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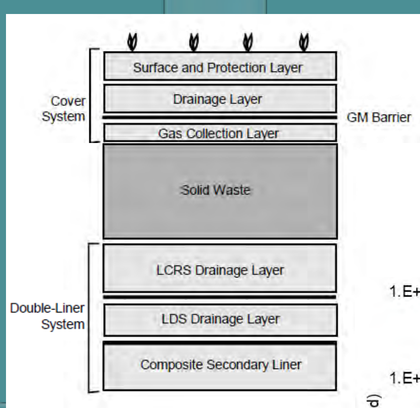
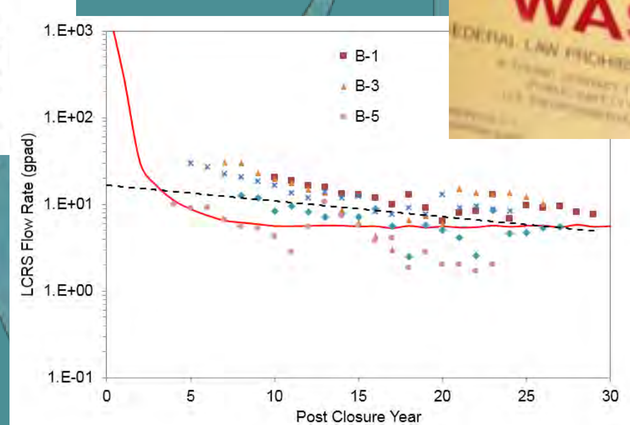
Post-Closure Performance of Liner Systems at RCRA Subtitle C Landfills

Final Report





Office of Research and Development
National Risk Management Research Laboratory
Land and Materials Management Division

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Final Report

Materials Management Branch
Land and Materials Management Division
National Risk Management Research Laboratory
Office of Research and Development
Cincinnati, OH

Foreword

The US Environmental Protection Agency (US EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under the mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, US EPA's research program is providing data and technical support for solving environmental problems today and building the scientific knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigating technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for preventing and controlling pollution of air, land, water, and subsurface resources; protecting water quality in public water systems; remediating contaminated sites, sediments, and ground water; preventing and controlling indoor air pollution; and restoring ecosystems. NRMRL collaborates with public and private sector partners to foster technologies that reduce the cost of compliance and anticipate emerging problems. NRMRL's research provides solutions to environmental problems by developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by US EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Cynthia Sonich-Mullin, Director
National Risk Management Research Laboratory

Executive Summary

Generation, transportation, treatment, storage, and disposal of hazardous waste are regulated under the Resource Conservation and Recovery Act of 1976 (RCRA), an act of Congress that gives the U.S. Environmental Protection Agency (EPA) authority to control hazardous waste from the "cradle-to-grave." Specifically, Subtitle C of RCRA pertains to management of hazardous waste.0F[1] This document is specifically focused on the long-term performance of landfill containment facilities (the "grave" in the above analogy) at RCRA Subtitle C facilities. Landfills are used for the environmentally protective disposal of hazardous waste, regulation of which is codified at 40 CFR Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," as published in various editions of the Federal Register since 1980. Sections of the regulation of relevance to this document are provided under Subpart N – Landfills (40 CFR §264.300 through .317) and Subpart G – Closure and Post-Closure (40 CFR §264.110 through .120).

Post-closure care (PCC) requirements for Subtitle C landfills involve monitoring and maintaining the waste containment systems for a presumptive period of 30 years (per 40 CFR §264.117), or an extended or reduced period based on the demonstration that such adjustment is necessary or sufficient, respectively, for the protection of human health and the environment. Hazardous waste landfills have been permitted under RCRA Subtitle C since 1984, over 30 years ago, thus an increasing number of facilities around the country are approaching the end of their presumptive 30-year PCC period. Stakeholders requested the EPA to provide guidance on how and when it may be appropriate to make such certifications or other decisions regarding the ongoing status of their site. For its part, in 2016 EPA issued "Guidelines for Evaluating the Post-Closure Care Period for Hazardous Waste Disposal Facilities under Subtitle C of RCRA."

The aim of the study is to facilitate the discussion and decision-making processes by illustrating what data are needed, highlighting categories of useful data that are typically lacking, and recommending techniques and tools to complement the EPA's "Guidelines for Evaluating the Post-Closure Care Period for Hazardous Waste Disposal Facilities under Subtitle C of RCRA". The study investigates the field performance of engineered double-liner systems based on data from 9 Subtitle C landfills sites that have completed several years of PCC. It is noted that the document is not intended to address policy issues (such as how

[1] Subtitle D of RCRA sets forth a framework for the management of non-hazardous solid wastes; however, management of non-hazardous solid waste is only of passing interest in this document.

landfills may be managed, controlled, or regulated after PCC has ended) or to provide generic answers to defining conditions for ending PCC.

Furthermore, also provides a follow-up for a broader EPA study published in 2002 entitled "Assessment and Recommendations for Improving the Performance of Waste Containment Systems." The 2002 study reported on the performance of active and closed hazardous and non-hazardous waste landfill units around the country using data collected in the 1980s and 1990s. In updating that study, EPA is specifically interested in supplementing the previous dataset with a further 10–15 years of performance data from closed Subtitle C landfill units.

Overall, the nine landfills yielded 45 individual double-lined closed units ranging in size from 1.4 to 11 acres, although most units were less than 5 acres in area. The oldest units in the study have been closed for over 29 years, while the newest are only 6 years into a PCC program. The thickness of waste in place above the liner ranged from 40 feet to 110 feet (average 70 to 80 feet). Amongst the 45 case study units, 11 different liner system designs and a further 11 different cover system designs are represented. These are combined into 13 unique containment system design configurations featuring commonality through the entire thickness of the unit from the top of the cover to the bottom of the liner. The discussion is interested in addressing the five broad research questions presented next.

1. *How much leachate is generated in closed Subtitle C landfills and what are the effects of site location (climatic region), cover system design, or waste type on leachate generation rates?*

In general, field data showed a decline in leachate flow from the LCRS and LDS. In all cases, placement of cover led to a reduction in the LCRS flow rate, including where only 12 inches of intermediate cover soil had been placed. Rainfall has an effect on leachate generation, with higher LCRS flows recorded at the four wet sites and very low or negligible flows recorded at three dry sites. The incidence of precipitation as rainfall versus snowfall does not appear to affect leachate generation at the wet sites.

An increasing trend in leachate generation was observed at some sites for a duration of time and was attributable to known operation and maintenance (O&M) issues affecting cover system performance. Erosion damage to cover systems was identified as a key issue affecting landfill performance in the post-closure period, with higher costs and effort associated with repairs needed during initial years of PCC before cover vegetation is fully established and the cover stabilized. Breaches in the cover system, particularly in the early years of PCC, could result in relatively long-term setbacks in terms of returning LCRS flow rates to expected levels once the cover is repaired. Routine cover inspection is essential for identifying issues related to erosion damage, water ponding on the cover system, or other issues, as this facilitates timely maintenance and repair to reduce leachate flow volumes.

Data from this study suggest the rate at which LCRS flow rate declines post-closure may be three to five times slower than reported in 2002 study or approximately an order of magnitude decrease in flow every 15−20 years. However, more field studies, preferably under a random selection procedure, are needed to validate this finding before recommendations for adjusting current industry projections and accruals for leachate management can be made. Furthermore, the rate of decrease in the leachate generation correlates with the maximum leachate generation at closure. In another word, cells that were wetter and had higher leachate flow at the time of closure continued to have relatively high flow well into their PCC period. This emphasizes the importance of good storm water control during the period of landfill operation and competent cover design and construction performed under strict CQA procedures so as to minimize peak leachate generation immediately after closure.

2. *What conclusions can be drawn regarding the hydraulic efficiencies of double-liner systems (i.e., leakage rates through primary liners) at Subtitle C landfills based on available leachate collection and removal system (LCRS) and leakage detection system (LDS) data?*

The "apparent" hydraulic efficiency (E_A) of the primary liner can be calculated as the flow in the LDS relative to the flow in the LCRS. If the only source of flow into the LDS sump is primary liner leakage, then E_A provides the true measure of the effectiveness of a particular liner in limiting or preventing advective transport across the liner. Overall, calculated E_A values from this study generally fall significantly short of the one suggested by the 2002 study (99%). Furthermore, as would be expected, the apparent liner efficiencies are significantly higher at dry sites than at wet sites.

A significant number of calculated E_A values in this study fall below zero (i.e., have negative E_A values). Negative values are interesting in that they indicate that flow in the LDS exceeded that in the LCRS. This may be the result of major defects in the primary liner system (which should have been identified during the construction of the liner system, or that the volume of liquids in the LDS cannot be attributed to liner leakage alone and may be caused by groundwater intrusion. It is possible that by distinguishing liquids with similar chemical signatures, leachate chemistry data can be used to quantify the portion of liquids comprising total LDS flow that could be attributable to primary liner leakage as opposed to other sources, thereby correcting the extent to which the LCRS and LDS are hydraulically connected. Using chlorides for chemical signature, the liner efficiencies increased drastically.

It is noted that this correction may grossly overestimate the collection efficiency as it does not take into account chemical attenuation of the liner system.

An interesting observation is that the thickness of material specified does not appear to affect the hydraulic performance of the barrier GM in either the cover or liner system for the units included in this study when compared across a common material type, although high-density polyethylene (HDPE) appeared to outperform polyvinyl chloride (PVC). Four sites featured a GM-only barrier in the primary liner, while all other designs feature a composite GM/CCL barrier. However, the primary liner design also does not appear to affect LDS flows; therefore it appears that construction of a composite primary liner may not be necessary as long as a composite secondary liner is constructed if one was only considering the limited number of units included in this study. More data are needed to evaluate this observation.

3. *How do predictions of leachate generation using the EPA's Hydrologic Evaluation of Landfill Performance (HELP) Model compare to observed generation rates at these sites?*

Based on the landfill cover designs and leachate flow rates from the sites evaluated in this study, the HELP Model appeared to be better suited to predicting long-term LCRS flow at wet rather than dry sites, which is consistent with published findings. The model predicts zero or near-zero LCRS flows at dry sites, whereas higher LCRS flow was observed at all four dry case study landfills. Based on our findings, it appears that it may be unreasonable to achieve a leachate flow rate of zero or near zero for a landfill site within the 30 years PCC period. Therefore, it is prudent to demonstrate that the absence of care for the leachate collection system would not pose a threat to water quality and human health and the environment. Such demonstrations may be made if enough data is available on leachate flow and chemical concentrations having reached quasi-steady state, predictable, and non-impacting conditions, albeit at a non-zero flow rate.

4. *What is the leachate chemistry at these sites, and does it exhibit asymptotic behavioral trends over the long term?*

Thirty chemical parameters were selected to represent leachate constituents of interest, based on those investigated in the 2002 study. These included water quality indicator parameters, macro indicators of dissolved organic matter, major inorganic cations and anions, trace metals, and trace volatile organic compounds (VOCs) frequently observed to be present in landfill leachate. Concentration trends in these data were examined to assess whether the asymptotic behavior was evident or could be predicted. Where available, leachate concentrations were compared to published data as well as EPA water quality standards. However, rather than directly comparing source leachate concentrations to a limit value (which defeats the performance-based intention of the regulation), a universal dilution/attenuation factor (DAF) of 20 was applied to represent a concentration decrease that would be expected prior to detection at a point of compliance (POC) monitoring well. This DAF value is equal to the default specified in the EPA's Soil Screening Guidance (EPA, 1996); however, use of a DAF of 20 for illustrative purposes in this study should not be misconstrued as a suggestion that this value has universal applicability nor that EPA has endorsed use of this value in lieu of site-specific analysis. In any evaluation of leachate chemistry and threat potential, a site-specific DAF should be calculated.

Significant variability was evident in the data for many constituents, particularly in the LCRS where differences between maximum and minimum observed values often span six or more orders of magnitude for cations/anions, trace metals, and VOCs. The general water quality characteristics of liquids from the LCRS and LDS drainage layers are also significantly different, again by multiple orders of magnitude in many cases. Although, contaminant transport through a liner can occur due to advective or diffusive flux, or both, given the order of magnitude differences in concentration of the chemical constituents in LCRS and LDS, advective flux may be considered as a primary driving mechanism for this variability.

The long-term outlook for leachate management based on observations of behavioral trends amongst selected leachate data from this study is mixed. Water quality indicators and major cations/anions suggest that the materials contained in Subtitle C landfills may not degrade under landfill conditions, or only degrade very slowly, such that observations based on similar behavioral trends from non-hazardous Subtitle D landfills cannot be extrapolated to characterize the expected performance of Subtitle C landfills.

5. *How could current monitoring, reporting, and recordkeeping requirements be improved to better ensure that the data necessary for performance demonstrations are collected?*

The unavailability of some critical site information and monitoring data limited the extent to which evaluations of leachate flow and chemistry could be completed or even performed in this study. Obvious data gaps and their effects are identified throughout this document. Fuller LCRS and LDS datasets, for example, would have expanded the level of detail to which cover and liner system performance could be evaluated, while a longer data record would have enabled a clearer picture of long-term stable leachate generation to be gathered. The focus and goal of this discussion is to reiterate some key data limitations and discuss their effect on limiting the study, in so doing providing some guidance to site operators and regulators as to what data that are not routinely collected would be valuable in demonstrating that one or more components of PCC at Subtitle C landfills could be modified over the long term. This is intended to provide motivation, rather than an obligation, for additional data collection.

Overall, significant variability existed between the case study units, which is beneficial to a study of this nature. In terms of variability in construction details, 11 different liner system designs and a further 11 different cover system designs were featured amongst the study units featured, combining to provide 13 unique containment system design configurations. Major variables in cover system design were represented. However, primary liner designs essentially comprised only two variables: GM/CCL and GM only. No case study units were constructed having a GM/GCL composite primary liner, although one site has a GCL secondary liner. As such, the efficacy of a GM/GCL primary liner design cannot be evaluated, an important limitation given the widespread use of GCLs in liner systems. In terms of facility operations, seven of the nine landfills are commercial facilities accepting hazardous waste from a wide range of generators. As such, an original research question from this study (does waste type affect leachate concentrations?) could not be addressed, as the commercial facilities accepted waste from multiple sources thereby making it difficult to compare waste chemistry for these sites, while there were insufficient data from non-commercial facilities against which to gauge variability between commercial and non-commercial sites. Further, waste manifests were not available, which meant that although some findings appeared to support the hypothesis that facility/waste type would affect leaching behavior and leachate characteristics, this could not be confirmed.

With regard to leachate chemistry data, many targeted leachate constituents are poorly represented in the LCRS dataset, while LDS chemistry is not monitored at all at many sites. Leachate chemistry data are most commonly collected semi-annually or annually, thereby limiting the overall size of the dataset available for analysis. An issue of importance identified in the process of collecting leachate chemistry data for this study is that site operators are reportedly only required to keep records for 3 years; as such, many older data are no longer available. If this is broadly representative of Subtitle C facilities, it represents an important limitation on assessing the long-term performance of containment systems and potential modifications to existing PCC programs. Given the focus on containment and leachate minimization at Subtitle C landfills, data availability may be reflective of the low level of concern operators have on managing leachate treatment and disposal costs (low leachate flows attract little interest because disposal costs are modest for small volumes). Many of the data used to support the performance demonstrations made in this study rely on non-compliance data collected only to meet influent limits imposed by a receiving facility for leachate treatment and are not routinely submitted to the state. This has implications in terms of being able to independently assess site performance, which would be important if an operator was unable to continue providing care.

Notice

This research was funded by the National Risk Management Research Laboratory (NRMRL) of the U.S. Environmental Protection Agency (EPA), Office of Research and Development (ORD) under the Safe and Healthy Communities Research Program. This report was prepared by Geosyntec Consultants of Columbia, Maryland under subcontract to RTI International of Research Triangle Park, North Carolina. Work was performed in accordance with a Work Assignment issued by EPA under Contract EP-D-11-084.

We acknowledge the support of the following individuals for preparing this report:

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Michael Houlihan, PE
Mohammed Al-Quraan
Keaton Botelho, PE
Herwig Goldemund, PhD
Beth Gross, PhD, PE
Vinay Krishnan Lakshminarayanan
Chunling Li, PhD, PE
Cory Russell
Andrew Stallings
Brianna Wallace, PE

<u>RTI International</u>
Coleen Northeim
Keith Weitz
<u>EPA Office of Research and Development (ORD)</u>
Thabet Tolaymat, PhD
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<u>EPA Office of Resource Conservation and Recovery (ORCR)</u>
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Lilybeth Colón

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Abbreviations

ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene and xylene
CAMU	corrective action management unit
CCL	compacted clay liner
CF	correction factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COD	chemical oxygen demand
CQA	construction quality assurance
DAF	dilution/attenuation factor
DOE	U.S. Department of Energy
DOM	dissolved organic matter
E_A	apparent liner efficiency
E_C	corrected liner efficiency
Eh	oxidation-reduction potential
E_M	modeled liner efficiency
EPA	U.S. Environmental Protection Agency
E_T	true liner efficiency
ET	evapotranspiration; evapotranspirative
FA	financial assurance
GCL	geosynthetic clay liner
GC	geocomposite
GM	geomembrane
GN	geonet
gpad	gallons per acre per day
GT	geotextile
HDPE	High-density polyethylene
HELP	Hydrologic Evaluation of Landfill [Model]
HHE	human health and environment
HW	hazardous waste
ITRC	Interstate Technology and Regulatory Council
LCRS	leachate collection and removal system
LDS	the leakage detection system
LFG	landfill gas
LLDPE	linear low-density polyethylene
LLRW	low-level radioactive waste
lphd	liter per hectare per day
MCL	maximum contaminant level
MSW	municipal solid waste
MSWI	municipal solid waste incineration

ND	non-detect
NRMRL	National Risk Management Research Laboratory (EPA)
O&M	operation and maintenance
OIG	Office of Inspector General (EPA)
ORCR	Office of Resource Conservation and Recovery (EPA)
ORD	Office of Research and Development (EPA)
OSDC	on-site disposal cell
OSDF	on-site disposal facility
PCC	post-closure care
POC	the point of compliance
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
SCS	Soil Conservation Service (U.S. Dept. of Agriculture)
SMCL	secondary maximum contaminant level
TDS	total dissolved solids
TOC	total organic carbon
TSDF	treatment, storage, and disposal facility
VOC	volatile organic compound
WWTP	wastewater treatment plant

1. INTRODUCTION

1.1 Overview and Terms of Reference

A research field of significant interest to the U.S. Environmental Protection Agency (EPA) is the long-term behavior of hazardous waste disposal facilities regulated under Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA). The regulation is codified under 40 CFR Part 264, as published in various editions of the Federal Register since 1980 (EPA, 2014a). Sections of the regulation of relevance to this research field are provided under Subpart N – Landfills (40 CFR §264.300 through .317) and Subpart G – Closure and Post-Closure (40 CFR §264.110 through .120). Post-closure care (PCC) requirements for Subtitle C landfills involve monitoring and maintaining the waste containment systems for a default period of 30 years (per 40 CFR §264.117), or an extended or reduced period based on demonstration that such adjustment is necessary or sufficient, respectively, for protection of human health and the environment (HHE). Adjusting the PCC period, or certifying that PCC is completed such that HHE remains protected in the absence of PCC, is at the discretion of the permitting authority (EPA Regional Administrator or Director of an authorized state program).

Hazardous waste landfills have been permitted under RCRA Subtitle C since 1984, over 30 years ago, which means that an increasing number of facilities around the country may soon have completed 30 years of PCC. Both the regulated and regulatory communities are faced with addressing the situation in which a decision is needed regarding the ongoing status of the site. A 2015 study by the EPA Office of Inspector General (OIG) estimated that over 1,500 hazardous waste disposal units across the nation had been "closed with waste in place" as of October 2014, although not all are under a permitted PCC program (EPA, 2015). The number of units for which a decision regarding the end of PCC will be needed was estimated at between 15 and 45 annually through 2030, with over half of these decisions falling in the next 10 years. The need for technical and procedural guidance has been identified by the regulated and regulatory communities alike. Notably, the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) issued a position paper calling for guidance from EPA on evaluating PCC criteria and modifying the PCC period (ASTSWMO, 2013). In response to these and other calls for increased clarity on the subject, EPA recently issued "Guidelines for Evaluating the Post-Closure Care Period for Hazardous Waste Disposal Facilities under Subtitle C of RCRA" (EPA, 2016). While the guidance does not provide specific details on how to conduct an evaluation, it does provide a framework that recommends the use of monitoring, modeling, and/or statistical analysis to determine if landfill contaminants (primarily leachate) would pose a threat to HHE at compliance or exposure points outside of the waste mass. This study provides updated information on the post-closure performance of Subtitle C landfill liner systems and, therefore, supports EPA's guidance on using performance-based demonstrations as the basis for extending, reducing, or ending PCC.

1.2 Purpose, Scope, and Limitations of the Study

The primary objective of this study is to investigate the field performance of engineered double-liner systems based on data from Subtitle C landfills that have completed several years of PCC and to quantify actual leachate generation rates, liner performance (i.e., leakage), and leachate chemistry during PCC in relation to current industry "norms" and expectations. It is anticipated that this study will help the EPA assess and update expectations for field performance of Subtitle C landfills in the PCC period, specifically as reported and discussed in Chapter 5 and Appendix E of the previous study prepared for EPA titled "Assessment and Recommendations for Improving the Performance of Waste Containment Systems" (EPA, 2002). This should be beneficial to both the regulatory and regulated communities in terms of making decisions regarding the long-term data collection and performance demonstrations necessary to evaluate, and ultimately adjust, PCC at Subtitle C landfills. As such, the intended audience of this document is state and EPA regional regulators, private industry, commercial facility owners/operators, landfill design engineers, and other hazardous waste professionals.

EPA (2002) reported on the performance of active and closed hazardous and non-hazardous waste landfill units around the country using data collected in the 1980s and 1990s. In updating that study with respect to hazardous waste landfills, EPA is specifically interested in supplementing the previous dataset with a further 10–15 years of performance data from closed Subtitle C landfill units in the interests of addressing the following four broad research questions:

1. What conclusions can be drawn regarding the hydraulic efficiencies of double-liner systems (i.e., leakage rates through primary liners) at Subtitle C landfills based on available leachate collection and removal system (LCRS) and leakage detection system (LDS) data?
2. How much leachate is generated in closed Subtitle C landfills and what are the effects of site location (climatic region), cover system design, or waste type on leachate generation rates?
3. How do predictions of leachate generation using the EPA's Hydrologic Evaluation of Landfill Performance (HELP) Model compare to observed generation rates at these sites?

4. What is the leachate chemistry at these sites, and do certain constituents exhibit asymptotic or other notable behavioral trends over the long-term?

This study aims to provide answers to these questions. However, it is important to clarify that the focus is on understanding the performance of liner systems rather than cover systems. This is because Subtitle C landfills routinely install double liners such that the performance (leakage) of the primary liner can be directly measured, while the performance of the cover system can only be indirectly estimated based on overall leachate generation. Similarly, it should be clarified that it is not the intent of this study to directly address PCC policy issues (such as how landfills may be managed, controlled, or regulated after PCC has ended) or to provide generic answers to defining conditions for ending PCC. These should be agreed via a site-specific discussion between the regulator and owner/operator, based on the application of the guidance issued by EPA (2016). This study aims to facilitate the discussion and decision-making processes by illustrating what data are needed, highlighting categories of useful data that are typically lacking, and recommending techniques and tools for evaluation of data.

Other important questions extend beyond the main study goals but can help further the understanding of long-term landfill performance and development of guidance to both evaluate and improve performance. These include:

1. How does leachate chemistry at Subtitle C landfills compare with water quality standards?
2. What models are routinely used to analyze leachate data and predict leachate generation and potential transport of hazardous waste constituents?
3. What are the expected or observed effects of extreme weather or seismic induced events (e.g., flood, excessive rainfall, or tsunami) on the performance of waste containment systems, particularly the cover?
4. Can performance data from studies such as this be used to assign risk-based evaluation criteria and procedures for demonstrating long-term protection of HHE?
5. How could current monitoring, reporting, and recordkeeping requirements be improved to better ensure that the data necessary for performance demonstrations are collected?

Although these additional questions were considered during this research study, they serve primarily to establish longer-term research goals for EPA.

Important limitations pertain to this study, mainly with regard to the relatively small number of contributory datasets available to evaluate the long-term performance of composite liner systems comprising both geosynthetic and clay barrier layers (liner system components are described in detail in Section 1.4.2). For inclusion in the study, therefore, a Subtitle C landfill disposal unit (i.e., discrete set of one or more cells, phases, modules, or areas) needed to be final capped (or have been inactive at final grade for an extended period under intermediate cover) and have a double-liner system with separate unit-specific measurement of liquid flow rate in the LCRS and LDS. The total number of Subtitle C landfills in the country with at least one doubled-lined closed unit is limited to a few dozen sites, such that the pool of candidate sites was small. Furthermore, to promote the free exchange of site performance data and operational experiences, participation in the study was fully voluntary on the part of site operators. As a result, the selected case studies cannot be assumed to be representative of a random subset of Subtitle C facilities.

1.3 Overview of Waste Regulations and Guidance

The Resource Conservation and Recovery Act (RCRA) is the public law that creates the framework for the proper management of hazardous and non-hazardous solid waste to protect communities and natural resources in the country. Specifically, the law describes the mandate and authority given to EPA by Congress to develop the RCRA program, which comprises regulations, guidance, and policies to ensure the safe management and cleanup of solid and hazardous waste as well as encourage source reduction and beneficial reuse. The term RCRA is often used interchangeably to refer to the law, regulations, and EPA policy and guidance. However, in the context of this study, the term refers specifically to EPA's regulation of hazardous and non-hazardous solid waste management under RCRA Subtitle C and D, respectively.

Hazardous waste is defined under RCRA as a solid waste that is not excluded from regulation as a hazardous waste under 40 CFR §261.4(b) and meets the criteria listed in 40 CFR §261.3. Hazardous waste management requires treatment, storage, and disposal as appropriate under 40 CFR Part 264, with specific restrictions on landfill disposal of hazardous waste controlled under 40 CFR Part 268. These intersecting regulations are complex, with detailed discussion beyond the scope of this document. However, for the purposes of this study, it is important to emphasize that waste in liquid form cannot be directly landfilled but must be encapsulated, solidified, and/or stabilized before disposal. This general restriction extends to hazardous waste containerized in drums. As such, disposal of free-draining liquids in the landfill waste stream should not be an appreciable source of leachate at Subtitle C landfills.

