**Pacific Gas and Electric Company**
*Humboldt Bay Power Plant*
*Paul J. Roller*
*Director and Plant Manager Humboldt Bay Nuclear*

1000 King Salmon Avenue
Eureka, CA 95503
707/444-0700

April 1, 2010

PG&E Letter HBL-10-003

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-133, License No. DPR-7
Humboldt Bay Power Plant Unit 3
Request for 10 CFR 20.2002 Alternate Disposal Approval and 10 CFR 30.11 Exemption of Humboldt Bay Power Plant Waste For Disposal at US Ecology Idaho

Dear Commissioners and Staff:

Pacific Gas and Electric Company (PG&E) requests NRC approval for alternate disposal of approximately 200,000 cubic feet of hazardous waste containing low-activity radioactive debris, at the US Ecology Idaho (USEI) Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous disposal facility located near Grand View, Idaho. This request is made under the alternate disposal provision contained in 10 CFR 20.2002 and the exemption provision in 10 CFR 30.11. The material will be generated during demolition of structures at the Humboldt Bay Power Plant (HBPP) site, including Unit 3 and non-nuclear Units 1 and 2. Special Nuclear Material is not present in the waste; therefore a 10 CFR Part 70.17 exemption is not required.

The USEI facility is permitted by the State of Idaho to accept the hazardous component of the waste (classified as RCRA hazardous for lead in accordance with Environmental Protection Agency Code D008). Enclosure 1 provides a conservative radiological assessment of the planned disposal and a description of the waste material. This waste material description includes the physical and chemical properties important to risk evaluation, along with the proposed manner and conditions of waste disposal. Further information about the USEI facility's environmental setting is provided in Attachment 1 to Enclosure 1 in compliance with 10 CFR 20.2002.

The subject waste material consists of concrete, steel, insulation, roofing material, gravel and other metal, wood and soil debris generated during dismantlement activities located at the HBPP site, the majority being from the non-nuclear Units 1 and 2. Radioactive contaminants, as shown in Enclosure 1, Table 1, have very low concentrations and are well within the waste acceptance criteria (WAC) set forth in USEI's permit issued by the Idaho Department of Environmental Quality (provided in Enclosure 2). Specifically, Table C.4b of USEI's WAC allows disposal of byproduct material with a 10 CFR 30.11 exemption.

NMSS01
FSME

The concentrations of the radionuclides in the waste are expected to be below levels requiring classification as radioactive material for shipment purposes under applicable U.S. Department of Transportation (DOT) regulations (49 CFR 173.401 Subpart I).

NRC Regulatory Issue Summary 2004-08, "Results of the License Termination Rule Analysis," dated May 28, 2004, states that "10 CFR 20.2002 does not establish a specific standard for approving on-site disposal requests. Staff's current practice is to approve on-site disposal based on a criterion of a "few millirem"." PG&E performed a radiological assessment in consultation with USEI. Based on this assessment, PG&E concludes that potential doses to members of the public, including workers involved in the transportation and placement of this waste, will be less than one millirem total effective dose equivalent (TEDE) in one calendar year for this project, and well within the "few millirem" criteria that the NRC has established.

PG&E intends to terminate operation of HBPP Units 1 and 2 in September 2010 and begin demolition shortly thereafter. Therefore, PG&E would appreciate your written response to this request within six months for authorization of alternate disposal at USEI under the provisions of 10 CFR 20.2002 and exemption of this material from NRC regulations for the purposes of disposal under the terms of 10 CFR 30.11.

If you wish to discuss the information in the enclosure, please contact David Sokolsky at (707) 444-0801.

Sincerely,

Paul J. Roller
*Director and Plant Manager Humboldt Bay Nuclear*

cc/enc: Elmo E. Collins, Jr., US NRC Region IV
John B. Hickman, US NRC
Chad Hyslop, US Ecology Idaho
James E. Kennedy, US NRC
Keith I. McConnell, US NRC
PG Fossil Gen HBPP Humboldt Distribution

Enclosures

# HUMBOLDT BAY POWER PLANT

# EVALUATION IN SUPPORT OF ALTERNATE WASTE DISPOSAL PROCEDURES IN ACCORDANCE WITH 10 CFR 20.2002

## 1. INTRODUCTION

Pacific Gas and Electric Company (PG&E) requests NRC authorization for disposal of hazardous waste, soils and debris containing low-activity radioactive materials in accordance with the provisions of 10 CFR 20.2002 and issuance of a specific exemption under 10 CFR 30.11. Since the subject material does not contain Special Nuclear Material, a 10 CFR 70.17 exemption is not required or requested. NRC approval of proposed disposal procedures, in accordance with 10 CFR 20.2002, will allow Humboldt Bay Power Plant (HBPP) to dispose of the waste described in Section 3 of this enclosure at the US Ecology Idaho (USEI) disposal facility. The USEI disposal facility is a Subtitle C Resource Conservation and Recovery Act (RCRA) hazardous waste disposal facility permitted by the State of Idaho and located near Grand View, Idaho.

Section 2 of this enclosure references Attachment 1 which describes the disposal site characteristics. A description of the material to be disposed is included in Section 3. The material description includes physical and chemical properties of the material important to risk evaluation and the proposed conditions of waste disposal. Section 4 provides radiological assessments, including potential transport dose to the public as well as USEI worker dose. A conclusion is provided in Section 5 that confirms doses will be well below NRC limits.

Attachment 1 to this enclosure contains a description of the USEI facility. Attachment 2 provides Microshield models and results pertaining to potential external and internal radiological dose hazards to the USEI workers and transportation workers. Attachment 3 contains the RESRAD modeling report used to calculate maximum dose projections. Attachment 4 contains an intruder scenario consistent with the NRC's Request for Additional Information on the Westinghouse Hematite project (Docket #07000036)

## 2. DISPOSAL SITE CHARACTERISTICS

A description of the USEI facility near Grand View, Idaho is provided in Attachment 1. USEI has refined the RESRAD model's parameters to reflect site-specific characteristics in place of certain default values.

## 3. DESCRIPTION OF THE WASTE

The waste consists of approximately 200,000 cubic feet of concrete, steel, insulation, roofing material, gravel and other metal, wood and soil debris from demolition of oil-fired Units 1 and 2 not associated with Unit 3 reactor operations. In addition, this request includes some material from Unit 3, primarily concrete shielding, building materials, and soil debris. Overall, these wastes exhibit an average bulk density of 55 pounds per cubic foot. The waste is classified primarily as RCRA hazardous for lead in accordance with Environmental Protection Agency (EPA) Code D008. The USEI facility is permitted to accept D008 waste, which is managed at the site by encapsulation treatment as required to meet EPA Land Disposal Restriction (LDR) requirements. Some asbestos containing material (ACM) is also included.

Portions of the waste are also contaminated with radionuclide concentrations equal to or less than the concentrations listed in Table 1 below. Based on the nature of the materials, a 10 CFR Part 30.11 exemption applies and a Part 70.17 exemption is not required.

TABLE 1- RADIONUCLIDES POTENTIALLY PRESENT
(ALL CONCENTRATIONS ARE IN PCI/G)

| Nuclide | pCi/gm |
|---|---|
| Cs-137 | 15 |
| Co-60 | 5 |
| Sr-90 | 1 |
| H-3 | 100 |
| C-14 | 1 |
| Fe-55 | 1 |
| Ni-63 | 10 |
| Eu-152 | 1 |
| Eu-154 | 1 |
| Ag-108M | 0.1 |

All shipments will be bounded by the maximum activity allowed in the site waste acceptance criteria (WAC) set forth in USEI's permit issued by the Idaho Department of Environmental Quality (provided in Enclosure 2). A running average for all shipments will be kept to ensure that the values in Table 1 are not exceeded over the course of the project.

These concentrations are below levels requiring the waste to be classified as radioactive material for shipment purposes under U.S. Department of Transportation (DOT) regulations.

## 4. RADIOLOGICAL ASSESSMENT

In the following conservatively developed exposure scenarios, the dose equivalent for the Maximally Exposed Individual (MEI) has been demonstrated not to exceed a few millirem per year. This standard of a "few millirem" per year to a member of the public is set forth in NRC Regulatory Issue Summary 2004-08, "Results of the License Termination Rule Analysis," dated May 28, 2004. The transportation workers and workers at the USEI site are treated as members of the public because the USEI site, while permitted under RCRA to accept certain radioactive materials, is not licensed under the Atomic Energy Act. Evaluations of both potential external and internal dose hazards to USEI workers and transportation workers are discussed below (see Microshield models in Attachment 2).

### 4.1. Transport Dose to Public

The materials will be transported by truck to the USEI facility. For normal highway transport conditions, the material will be enclosed in a strong-tight container verified to be in compliance with DOT external loose surface contamination limits prior to shipment. Therefore, transport will pose no potential for internal dose to the driver or other members of the public. Because of the very low average concentrations of radionuclides, potential external dose to members of the public, individually and as a whole, is conservatively calculated to be very low. External dose, as has been demonstrated in the worker dose assessment below, will be very low. As a result, the dose to other members of the general public can be reasonably concluded to be much less.

### 4.2. USEI Worker Dose Assessment

The distance from HBPP Unit 3 to the USEI disposal facility is approximately 659 miles. Assuming an average speed of 50 miles per hour, the trip is estimated to take 13.18 hours. At least 7 trucks will be used to transport the waste over the course of the project and for maximum logistical efficiency. Using 7 trucks, hauling the 300 intermodal containers, each truck driver will make 43 round trips. Calculated doses to truck drivers are provided in Table 2.

Upon receipt at the facility, the material will be surveyed and screened prior to being taken to the indoor stabilization facility on the USEI site. Five minutes is required to perform a survey of each truck. Based on current practice, the surveyor is assumed to stand with his body one meter from the truck or trailer during the survey with four surveyors sharing the surveying task. Calculated doses to surveyors are provided in Table 2.

The waste will then be delivered to the stabilization building for treatment of the D008 RCRA lead constituents. It is conservatively assumed that all waste from HBPP will require treatment, when in fact a portion of the waste will not, as determined by HBPP through its waste analysis and characterization program. The waste will be placed into a steel-lined concrete tank where it will be mixed with stabilization reagents. Wastes are wetted as they are emptied into the stabilization tanks to reduce dusting. The building is also equipped with a negative pressure air handling system so that air only moves into the building and is exhausted through HEPA filters. The stabilization process requires approximately 45 minutes, during which time the excavator operator is approximately 2.8 meters from the waste wearing a respirator within an enclosed cab. Four operators share the stabilization task. Calculated doses to stabilization operators are provided in Table 2.

After stabilization, the excavator operator removes the treated waste from the stabilization tank and places it into an on-site haul truck for transport to the disposal cell for burial. Doses to haul truck operators will be much less than to the truck drivers transporting the waste from HBPP since exposure times are much shorter. As a result, doses to haul truck operators are not analyzed

After this delivery to the disposal cell, a bulldozer operator wearing a respirator within an enclosed cab then spreads and compacts the waste.

For the purpose of the dose assessment, dust loading in the stabilization building is used in calculating a bounding case potential dose for all personnel who could possibly receive an inhalation dose. Personnel who work in the stabilization building are the maximally exposed individuals for inhalation dose compared to operations conducted in open air conditions. As noted, all personnel working in the stabilization building and in the disposal cells are required to wear air purifying respirators at all times.

A minimal dose is calculated for the two bulldozer operators who share the task of spreading and compacting the stabilized waste material once it has been deposited within the disposal cell. The average time to spread and compact 60 cubic yards of material (which is the capacity of two intermodal containers) is 15 minutes. This shorter exposure time results in a lesser potential dose from airborne radionuclides than what was calculated for the excavator operator. Calculated doses to disposal cell bulldozer operators are provided in Table 2.

Significantly, all USEI employees who work with any hazardous materials are required to participate in an Occupational Safety and Health Administration (OSHA) compliant respiratory protection program. Although respiratory protection is required for the above specified workers, no credit is taken for this proven form of protection in this conservative dose assessment. In summary, Table 2 presents the resulting, conservatively calculated doses to the transporters and USEI workers from the transport and disposal of the waste from HBPP.

TABLE 2- DOSES TO DRIVERS AND USEI EMPLOYEES FOR PROJECT

| Function | No. Employees | Time (hr) | External Exposure Rate (mR/hr) | Internal Dose Rate (mrem/hr) | Distance (m) | No. Reps | External Dose (mrem) | Internal Dose (mrem) | Total Dose (mrem) |
|---|---|---|---|---|---|---|---|---|---|
| HBPP driver | 7 | 13.18 | 4.63E-04 | 0 | 4.8 | 300 | 2.62E-01 | 0 | 2.62E-01 |
| Survey | 4 | 0.0833 | 7.27E-03 | 0 | 1 | 300 | 4.54E-02 | 0 | 4.54E-02 |
| Stab | 4 | 0.75 | 1.82E-03 | 9.61E-07 | 2.78 | 128 | 4.37E-02 | 2.31E-05 | 4.37E-02 |
| Cell | 2 | 0.25 | 3.85E-03 | 9.61E-07 | 2 | 128 | 6.15E-02 | 1.54E-05 | 6.15E-02 |

Copies of the Microshield results for these scenarios are presented in Attachment 2.

## 4.3. Post Closure Dose to the General Public

USEI's RCRA permit requires that it demonstrate that no person will receive a dose exceeding 15 millirem for 1,000 years after closure of the facility. This standard is more restrictive than the 25 millirem total effective dose equivalent (TEDE) NRC decommissioning limits as well as the limits for near surface disposal of low-level radioactive waste set forth in 10 CFR Part 61. The RESRAD code was used to make that demonstration. A number of default parameters in the model have been replaced with site specific parameters consistent with the facility's 2005 permit modification and a report prepared by its consultant (previously submitted to the NRC as part of an RAI for the Westinghouse exemption request for the Hematite project, Docket #07000036).

As can be seen in the RESRAD report (Attachment 3), the maximum dose calculated by the model for the disposal of the HBPP radionuclides is 4.5E-4 mrem/year at 1,000 years following closure of the facility.

In addition, a conservative intruder scenario was conducted using the method found in NUREG 0782. Calculated doses under this scenario were 0.134 mrem, well below the NRC's alternate disposal guidance. A copy of the intruder spreadsheet is found at Attachment 4.

## 5. CONCLUSION

PG&E developed this request and related evaluation in consultation with USEI, including health physics personnel responsible for the receiving disposal facility's radiological performance assessment. This assessment team led by PG&E performed a conservative radiological dose assessment of the material and determined that the potential dose to the workers involved in the transportation and placement of the material and to members of the general public after site closure will be less than one millirem per year TEDE from this project. This dose will be a small fraction of the NRC decommissioning limits for exposure to any member of the public of 25 millirem/yr TEDE, and well within the "few millirem" criteria that the NRC has established in NRC Regulatory Issue Summary (RIS) 2004-08, "Results of the License Termination Rule Analysis," dated May 28, 2004. RIS 2004-08, page 4, states that "10 CFR 20.2002 does not establish a specific standard for approving on-site disposal requests. Staff's current practice is to approve on-site disposal based on a criterion of a "few millirem." This request meets that criterion.

# USEI SITE DESCRIPTION

Environmental conditions at USEI's site are well-documented in previous submittals to the USNRC, most recently as part of the Westinghouse exemption request for the Hematite, Missouri project (Docket # 07000036).

In compliance with the requirements of 10 CFR 20.2002, two key documents are attached herein.

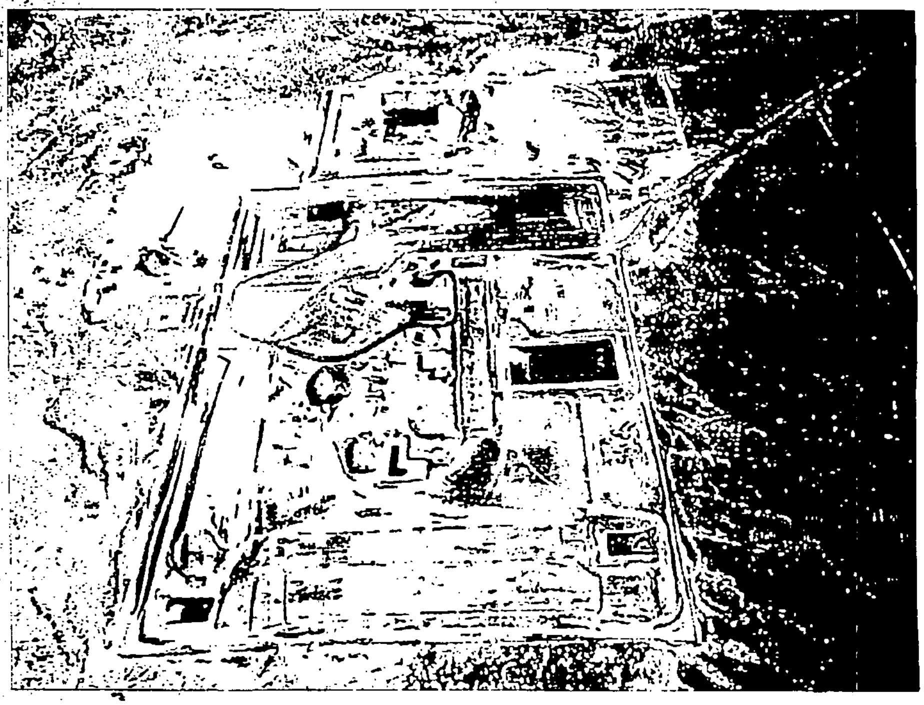
- Exhibit A: *Hazardous Waste Facility Siting License Application for Cell 16* (American Geotechnics, dated June 30, 2006); This document describes US Ecology Idaho's environmental setting and was accepted by the Idaho Department of Environmental Quality as part of the 2005 siting process, which resulted in IDEQ approval (December 6, 2006) of USEI's request to expand its landfill operations.

- Exhibit B: *Summary of Hydrogeologic Conditions and Groundwater Flow Model for US Ecology Idaho Facility, Grand View, Idaho* (Eagle Resources, dated January 13, 2010); This document provides a detailed description of site geology and hydrogeology.

# Hazardous Waste Facility Siting License Application Cell 16 Grand View, Idaho

Prepared for
**U.S. ECOLOGY IDAHO**

**June 28, 2006**



Prepared By
American Geotechnics

AMERICAN GEO TECHNICS

Prepared for

US Ecology Idaho
P.O. Box 400
Grand View, Idaho 83624

Attention: Simon Bell, Vice President of Hazardous Waste Operations

# Hazardous Waste Facility Siting License Application Cell 16

## Grand View, Idaho

American Geotechnics
Project No. 06B-C1202
June 30, 2006

Prepared by

**American Geotechnics**

Document No. 11

PROFESSIONAL ENGINEER REGISTERED 7042 STATE OF IDAHO REX WILLIAM HANSEN

6/30/2006

Tim C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Principal Engineer

AMERICAN GEO TECHNICS

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AMERICAN GEO TECHNICS

# 1.0 Introduction

US Ecology Idaho (USEI) is planning to construct a new Resource Conservation and Recovery Act (RCRA) Subtitle C and Toxic Substance Control Act (TSCA) landfill cell within Section 19 of Township 4S, Range 2E, Boise Meridian, Owyhee County, Idaho. Although a specific location for future cells is unknown at this time, two potential locations are shown on Figure 1, Site Vicinity Map, in Appendix A. This "*Site Certification Application*" (Application) is intended to provide information necessary to obtain site certification from the Idaho Department of Environmental Quality (DEQ) for proposed hazardous waste landfill cells within Section 19. Based on the information provided in this document, USEI requests that DEQ certify all of Section 19 for future hazardous waste landfill development.

USEI currently operates a RCRA Subtitle C and Toxic Substance Control Act (TSCA) Hazardous Waste Treatment, Storage and Disposal Facility (EPA ID No. IDD073114654) approximately 10 miles west of Grand View in Owyhee County, Idaho (Figure 2). The current permitted facility, known as USEI Site B (Site B), occupies approximately 120 acres in the north central portion of Section 19. USEI owns all of Section 19 (640 acres) and other adjoining property as outlined in Figure 2.

USEI proposes siting the remaining 400 acres of Section 19. Prior to the existing, active disposal Cell 15 reaching capacity, a new disposal Cell 16 is proposed for continued operation. Although operations are expected to continue at the same or an increased rate, an additional impact greater than that established by the current operating facility, is not anticipated.

This Application was prepared to comply with:

- Idaho's Department of Environmental Quality's (DEQ) Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities within Idaho
- Idaho Solid Waste Management Rules Idaho Department of Administration Procedures Act (IDAPA), Chapter 58
- Idaho Statutes Title 39, Chapter 58
- Title 40 of the Code of Federal Regulations (40 CFR), Parts 264

According to the aforementioned rules and regulations, it is necessary to evaluate and certify that the proposed landfill site meets certain conditions. This Application summarizes the applicability of current rules and regulations with respect to Section 19. This document demonstrates that Section 19 meets or exceeds minimum regulatory standards and is suitable for disposal of hazardous waste allowed by federal and state law or all solid waste allowed under the Idaho Solid Waste Facility Siting Act.

## 1.1 Name and Residence of the Applicant

> *"An applicant for a siting license shall include the name and residence of the applicant."* (Idaho Statutes 39-5813-a)

USEI is the applicant on this site license. The treatment, storage and disposal facility (TSDF) for which a siting license is being sought is located in Owyhee County, Grand View, Idaho.

USEI obtained a RCRA part B permit in December 1988 for commercial hazardous waste treatment, storage, and disposal at its Site B facility west of Grand View, Idaho. This application is for the expansion of that facility. The General Manager and contact is Ryan McDermott. The mailing address of USEI Site B is P.O. Box 400, Grand View, ID 83624.

## 1.2 Location

> *"An applicant for a siting license shall include the location of the proposed hazardous waste treatment, storage, or disposal facility."* (Idaho Statutes 39-5813-b)

Site B occupies approximately 120 acres in the northern half of Section 19, Township 4 South, Range 2 East, Boise Meridian. Section 19 is a parcel of land that encompasses 640 acres and is owned by USEI. The proposed siting area is the remainder of Section 19. It will encompass at least one new disposal cell within the remaining 400 acres minus buffer zones and excluded areas as discussed herein.

Owyhee County is a ranching and agricultural area of approximately 7,678 square miles. The county is sparsely populated, with an average population of 1.4 people per square mile.

The area surrounding Section 19 is very sparsely populated. The nearest public facility is a gas station mini-mart in Grand View, which is approximately 10 miles southeast of Section 19. Grand View has a population of approximately 500 persons. Approximately 170 people live within four miles of Section 19 (Exposure Information Report, 1985).

AMERICAN GEO TECHNICS

Additional Site Information is:

| | |
|---|---|
| EPA ID Number: | IDD073114654 |
| Physical Address: | 20400 Lemley Road<br>Grand View, ID 83624 |
| Telephone No.: | (208) 834.2275 |
| Latitude: | 43 03'-56" |
| Longitude: | 116 15'-44" |

AMERICAN GEO TECHNICS

## 2.0 Engineering and Hydrogeologic Information

*"An applicant for a siting license shall include engineering or hydrogeologic information to indicate compliance with technical criteria as adopted in the Hazardous Waste Management Plan if applicable."* (Idaho Statutes 39-5813-c)

Charles Feast, as senior hydrogeologist and project manager at CH2M Hill from 1979 to 1999, and since 2001 with Feast Geosciences, was the primary author or senior technical lead for most of the geologic and hydrogeologic studies conducted at Site B. Sections 2.1 through 2.6 of this Application were prepared from a summary document provided by Mr. Feast for this application (Feast 2006).

Since the mid-1980's, the geology and hydrogeology at Site B has been extensively studied and characterized to obtain and renew hazardous waste treatment, storage and disposal permits through the US Environmental Protection Agency (EPA) and DEQ. Most of this work has been conducted within the boundaries and perimeter of the current active portion of the facility. The following text draws directly from previous reports and studies and includes both direct text and amended or summarized text from numerous sources previously submitted to DEQ. The exception to the summation and paraphrasing of previous studies is a new geologic cross-section along the west side of the current facility boundary prepared specifically for this submittal.

### 2.1 Geologic Setting

#### General Geology

Section 19 lies within Owyhee County in southwestern Idaho and geographically comprises a portion of the Snake River Valley. The geology of the area surrounding Section 19 is dominated by the sedimentary facies of the Idaho Group, which are underlain by the older basalts and rhyolites of the western Snake River Plain. These sediments and volcanics were deposited in a fault-bounded basin on the western margin of the western Snake River Plain. The sediments and volcanics of the Snake River Plain unconformably contact the predominantly plutonic rocks of the mountainous highlands north and west of Section 19.

The oldest rocks of the mountainous area to the north and to the southwest of Section 19 are of Jurassic and Cretaceous age and are of granitic and granodioritic composition. These rocks represent the margin of the Idaho batholith, forming the extreme western limits of the Rocky Mountains. Metamorphic rocks are found locally associated with the plutonic rocks in the uplift.

Within the Snake River Valley are younger (Tertiary and Quaternary) deposits of the Idaho Group that were deposited as pediment sands, gravels, silts and clays of lacustrine (lake) and fluvial (river) origin in the form of piedmont plains with intermingled and superimposed silicic and basaltic extrusive volcanic and pyroclastic flow rocks that range in age from Miocene to early Recent. The floors of the presently active watercourses and their overflow areas are blanketed with the most recent materials. These recent materials were derived from deposits of windblown silts, fine sands, and bench or terrace deposits of pre-existing gravelly materials.

### General Stratigraphy

The stratigraphy and approximate thickness of each geologic unit can be characterized as follows, in ascending order (deepest and oldest first):

- Poison Creek Formation – 600 plus feet
- Banbury Basalts – 200 plus feet
- Chalk Hills Formation – 200 plus feet
- Glenns Ferry Formation – 1,500 plus feet
- Bruneau Formation – 0 to 100 plus feet

Figure E-7 (Appendix B), a detailed staratigraphic column prepared from the driller's log for an artesian well drilled in 1958 at Site B, illustrates the stratigraphic sequence at Section 19.

### Poison Creek and Chalk Hills Formations

The Poison Creek and Chalk Hills formations are lacustrine deposits of the Snake River Plain. The Poison Creek Formation separates the general groundwater systems from the local groundwater systems.

### Banbury Basalts

Approximately 200 feet of basalt, known as the Banbury Basalts, separate the Poison Creek Formation and the Chalk Hills Formation. These basalts are the first fractured rock system encountered beneath Section 19, and occur at a depth of approximately 2,285 feet below ground surface (bgs).

### Glenns Ferry Formation

The Glenns Ferry Formation represents lacustrine, fluvial, and flood plain deposits. The first encountered groundwater at the proposed siting area is in this formation. The first water-bearing zones beneath Section 19 consist of two groups of thin sand beds that are interbedded in the fine-grained lacustrine sediments of the Glenns Ferry Formation.

### Bruneau Formation

The Bruneau Formation consists of unconsolidated lake deposits containing basalt flows and tuff beds to high-energy river gravels. These are coarse-grained deposits that are located at the ground surface near Section 19.

### Subsurface Conditions

Subsurface conditions at Section 19 have been determined primarily based on the subsurface conditions encountered in the excavation of Landfill Cell 14 and Cell 15, and the logging of the groundwater monitoring wells drilled at various locations around Section 19.

Section 19 soils are composed primarily of layers of silty sands, sandy silts, silts, and massive clays. The top 30 to 40 feet are composed primarily of silty and gravelly sands, which are underlain by silty sands and clays to a depth of approximately 150 feet. Below 150 feet, thick beds of inorganic silts and clays are encountered. These materials were deposited primarily in a lacustrine environment. Soil boring data show that relatively consistent, uniform soil conditions exist throughout Section 19.

## 2.2 Hydrologeologic Setting

Detailed descriptions of the hydrogeology at Section 19 are provided in the numerous support documents prepared prior to and subsequent to the issuance of the Part B permit. The general description and discussion in the following paragraphs is provided to describe the subsurface conditions relevant to the Section 19 Siting Application and is not to provide a comprehensive presentation of the complex hydrogeology at Section 19.

Section 19 is underlain by two water-bearing units identified as the Upper and Lower Aquifers. These hydrologic units consist of two distinct swarms or sets of thin beds of very fine sand and fine silty sand embedded in a silty clay matrix. A confining layer of massive clay, 20 to 30 feet thick, separates the two aquifers.

Water chemistry, geologic core logging, and geophysical logging during site characterization differentiated the two aquifers. These two aquifers appear geologically similar over most of Section 19, with an exception occurring in the northwestern most corner. In this corner, the saturated portion of the Upper Aquifer appears thicker, most likely due a thicker sequence of sand layers acting as the host unit. The groundwater monitoring system established for Site B (as part of the permitting process) has maintained the Upper and Lower Aquifer distinction. The monitoring well system at Site B consists of 33 wells and piezometers in the Upper Aquifer, and 22 wells and piezometers in the Lower Aquifer, as shown on Figure 3.

The total saturated thickness of the Upper Aquifer ranges from less than 20 feet thick to about 80 feet thick. Within the aquifer section, the cumulative thickness of sand beds ranges from 1.5 feet to 35 feet, with an average thickness of approximately 7 feet. Sand beds appear to be thicker, and the cumulative sand bed thickness appears highest, in the northwestern portion of Section 19. The number of sand beds decrease, and individual beds thin, to the east and to the south of Section 19.

Water in the Upper Aquifer flows into Section 19 from the northwest and exits across the eastern facility boundary as shown on Figure 4. Water in the Lower Aquifer enters from the southwest, flows to the northeast and exits Section 19 beneath the eastern Site B boundary as shown on Figure 5. The Upper Aquifer exhibits unconfined (water table) to semi-confined conditions, while the Lower Aquifer is confined. Based on the surface elevation of the monitoring points, depth to water in the Upper Aquifer ranges from 135 feet to 190 feet bgs , and the potentiometric surface of the Lower Aquifer ranges from 190 feet to about 215 feet bgs .

The subsurface stratigraphy of Section 19, including the Upper Aquifer host lithologies that dip or slope downward to the northeast approximately 2 to 5 degrees. As a consequence of this dip, the sand beds hosting the Upper Aquifer gradually rise above water and progressively become unsaturated from north to south across Site B. The southern limit of saturation in the Upper Aquifer crosses the southern portion of Site B from northwest to southeast and slightly north of the northern edge of Cell 14. The Lower Aquifer also dips to the northeast, but is saturated beneath the entire Site B facility.

Figures 6 and 7 are north-south cross-sections along the western and eastern sides (respectively) of the current Site B boundaries. These figures show the principal stratigraphic units beneath Site B including the Lower Aquifer, the confining layer and primary stratigraphic divisions within and above the Upper Aquifer. The effect of the northerly dipping formations on the saturated thickness and southerly extent of the Upper Aquifer is illustrated on these figures by the intersection of the water table and the inner confining layer separating the Upper and Lower Aquifers.

There are no existing wells or borings in the eastern or western extents of Section 19 to document continuity of the hydrogeologic conditions studied in detail beneath and adjacent to the current Site B boundaries. However, the geologic setting, including outcrops visible in the southern and western topographic highlands bordering the plateau on which Site B is located, indicates similar stratigraphic continuity, and therefore similar hydrogeolic continuity beneath Section 19. This is especially true in the eastern portion of Section 19, where groundwater contours and flow lines are uniformly spaced and consistent, suggesting uniform conditions in the immediate area. The western portion of Section 19 is topographically higher than the east, and the extent of the Upper Aquifer in this portion of Section 19 is largely unknown. While well yields in both aquifers appear to vary according to the thickness and cumulative occurrence of sand beds within the saturated zone, they range from about 5 gallons per minute in the northwest corner of Site B to less than 0.5 gallons per minute across the eastern and southern extent of the Upper Aquifer. The Lower Aquifer is generally thinner and contains fewer sand beds. Lower Aquifer wells all yield less than 0.5 gallons per minute. The general water chemistry of the both aquifers is high in total dissolved solids, exceeding 1,000 mg/l in all wells except U-4, which is around 900 mg/l. The low well yields, combined with poor water quality, indicate that neither of the water bearing zones represent viable or economically significant resources.

## 2.3 Siting Criteria

### Depth to Groundwater

> *"No new hazardous waste land disposal facility shall be placed where the seasonal-high depth of the groundwater, beneath the proposed site, is less than 100 feet below the lowest point of disposal. Perched saturated zones may be exempt from exclusionary criterion if it can be demonstrated that the saturated zone has no economic or*

> *consumptive usable purpose.*" (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-1A)

Water levels in the Lower Aquifer monitoring wells range from 185 to 215 feet bgs depending on the surface elevation of measurement. Projecting future water levels in the Lower Aquifer is complicated by the transient effects of soil loading from Cells 14 and 15 and because the aquifer is under confined conditions under all but possibly the extreme southern edge of Cell 15. Under confined conditions, the depth to water in a well is less than the depth to water in the aquifer because the water rises above the confining layer in the well.

The Upper Aquifer is under unconfined/semi-confined water table conditions: consequently the measured depth to water is essentially the depth to saturated sediments. Water levels range from 135 feet bgs in the topographically low area near the northwest corner of Site B, to 198 feet bgs across the southeastern portion of Site B. The depth to water and subsequent rising water levels may limit the design depth of future cells that extend over that the northwest corner of Section 19 to disposal depths less than 35 feet bgs. This potential Cell location is discussed further in the following section. The low well yields from both the Upper and Lower Aquifers, combined with poor water quality, indicate that neither of the water bearing zones represent viable or economically significant resources.

**Fine Grained Unconsolidated Sediment Formations**

> *"No new hazardous waste land disposal facility shall be placed where the thickness of fine-grained (predominantly clay and silt) unconsolidated sediments above the water table is less than 25 feet."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-1B)

The thickness of fine-grained sediments above the Lower Aquifer exceeds 100 feet. In addition to the numerous beds of clay and silty clay comprising the lower part of the Upper Aquifer, the confining clay between the two aquifers consists of a single massive unit approximately 20 to 40 feet thick.

The thickness of fine-grained sediments above the Upper Aquifer exceeds 60 feet over most of Site B with the exception of the northwest corner. Here the higher groundwater and low topography combine to limit the amount of clay and silt to 25 to 30 feet thick. As shown on Figure 6, the sedimentary sequence above water is comprised of thinly bedded, fine sand with thickly bedded silts and clays. During previous monitoring well drilling, this sedimentary package has been logged as interbedded silty sand or sandy silt and clay. The individual silt and clay beds cannot usually be individually identified. At well U-1, a detailed, continuous core was obtained to a depth of 140 feet (CH2M Hill, 2000). In this boring, 31 feet of silt and clay beds were penetrated. The individual beds range from 1 inch to 2 feet thick. In addition, there are several relatively thick, fine silty sand beds that include thin beds of silt and clay not included in the cumulative total. In general, from about 120 feet and deeper, the sediments are predominantly (approximately 70 percent) silt size or finer (Figure 6).

### Groundwater Monitoring Considerations

A new waste disposal cell most likely will require modifications to the current monitoring well network. These modifications possibly include the abandonment of several wells, the installation of replacement wells, and new dedicated down gradient wells. The final layout of the cell determined during permitting, including the location of individual sub-cell sumps, will dictate the ultimate monitoring well configuration.

For example, if Cell 16 covers most of the western side of Section 19, subject to buffer and setback requirements across the west side, the following monitoring wells would likely be impacted:

- U-1
- U-2
- U-3
- Possibly L-38

In addition, the following piezometers (wells used for water levels only) would likely be impacted:

- UP-28
- UP-29
- LP-14

The general approach to modifying the groundwater monitoring system for a new Cell overlapping an existing well will be to drill suitable replacement background monitoring wells, and conduct parallel groundwater sampling over at least one hydrogeologic cycle to establish some correlation between the new and existing wells. Once a period of data overlap is obtained and a correlation determined, the existing wells will be plugged and abandoned according to state and federal regulations and the steel surface casing removed or cut off below the construction depth of the cell.

New down gradient wells, designated to monitor specific Cell leak detection and leak collection sumps, may be required. These wells would be installed in appropriate locations. For the example were a new Cell 16 to cover most of the western side of Section 19, new downgradient wells designated to specific leak detection and leak collection sumps would be installed along the west side of the existing Cell 5. Additionally, well locations would be considered where the wells not only monitor Cell sumps, but also groundwater impacts detected at existing wells such as U-1, which may have been exacerbated by the recent capping of Cell 5. Wells impacted by constructing a new Cell would likely be included in the semi-annual groundwater monitoring program.

A specific program addressing the modification of the monitoring well network, including installation of new wells and abandonment of existing wells, would be defined during the permit modification process. Likewise, the location of piezometers would be evaluated.

### Cell Design Excavation Depth

Prior to the final design and submission of the permit modification to DEQ, subsurface investigation would be performed to determine site specific subsurface characteristics. Additionally, ground water monitoring wells would be installed and monitored to determine the seasonal-high depth to groundwater. Results from these investigations and monitoring would be used to determine future construction design criteria to meeting all permitting requirements.

## 2.4 Rising Groundwater

Water levels in both the Upper and Lower aquifers at Site B were noted to be rising since 1984 when successive water level measurements were first recorded. In 1999 USEI conducted an evaluation of the rate of rise and sources of the rising groundwater (CH2M Hill, 1999). Consequently, DEQ required USEI to re-evaluate rising groundwater at Site B every two years. Thus, re-evaluation reports were prepared and submitted in 2001 (CH2M Hill, 2001), 2003 (Feast Geosciences, 2003) and 2005 (Feast Geosciences, 2006). The results of the initial study and subsequent re-evaluations are summarized as follows:

- The age of the Upper Aquifer water ranges from less than 1,000 years on the western (upgradient) portion of Site B, to 5,000 to 9,000 years before present on the eastern (downgradient) portion of the Site B.
- The Lower Aquifer ranges from 10,700 to 12,700 years before present in the wells across

the northern edge of Cell 14.

- The source of water in the Upper Aquifer appears to be Castle Creek.
- The source of water in the Lower Aquifer was not specifically identified, but based on gradient, the source is thought to be southwest of the site; and based on isotope data, the recharge area is thought to be at least 1,000 feet higher than the headwaters of Castle Creek.
- Upper Aquifer water levels have risen an average of 5.8 feet since 1989 and the Lower Aquifer water levels have risen an average of 6.3 feet.
- Using data collected since 1989, the rate of rise for the Upper Aquifer is 0.35 feet per year, and for the Lower Aquifer it is 0.49 feet per year.
- Beginning in 1997, the rate of rise in most of the Upper Aquifer and Lower Aquifer wells has decreased from the pre-1997 time frame. Since 1997, the average rate of rise in the Upper Aquifer is 0.23 feet per year and in the Lower Aquifer it is 0.37 feet per year.
- Water levels in the Upper Aquifer wells on the eastern side of Site B are rising more slowly than the wells on the western side (0.18 feet per year versus 0.34 feet per year).
- Water levels in the Lower Aquifer respond to changes in surficial un-loading and loading as Cell 14 and Cell 15 are/were excavated and re-filled and the excavation spoil piles were emplaced.
- The groundwater at Site B does not exhibit significant seasonal variations. Prior to the late 1990's water levels were rising fast enough to obscure the seasonal fluctuation. Since the late 1990's the rate of water level rise is slow enough that a seasonal fluctuation of about 0.5 feet is becoming evident in the hydrographs of most wells.
- Rising groundwater at Site B has not caused any significant changes to the flow paths in either aquifer or in the efficacy of the current monitoring well system.

Water levels measured in the Upper Aquifer wells in the northwest corner of Site B appear to be rising more slowly than any of the other Upper Aquifer wells across Site B. In addition, the rate of rise appears to be slowing down. From 2003 to 2005 the average rate of rise in wells U-3 and U-4 was 0.15 feet per year. This decreasing rate of rise is apparently the result of incoming water filling sandy sediments on the northwest side and the incoming groundwater backing up as the generally less transmissive Upper Aquifer, across the center and east sides of the Site B, slowly respond to the increased hydraulic head.

In the probable Upper Aquifer recharge area at Castle Creek, the water surface elevation is approximately 2450 feet mean sea level (msl). The maximum level for the Upper Aquifer at Site B is tied to the elevation of Castle Creek as the recharge source and dependent of the rate of recharge and subsequent lateral discharge of water across the site. As water levels rise, additional sand horizons become saturated and the aquifer is able to discharge more water. Consequently, there should be a self limiting maximum water level for the Upper Aquifer in the northwest portion of Site B. Although this exact level is not known, the self limiting maximum water level is at an elevation significantly lower than the recharge area.

There are no estimates of the maximum water level for the Lower Aquifer. Since the aquifer is confined, water levels could continue to rise until sufficient differential head develops across the confining bed between the Upper and Lower Aquifers so that upward leakage limits additional water level increases.

## 2.5 Depth to Fractured Rock

> *"No new hazardous waste land disposal facility shall be placed where the depth to fractured rock (e.g. basalt, rhyolite, limestone, dolomite, etc.) is less than 100 feet below the lowest point of disposal."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-1B)

Figure E-7 (Appendix B) is a stratigraphic column prepared from the log of a 3,100 foot deep artesian supply well drilled at Site B by the US Army Corps of Engineers (USACE) in 1958. Site B is underlain by 2,285 feet of clay and shale overlying the Banbury Basalt, which is the first fractured rock is encountered. This artesian well was plugged and abandoned 1986.

## 2.6 Surface Water

> *"No new hazardous waste land disposal facility shall be placed within 2500 feet of surface water bodies (e.g., lakes and perennial rivers or streams, etc.)."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-2A)

> *"The active portion of the facility shall be located such that the facility shall not cause contamination of surface waters, unless such surface waters are an integral part of the non-municipal solid waste management facility's operation for storm water and/or leachate management."* (IDAPA 58.01.06-013.01.C)

The surface water body nearest to Section 19 is Castle Creek. Castle Creek is a perennial stream running generally from southwest to northeast to its confluence with the Snake River to the north. As shown in Figure 8, Castle Creek is located within Sections 13 and 24 of Township 4S, Range 1E, in its reaches nearest to Section 19. Figure 8 shows the required 2,500 foot surface water body buffer zone. The buffer zone extends into the northwest corner of Section 19 and generally overlaps the required 500 foot inactive buffer zone where no active cells may be constructed, as discussed in Section 12.0. However, a small portion of the surface water buffer zone extends beyond the inactive buffer zone into the northwest corner of Section 19. This portion of Section 19 will be maintained as an inactive buffer to meet the surface water buffer zone requirement. That is, no landfill cells will be constructed within the portion of the surface water buffer zone that extends into Section 19 beyond the 500 foot inactive buffer zone.

## 2.7 Water Wells

> *"No new hazardous waste land disposal facility shall be sited within 1000 feet of existing public/private irrigation and water supply wells, unless it can be demonstrated that natural hydrogeologic barriers isolate the site location from the aquifer being pumped."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-2B)
>
> *"The active portion of the facility shall be located, designed and constructed such that the facility shall not cause contamination to a drinking water source or cause contamination of groundwater."* (IDAPA 58.01.06-13.01.D)

Figure 9 shows the locations and construction dates of all wells located within the vicinity of Section 19 that are registered with the Idaho Department of Water Resources (IDWR). According to the IDWR database, the well nearest to the Section 19 boundary (well #13) is registered to the Bonus Cove Ranch and has a domestic, single residence usage with a production capacity of 50 gallons per minute. The exact location of well #13 was not surveyed for this report. However, the IDWR database indicates that well #13 is located within the northwest quarter of the northeast quarter of Section 20. Thus, well #13 must be at least one-half of the distance of Section 20 from Section 19. That is, the well nearest to the siting area (well #13) is located at least one-half mile, or 2,640 feet from the Section 19 boundary, satisfying the regulatory constraints concerning proximity to water wells.

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## 2.8 Flood Plain

"*No new hazardous waste land disposal facility shall be sited within a floodplain of a 500-YEAR (recurrence interval) flood.*" (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-2C)

"*A facility shall not be located within a one hundred (100) year flood plain if the facility will restrict the flow of the one hundred (100) year flood, reduce the temporary water storage capacity of the flood plain, or result in a washout of solid waste so as to pose a hazard to human health and the environment.*" (IDAPA 58.01.06-13.01.A)

"*A facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-yr flood.*" (EPA 40 CFR 264.18.B)

No part of Section 19 is located within a designated A, B, or C class floodplain as identified by the Federal Emergency Management Agency (FEMA). Figure 10 depicts the elevations of Section 19 and demonstrates the natural elevation barriers that protect Section 19 from the flooding of Castle Creek. Approximately 95 percent of Section 19 is has an elevation greater than 2500 feet above sea level (msl). The lowest elevation in the northeast corner of Section 19 is approximately 2475 feet above MSL. This "lowest elevation" is approximately 1.5 miles away and 50 feet above the nearest stretch of Castle Creek, lying at approximately elevation 2425 feet above MSL. The topographic contours demonstrate the tendency of the natural landscape to direct floodwaters away from Section 19 toward the Snake River to the north, which is approximately 200 feet below the lowest elevation of Section 19.

## 2.9 Fault Zones, Seismic Zones, and Unstable Areas

"*No new hazardous waste land disposal facility shall be sited within areas that are in close proximity of active fault zones (i.e., displacement within Holocene time) or other tectonically active or unstable areas (e.g. paleo-landslides, etc.).*" (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-2D)

"*No facility may be located on land that would threaten the integrity of the design.*" (IDAPA 58.01.06-013.E)

"*Portions of new facilities where treatment, storage, or disposal of hazardous waste will be conducted must be located within 61 meters (200 feet) of a fault which has had displacement in Holocene time*". (EPA 40 CFR 264.18.A)

Figure 11 shows a satellite image of the Site B location and the distance to the nearest faults that have experienced movement within the Holecene epoch according to the Idaho Geologic Survey. The Halfway Gulch Fault and the Water Tank Fault are approximately 22 miles and 24 miles from the facility, respectively. Thus, the fault proximity regulations as stated above are satisfied.

Figure 12 shows the locations of earthquake epicenters occurring in Idaho from 1880 to present having a Richter magnitude of 4.5 or greater. Figures 13 and 14 display the 10 percent probability of exceeding the mapped firm ground acceleration and acceleration coefficients, respectively, during a 50 year period in Idaho. Figure 13 indicates the effective peak firm ground acceleration is less than 0.05g and Figure 14 indicates the effective peak velocity-related acceleration coefficient ($A_v$) is 0.09.

As shown in Figures 12, 13, and 14, Section 19 is located within a region exhibiting seismic stability, at least since the year 1880, and low probability of significant ground acceleration during a seismic event.

For the purpose of developing earthquake spectral response accelerations, Section 19 is classified as Site Class C, for use with the International Building Code.

As shown on the USGS Earthquake Hazards Program computer database output (Appendix C), the probable maximum horizontal acceleration (or probabilistic peak ground acceleration) having 10 percent or greater probability in 250 years in the vicinity of Section 19 is 0.11g. Thus, indicating the Site is located within a seismic impact zone, which is similar to other landfills in Southern Idaho. During the design phase, prior to applying for a permit modification, best management practices will be used to design engineered structures to withstand horizontal acceleration forces according to the International Building Code (IBC, 2000).

For instance, under the direction of an Idaho Registered Professional Engineer, a slope stability analysis will be performed incorporating seismic conditions and site-specific strength parameters to define maximum allowable cell slope conditions. Earthen embankments will be designed to withstand a 0.11g horizontal acceleration. Geosynthetic and clay liners utilized in the proposed landfill will be analyzed for tear and potential slippage under static and dynamic conditions and designed to remain stable under anticipated seismic accelerations. Additional landfill features, such as leachate collection, surface water control, and cover systems, will also be designed to remain stable under the anticipated seismic accelerations.

Section 19 does not contain surface or subterranean pysiographic features that are characteristic of unstable areas and thus does not pose a threat to the design integrity of a hazardous waste facility. (Characteristic physiographic features include poor foundation conditions; mass sliding conditions causing avalanches, debris slides, debris flows, block sliding, rock fall, solifluction; and karst conditions including sink holes, sinking streams, caves, large springs, or blind valleys.)

**2.10 Subsurface Mining, Caves, and Salt Bed Formations**

> *"No new hazardous waste land disposal facility shall be located within areas overlying any subsurface mining."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-2E)

> *"The placement of any noncontainerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited, except for the Department of Energy Waste Isolation Pilot Project in New Mexico."* (EPA 40 CFR 264.18.C)

No active, inactive, or abandoned mining operations exist beneath, or in the vicinity of Section 19. In addition, after conducting a mineral potential survey in 1992, the Bureau of Land Management concluded that no locatable or salable minerals were present in commercial quantities within Section 19 (Appendix D).

The geologic stratigraphy discussion in Section 2.0 does not indicate that salt dome or salt bed formations exist within Section 19.

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## 3.0 Waste Description and Environmental Protection Agency Waste Codes

"*An application for a siting license shall include a description of the types of wastes proposed to be handled at the facility.*" (Idaho Statutes 39-5813.D)

According to Title 40 of the Code of Federal Regulations, Section 261, hazardous wastes are described as (1) characteristic waste, (2) nonspecific source waste, (3) specific source waste, and (4) discarded commercial chemical products.

The Environmental Protection Agency (EPA) hazardous waste codes for waste accepted by USEI are shown in Table 1, on page 22 and 23 of this report. The contaminant listing for these waste codes are available in Title 40, Code of Federal Regulation, Section 261.

### 3.1 Characteristic Waste

Characteristic wastes (40 CFR 261. 20-24) are wastes the EPA identified as having one of the four characteristics, or traits, of hazardous waste: ignitability, corrosivity, reactivity, and toxicity. They are designated using a "D" in the waste code. Waste is considered hazardous if it exhibits any of these characteristics. These properties are measurable by standardized and available testing methods that can be found in a manual entitled Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846).

Some examples of characteristic wastes include certain paints, degreasers, and solvents that are ignitable (D001); corrosive battery acid (D002): certain reactive cyanides or sulfide-bearing wastes (D003): and wastes considered toxic because they contain high concentrations of heavy metals, such as cadmium (D006), lead (D008). or mercury (D009).

### 3.2 Nonspecific Source Wastes

Nonspecific source wastes (40 CFR 261. 31) are material-specific wastes. such as solvent wastes, electroplating wastes, or metal heat-treating wastes, commonly produced by a wide variety (non specific sources) of manufacturing and industrial processes. They are designated using an "F" in the waste code.

Some examples of nonspecific source waste are wastewater treatment sludges from electroplating operations (F006), process wastes such as distillation residues, heavy ends, tars, and reactor clean-out wastes (F024).

### 3.3 Specific Source Wastes

Specific source wastes (40 CFR 261.32) are wastes from specifically identified industries such as wood preserving, petroleum refining, steel mills, and organic chemical manufacturing. They are designated using a "K" in the waste code.

Some examples of specific source wastes are wastewater treatment sludge from the production of chrome yellow and orange pigments (K002), electric arc furnace dust (K061), and tar storage tank residues from coal tar refining (K147).

### 3.4 Discarded Commercial Chemical Products

Discarded commercial chemical products (40 CFR 261.33) are off-specification products, container residuals, spill residue runoff, or active ingredients that have spilled or are unused and intended to be discarded (designated with "P" and "U" waste codes). If the intent is to use the material or recycle it, it is not considered a hazardous waste.

Some examples of discarded commercial chemical products include: Aldicarb (P070), parathion (P089), and vinyl chloride (U043).

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Table 1
EPA Hazardous Waste Codes for Waste Accepted at US Ecology Idaho, Grand View, Idaho

| Characteristic Wastes | Non-specific Source Wastes | Specific Source Wastes | | | Discarded Commercial Chemical Products | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute Toxic Wastes | | | Toxic Wastes | | | | | |
| D001 | F001 | K001 | K047 | K124 | P001 | P050 | P106 | U001 | U048 | U095 | U143 | U189 | U247 |
| D002 | F002 | K002 | K048 | K125 | P002 | P051 | P108 | U002 | U049 | U096 | U144 | U190 | U248 |
| D003 | F003 | K003 | K049 | K126 | P003 | P054 | P109 | U003 | U050 | U097 | U145 | U191 | U249 |
| D004 | F004 | K004 | K050 | K131 | P004 | P057 | P110 | U004 | U051 | U098 | U146 | U192 | U271 |
| D005 | F005 | K005 | K051 | K132 | P005 | P058 | P111 | U005 | U052 | U099 | U147 | U193 | U278 |
| D006 | F006 | K006 | K052 | K136 | P007 | P059 | P112 | U006 | U053 | U101 | U148 | U194 | U279 |
| D007 | F007 | K007 | K060 | K141 | P008 | P060 | P113 | U007 | U055 | U102 | U149 | U196 | U280 |
| D008 | F008 | K008 | K061 | K142 | P009 | P062 | P114 | U008 | U056 | U103 | U150 | U197 | U328 |
| D009 | F009 | K009 | K062 | K143 | P010 | P063 | P115 | U009 | U057 | U105 | U151 | U200 | U353 |
| D010 | F010 | K010 | K069 | K144 | P011 | P064 | P116 | U010 | U058 | U106 | U152 | U201 | U359 |
| D011 | F011 | K011 | K071 | K145 | P012 | P065 | P118 | U011 | U059 | U107 | U153 | U202 | U364 |
| D012 | F012 | K013 | K073 | K147 | P013 | P066 | P119 | U012 | U060 | U108 | U154 | U203 | U367 |
| D013 | F019 | K014 | K083 | K148 | P014 | P067 | P120 | U014 | U061 | U109 | U155 | U204 | U372 |
| D014 | F020 | K015 | K084 | K149 | P015 | P068 | P121 | U015 | U062 | U110 | U156 | U205 | U373 |
| D015 | F021 | K016 | K085 | K150 | P016 | P069 | P122 | U016 | U063 | U111 | U157 | U206 | U387 |
| D016 | F022 | K017 | K086 | K151 | P017 | P070 | P123 | U017 | U064 | U112 | U158 | U207 | U389 |
| D017 | F023 | K018 | K087 | K156 | P018 | P071 | P127 | U018 | U066 | U113 | U159 | U208 | U394 |
| D018 | F024 | K019 | K088 | K157 | P020 | P072 | P128 | U019 | U067 | U114 | U160 | U209 | U395 |
| D019 | F025 | K020 | K093 | K158 | P021 | P073 | P185 | U020 | U068 | U115 | U161 | U210 | U404 |
| D020 | F026 | K021 | K094 | K159 | P022 | P074 | P188 | U021 | U069 | U116 | U162 | U211 | U409 |
| D021 | F027 | K022 | K095 | K161 | P023 | P075 | P189 | U022 | U070 | U117 | U163 | U213 | U410 |
| D022 | F028 | K023 | K096 | K169 | P024 | P076 | P190 | U023 | U071 | U118 | U164 | U214 | U411 |
| D023 | F032 | K024 | K097 | K170 | P026 | P077 | P191 | U024 | U072 | U119 | U165 | U215 | |
| D024 | F034 | K025 | K098 | K171 | P027 | P078 | P192 | U025 | U073 | U120 | U166 | U216 | |
| D025 | F035 | K026 | K099 | K172 | P028 | P081 | P194 | U026 | U074 | U121 | U167 | U217 | |
| D026 | F037 | K027 | K100 | K174 | P029 | P082 | P196 | U027 | U075 | U122 | U168 | U218 | |
| D027 | F038 | K028 | K101 | K175 | P030 | P084 | P197 | U028 | U076 | U123 | U169 | U219 | |
| D028 | F039 | K029 | K102 | K176 | P031 | P085 | P198 | U029 | U077 | U124 | U170 | U220 | |

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**Table 1**
**EPA Hazardous Waste Codes for Waste Accepted at US Ecology Idaho, Grand View, Idaho**

| Characteristic Wastes | Non-specific Source Wastes | Specific Source Wastes | | | Discarded Commercial Chemical Products | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute Toxic Wastes | | | Toxic Wastes | | | | |
| D029 | | K030 | K103 | K177 | P033 | P087 | P199 | U030 | U078 | U125 | U171 | U221 |
| D030 | | K031 | K104 | K178 | P034 | P088 | P201 | U031 | U079 | U126 | U172 | U222 |
| D031 | | K032 | K105 | | P036 | P089 | P202 | U032 | U080 | U127 | U173 | U223 |
| D032 | | K033 | K106 | | P037 | P092 | P203 | U033 | U081 | U128 | U174 | U225 |
| D033 | | K034 | K107 | | P038 | P093 | P204 | U034 | U082 | U129 | U176 | U226 |
| D034 | | K035 | K108 | | P039 | P094 | P205 | U035 | U083 | U130 | U177 | U227 |
| D035 | | K036 | K109 | | P040 | P095 | | U036 | U084 | U131 | U178 | U228 |
| D036 | | K037 | K110 | | P041 | P096 | | U037 | U085 | U132 | U179 | U234 |
| D037 | | K038 | K111 | | P042 | P097 | | U038 | U086 | U133 | U180 | U235 |
| D038 | | K039 | K112 | | P043 | P098 | | U039 | U087 | U134 | U181 | U236 |
| D039 | | K040 | K113 | | P044 | P099 | | U041 | U088 | U135 | U182 | U237 |
| D040 | | K041 | K114 | | P045 | P101 | | U042 | U089 | U136 | U183 | U238 |
| D041 | | K042 | K115 | | P046 | P102 | | U043 | U090 | U137 | U184 | U239 |
| D042 | | K043 | K116 | | P047 | P103 | | U044 | U091 | U138 | U185 | U240 |
| D043 | | K044 | K117 | | P048 | P104 | | U045 | U092 | U140 | U186 | U243 |
| | | K045 | K118 | | P049 | P105 | | U046 | U093 | U141 | U187 | U244 |
| | | K046 | K123 | | | | | U047 | U094 | U142 | U188 | U246 |

# 4.0 Scenic, Historic, Cultural and Recreational Information

> *"An application for a siting license shall include information showing harm to scenic, historic, cultural or recreational values is not substantial or can be mitigated."* (Idaho Statutes 39-5813.E)

In 1991, USEI's predecessor, Envirosafe Inc., commissioned a cultural resources clearance survey of Section 19 (see Appendix E) in support of proposed facility expansions. The survey was commissioned in order to identify and evaluate potential prehistoric or historic cultural resources within Section 19, and to protect any identified resources from potential destruction due to expanded landfill activities. The survey satisfies applicable governing Federal mandates including the Antiquities Act of 1906, the Historic Sites Act of 1935, the Historic Preservation Act (NHPA) of 1996, the National Environmental Policy Act of 1969 (NEPA), the Archeological and Historic Preservation Act of 1974 and other pertinent legislation.

