UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF SOLID AND HAZARDOUS WASTE

APPLICATION FOR A CLOSED LANDFILL PERMIT

CHESTER CLASS II LANDFILL, SANPETE COUNTY

SANPETE SANITARY LANDFILL COOPERATIVE

The applicant, Sanpete Sanitary Landfill Cooperative, herein submits, in duplicate, an original permit application, a general report, and a technical report to:

Dennis R. Downs, Executive Secretary
Division of Solid and Hazardous Waste
Utah Department of Environmental Quality
PO Box 144880
Salt Lake City, Utah 84114-4880

PART I--CLOSURE PERMIT APPLICATION
SANPETE CLASS II LANDFILL

1. Name of Facility: Chester Class II Landfill
2. Site Location: Approximately 5 miles north of Ephraim along U.S. Highway 89, in the southwest quarter of the southeast quarter of section 2, and the northwest quarter of the northeast quarter of section 11, both in T. 16 S., R. 3 E., SLBM
3. Facility Owner: Sanpete Sanitary Landfill Cooperative
4. Facility Operator: Larry Hansen
5. Contact Person: Douglas Bjerregaard, Chairman of the Landfill Board

   Address: 111 N 100 W
   Box 7
   Mayfield, Utah 84643

   Telephone: (435) 528 3255

6. Type of Facility: This closed landfill will be maintained as a "nonprofit" landfill.

   (x) Non-Commercial
   ( ) Commercial

   ( ) Initial Application
   (x) Permit Renewal
   Original Permit Number 89-01

7. Property Ownership

   (x) Presently owned by applicant

   Property owner (if different from the applicant)

   Name: same

   Address: ____________

Telephone ______________________________

____

8. Certification of submitted information.

Douglas Bjerregaard (Name of Official)

Chairman, Landfill Board (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 submitted 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: _________________________

SUBSCRIBED AND SWORN to This _____________ day of ___________________, 20______.

My commission expires on the _____________ day of ___________________, 20______.

____

Notary Public in and for

(SEAL) ____ County, Utah.

PART II - GENERAL DATA

1 INTRODUCTION

1.1 Description of the Site

The Sanpete Sanitary Landfill Cooperative owns and has operated a Class II Landfill under Utah Permit Number 89-01, issued January 23, 1989. The Landfill is about six miles north of Ephraim, Utah, just west of Highway 89, in portions of sections two and 11, T. 16 S., R. 3 E., Salt Lake Baseline and Meridian. Figure One is a map of the Class II Landfill.

1.2 Reasons for Closure

The Chester Class II Landfill has now been replaced by a new Class I Landfill constructed in the White Hills, west of Mayfield, Utah. The Class II Landfill was be closed to public use for two reasons:

1. The amount of waste disposed at the site exceeded 20 tons per day, the upper limit for operation of a Class II Landfill; and

2. Ground water occurs at relatively shallow depths (from about 35 feet to 45 feet below ground) under the Landfill.

1.3 Legal Description of Landfill Property

The Class II Landfill has been developed on about 25 acres of two parcels owned by Sanpete County. The two parcels are described as follows:

Sanpete County Tract 27207X

Beginning at the Southwest Corner of the Northeast Quarter of the Northeast Quarter of Section 11, T. 16 S., R. 3 E., of the Salt Lake Base and Meridian; running thence North 20 chains to the North line of said section; thence East 13.37 chains more or less to the East side of the State Highway (89); thence Southwesterly along the East side of the Highway to a point on the "40" line East of the point of beginning; thence West to the point of beginning. LESS HIGHWAY.

Sanpete County Tract 27038

Beginning at the Northwest corner of the East half of the Southeast quarter of the Southwest quarter of Section 2, T. 16 S., R. 3 E., Salt Lake Base and Meridian; thence East 660 feet, thence South 1,105.50 feet, thence East 2,200 feet, more or less, to the

West side of the State Highway (89), thence Southwesterly along the State Highway right of way 231.34 feet, more or less, to the South section line of Section 2, thence West 793.34 feet, more or less, to the 1/16th Section line, thence South 1,320 feet, thence West 1,320 feet, thence North 1,320 feet, thence West 660 feet, thence North 1,320 feet to the point of beginning. Being in Sections 2 and 11, T. 16 S., R. 3 E., Salt Lake Base and Meridian.

EXCEPTING THEREFROM 90% of all oil, gas and/or other minerals in, on or under said land, together with the right of ingress and egress for the purpose of exploring for and/or removing the same. Subject to easements, reservations and restrictions of record or in operation of law and equity.

1.4 History of Use

The Class II landfill has been operating since 1989. The amount of waste placed from opening the landfill to the end of 1994 was estimated by the Coop to be about 43,208 tons occupying 87,963 cubic yards at the landfill site. The amount of waste reported in subsequent annual reports and an estimated total for waste disposed through December 31, 2003, is shown in the following Table:

YEAR	WASTE DISPOSED (TONS)
1989 - 1994	43,208 (ESTIMATED)
1995	8,565
1996	8,425
1997	10,393
1998	10,957 (ESTIMATED)
1999	11,520
2000	11,172
2001	7,857
2002	802

2003	1
TOTAL DISPOSED THROUGH 12/31/03	112,900(APPROXIMATE)

Municipal waste has been placed in approximately 12 acres of the landfill. Dead animals have been placed in about one additional acre. Used tires once occupied an additional one half acre, but have been removed for recycling.

2 SCHEDULE FOR CLOSURE

2.1 Overlap With White Hills Class I Landfill Operations

The White Hills Landfill was constructed in June and July of 2001. First waste was accepted for disposal on July 9, 2001. Small quantities of household waste were received at the Class II Landfill in late 2001 and early 2002 during a brief transition period after the White Hills Class I Landfill was opened.

2.2 Notification of Schedule for Closure

In accordance with UAC R315-302-3 (4)(a) and (b) the owner and operator must notify the Executive Secretary of the intent to implement the closure plan in whole or part, 60 days prior to the projected final receipt of waste at the facility. Final closure activities will begin within 30 days after receipt of the final volume of waste and will be completed within 180 days from their starting time. Submittal of this Closure Permit Application (CPA) by Sanpete Sanitary Landfill Cooperative fulfills the requirement to notify the Executive Secretary of the intent to implement the closure plan in whole or part.

When the CPA is determined to be complete, the Executive Secretary will issue a draft closure permit and a mandatory 30-day public comment period will begin. Once the approval of the closure permit is granted, the construction drawings, and a quality assurance/quality control plan will be submitted to the Division for Executive Secretary review and approval. When the construction drawings and the quality assurance/quality control plan have been approved, construction of the final cover may begin.

Closure activities will begin on or about April 1, 2005, or immediately after the final receipt of the approved closure permit. Closure activities will be completed 180 days after the start of closure, on or before March 1, 2005. The following Table summarizes the schedule of closure:

Closure Event	Date to Begin	Date to Complete
Notice of Intent to Close	December 1, 2004	
Final Receipt of Class II Waste		July 1, 2004
Closure Construction Activities	April 1, 2005	October 1, 2005

2.3 Certification of Closure

Under current regulations, closure plan sheets signed by a professional engineer registered in the state of Utah (modified as necessary to represent as-built changes to final closure construction) will be presented to the Executive Secretary when facility closure is completed. Additionally, the owner and a professional engineer will certify to the Executive Secretary that the site has been closed in accordance with the approved closure plan.

2.4 Future Use for the Site

Construction of the final closure cap will require the excavation of large quantities of soil from that portion of the landfill property just east of the municipal solid waste cells. Excavation of the cover soils will result in the construction of a pit or trenches approximately 10 feet deep with a surface area of more than one acre.

The Sanpete Sanitary Landfill Cooperative has received a permit to operate a Class IVB landfill at the landfill property. Inert waste accepted will be placed in an existing green waste trench, and in the trenches or pits constructed during excavation of final cover soil for the Class II Landfill.

3 PLAN OF OPERATION

In accordance with UAC, copies of this Plan of Operation will be kept on file at the Coop's Class I Landfill office in the White Hills near Mayfield, Utah.

3.1 Schedule of Construction

The Coop stopped accepting municipal waste at the Class II Landfill after 2002, and final cover will be applied to all of the municipal waste cells. The site will be graded and filled. Drainage structures will be built at the closed Landfill, where necessary, to provide run-on control for the closed Class II Landfill and the new Class IVB facility. Pending approval from UDSHW, the Class II Landfill will be closed during the summer of 2005.

3.2 Solid Waste Handling Procedures

Solid waste will no longer be accepted at the closed Class II Landfill.

3.3 Contingency Plans in the Event of Fire or Release of Explosive Gases

In the event of an accidental fire or explosion, two fire extinguishers will be kept at the adjacent Class IV Landfill site: one on the front end loader and one in the operator's truck. If the fire cannot be extinguished or smothered with dirt, the operator will call 911 or radio for help. The Landfill Operator will immediately notify the Landfill Contractor's office of the situation.

If a release of explosive gases is detected by some other means than the observation of a fire or explosion, the Class IV Landfill gate will be closed. All personnel will be evacuated from the Landfill, and the operator will call 911 or radio for help.

If for some reason the radio is not working, the Landfill Operator will close the Landfill gate and go personally to the fire department to raise the alarm. The fire department is located approximately 5 miles from the Landfill at 625 S 100 E in Ephraim.

Before departing, the operator will evacuate all personnel from the Landfill. The Operator will not leave the vicinity except when safety is paramount, or unless directed to leave by the fire department. The fire chief will be made aware of the type of waste that is on fire and any hazards that may be encountered.

The Landfill Contractor, the Coop, and the UDEQ must be notified of landfill fires and explosive gas emissions immediately. A written report will be submitted to the UDEQ within 14 days of the event.

