LMS/AMC/S13961

Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, Amchitka, Alaska

May 2016

Approved for public release; further dissemination unlimited

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

ADEC	Alaska Department of Environmental Conservation
DOE	U.S. Department of Energy
ft	foot (feet)
LM	Office of Legacy Management
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NNSA/NV	National Nuclear Security Administration Nevada Operations Office
USFWS	U.S. Fish and Wildlife Service

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1.0 Introduction

1.1 Scope and Objective

In 2001, the U.S. Department of Energy (DOE) remediated six areas (Long Shot, Milrow, Cannikin, Site D, Site E, and Site F) associated with the Amchitka mud pit release sites located on Amchitka Island, Alaska. The objective of the remediation, conducted by the DOE National Nuclear Security Administration Nevada Operations Office (NNSA/NV) (now the NNSA Nevada Site Office [NNSA/NSO]), was to eliminate human and ecological exposure to contaminants associated with drilling mud by capping the drilling mud pits (NNSA/NV 2001).

Remediation of the six mud pit release sites in 2001 created seven sites where the mud pit materials were encapsulated in an engineered earthen disposal cell designated as a mud pit cap. The remediation at the Cannikin Site created two mud pit caps, Cannikin North and Cannikin South. Additionally, the Milrow mud pit release site was taken to an area called the Rifle Range for disposal.

To ensure the integrity and effectiveness of the remedial action, the mud pit sites will be inspected every 5 years as part of the DOE Office of Legacy Management (LM) Long-Term Surveillance Plan for Amchitka Island (DOE 2014a). This plan outlines the specific monitoring and inspection requirements for the mud pit caps and provides the procedures for conducting the inspections. The objective of this inspection is for DOE and Alaska Department of Environmental Conservation (ADEC) personnel to observe the damage to the mud pit caps from a June 2014 earthquake and discuss the mud pit cap repair alternatives.

On June 23, 2014, a 7.9-magnitude earthquake occurred 11 miles north of Amchitka Island (AEIC 2015). This earthquake was followed by several aftershocks with magnitudes ranging from 6.0 to 6.9 within a 100-mile radius. The intensity of these earthquakes prompted LM to send an inspection team to the island to view the mud pit cap sites. On August 26 and 27, 2014, the contractor inspection team, along with a representative from the U.S. Fish and Wildlife Service (USFWS), viewed all seven of the mud pit sites. Of the seven mud pit caps inspected, two showed no sign of damage (Cannikin Ground Zero and Cannikin South), three had minor cracks along the edge of the mud pit caps (Rifle Range, Long Shot, and Site F), and two had moderate damage (Sites D and E). The moderate damage observed on one of the mud pit caps (Site D) was where the soil cover had slumped away from the side of the mud pit cap, exposing a previously installed geomembrane. The other mud pit cap (Site E) with moderate damage had a significant crack along the uphill side of the mud pit, and the land surface downgradient of the mud pit cap had slumped away. The cap was still intact, but native soils upgradient and downgradient of the cap have cracked or slumped. No release or exposure from any of the mud pit caps was observed (DOE 2014b).

The team for this 5-year inspection will include DOE, Alaska Department of Environmental Conservation (ADEC), and Legacy Management Support (LMS) contractor personnel.

1.2 Background

Amchitka Island is located near the far west end of the Aleutian Islands, approximately 1,340 miles west-southwest of Anchorage, Alaska. From World War II until the early 1990s, the

island was used by multiple U.S. government agencies for a variety of military and research activities. Amchitka is currently uninhabited and is part of the Aleutian Islands Unit of the Alaska Maritime National Wildlife Refuge, which is administered by the U.S. Fish and Wildlife Service.

The mud pit release sites addressed by this plan are the result of drilling performed in support of three underground nuclear tests conducted on Amchitka during the late 1960s and early 1970s by the U.S. Department of Defense and the U.S. Atomic Energy Commission (predecessor agency to DOE). Long Shot (approximately 80 kilotons) was detonated on October 29, 1965. Milrow (approximately 1,000 kilotons) was detonated on October 2, 1969. The higher-yield Cannikin test ("less than 5 megatons") was detonated on November 6, 1971. In addition to these three sites, drilling was performed at three other sites (D, E, and F) where nuclear testing was considered but not performed. Figure 1 depicts the locations of these sites.

The activities at these six sites resulted in 12 drilling mud pits, where the drilling spoils were stored. The large-diameter emplacement boreholes were drilled using methods that employed large quantities of drilling mud (a mixture of bentonite, diesel fuel, and other compounds including chrome lignosulfonate and chrome lignite) to control viscosity and mitigate loss of drilling mud in the boreholes. The composition of the drilling mud used at Amchitka included 91–93 percent water, 6–8 percent oil, and other additives including cement, bentonite, paper, chrome lignosulfonate, chrome lignite, and sodium bicarbonate (DOE 2008). The drilling mud was commonly stored near the drill sites, in bermed pits excavated to hold large quantities of drilling fluid produced from drilling the boreholes.

During remediation, each mud pit was stabilized by removing standing water and mixing solidification soils into the drilling mud. Once the drilling mud was stabilized, a geosynthetic cap constructed of soil layers and a 30-mil (0.030-inch-thick) geomembrane cover was installed according to the *Remedial Action Work Plan Amchitka Island Mud Pit Closures* (NNSA/NV 2001) requirements. All mud pit caps were revegetated using a seed mat product, North American Green SC150. The SC150 mat consisted of a control blanket manufactured with a built-in USFWS-approved seed mix. Drainage ditches and energy dissipators were installed around the capped area to buffer the spread of water runoff from the cap. Table 1 summarizes the mud pit sites, including USFWS survey monument locations and elevations, along with the number of caps and energy dissipators installed at each site.

A final survey of all work areas was completed, and the resulting as-built drawings were included in the *Amchitka Island Surface Closure Report* (NNSA/NSO 2003). These drawings indicate final locations and elevations of all mud pit caps, drainage areas, and borrow soil areas. These drawings will be used to provide baseline reference conditions for the mud pit site inspections.

