IRON COUNTY
S⊛LID WASTE

PO BOX 743 • 3127 N. IRON SPRINGS ROAD • CEDAR CITY, UT 84721-0743 • OFFICE 435-865-7015 • FAX 435-586-5192

SW197

HAND DELIVERED

MAY 10 2011

UTAH DIVISION OF
SOLID & HAZARDOUS WASTE
2011.01161

May 9, 2011

Scott T. Anderson, Director
Division of Solid and Hazardous Waste
PO Box 144880
Salt Lake City, UT 84114-4880

Re: Iron County Class I and Class IVb Landfill Re-permit Application

Dear Mr. Anderson,

Enclosed you will find the Re-Permit Application for the Iron County Class I and Class IVb Landfills.

Please feel free to contact me with any questions you might have. I can be reached by phone at (435)531-6270 or by email at jscott@ironcounty.net.

Sincerely,

Jaren C. Scott
Iron County Solid Waste Supervisor

REPERMIT APPLICATION TO OPERATE A CLASS I LANDFILL

Iron County Armstrong and Lindsey Pit Operations

Submitted by

IRON COUNTY
SOLID WASTE

Prepared by

IGES, INC
4153 S Commerce Drive
Salt Lake City, Utah 84107

May 9, 2011

ANNOTATED TABLE OF CONTENTS

INTRODUCTION

Thıs document presents a repermıt applıcatıon to operate a Class I Munıcıpal Solıd Waste (MSW) landfill ın the Armstrong Pıt and a Constructıon and Demolıtıon (C&D) landfill ın the Lındsey Pıt ın Iron County, Utah Both pıts are located at the Iron County Landfill complex, whıch ıs owned by Iron County and operated by the Iron County Solıd Waste (ICSW) personnel The Iron County MSW ıs currently operated under permıt number 9401 ıssued by the Utah Solıd and Hazardous Waste Control Board

The area to be permıtted ıs ın Townshıp 35 South, Range 12 West, Sectıon 32, Salt Lake Baselıne and Merıdıan, Iron County, Utah (See Drawıng 1, Sıte Map ın Appendıx A)

In the five years that have passed sınce the current permıt was ıssued to Iron County Solıd Waste for the operatıon of the Armstrong and Lındsey Pıt, only mınor changes to the operatıon of that pıt have taken place

Thıs permıt applıcatıon does not represent a lateral expansıon to the currently permıtted landfill cells It does, however, contaın some changes ın engıneerıng and operatıonal ıssues at the landfill These changes ınclude

- Changes to final cover configuratıon – final cover contours have been slıghtly modıfied to enhance long-term landfill draınage and keep the MSW desıgn capacıty under the 2 5 mıllıon megagram aır qualıty permıttıng threshold value
- Changes ın waste stream volumes - the actual volume of waste beıng delıvered to the landfill ıs less than the orıgınal permıt estımates, resultıng ın ıncreased landfill lıfe
- Plan of Operatıon – The Plan of Operatıon has been revısed to reflect current operatıonal practıces

The followıng ıtems, whıch have been prevıously permıtted and are part of the operatıng record of the landfill, and sınce no changes ın sıte condıtıons have occurred, wıll not be dıscussed ın detaıl ın thıs permıt applıcatıon

- Lıner Exemptıon – a lıner exemptıon was granted durıng the ınıtıal landfill permıt, therefore, no synthetıc lıner or cover materıals are ıncluded ın the Armstrong Pıt

- Leachate collectıon and removal system exemptıon – due to unıque sıte condıtıons, the Armstrong Pıt has been exempted from the ıncorporatıon of a leachate collectıon and removal system

Part I of thıs document duplıcates the standard form outlınıng general data pertaınıng to the sıte Part II ıs a general report that ıncludes a facılıty descrıptıon and landfill operatıons plan Part III ıs the Professıonal Engıneerıng Report and ıncludes detaıls on the desıgn of the sıte closure, post-closure care and financıal assurance

REPERMIT APPLICATION TO
OPERATE A CLASS I LANDFILL

Iron County Armstrong and Lindsey Pit Operations

PART I – GENERAL INFORMATION

Part I General Information APPLICANT PLEASE COMPLETE ALL SECTIONS

I Landfill Type	☒ Class I ☐ Class V	**II Application Type**	☐ New Application ☒ Renewal Application	☐ Facility Expansion ☐ Modification

For Renewal Applications Facility Expansion Applications and Modifications Enter Current Permit Number 9401R2

III Facility Name and Location

Legal Name of Facility
Iron County Class I Landfill

Site Address (street or directions to site) 3127 N Iron Springs Road			County Iron
City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015

Township 35S	Range 12W	Section(s) 32	Quarter/Quarter Section NW	Quarter Section

Main Gate Latitude	degrees 37	minutes 43	seconds 03	Longitude degrees 113	minutes 13	seconds 48

IV Facility Owner(s) Information

Legal Name of Facility Owner
Iron County

Address (mailing)
P O Box 743

City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015

V Facility Operator(s) Information

Legal Name of Facility Operator
Iron County Solid Waste

Address (mailing)
P O Box 743

City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015

VI. Property Owner(s) Information

Legal Name of Property Owner
Iron County

Address (mailing)
P O Box 743

City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015

VII Contact Information

Owner Contact Jaren Scott		Title Manager	
Address (mailing) PO Box 743			
City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015
Email Address jscott@ironcounty net		Alternative Telephone (cell or other)	(435) 531-6720
Operator Contact Jaren Scott		Title Manager	
Address (mailing) PO Box 743			
City Cedar City	State UT	Zip Code 84720	Telephone (435) 865-7015
Email Address jscott@ironcounty net		Alternative Telephone (cell or other)	(435) 531-6720
Property Owner Contact		Title	
Address (mailing)			
City	State	Zip Code	Telephone
Email Address		Alternative Telephone (cell or other)	

Part I General Information (Continued)

VIII Waste Types (check all that apply)			**IX Facility Area**		
Waste Type	Combined Disposal Unit	Monofill Unit	Facility Area	______	acres
☐ Municipal Waste	☐	☐	Disposal Area	38	acres
☒ Construction & Demolition	☐	☒	Design Capacity		
☐ Industrial	☐	☐	Years	81	
☐ Incinerator Ash	☐	☐	Cubic Yards	6504825	
☐ Animals	☐	☐	Tons	6504825	
☐ Asbestos	☐	☐			
☐ PCB's (R315-315 7(3) only)	☐	☐			
☐ Other ____________	☐	☐			

VIII Waste Types (check all that apply)			**IX Facility Area**		
Waste Type	Combined Disposal Unit	Monofill Unit	Facility Area	______	acres
☒ Municipal Waste	☐	☒	Disposal Area	32	acres
☐ Construction & Demolition	☐	☐	Design Capacity		
☐ Industrial	☐	☐	Years	34	
☐ Incinerator Ash	☐	☐	Cubic Yards	3104025	
☒ Animals	☐	☒	Tons	1862415	
☐ Asbestos	☐	☐			
☐ PCB s (R315-315 7(3) only)	☐	☐			
☐ Other ____________	☐	☐			

X Fee and Application Documents

Indicate Documents Attached To This Application ☐ Application Fee Amount $

☒ Facility Map or Maps ☒ Facility Legal Description ☒ Plan of Operation ☒ Waste Description
☒ Ground Water Report ☒ Closure Design ☒ Cost Estimates ☒ Financial Assurance

Class V Special Requirements

☐ Documents required by UCA 19 6 108(9) and (10)

I HEREBY CERTIFY THAT THIS INFORMATION AND ALL ATTACHED PAGES ARE CORRECT AND COMPLETE

Signature of Authorized Owner Representative: [signature]	Title: Solid Waste Supervisor	Date: 6-13-2011
Name typed or printed: Jaren C Scott	Address: Po Box 743 Cedar City UT 84721	
Signature of Authorized Land Owner Representative (if applicable): [signature]	Title: Solid Waste Supervisor	Date: 6-13-2011
Name typed or printed: Jaren C. Scott	Address: Po Box 743 Cedar City, UT 84721	
Signature of Authorized Operator Representative (if applicable): [signature]	Title: Solid Waste Supervisor	Date: 6-13-2011
Name typed or printed: Jaren C Scott	Address: Po Box 743 Cedar City UT 84721	

RECEIVED
JUN 1 5 2011
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE
2011 01161

REPERMIT APPLICATION TO
OPERATE A CLASS I LANDFILL

Iron County Armstrong and Lindsey Pit Operations

PART II - GENERAL REPORT

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1 0 - FACILITY DESCRIPTION

Durıng the last repermıttıng of the Iron County Landfill (ICL) the exıstıng Class IVb Constructıon and Demolıtıon (Lındsey Pıt) Landfill and the exıstıng Munıcıpal Solıd Waste (Armstrong Pıt) Landfill operatıons were combıned ınto one landfill permıt Both landfills are owned by Iron County and are operated by Iron County Solıd Waste (ICSW) The Lındsey Pıt ıs located ımmedıately north of the Armstrong Pıt Drawıngs 1 and 2 (Appendıx A) show the locatıon of the Armstrong and Lındsey Pıts relatıve to the surroundıng topographıc features The Lındsey Pıt ıs utılızed exclusıvely for the dısposal of constructıon and demolıtıon (C&D) related waste whıle the Armstrong Pıt wıll contınue to receıve all other permıtted wastes (prımarıly MSW)

The Armstrong and Lındsey Pıts are located ın abandoned ıron mınes The topography ımmedıately adjacent to each pıt slopes downward from the west/northwest toward the western boundary of each pıt and east/northeast away from the eastern lımıts of the pıts The locatıon and geometry of the pıts (sıde-slope of a mountaın) ıs such that the sıte run-on ıncludes all dırect precıpıtatıon on the west/northwest sıde slopes surroundıng each pıt

The physıcal address for the ICL ıs 3127 N Iron Sprıngs Road The maın access road to the sıte has been paved for all-weather access The maın access road leads from Iron Sprıng Road at the north uphıll and south to the mouth of the Armstrong Pıt Access ınto the Lındsey Pıt area ıs vıa an ımproved and maıntaıned dırt road located off the maın access road The facılıty ıs entırely fenced, wıth publıc access through the lockıng gate at the maın entrance of the solıd waste facılıty The sıte ıs approxımately 12 mıles northwest of Cedar Cıty, Utah A vıcınıty and sıte map ıs ıncluded on Drawıng 1 ın Appendıx A

1 1 AREA SERVED

The ICL serves all of Iron County wıth the exceptıon of the C&D wastes dısposed at the Parowan Class IVb landfill Census data for Iron County has the 2010 populatıon at approxımately 46,163 resıdents The hıstorıc waste stream estımates m Iron County were approxımately 290 tons/day ın 2000, approxımately 300 tons/day ın 2001, and approxımately 320 tons/day ın 2002 based upon volumetrıc assessments The ınıtıal C&D waste stream was estımated to be approxımately 50% of the total waste enterıng the ICL In 2005 the ICL began usıng a scale to better track the actual weıght of waste delıvered to the landfill and how ıt was dıstrıbuted between the C&D and MSW pıts Scale data collected from 2006 through 2010 ındıcate an average combıned waste acceptance rate that ıs approxımately 40% less than the orıgınal estımates (MSW-134 ton/day, C&D-41 ton/day, average)

ICSW has collected weight-based data for the past 5-6 years of operation Based upon this data the Armstrong Pit has accepted MSW at an average rate of 41,650 tons per year C&D waste has been accepted at an average rate of 12,800 ton/year The projected growth rate of the waste stream was originally anticipated to be approximately 2 5% per year However, waste streams for both pits appear to have peaked in 2006-2007 and have been decreasing since that time For purposes of estimating landfill life, we determined the average waste acceptance rates from the past five years and held it constant for the next 10 years After 2021 we have assumed the landfill waste acceptance rate will mirror population growth trends for the county, increasing approximately 2 5% per year We anticipate that future fluctuations in economic conditions will continue to impact population growth, construction withm the county and therefore waste acceptance rates at the landfill

1.2 WASTE TYPES

Based upon the weight data collected since 2005 the Lindsey Pit has collected as much as 63 tons per day (2006) of C&D waste and as little as 19 tons per day (2010), average collection rate is 43 tons per day The Armstrong Pit takes approximately 134 tons per day of MSW on average, over the past 6 years the maximum daily waste intake rate rose as high as 152 tons per day (2007) and dropped as low as 115 tons per day in 2010 On average 23% of the waste accepted at the ICL is diverted to the Lindsey Pit

ICL currently separates metal, green waste and pallets from the waste stream and recycles those resources Currently approximately 400 tons of metal and 250 tons of wood wastes are recycled annually

The waste diverted into the Lindsey Pit is limited to the following types

- Yard Waste – brush, branches, clippings, leaves and grass
- Construction Wastes – waste generated from construction and includes building materials used in construction Construction related materials include packaging materials from products, waste lumber, wallboard, boxes from appliances, empty paint cans, empty caulking tubes, and empty sealer and adhesive cans "EMPTY" means that no more than 10% of the product remains inside the container
- Demolition Wastes – waste generated from the destruction or remodeling of buildings and houses Demolition Wastes may include furnaces, pipes, ducting and water heaters Furniture and other materials that are not part of the building structure must be removed before demolition
- Untreated wood, including pallets and crates

- Asphalt from roads and other surfaces

Wastes materials that are specifically prohibited from being placed in the Lindsey Pit (materials that will be managed in the Armstrong Pit) include the following

- Household Wastes
- Contaminated Soils
- Tanks of any kind
- Railroad ties
- Cardboard not directly generated from construction or demolition activities
- Furniture of all kind
- Metal not directly generated from construction or demolition activities
- Electronics of any kind
- Treated lumber

ICSW is currently separating white goods, scrap metal, and diverting green waste in conjunction with the overall recycling operation of the facility

1 3 FACILITY HOURS

The operating hours for the facility are 8 00 a m to 6 00 p m year round The facility is open Monday thru Saturday with the following holidays being observed

- New Years Day
- Human Rights Day
- Presidents Day
- Memorial Day
- July 4th
- Pioneers Day
- Labor Day
- Columbus Day
- Veterans Day
- Thanksgiving Day
- Christmas Day

The following facility information is posted at the gate

- Landfill Owner

- Days of Landfill Operation
- Hours of Landfill Operation
- Instructional Signs (no scavenging, no hazardous materials, dump in designated areas, etc)
- Emergency Telephone Numbers

1 4 LANDFILL EQUIPMENT

The following equipment is on site and used in landfill operations

- (2) 826G compactor
- D8R track dozer
- 25 ton off-highway truck
- 10-wheel dump truck
- 10-wheel water truck
- (2) 950 loaders
- CAT 140G road grader

1 5 LANDFILL PERSONNEL

The following briefly presents the responsibilities for all on-site landfill personnel at the ICL

Landfill Supervisor - The Supervisor is responsible for all matters relating to the Solid Waste Program for Iron County, including landfill operations, drop boxes, and all recycling functions The Supervisor is responsible that the landfill operations meet all Department of Solid and Hazardous Waste (DSHW) permit requirements The Supervisor conducts regular facility inspections and monitors all landfill activities The Supervisor is responsible for all operational documentation including the annual reports to DSHW The Supervisor is responsible for all persons on the site including visitors

Landfill Technicians – The landfill technicians are responsible for all day-to-day activities at the landfill These responsibilities include, waste acceptance and placement, traffic control, visual inspection of incoming waste, random waste screening operations, and general construction as it pertains to landfill operations The landfill technicians serve as both equipment operators and gatehouse attendants

Mechanic – The landfill mechanic is responsible for the preventive maintenance and minor repair work on all landfill equipment Responsibilities include maintaining equipment maintenance records, spare part inventories, and scheduling equipment vendors for required service calls

Roll-off Truck Driver - The roll-off truck driver is responsible for the deployment, retrieval, and dumping of all roll-off's managed by ICSW All roll-off truck drivers will maintain a valid Commercial Drivers License

2.0 - LEGAL DESCRIPTION

The Armstrong and Lindsey Pits are located on property currently owned by Iron County The ICL is located in Township 35 South, Range 12 West, in Section 32, Salt Lake Base and Meridian, Iron County, Utah

A copy of the legal description is included as Appendix B

3.0 – OPERATIONS PLAN

The Operation Plan for the ICL has been written to address the requirements of Utah State Solid Waste Regulations R315-305 and describes the proposed operations of the Armstrong and Lindsey Pits This updated Operations Plan reflects current landfill operations, data contained m the October 8, 1999 Operator's Manual, and changes in anticipated landfill operations

The following section details the operational specifics of the Iron County Landfill Forms used in the documentation of the operation are included in Appendix C

3 1 SCHEDULE OF CONSTRUCTION

3.1 1 Construction & Demolition Waste (Lindsey Pit)

Construction of the Lindsey Pit has been broken down into five remaining Phases (II-VI as shown on Drawings 3-5 – Appendix A) At the time of this permit application Phase I is considered finished, with waste placement in the pit currently reaching an elevation of approximately 5,520 feet Phase II will consist of continued placement of C&D waste into the bottom of the Lindsey Pit up to an elevation of approximately 5,625 feet Phase III will consist of the mass filling of the pit from the 5,625 foot level to elevation 5,700 Phase IV will be the placing of C&D from the top of Phase III to a maximum elevation of 5,815 feet During completion of this phase the top surface of each successive lift will maintain a minimum 2% slope to the east for storm water management and the final cap slope (3H 1V) will be constructed on the eastern edge of the pit Phase V will continue waste placement up to a maximum elevation of 5,960 feet The same 2% slope will remain on the top of each successive lift, and a 3 1 slope will contmue up from the east side of the pit Phase VI will constitute the final phase of landfilling that will extend the final surface to the final contours as indicated in Drawing 4 The landfill construction was presented m these Phases to facilitate 1) development of the Lindsey Pit, 2) improvement of public access to the bottom of the pit, 3) aid in the calculation of airspace and required cover soils, and 4) distribute closure costs over the final 5 phases of landfill construction The Phases in the Lindsey Pit are identified by number while the Phases in the

Armstrong Pit are identified by letters to distinguish the Phases in each pit The section views of the Lindsey Pit are presented in Drawing 5 – Appendix A

The operation of the C&D landfill will be continual in nature, the Phased arrangement is more of a design concept rather that actual operational milestones Based on the projected waste stream, Phase II will provide operational airspace for approximately the next 17 years, with design capacity being reached in approximately 2028 Phase III will commence operation in 2029 and last until approximately 2048 Phase IV will start upon the completion of Phase III and last until approximately 2072 Phase V will start at the completion of Phase IV and is projected to last until fall 2088 with Phase VI completing the landfill operations in approximately 2092 The landfill capacities are based upon a C&D waste stream starting at 12,710 tons per year for the next 10 years and escalating at 2 5% each year thereafter

3 1 2 Municipal Solid Waste (Armstrong Pit)

The Armstrong Pit began accepting solid waste in September of 1994 with a gross airspace capacity of 4 9 million cubic yards With a 25% reduction in airspace due to the inclusion of cover soils, the net remaining airspace available for MSW is approximately 3 5 million cubic yards The remaining construction of the Armstrong Pit has been broken into four Phases (B-E shown on Drawing 6 – Appendix A) Phase A consisted of placing the MSW waste into the bottom of the Armstrong Pit to an elevation of approximately 5,800 feet Phase B will consist of the mass filling of the pit to an elevation of 5,900 Currently the pit floor is at an average elevation of 5,850 with the current lift reaching ~5,870 feet in the southwest corner This lift will be completed across the entire pit floor before the last lift of Phase B will be initiated The top surface of this last lift will be sloped toward the entrance at with a minimum grade of 2% to promote surface run-off The final surface of Phase C will reach a maximum elevation of 5,950 and be sloped in two directions to aid in water management This will allow approximately half of the pit to be drained from the upper access road near the southeast corner of the pit Phases D and E will continue with this grading/drainage pattern until the final landfill cap is completed at an elevation of 6050 A graphic representation of the proposed fill sequence is shown on Drawing 6 – Appendix A

The landfill construction was presented in these Phases to facilitate 1) development of the Armstrong Pit, 2) development of public access to the working face, 3) aid in the calculation of airspace and required cover soils, 4) better manage surface drainage from the pit, and 5) spread final cap/closure costs over several phases of construction

The operation of the MSW landfill will be continual in nature, the Phased arrangement is more of a design concept rather that actual operational milestones Based on the historic waste stream, Phase A provided operational airspace for approximately the first 5 years, with design capacity being reached approximately 1998 Phase B commenced operation in 1998 and will last until approximately 2024 Phase C will start upon the completion of Phase B and last until approximately 2034 Phase D will start at the completion of Phase C and is projected to last until approximately 2041 The landfill capacities are based upon an average MSW waste stream of approximately 41,540 tons per year This rate is held constant until 2021 then escalates at 2 5% each year thereafter The projection of the landfill life is presented in Appendix D

3 1 3 Asbestos Pit

ICL operations were modified in 2005 to accommodate the disposal of asbestos containing materials The Asbestos Pit is located on the ICL property as indicated on Drawing 2 – Appendix A The legal description for the Asbestos Pit is as follows

> BEGINNING AT A POINT WHICH IS SITUATED S 0°18'26" W ALONG THE SECTION LINE 1211 13 FEET AND WEST 1226 11 FEET FROM THE EAST 1/4 CORNER OF SECTION 29, TOWNSHIP 35 SOUTH, RANGE 12 WEST, SALT LAKE BASE & MERIDIAN, THENCE S 28°36'54" W 755 08 FEET, THENCE N 53°20'15" W 521 79 FEET, THENCE N 17°37'14" E 349 23 FEET, THENCE N 88°25'57" E 674 72 FEET TO THE POINT OF BEGINNING AND CONTAINING 7 03 ACRES OF LAND

The ICL operations take in approximately 50 tons of asbestos material each year

3 2 DESCRIPTION OF WASTE HANDLING PROCEDURES

3 2 1 General

Since the commencement of operations of the ICL, several operational modifications have been made at the facility The modifications to the waste handling procedures were necessary to ensure the separation of any asbestos related wastes from the C&D and MSW waste The waste control program is designed to manage any asbestos wastes and to detect and deter attempts to dispose MSW in the C&D pit and to minimize the potential of hazardous or unacceptable wastes being delivered to either pit The program is designed to protect the health and safety of employees, customers, and the general public, as well as to protect against the contamination of the environment

The landfill site is open for public and private disposal Signs have been posted along the access road to clearly indicate (1) the types of wastes that are accepted at each facility, (2) the types of wastes not accepted at the site, and (3) the penalty for illegal disposal

All vehicles delivering wastes to the site must stop at the scale house Operations personnel will inquire as to the contents of each incoming load to direct the driver to the MSW landfill, the C&D landfill, recycling area, asbestos pit, or to reject the load due to unacceptable materials Any vehicle suspected of carrying unacceptable materials (liquid waste, sludges, or hazardous waste) will be prevented from entering the disposal areas unless the driver can provide evidence that the waste is acceptable for disposal at the site ICSW reserves the right to refuse service to any suspect load Vehicles carrying unacceptable materials will be required to exit the site without discharging their loads

Once it is determined that the wastes entering the landfill are not of a hazardous, asbestos or PCB containing materials, or of an unacceptable nature, the driver is directed to either the Armstrong (MSW) landfill or the Lindsey (C&D) landfill as appropriate Any loads that contain MSW or materials not suitable for disposal in the C&D landfill will be directed to the Armstrong Pit If the scale house personnel suspect that any load contains unacceptable materials, the scale house will then notify the a Landfill Technician that a load is suspect and that load will be further inspected at the C&D or MSW landfill tipping area before final disposal is allowed

Loads will be regularly surveyed at each of the tipping areas If a discharged load contains inappropriate or unacceptable material, the discharger will be required to reload the material and remove it from the landfill site If materials such as PCB's are suspected, the discharger will be required to reload the material and remove it from the landfill

If the discharger is not immediately identified, the area where the unacceptable material was discharged will be cordoned off Unacceptable material will be moved to a designated area for identification and preparation for proper disposal If the material is suspected to contain PCB's, a commercially available test kit will be utilized to confirms the presence material and it will be documented, reported to DSHW and the local health department and disposed of properly

3 2 2 Waste Acceptance

ICSW uses a solid waste software package entitled "PC Scale" With this program ICSW is able to track all incoming waste as well as bill and receive payment from all customers When a vehicle with waste stops on the scale, the scale operator identifies the load as to whether it is a commercial hauler, general public, or private individual with an account The proper codes are entered into the computer identifying the origin, hauler, and account number All loads larger than a pickup will are weighed and charged accordingly Information regarding all transactions is stored on the in house computer at the landfill All scale records are backed up on a weekly basis to minimize the potential for the loss of data The information stored on the computer serves as the daily log A monthly summary of all landfill transactions will be created and kept on file at the landfill Any or all transactions may be retrieved as necessary

No open burning is allowed No smoking is allowed near the work face

3 2 3 C&D Waste Disposal

The first phase of waste disposal in the C&D landfill (Phase I) involved end dumping the waste from the initial tipping area The geometry of the pit was such that the C&D waste was dozed downslope ınto place The bottoms 40 feet of the pıt were filled usıng thıs method Sınce that tıme the C&D wastes have been dumped at the toe of the work face when possıble and spread up the slope ın one to two foot lıfts, keepıng the slope at a typıcal five to one (horızontal to vertıcal) configuratıon Due to the access restrıctıons of the first Phase (and the ınıtıal portıon of the second Phase) of landfillıng, ICSW personnel typıcally elected to transfer C&D waste wıth untıl safer access was developed for publıc use

Typıcally the compactor ıs operated wıth the blade facıng uphıll Equıpment operatıons across the slope are avoıded to mınımıze the potentıal of equıpment tıppıng over In addıtıon to safety concerns, a toe of slope to crest of slope workıng orıentatıon provıdes the followıng benefits

- Increases effectıve compactıon
- Increased vısıbılıty for waste placement and compactıon
- More unıform waste dıstrıbutıon

The C&D wastes wıll be compacted by makıng three to five passes up and down the slope Compactıon reduces lıtter, dıfferentıal settlement, and the quantıtıes of cover soıl needed Compactıon also extends the lıfe of the sıte, reduces unıt costs, and leaves fewer voıds to help reduce vector problems Care ıs taken that no holes are left ın the compacted waste Voıds are filled wıth addıtıonal waste as they develop

Cover soıls wıll be applıed to all areas of the actıve cell at a mınımum of every 30 days

3 2 4 MSW Waste Dısposal

The first phase of waste placed ın the MSW landfill (Phase A) ınvolved end dumpıng the waste from the ınıtıal tıppıng area ınto the lowest areas of the Armstrong Pıt The ınıtıal geometry of the pıt was such that the waste was dozed downslope ınto place Once the bottom of the pıt was filled suffıcıently to provıde safe truck access to the workıng face, waste was delıvered dırectly to the workıng face Currently, waste delıvered to the workıng face ıs dumped at the toe of the workıng face when possıble and spread up the slope ın one to two foot lıfts, keepıng the slope at a typıcal five to one (horızontal to vertıcal) configuratıon

Work face dimensions will be kept narrow enough to minimize blowing litter and reduce the amount of soil needed for cover

Typically the compactor is operated with the blade facing uphill Equipment operations across the slope are avoided to minimize the potential of equipment tipping over In addition to safety concerns, a toe of slope to crest of slope working orientation provides the following benefits

- Increases effective compaction
- Increased visibility for waste placement and compaction
- More uniform waste distribution

Since the Lindsey Pit has commenced operation, The Armstrong Pit currently receives MSW waste only The wastes will be compacted by making three to five passes up and down the slope Compaction reduces litter, differential settlement, and the quantities of cover soil needed Compaction also extends the life of the site, reduces unit costs, and leaves fewer voids to help reduce vector problems Care is taken that no holes are left in the compacted waste Voids are filled with additional waste as they develop

Cover soils will be applied to all areas of the active cell daily Intermediate cover will be placed in active areas of the landfill that will not receive waste within 30 days

3 2 5 Special Wastes

3 2 5 1 Used Oil and Batteries

ICSW no longer accepts used oil or batteries at the landfill In the past they have been collected and transported to recycling facilities Patrons with these items now are directed to take these items to appropriate recycling facilities themselves

3.2 5 2 Bulky Wastes

Whıte goods are accepted at the ICL and are separated for recyclıng For applıances contaınıng refrıgerants, all refrıgerants must be removed prıor to dısposal at the ICL Once the removal of refrıgerants ıs double checked, applıances are loaded ınto the metal bın for recyclıng Used cars are accepted and stored near the Armstrong Pıt

3 2.5 3 Tıres

ICL accepts small quantıtıes of tıres from the general publıc Commercıal haulers are prohıbıted from dısposıng of tıres A total of four passenger tıres are accepted from the publıc wıth each load

3 2.5.4 Dead Anımals

Dead anımals are accepted at the Armstrong Pıt only The dead anımals are ıncorporated ınto the face of the landfill The ıncorporatıon of the carcasses ınto the landfill ıs accomplıshed by pushıng up the toe of the face and deposıtıng the anımal ın the bottom of the toe, waste ıs then pushed over the top of the anımal

3.2 5 5 Asbestos Waste

ICL has developed asbestos management procedures (and a separate fenced cell) to mınımıze the rısk of asbestos related waste to humans and the envıronment ICL accepts only locally generated asbestos waste Asbestos generators and transporters are requıred to make arrangements for asbestos dısposal at a mınımum of 24 hours prıor to delıvery to the landfill

Asbestos wastes shall be handled, transported, and dısposed ın a manner that wıll not permıt the release of asbestos fibers ınto the aır and must otherwıse comply wıth Sectıons R307-1-4 12 and R307-8 and 40 CFR Part 61, Subpart M, 1995ed

- Accept asbestos wastes by appoıntment only Requıre a 24 to 48 hour notıce

- Do not accept frıable asbestos waste unless ıt has been double bagged ın plastıc bags of 6-mıl or thıcker, and thoroughly wetted to prevent fiber release Asbestos slurries must be in leak-proof and air-tight rigid containers if they are too heavy for plastic bags

- All asbestos containers must be labeled with the name of the waste generator, the location where it was generated, and tagged with a warning label that conforms to the requirements of 40 Code of Federal Regulations (CFR) Part 61 149(2), 1991 ed

- Upon arriving at the gate, the transporter of the asbestos must present a waste shipment record The Landfill Technician will verify the quantities received and sign the waste shipment record Iron County Landfill personnel will send a copy of the waste shipment record to the generator within 30 days

- Direct the transporter to the asbestos trench for off-loading Caution the transporter to take care not to break the containers Cover the wastes immediately with at least 12 inches of soil

- Do not compact asbestos wastes until they are completely covered with a minimum of 12 inches of non-asbestos material

- Restrict public access to areas containing asbestos The asbestos containing areas are to be properly marked Warning signs will be placed at the entrance and around the perimeter of the disposal area at distances not exceeding 200 feet

3 2.5 6 Grease By-Products

Waste from restaurant grease traps and related by-products are accepted at the ICL If the waste passes the paint filter test, it is deposited in the Armstrong Pit and covered daily The grease related wastes are typically stabilized by the addition of sawdust prior to transport to the ICL facility ICL receives grease related wastes weekly If the grease trap or sump disposal wastes have excess liquids, the materials are dumped on a dedicated tailings pile and held until the excessive liquid evaporates Solid waste residue is then hauled to the working face

3 2 5 7 Dry Sewer Sludge

Dry sewer sludge ıs accepted for dısposal ınto the Armstrong Pıt ıf both the paınt filter test and all TCLP requırements are met

3 2 5 8 Car Wash Sedıment

Car wash sedıment ıs accepted for dısposal ınto the Armstrong Pıt ıf both the paınt filter test and all onsıte screenıng crıterıa are met Perıodıcally ICL requıres that a TCLP test be completed by waste generator for car wash sedıment

3 3 WASTE INSPECTION

3.3 1 Landfill Spottıng

Learnıng to ıdentıfy and exclude prohıbıted and hazardous waste from the ICL ıs a requırement to maıntaın each landfill classıficatıon and necessary for the safe operatıon of the facılıty The Landfill Technıcıans are requıred to receıve ınıtıal and perıodıc hazardous waste screenıng ınspectıon traınıng Waste screenıng certıficates of the traınıng receıved are kept ın the personnel files

3.3 2 Random Waste Screenıng

Random ınspectıons of ıncomıng loads are conducted accordıng to the schedule establıshed by the Landfill Supervısor If frequent vıolatıons are detected, addıtıonal random checks are scheduled at the dıscretıon of the Landfill Supervısor (typıcally 1 random check per 50 loads but no less than I random check per 100 loads)

If a suspıcıous or unknown waste ıs encountered, the Landfill Technıcıan proceeds wıth the waste screenıng as follows

- The drıver of the vehıcle contaınıng the suspect materıal ıs dırected to the waste screenıng area
- The random load ınspectıon record (Appendıx C) ıs completed
- Protectıve gear ıs worn (leather gloves, steel-toed boots, and hard hat)

- The suspect material is spread out with landfill equipment or hand tools and visually examined Suspicious marking or materials, like the ones listed below, are investigated further
  - Containers labeled hazardous
  - Material with unusual amounts of moisture
  - Biomedical (red bag) waste
  - Unidentified powders, smoke, or vapors
  - Liquids, sludges, pastes, or slurries
  - Asbestos or asbestos contaminated materials
  - Batteries
  - Other wastes not accepted by the Landfill

- The Landfill Supervisor is called if unstable wastes that cannot be handled safely or radioactive wastes are discovered or suspected

3 3 3 Removal of Hazardous or Prohibited Waste

Should hazardous or prohibited wastes be discovered during random waste screening or during tipping, the waste is removed from the landfill(s) as follows

- The waste is loaded back on the hauler's vehicle The hauler is then informed of the proper disposal options
- If the hauler or generator is no longer on the premises and is known, they are asked to retrieve the waste and informed of the proper disposal options
- The Landfill Supervisor arranges to have the waste transported to the proper disposal site and then bill the original hauler or generator

A record of the removal of all hazardous or prohibited wastes will be kept in the site operational records

3 3 4 Hazardous or Prohibited Waste Discovered After the Fact

If Hazardous or prohibited wastes are discovered after the fact, the following procedure will be used to remove them

- Access to the area is restricted
- The Landfill Supervisor is immediately notified
- The Landfill Technician removes the waste from the working face if it is safe to do so
- The waste is isolated in a secure area of the landfill and the area cordoned off
- Local authorities are notified as appropriate

The DSHW, the hauler (if known), and the generator (if known) will be notified within 24 hours of the discovery The generator (if known) is responsible for the proper cleanup, transportation, and disposal of the waste

3.3 5 Notification Procedures

The following agencies and people are contacted if any hazardous materials are discovered at the Landfill

▪ Jaren Scott, Landfill Supervisor	(435) 865-7015
▪ Iron County Health Department	(435) 586-2437
▪ Executive Secretary, DSHW	(801) 538-6170
▪ Iron Co Fire Department	(435) 586-2964

A record of conversation is completed as each of the entities is contacted The record of conversation is kept in the site operational records

3 4 FACILITY MONITORING AND INSPECTION

3 4 1 Groundwater

The Lindsey Pit is not required to monitor groundwater Groundwater monitoring of the Armstrong Pit is conducted as prescribed in the Groundwater and Leachate Monitoring Plan (Appendix E)

3 4 2 Surface Water

Run-on diversion structures have been installed around the perimeters of both pits in an effort to reduce the volume of water that can contact waste The diversion structures include both ditches and berms where appropriate Potential run-on waters are diverted before the waters drain onto the excavated slopes of the pit Due to the variability of surface soil and rock outcroppings, the location of the drainage structures have been field located

In general, surface water that falls within the pit excavations (below run-on diversion structures) will naturally be routed into low areas of the each pit The run-on will be directed, where possible, away from the access road at the entrance to the active face

Run-off from the final cover will be managed by a combination of berms and ditches The berms will be placed to divert the water around the active area to ditches Drawings 3, 4 and 6 (Appendix A) illustrate the locations of the run-off control structures, details for ditch construction are shown on Drawing 8

ICSW staff will inspect the drainage system monthly Temporary repairs will be made as required to any observed deficiencies until permanent repairs can be scheduled ICSW or a licensed general contractor will repair drainage facilities as required

3 4 3 Leachate Collection

The Lindsey Pit is not required to collect or monitor leachate The monitoring of leachate in the Armstrong Pit is conducted as prescribed in the Groundwater and Leachate Monitoring Plan (Appendix E)

3 4 4 Landfill Gas

The Lındsey Pıt ıs not requıred to monıtor landfill gas Landfill gases are measured quarterly at the Armstrong Pıt and around facılıty buıldıngs

3 4 5 General Inspectıons of Machınes and Equıpment

Routıne ınspectıons are necessary to prevent malfunctıons and deterıoratıon, operator errors, and dıscharges that may cause or lead to release of wastes to the envıronment or a threat to human health Landfill Technıcıans are responsıble for conductıng and recordıng routıne ınspectıons of the landfill facılıtıes and equıpment accordıng to the followıng schedule

- Landfill Technıcıans (when operatıng equıpment) perform pre-operatıonal ınspectıons of all equıpment daıly A post-operatıonal ınspectıon ıs performed at the end of each shıft whıle equıpment ıs coolıng down

