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BRIDGETON LANDFILL—WEST LAKE LANDFILL

GAMMA CONE PENETRATION TEST (GCPT)
WORK PLAN
REVISION 1

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

Prepared For:
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GCPT Work Plan
Bridgeton Landfill, LLC

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1 INTRODUCTION

A detailed subsurface investigation is proposed in Area 1 of Operable Unit 1 of the West Lake Landfill Superfund Site in order to identify the optimum location and obtain geotechnical data for a possible contingent isolation barrier immediately to the north of the Bridgeton Landfill - North Quarry Area. The investigation is the first step in a process that may ultimately lead to the construction of the thermal barrier. Table 1 presents a preliminary plan and schedule for this process.

This document prescribes the location, technology, and methodology of this investigation. In particular, Cone Penetration Testing is selected for gathering detailed data to evaluate the southern extent of impacted material.

1.1 SITE CONDITIONS

In the 1970's West Lake Landfill received contaminated waste, including soil mixed with leached barium sulfate residues containing traces of uranium, thorium and their long-lived daughter products. The presence of the radiologically impacted material (RIM) resulted in the West Lake Landfill being designated as a Superfund site. For purposes of this Work Plan, RIM will refer to radiologically impacted material present at a level above that deemed appropriate for unrestricted use (5 pCi/g above background). The RIM is located in two areas at the site: Area 1, which is adjacent to the North Quarry Landfill and thus is pertinent to this investigation; and Area 2, which is located along the northern portion of the site. Area 2 is approximately 1,000 feet (at the closest) from the outer boundary of the North Quarry Area and is separated from it by a road and a closed demolition landfill (Figure 1). Collectively, these two areas have been designated as Operable Unit 1 for the Superfund investigation and remediation activities while the rest of the site was designated as Operable Unit 2.

The southern border of Area 1 is contiguous to the waste mass of Bridgeton Landfill, a quarry-fill landfill containing municipal waste. At the present time, Bridgeton Landfill is experiencing a Subsurface Smoldering Event (SSE) in its South Quarry Area. While the SSE is currently a significant distance from OU-1 Area 1, Bridgeton Landfill wishes to develop a response strategy to ensure that the SSE does not spread into the Area 1 RIM. One contingency under consideration is a subsurface thermal barrier located between Bridgeton Landfill's waste mass and the RIM located within West Lake OU-1 Area 1.

1.2 PROPOSED ISOLATION BARRIER

Bridgeton Landfill has evaluated the possibility of an excavated isolation barrier as a contingency means to prevent the SSE from advancing into the radiologically impacted material in West Lake OU-1 Area 1. Specifically, Bridgeton Landfill evaluated the excavation of waste to create an isolation barrier south of the southern limit of radiologically impacted material. Such an approach would also limit the volume of waste excavation, consistent with concerns raised by the Lambert-St. Louis International Airport Authority. Finally the relative speed of construction, about three months, allows such a system to be implemented quickly. This isolation barrier would provide the physical barrier that Missouri Department of Natural Resources (MDNR) has requested.

In order to develop the design plans for the isolation barrier, additional subsurface data is needed between known extent of the Radiological Impacted Material (RIM) within West Lake OU-1 Area 1 and the Bridgeton Landfill - North Quarry Area. This work plan proposes advancing several Cone Penetration Tests (CPTs) to determine the characteristics of the subsurface materials within proposed alignments of the isolation barrier and in between the potential barrier alignments and the southern edge of the Area 1 fence. The CPT device proposed within the work plan will also be capable of measuring gamma counts which will provide a fairly high degree of certainty that the proposed isolation barrier can be constructed without encountering RIM.

Consistent with discussions with the Missouri Department of Natural Resources, this Gamma Cone Penetration Test (GCPT) investigation will be the first of two phased investigations to confirm the thermal barrier location. An additional Work Plan and Health and Safety Plan for a boring / coring technology will be submitted which will detail the locations and procedures of borings, core sample collection, and sampling for the eight radioisotopes, as well as other potential hazardous constituents of concern within the barrier alignment proposed following completion of the GCPT. However, the second phase of this investigation is outside the scope of this GCPT Work Plan and GCPT Health and Safety Plan

1.3 Goals of the Investigation

Therefore, the primary goals of this investigation are:

- Determine the stratigraphy, nature, and geotechnical properties of subsurface materials for design purposes,
- Determine liquid levels,
- Determine if RIM exists within the proposed alignments, and
- Determine depth to native material.

Therefore, the primary goals of the Phase 2 investigation will be:

- Obtain core samples for analytical testing, and
- Determine type of waste/subsurface material (i.e. rock, municipal solid waste, construction and demolition waste, etc.)

2 PREVIOUS INVESTIGATIONS

Previous investigations in the vicinity of the contingent thermal barrier did not contemplate construction of a physical structure; therefore, high-density geotechnical data does not exist. However, previous investigations have evaluated presence of radioactive materials at West Lake Landfill using downhole gamma radiation logging of soil borings, collection and analysis of surface and subsurface soil samples, and overland gamma surveys.

2.1 PRIOR INVESTIGATION METHODS

Downhole gamma radiation logging and overland gamma surveys were used as the primary detection methods for these investigations. In addition, soil samples were collected for analysis of uranium, radium, thorium isotopes and their decay products as well as for non-radiological constituents. Results of these investigations are presented in the Soil Boring/Surface Sample Investigation Report (McLaren/Hart, 1996) and the OU-1 Remedial Investigation Report (EMSI, 2000). Eight radionuclides were identified as contaminants of concern based on their long half-lives: U238, U234, Th230, Ra226 and Pb210 from the U238 series; U235 and Pa231 from the U235 series, as well as Th232. Isotopes from the Thorium-232 decay series are also present at levels above background, although to a lesser extent.

2.2 EXTENT OF AREA 1 CONTAMINATION

Downhole gamma logging by McLaren/Hart in Area 1 found elevated radiation levels varying from zero to sixteen feet below ground surface (bgs), while the thickness of the materials generally ranged from one to five feet in Area 1. In the northwest region of Area 1, elevated readings ranged from zero to six feet bgs, while to the southeast, elevated readings were found as deep as 15 feet bgs. The impacted area is illustrated in Figure 2.

An overland gamma survey also detected gamma radiation above background at the ground surface. Results of the overland gamma survey are also shown in Figure 2. Laboratory analyses of surface soil samples (the upper 6 inches) detected radionuclides at levels above 5 pCi/g above background at boring locations WL-106 and WL-114.

2.3 SFS ESTIMATE OF RIM BOUNDARY

The 2011 Supplemental Feasibility Study (SFS) included a detailed estimate of the extent of RIM. An outline of the known impacted material was created using the available boring data, as well as an outline of the known non-impacted area (see SFS Appendix B-1, Figures 3 and 4). Based on these boundary conditions, the estimated border of the RIM was interpolated between these two boundaries. These boundaries, the interpolated RIM limits, and borings used to estimate the limits are shown in Figure 2 of this Work Plan.

The SFS delineation of the extent of RIM was sufficient for purposes of developing and evaluating potential remedial alternatives for OU-1. However, construction of the proposed thermal barrier requires a high degree of confidence that the alignment for proposed thermal barrier is located outside of the extent of RIM. Therefore, as part of geotechnical investigation of the proposed alignment, data will also be obtained to confirm that the selected alignment is not located in areas where RIM is present.

3 Proposed Investigation

3.1 Overview of Technique

The goals of the investigation are to gather the required geotechnical data for design and to provide confirmatory observations that material within the proposed excavation area and in between the potential barrier alignments and the southern edge of the Area 1 fence do not contain radiologically impacted material above the level appropriate for unrestricted use. The approximate limits of the materials containing materials higher than the standard for unrestricted use (5 pCi/g above background) were delineated in the 2011 Supplemental Feasibility Study. The general approach is to increase the number of observations in situ to verify that the selected alignment for the thermal barrier is located outside of areas of RIM. In addition, information is to be collected at each location regarding the stratigraphy, nature, and geotechnical properties of the materials as well as liquid levels, as relates to the design of the barrier system. Cone penetration with piezometer pressure readings (Piezo-Cone or CPT) along with a gamma radiation (G) sensor in a tool string has been selected as the most effective means of obtaining all the desired information within the area of interest.

The GCPT technique does not generate waste or bring physical material to the surface, does not generate dust or airborne emissions, and does not require introduction or collection of water or liquids (other than decontamination procedures). Therefore, it is a very suitable method for investigating areas that have the potential to contain radiological materials above background and landfill refuse.

Conceptual evaluation of barrier designs, reported in the March 29, 2013, letter to Mrs. Fitch of MDNR from Craig Almanza, identified potential alignments along which the barrier could be constructed. The conceptual evaluation also identified that the amount of material requiring excavation and the depth of such a barrier would be substantially lessened – along with all the negative impacts associated with waste excavation – if the barrier alignment were moved toward the north. This would allow avoiding the existing slopes of the North Quarry fill and would reduce the depth of excavation along the eastern portion of the alignment, where quarry activity followed by landfilling would require a much deeper excavation the farther south the barrier is located. The proposed investigation allows collection of information south of and, in some locations, up to the projected line of RIM material, in order to confirm the absence of RIM in the selected location and in between the potential barrier alignments and the southern edge of the Area 1 fence.

3.2 Gamma Cone Penetration Testing (GCPT)

GCPT (Piezo-Cone) soundings are a standard means of subsurface investigation and have been in widespread use since the 1980's. The general methodology and equipment used is described in ASTM D5778 and consists of an instrumented conical tip and friction sleeve of approximately

37.5 mm in diameter, fitted on the lower end of push rods that are forced at a constant rate into the subgrade. An electrical pressure transducer is included in the interval between the conical tip and the friction sleeve. A typical cone assembly is shown in Appendix A.

Tip force, sleeve force and pressure are all recorded as the push rods are advanced. Reading intervals are taken at intervals not exceeding 50 mm. The advance rate of the probe is approximately 2 cm/second, which is the ASTM Standard.

The type of soils, including waste materials, is inferred based on the analysis of combination of tip, sleeve and pore pressure while advancing (referred to as dynamic pore pressure). Work at other sites has demonstrated that interfaces between waste material and natural soil can be identified.

While the dynamic pore pressure is useful in the determination of soil types, static pore pressures can also be measured by performance of pore pressure equalization tests. This will provide the necessary information to determine liquid levels in the potential excavation area. These are performed by temporarily halting the progress of the cone and monitoring the pore pressure change with time. Given the typically sandy nature of the natural overburden it is anticipated that such tests will be of limited duration prior to attaining near steady state readings.

