FOSTER WHEELER ENVIRONMENTAL CORPORATION

FINAL REPORT

RUNKLE RANCH SITE INVESTIGATION SIMI VALLEY, CA

Prepared for:

GreenPark Holdings, LLC
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October, 1999

VOLUME I

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LIST OF ACRONYMS

amsl	above mean sea level
bgs	below ground surface
CA SPC	California State Plane Coordinates
COC	Chain-of-Custody
COPC	Constituents of Potential Concern
cpm	counts per minute
Cs-137	Cesium-137
DCGLs	Derived Concentration Guideline Level
DOD	United States Department of Defense
DOE	United States Department of Energy
DGPS	Differential Global Positioning System
EPA	United States Environmental Protection Agency
Foster Wheeler Environmental	Foster Wheeler Environmental Corporation
GPS	Global Positioning System
GreenPark	GreenPark Holdings, LLC
H-3	tritium
LBGR	Lower Bound of the Grey Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
mrem/year	milli-rem per year
NaI	Sodium Iodide
NRC	United States Nuclear Regulatory Commission
pCi/g	pico-curie per gram
pCi/l	pico-curie per liter
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
RESRAD	Residual Radioactive Guidelines
SPC	State Plane Coordinates
Sr-90	Strontium-90
QA	Quality Assurance
QC	Quality Control

EXECUTIVE SUMMARY

Presented in this report are the results of the sampling program conducted at GreenPark Holdings, LCC (GreenPark) Runkle Ranch Property in Simi Valley, California. The work summarized in this report was conducted by Foster Wheeler Environmental Corporation (Foster Wheeler) at the request of GreenPark from June 28th through July 2nd 1999. There were two primary objectives of the sampling program at Runkle Ranch.

The first objective was to provide an initial reconnaissance evaluation of the presence of radionuclides in surface soils at the site. Radionuclides are specific atoms, which undergo a spontaneous change (or decay) in which energy, or particles, are emitted and a distinctly new atom or element is formed. Samples were analyzed for the following radionuclides of potential concern: cesium-137 (Cs-137), strontium-90 (Sr-90) and tritium (H-3). The second objective was to evaluate the nature of a tailings pile that is present on site. Samples were analyzed for Title 26 Metals, pH, and major cations and anions (Na^+, K^+, Mg^{2+}, Ca^{2+}, SO_4^{2-}, NO_3^- Cl^-).

During 1998, four soil samples taken from the Runkle Ranch property were found to contain measurable concentrations of the radioactive materials, tritium, strontium-90, and cesium-137. Previous studies by the USEPA and QST Environmental concluded that these materials were the constituents of concern in the Runkle Ranch area. The concentrations seen in these early samples were generally very low. All three of these radionuclides exist in nature, with the strontium and cesium present because of worldwide fallout from nuclear weapon tests and the Chernobyl accident. In the July 1995 EPA update entitled "The U.S. EPA Announces Results of Rocketdyne's offsite sampling program for the Santa Susana Field Laboratory" the average concentrations, measured in pico-curies per gram (pCi/g) of soil for the Sr-90 and Cs-137 or pico-curies per liter (pCi/L) of water for the tritium, were reported to be the following:

- Strontium (assumed to be 90) 0.103 pCi/g
- Cesium-137 0.20 pCi/g
- Tritium (H-3) 2,250 pCi/L

A curie is a unit of measure used to quantify radioactivity based on disintegration (or decay) of an element over time per minute, which are measured as radioactive emissions. There are 1,000,000,000,000 pico-curies per curie, as an example, in one gram of H-3 there are 9,800 curies or 9.8×10^{15} pico-curies.

Foster Wheeler was commissioned to determine the extent and magnitude of these materials and the resulting significance as they may affect the health and well-being of future residents at Runkle Ranch.

The methodology chosen was to collect and analyze soil samples using an accepted protocol and to compare the results with those dose limits previously proposed by the USEPA. The methodology chosen was from MARSSIM, (the Multi Agency Radiation Survey and Site Investigation Manual). This manual provides an approach developed collectively by the Environmental Protection Agency, the Nuclear Regulatory Commission, the Department of Defense, and the Department of Energy. MARRSIM allows calculation of the number of samples required to characterize the site based on a statistical approach. Based on MARSSIM, 58 locations were sampled for strontium-90, cesium-137 and tritium.

The exposure limit chosen was 15 mrem/year above natural background, which is a value already proposed by the EPA, which failed to be approved by the Office of Management and Budget because it is too restrictive. In addition, in 1997, the US Nuclear Regulatory Commission (NRC) established a clean-up limit of 25 mrem/year. 15 mrem/year is generally considered to be an acceptable end point, which is considered to be protective of human health by the USEPA, below which it is not useful or necessary to perform any remedial activity. The use of 15 mrem/year as the limit in this study lends an element of conservatism in an area where agreement on definite limits has yet to be established by the USEPA, US Department of Energy, or US Nuclear Regulatory Commission.

The results of the study indicate that the three radionuclides together will not cause a dose in excess of the 15 mrem/year limit, and that there is little (if any) difference between radionuclides found on the Runkle Ranch and those typical of southern California.

In perspective, the concentrations of strontium-90, cesium-137 and tritium and the annual dose attributable to them, were found to be insignificant. For example, concentrations of cesium-137 were in the range of concentrations normally seen from worldwide fallout, e.g., 0 to 1 pCi/g. Additionally, most concentrations of strontium-90 in soil were lower than the typical background concentration in soil of 0.7 pCi/g (also from fallout). For comparison, the human body contains radioactivity at a concentration of approximately 1.7 pCi/g, and consumer salt substitutes containing potassium chloride contain radioactivity at over 400 pCi/g.

Tritium was not measurable in any of the samples taken, indicating that the concentrations found at Runkle Ranch are less than the analytical sensitivity of 100 pCi/L. At worst, the concentrations are less than 0.5 percent of the EPA drinking water standard for tritium of 20,000 pCi/L.

Finally, the dose possible from exposure to the radionuclides measured was found definitively to be less than 15 mrem/year, and most likely to be less than 5 mrem/year. This is less than 5 percent of the average dose for a U.S. resident from radiation exposure in the United States, estimated in National Council of Radiation Protection and Measurements (NCRP) Report No. 93, "Ionizing Radiation Exposure of the Population of the United States." In addition, 15 mrem/year is much less than the variability in the background dose across the country.

The results of the chemical analysis of the soil, water, and precipitate samples collected in support of the tailings pile evaluation indicate there are no metals at concentrations of concern. No regulatory standards for soil were exceeded in the tailings. The only regulatory standard exceeded was the California Regional Water Quality Control Board CRWQCB water quality objectives for sulfate (250 mg/L) (CRWQCB, 1994) in the stream passing through the tailings. Chemical analysis of the soil and precipitate samples are dominated by sulfate salts, indicating naturally occurring high levels of SO_4^{2-}. No other regulatory standards for water or soil were exceeded by any of the samples collected from the tailings pile or the creek running through it.

1.0 INTRODUCTION

This report presents the results of surface soil and surface water sampling performed by Foster Wheeler Environmental Corporation (Foster Wheeler) from June 28th through July 2nd 1999, at GreenPark Holdings, LCC (GreenPark) Runkle Ranch Property in Simi Valley, California. The work summarized in this report was conducted at the request of GreenPark, in general accordance with a Work Plan prepared by Foster Wheeler dated June 18,1999.

1.1 OBJECTIVES

There were two primary objectives of the sampling program at Runkle Ranch. The first objective was to provide an initial reconnaissance evaluation of the presence of radionuclides in surface soils at the site. Radionuclides of potential concern were cesium-137 (Cs-137), strontium-90 (Sr-90) and tritium (H-3). The second objective was to evaluate the nature of a tailings pile that is present on site. Samples were analyzed for Title 26 Metals, pH and major cations and anions (Na^+, K^+, Mg^{2+}, Ca^{2+}, SO_4^{2-}, NO_3^-, Cl^-). The sampling program included collection of surface soil and surface water samples, sample location surveying using Global Positioning System (GPS) equipment, and laboratory analyses.

1.2 SCOPE

The scope of work that was used included the following:

- Preparation of a Work Plan and Health and Safety Plan
- Collection of surface soil and surface water samples
- Laboratory analysis
- Data evaluation and report preparation

2.0 SITE DESCRIPTION

The following site description has been prepared, in part, based on a review of existing preliminary site investigations.

2.1 LOCATION

The site covers an undeveloped area of approximately 550 acres located near the southern edge of Simi Valley in Ventura County, California (Figure 2-1). Residential neighborhoods lie along a portion of the northern boundary of the property. Currently open land is along the western and southern boundaries, however, there are plans for residential development. The northeastern portion of the property line is adjacent to the Brandeis Bardin Institute, an educational retreat center committed to the arts, culture and intellectual pursuits of the Jewish people. The Rocketdyne Santa Susana Field Laboratory, a facility used for research on rocket engines, and nuclear reactor development and applications is located to the southeast of the site. Rocketdyne has reported using radionuclides, including strontium-90 (Sr-90), cesium-137 (Cs-137), and tritium (H-3). Upon examination of available property maps, aerial photographs and topographic maps, it appears that the Runkle Ranch property is approximately 0.3 miles northwest of the Rocketdyne facility.

2.2 PHYSICAL SETTING

Simi Valley is classified as an interior valley with a moderate marine influence. Average rainfall is typically 13 to 14 inches per year. Average summer (July) high and low temperatures are 80°F and 50°F respectively, though daytime high temperatures may exceed 100°F for a week or more. Average winter high and low temperatures are 60°F and 50°F respectively, with frost on some occasions. Winds are predominantly from the northwest at approximately 2 to 5 mph. Santa Ana wind conditions may occur during the fall and winter, resulting in unseasonably warm temperatures and slight humidity.

The Runkle Ranch Property is located along the northern edge of the Simi Hills, and ranges in elevation from 1,000 to 1,400 feet above mean sea level (amsl). The northern portion of the site slopes gently to form rolling hills and valleys, with steeper hills to the south. Three unnamed ephemeral watercourses run through the site as indicated on the Calabasas and Simi Valley East 7.5 minute United States Geological Survey (USGS) topographic maps. These watercourses run predominantly from south to north through the property. Also located within the property boundaries is the Runkle Reservoir, a man made debris catch-basin. This reservoir is located along the eastern property line and was dry during site investigation activities.

The Simi Hills were formed from a thick sequence of marine sedimentary rocks that range from Upper Cretaceous to Lower Tertiary in age (Dibblee, 1982). These rocks are composed of predominantly clastic marine shales and sandstones with some conglomerate. The oldest unit exposed in the Simi Hills is the Cretaceous Chatsworth Formation, a thick sequence of arkosic sandstone interbeded with thin intervals of micaceous shale. Approximately 6,000 feet of this formation is exposed in this area. Above the Chatsworth, the Lower Tertiary units include, in ascending order, the Simi Conglomerate, Las Virgenes Sandstone, Santa Susana Formation, Llajas Formation, and the non-marine Sespe Formation. This Tertiary sequence is composed of alternating micaceous shales and sandstones, with some interbedded siltstones and clay shales. Approximately 3,300 feet of this Tertiary sequence is exposed in the Simi Hills.

Along the northern portion of the Simi Hills, the entire Cretaceous/Tertiary sequence of rocks dips north to northwest at approximately 20 to 30 degrees, towards the Simi Valley. It is not known whether these rocks were uplifted along a fault or anticlinally (Dibblee, 1982). No major faults have been identified in the northern portion of the Simi Hills, although the Boney Mountain-Simi fault has been identified along the southern margin (Campbell and Yerkes, 1966).

2.3 SITE HISTORY

In December 1998, QST Environmental (QST) conducted a limited surface soil survey at Runkle Ranch. Their objective was to determine if operations conducted at the nearby Rocketdyne facility had impacted on-site soils through surface water run-off. QST based their approach on a 1995 U.S. Environmental Protection Agency (EPA) update entitled "The US EPA Announces Results of Rocketdyne's Off-Site Sampling Program for the Santa Susana Field Laboratory". The EPA update suggests that average concentrations of these Chemicals of Potential Concern (COPCs) in soil samples collected from potential source areas identified at the Rocketdyne facility may only be slightly elevated over local background concentrations. In addition, the concentrations were below EPA reported averages for background concentrations in typical U.S. soils, and/or well below EPA-risk-based threshold levels that would likely trigger remedial action.

QST collected four soil samples and analyzed them for Cs-137, Sr-90 and H-3 (QST, 1999). Although limited, results of the study conducted by QST suggested that soil samples collected from Runkle Ranch contained Cs-137 and Sr-90 at concentrations slightly elevated over local background levels as reported by EPA, but were consistent with background levels reported for typical U.S. soils. Tritium results from samples collected by QST were reported to be slightly higher than background samples collected by QST, however, all QST tritium results were below the average local background concentration reported by EPA.

The only reported historical use of the property was for material storage and processing for an off-site sand and gravel surface mining operation located near the southern end of the site (RAMCO, 1998). The site is undeveloped, with only one abandoned structure, most likely associated with the surface mining operation. A white precipitate was observed on some soils in an on-site tailings pile from the sand and gravel operation. QST sampled and analyzed the substance for 23 metals, cyanide, phosphate, and pH. The sample was found to have a pH of 4.0, contain several metals at low levels, and be non-detect for cyanide and phosphate. No EPA Preliminary Remediation Goals (PRGs) for residential soil were exceeded (QST, 1999). PRGs are EPA risk-based numbers used for evaluating and cleaning up contaminated sites. The PRGs are used to screen pollutants in environmental media, potentially triggering further investigation, and providing initial cleanup goals, if applicable.

2.4 CURRENT ACTIVITIES

The property is currently used for cattle grazing. Local hang gliding groups are allowed access through the site, to locations beyond the property boundary. Residents have also been using the site for hiking and running.

3.0 SAMPLING APPROACH AND FIELD ACTIVITIES

As stated above, the site investigation at Runkle Ranch had two basic objectives. The first objective was to provide an evaluation of the potential presence of radionuclides, and the second was to evaluate the tailings pile present on-site. This section summarizes the methodology used in selecting the number and location of samples collected in support of both objectives. A summary of field activities implemented at Runkle Ranch from June 28th through July 2nd, 1999 is also presented.

3.1 SAMPLE DETERMINATION

Radionuclide Investigation

A dual-purpose field program was planned for investigation of the potential presence of radionuclides. The first objective was to collect soil samples on a site wide grid defined using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) methodology. MARSSIM is a set of guidelines used to identify a statistical approach to evaluate potential radionuclide contamination in soils. MARSSIM was jointly developed and approved by the U.S. EPA, the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Defense (DOD) and the U.S. Department of Energy (DOE). Prior to sampling, MARSSIM was used to determine the appropriate number of samples required to perform accepted statistical analyses.

In this case, MARSSIM was used to provide a design for a statistical assessment of whether Cs-137 and Sr-90 levels are present in surface soils above or below concentration levels of concern derived using U.S. DOE Residual Radioactive (RESRAD) material guidelines. RESRAD is a computer program developed for the DOE, which codes dose assessment methodology recommended for use in deriving site-specific soil guidelines per DOE Order 5400.5. Tritium (H-3) is not considered when calculating the concentration levels of concern in the RESRAD methodology. Although there is currently no accepted EPA method of analyzing for H-3 in soils, H-3 was analyzed along with Cs-137 and Sr-90 as a screening for its presence in surface soils. H-3 was analyzed using a DOE approved distillation method (LANL ER-210) developed by the Los Alamos National Laboratory. This method is used by most laboratories, and is currently accepted as the industry standard for assessing H-3 in soils.

In support of MARSSIM, fifty-seven (57) sample locations were required along a triangular grid pattern across the site. However, due to site geometry, 58 locations were included in the MARSSIM analysis. The locations of samples collected in support of the site-wide radiological investigation are shown on Figure 3-1. The method used in determining the number of samples required is explained in Appendix A.

The second objective of the radionuclide sampling effort was to collect additional surface soil and some surface water samples at locations that could potentially be downgradient of surface runoff from the Rocketdyne facility to the southeast. Based on site topography and the final coverage provided by the MARSSIM survey, 12 discretionary sample locations were selected to address this objective.

Three water samples were collected along the creek that flows from the general direction of Rocketdyne, even though direct runoff from Rocketdyne appears unlikely based on review of USGS topographic maps. Three soil samples were collected along this drainage at the southern end of the site. An additional three samples were collected from the dry sediments in the Runkle Reservoir located further downgradient. Three surface soil samples were also collected from the tailing piles and analyzed for Sr-90, Cs-137, and H-3. Discretionary soil and water sample locations are shown on Figure 3-1.

