6.6 Geophysical Investigation Plan

6.6.1 Pre-Survey Surface Inspection and Sweep (UXO Safety)

This information is reviewed in Section 5.01 of the General Site Wide Work Plan.

6.6.1.2 Personnel Qualifications

All geophysical investigations shall be supervised by a geophysicist meeting the qualification requirements listed in DID OE-025. During the geophysical investigation of the Bravo Area, a geophysicist will be on-site during data acquisition operations.

6.6.2 Site Description (provided in Chapter 2)

6.6.2.1 Geophysical Investigation Program Objectives

Based on the original Scope of Work for the Bravo EE/CA, a geophysical survey will be performed over 143.5 acres using oversized 1-acre grids where ½ acre is surveyed, oversized ½ acre grids where ¼ acre is surveyed, and ribbon walk transects in the Bravo portion of the Redevelopment Area of Ft. McClellan. The oversized grid method of data collection will be performed over 193 half-acre grids and 56 quarter-acre grids. Geophysical data will also be acquired over 83 miles of ribbon walk transects. In addition, geophysical data will be acquired over 17.5 acres of delineation transects. The delineation transects serve to further define areas of high OE concentration to ensure that sufficient geophysical and intrusive data is gathered using the grid method planned for those areas. Finally, 7.5 miles (13.56 acres) of mountain transects will be covered along slopes greater than 40 degrees in the M3-1L sampling sector, since these areas are too steep for other sampling methods. Intrusive “data validation” will be associated with the grids, ribbon walks, and mountain transects, but not the delineation transects. All methods are intended reduce the amount of brush cutting necessary during geophysical data collection. The objective of the geophysical investigation is to detect metallic objects and features (anomalies) equal to or larger than the size of a hand grenade or 37mm projectile that might be related to potential UXO contamination. These anomalies may represent a hazard for future activities planned for the site.

6.6.2.1.1 Based on the prove-out test performed in the summer of 1999, it is anticipated that the primary geophysical sensor technology that will be used to meet the program objectives is time domain electromagnetics (TDEM). For more information on the geophysical prove-out test please refer to the General Site Wide Work Plan, Attachment 5-1: Synopsis of Ft. McClellan Proveout Test, July 1999. Due to the dense and tall vegetation within the survey area, the most appropriate positioning technology to use to accurately locate the geophysical sensor systems for the oversized grid method is the Ultrasonic Ranging and Data System (USRADS). A 2.0-2.5 ft parallel line spacing will be employed on the grids. For the ribbon walk methodology, static global positioning system (GPS) measurements acquired at regular intervals will be used for positioning.

6.6.2.2 Area of Investigation

The Bravo Area is composed of ten sampling sectors totaling 3806 acres located in the southwest quadrant of Ft. McClellan. The area is heavily vegetated, hilly to mountainous terrain. The Area is asymmetrical, however its boundaries can be roughly defined by Summerall Gate Road to the north and west, Blue Mountain to the south and west, Range 24A to the south and east, and Bains Gap Road to the

north and east. Approximately 3,806 acres will be assessed during this investigation using geophysical data collected over 143.5 acres of grids and data collection transects. Approximately 31 additional acres will be sampled with a combination of delineation transects and mountain transects.

6.6.2.2.1 The ten sampling sectors within the Bravo Area are: M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, M3-3H, M4-1L, M4-1M, M4-1H, and M4-2H. Previous reconnaissance activities in these sectors by Foster Wheeler Environmental personnel have indicated two areas of low, three areas of medium, and five areas of probable high OE density in these sectors. The types of ordnance that may be present in the Bravo Area are addressed in the Conceptual Site Models presented in Chapter 6.7 of this work plan, as well as in Table 8.1, which summarizes explosive types and associated incendiary materials potentially located in the Bravo Area and vicinity.

6.6.2.3 Past, Current and Projected Future Use

6.6.2.3.1 The M4 Sectors

The M4 Sectors: M4-1L, M4-1M, M4-1H, and M4-2H, are located within the Bandholtz Range Area, which is located to the south of Bains Gap Road and east of Rocky Hollow Road. Previous investigations conducted in and around this section of the Bandholtz Range Area indicate the presence of historical impact areas. The following includes the names and known histories of specific firing ranges, training areas, and bivouac areas that are located within the M4 Sectors. It should be noted that the ordnance associated with these ranges are not necessarily high-explosive rounds since they were used for training purposes. Items found during reconnaissance activities were not handled, excavated, or removed, so determination was not made as to whether they were high explosive, practice, or training rounds.

- Combat Range #1 was built during the Inter-War period when it was used as a range for 37 mm anti-tank guns, and 75 mm artillery guns. There is historical evidence that Combat Range #1 was also used for artillery and mortar firing during WWI.

- The Bandholtz Rifle Range, later renamed Range 25, was built during the Inter-War period between WWI and WWII. It was in continuous use as a known distance range since its original establishment up to the time of base closure.

- Range 23 was opened in the Inter-War period as a pistol range and then was used as a rifle and machine gun range. It is located within the impact area of the WWI Artillery Impact Area and part of the range was included in the Combat Range #1 used during the Inter-War period. An expended 81-mm mortar was identified at the surface during a site visit.

- Old Range 21 was established after WWII for use as a rifle range and it was abandoned in 1967. This range is also included within the impact area of the WWI Artillery Impact Area and is included within the Inter-War period Combat Range #1 perimeter.

- Range 26, an Infiltration Course, was established after WWII and was in use until it was abandoned in 1974.

- Range 20, another Infiltration Course, was active from the mid 1980s period until base closure. Demolition devices and M60 machine guns were used in training exercises.

- Range 26, the Live Fire and Maneuver Range, was active from the 1950s until base closure. Historically the weapons used on this range were the M16A1, rifles, and small arms. During a site visit a signal illumination parachute flare was identified at the surface.

- The Blank Fire and Maneuver Range was known as Range 28. It was an active range from 1976 until base closure. The facilities present during its use include bleachers, latrines, a target house, a tower, and five firing lanes. Historical data suggests the M-16 (blank) was the only weapon used on this range. The range is located within the World War I Artillery Impact Area. During fieldwork multiple 3" projectiles, multiple 3" stokes mortars, multiple M18 smoke grenades, and fighting positions were identified in this area.

- Weapons Demo (ITT), also known as Range 29, was active from 1976 until base closure. Historically the weapons used on this range were .38/.45 caliber pistols, M16A1, M60, MG, M72, light anti-tank weapon (LAW), and M203s.

- Range 32, the Hand Grenade Range, was active from 1987 until base closure. Range 32 was constructed in 1987.

- Bivouac Site B-23 is located within the 4M Sectors of the Bravo Area. Rifle blanks and pyrotechnic devices such as smoke grenades were used to train at B-23.

Currently, the land in these sections of the Bandholtz Range is abandoned and not in use by any agency or group. Future use of the Bravo Area is anticipated as commercial, industrial, or recreational property.

6.6.2.3.2 The M3 Sectors

The M3 Sectors within the Bravo Area are: M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, and M3-3H. These sectors are part of the Washington Range Area, which is located to the west of Rocky Hallow Road and south of Summerall Gate Road. Previous investigations conducted in and around this section of the Washington Range Area indicate the presence of historical impact areas. The following includes the names and known histories of specific firing ranges, training areas, and bivouac areas that are located within the M3 Sectors.

- Combat Range #2 was built during the Inter-War period. There is no documentation of its specific use pre-WWII, but during the war it was divided into several ranges including a rocket range, a machine gun range, and two rifle grenade ranges all of which were abandoned by 1958.

- The Washington Known Distance Rifle Range was built during WWII and later renamed Range 18. It was in continuous use as a rifle range.

- Range 16 was established during WWII as a grenade court. In 1958 the range was divided into a Rocket Launcher (bazooka) area (Range 16) and a Rifle Grenade training area (Range 17). Then in 1967 the two ranges were again consolidated and used for rocket launchers and 40mm grenade launchers.

