PRELIMINARY HELP MODEL RESULTS
RED DEVIL MINE SITE
RED DEVIL, ALASKA

Prepared For:

U.S. Department of Interior
Bureau of Land Management
National Sciences and Technology Center

Prepared By:

Dynamac Corporation
20440 Century Boulevard
Germantown, Maryland 20874

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Potential Capping Scenarios for Red Devil Mine Site

Potential landfill cover designs for the Red Devil Mine Site were developed and analyzed with the assistance of the Hydrologic Evaluation of Landfill Performance (HELP) Version 3.1 computer model developed by EPA. This "quasi-two-dimensional hydrologic model" was issued by the U.S. Environmental Protection Agency (EPA) to conduct water balance analysis for landfills, cover systems, and other containment facilities (EPA, 1994, c, d). The model assists in the determination of appropriate waste disposal cover and liner design elements for a particular application.

Data related to the *in-situ* hydraulic conductivity of the contaminated tailings and soils were set up in a base model to reflect potential surface water percolation through the waste material. Weather and evaporative (root) - depth parameters for Bethel, Alaska were adjusted by attitude and longitude to reflect the centroid of the site. The analyses were run over a 30-year design life, which is consistent with RCRA design-life parameters. The summaries for each trial generated by HELP have been included in the attachment of this report.

No geotechnical data was available identifying the hydraulic conductivity of the contaminated tailings and borrow area soils at the time of preparation of this report. Therefore, theoretical values were used to develop the HELP analyses. Soil descriptions contained in the boring logs were used to apply generic published values of hydraulic conductivity. Based on these interpretations, the on site soils were determined to be desirable for use as one of the cap layers because of the relatively low permeability of the material.

XRF results, boring logs, laboratory analytical results, and the proposed removal actions were reviewed to select the most appropriate capping configuration. These results indicate that the contaminated materials in the retort area that require capping can be divided into two categories: 1) contaminated tailings and soils; and 2) contaminated debris. The retort building debris can be further divided into the following categories: 1) non-hazardous debris (non-hazardous solid waste), and 2) hazardous debris (hazardous solid waste). Based on this categorization, HELP modeling was performed for three distinct waste sources, which are as follow: non-hazardous tailings and soils; non-hazardous solid waste and soils; and hazardous solid waste and soil. Furthermore, multiple modeling runs were conducted for each waste category using different capping scenarios.

A. Non-Hazardous Tailings and Soils

Available analytical data identified that the tailings and soils contain high concentrations of mercury and arsenic. Two capping scenarios were modeled for the non-hazardous tailings and soil. The capping scenarios selected for use in HELP are:

A1. No Cover
A2. Three-Layer Cap

A1: No Cover

Under this capping scenario, the tailings and soils will be left uncovered without any vegetation. This scenario will act as a baseline for comparison to the other cap configurations. With no cap, the rate of percolation into the tailings and soils will continue to be high, and as a result, the potential of release of contaminants will continue to exist.

The HELP analysis was performed using the following assumptions under this scenario:

1. The tailings and soil have an average thickness of ten feet.
2. The tailings and soil have a surface area of approximately one acre.
3. The tailings and soil have an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The entire surface area may be subject to runoff; and
5. The cap surface area will not be revegetated.

A2: Three-Layer Cap

Under this capping scenario, the contaminated tailings and soils on the retort building pad will be covered with a low hydraulic conductivity layer, protective layer, and vegetative cover layer. Following cap placement, the surface will be seeded.

The HELP analysis was performed using the following assumptions under this scenario:

1. The tailings and soil have an average thickness of ten feet.
2. The tailings and soil have a surface area of approximately one acre.
3. The tailings and soil have an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The low hydraulic conductivity layer will be composed of two feet of compacted clayey soil excavated from appropriate borrow locations in the vicinity of the site (Boring Logs, Figures 1 through 11).
5. The average hydraulic conductivity of the low hydraulic conductivity layer is 1×10^{-7} cm/sec.
6. The protective layer will be composed of two feet of on-site sandy soil excavated from appropriate borrow locations in the vicinity of the site.
7. Soils in the protective layer have an average hydraulic conductivity of 5.8×10^{-3} cm/sec.
8. The vegetative cover layer will be composed of two feet of soil collected from appropriate borrow locations in the vicinity of the site (Boring Logs, Figures 1 through 11).
9. The soils in the vegetative cover layer have an average hydraulic conductivity of 3.6×10^{-6} cm/sec.