EMERGENCY TELEPHONE NUMBERS	
Facility	**Number**
Larry Hansen, SWM Contractor	(435)427-3812 (Home) (435)427-3815 (Store)
George Johansen, Health Department	(435) 462-2449, Ext. 12
Sheriff"s Office Highway Patrol	(435) 835-2191 (435) 896-2780
Fred Johnson, County Fire Marshall	(435) 835-2191

4 RECORD KEEPING

4.1 Record Location

The Cooperative or the Contract Operator will maintain and keep at the White Hills Landfill office near Mayfield, Utah, or the Cooperative's office in Mayfield, Utah: (1) records to include documentation of any demonstration made with respect to any location standard or exemption; (2) closure and post-closure care plans as required by Subsections R315-302-3(4) and (7); (3) cost estimates and financial assurance documentation as required by Subsection R315-309-2(3); and (4) other information pertaining to operation, maintenance, monitoring, or inspections as may be required by the Executive Secretary.

5 REPORTING

The Sanpete Sanitary Landfill Cooperative, as the owner of the closed facility, will be required to submit an annual report to the Executive Secretary by March 1 of each year for the most recent calendar year of operation. A sample of the annual reporting form which may be used is found in Appendix F of the UAC and has been provided as Attachment 1.

The annual report must include the following information:

1) Name and address of the facility;

2) Calendar year covered by the report;

3) Annual quantity, in tons, or volume in cubic yards, and estimated in-place density in

pounds per cubic yard of solid waste handled, including recycling of appliances and car bodies;

4) The annual update of the required financial assurance mechanism; and

5) Training programs or procedures completed.

In accordance with the UAC, the Coop will apply for a renewal of the facility's permit every five years.

6 POST-CLOSURE INSPECTIONS

Routine inspections are necessary to prevent malfunctions and deterioration, operator errors, and discharges which may cause or lead to release of wastes to the environment or to a threat to human health. Inspections will be performed quarterly as described below:

1) The Landfill Operator will conduct a walkthrough inspection and will document the condition of the closed facility as follows:

   a) fences and gates,
   b) access roads,
   c) run-off control system,
   d) litter and weed control,
   e) surface depressions, if any

2) The inspection form will be dated, the time of the inspection noted, and the form signed by the operator. The operator will include notations of observations made and the date and nature of any repairs or corrective action.

A sample of the form used to document these inspections is included in Attachment 2.

7 CLOSURE PLAN

7.1 Notification

According to UAC, the Coop must notify the Executive Secretary of the intent to implement closure of a unit or a facility no less than 60 days prior to the projected final receipt of waste. The Coop must then commence implementation of the closure 30 days after receipt of the final waste load, with the closure activities to be completed within 180 days from the initiation of the closure activities.

All waste at the Chester Class II Landfill is now covered with intermediate cover. Final closure operations are scheduled to begin according to the schedule shown in Section 2, Schedule for Closure, but no sooner than permission to proceed has been received from the Executive Secretary.

7.2 Closure Performance Standards

The Chester Class II Landfill will closed in a manner that will minimize the need for maintenance, and that will protect human health and the environment. Closure activities will include grading, covering, and seeding. Each of these activities are described briefly in Section 12 (below), and will be discussed fully in the Construction and Quality Assurance/Quality Control Plan prior to the commencement of closure activities.

7.3 Final Inspection

In accordance with UAC R315-302-3 (5)(a) and (b) the owner and operator will notify the Executive Secretary of the intent to implement the closure plan in whole or part, 60 days prior to the projected final receipt of waste at the facility. Final closure activities will begin within 30 days after receipt of the final volume of waste and will be completed within 180 days from their starting time.

Under current regulations, when facility closure is completed, closure plan sheets signed by a professional engineer registered in the state of Utah and modified as necessary to represent as-built changes to final closure construction are required to be presented to the Executive Secretary.

Additionally, certification by the owner and a professional engineer that the site has been closed in accordance with the approved closure plan will be presented to the Executive Secretary.

However, the UDEQ may consider changes to these requirements as they apply to Class II landfills and this section should be reviewed and existing regulations incorporated when the permit is updated every five years.

7.4 Record of Title, Land Use, and Zoning Restrictions

The closed Landfill will be rezoned, if necessary, to conform to local regulations after closure. A description of the Landfill history and filled areas will be permanently appended to the record of title no later than 60 days after certification of closure. Proof of the recording will be provided to the Executive Secretary. Land use restrictions will be assigned that conform to existing regulations for closed landfills at the time of closure.

8 POST-CLOSURE PLAN

Post-closure care is required for a period of 30 years or as long as the Executive Secretary determines is necessary for the facility to become stabilized and to protect the human health and the environment. When post-closure activities are completed, as determined by the Executive Secretary, the Coop will submit a certification to the Executive Secretary, signed by the owner and a professional engineer registered in the state of Utah, stating why post-closure activities are no longer necessary (i.e., little or no settlement, gas production, or leachate generation).

Because the Chester Class II closed Landfill is exempt from ground water monitoring, leachate control, and gas monitoring requirements, post-closure care will primarily consist of semiannual inspections to ensure cover integrity and the security of the facility. Annual post-closure expenditures are detailed in Section 9.2 of this permit application.

8.1 Corrective Action Program if Ground Water is Contaminated

In the event that ground water contamination is suspected, samples will be collected from one or more down gradient monitor wells to be constructed at the site. If analyses of the water show that contamination has occurred, the water will be pumped and treated according to a plan prepared by the Coop and approved by the UDSHW.

The Sanpete Sanitary Landfill Cooperative will serve as the point of contact during the post-closure period at the address and phone number as follows:

> 111 N 100 W, Box 7, Mayfield, Utah 84643
> (435) 528 3255

9 COST ESTIMATES AND FINANCIAL ASSURANCE

9.1 Closure Costs

The cost estimates for closure are based on a third party performing closure. Estimated costs must be based on the cost to close the largest area of the disposal facility or unit ever requiring a final cover.

The side slopes of final cover over the closed trenches shall not be greater than 3:1, horizontal to vertical. Slopes along the top of each closed trench shall not be less than two (2) percent.

The amount of final cover to be placed on the Landfill prism is equal to three (3) feet times the surface area (12 acres):

Solving: (12)(43560)(3) = 1,568,160 cubic feet, or 58,060 cubic yards.

In addition, one acre of the site is underlain by dead animals. Approximately two feet of soil will be placed over the dead animals. That amount is:

Solving: (1)(43,560)(2) = 87,160 cubic feet, or 3,227 cubic yards.

The total amount of soil to be placed as cover material is about **61,287** cubic yards.

The Estimated Closing Costs shown on Lines 2.2.1a and 2.3 of Table 2 include the costs for placing 36" of closure soil (61,287 cubic yards),

Closure costs are estimated to be **$198,928.24** (see Table 2, below)

A cost estimate for placing final cover and reseeding was obtained from Jensen Construction and is provided as Attachment 3.

TABLE 2: ESTIMATED CLOSURE COSTS

ITEM	UNIT MEASURE	COST/UNIT	N0. UNITS	TOTAL COST
1.0 Engineering				

TABLE 2: ESTIMATED CLOSURE COSTS					
ITEM		**UNIT MEASURE**	**COST/UNIT**	**N0. UNITS**	**TOTAL COST**
1.1	Topographic Survey	--	--	--	0.00
1.2	Boundary Survey for Affidavit	Hours	65.00	24	1,560.00
1.3	Site Evaluation	Hours	65.00	8	520.00
1.4	Development of Plans	Hours	65.00	8	520.00
1.5	Contract Administration, Bidding and Award	Hours	35.00	8	280.00
1.6	Administrative Cost for the Certification of Final Cover and Affidavit to the Public	Hours	65.00	4	260.00
1.7	Project Management; Construction Observation and Testing	Hours	50.00	120	6,000.00
1.8	Monitor Well Construction Cost				N/A
1.9	NPDES Construction Storm Water Permit, and other Permits				N/A
SUBTOTAL					**9,140.00**
10% CONTINGENCY					**914.00**
ENGINEERING TOTAL					**10,054.00**

ITEM		UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST
2.0	Construction				
2.1	Final Cover System				
2.1.1	Completion of Sidewall Liner	N/A	--	--	N/A
2.1.1a	Soil Placement	N/A	--	--	N/A
2.1.1b	Soil Processing	N/A	--	--	N/A
2.1.1c	Soil Amendment	N/A	--	--	N/A
2.1.1d	Soil Purchase	N/A	--	--	N/A
2.1.1e	Transportation	N/A	--	--	N/A
2.1.2	Drainage Layer on Sidewall	N/A	--	--	N/A
2.1.2a	Geotextile Filter Fabric	N/A	--	--	N/A
2.1.2b	Geonet/Geotextile Composite	N/A	--	--	N/A
2.1.2c	Geomembrane Sidewall Liner	N/A	--	--	N/A
2.2	Completion of Top Cover				
2.2.1	Infiltration Layer	N/A	--	--	0.00
2.2.1a	Soil Placement	cu yards	2.5	61,287	153,217.50
2.2.1b	Soil Processing	acre	13.00	1.5	33.50
2.2.1c	Soil Amendment	acre	--	--	N/A
2.2.1d	Soil Purchase	N/A	--	--	N/A
2.2.1e	Transportation	N/A	--	--	N/A
2.2.2	Flexible Membrane Cover	N/A	--	--	N/A

ITEM		UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST
2.2.2	Drainage Layer in Top	N/A	--	--	N/A
2.2.2a	Sand Layer	N/A	--	--	N/A
2.2.2b	Geotextile Filter Fabric	N/A	--	--	N/A
2.2.2c	Geonet/Geotextile Composite	N/A	--	--	N/A
2.3	Erosion Layer Placement	cu yards	--	--	N/A
2.4	Native Revegetation	sq. feet	0.015	67,500	1,012.50
2.5	Site Grading and Drainage	lump sum	1000	1	1,000.00
2.6	Site Fencing and Security	N/A	--	--	0.00
2.7	Leachate Collection System Completion	N/A	--	--	N/A
2.8	Completion of Gas Monitoring System	N/A	--	--	N/A
SUBTOTAL					**155,263.50**
10% CONTINGENCY					**15,526.35**
CONSTRUCTION TOTAL					**170,789.85**

ITEM		UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST
3.0	Ground water Characterization Cost				
4.0	Monitor Well Installation Costs				
4.1	Monitoring Well Installation	N/A	--	--	N/A

ITEM	UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST
4.2 Piezometer and Monitor Well Plugging	Per Well	--	--	N/A
SUBTOTAL				0.00
10% CONTINGENCY				0.00
Groundwater INSTALLATION TOTAL				0.00

Calculation of Total Closure Costs

Engineering Total:	$10,054.00
Ground Water Total:	0.00
Construction Total:	$170,789.85
___% Contract Performance Bond:	included
SUBTOTAL:	$180,843.85
Legal Fees (10% of Subtotal):	18,084.39
TOTAL CLOSURE COSTS:	**$198,928.24**

9.2 Post-Closure Costs

The post-closure cost estimates shown in Table 3, below, cover the 30-year post-closure period. It is anticipated that minimal care requirements will be necessary as the site is to be reseeded with native grasses that will not require irrigation or constant, routine maintenance. Anticipated tasks include semiannual inspections, record keeping, and maintaining cover integrity.