- The Rocket Range was developed during WWII and was part of Combat Range #2 until 1967 when it was abandoned. 2.36" rockets (bazookas) were identified at the surface during a site visit.

- The Machine Gun Range was established during WWII and was part of Combat Range #2. Two rifle grenade ranges were activated during WWII; however, both were abandoned during 1958. During a site visit remnants of WWII vintage rifle grenades were identified at the surface.

- During WWII a 60mm mortar range was established and later abandoned sometime between 1958 and 1967. During a site visit remnants of a 60mm HE mortar round was identified at the surface.

- The Washington Tank Range was instituted in 1958 and abandoned by 1967.

- Old Range 12 was built during WWII as a rifle range and was abandoned by 1967.

- Range 12 was built after WWII and was used as a competitive pistol range.

- The Washington Pistol Qualification, Range 13 was established during the Vietnam War and was active until base closure.

- Range 15 was set up after WWII and was used as a rifle and machine gun firing range until it was abandoned in 1967.

- Range 19 was built during the Vietnam War as a 10mm machine gun range. Later it was developed into a pistol qualification range. There was also a WWI machine gun camp located in this section of Bravo Area.

- The 1950 Rocket Launcher Range appears on a 1950 range map. The range map shows a 2.36" Rocket Launcher Range north of the 60mm mortar range. The range was abandoned before 1958.

Currently the land in the Washington Range Area is abandoned and not in use by any agency or group. Future use of the Bravo Area is anticipated as commercial, industrial, or recreational property.

6.6.2.4 Anticipated UXO Type, Composition, and Quantity

The types of ordnance that may be present in Bravo Area are addressed in the Conceptual Site Models presented in Chapter 6.7 of this work plan, as well as in Table 8.1, which summarizes explosive types potentially located in the Bravo Area and vicinity.

6.6.2.5 Anticipated Depth of UXO

The limit of the depth of investigation for this scope of work is four feet, though it is anticipated that most of the ordnance items found will be significantly more shallow than four feet. This statement is based on expected ordnance types from historical data in the ASR. Foster Wheeler Environmental's methodology was developed for this task based on the U.S. Army Corps of Engineers' Publication EM 1110-1-4009 Ordnance and Explosives Response Engineer Manual, which covers typical detection depths of ordnance items using various geophysical instruments. In addition, a geophysical prove-out test was performed in the summer of 1999. The purpose was to demonstrate that the geophysical sensor technology, time domain electromagnetics, to be used at Ft. McClellan will detect the suspected ordnance types under the specific conditions encountered at the site. The prove-out also demonstrated that the time domain electromagnetic detection to be performed with the EM-61 will meet the minimum requirements of the publication cited above.

6.6.2.6 Topography

6.6.2.6.1 The M4 Sectors

The M4 sectors are: M4-1L, M4-1M, M4-1H, and M4-2H. The M4 sectors comprise an area that is generally rectangular in shape and trends north-south. It is approximately 1.75 miles in length and 1 mile in width. The cluster of sectors are bounded to the north by Bains Gap Road, to the east by a string of hills at the foot of the Choccolocco Mountains, to the south by Kellog Drive, and to the west by Rocky Hollow Road. The topographic gradient within the M4 Area gently increases to the southeast and abruptly changes into a string of steep hills, which include Holloway Hill. There is also a significant unnamed hill located in the northeast corner of the area, directly adjacent to Bains Gap Road. Ingram Creek and South Branch Creek also flow through this area.

6.6.2.6.2 The M3 Sectors

The M3 Sectors: M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, M3-3H define an area that is approximately square. The area is approximately 3.5 miles in length and 2.25 miles in width. To the north the sectors are bounded by the building and office facilities that define the main administrative center of the Base, to the west by Kellog Drive, and to the east by the property boundary of the Base. The M3 Sector is extremely rugged terrain including the following hills: Iron Mountain, Wheeler, Reynolds, Perry, Gardner, Ford, Jerry, Baltzell, Sunset, and Howitzer. The entire area is defined by undulating terrain alternating between topographic highs and lows. The area also includes Yahoo Lake and several creeks and streams.

6.6.2.7 Vegetation

This information is discussed in Section 5.3.7 of the General Site Wide Work Plan. Details of the expected vegetation cover in the Bravo Area are discussed in the *Reconnaissance Findings, Conceptual Plan, and Proposed Scope of Work for EE/CA Sampling*, prepared by Foster Wheeler Environmental in August 2000 and included as Attachment 6-1 to this document.

6.6.2.8 Geologic Conditions

Fort McClellan is situated near the southern terminus of the Appalachian Mountain chain. All but the easternmost portion of the Main Post lie within the Valley and Ridge Province of the Appalachian Highlands. The portion of Fort McClellan west of Choccolocco Creek lies within the Piedmont Province. The age of the consolidated sedimentary and metamorphic rocks range from Precambrian to Pennsylvanian. On a large scale, most of the rocks have been intensely folded into an aggregate of northeast-southwest trending anticlines and synclines with associated thrust faults. Colluvial deposits characterize the shallow geology in the area. Table 5-1 in the General Site Wide Work Plan summarizes the major stratigraphic units underlying Fort McClellan.

6.6.2.8.1 The presence of metamorphic rocks increases the potential for minerals such as magnetite and other associated magnetic minerals. However, metamorphic rocks are only present east of the Bravo Area.

6.6.2.9 Soil Conditions

This information is reviewed in Section 5.3.9 of the General Site Wide Work Plan.

6.6.2.10 Shallow Groundwater Conditions

This information is discussed in Section 5.3.10 of the General Site Wide Work Plan.

6.6.2.11 Site Utilities

There are no known existing subsurface utilities in the areas that will be geophysically surveyed based on current information. However, if utilities are encountered during the initial surface sweep of the Bravo Area or detected during the geophysical investigation, they will be identified and their locations posted on the color-coded geophysical map of the area to ensure that intrusive activities occur in the safest manner possible.

6.6.2.12 Man-Made Features Potentially Affecting Geophysical Investigations

Man-made features such as above and below ground power lines, buildings, foundations, storage tanks (above and below ground), fences, landfills/disposal areas, roads, and any other features that may influence the geophysical investigation will be documented and accompany the USRADS/ DGPS field data acquisition form with specific information on the location, extent, and nature of the feature.

6.6.2.13 Site-Specific Dynamic Events

This information is discussed in Section 5.3.13 of the General Site Wide Work Plan.

6.6.2.14 Overall Site Accessibility and Impediments

The Bravo Area of Fort McClellan contains numerous paved roads, unpaved improved roads, and dirt roads, as well as fire breaks and trails that will be used to access areas to collect data. However, since grid locations are randomly selected and may not fall near roads or trails, and transects cross some of the more remote portions of the facility, it is anticipated that vegetation and terrain impediments will have to be overcome during field activities. Many of these conditions should be mitigated through the use all terrain vehicles, but some grids and transect starting points will likely only be accessible on foot.

6.6.2.15 Potential Worker Hazards

This information is reviewed in the Final General Site-Wide Plan, Section 5.5.16.

6.6.3 Geophysical Investigation Methods

6.6.3.1 Equipment

The EM-61 utilizes two coaxial receiver coils to measure the residual magnetic field generated by conductive and/or magnetic materials (i.e., non-ferrous and ferrous objects and features). The EM-61s employed during geophysical sampling of grids are designed to measure the residual magnetic field at a time when the response from conductive and/or magnetic objects is maximized compared to the response from most earth materials. The use of two receiver coils also makes it possible to differentiate, in a simplistic fashion, shallow versus deeper objects. An additional benefit of the specific design of the EM-61 system is that it permits a more focused observation of the subsurface in areas of cultural interference, as well as areas characterized by a high spatial density of medium to large-size (e.g., 81mm, 155mm) subsurface objects. This is due to both the mechanical design and operational parameters of the instrument, as well as the inherent nature of active EM fields, which diminish in magnitude at a much higher rate than other sensor technologies such as magnetometry.

