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Utah Division of Solid and Hazardous Waste

CLASS V LANDFILL APPLICATION

Prepared for

Green River Landfill, LLC
A Utah Limited Liability Company

Prepared by

Infill Companies
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April 2003

TABLE OF CONTENTS

SECTION ONE GENERAL INFORMATION 4
1.1 NAME OF FACILITY 4
1.2 SITE LOCATION 4
1.3 FACILITY OWNER 4
1.4 FACILITY OPERATOR 4
1.5 LOCAL CONTACT PERSON 4
1.6 TYPE OF FACILITY 4
1.7 TYPE OF APPLICATION 4
1.8 PROPERTY OWNERSHIP 5
1.9 CERTIFICATION OF SUBMITTED INFORMATION 5

SECTION TWO INTRODUCTION 6
2.1 PROJECT SUMMARY 6
2.2 GENERAL DESCRIPTION OF THE FACILITY 6
2.3 LEGAL DESCRIPTION OF FACILITY 6
2.4 TYPES OF WASTE AND AREA SERVED 6

SECTION THREE PLAN OF OPERATION 7
3.0 PLAN OF OPERATION 7
3.1 SCHEDULE OF CONSTRUCTION 7
3.2 DESCRIPTION OF ON-SITE WASTE HANDLING PROCEDURES 7
3.2.1 BALE-FILL OPERATION 8
3.2.2 COMPACTED FILL OPERATION 8
3.3 INSPECTIONS AND MONITORING 8
3.4 CONTINGENCY PLANS FOR FIRE OR EXPLOSION 9
3.5 CORRECTIVE ACTION PROGRAMS FOR GROUNDWATER CONTAMINATION 10
3.6 CONTINGENCY PLANS FOR OTHER RELEASES 10
3.6.1 EXPLOSIVE GAS 10
3.6.2 RUN-OFF CONTROL SYSTEM 10
3.7 FUGITIVE DUST 10
3.8 MAINTENANCE OF INSTALLED EQUIPMENT 10
3.9 PROCEDURES FOR EXCLUDING HAZARDOUS WASTE 10
3.10 PROCEDURES FOR CONTROLLING VECTORS 11
3.11 PLAN FOR ALTERNATIVE WASTE HANDLING 11
3.12 GENERAL TRAINING AND SAFETY PLAN 11
3.13 RECYCLING 11
3.14 COMMERCIAL DISPOSAL FACILITY REQUIREMENTS, SHWA 19-6-108(9) 12

SECTION FOUR GEOHYDROLOGICAL ASSESSMENT 12
4.0 GEOHYDROLOGICAL REPORT 12
4.1 LOCAL GEOLOGY 12
4.1.1 STRATIGRAPHY 13
4.1.2 STRUCTURAL GEOLOGY 14
4.2 REGIONAL GEOLOGY 14
4.3 GROUNDWATER 15
4.3.1 UPPER AQUIFER CHARACTERISTICS 15
4.3.2 UPPER AQUIFER RECHARGE 15
4.3.3 UPPER AQUIFER OUTFLOWS 16
4.3.4 PERCHED WATER 16
4.4 WELL INVENTORY 16
4.5 WATER RIGHTS 16
4.6 SURFACE WATER 16
4.7 WATER QUALITY 17
4.8 CALCULATION OF WATER BALANCE 17
4.8.1 HELP MODELING 18
4.8.1.1 HELP SENSITIVITY ANALYSIS 18
4.8.1.2 RESULTS 18

SECTION FIVE ENGINEERING REPORT 19
5.0 ENGINEERING REPORT 19
5.1 LOCATION STANDARDS 19
5.2 FACILITIY LIFE 20
5.3 CELL DESIGN - R315-303-3 (3)(c) EQUIVALENT DESIGN 20
5.3.1 GENERAL DESCRIPTION 21
5.3.2 PHASING 21
5.3.3 DAILY, INTERMEDIATE AND FINAL COVER 22
5.4 EQUIPMENT REQUIREMENTS AND AVAILABILITY 22
5.4.1 BALE-FILL EQUIPMENT 23
5.4.2 TRADITIONAL-FILL EQUIPMENT 23
5.5 BORROW SOURCES 23
5.6 RUN-OFF COLLECTION 23
5.7 GROUNDWATER MONITORING - WAIVER REQUEST 23
5.8 RUN-ON / RUN-OFF CONTROL SYSTEMS 23

SECTION SIX CLOSURE PLAN 24
6.0 CLOSURE PLAN 24
6.1 CLOSURE SCHEDULE 24
6.2 DESIGN OF FINAL COVER 24
6.3 SITE CAPACITY 24
6.4 FINAL INSPECTION 24

SECTION SEVEN POST-CLOSURE CARE 25
7.0 POST-CLOSURE CARE 25
7.1 SITE MONITORING 25
7.2 CHANGES TO TITLE, LAND USE AND ZONING 25
7.3 MAINTENANCE ACTIVITIES 25
7.4 FINAL COVER 25
7.5 RUN-ON / RUN-OFF CONTROL SYSTEMS 25
7.6 CONTACT PERSONS 25

SECTION EIGHT FINANCIAL ASSURANCE 26
8.0 FINANCIAL ASSURANCE 26
8.1 FINANCIAL ASSURANCE MECHANISM 27

SECTION NINE REFERENCES 28

LIST OF TABLES

Table 1 Schedule of Construction
Table 2 Inspection and Monitoring Schedule
Table 3 H.E.L.P. Modeling Results
Table 4 Summary of Estimated Closure & Post-Closure Costs for Cells 1, 2, or 3
Table 5 Summary of Estimated Closure & Post-Closure Costs for Cells 1 or 3
Table 6 Summary of Estimated Closure & Post-Closure Cost for Cell 2

LIST OF FIGURES

Figure 1 USGS Topographic Map
Figure 2 Geologic Map
Figure 3 Geologic Cross Section
Figure 4 Browns Wash Surface Hydrology

LIST OF DRAWINGS

Drawing 1 Cover Sheet
Location Map
Vicinity Map
Drawing 2 General Site Plan
Drawing 3 Site Preparation Grading Plan
Drawing 4 Berm Construction Plan
Drawing 5 Cell Cover Plan
Drawing 6 Section
Drawing 7 Sections and Details
Drawing 8 Cell #1 Filling Sequence
Drawing 9 Cell #2 Filling Sequence
Drawing 10 Cell #3 Filling Sequence

LIST OF APPENDICES

Appendix A Proof of Ownership w/ Legal Description
Appendix B Inspection Form
Appendix C Well Inventory
1. Point of Diversion Search
2. Place of Use Search
Appendix D Field and Laboratory Programs - 1994
1. Summary of Well, Exploratory Hole and Test Pit Location and Elevations
2. Perched Water Level Measurements
3. Summary of Slug Injection Tests
4. Geotechnical Laboratory Test Results
5. Chemical Laboratory Analytical Results
6. Exploratory Drill Hole, Piezometer, and Monitor Well Logs
7. Test Pit Logs
8. Slug Tests
Appendix E HELP Modeling Results
Appendix F Supporting Documentation
1. Needs Assessment Report
2. Department of Natural Resources, Division of Wildlife Resources
3. City of Green River Disposal Contract
Appendix G Engineering Calculations

SECTION ONE: GENERAL INFORMATION

1.0 GENERAL INFORMATION

Landfill Investors, LLC proposes to permit a Class V commercial solid waste landfill, the "Solitude Landfill", within the boundaries of the City of Green River, Emery County, Utah. The landfill will be a commercial nonhazardous solid waste disposal facility used for the disposal of municipal solid waste and any other nonhazardous solid waste, not otherwise limited by rule or solid waste permit for disposal. It is intended that the landfill will be operated in accordance with all Federal and State laws and regulations applicable to the management and operation of landfill sites. This includes, but is not limited to, the Rules of the Utah Solid Waste Disposal Act and Subtitle D of the Resource Conservation and Recovery Act.

1.1 NAME OF FACILITY

Solitude Landfill

1.2 SITE LOCATION

The landfill property is an irregularly shaped 320 acre parcel in Section 22, Township 21 South, Range 17 East, Salt Lake Base and Meridian (see Figure 1). The site is located approximately nine miles east of the Green River in the City of Green River. The latitude and longitude coordinates of the entry gate are:

Latitude:	N 38° 58' 20"
Longitude:	W 110°1' 42"

1.3 FACILITY OWNER

Green River Landfill, LLC
4570 Westgrove Drive, Suite 240
Addison, Texas 75001
972-407-0550

1.4 FACILITY OPERATOR

Landfill Investors, LLC
4570 Westgrove Drive, Suite 240
Addison, TX 75001
(972) 407-0701

1.5 LOCAL CONTACT PERSON

Pete Fote
2825 East Cottonwood Parkway, Suite 500
Salt Lake City, UT 84121
801-990-3456

1.6 TYPE OF FACILITY

Class V Commercial Landfill

1.7 TYPE OF APPLICATION

Initial Application

1.8 PROPERTY OWNERSHIP

Green River Landfill, LLC, a Utah Limited Liability Corporation, owns the property; proof of ownership is included in Appendix A.

1.9 CERTIFICATION OF SUBMITTED INFORMATION

The certification of submitted information is included below:

CERTIFICATION OF SUBMITTED INFORMATION

_____, President
(Name of Official) (Title)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____, Date 4/28/2003

SUBSCRIBED AND SWORN to before this 28th day of April, 2003.

My commission expires on the 5th day of February, 2005.

Roxie Hebert
Notary Public in and for

(SEAL) Dallas County, Texas.

ROXIE HEBERT
Notary Public, State of Texas
My Commission Expires
February 05, 2005

SECTION TWO INTRODUCTION

2.1 PROJECT SUMMARY

Green River Landfill, LLC (Owner), a Utah Limited Liability Corporation, and Landfill Investors, LLC (Operator) are a partnership of commercial landfill development firms with local offices in Salt Lake City, Utah. The Owner and Operator are making this application for the purpose of disposing of municipal solid waste and any other nonhazardous solid waste, not otherwise limited by rule or solid waste permit for disposal. The site for the new Class V Municipal Sold Waste (MSW) landfill is approximately nine miles east of the Green River in the City of Green River. The landfill will accept only waste delivered by truck and/or rail from municipal clients in Utah and throughout the United States under contract with Landfill Investors.

2.2 GENERAL DESCRIPTION OF THE FACILITY

The Solitude Landfill (Landfill) will be located on 320 acres of privately owned land located in Section 22, Township 21 South, Range 17 East, Salt Lake Base and Meridian. It is bordered on all sides by undeveloped land. Figure 1 shows the location of the site. Proof of ownership is included in Appendix A. Within the site boundaries are located three disposal cells and associated access roads.

The land use zoning of the site and the properties adjacent to the Landfill boundary is designated Industrial. The Landfill site will be surrounded by a chain-link security fence, phased in place as each cell is constructed. Other fencing may be placed between cells, as may be appropriate to or directed by various municipal clients. Access to the landfill will be gated to prevent unauthorized entrance when the landfill operator is not present. The locked gate will be located approximately 800 feet south of the northwest property corner. Entrance to the Landfill will be from the west along an improved all-weather road.

2.3 LEGAL DESCRIPTION OF FACILITY

The property was surveyed in June 1994 and the topography was mapped. The topographic map is provided here as Figure 2, Site Map.

2.4 TYPES OF WASTE AND AREA SERVED

The Landfill will accept waste as defined by R315-301-2 (11): The landfill will be a commercial nonhazardous solid waste disposal facility used for the disposal of municipal solid waste and any other nonhazardous solid waste, not otherwise limited by rule or solid waste permit for disposal. This waste will be delivered to the Landfill by truck and/or rail. The potential area served is the State of Utah and municipalities outside of the State of Utah. No hazardous waste will be accepted (see Section 3).

3.0. PLAN OF OPERATION

The purpose of the Plan of Operation is to provide an accurate description of the daily operation of the Landfill.

3.1 SCHEDULE OF CONSTRUCTION

The Owner will begin construction within 60 days following 1) approval by the Utah Department of Environmental Quality to operate the Landfill, 2) approval by the City of Green River to operate the Landfill, and 3) approval of the Governor and the Legislature. Table 1 presents the proposed schedule of general site construction, and construction of the first cell; however, rail access will be not be constructed until such time as the volume of waste makes it feasible or the demand of contracted municipalities requires it.

Table 1
Schedule of Construction

Start Date	Construction Activity	Completion Date
Notice + 60 days	Stake Disposal Cells for Excavation	Notice + 70 days
Notice + 72 days	Excavate First Disposal Cell & Stockpile Dirt	Notice + 102 days
Notice + 72 days	Grade and surface access road to site	Notice + 93 days
Notice + 102 days	Construct 1000 sf Operations Building	Notice + 144 days
Notice + 102 days	Fence & Gate Property	Notice + 137 days
Notice + 147 days	Facility Open for Disposal Operations	NA

Notice = Notice of Approvals and Contract Completion

The Landfill will be constructed with three disposal cells. One, two or all three cells may be constructed at once, depending on contractual arrangements with municipal clients. For example, two municipalities may allow co-mingling of their waste in one cell, while a third may demand a separate cell. Additionally, while it is intended to operate the Landfill as a bale-fill, a municipality that does not utilize baling technology will need a separate cell. The result of this potential variability is that the Schedule of Construction may be modified.

3.2 DESCRIPTION OF ON-SITE WASTE HANDLING PROCEDURES

The Landfill will be operated by Landfill Investors, LLC. Management of the Landfill will be conducted out of the operations office at the Landfill. The local contact at the site will be designated by the Owner's Utah Manager, Pete Fote. Daily operation of the landfill will be under the direction of his designated Landfill Operator (Operator) on site.

The landfill design will incorporate an excavated cut-and-fill method, excavating three disposal areas below the natural ground surface to an approximate maximum depth of between 30 to 35 feet (see Drawings 6 and 7). The bottom will be graded at approximately 2 percent slope, south to north, to follow the general topography of ground surface. The below-grade disposal area will be excavated and constructed prior to acceptance of waste. Disposal of waste will continue until the entire area has been filled to ground surface, then from ground surface up to a height of approximately 35 feet.
The gate to the landfill will be kept locked at all times that the landfill is not in operation. It is the responsibility of the operator to unlock the gate each morning and lock the gate at the

end of the day. The operator is responsible for directing vehicles to the proper location for disposal of waste. Direction of vehicles also may be accomplished through the placement of directional signs. An operator will attend the landfill at all times that the landfill is open.

3.2.1 Bale-Fill Operation.

The Operator will direct trucks with bales to the working face of the landfill cell designated for bales, where he will direct unloading and placement of the bales. Bales will be placed in such a manner as to reduce or eliminate air space between bales and to create the effect of an interlocking wall of bales. The number of bales accepted for disposal will be maintained on a daily basis. The Operator will take a photograph of the bale-fill working face at the end of each working day and prior to placement of required daily cover.

A Daily Operating Record form shall be completed during each day of operation at the landfill. An example of the Daily Operating Record is included in Appendix B. For the bale-fill cell, information shall include number and type/size of bales, inspection log, and any deviations from the approved Plan of Operation, along with the reason for the deviation. Completed forms shall be kept on file at the site.

3.2.2 Compacted Fill Operation

Non-baled waste may be delivered to the Landfill by either truck or rail car. In either event, the vehicles will be unloaded at the site and the waste moved to the working face of the compacted fill disposal cell. The operator will perform load counts on a daily basis, making a record of the number, type, maximum volume and tare weight of each delivery vehicle arriving at the site. A Daily Operating Record form shall be completed during each day of operation at the landfill. An example of the Daily Operating Record is included in Appendix B. Information shall include accurate load counts, type of waste, inspection log, and any deviations from the approved Plan of Operation, along with the reason for the deviation. Completed forms shall be kept on file at the site.

Incoming waste will be deposited at the working face under the direction of the operator. Refuse will be compacted across the working face with a compactor to achieve maximum practicable in-place density. The working goal for in-place density will be the range of 1100 to 1400 pounds per cubic yard. In-place density will be determined by calculation using disposal records (weight and volume) and a topographic survey. Density calculation will be performed on an annual basis so that the information will be complete in time for the annual report to the DEQ.

The working face of the compacted disposal cell will be covered daily with a minimum of six inches of soil over the surface of all exposed waste.

3.3 INSPECTIONS AND MONITORING

The schedule for inspections and monitoring of landfill facilities to ensure proper operation and maintenance is provided in Table 2.

TABLE 2
INSPECTION AND MONITORING SCHEDULE

Inspection/Monitoring Activity	Frequency
Access road and gate	Monthly
Fence inspection	Monthly
Landfill equipment maintenance	Per manufacturers recommendations
Closure final cover inspection	During closure activities
Post Closure Inspection/Maintenance	Quarterly
Post Closure Monitoring	Quarterly

There is no installed equipment at the landfill such as monitoring wells, leachate collection or gas collection systems, therefore there is no required maintenance as specified in UAC R315-302-2(2)(h).

3.4 CONTINGENCY PLANS FOR FIRE OR EXPLOSION

As a precaution to avoid a fire hazard, all waste shall be covered with soil on a daily basis (Section 3.2). In the event that fires do occur during operating hours, the burning material will be separated from other material and covered with soil, using on-site earth-moving equipment.

Small fires may be extinguished with the fire extinguishers provided in the site vehicles or by using on-site water, available from the water storage tank and/or the water trailer. Upon notification of an on-site fire, which is not controllable with on-site fire protection equipment, a long blast (greater than 30 seconds) on a vehicle horn will be sounded, and nonessential equipment will be shut down. All site personnel will assemble outside the landfill entrance, the City of Green River Fire Department will be alerted and all personnel will move to a safe distance from the involved area until the fire is extinguished. The telephone number and location of the nearest fire station will be displayed in the site office and in all site vehicles.

Fires that occur during times that the landfill is closed will be more difficult to control due to the time available for the fire to spread. If a fire is reported after hours, the Operator or Landfill Manager may utilize site equipment to segregate the burning portion and bury the fire with soil. Otherwise, the local fire department will be summoned to control the fire.

The contingency plan for dealing with explosive gasses is provided in Section 3.6.1. Such gases, however, are not expected to be generated within this Class V landfill due to the dry nature of the waste and the extremely limited availability of moisture to be entrained within the landfilled waste.

3.5 CORRECTIVE ACTION PROGRAMS FOR GROUNDWATER CONTAMINATION

Groundwater monitoring will not be performed at the Solitude Landfill; therefore no corrective action programs are included with this application.

3.6 CONTINGENCY PLANS FOR OTHER RELEASES

3.6.1 Explosive Gas

Due to the types of waste received and the dry climate of Utah, this landfill should generate little, if any, explosive gas. If quarterly gas monitoring indicates that methane gas exceeds the LEL at the property boundary; however, corrective measures will be implemented within ten (10) days. The contingency plan for implementing corrective measures will include 1) notification to The City of Green River and DEQ, 2) increasing quarterly monitoring frequency to monthly, and 3) installation of a passive venting system.

3.6.2 Run-Off Control System

During operation of the below-grade disposal operations, there will be no potential for failure of the run-off control system. During operation of the above-grade disposal operations, however, the perimeter berms that constitute the run-off control system could be compromised by such incidents as an excessively heavy rainfall or accidental breach by equipment. The contingency plan for dealing with such failure is first to re-direct surface flow (if any) back into the perimeter, and second to reconstruct the berm sufficiently to function as designed. All aspects of this contingency plan can and will be implemented using on-site equipment.

3.7 FUGITIVE DUST

Fugitive dust is not expected to be a nuisance; there are no residences within one-half mile of the facility. If, at any point in the operation of the facility, fugitive dust is determined to be a problem, measures will be taken to control it, which may include watering the road. Fugitive dust will be addressed routinely as necessary to comply with Division of Air Quality regulations.

3.8 MAINTENANCE OF INSTALLED EQUIPMENT

No equipment is installed, or is planned to be installed, at the Landfill, including groundwater monitoring equipment, leachate collection equipment, and gas collection and monitoring equipment.

3.9 PROCEDURES FOR EXCLUDING HAZARDOUS WASTE

The landfill will be a commercial, nonhazardous solid waste disposal facility and will accept waste as defined in R 15-301-2 (11). The landfill will accept municipal solid waste and any other nonhazardous solid waste, not otherwise limited by rule or solid waste permit for disposal; the landfill will not accept hazardous waste.

By contractual agreement, waste delivered to the Solitude Landfill that has originated from a Transfer Station will be required to design and implement procedures for excluding hazardous waste. These procedures will include, at a minimum, formal training of Transfer Station operators and / or collection personnel in the identification and removal of hazardous waste and hazardous materials.

Although procedures initiated at the respective Transfer Stations should preclude the delivery of hazardous waste to the Landfill, the Landfill Operator will also be responsible for identification and prohibition of unacceptable wastes that may be discovered in un-baled waste or loose waste delivered by a local or regional municipality that does not have access to a Transfer Station.

Loads will be inspected as they arrive and any suspicious waste will be refused access to the landfill. The dozer operator also will become aware of unacceptable waste in any waste material as he is working and compacting the load. Any suspicious waste discovered on the working face will be segregated from the other waste pending alternative disposal. The Landfill Manager will have the ultimate authority and responsibility for decisions regarding acceptance or rejection of any waste.

3.10 PROCEDURES FOR CONTROLLING VECTORS

The waste accepted at the Solitude Landfill will be either baled or loose. In either event, the waste will originate from a Transfer Station and as a result will be relatively dry. This type of waste does not lend itself to attracting or generating disease vectors; however, all waste shall be covered on a daily basis to prevent scattering of waste or attracting disease vectors. Standing water shall be allowed to drain to the extent possible to preclude the harboring of mosquito larvae.

3.11 PLAN FOR ALTERNATIVE WASTE HANDLING

If the site is closed for any reason, waste that is in transit may be stored in the transport containers (e.g., rail car on siding, truck trailer at site). Although the Solitude site comprises 320 acres, the entire facility (three cells and associated roadways, etc.) may not be constructed initially. In the event of an emergency, another area of the facility may be used to receive waste (whether for disposal or temporary storage), but only if such areas are constructed and available. If no such areas are available during an emergency, waste flows will be halted and waste in transit will be stored as described above.

3.12 GENERAL TRAINING AND SAFETY PLAN

Each employee who works with solid waste at the Landfill will be trained and have a working knowledge of basic maintenance and operational techniques necessary to operate and maintain the facility in a manner which does not endanger human health and safety or environmental quality, including emergency response and contingency plan implementation. Training will be accomplished through both on-the-job training and classroom training sessions (e.g. SWANA training classes).

The facility-training program will be directed by the Landfill Manager, or a designated professional trainer. Initial training will be completed within two months of employment followed by an annual review of basic waste management skills or formal annual training.

3.13 RECYCLING

Recycling activities will be performed by the contracted municipalities prior to any waste being delivered to the Landfill. No provisions for recycling will be made at the Landfill and the general public will not have access to the Landfill.

3.14 COMMERCIAL DISPOSAL FACILITY REQUIREMENTS, R315-310-3(2)

After receiving a permit from the Executive Secretary, Solitude will gain approval from the City of Green River, the Governor and the Legislature of the State of Utah.

SECTION FOUR GEOHYDROLOGICAL REPORT

4.0 GEOHYDROLOGICAL REPORT

The site is particularly suited for a landfill due to its remote location, small amount of annual precipitation (6.5 inches), high evapotranspiration (55.9 inches), low-permeable bedrock immediately below the site, the considerable depth to groundwater and the poor quality groundwater. The site, and the area surrounding the site, is not used for agriculture due to the lack of water and the poor soil and vegetative conditions.

The site conforms to the following location standards set forth in R315-302-1 (2):

- The site is not located within one thousand feet of any 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; or farmland which is classified as "prime," "unique," or of "statewide importance."
- No permanent dwellings or historic structures or properties exist within one-forth mile of the site.
- The site is not located within five miles of any airport runway.
- No archeological sites are nearby.
- The site is not located in a subsidence area, a dam failure flood area, above an underground mine, or above a salt dome or salt bed.
- The site is not located within 200 feet of a Holocene fault, nor is it located within a seismic impact zone.
- The local geology of the site, confirmed by field study, does not indicate that it is an unstable area subject to differential settling.
- The site is not located in any public land used by a public water system for watershed control for municipal drinking water purposes, or in a location that could cause contamination to a lake, reservoir, or pond.
- The site is not located in a flood plain or wetland area.
- Based on hydrogeologic studies in the area, the aquifer below the site is 200 to over 1000 feet below the surface. Although some isolated perched water pockets 25 to 40 feet below the surface were found along the ephemeral streams, the water quality of this water was found to be contain generally greater than 10,000 mg/L TDS.
- There are no threatened or endangered species at the site. (See letter from Utah Division of Wildlife Resources, Appendix F)

4.1 LOCAL GEOLOGY

The proposed landfill site lies on a gently northwest-sloping pediment that has developed on the Mancos Shale (see Figure 2, Geologic Map, and Figure 3, Geologic Cross Section). The site is typical of Badlands topography and is dissected with arroyos and ephemeral streams. Brown's Wash, a large ephemeral stream, crosses the northern portion of the site flowing west. A tributary of Brown's Wash also crosses the site flowing in a northwest direction and

joins Brown's Wash outside of the West boundary of site. Brown's Wash flows into the Green River approximately 6 miles west of the site.

The drainage area of Brown's Wash located upgradient from the Solitude Landfill site encompasses 27,930 acres (see attached map, Figure 4). The estimated flow in Brown's Wash originating from a 100-year storm event was calculated using the TR-20 SCS method. The attached sheets present the assumptions, input parameters, resulting hydrograph, and conclusions. Based on the input parameters used, the estimated peak flow from this storm event is 1020 cfs.

The calculated depth of flow of 3.46 ft will remain within the confines of the channel, which is approximately 5 ft deep. The peak velocity of 8.3 fps necessitates that some rip rap be placed on the banks of the channel, near the northeast corner of Cell 1, extending approximately 30 to 50 feet on either side of the point of closest approach of the channel to the site boundary. The riprap will serve to protect the corner of Cell 1 from undercutting. No other effects are anticipated from runoff in Browns Wash.

There is no runoff from open cells. All runoff in contact with waste is maintained within the open cell (see Figure 8 of the Permit Application). During construction and waste filling of the above-grade portion of the cells, a berm will be maintained around the perimeter of the open portion of the cell to prevent runoff.

Ground elevations at the site range from approximately 4300 to 4400 feet above mean sea level; the Green River, located six miles west of the site, is at about 4050 feet above sea level. The south edge of the site is bounded by low barren hills. The eroded flank of the East Tavuputs Plateau (Book Cliffs) is about 5 miles to the north and east of the site.

The climate of the site is semi-arid and generally has little vegetation, consisting of clumps of shad scale, occasional salt grasses, and isolated cactus plants (Hepwirth, 1963).

4.1.1 Stratigraphy

Soil cover over the site is generally very thin and consists of either a thin layer of alluvium or weathered shale. The northern and some of the central portions of the site are covered with alluvium and/or terrace deposits from the ephemeral stream channels in those areas (see Figure 2). Generally, alluvial deposits are near the base of the plateaus and near the larger stream channels where they contain a wide range of grain sizes, varying from boulders to clay. Subsurface logs from test pits and drill holes from the site show that the depth of alluvium generally ranges from 0 to 22 feet with the thicker depths near the stream channels. The remaining areas of the site are covered with an overburden that consists of silty clay material, weathered from the Mancos Shale bedrock. Test pits and borings indicate that the depths of silty clay overburden ranges from 0 to 5 feet. Test pit and drill hole logs are presented in Attachment 1.

Bedrock at the site consists of outcrops of the Mancos Shale formation, which is a dark-gray marine shale. Drilling logs from water and oil wells in the vicinity indicate that the Mancos Shale has a minimum thickness of about 1100 feet in the area of the site. Projecting the dip angle of the lower contact of the Mancos outcropping southwest of the site (see Figure 2, Geologic Map), the shale would be approximately 1420 feet thick below the site. The Mancos Shale formation has two distinguishable members in the lower part of the section in

the area of the site. In descending order these are the Ferron Sandstone and Tununk Shale. These both outcrop approximately 2 miles southwest of the site. Projecting the dip angle of these beds indicates that the Ferron Sandstone would be approximately 1300 feet below the site.

Directly below the Mancos Shale formation lies the Dakota Sandstone with a maximum thickness of 200 feet. The Dakota Sandstone comprises the top layer of the Mesozoic Sandstone Aquifer, an aquifer composed of a thick sequence of 11 bedrock units that are mostly sandstones. The maximum thickness of the Mesozoic Sandstone Aquifer is about 3000 feet. Underlying the Mesozoic Aquifer is the Lower Mesozoic and Upper Paleozoic confining beds, which are comprised of interbedded layers of siltstone, shale, sandstone and a highly impermeable layer of evaporites with a maximum thickness of 12,000 feet. Under the confining beds is the Lower Paleozoic Aquifer which is comprised of siltstones, sandstones, and limestones. A conceptual geologic cross section has been prepared as Figure 3 and shows a profile of general subsurface conditions

4.1.2 Structural Geology

A site investigation performed in 1994 included coring into the Mancos Shale to characterize the bedrock. The bedrock was determined to be highly weathered in the top 0 to 10 feet of the shale, rapidly grading to a competent shale to the maximum depth of the coring (140 feet). The Rock Quality Designation (RQD) of the bedrock ranged from 0 near the surface to 100% at about 30 feet deep and deeper. Joint spacing ranged from 0-1 inches near the surface to over 5 feet at the bottom of the corings. Some vertical fracturing was observed in the upper 20 feet of the corings, but at depths over 20 feet the joints were relatively clean and largely horizontal with some evaporite material (gypsum) found along the joints.

The nearest Holocene fault, the Little Grand Fault is located 1¼ miles south of the site. The Little Grand Fault runs generally east-west and is a normal fault that is approximately 12 miles in length (Rush, 1982). Although some smaller faults are located approximately 5 miles to the east and about 3 miles to the southwest, seismic activity at the site is probably governed by the larger and closer Little Grand Fault. Seismic activity at the site is considered minimal based on USGS National Seismic Hazard Mapping Project (http://geohazards.cr.usgs.gov/eq/index.html). According to the probabilistic ground motion values given for the site's coordinates, there is a 90% probability of not exceeding a horizontal acceleration of 0.05 g in 50 years.

4.2 REGIONAL GEOLOGY

The proposed facility is located in the northern portion of the Paradox Basin, which is in the Canyonlands section of the Colorado Plateau. The region is characterized by young-to-mature plateaus and large topographic relief. Paradox basin is not a definable physiographic feature but consists of the portion of the Colorado Plateau that is underlain by a thick sequence of evaporite (salt) beds.

Rock units in the area dip gently to the northwest. Identifiable rock outcroppings in the region include the Mesaverde Group, which is a sandstone unit with seams of shale and coal; the Book Cliffs and higher elevation plateaus are formed from Mesaverde Group. Below the Mesaverde Group lies the Mancos Shale formation which is a dark-grey marine

shale; the proposed site lies on an outcropping of the Mancos Shale Formation. Beneath the Mancos Shale formation lies the Dakota Sandstone which comprises the top layer of the Mesozoic Sandstone Aquifer, an aquifer composed of a thick sequence of 11 rock units that are mostly sandstones. The Dakota Sandstone outcrops about six miles south of the site. Further south of the site is a large outcropping of the Lower Mesozoic confining beds which consists of interbedded layers of siltstone, shale, sandstone, and evaporite beds. The Canyonlands area, approximately 30 miles south of the site, is formed from the Lower Mesozoic Confining beds. Under the confining beds is the Lower Paleozoic Aquifer which is comprised of siltstones, sandstones, and limestones.

4.3 GROUNDWATER

Based on drill holes from the surrounding area, the groundwater is at significant depths and is of generally low quality. Groundwater flow is generally to the west-southwest from areas of recharge (Book Cliffs) toward areas of discharge (Green River). Analysis of wells drilled in the area indicated minimum depth of water is 200 feet and maximum is over 1,000 feet.

Groundwater in the area occurs primarily in two separate aquifers: the upper Mesozoic sandstone aquifer and the lower Paleozoic aquifer. The upper and lower aquifers are hydraulically separated by thick beds of evaporates which effectively delineates the two aquifers and cause the aquifers to act independently. All ground water recharge to the aquifer system from the ground surface is limited to the upper aquifer, as the lower system is hydraulically isolated from the surface. Potential leakage between the aquifers is in an upward direction under the site (Rush, 1982).

4.3.1 Upper Aquifer Characteristics

The upper Mesozoic aquifer consists of a thick sequence of 11 northwesterly-dipping rock units that are mostly sandstones. The aquifer has a maximum thickness of 3,000 feet and is confined in the area of the site by the impermeable Mancos shale formation. Generally, water occurs in the rocks of the unsaturated part of the upper ground water system as a result of recharge from local precipitation. The precipitation vertically percolates downward toward the underlying zone of saturation where it begins to move horizontally. Regionally much of the upper aquifer is unsaturated, although perched water is common.

Water in the upper aquifer is generally found at depths greater than 200 feet. The potentiometric surface of the upper aquifer is the lowest near the Green River and rises away from the river: the elevation of the potentiometric surface is at least 200 feet below the ground surface of the site according to a potentiometric map developed by Rush (1982).

4.3.2 Upper Aquifer Recharge

Recharge from precipitation in the area of the site is probably minimal due to the outcropping of the impermeable Mancos Shale at the site. The majority of recharge to the upper aquifer system is greatest near the Book Cliffs, where the precipitation is relatively large, and along the ephemeral streams, where infiltration is most likely (Rush, 1982).

No recharge to the upper aquifer occurs due to inflows from the Green River. The potentiometric maps of the aquifer suggest instead that the river acts as a drain for the area. Recharge to the upper aquifer also occurs from subsurface inflows from the adjacent areas.

Potentiometric maps of the area indicate that most of the ground water inflow is from the San Raphael Swell to the west and the Book Cliff area to the north and east (Rush, 1982).

4.3.3 Upper Aquifer Outflows

Groundwater in the upper aquifer is too deep to be subject to evapotranspiration although the shale forms soils with minimal permeability and large porosity that retains temporarily stored water near the ground surface. Here it is easily discharged from perched water areas by transpiration due to plants and evaporation from the soil. Most of the evapotranspiration occurs along the larger ephemeral streams where there is perched water.

Several studies have been performed to determine the amount of outflow from the upper aquifer system into the Green River. Potentiometric maps and mass balance equations for the Green River indicate that regionally, there is flow from the upper aquifer into the Green River, although there appears to be very little local subsurface flow from the area based on potentiometric maps of the region. Regionally, subsurface flow from the area appears to flow from the area near the Green and Colorado River confluence to the south of the site. Discharge from wells and springs is believed to be minimal as there are no large diameter wells in the vicinity of the site, and there are few springs, and these springs generally flow from the perched water table (Rush, 1982)

4.3.4 Perched Water

During the 1994 field investigation, perched water was initially found in four locations at the site, in exploratory drill holes and monitor wells DH-2, MW-2, MW-5, MW-7 and DH-10. MW-7 was later discovered to be dry after completion of the monitor well. The only drill holes that produced perched water are found near the ephemeral streams. The perched water is believed to be isolated pockets of water that have been recharged from runoff from the ephemeral channels and does not extend across the site.

4.4 WELL INVENTORY

A search of water rights on file with the Utah Division of Water Rights indicated that no wells were located within 5 miles of the site (Appendix C).

4.5 WATER RIGHTS

The only water rights within a radius of 5 miles of the site include seven livestock watering ponds, five springs, and eight diversions along the ephemeral streams in the area. The City of Green River procures potable water from the Green River and does not utilize wells because of the significant depth to, and poor quality of, the ground water.

4.6 SURFACE WATER

Two large streams, the Colorado and Green Rivers, flow through the region in a southerly direction. The Colorado River is located approximately 45 miles east of the site and the Green River is located about 6 miles west of the proposed site. Two smaller perennial streams, the Price and San Rafael Rivers, enter the Green River from the northwest at a distance of 12 miles north and 16 miles south of the site, respectively. Most of the drainages in the area have ephemeral streams that flow in response to snowmelt or runoff from precipitation events.

4.7 WATER QUALITY

Existing data from Rush (1982) indicate that the ground water from the upper confining bed (Mancos Shale) and the upper aquifer (Mesozoic Sandstone) is brackish with dissolved solids levels from 500 to 14,000 mg/l. This would classify the water as Class II (drinking water) to Class IV (saline ground water) according to the *Administrative Rules For Ground Water Quality Protection*, (DWQ, 1993).

Perched water samples were obtained on July 29, 1994 from DH-2, DH-10, MW-2 and MW-5. Laboratory results, which are provided in Appendix D, indicate that the quality of the perched water below the site is of poor quality with TDS values ranging from 9,400 to 30,000 mg/l. These TDS values would generally classify the perched water as Class IV (Saline Groundwater), for TDS above 10,000 mg/l. This is based on the groundwater aquifer classification system established in the Utah Groundwater Quality Protection Regulations.

4.8 CALCULATION OF SITE WATER BALANCE

The site is semi-arid with annual precipitation at the site estimated to average 6.5 inches a year (*Utah Climate*, 1992). Annual evapotranspiration is significantly higher (55.9 inches) than the average precipitation at the Site. The site is characterized by a thin layer of soil that overlies the Mancos Shale bedrock. The soil consists of permeable silty gravel alluvium near the larger ephemeral streams with a thinner layer of silty clay soils over the rest of the site.

The upper ten feet of bedrock is highly weathered and permeable but grades rapidly to a non-weathered impermeable shale (permeability values range from 10^{-7} cm/sec to 10^{-13} cm/sec). The site is dissected with small arroyos that have developed in the largely silty clay overburden.

The range of ground water depths in the area, based on available well logs and references, ranges from 200 to over 1,000 feet below ground surface (Rush, 1982). Subsurface investigation of the site indicates that there is perched water near the larger ephemeral streams that ranges in depth from 27 to 39 feet.

Test results indicate that the minus 200 fraction of the soils (silt and clay portion) ranges between 5% and 44% in the alluvial areas of the site and between 20% and 90% in other areas of the site. The majority of the site soil would be generally classified as silty or sandy clay. Soils in the alluvial areas would be classified as either silty gravels or silty sand with gravel. A permeability test conducted on an uncompacted sample had a result of 2.2×10^{-4} cm/sec; tests conducted on compacted samples (95% Proctor maximum dry density) had results of 3.2 to 5.4×10^{-8} cm/sec.

4.8.1 HELP MODELING

Site conditions and the proposed design of the landfill were used to predict the site water balance and the hydrologic characteristics of the landfill using the computer program Hydrologic Evaluation of Landfill Performance (HELP). HELP calculates runoff, infiltration, evapotranspiration, and flux through the potential landfill. HELP has the option to synthetically produce rainfall based on data from one of 139 default cities in the program database. Grand Junction, Colorado is the closest city to the site which is in the database

(85 miles), and which has elevation and climate characteristics similar to Green River. The Grand Junction temperature and precipitation values were modified by entering temperature and precipitation values for Green River, Utah taken from *Utah Climate* (Ashcroft, 1992).

4.8.1.1 HELP Sensitivity Analysis

Two landfill hydrologic performance sensitivity cases were analyzed utilizing the HELP model, which included an active (open cell) case and a post-closure case. Both scenarios were modeled for a period of 20 years. The active period of the landfill is the worst-case scenario because there is significantly less evaporation and runoff than during post-closure conditions. Post-closure conditions were also modeled to predict long-term infiltration through the final cover, and infiltration through the landfill profile into the underlying bedrock.

The active (short-term) case conditions simulate the open waste cell during the commencement of disposal of waste material. The assumed exposed layer for the active case is a waste layer. Runoff in the model is allowed from the surface of the daily cover material. The maximum depth at which evaporation could occur (evaporative zone depth) was set to 30 inches. Because of the proposed phased construction it was assumed that the maximum area that will be exposed at a time is 2 acres. The rest of the cell area either would have been filled and the final cover constructed, or construction would not have started and the existing ground surface would be undisturbed.

The other case models post-closure conditions, simulating the cell after the final cover has been constructed. Runoff was allowed from 100 percent of the area in this case and the evaporative zone depth was set to 30 inches. Soil profiles for the cases are as follows:

<u>OPEN (ACTIVE) CASE - CASE 1</u>

- 6 inch silty clay daily cover material, permeability of 2.5E-5 cm/sec
- 10 ft layer of waste material
- 12-inch ripped and compacted shale layer, permeability of 6.8E-7 cm/sec
- Natural shale material

<u>POST-CLOSURE - CASE 2</u>

- 6-inch erosion resistant gravelly sand, permeability of 1E-2 cm/sec
- 24-inch evaporative layer / frost protection of silty sand, permeability of 1.2E-4 cm/sec
- 18-inch compacted shale layer, permeability of 6.8E-7 cm/sec
- 60-feet municipal waste
- 12-inch ripped and compacted shale layer, permeability of 6.8E-7 cm/sec
- Natural shale material

4.8.1.2 Results

HELP results indicate that during the open case, minimal infiltration into the underlying shale material took place. The model predicted approximately 0.03130 inches of infiltration per year during the active filling stage of the landfill.

During the closed period of the model, predicting the landfill after the final cover has been placed; HELP predicted no infiltration through the bottom layer of the landfill. In both cases

the majority of precipitation evaporates before infiltrating.

TABLE 1
HELP MODELLING RESULTS

WATER PROFILE (average annual totals)	OPEN CASE (In/yr)	CLOSED CASE (In/yr)
Precipitation	6.26	6.26
Runoff	0.304	0.00
Evaporation	5.981	6.256
Infiltration through cover liner	NA	0.00812
Infiltration through bottom liner	0.03130	0.00812

The worst-case scenario of the HELP model predicts a minimal amount of percolation into the underlying soil. Given the characteristics and thickness of the underlying Mancos shale formation at the site, and the great depth and poor quality of the groundwater in the area of the site, this percolation should be considered negligible.

SECTION FIVE ENGINEERING REPORT

5.0 ENGINEERING REPORT

The landfill will receive only municipal solid waste generated within Utah municipalities. Figure 2 presents a detailed topographic map of the facility. The property is relatively flat, sloping approximately 75 feet across approximately 6600 feet from the southeast corner to the northwest corner of the site.

Construction of the landfill will be completed using heavy equipment such as crawler-dozers, excavators, and scrapers. Soil that is removed during construction will be stockpiled on site to be used for daily cover and final cover. Other borrow areas will not be used. No blasting will be required to excavate the landfill cells. The site engineer will specify that the construction areas will be ripped using a crawler-dozer followed by excavation and removal of the ripped soils.

The landfill may receive clean fill material for disposal. Such materials will be used for cover and general grading, as needed. It is estimated that no more than 10% of the final cover material will need to be acquired from off-site at time of closure.

5.1 LOCATION STANDARDS

The proposed site for the Landfill meets the location standards of R315-302-1 (see Section 4.0).

5.2 FACILITY LIFE

Based on the facility design (see following Section 5.3), the total capacity of the site is 22 million cubic yards (Mcy). Accounting for 10% soil cover, the waste capacity of the site is 19.8 Mcy. The total designed capacity of each cell is, Cell 1 = 5 Mcy, Cell 2 = 11 Mcy, and Cell 3 = 6 Mcy

The Solitude Landfill expects to receive approximately 130,000 tons per year for disposal in Cell 1. At present, this waste is projected to arrive in compacted bales, each measuring approximately 2 cy and weighing approximately 1,400 pounds. Based on these assumptions, Cell 1 would have an approximate life of 12.12 years.

$$\frac{130{,}000 \text{ tons} \times 2{,}000}{1{,}400 \text{ lbs} / 2 \text{ cy}} = \frac{260{,}000{,}000 \text{ lbs}}{700 \text{ lbs/cy}}$$

$$\frac{260{,}000{,}000 \text{ lbs}}{700 \text{ lbs/cy}} = 371{,}428.57 \text{ cy}$$

$$\frac{5{,}000{,}000 \text{ cy} \times 0.9}{371{,}428.57 \text{ cy / year}} = 12.12 \text{ years}$$

Cells 2 and 3 are not currently planned for a specific user; however, potential users have been identified that could generate from 300,000 to 750,000 tons per year (tpy) for disposal. The following assumptions for calculating facility life are based on a maximum usage scenario.

- Cell 2 is filled and closed prior to Cell 3
- The maximum annual volume of waste (750,000 tpy) is received
- All waste in Cells 2 and 3 is co-mingled
- All waste in Cells 2 and 3 is delivered loosely compacted (400 – 800 lbs/cy)
- All waste is compacted on-site to an average density of 1,200 lbs/cy
- Daily cover soil will equal 10% of total volume

Based on those assumptions, the facility will dispose of 1,250,000 cubic yards of waste per year plus 125,000 cubic yards of soil for a total volume of 1,375,000 cubic yards per year. Since Cells 2 and 3 have a combined total designed capacity of 17 Mcy, the calculated facility life is approximately 12.36 years.

5.3 CELL DESIGN – R315-303-3 (3)(c) EQUIVALENT DESIGN

The Owner requests approval by the Executive Secretary for an Equivalent Design, incorporating no liners or leachate collection systems, based on operating practices and location characteristics which minimize the migration of solid waste constituents or leachate into the ground or surface water and which are at least as effective as the liners of R315-303-3 (3)(a) or (b). This standard, as well as the standard of R315-303-2 (1), is demonstrated in Section Four, Geohydrological Report, and is based on 1) the hydrogeologic characteristics of the facility and the surrounding land, 2) the climatic factors

of the area, 3) the volume and physical and chemical characteristics of the leachate and 4) predictions (HELP model) that maximize leachate generation. Additionally, operating procedures at each landfill cell minimize the working face and, consequently, minimize potential surface area for leachate generation from precipitation.

5.3.1 General Description

Each cell will be constructed for a designated municipality or group of municipalities, and may be operated as a bale-fill or as a traditional compacted loose-waste fill. No cell will be constructed prior to completion of a contract with a municipality to dispose of MSW generated within that municipality.

Each of the three disposal cells will be constructed below ground surface in the initial phase (see Drawings 1 through 10, attached) with 3:1 slopes to the bottom of the excavation. No blasting will be required to excavate the landfill cells. The cell will be ripped using a crawler-dozer followed by excavation and removal of the ripped soils.

Excavated soil will be used to construct berms around each cell (Drawings 4 and 6) to provide support for above-grade waste disposal. Cell depth ranges between 30 and 35 feet below the natural ground surface. The depth decreases towards the south end to facilitate stormwater collection.

The side-slopes of the excavation are proposed to be 3 horizontal to 1 vertical. An extensive field investigation included exploratory drill holes on the property and data collected indicated a silty clay zone of soil to depths of at least 20 feet below the surface. Silty clay soil should provide the slope stability necessary for any temporary 3:1 side-slopes. The side-slopes may be flattened at the discretion of the landfill operator, to maintain stability of the slopes. Berms will be located adjacent to the top of the vertical slopes (Drawings 4 and 6) to maintain an adequate safe distance of personnel and vehicular traffic from the top of the slope and to provide stormwater diversion. The berms will be constructed of stockpiled material from the excavated cell. Berms will be located an adequate distance away from the edge of the cell to avoid any stability problems.

5.3.2 Phasing

Cells 1 and 3 will be constructed in an orderly sequence, generally from north to south, while Cell 2 will be constructed generally from west to east (Drawings 8, 9 and 10). The natural ground surface elevation at the site varies approximately 100 feet as the topography slopes downward from the southeast to the northwest. Natural grade at the center of the cells is approximately 4335 feet (Cell 1), 4353 (Cell 2), and 4380 (Cell 3). The final elevation of the maximum cover section of each cell will be approximately 64 feet above these elevations. The final cover will be graded to a minimum 3 percent slope extending across the crown of a cell.

The working face in a traditional-fill cell will be constructed to a maximum slope of 4

horizontal to 1 vertical; for a bale-fill, the working face will be constructed to a maximum slope of 2 horizontal to 1 vertical based on slope stability of stacked bales. Cover material will be soil from the excavation of cells. Unloading of waste will be restricted to one area of the working face to limit the amount of waste exposed and the amount requiring cover. The working face will be covered on a daily basis.

5.3.3. Daily, Intermediate and Final Cover.

Daily cover will consist of six (6) inches of soil spread over the compacted waste to protect against both wind-dispersion of waste and propagation of vectors. When an active area of a cell is to be left unused for any length of time, such as construction phasing across a cell, the cell will be covered with a material capable of meeting the performance criteria of daily cover as well as the operational criteria of disposal operations.

An intermediate cover will be placed over the completed areas of a cell. The intermediate cover will consist of a minimum thickness of 12-inches of native soil stockpiled from the excavation. The intermediate cover will be compacted by a crawler-dozer to facilitate trafficability over the completed cells. Gravel may be placed over the intermediate cover in the unloading areas at the top of the working face to improve trafficability. The maximum duration is one year that intermediate cover would remain exposed prior to re-use or closure

Following the complete filling of an excavation cell to the top of the side berms, MSW will be disposed above grade across the surface of the cell. This disposal area will rise to a height of approximately 35 feet above natural grade and sloped to the center crown of the cell at a 3:1 slope. The final phase of disposal operations will be the commencement of closure operations by placement of final cover.

The final cover will consist of 24 inches of frost protection cover placed over 18 inches of compacted native clay with an in-place permeability of no greater than 1×10^{-7} cm/sec. Six inches of coarse aggregate will be placed over the cell for erosion control. The cover requirements are also discussed in detail in the following subsections covering final closure.

5.4 EQUIPMENT REQUIREMENTS AND AVAILABILITY

Equipment will be maintained and stored in one of two maintenance buildings, one located on site and one located off site. Landfill operating equipment may be shared between landfill cells, but will be specific to the type of disposal, i.e. bale-fill or traditional-fill. The Landfill Operator/Manager will have a utility truck capable of moving around the site during inclement weather and powerful enough to pull smaller trailer-mounted equipment that may be needed at the site. This vehicle will carry whatever tools are necessary for routine maintenance of the heavy equipment.

5.4.1 Bale-Fill Equipment

A bale-fill cell will require one or more fork-trucks capable of lifting the bales from a flatbed truck and placing them into the working face. Additionally, the flatbed trucks may be equipped with a crane capable of moving the bales from the truck to the working face. The

only other piece of equipment necessary for operation of the bale-fill will be a crawler-dozer capable of moving cover material to the working face and then spreading it across the working face.

5.4.2 Traditional-Fill Equipment

Traditional landfilling operations will require at least two pieces of equipment, one compactor and one crawler-dozer. The compactor will be designed for landfill operations, and will be equipped with compactor wheels. The crawler-dozer will be capable of moving and spreading cover material as well as loose MSW.

5.5 BORROW SOURCES

The construction of the landfill will necessarily require excavation and stockpiling of soil. As the excavation of the below-grade phases continue, soil will be stockpiled on site and, when possible, within the boundary of the cell being excavated. The Landfill will provide sufficient cover materials from on-site excavation, and no additional borrow areas should be required.

5.6 RUN-OFF COLLECTION

Potential stormwater run-off has been identified from two sources. First is the run-off that may contact waste in the excavation phase of disposal and would subsequently collect within the excavation. This run-off water may be allowed to evaporate or may be pumped to the top of the working face. No treatment is anticipated or proposed.

The second type of run-off is that which will move from the above grade disposal area to ground level. This may be stormwater that has contacted waste or it may be stormwater that sheets off the intermediate or final cover. In either event, this run-off water will be collected in the stormwater detention areas shown on Drawings 8, 9, and 10. This water will not be permitted to exit the property.

5.7 GROUNDWATER MONITORING – WAIVER REQUEST

In accordance with R315-308-1(3), the owner requests a waiver of groundwater monitoring requirements by the Executive Secretary based on the demonstration that there is no potential for migration of hazardous constituents from the facility to the groundwater during the active life of the facility and the post-closure care period. This demonstration is provided in Section Four, Geohydrological Report.

5.8 RUN-ON / RUN-OFF CONTROL SYSTEMS

Stormwater diversion ditches will be constructed using berms and designed to prevent stormwater from running on to the landfill site. These same diversion ditches will also serve to prevent stormwater run-off from leaving the site. These stormwater controls are shown in detail on Drawing 7.

6.0 CLOSURE PLAN

Final closure activities will be implemented when the final phase of the landfill has been completed and the design dimensions have bee reached, projected during the first quarter of 2014. Closure of the landfill will begin, however, as each cell completes the final phases of construction and design elevations are reached. These activities will eliminate the need to complete final closure on the entire 320 acres above grade. Closure of the site is to be performed in such a manner as to minimize potential effects of the landfill on the surrounding environment.

6.1 CLOSURE SCHEDULE

Final closure activities at the landfill will commence within 30 days after final placement of waste and shall be completed within 180 days. It has been estimated that the last cell to close will cease accepting waste in 2014.

6.2 DESIGN OF FINAL COVER

The closure of the landfill operations at the Solitude Landfill will minimize the need for further maintenance and will minimize any potential threat to human health and the environment. As a cell is constructed and filled above grade, the side slopes will be covered with 18 inches of compacted clay (Mancos shale), 24 inches of native soil comprising a frost protection layer, and six inches of coarse aggregate. This design will also provide 30 inches of frost protection for the clay layer. This process will be used so that only the uppermost 2-acre portion of a cell requires closure at any one time. After the final waste has been placed in a cell, the upper surface will be covered in a manner identical to the side slopes described above.

The final grades will be maintained at the designed slope of 4:1. The final contour plan of the cell closure is presented as Drawing 5. All run-off will be directed off and around the disposal cell.

6.3 SITE CAPACITY

The estimated total capacity of the landfill is approximately 19.8M cubic yards of waste.

6.4 FINAL INSPECTION

A final inspection will be performed at the Solitude Landfill at the termination of all landfill activities, including closure. The final inspection will determine if the landfill meets the closure requirements as outlined in the permit and closure plans. Inspection may include cell cover design requirements and maintenance of proper final grade on the cell to promote run-off.

7.0 POST-CLOSURE CARE

During the post-closure period, the landfill shall be inspected quarterly to determine the integrity of the cover and condition of the access road. Post-closure maintenance will consist of quarterly inspection of the cover; run-on/run-off control structures, and the monitoring structures, and making any necessary repairs.

7.1 SITE MONITORING

In addition to the annual inspections, post-closure monitoring of the landfill will include quarterly sampling for methane gas. Methane gas will be monitored at the perimeter of the landfill and within any buildings at the landfill during the post-closure period.

7.2 CHANGES TO TITLE, LAND USE AND ZONING

Plats and a statement of fact concerning the location of the disposal site shall be recorded as part of the record of title with the county recorder within 60 days after certification of closure.

7.3 MAINTENANCE ACTIVITIES

Post-closure maintenance will consist of quarterly inspections of the cover; run-on/run-off control structures, and the monitoring structures, and making any necessary repairs.

7.4 FINAL COVER

The final cover will be constructed on the uppermost surface of the cell after the waste placement has reached the designed elevation. The side slopes will have been closed, as the cell height increases, with 18 inches of compacted clay (Mancos shale), 24 inches of native soil comprising a frost protection layer, and six inches of coarse aggregate. The final cover material on the uppermost surface of the Solitude Landfill will be identical to the side slopes. The side slopes will be constructed with a maximum 4:1 slope and the upper surface will be constructed with a minimum 3% slope toward the crest of the side slopes.

Precipitation on the landfill cells will drain across the cell cover, through the run-off control berms, and off site.

7.5 RUN-ON / RUN-OFF CONTROL SYSTEMS

Run-on and run-off control systems are described elsewhere in Section 3.6.2 and Section 5.8.

7.6 CONTACT PERSONS

Local Contact: Pete Fote
2825 East Cottonwood Parkway, Suite 500
Salt Lake City, UT 84121
801-990-3456

8.0 FINANCIAL ASSURANCE

An estimate for the closure and post-closure care of the Solitude landfill is summarized in Tables 4, 5, 6 and 7. The estimate is based on the total area for final closure of 2 acres, and an entire cell area of 71 acres each for Cells 1 and 3, and 120 acres for Cell 2. All soil will come from on-site. These tables reflect the maximum area requiring closure at any one time, and has been compiled from information developed by the Oklahoma Department of Environmental Quality for estimating closure and post-closure care costs (see Section Nine)

Table 4
Summary of Estimated Closure Costs for Cell 1, 2, or 3

Task / Service	Quantity	Units	Unit Cost	Task Cost
Conduct Site Evaluation	1	Lump Sum	$2,750	$2,750
Remove Buildings & Equipment	1	Lump Sum	$2,450	$2,450
Final Grading	2	Acres	$1,122	$2,244
Move & Compact On-Site Clay	4,840	Cubic Yds	$3.20	$15,488
Move & Place Erosion Control Cover	1,613	Cubic Yds	$12.00	$19,356
Subtotal				**$42,288**
Technical & Professional Services	1	Lump Sum	7%	$2,960
Contingency	1	Lump Sum	10%	$4,229
Total				**$49,477**

Table 5
Summary of Estimated Post-Closure Costs for Cell 1 or 3

Task / Service	Quantity	Units	Unit Cost	Task Cost
Post-Closure Inspections[1]	120	Events	$500	$60,000
Methane Gas Monitoring[2]	120	Events	$140	$16,800
Repair / Maintain Cover[3]	4,260	Cubic Yds	$12	$51,120
Subtotal				**$127,920**
Technical & Professional Services	1	Lump Sum	7%	$8,954
Contingency	1	Lump Sum	10%	$12,792
Total				**$149,666**

Table 6
Summary of Estimated Post-Closure Costs for Cell 2

Task / Service	Quantity	Units	Unit Cost	Task Cost
Post-Closure Inspections[1]	120	Events	$500	$60,000
Methane Gas Monitoring[2]	120	Events	$140	$16,800
Repair / Maintain Cover[3]	7,200	Cubic Yds	$12	$86,400
Subtotal				**$163,200**
Technical & Professional Services	1	Lump Sum	7%	$11,424
Contingency	1	Lump Sum	10%	$16,320
Total				**$190,944**

NOTES TO TABLES:

[1] May be reduced to annual inspections upon site stabilization, with DEQ approval

[2] May be discontinued upon site stabilization, with DEQ approval

[3] Calculated at 2 cy/acre x 120 acres x 30 years

8.1 FINANCIAL ASSURANCE MECHANISM

The Owners propose to use a bond as the financial assurance mechanism. Each Cell will have its own bond as an individual funding mechanism. A stand-by trust fund will be established if bonds that do not allow partial-payments are used.

9.0 REFERENCES

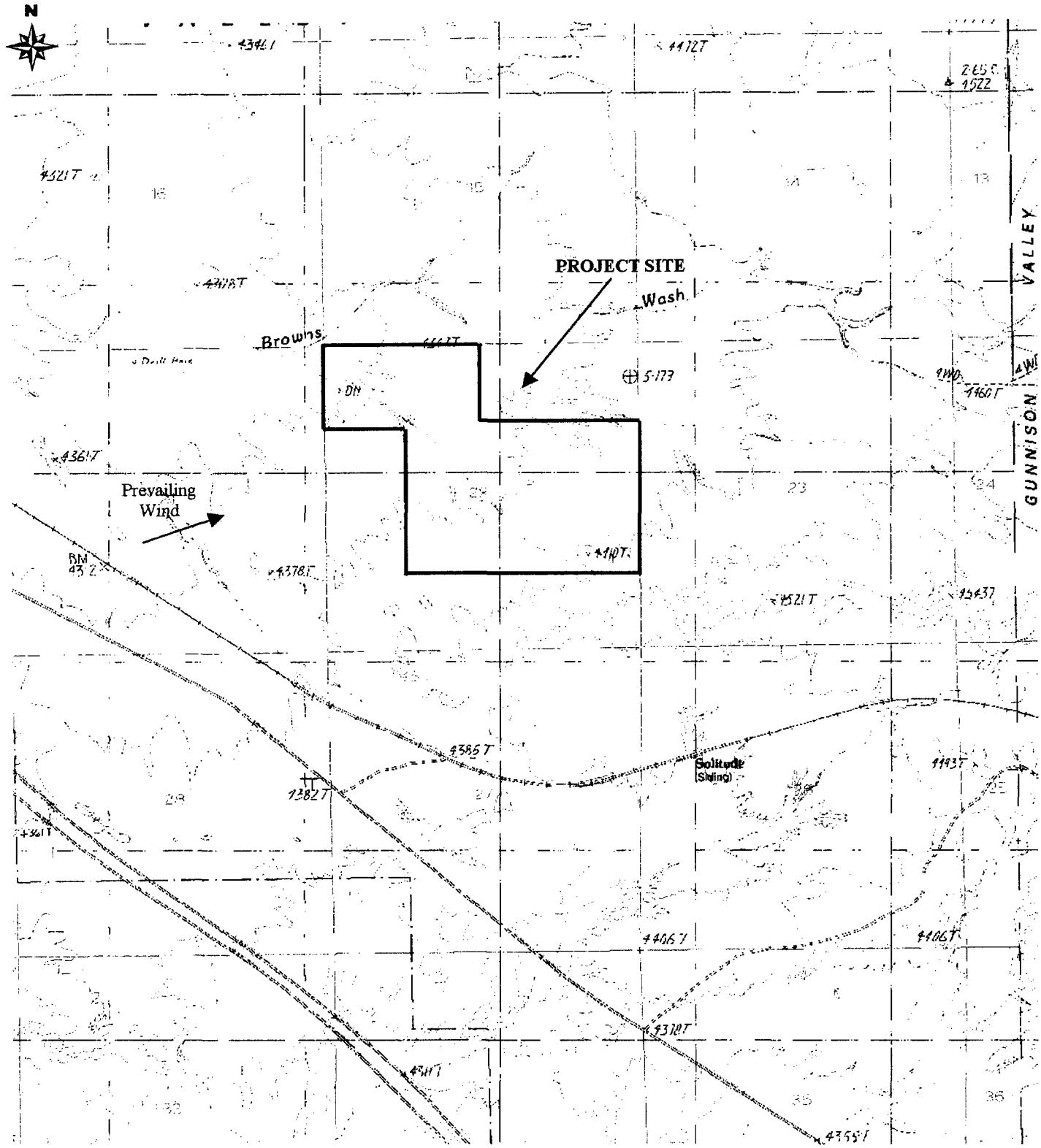
Ashcroft, G.L., Jensen, D.T., Brown, J.L., 1992, *Utah Climate*, Utah Climate Center, Utah State University.

Rush, F.E., 1982, *Regional Hydrology of the Green River – Moab Area, Northwestern Paradox Basin, Utah,* USGS, Denver CO.

Thiros, S.A. and W. C. Brothers, *USGS Technical Publication 102* - Ground-water hydrology of the upper Sevier River basin, south-central Utah, and simulation of ground-water flow in the valley-fill aquifer in Panguitch Valley, 1993.

State of Oklahoma, Department of Environmental Quality, Waste Management Division, *Solid Waste Financial Assurance Program Report*, December 22, 2000.

State of Utah, 2001, *Administrative Rules, Solid Waste Permitting and Management Rules R315-301 through 320*, Department of Environmental Quality, Division of Solid and Hazardous Waste.



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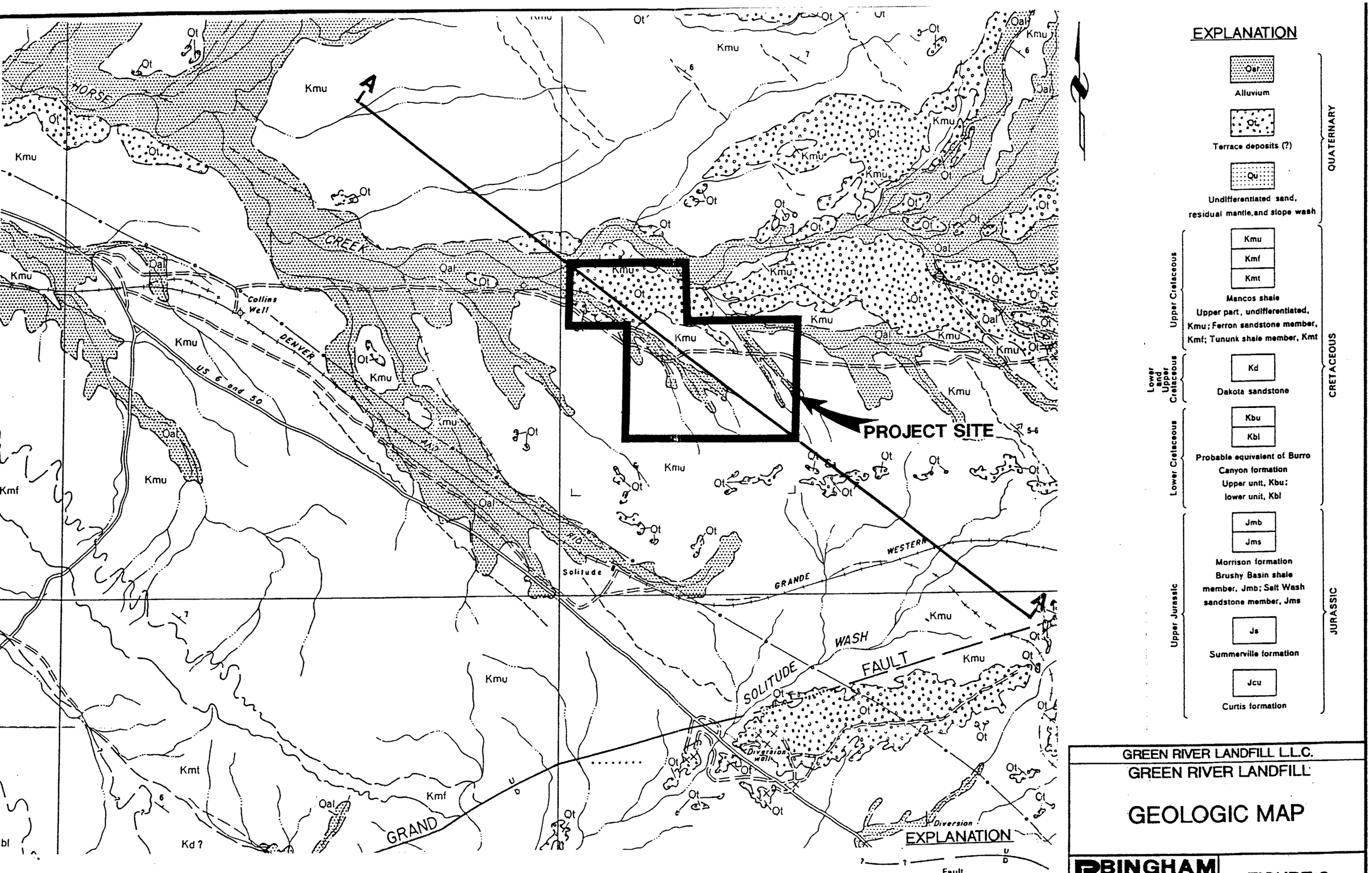
SCALE: 1:24,000
CONTOUR INTERVAL: 40 FEET

FIGURE 1

Green River NE Quadrangle
Utah – Grand County
7.5 Minute Series (Topographic) Map



eference:
hotogeologic Map of the Tidwell – 1 Quadrangle
rand County, Utah by V.H. Sable, 1955, Map I-87

GREEN RIVER LANDFILL L.L.C.

GREEN RIVER LANDFILL

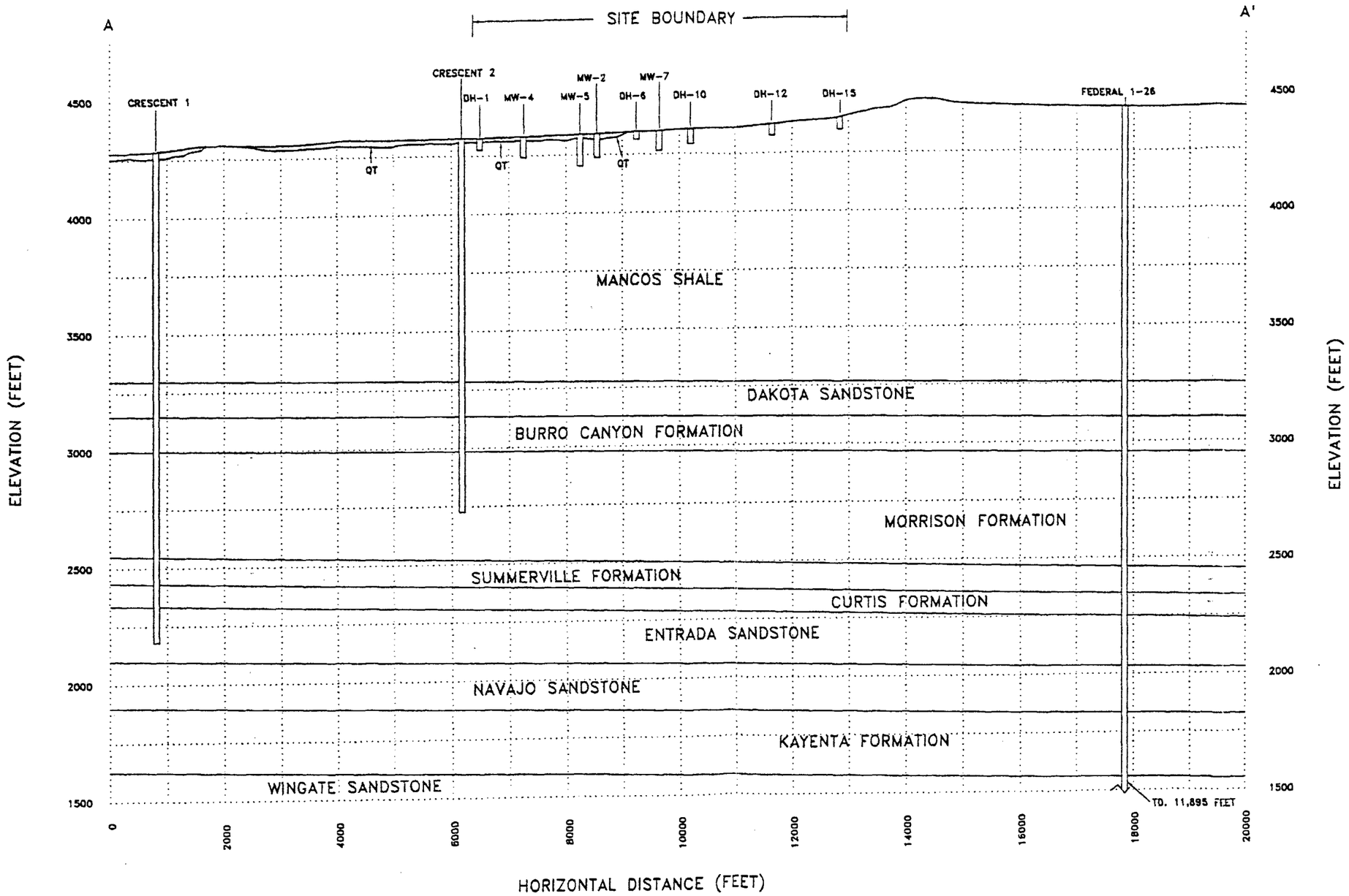
GEOLOGIC MAP

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 2

Date NOV. 1994 | Proj. # 2106-006 | Sht of

12/02/1994 f:\PROJ\2108\CAD\2108DHLS



0 1000 2000
Scale in Feet
HORIZONTAL SCALE

0 250 500
Scale in Feet
VERTICAL SCALE

QT- TERRACE DEPOSITS

GREEN RIVER LANDFILL L.L.C.