10. The entire tailings surface area may be subject to runoff.
11. The cap surface area will be revegetated (in HELP terminology, a "fair stand of grass" is assumed).

Because there was limited information regarding the actual hydraulic conductivity of soils and tailings at the site, theoretical average hydraulic conductivities of silty sandy gravelly soil, clayey soil, and sandy soil were taken from *Groundwater* (R. Allan Freeze, Department of Geological Sciences, University of British Columbia). However, it is recommended that geotechnical testing be conducted prior to the final cover design to determine the actual hydraulic conductivity of soils and tailings.

B. Non-Hazardous Solid Waste and Soil

Three capping scenarios were modeled for the non-hazardous solid waste and soil. The capping scenarios selected for use in HELP are:

B1. No Cover
B2. Single-Layer Cap (Simple Cap)
B3. Three-Layer Cap

B1: No Cover

Under this capping scenario, the compacted non-hazardous solid waste will be left uncovered without any vegetation. This scenario will act as a baseline for comparison to the other cap configurations. With no cap, the rate of percolation into the tailings and soils will continue to be high, and as a result, the potential of release of contaminants will continue to exist.

The HELP analysis was performed using the following assumptions under this scenario:

1. The solid waste has an average thickness of ten feet.
2. The solid waste has a surface area of approximately one acre.
3. The solid waste has an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The entire surface area may be subject to runoff.
5. The cap surface area will not be revegetated.

B2: Single-Layer Cap (Simple Cap)

Under this capping scenario, the compacted non-hazardous solid waste will be consolidated and placed as the bottom layer and subsequently covered with non-hazardous soil. The total depth of the waste source will be ten feet. This configuration was selected in an effort to stabilize the compacted structures and mining equipment and reduce long-term subsidence. The uncontaminated soil is placed on top of

the solid waste to reduce the potential for damage to the single layer cap. Following consolidation of the waste, a single two foot layer of on site soils will be placed over the waste and seeded.

The HELP analysis was performed using the following assumptions under this scenario:

1. The solid waste has an average thickness of ten feet.
2. Simple cover layer will be placed to a thickness of two feet.
3. The solid waste and soil has a surface area of approximately one acre.
4. The compacted solid waste and soils have an average hydraulic conductivity of 1×10^{-3} cm/sec.
5. Vegetative soils have an average hydraulic conductivity of 3.6×10^{-6} cm/sec.
6. The entire surface area may be subject to runoff.
7. The cap surface area will be revegetated (in HELP terminology, a "fair stand of grass" is assumed).

B3: Three-Layer Cap

Under this capping scenario, the compacted non-hazardous solid waste will be consolidated and placed as the bottom layer and subsequently covered with non-hazardous soils. The solid waste and soils on the retort building pad will be covered with a low hydraulic conductivity layer, protective sandy soil layer, and vegetative cover layer. Following cap placement, the surface will be seeded.

The HELP analysis was performed using the following assumptions under this scenario:

1. The compacted solid waste and soil have an average thickness of ten feet.
2. The solid waste and soils have a surface area of approximately one acre.
3. Solid waste and soils have an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The low hydraulic conductivity layer will be composed of two feet of compacted on-site clayey soil collected in the vicinity of the retort building area (Boring Logs, Figures 1 through 11.
5. Soils in the low hydraulic conductivity layer have an average hydraulic conductivity of 1×10^{-7} cm/sec.
6. The protective layer will be composed of two feet of on-site sandy soil excavated from appropriate borrow locations in the vicinity of the site.
7. Soils in the protective layer have an average hydraulic conductivity of 5.8×10^{-3} cm/sec.
8. The vegetative cover layer will be composed of two feet of soil collected in the vicinity of the site (Boring Logs, Figures 1 through 11).
9. The soils in the vegetative cover layer have an average hydraulic conductivity of 3.6×10^{-6} cm/sec.
10. The entire tailings surface area may be subject to runoff.
11. The cap surface area will be revegetated (in HELP terminology, a "fair stand of grass" is assumed).