Evaluation of Tailings Pile

A tailings pile from a former off-site sand and gravel mine is located along the southwest corner of the property. To evaluate the tailings pile, 12 surface soil samples, including two on-site background samples, were collected and analyzed for Title 26 metals, pH and major cations, and anions. Two surface water samples were also collected, one upstream of the tailings piles and one downstream, to evaluate if the tailings pile is affecting the quality of the surface water. The water samples were analyzed for Title 26 metals, pH and major cations and anions. A white precipitate was observed on surface soils in the tailings pile and was sampled during a previous investigation (QST, 1999). Results indicated the precipitate had a pH of 4, but were inconclusive with regard to the nature of the material. To further characterize the precipitate, an additional sample was collected and analyzed for Title 26 metals, pH and major cations and anions (Na^+, K^+, Mg^{2+}, Ca^{2+}, SO_4^{2-}, NO_3^-, Cl^-). This sample was carefully collected to obtain the precipitate only, and to exclude soil particles to the extent possible. The tailings pile evaluation sample locations are shown on Figure 3-2.

3.2 SAMPLE LOCATIONS

As discussed above, soil samples were collected at various locations in support of both the radiological investigation and the tailings pile evaluation. The majority of the samples were collected along a triangular grid pattern. The discretionary sample locations were selected to characterize the tailings pile and to further characterize the potential for radionuclide contamination based on topography and final grid coverage. In several cases, samples collected for both the radionuclide investigation and the tailings evaluation were collocated. Two field personnel collected all soil and water samples to be analyzed for radionuclides, and a third person collected soil and water samples used for evaluation of the tailings pile. Field procedures are described in the project Work Plan submitted to GreenPark on June 18, 1999.

Sample Location Surveying

Prior to the initiation of sampling, several property boundary locations were surveyed using a Differential Global Positioning System (DGPS). The DGPS system provided location data with accuracy's of approximately +/- 1 meter using United States Coast Guard broadcast differential correction signals. The coordinates were converted to California State Plane Coordinates (CA SPC) using coordinate transformation methods. The coordinates of the known points were used to calculate and assign coordinates, or "waypoints", to the proposed grid sample locations identified on Figure 2 of the Work Plan.

DGPS was used to navigate to each waypoint for collection of the sample at that location. The actual collection point was surveyed, assigned a sample number, and the coordinates were recorded electronically in the DGPS unit. If a sample location was inaccessible due to thick vegetation or extremely steep slopes, every attempt was made to get as near to the proposed location as possible. The sample was collected, and the location was surveyed and coordinates recorded. The surface water and discretionary samples were collected by locating the proposed sample locations based on topography, an aerial photograph, and accessibility. These samples were then assigned sample numbers and the locations where surveyed using DGPS. One discretionary sample, Sample GP-6-D, was not surveyed. The DGPS unit was not able to pick up the proper number of satellite signals for this sample. With the exception of sample GP-6-D, sample location coordinates are provided in Appendix B.

Sample Identification

The locations of all samples collected are shown on Figures 3-1 and 3-2. Samples collected in association with the MARSSIM site-wide grid were identified as GP-1-M through GP-59-M (sample GP-57-M could not be collected due to access problems). The discretionary soil samples were labeled GP-1-D, -3-D, -4-D, -5-D, -6-D, -7-D, -11-D, -17-D, and 19-D. Surface water samples collected in association with the radiological study were identified as GP-2-W, -8-W, and -9-W. Duplicate soil samples were collected at GP-17-M, GP-32-M, and GP-40-M and were labeled GP-61-M, GP-60-M, and GP-63-M, respectively. A duplicate water sample was collected at GP-08-W; it was labeled as GP-30-W.

Soil samples collected for evaluation of the tailings pile were identified as GP-10 through 21-D. Samples GP-11-D, GP-17-D and GP-19-D were collocated with the radiological survey discretionary samples of the same name. Sample GP-13-D and GP-21-D were background samples for the tailings pile analysis. A duplicate of sample GP-16-D was collected and labeled as GP-31-D. Sample GP-22-D is a sample of the white precipitate present in the tailings pile. This sample was not collected at a single point, but in an area surrounding this location in order to get enough material for analysis. Two water samples, GP-02-W and GP-09-W, collocated with radiological water samples, were also collected.

3.3 COLLECTION OF SOIL AND SURFACE WATER SAMPLES

Throughout the sampling event a total of 81 soil samples (plus 4 duplicates), 5 water samples (plus one duplicate) and one precipitate sample were collected in accordance with the procedures described in the Work Plan (Foster Wheeler, 1999). Surface soil samples were collected using a stainless steel trowel. Samples collected for metals analysis were collected using disposable trowels. The top layer of vegetation was removed and the sample location was screened for radiological activity using a GM Pancake Probe and a sodium iodide detector, as specified in the Work Plan (Foster Wheeler, 1999). The radiological screen field forms are included in Appendix C. Surface water grab samples were collected by placing the sample bottles in the stream.

4.0 RADIONUCLIDE SAMPLE RESULTS

The following section presents results of the radionuclide investigation. A description of the analytical approach is presented, followed by results from site wide grid investigation, and the results of discretionary radionuclide sampling.

4.1 ANALYTICAL APPROACH

Thermo Nutech Oak Ridge Laboratory analyzed all samples for radionuclides. Strontium-90 was analyzed using EIChroM Method SRW01, modified, with a specified Minimum Detectable Activity (MDA) of 0.05 pCi/g. Tritium analysis was performed by beta liquid scintillation using Method LANL ER-210 modified with a specified MDA of 100 pCi/l of water present. Cesium-137 was determined by Gamma Spectrometry. Gamma Spectrometry was performed using LANL ER-130 modified with a specified MDA of 0.05 pCi/g. Laboratory data sheets and chain-of-custody documents are presented in Appendix D.

In evaluating the data, two concepts are worthy of special note.

First, when analyzing samples with low concentrations of radionuclides it is necessary to establish a statistical basis for distinguishing between the presence of non naturally occurring radioactive materials and background radiation. The minimum detectable activity (MDA) is defined for each analytical technique so that measurements found to be above the value of the MDA indicate that radioactive material is present at the 95% confidence level (one is 95% sure that radioactive material is present). One cannot conclude with 95% confidence that radioactive material is present if the measured value is less than the MDA.

Secondly, gamma emitting radionuclides are identified using gamma spectroscopy by distinguishing a data maximum (peak) amidst a continuum of data points. Again, it is necessary to determine whether a small peak is significantly different from the adjacent data points. This is commonly done by ensuring that the size of the peak exceeds the MDA by at least the measurement uncertainty. One is 95% sure that a peak found in this manner is indicative of the presence of the radioactive material in question. When peaks are found that do not exceed the sum, the radionuclide is not considered to be present. Therefore, the concentrations of gamma emitting radionuclides, reported in Tables 4-1, 4-4, and 4-8 show those radionuclides confirmed to be present by peaks that exceed the uncertainties in the analysis.

4.2 SITE WIDE INVESTIGATION

A consensus methodology was developed for assessing the risk from soil containing low concentrations of radioactive material. Participants were the EPA, NRC, DOE, and DOD. The consensus was published as the Multi-Agency Radiation Survey and Site Investigation Manual

(MARSSIM). In summary, the methodology for each radionuclide presented consists of the following:

(1) Determine an annual dose that is regarded to be acceptable. 15 mrem/year is the dose proposed by EPA in 1993. The 15 mrem/year limit was widely criticized as being too low, and dropped. However, for conservative purposes, it is being used to evaluate GreenPark results. Since cesium-137 and strontium-90 are both expected, 7.5 mrem/year was the limit established for each, such that the total would not exceed 15 mrem/year.

(2) Compute, using a computer code, RESRAD, the concentration in soil that would give the annual dose limit. RESRAD sums the dose received by a future occupant from each applicable pathway (e.g., direct exposure, resuspension and inhalation, ingestion of vegetables, ingestion of meats, drinking water, and aquatic foods). For cesium-137, the concentration in soil that would give a total dose of 7.5 mrem/year was found to be 2.867 pCi/g. For strontium-90, a concentration of 1.23 pCi/g would give a dose of 7.5 mrem/year. These values are referred to as Derived Concentration Guide Levels (DCGLs)

(3) When available, use preliminary data to estimate the measurement variation to be expected, and use this information to determine the number of random samples required to give the desired degree of assurance. For this project, the preliminary data was taken from QST's report of Results of Preliminary Soil Sampling at Runkle Ranch (QSR, 1999). The number of samples required to achieve a 99% assurance for Runkle Ranch was found to be 57. To accommodate the spacial arrangement of sampling locations on site, 58 random samples were taken.

(4) Use the Wilcoxon Paired Sign Test to evaluate the results of the 58 samples analyzed. Each measured value (pCi/g) is subtracted from the DCGL and the sign of the result (+ or -) recorded. Note that if the concentrations in the soil were approximately the same as the DCGL, there would be similar numbers of "+s" and "-s", e.g., close to half of 58. ("+'s" indicating values less than the DCGL and "–'s" indicating values greater than the DCGL). In using this test, a critical value is calculated that allows one to draw one of the following two conclusions:

   - if the number of "+s" is greater than the critical value, the measured population is less than the DCGL. Therefore, the possible dose to any future individual is within allowable limits, and the soil is considered to be non-contaminated.

   - if the number of "+s" is lower than the critical value, the measured population is not less than the DCGL and the soil is considered to be contaminated.

The critical value was found to be 38. Since the assurance chosen was 99%, the initial conclusion can only be wrong 1% of the time when the number of "+s" exceeds 38. The error of this kind is further reduced by the greater the number of "+s" found to exceed the critical value.

Cesium-137

As shown in Table 4-1, the number of positive differences, or "+s", was found to be 58, meaning there were no minuses. This number far exceeds the critical value (38). Therefore, one concludes that the concentration of Cs-137 in the measured population (soil on the Runkle Ranch) is less than the DCGL. From this it follows that the future dose to an individual from cesium-137 is far less than the allowable dose of 7.5 mrem/year, and that cesium-137 is not a cause for concern.

Strontium-90

As shown in Table 4-2, the number of positive differences, or "+s" was found to be 41. This number exceeds the critical value (38). Therefore, one concludes that the concentration of Sr-90 in the measured population (soil on the Runkle Ranch) is less than the DCGL. From this it follows that the future dose to an individual from strontium-90 is less than the allowable dose of 7.5 mrem/year, and that strontium-90 is not a cause for concern.

Tritium (H-3)

As shown in Table 4-3, tritium was not present at a measurable concentration (above the MDA) in any of the samples analyzed. Therefore, tritium is not a cause for concern.

4.3 DISCRETIONARY SAMPLES

Discretionary samples were taken to provide additional information to supplement the findings of the site wide MARSSIM survey. Twelve locations were selected where contamination, if any, might be expected due to potential runoff from the nearby Rocketdyne facility. Locations already part of the site-wide survey were excluded from this group. Samples were taken and analyzed for Cs-137, Sr-90, H-3. In the course of the analysis all gamma emitting radionuclides are detected. The results of these samples are discussed as follows.

Cesium

Concentrations of Cs-137 were all less than the minimum detectable activity. These results are consistent with the Cs-137 results seen in the site-wide survey, and confirm that cesium-137 contamination is not a concern. For results, see Table 4-4.

Strontium

The Sr-90 concentrations in the discretionary samples were not different from those concentrations seen in the site-wide survey. Of the nine samples, three were above the DGCL, and two were below the MDA. The average concentration of the nine samples was lower than the average of the site wide survey samples. Since samples that were taken where contamination was thought to be most likely were no higher than the others, the results of the discretionary samples confirm the conclusion reached on the basis of the site-wide survey (i.e., that Sr-90 contamination is not a concern). See Table 4-5 for these results.

Tritium

Tritium was not detected in any of the discretionary soil samples at levels greater than the MDA. These results are entirely consistent with the H-3 results seen in the site-wide survey. In addition, tritium was not present in detectable concentrations in any of the three water samples collected. Together, these results confirm the conclusion from the site-wide survey that H-3 contamination is not a concern. For results, see Tables 4-6 and 4-7.

4.4 OTHER RADIONUCLIDES

Several other naturally occurring gamma emitting radionuclides were detected. These include potassium-40 (K-40) and radionuclides in the naturally occurring uranium and thorium decay series. Arkosic sandstone, which contains feldspars, is found in the vicinity. The feldspar fraction is a natural source of potassium (Tetra Tech Environmental, 1999), and potassium is approximately 0.01% K-40. The moderate concentrations of K-40 detected, reflect an unusually high concentration of potassium in the soil. However, the K-40 values are consistent with the K-40 background values previously reported by Rocketdyne (Rockwell International, 1996).

Thorium-234, bismuth-214, and lead-214, gamma emitting daughters of uranium-238 were also detected. Actinium-228 and lead-212, gamma emitting daughters of thorium-232 were detected as well. The concentrations of these radionuclides are consistent with usual soil concentrations (e.g., 0 to 2 pCi/g), and are lower than the general release criteria for uranium, 10 pCi/g, and thorium, 10 pCi/g (NRC 1981). Beryllium-7 is formed in the upper atmosphere by reactions with cosmic rays, and was detectable in one of the samples. For results, see Table 4-8.

4.5 RADIONUCLIDE DISTRIBUTIONS

The analytical results of samples collected for Cs-137, Sr-90, and H-3 are shown on Figures 4-1, 4-2 and 4-3, respectively. A discussion of the distribution of these radionuclides follows.

Cesium

None of the observed concentrations of Cs-137 exceeded values normally associated with background radiation (i.e., from world wide atomic testing), and there is no significant difference between samples from different areas (see Figure 4-1).

Strontium

The Sr-90 results were plotted on the site plot plan to determine if there was any significant spatial variation (see Figure 4-2). Two insubstantial correlations were seen. First, there appears to be an area with consistently lower concentrations. This area makes up most of the north end of the site. Secondly, there is an area with slightly higher average concentrations. It is in the lower central part of the site, and seems to be elongated in the SSW to NNE orientation. Because of the weakness of the correlation, and the generally low concentrations, no significance is attributed to the variation.

Tritium

There were no measurable concentrations (greater than MDA) seen in any of the samples. Therefore there is no indication of any tritium variability across the property sampled (see Figure 4-3).

Naturally Occurring Radionuclides

No significant variation was seen in the concentrations of naturally occurring radionuclides found on the Runkle Ranch Site.

4.6 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

The laboratory performed analysis on one duplicate water sample, GP-02-W, and four soil samples, GP-5-M, GP-42-M, GP-48-M, and GP-60-M. The data from the samples and duplicates were compared, and generally indicated that the variability of the original sample and the duplicate were within acceptable error bounds. The duplicate values were not used in the analysis of the data. The one exception was the lead-212 value for GP-5-M. In this case the higher result from the laboratory duplicate was used in order to be conservative.

In addition to the laboratory QA/QC analysis, Foster Wheeler personnel collected duplicate samples that were submitted blind to the lab. Duplicate samples were used to evaluate the precision of the laboratory analysis. Duplicate samples were collected at GP-17-M, GP-32-M, GP-40-M, and GP-08-W, and analyzed using the same constituents as the primary samples. The data from the samples and duplicates were compared, and generally indicated that the variability of original sample and the duplicate were within the error bounds. The duplicate values were not used in the analysis of the data. The one exception was the Cs-137 value for

GP-17-M/GP-61-M. In this case the higher result from GP-61-M was used in order to be conservative.

4.7 RADIOLOGICAL FIELD SCREENING RESULTS

Field screening measurements were made at each sample location using a Geiger-Mueller detector with a pancake probe to detect beta radiation. Gamma measurements were also made at some of the sampling locations. Instrument problems prevented 100% coverage. No unusual or elevated readings were seen.

5.0 TAILINGS PILE EVALUATION

Twelve soil samples (plus one duplicate), two surface water samples, and one precipitate sample were collected for evaluation of the tailings pile. The samples were sent for chemical analysis to Montgomery Watson Laboratories, a certified laboratory located in Pasadena, California. Laboratory data sheets and chain-of-custody documents are presented in Appendix D. The samples were analyzed using the following methods:

Analyte	Method
Alkalinity	SM2320B
Major Cations/Anions	SM1040
pH	4500HB
Mercury	245.1
Title 26 Metals (not including mercury)	EPA 200.7, EPA 300.0, SW 6010

The precipitate sample was also analyzed using a x-ray diffractometer in the Environmental Sciences Department at UC Riverside. The sample was run as a packed powder, on a Siemens D500 x-ray diffractometer, to help identify the mineral composition of the sample.

5.1 SURFACE SOIL SAMPLES

Twelve primary and one duplicate surface soil samples (GP-10-D through GP-21-D, GP-31-D) were collected for evaluation of the tailings pile. Two background samples, GP-13-D and GP-21-D, were collected from undisturbed soil adjacent to the tailings pile.

Surface soil sample analytical results are presented in Table 5-1. Metals detected in the soil samples include barium, chromium, copper, nickel, vanadium, and zinc. All results were at least 10 times lower than the EPA PRGs for each metal detected, and were near or below the levels found in background samples.