This study is not specifically concerned with non-hazardous solid waste landfills regulated under RCRA Subtitle D as codified under 40 CFR Parts 257 and 258. Subtitle D establishes minimum technical standards and guidelines for state solid waste plans (EPA, 1993). Non-hazardous waste materials regulated under Subtitle D include (1) household refuse, also known as municipal solid waste (MSW); (2) sludges from wastewater treatment plants or pollution control facilities; (3) non-hazardous industrial wastes (e.g., manufacturing process wastewaters and non-wastewater sludges and solids); and (4) other discarded materials resulting from industrial and commercial activities, (e.g., mining waste, oil and gas waste, construction and demolition debris, medical waste, agricultural waste, household hazardous waste, and conditionally exempt small quantity generator waste).

1.3.1 Regulation of Hazardous Waste Landfills

EPA has developed a comprehensive program to provide safe management of hazardous waste from the moment it is generated to its final disposal (a "cradle-to-grave" approach). RCRA Subtitle C regulations set criteria for hazardous waste generators and transporters, and for treatment, storage, and disposal facilities. This includes permitting requirements, enforcement, and corrective action or cleanup. The regulations governing hazardous waste identification, classification, generation, management, and disposal are found in 40 CFR 260 through 273 (EPA, 2014a). EPA typically authorizes states to implement and regulate hazardous waste programs in lieu of the federal government. If a state program does not exist, EPA has the authority to directly implement hazardous waste requirements in that state.

This study is most concerned with 40 CFR Part 264: Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. Sections of the regulation of particular relevance are provided under Subpart N – Landfills (40 CFR §264.300 through .317) and Subpart G – Closure and Post-Closure (40 CFR §264.110 through .120). Most of the hazardous disposal facilities regulated under RCRA Subtitle C that were included in this study are commercial waste treatment, storage, and disposal facilities (TSDFs); however, two industrial TSDFs are also included in the study. TSDFs are used for treatment, storage, and disposal of hazardous waste produced by general industrial and manufacturing activities. Commercial facilities are owned and operated by waste management companies and accept waste from multiple industries whereas industrial facilities are owned by and contain waste from the industrial process run by the owner. Corrective action management units (CAMUs) are special units created under RCRA to facilitate treatment, storage, and disposal of hazardous wastes managed for implementing site cleanups, and to remove disincentives to cleanup that the application of RCRA can sometimes impose. Requirements for CAMUs are provided under Subpart S – Special Provisions for Cleanup (40 CFR §264.550 through .555).

1.3.2 Post-Closure Monitoring and Maintenance

The guidelines for post-closure monitoring and maintenance systems required at a hazardous waste landfill are listed in §264.310(b) and require the owner and operator to comply with all post-closure requirements contained in §264.117 through .120, including maintenance and monitoring throughout the post-closure care period (as specified in the permit under §264.117). Financial assurance requirements for post-closure care are specified under §264.145(i). The owner or operator of a hazardous waste disposal unit must have a written post-closure plan providing a description of the planned monitoring and maintenance activities, the function of the monitoring equipment, and frequencies at which monitoring and maintenance activities will be performed. Specifically, the owner or operator must:

1. Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;
2. Continue to operate the leachate collection and removal system until leachate is no longer detected;
3. Maintain and monitor the leak detection system in accordance with 264.301(c)(3)(iv) and (4) and 264.303(c), and comply with all other applicable leak detection system requirements of this part;
4. Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of Subpart F (§264.90 through .101);
5. Prevent run-on and run-off from eroding or otherwise damaging the final cover; and
6. Protect and maintain surveyed benchmarks used in complying with §264.309 (Surveying and Recordkeeping).

Monitoring and inspection requirements for closed Subtitle C landfills specified under §264.303(c) include recording the volume of liquids removed from each leak detection system sump at least weekly during the closure period. After installation of the final cover has been certified, the volume of liquids removed from each leak detection system sump must initially be recorded at least monthly. If the liquid level in the sump stays below the pump operating level for two consecutive months, the amount of liquids in the sumps must be recorded at least quarterly. If the liquid level in the sump stays below the pump operating level for two consecutive quarters, the amount of liquids in the sumps must be recorded at least semi-annually. If at any time during the post-closure care period, the pump operating level is exceeded at units on quarterly or semi-annual recording schedules, the owner/operator must revert to monthly recording of the amounts of liquids removed from each sump until the liquid level again stays below the pump operating level for two consecutive months. In this regard, "pump operating level" refers to a liquid level based on pump activation level, sump dimensions, and other considerations that will avoid backup into the drainage layer and minimize buildup of hydraulic head. Pump operating levels must be proposed by owner/operators and approved by the EPA Regional Administrator or Director of an authorized state program.

1.4 Landfills as Waste Containment Systems

1.4.1 Waste Containment Goals

Landfills are land-based waste management units that contain solid waste as well as byproducts of waste decomposition (conversion of solids to more mobile liquid and gaseous phases). Gaseous phase byproducts are primarily associated with biological degradation processes that form landfill gas (LFG) and are less important in RCRA Subtitle C landfills than in Subtitle D landfills regulated under 40 CFR Part 258, as the latter generally contains significantly more organic materials disposed of as part of an MSW stream. Although some Subtitle C landfills feature LFG control systems, the performance of containment systems in controlling gaseous phase byproducts is not considered in this study. This study is concerned with the control of liquid phase byproducts (leachate), which are primarily comprised of liquid that has percolated through or emerged from the solid waste and contains soluble or suspended materials removed from the waste (Pohland & Harper, 1985).

Waste containment systems for landfills consist of liner systems that underlay the wastes placed on them and final cover systems constructed over the wastes. The primary function of the liner system is to minimize, to the extent achievable, the subsurface migration of waste constituents and degradation byproducts (i.e., leachate and gases) out of the landfill. The primary functions of the final cover system are threefold: contain and isolate the waste from the surrounding environment; minimize, to the extent achievable, the percolation of water into the waste body; and control the atmospheric emission of gases, if any, from the landfill. To achieve their performance objective of protecting the environment, multiple systems acting together are employed throughout the landfill's life (i.e., operation, closure, and post-closure). The performance objective for these systems is the protection of potential environmental receptors (groundwater, surface water, unsaturated soil, and air).

1.4.2 Containment System Components

Typical components of containment systems at Subtitle C landfills (Figure 1-1) and their role in meeting performance standards can be briefly described as follows:

- Liner system, typically a double-liner system with a composite clay/geosynthetic system, which provides containment of waste and waste byproducts (Rowe, 2005);

- Leachate management system, which collects leachate to minimize buildup of hydrostatic head above the liner and removes it for treatment and disposal (Rowe, 1998); and
- Final cover system (installed after closure), which provides long-term containment (Bonaparte et al., 2004), controls the rate of water entering the landfill from rainfall or snowmelt, provides storm water management, protects surface water quality, and can also provide a suitable platform for beneficial reuse options (Crest et al., 2010).

Active monitoring of landfill containment and control systems and potential receiving media is required (EPA, 2014a). Such monitoring is not only an important compliance tool to evaluate whether component systems are functioning as designed but also measures system performance over time.

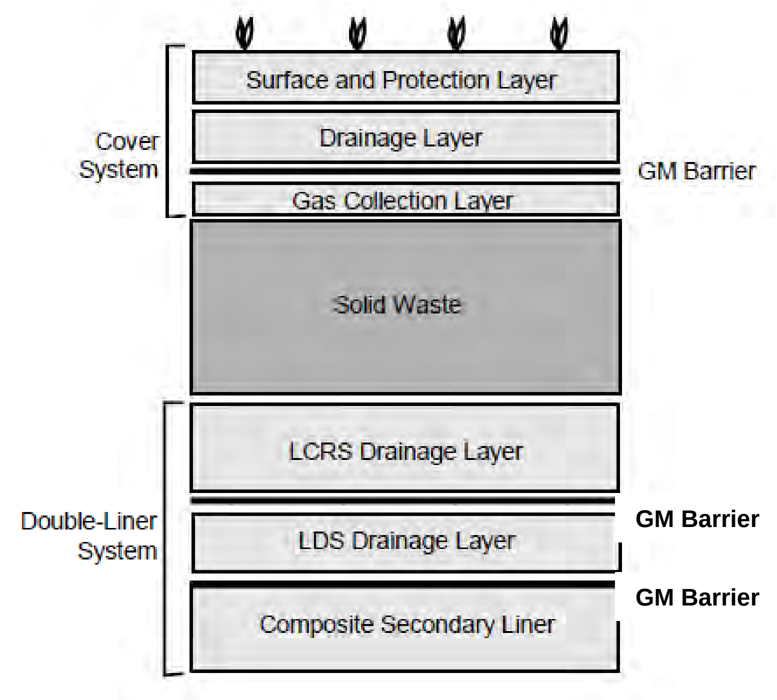


Figure 1-1. Schematic of typical cover and double-liner system for a Subtitle C landfill[2]

Liner and Leachate Management Systems

A liner system is a low-permeability barrier used to contain the waste and impede subsurface liquid or gas flow, primarily leachate. Liner systems are typically installed in accordance with an independent construction quality assurance (CQA) program, which provides third-party inspection, testing, documentation, and certification that liner

[2] Redrawn from Figure 5-1 of EPA (2002). Note that not all components will be present as shown in all Subtitle C containment system designs; in particular, a gas collection layer may not be specified and materials used in drainage layers may vary between granular soils and geosynthetic products.

components were installed in accordance with design specifications and regulatory requirements. Nevertheless, no liner material can be manufactured or installed to be perfectly impermeable (Giroud and Bonaparte, 1989; Giroud et al. 1997; EPA, 2002; Rowe, 2005). Therefore, the competent leachate containment design provides for a combination of barrier and drainage layers performing complementary functions. Barrier layers impede leachate percolation out of the landfill and improve the performance of overlying drainage layers, which serve to rapidly remove leachate and limit the buildup of hydraulic head on underlying barrier layers. Drainage layers collect and convey leachate from above the uppermost liner material towards controlled low-point collection points (sumps) on the liner where the liquids can be removed, thereby minimizing the hydraulic head on the liner and advective flux through the liner. Combinations of liners and drainage layers are collectively referred to as liner systems.

A double-liner system consists of a primary liner and a secondary liner, each overlain with a dedicated drainage layer. The drainage layer above the primary liner serves to remove leachate before it can develop a significant hydraulic head on the primary liner; as such, this drainage layer is referred to as the leachate collection and removal system (LCRS). The drainage layer between the primary and secondary liners serves to collect leachate that may leak through the primary liner; this drainage layer is thus referred to as the leak detection system (LDS). A schematic showing various components of a typical double-liner system is shown in Figure 1-1.

All double-liner systems being constructed at Subtitle C landfill facilities today have primary and secondary liners that include geomembranes (GMs). Due to its resistance to degradation by a wide range of chemicals, among other factors, high-density polyethylene (HDPE) is the most common type of GM barrier used in landfill liners. However, other GM materials include polyvinyl chloride (PVC), butyl rubber, polypropylene (PP), and Hypalon. Primary and/or secondary liners can consist of a GM alone, although this is rare, or a GM on top of a compacted clay liner (CCL) or geosynthetic clay liner (GCL). The latter two cases, which are referred to in this study as GM/CCL and GM/GCL liners, respectively, are known as "composite" liners and significantly outperform single liners because the properties of the two different barrier materials work synergistically to maximize the performance characteristics of the other (Rowe, 2011). Only double-lined landfills with GM, GM/CCL composite, or GM/GCL composite primary and secondary liners were included in this study. Sites with liner systems constructed with single CCL primary liners were not considered. The specific double-liner system types in service at the various landfill units included in this study are discussed in Chapter 3.

The LCRS and LDS drainage layers overlying the low permeability primary and secondary liners, respectively, which traditionally comprise a 12- to 24-inch layer of granular soil (sand or gravel), the main purpose of which is to collect and remove liquids to prevent buildup of hydraulic head on the liner, although the granular soil layer also serves to protect the liner system from damage during initial waste placement. Increasingly common, a specifically designed open-weave plastic mesh product termed a geonet (GN) or geocomposite (GC) is installed above the liner in conjunction with, or instead of, the granular soil layer to improve LCRS and/or LDS drainage performance and/or economics. Granular soil drainage layers are usually overlain by a geotextile (GT) fabric or similar permeable barrier to minimize intermixing of overlying waste and protective soil/gravel layers. A protective soil layer is installed above the LCRS, and/or the first two to four feet of waste is carefully selected and placed to form a protective "fluff layer" above the LCRS. A schematic illustration showing the locations of LCRS and LDS drainage layers in a double-liner system is shown in Figure 1-1. The specific LCRS and LDS designs and material types in service at the various landfill units included in this study are discussed in Chapter 3.

Cover System

Landfills require daily covers, intermediate covers, and final cover systems, depending on their stage of development. At most landfills, a daily cover (soil, select waste, or other material such as foam or fabric) is applied to waste at the end of each working day to provide temporary control of vectors and erosion of waste by wind and surface water runoff. The daily cover was not a primary focus of this study. The intermediate cover is often placed on open portions of landfill areas on which waste placement has ceased, either permanently or for an extended period. The intermediate cover serves the same purposes as daily cover, but at a higher performance level, and often comprises the subgrade foundation upon which a final cover is constructed. Intermediate cover usually consists of a thicker layer of soil or select waste than the daily cover and may include a temporary GM. As the active period of operation progresses, the landfill is filled with waste, and waste placement ceases. Depending on the method of operation, landfill units may be under intermediate cover for up to several years before a final cover system is constructed over the waste. The intermediate cover is of interest in this context because one of the case study landfills includes a unit in which waste has been placed to final grades but the final cover system has not yet been constructed.

The final cover system at a Subtitle C landfill typically consists of a barrier layer (GM, GM/GCL, or GM/ CCL) overlain by drainage and soil protection/vegetation layers. The barrier layer is constructed on a subgrade foundation layer above the waste. A gas distribution/collection layer is included beneath the barrier layer at landfills with wastes that generate gases during decomposition (EPA, 1989, 1991; Bonaparte et al., 2004). Final covers are engineered systems constructed over the entire aboveground surface of the landfill (i.e., a top area and side slopes). Final covers are designed to minimize water infiltration into the waste (i.e., leachate generation), control the migration of gases produced by waste decomposition, prevent against inadvertent intrusion, and be aesthetically acceptable (Koerner and Daniel, 1997). Similar to liner systems, final cover systems are typically installed in accordance with an independent CQA program, which provides third-party inspection, testing, documentation, and certification that cover system components were installed in accordance with design specifications, although (again similar to liners) no cover material can be manufactured or installed perfectly (EPA, 2002; Rowe, 2005). A schematic illustration of the various components of a typical cover system is shown in Figure 1-1. In some jurisdictions, the final cover system is often considered to replace the liner system as the primary means of environmental protection once it is installed at a site during closure construction. The specific cover system types in service at the various landfill units included in this study are discussed in Chapter 3.

1.5 Long-Term Performance of Landfill Containment Systems

1.5.1 Liner-System Performance

A number of textbooks and guidance documents have been developed to provide recommendations for design, permitting, operation, performance, and monitoring of hazardous waste landfills. However, most active research on design and performance of landfill containment systems predates the publication of the seminal study by EPA (2002) and was captured in the extensive literature review provided therein. That discussion is not reiterated here.

A report published by the National Academic Press (2007) on the performance of engineered barriers for containment of MSW, hazardous and toxic waste, and low-level radioactive waste (LLRW) focused on answering two primary questions: How well are engineered barrier systems working? How long are they likely to work effectively? Based on 20 years of data, the report concluded that "most engineered waste containment barrier systems that have been designed, constructed, operated, and maintained in accordance with current statutory regulations and requirements have thus far provided environmental protection at or above specified levels. Extrapolations of long-term performance can be made from existing data and models, but they will have high uncertainties until field data are accumulated for longer periods, perhaps 100 years or more. We will never have all the long-term observations and data that we would like." The report concluded that significant failures have been rare and, in general, repair or limited reconstruction has been possible when needed.

Since the late 1990s, a number of on-site disposal facilities (OSDFs), which are doubled-lined landfills for containment of mixed LLRW and RCRA wastes, have been constructed as part of the decommissioning and remediation of the U.S. Department of Energy (DOE) facilities such as the Feed Material Production Center in Fernald, Ohio and Idaho CERCLA Disposal Facility in Idaho Falls, Idaho (Koslow, 2015). Liquids management data (i.e., leachate collection system and leakage detection system flow rate and liquid chemical constituent data) from the operational and post-closure periods have been reported for a number of these facilities (e.g., Benson et al., 2007; Bonaparte et al., 2011; Bonaparte et al., 2016). In the latter study, performance data from three facilities were analyzed to calculate hydraulic containment efficiencies of the liner systems and to draw conclusions as to whether the liner systems are performing as expected. Based on the data presented, all facilities were found to be "performing very well in providing containment and collection of leachate." Performance metrics for the facilities were consistent with those presented in EPA (2002). However, the authors noted that the public availability of data for several of the facilities was limited and recommended more intensive liner system monitoring and information dissemination by DOE.

Although some recent research has focused on the design and hydraulic performance of CCLs exposed to high strength leachate (Safari et al., 2012), most geotechnical research on landfill containment systems since 2002 has focused on long-term material integrity and aging and their expected effect on the service life of HDPE geomembranes and other geosynthetics used in liner applications (e.g., Sangam and Rowe, 2002; Hsuan et al., 2005; Rowe and Rimal, 2008; Rowe et al., 2009; Rowe and Hoor, 2009; Rowe et al., 2010), including in applications at landfills for containment of mixed LLRW and RCRA wastes (Jo et al., 2005; Tian, 2015). The most significant aging mechanism in HDPE geomembranes used in landfill liners is chemical aging, with the extraction of antioxidants and then oxidation being the main degradation mechanisms. Eventually, the geomembrane will likely become brittle to the extent that it is considered to have reached the end of its service life. In addition to the in-service stresses imposed on a GM, Rowe, and Sangam (2002) highlighted that the real service life of a GM depends on its mechanical, hydraulic, and diffusive properties. Thus, a GM may lose strength while still performing satisfactorily as a barrier. Accordingly, the true hydraulic and diffusive service life of a GM may significantly exceed the service life determined based on the degradation of the physical and mechanical properties, especially if the tensile stresses are minimal.

Many researchers (cit. in Rowe, 2007 and 2011) have focused on the importance of manufacturing and construction practices in minimizing long-term field leakage through composite liners. Rowe (2011) concluded that "composite liners have performed extremely well in field applications for a couple of decades and that recent research both helps understand why they have worked so well, but also provides new insight into issues that need to be considered to ensure excellent long-term liner performance of composite liners." Factors potentially affecting the field performance of barrier materials in liners include avoiding excessive wrinkles in GMs, moisture loss and shrinkage of GCL panels (particularly overlaps), and desiccation of CCLs. These can be mitigated by imposing strict quality control (QC) protocols on manufacturers and CQA procedures on installation, particularly minimizing exposure to the sun and the wind (Rowe and Hosney, 2010).

The potential for LCRS clogging and malfunction has also been considered by several researchers (e.g., Fleming and Rowe, 2004; VanGulck and Rowe, 2004; Cooke et al., 2005; Rowe, 2005). Rowe (2005) reported that clog material forms by biologically induced processes that involve the removal of some of the organic leachate constituents and precipitation of some inorganic leachate constituents followed by an accumulation of inorganic particles originally suspended in leachate. Research suggests that the potential for clogging depends on the amount and composition of leachate and on the details of the design of the LCRS. However, most of the research has been performed on MSW landfills; as hazardous waste landfills generally contain significantly lower quantities of organic waste, which should reduce their clog potential. The lower the leachate generation rate, the lower the potential for clogging (other factors being equal). Given the significant decrease in leachate generation rates after landfill closure, the potential for biological clogging of the LCRS decreases after the landfill is closed with a final cover system.

1.5.2 Leachate Generation Modeling

Leachate generation can be estimated using water balance models, which are based on the principle of conservation of mass, in which water mass is conserved through the process. Typically, water in a landfill exists as an input, output, or in storage. The most important factor in the water balance equation is the storage in the cover soil and evapotranspiration. These two factors greatly affect surface runoff and the amount of precipitation that is allowed to infiltrate the cover system barrier layers (Kaushik et al., 2014). There are many variations in the assumptions and algorithms these models use. Generally, site-specific geometry (e.g., waste thickness, base liner, side slope inclination) as well as climatic and soil data are input to predict flow over a period of time. A water balance may be performed for various periods, ranging from one month to several decades, depending on the amount of data necessary. All models are limited by availability and accuracy of site-specific data (Peyton and Schroeder, 1993; EPA, 2004).

Although many public and commercial water balance models are available, the HELP Model developed by the U.S. Army Corps of Engineers for the EPA (Schroeder et al., 1994a and b) is the most widely used hydrologic model in the landfill industry, both in the United States and internationally (Berger, 2003). The model can be used to evaluate percolation through cover and liner systems, hydraulic head on liners, and, by association, leakage of leachate to the subsurface (Yalcin and Demirer, 2002; Alslaibi et al., 2013). Three versions of the model are currently available: HELP 3.07, Visual HELP 2.2, and HELP 3.95 D. Plans for improving the model and developing a future version (HELP 4 D) based on ongoing validation results and requests from the practice are described by Berger (2015).

HELP is a quasi-2D model because it considers either vertical or horizontal flow in each layer, but not both simultaneously. The model is popular for its ease of use in comparing different cover and liner types; a broad database of climatic and material property default values; ability to provide daily, monthly, or annual output; consideration of lateral drainage; and ability to evaluate up to 20 layers. The HELP Model has widespread regulatory acceptance both in the United States and internationally. There have been several criticisms levied about the model; for example, that it overestimates leachate generation and percolation through covers (particularly in arid and semi-arid conditions) by underestimating evapotranspiration (Vorster, 2001). However, many findings from validation studies are contradictory: for example, the model is reported to either under-predict or over-predict surface runoff (Paige et al., 1996) and assign too high or too low default values for field capacity and hydraulic conductivity depending on geographic region (Uguccioni and Zeiss, 1997). Some limitations are due to the maximum 1-day time resolution of the model and its input data. Any model using daily precipitation data can give only a rough estimate of surface runoff, especially in poorly vegetated regions experiencing large precipitation events. The empirically derived Soil Conservation Service (SCS) curve number method underlying the runoff sub-model should, strictly speaking, be calibrated for different regions and time periods of application. Similarly, using daily precipitation data cannot reproduce short-term peaks in lateral drainage from drainage layers in final covers (Berger, 2015).

Conventional soil mechanics theory used to describe hydraulic properties of solid waste such as field capacity assumes Darcian flow through a homogeneous porous matrix. However, the landfill waste body is, by its nature, highly heterogeneous. Observations (e.g., Bendz et al., 1997; Rosqvist, 1999; Fourie et al, 2001; Rosqvist et al., 2005) have shown significant channeling, or preferential flow, through waste layers, albeit generally measured at MSW landfills under high infiltration rates (open conditions). This results in lower practical field capacities, faster breakthrough times, and higher and non-uniform leachate discharge rates than obtained from the HELP Model, which assumes homogenous Darcian flow (Fellner and Brunner, 2010). Low infiltration rates (such as occur after application of landfill covers), however, are less likely to lead to pronounced channeling than high rates, because more time is allowed for absorption of water into waste particles, and capillary action in smaller pores redistributes moisture so that uniform flow through the waste layer may contribute more to overall moisture movement. As a result, channeling may only occur significantly in the initial phase of landfilling, or where high rates of liquids injection are attempted at bioreactor facilities (Bengtsson et al., 1994). This suggests that the HELP Model should be better at predicting leachate generation during PCC than during the operational period.

1.5.3 Potential Sources of Liquids Contributing to LCRS and LDS Flow

Leachate is produced when the field moisture-holding capacity of the landfill contents is exceeded. This occurs when the waste moisture deficit (the difference between the waste moisture content at placement and field capacity) is exceeded. Four principal factors govern leachate production at a landfill (Rees, 1980):

- The water content of the waste when placed;
- The volume of infiltrating rainfall;
- The volume and water content of sludges co-disposed with the waste; and
- Waste compaction and density.

Prior to closure, precipitation levels would be expected to be directly correlated to leachate generation (i.e., liquids volume recovered in the LCRS), and thus also have an indirect impact on LDS flow rates, since higher LCRS flow rates mean greater potential for primary liner leakage. However, leachate generation during the post-closure period is primarily controlled by the cover system, which limits infiltration. As such, LCRS and LDS flow rates would be expected to decrease significantly following completion of closure construction. Thereafter, any residual post-closure LDS flow is expected to be more dependent on imperfections in the liner and cover system construction (e.g., anchor trench tie-in and welding of cover and liner system geosynthetics), cover erosion issues, and groundwater conditions than on precipitation.

The performance of primary liners at double-lined landfills in limiting leakage of leachate is generally inferred by comparing LCRS and LDS flow rate and chemical constituent data. Pioneering studies by Bonaparte and Gross (1990) and Gross et al. (1990) identified four main potential sources of liquids contributing to LDS flow (Figure 1-2). The potential sources of LDS liquids identified in the figure include:

- Primary liner leakage (Source A);
- Construction water and compression water (Source B), comprising water (mostly rainwater) that infiltrates the LDS during construction and continues to drain to the LDS sump after the start of facility operation;
- Consolidation water expelled into the LDS from the CCL/GCL components of a composite primary liner as a result of clay consolidation under the weight of the waste (Source C); and
- Groundwater that percolates vertically or laterally through the secondary liner from outside the landfill or other external sources of water (e.g., condensation of water vapor in any gases encapsulated within the landfill), which condenses and infiltrates the LDS (Source D).

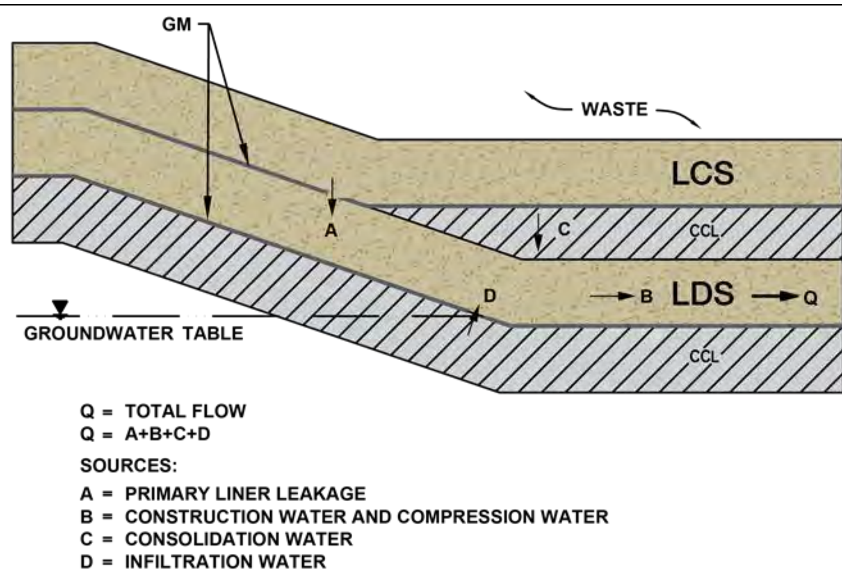


Figure 1-2. Potential sources of liquids contributing to LDS flow[3]

The contribution of Sources B and C is not insignificant, particularly at sites having granular drainage layers and thick CCL barrier layers (Bonaparte et al., 2011). However, such sources are expected to have less relevance when only post-closure performance of the liner is considered.