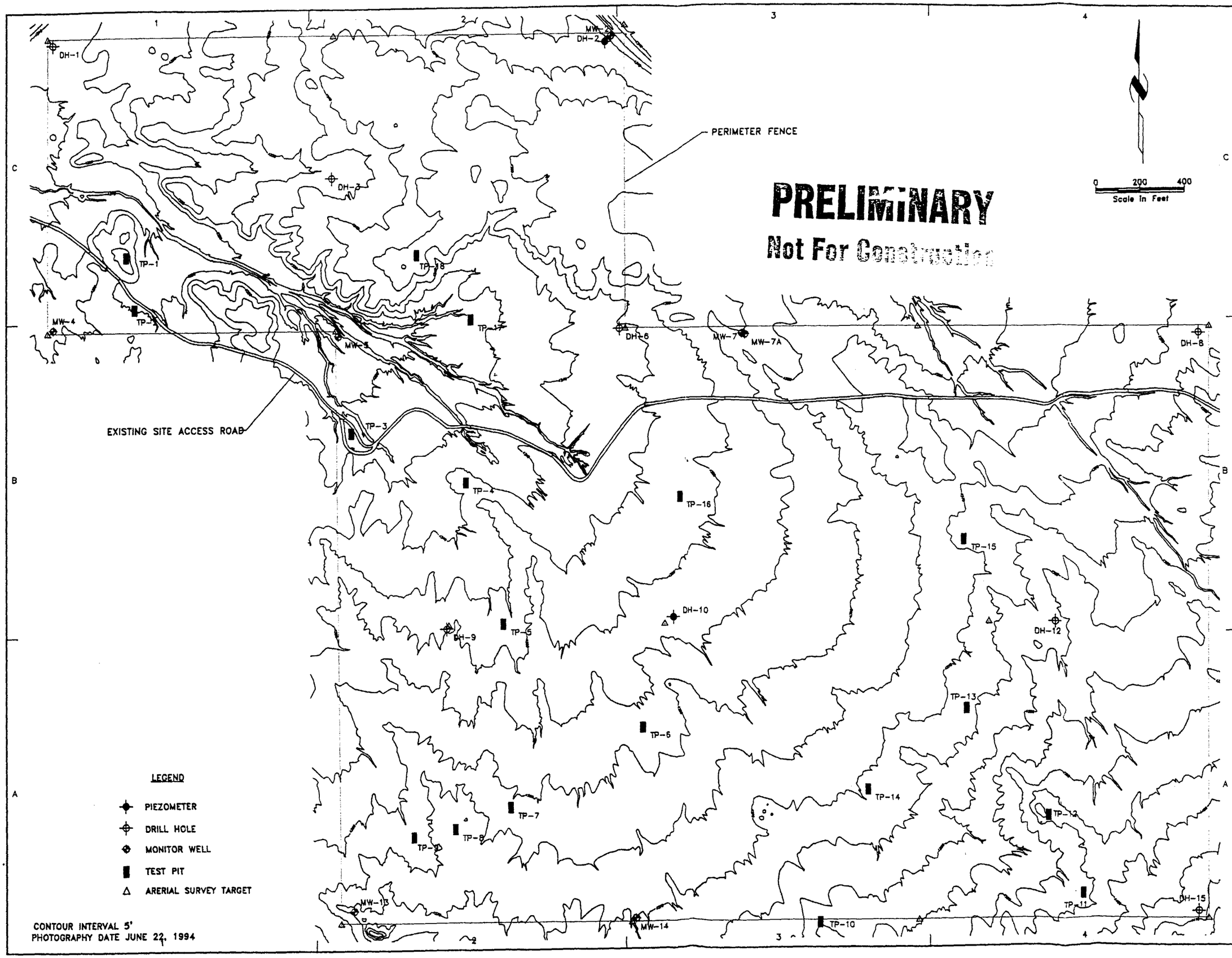
GREEN RIVER LANDFILL

CONCEPTUAL GEOLOGICAL CROSS SECTION A-A'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 3

Rev.	By	Date	Remarks	Date NOV 1994	Proj. #	JSR



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SOLITUDE LANDFILL
GENERAL SITE PLAN

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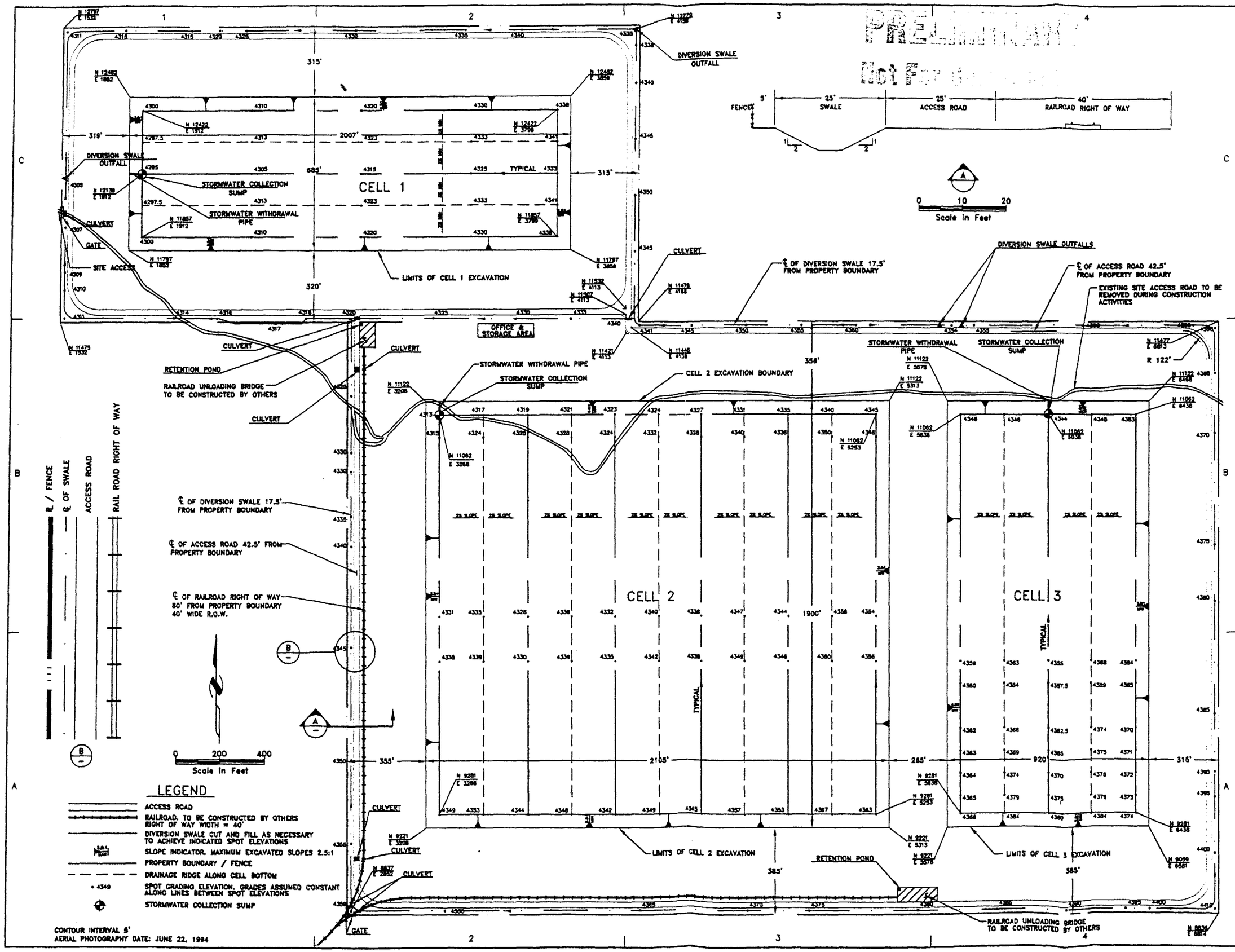
2



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SOLITUDE LANDFILL
SITE PREPARATION GRADING PLAN

PRELIMINARY NOT FOR CONSTRUCTION

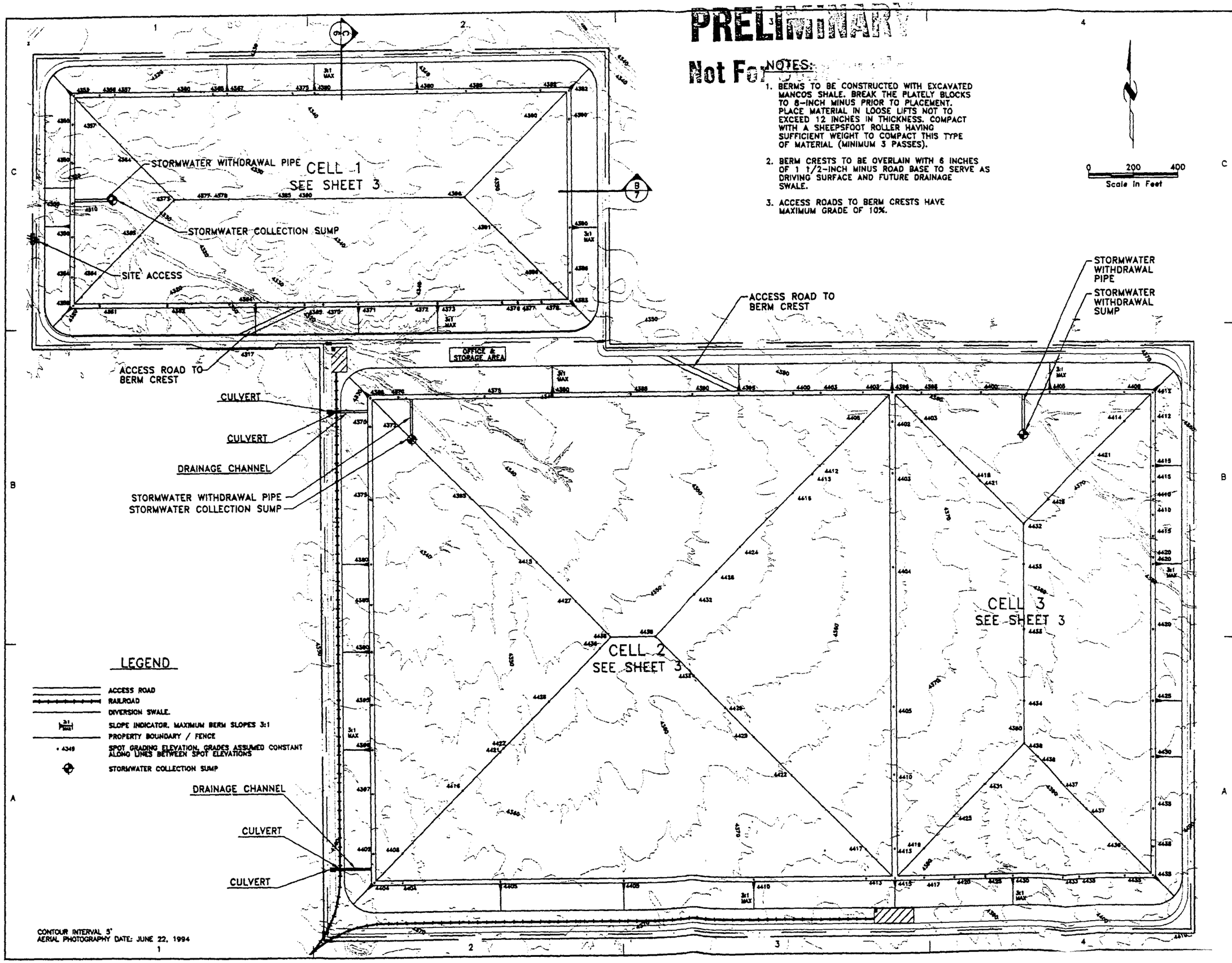
3

PRELIMINARY

Not For Construction

NOTES:

1. BERMS TO BE CONSTRUCTED WITH EXCAVATED MANCOS SHALE. BREAK THE PLATELY BLOCKS TO 8-INCH MINUS PRIOR TO PLACEMENT. PLACE MATERIAL IN LOOSE LIFTS NOT TO EXCEED 12 INCHES IN THICKNESS. COMPACT WITH A SHEEPSFOOT ROLLER HAVING SUFFICIENT WEIGHT TO COMPACT THIS TYPE OF MATERIAL (MINIMUM 3 PASSES).
2. BERM CRESTS TO BE OVERLAIN WITH 6 INCHES OF 1 1/2-INCH MINUS ROAD BASE TO SERVE AS DRIVING SURFACE AND FUTURE DRAINAGE SWALE.
3. ACCESS ROADS TO BERM CRESTS HAVE MAXIMUM GRADE OF 10%.



LEGEND

- ACCESS ROAD
- RAILROAD
- DIVERSION SWALE.
- SLOPE INDICATOR. MAXIMUM BERM SLOPES 3:1
- PROPERTY BOUNDARY / FENCE
- • 4349 SPOT GRADING ELEVATION. GRADES ASSUMED CONSTANT ALONG LINES BETWEEN SPOT ELEVATIONS
- STORMWATER COLLECTION SUMP

CONTOUR INTERVAL 5'
AERIAL PHOTOGRAPHY DATE: JUNE 22, 1994

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DRAWN BY:
CHECKED BY:

SHEET TITLE

SOLITUDE LANDFILL
BERM CONSTRUCTION PLAN

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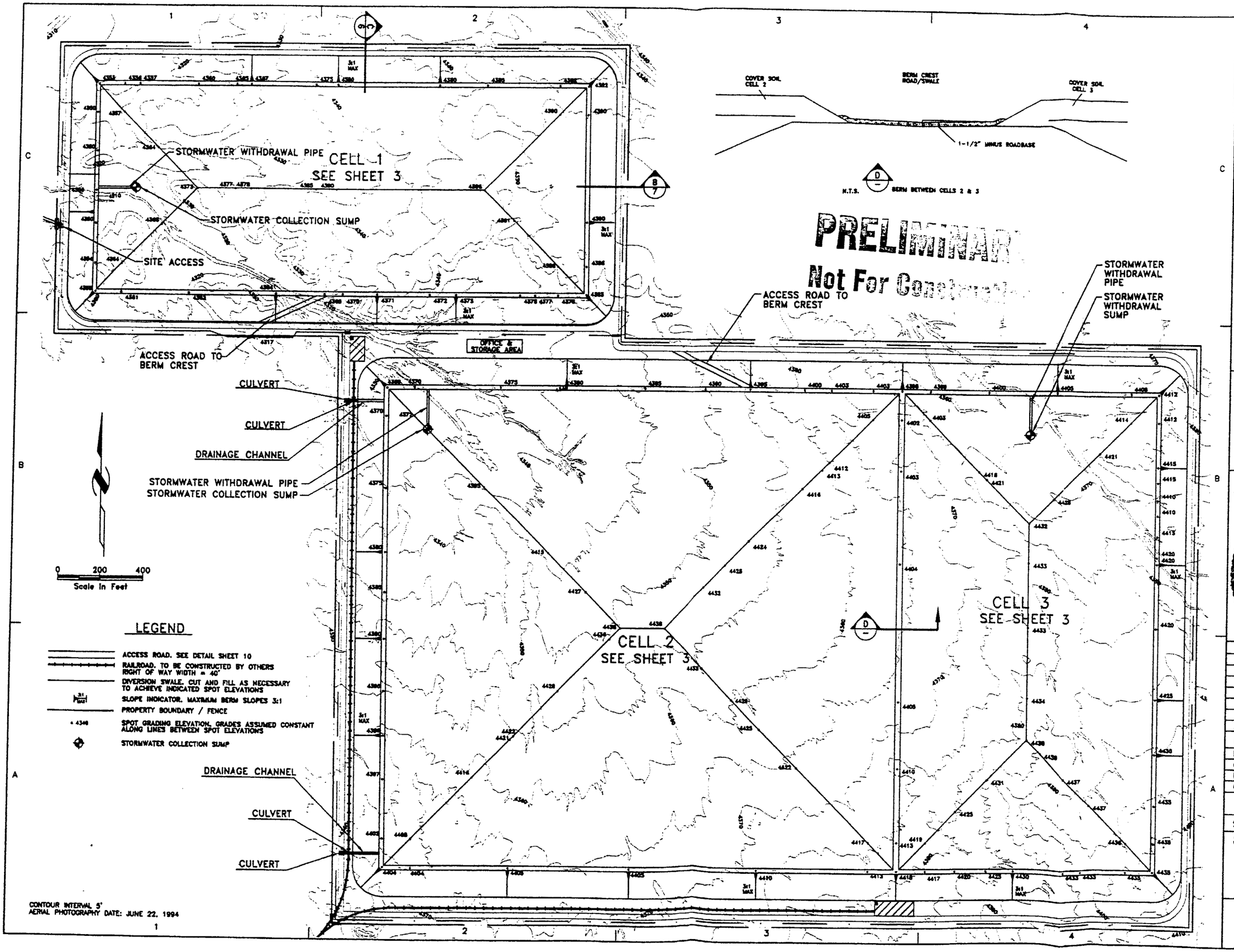
4



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NOTES:
1. SPOT ELEVATIONS ON COVER REPRESENT FINAL GRADE [illegible] MULCH LAYER.

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SOLITUDE LANDFILL
CELL COVER PLAN

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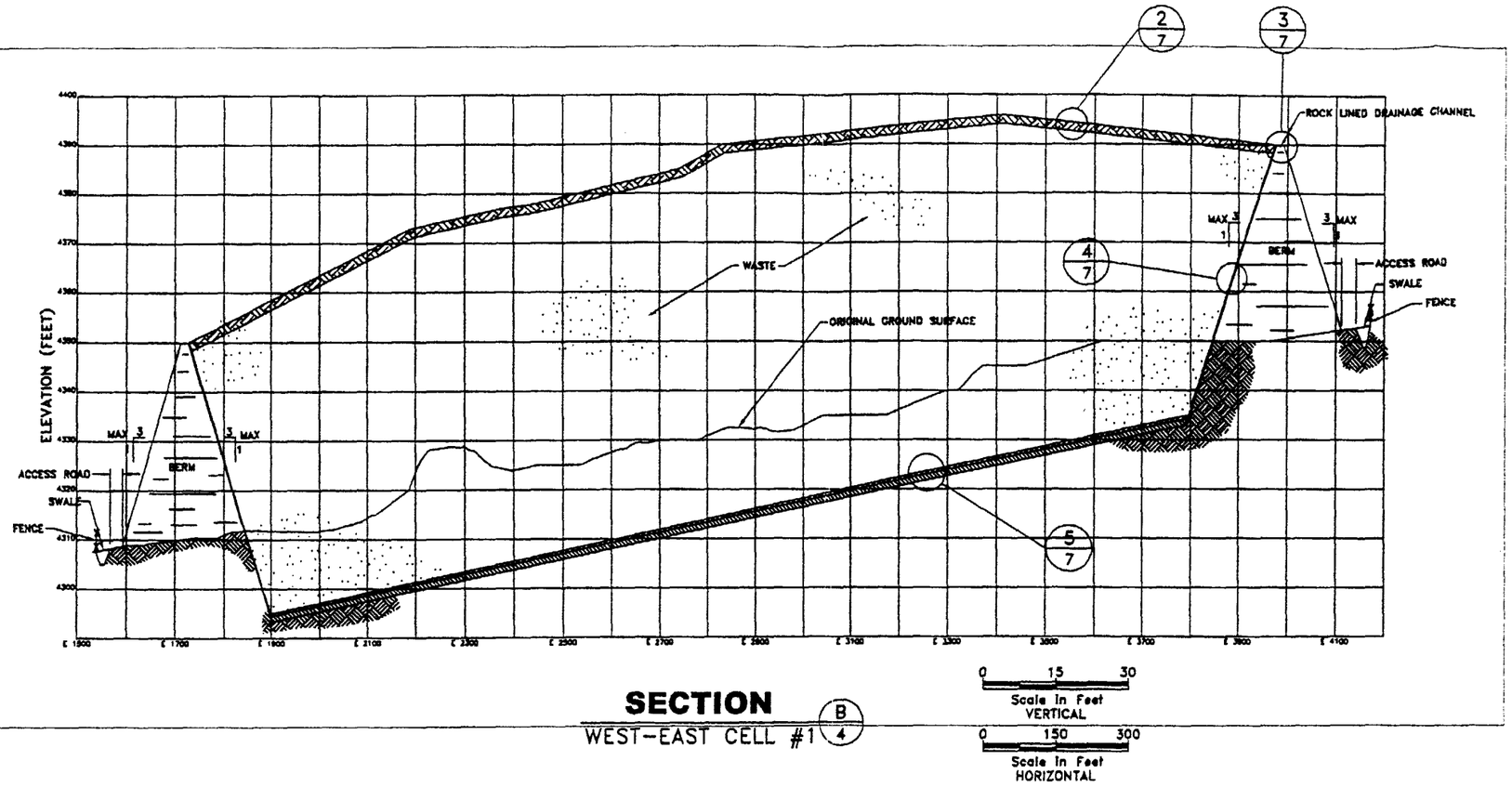
5



SECTION B/4

WEST-EAST CELL #1

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SHEET TITLE
SOLITUDE LANDFILL
SECTION

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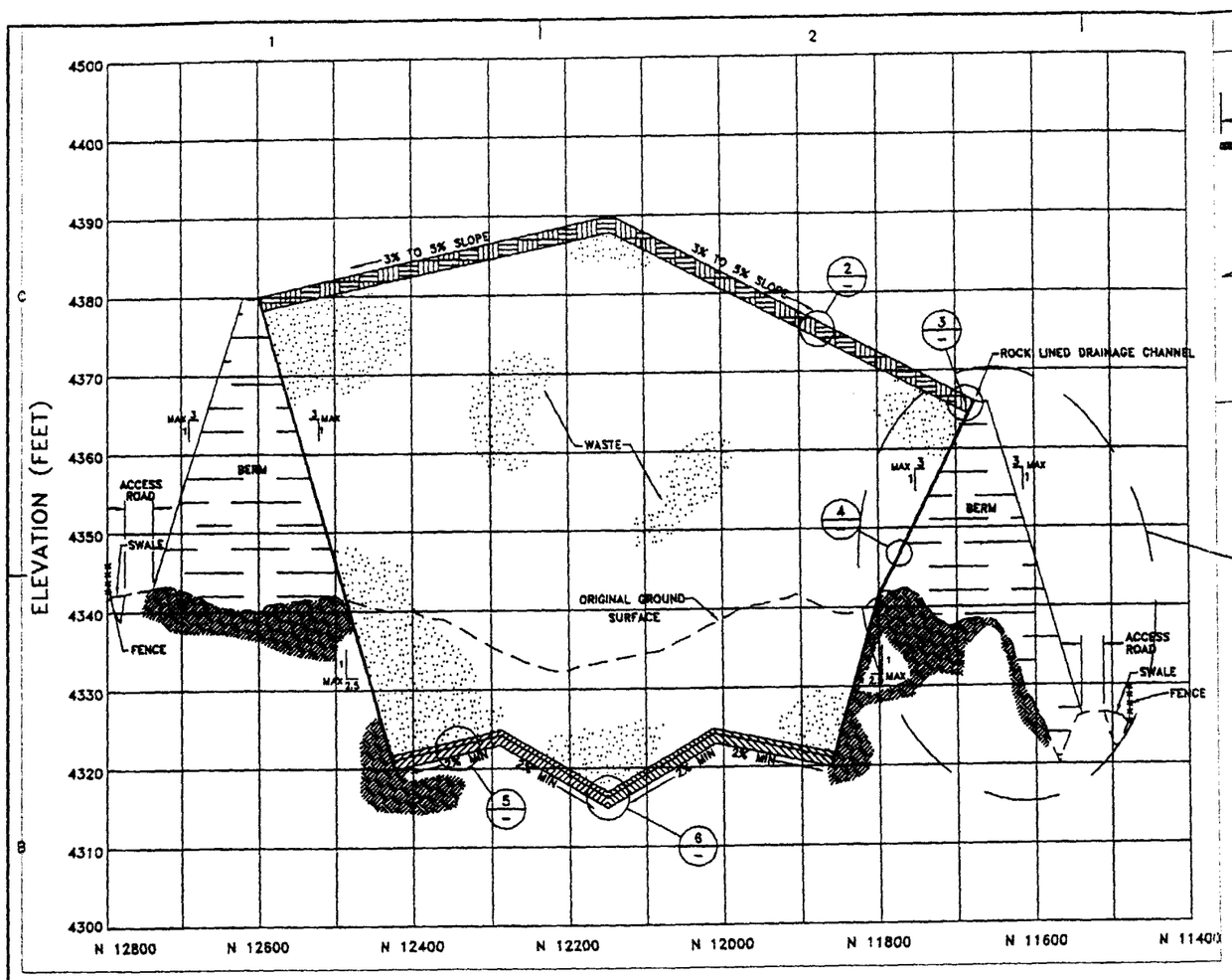
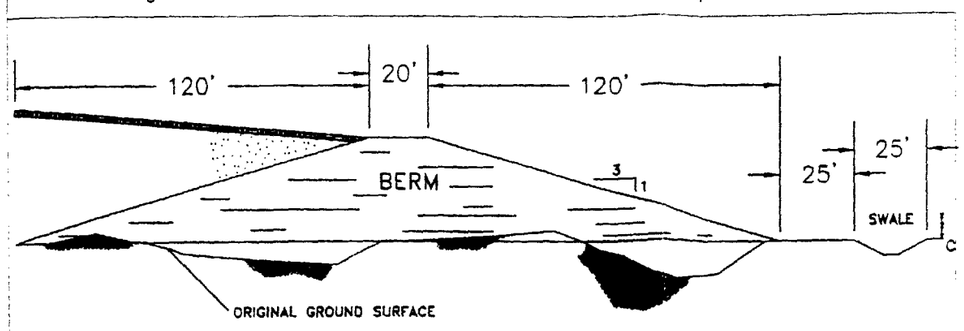
6



0 10 20
Scale In Feet
VERTICAL

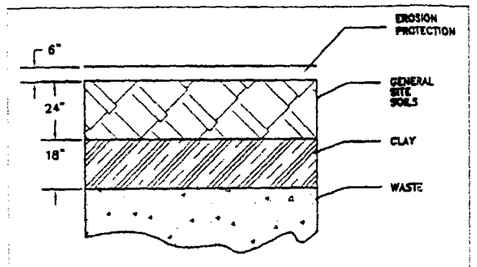
0 100 200
Scale In Feet
HORIZONTAL

SECTION
C/4 NORTH-SOUTH CELL#1

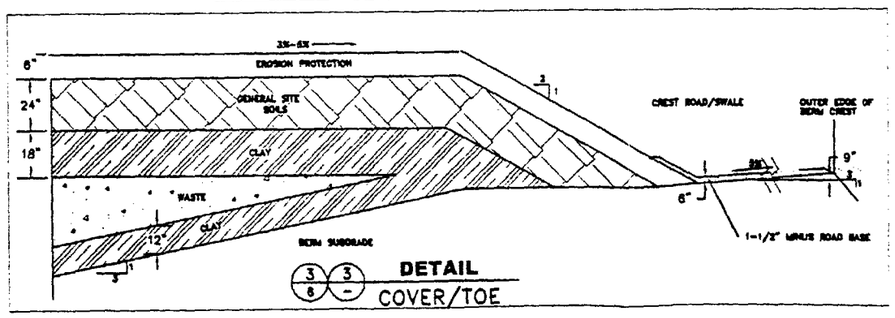


SECTION
E/- BERM

0 30 60
Scale In Feet



DETAIL
2/6 2/- CELL COVER
N.T.S.



DETAIL
3/6 3/- COVER/TOE

PRELIMINARY
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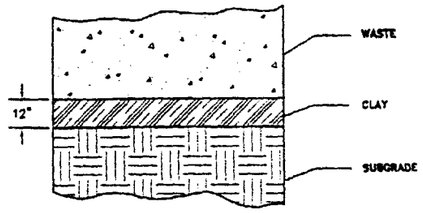
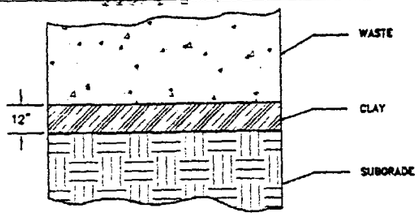
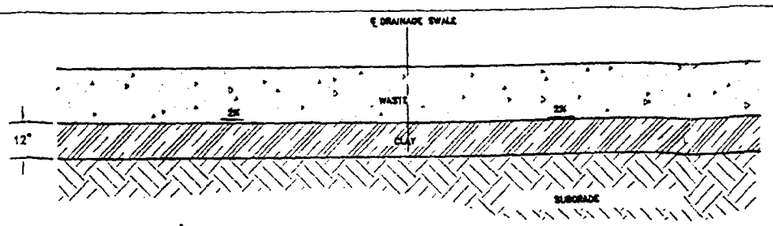


DETAIL
4/6 4/- CELL LINER (CELL SIDE SLOPES)
N.T.S.



DETAIL
5/6 5/- CELL LINER
N.T.S.



DETAIL
6/- CELL DRAINAGE
N.T.S.

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ROAD

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SOLITUDE LANDFILL
SECTIONS AND DETAILS

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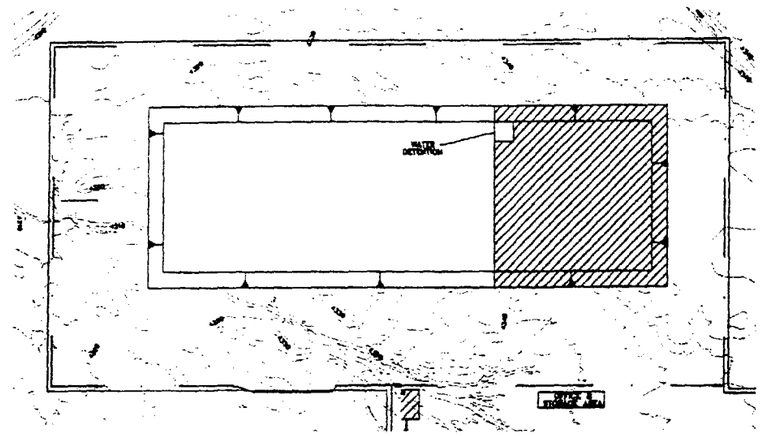
7



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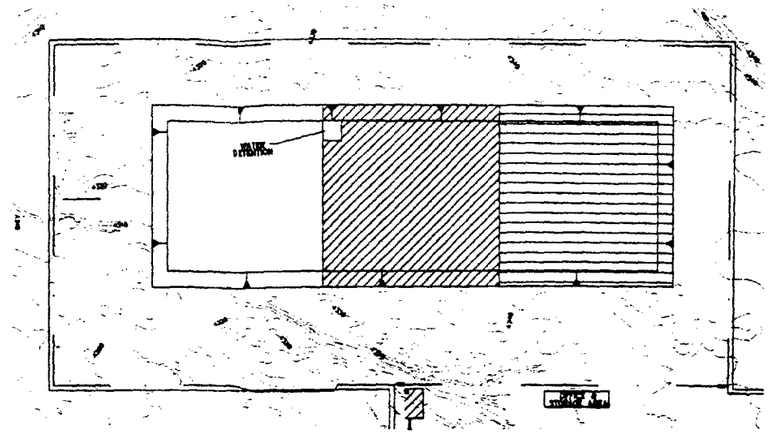

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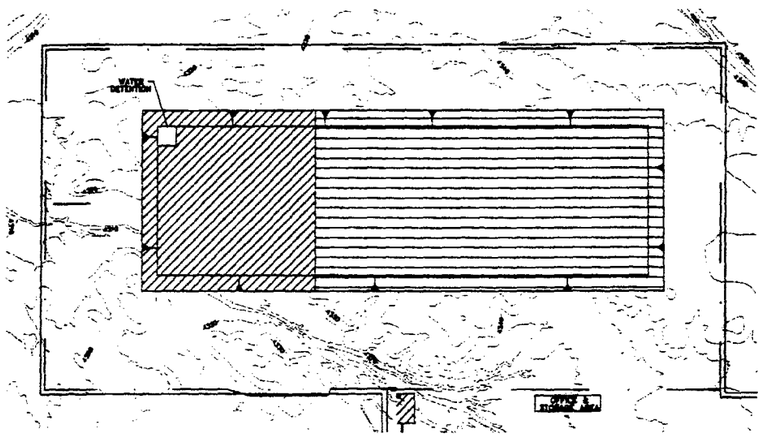

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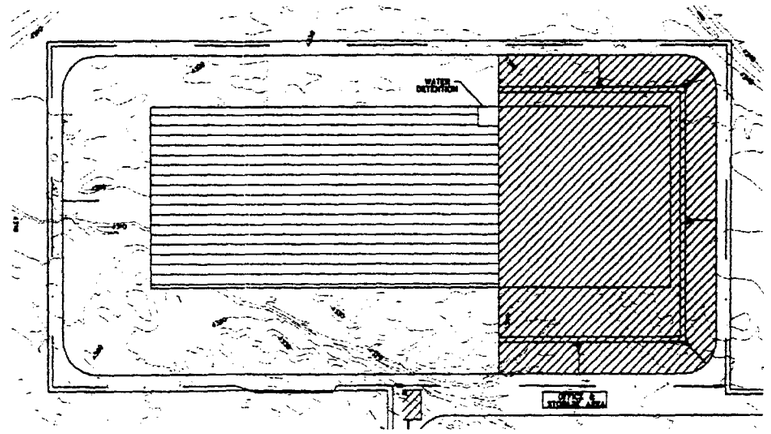

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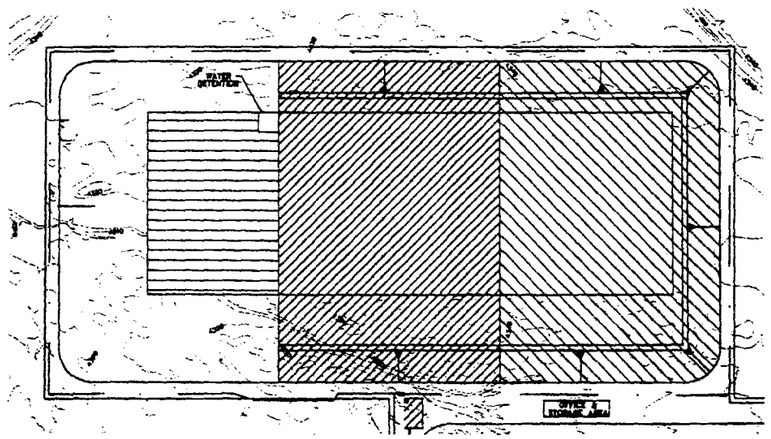

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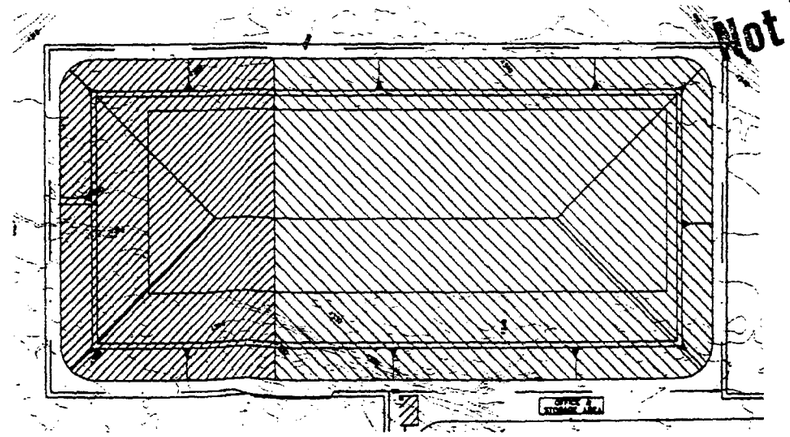

PHASE VI

ACTIVE CELL

FILL TO GROUND SURFACE

FILL TO FINAL COVER

PRELIMINARY
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SHEET TITLE
SOLITUDE LANDFILL
CELL II
FILLING SEQUENCE

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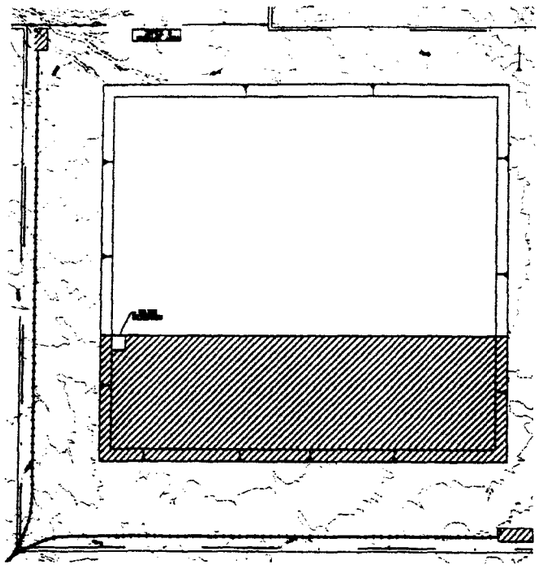
8



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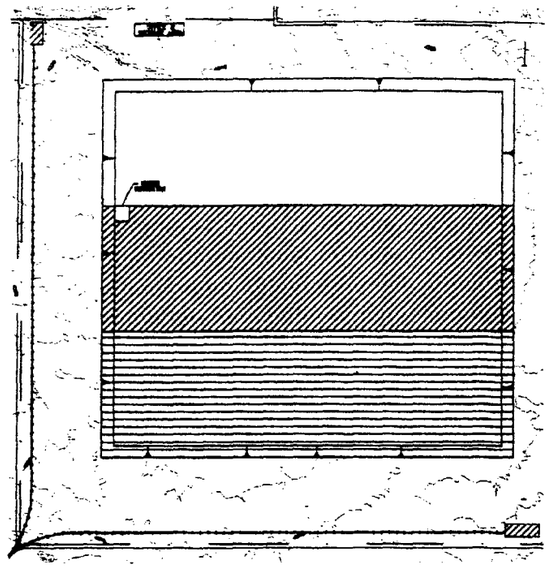

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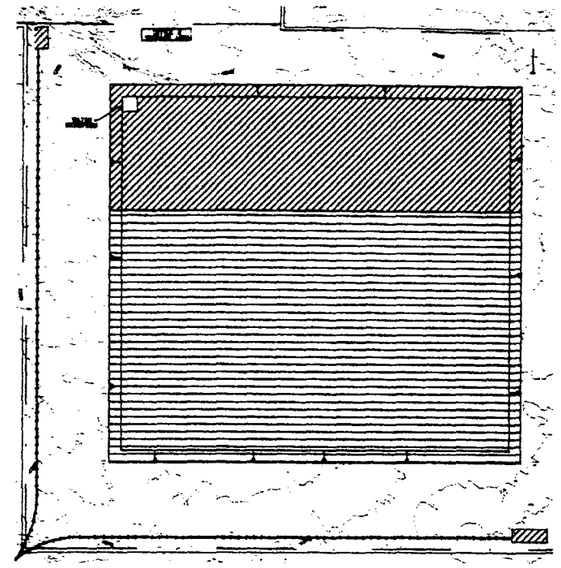

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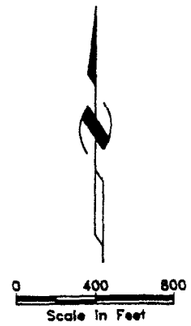
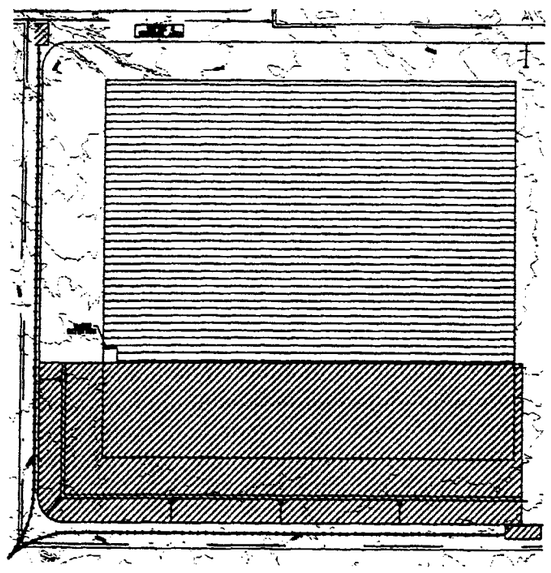


ACTIVE CELL

FILL TO GROUND SURFACE

FILL TO FINAL COVER

PRELIMINARY
Not For Construction



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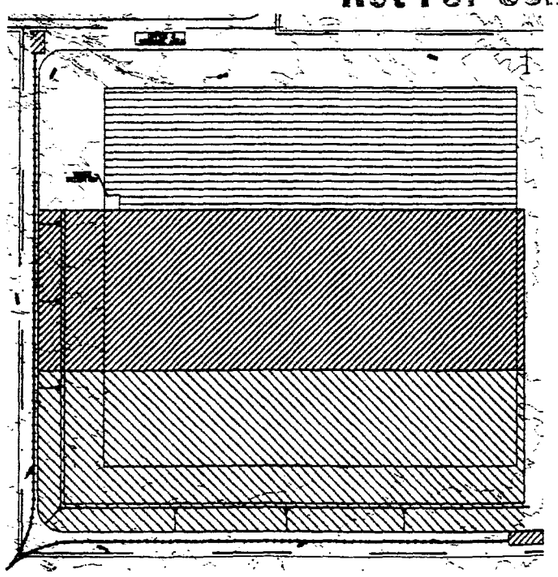

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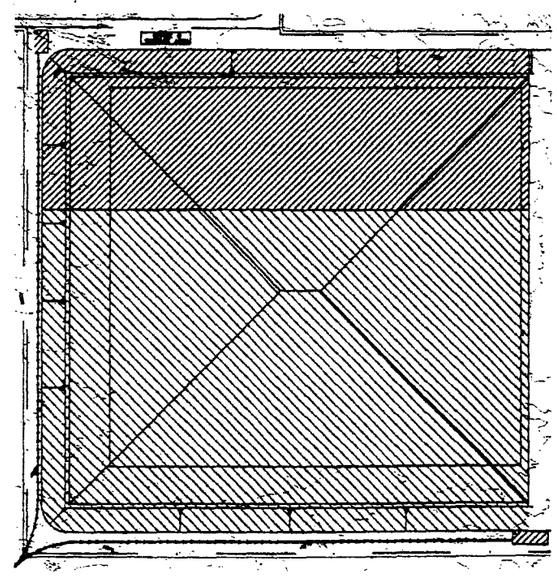

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STATE OF UTAH

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	01/11/02	DRAFT

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CHECKED BY:

SHEET TITLE
SOLITUDE LANDFILL
CELL #2
FILLING SEQUENCE

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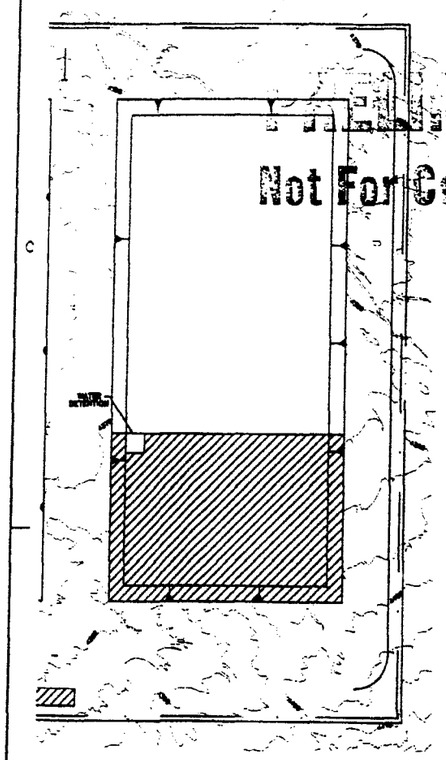

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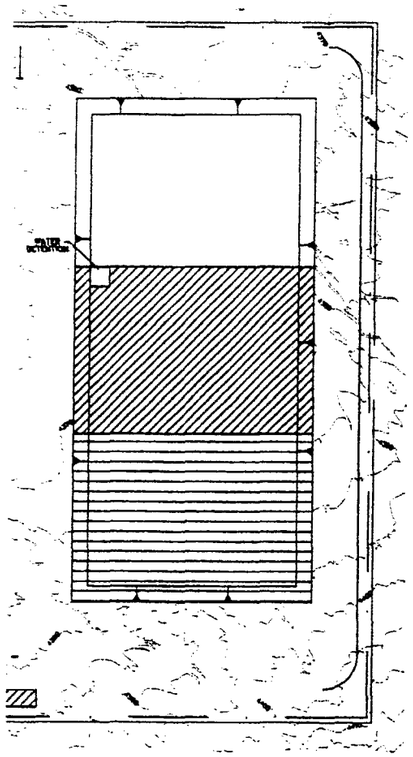

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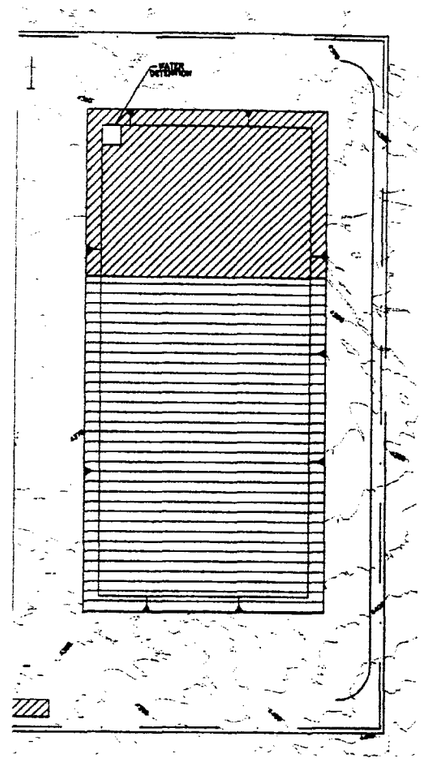
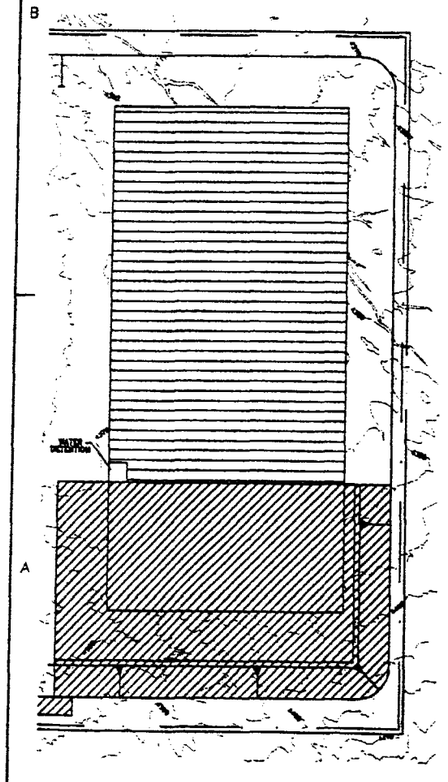
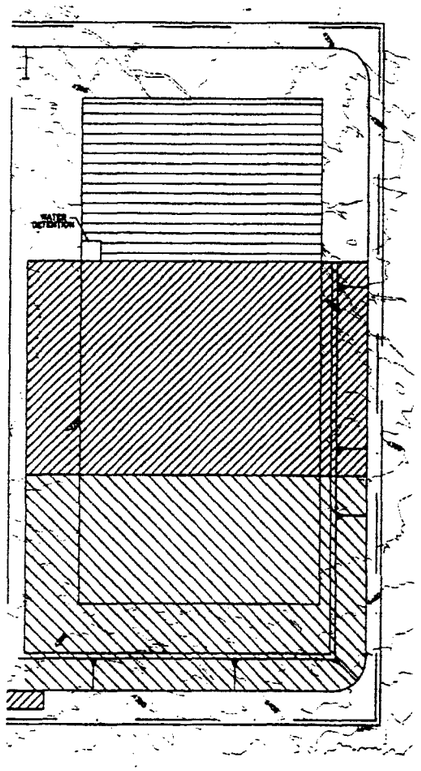


PHASE III

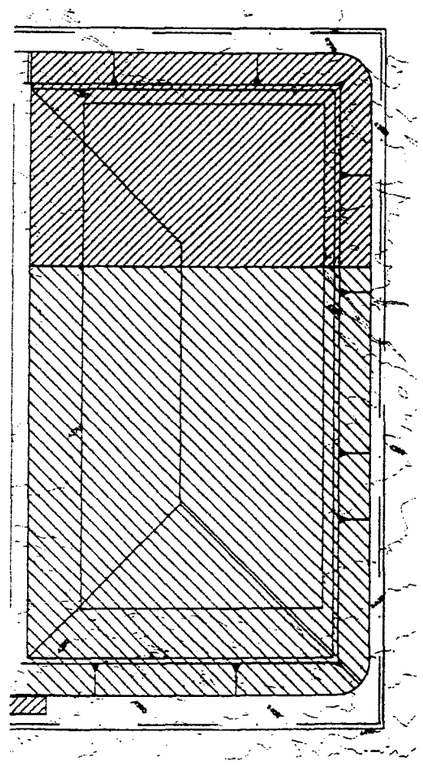
0 300 600
Scale In Feet



PHASE IV



PHASE V



PHASE VI

ACTIVE CELL

FILL TO GROUND SURFACE

FILL TO FINAL COVER

ATC ASSOCIATES INC

ATC Associates, Inc.
2681 Parleys Way
Suite 106
Salt Lake City, Ut 84109
(801) 412-0003

CONSULTANTS

THIS DRAWING HAS BEEN REVIEWED BY A PROFESSIONAL ENGINEER AND HAS BEEN DETERMINED TO REPRESENT CONSTRUCTIBLE STRUCTURES AND/OR PROJECT. REVISION OF THIS DRAWING MAY BE NECESSARY PRIOR TO CONSTRUCTION.

NOTICE
DRAWINGS PROVIDED BY ATC. ASSOC., INC. TO IGES FOR MODIFICATION ORIGINAL DRAWINGS AND ENGINEERING BY BINGHAM ENVIRONMENTAL, PROJECT 2108-008, NOV. 1994

NOTES:
1.

LICENSED PROFESSIONAL ENGINEER
No. 186632
KEVIN B. COSPER
STATE OF UTAH

MARK	DATE	DESCRIPTION
	8/29/02	FINAL PERMIT SUB.
	02/11/02	PERMIT SUBMITTAL
	01/11/02	DRAFT

ISSUE:
PROJECT NO:
CAD DWG FILE:
DRAWN BY:
CHECKED BY:

SHEET TITLE
SOLITUDE LANDFILL
CELL #3
FILLING SEQUENCE

FOR REVIEW PURPOSES ONLY NOT FOR CONSTRUCTION

APPENDIX A PROOF OF OWNERSHIP W/ LEGAL DESCRIPTION

E 456032 B 0574 P 330
Date 7-JAN-2002 16:19pm
Fee: 12.00 Check
MERLENE MOSHER, Recorder
Filed By VAR
For TRAVIS BOWEN
GRAND COUNTY CORPORATION

331

Send Recorded Deed To:
Law Office of Travis L. Bowen, P.C.
P. O. Box 11637
Salt Lake City, UT 84147-0637

Mail Tax Notice To:
Green River Landfill, L.L.C.
4570 Westgrove Suite 240
Addison, Texas 75001

Accommodation Recording
Not Examined

Property Identified As: 320 Acres unimproved property located within Grand County, Utah

QUIT-CLAIM DEED

For Value Received, Green River Ltd., a chartered Corporation of the Commonwealth of the Bahamas, hereinafter called the Grantor, hereby quitclaims unto Green River Landfill, L.L.C., a Utah limited liability company, hereinafter called the Grantee, the following premises, in the County of Grand, State of Utah to-wit:

The North half of the Northwest quarter, the Southeast quarter of the Northwest quarter, the South half of the Northeast quarter, the Northeast quarter of the Southwest quarter, and the North half of the Southeast quarter of Section 22, Township 21 South, Range 17 East, Salt Lake Base and Meridian, together with all mineral, oil and gas rights, said rights and reservations not being subject to the following:

Subject to City and/or County taxes and Assessments, not delinquent, Easements, Rights-Of-Way, Covenants, Conditions and Restrictions now of record.

To have and to hold the said premises, with their appurtenances, unto said Grantee and the Grantee's assigns forever.

Dated this 10th day of April, 1995.

GREEN RIVER LTD.

Rick Redle

Rick Redle, Trustee

011300

STATE OF Texas)
: SS.
COUNTY OF Dallas)

On this 30th day of November, 20 01, before me, a Notary Public in and for said State, personally appeared, Rick Redle, Trustee, known to me to be the person whose name is subscribed to the within instrument, and acknowledged to me that the same was executed.

ROXIE HEBERT
Notary Public, State of Texas
My Commission Expires
February 06, 2005

Roxie Hebert
Notary

011300

JAN 08 '02 04:49PM TRIGON GROUP LLC P.3/4
Received: 1/ 8/02 2:50PM; 972 407 0634 -> ATC Associates Inc; Page 3

E 456032 10574 P 331

APPENDIX B INSPECTION FORM

SOLITUDE LANDFILL
GENERAL INSPECTION FORM

Date: _____

Time: _____

Inspector: _____ _____
Printed Name Signature

Condition of Roadway: _____

_____

Condition of Gate & Entry: _____

_____

Condition of Fence: _____

_____

Condition of Run-on / Run-off Controls: _____

_____

Other Items: _____

_____

Recommended Actions: _____

_____

_____

_____

WASTE INSPECTION REPORT

Operator: _____ Date: _____ Time: _____

Generator: _____ Vehicle Type & ID: _____

Net Wt or Volume: _____ tons ☐ cubic yards ☐

Driver Name: _____

Load Description: _____

Types of Waste:

Household ☐	Commercial ☐	Industrial ☐
Ash ☐	Soil ☐	C&D ☐
Asbestos ☐	Tires ☐	Animals ☐
Sealed containers ☐		Free Liquid ☐
Contained gas ☐		
RCRA Hazwaste ☐	Describe: _____	

INSPECTION RESULTS: LOAD ACCEPTED ☐

LOAD REJECTED ☐

IF REJECTED, NOTIFY DEQ AND GENERATOR.

Date and time DEQ notified: _____

Date and time Generator notified: _____

INSPECTOR'S SIGNATURE: _____

MUNICIPAL WASTE FLOW RECORD

CELL NO. _____

DATE:_____

TIME	GENERATOR	MSW ☑	OTHER (describe)	VEHICLE TYPE	WEIGHT

DAILY OPERATING RECORD

DEVIATIONS FROM PLAN OF OPERATION

DATE: _____

This Record is to be used to note operations and operational systems that deviate from the Plan of Operation. Note time, condition that required deviation from Plan of Operation, and action taken. Sign or initial all entries.

RECORD OF PERSONNEL TRAINING

Name: _____

Title / Position: _____

Hire Date: _____ Supervisor: _____

Initial Training Date: _____ Trainer: _____

Material Covered: _____

_____

_____

Type of Training: ☐ OJT ☐ Classroom ☐ Seminar

☐ Other: _____

Verification / Certificate / Record in File? ☐ YES ☐ NO

☐ ANNUAL TRAINING ☐ OTHER: _____

Date: _____ Trainer: _____

Material Covered: _____

_____

Type of Training: ☐ OJT ☐ Classroom ☐ Seminar

☐ Other: _____

Verification / Certificate / Record in File? ☐ YES ☐ NO

☐ ANNUAL TRAINING ☐ OTHER: _____

Date: _____ Trainer: _____

Material Covered: _____

_____

Type of Training: ☐ OJT ☐ Classroom ☐ Seminar

☐ Other: _____

Verification / Certificate / Record in File? ☐ YES ☐ NO

☐ ANNUAL TRAINING ☐ OTHER: _____

Date: _____ Trainer: _____

Material Covered: _____

_____

Type of Training: ☐ OJT ☐ Classroom ☐ Seminar

☐ Other: _____

Verification / Certificate / Record in File? ☐ YES ☐ NO

☐ ANNUAL TRAINING ☐ OTHER: _____

Date: _____ Trainer: _____

Material Covered: _____

_____

Type of Training: ☐ OJT ☐ Classroom ☐ Seminar

☐ Other: _____

Verification / Certificate / Record in File? ☐ YES ☐ NO

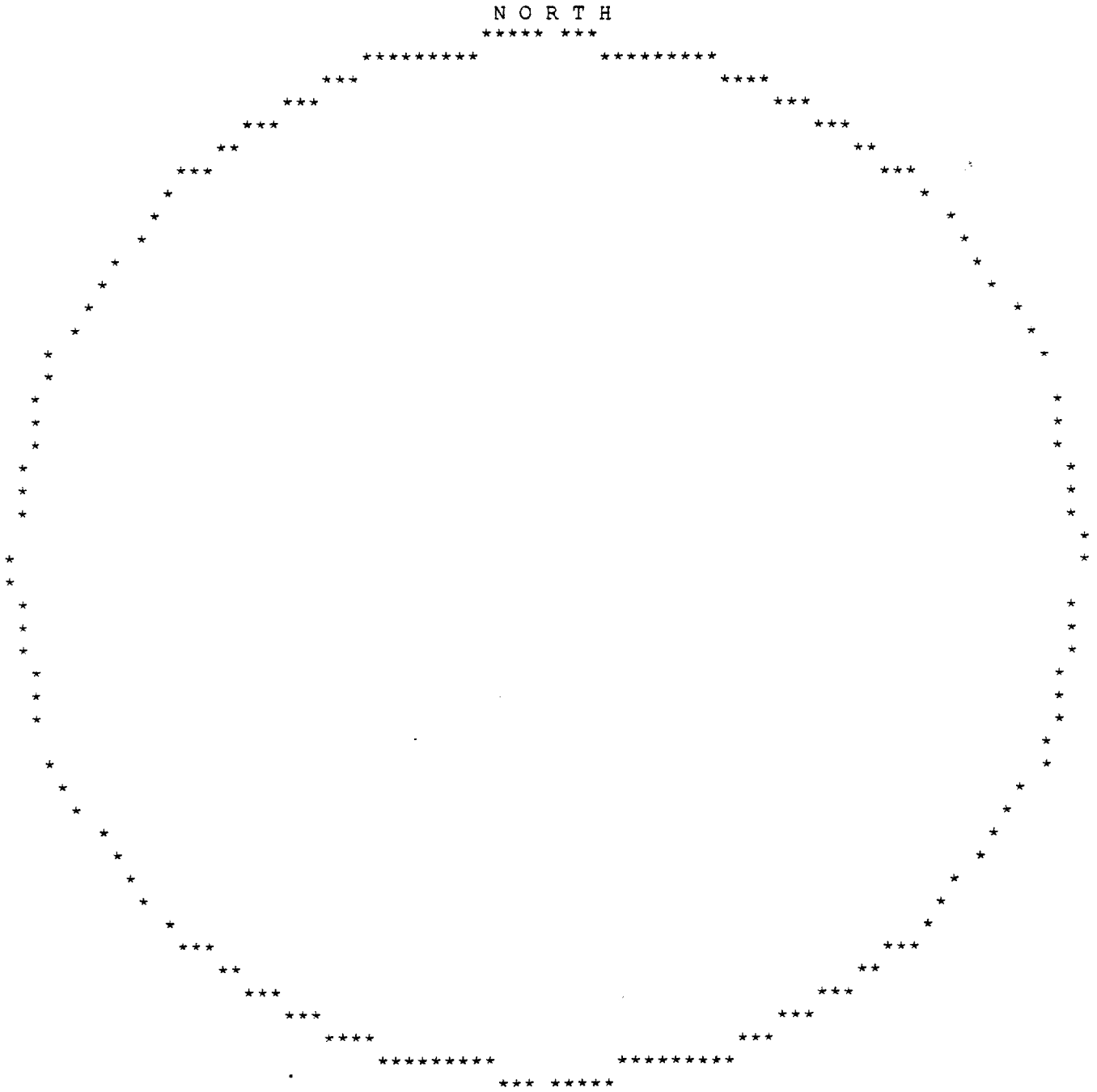
APPENDIX C WELL INVENTORY

1. POINT OF DIVERSION SEARCH

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED TUE, FEB 12, 2002, 1:
PLOT SHOWS LOCATION OF 0 POINTS OF DIVERSION

PLOT OF AN AREA WITH A RADIUS OF 11000 FEET FROM A POIN
S 2640 FEET, E 2640 FEET OF THE NW CORNER,
SECTION 22 TOWNSHIP 21S RANGE 17E SL BASE AND MERIDIA

PLOT SCALE IS APPROXIMATELY 1 INCH = 4000 FEET



2. PLACE OF USE SEARCH

UTAH DIVISION OF WATER RIGHTS

POUINFO Place of Use Listing

Version: 2001.06.28.00 Rundate: 02/12/2002 10:44 AM

WATER RIGHTS (PLACE OF USE) in: Township 21S Range 17E SL Base & Meridian

(The Division of Water Rights makes NO claims regarding the accuracy of this data!!

```
POD:     Point of Diversion ----S=Surface, U=Underground, P=Point to Point
ST/TOR:  Status/Type of Right
TYPE:    Type of Place of Use---I=Irrigated Acreage, P=Other Place of Use
USES:     I=Irrigation, S=Stockwatering, D=Domestic, Mu=Municipal, Mi=Mining, P=Pow
```

WR-CH-EX#	POD	ST/TOR	TYPE	WATER USES	N W 4				*	N E 4				*	S W 4				*	S E 4			
					N	N	S	S	*	N	N	S	S	*	N	N	S	S	*	N	N	S	S
					W	E	W	E	*	W	E	W	E	*	W	E	W	E	*	W	E	W	E

APPENDIX D FIELD AND LABORATORY PROGRAMS - 1994

FIELD PROGRAM

INTRODUCTION

Green River Landfill, L.L.C. (GRL) has investigated an area for a proposed landfill located approximately 7 miles east of Green River, Utah. The landfill area consists of 320 acres located in Section 22, Township 21 South, Range 17 East in Grand County, Utah.

Bingham Environmental, Inc. (Bingham) was retained by GRL to conduct a field investigation at the site to determine the physical and hydrogeological characteristics at the site. Field work was conducted during June and July, 1994. Bingham geologists and/or engineers supervised all field activities. The investigation consisted of the following tasks:

- Aerial Photography to produce a detailed topographic map
- Excavate 18 test pits with a track-mounted backhoe
- Drill 11 exploratory drill holes
- Install 2 piezometers
- Install 7 monitor wells
- Sample 2 monitor wells and 2 piezometers where perched water was encountered
- Perform slug tests on 2 wells

AERIAL PHOTOGRAPHY

Aerial targets were set up and surveyed by Bingham Engineering, Inc. on June 17, 1994, based on limited existing control points. Target locations are shown on the topographic site map (Figure 1). Olympus (Olympus) Aerial Surveys flew over and photographed the site on June 22, 1994. Olympus then produced the detailed topographic map from the aerial photography. The topographic map in Figure 1 is based on 5-foot contours and identified the access road across the site and the existing drainage across the site.

TEST PITS

A Bantam 266 track-mounted backhoe was used to excavate 18 test pits (TP-1 through TP-18) at the locations shown on Figure 1. The test pits were excavated to depths ranging from 8 to 17 feet below the ground surface and logs are included in Attachment 1. In general, the test pits encountered 1 to 3 feet of soil, generally consisting of silt or sandy silt, underlain by weathered shale. One notable exception to this lithology was encountered in TP-18, which had sand, gravel and cobbles to a depth of 12 feet, where the shale bedrock was then encountered. The shale became more competent with

depth, with excavation unable to extend below 8 and 17 feet. Bedding thickness ranged from less than 1 inch to about 4 inches. Grab samples, as indicated on the logs, were collected for laboratory testing from each of the test pits.

EXPLORATORY BORINGS

A CME 75 truck-mounted drill rig was used to drill 15 exploratory borings between June 20 and July 22, 1994. A Bingham hydrogeologist and/or engineer supervised the drilling operations during the duration of the drilling program. They located the holes, logged the subsurface soil and bedrock encountered and obtained relatively undisturbed and disturbed soil and bedrock samples. The majority of the soil samples were obtained by driving a standard penetration sampler (SPT) 18 inches. Relatively undisturbed soil samples were obtained using thin walled steel samplers (Shelby tubes) or a 24 inch long California split barrel sampler with 1.5-inch diameter by 4 inch long brass liners. All of the soil samples are recorded on the drill hole logs included in this attachment.

The holes were drilled with 8.25-inch diameter hollow stem augers from the surface generally to a depth of 14 to 19 feet, where they met refusal within the shale bedrock. The borings were then continued by coring to the desired depth (35 to 140 feet) using a carbide coring bit. Cores were recovered and logged from each hole. Competent bedrock (defined for this site as unbroken core lengths at least 12 inches or greater) was generally encountered at a depth of about 26 feet in the borings.

Perched water was encountered in four of the thirteen borings (DH-2, DH-5, DH-7, and DH-10) at depths ranging from 26 to 38 feet below the ground surface. Temporary piezometers were installed in DH-2, DH-7, and DH-10 using 2-inch hand-slotted and blank PVC pipe. DH-7 was later converted into a monitor well, but DH-2 and DH-10 remain as piezometers.

PERCHED WATER MONITOR WELLS

Seven of the fifteen borings were converted into groundwater monitor wells, completed to depths of between 50 and 100 feet. These include MW-2, MW-4, MW-5, MW-7, MW-7A, MW-13, and MW-14. Monitor well completion was accomplished with the installation of 2-inch diameter flush-coupled schedule 40 PVC pipe with 0.020-inch machine slotted screen in the bottom 60 to 80 feet, with the exception of MW-7A, which was screened in the bottom 27 feet. The annulus was backfilled with #10-20 Colorado silica sand to a minimum height of 2 feet above the screened interval. A bentonite pellet plug a minimum of two (2) feet thick was placed over the sand filter. The remaining annulus was backfilled with a cement-bentonite slurry. A protective concrete pad and locking steel casing were constructed at the surface of the monitor wells. Well completion details are included on the boring logs in this attachment.

Only two of the fifteen wells (MW-2 and MW-5) and the two piezometers currently have water. MW-7, when drilled and completed as a piezometer (DH-7) at a depth of 50 feet, contained water at a static level of 32 feet. The water disappeared after a monitor well was completed in the same hole to a depth of 85 feet. Another well (MW-7A) was installed 15 feet away to a depth of 45 feet; to date, no water has collected in this well either. This is indicative of the localized nature of the perched water.

Water levels have been measured in the existing monitor wells and piezometers throughout the field program. Water level measurements were determined using an electronic well probe. Each measurement is referenced to the top of the PVC casing (TOC) which was surveyed so that perched water elevations could be determined. The monitor well and piezometer water level elevations are tabulated in a table in this attachment. (Based on our investigation and analysis of water samples, we believe the water encounter in the wells is perched water which percolates from ? streams, which is not considered a consistent or viable aquifer.)

PERCHED WATER SAMPLING

The monitor wells were developed immediately after installation and then allowed to stabilize for several days before sampling, which was performed on July 29, 1994. Prior to sampling the water level was measured, and a minimum of three casing volumes of water were removed from each well using disposable polyethylene bailers. Specific conductance, temperature and pH were monitored during the bailing and a final reading was obtained prior to the sample collection. After the purging was completed the water level was allowed to return to approximately its original level and samples were obtained using polyethylene bailers.

Sample labels were filled out and attached to the sample bottles and the samples were stored on ice in coolers until the samples were delivered to the analytical laboratory. The samples were sent to the laboratory under chain of custody.

SLUG TESTS

Slug injection tests were performed on two (2) monitor wells identified as MW-2 and MW-5, on July 29, 1994 to estimate horizontal hydraulic conductivity values for the fractured bedrock. Each test consisted of injecting a known volume of previously bailed water back into the monitor well as rapidly as possible, and then measuring the depth to water as the water level dropped back to its original static level.

The tests were performed using automatic water level monitoring and logging equipment which provided accurate water level measurements during the recovery phase. The data was analyzed

using methods developed by Hvorslev (1951). Results of the tests have been tabulated and plotted and are included along with a summary of the estimated hydraulic conductivity values in this attachment.

SURVEYING

Bingham performed surveying of all monitor well, piezometer, exploratory drill hole, and test pit locations at the site, as part of the field program. The surveying included determining the horizontal coordinates and vertical elevations of these points. All vertical control was based on the USGS benchmark A-16 located approximately 1 mile from the site. The horizontal control was based on the USGS Utah Green River NE 7½ minute topographic quadrangle. The survey data is summarized in a table in this attachment.

LABORATORY TESTING AND ANALYSIS

GEOTECHNICAL LABORATORY TESTING

Selected samples were submitted to Bingham Engineering's materials testing laboratory for the following tests: moisture content, unit weight, grain size analysis, hydrometer, Atterberg limits, and permeability. The results of the tests are included within this attachment.

Atterberg Limits

Atterberg limits (which include the liquid and plastic limits) determinations were performed as an index to soil behavior, to aid in correlating various other test data and to aid in classifying samples.

Grain Size Analysis and Hydrometer

Standard mechanical grain size analysis was performed on selected soil samples obtained in conjunction with the field investigations. The test procedures consisted of washing a representative portion of each sample through a No. 200 sieve and recording the percent dry weight of the material passing the No. 200 sieve. Then the remaining sample, retained above the No. 200 sieve, was evaluated by a mechanical method to determine the percent by dry weight retained on selected sieve sizes. The material passing the 200 sieve was then further analyzed using a hydrometer for some of the samples.

Moisture Content and Unit Weight Determinations

Moisture content and density determinations were performed in order to aid in classifying materials and to correlate with other hydrogeologic properties.

Compaction Testing

Compaction tests were performed on two representative composite samples to determine the maximum dry density and optimum moisture content. The tests were performed in accordance with the ASTM D-698 Method of Compaction.

Permeability

Permeability testing was performed on three separate samples collected from overburden material at the site. The first test was performed on an uncompacted soil sample (TP-1, CA-2)

to determine natural infiltration rates of precipitation into the underlying shale bedrock. The other two tests were performed on compacted soil samples which were compacted to 98% of maximum dry density as determined by the standard Proctor. Information regarding the specific soil samples comprising Composite #1 and Composite #2 is given in the Permeability Test Results table presented in Attachment 1.

Triaxial Testing

Two composite samples (Composite #1 and Composite #2) were submitted for triaxial consolidated undrained with pore pressure testing. The results are included in this section.

Swelling Potential

Because the embankments of the landfill cells are to be constructed with excavated Mancos Shale material, laboratory testing was performed on soil and gravel size shale samples from the Green River Landfill site to determine the swelling potential the material would exhibit when wetted. The procedure used is as follows:

1) Specimens of gravel sized shale particles and weathered shale (soil) are placed in the consolidometer at natural moisture content, loaded in the normal manner to some preselected load, and allowed to come to equilibrium;

2) immerse the sample and observe the height increase until equilibrium is reached;

3) reduce the vertical pressure by a factor of two and observe the associated swell;

4) repeat step (3) until loading is removed;

5) plot the curve representing swelling pressure versus percent expansion.

The results of the testing are included on the attached graphs. The testing indicates that only slight to moderate swell characteristics were observed; a maximum of 1.12% under a loading of 130 pounds per square foot. Given a density of 110 pounds per cubic foot (pcf) for the shale at the site, this loading corresponds to a shallow depth of confinement of 0.12 feet. A swell of 1.12% would be equivalent to 0.02 inches.

The results indicate that the gravel sized shale and the soil are very similar in their swelling potential. Weathering of the shale is not expected to have an adverse effect on the stability of the embankments or the cover system.

CHEMICAL LABORATORY ANALYSIS

Perched water samples were submitted to American West Analytical Laboratory for chemical analysis. The results are included in this attachment and are summarized in Table 1 located after the text of the Hydrogeologic Report.

Field Quality Assurance/Quality Control

Sample Preservation - All samples were placed in Class A environmental containers provided by American West Analytical Laboratory (AWAL) with proper preservatives. The samples were stored in a cooler at 4°C until hand delivered to AWAL for analysis.

Chain of Custody - Samples selected to be sent to AWAL for analysis were hand delivered under strict chain of custody protocol.

Field Analysis Validation - Field analysis for the indicator parameters of conductivity and pH were compared to a certified laboratory analysis and the results compared very well.

Laboratory Quality Assurance/Quality Control

Field Duplicate - A field duplicate was collected from MW-5 and submitted to AWAL under the blind sample identification of MW-1.

