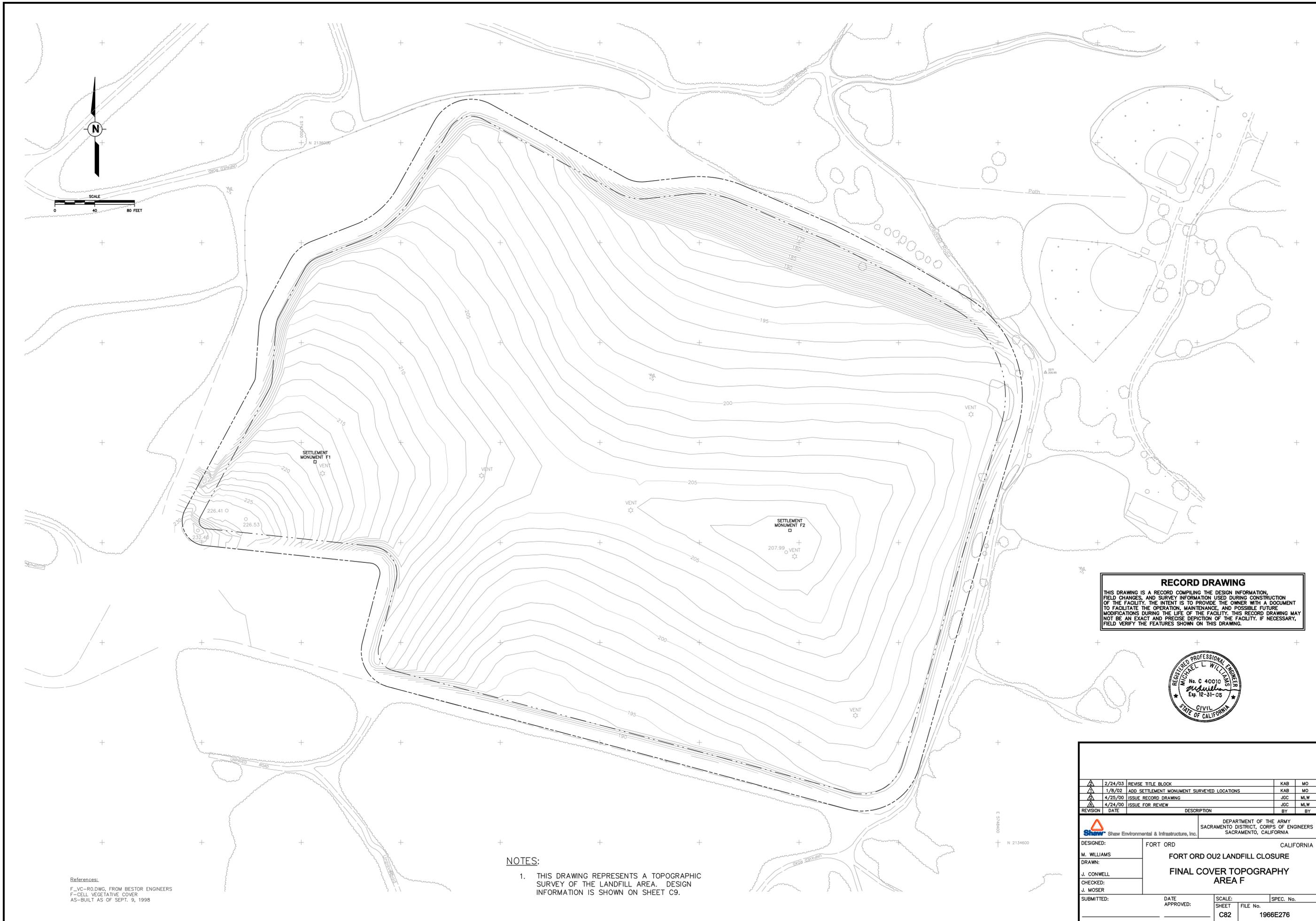
RECORD DRAWING
THIS DRAWING IS A RECORD COMPILING THE DESIGN INFORMATION, FIELD CHANGES, AND SURVEY INFORMATION USED DURING CONSTRUCTION OF THE FACILITY. THE INTENT IS TO PROVIDE THE OWNER WITH A DOCUMENT TO FACILITATE THE OPERATION, MAINTENANCE, AND POSSIBLE FUTURE MODIFICATIONS DURING THE LIFE OF THE FACILITY. THIS RECORD DRAWING MAY NOT BE AN EXACT AND PRECISE DEPICTION OF THE FACILITY. IF NECESSARY, FIELD VERIFY THE FEATURES SHOWN ON THIS DRAWING.