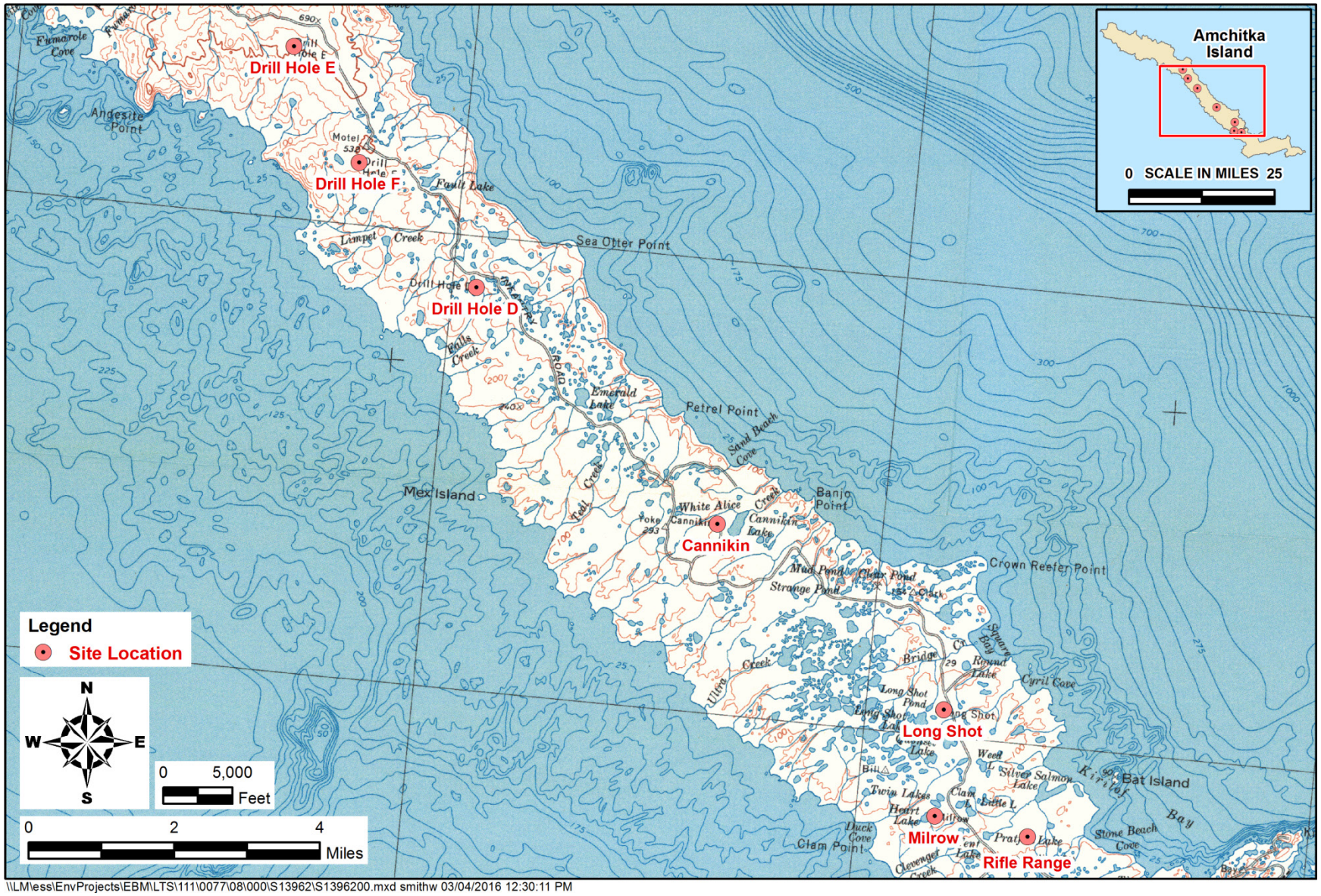

Figure 1. Historically Proposed Nuclear Testing Sites

Table 1. Amchitka Mud Pit Sites Closure Summary

Mud Pit Site	Location on Infantry Road	USFWS Survey Monument[a]	Number of Mud Pits	Number of Caps Installed	Number of Energy Dissipators Installed
Milrow (Rifle Range)	Mile Marker 2.4	Northing: 187,163.93 Easting: 2,187,922.29 Elevation: 55.88	1	1	2
Long Shot	Mile Marker 4.6	Northing: 196,199.27 Easting: 2,181,923.93 Elevation: 140.24	2 (East and West)	1 (East and West combined)	1
Cannikin—North/South Site	Mile Marker 10.4	Northing: 207,336.49 Easting: 2,165,121.83 Elevation: 255.87	2 (North and South)	1 (South consolidated into North)	1
Cannikin—Ground Zero Site	Mile Marker 10.4	Northing: 209,413.21 Easting: 2,165,078.89 Elevation: 202.11	1	1	2
Drill Site D	Mile Marker 16.1	Northing: 226,896.76 Easting: 2,147,772.85 Elevation: 304.75	3 (South, Northwest and Northeast)	2 (South; Northwest and Northeast combined)	2
Drill Site F	Mile Marker 18.8	Northing: 235,803.50 Easting: 2,139,216.90 Elevation: 480.96	1	1	1
Drill Site E	Mile Marker 20.25	Northing: 244,303.70 Easting: 2,134,932.10 Elevation: 524.52	2 (North and South)	1 (South only; North—no further action)	1

Notes:
[a] Horizontal datum AK State Plane 1983, NAD 83; Vertical datum NAVD 29.

1.3 Current Site Conditions

In early June 2015, a field team composed of LMS contractor, DOE, and USFWS personnel conducted a site visit to Amchitka Island. Investigators conducted field reconnaissance, drilled exploratory borings with a hand auger, and collected geotechnical and environmental samples. The *Alternatives Analysis Amchitka Island Mud Pit Cap Repair, Amchitka, Alaska* (DOE 2016) presents descriptions of the sites and past investigations, existing conditions, summaries of various repair/mitigation alternatives, and direct, unburdened, order-of-magnitude (−15% to +50%) associated costs.

The following Sections 1.3.1 through 1.3.7 present a summary of those observations.

1.3.1 Rifle Range (Milrow)

The Rifle Range site is east of Infantry Road between mile markers 2 and 3. The mud pit and cap generally range in height from 2 to 4 feet above grade and have 3 (horizontal) to 1 (vertical) (3H:1V) side slopes. The total area of the mud pit is approximately 1.2 acres.

A minor scarp was observed on the north side of the pit. Longitudinal cracks approximately 20 feet long and similar to those shown in Figure 4 of the November 2014 report (DOE 2014b) were observed. This scarp appeared to be in better condition than when it was observed during

the 2014 visit. No exposed liner was visible, and no new cracks or scarps were observed during the June 2015 visit. Surface water had collected at the edge of the cap in the designed toe drain on the north side of the pit. The top of the cap appeared to be flat with small depressions on the surface where water could collect. The mud pit cap soils were visually characterized as fine-grained material (silty sand) with some rock fragments. No sampling was conducted at this site.

1.3.2 Long Shot

The Long Shot site is located on the west side of Infantry Road between mile markers 4 and 5. The mud pit and cap range in height from 9 to 11 feet. The total area of the mud pit is approximately 1.6 acres. Slopes on the north, south, and east sides are approximately 2H:1V to 3H:1V. Slopes on the west side are estimated at 3H:1V.

A scarp was observed on the southwest corner that was approximately 15 feet in length; a scarp approximately 20 feet in length and two to three additional cracks were observed on the north side toward the east slope, and a crack/scarp was observed near the southeast corner. Parallel cracks were visible adjacent to each main crack location, particularly near the southeast corner. Some sloughing was observed near the southeast corner. Longitudinal and transverse cracking ranged from about 1 to 6 inches in width and 4 to 12 inches in depth. In general, cracks appeared deeper than those at the Rifle Range site.

A drainage channel was observed at the toe of the slope. No new scarps or cracks were observed since the contractor's 2014 inspection; existing scarps appeared to be healing with no continued or fresh damage. The geomembrane was not visible during our observations. No sampling was conducted.

1.3.3 Cannikin South

Cannikin South is a mounded site located off a spur road near mile marker 10 of Infantry Road. The site is approximately 0.7 acre in size and located 300 feet from the Cannikin Ground Zero site. All side slopes appear to be consistently sloped generally at 3H:1V.

Little to no soil distress was observed at this site. Small cracks were visible but appear to have naturally healed. Surface drainage at this location appeared to be to the southeast. No sampling was conducted.

1.3.4 Cannikin Ground Zero

Cannikin Ground Zero is located 300 feet from Cannikin South off a spur road near mile marker 10 of Infantry Road. Cannikin Ground Zero is relatively small at approximately half an acre in size. Cannikin Ground Zero has been referred to as Cannikin North in other documents.

Little to no soil distress was observed at this site. Small cracks were visible but appear to have healed by natural processes. Slopes were generally 2H:1V to 3H:1V. A drainage channel was observed at the toe of the mud pit cap. Standing water was observed in the drainage, which appeared flat. A drainage area with cobble-sized rock was observed on the west side of the pit and appeared to be an intended drain channel. No standing water was observed in that area. Surface features at this site appeared to slope down to the south. No sampling was conducted.

1.3.5 Site D

Site D is an approximately 7.5-acre site located near mile marker 16 of Infantry Road. The north and east slopes are approximately 2H:1V to 3H:1V; the slopes on the south, southeast, and southwest sides were estimated at 1.5H:1V to 2H:1V. On the south side of the pit, a lake exists at the immediate toe of the slope retaining the pit. The pit slope appeared to bulge at the lake's edge.

The north side of Site D showed sloughing and large scarps with associated cracking. Sloughing/movement appears to be fresh and ongoing. The geomembrane was exposed on the southeast side, but it appears to be intact. Soils exposed in slopes were sand and gravel. The pit appeared flat on top with areas of depression that would result in ponded water during rain events. A slight swale exists between an east and a west pit cap. Minor to no water was observed in the swale during the June 2015 visit. Topography and surface drainage at Site D appeared to slope toward the lake.

1.3.6 Site E

Site E is a relatively small pit (approximately 0.3 acre) with gentle side slopes estimated at 3H:1V, except the south slope, which was estimated at 2H:1V or steeper. Site E is located near mile marker 20 of Infantry Road and is the farthest north of the mud pits.

Isolated areas south of the mud pit have sloughed off (30 feet from the nearest toe edge of the mud pit cap). The sloughed area has steep side walls with exposed sand and gravel. This area appears to be actively eroding or sloughing. Two small drainage channels on both sides of the pit converge on the south side and adjacent to the distressed zone. Visible soils consisted of sandy silt with rock cover. Surface topography and drainage at Site E appeared to slope down toward the south.

1.3.7 Site F

Site F is located near mile marker 19 of Infantry Road and is approximately 0.6 acre in size. Slopes were estimated at 1.5H:1V on the south side (the edges are estimated to be closer to 2H:1V); slopes on the north side are approximately 4H:1V, and slopes on the east and west sides are approximately 3H:1V to 4H:1V. Visible soils consisted of sandy silt with rock cover.

The mud pit cap exhibited longitudinal cracking along the southwestern side of the crest of the mud pit cap. The south side of the impoundment had sloughed. The geomembrane was not exposed. Ponded water was observed on top of the geomembrane liner during the sampling effort. No new or continued damage was observed. Areas of potential damage and future failure zones were observed upgradient to the north and east of the mud pit cap.

2.0 Post-Closure Monitoring and Inspection Requirements

The cap inspections will be conducted every 5 years as provided for in the Long-Term Surveillance Plan (DOE 2014a). Post-closure monitoring and inspections of the mud pit sites are intended to determine whether:

- The geosynthetic caps are performing as designed.
- The geosynthetic caps are subsiding or eroding.
- The drainage ditches and/or energy dissipators are eroding.
- The vegetation is established and stable.
- Modifications to the administrative controls are needed.

The mud pit inspections will include the following activities:

- Cap integrity monitoring (subsidence and erosion)
- Vegetative cover monitoring
- Photographic documentation

2.1 Preliminary Activities

Certain activities must be completed prior to commencing inspection activities. These preliminary activities are identified in the following sections.

2.1.1 Access to the Maritime National Wildlife Refuge, Amchitka Island

Amchitka Island is part of the Alaska Maritime National Wildlife Refuge, which is administered by USFWS. Access to the island is currently restricted to government agencies and entities specifically approved by USFWS. LM will submit a Special Use Permit application to USFWS to obtain authorization to access the island and conduct monitoring activities. LM and its contractors may not access the island until USFWS authorization is given through issuance of the Special Use Permit.

2.1.2 Project Personnel

All project personnel will be trained and qualified to perform their assigned tasks. Objective evidence of qualifications may include academic credentials, personal résumés, registrations and licenses, and training records.

Personnel qualifications shall be evaluated against assigned responsibilities, and any identified training needs will be addressed. Training will be based on regulatory requirements, scopes of work, and applicable work instructions. Table 2 identifies the key project personnel proposed to conduct the cap inspections. Additional personnel may be assigned as required by the project.

Table 2. Key Project Personnel

Key Personnel	Proposed Inspection Tasks[a]
Geologist	Inspect cap integrity, record findings, and perform repairs as required by this Plan
Engineer	Perform surveying, photograph cap areas, and log results as required by this Plan
Biologist	Inspect vegetation cover over each cap, record findings, and revegetate as required by this Plan

Notes:
[a] Tasks may be assigned at the discretion of the performing entity or as required by field conditions or both.