One small potentially significant site was identified on the southern boundary of Section 19 where obsidian flakes were found. After reviewing the survey report, the Bureau of Land Management inspected and inventoried the site, declared that no further cultural work was necessary, and granted full cultural resource clearance for Section 19 (Appendix E).

In April of 2006, American Geotechnics issued an explanatory letter and a formal request for cultural resource guidance concerning expanded landfill operations in all of Section 19 to the Idaho State Historical Preservation Office (SHPO). The SHPO issued a response letter stating that Section 19 contained no sites eligible for the National Register of Historic Places (Appendix E). In addition, SHPO concluded that no further cultural resource investigation of Section 19 was necessary, and that landfill expansion within Section 19 may proceed without further review from the SHPO.

## 4.1 Parks and Reserved Lands

> *"The active portion of the facility shall not be located closer than one thousand (1000) feet from the boundary of any state or national park, or land reserved or withdrawn for scenic or natural use including, but not limited to, wild and scenic areas, national monuments, wilderness areas, historic sites, recreation areas, preserves and scenic trails."* (IDAPA 58.01.06-013.G)

In order to determine the proximity of Section 19 to reserved lands, American Geotechnics issued a formal request for information and guidance to the Idaho Department of Parks and Recreation (IDPR). In response, a letter was issued by Mr. Jeff Cook of the IDPR (Appendix F). Mr. Cook identified two reserved lands in the relative vicinity of Section 19; Bruneau Dunes State Park and the Snake River Birds of Prey National Conservation Area (SRBPNCA).

Bruneau Dunes State Park is located approximately 30 miles southeast of the US Ecology Hazardous Waste Landfill facility, well away from the required 1000 foot reserved lands buffer zone described above. The SRBPNCA occupies several miles of the Snake River and adjacent lands to the northwest of the US Ecology facility. The boundaries of the area are greater than 1000 feet from any Section 19 boundary. Mr. Cook requested that American Geotechnics contact Mr. John Sullivan for further guidance concerning possible effects expanded landfill activities within Section 19 may have on the SRBPNCA. Mr. Sullivan is the SRBPNCA manager. A summary of his response is provided in Section 4.2.

### 4.2 Snake River Birds of Prey National Conservation Area

American Geotechnics issued a formal request for information and guidance to Mr. John Sullivan concerning the impacts landfill construction and operation within Section 19 may have on the Snake River Birds of Prey National Conservation Area (SRBPNCA). Mr. Sullivan issued a response letter (Appendix F) requesting that a buffer zone be provided such that monitoring wells and associated access roads would not be required on Bureau of Land Management (BLM) owned lands adjacent to Section 19. In a subsequent telephone conference (Appendix F), Mr. Sullivan clarified his request, stating that access roads to monitoring wells on BLM lands could have detrimental effects by increasing access to areas near the SRBPNCA. After review, Mr. Sullivan indicated that the required 500 foot inactive buffer zone (see Section 12) would satisfy his request, as long as expanded landfill activities within Section 19 did not require monitoring wells or access roads to be constructed on BLM lands.

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## 5.0 Transport Risk and Accident Impact

> "*An application for a siting license shall include information showing that the risk and impact of accident during transport of hazardous waste is not substantial or can be mitigated.*" (Idaho Statutes 39-5813.F)

Section 19 is located within a sparsely populated region of Owyhee County Idaho. According to the 2005 census report, Owyhee County has a population density of 1.4 persons per square mile. The nearest population center to Section 19 is Grand View, Idaho, which has a population of 470 people (2005 Census Report) and is located approximately 10 miles southeast of the facility.

The two transportation routes leading to Section 19 are also located in sparsely populated areas. From Interstate 84 (I-84), the primary route to USEI's gate in Section 19 is via Simco Road which exits from I-84 approximately 20 miles northwest of Mountain Home, Idaho. Simco Road traverses primarily through agriculture lands and undeveloped lands owned by the Bureau of Land Management (BLM). A secondary route approaches USEI on State Highway 67 from Murphy, Idaho to the northwest. This route is also bounded by sparsely populated agricultural and BLM lands. The sparsely populated locations near Section 19 and routes leading to Section 19 help to minimize the risk and impact to human health due to an accident during waste transport.

With respect to environmental risk and impact, the wetlands, riparian zones, and waterways of the Snake River are particularly sensitive to waste transport accidents. Sensitive routes include bridges and roadways traveling adjacent to the river, or waterways leading to or originating from the river. Such stretches along the routes to Section 19 are minimal, occurring primarily over the bridge at Grand View, Idaho and at the Walters Ferry Bridge south of Nampa, Idaho. The SH-67 route also passes over several ephemeral and perennial streams, including Castle Creek. Overall, these sensitive areas are few and isolated along the two routes to Section 19, which helps to minimize the environmental risk and impact due to an accident during waste transport.

To further minimize the risk and impact of an accident during waste transport, each waste transporter is required to submit and adhere to a detailed accident contingency plan. Each plan is designed to minimize the risk of an accident, and to minimize the human and environmental impacts should an accident occur. The contingency plan requires all transport personnel to be trained and instructed according to Occupational Safety and Health Administration (OSHA) standards, and to receive yearly OSHA refresher courses.

Each waste transporter is trained and instructed in the general maintenance of all equipment, inspection and reporting procedures, contingency plan implementation, and operation and use of a respirator. In addition, each waste transporter is trained in emergency action, including procedures to contact emergency personnel, contain spills, protect the public, and assist police, fire department, and hazardous materials teams in identifying contaminants. Each transport vehicle must be routinely inspected to insure proper operation, and must include safety, spill control and emergency equipment. These measures are enforced to assure protection to the environment and the public to the extent possible in case of a waste transport accident. An example transportation contingency plan from Steve Forler Trucking, Inc., is shown in Appendix G.

## 6.0 Impact on Local Government

*"An application for a siting license shall include information showing that the impact on local government is not adverse regarding health, safety, cost and consistency with local planning and existing development or can be mitigated"*. (Idaho Statutes 39-5813.G)

### 6.1 Health and Safety

Additional landfills within Section 19 will be constructed in support of continued operations at Site B's existing facility. New landfills will be constructed and operated in a manner equal to, or similar to, current landfills. Thus, there will be no change in risk of incidents that would require local governmental services, and no significant change in operations at the site that would increase demands on local emergency response or law enforcement services.

### 6.2 Economic Impact

Site B is a significant source of revenue and economic vitality for Owyhee County, Elmore County, and the state of Idaho. A 2006 economic impact report commissioned by USEI (Appendix H) concluded the following:

Year 2005 direct and indirect fiscal impacts in Idaho includes:

- Provided 250 jobs
- Paid $14.8 million in payroll
- Provided $31.6 million in additional spending within Idaho
- Paid $4.75 million in taxes and fees

USEI is the largest property tax payer in Owyhee County and in the Bruneau-Grand View School District (providing approximately 15 percent of the District's total tax revenue).

USEI is Owyhee County's largest private non-agricultural employer.

The USEI average hourly wage is 39 percent higher than the average wage in Owyhee County. USEI provides full health coverage and other benefits after 30 days of hire to its employees.

USEI contributes $15,000 to $20,000 annually to local schools and community service organizations.

USEI is a growing company. Company employment has risen by 54 percent from the year 2000 to the year 2005. During that time, USEI spent a total of $13.3 million for facility improvements and capital equipment. Of those expenditures, 75 percent or $10.6 million were contracted to Idaho firms. USEI also paid just under $1.4 million in sales and income taxes to the State of Idaho during 2005.

In 2004, USEI worked with the Simplot Company and the Mountain Home Highway District to pave the remaining 12 miles of gravel along Simco Road. In addition to USEI transporters, Simco Road services Mountain Home Air Force Base, Grand View, and users of CJ Strike reservoir. As a result of this paving project, use of the Simco Road has increased approximately 300 percent. Positive impacts of the Simco Road paving project include reduced travel times, increased safety, increased real estate values along Simco Road, and decreased dust pollution.

### 6.3 Local Planning and Development

Local development is not anticipated because Section 19 is surrounded by properties owned by the Bureau of Land Management that are part of the Snake River Birds of Prey National Conservation Area.

## 7.0 Proximity to Residential Structures

> *"No new hazardous waste land disposal facility shall be sited within 5000 feet of any off-site residential structure that is routinely occupied at least 8 hours/day".* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-3A)

Figure 15 shows the residential locations in nearest proximity to Section 19, along with the required 5000 foot buffer zone associated with each residence. The 5000 foot buffer zone associated with the Hansen residence extends into the southern half of the western edge of Section 19. The area where Section 19 and the Hansen residential buffer zone overlap will be maintained as an inactive buffer area to satisfy the residential buffer zone requirement. No active cells shall be placed in this portion of Section 19.

# 8.0 Proximity to Schools, Airports, Hospitals, and Churches

*"No new hazardous waste land disposal facility shall be sited within 3 miles of schools, airports, hospitals, churches".* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-3B)

## 8.1 Area Schools

A list of public and private schools in the vicinity of Section 19 is provided in Appendix I. Each school was located using current phone directory and internet resources. Distances were estimated using aerial photographs. The school nearest to Section 19 is the Grand View Elementary School, located approximately 10 miles from Section 19.

## 8.2 Area Airports

Figure 16 shows a satellite photograph of Site B and the distance to the nearest Federal Aviation Administration (FAA) registered airports and the Mountain Home Air Force Base. The nearest FAA registered runway is located in Murphy, Idaho, approximately 18 miles from Section 19. The nearest turbofan jet airport is located at the Mountain Home Air Force Base, approximately 20 miles from Section 19. The FAA registered airports were located through a telephone inquiry with FAA personnel. Section 19 is outside the required proximity limits to airports.

## 8.3 Area Hospitals

A list of hospitals in the vicinity of Section 19 is provided in Appendix I. The hospitals were located using current phone directories and internet resources. Distances were estimated using aerial photographs. The medical center nearest to Section 19 is located on the Mountain Home Air Force Base, at a distance of approximately 20.5 miles. The nearest public hospital is located in Mountain Home, Idaho, at a distance of approximately 29.6 miles.

## 8.4 Area Churches

A list of churches in the vicinity of Section 19 is provided in Appendix I. The churches were located using current phone directories and internet resources. Distances were estimated using aerial photographs. The church nearest to Section 19 is located in Grand View, Idaho at a distance of approximately 10.3 miles.

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## 9.0 Proximity to Population Centers

> "*No new hazardous waste land disposal facility shall be sited within 3 miles from a population center greater than 150 people*". (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-3C)

As shown in Figure 1, Section 19 is not located within 3 miles of any population center greater than 150 people. The nearest existing population center greater than 150 people is Grand View, Idaho, located approximately 10 miles southeast of Section 19 on Hwy 78. Base on the distances cited above, siting a landfill in Section 19 will not present hazard to a population center.

## 10.0 Endangered or Threatened Species

> "*The facility shall not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife or result in the destruction or adverse modification of the critical habitat of endangered or threatened species as identified in 50 CFR Part 17*". (IDAPA 58.01.05-013.B)

In accordance with the Endangered Species Act of 1973, American Geotechnics issued a formal request to the United States Fish and Wildlife Service (USFWS) to determine the existence and status of any endangered, threatened, proposed endangered, or otherwise protected species that may be affected by hazardous waste landfill operations within Section 19. A response letter was issued by the USFWS (Appendix J) indicating that our request for information satisfied the requirements for obtaining an official list of species as required by the Endangered Species Act, Section 7(c).

In addition to providing an official list of endangered, threatened, and proposed species that may exist within Section 19, the USFWS response letter provides information and guidelines concerning formal consultations with the USFWS should these species be located.

The protected species listed by the USFWS include:

| | |
|---|---|
| • Snake River Physa snail (Physa natricina) | Listed Endangered |
| • Idaho Springsnail (Pyrgulopsis idahoensis) | Listed Endangered |
| • Utah Valvata (Valvata utahensis) | Listed Endangered |
| • Bliss Rapids snail (Taylorconcha serpenticola) | Listed Threatened |
| • Slickspot Peppergrass (Lepidium papilliferum) | Proposed Endangered |

American Geotechnics issued a formal request to the Idaho Fish and Game Department (IDFG) to determine the status of these protected species within Section 19. After review, the IDFG department issued a response letter (Appendix J) concluding that no federally listed endangered or threatened species were located on, or near, Section 19. In addition, the letter provided information concerning the likelihood of Slickspot Peppergrass existing within Section 19, concluding that the habitat necessary to support Slickspot Peppergrass does not exist within Section 19. The IDFG department arrived at this conclusion from personal experience and after consultation with the lead botanist at the Idaho

Conservation Data Center (Mr. Michael Mancuso). Based on the low likelihood of Slickspot Peppergrass existing within Section 19. the IDFGD stated that a rare plant survey to locate Slickspot Peppergrass in Section 19 was not warranted. Therefore, a rare plant survey to locate Slickspot Peppergrass was not conducted for this siting application.

Appendix J also includes a letter from Rebecca Thompson, a wildlife biologist, discussing the habitat necessary for each of the endangered snails listed by the USFWS above, and the possibility that such habitat exists within Section 19. As stated by Ms. Thompson, each of these snails exists within river waters, and no such habitat is provided within Section 19. Therefore, the probability of any of listed endangered snails existing within Section 19 is low.

In addition to federally listed species, several Bureau of Land Management (BLM) sensitive plant species are known to exist within Section 19 (Appendix J). These species include:

- Desert Pincushion (*Chaenactis stevioides*)
- Spreading Gelia (*Ipomopsis polycladon*)
- White-Margined Xax plant (*Glyptopleura marginata*)

The IDFG department provided remarks and guidance concerning each of these species, indicating that the exact location of these plants varies from year to year. The ability of these plants to relocate and the existence of seed sources on properties adjacent to Section 19. allows each of these plants to recolonize after any disturbance. Thus, the IDFG department stated that a rare plant survey to locate BLM sensitive plants was not warranted. Accordingly, no rare plant survey for these species was conducted for this siting application.

## 11.0 Wetlands

The USACE regulates all activities associated with waters of the United States, including wetlands. In particular, USACE administers Section 404 of the Clean Water Act, which requires a Department of the Army permit to be obtained for any operation releasing or discharging fill material into waters of the United States. American Geotechnics issued a formal inquiry to the USACE to determine whether hazardous waste landfill activities within Section 19 would adversely affect Castle Creek, or any other waterways under the jurisdiction of the USACE. After review, USACE issued a response letter (Appendix K) concluding that landfill activities within Section 19 would not involve areas under USACE jurisdiction, and that a permit under Section 404 of the Clean Water Act would not be required.

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## 12.0 Inactive Buffer Zone

*"An area of at least 500 feet surrounding the "active" (disposal location) portion of the site shall be provided as an inactive buffer zone."* (Idaho Hazardous Waste Management Plan: Minimum Technical Siting Criteria for Commercial Hazardous Waste Land Disposal Facilities Within Idaho-4)

*"The active portion of a facility shall not be located closer than one hundred (100) feet to the property line."* (IDAPA 58.01.06-013.F)

Figure 2 displays the USEI property and Section 19 boundaries. The 500 foot inactive buffer zones shall be maintained from the Section 19 boundary lines to the west and south. All of the USEI property within Section 18 shall be maintained as an inactive buffer zone, which will satisfy the 500 foot northern inactive buffer zone requirement. Thus, active cells may be placed up to the boundary of Section 19 to the north. The inactive buffer zone to the west is controlled by the western USEI property boundary. A 500 foot inactive buffer zone shall be maintained along the north and south legs of the western boundary as shown. Active cells may be constructed up to the western boundary of Section 19 where the USEI property boundary extends into Section 20 as shown.

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## 13.0 Composite Buffer Zone Map

Figure 17 displays the composite buffer zone requirements for Section 19 given the location of Castle Creek, the current USEI property boundaries, and the current residential locations. This siting application applies to all of Section 19. No active cells shall be placed in required buffer zones within Section 19. At present, there are two permanent buffer zones; the Castle Creek waterway buffer zone and the Bureau of Land Management (BLM) No-Waste Agreement buffer zone. With respect to land within Section 19, the Castle Creek waterway buffer zone is the only permanent buffer zone.

Non-permanent buffer zones within Section 19 include the 500 foot inactive buffer zone and the residential buffer zone corresponding to the Hansen residence as discussed in Section 7.0. The buffer zones are considered non-permanent because the boundaries defining these zones can potentially be relocated while satisfying regulatory requirements. For instance, should USEI acquire land adjacent to Section 19 to satisfy the inactive buffer zone requirements, active cells could be placed up to the boundary of Section 19. In addition, the residential buffer zone requirement within Section 19 could potentially be removed by USEI acquiring the existing Hansen residence.

In short, this siting application applies to all of Section 19. With regard to buffer zones, active cells may be constructed in any area of Section 19, as long as the buffer zone requirements are satisfied. The only permanent buffer zone within Section 19 is the Castle Creek waterway buffer, which extends into the northwest corner of Section 19, covering approximately 40 acres.

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## 14.0 Summary

In summary, it is American Geotechnics' opinion that Section 19 exceeds the minimum physical requirements for siting hazardous waste landfills. No physical features or conditions were identified that are believed to compromise the integrity of a landfill within Section 19 within the prescribed boundaries herein.

Prior to obtaining a waste permit, the landfill shall be designed to meet the minimum Federal and State design and construction standards for a RCRA Subtitle C Hazardous Waste Landfill.

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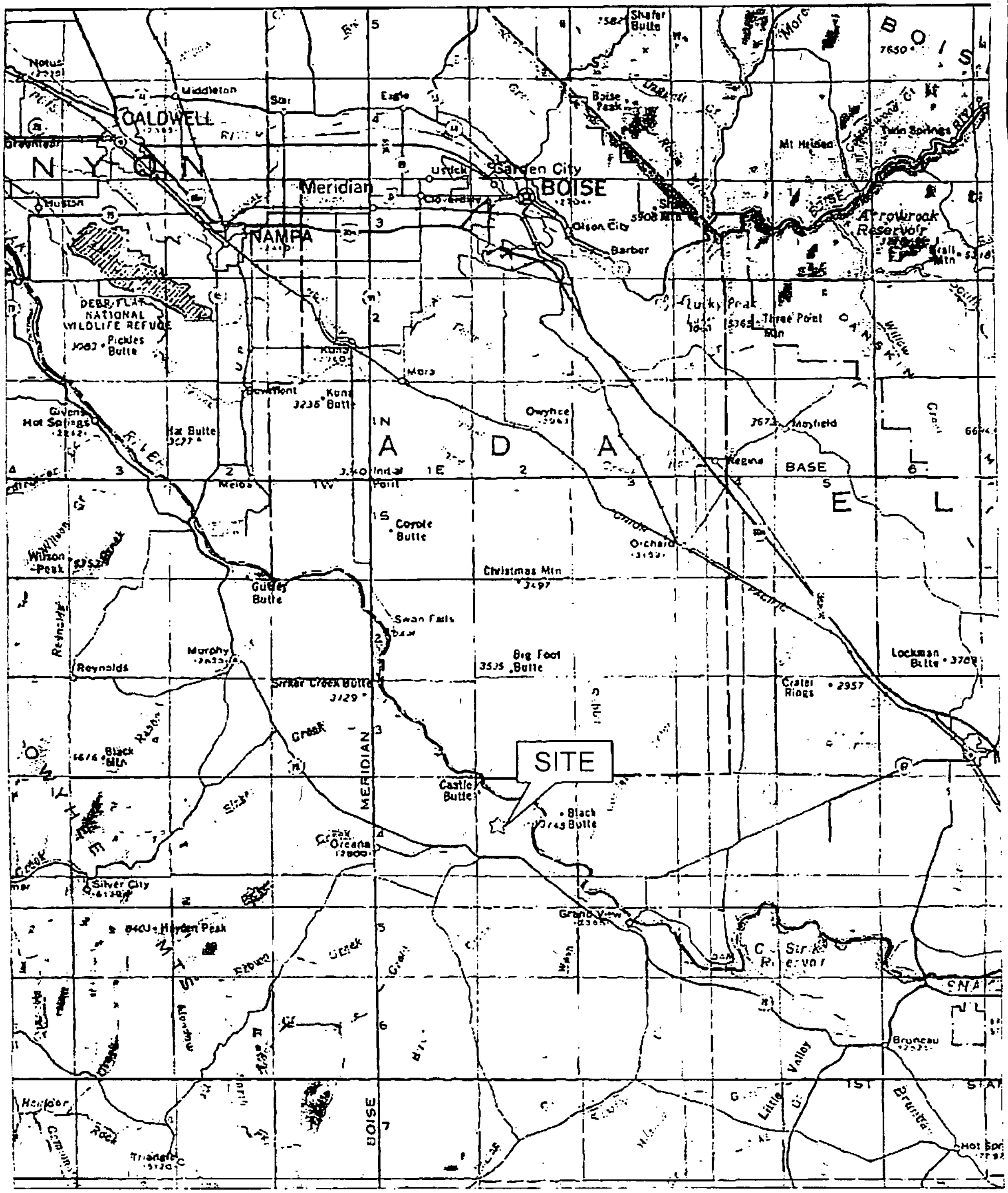
# APPENDIX A

## FIGURES




1.25 5 10

0 2.5

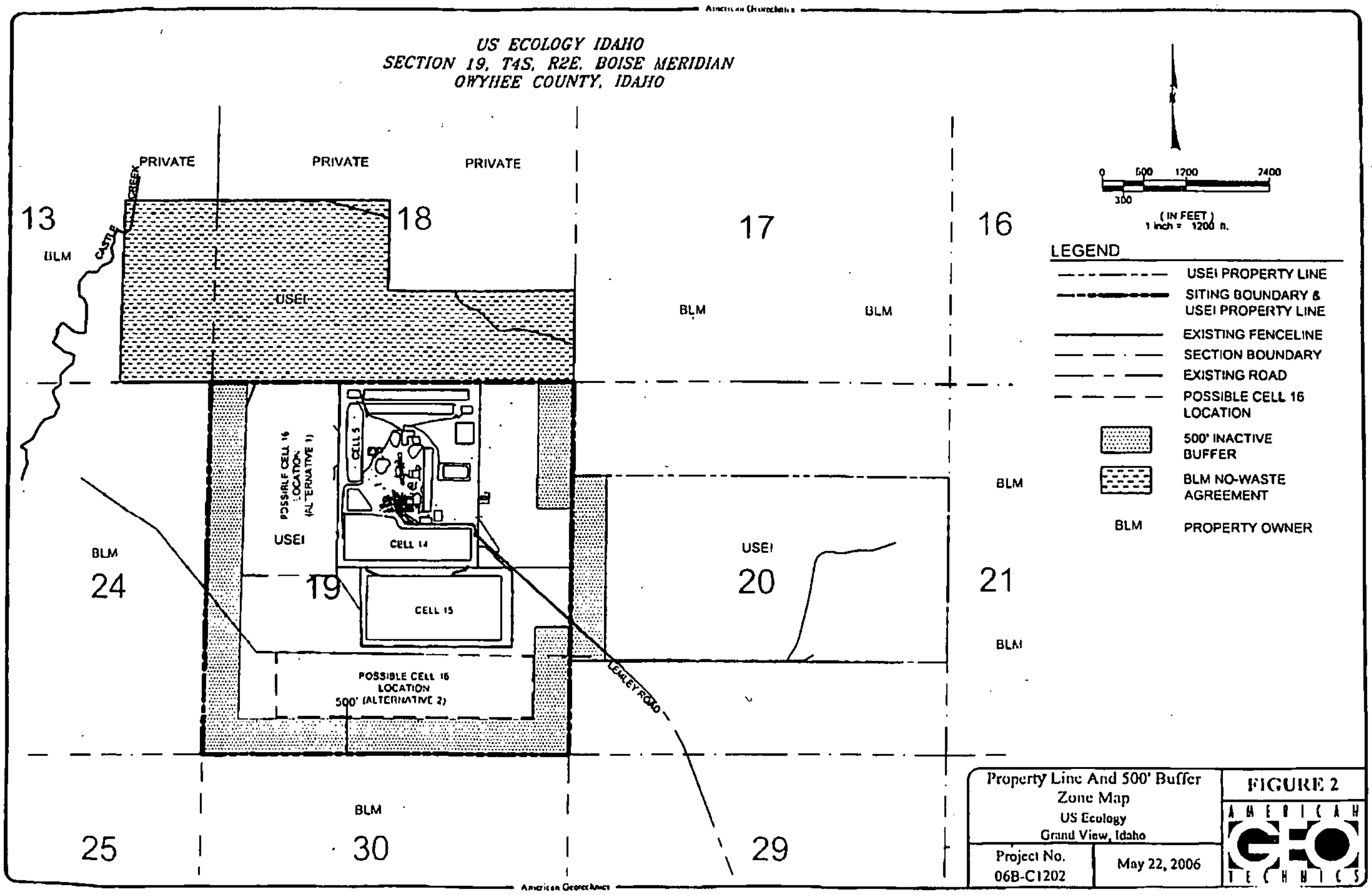
SCALE IN MILES:

VICINITY MAP
USEI-Cell 15 Phase II
Grand View, Idaho

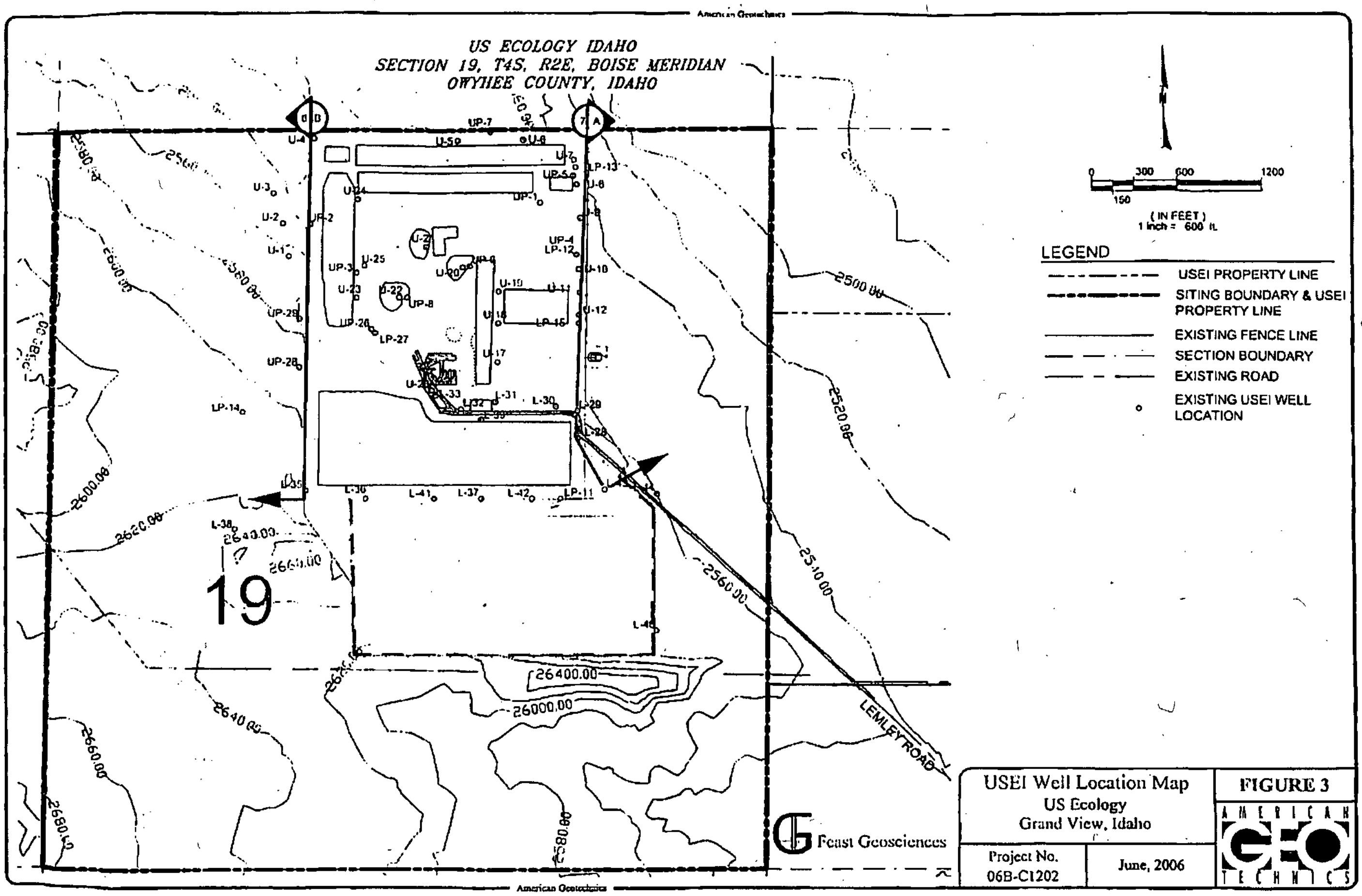
| Project No. | Date: |
|---|---|
| 06B-C1201 | June, 2006 |

**FIGURE 1**

AMERICAN GEO TECHNICS



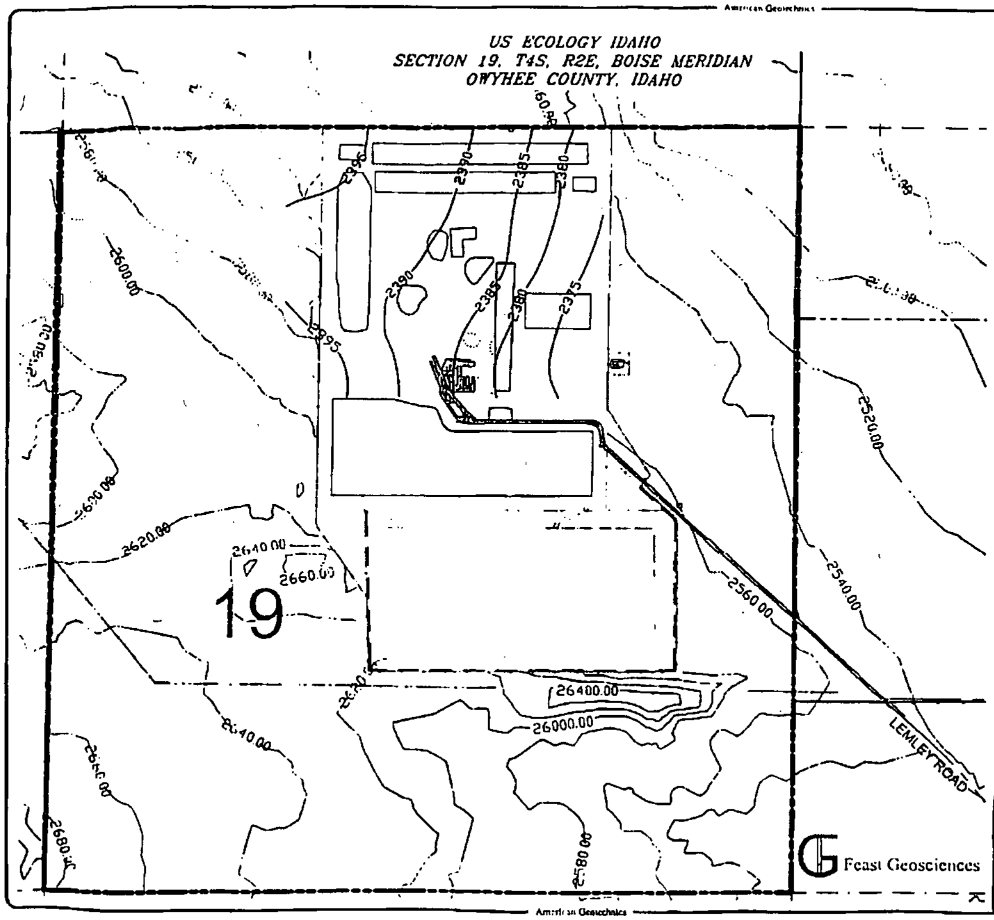
US ECOLOGY IDAHO
SECTION 19, T4S, R2E, BOISE MERIDIAN
OWYHEE COUNTY, IDAHO
PRIVATE
PRIVATE
PRIVATE
13
18
17
16
BLM
USEI
BLM
BLM
CELL 14
CELL 15
POSSIBLE CELL 16 LOCATION (ALTERNATIVE 1)
USEI
BLM
24
19
USEI
20
21
BLM
BLM
POSSIBLE CELL 16 LOCATION 500' (ALTERNATIVE 2)
LEMLEY ROAD
BLM
25
30
29
0 300 600 1200 2400
( IN FEET )
1 inch = 1200 ft.
LEGEND
USEI PROPERTY LINE
SITING BOUNDARY & USEI PROPERTY LINE
EXISTING FENCELINE
SECTION BOUNDARY
EXISTING ROAD
POSSIBLE CELL 16 LOCATION
500' INACTIVE BUFFER
BLM NO-WASTE AGREEMENT
BLM PROPERTY OWNER
Property Line And 500' Buffer Zone Map
US Ecology
Grand View, Idaho
Project No. 06B-C1202
May 22, 2006
FIGURE 2
AMERICAN GEO TECHNICS



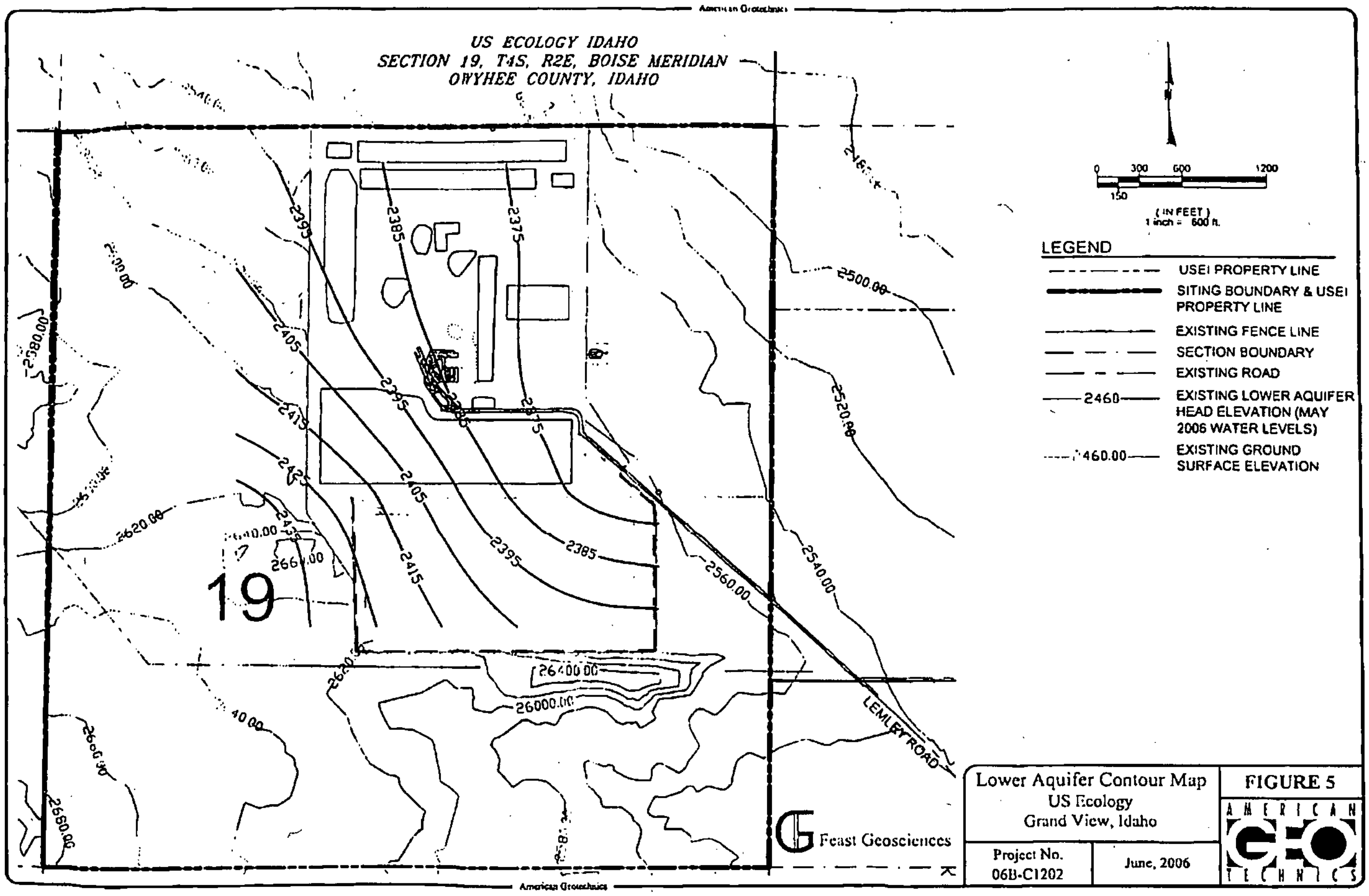

USEI Well Location Map
US Ecology
Grand View, Idaho

FIGURE 3

| Project No. 06B-C1202 | June, 2006 |
|---|---|




| Upper Aquifer Contour Map<br>US Ecology<br>Grand View, Idaho | | FIGURE 4 |
|---|---|---|
| Project No.<br>06B-C1202 | June, 2006 | AMERICAN GEOTECHNICS |



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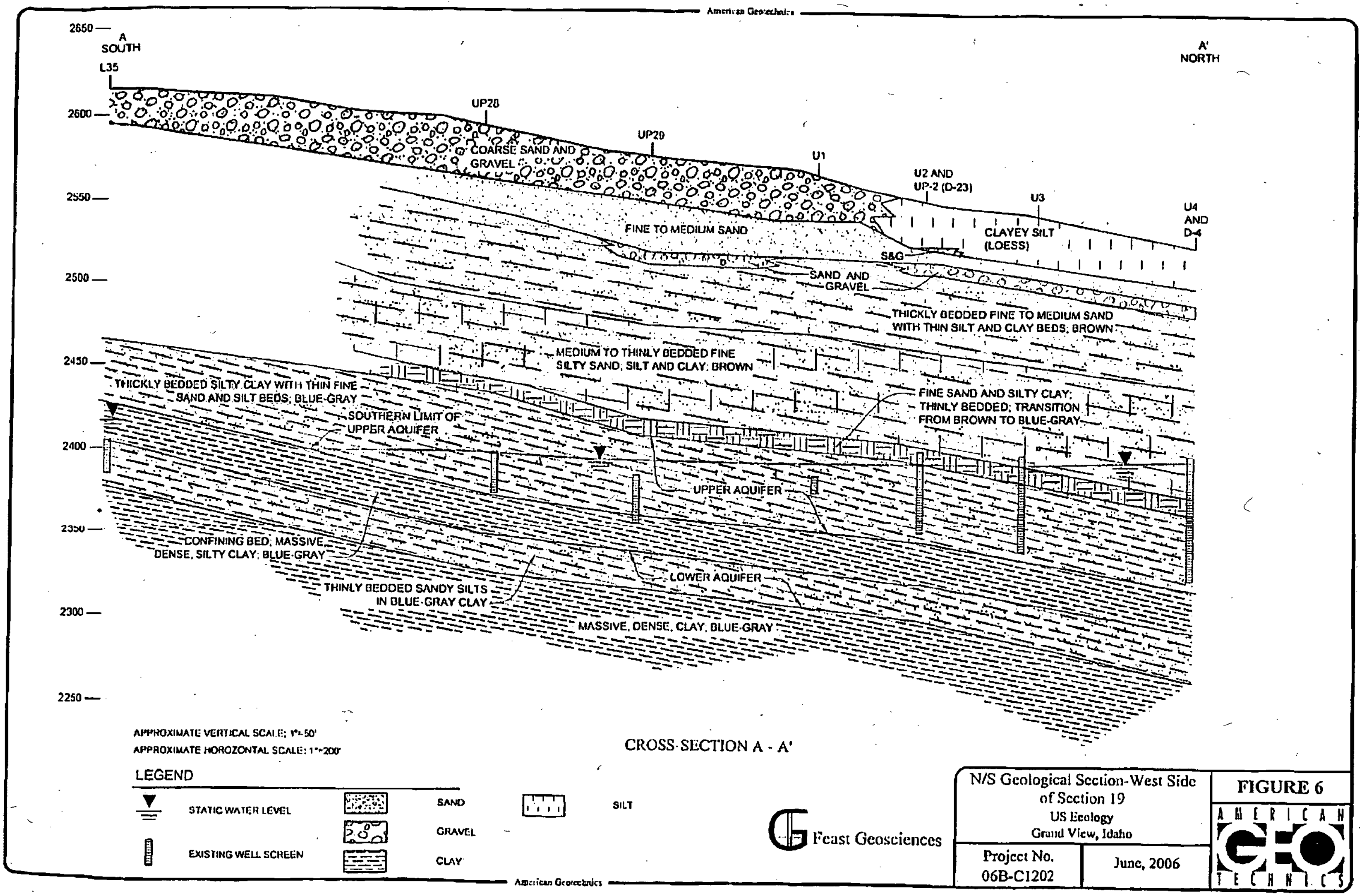
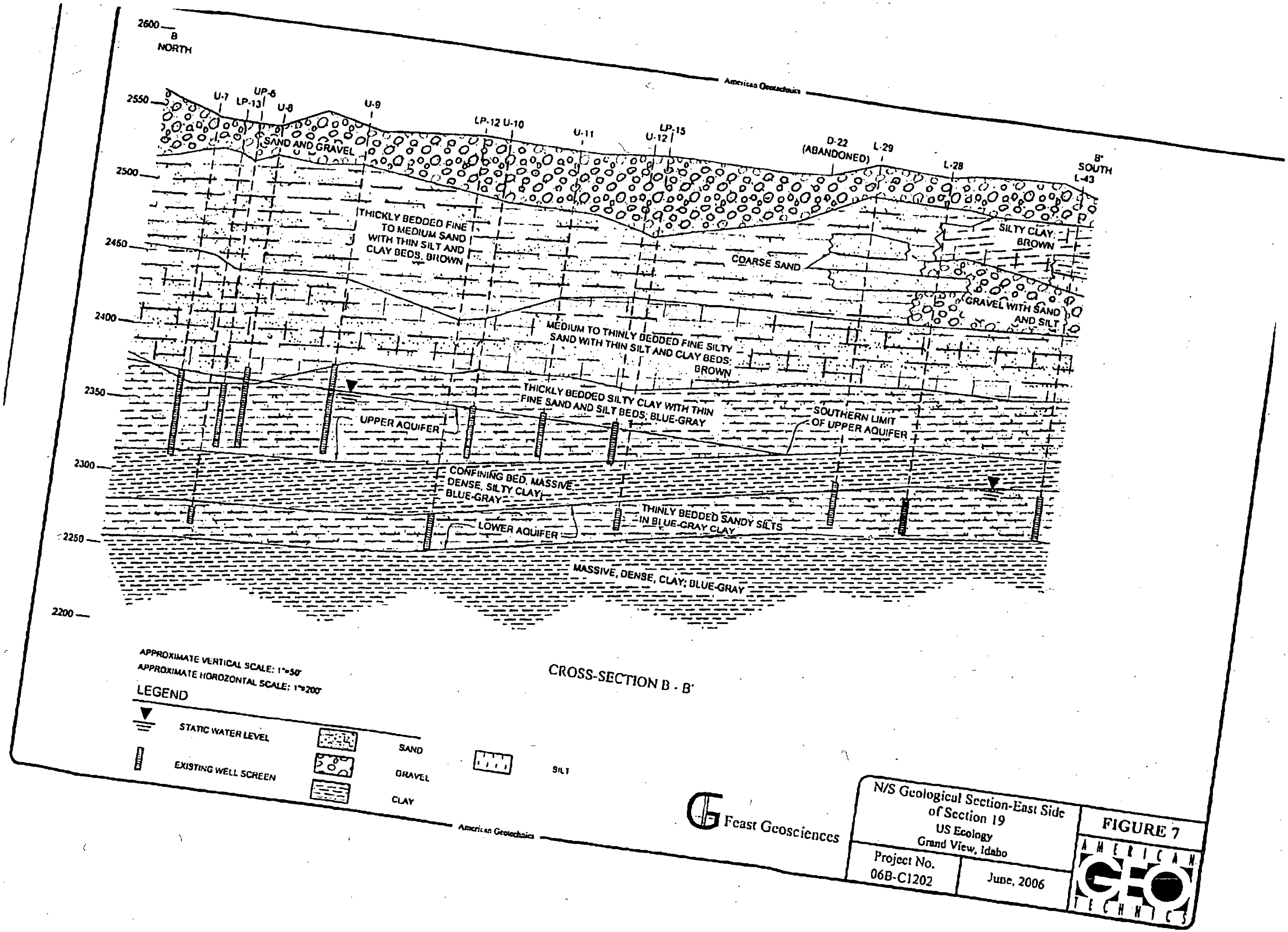
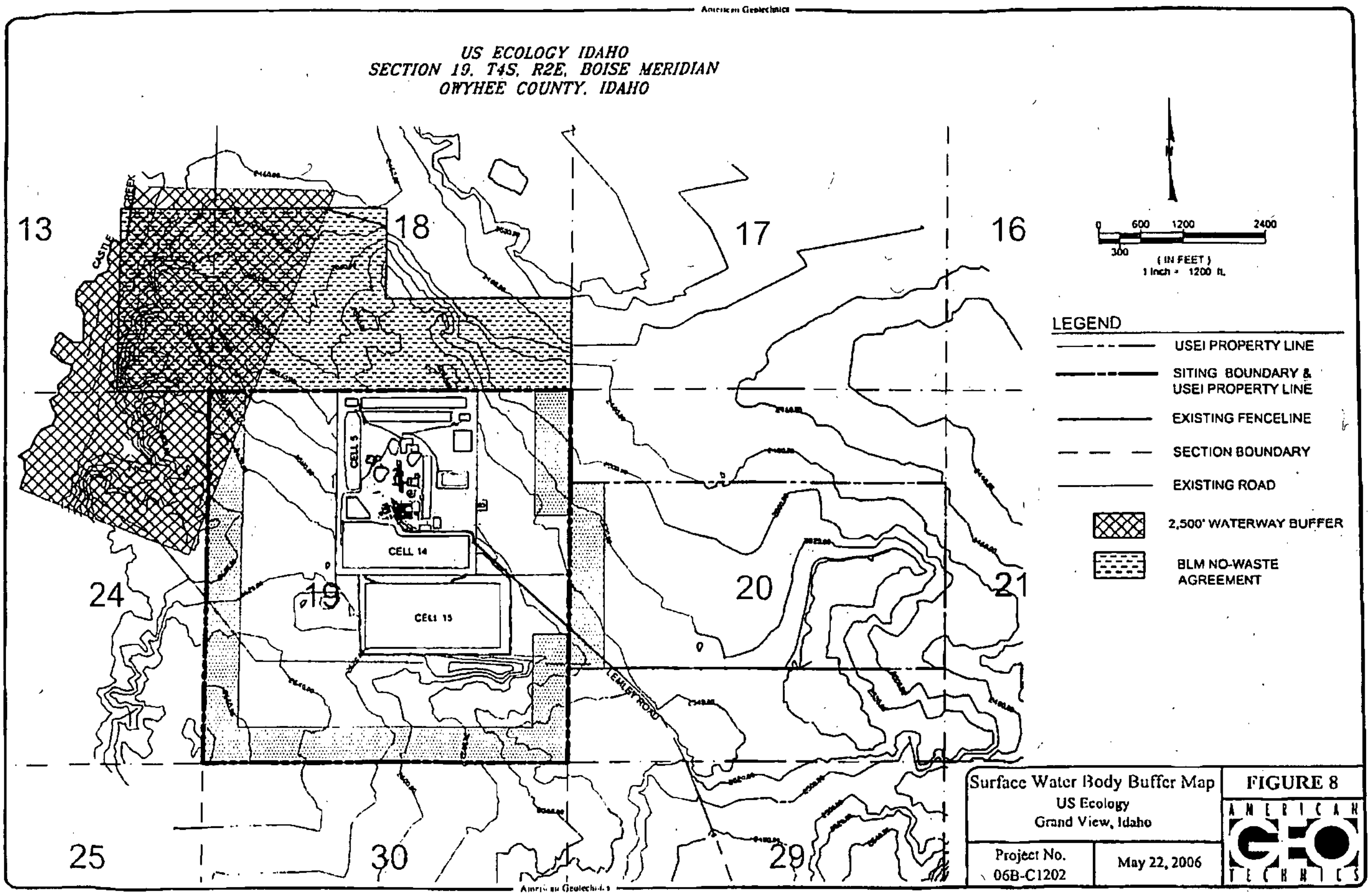
US ECOLOGY IDAHO
SECTION 19, T4S, R2E, BOISE MERIDIAN
OWYHEE COUNTY, IDAHO
LEGEND
USEI PROPERTY LINE
SITING BOUNDARY & USEI PROPERTY LINE
EXISTING FENCE LINE
SECTION BOUNDARY
EXISTING ROAD
2460 EXISTING LOWER AQUIFER HEAD ELEVATION (MAY 2006 WATER LEVELS)
2460.00 EXISTING GROUND SURFACE ELEVATION
(IN FEET)
1 inch = 600 ft.
19
LEMLEY ROAD
Feast Geosciences
Lower Aquifer Contour Map
US Ecology
Grand View, Idaho
FIGURE 5
Project No.
06B-C1202
June, 2006
AMERICAN GEOTECHNICS



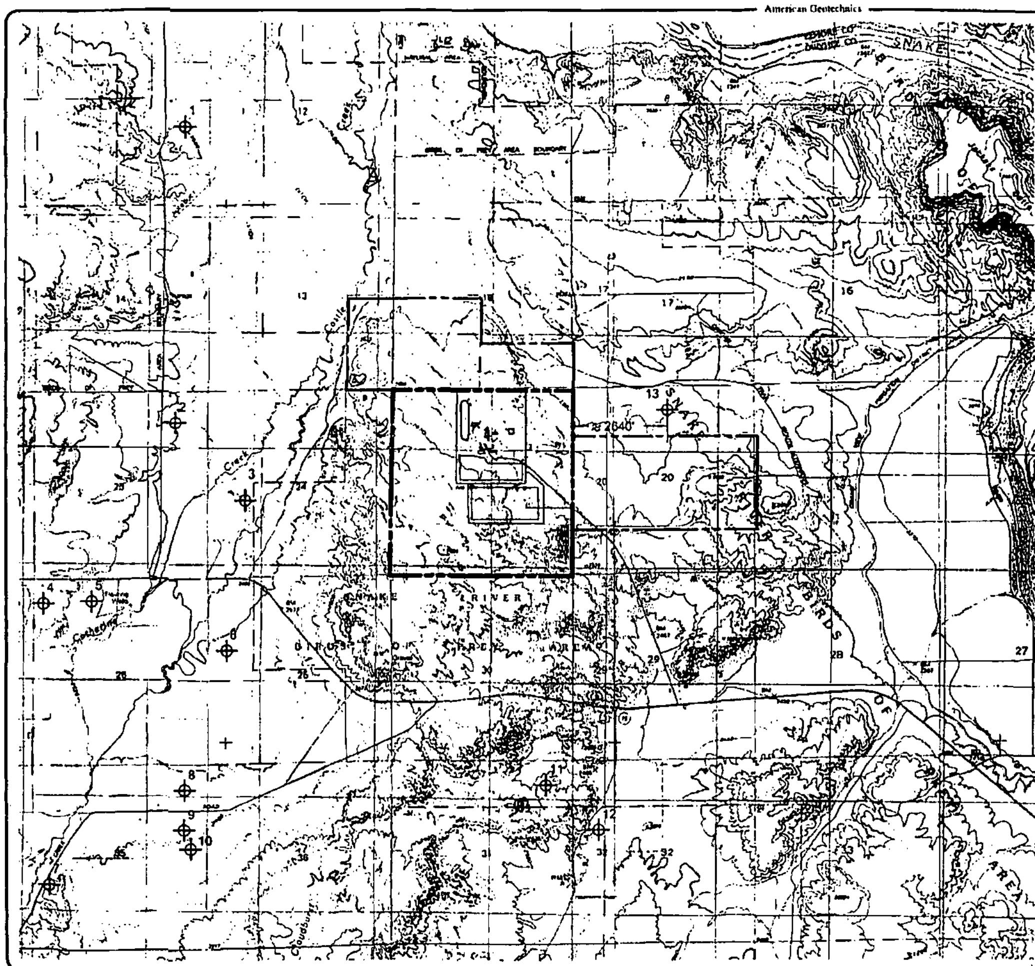
American Geotechnics
2650
2600
2550
2500
2450
2400
2350
2300
2250
A
SOUTH
L35
A'
NORTH
UP28
UP20
U1
U2 AND
UP-2 (D-23)
U3
U4
AND
D-4
COARSE SAND AND
GRAVEL
FINE TO MEDIUM SAND
CLAYEY SILT
(LOESS)
S&G
SAND AND
GRAVEL
THICKLY BEDDED FINE TO MEDIUM SAND
WITH THIN SILT AND CLAY BEDS; BROWN
MEDIUM TO THINLY BEDDED FINE
SILTY SAND, SILT AND CLAY; BROWN
THICKLY BEDDED SILTY CLAY WITH THIN FINE
SAND AND SILT BEDS; BLUE-GRAY
SOUTHERN LIMIT OF
UPPER AQUIFER
FINE SAND AND SILTY CLAY;
THINLY BEDDED; TRANSITION
FROM BROWN TO BLUE-GRAY
UPPER AQUIFER
CONFINING BED; MASSIVE,
DENSE, SILTY CLAY; BLUE-GRAY
LOWER AQUIFER
THINLY BEDDED SANDY SILTS
IN BLUE-GRAY CLAY
MASSIVE, DENSE, CLAY, BLUE-GRAY
APPROXIMATE VERTICAL SCALE: 1"=50'
APPROXIMATE HOROZONTAL SCALE: 1"=200'
CROSS-SECTION A - A'
LEGEND
STATIC WATER LEVEL
EXISTING WELL SCREEN
SAND
GRAVEL
CLAY
SILT
Feast Geosciences
N/S Geological Section-West Side
of Section 19
US Ecology
Grand View, Idaho
Project No.
06B-C1202
June, 2006
FIGURE 6
AMERICAN
GEO
TECHNICS
American Geotechnics