- All equıpment ıs on a regular maıntenance schedule The on-sıte mechanıc performs all oıl changes and a complete ınspectıon of each pıece of equıpment at thıs tıme A logbook ıs maıntaıned on each pıece of equıpment and any repaırs and comments concernıng the ınspectıon are contaıned ın the log Oıl samples are pulled when each machıne ıs servıced and results are recorded ın the machıne log

- Facılıty ınspectıons are completed on a quarterly basıs Any needed correctıve actıon ıtems are recorded and the Landfill Technıcıans complete needed repaırs If a problem ıs of an urgent nature, the problem ıs corrected ımmedıately

- Scale maıntenance wıll be performed as requıred, wıth calıbratıon performed annually at a mınımum The scale ıs certıfied on an annual basıs

3 5 CONTIGENCY AND CORRECTIVE ACTION PLANS

The followıng sectıons outlıne procedures to be followed ın case of fire, explosıon, run-on/run-off contamınatıon, or suspected groundwater contamınatıon

The Iron County Fire Department is contacted in all cases where hazardous materials are suspected to be involved

3 5.1 Fire

The potential for fire is a concern in any landfill The ICL follows a waste handling procedure to minimize the potential for a landfill fire If any load comes to the landfill on fire, the driver of the vehicle is directed to a pre-designated area away from the working face The burning waste is unloaded, spread out, and immediately covered with sufficient amounts of soil to smother the fire Once the burning waste cools and is deemed safe, the material will then be incorporated into the working face Some loads coming to the landfill may be on fire but not detected until after being unloaded at the working face If a load of waste that is on fire is unloaded at the working face, the load of waste is immediately removed from the working face, spread out, and covered with soil

The Iron County Fire department is called if it appears that landfill personnel and equipment cannot contain any fire at the landfill The Iron County Fire department is also called if a fire is burning below the landfill surface or is difficult to reach or isolate

In case of fire, the Landfill Supervisor is notified immediately A written report detailing the event is placed in the operating record within seven days, including any corrective action taken

3 5.2 Explosion

If an explosion occurs or seems possible, all personnel and customers are accounted for and the Landfill is evacuated Corrective action is immediately evaluated and implemented as soon as practicable

The Landfill Supervisor is notified immediately and the Iron County Fire department is called The Executive Secretary is notified immediately

3 5 3 Failure of Run-On/Run-Off Contamment

The purpose of the run-on/run-off control systems is to manage the stormwater fallmg in or near the landfill Due to the surroundmg topography and geometry of the Lindsey and Armstrong Pits, run-on control measures are limited Were possible, water is diverted away from the landfill by utilizing ditches and berms These ditches are inspected on a regular basis and repaired as needed All precipitation falling on the side slopes of the Pits will flow towards the workmg area The workmg face will be sloped to direct the run-on away from access roads

As the landfill reaches an elevation where the storm water will dram from the Lindsey and Armstrong Pit areas, perimeter ditches and berms will be constructed If a run-off ditch or berm fails, temporary berms or ditches will be constructed until a permanent run-off structure can be repaired

Any temporary berms or other structures are checked at least every 2 hours durmg the storm event until storm water flow has stopped Permanent improvements or repairs are made as soon as practicable

The Landfill Supervisor is notified immediately if a failure of the run-off systems is discovered The event is fully documented in the operating record, including corrective action within 14 days

3 5.4 Groundwater Contamination

If ground water contamination is ever suspected, studies to evaluate the potential contamination will be conducted and the existence and/or extent of contamination will be documented This program may include the installation of ground water monitoring wells A ground water monitoring program would be developed and corrective action taken as deemed necessary, with the approval of the Executive Secretary

3 6 CONTINGENCY PLAN FOR ALTERNATIVE WASTE HANDLING

The most probable reason for a disruption in the waste handling procedures at the ICL will be weather related The landfill(s) may close during periods of inclement weather such as high winds, heavy rain, snow, flooding, or any other weather-related condition that would make travel or operations dangerous The ICL may also close for other reasons like fire, natural disaster, etc In general, the ICSW staff works to minimize the possibility of disruption to waste disposal services from an operational standpoint

In case of equipment failure, replacement equipment will be rented or leased to continue operations while repairs are being made In the event of a disruption of service at the Iron County Landfill, wastes will be redirected to either the Parowan Landfill for Construction and Demolition waste or to Beaver County Landfill for MSW wastes

3 7 DISEASE AND VECTOR CONTROL

The vectors encountered at the ICL are flies, birds, mosquitoes, rodents, skunks, and snakes Due to the rural location of the landfill, stray house pets are occasionally encountered at the landfill The program for controlling these vectors is as follows

3 7 1 Insects

Eliminating breeding areas is essential in the control of insects ICSW will minimize the potential breeding areas by covering the waste with soil at a minimum of daily for the Armstrong Pit, every 30 days for the Lindsey Pit and by maintaining sloped surfaces to reduce ponded water

3 7 2 Rodents

Reducing potential food sources minimizes rodent populations at the landfill Due to the nature of the C&D wastes, no significant numbers of mice or rats have been seen or are anticipated at the Lindsey Pit The application of daily cover at the Armstrong Pit will minimize the potential food sources and the potential for rodents

In the unlikely event of a significant increase in the number of rodents at the ICL, a professional exterminator will be contacted The exterminator would then establish an appropriate protocol for pest control in accordance with all county, state and federal regulations

3 7.3 Birds

It is anticipated that the ICL will have minimal problems with birds Good landfilling practices of waste compaction, daily covering of working faces, and the minimization of ponded water will alleviate most of the bird problems If the occasional need arises, the birds will be encouraged to leave by using cracker and whistler shells

3 7 4 Household Pets

Because of the landfill's location, some stray cats and dogs have wandered onto landfill property When stray animals are encountered (and can be caught), they are turned over to the animal shelter located immediately east of the landfill If the Landfill Technicians are unable to apprehend the animals, they are chased off the property

3 7 5 Wildlife

The ICL has a variety of wildlife located on or near the landfill property Wildlife includes deer, snakes, foxes, skunks, and coyotes If problem skunks or snakes are encountered, they will be exterminated If other site wildlife becomes a problem, the landfill will coordinate with the Division of Wildlife Resources to provide methods and means to eliminate the problem

In the event that any of these vectors become an unmanageable problem, the services of a professional exterminator will be employed

3 7 6 Fugitive Dust

The road leading to the Armstrong Pit is paved, however, the access road to the Lindsey Pit is an improved dirt/gravel road and will need occasional dust control measures General landfill activities, site access by vehicles compounded by the occasional high wind may present a fugitive dust problem If the dust problem elevates above the "minimum avoidable dust level", the landfill applies water to problem areas

The ICL has a 10-wheel water truck on site to utilize for dust suppression Water is applied to the un-paved roads leading from the paved access road to the tipping face and at the tipping face if occasionally necessary due to excessively dusty loads Water will be applied as often as needed to control the dust

3.7 7 Litter Control

Because waste currently deposited in the Lindsey and Armstrong Pits is largely shielded from wind by each of the pits geometry, the blowing of litter is generally minimal However, due to the nature of landfilling operations, blowing litter will still be an occasional problem Landfill personnel perform routine litter cleanup to keep the landfill and surrounding properties clear of windblown debris

Whenever possible, the working face is placed down-wind so that blowing litter is worked into the landfill face During windy conditions, landfill personnel minimize the spreading of the waste to reduce the amount of windblown debris The prevailing wind on the site is from the southwest to the northeast

3 8 RECYCLING

Currently, recycling activities are conducted in conjunction with the ongoing MSW and C&D operations The bulk of materials recycled are metals and green waste

3 9 TRAINING PROGRAM

As part of the initial training of new employees, the Landfill Operator's Manual is required reading All personnel are required to review the approved permit annually

All personnel associated with the operation of the landfill receive site-specific training annually The "Sanitary Landfill Operator Training Course" offered by the Solid Waste Association of North America (SWANA) is required by all employees SWANA waste screening is also required of all Landfill Technicians Certificates of completion are kept in personnel files

Regular safety and equipment maintenance training sessions are held to ensure that employees are aware of the latest technologies and that good safety practices are used at all times

3 10 RECORDKEEPING

An operating record is maintained as part of a permanent record on the following items

- Vehicle weights, number of vehicles entering the landfill and types of wastes received on a monthly basis Daily logs are stored on the computer
- Deviations from the approved Plan of Operation
- Personnel training and notification procedures
- Random load inspection log

3 11 SUBMITTAL OF ANNUAL REPORT

ICSW will submit a copy of its annual report to the Executive Secretary by March 1 of each year for the most recent calendar or fiscal year of facility operation The annual report will include facility activities during the previous year and will include, at a minimum, the following

- Name and address of facility
- Calendar or fiscal year covered by the annual report
- Annual quantity, in tons or volume, in cubic yards, and estimated in-place density in pounds per cubic yard of solid waste
- Annual update of required financial assurances mechanism pursuant to Utah Administrative Code R315-309
- Training programs completed

3 12 INSPECTIONS

The Landfill Supervisor, or his/her designee, will inspect the facility to minimize malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of wastes to the environment or to a threat to human health These inspections are conducted on a quarterly basis, at a minimum A monthly inspection form (Appendix C) is kept as part of the operating record This form includes at least the date of inspection and name and name of the inspector with documentation of observations made and the nature of any repairs or corrective actions Inspection records are available to the Executive Secretary or an authorized representative upon request

3 13 RECORDING WITH COUNTY RECORDER

Plats and other data, as required by the County Recorder, will be recorded with the Iron County Recorder as part of the record of title no later than 60 days after certification of closure

3 14 STATE AND LOCAL REQUIREMENTS

The ICL wıll maıntaın complıance wıth all applıcable state and local requırements ıncludıng zonıng, fire protectıon, water pollutıon preventıon, aır pollutıon preventıon, and nuısance control

3 15 SAFETY

Landfill personnel are requıred to partıcıpate ın an ongoıng safety program Thıs program complıes wıth the Occupatıonal Safety and Health Admınıstratıon (OSHA), and the Natıonal Instıtute of Occupatıonal Safety and Health (NIOSH) regulatıons as applıcable Thıs program ıs desıgned to make the sıte and equıpment as secure as possıble and to educate landfill personnel about safe work practıces

3.16 EMERGENCY PROCEDURES

In the event of an accıdent or any other emergency sıtuatıon, the Landfill Technıcıan ımmedıately contacts the Landfill Supervısor and proceeds as dırected If the Landfill Supervısor ıs not avaılable, the Landfill Technıcıans calls the appropnate emergency number posted by the telephone The emergency telephone numbers are

▪ Iron County Central Dıspatch	911
▪ Fıre Department	(435) 586-2964
▪ Shenff's Office	(435) 867-7500
▪ Cedar Cıty Hospıtal	(435) 586-6587
▪ Jaren Scott, Landfill Supervısor	(435) 586-7015

Sıte commumcatıons are pnmanly conducted vıa radıo wıth cell phone and land lıne used as backup systems

APPLICATION TO RENEW A PERMIT TO OPERATE A CLASS I LANDFILL

Iron County Armstrong and Lindsey Pit Operations

PART III - TECHNICAL REPORT

TABLE OF CONTENTS

6 0 – REFERENCES

1.0 - GEOHYDROLOGICAL ASSESSMENT

1.1 GEOLOGY AND HYDROLOGY

1.1.1 Regional Geology

The geology and hydrogeology of this site have been studied for many years by government agencies and mining companies Previous work at Granite Mountain was compiled by MacKin, Nelson and Rowley (1976) and was fully detailed by Tahoma Resources (1990) in a previous landfill permit application The geology of the Iron Springs district, which contains the both the Lindsay and Armstrong Pits, is complex The area is in the transition zone between the Colorado Plateau and the Basin and Range provinces, and has been structurally active since at least early Cretaceous time This activity has created several faults which influence the aquifers in the area

1.1.2 Local Geology

The ICL complex is underlain by Mesozoic sedimentary rocks of the Carmel and Iron Springs formations intruded by middle Tertiary quartz monzonite of the Iron Springs laccolith Quartz monzonite extends to a depth of at least 4,900 feet below the site, where it is underlain by Navajo Sandstone The area is bounded along the southeast by the extinct Cory-Armstrong fault zone Late Tertiary to recent gravels that locally cover the east slope of Granite Mountain are not offset by the Cory-Armstrong Fault

1.1.3 Hydrology

The closest stream is Iron Springs Creek, an ephemeral flow, located approximately three miles northeast of the site Small dry washes are located near the landfill site, which convey surface flows from the Granite Mountains located northwest of the site

1.2 SOIL CHARACTERISTICS

The nature of extensive mining over several decades has resulted in the general absence of a soil matrix near each of the pits Daily cover materials are created from the weathered bedrock and from previously milled rock material

1.3 HYDROGEOLOGY AND GROUNDWATER

The most recent groundwater data and assessment (Annual Groundwater Monitoring Report – 2010) by Kleinfelder has been submitted to the DSHW as part of the landfill's annual report A copy of the table of contents for the Annual Groundwater Report is included in Appendix F

1.4 WATER RIGHTS

A search of the Utah Division of Water Rights database indicates the nearest water right diversion is located approximately ½ mile to the northeast of the scale house The database indicated that the water right is for a surface diversion used for stock watering, this diversion (well) is just over 1 mile northeast of the Lindsey Pit A group of four wells, also used for stock watering, are located approximately 1 25 miles north of the Lindsey Pit There are other water rights shown in the area, all are located more than 1 3 miles from the ICL

1.5 SURFACE WATER

As mentioned in Section 1 1 3, the nearest stream to the landfill site is Iron Springs Creek, an ephemeral flow, located approximately three miles north-northeast of the site

There are no wetlands located in the vicinity of the site, therefore the landfill will not adversely affect the wetland environment or any wildlife associated with wetlands

1.6 WATER QUALITY

1 6 1 Regional Ground Water Quality

Total-dissolved-solids (TDS) concentrations of Cedar Valley groundwater ranged from 158 to 2,752 mg/L (158 - 2,752 parts per million) in 1978 (Hurlow, 2002) The source of dissolved material is often the rocks through which the water flows Gypsum, for example, contributes significant quantities of sodium and calcium to groundwater In Cedar Valley, groundwater is generally classified as either a calcium-bicarbonate type or a magnesium-sulfate type, and is suitable for most uses Bjorklund and others (1978) did note, however, that the "concentration of dissolved solids tends to increase with time in areas where large quantities of water are pumped for irrigation " Water quality data was not available for any of the nearby wells

The basin-fill aquifer is the principal source of drinking water for residents of Cedar Valley Potential groundwater pollution sources include underground storage tanks, sewage lagoons, septic tank soil-absorption systems, and agricultural fertilizer Domestic waste-water in rural areas and some subdivisions is disposed of in on-site individual waste-water disposal systems Residential development, agriculture, and manufacturing are all taking place on the basin-fill aquifer

The principal groundwater contaminant identified in the Cedar Valley basin-fill aquifer is nitrate Concentrations in water wells in 1979 ranged from less than 0 06 mg/L to 57 4 mg/L (0 06 - 57 4 parts per million) (Joe Melling, Cedar City Manager, formerly with the Southwest Utah Public

Health Department, wrıtten communıcatıon, 1979) Nıneteen of these wells exceeded 10 mg/L (10 parts per mıllıon) (current Utah groundwater qualıty standards permıts a maxımum nıtrate concentratıon of 10 mg/L) The hıgh-nıtrate wells are dıstrıbuted throughout Cedar Valley, rather than concentrated ın a sıngle area of hıgh-mtrate concentratıon Hıgh-mtrate wells are more common near the Hurrıcane fault on the east sıde of the valley (Eısınger 1998)

1 6 2 Sıte Specıfic Ground Water Qualıty

The most recent groundwater qualıty data and assessment have been submıtted to the DSHW as part of the annual report, the table of contents for the Annual Groundwater Monıtorıng Report – 2010 ıs ıncluded ın Appendıx F

1.7 SITE WATER BALANCE

Among the possıble problems created by waste storage ın any landfill ıs the possıble contamınatıon of soıl, surface water or groundwater by dırect contact wıth the waste or by leached materıals from water passıng through the waste Due to low annual precıpıtatıon and hıgh annual evapotranspıratıon (the loss of water from soıl by both evaporatıon and transpıratıon from plant growth) rates assocıated wıth the semı-arıd clımate ın the Cedar Valley, the quantıty of water ınfiltratıng the landfill ıs predıcted to be small and therefore the leachate generatıon low

Based on the landfill desıgn, the arıd clımatıc condıtıons (11 5 ınches of raınfall vs 49 ınches of evaporatıon per year), ın-sıtu soıl condıtıons, geologıc obstacles to groundwater flow, and the operatıonal constraınt of no lıquıd waste dısposal, sıgmficant leachate generatıon from the cells of the landfill and ıts ımpacts to underlyıng groundwater ıs consıdered to be mınımal

Prevıous sıte water balance studıes utılızıng the HELP software evaluated the sıtes potentıal to generate leachate The results of the prevıous HELP analysıs are ıncluded ın Appendıx G

2.0 - ENGINEERING REPORT

2.1 LOCATION STANDARDS

The following sections present the Solid Waste Facility Locations Standards and discuss the status of the Iron County Landfill compliance with those requirements

2.1.1 Land Use Compatibility

The UDEQ Division of Solid and Hazardous Waste's Solid Waste Permitting and Management Rules state that no Class I, Class II or a Class V landfill will be located within

- One thousand feet of a national, state or county park, monument, or recreation area, designated wilderness or wilderness study area, or wild and scenic river area
- Ecologically and scientifically significant natural areas, including wildlife management areas and habitat for listed or proposed endangered species, as designated pursuant to the Endangered Species Act of 1982
- Farmland classified or evaluated as prime, unique, or of statewide importance by the U S Department of Agriculture, Soil Conservation Service, under the Prime Farmland Protection Act
- One-quarter mile of existing permanent dwellings, residential areas, and other incompatible structures, such as, schools, churches, and historic structures or properties listed or eligible to be listed in the State or National Register of Historic Places
- Proximity to an airport
- Areas with respect to archeological sites

2 1 1 1 Iron County Landfill (ICL) Status

- ICL landfills are not new or laterally expanding
- The ICL is not located within 1,000 feet of a national, state, or county park, monument, or recreation area, designated wilderness or wilderness study area, or wild and scenic river area
- Ecologically or scientifically significant natural areas have not been observed within or adjacent to the current site This site is an active landfill and has been used as such since 1994
- There are not soils within the landfill property boundaries that are classified prime soil types for farmland use according to the Soil Conservation Service (SCS) maps of Iron County Therefore, the site is not considered within a unique or important farmland zone

- There are no schools, churches, historic structures, or properties eligible to be listed in the State or National Register of Historic Places currently located within one-quarter mile of the property line that encloses the area currently being operated as a Landfill
- The Landfill is not located within 10,000 feet of a public-use airport runway used by turbojet aircraft The closest airport is located near Cedar City approximately 8 miles from the site
- No archaeologically significant discoveries have been made at the site, nor are any known to exist

2 1.2 Geologic Hazards and Geotechnical Engineering

The Utah State Regulations indicate "No new facility or lateral expansion of an existing facility shall be located in a subsidence area, a dam failure flood area, above an underground mine, above a salt dome, above a salt bed, or on or adjacent to geologic features which could compromise the structural integrity of the facility"

Neither of the landfill areas are located in a subsidence area, a dam failure flood area, above an underground mine, above a salt dome, or above a salt bed as mentioned in the Utah State Regulations (Harty, 1993) However, the landfill area is located on the eastern slope of the Granite Mountains Geologic hazards such as debris flows, alluvial fan flooding and faulting can be a potential concern in this area and were therefore assessed

2 1 2 1 Debris Flows and Alluvial Fan Flooding

The site is located in the mountains and according to geologic mapping of the area is not on an alluvial fan where flooding or debris flows have historically taken place and the potential for future occurrence is considered to be low

2 1 2 2 Liquefaction

Certain areas within the intermountain region also possess a potential for liquefaction during seismic events Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated The primary factors affecting liquefaction potential of a soil deposit are (1) level and duration of seismic ground motions, (2) soil type and consistency, and (3) depth to groundwater

Because the facility is founded largely on exposed bedrock the site has a very low potential for liquefaction and it should not be considered a concern for this site

2 1 2 3 *Seismicity and Faulting*

The site is situated near the eastern boundary of the Intermountain Seismic Belt, which is characterized by active seismicity and extensional normal faulting There are no known active faults that pass under or immediately adjacent to the site (Averitt and Threet, 1973, Hecker, 1993) The site is located approximately 10 to 12 miles west of the Cedar City-Parowan monocline The Cedar City-Parowan monocline and three faults in the general vicinity of the site show evidence of Holocene (less than 10,000 years old) movement The Enoch Graben is located approximately 12 miles northeast of the site, the Hurricane fault is located approximately 14 miles east of the site, and the Parowan Valley fault is located approximately 24 to 32 miles northeast of the site These three faults are reported to have been active in Holocene time (Hecker, 1993) In addition, the University of Utah Seismograph Stations publishes seismograph records of events throughout Utah These records show several historical seismic events that occurred in the Cedar City area, with magnitudes generally less than 4 to 5 Based on these conditions, the potential exists for moderate to high earthquake-induced ground motions at the site

2 1.2.4 *Seismic Impact Zone*

The EPA and the DSHW define a seismic impact zone as any location with a 10% or greater probability that the maximum horizontal acceleration (MHA) in lithified earth material, expressed as a percentage of the earth's gravitational pull, will exceed 0 10g in 250 years

The MHA in lithified earth material is defined in 40 CFR part 258 14 (EPA 1995) as the "maximum expected horizontal acceleration depicted on a seismic hazard map with a 90% or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on site specific seismic risk assessment " Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States as part of NEHRP/NSHMP (Frankel et al, 1996, FEMA, 1997) These maps serve as the basis for the International Building Code (IBC) Using NEHRP-based interactive software developed by Leyendecker et al (2000), probabilistic spectral accelerations corresponding to the MCE (maximum considered earthquake) seismic hazard levels were identified for the site, assuming rock-like conditions The MCE is often associated with a 2PE50 hazard level (equivalent to the 90% or greater probability that the acceleration will not be exceeded in 250 years) These spectral accelerations are consistent with 5% damping To account for site effects, site coefficients which vary with the magnitude of spectral acceleration should be used to modify the bedrock-based spectral acceleration values Based on information collected during previous boring explorations

(Bingham Environmental, 1999) we believe that the site is best described by Site Class B "rock" Corresponding site coefficients are shown in the following table

Seismic Event	Spectral Period	Mapped Acceleration (g)	Site Coefficient
MCE	PGA *	0 26	1 00
	0 2 sec (short)	0 65	1 00
	1 0 sec (long)	0 20	1 00

* Back-calculated based on standard spectral shape

Based on this information, the Maximum Horizontal Acceleration anticipated at the site is 0 26g Therefore, the site does lie within a Seismic Impact Zone defined by the EPA and the DSHW

2 1 2 5 Seismic Impact Zone Analysis

Cross-sections of the bottom excavation and final cover were generated and used in modeling static and seismic stability The most critical section (section with the steepest final slope) was modeled Section A of the Lindsey Pit was selected as the most critical section for seismic slope stability analysis based on the final side slopes and fill height Final side slopes are planned to be a maximum of 4 horizontal to 1 vertical Steeper, but shorter, slopes will be utilized along the northeast limits of the Armstrong Pit The sections and stability results are presented in Appendix H – Slope Stability

Two material types were used for the stability analyses foundation (insitu) bedrock and municipal solid waste (MSW) The following table presents the strength and unit weight parameters assumed for use in the stability analyses

Property	Foundation Bedrock	MSW
Unit Weight (pcf)	150	68
Cohesion (psf)	3000	150
Friction Angle (deg)	27	30

The bedrock strength parameters were derived based on the local geologic conditions described in Section 1 1 2 and the Hoek-Brown failure criterion (Hoek et al 2002) to develop equivalent continuum strength parameters for the stability analysis Due to limited laboratory and field data for the bedrock, lower bound values were used for the rock mass classification, resulting in more conservative bedrock properties However, a parametric stability analysis indicated the global stability of the fill was not sensitive to the bedrock strength parameters due to the lower strength of the MSW

Municipal unit weight parameters were estimated based upon historical data (Kavazanjian, et al , 1995) Based on this study (typical unit weight values range from 41 to 83 pcf, with an average range of 54 to 68 pcf), a value of 68 pcf was selected for this analysis Strength parameters were selected based on large scale direct shear testing performed insitu at the Dekorte Park Landfill in New Jersey which were found to correlate well with back calculated parameters from sites which experienced slope failures (Witham et al , 2000) Strength parameters and unit weight were assumed constant with depth

Static and pseudo-static analyses of the slope sections were performed using the most critical section of the landfill geometry and the bedrock and MSW parameters outlined previously Results are presented in Appendix H – Slope Stability The static and pseudo-static slope stability analyses were completed using the computer program Slide by Rocscience

Information from Singh and Sun (1995) suggest the potential for amplification of the ground motion as it propagates to the surface (top) of the landfill Using the IBC "rock" acceleration of 0 26g and the upper bound response given by Singh and Sun (1995), the maximum horizontal acceleration anticipated at the surface of the landfill is 0 36g This acceleration was used in the deformation analysis under seismic conditions

Simplified Newmark seismic deformation analyses were performed using the upper bound (conservative) relationships given by Hynes-Griffin and Franklin (1984) The yield acceleration of 0 35g was computed for the most critical section of the landfill Using the yield acceleration and the anticipated attenuated ground acceleration the seismic induced deformation is anticipated to be less than one foot

Section	Static Factor of Safety	Yield Acceleration	Attenuated Acceleration at the Top of Landfill	Anticipated Seismic Induced Deformation (feet)
Lindsey Pit – Section B	2 73	0 35g	0 36g	<1

Typical allowable limits in stability analyses are, a minimum factor safety of 1 5 during static conditions and a maximum allowable deformation of 1 foot Based on the results of the analyses performed usıng the planned geometry of the landfill the stabılıty of the slopes are above the mınımum standards

2 1 2 6 Unstable Areas

An unstable area means "a locatıon that ıs susceptıble to natural or human ınduced events or forces capable of ımpaırıng the ıntegrıty of some or all of the landfill structural components responsıble for preventıng releases from a facılıty" Unstable areas ınclude poor foundatıon condıtıons or karst terraın resultıng ın excessıve dıfferentıal settlement, or areas susceptıble to mass movement lıquefactıon

The sıte ıs located on bedrock deposıts that are not susceptıble to mass movement, lıquefactıon or excessıve foundatıon settlement The sıte ıs not located wıthın a publıc watershed and no water retentıon facılıtıes are located wıthın a reasonable dıstance down gradıent from the sıte

2 1 2 7 Iron County Landfill (ICL) Status

- ICL landfills are not new or laterally expandıng

2 1.3 Surface Water Requırements

UDEQ has adopted Subtıtle D locatıon restrıctıons for floodplaıns, wetlands and watersheds The landfill sıte does not currently fall wıthın a delıneated 100-year flood zone There are no known or desıgnated wetlands wıthın the lımıts of the landfill boundary The Landfill ıs not located ın a watershed for a publıc water system or a locatıon that could cause contamınatıon of a lake, reservoır, or pond There are no known endangered or threatened specıes wıthın the landfill area

2 1 3 1 Floodplaın

There has been very lıttle, ıf any, floodplaın mappıng performed outsıde of ıncorporated cıty boundarıes ın southern Utah Floodplaın mappıng for the Cedar Cıty area does not extend west of the aırport and as a result the sıte ıs not mapped ın a potentıal floodplaın Iron Sprıngs Creek ıs also located approxımately 200 feet below the sıte and floodıng of thıs creek should not be a concern at the landfill

2 1 3 2 Iron County Landfill (ICL) Status

- ICL landfills are not new or laterally expandıng

2.1.4 Groundwater Requırements

UDEQ locatıon restrıctıons wıth respect to groundwater protectıon ınclude the followıng

- No new facılıty shall be located at a sıte where the bottom of the lowest lıner ıs less than 5 feet above hıstorıcal hıgh levels of groundwater ın the uppermost aquıfer

- No new facılıty shall be located over a sole source aquıfer as desıgnated ın 40 CFR 149
- No new facılıty shall be located over groundwater classıfied as IB under Sectıon R317-6-3 3 (an ırreplaceable aquıfer)
- A new facılıty located above any aquıfer contaınıng groundwater whıch has total dıssolved solıds (TDSs) content below 1,000 mıllıgrams per lıter (mg/l) and does not exceed applıcable groundwater qualıty standards for any contamınant ıs permıtted only where the depth to groundwater ıs greater than 100 feet For a TDS content between 1,000 and 3,000 mg/l, the separatıon must be 50 feet or greater These separatıon dıstance requırements are waıved ıf the landfill ıs constructed wıth a composıte lıner
- No new facılıty shall be located ın desıgnated drınkıng water source protectıon areas or, ıf no such protectıon area ıs desıgnated, wıthın a dıstance to exıstıng drınkıng water wells or sprıngs for publıc water supplıes of 250-day groundwater travel tıme

2 1 4 1 Iron County Landfill Status

- ICL landfills are not new or laterally expandıng

The lowest poınt of the bottom of the landfill ıs at least 250 feet above the hıghest observed groundwater elevatıon noted ın the monıtorıng wells on and surroundıng the sıte Groundwater beneath the landfill area ıs not classıfied as a sole source or Class IB (ırreplaceable aquıfer) A groundwater transport study was not conducted as part of thıs ınvestıgatıon Based on thıs ınformatıon the ICL does meet the requırements of the groundwater protectıon locatıon restrıctıons

2.2 PHASED DESIGN - PROPOSED LANDFILL DEVELOPEMENT

As descrıbed ın Sectıon 3 1 of Part II, each of the Landfills wıll be developed ın Phases The followıng sectıons dıscuss the development of future Phases and the ıncremental fillıng of each of the landfills

2 2 1 Estımated Lıfe

The projected wastestream for the landfill wıll come from Iron County Estımated daıly waste tons beıng delıvered to the ICL operatıons ıs approxımately 175 tons per day based on recent records Lındsey Pıt (C&D) receıves approxımately 41 tons per day whıle the Armstrong Pıt (MSW) receıves approxımately 134 tons per day Only lımıted dıstınctıon ıs made ın the records between resıdentıal and commercıal waste dısposal Because the wastestream has been steadıly decreasıng over the past five years antıcıpated future aır space consumptıon has been evaluated assumıng a steady rate of waste dısposal for the next 10 years After that tıme, the wastestream ıs projected to ıncrease at a rate of 2 5% per year

All volume calculations were made using Autodesk Civil 3D software earthwork package integrated into AutoCAD Elevations for the ground surface were initially obtained by conventional aerial surveying methods and have been periodically updated using Global Positioning System (G P S) survey methods Site photographs have also been used to determine the extent and approximate elevation of waste in place m both landfill cells

The landfill life projections are only estimates, the actual life of the landfill will depend on several variables including the actual rate of waste being delivered, densities, settlement and the potential use of alternate daily cover materials The landfill life estimates presented below are based upon gross airspace calculations Net airspace will be approximately 75% less than the gross airspace due to daily, intermediate and final cover soils

2 2.1 1 Armstrong (MSW) Phase B

Phase B began operation as Phase A was complete Phase B has approximately 1,467,700 cubic yards of gross airspace available The airspace will provide landfilling capacity for approximately 13 years with capacity being reached in approximately 2024

2 2 1 2 Armstrong (MSW) Phase C

Phase C has approximately 1,118,000 cubic yards of gross airspace available which will provide landfill capacity for approximately 11 years with capacity being reached in approximately 2035

2 2 1.3 Armstrong (MSW) Phase D

Phase D of the Armstrong Pit construction will consume approximately 1,078,000 cubic yards of gross airspace Phase D is anticipated to receive waste through 2041

2 2 1 4 Armstrong (MSW) Phase E

Phase E of the Armstrong Pit construction will consume approximately 475,000 cubic yards of gross airspace Phase E is anticipated to receive waste through 2045 Phase E is the last planned Phase of the Armstrong Pit

2 2.1 5 Lindsey (C&D) Phase I

Development of Phase I withm the Lindsey C&D landfill cell began in November of 2002 and continued to an approximate elevation of 5,500 feet The available airspace of Phase I was approximated to be 75,000 cubic yards, providing just over 2 years of service

2 2 1 6 Lındsey (C&D) Phase II

Phase II of the Lındsey Pıt development wıll consıst of placıng C&D fill to an elevatıon of 5,625 feet The remaınıng gross aırspace of Phase II ıs projected to be 828,300 cubıc yards, provıdıng approxımately 17 years of servıce beıng completed near 2028

2 2 1 7 Lındsey (C&D) Phase III

Phase III of the Lındsey Pıt development wıll consıst of fill to an elevatıon of 5,700 feet msl The avaılable gross aırspace of Phase III has been projected to be 1,346,000 cubıc yards, provıdıng approxımately 20 years of servıce Completıon of Phase III ıs antıcıpated for the year 2048

2 2 1 8 Lındsey (C&D) Phase IV

Phase IV of the Lındsey Pıt development wıll consıst of waste placement up to a maxımum elevatıon of 5,190 feet Thıs phase wıll ınclude a portıon of the final cap slope on the east sıde of the landfill as ındıcated on Drawıng 3 (Appendıx A) The avaılable gross aırspace of Phase IV has been estımated to be 2,807,000 cubıc yards, provıdıng approxımately 24 years of servıce reachıng capacıty ın 2072

2 2 1 9 Lındsey (C&D) Phase V

Phase V of the Lındsey Pıt development wıll consıst of waste placement up to a maxımum elevatıon of 5,960 feet Thıs phase wıll consıst almost entırely of above ground waste placement at the sıte and ınclude a contınuatıon of the final cap slope on the east sıde of the landfill as ındıcated on Drawıng 3 (Appendıx A) The avaılable gross aırspace of Phase IV has been estımated to be 2,965,000 cubıc yards, provıdıng approxımately 16 years of servıce

2 2 1 10 Lındsey (C&D) Phase VI

Phase VI of the Lındsey Pıt development wıll consıst of waste placement up to the final cap surface as ındıcated on Drawıng 3 (Appendıx A) The avaılable gross aırspace of Phase VI has been estımated to be 726,800 cubıc yards, provıdıng approxımately 4 years of servıce Phase VI ıs the final planned Phase of the Lındsey Pıt

2.3 DAILY, INTERMEDIATE AND FINAL COVER

2 3 1 Daıly and Intermedıate Soıl Cover

Daıly cover soıls must meet the 6-ınch State requırements for protectıon agaınst odors, lıtter and vectors ın the Armstrong Pıt The daıly 6-ınch thıck cover wıll typıcally be obtaıned from the excavatıon of the surroundıng slopes and from prevıously mılled materıals

Intermedıate cover soıl requırements are governed by R315-303-4 The outsıde face of the daıly modules and waste areas that are expected to remaın ınactıve for more than 30 days wıll be protected with an additional 12 inch intermediate cover The borrow area for intermediate cover soils is the same for daily cover soils

Before the start of waste placement each day, cover soils on top of the previous lift will be stripped back and stockpiled for reuse as soil cover at the end of the day or as needed These recycled cover soils will be used first, the remainder of daily cover soils will be provided from cell excavation or stockpiled soils

All C&D wastes deposited in the Lindsey Pit will receive soil cover no less than every 30 days

2 3 2 Alternate Daily Cover

ICL has not historically utilized alternate daily cover materials Due to the nature of the landfilling operation, ICL proposes to utilize the following alternative daily cover materials as the need arises

- Wood chips – The wood chips created from the grinding of green waste as part of the green waste diversion process ICL intends to recycle the wood chips back to the community as a landscaping product Periodically, the timing of the wood chip sales may result in the generation of excess wood chips These wood chips may be utilized as an alternative daily cover to minimize the size of the wood chip stockpile

2 3 3 Final Cover

ICL will initiate the placement of the final cover system within 180 days after the disposal ceases in each of the closure phases Final cover construction will be completed withm 180 days after initiation

The final cover system will consist (from the bottom up) of

- Minimum of 18-inches of compacted site soils with a permeability of 1 x 10^{-5} cm/sec or less
- A vegetation support layer of soil that is a minimum of 6 inches in depth
- A layer of vegetation consisting of native grasses and shallow rooted shrubs

The final cover system (24" in total depth) will minimize surface water infiltration (thereby minimizing leachate generation), gas migration, maintain slope stability, control surface water and erosion, and be capable of supporting vegetative cover The vegetative cover has been selected with shallow root systems to prevent penetration into the soil matrix

The final cover will be the same for both the Armstrong and the Lindsey Pits The final cover will be constructed to the general contours as indicated on Drawings 3 & 6 (Appendix A)

2.4 MONITORING SYSTEM

2 4 1 Groundwater Monitoring System

The details of the ICL groundwater monitoring system are provided in the Groundwater and Leachate Monitoring Plan (Appendix E)

2 4 2 Leachate Monitoring

The details of the ICL leachate monitoring system are provided in the Groundwater and Leachate Monitoring Plan (Appendix E)

