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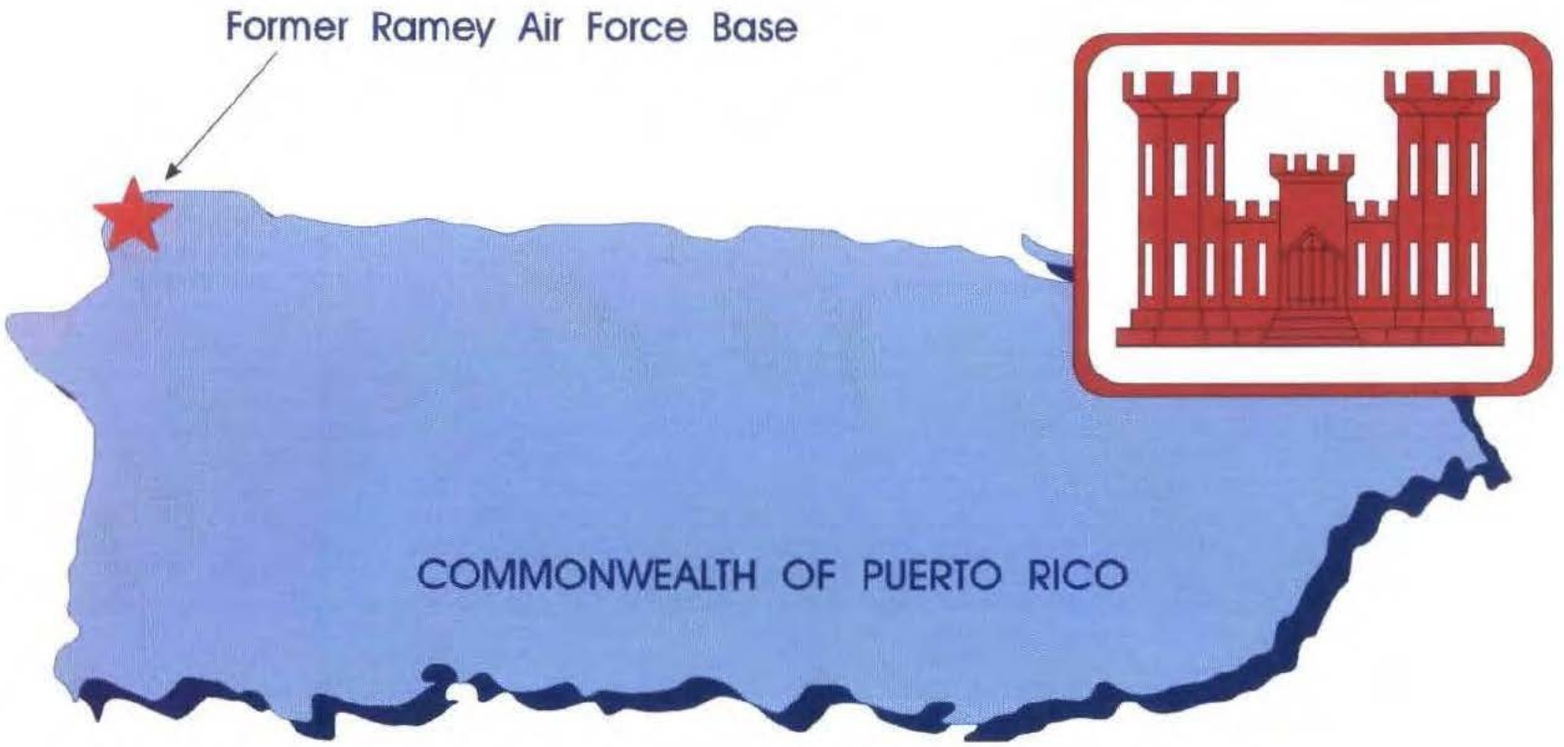
SITE INVESTIGATION WORK PLAN FOR LANDFILL AREAS 1 AND 2, FORMER RAMEY AIR FORCE BASE, AGUADILLA, PUERTO RICO

FINAL - VOLUME 2

February 1997



Prepared for:

Savannah District,
United States Army Corps of Engineers

ecology and environment, inc.
International Specialists in the Environment

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GDAP

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FINAL

GEOLOGIC DATA ACQUISITION PLAN FOR COMPLETION OF A SITE INVESTIGATION AT LANDFILL AREAS 1 AND 2, FORMER RAMEY AIR FORCE BASE, AGUADILLA, PUERTO RICO

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1. INTRODUCTION

This geologic data acquisition plan (GDAP) outlines standardized procedures to be used by Ecology and Environment, Inc., (E & E) in performing geologic field activities under contract to the United States Army Corps of Engineers (USACE), Savannah District, at the former Ramey Air Force Base (AFB) site in Aguadilla, Puerto Rico. E & E will utilize procedures detailed in this plan, as well as procedures found in the chemical data acquisition plan (CDAP) and the project work plan, to ensure that data of high quality are collected to support site characterization, engineering analyses, and recommendations. These procedures are consistent with the requirements of USACE, the United States Environmental Protection Agency (EPA), the Commonwealth of Puerto Rico and the data quality objectives stated in the project work plan.

This GDAP is a comprehensive document, and includes discussion and methodologies outside the scope of the project work plan. E & E has included these sections in the event that potential modifications to the project requirements might become necessary at some time in the future, should site conditions warrant. The project work plan should be consulted for current site-specific requirements.

In addition to the CDAP (E & E 1996a), which describes sample collection procedures, sample custody, analytical procedures, and field and laboratory quality assurance/quality control (QA/QC) procedures, additional plans that support this plan include the data management plan (DMP; E & E 1996b), which establishes minimum elements, parameters, and formats for all environmental monitoring data and documents; the project management plan (PMP; E & E 1996c), which outlines E & E's general technical and management

approach, specifies responsibilities of the E & E project manager and project team members, and describes coordination between USACE and E & E project personnel; the site-specific safety and health plan (SSHP; E & E 1996d), which specifies all site-specific safety and health information and procedures; and the project work plan (E & E 1996e), which contains site history and description information, and specific details about data collection activities.

2. QUALITY ASSURANCE/QUALITY CONTROL

2.1 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES FOR FIELD ACTIVITIES

All field activities described in this plan will be conducted to ensure that analytical results are representative of the media and conditions measured at the site, and are legally and scientifically defensible. To accomplish these objectives, E & E QA program personnel are responsible for seeing that field activities meet data quality objectives for the project, that quality control procedures outlined in this plan and the CDAP are followed, that field and laboratory personnel receive adequate training and supervision, and that corrective actions are implemented. E & E's QA program organization is outlined in Section 4 of the CDAP.

2.2 FIELD QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

2.2.1 Certification Requirements

All geologic data acquisition will be conducted under the supervision of a registered/professional geologist. This individual will have a minimum of three years' experience in planning and executing investigations at hazardous waste sites and a minimum of five years' overall geologic experience.

The senior driller shall be licensed by the Commonwealth. All topographic and location surveys shall be performed by a registered surveyor licensed by the Commonwealth.

2.2.2 Field Audits

Internal audits are conducted by E & E periodically, or as determined by E & E's program manager or QA officer. E & E's Regional QA Coordinator (or designee) will plan and conduct internal field audits that compare field operations to approved work plans, the

CDAP, and the GDAP. A checklist will be used to aid the auditor in identifying discrepancies or deviations from the plans; however, the checklist is not intended to be inclusive of all audit topics. Field systems and field performance will be audited simultaneously, resulting in a comprehensive field audit. During each comprehensive field audit, a detailed review of sampling technique, equipment decontamination procedures, sample management, documentation, field measurements, subcontractor management, and overall project management will be conducted. The auditor will be responsible for preparing a deficiency report upon completion of the audit and submitting this report to the E & E project and program managers. These managers will be responsible for initiating corrective actions. Prior to leaving the site, the auditor shall inform the field manager of all deficiencies found during the audit.