TABLE 3: ESTIMATED POST-CLOSURE COSTS					
	ITEM	UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST
1.0	Engineering Costs				
1.1	Post-Closure Plan	N/A	--	--	N/A
1.2	Site Inspection and RECORD KEEPING (semi-annual)	Inspection	100.00	60	6,000.00
1.3	Correctional Plans and Specifications (annual)	Hours	65.00	8	520.00
1.4	Site Monitoring (semi-annual)	N/A	--	--	N/A
2.0	Construction Cost	Sq. Feet	0.015	261,360	$3,800
3.0	Leachate Disposal	N/A	--	--	N/A
4.0	**Soil Amendment**	Acre	11.50	180	**2,070.00**
	SUBTOTAL				**12,390.00**
	10% CONTINGENCY				**1,239.00**
	TOTAL				**13,629.00**

Total Estimated Financial Assurance Costs

Closure Costs $198,928.24
Post-Closure Costs $13,629

Total Closure Plus Post-Closure Costs = $212,557.24

9.3 Financial Assurance Mechanism

Sanpete County has established a Trust Fund for closure and post-closure care of the Landfill. The Trust Fund meets the requirements set forth in UAC R315-309(2)(a). Proof of the existence of this Trust Fund will be submitted to the Executive Secretary at least 30 days prior to the commencement of closure operations.

Money in the trust fund will be used exclusively for closure, post-closure care, and corrective action. Guidelines for reimbursements, found in UAC R315-309-2(iv), state:

> *The owner or operator, or other person authorized to conduct closure, post-closure, or corrective action may request reimbursement from the trustee for closure, post-closure, or corrective action costs.*
>
> 1. *The request for reimbursement may be granted by the trustee only if sufficient funds are remaining to cover the remaining costs and if justification and documentation of the costs are placed in the operating record.*
>
> 2. *The owner or operator shall notify the Executive Secretary that documentation for the reimbursement has been placed in the operating record and that the reimbursement has been received.*

The fund will be evaluated annually and may be adjusted as needed.

PART III –TECHNICAL REPORT

10 DESCRIPTION OF SITE VICINITY

A scanned copy of part of the most recent Chester, Utah, U.S. Geological Survey (USGS) topographic map of the site area is provided as Attachment 4. This map shows the facility boundary, the property boundary, the latitude and longitude coordinates of the front gate, the land use and zoning of the surrounding areas, any existing utilities and structures within one-fourth mile of the site, surface drainage channels, and the direction of the prevailing winds.

As shown on the USGS map, there are no homes, one power line, and no culinary wells within one-fourth mile of the site boundaries. The Landfill property is zoned PF (Public Facilities). Lands to the north, west, and south are A Zone (Agricultural), while across Highway 89 to the east the lands are SL (Sensitive Lands). Prevailing winds are from the south southwest.

10.1 Location Standards

Regulations governing all Class II landfills in Utah state that an existing facility is not required to conform to location standards listed in UAC R315-302-1.

10.2 Ground Water Levels

Regulations for new landfills require that the lowest level of waste will be at least five feet above the historical high level of ground water. Since protection of ground water is an essential goal of landfill construction and regulation, the following information about ground water levels beneath the Chester Class II Landfill is included in this Closed Landfill Permit Application.

The requirement is met: the water levels in five test borings excavated at the Landfill site in 1995 encountered ground water at depths ranging from 35 to 46 feet below ground. The deepest closed trench is about 25 feet deep. A test boring at the west end of the deepest proposed Class IVB Landfill trench disclosed ground water 41 feet below ground level. The lowest level of waste is16 feet (41' - 25') above the shallowest known ground water level. Ground water is 46 feet below ground level at the east end of the same trench, or 21 feet below the deepest waste.

Sanpete Sanitary Landfill Cooperative acknowledges the importance of ground water protection. We wish to call your attention to a more recent study of groundwater levels in wells drilled north of the landfill prism. Our letter report, dated May 24, 2003, showed that water levels in those wells were virtually the same on that date as they were in 1995.

The following Table shows the water levels determined in 2003, compared to water levels measured in the same wells by Bingham Engineers on August 4, 1995:

Well	Elevation at Top of Casing	Water Level 8/4/1995	Elevation 8/4/1995	Water Level 5/23/2003	Elevation 5/23/2003
MW-1	5510.75'	43.68'	5467.07'	41.40'	5469.35'
MW-2	5507.16'	42.52'	5464.64'	42.71'	5464.45'
MW-3	5540.17'	48.51'	5491.66'	49.48'	5490.69'

In 1995, groundwater sloped downward 4.64 percent to the southwest at a bearing of South 39° West. In 2003, groundwater sloped downward 3.3 percent to the southwest at a bearing of South 55° West. Possible reasons for the slight differences in slope and bearing are many. One likely cause of the decreased slope (and, therefore, reduced ground water velocity) is the drought now afflicting Sanpete County and most of Utah.

11 ENGINEERING CONSIDERATIONS

11.1 Foundation Design Underlying the Facility

The Class II Landfill was constructed on natural soils, south and west of the open Class IVB inert waste Landfill. Materials underlying both of the Landfill sites consist of alluvial soils approximately 50 feet thick overlying weathered sandstone and shale bedrock of the Green River Formation.

The alluvial soils are sandy silts and clays, and poorly graded, silty and clayey sands with a little gravel. Engineering properties of the soils, as determined by Bingham Engineering and Tri-State Testing, are included in Sections 14.3 and 14.4 (below). The soils are easily excavated and stand vertically in existing trenches.

Five test borings constructed by Bingham Engineering in 1995 encountered ground water at depths ranging from 35 to 46 feet below the ground surface. Water bearing strata typically occur in unconsolidated soils five to 10 feet above the weathered bedrock surface.

11.2 Run-On/Run-Off Protection

11.2.1 Run-on Protection

The closed facility will be protected from run-on in two ways:

1) The existing Municipal Class II Landfill prism and the proposed Class IVB Landfill are bounded on the north, east, and south by berms constructed to protect the Municipal Landfill prism. The berms were originally constructed as roads, and are nowhere less than 12 inches high and ten feet wide. The design amount of potential run-on is determined by the amount of precipitation that would occur after a 25 year, 24 hour storm event of 2.1 inches.

2) Run-on from the west side of the site is impossible because the entire Landfill area slopes down to the west northwest (bearing 280 degrees) at approximately four (4) percent

Run-on is further limited by the road bed of U.S. Highway 89 and a parallel, abandoned railroad grade. The railroad grade is an intact barrier to run-on from a point 1.05 miles northeast of the northeast corner of the Landfill property, to the south side of the Landfill gate. The railroad grade has been breached south of the Landfill access road and gate in order to allow storm water to flow to the west, away from the U.S. Highway 89.

Culverts--North of the Landfill access road and gate, at least four, and perhaps five, 24 inch diameter culverts convey precipitation from the east side of Highway 89 through the railroad grade into pasture lands west of Highway 89. Each culvert is capable of conveying 31.4 cubic feet of water per second at a velocity of 10 feet per second.

Potential Run-On--The total amount of run-on that could be produced by a design storm east of Highway 89 that might be directed toward the Landfill is much less. The maximum area between the easterly Landfill berms and the drainage divide east of the proposed Class IVB Landfill is 530 acres. The amount of run-on from that area during a 25 year, 24 hour storm would be 11.62 cubic feet per second. In the unlikely event that the road bed and the railroad grade were breached by erosion, the entire run-on would be directed toward the Landfill.

Capacity of Ditches and Berms–Flow velocity in a vegetated ditch is approximately ten (10) feet per second. The cross-sectional area of a ditch required to transport 11.62 cubic feet per second is therefore only 1.162 square feet. However, it is likely that the velocity of the run-on would be reduced by ponding along Highway 89 and the abandoned railroad right of way.

Assuming a flow velocity of only five (5) feet per second, the cross-sectional area of the ditches impounded by the uphill side of the Landfill berms would have to be at least 2.324 square feet to divert water around the Landfill, or 2.789 square feet to obtain a safety factor of 1.2, or one hundred twenty (120) percent.

The existing berms are 12" (one foot) high. The natural slope down from east to west is four percent. Therefore, the width of the ditch formed by the uphill toe of the north-south trending berms and the natural slope is 25 feet, plus one foot from the toe of the berm to the top of the berm, assuming a side slope of 1:1, horizontal to vertical. These dimensions provide a ditch cross-sectional area of 13 square feet, for a safety factor of 559 percent if flow velocity is five (5) feet per second:

Ditch flow capacity = (13)(5) = 65 cubic feet per second (cfs)
Potential Run-On = 11.62 cfs
Ratio of ditch flow capacity to Potential Run-on = 65/11.62 = 5.59
Safety Factor 5.59 = or 559 percent

In the unlikely event that the velocity of flow in the ditch were reduced to two feet per second, the available ditch cross-sectional area of 13 square feet provides a safety factor of 224 percent:

Ditch flow capacity = (13)(2) = 26 cubic feet per second (cfs)
Potential Run-On = 11.62 cfs
Ratio of ditch flow capacity to Potential Run-on = 26/11.62 = 2.24
Safety Factor = 2.24, or 224 percent

11.2.2 Run-Off Protection

Since no water will be able to “run on” to the closed Landfill, a run-off system preventing water from leaving the Landfill site needs only address precipitation that falls within the new Class IVB facility. Precipitation that falls on the closed Class II Landfill will not contact waste. Therefore, water will be allowed to leave the landfill at the southwest corner of the property.

