APPENDIX I – GAMMA WALKOVER SURVEY

FINAL REMEDIAL INVESTIGATION REPORT
CASMALIA RESOURCES SUPERFUND SITE
CASMALIA, CALIFORNIA

Prepared By: URS Corporation

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BKG	background
cpm	counts per minute
Cs-137	cesium-137
CSC	Casmalia Steering Committee
dpm	disintegrations per minute
DQO	data quality objective
EPA	Environmental Protection Agency
ERG	Environmental Restoration Group
GIS	Geographic Information System
GPS	global positioning system
N/A	Not applicable
NaI	sodium iodide
NIST	National Institute of Standards and Technology
RI/FS	Remedial Investigation/Feasibility Study
Tc-99	technetium-99
µCi	micro-Curies
µR/hr	microrems per hour

1.0 INTRODUCTION

The Casmalia Steering Committee (CSC) completed the Gamma Walkover Survey in accordance with the June 2004 *RI/FS Work Plan* which was prepared by the CSC and submitted to the EPA.

1.1 Purpose of the Investigation

The purpose of the Gamma Walkover Survey was to generate coverage maps showing variation of gamma radiation levels at the Casmalia Resources Superfund Site (Site) within the "oil field waste spreading area" depicted in Figure 4-1 of the RI/FS Work Plan. In addition to the survey in the oil field waste spreading area, the Gamma Walkover Survey was conducted along two off-site background traverses. Data obtained from the off-site background traverses were used for comparison to on-site data.

Data collected during this investigation were reviewed and evaluated to determine whether further investigation is merited.

1.2 Scope of the Investigation

The investigation was conducted along a series of six traverses across the oil field waste spreading area and two background transects, as indicated in Figure 4-1d of the RI/FS Work Plan. A gamma walkover survey is the process of measuring local gamma radiation using a detector that is sensitive to gamma radiation. Each radiation reading and its position are logged. Data gathered during the Gamma Walkover Survey were used to generate a color map depicting radiation levels recorded along each transect. This map is used to show coverage of the transects and to visually compare the radiation levels recorded on-site to those recorded in background locations.

2.0 METHODOLOGY

The position and alignment of each planned transect was first located and marked in the field by a licensed land surveyor. Upon arrival at the Site, instrumentation was unpacked, checked, and assembled. Prior to conducting the Gamma Walkover Survey, each transect that had been marked was located and walked by the field crew. Transects were traversed as close to the intended path as site topography, access and physical limitations would allow. Data collected from the radiation meter were related to unique geographical positions using a Global Positioning System (GPS) unit. These readings were then plotted on a topographic map of the site using designated colors according to the range of the radiation readings.

2.1 Detailed Approach

Spatial coordinates for the end-points of each of the planned transects were derived electronically from the topographic base map for Figure 4-1d of the RI/FS Work Plan and provided in spreadsheet format to the land surveyor. Using these coordinates, the surveyor then located the end-points of each transect and staked them in the field, placing additional stakes along the length of transects as necessary to provide visual continuity from one point to the next. All transects were located and traversed as indicated on Figure 4-1d of the RI/FS Work Plan.

All instrumentation was removed from packing material and examined for possible damage caused by shipping. Detectors and meters were connected and source checked. Source checks are used to ensure the instruments are performing within their prospective ranges. GPS equipment was assembled and checked for proper configuration to allow the detectors to pass information to the data logger.

The radiation detector was used in a staff configuration due to the steep terrain of the survey areas. The staff consisted of the sodium Iodide (NaI) radiation detector connected approximately 12 inches above the ground and the GPS antenna attached to the top. Having the GPS antenna connected to the top of the staff allows the true position of the detector readings to be recorded. All other instrumentation was placed in a backpack worn by the surveyor. Instrumentation in the backpack included rate meter, GPS amplifier, GPS receiver, and battery packs. The GPS data logger was then used to view and record data. Radiation data were collected every 2 seconds along the predetermined transects as noted in Figure 4-1d of the June 2004 RI/FS Work Plan. Transects were walked at a pace of approximately 100 feet/minute. Off-site background transects were completed on August 16, 2004, followed by the on-site transects on August 18-19, 2004. Each day data were downloaded and plotted to ensure proper coverage of the individual transects.