REVISION	DATE	ISSUE FOR REVIEW	DESCRIPTION	BY	BY
2/24/03		REVISE TITLE BLOCK		KAB	MLW
1/8/02		ADD SETTLEMENT MONUMENT SURVEYED LOCATIONS		KAB	MO
4/25/00		ISSUE RECORD DRAWING		BWJ	MLW
4/7/00		ADD BOLLARDS AND FILL ON AREA D		BWJ	MLW
3/31/00		ISSUE FOR REVIEW		JCC	MLW

DESIGNED:		FORT ORD		CALIFORNIA	
M. WILLIAMS		FORT ORD OU2 LANDFILL CLOSURE			
DRAWN:		FINAL COVER TOPOGRAPHY AREAS B, C, AND D			
J. CONWELL					
CHECKED:					
SUBMITTED:		DATE APPROVED:		SCALE: AS SHOWN SHEET FILE No. C80	
				SPEC. No. 1966E274	

Shaw Environmental & Infrastructure, Inc. DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA



RECORD DRAWING
 THIS DRAWING IS A RECORD COMPILING THE DESIGN INFORMATION, FIELD CHANGES, AND SURVEY INFORMATION USED DURING CONSTRUCTION OF THE FACILITY. THE INTENT IS TO PROVIDE THE OWNER WITH A DOCUMENT TO FACILITATE THE OPERATION, MAINTENANCE, AND POSSIBLE FUTURE MODIFICATIONS DURING THE LIFE OF THE FACILITY. THIS RECORD DRAWING MAY NOT BE AN EXACT AND PRECISE DEPICTION OF THE FACILITY. IF NECESSARY, FIELD VERIFY THE FEATURES SHOWN ON THIS DRAWING.

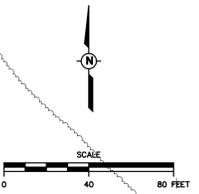


- NOTES:**
- THIS DRAWING REPRESENTS A TOPOGRAPHIC SURVEY OF THE LANDFILL AREA. DESIGN INFORMATION IS SHOWN ON SHEET C9.

References:
 F_VC-RO.DWG, FROM BESTOR ENGINEERS
 F-CELL VEGETATIVE COVER
 AS-BUILT AS OF SEPT. 9, 1998

REVISION	DATE	ISSUE FOR REVIEW	DESCRIPTION	BY	BY
2/24/03		REVISE TITLE BLOCK		KAB	MO
1/8/02		ADD SETTLEMENT MONUMENT SURVEYED LOCATIONS		KAB	MO
4/25/00		ISSUE RECORD DRAWING		JCC	MLW
4/24/00		ISSUE FOR REVIEW		JCC	MLW

		DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA	
DESIGNED:	FORT ORD CALIFORNIA		
M. WILLIAMS	FORT ORD OU2 LANDFILL CLOSURE		
DRAWN:	FINAL COVER TOPOGRAPHY		
J. CONWELL	AREA F		
CHECKED:			
J. MOSER			
SUBMITTED:	DATE APPROVED:	SCALE:	SPEC. No.
		C82	1966E276



RECORD DRAWING

THIS DRAWING IS A RECORD COMPILING THE DESIGN INFORMATION, FIELD CHANGES, AND SURVEY INFORMATION USED DURING CONSTRUCTION OF THE FACILITY. THE INTENT IS TO PROVIDE THE OWNER WITH A DOCUMENT TO FACILITATE THE OPERATION, MAINTENANCE, AND POSSIBLE FUTURE MODIFICATIONS DURING THE LIFE OF THE FACILITY. THIS RECORD DRAWING MAY NOT BE AN EXACT AND PRECISE DEPICTION OF THE FACILITY. IF NECESSARY, FIELD VERIFY THE FEATURES SHOWN ON THIS DRAWING.