2.2 Cap Integrity Monitoring

A physical inspection of each mud pit site will be conducted and will consist of visual observations and photo documentation of the caps, energy dissipators, and areas adjacent to the cap. Notable damage to or degradation of the cap (e.g., subsidence, rills, erosion, animal burrows), loss of vegetation over significant portions of the cap, erosion along the base of or adjacent to the cap, or erosion of drainage ditches or energy dissipators will be documented and reported. All findings from the site inspections will be documented on a post-closure monitoring checklist (see Appendix A) for submittal to DOE and for future reference and monitoring.

Cap inspections will follow the protocol outlined in Section 2.2.1.1, Inspection Protocol, and will consist of onsite visual inspections along transects at predetermined intervals, photographing each site from predetermined photopoints, collecting subsidence and erosion measurements as necessary, making cover vegetation estimates, and photographing and staking deficient areas both on and adjacent to the cap.

2.2.1 Subsidence and Erosion

Each mud pit cap will be inspected for evidence of the following items:

- Areas of subsidence (settling)
- Cracks or small channels
- Ponding water
- Intrusion by humans or animals
- Trails or tracks showing human or animal activity

The area surrounding and adjacent to each cap, including drainage ditches and energy dissipators, will be inspected for the following items:

- Sediment fill or clogging
- Cracks or small channels
- Ponding water
- Intrusion by humans or animals

The inspection will document the location and amount of subsidence and/or erosion and any other deficiencies observed. Measurements will be taken to determine what corrective action is necessary (see Section 2.3).

2.2.1.1 Inspection Protocol

Table 3 outlines the proposed inspection specifications for each site. Actual field conditions may dictate a different specification(s) for a given site, and minor modifications to the specifications may be warranted (and documented) at the time of the inspection. Figure 2 provides an example of the proposed cap inspection pattern for each site. The 20-foot (ft) spacing between transect lines is proposed to ensure adequate visual coverage of each cap, but spacing may be adjusted based on site conditions. The use of a GPS unit is proposed to stake the endpoints of the transects. A compass may be used to help the inspector stay on a straight course along each transect.

The inspection will begin at a predetermined corner of the cap and proceed in a predetermined direction and pattern (see Appendix B). All subsequent inspections of the cap will be conducted the same way, starting at the same point, and proceeding in the same direction and pattern. The inspection starting and ending points and the transect line stakes will be recorded using GPS and documented on an attachment to the inspection form, using the corresponding mud pit site drawing found in Appendix B of this plan. The direction and pattern of the inspection will also be documented on the corresponding drawing. Documentation will consist of completing the post-closure monitoring checklist; measuring, photographing, surveying, and staking any deficient conditions; and recording inspection direction, pattern, and GPS readings on the corresponding mud pit site drawing. Inspection of drainage ditches and energy dissipators will also be conducted in a predetermined, repeatable pattern and documented on the corresponding site drawing. Maps for each mud pit site indicating the proposed starting points, vegetative cover transects, and photopoints are included in Appendix B.

2.2.2 Vegetative Cover

The cap will be inspected to document the abundance and composition of vegetation on the cover and the presence of any weeds, excessive grazing, disease, pests, or significant areas dead vegetation. Vegetation composition of the cap will be estimated and compared to data collected in previous monitoring years. The team biologist will complete line transect data sheets (Appendix C) or record data in comparable electronic devices in the field, record any deficient conditions as described in Section Table 4, and analyze and summarize the data as attachments to the completed post-closure monitoring checklist (Appendix A).

2.2.2.1 Vegetative Cover Inspection Protocol

Each cap will be divided into transects for purposes of vegetation monitoring. Transects used to inspect the cap will also be used for vegetative cover monitoring (Table 3 and Appendix B). Along each inspection transect, 10-meter point-intercept line transects will be established at random intervals (random locations will be determined prior to the site visit). Line transects will be arranged perpendicular to the inspection transects, and point-intercept data will be recorded at 1-decimeter intervals along each transect. At a minimum, the same number of data points recorded in 2006 and 2011 will be taken. Vegetation monitoring data will be compiled and statistically analyzed after field work is complete.

Table 3. Proposed Cap Inspection Specifications

Mud Pit Site Name	Perimeter Inspection Starting Point[a]	Cap Inspection Pattern	Vegetation Inspection Transects[b]	Photopoints[c]
Milrow Rifle Range	South end of cap (on north side of energy dissipator)	• Begin at perimeter inspection starting point • Proceed northeast to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 4 transects (2 NW-SE, 2 SW-NE) • 9 total grid areas	4
Long Shot	Southeast corner of cap (just north of energy dissipator)	• Begin at perimeter inspection starting point • Proceed north to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 5 transects (3 N-W, 2 E-W) • 12 total grid areas	6
Cannikin North/South	Southeast corner of cap (just north of energy dissipator)	• Begin at perimeter inspection starting point • Proceed north to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 2 transects (1 NW-SE, 1 SW-NE) • 4 total grid areas	4
Cannikin Ground Zero	Easternmost corner of cap (at south end of energy dissipator)	• Begin at perimeter inspection starting point • Proceed northwest to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 5 transects (3 NW-SE, 2 SW-NE) • 12 total grid areas	6
Drill Site D – Northeast mud pit	Southeast corner of cap	• Begin at perimeter inspection starting point • Proceed north to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects to bend in cap, then proceed in NE-SW pattern • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 7 transects (6 SW-NE, 1 NW-SE) • 14 total grid areas	9
Drill Site D – Southwest mud pit	Southernmost edge of cap	• Begin at perimeter inspection starting point • Proceed northeast to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 4 transects (3 SW-NE, 1 NW-SE) • 8 total grid areas	6
Drill Site F	Far east side of cap	• Begin at perimeter inspection starting point • Proceed north to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 3 transects (2 N-S, 1 E-W) • 6 total grid areas	4
Drill Site E	Far northwest corner of cap	• Begin at perimeter inspection starting point • Proceed east to opposite side of cap • Continue to traverse and inspect cap on 20 ft transects until entire cap is inspected	• 2 transects (1 NW-SE, 1 SW-NE) • 4 total grid areas	4

Notes:
[a] All perimeter inspections will be conducted in a counterclockwise direction. See Appendix B for corresponding drawings.
[b] Number of transects is minimum number recommended.
[c] Number of photopoints is minimum number recommended. Photopoints are numbered in a counterclockwise direction.

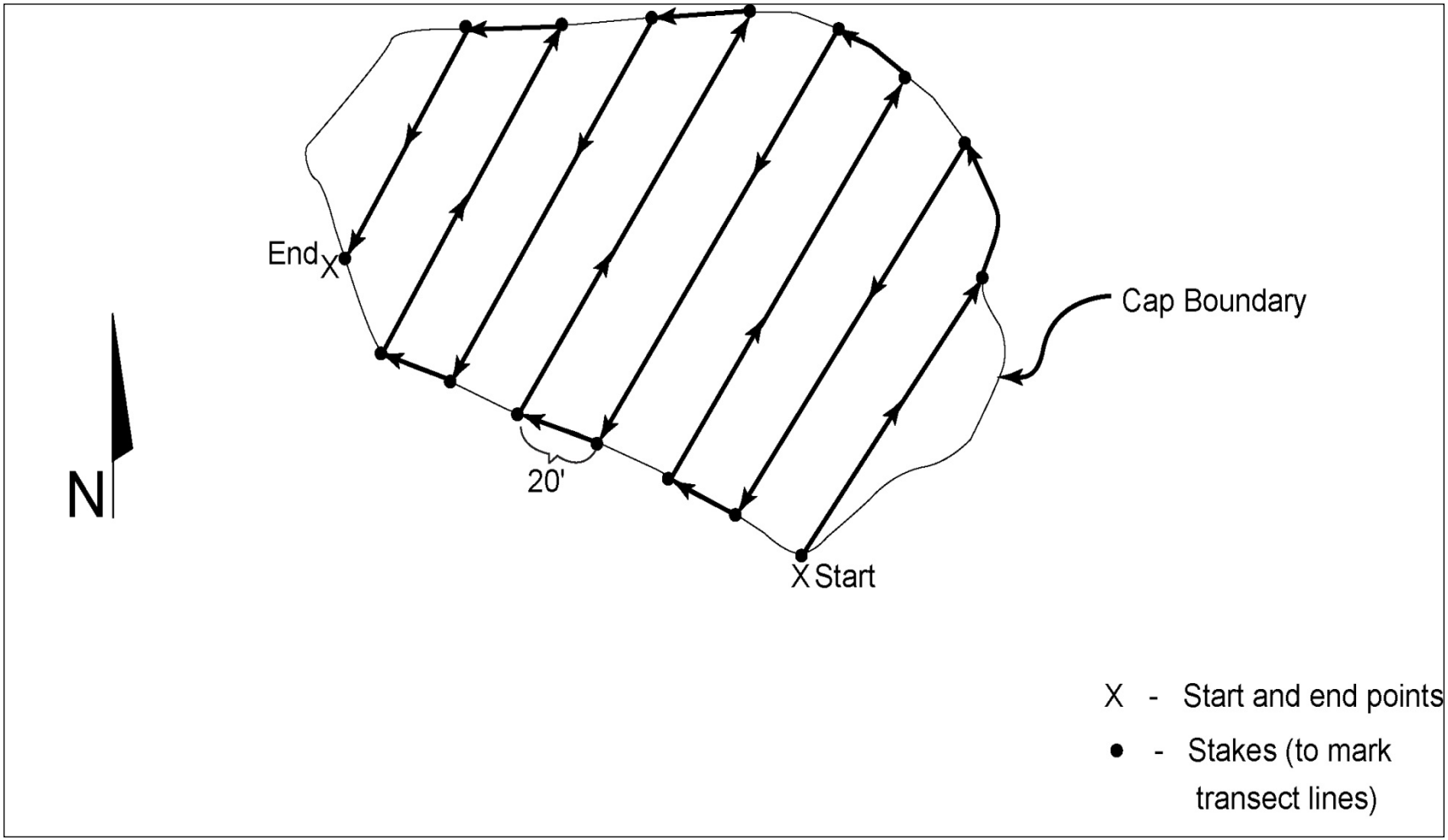

Figure 2. Example of Cap Inspection Pattern on 20-foot Transects

2.2.3 Photographic Documentation

Photographs will be taken during the inspection, at preestablished photopoints. During each subsequent inspection, photographs will be retaken from the same photopoints so that differences over time can be documented and referenced. The minimum number of permanent directional photopoints proposed for each site is listed in Table 3, and their proposed locations are indicated on the drawings in Appendix B. Each permanent photopoint will be staked, and the coordinates will be established using GPS and documented for future reference.