C. Hazardous Solid Waste and Soil

Two capping scenarios were modeled for the hazardous solid waste and soil. The capping scenarios selected for use in HELP are:

C1. No Cover
C2. Four -Layer Cap (Cap including Geomembrane)

C1: No Cover

Under this capping scenario, the compacted hazardous solid waste and soil will be left uncovered without any vegetation. This scenario will act as a baseline for comparison to the other cap configurations. With no cap, the rate of percolation into the tailings and soils will continue to be high, and as a result, the potential of release of contaminants will continue to exist.

The HELP analysis was performed using the following assumptions under this scenario:

1. The hazardous solid waste and soil have an average thickness of ten feet.
2. The hazardous solid waste and soils have a surface area of approximately one acre.
3. The hazardous solid waste and soils have an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The entire surface area may be subject to runoff.
5. The cap surface area will not be revegetated.

C2: Four-Layer Cap (Cap including Geomembrane)

Under this capping scenario, the compacted hazardous solid waste will be consolidated and placed as the bottom layer of the cap. Contaminated soils will then be placed over the compacted solid waste to act as a protective layer. The cap will consist of a low hydraulic conductivity layer, a geomembrane layer (0.04 inches), protective sandy-soil layer, and vegetative layer. Following cap placement, the surface will be seeded.

The HELP analysis was performed using the following assumptions under this scenario:

1. The compacted solid waste and soil have an average thickness of ten feet.
2. The compacted solid waste and soils have a surface area of approximately one acre.
3. The compacted solid waste and soils have an average hydraulic conductivity of 1×10^{-3} cm/sec.
4. The low hydraulic conductivity layer will be composed of two feet of compacted clayey soil collected from in the vicinity of the site (Boring Logs, Figures 1 through 11) and have an average hydraulic conductivity of 1×10^{-7} cm/sec.

5. The geomembrane layer will be composed of a 0.04 inch thick high density polyethylene (HDPE).
6. The protective layer will be composed of two feet of sandy soil collected from in the vicinity of the site.
7. The protective layer will have an average hydraulic conductivity of 5.8×10^{-3} cm/sec.
8. The vegetative cover layer will be composed of two feet of soil collected from in the vicinity of the site (Boring Logs, Figures 1 through 11).
9. The soils in the vegetative cover layer have an average hydraulic conductivity of 3.6×10^{-6} cm/sec.
10. The entire tailings surface area may be subject to runoff.
11. The cap surface area will be revegetated (in HELP terminology, a "fair stand of grass" is assumed).

A summary of the proposed configurations and percolation estimates for the three waste source scenarios are presented in Table 1.

Table 1- Summary of Preliminary HELP Model Analysis

Trial Description	Modeled Layer Configuration	Annual Average Percolation (cubic feet/year)
A1- No Cover	10 feet of soil and tailings	15238
A2 - Three-Layer Cap	10 feet of soil and tailings 2 foot low hydraulic conductivity layer 2 foot protective layer 2 foot vegetative layer	688
B1 - No Cover	10 feet of non-hazardous solid waste and soil	15238
B2 - Single-Layer Cap	10 feet of non-hazardous solid waste and soil 2 foot vegetative layer	1742
B3 - Three-Layer Cap	10 feet of non-hazardous soils and solid waste 2 foot low hydraulic conductivity layer 2 foot protective layer 2 foot vegetative layer	688
C1 - No Cover	10 feet of hazardous soils and solid waste	15238
C2 - Four-Layer Cap (Cap includes Geomembrane)	10 feet of hazardous soils and solid waste 2 foot low hydraulic conductivity layer 0.04 inch Geomembrane layer 2 foot protective layer 2 foot vegetative layer	0.009

The preliminary analyses presented in this section indicates that cap with soil liner and geomembrane layer has the lowest percolation rate when compared with other scenarios. In addition, comparison between percolation rates between simple cap and cap with soil liner indicates that cap with soil liner would be more effective in reducing the percolation rate.