[3] Based on Figure 3 of Bonaparte and Gross (1990), used with permission of the authors.

Gross et al. (1990) presented the following five-step approach for evaluating the sources of LDS liquid at a specific waste management unit:

1. Identify the potential sources of flow based on double-liner system design, climatic and hydrogeologic setting, and landfill operating history;
2. Calculate flow rates from each potential source;
3. Calculate the time frame for flow from each potential source;
4. Evaluate the potential sources of flow by comparing measured flow rates to calculated flow rates at specific points in time; and
5. Compare LCRS and LDS flow chemistry data to further establish the likely sources of liquid.

The approach outlined above was used to evaluate the performance of the primary liner systems in this study as discussed in Chapter 4. In addition to mechanisms identified above, the operators of participating case study sites were asked about other possible reasons for higher-than-expected flows in LDS sumps; where this occurred, it was mainly attributed to issues with the anchor trench tie-in design or cover erosion and repair. Selection of secondary liner system and LDS drainage layer materials on a side slope and base liners may also be important where groundwater is shallow and potentially in contact with the liner.

1.5.4 Leachate Chemistry

Leaching, which is the release of compounds from a solid to a solution, typically involves a number of interrelated physical, chemical, and biological processes (e.g., degradation, dissolution, desorption, complexation, or mineralization) and transport mechanisms, which can be grouped into those predominantly controlled by diffusion and those predominantly controlled by percolation and kinetics. Diffusion occurs where percolating liquids move mainly over the surface of a block of material rather than around individual particles or grains. Therefore, apart from initial wash-off effects, contaminant release is by diffusion through the interstitial spaces inside the block to the exposed surface. Contaminant release is thus related to the extent of this exposed surface. Percolation and kinetics refer to the situation where the liquid passes through a material, which comprises a mass of particles or granules and comes in direct contact with the surface of each particle. Contaminants transfer into solution by diffusion or dissolution and then migrate with the leachate. The factors controlling leaching also affect the composition of the resulting leachate, which in turn affect long-term management and treatment options (Renou et al., 2008). These factors include (Rees, 1980; Heasman, 1997; Morris, 2001):

- The source, nature, and physical properties of the waste material;

- The leaching mechanism;
- The chemistry of the contaminants concerned;
- The pH and redox potential of the leaching environment; and
- The nature and rate of movement of percolating liquids.

With regard to the last factor, hazardous waste materials may not degrade or only degrade very slowly, under landfill conditions. Reliable data on landfill leachate constituents collected over multiple years can support analyses of landfill processes and are needed to predict long-term trends in leachate chemistry with statistical confidence (Kylefors, 2003). However, while considerable research into the long-term composition of leachate has been conducted (e.g., Kjeldsen et al, 2002; Statom et al., 2004; Öman and Junestedt, 2008; Gibbons et al., 2014) this has tended to focus on non-hazardous waste landfills. In light of this, Tian (2015) analyzed leachate composition from four landfills constructed for containment of LLRW and hazardous wastes in the United States and compared concentrations of dissolved organic matter (measured as total organic carbon [TOC]), inorganic macro-components (including major cations and anions), and trace metals to values reported in the literature for MSW leachate. The study concluded that:

- Dissolved organic matter concentrations were insignificant when compared with MSW leachate;
- Concentrations of inorganic macro-components were broadly similar to MSW leachate; and
- Trace metal concentrations were relatively lower than in MSW leachate.

For major cations, the concentrations of Ca and Mg were found to be similar to those in MSW leachate, while K and Na concentrations were higher in MSW leachate. For major anions, sulfate concentrations were much lower in MSW leachate. Interestingly, the concentrations of trace metals were found to be relatively constant over time at the four sites studied. Overall, if current expectations are that the time taken for concentrations of constituents of concern in leachate to decrease to asymptotic levels will be similar for hazardous and non-hazardous landfills, this may not be appropriate.

Most recent research into the properties of hazardous waste and its byproducts of degradation and decay has focused on landfill diversion of materials in support of zero waste principles or the "circular economy" (e.g., López- Delgado and Tayibi, 2012). An exception is municipal solid waste incineration (MSWI) bottom ash and fly ash, which contains a considerable amount of heavy metals, salts, organic pollutants, and other potentially toxic components. Investigation into recovery of metals with resale value (e.g., copper, zinc, lead, and cadmium) from MSWI by controlled leaching using different solutions (nitric acid, hydrochloric acid, and sulfuric acid) and optimized parameters (temperature, controlled pH value, leaching time, and liquid/solid ratio) was reported by Tang and Steenari (2016) with recovery rates varying from 68 to 92%, although it is doubtful such conditions for leaching could exist in situ. At many hazardous waste landfills, incoming waste is mixed with a bulk solidifier/stabilizer (cement kiln dust, fly ash, Portland cement, or activated carbon), which can make up as much as 40% of the volume in a given landfill unit, or stabilized by encapsulation using polymers (Kim et al., 2009; López et al., 2015). The stabilization process can immobilize hazardous organic materials such as phenol and reduce the potential for heavy metals to leach out of the waste (Rho et al., 2001; Reich et al., 2002).

Despite the shortfall in leachate characterization studies and need to establish a basis for expectations regarding trend behavior, hazardous waste landfill leachate data can help determine liner performance and identify groundwater contamination sources, depending on the signature relationship to landfill sections, waste type, and waste age. Of particular interest to this study, comparison of the concentrations of key chemical constituents in temporal LCRS and LDS chemistry datasets can be used to establish the extent of the hydraulic connection between these drainage layers (i.e., whether primary liner leakage had contributed significantly to observed LDS flows). Several factors need to be considered in identifying the constituents of interest, including common occurrence in leachate, high solubility in water and low octanol-water coefficient, and high resistance to hydrolyzation.

The parameters analyzed from sites used in this study included pH, specific conductance, total dissolved solids (TDS), chemical oxygen demand (COD), major cations and anions, trace metals, and volatile organic compounds (VOCs). The chemical signatures for these parameters in LDS vs. LCRS liquids serve as justification for proceeding with correcting liner efficiency calculations; this is discussed in Chapter 5. If sufficient data on major cations and anions are available, Stiff and Piper diagrams can be used to subjectively describe ionic solutions and distinguish leachates with similar chemistry into clusters (Tonjes, 2013). Further, with respect to the major ions, chloride is of particular interest since it serves as a conservative parameter that does not take part in biochemical reactions and is not physically altered during the processes of leaching (Rowe, 1991). Therefore, despite differences in volumes between LCRS and LDS flow rates, chloride concentrations should be approximately constant between these two drainage layers if the primary source of liquids in the LDS is leakage through the primary liner.

1.5.5 Liner and Cover Stability

Problems affecting liner stability generally occur as a result of short-term unstable conditions developing during operations (Blight, 2008; Mitchell, 2009). Potential causes of liner instability include inadequate design (e.g., inappropriate selection of smooth GM materials in contact with slick clay resulting in lower-than-expected interface friction), poor construction inspection and quality assurance, and/or inadequate control of liquid waste and moisture conditions. For the most part, such problems are avoidable. Liner issues not addressed during construction would be difficult to repair during operation and almost impossible to repair after the closure of the landfill. However, liner failures after closure have not been reported at modern RCRA landfills.

Most cover stability issues are identified based on visual observations during routine inspections. These are generally less likely to increase the potential for environmental impacts due to compromised waste containment system integrity than liner system failures. Cover issues related to erosion or storm water ponding may result in increased infiltration and leachate generation; however, most cover issues can be remedied in a relatively straightforward manner if detected and repairs are made in a timely fashion.

1.6 Assessment and Termination of Post-Closure Care

1.6.1 Number of Closed Hazardous Waste Units

The EPA Office of Inspector General recently issued a report (EPA, 2015) to evaluate whether the EPA and authorized states and territories have sufficient safeguards to control and mitigate long-term public health, environmental, and fiscal risks at hazardous waste disposal sites beyond the 30-year PCC period. The report identified over 1,500 hazardous waste disposal units that had been assigned an operating code of "closed with waste in place" as of 9 October 2014 (Figure 1-3), although not all are reported to have entered into a permitted PCC program.

1.6.2 Process for Assessing Completion of Post-Closure Care

PCC for each hazardous waste management unit must begin after completion of closure and continue for 30 years thereafter according to 40 CFR §264.117(a), although discretion is provided to the permitting authority (EPA Regional Administrator or Director of an authorized state program) to adjust the post-closure period as necessary to protect HHE. Therefore, the presumption of a 30-year PCC period does not reflect a determination by EPA that 30 years is necessarily sufficient to eliminate potential threats to HHE in all cases. The regulations provide authority to conduct a case-by-case review of the PCC period and to establish arrangements to adjust the length of the post-closure care period on a facility-specific basis, where the records support a determination that the revised post-closure period will protect human health and the environment (EPA, 2016). In other words, the duration of PCC is a performance standard rather than a prescriptive standard.

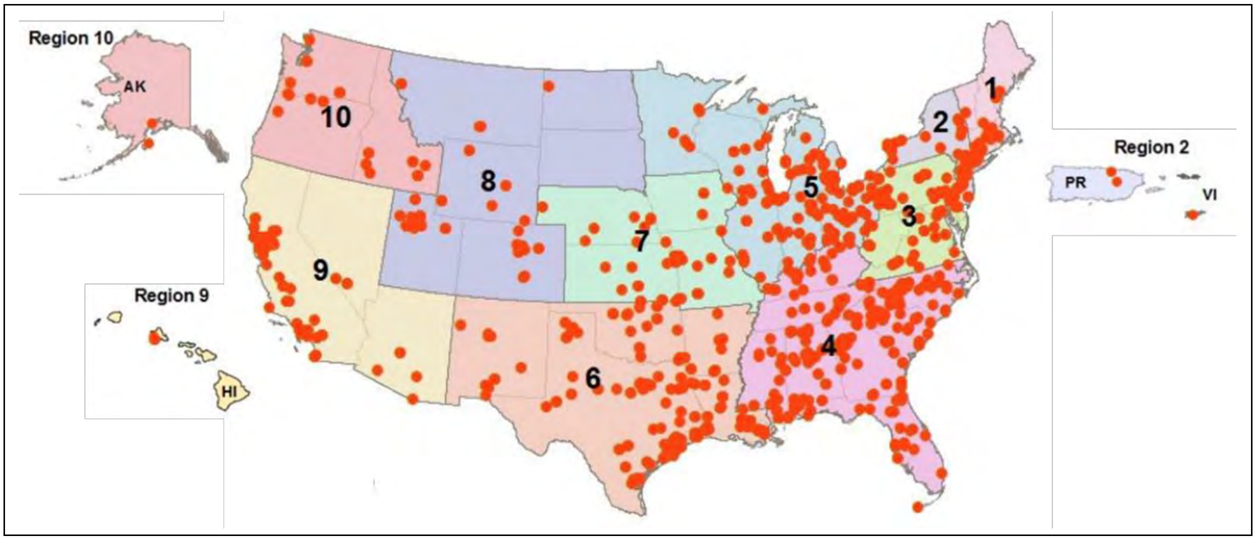


Figure 1-3. Distribution of closed hazardous waste disposal units in the United States[4]

In terms of the current state of the industry, EPA (2015) concluded that some important safeguards are in place, such as corrective action and other enforcement authorities that the EPA and authorized states can use to address cleanup needs at facilities undergoing PCC. States have exercised their authority, extending PCC and associated financial assurance when unacceptable risks remain. One state (Virginia) has also ended post-closure care at one facility and established other long-term care arrangements under an environmental covenant (see Section 1.6.3). If long-term problems arise after PCC, the implementing authority may be able to address these problems using its RCRA enforcement authority. Nevertheless, a number of challenges remain:

- In the absence of the finalized additional guidance from EPA, states have to make decisions on adjusting the PCC period;
- 18 states do not have environmental covenant statutes that strengthen controls for long-term protection of land use; and
- EPA and state hazardous waste programs will have an increased workload as more units reach the end of their expected 30-year PCC periods (the number of units for which a decision regarding the end of permitted PCC will be needed was estimated at between

[4] Modified from the cover map of EPA (2015). Red dots show the locations of hazardous waste disposal units. Numbers and color shading groups indicate EPA regions.

15 and 45 annually through 2030, with over 50% of these decisions falling in the next 10 years).

Post-closure activities must be continued until the permitting authority (generally, the state) determines that the facility is performing acceptably and that the post-closure permit can be terminated. If the permittee (i.e., site owner/operator) is unable to continue providing PCC under these conditions, in accordance with applicable terms of the financial mechanism used to provide the financial assurances the state may provide PCC using an independent third party contractor. To cover the costs of such post-closure care under these circumstances, the state would exercise the financial assurances provided for PCC. For this reason, many states require routine assessments of the adequacy of funding and financial assurances for PCC at all facilities within their jurisdiction. Utah Senate Bill 24 of 2005, for example, requires an assessment every 5 years (Baird and Seiger-Webster, 2011).

A few states have used their authority under RCRA to extend PCC. For example, Maryland evaluated information on a disposal unit approaching the end of its 30-year PCC care period in 2012. Maryland identified continuing risk and required the owner to renew its PCC permit for another 10 years. Further, Maryland required the owner to maintain financial assurance to cover this extended care. The amount of financial assurance is to remain great enough to cover 10 years of care throughout the extended permit period (EPA, 2015).

1.6.3 Case Study Example of Post-Closure Permit Termination

This study found evidence of only one Subtitle C landfill facility at which PCC has been demonstrated complete and the PCC permit terminated (Romanchik, 2013; EPA, 2015). This is the Wheelabrator Corporation Landfill, a 2.7-acre landfill located on 13 acres of land near Bedford, Virginia. The landfill was used for disposal of furnace dust and furnace slag generated from secondary steel (scrap) smelting operations conducted at the adjacent Wheelabrator Abrasives foundry. The landfill was operated for 16 years through 1985 and then closed with waste in place on 21 December 1988. At the time of closure, the waste inventory was estimated as 122,900 cubic yards.

On 29 September 1992 Virginia Department of Environmental Quality issued Wheelabrator a Hazardous Waste Management Post-Closure Permit (Permit) that required monitoring of upgradient and downgradient groundwater at the closed landfill as well as maintenance of the landfill cap. On 17 July 2003, the Permit was renewed for a 10-year period through 16 August 2013 with groundwater monitoring requirements reduced from quarterly to semi-annual sampling. On 29 September 2008, the compliance period (16 years) for the regulated unit ended and the groundwater monitoring constituent list was significantly reduced. Finally, on 9 August 2013, the department approved Class 3 Permit Modification to reduce the PCC period from 30 years to the time served to date. To comply with long-term stewardship goals, an environmental covenant was executed under Virginia's Uniform Environmental Covenants Act that allowed the site out of PCC in exchange for an annual certification by a certified professional engineer that required cap monitoring, maintenance, and site security obligations covered under the covenant are being met.

Based on a review of available documentation, it appears that termination of PCC at this site was approved based on demonstration of no unacceptable threat to HHE as a result of potential long-term leakage of leachate to groundwater. As such, the approval invokes the department's authority under the performance standard implicit in §264.117(a) rather than strict invocation of the prescriptive requirement under §264.310(b)(2) to continue to operate the leachate collection and removal system until leachate is no longer detected.

1.7 Long-Term Landfill Performance and Resilience

Some hazardous waste management units in place today may be under-designed for the future if conditions change significantly relative to recent historical patterns. This could have serious consequences for the integrity of hazardous waste disposal facilities, such as a cover system breach causing either subsidence or leaching of contaminants into the subsurface (Kelly and Winchester, 2005). Therefore, the vulnerability of existing and proposed hazardous waste disposal facilities should be evaluated with regard to long-term climatic hazards (e.g., inundation due to sea level rise, elevated temperatures, and/or groundwater elevation rise) as well as short-term hazards (e.g., possible increase in precipitation and associated flooding, increases in storm flooding/surges, potential changes in wave action and currents, king tides, seismic events such as earthquakes or tsunamis, and/or El Niño effects). Little research has been published on the long-term vulnerability of closed landfills to these events; as such, this represents a research need in terms of assessing the long-term performance of landfill containment systems.

Although very long-term design considerations and the effects of extreme climatic or other natural events are not routinely considered for RCRA Subtitle C landfills, very long-term performance requirements are considered for waste encapsulation designs (Reith and Caldwell, 1993) used for containment of extremely hazardous or radioactive wastes. For example, functional requirements for the design of an on-site disposal facility (OSDF) for mixed LLRW and RCRA waste containment based on 40 CFR §192.02(a) with a 1,000-year design life are described by Bonaparte et al. (2011 and 2016). These included potential mechanisms for performance failure such as long recurrence interval earthquake and storm events. Changes in erosional stability over time were also considered. For design, the performance period was divided into three operating timeframes: initial period, which extends from construction until the end of the 30-year post-closure monitoring period; intermediate period, which begins 30 years after final closure and lasts for at least 200 years and up to 1,000 years; and final period, which does not occur for at least 200 years and possibly up to 1,000 years after final closure of the facility. During the final period, it is assumed that liner and final cover system geosynthetics are non-functional along with synthetic components of LCRS and LDS drainage systems and pipes.

According to the National Academic Press (2007), long-term containment designs that allow for lifetimes of thousands of years are likely infeasible and prohibitively expensive; therefore, designs that allow for recovery, repair, or replacement of the barrier system components for the landfill cover system should be encouraged. The potential effects of changes in temperature and precipitation, sea level rise, and related flooding, as well as other extreme events such as earthquakes, could be minimized by building resiliency in design for repair and replacement of the barrier system components. The appropriate continuing management strategy would include ending maintenance, continuing maintenance, repair, and rehabilitation.

2. DATA COLLECTION AND ANALYSIS

2.1 Data Collection

The EPA, in partnership with the States, biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under RCRA and publishes a National Biennial Report to communicate the findings (EPA, 2011). This includes a list of reported RCRA sites in the United States, which helped in initial identification of candidate sites for this study.

Efforts were made to obtain data from a variety of facilities to represent the different waste generator and operator types regulated under Subtitle C, including commercial facilities and landfills dedicated to a specific industrial waste stream. Variability in geographic/climatic conditions was also sought, as discussed below. The cooperative participation of site managers and other operator personnel was also seen as key to success, in particular in understanding the nuances in the data (for example, many apparent anomalies can be readily explained from operational records: a 5-day spike in leachate flow may simply be the effect of a malfunctioning flowmeter that took a few days to notice, isolate, and replace). However, it is recognized that non-random selection of sites is likely to have biased the data set. Therefore, to gain some understanding of the extent of data that may be available without direct contact with the operator, site records and analytical data for one site (denoted Landfill F in the study) were obtained directly from the state.

2.1.1 Criteria for Case Study Site Selection

Landfill disposal units (i.e., cells, phases, modules, or areas) sought for inclusion in this study offered the following four main characteristics:

- Regulated under RCRA Subtitle C;
- Closed (i.e., final capped) or at final grade for an extended period under intermediate cover;
- Have a double-liner system with separate (unit-specific) measurement of liquid flow rate in the LCRS and LDS; and
- Collect leachate chemistry data independent of any active units in operation at the same facility.

2.1.2 Geographic and Climatic Distribution

For the purposes of this study, the continental United States was divided into four geographic regions: Northeast (NE), Southeast (SE), Northwest (NW), and Southwest (SW). These regions were constructed to broadly reflect climatic differences, as represented by average annual rainfall and temperature (Figure 2-1). Regional representation was established as a goal in selecting case study landfills for inclusion in the study.

Generally, facilities in the SE experience higher rainfall and evapotranspiration, and fewer days below freezing annually than other regions. Compared to the SE, facilities in the NE receive slightly lower rainfall, have lower evapotranspiration, and experience a significant number of days below freezing annually. Both the SW and NW are relatively dry (ignoring the coastal Pacific Northwest), with relatively low precipitation and relatively high evapotranspiration. Facilities in the SW may not experience any days below freezing annually while facilities in the NW should expect a significant number of days below freezing annually.

The climatic differences between regions would be expected to have a direct impact on leachate generation (LCRS flow rates) as well as an indirect impact on LDS flow rates since higher LCRS flow rates mean greater potential for primary liner leakage. However, LDS flow rates may be more dependent on liner system construction, cover system construction (in particular, tie-in of to the liner system anchor trench by welding cover and liner geomembranes (GM) together), and groundwater conditions than on precipitation. Climatic and other influences on LDS flow are examined as part of this study.

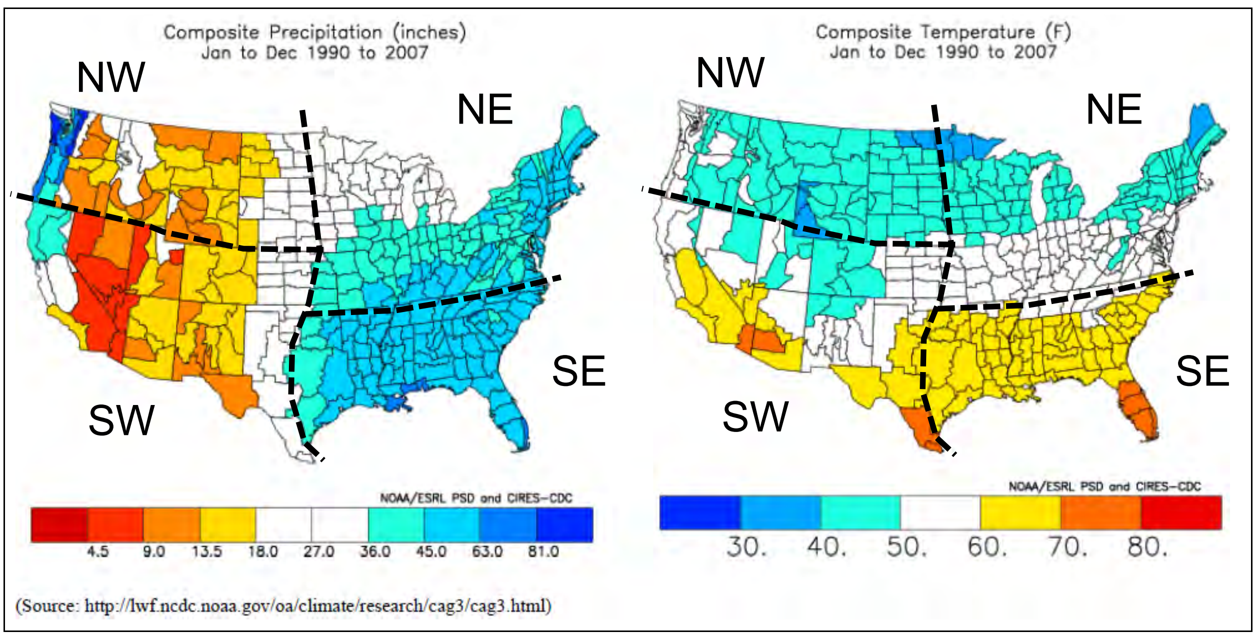


Figure 2-1. Geographical regions established for the study

2.1.3 Site Data Collection Protocol

The dataset available from closed landfill facilities reported in EPA (2002) included only 9 years of post-closure data from both MSW and hazardous waste units. A primary objective of this research was to extend the dataset for hazardous waste units by 20+ years. Thus, in developing a data collection protocol, care was taken to review material used in the preparation of that study and interview a number of professionals that were involved in data collection and analysis for that study. A review of other relevant publications and guidance related to liner, cover, and LCRS design at Subtitle C landfills was conducted to develop a Data Requirements Checklist (Appendix I). Checklist data were broadly categorized in terms of (1) design and construction of the liner, LCRS, LDS, and cover; (2) waste placement schedule, characteristics, and in-place volume; (3) LCRS and LDS flow quantities; and (4) leachate chemistry data.

To obtain the data identified on the checklist, owner/operators, EPA regions, and state regulators of Subtitle C landfills were contacted to identify candidate sites with one or more closed units that meet the minimum data requirements specified in the checklist. Efforts were made to include facilities in a variety of regions and climatic conditions. Based on feedback received, the data requirement checklist and/or candidate list was modified and a shortlist of sites developed from the initial pool of candidates. Thereafter, the operators of shortlisted sites were contacted with a formal request for participation in the study. After reviewing responses, a final list of sites was selected.

Data for this study were collected by Geosyntec during 2015 and 2016. Initially, data were requested in electronic format. After reviewing the data received for completeness in relation to the checklist requirements, Geosyntec traveled to the site or regulators' offices to collect additional data needed for the completion of this task. During the data collection process, Geosyntec interviewed site personnel with regard to the nature and frequency of any issues encountered with the cover or LCRS and LDS operation (e.g., repair of cap erosion or replacement of flowmeters).

2.2 Site Data

2.2.1 Site Information

The site information, design details, LCRS and LDS flow data, and chemistry data presented in this study were obtained from engineering drawings, project specifications, as-built records, and/or operation records, supplemented with interviews with facility owner/operators, monitoring personnel, and/or regulatory agencies. Efforts were made to obtain as complete a record of data as possible, from completion of liner construction through the time of data collection. The presentation and structure of the information provided in this study purposefully mirror that of Appendix E in EPA (2002). In this way, this report is intended to serve as a limited extension of that study.

2.2.2 Leachate Flow

The leachate flow data from the LCRS and LDS drainage layers were collected from site records. For all landfills, the daily, weekly, monthly, or yearly data were normalized to gallons per acre per day (gpad) to provide a common unit for comparison of leachate flow for this study. Attempts were made to collect data from the date of unit closure (i.e., "time zero" for PCC) to the current date in order to obtain as complete a timeline of post-closure flow. Average and peak flow data are provided in full in Appendix II.

As described in Chapter 4, flow data were used to evaluate the trends between average LCRS flow rates and average annual rainfall for a given site. Consistent with EPA (2002), which this study seeks to complement, the data were first assessed using a methodology presented by Gross et al. (1990) using LCRS and LDS flow data to evaluate the performance of primary liner in terms of apparent leakage through the primary liner. The basic approach involved the evaluation of relative LDS to LCRS flow rate to quantify the hydraulic performance of primary liner system.

2.2.3 Leachate Chemistry

Leachate chemistry data for both the LCRS and LDS as reported in monthly, quarterly or annual reports were assembled for sites, as available. Data from 30 parameters were sought, where available. For consistency, these parameters mirrored those reported by EPA (2002). Major categories of parameters analyzed in this study included:

- pH;
- Specific conductance and total dissolved solids (TDS);
- Macro-indicators of leachate quality, including chemical oxygen demand (COD), biochemical oxygen demand (BOD), and total organic carbon (TOC);
- Major cations (calcium, magnesium, sodium, and potassium);
- Major anions (chloride, sulfate, and alkalinity);
- Trace metals, including arsenic, cadmium, chromium, lead, nickel; and
- Volatile organic compounds, including benzene, toluene, ethylbenzene, and xylene (BTEX).