Each photograph will be logged on a photograph log (see Appendix D). A digital camera or 35-millimeter camera may be used. If digital images are made, they will be downloaded on a daily basis and archived.

Deficient areas will also be photographed and logged. The number and direction of these photos will be determined in the field on a case-by-case basis and will be such that the deficiency can be accurately viewed and documented.

2.3 Site Maintenance and Repair

Existing conditions of the mud pit caps have been documented in previous reports (DOE 2014, 2016). The current inspection will maintain the same protocol as for previous 5-year inspections with the exception being that no maintenance repairs will be performed this year. Repair of deficient site conditions will be categorized as either maintenance or structural. Deficiencies in a cap, energy dissipator, or drainage ditch will be evaluated, assigned to the appropriate repair category, and repaired as described below.

2.3.1 Maintenance Repairs

Site deficiencies that are considered maintenance repairs result from typical site conditions, including normal weather conditions, seasonal vegetation growth/die-out, and normal animal activity, and are minor in nature. If possible, these deficiencies will be corrected during the inspection. Those maintenance repair deficiencies that cannot be corrected at the time of the inspection will be noted and appropriate actions will be negotiated with the ADEC. Table 4 provides examples of conditions that may require maintenance repairs, associated repairs, and agency notification requirements.

2.3.2 Structural Repairs

Site deficiencies that are considered structural repairs result from atypical site conditions, including earthquakes, severe weather conditions, excessive vegetation growth/die-out, excessive animal activity, and vandalism. These conditions are considered significant and cannot be corrected during the inspection. Examples of structural repairs are provided in Table 4.

Table 4. Examples of Deficiencies Requiring Maintenance or Structural Repairs

Deficient Condition	Repair Action	Repair Schedule	Agency Notification
Maintenance Repair			
Cracks, subsidences, erosional rills, and/or animal burrows <15 centimeters (6 inches) deep and extending <1 meter (3 ft).	Backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable).	Repair by hand during site inspection visit.	None. Document deficiency and corrective action in inspection report.
Cracks, subsidences, erosional rills, and/or animal burrows >15 centimeters (6 inches) deep and extending >1 meter (3 ft) but not intruding into the cap geomembrane layer, energy dissipators, or drainage ditches.	Backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable).	Evaluate and repair by hand during site inspection visit or as site conditions allow.	Document deficiency and corrective action in inspection report. Plan for subsequent action at next 5-year inspection.
Vegetative cover <50% on cap grid.	Seed and mulch to reestablish vegetation.	Evaluate and repair by hand during site inspection visit or as site conditions allow.	Document deficiency and corrective action in inspection report. Plan for subsequent action at next 5-year inspection.
Moved or missing survey points (i.e., photopoints, transect line stakes).	Reestablish survey points.	Repair during site inspection visit.	None. Document deficiency and corrective action in inspection report.
Structural Repair			
Cracks, subsidences, erosional rills, and/or animal burrows >15 centimeters (6 inches) deep and extending >1 meter (3 ft), intruding into the cap geomembrane layer, energy dissipators, and/or drainage ditches.	Repair/reconstruct underlying structural layer, backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable). Resurveying of grade might be required.	Evaluate and repair as possible by hand during site inspection visit or as site conditions allow. Need for further action will be discussed with stakeholders.	Document deficiency and prepare corrective action plan in inspection report or as standalone document. Develop consensus with stakeholders as to further action.
Flood damage to site in form of new channels or debris deposits.	Repair/reconstruct underlying structural layer, backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable). Resurveying of grade might be required.	Evaluate and repair as possible by hand during site inspection visit or as site conditions allow. Need for further action will be discussed with stakeholders.	Document deficiency and prepare corrective action plan in inspection report or as standalone document. Develop consensus with stakeholders as to further action.
Man-made or animal intrusions resulting in removal of cover materials.	Repair/reconstruct underlying structural layer, backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable). Resurveying of grade might be required.	Evaluate and repair as possible by hand during site inspection visit or as site conditions allow. Need for further action will be discussed with stakeholders.	Document deficiency and prepare corrective action plan in inspection report or as standalone document. Develop consensus with stakeholders as to further action.
Encroachment of stream channels or gullies into cap materials.	Repair/reconstruct underlying structural layer, backfill with soil, compact to reestablish grade, and seed and mulch to reestablish vegetation (if applicable). Resurveying of grade might be required.	Evaluate and repair as possible by hand during site inspection visit or as site conditions allow. Need for further action will be discussed with stakeholders.	Document deficiency and prepare corrective action plan in inspection report or as standalone document. Develop consensus with stakeholders as to further action.

Structural repairs might involve regrading an area to modify drainage to reduce runoff or erosion problems. All repair work will attempt to preserve the original cover as-built design; however, permanent modification might be required to prevent a reoccurrence of detrimental site conditions. In that case, the area will be resurveyed to establish new baseline conditions. The method of and schedule for repairs will be developed in consultation between the Alaska Department of Environmental Conservation and DOE.

2.4 Recordkeeping and Reporting

2.4.1 Permanent File

LM will maintain a permanent file containing the mud pit sites inspection reports and other supporting documentation of the long-term surveillance activities. The repository for this file is located at the LM office in Grand Junction, Colorado. The information placed in the site file will include:

- Documentation of inspection results (e.g., checklists, drawings, survey results, photographs)
- Supporting information to help forecast future site surveillance and monitoring needs
- Reports to stakeholders regarding mud pit cap integrity, performance, and deficiencies

LM will update this file as necessary after the cap inspections, maintenance activities, or corrective actions are complete. These records will be maintained in accordance with DOE directives to ensure their proper handling, maintenance, and disposition, and with the archival procedures set forth in Title 41 *Code of Federal Regulations* Part 101 (41 CFR 101), "Federal Property Management Regulations," and 36 CFR Parts 1220–1239, Subchapter B, "Records Management." This file will be available for public review.

2.4.2 Inspection Reports

The cap inspection activities, observations, and deficiencies will be documented using inspection checklists, site drawings, photographs and photo logs, vegetative cover logs, and field notes. The entity performing the inspections will prepare an inspection report following completion of each 5-year review and will submit this report to LM for review and approval. The report will also contain the results of follow-up inspections and/or maintenance performed since the previous inspection. LM will, in turn, submit the report to the Alaska Department of Environmental Conservation within 90 days of completion of the inspection for information and review.

If corrective action is required to repair damage to a site during an inspection, a corrective action plan and subsequent corrective action report may also be prepared, at the discretion of LM. The corrective action documents may be submitted separately from the inspection report or as an attachment to it.

3.0 References

AEIC (Alaska Earthquake Information Center), 2015. Western Aleutians Seismicity, http://www.aeic.alaska.edu/maps/aleutian_attu_map.html, accessed January 12, 2016.

DOE (U.S. Department of Energy), 2008. *Record of Decision for Amchitka Surface Closure, Alaska*, LMS/AMC/S04623, Office of Legacy Management, August.

DOE (U.S. Department of Energy), 2014a. *Long-Term Surveillance Plan for the U.S. Department of Energy Amchitka, Alaska,* Site, LMS/AMC/S01980, Office of Legacy Management, July.

DOE (U.S. Department of Energy), 2014b. *Options Analysis for Repair, Mud Pit Cap Damage, Amchitka Island, Alaska*, LMS/AMC/S12293, Office of Legacy Management, November.

DOE (U.S. Department of Energy), 2016. *Alternatives Analysis Amchitka Island Mud Pit Cap Repair, Amchitka, Alaska,* LMS/AMC/S13408, Office of Legacy Management, January.

NNSA/NSO (National Nuclear Security Administration Nevada Site Office), 2003. *Amchitka Island Surface Closure Report*, Rev. 1, DOE/NV-819, Las Vegas, Nevada.

NNSA/NV (National Nuclear Security Administration Nevada Operations Office), 2001. *Remedial Action Work Plan Amchitka Island Mud Pit Closures,* Rev. 1, DOE/NV-682, Las Vegas, Nevada.

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Appendix A

Amchitka Mud Pit Release Sites
Post-Closure Monitoring Checklist

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site:	Date of Inspection:
Responsible Agency:	Project Manager:
Inspector (name, title, organization):	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of color 35 mm photographs (or equivalent) is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed			
2. Previous inspection reports reviewed			
a. Were anomalies or trends detected on previous inspections?			
b. Was maintenance performed on areas with anomalies?			
3. Site maintenance and repair records reviewed			
a. Has site repair resulted in a change from as-built conditions?			
b. Are revised as-builts available that reflect repair changes?			

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?			
b. Any new roads or trails?			
c. Change in the position of nearby washes?			
d. Erosion/deposition of nearby washes?			
e. New drainage channels?			
f. Change in surrounding vegetation?			
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?			
b. Signs damaged or removed?			
3. Cap			
a. Evidence of subsidence?			
b. Evidence of cracking?			
c. Evidence of erosion (wind or water)?			
d. Evidence of animal burrowing?			
e. Are site markers disturbed? By man?_____ By natural processes?_____			
f. Do natural processes threaten the integrity of cap or site marker?			