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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\trial A1\weather.D4
TEMPERATURE DATA FILE:     c:\help3\trial A1\temp.D7
SOLAR RADIATION DATA FILE: C:\Help3\trial A1\solar.D13
EVAPOTRANSPIRATION DATA:   C:\HELP3\trial A1\evapo.D11
SOIL AND DESIGN DATA FILE: c:\help3\trial A1\soil.D10
OUTPUT DATA FILE:          c:\help3\trial A1\output.OUT


TIME:  8:20    DATE:  5/ 9/2001


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   TITLE:  RED DEVIL - TRIAL A1- NO COVER

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 - NON-HAZARDOUS TAILING AND SOIL
MATERIAL TEXTURE NUMBER 5
THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1625 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND
A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 83.00
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 0.543 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.656 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0.464 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 19.504 INCHES
TOTAL INITIAL WATER = 21.724 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES

AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA AND STATION LATITUDE = 60.78 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.89	1.08	2.38	2.56	3.79	4.18
	3.00	4.34	3.01	2.23	1.53	1.18
STD. DEVIATIONS	0.42	0.62	1.13	1.25	2.00	1.82
	1.75	1.87	1.30	1.38	0.99	0.60
RUNOFF						

TOTALS 0.000 0.000 0.089 2.220 3.734 1.237
0.044 0.111 0.034 0.183 0.201 0.003

STD. DEVIATIONS 0.000 0.000 0.216 2.036 2.079 1.287
0.178 0.180 0.061 0.687 0.393 0.013

EVAPOTRANSPIRATION

TOTALS 0.631 0.705 1.145 1.361 0.466 2.660
2.703 3.111 2.301 1.404 0.840 0.658

STD. DEVIATIONS 0.084 0.140 0.199 0.358 0.303 1.087
1.204 1.162 0.785 0.544 0.379 0.172

PERCOLATION/LEAKAGE THROUGH LAYER 1

TOTALS 0.4317 0.3307 0.3107 0.2605 0.2376 0.2293
0.1146 0.3307 0.4096 0.4961 0.5152 0.5309

STD. DEVIATIONS 0.1371 0.0925 0.0794 0.0624 0.0544 0.0432
0.0906 0.2886 0.3564 0.3759 0.2796 0.1823

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	30.17	(4.016)	109502.6	100.00
RUNOFF	7.854	(3.2040)	28510.05	26.036
EVAPOTRANSPIRATION	17.986	(2.1996)	65290.39	59.625
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.19775	(1.39410)	15237.828	13.91550
CHANGE IN WATER STORAGE	0.128	(1.6535)	464.30	0.424

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.151	18698.9043
PERCOLATION/LEAKAGE THROUGH LAYER 1	0.093561	339.62515
SNOW WATER	8.95	32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3905

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0580

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	23.3623	0.1947

SNOW WATER 2.199

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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\Trial A2\weather.D4
TEMPERATURE DATA FILE:     c:\help3\Trial A2\temp.D7
SOLAR RADIATION DATA FILE: C:\Help3\Trial A2\solar.D13
EVAPOTRANSPIRATION DATA:   C:\HELP3\Trial A2\evapo.D11
SOIL AND DESIGN DATA FILE: c:\help3\Trial A2\soil.D10
OUTPUT DATA FILE:          c:\help3\Trial A2\output.OUT


TIME: 16:23    DATE:  5/ 4/2001

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   TITLE: RED DEVIL - TRIAL A2: THREE - LAYER CAP

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 - VEGETATIVE LAYER
MATERIAL TEXTURE NUMBER 25
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.3730 VOL/VOL
WILTING POINT = 0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3406 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.359999990000E-05 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - PROTECTIVE LAYER
MATERIAL TEXTURE NUMBER 2
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.0620 VOL/VOL
WILTING POINT = 0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0780 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.579999993000E-02 CM/SEC
SLOPE = 0.00 PERCENT
DRAINAGE LENGTH = 1.0 FEET