The Regional QA Coordinator will perform follow-up audits as necessary to confirm the implementation of corrective actions.

3. DESIGN AND INSTALLATION OF GROUNDWATER MONITORING WELLS

The principal objective of monitoring well installation is to provide groundwater samples that are representative of the screened aquifer. Secondary objectives of monitoring well drilling and installation may include the following:

- Provide water level data so that potentiometric maps can be constructed and flow paths determined;
- Provide access to aquifers so that aquifer tests can be conducted; and
- Provide soil and rock samples for geologic characterization of the study area.

3.1 PRE-DRILLING ACTIVITIES

Prior to entering the field to drill and install groundwater monitoring wells, the drilling specifications will be reviewed with the pre-qualified drilling subcontractor. The drilling subcontractor will be licensed by the State or other regulatory agency, as appropriate to the site; will have experience working on similar projects (this will apply both to the individual drillers as well as the drilling company); will have personnel who are Occupational Safety and Health Administration-(OSHA-) certified to work on hazardous waste sites; and will have the necessary equipment capabilities.

The necessary permits required to install groundwater monitoring wells will be obtained by the drilling subcontractor prior to field activities. Soil borings, drilling operations, and monitoring well construction will comply with regulatory requirements regarding

access, drilling, construction, groundwater extraction, and disposal of investigation-derived waste (IDW). Monitoring wells will be designed and constructed according to the following: EPA No. OSWER-9950.1-Resource Conservation and Recovery Act (RCRA) Ground Water Monitoring Technical Enforcement Guidance Document (TEGD) and the USACE manual, EM-1110-1-4000, Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites. Where conflicts occur between these guidance documents, the EPA TEGD will be used as guidance.

Underground utility clearance will be obtained prior to initiating field activities. Local utility companies (e.g., water, electricity) will be contacted to provide assistance in determining the locations of underground pipes and cables. If utility locations cannot be verified using underground atlases or other diagrams, a pipe locator will be used to clear the drilling site. Public utilities, such as the local telephone service, will be notified of the precise drilling location(s) so that they may initiate procedures for underground clearance.

3.2 SOIL BORING/WELL LOCATIONS AND DEPTHS

Soil borings/groundwater monitoring wells will be located both horizontally and vertically to ensure that soil and groundwater within the area of concern are monitored. The number of borings/wells installed and their locations and depths will be determined by the objectives of the monitoring program. Soil borings will be located adjacent to potential contaminant sources. Monitoring wells will be located upgradient and downgradient of the suspected contaminant sources. Specific location and depth information will be provided in the work plan.

3.3 DRILLING METHODS

The specific drilling method or methods to be utilized at a site will be specified in the work plan.

3.3.1 Hollow-Stem Auger Drilling

If possible, all boreholes for monitoring wells and split-spoon samples will be drilled using hollow-stem augers. This drilling method involves advancing a bit attached to the

appropriate diameter hollow-stem auger without the use of any drilling fluid. When the desired depth is achieved, the well casing is installed through the hollow center of the auger. The advantages of this method include: 1) the prevention of borehole caving; 2) the prevention of potential fluid circulation problems associated with other methods of drilling; and 3) the ability to drill without introducing any fluids into the formation.

3.3.2 Rotary Drilling

Deeper boreholes may require mud-rotary drilling techniques. An appropriately sized bit will be advanced at the end of hollow drilling rods. Drilling fluid is pumped through the rods and out through the bit. The drilling fluid acts as a lubricant for the bit, and also carries drill cuttings away from the bit and subsequently forces them to the surface. Cuttings are strained from the drilling fluid, and it is recirculated. This technique will only be used if the required depth of a borehole or the hardness of a formation prevents the use of hollow stem augers. All wastes associated with this process (i.e., drilling fluid and cuttings) will be drummed, labeled, and left on site, until final disposition can be determined (see Section 10 of this plan for IDW procedures). Depending on geology and other site-specific variations, drilling fluids used may include clean water, bentonite mud, or biodegradable mud.

3.3.3 Tri-Cone Reverse Air Drilling

Tri-cone reverse air drilling is very similar to mud rotary drilling methods with the exception that the circulation medium is air instead of mud. Air is compressed and circulated down through drill rods and up the borehole, carrying cuttings to the surface as the tri-cone bit is advanced. As cuttings are discharged and collected at the surface, formation samples can be visually classsified. Suelos Tech utilizes 100 percent oil-free air compressors to prevent the introduction of hydrocarbon-related compounds into the formation or cuttings. All wastes associated with this process will be drummed, labeled, and left on site until final disposition of IDW can be determined (see Section 10 of this plan for IDW procedures).

3.3.4 Split-Spoon Sampling

Split-spoon samples will be collected using 2- or 3-inch diameter, stainless steel, split-spoon samplers that are 1.5 to 2 feet in length. To advance the spoon, the drill rods and center bit will be removed, and the sampler will be attached to a rod and driven into the formation with a standard 140-pound hammer. The borehole will be drilled to the top of the sampling interval using hollow stem augers. After the spoon has been driven past the augers to the required sample depth, it will be retrieved and "split" open, enabling the collection of a representative core sample. Soil samples will be taken continuously on 1.5-foot centers from all wells and borings for stratigraphic control. Soil samples collected for geotechnical analysis will be collected in plastic or glass jars. Soil samples collected for chemical analysis will be containerized according to the analysis to be performed as specified in Section 4.4.5 of the CDAP.

As each split-spoon sampler is opened, an organic vapor analyzer (OVA), HNU, or other portable ionization detector will be used to screen the core for organic vapors. Any readings above background levels will be recorded in the logbook. In addition, each split-spoon core will be visually classified using the Unified Soil Classification System by the on-site geologist, and soil (or rock) characteristics (e.g., lithology, color, particle size, moisture content) will be entered in the boring log and/or the field logbook. The collection of samples for analysis will be as described for subsurface soil sampling (Section 4.4.5 of the CDAP), or in accordance with specific requirements described in the work plan.

Each split-spoon sampler will be completely decontaminated between sample intervals using the procedures outlined in Section 9.

3.4 WELL INSTALLATION

Generalized well construction diagrams for groundwater monitoring wells are shown in figures 3-1 and 3-2. All monitoring well installations will be conducted under the supervision of a Puerto Rico-registered Professional Engineer.