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site:	Date of Inspection:

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?			
b. Are weedy annual plants present? Do they require removal?			
c. Evidence of animals on cap?			
d. Evidence of excessive plant mortality?			
e. Has a vegetative cover log been completed?			
5. Photo Documentation			
a. Has a photo log been prepared?			
b. How many photos were taken? _____			

D. Field Conclusions			
1. Imminent hazard to integrity of cap? (If yes, immediate report required. Note the person or agency the report will be made to.)			
2. Are more frequent inspections required?			
3. Are existing maintenance actions satisfactory?			
4. Are existing repair actions satisfactory?			
5. Is other maintenance/repair necessary?			
6. Rationale for field conclusions:			
7. Factors contributing to or impacting inspection:			

E. Certification

I certify that I have conducted an inspection of the _____ Mud Pit Site cap in accordance with the Monitoring and Inspection Plan for the Amchitka Mud Pit Release Sites, Rev. ___, dated _____, as recorded on this checklist, attached sheets, field notes, vegetative cover log, photo logs, and photographs.

Inspector Printed Name:	Inspector Signature:
Title:	Date:

Appendix B

Amchitka Mud Pit Release Sites
Site Drawings

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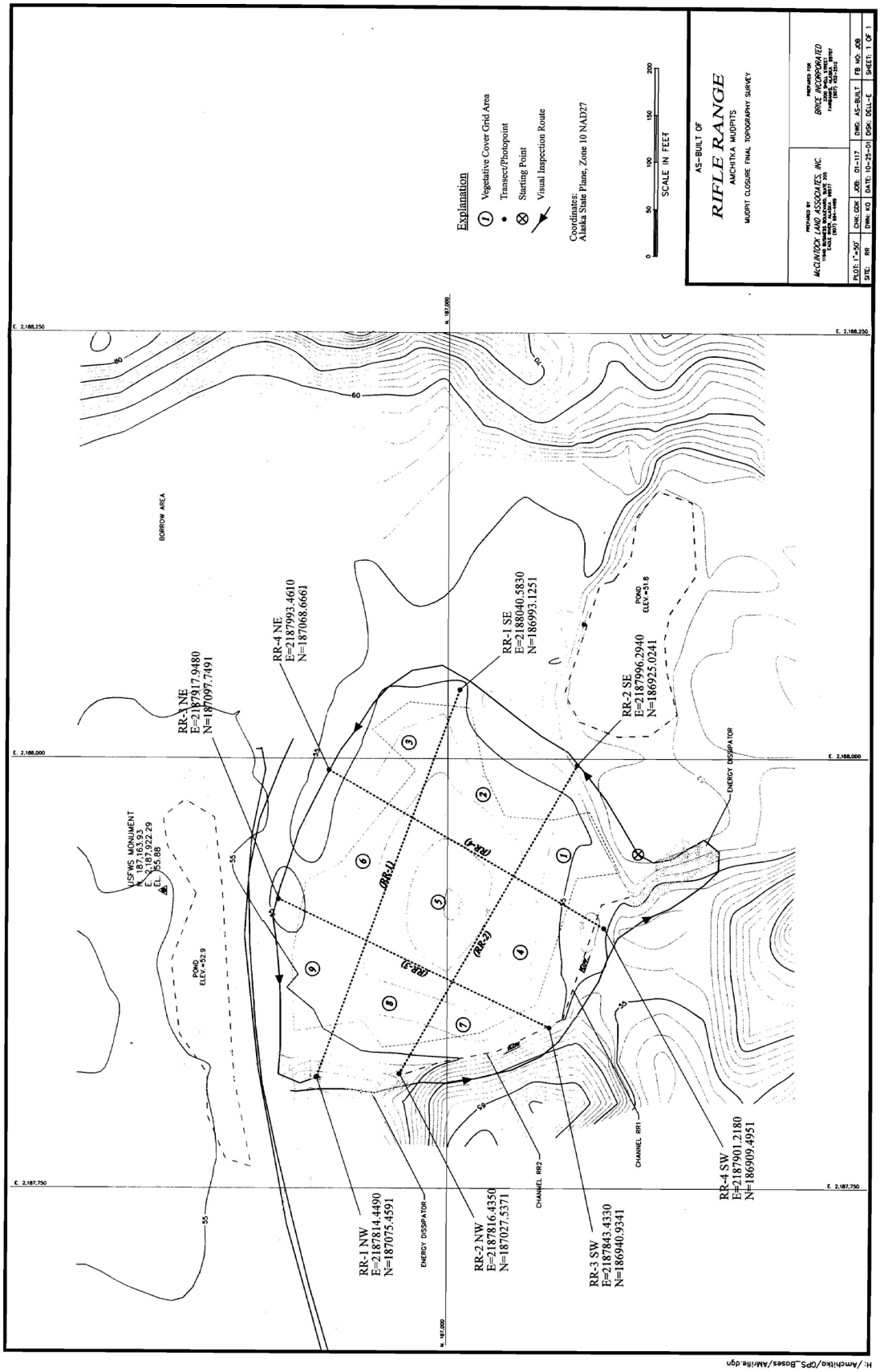
RIFLE RANGE
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
AS-BUILT OF
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
SCALE IN FEET
PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR
BRICE INCORPORATED
PLOT: 1"=50'
CHK: GDK
JOB: 01-117
DWG: AS-BUILT
FB NO: JOB
SITE: RR
DWN: KO
DATE: 10-25-01
DSK: DELL-E
SHEET: 1 OF 1
BORROW AREA
POND ELEV.=52.9
POND ELEV.=51.8
USFWS MONUMENT
N. 187,163.93
E. 2,187,922.29
EL. 55.88
RR-3 NE
E=2187917.9480
N=187097.7491
RR-4 NE
E=2187993.4610
N=187068.6661
RR-1 SE
E=2188040.5830
N=186993.1251
RR-2 SE
E=2187996.2940
N=186925.0241
RR-1 NW
E=2187814.4490
N=187075.4591
RR-2 NW
E=2187816.4350
N=187027.5371
RR-3 SW
E=2187843.4330
N=186940.9341
RR-4 SW
E=2187901.2180
N=186909.4951
ENERGY DISSIPATOR
CHANNEL RR1
CHANNEL RR2
E. 2,188,250
E. 2,188,000
E. 2,187,750
N. 187,000
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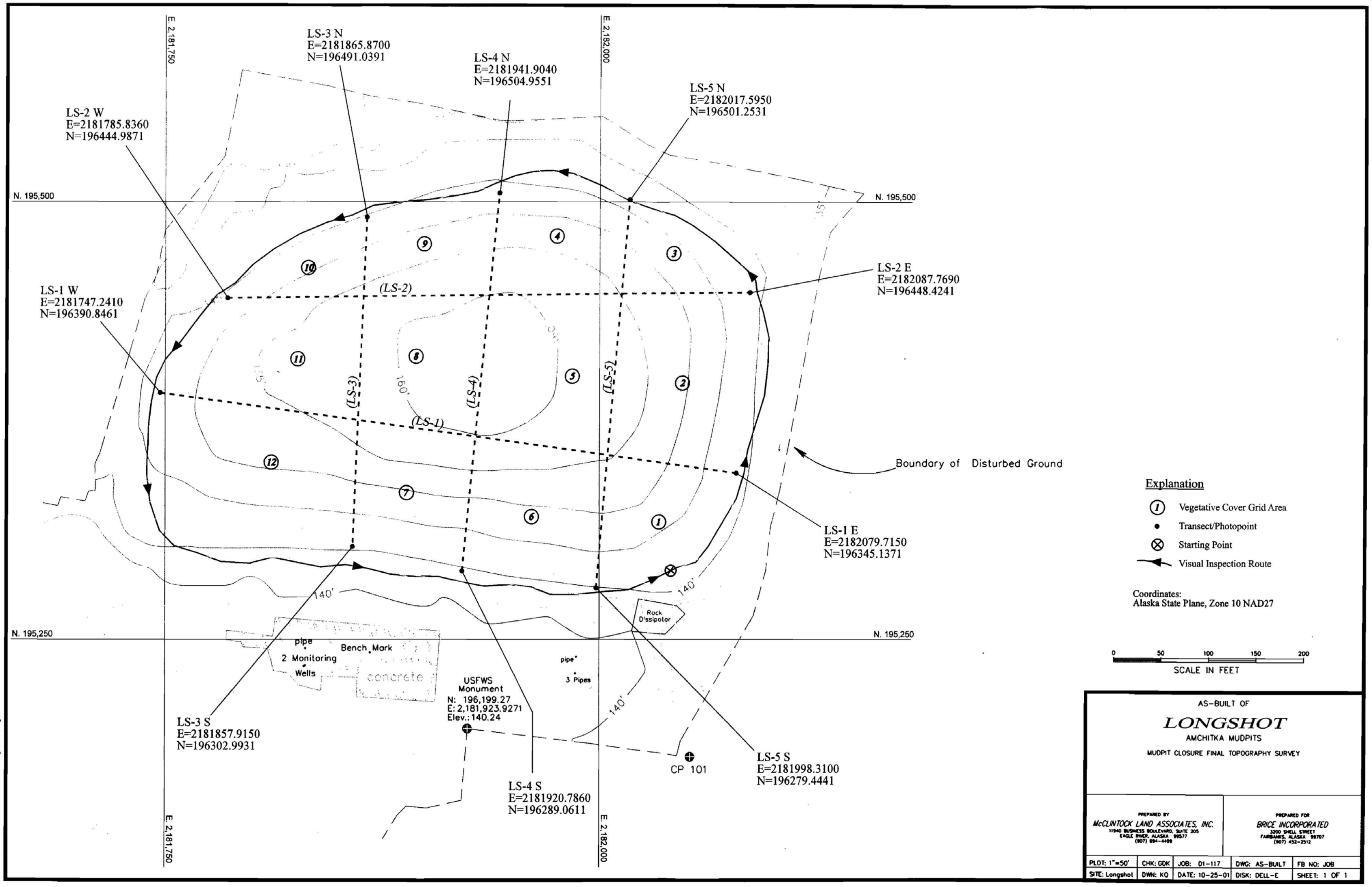
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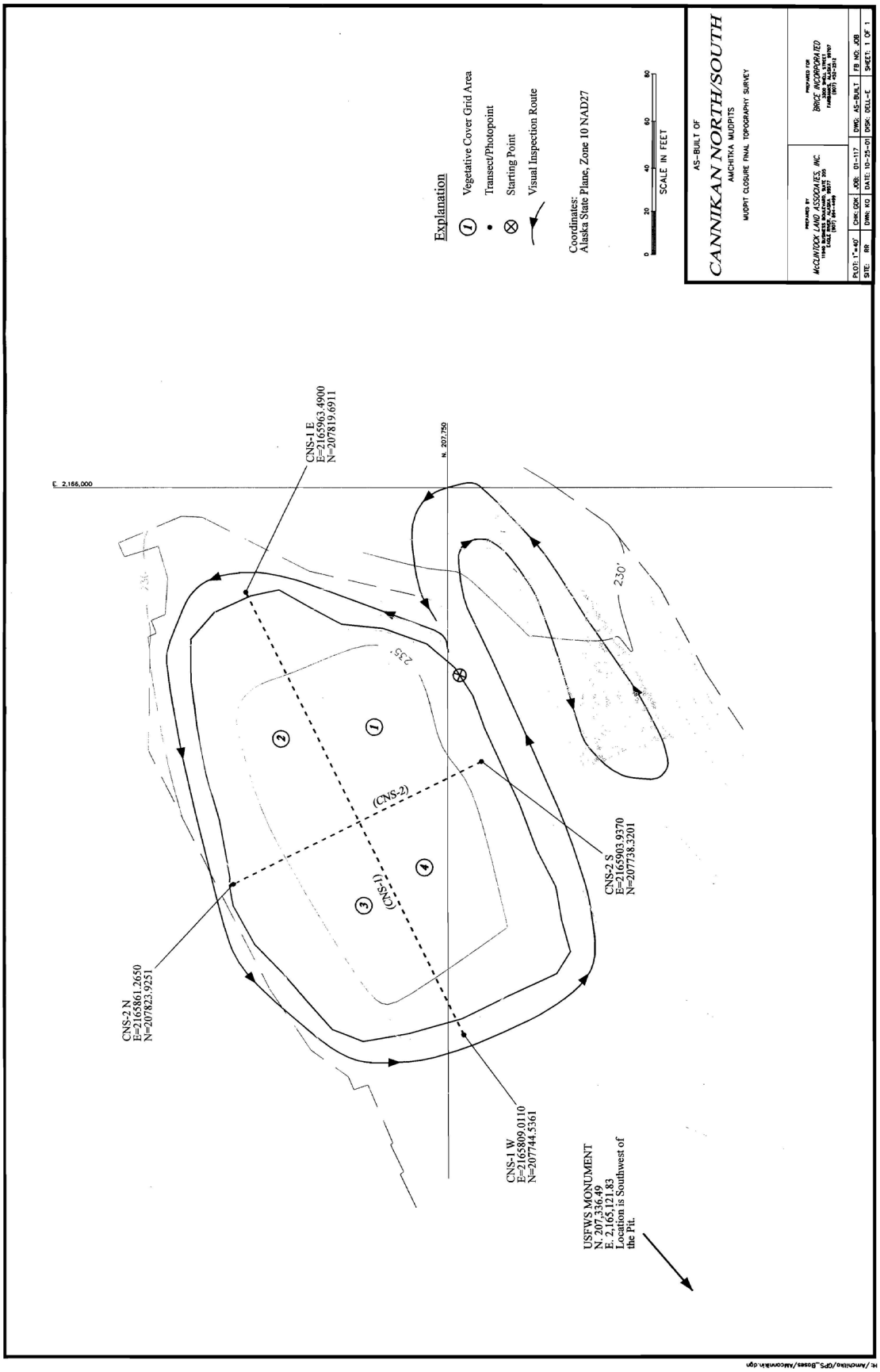
N=196491.0391
LS-4 N
E=2181941.9040
N=196504.9551
LS-5 N
E=2182017.5950
N=196501.2531
LS-2 W
E=2181785.8360
N=196444.9871
LS-1 W
E=2181747.2410
N=196390.8461
LS-2 E
E=2182087.7690
N=196448.4241
LS-1 E
E=2182079.7150
N=196345.1371
LS-3 S
E=2181857.9150
N=196302.9931
LS-4 S
E=2181920.7860
N=196289.0611
LS-5 S
E=2181998.3100
N=196279.4441
(LS-1)
(LS-2)
(LS-3)
(LS-4)
(LS-5)
N. 195,500
N. 195,250
E. 2,181,750
E. 2,182,000
140'
160'
Boundary of Disturbed Ground
Rock Dissipator
pipe
Bench Mark
2 Monitoring Wells
concrete
USFWS Monument
N: 196,199.27
E: 2,181,923.9271
Elev.: 140.24
3 Pipes
CP 101
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
SCALE IN FEET
AS-BUILT OF
LONGSHOT
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR
BRICE INCORPORATED
PLOT: 1"=50'
CHK: GDK
JOB: 01-117
DWG: AS-BUILT
FB NO: JOB
SITE: Longshot
DWN: KO
DATE: 10-25-01
DISK: DELL-E
SHEET: 1 OF 1