5.2 SURFACE WATER SAMPLES

Two surface-water grab samples were collected from a creek flowing through the tailings pile. Surface water flow through the stream, at the time the sample was collected, was minimal. Samples were collected in small pools barely large enough for the sample bottle and with only a slight trickle of downstream water movement. GPT-02-W was collected upstream of the tailings pile, and GP-9-W was collected downstream. California EPA and US EPA Region 9 drinking water standards were used to evaluate the water samples from the creek. The lowest regulatory standard [maximum contaminant level (MCL), PRG, RWQCB Water Quality Objective or secondary maximum contaminant level (SMCL), as reported by either the state or Federal EPA], was used to evaluate the results of these water samples.

Analytical results of surface water samples are shown in Table 5-2. The general chemistry of the water is dominated by sulfate, alkalinity, calcium, magnesium, and sodium. Sulfate (SO_4^{2-}) detected at 537 mg/L and 1460 mg/L in samples GPT-02-W and GP-09-W respectively, was the only analyte detected over the regulatory standard (250 mg/L). The surface soil analytical results shown on Table 5-1 and the precipitate sample analysis shown in Table 5-3 and discussed below, both indicate naturally occurring high levels of SO_4^{2-} in the soil. The pH of the upstream sample was near neutral (6.9), while the sample downstream was slightly alkaline (8.1). The electrical conductivities for the samples were 1820 µS/cm upstream and 2690 µS/cm downstream. Both are relatively high, possibly from salts due to evaporation of water from the small pools where the samples were collected. Concentration via evaporation may have also contributed to the elevated concentration of sulfate. Nitrate was below detection in both water samples.

The only metals detected in the water samples were silver, barium, mercury, molybdenum, and zinc all at concentrations well below the most conservative regulatory levels. The upstream sample had very low levels of barium and zinc. The downstream sample had detectable amounts of silver, mercury, molybdenum, and zinc. The silver was below its SMCL of 0.1 mg/L. Mercury was detected well below (8 times less) than its MCL of 0.002 mg/L. Molybdenum was found below its PRG by a factor of more than 5. Zinc in this sample was close to the level of the upstream sample (more than 100 times less than the SMCL of 5.0 mg/L).

5.3 PRECIPITATE SAMPLE

Results of the x-ray diffraction (XRD) analysis of the white precipitate from the tailings pile are shown in Attachment 3 of Appendix D. Major peaks in the XRD pattern at d-values of 4.39, 5.44, and 5.08 along with most of the minor peaks match those for hexahydrite ($MgSO_4 \cdot 6H_2O$), a common evaporite mineral. Under observation with a dissecting microscope, the crystals of the precipitate had a coarsely columnar shape, typical of hexahydrite. Most of the rest of the x-ray peaks indicated the presence of konyaite ($Na_2Mg(SO_4)_2 \cdot 5H_2O$), another sulfate evaporite mineral.

These two evaporite minerals are similar in character. They have similar chemical compositions, with the most significant difference being that konyaite has sodium where hexahydrite does not. The constituents of these minerals (water, sulfate, magnesium, and sodium) are common to soil. Both have high solubilities, and tend to be found at the front of water movement in soil during periods of dry conditions. They are commonly formed at the surface of soils where salts accumulate as a function of drying. The precipitate from the tailings pile was collected at the soil surface, and the sample readily dissolved in water. This suggests that the precipitate sample is consistent with the characteristics of evaporite minerals.

Results of the chemical analysis of the precipitate sample are shown in Table 5-3. US EPA PRGs for soils where used to evaluate the metals found. No EPA PRGs were exceeded in this sample, and only nickel and zinc were detected. Nickel was detected at a level 7 times less than its PRG, and zinc was found at a concentration 2600 times less than its PRG. In addition, cation/anion data showed elevated levels of Mg^{2+}, Na^{+} and SO_4^{2-}, which supports the XRD results discussed above (Table 5-3).

6.0 SUMMARY

This section summarizes the findings of the sampling programs conducted for GreenPark at their Runkle Ranch property. It is important to recognize that even the most comprehensive scope of services may not detect all the environmental liabilities at a particular site. Therefore, nothing herein shall be construed as a representation or certification that the site is either fully characterized or is free of environmental impairments and/or radionuclide contamination. The findings of the sampling program are summarized below.

6.1 RADIONUCLIDE INVESTIGATION

Soil and water samples were taken systematically across the Runkle Ranch site, and analyzed for cesium-137, strontium-90, tritium, and gamma emitting radionuclides. Low concentrations of cesium, strontium, and several naturally occurring radionuclides were detected. Tritium was not found above the MDA. Cesium-137 concentrations were typical of those associated with world-wide fallout (i.e. 0 to 1 pCi/g), and naturally occurring radionuclides were found at typical concentrations (i.e. 0 to 2 pCi/g). Of the naturally occurring radionuclides, only potassium-40 was higher than expected, and this simply indicated that the soil is potassium-rich. Strontium-90 which also can be a product of fallout was detected, and a weak correlation was observed between the concentration and the locations within the site.

The systematic collection of samples was designed to conform to the widely accepted MARSSIM test protocol to determine the significance of the cesium and strontium concentrations. The application of this protocol showed that the site wide concentrations of cesium-137 and strontium-90 were each below the respective values that would cause an annual dose of 7.5 mrem/year. Therefore, the annual dose from the two radionuclides of concern is less than the conservative limit assumed (i.e. 15 mrem/year). Based on the surface soil sampling that was conducted, the site is considered to be non-contaminated for the radionuclides detected.

6.2 EVALUATION OF TAILINGS PILE

The results of the chemical analysis of the soil, water, and precipitate samples collected indicate there are no metals present at concentrations of concern. The only regulatory standard exceeded was the CRWQCB water quality objective for sulfate (250 mg/L). Chemical analysis of the soil and precipitate indicate the samples are dominated by sulfate salts, indicating naturally occurring high levels of SO_4^{2-}. No other regulatory standards for water or soil were exceeded in any of the samples collected from the tailings pile or the creek running through it. Results of the XRD analysis of the precipitate sample confirmed the presence of magnesium and sodium/magnesium sulfate minerals. These constituents (evaporite minerals) are common to soil and are of no concern.

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TABLES

TABLES

Table 4-1

Cs-137 MARSSIM Grid Sample Results

Lab ID	Client ID	Analyte	Result	DCGL - Result	Sign	Error	MDA	Units
99-07018-06	GP-01-M	Cesium-137	0.12	2.73	1	0.06	0.07	PCI/G
99-07018-07	GP-02-M	Cesium-137	0.12	2.73	1	0.05	0.07	PCI/G
99-07017-20	GP-03-M	Cesium-137	0.07	2.79	1	0.04	0.07	PCI/G
99-07018-05	GP-04-M	Cesium-137	0.03	2.82	1	0.04	0.08	PCI/G
99-07018-04	GP-05-M	Cesium-137	0.15	2.71	1	0.07	0.09	PCI/G
99-07018-08	GP-06-M	Cesium-137	0.12	2.74	1	0.09	0.09	PCI/G
99-07018-09	GP-07-M	Cesium-137	0.04	2.81	1	0.04	0.08	PCI/G
99-07017-17	GP-08-M	Cesium-137	0.12	2.73	1	0.05	0.06	PCI/G
99-07017-18	GP-09-M	Cesium-137	0.08	2.78	1	0.06	0.08	PCI/G
99-07017-19	GP-10-M	Cesium-137	0.18	2.67	1	0.08	0.10	PCI/G
99-07017-14	GP-11-M	Cesium-137	0.28	2.57	1	0.10	0.07	PCI/G
99-07017-13	GP-12-M	Cesium-137	0.10	2.76	1	0.08	0.09	PCI/G
99-07017-12	GP-13-M	Cesium-137	0.12	2.74	1	0.08	0.09	PCI/G
99-07021-08	GP-14-M	Cesium-137	0.02	2.83	1	0.05	0.10	PCI/G
99-07021-09	GP-15-M	Cesium-137	0.06	2.80	1	0.09	0.10	PCI/G
99-07021-12	GP-16-M	Cesium-137	0.05	2.81	1	0.06	0.09	PCI/G
99-07017-16	GP-18-M	Cesium-137	0.07	2.79	1	0.06	0.07	PCI/G
99-07017-15	GP-19-M	Cesium-137	0.14	2.72	1	0.09	0.07	PCI/G
99-07019-13	GP-20-M	Cesium-137	0.04	2.82	1	0.05	0.09	PCI/G
99-07019-12	GP-21-M	Cesium-137	0.03	2.83	1	0.06	0.11	PCI/G
99-07019-11	GP-22-M	Cesium-137	0.27	2.59	1	0.10	0.08	PCI/G
99-07021-13	GP-23-M	Cesium-137	0.11	2.75	1	0.07	0.07	PCI/G
99-07021-11	GP-24-M	Cesium-137	0.18	2.67	1	0.07	0.07	PCI/G
99-07021-10	GP-25-M	Cesium-137	0.14	2.72	1	0.08	0.08	PCI/G
99-07017-06	GP-26-M	Cesium-137	0.10	2.76	1	0.07	0.08	PCI/G
99-07019-09	GP-27-M	Cesium-137	0.11	2.75	1	0.08	0.07	PCI/G
99-07019-10	GP-28-M	Cesium-137	0.23	2.62	1	0.11	0.09	PCI/G
99-07019-14	GP-29-M	Cesium-137	0.18	2.68	1	0.11	0.10	PCI/G
99-07021-14	GP-30-M	Cesium-137	0.09	2.77	1	0.08	0.09	PCI/G
99-07017-07	GP-31-M	Cesium-137	0.11	2.75	1	0.09	0.08	PCI/G
99-07017-05	GP-32-M	Cesium-137	0.10	2.75	1	0.07	0.10	PCI/G
99-07017-08	GP-33-M	Cesium-137	0.08	2.77	1	0.07	0.09	PCI/G
99-07017-09	GP-34-M	Cesium-137	0.09	2.77	1	0.07	0.08	PCI/G
99-07019-15	GP-35-M	Cesium-137	0.05	2.81	1	0.07	0.08	PCI/G
99-07021-07	GP-36-M	Cesium-137	0.11	2.75	1	0.07	0.08	PCI/G
99-07020-14	GP-37-M	Cesium-137	0.07	2.78	1	0.09	0.07	PCI/G
99-07019-08	GP-38-M	Cesium-137	0.01	2.85	1	0.04	0.08	PCI/G
99-07019-07	GP-39-M	Cesium-137	0.12	2.74	1	0.10	0.12	PCI/G
99-07020-15	GP-40-M	Cesium-137	0.00	2.86	1	0.05	0.07	PCI/G
99-07021-06	GP-41-M	Cesium-137	0.08	2.78	1	0.06	0.08	PCI/G
99-07020-04	GP-42-M	Cesium-137	0.19	2.66	1	0.08	0.09	PCI/G
99-07021-05	GP-43-M	Cesium-137	0.13	2.73	1	0.10	0.09	PCI/G
99-07021-15	GP-44-M	Cesium-137	0.00	2.86	1	0.05	0.09	PCI/G
99-07019-06	GP-45-M	Cesium-137	-0.02	2.87	1	0.05	0.07	PCI/G
99-07018-16	GP-46-M	Cesium-137	0.04	2.81	1	0.05	0.09	PCI/G
99-07018-17	GP-47-M	Cesium-137	0.13	2.72	1	0.06	0.08	PCI/G
99-07019-04	GP-48-M	Cesium-137	-0.01	2.86	1	0.06	0.10	PCI/G
99-07019-05	GP-49-M	Cesium-137	0.00	2.86	1	0.03	0.06	PCI/G
99-07020-12	GP-50-M	Cesium-137	0.30	2.55	1	0.11	0.07	PCI/G
99-07020-05	GP-51-M	Cesium-137	0.14	2.72	1	0.09	0.09	PCI/G
99-07020-11	GP-52-M	Cesium-137	-0.03	2.89	1	0.05	0.08	PCI/G
99-07020-13	GP-53-M	Cesium-137	0.09	2.77	1	0.06	0.09	PCI/G
99-07018-20	GP-54-M	Cesium-137	0.11	2.74	1	0.06	0.07	PCI/G
99-07018-19	GP-55-M	Cesium-137	0.14	2.72	1	0.08	0.09	PCI/G
99-07018-18	GP-56-M	Cesium-137	0.16	2.70	1	0.08	0.09	PCI/G
99-07020-09	GP-58-M	Cesium-137	0.00	2.86	1	0.05	0.08	PCI/G
99-07020-10	GP-59-M	Cesium-137	0.02	2.84	1	0.04	0.08	PCI/G
99-07017-11	GP-61-M *	Cesium-137	0.29	2.57	1	0.05	0.05	PCI/G
Cs-137 DCGL = 2.857 pCi/g α = 0.01	Number of Positive Differences (S+) N = 58		Critical Value =38		58			

M – MARSSIM Samples

* Gp-61-M is a duplicate of GP-17-M, the higher value was used for this analysis.

Table 4-2

Sr-90 MARSSIM Grid Sample Results

Lab ID	Client ID	Analyte	Result	DCGL Result	Sign	Error	MDA	Units
99-07018-06	GP-01-M	Strontium-90	1.36	-0.14	-1	0.40	0.71	PCI/G
99-07018-07	GP-02-M	Strontium-90	1.13	0.10	1	0.44	0.86	PCI/G
99-07017-20	GP-03-M	Strontium-90	0.85	0.38	1	0.42	0.87	PCI/G
99-07018-05	GP-04-M	Strontium-90	0.85	0.38	1	0.35	0.69	PCI/G
99-07018-04	GP-05-M	Strontium-90	0.65	0.58	1	0.40	0.87	PCI/G
99-07018-08	GP-06-M	Strontium-90	1.48	-0.25	-1	0.43	0.75	PCI/G
99-07018-09	GP-07-M	Strontium-90	1.34	-0.11	-1	0.40	0.74	PCI/G
99-07017-17	GP-08-M	Strontium-90	0.66	0.57	1	0.34	0.70	PCI/G
99-07017-18	GP-09-M	Strontium-90	0.83	0.40	1	0.38	0.75	PCI/G
99-07017-19	GP-10-M	Strontium-90	0.14	1.09	1	0.38	0.92	PCI/G
99-07017-14	GP-11-M	Strontium-90	1.10	0.13	1	0.40	0.73	PCI/G
99-07017-13	GP-12-M	Strontium-90	0.71	0.52	1	0.37	0.76	PCI/G
99-07017-12	GP-13-M	Strontium-90	1.17	0.06	1	0.38	0.69	PCI/G
99-07021-08	GP-14-M	Strontium-90	1.37	-0.14	-1	0.48	0.89	PCI/G
99-07021-09	GP-15-M	Strontium-90	1.13	0.10	1	0.34	0.58	PCI/G
99-07021-12	GP-16-M	Strontium-90	1.18	0.05	1	0.33	0.56	PCI/G
99-07017-10	GP-17-M	Strontium-90	1.07	0.16	1	0.41	0.75	PCI/G
99-07017-16	GP-18-M	Strontium-90	0.29	0.94	1	0.33	0.77	PCI/G
99-07017-15	GP-19-M	Strontium-90	0.15	1.08	1	0.36	0.88	PCI/G
99-07019-13	GP-20-M	Strontium-90	1.43	-0.20	-1	0.41	0.69	PCI/G
99-07019-12	GP-21-M	Strontium-90	0.71	0.52	1	0.34	0.68	PCI/G
99-07019-11	GP-22-M	Strontium-90	0.84	0.38	1	0.35	0.68	PCI/G
99-07021-13	GP-23-M	Strontium-90	0.85	0.38	1	0.34	0.66	PCI/G
99-07021-11	GP-24-M	Strontium-90	1.21	0.02	1	0.43	0.77	PCI/G
99-07021-10	GP-25-M	Strontium-90	1.05	0.18	1	0.39	0.73	PCI/G
99-07017-06	GP-26-M	Strontium-90	0.73	0.49	1	0.37	0.74	PCI/G
99-07019-09	GP-27-M	Strontium-90	1.09	0.14	1	0.39	0.72	PCI/G
99-07019-10	GP-28-M	Strontium-90	1.07	0.16	1	0.39	0.72	PCI/G
99-07019-14	GP-29-M	Strontium-90	5.13	-3.90	-1	0.69	0.84	PCI/G
99-07021-14	GP-30-M	Strontium-90	1.56	-0.34	-1	0.41	0.64	PCI/G
99-07017-07	GP-31-M	Strontium-90	0.63	0.60	1	0.32	0.66	PCI/G
99-07017-05	GP-32-M	Strontium-90	0.51	0.72	1	0.36	0.76	PCI/G
99-07017-08	GP-33-M	Strontium-90	0.81	0.42	1	0.38	0.76	PCI/G
99-07017-09	GP-34-M	Strontium-90	1.47	-0.24	-1	0.42	0.70	PCI/G
99-07019-15	GP-35-M	Strontium-90	0.79	0.44	1	0.35	0.70	PCI/G
99-07021-07	GP-36-M	Strontium-90	1.17	0.06	1	0.41	0.76	PCI/G
99-07020-14	GP-37-M	Strontium-90	1.16	0.07	1	0.39	0.68	PCI/G
99-07019-08	GP-38-M	Strontium-90	1.88	-0.65	-1	0.49	0.85	PCI/G
99-07019-07	GP-39-M	Strontium-90	0.77	0.46	1	0.37	0.73	PCI/G
99-07020-15	GP-40-M	Strontium-90	2.95	-1.72	-1	0.49	0.63	PCI/G
99-07021-06	GP-41-M	Strontium-90	1.37	-0.15	-1	0.42	0.73	PCI/G
99-07020-04	GP-42-M	Strontium-90	1.79	-0.56	-1	0.47	0.75	PCI/G
99-07021-05	GP-43-M	Strontium-90	0.67	0.56	1	0.39	0.83	PCI/G
99-07021-15	GP-44-M	Strontium-90	6.38	-5.15	-1	0.79	0.99	PCI/G
99-07019-06	GP-45-M	Strontium-90	0.54	0.69	1	0.37	0.80	PCI/G
99-07018-16	GP-46-M	Strontium-90	1.12	0.11	1	0.40	0.71	PCI/G
99-07018-17	GP-47-M	Strontium-90	0.91	0.32	1	0.39	0.76	PCI/G
99-07019-04	GP-48-M	Strontium-90	0.76	0.47	1	0.39	0.79	PCI/G
99-07019-05	GP-49-M	Strontium-90	0.81	0.41	1	0.35	0.68	PCI/G
99-07020-12	GP-50-M	Strontium-90	1.08	0.15	1	0.42	0.78	PCI/G
99-07020-05	GP-51-M	Strontium-90	1.15	0.08	1	0.45	0.86	PCI/G
99-07020-11	GP-52-M	Strontium-90	12.34	-11.11	-1	0.86	0.59	PCI/G
99-07020-13	GP-53-M	Strontium-90	0.90	0.33	1	0.39	0.76	PCI/G
99-07018-20	GP-54-M	Strontium-90	1.65	-0.43	-1	0.47	0.81	PCI/G
99-07018-19	GP-55-M	Strontium-90	0.77	0.46	1	0.40	0.82	PCI/G
99-07018-18	GP-56-M	Strontium-90	1.40	-0.17	-1	0.40	0.66	PCI/G
99-07020-09	GP-58-M	Strontium-90	1.29	-0.06	-1	0.42	0.75	PCI/G
99-07020-10	GP-59-M	Strontium-90	1.06	0.17	1	0.37	0.65	PCI/G