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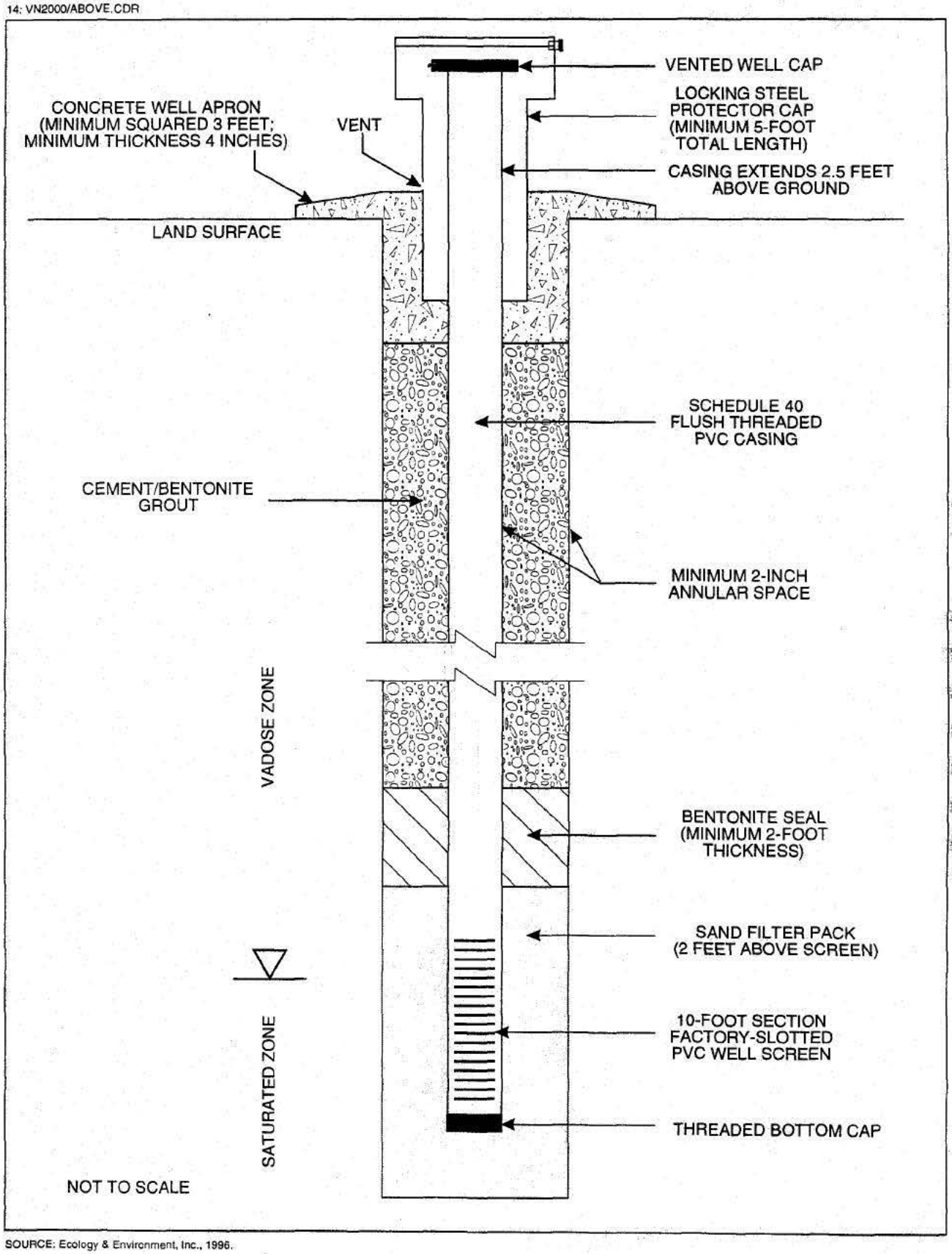
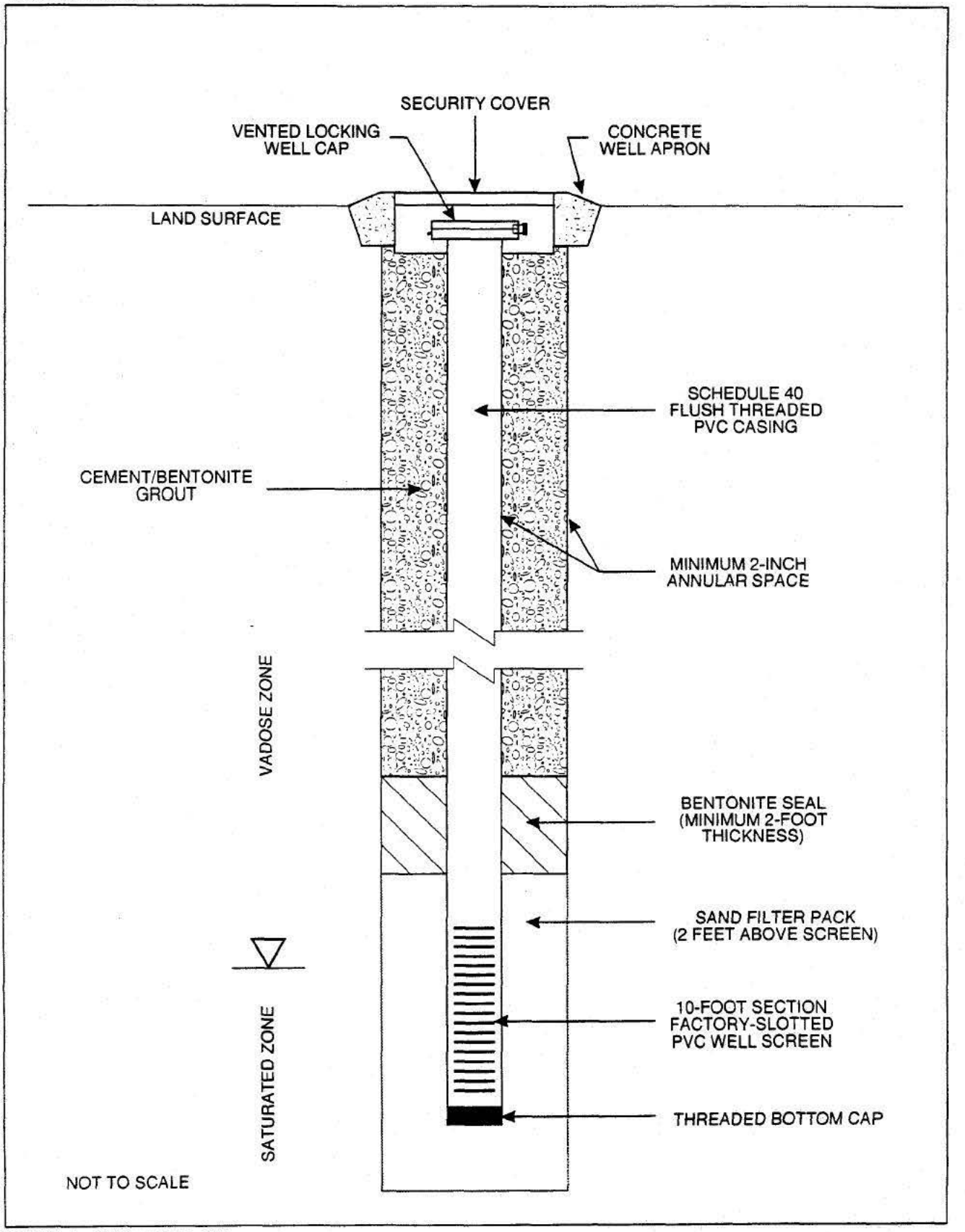


SOURCE: Ecology & Environment, Inc., 1996.

FIGURE 3-1 GENERALIZED MONITORING WELL CONSTRUCTION DIAGRAM ABOVE-GROUND PROTECTIVE CASING

14: VN2000/SURFACE.CDR



SOURCE: Ecology & Environment, Inc., 1996.

FIGURE 3-2 GENERALIZED MONITORING WELL CONSTRUCTION DIAGRAM SURFACE FLUSH-MOUNTED SECURITY COVER

3.4.1 Well Casing and Screen Materials

3.4.1.1 Well Casing

Unless otherwise specified in the work plan, all groundwater monitoring wells will be constructed of new 2-inch or 4-inch inner diameter Schedule 40 polyvinyl chloride (PVC) pipe. All well casing segments will have threaded, flush-coupled joints. No solvents or glues will be used as joining compounds. The well casing will conform to the requirements of the National Sanitation Foundation for potable water-grade pipe and shall bear the manufacturer's marking identifying it as such. Wells will be constructed so that not less than 2 inches of annular space exist between the boring wall and the centered well casing or between the inside of the auger and the centered well casing, if the well is constructed inside a hollow-stem auger.

The well casing will be capped and will extend a minimum of 2.5 feet above ground surface. A protective cover will be installed as described in Section 3.4.5. In high traffic areas, the well casing will be capped below ground surface (BGS) with a waterproof cover. A vent hole will be drilled into the well casing cap to permit pressure equalization. A permanent survey mark will be placed or scribed at the top of the inner casing.