AS-BUILT OF
CANNIKAN NORTH/SOUTH
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR
BRICE INCORPORATED
PLOT: 1"=40'
SITE: RR
CHK: CDK
DWN: KO
JOB: 01-117
DATE: 10-25-01
DWG: AS-BUILT
DSK: CCLL-E
FB NO: JOB
SHEET: 1 OF 1
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
0
20
40
60
80
SCALE IN FEET
E. 2,166,000
N. 207,750
CNS-1 E
E=2165963.4900
N=207819.6911
CNS-2 N
E=2165861.2650
N=207823.9251
CNS-2 S
E=2165903.9370
N=207738.3201
CNS-1 W
E=2165809.0110
N=207744.5361
USFWS MONUMENT
N. 207,336.49
E. 2,165,121.83
Location is Southwest of
the Pit.
(CNS-2)
(CNS-1)
230'
235'
1
2
3
4
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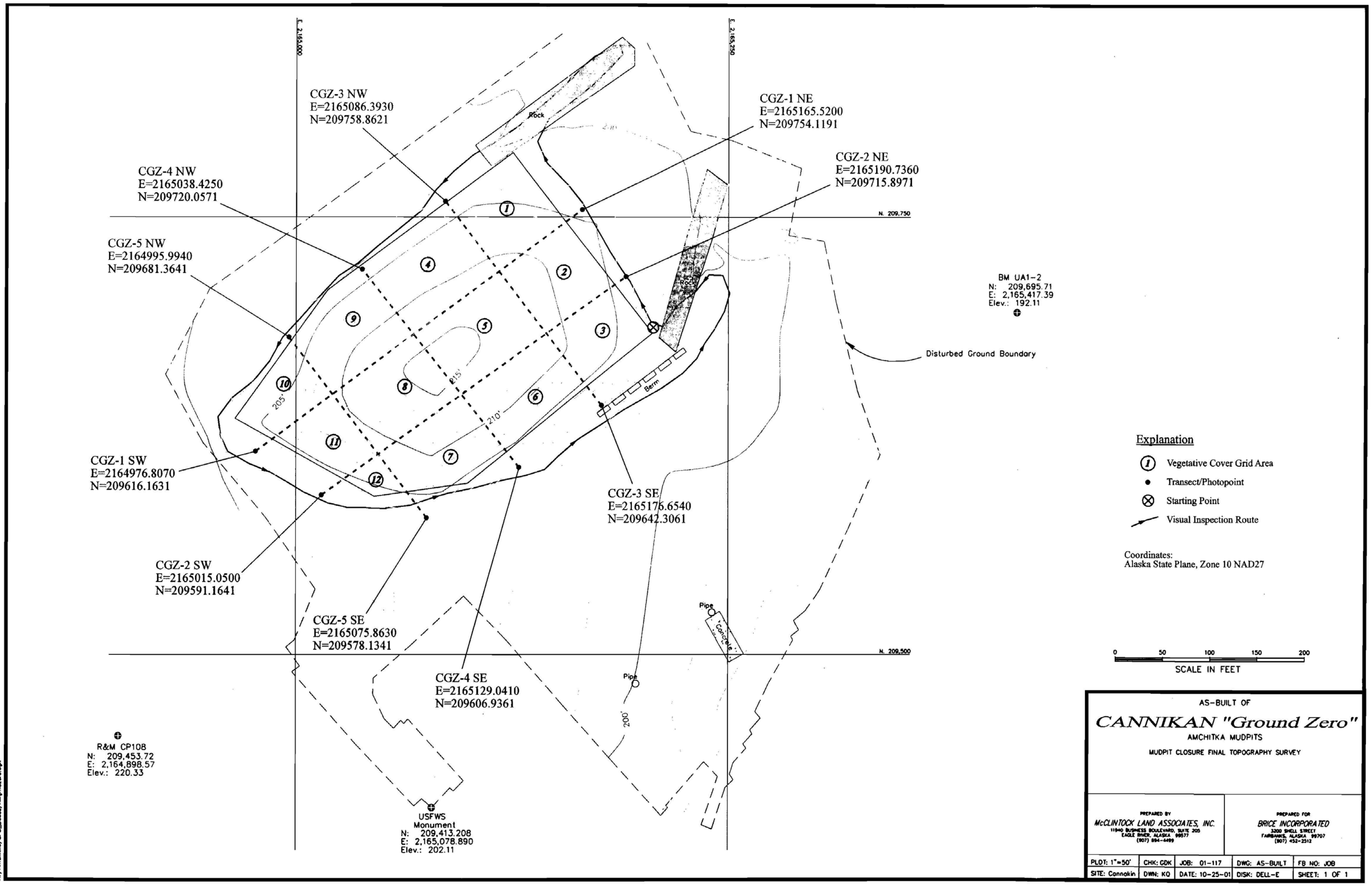
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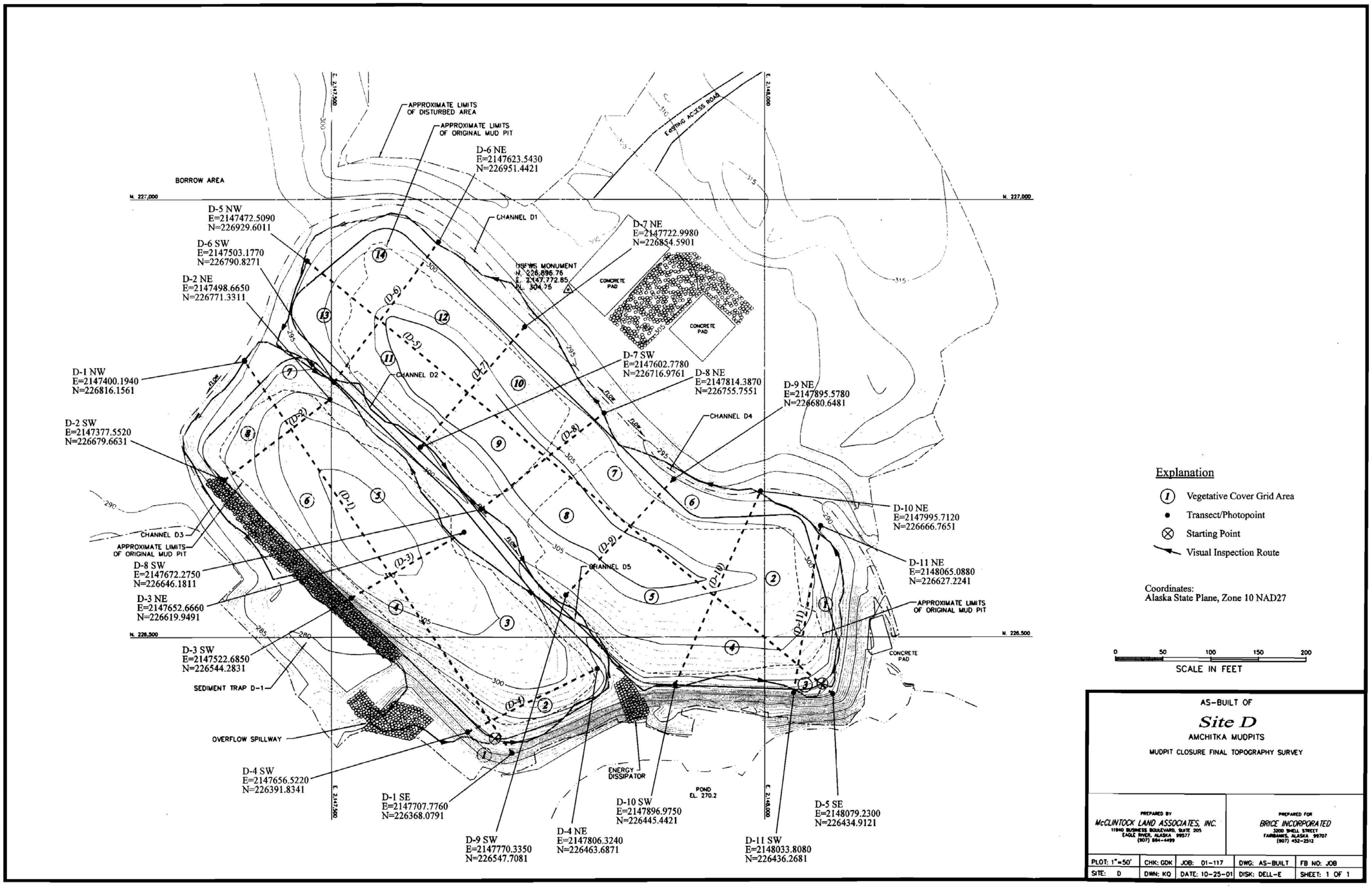
E=2165165.5200
N=209754.1191
CGZ-2 NE
E=2165190.7360
N=209715.8971
CGZ-4 NW
E=2165038.4250
N=209720.0571
CGZ-5 NW
E=2164995.9940
N=209681.3641
CGZ-1 SW
E=2164976.8070
N=209616.1631
CGZ-2 SW
E=2165015.0500
N=209591.1641
CGZ-5 SE
E=2165075.8630
N=209578.1341
CGZ-4 SE
E=2165129.0410
N=209606.9361
CGZ-3 SE
E=2165176.6540
N=209642.3061
E. 2,165,000
E. 2,165,250
N. 209,750
N. 209,500
Rock
Berm
205'
210'
215'
200'
Pipe
Pipe
Concrete
Disturbed Ground Boundary
BM UA1-2
N: 209,695.71
E: 2,165,417.39
Elev.: 192.11
R&M CP108
N: 209,453.72
E: 2,164,898.57
Elev.: 220.33
USFWS
Monument
N: 209,413.208
E: 2,165,078.890
Elev.: 202.11
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
0 50 100 150 200
SCALE IN FEET
AS-BUILT OF
CANNIKAN "Ground Zero"
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR
BRICE INCORPORATED
PLOT: 1"=50'
CHK: GDK
JOB: 01-117
DWG: AS-BUILT
FB NO: JOB
SITE: Cannakin
DWN: KO
DATE: 10-25-01
DISK: DELL-E
SHEET: 1 OF 1