Sr-90 DCGL = 1.229 pCi/g Number of Positive Differences (S+) 41

α = 0.01 N = 58 Critical Value = 38

M – MARSSIM Samples

Table 4-3

Tritium MARSSIM Grid Sample Results

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-06	GP-01-M	Tritium	1.59	2.97	5.10	PCI/G
99-07018-07	GP-02-M	Tritium	0.78	2.83	4.95	PCI/G
99-07017-20	GP-03-M	Tritium	1.08	3.03	5.27	PCI/G
99-07018-05	GP-04-M	Tritium	0.36	3.04	5.40	PCI/G
99-07018-04	GP-05-M	Tritium	-0.23	2.99	5.38	PCI/G
99-07018-08	GP-06-M	Tritium	0.57	2.92	5.14	PCI/G
99-07018-09	GP-07-M	Tritium	-0.37	3.02	5.45	PCI/G
99-07017-17	GP-08-M	Tritium	0.75	3.15	5.55	PCI/G
99-07017-18	GP-09-M	Tritium	0.35	2.87	5.09	PCI/G
99-07017-19	GP-10-M	Tritium	-0.36	2.90	5.25	PCI/G
99-07017-14	GP-11-M	Tritium	1.54	3.05	5.25	PCI/G
99-07017-13	GP-12-M	Tritium	0.11	2.99	5.33	PCI/G
99-07017-12	GP-13-M	Tritium	0.95	3.03	5.30	PCI/G
99-07021-08	GP-14-M	Tritium	-0.01	0.29	0.53	PCI/G
99-07021-09	GP-15-M	Tritium	0.07	0.29	0.51	PCI/G
99-07021-12	GP-16-M	Tritium	0.12	0.30	0.51	PCI/G
99-07017-10	GP-17-M	Tritium	-1.87	2.72	5.14	PCI/G
99-07017-16	GP-18-M	Tritium	-1.10	2.94	5.41	PCI/G
99-07017-15	GP-19-M	Tritium	1.11	3.12	5.43	PCI/G
99-07019-13	GP-20-M	Tritium	-2.07	3.01	5.65	PCI/G
99-07019-12	GP-21-M	Tritium	-0.86	3.08	5.62	PCI/G
99-07019-11	GP-22-M	Tritium	-0.97	3.07	5.62	PCI/G
99-07021-13	GP-23-M	Tritium	0.23	0.32	0.54	PCI/G
99-07021-11	GP-24-M	Tritium	0.26	0.31	0.52	PCI/G
99-07021-10	GP-25-M	Tritium	-0.18	0.28	0.53	PCI/G
99-07017-06	GP-26-M	Tritium	0.74	3.08	5.42	PCI/G
99-07019-09	GP-27-M	Tritium	-0.96	3.05	5.58	PCI/G
99-07019-10	GP-28-M	Tritium	0.74	3.23	5.67	PCI/G
99-07019-14	GP-29-M	Tritium	-2.35	2.86	5.43	PCI/G
99-07021-14	GP-30-M	Tritium	0.07	0.29	0.51	PCI/G
99-07017-07	GP-31-M	Tritium	1.54	2.83	4.86	PCI/G
99-07017-05	GP-32-M	Tritium	0.23	2.90	5.16	PCI/G
99-07017-08	GP-33-M	Tritium	0.74	3.08	5.41	PCI/G
99-07017-09	GP-34-M	Tritium	0.59	3.00	5.30	PCI/G
99-07019-15	GP-35-M	Tritium	2.30	3.28	5.57	PCI/G
99-07021-07	GP-36-M	Tritium	0.06	0.30	0.53	PCI/G
99-07020-14	GP-37-M	Tritium	1.95	3.07	5.23	PCI/G
99-07019-08	GP-38-M	Tritium	-2.50	2.89	5.51	PCI/G
99-07019-07	GP-39-M	Tritium	-1.48	3.07	5.68	PCI/G
99-07020-15	GP-40-M	Tritium	0.48	2.97	5.26	PCI/G
99-07021-06	GP-41-M	Tritium	0.17	0.29	0.49	PCI/G
99-07020-04	GP-42-M	Tritium	-0.45	2.60	4.74	PCI/G
99-07021-05	GP-43-M	Tritium	0.04	0.29	0.52	PCI/G
99-07021-15	GP-44-M	Tritium	0.12	0.30	0.51	PCI/G
99-07019-06	GP-45-M	Tritium	-2.08	3.01	5.66	PCI/G
99-07018-16	GP-46-M	Tritium	-0.13	2.97	5.33	PCI/G
99-07018-17	GP-47-M	Tritium	0.24	3.04	5.41	PCI/G
99-07019-04	GP-48-M	Tritium	0.61	3.21	5.65	PCI/G
99-07019-05	GP-49-M	Tritium	-0.23	2.98	5.34	PCI/G
99-07020-12	GP-50-M	Tritium	1.45	2.98	5.15	PCI/G
99-07020-05	GP-51-M	Tritium	-1.15	2.63	4.89	PCI/G
99-07020-11	GP-52-M	Tritium	1.22	2.75	4.75	PCI/G
99-07020-13	GP-53-M	Tritium	1.32	2.96	5.12	PCI/G
99-07018-20	GP-54-M	Tritium	-0.12	2.79	5.01	PCI/G
99-07018-19	GP-55-M	Tritium	-0.79	2.74	5.02	PCI/G
99-07018-18	GP-56-M	Tritium	-0.95	2.92	5.36	PCI/G
99-07020-09	GP-58-M	Tritium	1.60	2.85	4.89	PCI/G
99-07020-10	GP-59-M	Tritium	-0.74	2.85	5.22	PCI/G

All Tritium samples <MDA
M – MARSSIM Samples

Table 4-4

Cs-137 Discretionary Sample Results

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-10	GP-01-D	Cesium-137	-0.01	0.05	0.09	PCI/G
99-07018-11	GP-03-D	Cesium-137	0.02	0.06	0.12	PCI/G
99-07018-12	GP-04-D	Cesium-137	0.01	0.04	0.08	PCI/G
99-07018-13	GP-05-D	Cesium-137	-0.03	0.05	0.08	PCI/G
99-07018-14	GP-06-D	Cesium-137	0.01	0.03	0.06	PCI/G
99-07018-15	GP-07-D	Cesium-137	-0.03	0.04	0.07	PCI/G
99-07020-06	GP-11-D	Cesium-137	0.01	0.04	0.07	PCI/G
99-07020-07	GP-17-D	Cesium-137	-0.05	0.05	0.09	PCI/G
99-07020-08	GP-19-D	Cesium-137	0.03	0.06	0.11	PCI/G

All Cs-137 is <MDA

Table 4-5

Sr-90 Discretionary Sample Results

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-10	GP-01-D	Strontium-90	0.84	0.37	0.74	PCI/G
99-07018-11	GP-03-D	Strontium-90	0.69	0.35	0.71	PCI/G
99-07018-12	GP-04-D	Strontium-90	2.03	0.49	0.78	PCI/G
99-07018-13	GP-05-D	Strontium-90	0.80	0.33	0.62	PCI/G
99-07018-14	GP-06-D	Strontium-90	0.50	0.39	0.87	PCI/G
99-07018-15	GP-07-D	Strontium-90	1.25	0.41	0.73	PCI/G
99-07020-06	GP-11-D	Strontium-90	1.86	0.50	0.84	PCI/G
99-07020-07	GP-17-D	Strontium-90	0.88	0.35	0.68	PCI/G
99-07020-08	GP-19-D	Strontium-90	1.22	0.40	0.75	PCI/G
		Maximum Value	2.03			PCI/G
		Minimum Value	<MDA			PCI/G
		Average Value	1.12			PCI/G

D – Discretionary Samples

Table 4-6

Tritium Discretionary Sample Results

Lab ID	Client ID	Analyte	Result	DCGL - Result	Sign	Error	MDA	Units
99-07018-10	GP-01-D	Tritium	1.32		3.10	5.37		PCI/G
99-07018-11	GP-03-D	Tritium	1.25		2.94	5.09		PCI/G
99-07018-12	GP-04-D	Tritium	0.48		3.00	5.30		PCI/G
99-07018-13	GP-05-D	Tritium	0.24		3.07	5.46		PCI/G
99-07018-14	GP-06-D	Tritium	0.69		2.91	5.11		PCI/G
99-07018-15	GP-07-D	Tritium	-0.59		2.92	5.30		PCI/G
99-07020-06	GP-11-D	Tritium	2.26		2.86	4.82		PCI/G
99-07020-07	GP-17-D	Tritium	1.00		3.06	5.34		PCI/G
99-07020-08	GP-19-D	Tritium	-0.48		2.79	5.08		PCI/G

All Tritium samples <MDA

D – Discretionary Samples

Table 4-7

Tritium in Surface Water Sample Results

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07016-04	GP-02-W	Tritium	159.95	299.04	514.33	PCI/L
99-07016-06	GP-08-W	Tritium	-47.43	280.04	510.37	PCI/L
99-07016-05	GP-09-W	Tritium	-24.42	290.37	525.49	PCI/L
99-07016-07	GP-30-W *	Tritium	61.32	285.73	504.54	PCI/L

All Tritium samples <MDA

W – Water Samples

* GP-30-W is a duplicate of GP-08-W. The higher value is used in the Figure.