2.4.3 Landfill Gas

The decomposition of solid waste produces methane, a potentially flammable gas The accumulation of methane in site structures can result in fire and explosions that can injure employees and property, users of the landfill, and occupants of nearby structures In accordance with Subtitle D and Utah rules, ICL will conduct surface and facility structure gas monitoring at least quarterly for methane detection The concentration of methane gas generated by the landfill must not exceed 25% of the lower explosive limit (LEL) in the facility structures (excluding gas control or recovery system components) The concentration of methane gas generated by the landfill must not exceed the LEL at the facility boundary As outlined in EPA Subtitle D, Subpart C and the State of Utah Regulations, ICL will take all necessary steps to protect human health and will immediately notify UDEQ of methane levels detected above required limits and actions taken, if any Within 10 days of an incident, ICL will place documentation of the methane gas levels detected and a description of the interim steps taken to protect human health in the operating record Within 60 days of detection, ICL personnel will implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify UDEQ that the plan has been implemented The remediation plan will describe the nature and extent of the problem and describe the proposed remedy

2.5 DESIGN AND LOCATION OF RUN-ON/RUN-OFF CONTROL SYSTEMS

The main objectives of surface water management for the landfill are, to provide landfill drainage and to prevent off site run-on, preventing unnecessary surface water infiltration and subsequent leachate production, to contain surface runoff from open areas on-site, and to prevent erosion Federal regulations require 1) A run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm, and 2) Run-off control system from the active portion of the landfill to collect and to control at least the water volume resulting from a 24-hour, 25-year storm

2.5.1 Run-On from a 25-Year, 24-Hour Storm

The location of the site near the eastern base of the Granite Mountains will require that surface flows are diverted near the western boundary of the Lindsey and Armstrong pits Diversion structures were designed to accommodate peak flows generated by a 25-year, 24-hour storm event According to precipitation frequency data maintained by the National Oceanic and Atmospheric Administration (NOAA) anticipated rainfall for the design storm is 2 32 inches (2 89 inches for the 100-year 24-hour storm) Peak discharge was evaluated using the TR-55 graphical peak discharge method to be 115 cfs for the Armstrong Pit and 105 cfs for the Lindsey Pit A rip-rap lined trapezoidal channel having a bottom width of 3-feet, 2H 1V side slopes and a total depth of 3 5-feet should contain the peak flows, leaving 1-1 3 feet of free-board The required diversion channel was previously constructed uphill of both the Armstrong and Lindsey Pits Drawings 2 and 8 (Appendix A) indicate the location and details of the run-on control structures

2.5 2 Run-Off from a 25-Year, 24-Hour Storm

As discussed previously the 25-year, 24-hour storm potential precipitation at the landfill is 2 32 inches based on information from NOAA After fill and grading of the final landfill cell caps peak run-off will be approximately 25 and 36 cfs for the Armstrong and Lindsey Pits, respectively Run-off will be controlled using trapezoidal drainage channels constructed around the eastern perimeter of the landfill cells The final cover surface of both the Armstrong & Lindsey Pits fill will be graded to the contours indicated on Drawings 3 and 5 (Appendix A) Drawings 4, 6, and 8 (Appendix A) indicate the location and details of the run-off control structures

3.0 – CLOSURE PLAN

3.1 CLOSURE STRATEGY/SCHEDULE

This section describes the final cover construction, site capacity, schedule of closure implementation, estimated costs for closure, and final inspection procedures for the existing and future Phases at ICL

The Executive Secretary will be notified in writing at least 60 days prior to the anticipated last receipt of waste in accordance with R315-302-3(4)(a) Implementation of the final closure Phase will begin within 30 days after last receipt of waste Final closure of the entire landfill will be completed within 180 days of implementation of closure activities, unless an extension has been granted by the Executive Secretary

Closure will occur incrementally Each landfill Phase will be closed once it has been filled to design capacity The following table summarizes by landfill Phases the remaining landfill capacity and projected dates of service starting from January 1 of 2011

Landfill Phase	Airspace Remaining (cubic yards)	Projected Date of Completion
Armstrong Phase A	Complete	---
Armstrong Phase B	1,467,700	2024
Armstrong Phase C	1,118,000	2034
Armstrong Phase D	1,078,000	2041
Armstrong Phase E	475,000	2045
MSW TOTALS	**4,138,700 (GROSS)**	**3,104,000 (NET)**
Lindsey Phase I	Complete	---
Lindsey Phase II	828,300	2028
Lindsey Phase III	1,346,000	2048
Lindsey Phase IV	2,807,000	2072
Lindsey Phase V	2,965,000	2088
Lindsey Phase VI	726,800	2092
C&D TOTALS	**8,673,100 (GROSS)**	**6,504,825 (NET)**

The "net" volumes shown in the previous table reflect the volume available for MSW or C&D waste, assuming 25% of the gross volume will be consumed by daily and intermediate cover soils

To estimate the landfill life and project the timing of constructed projects, engineering assumptions about the extent of each Phase were made to be able to calculate volumes The length of time that each Phase will be in service will depend upon the day to day operation of the landfill and will vary from the specific dates of closure presented above It may be necessary, due to site access requirements, to partially fill future Phases to allow for final waste placement within a particular Phase

3.2 FINAL COVER DESIGN AND INSTALLATION

A preliminary design package consisting of drawings, specifications, and QA/QC plan will be prepared and submitted to the State of Utah DSHW for review and approval prior to each cover placement event A final closure certification package will be issued prior to final closure of the facility to ensure compliance with federal and state regulations effective at the time of closure The conceptual final cover design described herein is in accordance with current State of Utah regulations and RCRA Subtitle D criteria The final cover system is designed to control the emission of landfill gas, promote the establishment of vegetative cover, minimize infiltration and percolation of water into the waste, and minimize the erosion of the final cover soils throughout the post-closure care period and beyond Drawings 3 and 5 (Appendix A) show the final topography for the landfill

As discussed previously, the final covers will consist of a minimum of 18" of 1x10-5 soils and an additional six-inch layer of topsoil Cover slopes will not be steeper than a 4 1 maximum slope for the Lindsey Pit and 3 1 maximum slope for the Armstrong Pit Minimum slopes shall be no flatter than 20 1 (5%)

3.3 SEED, FERTILIZER AND MULCH

The 6-inch vegetative layer of the cap will be seeded with a mixture of grasses suitable for fast growth in the region, then fertilized and mulched

TRM's (turf reinforcement mats) will typically be placed in areas of concentrated runoff and/or drainage channels as necessary

Early establishment of vegetation on the landfill's final slope surface will impede soil erosion and promote evapotranspiration ICL will periodically evaluate vegetative growth, vigor, and color so that the integrity of the final cover system is maintained If stress signs on vegetation caused by landfill gas and leachate seeps are noted, the problem will be corrected Corrective procedures will be conducted based on current design recommendations and will be built consistent with construction specifications ICL staff or a licensed landscape contractor will make repairs, as necessary

3.4 LANDSCAPING

The landfill facility, including all surrounding grounds, will be maintained in conjunction with any scheduled maintenance activities (i e , road improvements, etc) The landscape of the landfill will be designed to be both functional and aesthetically pleasing

3.5 FINAL COVER CONTOURS

The landfill's final grades will be inspected and maintained in order to ensure its integrity and conformity with the conceptual final cover plans The final surface of the Lindsey Pit (Drawing 4) has been designed with a 4H 1V slope The final cap grading shown for the Armstrong Pit on Drawing 6 also has a maximum slope of 4H 1V and a minimum slope of 5%

Any areas where water has collected (ponded) will be regraded Erosion damage resulting from extremely heavy rainfall will be repaired ICL staff will inspect the final grading no less than quarterly

3.6 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

For construction of the final landfill cover, drawings, specifications and QA/QC procedures will be developed by a Utah licensed Professional Engineer and submitted to the State of Utah DSHW for review and approval prior to construction of each closure Phase

3.7 CLOSURE COST ESTIMATES

The current cost estimates for the closure of the ICL operation is provided in Appendix I – Closure/Post Closure Costs

3.8 CERTIFICATION OF CLOSURE AND RECORD KEEPING

A Utah licensed Professional Engineer will be retained to supervise closure of each of the development Phases The registered engineer will be employed by ICL, or will be an ICL-hired consultant and will certify the landfill was closed according to the closure plan Any amendment or deviation to the closure plan will be approved by the Executive Secretary and any associated permit modifications will be made Final closure work and documentation will be observed and reviewed by DSHW personnel as necessary

As part of the certification process, the engineer shall also provide closure as-built drawings to the Executive Secretary within 90 days following completion of closure activities

Additionally, the final plats and the amount and location of waste will be recorded on the site title The owner will file the notarized plat with the County Recorder within 60 days following certification of closure

4.0 – POST-CLOSURE CARE PLAN

4.1 MONITORING PROGRAM

Post closure activities will begin when closure is approved by the Executive Secretary The following presents the post-closure plan for the ICL facility The following subsections offer a description of the monitoring program, which includes groundwater monitoring, leachate and gas collection systems

4 1 1 Groundwater Armstrong and Lindsey Pits

Groundwater is currently monitored in the Armstrong Pit as detailed in the approved Groundwater and Leachate Monitoring Plan (Appendix E) ICL will continue a groundwater monitoring program as required for the 30-year post-closure care period

No groundwater monitoring is required or performed at the Lindsey Pit

4 1 2 Surface Water

Although no surface water sampling activities are scheduled for the landfill, ICL staff will inspect the drainage system no less than quarterly Temporary repairs to any observed damage will be made until permanent repairs can be scheduled ICL or a licensed general contractor will replace drainage facilities, if necessary

4 1 3 Leachate Collection and Treatment

4 1 3 1 Armstrong Pit

A leachate collection system was neither required nor installed during utilization of the unlined landfill

4 1 3 2 Lindsey Pit

A leachate collection system was neither required nor installed during utilization of the unlined landfill

4 1 4 Landfill Gas

Landfill gas monitoring wells have not been installed at the ICL site Landfill gas is monitored at operator level around the site perimeter to monitor explosive landfill gas emissions from both the Armstrong and Lindsey Pits The perimeter of each Pit, as well as all structures at the site, will be monitored quarterly to ensure compliance with State regulations regarding explosive landfill gas

During post-closure, ICL landfill personnel or a contracted company will be responsible for the gas observations at the facility perimeter and facility structures Monitoring will occur no less often than quarterly and will be conducted more often if the need arises In the event that a sample exceeds the regulatory level, ICL personnel will notify the DSHW immediately and undertake appropriate corrective actions

As outlined in R315-303-3(5), ICL will take all the necessary steps to protect human health and will immediately notify UDEQ of explosive gas levels detected above allowable levels and actions to be taken Also, within 7 days of incident, ICL will place in the operating record documentation of the explosive gas levels detected and a description of the interim steps taken to protect human health Within 60 days of detection, ICL personnel will implement a remediation plan for the explosive gas releases, place a copy of the plan in the operating record, and notify UDEQ that the plan has been implemented The remediation plan will describe the nature and extent of the problem and the proposed remedy

4.2 MAINTENANCE PROGRAM

The following subsections offer a description of the maintenance of installed equipment, including groundwater monitoring systems and leachate and gas collection systems

4 2 1 Monitoring Systems

4 2 1 1 Groundwater

All current and future groundwater monitoring wells will be inspected for signs of failure or deterioration during each sampling event If damage is discovered, the nature and extent of the problem will be recorded A decision will be made to replace or repair the well Possible repairs include redevelopment, chemical treatment, partial casing replacement or repair, sealing the annulus, or pumping and testing If a well needs to be replaced, it will be properly abandoned Damaged wells will be scheduled for repair or replacement

4 2 1 2 Surface Water

Draınage control problems can result ın accelerated erosıon of a partıcular area wıthın the landfill Dıfferentıal settlement of draınage control structures can lımıt theır usefulness and may result ın a faılure to properly dırect storm water off-sıte

Implementatıon of a post-closure maıntenance program wıll maıntaın the ıntegrıty of the final draınage system throughout the post-closure maıntenance perıod The final surface water draınage system wıll be evaluated and ınspected, no less than quarterly, for ponded water and blockage of, or damage to, draınage structures and swales Where erosıon problems are noted or draınage control structures need repaır, proper maıntenance procedures wıll be ımplemented as soon as sıte condıtıons permıt so that further damage ıs prevented Damaged draınage pıpes and broken dıtch lınıngs wıll be removed and replaced

ICL staff wıll ınspect the draınage system no less than quarterly Temporary repaırs wıll be made untıl permanent repaırs can be scheduled ICL or a lıcensed general contractor wıll replace draınage facılıtıes

4 2 1 3 Leachate Collectıon and Treatment

No systems are ınstalled, therefore no maıntenance ıs requıred

4 2 1 4 Landfill Gas

No systems are ınstalled, therefore no maıntenance ıs requıred

4 2 1 5 Fınal Gradıng

The landfill cover final grade wıll be ınspected no less than quarterly and maıntaıned ın order to preserve ıts ıntegrıty Evaluatıon and ınspectıon of the cover final grades wıll ınclude evaluatıons of vegetatıon and overall system perfonnance At the completıon of closure actıvıtıes, the surface of the cover wıll be surveyed to provıde a reference poınt for monıtorıng settlement

Areas where water has collected (ponded) wıll be regraded Erosıon damage resultıng from extremely heavy raınfall wıll be repaıred

4 2 2 Cover and Run-On/Run-Off Systems

The final cover system will incorporate features to manage storm water, minimize erosion, and provide for efficient removal of storm water The constructed cap will convey collected water via earthen dikes, swales, and drainage channels away from the landfill cover

Placement of all permanent drainage facilities will be completed during, or immediately following, installation of the final soil cover

4 3 SCHEDULE OF POST-CLOSURE ACTIVITIES

Post-closure activities, consisting of monitoring and maintaining the final cover and permanent drainage facilities, will be implemented periodically as areas of the landfill are filled to final grade

4 4 POST CLOSURE COST ESTIMATES

Updated cost estimates for post-closure care for the ICL facilities are presented in Appendix I – Closure/Post Closure Costs

4 5 CHANGES TO RECORD OF TITLE, LAND USE, AND ZONING

ICL will notify the Iron County Recorder's Office at any such time when there is a change to the Record of Title, land use plan, or zoning restrictions In addition, ICL will notify the Recorder at that time when the post-closure care period has expired

4 6 POST CLOSURE FACILITY CONTACTS

For all post-closure care information, all contact will be through the Iron County Commission or a designee Contact with Iron County officials will be at the following number

Iron County Courthouse	(435) 477-8300

4 7 POST CLOSURE LAND USE

Iron County will select an end use that will be limited to those that do not threaten the integrity of the existing control systems All activities will be approved by the appropriate cities/agencies prior to implementation Typical end uses range from recycling operations (which complement existing operations) to recreational activities Since the closure of the first landfill site may be nearly 40 years away, it is not currently possible to develop those land use plans to be consistent with surrounding land uses and the needs of the area that may be relevant at that future time

5.0 – FINANCIAL ASSURANCE

5.1 Closure Costs

Cost estimates have been developed for the closure Phases at ICL Appendix I – Closure/Post-Closure Costs contains the most recent closure cost data for the ICL Closure costs are updated each year and submitted with the Annual Report

5.2 Post-Closure Care Costs

Cost estimates have been developed for the post-closure care period at ICL Appendix I – Closure/Post-Closure Costs contains the most recent post-closure cost data for the ICL Post-Closure costs are updated each year and submitted with the Annual Report

5.3 Financial Assurance Mechanism

ICL maintains a closure account with the State Bank of Southern Utah The Iron County Landfill Final Closure Account has approximately $2,000,000 to date Iron County will continue to utilize the local governmental financial test to satisfy the financial assurance requirements Iron County will continue to accrue funds at the State Bank of Southern Utah that may be utilized as an environmental contingency fund but is not intended to function as the facility financial assurance fund

6.0 – REFERENCES

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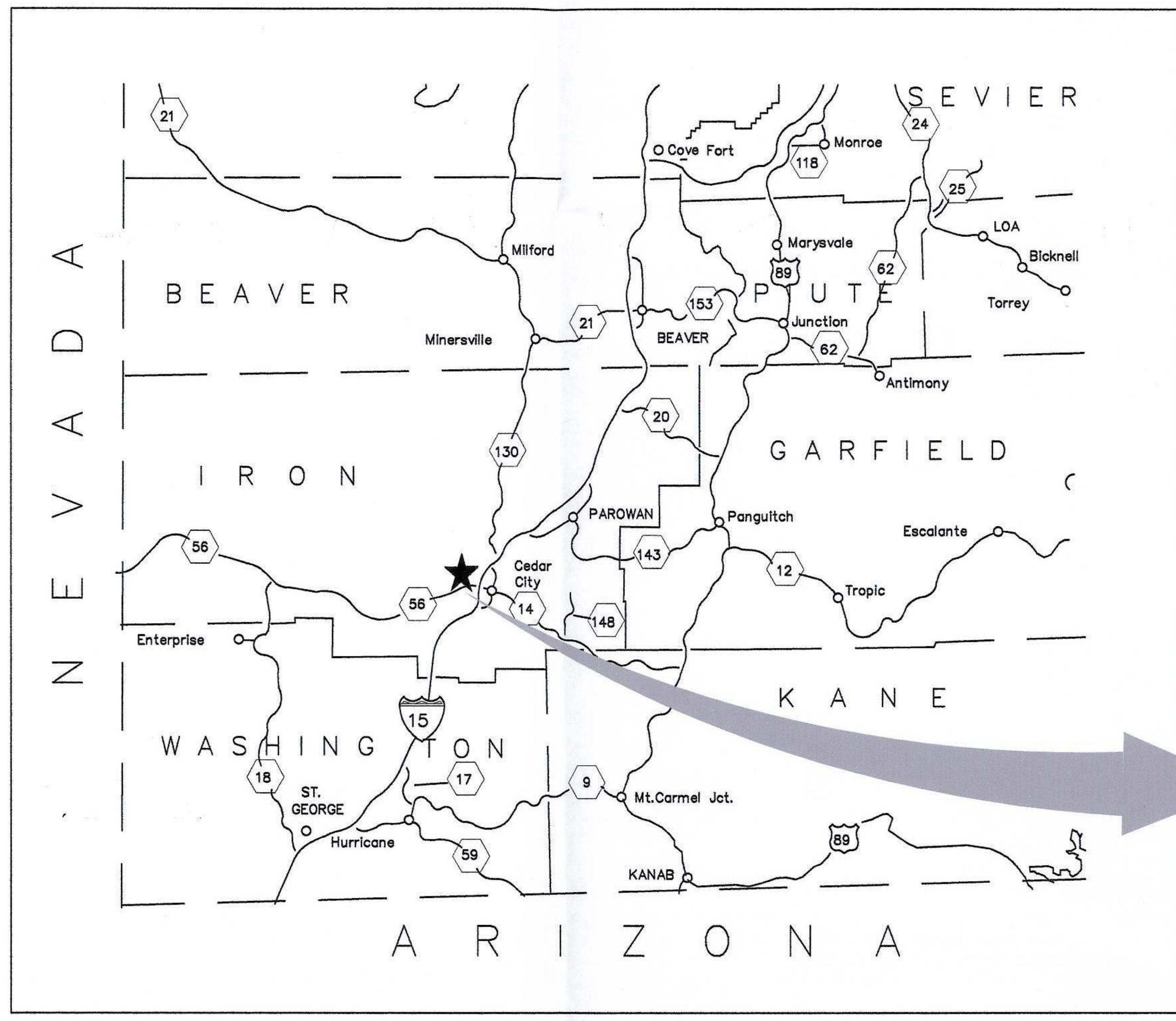
APPENDIX A

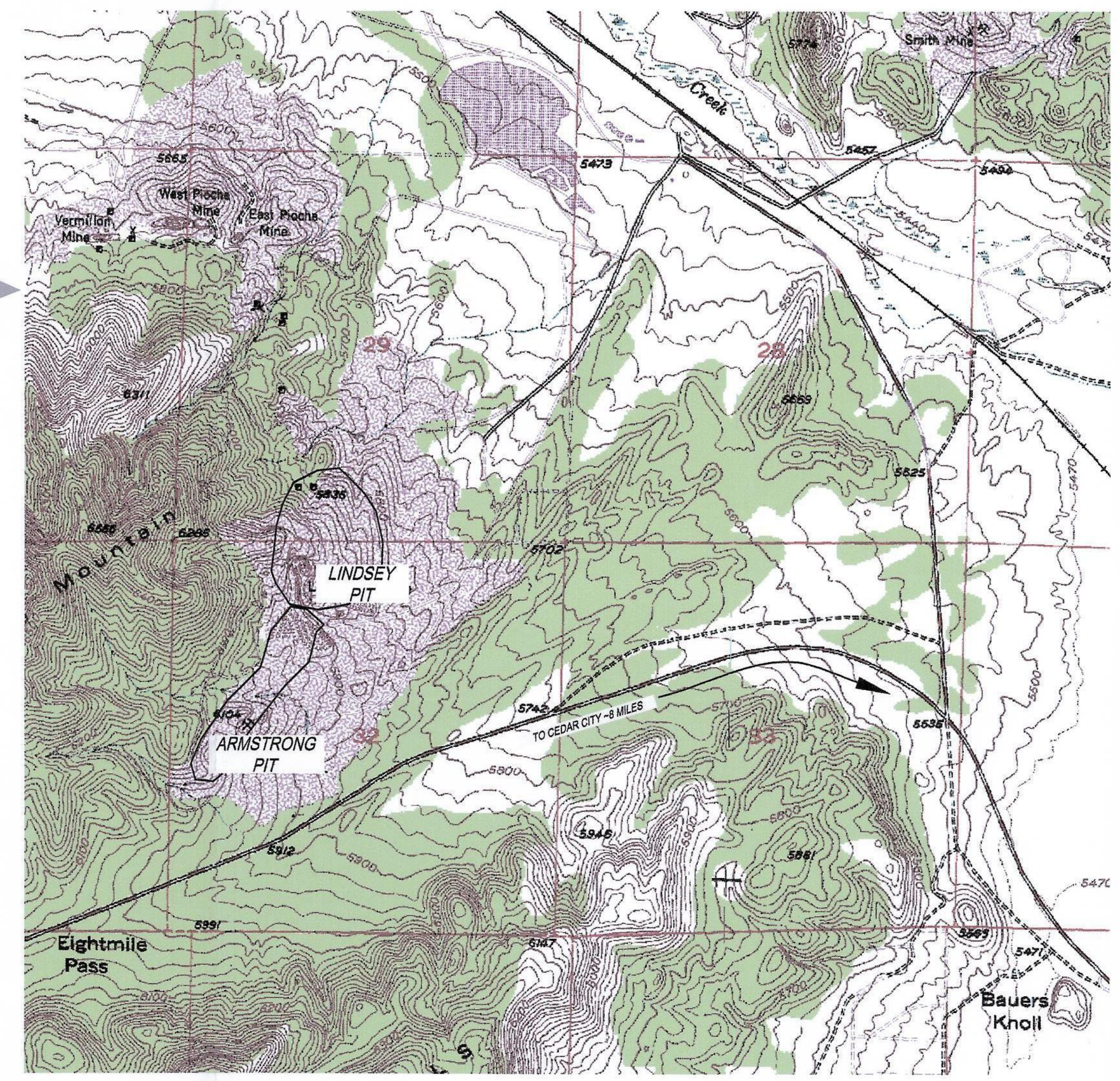
Drawings

IRON COUNTY LANDFILL

2011PERMIT RENEWAL

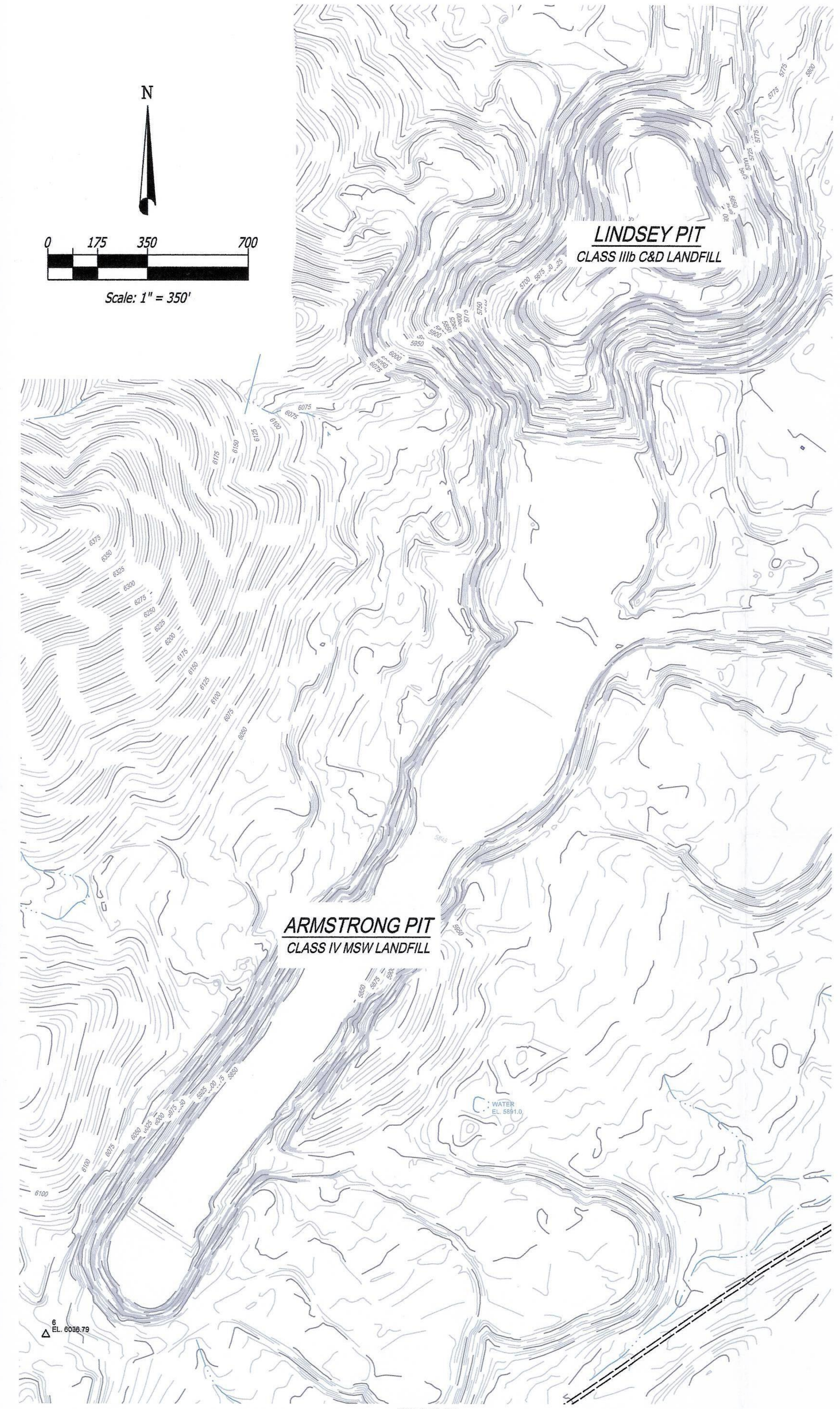


SITE LOCATION MAP



SITE VICINITY MAP

REFERENCE: USGS 7.5 MINUTE QUADRANGLE (CEDAR CITY NW)



SITE PLAN

REFERENCE: TOPOGRAPHIC MAP BY ROSENBERG AND ASSOCIATES PROVIDED BY CLIENT

SHEET	NAME
1	TITLE SHEET
2	GENERAL ARRANGEMENT
3	LINDSEY C&D PLAN VIEW
4	LINDSEY C&D FINAL GRADING
5	LINDSEY C&D PROFILE
6	ARMSTRONG MSW PLAN VIEW
7	ARMSTRONG MSW PROFILE
8	DETAILS

REFERENCE:
ADAPTED FROM MAP
PROVIDED BY CLIENT.
BY ROSENBERG ASSOCIATES

IRON COUNTY
SOLID WASTE

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Cedar City, Utah 84721
(435) 865-7015

CONSULTANTS

IGES®
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182 South 600 East, Suite 206
Salt Lake City, Utah 84102
(801)521-1800 Fax: (801)521-2800

MARK	DATE	DESCRIPTION
	05/09/11	PERMIT
-	04/25/11	DRAFT

ISSUE:

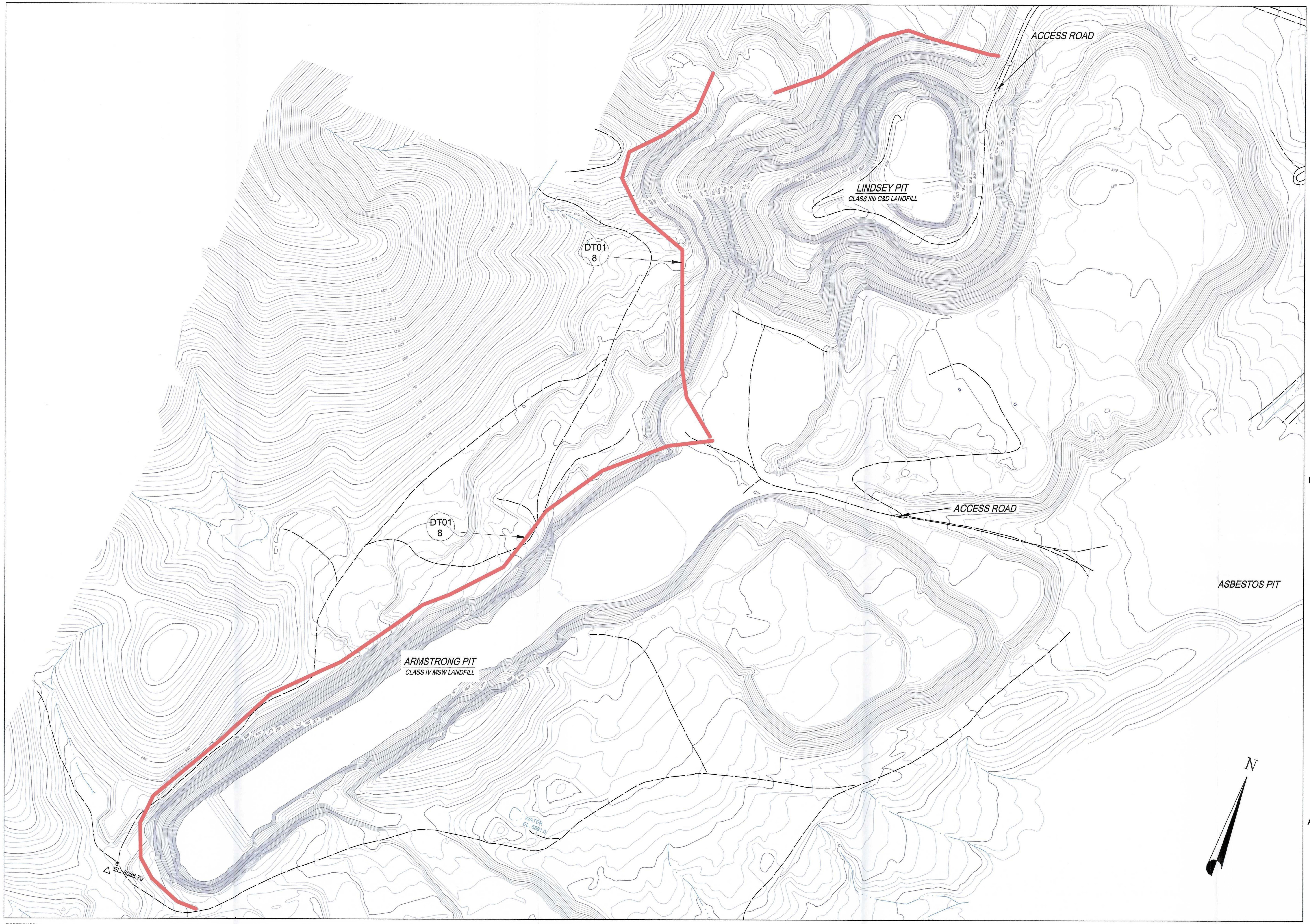
PROJECT NO.:	00454-007
CAD DWG FILE:	00454\007\lclf (2011).dwg
DRAWN BY:	JAH
DESIGNED BY:	BDM
CHECKED BY:	-
COPYRIGHT:	IGES 2011

SHEET TITLE

IRON COUNTY LANDFILL

TITLE SHEET

1



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RUN-ON DIVERSION BERM
SEE DT-01, SH 8

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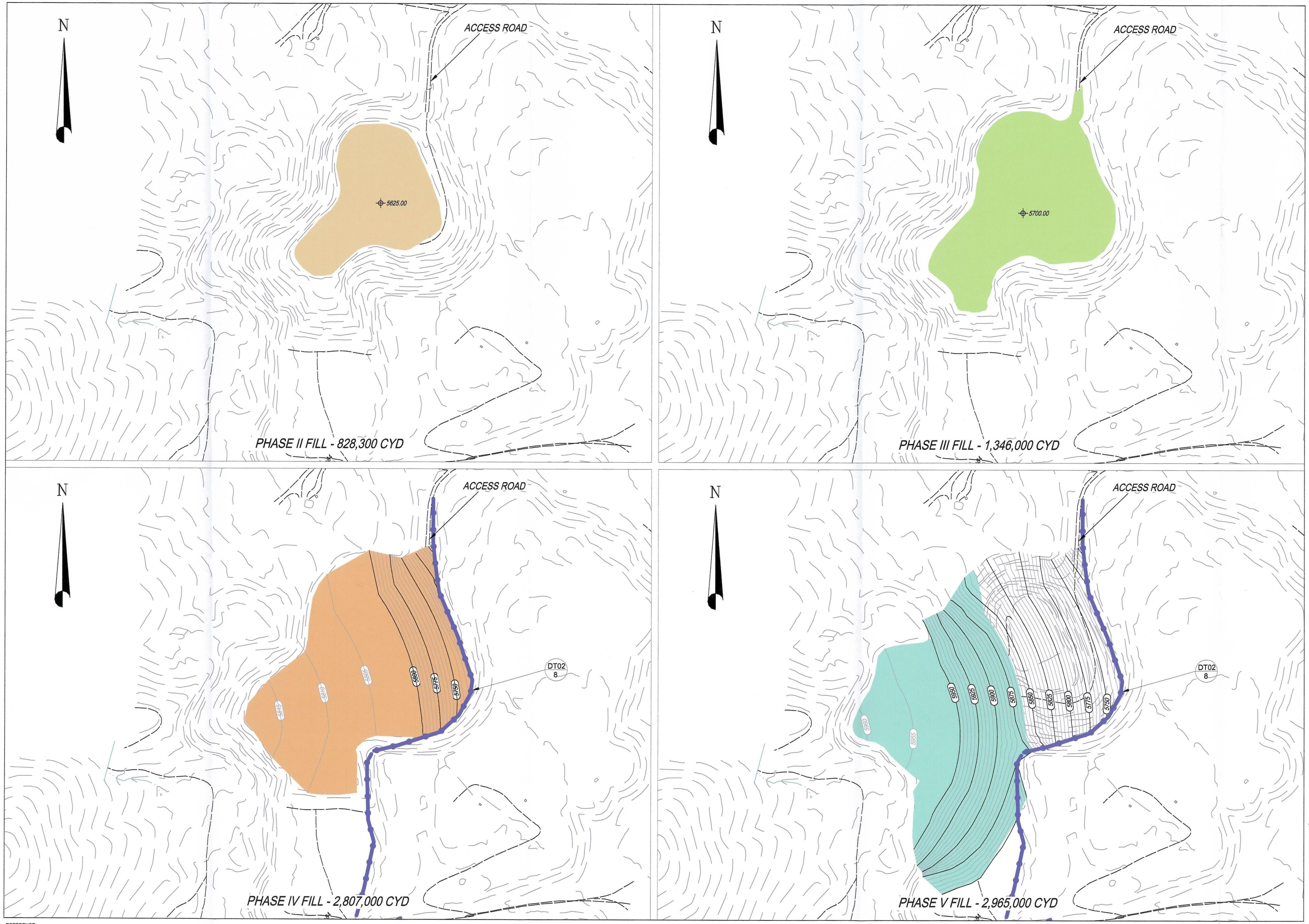
IRON COUNTY LANDFILL

GENERAL ARRANGEMENT

2



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Scale: 1" = 500'