LAYER 3

TYPE 4 - LOW HYDRAULIC CONDUCTIVITY LAYER
MATERIAL TEXTURE NUMBER 16
THICKNESS = 24.00 INCHES
POROSITY = 0.0000 VOL/VOL
FIELD CAPACITY = 0.0000 VOL/VOL
WILTING POINT = 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC
FML PINHOLE DENSITY = 0.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 0.00 HOLES/ACRE
FML PLACEMENT QUALITY = 4 - POOR

LAYER 4

TYPE 1 - NON-HAZARDOUS TAILING AND SOIL
MATERIAL TEXTURE NUMBER 5

THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1321 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #25 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 96.70
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 2.207 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.496 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 2.128 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 25.905 INCHES
TOTAL INITIAL WATER = 28.124 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 3
DRAIN #1: LATERAL DRAINAGE FROM LAYER 2 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 3
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 4

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.17 (4.016)	109502.6	100.00
RUNOFF	13.549 (3.4826)	49183.48	44.915
EVAPOTRANSPIRATION	16.305 (1.7778)	59185.88	54.050
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.01050 (0.02949)	38.119	0.03481
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.28214 (0.10520)	1024.168	0.93529
AVERAGE HEAD ON TOP OF LAYER 3	0.001 (0.001)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.18954 (0.15140)	688.032	0.62832
CHANGE IN WATER STORAGE	0.112 (1.2029)	407.07	0.372

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.314	19290.6934
DRAINAGE COLLECTED FROM LAYER 2	0.00645	23.41337
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.003402	12.34781
AVERAGE HEAD ON TOP OF LAYER 3	0.054	
MAXIMUM HEAD ON TOP OF LAYER 3	0.069	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	1.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.002899	10.52517
SNOW WATER	8.95	32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4356

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2660

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.7927	0.3664
2	1.8615	0.0776
3	0.0000	0.0000
4	18.6356	0.1553

SNOW WATER 2.199

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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\trial B1\weather.D4
TEMPERATURE DATA FILE:      c:\help3\trial B1\temp.D7
SOLAR RADIATION DATA FILE:  C:\Help3\trial B1\solar.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\trial B1\evapo.D11
SOIL AND DESIGN DATA FILE:  c:\help3\trial B1\soil.D10
OUTPUT DATA FILE:           c:\help3\trial B1\output.OUT


TIME:  8:20    DATE:  5/ 9/2001


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   TITLE:  RED DEVIL - TRIAL B1 - NO COVER

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 - NON-HAZARDOUS DEBRIS AND SOIL
MATERIAL TEXTURE NUMBER 5
THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1625 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND
A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 83.00
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 0.543 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.656 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0.464 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 19.504 INCHES
TOTAL INITIAL WATER = 21.724 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES

AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA AND STATION LATITUDE = 60.78 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.89	1.08	2.38	2.56	3.79	4.18
	3.00	4.34	3.01	2.23	1.53	1.18
STD. DEVIATIONS	0.42	0.62	1.13	1.25	2.00	1.82
	1.75	1.87	1.30	1.38	0.99	0.60

RUNOFF

TOTALS 0.000 0.000 0.089 2.220 3.734 1.237
0.044 0.111 0.034 0.183 0.201 0.003

STD. DEVIATIONS 0.000 0.000 0.216 2.036 2.079 1.287
0.178 0.180 0.061 0.687 0.393 0.013

EVAPOTRANSPIRATION

TOTALS 0.631 0.705 1.145 1.361 0.466 2.660
2.703 3.111 2.301 1.404 0.840 0.658

STD. DEVIATIONS 0.084 0.140 0.199 0.358 0.303 1.087
1.204 1.162 0.785 0.544 0.379 0.172

PERCOLATION/LEAKAGE THROUGH LAYER 1

TOTALS 0.4317 0.3307 0.3107 0.2605 0.2376 0.2293
0.1146 0.3307 0.4096 0.4961 0.5152 0.5309

STD. DEVIATIONS 0.1371 0.0925 0.0794 0.0624 0.0544 0.0432
0.0906 0.2886 0.3564 0.3759 0.2796 0.1823

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.17 (4.016)	109502.6	100.00
RUNOFF	7.854 (3.2040)	28510.05	26.036
EVAPOTRANSPIRATION	17.986 (2.1996)	65290.39	59.625
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.19775 (1.39410)	15237.828	13.91550
CHANGE IN WATER STORAGE	0.128 (1.6535)	464.30	0.424