6.6.3.1.1 The primary factors that affect the ability to detect objects or features with TDEM methods include volumetric size and orientation, distance from the sensor, the material properties contrast between the object or feature and the surrounding materials, and the magnitude of natural and manmade sources of “noise”.

6.6.3.1.2 The EM-61 is relatively insensitive to nearby surface cultural interference such as buildings, power lines, and fences, and has the ability to record digital data at 0.10-second intervals (using USRADS recording system), which translates to a spatial sample density of approximately 0.25 to 0.75 feet along the ground surface. When used with the Allegro digital recording hardware and software in GPS applications, digital data can be acquired at .075 to.05-second intervals, further increasing the sample density along the ground surface.

6.6.3.1.3 During the mountain transects, Schonstedt’s or White’s metal detectors will be employed to locate subsurface anomalies for intrusive investigation. These instruments were chosen since they can be carried in the extremely steep terrain being covered by the mountain transects.

6.6.3.2 Procedures

Each geophysical survey-sampling grid will be cleared of vegetation and other natural materials that may impede the data acquisition process, or significantly alter the resultant quality of data from the geophysical survey. After vegetation removal, UXO personnel will perform a surface clearance of metal in the grids prior to geophysical data acquisition. After these activities are completed, the area will be surveyed with the EM-61 and geo-referenced using the USRADS positioning system. Geophysical and position measurements will be digitally recorded and the raw data acquired in the field for each survey grid will be presented to the on-site data processing center at the end of each day's survey activities. These data will be processed, analyzed, and interpreted to prepare dig sheets for intrusive activities.

6.6.3.2.1 In order to survey densely wooded areas in the most efficient and cost-effective manner, portions of a one-acre site will be selectively cleared of vegetation and metallic items residing on the surface. Areas within the one-acre parcel that will be cleared will be those that require a minimum amount of time and use of ancillary equipment (e.g., chain saws, etc.). Priority for the removal of vegetation in the selected areas of the one-acre parcel will be based on the potential to degrade the quality of the geophysical data and/or adversely affect the safety of the geophysical equipment operators (e.g., tripping hazards). Qualified UXO personnel prior to the commencement of geophysical data acquisition activities will also remove metallic items located on the surface. Removal and disposition will conducted pursuant to the General Site Wide Work Plan.

6.6.3.2.2 Within the one-acre parcel that has been selectively cleared, the equivalent of 0.5 or 0.25 acres of geophysical data will be digitally collected using an EM-61 coupled to an USRADS positioning and data recording system. The data acquired may not be contiguous in all areas due to obstructions and other natural features that may adversely affect the data acquisition process. The proposed method of site vegetation removal, surface metal clearance, and geophysical survey permits the acquisition of the highest quality data to ensure the most accurate determination of the Presence of OE, or lack thereof, in a specific area.

6.6.3.2.3 To effectively use the USRADS positioning and data recording system, a minimum of three transponders will be located at positions with known coordinates (relative or absolute). The remaining transponders will be positioned over the area with a geometry that enables the instrument location to be accurately determined. A minimum of one location will be occupied with a transponder where the coordinates are known. However, this x-y coordinate will not be entered as a fixed (i.e., known) point in the USRADS acquisition software. Locations such as these will be used in the field as QC checks of the relative accuracy of the position coordinates. All transponders that are not located at points with known coordinates will have their location marked with PVC pin flag for future reference. A portable computer located near each survey grid will be used to record the EM-61 instrument data and coordinate position information. The intensity of the EM-61 measurements will be closely monitored to ensure the EM-61 data recording system is functioning properly.

6.6.3.2.4 For all transects, way points will be entered into GPS to allow teams to locate a given transect. Data collection transects will be laid out in a rectangular pattern with twelve 200-foot segments separated by 10 to 25 feet. Corners will be surveyed using GPS, and 200-foot segments will be marked using stakes. Segments will be surface cleared and brush cleared as necessary for EM-61 data collection. Navigation will be tracked using a combination of known GPS points and relative stake locations within the transect. Digital geophysical data will be collected along the transect using the one-meter EM-61 coil. During data collection, team members will place flags in the ground when audible signals are received from the EM-61 indicating the presence of an anomaly. Flags will be intrusively investigated following data collection. Digital geophysical data recorded for each transect will be available for processing and anomaly recognition if reacquisition of anomalies is necessary, but the intrusive investigation of the transects will be performed based on flagging audible anomalies and digging the flagged locations.

6.6.3.2.5 Delineation transects will be walked in approximately straight lines across areas of suspected high OE density to define the edges of those areas. Teams may deviate from the straight lines to avoid rough terrain. Navigation will be tracked using staked locations along the transect with GPS coordinates recorded at the stakes. Following surface and brush clearance, digital geophysical data will be collected using the EM-61 one-meter coil. The geophysical data will be processed and interpreted to identify anomalies and their geographical distribution. No intrusive sampling will be done along delineation transects.

6.6.3.2.6 Mountain transects will be walked generally along slope contours in steep areas over 40 degrees. Each transect team will consist of a UXO Technician III and two UXO Technician IIs. Transects will cover a 15-foot wide swath. OE will be detected using a visual survey of the 15-foot swath, assisted by a magnetometer covering the center 3 to 4 feet of the swath. Subsurface anomalies will be counted and recorded, and the team will intrusively investigate one anomaly approximately every 290 feet on average (equivalent to 10 per acre, or 137 digs over the 7.5 miles of transects). GPS points will be recorded periodically along each transect to track transect locations. GPS locations, as well as a photo and item description, will also be recorded for surface UXO finds and all intrusively investigated anomalies. Up to 70 additional anomalies over the 7.5 miles of transects will be intrusively investigated. This will allow additional characterization in areas encountered that appear to have a potentially high density of OE related items.

6.6.3.3 Personnel

The geophysical staff will consist of a Geophysical Task Manager (GTM), who meets the qualification requirements listed in DID OE-025, and two field geophysicists (FG). Three geophysical survey crews will be used to acquire data for the oversized grids and three survey crews will be also be used to collect the data for the ribbon walk transects. For the oversized grid application, each acquisition team will consist of one experienced USRADS operator and two UXO personnel. The ribbon walk transects will consist of two teams, an advance team and a data acquisition team. The advance team will consist of two UXO personnel. The data acquisition team will consist of three UXO personnel, one EM61 operator, one person to carry the Leica SR530 GPS data logger and backpack, and to carry supplies (water, first aid, pin flags, extra batteries for electronic equipment). Personnel qualifications are included in the Appendix A of this document.

6.6.3.3.1 The GTM will work with the field geophysicists and the Foster Wheeler Environmental PM to ensure the production rates are met and the data quality, especially during field data acquisition activities, is adequate to meet the program objectives. The GTM will be responsible for the overall quality of the geophysical program, and will provide guidance to the FGs in the processing and interpretation of the data. The FGs will process and interpret the geophysical data in conjunction with the GTM, as well as provide field QC oversight for the data acquisition and specific intrusive investigation processes (e.g., target reacquisition, comparison of excavation results with the interpreted geophysical characteristics). The data acquisition personnel will be responsible for collecting data and providing this data to the processing center on a daily basis. Due to the importance of maintaining an acceptable level of data quality for the geophysics portion of the investigative program, a more thorough description of the responsibilities of the FGs are reviewed below. The FGs are responsible for overall coordination of data acquisition, data processing, and technical review of geophysical and intrusive investigation data. The FGs work as an integrated team with the GTM and the PM to ensure the success of the geophysical phase of the project. The specific responsibilities of the FGs include the following:

- Scheduling field crew activities in concert with the Delivery Order Manager;
- Establishing and maintaining communications with data acquisition team personnel;

- Assisting the information systems manager with the maintenance of the data stream pertaining to the geophysical survey;
- Ensuring that all materials needed at the survey site are in stock (e.g., geophysical equipment, writing materials, tape, diskettes, CDROM, PVC pin flags, etc.);
- Planning the field data acquisition schedule for the next day with the Delivery Order Manager;
- Reporting survey production and level of quality information to the GTM on a bi-weekly basis;
- Performing weekly inspections of geophysical instrumentation;
- Creative thinking to improve the efficiency and/or quality of the data based on site- specific survey conditions;
- Processing and interpretation of the geophysical data;
- Comparison of the intrusive results with the characteristics of the geophysical data; and
- Transfer of the raw and positionally corrected data to CEHNC geophysical representative on a weekly basis.