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PHASE II FILL

PHASE III FILL

PHASE IV FILL

PHASE V FILL

RUN-OFF CONTROL CHANNEL
SEE DT-02, SH 8

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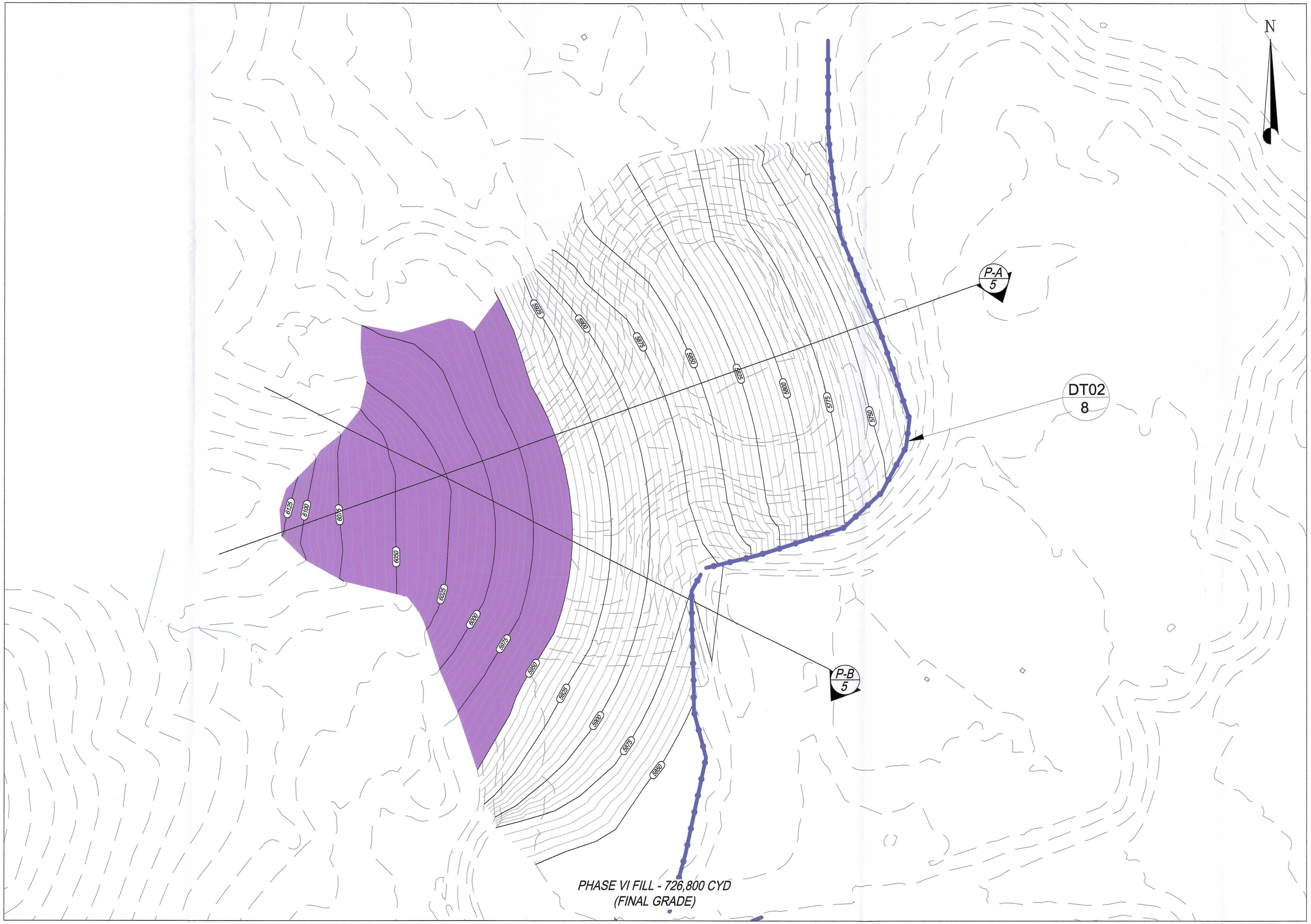
SHEET TITLE

IRON COUNTY LANDFILL

LINDSEY C&D PLAN VIEW



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Scale: 1" = 120'

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PHASE VI FILL

TOTAL REMAINING AIRSPACE (PHASE II-VI): 8,673,100 CYD

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IRON COUNTY LANDFILL

LINDSEY C&D FINAL GRADING

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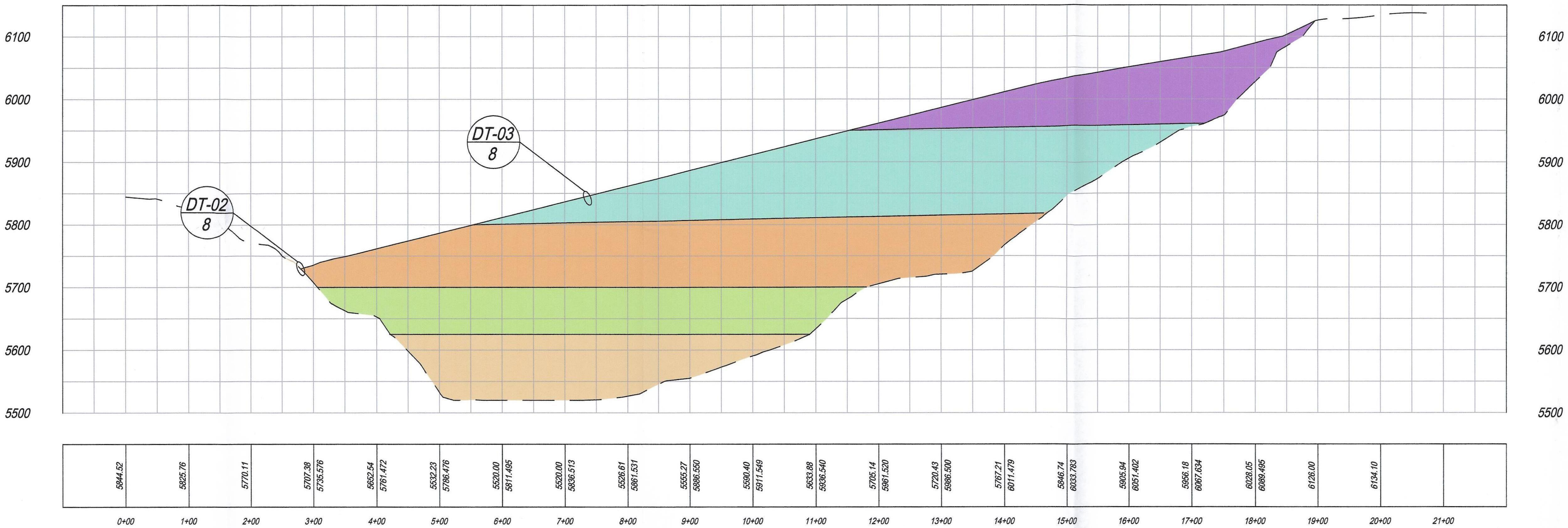

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PROFILE-A
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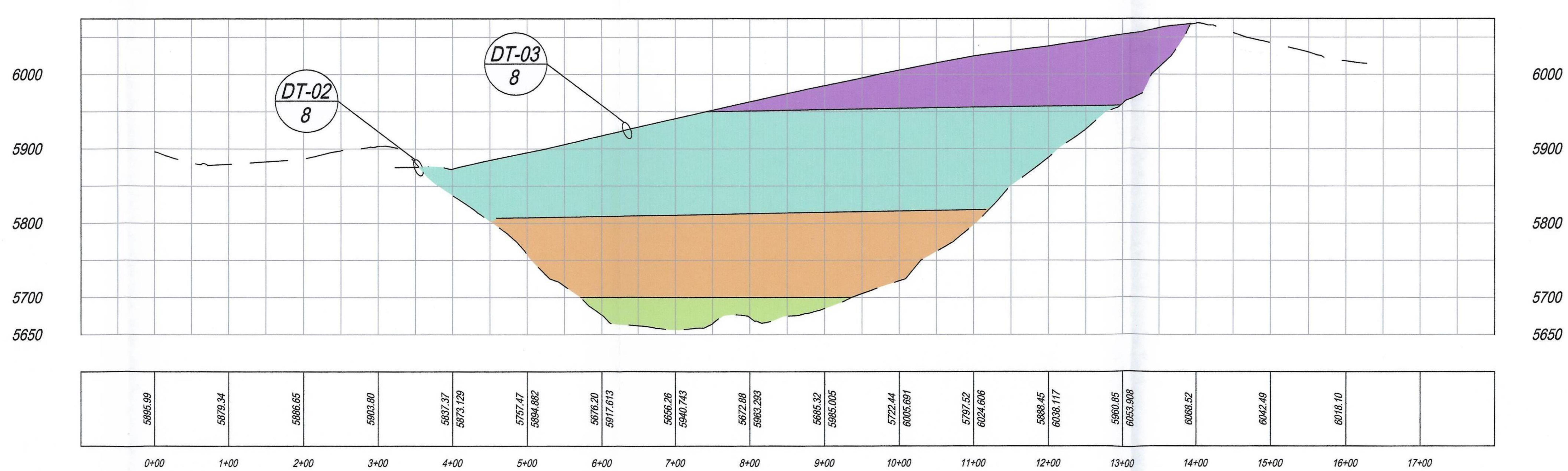

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Scale: 1" = 120'

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PHASE II FILL

PHASE III FILL

PHASE IV FILL

PHASE V FILL

PHASE VI FILL

TOTAL REMAINING AIRSPACE (PHASE II-VI): 8,673,100 CYD

MARK	DATE	DESCRIPTION
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IRON COUNTY LANDFILL

LINDSEY C&D PROFILE

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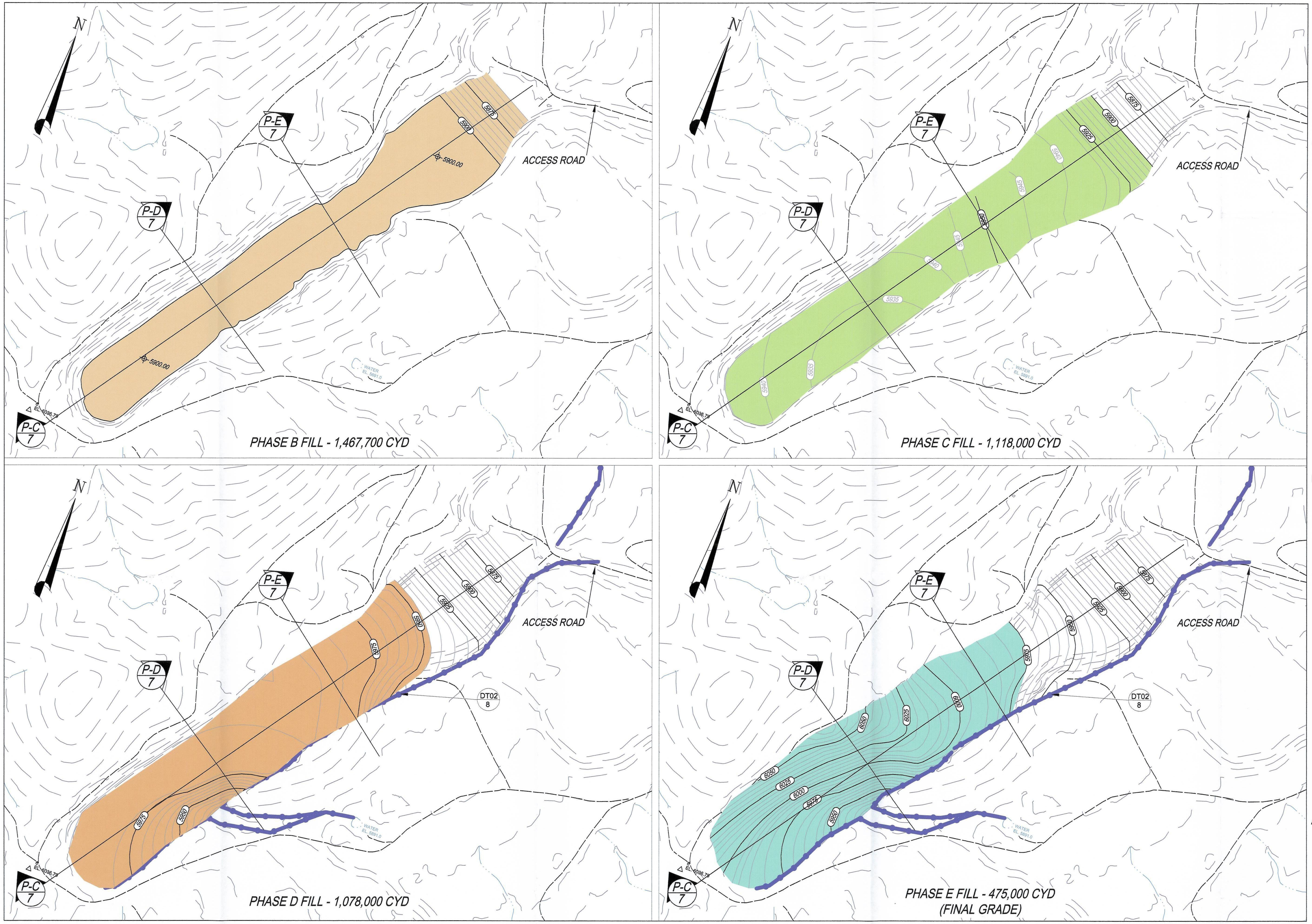

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PHASE B FILL

PHASE C FILL

PHASE D FILL

PHASE E FILL

TOTAL REMAINING AIRSPACE (PHASE B-F): 4,138,700 CYD

RUN-OFF CONTROL CHANNEL SEE DT-02, SH 8

MARK	DATE	DESCRIPTION
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-	04/25/11	DRAFT

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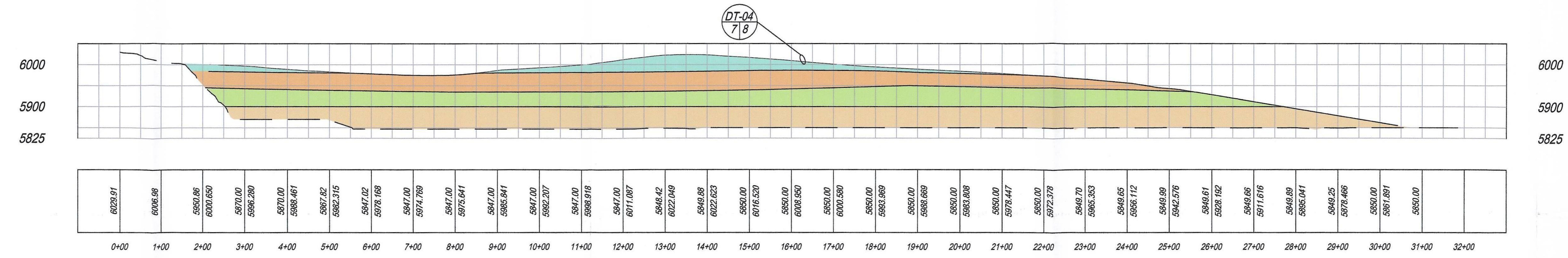
IRON COUNTY LANDFILL

ARMSTRONG MSW PLAN VIEW

6



P-C
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PROFILE-C
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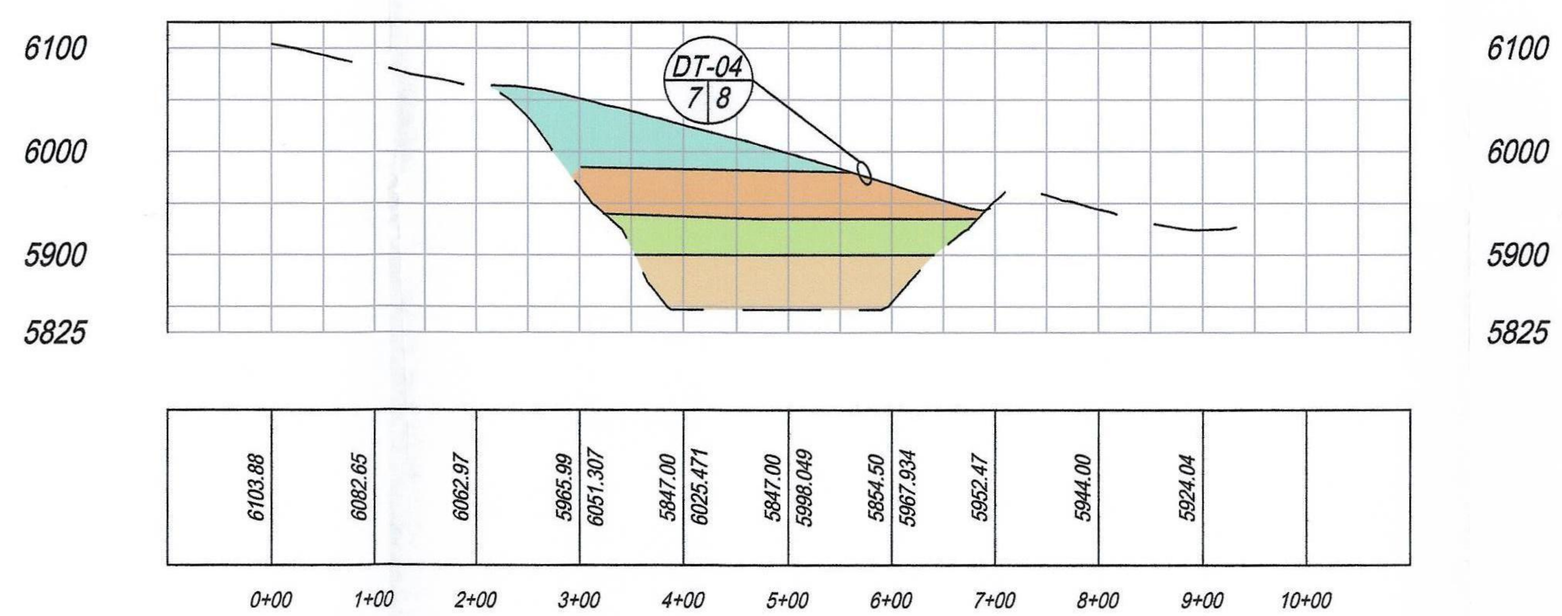

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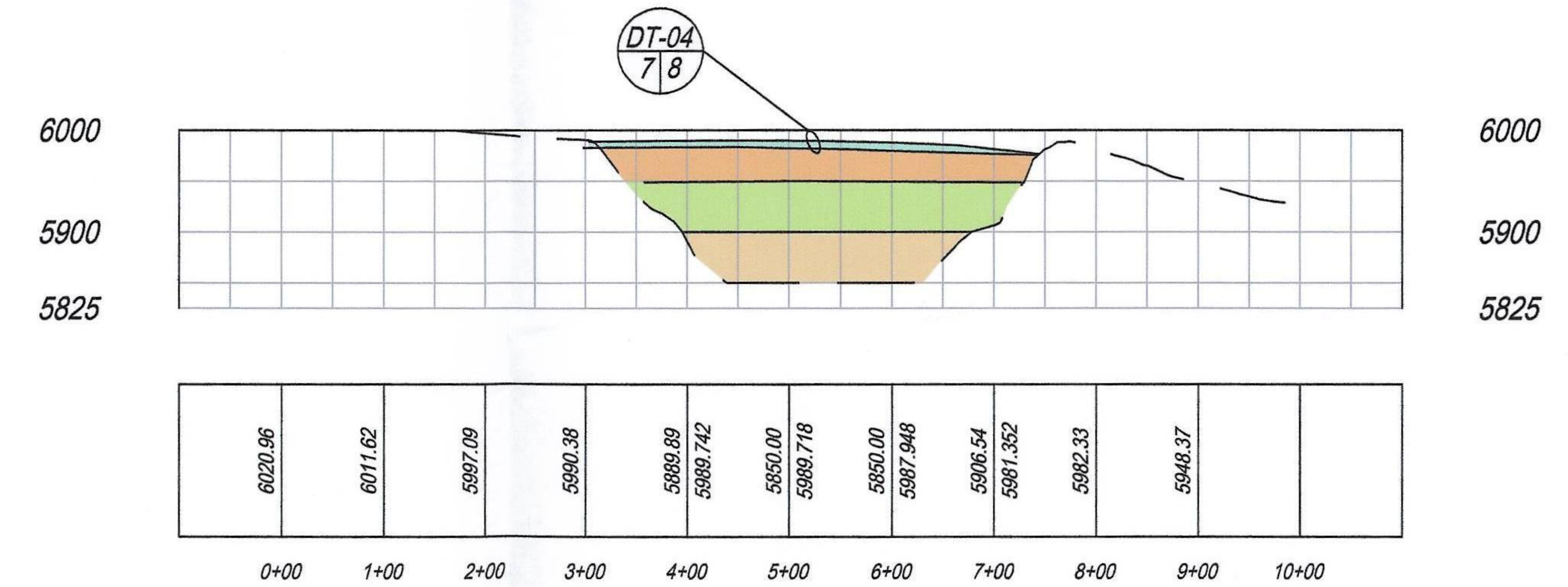

P-E
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- PHASE B FILL
- PHASE C FILL
- PHASE D FILL
- PHASE E FILL

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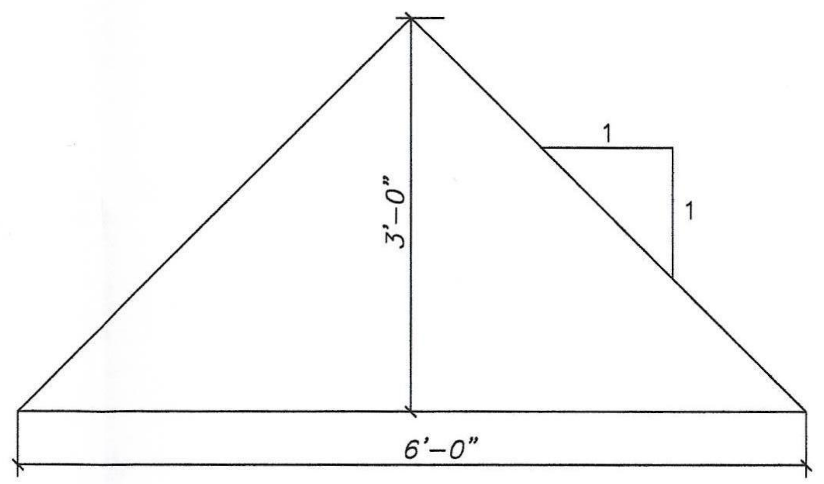
IRON COUNTY LANDFILL

ARMSTRONG MSW PROFILE

7



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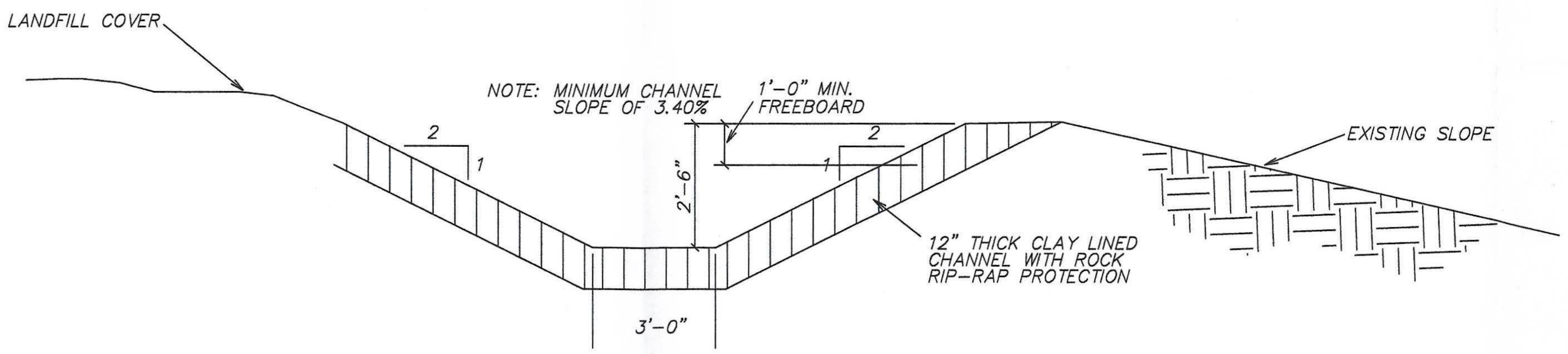
NTS



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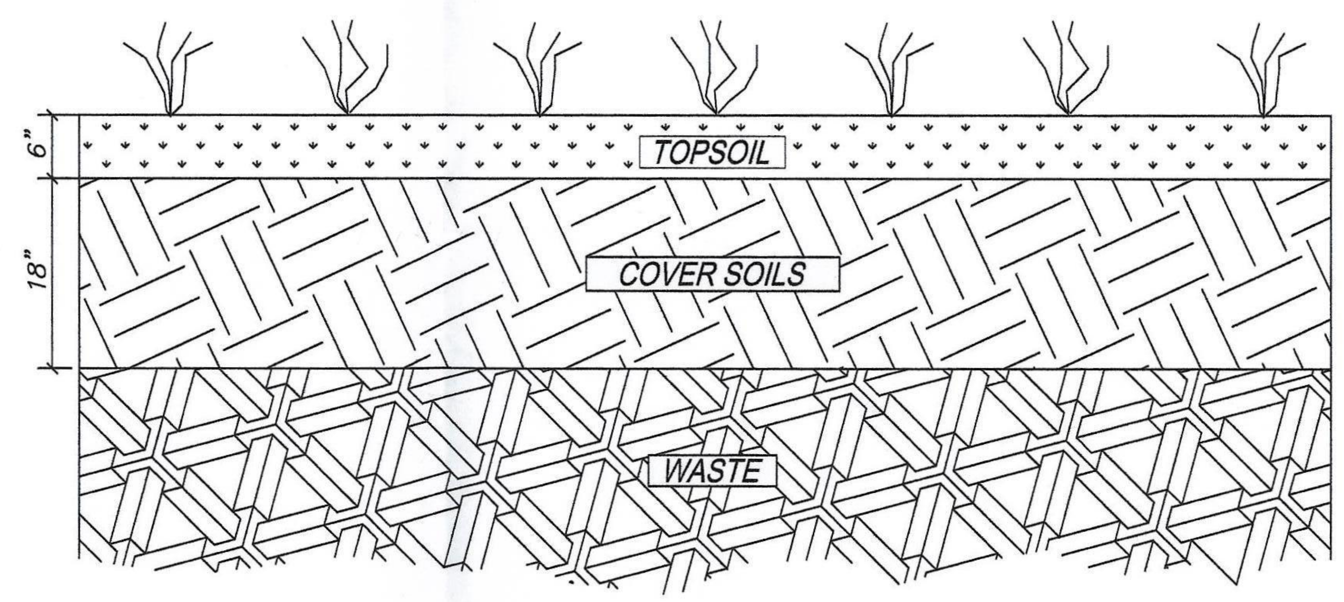

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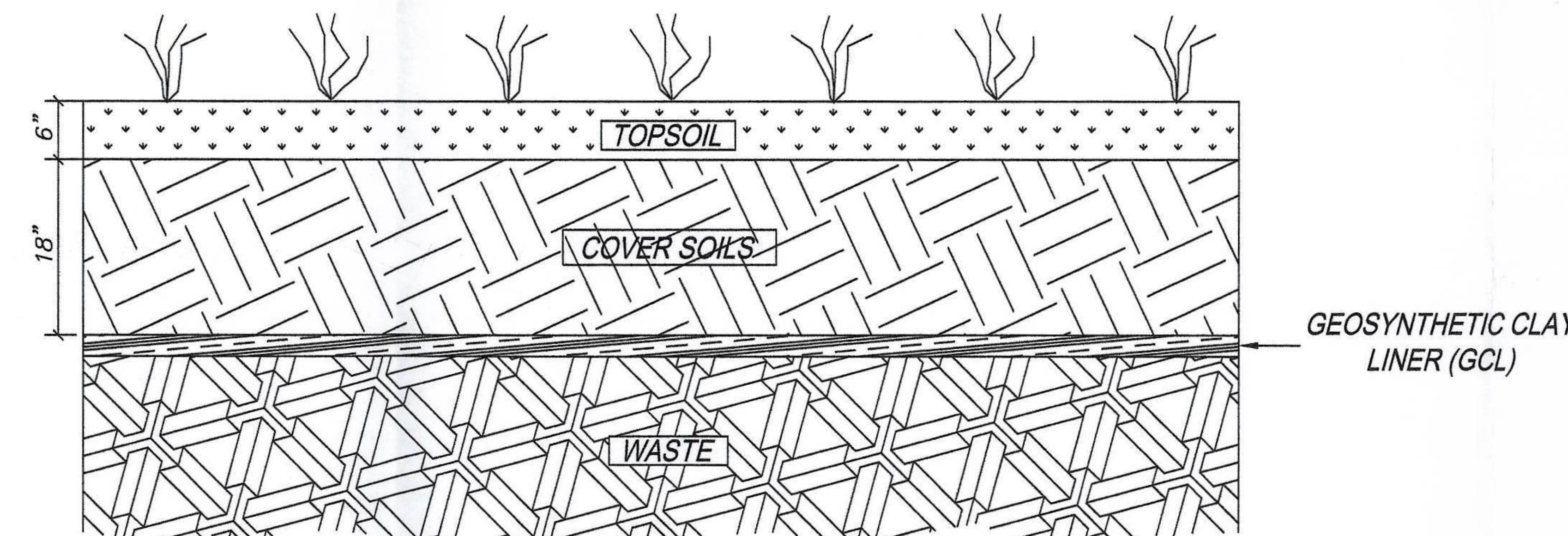

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SHEET TITLE

IRON COUNTY LANDFILL

DETAILS

8

APPENDIX B

Legal Description & Proof of Ownership

COPY

0299521 BK 0416 PG 0561 - 6

DIXIE B MATHESON - IRON COUNTY RECOR
1990 JUN 14 14:34 PM FEE $.00 BY
REQUEST. IRON COUNTY

QUITCLAIM DEED

USX CORPORATION (successor to United States Steel Corporation), a Delaware corporation ("USX") with an office at 600 Grant Street, Pittsburgh, Pennsylvania 15219-4776, hereby quitclaims to IRON COUNTY, UTAH, a body corporate and politic existing pursuant to the laws of the State of Utah ("County"), the following described patented lode mining claims, situate in the Iron Springs Mining District, in Iron County, State of Utah, to wit

LINDSAY LODE MINING CLAIM	U S. LOT NO. 53
WANDERER LODE MINING CLAIM	U S LOT NO 54
LITTLE ALLIE LODE MINING CLAIM	U S LOT NO 48
CORA #1 LODE MINING CLAIM	U S LOT NO 4797
BELGUIM LODE MINING CLAIM	U S. LOT NO 6725

Together with all and singular the mines, minerals, lodes and veins within the lines of said claims, and their dips and spurs and all dumps

County, for itself and its successors and assigns, by its acceptance of this Deed, accepts said mining claims in their current condition "as is" and does hereby assume and agree to perform all of the obligations and satisfy all of the liabilities of USX with respect to the said mining claims, whether existing under contract or other agreement or under federal, state or local law or regulations and, with respect to such laws or regulations, whether now existing or hereafter arising, including, but not limited to, any reclaimation, reforesting, restoration of natural grade, removing or otherwise dealing with hazardous materials of whatever sort, COPY

and waives any right of action which it may now or hereafter have to recover against USX any costs in connection with any of the foregoing, including, but not limited to, any right under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended

USX hereby represents and warrants to County that USX has no knowledge of (i) any existing obligation to reclaim, reforest or restore the above-described mining claims, whether pursuant to contract or agreement or federal state or local law, including, but not limited to, the Surface Mining Control and Reclamation Act, and (ii) the presence on said mining claims of any hazardous material The foregoing representation and warranty shall be for the benefit of County only and shall not inure to the benefit of the successors or assigns of County

IN WITNESS WHEREOF, USX Corporation has executed these presents this 17th day of November, 1989

USX CORPORATION

ATTEST.

[signature]
Assistant Secretary

BY [signature]
General Manager-Administration
& Group Comptroller

COMMONWEALTH OF PENNSYLVANIA)
) ss
COUNTY OF ALLEGHENY)

THIS IS TO CERTIFY that on the 17th day of November, 1989, before me, the undersigned, a Notary Public in and for

0299521 Bk 0416 Pg 0542

the Commonwealth of Pennsylvania duly commissioned and sworn, personally appeared C J Navetta & R M Stanton, as General Manager-Admin & Group Comptroller and Assistant Sect'y of USX Corporation, with authority to sign on its behalf, to me known and known to me to be the individual mentioned in and who executed the within and foregoing, and he acknowledged to me that he signed and sealed the same as the free and voluntary act and deed of said company, for the uses and purposes therein specified

WITNESS my hand and notarial seal hereto affixed the day and year first hereinabove written

Lois A Witt

Notary Public in and for
the Commonwealth of Pennsylvania
My Commission Expires on

NOTARIAL SEAL
LOIS A WITT, Notary Public
Pittsburgh Allegheny County, PA
My Commission Expires October 18,1990

APPENDIX C

Landfill Forms

Iron County Landfill

Monthly Inspection Form

(Please Check the Appropriate Column and record the needed repairs below)

Performed By:____________________ **Date:**____________________

1. Structures and Roads	**Condition** Satisfactory	Unsatisfactory
Buildings	________	________
Fences	________	________
Gates	________	________
Roads	________	________
Run-Off Control Systems	________	________

Recommended Repairs, Notes, and Comments

____

____

____

2. Operations		
Litter and Weeds	________	________
Daily Cover	________	________
Final Cover	________	________
Scrap Metal	________	________
Tree Limbs/Pallets	________	________

Recommended Repairs, Notes, and Comments

____

____

____

09-01-2009

IRON COUNTY LANDFILL
RANDOM LOAD INSPECTION RECORD
MSW LANDFILL

INSPECTION INFORMATION	
Inspector's Name	
Date of Inspection	
Time of Inspection	
Facility Name	
TRANSPORTATION COMPANY INFORMATION	
Company Name	
Address	
Phone Number	
VEHICLE INFORMATION	
Driver's Name	
Vehicle Type	
Vehicle License Number	
Vehicle Contents	☐ HOUSEHOLD ☐ COMMERCIAL ☐ OTHER ______
OBSERVATIONS AND ACTIONS TAKEN	

Photo Documentation ______ Yes ______ No

Inspector's Signature ______________________________ Date ______________

Driver's Signature ______________________________ Date ______________

Driver's Signature hereon denotes His presence during the inspection and does not admit confirm or identify liability

IRON COUNTY LANDFILL
RANDOM LOAD INSPECTION RECORD
C & D LANDFILL

INSPECTION INFORMATION	
Inspector's Name	
Date of Inspection	
Time of Inspection	
Facility Name	
TRANSPORTATION COMPANY INFORMATION	
Company Name	
Address	
Phone Number	
VEHICLE INFORMATION	
Driver's Name	
Vehicle Type	
Vehicle License Number	
Vehicle Contents	☐ HOUSEHOLD ☐ COMMERCIAL ☐ OTHER ______
OBSERVATIONS AND ACTIONS TAKEN	

Photo Documentation ______ Yes ______ No

Inspector's Signature ______________________________ Date ______________

Driver's Signature ______________________________ Date ______________

Driver's Signature hereon denotes His presence during the inspection and does not admit confirm or identity liability

APPENDIX D

Landfill Life

ARMSTRONG PIT OPERATIONAL LIFE (2 5% Annual Growth after 2021)

ACTIVE PHASE	YEAR	ESTIMATED DAILY MSW WASTE (Tons)	DAYS OF OPERATION	ESTIMATED YEARLY MSW WASTE (Tons)	ESTIMATED YEARLY MSW WASTE (Cu Yds)	CUMULATIVE MSW WASTE (Cubic Yards)	REMAINING LANDFILL CAPACITY (Cu Yds)	REMAINING LANDFILL CAPACITY (Percent)
							3 104 025	100 0%
B	2010	134	310	41 540	69 372	69 372	3 034 653	97 8%
B	2011	134	310	41 540	69 372	138 744	2 965 281	95 5%
B	2012	134	310	41 540	69 372	208 115	2 895 910	93 3%
B	2013	134	310	41 540	69 372	277 487	2 826 538	91 1%
B	2014	134	310	41 540	69 372	346 859	2 757 166	88 8%
B	2015	134	310	41 540	69 372	416 231	2 687 794	86 6%
B	2016	134	310	41 540	69 372	485 603	2 618 422	84 4%
B	2017	134	310	41 540	69 372	554 974	2 549 051	82 1%
B	2018	134	310	41 540	69 372	624 346	2 479 679	79 9%
B	2019	134	310	41 540	69 372	693 718	2 410 307	77 7%
B	2020	134	310	41 540	69 372	763 090	2 340 935	75 4%
B	2021	134	310	41 540	69 372	832 462	2 271 563	73 2%
B	2022	137	310	42 579	71 106	903 568	2 200 457	70 9%
B	2023	141	310	43 643	72 884	976 451	2 127 574	68 5%
B	2024	144	310	44 734	74 706	1 051 157	2 052 868	66 1%
C	2025	148	310	45 852	76 573	1 127 731	1 976 294	63 7%
C	2026	152	310	46 999	78 488	1 206 219	1 897 806	61 1%
C	2027	155	310	48 174	80 450	1 286 669	1 817 356	58 5%
C	2028	159	310	49 378	82 461	1 369 130	1 734 895	55 9%
C	2029	163	310	50 612	84 523	1 453 653	1 650 372	53 2%
C	2030	167	310	51 878	86 636	1 540 289	1 563 736	50 4%
C	2031	172	310	53 175	88 802	1 629 090	1 474 935	47 5%
C	2032	176	310	54 504	91 022	1 720 112	1 383 913	44 6%
C	2033	180	310	55 867	93 297	1 813 410	1 290 615	41 6%
C	2034	185	310	57 263	95 630	1 909 039	1 194 986	38 5%
D	2035	189	310	58 695	98 021	2 007 060	1 096 965	35 3%
D	2036	194	310	60 162	100 471	2 107 531	996 494	32 1%
D	2037	199	310	61 666	102 983	2 210 514	893 511	28 8%
D	2038	204	310	63 208	105 557	2 316 071	787 954	25 4%
D	2039	209	310	64 788	108 196	2 424 267	679 758	21 9%
D	2040	214	310	66 408	110 901	2 535 169	568 856	18 3%
D	2041	220	310	68 068	113 674	2 648 842	455 183	14 7%
E	2042	225	310	69 770	116 516	2 765 358	338 667	10 9%
E	2043	231	310	71 514	119 429	2 884 787	219 238	7 1%
E	2044	236	310	73 302	122 414	3 007 201	96 824	3 1%
E	2045	242	239	57 979	96 824	3 104 025	0	0 0%