The selection of PVC for well construction materials has been shown to be justified by recent research. Over a period of several hours, water standing in all traditional well construction materials (including stainless steel and Teflon®) has been shown to leach or desorb various chemical constituents. These studies have shown that proper purging techniques and minimal contact with any casing or sampling materials are the key elements in maintaining groundwater sample integrity. Therefore, the maximum residence time of the sample in the well (after purging) will be 15 minutes. Samples will be transferred to sampling containers immediately after collection.

3.4.1.2 Well Screen

The casing for each groundwater monitoring well will terminate in a 10-foot section of factory-manufactured 0.010-inch slotted screen or of a size determined to be compatible with the filter pack material, as discussed in Section 3.4.2. The bottom of the screen section

will have a threaded, solid PVC end cap to seal the bottom and act as a trap for sediment entering the well.

The top of the screen will be placed in the borehole so that the completed groundwater monitoring well will provide representative groundwater samples for chemical analysis of the uppermost water bearing zone, allowing for temporal fluctuations and the detection of floating product.

3.4.1.3 Well Centralizers

The need for centralizers to plumb a well is dependent upon the total depth of the well and the rigidity of the well casing materials. When used, they will be constructed of PVC and attached to the casing with stainless steel fasteners or strapping. The centralizers will be placed below the well screen and above the bentonite seal in such a way that does not hinder the flow of filter pack, bentonite pellets, or annular grout.

3.4.1.4 Surface Casing

As a precaution against introducing contaminants to the deeper zones during the drilling process, each well will be installed in two phases. Initially, a 6-inch ID, Schedule 40, PVC casing with a bottom cap will be installed through 8.25-inch ID, hollow-stem augers. The casing will be grouted in place and allowed to set for a minimum of 24 hours. Each surface casing will be set at least 5 feet below the base of the monitoring well. The monitoring well will then be completed.

3.4.2 Filter Pack Materials and Placement

Filter pack materials will consist of clean, inert, rounded, hard, natural siliceous materials selected to be compatible with the well screen slot size and aquifer materials. The required particle sizes of the filter pack will be based upon a sieve analysis (conforming to American Society for Testing and Materials (ASTM) test methods C 117 and C 136) conducted in the field on representative aquifer materials or on historical field data from the same formation at the site.

A minimum of 6 inches of filter pack material will be placed under the bottom of the well screen to provide a firm footing and an unrestricted flow under the screened area. The filter pack will be placed by tremie pipe in intervals of 2 feet to lessen the potential for annular bridging. If hollow-stem augers are being used, the filter pack will be constructed in conjunction with a slow, smooth extraction of the augers. The top of the filter pack will be sounded periodically during placement to determine its elevation above the screen and to prevent bridging. The top of the filter pack will extend to 2 feet above the top of the well screen.

3.4.3 Bentonite Seal

A 2-foot-thick (vertical minimum) bentonite seal will be established directly above the filter pack. The seal will consist of pure bentonite pellets placed into the annulus of the well. A high-yield strength bentonite designed for monitoring well sealing, such as Pure Gold (registered trade name) or an equivalent, shall be used for the seal.

The bentonite pellets will be tamped to minimize potential for bridging and ensure placement at the proper interval. The bentonite pellets will be hydrated by pouring clean water into the annulus using a ratio of 1 gallon of water for every 2 pounds of bentonite or according to the manufacturer's specifications. The hydration time of the pellets will follow the manufacturer's recommendations; at a minimum, a 1-hour hydration period will be allowed before grouting.

3.4.4 Grout Mixture

The annular space above the bentonite seal will be filled with a grout mixture to a level 2 feet BGS. The grout mixture will consist of not more than 7 gallons of water and 3 pounds of powdered bentonite to each 94-pound sack of Portland cement (ASTM Test Method C 150) or other appropriate method approved by the USACE Project Manager. The grout slurry will be mixed to a uniform and smooth consistency and will be approved by the on-site geologist prior to placement. The grout will be pumped into the borehole using a tremie pipe. The augers will be removed one section at a time during grouting. The grouting will be conducted continuously until the annular space is filled.

The grout will be allowed to set for a minimum of 24 hours before the surface pad and protective casing are installed.

3.4.5 Surface Protection

To provide well security, the remaining 2 feet between the top of the cement/ bentonite grout mixture and ground surface will be finished with a pure concrete mix around a length of protective steel casing, or a flush-mounted security cover (where necessary to avoid interference with site operations) with a locking cap. All wells will be padlocked and keyed alike following installation.

Aboveground protective casing (see Figure 3-1) will consist of 3- to 4-inch-diameter steel pipe with a hinged, locking cap. This outer casing will be a minimum of 5 feet in length and installed to a depth of 2 feet BGS in the concrete footing. Prior to the installation, the protective casing will be painted with a metal primer followed by epoxy or enamel suitable for metal. A concrete well apron (surface pad) will be installed around the well at the same time the steel protective casing is installed, in one contiguous unit. The well apron will be 3 feet squared by 4 inches thick, sloping away from the center. A minimum of 1 inch of the concrete well apron will be constructed below ground surface to prevent washing and undermining by soil erosion. Two drain holes will be drilled into the base of the steel casing, just above the well apron.

Four bumper guards (or protective posts) will be placed around the outside of the concrete well apron. The bumper guards will consist of steel pipes 3 to 4 inches in diameter and 5 feet in length, and will be installed 2 feet BGS in a concrete footing that is independent of the well apron. To increase their visibility, the bumpers will be painted prior to installation with metal primer followed by yellow epoxy or enamel paint suitable for metals.

If wells are located in traffic areas, flush-mounted well covers will be installed. Flush-mounted wells (see Figure 3-2) will be installed with the top of inner casing (TOIC) located just below ground surface. The inner well cap will have a vented, locking cover. A protective steel cover will be securely bolted into the concrete well apron. The steel cover will be mounted 1 to 2 inches above ground surface; the well apron will slope away from the center.

3.5 WELL DEVELOPMENT

A newly completed groundwater monitoring well will not be developed for at least 48 hours after well completion (depending on specific regulatory requirements). The new groundwater monitoring well will be developed by surging and pumping or bailing until the water inside the well is visibly free of sediment. In addition, the well will be developed until the pH, temperature, and specific conductance have stabilized. Stabilization will be considered achieved when the difference between consecutive readings is 10 percent. Acids, dispersing agents, and explosives will not be used to enhance well development. No water or other liquid will be introduced into the well other than formation water from that well.

If acceptable development has not been reached within 6 hours of continuous development action, the on-site geologist will stop all development activities and E & E will recommend additional development procedures to allow the well to meet USACE standards for water sampling.

After final development of the well, prior to sampling, water will be collected into a 1-liter clear glass jar. To document the clarity of the water, the jar will be photographed against a white background and submitted as part of the well log.

All development water will be collected in 55-gallon drums. Disposal of the development water will be in accordance with procedures outlined in Section 10 of this plan.

3.6 WELL/BOREHOLE ABANDONMENT

Well (or borehole) abandonment, also known as decommissioning, is the procedure whereby a well or borehole is permanently sealed in such a manner that it will not act as a conduit for migration of contaminants from the ground surface to the water table, or between aquifers. All monitoring well installations or well abandonment will be conducted under the supervision of a registered professional engineer or registered professional geologist.

Whenever possible, a monitoring well will be abandoned by completely removing the well casing and screen from the borehole, cleaning out the borehole, and completely filling the borehole with neat cement, a cement/bentonite mixture, or concrete. The fill materials will be selected to be compatible with the subsurface geology and will meet state well abandonment requirements. The grout will be placed into the well/borehole using a tremie

pipe positioned first at the bottom of the hole, then retracted slowly, as the grout fills the hole, to the ground surface.

If the well casing cannot be removed, or only partially removed, by drilling around it and pulling it out of the hole, the well may have to be grouted with the casing left in the borehole. The grouting will proceed as stated above. The well casing will be cut off at ground surface, and filled with concrete to a depth of 2 feet BGS. PVC casing may be removed by using a solid stem auger and carbide auger head to grind the casing into small cuttings that will be brought to the surface on the auger flights. A succession of increasingly larger augers may have to be used to "ream" the hole, ensuring that all casing fragments have been removed.