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-10	GP-01-D	Actinium-228	1.35	0.28	0.33	PCI/G
99-07018-06	GP-01-M	Actinium-228	0.78	0.19	0.20	PCI/G
99-07018-07	GP-02-M	Actinium-228	0.70	0.18	0.21	PCI/G
99-07017-20	GP-03-M	Actinium-228	1.04	0.21	0.23	PCI/G
99-07018-12	GP-04-D	Actinium-228	1.47	0.22	0.17	PCI/G
99-07018-05	GP-04-M	Actinium-228	0.73	0.21	0.23	PCI/G
99-07018-13	GP-05-D	Actinium-228	0.78	0.21	0.30	PCI/G
99-07018-04	GP-05-M	Actinium-228	0.83	0.23	0.31	PCI/G
99-07018-14	GP-06-D	Actinium-228	0.85	0.22	0.21	PCI/G
99-07018-08	GP-06-M	Actinium-228	0.86	0.27	0.34	PCI/G
99-07018-15	GP-07-D	Actinium-228	0.96	0.20	0.26	PCI/G
99-07018-09	GP-07-M	Actinium-228	0.98	0.21	0.22	PCI/G
99-07017-18	GP-09-M	Actinium-228	0.76	0.20	0.22	PCI/G
99-07020-06	GP-11-D	Actinium-228	0.97	0.21	0.25	PCI/G
99-07017-14	GP-11-M	Actinium-228	0.86	0.23	0.26	PCI/G
99-07017-13	GP-12-M	Actinium-228	0.72	0.31	0.35	PCI/G
99-07017-12	GP-13-M	Actinium-228	1.04	0.25	0.27	PCI/G
99-07021-09	GP-15-M	Actinium-228	1.07	0.26	0.31	PCI/G
99-07021-12	GP-16-M	Actinium-228	0.84	0.24	0.33	PCI/G
99-07020-07	GP-17-D	Actinium-228	1.46	0.31	0.38	PCI/G
99-07017-10	GP-17-M	Actinium-228	0.50	0.13	0.18	PCI/G
99-07017-16	GP-18-M	Actinium-228	0.53	0.20	0.28	PCI/G
99-07020-08	GP-19-D	Actinium-228	1.38	0.39	0.35	PCI/G
99-07017-15	GP-19-M	Actinium-228	0.79	0.23	0.26	PCI/G
99-07019-13	GP-20-M	Actinium-228	1.08	0.24	0.31	PCI/G
99-07019-12	GP-21-M	Actinium-228	0.98	0.30	0.32	PCI/G
99-07019-11	GP-22-M	Actinium-228	1.05	0.22	0.20	PCI/G
99-07021-13	GP-23-M	Actinium-228	1.16	0.21	0.20	PCI/G
99-07021-11	GP-24-M	Actinium-228	0.63	0.20	0.27	PCI/G
99-07021-10	GP-25-M	Actinium-228	0.92	0.22	0.24	PCI/G
99-07017-06	GP-26-M	Actinium-228	1.22	0.27	0.28	PCI/G
99-07019-09	GP-27-M	Actinium-228	0.91	0.22	0.23	PCI/G
99-07019-10	GP-28-M	Actinium-228	1.18	0.27	0.32	PCI/G
99-07019-14	GP-29-M	Actinium-228	1.01	0.30	0.35	PCI/G
99-07021-14	GP-30-M	Actinium-228	1.52	0.25	0.30	PCI/G
99-07017-05	GP-32-M	Actinium-228	1.18	0.27	0.34	PCI/G
99-07017-08	GP-33-M	Actinium-228	1.38	0.23	0.28	PCI/G
99-07017-09	GP-34-M	Actinium-228	1.53	0.26	0.25	PCI/G
99-07019-15	GP-35-M	Actinium-228	1.39	0.21	0.30	PCI/G
99-07021-07	GP-36-M	Actinium-228	1.56	0.23	0.26	PCI/G
99-07020-14	GP-37-M	Actinium-228	1.75	0.26	0.25	PCI/G
99-07019-08	GP-38-M	Actinium-228	1.71	0.27	0.27	PCI/G
99-07019-07	GP-39-M	Actinium-228	1.16	0.33	0.36	PCI/G
99-07020-15	GP-40-M	Actinium-228	1.43	0.23	0.27	PCI/G
99-07021-06	GP-41-M	Actinium-228	1.03	0.25	0.28	PCI/G
99-07020-04	GP-42-M	Actinium-228	1.38	0.24	0.29	PCI/G
99-07021-05	GP-43-M	Actinium-228	1.40	0.24	0.32	PCI/G
99-07021-15	GP-44-M	Actinium-228	0.83	0.25	0.32	PCI/G
99-07019-06	GP-45-M	Actinium-228	1.33	0.21	0.24	PCI/G
99-07018-17	GP-47-M	Actinium-228	0.92	0.30	0.30	PCI/G
99-07019-04	GP-48-M	Actinium-228	1.12	0.32	0.38	PCI/G
99-07019-05	GP-49-M	Actinium-228	0.97	0.16	0.19	PCI/G
99-07020-12	GP-50-M	Actinium-228	1.52	0.24	0.26	PCI/G
99-07020-05	GP-51-M	Actinium-228	1.21	0.32	0.33	PCI/G
99-07020-11	GP-52-M	Actinium-228	1.45	0.24	0.29	PCI/G
99-07020-13	GP-53-M	Actinium-228	1.47	0.31	0.33	PCI/G
99-07018-19	GP-55-M	Actinium-228	1.24	0.26	0.30	PCI/G
99-07018-18	GP-56-M	Actinium-228	1.30	0.32	0.38	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07020-09	GP-58-M	Actinium-228	1.58	0.26	0.26	PCI/G
99-07020-10	GP59-M	Actinium-228	1.58	0.22	0.22	PCI/G
		Maximum Value	1.75			PCI/G
		Minimum Value	0.50			PCI/G
		Average Value	1.12			PCI/G
99-07017-08	GP-33-M	Beryllium-7	0.64	0.50	0.75	PCI/G
99-07018-10	GP-01-D	Bismuth-214	0.89	0.19	0.15	PCI/G
99-07018-07	GP-02-M	Bismuth-214	0.80	0.14	0.11	PCI/G
99-07018-11	GP-03-D	Bismuth-214	0.94	0.23	0.18	PCI/G
99-07017-20	GP-03-M	Bismuth-214	0.86	0.16	0.13	PCI/G
99-07018-12	GP-04-D	Bismuth-214	0.88	0.16	0.14	PCI/G
99-07018-05	GP-04-M	Bismuth-214	0.35	0.12	0.13	PCI/G
99-07018-13	GP-05-D	Bismuth-214	0.52	0.16	0.16	PCI/G
99-07018-04	GP-05-M	Bismuth-214	0.75	0.17	0.16	PCI/G
99-07018-14	GP-06-D	Bismuth-214	0.71	0.13	0.11	PCI/G
99-07018-08	GP-06-M	Bismuth-214	0.69	0.17	0.16	PCI/G
99-07018-15	GP-07-D	Bismuth-214	0.45	0.15	0.13	PCI/G
99-07018-09	GP-07-M	Bismuth-214	0.62	0.14	0.12	PCI/G
99-07017-17	GP-08-M	Bismuth-214	0.69	0.12	0.11	PCI/G
99-07017-18	GP-09-M	Bismuth-214	0.54	0.14	0.14	PCI/G
99-07017-19	GP-10-M	Bismuth-214	0.53	0.15	0.15	PCI/G
99-07020-06	GP-11-D	Bismuth-214	0.46	0.13	0.13	PCI/G
99-07017-14	GP-11-M	Bismuth-214	0.57	0.14	0.17	PCI/G
99-07017-13	GP-12-M	Bismuth-214	0.57	0.19	0.18	PCI/G
99-07017-12	GP-13-M	Bismuth-214	0.63	0.18	0.18	PCI/G
99-07021-08	GP-14-M	Bismuth-214	1.15	0.20	0.16	PCI/G
99-07021-09	GP-15-M	Bismuth-214	0.95	0.22	0.17	PCI/G
99-07021-12	GP-16-M	Bismuth-214	0.62	0.20	0.15	PCI/G
99-07020-07	GP-17-D	Bismuth-214	0.81	0.19	0.21	PCI/G
99-07017-10	GP-17-M	Bismuth-214	0.57	0.12	0.10	PCI/G
99-07017-16	GP-18-M	Bismuth-214	0.39	0.12	0.13	PCI/G
99-07020-08	GP-19-D	Bismuth-214	0.68	0.20	0.21	PCI/G
99-07017-15	GP-19-M	Bismuth-214	0.66	0.16	0.15	PCI/G
99-07018-06	GP-1-M	Bismuth-214	0.82	0.14	0.12	PCI/G
99-07019-13	GP-20-M	Bismuth-214	0.84	0.17	0.14	PCI/G
99-07019-12	GP-21-M	Bismuth-214	0.67	0.19	0.18	PCI/G
99-07019-11	GP-22-M	Bismuth-214	1.02	0.17	0.14	PCI/G
99-07021-13	GP-23-M	Bismuth-214	0.73	0.13	0.12	PCI/G
99-07021-11	GP-24-M	Bismuth-214	0.73	0.15	0.14	PCI/G
99-07021-10	GP-25-M	Bismuth-214	0.80	0.15	0.14	PCI/G
99-07017-06	GP-26-M	Bismuth-214	0.89	0.19	0.16	PCI/G
99-07019-09	GP-27-M	Bismuth-214	0.75	0.15	0.13	PCI/G
99-07019-10	GP-28-M	Bismuth-214	0.82	0.21	0.17	PCI/G
99-07019-14	GP-29-M	Bismuth-214	0.79	0.21	0.20	PCI/G
99-07021-14	GP-30-M	Bismuth-214	0.75	0.17	0.16	PCI/G
99-07017-07	GP-31-M	Bismuth-214	0.99	0.17	0.14	PCI/G
99-07017-05	GP-32-M	Bismuth-214	0.75	0.21	0.17	PCI/G
99-07017-08	GP-33-M	Bismuth-214	0.95	0.19	0.17	PCI/G
99-07017-09	GP-34-M	Bismuth-214	1.10	0.17	0.17	PCI/G
99-07019-15	GP-35-M	Bismuth-214	0.95	0.17	0.14	PCI/G
99-07021-07	GP-36-M	Bismuth-214	1.07	0.17	0.13	PCI/G
99-07020-14	GP-37-M	Bismuth-214	1.11	0.19	0.14	PCI/G
99-07019-08	GP-38-M	Bismuth-214	1.07	0.18	0.14	PCI/G
99-07019-07	GP-39-M	Bismuth-214	0.60	0.19	0.19	PCI/G
99-07020-15	GP-40-M	Bismuth-214	0.93	0.16	0.14	PCI/G
99-07021-06	GP-41-M	Bismuth-214	0.86	0.19	0.14	PCI/G
99-07020-04	GP-42-M	Bismuth-214	0.82	0.17	0.14	PCI/G
99-07021-05	GP-43-M	Bismuth-214	1.10	0.20	0.16	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07021-15	GP-44-M	Bismuth-214	0.68	0.19	0.15	PCI/G
99-07019-06	GP-45-M	Bismuth-214	0.84	0.15	0.13	PCI/G
99-07018-16	GP-46-M	Bismuth-214	0.98	0.18	0.16	PCI/G
99-07018-17	GP-47-M	Bismuth-214	0.88	0.17	0.16	PCI/G
99-07019-04	GP-48-M	Bismuth-214	0.89	0.20	0.20	PCI/G
99-07019-05	GP-49-M	Bismuth-214	0.73	0.13	0.11	PCI/G
99-07020-12	GP-50-M	Bismuth-214	1.02	0.18	0.14	PCI/G
99-07020-05	GP-51-M	Bismuth-214	0.79	0.19	0.17	PCI/G
99-07020-11	GP-52-M	Bismuth-214	0.90	0.16	0.15	PCI/G
99-07020-13	GP-53-M	Bismuth-214	0.91	0.19	0.17	PCI/G
99-07018-20	GP-54-M	Bismuth-214	1.11	0.16	0.14	PCI/G
99-07018-19	GP-55-M	Bismuth-214	0.99	0.18	0.15	PCI/G
99-07018-18	GP-56-M	Bismuth-214	0.93	0.23	0.18	PCI/G
99-07020-09	GP-58-M	Bismuth-214	0.71	0.16	0.15	PCI/G
99-07020-10	GP59-M	Bismuth-214	0.99	0.16	0.14	PCI/G
		Maximum Value	1.15			PCI/G
		Minimum Value	0.35			PCI/G
		Average Value	0.80			PCI/G
99-07018-10	GP-01-D	Lead-212	1.52	0.24	0.14	PCI/G
99-07018-07	GP-02-M	Lead-212	0.66	0.11	0.12	PCI/G
99-07018-11	GP-03-D	Lead-212	1.88	0.28	0.14	PCI/G
99-07017-20	GP-03-M	Lead-212	0.96	0.14	0.10	PCI/G
99-07018-12	GP-04-D	Lead-212	1.27	0.17	0.10	PCI/G
99-07018-05	GP-04-M	Lead-212	0.85	0.12	0.08	PCI/G
99-07018-13	GP-05-D	Lead-212	1.44	0.23	0.12	PCI/G
99-07018-03	GP-05-M	Lead-212	0.75	0.13	0.11	PCI/G
99-07018-14	GP-06-D	Lead-212	1.03	0.14	0.08	PCI/G
99-07018-08	GP-06-M	Lead-212	1.40	0.22	0.12	PCI/G
99-07018-15	GP-07-D	Lead-212	1.05	0.17	0.10	PCI/G
99-07018-09	GP-07-M	Lead-212	0.95	0.14	0.09	PCI/G
99-07017-17	GP-08-M	Lead-212	1.24	0.18	0.10	PCI/G
99-07017-18	GP-09-M	Lead-212	0.99	0.15	0.11	PCI/G
99-07017-19	GP-10-M	Lead-212	0.97	0.15	0.12	PCI/G
99-07020-06	GP-11-D	Lead-212	1.24	0.18	0.11	PCI/G
99-07017-14	GP-11-M	Lead-212	0.93	0.15	0.11	PCI/G
99-07017-13	GP-12-M	Lead-212	0.61	0.17	0.12	PCI/G
99-07017-12	GP-13-M	Lead-212	1.36	0.19	0.12	PCI/G
99-07021-08	GP-14-M	Lead-212	1.86	0.23	0.16	PCI/G
99-07021-09	GP-15-M	Lead-212	1.60	0.24	0.12	PCI/G
99-07021-12	GP-16-M	Lead-212	1.09	0.16	0.11	PCI/G
99-07020-07	GP-17-D	Lead-212	1.88	0.29	0.16	PCI/G
99-07017-10	GP-17-M	Lead-212	0.48	0.08	0.07	PCI/G
99-07017-16	GP-18-M	Lead-212	0.48	0.13	0.09	PCI/G
99-07020-08	GP-19-D	Lead-212	2.02	0.30	0.14	PCI/G
99-07017-15	GP-19-M	Lead-212	1.07	0.18	0.11	PCI/G
99-07018-06	GP-1-M	Lead-212	0.78	0.13	0.09	PCI/G
99-07019-13	GP-20-M	Lead-212	1.66	0.24	0.13	PCI/G
99-07019-12	GP-21-M	Lead-212	1.15	0.21	0.15	PCI/G
99-07019-11	GP-22-M	Lead-212	1.08	0.16	0.11	PCI/G
99-07021-13	GP-23-M	Lead-212	1.20	0.16	0.10	PCI/G
99-07021-11	GP-24-M	Lead-212	1.07	0.18	0.11	PCI/G
99-07021-10	GP-25-M	Lead-212	0.89	0.14	0.11	PCI/G
99-07017-06	GP-26-M	Lead-212	1.31	0.18	0.12	PCI/G
99-07019-09	GP-27-M	Lead-212	1.05	0.15	0.10	PCI/G
99-07019-10	GP-28-M	Lead-212	1.29	0.19	0.13	PCI/G
99-07019-14	GP-29-M	Lead-212	1.60	0.25	0.13	PCI/G
99-07021-14	GP-30-M	Lead-212	1.38	0.22	0.12	PCI/G
99-07017-07	GP-31-M	Lead-212	1.40	0.19	0.12	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07017-05	GP-32-M	Lead-212	1.61	0.21	0.13	PCI/G
99-07017-08	GP-33-M	Lead-212	1.85	0.26	0.12	PCI/G
99-07017-09	GP-34-M	Lead-212	1.59	0.21	0.12	PCI/G
99-07019-15	GP-35-M	Lead-212	1.55	0.23	0.12	PCI/G
99-07021-07	GP-36-M	Lead-212	1.39	0.18	0.11	PCI/G
99-07020-14	GP-37-M	Lead-212	1.57	0.21	0.12	PCI/G
99-07019-08	GP-38-M	Lead-212	1.66	0.22	0.12	PCI/G
99-07019-07	GP-39-M	Lead-212	1.30	0.19	0.13	PCI/G
99-07020-15	GP-40-M	Lead-212	1.72	0.23	0.11	PCI/G
99-07021-06	GP-41-M	Lead-212	1.32	0.18	0.11	PCI/G
99-07020-04	GP-42-M	Lead-212	1.44	0.21	0.12	PCI/G
99-07021-05	GP-43-M	Lead-212	1.32	0.19	0.13	PCI/G
99-07021-15	GP-44-M	Lead-212	1.03	0.16	0.11	PCI/G
99-07019-06	GP-45-M	Lead-212	1.05	0.15	0.11	PCI/G
99-07018-16	GP-46-M	Lead-212	1.43	0.19	0.12	PCI/G
99-07018-17	GP-47-M	Lead-212	1.33	0.18	0.12	PCI/G
99-07019-04	GP-48-M	Lead-212	1.58	0.23	0.15	PCI/G
99-07019-05	GP-49-M	Lead-212	0.92	0.13	0.09	PCI/G
99-07020-12	GP-50-M	Lead-212	1.32	0.18	0.11	PCI/G
99-07020-05	GP-51-M	Lead-212	1.47	0.20	0.12	PCI/G
99-07020-11	GP-52-M	Lead-212	1.88	0.25	0.12	PCI/G
99-07020-13	GP-53-M	Lead-212	1.67	0.22	0.14	PCI/G
99-07018-20	GP-54-M	Lead-212	1.23	0.17	0.12	PCI/G
99-07018-19	GP-55-M	Lead-212	1.64	0.24	0.13	PCI/G
99-07018-18	GP-56-M	Lead-212	1.40	0.21	0.14	PCI/G
99-07020-09	GP-58-M	Lead-212	1.83	0.24	0.11	PCI/G
99-07020-10	GP-59-M	Lead-212	1.54	0.19	0.11	PCI/G
		Maximum Value	2.02			PCI/G
		Minimum Value	0.48			PCI/G
		Average Value	1.30			PCI/G
99-07018-10	GP-01-D	Lead-214	1.03	0.17	0.17	PCI/G
99-07018-06	GP-01-M	Lead-214	0.66	0.13	0.12	PCI/G
99-07018-07	GP-02-M	Lead-214	0.48	0.12	0.11	PCI/G
99-07018-11	GP-03-D	Lead-214	0.93	0.20	0.16	PCI/G
99-07017-20	GP-03-M	Lead-214	1.01	0.15	0.12	PCI/G
99-07018-12	GP-04-D	Lead-214	0.96	0.14	0.13	PCI/G
99-07018-05	GP-04-M	Lead-214	0.42	0.12	0.12	PCI/G
99-07018-13	GP-05-D	Lead-214	0.56	0.13	0.14	PCI/G
99-07018-04	GP-05-M	Lead-214	0.63	0.15	0.14	PCI/G
99-07018-14	GP-06-D	Lead-214	0.58	0.12	0.11	PCI/G
99-07018-08	GP-06-M	Lead-214	0.66	0.15	0.15	PCI/G
99-07018-15	GP-07-D	Lead-214	0.43	0.12	0.12	PCI/G
99-07018-09	GP-07-M	Lead-214	0.62	0.12	0.13	PCI/G
99-07017-17	GP-08-M	Lead-214	0.70	0.12	0.12	PCI/G
99-07017-18	GP-09-M	Lead-214	0.53	0.13	0.14	PCI/G
99-07017-19	GP-10-M	Lead-214	0.58	0.14	0.14	PCI/G
99-07020-06	GP-11-D	Lead-214	0.60	0.11	0.12	PCI/G
99-07017-14	GP-11-M	Lead-214	0.69	0.15	0.14	PCI/G
99-07017-13	GP-12-M	Lead-214	0.39	0.13	0.18	PCI/G
99-07017-12	GP-13-M	Lead-214	0.67	0.15	0.15	PCI/G
99-07021-08	GP-14-M	Lead-214	1.45	0.18	0.16	PCI/G
99-07021-09	GP-15-M	Lead-214	0.75	0.17	0.18	PCI/G
99-07021-12	GP-16-M	Lead-214	0.70	0.15	0.16	PCI/G
99-07020-07	GP-17-D	Lead-214	1.11	0.20	0.19	PCI/G
99-07017-10	GP-17-M	Lead-214	0.62	0.10	0.10	PCI/G
99-07017-16	GP-18-M	Lead-214	0.40	0.11	0.12	PCI/G
99-07020-08	GP-19-D	Lead-214	0.93	0.17	0.18	PCI/G
99-07017-15	GP-19-M	Lead-214	0.65	0.13	0.14	PCI/G
99-07019-13	GP-20-M	Lead-214	0.49	0.16	0.15	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07019-11	GP-22-M	Lead-214	0.96	0.15	0.14	PCI/G
99-07021-13	GP-23-M	Lead-214	0.57	0.12	0.11	PCI/G
99-07021-11	GP-24-M	Lead-214	0.56	0.15	0.15	PCI/G
99-07021-10	GP-25-M	Lead-214	0.68	0.15	0.12	PCI/G
99-07017-06	GP-26-M	Lead-214	0.98	0.16	0.16	PCI/G
99-07019-09	GP-27-M	Lead-214	0.67	0.11	0.12	PCI/G
99-07019-10	GP-28-M	Lead-214	0.99	0.18	0.18	PCI/G
99-07019-14	GP-29-M	Lead-214	0.75	0.16	0.17	PCI/G
99-07021-14	GP-30-M	Lead-214	0.87	0.16	0.15	PCI/G
99-07017-07	GP-31-M	Lead-214	0.92	0.14	0.15	PCI/G
99-07017-05	GP-32-M	Lead-214	0.96	0.19	0.19	PCI/G
99-07017-08	GP-33-M	Lead-214	0.89	0.16	0.15	PCI/G
99-07017-09	GP-34-M	Lead-214	1.17	0.15	0.17	PCI/G
99-07019-15	GP-35-M	Lead-214	0.56	0.18	0.14	PCI/G
99-07021-07	GP-36-M	Lead-214	0.92	0.19	0.15	PCI/G
99-07020-14	GP-37-M	Lead-214	1.19	0.17	0.15	PCI/G
99-07019-08	GP-38-M	Lead-214	0.99	0.16	0.15	PCI/G
99-07019-07	GP-39-M	Lead-214	0.83	0.17	0.17	PCI/G
99-07020-15	GP-40-M	Lead-214	1.17	0.15	0.14	PCI/G
99-07021-06	GP-41-M	Lead-214	0.85	0.17	0.16	PCI/G
99-07020-04	GP-42-M	Lead-214	0.97	0.13	0.14	PCI/G
99-07021-05	GP-43-M	Lead-214	1.09	0.19	0.17	PCI/G
99-07021-15	GP-44-M	Lead-214	0.85	0.16	0.15	PCI/G
99-07019-06	GP-45-M	Lead-214	0.75	0.14	0.14	PCI/G
99-07018-16	GP-46-M	Lead-214	0.91	0.18	0.15	PCI/G
99-07018-17	GP-47-M	Lead-214	0.90	0.15	0.15	PCI/G
99-07019-04	GP-48-M	Lead-214	0.86	0.19	0.20	PCI/G
99-07019-05	GP-49-M	Lead-214	0.67	0.11	0.10	PCI/G
99-07020-12	GP-50-M	Lead-214	0.92	0.16	0.14	PCI/G
99-07020-05	GP-51-M	Lead-214	0.64	0.17	0.17	PCI/G
99-07020-11	GP-52-M	Lead-214	0.85	0.15	0.14	PCI/G
99-07020-13	GP-53-M	Lead-214	0.81	0.15	0.17	PCI/G
99-07018-20	GP-54-M	Lead-214	0.94	0.15	0.15	PCI/G
99-07018-19	GP-55-M	Lead-214	0.86	0.18	0.16	PCI/G
99-07018-18	GP-56-M	Lead-214	1.08	0.19	0.19	PCI/G
99-07020-09	GP-58-M	Lead-214	0.82	0.14	0.13	PCI/G
99-07020-10	GP-59-M	Lead-214	0.95	0.14	0.14	PCI/G
		Maximum Value	1.45			PCI/G
		Minimum Value	0.39			PCI/G
		Average Value	0.80			PCI/G
99-07018-10	GP-01-D	Potassium-40	20.82	2.83	0.63	PCI/G
99-07018-06	GP-01-M	Potassium-40	12.28	1.84	0.42	PCI/G
99-07018-07	GP-02-M	Potassium-40	14.54	2.08	0.58	PCI/G
99-07018-11	GP-03-D	Potassium-40	16.76	2.63	0.79	PCI/G
99-07017-20	GP-03-M	Potassium-40	17.48	2.45	0.57	PCI/G
99-07018-12	GP-04-D	Potassium-40	16.19	2.24	0.53	PCI/G
99-07018-05	GP-04-M	Potassium-40	11.98	1.84	0.63	PCI/G
99-07018-13	GP-05-D	Potassium-40	21.16	2.95	0.62	PCI/G
99-07018-04	GP-05-M	Potassium-40	16.73	2.54	0.80	PCI/G
99-07018-14	GP-06-D	Potassium-40	14.95	1.97	0.54	PCI/G
99-07018-08	GP-06-M	Potassium-40	19.79	2.84	0.81	PCI/G
99-07018-15	GP-07-D	Potassium-40	16.84	2.31	0.55	PCI/G
99-07018-09	GP-07-M	Potassium-40	19.31	2.58	0.39	PCI/G
99-07017-17	GP-08-M	Potassium-40	18.56	2.49	0.49	PCI/G
99-07017-18	GP-09-M	Potassium-40	12.23	1.91	0.72	PCI/G
99-07017-19	GP-10-M	Potassium-40	12.17	2.00	0.64	PCI/G
99-07020-06	GP-11-D	Potassium-40	16.37	2.18	0.63	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07017-14	GP-11-M	Potassium-40	11.64	1.97	0.64	PCI/G
99-07017-13	GP-12-M	Potassium-40	11.25	2.08	0.79	PCI/G
99-07017-12	GP-13-M	Potassium-40	20.27	2.72	0.75	PCI/G
99-07021-08	GP-14-M	Potassium-40	17.60	2.47	0.69	PCI/G
99-07021-09	GP-15-M	Potassium-40	17.46	2.66	0.91	PCI/G
99-07021-12	GP-16-M	Potassium-40	19.67	2.82	0.77	PCI/G
99-07020-07	GP-17-D	Potassium-40	22.86	3.28	1.01	PCI/G
99-07017-10	GP-17-M	Potassium-40	6.90	1.10	0.40	PCI/G
99-07017-16	GP-18-M	Potassium-40	7.48	1.53	0.67	PCI/G
99-07020-08	GP-19-D	Potassium-40	21.44	3.08	1.00	PCI/G
99-07017-15	GP-19-M	Potassium-40	16.57	2.26	0.47	PCI/G
99-07019-13	GP-20-M	Potassium-40	18.21	2.48	0.65	PCI/G
99-07019-11	GP-22-M	Potassium-40	16.60	2.32	0.33	PCI/G
99-07021-13	GP-23-M	Potassium-40	18.53	2.42	0.40	PCI/G
99-07021-11	GP-24-M	Potassium-40	14.77	2.14	0.68	PCI/G
99-07021-10	GP-25-M	Potassium-40	15.10	2.24	0.57	PCI/G
99-07017-06	GP-26-M	Potassium-40	19.66	2.71	0.63	PCI/G
99-07019-09	GP-27-M	Potassium-40	15.32	2.18	0.50	PCI/G
99-07019-10	GP-28-M	Potassium-40	18.46	2.72	0.86	PCI/G
99-07019-14	GP-29-M	Potassium-40	18.13	2.79	0.58	PCI/G
99-07021-14	GP-30-M	Potassium-40	17.38	2.44	0.61	PCI/G
99-07017-07	GP-31-M	Potassium-40	15.67	2.30	0.57	PCI/G
99-07017-05	GP-32-M	Potassium-40	24.40	3.30	0.75	PCI/G
99-07017-09	GP-34-M	Potassium-40	15.04	2.25	0.53	PCI/G
99-07019-15	GP-35-M	Potassium-40	15.34	2.18	0.74	PCI/G
99-07021-07	GP-36-M	Potassium-40	16.87	2.40	0.55	PCI/G
99-07020-14	GP-37-M	Potassium-40	16.16	2.31	0.58	PCI/G
99-07019-08	GP-38-M	Potassium-40	12.81	1.92	0.45	PCI/G
99-07019-07	GP-39-M	Potassium-40	16.59	2.56	0.80	PCI/G
99-07020-15	GP-40-M	Potassium-40	14.02	1.98	0.50	PCI/G
99-07021-06	GP-41-M	Potassium-40	16.88	2.49	0.82	PCI/G
99-07020-04	GP-42-M	Potassium-40	17.47	2.38	0.68	PCI/G
99-07021-05	GP-43-M	Potassium-40	17.30	2.56	0.71	PCI/G
99-07021-15	GP-44-M	Potassium-40	16.74	2.55	0.69	PCI/G
99-07019-06	GP-45-M	Potassium-40	15.74	2.17	0.63	PCI/G
99-07018-16	GP-46-M	Potassium-40	18.96	2.59	0.53	PCI/G
99-07018-17	GP-47-M	Potassium-40	18.13	2.52	0.71	PCI/G
99-07019-04	GP-48-M	Potassium-40	26.86	3.69	0.92	PCI/G
99-07019-05	GP-49-M	Potassium-40	15.69	2.13	0.35	PCI/G
99-07020-12	GP-50-M	Potassium-40	17.62	2.50	0.65	PCI/G
99-07020-05	GP-51-M	Potassium-40	15.87	2.55	0.84	PCI/G
99-07020-11	GP-52-M	Potassium-40	25.01	3.11	0.72	PCI/G
99-07020-13	GP-53-M	Potassium-40	17.56	2.48	0.68	PCI/G
99-07018-20	GP-54-M	Potassium-40	17.53	2.50	0.55	PCI/G
99-07018-19	GP-55-M	Potassium-40	17.38	2.51	0.68	PCI/G
99-07018-18	GP-56-M	Potassium-40	21.08	3.05	0.96	PCI/G
99-07020-09	GP-58-M	Potassium-40	22.91	3.02	0.78	PCI/G
99-07020-10	GP-59-M	Potassium-40	21.73	2.80	0.53	PCI/G
		Maximum Value	26.86			PCI/G
		Minimum Value	6.90			PCI/G
		Average Value	17.09			PCI/G
99-07018-10	GP-01-D	Thallium-208	1.05	0.23	0.25	PCI/G
99-07018-06	GP-01-M	Thallium-208	0.86	0.17	0.18	PCI/G
99-07018-07	GP-02-M	Thallium-208	0.81	0.17	0.18	PCI/G
99-07018-11	GP-03-D	Thallium-208	1.34	0.26	0.31	PCI/G
99-07017-20	GP-03-M	Thallium-208	1.04	0.20	0.19	PCI/G
99-07018-12	GP-04-D	Thallium-208	1.24	0.21	0.19	PCI/G
99-07018-05	GP-04-M	Thallium-208	0.66	0.14	0.15	PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-13	GP-05-D	Thallium-208	0.77	0.21	0.23	PCI/G
99-07018-04	GP-05-M	Thallium-208	0.85	0.18	0.24	PCI/G
99-07018-14	GP-06-D	Thallium-208	0.82	0.15	0.15	PCI/G
99-07018-08	GP-06-M	Thallium-208	0.69	0.22	0.22	PCI/G
99-07018-15	GP-07-D	Thallium-208	0.74	0.18	0.20	PCI/G
99-07018-09	GP-07-M	Thallium-208	0.88	0.16	0.16	PCI/G
99-07017-18	GP-09-M	Thallium-208	0.69	0.17	0.19	PCI/G
99-07017-19	GP-10-M	Thallium-208	0.67	0.19	0.25	PCI/G
99-07020-06	GP-11-D	Thallium-208	0.78	0.17	0.19	PCI/G
99-07017-14	GP-11-M	Thallium-208	0.90	0.23	0.22	PCI/G
99-07017-13	GP-12-M	Thallium-208	0.63	0.22	0.25	PCI/G
99-07017-12	GP-13-M	Thallium-208	0.99	0.21	0.20	PCI/G
99-07021-08	GP-14-M	Thallium-208	1.43	0.26	0.25	PCI/G
99-07021-09	GP-15-M	Thallium-208	0.84	0.22	0.23	PCI/G
99-07021-12	GP-16-M	Thallium-208	0.91	0.21	0.22	PCI/G
99-07020-07	GP-17-D	Thallium-208	1.31	0.29	0.30	PCI/G
99-07017-10	GP-17-M	Thallium-208	0.42	0.12	0.13	PCI/G
99-07017-16	GP-18-M	Thallium-208	0.49	0.16	0.20	PCI/G
99-07020-08	GP-19-D	Thallium-208	1.37	0.27	0.27	PCI/G
99-07017-15	GP-19-M	Thallium-208	0.82	0.17	0.20	PCI/G
99-07019-13	GP-20-M	Thallium-208	1.21	0.21	0.22	PCI/G
99-07019-12	GP-21-M	Thallium-208	0.96	0.21	0.27	PCI/G
99-07021-13	GP-23-M	Thallium-208	0.98	0.18	0.16	PCI/G
99-07021-11	GP-24-M	Thallium-208	0.95	0.20	0.19	PCI/G
99-07021-10	GP-25-M	Thallium-208	0.83	0.18	0.18	PCI/G
99-07017-06	GP-26-M	Thallium-208	0.98	0.20	0.24	PCI/G
99-07019-09	GP-27-M	Thallium-208	0.96	0.19	0.20	PCI/G
99-07019-10	GP-28-M	Thallium-208	1.08	0.25	0.22	PCI/G
99-07019-14	GP-29-M	Thallium-208	0.90	0.22	0.26	PCI/G
99-07021-14	GP-30-M	Thallium-208	1.20	0.22	0.22	PCI/G
99-07017-05	GP-32-M	Thallium-208	1.28	0.25	0.24	PCI/G
99-07017-08	GP-33-M	Thallium-208	1.25	0.21	0.21	PCI/G
99-07017-09	GP-34-M	Thallium-208	1.54	0.26	0.24	PCI/G
99-07019-15	GP-35-M	Thallium-208	1.06	0.19	0.21	PCI/G
99-07020-14	GP-37-M	Thallium-208	1.63	0.25	0.23	PCI/G
99-07019-08	GP-38-M	Thallium-208	1.44	0.24	0.22	PCI/G
99-07019-07	GP-39-M	Thallium-208	1.10	0.24	0.30	PCI/G
99-07020-15	GP-40-M	Thallium-208	1.18	0.21	0.20	PCI/G
99-07021-06	GP-41-M	Thallium-208	1.12	0.22	0.19	PCI/G
99-07020-04	GP-42-M	Thallium-208	1.16	0.22	0.19	PCI/G
99-07021-05	GP-43-M	Thallium-208	1.20	0.25	0.23	PCI/G
99-07021-15	GP-44-M	Thallium-208	0.95	0.20	0.19	PCI/G
99-07019-06	GP-45-M	Thallium-208	1.39	0.20	0.18	PCI/G
99-07018-16	GP-46-M	Thallium-208	1.30	0.24	0.23	PCI/G
99-07018-17	GP-47-M	Thallium-208	1.04	0.22	0.23	PCI/G
99-07019-04	GP-48-M	Thallium-208	1.33	0.28	0.29	PCI/G
99-07019-05	GP-49-M	Thallium-208	1.00	0.17	0.15	PCI/G
99-07020-12	GP-50-M	Thallium-208	1.26	0.22	0.22	PCI/G
99-07020-05	GP-51-M	Thallium-208	1.27	0.24	0.23	PCI/G
99-07020-11	GP-52-M	Thallium-208	1.30	0.22	0.23	PCI/G
99-07020-13	GP-53-M	Thallium-208	1.48	0.25	0.23	PCI/G
99-07018-20	GP-54-M	Thallium-208	1.23	0.23	0.21	PCI/G
99-07018-19	GP-55-M	Thallium-208	1.20	0.23	0.24	PCI/G
99-07018-18	GP-56-M	Thallium-208	1.30	0.25	0.26	PCI/G
99-07020-09	GP-58-M	Thallium-208	0.92	0.21	0.22	PCI/G
99-07020-10	GP-59-M	Thallium-208	1.35	0.22	0.19	PCI/G
		Maximum Value	1.63			PCI/G
		Minimum Value	0.42			PCI/G
		Average Value	1.05			PCI/G