The gamma radiation logging will be performed using a proprietary device that is included in the equipment tool string behind the GCPT head. The device uses Cesium Iodide crystals. The device differs from a typical downhole logging gamma detector in that it is part of the push rod system and therefore has greater shielding from the thicker rod walls and is smaller in diameter for the same reason. However the device has been used successfully on other projects to detect the differences between clays and silts. A site specific empirical relationship will be developed using previously logged holes, as described in Section 3.2.1.2.

As stated previously, the purpose of the GCPT investigation is to identify subsurface radioactive material that may be present. The process is qualitative in nature and is not intended to be quantitative. Once the initial data is collected from the GCPT investigation (Phase 1) and a proposed location for the thermal barrier is determined, soil samples will be taken to perform a more complete analysis (Phase 2).

The soil core samples will be collected using sonic drilling, GeoProbe drilling, or other available and appropriate technologies. The samples will be collected using Auxier Procedure 3.3. The soil samples will be taken at various depth locations of the core boring sample. Biased samples will be taken at locations of radioactivity as identified by field radiation detection instruments. Other samples will also be taken where no radiation is detected by such radiation detection instruments. This procedure will be detailed in the Phase 2 Investigation Work Plan.

3.2.1 CPT Techniques

3.2.1.1 Cone Rig

A track mounted rig is proposed for the project. The rig will be able to supply 25 to 30 tons of down pressure. The track mounted rig exerts a limited ground pressure (less than 4 psi) and does not require hold-down anchors. This should avoid breaking the ground surface other than at the probe hole. The rig is self-contained, with all equipment readout, recording and on-board electricity within the equipment cab.

3.2.1.2 GCPT Correlation

3.2.1.2.1 CPT Device (Lithology Correlation)

These units will be correlated and tested in accordance with ASTM D5778. Correlation to in situ conditions for verification of the various zonation algorithms that may be applied will occur at soundings proximate to WL-108, WL-111, and WL-119 as well as at the gamma sensor calibration holes, as described below. The GCPT device correlation will only be between waste and in-situ alluvium.

3.2.1.2.2 Gamma Sensor (Radiological Impacted Material Correlation)

The gamma sensor readings will be correlated to site conditions in two ways. Soundings near the locations listed above, which are well outside the estimated RIM limits, will be used to establish a range of counts that are typical of background. This initial background value will be used to determine what readings obtained in the sounding locations trigger decontamination procedures. The value may be modified as the work progresses in non-RIM soundings.

In addition, soundings will be performed at the PVC-38 location, where previous gamma logging measured levels above background. The resulting readings will be used to evaluate a relationship between previous counts and the GCPT unit. If the original casing can be found, attempts will be made to advance the GCPT head within the existing casing. Otherwise two soundings will be performed, located at a 2-foot offset from the hole to the north or south, and will be advanced to a depth of 20 feet.

The use of boring hole PVC-38 is to correlate the readings obtained by the GCPT device in a boring known to have increased levels of radiation. This procedure will ensure that the device is operating as expected as the sensitivity to radiation is confirmed. As recommended by the USEPA in General Issue comment number 2, the correlation will also include a boring location of low or intermediate gamma readings to further define the relative sensitivity of the GCPT device. Boring hole PVC-28 will be used as an additional correlation site.

A daily response check of the GCPT will be performed with a check source such as a container of potassium carbonate (K_2CO_3) (which contains the naturally occurring isotope potassium 40) or a button source. This response check will be performed at the beginning and end of each day.

The sensor correlation readings will be taken prior to performance of the other soundings.

3.3 INVESTIGATION PROCEDURES

3.3.1 Land Clearing

As depicted on Figure 3, there will be 68 GCPT locations, with the 10 additional sampling locations extending to the southern perimeter fence line, in addition to GCPT calibration locations. The existing conditions of Area 1 include woody overgrowth and trees. Paths will be developed to minimize the clearing, but to allow access to all the GCPT locations. The vegetation will be cleared by selective woody vegetation removal techniques which allow small track mounted machines to cut and grind the vegetation in place. This should also minimize soil disturbance.

The path for the GCPT test locations will be determined by connecting nearby clearing paths which will originate from a cleared baseline (approximately following the N-1 Alignment). Paths connecting consecutive GCPT locations will start from this baseline, as depicted in Figure 3.

The paths will be guided by an onsite surveyor, and an onsite health physicist who will conduct an overland gamma scan. A Ludlum 2221 ratemeter/scaler mated to a Ludlum 44-20 3x3" NaI detector will be used to survey selected portions of ground surface within and around Area 1. This instrument will be coupled to a Trimble GPS and operated in the ratemeter mode. This mode will allow the gamma count rate from the instrument to be collected at one-second intervals and assigned to its specific measurement location (latitude and longitude).

The operator will hold the detector approximately 30 cm above the ground surface and advance across the areas of interest in a series of straight lines at a rate of approximately one meter per second. The separation distance between the lines will be approximately 1.5 meters. After the survey, the field data will be processed using a combination of industry-standard commercial computer applications. Because all data points will be tied to a spatial coordinate, a map of the data will identify areas of surface soil containing RIM. These areas can then be located in the field and avoided or covered.

If the overland gamma scan indicates a radiological level over background, the health physicist will notify the clearing crew that they could be in an area that has surface RIM, and to proceed in a manner that avoids ground disturbance. The path will be cleared of vegetation 10-20 feet in the general direction dictated by the onsite surveyor, then the cleared path and the path to be cleared (as much as practicable) will be scanned with the overland gamma scan, then the next section will be cleared. This procedure will be used in the same sequence until the desired test location has been reached. It is envisioned that paths to each test location will be approximately 10-15 feet wide, while a larger area (25-30 feet diameter) will be cleared at each test location.

The brush clearing will be accomplished by using a skid steer rotary brush and tree cutter. This device is an attachment to a track mounted skid steer tractor in the front of the machine, so the cutting and grinding platform will advance before the tractor and operator. The operator will place the cutting surface a few inches above the ground surface, and the ground wood chips will be coarsely ground and left in place. This should provide an adequate surface for the geotextile.

Small trees a few inches in trunk diameter will be shred in place. If larger tree diameters are encountered, an attempt will be made to alter the path around the tree. If it is impossible to avoid the large diameter tree, then a logger will be tasked to cut the tree at the surface. The tree will then be pushed to the side of the alignment by the skid steer and left in place.

Attempts will be made to minimize grinding of vegetation as much as possible. If appropriate and indicated, vegetation may be wetted before grinding. It is the goal to minimize any airborne particles generated by the vegetation clearing process. Extra effort shall be given to find suitable paths that do not require grubbing, and the use handheld equipment to clear/prune vegetation will be used where practicable.

3.3.2 Near-Surface Preparation

Once the path is cleared, a crew will deploy a minimum 6 ounce per square yard non-woven geotextile, and then approximately 6-8 inches of rock aggregate will be spread to advance gravel roads to each test location along the cleared alignments. This should greatly reduce the risk that soil contamination may be transmitted to the field crew, and minimize any rutting due to ingress and egress.

The area of investigation is known to contain small surficial layers of concrete and other inert rubble which in some locations may extend below the ground surface several feet. If necessary, a small trackhoe will be used to push rubble aside and, if necessary, remove near surface material below grade. Such an excavation, if required, will be kept to minimum practical dimensions and the resulting void will be backfilled with clean soil material which is tracked or pounded in place to create a stable surface for the geotextile and gravel pad described above. The rubble that is removed to the side of the CPT investigation area will be radiologically screened as described in Appendix C and allowed to remain in place if screening is negative.

Any removal of any surficial concrete or other rubble will be kept to an absolute minimum. Attempts will be made to disturb the soil as little as possible, if at all. A radiation survey will be performed of any such materials moved and records will be maintained.

3.3.3 Surveying

Once the final location for the GCPT has been cleared and the gravel access corridor has been constructed, the surveyor will affix a stake at the proposed location. The stake will be marked with a high visibility flag and the GCPT number, the Northing, Easting, and final ground surface elevation will be documented with permanent marker onto the stake. This information will also be recorded by the surveyor onto his/her field book or data logger.

3.3.4 GCPT Logging

Once the locations have been staked and checked, the GCPT rig will be deployed. It is envisioned that the GCPT rig will proceed to the first location, WL-111. This was a previously logged boring from the 1996 McLaren/Hart field investigation that included both lithology and downhole gamma logging. The rig operator will check the location and elevation information that is marked on the survey lathe to the information within the operator's notes. If there is any deviation, the operator will notify the Project Manager, who will determine if additional surveying is needed. If there is no conflict in the data, the GCPT rig operator will conduct the GCPT and log the data. The GCPT operator and the Project Manager will then determine if the gamma logging confirmed the absence of RIM material, consistent with the 1996 gamma log. In addition, the Project Manager will compare lithology from the new GCPT log and the 1996 McLaren/Hart boring for general consistency.

Please note that it is expected that WL-111 will contain no RIM due to the 1996 McLaren/Hart information.

This same procedure will be repeated at the WL-108 and WL-119 boring locations for consistency review with the previous work.

The GCPT rig will then be deployed to PVC-38 and PVC-28, where RIM is expected to be found. After the GCPT log is obtained from this location, the data will be downloaded and analyzed to determine if the GCPT was able to detect elevated gamma counts as the 1996 McLaren/Hart gamma log did, as shown on the original NGamma log included in Appendix B. The GCPT operator will then move the rig to the decontamination area for proper decontamination and radiological survey in accordance with this Work Plan. Based on the data collected, the Project Manager will determine whether readings at additional locations are needed.

Once it has been determined that the procedure is adequate for the determination of RIM and non-RIM materials, the GCPT rig will advance to each of the GCPT boring locations. After each GCPT test, the rig will be scanned and decontaminated before proceeding to the next test location. Each sounding hole will be filled with bentonite-coated pea gravel from the surface.

3.4 Contamination Surveys and Decontamination Procedures

The potential to spread contamination will be mitigated by checking equipment and personnel as they leave Permitted Areas. If contamination is identified, the contamination will be removed and the equipment rechecked. This is an iterative process that will continue until equipment and personnel meet exit criteria.

3.4.1 Radiological Surveys

Surveys will be used to monitor and control exposures and the potential spread of contamination. The following subsections describe the surveys to be used and their requirements.