NOTES:

1. THIS DRAWING REPRESENTS A TOPOGRAPHIC SURVEY OF THE LANDFILL AREA. DESIGN INFORMATION IS SHOWN ON SHEET C8.

References:
E_VC_R2.DWG FROM BESTOR ENGINEERS AND
E-CELL LINER AS-BUILT AS OF DEC. 6, 2002.

DESIGNED:	M. WILLIAMS	DATE:	3/3/03	DESCRIPTION:	UPDATE INTERIM AREA TOPO. REVISE TITLE BLOCK	BY:	KAB	MLW
DRAWN:		DATE:	4/24/00	DESCRIPTION:	ISSUE RECORD DRAWING	BY:	JCC	MLW
CHECKED:	K. BLACK	DATE:	4/24/00	DESCRIPTION:	ISSUE FOR REVIEW	BY:	JCC	MLW
SUBMITTED:	J. MOSER	DATE APPROVED:		SCALE:		FILE No.		SPEC. No.
				C81		1966E275		

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

FORT ORD CALIFORNIA

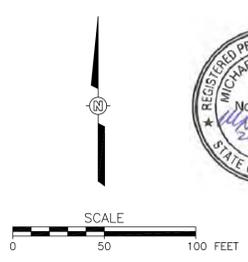
FORT ORD OU2 LANDFILL CLOSURE

FINAL COVER TOPOGRAPHY
AREA E



REFERENCES:
 PHASE 1 TOPOGRAPHY SURVEYED JULY 2013 BY
 ITSI-GILBANE
 EXISTING TOPOGRAPHY SURVEYED MAY 2011 BY
 ITSI-GILBANE

- LEGEND
- VE8 ● NEW VENT LOCATION
 - ▲ EXISTING VENT LOCATION
 - EXISTING SETTLEMENT MONUMENT
 - NEW SETTLEMENT MONUMENT
 N 2134397.73
 E 5746295.80
 ELEV. 264.18'



RECORD DRAWING	Date	Symbol	Description	Approved
1/23/14				

Designed by: M. WILLIAMS	Date: JANUARY 2014	Rev:
Drawn by: K. BLACK	Design file no.:	
Reviewed by: T. CHILLOTTO	Drawing Code:	
Submitted by:	File name:	
	Plot date:	AS NOTED
	Dwg scale:	

CB&I Federal Services LLC
 1230 Columbia Street
 Suite 1200
 San Diego, California 92101

Former Fort Ord, CA
 Operable Unit 2 - Landfills
 Area E Vertical Expansion
RECORD DRAWING
PHASE 1 COVER TOPOGRAPHY

Sheet reference number:
C-11

Appendices

Appendix A

Responses to USEPA Comments on the Draft Iso-Settlement Survey Technical Report

Responses to Comments submitted by the Environmental Protection Agency (USEPA)¹

GENERAL COMMENTS: The text states that waste from other Fort Ord remediation sites was relocated and utilizes the term remediation waste; however, the composition of this waste is unclear. The Report omits any description of this waste. Please revise the text to include additional detailed information on the composition of the remediation waste.

RESPONSE TO GENERAL COMMENTS: *The Technical Report was revised to note that, per the Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill (Administrative Record No. OU2-523), “remediation waste” is soil and debris excavated from remediation areas at the former Fort Ord and consolidated in the OU2 Landfills. For example, this includes soil and debris from the Site 39 Inland Ranges that may be contaminated with metals or munitions constituents.*

SPECIFIC COMMENTS

SPECIFIC COMMENT 1: Section 2.1 Base Topography, Page 4: The first full sentence on this page states that clean soil was obtained from a borrow source area; however, it is unclear where this area is located. Also, it is not clear if laboratory analysis was performed to demonstrate that this source area contains clean soil. Please revise the Report to include additional information regarding the borrow area soil, including any analytical data that documents the lack of contaminants in the soil, and update Figure 2 to show its location.