Table 4-8

Other Radionuclides Detected in all Samples

Lab ID	Client ID	Analyte	Result	Error	MDA	Units
99-07018-10	GP-01-D	Thorium-234	2.65	2.02	1.66	PCI/G
99-07018-07	GP-02-M	Thorium-234	2.67	1.06	1.18	PCI/G
99-07018-11	GP-03-D	Thorium-234	2.90	1.70	1.72	PCI/G
99-07018-14	GP-06-D	Thorium-234	2.10	1.16	1.07	PCI/G
99-07018-15	GP-07-D	Thorium-234	1.43	1.16	1.23	PCI/G
99-07017-18	GP-09-M	Thorium-234	1.32	0.83	1.17	PCI/G
99-07020-06	GP-11-D	Thorium-234	1.88	1.43	1.18	PCI/G
99-07021-08	GP-14-M	Thorium-234	1.21	1.03	1.47	PCI/G
99-07021-09	GP-15-M	Thorium-234	1.58	1.54	1.38	PCI/G
99-07020-07	GP-17-D	Thorium-234	5.62	2.21	2.00	PCI/G
99-07020-08	GP-19-D	Thorium-234	2.57	1.68	2.00	PCI/G
99-07017-15	GP-19-M	Thorium-234	1.45	1.17	1.37	PCI/G
99-07019-13	GP-20-M	Thorium-234	1.75	1.51	1.42	PCI/G
99-07017-06	GP-26-M	Thorium-234	4.63	1.70	1.44	PCI/G
99-07019-14	GP-29-M	Thorium-234	2.60	1.89	1.55	PCI/G
99-07021-14	GP-30-M	Thorium-234	2.38	1.56	1.47	PCI/G
99-07017-05	GP-32-M	Thorium-234	2.48	1.58	1.81	PCI/G
99-07017-08	GP-33-M	Thorium-234	2.94	1.48	1.51	PCI/G
99-07019-15	GP-35-M	Thorium-234	3.37	1.51	1.33	PCI/G
99-07020-15	GP-40-M	Thorium-234	1.99	0.90	1.29	PCI/G
99-07020-04	GP-42-M	Thorium-234	1.41	0.93	1.40	PCI/G
99-07021-15	GP-44-M	Thorium-234	3.79	1.79	1.31	PCI/G
99-07018-17	GP-47-M	Thorium-234	2.59	1.41	1.45	PCI/G
99-07019-04	GP-48-M	Thorium-234	2.37	1.74	2.01	PCI/G
99-07020-05	GP-51-M	Thorium-234	2.55	1.68	1.55	PCI/G
99-07020-11	GP-52-M	Thorium-234	1.80	1.64	1.56	PCI/G
99-07020-13	GP-53-M	Thorium-234	1.78	1.56	1.65	PCI/G
99-07018-19	GP-55-M	Thorium-234	4.54	3.00	3.67	PCI/G
99-07018-18	GP-56-M	Thorium-234	2.34	1.69	1.76	PCI/G
99-07020-10	GP-59-M	Thorium-234	3.09	2.66	3.25	PCI/G
		Maximum Value	5.62			PCI/G
		Minimum Value	<MDA			PCI/G
		Average Value	2.53			PCI/G