3.4.1.1 Baseline Entry Survey – Equipment

All vehicles and large equipment entering Area 1 will be surveyed by the RCT (Radiation Control Technician) for fixed alpha and beta contamination before its initial entrance into Area 1. The survey will be conducted using a Ludlum Model 12 coupled to a Model 43-5 (or equivalent), and a Ludlum Model 12 coupled to a Model 44-9 (or equivalent) as described in A&A Procedure 2.7.

3.4.1.2 Permitted Area Exit Survey - Personnel

Personnel exiting a Permitted Area will have their shoes and clothing scanned upon leaving the area, as described in A&A Procedure 2.7. Records will include the name of the individual, the results of the exit survey, the location, and the times they entered and left the area on the a standard form such as A&A Form 11, Personnel Monitoring Form or a log sheet attached to a copy of the Radiation Work Permit. A reading of two (2) times the ambient background level will require decontamination before leaving the area.

3.4.1.3 Permitted Area Exit Survey - Equipment

Heavy equipment working inside a Permitted Area will be surveyed by the RCT before leaving the area. All surfaces in contact with soil will be scanned for beta surface activity with a Ludlum Model 12 coupled to a Model 44-9 (or equivalent) as described in A&A Procedure 2.7. A reading of two (2) times the ambient background level will require the equipment be decontaminated and resurveyed before it leaves the Permitted Area.

Sections of the downhole probe body will be sampled with a swipe between sampling locations detect any removable activity on the surface of the tool string. The swipe samples will be screened in the field with a Ludlum Model 12 coupled to a Model 43-5 alpha detector. A final measurement of alpha and beta activity on the smear will be performed using a Ludlum 2929 coupled to a Ludlum 43-10-1 or a low-background alpha/beta counter such as a XLB-5.

3.4.1.4 Final Release Survey - Equipment

Equipment working inside a Permitted Area and equipment that might inadvertently contact contaminated soil outside a cleared easement will be surveyed by the RCT before leaving Area 1. All surfaces in contact with soil will be scanned for alpha and beta contamination with a Ludlum Model 12 coupled to a Model 44-9 (or equivalent), and a Ludlum Model 12 coupled to a Model 44-5 (or equivalent) as described in A&A Procedure 2.7.

Removable contamination will be sampled by swiping 100 cm^2 areas on parts of the equipment that were in contact with soil surfaces as described in Procedure 3.6. These smear samples will be counted with a Ludlum Model 29 coupled to a Ludlum 2929 coupled to a 43-10-1.

If contamination is found, the vehicle will be decontaminated until it meets final release standards listed in Table 2. The equipment identification and the final results will be recorded on the appropriate equipment release form from the A&A Procedures Manual and the equipment will be unconditionally released from Area 1.

Table 2 Final Release Survey Limits for Equipment

Parameter	Limit	Meter Reading [a]
Fixed Alpha (Ra-226 & Th-230)	100 dpm/100cm^2, average 300 dpm/100cm^2, maximum	20 cpm Mo 12/Mo 43-5 60 cpm Mo 12/Mo 43-5
Fixed Beta (U_{nat} & assoc. decay products)	5,000 dpm/100cm^2, average 15,000 dpm/100cm^2, maximum	750 cpm Mo 12/Mo 44-9 2250 cpm Mo 12/Mo 44-9
Removable Alpha	20 dpm/100cm^2, average	na
Removable Beta	1,000 dpm/100cm^2, average	na

[a] Nominal values. Meter efficiencies will be reevaluated at the site.

3.4.2 Equipment Decontamination

All equipment (including but not limited to the GCPT rig) will be surveyed in accordance with Section 3.4.1 of the Work Plan. If radioactive contamination is detected, the equipment will be decontaminated. A phased approach to decontamination will be employed to minimize the generation of solid waste and waste water.

3.4.2.1 Dry Decontamination

It is expected that any contamination will be associated with loose, removable dirt and mud that may attach to the equipment's surfaces during operations. If contamination is detected on equipment after operations are completed in a Permitted Area, an attempt will be made to decontaminate the equipment before moving to the next Permitted Area. Visual patches of dirt and mud will be removed from the contaminated surfaces of the equipment using damp wipes, brushes, and scrapers. Used decontamination supplies will be placed in marked containers or bags. Chunks of removed mud and dirt will be placed down the closest sounding holes to the extent practical. The remainder of material removed during dry decontamination will be placed in a separate container with hard plastic or metal sides and staged for retrieval and sampling. The equipment will be resurveyed and allowed to leave the next Permitted Area if it meets the requirements described in Section 3.4.1.3.

3.4.2.2 GCPT Rig Decontamination

The CPT rig is equipped with a rod cleaning system. Tool strings (push rod probes) will be washed/wiped as they are removed from the ground to remove visible dirt and mud.

The washing system passes the rods, upon extraction, through a chamber with a wiper at the top and bottom. Heated wash water can be introduced as needed into the chamber to clean the rods more thoroughly. Upon completion of the soundings the washing chamber will be washed with Alconox and triple rinsed, and the wipers will be replaced. The wash water generated by these operations will be piped to the exterior of the rig, where it will be then collected outside the CPT rig and retained in a portable tank.

3.4.2.3 Wet Decontamination of Equipment

If dry decontamination is not sufficient to meet release levels, the equipment will be moved to the radiological decontamination pad. Contaminated surfaces will be scrubbed with brushes and soapy water until they are visually clean. The equipment will be surveyed again for both alpha and beta surface activity. If fixed or removable activity exceeding the release limits is found, the contaminated surface will be decontaminated using more aggressive methods such as pressure washing or abrasive blasting until the release criteria are met.

3.4.2.4 Waste/Water Management

Water used to decontaminate equipment will be placed in marked holding tanks and/or drums, sampled, and packaged and shipped to a licensed, managed disposal site.

Any solid radioactive waste generated will be packaged and characterized for shipping. This material will be shipped to managed disposal/treatment facilities that are permitted to receive the waste.