Total Landfill Capacity in Tons = 1 858 698

Approximate Gross Air Space Remaining (Cubic Yards) = 4 138 700

Net Air Space based upon a 25% reduction to allow for cover soils

Approximate Net Air Space Remaining (Cubic Yards) = 3 104 025

Conversion of tons of waste to Cubic Yards of waste is based upon an estimated conversion rate of 1 200 pounds per one Cubic Yard of MSW waste

Total Remaining Landfill Capacity in Tons = 1 862 415 (1 689 554 Megagrams (MG) of waste capacity)

Waste acceptance held constant at 134 ton/day (2005 2010 average) and increased at 2 5%/year for each year after 2021

LINDSEY PIT OPERATIONAL LIFE (2 5% Annual Growth after 2021)

ACTIVE PHASE	YEAR	ESTIMATED DAILY C&D WASTE (Tons)	DAYS OF OPERATION	ESTIMATED YEARLY C&D WASTE (Tons)	ESTIMATED YEARLY C&D WASTE (Cu Yds)	CUMULATIVE C&D WASTE (Cubic Yards)	REMAINING NET AIRSPACE (Cu Yds)	REMAINING LANDFILL CAPACITY (Percent)
							6 504 825	100 0%
II	2011	41	310	12 710	31 775	31 775	6 473 050	99 5%
II	2012	41	310	12 710	31 775	63 550	6 441 275	99 0%
II	2013	41	310	12 710	31 775	95 325	6 409 500	98 5%
II	2014	41	310	12 710	31 775	127 100	6 377 725	98 0%
II	2015	41	310	12 710	31 775	158 875	6 345 950	97 6%
II	2016	41	310	12 710	31 775	190 650	6 314 175	97 1%
II	2017	41	310	12 710	31 775	222 425	6 282 400	96 6%
II	2018	41	310	12 710	31 775	254 200	6 250 625	96 1%
II	2019	41	310	12 710	31 775	285 975	6 218 850	95 6%
II	2020	41	310	12 710	31 775	317 750	6 187 075	95 1%
II	2021	41	310	12 710	31 775	349 525	6 155 300	94 6%
II	2022	42	310	13 028	32 569	382 094	6 122 731	94 1%
II	2023	43	310	13 353	33 384	415 478	6 089 347	93 6%
II	2024	44	310	13 687	34 218	449 696	6 055 129	93 1%
II	2025	45	310	14 029	35 074	484 770	6 020 055	92 5%
II	2026	46	310	14 380	35 950	520 720	5 984 105	92 0%
II	2027	48	310	14 740	36 849	557 570	5 947 255	91 4%
II	2028	49	310	15 108	37 770	595 340	5 909 485	90 8%
III	2029	50	310	15 486	38 715	634 055	5 870 770	90 3%
III	2030	51	310	15 873	39 683	673 737	5 831 088	89 6%
III	2031	52	310	16 270	40 675	714 412	5 790 413	89 0%
III	2032	54	310	16 677	41 692	756 104	5 748 721	88 4%
III	2033	55	310	17 094	42 734	798 838	5 705 987	87 7%
III	2034	57	310	17 521	43 802	842 640	5 662 185	87 0%
III	2035	58	310	17 959	44 897	887 537	5 617 288	86 4%
III	2036	59	310	18 408	46 020	933 557	5 571 268	85 6%
III	2037	61	310	18 868	47 170	980 727	5 524 098	84 9%
III	2038	62	310	19 340	48 349	1 029 076	5 475 749	84 2%
III	2039	64	310	19 823	49 558	1 078 634	5 426 191	83 4%
III	2040	66	310	20 319	50 797	1 129 431	5 375 394	82 6%
III	2041	67	310	20 827	52 067	1 181 499	5 323 326	81 8%
III	2042	69	310	21 347	53 369	1 234 867	5 269 958	81 0%
III	2043	71	310	21 881	54 703	1 289 570	5 215 255	80 2%
III	2044	72	310	22 428	56 071	1 345 641	5 159 184	79 3%
III	2045	74	310	22 989	57 472	1 403 113	5 101 712	78 4%
III	2046	76	310	23 564	58 909	1 462 022	5 042 803	77 5%
III	2047	78	310	24 153	60 382	1 522 404	4 982 421	76 6%
III	2048	80	310	24 757	61 891	1 584 295	4 920 530	75 6%
IV	2049	82	310	25 375	63 439	1 647 734	4 857 091	74 7%
IV	2050	84	310	26 010	65 025	1 712 758	4 792 067	73 7%
IV	2051	86	310	26 660	66 650	1 779 409	4 725 416	72 6%
IV	2052	88	310	27 327	68 316	1 847 725	4 657 100	71 6%
IV	2053	90	310	28 010	70 024	1 917 749	4 587 076	70 5%
IV	2054	93	310	28 710	71 775	1 989 524	4 515 301	69 4%
IV	2055	95	310	29 428	73 569	2 063 094	4 441 731	68 3%
IV	2056	97	310	30 163	75 409	2 138 502	4 366 323	67 1%
IV	2057	100	310	30 918	77 294	2 215 796	4 289 029	65 9%
IV	2058	102	310	31 690	79 226	2 295 022	4 209 803	64 7%
IV	2059	105	310	32 483	81 207	2 376 229	4 128 596	63 5%
IV	2060	107	310	33 295	83 237	2 459 466	4 045 359	62 2%
IV	2061	110	310	34 127	85 318	2 544 784	3 960 041	60 9%
IV	2062	113	310	34 980	87 451	2 632 235	3 872 590	59 5%
IV	2063	116	310	35 855	89 637	2 721 872	3 782 953	58 2%
IV	2064	119	310	36 751	91 878	2 813 750	3 691 075	56 7%
IV	2065	122	310	37 670	94 175	2 907 925	3 596 900	55 3%
IV	2066	125	310	38 612	96 529	3 004 454	3 500 371	53 8%
IV	2067	128	310	39 577	98 943	3 103 397	3 401 428	52 3%
IV	2068	131	310	40 566	101 416	3 204 813	3 300 012	50 7%
IV	2069	134	310	41 581	103 952	3 308 765	3 196 060	49 1%
IV	2070	137	310	42 620	106 550	3 415 315	3 089 510	47 5%
IV	2071	141	310	43 686	109 214	3 524 529	2 980 296	45 8%
IV	2072	144	310	44 778	111 944	3 636 474	2 868 351	44 1%
V	2073	148	310	45 897	114 743	3 751 217	2 753 608	42 3%
V	2074	152	310	47 045	117 612	3 868 829	2 635 996	40 5%
V	2075	156	310	48 221	120 552	3 989 381	2 515 444	38 7%
V	2076	159	310	49 426	123 566	4 112 946	2 391 879	36 8%
V	2077	163	310	50 662	126 655	4 239 601	2 265 224	34 8%
V	2078	168	310	51 929	129 821	4 369 422	2 135 403	32 8%
V	2079	172	310	53 227	133 067	4 502 489	2 002 336	30 8%

V	2080	176	310	54 557	136 393	4 638 883	1 865 942	28 7%
V	2081	180	310	55 921	139 803	4 778 686	1 726 139	26 5%
V	2082	185	310	57 319	143 298	4 921 984	1 582 841	24 3%
V	2083	190	310	58 752	146 881	5 068 865	1 435 960	22 1%
V	2084	194	310	60 221	150 553	5 219 418	1 285 407	19 8%
V	2085	199	310	61 727	154 317	5 373 735	1 131 090	17 4%
V	2086	204	310	63 270	158 175	5 531 910	972 915	15 0%
V	2087	209	310	64 852	162 129	5 694 039	810 786	12 5%
V	2088	214	310	66 473	166 182	5 860 221	644 604	9 9%
VI	2089	220	310	68 135	170 337	6 030 558	474 267	7 3%
VI	2090	225	310	69 838	174 595	6 205 153	299 672	4 6%
VI	2091	231	310	71 584	178 960	6 384 113	120 712	1 9%
VI	2092	237	204	48 285	120 712	6 504 825	0	0 0%

Approximate Gross Air Space (Cubic Yards) = 8 673 100
Net Air Space based upon a 25% reduction to allow for cover soils
Approximate Net Air Space (Cubic Yards) = 6 504 825
Conversion of tons of waste to Cubic Yards of waste is based upon an estimated conversion rate of 800 pounds per one Cubic Yard of C&D waste

DIVISION OF AIR QUALITY SIZE CUTOFF

2 5 million MG of MSW permitted
2 5 million cubic meters
@ 1 102 tons per MG

2 5 million MG equals | 2 76 million tons of permitted MSW capacity |

IRON COUNTY LANDFILL PERMITTED CAPACITY

	1 43 million cubic yards in-place (MSW and soil)	
plus	4 14 million cubic yards of remaining capacity (MSW and soil)	
	5 57 million cubic yards (total airspace)	
less	0 105 million cubic yards (cover soils)	
equals	5 46 million cubic yards (net airspace)	
less	25% for daily and intermediate cover soils	4 10 million cubic yards available for MSW

4 10 million cubic yards is converted to tons by the ratio of 1200 lbs/cubic yard
or 6 tons per cubic yard
4 10 million cubic yards multiplied by 6 tons per cubic yard equals | 2 46 million tons of planned MSW capacity |

Iron County Landfill is approximately 300,000 tons below the air quality size criteria

APPENDIX E

Groundwater and Leachate Monitoring Plan

GROUNDWATER AND LEACHATE MONITORING PLAN

AT

IRON COUNTY MUNICIPAL LANDFILL
ARMSTRONG PIT
IRON COUNTY, UTAH

MAY 1999

GROUNDWATER AND LEACHATE MONITORING PLAN

AT

IRON COUNTY MUNICIPAL LANDFILL
ARMSTRONG PIT
IRON COUNTY, UTAH

Prepared for

IRON COUNTY SOLID WASTE
3127 N Iron Springs Road
Cedar City, Utah 84720

Prepared By

BINGHAM ENVIRONMENTAL, INC
5160 Wiley Post Way
Salt Lake City, Utah 84116

May 5, 1999

GROUNDWATER AND LEACHATE MONITORING PLAN

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SECTION ONE

INTRODUCTION

1 1 GENERAL

The Iron County Municipal Landfill (Armstrong Pit) is a Class I noncommercial municipal solid waste (MSW) landfill owned and operated by Iron County It is a solid waste disposal facility for both communities and unincorporated areas of Iron County The landfill is located west of Cedar City in Township 35 South, Range 12 West, Section 32 in an abandoned open pit iron mine on the east slope of Granite Mountain near Iron Springs The Armstrong Pit began accepting solid waste in September of 1994 and has a design capacity of 4 2 million cubic yards

This Groundwater and Leachate Monitoring Plan provides specific details on procedures and methods that will be used in the field and laboratory to meet project objectives for data quality of all groundwater monitoring required under R315-308-2 Specific statistical methods to be used in determining whether a significant change has occurred as compared to background will consist of the control chart approach This Plan also provides procedures for sampling the collection (pan) lysimeter located within the Landfill

1 2 HYDROGEOLOGY

The geology and hydrogeology of this site has been studied for many years by government agencies and mining companies Previous work at Granite Mountain was compiled by MacKin, Nelson, and Rowley (1976) and was fully detailed by Tahoma Resources (1990) in the last application

The geology of the Iron Spring district, which contains the landfill, is complex The area is in the transition zone between the Colorado Plateau and the Basin and Range provinces, and has been structurally active since at least early Cretaceous time This activity has created several faults which influence the aquifers in the area These faults create fault controlled aquitards separating the bedrock mountains from the alluvial aquifers For example, the Blowout Pit, on the south flank of Iron Mountain has filled with water to approximately 6,275 feet above sea level while a water well five miles north of the Blowout Pit has static level of 5,120 feet above sea level, 1,155 feet lower than the water level at Blowout Pit The water well pump tests showed no significant drawdown indicating a highly transmissive alluvial aquifer The apparent difference between the two water levels is the presence of the Eight Mile Pass Fault Zone, located between them

At the landfill site, bedrock is exposed at the surface indicating the shallowest zones of groundwater occur in fractured quartz monzonite and sedimentary rocks These bedrock aquifers have been explored by drilling The drilling indicated that at the landfill site, approximately 50 feet of iron ore is present at the surface of the pit bottom followed by a fault gouge encountered for the next 15 feet Immediately beneath the fault is a confined aquifer in quartzite and sandstone This aquifer is present through the site, however, it seems likely fault aquitards isolate sections from communicating one with another The Cory-Armstrong and Eight Mile Pass fault zones act as aquitards between the bedrock aquifer at the site and the potable water supply in Cedar City

The alluvial aquifer nearest to the site is the Iron Spring Creek water table aquifer This aquifer appears to be perched above the bedrock aquifers present at the site, and is distinctly different chemically, indicating the two aquifers are not interconnected

SECTION TWO

GROUNDWATER MONITORING NETWORK AND LEACHATE MONITORING LYSIMETER

2 1 MONITOR WELL NETWORK

The approved compliance monitor well network at the Iron County Municipal Landfill consists of three (3) monitoring wells identified as BH-2, BH-5 and BH-7 Locations of the wells are shown on Figure 1 Monitoring well completion details and survey information for the compliance monitor wells are summarized in Tables 1 and 2 respectively Details of the monitor wells are provided in Attachment 1

Table 1

MONITOR WELL COMPLETION DETAILS
Iron County Municipal Landfill

Well ID	Elevation Above Mean Sea Level (feet)			
	Screen		Pump Intake	Groundwater (Mar 1998)
	Top	Bottom		
BH-2	5,352 68	5,332 68	5,343 18	5,387 98
BH-5	5,464 03*	5,444 03*	5,449 13	5,483 03
BH-7	5,453 72*	5,433 72*	5,438 72	5,482 72

Estimated based on reported well specifications

Table 2

SUMMARY OF MONITOR WELL LOCATIONS AND ELEVATIONS
Iron County Municipal Landfill

Well ID	Northing (feet)	Easting (feet)	Elevation Ground Surface (feet)
BH-2	12,072 6	9,636 6	5,652 18
BH-5	10,703 4	8,707 9	5,857 03
BH-7	8,665 1	8,186 0	5,923 72

2 2 COLLECTION LYSIMETER

A collection (pan) lysimeter was installed at the base of the Landfill, at the location shown in Figure 1, prior to waste placement Details of the pan lysimeter are provided in Attachment 1 The lysimeter stand pipe will continue to be extended vertically as MSW is placed in the Landfill to provide access for monitoring throughout the life of the Landfill

The lysimeter will be monitored to determine leachate generation rates, leachate quality, and potential for impact to groundwater and is not considered a point of compliance in the groundwater monitoring network

SECTION THREE

GROUNDWATER SAMPLING PROCEDURES

The following subsections detail specific sampling techniques and methodology to be used during all groundwater monitoring to provide consistent quality groundwater data Sampling personnel must have a copy of the approved Groundwater and Leachate Monitoring Plan in the field during each groundwater sampling event Groundwater monitoring network wells are required to be sampled semi-annually according to R315-308-2(4)(b) after background levels are established The pan lysimeter will also be sampled during the semi-annual groundwater sampling events as described in Section Four of this Plan

3 1 GENERAL

The sampling procedures consist of obtaining groundwater samples from the compliance monitor wells, identified in Section 2 1, utilizing a dedicated bladder pump system and micro-purging techniques Coordination for conducting the sampling events will be established prior to sampling Sampling equipment will be prepared and properly calibrated prior to sampling each monitor well All information obtained in the field shall be recorded on a Groundwater Monitoring Data Sheet, similar to the one presented in Attachment 2

Upon arrival at a well, the condition of each of the monitor wells will be observed and noted on the field data sheet, i e , that the wells are secured with a lock, that the apron is intact, and the outer casing is in good repair Any required repairs will be noted on the field sampling sheets

The monitor wells shall be sampled using currently accepted and approved technology or approved equivalent techniques Groundwater sampling will be performed by competent personnel who are familiar with proper sampling techniques and health and safety procedures Groundwater samplers should also be knowledgeable in techniques of well purging, sample collection and preservation, decontamination, and quality assurance/quality control (QA/QC) The sampler will wear a new pair of latex gloves at each well for handling sampling equipment and containers

3 2 WATER LEVEL MEASUREMENTS

A special cap is installed on the protective casing of each well for installation of the dedicated bladder pump Water levels will be taken through the access hole in the cap and the depth to groundwater measured from the top of the cap An air line may be installed alongside the dedicated bladder pump to obtain depth to groundwater measurements The elevations of the caps will be determined by a registered engineer or licensed surveyor and reported to the nearest 0 01 foot Prior to and sampling, water level readings must be obtained using a conductivity-based water level indicator or equivalent instrument capable of obtaining measurements to the nearest

0 01 feet The probe will be decontaminated between use at each well by washing with a non-phosphate detergent and rinsing three times with deionized or distilled water The probe will then be lowered into the well casing until the level indicator alarm sounds or light goes on The depth to water is read from the top of the cap to the nearest 0 01 foot This measurement will be repeated until two consecutive readings agree to the nearest 0 01 foot The depth to groundwater will be recorded immediately on the Groundwater Monitoring Data Sheet to the nearest 0 01 feet Water levels should be measured every 5 minutes or every 5 pump cycles during purging to monitor for excessive drawdown The pumping rate should be decreased if the water level drops more than 0 2 feet below the initial water level measurement The water level should also be taken post sampling just prior to turning off the pump to determine if pumping has created excessive drawdown and adjustment of pumping rates are necessary

3 3 WELL MICROPURGING

Prior to sampling, the wells will be purged, using micro-purging techniques, to ensure the groundwater sample is representative of formation water The pump controller will be attached to the pump air supply line The oil-less compressor, if used, should be located downwind and away from the well, to minimize the potential for sample contamination from exhaust gases Compressed gas may be used and the air supply line attached to the pump controller The pump should be started and adjusted to a discharge rate at or below 0 5 liters per minute The groundwater which is being discharged from the well should be monitored for specific conductance dissolved oxygen, temperature, and pH All four parameters will be recorded on the field data sheets at 3 minute intervals The groundwater sample will be collected after all four parameters have stabilized (three consecutive measurements within 10%), indicating adequate purging At a minimum, the amount of water that can be contained by the tubing from the pump to the ground surface will be purged from the well to ensure sample quality

Purge water will be disposed of on the ground surface no closer than 20 feet from any well If any well produces water with constituents exceeding primary drinking water quality standards (determined from the most recent sampling event) all purge water from that well will be containerized and disposed of appropriately

3 4 FIELD MEASUREMENTS

Field parameters, including specific conductance, dissolved oxygen, temperature, and pH, will be monitored at three minute intervals and recorded on field data sheets After the parameters stabilize the groundwater sample will be collected Monitoring probes will not be placed into the sample containers which will be submitted to the laboratory for analysis After the water in the beaker is tested for field parameters it will be disposed of After samples have been collected for laboratory analysis, another beaker of water is to be retested for pH, temperature, dissolved oxygen, and specific conductance as a measure of purging efficiency and as a check of the stability of the water samples over time These readings, along with date, time, well ID, purge volume, and presampling and post sampling water levels, will be recorded on the Groundwater Monitoring Data Sheet The instrument(s) used to perform field measurements will be calibrated prior to sampling each well

3 5 SAMPLE COLLECTION AND PRESERVATION

After the field parameters have stabilized (dissolved oxygen is considered to be the best indicator) the pump discharge rate will be adjusted to a low flow of approximately 0 1 liters per minute to minimize the potential for bottle overtopping The groundwater sampler will wear a new pair of disposable gloves to handle sampling equipment and sample containers at each well The groundwater samples will be collected directly from the pump discharge line into laboratory supplied bottles without filtering Table 3 summarizes the types of containers and associated preservatives that will be used for sample storage and transport Any required preservatives will be added to the containers in advance by the laboratory

Table 3

REQUIRED SAMPLE CONTAINERS AND PRESERVATIVES

Parameter	Sample Container	Preservative	Holding Time
Volatile Organic Compounds (VOCs)	Five (5) 40 ml glass vials with Teflon-lined lid	HCL, 4°C	14 days
EDB, DBCP	Two (2) 40 ml glass vials with Teflon-lined lid	Na_2SO_4, 4°C	14 days
TOC and NH_3	One (1) 16 ounce HDPE	H_2SO_4, 4°C	28 days
Inorganics	One (1) ½ gallon HDPE	4°C	28 days
Metals	One (1) 16 ounce HDPE	HNO_3, 4°C	6 months

Sample containers will be filled in the following order to minimize degradation of sensitive parameters

1 VOCs
2 TOC and NH_3
3 Inorganics
4 Metals

Care should be taken to maintain the lids on the containers until the time to fill the container with the sample Once filled, the containers should be immediately capped to minimize contact with dust and ambient air, and to avoid volatilization of the sample The VOC vials will be completely filled with zero head space Samples will be labeled and immediately stored on ice in a cooler until delivered to the laboratory for analysis under chain of custody Field blank and duplicate samples will be prepared as part of the QA/QC Plan outlined in Section Six

3 6 DECONTAMINATION

The water level indicator, field parameters instrument(s) and any other sampling equipment will be decontaminated between wells with a non-phosphate detergent, then triple rinsed with distilled (or deionized) water

3 7 SAMPLE HANDLING

Once collected, each sample will be immediately labeled, recorded on the Groundwater Monitoring Data Sheet, and placed in a sample cooler with ice for transport to the laboratory All samples will be delivered to the State of Utah Certified laboratory within a sufficient time frame to insure that project hold times will not be exceeded by the laboratory for the specified parameters Each sample will be accompanied by a chain-of-custody form filled out at the time of sample collection

3 8 DOCUMENTATION

An essential part of the sample collection activity is the documentation of the site measurements and ensuring the integrity of the sample from collection to data reporting The following records and actions will be taken

1 Sample Labels. All samples will be labeled with the sample identification, name of the sampler, date and time of collection, and type of preservative (if required) The sample label will be filled out completely and attached to each sample bottle or container at the time of collection

2 Chain-of-Custody. A chain-of-custody form will accompany all samples from the time of collection to completion of laboratory analysis The chain-of-custody record will establish the documentation necessary to trace sample possession from the time of collection through receipt by the analytical laboratory The original form will accompany the samples to the laboratory and copies will go into the project file Original forms will be returned with the analytical results from the laboratory

3 Sampling Record. Pertinent field measurements and observations noted during sampling will be recorded by the field technician on the Groundwater Monitoring Data Sheet (one for each well) and in his field notes

Examples of the Sample Labels, Chain-of-Custody, and Groundwater Monitoring Data Sheet forms are included in Attachment 2

3 9 SAMPLE IDENTIFICATION

Each sample will be given a unique identification consisting of the monitor well ID For example, groundwater sampled from monitor well BH-2 will be labeled "BH-2" The field duplicate sample will generally be obtained from BH-2 or BH-5 and will be labeled "BH-9" and field notes will verify from which monitor well it was obtained

SECTION FOUR

LYSIMETER SAMPLING PROCEDURES

4 1 GENERAL

The following subsections detail specific sampling techniques and methodology to be used during all lysimeter monitoring to provide consistent quality monitoring data Sampling personnel must have a copy of the approved Groundwater and Leachate Monitoring Plan in the field during each sampling event The lysimeter will be sampled semi-annually during the groundwater sampling events to provide information about leachate production rates and quality Pan lysimeters are not considered a point of compliance for groundwater monitoring as required by UACR 315-308

The sampling procedures consist of obtaining water levels and samples from the pan lysimeter, identified in the site map, utilizing a water level indicator and pump Coordination for conducting the sampling events will be established prior to sampling Sampling equipment will be prepared and properly calibrated prior to each sampling event All information obtained in the field shall be recorded on a Groundwater Monitoring Data Sheet, similar to the one presented in Attachment 2

Sampling will use currently accepted and approved technology or approved equivalent techniques Sampling will be performed by competent personnel who are familiar with proper sampling techniques, and health and safety procedures Samplers should also be knowledgeable in techniques of sample collection and preservation, decontamination, and quality assurance/quality control (QA/QC) The sampler will wear a new pair of latex gloves at each location for handling sampling equipment and containers

4 2 WATER LEVEL MEASUREMENTS

Water levels will be obtained in the lysimeter stand pipe Depth to leachate and total leachate depth will be measured Prior to sampling, water level readings must be obtained using a conductivity-based water level indicator or equivalent instrument capable of obtaining measurements The probe will be decontaminated between each use by washing with a non-phosphate detergent and rinsing three times with deionized or distilled water The probe will then be lowered into the stand pipe until the level indicator alarm sounds or light goes on The depth to water is read from the top of the cap to the nearest 0 01 foot The depth will be recorded immediately on the Groundwater Monitoring Data Sheet to the nearest 0 01 feet The water level indicator or weighted tape measure will then be lowered until the bottom is reached and the total depth recorded to the nearest 0 01 feet

4 3 LYSIMETER SAMPLING

If leachate is detected in the lysimeter then all the leachate collected in the pan lysimeter will be removed using a bailer or pump A sample will be obtained from the removed leachate and immediately be placed into sample bottles to ensure as much sample as possible will be collected Any excess leachate will be containerized for proper disposal based on the chemical properties as determined from the laboratory analysis Total volume of leachate removed from the lysimeter will be recorded on the field data sheet

4 4 FIELD MEASUREMENTS

Leachate will not be sampled for field parameters to minimized the risk of cross contamination in the compliance monitoring well network

4 5 SAMPLE COLLECTION AND PRESERVATION

Sample containers will be filled in the following order to minimize degradation of sensitive parameters

1. VOCs
2. TOC and NH_3
3. Inorganics
4. Metals

Care should be taken to maintain the lids on the containers until the time to fill the container with the sample Once filled, the containers should be immediately capped to minimize contact with dust and ambient air, and to avoid volatilization of the sample The VOC vials will be completely filled with zero head space Samples will be labeled and immediately stored on ice in a cooler until delivered to the laboratory for analysis under chain of custody Field blank and duplicate samples will be prepared as part of the QA/QC Plan outlined in Section Six Samples for the lysimeter shall not be stored or transported in the same cooler as the compliance monitoring well samples

4 6 DECONTAMINATION

The water level indicator and any other sampling equipment used will be decontaminated between locations with a non-phosphate detergent, then triple rinsed with distilled (or deionized) water

4 7 SAMPLE HANDLING

Once collected, each sample will be immediately labeled, recorded on the Groundwater Monitoring Data Sheet, and placed in a sample cooler, separate from the compliance monitoring well samples, with ice for transport to the laboratory All samples will be delivered to the State of Utah Certified laboratory within a sufficient time frame to insure that project hold times will not be exceeded by the laboratory for the specified parameters Each sample will be accompanied by a chain-of-custody form filled out at the time of sample collection

4 8 DOCUMENTATION

An essential part of the sample collection activity is the documentation of the site measurements and ensuring the integrity of the sample from collection to data reporting The following records and actions will be taken

1 Sample Labels. All samples will be labeled with the sample identification, name of the sampler, date and time of collection, and type of preservative (if required) The sample label will be filled out completely and attached to each sample bottle or container at the time of collection

2 Chain-of-Custody. A chain-of-custody form will accompany all samples from the time of collection to completion of laboratory analysis The chain-of-custody record will establish the documentation necessary to trace sample possession from the time of collection through receipt by the analytical laboratory The original form will accompany the samples to the laboratory and copies will go into the project file Original forms will be returned with the analytical results from the laboratory

3 Sampling Record. Pertinent field measurements and observations noted during sampling will be recorded by the field technician on the Groundwater Monitoring Data Sheet (one for each well) and in his field notes

Examples of the Sample Labels, Chain-of-Custody, and Groundwater Monitoring Data Sheet forms are included in Attachment 2

4 9 SAMPLE IDENTIFICATION

Each sample will be given a unique identification consisting of the monitor well ID For example, leachate sampled from the lysimeter will be labeled "L-1"

SECTION FIVE

SAMPLE ANALYSIS

5 1 DETECTION MONITORING ANALYSIS

All laboratory chemical analyses will be conducted according to EPA standards and procedures as set forth in EPA SW-846 or other EPA approved test method Samples will be analyzed for constituents listed in R315-308-4 using the recommended EPA Method The laboratory will follow the procedures as described and identified and/or adjust for potential interferences Laboratory personnel will provide information on the precision and accuracy of the testing, and include results of QA/QC laboratory samples A list of parameters, EPA methods, required detection limits, and holding times are provided in Table 4

The Rule states in R315-308-2(4)(d) that analysis shall be performed for the required constituents on unfiltered samples Samples will be collected without filtering in the field and the laboratory will be instructed to analyze unfiltered samples

SECTION SIX

QUALITY ASSURANCE/QUALITY CONTROL

A detailed quality assurance/quality control (QA/QC) Plan has been developed for sampling and analysis of the groundwater and leachate The objective of the monitoring Plan is to obtain high quality, consistent data that may be used to track long-term variations and trends in the groundwater at the site Specific QA/QC procedures have been developed to accomplish this objective, as well as to identify sampling or laboratory analytical errors which may occur A Quality Assurance Officer (QAO) will be assigned by Iron County to review the data for completeness, accuracy and precision The QAO is generally affiliated with the organization performing the sampling

6 1 ACCURACY

Accuracy is the nearness of a measurement or set of measurements to the true value It is evaluated by means of a matrix spike sample analysis A known quantity of analyte is added to sample matrix The spike concentrations added are 1 0 ppm for metals and 20 ppb for volatile organic compounds A sample identified as a field blank may not be used for the analysis Spike recovery is calculated using the following equation

$$\%R = \frac{(SSR-SR)}{SA} X\ 100$$

Where R = Spike Recovery
SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Target recoveries of 80% to 120% are acceptable for most analytes (70% to 130% for arsenic, lead, selenium, and thallium) Some organic constituents have acceptable ranges of 60% to about 140% If the spike recovery falls outside the specified range, the data will be qualified as "estimated" or "rejected"

6 2 PRECISION

Precision is an assessment of the agreement between a set of replicate measurements without assumption or knowledge of the true value Precision is evaluated by means of duplicate sample analysis

Precision is determined using the following formula

$$RPD = \frac{(S-D)}{(S+D)/2} X 100$$

Where RPD = Relative Percent Difference
S = Sample Result
D = Duplicate Sample Result

Duplicate samples will have a control limit of ±20% for the Relative Percent Difference (RPD) for sample values greater than 5 times the laboratory detection limit (LDL) If the sample values are less than 5 times the laboratory detection limit, a control limit of ± the LDL shall be used

If field duplicate analysis results for a particular Analyte falls outside the control windows of ±20% or ±LDL, which ever is appropriate, the results for that Analyte in all other samples associated with that laboratory set may be flagged as estimated

6 3 QA/QC SAMPLES

6 3 1 Field Duplicates

A blind duplicate sample will be collected and submitted for analysis during each sampling round to assess data precision It will be labeled in such a way so its identity as a duplicate sample will not be known by the analytical laboratory

6 3 2 Laboratory QA/QC Samples

The laboratory is required to provide results for two types of QA/QC samples method blanks and matrix spike/matrix spike duplicates Method blank results are required for each analyte listed in Table 4 Matrix spike/matrix spike duplicates are required for each metal and inorganic analyte and for a representative number of organic analytes

Method blanks provide verification that an analyte has not been introduced into the sample during laboratory handling and analysis Matrix spike/matrix spike duplicates provide an indication of the laboratory accuracy and precision

6 3 3 Trip and Field Blanks

A trip blank and a field blank will be prepared and sealed by the analytical laboratory prior to the sampling event Both blanks will be prepared by the laboratory using aqueous solutions that are ASTM Grade 2 reagent

The trip blank will be transported to the sampling site and back to the laboratory without being opened, accompanying the sample bottles the entire time It serves as a check on sample contamination originating from sample transport, shipping, and from site conditions

The field blank container is opened in the field for the same amount of time as the collection of one of the groundwater samples It is then sealed and is transported with the other samples to the laboratory It serves as a check on environmental contamination

The trip blank and field blank will be analyzed if the previous round of groundwater sampling detected any organic constituents, or if inorganic constituents are detected to be significantly above background concentrations If an unexpected contaminant is encountered in a groundwater sample from the site, the field blank and trip blank will be analyzed after the next sampling event to rule out contamination originating from another source The blanks would be analyzed for the same landfill parameters listed in Table 4

6 4 REPORTING LIMITS

The laboratory is required to meet the established reporting limits given in Table 4 for each analyte The reporting limits are designed to be below the drinking water quality criteria If the laboratory is unable to meet the required limit for an analyte or group of analytes due to characteristics of the sample, the laboratory is required to contact Iron County or their sampling representative immediately If changes in the sampling protocol or established reporting limit are necessary, the DSHW will be immediately notified

6 5 LABORATORY INTERNAL QUALITY CONTROL

6 5 1 Calibration Procedures and Frequency

Laboratories subcontracted to perform chemical analyses will be certified by the State of Utah for environmental analysis The laboratory must provide a copy of the most recent letter from the Utah Bureau of Laboratory Improvement certifying that the laboratory is approved for each of the analyses performed As such, they will follow the calibration procedures according to and at the minimum frequency required by the State of Utah

6 5 2 Internal Quality Control Checks

The laboratory will conduct internal quality control checks according to its own QA Plan that is a part of State certification requirements The laboratory will summarize the results of these quality control checks and submit them with the analytical results

The quality control checks and the laboratory performance and system audits will include

1. Method blanks
2. Laboratory control samples
3. Calibration check samples
4. Replicate samples
5. Matrix-spiked samples
6. "Blind" quality control samples
7. Control charts
8. Surrogate samples
9. Zero and span gases
10. Reagent quality control checks

6 5 3 Preventive Maintenance Procedures and Schedules

Preventive maintenance procedures and schedules will be followed according to specifications outlined in the requirements for laboratory certification by the State

6 5 4 Corrective Action for Laboratory Problems

Corrective action will be initiated if results of analysis are not within the precision, accuracy and completeness specified in Sections 6 1, 6 2, 6 3, 6 4, 6 5 1 and 6 5 2 of the Groundwater and Leachate Monitoring Plan Sufficient quantities of sample will be retained by the lab so that parameters could be reanalyzed if results are unacceptable and hold times have not been exceeded In the event that hold times are exceeded, the QAO will decide if a resampling and reanalysis is required

SECTION SEVEN

DATA ANALYSIS PLAN

7 1 DATA VALIDATION

When the laboratory data is received, it will be reviewed by the QAO to assess data validity The data package will be checked to insure that

- Sample I D's match chain-of-custody and field notes and can be matched to sample location, date, and time
- Samples were analyzed by requested methods
- Samples were analyzed within holding times
- Analysis reporting limits are acceptable
- Laboratory method blank results are included and acceptable
- Laboratory matrix spike/matrix spike duplicate results for representative analytes are included and acceptable
- Field duplicate sample results are included and acceptable

If potential problems or discrepancies are encountered, the laboratory will be notified and requested to help resolve the question If the cause of the problem cannot be located, the affected data will be qualified or the affected wells will be resampled, depending on the severity of the problem The QAO will use professional judgment to assign qualifiers to data that do not meet the required data quality objectives If the data appears usable and can be combined with the historical data with no reservations, then no qualifier will be attached The reasoning will be detailed in the report prepared for the sampling event

If the data appears to accurately represent the presence or absence of an analyte, but the quantification of the analyte is in question, then a "J" will be assigned to the reported concentration to indicate it is an estimated quantity An example of this might be a case where arsenic is reported in the sample, but arsenic recoveries in the matrix spike/matrix spike duplicate are very low (such as 50%) The QAO may feel that the reported arsenic value is useful information even if the result is probably too low In this case, a "J" would appear next to the reported result in subsequent tabulations of the data for that well

If the data for an analyte appear compromised to the point where the reported result is not useful (such as the appearance of methylene chloride in the method blank and in a sample at similar concentrations), the data will receive an "R" qualifier indicating it is rejected The reported result will continue to be shown in subsequent tabulations, but the "R" qualifier will flag the user not to include the result in statistical compilations, etc

In all cases where data receive qualifiers, an explanation of the QAO's judgement will be given in the report of the sampling round where the qualified data are first reported

7 2 DATA ANALYSIS

The data will be analyzed by

- Looking for the presence of non-naturally occurring compounds in the sample (such as volatile organic compounds), and
- Plotting the concentrations of naturally occurring constituents (metals and minerals) in each well on control charts for that well

If non-naturally occurring compounds are reported by the laboratory, the validity of the results(s) will be assessed by reviewing method blank results, raw laboratory data, the compound's potential status as a common laboratory contaminant, and the reported concentration relative to the method detection limit If the positive results appear potentially valid, the affected well will be resampled to verify the result

The relative concentrations of naturally-occurring constituents will be analyzed to assess whether the water is impacted Inter-well comparisons of water quality data, between upgradient and downgradient wells, are at times complicated by natural variations within the wells

Background water quality will be established by reviewing a minimum of eight independent sampling event results from each upgradient well and a minimum of four independent sampling event results from each downgradient well