A record of each abandoned well will be prepared for submittal to the appropriate agency. Information will include project name, well identification, location (with reference to any replacement well or borehole), a copy of the boring log, reasons for abandonment, total depth before grouting, water level, type/composition of grout, total amount of grout, date of grouting, and a list of any casing or items left in the borehole.

3.7 WELL IDENTIFICATION

An engraved or embossed metal plate will be permanently affixed to the well casing or outer protective casing identifying the contractor's name, registration number, well number, depth, date of installation, and elevation of the TOIC. In addition, a permanent marker labeled "MONITORING WELL-NOT FOR WATER SUPPLY" will be installed on the outer protective casing. A placard identifying the well number in large enough type as to be legible from a road or trail will be attached to the bumper guards.

3.8 DRILLING LOG

Detailed well installation activities will be neatly recorded in the field in a drilling log. Additional procedures for completing the logs are discussed in Section 7 of this plan. The original and one copy of each log or logbook will be submitted to the USACE Project Manager within 30 days of completion of the fieldwork.

3.9 SITE RESTORATION

All work areas around and leading to the groundwater monitoring wells or boreholes will be restored to a condition equivalent to that of preinstallation.

4. GROUNDWATER MEASUREMENTS

The determination of groundwater flow paths and an understanding of the impact of external influences on flow direction (e.g., intermittent well pumping, temporal variations in recharge) are necessary to identify upgradient and downgradient groundwater samples.

4.1 GROUNDWATER LEVEL MEASUREMENTS

Groundwater level measurements from boreholes, piezometers, or monitoring wells used to determine a single potentiometric surface will be collected within a 24-hour period unless situations that may cause water level variability (e.g., active recharge due to precipitation) necessitate more frequent measurements. All measurements shall be made and recorded to the nearest 0.01 foot, referencing TOIC of the groundwater monitoring well. This reference point shall be surveyed and tied to the National Geodetic Vertical Datum (NGVD). All devices used for water level measurements will be calibrated against a steel surveyor's chain. Water level measuring equipment will be decontaminated prior to use in each well following procedures outlined in Section 9 of this plan.

Water level measuring data will be recorded in the field logbook immediately upon completion of field measurements. These data shall include well number, date and time of measurement, depth to water, total depth of well, reference point, and any applicable comments such as weather events or the presence and relative location of any nearby surface water bodies.

One of the following devices will be used to measure water levels.

4.1.1 Weighted Tape Method

A weighted calibrated measuring tape (in 0.01-foot increments) will be lowered slowly into the well until visual or audible evidence of contact with the static water surface is made.

4.1.2 Chalked Tape Method

A weighted steel measuring tape (calibrated in 0.01-foot increments) will be rubbed with chalk and lowered into the well. Distance to the water surface will be obtained by subtracting the wet chalked length from the total measured length. The tape will be withdrawn quickly from the well to prevent water from rising up the tape due to capillary action.

4.1.3 Electric Water Level Indicator (Sounder) Method

This instrument consists of a probe attached to the end of a dual conductor wire (calibrated in 0.01-foot increments) with a metered or audible indicator signalling water contact when lowered into the well. Oil present in the well may insulate the contacts of the probe giving an incorrect reading; dual-phase water level indicators will be used if oil is suspected in the well.

4.2 TOTAL WELL DEPTH MEASUREMENT TECHNIQUES

Weighted tapes or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weight or probe is felt resting on the bottom of the well. Because tape buoyancy and weight effects may be encountered, total well depth measurements will be repeated at least twice. Each measurement will be recorded in the field logbook.

5. GEOPHYSICAL SURVEYS

A variety of geophysical survey techniques may be utilized during a contamination assessment in order to identify the presence of buried objects, evaluate subsurface soil lithologies, and delineate the presence/extent of soil and groundwater contamination. These data can be extremely useful in identifying potential areas of subsurface disturbance, thereby allowing the most efficient and cost-effective selection of sampling locations.

Potential geophysical survey techniques that may be required during a site investigation include:

- Electromagnetic conductivity surveys;
- Magnetometer surveys; and
- Ground-penetrating radar surveys.

Geophysical survey data will be collected at sampling points that will be established across the site prior to the survey initiation. The sampling grid will be established based on an historical review of information on the site and will cover the entire working limits of the site as determined by this review. Initial sample point grid spacings may vary between 10 and 250 feet depending upon the size of the site, the type of geophysical survey technique, and the size and proximity of cultural interferences (e.g., buildings, underground utilities, overhead power lines, fences, metal scrap). More compact grid point spacings and measurements will be employed in areas of anomalous readings to assist in delineating the nature and extent of such anomalous areas. Several of the potential geophysical techniques also allow

readings to be continuously monitored during traversal between marked grid points. Prior to the initiation of the geophysical surveys, a grid line will be established and measurements recorded at a presumed background location in the immediate site vicinity. All sample points and areas of anomalous readings will be marked and labeled in the field, surveyed, recorded, and mapped.

Geophysical survey data will be recorded in the field in one of two ways: manually entered into the site logbook during the survey, or electronically logged into the data recording component of the geophysical units during the survey. These data will be presented in the form of computer-generated two- and three-dimensional isopleth maps as well as in the form of strip charts or data tables. All maps, strip charts, and data tables will be labeled according to the site and grid pattern. An interpretation of the data will accompany the maps and strip charts.

5.1 ELECTROMAGNETIC CONDUCTIVITY SURVEYS

The electromagnetic conductivity (EM) geophysical technique measures the apparent terrain conductivity of a portion of the Earth's subsurface. The EM instrument transmitter coil (dipole) is energized by an alternating current that generates a primary magnetic field. This primary magnetic field induces a secondary magnetic field in the subsurface that is sensed by the receiver coil (dipole). The receiver coil measures the ratio of the primary and secondary magnetic fields and yields a reading of this ratio in millimhos per meter. The ratio of the field strengths is proportional to the intercoil spacing and frequency of the instrument as well as to the permeability and conductivity of the surrounding area. When intercoil spacing and frequency are fixed (as a function of instrument design or manually fixed intercoil spacing), the field ratio represents a direct indication of apparent terrain conductivity.

Apparent terrain conductivity is influenced by a number of factors, including moisture content of the subsurface, presence and concentration of dissolved chemical species, and characteristics of the solid matrix (e.g., porosity, clay content, mineral composition, compaction). Individual EM readings reflect the combined influence of all of these factors averaged over the effective exploration depth of the instrument (the effective exploration depth being determined by the distance between the transmitting and receiving coils of the instru-

ment at a given frequency). Assuming that the natural characteristics of the solid matrix remain constant for the area under investigation, EM readings can be considered indicative of varying concentrations of adsorbed soil matrix contaminant species, or dissolved contaminant species in groundwater, or soil that has been artificially disturbed in some other way.

The EM surveys will be performed using the Geonics EM-31 and EM-34 instruments. The EM-31 has effective exploration depth of approximately 3 and 6 meters (10 and 20 feet, respectively), depending on whether the coils are oriented perpendicular (horizontal coplanar mode) or parallel (vertical coplanar mode) to the surface (the intercoil spacing is fixed in this instrument). At each EM-31 survey grid point, four readings will be recorded: one parallel and one perpendicular to the grid line for both the horizontal coplanar and vertical coplanar modes. Transition from the horizontal to vertical coplanar mode is implemented by simply turning the instrument on its side.

The EM-34 has effective exploration depths of approximately 15 to 60 meters (50 to 200 feet) depending on the intercoil spacing and orientation. At each EM-34 survey grid point, at least three readings will be recorded: at intercoil spacings of 10 (32.8), 20 (65.6), and 40 (131.2) meters (feet) in the normal operating condition. The EM-34 survey will usually be performed only if the EM-31 survey has indicated the presence of anomalous areas that might represent a contaminant plume or source area.