1. SUMMARY OF WELL, EXPLORATORY HOLE AND TEST PIT LOCATION AND ELEVATIONS

SUMMARY OF WELL, EXPLORATORY HOLE AND TEST PIT LOCATION AND ELEVATIONS GREEN RIVER LANDFILL

DRILL HOLE ID	PROJECT COORDINATES		ELEV. GROUND SURFACE (feet)	ELEV. TOP PROTECTIVE CASING WITH LID (feet)	ELEV. TO OF PVC W/O CAP (feet)	TEMP BENCH MARK (feet)
	Northing (feet)	Easting (feet)				
DH-1	12768.8	1557.1	4313.1	NA	NA	NA
DH-2	12753.5	4082.5	4340.5	NA	4345.28	NA
DH-3	12159.5	2840.0	4333.4	NA	NA	NA
DH-6	11474.3	4140.6	4343.5	NA	NA	NA
DH-8	11445.7	6765.2	4371.6	NA	NA	NA
DH-9	10142.4	3343.0	4348.6	NA	NA	NA
DH-10	10183.3	4374.3	4352.5	NA	4353.83	NA
DH-12	10155.9	6113.2	4377.5	NA	NA	NA
DH-15	8865.9	6768.1	4406.8	NA	NA	NA
MW-2	12778.4	4110.8	NA	4341.39	4341.30	4338.96
MW-4	11489.8	1557.5	4318.5	4321.51	4321.46	NA
MW-5	11452.7	2865.2	NA	4328.51	4328.29	4326.85
MW-7	11447.3	4701.7	4355.8	4358.71	4358.65	NA
MW-7A	11443.7	4716.4	4355.8	4358.75	4358.67	NA
MW-13	8891.7	2912.2	4372.2	4375.22	4375.10	NA
MW-14	8849.3	4187.8	4369.9	4372.81	4372.77	NA
TP-1	11811.7	1900.4	4327.0	NA	NA	NA
TP-2	11577.2	1937.8	4319.9	NA	NA	NA
TP-3	11018.8	2920.4	4331.3	NA	NA	NA
TP-4	10793.8	3437.4	4342.8	NA	NA	NA
TP-5	10161.2	3599.7	4347.8	NA	NA	NA
TP-6	9695.2	4226.9	4356.6	NA	NA	NA
TP-7	9345.4	3623.7	4361.0	NA	NA	NA
TP-8	9250.6	3372.0	4368.4	NA	NA	NA
TP-9	9216.7	3185.1	4361.9	NA	NA	NA
TP-10	8824.3	5039.5	4384.8	NA	NA	NA
TP-11	8945.1	6244.1	4392.6	NA	NA	NA
TP-12	9291.1	6081.2	4398.4	NA	NA	NA
TP-13	9769.4	5711.6	4372.1	NA	NA	NA
TP-14	9411.9	5261.0	4367.5	NA	NA	NA
TP-15	10522.3	5700.1	4372.5	NA	NA	NA
TP-16	10720.2	4411.7	4347.9	NA	NA	NA
TP-17	11520.7	3466.5	4332.7	NA	NA	NA
TP-18	11809.8	3223.7	4347.4	NA	NA	NA

NA - Not Available or Applicable

11/21/94

2. PERCHED WATER LEVEL MEASUREMENTS

PERCHED WATER LEVEL MEASUREMENTS
GREEN RIVER LANDFILL

WELL ID #	Depth to water from top of PVC casing (feet)	GRDWTR SURFACE ELEVATION (feet)	Depth to water from top of PVC casing (feet)	GRDWTR SURFACE ELEVATION (feet)	Depth to water from top of PVC casing (feet)	GRDWTR SURFACE ELEVATION (feet)	Depth to water from top of PVC casing (feet)	GRDWTR SURFACE ELEVATION (feet)	Depth to water from top of PVC casing (feet)	GRDWTR SURFACE ELEVATION (feet)
	July 14, 1994		July 19, 1994		July 22, 1994		July 28, 1994		November 18, 1994	
DH-2	29.97	4315.31	28.06	4317.22	27.46	4317.82	26.72	4318.56	29.48	4315.80
MW-2	27.98	4313.32	26.20	4315.10	25.75	4315.55	25.04	4316.26	25.50	4315.80
MW-4	NA	NA	NA	NA	DRY	DRY	DRY	DRY	DRY	DRY
MW-5	29.96	4298.33	30.68	4297.61	31.05	4297.24	31.67	4296.62	32.21	4296.08
MW-7	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
MW-7A	NA	NA	NA	NA	NA	NA	DRY	DRY	DRY	DRY
DH-10	37.68	4316.15	37.52	4316.31	37.42	4316.41	37.57	4316.26	39.05	4314.78
MW-13	DRY	DRY	NA	NA	DRY	DRY	DRY	DRY	DRY	DRY
MW-14	NA	NA	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

11/21/94

NA Not measured

3. SUMMARY OF SLUG INJECTION TESTS

SUMMARY OF SLUG INJECTION TESTS
GREEN RIVER LANDFILL

Well I.D.	Screen Length (feet)	Effective Aquifer Length (feet)	Volume of Water Injected (gallons)	Calculated Ho (feet)	Hydraulic Conductivity (cm/sec)	Analysis Method
MW-2	75.0	75.0	2.6	15.93	7.6E-05	1
MW-5	60.0	60.0	0.84	5.15	2.1E-05	1

10/14/94

Analysis Methods:

1. Hvorslev
2. Cooper-Bredehoeft-Papadopulos
3. Ferris-Knowles
4. Bouwer

4. GEOTECHNICAL LABORATORY TEST RESULTS

SECTION SIX

SHALE SWELLING POTENTIAL

The embankments of the landfill cells are to be constructed with excavated Mancos Shale material. Laboratory testing was performed on shale samples from the Green River Landfill site to determine the swelling potential the shale and soil would exhibit when wetted. The procedure used is as follows:

1) Specimens of shale and weathered shale (soil) are placed in the consolidometer at natural moisture content, loaded in the normal manner to some preselected load, and allowed to come to equilibrium;

2) immerse the sample and observe the height increase until equilibrium is reached;

3) reduce the vertical pressure by a factor of two and observe the associated swell;

4) repeat step (3) until loading is removed;

5) plot the curve representing swelling pressure versus percent expansion.

The results of the testing are included on the graphs included in Attachment 3. The testing indicates that the largest swell observed was a 1.12% under a loading of 0.013 ksf (thousand pounds/square foot). Given a density of 110 pounds per cubic foot (pcf) for the shale at the site, this loading corresponds to a depth of 0.12 feet. A swell of 1.12% would be equivalent to 0.02 inches.

The results indicate that the shale and the weathered shale are very similar in their swelling potential. Weathering of the shale is not expected to have an adverse effect on the stability of the embankments.

Purpose: Calculate factor of safety for the outer surface of the waste cell embankment.

Assume: Use PC-STABL5M to predict stability
Embankment material is excavated shale
4 cases: 1) Static case
2) Static with vehicle loading (top and mid-point of embankment)
3) Pseudo-static (earthquake)
Earthquake acceleration is less than 0.10 g (use 0.10 g for analysis)
*Use acceleration with 90% of not being exceeded in 250 years.
* S.T. Algermissen, et al.; 1982; "Probabilistic Estimates of Maximum Acceleration And Velocity In Rock In The Contiguous United States"; U.S.G.S Open File Report, 82-1033

Soil Parameters

Mancos Shale

Shale material is a blocky angular rockfill typically well graded with a maximum dimension of 18" and very little fines.

Strength of the shale is determined from the following:
* Yong R.M., 1980, "Laboratory Shear Strength of Soil", An ASTM symposium in Chicago Ill., June 25, 1980, ASTM 740
* Winterkorn H.F., Fang H., 1975, "Foundation Engineering Handbook"

	Rockfill (1)	In-Situ (2)
ϕ	30°	15°
C	0	5000 psf
γ_d	120	130
γ_{sat}	145	155

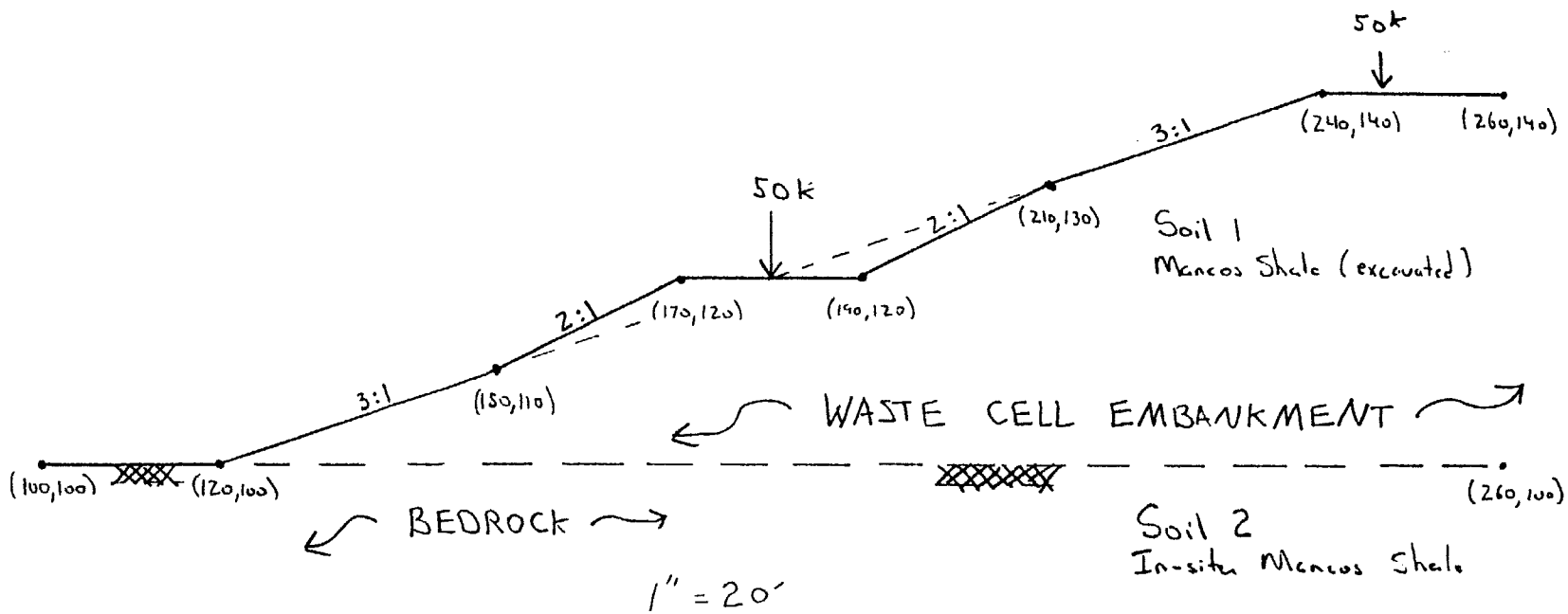
(1) From Winterkorn → ϕ well graded angle = 35°
ϕ poorly graded angle = 33°
From ASTM 740 → ϕ = 36° from Fig 6.
Conservatively assume ϕ = 30°

(2) From Winterkorn → C for unfavorable shale ranges 5-100 psi (720-14,400 psf)
C for favorable shale ranges 100 to >1000 psi
ϕ for unfavorable shale ranges 10-20°
ϕ for favorable shale ranges 20-65°
Conservatively assume ϕ = 15°
C = 35 psi (5000 psf)

Green River Landfill STABL Modeling DEW 10/25/94 2106-006

Assume: No phreatic surface
Cases → 1) static (with applied vehicle load (50k))
2) Pseudo-Static without applied vehicle load (earthquake)
Soil parameters given below →
Horizontal acceleration = 0.10g

	Soil 1	Soil 2
γ	120	130
γ_{sat}	145	155
C	0	5000 psf
ϕ	30°	15°



AMPAD 22-141 50 SHEETS 22-142 100 SHEETS 22-144 200 SHEETS

Results of STABL Runs

	Factor of safety	Required
Static	1.8	1.5
Static - load at top embank.	1.5	1.5
Static - load at mid-point	1.9	1.5
Pseudo-Static (E quake)	1.3	1.0

Because calculated F.S. ≥ Required, landfill is stable.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	11/25/94
Time of Run:	16:20
Run By:	DEW
Input Data Filename:	RUN1NOL
Output Filename:	RUN1NOL.OUT

PROBLEM DESCRIPTION:
ITEX Green River Landfill - Run1 (Static case with no vehicle loading)

BOUNDARY COORDINATES

7 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	100.00	120.00	100.00	2
2	120.00	100.00	150.00	110.00	1
3	150.00	110.00	170.00	120.00	1
4	170.00	120.00	190.00	120.00	1
5	190.00	120.00	210.00	130.00	1
6	210.00	130.00	240.00	140.00	1
7	240.00	140.00	260.00	140.00	1
8	120.00	100.00	260.00	100.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	145.0	.0	30.0	.00	.0	1
2	130.0	155.0	5000.0	15.0	.00	.0	1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

15 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 105.00 ft.
and X = 164.00 ft.

Each Surface Terminates Between X = 240.00 ft.
and X = 260.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 80.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.76	106.22
3	152.53	108.36
4	162.25	110.72
5	171.91	113.30
6	181.51	116.11
7	191.04	119.14
8	200.50	122.39
9	209.88	125.86
10	219.17	129.54
11	228.38	133.44
12	237.50	137.55
13	242.61	140.00

Circle Center At X = 55.5 ; Y = 529.0 and Radius, 431.7

*** 1.813 ***

Individual data on the 17 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	9.8	803.4	.0	.0	.0	.0	.0	.0	.0
2	7.2	1545.0	.0	.0	.0	.0	.0	.0	.0
3	2.5	775.7	.0	.0	.0	.0	.0	.0	.0
4	9.7	4847.3	.0	.0	.0	.0	.0	.0	.0
5	7.7	5864.2	.0	.0	.0	.0	.0	.0	.0
6	1.9	1594.1	.0	.0	.0	.0	.0	.0	.0
7	9.6	6094.1	.0	.0	.0	.0	.0	.0	.0
8	8.5	2585.7	.0	.0	.0	.0	.0	.0	.0
9	1.0	159.9	.0	.0	.0	.0	.0	.0	.0
10	9.5	2402.1	.0	.0	.0	.0	.0	.0	.0
11	9.4	3902.5	.0	.0	.0	.0	.0	.0	.0
12	.1	61.0	.0	.0	.0	.0	.0	.0	.0
13	9.2	4185.3	.0	.0	.0	.0	.0	.0	.0
14	9.2	3425.2	.0	.0	.0	.0	.0	.0	.0
15	9.1	2351.1	.0	.0	.0	.0	.0	.0	.0
16	2.5	429.8	.0	.0	.0	.0	.0	.0	.0
17	2.6	195.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.53	100.18
2	130.39	101.82
3	140.21	103.69
4	149.99	105.78
5	159.72	108.11
6	169.39	110.65
7	179.00	113.43
8	188.54	116.42
9	198.01	119.64
10	207.40	123.07
11	216.71	126.72
12	225.93	130.58
13	235.06	134.66
14	244.10	138.95
15	246.18	140.00

Circle Center At X = 54.7 ; Y = 526.2 and Radius, 431.1

*** 1.816 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.88	105.52
3	152.75	107.07
4	162.57	108.98
5	172.31	111.24
6	181.96	113.85
7	191.52	116.81
8	200.96	120.10
9	210.28	123.74
10	219.46	127.70
11	228.49	132.00
12	237.36	136.61
13	243.34	140.00

Circle Center At X = 104.6 ; Y = 381.0 and Radius, 278.2

*** 1.838 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.53	100.18
2	130.37	101.94
3	140.18	103.88
4	149.95	106.01
5	159.68	108.33
6	169.36	110.83
7	178.99	113.51
8	188.57	116.38
9	198.10	119.42
10	207.56	122.65
11	216.97	126.05
12	226.30	129.64
13	235.57	133.39
14	244.77	137.33
15	250.70	140.00

Circle Center At X = 32.5 ; Y = 620.8 and Radius, 528.0

*** 1.850 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.91	105.20
3	152.82	106.50
4	162.68	108.21
5	172.45	110.34
6	182.12	112.87
7	191.68	115.80
8	201.11	119.13
9	210.39	122.85
10	219.51	126.96
11	228.45	131.44
12	237.19	136.29
13	243.26	140.00

Circle Center At X = 116.8 ; Y = 343.0 and Radius, 239.2

*** 1.852 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.63	101.21
2	133.62	101.72
3	143.58	102.65
4	153.48	104.00
5	163.33	105.77
6	173.08	107.95
7	182.74	110.55
8	192.28	113.55
9	201.68	116.96
10	210.93	120.76
11	220.01	124.95
12	228.91	129.52
13	237.60	134.46
14	246.08	139.77
15	246.41	140.00

Circle Center At X = 116.7 ; Y = 337.0 and Radius, 235.9

*** 1.865 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.63	101.21
2	133.57	102.33
3	143.47	103.75
4	153.32	105.46
5	163.12	107.46
6	172.85	109.75
7	182.51	112.33
8	192.09	115.20
9	201.58	118.35
10	210.98	121.79
11	220.26	125.50
12	229.43	129.48
13	238.48	133.74
14	247.40	138.27
15	250.58	140.00

Circle Center At X = 91.0 ; Y = 435.5 and Radius, 335.9

*** 1.867 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.05	105.35
2	146.03	105.99
3	155.97	107.11
4	165.84	108.72
5	175.62	110.80
6	185.29	113.36
7	194.82	116.38
8	204.19	119.86
9	213.39	123.80
10	222.38	128.18
11	231.14	132.99
12	239.67	138.22
13	242.27	140.00

Circle Center At X = 127.9 ; Y = 310.7 and Radius, 205.5

*** 1.870 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.05	105.35
2	145.79	107.63
3	155.50	110.03
4	165.18	112.54
5	174.83	115.17
6	184.44	117.91
7	194.03	120.76
8	203.58	123.72
9	213.09	126.80
10	222.57	129.99
11	232.01	133.29
12	241.41	136.69
13	250.20	140.00

Circle Center At X = -53.3 ; Y = 934.7 and Radius, 850.7

*** 1.873 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.90	115.45
2	170.85	116.45
3	180.73	117.97
4	190.51	120.03
5	200.18	122.60
6	209.69	125.69
7	219.02	129.29
8	228.15	133.37
9	237.04	137.94
10	240.58	140.00

Circle Center At X = 147.4 ; Y = 300.7 and Radius, 185.7

*** 1.878 ***

```
        Y        A   X   I   S        F   T

        .00    32.50    65.00    97.50   130.00   162.50

X      .00 +--------+--------+--------+--------+--------+
        -
        -
        -
        -
        -
     32.50 +
        -
        -
        -
        -
        -
A    65.00 +
        -
        -
        -
        -
        -
X    97.50 +                    *
        -                   .
        -                   .
        -                  ...
        -                 . ..*
        -                 ....6
I   130.00 +                  .....2.
        -                .....61
        -               .......21
        -               .......68.
        -               .......61*
        -               ........29.
S   162.50 +                 ........5190
        -               ........82. *
        -               ........6310
        -               ..........20
        -               .........631
        -               ..........62*
    195.00 +                ...........89
        -               ...........621
        -                ...........82
        -                ...........631*
        -                 ............21
        -                 ..........639
F   227.50 +                    ...........21
        -                  ...........2.
        -                   ..........61*
        -                    ..........41
        -                      ........4
        -                       .......
T   260.00 +                    *      ...*
```

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	11/25/94
Time of Run:	16:45
Run By:	DEW
Input Data Filename:	RUN1TOP
Output Filename:	RUN1TOP.OUT

PROBLEM DESCRIPTION:
ITEX Green River Landfill - Run1 (Static case with vehicle loading at top)

BOUNDARY COORDINATES

7 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	100.00	120.00	100.00	2
2	120.00	100.00	150.00	110.00	1
3	150.00	110.00	170.00	120.00	1
4	170.00	120.00	190.00	120.00	1
5	190.00	120.00	210.00	130.00	1
6	210.00	130.00	240.00	140.00	1
7	240.00	140.00	260.00	140.00	1
8	120.00	100.00	260.00	100.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	145.0	.0	30.0	.00	.0	1
2	130.0	155.0	5000.0	15.0	.00	.0	1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	245.00	255.00	5000.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

15 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 110.00 ft.
and X = 164.00 ft.

Each Surface Terminates Between X = 240.00 ft.
and X = 260.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 80.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	161.16	115.58
2	171.07	114.29
3	181.06	113.84
4	191.06	114.24
5	200.98	115.48
6	210.76	117.56
7	220.33	120.46
8	229.62	124.16
9	238.57	128.63
10	247.10	133.84
11	255.16	139.76
12	255.44	140.00

Circle Center At X = 181.3 ; Y = 231.8 and Radius, 118.0

*** 1.482 ***

Individual data on the 17 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	8.8	2955.8	.0	.0	.0	.0	.0	.0	.0
2	1.1	727.6	.0	.0	.0	.0	.0	.0	.0
3	10.0	7115.3	.0	.0	.0	.0	.0	.0	.0
4	8.9	6412.3	.0	.0	.0	.0	.0	.0	.0
5	1.1	766.5	.0	.0	.0	.0	.0	.0	.0
6	9.9	9699.8	.0	.0	.0	.0	.0	.0	.0
7	9.0	12234.5	.0	.0	.0	.0	.0	.0	.0
8	.8	1154.1	.0	.0	.0	.0	.0	.0	.0
9	9.6	14742.1	.0	.0	.0	.0	.0	.0	.0
10	9.3	14138.7	.0	.0	.0	.0	.0	.0	.0
11	8.9	12489.8	.0	.0	.0	.0	.0	.0	.0
12	1.4	1838.6	.0	.0	.0	.0	.0	.0	.0
13	5.0	5380.3	.0	.0	.0	.0	.0	.0	.0
14	2.1	1714.5	.0	.0	.0	.0	.0	.0	10507.5
15	7.9	3089.6	.0	.0	.0	.0	.0	.0	39492.5
16	.2	6.0	.0	.0	.0	.0	.0	.0	.0
17	.3	4.0	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	158.32	114.16
2	168.27	113.22
3	178.27	113.05
4	188.25	113.64
5	198.16	115.00
6	207.93	117.11
7	217.52	119.96
8	226.86	123.55
9	235.89	127.83
10	244.57	132.80
11	252.84	138.42
12	254.83	140.00

Circle Center At X = 175.6 ; Y = 242.9 and Radius, 129.9

*** 1.485 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	161.16	115.58
2	170.90	113.31
3	180.82	112.10
4	190.82	111.97
5	200.78	112.92
6	210.57	114.93
7	220.10	117.99
8	229.23	122.06
9	237.88	127.08
10	245.93	133.01
11	253.30	139.77
12	253.50	140.00

Circle Center At X = 187.0 ; Y = 204.6 and Radius, 92.7

*** 1.514 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	161.16	115.58
2	170.86	113.15
3	180.77	111.84
4	190.77	111.64
5	200.73	112.57
6	210.52	114.61
7	220.01	117.74
8	229.10	121.91
9	237.66	127.08
10	245.58	133.18
11	252.63	140.00

Circle Center At X = 187.5 ; Y = 200.4 and Radius, 88.8

*** 1.541 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.63	111.32
2	162.48	109.60
3	172.45	108.76
4	182.45	108.83
5	192.40	109.78
6	202.23	111.62
7	211.86	114.34
8	221.20	117.90
9	230.19	122.28
10	238.75	127.45
11	246.81	133.37
12	254.31	139.98
13	254.33	140.00

Circle Center At X = 176.8 ; Y = 220.4 and Radius, 111.7

*** 1.557 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	117.00
2	173.99	116.53
3	183.99	116.71
4	193.95	117.52
5	203.85	118.98
6	213.63	121.07
7	223.25	123.78
8	232.68	127.10
9	241.88	131.03
10	250.81	135.54
11	258.39	140.00

Circle Center At X = 176.3 ; Y = 272.0 and Radius, 155.5

*** 1.566 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.74	104.25
2	142.74	104.31
3	152.72	104.84
4	162.67	105.83
5	172.57	107.28
6	182.38	109.19
7	192.10	111.55
8	201.70	114.36
9	211.15	117.61
10	220.45	121.30
11	229.56	125.42
12	238.47	129.96
13	247.17	134.90
14	255.23	140.00

Circle Center At X = 136.4 ; Y = 319.4 and Radius, 215.2

*** 1.570 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.90	103.30
2	139.87	102.61
3	149.87	102.50
4	159.86	102.97
5	169.80	104.03
6	179.67	105.66
7	189.42	107.86
8	199.03	110.63
9	208.47	113.95
10	217.69	117.81
11	226.67	122.21
12	235.39	127.11
13	243.80	132.52
14	251.88	138.41
15	253.81	140.00

Circle Center At X = 146.7 ; Y = 274.3 and Radius, 171.8

*** 1.589 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.90	103.30
2	139.84	102.27
3	149.83	101.87
4	159.83	102.10
5	169.79	102.96
6	179.68	104.44
7	189.46	106.54
8	199.09	109.25
9	208.52	112.56
10	217.73	116.46
11	226.68	120.93
12	235.32	125.95
13	243.64	131.51
14	251.59	137.58
15	254.38	140.00

Circle Center At X = 151.2 ; Y = 260.8 and Radius, 159.0

*** 1.593 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.26	107.09
2	151.17	105.74
3	161.15	105.14
4	171.15	105.30
5	181.11	106.23
6	190.97	107.90
7	200.67	110.31
8	210.17	113.46
9	219.39	117.31
10	228.30	121.86
11	236.84	127.06
12	244.96	132.90
13	252.61	139.34
14	253.29	140.00

Circle Center At X = 164.0 ; Y = 236.8 and Radius, 131.7

*** 1.594 ***

```
        Y       A   X   I   S       F   T

        .00   32.50   65.00   97.50   130.00   162.50

X     .00 +--------+--------+--------+--------+--------+
          -
          -
          -
          -
          -
    32.50 +
          -
          -
          -
          -
          -
A   65.00 +
          -
          -
          -
          -
          -
X   97.50 +                    *
          -
          -                  .
          -                  .
          -                 ..*
          -                .....
I  130.00 +                  .....8
          -                .....7
          -                .....970
          -               ..........
          -               ......970*
          -               ..........2
S  162.50 +                  ......9875.1
          -               .......8..2 *
          -               .......05.16
          -               .......9831.
          -               ........57.6
          -               ........831.*
   195.00 +                  .........5.6.
          -               .........521..
          -                .........826.
          -                .........316..*
          -                 .........82...
          -                  ........316..
F  227.50 +                     .........917..
          -                   .........6..
          -                    .......21..*
          -                    ........62../1
          -                     .......16.
          -                       ......11/
T  260.00 +                      *       .*
```

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	11/25/94
Time of Run:	16:45
Run By:	DEW
Input Data Filename:	RUN1
Output Filename:	RUN1.OUT

PROBLEM DESCRIPTION:
ITEX Green River Landfill - Run1 (Static case with vehicle loading)

BOUNDARY COORDINATES

7 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	100.00	120.00	100.00	2
2	120.00	100.00	150.00	110.00	1
3	150.00	110.00	170.00	120.00	1
4	170.00	120.00	190.00	120.00	1
5	190.00	120.00	210.00	130.00	1
6	210.00	130.00	240.00	140.00	1
7	240.00	140.00	260.00	140.00	1
8	120.00	100.00	260.00	100.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure (psf)	Piez. Surface No.
1	120.0	145.0	.0	30.0	.00	.0	1
2	130.0	155.0	5000.0	15.0	.00	.0	1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	180.00	190.00	2500.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

15 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 110.00 ft.
and X = 164.00 ft.

Each Surface Terminates Between X = 240.00 ft.
and X = 260.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 80.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.26	107.09
2	151.08	109.00
3	160.85	111.15
4	170.55	113.55
5	180.20	116.19
6	189.77	119.08
7	199.27	122.21
8	208.69	125.57
9	218.02	129.17
10	227.25	133.00
11	236.39	137.07
12	242.56	140.00

Circle Center At X = 70.7 ; Y = 496.5 and Radius, 395.7

*** 1.864 ***

Individual data on the 17 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	8.7	636.3	.0	.0	.0	.0	.0	.0	.0
2	1.1	178.7	.0	.0	.0	.0	.0	.0	.0
3	9.8	3407.6	.0	.0	.0	.0	.0	.0	.0
4	9.2	5964.4	.0	.0	.0	.0	.0	.0	.0
5	.6	432.4	.0	.0	.0	.0	.0	.0	.0
6	9.4	5843.9	.0	.0	.0	.0	.0	.0	.0
7	.2	90.6	.0	.0	.0	.0	.0	.0	492.6
8	9.6	2715.4	.0	.0	.0	.0	.0	.0	23936.6
9	.2	24.2	.0	.0	.0	.0	.0	.0	570.8
10	9.3	1822.1	.0	.0	.0	.0	.0	.0	.0
11	9.4	3506.2	.0	.0	.0	.0	.0	.0	.0
12	1.3	606.2	.0	.0	.0	.0	.0	.0	.0
13	8.0	3573.4	.0	.0	.0	.0	.0	.0	.0
14	9.2	3464.7	.0	.0	.0	.0	.0	.0	.0
15	9.1	2454.6	.0	.0	.0	.0	.0	.0	.0
16	3.6	637.9	.0	.0	.0	.0	.0	.0	.0
17	2.6	186.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.37	100.46
2	131.35	101.14
3	141.29	102.21
4	151.19	103.64
5	161.02	105.45
6	170.78	107.62
7	180.45	110.16
8	190.02	113.06
9	199.48	116.32
10	208.80	119.93
11	217.99	123.89
12	227.02	128.19
13	235.88	132.82
14	244.56	137.79
15	248.10	140.00

Circle Center At X = 108.0 ; Y = 366.3 and Radius, 266.2

*** 1.872 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.26	107.09
2	151.19	108.29
3	161.06	109.87
4	170.87	111.84
5	180.59	114.20
6	190.21	116.93
7	199.71	120.03
8	209.09	123.51
9	218.33	127.34
10	227.40	131.54
11	236.31	136.08
12	243.29	140.00

Circle Center At X = 115.7 ; Y = 361.0 and Radius, 255.2

*** 1.914 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.90	103.30
2	139.83	104.42
3	149.73	105.85
4	159.58	107.59
5	169.37	109.64
6	179.08	111.99
7	188.73	114.64
8	198.28	117.60
9	207.74	120.85
10	217.09	124.39
11	226.32	128.23
12	235.43	132.36
13	244.41	136.76
14	250.51	140.00

Circle Center At X = 99.2 ; Y = 420.7 and Radius, 318.9

*** 1.918 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.74	104.25
2	142.72	104.75
3	152.68	105.72
4	162.58	107.14
5	172.40	109.01
6	182.13	111.34
7	191.73	114.11
8	201.21	117.31
9	210.52	120.95
10	219.66	125.01
11	228.60	129.49
12	237.33	134.37
13	245.82	139.65
14	246.32	140.00

Circle Center At X = 126.7 ; Y = 321.7 and Radius, 217.5

*** 1.920 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.26	107.09
2	151.22	107.97
3	161.13	109.31
4	170.97	111.10
5	180.72	113.33
6	190.36	116.00
7	199.86	119.11
8	209.22	122.64
9	218.40	126.60
10	227.39	130.97
11	236.18	135.75
12	243.23	140.00

Circle Center At X = 126.9 ; Y = 326.0 and Radius, 219.4

*** 1.933 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.11	108.04
2	153.84	110.32
3	163.55	112.72
4	173.22	115.25
5	182.87	117.89
6	192.48	120.66
7	202.05	123.54
8	211.59	126.54
9	221.09	129.66
10	230.56	132.90
11	239.98	136.25
12	249.35	139.72
13	250.07	140.00

Circle Center At X = -35.0 ; Y = 893.4 and Radius, 805.6

*** 1.947 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.11	108.04
2	154.09	108.67
3	164.02	109.84
4	173.87	111.53
5	183.63	113.74
6	193.25	116.47
7	202.71	119.70
8	211.99	123.42
9	221.06	127.64
10	229.89	132.32
11	238.47	137.47
12	242.21	140.00

Circle Center At X = 137.2 ; Y = 295.8 and Radius, 187.9

*** 1.971 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.05	102.35
2	137.05	102.36
3	147.04	102.84
4	157.00	103.79
5	166.90	105.21
6	176.72	107.09
7	186.44	109.43
8	196.04	112.23
9	205.50	115.47
10	214.79	119.16
11	223.91	123.28
12	232.81	127.82
13	241.50	132.78
14	249.94	138.14
15	252.58	140.00

Circle Center At X = 131.8 ; Y = 314.8 and Radius, 212.5

*** 1.980 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.37	100.46
2	131.26	101.92
3	141.12	103.58
4	150.95	105.43
5	160.74	107.47
6	170.49	109.71
7	180.19	112.13
8	189.84	114.74
9	199.44	117.53
10	208.99	120.52
11	218.47	123.69
12	227.89	127.04
13	237.25	130.58
14	246.53	134.29
15	255.74	138.19
16	259.79	140.00

Circle Center At X = 51.3 ; Y = 607.8 and Radius, 512.2

*** 1.987 ***

1

```
        Y       A   X   I   S       F   T

        .00   32.50   65.00   97.50   130.00   162.50

X     .00 +--------+--------+--------+--------+--------+
        -
        -
        -
        -
        -
    32.50 +
        -
        -
        -
        -
        -
A   65.00 +
        -
        -
        -
        -
        -
X   97.50 +                    *
        -
        -                   .
        -                   .
        -                  ..*
        -                 ....9
I  130.00 +                   ....24
        -                .....95
        -                .....241
        -               .......97.
        -               .......23*
        -               .......94..
S  162.50 +                  .......2517.
        -               .......9.41 *
        -               ........237.
        -               ........9231 /1
        -               .........587
        -               ..........23*1/
   195.00 +                  ..........987
        -               ...........231
        -                ..........94.
        -                ...........231*
        -                 ..........9231
        -                  ..........587
F  227.50 +                    ...........231
        -                   .........9.4
        -                    ........021*
        -                    .........921
        -                     .......0.2
        -                       ......9
T  260.00 +                     *       .*
```

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	11/25/94
Time of Run:	16:20
Run By:	DEW
Input Data Filename:	RUN1EQ
Output Filename:	RUN1EQ.OUT

PROBLEM DESCRIPTION:
ITEX Green River Landfill - Run1 (Psuedo-static case)

BOUNDARY COORDINATES

7 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	100.00	120.00	100.00	2
2	120.00	100.00	150.00	110.00	1
3	150.00	110.00	170.00	120.00	1
4	170.00	120.00	190.00	120.00	1
5	190.00	120.00	210.00	130.00	1
6	210.00	130.00	240.00	140.00	1
7	240.00	140.00	260.00	140.00	1
8	120.00	100.00	260.00	100.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	145.0	.0	30.0	.00	.0	1
2	130.0	155.0	5000.0	15.0	.00	.0	1

A Horizontal Earthquake Loading Coefficient
Of .100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

15 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 105.00 ft.
and X = 164.00 ft.

Each Surface Terminates Between X = 240.00 ft.
and X = 260.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 80.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.76	106.22
3	152.53	108.36
4	162.25	110.72
5	171.91	113.30
6	181.51	116.11
7	191.04	119.14
8	200.50	122.39
9	209.88	125.86
10	219.17	129.54
11	228.38	133.44
12	237.50	137.55
13	242.61	140.00

Circle Center At X = 55.5 ; Y = 529.0 and Radius, 431.7

*** 1.339 ***

Individual data on the 17 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	9.8	803.4	.0	.0	.0	.0	80.3	.0	.0
2	7.2	1545.0	.0	.0	.0	.0	154.5	.0	.0
3	2.5	775.7	.0	.0	.0	.0	77.6	.0	.0
4	9.7	4847.3	.0	.0	.0	.0	484.7	.0	.0
5	7.7	5864.2	.0	.0	.0	.0	586.4	.0	.0
6	1.9	1594.1	.0	.0	.0	.0	159.4	.0	.0
7	9.6	6094.1	.0	.0	.0	.0	609.4	.0	.0
8	8.5	2585.7	.0	.0	.0	.0	258.6	.0	.0
9	1.0	159.9	.0	.0	.0	.0	16.0	.0	.0
10	9.5	2402.1	.0	.0	.0	.0	240.2	.0	.0
11	9.4	3902.5	.0	.0	.0	.0	390.3	.0	.0
12	.1	61.0	.0	.0	.0	.0	6.1	.0	.0
13	9.2	4185.3	.0	.0	.0	.0	418.5	.0	.0
14	9.2	3425.2	.0	.0	.0	.0	342.5	.0	.0
15	9.1	2351.1	.0	.0	.0	.0	235.1	.0	.0
16	2.5	429.8	.0	.0	.0	.0	43.0	.0	.0
17	2.6	195.2	.0	.0	.0	.0	19.5	.0	.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.53	100.18
2	130.39	101.82
3	140.21	103.69
4	149.99	105.78
5	159.72	108.11
6	169.39	110.65
7	179.00	113.43
8	188.54	116.42
9	198.01	119.64
10	207.40	123.07
11	216.71	126.72
12	225.93	130.58
13	235.06	134.66
14	244.10	138.95
15	246.18	140.00

Circle Center At X = 54.7 ; Y = 526.2 and Radius, 431.1

*** 1.343 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.88	105.52
3	152.75	107.07
4	162.57	108.98
5	172.31	111.24
6	181.96	113.85
7	191.52	116.81
8	200.96	120.10
9	210.28	123.74
10	219.46	127.70
11	228.49	132.00
12	237.36	136.61
13	243.34	140.00

Circle Center At X = 104.6 ; Y = 381.0 and Radius, 278.2

*** 1.359 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.53	100.18
2	130.37	101.94
3	140.18	103.88
4	149.95	106.01
5	159.68	108.33
6	169.36	110.83
7	178.99	113.51
8	188.57	116.38
9	198.10	119.42
10	207.56	122.65
11	216.97	126.05
12	226.30	129.64
13	235.57	133.39
14	244.77	137.33
15	250.70	140.00

Circle Center At X = 32.5 ; Y = 620.8 and Radius, 528.0

*** 1.361 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.95	104.32
2	142.91	105.20
3	152.82	106.50
4	162.68	108.21
5	172.45	110.34
6	182.12	112.87
7	191.68	115.80
8	201.11	119.13
9	210.39	122.85
10	219.51	126.96
11	228.45	131.44
12	237.19	136.29
13	243.26	140.00

Circle Center At X = 116.8 ; Y = 343.0 and Radius, 239.2

*** 1.369 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.05	105.35
2	145.79	107.63
3	155.50	110.03
4	165.18	112.54
5	174.83	115.17
6	184.44	117.91
7	194.03	120.76
8	203.58	123.72
9	213.09	126.80
10	222.57	129.99
11	232.01	133.29
12	241.41	136.69
13	250.20	140.00

Circle Center At X = -53.3 ; Y = 934.7 and Radius, 850.7

*** 1.372 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.63	101.21
2	133.57	102.33
3	143.47	103.75
4	153.32	105.46
5	163.12	107.46
6	172.85	109.75
7	182.51	112.33
8	192.09	115.20
9	201.58	118.35
10	210.98	121.79
11	220.26	125.50
12	229.43	129.48
13	238.48	133.74
14	247.40	138.27
15	250.58	140.00

Circle Center At X = 91.0 ; Y = 435.5 and Radius, 335.9

*** 1.375 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.63	101.21
2	133.62	101.72
3	143.58	102.65
4	153.48	104.00
5	163.33	105.77
6	173.08	107.95
7	182.74	110.55
8	192.28	113.55
9	201.68	116.96
10	210.93	120.76
11	220.01	124.95
12	228.91	129.52
13	237.60	134.46
14	246.08	139.77
15	246.41	140.00

Circle Center At X = 116.7 ; Y = 337.0 and Radius, 235.9

*** 1.380 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.05	105.35
2	146.03	105.99
3	155.97	107.11
4	165.84	108.72
5	175.62	110.80
6	185.29	113.36
7	194.82	116.38
8	204.19	119.86
9	213.39	123.80
10	222.38	128.18
11	231.14	132.99
12	239.67	138.22
13	242.27	140.00

Circle Center At X = 127.9 ; Y = 310.7 and Radius, 205.5

*** 1.382 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.90	115.45
2	170.85	116.45
3	180.73	117.97
4	190.51	120.03
5	200.18	122.60
6	209.69	125.69
7	219.02	129.29
8	228.15	133.37
9	237.04	137.94
10	240.58	140.00

Circle Center At X = 147.4 ; Y = 300.7 and Radius, 185.7

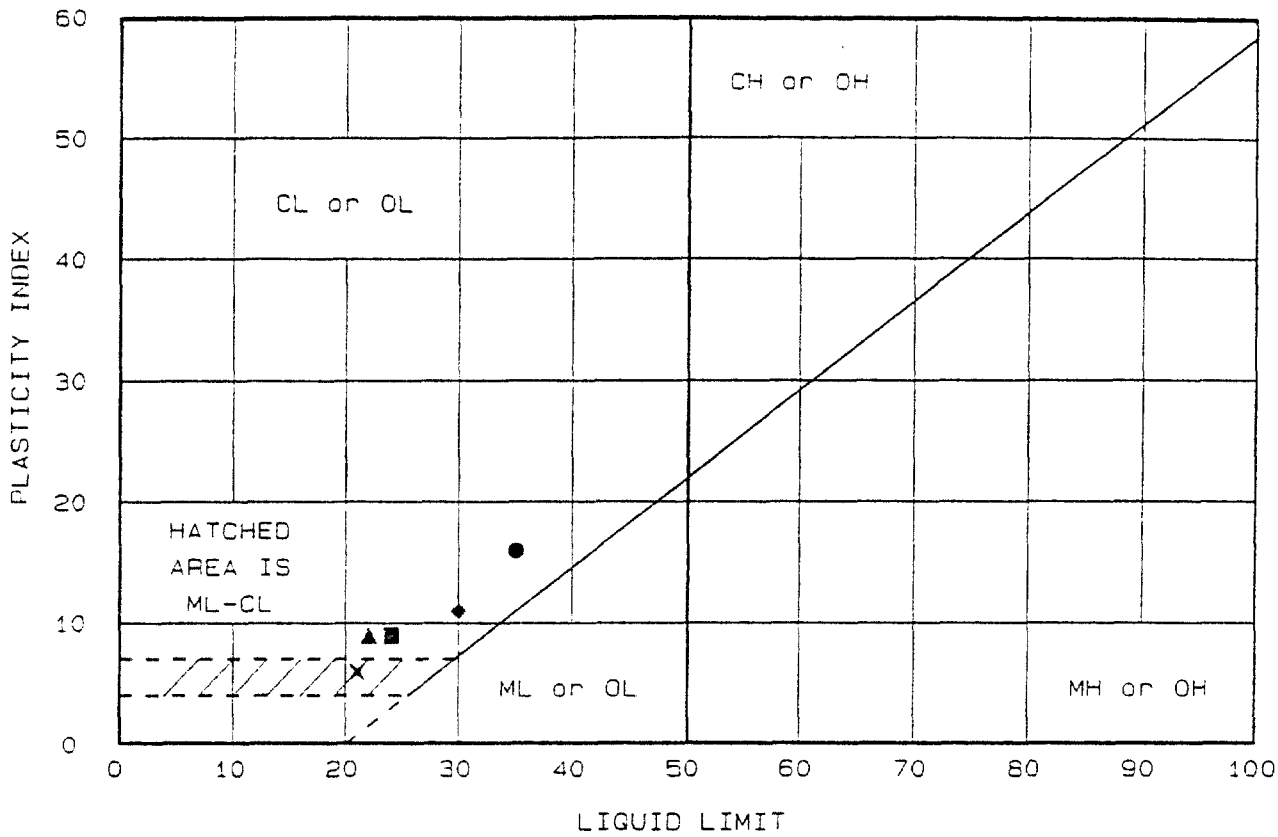
*** 1.383 ***

```
        Y       A   X   I   S       F   T

        .00   32.50   65.00   97.50   130.00   162.50

X     .00 +--------+--------+--------+--------+--------+
          -
          -
          -
          -
          -
    32.50 +
          -
          -
          -
          -
          -
A   65.00 +
          -
          -
          -
          -
          -
X   97.50 +                    *
          -                  .
          -                  .
          -                 ...
          -               . ..*
          -               ....7
I  130.00 +                  .....2.
          -               .....71
          -              .......21
          -              .......86.
          -              .......71*
          -              ........26.
S  162.50 +                 ........5160
          -              ........92. *
          -              ........8310
          -              ..........20
          -              .........831
          -              ..........72*
   195.00 +                 ...........96
          -              ...........721
          -               ...........92
          -               ...........731*
          -                ............21
          -                ...........836
F  227.50 +                     ...........21
          -                  ...........2.
          -                   ..........71*
          -                    ..........41
          -                      ........4
          -                       .......
T  260.00 +                      *      ...*
```

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-85
●	DH-3, CA-1	35	19	16		
▲	MW-5 S-1	22	13	9		
■	MW-5, CA-2	24	15	9		
◆	DH-6, S-1	30	19	11		
×	DH-8, S-1	21	15	6		

Project No.: 2106-004
Project: Subsurface Investigation

Client: Green River Landfill
Location: Green River

Date: 08-17-94

Remarks:

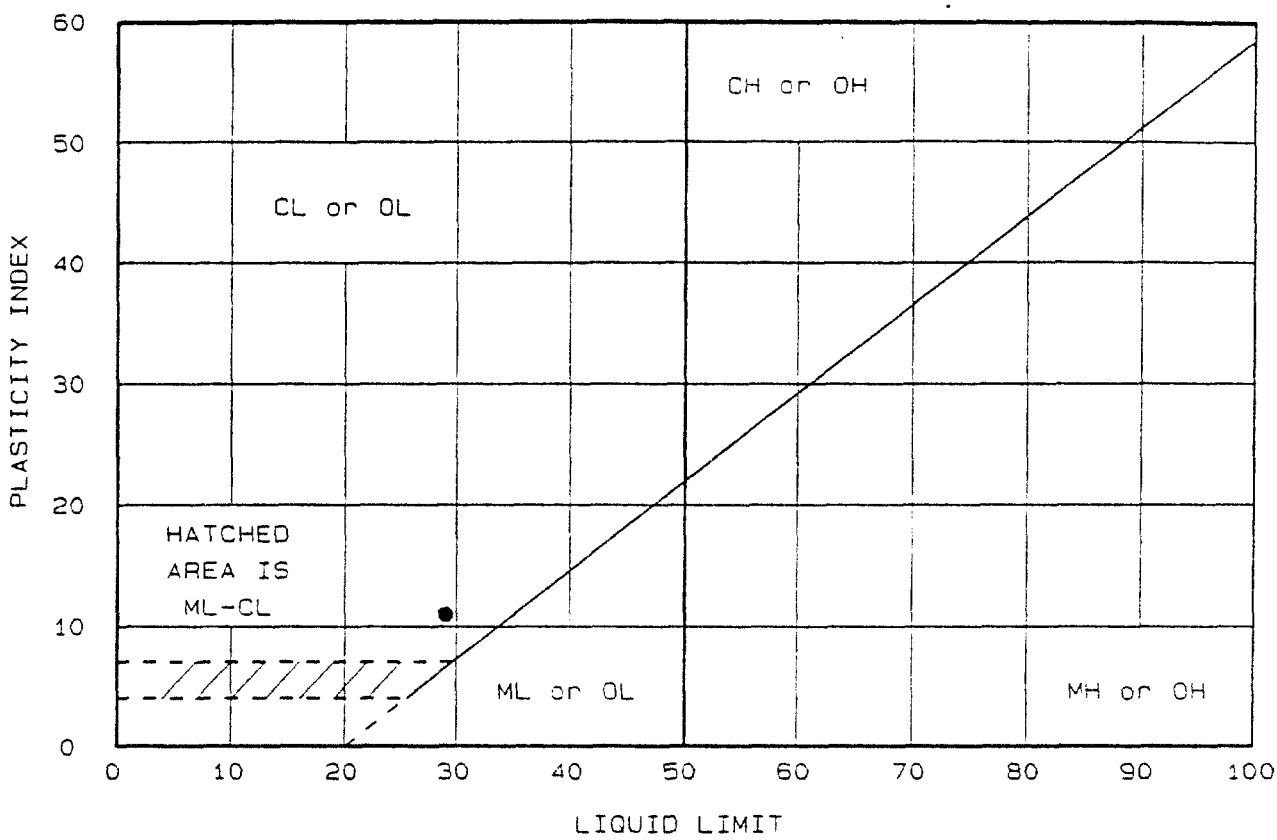
Tested By: BB

LIQUID AND PLASTIC LIMITS TEST REPORT

Bingham Engineering

Fig. No _____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	ASTM D 2487-85
● TP-3, B-1	29	18	11		

Project No.: 2106-004
Project: Subsurface Investigation

Client: Green River Landfill
Location: Green River

Date: 08-17-94

Remarks:

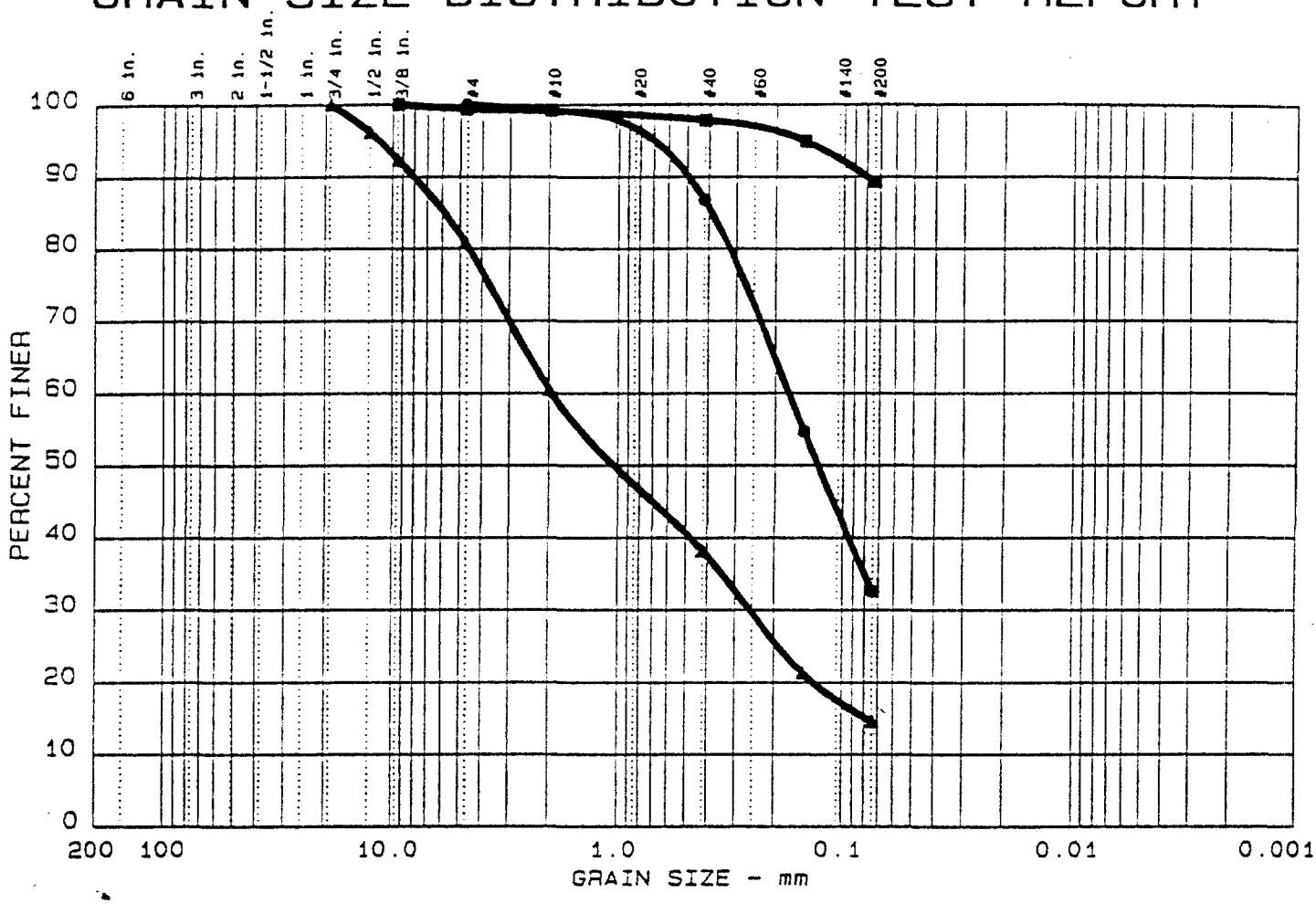
Tested By: BB

LIQUID AND PLASTIC LIMITS TEST REPORT

Bingham Engineering

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	67.4	32.6	
▲	0.0	19.2	66.2	14.6	
■	0.0	0.6	10.1	89.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.39	0.17	0.13					
▲			5.89	1.95	1.05	0.257	0.0776			
■										

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Clayey Sand	SC	A-2-4
▲ Brown Gravely Clayey Sand	SC	A-1-b
■ Brown Fine Sandy Clay	CL	A-4

Project No.: 2106-004
Project: Green River Landfill
● Location: DH-1, CA-2
▲ Location: DH-1, B-3
■ Location: DH-9, CA-1 Depth 8.0' to 12.0'
Date: 08-17-94

Remarks:

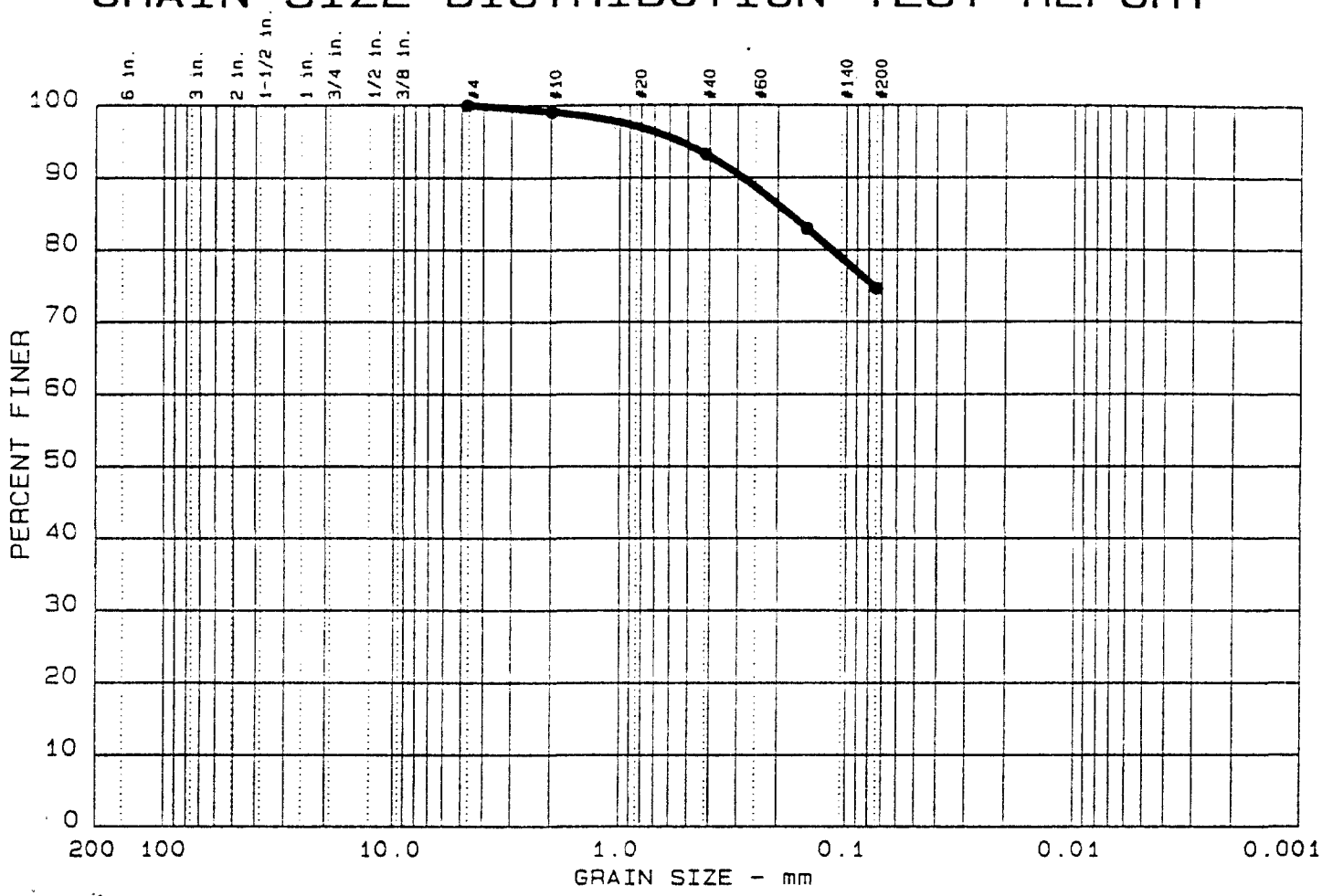
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	25.4	74.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.18							

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Fine Sandy Clay	CL	A-4

Project No.: 2106-004

Project: Green River Landfill

● Location: DH-12, CA-1 Depth 8.0' to 12.0'

Date: 08-17-94

Remarks:

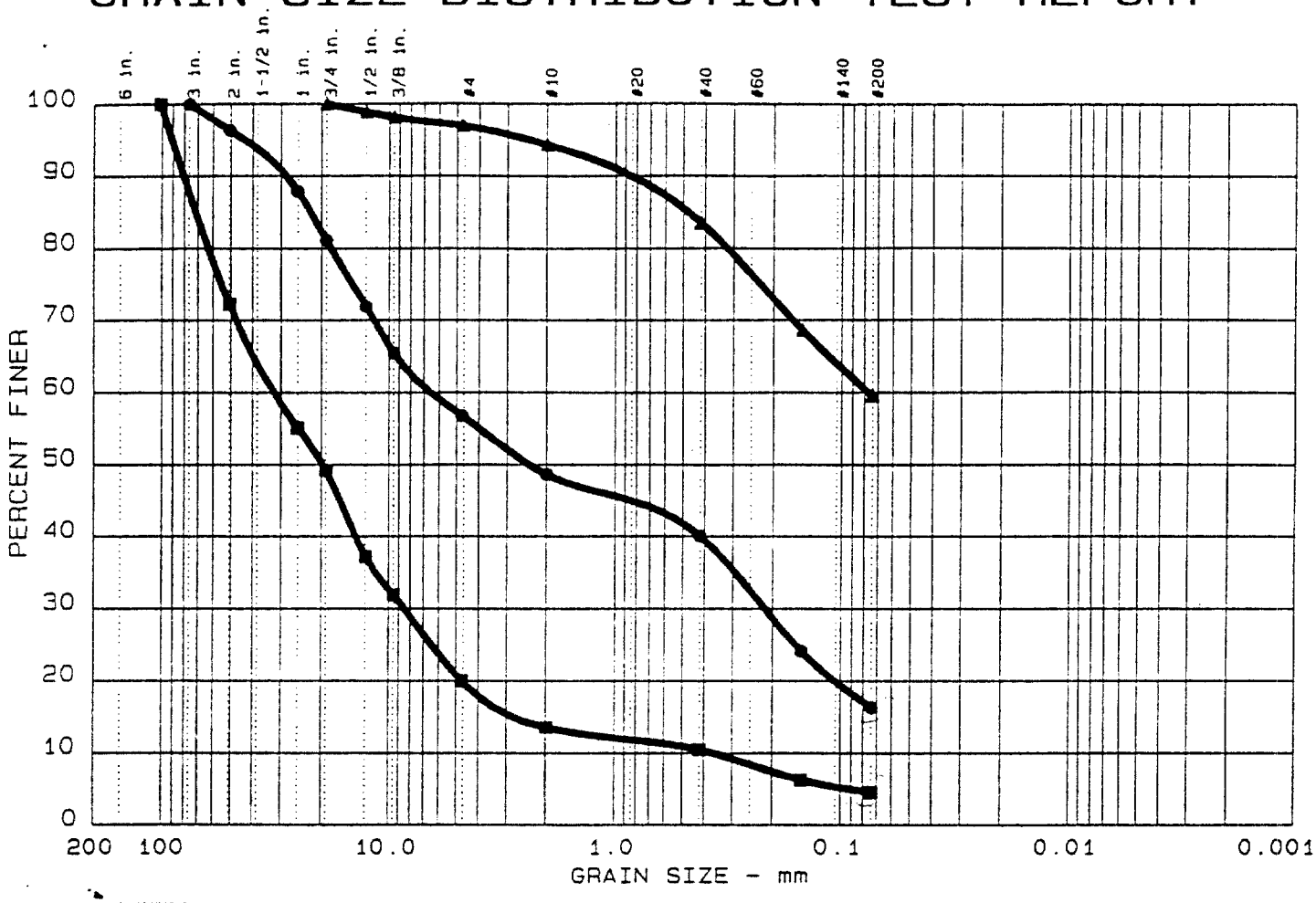
Tested By: JO

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	43.3	40.4	16.3	
▲	0.0	3.0	37.5	59.5	
■	12.4	67.6	15.4	4.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	29	11	22.39	6.53	2.37	0.216				
▲			0.48	0.08						
■			71.45	32.28	19.66	8.482	2.7765	0.3660	6.09	88.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Sandy Clayey Gravel	GC	A-2-6
▲ Brown Clayey Sand	CL	A-4
■ Brown Sandy Gravel	GP	A-1-a

Project No.: 2106-004

Project: Green River Landfill

● Location: TP-1, B-1 Depth 0' to 3.0'

▲ Location: TP-3, B-1 Depth 0.0' ot 2.5'

■ Location: TP-18, B-1 Depth 0.0' to 12.0'

Date: 08-17-94

Remarks:

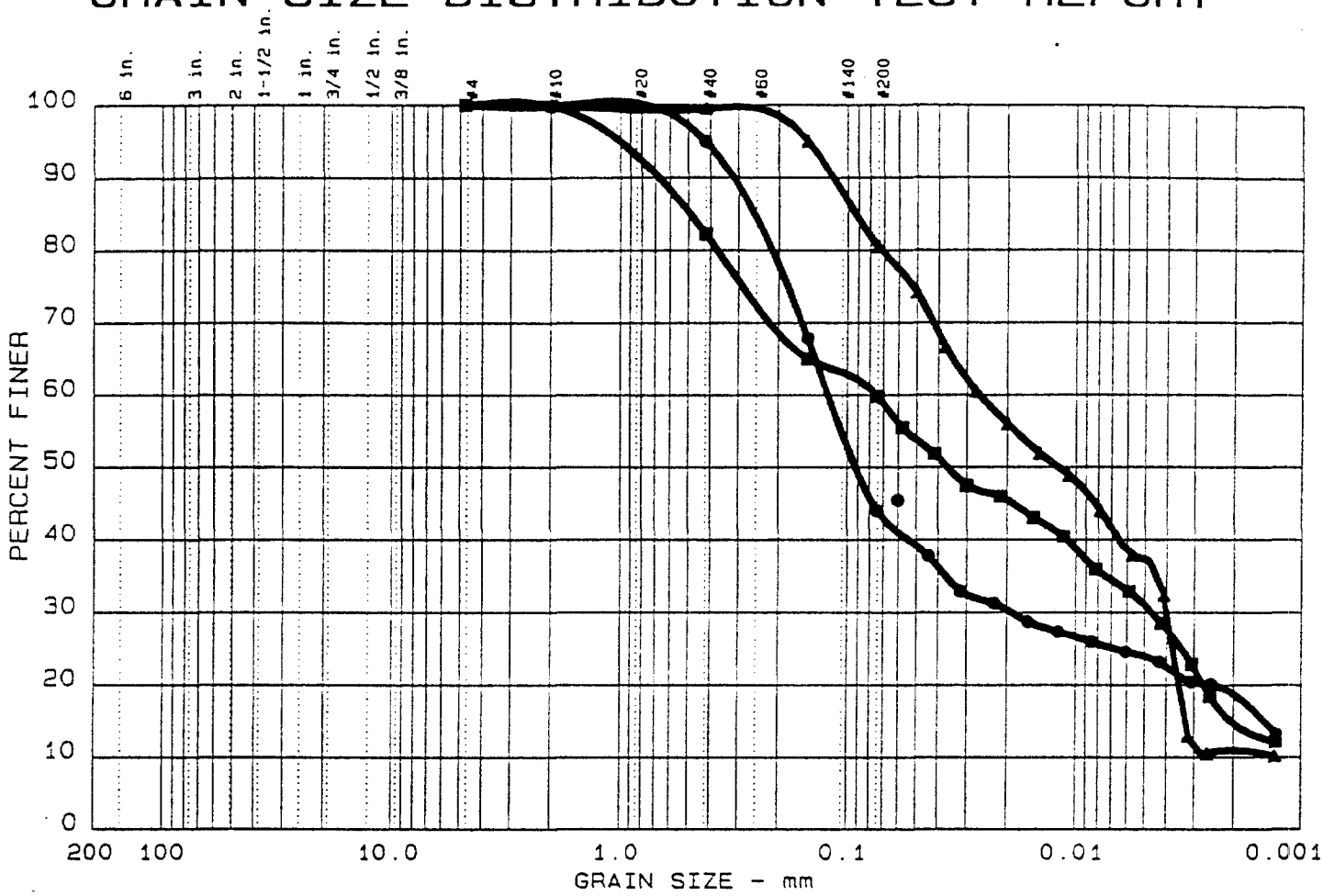
Tested By: JO

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	56.0	20.0	24.0
▲	0.0	0.0	19.5	43.0	37.5
■	0.0	0.0	40.1	28.9	31.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.25	0.12	0.09	0.019	0.0015			
▲	24	9	0.09		0.01	0.004	0.0033			
■	30	11	0.49	0.07	0.04	0.005	0.0021			

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Clayey Silty Fine Sand	SC	A-4
▲ Light Tand Fine Sandy Silty Clay	CL	A-4
■ Brown Sandy Silty Clay	CL	A-6

Project No.: 2106-004
Project: Green River Landfill
● Location: DH-2, B-1
▲ Location: MW-5, CA-2 Depth 8.0' to 12.0'
■ Location: DH-5, S-1
Date: 08-17-94

Remarks:

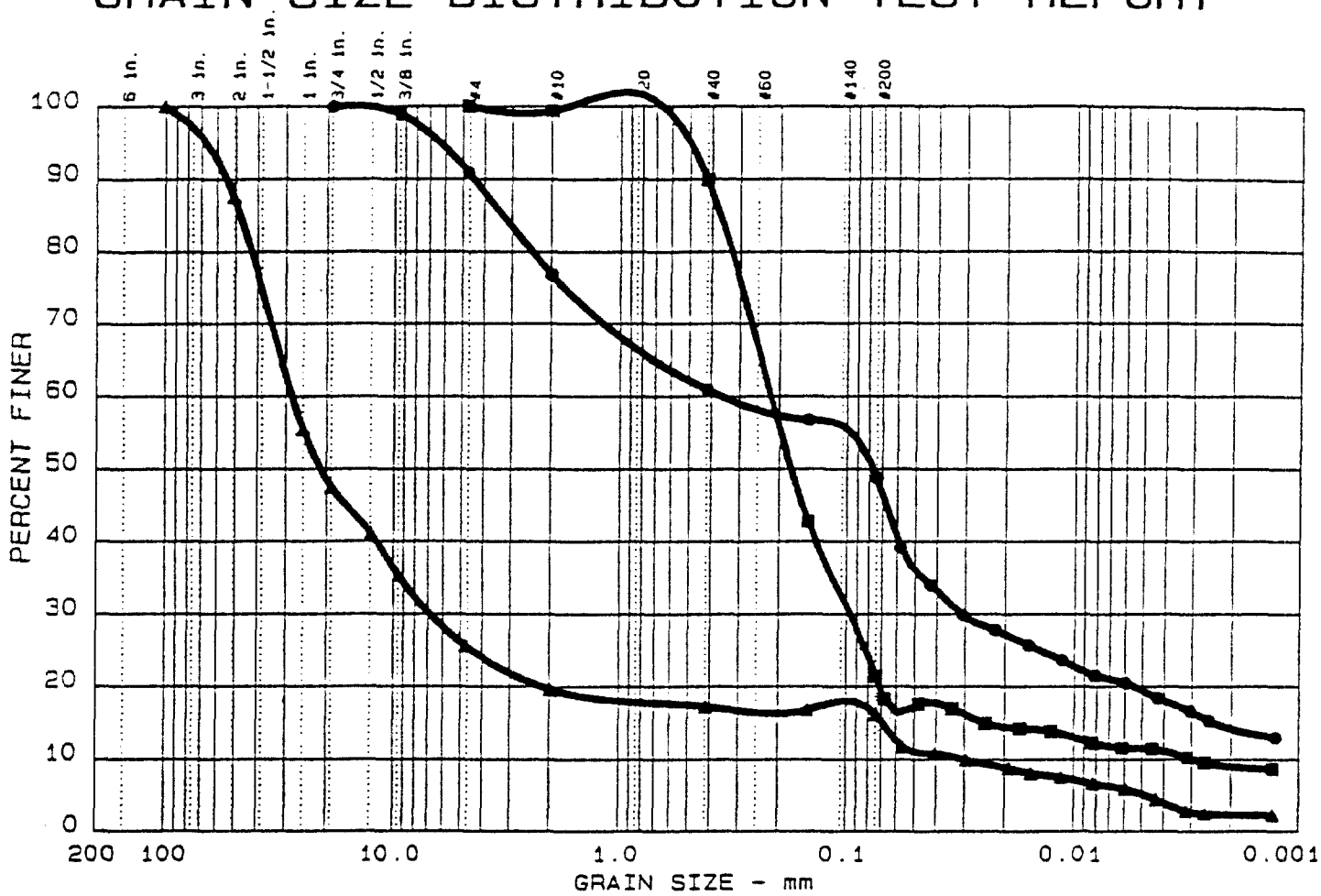
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	9.1	42.2	29.4	19.3
▲	2.9	71.5	9.5	11.0	5.1
■	0.0	0.0	78.6	9.8	11.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	21	6	3.27	0.36	0.08	0.031	0.0024			
▲			47.53	28.31	21.23	6.871	0.0687	0.0307	54.33	922.6
■			0.37	0.22	0.16	0.096	0.0248	0.0029	14.42	74.3

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Clayey Silty Sand W/Some Fine Gravel	SC-SM	A-4
▲ Brown Silty Gravel W/Some Sand	GM	A-1-b
■ Brown Clayey Fine Sand	SC	Unclassifie

Project No.: 2106-004
Project: Green River Landfill
● Location: DH-8, S-1
▲ Location: TP-2, B-1
■ Location: DH-1, B-1
Date: 08-17-94

Remarks:

Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

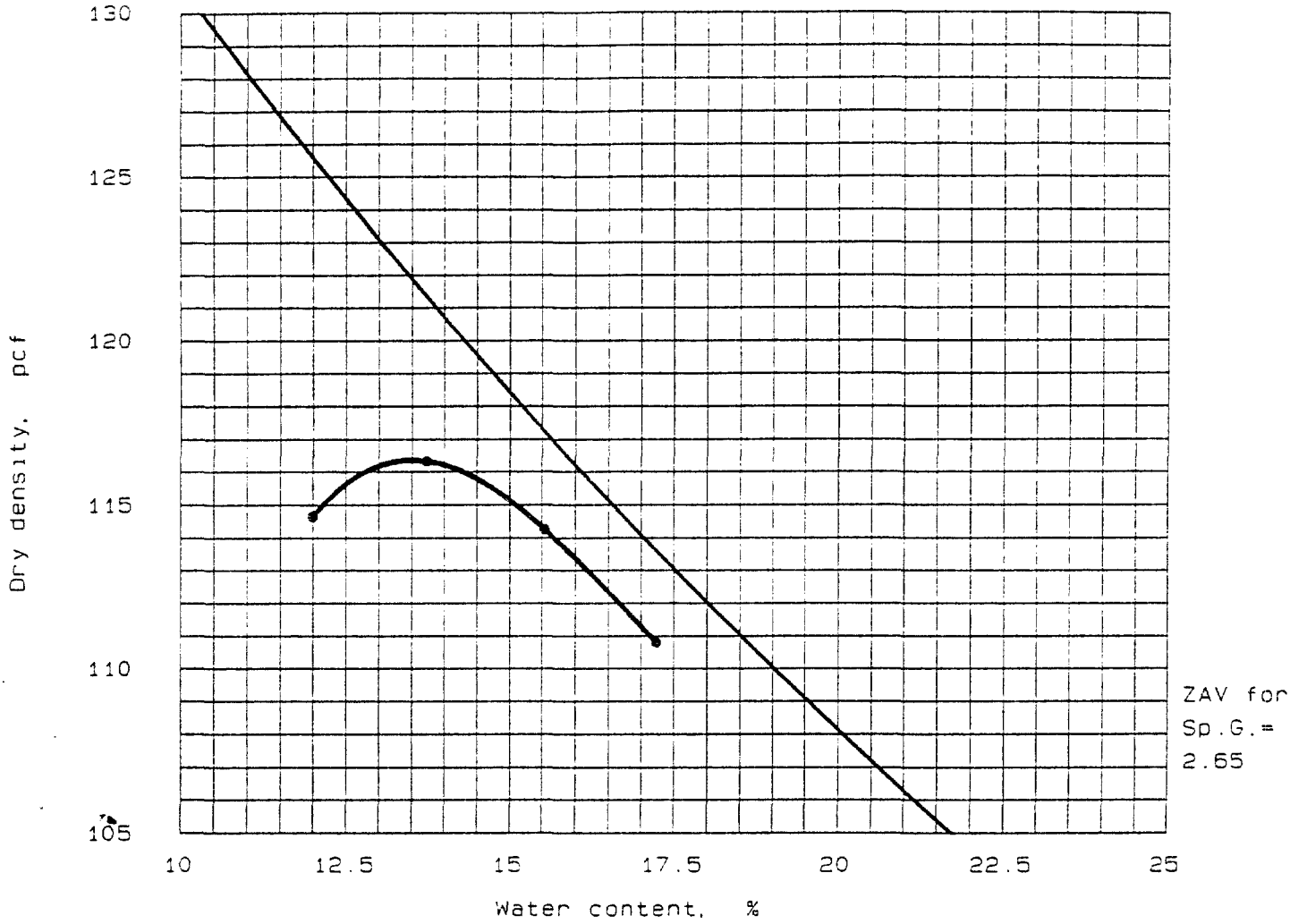
Bingham Engineering

Figure No

MOISTURE CONTENT AND UNIT WEIGHT
GREEN RIVER LANDFILL

Sample Location	Sample Number	Moisture Content	Dry Density
DH-1	CA-2	5.79	102.92
DH-3	CA-1	6.05	102.37
MW-5	CA-2	3.19	103.21
MW-7	CA-1	6.08	107.05
DH-9	CA-1	4.9	110.34
DA-12	CA-1	5.45	91.45

PROCTOR TEST REPORT



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL							

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 13.5 % Maximum dry density = 116.4 pcf	Sandy Silty Clay

Project No.: 2106-003

Project: Green River Landfill

Location: Composite #1

Date: 09/16/94

Remarks:

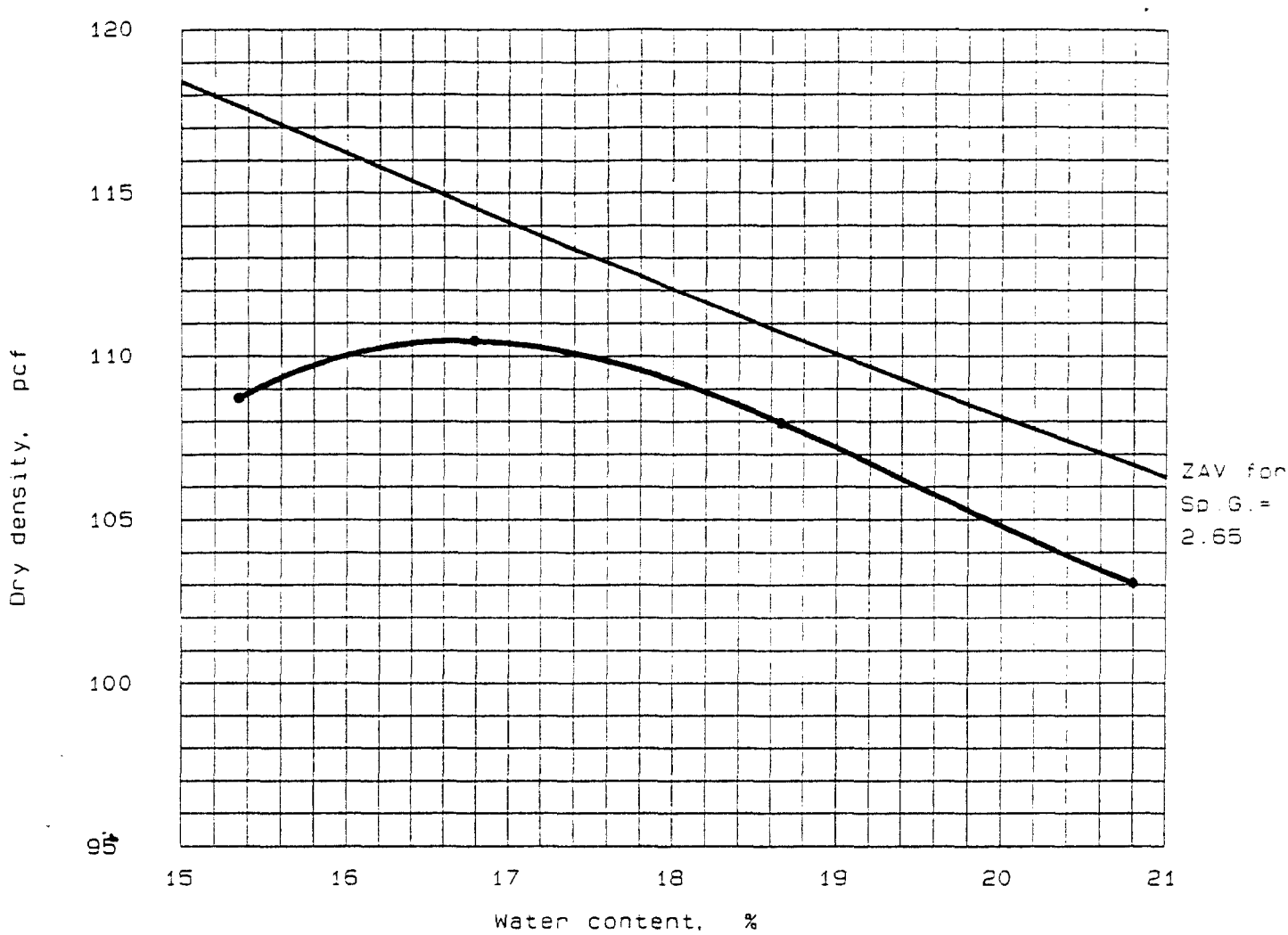
M.M.