6.6.3.3.2 The members of the oversized grid or ribbon walk data acquisition teams are responsible for the acquisition of geophysical data and will work in conjunction with the FGs. Their responsibilities include:

- Following the designed geophysical survey protocol in a consistent manner;
- Documenting pertinent information for each USRADS or DGPS setup file (e.g., acquisition settings, data acquisition personnel for the EM61 backpack and coil, sources if interference, etc.);
- Transfer of data from the data recording devices to PCMCIA (or equivalent) media and delivery of the raw, uncorrected position and EM61 data for each USRADS or DGPS setup file for each grid (organized by date and grid hierarchy) to the processing center on a daily basis;
- Maintaining geophysical and related equipment and supplies in excellent condition; and
- Performing weekly inspections of position instrumentation.

6.6.3.4 Production Rates

It is estimated that 1.75 acres of data can be acquired per crew for the oversized grid surveys. Production rates for transects are estimated to be less than 1 mile per day for the data collection transects through rough terrain and for delineation transects over high-density sectors. Factors that may affect the production rate include excessive grade of topography, increased near-surface vegetation and tree density, accessibility (i.e., remoteness of site), site-specific “noise” (i.e., radio transmissions, large magnetic storms) and other dynamic events.

6.6.3.5 Data Resolution, or Line/Grid Width Requirements

This information is discussed in Section 5.4.5 of the General Site Wide Work Plan.

6.6.3.6 Data Density

This information is discussed in Section 5.4.6 of the General Site Wide Work Plan.

6.6.3.7 Data Processing

The Foster Wheeler Environmental FGs will perform preliminary geophysical and navigation data processing and Quality Control (QC) checks on a daily basis at the on-site processing center. The final analysis and interpretation of the data will also be performed at the on-site processing center and at a centralized processing center located at the Foster Wheeler Environmental Lakewood, Colorado office. Processing, QC, and analysis and interpretation of the data are performed with internally developed software that has been specifically produced to integrate and interpret digital geophysical data acquired with USRADS and DGPS positioning systems. The specific parameters used to process the data may vary. However, the processing parameters and results are documented in digital computer files so that the sequence of events can be reconstructed and analyzed at a later date, if necessary. This level of documentation helps to ensure that the overall process is repeatable.

6.6.3.6.1 The Foster Wheeler Environmental computer workstation(s) at the on-site processing center will be used to store all finalized project data for the geophysical survey. Digital processing/interpretation portfolios will be maintained for the survey so that the processing/interpretation sequence can be reproduced at a future date, if necessary. The format of the digital geophysical data, as well as the graphics produced, will be compatible with the existing project database protocols (CEHNC ASCII ADF space delimited x,y,z file format, with appropriate header information). Foster Wheeler Environmental shall preserve the integrity of the raw, positionally corrected data and ensure that these data are provided to a CEHNC representative on a weekly basis.

6.6.3.6.2 The geophysical and position data supplied to CEHNC will allow for corrections such as navigation, and instrument bias shift but there will be no filtering or normalization of this data. All corrections to the data and pertinent field activities will be documented in a Microsoft Word file that will be delivered to CEHNC with the numerical data. Each grid or ribbon walk segment shall be logically and sequentially named so that the file name can be easily correlated with the grid name used by other project personnel.

6.6.4 Location Surveying, Mapping and Navigation

This information is discussed in Section 5.5 of the General Site Wide Work Plan.

6.6.5 Instrument Standardization

This information is discussed in Section 5.6 of the General Site Wide Work Plan.

6.6.6 Data Processing, Correction, and Analysis

This information is discussed in Section 5.7 of the General Site Wide Work Plan.

6.6.7 Quantitative Interpretation and Dig Sheet Development

This information is discussed in Section 5.8 of the General Site Wide Work Plan. For this specific task, signal peaks recorded by the EM-61 that are separated by more than 3.5 ft will be selected as individual targets unless ancillary information (signal gradient, anomaly shape) suggest the anomaly is unique. Areas of increased target density will be identified on the dig sheets as “multiple targets probable” in order to assist excavation personnel to the highest degree possible.

6.6.8 Anomaly Reacquisition

Based on the site characteristics, it is anticipated that USRADS (oversized grid) and GPS and/or DGPS (ribbon walk) will be the primary methods used to provide navigation assistance to relocate the x-y grid

coordinates of interpreted targets. Based on some of the results from the 1999 Fort McClellan prove-out test, as well as testing conducted by Foster Wheeler Environmental personnel at the M1.01 Parcel in December 2000, the USRADS transponders will be positioned around and within the survey grid at the same x-y locations used during data acquisition. Small non-metallic markers (e.g., PVC pin flags) will be used to mark the location of all transponders during the data acquisition process so that this objective can be achieved. This procedure should ensure that anomalies selected for excavation can be reacquired within approximately 1 - 2 feet of their interpreted location.

6.6.8.1 The reacquisition teams for the ribbon walk portion of the geophysical survey will return to the general target area using a Garmin handheld GPS unit. Once in the general area the teams will be able to orient themselves relative to the stakes defining the original route, and excavate flagged anomalies.

6.6.8.2 Because of the relatively long time it takes to setup and initialize the USRADS positioning system, a robotic total station instrument will also be tested prior to or during the initial stages of the program in order to assess its effectiveness for target relocation for the oversized grids. Based on the client's acceptance of the test results, the robotic total station may be used for target reacquisition in lieu of the USRADS. If the robotic total station is used, it will be positioned at one of the known coordinates (preferably the southwest corner of the grid), and the relative grid north direction determined by occupying another known coordinate (preferably the northwest corner of the grid). As an alternate, in grids with low concentrations of anomalies, dig locations may be reacquired using taped distances from known coordinates within a given grid.

6.6.8.3 At this stage, an EM-61 (Hand-held mode) and/ or Vallon VMX 2 will be used by a qualified Foster Wheeler Environmental UXO and/or a FGs to pinpoint the target location within approximately 20-cm. Qualification will be proved through a successful completion of a prove-out grid with an EM-61 hand held (HH) and a Vallon VMX 2. The interpreted target position will be marked on the ground surface with a boot mark or other simplistic method of identifying the interpreted location. Using the interpreted location as the origin of search, a 3.5 ft radius will be scanned with the reacquisition instrument. The reacquired location of the target will be flagged and a unique identification number written on the flag. This location will also be digitally stored or transcribed onto the reacquisition sheet in relative or absolute coordinates, <u>not</u> as an offset from the interpreted location.

6.6.8.4 Where there is an indication during reacquisition of multiple targets within a 3.5 ft radius of the interpreted location, or a positive instrument indication is not received, the interpreted location will be flagged and the pertinent information logged on the target reacquisition sheet (e.g., positive instrument response at x= 23, y= 57, ~ 4.5 ft SW of interpreted location, or multiple small hits ~ 5 ft N of interpreted location). The reacquisition information will be returned to the on-site processing center and stored in a separate folder for each grid. Reacquisition information will be reviewed by the FGs on a daily basis, and the GTM informed of interpreted locations that have been flagged, however reacquisition data indicate may not exist within a 3.5 ft radius of the flag. Foster Wheeler Environmental will also report any anomalies that could not be reacquired and the reason(s) for the occurrence.