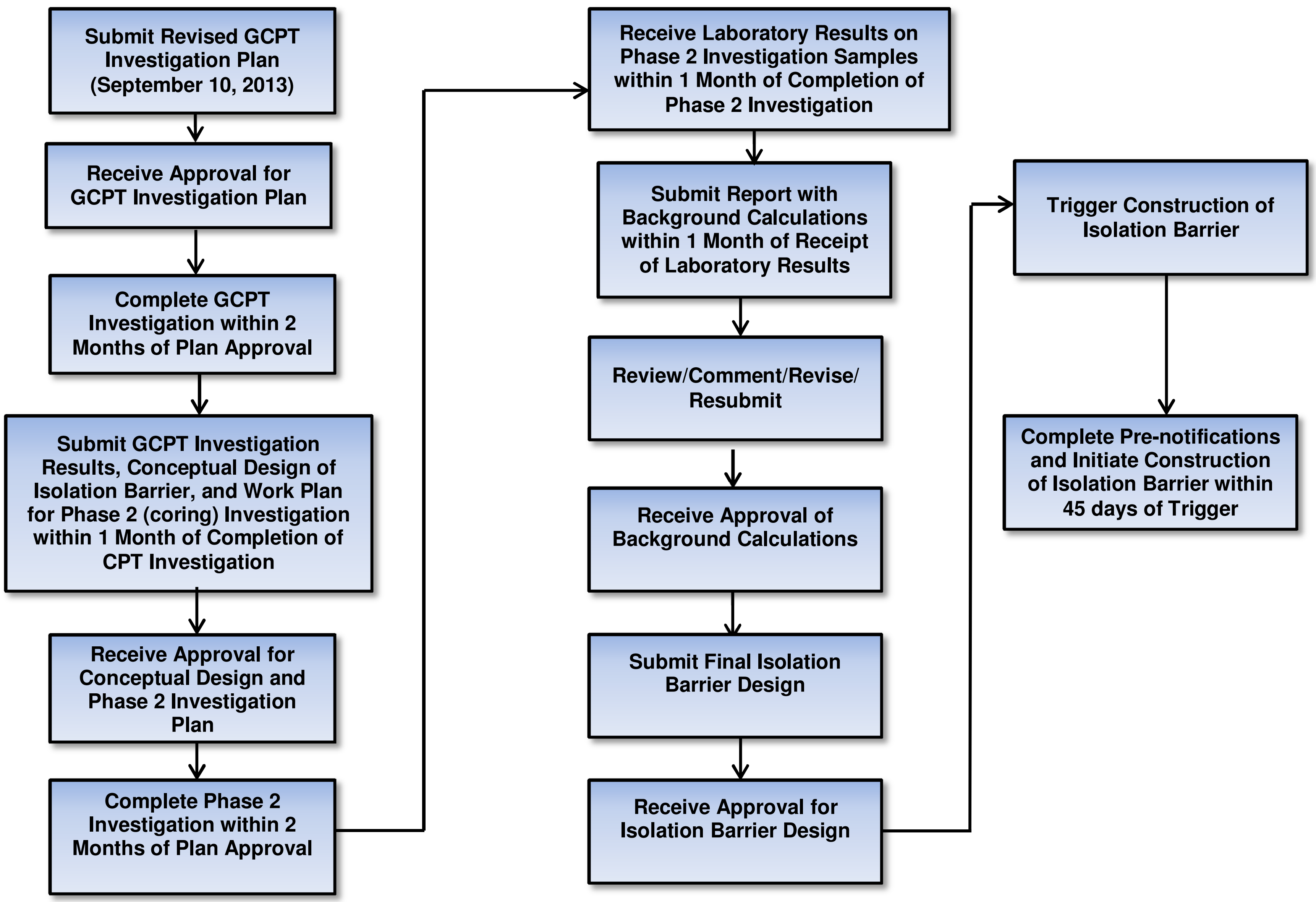
3.4.2.5 Final Housekeeping Wash-down

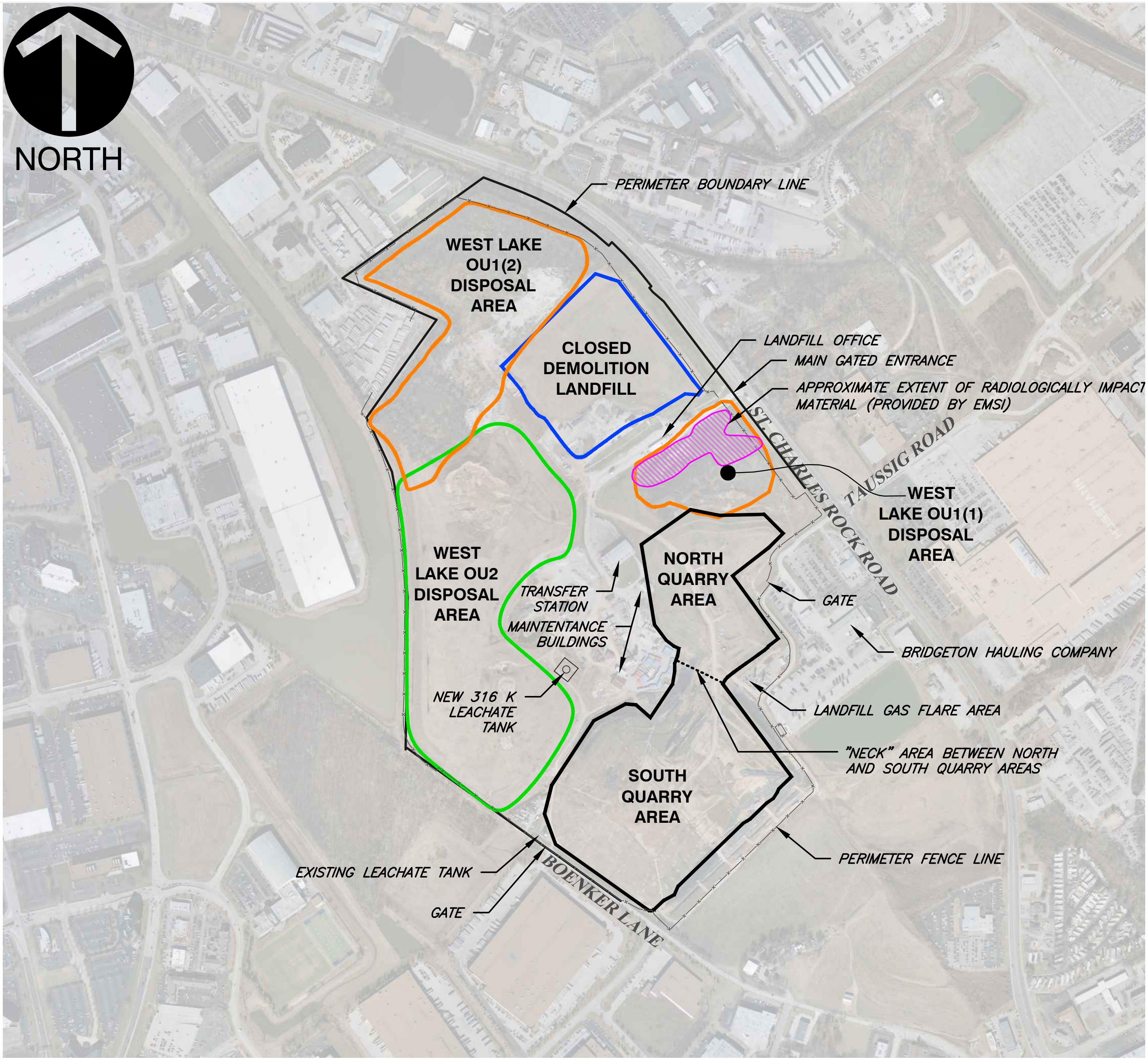
Because of the very high visibility of this sampling event, any equipment released from Area 1 will be washed with soap and water to remove visible dirt from its surfaces prior to its removal from the project. This final housekeeping can be performed in an uncontrolled area and any water generated from this final cleaning of previously released equipment will be considered unimpacted.

3.4.3 Decontamination Pads

Two separate decontamination pads will be constructed directly from the gravel clearing pads. A radiological decontamination pad will be constructed near PVC-38. This pad will be used to decontaminate equipment failing the free-release radiological requirements. A second pad will be provided for general cleaning of equipment that has not been exposed to RIM materials. This pad will be placed close to the fence near the entrance road to the OU-1 Area 1. These pads will be constructed using a geotextile and 8 inches of gravel.

TABLE 1
SCHEDULE FOR CONTINGENT ISOLATION BARRIER





REFERENCE

1. AERIAL IMAGERY PROVIDED BY EAST WEST GATEWAY COORDINATING COUNCIL OF MISSOURI AND ILLINOIS, COLLECTED IN LATE FEBRUARY AND EARLY MARCH OF 2012.

2. BOUNDARY INFORMATION PROVIDED BY SHERBUT-CARSON & ASSOCIATES, P.C. DRAWING NAME-1111 LEASE EXHIBIT.DWG RECEIVED ON 03/04/2013

SCALE IN FEET

0 1000 2000

BRIDGETON LANDFILL, LLC
13570 ST. CHARLES ROCK ROAD
BRIDGETON, MISSOURI

FACILITY MAP

DRAWN BY: MSP	CHECKED BY: MRB	APPROVED BY: DRAFT	FIGURE NO.:
DATE: JUN. 2013	DWG SCALE: 1"=1000'	PROJECT NO: 131-178.0001	1

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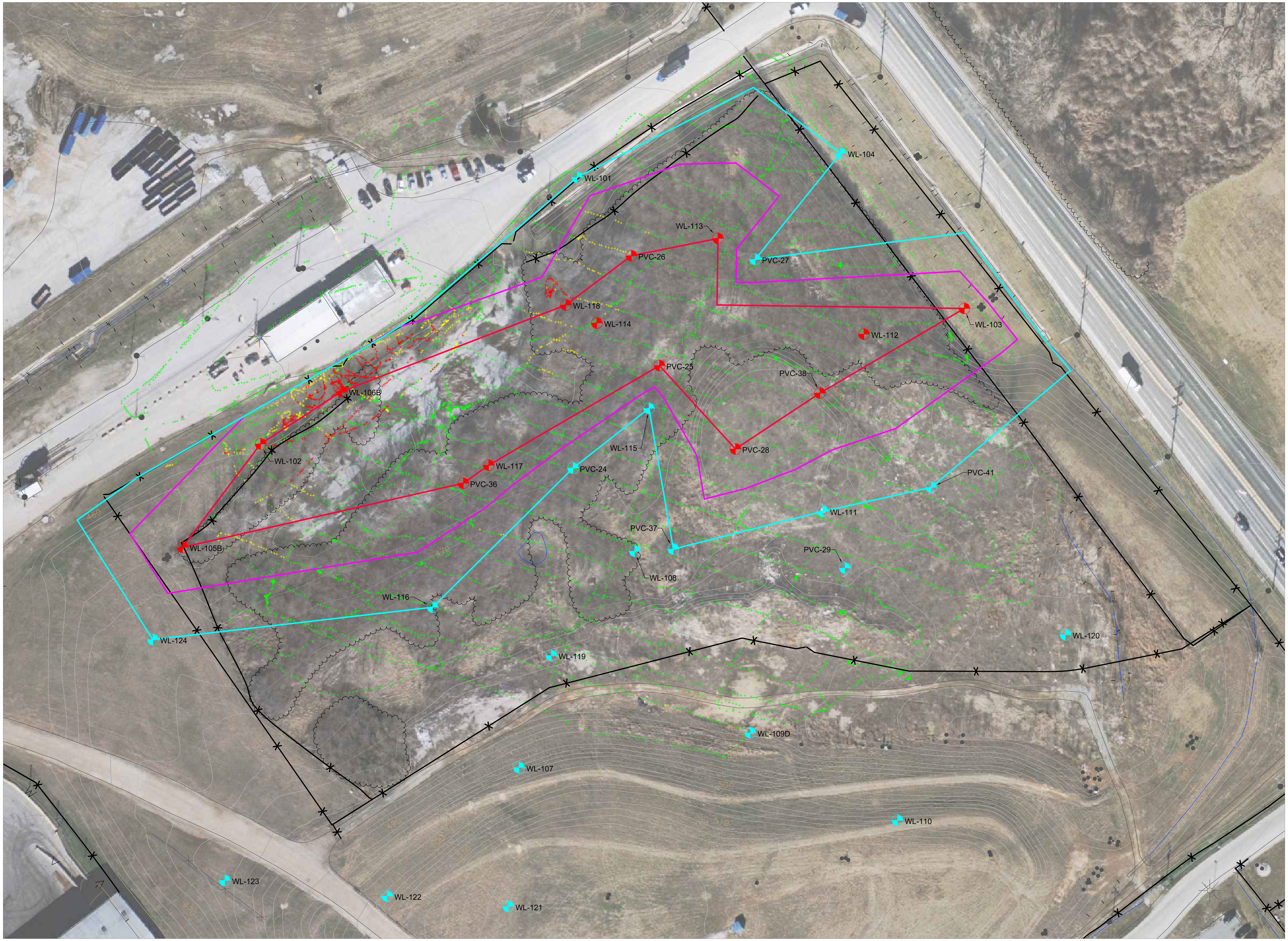
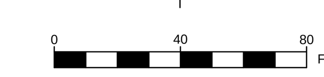
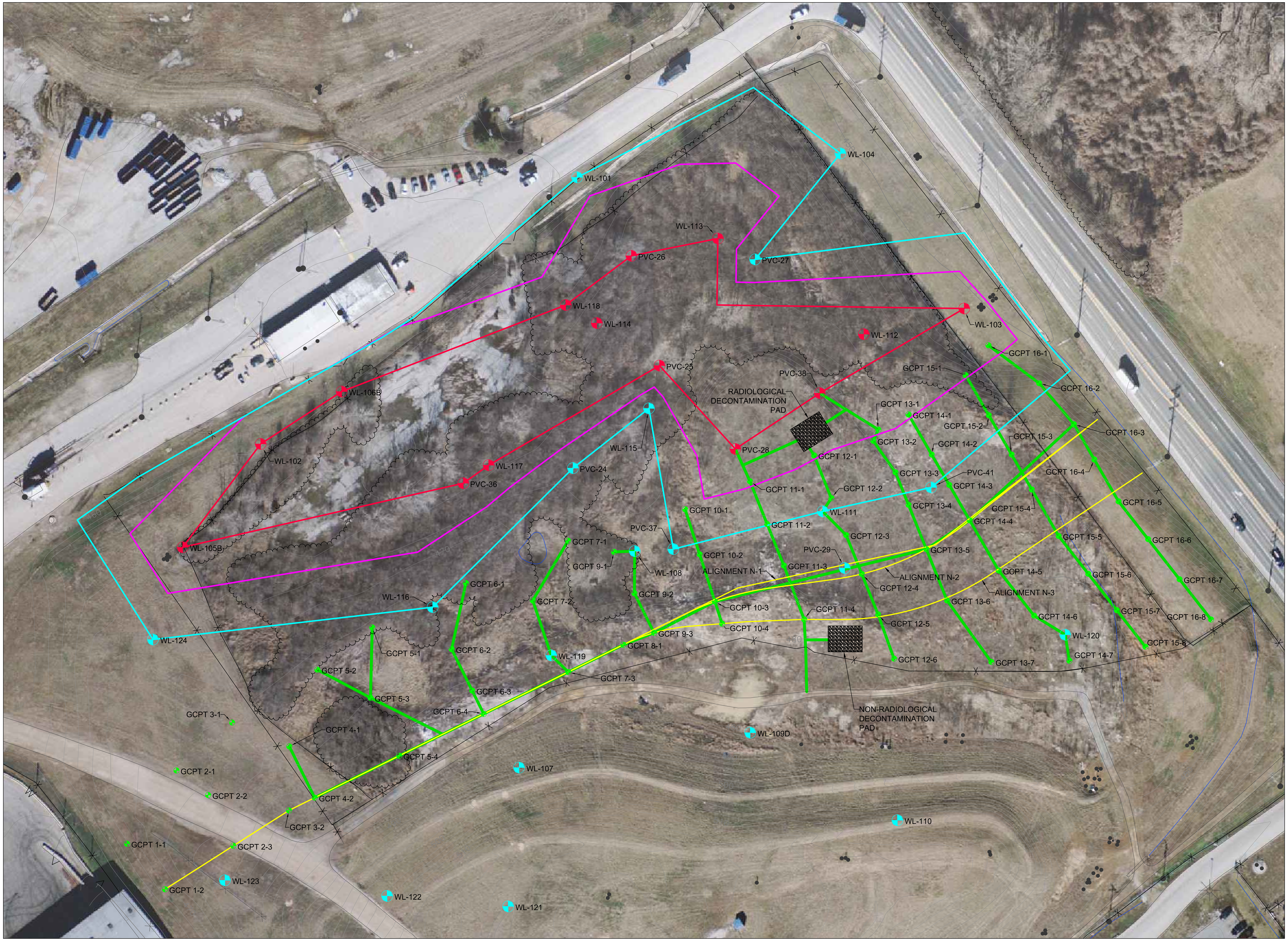