B
NORTH
B'
SOUTH
2600
2550
2500
2450
2400
2350
2300
2250
2200
U-7
LP-13
UP-6
U-8
U-9
LP-12 U-10
U-11
U-12
LP-15
D-22
(ABANDONED)
L-29
L-28
L-43
SAND AND GRAVEL
THICKLY BEDDED FINE TO MEDIUM SAND WITH THIN SILT AND CLAY BEDS, BROWN
COARSE SAND
SILTY CLAY; BROWN
GRAVEL WITH SAND AND SILT
MEDIUM TO THINLY BEDDED FINE SILTY SAND WITH THIN SILT AND CLAY BEDS; BROWN
THICKLY BEDDED SILTY CLAY WITH THIN FINE SAND AND SILT BEDS; BLUE-GRAY
UPPER AQUIFER
SOUTHERN LIMIT OF UPPER AQUIFER
CONFINING BED, MASSIVE DENSE, SILTY CLAY; BLUE-GRAY
THINLY BEDDED SANDY SILTS IN BLUE-GRAY CLAY
LOWER AQUIFER
MASSIVE, DENSE, CLAY; BLUE-GRAY
American Geotechnics
APPROXIMATE VERTICAL SCALE: 1"=50'
APPROXIMATE HOROZONTAL SCALE: 1"=200'
CROSS-SECTION B - B'
LEGEND
STATIC WATER LEVEL
EXISTING WELL SCREEN
SAND
GRAVEL
CLAY
SILT
American Geotechnics
Feast Geosciences
N/S Geological Section-East Side of Section 19
US Ecology
Grand View, Idaho
Project No.
06B-C1202
June, 2006
FIGURE 7
AMERICAN GEO TECHNICS


American Geotechnics
US ECOLOGY IDAHO
SECTION 19, T4S, R2E, BOISE MERIDIAN
OWYHEE COUNTY, IDAHO
13
18
17
16
24
19
20
21
25
30
29
CELL 5
CELL 14
CELL 15
CASTLE CREEK
LEMLEY ROAD
0
600
1200
2400
300
( IN FEET )
1 inch = 1200 ft.
LEGEND
USEI PROPERTY LINE
SITING BOUNDARY & USEI PROPERTY LINE
EXISTING FENCELINE
SECTION BOUNDARY
EXISTING ROAD
2,500' WATERWAY BUFFER
BLM NO-WASTE AGREEMENT
Surface Water Body Buffer Map
US Ecology
Grand View, Idaho
Project No.
06B-C1202
May 22, 2006
FIGURE 8
AMERICAN GEO TECHNICS
American Geotechnics

American Geotechnics




LEGEND

EXISTING WELL LOCATION
US ECOLOGY PROPERTY LINE
SITING BOUNDARY & USEI PROPERTY LINE

INDEX OF WELL LOGS

| WELL LOG NO. | TOTAL DEPTH (FEET) | USE | DATE DRILLED |
|---|---|---|---|
| 1 | 1,115 | D | 11/4/1988 |
| 2 | 600 | D | 12/25/1969 |
| 3 | 200 | S | 10/20/1992 |
| 4 | 650 | D | 12/31/1999 |
| 5 | 840 | S | 1/30/1993 |
| 6 | 600 | D | 2/2/2004 |
| 7 | 85 | I | 9/12/1966 |
| 8 | 680 | D | 6/5/2002 |
| 9 | 460 | D | 7/20/2002 |
| 10 | 710 | D | 6/10/2004 |
| 11 | 28 | D | 3/19/1980 |
| 12 | 420 | D | 4/1/1987 |
| 13 | 73 | D | 11/20/1996 |

NOTES
D = DOMESTIC
I = IRRIGATION
S = STOCK WATER

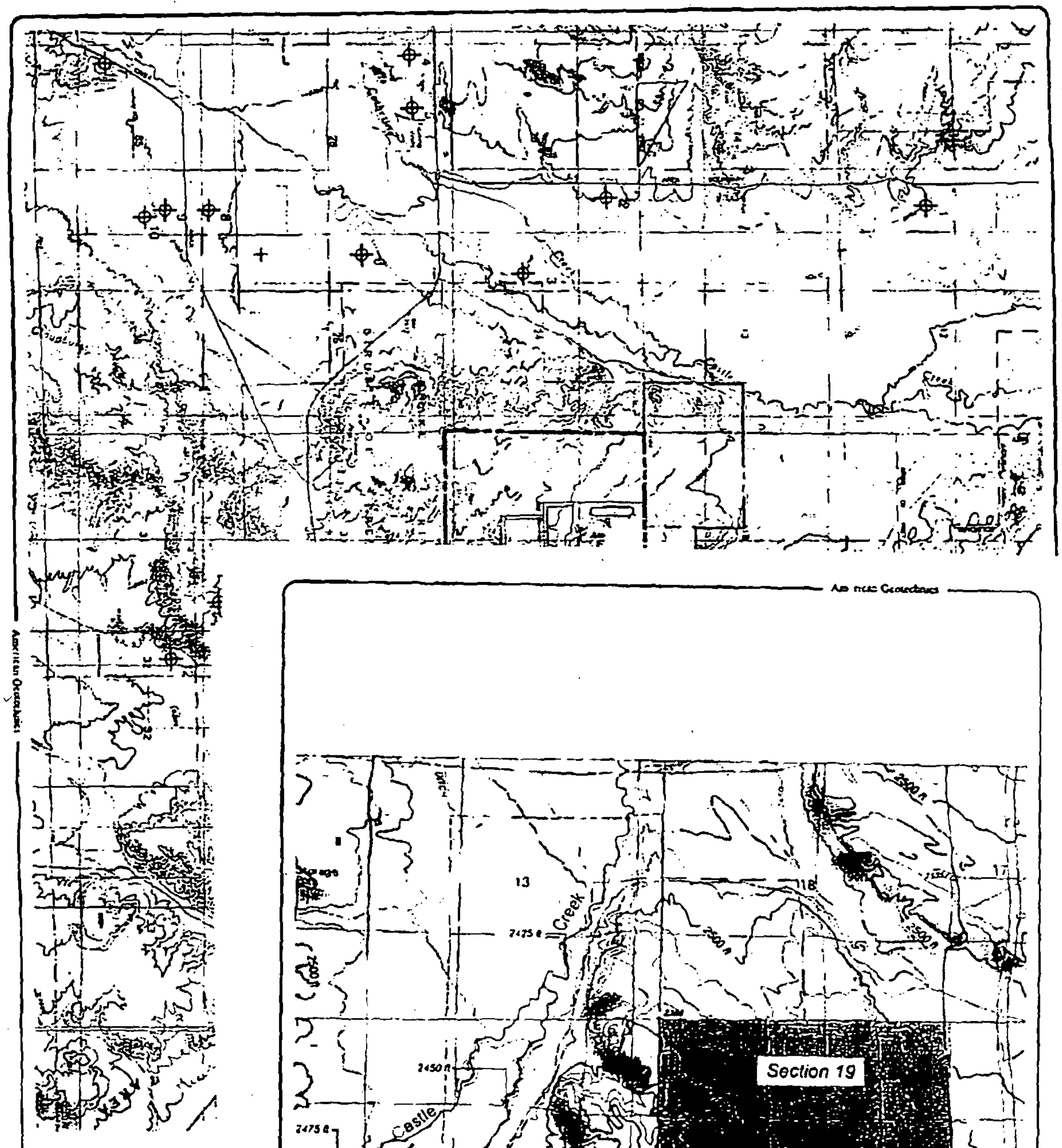
Existing Surrounding Well Location Map
US Ecology
Grand View, Idaho

Project No. 06B-C1202 | May 22, 2006

FIGURE 9

AMERICAN GEOTECHNICS

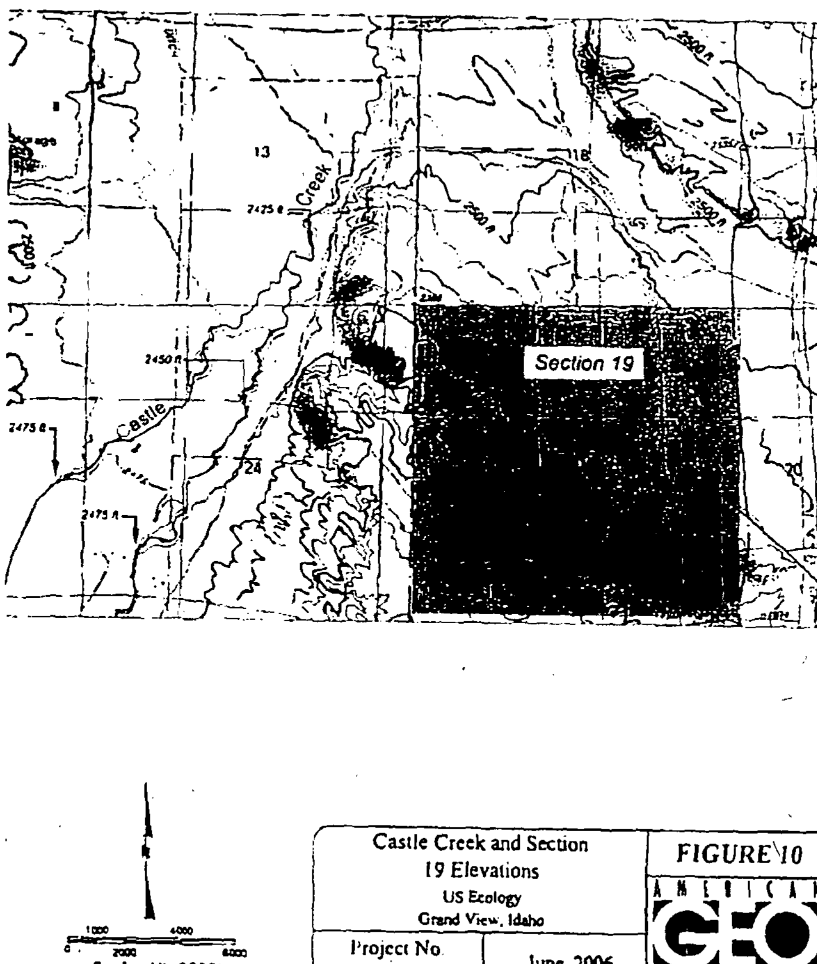
American Geotechnics



Existing Surrounding Well Location Map
US Ecology
Grand View, Idaho

Project No. 06B-C1202 | May 22, 2006

FIGURE 9

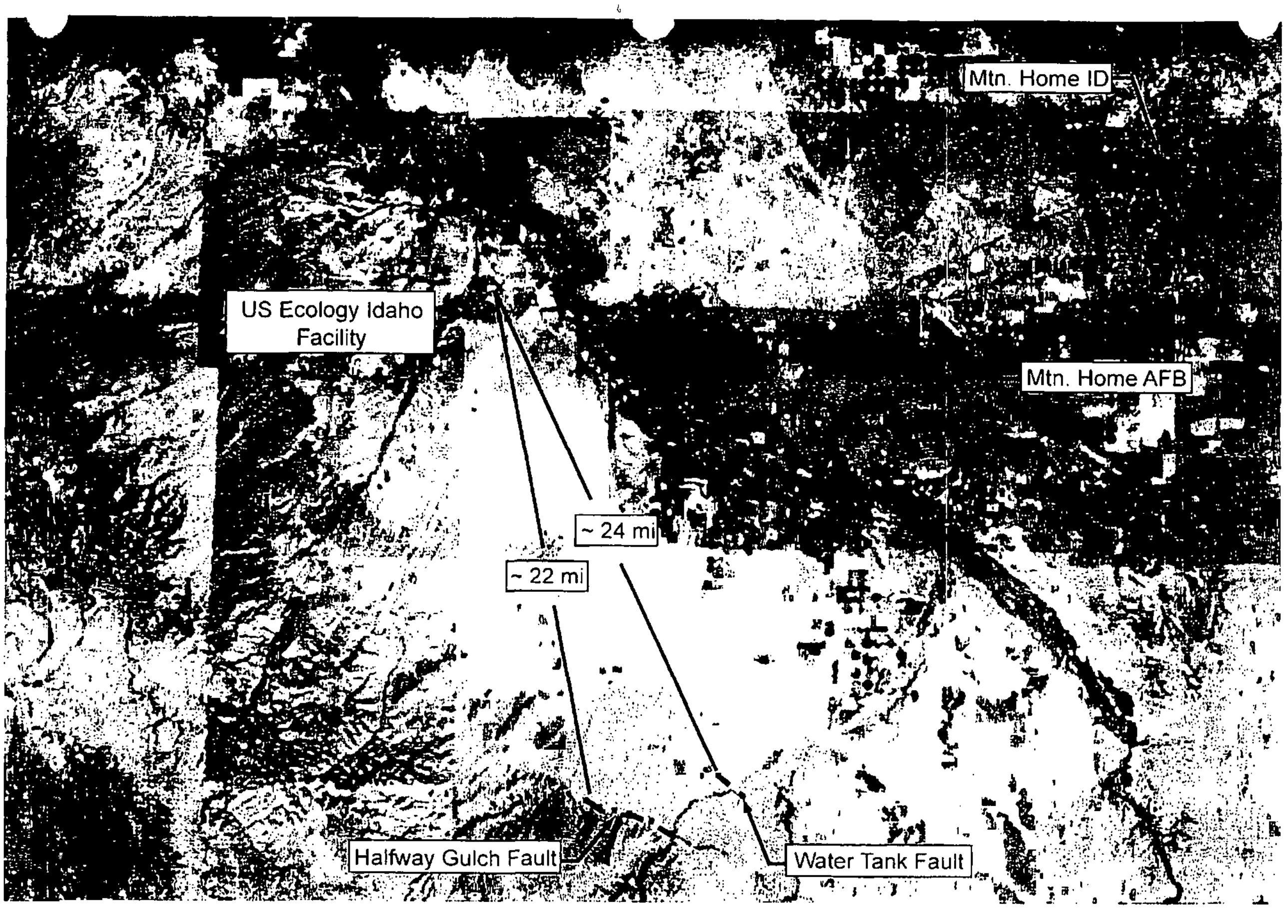



Castle Creek and Section 19 Elevations
US Ecology
Grand View, Idaho

Project No. 06B-C1202 | June 2006

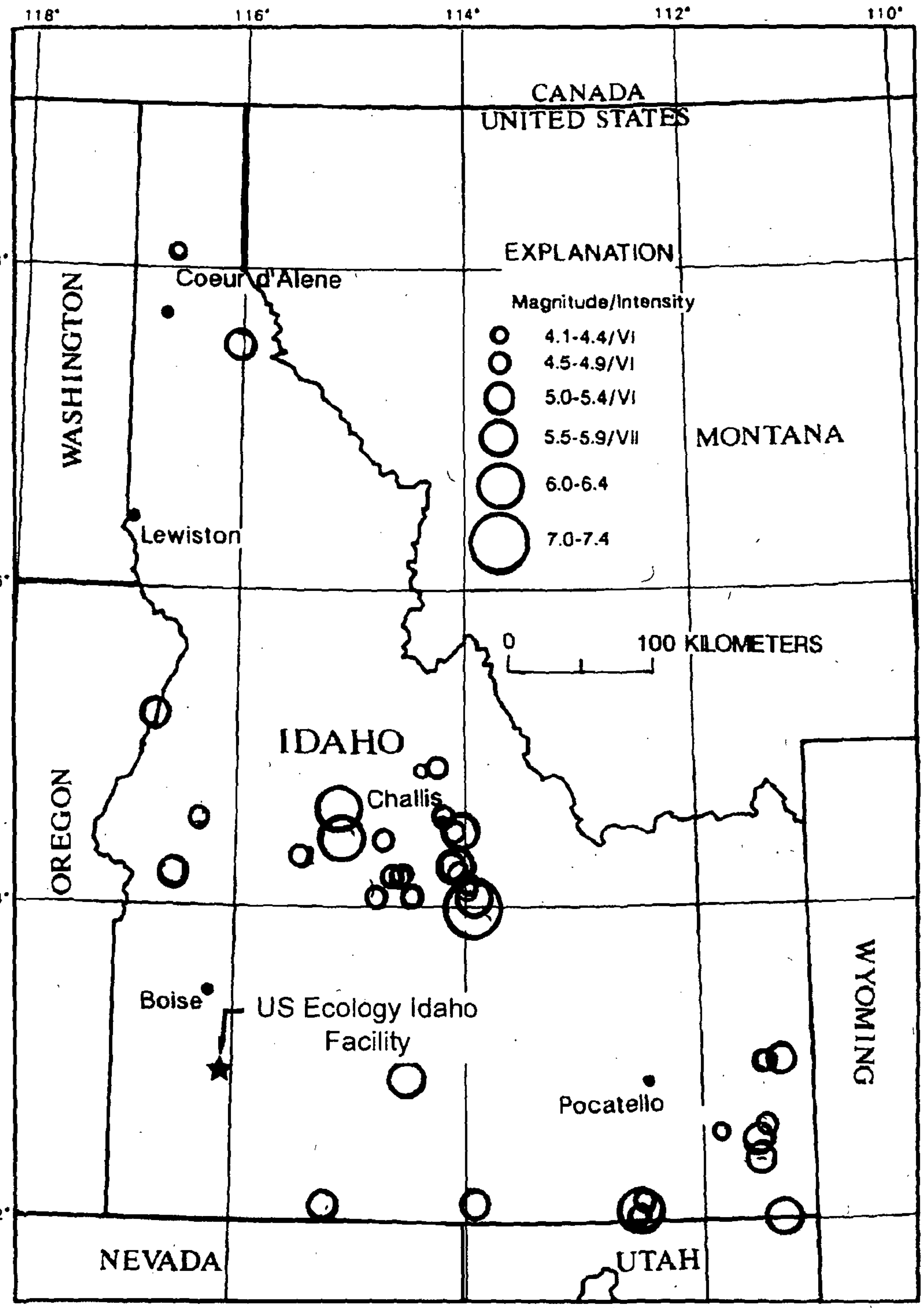
FIGURE 10

American Geotechnics



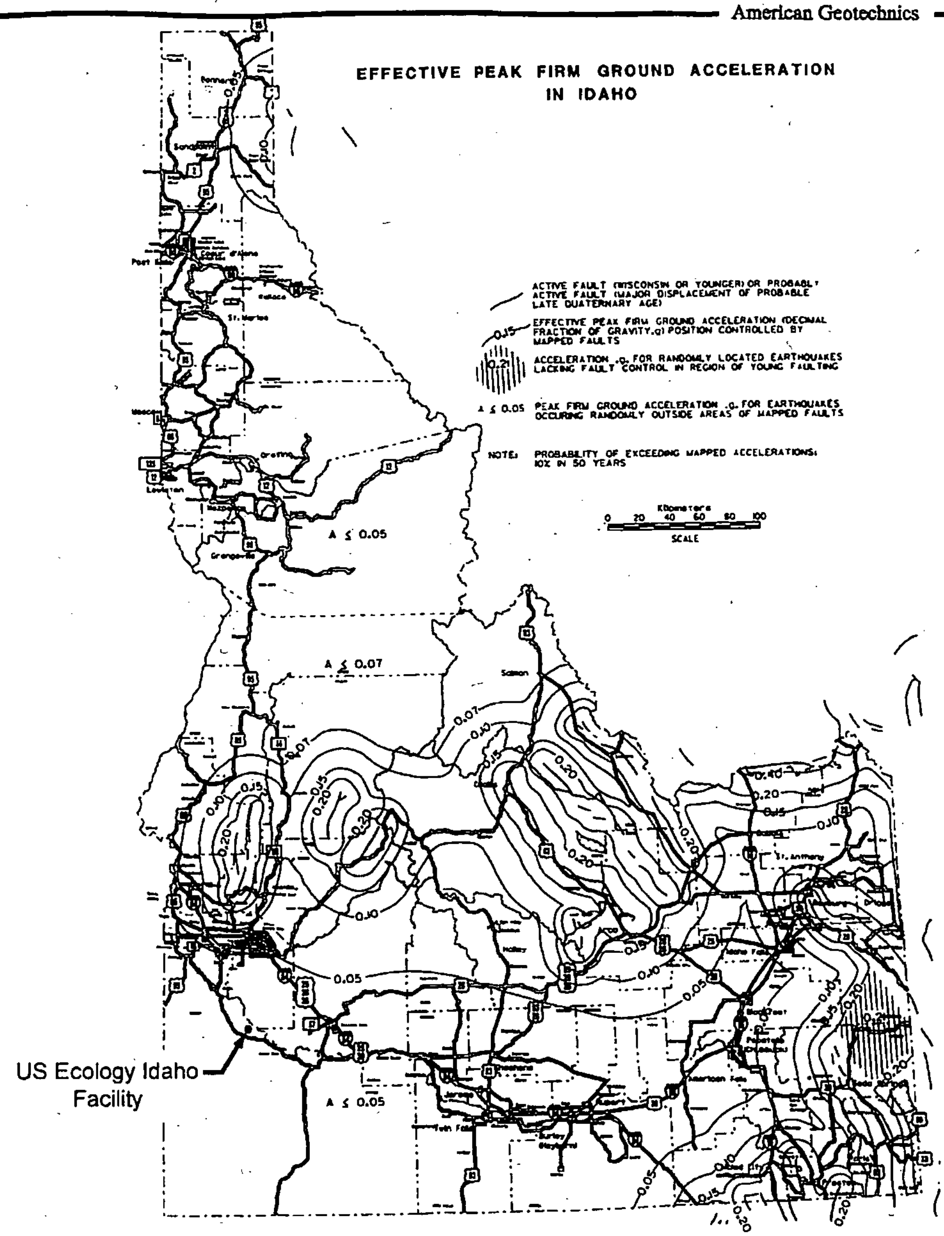

N.T.S

| DISTANCES TO FAULTS ACTIVE DURING THE HOLOCENE EPOCH<br>US Ecology<br>Grand View, Idaho | | FIGURE 11 |
|---|---|---|
| Project No.<br>06B-C1202 | March, 2006 | AMERICAN GEOTECHNICS |




Earthquakes in Idaho with magnitudes ≥ 4.5 or intensity ≥ VI.

| IDAHO HISTORICAL EARTHQUAKE MAP - 1880 TO PRESENT<br>US Ecology Idaho<br>Grand View, ID | | FIGURE 12 |
|---|---|---|
| Project No.<br>06B-C1202 | April, 2006 | AMERICAN GEO TECHNICS |

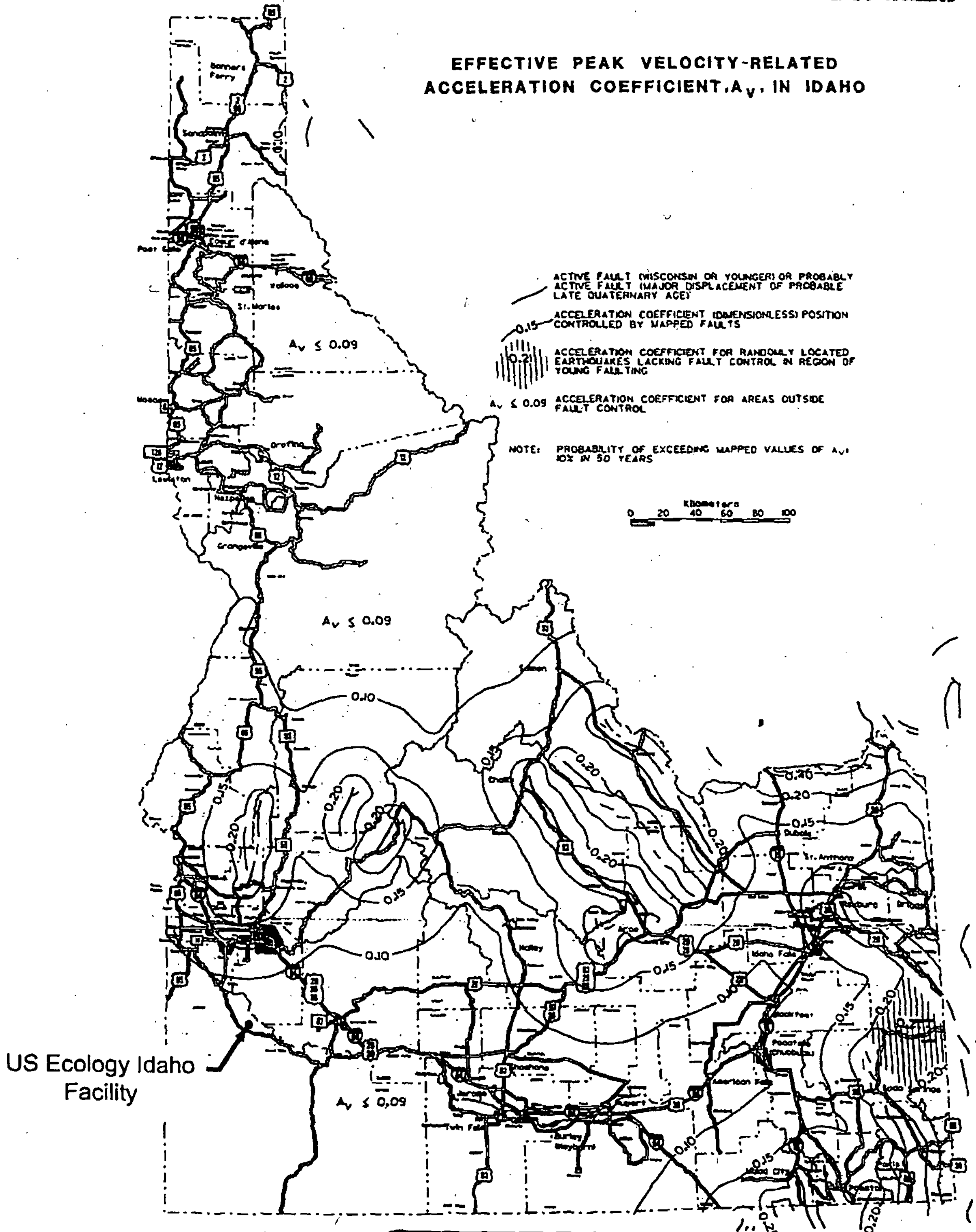



EFFECTIVE PEAK FIRM GROUND ACCELERATION MAP
US Ecology
Grand View, Idaho

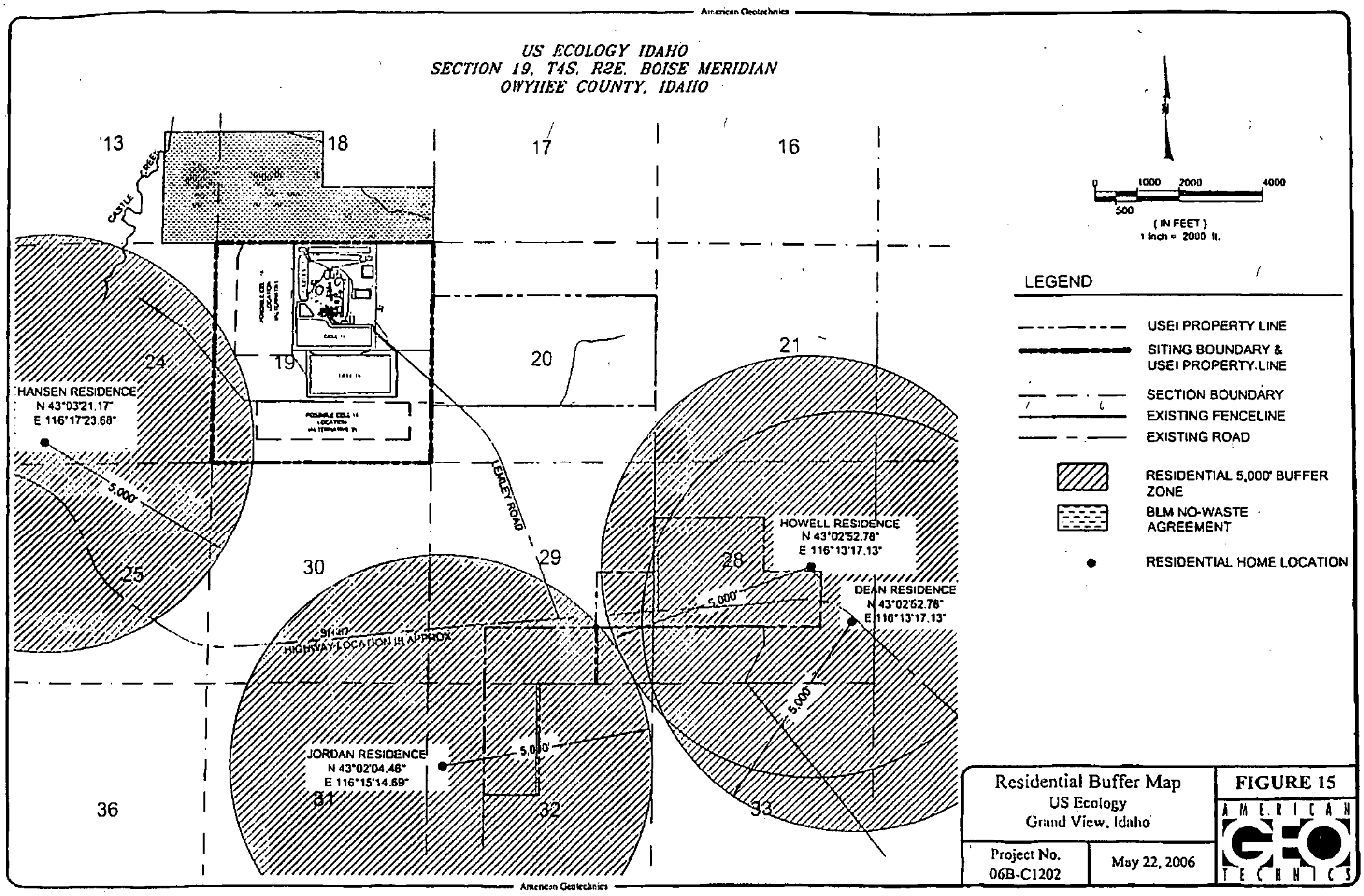
FIGURE 13

AMERICAN GEO TECHNICS

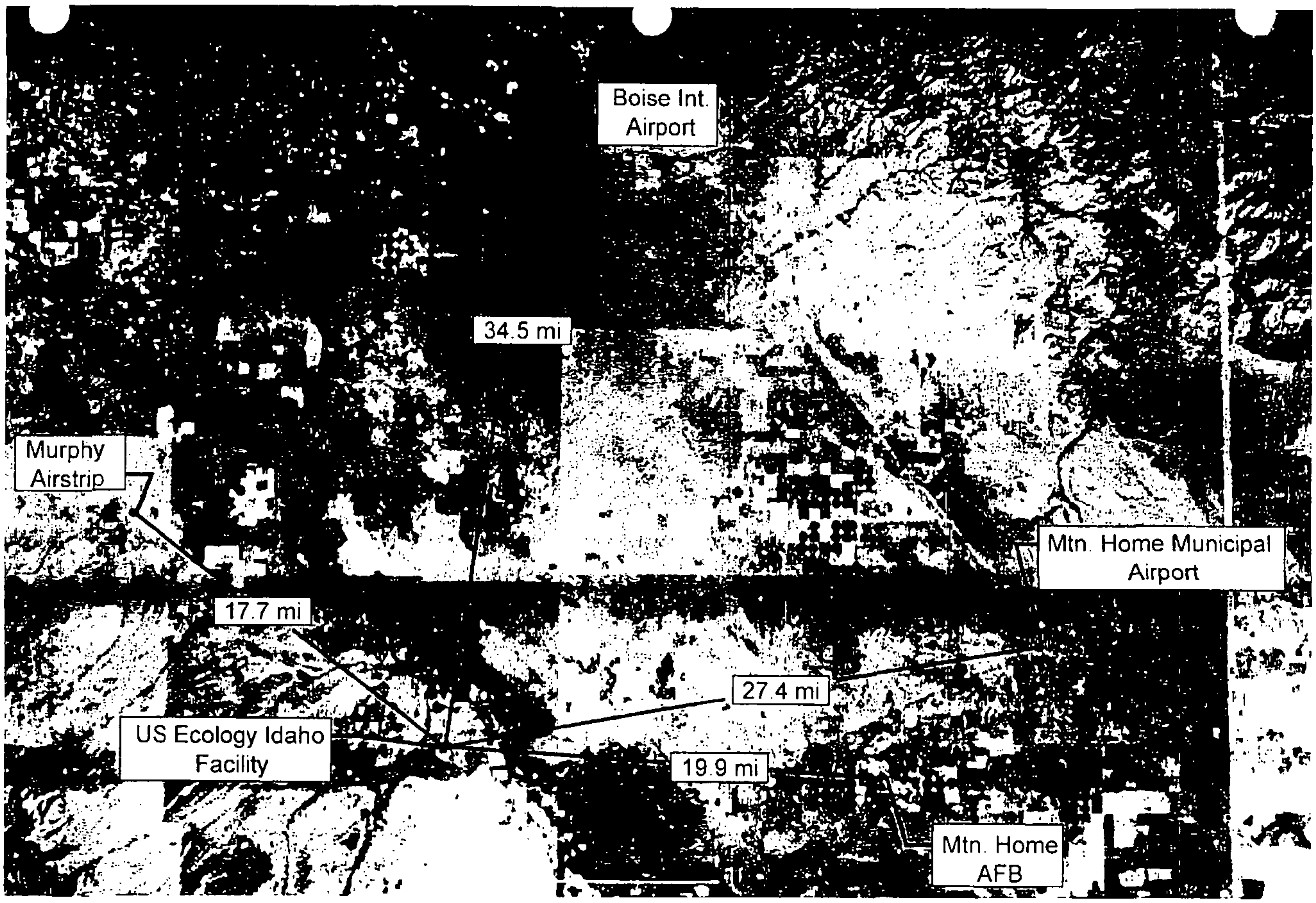
| Project No. 06B-C1202 | March, 2006 |
|---|---|



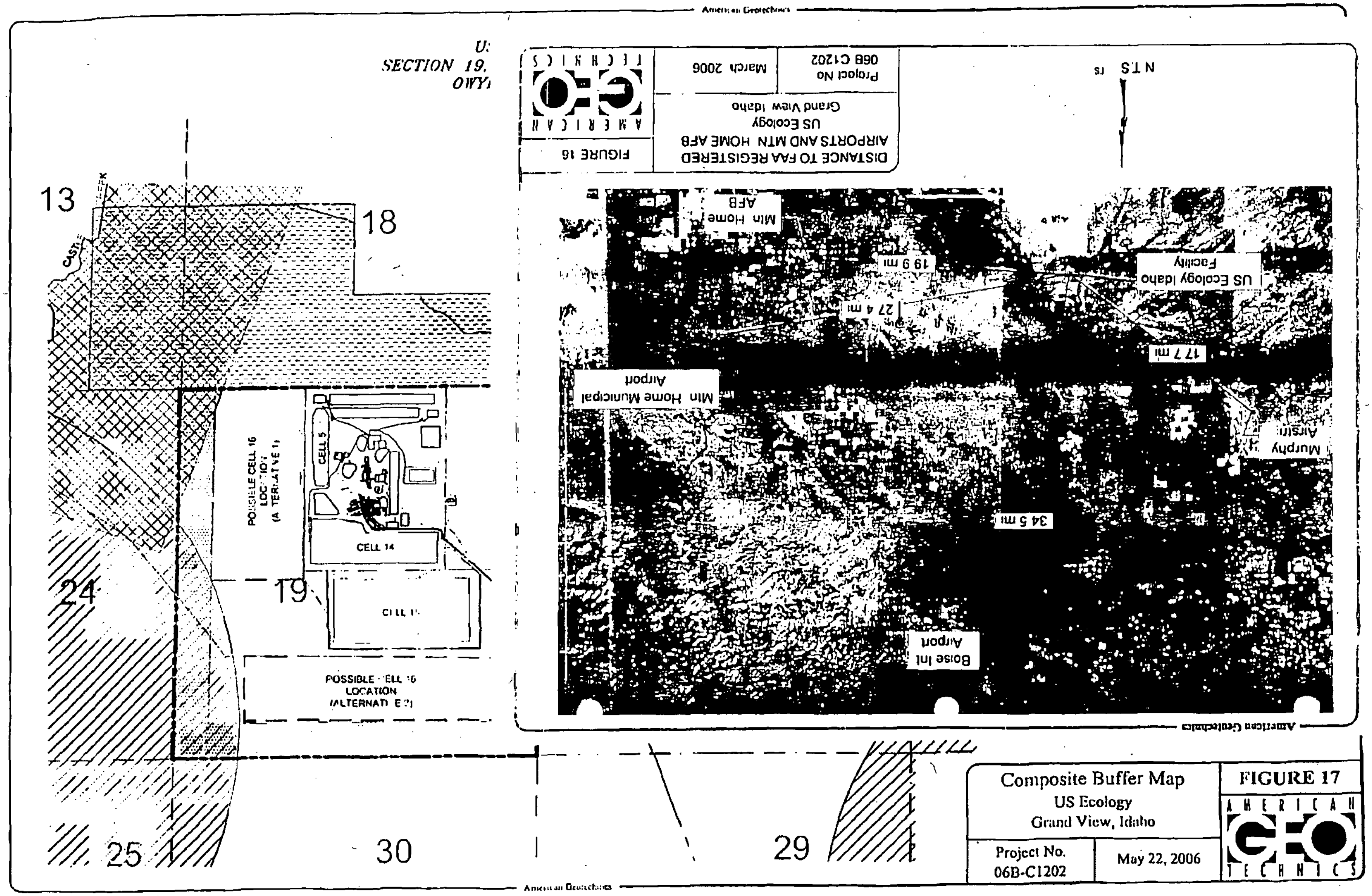

| EFFECTIVE PEAK VELOCITY-RELATED ACCELERATION COEFFICIENT<br>US Ecology<br>Grand View, Idaho | | FIGURE 14 |
|---|---|---|
| Project No.<br>06B-C1202 | March, 2006 | AMERICAN GEO TECHNICS |




| Residential Buffer Map<br>US Ecology<br>Grand View, Idaho | | FIGURE 15 |
|---|---|---|
| Project No.<br>06B-C1202 | May 22, 2006 | AMERICAN GEOTECHNICS |




| | | |
|---|---|---|
| DISTANCE TO FAA REGISTERED AIRPORTS AND MTN. HOME AFB<br>US Ecology<br>Grand View, Idaho | | FIGURE 16 |
| Project No. 06B-C1202 | March, 2006 | AMERICAN GEO TECHNICS |


SECTION 19,
13
18
19
24
25
30
29
POSSIBLE CELL 16 LOCATION (ALTERNATIVE 1)
POSSIBLE CELL 16 LOCATION (ALTERNATIVE 2)
CELL 5
CELL 14
DISTANCE TO FAA REGISTERED AIRPORTS AND MTN HOME AFB
US Ecology
Grand View Idaho
Project No 06B C1202
March 2006
FIGURE 16
AMERICAN GEOTECHNICS
N.T.S
Mtn Home AFB
19.9 mi
27.4 mi
US Ecology Idaho Facility
17.7 mi
Mtn Home Municipal Airport
Murphy Airstrip
34.5 mi
Boise Int Airport
American Geotechnics
Composite Buffer Map
US Ecology
Grand View, Idaho
Project No. 06B-C1202
May 22, 2006
FIGURE 17
AMERICAN GEOTECHNICS

AMERICAN GEO TECHNICS

# APPENDIX B

## DETAILED STRATIGRAPHIC COLUMN FROM ARTESIAN WELL

ESII Part B Renewal Application
EPA I.D. No. IDD073114654
Date: June 12, 1998
Revision No.: 0