6.6.8.5 A separate excavation team will return to the grid and excavate each flagged location. The excavation information will be digitally logged on a field computer and transferred to the on-site processing center on a daily basis. The Foster Wheeler Environmental SUXO and FGs will approve any detectors used for additional search at or surrounding the flagged location and/or for hole clearance prior to use by the excavation team.

6.6.9 Feed-Back Process (Comparison of Dig-Sheet Predictions with Ground-Truth)

Intrusive investigation results will be constantly evaluated and compared against interpretation data to ensure that the interpretation is as repeatable and accurate as possible for the specific site conditions. Should intrusive results diverge significantly from interpretation data, CEHNC will be notified and a

procedure implemented to evaluate the components of the relevant processes involved. This procedure will ensure that the disparity between the results is minimized for subsequent grids investigated in the Bravo Area. If necessary, geophysical investigation components will be evaluated including data acquisition (coverage, density, quality, noise levels, positioning), data processing (merging of EM data and position data, filtering if necessary, background shifts), and data interpretation (anomaly analysis, computer calculations for locations, sizes, and depths). The procedures for target reacquisition will also be evaluated. Corrective measures will be implemented, as necessary, to ensure that subsequent interpretive data and/or reacquisition procedures are modified to more accurately reflect ground-truth results.

6.6.9.1 For the investigative methods proposed for use in the Bravo Area, Foster Wheeler Environmental believes that for singular, isolated (not multiple, closely spaced) targets, 95% of these items will be excavated within a 20 cm radius of their surface location as marked in the field after target reacquisition. In addition, there will be no more than 15% "false positives" where the anomalies reacquired by the excavation team and/or target reacquisition team result in no detectable, metallic material during excavations.

6.6.10 Quality Control

Quality control mechanisms will be implemented to ensure the data acquisition, processing and interpretation, and target reacquisition practices are monitored to a sufficient level to meet the overall program objectives for a particular area.

6.6.10.1 Each EM-61, USRADS, and GPS used during the project will be listed according to make, model, and serial number in the field logbooks and/or in the digital data logger for the respective instruments. Instrument functional and repeatability tests for the EM-61, USRADS, and GPS will be digitally recorded and available for review by quality assurance (QA) personnel. Instrument-specific functional and testing procedures are described below.

6.6.10.2 At the beginning of each EM-61 data acquisition file prior to the commencement of coil movement, data will be acquired for approximately 30 seconds to ensure the repeatability of the data measurements. At the commencement of coil movement, the instrument operator will traverse over a elongated metallic object (Schonstedt, rebar, etc.) a minimum of three times in opposite directions to ensure the detection capability of the EM-61, as well as provide timing information used to positionally shift the USRADS and GPS measurement locations. The actual position of this “time synch” target will be marked in the field with three PVC pin flags (two on the end and one in the middle). These flags will not be removed until the final excavation has been performed on that grid.

6.6.10.3 No calibration will be made to the EM-61, USRADS, or GPS instrumentation since they are calibrated prior to leaving the factory. However, EM-61 and positioning measurements will be recorded over a portion of an existing data acquisition for each data acquisition session or at a designated location to provide information on the precision and repeatability of the entire data acquisition process.

6.6.10.4 QC mechanisms will also be applied to the analysis and interpretation of the geophysical data. All significant processing and interpretation parameters are digitally logged to a computer file to provide an audit trail for QA. Above ground cultural features (e.g., metallic monitoring wells, time synch target) will be noted in the field notebook and surveyed using the USRADS or DGPS technology where relevant. In addition, these targets interpreted to be the result of above ground cultural features may be selected for target reacquisition to exhibit the repeatability of the acquisition, processing, interpretation, and target reacquisition processes.

6.6.11 Corrective Measures

This information is provided in Section 5.8 of the General Site Wide Work Plan.

6.6.12 Records Management

This information is presented in Sections 5.2.7 and 14 of the General Site Wide Work Plan.

6.6.13 Interim Reporting

This information is presented for the geophysical data in Section 5.2.7 of the General Site Wide Work Plan.

6.6.14 Final Reports and Maps

This information is presented in Section 14 of the General Site Wide Work Plan.

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6.7 Ordnance and Explosives Risk and Protectiveness Assessment

6.7.1 Introduction

6.7.1.1 This section provides the plan for the analysis of potential exposures to ordnance and explosives (OE) to be performed for Bravo Area at Fort McClellan, in Anniston, AL in Calhoun County. An initial baseline OE risk assessment and a subsequent assessment of the level of protectiveness and risk reduction afforded by candidate response action alternatives will be undertaken as part of the Engineering Evaluation / Cost Analysis (EE/CA) being performed for Bravo Area. This analysis will be conducted using the Ordnance and Explosives Risk Impact Assessment (OERIA) methodology.

6.7.2 Identification of Sampling or Characterization Sectors within Bravo Area

Bravo Area consists of a backward "L"-shaped area located in the southern portion of the Fort McClellan Redevelopment Area (see Figure 2-2). Bravo Area lies south and east of the Main Post, west of the Choccolocco Mountains.

6.7.2.1 Based on the review of the historical records for this portion of Fort McClellan and the field reconnaissance data, Bravo Area was previously divided into ten sectors for purposes of the Phase I Site Characterization (See Figures 6-14 through 6-23):

- Sector M3-1L (in Redevelopment Parcel M3) – Located to the east of the Choccolocco Mountains and north of the Skeleton Mountains. This is the largest and southernmost of the Bravo Area sampling sectors.
- Sector M3-1M (in Redevelopment Parcel M3) – Located west of Perry Hill, running north-to-south through the Bypass Corridor. This sector also encompasses Sunset Hill and Yahoo Lake to the East.
- Sector M3-2M (in Redevelopment Parcel M3) – Located east of Sunset Hill and south of the Main Post. (NOTE: Sector M3-3H lies wholly within this sector)
- Sector M3-1H (in Redevelopment Parcel M3) – This sector is near the Bypass Corridor, west of Sunset Hill, and south of the M1.01 Parcel.
- Sector M3-2H (in Redevelopment Parcel M3) – Located northwest of Yahoo Lake along the Bypass Corridor near Iron Mountain.
- Sector M3-3H (in Redevelopment Parcel M3) – Located to the southeast of Sunset Hill and south of the Main Post. (NOTE: This sector is located within the outer boundaries of Sector M3-2M)
- Sector M4-1L (in Redevelopment Parcel M4) – This sector runs northeast-to-southwest along the southeast border of the Main Post.
- Sector M4-1M (in Redevelopment Parcel M4) – Located to the west of the Choccolocco Mountains and the southeast portion of the Main Post. (NOTE: Sectors M4-1H and M4-2H lie wholly within this sector)
- Sector M4-1H (in Redevelopment Parcel M4) – Bordered by the Choccolocco Mountains to the East and the southeast portion of the Main Post. (NOTE: This sector is located within the outer boundary of Sector M4-1M)

- Sector M4-2H (in Redevelopment Parcel M4) – Located southeast of the Main Post and west of the Choccolocco Mountains. (NOTE: This sector is located within the outer boundary of Sector M4-1M)

6.7.2.2 The available information for each of these areas was reviewed and evaluated. Based on this information, a conceptual picture of the possible sources of OE items was developed for each of these characterization sectors, as well as the potential for direct contact exposure to those items assuming future redevelopment or reuse activities. This background and perspective was applied directly during the preparation of the Work Plan for the Phase I Site Characterization of the Bravo Area. This conceptual understanding, formulated as a conceptual model of potential exposures to OE, is summarized below for each site characterization sector.

6.7.3 Conceptual Site Models

6.7.3.1 Overview of Conceptual Site Models

6.7.3.1.1 A conceptual site model (CSM) depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of an area. The CSM identifies the primary sources or ordnance-related activities that were, or may have been, conducted at some point in time that resulted in OE being present in an area. A CSM also identifies the principal mechanisms by which ordnance items may migrate or move from one location to another in the area or shift from one depth in the soil to another. The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil or other environmental media. These locations may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with redevelopment or reuse of the area. At Ft. McClellan, these may generally include future residential, commercial or industrial workers, construction workers, possible hunters, and recreational users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the Bravo Area sectors.