LEGEND

	EXISTING GRADE (2' CONTOUR)
500	EXISTING GRADE (10' CONTOUR)
	ELEVATED DOWNHOLE GAMMA READING
	BOUNDARY OF ELEVATED DOWNHOLE READINGS
	NON-ELEVATED DOWNHOLE GAMMA READING
	BOUNDARY OF NON-ELEVATED DOWNHOLE READINGS
	INTERPOLATED RIM LIMITS
	OVERLAND GAMMA READING, BACKGROUND OR LESS
	OVERLAND GAMMA READING, 2X BACKGROUND OR LESS
	OVERLAND GAMMA READING, MORE THAN 2X BACKGROUND
	FENCE

WEST LAKE LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	WEST LAKE LANDFILL OU-1 AREA 1 RIM INVESTIGATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: JULY 2013 DESIGNED BY: DPE APPROVED BY: DRF	FIGURE
PREVIOUS INVESTIGATIONS			REVISION / DATE	2
PROJECT NUMBER: BT-012	FILE PATH: P:\Bridgeton Landfill\BT-012 (OU-1 A1 South RIM Determination)\Step 3 - Drawings\BT-012 GCPT INVESTIGATION.dwg			



SCALE: 1" = 40'

0 40 80 Feet

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- POTENTIAL BARRIER ALIGNMENT
- GCPT LOCATION
- CLEARING PATH
- ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF ELEVATED DOWNHOLE READINGS
- NON-ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF NON-ELEVATED DOWNHOLE READINGS
- INTERPOLATED RIM LIMITS
- FENCE

WEST LAKE LANDFILL
13570 ST. CHARLES ROCK ROAD
BRIDGETON, MISSOURI 63044

WEST LAKE LANDFILL OU-1
AREA 1 RIM INVESTIGATION

PROPOSED INVESTIGATION

Engineering for a Better World
FEEZOR ENGINEERING, INC.

DATE: JULY 2013		
DESIGNED BY: DPE		
APPROVED BY: DRF		
1	9-6-13	PML
REV #	DATE	BY

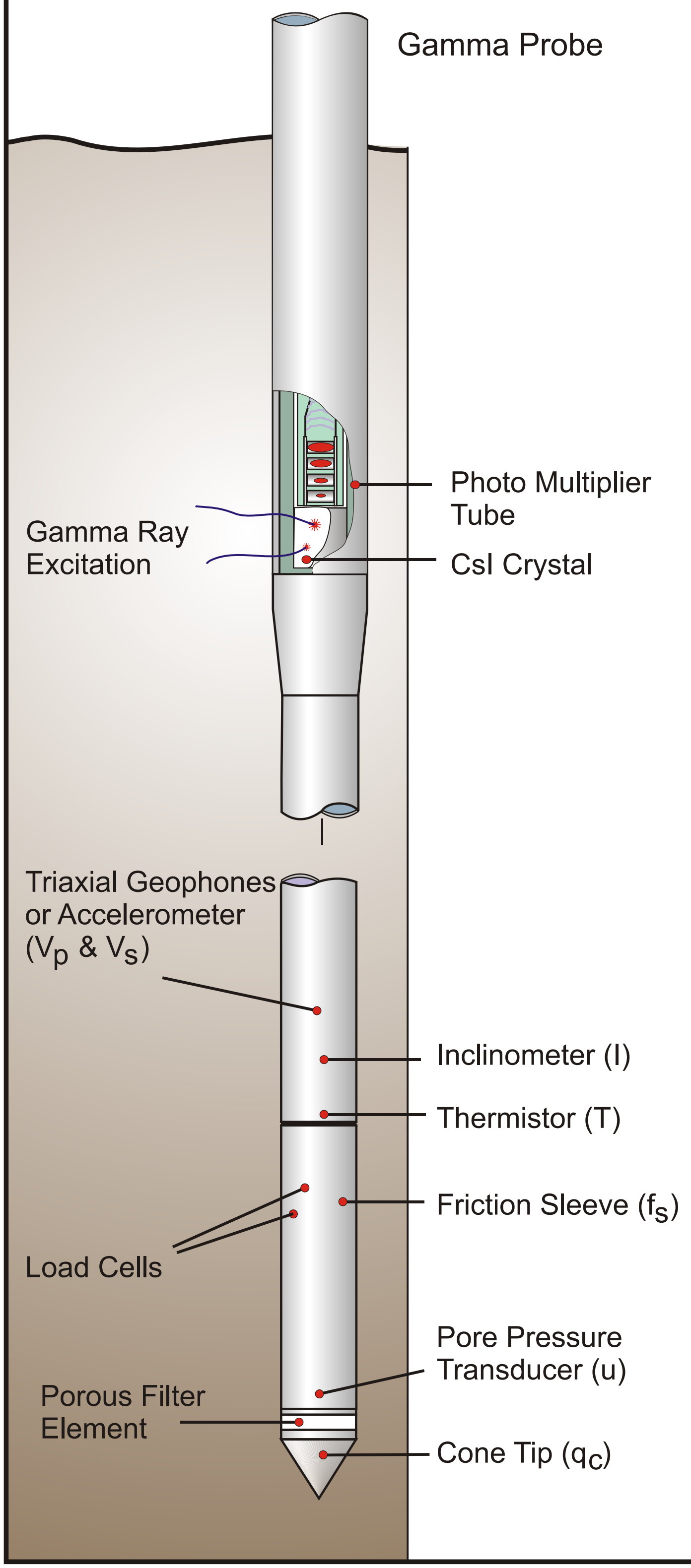
FIGURE 3

PROJECT NUMBER: BT-012 FILE PATH: P:\Bridgeton Landfill\BT-012 (OU-1 A1 South RIM Determination)\Step 4 - Drawings\BT-012 GCPT INVESTIGATION 2013-09-09 (renumbered From North).dwg

APPENDIX A

GAMMA CONE PENETRATION TEST (GCPT) VENDOR INFORMATION

Gamma Cone Penetrometer (GCPT)



GCPT Description

The Gamma Cone Penetrometer (GCPT) can be used to better identify soil stratigraphy in conjunction with the CPT using natural gamma radiation which is present in all soil. Finer soils contain a greater amount of the radioactive elements; potassium, uranium and thorium. A continuous gamma ray profile can be logged and used to improve the CPT interpreted stratigraphy.

In addition, the GCPT has environmental applications. It can be used to locate radioactive contamination based on a gross gamma ray count. Once the contamination is located, the GCPT can develop a gamma energy spectrum in order to identify a contaminant. Since the GCPT is a penetration tool, there are no cuttings brought to the surface and worker exposure is minimized.