The data were used to estimate the time that may be required for concentrations of constituents of interest in leachate to decrease to asymptotic levels during PCC (Section 6.2). As discussed in Section 5.3, leachate chemistry data were also used to quantify the portion of liquids comprising total LDS flow that should be attributable to primary liner leakage as opposed to other sources (i.e., by demonstrating a lack of hydraulic connection between the LCRS and LDS). In some cases, this allowed the apparent liner efficiency to be corrected based on relative concentrations of seven key cations and anions (particularly chloride) as well as selected VOCs in the LCRS and LDS. Similar to the approach in EPA (2002), the presence of chemical constituents in the LDS was evaluated empirically (i.e., the concentrations of chemicals collected in the LDS were directly compared to concentrations of the same chemicals collected in LCRS). No fate and transport analysis were performed to account for attenuation of the LCRS chemicals migrating through the primary liner CCL. However, to minimize the effects of attenuation, the key chemical constituents were selected based on their high solubility in water, low octanol-water coefficient, high resistance to hydrolyzation, and high resistance to anaerobic biodegradation in soil.

The leachate chemistry database is too large and complex to meaningfully summarize here but is presented in full in Appendix III. It is noted that the database is limited in terms of its completeness and the duration of monitoring. Many key leachate constituents are poorly represented in the LCRS dataset (e.g., TDS, COD, and BOD), while LDS chemistry is not monitored at many sites. Further, site operators are only required to keep records for 3 years; as such, many older records are no longer available. If this lack of data exists across all other Subtitle C facilities (i.e., is not unique to the case studies), this represents an important limitation on assessing the long-term performance of Subtitle C containment systems.

2.2.4 Quality Assurance Project Plan

Collection and review of data for this study were performed in accordance with the quality assurance project plan (QAPP) developed for the Work Assignment. The QAPP was developed in accordance with guidance provided in the EPA's National Risk Management Research Laboratory (NRMRL) quality assurance requirements for secondary data projects (EPA, 2008). The QAPP was approved by EPA prior to the initiation of data gathering. The primary focus of the QAPP was to verify that the environmental and related data compiled for reference or use on this project are complete, accurate, and of the type, quantity, and quality required for their intended use.

In compiling information from secondary data sources for this report, every effort was made to identify and select data sources that have undergone peer and public review to varying degrees. Specific elements addressed by the QAPP include identifying the sources of secondary data and rationale for selecting the data sources used, presenting the hierarchy for data sources (Table 2-1), describing the review process and data quality criteria/metrics, discussing quality checks and procedures should errors be identified, and explaining how data will be managed, analyzed, and interpreted.

Table 2-1. Data quality assessment guide for source

Quality Ranking	Source
Highest	Federal, state and local government agencies
Second	Consultant reports for state and local government agencies
Third	Non-governmental organization (NGO) studies, peer-reviewed journal articles, and peer-reviewed conference proceedings
Fourth	Conference proceedings and other trade literature that are not peer-reviewed
Fifth	Individual estimates

With regard to data from the individual case studies presented in Chapter 3 and discussed in Chapters 4 to 6, a key focus of the QAPP was to ensure that the environmental and related data were complete, accurate, and of the type and quality required for their intended use. Potential data sources available for each site were reviewed to identify the level of quality assurance (QA) and quality control (QC) applied during collection and analysis of samples. Significant limitations on the use of data were documented prior to inclusion in this report in an effort to ensure that the data are appropriate for their intended use and representative of site conditions. Although it important to note that specific vetting of individual site data was not possible, data that were officially submitted to federal or state agencies were assumed to represent sources equivalent to the second tier in Table 2-1 (i.e., consultants reports for submission to state agencies or the relevant regulatory authority, for which data have undergone QA and QC procedures consistent with such submissions). These data were prioritized. Where data are included in the report that were received directly from the site operator or their consultants but that had not been officially submitted to the regulator, these sources are considered to represent fifth tier sources in the table. Examples of this category of data include operators' anecdotal recollections regarding the locations and timing of localized cap repairs. Use of such information is limited but included, where useful, to the case study discussions; in all cases, data limitations are clearly identified in the report text. The age of secondary data sources was also considered as a quality criterion per the scheme listed in Table 2-2.

Table 2-2. Data quality assessment guide for timeliness

Quality Ranking	**Source**
Highest	Data from sources dated 2010–2016
Second	Data from sources dated 2005–2009
Third	Data from sources dated 2000–2004
Fourth	Data from sources dated 1999 or prior

3. REVIEW OF CASE STUDY LANDFILLS

3.1 Overview

Nine doubled-lined Subtitle C landfills featuring one or more closed unit were selected as case studies. All data are blinded, with a single-letter alphabetic designation randomly assigned to each site. There are at least two case study sites from each of the four U.S. geographic regions (Figure 3-1). However, this study presents only a very small fraction of the total of over 1,500 hazardous waste sites closed Subtitle C sites nationwide. The nine sites do not represent a statistically significant number of sites to represent Subtitle C sites or to predict performance across different landfill design characteristics or climatic regions.

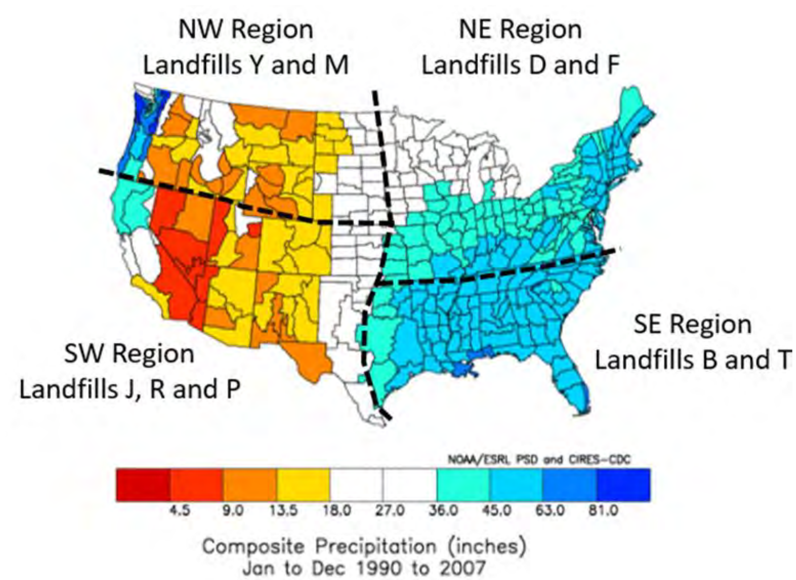


Figure 3-1. Distribution of landfill sites in U.S. geographical regions established for this study

The majority (7 of 9) of sites are commercial facilities that accepted hazardous waste from multiple sources. Two are industrial facilities that accepted waste from a single generator. One site (Landfill M) has a unit that is not formally closed but has been dormant under intermediate soil cover for several years. Facility information, including average annual rainfall, subsurface soil types, and nominal depth to groundwater below ground surface is summarized in Table 3-1. The nominal depth to groundwater affords an understanding of the separation distance between the base of the landfill and the water table, and thus the potential for the direct intersection between the landfill liner system and groundwater.

Table 3-1. General site information

Landfill designation	Geographic region	Average annual rainfall (inches) (1)	Average annual snowfall (inches) (1)	Nominal depth to groundwater (feet)(2)	Subsurface soil type(s)
B	SE	47	--	<5	Claystone
T	SE	70	--	<5	Sandy silt and clay
J	SW	11	--	300	Clays and sandstone
R	SW	6.5	--	250	Sands and clays
P	SW	28	--	40	Clay
Y	NW	10	--	120	Gravelly sands to silty clays
M	NW	9.5	--	200	Clays
D	NE	42	17	10	Clay and gravelly sands
F	NE	40	60	90	Sands to silty loam

Notes:
1). The average annual rainfall and snowfall were computed based on nearest weather station data to the site.
2). The nominal depth to groundwater was based on design and/or groundwater monitoring reports made available by the operator.

Overall, the nine landfills yielded 45 individual double-lined closed units for investigation in this study. A database was developed based on reports made available by the operators that include design information and monitoring data collected at each individual unit. The data collected are summarized in Appendix II:

- General landfill construction information (Table II-1);
- Landfill liner system design details (Table II-2);
- Final cover system design details (Table II-3);
- LCRS and LDS annual average (Tables II-4A-C) and annual peak (Tables II-5A-C) flow, normalized as gallons per acre per day (gpad); and
- LCRS and LDS chemistry data (Table II-6).

Available LCRS and LDS flow and chemistry data are presented in full in Appendices III and IV, respectively.

3.2 General Description of Case Study Facilities

3.2.1 Landfill Construction and Operation

Overall, 45 individual double-lined units at nine separate landfill facilities are included in this study. Individual units at case study landfills ranged in size over an order of magnitude from 1.4 acres to 11.3 acres, although most units were less than 5 acres in area. The oldest units in the study have been closed for over 29 years, while the newest are only 6 years into a PCC program (the study unit at Landfill M is not closed with a final cover, but has been inactive with waste at final grade for 4 years). Individual units featured various LCRS and LDS flow measuring devices (Table II-1). In most cases, liquids in the LCRS and LDS were each drained to a single sump serving the entire unit; however, a few units featured multiple sumps each equipped with individual flow measuring devices. The thickness of waste in place above a liner ranged from 40 feet to 110 feet, although the thickness of waste in most units was in the range of 70 to 80 feet. All liner and cover construction at the study units was performed under a construction quality assurance (CQA) program.

3.2.2 Liner System and Cover System Design

Amongst the 45 case study units, 11 different liner system designs and a further 11 different cover system designs are represented. For discussion in this report, these are combined into 13 unique containment system design configurations featuring commonality through the entire thickness of the unit from cover to liner (Table 3-2).

Table 3-2. Commonality of liner system, LCRS and LDS drainage system, and cover system for different case study design configurations

Design Configuration	Landfill	Sub-group	Number of units	Primary Liner		LCRS		LDS		Cover system				
				Composite (GM/CCL)	Geomembrane	Granular soil(1)	Geosynthetic (GC or GN)	Granular soil(1)	Geosynthetic (GC or GN)	Composite (GM/CCL)	Composite (GM/GCL)	Composite (CCL/GM)	Geomembrane	Soil(1)
1	B	B-1 to B-6	6	✓		✓		✓				✓		
2		B-7 and B-8	2	✓		✓		✓		✓				
3	T	T-1 to T-18	18	✓		✓		✓		✓				
4	J	J-1 to J-3	3	✓		✓		✓	✓				✓	
5	R	R-1	1	✓			✓		✓	✓				
6		R-2 to R-5	4	✓			✓		✓	✓				
7	P	P-1	1		✓		✓		✓	✓				
8		P-2 to P-4	3		✓		✓		✓		✓			
9	Y	Y-1	1		✓	✓		✓			✓			
10		Y-2 and Y-3	2		✓	✓		✓	✓		✓			
11	M	M-1	1	✓		✓	✓		✓					✓
12	D	D-1 and D-2	2		✓		✓		✓		✓			
13	F	F-1	1		✓		✓		✓		✓			
TOTAL			**45**	**35**	**10**	**32**	**13**	**27**	**18**	**27**	**8**	**6**	**3**	**1**

Note 1). The granular soil is either coarse sand or gravel, Soil is general fill.

Inspection of Table 3-2 reveals the following commonalities and differences in containment system design traits amongst the case study units:

- Liner system: Most of the study units had a GM/CCL composite primary liner system (80%), with seven design configurations (1−6 plus 11) featuring this liner design. A single geomembrane primary liner was featured in 20% of study units (configurations 7−

10 and 12−13). No case study units were constructed having a GM/GCL composite primary liner, although one site (Landfill D) utilizes a GCL in the secondary liner.

- LCRS: Six design configurations (1−4 and 9−10), comprising 80% of the study units, had 12 inches of sand as the LCRS drainage layer while the other seven configurations (comprising 20% of study units) had a geocomposite (GC) or geonet (GN) drainage layer.
- LDS: A 12-inch sand drainage layer was in 60% of the study units (four design configurations, 1−3 and 9), while the remaining 40% (representing nine configurations) had a GC or GN drainage layer.
- Cover system: A GM/CCL composite cover design was used for 59% of the study units (six design configurations), while 18% (four configurations) were constructed having a GM/GCL composite cover system. Six study units (14% of the total, all design configuration 1 at Landfill B) were constructed in reverse with a CCL/GM cap. Two special-case cover design types exist:
    - Landfill J had an MSW overfill landfill constructed above it and thus its cover system acts as the liner system for the overlying landfill (design type 4), and
    - Landfill M currently has intermediate cover soil in place (design type 11) although the approved final cover design is an all-soil evapotranspiration cover system.

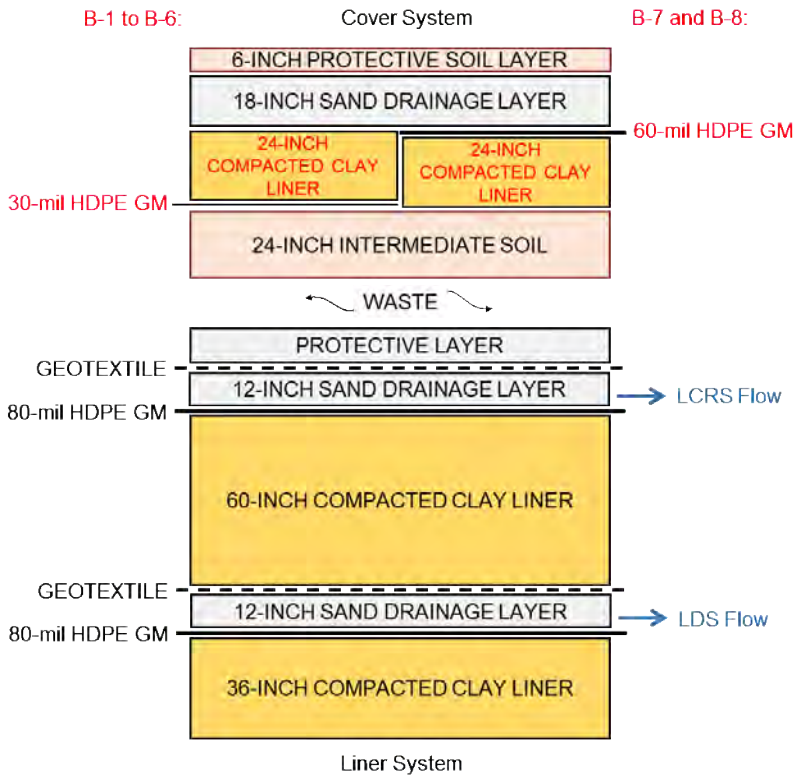
Landfill B

The site is located in the SE region and is fully closed with no active receipt of waste for treatment, storage, or disposal. The mean annual precipitation at the site is 47 inches with minimal depth to groundwater. The subsurface soil mainly consists of claystone with a few sand lenses. The eight study units at this landfill (B-1 to B-8) vary in size from 3.7 to 8.8 acres. Waste thicknesses above the liner range from about 45 feet to 110 feet (average 75 feet).

The liner and cover system details are as follows:

- Primary Liner (all): 80-mil HDPE GM overlying a 60-in CCL
- LCRS Drainage Layer (all): GT overlying a 12-in thick sand layer
- Secondary Liner (all): 80-mil HDPE GM overlying a 36-in CCL
- LDS Drainage Layer (all): GT overlying a 12-in thick sand layer
- Cover (B-1 to B-6): 24-in CCL overlying a 30-mil HDPE GM
- Cover (B-7 and B-8): 60-mil HDPE GM overlying a 24-in CCL
- Cover Drainage/Protective Layers (all): 18-in sand layer underlying 6-in protective soil

Note that the typical composite barrier configuration (geomembrane overlying soil layer) is reversed in the cover system for units B-1 to B-6, where the GM is placed under the CCL. This has important ramifications on cover system performance and leachate flow as discussed in Chapter 4. The configurations of the liner and cover systems for units at Landfill B are shown in Figure 3-2.



This cross-section corresponds with Configuration Nos. 1 and 2 in Table 3-2.
Notice the two different cover designs used at the site: variations are highlighted in red.

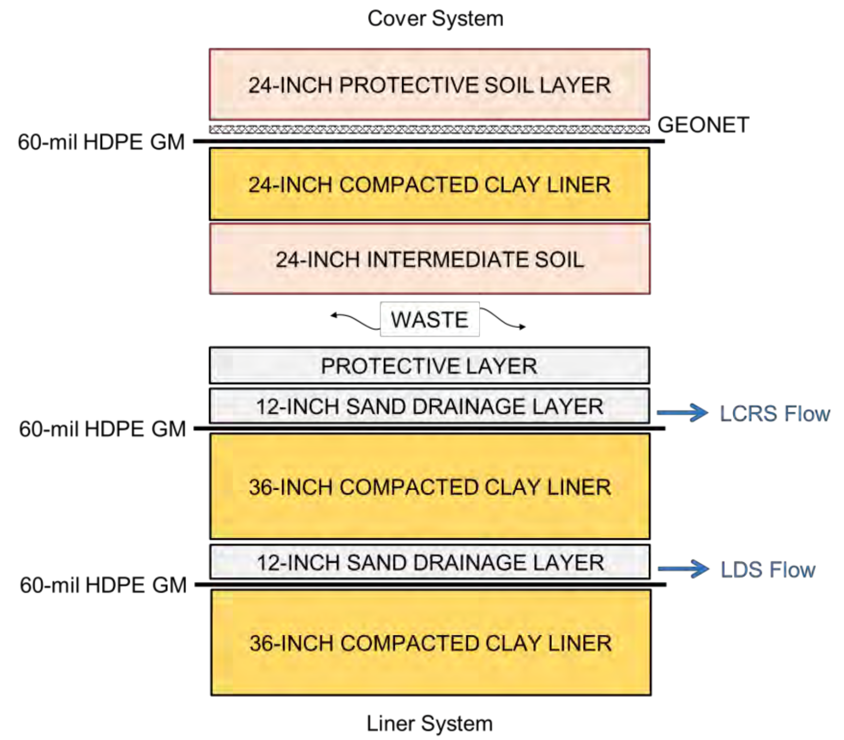
Figure 3-2. Liner and cover system cross-sections for Landfill B

Landfill T

The site is located in the SE region and is currently operational (i.e., some active units are accepting waste). The mean annual precipitation at the site is 70 inches with minimal depth to groundwater below ground level, which implies that groundwater is in contact with the liner system. The subsurface soil mainly consists of sandy silt and clay. Eighteen closed units (T-1 to T-18) are part of this study.

The closed units at Landfill T range in size from 1.4 to 4.2 acres with a waste thickness of 70 to 80 feet. All units have the same liner and cover system design, details of which are as follows (Figure 3-3):

- Primary Liner: 60-mil HDPE GM overlying a 36-in CCL
- LCRS Drainage Layer: 12-in thick sand layer overlain by 12-in protective soil layer with permeability greater than 1×10^{-2} cm/s
- Secondary Liner: 60-mil HDPE GM overlying a 36-in CCL
- LDS Drainage Layer: 12-in thick sand layer
- Cover: 60-mil HDPE GM overlying a 24-in CCL
- Cover Drainage/Protective Layers: GN underlying 24-in protective soil



This cross-section corresponds with Configuration No. 3 in Table 3-2.

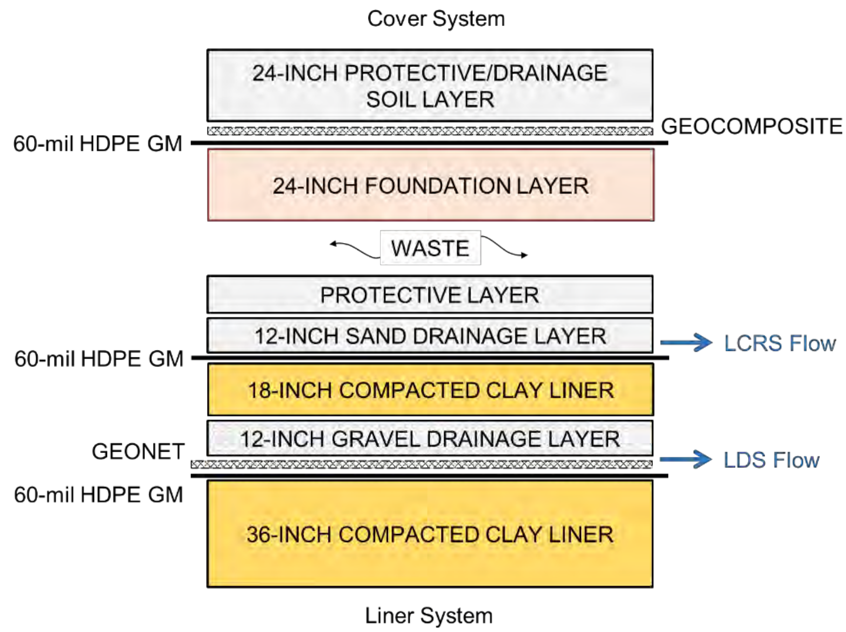
Figure 3-3. Liner and cover system cross-sections for Landfill T

Landfill J

This site is located in the SW region and is currently operational. The region is arid, with mean annual precipitation at the site only 11 inches. The depth to groundwater is 300 feet. Subsurface soils mainly consist of clay and sandstone. Three conjoined landfill units (J-1 to J-3) comprise a single closed landfill unit that is part of this study. These units have an MSW overfill landfill constructed above them such that the liner system for the overlying MSW landfill system is integrated with the cover system for Landfill J. The three units are all about 10 acres in area with waste thickness above the liner of 90 feet.

All units have same liner and cover system design, details of which are as follows (Figure 3-4):

- Primary Liner: 60-mil HDPE GM overlying an 18-in CCL
- LCRS Drainage Layer: 12-in thick sand layer overlain by 24-in soil layer with geotextile
- Secondary Liner: 60-mil HDPE GM overlying a 36-in CCL
- LDS Drainage Layer: 12-in thick gravel layer overlying a GN
- Cover: 60-mil HDPE GM overlying a 24-in foundation layer
- Cover Drainage/Protective Layers: GC underlying 24-in protective/drainage soil layer which also acts as LCRS for an overlying MSW cell



This cross-section corresponds with Configuration No. 4 in Table 3-2.

Figure 3-4. Liner and cover system cross-sections for Landfill J

Landfill R

The site is located in the SW region and is currently operational. The site is located in an arid region with mean annual precipitation at the site of 6.5 inches and depth to groundwater of 250 feet. The subsurface soils mainly consist of sand and clay. Five landfill units (R-1 to R-5) are part of this study. The units vary in size from 5.0 to 7.6 acres with the maximum thickness of waste in R-1 being about 70 feet and in R-2 to R-5 being about 100 feet. All units have a similar cover system; however, R-1 has a different liner system design to the other units.

The liner and cover system details are as follows (Figure 3-5):

- Primary Liner (R-1): 40-mil PVC GM overlying a 36-in CCL
- Primary Liner (R-2 to R-5): 80-mil HDPE GM overlying a 36-in CCL
- LCRS Drainage Layer (R-1): GN overlay by 18-in thick protective soil layer
- LCRS Drainage Layer (R-2 to R-5): GC
- Secondary Liner (R-1): 40-mil PVC GM overlying a 36-in CCL
- Secondary Liner (R-2 to R-5): 80-mil HDPE GM overlying a 36-in CCL
- LDS Drainage Layer (R-1): GN
- LDS Drainage Layer (R-2 to R-5): GC
- Cover (all): 80-mil HDPE GM overlying a 24-in CCL
- Cover Drainage/Protective Layers (all): GT underlying 24-in protective soil

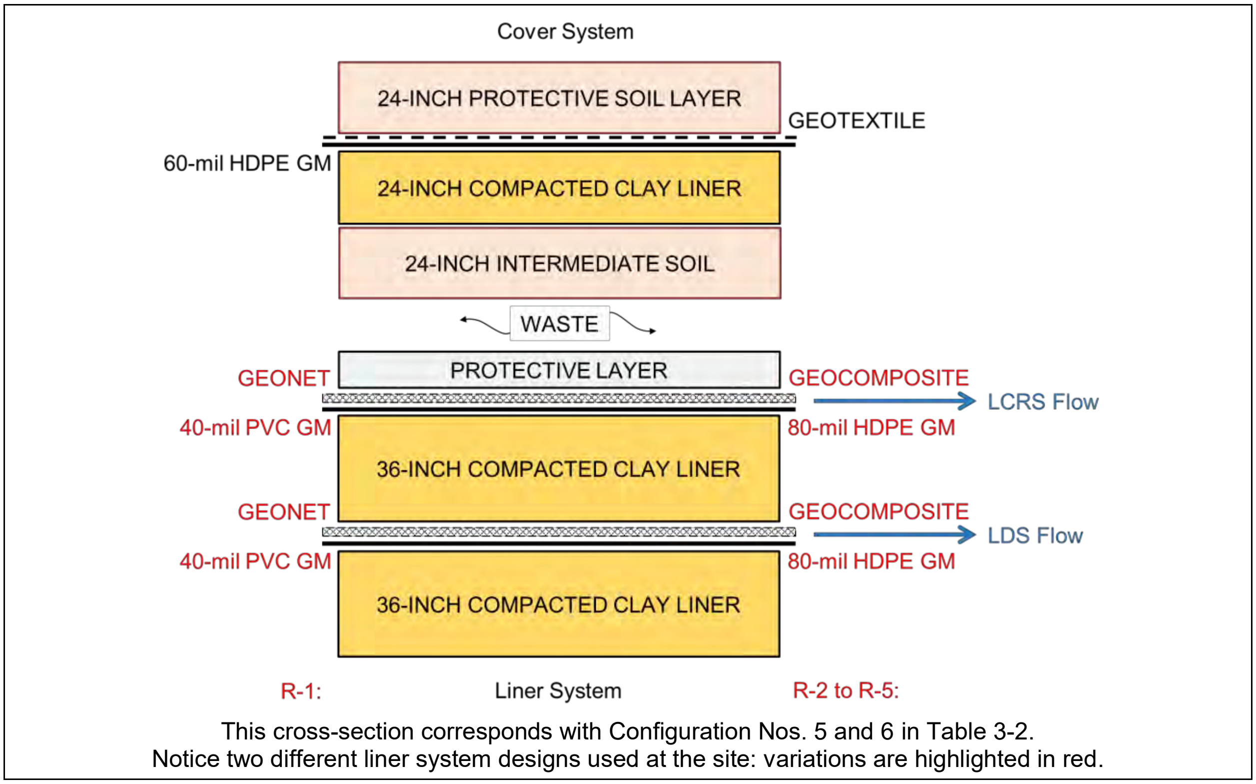


Figure 3-5. Liner and cover system cross-sections for Landfill R

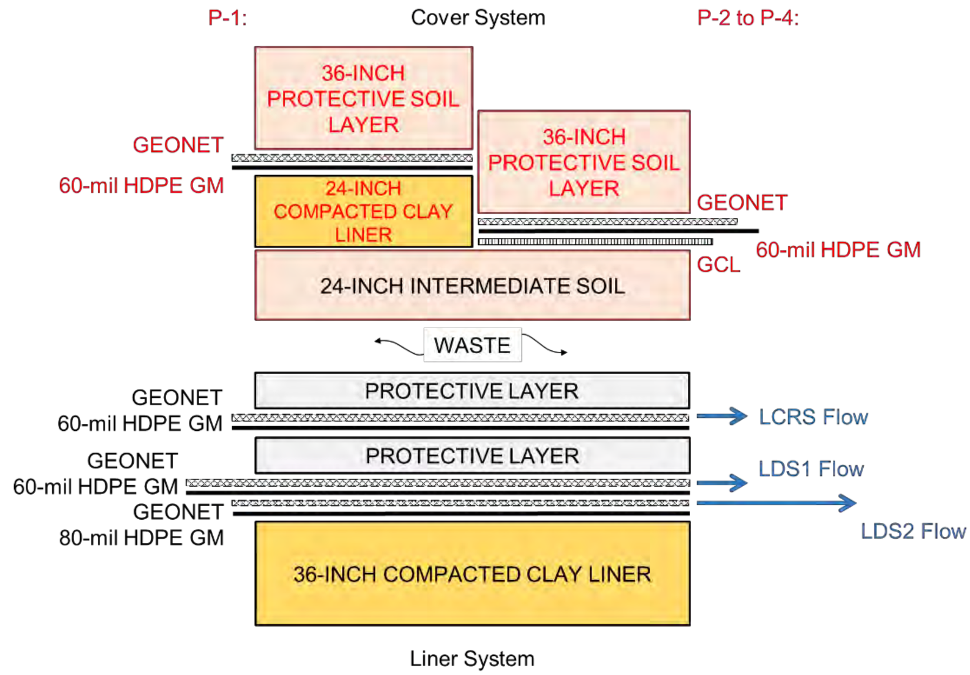
Landfill P

The site is located in the SW region and is currently operational. The mean annual precipitation at the site is 28 inches and the average depth to groundwater is 40 feet below ground level. The subsurface soil mainly consists of clay. Four landfill units (P-1 to P-4) are part of this study, each with an area of 10 acres and a maximum thickness of waste above the liner of 42 feet.