6.7.3.1.2 The CSM for each Phase I Site Characterization sector is presented below, along with highlighted discussions of the findings of the Phase I Site Characterization investigation relative to the elements of the CSM.

6.7.3.2 Conceptual Site Models for Bravo Area Characterization Sectors

6.7.3.2.1 Conceptual Site Model for Characterization Sector M3-1L

6.7.3.2.1.1 Figure 6-14 presents the CSM for potential exposures to OE in Characterization Sector M3-1L in Redevelopment Parcel M3. The CSM was developed in recognition of multiple uses of this area over time, as depicted in the inserted table in Figure 6-14 (Note: Plate 3 of the ASR indicates the earliest activities in the area, with more recent periods of use on subsequent plates through Plate 10 from the ASR). This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. The CSM identifies the primary sources or ordnance-related activities that were, or may have been conducted at some point in time, that resulted in ordnance being present in this sector. The primary sources were various firing points and range safety fans located throughout the sector, and an impact or target area. Firing is the mechanism by which OE would have been deposited into a range safety fan or impact/target area. At the non-small arms firing points, ordnance may also have been released as the result of mishandling, poor

housekeeping, or loss. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.1.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include passive recreational and cultural users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.2 Conceptual Site Model for Characterization Sector M3-1M

6.7.3.2.2.1 Figure 6-15 presents the CSM for potential exposures to OE in Characterization Sector M3-1M in Redevelopment Parcel M3. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. Direct contact with the surface water and sediments (as potential exposure media) also is indicated but OE presence in these areas has not been confirmed (represented as a dashed box in Figure 6-15). The primary identified sources were various firing points and range safety fans located throughout the sector, and combat ranges. An impact or target area for ordnance and munitions (not limited to small arms) also is indicated by the historical documentation, but has not been confirmed (and is therefore depicted in the CSM as a dashed source box). Firing is the mechanism by which OE would be deposited into the range safety fans or impact/target area. At the non-small arms firing points, ordnance may be present as the result of mishandling, poor housekeeping, or loss. OE may be present in the combat range area as the result of firing, poor housekeeping, mishandling, or loss. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector. The potential release to surface water or sediments also is indicated.

6.7.3.2.2.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another (e.g., soil to sediment). These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future residents, commercial workers, construction workers, and active recreational and cultural users of the area. Terrestrial and aquatic wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.3 Conceptual Site Model for Characterization Sector M3-2M

6.7.3.2.3.1 Figure 6-16 presents the CSM for potential exposures to OE in Characterization Sector M3-2M in Redevelopment Parcel M3. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. The primary sources were a firing point, various range safety fans

located throughout the sector, and an impact/target area. At the firing point, ordnance may have been released due to mishandling, poor housekeeping, or loss. OE may be present in the range safety fans and the impact/target area as the result of being fired. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.3.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future residents, commercial or industrial workers, construction workers, and passive recreational users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.4 Conceptual Site Model for Characterization Sector M3-1H

6.7.3.2.4.1 Figure 6-17 presents the CSM for potential exposures to OE in Characterization Sector M3-1H in Redevelopment Parcel M3. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. Direct contact with the surface water and sediments (as potential exposure media) is also indicated but OE presence in these media has not been confirmed (represented as a dashed box in Figure 6-17). The primary sources were a firing point, various range safety fans located throughout the sector, and two combat/training areas. OE may be present in the range safety fans as a result of being fired. At the firing point, ordnance may be present due to mishandling, poor housekeeping, or loss. OE may be present in the combat range/training areas as a result of firing, poor housekeeping, mishandling, or loss. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector. The potential release to surface water or sediments also is indicated.

6.7.3.2.4.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future residents, commercial workers, construction workers, and passive recreational users of the area. Terrestrial and aquatic wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.5 Conceptual Site Model for Characterization Sector M3-2H

6.7.3.2.5.1 Figure 6-18 presents the CSM for potential exposures to OE in Characterization Sector M3-2H in Redevelopment Parcel M3. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. The primary sources were a firing point, various range safety fans located throughout the sector, and impact/target areas. OE may be present in the range safety fans and the impact/target areas as the result of being fired. At the firing point, ordnance may be

present due to mishandling, poor housekeeping, or loss. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.5.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future passive recreational and cultural users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.6 Conceptual Site Model for Sector M3-3H

6.7.3.2.6.1 Figure 6-19 presents the CSM for potential exposures to OE in Characterization Sector M3-3H in Redevelopment Parcel M3. This CSM depicts the potential exposure pathways associated with direct contact with energetic ordnance and explosive items on the ground surface and in the subsurface soils of this sector. The primary sources were various range safety fans located throughout the sector and an impact or target area. OE may be present in the range safety fans and the impact or target area as the result of being fired. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.6.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future residents or recreational users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.7 Conceptual Site Model for Characterization Sector M4-1L

6.7.3.2.7.1 Figure 6-20 presents the CSM for potential exposures to OE in Characterization Sector M4-1L in Redevelopment Parcel M4. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. Direct contact with the surface water and sediments (as potential exposure media) also is indicated but OE presence in these areas has not been confirmed (represented as a dashed box in Figure 6-20). The primary sources were a range safety fan, two bivouac areas, and two training areas. The non-small arms impact/target area for ordnance and munitions also is indicated by the historical documentation, but has not been confirmed (and is therefore depicted in the CSM as a dashed source box). OE may be present in the range safety fan and the impact/ target area as a result of being fired. OE may have been purposefully placed or deposited into the bivouac areas and may be present in the training areas as a result of firing, poor housekeeping, mishandling, or loss. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector. The potential release to surface water or sediments also is indicated.

6.7.3.2.7.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future passive recreational users of the area. Terrestrial and aquatic wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.8 Conceptual Site Model for Characterization Sector M4-1M

6.7.3.2.8.1 Figure 6-21 presents the CSM for potential exposures to OE in Characterization Sector M4-1M in Redevelopment Parcel M4. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of this sector. The primary sources were various firing points and range safety fans located throughout the sector, combat/ maneuvers areas, impact or target areas, bivouac areas, a training area, and a demonstration/ testing area. At the firing points, ordnance may be present due to mishandling, poor housekeeping, or loss. OE may be present in the range safety fans and the impact or target areas as the result of being fired. OE may be present in the combat range/ maneuvers areas and the training area as the result of firing, poor housekeeping, mishandling, or loss. OE may have been purposefully placed or deposited in the bivouac areas, or released as the result of poor housekeeping, mishandling, or loss. OE may be present in the demonstration/ testing area as the result of kickouts or the incomplete destruction or disposal of items. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.8.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future commercial or industrial workers, construction workers, and active and passive recreational users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.9 Conceptual Site Model for Characterization Sector M4-1H

6.7.3.2.9.1 Figure 6-22 presents the CSM for potential exposures to OE in Characterization Sector M4-1H in Redevelopment Parcel M4. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in subsurface soils of this sector. The primary sources were two firing points in the sector, a combat/maneuvers area, and an impact or target area. At the firing points, ordnance may be present due to mishandling, poor housekeeping, or loss. OE may be present in the combat range/maneuvers area as the result of firing, poor housekeeping, mishandling, or loss. OE may be present in the impact or target area as the result of being fired. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector.

6.7.3.2.9.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector or shift from one depth in the soil to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future recreational users of the area. Terrestrial wildlife also may be exposed to ordnance items present in the sector.