APPROXIMATE LIMITS OF DISTURBED AREA
APPROXIMATE LIMITS OF ORIGINAL MUD PIT
BORROW AREA
EXISTING ACCESS ROAD
D-6 NE E=2147623.5430 N=226951.4421
D-5 NW E=2147472.5090 N=226929.6011
D-6 SW E=2147503.1770 N=226790.8271
D-2 NE E=2147498.6650 N=226771.3311
D-1 NW E=2147400.1940 N=226816.1561
D-2 SW E=2147377.5520 N=226679.6631
CHANNEL D1
CHANNEL D2
CHANNEL D3
CHANNEL D4
CHANNEL D5
D-7 NE E=2147722.9980 N=226854.5901
USFWS MONUMENT N. 226,896.76 E. 2147,772.85 EL. 304.75
CONCRETE PAD
D-7 SW E=2147602.7780 N=226716.9761
D-8 NE E=2147814.3870 N=226755.7551
D-9 NE E=2147895.5780 N=226680.6481
D-10 NE E=2147995.7120 N=226666.7651
D-11 NE E=2148065.0880 N=226627.2241
D-8 SW E=2147672.2750 N=226646.1811
D-3 NE E=2147652.6660 N=226619.9491
D-3 SW E=2147522.6850 N=226544.2831
SEDIMENT TRAP D-1
OVERFLOW SPILLWAY
D-4 SW E=2147656.5220 N=226391.8341
D-1 SE E=2147707.7760 N=226368.0791
D-9 SW E=2147770.3350 N=226547.7081
D-4 NE E=2147806.3240 N=226463.6871
ENERGY DISSIPATOR
POND EL. 270.2
D-10 SW E=2147896.9750 N=226445.4421
D-11 SW E=2148033.8080 N=226436.2681
D-5 SE E=2148079.2300 N=226434.9121
N. 227,000
N. 226,500
E. 2147,500
E. 2148,000
FLOW
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates: Alaska State Plane, Zone 10 NAD27
0 50 100 150 200
SCALE IN FEET
AS-BUILT OF
Site D
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY McCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR BRICE INCORPORATED
PLOT: 1"=50' CHK: GDK JOB: 01-117 DWG: AS-BUILT FB NO: JOB
SITE: D DWN: KQ DATE: 10-25-01 DISK: DELL-E SHEET: 1 OF 1
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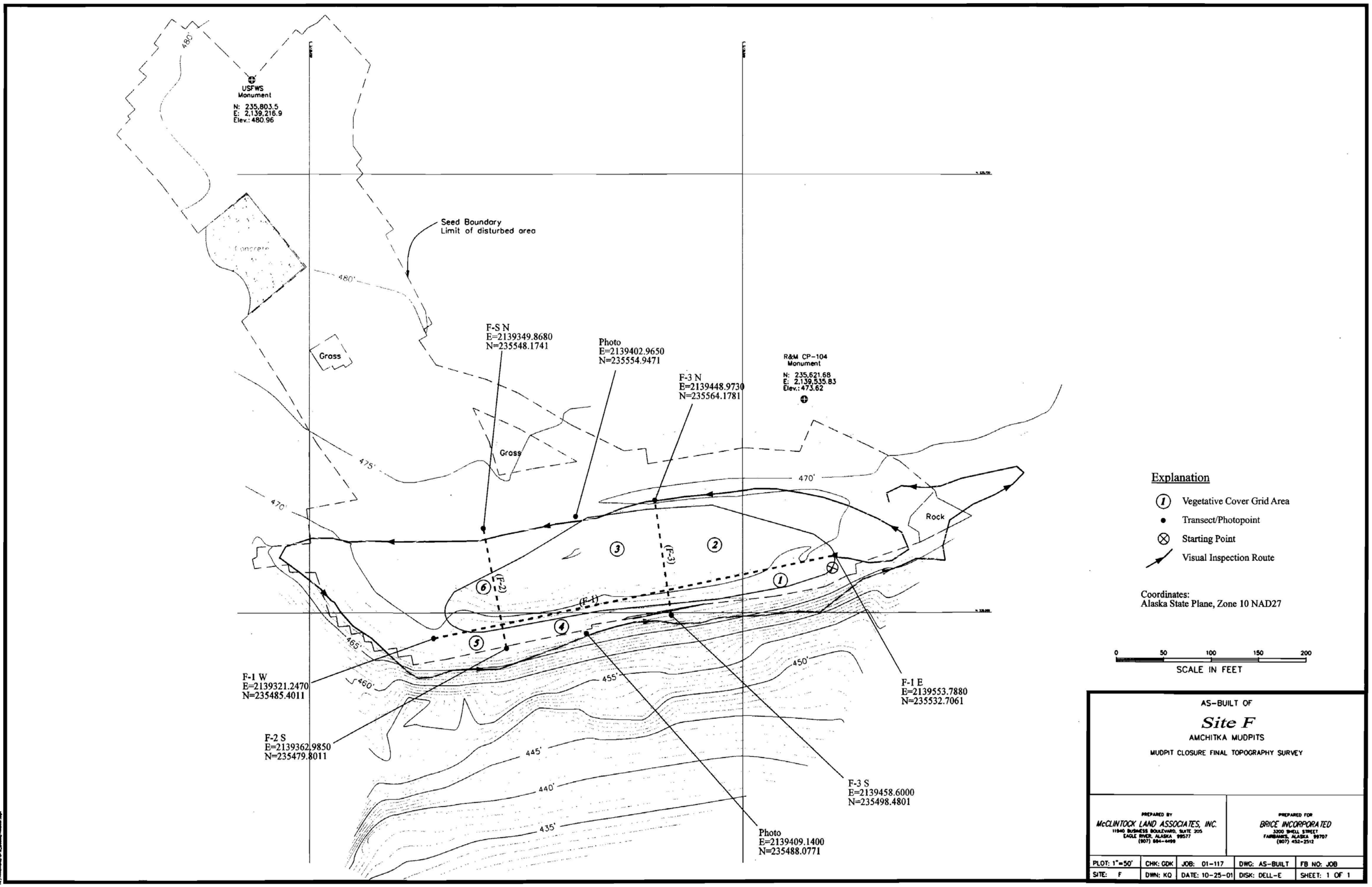
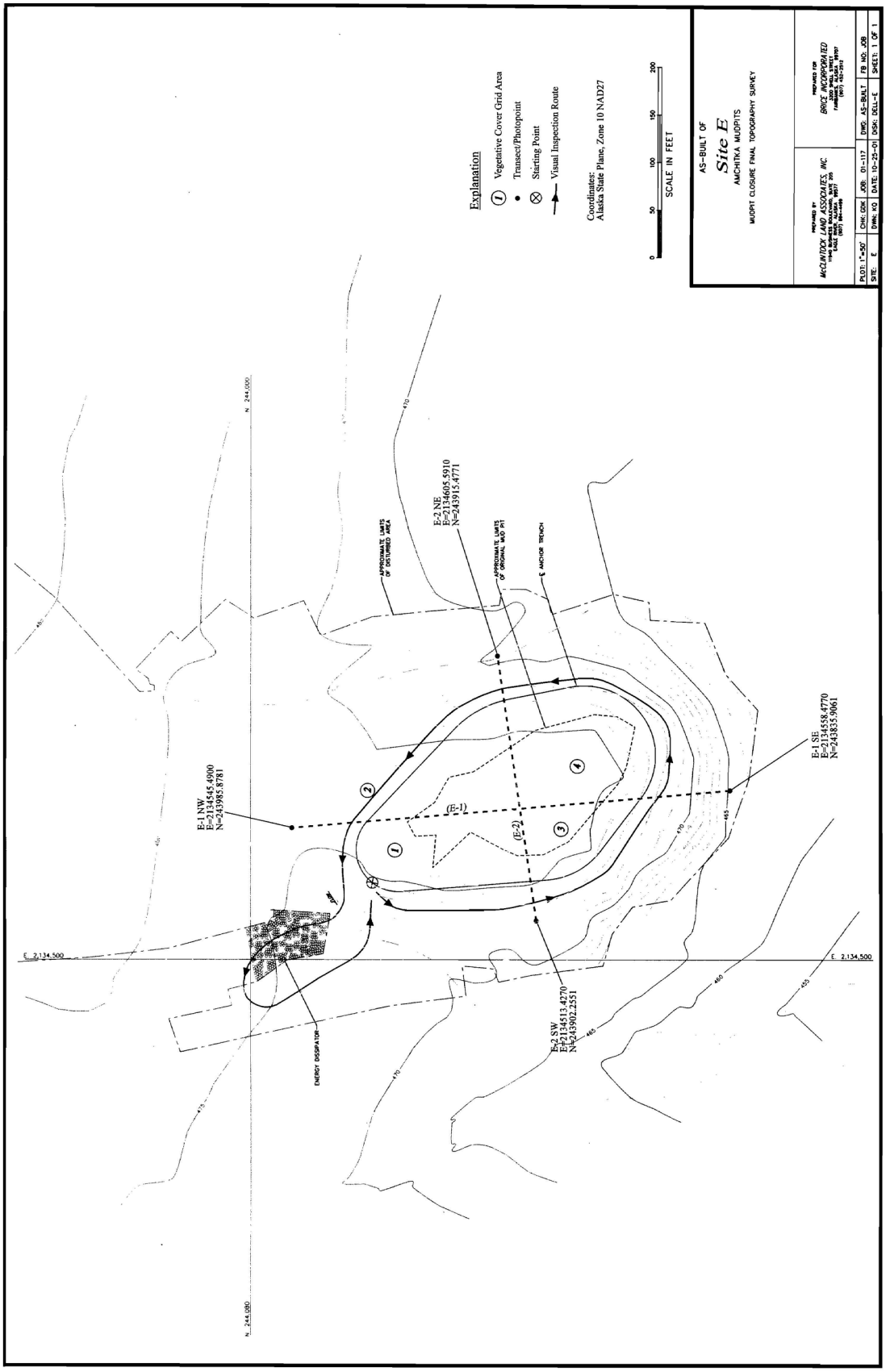