PROCTOR TEST REPORT

Bingham Engineering

Figure No. _____

PROCTOR TEST REPORT



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL							

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 16.7 % Maximum dry density = 110.5 pcf	Gray Sandy Clay

Project No.: 2106-003

Project: Green River Landfill

Location: Composite #2

Date: 09-16-94

Remarks:

Tested By: MM

PROCTOR TEST REPORT

Bingham Engineering

Figure No. _____

PERMEABILITY TEST RESULTS
GREEN RIVER LANDFILL

Sample Location	Sample Number	Permeability (cm/sec)
DH-1	CA-2*	2.2 E -4
COMPOSITE #1		5.4 E -8
COMPOSITE #2		3.2 E -8

* uncompacted sample

Composite #1 = TP-2 B-1
TP-10 B-1
DH-1 B-2
DH-1 B-3
DH-1 B-4
DH-2 B-2

Composite #1 compacted to 95.6% Proctor and 2.1% above optimum moisture

Composite #2 = MW-5 S-1
DH-6 S-1
TP-4 B-1
TP-8 B-1
TP-3 B-1

Composite #2 compacted to 95.6% Proctor and 3.3% above optimum moisture

KEY	○	○	○	○
BORING	COMPOSITE SAMPLE #2			
SAMPLE	REMOLD 95% MDD +3% OMC			
DEPTH (FEET)	MDD = 110.5 PCF at 16.7% OMC			
INITIAL w, %	19.7			
INITIAL γ_d, PCF	105.0			
INITIAL e_o				
INITIAL B	0.12			
FINAL w, %			16.7	
FINAL γ_d, PCF			118.4	
FINAL e_f				
FINAL B			1.00	
BACK PRESSURE (PSI)	29.0	29.0	29.0	
STRAIN RATE (INCHES / MINUTE)	.002	.002	.002	

SATURATED

MULTI-

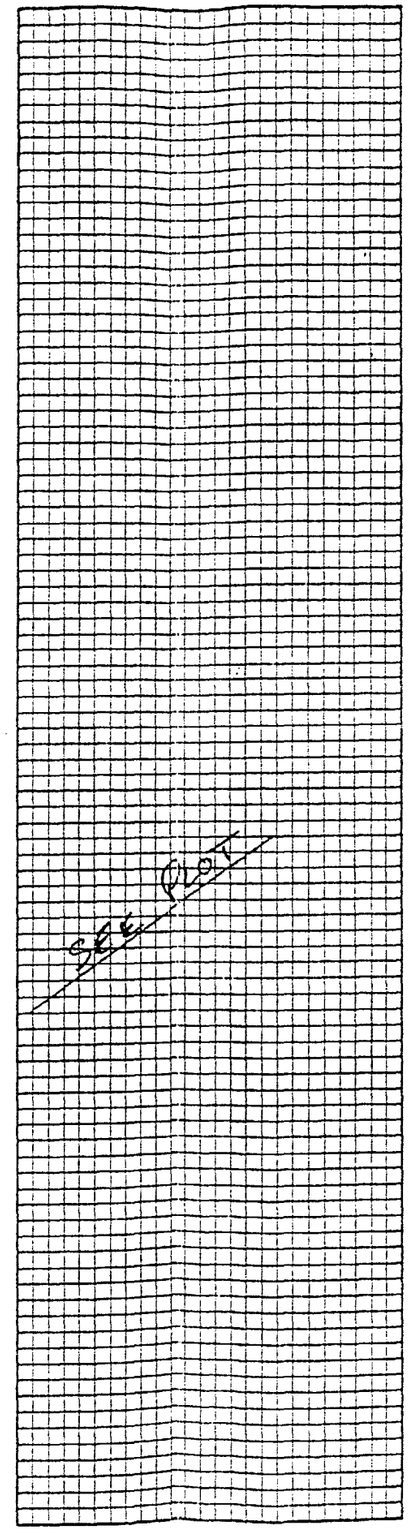
STRESS CONDITION	PEAK $\bar{\sigma}_1 - \bar{\sigma}_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\bar{\sigma}_1 - \bar{\sigma}_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\bar{\sigma}_1 - \bar{\sigma}_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\bar{\sigma}_1 - \bar{\sigma}_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$
TOTAL STRESS: ε, %		4.13		5.89		10.86		
TOTAL STRESS: TIME TO FAIL (MIN.)								
TOTAL STRESS: σ_3, PSF		4032		8064		12096		
TOTAL STRESS: $\sigma_1 - \sigma_3$		3973		11052		21090		
TOTAL STRESS: σ_1, PSF		8005		19116		33186		
TOTAL STRESS: $\frac{1}{2}(\sigma_1 - \sigma_3)$		1986		5526		10545		
TOTAL STRESS: $\frac{1}{2}(\sigma_1 + \sigma_3)$		6019		13590		22641		
TOTAL STRESS: u, PSF		1570		2218		2016		
TOTAL STRESS: A, $u/(\sigma_1 - \sigma_3)$		0.395		0.20		0.096		
EFFECTIVE STRESS: ε, %								
EFFECTIVE STRESS: TIME TO FAIL (MIN.)								
EFFECTIVE STRESS: $\bar{\sigma}_3$, PSF		2462		5846		10080		
EFFECTIVE STRESS: $\bar{\sigma}_1 - \bar{\sigma}_3$		3973		11052		21090		
EFFECTIVE STRESS: $\bar{\sigma}_1$, PSF		6435		16899		31170		
EFFECTIVE STRESS: $\frac{1}{2}(\bar{\sigma}_1 - \bar{\sigma}_3)$		1986		5526		10545		
EFFECTIVE STRESS: $\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_3)$		4449		11373		20625		
EFFECTIVE STRESS: u, PSF		—		—		—		
EFFECTIVE STRESS: A, $u/(\bar{\sigma}_1 - \bar{\sigma}_3)$		—		—		—		
EFFECTIVE STRESS: $\bar{\sigma}_1/\bar{\sigma}_3$		2.61		2.89		3.09		

REMARKS

PRINCIPAL STRESS RATIO $\bar{\sigma}_1/\bar{\sigma}_3$

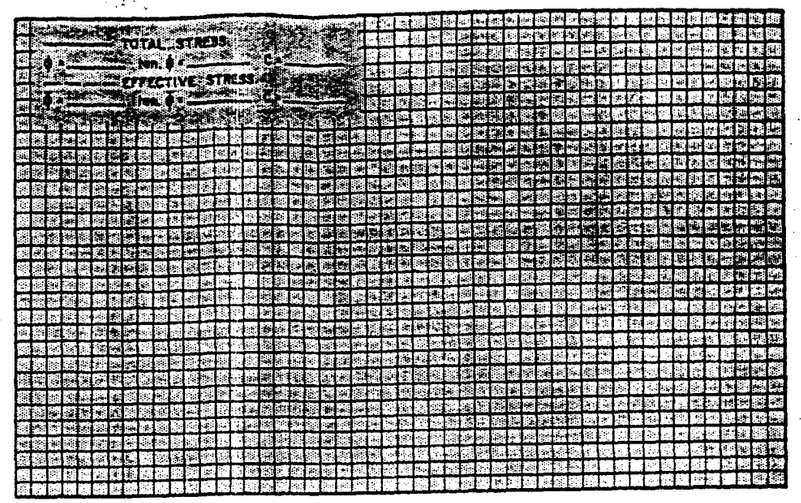
PORE PRESSURE, AU, PSF OR VOLUMETRIC STRAIN, ε_v, %

PRINCIPAL STRESS DIFFERENCE $\sigma_1 - \sigma_3$, PSF



AXIAL STRAIN, ε, %

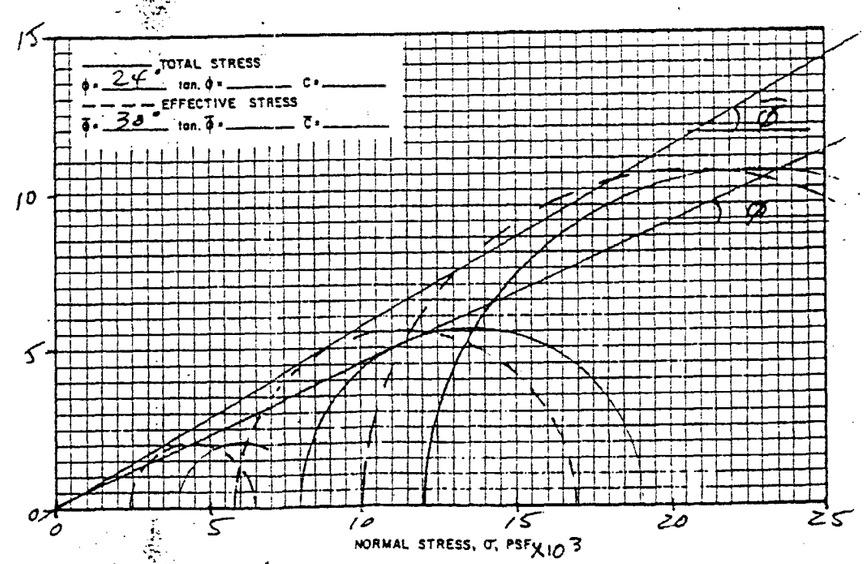
SHEAR STRESS, T, PSF



NORMAL STRESS, σ, PSF

MOHR ENVELOPE – PEAK STRESS

SHEAR STRESS, T, PSF X 10^3



MOHR ENVELOPE – MAXIMUM EFFECTIVE STRESS RATIO

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST: CONS-UNDRAINED W PORE PRESSURE

TYPE MATERIAL: REMOLD

SAMPLE DESCRIPTION

CLASSIFICATION: CL

LIQUID LIMIT: — PLASTIC LIMIT: — SPECIFIC GRAVITY, G_s: —

PROJECT: BINGHAM ENGR.

LOCATION: GREEN RIVER LANDFILL

JOB NO. 05461-029-6079 PREPARED BY EEL, 10/6/94

CHECKED BY _____, / /

KEY				
BORING	COMPOSITE #1			
SAMPLE	REMOLD 95% MDD at +3% OMC			
DEPTH (FEET)	MDD = 116.4 PCF at 13.5% OMC			
INITIAL w, %	16.5			
INITIAL γ_d, PCF	110.6			
INITIAL e_0				
INITIAL B	0.1			
FINAL w, %			14.7	
FINAL γ_d, PCF			121.4	
FINAL e_f				
FINAL B			0.98	
BACK PRESSURE (PSI)	39.0	39.0	39.0	
STRAIN RATE (INCHES / MINUTE)	0.002	.002	.002	

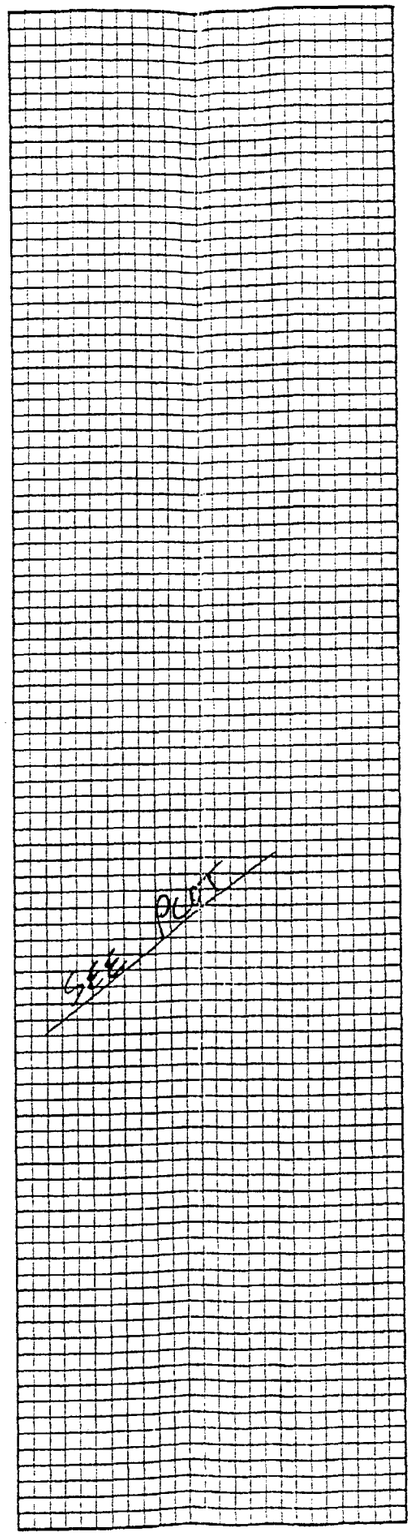
MULTI-STAGED

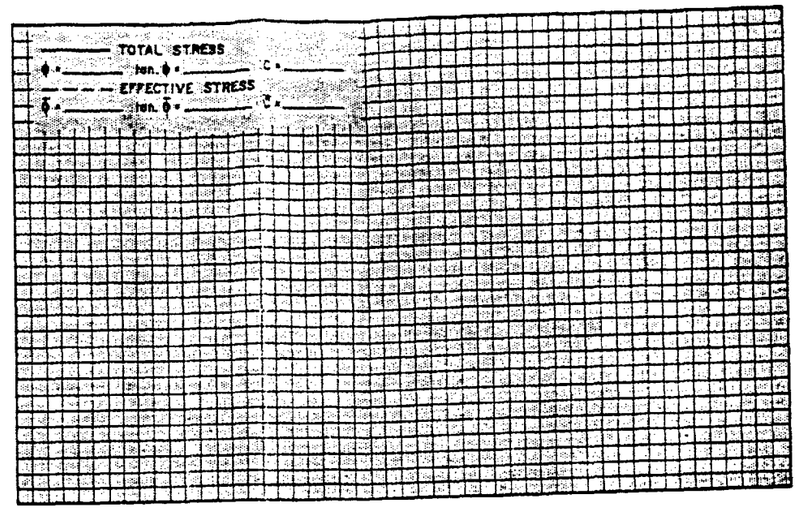
STRESS CONDITION	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$
TOTAL STRESS ε, %		3.59		4.62		3.21		
TOTAL STRESS TIME TO FAIL (MIN.)								
TOTAL STRESS σ_3, PSF		4032		8064		11952		
TOTAL STRESS $\sigma_1 - \sigma_3$		4050		9355		16613		
TOTAL STRESS σ_1, PSF		8082		17419		28565		
TOTAL STRESS $\frac{1}{2}(\sigma_1 - \sigma_3)$		2025		4677		8307		
TOTAL STRESS $\frac{1}{2}(\sigma_1 + \sigma_3)$		6057		12742		20259		
TOTAL STRESS u, PSF		2002		4349		5414		
TOTAL STRESS A, $u/(\sigma_1 - \sigma_3)$		0.494		0.465		0.326		
EFFECTIVE STRESS ε, %								
EFFECTIVE STRESS TIME TO FAIL (MIN.)								
EFFECTIVE STRESS $\bar{\sigma}_3$, PSF		2030		3715		6538		
EFFECTIVE STRESS $\bar{\sigma}_1 - \bar{\sigma}_3$		4050		9355		16613		
EFFECTIVE STRESS $\bar{\sigma}_1$, PSF		6080		13070		23151		
EFFECTIVE STRESS $\frac{1}{2}(\bar{\sigma}_1 - \bar{\sigma}_3)$		2025		4677		8307		
EFFECTIVE STRESS $\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_3)$		4056		8392		14844		
EFFECTIVE STRESS u, PSF		—		—		—		
EFFECTIVE STRESS A, $u/(\bar{\sigma}_1 - \bar{\sigma}_3)$		—		—		—		
EFFECTIVE STRESS $\bar{\sigma}_1/\bar{\sigma}_3$		2.99		3.52		3.54		
REMARKS								

PRINCIPAL STRESS RATIO $\bar{\sigma}_1/\bar{\sigma}_3$

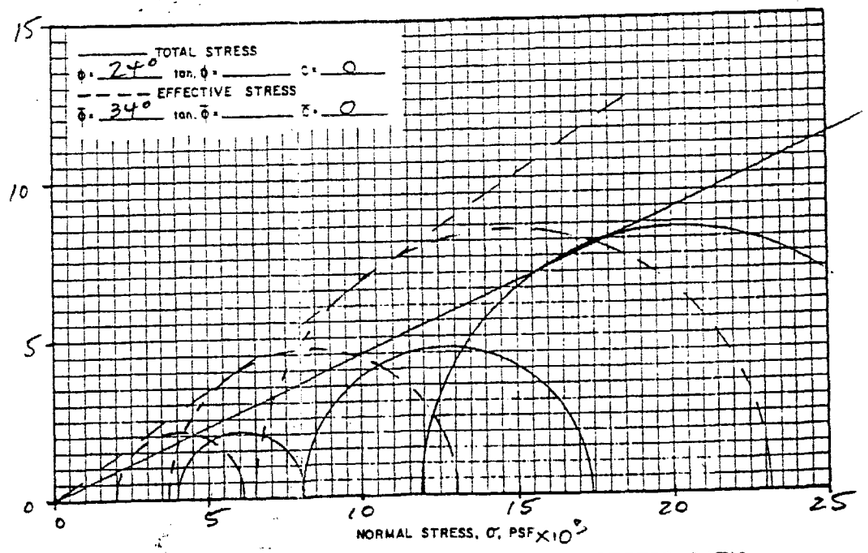
PORE PRESSURE, Δu, PSF OR VOLUMETRIC STRAIN, ε_v, %

PRINCIPAL STRESS DIFFERENCE $\sigma_1 - \sigma_3$, PSF





MOHR ENVELOPE – PEAK STRESS



MOHR ENVELOPE – MAXIMUM EFFECTIVE STRESS RATIO

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST CONS-UNDRAINED W PORE PRESSURE

TYPE MATERIAL REMOLD

SAMPLE DESCRIPTION

CLASSIFICATION CL

LIQUID LIMIT — PLASTIC LIMIT — SPECIFIC GRAVITY, G_s —

PROJECT BINGHAM ENGR.

LOCATION GREEN RIVER LANDFILL

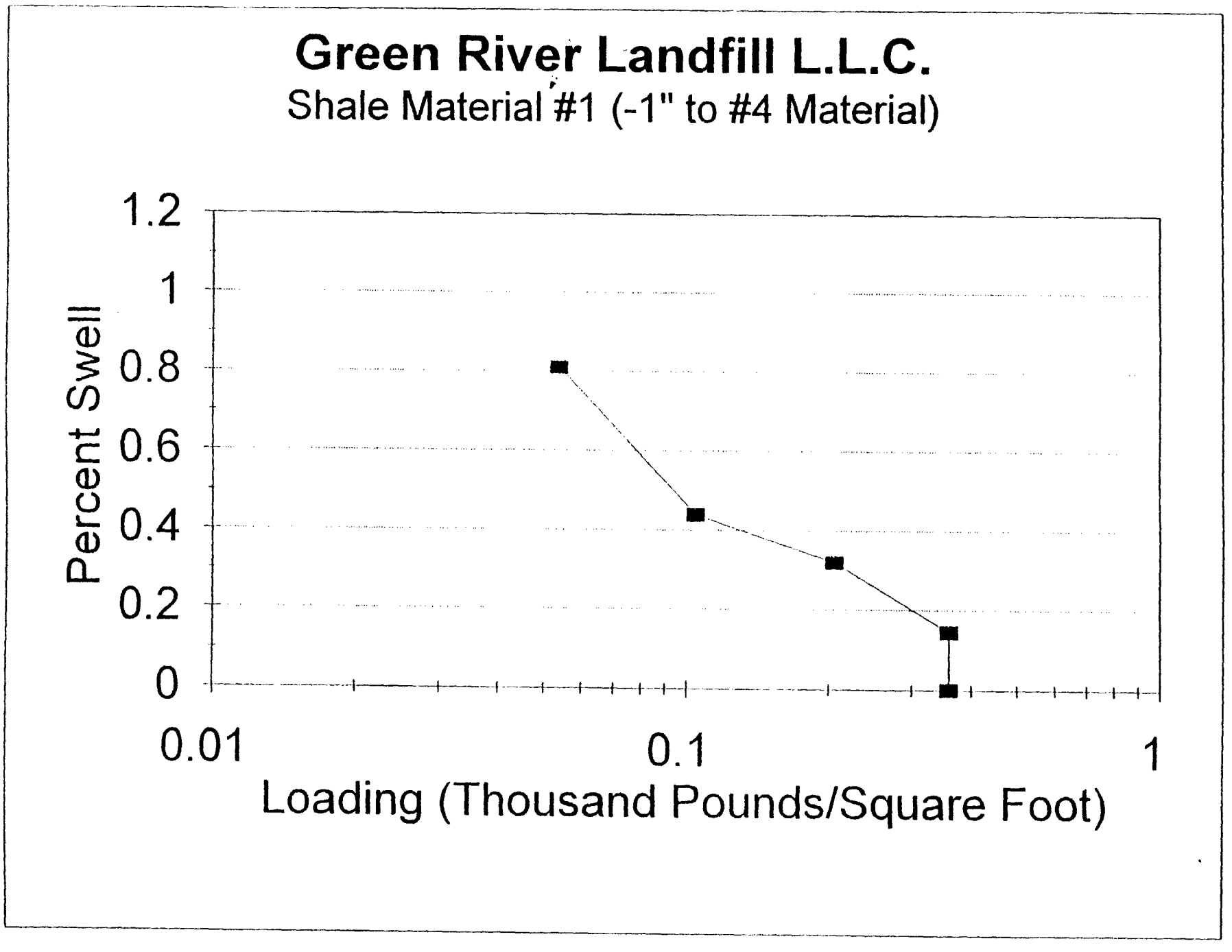
JOB NO. 05461-029-6079 PREPARED BY EGL, 10/6/94

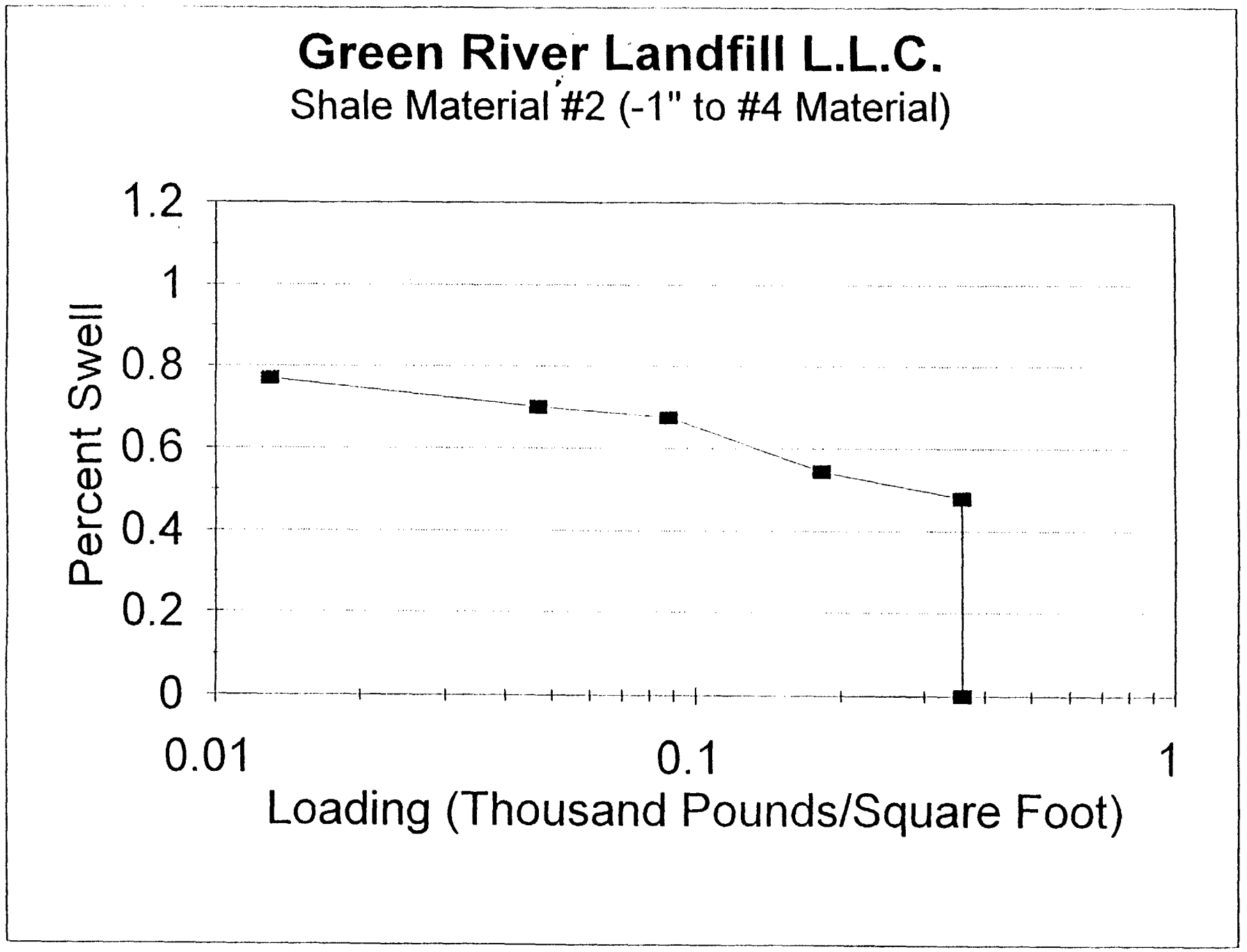
CHECKED BY _____, / /

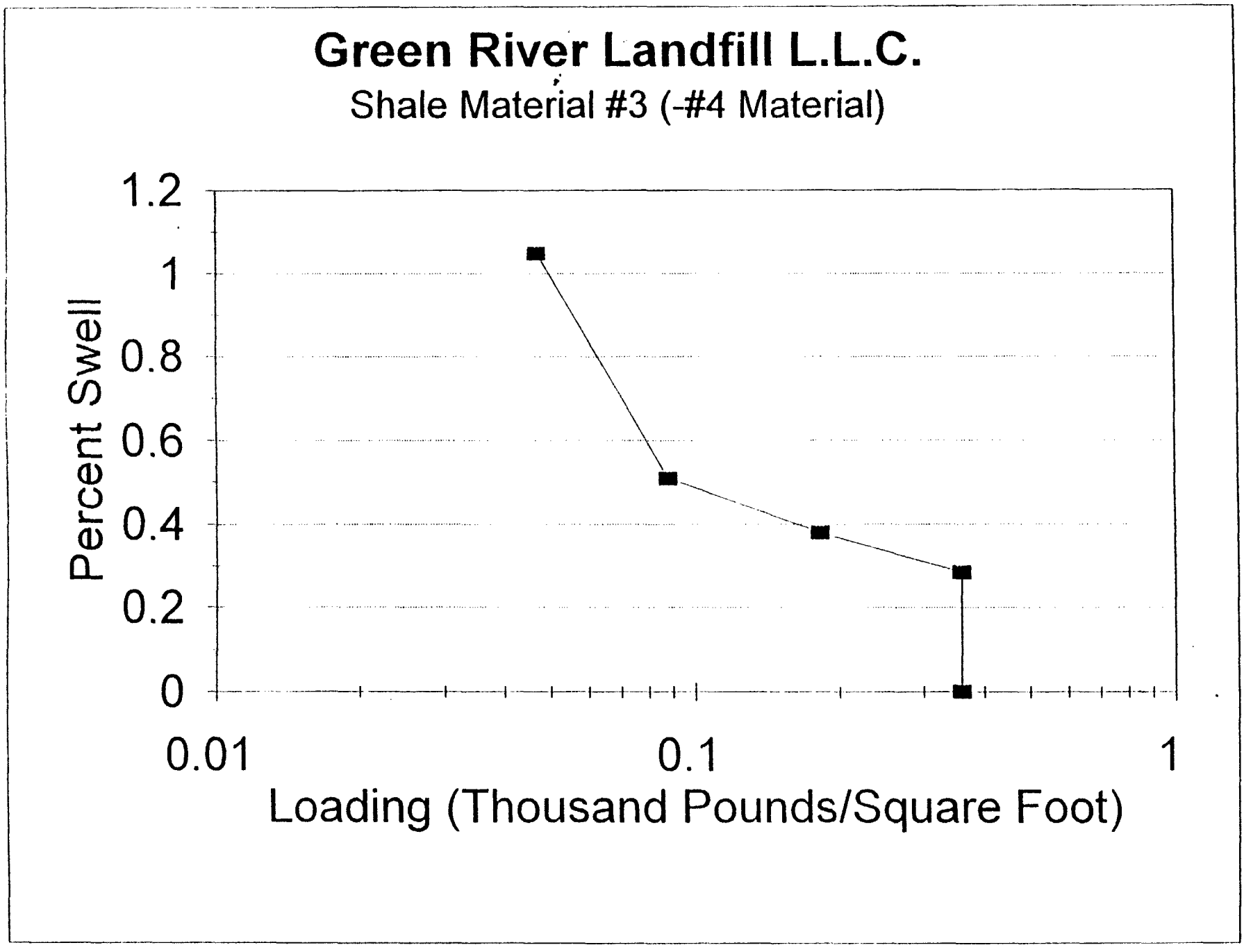
PLATE

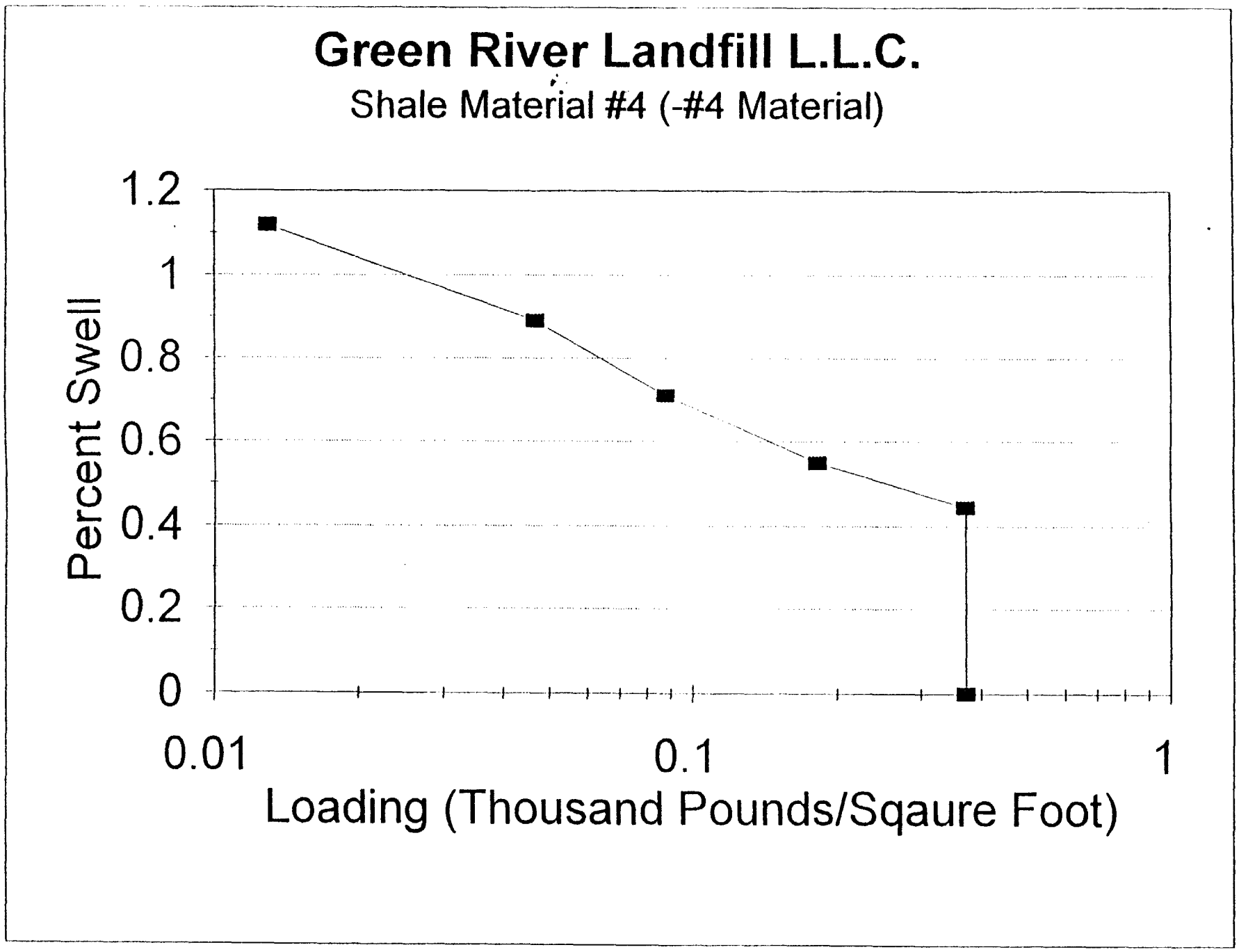
SHALE CHARACTERISTICS
MANCOS SWELLING POTENTIAL LABORATORY TESTING
GREEN RIVER LANDFILL L.L.C.

Sample No.	Sieve Size	Specific Gravity	Initial Void Ratio	Natural Moisture	Dry Density
1	- 1" to #4	2.65	0.7168	3.1 %	96.4 pcf
2	- 1" to #4	2.65	0.6696	2.9 %	99.1 pcf
3	- #4	2.65	0.5247	6.4 %	108.5 pcf
4	- #4	2.65	0.4903	6.4 %	111.0 pcf


Green River Landfill L.L.C.
Shale Material #1 (-1" to #4 Material)
Percent Swell
1.2
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
Loading (Thousand Pounds/Square Foot)


Green River Landfill L.L.C.
Shale Material #2 (-1" to #4 Material)
Percent Swell
1.2
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
Loading (Thousand Pounds/Square Foot)


Green River Landfill L.L.C.
Shale Material #3 (-#4 Material)
Percent Swell
1.2
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
Loading (Thousand Pounds/Square Foot)


Green River Landfill L.L.C.
Shale Material #4 (-#4 Material)
Percent Swell
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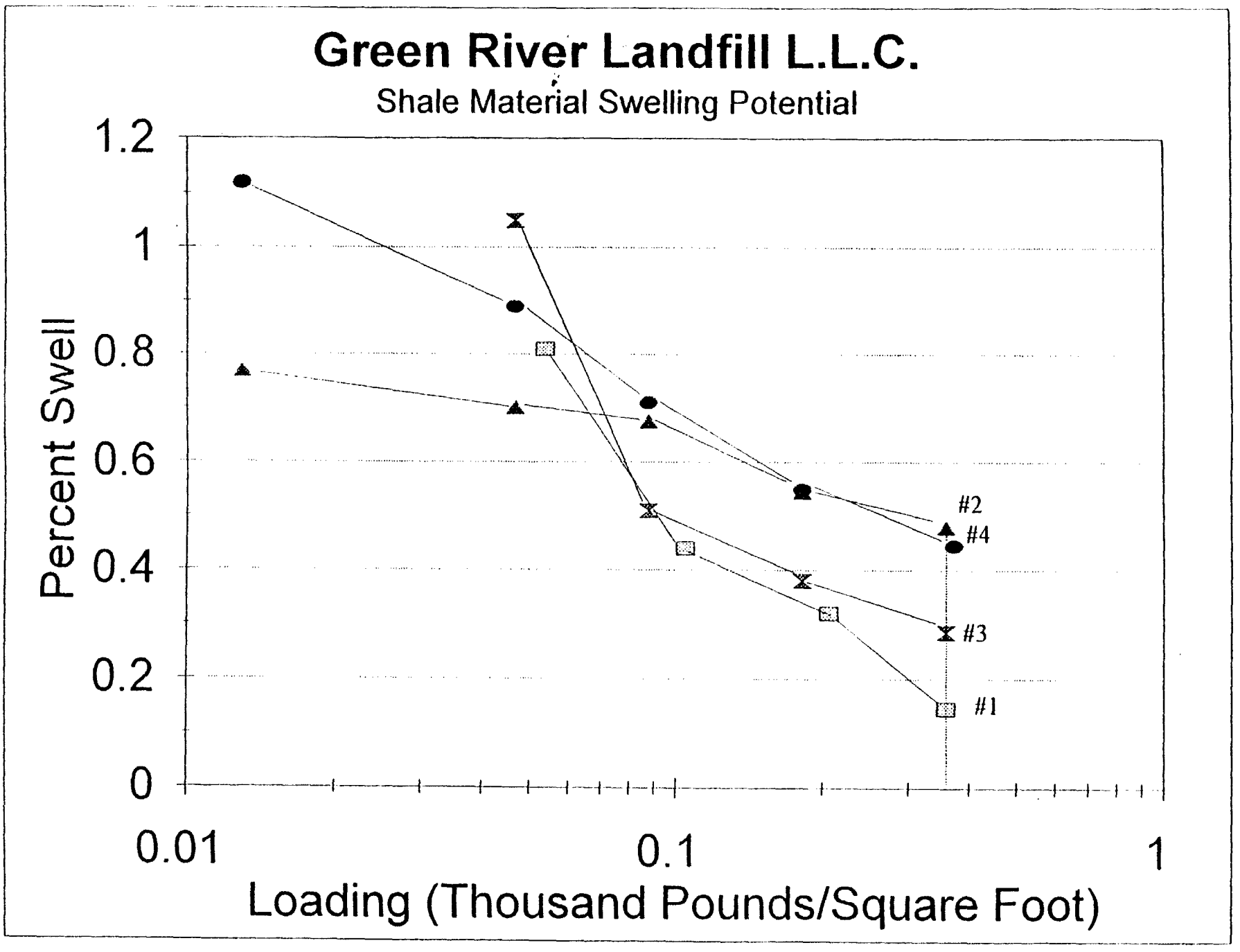
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
Loading (Thousand Pounds/Sqaure Foot)


Green River Landfill L.L.C.
Shale Material Swelling Potential
Percent Swell
1.2
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
Loading (Thousand Pounds/Square Foot)
#2
#4
#3
#1

5. CHEMICAL LABORATORY ANALYTICAL RESULTS

INORGANIC ANALYSIS REPORT

AMERICAN WEST ANALYTICAL LABORATORIES

'est 3600 South
lt Lake City, Utah
84115

(801) 263-8686
(801) 263-8687

Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-01
Field Sample ID: Green River, UT/MW-1

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	**0.1**
Antimony	6010	0.1	<0.1
Arsenic	7060	0.005	<0.005
Barium	6010	0.002	**0.009**
Beryllium	6010	0.005	<0.005
Cadmium	6010	0.004	**0.005**
Chromium	6010	0.005	<0.005
Cobalt	6010	0.01	<0.01
Copper	6010	0.004	**0.014**
Iron	6010	0.01	**0.10**
Lead	7421	0.005	<0.005
Manganese	6010	0.005	**0.051**
Mercury	7471	0.0002	<0.0002
Molybdenum	6010	0.1	<0.1
Nickel	6010	0.005	**0.033**
Selenium	7740	0.005	**0.61**
Silver	6010	0.005	<0.005
Thallium	6010	0.4	<0.4
Tin	6010	0.1	**0.1**
Vanadium	6010	0.005	**0.016**
Zinc	6010	0.002	**0.038**

Released by: _____
Laboratory Supervisor

Report Date 8/8/94

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AMERICAN WEST ANALYTICAL LABORATORIES

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Salt Lake City, Utah
84115

(801) 263-8686
Fax (801) 263-8687

Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-01
Field Sample ID: Green River, UT/MW-1

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

TOTAL METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Calcium	6010	0.01	440.
Magnesium	6010	0.01	710.
Potassium	6010	0.01	28.
Sodium	6010	0.01	6,400.
OTHER CHEMISTRIES			
Bicarbonate (as $CaCO_3$)	310.1	10.	1,100.
Carbonate (as $CaCO_3$)	310.1	10.	<10.
Chloride	4500 CLB	0.5	250.
Conductivity	120.1	10.	21,000. µmhos/cm @ 25° C
Cyanide	335.3	0.005	0.01
Fluoride	340.1	0.1	6.8
Nitrate (as N)	353.2	0.01	140.
pH	150.1	0.1	7.3
Sulfate	375.4	5.0	15,000.
TDS	160.1	1.0	20,000.

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Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-02
Field Sample ID: Green River, UT/MW-2

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	<0.1
Antimony	6010	0.1	<0.1
Arsenic	7060	0.005	<0.005
Barium	6010	0.002	**0.008**
Beryllium	6010	0.005	<0.005
Cadmium	6010	0.004	<0.004
Chromium	6010	0.005	<0.005
Cobalt	6010	0.01	<0.01
Copper	6010	0.004	<0.004
Iron	6010	0.01	**0.04**
Lead	7421	0.005	<0.005
Manganese	6010	0.005	**0.032**
Mercury	7471	0.0002	<0.0002
Molybdenum	6010	0.1	<0.1
Nickel	6010	0.005	<0.005
Selenium	7740	0.005	<0.005
Silver	6010	0.005	<0.005
Thallium	6010	0.4	<0.4
Tin	6010	0.1	<0.1
Vanadium	6010	0.005	<0.005
Zinc	6010	0.002	**0.008**

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(801) 263-8686
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Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-02
Field Sample ID: Green River, UT/MW-2

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

TOTAL METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Calcium	6010	0.01	31.
Magnesium	6010	0.01	21.
Potassium	6010	0.01	7.9
Sodium	6010	0.01	4,500.
OTHER CHEMISTRIES			
Bicarbonate (as $CaCO_3$)	310.1	10.	1,300.
Carbonate (as $CaCO_3$)	310.1	10.	<10.
Chloride	4500 CLB	0.5	2,000.
Conductivity	120.1	10.	16,000. µmhos/cm @ 25° C
Cyanide	335.3	0.005	<0.005
Fluoride	340.1	0.1	3.0
Nitrate (as N)	353.2	0.01	0.03
pH	150.1	0.1	7.5
Sulfate	375.4	5.0	5,900.
TDS	160.1	1.0	11,000.

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Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-03
Field Sample ID: Green River, UT/MW-5

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	**0.1**
Antimony	6010	0.1	<0.1
Arsenic	7060	0.005	<0.005
Barium	6010	0.002	**0.005**
Beryllium	6010	0.005	<0.005
Cadmium	6010	0.004	**0.005**
Chromium	6010	0.005	<0.005
Cobalt	6010	0.01	<0.01
Copper	6010	0.004	**0.023**
Iron	6010	0.01	**0.11**
Lead	7421	0.005	<0.005
Manganese	6010	0.005	**0.020**
Mercury	7471	0.0002	<0.0002
Molybdenum	6010	0.1	<0.1
Nickel	6010	0.005	**0.032**
Selenium	7740	0.005	**0.51**
Silver	6010	0.005	<0.005
Thallium	6010	0.4	<0.4
Tin	6010	0.1	**0.1**
Vanadium	6010	0.005	**0.017**
Zinc	6010	0.002	**0.058**

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Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-03
Field Sample ID: Green River, UT/MW-5

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

TOTAL METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Calcium	6010	0.01	**440.**
Magnesium	6010	0.01	**720.**
Potassium	6010	0.01	**27.**
Sodium	6010	0.01	**6,400.**
OTHER CHEMISTRIES			
Bicarbonate (as $CaCO_3$)	310.1	10.	**1,100.**
Carbonate (as $CaCO_3$)	310.1	10.	<10.
Chloride	4500 CLB	0.5	**180.**
Conductivity	120.1	10.	**21,000.** µmhos/cm @ 25° C
Cyanide	335.3	0.005	**0.008**
Fluoride	340.1	0.1	**6.8**
Nitrate (as N)	353.2	0.01	**130.**
pH	150.1	0.1	**7.2**
Sulfate	375.4	5.0	**15,000.**
TDS	160.1	1.0	**19,000.**

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Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-04
Field Sample ID: Green River, UT/DH-2

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
TDS	160.1	1.0	**9,400.**

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AMERICAN
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LABORATORIES

Client: Bingham Environmental
Date Received: August 1, 1994
Lab Sample ID Number: 19299-05
Field Sample ID: Green River, UT/DH-10

Contact: Kevin Cosper
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
TDS	160.1	1.0	30,000.

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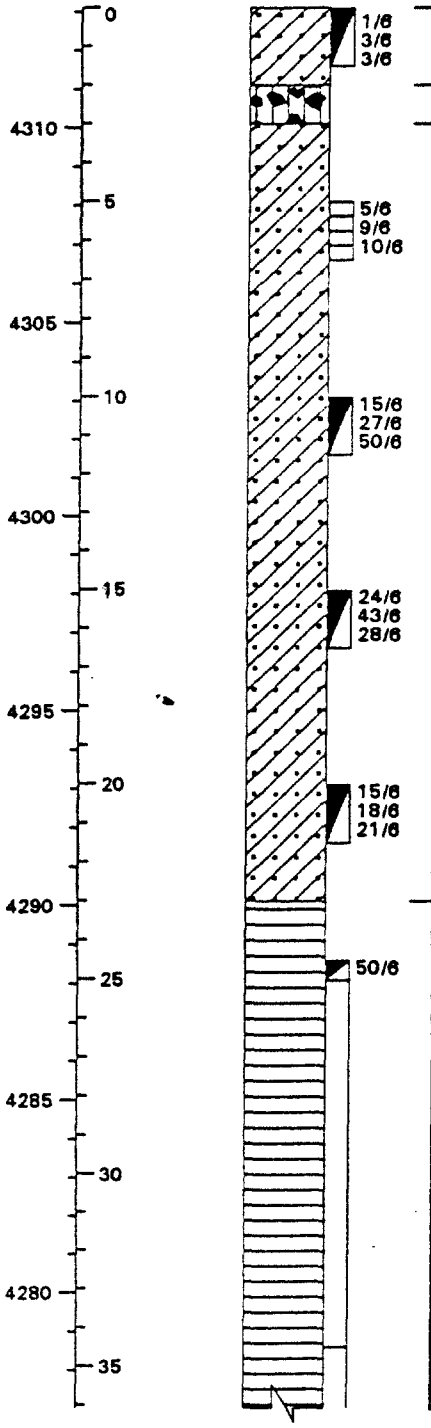
6. EXPLORATORY DRILL HOLE, PIEZOMETER, AND MONITOR WELL LOGS

DRILL HOLE LOG
DRILL HOLE NO.: DH-1

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: Northwest Corner
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-21-94
TOC ELEV.: NA
GS ELEV.: 4313.12
LOGGED BY: DEW
HOLE NO.: DH-1



ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
		[SC] CLAYEY SAND: Brown, slightly silty, roots, medium dense, dry.	B-1	0-1.5	14/18	
		[GM] SILTY GRAVEL: Brown, slightly clayey, dense, dry.				
		[SC] CLAYEY SAND: Brown, occasional gravel, medium dense to dense, slightly moist.	CA-2	5-6.5	16/18	
			B-2	10-11.5	18/18	
			B-3	15-16.5	18/18	
		...Grades dense.				
			B-4	20-21.5	18/18	
		SHALE: Gray, gypsum along fractures, very close to close spaced fractures, fractures are non-intersecting open planes with intersecting open planes at 26 feet, slightly weathered to fresh, dry. (Began coring at 25 feet)	B-5	24.5-25 25-34.5	6/6 114/114	..... 0 33 58 75 83 100
		...Close to moderate spaced factures from 29 to 34.5 feet.				
		...Moderate spaced fractures from 34.5 to 50 feet.		34.5-44.5	120/120	

Hole diameter is 7.75 inches from 0 to 25 feet; and 4.25 inches from 25 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-1

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: Northwest Corner
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-21-94
TOC ELEV.: NA
GS ELEV.: 4313.12
LOGGED BY: DEW
HOLE NO.: DH-1

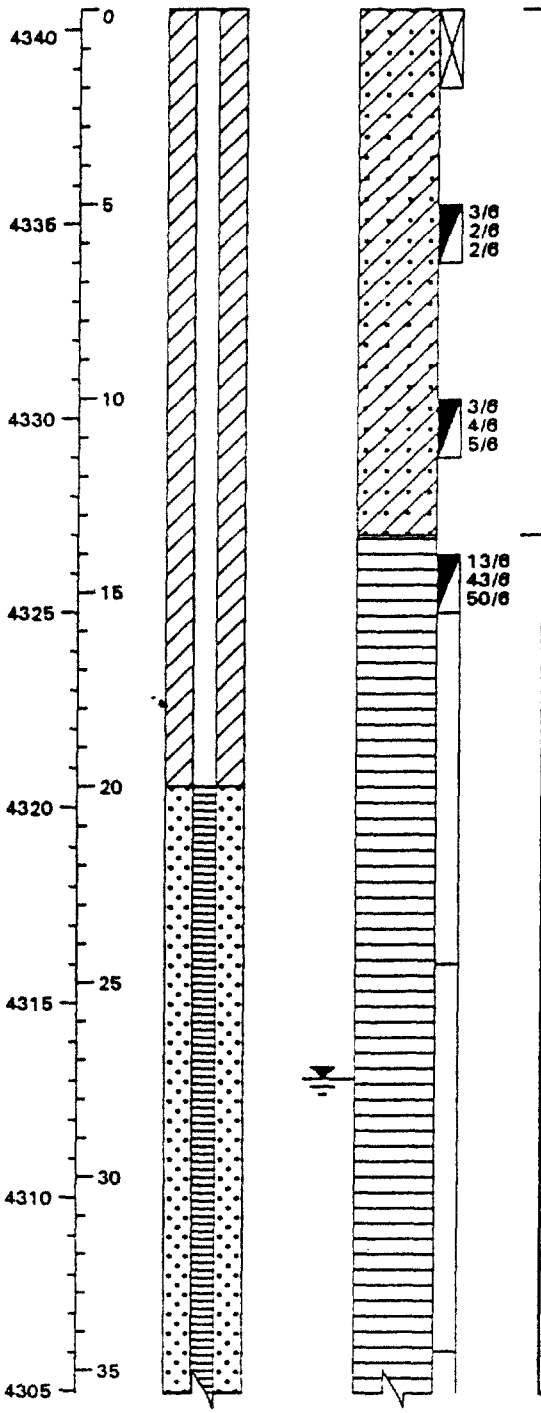
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4275						
40						
4270						
45				44.5-50	120/120	
4265						
50						
4260						
55						
4255						
60						
4250						
65						
4245						
70						

Hole diameter is 7.75 inches from 0 to 25 feet; and 4.25 inches from 25 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 27.46'

PROJECT NO.: 2106-002
DATE: 6-22-94
TOC ELEV.: 4345.28
GS ELEV.: 4340.53
LOGGED BY: DEW
HOLE NO.: DH-2



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[SC] CLAYEY SAND: Brown, slightly silty, roots, occasional gravel, loose to medium dense, dry to moist.	S-1	0-2	24/24	
	B-1	5-6.5	18/18	
	B-2	10-11.5	18/18	
...Grades gravely.				
SHALE: Gray, gypsum along fractures, very close to close spaced fractures, fractures are non-intersecting open planes, fresh, dry. (Began coring at 15.5 feet)	B-3	14-15.5	18/18	
		15.5-24.5	108/108	0
				58
...Moderate spaced fractures from 18.5 to 24.5 feet.				33
				100
...Close spaced fractures from 24.5 to 43.5 feet.		24.5-34.5	120/120	25
				100
				0
...Grades wet.				92
				100
				75
				100
				67
		34.5-	108/	100

Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 43.5 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 27.46'

PROJECT NO.: 2106-002
DATE: 6-22-94
TOC ELEV.: 4345.28
GS ELEV.: 4340.53
LOGGED BY: DEW
HOLE NO.: DH-2

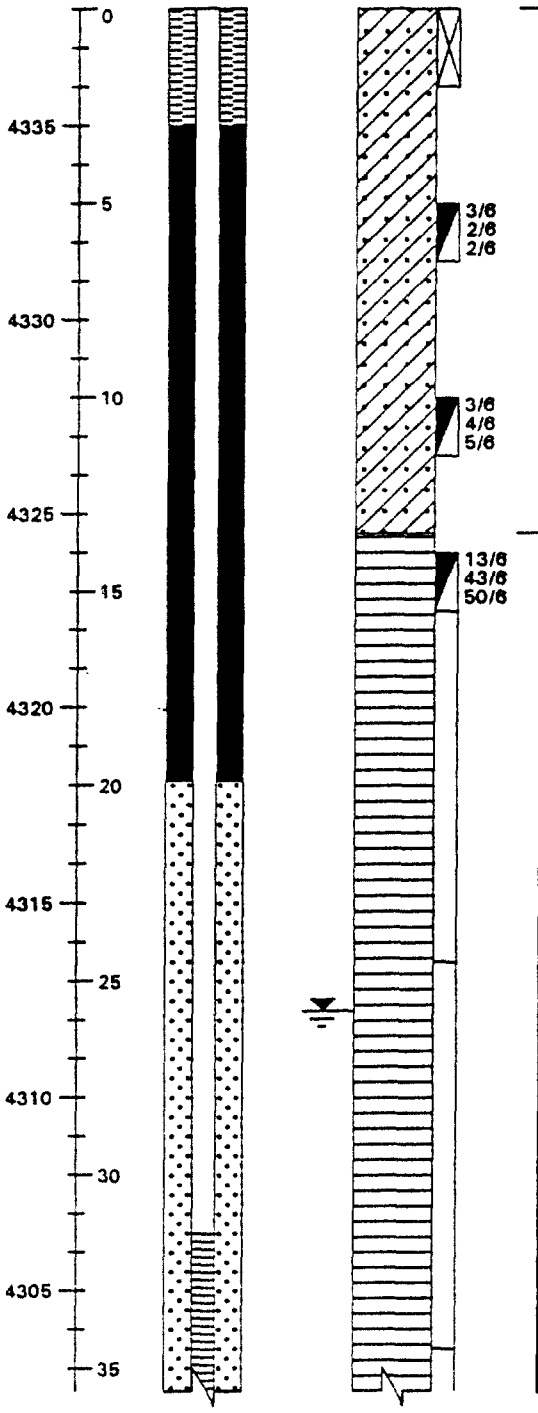
ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
					43.5	108	
4300 / 40							75
4295 / 45							
4290 / 50							
4285 / 55							
4280 / 60							
4275 / 65							
4270 / 70							

Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 43.5 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: 38 feet north of DH-2
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 25.75'

PROJECT NO.: 2106-003
DATE: 7-12-94
TOC ELEV.:
GS ELEV.: 4338
LOGGED BY: DCH
HOLE NO.: MW-2



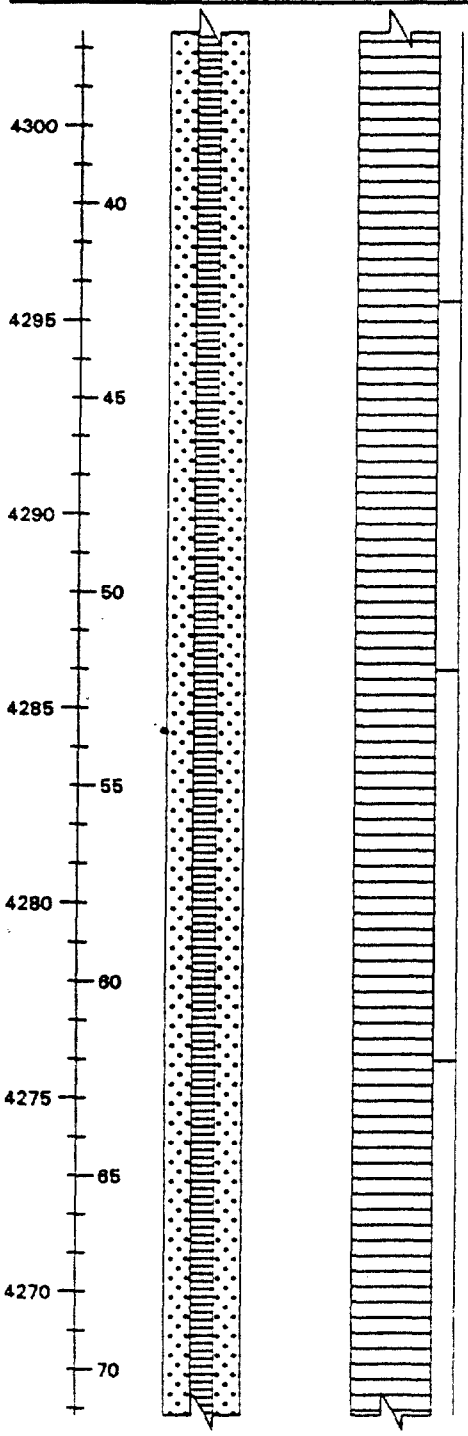
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[SC] CLAYEY SAND: Brown, slightly silty, roots, occasional gravel, loose to medium dense, dry to moist.	S-1	0-2	24/24	
	B-1	5-6.5	18/18	
	B-2	10-11.5	18/18	
...grades gravely.				
SHALE: Gray, gypsum along fractures, very close to close spaced fractures, fractures are non-intersecting open planes with intersecting open planes starting at 44 feet, fresh, dry.	B-3	14-15.5	18/18	
		15.5-24.5	108/108	0
...Moderate spaced fractures from 18.5 to 24.5 feet.				58
				33
				100
...Close spaced fractures from 24.5 to 43.5 feet.		24.5-34.5	120/120	25
				100
...Grades wet.				0
				92
				100
				75
				100
				67
		34.5-	96/96	100

Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 102 feet. Log information from 0 to 42.5 feet obtained from DH-2 log (DH-2 is 38 feet south of MW-2).

DRILL HOLE LOG
DRILL HOLE NO.: MW-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: 38 feet north of DH-2
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 25.75'

PROJECT NO.: 2106-003
DATE: 7-12-94
TOC ELEV.:
GS ELEV.: 4338
LOGGED BY: DCH
HOLE NO.: MW-2



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
		42.5		
...Close to moderate spaced fractures from 42.5 to 50 feet with very close spaced fractures at 44 feet, dry with occassional wet fractures.		42.5-52	114/114	100 83 100
...Moderate to wide spaced fractures from 52 to 102 feet with very close spaced fractures at 81.8 feet.		52-62	120/120	92 75 100
		62-72	120/120	

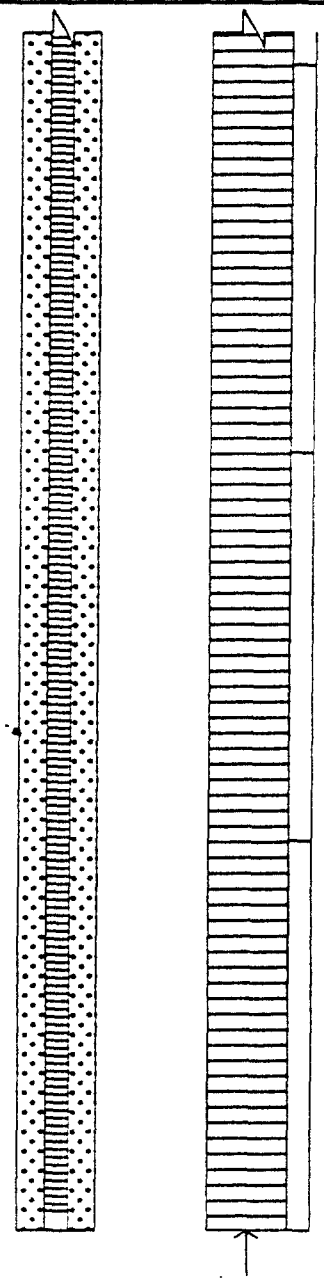
Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 102 feet. Log information from 0 to 42.5 feet obtained from DH-2 log (DH-2 is 38 feet south of MW-2).

DRILL HOLE LOG
DRILL HOLE NO.: MW-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: 38 feet north of DH-2
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 25.75'

PROJECT NO.: 2106-003
DATE: 7-12-94
TOC ELEV.:
GS ELEV.: 4338
LOGGED BY: DCH
HOLE NO.: MW-2

ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4265					72-82	120/120	
75							
4260							
80							83
4255					82-92	120/120	100
85							
4250							
90							
4245					92-102	120/120	
95							
4240							
100							
4235							
105							

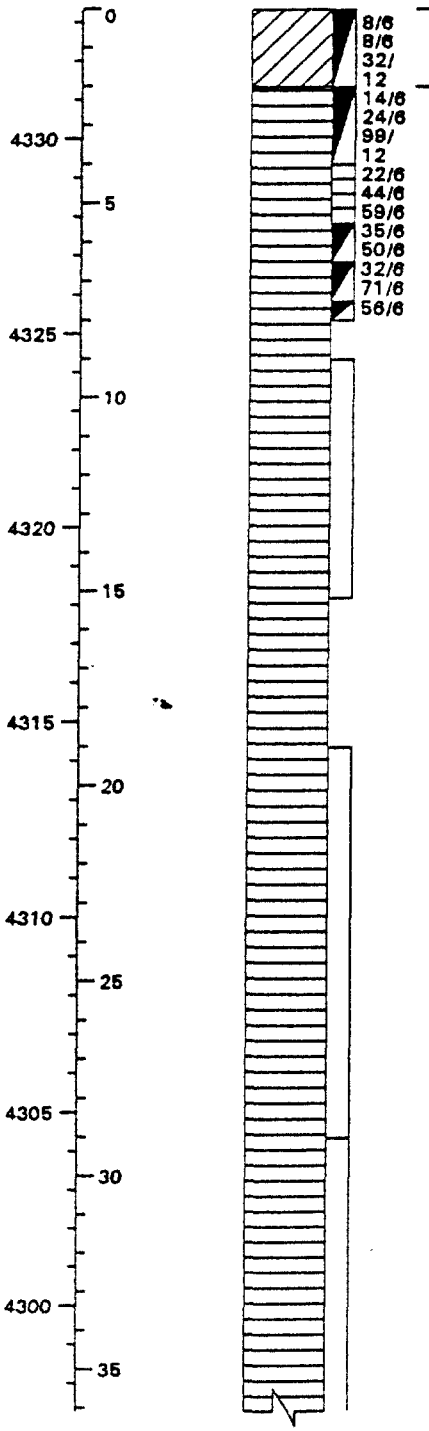


Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 102 feet. Log information from 0 to 42.5 feet obtained from DH-2 log (DH-2 is 38 feet south of MW-2).