6.7.3.2.10 Conceptual Site Model for Characterization Sector M4-2H

6.7.3.2.10.1 Figure 6-23 presents the CSM for potential exposures to OE in Characterization Sector M4-2H in Redevelopment Parcel M4. This CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in subsurface soils of this sector. Direct contact with the surface water and sediments (as potential exposure media) is also indicated but OE presence in these areas has not been confirmed. The primary sources were a firing point, various range safety fans located throughout the sector, two combat range areas, an impact or target area, and a demonstration/ testing area. At the firing point, ordnance may be present due to mishandling, poor housekeeping, or loss. OE may be present in the range safety fans and the impact or target area as the result of being fired. OE may be present in the combat range areas as the result of firing, poor housekeeping, mishandling, or loss. OE may be present in the demonstration/testing area as the result of kickouts or the incomplete destruction or disposal of items. These releases result in OE likely being present on the ground surface or in the subsurface soils of the sector. The potential release to surface water or sediments also is indicated.

6.7.3.2.10.2 This CSM also indicates the principal mechanisms by which ordnance items may migrate or move from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution and human activity, precipitation run-off, and erosion and frost heave (in limited, specific locations). The net result of the original deposition of the ordnance items and the localized transport and migration processes is a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. These may include future commercial or industrial workers, construction workers, and passive recreational users of the area. Terrestrial and aquatic wildlife also may be exposed to ordnance items present in the sector.

6.7.4 Projected Future Land Use and the Specification of Risk Assessment Sectors

6.7.4.1 All of Bravo Area within the ten Phase I Site Characterization sectors is within the area designated for potential redevelopment at Ft. McClellan. A refinement of the projected land use for Ft. McClellan (including Bravo Area) is presented in "*Land Use Plan 2020 Fort McClellan Reuse Plan*, prepared by EDAW for the *Fort McClellan Reuse and Development Authority*". Based on this recent projection of facility-wide future land use, Bravo Area includes a number of different land reuse designations:

- Active Recreation;
- Passive Recreation;

- Cultural;
- Development Reserve;
- Retail; and
- Mixed Business (Commercial or Industrial).

6.7.4.2 The risk assessment will be performed on areas within Bravo Area that are similar with respect to the:

1) history of ordnance-related activities in the area;

2) nature and amount of OE found during past reconnaissance and characterization activities; and

3) projected future land use for the area (as it affects the type of activities likely to be performed by people in the area and the manner and intensity with which they are likely to interact and intrude into the ground).

6.7.4.3 Based on an analysis of these factors, the ten Bravo Area characterization sectors may be further subdivided into more and smaller assessment areas for purposes of the risk assessment.

6.7.5 The Ordnance and Explosives Risk Impact Assessment Methodology

6.7.5.1 Introduction

6.7.5.1.1 Foster Wheeler Environmental plans to apply the 27 March 2001 Interim Guidance for the Ordnance and Explosives Risk Impact Assessment (OERIA) methodology to evaluate the level of potential exposure to OE indicated to be present in the various risk assessment sectors of Bravo Area. The OERIA process was developed by representatives of the U.S. Army Corps of Engineers as a stakeholder-friendly method of qualitative risk assessment to use for OE site EE/CAs. The OERIA process is based on the premise that OE risk is assessed (in large measure) and presented for purposes of communication with the site stakeholders, rather than to explicitly quantify it. As part of this analysis, Foster Wheeler Environmental will evaluate the nature and magnitude of potential exposures to OE in sub-areas of Bravo Area relative to current conditions and a set of candidate response action alternatives. Application of the OERIA methodology to Bravo Area will involve the direct analysis of site conditions relative to the following particular factors which are highlighted because of their role in determining or affecting the level of risk posed by OE that may be present in an area:

- nature of OE present (or suspected of being present) in each area;
- characteristics of the accessibility and stability of each area; and
- recreational or occupational activities expected to be performed in the area under projected future land reuse scenarios as defined in *"Land Use Plan 2020 - Fort McClellan Reuse Plan"*, prepared by EDAW for the *Fort McClellan Reuse and Development Authority*.

6.7.5.1.2 Information on these factors will be compiled and evaluated to develop a qualitative assessment of the potential for exposure to OE in each sector defined for the risk assessment. The OERIA process will be applied to develop a baseline estimate of the potential for exposure given

current site conditions and known site activities. The process will then be applied again for each risk assessment sector to assess the potential for exposure to OE assuming the conduct of the activities likely to be associated with the future use(s) of Bravo Area. The first (current use) assessment will be performed assuming that conditions relating to the presence of OE in each sector and the characteristics of the sites themselves remain as they were observed to be during the recent Phase I Site Characterization effort. The second (future use) assessment will then be performed assuming that each candidate response action alternative would be implemented with the goal of altering one or more of the factors that affect the level of protectiveness against OE exposure in that risk assessment sector. These results will be used as an input to the evaluation of the Protectiveness of Public Health and the Environment element of the Effectiveness Criterion performed for the EE/CA.

6.7.5.2 Performance of the OERIA Risk Assessment

6.7.5.2.1 The OERIA methodology will be applied for Bravo Area in three sequential steps, as outlined in the published guidance:

1) Review the base OERIA risk factors and identify any additional site-specific risk factors needed to better assess or communicate the OE-related risks in Bravo Area or to distinguish between the various candidate response action alternatives;

2) Perform the baseline risk assessment for each risk assessment sector; and

3) Assess the level of OE protection afforded by each candidate response action alternative for each risk assessment sector.

6.7.5.2.2 These steps will be applied for each identified Bravo Area risk assessment sector. It is anticipated that there will be a minimum of 10 risk assessment sectors, corresponding to the original Bravo Area site characterization sectors. As was noted above, the area within a risk assessment sector must have similar OE characteristics and similar projected future activities. As such, an analysis of the site characterization data will be made to determine if any of the site characterization sectors must be further divided prior to the risk assessment because of marked differences in the amount or nature of OE that is present. In addition, the future land use plan for Bravo Area will be considered to ensure that risk assessment sectors also are projected to have similar future activities and likely levels of interaction with the ground. The application of the OERIA methodology is anticipated to be similar and consistent with the revised approach used in the OE risk assessment conducted for the Alpha Area EE/CA. This revised approach is summarized below.

6.7.5.2.3 OERIA Step 1: Risk Factor Selection

6.7.5.2.3.1 This step of the OERIA process establishes the factors important to considering and communicating OE risk in the specific context of Ft. McClellan and Bravo Area. The basic OERIA risk factors will be the starting point for this identification process. These basic factors are listed in Table 6-2. They are seen to be associated with the nature and distribution of the OE items present, the physical characteristics of the site being assessed, and factors describing the type and scale of human activity likely to be conducted in that area. These basic risk factors are further described below.

Table 6-2
The Basic OERIA Risk Factors

Ordnance Risk Factors				**Site Risk Factors**		**Human Risk Factors**	
Type	Sensitivity	Quantity or Density	Depth	Accessibility	Stability	Activities	Population

6.7.5.2.3.1.1 Basic OERIA Ordnance Risk Factors

- The type of OE present affects the likelihood of injury and the severity of an incident. The OERIA documentation defines four categories for this factor, from Category 0 (inert OE or scrap that could cause no explosive injury) to Category 3 (OE that will kill an individual if detonated by that individual's activities).

- OE sensitivity affects the likelihood of the item functioning as designed and the severity of an incident. The OERIA documentation defines four categories for this factor, from Category 0 (inert OE or scrap that could cause no explosive injury) to Category 3 (OE that is very sensitive).

- OE quantity or density affects the likelihood that an individual will be exposed to energetic OE. There is assumed to be a clear relationship between OE density and the potential for harm. More OE is expected to present more potential for exposure. The OERIA documentation directs that the distribution, location, and the characteristic density of OE be described.

- OE depth in the ground affects the likelihood that an individual will be exposed as the result of his or her activities.

6.7.5.2.3.1.2 Basic OERIA Site Risk Factors

- The accessibility of the site affects the likelihood of people being exposed to OE. Any man-made (e.g., walls or fences) or natural barriers (e.g., terrain, topography, and vegetative cover) that preclude or limit access to the site are considered. The OERIA documentation defines three categories for this factor, from "Complete Restriction to Access" (where all points of entry are controlled) to "No Restrictions to Site" (No man-made barriers, gently sloping terrain, no vegetation that restricts access, and no water bodies that restrict access).