Water that could run off to the west from the Class IVB facility will be retained by a three-foot high berm. The berm will be constructed along the eastern edge of the closed Class II

Landfill. The berm will be designed to retain more than .22 cfs, the amount of run-off that could occur after a 25 year, 24 hour storm event of 2.1 inches of precipitation on 25 acres.

A 25 year, 24 hour storm event could produce localized ponding or erosion on the closed Class II Landfill. If this occurs, the closed Landfill will be regraded so that water cannot accumulate there or percolate through the cover material.

The demonstration that the run-on control berms are adequate is presented in Section 11.2.1. The volumes of run-off for a 25 year, 24 hour storm were calculated with the USDA TR-55 formulas for estimating run-off. Figure 4 is a map showing Landfill slopes as measured with a hand level and compass, and the location of run-on control berms. Figure 5 is a map showing the drainage area, culverts through Highway 89 and the railroad grade, and breaches in the railroad grade south of the Landfill gate.

11.2.3 Contingency Plan for Failure of Run-Off Containment System

In the event that the run-off containment system fails due to a storm or accidental breach, the operator will immediately transport additional cover soils to the breached area of the berm to repair the breach. Soils placed into the breach will be compacted by the wheels or tracks of the loader used to transport the soils. Solid waste that may have been transported beyond the containment berms will be collected and placed in the open disposal area.

11.3 Fugitive Dust Control

Fugitive dust will be controlled by minimizing excavation of natural vegetation. Filled depressions and units requiring closure will be regraded and revegetated as soon as practicable. If the above measures do not control the dust and it becomes a problem, the Landfill Operator will request the use of either a county, city, or private water truck in order to lightly moisten the ground with water.

12 CLOSURE ACTIVITIES

12.1 Removal of Recyclable Materials

All tires, metals, batteries and other recyclable materials will be sold and transported out of the landfill by contractors to be selected by the Coop. Recyclable materials received after July 1, 2004, have been stored in that portion of the Coop property that is in use as a Class IVB Landfill.

12.2 Combustion of Green Waste
Yard waste, tree limbs, and other green waste have been stored in areas just north of the municipal waste landfill cells (see Figure Three, Class IVB Landfill Map). The green waste may be burned while the Class II landfill is open, at such a time as a permit may be obtained from the Sanpete County Fire Marshall. The resulting ashes will be covered with at least six inches of cover soils excavated from the pit that will be used to obtain materials for the alternative final cover. Combustible green waste materials received after July 1, 2004, will be placed on that portion of the Coop property that will remain in use as a Class IVB Landfill.

12.3 Grading of Waste Prisms
Municipal waste has been placed in an approximately 12-acre area-method fill resembling half of an elongated football or a cigar. The surface of the fill is uneven, and will be graded before placement of the final cover.

Dead animals have been buried in approximately one additional acre of the Class II Landfill. The depth of the fill now present over the dead animals will be measured by digging test pits on a grid of about 100 feet by 100 feet. Sufficient final cover soil will then be spread over the dead animals to assure at least two feet of cover.

Side slopes on the graded fills will not be steeper than 3:1 (horizontal:vertical), while slopes along the tops of the fills will not be less than two percent (no less than two feet vertically in 100 horizontal feet). The proposed slopes are shown on Figure Two, Final Cover Plan and Cross Sections.

12.4 Placement of Final Cover
The Sanpete County Sanitary Landfill Cooperative will construct an alternative final cover consisting of 36 inches of loosely compacted, silty, clay loam soils (USCS Classification "CL"). The final cover materials will be excavated onsite from a pit or trenches east of the municipal solid waste cells. The thickness of the final cover (36 inches) shall be in addition to the thickness of intermediate cover material already placed over the waste prism.

12.5 Seeding
The monolithic "evapotranspiration" cover will be protected from erosion by incorporation of amended (fertilized) earthen materials in the top six (6) inches that are capable of sustaining vegetative growth. The final cover will be seeded with suitable vegetation. The seed mix will be selected in consultation with representatives of the U.S. Forest Service and other experienced agency personnel and farmers in Sanpete County. The design of the seed mix will be submitted to the Executive Secretary for review before seeds are sown on the closure cap.

PART IV--ANALYTICAL PROCEDURE FOR DESIGN OF THE FINAL COVER

13 ONGOING RESEARCH BY OTHERS

Proposed closure of the Chester Class II Landfill in Sanpete County, Utah, comes at a time when extensive research is underway on alternative final closure caps. The prescriptive Subtitle D closure cap, consisting of 18" of low permeability clays overlain by six (6) inches of soil capable of sustaining vegetative growth, has proven unsuitable for use in arid and semiarid climates. The clay infiltration layer tends to dry out and crack, leaving highly permeable conduits for the entry of water into underlying wastes. Water retained in cracks by capillary forces freezes in cold winters, enlarging the conduits.

A promising alternative closure cap design is the monolithic, or evapotranspiration (ET) cap. This cap relies on the water retention capability of a thick layer of loosely compacted soil, and the transpiration of moisture by established vegetation to minimize the percolation of moisture into waste. A growing data base of actual field studies now shows that ET caps perform as well as or better than prescriptive closure caps in arid and semiarid environments.

13.1 Sandia National Laboratories Alternative Landfill Cover Demonstration (ALCD)

Under the direction of lead investigator Stephen F. Dwyer, Sandia has been measuring infiltration rates through six closure caps constructed near Albuquerque, New Mexico. Two of the caps are prescriptive Subtitle D and Subtitle C designs, while four others are experimental, alternative final cover caps. Construction of all the caps at one site has provided uniformity of climate, soil types, and vegetation.

The most recent summary of Dwyer’s work was published in September 2003 by the U.S. Environmental Protection Agency. The results of his study will be used to design covers for sites contaminated during nuclear energy research and development.

Dwyer concluded that the evapotranspiration cover, as constructed near Albuquerque, gave equivalent performance to a Subtitle C hazardous waste site prescriptive cover. The ET cover also performed significantly better than the Subtitle D landfill prescriptive cover.

The following Table shows percolation rates measured for each closure cap constructed by ALCD:

Year	Measured Percolation Flux Rates (mm/year)					
	Subtitle D	GCL	Subtitle C	Capillary Barrier	Anisotropic barrier	ET
1997 (5/1-12/31)	10.62	1.51	0.12	1.62	0.15	0.22
1998	4.96	0.38	0.30	0.82	0.14	0.44
1999	3.12	4.31	0.04	0.85	0.28	0.01
2000	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	0.00	0.00	0.00
2002 (1/1-6/25)	0.74	0.00	0.00	0.00	0.00	0.00
Average Rate/Year	3.76	1.20	0.09	0.64	0.11	0.13

13.2 U.S. EPA Alternative Cover Assessment Program (ACAP)
The water balance of twenty-one landfill final cover test sections is being evaluated at ten sites across the continental United States. Seventeen of the test sections have been modeled for water balance predictions using HELP3 and UNSAT-H computer programs. Most of the climatic, soil, and vegetative data input to both programs were measured in the field or laboratory. For those inputs where measurements were not obtained, estimates were made from published information.

Field measurements through 2000 have shown that alternative covers constructed in arid and semiarid climates are transmitting significantly less percolation than the alternative covers in humid climates. Percolation rates for the alternative covers in arid and semiarid climates (with the exception of a "thinner" monolithic cover at Sacramento, California) typically are less than one (1) millimeter per year. In contrast, the percolation rate expected from a Subtitle D prescriptive cover is three (3) millimeters per year (Bolen, M.B., Roesler, A.C., Benson, C.H., and Albright, W.H., 2001, p.3-1).

Gary Player visited the Kiefer (Sacramento) landfill on Monday, March 17, 2003. He was given a tour of the landfill, including the ACAP installation, by Mr. Duane Wiseman, Landfill Operations Supervisor. Player and Wiseman were accompanied by two environmental scientists employed by Sacramento County, operator of the landfill.

Both alternative covers were heavily vegetated, with no bare ground visible. The landfill personnel stated that a variety of miniature lupin constituting 10 to 15 percent of the plants was an annual species that died off in late spring or early summer. Failure of that species to transpire actively throughout the year may be a factor in the poor performance of the "thinner" of two ET covers installed at Kiefer.

Another potential problem influencing the performance of the ET covers is the presence of run-off control berms surrounding the test covers. The berms are designed to contain run-off and direct it through a measuring device, but the berms may be causing ponds to form over the test covers during periods of intense rainfall.

The following Table summarizes percolation data from six arid and semiarid ACAP sites in the western United States (Roesler, et. al., 2002, p. 37):

Left Blank for pagination. (Insert Roesler Table 4.1)

13.3 Comparison of ALCD and ACAP Percolation Results

All of the ALCD test covers were constructed at one site. In contrast, each of ten ACAP sites is unique, and the caps constructed for monitoring and simulation also differ from place to place. For that reason, the ALCD data is useful for direct comparisons of a few cover designs, while ACAP studies may be most useful for the calibration of computer programs for landfill water balance analysis throughout the United States. However, both sets of data consistently show that alternative ET covers, with the exception of one cover at the Kiefer Landfill near Sacramento, California, have performed as well as or better than Subtitle D Prescriptive covers.