E & E's standard operating procedures for conducting electromagnetic conductivity surveys at hazardous waste sites can be found in Appendix A of this plan.

5.2 MAGNETOMETER SURVEYS

Magnetometer (mag) surveys will be performed using a proton magnetometer or gradiometer. Proton magnetometers measure the intensity of the total magnetic field at the surface of the Earth. Protons in a chamber within the magnetometer align with the Earth's magnetic field, and the number of protons that align is directly proportional to the intensity of the total magnetic field. The number of aligned protons is converted to a number (read in gammas), which represents the intensity of the total magnetic field at that point. The presence of buried materials with magnetic properties will produce anomalously high total magnetic field intensities. Consequently, mag surveys can be employed to locate buried ferromagnetic

materials (e.g., metal drums and pipes). Gradiometers are motor magnetometers that consist of two stacked Mags; one measures the induced magnetic field while the other measures the total magnetic field. Thus, a gradient between the two is generated at each particular station.

The measured intensity of the Earth's total magnetic field at a given point is influenced by a number of factors, including the natural occurrence of metals in subsurface lithologic materials; the presence of man-made metal-containing objects such as buildings and pipelines; the permanent magnetic strength of buried metal objects; the intensity of the induced magnetic strength; the shape, orientation, and degree of deterioration of any buried metal objects; and natural diurnal variations. The potential influence of all of these factors will be considered with establishing the mag survey grid and when interpreting the resultant data. A gradiometer measures this influence automatically; however, when separate proton mags are the only instrument available, a diurnal variation measurement station will be established (away from all cultural features) to allow quantification of this natural fluctuation in the Earth's magnetic field.

E & E's standard operating procedures for conducting magnetometer surveys can be found in Appendix B of this plan.

5.3 GROUND-PENETRATING RADAR SURVEYS

Ground-penetrating radar (GPR) surveys will be conducted using GPR systems. These GPR instruments transmit high frequency radio waves into the subsurface through a small antenna that is moving slowly across the surface of the ground. This electromagnetic signal is reflected back to a receiving antenna from the interfacial surfaces between materials that exhibit different electrical properties. The variations in the return signal are continuously amplified, filtered, processed, and recorded to produce a continuous diagrammatic cross-sectional profile of shallow subsurface conditions. The interfacial boundaries that generate reflections of the electromagnetic signal commonly are associated with natural geologic and hydrogeologic features: bedding, cavities, fractures, intrusions, variation in type and degree of cementation, and variation in moisture and clay content. The interface between subsurface soils and such buried man-made objects as tanks and drums can also produce a signal reflection. Furthermore, given that the presence of adsorbed or dissolved contaminant species

can also affect the electrical properties of subsurface lithologic units, GPR surveys can also provide an indication of the presence and extent of subsurface contamination (especially if computer enhancement of signal reflection profiles is employed).

The exploration depth of GPR surveys is highly site-specific and highly dependent upon the specific properties of the subsurface materials. In particular, the presence of such electrically conductive materials as clays in the shallow subsurface will greatly restrict the exploration depth. However, the continuous profiles provided by GPR surveys offer the potential of obtaining substantially more detail than is possible from many of the alternative geophysical survey techniques.

E & E's standard operating procedures for conducting ground-penetrating radar surveys at hazardous waste sites is found in Appendix C of this plan.

5.4 GEOPHYSICAL SURVEY DATA REDUCTION AND INTERPRETATION

For all above-mentioned surface geophysical methods, data reduction and interpretation will be performed manually or with relevant computer software packages in the field or in-house. E & E owns a number of software packages that evaluate raw field data and provide hard copy graphic representations.

For the most part, geophysical data will be analyzed immediately after retrieval from the field. This allows for a timely and enhanced understanding of the subsurface site conditions, allowing refinements to the continued geophysical survey or adjustments to the locations for soil borings or groundwater monitoring well installation.

6. GEOTECHNICAL SAMPLE COLLECTION AND METHODOLOGY

A representative selection of soil samples collected from soil borings or surface samples may be analyzed in the laboratory for physical parameters. These analyses will verify the visual soil classification performed in the field and provide additional information useful for stratigraphic correlation and determination of remedial design parameters. Samples collected for analysis of physical parameters will be specified in the work plan.

In sampling for physical parameters of soils, care will be taken to preserve the natural stratification of the samples. If the number of analyses required are fewer than the number of distinct stratigraphic units found in a boring, professional judgement will be exercised in choosing samples. Variables that will be considered include apparent contamination, grain size, and saturation.

Many physical testing laboratories do not have the capabilities of accepting samples contaminated with hazardous substances. Laboratories selected for testing samples with the potential to contain hazardous substances must meet strict criteria for decontamination of equipment between samples (as described in Section 9 of this plan), and must have procedures in place for storage and eventual disposal of the samples (see Section 5.1 of the CDAP). The sample chain-of-custody form will contain information regarding the suspected level of contamination of each sample.

6.1 GRAIN-SIZE DISTRIBUTION (ASTM TEST METHODS C 136-84a AND C 117-90)

ASTM Test Method C 136 describes the determination of particle size distribution of fine and coarse aggregates by mechanical sieving of dry samples. This method is limited to

materials coarser than 75 micrometers (μm) in size. Finer materials will be classified using ASTM Test Method C 117.

Samples will be collected directly from split-spoon samplers and placed into pre-cleaned, labeled, 8-ounce glass jars. A clean stainless steel trowel or knife will be used to remove a thickness of homogeneous soil from the core to the sample jar. The minimum amount of sample required is dependent upon the grain size distribution, which can be estimated in the field.

For fine aggregate, the following minimum amount will be collected:

Aggregate with at least 95% passing a 2.36-mm (No. 8) sieve = 100 grams (g)

Aggregate with at least 85% passing a 4.75-mm (No.4) sieve
and more than 5% retained on a 2.36-mm (No. 8) sieve = 500 g

For coarse aggregate, the following minimum amount will be collected:

Nominal Maximum Size, Square Openings, mm (inches)	Minimum Weight of Test Sample, kilograms (pounds)
9.5 (3/8)	1 (2)
12.5 (½)	2 (4)
19.0 (¾)	5 (11)
25.0 (1)	10 (22)
37.5 (1½)	15 (33)
50 (2)	20 (44)
63 (2½)	35 (77)
75 (3)	60 (130)
90 (3½)	100 (220)
100 (4)	150 (330)
112 (4½)	200 (440)
125 (5)	300 (660)
150 (6)	500 (1100)

For mixtures of fine and coarse aggregates, the minimum sample sizes will correspond to the coarse aggregate amounts above.

There are no sample preservation or holding time considerations for this method.

ASTM Test Method C 117 describes the determination of the amount of material finer than a 75-μm (No. 200) sieve in aggregate by washing. The results of this test method

are included in the calculation in ASTM Test Method C 136; the results of both methods are reported together as total grain-size distribution.

Samples will be collected directly from split-spoon samplers and placed into pre-cleaned, labeled, 8-ounce glass jars. A clean stainless steel trowel or knife can be used to remove a thickness of homogeneous soil from the core to the sample jar. The minimum amount of reduced sample required is dependent upon the grain size distribution, which can be estimated in the field:

Nominal Maximum Size	Minimum Mass, g
2.36 mm (No. 8)	100
4.75 mm (No. 4)	500
9.5 mm (3/8 in.)	1000
19.0 mm (¾ in.)	2500
37.5 mm (1½ in.) or larger	5000

There are no sample preservation or holding time considerations for this method.

6.2 ATTERBURG LIMITS (ASTM TEST METHOD D 4318-84)

This test method describes the determination of the liquid limit, plastic limit, and plasticity index of soils. Collectively, the liquid and plastic limits of soils (along with the shrinkage limit) are referred to as the Atterburg limits.