Once the background levels are established for the site wells, the control chart approach will be the statistical method used to analyze the sampling data from each succeeding sample event The statistical method will satisfy the requirements of R315-308-2(7) (d)

7 3 DATA REPORTING

Semi-annual monitoring reports will be prepared within 60 days of the sampling date, which will include the following information

- Description of sampling activities
- Discussion of data validity
- Discussion of laboratory QA/QC
- Presentation of water elevation measurements, groundwater direction and flow rate
- Presentation of field and laboratory data

SECTION EIGHT

SITE SAFETY

In order to satisfy the requirement listed in R315-308-2(3)(g), the following health and safety procedures will be followed to ensure employee health and safety during well installation and monitoring at the site

8 1 DRILLING

If drilling is required at site, it will be performed by drillers and geologist/engineering personnel who have had 40 hour HAZWOPER training in accordance with OSHA requirements set forth in 29 CFR 1910 Workers should become familiar with the site and potential hazards before initiating the work, by talking with the landfill manager It is recommended that workers utilize Level D personal protection consisting of

- Coveralls and long sleeve shirt
- Safety boots or shoes
- Safety glasses or goggles
- Hard hat
- Work gloves

8 2 MONITORING

Groundwater and Leachate Monitoring shall be performed by personnel who have had 40 hour HAZWOPER training in accordance with OSHA requirements set forth in 29 CFR 1910 It is also recommended that personnel performing the groundwater sampling have attended a sampling procedure class such as the State of Utah UST Soil and Groundwater Sampler training and certification Workers should become familiar with the site and potential hazards before the work is performed, by talking with the landfill manager It is recommended that workers utilize Level D personal protection consisting of

- Coveralls and long sleeve shirt
- Safety boots or shoes
- Safety glasses or goggles
- Vinyl gloves

SECTION NINE

REFERENCES

Ashcroft, G L , Jensen, D T , Brown, J L , *Utah Climate*, Utah Climate Center, Utah State University, 1992

EPA, 1983, Methods for Chemical Analysis of Water and Wastes EPA 600-4-79-020, Revised March 1983

EPA, 1986, Test Methods for Evaluating Solid Waste, EPA SW-846, Third Edition

Tahoma Resources, *Responses to the NOTICE OF DEFICIENCY Concerning the Iron County Application,* May 8, 1990

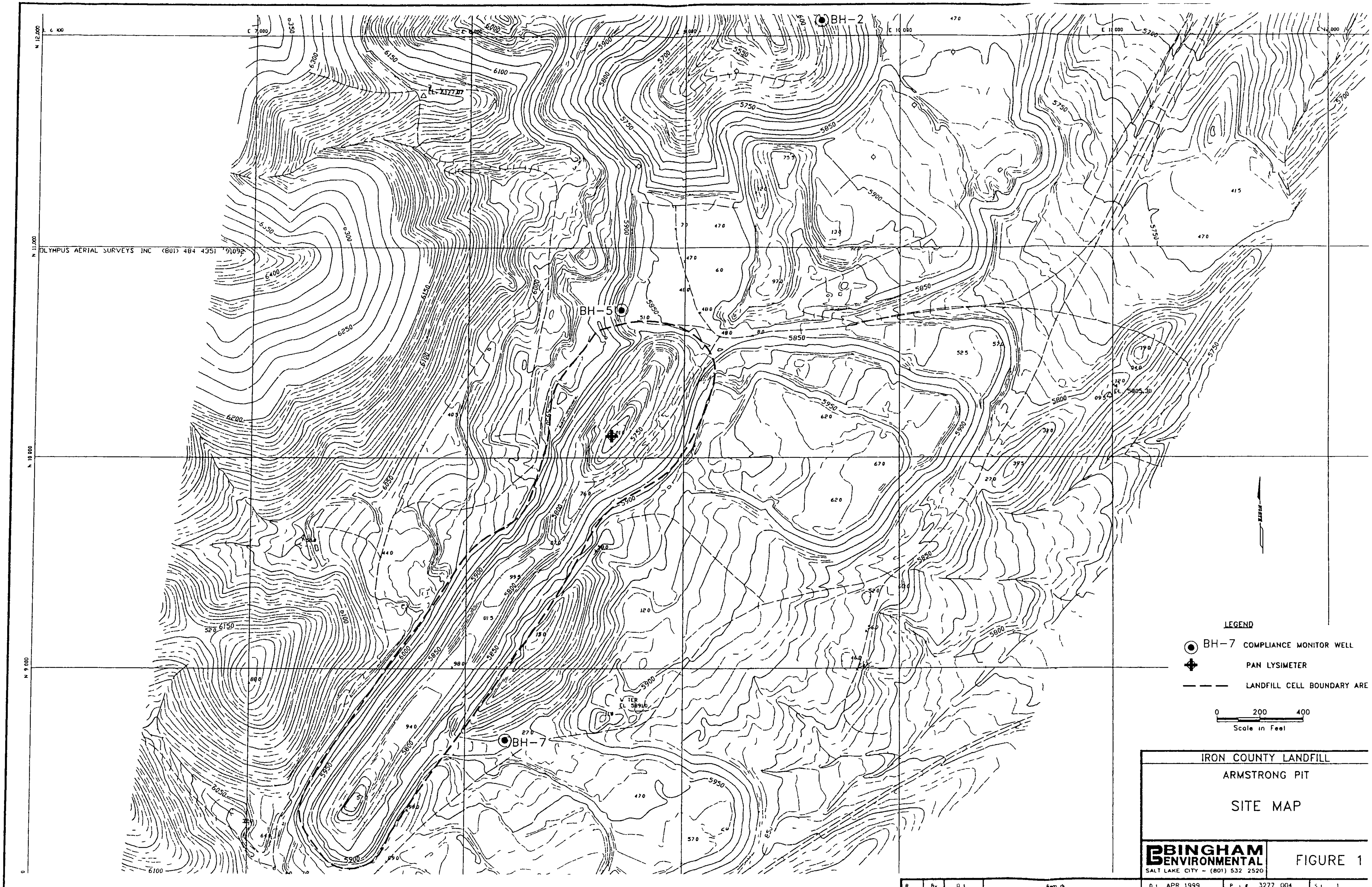
Tahoma Resources, *Groundwater Monitoring Plan, Addendum to the Groundwater Discharge Permit Application, Proposed Armstrong Pit Landfill Site*, Iron County, Utah, January 31, 1992

TABLE 4

GROUNDWATER SAMPLING PARAMETERS IRON COUNTY MUNICIPAL LANDFILL			
CONSTITUENT	Method	Detection Limit (mg/L)	Hold Time
METALS (total)			
Antimony	7041	0 002	6 months
Arsenic	7060	0 005	6 months
Barium	6010	0 002	6 months
Beryllium	6010	0 001	6 months
Cadmium	6010	0 003	6 months
Chromium	6010	0 01	6 months
Cobalt	6010	0 01	6 months
Copper	6010	0 004	6 months
Lead	7421	0 005	6 months
Mercury	7470	0 0002	28 days
Nickel	6010	0 01	6 months
Selenium	7740	0 005	6 months
Silver	6010	0 01	6 months
Thallium	7841	0 001	6 months
Vanadium	6010	0 005	6 months
Zinc	6010	0 01	6 months
INORGANIC CONSTITUENTS			
Ammonia (as N)	350 1	0 05	28 days
Bicarbonate (as CaCO3)	310 1	10	28 days
Carbonate (as CaCO3)	310 1	10	28 days
Calcium	6010	0 05	6 months
Chloride	300	0 5	28 days
Iron	6010	0 01	6 months
Magnesium	6010	0 05	6 months
Manganese	6010	0 005	6 months
Nitrate (as N)	352 2	0 01	48 hours
pH	150 1	0 1	Immediately
Potassium	6010	0 1	6 months
Sodium	6010	0 1	6 months
Sulfate	375 4	5 0	28 days
TDS	160 1	10 0	7 days
TOC	415 1	10 0	28 days

TABLE 4

GROUNDWATER SAMPLING PARAMETERS IRON COUNTY MUNICIPAL LANDFILL			
CONSTITUENT	Method	Detection Limit (mg/L)	Hold Time
ORGANIC CONSTITUENTS			
Acetone	8260	0 010	14 days
Acrylonitrile	8260	0 005	14 days
Benzene	8260	0 002	14 days
Bromochloromethane	8260	0 002	14 days
Bromodichloromethane	8260	0 002	14 days
Bromoform	8260	0 002	14 days
Carbon Disulfide	8260	0 002	14 days
Carbon Tetrachloride	8260	0 002	14 days
Chlorobenzene	8260	0 002	14 days
Chloroethane	8260	0 005	14 days
Chloroform	8260	0 002	14 days
Dibromochloromethane	8260	0 002	14 days
1,2-Dibromo-3-chloropropane	504	0 0002	14 days
1,2-Dibromoethane	504	0 00002	14 days
1 2-Dichlorobenzene	8260	0 002	14 days
1,4-Dichlorobenzene	8260	0 002	14 days
trans-1 4-Dichloro-2-butene	8260	0 010	14 days
1,1-Dichloroethane	8260	0 002	14 days
1,2-Dichloroethane	8260	0 002	14 days
1 1-Dichloroethylene	8260	0 002	14 days
cis-1,2-Dichloroethylene	8260	0 002	14 days
trans-1 2-Dichloroethylene	8260	0 002	14 days
1 2-Dichloropropane	8260	0 002	14 days
cis-1 3-Dichloropropene	8260	0 0005	14 days
trans-1 3-Dichloropropene	8260	0 0005	14 days
Ethylbenzene	8260	0 002	14 days
2-Hexanone	8260	0 005	14 days
Methyl bromide	8260	0 005	14 days
Methyl chloride	8260	0 002	14 days
Methylene bromide	8260	0 002	14 days
Methylene chloride	8260	0 002	14 days
Methyl ethyl ketone	8260	0 010	14 days
Methyl Iodide	8260	0 005	14 days
4-Methyl-2-pentanone	8260	0 005	14 days
Styrene	8260	0 002	14 days
1,1,1,2-Tetrachloroethane	8260	0 002	14 days
1,1,2,2-Tetrachloroethane	8260	0 002	14 days
Tetrachloroethylene	8260	0 002	14 days
Toluene	8260	0 002	14 days
1,1,1-Trichloroethane	8260	0 002	14 days
1,1,2-Trichloroethane	8260	0 002	14 days
Trichloroethylene	8260	0 002	14 days
Trichlorofluoromethane	8260	0 002	14 days
1,2,3-Trichloropropane	8260	0 002	14 days
Vinyl acetate	8260	0 005	14 days
Vinyl chloride	8260	0 002	14 days
Xylenes	8260	0 002	14 days



BH-2
BH-5
BH-7
OLYMPUS AERIAL SURVEYS INC (801) 484 4351 91092
LEGEND
BH-7 COMPLIANCE MONITOR WELL
PAN LYSIMETER
LANDFILL CELL BOUNDARY ARE
0 200 400
Scale in Feet
IRON COUNTY LANDFILL
ARMSTRONG PIT
SITE MAP
BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532 2520
FIGURE 1
APR 1999
3277 004

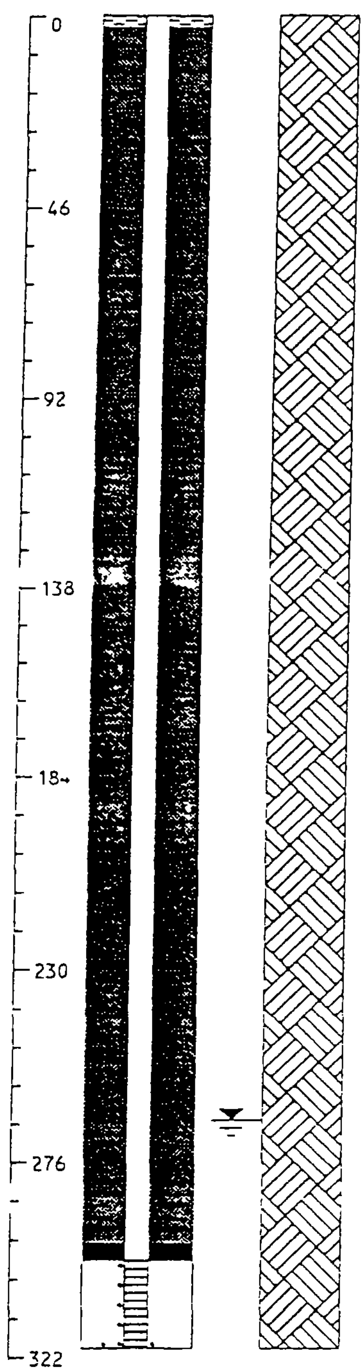
ATTACHMENT 1
WELL LOGS, COMPLETION DETAILS
AND
LYSIMETER CONSTRUCTION DETAILS

DRILL HOLE LOG
MONITOR WELL NO BH 2

PROJECT Iron County Landfill
CLIENT/OWNER Iron County Landfill
HOLE LOCATION North of the existing landfill
DRILLER Boyles Bros Drilling
DRILL RIG NA
DEPTH TO WATER 266' HOLE DIAMETER 6 25

PROJECT NO 3277-004
DATE 9-10 90
TOC ELEV 5652 18'
GS ELEV NA
LOGGED BY NA
WELL NO BH-2

ELEVATION / DEPTH	WELL DETAILS	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)	Recovery (in/in)
			QZ	QUARTZ			



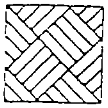
Well completion details based on available information Drill hole log based on BH-5 located approximately 1600 ft to the southwest

Figure No 1

KEY TO SYMBOLS

Symbol Description

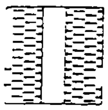
Strata symbols


Quartz

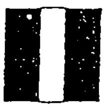
Misc. Symbols

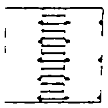

Water table

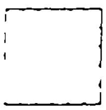
Monitor Well Details


Protective well cover set in concrete


Bentonite-cement slurry blank 1 5 O D schedule 40 PVC pipe


Bentonite seal blank 1 5 O D schedule 40 PVC pipe


Silica sand 010 slot 1 5 O D schedule 40 PVC pipe


Silica sand no PVC pipe

Notes

1 Monitor well BH-2 was drilled and installed on September 10 1990 The holes were drilled with the use of a truck mounted drill rig utilizing 6 25 inch O D rotary and down hole hammer with air

2 Water level shown on the drill hole log was measured on September 13 1990

3 The exact location of BH 2 is 365 feet North and 120 feet west from South 1/4 corner Section 29 Township 35 South Range 12 West SLBM

4 This drill log represents a compilation of the best available data from the February 1994 permit application and well log for BH-5 located approximately 1600 feet to the Southwest

5 These logs are subject to the limitations conclusions and recommendations in this report

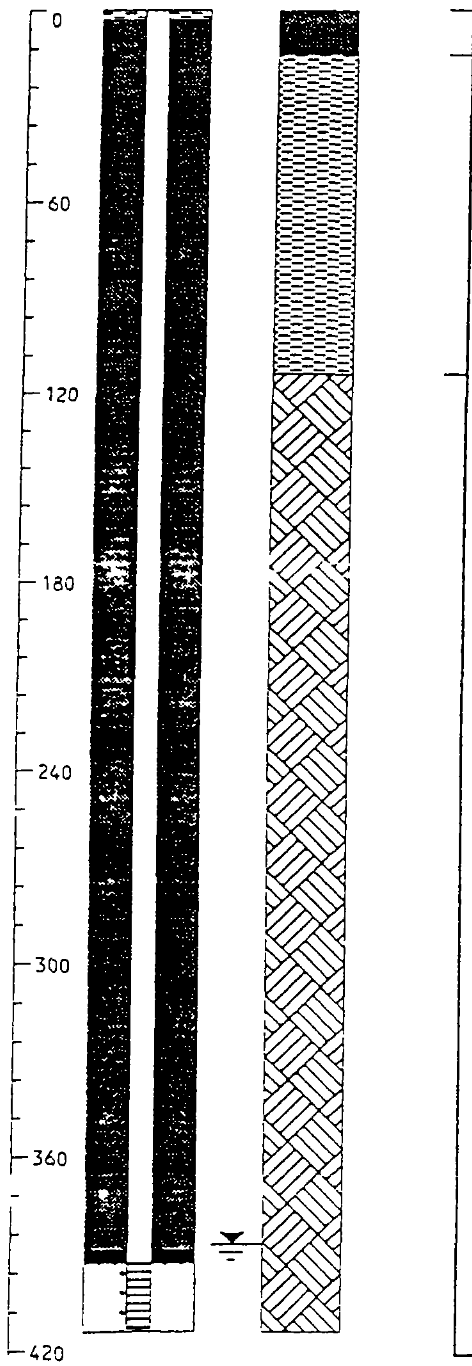
DRILL HOLE LOG

MONITOR WELL NO BH 5

PROJECT Iron County Landfill
CLIENT/OWNER Iron County Landfill
HOLE LOCATION North end of the existing landfill
DRILLER Boyles Bros Drilling
DRILL RIG NA
DEPTH TO WATER 387 HOLE DIAMETER 6 25

PROJECT NO 3277-004
DATE 10-13-91
TOC ELEV 5857 03
GS ELEV NA
LOGGED BY NA
WELL NO BH-5

ELEVATION / DEPTH	WELL DETAILS	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)	Recovery (in/in)
			FILL	Shot Rock Fill			
				Siltstone and Limestone			
			QZ	Quartz Monzonite			



Well completion details based on available information

Figure No 1

KEY TO SYMBOLS

Symbol	Description
	Strata symbols
	Fill
	Siltstone
	Quartz
	Misc Symbols
	Water table
	Monitor Well Details
	Protective well cover set in concrete
	Bentonite-cement slurry blank 2 5 O D schedule 40 PVC pipe
	Bentonite seal blank 2 5 O D schedule 40 PVC pipe
	Silica sand 010 slot 2 5 O D schedule 40 PVC pipe
	Silica sand no PVC pipe

Notes.

1 Monitor well BH 5 was drilled and installed on October 13 1991 The holes were drilled with the use of a truck mounted drilling utilizing 6 25 inch O D rotary and down hole hammer with air

2 Water level shown on the drill hole log was measured on October 18 1991

3 The exact location of BH 5 is 934 feet South and 3819 feet West from the NE corner Section 32 Township 35 South Range 12 West SLBM

4 This drill log represents a compilation of the best available data from the February 1994 permit application and well log for BH 5

5 These logs are subject to the limitations conclusions and recommendations in this report

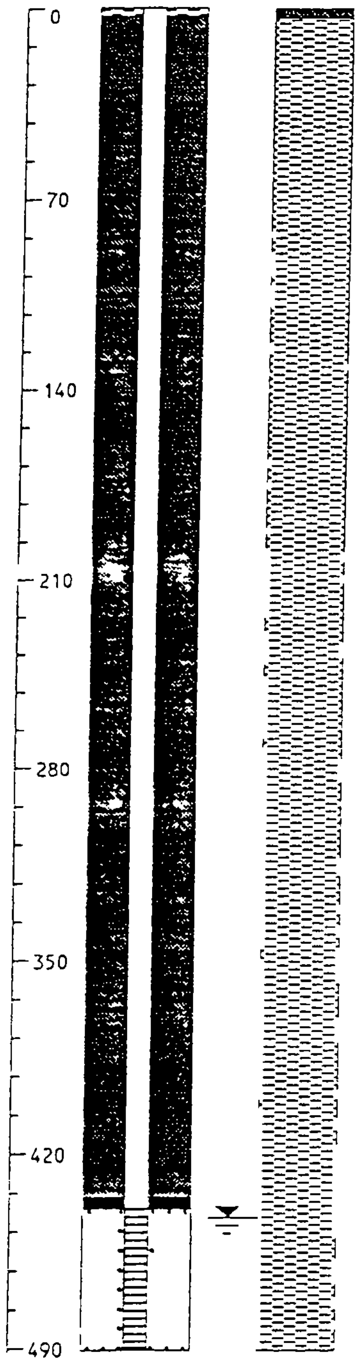
DRILL HOLE LOG

MONITOR WELL NO BH 7

PROJECT Iron County Landfill
CLIENT/OWNER Iron County Landfill
HOLE LOCATION South end of existing landfill
DRILLER Boyles Bros Drilling
DRILL RIG NA
DEPTH TO WATER 443' HOLE DIAMETER 6 25

PROJECT NO 3277-004
DATE 10-30-91
TOC ELEV 5923 72
GS ELEV NA
LOGGED BY NA
WELL NO BH-7

ELEVATION / DEPTH	WELL DETAILS	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)	Recovery (in/in)
			FILL	Artificial Fill Siltstone Shale and Sandstone			



Well completion details based on available information

Figure No 1

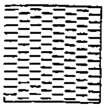
BINGHAM ENVIRONMENTAL

KEY TO SYMBOLS

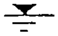
Symbol Description

Strata symbols

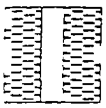

Fill


Siltstone

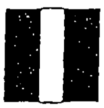
Misc. Symbols

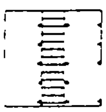

Water table

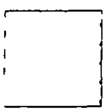
Monitor Well Details


Protective well cover set in concrete


Bentonite-cement slurry blank 2 5 O D schedule 40 PVC pipe


Bentonite seal blank 2 5 O D schedule 40 PVC pipe


Silica sand 010 slot 2 5 O D schedule 40 PVC pipe


Silica sand no PVC pipe

Notes.

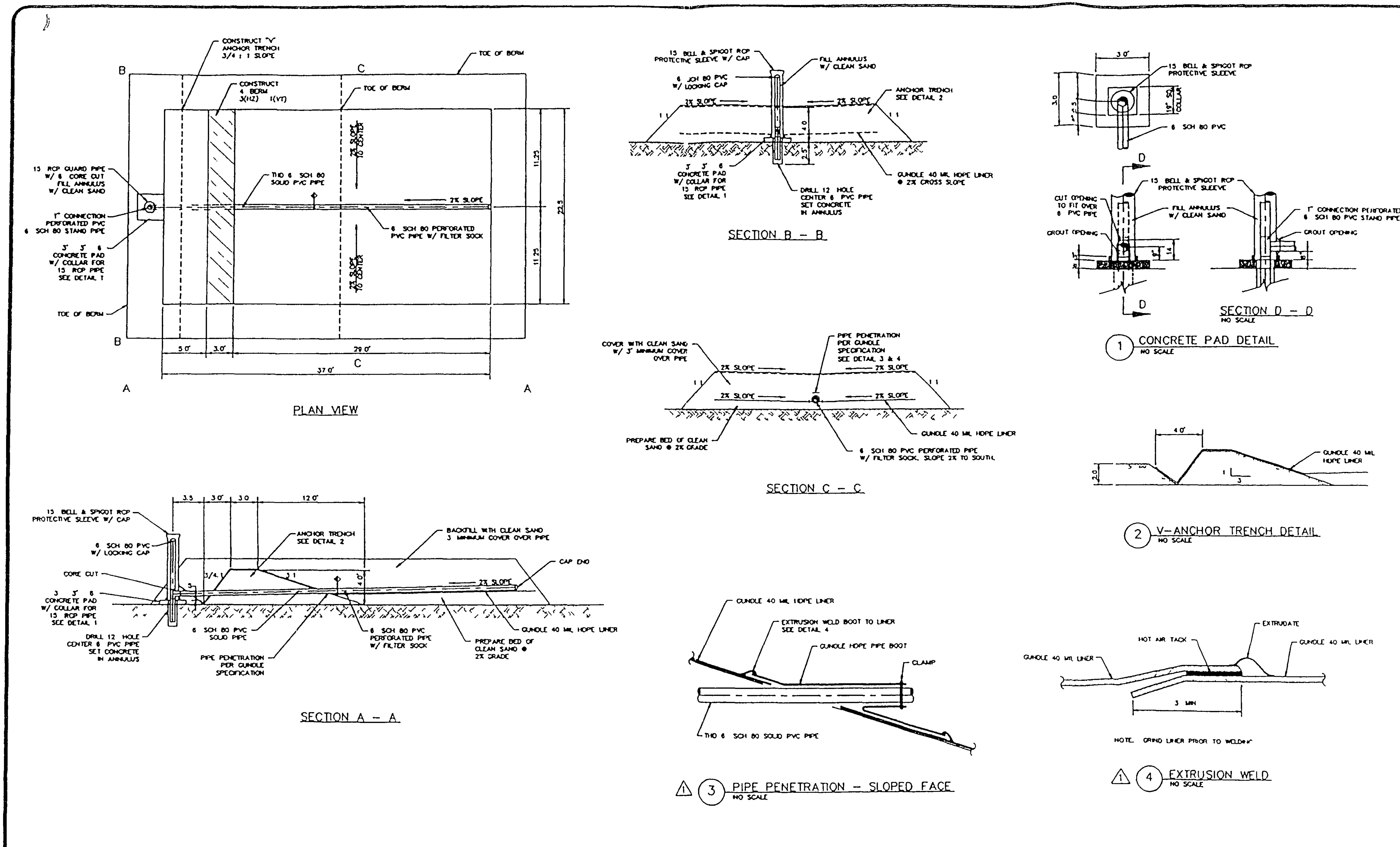
1 Monitor well BH 7 was drilled and installed on October 30 1991 The holes were drilled with the use of a truck mounted drill rig utilizing 6 25 inch O D rotary and down hole hammer with air

2 Water level shown on the drill hole log was measured on December 10 1991

3 The exact location of BH 7 is 3027 feet South and 4469 feet west from the NE corner, Section 32 Township 35 South Range 12 West SLBM

4 This drill log represents a compilation of the best available data from the February 1994 permit application and well log for BH 7

5 These logs are subject to the limitations conclusions and recommendations in this report



No	Revision	By	Date
1	PENETRATION DETAILS	RHW	2/94

Project Number E1 14 02 94
Designed By RHW
Drawn By SRP
Checked By ______ Date ______

ECKHOFF WATSON AND PREATOR ENGINEERING
ENGINEERS PLANNERS SURVEYORS SALT LAKE CITY

PAN LYSIMETER PLAN/SECTIONS AND DETAILS
ARMSTRONG LANDFILL
IRON COUNTY, UTAH

Sheet Number 4 / 4

ATTACHMENT 2
SAMPLING FORMS

GROUNDWATER MONITORING SHEET

Date ____________________ Well ID/Sampling Location ____________________
Job Number ____________________ Time of Arrival at Well ____________________
Owner ____________________ Air Temperature ____________________
Site Description ____________________
Weather Conditions ____________________
Sampled By ____________________
Sampling Equipment ____________________

Pump Depth (ft.) ____________________ Time Pump On ____________________
Depth to Well Bottom (ft.) ____________________ Time Pump Off ____________________
Depth to Groundwater (ft.) Purge Volume (gal.) ____________________
Presampling ____________________ Purge Flow Rate (l/min.) ____________________
Postsampling ____________________ Sample Flow Rate (l/min.) ____________________

Well in good condition? ☐Yes ☐No
Was lock secured upon arrival? ☐Yes ☐No
Is well operating correctly? ☐Yes ☐No

Explain any problems that may exist
____
____

Time	PH	Dissolved Oxygen	Spec. Conductivity/Corrected	Temp
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	

Receiving Laboratory ____________________ Date Received ____________________

Comments
____
____
____
____
____

Sampler's Initials ____________

Example Sample Label

Date ______________________ Time ______________________

Sampler ____

Sample ID ______________________________________

Description ____

____

____

Preservative ________________________

CHAIN OF CUSTODY

CLIENT ____________________

ADDRESS ____________________

____

PHONE/FAX ____________________

CONTACT ____________________

LAB # ____________________

SITE

SAMPLER'S SIGNATURE

SAMPLE ID	SAMPLE DATE/TIME	MATRIX	# OF CONTAINERS	BTX/TPH	VOLATILES	SEMIVOLATILES	D LIST METALS	ET PROFILE														TURN AROUND TIME	COMMENTS

TURN AROUND TIMES
I = Priority I
II = Priority II
III = 5 Day Rush
S = Standard

Quote # / P.O. # ____________________

Special Instructions ____________________

Relinquished By *Signature*	Date/Time	Received By *Signature*	Date/Time
PRINT NAME		PRINT NAME	
Relinquished By *Signature*	Date/Time	Received By *Signature*	Date/Time
PRINT NAME		PRINT NAME	
Dispatched By *Signature*	Date/Time	Received for Laboratory By	Date/Time
PRINT NAME		PRINT NAME	

APPENDIX F

~~2003~~ 2010 Annual Groundwater Monitoring Report

ANNUAL
GROUNDWATER MONITORING REPORT - 2010
IRON COUNTY MUNICIPAL LANDFILL
ARMSTRONG PIT
IRON COUNTY, UTAH

March 3, 2011

A report prepared for

Iron County Solid Waste
3127 North Iron Springs Road
PO Box 743
Cedar City, UT 84720
Attn Mr Jaren Scott

File No 101267 3

ANNUAL GROUNDWATER MONITORING REPORT - 2010
IRON COUNTY MUNICIPAL LANDFILL
ARMSTRONG PIT
IRON COUNTY, UTAH

Prepared by

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March 3, 2011

KLEINFELDER

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APPENDICES

1 EXECUTIVE SUMMARY

This annual groundwater monitoring report presents the results of groundwater monitoring conducted by Iron County Landfill personnel at the Iron County Municipal Landfill near Cedar City, Utah, during calendar year 2010 Groundwater samples have been collected from three monitoring wells (designated BH-2, BH-5, and BH-7) near the landfill on a regular basis since 1992, and analyzed for various organic and inorganic parameters as required by the State of Utah Department of Environmental Quality Division of Solid and Hazardous Waste (DSHW)

Groundwater data acquired during the period from February 1992 to September 1994, prior to placement of solid waste into the landfill, have been used to establish background conditions for the local groundwater, and generate prediction limits" for each analyte Analytical data acquired from groundwater samples collected during each calendar year are compared to these prediction limits to assess whether a impact" is occurring (i e , did an analyte concentration exceed its respective prediction limit), or has occurred, to the local groundwater Since the groundwater regime at the Iron County Landfill appears to be discontinuous in nature, intra-well comparisons are used to monitor the groundwater quality (i e , data from the various sampling events are compared with previous results from the same well rather than against other wells)

Prior to 2001, groundwater sampling was performed at all three landfill wells on a semiannual basis The detection of volatile organic compounds during 2001 in well BH-5 resulted in the requirement for more stringent ("assessment") monitoring at that well This has entailed the analysis of additional parameters once a year, as well as a quarterly sampling frequency at BH-5 as required by R315-308-2 (10) and (11), rather than the semi-annual monitoring performed at the other two wells

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The results of the 2010 groundwater sampling at the Iron County Landfill are summarized as follows

- Five volatile organic compounds (VOCs) were detected at concentrations at or above their laboratory reporting limits in 2010, but below their respective Utah Groundwater Protection Standards Tetrachloroethene was detected in well BH-5 during all four of the sampling events at concentrations exceeding its prediction limit, the only VOC to exceed its prediction limit Although a few volatile compounds are persistent in the groundwater at relatively low concentrations, VOCs are not significant contaminants of concern at the landfill

- With the exception of thallium and arsenic in well BH-2, and selenium in well BH-5, the detected concentrations of metallic analytes remain statistically in control when compared to their established prediction limits

- Based on the results of the inorganic analyses, no significant change in general groundwater chemistry has occurred during this monitoring period, although the total dissolved solids, bicarbonate, and chloride concentrations in wells BH-2 and/or BH-5 have shown a general increase over the last 5-7 years

- Of the more than 100 semi-volatile organic compounds (SVOCs) required for analysis annually in well BH-5, only bis(2-ethylhexyl)phthalate was detected above its laboratory reporting limit this period, and this detection is considered to be the result of sample contamination Semi-volatile compounds are not currently contaminants of concern at the Iron County Landfill

Based on the 2010 groundwater monitoring at the Iron County Landfill, the following are recommended

- Continue the groundwater sampling program currently in place at the landfill, as required by the State of Utah i e , semi-annual detection monitoring at wells BH-2 and BH-7, and quarterly monitoring at BH-5

- Measure the depth to groundwater and total well depth at each well on an annual basis The existing dedicated pumps should be placed in each well approximately halfway between the groundwater level and the bottom of the well

- The dedicated low-flow pumps in each of the wells should be removed and inspected for corrosion, fouling, and function each year

- Should fouling of the well screens in any of the wells be suspected or evident, we recommend that the fouled well(s) be cleaned or replaced Since the wells currently in place in and in the vicinity of the landfill are small-diameter wells, they would be difficult to treat In that case, well replacement with larger diameter wells is recommended

2 INTRODUCTION

2 1 SITE LOCATION AND DESCRIPTION

The Iron County Municipal Landfill is located about 11 miles northwest of Cedar City, Utah, on the eastern slope of Granite Mountain, and occupies a former open-pit iron mine known as the Armstrong Pit The landfill is located in the NW¼ of the SW¼, Section 32, Township 35 South, Range 12 West, Salt Lake Base and Meridian, and is about 5,800 feet above mean sea level (msl) in elevation Figure 1 (Site Location Map) shows the location of the Armstrong Pit

The Iron County Landfill at the Armstrong Pit is a Class I landfill (municipal non-commercial landfill receiving an average of more than 20 tons of solid waste per day) and currently operates under State of Utah Solid Waste Permit No 94-01 as renewed in 1999 and again in 2006 The original permit was issued in January 1994, and the Armstrong Pit began receiving solid waste in September 1994 Approximately 35,763 tons of solid waste were accepted into the landfill during calendar year 2010, resulting in a total of about 1,034,003 tons of municipal solid waste in place as of the end of 2010 The estimated final capacity of the Armstrong Pit is about 6,000,000 cubic yards

2 2 REGULATORY BACKGROUND

The operating permit for the Iron County Landfill requires regular semi-annual groundwater sampling as described in R315-308-2 of the Utah Administrative Code (UAC) In accordance with these requirements, three monitoring wells (designated BH-2, BH-5, and BH-7) were installed in 1991 and are currently in service near the Armstrong Pit These three wells have been used for monitoring the local groundwater quality since that time (Tahoma, 1997) by means of regular groundwater sampling conducted each year by Iron County Solid Waste personnel

Kleinfelder completed a statistical analysis of groundwater data collected prior to waste placement at the Iron County Landfill (Kleinfelder, 1999) that assessed the background (pre-waste) groundwater quality at the landfill, and generated proposed "prediction limits' for the various analytes based on accepted statistical techniques (ASTM, 1996, ASTM, 1998) The individual prediction limits were established as follows

- At the practical quantitation limit (PQL), also referred to as the reporting limit, for analytes not detected above the reporting limit during background sampling,
- At the highest detected concentration for analytes detected between 0 and 25 percent of the time during background sampling, or
- For analytes with a greater than 25 percent frequency of detections in the background sample population, Shewart-CUSUM charts are used to provide prediction limits and track groundwater conditions

As required under the detection monitoring program, these prediction limits are used to assess whether a significant change in groundwater quality has occurred, or is occurring, since the placement of solid waste at the Armstrong Pit

Due to the detection of low concentrations of VOCs during 2001 in well BH-5, the DSHW has required more frequent monitoring at that well This assessment monitoring" also differs from the twice-a-year detection monitoring in that it requires the analysis of additional parameters for samples collected from BH-5, as well as a quarterly sampling frequency for BH-5 as required by R315-308-2 (10) and (11) UAC

2 3 GROUNDWATER SAMPLING SUMMARY

The locatıons of the three wells used for groundwater monıtorıng at the Iron County Landfıll are shown on Fıgure 2 (Monıtorıng Well Locatıons) Groundwater samplıng has been conducted accordıng to the applıcable Groundwater Monıtorıng Plan that was ıncorporated as part of the orıgınal Solıd Waste Permıt (Tahoma, 1992) Sınce March 1999, Iron County personnel have collected samples usıng low-flow ("mıcropurgıng') techniques wherein each well contains a dedicated low-volume pump operated by a portable cylinder of compressed gas Samples are collected upon stabilization of physical parameter measurements during well purging

Since groundwater wells are screened at different intervals and the groundwater regime at the Iron County Landfill may be discontinuous in nature, intra-well comparisons have been used to monitor the groundwater quality (ı e , data from the various sampling events are compared with previous results from the same well rather than against other wells) Intra-well comparisons are made by comparing data from post-background sampling against data considered part of the background population from that well

This report discusses the current groundwater beneath the Iron County Landfill For comparison purposes, all of the groundwater data collected from wells BH-2, BH-5, and BH-7 since 1992 are tabulated and presented in this report However, emphasis will be placed on the results from the detection and assessment monitonng conducted during this reporting period (calendar year 2010)

3 GROUNDWATER ASSESSMENT

3 1 GROUNDWATER LEVEL MEASUREMENTS AND ELEVATIONS

Depth-to-water measurements have been recorded ın wells BH-2, BH-5, and BH-7 durıng the samplıng events at the Iron County Landfıll followıng the protocol descrıbed ın Appendıx A, Samplıng Actıvıtıes Protocol Depth-to-groundwater measurements are converted to groundwater elevatıons above (mean sea level) for the three wells by subtractıng the measured depths from the surveyed top-of-well casıng elevatıons Current and hıstorıcal groundwater elevatıon data are shown ın Table 1, Depth to Water and Groundwater Elevatıons, February 1992 to December 2010