CPT Tracks

Features

- 25-30 Ton Thrust Capacity
- 4 Point Leveling Jacks
- Low Ground Pressure
- Stainless Steel Laboratory Interior
- Onboard Air & 110 v Electricity
- Built In Automatic Seismic Beam
- Positive Air Shut Off
- M2.5 Drill for CPT Drillouts

Services

- CPT Testing
- Seismic CPT Testing
- Push-in Electronic Piezometers & Dataloggers
- RCPT, UVIF-CPT, Gamma CPT
- Direct Push Soil & Water Sampling
- Direct Push Well Installations
- MIP(Membrane Interface probe) Testing
- Shallow Auger Drilling
- SDMT Testing

Advantages

- 30 ton Thrust Capacity
- Unprecedented Penetration Capabilities
- Clean, Dry & Warm Working Space
- No Anchoring Required
- Excellent Production Rates
- CPT Engineer & Technician Teams
- Environmental & Geotechnical Services
- 3.8 PSI Ground Pressure

APPENDIX B

SOIL BORINGS AND DOWNHOLE GAMMA LOGS
WL-108, WL-111, WL-119

DOWNHOLE GAMMA LOGS PVC-28 AND 38

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-108	07.0803035.003.002	1 of 1

Start/Finish Date	Site Name and Location
9/5/95	West Lake Landfill; Bridgeton, Missouri

Drilling Contractor	**Boring Location:**	Area 1
Drilling Service Company	**Ground Surface Elevation:**	472.5
Driller	**Northing:**	1069144.21
Bruce Murphy	**Easting:**	516379.68

Drilling Equipment	McLaren/Hart Geologist/Office
LDH-80T Drill Rig, Large Diameter Auger	Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Auger	22'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-108 5'	Background (0.02-0.04)	0.0-22.0' Landfill Debris: trashy debris consisting of wood, plastic, paper, rubber, metal, and cardboard; soil consisting of olive brown to dark gray silt, and rock; dry to wet.
10	None Taken	None Taken	
15	None Taken	None Taken	@ 12' wet
20	None Taken	None Taken	
25	None Taken	None Taken	Boring abandoned @ 22.0'

Notes:

Radiological sample collected at 5 feet below ground surface.
Non-radiological grab sample collected from perched water.
Perched water encountered at 12 feet below ground surface.
Groundwater not encountered during boring activities

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-111	07.0803035.003.002	1 of 1

Start/Finish Date	Site Name and Location
9/11/95	West Lake Landfill; Bridgeton, Missouri

Drilling Contractor Drilling Service Company	**Boring Location:**	Area 1
	Ground Surface Elevation:	474.5
Driller Bruce Murphy	**Northing:**	1069187.35
	Easting:	516583.61

Drilling Equipment	McLaren/Hart Geologist/Office
LDH-80T Drill Rig, Large Diameter Auger	Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Augers	52'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-111 5'	Background (0.02-0.04)	0.0-50.0' Landfill Debris: trashy debris consisting of wood, plastic, cloth, brick, rubber, paper, wire, glass, and metal; soil consisting of olive brown to gray silt, dark gray to grayish brown silty clay, and crushed rock; dry to wet.
10	WL-111 10'	Background (0.02-0.04)	
15	WL-111 15'	Background (0.02-0.04)	
20	WL-111 20'	Background (0.02-0.04)	
25	WL-111 25'	Background (0.02-0.04)	
30	WL-111 30'	Background (0.02-0.04)	
35	WL-111 35'	Background (0.02-0.04)	
40	WL-111 40'	Background (0.02-0.04)	
45	WL-111 45'	Background (0.02-0.04)	@ 45' wet
50	WL-111 50'	Background (0.02-0.04)	
55	WL-111 51'	Background (0.02-0.04)	50.0-52.0' Native Alluvium: dark gray, silty, very fine-grained sand; wet. Boring terminated @ 52.0'.

Notes:

Radiological samples collected at 5 and 51 feet below ground surface.

Non-radiological samples not collected during boring activities.

Perched water not encountered during boring activities.

Groundwater encountered at 45 feet below ground surface.

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-119	07.0803035.003.002	1 of 1

Start/Finish Date 9/29/95	**Site Name and Location** West Lake Landfill; Bridgeton, Missouri
Drilling Contractor Drilling Service Company	**Boring Location:** Area 1 **Ground Surface Elevation:** 477.4
Driller Bruce Murphy	**Northing:** 1069031.14 **Easting:** 516289.26
Drilling Equipment LDH-80T Drill Rig, Large Diameter Auger	**McLaren/Hart Geologist/Office** Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Augers	50'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-119 5'	Background (0.01-0.04)	0.0-44.0' Landfill Debris: trashy debris consisting of yard waste, insulation, wire, wood, plastic, shingles, cloth, carpet, paper, glass, and metal; soil consisting of light brown to dark gray, silty, plastic clay to sandy silt; dry to moist.
10	None Taken	Background (0.01-0.04)	
15	WL-119 15'	Background (0.01-0.04)	
20	None Taken	Background (0.01-0.04)	
25	WL-119 25'	Background (0.01-0.04)	
30	None Taken	Background (0.01-0.04)	
35	None Taken	Background (0.01-0.04)	
40	None Taken	Background (0.01-0.04)	
45	WL-119 45'	Background (0.01-0.04)	44.0-50.0' Native Alluvium: dark gray, silty, fine to medium-grained sand; moist.
50	WL-119 50'	Background (0.01-0.04)	Boring terminated @ 50.0'

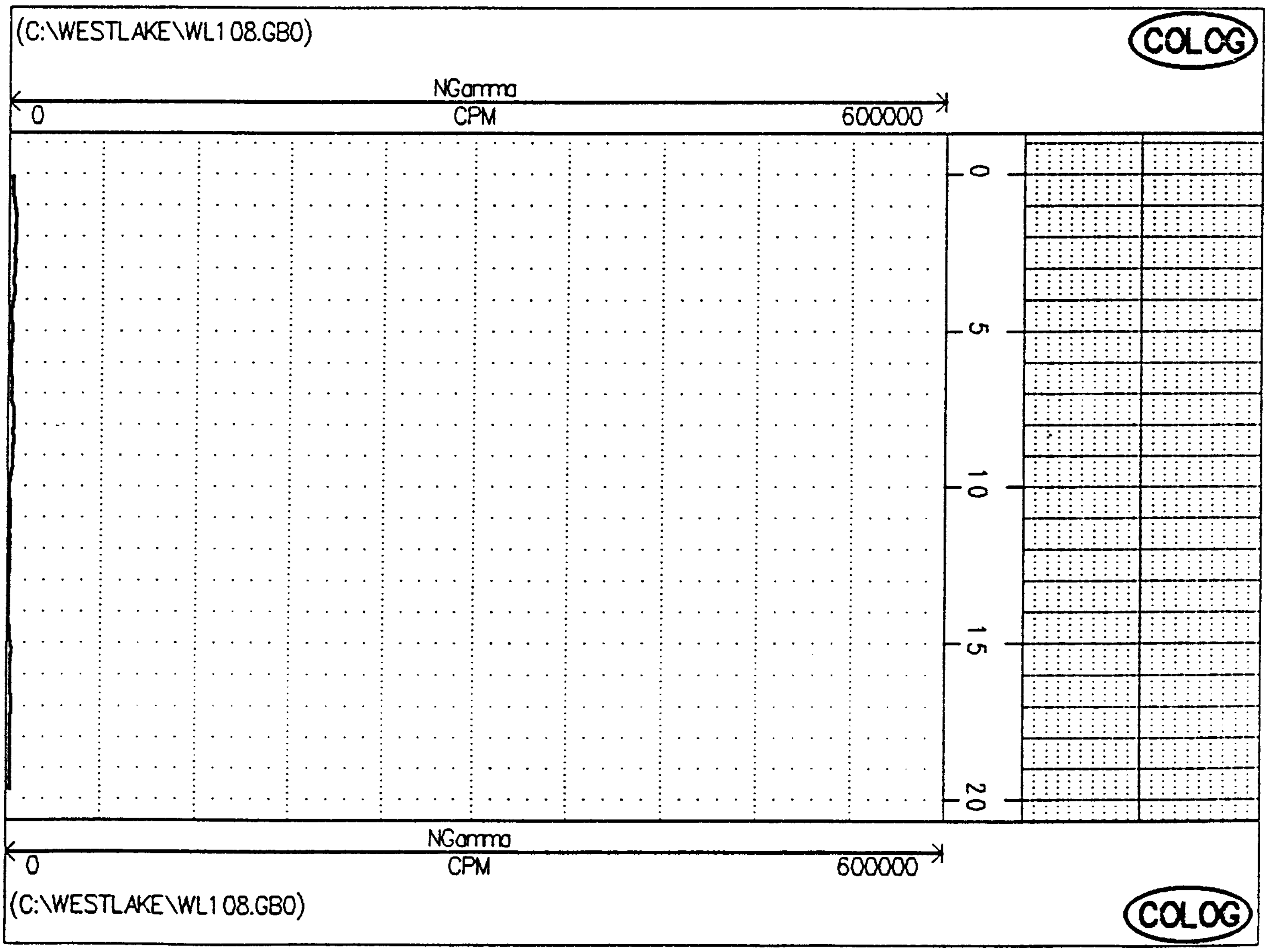
Notes:

Radiological samples collected at 5 and 50 feet below ground surface; duplicate collected and analyzed for 50' sample.

Non-radiological samples collected at 50 feet below ground surface; priority pollutant and priority pollutant duplicate sample collected and analyzed.

Perched water not encountered during boring activities.