DRILL HOLE LOG
DRILL HOLE NO.: DH-3

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-22-94
TOC ELEV.: NA
GS ELEV.: 4333.36
LOGGED BY: DEW
HOLE NO.: DH-3



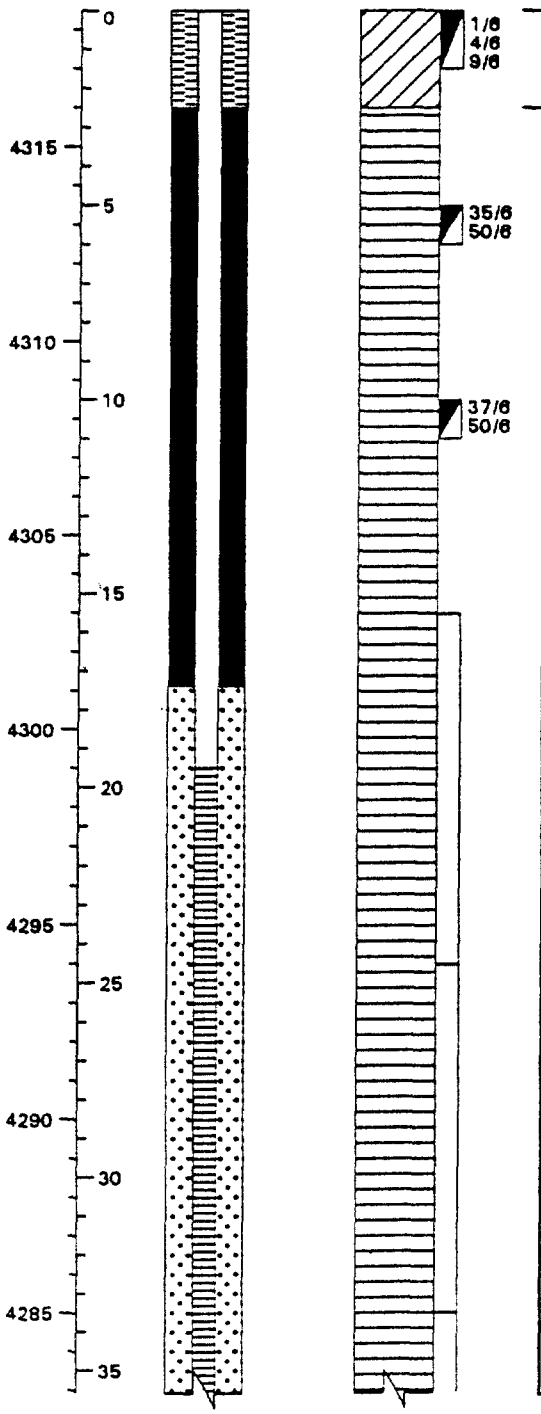
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, sandy, roots, very stiff to hard, dry.	B-1	0-2	22/24	
SHALE: Gray, weathered, moderately hard, dry.	B-2	2-4	18/24	
...Gypsum in fractures.	CA-1	4-5.5	18/18	
...Grades hard.	B-3	5.5-6.5	8/12	
	B-4	6.5-7.5	10/12	
	B-5	7.5-8	6/6	
(Began coring at 9 feet.) ...Silt in fractures, very close spaced factures, fractures are non-intersecting open planes, fresh, dry.		9-16.2	74/74	0
...Shattered fractures from 13 to 16.2 feet. ...Gypsum in fractures from 14 to 35 feet				
...Very close spaced fractures from 19 to 35 feet.		19-29	96/120	33
...fractures are non-intersecting and intersecting open planes from 21 to 49 feet.				0
				33
				0
...Core slightly damp		29-39	120/120	0
				42
...Moderate spaced fractures from 35 to 39 feet.				100

Hole diameter is 7.75 inches form 0 to 9 feet; and 4.25 inches from 9 to 49 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-4

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 6-21-94
TOC ELEV.: 4321.46
GS ELEV.: 4318.51
LOGGED BY: DEW
HOLE NO.: MW-4



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, roots, sandy, stiff, dry. ...Grades gravely.	B-1	0-1.5	7/18	
SHALE: Gray, moderately hard to hard, dry. ...Gypsum in fractures.				
...grades hard.	B-2	5-6	10/12	
	B-3	10-11	10/12	
(Began coring at 15.5 feet.) ...Gypsum in fractures, very close to close spaced fractures, fractures are non-intersecting open planes with intersecting open planes at 40 feet, slightly weathered to fresh, dry.		15.5-24.5	120/120	0
				92
				67
				58
...Moderate spaced fractures from 24.5 to 50 feet, damp.		24.5-33.5	108/108	50
				100
...Grades moist.		33.5-43.5	120/120	

Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-4

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 6-21-94
TOC ELEV.: 4321.46
GS ELEV.: 4318.51
LOGGED BY: DEW
HOLE NO.: MW-4

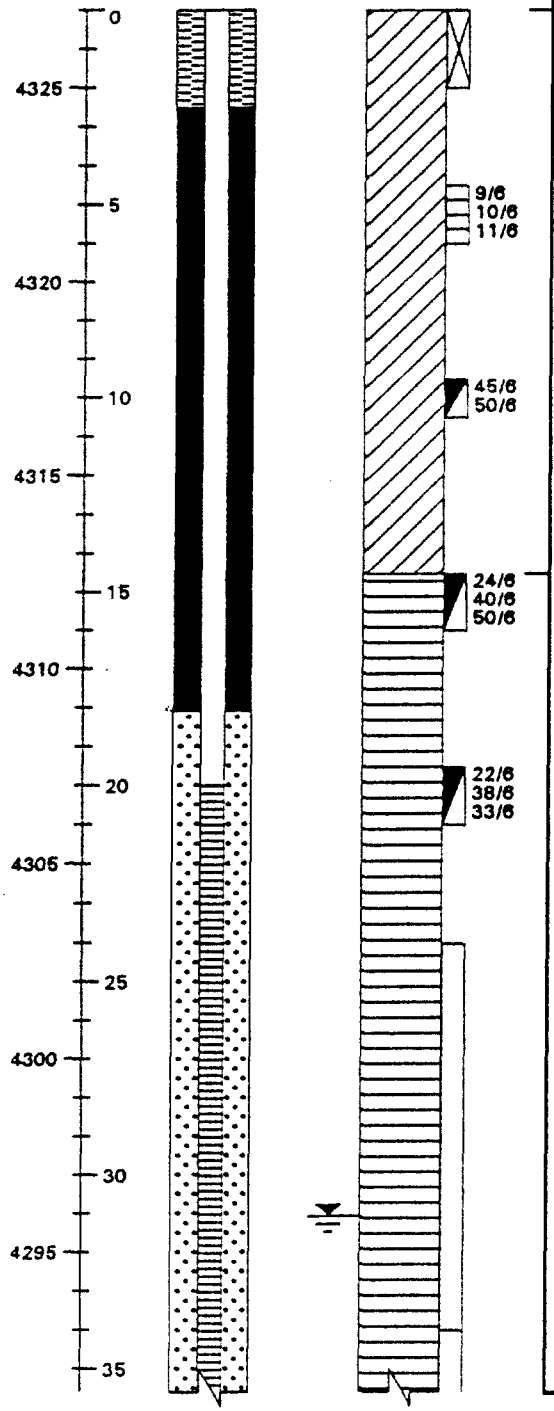
ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4280 / 40							
4275 / 45					43.5-50	78/78	
4270 / 50							
4265 / 55			...Fractures are spaced wide from 50 to 65 feet, fractures are non-intersecting planes from 51 to 90 feet.		51-60	108/108	
4260 / 60					60-70	120/120	92 / 100
4255 / 65			...Fractures and spaced very wide.				
4250 / 70					70-80	120/120	

Hole diameter is 7.75 inches from 0 to 15.5 feet; and 4.25 inches from 15.5 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-5

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 31.05'

PROJECT NO.: 2106-003
DATE: 6-30-94
TOC ELEV.:
GS ELEV.: 4327
LOGGED BY: DCH
HOLE NO.: MW-5



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, slightly sandy, very stiff to hard, dry.	S-1	0-2	24/24	
	CA-2	4.5-6	14/16	
	B-3	9.5-10.5	8/12	
SHALE: Gray, very weathered, moderately hard, dry.	B-4	14.5-16	14/18	
	B-5	19.5-21	13/18	
(Began coring at 24 feet.) ...Gypsum along some fractures, fractures shattered to close spaced fractures from 24 to 29 feet & lose to moderate spaced fractures from 29 to 54 feet, fractures are non-intersecting and intersecting open planes, slightly weathered to fresh, dry to moist.		24-34	120/120	67
				33
				50
				100
				75
				100
...Grades wet.		34-44	120/120	

Hole diameter is 7.75 inches from 0 to 24 feet; and 4.25 inches from 24 to 139 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-5

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 31.05'

PROJECT NO.: 2106-003
DATE: 6-30-94
TOC ELEV.:
GS ELEV.: 4327
LOGGED BY: DCH
HOLE NO.: MW-5

ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4255							92
							75
							100
75					74-84	120/120	50
							100
4250							
							42
							50
80							67
							92
4245							75
							100
85					84-94	120/120	
							75
4240							100
							83
90			...Moderate to wide spaced fractures from 84 to 139.5 feet.				100
4235							
95					94-104	120/120	
4230							
100							
4225							
105					104-114	120/120	

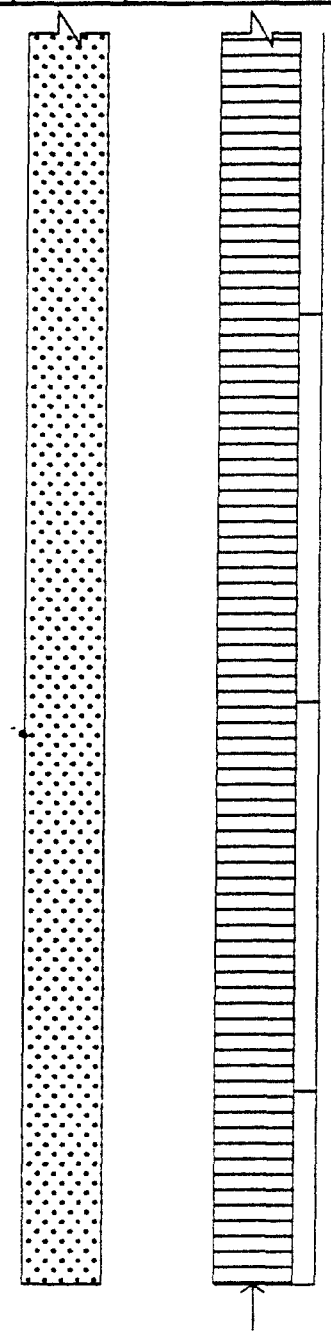
Hole diameter is 7.75 inches from 0 to 24 feet; and 4.25 inches from 24 to 139 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-5

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 31.05'

PROJECT NO.: 2106-003
DATE: 6-30-94
TOC ELEV.:
GS ELEV.: 4327
LOGGED BY: DCH
HOLE NO.: MW-5

ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4220							
110							
4215							
115					114-124	120/120	
4210							
120							
4205							
125					124-134	120/120	
4200							
130							
4195							
135					134-139	60/60	
4190							
140							
4185							

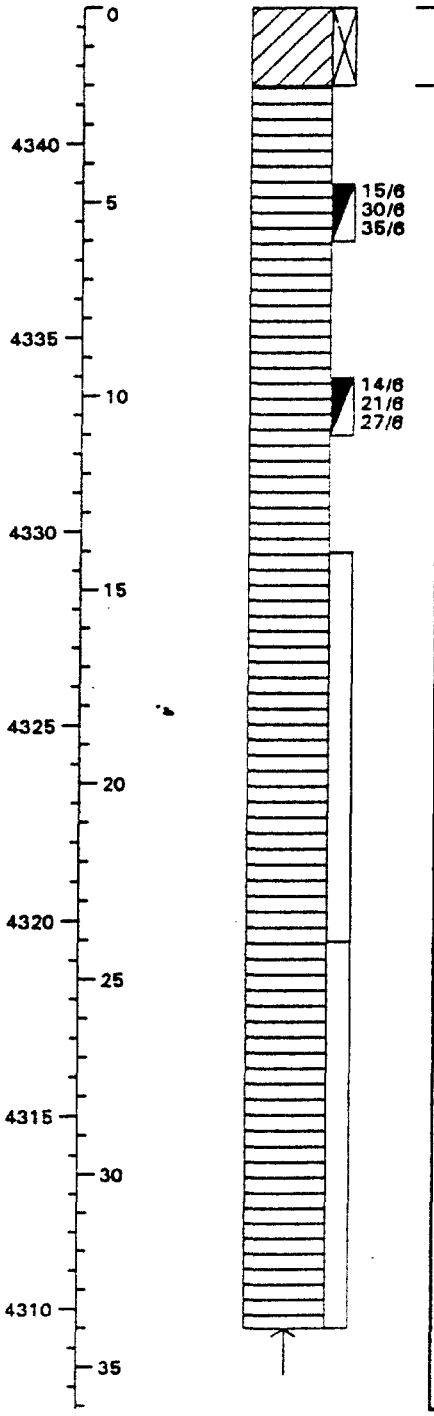


Hole diameter is 7.75 inches from 0 to 24 feet; and 4.25 inches from 24 to 139 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-6

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-23-94
TOC ELEV.: NA
GS ELEV.: 4343.51
LOGGED BY: DEW
HOLE NO.: DH-6



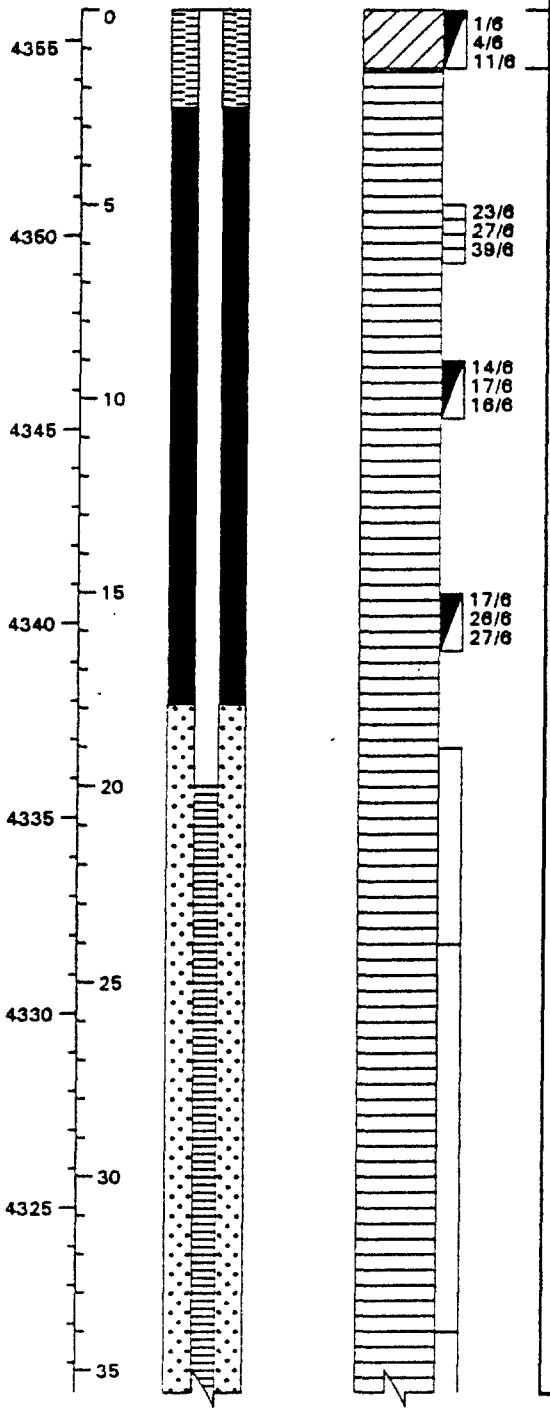
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, sandy, stiff, dry.	S-1	0-2	24/24	
SHALE: Gray, weathered, firm to moderately hard, dry.				
	B-1	4.5-6	16/18	
	B-2	9.5-11	16/18	
...Grades hard.				
(Began coring at 14 feet)				
...very close to moderate spaced fractures		14-24	116/120	0
fractures are non-intersecting and intersecting open planes, slightly weathered ts fresh, dry.				42
...Fractures are non-intersecting open planes from 17 to 34 feet.				0
				100
		24-34	120/120	

Hole diameter is 7.75 inches from 0 to 14 feet; and 4.25 inches from 14 to 34 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-7

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 6-23-94
TOC ELEV.: 4358.65
GS ELEV.: 4355.81
LOGGED BY: DEW
HOLE NO.: MW-7



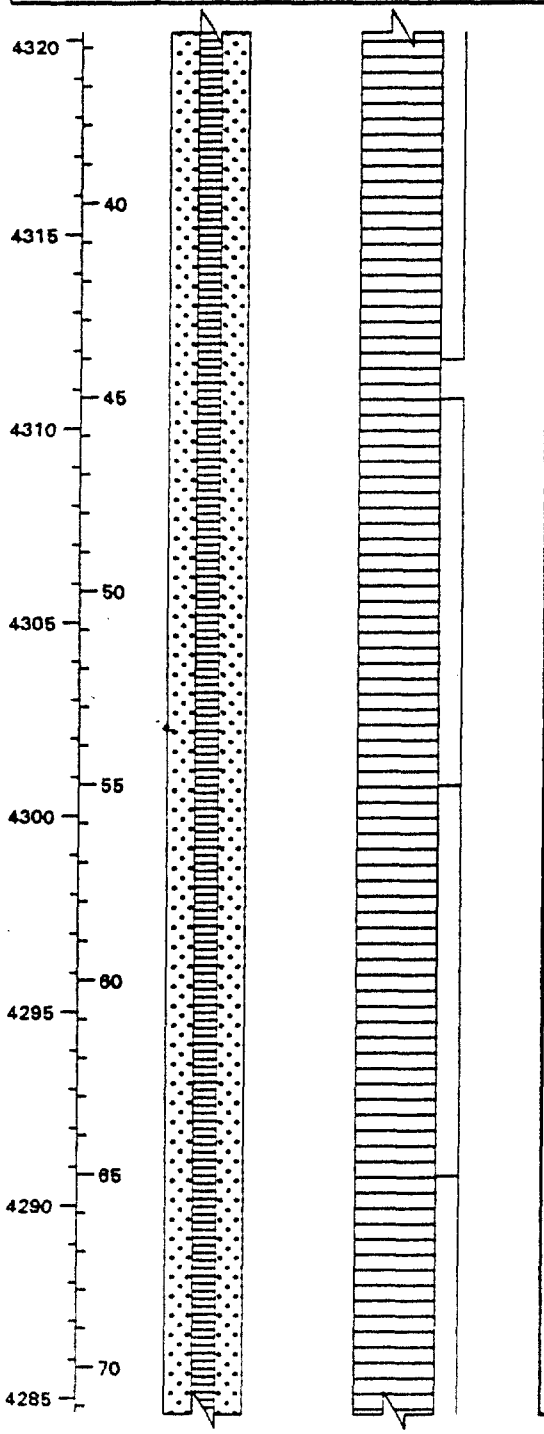
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, slightly sandy, stiff, dry.	B-1	0-1.5	16/18	
SHALE: Gray, firm to moderately hard, dry.				
	CA-1	5-6.5	18/18	
	B-2	9-10.5	16/18	
...Gypsum in fractures.	B-3	15-16.5	16/18	
(Began coring at 19 feet) ...very close spaced fractures, fractures are non-intersecting and intersecting open planes, slightly weathered to fresh, dry.		19-24	56/60	0
...Close to moderate spaced fractures from 24 to 34 feet.		24-34	120/120	33 67 100
				92 100
...Wide spaced fractures from 34 to 44 feet.		34-44	120/120	

Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from 19 to 85 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-7

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 6-23-94
TOC ELEV.: 4358.65
GS ELEV.: 4355.81
LOGGED BY: DEW
HOLE NO.: MW-7



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
...Grades wet.				
...Grades dry.		45-55	120/120	0 100
		55-65	120/120	75 100
				75 42 100
		65-75	120/120	0 92 100

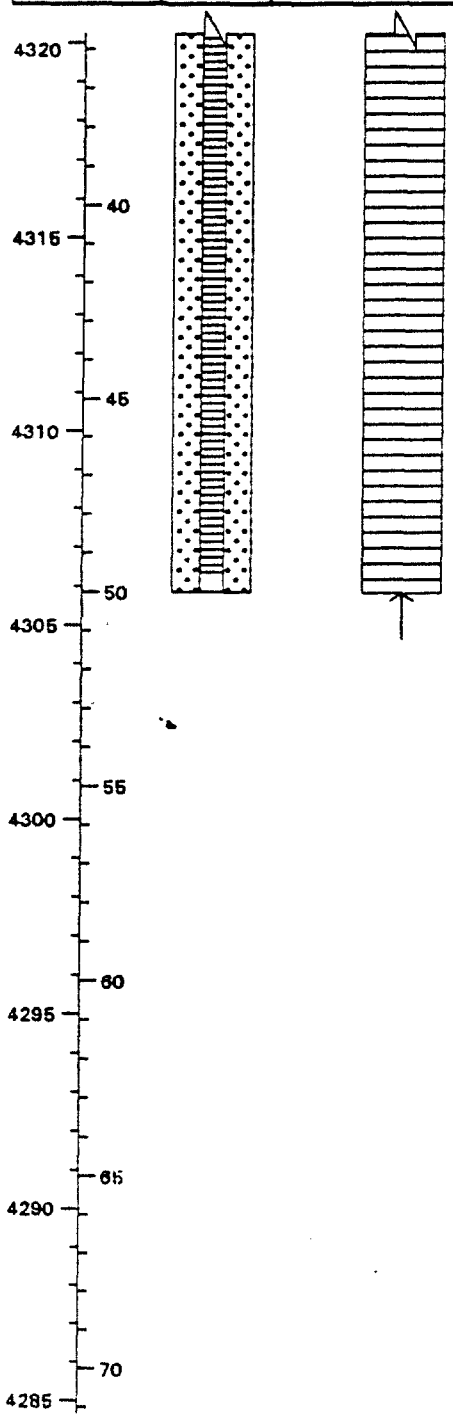
Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from 19 to 85 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-7A

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill, L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 6-23-94
TOC ELEV.: 4358.67
GS ELEV.: 4355.84
LOGGED BY: DEW
HOLE NO.: MW-7A

ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)

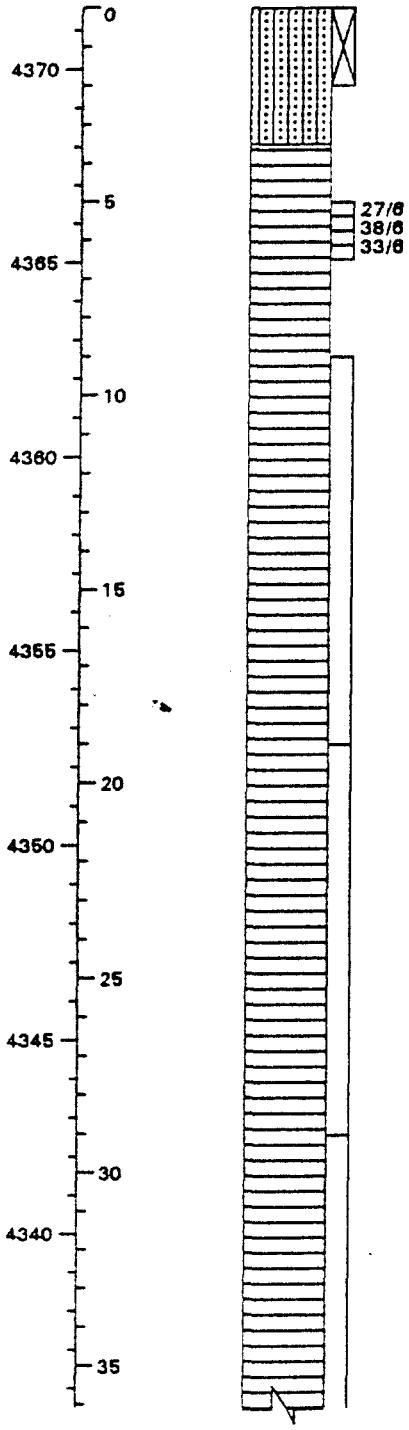


Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from 19 to 85 feet. Log information obtained from MW-7 located 15 feet west of MW-7A.

DRILL HOLE LOG
DRILL HOLE NO.: DH-8

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-24-94
TOC ELEV.: NA
GS ELEV.: 4371.59
LOGGED BY: DEW
HOLE NO.: DH-8



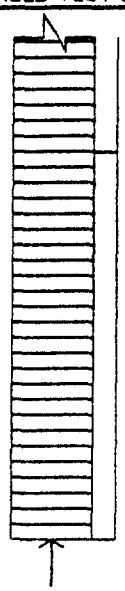
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
		[SM] SILTY SAND: Brown, roots, clayey, medium dense, dry.	S-1	0-2	22/24	
		SHALE: Gray, gypsum, firm to moderately hard, dry.	CA-1	5-6.5	18/18	
		(Began coring at 9 feet.) ...Gypsum along fractures, shattered to very close spaced fractures, fractures are intersecting and non-intersecting open planes, highly to moderately weathered, dry.		9-19	90/120	0
		...Close to moderate spaced factures, non-intersecting open planes.		19-29	116/120	
		...Weathering grades to fresh.				33
						83
						58
						0
						100
				29-39	120/120	

Hole diameter is 7.75 inches from 0 to 9 feet; and 4.25 inches form 9 to 49 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-8

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-24-94
TOC ELEV.: NA
GS ELEV.: 4371.59
LOGGED BY: DEW
HOLE NO.: DH-8

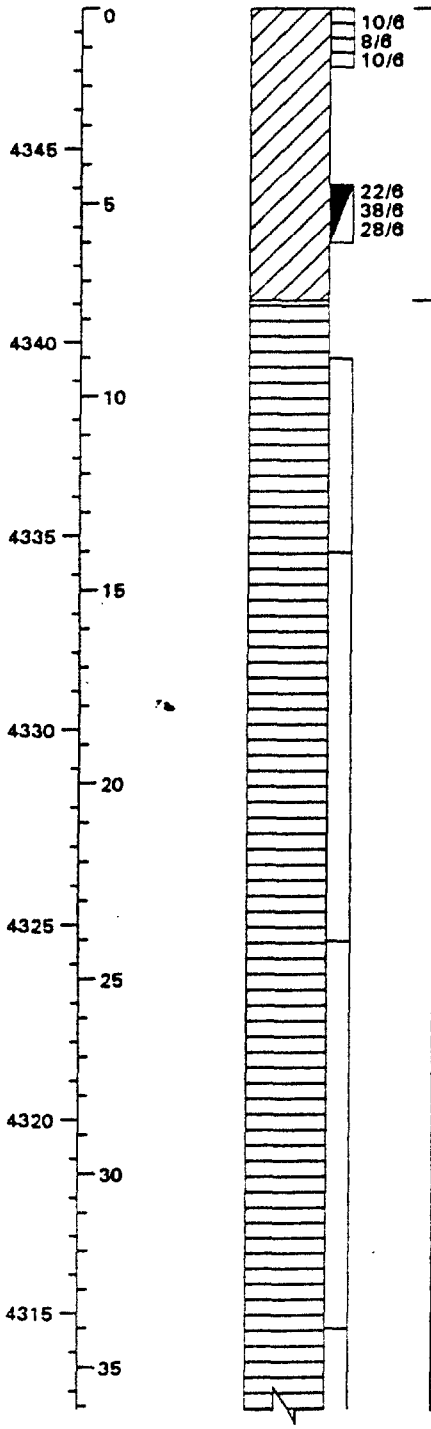
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4335						
40				39-49	120/120	67
						100
4330						
						83
						100
45						
4325						
50						
4320						
55						
4315						
60						
4310						
65						
4305						
70						
4300						

Hole diameter is 7.75 inches from 0 to 9 feet; and 4.25 inches form 9 to 49 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-9

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-29-94
TOC ELEV.: NA
GS ELEV.: 4348.61
LOGGED BY: DCH
HOLE NO.: DH-9



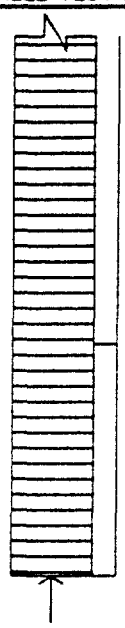
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, roots, sandy, very stiff to hard, dry.	CA-1	0-1.5	12/18	
	B-2	4.5-6	15/18	
SHALE: Gray, weathered, firm to hard, dry. (Began coring at 9 feet.)				
...Gypsum along fractures, very close to close spaced fractures with with occasional shattered fractures, fractures are non-intersecting and intersecting open planes, lightly weathered to fresh, dry.		9-14	48/60	33
				67
				33
				0
		14-24	109/120	
				33
...Moderate spaced fractures from 18 to 34 feet.				100
		24-34	120/120	
...Very close to close spaced fractures from 34 to 44 feet.		34-44	120/120	

Hole diameter is 7.75 inches from 0 to 9 feet; and 4.25 inches from 9 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-9

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-29-94
TOC ELEV.: NA
GS ELEV.: 4348.61
LOGGED BY: DCH
HOLE NO.: DH-9

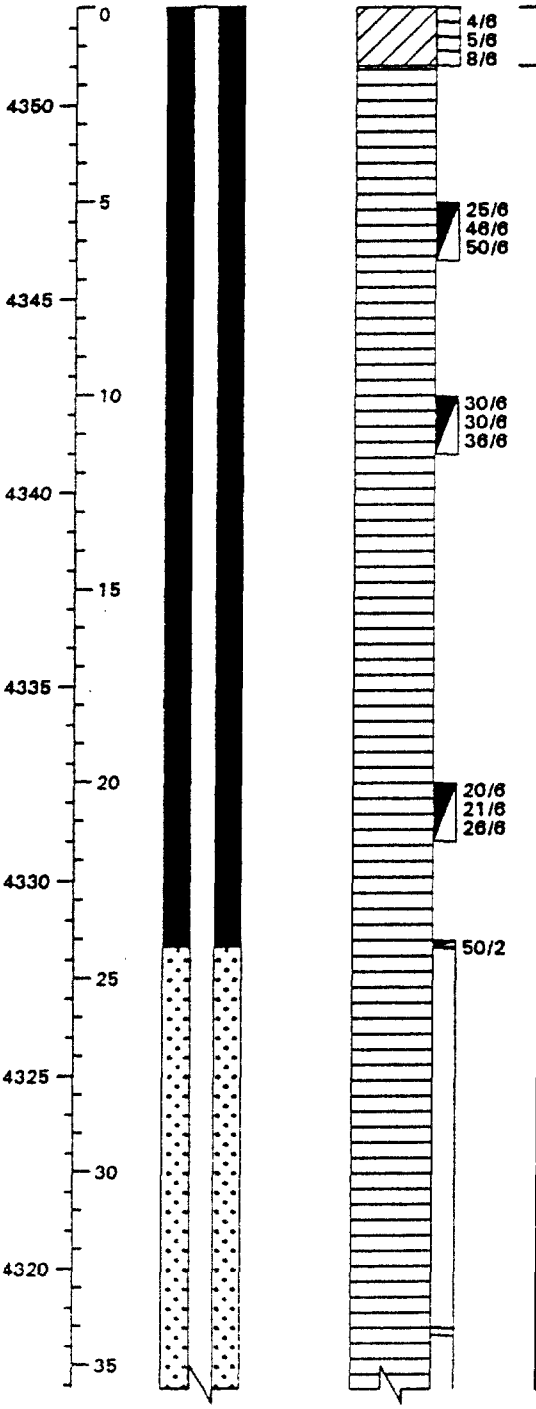
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4310						75
						100
						92
40						100
4305		...Close to moderately spaced fractures from 44 to 50 feet.				75
						0
45				44-50	72/72	100
						75
						92
4300						75
						100
50						
4295						
55						
4290						
60						
4285						
65						
4280						
70						

Hole diameter is 7.75 inches from 0 to 9 feet; and 4.25 inches from 9 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-10

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 37.42'

PROJECT NO.: 2106-002
DATE: 6-27-94
TOC ELEV.: 4353.83
GS ELEV.: 4352.53
LOGGED BY: DEW
HOLE NO.: DH-10



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, roots, sandy, stiff, dry.	CA-1	0-1.5	18/18	
SHALE: Gray, very to moderately weathered, moderately hard, dry.				
	B-1	5-6.5	18/18	
...Gypsum in fractures.	B-2	10-11.5	17/18	
	B-3	20-21.5	18/18	
(Began coring at 24 feet.) ...very close to close spaced fractures, fractures are intersecting and non-intersecting open planes, slightly weathered to fresh, dry.	B-4	24-24.2	18/18	
		24.2-34	120/120	0
				43
				0
				67
				0
				43
				100
				33
				100
		34-44	120/120	

Hole diameter is 7.75 inches from 0 to 24 feet; and 4.25 inches from 24 to 64 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-10

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: 37.42'

PROJECT NO.: 2106-002
DATE: 6-27-94
TOC ELEV.: 4353.83
GS ELEV.: 4352.53
LOGGED BY: DEW
HOLE NO.: DH-10

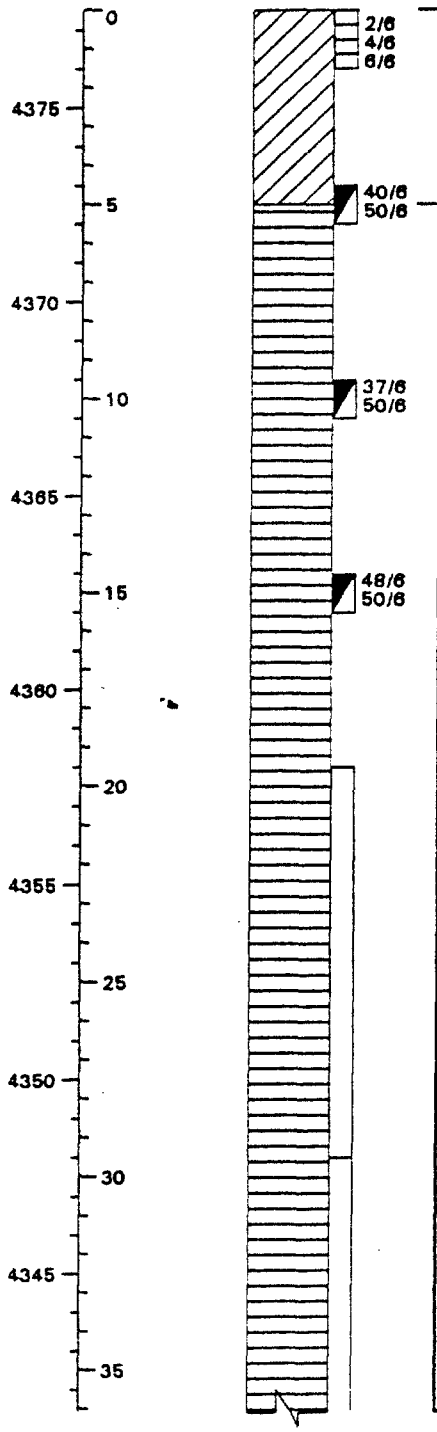
ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4315							83
40							92
							100
4310							
45			...Grades wet. ...Moderate spaced fractures with occasional shattered fractures.		44-54	120/120	75
							100
4305							
50							33
4300							67
							100
55					54-64	120/120	67
							100
4295							92
							100
60							
4290							
65							
4285							
70							

Hole diameter is 7.75 inches from 0 to 24 feet; and 4.25 inches from 24 to 64 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-12

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-24-94
TOC ELEV.: NA
GS ELEV.: 4377.53
LOGGED BY: DEW
HOLE NO.: DH-12



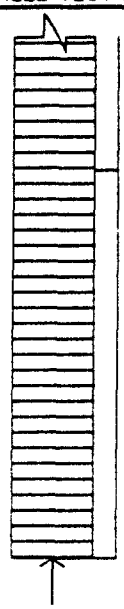
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
		[CL] SILTY CLAY: Brown, sandy, stiff, dry.	CA-1	0-1.5	18/18	
		...Boulder approximatly 1.5 feet thick.				
		SHALE: Grayish tan, very to moderately weathered, moderately hard, dry.	B-2	4.5-5.5	12/12	
			B-3	9.5-10.5	12/12	
			B-4	14.5-15.5	12/12	
		(Began coring at 19.5 feet.) ...Gray, close to moderate spaced fractures, fractures are non-intersecting to intersecting open planes, slightly weathered to fresh, moist.		19.5-29.5	120/120	100
						75
						100
						75
						100
		...Moderate to wide spaced fractures from 29.5 to 49.5 feet with very close spaced fractures at 20 to 20.5 feet, dry.		29.5-39.5	120/120	50
						100

Hole diameter is 7.75 inches from 0 to 19.5 feet; and 4.25 inches from 19.5 to 49.5 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-12

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-24-94
TOC ELEV.: NA
GS ELEV.: 4377.53
LOGGED BY: DEW
HOLE NO.: DH-12

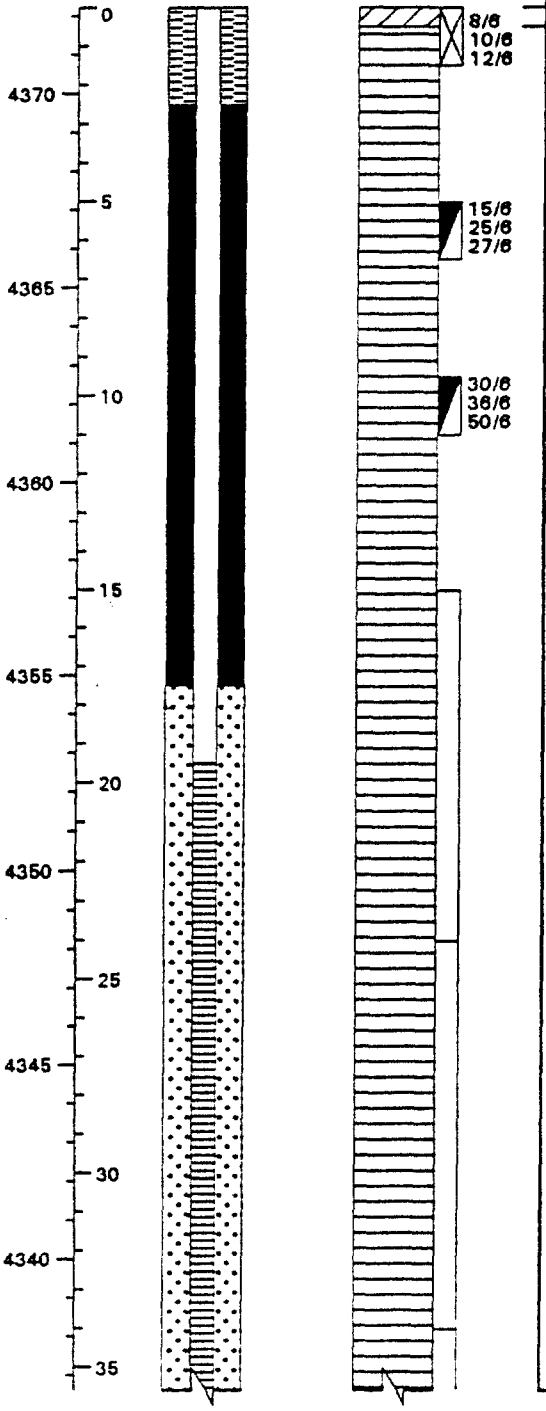
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4340						
40				39.5-49.5	120/120	58
						75
4335						100
45						
4330						
50						
4325						
55						
4320						
60						
4315						
65						
4310						
70						

Hole diameter is 7.75 inches from 0 to 19.5 feet; and 4.25 inches from 19.5 to 49.5 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-13

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-19-94
TOC ELEV.: 4375.10
GS ELEV.: 4372.22
LOGGED BY: DCH
HOLE NO.: MW-13



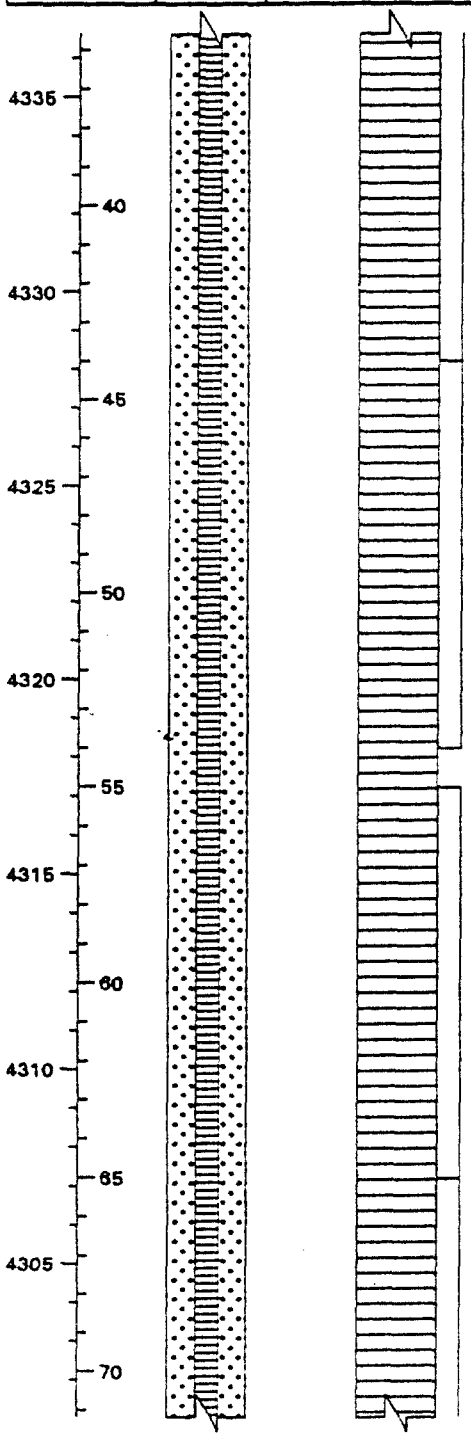
Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, sandy, roots, very stiff, dry.	CA-1	0-1.5	16/18	
SHALE: Grayish tan, gypsum in fractures, very to moderately weathered, moderatly hard, dry.				
	B-2	5-6.5	12/18	
	B-3	9.5-11	12/18	
(Began coring at 15 feet.) ...gypsum along some fractures, very close to close spaced fractures with occasional shattered fractures, fractures are non-intersecting and intersecting open planes, slightly weathered to fresh, dry.		15-24	108/108	33, 42, 33, 0, 100, 33, 50
...grades wet.		24-34	120/120	0, 100, 42, 100
...Grades dry.		34-44	120/120	

Hole diameter is 7.75 inches from 0 to 15 feet; and 4.25 inches from from 15 to 100 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-13

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-19-94
TOC ELEV.: 4375.10
GS ELEV.: 4372.22
LOGGED BY: DCH
HOLE NO.: MW-13



ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
							0
							100
							75
							50
							67
							100
							50
							100
			...Close to moderate spaced fractures from 44 to 49 feet & very close to close spaced fractures from 49 to 54 feet.		44-54	120/120	
							92
			...Moderate to wide spaced fractures from 55 to 95 feet.		55-65	120/120	100
							83
							100
					65-75	120/120	83
							100
							58

Hole diameter is 7.75 inches from 0 to 15 feet; and 4.25 inches from from 15 to 100 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-13

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-19-94
TOC ELEV.: 4375.10
GS ELEV.: 4372.22
LOGGED BY: DCH
HOLE NO.: MW-13

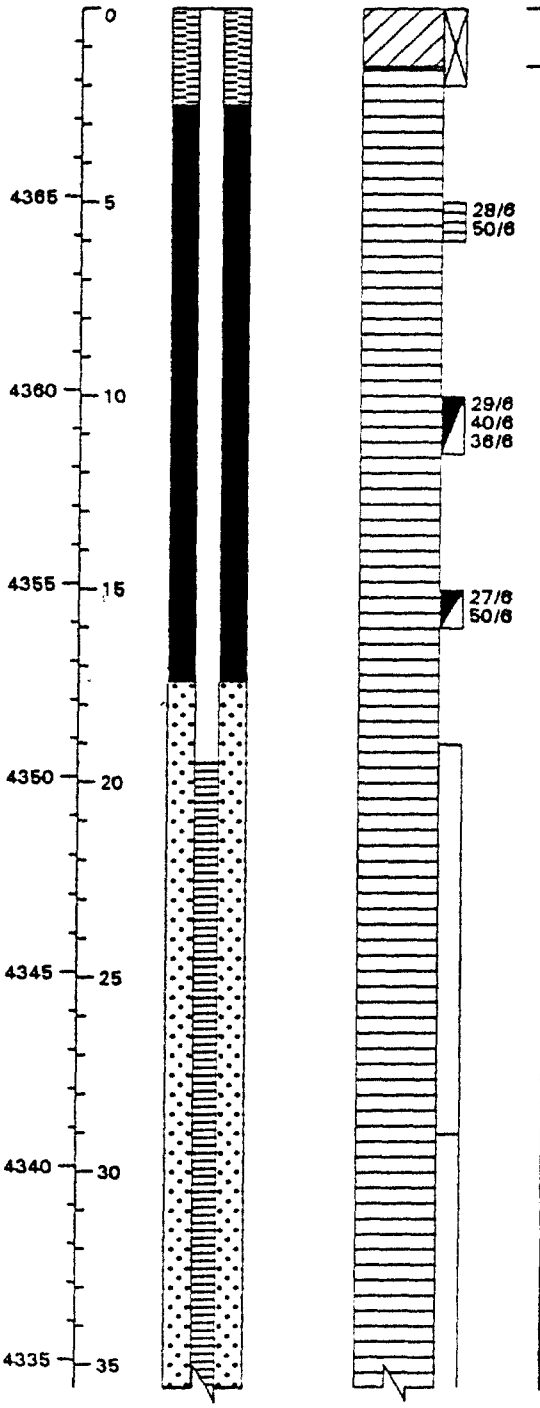
ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4300							100
75			...Grades with very moist & wet zones from 75 to 100 feet.		75-85	120/120	
4295							
80			...Close spaced fractures from 80.8 to 81.1 feet.				50
4290							100
85					85-95	120/120	42
4285							100
90							
4280							
95					95-100	60/60	83
4275							
100							
4270							
105							

Hole diameter is 7.75 inches from 0 to 15 feet; and 4.25 inches from from 15 to 100 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-14

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-15-94
TOC ELEV.: 4372.77
GS ELEV.: 4369.86
LOGGED BY: DCH
HOLE NO.: MW-14



Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
[CL] SILTY CLAY: Brown, roots, sandy, stiff, dry.	S-1	0-2	24/24	
SHALE: Grayish tan, gypsum in fractures, very to moderately weathered, moderately hard, dry.				
	CA-2	5-6	8/12	
	B-3	10-11.5	14/18	
	B-4	15-16	8/12	
(Began coring at 19 feet.) ...Shattered to close spaced fractures, fractures are non-intersecting and intersecting open planes, slightly weathered to fresh, dry.		19-29	120/120	0
				50
				67
				33
				58
				33
				83
				75
...Moderate spaced fractures from 27 to 29 feet.				100
...Very close to close spaced fractures from 29 to 36 feet.		29-39	120/120	0
				58
				100
				83

Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from from 19 to 99 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-14

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-15-94
TOC ELEV.: 4372.77
GS ELEV.: 4369.86
LOGGED BY: DCH
HOLE NO.: MW-14

ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
			...Close to moderate spaced fractures from 36 to 59 feet.				92 / 100
4330 — 40					39-49	120/120	
4325 — 45							
4320 — 50					49-59	120/120	75 / 100
4315 — 55							75 / 100
4310 — 60			...Wide spaced fractures from 59.5 to 99 feet.		59.5-69	114/114	
4305 — 65							67 / 100
4300 — 70					69-79	120/120	

Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from from 19 to 99 feet.

DRILL HOLE LOG
DRILL HOLE NO.: MW-14

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C. .
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-003
DATE: 7-15-94
TOC ELEV.: 4372.77
GS ELEV.: 4369.86
LOGGED BY: DCH
HOLE NO.: MW-14

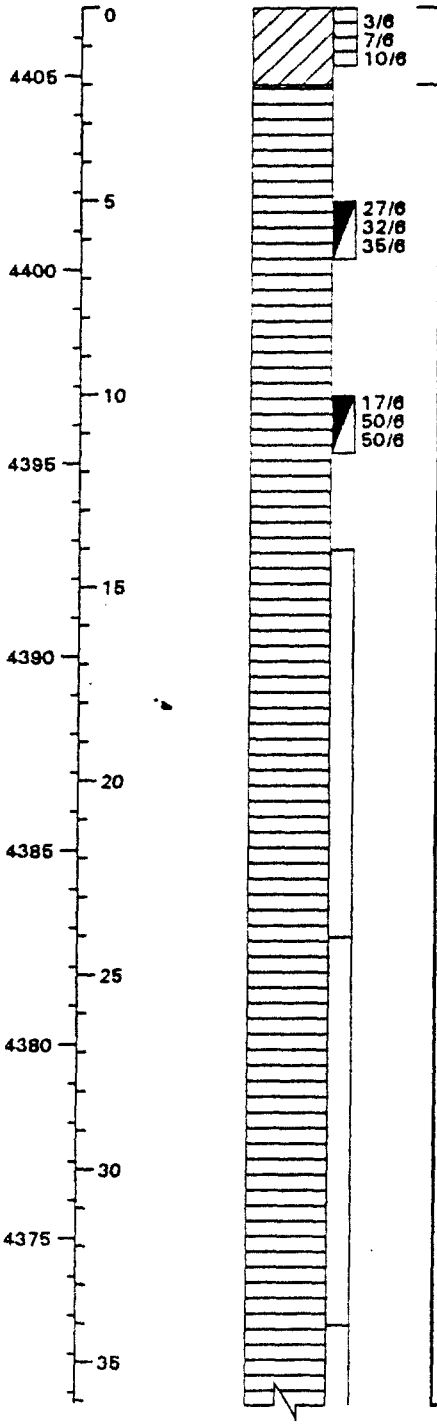
ELEVATION / DEPTH	WELL DETAILS	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4295 – 75							
4290 – 80			...Grades moist to very moist.		79-89	120/120	75 / 100
4285 – 85							
4280 – 90					89-99	120/120	
4275 – 95							
4270 – 100							
4265 – 105							

Hole diameter is 7.75 inches from 0 to 19 feet; and 4.25 inches from from 19 to 99 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-15

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-21-94
TOC ELEV.: NA
GS ELEV.: 4406.79
LOGGED BY: DEW
HOLE NO.: DH-15



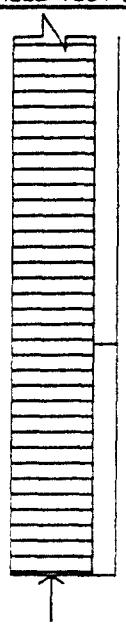
ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
		[CL] SILTY CLAY: Brown, roots, sandy, stiff to very stiff, dry.	CA-1	0-1.5	18/18	
		SHALE: Tan, gypsum in fractures, highly to moderately weathered, moderately hard to hard, dry.				
			B-1	5-6.5	16/18	
			B-2	10-11.5	11/18	
		(Began coring at 14 feet.) ...Gray, wide spaced fractures, fractures are non-intersecting open planes, weathered fresh, dry.		14-24	120/120	
		...Close to moderate spaced fractures from 24 to 44 feet.		24-34	120/120	
				34-44	120/120	

Hole diameter is 7.75 inches from 0 to 14 feet; and 4.25 inches from 14 to 50 feet.

DRILL HOLE LOG
DRILL HOLE NO.: DH-15

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION:
DRILLER: Overland Drilling, Inc.
DRILL RIG: CME 75
DEPTH TO WATER: None

PROJECT NO.: 2106-002
DATE: 6-21-94
TOC ELEV.: NA
GS ELEV.: 4406.79
LOGGED BY: DEW
HOLE NO.: DH-15

ELEVATION / DEPTH	ROCK & SOIL SYMBOLS, SAMPLER SYMBOLS AND FIELD TEST DATA	Description	Sample Number	Sample Depth (ft)	Sample Recovery (in/in)	RQD (%)
4370						
40						
4365						
45		...Close spaced fractures from 44 to 50 feet		44-50	72/72	
4360						
50						
4355						
55						
4350						
60						
4345						
65						
4340						
70						
4335						

Hole diameter is 7.75 inches from 0 to 14 feet; and 4.25 inches from 14 to 50 feet.

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Clayey sand
	Silt gravel
	Shale
	Silty Clay
	Silty sand
Misc. Symbols	
	Boring continues
	Drill hole completion depth
	Water table
Rock and Samplers	
	Standard penetration test (SPT)
	California sampler
	Rock core

Symbol	Description
	Undisturbed thin wall shelby tube
Monitor Well Details	
	Assorted cuttings blank 2" O.D. PVC pipe
	Silica sand 20 slot 2" O.D. PVC pipe.
	Protective well cover set in concrete
	Bentonite cell blank 2" O.D. PVC pipe
	Silica sand blank 2" O.D. PVC pipe
	Silica sand no PVC pipe

KEY TO SYMBOLS

Notes:

1. Drill holes DH-1,2,3,6,8,9,10,12 & 15, and monitor wells MW-2,4,5,7,7A, 13 and 14 were drilled and installed on June 20, 1994 through July 21, 1994. The holes were drill with the use of a CME 750 all-terrian drill rig utilizing 7.75 inch diameter (O.D.) hollow stem argers and an NX core drilling system.

2. Free water was encountered in drilling DH-2, DH-10, MW-2 and MW-5. Water levels were measured on July 22, 1994.

3. RQD percentage based on 12 inch length

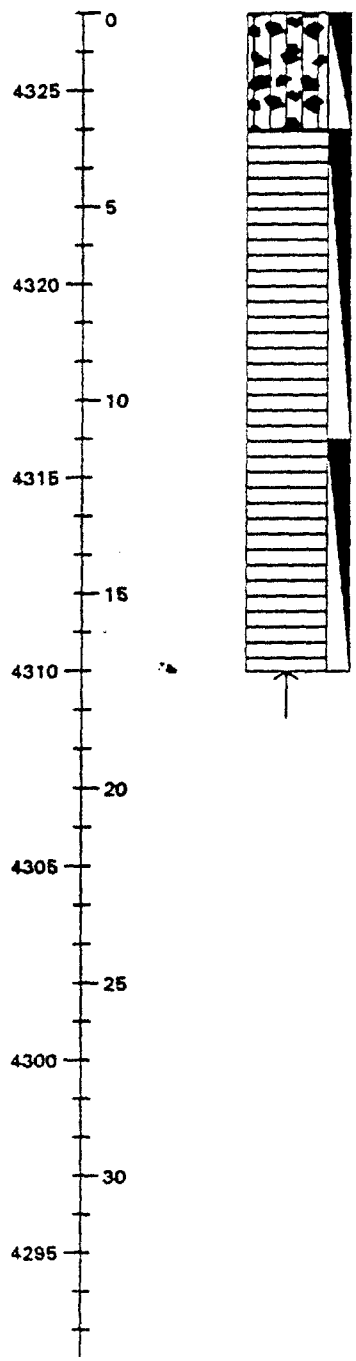
4. These logs are subject to the limitations, conclusions, and recommendations in this report.

7. TEST PIT LOGS

TEST PIT LOG
TEST PIT NO.: TP-1

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4327.0
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/20/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-1

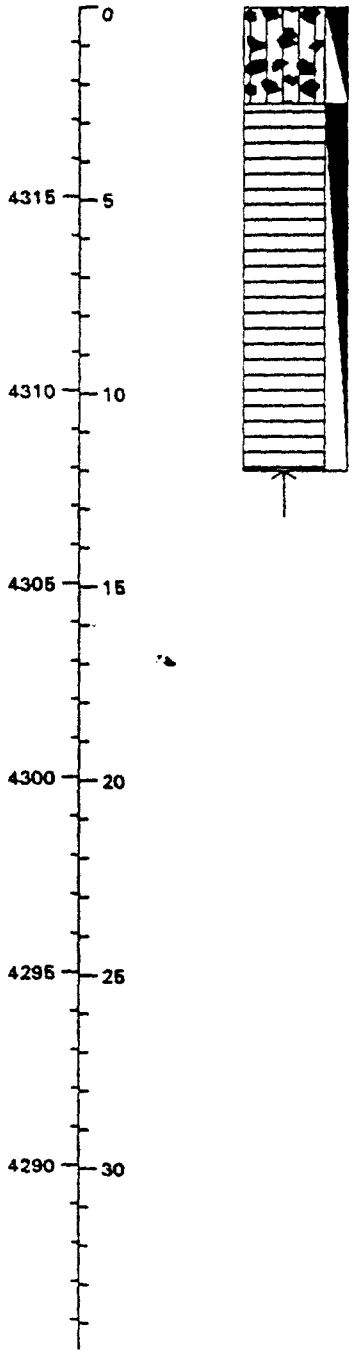


USCS	Description	Sample Number	Sample Depth (ft)
GM	SILTY GRAVEL: Tan, slightly clayey and sandy, dry.	B-1	0 - 3
ROCK	SHALE, weathered, gray-black, dry	B-2	3 - 11
	grades more competent, black, dry to slightly moist	B-3	11 - 17

TEST PIT LOG
TEST PIT NO.: TP-2

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4319.9
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/20/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-2

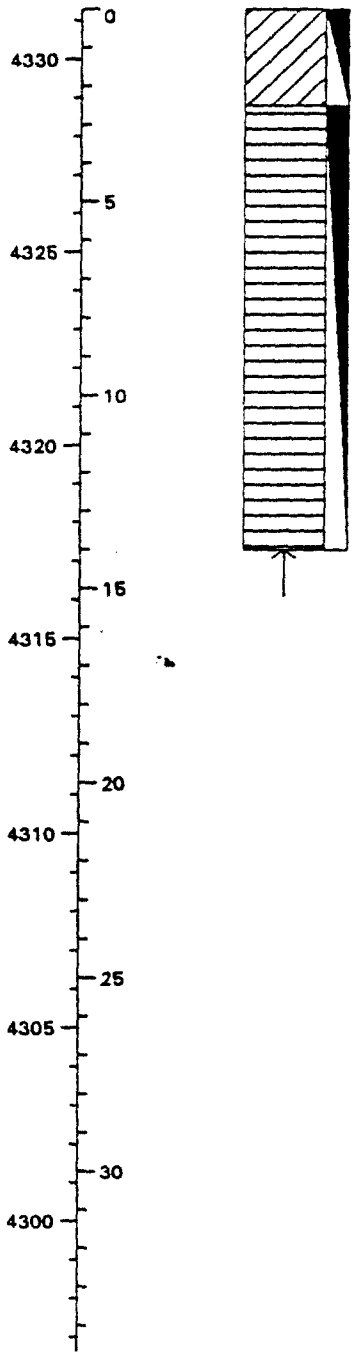


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		GM	SILTY GRAVEL: tan, some sand, dry	B-1	0 - 2.5
		ROCK	SHALE, weathered, gray-black, dry	B-2	2.5 - 12
			grades more competent, black, dry to slightly moist		

TEST PIT LOG
TEST PIT NO.: TP-3

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4331.3
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/20/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-3

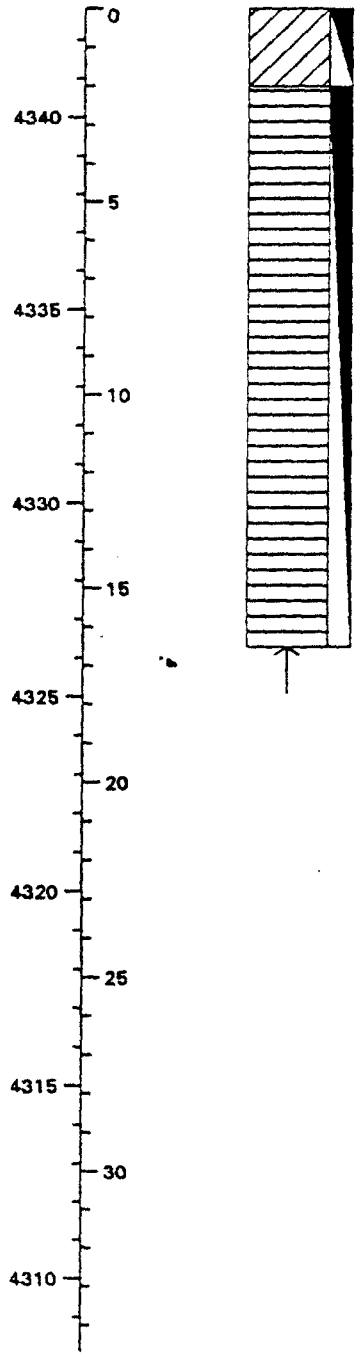


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, dry	B-1	0 - 2.5
		ROCK	SHALE, weathered, gray-black, dry	B-2	2.5 - 14
			vertical joint oriented approx. north-south noted from 5' to 10'		
			grades more competent, black, dry to slightly moist		

TEST PIT LOG
TEST PIT NO.: TP-4

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4342.8
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/20/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-4

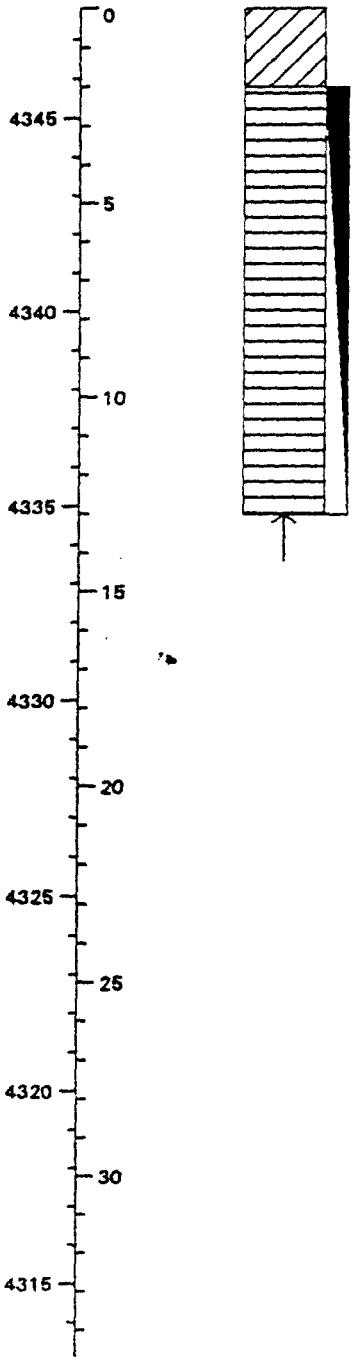


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, root material, dry	B-1	0 - 2
		ROCK	SHALE, weathered, gray-black, dry	B-2	2 - 16.5
			grades more competent, black, dry to slightly moist		

TEST PIT LOG
TEST PIT NO.: TP-5

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4347.8
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/20/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-5

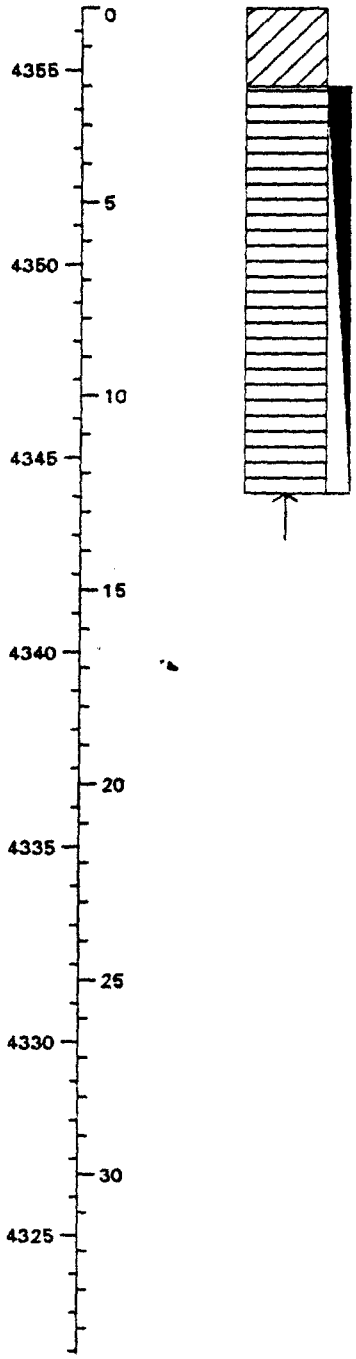


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, root material, dry		
		ROCK	SHALE, weathered, gray-black, dry	B-1	2 - 13
			grades more competant, black, dry to sightly moist		

TEST PIT LOG
TEST PIT NO.: TP-6

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4356.6
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-6

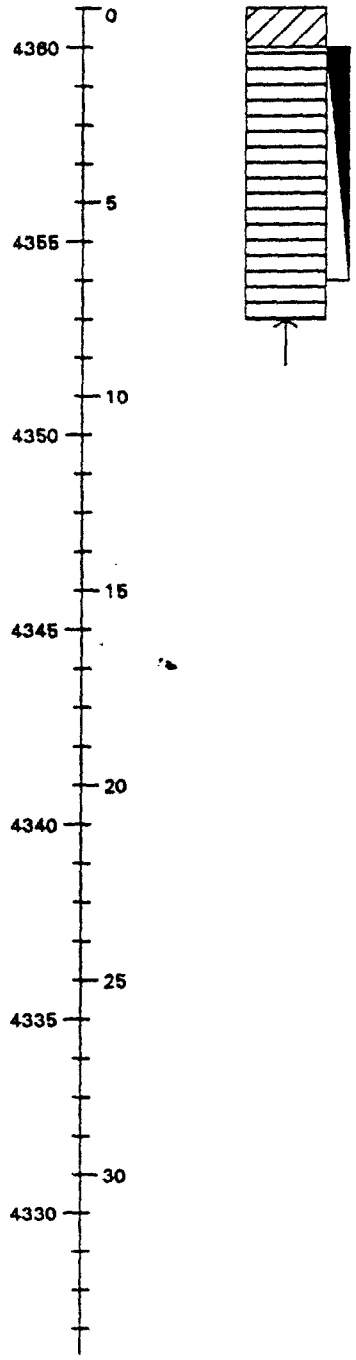


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, root material, dry		
		ROCK	SHALE, weathered, gray-black, dry hard layer 6" thick	B-1	2 - 12.5
			grades more competant, black, dry to sightly moist		

TEST PIT LOG
TEST PIT NO.: TP-7

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4361.0
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-7

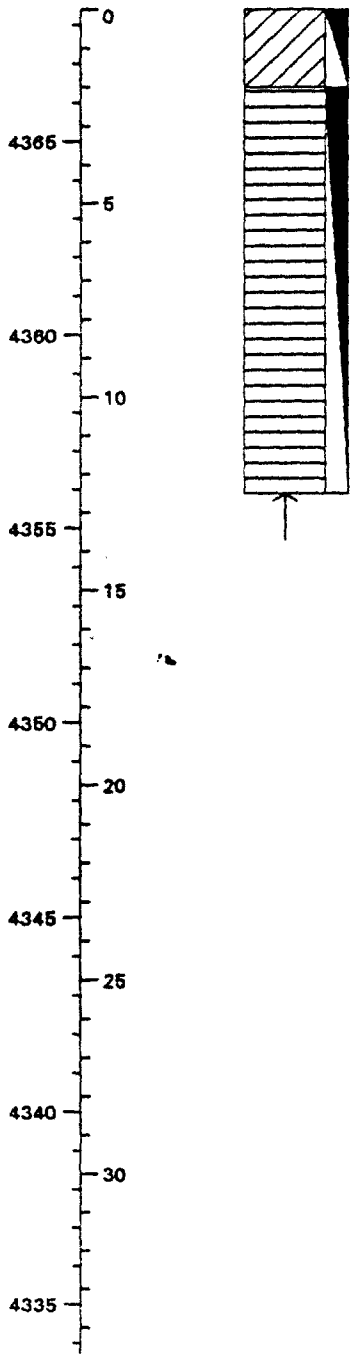


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, dry		
		ROCK	SHALE, weathered, gray-black, dry	B-1	2 - 8
			grades more competant, black, dry to sightly moist		

TEST PIT LOG
TEST PIT NO.: TP-8

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4368.4
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-8

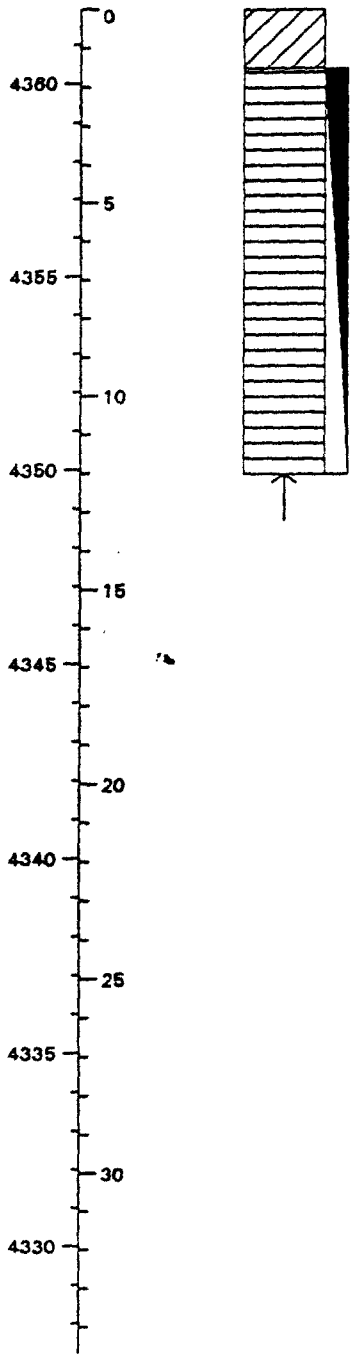


USCS	Description	Sample Number	Sample Depth (ft)
CL	SILTY CLAY: tan, dead organic matter, shale flakes, some sand, dry	B-1	0 - 2
ROCK	SHALE, gray-black, dry to slightly moist	B-2	2 - 12.5
	vertical joint oriented approx. north-south from 2' depth to bottom of pit		

TEST PIT LOG
TEST PIT NO.: TP-9

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4361.9
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-9

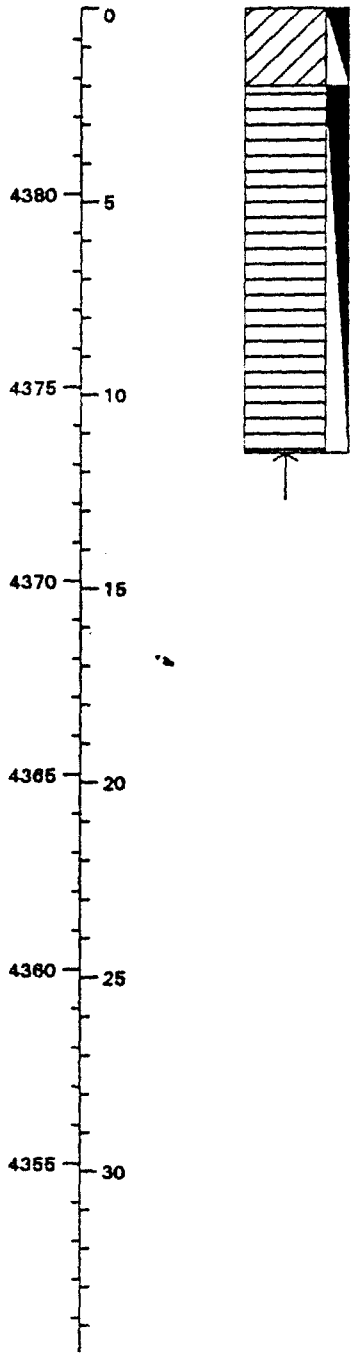


USCS	Description	Sample Number	Sample Depth (ft)
CL	SILTY CLAY: tan, root material, dry		
ROCK	SHALE, gray-black, dry to slightly moist	B-1	1.5 - 12

TEST PIT LOG
TEST PIT NO.: TP-10

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4384.8
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-10

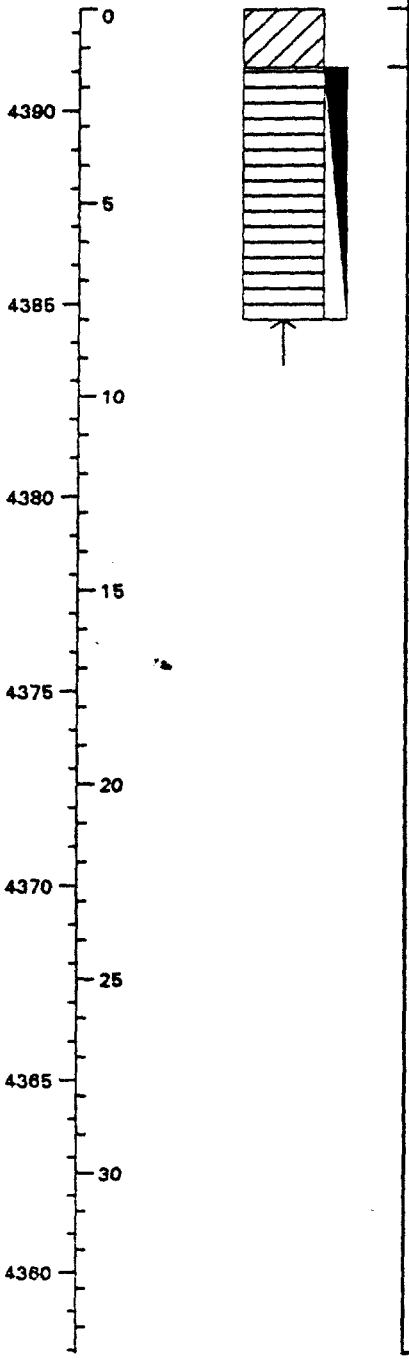


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, some sand, thin layer of gravel on surface, dry	B-1	0 - 2
		ROCK	SHALE, gray-black, dry to slightly moist, breaks into small fragments	B-2	2 - 11.5

TEST PIT LOG
TEST PIT NO.: TP-11

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4392.6
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-11

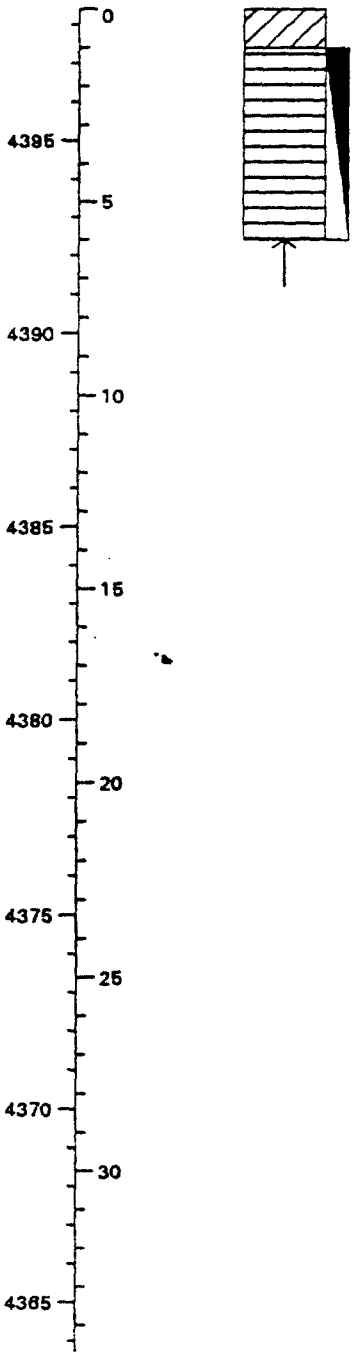


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, some sand, root material, dry		
		ROCK	SHALE, gray-black, dry to slightly moist, blocky, breaks into blocks 5" to 8" across	B-1	1.5 - 8

TEST PIT LOG
TEST PIT NO.: TP-12

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4398.4
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-12

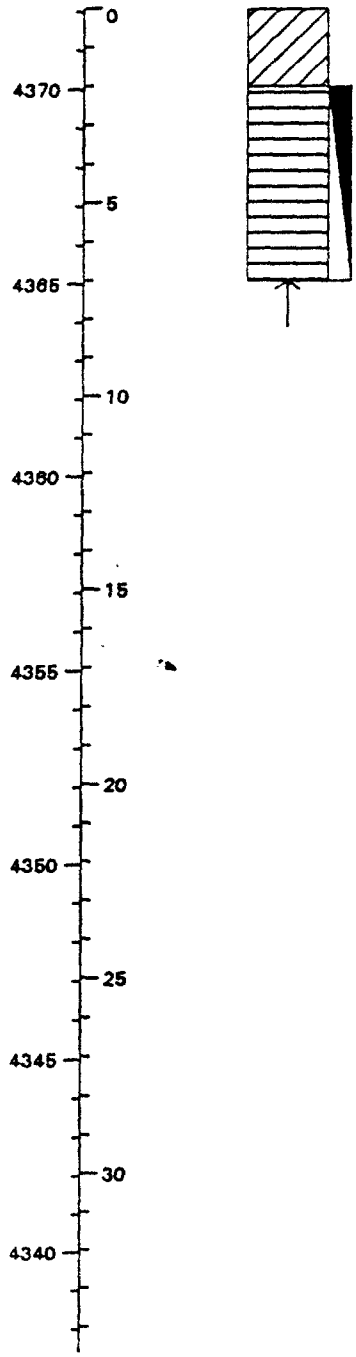


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: tan, dry		
		ROCK	SHALE, gray-black, dry to slightly moist, blocky, blocks 8" to 14" blocks, concave and convex partition surfaces	B-1	1 - 6

TEST PIT LOG
TEST PIT NO.: TP-13

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4372.1
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-13

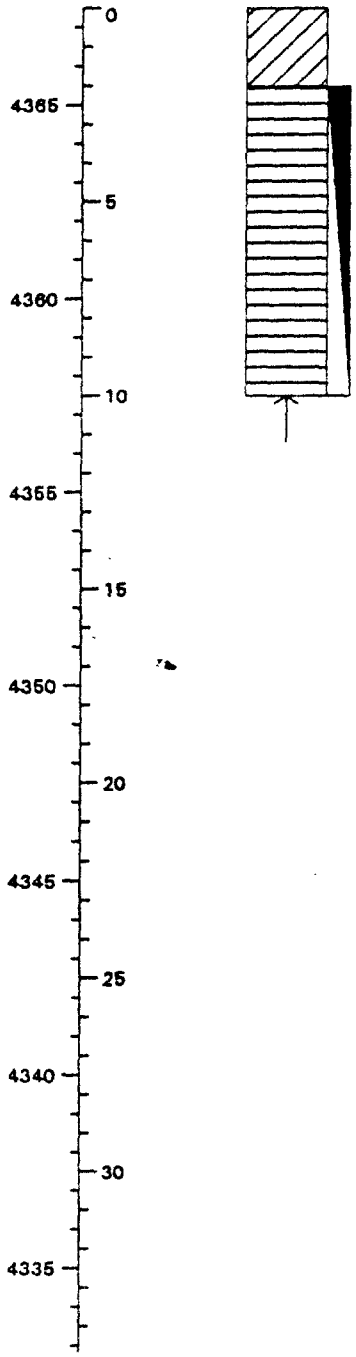


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: gray-brown, root matter, dry		
		ROCK	SHALE, gray-black, dry to slightly moist, blocky	B-1	2 - 7

TEST PIT LOG
TEST PIT NO.: TP-14

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4367.5
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-14