RESPONSE TO SPECIFIC COMMENT 1: *A footnote was added to Section 2.1 to reference the document that describes the laboratory analyses performed for borrow source soils and Figure 2 was revised to indicate the location of the borrow source area. However, please note that the purpose of Section 2.1 is to describe the base topography of the OU2 Landfills used for comparison with current survey data to determine differential settlement (Section 1.1 was also revised to clarify this). Information about the borrow source is irrelevant for this purpose.*

SPECIFIC COMMENT 2: Photographs, PDF Page 24-28: Of the five photographs presented in the Report, four of them contain the exact same timestamp, 13:59:35 on 2 May 2023. If these photographs were taken on the same day, it would be impossible to take all four at exactly the same time. Please revise the photograph timestamps or remove them while retaining the date stamp. In addition, the description of photos 3, 4, and 5 on pages 26, 27, and 28 of the .pdf file, respectively, do not match the descriptions in the Table of Contents. For example, the description of photo 3 is “Eastern Area D” in the Table of Contents, but “Area E Phase 1 and Phase 2 Vertical Expansion Areas” in the photo description. Please determine the correct photo description for photos 3, 4, and 5 and ensure that the descriptions in the Table of Contents match the descriptions on page 26, 27, and 28 of the.pdf file.

¹ In a letter dated July 21, 2023 (see Administrative Record No. [OU2-741.5](#)). The comments are reproduced here as provided to the U.S. Department of the Army (Army) and there have been no changes to spelling, grammar, or punctuation.

RESPONSE TO SPECIFIC COMMENT 2: *The correct timestamps were placed on each of the photographs and the descriptions in the Table of Contents were corrected.*

SPECIFIC COMMENT 3: Table 1. Chronology of Surveys and Related Events: Table 1 does not note the preparation of the Report. Please revise Table 1 to include preparation of the Report in June 2023.

RESPONSE TO SPECIFIC COMMENT 3: *As noted in Section 2.1 of the Report, the purpose of Table 1 is to provide a historical landfill survey chronology to facilitate development of the base topography. Preparation of the Report is not relevant to this and Table 1 was not revised per the comment.*

Appendix B

Responses to DTSC Comments on the Draft Iso-Settlement Survey Technical Report

Responses to Comments submitted by the California Department of Toxic Substances Control (DTSC)¹

GENERAL COMMENT: DTSC found that in the documentation, it states that the landscaped moved in some areas a lot more than others. Did this movement cause any issues, and could you state this in the document?

RESPONSE TO GENERAL COMMENT: *There were no issues identified that resulted from differential settlement around the Operable Unit 2 (OU2) Landfills. Each Area of the OU2 Landfills is described in Section 3.0 of the Technical Report, which includes discussion of the likely causes of differential settlement (e.g., consolidation settlement, hydrocompaction, slope stability, construction activities, etc.) and, as stated in Section 4.0 of the Technical Report, no adverse impacts related to settlement have occurred and none are expected.*

DTSC ENGINEERING AND SPECIAL PROJECTS OFFICE (ESPO) COMMENT 1: ESPO recommends that Section 1.2 of the Iso-Settlement Survey be revised to include, or cite sections in prior reports that include, a more detailed explanation of the Conceptual Site Model. Additional information should include a summary of pathways to receptors by contaminants in all media.