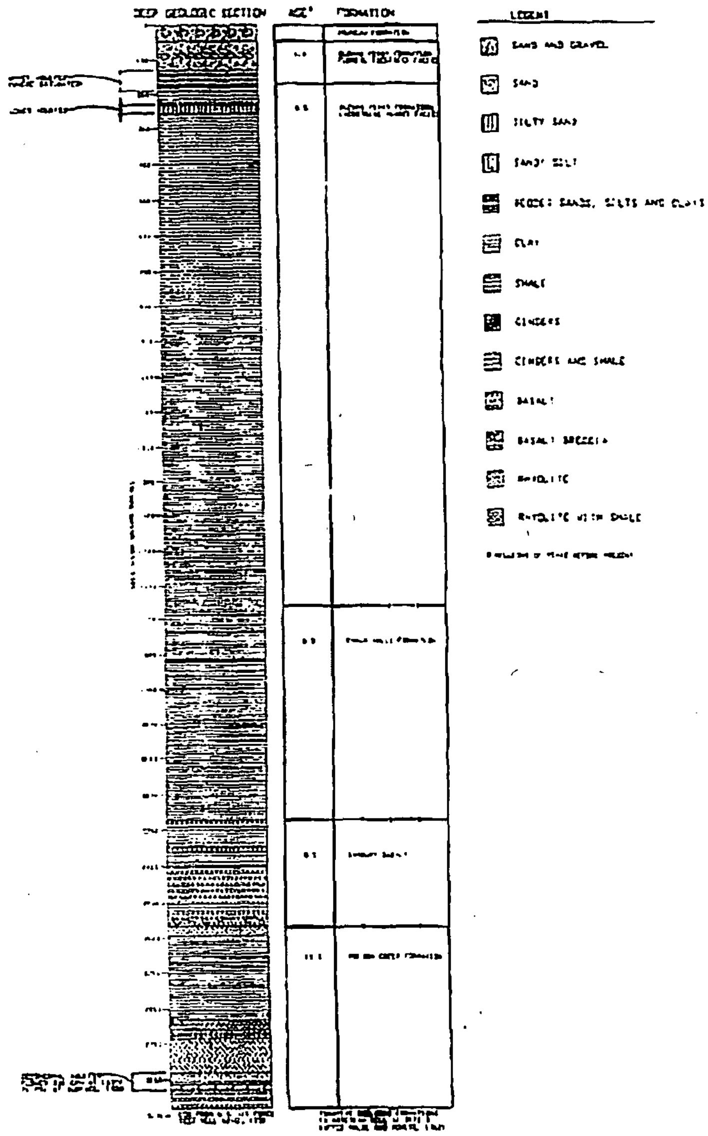



FIGURE E-7
STRATIGRAPHIC COLUMN
FROM ARTESIAN WELL

# APPENDIX C

## US GEOLOGICAL SOCIETY PROBABILISTIC GROUND MOTION VALUES

USGS
science for a changing world

```
LOCATION                    43.0656 Lat.  -116.2622 Long.
The interpolated Probabilistic ground motion values, in %g,
at the requested point are:
              10%PE in 50 yr   2%PE in 50 yr = 10% IN 250 YRS
   PGA            5.17             11.00
0.2 sec SA       11.68             26.02
1.0 sec SA        4.19              8.78
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

SEISMIC HAZARD: Hazard by Lat/Lon, 2002

AMERICAN GEO TECHNICS

# APPENDIX D

## MINERAL POTENTIAL REPORT FOR SECTION 19

,60—11

Serial Number

IDI-28152

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MINERAL REPORT

MINERAL POTENTIAL REPORT
FOR
ENVIROSAFE LAND EXCHANGE
UNDER
SECTION 206
OF THE
FEDERAL LAND POLICY AND MANAGEMENT ACT
OF 1976

LANDS INVOLVED

BOISE MERIDIAN, OWYHEE COUNTY, IDAHO

SELECTED LANDS
T. 4 S., R. 2 E.
Sec. 19: Lots 1-4 (inclusive)
E1/2NE1/4, W1/2E1/2NW1/4
E1/2SW1/4, SE1/4
Containing 502.68 acres

OFFERED LANDS
T. 5 S., R. 3 E.
Sec. 14: Lot 8
Sec. 15: Lots 8 and 9
Sec. 22: Lot 3
Sec. 23: Lot 2
Containing 118.16 acres

BUREAU OF LAND MANAGEMENT · CERTIFIED · J. C. Harksen · 0067 · MINERAL EXAMINER · U.S. DEPARTMENT OF THE INTERIOR

Prepared By:

(Signature)

GEOLOGIST
(Title)

(Date)

BUREAU OF LAND MANAGEMENT · CERTIFIED · Robert E. DeTar · REVIEW 023 · MINERAL EXAMINER · U.S. DEPARTMENT OF THE INTERIOR

Technical Approval:

Robert E. DeTar
(Signature)

Geologist
(Title)

Nov 4, 1992
(Date)

Management Acknowledgement:

(Signature)

Bruneau Area Mgr.
(Title)

11/5/92
(Date)

☆ U.S. Government Printing Office: 1984-776-009/4879 R8

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The subject lands have no mineral potential for locatable or salable minerals as neither locatable or salable minerals are present in commercial quantities. The subject lands are prospectively valuable for oil and gas as well as geothermal resources. No other leasable minerals occur in the subject area.

It has been determined that surface entry on the lands would not interfere with operations under the mineral leasing laws.

No mining claims are known to occur on the selected lands.

It is recommended that the lands be considered for trade in accordance with the Federal Land Policy and Management Act of 1976 and all other regulations appertaining thereto (43 CFR 2710).

## INTRODUCTION

The offered lands are an island in the Snake River (Gold Isle) just east of Grand View, Idaho while the selected lands are located on an arid, rolling upland about seven miles northwest of Grand View, Idaho.

Both the offered and selected lands were identified for trade through a request from Envirosafe Incorporated. This report is prepared in accordance with the Federal Land Policy and Management Act of 1976, Section 206, Exchanges.

The purpose of this report is to present information relative to the potential for salable and locatable mineral development on both the offered and the selected lands. The conclusions reached in this report are limited to only the classification for mineral potential and should not be used for any other purpose.

## LANDS INVOLVED

The subject lands are:

SELECTED LANDS
Boise Meridian, Owyhee County, Idaho
T. 4 S., R. 2 E.
Sec. 19: Lots 1-4 (inclusive)
E1/2NE1/4, W1/2E1/2NW1/4
E1/2SW1/4, SE1/4
Containing 502.68 acres.

AMERICAN GEO TECHNICS

# APPENDIX E

## CULTURAL RESOURCES

April 1, 2006
Project No. 05B-C1202

ID State Historical Preservation Office
210 Main St.
Boise, Idaho 83702

Attention: Suzie Nietzel

SUBJECT: US Ecology Idaho, Section 19 Siting and Historical Preservation
Grand View, Idaho

Dear Suzie:

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on historically sensitive sites. We appreciate your guidance in this regard, and are sending this letter as a formal request for the Idaho Historical Preservation Office to review the expansion plans for any potential affects on historical sites. As you requested, we have attached Figure 2A (Attachment A) indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho. The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

We have also attached several supporting documents that may help you with your review. The second document (Attachment B) includes a cultural resource survey that was commissioned by US Ecology Idaho's predecessor, Envirosafe Inc. The survey was conducted to identify any culturally significant sites within Section 19 that may be damaged or destroyed by landfill activities. Once the survey was completed and reviewed, cultural resource clearance was granted (see Attachment C) by the Bureau of Land Management (BLM). Envirosafe Inc. then acquired the whole of Section 19 through a land exchange.

The cultural resource survey report identifies a site (labeled ES-1 in the report) that may be eligible for the National Register of Historic Places under criterion D.

During our phone conversation you expressed concern over the appearance of landfills in relatively close proximity to the Oregon Trail (~ 1 mile). Recently, US Ecology obtained 309 acres, north of Section 19 in Sections 13 and 18. This property is shown in Figure 2A. As required by the land transaction with BLM, to protect the view shed with the Oregon Trail, US Ecology is in the process of modifying their RCRA Part B Operating Permit, under a Class 2 Modification with the Idaho Department of Environmental Quality (DEQ). The modification guarantees for perpetuity that US Ecology will not build or construct a landfill within these 309 acres with the possible exception of a monitoring well. The modification has been filed with DEQ. As required by law a public meeting was held and a public comment period has been advertised. The comment period will continue through May 6, 2006. Currently, DEQ has not received any public comments regarding the Class 2 Modification.

Additionally, we have included an aerial photograph of the US Ecology Hazardous Waste Landfill in Attachment D to help you analyze the visual aspects both active and capped landfills. All new landfills will be designed to lie softly on the ground, meaning that visual impacts of the finished product are minimized to the extent possible. Capped landfills will have an appearance similar to those shown in cells 5 and 10 of Attachment D. Each landfill is re-vegetated with native plant species to provide natural habitat and blend into the natural terrain as much as possible.

The photograph in Attachment D shows cells 14 and 15 during construction. New landfills will be designed and have an appearance during construction similar to that of cell 15. Each cell is constructed in phases. The active phase of cell 15 is shown in the left side of the cell 15 boundaries. As construction progresses, the active phase will be filled and covered. The next phase will begin with a similar pit being excavated toward the right edge of the cell 15 boundaries. Once construction is complete, the cell will be re-vegetated and have an appearance similar to that of cells 5 and 10.

We hope this information will help you in your assessment of cultural and historical resources that may be affected by the US Ecology Idaho Hazardous Waste Landfill expansion. Please provide a letter indicating the status of any such resources that may be adversely affected by the addition of landfills located within Section 19. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com* or *tjohnson@americangeotechnics.com*. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

Respectfully submitted,

American Geotechnics

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Principal Engineer

Attachment A: Figure 2A Property Line & Section 19 Siting Map

Attachment B: A Cultural Resources Survey of a Proposed Expansion of the Envirosafe Waste Facility

Attachment C: Bureau of Land Management Cultural Resources Clearance

Attachment D: US Ecology Idaho Hazardous Waste Facility Aerial Photograph

Attachment E: John Sullivan (Bureau of Land Management District Manager) Telecon Report

*Letter included without attachments unless otherwise noted.*

IDAHO STATE HISTORICAL SOCIETY

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**Our mission: to educate through the identification, preservation, and interpretation of Idaho's cultural heritage.**

www.idahohistory.net

Dirk Kempthorne
Governor of Idaho

Steve Guerber
Executive Director


**Administration**
2205 Old Penitentiary Road
Boise, Idaho 83712-8250
Office: (208) 334-2682
Fax: (208) 334-2774

**Archaeological Survey of Idaho**
210 Main Street
Boise, Idaho 83702-7264
Office: (208) 334-3847
Fax: (208) 334-2775

**Historical Museum and Education Programs**
610 North Julia Davis Drive
Boise, Idaho 83702-7695
Office: (208) 334-2120
Fax: (208) 334-4059

**Historic Preservation Office**
210 Main Street
Boise, Idaho 83702-7264
Office: (208) 334-3861
Fax: (208) 334-2775

**Historic Sites Office**
2445 Old Penitentiary Road
Boise, Idaho 83712-8254
Office: (208) 334-2844
Fax: (208) 334-3225

**Public Archives and Research Library**
2205 Old Penitentiary Road
Boise, Idaho 83712-8250

**Public Archives**
Office: (208) 334-2620
Fax: (208) 334-2626

**Research Library**
(208) 334-3556

**Oral History**
Office: (208) 334-3863
Fax: (208) 334-3198


May 18, 2006

Mr. Timothy Johnson
American GeoTechnics
2300 N. Yellowstone Hwy., Ste. 203
Idaho Falls, Idaho 83401

RE: U.S. Ecology Grandview--Section 19 Siting
Section 106 (Historic Preservation) Review

Dear Mr. Johnson:

Thank you for requesting our views on the need to conduct additional archaeological survey in the area planned for expansion of US Ecology's Hazardous Waste Site near Grand View, Idaho (Section 19, T4S, R2E). As we discussed on the telephone, all of Section 19 has been surveyed for archaeological properties, and no properties were identified that are considered eligible for the National Register of Historic Places. Therefore, expansion of the facility can proceed with no further review from our office. We should be notified immediately, however, if archaeological remains are discovered during construction activities.

We appreciate your cooperation. If you have any questions, please feel free to contact me at 208-334-3847, ext. 107.

Sincerely,

Suzi

Susan Pengilly Neitzel
Deputy SHPO and
Compliance Coordinator

# A CULTURAL RESOURCES SURVEY OF A PROPOSED EXPANSION OF THE ENVIROSAFE WASTE FACILITY, OWYHEE COUNTY, IDAHO

by

Ann S. Polk
Staff Archaeologist

Prepared for:

Envirosafe Services of Idaho, Inc.
P.O. Box 16217
Boise, Idaho 83715-6217

Prepared by:

Sagebrush Archaeological Consultants
4263 Monroe Boulevard
Ogden, Utah 84403

Under Authority of Cultural Resources Use Permit No. ID-I-28592-1

Archaeological Report No. 474

August 15, 1991

# INTRODUCTION

In July, 1991 Envirosafe Services of Idaho, Inc. of Boise, Idaho (ESII) requested that Sagebrush Archaeological Consultants (Sagebrush) conduct a cultural resources clearance survey of a proposed expansion of their existing waste facility near Grandview, Owyhee County, Idaho. The project was carried out to comply with governing Federal mandates including the Antiquities Act of 1906, the Historic Sites Act of 1935, the Historic Preservation Act (NHPA) of 1966 (P.L. 89-665 as amended by P.L. 96-515), Executive Order 11593 of 1971, the National Environmental Policy Act of 1969 (NEPA), and the Archaeological and Historic Preservation Act of 1974 and other pertinent legislation.

The project will involve expansion of the existing facility onto surrounding Bureau of Land Management (BLM) lands. The project lies in T. 4N., R. 2E., S. 19 on the Castle Butte, Idaho 7.5' USGS Quadrangle (1948; 1976 P.I.)(Figure 1). A total of approximately 438 acres of contiguous land was surveyed on the southern, eastern and western sides of the existing facility and the area surveyed by Sagebrush in 1990 for the initial expansion area.

The survey was conducted by Sean Blaine and the author on August 1 and 2, 1991 under authority of Cultural Resources Use Permit No. ID-I-28592-1 issued by the Idaho State Office of the Bureau of Land Management.

## Statement of Objectives

The present project is being undertaken in order to identify and evaluate any prehistoric or historic cultural resources present within the surveyed corridor in order to increase the known data base and protect any identified resources from potential destruction. Should sites be found they will be identified for avoidance or, if that is not possible, additional evaluation and possible mitigative measures. Artifacts collected as part of this project will be deposited at the Southwest Idaho Regional Archaeological Center in Boise, Idaho. Field notes are held on file by Sagebrush.

The survey area is on a broad plain several miles south of the Snake River in low hilly terrain. There are a few shallow arroyos and several deep ones at the western edge of the survey area above Castle Creek drainage and one large one in the southeastern part of the survey area. Vegetation in the area is generally sparse with sagebrush and bunchgrass and shadscale dominant. Because of the arid nature of the area (the nearest permanent water source is Castle Creek located about 660 meters to the west) and the absence of significant lithic resources in the area, it is likely that prehistoric site density is quite low. Evidence of historic activity will likely be absent due to the lack of water and the fact that this area does not lie on any well-traveled corridors through southern Idaho. The South Alternate Route of the Oregon Trail is nearly one mile north and northeast of the survey area. It is likely that no historic remains will be found in the survey area.

## Previous Research

Prior to conducting the survey of the project area a search was made of the cultural resources records of the State Historic Preservation Office (SHPO) through Susie Nietzel on August 1, 1991. In 1989, Frank Jenks (BLM, Bruneau Resource Area) surveyed a 0.25 acre well site for ESII in section 19 SENENW and found no cultural resources. In 1990, Sagebrush conducted a cultural resources inventory east, south and west of the existing ESII waste disposal site and found only one isolated artifact in section 19.

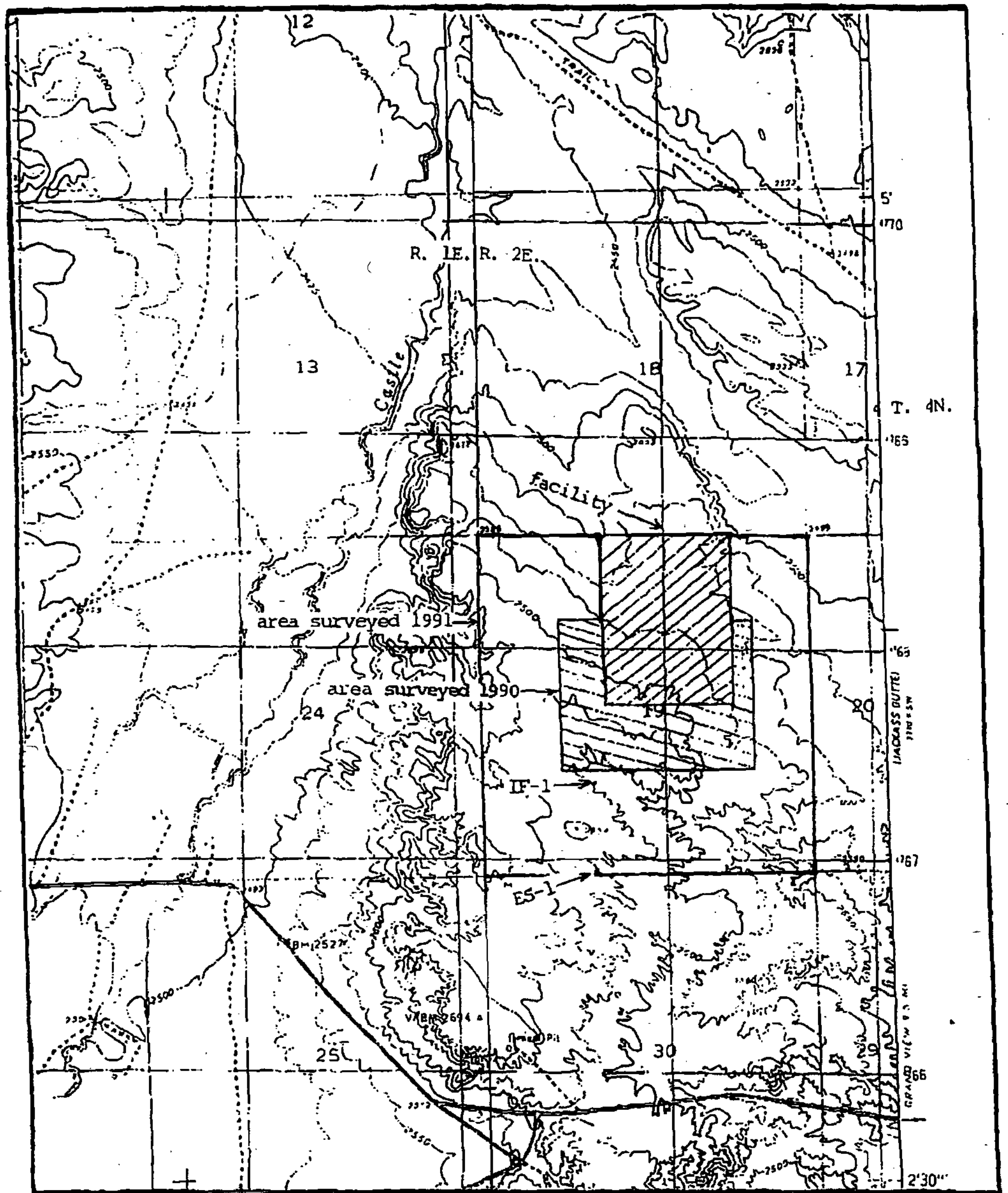



Figure 1. Location of cultural resources survey of proposed expansion of existing waste facility near Grandview, Owyhee County, Idaho. Taken from: USGS Castle Butte 7.5' Quadrangle (1948; P.R. 1976). Note site ES-1 and isolated find IF-1.

A search was also made of the National Register of Historic Places (NRHP) for significant sites in the area. None were found.

## ENVIRONMENT

The survey area is located within the Snake River Plain on the south side of the Snake River. Locally, the area consists of low rolling hills and slight to steep slopes. The elevation of the area ranges from 2500 up to 2700 feet a.s.l. There are a few sand ridges in the southwestern part of the area, but most of the soils are silts and sandy silts.

Vegetation in the survey area is sparse (20 percent average) dominated by sagebrush, bunch-grass, shadscale, four-wing saltbush and devil's thorn. Vegetation is even sparser on the north central portion of the survey area where a loose pavement of basaltic pebbles are found.

The nearest permanent water source is Castle Creek located about 660 meters to the west and the Snake River located two miles to the north. There are several shallow and deep arroyos within the survey area, but they seldom carry water.

Natural disturbance in the area includes arroyo cutting, sheetwash erosion and some minor aeolian movement of the sand areas. Cultural disturbance consists largely of the Envirosafe waste facility adjacent to the survey area (which was originally a Titan missile silo area), but also includes the gravelled access road into the facility, a gravelled section line road, several two-track dirt roads and a fence line.

## METHODOLOGY

The survey was conducted by Sean Blaine and the author on August 1 and 2, 1991. The survey block was walked in parallel transects spaced no more than 30 meters apart. The outer perimeter of the survey area was marked with stakes. The interior perimeter was marked by the Envirosafe facility fence line, a range fenceline and some old wooden stakes from the previous survey. The ground visibility was excellent. All that obscured the surface was the sparse vegetation and some gravelled access road surface in the eastern part of the survey area.

For the purposes of this project a site was considered to be a locus of human activity at least 50 years old. There had to be five or more artifacts or a feature found within a 50 foot radius. Less than this number of artifacts was considered an isolated occurrance.

## RESULTS

One prehistoric site and one isolated artifact were found during the survey of the proposed waste facility expansion area. Site ES-1 is located in the SESWSESW of S. 19 at the lee side of a sand dune and consists of a small obsidian flake scatter with three concentrations of flakes, associated with two concentrations of fire-cracked rock. This may have been a small campsite which contains limited evidence of primary and secondary lithic reduction activity. Shatter and several tertiary flakes were also noted.

IF-1, an isolated patinated obsidian biface midsection, is located in the SESWNESW of S. 19. It was found in a relatively flat area with sandy silt soil. The isolated artifact, which was found on an erosional surface, was not associated with other artifacts or features.

The expected occurrences for prehistoric sites on this survey were confirmed. Only one small site and one isolated artifact were found in the area inventoried. The results for the historic sites were also confirmed: none were found. The limited evidence of prehistoric activity is likely due to the arid nature of the area, but the fact that any artifacts were found is probably because of the occurrence of obsidian nodules in the gravels of the area. These nodules were, no doubt, quarried here and other places as raw material for tool manufacture. The absence of historic sites is, as previously noted, probably due to the absence of water and the fact that the area has never been well-traveled.

## RECOMMENDATIONS

Site ES-1 appears to be an ephemeral site. However, because there is loose shifting sand in the dune on the site, it may possess depth and limited intact subsurface cultural deposits. The observable prehistoric activity appears to be limited to some lithic reduction of locally occurring obsidian and limited occupation as evidenced by fire cracked rock on the site. In light of this information, site ES-1 is recommended eligible to the NRHP under criterion d.

This investigation was conducted with techniques which are considered adequate for evaluating cultural resources which could be adversely affected by the project. However, should cultural resources be discovered during construction, a report should be made immediately to the Boise District, Bureau of Land Management, Boise, Idaho.

I certify that I conducted the investigation reported here, that my observations and methods are fully documented, and that this report is complete and accurate to the best of my knowledge.

Signature of Reporter Date

ID-1-93-B-5

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
BOISE DISTRICT OFFICE

CULTURAL RESOURCE CLEARANCE WORKSHEET

1. Project Title and/or Case Number
Envirosafe Land Exchange - IDI-28152

2. Project/Action Description (Type of action, size, location, etc.)
The project is a land exchange involving 502 acres of BLM lands contiguous to the Envirosafe Waste Treatment Facility.

3. Individual and Organization Conducting Inventory
Michael R. Polk, Principal Investigator
Sagebrush Archeaological Consultants

4. Date of Inventory
8/17/90, 8/15/91, 4/20/92

5. Legal Location of Inventory/USGS Quad
T4S, R2E, Section 19, as shown on map / Castle Butte 7.5' USGS

6. List Site Numbers and Results of Evaluation
IF-1 - 8/17/90 & IF-1, ES-1 (10OE3821) - 8/15/91
ES-1 was determined eligible and required testing for mitigation.

7.* [X] Full Clearance [ ] Conditional Clearance [ ] Negative Clearance

8. Mitigation or Special Stipulations Needed to Protect Cultural Resource Values
The project area has been inventoried to current standards. Site 10 OE 3821 has been tested and evaluated. No further cultural work is needed. Project may proceed as planned.

| Signature | Date |
|---|---|
| 9. Cultural Resource Specialist<br>Lois M. Palmgren | 12/9/92 |
| 10. Area/District Manager<br>John C. Sullivan | 12-9-92 |

* Cultural resource clearance will indicate that an action has no impact upon cultural resources, or that impacts have been satisfactorily resolved. A conditional or negative clearance will indicate that cultural resource problems are not resolved and further steps must be taken to mitigate the impact. Copies of completed clearance worksheet must be submitted to the State Historic Preservation Officer.

ID-010-8100-3
Rev. May 1989

AMERICAN GEO TECHNICS

# TELECON REPORT

| | | | |
|---|---|---|---|
| | | DATE: | April 19, 2006 |
| TO: | John Sullivan | TIME: | 9:00 a.m. |
| LOCATION: | Bureau of Land Management<br>Field Manager<br>384-3338<br>john_sullivan@blm.gov | PROJECT NO.: | 06B-C1202 |
| From | Tim Johnson | DISTRIBUTION: | John Sullivan<br>Rex Hansen<br>Tim Johnson |
| LOCATION: | American Geotechnics, Boise Office | | |
| SUBJECT: | US Ecology Section 19 Siting: BLM mineral potential and cultural resources reports | | |

Item:

As Stated by Tim

*"John and Tim spoke by concerning US Ecology Idaho's plan to expand their facility. Tim asked John about obtaining cultural resource and mineral potential clearance for the expansion, including all of Section 19. John explained to Tim that no such clearance was necessary, because Section 19 is owned by US Ecology Idaho and is therefore private land. John explained that cultural resource and mineral potential studies were completed when the previous owner of US Ecology Idaho Hazardous Waste Site (Envirosafe) obtained Section 19 from BLM. John explained that BLM clearance concerning cultural resources and mineral potential in Section 19 was granted prior to the sale to ensure the protection of any sensitive areas."*

As stated by John through email (exactly)

*"John Sullivan informed Tim Johnson that the portion of Section 19 located outside of US Ecology's current Hazmat Facility was acquired by Envirosafe Services of Idaho. Inc. (predecessor to US Ecology) through a land exchange with BLM. The land exchange process included a cultural inventory and a mineral potential report to verify that no significant cultural or mineral resources existed on the lands being transferred to Envirosafe. However, now that Section 19 is in private ownership, BLM has no further management or regulatory interest in the property. US Ecology need only concern themselves with whatever regulatory requirements exist from EPA, DEQ, or other state or local agencies."*

Tim Johnson

AMERICAN GEO TECHNICS

# APPENDIX F

## PARKS AND RECREATION

AMERICAN GEO TECHNICS

April 18, 2006
Project No. 05B-C1202

Idaho Department Parks and Recreation
PO Box 83720
Boise, Idaho 83720-0065

Attention: Richard Novotny

SUBJECT: US Ecology Idaho, Section 19 Siting Application and Reserved Areas
Grand View, Idaho

Dear Richard,

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on reserved, scenic, or natural use lands. We appreciate your guidance in this regard, and are sending this letter as a formal request for the Idaho Department of Parks and Recreation to identify any state or national park, or land reserved for scenic or natural use that may be affected. These lands include, but are not limited to, wild and scenic areas, national monuments, wilderness areas, historic sites, recreation areas, preserves, and scenic trails. As you requested, we have attached a map indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho.

The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

Please provide a letter indicating the existence and/or status of any reserved or withdrawn areas that may be adversely affected by the addition of landfills located within Section 19. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com* or *tjohnson@americangeotechnics.com*. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

American Geotechnics 2300 N Yellowstone Hwy, Suite 203 • Idaho Falls, ID 83401 • (208) 523-8710
5260 Chinden Blvd. • Boise, ID 83714 • (208) 658-8700

Respectfully submitted,

**American Geotechnics**

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachment: Figure 2, Property Line & Section 19 Siting Map, US Ecology, Grandview, Idaho. April 2006.

*Letter included without attachments unless otherwise noted.*

DIRK KEMPTHORNE
governor

Robert L. Meinen
director

Dean Sangrey, Administrator
operations division

David Ricks, Administrator
management services division



IDAHO DEPARTMENT OF
PARKS AND RECREATION

p.o. box 83720
boise, idaho 83720-0065

(208) 334-4199

fax (208) 334-3741

tdd 1-800-377-3529

street address
5657 Warm Springs Avenue

www.parksandrecreation.idaho.gov

May 24, 2006

Rex W. Hansen, PE Geotechnical Engineer
American Geotechnics
5620 Chinden Blvd.
Boise, ID 83714

RE: US Ecology Idaho Hazardous Waste Site Expansion

Dear Mr. Hansen:

This letter is in response to your letter regarding US Ecology Idaho Hazardous Waste Site Expansion sent to Richard Novotony, Staff Engineer. US Ecology proposes to expand its hazardous waste site in Owyhee County. You requested that the Idaho Department of Parks and Recreation (IDPR) identify any state or national park or land reserved for scenic or natural use that may be affected.

Thank you for including a map of the proposal. The map made our analysis easier.

The nearest IDPR facility is Bruneau Dunes State Park that is located 30 miles southeast of the site. The nearest National Conservation Area is the Snake River Birds of Prey. Contact the John Sullivan, NCA Manager at (208) 384-3300 for more information on impacts to the NCA. Note: The NCA is not located in Section 19.

Thank you for the opportunity to comment on this proposal. If you have any questions about these comments, please contact me at (208) 334-4180 ext. 230.

Sincerely,

Jeff Cook

Jeff Cook, Outdoor Recreation Analyst
Comprehensive Planning, Research, and Review

April 17, 2006
Project No. 05B-C1202

Snake River Birds of Prey National Conservation Area
Bureau of Land Management
Four Rivers Field Office
3948 Development Ave.
Boise, Idaho 83705

Attention: John Sullivan, NCA Manager

SUBJECT: US Ecology Idaho, Section 19 Siting: Snake River Birds of Prey Area
Grand View, Idaho

Dear John:

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on the Snake River Birds of Prey National Conservation Area. We appreciate your guidance in this regard, and are sending this letter as a formal request for your review of the proposed expansion and comments concerning any potential adverse effects the expansion may have on the Birds of Prey Area. We have attached a map indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho.

The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. Landfills will not be placed on US Ecology Idaho property in Section 20 to the east. Nor will landfills be placed on US Ecology Idaho property in Section 18 to the north or Section 13 to the northwest. The property in Sections 18 and 13 was acquired by US Ecology Idaho from the Bureau of Land Management under the agreement that the land would be protected as a buffer zone. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

Please provide a letter indicating any adverse effects that additional hazardous waste landfills within Section 19 may have on the Snake River Birds of Prey National Conservation Area. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com* or *tjohnson@americangeotechnics.com*. Alternatively, you may fax your response to our office at (208) 658-8703. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

Respectfully submitted,

American Geotechnics

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachment: Figure 2, Property Line & Section 19 Siting Map, US Ecology, Grandview, Idaho. April 2006.

*Letter included without attachments unless otherwise noted.*

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Boise District Office
3948 Development Avenue
Boise, Idaho 83705
http://www.id.blm.gov/offices/lsrd

TAKE PRIDE® IN AMERICA

In Reply Refer To:
6230

May 26, 2006

Timothy C. Johnson
American Geotechnics
5260 Chinden Blvd.
Boise, ID 83714

Dear Mr. Johnson:

I am in receipt of your April 17, 2006 letter requesting a review of US Ecology Idaho's proposed landfill expansion in Section 19, T. 4 S., R. 2 E., Boise Meridian, Idaho. Section 19 is bordered by BLM-administered public lands in the Snake River Birds of Prey National Conservation Area (NCA). As you probably know, the original approximate 100-acre landfill was previously surrounded by BLM land. In 1994, US Ecology Idaho's predecessor (Envirosafe) acquired from BLM the remaining lands in Section 19 through a land exchange. US Ecology Idaho acquired the lands in Sections 13 and 18 from BLM in a subsequent (2005) land exchange.

Prior to the 1994 land exchange, Envirosafe constructed several monitoring wells on BLM land in Section 19. As part of the permit for the current landfill expansion proposal, we would request DEQ and/or EPA to require setbacks from adjacent property of sufficient width to accommodate construction of future monitoring wells wholly within US Ecology Idaho's existing property. This would preclude additional impacts to the NCA's raptor and raptor prey habitat from construction and maintenance of well pads and access roads. It would also preclude associated off-site impacts resulting from increased recreational use of the access roads.

Thank you for the opportunity to comment on the proposed landfill expansion. Please contact me at 384-3338 if you have any questions.

Sincerely,

John Sullivan

John Sullivan
NCA Manager

RECEIVED

MAY 19 2006

AMERICAN GEO TECHNICS

## TELECON REPORT

| | | | |
|---|---|---|---|
| | | DATE: | June 1, 2006 |
| TO: | John Sullivan | TIME: | 11:45 a.m. |
| LOCATION: | Bureau of Land Management<br>Manager<br>384-3338<br>john_sullivan@blm.gov | PROJECT NO.: | 06B-C1202 |
| From | Tim Johnson | DISTRIBUTION: | John Sullivan<br>Rex Hansen<br>Tim Johnson |
| LOCATION: | American Geotechnics, Boise Office | | |
| SUBJECT: | US Ecology Section 19 Siting: Birds of Prey National Conservation Area | | |

Item:
Prior to this conversation, John submitted a response letter to American Geotechnics discussing possible effects additional hazardous waste landfill cells within Section 19 could have on the Birds of Prey NCA area. In the letter, John requested that the Idaho Department of Environmental Quality and/or the Environmental Protection Agency "require setbacks from adjacent property of sufficient width to accommodate construction of future monitoring wells wholly within US Ecology Idaho's existing property. This would preclude additional impacts to the NCA's raptor and raptor prey habitat from construction and maintenance of well pads and access roads. It would also preclude associated off-site impacts resulting from increased recreational use of the access roads."

Tim called John for clarification on this issue. Tim asked John if the purpose of his letter was to ensure that monitoring wells and associated access roads would not need to be placed on BLM lands. John concurred. Tim then explained to John that a 500 foot inactive buffer zone was required for the siting application, and that no active cells would be constructed within 500 feet of any Section 19 boundary. Tim then asked John if he (John) felt that a 500 foot boundary would be sufficient for the purposes stated in his (John's) letter. John stated that a 500 foot boundary would be sufficient, as long cell construction and operation did not require monitoring wells or access roads to be constructed on Bureau of Land Management property.

Tim Johnson

# APPENDIX G

## TRANSPORTATION CONTINGENCY PLAN

# STEVE FORLER TRUCKING, INC.

# TRANSPORTER CONTINGENCY PLAN

TABLE OF CONTENTS

CONTINGENCY PLAN

1. **EMERGENCY ACTION:** In the event of an emergency or hazardous waste spill during transportation, the transporter must take appropriate immediate action as per 40CFR part 263.30 to protect human health and the environment. In accordance with 40CFR part 263.32 the transporter must also clean up any hazardous waste discharge that occurs during transportation or take such action as may be required or approved by Federal, State or local officials so that the hazardous waste discharge no longer presents a hazard to human health or the environment.

1.1 Driver Procedures:

1.1.1. Immediately contact the local police and/or fire department by calling 911.

1.1.2. Immediately contact the company Owner and Idaho Operations Managers at the numbers listed below and report the incident to them. It is their responsibility to immediately implement the Transporter Contingency Plan Notification Procedures.

| | | |
|---|---|---|
| Owner/WA Ops.: | Steve Forler | Work- (360) 893-6230<br>Cell- (253) 209-0826 |
| Idaho Operations: | Lyle Hanks | Cell- (208) 599-1891 |

1.1.3. Containment: The critical problem is to prevent the escape of any spilled liquid or solid into the ground or into the storm or sanitary sewer. A barrier will be erected immediately to prevent escape of spilled material/waste liquids, using whatever material is at hand, even a dirt curb to prevent spreading of the spill. Containment of solids will be dependant on wind and weather conditions. Using the tarpaulin in the vehicle, or visqueen in spill kit, if conditions are wet and/or windy.

1.1.4. Remain with the unit and warn pedestrians and motorists to stay away from the spill area, pointing out to them the danger involved.

1.1.5. Upon the arrival of the police and/or fire department, the driver will inform them of what kind of material has been spilled and request the area be blocked off to pedestrians and vehicles to prevent property damage or any serous personal injury.

1.1.6. The driver will notify Chemical Transportation Emergency Center to request information regarding the hazardous material that was spilled: **CHEMTREC 800-424-9300**

1.2. Emergency Coordinator Transporter Contingency Plan Notification Procedures:

1.2.1. The Emergency Coordinator will immediately notify the National Response Center and Director of the Office of Hazardous Material Regulation, Material Transportation Bureau, Department of Transportation, in the event of:

- A person is killed or requires hospitalization due to injuries
- Carrier or property damage exceeds $50,000.
- Notification caused by continuing danger of life
- Incidents requiring evacuation of the general public for one or more hours
- If the major transportation artery or facility is slowed or shutdown for one or more hours
- Fire, breakage, spillage, or suspected contamination occurs involving shipments of infectious substances
- There has been a release of a marine pollutant in a quantity exceeding 450 L (119 gallons) for liquid or 400 kg (882 lbs) for solids
- A situation exists of such a nature (eg. A continuing danger to life exists at the scene of the incident) that, in the judgment of the carrier, it should be reported to the National Response Center even though it does not meet the criteria of paragraph (a) 1,2 or 3 of section 49CFR part 171.15

1.2.2. Steve Forler Trucking must also contact the National Response Center and give notice for hazardous wastes as required under 40CFR 263.30( c) (1).

1.2.3. Call the proper State Authority using the telephone numbers listed under Part 3 of the Contingency Plan.

1.2.4. Follow the Emergency Coordinator Transporter Contingency Plan Notification Procedure.

1.2.5. Follow all the procedures from Part 2 through Part 11 that follows:

## 2. EMERGENCY REPORTING:

2.1. In the event of an emergency or a hazardous waste spill during transportation, the Emergency Coordinator will gather the following information from the driver and relay it to the National Response Center and the Department of Public Safety (see phone numbers in Section 3).

- Name of person reporting the incident
- Name, address, and I.D. Number of the transporter
- Phone number where person reporting can be reached
- Date, time and location of the incident
- The extent of injuries, if any
- Classification, name and quantity of hazardous materials/ wastes involved.
- Type of incident and nature of hazardous material/waste involved and whether a continuing danger exists at the scene

- For each waste product involved provide:

    - Name and I.D. number of generator
    - Product shipping name, hazard class, and ID number (UN or NA number)
    - Estimated quantity of material spilled
    - If possible the extent of contamination to land, water or air

- Shipping name, hazard class and the U.N. number of any other material carried.

2.2 In the event of an emergency or a hazardous waste spill during the transportation, the transporter will immediately notify the affected municipality of the occurrence and the nature of the spill, along with the local fire and police departments.

2.3 The generator of the hazardous waste will be notified:
Bill Hague, Honeywell at (973) 455 - 2175

2.4 The transporter will submit a report of the incident in writing within 30 days to the Director, Office of Hazardous Material Registration, Materials Transportation Bureau, Department of Transportation, Washington, D.C.. 20590, send a copy to the Idaho Department of Environmental Quality at 1410 North Hilton, Boise, Idaho 83706, and send another copy of the report to the generator.

2.5 Additional follow-up is also required by 40 CFR part 263.30 ( c)(2) stating that a written report for hazardous waste incidents must be sent to the Director, Office of hazardous Materials Regulation, Materials Transportation Bureau, Department of Transportation, Washington, DC 20590.

3. EMERGENCY RESPONSE NUMBERS
    - STEVE FORLER TRUCKING 253-209-0816
    - CHEMTREC 800-424-9300
    - Idaho Emergency Communication Center (IECC) 1-800-632-8000
    - U.S. COAST GUARD/USEPA NATIONAL RESPONSE CENTER 800-424-8802 OR 202-426-2675

4. EMERGENCY CORRDINATORS AND CONTACTS:

    1. STEVE FORLER
    19827 150th Avenue East
    Graham, WA 98338
    Or P.O. Box 1479
    Orting, WA 98360
    Office # 800-406-1173
    Cell-253-209-0816

    2. LYLE HANKS

P.O. Box 1029
Mountain Home, ID 83647
208-599-1891

5. EMERGENCY CONTRACTOR:

    1. Environmental Management Solution
       5111 Alworth, Suite G
       Boise, ID 83714
       208-939-0154 office
       208-841-1952 cell

6. EMERGENCY MEDICAL RESPONSE

Phone Numbers:

Grand View EMT 800-632-8000
Elmore Memorial Hospital (208) 587-8401

Directions to Elmore Memorial Hospital:

| | |
|---|---|
| From USEI Site: | Turn Left (East) on Highway 78 to Grand View<br>Turn Left (North) on Highway 67 towards Mountain Home |
| From Simco / RTF: | South on Simco Road to Highway 67<br>Turn Left (East) on Highway 67 towards Mountain Home |
| | Turn Left (north) onto Highway 51<br>Turn Left (north) on North 2nd Street East<br>Turn Right onto East 4th Street North<br>Turn Left onto North 6th Street East<br>Turn Right on East 9th Street North |

7. EXTERNAL COMMUNICATIONS

The only means of communication the driver will have in the truck will be a citizens band radio and/or a cell phone.

8. ROUTINE DECONTAMINATION PROCEDURES

8.1. A truck or trailer exposed to a spill or leak will be decontaminated at the site in order to prevent any further release to the extent that it can be transported (or move under its own power) to an authorized facility capable of further decontamination, if necessary.

8.2. Equipment will be decontaminated in the following manner: Each Item used will be placed in an open head container and thoroughly rinsed with a compatible solvent or cleaning compound. The residue or wash water will then be drained into a tight head container, sealed and disposed of in accordance with Federal and State Regulations at an authorized disposal site.

8.3. Contaminated clothing will be placed with the clean up residue and disposed of in accordance with Federal and State regulations at an authorized disposal site. If clothing is re-usable, then it will be decontaminated properly and the residue added to the other waste

## 9. TRAINING

9.1. The emergency coordinator will train and instruct all personnel in the following areas:

- 24 hour OSHA Training
- Yearly 8 hour refresher OSHA Training
- General maintenance of all equipment
- Inspection and Reporting Procedures
- Response to Emergencies
- Contingency Plan Implementation
- Operation and use of Respirator

## 10. SAFETY, SPILL CONTROL AND EMERGENCY EQUIPMENT

Each tractor carries the following emergency equipment, stored in a sturdy aluminum box or over-pack drum:

- Gloves
- Goggles
- Slicker Suit
- Boots
- Respirator
- Hazorb
- Shovel
- Hard hat
- DOT Emergency Response Guidebook
- Skin and Eye Neutralization Solution
- Emergency reflective triangles (3)

Each tractor also carries:

- First Aid Kit
- Ten (10) pound ABC fire extinguisher

## 11. MAINTENANCE

Trucks and trailer are on a regimented maintenance schedule set up by Steve Forler Trucking Inc. Drivers do a pre-trip check before leaving the yard. All other maintenance is done by qualified mechanic with the exception of major repairs. All equipment will be tested and maintained as necessary to ensure its proper operation.

## 12. FOLLOW UP PROCEDURES

12.1.1. Decontamination: A truck or trailer exposed to a spill or leak will be decontaminated at the site in order to prevent any further release to the extent that it can be transported (or move under its own power) to an authorized facility capable of further decontamination, if necessary. Equipment will be decontaminated in the following manner: Each Item used will be placed in an open head container and thoroughly rinsed with a compatible solvent or cleaning compound. The residue or wash water will then be drained into a tight head container, sealed and disposed of in accordance with Federal and State Regulations at an authorized disposal site. Contaminated clothing will be placed with the clean up residue and disposed of in accordance with Federal and State regulations at an authorized disposal site. If clothing is re-usable, it will be decontaminated properly and the residue added to the other waste.

12.1.2. Notification: As previously stated in this plan the following will be notified in case of an incident: The Department of Transportation, Director, Office of Hazardous Materials Registration, Materials Transportation Bureau, Washington D.D. 20590, by written notice of the spill and nature of the incident

12.1.3. Cleanup: Spilled material will be cleaned up by the contractor or cleanup contractor in accordance with Local State and Federal Regulations.

# APPENDIX H

## ECONOMIC IMPACT REPORT

# AN ANALYSIS OF THE ECONOMIC AND FISCAL IMPACTS OF AMERICAN ECOLOGY CORPORATION'S IDAHO OPERATIONS

Prepared by:

Don Reading, PhD
Consulting Economist
Ben Johnson Associates, Inc.
6070 Hill Road
Boise, Idaho 83703

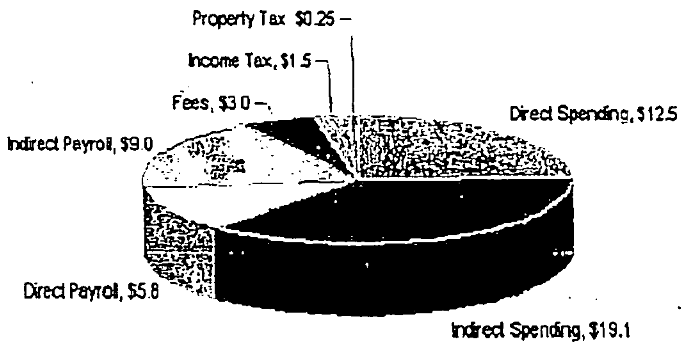
February 2006

*Executive Summary*

- American Ecology and its employees added $51 million to the Idaho economy in 2005.

- Direct and indirect annual Idaho impacts include:
    - 250 jobs
    - $14.8 million in payroll
    - $31.6 million in additional spending
    - $4.75 million in taxes and fees

## 2005 Economic Impact ($51 million)




- Founded in 1952, American Ecology is the oldest company in the waste management industry and is headquartered in Boise. Its largest treatment and disposal facility is located near Grand View and operates as "US Ecology Idaho."

- US Ecology Idaho is the largest property taxpayer in Owyhee County and the largest taxpayer in the Bruneau-Grand View School District (15% of the District's total tax revenue).

- With 67 current employees, US Ecology Idaho is Owyhee County's largest private non-agriculture employer. Its average hourly wages are 39% higher than the average wage in Owyhee County. The company provides full health coverage and other benefits after 30 days of hire.

- The Company contributes $15,000 to $20,000 annually to local schools and community service organizations, including the Future Farmers of America, meals-on-wheels, other senior center programs, and educational projects.

*American Ecology is Growing*
American Ecology Corporation is a growing company. Revenues have grown from $42 million in 2000 to over $54 million in 2004. The company's stock price has also risen in five years from about $2 per share to its current value of about $17 dollars.[1] The Company's stock has outperformed industry averages over the past five years (See Figure 1).

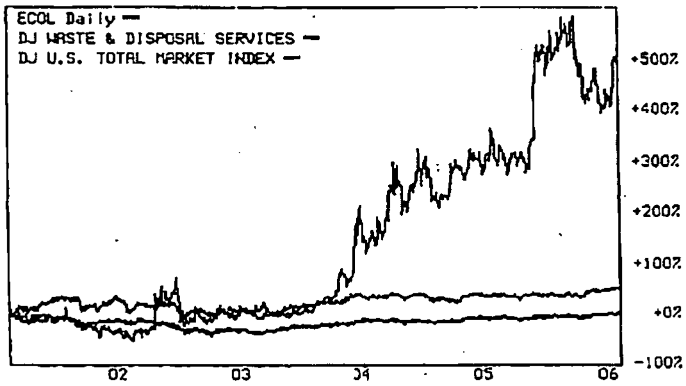



**Figure 1: American Ecology's five-year stock performance**

A key to the Company's success is the company's US Ecology Idaho operations. Business growth in Idaho fueled the increased in-state employment, spending, and tax and fee payments which are the subject of this report.

*Economic Impact Extends Statewide*
Economic impact to a region is more than just direct expenditures by a Company or the wages paid to workers. Workers spend a portion of their income in the community which in turn becomes sales to other firms. US Ecology purchases goods and services from other companies, who in turn purchase goods and services from their suppliers, and so on. The sums of the spending, employment, and personal income associated with these inter-industry transactions are called *indirect impacts*. This positive impact is known as the multiplier effect.

The multiplier is the indicator of how many times this spending turns over in the economy. Economic studies of the waste disposal industry have shown multipliers that range from 2.0 to 2.7 depending on the location and the type of multiplier. There are a variety of multipliers that depend on the economic measure of interest. Multipliers are calculated based on revenue, jobs, payroll, etc. Beck and Chartwell found multipliers for the waste disposal industry of 2.58 for

[1] AEC is a publicly traded ("ECOL") provider of radioactive and hazardous waste services. The Company operates four disposal facilities through its US Ecology subsidiaries. These include Grand View, Idaho; Robstown, Texas; Beatty, Nevada and Richland, Washington.

jobs, 2.56 for payroll, and 2.23 for revenue. These are the values used in this report.[2]

To illustrate how a multiplier works: The jobs multiplier of 2.58 would mean that for each employee of American Ecology, an additional 1.58 jobs is created (for a total of 2.58 jobs).

*Company Services*
US Ecology Idaho provides treatment and disposal services for PCB, hazardous, and non-hazardous wastes. Customers include steel mills, medical and academic institutions, refineries and chemical manufacturing facilities. In addition, the facility accepts certain naturally occurring and accelerator-produced radioactive materials and low activity radioactive material exempted from regulation by the U.S. Nuclear Regulatory Commission. Substantial waste volumes are received under a contract with the U.S. Army Corps of Engineers.

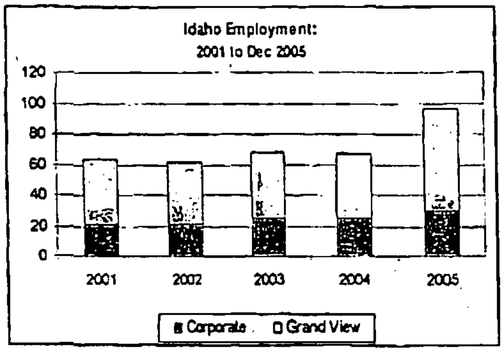
*Company's Economic and Fiscal Impact is Significant*
American Ecology's corporate headquarters have been located in Boise since 1995. As of January 2006, 30 people worked at its offices in the Park Center area of southeast Boise. Most of these employees reside in Ada County.

The US Ecology Idaho facility currently employs 67 people from the Grand View/Mountain Home area. The facility and surrounding buffer zone occupies 1,100 acres of Company-owned land 60 miles southeast of Boise and an additional 120 acres at a rail transfer facility located on Simco Road in Elmore County. The Grand View facility is regulated under permits and regulations of the Idaho Department of Environmental Quality and the U.S. Environmental Protection Agency.