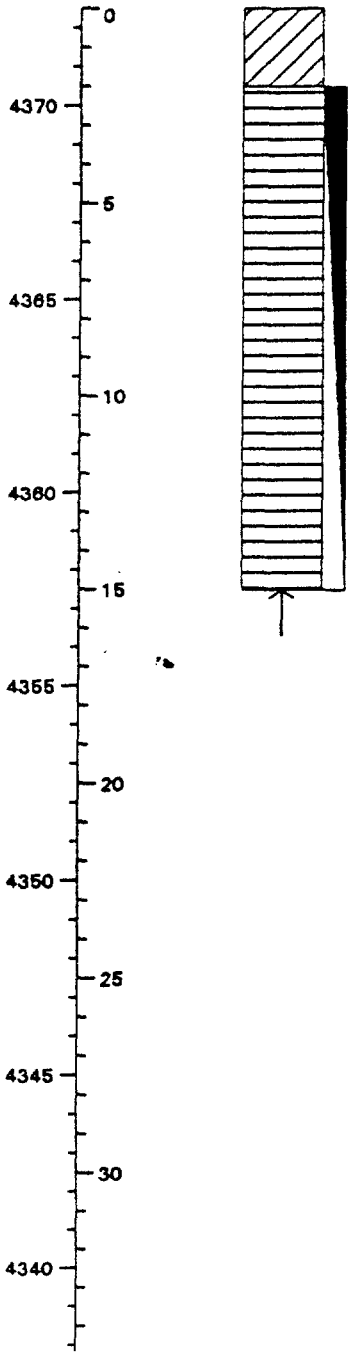


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: gray-brown, dry		
		ROCK	SHALE, gray-black, dry to slightly moist, breaks into small blocks	B-1	2 - 10

TEST PIT LOG
TEST PIT NO.: TP-15

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4372.5
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-15

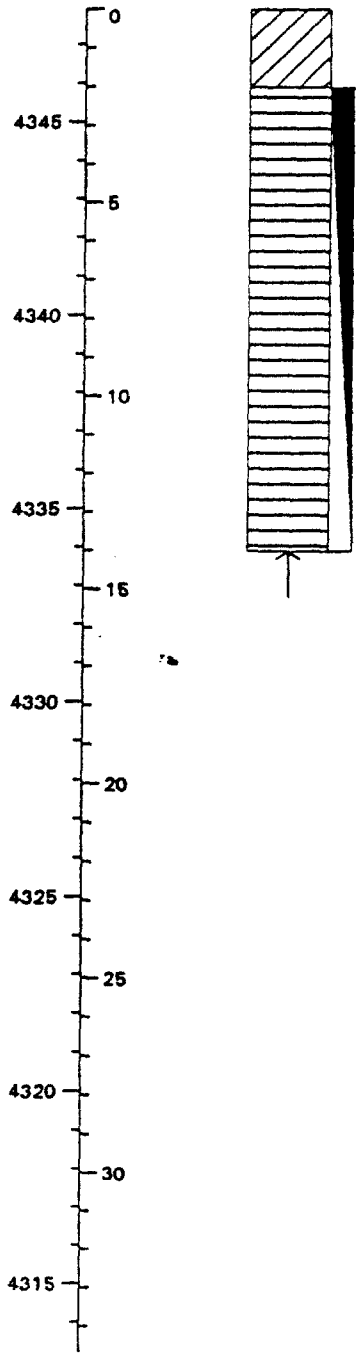


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: gray-brown, dry		
			orange layer of weathered shale 4" thick		
		ROCK	SHALE, gray-black, dry to slightly moist, breaks into 1" to 4" blocks	B-1	2 - 15
			grades more competant with 6" to 12" blocks		

TEST PIT LOG
TEST PIT NO.: TP-16

PROJECT: .Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4347.9
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-16

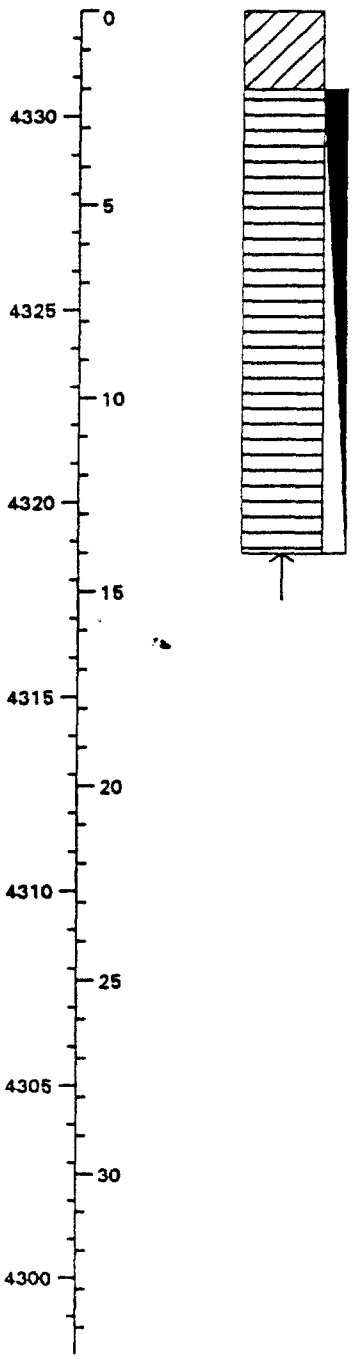


ELEVATION / DEPTH	SOIL SYMBOLS, SAMPLER SYMBOLS, AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth (ft)
		CL	SILTY CLAY: gray-brown, shale fragments, dry		
		ROCK	SHALE, gray-black, dry to slightly moist	B-1	2 - 14
			large joint visible on northeast wall of trench oriented approx. north-south, extends from 2' to bottom of pit		

TEST PIT LOG
TEST PIT NO.: TP-17

PROJECT: Green River Landfill
CLIENT/OWNER: Green River Landfill L.L.C.
LOCATION: N/A
EQUIPMENT: TRACKHOE
GS ELEV.: 4332.7
DEPTH TO WATER: N/A

PROJECT NO.: 2106-002
DATE: 6/21/94
LOGGED BY: KBC
PIT WIDTH: 3 ft
PIT LENGTH: 10 ft
TEST PIT NO.: TP-17



USCS	Description	Sample Number	Sample Depth (ft)
CL	SILTY CLAY: gray-brown, shale fragments, dry		
ROCK	SHALE, gray-black, dry to slightly moist, blocky, blocks 1" to 6" across	B-1	2 - 14

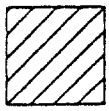
KEY TO SYMBOLS

Symbol	Description

Strata symbols

Silty gravel

Shale



Silty clay

Variable gravel
and silty sand
mix

Well graded gravel

Misc. Symbols

↑ Drill hole completion depth

Soil Samplers

Bulk/Grab sample

Notes:

1. Test pits were excavated on June 20 and 21, 1994 using a track-mounted backhoe.

2. No free water was encountered at the time of excavation.

3. These logs are subject to the limitations, conclusions, and recommendations in this report.

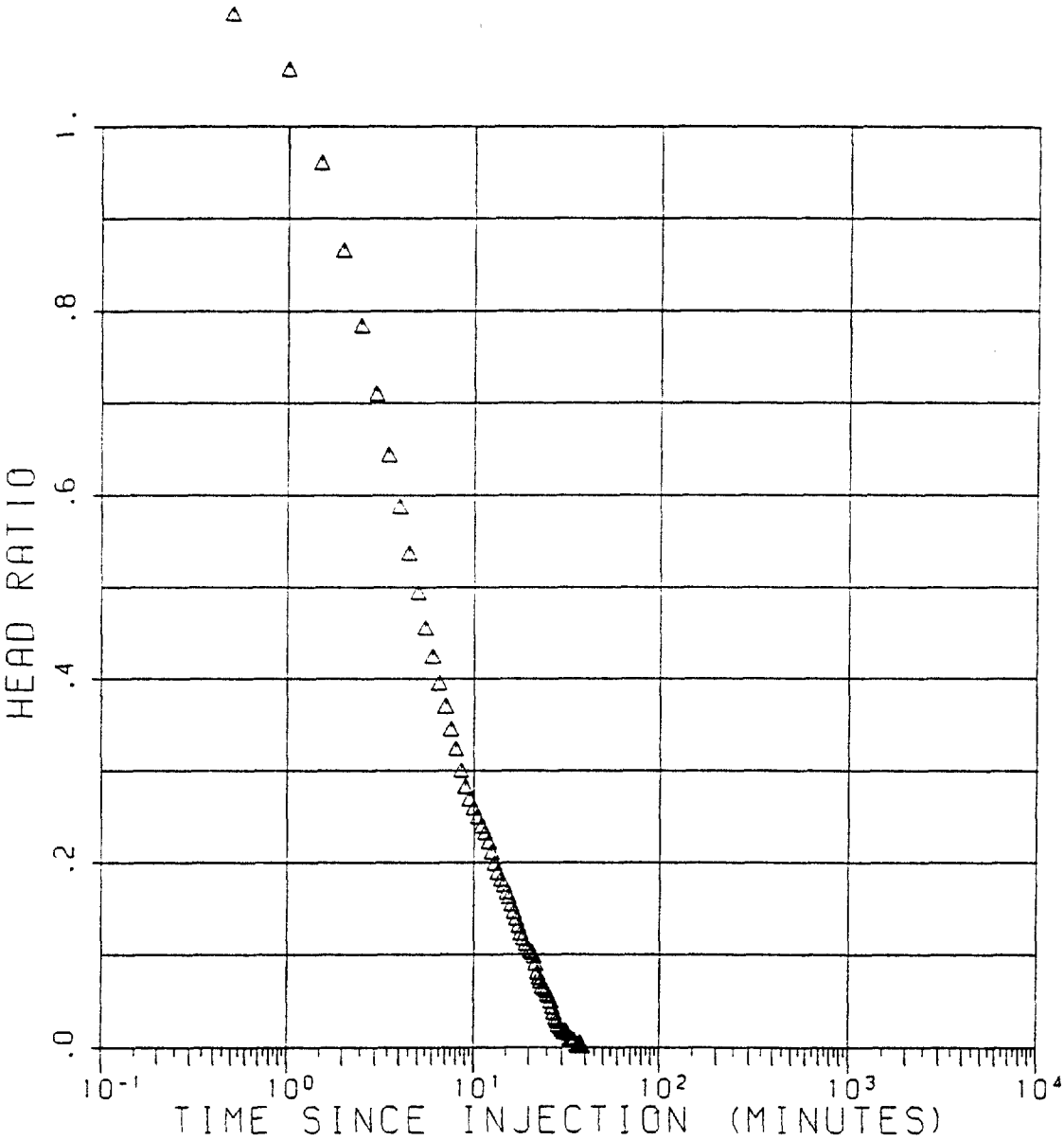
WELL # MW-5

WELL DIAMETER= 4.25 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= .84 GALLONS
LENGTH OF AQUIFER TESTED= 60.00 FEET
VALUE OF H0= 5.15 FEET
STATIC WATER LEVEL= 5.39 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.50	11.17	5.78	1.123	2.000
1.00	10.86	5.47	1.063	1.000
1.50	10.34	4.95	.962	.667
2.00	9.85	4.46	.866	.500
2.50	9.43	4.04	.785	.400
3.00	9.05	3.66	.711	.333
3.50	8.71	3.32	.645	.286
4.00	8.42	3.03	.589	.250
4.50	8.16	2.77	.538	.222
5.00	7.94	2.55	.495	.200
5.50	7.74	2.35	.457	.182
6.00	7.58	2.19	.425	.167
6.50	7.43	2.04	.396	.154
7.00	7.30	1.91	.371	.143
7.50	7.17	1.78	.346	.133
8.00	7.06	1.67	.324	.125
8.50	6.94	1.55	.301	.118
9.00	6.85	1.46	.284	.111
9.50	6.78	1.39	.270	.105
10.00	6.73	1.34	.260	.100
10.50	6.68	1.29	.251	.095
11.00	6.63	1.24	.241	.091
11.50	6.59	1.20	.233	.087
12.00	6.54	1.15	.223	.083
12.50	6.48	1.09	.212	.080
13.00	6.42	1.03	.200	.077
13.50	6.37	.98	.190	.074
14.00	6.33	.94	.183	.071
14.50	6.30	.91	.177	.069
15.00	6.26	.87	.169	.067
15.50	6.23	.84	.163	.065
16.00	6.19	.80	.155	.063
16.50	6.15	.76	.148	.061
17.00	6.11	.72	.140	.059
17.50	6.07	.68	.132	.057
18.00	6.03	.64	.124	.056
18.50	6.00	.61	.119	.054
19.00	5.97	.58	.113	.053
19.50	5.95	.56	.109	.051
20.00	5.93	.54	.105	.050
20.50	5.92	.53	.103	.049
21.00	5.90	.51	.099	.048

21.50	5.86	.47	.091	.047
22.00	5.81	.42	.082	.045
22.50	5.78	.39	.076	.044
23.00	5.76	.37	.072	.043
23.50	5.73	.34	.066	.043
24.00	5.72	.33	.064	.042
24.50	5.71	.32	.062	.041
25.00	5.69	.30	.058	.040
25.50	5.68	.29	.056	.039
26.00	5.65	.26	.051	.038
26.50	5.62	.23	.045	.038
27.00	5.59	.20	.039	.037
27.50	5.56	.17	.033	.036
28.00	5.54	.15	.029	.036
28.50	5.52	.13	.025	.035
29.00	5.51	.12	.023	.034
29.50	5.50	.11	.021	.034
30.00	5.49	.10	.019	.033
30.50	5.48	.09	.017	.033
31.00	5.48	.09	.017	.032
31.50	5.48	.09	.017	.032
32.00	5.47	.08	.016	.031
32.50	5.45	.06	.012	.031
33.00	5.44	.05	.010	.030
33.50	5.44	.05	.010	.030
34.00	5.43	.04	.008	.029
34.50	5.43	.04	.008	.029
35.00	5.43	.04	.008	.029
35.50	5.41	.02	.004	.028
36.00	5.40	.01	.002	.028
36.50	5.41	.02	.004	.027
37.00	5.41	.02	.004	.027
37.50	5.42	.03	.006	.027
38.00	5.41	.02	.004	.026
38.50	5.40	.01	.002	.026
39.00	5.39	.00	.000	.026



SLUG TEST OF WELL MW-5

HEAD RATIO VS LOG TIME

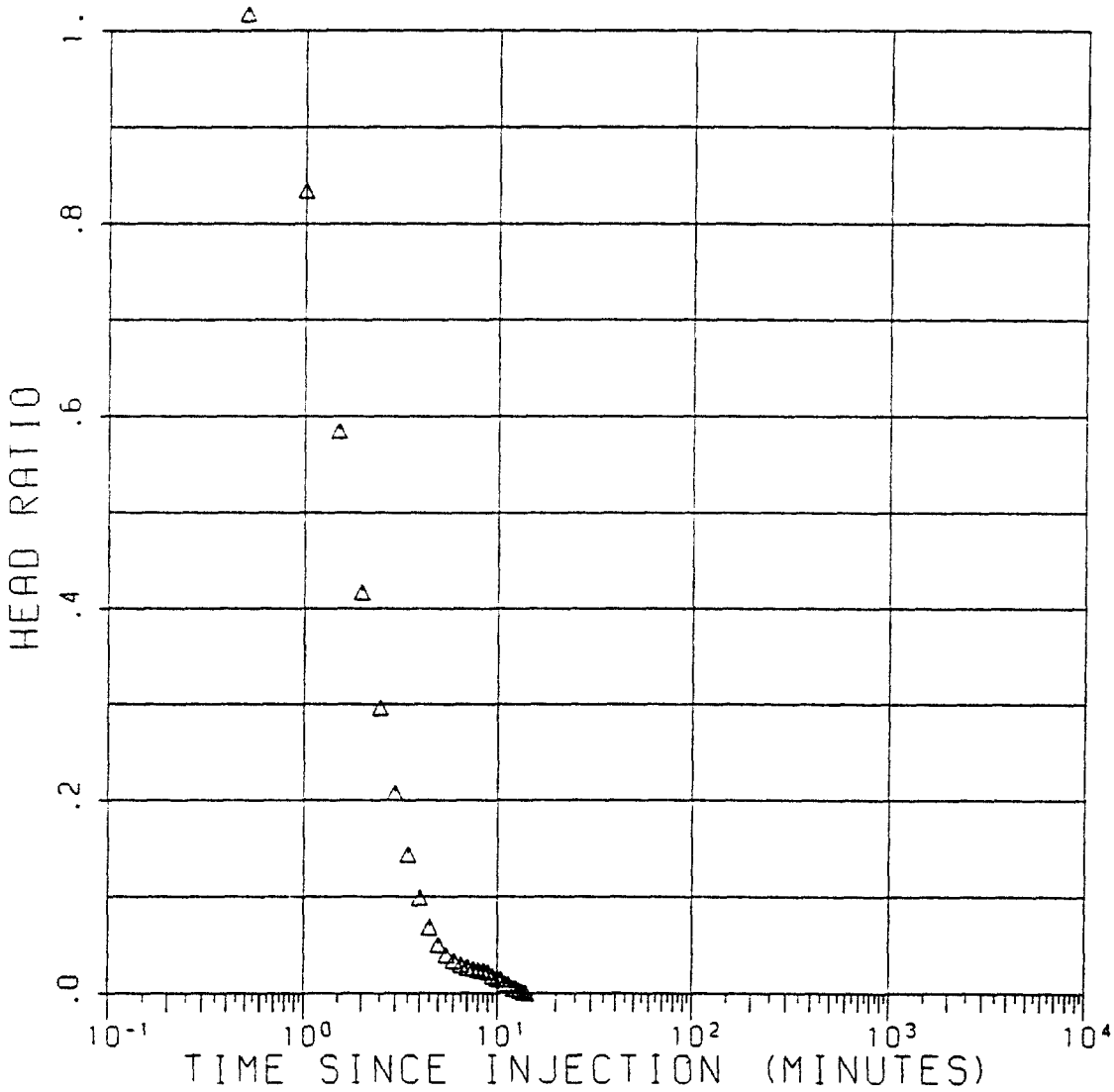
8. SLUG TESTS

WELL # MW-2

WELL DIAMETER= 4.25 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 2.60 GALLONS
LENGTH OF AQUIFER TESTED= 75.00 FEET
VALUE OF H0= 15.93 FEET
STATIC WATER LEVEL= 2.75 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.50	18.97	16.22	1.018	2.000
1.00	16.05	13.30	.835	1.000
1.50	12.08	9.33	.586	.667
2.00	9.40	6.65	.417	.500
2.50	7.48	4.73	.297	.400
3.00	6.06	3.31	.208	.333
3.50	5.04	2.29	.144	.286
4.00	4.33	1.58	.099	.250
4.50	3.85	1.10	.069	.222
5.00	3.56	.81	.051	.200
5.50	3.39	.64	.040	.182
6.00	3.29	.54	.034	.167
6.50	3.23	.48	.030	.154
7.00	3.18	.43	.027	.143
7.50	3.15	.40	.025	.133
8.00	3.13	.38	.024	.125
8.50	3.12	.37	.023	.118
9.00	3.10	.35	.022	.111
9.50	3.04	.29	.018	.105
10.00	3.00	.25	.016	.100
10.50	2.98	.23	.014	.095
11.00	2.91	.16	.010	.091
11.50	2.90	.15	.009	.087
12.00	2.83	.08	.005	.083
12.50	2.83	.08	.005	.080
13.00	2.79	.04	.003	.077
13.50	2.77	.02	.001	.074
14.00	2.76	.01	.001	.071
14.50	2.75	.00	.000	.069



SLUG TEST OF WELL MW-2

HEAD RATIO VS LOG TIME

APPENDIX E HELP MODELING RESULTS

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**           HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                     **
**            DEVELOPED BY ENVIRONMENTAL LABORATORY                         **
**             USAE WATERWAYS EXPERIMENT STATION                            **
**         FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                          **
**                                                                          **
******************************************************************************
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```

PRECIPITATION DATA FILE: C:\HELP3\PRECIP8C.D4
TEMPERATURE DATA FILE: C:\HELP3\TEMP8C.D7
SOLAR RADIATION DATA FILE: C:\HELP3\RAD8C.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\EVAP8C.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\SOIL8C.D10
OUTPUT DATA FILE: C:\HELP3\OUT C 8.OUT

TIME: 22:47 DATE: 8/ 5/2002

****

TITLE: Solitude Landfill -- Green River, Utah -- Closed Case

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4170 VOL/VOL

FIELD CAPACITY = 0.0450 VOL/VOL
WILTING POINT = 0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0974 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10
THICKNESS = 24.00 INCHES
POROSITY = 0.3980 VOL/VOL
FIELD CAPACITY = 0.2440 VOL/VOL
WILTING POINT = 0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1836 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

LAYER 3

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 29
THICKNESS = 18.00 INCHES
POROSITY = 0.4510 VOL/VOL
FIELD CAPACITY = 0.4190 VOL/VOL
WILTING POINT = 0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.680000028000E-06 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18
THICKNESS = 720.00 INCHES
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 29
THICKNESS = 12.00 INCHES
POROSITY = 0.4510 VOL/VOL
FIELD CAPACITY = 0.4190 VOL/VOL
WILTING POINT = 0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.680000028000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 1 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER = 72.40
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 100.000 ACRES
EVAPORATIVE ZONE DEPTH = 30.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 4.991 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 12.054 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 3.372 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 228.761 INCHES
TOTAL INITIAL WATER = 228.761 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM GRAND JUNCTION COLORADO

STATION LATITUDE = 39.07 DEGREES
MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 116
END OF GROWING SEASON (JULIAN DATE) = 288
EVAPORATIVE ZONE DEPTH = 30.0 INCHES

AVERAGE ANNUAL WIND SPEED = 8.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 60.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 36.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 36.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 57.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.40	0.32	0.59	0.50	0.61	0.41
0.57	0.74	0.71	0.87	0.41	0.39

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.90	32.60	42.90	52.40	61.90	71.30
78.50	75.60	65.50	52.90	39.10	27.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO
AND STATION LATITUDE = 39.07 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.33	0.29	0.51	0.54	0.59	0.45

	0.49	0.82	0.59	0.81	0.54	0.32
STD. DEVIATIONS	0.16	0.17	0.23	0.27	0.43	0.48
	0.33	0.37	0.46	0.58	0.35	0.20

RUNOFF

TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION

TOTALS	0.310	0.318	0.417	0.480	0.705	0.491
	0.397	0.671	0.770	0.784	0.575	0.338
STD. DEVIATIONS	0.152	0.146	0.257	0.276	0.502	0.452
	0.321	0.479	0.548	0.665	0.357	0.175

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0008	0.0009	0.0009	0.0005	0.0005
	0.0003	0.0010	0.0009	0.0010	0.0008	0.0003
STD. DEVIATIONS	0.0000	0.0028	0.0011	0.0016	0.0007	0.0011
	0.0003	0.0021	0.0026	0.0020	0.0012	0.0007

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0008	0.0009	0.0009	0.0005	0.0005
	0.0003	0.0010	0.0009	0.0010	0.0008	0.0003
STD. DEVIATIONS	0.0000	0.0028	0.0011	0.0016	0.0007	0.0011
	0.0003	0.0021	0.0026	0.0020	0.0012	0.0007

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000
	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	6.26	(1.028)	2271109.5	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	6.256	(1.0693)	2270784.75	99.986
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00812	(0.00713)	2947.603	0.12979
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00812	(0.00713)	2947.603	0.12979
AVERAGE HEAD ON TOP OF LAYER 5	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.007	(0.3214)	-2623.24	-0.116

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	
PRECIPITATION	0.80	290400.000	
RUNOFF	0.000	0.0000	
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.005388	1955.78467	
AVERAGE HEAD ON TOP OF LAYER 3	0.004		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.005388	1955.78467	
AVERAGE HEAD ON TOP OF LAYER 5	0.002		
SNOW WATER	0.47	170607.0310	

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2077
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1442

****

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	0.2702	0.0450
2	4.5759	0.1907
3	8.1180	0.4510
4	210.2400	0.2920
5	5.4120	0.4510

SNOW WATER 0.000

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****

FIELD CAPACITY = 0.3710 VOL/VOL
WILTING POINT = 0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3505 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.249999994000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18
THICKNESS = 120.00 INCHES
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2735 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 3

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 29
THICKNESS = 12.00 INCHES
POROSITY = 0.4510 VOL/VOL
FIELD CAPACITY = 0.4190 VOL/VOL
WILTING POINT = 0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.680000028000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #14 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER = 96.60
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 2.000 ACRES
EVAPORATIVE ZONE DEPTH = 30.0 INCHES

INITIAL WATER IN EVAPORATIVE ZONE = 6.888 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 18.978 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 3.354 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 40.332 INCHES
TOTAL INITIAL WATER = 40.332 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
GRAND JUNCTION COLORADO

STATION LATITUDE = 39.07 DEGREES
MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 116
END OF GROWING SEASON (JULIAN DATE) = 288
EVAPORATIVE ZONE DEPTH = 30.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 60.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 36.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 36.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 57.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.40	0.32	0.59	0.50	0.61	0.41
0.57	0.74	0.71	0.87	0.41	0.39

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.90	32.60	42.90	52.40	61.90	71.30
78.50	75.60	65.50	52.90	39.10	27.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GRAND JUNCTION COLORADO
AND STATION LATITUDE = 39.07 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.33	0.29	0.51	0.54	0.59	0.45
	0.49	0.82	0.59	0.81	0.54	0.32
STD. DEVIATIONS	0.16	0.17	0.23	0.27	0.43	0.48
	0.33	0.37	0.46	0.58	0.35	0.20
RUNOFF						
TOTALS	0.003	0.000	0.005	0.011	0.043	0.035
	0.035	0.051	0.038	0.072	0.010	0.001
STD. DEVIATIONS	0.008	0.001	0.009	0.018	0.054	0.075
	0.065	0.065	0.054	0.127	0.018	0.005
EVAPOTRANSPIRATION						
TOTALS	0.308	0.337	0.470	0.378	0.515	0.494
	0.414	0.653	0.628	0.793	0.651	0.342
STD. DEVIATIONS	0.151	0.143	0.260	0.144	0.416	0.444
	0.351	0.483	0.494	0.576	0.349	0.164
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0005	0.0011	0.0055	0.0017	0.0016	0.0055
	0.0059	0.0041	0.0011	0.0018	0.0016	0.0010
STD. DEVIATIONS	0.0023	0.0023	0.0157	0.0027	0.0026	0.0184
	0.0201	0.0121	0.0016	0.0029	0.0022	0.0017

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001
	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0002	0.0000	0.0000	0.0002
	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	6.26	(1.028)	45422.2	100.00
RUNOFF	0.304	(0.1677)	2209.71	4.865
EVAPOTRANSPIRATION	5.981	(1.1320)	43422.56	95.598
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.03130	(0.07444)	227.209	0.50022
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.060	(0.5446)	-437.30	-0.963

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	
PRECIPITATION	0.80	5808.000	
RUNOFF	0.273	1983.5400	
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.012390	89.94880	
AVERAGE HEAD ON TOP OF LAYER 3	0.004		
SNOW WATER	0.47	3412.1404	

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2447
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1518

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.6205	0.2701
2	32.0952	0.2675
3	5.4120	0.4510
SNOW WATER	0.000	

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APPENDIX F SUPPORTING DOCUMENTATION

Needs Assessment Report

Permitting the Solitude Class V Landfill

Green River, Utah

April 16, 2003

Prepared for:

Green River Landfill, LLC
4570 Westgrove Drive, Suite 240
Addison, Texas 75001
(972) 407-0701

Infill Companies
2825 East Cottonwood Parkway, Suite 500
Salt Lake City, Utah 84121
(801) 990-3456

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**                                                                          **
**                                                                          **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**           HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                     **
**            DEVELOPED BY ENVIRONMENTAL LABORATORY                         **
**             USAE WATERWAYS EXPERIMENT STATION                            **
**         FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\HELP3\PRECIP8O.D4
TEMPERATURE DATA FILE:      C:\HELP3\TEMP8O.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\RAD8O.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\EVAP8O.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\SOIL8O.D10
OUTPUT DATA FILE:           C:\HELP3\OUT O 8.OUT


TIME:  22:43    DATE:  8/ 5/2002


******************************************************************************

   TITLE:  Solitude Landfill -- Green River, Utah -- Open Case

******************************************************************************


   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                    LAYER  1
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           TYPE 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER  14
     THICKNESS              =     6.00  INCHES
     POROSITY               =     0.4790 VOL/VOL
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Index

1. Executive Summary Page 3

2. Introduction and Background Page 4

3. Compliance to State Statute 19-6-108 (10) Page 5

4. Narrative Page 9

5. Conclusions Page 14

6. References Page 16

1. Executive Summary

The Utah solid waste industry is clearly following the national and global trend of fewer but larger remote, disposal sites (megafills), which are owned and operated by profitable private sector entities. The March 13, 2003 request for proposal (RFP) initiated by all of the municipal solid waste (MSW) generators along the Wasatch Front reflects a real need for competition to keep the MSW market healthy.

The Solitude Landfill will provide public sector clients new innovative and efficient methods of handling and transport including access to equipment and technologies not offered or utilized by other local or nation disposal facilities. The public sector administrator will be able to select from a menu of services, equipment and options for disposal that have not been offered in the local or national MSW market before.

The Solitude landfill is located in a remote, secluded area that is accessed by both rail and surface sources. More importantly it is in a unique siting that provides exceptional benefits in low annual precipitation, high evaporation, a geological strata with little or poor quality ground water and a barrier to groundwater of over 1,100 feet of dense Mancos shale.

When considering permitting requirements the Department of Environmental Quality, Division of Hazardous Waste (DEQ) concluded that Solitude qualified for an alternative cell design that does not require groundwater monitoring or leacheat collection. Because of the favorable siting the operating, closure and post closure monitoring requirements are very cost efficient translating into significant cost savings for both public and private sector clients.

2. Background

Infill Companies (Infill) was contracted by Green River Landfill, LLC to perform a Needs Assessment for the permitting of the Solitude Class V Landfill located in the City of Green River, Emery County, Utah. The basis for this assessment complies with the requirements outlined in 19-6-108 (10) of the Utah Code, Annotated.

The Solitude Landfill is currently permitted by the Department of Environmental Quality, Division of Solid and Hazardous Waste as a Class I Landfill (#0201) based on a Municipal Solid Waste Contract (MSW) with the City of Green River. The Class V designation will allow Solitude to capitalize on additional sources of MSW both within and outside of the State of Utah.

Information contained in this assessment comes from a variety of sources including correspondence, telephone calls and meetings with MSW generators in Utah and locations throughout the United States. Information gathered during the research include telephone conversations, personal meetings, written reports, technical papers, policy studies, state, county and municipal records, waste inventory reports and internet searches.

3. Compliance to State Statute 19-6-108-(10)

19-6-108-(10)

a. Evidence that the proposed commercial facility has a proven market of nonhazardous solid or hazardous waste including:

i. Information on the sources, quantity, and price charged for treating, storing, and disposing of potential nonhazardous solid or hazardous waste in the state and regionally

Response:

1. Utah municipal solid waste (MSW) tonnage in 2001 was 2,467,915[1] tons with the majority of that total generated on the Wasatch Front (Brigham City to Nephi)
2. Current tip fees at MSW landfills and transfer stations along the Wasatch Front are from $11.00 to $30.00 per ton[2].
3. *Envision Utah* project that in 2020 growth along the Wasatch Front will add an additional 1 million Utah residents[3]
4. Current per person generation of MSW is 5.97 lb/person/day[4] or an additional 1.1 million tons of MSW by 2020
5. Currently approximately 600,000[5] tons of the Utah MSW waste stream is transported to one Class V commercial landfill with an additional 65,844 tons from out of state sources.
6. In state MSW tip fees at that Class V landfill ranged between $20.00 to $26.00 per ton[6]
7. Nationally the February 2003 MSW totals were 1.082 tons per day[7] (±282,000,000 tons annualized)
8. The February 2003 average tip fee for that tonnage was $36.93 per ton[8]

ii. A market analysis of the need for a commercial facility given existing and potential generation of nonhazardous solid or hazardous waste in the state and regionally and

Response:

1. Addressing landfill site needs along the Wasatch Front, DEQ's *Utah Solid Waste Plan Update, March 2002* states: ***"As the population has increased the need for more disposal volume and the need for alternatives to disposal***

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[1] Department of Environmental Quality, Division of Solid & Hazardous Waste, *Utah Landfill Inventory* March 2002.
[2] Conversations with administrators of MSW facilities along the Wasatch Front during 2002 and 2003.
[3] www.envisionutah.org/Frame-3.htm
[4] Department of Environmental Quality, Division of Solid and Hazardous Waste, *Utah Solid Waste Plan Update*, March 2002 page 2
[5] Department of Environmental Quality, Division of Solid & Hazardous Waste, *Utah Landfill Inventory* March 2002.
[6] Conversations with administrators of MSW facilities along the Wasatch Front during 2002 and 2003.
[7] Chartwell Solid Waste Market Data & Research, www.wasteinfo.com April 10, 2003
[8] Ibid

has become apparent. Siting of new landfills becomes more difficult as population grows and availability of land that is suited for landfill siting is limited by encroaching housing and other land uses[9]"

2. Privatization, out-sourcing and exporting of MSW continues to be both the local and national trend for municipal landfills.
3. In 2000 the number of landfill that accepted MSW decreased to 1,967 while the average landfill size increased.[10]
4. In 1999 only 13 of the 30 largest cities in the US owned a MSW landfill[11]
5. Three of the 13 cities had or were in the process of privatization.

iii. A review of other existing and proposed commercial nonhazardous solid or hazardous waste facilities regionally and nationally that would compete for the treatment, storage or disposal of the nonhazardous solid or hazardous waste;

Response:

1. Nationally a study of commercial landfill managers conducted in 2000 showed that the 11 'major players' accounted for disposal of less than 45% of the MSW waste stream [12]
2. No 'major player' controlled more than 23% of the market share.[13]
3. Over fifty-seven percent of the total MSW waste stream is handled by non-major players[14]

b. Public Benefits of the Proposed Facility

i. The need in the state for additional capacity for the management of nonhazardous solid or hazardous waste:

Response:

1. Availability of currently permitted disposal area cannot be the only criteria for evaluation of competition. This narrow evaluation method eliminates technology advancements, developments in handling methods, efficiencies in transportation and more cost efficient siting locations.
2. Government cannot allow only one provider of services to be permitted by a state agency.
3. The essential element of competition is eliminated allowing the monopolist to ignore market conditions, customer's needs and advancement in technology.
4. A monopoly has historically always led to excessive profits and operational complacency.

---

[9] Department of Environmental Quality, Division of Solid and Hazardous Waste, *Waste Plan Update*, March 2002 page 7

[10] United States Environmental Protection Agency *Municipal Solid Waste in the United States: 2000 Fact and Figures*, June 2002, page 14

[11] City of Houston, Public Works and Engineering Department, *Survey of Large Cities' Solid Waste Management Systems*, revised April 1999

[12] Reason Public Policy Institute *Privatizing Landfills: Market Solutions for Solid-Waste Disposal* May 2000 page 7

[13] ibid

[14] ibid

5. Historical growth patterns and population projections indicate that the need for MSW disposal will increase faster in Utah than on a national basis.
6. A coalition of all MSW generators along the Wasatch Front recently released an RFP seeking consultant services to evaluate existing and planned solid waste disposal sites in Utah.
7. An additional rural, environmentally friendly, geologic sound and economical based landfill will provide an alternative to the one option currently available in the state.
8. Liability will be greatly reduced as MSW will not be co-mingled with other forms and sources of waste currently being accepted in the only competing Class V landfill.
9. Strict adherence to sources and types of waste will reduce the need for environmental liability and costly remediation.
10. Preservation of existing capacity in regional municipal landfills is an immediate benefit for the permitting of the Solitude Class V Landfill.

ii. the energy and resources recoverable by the proposed facility:

Response:

1. Bale fill resources and technology will be offered to MSW generators.
2. Bale fill is a more efficient technology as the waste is compacted only once reducing significant energy and labor consumption at the transfer station, during transport and within the landfill.
3. Because of the extremely dry climate and soil conditions at Solitude, bale fill will provide a renewable source of energy for future generation.
4. Bale fill technology at the transfer station and at Solitude will help reduce handling and operational expenses.
5. Bale fill will provide heaver weight for each train car and therefore reduce energy consumption and expense during transport.

iii. The reduction of nonhazardous solid or hazardous waste management methods, which are less suitable for the environment, that would be made possible by the proposed facility;

Response:

1. Solitude is located on a unique parcel of land that has no wells and no surface or subsurface water sources. Isolated perched water is rare and when encountered has high levels of total dissolved solids (TDS) values ranging from 9,400 to 30,000 mg/l.
2. Mancos Shale underlies Solitude at least 1,100 feet thick below the surface. Permeability values for the Mancos Shale are in the range of 10 to the -7 and 10 to the -13 cm. sec.
3. The climate is very dry with average annual precipitation of 6.5 inches and evaporation of approximately 56 inches.

4. These conditions ensure that *if* any leacheat is produced and migrates into the soil the transfer will be on the order of hundredths to thousandths of an inch per year.
5. If a release did reach a subsurface source of water over eons of years there would be no negative affect to the water.

iv. whether any other available site or method for the management of hazardous waste would be less detrimental to the public health or safety or to the quality of the environment;

Response:

1. We are not requesting a hazardous waste permit.

c. compliance history of an owner or operator of a proposed commercial nonhazardous solid or hazardous waste treatment, storage, or disposal facility, which may be applied by the executive secretary in a nonhazardous solid or hazardous waste operation plan decision, including any plan conditions.

Response:

1. The principals of the owner and operator have never been found in violation of any EPA or state waste regulations. Attached please find experience résumé's outlining non-hazardous and hazardous waste management, treatment, and disposal experience.

CLASS II LANDFILL DESIGN AND CONSTRUCTION PHASE I

Start Date: June 1989
Completion Date: October 1992

PROJECT DESCRIPTION

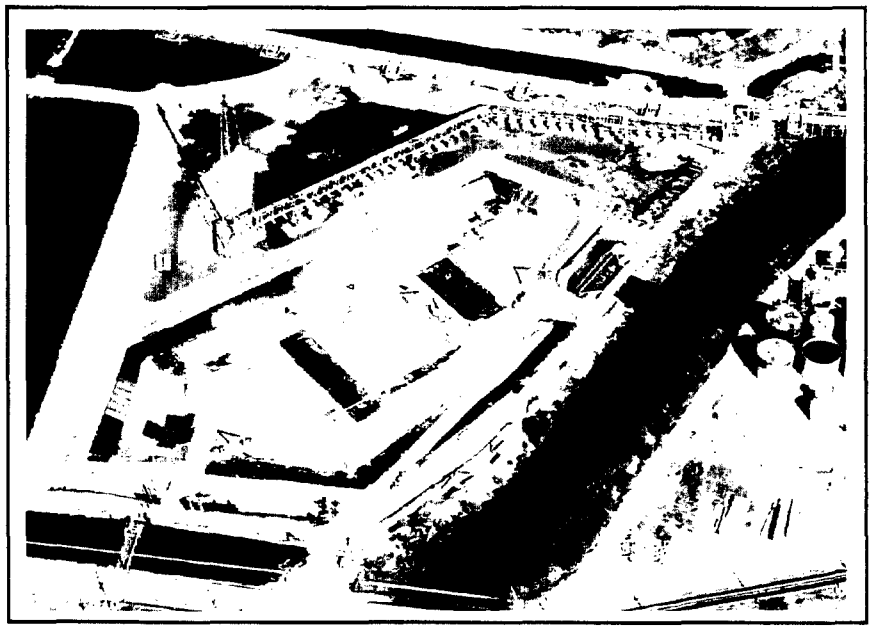
This project involved the excavation, removal and transportation of approximately 145,000 cubic yards of spent clay waste material and the development of a 400,000 cubic yard capacity Class II Landfill. The first challenge of the project was the removal of the existing waste from the planned Class II Landfill area. The material was excavated and deposited in an adjacent landfill area for future remediation by ITEX. This task was accomplished with the combination of specially constructed waste transfer pumps and long reach excavation equipment that worked from flotation units in the impoundment. During the construction of this project, ITEX negotiated with the regulatory agency for an "in-place" liner designation. The result of this "in-place" liner designation and engineering documentation by ITEX was a net savings to the client of $1,040,000.00. Phase I of the Class II Landfill was completed and received its first Class II waste in July of 1989.

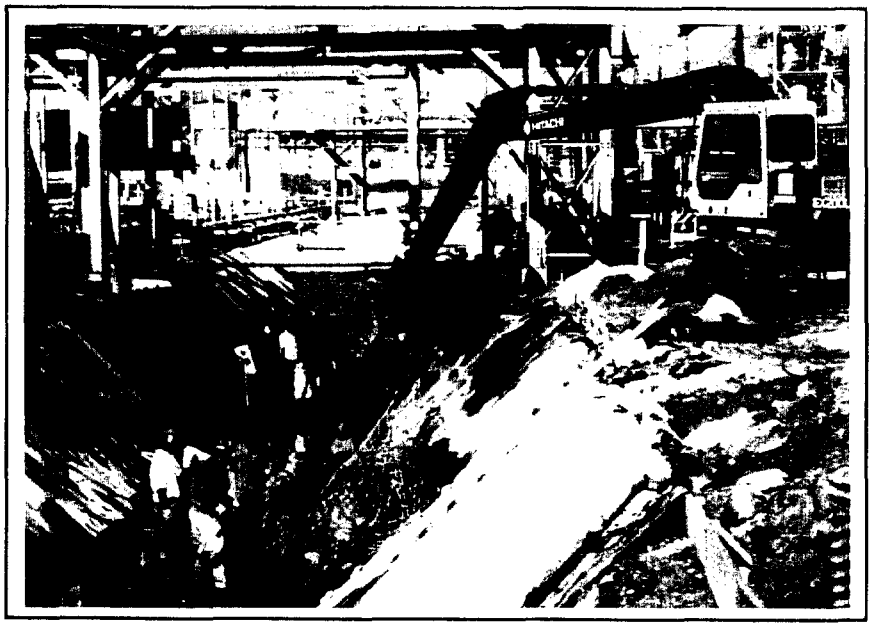
MINIMUM TECHNOLOGY REQUIRED (MTR)

SURFACE IMPOUNDMENT CONSTRUCTION PROJECT

PROJECT DESCRIPTION

This project is a portion of the construction and clean-up effort of the Master Remediation Plan (MRP) for a major refinery. The challenge of this project was the ever changing subgrade variation and fast track construction effort necessary to meet the more stringent regulatory requirements that were about to become effective. The requirements of the project included the construction of a three (3) foot thick layer of imported and recompacted clay, a one (1) foot thick drainage layer, a leachate collection system and a flexible membrane liner with a 5" concrete protective layer. All the above layered systems, when working in unison, provide the most risk free barrier to contamination release from surface impoundments.



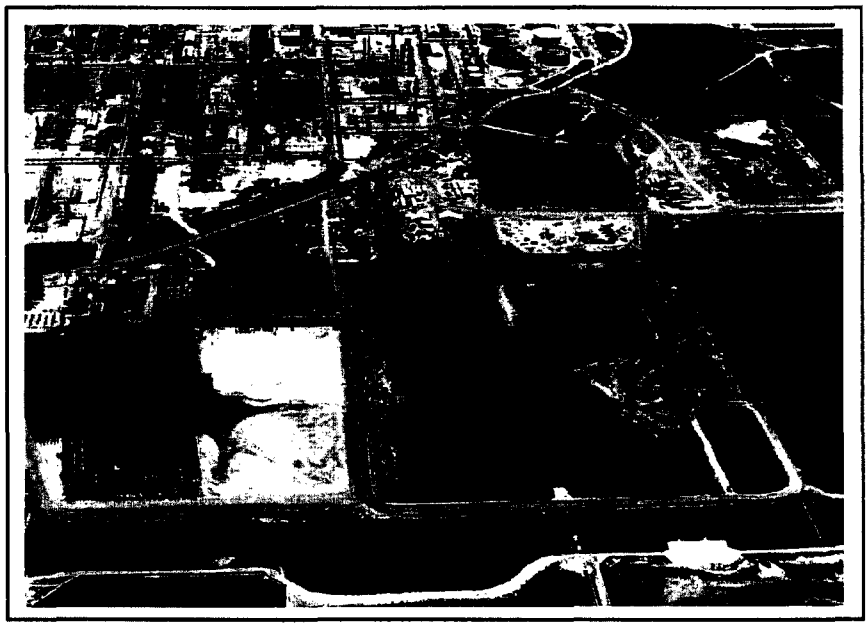


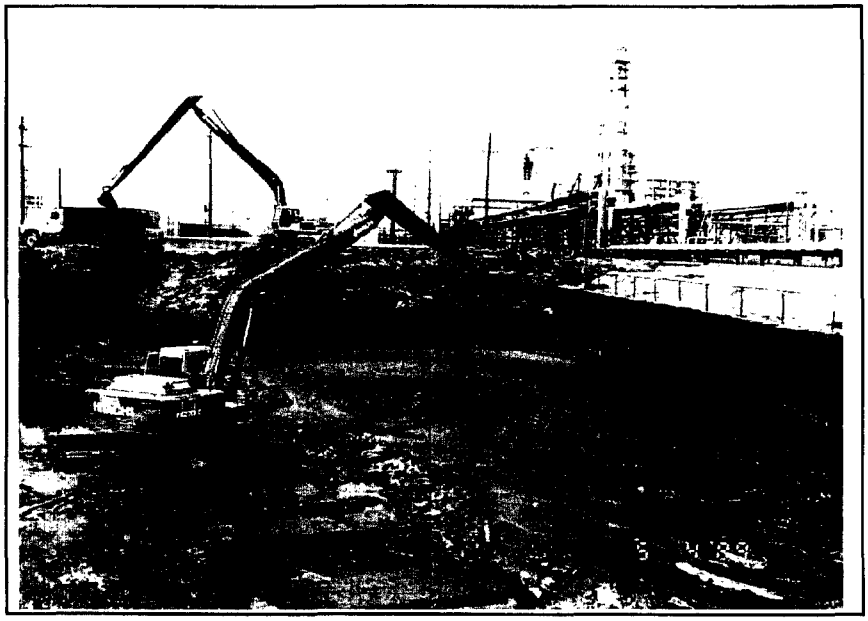
CLASS II LANDFILL DESIGN AND CONSTRUCTION PHASE II

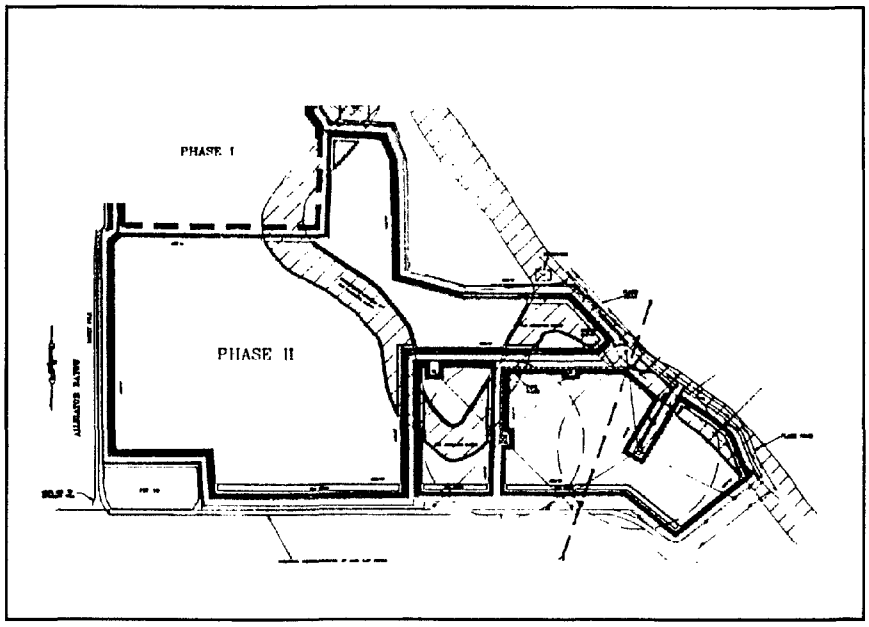
Start Date: June 1989
Completion Date: October 1992

PROJECT DESCRIPTION

This project included the remediation of 725,000 cubic yards of spent clay material through the ARCHON Solidification System and the creation of a 1,450,000 cubic yard capacity Class II landfill. On June 14, 1989, the Texas Water Commission classified ARCHON treated spent clay as Class II non-hazardous material. The Class II waste classification provided the client the flexibility of using treated spent clay as a substitute, in some cases, for imported fill material. The development of the 1,450,000 cubic yard Class II Landfill provided the client the on-plant capacity to be totally self-sufficient in their non-hazardous waste management programs.







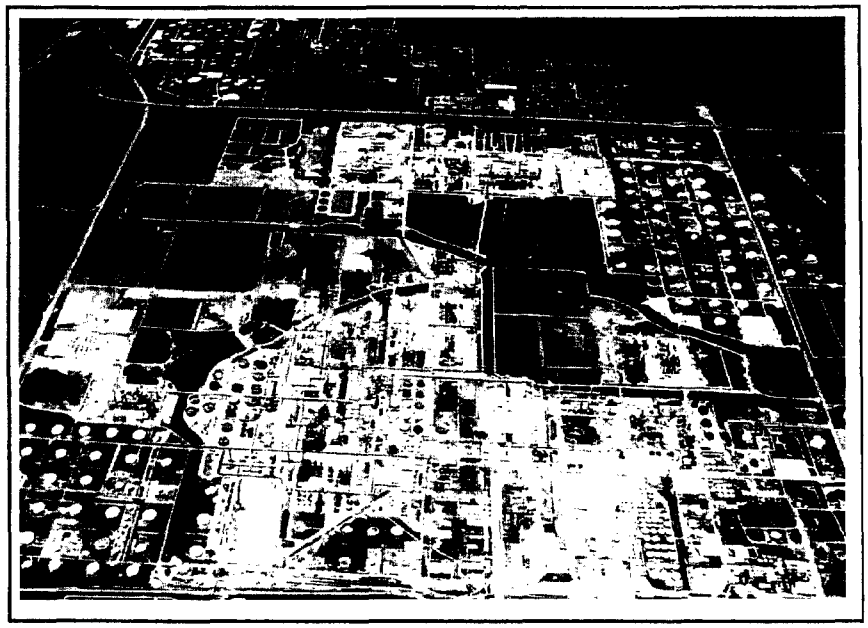
MASTER REMEDIATION PLAN
for
STAR ENTERPRISE REFINERY
Port Arthur, Texas

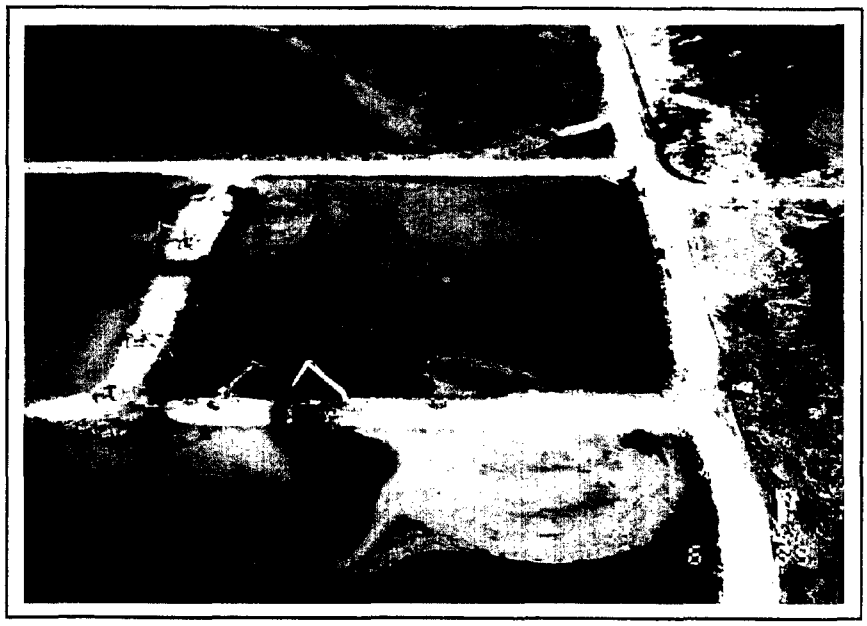
PROJECT DESCRIPTION

ITEX developed and implemented the Master Remediation Plan (MRP) when it became evident that the regulatory changes, i.e., TCLP and Primary Sludge Listing, were going to be promulgated. The basis of the MRP was to provide the refinery with operational wastewater management while consolidating and remediating the 3,000,000 cubic yards of contaminated sludge before the Primary Sludge Listing and TCLP Regulations went into effect. ITEX provided all services of the MRP with in-house staff and equipment. These services which include both engineering and construction activities are listed below:

- Analytical Testing
- Laboratory Analysis
- Surveying
- Sludge Consolidation
- Contaminated Soil Treatment and Transportation
- MTR Cell Construction
- Plant Site Preparation and Demolition
- Import Clay Hauling for Liners/Caps and Levee
- Construction of Levees and Liners
- Pipe Installation
- Quality Assurance/Quality Control
- Construction Design and Engineering

Phase I was a single source award with a twelve (12) month completion schedule. Phase I was completed in May 1991. Total project cost for Phase I was $180 million.



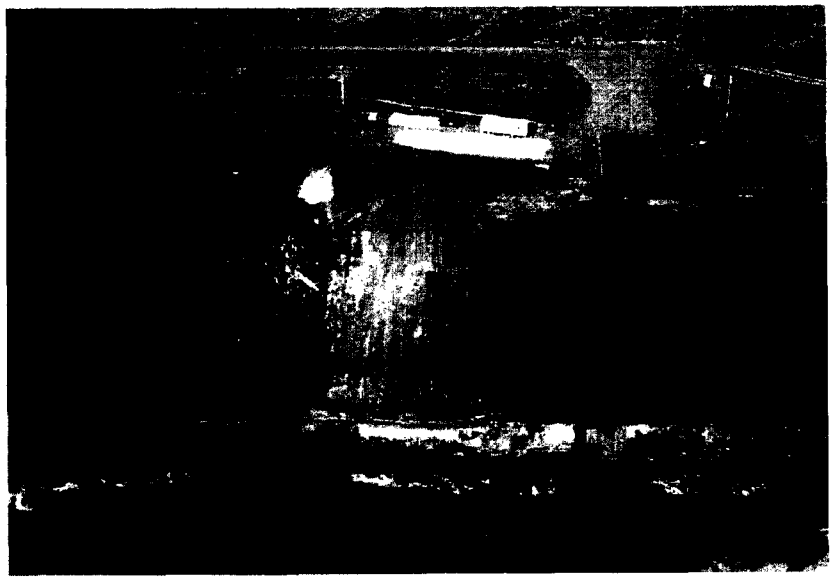


KERR-McGEE
ACID NEUTRALIZATION DEMONSTRATION
Cushing, Oklahoma

PROJECT EXPERIENCE

During the spring of 1987, ITEX was awarded a demonstration project for neutralization and solidification of acidic sludge located in five (5) open pits near Cushing, Oklahoma. The waste had been produced as a by-product of a lube oil cracking operation which was abandoned in the mid 1960's. ITEX used an in-situ process which was performed simply to increase the pH from near two (2) to above seven (7) and to create a stable material capable of supporting a cap system for closure. A second demonstration was carried out to provide an in-situ remediated waste with the same specification as above, but with more stringent requirements for size reduction and complete homogenization. ITEX realized early on that size reduction and homogenizations were key elements in the reduction of leachable constituents and the efficiency in additive utilization; therefore, allowing for cost reductions.

ITEX was successful in both demonstrations, even with the increased specifications. Experience from these demonstrations was used in the basic design and theory for the current ARCHON Solidification technique.



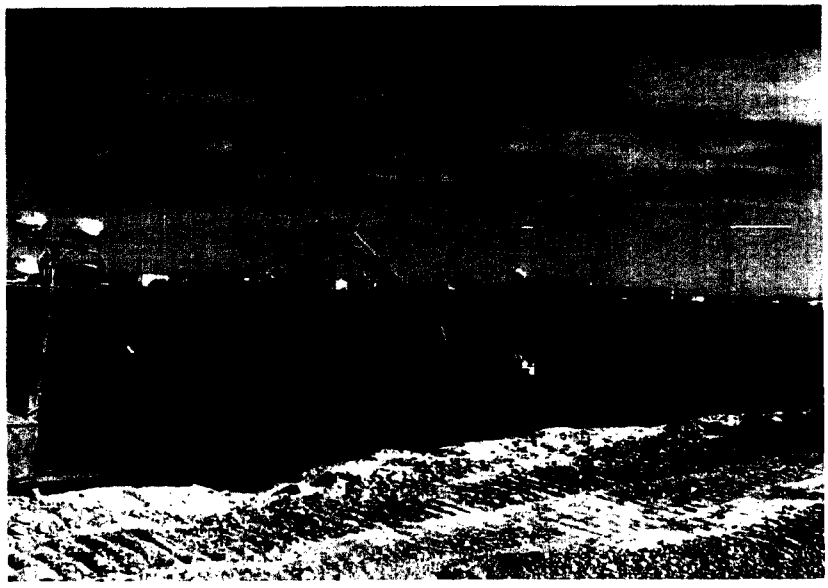
WASTE AVERAGING BASIN SLUDGE SOLIDIFICATION
La Porte, TX

Start Date: October 1991
Completion Date: October 1991

PROJECT DESCRIPTION

This was a competitively bid project requiring ITEX to solidify and consolidate Class I non-hazardous organic sludges found in the Waste Averaging Basin at the DuPont La Porte Plant. ITEX utilized specially designed mixing apparatus to solidify the sludges in-situ with 7.5% cement. Specifications required the material to pass the Paint Filter Liquids Test by EPA Method 9095. Once passing this test, the material was consolidated into stockpiles for removal from the basin. The key element of this project was the fast track approach taken that allowed ITEX to mobilize and construct the work to achieve an early completion date.

In conjunction with this project, ITEX performed all health and safety requirements using our in-house professionals. Responsibilities include extensive daily air monitoring, personnel protection and OSHA training. All field personnel were required to maintain Level C protection.



CLOSURE OF CLASS I LANDFILL AND NON-HAZARDOUS PONDS

Texaco Refining and Marketing
Amarillo, Texas

Start Date: April 1990
Completion Date: August 1990

PROJECT DESCRIPTION

This project at a decommissioned petroleum refinery, consisted of both inactive and active waste management units. The inactive units included a 10 acre Class I Hazardous Waste Landfill, three Wastewater Reservoirs, a Water Treatment Sludge Pond, and an undesignated contaminated area. The facility also included an active 7.5 acre Hazardous Waste Land Treatment Unit.

Prior to beginning construction activities, ITEX prepared a closure plan for non-hazardous waste and provided the technical support necessary to gain the Texas Water Commission approval. Once the closure plan was approved, ITEX completed the construction plan for remediation of this project.

Construction activities included in-situ stabilization of 110,000 cy of contaminated soils, upgrading existing levees with placement of over 35,000 cy of clay, installation of 75,000 cy of clay cap material, and placement of 30,000 cy of topsoil. Upon completion of the project, ITEX obtained final certified closure per the approved closure plan.

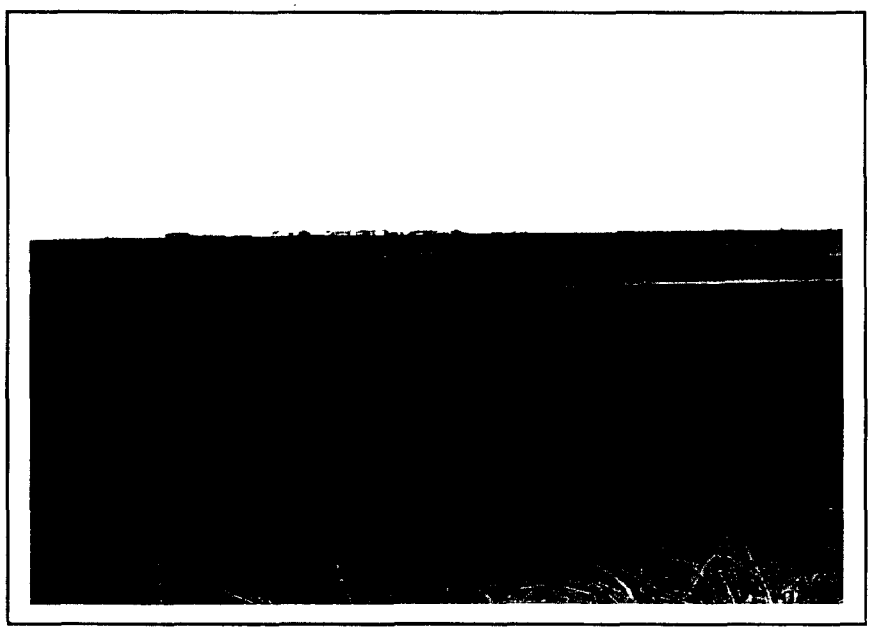
STORMWATER IMPOUNDMENT CLEAN-UP AND MAINTENANCE PROJECT
Southwest Refining

Start Date: July 1991
Completion Date: January 1992

PROJECT DESCRIPTION

This project was a competitive bid construction project that involved removal of sludges hazardous by characteristic of reactivity, and hauling those sludges in a dewatered state to Southwest Refinery's permitted hazardous waste landfarm for proper disposal. The nature of the sludge was oil (10-20%) with high moisture content (75-90%).

The key element of this job was to decant (dewater) the sludge to a level allowed for hydraulic loading at the permitted landfill. This was achieved by diesel and hydraulic pumping techniques designed for the project. The working conditions on this project required sealing of permeable levees bonded by the Houston ship channel. As the removal of the sludge progresses, the visible "clean bottom" is tested and clean clays will be installed to specifications and the impoundment will once again be ready to accept stormwater runoff from the active plant.



RETENTION POND CLOSURE
Diamond Shamrock
Three Rivers, Texas

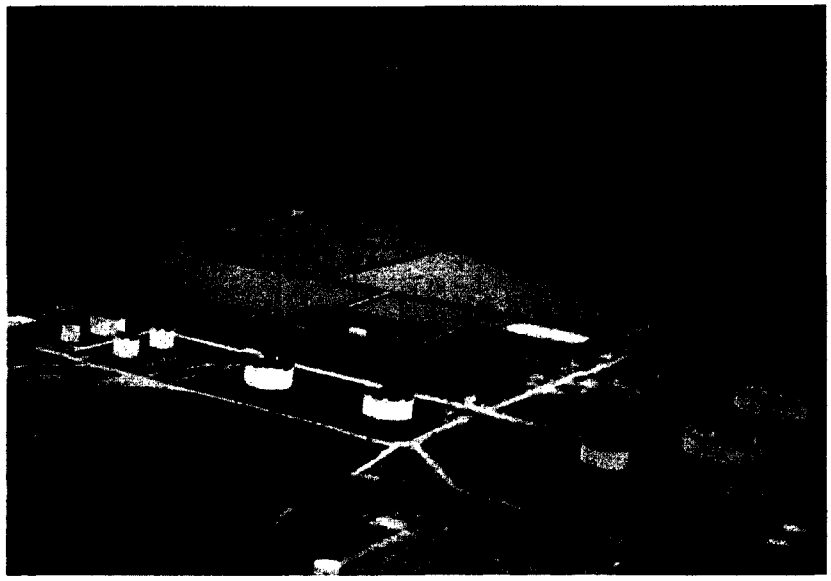
Start Date: April 1992
Completion Date: June 1992

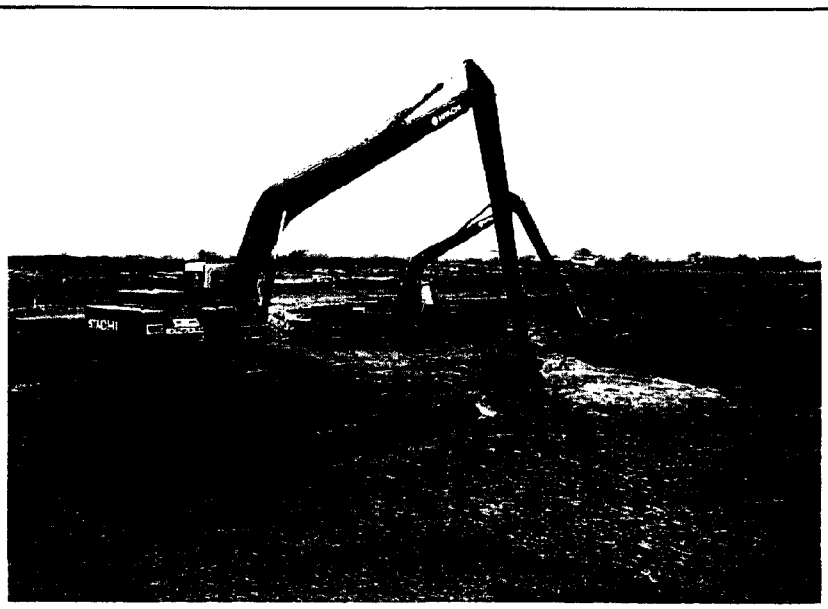
Project Description

ITEX developed and implemented a remediation plan for four active wastewater retention ponds. The four ponds contained listed hazardous waste sludges which were also classified hazardous due to the Toxicity Characteristics. This turn key project was completed prior to the effective date of new Land Disposal Restrictions for Primary Listed Sludges (F037 & F038).

The scope of work included the excavation and consolidation of over 12,000 cy of hazardous sludge and contaminated soil; the clean closing, upgrading and returning to service two of the ponds for stormwater retention; the in-situ treatment and stabilization of 22,000 cy of hazardous sludges and contaminated soils; and the construction of a RCRA cap for in-place closure of the treated material. Existing segregation levees were upgraded with clay to provide access to remote areas and to increase the barrier between the treated material and the cleaned ponds.

Treatment of the consolidated sludges by an in-situ method dictated that sludge had to be treated in depths as great as eight feet. This was successfully accomplished through the use of the ITEX designed in-situ processor and specially blended proprietary additive. The total project cost including all incidental work was $1.3 million.



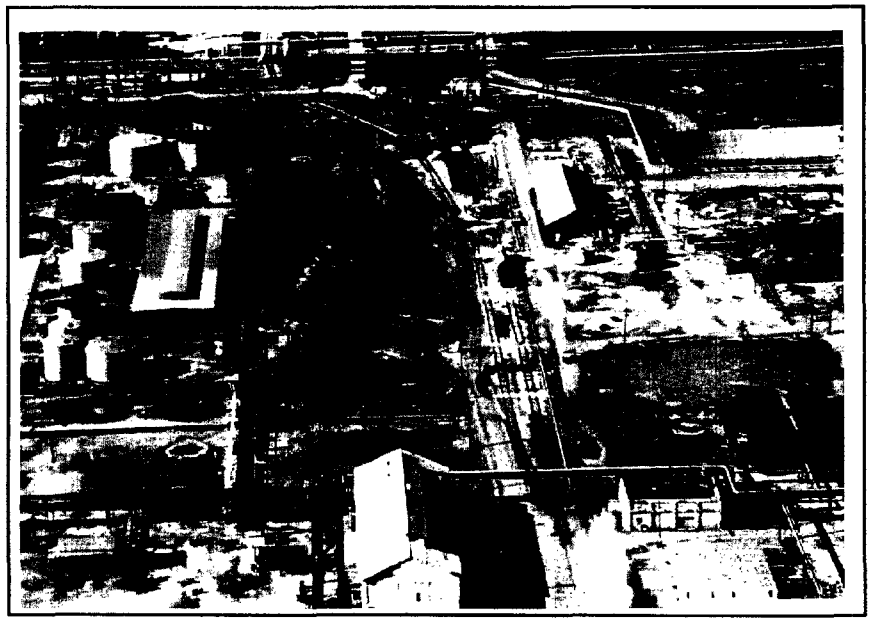


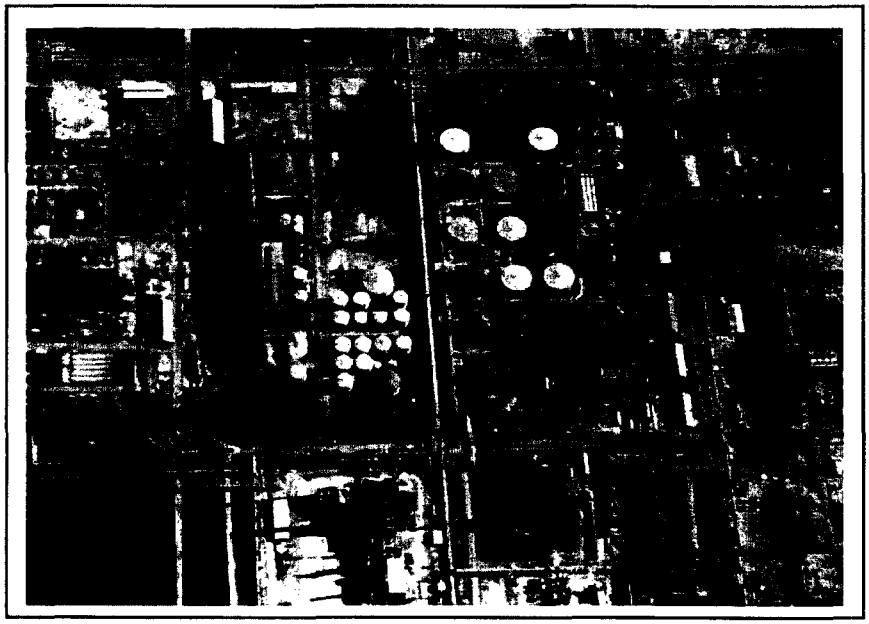
DELAYED COKER UNIT (DCU) SITE DEMOLITION AND SOIL REMEDIATION PROJECT

Start Date: May 1990
Completion Date: July 1990

PROJECT DESCRIPTION

This area required a multi-faceted approach from a design, construction and regulatory standpoint. Initially, it was thought the site required a formal closure plan in order to remediate the high metal concentration of the top eight (8) feet along with the low pH material. At this point ITEX was asked to investigate the project from a regulatory, design, and construction viewpoint. ITEX's position was that a closure plan was not necessary, and that contaminated material need only be handled in an "environmentally sound manner." The Texas Water Commission approved this approach, providing the DCU Project with the advantages of no ground water monitoring and no landfill designation. This designation was also important to the extent that the delays usually connected with a closure plan approval process were not encountered. The project consisted of excavation and hauling of approximately 40,000 cubic yards to the new Class II Landfill, treating and recompacting approximately 120,000 cubic yards of low pH contaminated material, and installation of a sheet pile cut-off wall.