Th-234 is in naturally occurring uranium series
Ac-228 is in the naturally occurring thorium series
All Be-7 is <MDA
Bi-214 is in the naturally occurring uranium series
Pb-212 is in the naturally occurring thorium series
Pb-214 is in the naturally occurring uranium series
K-40 is naturally occurring
Tl-208 is in the naturally occurring thorium series
D – Discretionary Samples
M – MARSSIM Samples

Table 5-1
Analytical Results of Tailings Pile Surface Soil Samples
Runkle Ranch, Simi Valley, California
June-July 1999

(concentrations in mg/Kg)

	Preliminary Remediation Goal Residential Soil	GP-31-D	GP-10-D	GP-11-D	GP-12-D	GP-13-D	GP-14-D	GP-15-D	GP-16-D	GP-17-D	GP-18-D	GP-19-D	GP-20-D	GP-21-D
Silver	370	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	0.38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	5200	37	46	48	33	100	53	37	39	36	30	44	51	110
Beryllium	150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	3300	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	210	6.9	12	11	9.1	21	13	9.4	9.5	8.5	7.3	3.8	8.9	21
Copper	2800	8.1	16	14	10	15	14	12	11	9.8	8.6	8.6	11	13
Mercury	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molydbenum	370	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	150	ND	8.8	ND	ND	12	ND	ND	ND	ND	ND	ND	ND	ND
Lead	130	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Antimony	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selinium	370	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	520	25	32	32	29	45	38	29	33	27	22	ND	35	51
Zinc	22000	32	45	44	36	88	48	36	36	33	32	34	37	95
Alkalinity	NE	ND	ND	ND	50	60	ND	ND	ND	ND	ND	ND	190	90
Anion Sum (meq/kg)	NE	0.95	131	1.67	1.14	0.09	3.76	10.2	0.83	0.59	2.26	0.64	3.98	1.91
Calcium Total	NE	ND	1300	ND	64	55	ND	79	51	ND	ND	55	88	72
Cation Sum (meq/kg)	NE	5.02	141	ND	17.2	8.59	ND	3.95	9.63	5.76	ND	2.75	10.5	10.4
Chloride	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Specific Conductance (µS/cm)	NE	19	1290	30	17	19	59	130	18	13	34	14	41	27
Potassium Total	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium Total	NE	61	920	ND	170	71	ND	ND	86	70	ND	ND	74	83
Sodium Total	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate-N	NE	1.2	ND	1.1	1.9	1.3	1.6	1.4	1.5	1.8	1.6	1.9	2.5	1.5
Lab pH (pH units)	NE	7.6	4.8	6.5	8.5	8.3	7.2	7.0	7.8	7.9	7.7	7.8	8.7	8.4
Sulfate	NE	41.7	6300	76.6	ND	ND	175	485	34.6	22	103	24.1	ND	ND

NE - Not Established
ND - Not Detected

Attorney-Client Privileged and Attorney Work Product Material

Table 5-2
Analytical Results of Tailings Pile Surface Water Samples
Runkle Ranch, Simi Valley, California
June-July 1999

(concentrations in mg/L)

Title 26 Metals	California Drinking Water Standards MCL	GPT-02-W	GP-09-W
Silver	0.1 [1]	ND	0.083
Arsenic	0.05	ND	ND
Barium	1.0	0.060	ND
Beryllium	0.004	ND	ND
Cadmium	0.005	ND	ND
Cobalt	2.2 [2]	ND	ND
Chromium	0.05	ND	ND
Copper	1.0 [1]	ND	ND
Mercury	0.002	ND	0.000247
Molydbenum	0.18 [2]	ND	0.031
Nickel	0.1	ND	ND
Lead	0.004 [2]	ND	ND
Antimony	0.006	ND	ND
Selinium	0.05	ND	ND
Thallium	0.002	ND	ND
Vanadium	0.26 [2]	ND	ND
Zinc	5.0 [1]	0.024	0.027
Alkalinity	NE	406	289
Anion Sum[3]	NE	21.6	38.8
Calcium Total	NE	171	220
Cation Sum[3]	NE	21	33.8
Chloride	150 [4]	83	91.6
Specific Conductance[5]	NE	1820	2690
Potassium Total	NE	5.6	14
Magnesium Total	NE	96.1	120
Sodium Total	NE	102	290
Nitrate-N	10.0	ND	ND
Lab pH[6]	6.8-8.5	6.9	8.1
Sulfate	250 [4]	537	1460

1 Secondary MCLs based on odor, taste, and appearance

2 Preliminary Remedial Goal for Tap Water

3 Units for anion and cation sums are meq/L

4 CRWQCB water quality objective for the Calleguas Watershed

5 The unit for conductivity is µS/cm

6 Units of pH

MCL - Maximum Contaminant Level

NE - None Established

ND - Not Detected

Table 5-3
Analytical Results of Tailings Pile Precipitate Sample
Runkle Ranch, Simi Valley, California
June-July 1999

Metals	Preliminary Remediation Goal Residential Soil	GP-22-D (mg/Kg)
Silver	370	ND
Arsenic	0.38	ND
Barium	5200	ND
Beryllium	150	ND
Cadmium	37	ND
Cobalt	3300	ND
Chromium	210	ND
Copper	2800	ND
Mercury	22	ND
Molydbenum	370	ND
Nickel	150	20
Lead	130	ND
Antimony	30	ND
Selinium	370	ND
Thallium	6	ND
Vanadium	520	ND
Zinc	22000	8.2

Anion/Cation/Other	PRG	(g/Kg)
Alkalinity	NE	8.00
Anion Sum (eq/kg)	NE	1864.00
Calcium Total	NE	420.00
Cation Sum (eq/kg)	NE	1798.00
Chloride	NE	1086.00
Specific Conductance (µs/cm)	NE	35800.00
Potassium Total	NE	142.00
Magnesium Total	NE	17000.00
Sodium Total	NE	8600.00
Nitrate-N	NE	ND
Lab pH (pH units)	NE	6.0
Sulfate	NE	88000.00

NE - None Established
ND - Not Detected

FIGURES

APPENDICES

FIGURES

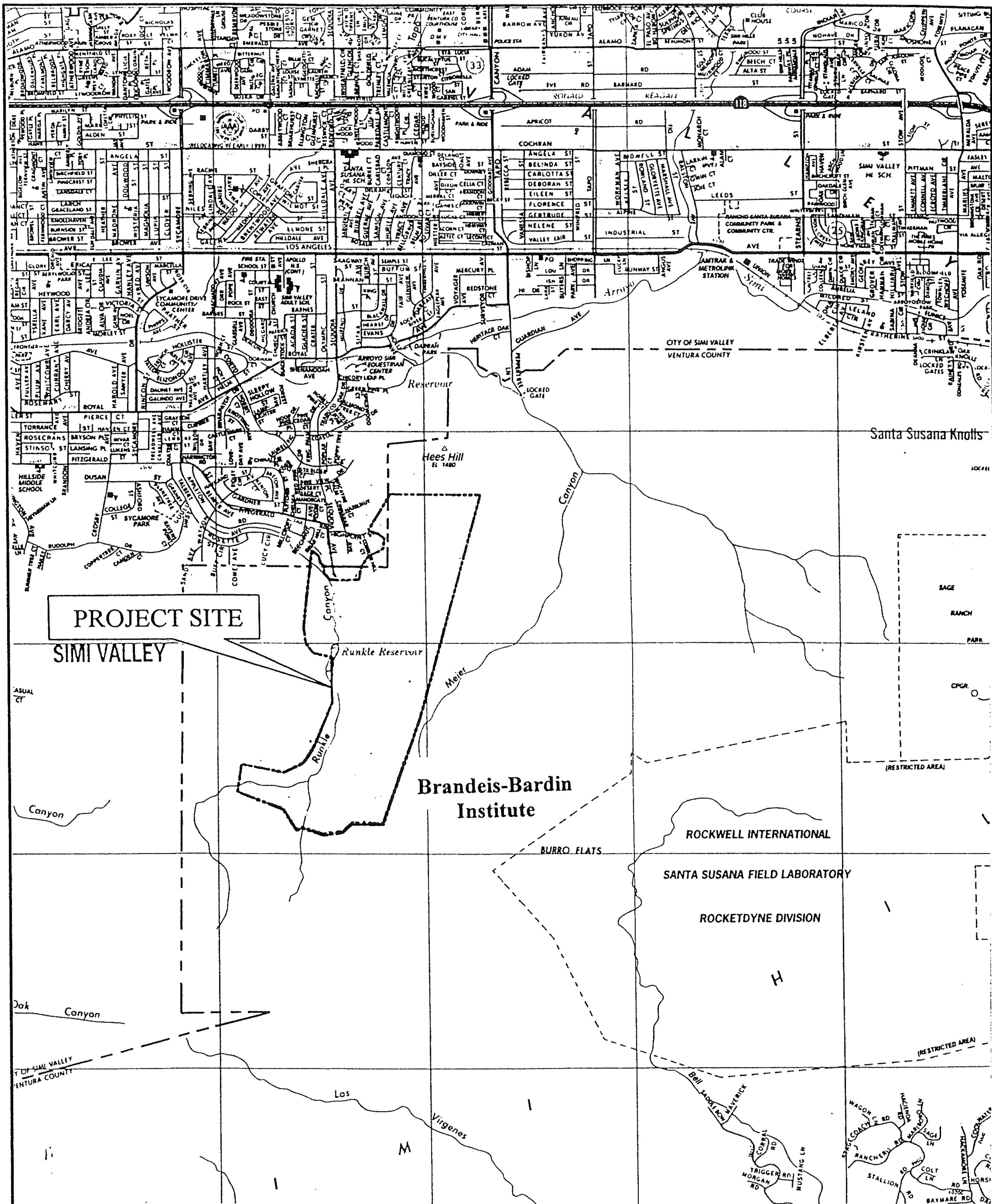


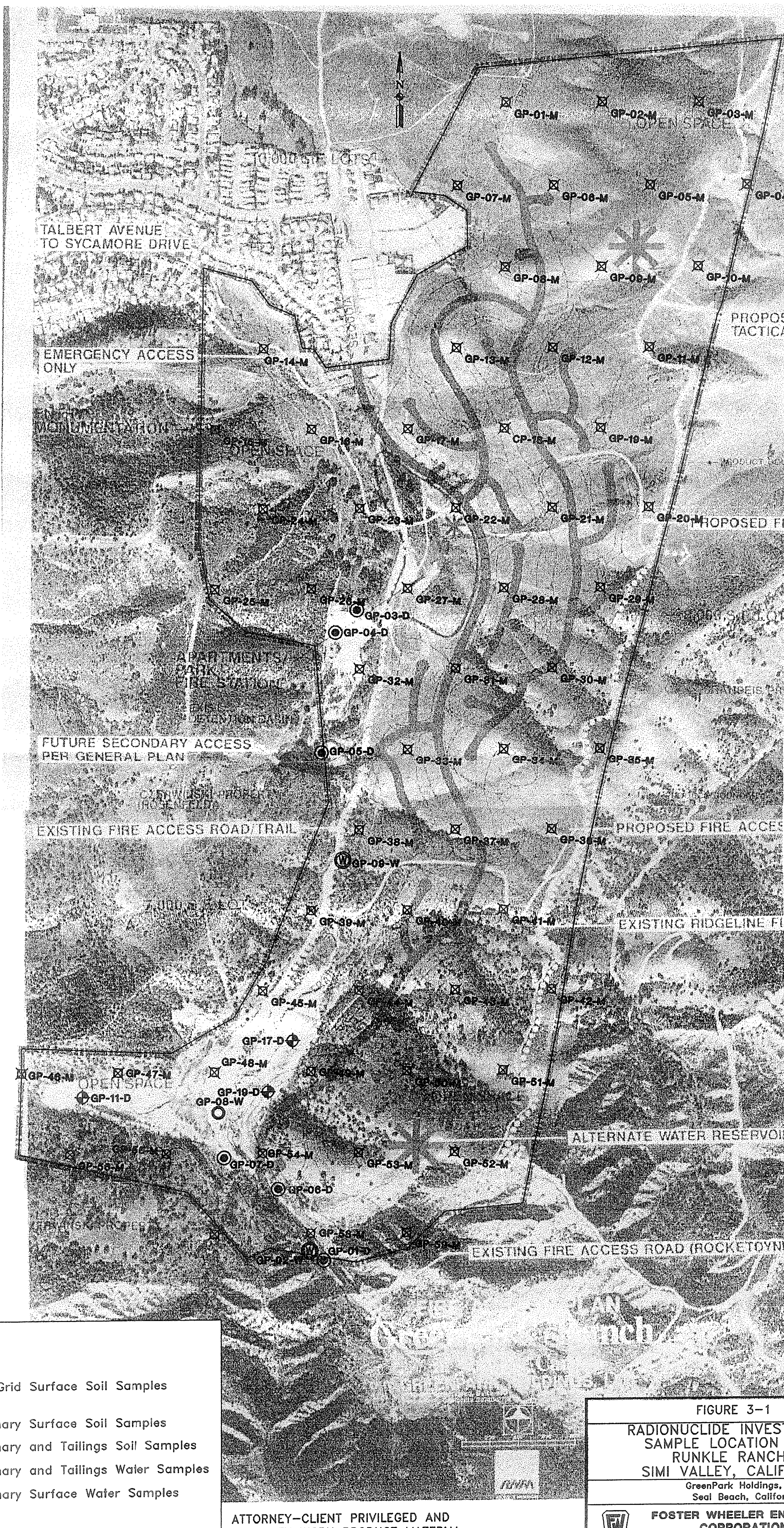
FIGURE 2–1

RUNKLE RANCH SITE LOCATION MAP
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Site location and scale are approximate.



ATTORNEY-CLIENT PRIVILEGED AND
ATTORNEY WORK PRODUCT MATERIAL.