Samples will be collected directly from split-spoon samplers and placed into pre-cleaned, labeled, 8-ounce glass jars with Teflon®-lined caps. A clean stainless steel trowel or knife can be used to remove a thickness of homogeneous soil from the core to the sample jar. A minimum of 200 grams of sample that would pass through a 425-μm (No. 40) sieve is required for each analysis. The jars will be filled to retain the natural water content.

There are no sample preservation or holding time considerations for this method.

6.3 MOISTURE CONTENT (ASTM TEST METHOD D 2216-90)

This test method describes the laboratory determination of the water (moisture) content of soil, rock, and soil-aggregate mixtures by mass. The water content is expressed as a percentage of the mass of "pore" or "free" water in a given mass of material to the mass of

the solids in the material. "Solids" are defined as the naturally occurring mineral particles of soil and rock that are not readily soluble in water. Materials containing significant amounts of hydrated water (such as gypsum) may present a special problem as this slowly dehydrates at the standard drying temperature (110°C). In addition, some organic materials may be decomposed at this temperature. Therefore, it may be desirable to dry soils suspected of containing these substances at 60°C or in a desiccator at room temperature.

When tested by this method, materials containing water with substantial amounts of soluble solids (such as salt in the case of marine sediments) will give a mass of solids that includes the previously soluble solids. These materials require special treatment to remove or account for the presence of precipitated solids in the dry mass of the sample, or a qualified definition of water content must be used.

Because this method requires the drying of material in an oven at high temperatures, adequate health and safety precautions must be taken in determining the water content of contaminated soils.

Samples will be collected as soon as possible after opening the sample barrel and placed into precleaned, labeled, 8-ounce glass jars with Teflon®-lined caps. A stainless steel trowel or knife will be used to remove a thickness of homogeneous soil from the core to the sample jar. Jars will be filled and stored in such a way as to prevent or minimize moisture condensation onto the insides of the sample containers.

The minimum amount of sample required is equivalent to that required for ASTM Test Method C 136 (refer to Section 6.1).

7. LOGGING AND DESCRIBING SOIL AND ROCK SAMPLES

All soil and rock samples (both cores and cuttings) will be described and classified in the field by a qualified geologist or hydrogeologist who will be present during all drilling and well construction operations.

7.1 LOGGING FORMS AND PROCEDURES

A single continuous drilling log will be produced for soil and rock samples obtained from a single boring or well location. Drilling logs will be completed on the USACE Hazardous and Toxic Waste (HTW) drilling log form. Alternately, if approved by the USACE Project Manager, E & E's spiral-bound geotechnical logbook will be used. Examples of the USACE HTW drilling log form and E & E's Geotechnical Logbook are included in Appendix D. At a minimum, all geologic logging forms will include this information:

1) Project name
2) Site location
3) Boring/well location
4) Boring/well number
5) Drilling contractor
6) Drilling equipment (size and type)
7) Name of driller
8) Drilling date(s)
9) Name of geologist
10) Reference elevation for all depth measurements
11) Total depth of hole, in tenths of feet from surface
12) Depth of each change of stratum

13) Thickness of each stratum, in inches
14) Identification and description of the materials of which each stratum is composed (using USCS classifications)
15) Location of any fractures, joints, faults, cavities, or weathered zones
16) Nominal hole diameters, in inches
17) Types and sizes of samplers being used
18) Depth interval from which each formation sample was collected (include sample number, sample recovery, in inches, and blow counts per six inches)
19) Depth at which hole diameter (bit size) changes
20) Depth of any loss of tools or equipment, or drilling fluids
21) Depth at which groundwater is first encountered, in tenths of feet
22) Depth to the static water level and changes in static water level with well depth
23) Construction details of monitoring well
24) Depth and type of well casing
25) Description (to include length, location, diameter, slot size, material, and manufacturer) of well screen(s)
26) Description (to include composition, grain size, amount, positioning, and manufacturer) of sand pack
27) Description (to include composition, amount, positioning, manufacturer, and time allowed for hydration) of bentonite seal
28) Description (to include mixture, amount, positioning, and manufacturer) of cement grout
29) Any sealing-off of water-bearing strata
30) Static water levels upon well completion and after development
31) Well development parameters (to include total volume withdrawn, pH, specific conductance, and temperature)
32) Completion date(s)
33) Type of pump/bailer and water removal rate
34) Sample numbers and depth of sample from each well

7.2 SOIL DESCRIPTION AND CLASSIFICATION

In the acquisition of geologic data, the term "soil" will refer to all unconsolidated materials above bedrock. Soil cores and cuttings will be described in the boring logs as precisely as possible (i.e., formation name, color [based on Muncell soil color charts, or Geological Society of America color charts], consolidation, structure, organic content, moisture content, and relative density). Examples of these parameters can be found in E & E's Standard Operating Procedures for Logging and Describing Soil and Rock Samples (Appendix E).

Soils will be classified in the field using the Unified Soil Classification System (ASTM Test Method D 2487) included in Appendix F of this plan. The estimated grain-size distribution of soils in the saturated zone will be used in checking the suitability of the filter pack material in the wells. In addition, grain-size distribution may be verified in the laboratory according to ASTM test methods C 117 and C.136 (see Section 6).

7.3 ROCK DESCRIPTION AND CLASSIFICATION

Rock cuttings and core samples can be classified descriptively (e.g., formation name, color) or classified on the basis of origin (e.g., igneous, sedimentary, metamorphic). Several classification systems for each of these rock types have been cited in the literature. E & E's Standard Operating Procedures for Logging and Describing Soil and Rock Samples (Appendix E) provides a compilation of various rock classification systems that can be used in the field.

8. SURVEYING

Prior to commencing fieldwork, the surveyor will review site maps and any other readily obtainable maps that encompass the project area. The surveyor will ascertain the locations and conditions of all horizontal and vertical control available for the project using benchmark descriptions, maps, and listings provided by the USACE, as well as any other readily obtainable documents. The surveyor will consider the surveying needs for each site as set forth by the project work plan and decide what surveying methods and what control will be used to provide the necessary level of horizontal and vertical accuracy for the items being surveyed at the site.

It is expected that conventional land surveying equipment and techniques will be utilized and that a horizontal accuracy of 1 foot and vertical accuracy of 0.1 foot (for ground elevations) will be achievable with a total station, and vertical accuracy of 0.01 foot (for wells) will be achievable with an autolevel. For projects where control is not readily available on the State Plane Coordinate System, the government will provide control information for an existing grid system to be used by the surveyor. If a local grid system does not exist, the surveyor will establish one for the project using an assumed north as close as possible to true north and reference coordinates in meters. Elevations shall be referenced to the NGVD of 1929. A minimum of three benchmarks shall be constructed as needed for the project, and a sketch or diagram shall be created showing ties to at least three prominent existing site features for each new benchmark.

At each site where boreholes or monitoring wells have been installed, the surveyor will locate the coordinates of these points to the nearest foot. In addition, sampling points and points used in subsurface geophysical surveys will be surveyed to the nearest foot when present. Topographic surveys, where required, will be performed by the surveyor with an adequate density of ground surface points to develop a topographical map with a 1-foot contour interval, unless another interval is specified for the site. This topographical map will include spot elevations at a density that corresponds to the contour interval. Traverses in horizontal surveys are expected to be closed with a precision of 1:10,000 or better.

Elevations will be surveyed to the nearest 0.01 foot for the TOIC of all aboveground and flush-mounted monitoring wells. Boreholes, monitoring wells, and other ground surface elevations will be surveyed to the nearest 0.1 foot. The field notes will be prepared and submitted to E & E for inclusion in the final report. The location and identification of all boreholes, monitoring wells, and monuments will be plotted on maps with a scale adequate to show their locations with reference to other structures at the individual sites. In addition, a list of these points will be tabulated (including their designation, X and Y coordinates and required elevations, and survey station number), corresponding to the surveyors field notes. The plot, tables, field books, and computation sheets will be included in the final report.