The jobs provided by the Company in Idaho cover a wide range of skills from the corporation's executive management group to professional chemists, health and safety and environmental specialists, heavy equipment operators, accountants, information technology and computer professionals, and support staff. The Company's economic contribution is especially important to Owyhee (population 10,998) and Elmore counties (population 28,878).

*Employment*
US Ecology employment in Idaho has grown 54% in the past five years. Current statewide employment stands at 97. US Ecology is now Owyhee County's largest non-agricultural private sector employer. Growth of Company employment and the job creation multiplier associated with US Ecology is depicted in Figure 2:

[2] R.W. Beck and Chartwell Information Publishers (2001), 'Size of the United States Solid Waste Industry.' Sponsored by the Environmental Research and Education Foundation, Washington D.C.



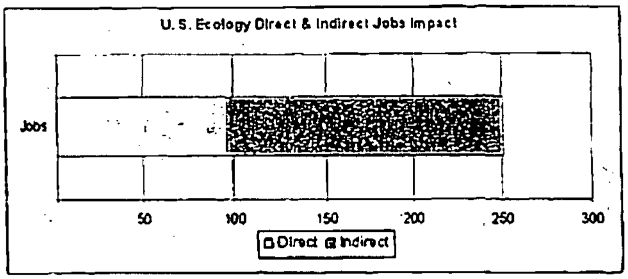




**Figure 2: Company growth in employment, and total job impact using a multiplier.**

*Payroll and Benefits*

The Company payroll for the Idaho waste facility and headquarters was $5.8 million in 2005. The current average hourly wage of all 97 Idaho workers is $20.42. The average wage for US Ecology Idaho employees is currently $15.13 per hour.[3] This figure excludes corporate employees and exceeds the average wage in Owyhee County ($10.89 per hour) by 39%. In addition, employees add 13% on average to their wages by working overtime. See Figure 3:

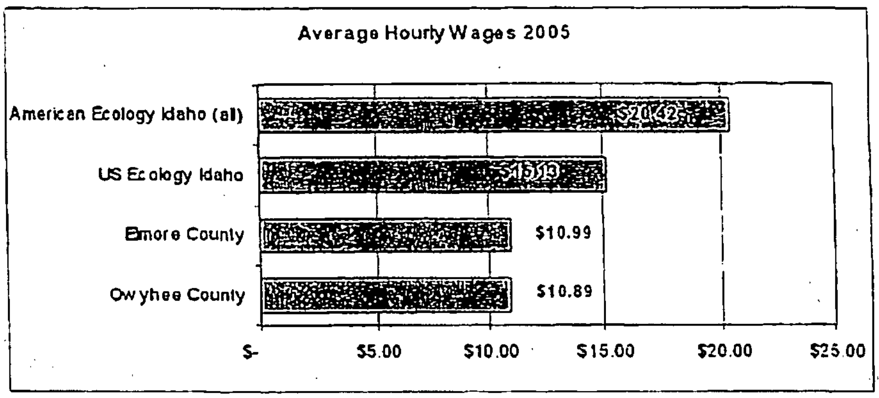



**Figure 3: US Ecology jobs pay more than the Owyhee and Elmore County average.**

All American Ecology employees including subsidiary US Ecology Idaho receive full benefits equal to an average of 30% of payroll after 30 days of hire. The benefits include a complete range of health insurance and retirement coverage, as well as mandatory social security and workers compensation coverage.

US Ecology's average wages compare favorably against other industries in the state, and other new jobs being created in Idaho[4] and exceed many jobs in the high tech industry. See Figure 4:

3 Non-corporate employee wage current as of December 2005.
4 Idaho Dept. of Commerce Idaho Occupational Employment and Wage Survey for 2005 – January 2006 edition

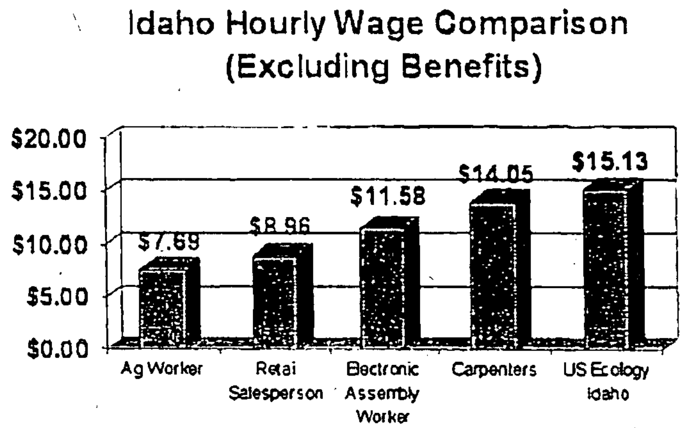



**Figure 4: US Ecology jobs pay more than many other Idaho jobs.**

*Capital Spending*

Over the past five years US Ecology Idaho has spent a total of $13.3 million for facility improvements and capital equipment. Of those expenditures, 75% or $10.6 million have been spent through Idaho firms. See Figure 5:

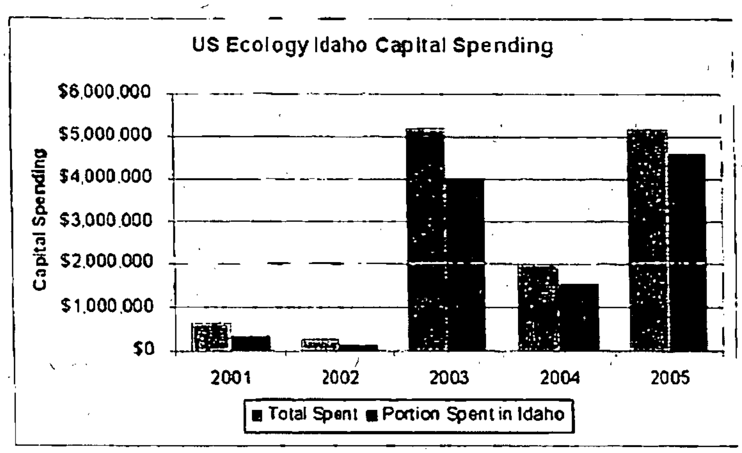



**Figure 5: US Ecology capital spending and share spent with other Idaho companies.**

*Vendor Purchases in Idaho*

In addition to capital spending, US Ecology also purchases goods and services from Idaho vendors to support ongoing operations. During 2005 the Company purchased $10.7 million in goods and services from Idaho construction and trucking companies, reagent suppliers, consulting firms, and law and accounting firms. With the multiplier effect, this spending adds another $13.2 million to the Idaho economy. See Figure 6:

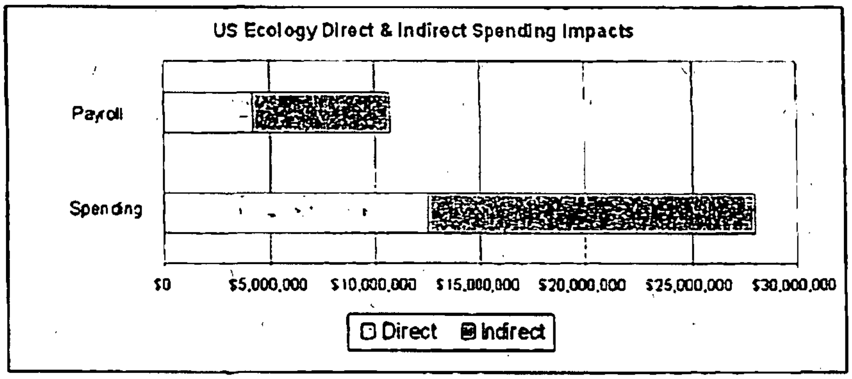



**Figure 6: Total payroll and spending impact.**

*Government Fiscal Support*

In 2005, the Company paid nearly $5 million to state and local government in general taxes and tipping fees for waste disposal. Over the past 5 years tipping fee payments to the State General Fund have been over $9.1 million and nearly $481 thousand to Owyhee County. These fee payments have increased each year for the last five years due to increased business activity (See Figure 7). In 2005, tipping fees reached nearly $3 million. Unlike taxes, fees create a multiplier effect, resulting in an additional $3.7 million in Idaho spending in 2005.

In Owyhee County, tipping fees paid by US Ecology are used for emergency preparedness and response projects such as:

- Funding over 75% of the County's 911 system
- Purchasing ambulances and fire engines
- Training and equipping emergency response teams
- Contributing to Homedale Airport pesticide clean-up
- Supplying video cameras for police & emergency responders

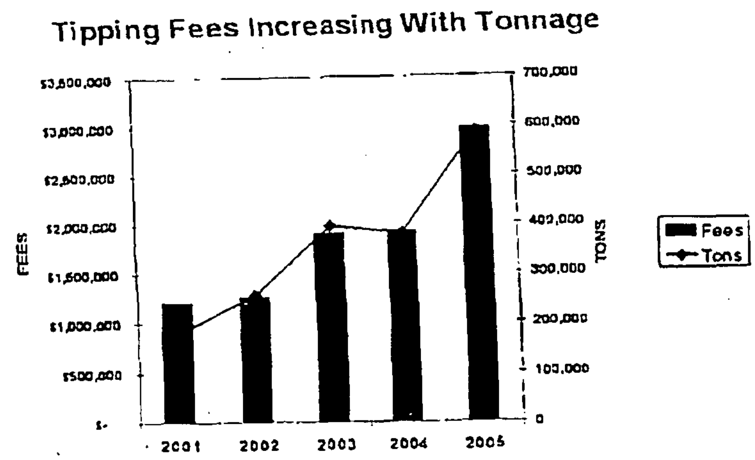



**Figure 7: State and County fees increase**

The Company also pays property taxes to Elmore and Owyhee counties. Assessed taxes for 2006 for Elmore County are over $31 thousand, and over $218 thousand in Owyhee County. In Owyhee County the company accounts for 4% of county tax revenues. Of the company's annual property taxes, $103 thousand goes directly to the Grand View – Bruneau School District, providing 15% of the District's property tax revenues. The Company is the School District's largest property taxpayer.

In addition, during 2005 the Company paid just under $1.4 million in sales and income taxes to the State of Idaho. Figure 8 depicts US Ecology Idaho's 2005 property and sales and income taxes:

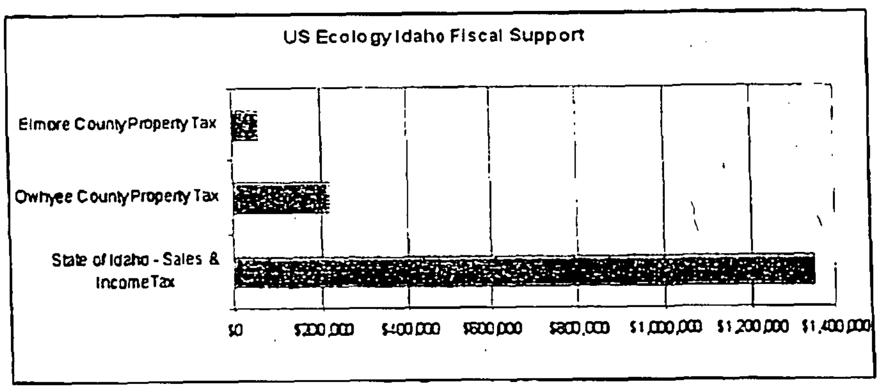



**Figure 8: Support to local and state government via property, sales, and income taxes.**

*Charitable Contributions*

US Ecology Idaho maintains an annual charitable contribution program, and donates $15,000 to $20,000 annually to worthwhile causes in the community. A panel of local community leaders helps choose projects to fund. Contributions have included support for the Owyhee County Museum, Little League, FFA classes, elementary school computer program, senior citizen centers and meals-on-wheels programs, and dozens of other worthwhile causes. 2005 donations included:

| | |
|---|---|
| Grand View American Legion | Funds toward roof repair |
| Eastern Owyhee County Library | Sagebrush InfoCenter Automation Program & Tech Support to network the schools with the library |
| Grand View Lions Club | In-kind contribution to help fill the ditch next to Hwy 67 in Grand View for pedestrian and vehicle safety |
| Grand View Little League | Equipment |
| Homedale FFA | LCD projector for classes and demonstrations |
| Homedale High School | Material to build 12 bat houses for insect control |
| Homedale Public Library | Audio books |
| Homedale Senior Center | Commercial two-door freezer |
| Marsing Elementary | Computers for classroom, ESL and after-school programs |
| Marsing Resource Center | Copier and cartridges for after-school program |
| Marsing Senior Center | Commercial freezer and ice machine |
| Oreana Community Hall | Funds toward new furnace |
| Owyhee County Probation Dept. | After school program resources |
| Rimrock Jr-Sr High School | Centrifuge and spectrophotometer for science class |
| Silver City Fire & Rescue, Inc. | In-kind contribution for helipad |

US Ecology also provides personnel and equipment for annual Household Hazardous Waste Clean-up events in Mountain Home and Glenns Ferry. Over 50 barrels of household hazardous waste are collected and disposed by the company annually. This will be the company's 12th year of providing this service.

*Road Paving Project*

In 2004, US Ecology Idaho teamed up with the Simplot Company and the Mountain Home Highway District to pave the 12 remaining gravel miles of Simco Road in Elmore County from Interstate-84 south to Highway 67. The improved road benefits the operations of Simplot and US Ecology Idaho, as well as the Mountain Home Air Force Base, residents of Grand View and Owyhee County, and recreational users of CJ Strike Reservoir. As a result of this paving project, use of the road has increased from 300 vehicles per day in 2004 to an average of 900 vehicles per day in February 2005, a 300% increase. Road paving positive externalities (or positive side benefits) include reduced travel times, increased safety, increased real estate values in the vicinity of the road and lower air pollution from dust. See Figure 9:

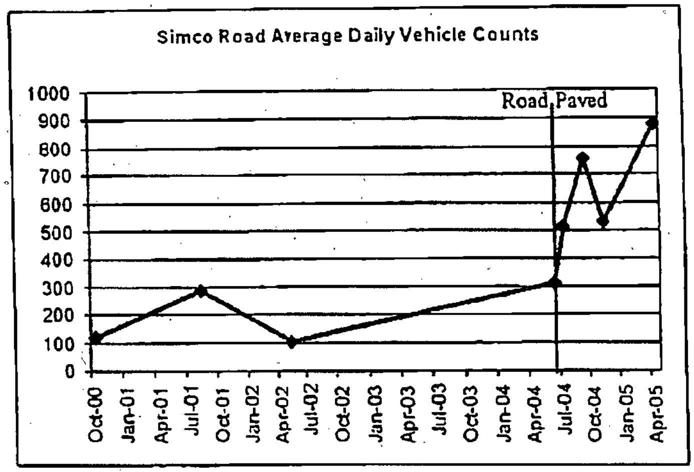



**Figure 9: Traffic has increased dramatically on Simco Road following 2004 paving.**

*Economic Impact Summary*

The Company's employment of 97 people creates an additional 153 jobs in Idaho.

The annual payroll of $5.8 million generates an additional payroll of $9.0 million as the spending turns over in the Idaho economy.

The purchase of $12.5 million in goods and services in Idaho in 2005 causes an additional $15.4 million in spending.

Payment of nearly $5 million in taxes and fees provides significant support to local governments and contributes significantly to overall state revenues. An economic impact multiplier is calculated for tipping fee payments of $3 million, adding another $3.7 million to the Idaho economy.

*Conclusion*

Idaho-based American Ecology Corporation's financial strength has been aided by the growth of its in-state waste treatment and disposal business. Employment, revenue, spending on goods and services, taxes and fees have all increased as its Idaho business has grown. The overall economic impact of the company to the state is significant, with a combined direct and indirect impact of 250 jobs, $14.7 million in payroll, and $31.6 million in additional spending. State and local governments accrued nearly $5 million in additional tax and fee payments. See Figure 10:

## 2005 Economic Impact ($51 million)

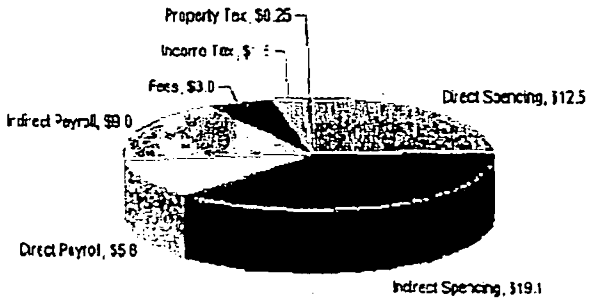



Figure 10: American Ecology added $51 million to Idaho's economy in 2005.

## Author's Biography

Don Reading, PhD has more than 20 years of experience in the field of economics. He received his B.S. in Economics from Utah State University, an M.S. in Economics from the University of Oregon, and a PhD in Economics from Utah State University. In his career, Dr. Reading has worked for Ben Johnson Associates, the Idaho Public Utilities Commission and as an educator in Tennessee, Idaho and Hawaii. A Boise resident, Dr. Reading consults for several Idaho companies, including Idaho Power, Amalgamated Sugar, and J.R. Simplot Company. He is one of four economists providing yearly forecasts of statewide personal income to the State of Idaho for purposes of establishing state personal income tax rates. Dr. Reading has also prepared economic forecasts for the Southeast Idaho Council of Governments and the Revenue Projection Committee of the Idaho State Legislature. He has been a member of the several Northwest Power Planning Council Statistical Advisory Committees and is currently vice chairman of the Governor's Economic Research Council in Idaho.

Boise Office:
Ben Johnson Associates, Inc. 6070 Hill Road Boise, Idaho 83703
Ph: (208) 342-1700 Fax: (208) 384-1511 email: dreading@mindspring.com

# APPENDIX I

## AREA SCHOOLS, HOSPITALS, AND CHURCHES

**Public and Private Schools near US Ecology Idaho Hazardous Waste Landfill Facility**

| School | | Distance to USEI (straight line) |
|---|---|---|
| Grand View Elementary School<br>205 1st Street<br>Grand View, ID. 83624 | (208) 834-2775 | ~ 10.2 miles |
| Rimrock Jr-Sr High School<br>39678 State Highway 78<br>Bruneau, ID 83604 | (208) 834-2260 | ~16.7 miles |
| Desert View Christian School<br>33386 Mud Flat Road<br>Grand View, ID. 83624 | (208) 834-2802 | ~45.9 miles |
| Liberty Elementary School<br>200 Main Street<br>Mtn. Home AFB, ID. 83648 | (208) 832-4665 | ~20.8 miles |
| Bruneau Elementary School<br>28541 Benham Ave.<br>Bruneau, ID. 83624 | (208) 845-2492 | ~26.6 miles |
| Mtn. Home AFM Primary School<br>100 Gunfighter Ave.<br>Mtn. Home AFB, ID. 83648 | (208) 832 4651 | ~20.6 miles |
| West Elementary<br>415 W 2nd Street<br>Mtn. Home, ID. 83647 | (208) 587-2595 | ~28.0 miles |
| Melba Elementary<br>520 Broadway Ave.<br>Melba, ID. 83641 | (208) 495-2500 | ~25.7 miles |

AMERICAN GEO TECHNICS

## Hospitals near US Ecology Idaho Hazardous Waste Landfill Facility

| Hospital | | Distance to USEI (straight line) |
|---|---|---|
| Mtn. Home AFB Medical Facility<br>90 Hope Drive Bldg. 6000<br>Mtn. Home AFB, ID. 83648 | (208) 834-2775 | ~ 20.5 miles |
| Elmore Memorial Hospital<br>895 North 6th East<br>Mtn. Home, ID 83647 | (208) 587-8401 | ~29.6 miles |
| Mercy Medical Center<br>1512 12th Ave<br>Nampa, ID. 83686 | (208) 463-5000 | ~36.7 miles |

AMERICAN GEO TECHNICS

## Churches near US Ecology Idaho Hazardous Waste Landfill Facility

| Churches | | Distance to USEI (straight line) |
|---|---|---|
| Knight Community Church<br>630 Idaho Street<br>Grand View, ID. 83624 | (208) 834-2415 | ~ 10.3 miles |
| Grand View Mennonite Church<br>Grand View, ID 83624 | (208) 834-2039 | ~unlisted location |
| Valley Christian Fellowship<br>P.O. Box 661<br>Grand View, ID. 83624 | (208) 834-2655 | ~13.3 miles |
| Church of Jesus Christ of Latter-Day Saints<br>359450 State Highway 78<br>Grand View, ID. 83624 | (208) 832-2181 | ~13.5 miles |
| Faith Tabernacle<br>Mission Lane<br>Murphy, ID. 83650 | (208) 495-2718 | ~17.7 miles |
| Church of Jesus Christ of Latter-Day Saints<br>Bldg. 156 Airbase Road<br>Mtn. Home, ID. 83647 | (208) 832 4211 | ~20.6 miles |
| Jesus Name Tabernacle<br>4940 Airbase Road<br>Mtn. Home, ID. 83647 | (208) 587-0788 | ~21.1 miles |
| Emmanuel Baptist Church<br>3850 Airbase Road<br>Mtn. Home, ID. 83647 | (208) 587-5207 | ~21.1 miles |

AMERICAN GEO TECHNICS

# APPENDIX J

## ENDANGERED OR THREATENED SPECIES

A M E R I C A N GEO T E C H N I C S

April 17, 2006
Project No. 05B-C1202

US Fish and Wildlife Service
1387 South Vinnell Way, Suite 368
Boise, Idaho 83709-1657

Attention: Becky Baker

SUBJECT: US Ecology Idaho, Section 19 Siting and Endangered Species
Grand View, Idaho

Dear Becky:

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on endangered species. We appreciate your guidance in this regard, and are sending this letter as a formal request for the US Fish and Wildlife Service to review the endangered species and habitat that may be affected. As you requested, we have attached a map indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho.

The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

Please provide a letter indicating the existence and/or status of any endangered species or habitat that may be adversely affected by the addition of landfills located within Section 19. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com* or *tjohnson@americangeotechnics.com*. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

April 17, 2006
Project No. 05B-C1202



Respectfully submitted,

American Geotechnics

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachment: Figure 2, Property Line & Section 19 Siting Map, US Ecology, Grandview, Idaho. April 2006.

RECEIVED

MAY 0 3 2006

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Snake River Fish and Wildlife Office
1387 S. Vinnell Way, Room 368
Boise, Idaho 83709
Telephone (208) 378-5243
http://IdahoES.fws.gov

MAY 0 2 2006

Timothy C. Johnson EIT & Rex W. Hansen PE
American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714

Subject: Proposed Hazardous Waste Site – Section 19, Grand View, Owyhee County, Idaho – Species List
File #970.3800 SL 06-0548

Dear Mr. Johnson and Mr. Hansen:

The Fish and Wildlife Service (Service) is providing you with a list of endangered, threatened, proposed, and/or candidate species, and proposed critical habitat which may occur in the area of the proposed Section 19 Hazardous Waste Site. You requested this list by letter on April 17, 2006. This list fulfills the requirements for a species list under section 7(c) of the Endangered Species Act of 1973 (Act), as amended. If the project decision has not been made within 180 days of this letter, regulations require that you request an updated list. Please refer to the species list (SL) number shown above in all correspondence and reports.

Section 7 of the Act requires Federal agencies to assure that their actions are not likely to jeopardize the continued existence of endangered or threatened species. Federal funding, permitting, or land use management decisions are considered to be Federal actions subject to section 7. If the proposed action may affect a listed species, consultation with the Service is required. Formal consultation must be initiated for any project that is likely to adversely affect a threatened or endangered species. If a project involves a major construction activity and may affect listed species, Federal agencies are required to prepare a Biological Assessment. If a proposed species is likely to be jeopardized or if proposed critical habitat will be adversely modified by a Federal action, regulations require a conference between the Federal agency and the Service. A Federal agency may designate, in writing, you or another non-Federal entity to represent them in an informal consultation.

If you have any questions about your responsibilities under section 7 of the Act, or require further information, please contact the Snake River Fish and Wildlife Office at (208) 378-5243. Thank you for your continued interest in endangered species conservation.

Sincerely,

for

Jeffery L. Foss, Field Supervisor
Snake River Fish and Wildlife Office

May 2006

AMERICAN GEOTECHNICS – SECTION 19 HAZARDOUS WASTE SITE
OWHYEE COUNTY, IDAHO
SPECIES LIST 06-0548

| LISTED SPECIES | COMMENTS |
|---|---|
| Snake River physa snail *(Physa natricina)* | LE |
| Idaho springsnail *(Pyrgulopsis idahoensis)* | LE |
| Snake River physa snail *(Physa natricina)* | LE |
| Bliss Rapids snail *(Taylorconcha serpenticola)* | LT |
| Utah valvata *(Valvata utahensis)* | LE |

| PROPOSED SPECIES/CRITICAL HABITAT | |
|---|---|
| Slickspot peppergrass *(Lepidium papilliferum)* | PE |

CANDIDATE SPECIES[1]

None

[1] Candidate species have no protection under the Act, but are included for your early planning consideration. Candidate species could be proposed or listed during the project planning period, and would then be covered under Section 7 of the Act. The Service advises an evaluation of potential effects on candidate species that may occur in the project area.

May 2006

April 17, 2006
Project No. 05B-C1202

Idaho Department of Fish and Game
3101 South Powerline Rd.
Nampa, Idaho 83686

Attention: Eric Lietzinger

SUBJECT: US Ecology Idaho, Section 19 Siting: Endangered Species and Habitat
Grand View, Idaho

Dear Eric:

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on endangered species. We appreciate your guidance in this regard, and are sending this letter as a formal request for the Idaho Department of Fish and Game to review the endangered species and habitat that may be affected. As you requested, we have attached a map indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho.

The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. Landfills will not be placed on US Ecology Idaho property in Section 20 to the east. Nor will landfills be placed on US Ecology Idaho property in Section 18 to the north or Section 13 to the northwest. The property in Sections 18 and 13 was acquired by US Ecology Idaho from the Bureau of Land Management under the agreement that the land would be protected as a buffer zone. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

Please provide a letter indicating the existence and/or status of any endangered species or habitat that may be adversely affected by the addition of landfills located within Section 19. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com or tjohnson@americangeotechnics.com*. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

Respectfully submitted,

**American Geotechnics**

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachment: Figure 2, Property Line & Section 19 Siting Map, US Ecology, Grandview, Idaho. April 2006.

*Letter included without attachments unless otherwise noted.*

IDAHO DEPARTMENT OF FISH AND GAME
SOUTHWEST REGION
3101 South Powerline Road
Nampa, Idaho 83686

Dirk Kempthorne/Governor
Steven M. Huffaker/Director

May 16, 2006

Timothy Johnson
American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714

Subject: U. S. Ecology Waste Site Expansion

Dear Mr. Johnson:

The Idaho Department of Fish and Game (Department) has reviewed your request for the identification of any federally listed endangered or threatened species in the area of the proposed U. S. Ecology Waste Site just north of Highway 78 in Owyhee County.

According to the Conservation Data Center (CDC) database and CDC staff, there are no federally listed endangered or threatened species on or near the project site.

Slickspot peppergrass (*Lepidium papilliferum*), which is proposed to be listed as an endangered species, does not occur in or near the project area. CDC staff (Michael Mancuso, botanist) informed us that the habitat necessary to support slickspot peppergrass does not exist in the project area. Also, according to a slickspot peppergrass distribution map prepared by the U. S. Fish and Wildlife Service, the project site is outside the known range of the species. Therefore, surveys for slickspot peppergrass are not warranted.

In 2000, the project area was surveyed and several Bureau of Land Management sensitive plant species were found on the property. These were:

Desert pincushion (*Chaenactis stevioides*)
Spreading gilia (*Ipomopsis polycladon*)
White-margined wax plant (*Glyptopleura marginata*)

These plants are all annuals that bloom in the spring and are difficult to see or identify by mid summer. Because they are annuals their distribution is somewhat ephemeral, meaning their exact locations may vary from year to year. These plants were also located on adjacent Bureau of Land Management property.

Surveys for these sensitive plants are also not warranted because we already know they exist in the area. The seed sources on adjacent property together with the ephemeral distribution of these plants make it possible for them to recolonize the area after disturbance or continue to exist in areas that won't be disturbed.

Thank you for the opportunity to comment. If you have any questions, please contact Eric Leitzinger in the Southwest Regional Office at 465-8465.

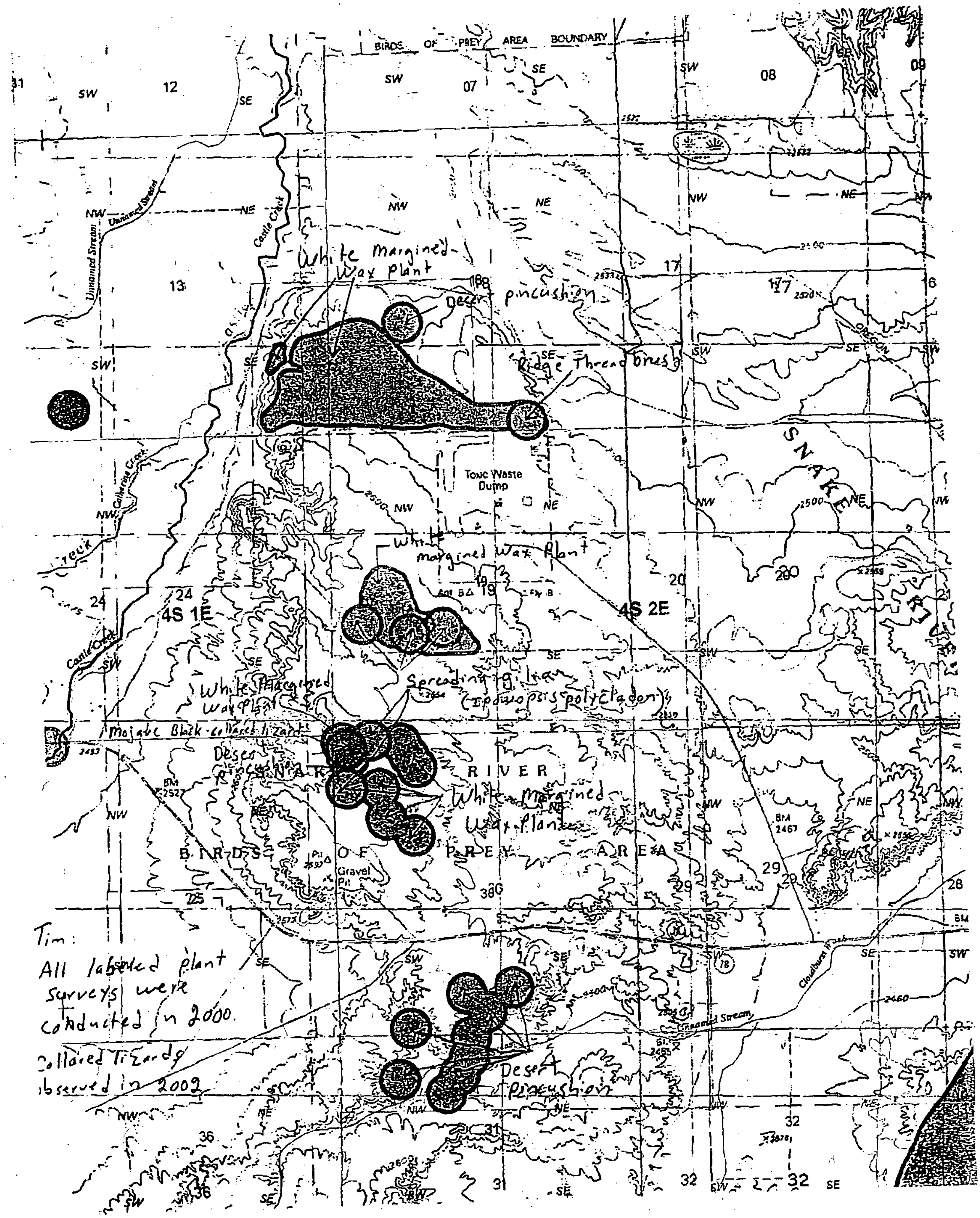
Sincerely,

Eric Leitzinger
for

Al Van Vooren
Southwest Regional Supervisor

AV/el

Cc: NRPB



BIRDS OF PREY AREA BOUNDARY
White margined Wax plant
Desert pincushion
Ridge Thread bush
Toxic Waste Dump
White margined Wax plant
4S 1E
4S 2E
Spreading gilia (Ipomopsis polycladon)
White Margined Wax Plant
Mojave Black-collared lizard
Desert pincushion
SNAKE RIVER
White Margined Wax Plants
BIRDS OF PREY AREA
Gravel Pit
Castle Creek
Unnamed Stream
Tim:
All labeled plant surveys were conducted in 2000.
Collared lizards observed in 2002
Desert Pincushion
Cloudburst Wash

May 22, 2006

Timothy Johnson
American Geotechnics
5260 Chinden Blvd.
Boise, ID 83714

Re: USEI Section 19 Landfill Siting
Threatened and Endangered Snail Species

Dear Mr. Johnson,

This letter is in response to your request concerning threatened and endangered snails and the USEI expansion plan in Section 19. On May 3, 2006, you and Mr. Rex Hansen received a letter from the US Fish and Wildlife Service listing the endangered, threatened, proposed, and candidate species potentially occurring in the location of the proposed Section 19 hazardous waste site. This list included four species of snails known to occur in Owyhee County, Idaho, the Snake River physa, Idaho springsnail, Bliss Rapids snail, and Utah valvata. The range of each of these species is restricted to the Snake River. Since the river is approximately 2.25 miles north of Section 19, it is my professional opinion that these species do not occur in the Section 19 landfill siting area.

Specific information on habitat for these snail species follows:

Utah Valvata Snail-
The Utah valvata snail lives in deep pools adjacent to rapids or in perennial flowing waters associated with spring complexes. The species avoids habitats with heavy currents or rapids. The snail prefers well-oxygenated habitats of non-reducing calcareous mud or mud-sand substrate among beds of submergent aquatic vegetation. The species is absent from pure gravel-boulder bottoms. <u>Distribution of this species is limited to a few springs and mainstem reaches in the Middle Snake River from American Falls Reservoir to the Hagerman Valley</u>. There has been one recent collection of the Utah valvata snail from the Big Wood River drainage, but it is not known if this observation represents a relict population or recent colonization from irrigation returns via canals originating from locations of existing populations.

Snake River Physa Snail
The Snake River physa snail occurs on the underside of gravel-to-boulder size substrate in swift currents in the main stem of the Snake River. The species requires free flowing, turbulent, cold, well oxygenated waters. The Snake River physa snail has been found on boulders in the deepest accessible part of the river at the margins of rapids. <u>Its distribution is limited to only a few locations in the Snake River, mostly in the Hagerman and King Hill Reaches</u>.

Bliss Rapids Snail
The Bliss Rapids snail lives only in well-oxygenated coldwater in the gravel and boulders of swift currents, usually just below canyon segments of the Snake River, in rapids or on boulder bars just below rapids. It is found in a few isolated colonies, mainly in the Hagerman Valley in Idaho. <u>Its</u>

distribution is limited to a few locations in the main stem of the Snake River from King Hill to Banbury Springs.

**Idaho Spring Snail**

The Idaho spring snail is only found in the permanently flowing waters of the main Snake River. This species feeds on plant debris and microorganisms as it glides along the river bottom. It occurs only in a few mainstem Snake River sites near C.J. Strike Reservoir upstream to Bancroft Springs.

Due to the lack of perennial streams in Section 19, no suitable habitat exists in the proposed landfill siting to support these four species of snails.

Do not hesitate to call our office at (208) 939-1022 if you require any additional information.

Sincerely,

Rebecca Thompson
Wildlife Biologist
Bionomics Environmental, Inc.

*110 W. 31st Street, Suite 200*
*Boise, Idaho 83714*
*(208) 939-1022 phone (208) 368-0001 fax*

AMERICAN GEO TECHNICS

# APPENDIX K

## US ARMY CORPS OF ENGINEERS WETLAND DELINEATION

AMERICAN GEO TECHNICS

April 17, 2006
Project No. 05B-C1202

US Army Core of Engineers, Regulatory Division
204 N 8th St., Rm 140
Boise, Idaho 83702

Attention: Greg Martinez

SUBJECT: US Ecology Idaho, Section 19 Siting Application
Grand View, Idaho

Dear Greg,

We recently spoke by phone concerning the expansion of the US Ecology Idaho Hazardous Waste Site in Grand View, Idaho, and the potential effects such an expansion may have on regulated entities in the area. We appreciate your guidance in this regard, and are sending this letter as a formal request for the US Army Core of Engineers to identify any regulated items under their jurisdiction that may be affected or have an effect on future landfills. These items include, but are not limited to, wetlands and flood plains. As you requested, we have attached a map indicating the area US Ecology will apply to have approved for future landfills. This area includes all of Section 19, which is located within Township 4S, Range 2E, Owyhee County, Boise Meridian, Idaho.

The map shows the current US Ecology Idaho property boundaries. A bold line is shown bounding Section 19 as the area being considered for hazardous waste landfills. We request that you consider all of Section 19 in your review as shown within the bold siting boundary line.

Please provide a letter indicating the existence and/or status of any regulated items that may be adversely affected by the addition of landfills or may adversely affect landfills located within Section 19. For your convenience, you may email a signed copy of a letter in PDF format to either *rhansen@americangeotechnics.com* or *tjohnson@americangeotechnics.com*. Please let us know if there is anything else we can do to help you with your review, and thank you in advance for your efforts on our behalf.

Respectfully submitted,

American Geotechnics

Timothy C. Johnson, EIT
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachment: Figure 2, Property Line & Section 19 Siting Map, US Ecology, Grandview, Idaho. April 2006.

*Letter included without attachments unless otherwise noted.*

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WASHINGTON 99362-1876

REPLY TO
ATTENTION OF

May 9, 2006

RECEIVED

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Regulatory Division

SUBJECT: NWW No. 060600050

Mr. Rex W. Hansen, P.E.
American Geotechnics
5260 Chinden Boulevard
Boise, Idaho 83714

Dear Mr. Hansen:

This is in response to your April 17, 2006 letter requesting our comments on U.S. Ecology Idaho's proposed expansion of their hazardous waste site near Grand View, Idaho. Based on our review of the information provided with your letter, the project will have no effect on navigation, flood control, or any Federal projects administered by the Corps of Engineers.

Regarding our regulatory responsibilities, Section 404 of the Clean Water Act (33 U.S.C. 1344) requires a Department of the Army permit be obtained for the discharge of dredged or fill material into waters of the United States. Castle Creek is a water regulated under Section 404. Activities regulated under Section 404 include excavation and mechanized landclearing activities which result in the discharge of dredged material and destroy or degrade waters of the United States.

Based on the information provided, it appears the proposed project will not involve work in areas subject to our jurisdiction and a Department of the Army permit will not be required. If you have any questions concerning these regulatory matters, please contact Mr. Greg Martinez at 208-345-2154, fax 208-345-2968.

Sincerely,

A. Bradley Daly

A. Bradley Daly
Chief. Regulatory Division

# Summary of Hydrogeologic Conditions and Groundwater Flow Model

## US Ecology Idaho Facility
## Grand View, Idaho

**January 13, 2010**

**Prepared by;**

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# 1 Introduction and Executive Summary

US Ecology Idaho (USEI) currently operates a RCRA Subtitle C and Toxic Substance Control Act (TSCA) Hazardous Waste Treatment, Storage and Disposal Facility (EPA ID No. DD073114654) located approximately 10 miles west of Grand View in Owyhee County, Idaho (Figure 1). The facility is located approximately in the middle of Section 19, T4S, R2E. The USEI facility was previously one of three Titan missile bases in southwestern Idaho constructed and later decommissioned in the early to mid-1960's. The US Air Force designated the three bases Sites A, B and C. The USEI Grand View facility is Site B.

The USEI facility is operated under the authority of the permit issued and monitored by the Idaho Department of Environmental Quality (IDEQ). USEI has submitted a siting license application (Application) to add Cell 16 as additional storage capacity at the site[1]. This siting license was subsequently approved by the IDEQ after the prescribed review and public process[2]. The Siting Application includes a comprehensive description of subsurface conditions at the site that is has been confirmed by over 25 years of investigations by USEI and previous site owners and operators and their environmental consultants.

Because the USEI facility is not licensed by the U.S. Nuclear Regulatory Agency (NRC) and because Idaho does not have authority as an Agreement State to implement NRC regulations for disposal of wastes from NRC regulated facilities exemptions are necessary from the requirements of 10 C.F.R. § 20 for disposal at USEI. Pursuant to this requirement, Westinghouse Electric Company, LLC (WEC) has requested an amendment to its NRC license and authorization under the provisions of 10 C.F.R. § 20.2002 to ship waste from its Hematite facility in Festus, Missouri to USEI for disposal ("WEC Request"). In response to this application, the NRC has asked questions about the USEI site geology and groundwater that are the subject of this report. This report also addresses seven specific contentions raised by one commenter (CCI) in formal comments to the NRC regarding the WEC request (Appendix B)[3].

As an aid in further demonstrating site hydrogeologic conditions at Site B, we have prepared the following: 1) Summary of hydrogeologic conditions; 2) Quantitative analysis of hydrologic conditions using three-dimensional illustrations, geotechnical engineering analysis, and numerical modeling of groundwater flow; and 3) Use of the quantitative analysis to address comments made by one commenter on this matter.

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[1] American Geotechnics, June 30, 2006: Hazardous Waste Facility Siting License Application Cell 16 Grand View, Idaho

[2] Idaho Department of Environmental Quality siting license approval letter to US Ecology Idaho dated December 6, 2006

[3] Citizens for a Clean Idaho (CCI), an Idaho citizens group, raised seven specific contentions to the US Nuclear Regulatory Commission as part of its request for a public hearing on the Westinghouse proposal. The Atomic Safety Licensing Board subsequently denied the request for a hearing.

In summary, this report will demonstrate the following:

- Site geologic and hydrogeologic conditions are well understood based on decades of environmental study and reports prepared by environmental professionals and accepted by the IDEQ.

- The site is underlain by two, discrete, low yielding, water-bearing units referred to as the Upper and Lower Aquifers.

- Rising groundwater conditions in both aquifers at the site are well documented and have been investigated and the potential impacts on groundwater monitoring have been systematically evaluated since 1999.

- The materials that overlie the Upper Aquifer are sufficiently permeable to allow water entering them to drain to the north and east which will limit the elevations to which groundwater will rise.

- A three-dimensional model has been developed that uses site specific and regional data and information that quantitatively demonstrates that drainage function of the permeable materials above the present zone of saturation will prevent water levels from continuing to rise and will prevent the formation of new groundwater discharge to the surface via springs and seeps.

- The model was used to demonstrate the limits on water level rises and the lack of new groundwater discharge to the surface under the a hypothetical and extremely unlikely condition of increasing recharge from precipitation from the current value of zero to a value that would result from permanently quadrupling the annual precipitation in the region.

- As a result, under both expected and extremely unlikely, hypothetical scenarios, the parameters and assumptions used for the site's RESRAD model remain sound.

This report has been prepared by licensed and certified professional engineers and geologists at the request of USEI.

Mr. Eric Lappala, P.E., P.H, Eagle Resources, P.A., provided the overall report collation and preparation including assembling and completing the figures. In addition Mr. Lappala was the primary author of Section 3 including the development of the numerical groundwater flow model and associated simulations. Mr. Rex Hanson, P.E., American Geotechnics, Inc., provided the geotechnical evaluation and discussion of water level responses to soil loading at Site B found in Section 3.1. Mr. Charles Feast, P.G., Feast Geosciences, LLC, prepared Section 2 describing the Site Hydrogeology and Section 3.2 which discusses long term water level trends at the USEI site. Mr. Lappala also conducted the RESRAD modeling presented in Section 4.

It is our collective professional opinion that the data, information and analyses included in reports that have been prepared over the last 25 years and which are summarized in the Siting Application comprise an adequate technical basis to demonstrate understanding and description of the hydrogeologic conditions at Site B.

# 2 Summary of Site Hydrogeologic Conditions

USEI and previous owners of the facility have conducted extensive studies and characterization of the groundwater and unsaturated (vadose) zone beneath Site B over the last 25 years. This report provides a summary of the hydrogeologic conditions based upon those studies and uses site specific information as well as regional information to extend the understanding of these conditions to an area of approximately nine (9) square miles that is centered on the site (Figure 1).

## *2.1 Hydrogeologic Setting*

The USEI Facility sits on a low flat topped knoll at an elevation of 2545 to 2600 feet (Figure 1). Surrounding surface elevations range from 2450 to 2475 feet on the west, north and southeast and 2500 feet on the south side. The Snake River, at elevation approximately 2,335 flows from east to west approximately three miles to the east and two miles to the north of the site. Two perennial streams, Castle and Catherine Creeks flow from south to north approximately 2,000 feet west of northwest corner of Section 19 and 4,000 feet west of the southwest corner of Section 19 (Figure 1). The two creeks join at the approximate northern edge of Section 19 and the combined creek, Castle Creek, continues to the north approximately two miles where it discharges into the Snake River.

Site studies based upon geologic cores, geophysical logs and hundreds of water quality samples from dozens of borings and wells have concluded that below a thick vadose zone there are two, independent, water-bearing zones within the upper 300 feet beneath the site. Out of convenience and convention to ease communication with the regulatory agencies (US EPA and IDEQ) these units have been designated the Upper and Lower Aquifers (Figure 2), although neither "aquifer" is capable of producing significant water. The aquifers and the clay unit that separates them beneath the Site dip downward to the north-northeast at 3 to 5 degrees.

Underlying the Lower Aquifer and extending to a depth of approximately 2400 feet are progressively indurated clays and shale that comprise the confining bed for a deep, geothermal, artesian aquifer present in basalt that was penetrated by a 3100 foot deep well installed by the US Air Force.

The general geologic history of the subsurface at USEI Site B, pertinent to this report begins with the placement of the Banbury Basalts in late Miocene time, approximately 5 to 6 million years ago (mya). Overlying the Banbury Basalt is the Glenns Ferry Formation of Pliocene age (approximately 5 to 2 mya). The Glenns Ferry Formation consists of a thick section of predominantly clay, silt and fine sand beds deposited in a series of large, regional lakes that formed behind temporary lava dams across the Snake River near the Idaho-Oregon border. The Glenns Ferry Formation beneath Site B consists of both lacustrine (lake deposits) and fluvial (flood plain) sediments. The sedimentary record at Site B reflects a general pattern of coarsening upward, as the large regional lakes filled in, dried up or drained. In general the deeper portions of the Glenns Ferry Formation is almost entirely thick, massive, lacustrine clay and silt but the upper parts, including the Upper and Lower Aquifers and much of overlying vadose sediments, represent a transition from lacustrine to fluvial sediments. This coarsening-upward sedimentary pattern is very significant to the understanding of the hydrogeology of Site B.

Above the Glenns Ferry Formation is the Pleistocene Bruneau Formation (less than 1.5 mya) that forms a mantle of fine to coarse sands and mixed sand and gravel. The Bruneau Formation was deposited, and subsequently reworked, by the Snake River after the regional lake forming conditions at the end of the Pliocene had ceased.

## *2.2 Hydrostratigraphic Units*

To assist in presenting the hydrogeologic conditions documented by past studies and reports a three-dimensional cross-section that cuts from west to east through the Cell 14 of the USEI site is presented as Figure 2. Figure 3 provides a detailed north-south cross section along the east side of Site B. These sections have been prepared using the lithologic logs of wells and borings that were drilled to characterize the Upper and Lower Aquifers.

Six hydrostratigraphic units are important to understanding site hydrogeology and its ability to isolate disposed wastes. These units, beginning at ground surface and extending to a depth of about 3300 feet consist of the following: 1) Vadose Zone; 2) Upper Aquifer; 3) Upper Confining Clay; 4) Lower Aquifer; 5) Lower Confining Clay and Shale, and 6) the basalt artesian aquifer.

### 2.2.1 Vadose Zone

The vadose zone is the interval of unsaturated materials extending downward from the land surface to the top of the uppermost zone of permanent saturation (Upper Aquifer). At the USEI site, the vadose zone is 150 to 200 feet of thick. Locally a discontinuous, surficial gravel layer is present over parts of the site but large areas of these deposits were disturbed beginning with the construction of the missile base in the late 1950's. The upper part of the vadose zone, below the surficial gravels (where present), consists of thick beds of dry, fine to medium, sand with thin beds of silt and clay. The lower part of the vadose zone consists of medium to thinly bedded fine silty sand, silt and clay. West of the site, along the east wall of the Castle Creek valley, the materials comprising the vadose zone beneath the site crop out and form relatively steep slopes as shown in Figures 1 and 2.

The grain size distribution, moisture content and hydraulic properties of the various stratigraphic units within the vadose zone have been characterized by extensive sampling, field testing, and laboratory testing[4]. Using these characteristics, a three dimensional,

[4] CH2MHill, 1986. Vadose Zone Characteristics at ESII Site B Grand View Idaho

Saturated-Unsaturated Transport (SUTRA[5]) model was used to evaluate movement of water through the vadose zone. This analysis concluded that the overall low moisture content and hydraulic contrast between the numerous discrete beds comprising the vadose zone at USEI Site B provide a high degree of protection against vertical movement of water from the surface to the Upper Aquifer. In addition the model results indicated that the vadose zone would retain more water than could reasonably be produced on the site if such water were to enter the vadose zone as a result of the failure of the disposal cell liner systems[6].

### 2.2.2 Upper Aquifer

The Upper Aquifer is an unconfined or water-table aquifer. The top of the aquifer is defined by the current position of the water table. The lower part of the Upper Aquifer consists of fine sand and silt beds in a predominantly silty-clay matrix. The frequency and thickness of sand beds generally increase upwards within the Upper Aquifer and the uppermost portion of the Upper Aquifer is predominantly fine to medium sand. As a result of the north-northeast dip of the Upper Aquifer, the saturated thickness of the Upper Aquifer is wedge shaped with the greatest thickness along the northern boundary of the site. And as shown on Figure 3, the saturated thickness of the Upper Aquifer thins to the south. The southern extent of saturation in the Upper Aquifer crosses from northwest to southeast across the site approximately at the northern toe of Cell 14 as shown in Figure 4.

As a result of the combination of decreasing saturated thickness, and the fact that the lower part of the Upper Aquifer contains less sand, the well yields of the Upper Aquifer also decrease from north to south. Across the northern portion of the site where the aquifer is the thickest and contains the highest percentage of sands, well yields of 1 to 3 gallons per minute (gpm) can be maintained. Toward the southern extent of the aquifer where it is thinner and there are fewer and thinner saturated sand beds, well yields fall off to less than 0.5 gpm.

Water levels in the Upper Aquifer are generally 165 to 200 feet below ground level depending on the ground surface elevation at the well head. In the extreme northwest corner of the site in the vicinity of well U-4, the topography is the lowest and the depth to water in the Upper Aquifer is approximately 130 feet.

### 2.2.3 Upper Confining Unit

Underlying the Upper Aquifer is a thick, massive clay and silty clay 20 to 35 feet thick with sufficiently low permeability to hydraulically separate the Upper and Lower Aquifers. This material is similar to that being mined from the Ketterling source located 2 miles southeast of the site. The clays from this source are being used for the low permeability clay liners at the site and have a permeability of approximately $1.0 \times 10^{-6}$

[5] Voss, C.I., 1984 A Finite Element Simulation Model for Saturated-Unsaturated, Fluid-density-dependent Groundwater Flow with Energy Transport or Chemically-reactive Single-Species Solute Transport: U.S. Geological survey Water Resources Investigation Report 84-4369.

[6] CH2MHill, 1987. Computer modeling results for the Part B Permit Application, ESII Site B Grand View Idaho.

cm/sec (0.003 ft/day). The permeability of samples of the deep lacustrine clays determined during site characterization [7] ranged from $1.0 \times 10^{-6}$ cm/sec to $1.0 \times 10^{-7}$ cm/sec.

### 2.2.4 Lower Aquifer

The Lower Aquifer is a confined aquifer and is saturated beneath the entire site. The Lower Aquifer is bounded by upper and lower confining clays and consists of a "swarm" of thin lamina, partings, and thin beds of very fine sand with an aggregate thickness of approximately 3 feet that is embedded in approximately 30 feet of silty clay. The Lower Aquifer is an extremely low water yielding formation. None of the Lower Aquifer wells can be pumped continuously and estimates from observations of water level recovery rates indicate that even under extreme drawdown conditions the formation yields less than 0.01 gpm.

Beneath the southern edge of the Site the depth to water in the Lower Aquifer is typically 190 to 210 feet.

### 2.2.5 Deeper Hydrostratigraphic Units

Based upon the log of the 3,100 foot deep artesian supply well drilled on site by the U.S. Air Force, site, approximately 2285 feet of clay and shale underlie the Lower Aquifer and separate it from the Banbury Basalt and deeper basalt aquifers. The Banbury Basalt and deeper basalts are local and regional geothermal, artesian aquifer. The artesian well at Site B was plugged and abandoned in 1985 using oil field techniques and contractors[8].

## *2.3 Recharge, Movement, and Discharge of Groundwater*

Understanding the operation of any hydrogeologic system requires knowing the location, timing, and magnitudes of water entering (recharge), flowing through, and leaving the system (discharge).

### 2.3.1 Groundwater Recharge

Four potential sources of groundwater recharge have been evaluated by past studies of the USEI site: deep percolation of precipitation, infiltration of ponded precipitation in uncompleted waste cells; streamflow losses from Castle and Catherine Creeks, and upward leakage from the geothermal artesian aquifer or from the abandoned artesian well. As shown in the following sections, recharge from the creeks is the only plausible and reasonable source of groundwater present in the Upper and Lower Aquifers.

#### 2.3.1.1 Recharge from Precipitation

Previous studies conducted as part of the permitting of the USEI site have clearly demonstrated that the arid conditions and thick vadose zone at the site preclude measurable recharge to the saturated zone from infiltration of precipitation. The mean annual precipitation at the site is less than 7 inches per year based upon 47 years of

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[7] CH2MHill, 1986. Vadose Zone Characteristics at ESII Site B Grand View Idaho

[8] CH2M HILL, June 1986). Report on Plugging the Artesian Well at USEI Site B Near Grand View, ID. Boise, ID.

record at Grand View Idaho[9]. Records of precipitation and potential evapotranspiration (PET) for Grand View, Idaho from 1993 to the present show that average annual precipitation was 6.1 inches and average annual PET was 57.3 inches[10]. In addition site runoff is routed to lined evaporation basins and prevented from ponding and infiltrating. Consequently, all precipitation falling on the site is returned to the atmosphere by ET from the soil zone before it infiltrates deeper. The vadose zone characterization and SUTRA model results[6] confirmed that recharge from precipitation is insignificant at the USEI site.