The liner and cover system details are as follows (Figure 3-6):

- Primary Liner (all): 60-mil HDPE GM
- LCRS Drainage Layer (all): GN overlain by 24-in protective cover layer
- Secondary Liner (all): 80-mil HDPE GM overlying a 36-in CCL
- Lower LDS Drainage Layer (all): GN overlain by intermediate liner (60-mil HDPE GM)
- Upper LDS Drainage Layer (all): GN overlain by 24-in. the protective layer and underlain by intermediate liner
- Cover (P-1): 60-mil HDPE GM overlying a 24-in CCL
- Cover (P-2 to P-4): 60-mil HDPE GM overlying a GCL
- Cover Drainage/Protective Layers (all): GN underlying 36-in protective soil

This site is unique in that it has an intermediate liner system situated between the primary and secondary liners with an overlying GN drainage layer providing separate recovery and recording of liquid flows. For ease of identification on the figure and throughout this report, the upper LDS drainage layer is denoted "LDS1" while the lower LDS drainage layer in denoted "LDS2." In terms of assessing the performance of the primary liner, the sum of flows in LDS1 and LDS2 is used to compare to flow in the LCRS.



This cross-section corresponds with Configuration Nos. 7 and 8 in Table 3-2.
Notice two different cover system designs used at the site: variations are highlighted in red.

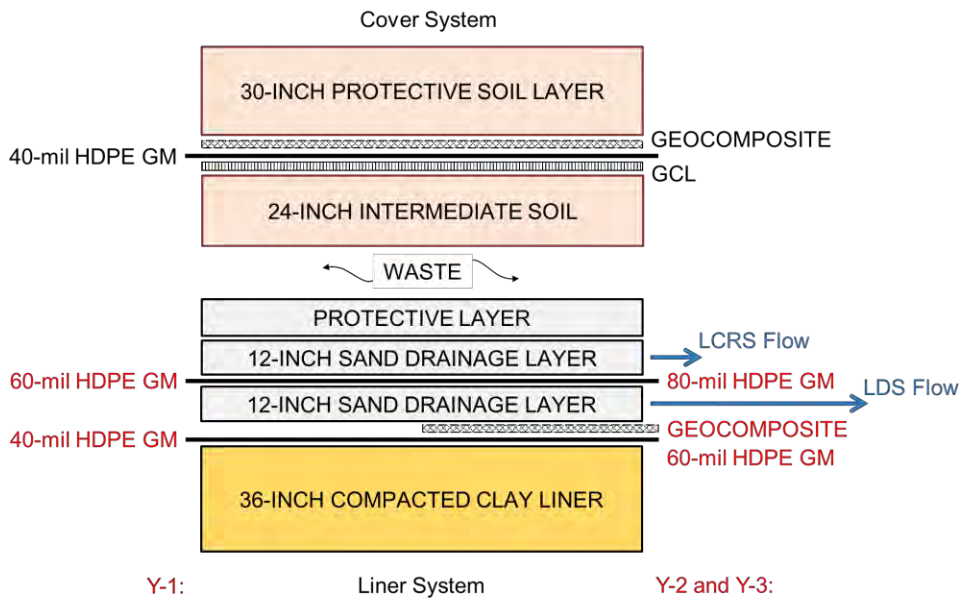
Figure 3-6. Liner and cover system cross-sections for Landfill P

Landfill Y

The site is located in the NW region and is currently operational. Mean annual precipitation at the site is 10 inches and depth to groundwater is 120 feet below ground level. Subsurface soils mainly consist of gravelly sand and silty clay. Three landfill units (Y-1 to Y-3) are part of this study, all of which have similar dimensions with an average area of 1.75 acres and maximum waste thickness of about 55 feet. All units have the same cover system; however, Y-1 has a different liner system from the other two units. The liner and cover system details are as follows (Figure 3-7):

- Primary Liner (Y-1): 60-mil HDPE GM
- Primary Liner (Y-2 and Y-3): 80-mil HDPE GM
- LCRS Drainage Layer (all): 12-in thick sand layer overlain by 6-in soil layer with geotextile
- Secondary Liner (Y-1): 40-mil HDPE GM overlying a 36-in CCL
- Secondary Liner (Y-2 and Y-3): 60-mil HDPE GM overlying a 36-in CCL

- LDS Drainage Layer (Y-1): 12-in thick sand layer
- LDS Drainage Layer (Y-2 and Y-3): 12-in thick sand layer overlying a GC
- Cover (all): 40-mil HDPE GM overlying a GCL
- Cover Drainage/Protective Layers (all): GC underlying 30-in protective soil



This cross-section corresponds with Configuration Nos. 9 and 10 in Table 3-2.
Notice two different liner system designs used at the site: variations are highlighted in red.

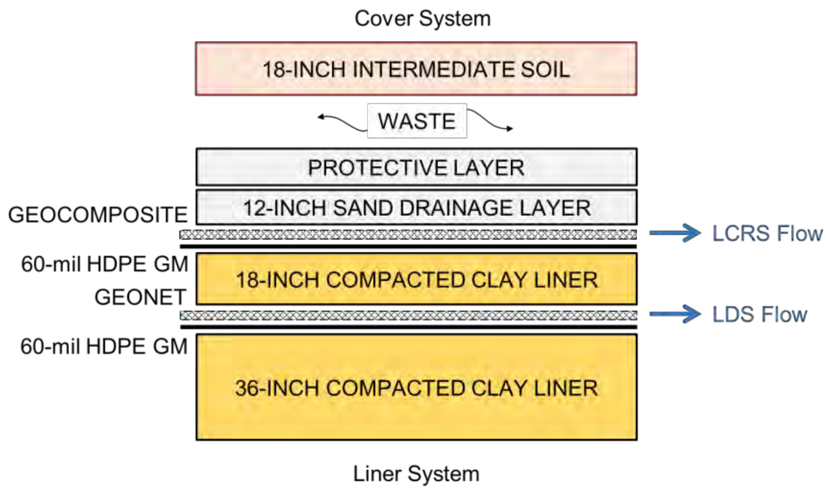
Figure 3-7. Liner and cover system cross-sections for Landfill Y

Landfill M

The site is located in the NW region and is currently operational. The mean annual precipitation at the site is 9.5 inches and depth to groundwater is 100 feet below ground level. The subsurface soil mainly consists of clay. A single landfill unit (M-1) is included in this study. The unit has an area of 9 acres with a maximum thickness of waste of 110 feet. The liner and cover system details for Landfill M are as follows (Figure 3-8):

- Primary Liner: 60-mil HDPE GM overlying an 18-in CCL
- LCRS Drainage Layer: 12-in thick sand layer with a GC overlain by 12-inch surface course material as a protective layer
- Secondary Liner: 60-mil HDPE GM overlying a 36-in CCL
- LDS Drainage Layer: GN
- Cover: Intermediate cover only, comprising 18-in select soil layer

The approved final cover design for the landfill consists of an evapotranspiration cover comprising a 3-foot soil layer. The waste in M-1 has been at final grades with the intermediate cover in place for 4 years.



This cross-section corresponds with Configuration No. 11 in Table 3-2.

Figure 3-8. Liner and cover system cross-sections for Landfill M

Landfill D

Landfill D is located in the NE region and comprises an on-site disposal cell (OSDC) for hazardous waste generated from the closure of an industrial facility. The mean annual precipitation at the site is 40 inches (annual average snowfall is 17 inches) and groundwater is shallow at only 10 feet below ground level. The subsurface soils mainly consist of sands to silty loam. Two units (D-1 and D-2) are part of this study, D-1 having an area of 3.2 acres and D-2 an area of 5.8 acres. The maximum thickness of waste is 50 feet.

The liner and cover system details are identical for both units (Figure 3-9):

- Primary Liner: 60-mil HDPE GM
- LCRS Drainage Layer: GC overlain by 12-in protective soil layer with permeability greater than 1×10^{-3} cm/s
- Secondary Liner: 60-mil HDPE GM overlying a GCL above a 12-in foundation layer
- LDS Drainage Layer: GC
- Cover: 40-mil LLDPE GM overlying a GCL
- Cover Drainage/Protective Layers: GC underlying 24-in protective soil

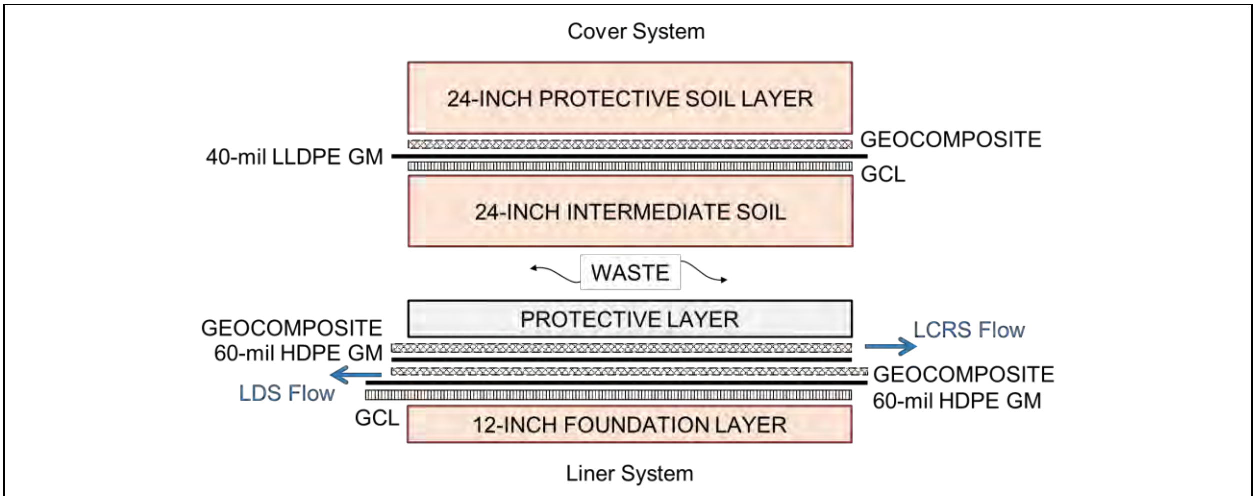


Figure 3-9. Liner and cover system cross-sections for Landfill D

Landfill F

The site is located in the NE region and is used for disposal of hazardous waste generated at an operational industrial facility. The mean annual precipitation at the site is 40 inches (annual average snowfall is 60 inches) and the average depth to groundwater is 90 feet below the ground surface. Subsurface soils mainly consist of sands to silty loam. A single landfill unit (F-1) is included in this study, with a liner area of 6 acres and a maximum thickness of waste of 50 feet.

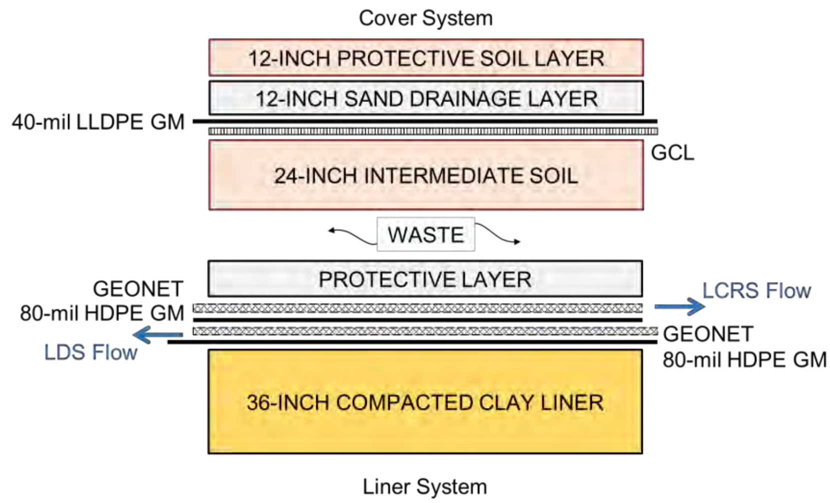
The liner and cover system details (Figure 3-10) for F-1 are as follows:

- Primary Liner: 80-mil HDPE GM
- LCRS Drainage Layer: GN
- Secondary Liner: 80-mil HDPE GM overlying 36-in CCL
- LDS Drainage Layer: GN
- Cover: 40-mil LLDPE GM overlying a GCL
- Cover Drainage/Protective Layers: 12-in sand layer underlying 12-in protective soil

3.3 Post-Closure Monitoring and Maintenance

3.3.1 Leachate Management

The LCRS and LDS from each landfill unit drain to low points (i.e., sumps) on the primary and secondary liners, respectively, from where liquids are removed using pumps and side slope risers. Dedicated LCRS and LDS sumps are isolated from each other. The volume of liquids collected in each sump is recorded using a variety of devices, including automated accumulating flowmeters or periodic pumping based on liquid height exceeding an action threshold. To be included in the study, liquid flows in the LCRS and LDS had to be measured



This cross-section corresponds with Configuration No. 13 in Table 3-2.

Figure 3-10. Liner and cover system cross-sections for Landfill F

individually per landfill unit. In most cases, each landfill unit featured only one LCRS and LDS sump. Where a landfill unit had more than one sump, data were combined to represent total flow in the LCRS/LDS.

Leachate Flow

Leachate flow data from the LCRS and LDS drainage layers were collected from operators' site records. These were provided in the same format in which they are submitted in reports to regulators, and are assumed to have undergone QA and QC checks consistent with such submissions. The leachate flow database is included as Appendix III.

For each landfill unit, the daily, weekly, monthly, or yearly data were normalized to annual average and peak flow in terms of gallons per acre per day (gpad) to provide a common unit for comparison of leachate flow for this study. Attempts were made to collect data from the date of closure (i.e., time zero for PCC) through to the current time in order to obtain a complete timeline of post-closure flow from each unit. Average and peak flow data along with the sampling frequency and a total number of data points available from each unit are summarized in Tables II-4 and II-5 in Appendix II.

As described in Chapters 4 and 5, flow data were used to evaluate trends between average LCRS flow rates and average annual rainfall for a given site. Consistent with EPA (2002), which this study seeks to complement, the LCRS and LDS data were also comparatively assessed to evaluate the hydraulic performance of the primary liner in terms of apparent leakage.

Leachate Chemistry

Leachate chemistry data for both the LCRS and LDS as reported in monthly, quarterly or annual reports were assembled from operators' site records, as available. Data from 30 parameters were sought, where available; these parameters mirrored those reported by EPA (2002). Major categories of parameters targeted in this study included:

- pH;
- Specific conductance and TDS;
- Macro-indicators of leachate quality, including COD, BOD, and TOC;
- Major cations (calcium, magnesium, sodium, and potassium);
- Major anions (chloride, sulfate, and alkalinity);
- Trace metals, including arsenic, cadmium, chromium, lead, nickel; and
- Volatile organic compounds, including BTEX.

Leachate chemistry data from the LCRS and LDS drainage layers were collected from operators' site records. These were provided in the same format in which they are submitted in reports to regulators or to meet influent monitoring requirements of wastewater treatment facilities, and are assumed to have undergone QA and QC checks consistent with such submissions. The leachate chemistry database is too large and complex to meaningfully summarize in this report; however, the availability of leachate chemistry at each of the nine case study landfills is provided as Table II-7 in Appendix II, with the full database included as Appendix IV. Leachate data are discussed in Section 5.1 in the context of correcting apparent liner efficiency calculations and in Section 6.2 in terms of temporal trends observed in leachate quality parameters. Where possible, the latter serves to estimate the time that may be required for concentrations of constituents of interest in leachate to decrease to asymptotic levels during PCC.

It is noted that the leachate chemistry database is limited in terms of its completeness and the duration of monitoring although it is important to acknowledge that "completeness" in this context refers to the availability of the full suite of 30 parameters targeted in this study and not to data requirements specified for compliance. Many targeted leachate constituents are poorly represented in the LCRS dataset, while LDS chemistry is not monitored at all at many sites. In the latter case, it is noted that three sites (Landfills R, Y, and M) have zero flow in the LDS, which negates the ability to collect samples for analysis. In the context of this data assessment, therefore, this should not be construed as a data gap. An issue of importance identified in the process of collecting leachate chemistry data for this study is that many site operators reported only being required to keep records for 3 years, so older data are no longer available. As there are no specific requirements for monitoring and retaining records of leachate quality under 40 CFR 264, this may reflect state-specific rules or site-specific agreements with receiving facilities for leachate treatment and disposal. Whatever the reason, if this lack of data at the case study landfills is representative of the majority of Subtitle C facilities, it will be an important limitation on assessing the long-term performance of Subtitle C containment systems and potential modifications to existing PCC programs.

Leachate Treatment and Disposal

The manner in which leachate from the case study landfills is treated and disposed of varies between the sites. For example:

- At Landfills B and P, leachate collected from the closed units is processed at an on-site leachate treatment plant that evaporates most of the effluent. The brine residuals from the evaporation process are sent off-site for incineration or disposal.
- Landfill J uses one of three options to dispose of leachate depending on constituents determined from chemical analysis of leachate, including evaporation in on-site ponds, stabilization prior to being disposed of in the landfill, or off-site transfer for treatment (VOC removal) and disposal.
- At Landfills R, T, and F, leachate is transported off-site for treatment and disposal.
- At Landfill D, leachate collected from D-1 is managed at an on-site water treatment plant, while leachate from D-2 is shipped off-site for disposal.
- Landfills Y and M dispose of leachate on-site using evaporation ponds, although some leachate is also sent to a wastewater treatment plant.

It is noted that only anecdotal information from site operators was provided with regard to compiling the above list. Operators did not complain of any significant problems related to leachate treatment and disposal. The strong focus on containment and reducing leachate flow volumes is likely a contributing factor. Operators interviewed for this study indicated that actual leachate disposal costs were generally in line with expectations.

3.3.2 Cover Monitoring and Maintenance

As part of this study, a small number of site operators were informally interviewed regarding site-specific conditions and the extent of cover monitoring and maintenance activities being conducted. In particular, whether the level of maintenance has increased or decreased noticeably over time, what the greatest challenges have been (e.g., extreme weather events) in maintaining and monitoring the containment systems, and noticeable trends in the type of recurring issues and whether these can be directly related to causal effects (e.g., leakage/scouring around the boot between cap geosynthetics and headwalls at stormwater drainage swales at the anchor trench, erosion and infiltration around appurtenances in the cover).

This small number of operators indicated that the general level of cover monitoring and maintenance performed and the costs associated with these activities had been relatively steady over the years, with higher costs associated with repairs needed during the initial years of PCC before cover vegetation was fully established and the cover stabilized. The biggest reported challenge has been erosion control and protection of the cover specifically due to high rainfall following a long spell of dry weather. This led one operator to focus on the timely and effective seeding of newer caps and to limit side slopes to 3H:1V to help prevent erosion issues. Cover penetrations at Subtitle C landfills are generally more limited than at Subtitle D landfills, as it is often not necessary to install LFG collection wells. Most penetrations were for vertical riser pipes at LCRS and LDS sumps. Maintenance and localized repair of these penetrations were not reported as being a significant issue. The low levels of biodegradable material disposed of within Subtitle C landfills relative to Subtitle D landfills also limit issues with the differential settlement of the cover.

3.3.3 General Status of Post-Closure Care

As part of this study, a small number of site operators were informally interviewed regarding the general status of the closed units at their facility and monitoring and maintenance conducted under the PCC program. Questions posed included whether progress has been made in improving the stability of the cover system, what the costs associated with PCC have been and how these compare with expectations, what their anticipation is for the total duration of PCC, and whether any steps have been employed or considered for implementing any sort of passive control systems that could potentially reduce the long-term PCC burden (e.g., alternative covers or on-site engineered wetlands). Operators were also asked about the adequacy of financial assurance (FA) requirements for PCC. Finally, operators were asked what challenges to innovation and creativity they face with regard to optimizing PCC, and how EPA could help incentivize action in this area.

Responses from operators are summarized below. It is noted that the information provided below is subjective in nature and should be taken as such:

- Closed units at the case study sites have mostly performed well during PCC with steady leachate generation rates in line with modeled predictions. Where significant deviations from expected flow rates have occurred, these have been traced to minor issues with the containment system, notably the anchor trench tie-in between the liner and cover systems that, once repaired, have rapidly returned to the expected level. Leachate chemistry has not deviated from acceptance criteria for treatment and disposal, such that leachate management has not been an issue or represented a higher-than-expected cost.
- Non-routine operation and maintenance (O&M) issues were mostly related to equipment repair and replacement due to clogging of pumps and flow meters. The latter is

particularly important as it has caused a number of sites concerns about apparently high or fluctuating leachate generation rates that were ultimately traced to faulty meters.

- The highest costs (or at least, most notably high costs from the perspective of operators) are related to PCC activities associated with a third-party engineer providing routine facility inspections and technicians conducting groundwater monitoring in the preparation of reports to be submitted to the overseeing agency. One operator opined that climate change has seemingly caused wider seasonal fluctuations in groundwater levels in recent years relative to historical data, but that has not significantly impacted the provision of PCC at the site to date.
- Most operators appear to assume that PCC will be conducted for 30 years with monitoring and maintenance activities being progressively reduced or scaled back based on facility performance before eventually being terminated. It is not clear whether the expectation is that the 30-year period applies to the time until the scaling back of activities would commence or the time at which activities will be terminated.
- In general, operators consider their FA provisions to be adequate for the assumed PCC program at the site but understand that the funds cannot last in perpetuity. As such, they suggested that some certainty or guidance on the process for scaling back and elimination of PCC activities is needed. Also, some operators noted that original FA estimates were done 20+ years ago and that adjustment factors for increases in costs and the complexity of PCC activities (e.g., as a result of improved analytical techniques and survey methods) may be needed.
- In general, operators have looked to remain with the prescriptive standards for design and operation of Subtitle C landfills. This is likely in the interest of improving cost certainty, as the perception is that alternative designs are riskier. Nevertheless, one operator is evaluating on-site leachate treatment using novel biological treatment technologies, and two operators are trying to permit an all-soil evapotranspiration (ET) final cover. It is noted that one case study site (Landfill M) already has an ET cover permitted.
- With regard to incentives that EPA could provide, one operator called for the option of recirculating leachate collected from closed units at their facility into active units. Another operator would like EPA to provide guidance on permitting ET covers at hazardous waste landfills and to provide guidance on how to scale back and end PCC activities based on an assessment of performance data.

4. ANALYSIS OF LEACHATE FLOW DATA

4.1 Temporal Trends in Leachate Flow Rates in the LCRS and LDS

This section focuses on understanding temporal trends in LCRS and LDS flow data. All the landfill units in the study were operated with the strategy of liquid removal from both LCRS and LDS in order to minimize potential head buildup and leakage through the primary and secondary liners. In accordance with 40 CFR §264.301(a)(2), the buildup of hydraulic head on the primary liner must be limited to less than 12 inches. Throughout this chapter, LCRS and LDS flows are normalized to gallons per acre per day (gpad) to facilitate comparison of results between different sites. Because the potential for leachate generation is closely tied to precipitation levels, the distinction is made between sites in "wet" climates, at which average annual precipitation exceeds 25 inches and "dry" sites at which average annual precipitation falls well below this level. Use of 25 inches of annual rainfall as the distinction between wet and dry landfill conditions is consistent with the EPA's approach to assigning decay factors for methane generation modeling at Subtitle D landfills (EPA, 1995). As such, the discussion is grouped between four wet sites (Landfills B, T, D, and F), four dry sites (Landfills J, R, Y, and M), and one in-between (cusp) site with unique liner design (Landfill P). Within each category, data are presented for groups of units comprising each of the 13 design configurations listed in Table 3-2.

4.1.1 Wet Sites – Landfills B, T, D, and F

Landfill B receives an average of 47 inches of rainfall annually while Landfill T receives an average of 70 inches. Both Landfills B and T are in hot and wet climates with groundwater at or near the ground surface. The climate at Landfills D and F is also wet but colder: these landfills receive 42 and 40 inches of average annual rainfall and 17 and 60 inches of average annual snowfall, respectively. Groundwater is shallow at Landfill D (10 feet) and deep at Landfill F (90 feet).

Landfill B, Units B-1 to B-6 (Design Configuration No. 1)

Available leachate data for these units includes monthly LCRS and LDS flow volumes for up to 29 years of PCC (Figure 4-1, note the difference in y-axis scale between the two graphs).