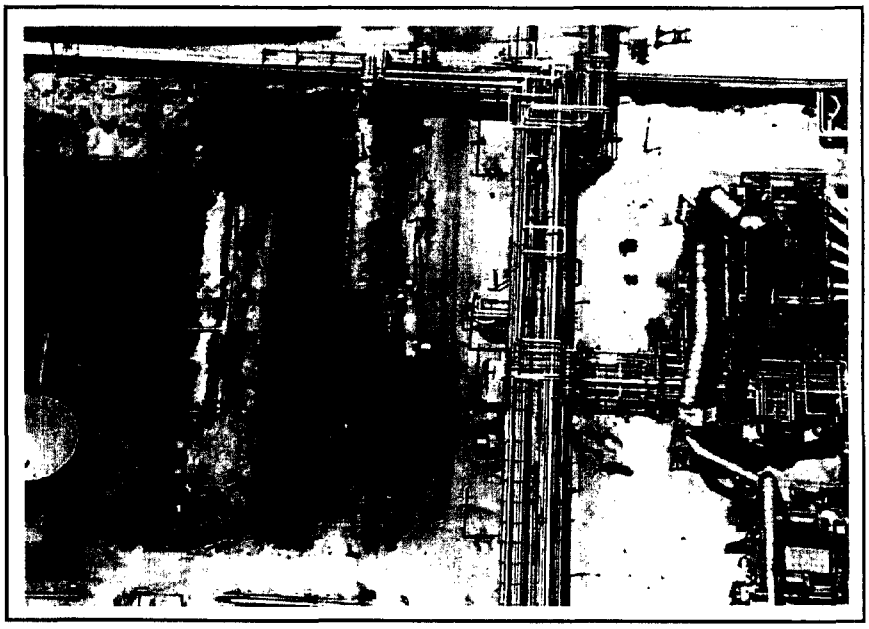


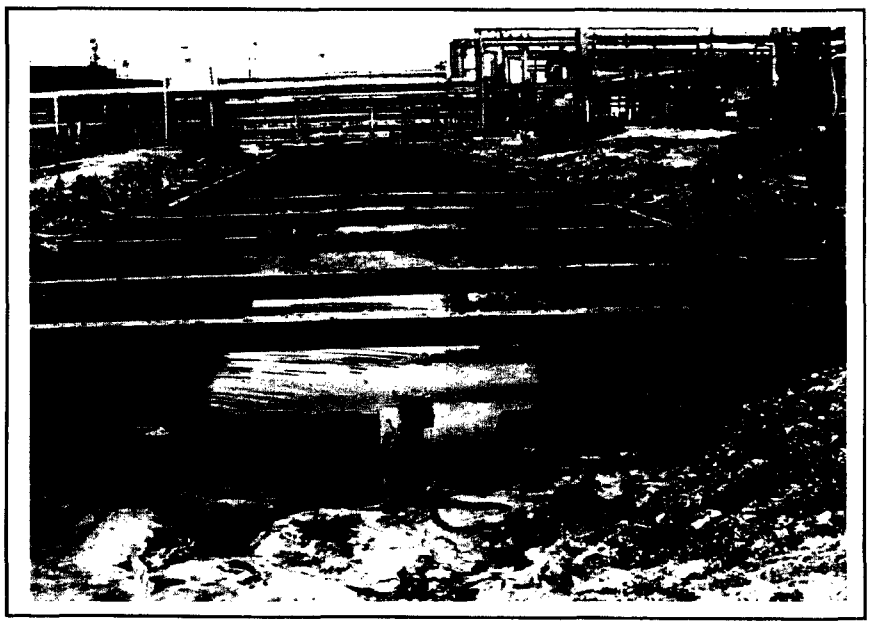
CLOSURE OF REFINERY SKIMMERS

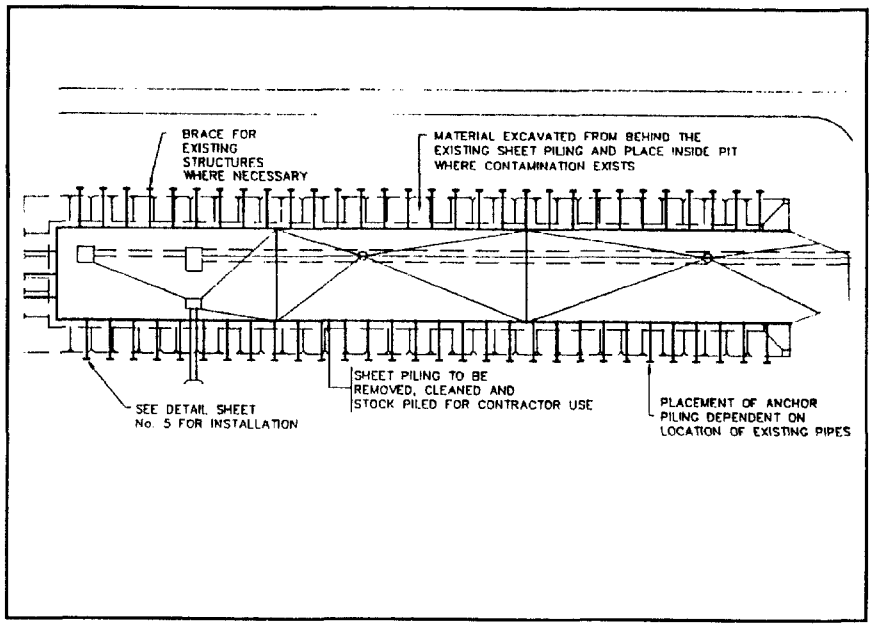
Start Date: March 1989
Completion Date: 1st Qtr. 1990

PROJECT DESCRIPTION

This project involved the removal, consolidation, cleaning, remediation and backfilling of four skimmer pits. ITEX reviewed an existing unapproved closure plan, modified the plan to secure regulatory approval and implemented a clean closure plan. The existing skimmer pit material will be processed through the ARCHON Remediation Process.







CLASS I HAZARDOUS WASTE LANDFILL CLOSURE

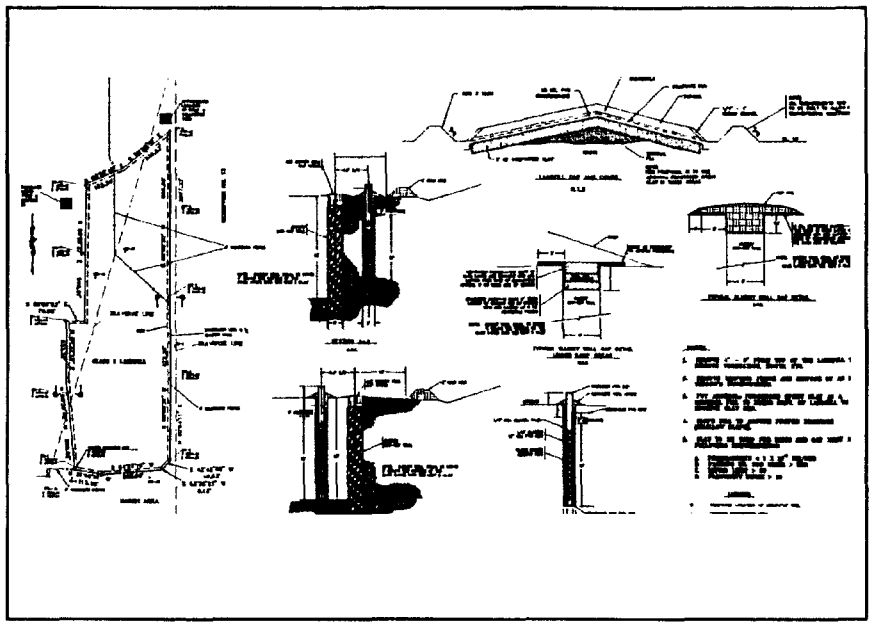
Start Date: September 1989
Completion Date: February 1990

PROJECT DESCRIPTION

ITEX was the prime contractor for the containment and closure of a 10.08 acre Class I - Hazardous Waste Landfill, three wastewater reservoirs, a water treatment sludge pond and an undesignated contaminated area. The project site was located at a decommissioned petroleum refinery. ITEX physically contained the waste and developed a plan to stabilize the waste by mixing the oily sludge with waste lime laden soils. The resulting material was compacted in the Class I landfill. The final Class I cap and cover system was designed and constructed by ITEX.

All services under this contract were performed by ITEX. Environmental regulatory work prepared by ITEX for this project included:

- Sampling and characterization of Impoundment sludges.
- Preparation of a closure plan for non-hazardous impoundments.
- Preparation of an amendment to an existing closure plan for the hazardous waste landfill.

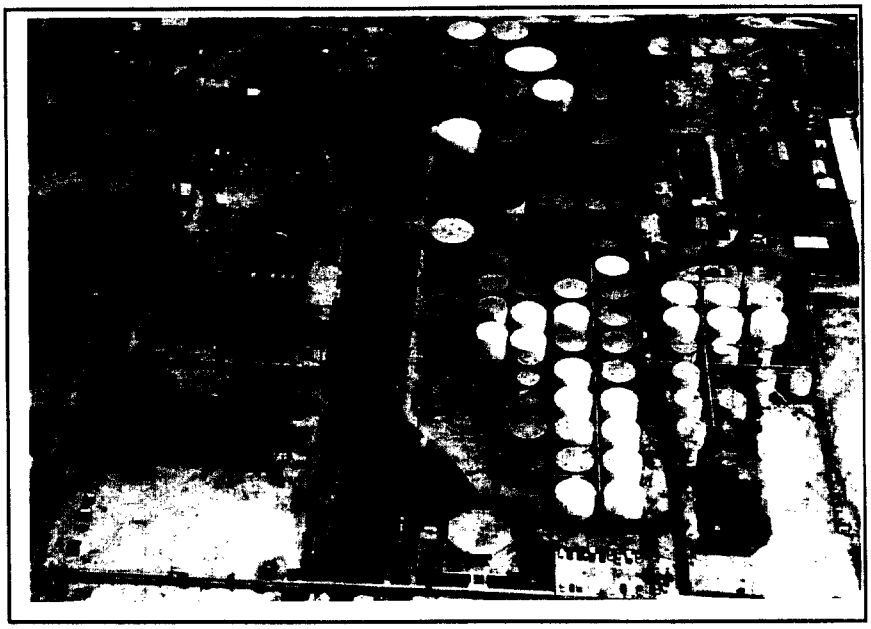


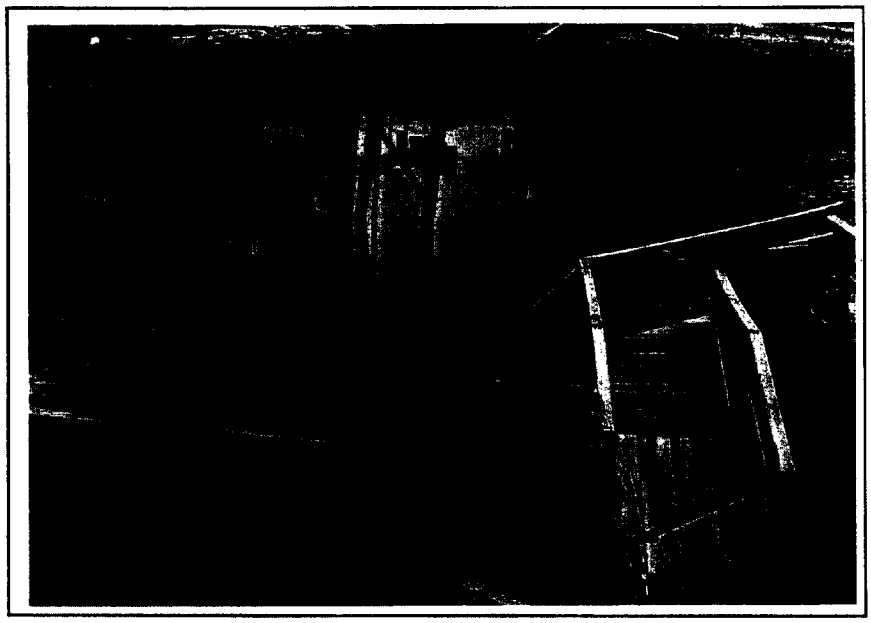
REFINERY WASTEWATER AND STORMWATER MANAGEMENT

PROJECT DESCRIPTION

This project involved an extensive study of a refinery wastewater and stormwater management system. The closing of the open ditches required extensive experience in stormwater and wastewater projects. In order to officially close the ditches, clean bottom had to be analytically proven. ITEX's plan allowed for the cleaning of the ditches while simultaneously installing all the necessary pipe systems to handle the plant's stormwater and wastewater needs. This approach maintained the ditches as clean closed while the execution and installation of properly engineered and installed wastewater and stormwater management systems occurred.

In 1989, regulations concerning all sediment upstream of API Separators being listed as a hazardous waste included the open ditches which were used for wastewater and stormwater management. The objective was to consolidate all the affected ditches into one area for remediation and disposal. The waste storage area became one hazardous waste management unit as opposed to multiple units since the ditches were later closed in place. This removed the significant monitoring requirements that closure of hazardous waste management units require. This consolidation also improved the possibility of remediating all the open ditch material prior to the primary sludge listing becoming effective.



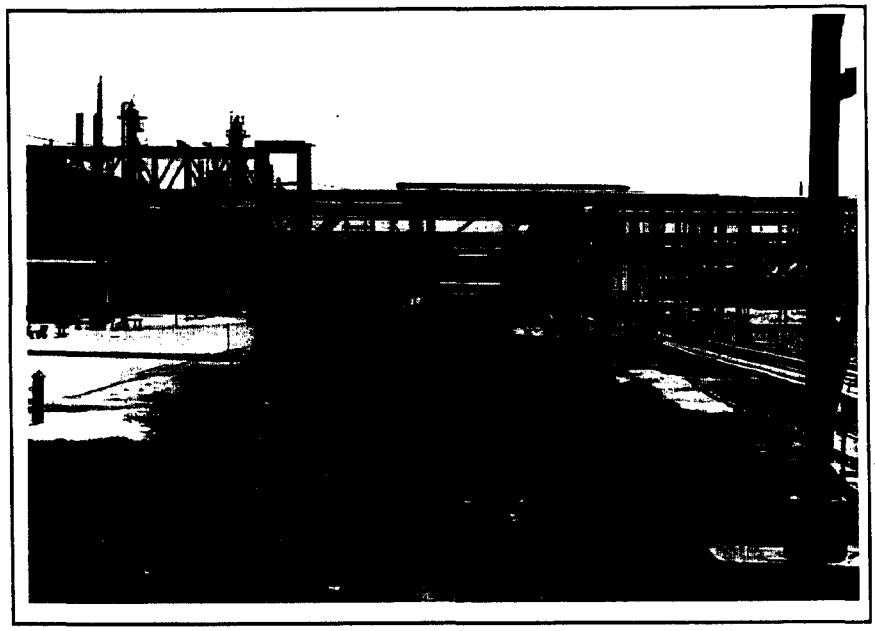


DITCH
REMEDIAL ACTION PLAN
Mobil Chemical Company

Start Date: August 1990
Completion Date: December 1990

PROJECT DESCRIPTION

The site consisted of open ditches with contaminated oily and low pH sludges that were to become TC regulated. This project presented ITEX with opportunity to provide the client with a fast track construction effort resulting in regulatory compliance of the ditches. ITEX overcame unique working conditions to complete this project. An active water management system had to remain largely undisturbed while construction/remediation activities were taking place. ITEX excavated from existing ditches, 30,000 cy of contaminated and uncontaminated soils. The contaminated soils were remediated using the ARCHON Solidification process and placed in an ITEX constructed, on-site landfill. The uncontaminated soils did not require treatment and were place directly into the landfill. Testing and documentation of clean ditch bottom was performed in accordance with EPA approved parameters. Following the excavation, ITEX graded and shaped the 4,100 LF of existing cleaned ditches and installed a gunite liner, double lined leachate collection system, and underdrain collection system. The newly completed lined ditch system doubled the ditch conveyance capacity of Mobil Chemical's water management system. This fast track project was completed on time and with little effect on the normal daily operation of the plant.



RADIOACTIVE WASTE DECONTAMINATION PROJECT

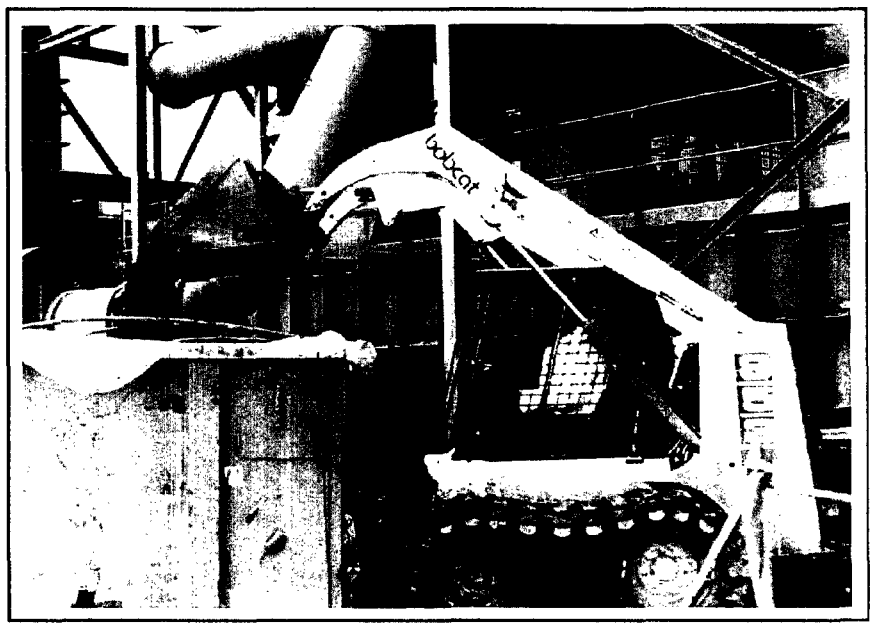
Project Description

ITEX was contracted by the owner of a steel mill in Illinois, for the removal of approximately 600 tons of K061 emission control dust. The contract was awarded following a survey of the electric furnace emission control system by the State of Illinois Department of Nuclear Safety. Upon finding Cesium 137 contamination in the emission control system, the State notified the owner that this low level radioactive contamination was to be removed and radiation levels reduced to health-based allowable levels.

ITEX was required to complete cleanup operations within a two week period, coinciding with the plant's scheduled winter shutdown. This allowed the owner to return to full production on the scheduled start-up date.

Scheduling concerns were not allowed to compromise responsibility for worker health and safety. All employees were required to wear Level C personnel protective equipment, during work and clean-up activities. An extensive program was initiated to monitor and minimize radiation exposure. When working in confined spaces, the air quality was monitored and special lighting was added to enhance working conditions.

Faced with a rapidly approaching deadline, ITEX worked around the clock, completing the project on schedule, amassing approximately 20,000 man-hours in 18 days, without serious injury or incident.



HAZARDOUS WASTE DE-LISTING PROJECT

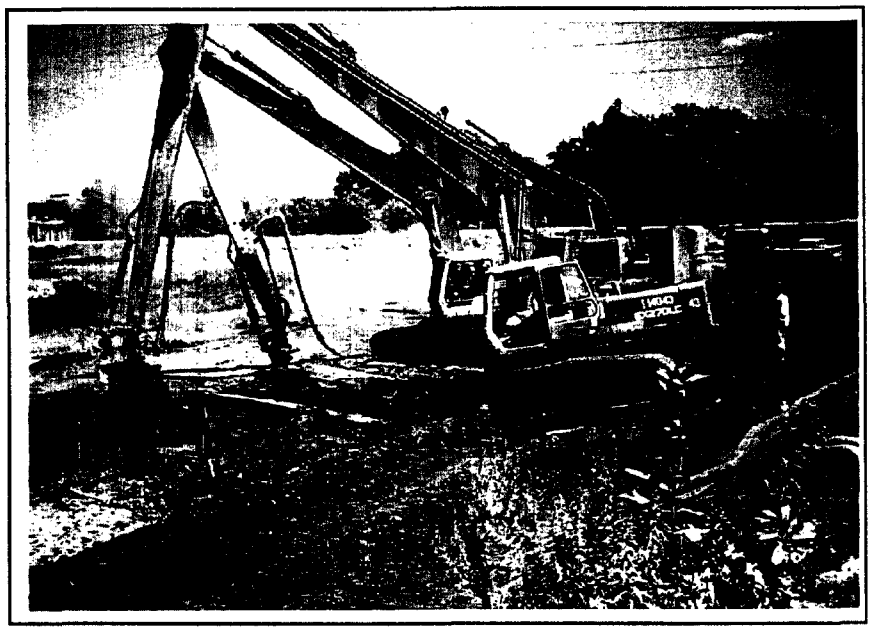
Project Description

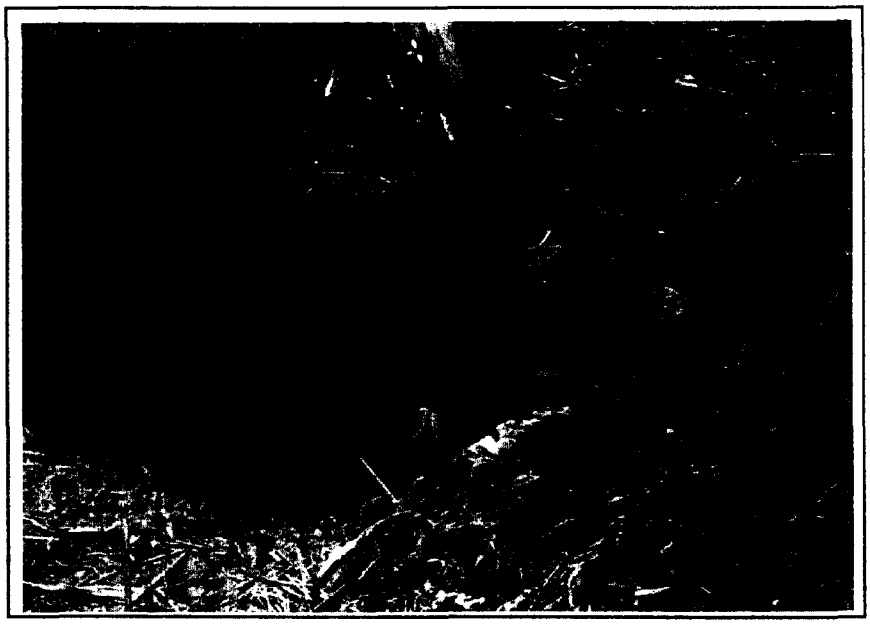
ITEX qualified and competitively bid for the de-listing of RCRA hazardous wastewater sludges, K062 spent pickle liquor solids, found at a wire mill facility in Illinois.

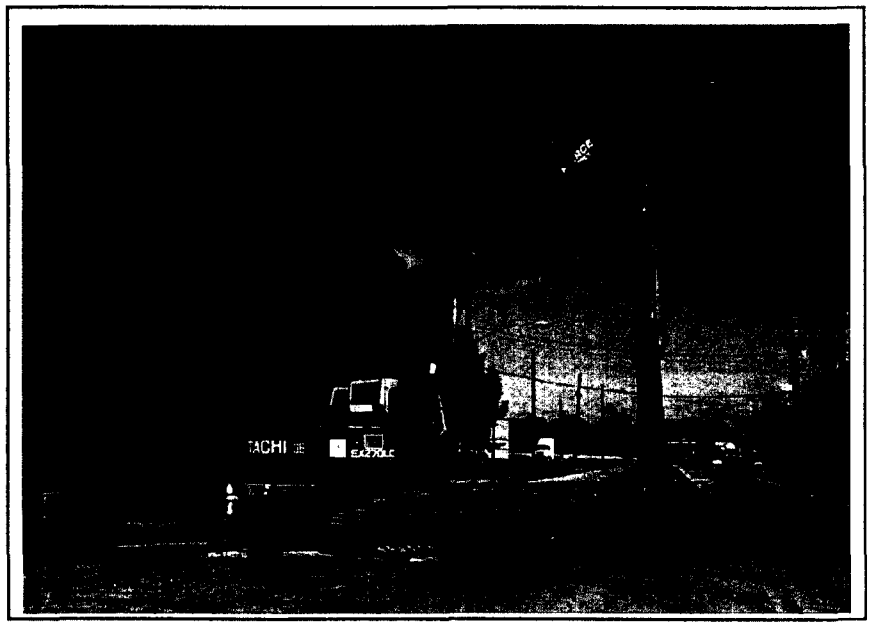
Stabilization and solidification of approximately 40,000 cubic yards of hazardous sludges and bottom soils was accomplished through utilization of the ITEX designed and fabricated In-Situ Processor. ITEX conducted bench-scale testing to develop an additive blend capable of providing cost benefits, in addition to meeting treatment requirements.

Treatment specifications required the material to pass de-listing threshold TCLP concentrations for leachable metals, with allowable concentrations for lead, the primary analyte of concern, less than 0.218 mg/1. For untreated materials, leachable lead concentrations ranged between 13 and 16 mg/1.

To track treatment progress, the retention basin was subdivided into 20'x20' cells, each containing approximately 100 cubic yards of treated material. At a frequency of one sample per 20 cubic yards of treated material, performance samples were taken to monitor adherence to treatment parameters. Performance sampling has shown 95% of TCLP samples with lead levels below detection limits. Currently, the treated material is awaiting final testing verification for submittal to the Illinois Pollution Control Board for de-listing purposes.





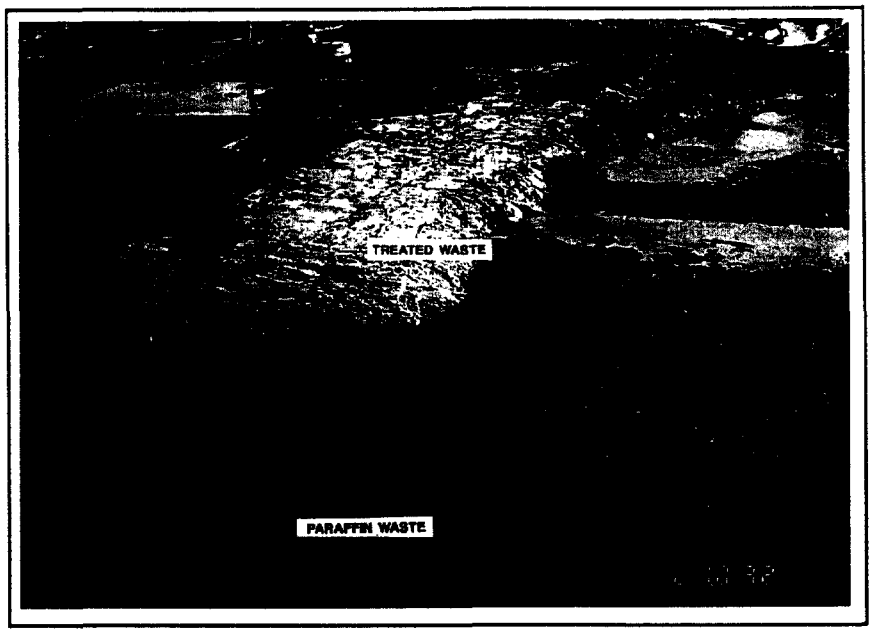


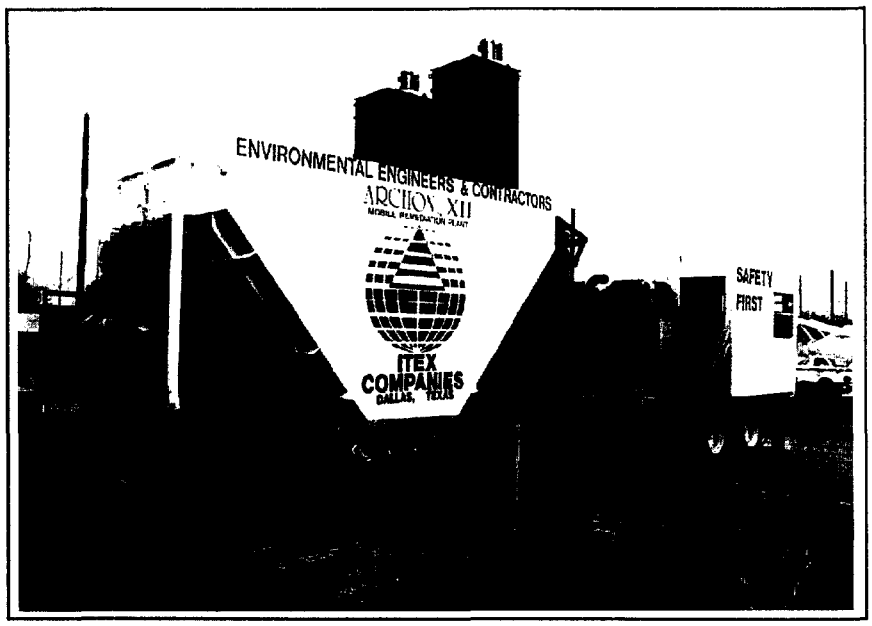
CLOSURE OF A BARGE CLEANING SETTLING POND
State of Louisiana

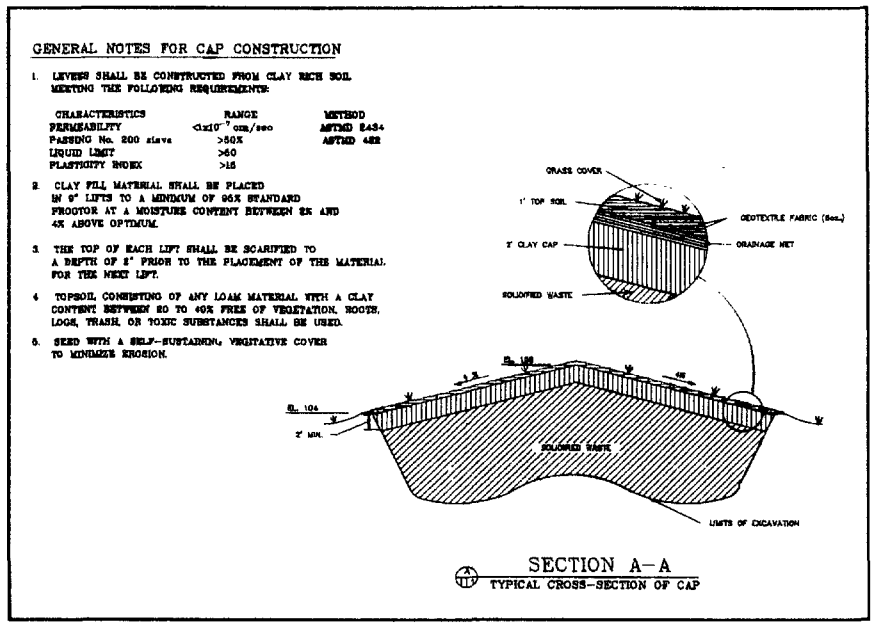
PROJECT DESCRIPTION

This project consisted of the closure of a settling pond used to store oily water from the barge cleaning process at a Gulf Coast Facility. ITEX developed a remediation and closure plan to stabilize/solidify all of the contents of the existing impoundment and close in-place as a landfill. The settling pond contains approximately 35,000 cubic yards of paraffin, oil, sludge and contaminated soil. The impoundment was divided into several sections by the construction of clay segregation levees to facilitate waste consolidation and disposal cell construction. Consolidating the paraffins, oils, sludges and soils allowed the various non-hazardous waste components to be mixed, providing a more consistent material for treatment. The consolidated waste was excavated and stabilized with the ARCHON Remediation Process and placed in the cleaned cell, for final disposal.

In preparation of this plan, ITEX conducted bench-scale and pilot-scale treatability studies for the solidification of the waste to ensure that the treatment goals were met and that the final material exhibited sufficient bearing strength to support the cap and cover system. QA/QC testing conducted during full-scale operations have confirmed that these goals have been achieved. ITEX's staff worked interactively with the facility's environmental staff and the Louisiana Department of Environmental Quality for final approval of the remediation and closure plan.







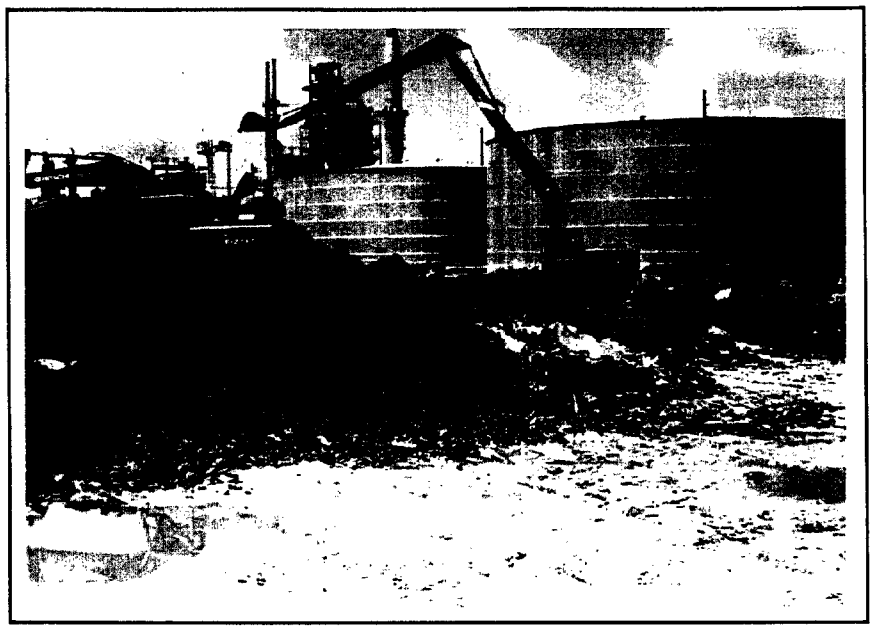
MOBIL OIL EXCAVATION AND EXPANSION PROJECT

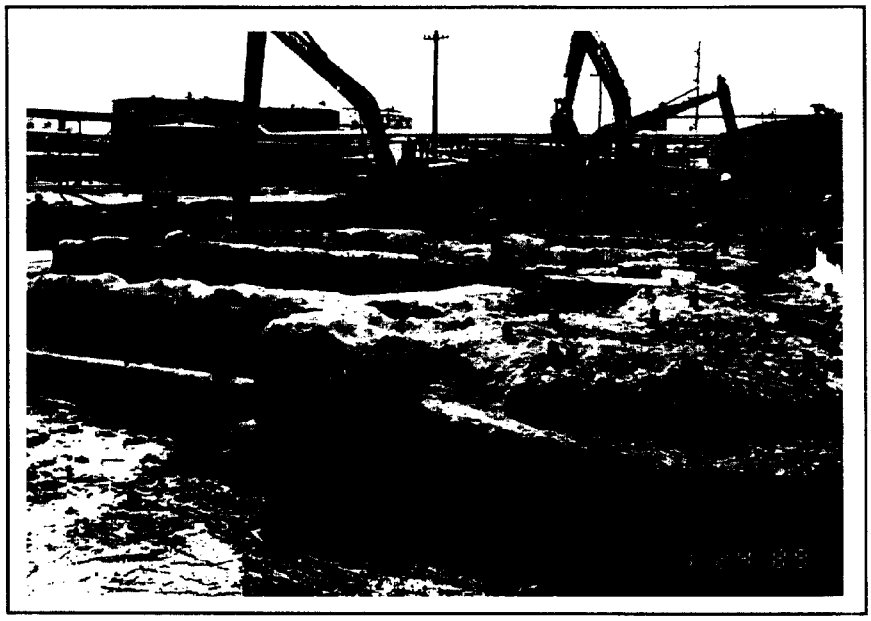
Start Date: July 1990
Completion Date: October 1990

PROJECT DESCRIPTION

ITEX was responsible for the excavation and disposal of 33,000 cubic yards of contaminated soils for Mobil Oil Corporation. The work was executed under a unit price contract with a 1.7 million dollar estimate.

The excavated site was previously occupied by active process units which contributed to several large areas of contaminated underlying soils and foundations. ITEX successfully obtained the state classification and waste code from the Texas Water Commission to determine appropriate disposal and treatment methods. ITEX demolished pipe and concrete, excavated contaminated areas, transported and disposed of material in a temporary waste storage area. The site was backfilled with clean imported clay. This project began in August, 1990, and was completed in November, 1990 according to the original 4-month schedule.





4. Needs Assessment Narrative

The enactment of the Resource Conservation and Recovery Act (RCRA) has had a dramatic affect on the solid waste industry, both positive and negative. *Subtitle D* of RCRA and other regulations that govern siting, design, construction, operation and eventual closure has likewise affected the financial ability of landfills to fund necessary capital and operating costs. The paradigm of landfill ownership / management has changed dramatically over the past years and will continue to evolve for both public and private sector entities.

Nationally the generation, recycling and disposal of municipal solid waste (MSW) has also changed substantially. In 1960 the average MSW generation per person per day was 2.7 pounds. That number grew to 3.7 pounds per person per day in 1980 and increased to 4.5 pounds per person per day in the 1990's. Studies concur that the number has stabilized over the past ten years at approximately 4.5 pounds per person per day.[15]

Based on 2000 population numbers the amount of MSW generated in the US was 231.9 million tons an increase of .03 percent (900,000 tons) from the 1999 figures; approximately 55.3 percent (128,240,000 tons) of the total MSW generated was land filled.[16]

According to the *Directory of Solid Waste Disposal,* the percentage of landfill facilities owned by the public sector declined from 83% in 1984 to 73% in 1997 and 64% in 1998.[17]. Current estimates place the figure below 40%. Even with growing populations and a dramatic increase of the waste stream 8,000 operating landfills in 1988 declined to approximately 3,000 in 1996; by 2000 that number declined to 1,967 while the average size of landfills increased dramatically.[18]

Approximately one half of the operating landfills in population areas over 100,000 residents were operated by the public sector; another 10 percent were publicly owned but operated by private firms through a variety of contractual arrangements. The balance of the landfills (38%) were both privately owned and privately operated. These numbers shown that approximately half of the nation's landfills were privately owned and operated.[19]

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[15] United States Environmental Protection Agency *Municipal Solid Waster in the United States: 2000 Facts and Figures*, page 5
[16] Ibid page 14
[17] Chartwell Information Publishers, 1998 www.wasteinfo.com *Directory of Solid Waste Disposal*, p.13.
[18] United States Environmental Protection Agency *Municipal Solid Waste in the United States: 2000 Facts and Figures*, June 2002 page 14
[19] Reason Public Policy Institute by Segal and Moore *Privatizing Landfills: Market Solutions for Solid-Waste Disposal*, page 2

Exporting MSW to remote megafills continues to be an economical method of waste management for many large metropolitan producers. A 1999 study conducted by Houston's Public Works and Engineering Department found that considering the 30 largest US cities only 13 owned landfill, two of the 13 had privatized their MSW operation and a third was studying privatization.[20]

Although private firms owned only 38% of the total number of landfills for communities with populations over 100,000 they disposed of 58% (expressed in tons) of municipal solid waste. It should be noted that the private firms owned over 67% of the total landfill capacity. By comparison the public agencies owned 62% of landfill for communities with population over 100,000 but they accounted for only 42% of the municipal solid waste, again expressed in tons. The public sector owned only 33% of the disposal capacity[21].

The paradigm shift to large, remote, privately owned megafills is clear. Private sector entities usually have greater access to capital markets and are able to adapt quickly to new and innovative methods of siting, construction, transportation and operation. This flexibility develops efficient and cost effective disposal solutions for clients over an ever-expanding market area.

In 1993 disposal rates nationally at municipal and private landfills in the North East were at $85.00 to $135.00 per ton[22]. Information gathered by *Chartwell Information* shows that in February 2003 the national average disposal rates for MSW was $36.93/ton with an average daily volume of 1.082 million tons[23].

In Utah the primary source for commercial nonhazardous solid waste is centered along the Wasatch Front. This is more specifically defined as communities from Brigham City in the north to Nephi in the south, Kamas in the east and Grantsville in the west. This is where Utah's predominate concentration of the 2.2 million people live and where rail lines, transfer stations and surface roads facilitate the transportation of the current waste stream.

The population of the Wasatch Front is expected to grow an additional one million people by the year 2020 according to Envision Utah Annual Report. As reported in the Department of Environmental Quality (DEQ) Division of Solid and Hazardous Waste Plan Update, dated March 2002, the per person generation of 5.97 lb/person/day translates the population increase to approximately 1.1 million tons of additional MSW

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[20] City of Houston, Public Works and Engineering Department, *Survey of Large Cities' Solid Waste management Systems,* revised April 1999

[21] Reason Public Policy Institute by Segal and Moore *Privatizing Landfills: Market Solutions for Solid-Waste Disposal*, pages 2 & 3

[22] Reason Public Policy Institute, *Mandates or Incentives? Comparing Packaging Regulations with User Fees for Trash Collection* May 1993 by Lynn Scarlett page 21

[23] Chartwell Information, www.wasteinfo.com *Solid Waste Market Data & Research*, April 10, 2003.

by the year 2020. This source represents a 44% increase in Utah's current 2,467,915 tons of MSW.[24]

Utah imported 122,753 tons of MSW from 1995 to 2000 with a total of 65,844 tons imported in 2000 alone[25]. This will continue to increase as MSW landfills continue to follow the national trend of closing local MSW landfills and transporting their waste streams to mega regional landfills.

In addition, from 1994 to 2000, Utah generated and disposed of an average of 446,702 tons of industrial waste. In 2000, Utah generated and disposed of 580,407 tons of industrial waste, an increase of 30% over the 1994-2000 six year average[26].

From 1994 to 2000, Utah imported 3,568,411 tons of Industrial Waste, an average 509,773 tons per year. Additionally, Utah generated and disposed of 3,126,913 tons of Industrial Waste during the same period, a yearly average of 446,702 tons[27].

While the Wasatch Front may serve as the primary source of Solitude's MSW waste stream, significant quantities may be shipped by rail both regionally and nationally. Deregulation of the rail industry helped fuel the substantial decreases in the number of MSW facilities nationally and the increase of regional megafills.

Disposal rates locally, as nationally continue to increase in an effort to maintain a balance between regulatory requirements and operating expenses. Rates along the Wasatch Front range between $11.00 per ton at Tans Jordan Landfill for member municipalities to over $30.00 per ton at Utah County's North Pointe and the Salt Lake Valley Transfer Station[28]. Trans Jordan management indicated their Board is currently reviewing new pricing strategies that will result in an increase in prices.

North Point, Salt Lake Valley and Weber County Transfer Station contract with the only Class V Landfill in the State licensed to receive MSW, East Carbon Development Corporation, (ECDC). The monopolistic control of ECDC has produced concern over the ability of the municipalities and transfer stations to effectively manage their costs, both now and in the future.

On March 13, 2003 a coalition of municipal solid waste (MSW) generators and landfill operators issued a request for proposal (RFP) seeking a qualified consultant to analyze public and private disposal facilities which are, or may be available to receive MSW from their facilities.

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[24] Department of Environmental Quality, Division of Solid and Hazardous Waste, *Utah Landfill Inventory*, March 2002 page 2
[25] Ibid 7
[26] Ibid page 12
[27] Ibid page 12
[28] Conversations with administrators of MSW facilities along the Wasatch Front, 2002 and 2003

Of specific importance is that the coalition included all of the MSW generators along the Wasatch Front including: Cache, Weber, Box Elder, Davis, Salt Lake, Tooele and Utah Counties; the collective group accounts for approximately 85% of all of the MSW generated in Utah.

The Utah solid waste industry is clearly following the national and global trend of fewer but larger remote, disposal sites (megafills), which are owned and operated by profitable, private sector entities.

The March 13, 2003 (RFP) clearly reflects the need for competition in the Utah MSW market. Capacity alone is no substitute for competition.

Solitude landfill is designed and will provide public sector clients innovative and efficient methods of handling and transport of MSW, which will dramatically reduce overall expenses. Solitude will also provide services and access to equipment technologies not offered or utilized by other local or national MSW disposal facility.

Because of these efficient and cost savings innovations it will be possible for large metropolitan clients to export MSW over longer distances without dramatically increase export fees.

As the only licensed and operating Class V commercial disposal facility in Utah ECDC offers an abundance of disposal area through yet undeveloped land. They are however, a monopoly with no competition to assure that their price for disposal is reasonable and competitive with newer technologies and a landfill site that offers a safer disposal facility utilizing new and proven methods of handling and disposal.

Because Solitude landfill has obtained a Class I permit and is able to offer alternative methods of disposal and competitive price in a safer disposal environment ECDC is finally offering a variety of disposal options with the promise of competitive pricing. It is clear that having an abundance of airspace is not the only consideration the DEQ can use in determining the need for permitting additional Class V landfills in Utah.

Advances in the technology of collection, handling and disposal of municipal solid waste through transfer stations has likewise demanded advances in the technology in handling, transportation, siting of landfill facilities and the ultimate disposal of a waste stream that is both economical and environmentally safe.

The Solitude landfill is located in a remote, seclude area that is accessed by both rail and surface sources but more importantly it is in a unique siting that provides exceptional benefits in low annual precipitation, high evaporation, a geological strata with little or poor quality ground water and a barrier of over 1,100 feet of dense Mancos shale.

According to DEQ's *Utah Solid Waste Plan Update*,

> ***"As the population has increased the need for more disposal volume and the need for alternatives to disposal has become apparent. Siting of new landfills becomes more difficult as population grows and availability of land that is suited for landfill siting is limited by encroaching housing and other land uses."***[29]

Because ECDC is the only class V Landfill licensed in the State to receive MSW, these political subdivision's future disposal options are severally restricted. ECDC's monopolistic control of class V waste streams inhibits these communities ability to compare the market place's most competitive prices and newest technologies.

The fundamental goal for the public sector client to outsource is not only to provide continued economical sound service to their constituents but the goal of reducing the potential of environmental liability during the disposal, closure and post closure periods.

The lack of competition can only exacerbate a community's ability to provide the most competitive prices, technologically advanced and most environmentally safe management of their communities waste streams.

While capacity is of some concern, of more importance is the lack of viable landfill sites permitted in this area, thus inhibiting the competitive options for local and national entities. Additionally, urbanization continues to encroach on rural areas limiting the options available for politically and economically acceptable landfill sites.

The permitting of Solitude as a Class V Landfill will give local and national market clients an environmentally sound and safe landfill site that utilizes a variety of handling and transportation technologies that will result in competitive, safe disposal price.

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[29] Department of Environmental Quality, Division of Solid and Hazardous Waste, *Utah Solid Waste Plan Update*, March 2002 page 7

5. Conclusions

The March 13, 2003 request for proposal (RFP) initiated by all of the municipal solid waste (MSW) generators along the Wasatch Front indicates that Utah is moving in a similar direction as the national and global markets have taken in past years to solve MSW handling and disposal needs.

The action of the MSW generators in Utah will evaluate large, privately owned and efficiently operated 'megafills', which are capable of serving multiple public and private sector clients who are situated over a large geographical area. Currently only one Class V landfill is licensed and is in operation in the State of Utah.

The East Carbon Development Company located in Carbon County, Utah enjoys monopoly status as the only Class V landfill licensed to serve both Utah and out of state clients. They defend their position because of the large unused reserves of airspace within their facility.

Capacity of the only permitted Class V landfill must not be the base criteria for evaluation of competition by the Department of Environmental Quality. This narrow evaluation method eliminates not only competition but does not consider technology advancements, developments in handling equipment, efficiencies in transportation and more cost efficient siting locations.

Government cannot allow only one provider of services to be permitted by a state agency. The most essential element of competition is totally eliminated allowing the monopolist to ignore market conditions, customer's needs and market developments. A monopoly has historically led to unfair market control, excessive profits and operational complacency.

Competition will require all private sector entities to be more responsive to both public and private sector clients. Competition also encourages landfill entities to explore creative out-sourcing options for the public sector producer of MSW.

Competition has and will be directed by well-managed, profitable entities that rely on creative innovations and technologies, which will continually shift and advance the paradigm of MSW management.

Disposal rates on both a local and national basis have and will continue to increase as regulatory and economic conditions dictate their direction. Currently disposal rates along the Wasatch Front range between $11.00 per ton at Trans Jordan for member municipalities to over $30.00 at North Point and the Salt Lake Valley Transfer Station[30].

[30] Conversations with administrators of MSW facilities along the Wasatch Front 2002 and 2003

Nationally rates are considerably higher at $85.00 to $135.00 per ton at some locations in the North East[31]. Information gathered by *Chartwell Information* shows that in February 2003 the national average disposal rates was $36.93/ton with an average daily volume of 1.082 million tons[32]. A large amount of that MSW is exported to remote disposal areas; considering the 30 most populated areas in the US, only 13 operate landfills[33].

The Solitude Landfill has worked diligently to site a landfill that is superior in every way to existing facilities in the Mountain Region and is implementing advancements in MSW handling technologies to provide a landfill that will be environmentally safe yet able to accommodate new paradigms for MSW disposal.

The Solitude Landfill's advances in MSW handling combined with competition for rail contracts have created significant transportation cost savings allowing MSW to be transported longer distances with minimal increase in cost. These advancements have placed a number of metropolitan areas within the Solitude Landfill market area.

It is clear that when evaluated in all areas including siting, design, transportation corridors, public and environmental safety, use of technology advancements, economics, closure and post closure maintenances the Solitude Landfill will be the most efficient and popular Class V landfill in the State of Utah.

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[31] Reason Public Policy Institute, *Mandates or Incentives? Comparing Packaging Regulations with User Fees for Trash Collection* by Lynn Scarlett page 21

[32] Chartwell Information Solid Waste Market Data & Research, April 10, 2003.

[33] City of Houston, Public Works and Engineering Department, *Survey of Large Cities' Solid Waste management Systems,* revised April 1999

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Segal, G.F. and Moore, A.T. Reason Public Policy Institute *Privatizing Landfills: Market Solutions for Solid-Waste Disposal,* May 2000

Lynn Scarlett, Reason Public Policy Institute, *Mandates or Incentives? Comparing Packaging Regulations with User Fees for Trash Collection* May 1993

AGREEMENT FOR SOLID WASTE DISPOSAL

THIS AGREEMENT is made and entered into as of this 13th day of August, 2002, by and between the City of Green River, a municipal corporation with official mailing address at P.O. Box 620 Green River, Utah 84525 (the "City") and Landfill Investors, L.L.C., a Nevada limited liability company ("Landfill"), as the authorized Agent-in-Fact for Green River Landfill, LLC, a Utah limited liability company ("Green River") (Landfill and Green River may sometimes hereinafter be collectively referred to as the "Owner"), whose mailing address is 4570 Westgrove Drive, Suite 240 Addison, Texas 75001.

WHEREAS, Owner owns a parcel of land located within the jurisdictional boundaries of the City and may from time to time acquire additional land contiguous to said parcel for the purpose of constructing and operation a Class V landfill (with the Municipal Exemption); and

WHEREAS, Owner has applied for a Class V Solid Waste (with the Municipal Exemption) Permit in the name of the *Solitude Landfill* ("Solitude") from the State of Utah, Department of Environmental Quality, Division of Solid and Hazardous Waste; and

WHEREAS, Owner and the City entered into a Memorandum of Understanding on the 12th day of February 2002 (the "MOU") which, among other matters, contemplates that prior to the City's issuance of certain permits for the construction, development and operation of Solitude by Owner, the City and Owner will negotiate and agree upon the Host Fees that will be due and payable to the City by Owner as a result of Owner's operation of Solitude (the "Host Fees"); and

WHEREAS, the Utah Solid Waste Management Act, Section 26-32-1, et. seq., Utah Code Annotated 1953, as amended (the "Act"), provides that the governing body of a public entity may assume, by agreement, responsibility for the collection and disposition of solid waste whether generated within or outside of it's jurisdictional boundaries and that the said governing body may enter into long-term agreements with private entities to provide for the operation of a solid waste management facility; and

WHEREAS, the City and Owner are desirous of expanding the benefits provided to the City under the MOU by contracting with each other to provide for the disposal and management of solid waste generated by households, governmental offices and retail establishments within the City (the "City's Solid Waste"), provided that in any given year the annual tonnage of such solid waste does not exceed the prior years tonnage by more than ten percent (10%).

Initials: BJS

NOW THEREFORE, for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the City and Owner agree as follows:

1. *Disposal Site for the City's Solid Waste.* Owner agrees to provide, at no cost to the City, a space within Solitude for the disposal of the City's Solid Waste; provided, however, that the City's Solid Waste must be lawfully transported to Solitude by commercial carriers only at the City's sole expense. City and Owner further agree that Solitude shall not be open or otherwise be made available for access by the general public and that access thereto for the deposit of the City's Solid Waste shall be restricted to those entities licensed by City and approved by Owner for the transport of the City's Solid Waste from the City to Solitude; provided such entities deliver or transport City's Solid Waste in a manner consistent with current practices for the transportation and delivery of the City's Solid Waste to landfills currently owned or operated by Emery County, Utah.

   Owner hereby reserves the right to reject for disposal any and all of the City's Solid Waste which may be legally classified or identified as a material or substance other than Solid Waste as defined by the Act.

2. *No Host Fee Due for the City's Solid Waste.* Owner shall not owe, nor be liable to, the City for payment of any Host Fees for the disposal in Solitude of the City's Solid Waste.

3. *Term of Agreement.* This Agreement shall be effective upon its execution by City and Owner; provided, however, Owner shall not be obligated to accept the City's Solid Waster for deposit or disposal in Solitude until Owner commences operations at Solitude. This Agreement shall continue in full force and effect (i) so long as Solitude remains in operation under applicable permits issued by the State of Utah and the City or (ii) for ten (10) years following the first acceptance of the City's Solid Waste in Solitude, whichever occurs first.

   The City will have an option to renew this contract for an additional period of ten (10) years.

4. *Assignment.* This Agreement shall be assignable by Owner only upon the consent of City; provided that the City shall not unreasonably withhold such consent and provided further that the City's prior consent shall not be required for an assignment by Owner to any person or entity currently affiliated with Owner or any assignment by City to Owner.

5. *Applicable Law; Venue.* This Agreement shall be constructed and enforced in accordance with the provisions of the laws of the State of Utah. Venue of any actions brought to enforce, construe, cancel, terminate, rescind or recover for the breach of the provisions of the Agreement shall be in the courts of Salt Lake County, Utah.

Initials: BJS

6. *Entire Agreement.* The City and Owner acknowledge and agree that this Agreement contains the entire agreement between them and supercedes all previous discussions and oral agreements between them relating in any way to the arrangements for the deposit and delivery of the City's Solid Waste in Solitude and may only be modified or amended by a written agreement executed by both the Owner and the City.

7. *Agreement Binding.* This Agreement shall be binding upon and inure to the benefit of the City's and Owner's successors and assigns.

8. *Enforceability:* The City and Owner represent and warrant to the other that this Agreement is the authorized action of each, that this Agreement is duly executed in conformity with the requirements of all applicable law and that this Agreement is enforceable in accordance with its terms.

This Agreement was executed by Owner and presented to the Governing Body of the City of Green River and was accepted and approved by that Governing Body on the 13th day of August, 2002.

Attest:

Conae Black
City Recorder

City of Green River

By: _____
Its Mayor

Landfill Investors, LLC., on behalf of itself and as Agent-in-Fact for Green River, LLC

By: _____
Its President

Initials: BJS

Michael O. Leavitt
Governor

Kathleen Clark
Executive Director

John Kimball
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

1594 West North Temple, Suite 2110
PO Box 146301
Salt Lake City, Utah 84114-6301
801-538-4700
801-538-4709 (Fax)
801-538-7458 (TTY)

January 10, 2002

Gretchen A. Semerad
ATC Associates, Inc.
2681 Parleys Way, Suite 106
Salt Lake City, UT 84109

Dear Ms. Semerad,

I am writing in response to your request dated December 27, 2001 for information regarding species of special concern proximal to the proposed Solitude Landfill project in Green River, Utah.

The Utah Division of Wildlife Resources (UDWR) does not have records of occurrence for any threatened, endangered, or sensitive species in the area of the proposed landfill site.

The information provided in this letter is based on data existing in the Utah Division of Wildlife Resources' central database at the time of the request. It should not be regarded as a final statement on the occurrence of any species on or near the designated site, nor should it be considered a substitute for on-the-ground biological surveys. Moreover, because the Utah Division of Wildlife Resources' central database is continually updated, and because data requests are evaluated for the specific type of proposed action, any given response is only appropriate for its respective request.

In addition to the information you requested, other significant wildlife values might also be present on the designated site. Please contact UDWR's regional habitat manager, Derris Jones, at (435) 636-0267, if you have any questions.

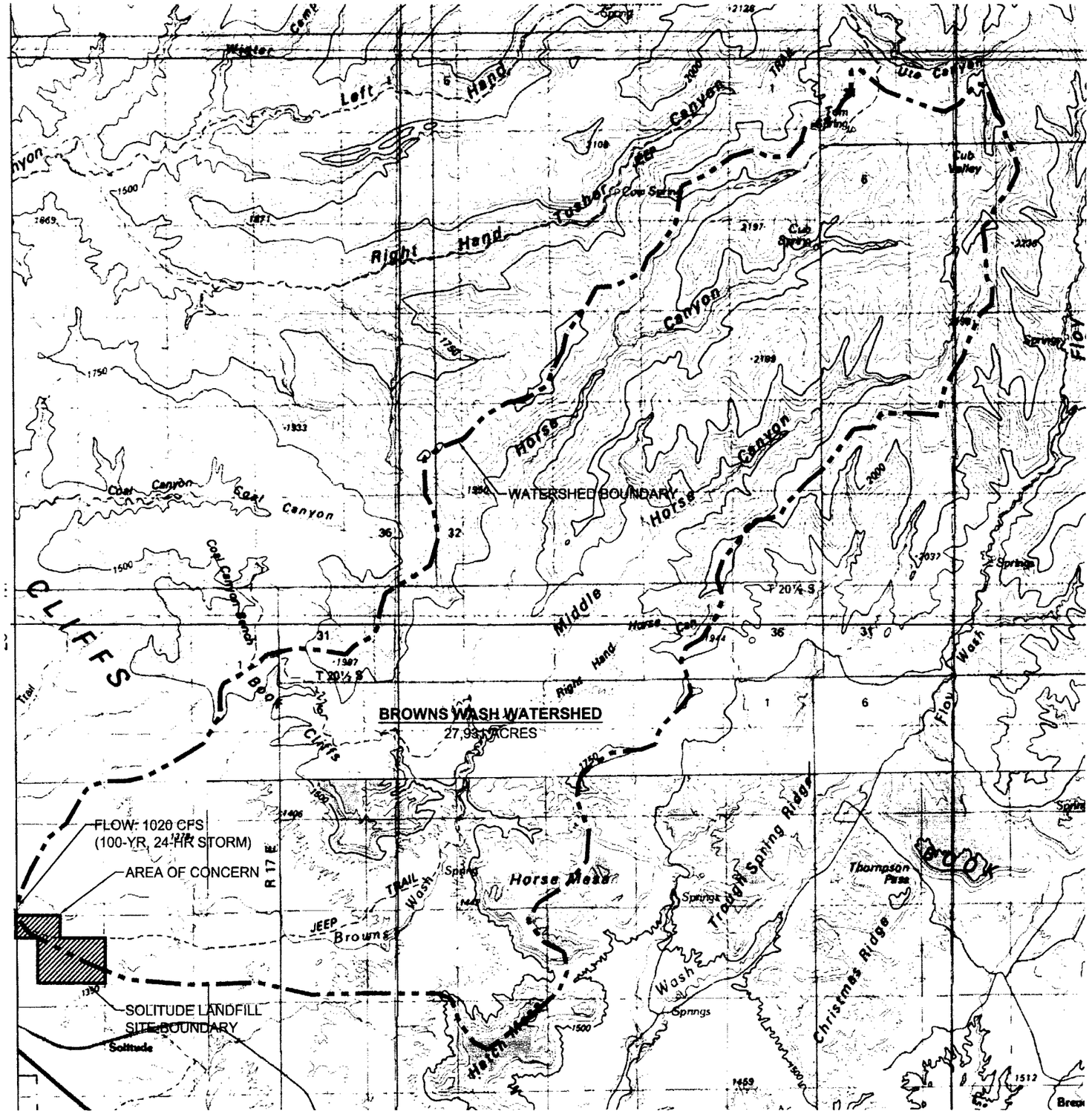
The UNHP normally charges for this type of request, but due to the small amount of research and time required to fulfill this request, you will not be charged for this information. Please contact our office at (801) 538-4759 if you require further assistance.

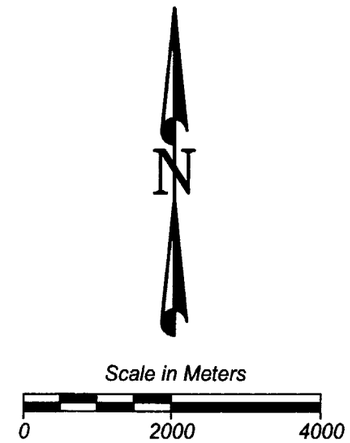
Sincerely,
Anne Axel
Information Manger

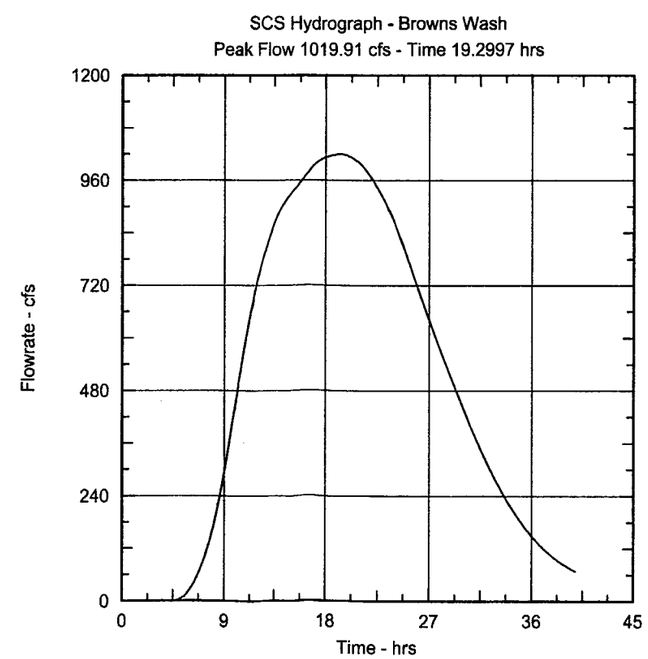
APPENDIX G ENGINEERING CALCULATIONS

SOLITUDE LANDFILL

BROWNS WASH
SURFACE HYDROLOGY







SOLITUDE LANDFILL
Browns Wash Surface Water Hydrology

TR-20 SCS Method

Given Input Data:

Description	Browns Wash
Drainage area	27930.74 ac
Runoff curve number, CN	65
Time of concentration, Tc	12.1455 hrs
Dimensionless Hydrograph	scsdim
Rainfall	2.63 in
Distribution Curve	tr20t2: Type 2, 24 hrs
Duration	24.0000 hrs
Antecendent Moisture Condition	Type II
Time Increment, Tp	0.1000 hrs

Computed Results:

Peak discharge, qp	1019.91 cfs
Peak Time, Tp	19.30 hrs
Peak rate factor	484
Constant, K	0.7500
Runoff Volume	0.68 in
	19273.54 cfs-hrs
	1592.77 acft

Hydraulics - Culvert Calculator

Given Input Data:

Channel Type.....Trapezoidal
Flow Rate.....1020 cfs
Slope.....0.0035 ft/ft
Manning's Roughness.....0.02 (Earth Channel)
Side Slope.....3H:1V
Base Width.....25 ft

Computed Results:

Velocity.....8.3305 fps
Area.....258.11 sf
Perimeter.....62.98 ft
Wetted Area.....122.32 sf
Wetted Perimeter.....46.88 ft
Hydraulic Radius.....2.61 ft
Top Width.....45.76 ft
Percent Full.....57.62 ft
Depth of Flow.....3.46 ft