Copies of field notes from all surveys will be submitted to the USACE Project Manager within 30 days of completion of the field survey. Two copies of the survey data will be provided on floppy diskettes in a format that meets the USACE computer-assisted drafting and design (CADD) deliverables standard.

9. CONTAMINATION PREVENTION AND EQUIPMENT DECONTAMINATION PROCEDURES

Sampling methods and equipment have been selected to prevent or reduce cross contamination in sampled media and in samples, and to minimize the generation of IDW. Glass, Teflon®, stainless steel, or other suitable inert containers will be used for the application of rinse solvents. Disposable outer garments and sampling equipment will be used as appropriate. Equipment or supplies which cannot be effectively decontaminated (e.g., sample tubing or rope) will be disposed of before moving to the next sampling location. Most investigation/sampling equipment will be cleaned at the site prior to use, between sampling locations or as specified in the workplan, and prior to transport back to the equipment storage area. Decontamination of field equipment will be noted in the project logbook. All deviations from written decontamination procedures will be noted in the logbook; otherwise, a notation will be made each day that decontamination was conducted as specified in the project documents.

9.1 DECONTAMINATION PROCEDURES

Teflon®, glass, stainless steel, or metal equipment used to collect samples for organic compounds and trace metals analyses will be decontaminated in the following sequence:

- Steam clean (drilling equipment only);
- Detergent (Alconox®; Liquinox® or equivalent will be used if nutrients are analytes) scrub with brushes;
- Clean (tap) water rinse (with a steam cleaner for drilling equipment);

- Deionized water rinse;
- Nanograde isopropanol rinse (twice);
- Air drying; or
- Analyte-free water rinse (if equipment is not dry); and
- Wrap in aluminum foil (if not to be used immediately).

Teflon® implements used for the collection of samples for metals analyses will require the following decontamination procedure:

- Detergent (Alconox®; Liquinox® or equivalent will be used if nutrients are analytes) scrub with brushes;
- Clean (tap) water rinse;
- 10% nitric acid solution rinse (10% hydrochloric acid solution will be used if nutrients are analytes);
- Deionized water rinse;
- Nanograde isopropanol rinse (twice);
- Air drying; or
- Analyte-free water rinse (if equipment is not dry); and
- Wrap in aluminum foil (if not to be used immediately).

Neoprene gloves used during sampling will be replaced between sampling locations or decontaminated using the following procedure:

- Detergent scrub with brushes;
- Clean (tap) water rinse; and
- Air drying.

Water level indicators, tape measures, and other downhole instruments (as well as field instruments such as pH and conductivity meters) will be decontaminated using the following procedure:

- Detergent wipe or scrub with brushes;
- Clean (tap) water wipe or rinse;
- Deionized water wipe or rinse; and
- Air drying.

New Tygon® tubing will be decontaminated prior to transport to the field site using the following procedure:

- Detergent with hot tap water flush;
- Hot tap water rinse;
- Analyte-free water rinse;
- Aluminum foil cap at each end of tubing; and
- Storage of clean tubing in a clean plastic bag.

New Teflon® tubing used with sample pumps will be decontaminated prior to transport to the field site using the following procedure:

- Clean the outside of the tubing using the following procedure:
  - Detergent and tap water scrub,
  - Tap water rinse,
  - 10% nitric acid solution rinse,
  - Tap water rinse,
  - Isopropanol rinse, and
  - Analyte-free water rinse.
- Assemble tubing and pump over clean aluminum foil;
- Use detergent and hot tap water flush;

- Flush with 10% nitric acid solution, turn off pump, and allow solution to sit for 15 minutes;
- Flush with tap water;
- Flush with isopropanol, turn off pump, and allow solution to sit for 15 minutes;
- Flush with analyte-free water;
- Rinse tubing exterior with analyte-free water; and
- Store and transport clean tubing wrapped in aluminum foil.

Automatic wastewater samplers will be decontaminated as follows:

- Detergent wash of exterior and accessible interior areas and tap water rinse;
- Clean damp cloth wipe of gauges, knobs, and timing mechanisms;
- Replacement or decontamination of sample tubing as described in this section;
- Disassembly of funnel, distributor, and header mechanisms (if necessary), then wash with detergent and rinse with deionized water;
- Cleaning of reusable glass sample containers:
  - Detergent and hot tap water wash,
  - Hot tap water rinse,
  - 10% nitric acid rinse (if metals are analytes),
  - Tap water rinse,
  - Analyte-free water rinse,
  - Isopropanol rinse (if organics are analytes),
  - Air drying, and
  - Aluminum foil cover.
- Decontamination of reusable plastic containers in the same manner as the glass containers discussed above; however, a solvent rinse will not be performed.

Ice chests and shipping containers will be decontaminated using the following procedure:

- Detergent scrub (interior and exterior) with brushes;
- Clean (tap) water rinse; and
- Air drying.

9.2 SOURCE WATER

Analyte-free water, used in the preparation of field QC samples and in equipment decontamination, will be obtained from a water purification system owned by E & E. The water source will be a municipal water supply. The water purification system is identical to the system used by EPA Region IV and has been guaranteed to meet EPA Region IV specifications for analyte-free water. Analyte-free water is without detectable concentrations of any components of interest or interfering compounds. The water will be transported in 0.5-gallon amber jars. The cleanliness of the water will be monitored by reviewing field QC sample data.

10. INVESTIGATION-DERIVED WASTE

Unless otherwise directed by the USACE Project Manager, all IDW will be handled in a manner consistent with EPA guidance provided in *EPA Region IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual*, February 1991, Section 4.5, and *Management of Investigation-Derived Wastes During Site Inspections*, EPA/540/G-91/009, May 1991. The waste disposal methods to be implemented for IDW will be dependent upon the classification of the waste as RCRA hazardous or RCRA nonhazardous. Classification of IDW will be based on historical site information, including analytical data when available. Disposal practices for a specific project will be addressed in the site-specific work plan and site-specific chemical data acquisition plan (SCDAP).

IDW includes disposable equipment and personal protection equipment (PPE), purge and development waters, drilling fluids, soil cuttings, and decontamination fluids.

In general, the following procedures will be followed to dispose of IDW unless otherwise directed by the USACE Project Manager:

RCRA Investigation-Derived Hazardous Waste

- RCRA hazardous wastes may be placed in an active facility waste treatment system, or they may be disposed of in the source area if such an action does not pose a threat to human health or the environment; and

- If on-site disposal is not feasible, the wastes will be containerized, labeled, and stored on site for subsequent disposal as provided in the site-specific work plan and SCDAP.

RCRA Investigation-Derived Nonhazardous Waste

- RCRA nonhazardous wastes (except disposable equipment and PPE) will be disposed of on site when possible. Liquid wastes, such as monitoring well development and purge waters, will be poured onto the ground and allowed to infiltrate near the source area or downgradient from the well. Decontamination waters will be poured onto the ground in the decontamination area. Soil cuttings will be returned to the borehole, spread on the surface near the borehole, or spread elsewhere on the site as appropriate. When on-site disposal is not possible, the wastes will be containerized as described above; and

- RCRA nonhazardous and decontaminated disposable equipment and PPE will be double-bagged and placed inside a dumpster for disposal at a sanitary landfill.

All Cases for IDW

- Decontamination solvents (isopropanol and acetone) will be collected in a container and allowed to evaporate during the course of the day. If it becomes necessary to dispose of a large quantity of solvent, the waste solvent will be containerized, properly labeled, and stored on site for subsequent disposal;

- Waste acids and bases will be diluted or neutralized and flushed into a sanitary sewer; and

- Waste calibration standards will be flushed into a sanitary sewer.

11. REFERENCES

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