Data collection was performed in two parts. The GPS data were recorded every second and the radiation readings were recorded every two seconds, each were time stamped as they were fed to the data logger. Given the GPS time and position at point A (before the reading was logged) and point B (after the reading was logged), a true position was then calculated along the transect segment using the difference in time from the radiation reading. This operation is performed within the GPS software (Terra Sync®). All data readings were exported to a database format for review and plotting.

Data were plotted using ArcView® geographic information system (GIS) software. Plotting the data over a topographic map provided reference to existing Site features. Range value colors were chosen to best represent the data of interest. All data were reviewed for consistency and potential anomalies.

2.1.1 Contractors and Subcontractors

The CSC contracted URS Corporation to complete the work. URS subcontracted initial land surveying of the transect alignments to Pacific Engineering, Incorporated of Santa Maria, California (California contractors license No. A717253). All surveying conducted by Pacific Engineering was performed under the direct supervision of a California registered civil engineer (Leroy Cadena, California registered civil engineer No. C55373). URS personnel trained and experienced in performing gamma walkover surveys were used to complete the field data acquisition, reduction, and analysis. Graphical data presentation was completed by URS GIS operators.

2.1.2 Equipment and Tools

As described in the RI/FS Work Plan (Section 3.1 of Standard Operating Procedure 5-7), the equipment used for the Gamma Walkover Survey consisted of a 3-inch sodium iodide (NaI) detector, rate meter, and a GPS unit. Once acquired, field data were then downloaded to a field laptop computer where they were reviewed and plotted on a daily basis. All other equipment and supplies supplement these main pieces of instrumentation.

In addition to the 3-inch NaI detector, a pancake personnel frisker and micro-Rems per hour (µR/hr) meter were used to ensure safe work environments such that contamination, if found, would be controlled and managed. Personnel were checked prior to leaving the field. Hands, boots, and outer clothing were surveyed with extra attention given to bottom of the pant legs where dirt and sediment might accumulate. Upon completion of the field survey activities no contamination had been found on the staff or any equipment used in the field. Specifics regarding the equipment utilized are summarized in Table I-1, below.

Table I-1
Radiation Detection Equipment

Meter			
Type	µR/hr Meter	Frisker	Ratemeter
Make	Ludlum	Ludlum	Ludlum
Model	Model 19	Model 12	Model 2221
Serial No.	180310	125264	144863
Calibration Due Date	15-Apr-05	13-Aug-05	15-Jun-05
Probe			
Make	N/A	Pancake	Bicron
Model	N/A	44-9	3-inch NaI
Serial No.	N/A	PR103362	037117

Check sources were used on a daily basis to ensure proper operation of equipment. Instrument and source calibration certificates are included as Attachment I-1. Three radiation check sources were present during the survey. Two sources were obtained from Environmental Restoration Group (ERG) along with the instrumentation, namely a cesium-137 (Cs-137) gamma source, and technetium-99 (Tc-99) beta source. The Tc-99 beta source is National

Institute of Standards and Technology (NIST) traceable. See Attachment I-1 for the certificate of traceability. The three mantle gamma source was used only for consistency between projects. Mantles have a long half-life and are made of natural radioactive material, allowing interpretation of data between projects to be more consistent. Details regarding the radiatiion check source materials utilized are summarized in Table I-2, below.

Table I-2
Radiation Check Source Identification

Source Origin	Source Type	Activity	Serial Number	Date
ERG	Cs-137	5.37 micro-Curies (µCi)	329-94	5/11/1994
ERG	Tc-99	8,730 disintegrations per minute (dpm)	97Tc470	8/27/1997
URS	3 Mantle*	N/A	N/A	N/A

Note: Check source only.

2.2 Deviations from the RI/FS Work Plan

The CSC did not deviate from the scope and methods described in the June 2004 *RI/FS Work Plan* in completing this Gamma Walkover Survey investigation. The northeast background transect in the North Canyon area was incidentally placed near or over a ravine, and was moved only enough to allow the surveyor a clear path to walk the transect.