13.4 Performance of Computer Models of Water Balance

A direct comparison of field results from the ACAP sites has been made with computerized model predictions for water balance for seventeen of the final cover test sections. Roesler, Benson, and Albright (2002) reported the following conclusions in their Executive Summary:

> "Data from the test sections simulating a composite cover (i.e., a geosynthetic clay liner or compacted clay barrier overlain by a geomembrane) indicate that these covers are very effective when constructed properly. Percolation rates for the composite covers are generally less than 1 mm/yr in semiarid and arid regions, and 5 mm/yr in humid regions. **Data from the test sections simulating compacted clay covers show that clay barriers are highly susceptible to dessication cracking and can transmit percolation at large rates (several hundred mm/yr).**"
>
> "**Predictions of the water balance made with HELP and UNSAT-H generally were not accurate even though the parameters used as inputs were well defined.** Discrepancies between field conditions and model predictions were related to the prediction of surface runoff, frozen ground conditions, preferential flow, and uncertainty in vegetation characteristics. Initial simulations were conducted with "as constructed" input parameters (i.e., saturated hydraulic conductivity, runoff curve number) greatly over-predicted surface runoff, which resulted in the subsequent flow processes being incorrect. Hydraulic conductivity of the surface layer was measured on specimens collected immediately after construction that probably did not include macroscopic features (dessication and freeze-thaw cracks, root holes, worm holes, etc.) that effect the saturated hydraulic conductivity at field scale. Therefore, additional simulations were conducted using an "adjusted" saturated hydraulic conductivity and runoff curve number for the surface layer. **Model predictions improved when the surface layer was more permeable, but the predictions were still inconsistent over time.** Also, modeling of frozen ground conditions appears to be significant at sites in cooler climates if surface runoff due to melt water is to be predicted accurately."

More specific information is provided in Section 6.2.2, Percolation in Alternative Covers, on pages 221 and 222 of the same 2002 report:

> **"Neither HELP (nor) UNSAT-H predicted percolation from the alternative covers accurately, and no general bias in the models (i.e., over-prediction or under-prediction of percolation) was apparent**. Both models captured the seasonal changes in percolation. The seasonal changes in soil water storage and evapotranspiration, both of which strongly influence percolation, were also captured. **However, nuances in the field data (e.g., elevated soil water storage or lower than expected evapotranspiration) were not captured by the models, and these nuances typically controlled the percolation rate**. Preferential flow also appears to affect the percolation rate at some sites. Currently, preferential flow cannot be predicted reliably with conventional models."
>
> "Accurate predictions of percolation rate are tied to the predictions of soil water storage and evapotranspiration. Both of these water balance components are strongly influenced by the hydraulic properties of the covers (sic) soils and the properties of the vegetation. Thus properties representative of the field condition are necessary to predict the water balance of alternative covers accurately."

Practical implications of the ACAP research were then summarized in Section 6.3:

> "**Analysis of the field data collected to date indicates that alternative covers generally are effective in limiting percolation to small amounts (< 1 mm/yr) in semiarid and arid areas provided the cover is designed for adequate storage capacity and is seeded with vegetation that can effectively remove stored water**."

Emphasis added by Gary F. Player.

14 SITE SPECIFIC DESIGN FOR CHESTER, SANPETE COUNTY

14.1 Geography

The Chester Class II Landfill site is located along the west side of Utah Highway 89 in the northeast quarter of section 11, T. 16 S., R. 3 E., Salt Lake Baseline and Meridian. The latitude of the site is approximately 39° 26' 30" North. The Landfill site slopes gently downward to the west-northwest, at a slope of four (4) to five (5) percent. The median elevation of the site is 5,540 feet above mean sea level. Remaining undisturbed portions of the site support a moderately dense growth of sagebrush and native grasses.

14.2 Climate

The closest weather station with a long term climatic record is at Ephraim Sorensen's Field. The period of record, available from the Western Region Climate Center at the Desert Research Institute, is September 1, 1949 through December 31, 2001.

14.2.1 Temperature

Average annual temperature at Sorensen's Field is 47.6 degrees Fahrenheit. January is the coldest month, averaging 24.80 degrees F., while July is the warmest month, averaging 71.64 degrees F. The hottest year of record was 1972, averaging 52.9 degrees F. The coldest year of record was 1973, averaging 43.2 degrees F.

It is interesting to note that all of the five (5) coldest years of record occurred before 1985. However, only two (2) of the five (5) hottest years have occurred since 1985. Those years, 1994 and 2001, each averaged 49.9 degrees F. The following Table lists the average annual temperature, along with the five hottest and five coldest years:

ANNUAL TEMPERATURES AT SORENSEN'S FIELD, EPHRAIM, UTAH	
Average	47.6 (Degrees Fahrenheit)
1972 (hottest)	52.9
1964	50.8
1981	50.2
1994	49.9

2001	49.9
1984	45.3
1955	45.2
1951	44.9
1975	44.7
1973 (coldest)	43.2

14.2.2 Precipitation
Average annual precipitation at Sorensen's Field is 11.84 inches (300.74 millimeters) per year. The maximum recorded precipitation is 19.89 inches in 1983. The following Table lists the average annual precipitation, along with the five wettest and five driest years:

ANNUAL PRECIPITATION AT SORENSEN'S FIELD, EPHRAIM, UTAH		
Average	11.84 (Inches)	300.74 (Millimeters)
1983 (Wettest)	19.89	505.21
1980	16.78	426.21
1984	16.73	424.94
1995	16.20	411.48
1998	15.92	404.37
1956	7.95	201.93
1974	7.29	185.166
1950	6.81	172.97
1958	6.18	156.97
1976 (Driest)	5.21	132.33

14.2.3 Snow Depth

Average snow depth is low. The average is highest in late January, when it is less than four and one half (4.5) inches. Virtually no snow remains on the ground during February, while about one and one half (1.5) inches of snow remains on the ground in March. Less than one half inch of snow is present on the ground in December. No other month, on average, has any snow on the ground.

14.3 Soil Properties Determined by Bingham Engineering

Soil samples from natural soils occurring beneath the Landfill site were obtained from test borings drilled in 1995 by Bingham Engineering. These were analyzed by Bingham in order to obtain values for classification and to determine saturated hydraulic conductivity. The following Table summarizes the results of their soil analyses:

Soil Property	Boring MW-1, 10'	Boring MW-1, 25'	Boring MW-2, 15'	Boring MW-3, 40'
Percent Gravel	4.50	17.50	6.00	6.00
Percent Sand	30.00	36.00	25.00	25.00
Percent Silt	40.00	24.50	35.00	47.00
Percent Clay	26.00	22.00	34.00	22.00
Percent Sand, Excluding Gravel*	31.30	43.60	26.60	26.60
Percent Silt, Excluding Gravel*	41.70	29.70	37.20	50.00
Percent Clay, Excluding Gravel*	27.10	26.70	36.20	23.40
USDA Classification	Loam	Loam	Clay Loam	Loam

Soil Property	Composite Sample 1	Composite Sample 2
Percent Gravel	9.00	18.00

Percent Sand	19.00	29.00
Percent Silt	42.00	29.00
Percent Clay	30.00	24.00
Percent Sand, Excluding Gravel*	20.90	35.40
Percent Silt, Excluding Gravel*	46.20	35.40
Percent Clay, Excluding Gravel*	33.00	29.30
USDA Classification	Clay Loam	Clay Loam
Hydraulic Conductivity as determined on remolded samples **	7.1×10^{-4} cm/second (compacted to 95% of maximum dry density)	2.9×10^{-5} cm/second (compacted to 96.3% of maximum dry density)

* *In the USDA system of textural classification soil texture is determined using only the weight proportion of soil particles less than 2 mm in diameter as determined from laboratory particle-size distribution analyses (gradation). Coarser particles are considered "rock fragments," and are not utilized for "fine earth" soil classification.*

** *Analyses of hydraulic conductivity for samples compacted to 95% of maximum dry density ranged from 3.0×10^{-4} to 7.1×10^{-4} cm/second.*

Fine-grained soils from five feet below ground level (BGL) along with gravelly sand soils recovered from depths of 10 feet and 20 feet BGL were combined in Bingham's Composite Sample No. l and tested for permeability. These combined soils had the slowest infiltration rates of Bingham's four permeability tests. Three other permeability tests were conducted on coarser materials from 25 feet BGL or deeper.

14.4 Soil Properties Determined by Tri-State Testing Laboratories, Inc.
Additional soil samples were recovered from an open trench at the northern edge of the existing landfill prism. The trench was about 28 feet deep. Soils in the first ten feet below ground level are mostly silt and clay, with only traces of gravel. Below 10 feet silty, clayey, sand and gravel are predominant. All soils are tan and dry down to about 25 feet. Soils below

25 feet are moist and orange-brown in color, suggesting oxidation from fluctuating levels of ground water.

Channel samples were collected from a ten-foot thick layer of sandy clay (CL) present from ground level to 10 feet below ground. Soil properties (gradation, PI, plastic limit, MDD and OMC) were obtained for three clay samples. These values were determined by Tri-State Testing Laboratories, Inc.

The specified soil properties of final cover materials are described below:

. **CHARACTERIZATION TEST RESULTS OF FINAL COVER MATERIALS**

SAMPLE	GRAVEL %	SAND %	SILT AND CLAY %	MDD (pcf)	OMC (%)	LL	PI	USCS NAME
"S"	2.2	31.5	66.3	100.5	20.5	34	13	CL
"D"	10.6	33.9	55.5	102	20.5	35	15	CL
Composite	6.4*	32.7*	60.9*	101.2	20.5	34.5*	14*	CL

* *Values with an asterisk are mathematical averages of values for samples "S" and "D." Values without asterisks are results from physical measurements.*

Constant head permeability values for the samples analyzed by Tri-State were obtained by IGES consultants of Salt Lake City, Utah. All tests were run at 5 psi back pressure.

PERMEABILITY TEST RESULTS OF INFILTRATION LAYER COVER MATERIALS

SAMPLE NUMBER	PERMEABILITY	SAMPLE PREPARATION
"S"	2.26 X 10^-5	90% MDD
"S"	3.29 X 10^-7	95% MDD
"D"	3.26 X 10^-5	90%MDD
"D"	1.72 X 10^-7	95% MDD
PHYSICAL MIXTURE OF "S" AND "D"	8.32 x 10^-6	93% MDD

15 HELP3 MODEL INPUT AND RESULTS

Each HELP3 output file included with this CPA contains summaries of the input parameters. The following discussion may be beneficial to reviewers and potential interveners unfamiliar with the HELP3 computer model. The following overview of the HELP3 input values is copied from Section 3.1 of the engineering documentation.