- Site stability affects the likelihood of coming into contact with OE as the result of recurring natural processes (e.g., frost heave, sand movement, or erosion) or because of extreme natural events (e.g., tornadoes, earthquakes, or hurricanes). The OERIA documentation defines three categories for this factor, from "Site Stable" (where OE should not be exposed by natural events) to "Site Unstable" (where OE is most likely to be exposed by natural events).

6.7.5.2.3.1.3 Basic OERIA Human Risk Factors

- The types of activities conducted at a site are related to the likelihood of people coming into contact with OE. The activities are generally classified as "recreational" (e.g., hiking, biking, or camping) or "occupational" (e.g., farming, industrial, or construction). The OERIA process

also considers the contact probability level associated with an activity or set of similar activities. The OERIA documentation defines three categories for this factor: "low", "moderate", and "significant". In general, recreational activities have a lower contact probability than occupational activities. Also, activities anticipated to disturb the surface of the ground or shallow depths in the soil have a higher contact probability than activities that would only disturb deeper soil. The OERIA guidance states to use the minimum depth of OE found in the area as the depth to consider in the analysis.

- The number of people using the site affects the likelihood of encountering OE. Again, there is assumed to be a clear relationship between the number of people using the area and the potential for harm. More individuals conducting activities in the area is expected to present more potential for exposure. The OERIA documentation suggests that an estimate of the number of people using the site can be made based on the type of site, access restrictions, population, or other demographic information.

6.7.5.2.3.1.4 Tailoring and Adding Site-Specific Risk Factors

6.7.5.2.3.1.4.1 Each of these basic sets of OERIA risk factors will be critically reconsidered in the context of Ft. McClellan, Bravo Area, and the site stakeholders. The basic OERIA risk factors will either be retained in their basic form, tailored in some manner to better fit conditions or circumstances at Bravo Area, or will be supplemented with a new or related factor. It is anticipated that the basic risk factors will be modified in much the same way and for very similar reasons as they were for the revised Alpha Area OE risk assessment. This key difference may lead to less of a need to separately evaluate current and future use land use scenarios (if they turn out to be very similar or the same). An example of the tailored set of risk factors used in the Alpha Area analyses is presented in Table 6-3.

Table 6-3
Tailored OERIA Risk Factors
(as used in the revised Alpha Area risk assessment)

Ordnance Risk Factors				**Site Risk Factors**		**Human Risk Factors (Current and Future Land Use)**		
OE Type	OE Sensitivity	OE Item Density	OE Item Depth Distribution	Site Access	Site Stability	Activity	OE Contact Probability Level	Population

6.7.5.2.3.1.4.2 The establishment of the risk factors, comprised of the basic OERIA risk factors with the noted tailoring and supplemental information, completes Step 1 of the OERIA process.

6.7.5.2.4 OERIA Step 2: Baseline Risk Assessment

6.7.5.2.4.1 This step of the OERIA process involves compiling and documenting what is known about the set of risk factors established for each risk assessment sector. The bases of this assessment are the conditions in each risk assessment sector that currently exist based on the information gathered up to that time. The first rows of the OERIA assessment table for each risk assessment sector (see the example in Table 6-3) will contain the results of the baseline risk assessment. The sector-specific OERIA tables will document how the various risk factors were interpreted and assigned values. Wherever appropriate, the OERIA factor definitions contained in the Interim OERIA Guidance will be used. Other site-specific definitions or modifications of

the Interim Guidance definitions will be clearly defined in the text or footnotes to the OERIA tables.

6.7.5.2.5 OERIA Step 3: Assess Candidate Response Action Alternatives

6.7.5.2.5.1 After the baseline assessment is completed, a set of candidate response action alternatives will be assessed for each risk assessment sector. The OERIA risk factors relative to potential exposures to OE will be estimated assuming the successful implementation of each alternative. The response alternatives will be comparatively ranked with respect to their impact on reducing OE-related exposure and risk in each risk assessment sector.

6.7.5.2.5.2 It is anticipated that the following six candidate response action alternatives will be evaluated for each Bravo Area risk assessment sector:

- Alternative 1: No Further Action
- Alternative 2: Institutional Controls
- Alternative 3: Construction Support
- Alternative 4: Surface Clearance
- Alternative 5: Clearance to 1 Foot Depth
- Alternative 6: Clearance to Depth

6.7.5.2.5.2 The specific details of the components and features of each of these candidate response actions will be defined prior to the performance of the OE risk assessment.

6.7.5.2.5.3 Each of the candidate response action alternatives will be evaluated with respect to its anticipated impact on the risk factors established for the Bravo Area risk assessment. Each response action alternative will be assessed and scored using the same process used for the baseline assessment. Once all individual risk factors for each alternative are scored relative to their impact on reducing potential OE exposures, the alternatives will be assigned an overall relative ranking.

6.7.5.2.5.4 An overall OERIA protectiveness ranking will be developed for each set of response action alternatives relative to the conditions in each risk assessment sector. The published documentation for the OERIA methodology does not provide specific guidance on how an overall ranking should be developed. This guidance also does not place limits or otherwise constrain this development. A simple, but systematic, approach will be used for the Bravo Area EE/CA for generating an overall ranking of the response action alternatives with respect to OE exposure potential and protectiveness. This approach will be based in large measure on professional judgment, logic, and an explicit effort to maintain consistency across the selected OERIA risk factors and across the different candidate response action alternatives. The revised approach used to develop an overall OERIA protectiveness ranking in the Alpha Area EE/CA will be considered as the prime candidate for use in Bravo Area. This selection, if appropriate, will foster consistency across the various areas of Ft. McClellan and facilitate risk communication efforts to the site stakeholders.

6.7.5.2.5.5 All the identified risk factors (ordnance, site, and human) will be considered in the development of the overall protectiveness ranking for each response action alternative. The relationship of these factors on protectiveness will be evaluated collectively to develop an overall protectiveness ranking for each alternative for that area for both current and projected future land use. The protectiveness levels to be used are:

- High - Assigned to the alternative or set of alternatives with the best level of OE protectiveness or risk reduction relative to existing conditions and the projected activities for that area.
- Low - Assigned to the alternative or set of alternatives with the lowest level of OE protectiveness or risk reduction relative to existing conditions and the projected activities for that area.
- Moderate - Assigned to alternatives with a level of protectiveness or risk reduction greater than Low and less than High.
- Baseline - Assigned protectiveness level for Alternative 1 – No Further Action.

6.7.5.2.5.6 Once the overall OERIA rankings for all candidate response action alternatives for a given sector are developed, the set of rankings will be reviewed collectively to ensure that ordering is consistent with the risk factor scores that were used to develop it. The rankings will also be examined to look for possible inconsistencies across the various risk factors considered in the assessment. Any adjustments that may have to be made relative to these considerations will be documented in the footnotes of the OERIA assessment summary tables for that risk assessment sector.

6.7.6 Summary

6.7.6.1 Throughout the assessment of potential exposures to possible residual OE items, Foster Wheeler Environmental will apply the 27 March 2001 Interim Guidance for the OERIA methodology (or the most updated version available at the time of the analysis) in a manner consistent with the available documentation and consistent with information obtained from communications with the staff of the USACE. The expected land uses and activities at the site, the projected frequency of occurrence of activities, and the expected distribution of surface and subsurface OE will likely be the most influential factors in the assessment. The range of activities currently conducted at the site or reasonably projected for the future and the numbers of plausible participants in these activities will be identified based on: the site reconnaissance performed by Foster Wheeler personnel; discussions with USACE personnel; and the most current, published plans for future reuse of Bravo Area. The expected type and amount of surface and subsurface OE present at the site will be estimated based on an evaluation of site-specific inspection and sampling data from the Phase I Site Characterization and the historical records of the site. The results of the risk assessment will be used in the broader evaluation of response action alternatives for each area.