Hydrograph Output

```
#Units=Time,hrs,Flowrate,cfs
#SCS Hydrograph Data
#Time - hrs   Flowrate - cfs
#------------ -------------
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4.80000000,0.69966364
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38.90000000,82.58875943
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39.20000000,77.82119181
39.30000000,76.29424489
39.40000000,74.79634384
39.50000000,73.32733608
39.60000000,71.89011693
39.70000000,70.48484582

39.80000000,69.11010796
39.90000000,69.10957415

Purpose: Calculate max discharge of ~~mean~~ max outfall and use this flowrate to size the silt fence.

Assume: Flow from all contributing Areas peak at same time
Four outfalls
25-yr, 24-hr storm
Waste cell is [illegible] (largest flow)
? "disturbed" I belive, meaning cell has been stripped of vegetation

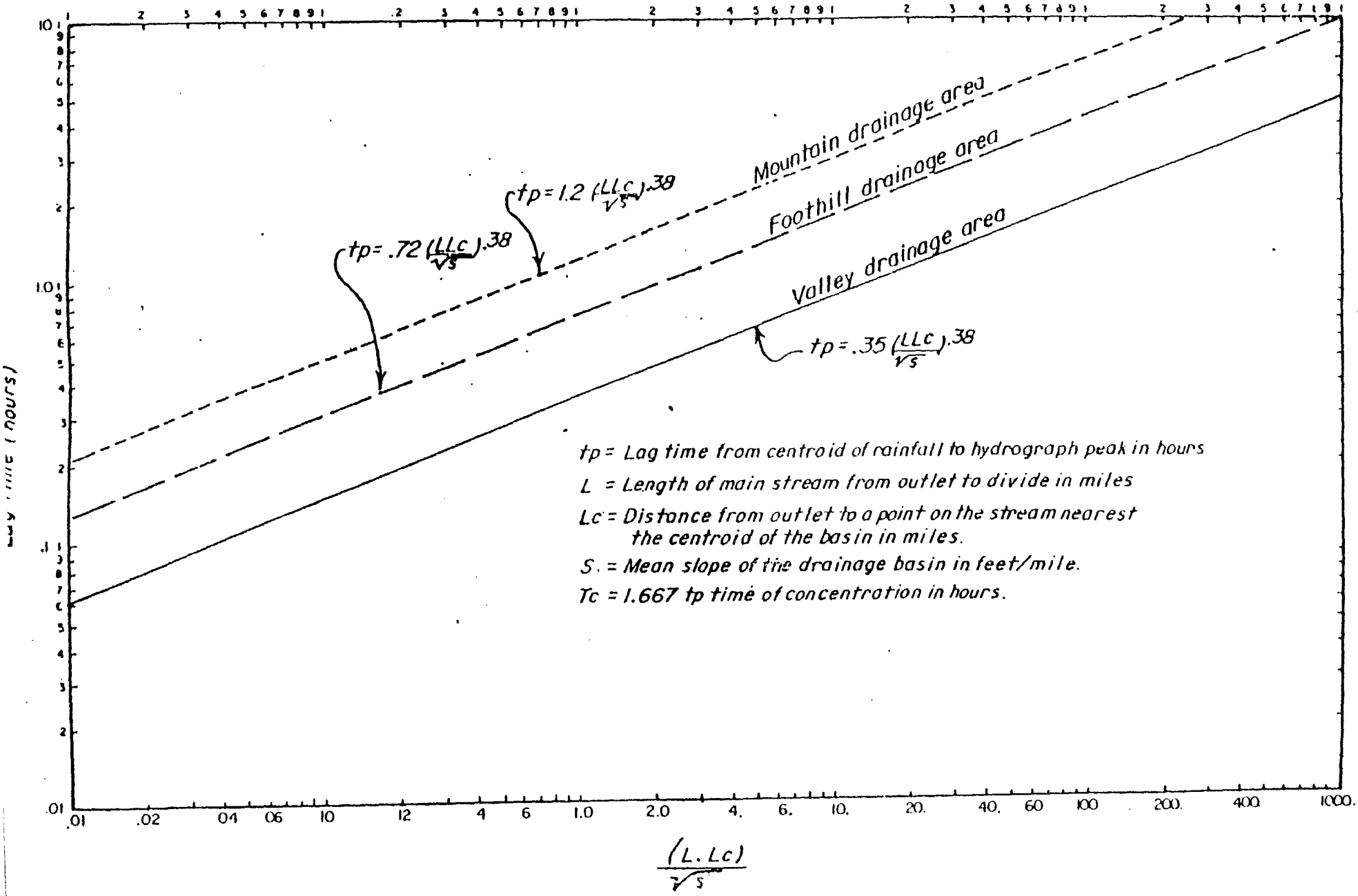
Determine Outfall Flows

1 →	1/2 of Area A	8
	Area B	60
	Area C	205
	Waste cell (200 acres)	375
		648 cfs

2 →	1/2 of Area A	8
	Waste cell (15 acres)	28
		36 cfs

3 →	Waste cell (65 acres)	122 cfs

4 →	[illegible] cell (40 acres)	130
		75
		205 cfs



Relationship between basin lag and basin characteristics (U.S. Corps of Engineers)

Purpose: Calculate runon from upgradient areas that surround the proposed site from the 25 yr - 24 hr and 100 yr - 24 hr storm.

Assume: Runon from areas shown on attached sheet
Use SCS method to calculate runoff
CN = 92 (Design of Small Dams, BOR 1977)
Areas are undisturbed with poor-condition herbaceous vegetation
Soil group is ? → not sure, almost certain it is D
25 yr, 24 hr storm = 2.0" (NOAA Atlas 2, 1973)
100 yr, 24 hr storm = 2.5"
Four areas ? produce runon

? probably just delete

	Area (mi^2)
A	0.014
B	0.058
C	0.19
D	0.14

Determine Time of Concentration (t_c)

$$t_c = 1.667\,(C)\left[(L)(L_c)(S)^{-1/2}\right]^{0.38}$$

C = constant based on drainage area
0.35 for valley drainage
0.72 for foothill drainage
1.2 for mountain drainage
L = Length of main stream (miles)
L_c = Distance from outlet to centroid of area (miles)
S = Mean slope (feet/mile)

A →
L = 500'
L_c = 200'
S = 265 feet/mile
C = 0.72
t_c = 0.05 hr

B →
L = 2000'
L_c = 700'
S = 90
C = 0.72
t_c = 0.16 hr

C →
L = 1700'
L_c = 510'
S = 220
C = 0.72
t_c = 0.10 hr

D →
L = 2800
L_c = 1200
S = 170
C = 0.72
t_c = 0.20 hr

ITEX, Site Runoff (Undisturbed, 0.25 sq. miles), 100-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 2.500 DURATION = 24.0 RUNOFF = 1.693

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
22.500	.0030	.0028	4.52	
22.600	.0030	.0028	4.52	
22.700	.0030	.0028	4.52	
22.800	.0030	.0028	4.52	
22.900	.0030	.0028	4.52	
23.000	.0030	.0028	4.52	
23.100	.0030	.0028	4.52	
23.200	.0030	.0028	4.52	
23.300	.0030	.0028	4.52	
23.400	.0030	.0028	4.53	
23.500	.0030	.0028	4.53	
23.600	.0030	.0028	4.53	
23.700	.0030	.0028	4.53	
23.800	.0030	.0028	4.53	
23.900	.0030	.0028	4.53	
24.000	.0030	.0028	4.53	
24.100	.0000	.0000	4.53	
24.200	.0000	.0000	1.50	
24.300	.0000	.0000	.34	
24.400	.0000	.0000	.06	
24.500	.0000	.0000	.00	
TOTALS	2.500	1.6931	2761.68	

STORM HYDROGRAPH VOLUME = 22.82 ACRE-FEET

MAXIMUN STORM DISCHARGE = 362.05 CFS

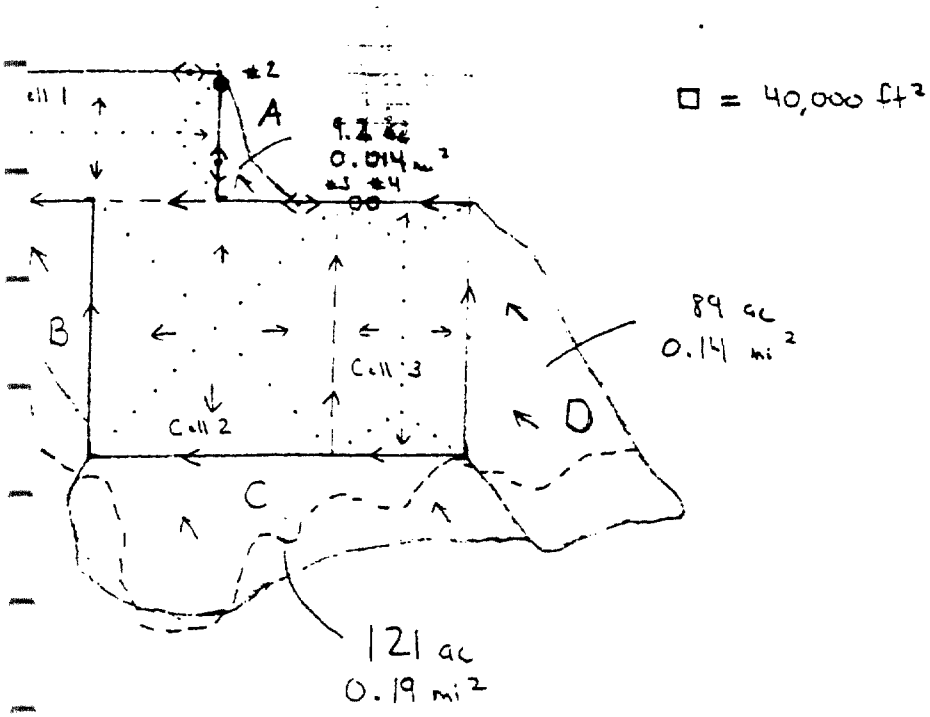
Calculate Runoff

Flow (cfs)

Area	25-yr 24-hr	100-yr 24-hr	10-yr, 24-hr
A	15	20	12
B	60	80	42
C	205	275	150
D	130	175	110
	410		

AMPAD 22-142 100 SHEETS 22-144 200 SHEETS

ITEX , 2106-006 , DEW, 11/15/94



□ = 40,000 ft²

culate Drainage Areas

ITEX, Drainage "A" Runon, 25-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.237
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00	
.100	.0024	.0000	.00	
.200	.0024	.0000	.00	
.300	.0024	.0000	.00	
.400	.0024	.0000	.00	
.500	.0024	.0000	.00	
.600	.0024	.0000	.00	
.700	.0024	.0000	.00	
.800	.0024	.0000	.00	
.900	.0024	.0000	.00	
1.000	.0024	.0000	.00	
		NO RUNOFF		
6.500	.0040	.0000	.00	
6.600	.0040	.0001	.00	
6.700	.0040	.0001	.01	
6.800	.0040	.0001	.01	
6.900	.0040	.0002	.01	
7.000	.0040	.0002	.02	
7.100	.0040	.0002	.02	
7.200	.0040	.0003	.02	
7.300	.0040	.0003	.02	
7.400	.0040	.0003	.03	
7.500	.0040	.0004	.03	
7.600	.0040	.0004	.03	
7.700	.0040	.0004	.04	
7.800	.0040	.0005	.04	
7.900	.0040	.0005	.04	
8.000	.0040	.0005	.04	
8.100	.0054	.0008	.05	
8.200	.0054	.0008	.06	
8.300	.0054	.0009	.07	
8.400	.0054	.0009	.08	
8.500	.0054	.0010	.08	
8.600	.0054	.0010	.08	
8.700	.0054	.0011	.09	
8.800	.0054	.0011	.09	
8.900	.0054	.0012	.10	
9.000	.0054	.0012	.10	
9.100	.0064	.0015	.11	
9.200	.0064	.0016	.13	
9.300	.0064	.0016	.14	
9.400	.0064	.0017	.14	
9.500	.0064	.0017	.15	
9.600	.0072	.0020	.15	

9.700	.0072	.0021	.17
9.800	.0072	.0022	.18
9.900	.0072	.0022	.19
10.000	.0072	.0023	.19
10.100	.0092	.0030	.20
10.200	.0092	.0031	.26
10.300	.0092	.0032	.27
10.400	.0092	.0033	.28
10.500	.0092	.0034	.29
10.600	.0124	.0048	.30
10.700	.0124	.0050	.40
10.800	.0124	.0051	.43
10.900	.0124	.0053	.45
11.000	.0124	.0054	.46
11.100	.0192	.0087	.47
11.200	.0192	.0090	.72
11.300	.0192	.0093	.78
11.400	.0192	.0096	.81
11.500	.0192	.0099	.84
11.600	.0832	.0461	.87
11.700	.0832	.0504	3.61
11.800	.1520	.1011	4.33
11.900	.2208	.1621	8.26
12.000	.2208	.1749	13.43
12.100	.0288	.0235	15.12
12.200	.0288	.0237	3.85
12.300	.0288	.0238	2.24
12.400	.0288	.0240	2.09
12.500	.0288	.0241	2.10
12.600	.0148	.0124	2.11
12.700	.0148	.0125	1.23
12.800	.0148	.0125	1.10
12.900	.0148	.0125	1.09
13.000	.0148	.0126	1.10
13.100	.0108	.0092	1.10
13.200	.0108	.0092	.84
13.300	.0108	.0092	.81
13.400	.0108	.0092	.81
13.500	.0108	.0092	.81
13.600	.0084	.0072	.81
13.700	.0084	.0072	.66
13.800	.0084	.0072	.63
13.900	.0084	.0072	.63
14.000	.0084	.0072	.63
14.100	.0060	.0052	.63
14.200	.0060	.0052	.48
14.300	.0060	.0052	.46
14.400	.0060	.0052	.45
14.500	.0060	.0052	.45
14.600	.0060	.0052	.45
14.700	.0060	.0052	.46
14.800	.0060	.0052	.46
14.900	.0060	.0052	.46
15.000	.0060	.0052	.46
15.100	.0060	.0052	.46

15.200	.0060	.0052	.46
15.300	.0060	.0052	.46
15.400	.0060	.0052	.46
15.500	.0060	.0052	.46
15.600	.0060	.0052	.46
15.700	.0060	.0052	.46
15.800	.0060	.0052	.46
15.900	.0060	.0052	.46
16.000	.0060	.0052	.46
16.100	.0036	.0031	.46
16.200	.0036	.0032	.30
16.300	.0036	.0032	.28
16.400	.0036	.0032	.28
16.500	.0036	.0032	.28
16.600	.0036	.0032	.28
16.700	.0036	.0032	.28
16.800	.0036	.0032	.28
16.900	.0036	.0032	.28
17.000	.0036	.0032	.28
17.100	.0036	.0032	.28
17.200	.0036	.0032	.28
17.300	.0036	.0032	.28
17.400	.0036	.0032	.28
17.500	.0036	.0032	.28
17.600	.0036	.0032	.28
17.700	.0036	.0032	.28
17.800	.0036	.0032	.28
17.900	.0036	.0032	.28
18.000	.0036	.0032	.28
18.100	.0036	.0032	.28
18.200	.0036	.0032	.28
18.300	.0036	.0032	.28
18.400	.0036	.0032	.28
18.500	.0036	.0032	.28
18.600	.0036	.0032	.28
18.700	.0036	.0032	.28
18.800	.0036	.0032	.28
18.900	.0036	.0032	.28
19.000	.0036	.0032	.28
19.100	.0036	.0032	.28
19.200	.0036	.0032	.28
19.300	.0036	.0032	.28
19.400	.0036	.0032	.28
19.500	.0036	.0032	.28
19.600	.0036	.0032	.28
19.700	.0036	.0032	.28
19.800	.0036	.0032	.28
19.900	.0036	.0032	.28
20.000	.0036	.0032	.28
20.100	.0024	.0021	.28
20.200	.0024	.0021	.20
20.300	.0024	.0021	.19
20.400	.0024	.0021	.19
20.500	.0024	.0021	.19
20.600	.0024	.0021	.19

20.700	.0024	.0021	.19
20.800	.0024	.0021	.19
20.900	.0024	.0021	.19
21.000	.0024	.0021	.19
21.100	.0024	.0021	.19
21.200	.0024	.0021	.19
21.300	.0024	.0021	.19
21.400	.0024	.0021	.19
21.500	.0024	.0021	.19
21.600	.0024	.0021	.19
21.700	.0024	.0021	.19
21.800	.0024	.0021	.19
21.900	.0024	.0021	.19
22.000	.0024	.0021	.19
22.100	.0024	.0021	.19
22.200	.0024	.0021	.19
22.300	.0024	.0021	.19
22.400	.0024	.0021	.19
22.500	.0024	.0021	.19
22.600	.0024	.0021	.19
22.700	.0024	.0021	.19
22.800	.0024	.0021	.19
22.900	.0024	.0021	.19
23.000	.0024	.0021	.19
23.100	.0024	.0021	.19
23.200	.0024	.0021	.19
23.300	.0024	.0021	.19
23.400	.0024	.0021	.19
23.500	.0024	.0021	.19
23.600	.0024	.0021	.19
23.700	.0024	.0021	.19
23.800	.0024	.0021	.19
23.900	.0024	.0021	.19
24.000	.0024	.0021	.19
24.100	.0000	.0000	.19
24.200	.0000	.0000	.03
24.300	.0000	.0000	.00
24.400	.0000	.0000	.00
TOTALS	2.000	1.2370	108.44

STORM HYDROGRAPH VOLUME = .90 ACRE-FEET
MAXIMUN STORM DISCHARGE = 15.12 CFS

ITEX, Drainage "B" Runon, 25-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.237
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00	
.100	.0024	.0000	.00	
.200	.0024	.0000	.00	
.300	.0024	.0000	.00	
.400	.0024	.0000	.00	
.500	.0024	.0000	.00	
.600	.0024	.0000	.00	
.700	.0024	.0000	.00	
.800	.0024	.0000	.00	
.900	.0024	.0000	.00	
1.000	.0024	.0000	.00	
		NO RUNOFF		
6.400	.0040	.0000	.00	
6.500	.0040	.0000	.00	
6.600	.0040	.0001	.01	
6.700	.0040	.0001	.02	
6.800	.0040	.0001	.03	
6.900	.0040	.0002	.04	
7.000	.0040	.0002	.06	
7.100	.0040	.0002	.07	
7.200	.0040	.0003	.08	
7.300	.0040	.0003	.10	
7.400	.0040	.0003	.11	
7.500	.0040	.0004	.12	
7.600	.0040	.0004	.13	
7.700	.0040	.0004	.15	
7.800	.0040	.0005	.16	
7.900	.0040	.0005	.17	
8.000	.0040	.0005	.18	
8.100	.0054	.0008	.19	
8.200	.0054	.0008	.23	
8.300	.0054	.0009	.28	
8.400	.0054	.0009	.31	
8.500	.0054	.0010	.33	
8.600	.0054	.0010	.35	
8.700	.0054	.0011	.37	
8.800	.0054	.0011	.39	
8.900	.0054	.0012	.41	
9.000	.0054	.0012	.43	
9.100	.0064	.0015	.45	
9.200	.0064	.0016	.50	
9.300	.0064	.0016	.56	
9.400	.0064	.0017	.59	
9.500	.0064	.0017	.62	
9.600	.0072	.0020	.64	

9.700	.0072	..0021	.70
9.800	.0072	.0022	.76
9.900	.0072	.0022	.80
10.000	.0072	.0023	.83
10.100	.0092	.0030	.86
10.200	.0092	.0031	.98
10.300	.0092	.0032	1.12
10.400	.0092	.0033	1.19
10.500	.0092	.0034	1.24
10.600	.0124	.0048	1.28
10.700	.0124	.0050	1.51
10.800	.0124	.0051	1.75
10.900	.0124	.0053	1.87
11.000	.0124	.0054	1.95
11.100	.0192	.0087	2.02
11.200	.0192	.0090	2.55
11.300	.0192	.0093	3.12
11.400	.0192	.0096	3.39
11.500	.0192	.0099	3.56
11.600	.0832	.0461	3.69
11.700	.0832	.0504	9.30
11.800	.1520	.1011	15.58
11.900	.2208	.1621	25.81
12.000	.2208	.1749	43.83
12.100	.0288	.0235	58.07
12.200	.0288	.0237	40.86
12.300	.0288	.0238	19.52
12.400	.0288	.0240	12.61
12.500	.0288	.0241	10.07
12.600	.0148	.0124	9.15
12.700	.0148	.0125	7.40
12.800	.0148	.0125	5.61
12.900	.0148	.0125	5.04
13.000	.0148	.0126	4.84
13.100	.0108	.0092	4.78
13.200	.0108	.0092	4.27
13.300	.0108	.0092	3.75
13.400	.0108	.0092	3.59
13.500	.0108	.0092	3.54
13.600	.0084	.0072	3.52
13.700	.0084	.0072	3.21
13.800	.0084	.0072	2.90
13.900	.0084	.0072	2.80
14.000	.0084	.0072	2.77
14.100	.0060	.0052	2.76
14.200	.0060	.0052	2.44
14.300	.0060	.0052	2.13
14.400	.0060	.0052	2.02
14.500	.0060	.0052	1.99
14.600	.0060	.0052	1.98
14.700	.0060	.0052	1.98
14.800	.0060	.0052	1.98
14.900	.0060	.0052	1.98
15.000	.0060	.0052	1.98
15.100	.0060	.0052	1.99

15.200	.0060	.0052	1.99
15.300	.0060	.0052	1.99
15.400	.0060	.0052	1.99
15.500	.0060	.0052	1.99
15.600	.0060	.0052	1.99
15.700	.0060	.0052	2.00
15.800	.0060	.0052	2.00
15.900	.0060	.0052	2.00
16.000	.0060	.0052	2.00
16.100	.0036	.0031	2.00
16.200	.0036	.0032	1.68
16.300	.0036	.0032	1.36
16.400	.0036	.0032	1.25
16.500	.0036	.0032	1.22
16.600	.0036	.0032	1.20
16.700	.0036	.0032	1.20
16.800	.0036	.0032	1.20
16.900	.0036	.0032	1.21
17.000	.0036	.0032	1.21
17.100	.0036	.0032	1.21
17.200	.0036	.0032	1.21
17.300	.0036	.0032	1.21
17.400	.0036	.0032	1.21
17.500	.0036	.0032	1.21
17.600	.0036	.0032	1.21
17.700	.0036	.0032	1.21
17.800	.0036	.0032	1.21
17.900	.0036	.0032	1.21
18.000	.0036	.0032	1.21
18.100	.0036	.0032	1.21
18.200	.0036	.0032	1.21
18.300	.0036	.0032	1.21
18.400	.0036	.0032	1.21
18.500	.0036	.0032	1.21
18.600	.0036	.0032	1.21
18.700	.0036	.0032	1.21
18.800	.0036	.0032	1.21
18.900	.0036	.0032	1.21
19.000	.0036	.0032	1.21
19.100	.0036	.0032	1.22
19.200	.0036	.0032	1.22
19.300	.0036	.0032	1.22
19.400	.0036	.0032	1.22
19.500	.0036	.0032	1.22
19.600	.0036	.0032	1.22
19.700	.0036	.0032	1.22
19.800	.0036	.0032	1.22
19.900	.0036	.0032	1.22
20.000	.0036	.0032	1.22
20.100	.0024	.0021	1.22
20.200	.0024	.0021	1.06
20.300	.0024	.0021	.89
20.400	.0024	.0021	.84
20.500	.0024	.0021	.82
20.600	.0024	.0021	.81

20.700	.0024	.0021	.81
20.800	.0024	.0021	.81
20.900	.0024	.0021	.81
21.000	.0024	.0021	.81
21.100	.0024	.0021	.82
21.200	.0024	.0021	.82
21.300	.0024	.0021	.82
21.400	.0024	.0021	.82
21.500	.0024	.0021	.82
21.600	.0024	.0021	.82
21.700	.0024	.0021	.82
21.800	.0024	.0021	.82
21.900	.0024	.0021	.82
22.000	.0024	.0021	.82
22.100	.0024	.0021	.82
22.200	.0024	.0021	.82
22.300	.0024	.0021	.82
22.400	.0024	.0021	.82
22.500	.0024	.0021	.82
22.600	.0024	.0021	.82
22.700	.0024	.0021	.82
22.800	.0024	.0021	.82
22.900	.0024	.0021	.82
23.000	.0024	.0021	.82
23.100	.0024	.0021	.82
23.200	.0024	.0021	.82
23.300	.0024	.0021	.82
23.400	.0024	.0021	.82
23.500	.0024	.0021	.82
23.600	.0024	.0021	.82
23.700	.0024	.0021	.82
23.800	.0024	.0021	.82
23.900	.0024	.0021	.82
24.000	.0024	.0021	.82
24.100	.0000	.0000	.82
24.200	.0000	.0000	.49
24.300	.0000	.0000	.16
24.400	.0000	.0000	.05
24.500	.0000	.0000	.01
24.600	.0000	.0000	.00
TOTALS	2.000	1.2370	472.13

STORM HYDROGRAPH VOLUME = 3.90 ACRE-FEET
MAXIMUN STORM DISCHARGE = 58.07 CFS

ITEX, Drainage "C" Runon, 25-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.237

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00
.100	.0024	.0000	.00
.200	.0024	.0000	.00
.300	.0024	.0000	.00
.400	.0024	.0000	.00
.500	.0024	.0000	.00
.600	.0024	.0000	.00
.700	.0024	.0000	.00
.800	.0024	.0000	.00
.900	.0024	.0000	.00
1.000	.0024	.0000	.00
		NO RUNOFF	
6.400	.0040	.0000	.00
6.500	.0040	.0000	.00
6.600	.0040	.0001	.03
6.700	.0040	.0001	.07
6.800	.0040	.0001	.12
6.900	.0040	.0002	.16
7.000	.0040	.0002	.20
7.100	.0040	.0002	.25
7.200	.0040	.0003	.29
7.300	.0040	.0003	.33
7.400	.0040	.0003	.37
7.500	.0040	.0004	.41
7.600	.0040	.0004	.45
7.700	.0040	.0004	.49
7.800	.0040	.0005	.53
7.900	.0040	.0005	.57
8.000	.0040	.0005	.60
8.100	.0054	.0008	.64
8.200	.0054	.0008	.85
8.300	.0054	.0009	.97
8.400	.0054	.0009	1.05
8.500	.0054	.0010	1.11
8.600	.0054	.0010	1.17
8.700	.0054	.0011	1.24
8.800	.0054	.0011	1.30
8.900	.0054	.0012	1.36
9.000	.0054	.0012	1.42
9.100	.0064	.0015	1.47
9.200	.0064	.0016	1.73
9.300	.0064	.0016	1.87
9.400	.0064	.0017	1.97
9.500	.0064	.0017	2.05
9.600	.0072	.0020	2.12

9.700	.0072	.0021	2.38
9.800	.0072	.0022	2.54
9.900	.0072	.0022	2.64
10.000	.0072	.0023	2.73
10.100	.0092	.0030	2.82
10.200	.0092	.0031	3.45
10.300	.0092	.0032	3.78
10.400	.0092	.0033	3.96
10.500	.0092	.0034	4.09
10.600	.0124	.0048	4.21
10.700	.0124	.0050	5.37
10.800	.0124	.0051	5.95
10.900	.0124	.0053	6.24
11.000	.0124	.0054	6.45
11.100	.0192	.0087	6.65
11.200	.0192	.0090	9.41
11.300	.0192	.0093	10.74
11.400	.0192	.0096	11.36
11.500	.0192	.0099	11.80
11.600	.0832	.0461	12.17
11.700	.0832	.0504	42.26
11.800	.1520	.1011	57.34
11.900	.2208	.1621	103.47
12.000	.2208	.1749	171.02
12.100	.0288	.0235	204.99
12.200	.0288	.0237	89.22
12.300	.0288	.0238	43.38
12.400	.0288	.0240	31.98
12.500	.0288	.0241	29.64
12.600	.0148	.0124	29.80
12.700	.0148	.0125	20.19
12.800	.0148	.0125	16.53
12.900	.0148	.0125	15.66
13.000	.0148	.0126	15.51
13.100	.0108	.0092	15.55
13.200	.0108	.0092	12.76
13.300	.0108	.0092	11.71
13.400	.0108	.0092	11.47
13.500	.0108	.0092	11.43
13.600	.0084	.0072	11.45
13.700	.0084	.0072	9.76
13.800	.0084	.0072	9.12
13.900	.0084	.0072	8.97
14.000	.0084	.0072	8.95
14.100	.0060	.0052	8.96
14.200	.0060	.0052	7.26
14.300	.0060	.0052	6.61
14.400	.0060	.0052	6.45
14.500	.0060	.0052	6.42
14.600	.0060	.0052	6.43
14.700	.0060	.0052	6.43
14.800	.0060	.0052	6.44
14.900	.0060	.0052	6.44
15.000	.0060	.0052	6.45
15.100	.0060	.0052	6.45

15.200	.0060	.0052	6.46
15.300	.0060	.0052	6.46
15.400	.0060	.0052	6.47
15.500	.0060	.0052	6.47
15.600	.0060	.0052	6.48
15.700	.0060	.0052	6.48
15.800	.0060	.0052	6.49
15.900	.0060	.0052	6.49
16.000	.0060	.0052	6.50
16.100	.0036	.0031	6.50
16.200	.0036	.0032	4.77
16.300	.0036	.0032	4.10
16.400	.0036	.0032	3.94
16.500	.0036	.0032	3.91
16.600	.0036	.0032	3.91
16.700	.0036	.0032	3.91
16.800	.0036	.0032	3.91
16.900	.0036	.0032	3.91
17.000	.0036	.0032	3.92
17.100	.0036	.0032	3.92
17.200	.0036	.0032	3.92
17.300	.0036	.0032	3.92
17.400	.0036	.0032	3.92
17.500	.0036	.0032	3.92
17.600	.0036	.0032	3.93
17.700	.0036	.0032	3.93
17.800	.0036	.0032	3.93
17.900	.0036	.0032	3.93
18.000	.0036	.0032	3.93
18.100	.0036	.0032	3.93
18.200	.0036	.0032	3.93
18.300	.0036	.0032	3.94
18.400	.0036	.0032	3.94
18.500	.0036	.0032	3.94
18.600	.0036	.0032	3.94
18.700	.0036	.0032	3.94
18.800	.0036	.0032	3.94
18.900	.0036	.0032	3.95
19.000	.0036	.0032	3.95
19.100	.0036	.0032	3.95
19.200	.0036	.0032	3.95
19.300	.0036	.0032	3.95
19.400	.0036	.0032	3.95
19.500	.0036	.0032	3.95
19.600	.0036	.0032	3.96
19.700	.0036	.0032	3.96
19.800	.0036	.0032	3.96
19.900	.0036	.0032	3.96
20.000	.0036	.0032	3.96
20.100	.0024	.0021	3.96
20.200	.0024	.0021	3.08
20.300	.0024	.0021	2.74
20.400	.0024	.0021	2.66
20.500	.0024	.0021	2.64
20.600	.0024	.0021	2.64

20.700	.0024	.0021	2.65
20.800	.0024	.0021	2.65
20.900	.0024	.0021	2.65
21.000	.0024	.0021	2.65
21.100	.0024	.0021	2.65
21.200	.0024	.0021	2.65
21.300	.0024	.0021	2.65
21.400	.0024	.0021	2.65
21.500	.0024	.0021	2.65
21.600	.0024	.0021	2.65
21.700	.0024	.0021	2.65
21.800	.0024	.0021	2.65
21.900	.0024	.0021	2.65
22.000	.0024	.0021	2.65
22.100	.0024	.0021	2.65
22.200	.0024	.0021	2.65
22.300	.0024	.0021	2.65
22.400	.0024	.0021	2.66
22.500	.0024	.0021	2.66
22.600	.0024	.0021	2.66
22.700	.0024	.0021	2.66
22.800	.0024	.0021	2.66
22.900	.0024	.0021	2.66
23.000	.0024	.0021	2.66
23.100	.0024	.0021	2.66
23.200	.0024	.0021	2.66
23.300	.0024	.0021	2.66
23.400	.0024	.0021	2.66
23.500	.0024	.0021	2.66
23.600	.0024	.0021	2.66
23.700	.0024	.0021	2.66
23.800	.0024	.0021	2.66
23.900	.0024	.0021	2.66
24.000	.0024	.0021	2.66
24.100	.0000	.0000	2.66
24.200	.0000	.0000	.88
24.300	.0000	.0000	.20
24.400	.0000	.0000	.04
24.500	.0000	.0000	.00
TOTALS	2.000	1.2370	1533.46

STORM HYDROGRAPH VOLUME = 12.67 ACRE-FEET
MAXIMUN STORM DISCHARGE = 204.99 CFS

ITEX, Drainage "D" Runon, 25-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.237
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00	
.100	.0024	.0000	.00	
.200	.0024	.0000	.00	
.300	.0024	.0000	.00	
.400	.0024	.0000	.00	
.500	.0024	.0000	.00	
.600	.0024	.0000	.00	
.700	.0024	.0000	.00	
.800	.0024	.0000	.00	
.900	.0024	.0000	.00	
1.000	.0024	.0000	.00	
	NO RUNOFF			
6.400	.0040	.0000	.00	
6.500	.0040	.0000	.00	
6.600	.0040	.0001	.01	
6.700	.0040	.0001	.03	
6.800	.0040	.0001	.06	
6.900	.0040	.0002	.09	
7.000	.0040	.0002	.12	
7.100	.0040	.0002	.15	
7.200	.0040	.0003	.19	
7.300	.0040	.0003	.22	
7.400	.0040	.0003	.25	
7.500	.0040	.0004	.28	
7.600	.0040	.0004	.30	
7.700	.0040	.0004	.33	
7.800	.0040	.0005	.36	
7.900	.0040	.0005	.39	
8.000	.0040	.0005	.42	
8.100	.0054	.0008	.44	
8.200	.0054	.0008	.52	
8.300	.0054	.0009	.63	
8.400	.0054	.0009	.71	
8.500	.0054	.0010	.76	
8.600	.0054	.0010	.82	
8.700	.0054	.0011	.86	
8.800	.0054	.0011	.91	
8.900	.0054	.0012	.95	
9.000	.0054	.0012	.99	
9.100	.0064	.0015	1.04	
9.200	.0064	.0016	1.14	
9.300	.0064	.0016	1.27	
9.400	.0064	.0017	1.36	
9.500	.0064	.0017	1.43	
9.600	.0072	.0020	1.49	

9.700	.0072	.0021	1.61
9.800	.0072	.0022	1.75
9.900	.0072	.0022	1.85
10.000	.0072	.0023	1.92
10.100	.0092	.0030	1.99
10.200	.0092	.0031	2.23
10.300	.0092	.0032	2.55
10.400	.0092	.0033	2.74
10.500	.0092	.0034	2.87
10.600	.0124	.0048	2.98
10.700	.0124	.0050	3.39
10.800	.0124	.0051	3.97
10.900	.0124	.0053	4.31
11.000	.0124	.0054	4.53
11.100	.0192	.0087	4.70
11.200	.0192	.0090	5.64
11.300	.0192	.0093	7.00
11.400	.0192	.0096	7.76
11.500	.0192	.0099	8.23
11.600	.0832	.0461	8.59
11.700	.0832	.0504	18.01
11.800	.1520	.1011	32.80
11.900	.2208	.1621	53.31
12.000	.2208	.1749	90.93
12.100	.0288	.0235	126.84
12.200	.0288	.0237	107.03
12.300	.0288	.0238	57.63
12.400	.0288	.0240	35.80
12.500	.0288	.0241	27.20
12.600	.0148	.0124	23.13
12.700	.0148	.0125	18.64
12.800	.0148	.0125	14.30
12.900	.0148	.0125	12.40
13.000	.0148	.0126	11.68
13.100	.0108	.0092	11.38
13.200	.0108	.0092	10.42
13.300	.0108	.0092	9.16
13.400	.0108	.0092	8.61
13.500	.0108	.0092	8.41
13.600	.0084	.0072	8.33
13.700	.0084	.0072	7.78
13.800	.0084	.0072	7.02
13.900	.0084	.0072	6.69
14.000	.0084	.0072	6.57
14.100	.0060	.0052	6.51
14.200	.0060	.0052	5.97
14.300	.0060	.0052	5.20
14.400	.0060	.0052	4.87
14.500	.0060	.0052	4.74
14.600	.0060	.0052	4.68
14.700	.0060	.0052	4.66
14.800	.0060	.0052	4.67
14.900	.0060	.0052	4.67
15.000	.0060	.0052	4.67
15.100	.0060	.0052	4.68

15.200	.0060	.0052	4.68
15.300	.0060	.0052	4.69
15.400	.0060	.0052	4.69
15.500	.0060	.0052	4.69
15.600	.0060	.0052	4.70
15.700	.0060	.0052	4.70
15.800	.0060	.0052	4.70
15.900	.0060	.0052	4.71
16.000	.0060	.0052	4.71
16.100	.0036	.0031	4.71
16.200	.0036	.0032	4.18
16.300	.0036	.0032	3.39
16.400	.0036	.0032	3.05
16.500	.0036	.0032	2.92
16.600	.0036	.0032	2.86
16.700	.0036	.0032	2.84
16.800	.0036	.0032	2.84
16.900	.0036	.0032	2.84
17.000	.0036	.0032	2.84
17.100	.0036	.0032	2.84
17.200	.0036	.0032	2.84
17.300	.0036	.0032	2.84
17.400	.0036	.0032	2.84
17.500	.0036	.0032	2.85
17.600	.0036	.0032	2.85
17.700	.0036	.0032	2.85
17.800	.0036	.0032	2.85
17.900	.0036	.0032	2.85
18.000	.0036	.0032	2.85
18.100	.0036	.0032	2.85
18.200	.0036	.0032	2.85
18.300	.0036	.0032	2.85
18.400	.0036	.0032	2.86
18.500	.0036	.0032	2.86
18.600	.0036	.0032	2.86
18.700	.0036	.0032	2.86
18.800	.0036	.0032	2.86
18.900	.0036	.0032	2.86
19.000	.0036	.0032	2.86
19.100	.0036	.0032	2.86
19.200	.0036	.0032	2.86
19.300	.0036	.0032	2.86
19.400	.0036	.0032	2.87
19.500	.0036	.0032	2.87
19.600	.0036	.0032	2.87
19.700	.0036	.0032	2.87
19.800	.0036	.0032	2.87
19.900	.0036	.0032	2.87
20.000	.0036	.0032	2.87
20.100	.0024	.0021	2.87
20.200	.0024	.0021	2.60
20.300	.0024	.0021	2.20
20.400	.0024	.0021	2.03
20.500	.0024	.0021	1.96
20.600	.0024	.0021	1.93

20.700	.0024	.0021	1.92
20.800	.0024	.0021	1.92
20.900	.0024	.0021	1.92
21.000	.0024	.0021	1.92
21.100	.0024	.0021	1.92
21.200	.0024	.0021	1.92
21.300	.0024	.0021	1.92
21.400	.0024	.0021	1.92
21.500	.0024	.0021	1.92
21.600	.0024	.0021	1.92
21.700	.0024	.0021	1.92
21.800	.0024	.0021	1.92
21.900	.0024	.0021	1.92
22.000	.0024	.0021	1.92
22.100	.0024	.0021	1.92
22.200	.0024	.0021	1.92
22.300	.0024	.0021	1.93
22.400	.0024	.0021	1.93
22.500	.0024	.0021	1.93
22.600	.0024	.0021	1.93
22.700	.0024	.0021	1.93
22.800	.0024	.0021	1.93
22.900	.0024	.0021	1.93
23.000	.0024	.0021	1.93
23.100	.0024	.0021	1.93
23.200	.0024	.0021	1.93
23.300	.0024	.0021	1.93
23.400	.0024	.0021	1.93
23.500	.0024	.0021	1.93
23.600	.0024	.0021	1.93
23.700	.0024	.0021	1.93
23.800	.0024	.0021	1.93
23.900	.0024	.0021	1.93
24.000	.0024	.0021	1.93
24.100	.0000	.0000	1.93
24.200	.0000	.0000	1.39
24.300	.0000	.0000	.58
24.400	.0000	.0000	.22
24.500	.0000	.0000	.08
24.600	.0000	.0000	.02
24.700	.0000	.0000	.00
TOTALS	2.000	1.2370	1112.24

STORM HYDROGRAPH VOLUME = 9.19 ACRE-FEET
MAXIMUN STORM DISCHARGE = 126.84 CFS

ITEX, Drainage "A" Runon, 10-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 1.600 DURATION = 24.0 RUNOFF = .886

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.500	.0019	.0016	.14
23.600	.0019	.0016	.14
23.700	.0019	.0016	.14
23.800	.0019	.0016	.14
23.900	.0019	.0016	.14
24.000	.0019	.0016	.14
24.100	.0000	.0000	.14
24.200	.0000	.0000	.02
24.300	.0000	.0000	.00
24.400	.0000	.0000	.00
TOTALS	1.600	.8859	77.66

STORM HYDROGRAPH VOLUME = .64 ACRE-FEET

MAXIMUN STORM DISCHARGE = 11.07 CFS

ITEX, Drainage "B" Runon, 10-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 1.600 DURATION = 24.0 RUNOFF = .886
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.800	.0019	.0016	.63
23.900	.0019	.0016	.63
24.000	.0019	.0016	.63
24.100	.0000	.0000	.63
24.200	.0000	.0000	.38
24.300	.0000	.0000	.12
24.400	.0000	.0000	.04
24.500	.0000	.0000	.01
24.600	.0000	.0000	.00
TOTALS	1.600	.8859	338.12

STORM HYDROGRAPH VOLUME = 2.79 ACRE-FEET
MAXIMUN STORM DISCHARGE = 41.98 CFS

ITEX, Drainage "C" Runon, 10-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 1.600 DURATION = 24.0 RUNOFF = .886

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.100	.0019	.0016	2.03
23.200	.0019	.0016	2.03
23.300	.0019	.0016	2.03
23.400	.0019	.0016	2.03
23.500	.0019	.0016	2.03
23.600	.0019	.0016	2.04
23.700	.0019	.0016	2.04
23.800	.0019	.0016	2.04
23.900	.0019	.0016	2.04
24.000	.0019	.0016	2.04
24.100	.0000	.0000	2.04
24.200	.0000	.0000	.68
24.300	.0000	.0000	.16
24.400	.0000	.0000	.03
24.500	.0000	.0000	.00
TOTALS	1.600	.8859	1098.20

STORM HYDROGRAPH VOLUME = 9.08 ACRE-FEET

MAXIMUN STORM DISCHARGE = 149.38 CFS

ITEX, Drainage "D" Runon, 10-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 1.600 DURATION = 24.0 RUNOFF = .886

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.400	.0019	.0016	1.50
23.500	.0019	.0016	1.50
23.600	.0019	.0016	1.50
23.700	.0019	.0016	1.50
23.800	.0019	.0016	1.50
23.900	.0019	.0016	1.50
24.000	.0019	.0016	1.50
24.100	.0000	.0000	1.50
24.200	.0000	.0000	.50
24.300	.0000	.0000	.11
24.400	.0000	.0000	.02
24.500	.0000	.0000	.00
TOTALS	1.600	.8859	809.20

STORM HYDROGRAPH VOLUME = 6.69 ACRE-FEET

MAXIMUN STORM DISCHARGE = 110.07 CFS

0.25 mile²

Purpose: Calculate runoff from upgradient area (0.25 mi²) of the landfill. Assume both disturbed and undisturbed conditions.

Assume: Use SCS method to calculate runoff from landfill.
CN = 94 for disturbed areas. Viessman, 1989
CN - 92 for undisturbed areas.
$t_c \simeq 0$, [illegible] because runoff is [illegible] → basically saying time of concentration (t_c) is zero because runoff is instaneous.

instantaneous? ~~instantaneous?~~

not exactly sure, need to look @ my Viessman book.

25 yr 24 hr storm = 2.0"
100 yr 24 hr storm 2.5"
10 yr, 24 hr storm = 1.0"

Results From STORM

Runoff from 0.25 mile² area (cfs)
~~Runoff from 0.25 mile² area (cfs)~~

	25-yr 24-hr	100-yr 24-hr	10-yr 24-hr
Disturbed	300	390	225
Undisturbed	270	365	

ITEX, Site Runoff (Disturbed, 0.25 sq. miles), 25-yr, 24 hr Storm
STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.396
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =94.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00	
.100	.0024	.0000	.00	
.200	.0024	.0000	.00	
.300	.0024	.0000	.00	
.400	.0024	.0000	.00	
.500	.0024	.0000	.00	
		No Runoff		
4.900	.0032	.0000	.00	
5.000	.0032	.0000	.00	
5.100	.0032	.0000	.00	
5.200	.0032	.0001	.02	
5.300	.0032	.0001	.06	
5.400	.0032	.0001	.11	
5.500	.0032	.0001	.16	
5.600	.0032	.0002	.21	
5.700	.0032	.0002	.26	
5.800	.0032	.0002	.31	
5.900	.0032	.0003	.36	
6.000	.0032	.0003	.40	
6.100	.0040	.0004	.45	
6.200	.0040	.0004	.59	
6.300	.0040	.0005	.68	
6.400	.0040	.0005	.76	
6.500	.0040	.0006	.82	
6.600	.0040	.0006	.89	
6.700	.0040	.0006	.96	
6.800	.0040	.0007	1.02	
6.900	.0040	.0007	1.08	
7.000	.0040	.0008	1.14	
7.100	.0040	.0008	1.21	
7.200	.0040	.0008	1.27	
7.300	.0040	.0009	1.32	
7.400	.0040	.0009	1.38	
7.500	.0040	.0009	1.44	
7.600	.0040	.0010	1.49	
7.700	.0040	.0010	1.55	
7.800	.0040	.0010	1.60	
7.900	.0040	.0011	1.66	
8.000	.0040	.0011	1.71	
8.100	.0054	.0015	1.76	
8.200	.0054	.0016	2.25	
8.300	.0054	.0016	2.49	
8.400	.0054	.0017	2.62	
8.500	.0054	.0017	2.71	
8.600	.0054	.0018	2.80	

8.700	.0054	.0018	2.88
8.800	.0054	.0019	2.96
8.900	.0054	.0019	3.04
9.000	.0054	.0020	3.12
9.100	.0064	.0024	3.20
9.200	.0064	.0025	3.68
9.300	.0064	.0025	3.94
9.400	.0064	.0026	4.07
9.500	.0064	.0026	4.18
9.600	.0072	.0030	4.28
9.700	.0072	.0031	4.74
9.800	.0072	.0032	4.99
9.900	.0072	.0033	5.14
10.000	.0072	.0033	5.26
10.100	.0092	.0043	5.36
10.200	.0092	.0044	6.50
10.300	.0092	.0045	7.04
10.400	.0092	.0046	7.30
10.500	.0092	.0047	7.47
10.600	.0124	.0065	7.62
10.700	.0124	.0066	9.61
10.800	.0124	.0068	10.54
10.900	.0124	.0069	10.95
11.000	.0124	.0071	11.22
11.100	.0192	.0112	11.45
11.200	.0192	.0115	16.04
11.300	.0192	.0118	18.11
11.400	.0192	.0121	18.98
11.500	.0192	.0123	19.51
11.600	.0832	.0561	19.94
11.700	.0832	.0597	67.73
11.800	.1520	.1163	89.96
11.900	.2208	.1809	157.66
12.000	.2208	.1905	253.00
12.100	.0288	.0254	296.25
12.200	.0288	.0255	128.13
12.300	.0288	.0256	61.78
12.400	.0288	.0257	45.25
12.500	.0288	.0258	41.81
12.600	.0148	.0133	41.96
12.700	.0148	.0133	28.40
12.800	.0148	.0133	23.22
12.900	.0148	.0133	21.98
13.000	.0148	.0134	21.74
13.100	.0108	.0098	21.78
13.200	.0108	.0098	17.87
13.300	.0108	.0098	16.38
13.400	.0108	.0098	16.03
13.500	.0108	.0098	15.97
13.600	.0084	.0076	15.99
13.700	.0084	.0076	13.62
13.800	.0084	.0076	12.73
13.900	.0084	.0077	12.51
14.000	.0084	.0077	12.48
14.100	.0060	.0055	12.49

14.200	.0060	.0055	10.11
14.300	.0060	.0055	9.20
14.400	.0060	.0055	8.98
14.500	.0060	.0055	8.94
14.600	.0060	.0055	8.94
14.700	.0060	.0055	8.95
14.800	.0060	.0055	8.95
14.900	.0060	.0055	8.96
15.000	.0060	.0055	8.96
15.100	.0060	.0055	8.97
15.200	.0060	.0055	8.97
15.300	.0060	.0055	8.98
15.400	.0060	.0055	8.98
15.500	.0060	.0055	8.98
15.600	.0060	.0055	8.99
15.700	.0060	.0055	8.99
15.800	.0060	.0055	9.00
15.900	.0060	.0055	9.00
16.000	.0060	.0055	9.01
16.100	.0036	.0033	9.01
16.200	.0036	.0033	6.60
16.300	.0036	.0033	5.68
16.400	.0036	.0033	5.46
16.500	.0036	.0033	5.41
16.600	.0036	.0033	5.41
16.700	.0036	.0033	5.42
16.800	.0036	.0033	5.42
16.900	.0036	.0033	5.42
17.000	.0036	.0033	5.42
17.100	.0036	.0033	5.42
17.200	.0036	.0033	5.42
17.300	.0036	.0033	5.42
17.400	.0036	.0033	5.43
17.500	.0036	.0033	5.43
17.600	.0036	.0033	5.43
17.700	.0036	.0033	5.43
17.800	.0036	.0033	5.43
17.900	.0036	.0033	5.43
18.000	.0036	.0033	5.43
18.100	.0036	.0033	5.43
18.200	.0036	.0033	5.44
18.300	.0036	.0033	5.44
18.400	.0036	.0033	5.44
18.500	.0036	.0033	5.44
18.600	.0036	.0033	5.44
18.700	.0036	.0033	5.44
18.800	.0036	.0033	5.44
18.900	.0036	.0033	5.45
19.000	.0036	.0033	5.45
19.100	.0036	.0033	5.45
19.200	.0036	.0033	5.45
19.300	.0036	.0033	5.45
19.400	.0036	.0033	5.45
19.500	.0036	.0033	5.45
19.600	.0036	.0033	5.45

19.700	.0036	.0033	5.46
19.800	.0036	.0033	5.46
19.900	.0036	.0033	5.46
20.000	.0036	.0033	5.46
20.100	.0024	.0022	5.46
20.200	.0024	.0022	4.24
20.300	.0024	.0022	3.78
20.400	.0024	.0022	3.67
20.500	.0024	.0022	3.64
20.600	.0024	.0022	3.64
20.700	.0024	.0022	3.64
20.800	.0024	.0022	3.64
20.900	.0024	.0022	3.64
21.000	.0024	.0022	3.65
21.100	.0024	.0022	3.65
21.200	.0024	.0022	3.65
21.300	.0024	.0022	3.65
21.400	.0024	.0022	3.65
21.500	.0024	.0022	3.65
21.600	.0024	.0022	3.65
21.700	.0024	.0022	3.65
21.800	.0024	.0022	3.65
21.900	.0024	.0022	3.65
22.000	.0024	.0022	3.65
22.100	.0024	.0022	3.65
22.200	.0024	.0022	3.65
22.300	.0024	.0022	3.65
22.400	.0024	.0022	3.65
22.500	.0024	.0022	3.65
22.600	.0024	.0022	3.65
22.700	.0024	.0022	3.65
22.800	.0024	.0022	3.65
22.900	.0024	.0022	3.66
23.000	.0024	.0022	3.66
23.100	.0024	.0022	3.66
23.200	.0024	.0022	3.66
23.300	.0024	.0022	3.66
23.400	.0024	.0022	3.66
23.500	.0024	.0022	3.66
23.600	.0024	.0022	3.66
23.700	.0024	.0022	3.66
23.800	.0024	.0022	3.66
23.900	.0024	.0022	3.66
24.000	.0024	.0022	3.66
24.100	.0000	.0000	3.66
24.200	.0000	.0000	1.21
24.300	.0000	.0000	.28
24.400	.0000	.0000	.05
24.500	.0000	.0000	.00
TOTALS	2.000	1.3963	2277.54

STORM HYDROGRAPH VOLUME = 18.82 ACRE-FEET
MAXIMUM STORM DISCHARGE = 296.25 CFS

ITEX, Site Runoff (Undisturbed, 0.25 sq. miles), 25-yr, 24 hr Storm
STORM HYDROGRAPH RAIN = 2.000 DURATION = 24.0 RUNOFF = 1.237
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00
.100	.0024	.0000	.00
.200	.0024	.0000	.00
.300	.0024	.0000	.00
	No Runoff		
6.200	.0040	.0000	.00
6.300	.0040	.0000	.00
6.400	.0040	.0000	.00
6.500	.0040	.0000	.01
6.600	.0040	.0001	.04
6.700	.0040	.0001	.10
6.800	.0040	.0001	.15
6.900	.0040	.0002	.21
7.000	.0040	.0002	.27
7.100	.0040	.0002	.32
7.200	.0040	.0003	.38
7.300	.0040	.0003	.43
7.400	.0040	.0003	.49
7.500	.0040	.0004	.54
7.600	.0040	.0004	.59
7.700	.0040	.0004	.64
7.800	.0040	.0005	.70
7.900	.0040	.0005	.75
8.000	.0040	.0005	.80
8.100	.0054	.0008	.84
8.200	.0054	.0008	1.11
8.300	.0054	.0009	1.27
8.400	.0054	.0009	1.38
8.500	.0054	.0010	1.46
8.600	.0054	.0010	1.55
8.700	.0054	.0011	1.63
8.800	.0054	.0011	1.71
8.900	.0054	.0012	1.79
9.000	.0054	.0012	1.86
9.100	.0064	.0015	1.94
9.200	.0064	.0016	2.27
9.300	.0064	.0016	2.46
9.400	.0064	.0017	2.59
9.500	.0064	.0017	2.69
9.600	.0072	.0020	2.79
9.700	.0072	.0021	3.13
9.800	.0072	.0022	3.34
9.900	.0072	.0022	3.47
10.000	.0072	.0023	3.59
10.100	.0092	.0030	3.70

10.200	.0092	.0031	4.54
10.300	.0092	.0032	4.97
10.400	.0092	.0033	5.20
10.500	.0092	.0034	5.38
10.600	.0124	.0048	5.54
10.700	.0124	.0050	7.07
10.800	.0124	.0051	7.82
10.900	.0124	.0053	8.21
11.000	.0124	.0054	8.49
11.100	.0192	.0087	8.74
11.200	.0192	.0090	12.38
11.300	.0192	.0093	14.13
11.400	.0192	.0096	14.95
11.500	.0192	.0099	15.52
11.600	.0832	.0461	16.01
11.700	.0832	.0504	55.61
11.800	.1520	.1011	75.44
11.900	.2208	.1621	136.14
12.000	.2208	.1749	225.03
12.100	.0288	.0235	269.72
12.200	.0288	.0237	117.40
12.300	.0288	.0238	57.07
12.400	.0288	.0240	42.08
12.500	.0288	.0241	39.00
12.600	.0148	.0124	39.21
12.700	.0148	.0125	26.57
12.800	.0148	.0125	21.75
12.900	.0148	.0125	20.61
13.000	.0148	.0126	20.41
13.100	.0108	.0092	20.46
13.200	.0108	.0092	16.79
13.300	.0108	.0092	15.41
13.400	.0108	.0092	15.09
13.500	.0108	.0092	15.04
13.600	.0084	.0072	15.06
13.700	.0084	.0072	12.84
13.800	.0084	.0072	12.00
13.900	.0084	.0072	11.81
14.000	.0084	.0072	11.78
14.100	.0060	.0052	11.79
14.200	.0060	.0052	9.55
14.300	.0060	.0052	8.69
14.400	.0060	.0052	8.49
14.500	.0060	.0052	8.45
14.600	.0060	.0052	8.46
14.700	.0060	.0052	8.46
14.800	.0060	.0052	8.47
14.900	.0060	.0052	8.48
15.000	.0060	.0052	8.48
15.100	.0060	.0052	8.49
15.200	.0060	.0052	8.50
15.300	.0060	.0052	8.50
15.400	.0060	.0052	8.51
15.500	.0060	.0052	8.52
15.600	.0060	.0052	8.52

15.700	.0060	.0052	8.53
15.800	.0060	.0052	8.54
15.900	.0060	.0052	8.54
16.000	.0060	.0052	8.55
16.100	.0036	.0031	8.55
16.200	.0036	.0032	6.27
16.300	.0036	.0032	5.40
16.400	.0036	.0032	5.19
16.500	.0036	.0032	5.14
16.600	.0036	.0032	5.14
16.700	.0036	.0032	5.15
16.800	.0036	.0032	5.15
16.900	.0036	.0032	5.15
17.000	.0036	.0032	5.15
17.100	.0036	.0032	5.15
17.200	.0036	.0032	5.16
17.300	.0036	.0032	5.16
17.400	.0036	.0032	5.16
17.500	.0036	.0032	5.16
17.600	.0036	.0032	5.17
17.700	.0036	.0032	5.17
17.800	.0036	.0032	5.17
17.900	.0036	.0032	5.17
18.000	.0036	.0032	5.17
18.100	.0036	.0032	5.18
18.200	.0036	.0032	5.18
18.300	.0036	.0032	5.18
18.400	.0036	.0032	5.18
18.500	.0036	.0032	5.18
18.600	.0036	.0032	5.18
18.700	.0036	.0032	5.19
18.800	.0036	.0032	5.19
18.900	.0036	.0032	5.19
19.000	.0036	.0032	5.19
19.100	.0036	.0032	5.19
19.200	.0036	.0032	5.20
19.300	.0036	.0032	5.20
19.400	.0036	.0032	5.20
19.500	.0036	.0032	5.20
19.600	.0036	.0032	5.20
19.700	.0036	.0032	5.21
19.800	.0036	.0032	5.21
19.900	.0036	.0032	5.21
20.000	.0036	.0032	5.21
20.100	.0024	.0021	5.21
20.200	.0024	.0021	4.05
20.300	.0024	.0021	3.61
20.400	.0024	.0021	3.50
20.500	.0024	.0021	3.48
20.600	.0024	.0021	3.48
20.700	.0024	.0021	3.48
20.800	.0024	.0021	3.48
20.900	.0024	.0021	3.48
21.000	.0024	.0021	3.48
21.100	.0024	.0021	3.48

21.200	.0024	.0021	3.48
21.300	.0024	.0021	3.49
21.400	.0024	.0021	3.49
21.500	.0024	.0021	3.49
21.600	.0024	.0021	3.49
21.700	.0024	.0021	3.49
21.800	.0024	.0021	3.49
21.900	.0024	.0021	3.49
22.000	.0024	.0021	3.49
22.100	.0024	.0021	3.49
22.200	.0024	.0021	3.49
22.300	.0024	.0021	3.49
22.400	.0024	.0021	3.49
22.500	.0024	.0021	3.49
22.600	.0024	.0021	3.50
22.700	.0024	.0021	3.50
22.800	.0024	.0021	3.50
22.900	.0024	.0021	3.50
23.000	.0024	.0021	3.50
23.100	.0024	.0021	3.50
23.200	.0024	.0021	3.50
23.300	.0024	.0021	3.50
23.400	.0024	.0021	3.50
23.500	.0024	.0021	3.50
23.600	.0024	.0021	3.50
23.700	.0024	.0021	3.50
23.800	.0024	.0021	3.50
23.900	.0024	.0021	3.51
24.000	.0024	.0021	3.51
24.100	.0000	.0000	3.51
24.200	.0000	.0000	1.16
24.300	.0000	.0000	.27
24.400	.0000	.0000	.05
24.500	.0000	.0000	.00
TOTALS	2.000	1.2370	2017.71

STORM HYDROGRAPH VOLUME = 16.68 ACRE-FEET
MAXIMUM STORM DISCHARGE = 269.72 CFS

ITEX, Site Runoff (Disturbed, 0.25 sq. miles), 100-yr, 24 hr Storm
STORM HYDROGRAPH RAIN = 2.500 DURATION = 24.0 RUNOFF = 1.869
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =94.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00
.100	.0030	.0000	.00
.200	.0030	.0000	.00
.300	.0030	.0000	.00
	No Runoff		
4.200	.0040	.0000	.00
4.300	.0040	.0000	.00
4.400	.0040	.0001	.03
4.500	.0040	.0001	.10
4.600	.0040	.0002	.17
4.700	.0040	.0002	.25
4.800	.0040	.0003	.33
4.900	.0040	.0003	.40
5.000	.0040	.0004	.48
5.100	.0040	.0004	.55
5.200	.0040	.0004	.62
5.300	.0040	.0005	.69
5.400	.0040	.0005	.76
5.500	.0040	.0006	.82
5.600	.0040	.0006	.89
5.700	.0040	.0006	.96
5.800	.0040	.0007	1.02
5.900	.0040	.0007	1.08
6.000	.0040	.0008	1.14
6.100	.0050	.0010	1.21
6.200	.0050	.0010	1.49
6.300	.0050	.0011	1.65
6.400	.0050	.0012	1.76
6.500	.0050	.0012	1.85
6.600	.0050	.0013	1.94
6.700	.0050	.0013	2.02
6.800	.0050	.0014	2.10
6.900	.0050	.0014	2.18
7.000	.0050	.0015	2.26
7.100	.0050	.0015	2.34
7.200	.0050	.0015	2.42
7.300	.0050	.0016	2.49
7.400	.0050	.0016	2.57
7.500	.0050	.0017	2.64
7.600	.0050	.0017	2.71
7.700	.0050	.0018	2.78
7.800	.0050	.0018	2.84
7.900	.0050	.0018	2.91
8.000	.0050	.0019	2.98
8.100	.0067	.0026	3.04
8.200	.0067	.0027	3.85
8.300	.0068	.0027	4.22

8.400	.0068	.0028	4.40
8.500	.0067	.0029	4.52
8.600	.0068	.0029	4.62
8.700	.0068	.0030	4.73
8.800	.0067	.0030	4.83
8.900	.0068	.0031	4.92
9.000	.0068	.0032	5.02
9.100	.0080	.0038	5.11
9.200	.0080	.0039	5.85
9.300	.0080	.0040	6.22
9.400	.0080	.0040	6.39
9.500	.0080	.0041	6.52
9.600	.0090	.0047	6.64
9.700	.0090	.0048	7.32
9.800	.0090	.0049	7.67
9.900	.0090	.0049	7.85
10.000	.0090	.0050	7.99
10.100	.0115	.0065	8.12
10.200	.0115	.0066	9.79
10.300	.0115	.0067	10.56
10.400	.0115	.0068	10.88
10.500	.0115	.0070	11.09
10.600	.0155	.0095	11.27
10.700	.0155	.0097	14.13
10.800	.0155	.0099	15.41
10.900	.0155	.0100	15.93
11.000	.0155	.0102	16.25
11.100	.0240	.0161	16.51
11.200	.0240	.0164	23.00
11.300	.0240	.0167	25.83
11.400	.0240	.0170	26.92
11.500	.0240	.0173	27.53
11.600	.1040	.0777	27.99
11.700	.1040	.0815	93.99
11.800	.1900	.1564	123.40
11.900	.2760	.2392	212.83
12.000	.2760	.2486	336.02
12.100	.0360	.0329	388.48
12.200	.0360	.0330	167.43
12.300	.0360	.0331	80.38
12.400	.0360	.0332	58.67
12.500	.0360	.0333	54.11
12.600	.0185	.0171	54.25
12.700	.0185	.0172	36.69
12.800	.0185	.0172	29.99
12.900	.0185	.0172	28.37
13.000	.0185	.0172	28.05
13.100	.0135	.0126	28.08
13.200	.0135	.0126	23.03
13.300	.0135	.0126	21.11
13.400	.0135	.0126	20.65
13.500	.0135	.0126	20.56
13.600	.0105	.0098	20.58
13.700	.0105	.0098	17.53
13.800	.0105	.0098	16.38
13.900	.0105	.0098	16.10
14.000	.0105	.0098	16.05

14.100	.0075	.0070	16.05
14.200	.0075	.0070	12.99
14.300	.0075	.0070	11.83
14.400	.0075	.0070	11.54
14.500	.0075	.0070	11.49
14.600	.0075	.0070	11.49
14.700	.0075	.0071	11.50
14.800	.0075	.0071	11.50
14.900	.0075	.0071	11.50
15.000	.0075	.0071	11.51
15.100	.0075	.0071	11.51
15.200	.0075	.0071	11.52
15.300	.0075	.0071	11.52
15.400	.0075	.0071	11.52
15.500	.0075	.0071	11.53
15.600	.0075	.0071	11.53
15.700	.0075	.0071	11.54
15.800	.0075	.0071	11.54
15.900	.0075	.0071	11.54
16.000	.0075	.0071	11.55
16.100	.0045	.0043	11.55
16.200	.0045	.0043	8.47
16.300	.0045	.0043	7.29
16.400	.0045	.0043	7.00
16.500	.0045	.0043	6.94
16.600	.0045	.0043	6.94
16.700	.0045	.0043	6.94
16.800	.0045	.0043	6.94
16.900	.0045	.0043	6.94
17.000	.0045	.0043	6.94
17.100	.0045	.0043	6.94
17.200	.0045	.0043	6.95
17.300	.0045	.0043	6.95
17.400	.0045	.0043	6.95
17.500	.0045	.0043	6.95
17.600	.0045	.0043	6.95
17.700	.0045	.0043	6.95
17.800	.0045	.0043	6.95
17.900	.0045	.0043	6.96
18.000	.0045	.0043	6.96
18.100	.0045	.0043	6.96
18.200	.0045	.0043	6.96
18.300	.0045	.0043	6.96
18.400	.0045	.0043	6.96
18.500	.0045	.0043	6.96
18.600	.0045	.0043	6.96
18.700	.0045	.0043	6.97
18.800	.0045	.0043	6.97
18.900	.0045	.0043	6.97
19.000	.0045	.0043	6.97
19.100	.0045	.0043	6.97
19.200	.0045	.0043	6.97
19.300	.0045	.0043	6.97
19.400	.0045	.0043	6.97
19.500	.0045	.0043	6.97
19.600	.0045	.0043	6.98
19.700	.0045	.0043	6.98

19.800	.0045	.0043	6.98
19.900	.0045	.0043	6.98
20.000	.0045	.0043	6.98
20.100	.0030	.0029	6.98
20.200	.0030	.0029	5.43
20.300	.0030	.0029	4.83
20.400	.0030	.0029	4.69
20.500	.0030	.0029	4.66
20.600	.0030	.0029	4.66
20.700	.0030	.0029	4.66
20.800	.0030	.0029	4.66
20.900	.0030	.0029	4.66
21.000	.0030	.0029	4.66
21.100	.0030	.0029	4.66
21.200	.0030	.0029	4.66
21.300	.0030	.0029	4.66
21.400	.0030	.0029	4.66
21.500	.0030	.0029	4.66
21.600	.0030	.0029	4.66
21.700	.0030	.0029	4.66
21.800	.0030	.0029	4.66
21.900	.0030	.0029	4.66
22.000	.0030	.0029	4.66
22.100	.0030	.0029	4.66
22.200	.0030	.0029	4.66
22.300	.0030	.0029	4.66
22.400	.0030	.0029	4.67
22.500	.0030	.0029	4.67
22.600	.0030	.0029	4.67
22.700	.0030	.0029	4.67
22.800	.0030	.0029	4.67
22.900	.0030	.0029	4.67
23.000	.0030	.0029	4.67
23.100	.0030	.0029	4.67
23.200	.0030	.0029	4.67
23.300	.0030	.0029	4.67
23.400	.0030	.0029	4.67
23.500	.0030	.0029	4.67
23.600	.0030	.0029	4.67
23.700	.0030	.0029	4.67
23.800	.0030	.0029	4.67
23.900	.0030	.0029	4.67
24.000	.0030	.0029	4.67
24.100	.0000	.0000	4.67
24.200	.0000	.0000	1.55
24.300	.0000	.0000	.36
24.400	.0000	.0000	.06
24.500	.0000	.0000	.00
TOTALS	2.500	1.8694	3049.13

STORM HYDROGRAPH VOLUME = 25.20 ACRE-FEET
MAXIMUM STORM DISCHARGE = 388.48 CFS

ITEX, Site Runoff (Undisturbed, 0.25 sq. miles), 100-yr, 24 hr Storm
STORM HYDROGRAPH RAIN = 2.500 DURATION = 24.0 RUNOFF = 1.693
STORM DISTRIBUTION IS SCS 24-HR
CURVE NUMBER METHOD CN =92.0

TIME (HOURS)	RAINFALL (INCHES)		NET RAIN (INCHES)	DISCHARGE (CFS)
.000	.0000	.0000	.00	
.100	.0030	.0000	.00	
.200	.0030	.0000	.00	
.300	.0030	.0000	.00	
	No Runoff			
5.300	.0040	.0000	.00	
5.400	.0040	.0000	.00	
5.500	.0040	.0000	.01	
5.600	.0040	.0001	.04	
5.700	.0040	.0001	.10	
5.800	.0040	.0001	.15	
5.900	.0040	.0002	.21	
6.000	.0040	.0002	.27	
6.100	.0050	.0003	.32	
6.200	.0050	.0004	.45	
6.300	.0050	.0004	.55	
6.400	.0050	.0005	.64	
6.500	.0050	.0005	.73	
6.600	.0050	.0006	.81	
6.700	.0050	.0006	.89	
6.800	.0050	.0007	.96	
6.900	.0050	.0007	1.04	
7.000	.0050	.0007	1.12	
7.100	.0050	.0008	1.19	
7.200	.0050	.0008	1.27	
7.300	.0050	.0009	1.34	
7.400	.0050	.0009	1.41	
7.500	.0050	.0010	1.48	
7.600	.0050	.0010	1.55	
7.700	.0050	.0010	1.62	
7.800	.0050	.0011	1.68	
7.900	.0050	.0011	1.75	
8.000	.0050	.0012	1.81	
8.100	.0067	.0016	1.88	
8.200	.0067	.0017	2.41	
8.300	.0068	.0018	2.68	
8.400	.0068	.0018	2.83	
8.500	.0067	.0019	2.95	
8.600	.0068	.0020	3.06	
8.700	.0068	.0020	3.16	
8.800	.0067	.0021	3.26	
8.900	.0068	.0021	3.36	
9.000	.0068	.0022	3.46	
9.100	.0080	.0027	3.56	
9.200	.0080	.0028	4.11	

9.300	.0080	.0028	4.41
9.400	.0080	.0029	4.58
9.500	.0080	.0030	4.71
9.600	.0090	.0035	4.83
9.700	.0090	.0035	5.37
9.800	.0090	.0036	5.67
9.900	.0090	.0037	5.85
10.000	.0090	.0038	6.00
10.100	.0115	.0050	6.14
10.200	.0115	.0051	7.46
10.300	.0115	.0052	8.10
10.400	.0115	.0053	8.41
10.500	.0115	.0055	8.63
10.600	.0155	.0075	8.83
10.700	.0155	.0077	11.16
10.800	.0155	.0079	12.25
10.900	.0155	.0081	12.76
11.000	.0155	.0083	13.11
11.100	.0240	.0132	13.41
11.200	.0240	.0136	18.83
11.300	.0240	.0139	21.31
11.400	.0240	.0143	22.38
11.500	.0240	.0146	23.06
11.600	.1040	.0668	23.62
11.700	.1040	.0716	80.69
11.800	.1900	.1405	107.73
11.900	.2760	.2202	190.17
12.000	.2760	.2333	307.41
12.100	.0360	.0312	362.05
12.200	.0360	.0313	156.83
12.300	.0360	.0314	75.78
12.400	.0360	.0316	55.60
12.500	.0360	.0317	51.40
12.600	.0185	.0163	51.61
12.700	.0185	.0164	34.94
12.800	.0185	.0164	28.58
12.900	.0185	.0164	27.06
13.000	.0185	.0165	26.77
13.100	.0135	.0120	26.82
13.200	.0135	.0120	22.01
13.300	.0135	.0121	20.18
13.400	.0135	.0121	19.75
13.500	.0135	.0121	19.68
13.600	.0105	.0094	19.70
13.700	.0105	.0094	16.79
13.800	.0105	.0094	15.69
13.900	.0105	.0094	15.43
14.000	.0105	.0094	15.38
14.100	.0075	.0067	15.40
14.200	.0075	.0068	12.47
14.300	.0075	.0068	11.35
14.400	.0075	.0068	11.08
14.500	.0075	.0068	11.03
14.600	.0075	.0068	11.03
14.700	.0075	.0068	11.04

14.800	.0075	.0068	11.05
14.900	.0075	.0068	11.05
15.000	.0075	.0068	11.06
15.100	.0075	.0068	11.06
15.200	.0075	.0068	11.07
15.300	.0075	.0068	11.08
15.400	.0075	.0068	11.08
15.500	.0075	.0068	11.09
15.600	.0075	.0068	11.10
15.700	.0075	.0068	11.10
15.800	.0075	.0068	11.11
15.900	.0075	.0068	11.11
16.000	.0075	.0068	11.12
16.100	.0045	.0041	11.12
16.200	.0045	.0041	8.15
16.300	.0045	.0041	7.02
16.400	.0045	.0041	6.74
16.500	.0045	.0041	6.68
16.600	.0045	.0041	6.69
16.700	.0045	.0041	6.69
16.800	.0045	.0041	6.69
16.900	.0045	.0041	6.69
17.000	.0045	.0041	6.69
17.100	.0045	.0041	6.70
17.200	.0045	.0041	6.70
17.300	.0045	.0041	6.70
17.400	.0045	.0041	6.70
17.500	.0045	.0041	6.70
17.600	.0045	.0041	6.71
17.700	.0045	.0041	6.71
17.800	.0045	.0041	6.71
17.900	.0045	.0041	6.71
18.000	.0045	.0041	6.71
18.100	.0045	.0041	6.72
18.200	.0045	.0041	6.72
18.300	.0045	.0041	6.72
18.400	.0045	.0041	6.72
18.500	.0045	.0041	6.72
18.600	.0045	.0041	6.72
18.700	.0045	.0041	6.73
18.800	.0045	.0041	6.73
18.900	.0045	.0041	6.73
19.000	.0045	.0041	6.73
19.100	.0045	.0041	6.73
19.200	.0045	.0041	6.74
19.300	.0045	.0041	6.74
19.400	.0045	.0041	6.74
19.500	.0045	.0041	6.74
19.600	.0045	.0041	6.74
19.700	.0045	.0041	6.74
19.800	.0045	.0041	6.75
19.900	.0045	.0041	6.75
20.000	.0045	.0041	6.75
20.100	.0030	.0028	6.75
20.200	.0030	.0028	5.25

20.300	.0030	.0028	4.67
20.400	.0030	.0028	4.53
20.500	.0030	.0028	4.50
20.600	.0030	.0028	4.51
20.700	.0030	.0028	4.51
20.800	.0030	.0028	4.51
20.900	.0030	.0028	4.51
21.000	.0030	.0028	4.51
21.100	.0030	.0028	4.51
21.200	.0030	.0028	4.51
21.300	.0030	.0028	4.51
21.400	.0030	.0028	4.51
21.500	.0030	.0028	4.51
21.600	.0030	.0028	4.51
21.700	.0030	.0028	4.51
21.800	.0030	.0028	4.51
21.900	.0030	.0028	4.51
22.000	.0030	.0028	4.52
22.100	.0030	.0028	4.52
22.200	.0030	.0028	4.52
22.300	.0030	.0028	4.52
22.400	.0030	.0028	4.52
22.500	.0030	.0028	4.52
22.600	.0030	.0028	4.52
22.700	.0030	.0028	4.52
22.800	.0030	.0028	4.52
22.900	.0030	.0028	4.52
23.000	.0030	.0028	4.52
23.100	.0030	.0028	4.52
23.200	.0030	.0028	4.52
23.300	.0030	.0028	4.52
23.400	.0030	.0028	4.53
23.500	.0030	.0028	4.53
23.600	.0030	.0028	4.53
23.700	.0030	.0028	4.53
23.800	.0030	.0028	4.53
23.900	.0030	.0028	4.53
24.000	.0030	.0028	4.53
24.100	.0000	.0000	4.53
24.200	.0000	.0000	1.50
24.300	.0000	.0000	.34
24.400	.0000	.0000	.06
24.500	.0000	.0000	.00
TOTALS	2.500	1.6931	2761.68

STORM HYDROGRAPH VOLUME = 22.82 ACRE-FEET
MAXIMUN STORM DISCHARGE = 362.05 CFS

ITEX, Site Runoff (Disturbed, 160 acres), 10-yr, 24 hr Storm

STORM HYDROGRAPH RAIN = 1.600 DURATION = 24.0 RUNOFF = 1.027

STORM DISTRIBUTION IS SCS 24-HR

CURVE NUMBER METHOD CN =94.0

TIME (HOURS)	RAINFALL (INCHES)	NET RAIN (INCHES)	DISCHARGE (CFS)
23.600	.0019	.0017	2.84
23.700	.0019	.0017	2.84
23.800	.0019	.0017	2.84
23.900	.0019	.0017	2.84
24.000	.0019	.0017	2.84
24.100	.0000	.0000	2.84
24.200	.0000	.0000	.94
24.300	.0000	.0000	.22
24.400	.0000	.0000	.04
24.500	.0000	.0000	.00
TOTALS	1.600	1.0271	1675.26

STORM HYDROGRAPH VOLUME = 13.85 ACRE-FEET

MAXIMUN STORM DISCHARGE = 222.31 CFS.

Purpose: Size drainage swales to convey 100-yr, 24-hr storm

Assume:
- Swale around the perimeter of the landfill is excavated into the shale bedrock, n =
- Swale between cells
- Side slope = 2:1
- Size swale to convey runon/runoff
- Assume entire site is disturbed and contributes runoff
- Runon → A 20
  B 80 Max flow (cfs)
  C 275
  D 175
- Runoff from site = 390 cfs per 160 acres
- Use Mannings Equation to size channel

South and West Perimeter Swale

Swale runs from SE corner of Cell 3 to NW corner of Cell 2 to outfall #1

* SE corner of Cell 3 to midpoint to SW corner of Cell 2

Flow = 1/2 Area C = 138 cfs
Waste cell (30 ac) = 73 cfs
Use 210 cfs

Min slope = 1%
n = 0.03 (Flemmer, 1986)
Min depth = 4'

Size channel

assume b = 2' → y = 3.4' width = 3.4(4) + 2 = 15.6
b = 4' → y = 3.0' 3.0(4) + 4 = 16.0

To elev 4375' use b = 3', y = 4' (max velocity = 8.3 fps)

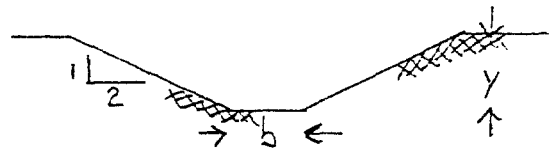
* Midpoint (SE Cell 3 to SW Cell 2) to SW corner Cell 2

Flow = Area C = 275 cfs
Waste cell (55ac) = 135 cfs
Use 410 cfs

Min depth = 4'
n = 0.03
Min. slope = 1%

Size channel
assume b = 6' → y = 3.7'

Use: b = 6', y = 4' (min) → velocity = 8.3 fps
b = 2' y = 5' (min)
b = 0 for y ≥ 6' → velocity = 7.8 fps



If s = 0.5%, b = 3' → y = 4.9'

From elev 4375 to 4359 use b = 3' y = 5' (max velocity = 8.4 fps)

* From SW corner Cell 2 to NW corner Cell 2

Flow = Area C = 275 cfs
Waste Cell (95ac) = 232 cfs
Use 510 cfs

Min slope = 1%

assume b = 3' → y = 4.7'

(from 4340 to 4330)

From elev 4359 to 4320 use b = 3', y = 5' (max velocity = 14.4 fps)

* From NW corner of Cell 2 to Outfall 1

Flow = Area C = 275
Area B = 80
Waste cell (215 ac) = 524
Use flow = 880 cfs

Swale → b = 3', s = 1%, m = 2, y = 5.86'
b = 3', s = 0.5% → y = 6.8'

Use b = 3', y = 6' for slopes 1% or greater
b = 3', y = 7' (min) for 0.5% ≤ slope ≤ 1.0%

East and North Perimeter Swale

Swale runs for SE corner of cell 3 TO NE corner of cell 3 to NW corner of cell 3

* SE corner of cell 3 to midpoint of East side of cell 3

Flow = Area D (3/4 AREA) = 131 cfs
Waste Cell (15.7 acres) = 38 cfs
Use FLOW = 169 cfs

Min Slope = 1%
n = 0.03

Swale → b = 3', s = 1%, m = 2, y = 2.87

Use b = 3', y = 3' FROM SE CORNER CELL 3 to midpoint EAST SIDE CELL 3 @ 1% min slope (Max Vel. = 8.72 fps)

* MIDPOINT EAST SIDE cell 3 TO NE corner cell 3

FLOW = AREA D = 175 cfs
Waste Cell (14.5 + 15.7 acres) = 73.6 cfs

Use 249 cfs

Min slope = 1%
n = 0.03

Size channel.

Swale b = 3', y = 3.41' Vel = 7.43 fps

<u>Use b = 3', y = 4', (max velocity = 9.62 fps)</u>

* NE corner cell 3 TO OUTFALL

FLOW = AREA D = 175 cfs
Waste Cell (14.5 + 15.7 + 9.6 acres) = 97 cfs

Use 272 cfs

Min slope = 1%
n = 0.03

SIZE CHANNEL

Swale b = 3'; y = 3.55', VEL = 7.59 fps

<u>Use b = 3', y = 4'; (MAX VELOCITY = 7.59 fps)</u>

<u>NORTHEAST CORNER CELL 1</u>

Swale runs East into NE corner + North into NE corner

* North Side Cell 1 Elev 4340 → OUTFALL

FLOW = Waste Cell (3.5 acres) = 8.5 cfs

Min Slope = 1%
n = 0.03

Size channel:
Swale b = 2', y = .77' Vel = 3.12 fps

* East Side Cell 1, Elev 4350 → OUTFALL NE corner

FLOW = Waste Cell (6.4 acres) = 15.6 cfs
½ Area A = 10 cfs Use 25.6 cfs
Min Slope = 1%
n = 0.03

SIZE CHANNEL

Swale b = 2', y = 1.32 ft Vel = 4.28 fps

Use b = 2', y = 2' (Max Vel. = 5.40 fps)

NORTH SIDE CELL 1 TO OUTFALL ON WEST SIDE CELL 1

Swale runs West on North side Cell 1 Then South to Outfall

* Elev 4340 TO NW corner CELL 1

FLOW = Waste Cell (26.8 acres) = 65 cfs

Min slope = 0.0% Use 65 cfs
n = 0.03

SIZE CHANNEL

Swale b = 3', y = 1.56', Vel = 6.80 fps

Use b = 3', y = 2', (Max Vel = 8.78 fps)

* NW corner Cell 1 TO outfall

Flow = Waste Cell (26.8 + 4.8 acres) = 77 cfs
Use 77 cfs

Min Slope = 0.6%
n = 0.03

Size Channel

Swale b = 3', y = 2.25', Vel = 4.55 fps

Use b = 3', y = 3' (Max Vel = 4.55 fps)

NORTH SIDE Cell 2 TO NW CORNER CELL 2

Swale runs West from Elev 4360 Between Cell 1 + Cell 2 TO NW Corner Cell 1

* East Side Cell 1 South to SE corner Cell 1

FLOW = 1/2 Area A = 10 cfs
Waste Cell (2.9 acres) = 7 cfs
Use 17 cfs

Min Slope = 1%
n = 0.03

Size Channel

Swale b = 2', y = .92, V = 4.85 fps

Use b = 2' y = 1' (Max Vel = 4.85 fps)

* North side Cell 2 TO SE corner Cell 1

FLOW = Waste Cell (24.7 acres) = 160 cfs
Use 77 cfs

Min Slope = 2%
n = 0.03

Size channel

Swale b = 3', y = 1.50', Vel = 6.66 fps

Use b = 3', y = 2 (Max Vel = 6.66 fps)

* SE corner Cell 1 to NW corner Cell 2

FLOW = WASTE CELL 2 (24.7 + 31.1) = 136 cfs
WASTE CELL 1 (2.9 ac) = 7 cfs
Area A = 10 cfs
Use 153 cfs

Min slope = 1%
n = 0.03

SIZE CHANNEL

Swale b = 3', y = 2.75' Vel = 6.56 fps

USE b = 3', y = 3' (Max Vel = 8.50 fps)