> "The HELP model requires general climate data for computing potential evapotranspiration; daily climatologic data; soil characteristics; and design specifications to perform the analysis. The required general climate data include growing season, average annual wind speed, average quarterly relative humidities, normal mean monthly temperatures, maximum leaf area index, evaporative zone depth and latitude. Default values for these parameters were compiled or developed from the "Climates of the States" (Ruffner, 1985) and "Climatic Atlas of the United States" (National Oceanic and Atmospheric Administration, 1974) for 183 U.S. cities. Daily climatologic (weather) data requirements include precipitation, mean temperature and total global solar radiation. Daily rainfall data may be input by the user, generated stochastically, or taken from the model's historical data base. The model contains parameters for generating synthetic precipitation for 139 U.S. cities. The historical data base contains five years of daily precipitation data for 102 U.S. cities. Daily temperature and solar radiation data are generated stochastically or may be input by the user."
>
> "Necessary soil data include porosity, field capacity, wilting point, saturated hydraulic conductivity, initial moisture storage, and Soil Conservation Service (SCS) runoff curve number for antecedent moisture condition II. The model contains default soil characteristics for 42 material types for use when measurements or site-specific estimates are not available. The porosity, field capacity, wilting point and saturated hydraulic conductivity are used to estimate the soil water evaporation coefficient and Brooks-Corey soil moisture retention parameters. Design specifications include such items as the slope and maximum drainage distance for lateral drainage layers; layer thicknesses; layer description; area; leachate recirculation procedure; subsurface inflows; surface characteristics; and geomembrane characteristics."

Each input parameter for the Chester Class II Landfill CPA modeling was selected from default values included in the program, or manually chosen and entered by Utah Professional Geologist Gary F. Player. Player has approximately ten years of experience preparing accepted HELP3 models for landfills in Utah, Nevada, and Idaho. The following discussion provides the rationale for his choices.

15.1 Climate Data

The climate data was generated stochastically, using historical data for Ephraim's Sorensen's Field weather station–the closest data set. Synthetic precipitation, temperature, and solar radiation tables were generated by the HELP3 program for sixty years of average climate with predicted fluctuations from the mean.

Rainfall, daily snow depth, and temperature data for Sorensen's Field were obtained from the Western Regional Climate Center of the Desert Research Institute, Las Vegas, Nevada. The period of record for precipitation was from 1949 to early 2003. The period of record for daily snow depth was from September 1949, to the end of 2001. The period of record for temperature was from 1950 to January of 2003.

Statistical parameters for Salt Lake City were used for the generation of synthetic climate data for Sorensen's Field. Salt Lake City was chosen, as it is the closest city with statistical climatological data incorporated in the HELP3 program. The climate at Salt Lake City is somewhat different from that of Sanpete County. However, the differences cancel each other out: Salt Lake City is slightly warmer with a longer growing season, while the humidity is higher than Sanpete County (reducing evaporation potential) due to the lake effect of Great Salt Lake. The cumulative effect of differences in evaporation and transpiration is slight.

Initially errors occurred when climate data for wettest and driest years were modeled for one year only. The stochastically generated annual precipitation differed from the total of the manually entered monthly values. This program-induced error was overcome by modeling each "wettest" and "driest" year for sixty years, and then extracting the data for one year that most closely matched the actual, measured, climate data. The extracted data was then entered manually as user specified daily precipitation values for the wettest and driest years.

15.2 HELP3 Soil Data

Soil information used in the Chester Class II HELP3 models was compiled from:

(1) site specific laboratory analyses; and
(2) published values for thousands of similar soils summarized in technical publications.

15.2.1 Site Specific Laboratory Analyses
Two sets of laboratory analyses were provided in the *Closure Plan - Sanpete Class II Landfill* which was delivered to you on April 14, 2003. The first set was prepared from test borings completed by Bingham Engineers in 1995. The second set consisted of bulk samples collected from trenches logged by Gary F. Player in 2000. This set was analyzed by Tri-State Laboratories and IGES, Inc. Summaries of these analyses are presented in Sections 14.3 and 14.4 (above).

Four additional bulk samples were collected by Player in April and May of 2003. These were analyzed by GEO Consultants of Cedar City, Utah, under the direction of Joel A. Myers, P.E. Two of the samples were of intermediate cover in place on the northern and southern ends of the landfill prism. The remaining two samples were taken from the first five feet of soils exposed in a trench north of the landfill prism. Copies of these four analyses were included as an Appendix to the Revised Response to the Request for Additional Information dated June 16, 2004. The GEO Consultants data are summarized in the following Table:

Sample	Sand Percent	Silt Percent	Clay Percent	USCS Name	USDA Classification
Intermediate Cover, S. End	34	40.2	25.8	CL-ML	Loam
Intermediate Cover, N. End	36.2	13	50.7	CL	Clay
Chester 1 (Trench)	30.7	48.5	20.8	CL	Loam
Chester 2 (Trench)	27	30	43	CL	Clay (near Clay Loam)

15.2.2 Published Values
Data for manually entered porosity, field capacity, wilting point and saturated hydraulic conductivity values were developed from a table prepared by Rawls and Brakensiek (1985). Their table contains moisture retention data for loam (383 samples), clay loam (366 samples), and clay (291 samples).

The Coop will construct the entire thickness of the closure cap without segregating the organic rich few inches of onsite soils. Sufficient organic and/or synthetic fertilizers will be applied as needed to encourage the growth of vegetation on the closure cap.

The so-called "bath tub effect" will not occur beneath the Closed Chester Class II Landfill. Section R315-303-3(4)(a)(i)(A) of the rules requires that the final cover, in no case, shall be more permeable than the bottom liner system or natural subsoils present beneath the landfill.

The proposed alternative closure cap will be constructed of loosely compacted clay loam and clay loam soils excavated from the landfill site. Numerous site specific physical measurements of saturated hydraulic conductivity are on hand for these soils when moderately compacted (as in the intermediate cover).

A test pad was constructed onsite using the specified cover soils in October of 2000. Minimal compactive effort using rubber tired vehicles provided compaction values ranging from 88 percent of maximum dry density (MDD), to 98.5 percent of MDD.

Test pad soils were collected from a surficial ten foot thick layer of sandy clay (CL) present just north of the landfill prism at the Class II Landfill site. Soil properties (gradation, PI, plastic limit, MDD and OMC) were obtained for three soil samples. These values were determined by Tri-State Testing Laboratories, Inc. The specified soil properties of infiltration layer materials are repeated below.

CHARACTERIZATION TEST RESULTS OF INFILTRATION LAYER MATERIALS

SAMPLE	GRAVEL %	SAND %	-200 %	MDD (pcf)	OMC (%)	LL	PI	USCS NAME
"S"	2.2	31.5	66.3	100.5	20.5	34	13	CL
"D"	10.6	33.9	55.5	102	20.5	35	15	CL
Composite	6.4*	32.7*	60.9*	101.2	20.5	34.5*	14*	CL

** Values with an asterisk are mathematical averages of values for samples "S" and "D." Values without asterisks are results from physical measurements of the sample.*

Constant head permeability values were measured by IGES consultants of Salt Lake City, Utah. All tests were run at 5 psi back pressure.

PERMEABILITY TEST RESULTS OF COVER MATERIALS

SAMPLE NUMBER	PERMEABILITY (cm/sec)	SAMPLE PREPARATION
"S"	2.26 X 10^-5	90% MDD
"S"	3.29 X 10^-7	95% MDD
"D"	3.26 X 10^-5	90%MDD
"D"	1.72 X 10^-7	95% MDD
COMPOSITE	8.32 x 10^-6	93% MDD

The saturated hydraulic conductivity value of the composite sample (prepared by physically mixing shallow samples "S" and "D"), 8.32 x 10^-6 cm/sec at 93 percent MDD, is equivalent to a rate of **8.61 feet per year**, or about 103 inches per year.

These "permeability" (saturated hydraulic conductivity) values are substantially less than values measured by Bingham Engineers from samples collected at depths greater than 10 feet below ground level in their test borings. The Bingham values (at 95 percent MDD) range from 2.9 x 10^-5 to 3.0 x 10^-4 cm/sec, equivalent to **30 feet to 310 feet per year**.

15.3 Plants

The selected seed mix will represent the local "climax" plant community. However, the mix will not be restricted to native plants. Nonnative plants may be selected that will enhance the vegetative cover. For example, drought resistant plants that transpire throughout the growing season would be preferable to native annual plants that become dormant in early summer.

Model simulations presented with this CPA have been run with an LAI of 1.6. That is the value for a poor stand of grass that the program provides for Salt Lake City, Utah. Use of "bare ground" dramatically increases modeled run-off, thereby decreasing the amount of annual precipitation that percolates through the landfill cover. The "poor stand of grass" is a more conservative LAI value.

16 FINAL COVER CONFIGURATION

Accurate modeling of landfill slopes is problematic. The shape of the landfill prism has varied and will always vary with time, due to (1) the application of waste, (2) grading before placement of the final cover, and (3) settlement of waste during the post-closure period.

Computer models presented with this CPA are based on the most conservative approach. Modeling of the proposed landfill closure cap incorporates the assumption of low, 5 percent slopes over the entire 12 acres of the landfill prism. Manually entered gentle slopes combined with the maximum slope distance of 1200 feet force the HELP3 program to calculate SCS runoff curve numbers that reduce runoff and maximize percolation rates through the surface layer of soils.

16.1 Percent Gravel

The amount of gravel in the soil that will be used in the alternative final cover cap is negligible. Material greater than 2 millimeters in diameter is considered "rock fragments," or gravel for the USDA soil classification. One shallow sample tested by Bingham Engineers contained 4.5 percent gravel greater than 2 millimeters in diameter.