RESPONSE TO ESPO COMMENT 1: *A reference to the Quality Assurance Project Plan (QAPP) for the OU2 Landfills was added to Section 1.2 per the comment. The QAPP includes a more detailed description of the conceptual site model, including a summary of pathways to receptors by contaminants in media associated with the OU2 Landfills. However, please note that the purpose of the Technical Report is to evaluate the impacts of differential settlement at the OU2 Landfills (Section 1.1 was also revised to clarify this). Information about pathways to receptors is irrelevant to this purpose.*

ESPO COMMENT 2: ESPO recommends that Section 1.3 of the Iso-Settlement Survey be revised to include, or cite sections in prior reports that include, a more detailed explanation of the remedy. Additional information should include: a) at what stage is remedy implementation, is it done?, b) what are the layer thicknesses of the various components of the cap?, c) are any other regulatory agencies involved with Fort Ord OU-2?

RESPONSE TO ESPO COMMENT 2: *Section 1.3 was revised to cite references that define the remedy.*

RESPONSE TO ESPO COMMENT 2a: *The text was revised to clarify the remedy status.*

RESPONSE TO ESPO COMMENT 2b: *Section 1.3 was revised to note the thickness of each component of the engineered cover system.*

RESPONSE TO ESPO COMMENT 2c: *The lead and support agencies involved with the implementation of the OU2 remedy are noted in the cited documents added to Section 1.3 per the response to Comment 2.*

¹ In a letter dated August 21, 2023 (see Administrative Record No. [OU2-741.4](#)). The comments are reproduced here as provided to the U.S. Department of the Army (Army) and there have been no changes to spelling, grammar, or punctuation.

ESPO COMMENT 3a: ESPO notes that units are not indicated on the Elevations Table of the Iso-Settlement Maps.

RESPONSE TO ESPO COMMENT 3a: *The iso-settlement maps in Attachment B to the Technical Report were revised to note units in the elevations tables.*

ESPO COMMENT 3b: ESPO notes from the narrative on Page 8 that the settlement at Area E is characterized by the changes at the monuments, reported to be 8-inches of decline at SM-E1, and 5-inches of decline at SM- -E4. ESPO also notes that the Iso-Settlement Map for Area E shows elevation changes of 1 to 2 feet, if those are indeed the units presented. The Iso-settlement maps for other areas show similar, sometimes larger, elevation changes. These are all characterized by the first sentence of Section 3.0, and elsewhere, as not significant.

ESPO does not dispute the author’s characterization that elevation changes are not significant, though phrases such as, “ Minor to moderate sloughing of the vegetative cover has occurred on the western slopes of Interim Area E resulting in decreases in elevation of 1 foot to 3 feet relative to the 2003 base topography.” are noteworthy. ESPO recommends that the Iso-Settlement Survey be revised to include a description of whether elevation changes indicate the final cover thickness is less than, or near, the required minimum or may cause ponding, and if so, when will repairs be made.

RESPONSE TO ESPO COMMENT 3b: *Section 3.0 of the Technical Report was revised per the comment. The design thickness of the vegetative cover layer is a minimum of 2 feet (Administrative Record No. OU2-630B) and, per Title 27 of the California Code of Regulations (27CCR) Section 21090, the vegetative layer thickness must be not less than one foot. Inspections of sloughed areas before and during repairs show the vegetative cover meets or exceeds the design thickness (e.g., see Administrative Record No. [OU2-712](#)) and annual engineering inspections of the OU2 Landfills have found no evidence 27CCR requirements for cover thickness are not being met (e.g., see Administrative Record No. [OU2-738B](#)).*

ESPO COMMENT 4: ESPO notes that Sheet C-11 in Attachment C (Page 43) is referred to on Page 8 as being part of Area E. However, this reviewer’s comparison of Sheet C-11, which has no Area designation, with the drawing on the prior Page 42, which is designated as related to Area E, shows no resemblance. This casts doubt as to the particular Area that is intended to be shown on Sheet C-11.

ESPO recommends that Sheet C-11 of the Iso-Settlement Survey be revised to clarify what is being shown.