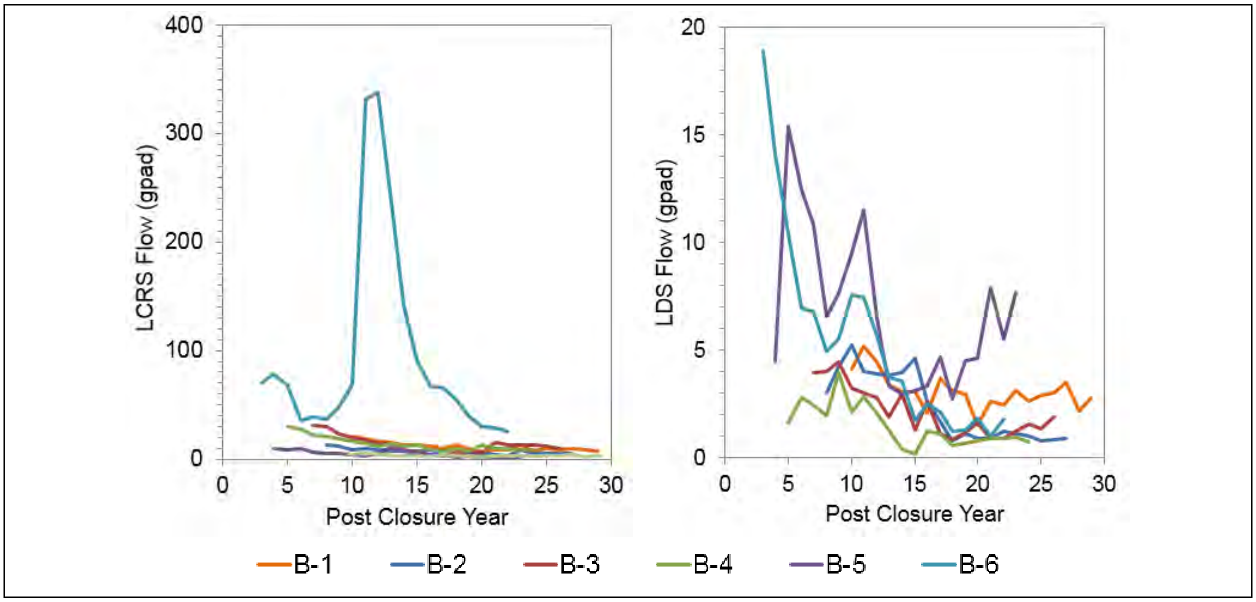


Figure 4-1. Annual average LCRS and LDS flow, B-1 to B-6

Of interest to this design is the fact that the typical composite barrier configuration (geomembrane overlying soil layer) is reversed in the cover system for units B-1 to B-6, where the GM is placed under the CCL. With the exception of B-6, LCRS flow rates for all units are below 100 gpad, with most below 10 gpad. Trends have been predictably downward or steady. Unit B-6 is not contiguous with B-1 through B-5 but forms part of a separate landfill mound with units B-7 and B-8. The sudden spike in LCRS flow in B-6 after 10 years was mainly attributed by the site operator to overtopping of an operational berm in B-8. In support of this, after the berm was repaired the LCRS flow rate in B-6 has trended down to similar levels recorded for the other five units.

Flow rates recorded in the LDS appear more erratic than in the LCRS, although this may simply reflect the low volumes of liquids recovered in the LDS. This behavior is most notable in B-5, although no specific causal factors were identified. With the exception of B-5, trends are steady or declining with most units exhibiting LDS flow below 5 gpad in recent years.

Landfill B, Units B-7 and B-8 (Design Configuration No. 2)

Available leachate data for these two units includes monthly LCRS and LDS flow volumes for up to 17 years of PCC. Annual average LCRS and LDS flow rates are presented in Figure 4-2 (note the difference in y-axis scale between the two graphs). As noted above, units B-7 and B-8 form part of a separate landfill mound to the other six closed units at Landfill B.

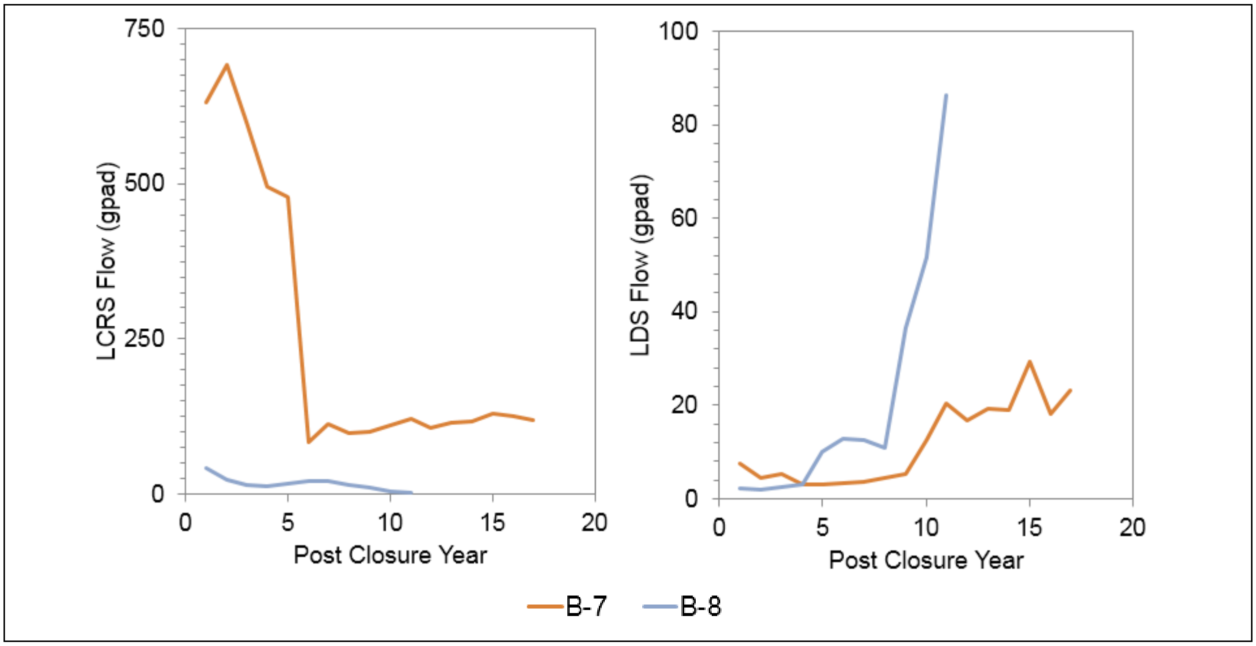


Figure 4-2. Annual average LCRS and LDS flow, B-7 and B-8

LCRS flow in B-8 is very low, trending downwards while the LDS flow rate exceeds that of the LCRS and is trending upward to 100 gpad. The LCRS flow rate in B-7 has decreased significantly since the closure of the unit and is relatively steady at a value of about 100 gpad. The LDS flow is increasing and currently is about 20 gpad.

Landfill T (Design Configuration No. 3)

Available leachate data for Landfill T in the PCC period includes annual total LCRS and LDS flow volumes for up to 7 years in T-1 to T-6 and daily flow volumes for T-7 to T-18 for years 10 through 23 of PCC. Earlier records for T-7 through T-18 are not available. Annual average LCRS and LDS flow rates for the 18 units are presented in Figure 4-3 (note the difference in y-axis scale between the two graphs). LCRS flow rates are generally below 100 gpad, with some units below 10 gpad; however, trending behavior is difficult to visualize in most cases. T-16 exhibited an increase in LCRS flow rate between years 7 and 16 of PCC that the site operator made several attempts at addressing with partial success (as denoted by the "saw tooth" shape of the graph during this period) and was finally able to trace to a localized cover system breach. The cover was repaired in year 16, which resulted in rapid reduction in LCRS flow to rates similar to other units.

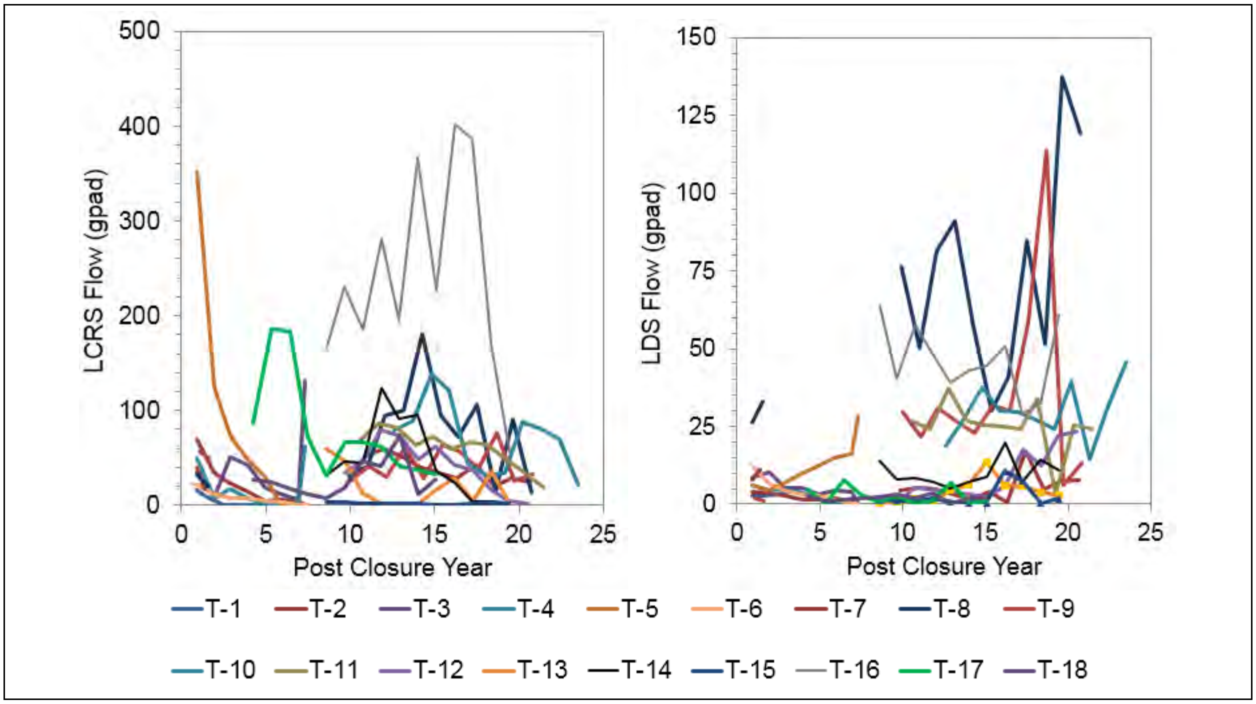


Figure 4-3. Annual average LCRS and LDS flow, Landfill T

As with LCRS flow data, steady or downward trends in LDS flow are not easy to visualize. Although LDS flow rates for T-1 to T-6 are below 10 gpad (with the exception of T-5), the LDS flow rates for T-7 to T-18 are significantly higher, similar in many cases to LCRS flow rates. This may be due to the shallow groundwater table at this site or lateral infiltration of stormwater runoff as detailed in Section 5 (Landfill T experiences an average of 70 inches of rain annually, the highest rainfall of any of the case study sites).

Landfill D (Design Configuration No. 12)

Available leachate data for Landfill D includes monthly LCRS and LDS flow volumes for two units D-1 and D-2, which have been closed for 7 and 9 years, respectively. The annual average LCRS and LDS flow rate for both units are presented in Figure 4-4. LCRS flow volumes in both units decreased rapidly from pre-closure levels and remained in a relatively steady state of decline since placement of the cover system. The climate at Landfill D is reasonably wet at 42 inches of average annual rainfall; however, of additional interest is the average annual snowfall of 17 inches at the site. Gradual melting of snow accumulated on the cover surface in spring has been reported as a significant factor influencing higher-than-expected leachate generation at landfills during the operational period; however, this does not appear to have influenced leachate rates during post-closure case at Landfill D.

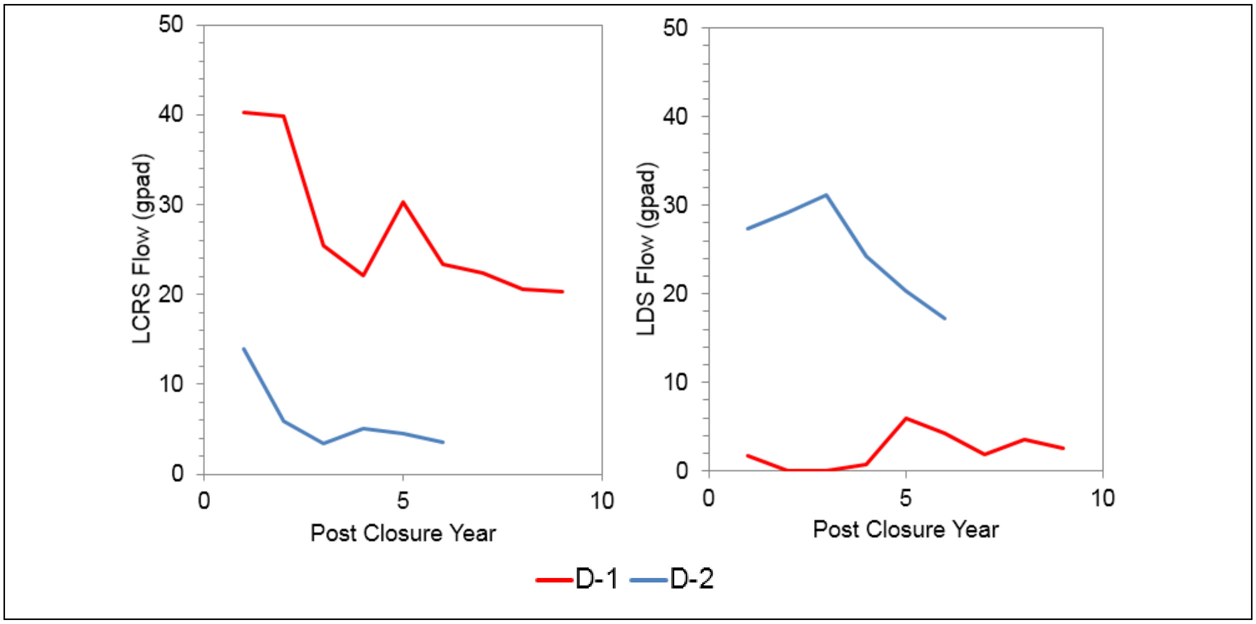


Figure 4-4. Annual average LCRS and LDS flow, Landfill D

The LDS volumes for D-1 have been below 5 gpad since the closure, whereas the LDS volumes in D-2 initially increased for the first 4 years after closure before exhibiting a steeply declining trend over the last 3 years. LDS flows in D-2 are also higher than LCRS flows. D-2 had a very short operational period of only 1 year: this compares to more than 10 years for most other facilities included in the study.

Landfill F (Design Configuration No. 13)

Available leachate data for the single case study unit F-1 at Landfill F includes monthly LCRS and LDS flow volumes for 12 years of PCC (Figure 4-5, note difference in y-axis scales).

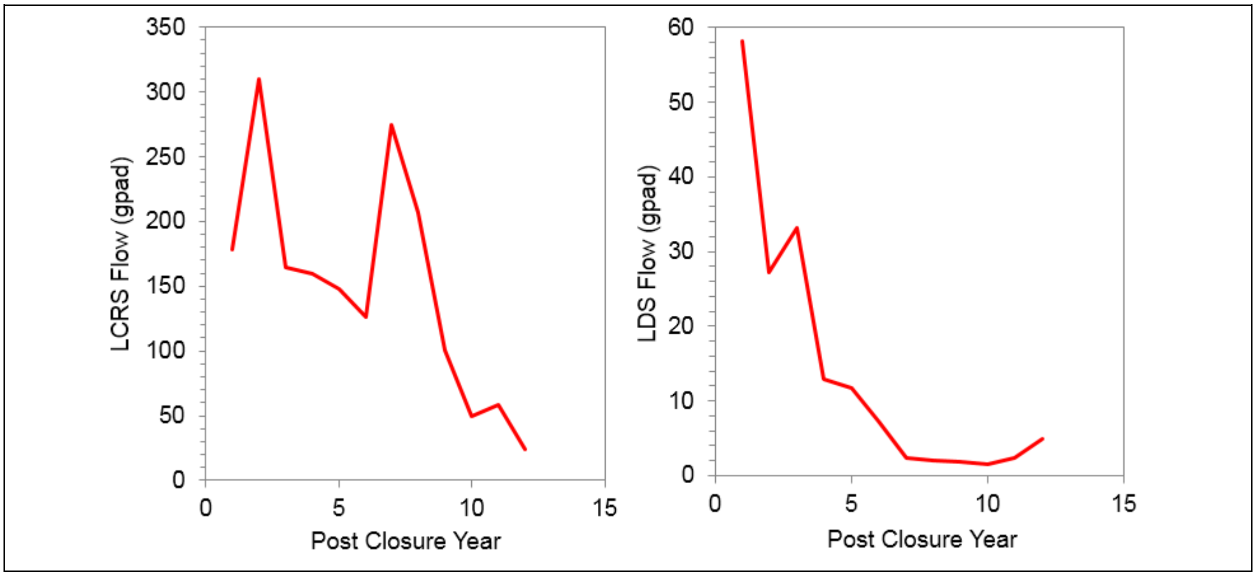


Figure 4-5. Average annual LCRS and LDS flow, Landfill F

Both LCRS and LDS flows have trended significantly downward at Landfill F, with current LCRS flows below 50 gpad and LDS flows below 5 gpad. The climate at the site is wet: 40 inches of average annual rainfall and 60 inches of average annual snowfall.

4.1.2 Dry Sites – Landfills J, R, Y, and M

This category of sites includes those in arid climates with deep groundwater tables. Landfill J receives only 11 inches of rainfall per year on average. Groundwater is also very deep at 300 feet below ground level. Landfill R is the aridest of all case study sites, with average annual precipitation of only 6.5 inches and a depth to groundwater of 250 feet. Landfill Y receives only 10 inches of annual rainfall on average, with deep groundwater (120 feet below ground level). Landfill M has average annual precipitation of only 9.5 inches and a depth to groundwater of 200 feet. Overall, it should be expected that this category of case study units would exhibit the lowest LCRS and LDS flows. Of particular note, three of the sites (Landfills R, Y, and M) are so dry that only negligible LDS flow has ever been recorded.

Landfill J (Design Configuration No. 4)

Available leachate data for Landfill J includes monthly LCRS and LDS flow volumes for all three case study units J-1 to J-3 for 17 years of PCC. Annual average LCRS and LDS flow rates are presented in Figure 4-6. LCRS and LDS flow rates for all three units are mostly below 1 gpad, which is not surprising since these as these units are situated directly beneath an MSW overfill landfill and the site is located in an arid region with very deep groundwater. As the cover system is directly beneath and in contact with the liner system for the overlying MSW landfill, the only liquid available to infiltrate the cover and form leachate is leakage through the liner system of the overlying MSW landfill. As such, post-closure leachate flows at Landfill J may be skewed relative to a typically closed landfill in that increased overburden pressures resulting from ongoing waste disposal in the overfill landfill may be contributing to larger-than-normal compression of the waste. This may partially help to explain why LDS flow rates generally equal or exceed LCRS flows. In particular, J-1 has experienced LDS flow rates of up to 5 gpad while LCRS flows have not exceeded 1 gpad. However, it is important to note that flows in both drainage layers are very low in relation to observations at most other sites.

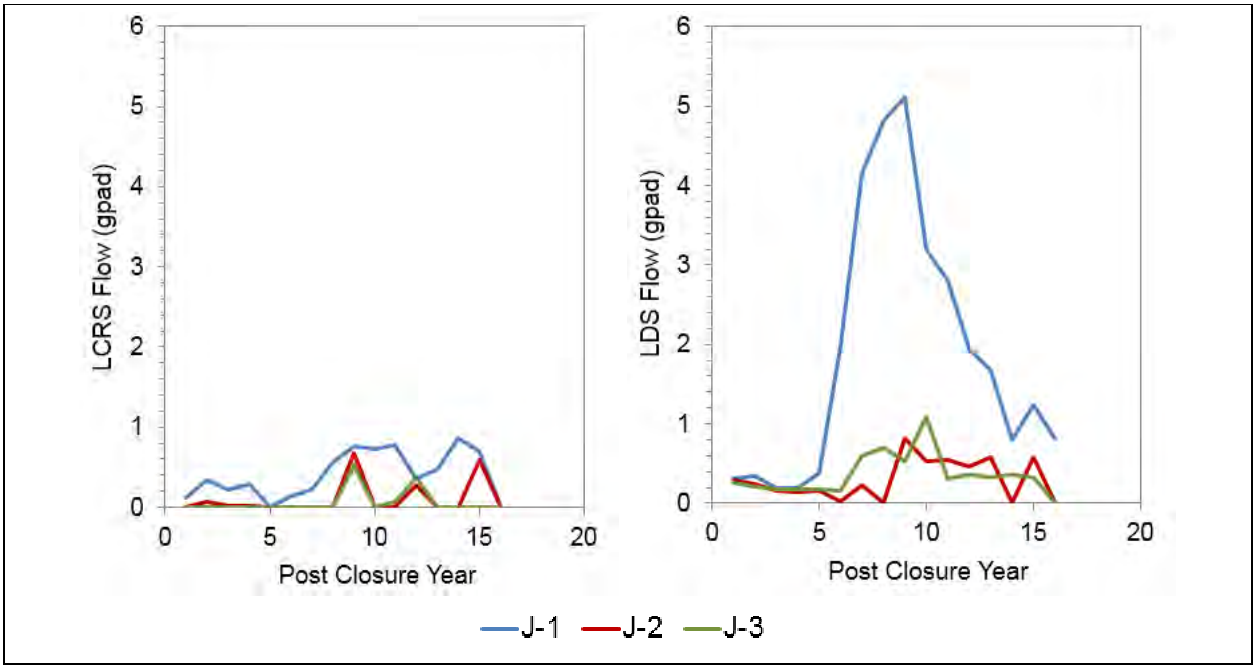


Figure 4-6. Annual average LCRS and LDS flow, Landfill J

Landfill R (Design Configuration Nos. 5 and 6)

The liner design for R-1 differs slightly from that of R-2 to R-5 with regard to the types of geosynthetic drainage (geonet vs. geocomposite) and barrier materials (40-mil PVC GM vs. 80-mil HDPE GM) specified. However, the designs are similar enough to be presented and discussed concurrently. Available leachate data for all five units includes monthly LCRS and LDS flow volumes for 13 years of PCC (Figure 4-7). The LCRS flow rate started near 10 gpad in R-1 but has declined steeply in subsequent years. LCRS flows in the other four units started slightly lower and have also declined, albeit less steeply. LDS flows have been zero throughout the PCC period with the exception of one reading of 1 gpad in year 10 in R-1.

Landfill Y (Design Configuration Nos. 9 and 10)

The liner design for Y-1 differs slightly from that of Y-2 and Y-3 with regard to the LCRS drainage layer design (Y-2 and Y-3 feature a GC in addition to a sand drainage layer, while Y-1 feature only a sand layer) and the specifications for geomembrane barrier materials. However, the designs are similar enough to be presented and discussed concurrently. Available leachate data for Landfill Y includes weekly LCRS and LDS flow volumes for three units for years 2 through 10 of PCC. Earlier records are missing. Annual average LCRS flow rates are presented in Figure 4-8. As shown, LCRS flow rates for all three units have trended downward since closure and have always been less than 10 gpad. LDS flows at this dry site (10 inches of annual rainfall on average) with deep groundwater (120 feet below ground level) have been negligible and are not shown or discussed.

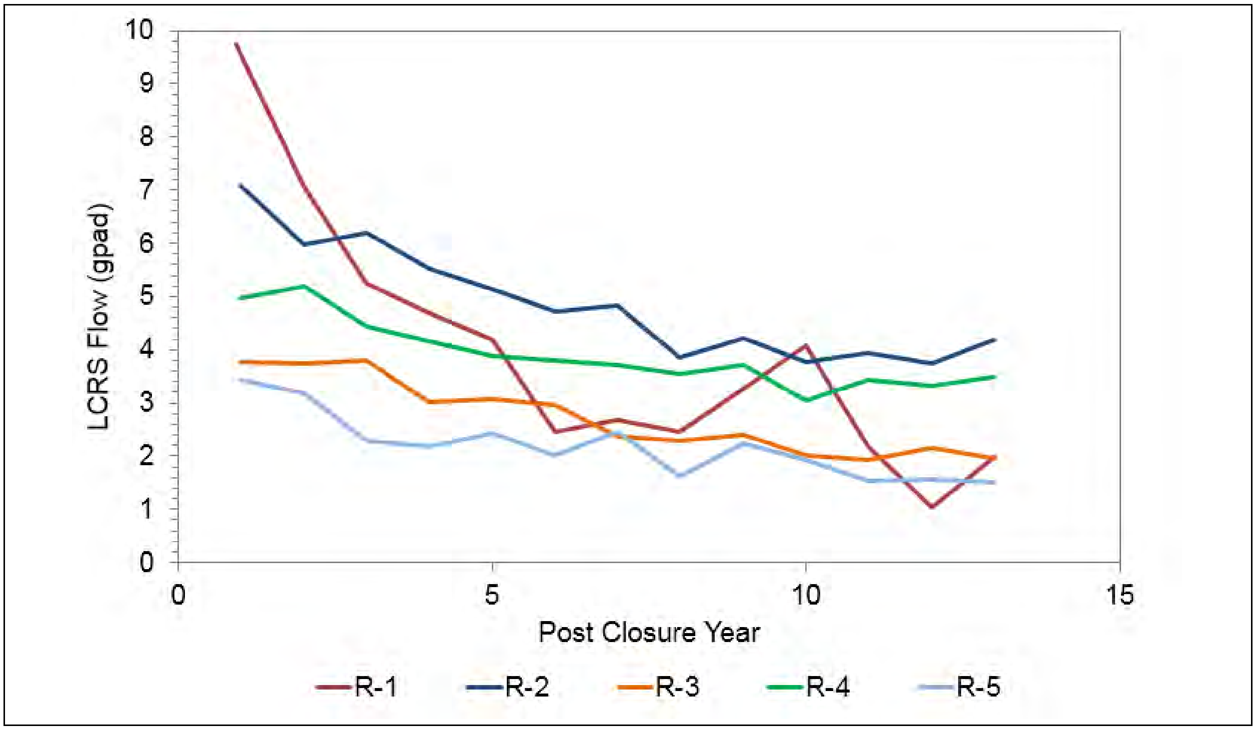


Figure 4-7. Annual average LCRS flow, Landfill R

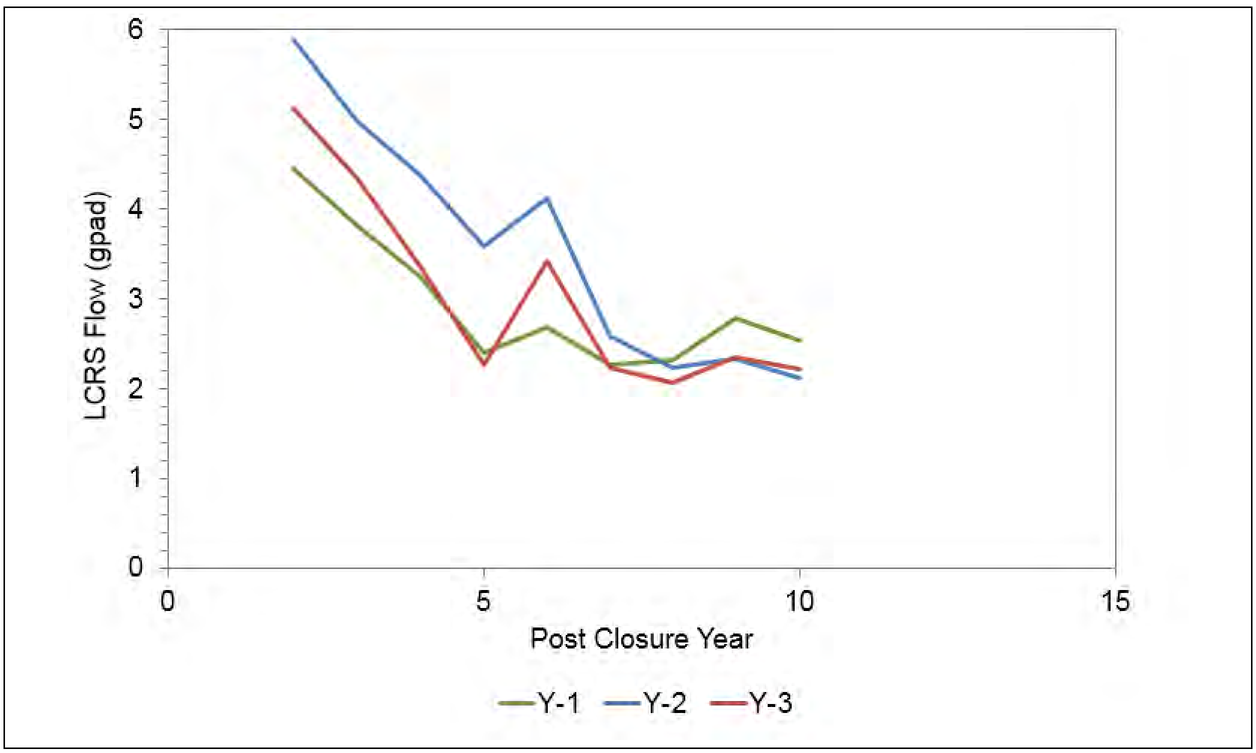


Figure 4-8. Annual average LCRS flow, Landfill Y

Landfill M (Design Configuration No. 11)

Available leachate data for Landfill M includes monthly LCRS and LDS flow volumes from one unit (M-1) within which waste has been placed to final grades and left undisturbed for the last 4 years, but at which a final cover system has not yet been constructed. An alternative all-soil evapotranspiration final cover system has been approved for the site. The intermediate cover comprises an 18-in thick layer of the select soil. Despite this permeable cover, annual average LCRS flows are very low, trending downward from less than 20 gpad (Figure 4-9), and LDS flows have been negligible (not shown). The highest recorded LDS flow rate was 0.14 gpad in year 1, this has since declined to 0.07 gpad. Landfill M is one of the driest sites in this study, with average annual precipitation of only 9.5 inches and a depth to groundwater of 200 feet.