The three groundwater wells penetrate three dıstınct rock types and what appear to be three separate aquıfers (Tahoma, 1997) Thıs does not allow for a realıstıc determınatıon of a local groundwater gradıent and flow dırectıon (ı e , 'upgradıent' and downgradıent" dırectıons) As such, no meanıngful groundwater surface contour map can be generated from the data, nor local groundwater velocıtıes estımated However, the followıng general condıtıons can be noted regardıng groundwater elevatıons ın the three wells

- The groundwater elevatıon ın well BH-2 has hıstorıcally been approxımately 80 to 100 feet lower than the elevatıons ın wells BH-5 and BH-7 The measured groundwater elevatıons ın well BH-2 have also shown the most fluctuatıons from year to year, especıally durıng the perıod of 2002-2004 Groundwater elevatıons ın thıs well are generally hıgher ın the sprıng than ın the fall, but otherwıse have remaıned ın the general range of 5,376-5,382 feet msl sınce 2003

- Groundwater elevatıons ın wells BH-5 and BH-7 are hıstorıcally sımılar, rangıng from 5,472 to 5,478 feet msl sınce 2000 Measured elevatıons ın both of these wells ın 2010 are relatıvely low as compared to prevıous elevatıons

- Overall, groundwater levels at the Iron County Landfıll declıned after 1999-2000, but have held relatıvely steady sınce 2003-2004 The large dıfferences ın groundwater levels and fluctuatıons between the wells are ındıcatıve of the dıscontınuous nature of the shallow aquıfer(s) at the landfıll

3 2 GROUNDWATER SAMPLING AND ANALYSIS FOR 2010

3 2 1 Samplıng Frequency and Analyses

Groundwater samples were collected by Iron County personnel accordıng to the protocol descrıbed ın Appendıx A, on Aprıl 8, July 27, September 22, and December 13 2010 Durıng the July and December 2010 samplıng events, groundwater samples were collected only from well BH-5 as part of the quarterly groundwater assessment monıtorıng for that well

Currently, the groundwater samples collected from wells BH-2 and BH-7 are submıtted for analysıs of the constıtuents lısted ın Table 2a, Laboratory Analyses for Detectıon Groundwater Monıtorıng, on a semıannual basıs As required by the DSHW, the samples collected from well BH-5 are also submıtted for analysıs of the constıtuents lısted ın Table 2a durıng three of the four quarterly samplıng events In addıtıon, groundwater samples collected from BH-5 are submıtted for the analysıs of the constıtuents lısted ın Table 2b, Laboratory Analyses for Assessment Monıtorıng, once each calendar year Two semı-volatıle constıtuents (pentachlorophenol and benzo[a]pyrene) are also requıred for analysıs for all BH-5 samplıng events

3 2 2 Field Parameters Measurements Summary

Field parameters pH, temperature, and specific conductivity are regularly collected as part of the low-flow sampling protocol These field parameters are summarized in Table 3, Field Measurements Summary, which includes the data from current and prior monitoring events conducted at the landfill

Similar to previous reporting periods, conductivity measurements from the 2010 sampling events indicate that different conditions exist in each well with respect to the total dissolved solids (TDS) content in the groundwater The field conductivity measurements in well BH-7 have historically been 25 to 30 percent lower than well BH-5, and approximately half of those measured in BH-2 This is confirmed by the laboratory analysis of TDS in each of the wells, which shows that the groundwater TDS content in well BH-7 is lower than in BH-5, which is itself significantly lower in TDS than BH-2 The measured specific conductance in all three of the wells continues to increase slightly, especially the measurements collected in the last six months of 2010

In addition to differences in specific conductivity, differences are also present in the field-measured pH values from the three wells In general, the pH measured in BH-2 is usually the highest of the three wells (ranging between 7 5 and 8 5), but was similar to that measured in well BH-5 in 2010, at about 7 0 Well BH-7 showed the highest (most basic) pH measurements this period at 7 3 and 7 6 for the spring and fall events, respectively

3 3 GROUNDWATER ANALYTICAL RESULTS SUMMARY

3 3 1 General

This section summarizes the analytical results for the groundwater sampling events conducted at the Iron County Municipal Landfill during 2010 Analytical results for the groundwater sampling are presented in Tables 4 through 8, which summarize the results of the analysis for VOCs, metals, miscellaneous inorganic analyses, pesticides/herbicides, and SVOCs, respectively

The PQLs (laboratory reporting limits) for the analyzed parameters, both organic and inorganic, are shown on the respective summary tables, as well as the individual prediction limits where established non-parametrically The current Utah Groundwater Protection Standards (GWPSs) for each analyte, where established, are also shown on the respective summary tables Copies of the laboratory reports for the 2010 sampling events are included with this report in Appendix B

3 3 2 Volatile Organic Compounds

As shown in Table 4, only a few VOCs have ever been detected above their reporting limits, most of which have been detected in well BH-5 The following summarize the 2010 VOC results by well

Well BH-2

Similar to 2008 and 2009, the volatile compound 1,4-dichlorobenzene was detected above its reporting limit, although below its prediction limit, from the sample collected during the September 2010 event This compound was detected at a concentration of 0 54 micrograms per liter (µg/L) This compound was first detected in BH-2 during the November 2007 sampling event and, with the exception of The April 2010 sampling event, it has been detected at a relatively low concentration every event since then

In addition, the VOCs acetone and methylene chloride were detected in BH-2 dunng the September sampling event at concentrations of 6 88 and 0 54 µg/L, respectively These compounds were also detected at similar concentrations in the trip blank submitted for that sampling event As such, these detections may result from contamination associated with the provided sample containers and/or transport

Well BH-5

Because of persistent detections of concentrations of two VOCs (1,1-dichloroethane [1,1-DCA] and 1,1-dichloroethene [1,1-DCE]) dunng 2000 and 2001 in well BH-5, the DSHW has required assessment monitoring for that well since the summer of 2002 The following summanze the VOC results in well BH-5 for 2010

- 1,1-DCA was detected dunng all four sampling events at concentrations ranging from 0 63 to 0 85 µg/L, none of which exceeded the the prediction limit of 1 0 µg/L These concentrations are similar to those reported over the last several years, i e , the concentration of 1,1-DCA does not appear to be increasing in well BH-5, but remains persistent at this relatively low level

- Tetrachloroethene (PCE) was also detected in well BH-5 dunng all four of the 2010 sampling events at concentrations ranging from 1 13 to 1 70 µg/L These concentrations all exceeded the prediction limit of 1 0 µg/L for PCE, which was the only VOC to exceed its respective prediction limit this reporting penod Based on the results for 2010, the concentration of PCE has increased slightly in well BH-5, although concentrations of this compound exceeding its prediction limit have been detected sporadically since 2003

- The volatile compound cis-1,2-dichloroethene (cis-1,2-DCE) was detected in well BH-5 in Apnl 2010 at a concentration of 0 57 µg/L This compound has been previously detected at concentrations over 1 0 µg/L dunng the penod of 2004-06 The prediction limit for cis-1,2-DCE is 1 0 µg/L

- Tnchlorofluoromethane was detected in well BH-5 dunng the Apnl 2010 sampling event at the reporting limit of 0 50 µg/L This VOC was also detected at low levels (0 55 µg/L) durıng the last two samplıng events ın 2009 The predıctıon lımıt for trıchlorofluoromethane ıs 1 0 µg/L

Sımılar to well BH-2, acetone and methylene chlorıde were detected ın BH-5 durıng the September samplıng event at concentratıons of 2 83 and 0 57 µg/L, respectıvely Sınce these compounds were also detected ın the trıp blank submıtted for thıs samplıng event, these detectıons are most lıkely related to sample contaıner contamınatıon and/or sample transport Acetone was also detected durıng the December 2010 samplıng event at 6 29 µg/L and, as wıth the September samplıng, was also detected ın the assocıated trıp blank

Well BH-7

No VOCs were detected above theır reportıng lımıts ın well BH-7 durıng semı-annual samplıng ın 2010 wıth the exceptıon of methylene chlorıde, whıch was detected at a low concentratıon durıng the September 2010 samplıng event Sınce thıs compound was also detected ın the assocıated trıp blank, ıt ıs consıdered to be a result of contamınatıon orıgınatıng from the provıded sample contaıners and/or sample transport

3 3 3 Metals

Groundwater samples were analyzed for total concentratıons of crıterıa pollutant and other general metals durıng 2010 groundwater samplıng Of the 18 metals that have been monıtored at the Armstrong Pıt, only beryllıum has never been detected at the landfıll at concentratıons above ıts respectıve reportıng lımıt Of the other metals, only arsenıc, chromıum, lead, and thallıum have been detected above theır respectıve GWPS Wıth the exceptıon of thallıum, these detectıons all occurred from 1992 to 1994, prıor to the placement of waste ınto the Armstrong Pıt Hıstorıcal and current results for the metals analyses are ıncluded ın Table 5, Metals Results Summary

The analytical laboratory reduced the reporting limits significantly for the majority of reported metals in 2008 With the exceptions of chromium, iron, mercury, tin, and vanadium, all of the metallic analytes now have lower reporting limits than those previous to 2008 These reduced reporting limits were the result of a change by the analytical laboratory (American West Analytical Laboratory) to an inductively coupled plasma/mass spectrometer (ICP/MS) method, Environmental Protection Agency (EPA) Method 6020, rather than the former standard ICP method (EPA Method 6010)

The following summarize the metals results for the 2010 sampling events

- The detected concentration of thallium during both sampling events in well BH-2 (3 4 µg/L) exceeded the established GWPS of 2 0 µg/L for this metal, continuing a trend from 2005 However, based on results from the last 6 years, detected concentrations of thallium in BH-2 do not appear to be increasing in this well This metal will continue to be monitored closely for increases due to its toxicity, and consequent low GWPS

- The detected arsenic concentrations in the samples collected from BH-2 in 2010 remain relatively high, and continue to exceed their statistical prediction limits (Section 3 4) as they have since 2005 Since increasing significantly in 2005, the arsenic concentrations in this well have remained relatively constant, remaining in the general range of 15 µg/L to 30 µg/L The arsenic concentrations detected at the landfill are well below the 50 µg/L GWPS for arsenic

- Selenium was detected in the samples collected from well BH-5 during all four sampling events at this well in 2010 These concentrations ranged from 4 2 to 5 4 µg/L, all of which are above the prediction limit of 4 0 µg/L, but well below the GWPS of 50 µg/L Selenium has been detected sporadically at levels similar to these, and greater, dating back to 1997

3 3 4 Miscellaneous Inorganic Analyses

No groundwater protection standards have been established for the various miscellaneous inorganic constituents and, as such, no statistical analysis is required and no prediction limits have been established These parameters are discussed in this section, however, to provide information on general chemistry and spatial variability of the local groundwater

The historical and current analytical results for the miscellaneous inorganic parameters are presented in Table 6, Miscellaneous Inorganic Results Summary Miscellaneous inorganic results for 2010 are generally consistent with past sampling results No significant recent deviations or trends are evident for these analytes based on the 2010 groundwater sampling analytical results, although TDS concentrations have increased significantly in wells BH-2 and BH-5 over the previous 4-6 years, as have chloride and bicarbonate concentrations in BH-2 since 2006

3 3 5 Assessment Monitoring Parameters

As noted previously, the detection of organic compounds in well BH-5 above the established prediction limit(s) has required assessment monitoring in that well The required sampling parameters for assessment monitoring are noted in Appendix II of 40CFR Part 258 These required analytes include, in addition to those required for detection monitoring (Sections 3 3 2 through 3 3 4), the following

- Pesticides by EPA Method 8081B,
- Herbicides by EPA Method 8151A,
- Twelve (12) additional VOCs by EPA Method 8260B, and
- SVOCs by EPA Method 8270

Complete assessment sampling, involving collection of groundwater for analysis of all parameters listed above, was conducted at BH-5 on July 27, 2010 The following paragraphs summarize the results of the assessment monitoring at well BH-5 for the above-noted additional parameters

Pesticide/PCB Analyses

Samples collected from well BH-5 in July 2010 were submitted for analysis of 19 common pesticides and for polychlorinated biphenyls (PCBs) by EPA Method 8081A and 8082A, respectively As shown in Table 7, Pesticides and Herbicides Results Summary, no pesticide compounds were detected in BH-5 during the July 2010 sampling above their respective reporting limits

No PCBs were detected above the laboratory reporting limit of 0 50 µg/L this reporting period

Herbicide Analyses

Samples collected from well BH-5 were also submitted for analysis of four common herbicides (2,4-D, 2,4,5-TP [Silvex], Dinoseb, and 2,4,5-T) by EPA Method 8151A in July of this reporting period As shown in Table 7 no herbicides were detected above their reporting limit of 1 0 µg/L

Additional VOC Analyses

In addition to the VOCs required under the detection-monitoring program, an additional 12 compounds are required under Appendix II for assessment monitoring None of these additional Appendix II VOC compounds have been detected at BH-5 since initiation of assessment monitoring in that well in 2002

SVOC Analyses

Under assessment monitoring, more than 100 semi-volatile compounds are required for annual analysis as designated in 40CFR Part 258, Appendix II, although no quantitative groundwater protection standards are currently established for these analytes These compounds, and the sampling results summary, are shown in Table 8, Semi-volatile Organic Results Summary

Due to the detection of two SVOC compounds (pentachlorophenol and benzo[a]pyrene) in previous sampling events, these compounds must be requested for analysis each of the quarterly sampling events at BH-5 The 2010 results for these two compounds are summarized below

- Pentachlorophenol was first detected in BH-5 at a concentration of 1 9 µg/L during the December 2003 sampling event This compound was detected at least once per year since then until June 2006 at concentrations up to 2 4 µg/L However, this compound has not been detected above its reporting limit of 1 0 µg/L since 2006

- Benzo(a)pyrene was first detected during the September 2005 sampling event in BH-5 at a concentration of 0 35 µg/L This compound was detected again during March 2007 sampling at a concentration of 0 37 µg/L, just above its reporting limit of 0 20 µg/L, but has not been detected in BH-5 since then

The SVOC bis(2-ethylhexyl)phthalate was detected in BH-5 dunng the July 2010 sampling at a concentration of 12 3 µg/L This compound has been detected twice previously in September 2002, at a concentration of 34 µg/L, and in November 2009 at a concentration of 12 3 µg/L This compound was also detected in the method blank associated with the BH-5 SVOC analyses at a concentration of 38 µg/L, indicating contamination originating from laboratory processes, e g , sample preparation and/or analysis Bis(2-ethylhexyl)phthalate is ubiquitous in the environment and therefore a common source of field and laboratory contamination

3 4 COMPARISON OF 2010 GROUNDWATER ANALYTICAL RESULTS WITH ESTABLISHED PREDICTION LIMITS

As summarized in Section 2 2, the results of post-background sampling events at the Iron County Municipal Landfill are evaluated for statistically significant changes by

- Comparing the 2010 sample results to the established prediction limits, as described in Appendix C, for those analytes that were detected 25 percent of the time or less during the background period, or

- Comparing normalized concentrations (Z_i) and cumulative increases (S_i) by means of Shewart-CUSUM charts (also described in Appendix C) against control limits for each parameter detected more than 25 percent of the time during background sampling

The individual Shewart-CUSUM charts, as updated with the 2010 detection and assessment sampling data, are included with this report in Appendix D Only charts for those parameters required for statistical evaluation (and detected more than 25 percent of the time during background sampling) have been included with this report Control charts are included for the following parameters

- Antimony (well BH-2),
- Arsenic (all wells),
- Barium (all wells),
- Chromium (wells BH-5 and BH-7),
- Copper (wells BH-2 and BH-5),
- Lead (all wells),

- Selenium (wells BH-2 and BH-7), and
- Zinc (all wells)

The following sections discuss the parameters that are approaching or have exceeded the established prediction limits during 2010 For ease of comparison, the prediction limits used for each parameter have been included in Tables 4 and 5 for each well except where tracked using Shewart-CUSUM charts Note that those analyte concentrations exceeding their prediction limits, either non-parametric or Shewart-CUSUM, are indicated in red on the respective results summary table(s)

3 4 1 Volatile Organic Compounds

Prediction limits for VOCs are set at the method PQL for all parameters since organic compounds were detected only infrequently during background sampling The respective prediction limits for all required organic compounds are shown in Table 4 and discussed in Appendix C It should be noted that the established reporting limits (PQLs) for VOCs are currently below the respective prediction limits for many of the analytes as shown in Table 4 This is due to the elevated PQLs reported by the laboratory during the background sampling period of 1992-94 Because of this, it is difficult to establish prediction limits for the ongoing analyses using the current PQLs reported by AWAL Although the prediction limits are currently set lower than the PQLs reported during background sampling, they are higher than the currently reported PQLs

Only one VOC was detected at or above its respective prediction limit during 2010, PCE was detected at concentrations ranging from of 1 13 to 1 70 µg/L, all just above the prediction limit of 1 0 µg/L during all four of the sampling events at BH-5 Although this compound has been detected sporadically at or above its prediction limit dating back to June 2003, it appears that PCE concentrations are currently increasing slightly in BH-5 However, all detected concentrations are well below the GWPS value of 5 0 µg/L for this compound

3 4 2 Metals

The detected concentrations of thallium (3 4 µg/L) in well BH-2 for both 2010 sampling events were above this element's non-parametrically established prediction limit of 3 0 µg/L The thallium concentrations detected in BH-2 during 2010 are similar to those detected at this well since 2005, and comparable to intermittent detections dating back to background sampling in 1992-94 Thallium was not, however, detected above its reporting limit in either of the other two wells in 2010

Arsenic concentrations detected in well BH-2 have exceeded the parametrically established prediction limit for this element since 2006, and remain statistically out of control in this well This is presented graphically on the Shewart-CUSUM charts for arsenic included in Appendix D

The detected concentrations of selenium in well BH-5 of 4 8 µg/L, 5 4 µg/L, 4 2 µg/L, and 4 4 µg/L during the April, July, September, and December 2010 sampling events, respectively, were all above the prediction limit (4 0 µg/L) for this element in BH-5

With the exception of the above-noted thallium, arsenic, and selenium results in 2010, the detected concentrations of metallic analytes remained in control as determined by comparison with their established prediction limits

3 4 3 General Inorganic Parameters

Since no GWPS has been established for the general inorganic parameters analyzed as part of the semi-annual groundwater sampling (Table 6), no statistical evaluation is required for these parameters The analytical results for these parameters are discussed in Section 3 3 4

3 5 QUALITY CONTROL ASSESSMENT

3 5 1 Laboratory QA/QC Procedures and Results

Several standard quality assurance/quality control (QA/QC) procedures are employed on the part of the laboratory dunng analysis of the groundwater samples submitted from the Iron County Landfill These laboratory procedures included

- *Method Blanks (MB)* - Method blanks provide information on possible cross-contamination of samples during laboratory preparation and analysis, and consist of aliquots of purified water that are prepared (filtered, digested, titrated, etc) along with the submitted samples

- *Laboratory Check Samples (LCS)* – A LCS is analyzed as part of each batch of submitted samples to venfy the accuracy of the analytical equipment A LCS is prepared separately with a known concentration of the analyte or analytes

- *Matrix Spikes (MS)* – Matnx spikes are used to test for matnx interference in the submitted samples A known concentration of a given analyte is added to an aliquot from a submitted sample, and the detected concentration compared to the onginal amount added Poor recovery of the 'spiked" amount indicates a sample matrix that is causing interference

- *Matrix Spike Duplicate (MSD)* – Similar to matnx spikes, matnx spike duplicates are used to test for matrix interference in the analyzed samples

The results of the laboratory QC samples are not tabulated, but are included with the sample analytical data on the laboratory reports included in Appendix B Several instances of matrix interference, and associated problems with matrix spike and duplicate recoveries, were reported, especially for the MS/MSD results from the VOC and inorganics analyses With the exception of one SVOC method blank (below), no significant laboratory contamination problems were noted in the various associated laboratory QC sample analyses for 2010 In addition, sample preparation and analytical equipment were within specifications for the requested analytes at the contracted laboratory

The SVOC compound bis(2-ethylhexyl)phthalate was detected in the laboratory method blank analyzed for the July 2010 sampling event at a concentration of 38 6 µg/L, and also in the BH-5 groundwater sample The laboratory noted that these detections were likely the result of outside contamination

The only holding times that were exceeded were for the pH analyses This is due to the very short holding time for this analysis (24 hours) and the associated transit time for shipping the samples to the analytical laboratory in Salt Lake City from Iron County

3 5 2 Field QA/QC Procedures and Results

In addition to those techniques employed by the laboratory, other QA/QC procedures are used during field sampling to ensure data reliability These procedures commonly include

- *Field Duplicates* – Field duplicate samples are collected as a separate sample from the same well, using the same sampling procedure as the duplicated sample They are typically given another sample designation, prepared and analyzed as a separate sample by the laboratory, and the results of the original sample and the duplicate sample are then compared to verify the ability of the sample method and analytical equipment to replicate the sample result

- *Equipment Blanks* – An equipment blank (or field blank) is generally a sample of clean (filtered and/or distilled) water that is collected using the same procedures, equipment, and containers as the collected groundwater samples Results of the analysis of the equipment blank yield information on potential contamination originating from sampling equipment, added preservatives, and/or sample containers

- *Trip Blanks* – Trip blanks are prepackaged aliquots of laboratory pure water sent with the sample containers to the field, and returned in the same coolers with the collected samples to provide an indication of sample leakage or other cross-contamination that could occur during sample transit Trip blanks are generally analyzed for volatile constituents only as these have the highest potential to cross-contaminate other samples during handling and shipment

Trip blanks were included and analyzed for VOCs during all of the sampling events at the Iron County Landfill in 2010 No VOCs were detected above their respective reporting limits in the trip blanks submitted in April and July However, the VOC acetone was detected in the trip blanks submitted during the September and December 2010 sampling, and methylene chloride was also detected in the September trip blank Detections of these two compounds were also noted in the associated groundwater samples

One equipment blank, labeled as "BH-9", was submitted for the September 2010 sampling event Methylene chloride was reported in the equipment blank at a relatively low concentration of 0 60 µg/L, and acetone was also detected at a concentration of 3 52 µg/L With the exception of acetone in well BH-7, these volatile compounds were also detected in the all of the associated groundwater samples submitted in September 2010 Since these two VOCs were detected in the equipment blank, trip blanks, and associated groundwater samples, the source of these volatiles appears to be associated with the sample containers, handling, and/or shipping procedures

4 CONCLUSIONS AND RECOMMENDATIONS

4 1 SUMMARY AND CONCLUSIONS

Data generated from groundwater samplıng at the Iron County Landfıll (Armstrong Pıt) durıng the background penod of early 1992 to late 1994 have been used to establısh background concentratıons for each of the analytes requıred for detectıon monıtorıng Annual ıntra-well comparısons are made at each ındıvıdual well by companng post-background samplıng data for each calendar year agaınst data consıdered part of the background populatıon for that well

Based on the background data, and companson of that data wıth 2010 samplıng results, the followıng conclusıons can be made regardıng the current groundwater qualıty at the Iron County Landfıll

- *VOCs are not sıgnıficant contamınants of concern at the landfıll* Wıth the exceptıon of compounds attrıbutable to external contamınatıon, fıve VOCs were detected at or above theır respectıve reportıng lımıts ın 2010 1,4-dıchlorobenzene ın well BH-2, and 1,1- DCA, cıs-1,2 DCE, tnchlorofluoromethane, and PCE ın well BH-5 Of these, only PCE ın BH-5 was detected at a concentratıon above ıts predıctıon lımıt The concentratıons of all detected volatıles are well below theır respectıve GWPSs

- *Most metals results remaın ın control* Wıth the exceptıon of thallıum and arsenıc ın BH-2 and selenıum ın BH-5, the detected concentratıons of metallıc analytes are ın control as determıned by companson wıth establıshed predıctıon lımıts Only the concentratıons of thallıum ın BH-2 contınue to exceed the establıshed GWPS

- *General groundwater chemistry remains unchanged* The analyses of miscellaneous inorganic parameters indicates that, in general, few significant overall changes in groundwater chemistry have occurred during the monitoring period, although TDS concentrations have increased in wells BH-2 and BH-5 over the previous 5-7 years, as have chloride and bicarbonate concentrations in BH-2

- *Pesticides, herbicides, and PCBs are not currently contaminants of concern* No PCBs or herbicides were reported in well BH-5 above their reporting limits during assessment monitoring in 2010, nor have they been detected during previous sampling at BH-5 Although one pesticide (endosulfan sulfate) was detected at a relatively low level during the June 2009 assessment sampling, this compound was not detected in 2010

- *SVOCs are not currently contaminants of concern* Of the more than 100 semi-volatile compounds required for analysis in well BH-5, only one was detected above its reporting limit(s) this period The detected compound, bis(2-ethylhexyl) phthalate, was also detected in the associated laboratory method blank and reported by the laboratory as most likely due to outside contamination SVOCs are not commonly detected during groundwater sampling at the Iron County Landfill

The previous appearance and/or persistence of a small number of VOCs such as PCE, cis-1,2-DCE, trichlorofluoromethane, and 1,1-DCA in well BH-5, and 1,4-dichlorobenzene in well BH-2, could indicate minor infiltration of chlorinated compounds into these wells, either from the landfill or another, possibly mining-related, source Although some VOCs remain persistent in the groundwater at low levels, the results from the 2010 monitoring do not show any significant increase in the number of VOCs detected at the Iron County Landfill Concentrations of PCE have increased slightly in well BH-5, exceeding its prediction limit during all four of the sampling events in 2010

However, detected concentrations of this compound have also exceeded its prediction limit sporadically since 2003

The persistence of the metallic analyte thallium in well BH-2, the statistical increase in arsenic concentrations in BH-2 since 2005, and the increase in dissolved solids, chloride, and bicarbonate in this well over the last several years could also indicate infiltration of dissolved constituents into BH-2 Similar to the VOC analyses, however, results from the 2010 sampling do not show an overall increase in concentrations of metallic analytes, or in the number of analytes exceeding their established prediction limits

4 2 RECOMMENDATIONS

Based on the sampling results from the 2010 groundwater monitoring at the Iron County Landfill, we recommend the following

- Continue the groundwater sampling program currently in place at the landfill as required by DSHW i e , semi-annual detection monitoring at wells BH-2 and BH-7, and quarterly monitonng at BH-5

- The depth to ambient groundwater and total well depth should be measured at each well on an annual basis, at a minimum The existing dedicated pumps should be placed in each well intermediate in the standing water column, i e , approximately halfway between the groundwater surface and the bottom of the well

- The dedicated low-flow pumps in each of the wells should be removed and inspected for corrosion, fouling, and function each year, at a minimum

- Should fouling of the well screens in any of the wells be suspected or evident, we recommend that the fouled well(s) be cleaned or replaced Since the wells currently in place at the landfill are small-diameter wells, they would be difficult to treat In that case, well replacement with larger diameter wells is recommended

Future groundwater sampling should include at least one equipment blank and two trip blanks annually These QA/QC samples can help assess whether reported detections of analytes are actually endemic to the local groundwater or result from sampling or laboratory contamination

5 LIMITATIONS

The fındıngs, conclusıons, and recommendatıons presented ın thıs report are based upon ınformatıon presented to Kleınfelder by others Informatıon for thıs report has been provıded by

- Geologıc and hydrologıc reports prepared by other consultıng fırms,
- Laboratory data provıded to Kleınfelder by Iron County personnel,
- Fıeld data collected by Iron County personnel, and
- Results of chemıcal analyses by a commercıal analytıcal laboratory

The work for the report was performed ın a manner consıstent wıth that level of care and skıll ordınarıly exercısed by other members of Kleınfelder's professıon practıcıng ın the same localıty, under sımılar condıtıons and at the date the servıces are provıded Our conclusıons opınıons and recommendatıons are based on a lımıted number of observatıons and data It ıs possıble that condıtıons could vary between or beyond the data evaluated Kleınfelder makes no other representatıon, guarantee, or warranty, expressed or ımplıed, regardıng the servıces, communıcatıon (oral or wrıtten), report, opınıon or ınstrument of servıce provıded

Kleınfelder offers vanous levels of ınvestıgatıve and engıneerıng servıces to suıt the varyıng needs of dıfferent clıents It should be recognızed that defınıtıon and evaluatıon of geologıc and envıronmental condıtıons are a dıffıcult and ınexact scıence Judgments leadıng to conclusıons and recommendatıons are generally made wıth ıncomplete knowledge of the subsurface condıtıons present due to the lımıtatıons of data from fıeld studıes Although nsk can never be elımınated, more detaıled and extensıve studıes yıeld more ınformatıon, whıch may help understand and manage the level of rısk Sınce detaıled study and analysıs ınvolves greater expense, our clıents partıcıpate ın determınıng levels of servıce that provıde adequate ınformatıon for theır purposes at acceptable levels of risk More extensive studies, including subsurface studies or field tests, should be performed to reduce uncertainties Acceptance of this report will indicate that the client has reviewed the document and determined that it does not need or want a greater level of service than provided

6 REFERENCES

American Society for Testing and Materials (ASTM) (1996) *Provisional Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs* ASTM Designation PS 64-96 May 7, 1996

ASTM (1998) *Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs* ASTM Designation D6312-98 December 1998

Kleinfelder, Inc (1999) *Groundwater Monitoring Report, 1992-1998 Iron County Municipal Landfill, Armstrong Pit, Iron County, Utah* Salt Lake City

Tahoma Companies, Inc (1992) *Groundwater Monitoring Plan – Addendum to the Ground Water Discharge Permit Application, Proposed Armstrong Pit Landfill Site* August 1991 Revised January 1992

Tahoma Companies, Inc (1997) *Groundwater Analysis for Iron County* March 1997

APPENDIX G

HELP Modeling

FRACTION OF AREA ALLOWING RUNOFF = 100 0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1 000 ACRES
EVAPORATIVE ZONE DEPTH = 18 0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 1 800 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 7 866 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0 432 INCHES
INITIAL SNOW WATER = 0 000 INCHES
INITIAL WATER IN LAYER MATERIALS = 26 280 INCHES
TOTAL INITIAL WATER = 26 280 INCHES
TOTAL SUBSURFACE INFLOW = 0 00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
CEDAR CITY UTAH

STATION LATITUDE = 37 50 DEGREES
MAXIMUM LEAF AREA INDEX = 0 00
START OF GROWING SEASON (JULIAN DATE) = 125
END OF GROWING SEASON (JULIAN DATE) = 284
EVAPORATIVE ZONE DEPTH = 18 0 INCHES
AVERAGE ANNUAL WIND SPEED = 8 80 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 64 00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 36 00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 34 00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 58 00 %

NOTE PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CEDAR CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0 69	0 89	1 36	1 10	0 84	0 43
1 09	1 47	0 98	0 95	1 00	0 70

NOTE TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CEDAR CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
29 50	34 60	40 10	47 50	56 50	66 70
74 10	72 00	63 00	51 70	39 70	30 70

NOTE SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CEDAR CITY UTAH
AND STATION LATITUDE = 37 50 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU FEET	PERCENT
PRECIPITATION	5 46	19819 801	100 00
RUNOFF	0 003	11 477	0 06
EVAPOTRANSPIRATION	4 681	16991 443	85 73
PERC /LEAKAGE THROUGH LAYER 2	0 018410	66 827	0 34
CHANGE IN WATER STORAGE	0 758	2750 049	13 88
SOIL WATER AT START OF YEAR	26 280	95396 281	
SOIL WATER AT END OF YEAR	27 038	98146 336	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00

ANNUAL WATER BUDGET BALANCE 0 0000 0 003 0 00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU FEET	PERCENT
PRECIPITATION	9 64	34993 203	100 00
RUNOFF	0 002	7 370	0 02
EVAPOTRANSPIRATION	7 306	26519 596	75 78
PERC /LEAKAGE THROUGH LAYER 2	0 024777	89 939	0 26
CHANGE IN WATER STORAGE	2 308	8376 297	23 94
SOIL WATER AT START OF YEAR	27 038	98146 336	
SOIL WATER AT END OF YEAR	29 345	106522 633	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	0 000	0 00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU FEET	PERCENT
PRECIPITATION	15 31	55575 293	100 00
RUNOFF	0 020	70 800	0 13
EVAPOTRANSPIRATION	13 674	49637 234	89 32
PERC /LEAKAGE THROUGH LAYER 2	0 082111	298 063	0 54
CHANGE IN WATER STORAGE	1 534	5569 204	10 02
SOIL WATER AT START OF YEAR	29 345	106522 633	
SOIL WATER AT END OF YEAR	30 879	112091 836	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 007	0 00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU FEET	PERCENT
PRECIPITATION	6 66	24175 801	100 00
RUNOFF	0 008	30 842	0 13

EVAPOTRANSPIRATION	5 523	20046 752	82 92
PERC /LEAKAGE THROUGH LAYER 2	0 435803	1581 964	6 54
CHANGE IN WATER STORAGE	0 693	2516 241	10 41
SOIL WATER AT START OF YEAR	30 879	112091 836	
SOIL WATER AT END OF YEAR	31 485	114292 156	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 087	315 917	1 31
ANNUAL WATER BUDGET BALANCE	0 0000	0 003	0 00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU FEET	PERCENT
PRECIPITATION	10 56	38332 801	100 00
RUNOFF	0 011	38 274	0 10
EVAPOTRANSPIRATION	9 925	36028 184	93 99
PERC /LEAKAGE THROUGH LAYER 2	0 337155	1223 873	3 19
CHANGE IN WATER STORAGE	0 287	1042 466	2 72
SOIL WATER AT START OF YEAR	31 485	114292 156	
SOIL WATER AT END OF YEAR	31 860	115650 539	

SNOW WATER AT START OF YEAR	0 087	315 917	0 82
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	0 005	0 00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU FEET	PERCENT
PRECIPITATION	11 19	40619 703	100 00
RUNOFF	0 072	261 016	0 64
EVAPOTRANSPIRATION	9 289	33718 125	83 01
PERC /LEAKAGE THROUGH LAYER 2	0 316221	1147 881	2 83
CHANGE IN WATER STORAGE	1 513	5492 693	13 52
SOIL WATER AT START OF YEAR	31 860	115650 539	
SOIL WATER AT END OF YEAR	33 110	120189 039	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 263	954 196	2 35
ANNUAL WATER BUDGET BALANCE	0 0000	-0 011	0 00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU FEET	PERCENT
PRECIPITATION	10 97	39821 098	100 00
RUNOFF	0 066	239 229	0 60
EVAPOTRANSPIRATION	7 261	26356 625	66 19
PERC /LEAKAGE THROUGH LAYER 2	0 531866	1930 673	4 85
CHANGE IN WATER STORAGE	3 111	11294 575	28 36
SOIL WATER AT START OF YEAR	33 110	120189 039	
SOIL WATER AT END OF YEAR	36 484	132437 812	
SNOW WATER AT START OF YEAR	0 263	954 196	2 40
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 006	0 00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU FEET	PERCENT

	INCHES	CU FEET	PERCENT
PRECIPITATION	13 72	49803 602	100 00
RUNOFF	0 128	465 415	0 93
EVAPOTRANSPIRATION	10 749	39019 492	78 35
PERC /LEAKAGE THROUGH LAYER 2	0 693746	2518 300	5 06
CHANGE IN WATER STORAGE	2 149	7800 406	15 66
SOIL WATER AT START OF YEAR	36 484	132437 812	
SOIL WATER AT END OF YEAR	38 565	139991 062	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 068	247 147	0 50
ANNUAL WATER BUDGET BALANCE	0 0000	-0 012	0 00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU FEET	PERCENT
PRECIPITATION	11 13	40401 902	100 00
RUNOFF	0 117	425 342	1 05
EVAPOTRANSPIRATION	8 754	31778 248	78 66
PERC /LEAKAGE THROUGH LAYER 2	0 847137	3075 107	7 61
CHANGE IN WATER STORAGE	1 411	5123 202	12 68

SOIL WATER AT START OF YEAR	38 565	139991 062	
SOIL WATER AT END OF YEAR	40 044	145361 422	
SNOW WATER AT START OF YEAR	0 068	247 147	0 61
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	0 005	0 00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU FEET	PERCENT
PRECIPITATION	18 78	68171 398	100 00
RUNOFF	0 303	1101 670	1 62
EVAPOTRANSPIRATION	10 997	39918 094	58 56
PERC /LEAKAGE THROUGH LAYER 2	1 312045	4762 724	6 99
CHANGE IN WATER STORAGE	6 168	22388 928	32 84
SOIL WATER AT START OF YEAR	40 044	145361 422	
SOIL WATER AT END OF YEAR	43 411	157583 047	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	2 801	10167 297	14 91
ANNUAL WATER BUDGET BALANCE	0 0000	-0 021	0 00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU FEET	PERCENT
PRECIPITATION	8 44	30637 199	100 00
RUNOFF	1 445	5244 315	17 12
EVAPOTRANSPIRATION	8 114	29453 187	96 14
PERC /LEAKAGE THROUGH LAYER 2	2 624547	9527 104	31 10
CHANGE IN WATER STORAGE	-3 743	-13587 399	-44 35
SOIL WATER AT START OF YEAR	43 411	157583 047	
SOIL WATER AT END OF YEAR	42 469	154162 953	
SNOW WATER AT START OF YEAR	2 801	10167 297	33 19
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 010	0 00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU FEET	PERCENT
PRECIPITATION	14 09	51146 695	100 00
RUNOFF	0 700	2542 020	4 97
EVAPOTRANSPIRATION	9 064	32901 531	64 33
PERC /LEAKAGE THROUGH LAYER 2	3 552256	12894 689	25 21
CHANGE IN WATER STORAGE	0 774	2808 464	5 49
SOIL WATER AT START OF YEAR	42 469	154162 953	
SOIL WATER AT END OF YEAR	43 243	156971 406	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 009	0 00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU FEET	PERCENT
PRECIPITATION	14 07	51074 102	100 00
RUNOFF	0 267	970 563	1 90