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.151	18698.9043
PERCOLATION/LEAKAGE THROUGH LAYER 1	0.093561	339.62515
SNOW WATER	8.95	32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3905

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0580

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	23.3623	0.1947

SNOW WATER 2.199

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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\trial B2\weather.D4
TEMPERATURE DATA FILE: c:\help3\trial B2\temp.D7
SOLAR RADIATION DATA FILE: C:\Help3\trial B2\solar.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\trial B2\evapo.D11
SOIL AND DESIGN DATA FILE: c:\help3\trial B2\soil.D10
OUTPUT DATA FILE: c:\help3\trial B2\output.OUT

TIME: 16:34 DATE: 5/ 4/2001

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TITLE: RED DEVIL - TRIAL B2: SINGLE - LAYER CAP

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

LAYER 1

TYPE 1 - VEGETATIVE LAYER
MATERIAL TEXTURE NUMBER 25
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.3730 VOL/VOL
WILTING POINT = 0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3406 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.359999990000E-05 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - NON-HAZARDOUS DEBRIS AND SOIL
MATERIAL TEXTURE NUMBER 5
THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1357 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #25 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND
A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 96.70
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 2.207 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.496 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 2.128 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 24.460 INCHES
TOTAL INITIAL WATER = 26.679 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	30.17	(4.016)	109502.6	100.00
RUNOFF	13.326	(3.4622)	48373.45	44.176
EVAPOTRANSPIRATION	16.205	(1.8902)	58822.58	53.718
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.47998	(0.26074)	1742.328	1.59113
CHANGE IN WATER STORAGE	0.155	(1.2609)	564.22	0.515

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.314	19288.4648
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.005787	21.00752
SNOW WATER	8.95	32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4341

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2660

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.8481	0.3687
2	20.2954	0.1691
SNOW WATER	2.199	

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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\trial B3\weather.D4
TEMPERATURE DATA FILE:     c:\help3\trial B3\temp.D7
SOLAR RADIATION DATA FILE: C:\Help3\trial B3\solar.D13
EVAPOTRANSPIRATION DATA:   C:\HELP3\trial B3\evapo.D11
SOIL AND DESIGN DATA FILE: c:\help3\trial B3\soil.D10
OUTPUT DATA FILE:          c:\help3\trial B3\output.OUT


TIME: 16:23    DATE:  5/ 4/2001


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   TITLE: RED DEVIL - TRIAL B3: THREE - LAYER CAP

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 - VEGETATIVE LAYER
MATERIAL TEXTURE NUMBER 25
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.3730 VOL/VOL
WILTING POINT = 0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3406 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.359999990000E-05 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - PROTECTIVE LAYER
MATERIAL TEXTURE NUMBER 2
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.0620 VOL/VOL
WILTING POINT = 0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0780 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.579999993000E-02 CM/SEC
SLOPE = 0.00 PERCENT
DRAINAGE LENGTH = 1.0 FEET

LAYER 3

TYPE 4 - LOW HYDRAULIC CONDUCTIVITY LAYER
MATERIAL TEXTURE NUMBER 16
THICKNESS = 24.00 INCHES
POROSITY = 0.0000 VOL/VOL
FIELD CAPACITY = 0.0000 VOL/VOL
WILTING POINT = 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC
FML PINHOLE DENSITY = 0.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 0.00 HOLES/ACRE
FML PLACEMENT QUALITY = 4 - POOR

LAYER 4

TYPE 1 - NON-HAZARDOUS DEBRIS AND SOIL
MATERIAL TEXTURE NUMBER 5

THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1321 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #25 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 96.70
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 2.207 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.496 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 2.128 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 25.905 INCHES
TOTAL INITIAL WATER = 28.124 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 3
DRAIN #1: LATERAL DRAINAGE FROM LAYER 2 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 3
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 4