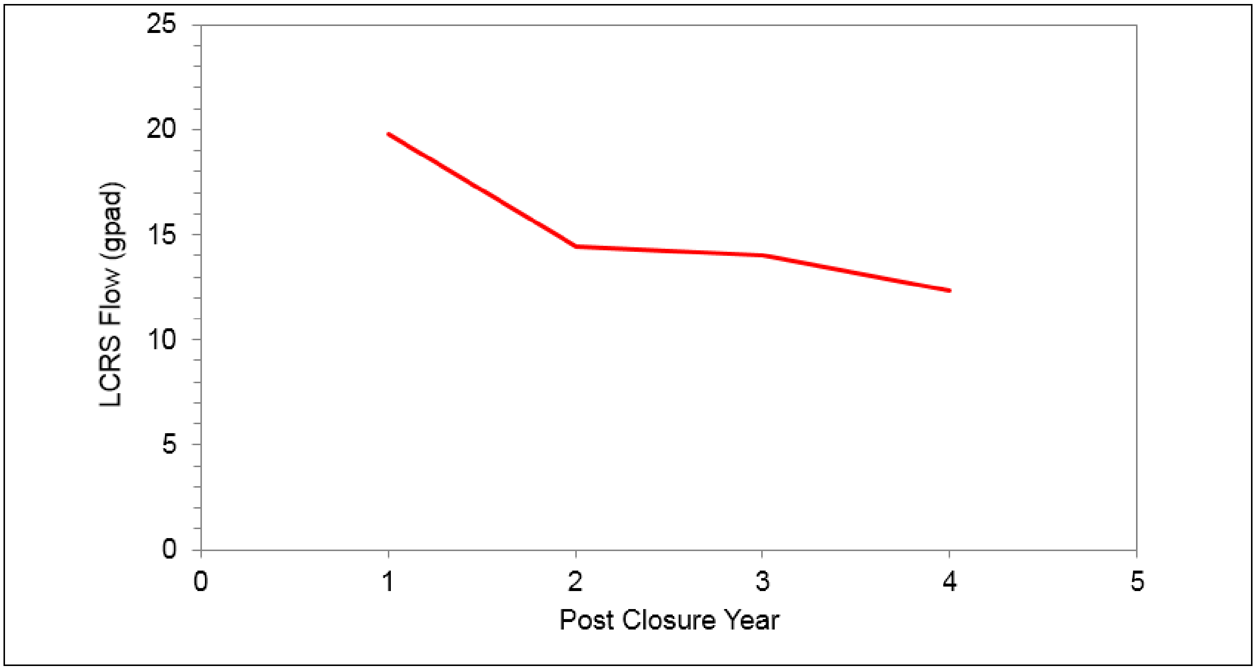


Figure 4-9. Annual average LCRS flow, Landfill M

4.1.3 Climatic Cusp Site – Landfill P

Landfill P experiences about 28 inches of rainfall annually, near the nominal value of 25 inches considered to separate wet and dry sites. As such, this site is considered a climatic cusp between the wet and dry site categories discussed above. The depth to groundwater represents an in-between condition relative to other sites; it is not excessively deep at only 40 feet below ground level, but this is significantly deeper than the three sites with shallow groundwater included in this study, at which groundwater is within 10 feet of the ground surface.

This site is also unique in that it has an intermediate liner system situated between the primary and secondary liners, with an overlying GN drainage layer providing separate recovery and recording of liquid flows (as depicted in Figure 3-5). For ease of identification in this report, the upper LDS drainage layer is denoted "LDS1" while the lower LDS drainage layer in denoted "LDS2." For assessing the performance of the primary liner, liquid flows in the LCRS are compared to the sum of flows in LDS1 and LDS2. The primary and intermediate liners are a single GM barrier sandwiched between two drainage layers. As such, it should not be expected that flow volume recorded in the LCRS, LDS1, and LDS2 would be substantially different if the only source of liquids is leakage through the GM.

There are four study units at Landfill P. The cover system design for the oldest unit P-1 is distinct from that of the three newer units P-2 to P-4 in that it features a 24-in CCL barrier layer whereas the other units feature a slimmer design utilizing a GCL barrier. As such, P-1 represents a notably different design configuration to that of the other three units.

Landfill P, Unit P-1 (Design Configuration No. 7)

Available leachate data for P-1 includes weekly LCRS and LDS flow volumes for years 4 to 21 of PCC (Figure 4-10). Earlier records are missing. LCRS flow exhibits a downward trend and has been less than 10 gpad for the entire PCC period. As noted above, the unusual triple-GM liner design at P-1 would be expected to result in flow volumes which show similar trends in the LCRS, LDS1, and LDS2. In fact, flow rates in LDS1 and LDS2 are similar and substantially greater than flows in the LCRS suggesting either a major defect in the primary liner GM or supplementary source of liquids in LDS1 and LDS2. Neither LDS flows exhibit real signs of trending behavior, although flow rates have declined relatively consistently since reaching peaks in year 13.

Landfill P, Units P-2 to P-4 (Design Configuration No. 8)

Available leachate data for P-2 to P-4 includes weekly LCRS and LDS flow volumes for up to 17 years of PCC. Annual average LCRS and LDS flow rates for all three units are presented in Figure 4-11. As with P-1, LCRS flow exhibits a downward trend in all three units and has been less than 10 gpad over the entire PCC period with the exception of the first 2 years in P-4. As noted above, the unusual triple-GM liner design at Landfill P would be expected to result in similar trends in flow volumes in the LCRS, LDS1, and LDS2. This is the case in P-4, although flow in the two LDS layers has been more erratic than in the LCRS. In P-2 and P-3, flow rates in LDS2 often exceed those in LDS1, while both LDS1 and LDS2 flow rates are greater than corresponding LCRS flows indicating either a major defect in the primary liner GM or supplementary source of liquids in LDS1 and LDS2.

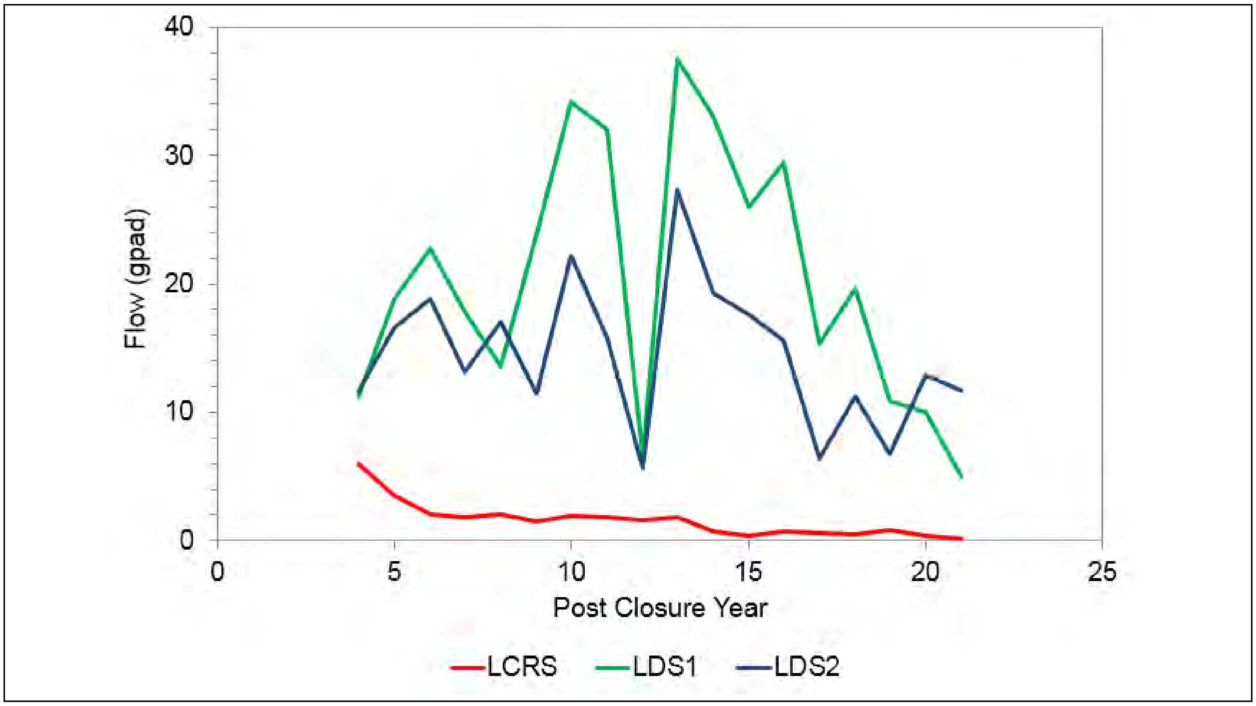


Figure 4-10. Annual average LCRS and LDS flow, P-1

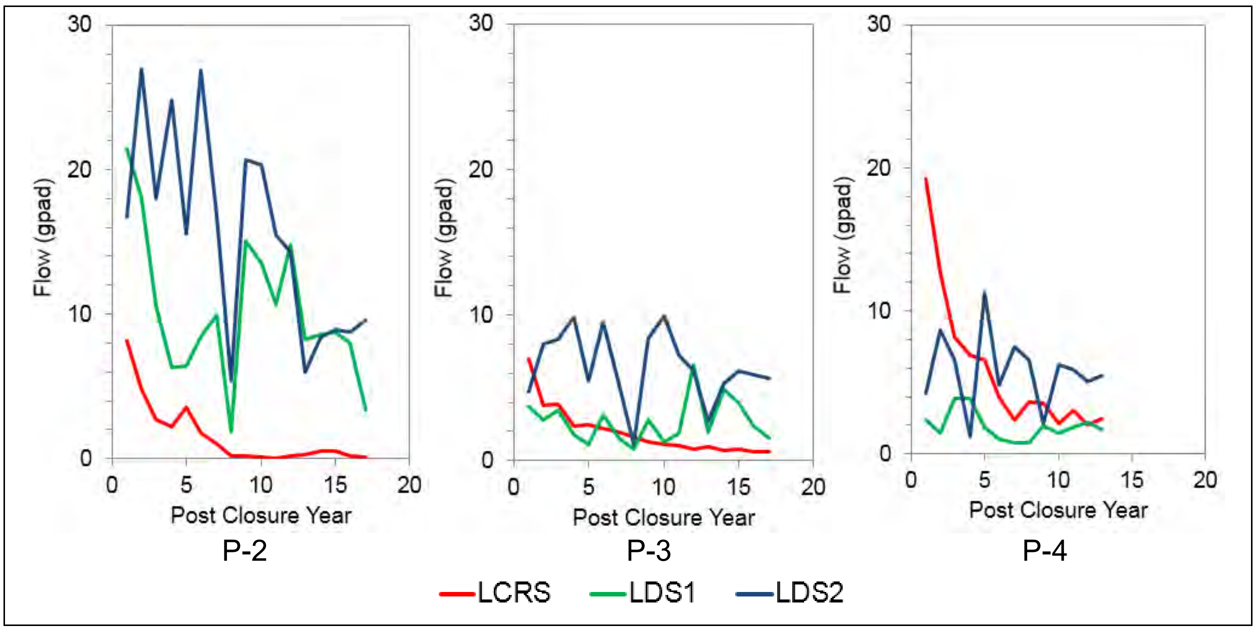


Figure 4-11. Annual average LCRS and LDS flow, P-2 to P-4

4.2 Comparing LCRS Flow Data to Modeled Predictions

Cognizant of the advantages and limitations of water balance modeling previously outlined in Section 1.5.2, the performance of the HELP Model as a predictive design tool was compared to the LCRS flow data obtained from the case study landfill units. Consistent with previous sections in Chapter 4, HELP Model results are presented and discussed in terms of the 13 unique design configurations representing different cover, primary liner, and LCRS/LDS drainage layer configurations amongst the 45 case study units (as listed in Table 3-8).

4.2.1 Methodology

Modeling Leachate Generation

HELP Version 3.07 (Schroeder et al., 1994a) was used to estimate landfill leachate generation before and after placement of the final cover system. The methodology used average annual (not peak) HELP Model results calculated for a 100-year period to simulate the range of weather conditions that a landfill may experience. Weather data for the simulation (i.e., daily precipitation, temperature, and solar radiation values) were generated by the model based on default assumptions for the closest city in the model's database to the landfill location. Material properties for soil layers were selected based on default values. Protective cover soil and waste were modeled as vertical percolation layers. GMs, GCLs, and CCLs were modeled as barrier soil layers and the LCRS and LDS were modeled as lateral drainage layers. With regard to the selection of a representative number of GM defects to input to the model, a 10-year survey by Forget et al. (2005) reported 0.5 defects/hectare for sites with strict CQA and 16 defects/hectare without CQA. All the case study sites had CQA performed during liner and cover construction, suggesting a value of 0.5 defects/hectare may be appropriate. However, whether the level of CQA performed at each case study could be similarly interpreted as "strict" was unknown. Therefore, GMs were conservatively assumed to have 2 defects/acre, in the middle of the range of 1 to 4 defects/acre suggested by EPA (Schroder et. Al, 1994) for "good quality GM installation." Cell geometry, drainage length, and waste height were input based on landfill design plans (see Table II-1 in Appendix II). The input parameters for each HELP Model run are provided in Appendix V.

Three scenarios were modeled for each of the 13 design configurations to establish boundary conditions based on expected landfill leachate generation before and after placement of the final cover system:

- HELP Model Scenario No. 1 (pre-closure conditions with default input): The first scenario assumes that waste had been placed to final grades but no engineered measures beyond intermediate cover soil application had been implemented to prevent direct infiltration of rainwater into the landfill. This flat-line value serves to provide a (likely overestimated) upper-bound indication of short-term LCRS and LDS flows expected in the first few years after closure.

- HELP Model Scenario No. 2 (long-term quasi-steady state conditions with default input): The second scenario assumes a final cover system has been constructed over the waste and the cover is assumed to be well established, graded, and stabilized with good vegetation coverage and capable of diverting most incident rainfall as stormwater runoff. This flat-line value serves as a lower-bound limit on expected LCRS and LDS flows over the long-term.
- HELP Model Scenario No. 3 (annual LCRS flow model with site-specific input): In the third scenario, a more representative prediction of annual changes in leachate flow was attempted. First, the HELP Model was run under similar default input assumptions as for Scenario 1, except that it was assumed that waste had been placed to final grades for the entire operational life of the landfill unit(s). The model was run only for the operational period. The output file from this run was then used to assign site-specific values of volumetric water storage in each layer (i.e., cover, waste mass, and liner) in the last year of operation (i.e., immediately prior to capping). The HELP Model was then rerun for 30 years under conditions of final cover (akin to Scenario 2), but with site-specific values for water storage in the waste mass and liner (default values were used for water storage in the cover since these layers would have been newly constructed). The output file from this model run showed annual flow in the LCRS and LDS drainage layers on a year-on-year basis for 30-years of PCC.

Calculating Trends in LCRS Flow

Assuming that LCRS flow rates decrease exponentially after closure, which is consistent with observations in EPA (2002), expected leachate generation can be modeled as an exponential best-fit trend line to the data. An exponential decay model of the form shown in Equation 4-1 can be constructed, where *f* is a slope factor that depends mainly on the type of cover in place:

$$\frac{L_t}{L_{PEAK}} = e^{-ft} \qquad (4-1)$$

Leachate generation is plotted as a function of time (t), such that the ratio of leachate generated in any given year during the post-closure period (L_t) is a function of peak leachate generation at or soon after closure (L_{PEAK}).

4.2.2 Results

Upper- and Lower-Bound Thresholds for LCRS and LDS Flow

Results from HELP Model Scenario Nos. 1 and 2 representing upper bound (intermediate cover) and lower bound (final cover) average flow rates in the LCRS and LDS, respectively, are summarized for all 13 design configurations in Table 4-1.

Table 4-1. Modeled LCRS and LDS flow

Design configuration	Climate Condition	Study Unit(s)	Average annual flow from HELP Model (gpad)				Notes
			Scenario No. 1: Intermediate cover (pre-closure)		Scenario No. 2: Final cover (post-closure)		
			LCRS	LDS	LCRS	LDS	
1	Wet	B-1 to B-6	1243	5E-01	5	4E-03	
2	Wet	B-7 to B-8	1243	5E-01	5E-01	4E-04	
3	Wet	T-1 to T-18	1319	8E-02	5E-05	2E-07	
4	Dry	J-1 to J-3	0.2	4E-05	Zero	Zero	1
5	Dry	R-1	38	2E-03	1E-04	1E-05	
6	Dry	R-2 to R-5	38	2E-05	1E-04	8E-07	
7	Cusp	P-1	122	1E-02	3E-04	5E-06	4
8	Cusp	P-2 to P-4	122	1E-02	2E-04	4E-06	4
9	Dry	Y-1	5	9E-01	8E-07	1E-05	2
10	Dry	Y-2 to Y-3	5	9E-01	8E-07	1E-05	2
11	Dry	M-1	129	2E-04	22	2E-05	3
12	Wet	D-1 to D-2	504	15	5E-05	3E-04	2
13	Wet	F-1	559	16	2E-03	3E-04	

Notes:
1). Landfill J has an overfill MSW landfill.
2). Landfills Y and D have more flow in the LDS than LCRS after the final cover is placed due to a boundary constraint in the HELP Model, see discussion below.
3). Scenario 2 at Landfill M is hypothetical, as the final cover has not yet been placed (current cover performance reflects Scenario 1).
4). LDS flow is for lower drainage layer (LDS2).

Flow values from the HELP Model are converted to gpad to allow easy comparison to field data. These results are primarily used to estimate modeled liner efficiency for comparison to effective liner efficiency calculations in Section 5.2. Blinded input and output files from each HELP Model run are provided in Appendix V. Some observations on the results presented in the table include:

- Design Configuration Nos. 1 and 2: Units B-1 to B-6 have a thinner cover system GM as compared to B-7 and B-8, and the GM and CCL layers are switched such that the CCL overlies the GM. This is reflected in the significant difference in modeled LCRS and LDS flows post-closure (a CCL overlying a GM is leakier because it does not take advantage of the synergistic benefits of a composite barrier in which an underlying CCL or GCL effectively "plugs" holes in the overlying GM).
- Design Configuration Nos. 2 and 3: Units B-7 and B-8 have an 18-in sand drainage layer above the barrier layer in the final cover system whereas all units at Landfill T have a GN drainage layer. This is reflected in the significant difference in LCRS and LDS flows post-closure between these two configurations (overall, a GN has been shown to be more efficient at reducing flows).
- Design Configuration No. 4: The cover system for J-1 to J-3 is integrated with a liner for an overfill MSW landfill covering the entire surface area of the three units. Modeling infiltration through the final cover is not meaningful under these conditions, as the only source of infiltrating water is leakage through the overlying liner, which is negligible (the HELP Model analysis would show zero flow in the LCRS and LDS).

- Design Configuration Nos. 5 and 6: R-1 has a 40-mil PVC GM liner while the other units at Landfill R (R-2 to R-5) have an 80-mil HDPE liner. The apparently superior performance of the HDPE liner at limiting leakage as compared to PVC is reflected in the model results for LDS flow as the HELP model default values assign two orders of magnitude lower permeability to HDPE GM when compared with PVC GM.
- Design Configuration Nos. 7 and 8: P-1 has a different cover system design to P-2 to P-4, although this does not significantly affect hydraulic performance. More importantly, all four units have three basal drainage layers (LCRS, LDS1, and LDS2) separated by single GM liners. The HELP Model output did not show any flow in the upper LDS1 once the final cover was placed (although flow has been observed in this layer). Results in the table thus represent modeled flow in the LCRS and lower LDS2.
- Design Configuration Nos. 9 and 10: Y-2 and Y-3 have a thicker GM in the primary liner than Y-1, although this does not affect modeled advective flow through the primary liner.
- Design Configuration Nos. 9, 10, and 12: HELP Model output for Y-1 to Y-3 and D-1 shows higher flow in the LDS than LCRS after the final cover is placed, although it is important to note that flow values in both drainage layers are extremely low in all affected units. This result is possibly due to a boundary constraint in the HELP Model in that the preferential flow path for a very small thickness of liquid above the GM in the LCRS layer is vertical (down through a hypothetical defect in the GM) rather than lateral. Therefore, all this liquid is erroneously assigned as vertical leakage through the primary liner by the model rather than lateral conveyance in the LCRS.
- Design Configuration No. 11: Landfill M is located in an arid region and has a composite primary liner resulting in minimal flow in LDS when compared with LCRS. The study unit M-1 is not technically closed, but has been filled to final grades and is inactive under the intermediate cover soil. Due to the dry climate and low leachate flows observed, an all-soil ET cover has been permitted as final cover at this facility.

Estimating Timeframes to Achieve Steady State Leachate Flow

In order to better understand behavioral trends in leachate generation based on field observations, annual LCRS flow measurements were compared to annual flow rates predicted from HELP Model Scenario 3. Acknowledging limitations in the HELP Model (see Section 1.5.2), the basis for this comparison is that if the HELP Model provides an accurate prediction of long-term leachate flow post-capping, the LCRS flow rates would decrease to a value approximating the quasi-steady state flow rate predicted by the model under this scenario. Selected results from six of the 13 design configurations representing the case study units are presented in Figure 4-12 through Figure 4-15. The selected results feature four of the case study sites: wet Landfills B and F and dry Landfills R and Y. With reference to each figure, the estimated time to reach quasi-steady state leachate flow as predicted by the HELP Model is shown for individual units as well as for the average of all data comprising a different design configuration in Table 4-2. The value of the slope factor (*f*) from the best-fit trend line and the coefficient of correlation to the data (R^2) are also shown.