Cover soils tested by GEO Consultants and Tri-State Testing utilized sieve size 4 as the cutoff for gravel, or 4.8 millimeters. This value, established by ASTM for USCS gradation curves, allows slightly coarser material to be classified as sand. The gravel in four GEO Consultant samples ranged from 1.4 to 5.2 percent. The gravel amounts in two Tri-State samples were 0.6 percent and 2.2 percent.

The most likely case for the percentage of gravel in soils to be utilized in the final cover is 5 percent larger than 2 millimeters in diameter. That amount would require the addition of 1.8 inches to a 36-inch thick ET cover. If the percentage of gravel were found to be10 percent, the extra cover thickness would be only 3.6 inches. The amount of soil needed to expand the cover for the occurrence of gravel will be determined during installation, when many additional samples for gradation will be collected.

16.2 No Credit for Intermediate Cover

All the soils analyses to date have shown that the intermediate cover now in place is identical in gradation and other soil properties to the materials present in the upper ten feet of soils exposed in trenches adjacent to the landfill prism. That is because the intermediate cover materials were excavated out of the shallow portions of the adjacent trenches.

The intermediate soils were placed and moderately compacted with rubber tired vehicles, as were the soils placed over the test pad referenced above. The compacted soils provide a good foundation for the final cover, but the moisture holding capacity and suitability as a substrate for plant growth is reduced by compaction. For those reasons, the intermediate cover will **not** be counted as part of the 36" thick closure cap.

PART V--FINAL HELP3 COMPUTER MODELING

The Cooperative prepared several additional computer models in an attempt to represent most accurately the performance of the proposed Chester ET closure cap.

Each model was prepared with the assumptions discussed above. The climate values and initial moisture content vary to reflect available data and antecedent modeling.

17 WET AND DRY CONDITIONS

Tables presented below include results of models of the Subtitle D prescribed cover using default soil type 11 for topsoil. Default soil type 25 was used for the 18 inches of barrier soil. The slope was reduced to 5 percent, with a slope distance of 1200 feet, and a poor stand of grass. This is a more conservative approach than using steeper slopes and shorter slope distances. Annual percolation through the base of layer two after 60 years of average climate was .04501 inches per year, or 0.38372 percent of annual precipitation.

Additional model simulations were performed to independently represent the five wettest and driest years. Two sets of models were run for both the recommended 36" evapotranspiration cover cap and a 24" thick Subtitle D cap. The first set of models ran for sixty years at average climates, followed by the five wettest years on record (from wettest to fifth wettest), followed by another sixty years at average climates. A second set of models for both closure cap types was run for sixty years at average climates, followed by the five driest years on record (from fifth driest to driest), followed by another sixty years at average climates.

17.1 Models Incorporating the Five Wettest Years

The following Table compares the results of 14 HELP3 model runs representing 60 years of average climate, followed by the five wettest years in descending order, and then another 60 years of average climate.

Climate Model	Total Years	Landfill Model Name (.d10)	Output File Name (.out)	Start Layer(s) M.C. (%)	End Layer(s) M.C. (%)	Average Annual Percolation (inches)	Closure Cap Design
CHESTAVE	60	CH36NU60	CHAVE60	.187	.2802	0.02293	36" ET
CHES1983	1	CH36NU61	CHESNU61	.2802	.3502	0.76160	36" ET
CHES1980	1	CH36NU62	CHESNU62	.3502	.3165	2.33192	36" ET
CHES1984	1	CH36NU63	CHESNU63	.3165	.2726	0.69701	36" ET
CHES1995	1	CH36NU64	CHESNU64	.2726	.2035	0.01279	36" ET
CHES1998	1	CH36NU65	CHESNU65	.2035	.2422	0.00001	36" ET
CHESTAVE	60	CH36N125	CHSNU125	.2422	.2793	0.0275	36" ET
CHESTAVE	60	SUBDDS25	SUBDDS25	1. .187 2. .266	1. .3323 2. .3292	0.04501	SUBTITLE D, 24"
CHES1983	1	SUBDNU61	SUBDDS61	1. .3323 2. .3292	1. .2765 2. .4186	2.02997	SUBTITLE D, 24"
CHES1980	1	SUBDNU62	SUBDDS62	1. .2765 2. .4186	1. .2507 2. .3682	2.71888	SUBTITLE D, 24"
CHES1984	1	SUBDNU63	SUBDDS63	1. .2507 2. .3682	1. .4583 2. .3363	0.06708	SUBTITLE D, 24"
CHES1995	1	SUBDNU64	SUBDDS64	1. .4583 2. .3363	1. .3082 2. .2692	1.667987	SUBTITLE D, 24"
CHES1998	1	SUBDNU65	SUBDDS65	1. .3082 2. .2692	1. .3429 2. .3414	0.00148	SUBTITLE D, 24"
CHESTAVE	60	SUBDN125	SUBDN125	1. .3429 2. .3414	1. .3301 2. .3355	0.03669	SUBTITLE D, 24"

The following Table juxtaposes the modeling results for the 36" ET and Subtitle D covers, incorporating the five wettest years:

Climate Model	Number of Years	Closure Cap Design	Average Annual Percolation (inches)		Average Annual Percolation (inches)	Closure Cap Design
CHESTAVE	60	Subtitle D 24"	0.04501		0.02293	36" ET
CHES1983	1	Subtitle D 24"	2.02997		0.76160	36" ET
CHES1980	1	Subtitle D 24"	2.71888		2.33192	36" ET
CHES1984	1	Subtitle D 24"	0.06708		0.69701	36" ET
CHES1995	1	Subtitle D 24"	1.667987		0.01279	36" ET
CHES1998	1	Subtitle D 24"	0.00148		0.00001	36" ET
CHESTAVE	60	Subtitle D 24"	0.03669		0.0275	36" ET

17.2 Models Incorporating the Five Driest Years

Another set of HELP3 models was then run using the five driest years in place of the five wettest years. In this case, the driest years were modeled from the fifth driest year to the driest year:

Climate Model	Years	Landfill Model Name (.d10)	Output File Name (.out)	Start Layer(s) M.C. (%)	End Layer(s) M.C. (%)	Average Annual Percolation (inches)	Closure Cap Design
CHESTAVE	60	CH36NU60	CHAVE60	.187	.2802	0.02293	36" ET
CHES1956	1	CDRY3661	CHDRY61	.2802	.2126	0.0145	36" ET
CHES1974	1	CDRY3662	CHDRY62	.2126	.2086	0.00004	36" ET
CHES1950	1	CDRY3663	CHDRY63	.2086	.2228	0.00002	36" ET
CHES1958	1	CDRY3664	CHDRY64	.2228	.2017	0.00009	36" ET
CHES1976	1	CDRY3665	CHDRY65	.2017	.1888	0.00001	36" ET
CHESTAVE	60	CDRY125	CHDRY125	.1888	.2800	0.02240	36" ET
CHESTAVE	60	SUBDDS25	SUBDDS25	1. .187 2. .266	1. .3323 2. .3292	0.04501	SUBTITLE D, 24"
CHES1956	1	SUBDRY61	SUBDRY61	1. .3323 2. .3292	1. .3016 2. .2616	0.015116	SUBTITLE D, 24"
CHES1974	1	SUBDRY62	SUBDRY62	1. .3016 2. .2616	1. .3285 2. .2798	0.00095	SUBTITLE D, 24"
CHES1950	1	SUBDRY63	SUBDRY63	1. .3285 2. .2798	1. .2549 2. .3348	0.00175	SUBTITLE D, 24"
CHES1958	1	SUBDRY64	SUBDRY64	1. .2549 2. .3348	1. .2749 2. .2680	0.00474	SUBTITLE D, 24"
CHES1976	1	SUBDRY65	SUBDRY65	1. .2749 2. .2680	1. .2002 2. .2616	0.00829	SUBTITLE D, 24"
CHESTAVE	60	SBDRY125	SBDRY125	1. .2002 2. .2616	1. .3301 2. .3353	0.04348	SUBTITLE D, 24"

The following Table juxtaposes the modeling results for the 36" ET and Subtitle D covers, incorporating the five driest years:

Climate Model	Number of Years	Closure Cap Design	Average Annual Percolation (inches)		Average Annual Percolation (inches)	Closure Cap Design
CHESTAVE	60	Subtitle D 24"	0.04501		0.02293	36" ET
CHES1956	1	Subtitle D 24"	0.015116		0.0145	36" ET
CHES1974	1	Subtitle D 24"	0.00095		0.00004	36" ET
CHES1950	1	Subtitle D 24"	0.00175		0.00002	36" ET
CHES1958	1	Subtitle D 24"	0.00474		0.00009	36" ET
CHES1976	1	Subtitle D 24"	0.00829		0.00001	36" ET
CHESTAVE	60	Subtitle D 24"	0.04348		0.02240	36" ET

18 SUCCESSFUL DEMONSTRATION

The two sets of models tabulated above present 250 years of HELP3 simulations. The 36" ET cover performed better in all but one year: 1984. That year is the third wettest year. The ET cover outperformed the Subtitle D cover during the first sixty years of average climate, the wettest year, the second wettest year, the fourth wettest year, the fifth wettest year, and for an additional 60 years of average climate thereafter. The ET cover also outperformed the Subtitle D cover throughout the entire set of driest year simulations.

The UDSHW has communicated to Gary F. Player several times that Subtitle D covers should not be expected to perform as well as modeled by HELP3. The reasons for the failure of the Subtitle D clay barrier cap are:

(1) Cracking after drying (dessication cracks);
(2) Enlargement of cracks due to Utah’s active freeze-thaw cycle; and

(3) Propagation of cracks due to landfill settlement.

The HELP3 model predicted that moisture contents in the lower, barrier clay layer would be reduced below the wilting point of default soil 25 (.266 vol./vol.) after the "driest" years 1956 and 1976. The predicted moisture content after 1956 was .2616 vol./vol., and the predicted moisture content after 1976 was also .2616 vol./vol. The moisture content for barrier soil in Subtitle D cover models in the years following 1956 and 1976 were manually set at .266 vol./vol., creating a conservative set of parameters for moisture content in the "driest years" set of models.