### 2.3.1.2 Infiltration from Waste Cells

Liquid wastes are not accepted at the USEI facility as a condition of their operating permit with IDEQ. The liner and leachate collection systems for the waste cells at the USEI site are constructed to contain and remove any liquids that may accumulate as a result of an extreme rainfall event falling on the cells prior to closure. As part of previous permitting of the site, analyses were conducted to assess the fate of a release of water from a hypothetical liner failure. These studies have shown that water from such a failure would not reach the water table in the Upper Aquifer because it would be retained by capillarity in the thick vadose zone present at the site[4,5,11,12].

### 2.3.1.3 Lateral Recharge from Castle and Catherine Creeks

Catherine and Castle Creeks originate in the Owyhee Mountains south of the site and have a combined drainage area of 248 square miles[13]. Both of these streams are designated as perennial on the U.S. Geological Survey 7.5 topographic map of the area[14].

Site studies since 1999[15] have identified Castle Creek northwest and southwest of Site B as the probable recharge source for the Upper and Lower Aquifers. The strata containing the Upper and Lower Aquifers dip to the north-northeast at 3 to 5 degrees and the lateral trend of the strata, the strike, is southeast-northwest. Extending the strike of the Upper Aquifer sediments indicates the upper part of the aquifer probably underlies Castle Creek northwest of the northwest corner of Section 19. Projecting the Lower Aquifer up-dip to the southwest indicates that recharge to the Lower Aquifer probably occurs along the reach of Castle Creek lying south of approximately the north boundary of Section 24 (Figures 1 and 2).

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[9] http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?WWDI~StnSrch: National Climatic Data Center Station 103760, Grand View, ID.

[10] http://www.usbr.gov/pn/agrimet/wxdata.html : U.S. Bureau of Reclamation AGRIMET Station Grand View, ID

[11] CH2MHill, February 1986. ESII Site B Site Characterization and Groundwater Monitoring Program, Envirosafe Services of Idaho, Inc., Grand View, ID. U.S. EPA I.D. No. IDD073114654. Boise, ID.

[12] Eagle Resources, P.A. April 2005. Site-Specific RESRAD Water Pathway Parameters for the Contaminated Soil, Vadose Zone and Saturated Zone, US Ecology Grand View Idaho.

[13] http://www.idwr.idaho.gov/GeographicInfo/GISdata/watersheds.htm: Idaho Department of Water Resources online GIS Data.

[14] http://data.geocomm.com/catalog/US/61053/425/index.html: U.S. Geological Survey, Castle Butte 7.5 minute topographic map, digital version.

[15] CH2MHill, 1999 Rising Groundwater Study

### 2.3.1.4 Upward Leakage from the Geothermal Artesian Aquifer or from the Abandoned Artesian Well

Site studies since 1999[16] and data collected during each semi-annual groundwater sampling event have examined geochemistry, water level and temperature data in an effort to determine if the Lower Aquifer is being recharged by vertical movement either as diffuse flow through the thick lower confining strata beneath the Lower Aquifer, or as leakage up the well wellbore of the abandoned artesian well drilled by the U.S. Air Force. Based on these analyses there is no evidence that vertical leakage at the site is a significant source of recharge to the Lower Aquifer.

## 2.3.2 Groundwater Movement and Age Dating

The characterization of the movement of groundwater in the Upper and Lower Aquifers has been documented by using both water level elevation measurements in monitoring wells and age dating of water samples from the water wells.

### 2.3.2.1 Groundwater Flow Directions

Water level measurements in Upper Aquifer monitoring wells and Lower Aquifer monitoring wells that have been taken over the last 20+ years have been used to document the direction of groundwater movement and to infer the approximate rates of such movement. These data show that groundwater in the Upper Aquifer flows along strike from its recharge area along Castle Creek northwest of Section 19 and flows to the east-southeast (Figures 2 and 4). Groundwater in the Lower Aquifer moves down dip to the northeast from the apparent recharge area along Castle Creek drainage southwest of the site (Figures 2 and 5).

In addition to the lateral flow regimes described above there are vertical gradients between the aquifers. Based on previous studies[17], the confining clay between the aquifers has a hydraulic conductivity of $1.0 \times 10^{-6}$ cm/sec to $1.0 \times 10^{-7}$ cm/sec. Across the northern one-third of the site the water level in the Upper Aquifer is higher than the Lower Aquifer and thus there is a downward gradient and therefore under Darcy's law a calculable flow. However, the flux of water across the confining clay under these head conditions is not significant.

Across the south central part of the site, there is a zone where an upward gradient exists from the Lower to the Upper Aquifer. Based upon the difference in measured water levels in the Upper and Lower Aquifers in this zone and the low hydraulic conductivity of the clay that separates them, the leakage from Lower to Upper Aquifer is insignificant. The lack of significant exchange of water between the two aquifers has been clearly demonstrated by the distinct different water chemistry of the two aquifers.

[16] CH2MHill, 1999 Rising Groundwater Study

[17] CH2MHill, 1986. Vadose Zone Characteristics at ESII Site B Grand View Idaho

### 2.3.2.2 Groundwater Age Dating

Age dating conducted in 1999[18] indicates that "new" 700-900 year old groundwater is coming in from the northwest in the higher permeable parts of the Upper Aquifer and is mixing with and displacing the older water in the less permeable parts of the Upper Aquifer across the eastern and south central portions of the site. The oldest Upper Aquifer water was dated at about 9,500 years old.

Water in the Lower Aquifer is moving very slowly to the northeast (down dip) from the projected recharge area along Castle Creek southwest of the site. Lower Aquifer water at Site B was dated at about 12,000 years old, about the same age as the samples collected from two artesian wells in the area. This suggests that while hydraulic head (pressure) and gradient (flow direction) are being influenced by the recharge area, modern recharge water has not reached Site B. The extreme sluggish movement of water in the Lower Aquifer makes it difficult to positively identify the source of water in the Lower Aquifer.

## 2.3.3 Discharge of Groundwater

As documented by the direction of groundwater flow based on contours of water levels shown in Figures 2, 4, and 5, both of the aquifers discharge through the north and east boundaries of the analysis area. Although there has been no specific aquifer characterization efforts conducted off site to the east and northeast the continuation of the aquifers is implied by the consistency and continuity of the water level contours and groundwater potential lines for both aquifers.

## 2.3.4 Water Level Trends, Causes and Effects

Beginning with the first sets of sequential water level measurements in test wells installed during the site characterization process in the mid 1980's it was observed that water levels were rising slowly in monitoring wells at USEI Site B. The upward trend in water levels at Site B is one of the major issues raised by CCI.

The issue of rising groundwater at the site has been evaluated by USEI and the previous site owners. The results of these studies have been presented in reports beginning with the primary report in 1999[19] and with subsequent updates in 2001, 2003 and 2006. In addition, beginning in 2006, each semi-annual groundwater sampling report contains an evaluation of water level trends updated with the most recent set of water level data.

### 2.3.4.1 Water Level Trends

Figure 6 provides examples of hydrographs for Upper and Lower Aquifer wells at Site B. The hydrograph for Upper Aquifer well U-7 along the northern boundary of the site shows that the rate of water level rise has flattened considerably since approximately 2000. Well U-26 at the extreme southern extent of the Upper Aquifer shows a longer, steeper trend but also a distinct flattening of the water level trend line beginning in about 2004.

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[18] CH2MHill, 1999 Rising Groundwater Study
[19] CH2MHill, 1999 Rising Groundwater Study

The hydrographs for Lower Aquifer wells shown on Figure 6 have similar water level trends to the Upper Aquifer wells. Well LP-13 in the extreme northeast corner of the site shows a flattening trend similar to adjacent well U-7. Well L-33 in the center of the site shows a flattening trend similar to well U-26.

The hydrograph for Lower Aquifer well L-38 is provided to illustrate the water level response to surface loading observed in this, and several other Lower Aquifer wells. One of CCI's issues was directly related to this hydrograph. As can be seen by this hydrograph, a large spike in the water level occurred in mid-1992. This spike correlates with the stock piling of soil excavated from Cell 14. Following this sudden increase, the water levels slowly declined in a smooth curve over the next 5 years as the hydrostatic conditions in the aquifer re-equilibrated. Other, smaller, changes in surface loading occurred as additional soil stockpiles were placed, or moved in the area (1997 and 2002). Since about 2005 water levels have remained fairly constant. Other Lower Aquifer wells around L-38 and adjacent to Cell 15 show the effects of loading from the stockpiling of soils associated with cell construction. The geotechnical assessment, presented in Section 3.1 provides a more detailed analysis of the affects of soil loading on water levels.

### 2.3.4.2 Causes of Rising Water Levels

The specific causes of rising water levels in each well at Site B are not known but can be reasonably attributed to several processes based on the known site history and hydrogeology. Both aquifers appear to be responding to some change of conditions which may include long term (thousands to tens of thousands of years) precipitation cycles. The sluggish response of both aquifers, especially the Lower Aquifer, makes it difficult to determine the lag time components of any changes due to variations in paleo-climates.

The age dating study briefly discussed in Section 2.3.2.2 suggests both the Upper and Lower Aquifer originally had similarly-aged water of around 12,000 years old. Currently the oldest water in the Upper Aquifer is about 9,500 years old but as shown by this study it appears that younger water is entering the aquifer from the northwest and displacing and mixing with the original water. Therefore, in the case of the Upper Aquifer the rising water levels appear to be associated with post-ice age climate change and/or changes in streambed geometry in Castle Creek within the last 10,000 to 12,000 years.

The Lower Aquifer is confined across Site B and therefore rising water level measurements indicate increasing pressure and not an actual increase in the saturated thickness of the aquifer. Pressure or potentiometric responses in confined aquifers can be transmitted rapidly over relatively long distances. As was discussed in the previous section, changes in surface loading can quickly affect the potentiometric surface in Lower Aquifer wells. Increases in the hydraulic head in the recharge area of the Lower Aquifer could also cause water levels to rise in the Lower Aquifer wells. Therefore water level rises in the Lower Aquifer may be caused by both local affects and longer term climatic changes possibly complicated by the anthropomorphic changes in the Castle Creek and Catherine Creek drainage areas. These changes include the relatively recent drilling and incomplete abandonment of uncontrolled flowing wells, use of storage reservoirs to capture spring runoff and land use changes including irrigation in the general implied recharge area for the Lower Aquifer southwest of Site B.

Surface loading (and unloading) has been nearly continuous at Site B since the mid-1950s when the U.S. Air Force began construction of the missile base. To construct the subsurface structures and inter-connecting tunnels the upper 80 feet of sediments was splayed back across large swaths of the site and three excavations approximately 60 feet in diameter and 170 feet deep were made for the silos. This excavated soil was stockpiled over large areas of the site. Following decommissioning of the missile base the site has been in almost continual use for hazardous waste storage which has also involved excavation and stockpiling soils.

While there has been no correlative cause and effect of short term water level fluctuations associated with surface loading observed in the Upper Aquifer wells it is important to note that all of the significant construction activity at Site B since the mid-1980s has been over the southern portion of the site which overlies the Lower Aquifer. The Lower Aquifer water levels are clearly impacted by surface loading and compaction, the affects of which can operate over periods at least as long as 10 years for the relatively small surface loading near L-38 (Figure 6).

Rising groundwater levels in the Upper Aquifer are also increasing the hydraulic load on the Lower Aquifer where the Upper Aquifer directly overlies the Lower Aquifer across the northern half of the site (wells U-7 and LP-13, Figure 6). This hydraulic loading probably also affects water levels in the Lower Aquifer under the southern half of the site by the flattening the gradient and causing water to "back up".

Therefore, it is likely that the rising water levels observed in the wells at USEI Site B are due to multiple causes including long term, complex changes in the recharge of both aquifers, localized surface loading, and hydraulic loading.

## 2.3.4.3 Effects of Rising Water Levels

As the water level in the Upper Aquifer rises it causes the southern extent of saturation move to the south (because of the NE dip), about 20 feet south for every 1 foot of rise. Since the Upper Aquifer is unconfined, water level rises represent increasing saturated thickness. The cross section provided in Figure 3 illustrates how the southern extent of saturation in the Upper Aquifer will move in response to water level changes.

As water levels rise in the Upper Aquifer rise, additional sand beds and higher permeability sediments will be encountered because of the coarsening upward characteristic of this formation. As more of these transmissive sediments become saturated water will flow more freely to the east and northeast and the rate of water level rise across the northern portion of the site will decline. This flattening of the water level trend is present in all the Upper Aquifer wells across the northern side of the site as illustrated in Figure 6 by the hydrograph for well U-7. In general this trend of flattening hydrographs should progressively advance from north to south across the site to include additional Upper Aquifer wells.

Potentiometric pressure rises in the Lower Aquifer, beneath the southern portion of the site, are increasing the gradient across the confining clay and into the overlying Upper Aquifer sediments. As the gradient increases the upward flux of water will also increase. However, the low permeability of the confining clay restricts this leakage to insignificant amounts. Currently under the southern one-third of the site the Upper Aquifer sediments are not saturated and the minor quantity of leakage that does cross the confining bed will gradually move down dip to the northeast where it will be incorporated into the flow dynamics of the Upper Aquifer and subsequently will flow to the east. Where leakage occurs into an area where the Upper Aquifer is currently saturated the water will simply flow with the Upper Aquifer. The small amount of water moving into the Upper Aquifer from the Lower Aquifer will not affect the flow patterns in the Upper Aquifer because of the relatively higher permeability and transmissivity of the Upper Aquifer.

The overall affect of rising groundwater at Site B is minimal: over the 25 years of monitoring, water levels have risen and average of 6 to 7 feet in both aquifers. Gradients and flow directions within and between both aquifers have remained relatively stable. The affects of water level rises over longer terms and under hypothetical recharge conditions is discussed in Section 3 of this report.

# 3 Quantitative Analysis of Hydrogeologic Conditions

To demonstrate clearly that the hydrogeologic conditions beneath and in the vicinity of the USEI site are adequately understood, to provide an explanation of the likely source of rising water levels in monitoring wells, and to provide a tool to demonstrate the fate of groundwater rising into the permeable sands, we present the following three analyses:

1. A geotechnical analysis that provides an explanation of fluctuations in water levels in Lower Aquifer monitoring wells around Cell 15;

2. An explanation for the long term trends of water levels in the Upper and Lower Aquifers; and

3. A groundwater flow model analysis that demonstrates that the hydrogeologic conditions described in the previous section can be quantified and that quantitatively demonstrates the fate of water rising above the top of the Upper Aquifer, independent of the reason for the rising levels.

## *3.1 Geotechnical Analysis of Fluctuating Water Levels in the Lower Aquifer Around Cell 15*

Several of CCI's comments imply that the pattern of water level responses in Lower Aquifer monitoring well L-38 cannot be reasonably well explained and that therefore the site is too complex to adequately characterize. However an evaluation of the effects of loading by site operations (stockpiling excavated material from a cell and refilling the cell with waste and backfill) by a licensed professional geotechnical engineer has shown that this such loading is a plausible explanation for both the sudden changes in water level elevations as a result of increased overburden pressure, consolidation of clays within the aquifers and confining layer, and migration to sand and silt stringers.

### 3.1.1 Effects of Cell Construction

Stockpiling sand adjacent to the cells and waste placement in the cells has caused the underlying soil stratums to consolidate. Geotechnical analysis performed prior to the construction of Cell 15 indicates the underlying stratums were expected to experience approximately 3 feet of consolidation, with approximately one-half of the consolidation occurring within the saturated soil layers.

The quantity of water that is squeezed or displaced from the underlying saturated stratum related to the construction of Cell 15 and the adjacent stockpile is estimated below:

Displaced volume of water = Footprint of Cell 15 and sand stockpile * Consolidation

$$= [(39 \text{ acres} + 13 \text{ acres}) * (43{,}560 \text{ ft}^2/\text{acre})] * (1.5 \text{ ft})$$
$$= 3.4 \times 10^6 \text{ ft}^3 * 7.48 \text{ gallons/ft}^3$$
$$= 25 \times 10^6 \text{ gallons.}$$

Thus, the volume of groundwater that is ultimately squeezed out of the Glenns Ferry Formation as a result of Cell 15 construction is very substantial (approximately 25 million gallons).

The driving force displacing this volume of water is also considerable. If the ultimate load from the waste placed in Cell 15 and the sand stockpiles placed adjacent to Cell 15 were applied instantaneously, the driving force displacing groundwater from the saturated soil stratums would be approximately 50 psi (based upon an average net loading of 60 feet of material with a typical density of 120 pcf). The loading induced by cell construction at the site is not applied instantaneously. However, we expect that accelerated loading would result in displacement pressures approaching the upper limit of 50 psi and that slower loading would result in a lower displacement pressure, approaching the lower limit of 0 psi.

Ultimately, when waste placement and cell construction is completed at the site, the additional pressure head caused by these activities is expected to dissipate as the displaced water escapes the soil layers at the site. In evaluating a consolidation curve for the site conditions, the underlying soil stratums are expected to achieve 90 percent of ultimate consolidation within 25 years of complete loading. In the interim period, an increased pressure head will exist with a variable magnitude.

These observed changes of the water surface within the monitor wells (5 to 10 feet) are indicative of approximately an additional 2.2 to 4.4 psi of pressure head in the Lower Aquifer. These values are well below the maximum additional pressure head of 50 psi and are much closer to the lower limit of 0 psi.

### 3.1.2 Conclusions Regarding Lower Aquifer Water Level Fluctuations

During the last 8 years, landfill cell construction and waste placement has accelerated resulting in increased pressure within the site soils across the southern portion of the site. This increase in pressure causes water from the underlying strata to be manifested in water level rises in wells that are connected to the zones undergoing consolidation. As discussed in Section 2.3.4.2 surface loading is a component of the rising water levels in the lower aquifer, especially across the southern portion of the site.

## *3.2 Long Term Trends in Water Levels*

The ultimate upper limit of water levels in the upper and lower aquifer is controlled by three factors: the elevation head of the recharge, the aquifer transmissvity or ability to transmit the incoming water to point(s) of discharge, and the surface elevations on the down-gradient side of the site.

With regard to the Upper Aquifer, the apparent recharge source is Castle Creek northwest of the site at an elevation of approximately 2425 to 2450 feet. The ultimate possible water level in the Upper Aquifer is therefore 2425 to 2450 feet. Currently the water level in the Upper Aquifer ranges from 2373 to about 2400 feet. Water level data indicate this recharge water is moving into and across the site and is discharging east of the site. Since there is apparently an established discharge area for Upper Aquifer, the maximum water level will be lower than the recharge elevation.

In addition, as discussed previously, as the saturated thickness of the Upper Aquifer increases the transmissivity of the aquifer also increases, and under conditions of constant recharge the resultant water levels will reach a point of equilibration. As illustrated by the hydrograph for U-7 shown on Figure 6, the Upper Aquifer wells along the northern portion of the site may be reaching this equilibration point. The water level in well U-7 is currently at elevation 2376 feet and has been stable at this elevation since 2000.

The apparent recharge area (or pressure head source) affecting the Lower Aquifer in the Castle Creek drainage southwest of the site is at an approximate elevation of 2500 feet. For the same reasons discussed above, since there is a flow-discharge pattern established in the Lower Aquifer, the ultimate water level will be somewhat less than 2500 feet. The current water levels in the Lower Aquifer range from 2370 to 2446 feet. However, it is important to note that the Lower Aquifer is confined and these are elevation or pressure heads measured in wells and they do not represent the top of the zone of saturation.

There are two discharge regimes that will affect the ultimate pressure head in the Lower Aquifer, the lateral discharge area off site to the northeast, and vertical leakage into the overlying Upper Aquifer sediments as discussed in section 2.3.4.2. Under the current pressure heads there is insignificant leakage, however, if the pressure heads continue to increase there may be a self limiting increase in leakage into the Upper Aquifer. Since the Upper Aquifer is much more permeable than the Lower Aquifer any increased leakage will be quickly assimilated and discharged with the Upper Aquifer flow.

The ultimate water level elevation in the Upper Aquifer, and any component of Lower Aquifer water entering the Upper Aquifer, will be the surface elevations east of the site. If water levels in the Upper Aquifer rise to this level springs and surface discharges will develop. The Snake River, elevation approximately 2355 is the ultimate base level for the groundwater in this area. Between the Snake River and Site B the surface terrain rises to a bench at 2400. Ground surface gradually rise to 2500 feet northeast of the site. There are smaller drainages due east of the northern boundary of Section 19 at elevation 2450 that would probably develop surface flow if regional groundwater levels rose to this elevation. However, as discussed in Section 3, even under hypothetical conditions of climate change that would increase the regional groundwater recharge from the present value of zero to 4 inches/year, groundwater levels will not rise to the land surface to produce spring discharge east of Site B.

In summary, the elevations of the recharge areas for both aquifers provide one general sense of the maximum water level elevation if water levels continue to rise. Aquifer properties and flow-discharge dynamics however will provide a self limiting water levels that are lower than the recharge elevations. Topography and existing drainages east of the site provide additional controls limiting the maximum water levels at Site B. To address some of the issues associated with long term water levels trends under current and hypothetical future conditions, USEI has conducted additional groundwater modeling. These modeling efforts and results are discussed in the following section.

## *3.3 Groundwater Flow Model Analysis*

Numerical models of groundwater flow are commonly used to evaluate and demonstrate the operation of hydrogeologic systems. These models provide the ability to represent complex conditions such as the presence and three-dimensional geometries of multiple aquifers and confining zones, complex recharge areas connected to different aquifers at different locations, and conditions that would result from factors such as those causing water levels to rise at the site.

A three-dimensional numerical model of groundwater flow has been built based upon the information and data in the Application, and regional topographic and geologic information available in the public domain. This model is a mathematical representation of the three-dimensional system illustrated in Figure 2.

### 3.3.1 Model Construction

The groundwater model was constructed using a 100-ft x 100-ft square grid of computational cells that cover the analysis area shown in Figure 1 that is centered on the site. All horizontal coordinates used to construct the model are in feet based on the Idaho West State Plane system. All vertical coordinates are in feet based on the NAVD88 Datum.

Figure 2 illustrates the geometry of the five layers that represent hydrostratigraphic units used to construct the model. Each of the units described above is included with the exception of the deep artesian fractured basalt aquifers. The thickness and low permeability of the clays and shales separating this unit from the Lower Aquifer preclude any significant effect on the units above it caused by conditions within the artesian basalt aquifer.

Note that because the model uses hydrostratigraphic units to define layers, they may or may not be saturated. The top of the zone of saturation or watertable is computed as part of the model output, and is not specified a-priori. Measures of how well the model represents the modeled system are the degree of fit between the computed elevation of the watertable and the lateral extent of the zone of saturation of the upper aquifer which dips to the north and east at 3 to 5 degrees.

### 3.3.1.1 Layer 1: Bruneau Formation

The top of the uppermost layer (Layer 1) which represents the Bruneau Formation was taken as the elevation of the land surface. The elevation of the land surface was downloaded from the U.S. Geological Survey National Elevation Dataset (NED) in on a 10 meter x 10 meter grid for the analysis area shown in Figure 1. The elevation of the land surface for each of the 100 ft x 100 ft model cells was interpolated from the NED grid using the ArcInfo(tm) GIS program. The bottom of Layer 1 in the model is the top of the Upper Aquifer.

As shown in Figure 2, the bottom of Layer 1 or the Bruneau Formation occurs at the toe of the steep slopes extending into the valley of Castle Creek from the plateau upon which the site is located. The model truncated layer one at this boundary.

Based upon lithologic descriptions and previous studies[6,7], the hydraulic conductivity of Layer 1 was modeled using a value representative for a fine sand of 10 ft/day ($4.0 \times 10^{-3}$ cm/sec).

### 3.3.1.2 Layer 2: Upper Aquifer

Layer 2 in the model represents the hydrostratigraphic unit that includes the saturated Upper Aquifer and materials above the zone of saturation. The term Upper Aquifer is used for the purposes of this report to refer to this entire hydrostratigraphic unit. The top of this unit was determined using the cross sections shown as 6 and 7 in the Siting Application (Figure 3 in this report) as well as lithologic logs of wells and borings that were drilled to characterize the Upper and Lower Aquifer. This information was used to prepare a hand-drawn contour map of the top of the Upper Aquifer. The contours were drawn to honor the observed dip from south-southwest to north-north east discussed in previous site investigations. Where these contours intersected the land surface, the land surface elevation was used as the top of layer. This results in the correct modeling of thinning of the Upper Aquifer in the lower parts of the valley of Castle Creek south of the north boundary of Section 24 as illustrated in Figure 2. The contours were interpolated to the model grid cells using ArcInfo.

Based on the sections in the Application and lithologic logs of borings and wells, the Upper Aquifer was assumed to have a constant average thickness of 45 feet. The bottom elevation of Layer 2 was therefore assigned by subtracting this value from the top elevation for each model grid cell.

Based upon information in the Application and site studies the hydraulic conductivity of the Upper Aquifer was modeled using a value representative of a sandy silt of 1 ft/day (4 x $10^{-4}$ cm/sec). This value was used as a generalization of the value of 0. 6 ft/day that is reported in the studies used to permit the site.

### 3.3.1.3 Layer 3: Upper Confining Clay

Layer 3 in the model represents the upper confining clay. Based upon the sections in Figures 6 and 7 of the Siting Application and logs of wells and borings on the site, this layer was assumed to have a constant average thickness of 38 feet and therefore the elevation of the bottom of this layer was determined by subtracting this value from the top elevation at each model grid cell.

Based upon information in the application and other site studies, the hydraulic conductivity of Layer 3 was modeled using a value representative of the clay from the Kettering Source of or 1 x $10^{-6}$ cm/sec (0.003 ft/day). This value is at the upper (more permeable) end of the range of 1 x $10^{-7}$ to 1 x $10^{-6}$ cm/sec for the upper confining clay based upon laboratory testing of core samples of the deep lacustrine clays in the Glenns Ferry Formation[7].

### 3.3.1.4 Layer 4: Lower Aquifer

Layer 4 in the model represents the Lower Aquifer. Based upon the sections in Figures 6 and 7 of the Siting Application and logs of wells and borings on the site, this layer was assumed to have a constant average thickness of 30 feet and therefore the elevation of the bottom of this layer was determined by subtracting this value from the top elevation at each model grid cell.

Based upon information in the application and other site studies, the hydraulic conductivity of Layer 3 was modeled using a value representative of a clayey to sandy silt of 0.1 ft/day (4 x $10^{-5}$ cm/sec). This is a generalization of the value of 0.29 ft/day for the hydraulic conductivity of the Lower Aquifer. Recent tests of the new Lower Aquifer wells show that the average hydraulic conductivity is lower than the value in the permit and hence the value used in the model is reasonable.

### 3.3.1.5 Layer 5: Artesian Aquifer Confining Layer

Layer 5 in the model represents the upper portion of the over 2000 feet of clay and shale that overly the deep artesian basalt aquifer. The bottom of Layer 5 was set an arbitrary constant elevation of 2,100 feet. The hydraulic conductivity of this layer was set to the same value of 1 x $10^{-6}$ cm/sec (0.003 ft/day) used for the upper confining clay.

## 3.3.2 Boundary Conditions

All model boundary conditions assumed steady state (time-invariant) to represent the conditions of dynamic equilibrium between recharge and discharge to the modeled system. Boundary conditions were specified to define inflow and outflow at the model boundaries as well as to represent the hydraulic connection between the system and Castle and Catherine Creeks.

#### 3.3.2.1 Castle and Catherine Creeks

Because site studies concluded that these creeks are the source of recharge to the Upper and Lower Aquifer, they were included in the model to see if such a conclusion was reasonable. Both creeks were modeled using a River boundary condition that requires the specification of the elevation of the water surface in the creeks, the elevation of the streambed, and a hydraulic conductance per unit area of bottom sediments in the creeks. The cells representing the creeks were assigned by interpolating the locations digitized from the U.S. G.S topographic maps to the nearest grid cell. The elevations of the water surface were assigned to be the land surface elevation for the cells representing the creek, and the streambed elevation was assigned as being one (1) foot lower. The conductance of the streambed was assigned a value of 10 ft/day to represent a high degree of hydraulic connection.

#### 3.3.2.2 Lateral Boundaries

Based upon an evaluation of the general topography, the northwest and southeast model boundaries extending approximately one mile from the respective corners of the model were assigned a no-flow boundary condition in Layers 2, 3, and 4 to model regional groundwater flow paths. The entire lateral boundaries of Layer 1(Bruneau) and Layer 5 (Lower Confining Clay) were modeled as no flow boundaries.

To model regional flow into the model across the southern half analysis boundary a General Head Boundary (GHB) was used for layers 2, 3, and 4 with a driving head elevation varying linearly from 2,510 feet at the southwest analysis corner to 2,590 feet at the southeast analysis corner and a conductance of 0.01ft/day.

To model regional flow out of the model that discharges to the north and east analysis boundaries, a General Head Boundary was used for layers 2,3, and 4 with a driving head equal to the average elevation of the Snake River from the U.S.G.S. topographic maps and a conductance of 0.01 ft/day. The conductance value was reduced from an initial value of 0.1 to achieve a reasonable match between modeled and measured water level contours at the site as discussed below.

### 3.3.3 Sources and Sinks

As discussed above, previous studies have concluded that there is no measureable recharge from precipitation at the site - ET exceeds precipitation by 7 times. Consequently, for the analysis used to simulate present and expected future conditions a recharge rate of zero was assigned to the entire top of the model (land surface).

Simulation of the potential discharge from springs that may form in the case that the modeled watertable rises to intersect the land surface is accomplished using a Drain boundary condition assigned to the top surface of the model. Based upon site studies U.S.G.S topographic maps, there are no springs that emanate from the modeled units within the modeled area. Consequently for modeling present and expected future conditions no drain boundaries were modeled. However, as discussed subsequently, this condition was used to assess the potential for springs to develop under the hypothetical extreme climatic change analysis used to force water levels to rise into Layer 1 of the model beneath the site.

Although there are wells that apparently pump from the modeled units within the analysis boundary, they are all located west of Castle Creek and therefore the River boundary condition used for the creek would preclude any modeled effects of pumping from these wells on modeled heads east of Castle Creek. Consequently no wells were included in the model.

### 3.3.4 Comparison of Modeled and Measured Water Levels

To assess the reasonableness of the numerical model contours of modeled water levels were compared to those in Figures 4 and 5 of the Siting Application. Figures 7 and 8 show this comparison and the areas where the model shows the Upper Aquifer to be unsaturated. The only model parameter adjusted to achieve this degree of fit was the conductance of the General Head Boundary used to represent the discharge to north and east portions of the model boundary (eventual discharge to the Snake River alluvium). Based upon professional judgment and over 40 years of applying groundwater flow models, this fit is acceptable for the purposes of using the model to understand the flow system and to test the conclusion stated above regarding the limiting effect on rising water levels provided by the permeable materials lying above the Upper Aquifer.

### 3.3.5 Model Analyses of Rising Water Levels

Because the model reasonably well reproduces observed water levels in the Upper and Lower Aquifers and the portion of the Upper Aquifer that is unsaturated, it comprises a reasonable tool to evaluate the consequences of rising water levels at the site. In particular it was used to evaluate the effect that the higher permeability materials of the Bruneau Formation have in serving to drain water to the north and east and therefore to prevent water levels from rising more than a few feet above the current top of the zone of saturation.

As has been documented by other studies[6,7] and described elsewhere in this report, the arid climate and thick vadose zone preclude recharge from infiltration of precipitation. However, to force water levels to rise into the upper part of the Upper Aquifer and the overlying Bruneau Formation, a hypothetical recharge rate of four inches per year was applied to the entire model analysis area. This rate is hypothetical but would correspond to an average annual precipitation of greater than 40 inches per year based upon a commonly used recharge rate of 10% of this rate in temperate areas of the U.S.

Figure 7 and 8 show the modeled increases in water levels and the changes on flow patterns that resulted from application of the hypothetical increased recharge. The modeled recharge applied to the analysis area causes water levels to rise under the topographically high areas east of Castle Creek, including under the site. These rises are sufficient to saturate the Upper Aquifer beneath all of these areas. However, as shown in Figure 8, the high permeability materials of the Bruneau Formation limit the rise to a few feet into this unit.

### 3.3.6 Conclusions from model construction and analyses

A representative quantitative model has been constructed using site specific information that has been developed from over 20 years of investigations and measurements at the site. The model incorporates the geometry and hydraulic properties of the five hydrostratigraphic units occurring below the site. The model includes recharge from Castle and Catherine Creeks and accounts for regional inflow from the south and west and for regional outflow to the north and east that eventually discharges to the alluvium of the Snake River.

The agreement between modeled water levels and gradients and those interpreted by hand from water level measurements in wells screened in both the Upper and Lower Aquifer is adequate to have confidence that the model is a reasonable representation of the hydrogeologic conditions beneath and in the vicinity of the site.

The model was used to clearly demonstrate that even under the hypothetical climate change conditions evaluated with the groundwater model that the recharge of 4 inches per year from this hypothetical and extremely unlikely condition is not sufficient to reverse the gradient and produce flow from the site towards any reach of Castle Creek. Furthermore this analysis shows that there is no potential to develop new surface water discharge to the north and east of the site because the high permeability of the materials occurring above the Upper Aquifer drain any water that rises into them and precludes the watertable from rising to the land surface, even in topographically low areas.

# 4 Assessment of the Site B RESRAD Model

USEI currently uses a RESRAD model to assess the potential dose from materials that are proposed to be disposed at Site B. The current RESRAD model for the site uses site-specific parameters to characterize the vadose and saturated zones that were developed and documented by Eagle Resources in 2005[20]. The site-specific parameters were developed using the same studies and reports cited in the present report regarding the degree of protection afforded by the thick vadose zone and the arid climate[6,15].

The saturated zone included in the site-specific RESRAD model corresponds to the Upper Aquifer discussed in this report. The site RESRAD model simulated the adjective (non-dispersion or ND) mode that assumes that the intruder water supply well is located at the down-gradient edge of the waste disposal facility.

RESRAD is a screening model that uses bounding conditions to define transport pathways, including flow in the saturated zone to the intruder well. As such, RESRAD does not explicitly simulate the regional effects of recharge from Castle Creek and discharge to the north and east. RESRAD also assumes that the lithologic unit comprising the saturated zone is horizontal and uniform in thickness. One of the purposes of constructing and applying the three-dimensional model described in Section 3.3 of this report was to assess the combined effects of the regional recharge and discharge with the

[20] Eagle Resources, April 2005: Site-Specific RESRAD Water Pathway Parameters for the Contaminated Soil, Vadose Zone, and Saturated Zone, US Ecology Grand View Idaho.

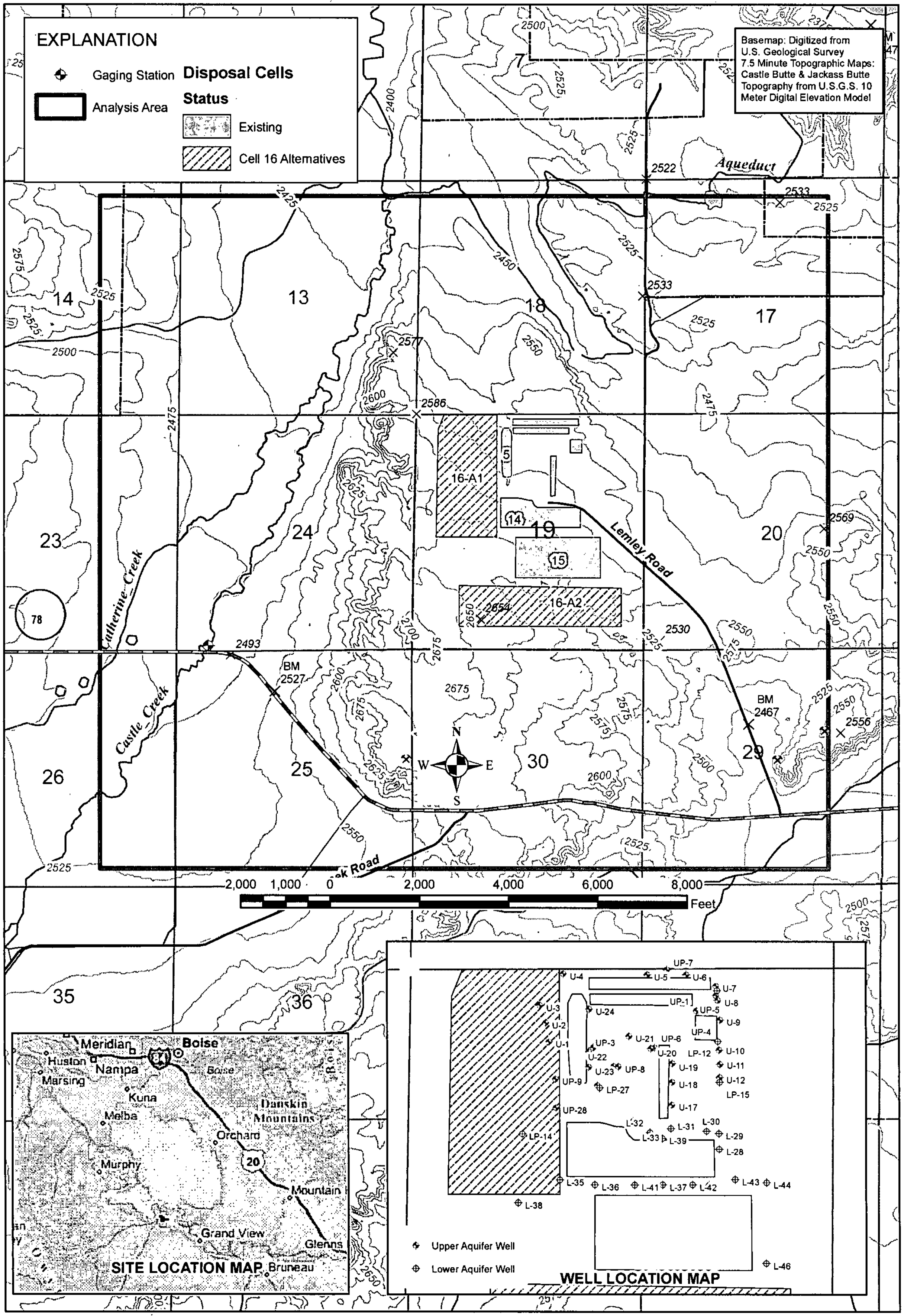
known dip to the northeast of the hydrostratigraphic unit that includes the Upper Aquifer as well as the units that correspond to the Lower Aquifer and the confining unit that separates the Upper and Lower Aquifers.

The hydraulic gradient used in the RESRAD model to compute the rate at which water would migrate from below the waste zones to the intruder well located at the edge of the disposal site was 0.011. The computed hydraulic gradient across Site B with the three-dimensional model discussed in Section 3.3 of this report was 0.012. The agreement between these values of the hydraulic gradient shows that the RESRAD model correctly incorporates the effects of regional discharge and discharge across the site.

The value of hydraulic conductivity of the Upper Aquifer for the model described in Section 3.3 was 1 ft/day. The hydraulic conductivity used in the RESRAD well intruder scenario to compute the advective flow in the saturated zone to the well was 25 meters/year (0.23 ft/day). The lower hydraulic conductivity used by the RESRAD model is conservative (more protective) because it results in a smaller volumetric rate of clean water entering the intruder well from that portion of the well's cone of depression that is outside the site boundary than would be the case using the value used for the model described in Section 3.3 of this report. This results in a higher computed dose from the intruder well with the parameters used in the RESRAD model than would be the case if the value of 1 ft/day from the current model were used.

In conclusion, the analyses presented in this report are consistent with the assumptions and parameters used in the Site B RESRAD model for the water pathway involving the intruder well scenario. The RESRAD model correctly represents the regional hydraulic gradient across the site, and the hydraulic conductivity used results in a conservative higher dose from the water pathway than would be the case if the value used in the model developed for this report had been used.

# 5 APPENDIX A: Figures

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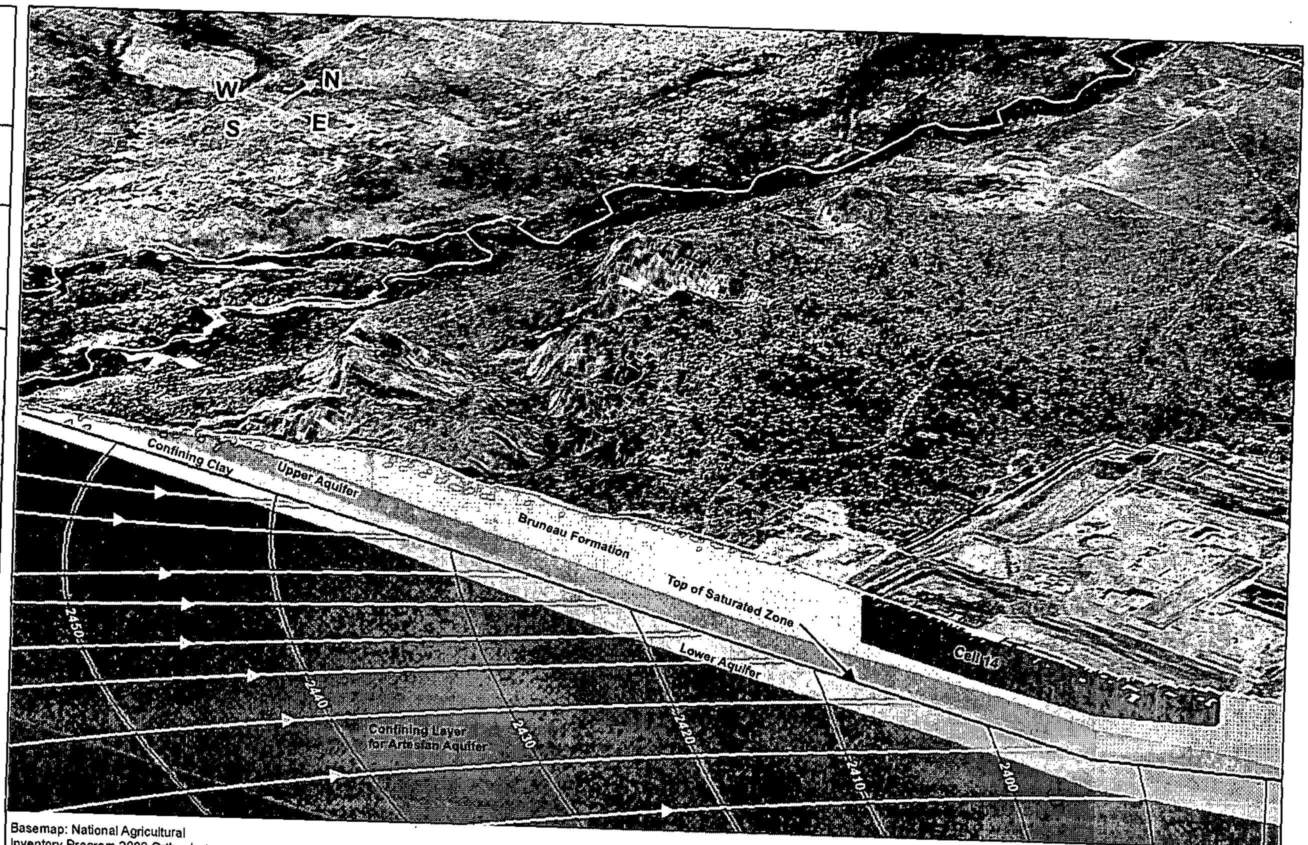
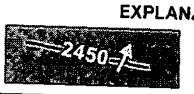
| Eagle Resources<br>4005 Lake Springs Court<br>Raleigh, NC 27613<br>919.345.1013<br>www.eagleresources.com | US Ecology Idaho | Project No. 20019.1 | Summary of Hydrogeologic Conditions and Groundwater Flow Model | Figure |
| | | Approved: EGL | Location and Site Features of the USEI Facility | 1 |
| | | Date: 12/17/09 | | |




Basemap: National Agricultural Inventory Program 2009 Orthophoto

Vertical Exaggeragion: 2.5X

**EXPLANATION**




Contour on Surface of Zone of Saturation Under Present and Expected Future Conditions; Contours on Top of Saturation Zone (Elevation Datum: NAVD88); and Directions of Groundwater Flow.

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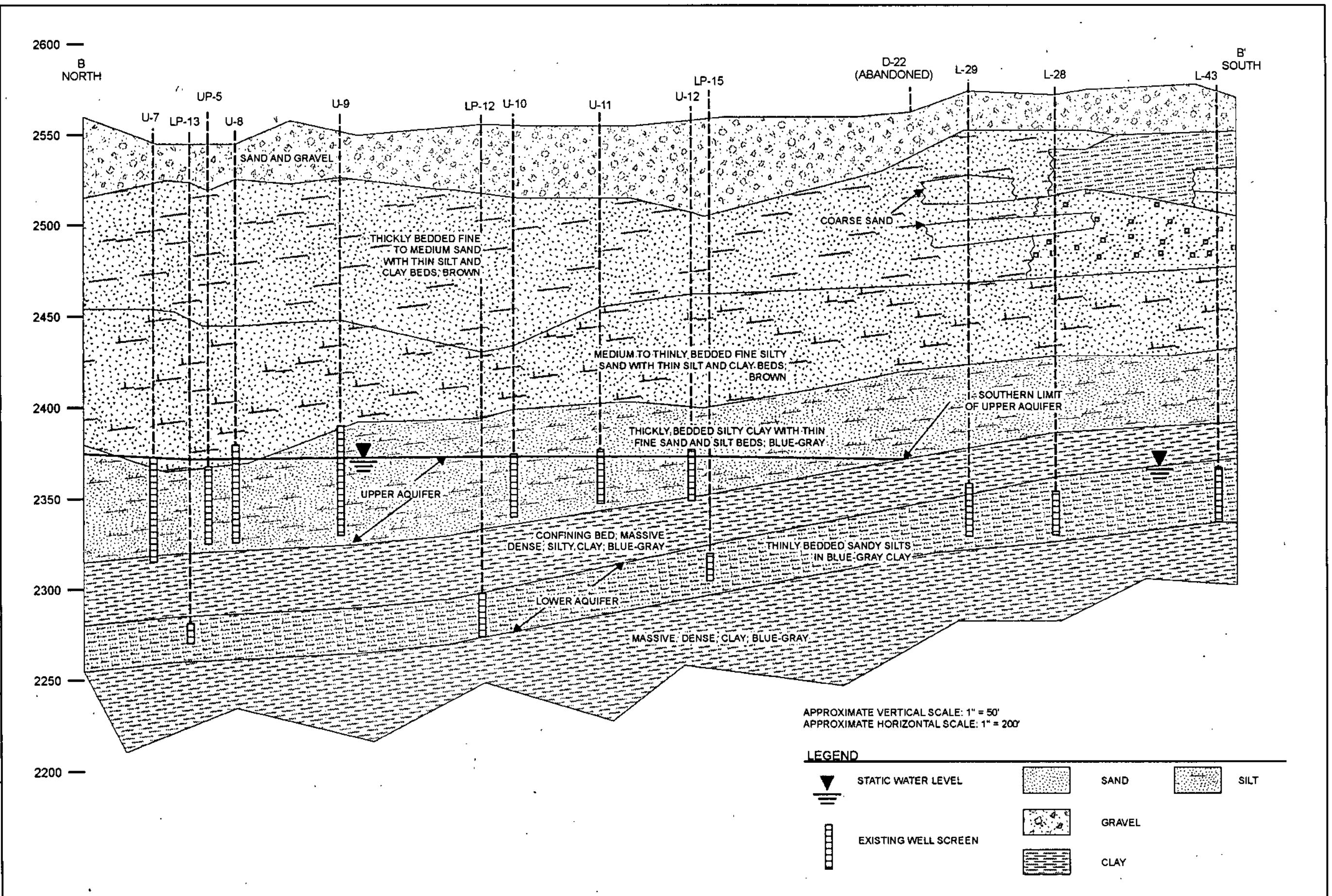
Approved
Date

**Summary of Hydrogeologic Conditions and Groundwater Flow Model**

Three-dimensiaol section through the USEI site showing hydrostratigraphic units and present and expected future water level conditions.

Figure 2

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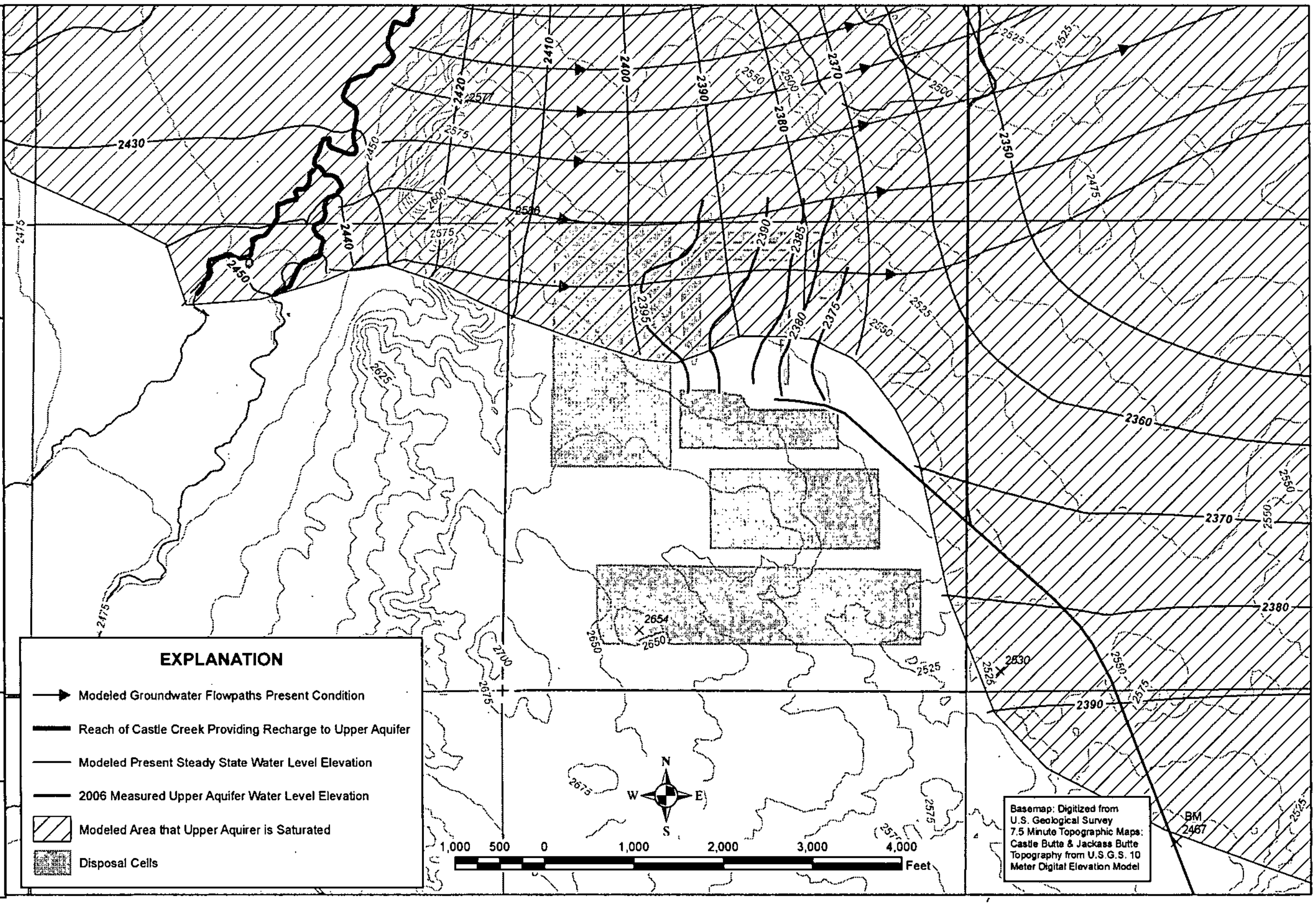
**Summary of Hydrogeologic Conditions and Groundwater Flow Model**

**North-South Geological Section - East Side of Section 19. (From Figure 7 in Siting Application) Original Prepared by Feast Geosciences.**

**Figure 3**

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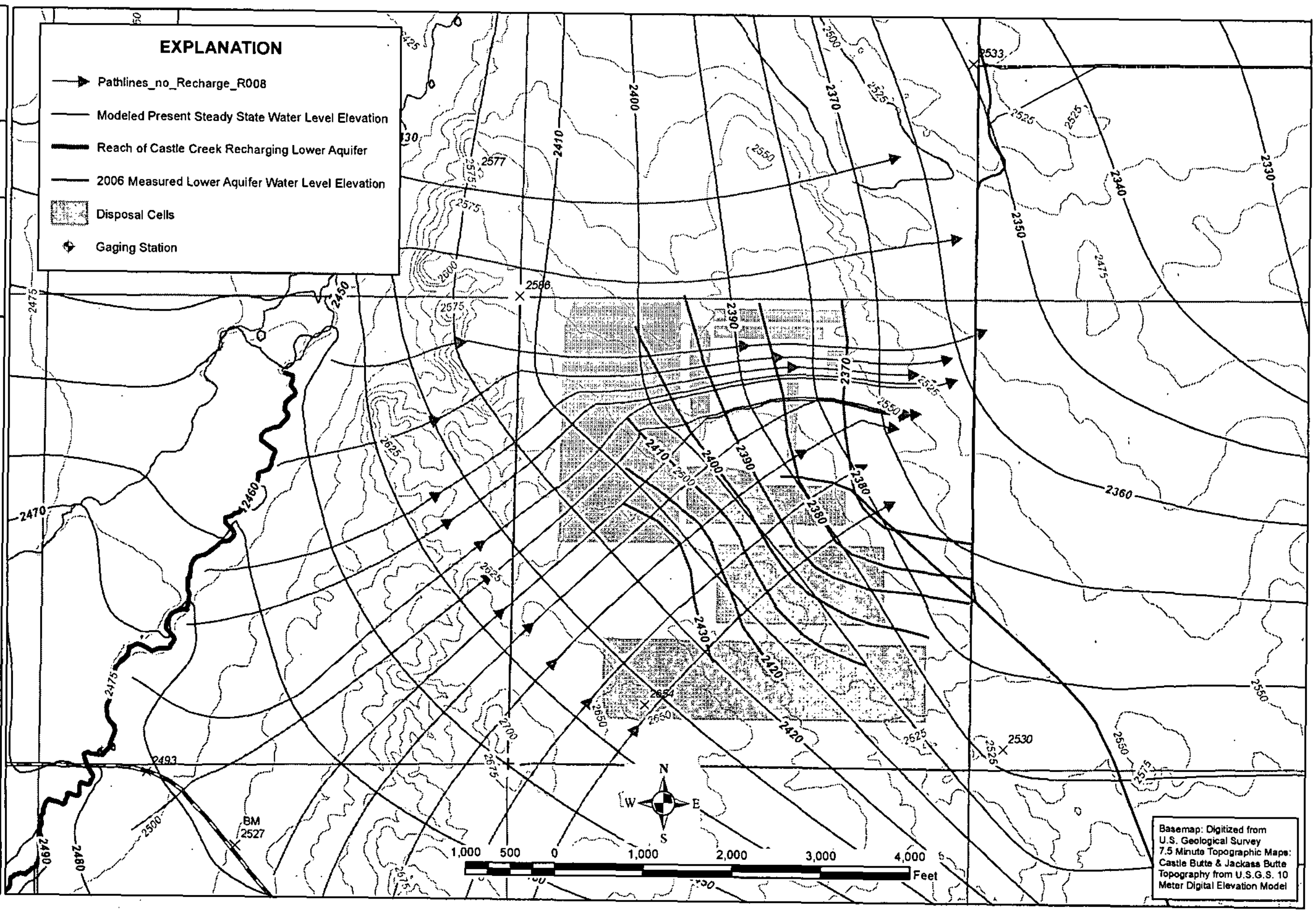
Summary of Hydrogeologic Conditions and Groundwater Flow Model

Plan view of hydrogeologic conditions in the Upper Aquifer under present and expected future conditions.

Figure 4

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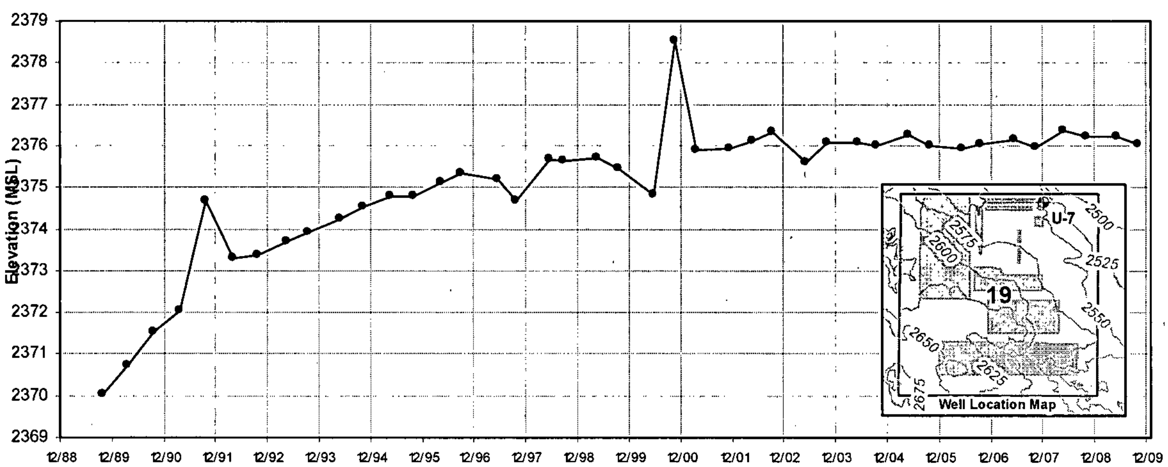
Summary of Hydrogeologic Conditions and Groundwater Flow Model

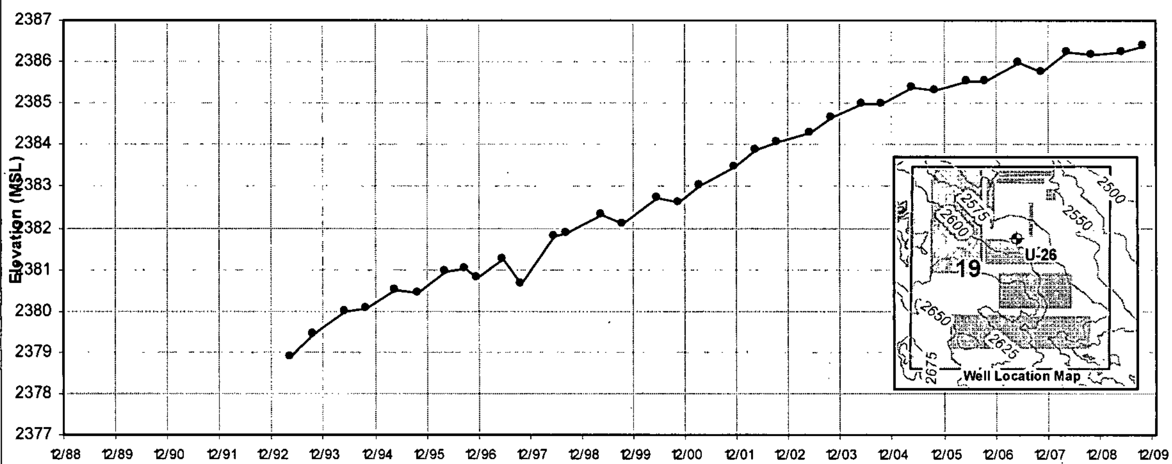
Plan view of hydrogeologic conditions in the Lower Aquifer under present and expected future conditions.

Figure 5

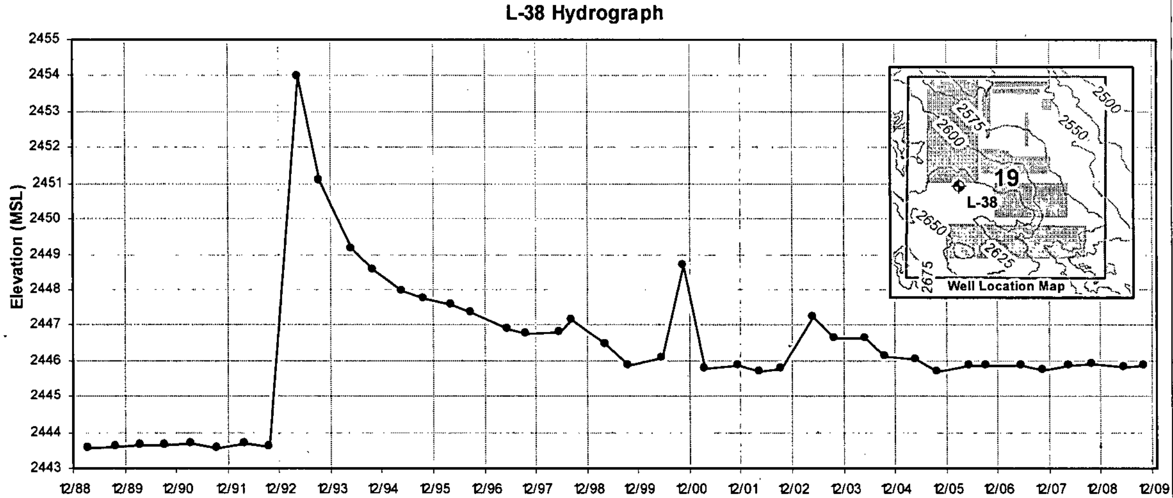
U-7 Hydrograph




U-26 Hydrograph




L-38 Hydrograph

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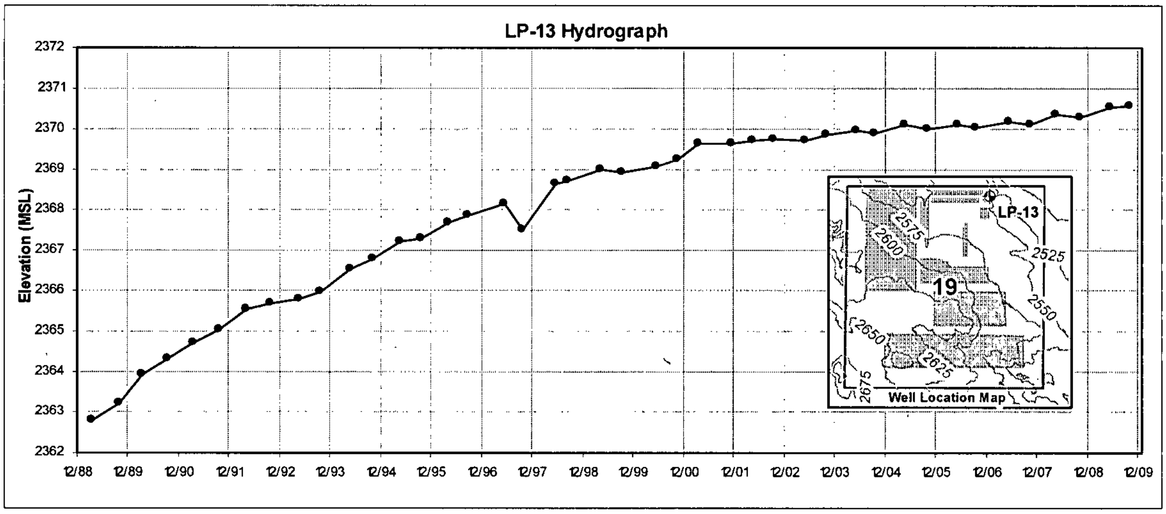
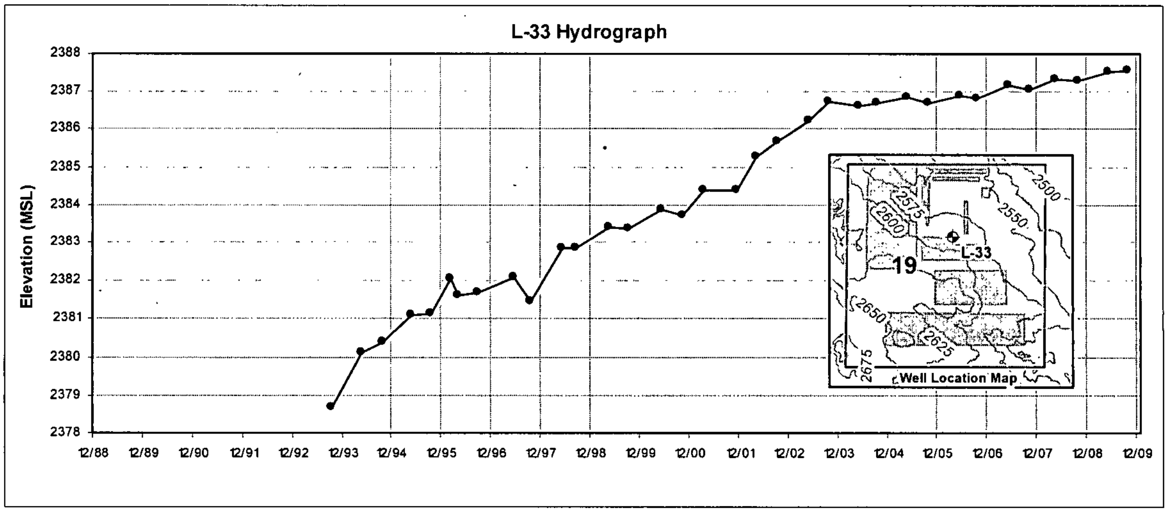
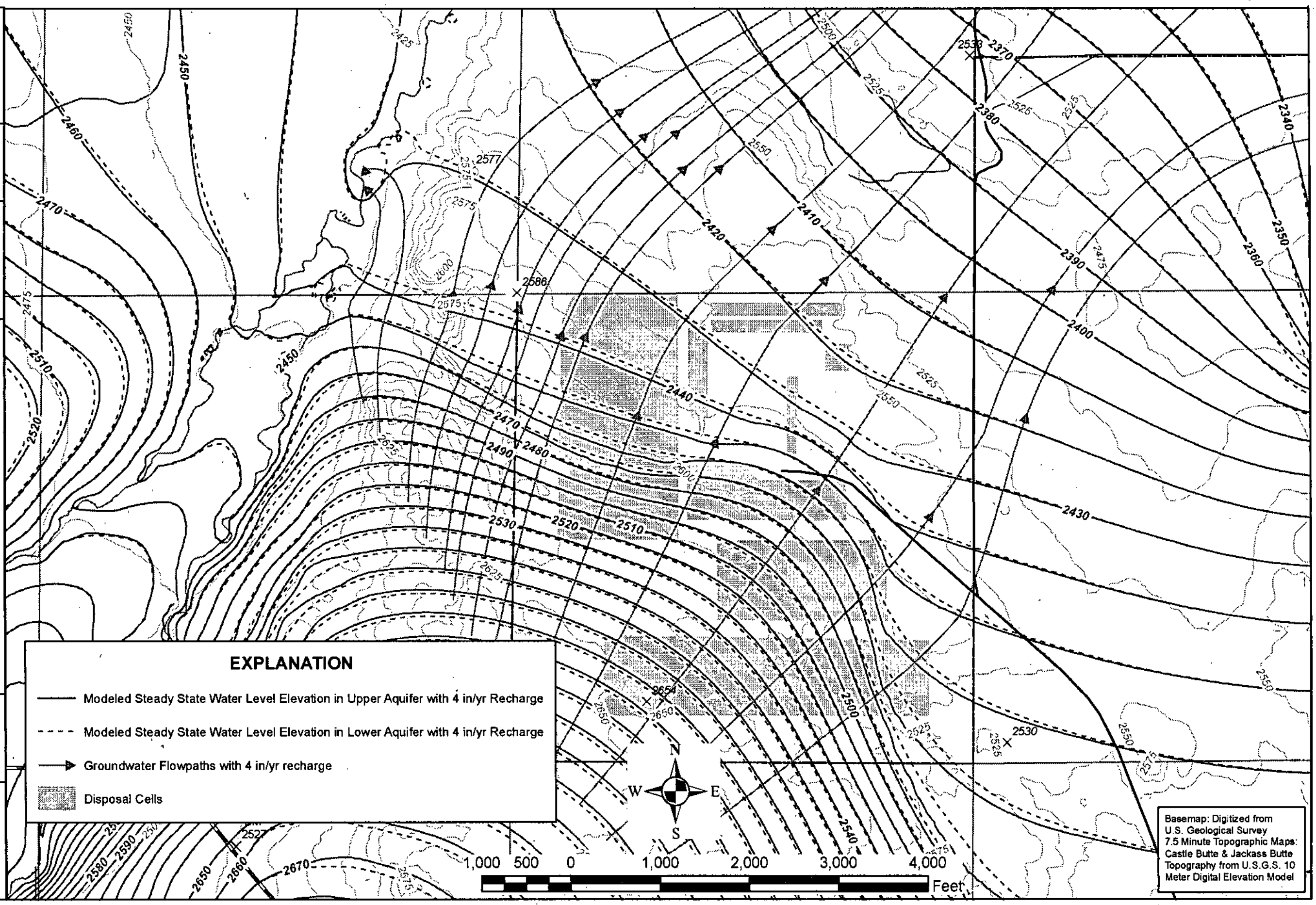
| Eagle Resources<br>4005 Lake Springs Court<br>Raleigh, NC 27613<br>919.345.1013<br>www.eagleresources.com | US Ecology Idaho | Project No. 20019.1<br>Approved: EGL<br>Date: 12/17/09 | Summary of Hydrogeologic Conditions and Groundwater Flow Model<br>Example Hydrographs of Water Level Elevation in Upper and Lower Aquifer Wells. | | Figure<br>6 |




| | | | | | |
|---|---|---|---|---|---|
| Eagle Resources<br>4005 Lake Springs Court<br>Raleigh, NC 27613<br>919.345.1013<br>www.eagleresources.com | US Ecology Idaho | Project No. 20019.1<br>Approved: EGL<br>Date: 12/17/09 | Summary of Hydrogeologic Conditions and Groundwater Flow Model<br>Example Hydrographs of Water Level Elevation in Upper and Lower Aquifer Wells. | | Figure 6a |





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Raleigh, NC 27613
919.345.1013
www.eagleresources.com

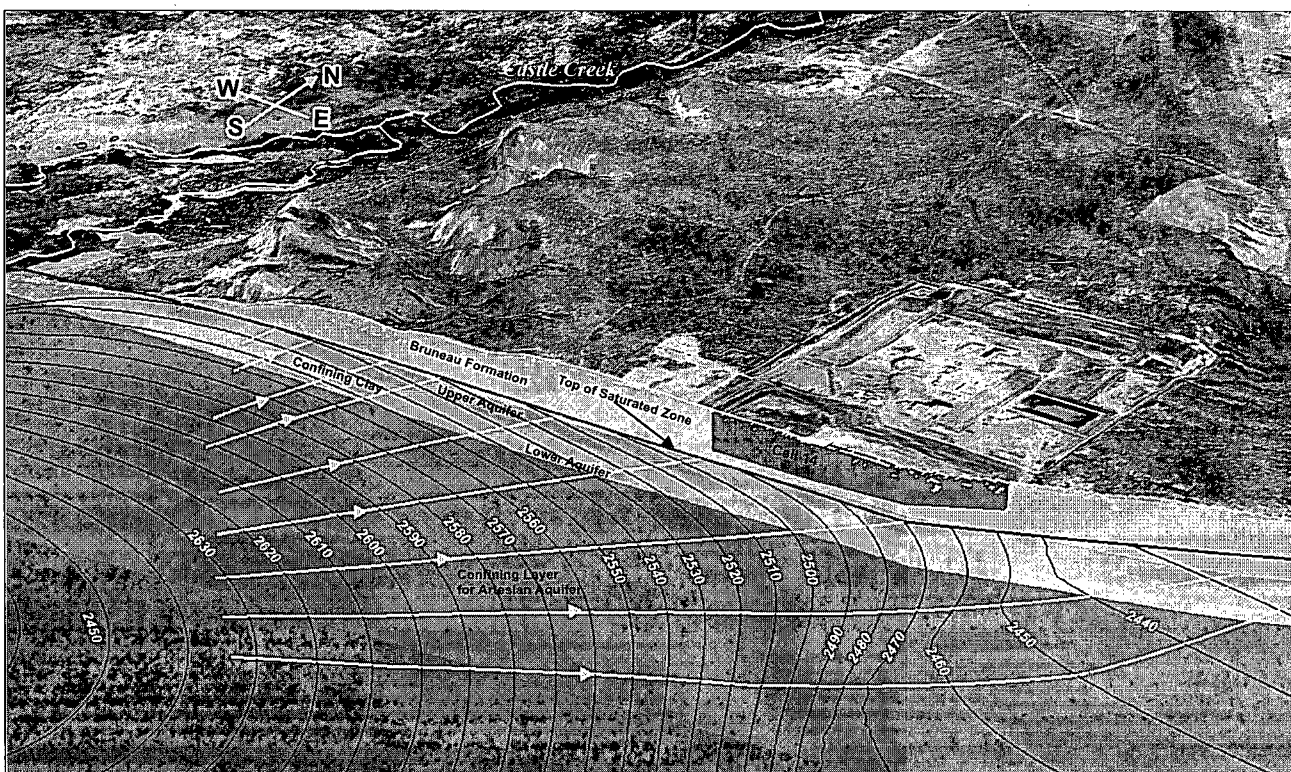

**US Ecology Idaho**

Project No. 20019.1
Approved: EGL
Date: 12/10/2009
Approved
Date

**Summary of Hydrogeologic Conditions and Groundwater Flow Model**

**Plan view of hypothetical hydrogeologic conditions in the Upper and Lower Aquifers in the event of a climate change producing annual precipitation of 40 inches and a regional recharge rate of 4 inches per year.**

**Figure 7**




Basemap: National Agricultural Inventory Program 2009 Orthophoto

Vertical Exaggeragion: 2.5X