480'
USFWS Monument
N: 235,803.5
E: 2,139,216.9
Elev.: 480.96
Concrete
Seed Boundary
Limit of disturbed area
480'
Grass
F-S N
E=2139349.8680
N=235548.1741
Photo
E=2139402.9650
N=235554.9471
F-3 N
E=2139448.9730
N=235564.1781
R&M CP-104
Monument
N: 235,621.68
E: 2,139,535.83
Elev.: 473.62
Grass
475'
470'
470'
Rock
(F-2)
(F-3)
(F-1)
465'
460'
455'
450'
445'
440'
435'
F-1 W
E=2139321.2470
N=235485.4011
F-2 S
E=2139362.9850
N=235479.8011
Photo
E=2139409.1400
N=235488.0771
F-3 S
E=2139458.6000
N=235498.4801
F-1 E
E=2139553.7880
N=235532.7061
Explanation
Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
0 50 100 150 200
SCALE IN FEET
AS-BUILT OF
Site F
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
11940 BUSINESS BOULEVARD, SUITE 205
EAGLE RIVER, ALASKA 99577
(907) 694-4499
PREPARED FOR
BRICE INCORPORATED
3200 SHELL STREET
FAIRBANKS, ALASKA 99707
(907) 452-2512
PLOT: 1"=50'
CHK: GDK
JOB: 01-117
DWG: AS-BUILT
FB NO: JOB
SITE: F
DWN: KO
DATE: 10-25-01
DISK: DELL-E
SHEET: 1 OF 1


AS-BUILT OF
Site E
AMCHITKA MUDPITS
MUDPIT CLOSURE FINAL TOPOGRAPHY SURVEY
PREPARED BY
MCCLINTOCK LAND ASSOCIATES, INC.
PREPARED FOR
BRICE INCORPORATED
PLOT: 1"=50'
SITE: E
CHK: GDK
DWN: KO
JOB: 01-117
DATE: 10-25-01
DWG: AS-BUILT
DSN: DELL-E
FB NO: JOB
SHEET: 1 OF 1
Explanation
1 Vegetative Cover Grid Area
Transect/Photopoint
Starting Point
Visual Inspection Route
Coordinates:
Alaska State Plane, Zone 10 NAD27
SCALE IN FEET
E-1 NW
E=2134545.4900
N=243985.8781
E-2 NE
E=2134605.5910
N=243915.4771
E-1 SE
E=2134558.4770
N=243835.9061
E-2 SW
E=2134513.4270
N=243902.2551
APPROXIMATE LIMITS OF DISTURBED AREA
APPROXIMATE LIMITS OF ORIGINAL MUD PITS
E ANCHOR TRENCH
ENERGY DISSIPATOR
(E-1)
(E-2)
E 2,134,500
N 244,000
N 243,080

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Appendix C

Amchitka Mud Pit Release Sites
Line Transect Data Sheet

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Location: Amchitka Island Cap: Date: Sampler:

Plant species	Tran:	Tran:	Tran:	Tran:	Tran:	Tran:	Tran:
	Pt:	Pt:	Pt:	Pt:	Pt:	Pt:	Pt:
Litter							
Bare ground							
Rock							

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Appendix D

Photograph Log

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PHOTOGRAPH LOG

Mud Pit Site:				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Note if photopoint)**

*GPS location datum AK State Plane 1983

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