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	30.17	(4.016)	109502.6	100.00
RUNOFF	13.549	(3.4826)	49183.48	44.915
EVAPOTRANSPIRATION	16.305	(1.7778)	59185.88	54.050

LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.01050 (0.02949)	38.119	0.03481
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.28214 (0.10520)	1024.168	0.93529
AVERAGE HEAD ON TOP OF LAYER 3	0.001 (0.001)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.18954 (0.15140)	688.032	0.62832
CHANGE IN WATER STORAGE	0.112 (1.2029)	407.07	0.372

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.314	19290.6934
DRAINAGE COLLECTED FROM LAYER 2	0.00645	23.41337
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.003402	12.34781
AVERAGE HEAD ON TOP OF LAYER 3	0.054	
MAXIMUM HEAD ON TOP OF LAYER 3	0.069	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	1.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.002899	10.52517
SNOW WATER	8.95	32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4356

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2660

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.7927	0.3664
2	1.8615	0.0776
3	0.0000	0.0000
4	18.6356	0.1553

SNOW WATER 2.199

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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\trial C1\weather.D4
TEMPERATURE DATA FILE:      c:\help3\trial C1\temp.D7
SOLAR RADIATION DATA FILE:  C:\Help3\trial C1\solar.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\trial C1\evapo.D11
SOIL AND DESIGN DATA FILE:  c:\help3\trial C1\soil.D10
OUTPUT DATA FILE:           c:\help3\trial C1\output.OUT


TIME:  8:20    DATE:  5/ 9/2001


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   TITLE: RED DEVIL - TRIAL C1: NO COVER

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 - HAZARDOUS DEBRIS AND SOIL
MATERIAL TEXTURE NUMBER 5
THICKNESS = 120.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1625 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 5 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND
A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 83.00
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 0.543 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.656 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0.464 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 19.504 INCHES
TOTAL INITIAL WATER = 21.724 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES

AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA AND STATION LATITUDE = 60.78 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.89	1.08	2.38	2.56	3.79	4.18
	3.00	4.34	3.01	2.23	1.53	1.18
STD. DEVIATIONS	0.42	0.62	1.13	1.25	2.00	1.82
	1.75	1.87	1.30	1.38	0.99	0.60
RUNOFF						

TOTALS 0.000 0.000 0.089 2.220 3.734 1.237
0.044 0.111 0.034 0.183 0.201 0.003

STD. DEVIATIONS 0.000 0.000 0.216 2.036 2.079 1.287
0.178 0.180 0.061 0.687 0.393 0.013

EVAPOTRANSPIRATION

TOTALS 0.631 0.705 1.145 1.361 0.466 2.660
2.703 3.111 2.301 1.404 0.840 0.658

STD. DEVIATIONS 0.084 0.140 0.199 0.358 0.303 1.087
1.204 1.162 0.785 0.544 0.379 0.172

PERCOLATION/LEAKAGE THROUGH LAYER 1

TOTALS 0.4317 0.3307 0.3107 0.2605 0.2376 0.2293
0.1146 0.3307 0.4096 0.4961 0.5152 0.5309

STD. DEVIATIONS 0.1371 0.0925 0.0794 0.0624 0.0544 0.0432
0.0906 0.2886 0.3564 0.3759 0.2796 0.1823

****

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.17 (4.016)	109502.6	100.00
RUNOFF	7.854 (3.2040)	28510.05	26.036
EVAPOTRANSPIRATION	17.986 (2.1996)	65290.39	59.625
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.19775 (1.39410)	15237.828	13.91550
CHANGE IN WATER STORAGE	0.128 (1.6535)	464.30	0.424

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.151	18698.9043
PERCOLATION/LEAKAGE THROUGH LAYER 1	0.093561	339.62515