**EXPLANATION**

2450 — Contour on Surface of Zone of Saturation Under Present and Expected Future Conditions; Contours on Top of Saturation Zone (Elevation Datum: NAVD88); and Directions of Groundwater Flow.

Eagle Resources
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Raleigh, NC 27613
919.345.1013
www.eagleresources.com

**US Ecology Idaho**

Project No. 20019.1
Approved: EGL
Date: 12/10/2009
Approved
Date

**Summary of Hydrogeologic Conditions and Groundwater Flow Model**

Three-dimensional section through the USEI Site showing hydrostratigraphic units and water levels resulting from a climate change that produces annual precipitation of 40 inches/year.

Figure 8

# 6 APPENDIX B: Response to CCI Issues

The following presents our response to the seven (7) issues that Mr. Gililan as the commenter for CCI raises to the WEC application.

**Issue 1:** *Contrary to the stated conclusion in the application, the applicant conclusively demonstrates that there is a direct hydrologic connection between Castle Creek and all the underlying aquifers at Site B, which is typically the opposite conclusion one hopes to arrive at with regard to hazardous waste storage sites.*

**RESPONSE:**
The author's statement that it is necessary to have no connection between surface water and groundwater is not a requirement for a site to be protective. In the case such as is with the USEI site, when surface water serves as a recharge source rather than a discharge source, such connection needs to be understood, but is not a restriction on site protectiveness. Site studies and the modeling analysis presented in this response show that Castle Creek is the up-gradient recharge source for the groundwater beneath the site. Groundwater flow directions in both aquifers are away from Castle Creek to the east and northeast and not toward it as the author seems to imply by the oft repeated concern that the groundwater and surface water systems are connected.

Even under the hypothetical climate change conditions evaluated with the groundwater model Castle Creek continues to be a recharge source to the Upper and Lower Aquifers. The modeled recharge of 4 inches per year from this hypothetical and extremely unlikely condition is not sufficient to reverse the gradient and produce flow from the site towards any reach of Castle Creek.

Furthermore this analysis shows that there is no potential to develop new surface water discharge to the north and east of the site because the high permeability of the materials occurring above the Upper Aquifer drain any water that rises into them and precludes the watertable from rising to the land surface, even in topographically low areas.

**Issue 2:** *The applicant's study indicates that the local hydraulic head associated with the underlying artesian aquifer is significant and geologically impressive while simultaneously documenting through site well data that the area groundwater table is rising. In ideal storage siting, the applicant typically wants to demonstrate a very deep below ground, static and or receding groundwater table. The applicant has documented the opposite condition.*

**RESPONSE:**
The presence of a deep artesian basalt aquifer beneath the site Basalt is a statement of fact and the Application includes the log of the properly abandoned and sealed well on site that was completed in this aquifer. We are not aware of any statements in the Application or other reports on site hydrogeologic conditions that conclude that there is any effect either by the artesian aquifer on the units above its confining unit or any

potential effect on this aquifer that is or could be imposed by the units above its confining layer.

The wording in Mr. Gililan's comment implies that the artesian aquifer is somehow the source of groundwater in the Upper and Lower Aquifer and consequently the cause of the rising water levels at the site. The 1999 Rising Groundwater Study concluded that there was no indication of leakage from the deep artesian aquifer via either the confining bed or the well bore. Sections 2.3 and 3.2 of this report discuss the potential causes for rising water levels and as clearly demonstrated in Section 3.1 of this response, the shorter term fluctuations in water levels in wells near Cell 15 are adequately explained by variations in loading at the surface during cell construction, filling, and completion.

We are not aware of state or federal requirements for site suitability that require demonstration of deep and or receding watertable conditions.

**Issue 3:** *The applicant's analysis largely considers the risk of downward contaminant leakage to the underlying Upper and Lower Aquifers which are connected to Castle Creek. However, given the documented groundwater rise, the more likely pathway for contaminants leaving the site is through dispersal in a saturated near surface water table which also includes and permits significant lateral contaminant movement.*

**RESPONSE:**
It is true that previous studies by CH2M Hill and Eagle Resources[4,6,7,8] have shown that not only is there no discernable recharge from precipitation due to the arid climate and thickness of the vadose zone. These studies have also demonstrated that a release of water from extreme precipitation events that might collect in uncompleted cells and be released via a total liner failure would be retained in the vadose zone and not recharge the Upper Aquifer. The CH2M Hill Study used three-dimensional unsaturated transport computer simulations that used extreme, hypothetical releases of water to try to get something to reach the groundwater. After 10,000 simulated years the release faded into background soil moisture levels and effectively stopped moving.

Quantitative analysis with the model presented in this report demonstrate that if, water levels rise into the increasingly permeable materials in the upper part of the Upper Aquifer that they will conduct such water to the north and east. This limiting condition on water levels is functional even under hypothetical conditions of extreme climatic change that would permanently increase rainfall at the site sufficient to increase recharge from zero to 4 inches per year. These analyses demonstrate that there is no potential for new surface water discharge to springs and seeps by a rising water table around the site and along groundwater flow paths to the north and east.

**Issue 4:** *The applicant's data and analysis suggests a highly unusual and dynamic relationship between surface ground pressure at Site B and the underlying aquifers such that simple excavation of trenches and stockpiling overburden on the site dramatically and rapidly alters the elevation of the underlying groundwater.*

**RESPONSE:**
See Section 3.1 of this response document and responses to Issues 1, 2, and 3. Furthermore, the rise in the potentiometric surface at well L-38 in 1992 was in direct response to the geologically sudden increase in surface loading as the spoils from the excavation of trench 14 were stockpiled adjacent to this well. For the next 10 years water levels slowly recovered (declined) as the aquifer reached a new equilibrium with this loading. In 2002 additional spoils were moved into the area causing another small increase with a commensurate gradual decline for about 3 years. Since 2005 water levels in this well have been approximately constant. Other Lower Aquifer wells in the vicinity of Cells 14 and 15 also show rapid water level variations apparently related stockpiling and moving of spoils and the excavating and filling of trenches. Lower Aquifer wells more distant from the construction activity do not show these variations. The author should review the concept of hydraulic soil loading and effective stress on confined aquifer systems.

**Issue 5:** *The applicant clearly states that well log data analysis from UP-28 and U-29 indicate anomalies in expected potentiometric surfaces based on other well data onsite, and that these anomalies can be explained by upward leakage from the Lower Aquifer to the Upper Aquifer.*

**RESPONSE:**
The water levels in these two wells are not consistent with the expected water level for Upper Aquifer wells. During construction the boreholes at both wells were advanced into the Lower Aquifer to allow borehole geophysics to be used to positively identify the top of the Lower Aquifer and bottom of the Upper Aquifer. After logging the bottom portion of the boreholes were plugged back with bentonite grout. There are three possibilities for the higher than expected water levels in these wells: the water levels are real and reflect a recharge pathway or higher transmissivity zone in the Upper Aquifer; the water levels are an indication that the bottom seal in the borehole was not complete or sufficient to prevent the higher heads in the Lower Aquifer from dominating the water levels in the wells; or there is significant leakage of water through the confining bed at this location. The geologic and geophysical logs for these wells indicate the confining bed is present, intact, and similar to the confining bed encountered beneath the site at other wells. Consequently the most likely cause of these high water levels is leakage up the well bore or lateral movement of water from recharge areas at higher elevations along Castle Creek. Regardless of the cause of these water levels they have no affect on the groundwater monitoring at the Site.

**Issue 6:** *Based on the applicant's acknowledgment of complex site stratigraphy, communication between the Upper, Lower, Artesian, and Castle Creek shallow alluvial aquifer, and that time trends on this data show rapidly changing conditions, discussions concerning groundwater flux and velocity can be considered no more than speculative exercises.*

**RESPONSE:**

The author needs to read and study the many reports issued on the hydrogeology of Site B. There are no data that suggest the deep regional geothermal artesian aquifer is affecting or communicating with the upper or Lower Aquifers at Site B. The 1999 Rising Groundwater report addressed this issue directly and concluded there was no evidence from head, temperature or chemistry that the artesian well, plugged in 1985, on site was leaking. This conclusion has been confirmed by water level, temperature and chemistry data collected in the 20 years since the 1999 report was issued.

The "rapidly" changing conditions referenced by the author are apparently directed at the water level response in several of the Lower Aquifer wells across the southern portion of the site. These pressure heads in these wells, notably wells L-38 and LP-14, reacted to rapidly changing surface loads as cells 14 and 15 were excavated, the spoils stock piled and the cells backfilled up to and above original grade. With the exception of the Upper Aquifer across the northern portion of the site the groundwater systems at Site B have very low permeability, are internally complexly inter-bedded with thin, laterally discontinuous beds and lamina of fine sands, silts and clay and are therefore too sluggish or "hydraulically retarded" to have the "rapidly changing" conditions the author cites in his concern. With the exception of the few Lower Aquifer wells mentioned above, water levels while rising gradually have maintained inter-well and inter-aquifer gradients and consequently flow directions have been remarkably consistent over the 25 years the site has been monitored.

Groundwater flux evaluations were presented during the site characterization process as a way to account for water movement through the subsurface at Site B. Certain simplifying and generalizations assumptions are required because of the natural variation in aquifer properties, variations in head and head relationships within and between geologic units. A vertical flux from the Upper Aquifer into the Lower Aquifer across the northern portion of the site was addressed because the fundamental law addressing groundwater flow, Darcy's Law, mathematically does not allow "no" flow when there is permeability and a gradient. In actuality there are recognized lower limits of flux in natural systems and while Darcy's Law indicates the potential for flux between the aquifers, water chemistry separation between the upper and Lower Aquifers indicates any flux, if occurring, is minimal.

**Issue 7**: *The applicant clearly states a significant trend in groundwater rise beneath the site that is not related to any measurable change in the contributing areas precipitation or surface distribution of water related to agriculture or water storage facilities. Therefore, the observed rise in water table has to be related to a change in conditions in the overall hydrogeographic watershed.*

**RESPOSE:**
The use of the term ".. hydrogeographic watershed.." illustrates that at best Mr. Gillian's familiarity is with the elements of surface water hydrology which are defined by topographic basins or watersheds. There is no definition of hydrogeographic in any of the hydrogeologic literature. In fact, it is at best misleading because hydrogeologic units are defined by the presence and interconnection of hydrostratigraphic units, or subsurface features that exhibit similar hydraulic properties over connected zones or regions.

The analyses in this report show that there are reasonable and supportable explanations for the water level rises and further more that geometry and permeability of the sands that occur in the upper part of and above the Upper Aquifer place limits on future rises. This limiting function of these permeable materials on water level rises has been further demonstrated for a hypothetical and extremely unlikely condition that would increase recharge to the Upper Aquifer from zero to four (4) inches per year.

MICROSHIELD MODELS AND RESULTS PERTAINING TO

POTENTIAL EXTERNAL AND INTERNAL DOSE HAZARDS

TO TRANSPORTATION WORKERS AND TO USEI WORKERS

(8 PAGES ATTACHED)

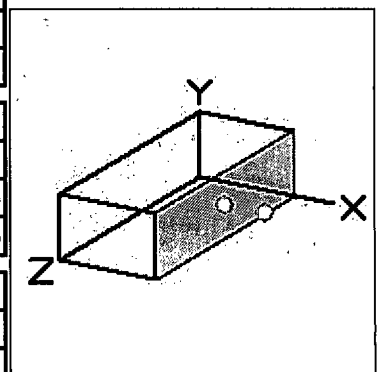
| MicroShield 7.02<br>American Ecology (08-MSD-7.02.1418) |
|---|

| Date | By | Checked |
|---|---|---|
| | | |

| Filename | Run Date | Run Time | Duration |
|---|---|---|---|
| HBPP mix in 30cy IM-surveyor rev.ms7 | October 1, 2009 | 12:29:24 PM | 00:00:01 |

| Project Info | |
|---|---|
| Case Title | HBPP Mix rev |
| Description | In 30 cy IM |
| Geometry | 13 - Rectangular Volume |

| Source Dimensions | |
|---|---|
| Length | 243.84 cm (8 ft) |
| Width | 617.22 cm (20 ft 3.0 in) |
| Height | 152.4 cm (5 ft 0.0 in) |




| Dose Points | | | |
|---|---|---|---|
| A | X | Y | Z |
| #1 | 245.394 cm (8 ft 0.6 in) | 76.2 cm (2 ft 6.0 in) | 308.61 cm (10 ft 1.5 in) |
| #2 | 344.363 cm (11 ft 3.6 in) | 76.2 cm (2 ft 6.0 in) | 308.61 cm (10 ft 1.5 in) |

| Shields | | | |
|---|---|---|---|
| Shield N | Dimension | Material | Density |
| Source | 810.0 ft³ | Concrete | 0.88 |
| Shield 1 | .018 ft | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input: Grouping Method - Standard Indices**
**Number of Groups: 25**
**Lower Energy Cutoff: 0.015**
**Photons < 0.015: Included**
**Library: Grove**

| Nuclide | Ci | Bq | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ag-108m | 2.0184e-006 | 7.4682e+004 | 8.8000e-008 | 3.2560e-003 |
| Ba-137m | 3.0276e-004 | 1.1202e+007 | 1.3200e-005 | 4.8840e-001 |
| C-14 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Co-60 | 1.0092e-004 | 3.7341e+006 | 4.4000e-006 | 1.6280e-001 |
| Cs-137 | 3.0276e-004 | 1.1202e+007 | 1.3200e-005 | 4.8840e-001 |
| Eu-152 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Eu-154 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Fe-55 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| H-3 | 2.0184e-003 | 7.4682e+007 | 8.8000e-005 | 3.2560e+000 |
| Ni-63 | 2.0184e-004 | 7.4682e+006 | 8.8000e-006 | 3.2560e-001 |
| Sr-90 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Y-90 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |

| **Buildup: The material reference is Source<br>Integration Parameters** | |
|---|---|
| X Direction | 20 |
| Y Direction | 20 |
| Z Direction | 20 |

**Results - Dose Point # 1 - (8.051,2.5,10.125) ft**

| Energy (MeV) | Activity (Photons/sec) | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 5.016e+05 | 1.266e-149 | 2.777e-28 | 1.086e-150 | 2.382e-29 |
| 0.02 | 4.898e+04 | 7.273e-70 | 4.268e-29 | 2.519e-71 | 1.478e-30 |
| 0.03 | 6.598e+05 | 3.289e-24 | 6.665e-24 | 3.260e-26 | 6.606e-26 |
| 0.04 | 7.496e+05 | 1.149e-12 | 3.833e-12 | 5.081e-15 | 1.695e-14 |
| 0.05 | 1.491e+05 | 4.381e-09 | 2.172e-08 | 1.167e-11 | 5.787e-11 |
| 0.08 | 5.292e+03 | 8.871e-07 | 6.771e-06 | 1.404e-09 | 1.072e-08 |
| 0.1 | 5.145e+05 | 4.789e-04 | 3.634e-03 | 7.327e-07 | 5.560e-06 |
| 0.2 | 1.070e+05 | 1.140e-03 | 6.414e-03 | 2.013e-06 | 1.132e-05 |
| 0.3 | 2.019e+05 | 4.828e-03 | 2.255e-02 | 9.159e-06 | 4.278e-05 |
| 0.4 | 1.194e+05 | 4.789e-03 | 1.958e-02 | 9.331e-06 | 3.815e-05 |
| 0.5 | 5.830e+03 | 3.458e-04 | 1.276e-03 | 6.787e-07 | 2.504e-06 |
| 0.6 | 1.024e+07 | 8.336e-01 | 2.823e+00 | 1.627e-03 | 5.511e-03 |
| 0.8 | 4.918e+05 | 6.599e-02 | 1.967e-01 | 1.255e-04 | 3.742e-04 |
| 1.0 | 4.283e+06 | 8.479e-01 | 2.303e+00 | 1.563e-03 | 4.245e-03 |
| 1.5 | 4.199e+06 | 1.683e+00 | 3.907e+00 | 2.832e-03 | 6.573e-03 |
| **Totals** | **2.228e+07** | **3.442e+00** | **9.283e+00** | **6.169e-03** | **1.680e-02** |

**Results - Dose Point # 2 - (11.298,2.5,10.125) ft**

| Energy (MeV) | Activity (Photons/sec) | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 5.016e+05 | 7.317e-115 | 9.229e-29 | 6.276e-116 | 7.916e-30 |
| 0.02 | 4.898e+04 | 1.590e-55 | 1.418e-29 | 5.509e-57 | 4.913e-31 |
| 0.03 | 6.598e+05 | 1.592e-20 | 3.183e-20 | 1.578e-22 | 3.154e-22 |
| 0.04 | 7.496e+05 | 2.291e-11 | 7.093e-11 | 1.013e-13 | 3.137e-13 |
| 0.05 | 1.491e+05 | 1.638e-08 | 7.291e-08 | 4.363e-11 | 1.942e-10 |
| 0.08 | 5.292e+03 | 9.585e-07 | 6.188e-06 | 1.517e-09 | 9.793e-09 |
| 0.1 | 5.145e+05 | 4.040e-04 | 2.557e-03 | 6.181e-07 | 3.912e-06 |
| 0.2 | 1.070e+05 | 6.922e-04 | 3.278e-03 | 1.222e-06 | 5.785e-06 |
| 0.3 | 2.019e+05 | 2.725e-03 | 1.082e-02 | 5.169e-06 | 2.053e-05 |
| 0.4 | 1.194e+05 | 2.601e-03 | 9.115e-03 | 5.069e-06 | 1.776e-05 |
| 0.5 | 5.830e+03 | 1.829e-04 | 5.824e-04 | 3.589e-07 | 1.143e-06 |
| 0.6 | 1.024e+07 | 4.317e-01 | 1.269e+00 | 8.425e-04 | 2.478e-03 |
| 0.8 | 4.918e+05 | 3.305e-02 | 8.642e-02 | 6.287e-05 | 1.644e-04 |
| 1.0 | 4.283e+06 | 4.137e-01 | 9.940e-01 | 7.626e-04 | 1.832e-03 |
| 1.5 | 4.199e+06 | 7.830e-01 | 1.633e+00 | 1.317e-03 | 2.748e-03 |
| **Totals** | **2.228e+07** | **1.668e+00** | **4.009e+00** | **2.998e-03** | **7.271e-03** |

**MicroShield 7.02**
**American Ecology (08-MSD-7.02.1418)**

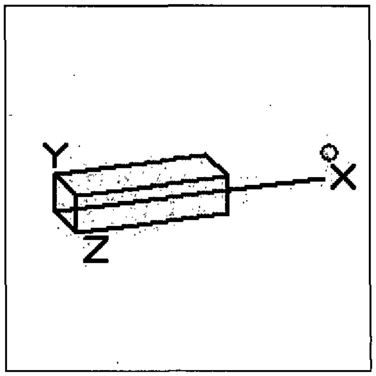
| Date | By | Checked |
|---|---|---|
| October 14, 2009 | Russ Meyer | |

| Filename | Run Date | Run Time | Duration |
|---|---|---|---|
| HBPP mix in 30cy IM-driver rev.ms7 | October 14, 2009 | 4:59:12 PM | 00:00:01 |

| Project Info | |
|---|---|
| Case Title | HBPP Mix rev |
| Description | In 30 cy IM-driver |
| Geometry | 13 - Rectangular Volume |

| Source Dimensions | |
|---|---|
| Length | 617.22 cm (20 ft 3.0 in) |
| Width | 243.84 cm (8 ft) |
| Height | 152.4 cm (5 ft 0.0 in) |

| Dose Points | | | |
|---|---|---|---|
| A | X | Y | Z |
| #1 | 1.1e+3 cm (36 ft 3.2 in) | 121.92 cm (4 ft) | 60.96 cm (2 ft) |




| Shield N | Dimension | Material | Density |
|---|---|---|---|
| Source | 2.29e+07 cm³ | Concrete | 0.88 |
| Shield 1 | .549 cm | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input: Grouping Method - Standard Indices**
**Number of Groups: 25**
**Lower Energy Cutoff: 0.015**
**Photons < 0.015: Included**
**Library: Grove**

| Nuclide | Ci | Bq | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ag-108m | 2.0184e-006 | 7.4682e+004 | 8.8000e-008 | 3.2560e-003 |
| Ba-137m | 3.0276e-004 | 1.1202e+007 | 1.3200e-005 | 4.8840e-001 |
| C-14 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Co-60 | 1.0092e-004 | 3.7341e+006 | 4.4000e-006 | 1.6280e-001 |
| Cs-137 | 3.0276e-004 | 1.1202e+007 | 1.3200e-005 | 4.8840e-001 |
| Eu-152 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Eu-154 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Fe-55 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| H-3 | 2.0184e-003 | 7.4682e+007 | 8.8000e-005 | 3.2560e+000 |
| Ni-63 | 2.0184e-004 | 7.4682e+006 | 8.8000e-006 | 3.2560e-001 |
| Sr-90 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |
| Y-90 | 2.0184e-005 | 7.4682e+005 | 8.8000e-007 | 3.2560e-002 |

**Buildup: The material reference is Source**

| Integration Parameters | |
|---|---|
| X Direction | 20 |
| Y Direction | 20 |
| Z Direction | 20 |

| Results | | | | | |
|---|---|---|---|---|---|
| **Energy (MeV)** | **Activity (Photons/sec)** | **Fluence Rate MeV/cm²/sec No Buildup** | **Fluence Rate MeV/cm²/sec With Buildup** | **Exposure Rate mR/hr No Buildup** | **Exposure Rate mR/hr With Buildup** |
| 0.015 | 5.016e+05 | 7.349e-119 | 1.049e-29 | 6.304e-120 | 8.994e-31 |
| 0.02 | 4.898e+04 | 3.676e-57 | 1.611e-30 | 1.273e-58 | 5.582e-32 |
| 0.03 | 6.598e+05 | 3.831e-21 | 7.678e-21 | 3.797e-23 | 7.610e-23 |
| 0.04 | 7.496e+05 | 5.530e-12 | 1.703e-11 | 2.446e-14 | 7.533e-14 |
| 0.05 | 1.491e+05 | 2.864e-09 | 1.245e-08 | 7.630e-12 | 3.316e-11 |
| 0.08 | 5.292e+03 | 9.414e-08 | 5.670e-07 | 1.490e-10 | 8.973e-10 |
| 0.1 | 5.145e+05 | 3.386e-05 | 1.983e-04 | 5.180e-08 | 3.033e-07 |
| 0.2 | 1.070e+05 | 4.768e-05 | 2.132e-04 | 8.416e-08 | 3.762e-07 |
| 0.3 | 2.019e+05 | 1.820e-04 | 6.926e-04 | 3.452e-07 | 1.314e-06 |
| 0.4 | 1.194e+05 | 1.716e-04 | 5.809e-04 | 3.344e-07 | 1.132e-06 |
| 0.5 | 5.830e+03 | 1.198e-05 | 3.707e-05 | 2.351e-08 | 7.276e-08 |
| 0.6 | 1.024e+07 | 2.814e-02 | 8.075e-02 | 5.493e-05 | 1.576e-04 |
| 0.8 | 4.918e+05 | 2.141e-03 | 5.496e-03 | 4.072e-06 | 1.045e-05 |
| 1.0 | 4.283e+06 | 2.669e-02 | 6.322e-02 | 4.920e-05 | 1.165e-04 |
| 1.5 | 4.199e+06 | 5.027e-02 | 1.041e-01 | 8.458e-05 | 1.752e-04 |
| **Totals** | **2.228e+07** | **1.077e-01** | **2.553e-01** | **1.936e-04** | **4.630e-04** |

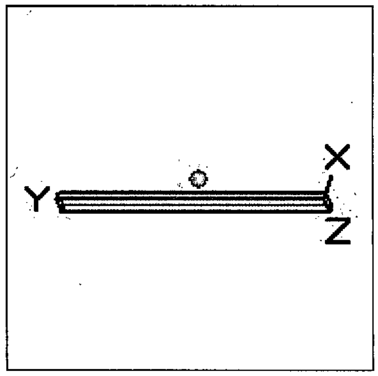
| MicroShield 7.02<br>American Ecology (08-MSD-7.02.1418) |
|---|

| Date | By | Checked |
|---|---|---|
| | | |

| Filename | Run Date | Run Time | Duration |
|---|---|---|---|
| HBPP mix cell rev.ms7 | October 1, 2009 | 12:10:04 PM | 00:00:01 |

| Project Info | |
|---|---|
| Case Title | HBPP Mix rev. |
| Description | Cell |
| Geometry | 13 - Rectangular Volume |

| Source Dimensions | |
|---|---|
| Length | 91.44 cm (3 ft) |
| Width | 182.88 cm (6 ft) |
| Height | 2.7e+3 cm (90 ft) |




| Dose Points | | | |
|---|---|---|---|
| A | X | Y | Z |
| #1 | 292.638 cm (9 ft 7.2 in) | 1.4e+3 cm (45 ft) | 45.72 cm (1 ft 6.0 in) |

| Shields | | | |
|---|---|---|---|
| Shield N | Dimension | Material | Density |
| Source | 1620.0 ft³ | Concrete | 0.88 |
| Shield 1 | .041 ft | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input: Grouping Method - Standard Indices**
**Number of Groups: 25**
**Lower Energy Cutoff: 0.015**
**Photons < 0.015: Included**
**Library: Grove**

| Nuclide | Ci | Bq | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ag-108m | 4.0368e-006 | 1.4936e+005 | 8.8000e-008 | 3.2560e-003 |
| Ba-137m | 6.0553e-004 | 2.2405e+007 | 1.3200e-005 | 4.8840e-001 |
| C-14 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |
| Co-60 | 2.0184e-004 | 7.4682e+006 | 4.4000e-006 | 1.6280e-001 |
| Cs-137 | 6.0553e-004 | 2.2405e+007 | 1.3200e-005 | 4.8840e-001 |
| Eu-152 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |
| Eu-154 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |
| Fe-55 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |
| H-3 | 4.0368e-003 | 1.4936e+008 | 8.8000e-005 | 3.2560e+000 |
| Ni-63 | 4.0368e-004 | 1.4936e+007 | 8.8000e-006 | 3.2560e-001 |
| Sr-90 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |
| Y-90 | 4.0368e-005 | 1.4936e+006 | 8.8000e-007 | 3.2560e-002 |

**Buildup: The material reference is Source**

| Integration Parameters | |
|---|---|
| X Direction | 20 |
| Y Direction | 20 |
| Z Direction | 20 |

| Results | | | | | |
|---|---|---|---|---|---|
| Energy (MeV) | Activity (Photons/sec) | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
| 0.015 | 1.003e+06 | 1.922e-249 | 4.647e-29 | 1.648e-250 | 3.986e-30 |
| 0.02 | 9.797e+04 | 6.301e-116 | 7.141e-30 | 2.182e-117 | 2.473e-31 |
| 0.03 | 1.320e+06 | 8.483e-40 | 2.127e-28 | 8.407e-42 | 2.108e-30 |
| 0.04 | 1.499e+06 | 4.522e-20 | 1.779e-19 | 2.000e-22 | 7.866e-22 |
| 0.05 | 2.982e+05 | 2.406e-13 | 1.570e-12 | 6.410e-16 | 4.183e-15 |
| 0.08 | 1.058e+04 | 2.089e-08 | 2.301e-07 | 3.306e-11 | 3.642e-10 |
| 0.1 | 1.029e+06 | 2.939e-05 | 3.189e-04 | 4.497e-08 | 4.878e-07 |
| 0.2 | 2.139e+05 | 1.734e-04 | 1.265e-03 | 3.060e-07 | 2.233e-06 |
| 0.3 | 4.039e+05 | 8.411e-04 | 4.855e-03 | 1.595e-06 | 9.210e-06 |
| 0.4 | 2.388e+05 | 8.859e-04 | 4.341e-03 | 1.726e-06 | 8.459e-06 |
| 0.5 | 1.166e+04 | 6.641e-05 | 2.867e-04 | 1.304e-07 | 5.628e-07 |
| 0.6 | 2.048e+07 | 1.645e-01 | 6.400e-01 | 3.210e-04 | 1.249e-03 |
| 0.8 | 9.836e+05 | 1.352e-02 | 4.501e-02 | 2.571e-05 | 8.561e-05 |
| 1.0 | 8.567e+06 | 1.781e-01 | 5.293e-01 | 3.283e-04 | 9.756e-04 |
| 1.5 | 8.397e+06 | 3.664e-01 | 9.009e-01 | 6.165e-04 | 1.516e-03 |
| **Totals** | **4.455e+07** | **7.245e-01** | **2.126e+00** | **1.295e-03** | **3.847e-03** |

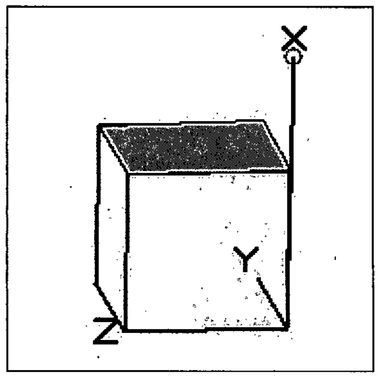
**MicroShield 7.02**
**American Ecology (08-MSD-7.02.1418)**

| Date | By | Checked |
|---|---|---|
| | | |

| Filename | Run Date | Run Time | Duration |
|---|---|---|---|
| HBPP mix stab.ms7 | October 1, 2009 | 12:43:47 PM | 00:00:01 |

| Project Info | |
|---|---|
| Case Title | HBPP Stab Operator |
| Description | HBPP Mix @ edge of pit 9.11 ft from waste |
| Geometry | 13 - Rectangular Volume |

| Source Dimensions | |
|---|---|
| Length | 385.572 cm (12 ft 7.8 in) |
| Width | 385.572 cm (12 ft 7.8 in) |
| Height | 385.572 cm (12 ft 7.8 in) |




| Dose Points | | | |
|---|---|---|---|
| A | X | Y | Z |
| #1 | 663.245 cm (21 ft 9.1 in) | 0.0 cm (0.0 in) | 0.0 cm (0.0 in) |

| Shields | | | |
|---|---|---|---|
| Shield N | Dimension | Material | Density |
| Source | 2024.285 ft³ | Concrete | 0.88 |
| Shield 1 | .042 ft | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input: Grouping Method - Standard Indices**
**Number of Groups: 25**
**Lower Energy Cutoff: 0.015**
**Photons < 0.015: Included**
**Library: Grove**

| Nuclide | Ci | Bq | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ag-108m | 5.0443e-006 | 1.8664e+005 | 8.8000e-008 | 3.2560e-003 |
| Ba-137m | 7.5664e-004 | 2.7996e+007 | 1.3200e-005 | 4.8840e-001 |
| C-14 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |
| Co-60 | 2.5221e-004 | 9.3319e+006 | 4.4000e-006 | 1.6280e-001 |
| Cs-137 | 7.5664e-004 | 2.7996e+007 | 1.3200e-005 | 4.8840e-001 |
| Eu-152 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |
| Eu-154 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |
| Fe-55 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |
| H-3 | 5.0443e-003 | 1.8664e+008 | 8.8000e-005 | 3.2560e+000 |
| Ni-63 | 5.0443e-004 | 1.8664e+007 | 8.8000e-006 | 3.2560e-001 |
| Sr-90 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |
| Y-90 | 5.0443e-005 | 1.8664e+006 | 8.8000e-007 | 3.2560e-002 |

**Buildup: The material reference is Source**

| Integration Parameters | |
|---|---|
| X Direction | 20 |
| Y Direction | 20 |
| Z Direction | 20 |

**Results**

| Energy (MeV) | Activity (Photons/sec) | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 1.253e+06 | 3.665e-258 | 5.149e-29 | 3.144e-259 | 4.416e-30 |
| 0.02 | 1.224e+05 | 5.669e-120 | 7.912e-30 | 1.964e-121 | 2.741e-31 |
| 0.03 | 1.649e+06 | 2.361e-41 | 2.357e-28 | 2.340e-43 | 2.336e-30 |
| 0.04 | 1.873e+06 | 5.157e-21 | 2.043e-20 | 2.281e-23 | 9.038e-23 |
| 0.05 | 3.726e+05 | 4.540e-14 | 3.010e-13 | 1.209e-16 | 8.018e-16 |
| 0.08 | 1.323e+04 | 6.550e-09 | 7.578e-08 | 1.037e-11 | 1.199e-10 |
| 0.1 | 1.286e+06 | 1.066e-05 | 1.233e-04 | 1.631e-08 | 1.887e-07 |
| 0.2 | 2.673e+05 | 7.468e-05 | 5.756e-04 | 1.318e-07 | 1.016e-06 |
| 0.3 | 5.047e+05 | 3.721e-04 | 2.243e-03 | 7.058e-07 | 4.255e-06 |
| 0.4 | 2.984e+05 | 3.967e-04 | 2.017e-03 | 7.729e-07 | 3.930e-06 |
| 0.5 | 1.457e+04 | 2.996e-05 | 1.337e-04 | 5.881e-08 | 2.624e-07 |
| 0.6 | 2.559e+07 | 7.462e-02 | 2.992e-01 | 1.457e-04 | 5.841e-04 |
| 0.8 | 1.229e+06 | 6.183e-03 | 2.115e-02 | 1.176e-05 | 4.024e-05 |
| 1.0 | 1.070e+07 | 8.196e-02 | 2.500e-01 | 1.511e-04 | 4.608e-04 |
| 1.5 | 1.049e+07 | 1.706e-01 | 4.311e-01 | 2.871e-04 | 7.253e-04 |
| **Totals** | **5.567e+07** | **3.343e-01** | **1.007e+00** | **5.972e-04** | **1.820e-03** |

# RESRAD REPORT

# TO DETERMINE MAXIMUM DOSE PROJECTIONS

(25 PAGES)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 11

| Menu | Parameter | Current Value# | Base Case* | Parameter Name |
|---|---|---|---|---|
| A-1 | DCF's for external ground radiation, (mrem/yr)/(pCi/g) | | | |
| A-1 | Ag-108 (Source: FGR 12) | 1.143E-01 | 1.143E-01 | DCF1( 1) |
| A-1 | Ag-108m (Source: FGR 12) | 9.640E+00 | 9.640E+00 | DCF1( 2) |
| A-1 | Ba-137m (Source: FGR 12) | 3.606E+00 | 3.606E+00 | DCF1( 3) |
| A-1 | C-14 (Source: FGR 12) | 1.345E-05 | 1.345E-05 | DCF1( 4) |
| A-1 | Co-60 (Source: FGR 12) | 1.622E+01 | 1.622E+01 | DCF1( 5) |
| A-1 | Cs-137 (Source: FGR 12) | 7.510E-04 | 7.510E-04 | DCF1( 6) |
| A-1 | Eu-152 (Source: FGR 12) | 7.006E+00 | 7.006E+00 | DCF1( 7) |
| A-1 | Eu-154 (Source: FGR 12) | 7.678E+00 | 7.678E+00 | DCF1( 8) |
| A-1 | Fe-55 (Source: FGR 12) | 0.000E+00 | 0.000E+00 | DCF1( 9) |
| A-1 | Gd-152 (Source: FGR 12) | 0.000E+00 | 0.000E+00 | DCF1( 10) |
| A-1 | H-3 (Source: FGR 12) | 0.000E+00 | 0.000E+00 | DCF1( 11) |
| A-1 | Ni-63 (Source: FGR 12) | 0.000E+00 | 0.000E+00 | DCF1( 12) |
| A-1 | Sr-90 (Source: FGR 12) | 7.043E-04 | 7.043E-04 | DCF1( 13) |
| A-1 | Y-90 (Source: FGR 12) | 2.391E-02 | 2.391E-02 | DCF1( 14) |
| | | | | |
| B-1 | Dose conversion factors for inhalation, mrem/pCi: | | | |
| B-1 | Ag-108m+D | 2.830E-04 | 2.830E-04 | DCF2( 1) |
| B-1 | C-14 (Class: ORGANIC) | 2.090E-06 | 2.090E-06 | DCF2( 2) |
| B-1 | C-14 (Class: CO2) | 2.350E-08 | 2.350E-08 | C14GInhDCF |
| B-1 | Co-60 | 2.190E-04 | 2.190E-04 | DCF2( 3) |
| B-1 | Cs-137+D | 3.190E-05 | 3.190E-05 | DCF2( 4) |
| B-1 | Eu-152 | 2.210E-04 | 2.210E-04 | DCF2( 5) |
| B-1 | Eu-154 | 2.860E-04 | 2.860E-04 | DCF2( 7) |
| B-1 | Fe-55 | 2.690E-06 | 2.690E-06 | DCF2( 8) |
| B-1 | Gd-152 | 2.430E-01 | 2.430E-01 | DCF2( 9) |
| B-1 | H-3 | 6.400E-08 | 6.400E-08 | DCF2( 10) |
| B-1 | Ni-63 | 6.290E-06 | 6.290E-06 | DCF2( 11) |
| B-1 | Sr-90+D | 1.308E-03 | 1.300E-03 | DCF2( 12) |
| | | | | |
| D-1 | Dose conversion factors for ingestion, mrem/pCi: | | | |
| D-1 | Ag-108m+D | 7.620E-06 | 7.620E-06 | DCF3( 1) |
| D-1 | C-14 | 2.090E-06 | 2.090E-06 | DCF3( 2) |
| D-1 | Co-60 | 2.690E-05 | 2.690E-05 | DCF3( 3) |
| D-1 | Cs-137+D | 5.000E-05 | 5.000E-05 | DCF3( 4) |
| D-1 | Eu-152 | 6.480E-06 | 6.480E-06 | DCF3( 5) |
| D-1 | Eu-154 | 9.550E-06 | 9.550E-06 | DCF3( 7) |
| D-1 | Fe-55 | 6.070E-07 | 6.070E-07 | DCF3( 8) |
| D-1 | Gd-152 | 1.610E-04 | 1.610E-04 | DCF3( 9) |
| D-1 | H-3 | 6.400E-08 | 6.400E-08 | DCF3( 10) |
| D-1 | Ni-63 | 5.770E-07 | 5.770E-07 | DCF3( 11) |
| D-1 | Sr-90+D | 1.528E-04 | 1.420E-04 | DCF3( 12) |
| | | | | |
| D-34 | Food transfer factors: | | | |
| D-34 | Ag-108m+D , plant/soil concentration ratio, dimensionless | 1.500E-01 | 1.500E-01 | RTF( 1,1) |
| D-34 | Ag-108m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-03 | 3.000E-03 | RTF( 1,2) |
| D-34 | Ag-108m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.500E-02 | 2.500E-02 | RTF( 1,3) |
| D-34 | | | | |

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 11

| Menu | Parameter | Current Value# | Base Case* | Parameter Name |
|---|---|---|---|---|
| D-34 | C-14 , plant/soil concentration ratio, dimensionless | 5.500E+00 | 5.500E+00 | RTF( 2,1) |
| D-34 | C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.100E-02 | 3.100E-02 | RTF( 2,2) |
| D-34 | C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 1.200E-02 | 1.200E-02 | RTF( 2,3) |
| D-34 | | | | |
| D-34 | Co-60 , plant/soil concentration ratio, dimensionless | 8.000E-02 | 8.000E-02 | RTF( 3,1) |
| D-34 | Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-02 | 2.000E-02 | RTF( 3,2) |
| D-34 | Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 3,3) |
| D-34 | | | | |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02 | 4.000E-02 | RTF( 4,1) |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02 | 3.000E-02 | RTF( 4,2) |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 8.000E-03 | 8.000E-03 | RTF( 4,3) |
| D-34 | | | | |
| D-34 | Eu-152 , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 5,1) |
| D-34 | Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 5,2) |
| D-34 | Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 5.000E-05 | 5.000E-05 | RTF( 5,3) |
| D-34 | | | | |
| D-34 | Eu-154 , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 7,1) |
| D-34 | Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 7,2) |
| D-34 | Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 5.000E-05 | 5.000E-05 | RTF( 7,3) |
| D-34 | | | | |
| D-34 | Fe-55 , plant/soil concentration ratio, dimensionless | 1.000E-03 | 1.000E-03 | RTF( 8,1) |
| D-34 | Fe-55 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-02 | 2.000E-02 | RTF( 8,2) |
| D-34 | Fe-55 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 3.000E-04 | 3.000E-04 | RTF( 8,3) |
| D-34 | | | | |
| D-34 | Gd-152 , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 9,1) |
| D-34 | Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 9,2) |
| D-34 | Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-05 | 2.000E-05 | RTF( 9,3) |
| D-34 | | | | |
| D-34 | H-3 , plant/soil concentration ratio, dimensionless | 4.800E+00 | 4.800E+00 | RTF( 10,1) |
| D-34 | H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.200E-02 | 1.200E-02 | RTF( 10,2) |
| D-34 | H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 1.000E-02 | 1.000E-02 | RTF( 10,3) |
| D-34 | | | | |
| D-34 | Ni-63 , plant/soil concentration ratio, dimensionless | 5.000E-02 | 5.000E-02 | RTF( 11,1) |
| D-34 | Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 5.000E-03 | 5.000E-03 | RTF( 11,2) |
| D-34 | Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-02 | 2.000E-02 | RTF( 11,3) |
| D-34 | | | | |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless | 3.000E-01 | 3.000E-01 | RTF( 12,1) |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-03 | 8.000E-03 | RTF( 12,2) |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 12,3) |
| | | | | |
| D-5 | Bioaccumulation factors, fresh water, L/kg: | | | |
| D-5 | Ag-108m+D , fish | 5.000E+00 | 5.000E+00 | BIOFAC( 1,1) |
| D-5 | Ag-108m+D , crustacea and mollusks | 7.700E+02 | 7.700E+02 | BIOFAC( 1,2) |
| D-5 | | | | |
| D-5 | C-14 , fish | 5.000E+04 | 5.000E+04 | BIOFAC( 2,1) |
| D-5 | C-14 , crustacea and mollusks | 9.100E+03 | 9.100E+03 | BIOFAC( 2,2) |
| D-5 | | | | |
| D-5 | Co-60 , fish | 3.000E+02 | 3.000E+02 | BIOFAC( 3,1) |
| D-5 | Co-60 , crustacea and mollusks | 2.000E+02 | 2.000E+02 | BIOFAC( 3,2) |
| D-5 | | | | |

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 11

| Menu | Parameter | Current Value# | Base Case* | Parameter Name |
|---|---|---|---|---|
| D-5 | Cs-137+D , fish | 2.000E+03 | 2.000E+03 | BIOFAC( 4,1) |
| D-5 | Cs-137+D , crustacea and mollusks | 1.000E+02 | 1.000E+02 | BIOFAC( 4,2) |
| D-5 | | | | |
| D-5 | Eu-152 , fish | 5.000E+01 | 5.000E+01 | BIOFAC( 5,1) |
| D-5 | Eu-152 , crustacea and mollusks | 1.000E+03 | 1.000E+03 | BIOFAC( 5,2) |
| D-5 | | | | |
| D-5 | Eu-154 , fish | 5.000E+01 | 5.000E+01 | BIOFAC( 7,1) |
| D-5 | Eu-154 , crustacea and mollusks | 1.000E+03 | 1.000E+03 | BIOFAC( 7,2) |
| D-5 | | | | |
| D-5 | Fe-55 , fish | 2.000E+02 | 2.000E+02 | BIOFAC( 8,1) |
| D-5 | Fe-55 , crustacea and mollusks | 3.200E+03 | 3.200E+03 | BIOFAC( 8,2) |
| D-5 | | | | |
| D-5 | Gd-152 , fish | 2.500E+01 | 2.500E+01 | BIOFAC( 9,1) |
| D-5 | Gd-152 , crustacea and mollusks | 1.000E+03 | 1.000E+03 | BIOFAC( 9,2) |
| D-5 | | | | |
| D-5 | H-3 , fish | 1.000E+00 | 1.000E+00 | BIOFAC( 10,1) |
| D-5 | H-3 , crustacea and mollusks | 1.000E+00 | 1.000E+00 | BIOFAC( 10,2) |
| D-5 | | | | |
| D-5 | Ni-63 , fish | 1.000E+02 | 1.000E+02 | BIOFAC( 11,1) |
| D-5 | Ni-63 , crustacea and mollusks | 1.000E+02 | 1.000E+02 | BIOFAC( 11,2) |
| D-5 | | | | |
| D-5 | Sr-90+D , fish | 6.000E+01 | 6.000E+01 | BIOFAC( 12,1) |
| D-5 | Sr-90+D , crustacea and mollusks | 1.000E+02 | 1.000E+02 | BIOFAC( 12,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R011 | Area of contaminated zone (m**2) | 8.822E+04 | 1.000E+04 | --- | AREA |
| R011 | Thickness of contaminated zone (m) | 3.360E+01 | 2.000E+00 | --- | THICK0 |
| R011 | Length parallel to aquifer flow (m) | 5.820E+02 | 1.000E+02 | --- | LCZPAQ |
| R011 | Basic radiation dose limit (mrem/yr) | 2.500E+01 | 3.000E+01 | --- | BRDL |
| R011 | Time since placement of material (yr) | 0.000E+00 | 0.000E+00 | --- | TI |
| R011 | Times for calculations (yr) | 1.000E+00 | 1.000E+00 | --- | T( 2) |
| R011 | Times for calculations (yr) | 3.000E+00 | 3.000E+00 | --- | T( 3) |
| R011 | Times for calculations (yr) | 1.000E+01 | 1.000E+01 | --- | T( 4) |
| R011 | Times for calculations (yr) | 3.000E+01 | 3.000E+01 | --- | T( 5) |
| R011 | Times for calculations (yr) | 1.000E+02 | 1.000E+02 | --- | T( 6) |
| R011 | Times for calculations (yr) | 3.000E+02 | 3.000E+02 | --- | T( 7) |
| R011 | Times for calculations (yr) | 1.000E+03 | 1.000E+03 | --- | T( 8) |
| R011 | Times for calculations (yr) | not used | 0.000E+00 | --- | T( 9) |
| R011 | Times for calculations (yr) | not used | 0.000E+00 | --- | T(10) |
| | | | | | |
| R012 | Initial principal radionuclide (pCi/g): Ag-108m | 1.100E-04 | 0.000E+00 | --- | S1(1) |
| R012 | Initial principal radionuclide (pCi/g): C-14 | 1.120E-03 | 0.000E+00 | --- | S1(2) |
| R012 | Initial principal radionuclide (pCi/g): Co-60 | 5.620E-03 | 0.000E+00 | --- | S1(3) |
| R012 | Initial principal radionuclide (pCi/g): Cs-137 | 1.680E-02 | 0.000E+00 | --- | S1(4) |
| R012 | Initial principal radionuclide (pCi/g): Eu-152 | 1.120E-03 | 0.000E+00 | --- | S1(5) |
| R012 | Initial principal radionuclide (pCi/g): Eu-154 | 1.120E-03 | 0.000E+00 | --- | S1(7) |
| R012 | Initial principal radionuclide (pCi/g): Fe-55 | 1.120E-03 | 0.000E+00 | --- | S1(8) |
| R012 | Initial principal radionuclide (pCi/g): H-3 | 1.120E-01 | 0.000E+00 | --- | S1(10) |
| R012 | Initial principal radionuclide (pCi/g): Ni-63 | 1.120E-02 | 0.000E+00 | --- | S1(11) |
| R012 | Initial principal radionuclide (pCi/g): Sr-90 | 1.120E-03 | 0.000E+00 | --- | S1(12) |
| R012 | Concentration in groundwater (pCi/L): Ag-108m | not used | 0.000E+00 | --- | W1( 1) |
| R012 | Concentration in groundwater (pCi/L): C-14 | not used | 0.000E+00 | --- | W1( 2) |
| R012 | Concentration in groundwater (pCi/L): Co-60 | not used | 0.000E+00 | --- | W1( 3) |
| R012 | Concentration in groundwater (pCi/L): Cs-137 | not used | 0.000E+00 | --- | W1( 4) |
| R012 | Concentration in groundwater (pCi/L): Eu-152 | not used | 0.000E+00 | --- | W1( 5) |
| R012 | Concentration in groundwater (pCi/L): Eu-154 | not used | 0.000E+00 | --- | W1( 7) |
| R012 | Concentration in groundwater (pCi/L): Fe-55 | not used | 0.000E+00 | --- | W1( 8) |
| R012 | Concentration in groundwater (pCi/L): H-3 | not used | 0.000E+00 | --- | W1(10) |
| R012 | Concentration in groundwater (pCi/L): Ni-63 | not used | 0.000E+00 | --- | W1(11) |
| R012 | Concentration in groundwater (pCi/L): Sr-90 | not used | 0.000E+00 | --- | W1(12) |
| | | | | | |
| R013 | Cover depth (m) | 3.600E+00 | 0.000E+00 | --- | COVER0 |
| R013 | Density of cover material (g/cm**3) | 1.780E+00 | 1.500E+00 | --- | DENSCV |
| R013 | Cover depth erosion rate (m/yr) | 1.000E-04 | 1.000E-03 | --- | VCV |
| R013 | Density of contaminated zone (g/cm**3) | 1.500E+00 | 1.500E+00 | --- | DENSCZ |
| R013 | Contaminated zone erosion rate (m/yr) | 1.000E-03 | 1.000E-03 | --- | VCZ |
| R013 | Contaminated zone total porosity | 4.000E-01 | 4.000E-01 | --- | TPCZ |
| R013 | Contaminated zone field capacity | 2.000E-01 | 2.000E-01 | --- | FCCZ |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+01 | 1.000E+01 | --- | HCCZ |
| R013 | Contaminated zone b parameter | 5.300E+00 | 5.300E+00 | --- | BCZ |
| R013 | Average annual wind speed (m/sec) | 2.000E+00 | 2.000E+00 | --- | WIND |
| R013 | Humidity in air (g/m**3) | 8.000E+00 | 8.000E+00 | --- | HUMID |
| R013 | Evapotranspiration coefficient | 7.500E-01 | 5.000E-01 | --- | EVAPTR |
| R013 | Precipitation (m/yr) | 1.840E-01 | 1.000E+00 | --- | PRECIP |
| R013 | Irrigation (m/yr) | 2.000E-01 | 2.000E-01 | --- | RI |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R013 | Irrigation mode | overhead | overhead | --- | IDITCH |
| R013 | Runoff coefficient | 2.000E-01 | 2.000E-01 | --- | RUNOFF |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06 | 1.000E+06 | --- | WAREA |
| R013 | Accuracy for water/soil computations | 1.000E-03 | 1.000E-03 | --- | EPS |
| | | | | | |
| R014 | Density of saturated zone (g/cm**3) | 1.500E+00 | 1.500E+00 | --- | DENSAQ |
| R014 | Saturated zone total porosity | 4.300E-01 | 4.000E-01 | --- | TPSZ |
| R014 | Saturated zone effective porosity | 4.000E-01 | 2.000E-01 | --- | EPSZ |
| R014 | Saturated zone field capacity | 4.000E-01 | 2.000E-01 | --- | FCSZ |
| R014 | Saturated zone hydraulic conductivity (m/yr) | 2.500E+01 | 1.000E+02 | --- | HCSZ |
| R014 | Saturated zone hydraulic gradient | 1.000E-02 | 2.000E-02 | --- | HGWT |
| R014 | Saturated zone b parameter | 5.000E+00 | 5.300E+00 | --- | BSZ |
| R014 | Water table drop rate (m/yr) | 1.000E-03 | 1.000E-03 | --- | VWT |
| R014 | Well pump intake depth (m below water table) | 1.000E+01 | 1.000E+01 | --- | DWIBWT |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND | ND | --- | MODEL |
| R014 | Well pumping rate (m**3/yr) | 2.500E+02 | 2.500E+02 | --- | UW |
| | | | | | |
| R015 | Number of unsaturated zone strata | 5 | 1 | --- | NS |
| R015 | Unsat. zone 1, thickness (m) | 1.000E+00 | 4.000E+00 | --- | H(1) |
| R015 | Unsat. zone 1, soil density (g/cm**3) | 1.630E+00 | 1.500E+00 | --- | DENSUZ(1) |
| R015 | Unsat. zone 1, total porosity | 5.200E-01 | 4.000E-01 | --- | TPUZ(1) |
| R015 | Unsat. zone 1, effective porosity | 1.000E-01 | 2.000E-01 | --- | EPUZ(1) |
| R015 | Unsat. zone 1, field capacity | 4.500E-01 | 2.000E-01 | --- | FCUZ(1) |
| R015 | Unsat. zone 1, soil-specific b parameter | 1.100E+01 | 5.300E+00 | --- | BUZ(1) |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr) | 1.500E-02 | 1.000E+01 | --- | HCUZ(1) |
| | | | | | |
| R015 | Unsat. zone 2, thickness (m) | 4.600E+00 | 0.000E+00 | --- | H(2) |
| R015 | Unsat. zone 2, soil density (g/cm**3) | 1.690E+00 | 1.500E+00 | --- | DENSUZ(2) |
| R015 | Unsat. zone 2, total porosity | 3.400E-01 | 4.000E-01 | --- | TPUZ(2) |
| R015 | Unsat. zone 2, effective porosity | 3.300E-01 | 2.000E-01 | --- | EPUZ(2) |
| R015 | Unsat. zone 2, field capacity | 7.000E-02 | 2.000E-01 | --- | FCUZ(2) |
| R015 | Unsat. zone 2, soil-specific b parameter | 2.000E+00 | 5.300E+00 | --- | BUZ(2) |
| R015 | Unsat. zone 2, hydraulic conductivity (m/yr) | 2.200E+03 | 1.000E+01 | --- | HCUZ(2) |
| | | | | | |
| R015 | Unsat. zone 3, thickness (m) | 2.130E+01 | 0.000E+00 | --- | H(3) |
| R015 | Unsat. zone 3, soil density (g/cm**3) | 1.300E+00 | 1.500E+00 | --- | DENSUZ(3) |
| R015 | Unsat. zone 3, total porosity | 5.200E-01 | 4.000E-01 | --- | TPUZ(3) |
| R015 | Unsat. zone 3, effective porosity | 4.000E-01 | 2.000E-01 | --- | EPUZ(3) |
| R015 | Unsat. zone 3, field capacity | 4.900E-01 | 2.000E-01 | --- | FCUZ(3) |
| R015 | Unsat. zone 3, soil-specific b parameter | 3.000E+00 | 5.300E+00 | --- | BUZ(3) |
| R015 | Unsat. zone 3, hydraulic conductivity (m/yr) | 9.000E+02 | 1.000E+01 | --- | HCUZ(3) |
| | | | | | |
| R015 | Unsat. zone 4, thickness (m) | 1.680E+01 | 0.000E+00 | --- | H(4) |
| R015 | Unsat. zone 4, soil density (g/cm**3) | 1.310E+00 | 1.500E+00 | --- | DENSUZ(4) |
| R015 | Unsat. zone 4, total porosity | 4.900E-01 | 4.000E-01 | --- | TPUZ(4) |
| R015 | Unsat. zone 4, effective porosity | 4.300E-01 | 2.000E-01 | --- | EPUZ(4) |
| R015 | Unsat. zone 4, field capacity | 4.800E-01 | 2.000E-01 | --- | FCUZ(4) |
| R015 | Unsat. zone 4, soil-specific b parameter | 5.000E+00 | 5.300E+00 | --- | BUZ(4) |
| R015 | Unsat. zone 4, hydraulic conductivity (m/yr) | 6.000E+01 | 1.000E+01 | --- | HCUZ(4) |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R015 | Unsat. zone 5, thickness (m) | 1.220E+01 | 0.000E+00 | --- | H(5) |
| R015 | Unsat. zone 5, soil density (g/cm**3) | 1.500E+00 | 1.500E+00 | --- | DENSUZ(5) |
| R015 | Unsat. zone 5, total porosity | 5.200E-01 | 4.000E-01 | --- | TPUZ(5) |
| R015 | Unsat. zone 5, effective porosity | 1.500E-01 | 2.000E-01 | --- | EPUZ(5) |
| R015 | Unsat. zone 5, field capacity | 3.200E-01 | 2.000E-01 | --- | FCUZ(5) |
| R015 | Unsat. zone 5, soil-specific b parameter | 8.000E+00 | 5.300E+00 | --- | BUZ(5) |
| R015 | Unsat. zone 5, hydraulic conductivity (m/yr) | 1.000E-01 | 1.000E+01 | --- | HCUZ(5) |
| | | | | | |
| R016 | Distribution coefficients for Ag-108m | | | | |
| R016 | Contaminated zone (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCC( 1) |
| R016 | Unsaturated zone 1 (cm**3/g) | 1.800E+02 | 0.000E+00 | --- | DCNUCU( 1,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCU( 1,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCU( 1,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCU( 1,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCU( 1,5) |
| R016 | Saturated zone (cm**3/g) | 9.000E+01 | 0.000E+00 | --- | DCNUCS( 1) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 1.910E-05 | ALEACH( 1) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 1) |
| | | | | | |
| R016 | Distribution coefficients for C-14 | | | | |
| R016 | Contaminated zone (cm**3/g) | 5.000E+00 | 0.000E+00 | --- | DCNUCC( 2) |
| R016 | Unsaturated zone 1 (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCU( 2,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCU( 2,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCU( 2,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCU( 2,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCU( 2,5) |
| R016 | Saturated zone (cm**3/g) | 1.000E+00 | 0.000E+00 | --- | DCNUCS( 2) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 3.333E-04 | ALEACH( 2) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 2) |
| | | | | | |
| R016 | Distribution coefficients for Co-60 | | | | |
| R016 | Contaminated zone (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCC( 3) |
| R016 | Unsaturated zone 1 (cm**3/g) | 5.500E+02 | 1.000E+03 | --- | DCNUCU( 3,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCU( 3,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCU( 3,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCU( 3,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCU( 3,5) |
| R016 | Saturated zone (cm**3/g) | 6.000E+01 | 1.000E+03 | --- | DCNUCS( 3) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.862E-05 | ALEACH( 3) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 3) |
| | | | | | |
| R016 | Distribution coefficients for Cs-137 | | | | |
| R016 | Contaminated zone (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCC( 4) |
| R016 | Unsaturated zone 1 (cm**3/g) | 5.000E+02 | 4.600E+03 | --- | DCNUCU( 4,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCU( 4,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCU( 4,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCU( 4,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCU( 4,5) |
| R016 | Saturated zone (cm**3/g) | 2.800E+02 | 4.600E+03 | --- | DCNUCS( 4) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 6.147E-06 | ALEACH( 4) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 4) |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R016 | Distribution coefficients for Eu-152 | | | | |
| R016 | Contaminated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCC( 5) |
| R016 | Unsaturated zone 1 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 5,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 5,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 5,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 5,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 5,5) |
| R016 | Saturated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCS( 5) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.087E-06 | ALEACH( 5) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 5) |
| | | | | | |
| R016 | Distribution coefficients for Eu-154 | | | | |