FIGURE 3-1

RADIONUCLIDE INVESTIGATION
SAMPLE LOCATION MAP
RUNKLE RANCH
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENAL
CORPORATION

F:\2164 GREENPARK\DWG\FIG3-1.DWG
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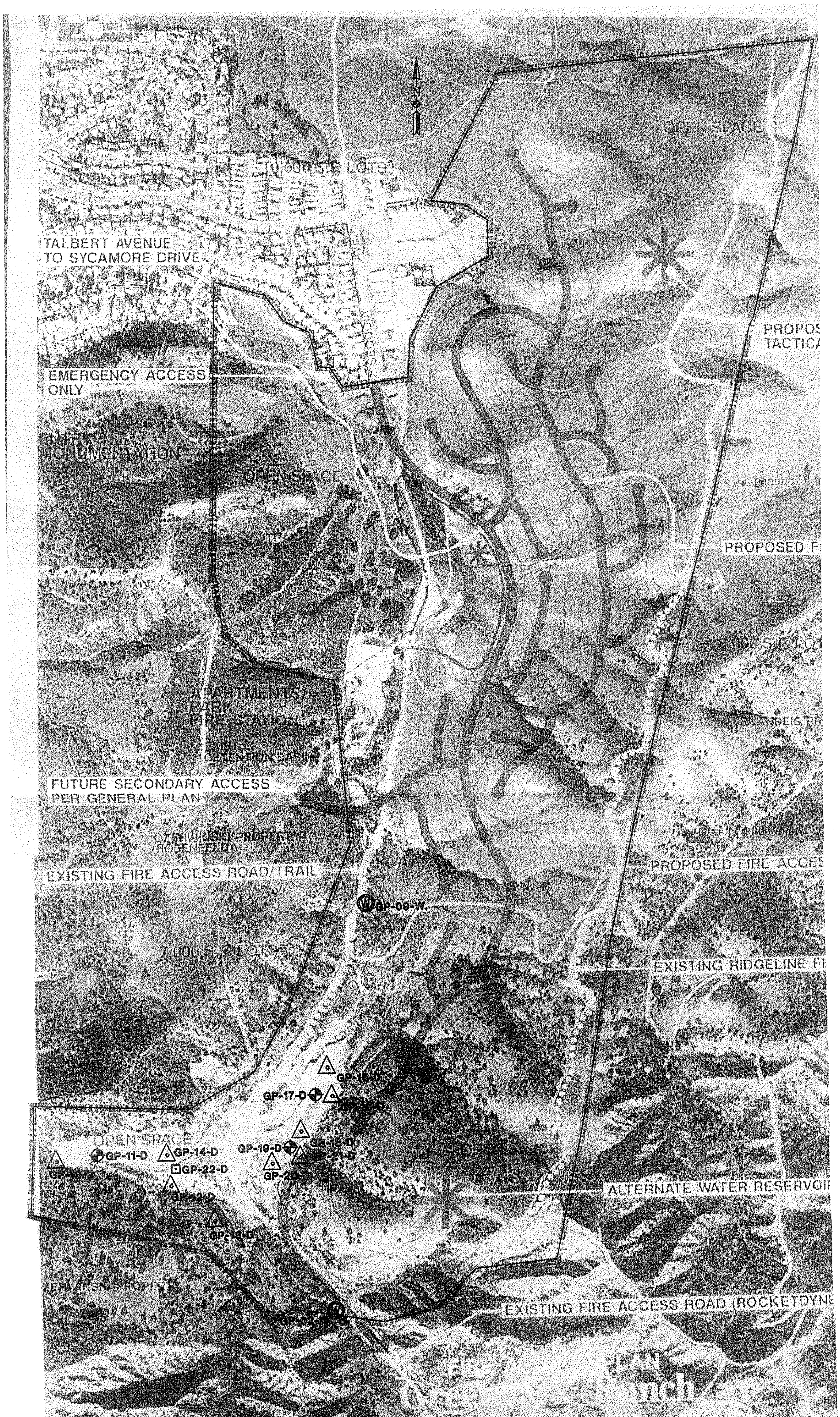


LEGEND:

- Tailings and Discretionary Soil Samples
- Tailings Soil Samples
- Tailings and Discretionary Water Samples
- Precipitate Sample

NOT TO SCALE

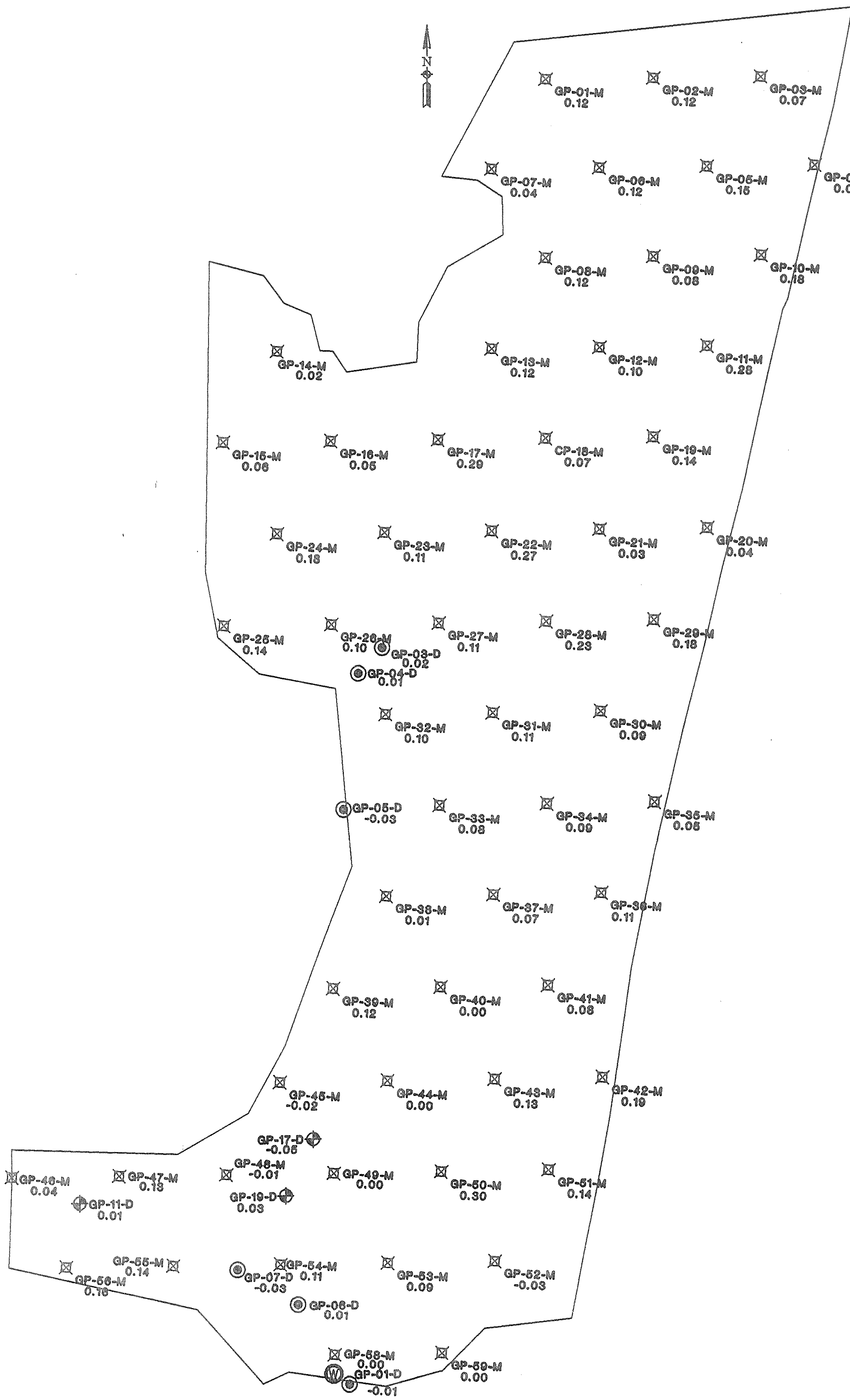
ATTORNEY–CLIENT PRIVILEGED AND
ATTORNEY WORK PRODUCT MATERIAL.

FIGURE 3-2

TAILING PILE EVALUATION
SAMPLE LOCATION MAP
RUNKLE RANCH
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENAL CORPORATION



LEGEND:

- GP-59-M MARSSIM Grid Surface Soil Samples
- Discretionary Surface Soil Samples
- Discretionary and Tailings Soil Samples
- Discretionary and Tailings Water Samples
- Discretionary Surface Water Samples

NOTE: ANALYTICAL RESULTS IN pCi/g

NOT TO SCALE

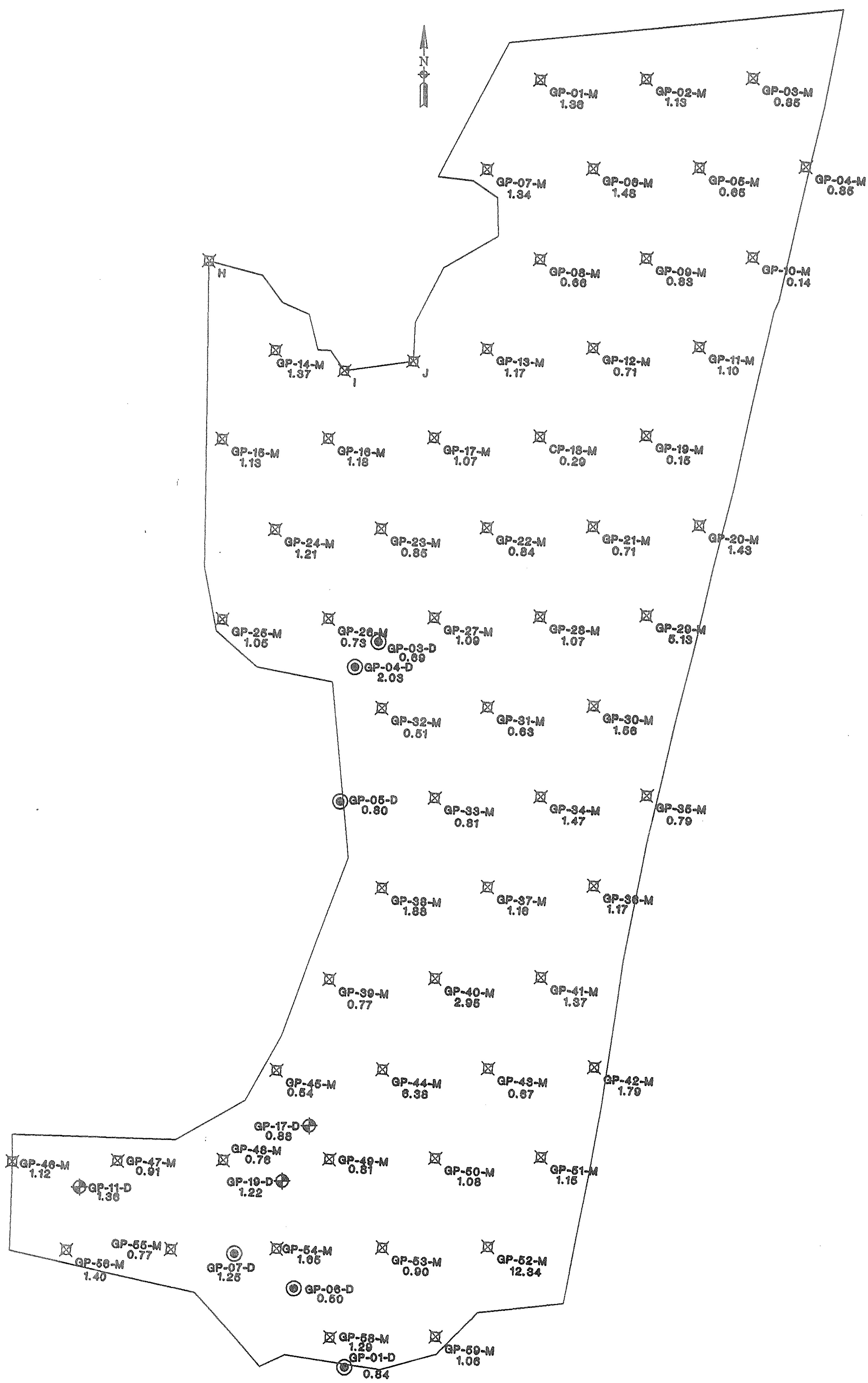
ATTORNEY-CLIENT PRIVILEGED AND
ATTORNEY WORK PRODUCT MATERIAL.

FIGURE 4-1

CS-137 ANALYTICAL RESULTS
RUNKLE RANCH
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENAL CORPORATION



LEGEND:

- MARSSIM Grid Surface Soil Samples (GP-59-M)
- Discretionary Surface Soil Samples
- Discretionary and Tailings Soil Samples
- Discretionary Surface Water Samples

NOTE: ANALYTICAL RESULTS IN pCi/g

NOT TO SCALE

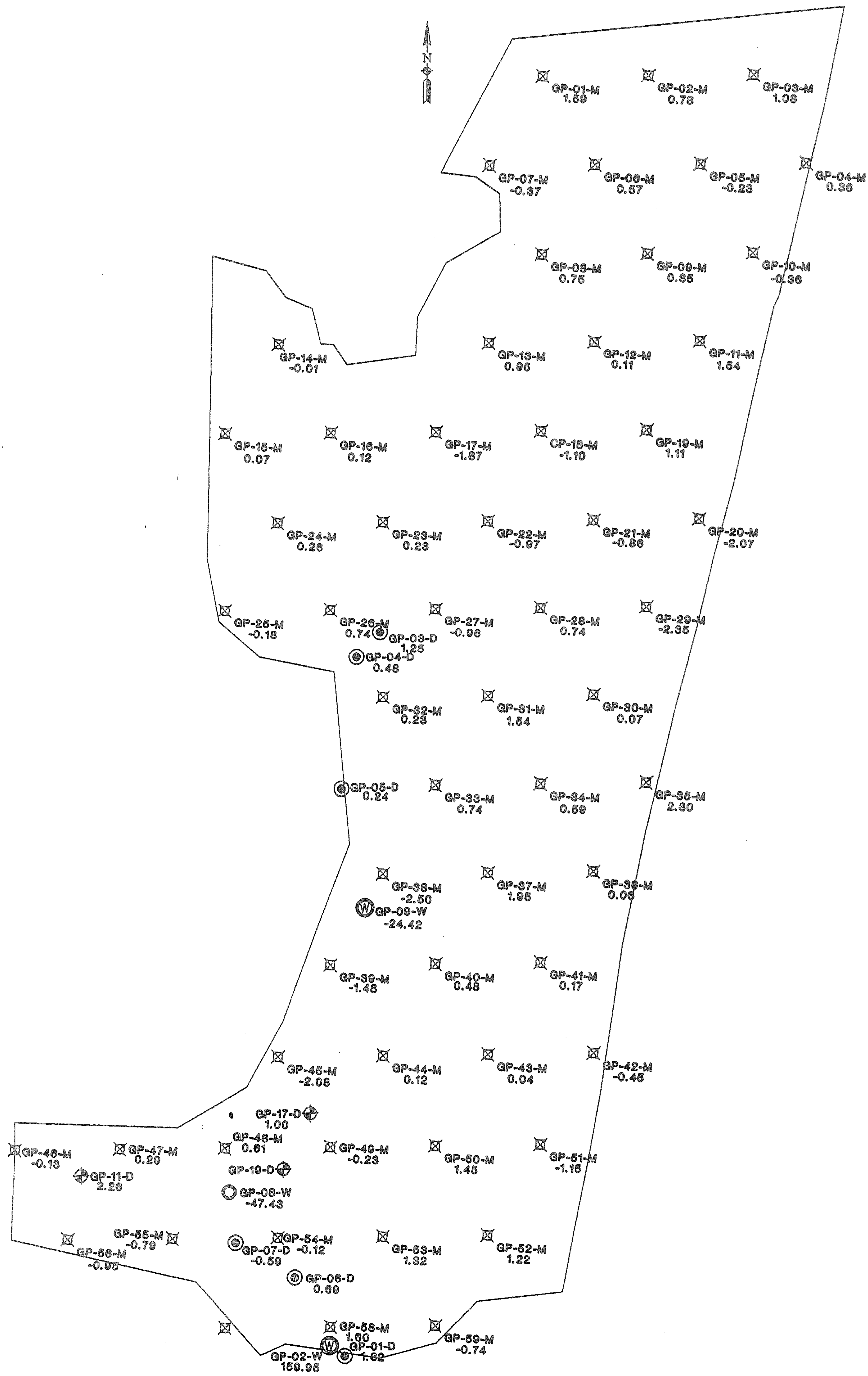
ATTORNEY–CLIENT PRIVILEGED AND
ATTORNEY WORK PRODUCT MATERIAL.

FIGURE 4–2

SR–90 ANALYTICAL RESULTS
RUNKLE RANCH
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENAL
CORPORATION



LEGEND:

- MARSSIM Grid Surface Soil Samples (GP-59-M)
- Discretionary Surface Soil Samples
- Discretionary and Tailings Soil Samples
- Discretionary and Tailings Water Samples
- Discretionary Surface Water Samples

NOTE: ANALYTICAL RESULTS IN pCi/g

NOT TO SCALE

ATTORNEY–CLIENT PRIVILEGED AND ATTORNEY WORK PRODUCT MATERIAL.

FIGURE 4–3

TRITIUM ANALYTICAL RESULTS
RUNKLE RANCH
SIMI VALLEY, CALIFORNIA

GreenPark Holdings, LLC.
Seal Beach, California

FOSTER WHEELER ENVIRONMENAL CORPORATION

FINAL REPORT

RUNKLE RANCH
SITE INVESTIGATION
SIMI VALLEY, CA

Prepared for:

GreenPark Holdings, LLC
3030 Old Ranch Parkway, Suite 450
Seal Beach, CA 90740

October, 1999

VOLUME I