3.0 INVESTIGATION RESULTS

Figure I-1 presents a coverage map showing variation of gamma radiation levels across the oil field spreading area compared to background radiation recorded in the two separate off-site locations. The color scheme shows the range of the readings in relation to background, coded according to the number of standard deviations above background. Based on a Normal Distribution around the background mean, 68.3 percent of readings would be within one standard deviation of the mean; 95.4 percent would be within two, and 99.7 percent would be within three standard deviations. No readings exceed the background mean plus three standard deviations, suggesting that the readings are all around background levels.

3.1 Data Presentation

Data consist of radiation readings from the six transects across the oil field waste spreading area (Transects T-1 through T-6), two off-site background locations (Transects B-1 and B-2), and the daily source check readings. Summary of data for each of the transects surveyed are presented in Table I-3, below, as gross counts per minute (cpm).

Table I-3
Data Summary

Transect	Location	Minimum	Maximum	Average	Total No. Readings
T1	On-site	18,006	26,845	21,636	1,324
T2	On-site	18,202	29,176	22,463	340
T3	On-site	18,861	33,072	22,349	284
T4	On-site	18,849	27,016	22,964	228
T5	On-site	18,819	27,626	23,380	289
T6	On-site	19,293	27,174	22,275	282
B1	Background	19,506	28,794	23,457	963
B2	Background	24,989	30,950	27,475	915

3.1.1 Oil Field Waste Spreading Areas

On-site readings were collected as planned. A total of 2,747 individual readings were recorded for the six on-site transects along a total linear distance of approximately 4,213 feet. Readings ranged from 18,006 cpm in transect T1 to 33,072 cpm in transect T3. The average on-site transect reading is 22,171 $\pm$ 2,166 cpm. All on-site readings are presented in electronic format in Attachment I-2. Two readings (of the 284 total readings in this transect) in the central portion of transect T3 were found to be higher than the maximum recorded background value. The two readings are discussed below but were low enough that they are not considered significant.

3.1.2 Background

Background readings were collected prior to collecting on-site data. Off-site background readings were collected as planned. A total of 1,878 readings were recorded for the two background transects along a total linear distance of approximately 3,212 feet. Background readings range from 19,506 cpm in B1 to 30,950 cpm in B2. The average background reading is

25,414 ± 2,610 cpm. All background readings are presented in electronic format in Attachment I-2.

3.1.3 Daily Source Check

Operational check sources were recorded on a daily basis and used to ensure the proper operation of the instrumentation. Results of all daily source check measurements are presented in Attachment I-3, and daily operational check source responses are presented in Table I-4, below. All operational check source responses were within expectations.

Table I-4
Daily Operational Check Source Responses

Date	Serial#	BKG (cpm)	Response (cpm)	Source
8/17/2004	14,4863	22,555	68,571	Cs-137
8/18/2004	14,4863	22,381	65,095	Cs-137

3.2 Conclusions

The maximum on-site data reading was 33,072 cpm, which is 6 percent greater than the maximum background reading of 30,950 cpm but still less than the average background plus 3 standard deviations (33,243 cpm). There were two readings above the largest background reading of 30,950 cpm, both adjacent to one another and occurring in the central portion of transect T3. All other 2,745 readings were below the largest background reading. These two readings are statistically reasonable, representing less than 0.1 percent of the total number of readings, being 2 out of 2,747 data readings. In a normal distribution, 0.3 percent of readings would be expected to fall outside of three standard deviations from the mean. The magnitude of these values is relatively insignificant compared to background and presents only minimal radiological risk.

The average on-site reading was 22,171 cpm compared to the average background reading of 25,414 cpm. The on-site average value is 13 percent lower than the off-site background average value.

4.0 EVALUATION OF ADDITIONAL DATA NEEDS

While data quality objectives (DQOs) have been established for many elements of the RI, no DQOs exist for this specific activity. Because the Gamma Walkover Survey was successful in characterizing radiological conditions in the oil field waste spreading area, the objectives for this task as stated in the RI/FS Work Plan have been met. Moreover, due to the low on-site readings with respect to background, no further investigation is required with regard to radiological contamination in the oil field waste spreading areas.