Groundwater not encountered during boring activities.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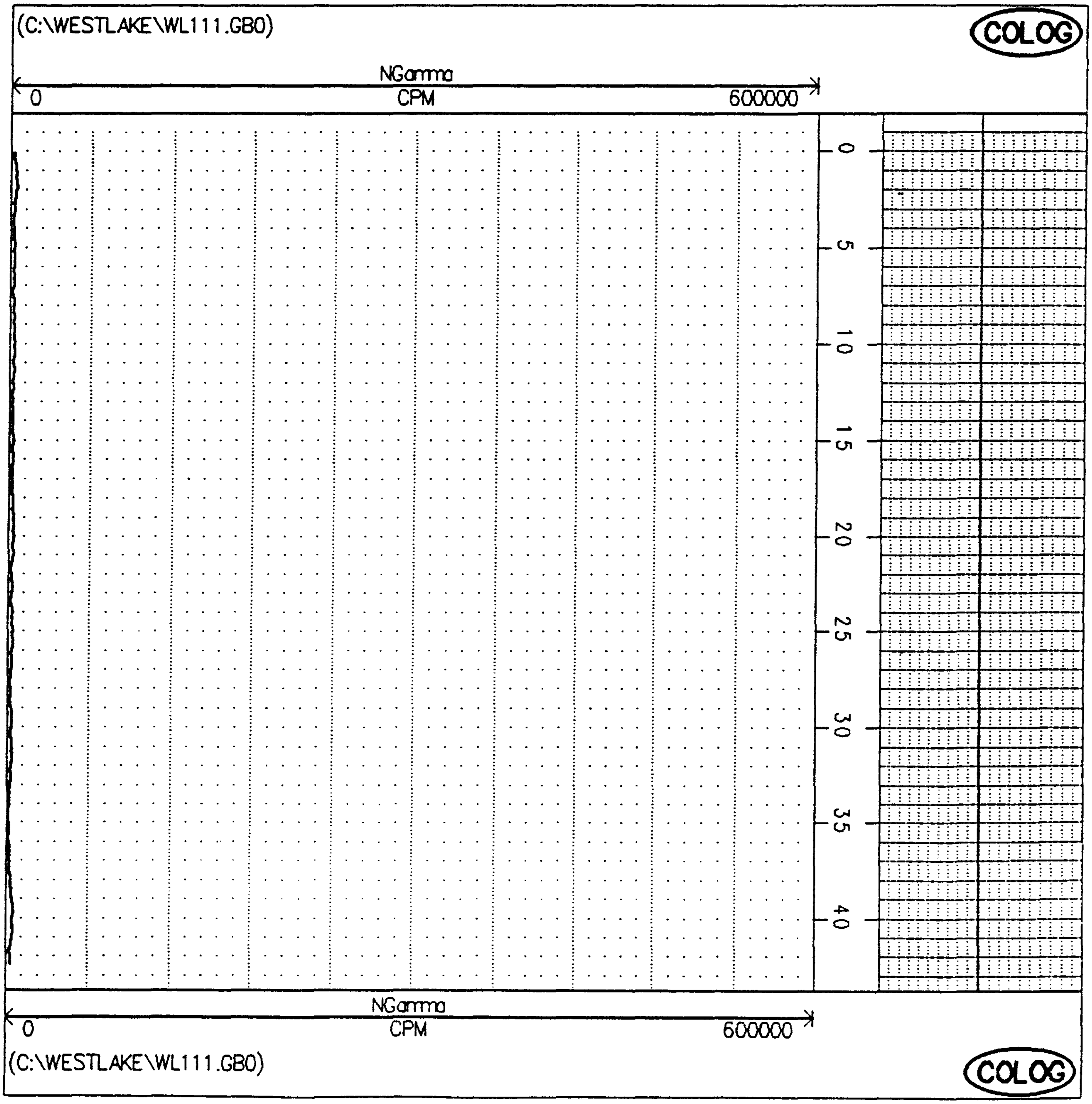
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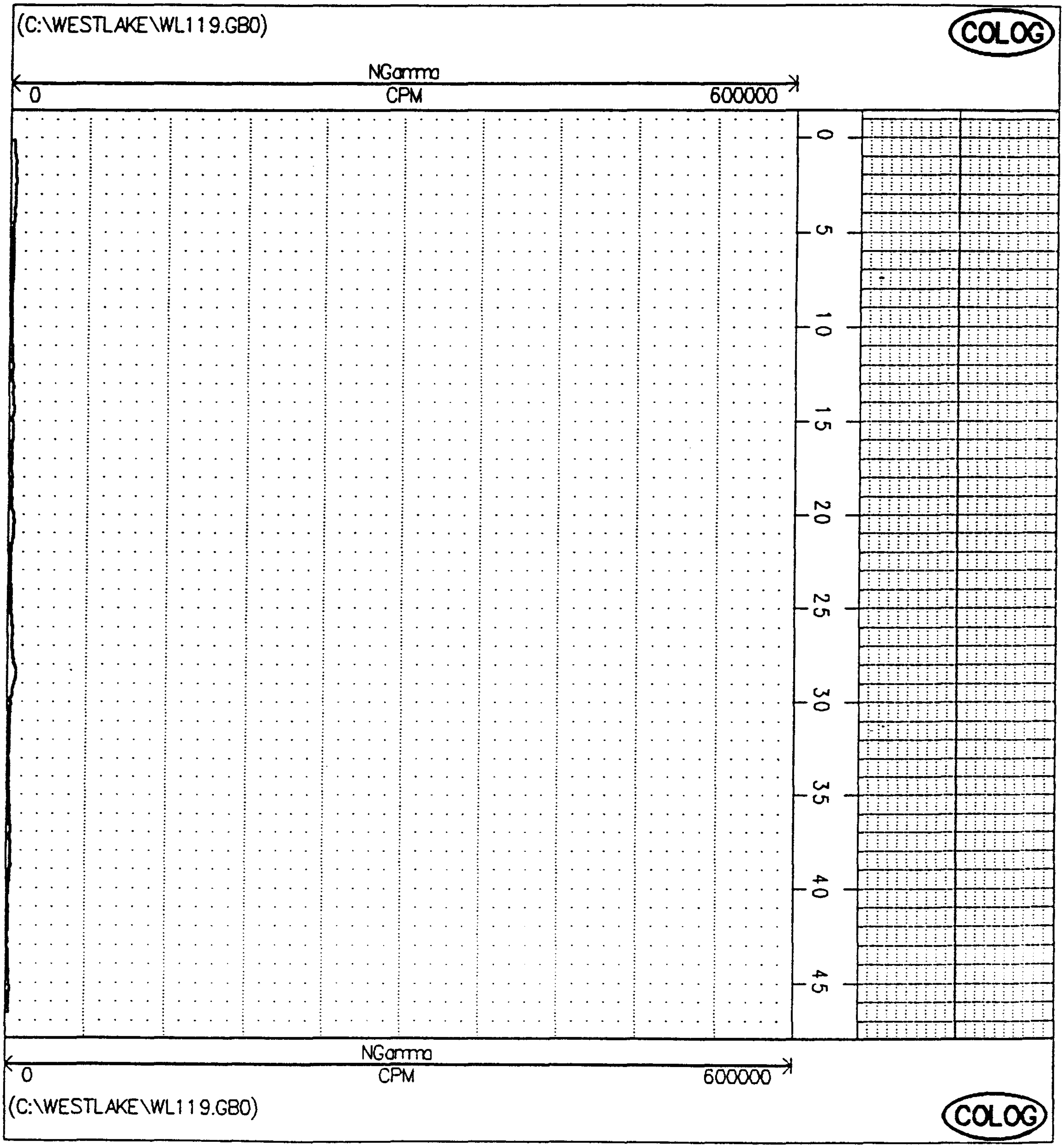
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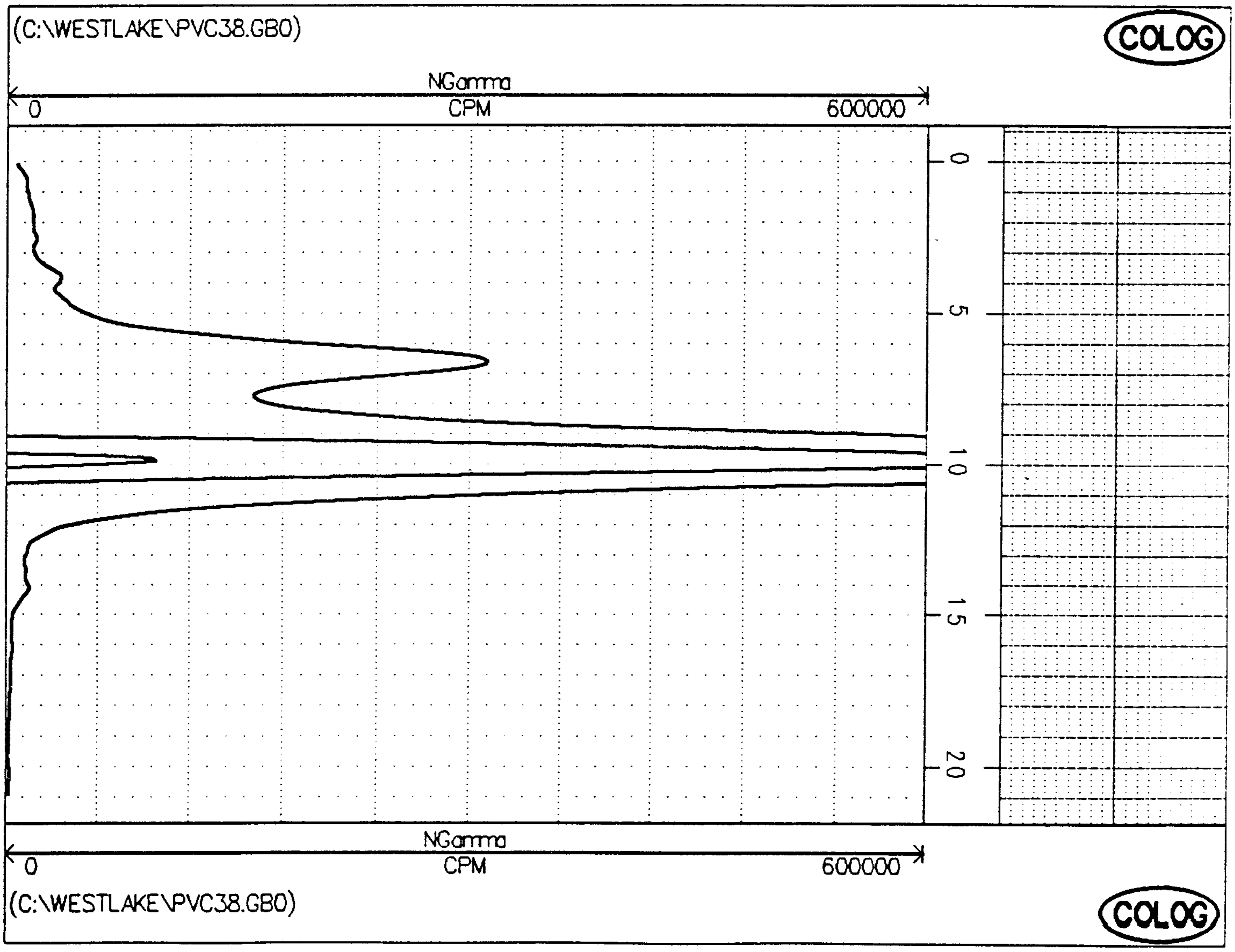
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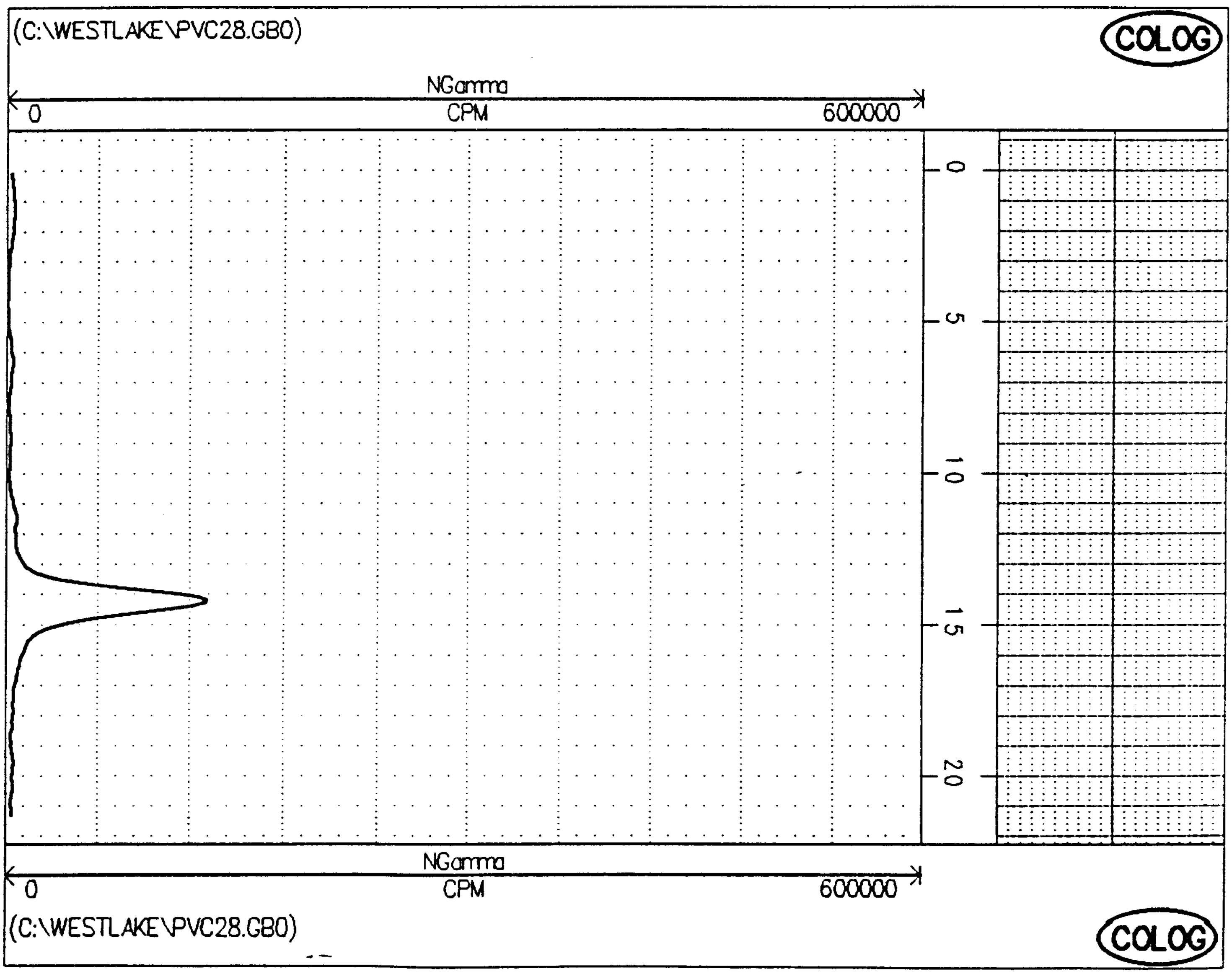