RESPONSE TO ESPO COMMENT 4: *The title block on Sheet C-11 states that it depicts a portion of Area E, specifically the Phase 1 cover topography. Additionally, certain features on Sheet C-11, such as settlement monuments, landfill gas vents and bollards, and gravel roads, can be correlated with the same features shown on Sheet C81, which shows all of Area E. Further, Sheet C-11 is a signed and approved record drawing. Sheet C-11 was not revised per the comment.*

Appendix C

Responses to FOCAG Comments on the Draft Iso-Settlement Survey Technical Report

Responses to Comments submitted by Fort Ord Community Advisory Group (FOCAG)¹ on the Draft Report

COMMENT 1: Page 1, 1.2 Brief Summary of Conceptual Site Model. The bulk of the Ft. Ord landfills were dug up and moved across Imjin Road. An explanation should be provided to the reader as to this remedy.

RESPONSE TO COMMENT 1: *Fort Ord Operable Unit 2 (OU2) Landfills historically consisted of six landfill areas (lettered A through F). Area A (33 acres on the north side of Imjin Road) was clean closed and no landfill waste remains in this area (see Administrative Record No. [OU2-599A](#)). The waste from Area A was consolidated in the other already existing Areas B through F (120 acres on the south side of Imjin Road). Area A was only approximately 20 percent of the total landfill acreage, not the “bulk” of it. However, Section 1.3 of the Technical Report was revised per the comment to note the transfer of landfill waste from the north side of Imjin Road to the south side.*

COMMENT 2: Page 1, 1.3 Brief Summary of the OU2 Landfills Remedy. There are little to no records so characterizing it as “on-base waste disposal typical of municipal landfills at the time”, is inadequate. It was a military infantry training base since 1917. Further it was CDEC Headquarters for the West Coast. Lots of supplies, armaments, chemicals, that the Army and it’s onsite populace didn’t need or want anymore were buried here. The reader should be provided an explanation of CDEC and experimental weapons and munitions.

Your summary states, “Detailed disposal records are not available”

The FOCAG opines that’s is for two main reasons,

- 1) Upon the closure of Fort Ord, records were sent offsite to a destination not revealed to the civilian populace.
- 2) Throwing hazardous materials away by burying them was standard pattern and practice in the day.

RESPONSE TO COMMENT 2: *The OU2 Landfills were used for residential and on-base waste disposal typical of municipal landfills during the time the OU2 Landfills were operated. This is an accurate description because, while detailed disposal records are not available, information gathered during field activities and from other sources indicates household and on-base commercial refuse, dried sewage sludge, construction debris, and small amounts of chemical waste (paint, oil, pesticides, electrical equipment, ink, and epoxy adhesive) were placed in the OU2 Landfills (see Administrative Record No. [OU2-222](#)).*

The U.S. Environmental Protection Agency (USEPA) added Fort Ord to the National Priorities List in 1990, but Fort Ord did not close until late 1994. Therefore, Fort Ord documents relevant to the CERCLA process were retained and many of these can be found in the Administrative Record. There is no evidence such documents were shipped offsite or destroyed. Regardless, the Army continues to follow the CERCLA process to appropriately investigate, characterize, and clean up hazardous substances at the former Fort Ord.

¹ In a letter dated July 21, 2023 (see Administrative Record No. [OU2-741.2](#)). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

A review of historical records indicates the Combat Developments Experimentation Command (CDEC) used facilities at Fort Ord for administrative functions and CDEC field experiments were conducted at Fort Hunter Liggett. The United States Army Combat Developments Experimentation Command (USACDEC) Experimentation Manual states that the CDEC used Fort Ord “only rarely” for field experimentation as Fort Hunter Liggett was preferred due to the isolation from urban populations and dark night skies making it a “excellent site” for combat training experimentation (USACDEC Experimentation Manual dated Oct. 1981. <https://apps.dtic.mil/dtic/tr/fulltext/u2/a124297.pdf>). The presence of CDEC administrative facilities at the former Fort Ord is not relevant to settlement at the OU2 Landfills and the Technical Report was not revised based on the comment.