SNOW WATER 8.95 32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3905

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0580

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	23.3623	0.1947

SNOW WATER 2.199

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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\Trial C2\weather.D4
TEMPERATURE DATA FILE:      c:\help3\Trial C2\temp.D7
SOLAR RADIATION DATA FILE:  C:\Help3\Trial C2\solar.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\Trial C2\evapo.D11
SOIL AND DESIGN DATA FILE:  c:\help3\Trial C2\soil.D10
OUTPUT DATA FILE:           c:\help3\Trial C2\output.OUT


TIME: 12:53     DATE:  5/ 7/2001


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

   TITLE: RED DEVIL - TRIAL C2: FOUR - LAYER CAP

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   NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
          COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
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LAYER 1

TYPE 1 -VEGETATIVE LAYER
MATERIAL TEXTURE NUMBER 25
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.3730 VOL/VOL
WILTING POINT = 0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3406 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.359999990000E-05 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - PROTECTIVE LAYER
MATERIAL TEXTURE NUMBER 2
THICKNESS = 24.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.0620 VOL/VOL
WILTING POINT = 0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0784 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.579999993000E-02 CM/SEC

LAYER 3

TYPE 3 - GEOMEMBRANE LAYER
MATERIAL TEXTURE NUMBER 35
THICKNESS = 24.00 INCHES
POROSITY = 0.0030 VOL/VOL
FIELD CAPACITY = 0.0020 VOL/VOL
WILTING POINT = 0.0010 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0030 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.199999996000E-12 CM/SEC

LAYER 4

TYPE 4 - LOW HYDRAULIC CONDUCTIVITY LAYER
MATERIAL TEXTURE NUMBER 16
THICKNESS = 0.04 INCHES
POROSITY = 0.0000 VOL/VOL
FIELD CAPACITY = 0.0000 VOL/VOL
WILTING POINT = 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC
FML PINHOLE DENSITY = 0.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 0.00 HOLES/ACRE
FML PLACEMENT QUALITY = 4 - POOR

LAYER 5

TYPE 1 - HAZARDOUS DEBRIS AND SOIL
MATERIAL TEXTURE NUMBER 5
THICKNESS = 24.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1310 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #25 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 535. FEET.

SCS RUNOFF CURVE NUMBER = 96.70
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 2.207 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 3.496 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 2.128 INCHES
INITIAL SNOW WATER = 2.220 INCHES
INITIAL WATER IN LAYER MATERIALS = 13.199 INCHES

TOTAL INITIAL WATER = 15.419 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE = 200.00 DEGREES
MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 147
END OF GROWING SEASON (JULIAN DATE) = 286
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 54.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 49.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.01	1.12	2.20	3.21	3.96	4.18
3.22	4.11	3.09	2.16	1.52	1.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.90	5.70	10.70	23.40	40.30	50.60
54.70	52.80	45.00	29.70	17.50	4.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA AND STATION LATITUDE = 60.78 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 3
DRAIN #1: LATERAL DRAINAGE FROM LAYER 2 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 5

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	30.17	(4.016)	109502.6	100.00
RUNOFF	13.549	(3.4826)	49183.48	44.915
EVAPOTRANSPIRATION	16.305	(1.7778)	59185.88	54.050
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.29266	(0.12090)	1062.344	0.97015
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.013	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.017	(0.003)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00001)	0.009	0.00001
CHANGE IN WATER STORAGE	0.020	(1.2155)	70.87	0.065

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.73	13539.900
RUNOFF	5.314	19290.6934
DRAINAGE COLLECTED FROM LAYER 2	0.01009	36.61664
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00007
AVERAGE HEAD ON TOP OF LAYER 3	0.068	
MAXIMUM HEAD ON TOP OF LAYER 3	0.086	

LOCATION OF MAXIMUM HEAD IN LAYER 2
(DISTANCE FROM DRAIN) 1.0 FEET

PERCOLATION/LEAKAGE THROUGH LAYER 5 0.000038 0.13713

SNOW WATER 8.95 32499.2480

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4356

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2660

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.7927	0.3664
2	1.8688	0.0779
3	0.0001	0.0030
4	0.0000	0.0000
5	3.1440	0.1310

SNOW WATER 2.199

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