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APPENDIX C

RADIOLOGICAL FRISKING PROCEDURES

PROCEDURE 2.7
MONITORING PERSONNEL AND EQUIPMENT FOR RADIOACTIVE CONTAMINATION

1.0 PURPOSE

1.1 To describe the general approach for monitoring personnel and equipment for radioactive contamination.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Upon exiting potentially contaminated areas, monitoring of clothing and exposed skin surfaces will be performed. Equipment and materials will also be monitored and shown to be free of contamination before release for use without radiological restrictions or controls.

3.2 Equipment

3.2.1 Ratemeter-scaler: Model 3 or Model 2221, Ludlum Measurements, Inc.; or equivalent, equipped with audible speaker or headphones.

3.2.2 Detector: Selected detectors are indicated below. Equivalent detectors are also acceptable.

Activity	**Detector Type**	**Model**
Alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	Gas proportional	Ludlum 43-68, Ludlum 239-1
Beta	Gas proportional	Ludlum 43-68, Ludlum 239-1
	Geiger-Mueller	Ludlum 44-9, Eberline HP-260

3.2.3 Instrument cables

3.2.4 Check sources

3.2.5 Record Forms and/or field logbook

3.3 Quality Control Check

Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and source responses following Procedure 2.1.

3.4 Surface Scanning

3.4.1 Headphones or other audible signal operating modes are used for scanning.

3.4.2 Set the instrument response for "FAST", response where possible.

3.4.3 Pass the detector slowly over the surface. The detector should be kept as close to the surface as conditions allow. The speed of detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor. While scanning for alpha or beta activity, the detector is typically moved about one detector width per second.

3.4.3 Note increases in count rate as indicated by the audible meter output. Identifiable increases in the audible response suggest possible contamination and should be resurveyed at a slower rate to confirm findings.

3.5 Personnel Monitoring

3.5.1 When monitoring for skin or clothing contamination, give particular attention to the hands, shoes, pant and shirt cuffs, knees, and other surfaces which have a high likelihood of contamination.

3.5.2 If there is detectable contamination, it should be removed as directed by the Health and Safety Committee (HSC) Chairperson. Decontamination guidance will be provided in the Survey Work Plan. The Site Safety Officer will implement decontamination or other contamination control actions at the project site.

3.6 Equipment Monitoring

3.6.1 For equipment surveys, attention should be given to monitoring cracks, openings, joints, and other areas where contamination might accumulate.

3.6.2 Measure levels of total and removable surface contamination (see Procedures 2.3 and 3.6) at locations of elevated direct radiation identified by the scan and at additional representative surface locations.

3.6.3 Acceptable surface contamination levels will be established on a project-specific basis, with details, including decontamination instructions, provided in the Survey Work Plan.

3.7 Document results of contamination surveys in field records

PROCEDURE 2.3
DIRECT RADIATION MEASUREMENT

1.0 PURPOSE

1.1 To describe the method for measuring total alpha and beta radiation levels on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment

3.1.1 Ratemeter-scaler: Model 3, Model 2220 or 2221, Ludlum Instrument Corporation; or equivalent

3.1.2 Detector: Selected detectors are listed below: Equivalent detectors are also acceptable

Activity	Detector Type	Model
alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	gas proportional	Ludlum 43-68
beta	Geiger-Mueller	Ludlum 44-9, Eberline HP-260
	gas proportional	Ludlum 43-68

3.1.3 Cables

3.1.4 Check source

3.1.5 Record forms

3.2 Quality Control Check

3.2.1 Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and check source responses. Follow the procedures described in Procedure 2.1.

3.3 Direct Measurement

3.3.1 When applicable, team members performing instrument checks will calculate the average and maximum "field action levels" for instrument combination based on the specific site criteria and background.

Action level (cpm) = [site criteria (dpm/100 cm^2) x E x G x T] + B

T = count time (minutes)
E = operating efficiency (counts/disintegration)
G = geometry (total detector area (cm^2)/100)

	Total Area	Active Area
43-5 detector area =	80 cm^2	60 cm^2
43-1 detector area =	80 cm^2	50 cm^2
43-68 detector area =	126 cm^2	100 cm^2
44-9 detector area =	20 cm^2	15.5 cm^2
HP-260 detector area =	20 cm^2	15.5 cm^2

B = background (cpm)

A field count at or above this value indicates that further investigation in this location is necessary.

NOTE: For a particular site, the action level may be established as any activity exceeding background.

3.3.2 Select an appropriate counting time. A counting time is desired which will achieve a minimum detectable activity (see Procedure 4.2) value less than 50% of the applicable criteria. For most radionuclides a 1-minute count, using the instruments listed above, is adequate to achieve this sensitivity. For radionuclides having guidelines of 5000 dpm/100 cm^2, average and 15,000 dpm/100 cm^2, maximum, 0.5 minute counting times may be acceptable.

3.3.3 Place the detector face in contact with the surface to be surveyed. The detector face is typically constructed of a very thin and fragile material, so care must be exercised to avoid damage by rough surfaces or sharp objects. (Scans should have been performed, prior to this point, to identify representative locations and locations of elevated direct surface radiation for measurement.)

3.3.4 Set the meter timer switch, press the count-reset button, and accumulate the count events until the meter display indicates that the count cycle is complete.

3.3.5 Record the count and time on the appropriate record form.

3.3.6 If the location has a surface activity level above background, the area around the measurement locations should be scanned to determine the homogeneity of the measured activity level in the area. Dimensions and activity levels of inhomogeneities should be documented on the appropriate record form.

3.3.7 The surface activity may be calculated according to Procedure 4.3.

PROCEDURE 3.6
REMOVABLE ACTIVITY SAMPLING

1.0 PURPOSE

1.1 To provide guidelines for measuring removable alpha and beta radioactivity on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment and Materials

3.1.1 Smears, Mazlin wipes, filter papers (like Whatman 47 mm dia. glass fiber) or equivalent

3.1.2 Glassine or paper envelopes

3.1.3 Record forms

3.1.4 Counting equipment

3.2 Sample Collection

NOTE: Direct measurements will be completed before a smear sample is taken.

3.2.1 Grasp the smear (filter) paper by the edge, between the thumb and index finger.

3.2.2 Applying moderate pressure with two or three fingers, wipe the numbered side of the paper over approximately 100 cm^2 of the surface.

3.2.3 Place the filter in an envelope.

3.2.4. Record the smear number, site, date, location of the smear, and name of sample collector on the envelope.

3.2.5 Label and secure in accordance with Procedures 3.7 and 3.8. Record pertinent information on the Chain-of-Custody Form.

3.2.6 If the direct measurement was elevated, the smear should be monitored (procedures 2.2 and 2.3) to determine whether contaminated material was transferred to the smear. If an activity level greater than 250 cpm is detected, the smear envelope should be marked as such.

NOTE: Smears having activity levels greater than 2500 cpm should be counted using field instrumentation. Decisions regarding further analyses and method of disposal of contaminated smears will be made by the PM and SSM on a case-by-case basis.

3.3 Field Sample Measurement

3.3.1 If the object of the survey is to determine if radon or thoron daughter products or other short half-life radionuclides are present, the smears should be counted within 1-2 hours before significant decay of short-lived radionuclides has occurred.

3.3.2 If necessary, smears can be counted in the field using portable instrumentation (see Procedure 2.3).

3.3.3 Record count and counting time data on the appropriate record form.

3.3.4 Subtract the background count (determined by counting blank or unused smear) and convert net count to dpm/100 cm^2, using proper time and detector efficiency values.

$$\frac{DPM}{100\,CM^2} = \left(\frac{NETCOUNT}{TIME(\mathrm{MIN}) * EFFICIENCY * \left(\frac{COUNT}{DISINTEGRATION} \right) * OTHERMODIFIYINGFACTORS} \right)$$