18.1 Comparison of Total Percolation Through Each Cap

The total amount of moisture percolating through each cap during the 250 years modeled is summarized in the following Table:

Climate Model	Number of Years	Closure Cap Design	Total Percolation (inches)		Total Percolation (inches)	Closure Cap Design
CHESTAVE	60	Subtitle D 24"	2.7006		1.3758	36" ET
CHES1983	1	Subtitle D 24"	2.02997		0.76160	36" ET
CHES1980	1	Subtitle D 24"	2.71888		2.33192	36" ET
CHES1984	1	Subtitle D 24"	0.06708		0.69701	36" ET
CHES1995	1	Subtitle D 24"	1.667987		0.01279	36" ET
CHES1998	1	Subtitle D 24"	0.00148		0.00001	36" ET
CHESTAVE	60	Subtitle D 24"	2.2014		1.65	36" ET
125 YEARS TOTAL	**(WETTEST)**	**Subtitle D 24"**	**11.387397**		**6.82912**	**36" ET**

Climate Model	Number of Years	Closure Cap Design	Total Percolation (inches)		Total Percolation (inches)	Closure Cap Design
CHESTAVE	60	Subtitle D 24"	2.7006		1.3758	36" ET
CHES1956	1	Subtitle D 24"	0.015116		0.0145	36" ET
CHES1974	1	Subtitle D 24"	0.00095		0.00004	36" ET
CHES1950	1	Subtitle D 24"	0.00175		0.00002	36" ET
CHES1958	1	Subtitle D 24"	0.00474		0.00009	36" ET
CHES1976	1	Subtitle D 24"	0.00829		0.00001	36" ET
CHESTAVE	60	Subtitle D 24"	2.6088		1.344	36" ET
125 YEARS TOTAL	**(DRIEST)**	**Subtitle D 24"**	**5.340246**		**2.73446**	**36" ET**
250 YEARS TOTAL	**(ALL MODELS)**	**Subtitle D 24"**	**16.727643**		**9.56358**	**36" ET**

18.2 Conclusions about Leachate Percolation

The 36" ET cover cap has been shown to perform significantly better than the Subtitle D 24" cap in 249 out of 250 years modeled.

The total amount of leachate predicted from the Subtitle D cap over the 125-year period including the wettest years is 1.67 times greater than the leachate predicted from the 36" ET cap during the same period. The total amount of leachate predicted from the Subtitle D cap over the 125-year period including the driest years is 1.95 times greater than the leachate predicted from the 36" ET cap during the same period. The total amount of leachate predicted from the Subtitle D cap over the entire 250 year period is 1.75 times greater than the leachate predicted from the 36" ET cap during the same period.

The HELP3 model does not take into account the likely cracking and consequent failure of the Subtitle D barrier clay layer.

PART VI--INFORMATION CONTAINED IN THE MARCH 22, 2004 LETTER

After a thorough review of site conditions and computer modeling predictions of leachate at Chester, the Sanpete Sanitary Landfill Cooperative and their consultants have concluded that the proposed 36-inch thick cap of locally excavated fine-grained soils is a more stringent design than the standard design specified in Subsection R315-303-3(4)(a) to protect human health or the environment. We have also concluded that the proposed 36-inch thick cap meets the published regulatory requirements of the U.S. Environmental Protection Agency and the Utah Division of Solid and Hazardous Waste.

19 COMPARISON OF PERCOLATION RATES FOR ET AND SUBTITLE D CLOSURE CAPS

Two sets of HELP3 models have been presented to UDSHW. The first set was included in the Sanpete Sanitary Landfill Cooperative Class II Landfill Closure Plan, April 16, 2003. The following Table 1 (repeated from April 16, 2003) shows that, given the same climatic conditions, the proposed 36-inch ET final closure cap performs twice as well as a prescribed Subtitle D clay cap. Both caps discharged some water after the two wettest years, but then were effective for the next 68 modeled years. Documentation for the data shown in this and the other Tables in this letter were presented to UDSHW in the respective reports.

Year or Years	Thirty-six Inch ET Cover Percolation (Inches/Year)	Subtitle D Clay Cap Percolation (Inches/Year)
60 Years with Average Climate	.02512 (.638 mm/yr)	.05463 (1.39 mm/yr)
1983 as Year 61 (Wettest)	1.44952	1.42499

1980 as Year 62	4.04740	5.66077
1984 as Year 63	.00002	.00300
1995 as Year 64	.000125	.08115
1998 as Year 65	.00000	.00421
1956 as Year 66	.00001	.00143
1974 as Year 67	.00000	.01549
1950 as Year 68	.00004	.21401
1958 as Year 69	.00025	.66049
1976 as Year 70 (Driest)	.00001	.00146
60 More Years with Average Climate, total of 130 years	.02505	.05456

20 APPLICABLE REGULATIONS

40 CFR Chapter 1 (7-1-96 Edition) lists acceptable closure criteria for municipal solid waste landfills. Section 258.60 (a) describes the so-called "standard" Subtitle D cover as follows:

> The final cover system must be designed and constructed to: (1) have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1X10^{-5}$ cm/sec, whichever is less, and (2) minimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum of 18- inches of earthen material, and (3) minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth.

Section 258.60 (b) then states that the Director of an approved state may approve an alternative final cover design that includes:

> (1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (a)(1) and (a)(2) of this section, and (2) an erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a)(3) of this section.

Utah, an approved state, has promulgated the following regulation concerning closure caps in R-315-303-3, Standards for Design. Section R315-303-3(4) states that, at closure, the owner or operator of a Class II landfill (such as the Chester Landfill) shall use one of the following designs for the final cover:

> (a) Standard design. The standard design of the final cover shall consist of two layers:
> (I) a layer to minimize infiltration, consisting of at least 18 inches of compacted soil, or equivalent, with a permeability of 1 X 10^{-5} cm/sec or less, or equivalent, shall be placed upon the final lifts;
> (A) in no case shall the cover of the final lifts by more permeable than the bottom liner system or natural subsoils present in the unit; and
> (B) the grade of surface slopes shall not be less than 2%, nor the grade of side slopes more than 33%, except where construction integrity and the integrity of erosion control can be demonstrated at steeper slopes; and
> (II) a layer to minimize erosion, consisting of:
> (A) at least 6 inches of soil capable of sustaining vegetative growth placed over the compacted soil cover and seeded with grass, other shallow rooted vegetation, or other native vegetation; or
> (B) other suitable material, approved by the Executive Secretary.
>
> (b) Alternative Design. The Executive Secretary may approve an alternative final cover design, on a site specific basis, if it can be documented that:
> (I) the alternative final cover achieves an equivalent reduction in infiltration as specified as the standard design in Subsection R315-303-0(4)(a)(I); and
> (II) the alternative final cover provides equivalent protection from wind and water erosion as specified as the standard design in Subsection R315-303-3(4)(b)(ii)

The Solid Waste Permitting and Management Rules, dated October 15, 2003, include a third, more stringent, alternative closure cap alternative:

(c) If a landfill has been constructed using an approved alternative landfill design, including a waiver, or exemption, from the liner or ground water monitoring requirements, the Executive Secretary may require, on a site specific basis, the landfill closure to be a more stringent design than the standard design specified in Subsection R315-303-3(4)(a) to protect human health or the environment.

Sanpete has provided a design for a more stringent closure cap than the Subtitle D cap specified in R315-303-3(4)(a). Computer modeling summarized above demonstrates that over a 130-year period the proposed 36-inch closure cap would allow infiltration of a little less than half as much moisture as a standard design described in Subsection R315-303-3(4)(a).

Tables included in the July 31, 2003 Letter Report show infiltration through The Subtitle D standard design after 250 years would total 1.75 times more infiltration than would penetrate the proposed 36" thick evapotranspiration final cover cap in the same period. Therefore, the proposed landfill closure cap is a “more stringent design” than the standard design specified in Subsection R315-303-3(4)(a) to protect human health or the environment.

The last row from the comparison table in our July 31, 2003 letter is repeated below with columns rearranged and an additional row showing average annual infiltration:

Climate Model	Number of Years	Percolation (inches)	Closure Cap Design		Closure Cap Design	Percolation (inches)
(ALL MODELS)	**250 YEARS TOTAL**	**9.56358**	**36" ET**		**Subtitle D 24"**	**16.727643**
(ALL MODELS)	**250 YEARS AVERAGE**	**.03825**	**36" ET**		**Subtitle D 24"**	**.06691**

21 FINAL COVER DESIGN

21.1 Materials

The infiltration layer for the final cover will be constructed of shallow soils obtained from the first ten feet of soils in a pit on the landfill property. The soils in the first 10 feet below ground level are clay loams, with a USCS class name of clay (CL), and a saturated hydraulic conductivity less than 3.26 X 10^{-5} centimeters per second, when compacted to at least 90% of maximum dry density.

Copies of analyses of the soils from the surface to ten feet below ground level are presented in Appendices II and III.

21.2Thickness

The evapotranspiration cover will be at least 36 inches thick. This thickness does not include intermediate cover soils that have already been placed over most of the landfill prism. The thickness of the cover may be increased to reflect measured quantities of gravel coarser than 2 millimeters.

21.3 Construction Procedures

The ET cap will not be installed at "greater than optimum" moisture content (as is required for a Subtitle D prescriptive cap), but with relatively dry soil at field conditions typical of Sanpete County. For that reason, the ET cover will be much less prone to damage from dessication or freeze-thaw cycles than a prescribed Subtitle D compacted clay cap.

A Landfill Closure Construction Plan will be submitted to UDSHW for approval by the Executive Secretary before constructing the final cover. The Plan will illustrate how the final cover will be installed and will include construction drawings and a Quality Assurance/Quality Control plan.

Respectfully Submitted,

Gary F. Player
Utah Professional Geologist No. 5280804-2250

Doug Bjerregaard
Chairman, Sanpete Sanitary
Landfill Cooperative

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