COMMENT 3: Page 1, 1.3 Brief Summary of the OU2 Landfills Remedy. The movement of the Army landfills and the covering the top with a rubberized type cover was referred to as a CAMU by Army BRAC during Community Involvement Workshops (C.I.W.). CAMU stood for “Corrective Action Management Unit”. There were many waste disposal cells moved and the contents dumped into many other dug out areas with no liner beneath it. This document should explain the concept of the CAMU at the time, and the reasons for selecting the CAMU as a remedy.

Some public members at BRAC Community Involvement Workshops (C.I.W.) referred to the engineered cover system as like a “shower cap”.

RESPONSE TO COMMENT 3: As discussed in the response to Comment 1, the waste from Area A was moved and consolidated in already existing Areas B through F. There were not “many waste disposal cells” nor “many other dug out areas.”

The geomembrane that is part of the engineered cover system for the OU2 Landfills is not a “rubberized type cover;” it is made of linear low-density polyethylene (LLDPE), which has much more flexibility, tensile strength, and more conformability that makes it highly suitable for this application. The engineered cover system is functioning as designed and is protective of human health and the environment (Administrative Record No. [BW-2925](#)).

Relocation of waste from Area A to Areas B through F and construction of the engineered cover system were elements of the remedy for the OU2 Landfills, but not what constitutes a CAMU. As defined in California Code of Regulations (CCR), Title 22 Section 66264.552, a CAMU is an area within a facility designated for purposes of carrying out corrective action requirements under CCR Title 22 and Resource Conservation and Recovery Act (RCRA) Section 308(h). In general, the CAMU regulations were developed to give regulatory agencies flexibility in selecting and implementing the most effective and appropriate waste management strategies for the cleanup of large, complex sites such as the former Fort Ord, which had numerous remediation sites and an existing landfill that required fill material for closure (see Administrative Record Nos. [RI-019](#) and [OU2-523](#)). The Technical Report was not revised based on the comment.

COMMENT 4: Page 3, 2.1 Base Topography. Regarding new dumpsites B, C, D, E, and F, shouldn't the initial depths below ground surface of each cell be provided to the reader, for the record?

It is disclosed that a portion of Area E was left open to accept “waste” from other Fort Ord remediation sites. Should not the types of waste be disclosed? For example the Beach Ranges, called site 3, had tons of spent lead bullets that were sifted from the sand, and put atop a dump cell.

Also, “waste” from the Army Tank training area next to Del Rey Oaks was transferred to a cell. This would have been mostly spent munitions and such.

Area E was then sealed above and below by a sealed membrane. It was referred to as being like a giant Calzone by BRAC representatives at a Fort Ord Technical Workshop. Shouldn’t there be specific disclosure of the types and lbs. of waste disposed of in this manner?

RESPONSE TO COMMENT 4: *Areas B through F are not new dumpsites. As stated in Section 1.2, the OU2 Landfills, including Areas B through F, were active from 1955 to 1987 and were used for residential and on-base waste disposal typical of municipal landfills during that time. Waste was placed in parallel trenches 10 to 30 feet deep and then covered over with the native dune sand excavated during trenching operations.*

The types and volumes of remediation waste are disclosed when the waste is brought to the OU2 Landfills. For example, for Site 3, this information is provided in the Final Remedial Action Confirmation Report and Post-Remediation Risk Assessment, Site 3 Remedial Action, Basewide Investigation Sites, Fort Ord, California (Administrative Record No. [SITE3-105A](#)). However, the Technical Report was revised (a footnote was added to Section 2.1) to note that, per the Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill (Administrative Record No. [OU2-523](#)), “remediation waste” is soil and debris excavated from remediation areas at the former Fort Ord and consolidated in the OU2 Landfills. For example, this includes soil and debris from the Site 39 Inland Ranges that may be contaminated with lead and explosives compounds.

There are no documented tank training areas near the city of Del Rey Oaks. As described in the Comprehensive Basewide Range Assessment Reports (Administrative Record Nos. [BW-2300J](#), [BW-2300L](#), and [BW-2300M](#)), there was an anti-tank training range near Del Rey Oaks. Specifically, Historical Area (HA)-26D was designated for machine gun and anti-tank training. However, after an investigation, it was determined HA-26D did not require remediation and no waste was transferred from HA-26D to the OU2 Landfills.