| R016 | Contaminated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCC( 7) |
| R016 | Unsaturated zone 1 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 7,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 7,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 7,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 7,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 7,5) |
| R016 | Saturated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCS( 7) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.087E-06 | ALEACH( 7) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 7) |
| | | | | | |
| R016 | Distribution coefficients for Fe-55 | | | | |
| R016 | Contaminated zone (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCC( 8) |
| R016 | Unsaturated zone 1 (cm**3/g) | 1.650E+02 | 1.000E+03 | --- | DCNUCU( 8,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCU( 8,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCU( 8,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCU( 8,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCU( 8,5) |
| R016 | Saturated zone (cm**3/g) | 2.200E+02 | 1.000E+03 | --- | DCNUCS( 8) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 7.822E-06 | ALEACH( 8) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 8) |
| | | | | | |
| R016 | Distribution coefficients for H-3 | | | | |
| R016 | Contaminated zone (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCC(10) |
| R016 | Unsaturated zone 1 (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCU(10,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCU(10,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCU(10,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCU(10,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCU(10,5) |
| R016 | Saturated zone (cm**3/g) | 0.000E+00 | 0.000E+00 | --- | DCNUCS(10) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 1.031E-02 | ALEACH(10) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK(10) |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R016 | Distribution coefficients for Ni-63 | | | | |
| R016 | Contaminated zone (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCC(11) |
| R016 | Unsaturated zone 1 (cm**3/g) | 6.500E+02 | 1.000E+03 | --- | DCNUCU(11,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCU(11,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCU(11,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCU(11,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCU(11,5) |
| R016 | Saturated zone (cm**3/g) | 4.000E+02 | 1.000E+03 | --- | DCNUCS(11) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 4.304E-06 | ALEACH(11) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK(11) |
| | | | | | |
| R016 | Distribution coefficients for Sr-90 | | | | |
| R016 | Contaminated zone (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCC(12) |
| R016 | Unsaturated zone 1 (cm**3/g) | 1.100E+02 | 3.000E+01 | --- | DCNUCU(12,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCU(12,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCU(12,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCU(12,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCU(12,5) |
| R016 | Saturated zone (cm**3/g) | 1.500E+01 | 3.000E+01 | --- | DCNUCS(12) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 1.135E-04 | ALEACH(12) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK(12) |
| | | | | | |
| R016 | Distribution coefficients for daughter Gd-152 | | | | |
| R016 | Contaminated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCC( 9) |
| R016 | Unsaturated zone 1 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 9,1) |
| R016 | Unsaturated zone 2 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 9,2) |
| R016 | Unsaturated zone 3 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 9,3) |
| R016 | Unsaturated zone 4 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 9,4) |
| R016 | Unsaturated zone 5 (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCU( 9,5) |
| R016 | Saturated zone (cm**3/g) | -1.000E+00 | -1.000E+00 | 8.249E+02 | DCNUCS( 9) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.087E-06 | ALEACH( 9) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 9) |
| | | | | | |
| R017 | Inhalation rate (m**3/yr) | 8.400E+03 | 8.400E+03 | --- | INHALR |
| R017 | Mass loading for inhalation (g/m**3) | 1.000E-04 | 1.000E-04 | --- | MLINH |
| R017 | Exposure duration | 3.000E+01 | 3.000E+01 | --- | ED |
| R017 | Shielding factor, inhalation | 4.000E-01 | 4.000E-01 | --- | SHF3 |
| R017 | Shielding factor, external gamma | 7.000E-01 | 7.000E-01 | --- | SHF1 |
| R017 | Fraction of time spent indoors | 5.000E-01 | 5.000E-01 | --- | FIND |
| R017 | Fraction of time spent outdoors (on site) | 2.500E-01 | 2.500E-01 | --- | FOTD |
| R017 | Shape factor flag, external gamma | 1.000E+00 | 1.000E+00 | >0 shows circular AREA. | FS |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R017 | Radii of shape factor array (used if FS = -1): | | | | |
| R017 | Outer annular radius (m), ring 1: | not used | 5.000E+01 | --- | RAD_SHAPE( 1) |
| R017 | Outer annular radius (m), ring 2: | not used | 7.071E+01 | --- | RAD_SHAPE( 2) |
| R017 | Outer annular radius (m), ring 3: | not used | 0.000E+00 | --- | RAD_SHAPE( 3) |
| R017 | Outer annular radius (m), ring 4: | not used | 0.000E+00 | --- | RAD_SHAPE( 4) |
| R017 | Outer annular radius (m), ring 5: | not used | 0.000E+00 | --- | RAD_SHAPE( 5) |
| R017 | Outer annular radius (m), ring 6: | not used | 0.000E+00 | --- | RAD_SHAPE( 6) |
| R017 | Outer annular radius (m), ring 7: | not used | 0.000E+00 | --- | RAD_SHAPE( 7) |
| R017 | Outer annular radius (m), ring 8: | not used | 0.000E+00 | --- | RAD_SHAPE( 8) |
| R017 | Outer annular radius (m), ring 9: | not used | 0.000E+00 | --- | RAD_SHAPE( 9) |
| R017 | Outer annular radius (m), ring 10: | not used | 0.000E+00 | --- | RAD_SHAPE(10) |
| R017 | Outer annular radius (m), ring 11: | not used | 0.000E+00 | --- | RAD_SHAPE(11) |
| R017 | Outer annular radius (m), ring 12: | not used | 0.000E+00 | --- | RAD_SHAPE(12) |
| | | | | | |
| R017 | Fractions of annular areas within AREA: | | | | |
| R017 | Ring 1 | not used | 1.000E+00 | --- | FRACA( 1) |
| R017 | Ring 2 | not used | 2.732E-01 | --- | FRACA( 2) |
| R017 | Ring 3 | not used | 0.000E+00 | --- | FRACA( 3) |
| R017 | Ring 4 | not used | 0.000E+00 | --- | FRACA( 4) |
| R017 | Ring 5 | not used | 0.000E+00 | --- | FRACA( 5) |
| R017 | Ring 6 | not used | 0.000E+00 | --- | FRACA( 6) |
| R017 | Ring 7 | not used | 0.000E+00 | --- | FRACA( 7) |
| R017 | Ring 8 | not used | 0.000E+00 | --- | FRACA( 8) |
| R017 | Ring 9 | not used | 0.000E+00 | --- | FRACA( 9) |
| R017 | Ring 10 | not used | 0.000E+00 | --- | FRACA(10) |
| R017 | Ring 11 | not used | 0.000E+00 | --- | FRACA(11) |
| R017 | Ring 12 | not used | 0.000E+00 | --- | FRACA(12) |
| | | | | | |
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.600E+02 | 1.600E+02 | --- | DIET(1) |
| R018 | Leafy vegetable consumption (kg/yr) | 1.400E+01 | 1.400E+01 | --- | DIET(2) |
| R018 | Milk consumption (L/yr) | 9.200E+01 | 9.200E+01 | --- | DIET(3) |
| R018 | Meat and poultry consumption (kg/yr) | 6.300E+01 | 6.300E+01 | --- | DIET(4) |
| R018 | Fish consumption (kg/yr) | not used | 5.400E+00 | --- | DIET(5) |
| R018 | Other seafood consumption (kg/yr) | not used | 9.000E-01 | --- | DIET(6) |
| R018 | Soil ingestion rate (g/yr) | 3.650E+01 | 3.650E+01 | --- | SOIL |
| R018 | Drinking water intake (L/yr) | 5.100E+02 | 5.100E+02 | --- | DWI |
| R018 | Contamination fraction of drinking water | 1.000E+00 | 1.000E+00 | --- | FDW |
| R018 | Contamination fraction of household water | not used | 1.000E+00 | --- | FHHW |
| R018 | Contamination fraction of livestock water | 1.000E+00 | 1.000E+00 | --- | FLW |
| R018 | Contamination fraction of irrigation water | 1.000E+00 | 1.000E+00 | --- | FIRW |
| R018 | Contamination fraction of aquatic food | not used | 5.000E-01 | --- | FR9 |
| R018 | Contamination fraction of plant food | -1 | -1 | 0.500E+00 | FPLANT |
| R018 | Contamination fraction of meat | -1 | -1 | 0.100E+01 | FMEAT |
| R018 | Contamination fraction of milk | -1 | -1 | 0.100E+01 | FMILK |
| | | | | | |
| R019 | Livestock fodder intake for meat (kg/day) | 6.800E+01 | 6.800E+01 | --- | LFI5 |
| R019 | Livestock fodder intake for milk (kg/day) | 5.500E+01 | 5.500E+01 | --- | LFI6 |
| R019 | Livestock water intake for meat (L/day) | 5.000E+01 | 5.000E+01 | --- | LWI5 |
| R019 | Livestock water intake for milk (L/day) | 1.600E+02 | 1.600E+02 | --- | LWI6 |
| R019 | Livestock soil intake (kg/day) | 5.000E-01 | 5.000E-01 | --- | LSI |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R019 | Mass loading for foliar deposition (g/m**3) | 1.000E-04 | 1.000E-04 | --- | MLFD |
| R019 | Depth of soil mixing layer (m) | 1.500E-01 | 1.500E-01 | --- | DM |
| R019 | Depth of roots (m) | 9.000E-01 | 9.000E-01 | --- | DROOT |
| R019 | Drinking water fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWDW |
| R019 | Household water fraction from ground water | not used | 1.000E+00 | --- | FGWHH |
| R019 | Livestock water fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWLW |
| R019 | Irrigation fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWIR |
| | | | | | |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2) | 7.000E-01 | 7.000E-01 | --- | YV(1) |
| R19B | Wet weight crop yield for Leafy (kg/m**2) | 1.500E+00 | 1.500E+00 | --- | YV(2) |
| R19B | Wet weight crop yield for Fodder (kg/m**2) | 1.100E+00 | 1.100E+00 | --- | YV(3) |
| R19B | Growing Season for Non-Leafy (years) | 1.700E-01 | 1.700E-01 | --- | TE(1) |
| R19B | Growing Season for Leafy (years) | 2.500E-01 | 2.500E-01 | --- | TE(2) |
| R19B | Growing Season for Fodder (years) | 8.000E-02 | 8.000E-02 | --- | TE(3) |
| R19B | Translocation Factor for Non-Leafy | 1.000E-01 | 1.000E-01 | --- | TIV(1) |
| R19B | Translocation Factor for Leafy | 1.000E+00 | 1.000E+00 | --- | TIV(2) |
| R19B | Translocation Factor for Fodder | 1.000E+00 | 1.000E+00 | --- | TIV(3) |
| R19B | Dry Foliar Interception Fraction for Non-Leafy | 2.500E-01 | 2.500E-01 | --- | RDRY(1) |
| R19B | Dry Foliar Interception Fraction for Leafy | 2.500E-01 | 2.500E-01 | --- | RDRY(2) |
| R19B | Dry Foliar Interception Fraction for Fodder | 2.500E-01 | 2.500E-01 | --- | RDRY(3) |
| R19B | Wet Foliar Interception Fraction for Non-Leafy | 2.500E-01 | 2.500E-01 | --- | RWET(1) |
| R19B | Wet Foliar Interception Fraction for Leafy | 2.500E-01 | 2.500E-01 | --- | RWET(2) |
| R19B | Wet Foliar Interception Fraction for Fodder | 2.500E-01 | 2.500E-01 | --- | RWET(3) |
| R19B | Weathering Removal Constant for Vegetation | 2.000E+01 | 2.000E+01 | --- | WLAM |
| | | | | | |
| C14 | C-12 concentration in water (g/cm**3) | 2.000E-05 | 2.000E-05 | --- | C12WTR |
| C14 | C-12 concentration in contaminated soil (g/g) | 3.000E-02 | 3.000E-02 | --- | C12CZ |
| C14 | Fraction of vegetation carbon from soil | 2.000E-02 | 2.000E-02 | --- | CSOIL |
| C14 | Fraction of vegetation carbon from air | 9.800E-01 | 9.800E-01 | --- | CAIR |
| C14 | C-14 evasion layer thickness in soil (m) | 3.000E-01 | 3.000E-01 | --- | DMC |
| C14 | C-14 evasion flux rate from soil (1/sec) | 7.000E-07 | 7.000E-07 | --- | EVSN |
| C14 | C-12 evasion flux rate from soil (1/sec) | 1.000E-10 | 1.000E-10 | --- | REVSN |
| C14 | Fraction of grain in beef cattle feed | 8.000E-01 | 8.000E-01 | --- | AVFG4 |
| C14 | Fraction of grain in milk cow feed | 2.000E-01 | 2.000E-01 | --- | AVFG5 |
| | | | | | |
| STOR | Storage times of contaminated foodstuffs (days): | | | | |
| STOR | Fruits, non-leafy vegetables, and grain | 1.400E+01 | 1.400E+01 | --- | STOR_T(1) |
| STOR | Leafy vegetables | 1.000E+00 | 1.000E+00 | --- | STOR_T(2) |
| STOR | Milk | 1.000E+00 | 1.000E+00 | --- | STOR_T(3) |
| STOR | Meat and poultry | 2.000E+01 | 2.000E+01 | --- | STOR_T(4) |
| STOR | Fish | 7.000E+00 | 7.000E+00 | --- | STOR_T(5) |
| STOR | Crustacea and mollusks | 7.000E+00 | 7.000E+00 | --- | STOR_T(6) |
| STOR | Well water | 1.000E+00 | 1.000E+00 | --- | STOR_T(7) |
| STOR | Surface water | 1.000E+00 | 1.000E+00 | --- | STOR_T(8) |
| STOR | Livestock fodder | 4.500E+01 | 4.500E+01 | --- | STOR_T(9) |
| | | | | | |
| R021 | Thickness of building foundation (m) | not used | 1.500E-01 | --- | FLOOR1 |
| R021 | Bulk density of building foundation (g/cm**3) | not used | 2.400E+00 | --- | DENSFL |
| R021 | Total porosity of the cover material | not used | 4.000E-01 | --- | TPCV |
| R021 | Total porosity of the building foundation | not used | 1.000E-01 | --- | TPFL |

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R021 | Volumetric water content of the cover material | not used | 5.000E-02 | --- | PH2OCV |
| R021 | Volumetric water content of the foundation | not used | 3.000E-02 | --- | PH2OFL |
| R021 | Diffusion coefficient for radon gas (m/sec): | | | | |
| R021 | in cover material | not used | 2.000E-06 | --- | DIFCV |
| R021 | in foundation material | not used | 3.000E-07 | --- | DIFFL |
| R021 | in contaminated zone soil | not used | 2.000E-06 | --- | DIFCZ |
| R021 | Radon vertical dimension of mixing (m) | not used | 2.000E+00 | --- | HMIX |
| R021 | Average building air exchange rate (1/hr) | not used | 5.000E-01 | --- | REXG |
| R021 | Height of the building (room) (m) | not used | 2.500E+00 | --- | HRM |
| R021 | Building interior area factor | not used | 0.000E+00 | --- | FAI |
| R021 | Building depth below ground surface (m) | not used | -1.000E+00 | --- | DMFL |
| R021 | Emanating power of Rn-222 gas | not used | 2.500E-01 | --- | EMANA(1) |
| R021 | Emanating power of Rn-220 gas | not used | 1.500E-01 | --- | EMANA(2) |
| | | | | | |
| TITL | Number of graphical time points | 512 | --- | --- | NPTS |
| TITL | Maximum number of integration points for dose | 17 | --- | --- | LYMAX |
| TITL | Maximum number of integration points for risk | 1 | --- | --- | KYMAX |

Summary of Pathway Selections

| Pathway | User Selection |
|---|---|
| 1 -- external gamma | active |
| 2 -- inhalation (w/o radon) | active |
| 3 -- plant ingestion | active |
| 4 -- meat ingestion | active |
| 5 -- milk ingestion | active |
| 6 -- aquatic foods | suppressed |
| 7 -- drinking water | active |
| 8 -- soil ingestion | active |
| 9 -- radon | suppressed |
| Find peak pathway doses | active |

**Contaminated Zone Dimensions**

| | |
|---|---|
| Area: | 88221.00 square meters |
| Thickness: | 33.60 meters |
| Cover Depth: | 3.60 meters |

**Initial Soil Concentrations, pCi/g**

| | |
|---|---|
| Ag-108m | 1.100E-04 |
| C-14 | 1.120E-03 |
| Co-60 | 5.620E-03 |
| Cs-137 | 1.680E-02 |
| Eu-152 | 1.120E-03 |
| Eu-154 | 1.120E-03 |
| Fe-55 | 1.120E-03 |
| H-3 | 1.120E-01 |
| Ni-63 | 1.120E-02 |
| Sr-90 | 1.120E-03 |

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

| t (years): | 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 | 1.000E+03 |
|---|---|---|---|---|---|---|---|---|
| TDOSE(t): | 9.356E-24 | 8.217E-24 | 6.339E-24 | 2.559E-24 | 1.949E-25 | 1.629E-28 | 6.305E-10 | 4.549E-04 |
| M(t): | 3.742E-25 | 3.287E-25 | 2.536E-25 | 1.024E-25 | 7.798E-27 | 6.515E-30 | 2.522E-11 | 1.820E-05 |

Maximum TDOSE(t): 4.549E-04 mrem/yr at t = 1.000E+03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 6.117E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 9.302E-24 | 0.9943 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 1.151E-28 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 1.754E-26 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 3.601E-26 | 0.0038 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 9.356E-24 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.117E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.302E-24 | 0.9943 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.151E-28 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.754E-26 | 0.0019 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.601E-26 | 0.0038 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.356E-24 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 6.094E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 8.167E-24 | 0.9939 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 1.127E-28 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 1.668E-26 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 3.333E-26 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 8.217E-24 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.094E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.167E-24 | 0.9939 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.127E-28 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.668E-26 | 0.0020 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.333E-26 | 0.0041 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.217E-24 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 6.048E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 6.295E-24 | 0.9931 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 1.080E-28 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 1.508E-26 | 0.0024 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 2.856E-26 | 0.0045 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 6.339E-24 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.048E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.295E-24 | 0.9931 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.080E-28 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.508E-26 | 0.0024 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.856E-26 | 0.0045 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.339E-24 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 5.892E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 2.531E-24 | 0.9893 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 9.293E-29 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 1.059E-26 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 1.662E-26 | 0.0065 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 2.559E-24 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.892E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.531E-24 | 0.9893 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.293E-29 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.059E-26 | 0.0041 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.662E-26 | 0.0065 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.559E-24 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 5.466E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 1.875E-25 | 0.9617 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 6.055E-29 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 3.855E-27 | 0.0198 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 3.543E-27 | 0.0182 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 1.949E-25 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.466E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.875E-25 | 0.9617 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.055E-29 | 0.0003 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.855E-27 | 0.0198 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.543E-27 | 0.0182 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.949E-25 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 4.203E-31 | 0.0026 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 2.073E-29 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 1.352E-29 | 0.0830 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 1.124E-28 | 0.6899 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 1.584E-29 | 0.0972 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 1.629E-28 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.203E-31 | 0.0026 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.073E-29 | 0.1273 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.352E-29 | 0.0830 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.124E-28 | 0.6899 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.584E-29 | 0.0972 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.629E-28 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 1.984E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 1.864E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 4.611E-33 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 3.894E-31 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.984E-31 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.864E-31 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.611E-33 | 0.0000 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 4.781E-10 | 0.7583 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.113E-11 | 0.0970 | 2.482E-11 | 0.0394 | 6.646E-11 | 0.1054 | 6.305E-10 | 1.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 4.781E-10 | 0.7583 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.113E-11 | 0.0970 | 2.482E-11 | 0.0394 | 6.646E-11 | 0.1054 | 6.305E-10 | 1.0000 |

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 1.435E-32 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| C-14 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 1.435E-32 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Ag-108m | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.435E-32 | 0.0000 |
| C-14 | 1.548E-04 | 0.3403 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.934E-04 | 0.4251 | 5.165E-05 | 0.1135 | 5.507E-05 | 0.1210 | 4.549E-04 | 1.0000 |
| Co-60 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Cs-137 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-152 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Eu-154 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Fe-55 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| H-3 | 3.143E-30 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.019E-31 | 0.0000 | 1.632E-31 | 0.0000 | 4.370E-31 | 0.0000 | 4.145E-30 | 0.0000 |
| Ni-63 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total | 1.548E-04 | 0.3403 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.934E-04 | 0.4251 | 5.165E-05 | 0.1135 | 5.507E-05 | 0.1210 | 4.549E-04 | 1.0000 |

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent (i) | Product (j) | Thread Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 | 1.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ag-108m+D | Ag-108m+D | 1.000E+00 | 5.561E-27 | 5.540E-27 | 5.499E-27 | 5.356E-27 | 4.969E-27 | 3.821E-27 | 1.804E-27 | 1.305E-28 |
| C-14 | C-14 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.062E-01 |
| Co-60 | Co-60 | 1.000E+00 | 1.655E-21 | 1.453E-21 | 1.120E-21 | 4.504E-22 | 3.336E-23 | 3.688E-27 | 1.832E-38 | 0.000E+00 |
| Cs-137+D | Cs-137+D | 1.000E+00 | 6.853E-27 | 6.708E-27 | 6.426E-27 | 5.531E-27 | 3.604E-27 | 8.046E-28 | 1.109E-29 | 3.414E-36 |
| Eu-152 | Eu-152 | 7.208E-01 | 1.129E-23 | 1.073E-23 | 9.703E-24 | 6.813E-24 | 2.481E-24 | 7.232E-26 | 2.967E-30 | 1.401E-45 |
| Eu-152 | Eu-152 | 2.792E-01 | 4.373E-24 | 4.158E-24 | 3.758E-24 | 2.639E-24 | 9.611E-25 | 2.801E-26 | 1.149E-30 | 0.000E+00 |
| Eu-152 | Gd-152 | 2.792E-01 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Eu-152 | ∑DSR(j) | | 4.373E-24 | 4.158E-24 | 3.758E-24 | 2.639E-24 | 9.611E-25 | 2.801E-26 | 1.149E-30 | 0.000E+00 |
| Eu-154 | Eu-154 | 1.000E+00 | 3.215E-23 | 2.976E-23 | 2.550E-23 | 1.484E-23 | 3.164E-24 | 1.414E-26 | 2.736E-33 | 0.000E+00 |
| Fe-55 | Fe-55 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| H-3 | H-3 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.629E-09 | 3.701E-29 |
| Ni-63 | Ni-63 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Sr-90+D | Sr-90+D | 1.000E+00 | 1.865E-35 | 1.825E-35 | 1.747E-35 | 1.500E-35 | 9.693E-36 | 2.105E-36 | 2.681E-38 | 5.605E-45 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

| Nuclide (i) | t= 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 | 1.000E+03 |
|---|---|---|---|---|---|---|---|---|
| Ag-108m | *2.609E+13 | *2.609E+13 | *2.609E+13 | *2.609E+13 | *2.609E+13 | *2.609E+13 | *2.609E+13 | *2.609E+13 |
| C-14 | *4.455E+12 | *4.455E+12 | *4.455E+12 | *4.455E+12 | *4.455E+12 | *4.455E+12 | *4.455E+12 | 6.155E+01 |
| Co-60 | *1.132E+15 | *1.132E+15 | *1.132E+15 | *1.132E+15 | *1.132E+15 | *1.132E+15 | *1.132E+15 | *1.132E+15 |
| Cs-137 | *8.704E+13 | *8.704E+13 | *8.704E+13 | *8.704E+13 | *8.704E+13 | *8.704E+13 | *8.704E+13 | *8.704E+13 |
| Eu-152 | *1.765E+14 | *1.765E+14 | *1.765E+14 | *1.765E+14 | *1.765E+14 | *1.765E+14 | *1.765E+14 | *1.765E+14 |
| Eu-154 | *2.639E+14 | *2.639E+14 | *2.639E+14 | *2.639E+14 | *2.639E+14 | *2.639E+14 | *2.639E+14 | *2.639E+14 |
| Fe-55 | *2.410E+15 | *2.410E+15 | *2.410E+15 | *2.410E+15 | *2.410E+15 | *2.410E+15 | *2.410E+15 | *2.410E+15 |
| H-3 | *9.597E+15 | *9.597E+15 | *9.597E+15 | *9.597E+15 | *9.597E+15 | *9.597E+15 | 4.441E+09 | *9.597E+15 |
| Ni-63 | *5.917E+13 | *5.917E+13 | *5.917E+13 | *5.917E+13 | *5.917E+13 | *5.917E+13 | *5.917E+13 | *5.917E+13 |
| Sr-90 | *1.365E+14 | *1.365E+14 | *1.365E+14 | *1.365E+14 | *1.365E+14 | *1.365E+14 | *1.365E+14 | *1.365E+14 |

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

| Nuclide (i) | Initial (pCi/g) | tmin (years) | DSR(i,tmin) | G(i,tmin) (pCi/g) | DSR(i,tmax) | G(i,tmax) (pCi/g) |
|---|---|---|---|---|---|---|
| Ag-108m | 1.100E-04 | 0.000E+00 | 5.561E-27 | *2.609E+13 | 1.305E-28 | *2.609E+13 |
| C-14 | 1.120E-03 | 1.000E+03 | 4.062E-01 | 6.155E+01 | 4.062E-01 | 6.155E+01 |
| Co-60 | 5.620E-03 | 0.000E+00 | 1.655E-21 | *1.132E+15 | 0.000E+00 | *1.132E+15 |
| Cs-137 | 1.680E-02 | 0.000E+00 | 6.853E-27 | *8.704E+13 | 0.000E+00 | *8.704E+13 |
| Eu-152 | 1.120E-03 | 0.000E+00 | 1.566E-23 | *1.765E+14 | 0.000E+00 | *1.765E+14 |
| Eu-154 | 1.120E-03 | 0.000E+00 | 3.215E-23 | *2.639E+14 | 0.000E+00 | *2.639E+14 |
| Fe-55 | 1.120E-03 | 0.000E+00 | 0.000E+00 | *2.410E+15 | 0.000E+00 | *2.410E+15 |
| H-3 | 1.120E-01 | 217.1 ± 0.4 | 4.199E-07 | 5.954E+07 | 3.701E-29 | *9.597E+15 |
| Ni-63 | 1.120E-02 | 0.000E+00 | 0.000E+00 | *5.917E+13 | 0.000E+00 | *5.917E+13 |
| Sr-90 | 1.120E-03 | 0.000E+00 | 0.000E+00 | *1.365E+14 | 0.000E+00 | *1.365E+14 |

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

| Nuclide (j) | Parent (i) | THF(i) | DOSE(j,t), mrem/yr t= 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 | 1.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ag-108m | Ag-108m | 1.000E+00 | 6.117E-31 | 6.094E-31 | 6.048E-31 | 5.892E-31 | 5.466E-31 | 4.203E-31 | 1.984E-31 | 1.435E-32 |
| C-14 | C-14 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.549E-04 |
| Co-60 | Co-60 | 1.000E+00 | 9.302E-24 | 8.167E-24 | 6.295E-24 | 2.531E-24 | 1.875E-25 | 2.073E-29 | 0.000E+00 | 0.000E+00 |
| Cs-137 | Cs-137 | 1.000E+00 | 1.151E-28 | 1.127E-28 | 1.080E-28 | 9.293E-29 | 6.055E-29 | 1.352E-29 | 1.864E-31 | 0.000E+00 |
| Eu-152 | Eu-152 | 7.208E-01 | 1.265E-26 | 1.202E-26 | 1.087E-26 | 7.631E-27 | 2.779E-27 | 8.100E-29 | 3.323E-33 | 0.000E+00 |
| Eu-152 | Eu-152 | 2.792E-01 | 4.898E-27 | 4.657E-27 | 4.209E-27 | 2.956E-27 | 1.076E-27 | 3.137E-29 | 1.287E-33 | 0.000E+00 |
| Eu-152 | ∑DOSE(j) | | 1.754E-26 | 1.668E-26 | 1.508E-26 | 1.059E-26 | 3.855E-27 | 1.124E-28 | 4.611E-33 | 0.000E+00 |
| Gd-152 | Eu-152 | 2.792E-01 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Eu-154 | Eu-154 | 1.000E+00 | 3.601E-26 | 3.333E-26 | 2.856E-26 | 1.662E-26 | 3.543E-27 | 1.584E-29 | 0.000E+00 | 0.000E+00 |
| Fe-55 | Fe-55 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| H-3 | H-3 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.305E-10 | 4.145E-30 |
| Ni-63 | Ni-63 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Sr-90 | Sr-90 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

| Nuclide (j) | Parent (i) | THF(i) | S(j,t), pCi/g t= 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 | 1.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ag-108m | Ag-108m | 1.000E+00 | 1.100E-04 | 1.094E-04 | 1.082E-04 | 1.041E-04 | 9.333E-05 | 6.361E-05 | 2.127E-05 | 4.600E-07 |
| C-14 | C-14 | 1.000E+00 | 1.120E-03 | 1.119E-03 | 1.118E-03 | 1.115E-03 | 1.105E-03 | 1.070E-03 | 9.773E-04 | 7.111E-04 |
| Co-60 | Co-60 | 1.000E+00 | 5.620E-03 | 4.927E-03 | 3.788E-03 | 1.508E-03 | 1.087E-04 | 1.090E-08 | 4.100E-20 | 0.000E+00 |
| Cs-137 | Cs-137 | 1.000E+00 | 1.680E-02 | 1.642E-02 | 1.567E-02 | 1.333E-02 | 8.398E-03 | 1.666E-03 | 1.638E-05 | 1.543E-12 |
| Eu-152 | Eu-152 | 7.208E-01 | 8.073E-04 | 7.664E-04 | 6.907E-04 | 4.799E-04 | 1.696E-04 | 4.453E-06 | 1.355E-10 | 2.105E-26 |
| Eu-152 | Eu-152 | 2.792E-01 | 3.127E-04 | 2.969E-04 | 2.675E-04 | 1.859E-04 | 6.571E-05 | 1.725E-06 | 5.248E-11 | 8.153E-27 |
| Eu-152 | ∑S(j): | | 1.120E-03 | 1.063E-03 | 9.582E-04 | 6.659E-04 | 2.353E-04 | 6.178E-06 | 1.880E-10 | 2.920E-26 |
| Gd-152 | Eu-152 | 2.792E-01 | 0.000E+00 | 1.956E-18 | 5.575E-18 | 1.565E-17 | 3.048E-17 | 3.837E-17 | 3.857E-17 | 3.852E-17 |
| Eu-154 | Eu-154 | 1.000E+00 | 1.120E-03 | 1.035E-03 | 8.843E-04 | 5.095E-04 | 1.054E-04 | 4.249E-07 | 6.117E-14 | 6.924E-38 |
| Fe-55 | Fe-55 | 1.000E+00 | 1.120E-03 | 8.664E-04 | 5.185E-04 | 8.595E-05 | 5.062E-07 | 7.936E-15 | 3.985E-37 | 0.000E+00 |
| H-3 | H-3 | 1.000E+00 | 1.120E-01 | 1.048E-01 | 9.176E-02 | 5.764E-02 | 1.526E-02 | 1.459E-04 | 2.477E-10 | 1.579E-30 |
| Ni-63 | Ni-63 | 1.000E+00 | 1.120E-02 | 1.112E-02 | 1.096E-02 | 1.042E-02 | 9.018E-03 | 5.438E-03 | 1.282E-03 | 8.159E-06 |
| Sr-90 | Sr-90 | 1.000E+00 | 1.120E-03 | 1.094E-03 | 1.042E-03 | 8.818E-04 | 5.465E-04 | 1.025E-04 | 8.573E-07 | 4.596E-14 |

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 3.75 seconds

INTRUDER DOSE CALCULATION SPREADSHEET
(1 PAGE)

# Construction Scenario
# Dose to Inadvertent Intruder

| Dose Calculation per NUREG-0782 G-57 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Isotope | PCDF (Sv/Bq) | Half Life (years) | $C_w$ ($Ci/m^3$) | $f_o$ | $f_d$ | $f_w$ | $f_s$ | % of year for Exposure | Dose (mrem/year) |
| Air | Cs-137 | 8.63E-09 | 30.1 | 2.54E-05 | 0.501 | 0.5 | 1 | 2.84E-10 | 5.70% | 3.28E-15 |
| | Co-60 | 5.91E-08 | 5.3 | 8.45E-06 | 0.019 | 0.5 | 1 | 2.84E-10 | 5.70% | 2.90E-16 |
| | Sr-90 | 3.51E-07 | 28.9 | 1.69E-06 | 0.487 | 0.5 | 1 | 2.84E-10 | 5.70% | 8.65E-15 |
| | H-3 | 1.73E-11 | 12.3 | 1.69E-04 | 0.185 | 0.5 | 1 | 2.84E-10 | 5.70% | 1.62E-17 |
| | C-14 | 6.36E-12 | 5730.0 | 1.69E-06 | 0.996 | 0.5 | 1 | 2.84E-10 | 5.70% | 3.21E-19 |
| | Fe-55 | 7.26E-10 | 2.7 | 1.69E-06 | 0.000 | 0.5 | 1 | 2.84E-10 | 5.70% | 1.66E-20 |
| | Ni-63 | 1.70E-09 | 100.1 | 1.69E-05 | 0.812 | 0.5 | 1 | 2.84E-10 | 5.70% | 6.99E-16 |
| | Eu-152 | 5.97E-08 | 13.5 | 1.69E-06 | 0.215 | 0.5 | 1 | 2.84E-10 | 5.70% | 6.49E-16 |
| | Eu-154 | 7.73E-08 | 8.6 | 1.69E-06 | 0.089 | 0.5 | 1 | 2.84E-10 | 5.70% | 3.48E-16 |
| | Ag-108m | 7.66E-08 | 418.0 | 1.69E-07 | 0.951 | 0.5 | 1 | 2.84E-10 | 5.70% | 3.69E-16 |
| Direct Gamma | Cs-137 | 4.02E-21 | 30.1 | 2.40E-05 | 0.501 | 0.5 | 1 | 0.057 | N/A | 1.61E-04 |
| | Co-60 | 8.68E-17 | 5.3 | 8.00E-06 | 0.019 | 0.5 | 1 | 0.057 | | 4.48E-02 |
| | Sr-90 | 3.77E-21 | 28.9 | 1.60E-06 | 0.487 | 0.5 | 1 | 0.057 | | 9.78E-06 |
| | H-3 | 0 | 12.3 | 1.60E-04 | 0.185 | 0.5 | 1 | 0.057 | | 0.00E+00 |
| | C-14 | 7.20E-23 | 5730.0 | 1.60E-06 | 0.996 | 0.5 | 1 | 0.057 | | 3.82E-07 |
| | Fe-55 | 0 | 2.7 | 1.60E-06 | 0.000 | 0.5 | 1 | 0.057 | | 0.00E+00 |
| | Ni-63 | 0 | 100.1 | 1.60E-05 | 0.812 | 0.5 | 1 | 0.057 | | 0.00E+00 |
| | Eu-152 | 3.75E-17 | 13.5 | 1.60E-06 | 0.215 | 0.5 | 1 | 0.057 | | 4.29E-02 |
| | Eu-154 | 4.11E-17 | 8.6 | 1.60E-06 | 0.089 | 0.5 | 1 | 0.057 | | 1.95E-02 |
| | Ag-108m | 5.16E-17 | 418.0 | 1.60E-07 | 0.951 | 0.5 | 1 | 0.057 | | 2.61E-02 |
| Total | | | | | | | | | | **1.34E-01** |

The total dose to the inadvertent intruder is estimated using the following equation:

$$H = \sum_{n} (f_o f_d f_w f_s)_{air} C_w \, PDCF_3 + \sum_{n} (f_o f_d f_w f_s)_{DirectGamma} C_w \, PDCF_5$$

Explanation of calculation and terms:

| | |
|---|---|
| $PDCF_3$ | Radionuclide Specific Pathway Dose Conversion Factor for Inhalation<br>Source: FGR 11, Table 2.1 - "Inhalation Doses (Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Inhalation). Slowest transport class used. |
| $PDCF_5$ | Radionuclide Specific Pathway Dose Conversion Factor for direct Gamma Exposure<br>Source: FGR 12, Table III.7 - "External Exposure to Radionuclides in Air, Water and Soil". Doses for submersion and from a plane source of infinite depth were summed to obtain the total direct gamma dose. |
| $C_w$ | Radionuclide Concentration in Waste |
| $f_o$ | Activity fraction remaining after decay<br>$f_o = e^{-\lambda t}$ where t is the the time period between the end of active disposal and the initiation of the scenario; the site closure plan for USEI ensures maintenance for 30 years after closure. |
| $f_d$ | Dilution factor due to particular disposal practices<br>0.5 for random, 0.75 for stacked, or 0.5 for decontainerized - much of the waste disposed of at USEI is decontainerized soil. |
| $f_w$ | Waste form and Package Factor - No credit is taken for waste form or solidification |
| $f_s$ | Site Selection Factor<br>$f_s = T_{sa} \times ExposureFactor$<br>$T_{sa} = 2.53 \times 10^{-10} \times (10/v) \times (s/30) \times (50/PE)^2 = 2.81 \times 10^{-10}$<br>where:<br>v = 4.47 m/s (average annual wind speed at Boise, ID Airport)<br>s = 50% (default silt content of soil)<br>PE = 91 (default precipitation-evaporation index) |

| Nuclide | pCi/g | Ci/g | Ci/kg | Ci/m^3 |
|---|---|---|---|---|
| Cs-137 | 15 | 1.5E-11 | 0.000000015 | 2.40E-05 |
| Co-60 | 5 | 5E-12 | 0.000000005 | 8.00E-06 |
| Sr-90 | 1 | 1E-12 | 0.000000001 | 1.60E-06 |
| H-3 | 100 | 1E-10 | 0.0000001 | 1.60E-04 |
| C-14 | 1 | 1E-12 | 0.000000001 | 1.60E-06 |
| Fe-55 | 1 | 1E-12 | 0.000000001 | 1.60E-06 |
| Ni-63 | 10 | 1E-11 | 0.00000001 | 1.60E-05 |
| Eu-152 | 1 | 1E-12 | 0.000000001 | 1.60E-06 |
| Eu-154 | 1 | 1E-12 | 0.000000001 | 1.60E-06 |
| Ag-108M | 0.1 | 1E-13 | 1E-10 | 1.60E-07 |

USEI PART B PERMIT

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ISSUED BY THE STATE OF IDAHO

CHAPTER C.3 "WASTE ACCEPTANCE CRITERIA"

(PAGES 4 THROUGH 8 IN CHAPTER C)

# C.3 WASTE ACCEPTANCE CRITERIA

## *C.3.1 Pre-acceptance Review*

The preacceptance protocol has been designed to ensure that only hazardous and radioactive material that can be properly and safely stored, treated and/or disposed of by USEI are approved for receipt at the facility. A two-step approach is taken by USEI.. The first step is the chemical and/or radiological and physical characterization of the candidate waste stream by the generator. The second step is the preacceptance evaluation performed by USEI to determine the acceptability of the waste for receipt at the facility. Figure C-2 presents a logic diagram of the preacceptance protocol that is utilized at the facility.

## *C.3.2 Radioactive Material Waste Acceptance Criteria*

The following waste acceptance criteria are established for accepting radiological contaminated waste material that is generally or specifically exempted from regulation by the Nuclear Regulatory Commission (NRC) or an Agreement State under the Atomic Energy Act of 1954 ("AEA"), as amended. Material may also be accepted if it is not regulated or licensed by the NRC or has been authorized for disposal by the IDEQ and is within the numeric waste acceptance criteria. Waste acceptance criteria are consistent with these restrictions.

The following five tables establish types and concentrations of radioactive materials that may be accepted. These tables are based on categories and types of radioactive material not regulated by the NRC based on statute or regulation or specifically approved by the NRC or and Agreement State for alternate disposal. The criteria are consistent with these restrictions and detailed analyses set forth in *Waste Acceptance Criteria and Justification for FUSRAP Material*, prepared by Radiation Safety Associates, Inc. (RSA) as subsequently refined, expanded and updated in *Waste Acceptance Criteria and Justification for Radioactive Material*, prepared by USEI.

Material may be accepted if the material has been specifically exempted from regulation by rule, order, license, license condition, letter of interpretation, or specific authorization under the following conditions: Thirty (30) days prior to intended shipment of such materials to the facility, USEI shall notify IDEQ of its intent to accept such material and submit information describing the material's physical, radiological, and/or chemical properties, impact on the facility radioactive materials performance assessment, and the basis for determining that the material does not require disposal at a facility licensed under the AEA. The IDEQ will have 30 days from receipt of this notification to reject USEI's determination or require further information and review. No response by IDEQ within thirty (30) days following receipt of such notice shall constitute concurrence. IDEQ concurrence is not required for generally exempted material as set forth in Table C.4a.

Based on categories of waste described in the waste acceptance criteria, the concentration of the various radionuclides in the conveyance (e.g., rail car gondola, other container etc.) shall not exceed the concentration limits established in the WAC without the specific written approval of the IDEQ unless generally exempted as set forth in Table C.4a. Radiological surveys will be performed as outlined in ERMP-01 to verify compliance with the WAC. If individual "pockets" of activity are detected indicating the limits may be exceeded, the RSO or RPS shall investigate the discrepancy and estimate the extent or volume of the material with the potentially elevated radiation levels. The RPS or RSO shall then make a determination on the compliance of the entire conveyance load with the appropriate WAC limits. If the conveyance is determined not to meet the limits, USEI will notify IDEQ's RCRA Program Manager within 24 hours of a concentration based exceedance of the facility WAC to evaluate and discuss management options. The findings and resolution actions shall then be documented and submitted to the IDEQ.

The radioactive material waste acceptance criteria, when used in conjunction with an effective radiation monitoring and protection program as defined in the USEI *Radioactive Material Health and Safety Plan* and *Exempt Radioactive Materials Procedures* provides adequate protection of human health and the environment. Included within this manual are requirements for USEI to submit a written summary report of Table C.1 through C.2 radioactive material waste receipts showing volumes and radionuclide concentrations disposed at the USEI site on a quarterly basis. USEI will also submit a Table C.3 through C.4b annual report of exempted products devices, materials or items within 60 (sixty) days of year end (December 31st). The annual report will provide total volumes or mass of isotopes and total activity by isotope listing the activity of each radionuclide disposed during the preceding year, and the cumulative total of activity for each radionuclide disposed at the facility. The report will include an updated analysis of the impact on the facility performance assessment.

These criteria and procedures are designed to assure that the highest potential dose to a worker handling radioactive material at USEI shall not exceed 400 mrem/year TEDE dose, and that no member of the public is calculated to receive a potential dose exceeding 15 mrem/year TEDE dose, from the USEI program. TEDE is defined as the "Total Effective Dose Equivalent", which equals the sum of external and internal exposures. The public dose limit during operation activities is limited to 100 mrem/yr TEDE dose. An annual summary report of environmental monitoring results will be submitted to IDEQ by June 1st for the preceding year.

Materials that have a radioactive component that meets the criteria described in Tables C.1 through C.4b and are RCRA regulated material will be managed as described within this WAP for the RCRA regulated constituents.

### Table C.1: Unimportant Quantities of Source Material Uniformly Dispersed* in Soil or Other Media**

| | Status of Equilibrium | Maximum Concentration of Source Material | Sum of Concentrations Parent(s) and all progeny present*** |
|---|---|---|---|
| a | Natural uranium in equilibrium with progeny | <500 ppm / 167 pCi/g ($^{238}$U activity) | ≤ 3000 pCi/g |
| | Refined natural uranium ($^{238}$U, $^{235}$U, $^{234}$U; $^{234}$Th, $^{234m}$Pa, $^{231}$Th) | <500 ppm / 333 pCi/g | ≤ 2000 pCi/g |
| | Depleted Uranium ( $^{234}$Th, $^{234m}$Pa) | <500 ppm / 169 pCi/g | ≤ 2000 pCi/g |
| b | Natural thorium ($^{232}$Th + $^{228}$Th) | <500 ppm / 110 pCi/g | ≤ 2000 pCi/g |
| | $^{230}$Th in equilibrium with progeny | <0.01 ppm / 200 pCi/g | ≤2000 pCi/g |
| | $^{230}$Th (with no progeny) | 0.1 ppm / ≤2000 pCi/g | |
| | Any mixture of Thorium and Uranium | Sum of ratios ≤ 1**** | ≤2000 pCi/g |

### Table C.2: Naturally Occurring Radioactive Material Other Than Uranium and Thorium Uniformly Dispersed* in Soil or Other Media**

| | Status of Equilibrium | Maximum Concentration of Parent Nuclide | Sum of Concentrations of Parent and All Progeny Present*** |
|---|---|---|---|
| a | $^{226}$Ra or $^{228}$Ra with progeny in bulk form [1] | 500 pCi/g | ≤ 4500 pCi/g |
| b | $^{226}$Ra or $^{228}$Ra with progeny in reinforced IP-1 containers [1] | 1500 pCi/g | 13,500 pCi/g |
| c | $^{210}$Pb with progeny( Bi & $^{210}$Po) | 1500 pCi/g | 4500 pCi/g |
| | $^{40}$K | 818 pCi/g | N/A |
| | Any other NORM | | ≤3000 pCi/g |

[1] Any material containing $^{226}$Ra greater than 222 pCi/g shall be disposed at least 6 meters from the external point on the completed cell.

### Table C.3: Non-Production Particle Accelerator Produced Radioactive Material*****

| Acceptable Material | Activity or Concentration |
|---|---|
| Any non-production particle accelerator produced radionuclide. | All materials shall be packaged in accordance with USDOT packaging requirements. Any packages containing iodine or volatile radionuclides will have lids or covers sealed to the container with gaskets. Contamination levels on the surface of the packages shall not exceed those allowed at point of receipt by USDOT rules. Gamma or x-ray radiation levels may not exceed 10 millirem per hour anywhere on the surface of the package. All packages received shall be directly disposed in the active cell. All containers shall be certified to be 90% full. |

*Average over conveyance or container. The use of the phrase "over the conveyance or container is meant to reflect the variability on the generator side. The concentration limit is the primary acceptance criteria.

**Unless otherwise authorized by IDEQ, other Media does not include radioactively contaminated liquid (except for incidental liquids in materials). See radioactive contaminated liquid definition (definition section of Part B permit).

*** Diffuse waste with a total concentration (sum of concentrations of all radionuclides present) which is 2000 pCi/g or less may be accepted at the site (i.e., the controlling limit is 2000 pCi/g).

**** $$\frac{\text{Conc. of U in sample}}{\text{Allowable conc. of U}} + \frac{\text{Conc. of Th in Sample}}{\text{Allowable conc. of Th}} \leq 1$$

***** Any material that has been made radioactive by use of a non-production particle accelerator as set forth in Federal Register, Vol. 72, No. 189, Monday October 1, 2007, page 55868.

**Table C.4a: NRC Exempted Products, Devices or Items**

| Exemption 10 CFR Part* | Product, Device or Item | Isotope, Activity or Concentration |
|---|---|---|
| 30.15 | As listed in the regulation | Various isotopes and activities as set forth in 30.15 |
| 30.14, 30.18 | Other materials, products or devices specifically exempted from regulation by rule, order, license, license condition, concurrence, or letter of interpretation | Radionuclides in concentrations consistent with the exemption |
| 30.19 | Self-luminous products containing tritium, $^{85}Kr$, $^{3}H$ or $^{147}Pm$ | Activity by Manufacturing license |
| 30.20 | Gas and aerosol detectors for protection of life and property from fire | Isotope and activity by Manufacturing license |
| 30.21 | Capsules containing $^{14}C$ urea for *in vivo* diagnosis of humans | $^{14}C$, one μCi per capsule |
| 40.13(a) | Unimportant quantity of source material: see table above | ≤0.05% by weight source material |
| 40.13(b) | Unrefined and unprocessed ore containing source material | As set forth in rule |
| 40.13(c)(1) | Source material in incandescent gas mantles, vacuum tubes, welding rods, electric lamps for illumination | Thorium and uranium, various amounts or concentrations, see rules |
| 40.13(c)(2) | (i)Source material in glazed ceramic tableware<br>(ii)Piezoelectric ceramic<br>(iii) Glassware not including glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction | ≤20% by weight<br>≤2% by weight<br>≤10% by weight |
| 40.13(c)(3) | Photographic film, negatives or prints | Uranium or Thorium |
| 40.13(c)(4) | Finished product or part fabricated of or containing tungsten or magnesium-thorium alloys. Cannot treat or process chemically, metallurgically, or physically. | ≤4% by weight thorium content. |
| 40.13(c)(5) | Uranium contained in counterweights installed in aircraft, rockets, projectiles and missiles or stored or handled in connection with installation or removal of such counterweights. | Per stated conditions in rule. |
| 40.13(c)(6) | Uranium used as shielding in shipping containers if conspicuously and legibly impressed with legend "CAUTION RADIOACTIVE SHIELDING – URANIUM" and uranium incased in at least 1/8 inch thick steel or fire resistant metal. | Depleted Uranium |
| 40.13(c)(7) | Thorium contained in finished optical lenses | ≤30% by weight thorium, per conditions in rule. |
| 40.13(c)(8) | Thorium contained in any finished aircraft engine part containing nickel-thoria alloy. | ≤4% by weight thorium, per conditions in rule. |

**Table C.4b: Materials Specifically Exempted by the NRC Or NRC Agreement State**

| Exemption | Materials | Isotope, Activity or Concentration* |
|---|---|---|
| 10 CFR 30.11*** | Byproduct material including production particle accelerator material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.**** | Byproduct material at concentrations consistent with the exemption** |
| 10 CFR 40.14*** | Source material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.**** | Source material at concentrations consistent with the exemption. |
| 10 CFR 70.17 | Special Nuclear Material (SNM) exempted from NRC regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.**** | SNM at concentrations consistent with the exemption. |

*Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm.

**Specifically exempted production beam accelerator may be received under Table C.3 provisions [10 CFR 20.2008 (b)]

***Also includes equivalent Agreement State regulation where applicable.

**** Similar material not regulated or licensed by the NRC may also be accepted. Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm. IDEQ shall be notified prior to the receipt of Special Nuclear Material not regulated or licensed by the NRC.

Additional Information for USEI's Waste Analysis Plan

1. US Ecology Idaho, Inc. (USEI) may receive contaminated materials or other materials as described in Tables C.1 - C.4b above. USEI may not accept for disposal any material that by its possession would require USEI to have a radioactive material license from the Nuclear Regulatory Commission (NRC).

2. Unless approved in advance by USEI and IDEQ, average activity concentrations may not exceed those concentrations enumerated in Tables C.1 and C.2. Additionally, for Tables C.1 and C.2, individual pockets of material may exceed the WAC for the radionuclides present as long as the average concentration of all radionuclides within the package or conveyance remains at or below the WAC and the highest dose rate measured on the outside of the unshielded package or conveyance does not exceed those action levels enumerated in ERMP-01.

3. Other items, devices or materials listed in Table C.4a, which are exempted in accordance with 10 CFR Parts 30, 40 or equivalent Agreement State regulations or 10 CFR Part 70 may be accepted at or below the activities (per device or item) or concentrations specified in those exemptions.

4. The generator of the exempted or non-production particle accelerator produced waste must specify that the waste meets applicable acceptance criteria and/or exemption requirements.

5. In accordance with permit requirements, notification of any exceedance of the WAC will be provided to the RCRA Program Manager within 24 hours, in accordance with the permit.