EVAPOTRANSPIRATION	10 793	39178 953	76 71
PERC /LEAKAGE THROUGH LAYER 2	1 945928	7063 719	13 83
CHANGE IN WATER STORAGE	1 064	3860 881	7 56
SOIL WATER AT START OF YEAR	43 243	156971 406	
SOIL WATER AT END OF YEAR	43 354	157376 516	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 952	3455 777	6 77
ANNUAL WATER BUDGET BALANCE	0 0000	-0 016	0 00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU FEET	PERCENT
PRECIPITATION	9 90	35937 004	100 00
RUNOFF	0 035	126 318	0 35
EVAPOTRANSPIRATION	10 059	36513 855	101 61
PERC /LEAKAGE THROUGH LAYER 2	1 241279	4505 842	12 54
CHANGE IN WATER STORAGE	-1 435	-5209 004	-14 49
SOIL WATER AT START OF YEAR	43 354	157376 516	
SOIL WATER AT END OF YEAR	42 871	155623 281	

SNOW WATER AT START OF YEAR	0 952	3455 777	9 62
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 009	0 00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU FEET	PERCENT
PRECIPITATION	11 34	41164 207	100 00
RUNOFF	0 009	33 392	0 08
EVAPOTRANSPIRATION	9 785	35519 531	86 29
PERC /LEAKAGE THROUGH LAYER 2	0 822795	2986 747	7 26
CHANGE IN WATER STORAGE	0 723	2624 534	6 38
SOIL WATER AT START OF YEAR	42 871	155623 281	
SOIL WATER AT END OF YEAR	43 269	157066 078	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 326	1181 737	2 87
ANNUAL WATER BUDGET BALANCE	0 0000	0 003	0 00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU FEET	PERCENT
PRECIPITATION	11 97	43451 094	100 00
RUNOFF	0 195	708 152	1 63
EVAPOTRANSPIRATION	9 694	35190 316	80 99
PERC /LEAKAGE THROUGH LAYER 2	2 022255	7340 787	16 89
CHANGE IN WATER STORAGE	0 058	211 860	0 49
SOIL WATER AT START OF YEAR	43 269	157066 078	
SOIL WATER AT END OF YEAR	42 969	155975 734	
SNOW WATER AT START OF YEAR	0 326	1181 737	2 72
SNOW WATER AT END OF YEAR	0 684	2483 951	5 72
ANNUAL WATER BUDGET BALANCE	0 0000	-0 023	0 00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU FEET	PERCENT

PRECIPITATION	8 38	30419 400	100 00
RUNOFF	0 015	53 567	0 18
EVAPOTRANSPIRATION	8 540	31001 947	101 92
PERC /LEAKAGE THROUGH LAYER 2	0 702681	2550 732	8 39
CHANGE IN WATER STORAGE	-0 878	-3186 842	-10 48
SOIL WATER AT START OF YEAR	42 969	155975 734	
SOIL WATER AT END OF YEAR	42 775	155272 844	
SNOW WATER AT START OF YEAR	0 684	2483 951	8 17
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 004	0 00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU FEET	PERCENT
PRECIPITATION	8 97	32561 094	100 00
RUNOFF	0 247	897 238	2 76
EVAPOTRANSPIRATION	5 838	21193 656	65 09
PERC /LEAKAGE THROUGH LAYER 2	2 254619	8184 268	25 14
CHANGE IN WATER STORAGE	0 630	2285 948	7 02

SOIL WATER AT START OF YEAR 42 775 155272 844

SOIL WATER AT END OF YEAR 43 405 157558 781

SNOW WATER AT START OF YEAR 0 000 0 000 0 00

SNOW WATER AT END OF YEAR 0 000 0 000 0 00

ANNUAL WATER BUDGET BALANCE 0 0000 -0 016 0 00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU FEET	PERCENT
PRECIPITATION	7 87	28568 102	100 00
RUNOFF	0 144	523 016	1 83
EVAPOTRANSPIRATION	6 926	25141 875	88 01
PERC /LEAKAGE THROUGH LAYER 2	1 108296	4023 114	14 08
CHANGE IN WATER STORAGE	-0 309	-1119 881	-3 92
SOIL WATER AT START OF YEAR	43 405	157558 781	
SOIL WATER AT END OF YEAR	42 787	155318 172	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 309	1120 731	3 92
ANNUAL WATER BUDGET BALANCE	0 0000	-0 023	0 00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU FEET	PERCENT
PRECIPITATION	12 28	44576 406	100 00
RUNOFF	0 181	656 036	1 47
EVAPOTRANSPIRATION	9 092	33005 473	74 04
PERC /LEAKAGE THROUGH LAYER 2	2 616279	9497 093	21 31
CHANGE IN WATER STORAGE	0 391	1417 807	3 18
SOIL WATER AT START OF YEAR	42 787	155318 172	
SOIL WATER AT END OF YEAR	43 487	157856 719	
SNOW WATER AT START OF YEAR	0 309	1120 731	2 51
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 003	0 00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU FEET	PERCENT
PRECIPITATION	7 78	28241 402	100 00
RUNOFF	0 004	14 688	0 05
EVAPOTRANSPIRATION	5 220	18948 854	67 10
PERC /LEAKAGE THROUGH LAYER 2	1 125354	4085 036	14 46
CHANGE IN WATER STORAGE	1 431	5192 819	18 39
SOIL WATER AT START OF YEAR	43 487	157856 719	
SOIL WATER AT END OF YEAR	44 340	160953 344	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 577	2096 191	7 42
ANNUAL WATER BUDGET BALANCE	0 0000	0 006	0 00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU FEET	PERCENT
PRECIPITATION	10 70	38841 004	100 00
RUNOFF	0 123	447 496	1 15
EVAPOTRANSPIRATION	8 335	30255 957	77 90

PERC /LEAKAGE THROUGH LAYER 2	4 027022	14618 090	37 64
CHANGE IN WATER STORAGE	-1 785	-6480 529	-16 68
SOIL WATER AT START OF YEAR	44 340	160953 344	
SOIL WATER AT END OF YEAR	42 798	155357 328	
SNOW WATER AT START OF YEAR	0 577	2096 191	5 40
SNOW WATER AT END OF YEAR	0 334	1211 681	3 12
ANNUAL WATER BUDGET BALANCE	0 0000	-0 010	0 00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU FEET	PERCENT
PRECIPITATION	14 75	53542 496	100 00
RUNOFF	0 086	313 451	0 59
EVAPOTRANSPIRATION	12 020	43631 605	81 49
PERC /LEAKAGE THROUGH LAYER 2	1 992104	7231 338	13 51
CHANGE IN WATER STORAGE	0 652	2366 103	4 42
SOIL WATER AT START OF YEAR	42 798	155357 328	
SOIL WATER AT END OF YEAR	43 483	157843 062	
SNOW WATER AT START OF YEAR	0 334	1211 681	2 26

SNOW WATER AT END OF YEAR	0 301	1092 047	2 04
ANNUAL WATER BUDGET BALANCE	0 0000	0 000	0 00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU FEET	PERCENT
PRECIPITATION	12 13	44031 902	100 00
RUNOFF	0 233	844 447	1 92
EVAPOTRANSPIRATION	10 362	37614 234	85 42
PERC /LEAKAGE THROUGH LAYER 2	2 730899	9913 165	22 51
CHANGE IN WATER STORAGE	-1 196	-4339 943	-9 86
SOIL WATER AT START OF YEAR	43 483	157843 062	
SOIL WATER AT END OF YEAR	42 588	154595 172	
SNOW WATER AT START OF YEAR	0 301	1092 047	2 48
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	0 000	0 00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU FEET	PERCENT
PRECIPITATION	7 39	26825 703	100 00
RUNOFF	0 001	5 184	0 02
EVAPOTRANSPIRATION	5 430	19712 437	73 48
PERC /LEAKAGE THROUGH LAYER 2	1 367549	4964 202	18 51
CHANGE IN WATER STORAGE	0 591	2143 885	7 99
SOIL WATER AT START OF YEAR	42 588	154595 172	
SOIL WATER AT END OF YEAR	42 803	155373 844	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 376	1365 207	5 09
ANNUAL WATER BUDGET BALANCE	0 0000	-0 006	0 00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU FEET	PERCENT
PRECIPITATION	8 27	30020 098	100 00

RUNOFF	0 008	29 707	0 10
EVAPOTRANSPIRATION	7 055	25608 676	85 31
PERC /LEAKAGE THROUGH LAYER 2	1 456268	5286 252	17 61
CHANGE IN WATER STORAGE	-0 249	-904 533	-3 01
SOIL WATER AT START OF YEAR	42 803	155373 844	
SOIL WATER AT END OF YEAR	42 930	155834 516	
SNOW WATER AT START OF YEAR	0 376	1365 207	4 55
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 003	0 00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU FEET	PERCENT
PRECIPITATION	15 76	57208 809	100 00
RUNOFF	0 370	1343 783	2 35
EVAPOTRANSPIRATION	11 427	41479 070	72 50
PERC /LEAKAGE THROUGH LAYER 2	3 507973	12733 942	22 26
CHANGE IN WATER STORAGE	0 455	1652 044	2 89
SOIL WATER AT START OF YEAR	42 930	155834 516	

SOIL WATER AT END OF YEAR	43 385	157486 562	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 031	0 00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU FEET	PERCENT
PRECIPITATION	10 91	39603 301	100 00
RUNOFF	0 459	1664 423	4 20
EVAPOTRANSPIRATION	8 896	32292 486	81 54
PERC /LEAKAGE THROUGH LAYER 2	0 935767	3396 833	8 58
CHANGE IN WATER STORAGE	0 620	2249 570	5 68
SOIL WATER AT START OF YEAR	43 385	157486 562	
SOIL WATER AT END OF YEAR	43 912	159401 281	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 092	334 855	0 85
ANNUAL WATER BUDGET BALANCE	0 0000	-0 014	0 00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU FEET	PERCENT
PRECIPITATION	8 48	30782 404	100 00
RUNOFF	0 000	0 000	0 00
EVAPOTRANSPIRATION	9 026	32762 951	106 43
PERC /LEAKAGE THROUGH LAYER 2	0 194604	706 414	2 29
CHANGE IN WATER STORAGE	-0 740	-2686 952	-8 73
SOIL WATER AT START OF YEAR	43 912	159401 281	
SOIL WATER AT END OF YEAR	43 264	157049 172	
SNOW WATER AT START OF YEAR	0 092	334 855	1 09
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	-0 007	0 00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU FEET	PERCENT
PRECIPITATION	13 76	49948 805	100 00
RUNOFF	0 003	12 415	0 02
EVAPOTRANSPIRATION	11 320	41093 047	82 27
PERC /LEAKAGE THROUGH LAYER 2	2 294668	8329 646	16 68
CHANGE IN WATER STORAGE	0 142	513 681	1 03
SOIL WATER AT START OF YEAR	43 264	157049 172	
SOIL WATER AT END OF YEAR	43 406	157562 859	
SNOW WATER AT START OF YEAR	0 000	0 000	0 00
SNOW WATER AT END OF YEAR	0 000	0 000	0 00
ANNUAL WATER BUDGET BALANCE	0 0000	0 016	0 00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0 67	0 66	1 27	0 72	0 79	0 53

1 07 1 49 0 86 1 12 0 96 0 88

STD DEVIATIONS 0 46 0 54 0 86 0 64 0 66 0 71
0 91 1 47 1 19 1 25 0 89 0 95

RUNOFF

TOTALS 0 049 0 007 0 005 0 000 0 001 0 002
0 023 0 047 0 017 0 011 0 007 0 006

STD DEVIATIONS 0 244 0 021 0 024 0 000 0 005 0 008
0 063 0 133 0 068 0 040 0 032 0 031

EVAPOTRANSPIRATION

TOTALS 0 592 0 712 1 017 0 854 0 781 0 520
0 609 0 994 0 669 0 749 0 752 0 589

STD DEVIATIONS 0 309 0 437 0 608 0 509 0 674 0 477
0 458 0 834 0 554 0 648 0 436 0 351

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS 0 0431 0 0667 0 1423 0 0748 0 0594 0 0485
0 0925 0 1752 0 2661 0 1687 0 1718 0 1284

STD DEVIATIONS 0 1219 0 1486 0 2299 0 0825 0 0561 0 0536
0 1222 0 2320 0 4853 0 4391 0 4053 0 2413

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AVERAGE ANNUAL TOTALS & (STD DEVIATIONS) FOR YEARS 1 THROUGH
30

	INCHES	CU FEET	PERCENT
PRECIPITATION	11 02 (3 058)	40009 9	100 00

RUNOFF	0 175	(0 2900)	636 05	1 590
EVAPOTRANSPIRATION	8 839	(2 1973)	32083 78	80 190
PERCOLATION/LEAKAGE THROUGH LAYER 2	1 43741	(1 11828)	5217 812	13 04131
CHANGE IN WATER STORAGE	0 571	(1 7025)	2072 22	5 179

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU FT)
PRECIPITATION	3 61	13104 300
RUNOFF	1 289	4678 1919
PERCOLATION/LEAKAGE THROUGH LAYER 2	0 146586	532 10699
SNOW WATER	3 28	11902 0566
MAXIMUM VEG SOIL WATER (VOL/VOL)	0 2519	
MINIMUM VEG SOIL WATER (VOL/VOL)	0 0240	

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1 3798	0 0767
2	42 0260	0 2918

SNOW WATER 0 000

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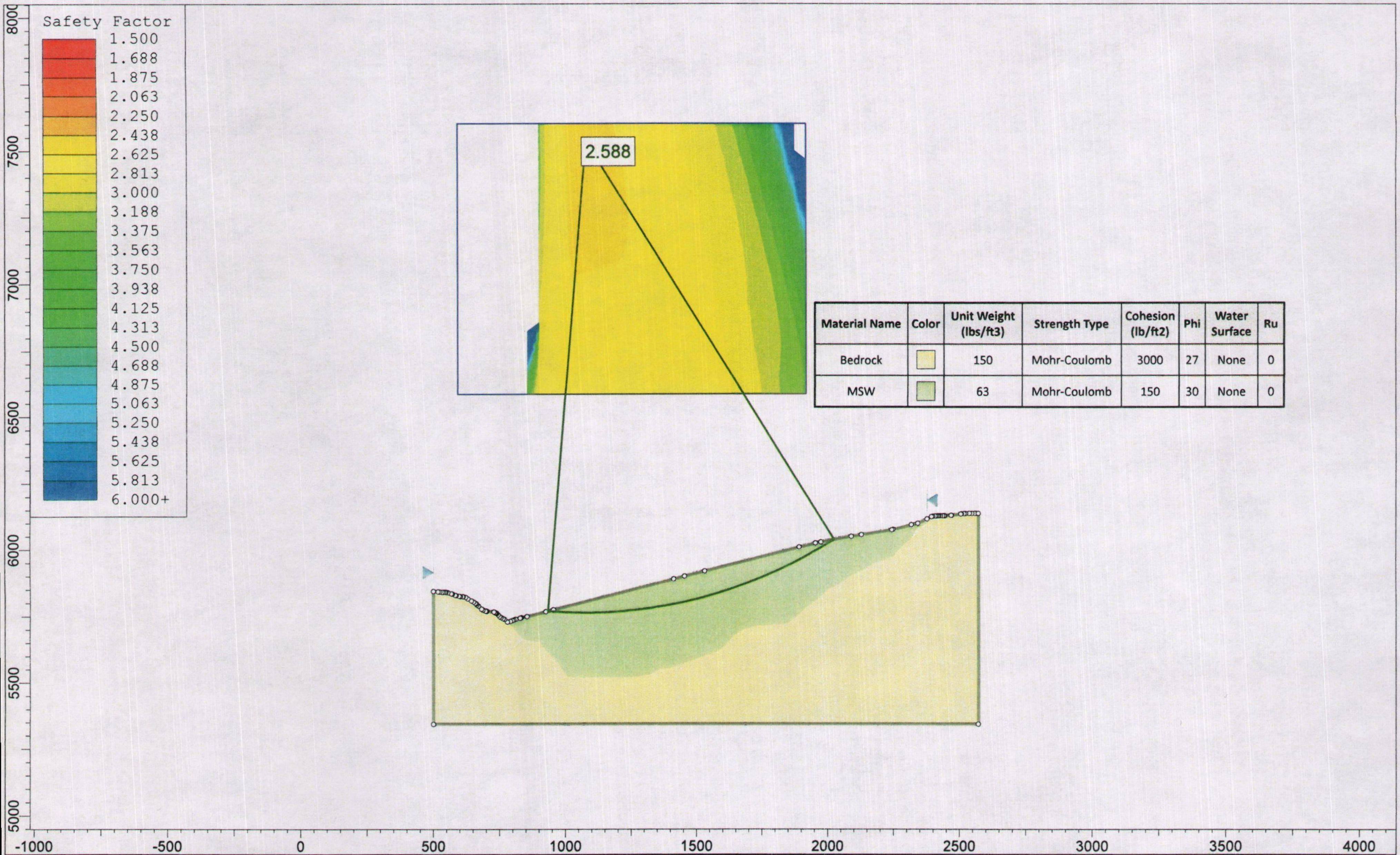
APPENDIX H

Slope Stability

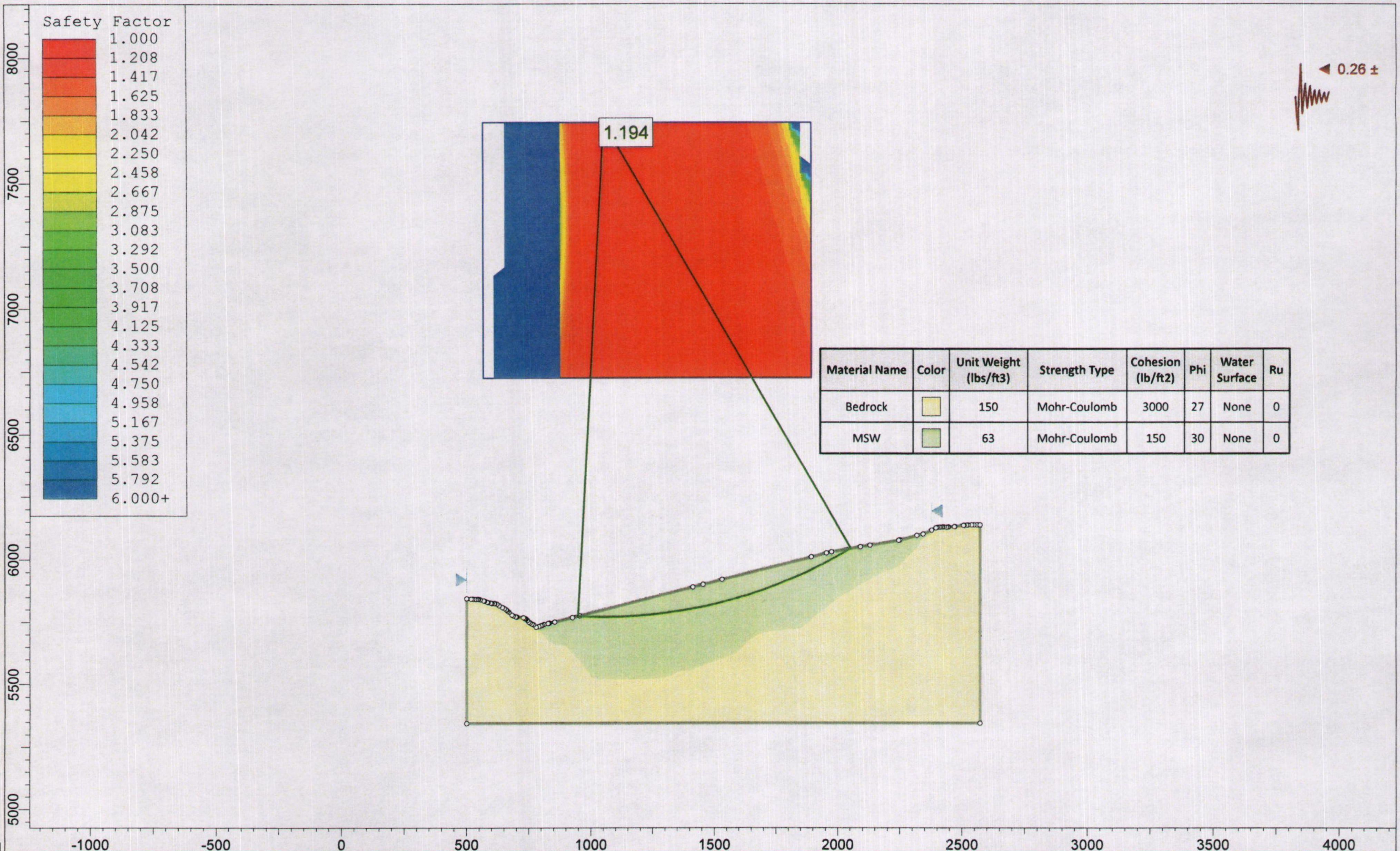


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Bedrock		150	Mohr-Coulomb	3000	27	None	0
MSW		63	Mohr-Coulomb	150	30	None	0

IGES®

SLIDEINTERPRET 6.009

Project	Iron County Landfill		
Analysis Description	Bishop Simplified		
Drawn By	JH	*Company*	Iron County Solid Waste
Date	4/8/2011, 3:44:54 PM	*File Name*	Lindsey Final Cover - Static.slim

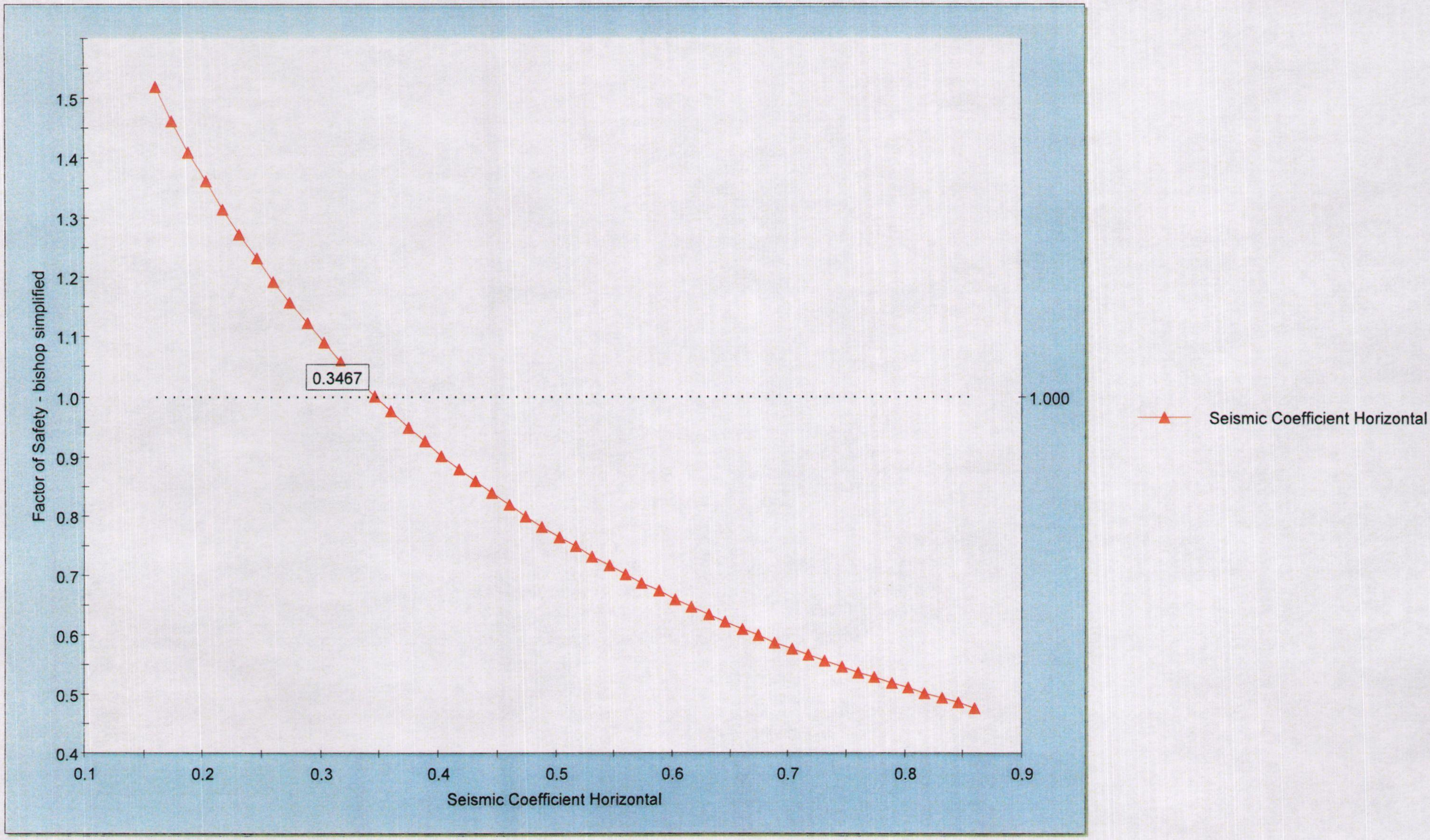


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Bedrock		150	Mohr-Coulomb	3000	27	None	0
MSW		63	Mohr-Coulomb	150	30	None	0

IGES®

SLIDEINTERPRET 6.009

Project	Iron County Landfill		
Analysis Description	Bishop Simplified		
Drawn By	JH	*Company*	Iron County Solid Waste
Date	4/8/2011, 3:44:54 PM	*File Name*	Lindsey Final Cover - Seismic.slim



IGES®	Project	Iron County Landfill	
	Analysis Description	Bishop Simplified	
	Drawn By	JH	Company: Iron County Solid Waste
SLIDEINTERPRET 6.009	Date	4/8/2011, 3:44:54 PM	File Name: Lindsey Final Cover - Seismic.slim

APPENDIX I

Closure/Post-Closure Costs

LANDFILL CLOSURE AND POST-CLOSURE COSTS

Armstrong Closure Costs 2044			
	Section 1 0 Engineering	$44,000	
	Section 2 0 Construction	$1 277 462	
	10% Contingency	$132 146	
	Subtotal		$1 453 608
Lindsey Closure Costs 2094			
	Section 1 0 Engineering	$44 000	
	Section 2 0 Construction	$572 500	
	10% Contingency	$61 650	
	Subtotal		$678 150
Armstrong & Lindsey Landfill Post Closure Costs (30 years)			$1 015 080
TOTAL LANDFILL CLOSURE AND POST-CLOSURE COSTS			$3,146,838

ARMSTRONG - PIT CLOSURE COSTS

Section 1.0 - Engineering

(ESTIMATED DATE OF CLOSURE= 2045, AREA= 1,381,000 FT SQ)

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
1.1	**Topographic Survey**	LS	$7,000	1	$7,000
1.2	**Boundary Survey for Closure**	NA	$2,500	1	$2,500
1.3	**Site Evaluation**	NA		1	$0
1.4	**Development of Plans (Cover and Gas Collection)**	LS	$12,000	1	$12,000
1.5	**Contract Administration - (Bidding and Award)**	LA	$2,500	1	$2,500
1.6	**Administrative Costs - (Certification of Final Cover and Closure Notice)**	LS	$6,000	1	$6,000
1.7	**Project Management - (Construction Observation and Testing)**	LS	$14,000	1	$14,000
1.8	**Monitor Well Consultant Cost**	NA			$0
1.9	**Other Environmental Permit Costs**	NA			$0
			Engineering Subtotal		$44,000

Section 2.0 - Construction

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
2.1	**Final Cover System**				
2.1.1	***Site Preparation/ Site Regrading***	ACRE	$1,000	32.0	$32,000
2.1.2	*Gas Collection Layer/Pipes*	Included below			$0
2.1.3	*Low permeability Layer (Soil - If Applicable)*				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	NA			$0
c	Soil Transportation	NA			$0
d	Soil Placement	NA			$0
e	Soil Amendment (compact)	NA			$0
2.1.4	***Low permeability Layer (Synthetic - If Applicable)***				
a	Geotextile	NA			$0
b	GCL	SQ FT	$0.50	1,460,000	$730,000
c	Geomembrane (HDPE,PVC,LLDPE,etc...)	SQ FT			$0
2.1.5	***Drainage Layer (Soil - If Applicable)***				
a	Geotextile	NA			$0
b	Sand/Gravel	NA			$0
2.1.6	***Drainage Layer (Synthetic - If Applicable)***				
a	Geotextile	NA			$0
b	Geonet/Geocomposite	SQ FT			$0
2.1.7	***Erosion Protection Soil Layer***				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	CY	$0.50	76,722	$38,361
c	Soil Transportation	CY	$2.00	76,722	$153,444
d	Soil Placement	CY	$0.75	76,722	$57,542
e	Soil Amendment (compact)	CY			$0
2.1.8	***Topsiol Layer***				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	CY	$0.50	25,574	$12,787
c	Soil Transportation	CY	$2.00	25,574	$51,148
d	Soil Placement	CY	$0.75	25,574	$19,181
e	Soil Amendment	NA			$0
2.1.9	***Revegetation***				
a	Seeding	ACRE	$800	32.0	$25,600
b	Fertilizing	ACRE	$800	32.0	$25,600
c	Mulch	ACRE	$200	32.0	$6,400
d	Tacifier	ACRE	$200	32.0	$6,400
2.2	**Stormwater Protection Structures**				
a	Culverts	NA			$0
b	Pipes	NA			$0
c	Ditches/Berms	FT	$16	6,500	$104,000
d	Detention Basins	NA			$0
2.3	**Gas Collection System**				
a	Design	Included In Section 1.0			$0
b	Additional Gas Collection Wells and Connection	EA			$0
2.4	**Leachate Collection System**				
a	Design	NA			$0
b	Additional Equipment / Installation	NA			$0
2.5	**Groundwater Monitoring System**				
a	Monitor Well Installation	NA			$0
b	Monitor Well Abandonment	NA			$0
2.6	**Site Security**				
a	Lighting, signs, etc...	NA			$0
b	Fencing and Gates	NA			$0
2.7	**Miscellaneous**				
a	Performance Bonds	LS	$10,000	1	$10,000
b	Contract/Legal fees	LS	$5,000	1	$5,000
			Construction Subtotal		$1,277,462

Total	$1,321,462
10% Contingency	$132,146
Subtotal Closure Cost	$1,453,608

LS - LUMP SUM
NA - NOT APPLICABLE
EA - EACH
CY - CUBIC YARD
FT - FEET

LINDSEY - PIT CLOSURE COSTS

Section 1.0 - Engineering

(ESTIMATED DATE OF CLOSURE=2092, AREA=1,647,000 FT SQ)

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
1.1	**Topographic Survey**	LS	$7,000	1	$7,000
1.2	**Boundary Survey for Closure**	NA	$2,500	1	$2,500
1.3	**Site Evaluation**	NA			$0
1.4	**Development of Plans** (Cover)	LS	$12,000	1	$12,000
1.5	**Contract Administration** - (Bidding and Award)	LA	$2,500	1	$2,500
1.6	**Administrative Costs** - (Certification of Final Cover and Closure Notice)	LS	$6,000	1	$6,000
1.7	**Project Management** - (Construction Observation and Testing)	LS	$14,000	1	$14,000
1.8	**Monitor Well Consultant Cost**	NA			$0
1.9	**Other Environmental Permit Costs**	NA			$0
				Engineering Subtotal	$44,000

Section 2.0 - Construction

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
2.1	**Final Cover System**				
2.1.1	***Site Preparation/ Site Regrading***	ACRE	$1,000	38.0	$38,000
2.1.2	*Gas Collection Layer/Pipes*	Included below			
2.1.3	*Low permeability Layer (Soil - If Applicable)*				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	NA			$0
c	Soil Transportation	NA			$0
d	Soil Placement	NA			$0
e	Soil Amendment (compact)	NA			$0
2.1.4	***Low permeability Layer (Synthetic - If Applicable)***				
a	Geotextile	NA			$0
b	GCL	NA			$0
c	Geomembrane (HDPE,PVC,LLDPE,etc...)	NA			$0
2.1.5	***Drainage Layer (Soil - If Applicable)***				
a	Geotextile	NA			$0
b	Sand/Gravel	NA			$0
2.1.6	***Drainage Layer (Synthetic - If Applicable)***				
a	Geotextile	NA			$0
b	Geonet/Geocomposite	NA			$0
2.1.7	***Erosion Protection Soil Layer***				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	CY	$0.50	91,500	$45,750
c	Soil Transportation	CY	$2.00	91,500	$183,000
d	Soil Placement	CY	$0.75	91,500	$68,625
e	Soil Amendment (compact)	CY			$0
2.1.8	***Topsiol Layer***				
a	Soil Purchase	NA			$0
b	Soil Processing (load)	CY	$0.50	30,500	$15,250
c	Soil Transportation	CY	$2.00	30,500	$61,000
d	Soil Placement	CY	$0.75	30,500	$22,875
e	Soil Amendment	NA			$0
2.1.9	***Revegetation***				
a	Seeding	ACRE	$800	38.0	$30,400
b	Fertilizing	ACRE	$800	38.0	$30,400
c	Mulch	ACRE	$200	38.0	$7,600
d	Tacifier	ACRE	$200	38.0	$7,600
2.2	**Stormwater Protection Structures**				
a	Culverts	NA			$0
b	Pipes	NA			$0
c	Ditches/Berms	FT	$16	3,500	$56,000
d	Detention Basins	NA			$0
2.3	**Gas Collection System**				
a	Design	Included In Section 1.0			$0
b	Additional Gas Collection Wells and Connection	LS			$0
2.4	**Leachate Collection System**				
a	Design	NA			$0
b	Additional Equipment / Installation	NA			$0
2.5	**Groundwater Monitoring System**				
a	Monitor Well Installation	NA			$0
b	Monitor Well Abandonment	NA			$0
2.6	**Site Security**				
a	Lighting, signs, etc...	NA			$0
b	Fencing and Gates	NA	$1,000	1	$1,000
2.7	**Miscellaneous**				
a	Performance Bonds	LS	$10,000		$0
b	Contract/Legal fees	LS	$5,000	1	$5,000
				Construction Subtotal	$572,500

Total	$616,500
10% Contingency	$61,650
Subtotal Closure Cost	$678,150

LS - LUMP SUM
NA - NOT APPLICABLE
EA - EACH
CY - CUBIC YARD
FT - FEET

LANDFILL POST-CLOSURE COSTS (30 YEARS)

Section 1.0 - Engineering

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
1.1	**Post-Closure Plan**	NA			$0
1.2	**Annual Report** (including results from gas, leachate, and ground water sampling - details of maintenance performed)	LS	$2,500	30	$75,000
a	Quarterly Site Inspections	LS	$320	120	$38,400
b	Plan Update	LS	$200	30	$6,000
				Engineering Subtotal	$119,400

Section 2.0 - Gas Collection System - Sampling

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
2.1	**Sample Collection**	LS			$0
2.2	**Sample Analysis**	NA			$0
2.3	**Report** (Part of Annual Report)				
		Gas Collection System - Sampling Subtotal			$0

Section 3.0 - Leachate Collection System - Sampling

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
2.1	**Sample Collection**	LS			$0
2.2	**Sample Analysis**	NA			$0
2.3	**Report** (Part of Annual Report)				
		Leachate Collection System - Sampling Subtotal			$0

Section 4.0 - Ground Water Monitoring System - Sampling

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
3.1	**Sample Collection**	LS	$320	120	$38,400
3.2	**Sample Analysis**	LS	$3,000	120	$360,000
3.3	**Report**	LS	$7,500	30	$225,000
	Ground Water Collection System - Sampling Subtotal				$623,400

Section 5.0 - Facility Operations and Maintenance

Item	Description	Unit Measure	Cost/Unit	No. Units	Total Cost
4.1	**Cover**				
a	Soil Replacement	LS	$2,000	30	$60,000
b	Vegetation/Reseeding	LS	$1,000	30	$30,000
4.2	**Storm Water Protection Structures**				
a	Ditch and Culvert Maintenance	LS	$500	30	$15,000
b	Berm and Basin Maintenance	LS	$500	30	$15,000
4.3	**Gas Collection System**				
a	System Operation	NA			$0
b	System Repair	LS			$0
4.4	**Leachate Collection System**				
a	System Operation	NA		30	$0
b	System Repair	NA		30	$0
4.5	**Ground Water Monitoring System**				
a	System Operation	NA		30	$0
b	System Repair	LS	$1,000	30	$30,000
4.6	**Site Security**				
a	Lighting, signs, etc...	LS	$500	30	$15,000
b	Fencing and Gates	LS	$500	30	$15,000
4.7	**Miscellaneous**				
a					
b					
		Facility Operations and Maintenance Subtotal			$180,000

Total	$922,800
10% Contingency	$92,280
Total Post-Closure Cost	$1,015,080