Details about the Area E vertical expansions, including the types and volumes of waste disposed of, are provided in the Final Design Report, Revised OU2 Landfill Area E Expansion Construction, Former Fort Ord, California (Administrative Record No. [OU2-683B](#)) and the Final Quality Control and Quality Assurance Report, Area E Phase I, Operable Unit 2 Landfills, Former Fort Ord, California (Administrative Record No. [OU2-687B](#)).

COMMENT 5: Page 4, 2.2 Measurement Error. Compaction of landfill contents over time is understandable. However, not calculated or discussed is how much of these landfill contents may be leaching into the unlined areas beneath these landfills? Are there estimates?

This is critical in that, for example PFAS is often found;

1) near dumpsites

- 2) near airports
- 3) near military bases

Former Fort Ord has all three. Also given it's proximity to the ocean, much of former Fort Ord has a sandy loam soil. This may enhance a landfills toxic contents leaching into the soil underneath.

RESPONSE TO COMMENT 5: *There is a difference between compaction and settlement. Compaction is the process of making something more compact or dense by applying force to it. Landfill settlement is the vertical displacement of waste due to compression, decomposition of the waste, and creep phenomenon of the waste particles (the tendency of a solid material to undergo slow deformation while subject to persistent mechanical stresses).*

The engineered landfill cover system, constructed in accordance with the remedy identified in the Record of Decision, Operable Unit 2, Fort Ord Landfills (ROD; Administrative Record No. [OU2-480](#)), is specifically designed to prevent leaching to the soil and groundwater, and the remedy for the OU2 Landfills is functioning as designed and is protective of human health and the environment (Administrative Record No. [BW-2925](#)).

Based on the operational history of the OU2 Landfills, groundwater samples were collected from twelve OU2 monitoring wells for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) analysis during the First Quarter 2019 OU2 groundwater monitoring program event. PFOA and PFOS were not detected in A-Aquifer wells near the OU2 Landfills (monitoring wells MW-OU2-27-A, -44-A, and -73-A), indicating the OU2 Landfills are not a continuing source of per- and polyfluoroalkyl substances (PFAS) in groundwater (Administrative Record No. [BW-2942](#)). The Technical Report was not revised based on the comment.

COMMENT 6: Page 5, 3.0 Differential Settlement Findings. On page 5 terms such as “pore fluid”, “hydrocompaction”, and “subsidence at the ground surface” do not offer the reader much in the way of “Findings” and not how it pertains to how much of the landfill contents may be leaching into the unlined areas beneath these landfills.

- Area B- 1 foot to 2 feet, or 4 to 5 feet near the perimeter road
- Area C- Less than 1 foot, or 3 to 4 feet in the area of road maintenance
- Area D- 1 foot to 3 feet
- Area E- 1 foot to 3 feet, then some more careful measurements
- Area F- 1 foot to 2 feet

RESPONSE TO COMMENT 6: *Each of the terms mentioned in the comment are defined in Section 3.0 and appropriate references are cited should the reader desire to learn more about settlement mechanisms that might occur at landfills and differences in settlement measurements of the Landfill Areas between measurement events. As noted in Section 1.1, the purpose of the Technical Report is to present the results of the iso-settlement survey conducted at the OU2 Landfills in accordance with CCR Title 27, Section 21090(e)(2) to evaluate whether differential settlement is impairing either the engineered cover system or the free drainage of surface flow. The findings pertain only to this evaluation and the measurements of settlement are not related to leaching. As stated above, the engineered landfill cover system, constructed in accordance with the remedy identified in the ROD (Administrative Record No.*

[OU2-480](#)), is specifically designed to prevent leaching to the soil and groundwater, and the remedy for the OU2 Landfills is functioning as designed and is protective of human health and the environment (Administrative Record No. [BW-2925](#)). The Technical Report was not revised based on the comment.