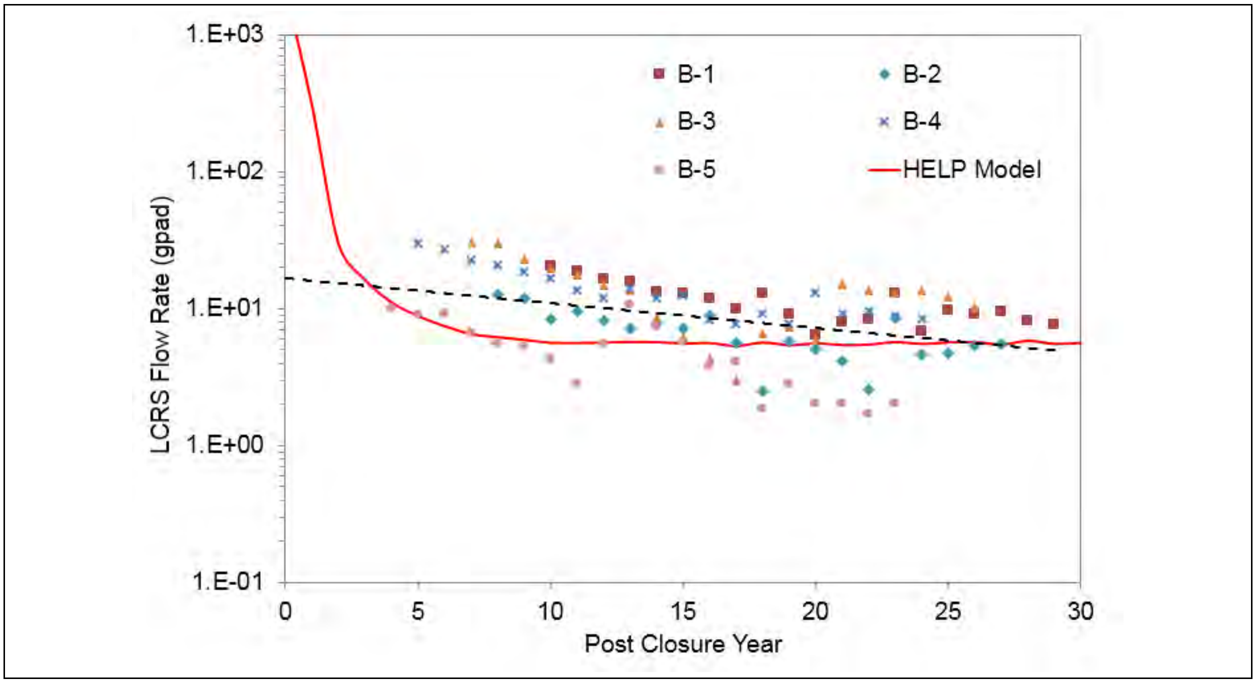


Figure 4-12. Trends in long-term LCRS flow, B-1 to B-5

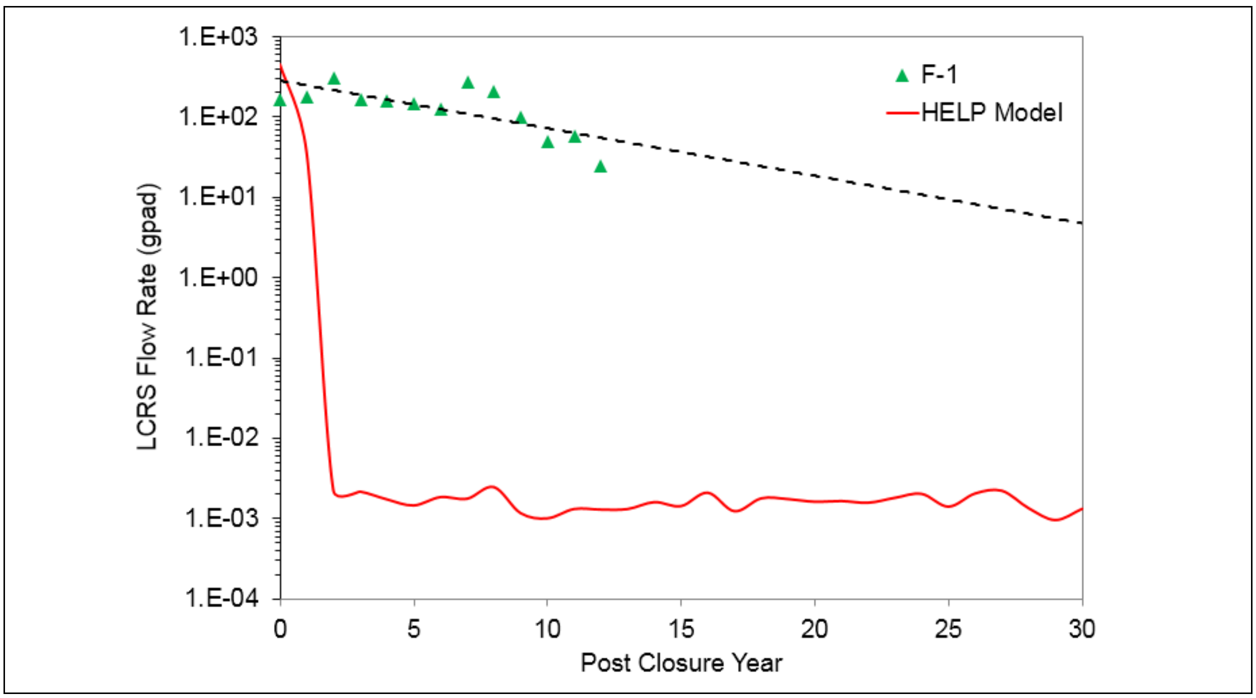


Figure 4-13. Trends in long-term LCRS flow, F-1

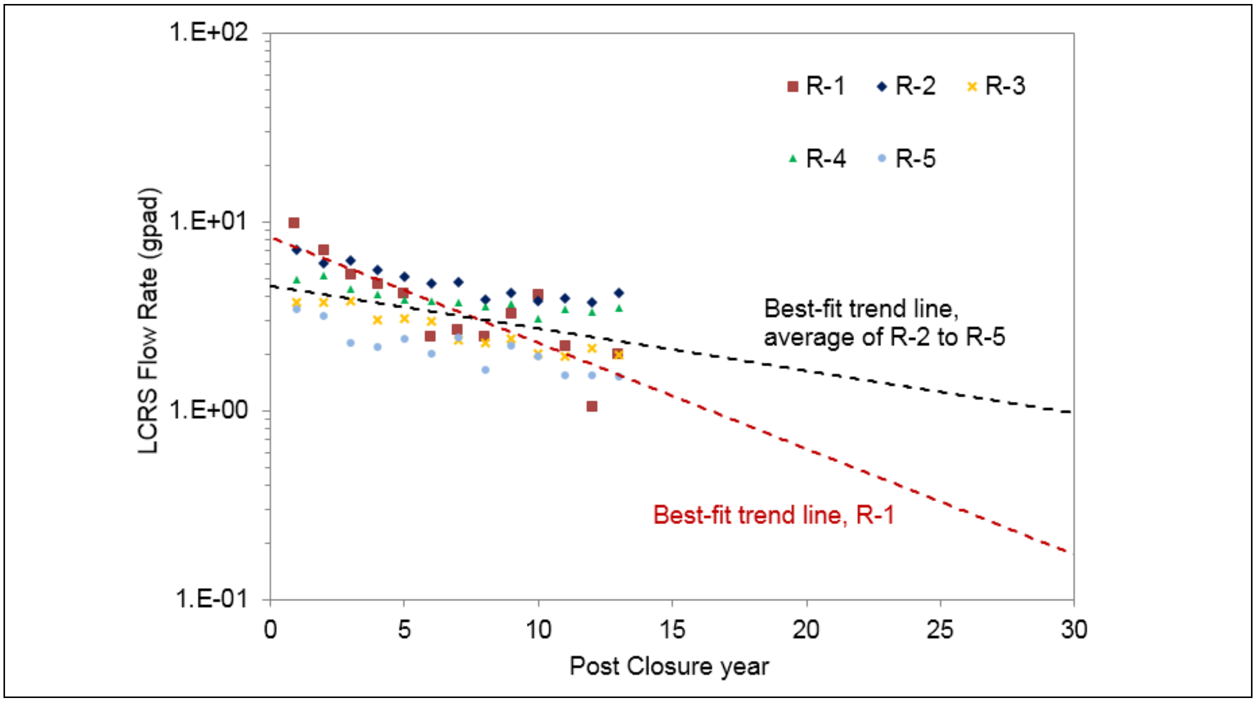


Figure 4-14. Trends in long-term LCRS flow, R-1 to R-5

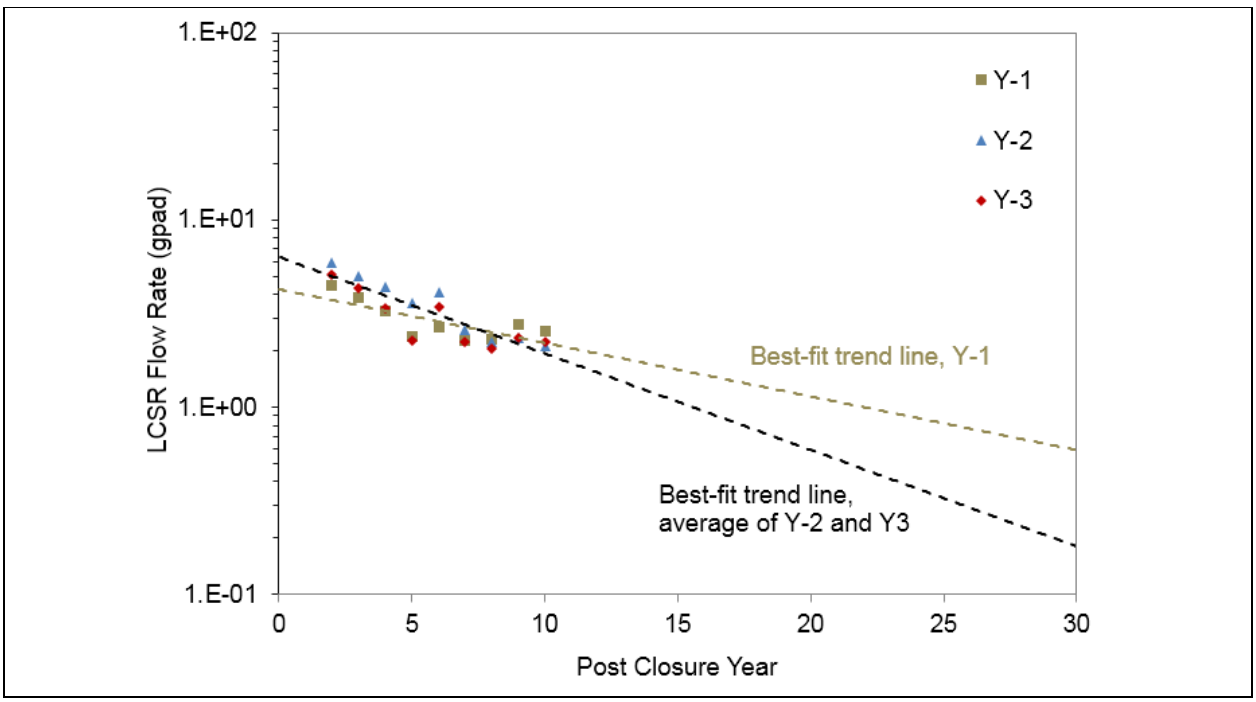


Figure 4-15. Trends in long-term LCRS flow, Y-1 to Y-3

Table 4-2. Estimated timeframe to achieve steady state leachate flow

Design configuration	Climate Condition	Cover system barrier layer design	Study Unit	Characteristic of best-fit exponential trend line to the data		Time to intercept HELP Model flow rate(1) (years)
				Slope factor (*f*)	Correlation coefficient (R^2)	
1	Wet	24-in CCL over 80-mil HDPE GM	B-1	0.05	0.64	29
			B-2	0.05	0.43	18
			B-3	0.05	0.19	27
			B-4	0.06	0.78	28
			B-5	0.09	0.68	8
			B-1 to B-5	0.04	0.16	27
13	Wet	40-mil LLDPE over GCL	F-1	0.13	0.54	97
5	Dry	80-mil HDPE GM over 24-in CCL	R-1	0.13	0.73	Not calculated
6	Dry	80-mil HDPE GM over 24-in CCL	R-2	0.05	0.85	Not calculated
			R-3	0.06	0.91	Not calculated
			R-4	0.03	0.79	Not calculated
			R-5	0.06	0.77	Not calculated
			R-2 to R-5	0.05	0.26	Not calculated
9	Dry	40-mil HDPE GM over GCL	Y-1	0.07	0.58	Not calculated
10	Dry	40-mil HDPE GM over GCL	Y-2	0.13	0.92	Not calculated
			Y-3	0.10	0.71	Not calculated
			Y-2 and Y-3	0.12	0.78	Not calculated

Note:
1). The HELP model predicted zero LCRS flow at dry Landfills R and Y after 30 years; therefore, the time to intercept HELP model could not be calculated.

Overall, the analysis suggests that it would take from 8 to 97 years to reach the steady state flow rate suggested by the HELP model. It is interesting that only one unit require more than 30 years to reach steady state. In summary and discussion of the results presented in Table 4-2 and Figures 4-12 to 4-15:

- Design Configuration No. 1 (B-1 to B-5): The time to reach the steady-state flow rate (approximately 5 gpad) predicted by the HELP Model was less than 30 years for all five units at this wet landfill. Values for the slope factor (*f*) vary from 0.05 to 0.09, with the average for all units being 0.06 (the field data are poorly correlated to the trend line developed for the average). Overall, it is assumed that quasi-steady state leachate generation will continue at the level predicted by the HELP Model, perhaps declining to about 1 gpad as suggested by B-5.
- Design Configuration No. 13 (F-1): The HELP Model predicts that LCRS flow at this single-unit wet landfill would decline to about 0.001 gpad within four years of closure and remain steady thereafter. This seems an impractically low target for ending leachate management, although the best-fit trend line to the data (f = 0.13, R^2 = 0.54) suggests that this steady state flow rate would be reached in 97 years. In addition, the data record extends only 12 years at this site and fitting a trend to only the most recent 5 or 6 years of data would produce a much steeper trend line.

- Design Configurations Nos. 5 and 6 (R-1, R-2 to R-5): The steady state flow rate predicted by the HELP Model for both these configurations is on the order of 10^{-4} gpad; however, as discussed previously the model does not properly account for lateral drainage at very low flows in LCRS drainage media (as shown in Table 4-1, the HELP Model predicts that LDS flows would be two orders higher than LCRS flows). As such, the HELP Model may not provide accurate estimates of steady state leachate flow at very dry sites such as Landfill R, and comparisons to modeled predictions are not made in Figure 4-14 or Table 4-2.
- Design Configurations Nos. 9 and 10 (Y-1, Y-2, and Y-3): The steady state flow rate predicted by the HELP Model for both design configurations at dry Landfill Y is on the order of 10^{-7} gpad. This prediction may not be accurate for the reasons discussed above, and comparisons between best-fit trend lines and modeled predictions are not made in Figure 4-15 or Table 4-2.

With regard to the slope factor calculated from these results, it is interesting to note that this is significantly lower than that calculated from the dataset reported by EPA (2002), which suggested an order of magnitude decrease in LCRS flow rate should be expected every 5 years after closure. This would equate to a slope factor f = 0.5 in Equation 4-1. Slope factors calculated from this study suggest values less than 0.15, or even less than 0.1, may be more appropriate at most Subtitle C landfills. The dataset utilized in this study is larger (45 individual units with up to 29 years of post-closure data) than for the 2002 study (33 units with up to 9 years of post-closure data). In particular, the lack of data from many units beyond year six of PCC in the EPA (2002) study, inclusion of MSW landfills, and the very low flow rates reported for a few units after year six, suggests that the data may have been skewed by a small number of very dry or high performing sites. If current industry projections of post-closure leachate generation are based on the 2002 data, expectations may need to be reset in terms of the rate of decline in LCRS flow. Rather than an order of magnitude decrease every 5 years, it is more reasonable to expect an order of magnitude decrease every 15−20 years. However, more field studies are needed to validate this finding before recommendations for adjusting current industry projections and accruals for leachate management are made.

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5. ANALYSIS OF PRIMARY LINER PERFORMANCE

5.1 Apparent Hydraulic Efficiency of the Primary Liner

5.1.1 Methodology

Consistent with the study by EPA (2002), concurrent LCRS and LDS flow data from the case study landfill units were evaluated to estimate leakage rates and the hydraulic efficiency of the primary liner. Using a method suggested by Bonaparte et al. (1996), the "apparent" hydraulic efficiency, EA, of the primary liner can be calculated from observed LCRS and LDS flow rates as:

$$E_A(\%) = \left(1 - \frac{LDS\ Flow\ Rate}{LCRS\ Flow\ Rate}\right) \times 100 \qquad (5-1)$$

The parameter EA is referred to as an "apparent" hydraulic efficiency because flow into the LDS sump may be attributed to sources other than leakage through the primary liner. If the only source of flow into the LDS sump is primary liner leakage, then Equation 5-1 provides the "true" liner hydraulic efficiency (ET). True liner efficiency provides a measure of the effectiveness of a particular liner in limiting or preventing advective transport across the liner. For example, if a liner has an ET of 99%, the rate of leakage through the primary liner would be 1% of the LCRS flow rate. The leakage rate for a given composite liner system is directly proportional to a number of defects in GM and leachate head over the liner system (Touze-Foltz and Giroud 2003; Giroud and Touze-Foltz 2005). Therefore, the true efficiency of a liner is not a constant, but rather a function of the hydraulic head in the LCRS and size of the area over which LCRS flow is occurring (Bonaparte et al., 2016).

The higher the value of EA, the smaller the flow rate from the LDS compared to the LCRS flow rate. The value of EA may range from zero to 100% with a value of zero corresponding to a LDS flow rate equal to the LCRS flow rate, and a value of 100% indicating no flow in the LDS (indicating a perfect liner). Negative values indicate that flow volumes in the LDS exceed those in the LCRS, which was observed at many case study units (Section 4.1).

5.1.2 Values Calculated by EPA (2002)

EPA (2002) reported the apparent efficiency of a number of different primary liner configurations for individual cells for which continuous LCRS and LDS flow rate data were available from the start of operation and for a significant monitoring period thereafter. In summary of data provided for the post-closure period:

- GM Liners: Calculated values for E_A from six individual cells ranged from 62.0 to 85.4%, 68.8%, 91.1 to 98.6%, 92.3%, 99.7%, and 99.6%.
- GM/GCL Liners: Calculated values for E_A from six individual cells ranged from 89.6%, 98.8%, 100%, 100%, 99.6%, and 100%.
- GM/CCL and GM/GCL/CCL Liners: Calculated values for E_A from four individual cells ranged from -1,300 to 83.4%, 36.3to 80.5%, and 81.8 to 96.8%, and 94.0 to 97.2%.

In each category, single values (other than a range) indicate that only one calculation was performed for an individual cell. It is noted that the above results may include cells at non-hazardous waste landfills (i.e., MSW landfills with higher leachate generation potential than most hazardous waste landfills). Negative values indicate that flow in the LDS exceeded that in the LCRS. Overall, the authors concluded that "flows from the LDS of cells with composite liners are usually very low. The true hydraulic efficiency of composite liners may often exceed 99.9%."

5.1.3 Values Calculated in this Study

Available flow data from each of the 45 units at the nine case study landfills was evaluated to calculate leakage rates and apparent hydraulic efficiencies of the primary liners based on landfill leachate generation rates (i.e., LDS versus LCRS flow rates). The minimum, maximum, and average value of liner efficiencies for each unit are summarized in Tables 5-1 to 5-3 along with the number of data points for each unit that falls into different EA ranges.

values were calculated. In addition, average values were calculated using positive values only. It is also important to note that the liner efficiencies reflected in the tables were calculated as static values from average LCRS and LDS flow rates in the post-closure period. As these flows tend to decrease with time, E_A values may dynamically increase or decrease with time depending on the relative rates of decrease of LCRS flow versus LDS flow. Overall, only 5% of the units exhibited an efficiency E_A value greater than 99% with 73% of the units having an E_A value that is less than 90%. Furthermore, the apparent liner efficiencies calculated across the sites are significantly higher at dry than at wet sites. For the wet landfill sites, the total number of E_A values exceeding 99% is 96, representing 79% of the data, in Table 5-2. The proportion of sites at which E_A values are negative is approximately equal at 16 and 17% at wet and dry sites, respectively. It is interesting to note that the collection efficiencies calculated for dry landfill sites were much lower than those for wet ones. Only 1 percent of the units examined demonstrated an efficiency that is higher than 90% as presented in Table 5-1C.

Table 5-1. Apparent liner efficiency, E_A (wet sites)

Design configuration	Primary liner system	Unit	Apparent liner efficiency, E_A			Breakdown of data				
							E_A value			
			Minimum	**Maximum**	**Average**[1]	**Number**	**<0%**	**0% to 90%**	**90% to 99%**	**>99 %**
1	80-mil HDPE GM over 60-in CCL	B-1	62%	83%	72%	20	0	20	0	0
		B-2	35%	87%	67%	20	0	20	0	0
		B-3	38%	94%	81%	20	0	17	3	0
		B-4	79%	98%	89%	20	0	9	11	0
		B-5	0%	68%	48%	20	15	5	0	0
		B-6	73%	98%	91%	20	0	8	12	0
2	80-mil HDPE GM over 60-in CCL	B-7	77%	99%	91%	18	0	8	6	4
		B-8	0%	97%	65%	12	3	6	3	0
3	60-mil HDPE GM over 36-in CCL	T-1	0%	84%	77%	8	6	2	0	0
		T-2	71%	94%	83%	8	1	6	1	0
		T-3	0%	90%	73%	8	1	6	0	1
		T-4	0%	88%	42%	8	1	6	0	1
		T-5	0%	98%	84%	8	3	2	3	0
		T-6	31%	100%	54%	8	0	6	0	2
		T-7	60%	98%	83%	13	0	8	5	0
		T-8	0%	68%	35%	13	6	7	0	0
		T-9	0%	82%	56%	14	4	8	2	0
		T-10	0%	82%	56%	11	1	10	0	0
		T-11	0%	93%	60%	11	1	9	1	0
		T-12	0%	99%	81%	11	2	4	5	0
		T-13	0%	100%	68%	11	4	5	1	1
		T-14	0%	94%	74%	11	3	5	3	0
		T-15	0%	75%	57%	11	4	7	0	0
		T-16	0%	92%	81%	11	1	9	1	0
		T-17	83%	100%	96%	11	0	1	7	3
		T-18	64%	100%	88%	11	0	4	6	1
12	60-mil HDPE GM	D-1	80%	100%	92%	10	0	4	3	3
		D-2	0%	45%	45%	7	6	1	0	0
13	80-mil HDPE GM	F-1	59%	99%	88%	13	0	4	7	2
					TOTAL	**367**	**62 17%**	**207 56%**	**80 22%**	**18 5%**

Note:
1. Average values were calculated using positive values only.

Table 5-2. Apparent liner efficiency, E_A (dry sites)

Design configuration	Primary liner system	Unit	Apparent liner efficiency, E_A			Breakdown of data				
			Minimum	Maximum	Average[1]	Number	E_A value <0%	0% to 90%	90% to 99%	>99 %
4	60-mil HDPE GM over 18-in CCL	J-1	0%	35%	18%	15	12	3	0	0
		J-2	0%	1%	1%	6	5	1	0	0
		J-3	0%	3%	3%	3	2	1	0	0
5	40-mil PVC GM over 36-in CCL	R-1	84%	100%	99%	13	0	1	0	12
6	80-mil HDPE GM over 36-in CCL	R-2	100%	100%	100%	13	0	0	0	13
		R-3	100%	100%	100%	13	0	0	0	13
		R-4	100%	100%	100%	13	0	0	0	13
		R-5	100%	100%	100%	13	0	0	0	13
9	60-mil HDPE GM	Y-1	100%	100%	100%	9	0	0	0	9
10	80-mil HDPE GM	Y-2	100%	100%	100%	9	0	0	0	9
		Y-3	99%	100%	100%	9	0	0	0	9
11	60-mil HDPE GM over 18-in CCL	M-1	99%	100%	99%	5	0	0	0	5
					TOTAL	**121**	**19** **16%**	**6** **5%**	**0** **0%**	**96** **79%**

Note:
1. Average values were calculated using positive values only.

Table 5-3. Apparent liner efficiency, E_A (cusp site)

Design configuration	Primary liner system	Unit	Apparent liner efficiency, E_A			Breakdown of data				
			Minimum	Maximum	Average[1]	Number	E_A value <0%	0% to 90%	90% to 99%	>99 %
7	60-mil HDPE GM	P-1	0%	0%	0%	18	18[2]	0	0	0
			0%	0%	0%	18	18[2]	0	0	0
8	60-mil HDPE GM	P-2	0%	48%	48%	18	17	1	0	0
			0%	1%	1%	18	17	1	0	0
		P-3	0%	72%	39%	18	10	8	0	0
			0%	46%	46%	18	17	1	0	0
		P-4	0%	92%	62%	14	1	12	1	0
			0%	79%	48%	14	10	4	0	0
					TOTAL[1]	**136**	**108** **79%**	**27** **20%**	**1** **1%**	**0** **0%**

Note:
1. Average values were calculated using positive values only.
2. Calculated as [1-(LDS1+LDS2)]/LCRS.

As noted previously, a calculated value for E_A below zero indicates that sources other than liner leakage are contributing to liquid volumes in the LDS. For simplicity, minimum apparent liner efficiency is reported as 0% in the tables where one or more negative values were calculated. In addition, average values were calculated using positive values only. It is also important to note that the liner efficiencies reflected in the tables were calculated as static values from average LCRS and LDS flow rates in the post-closure period. As these flows tend to decrease with time, EA values may dynamically increase or decrease with time depending on the relative rates of decrease of LCRS flow versus LDS flow. Overall, only 5% of the units exhibited an efficiency EA value greater than 99% with 73% of the units having an EA value that is less than 90%. Furthermore, the apparent liner efficiencies calculated across the sites are significantly higher at dry than at wet sites. For the wet landfill sites, the total number of EA values exceeding 99% is 96, representing 79% of the data, in Table 5-2. The proportion of sites at which EA values are negative is approximately equal at 16 and 17% at wet and dry sites, respectively. It is interesting to note that the collection efficiencies calculated for dry landfill sites were much lower than those for wet ones. Only 1 percent of the units examined demonstrated an efficiency that is higher than 90% as presented in Table 5-3.

While the data evaluated here are limited, it appears that the use of a GM/CCL composite barrier system may not outperform the use of a single GM barrier as the primary liner in either wet or dry sites. Landfills B and T do not perform better than Landfills D and F, while Landfills J, R, and M do not outperform Landfill Y.

The following site-specific observations are offered, which emphasize a number of important limitations on the use of EA as a measure of liner performance:

- Rainfall and the depth of groundwater are at/near ground level in wet climates (such as that found at Landfill sites B and T) can be factors contributing to the low apparent liner efficiencies at those sites. While the hydraulic connection between the secondary liner and groundwater is not confirmed there is a potential for groundwater to intrusion into the LDS. Furthermore, precipitation, especially after large events, may infiltrate into anchor trenches or defects/appurtenances in the final cover system and migrate to the LCRS or LDS.
- Low leachate generation volume at arid climate landfills (such as Landfill J) can be low, LCRS (<0.001 gpad) and LDS (<0.1 gpad). Thus small variability in leachate volume measurement could translate to an extreme calculated efficiency. This may explain why the apparent liner efficiencies are mostly below zero site J.

Thus, it is important to take into account site-specific consideration when evaluating liner efficiency. Below are some examples of how site-specific conditions were used to explain efficiencies calculated for some of these sites:

- Landfills R, Y, and M are located in arid climates with little yearly rainfall, resulting in very low LCRS flows, negligible LDS flows, and high apparent liner efficiencies.
- Landfill F is an industrial site located in NE region with high average annual precipitation as both rainfall and snowfall. Minimum and maximum EA values for this site represent a temporal improvement: liner efficiency increased from 59% at closure to 94% five years

later. This suggests that EA may not be an effective measure of liner performance in early years while excess residual water in the landfill from the construction and operational phases is working its way out via the LCRS.

From the above, site-specific climatic, construction, and operational factors clearly have an important influence over calculated values for EA. This level of subjectivity provides a high level of uncertainty when using EA. A method to improve estimates of liner efficiency by correcting for relative LDS and LCRS chemistry data is discussed in Section 5.3.

5.2 Modeled Hydraulic Efficiency of the Primary Liner

5.2.1 Methodology

Expected post-closure LCRS and LDS flow rates for each of the 13 different design configurations were calculated using the HELP Model based on default inputs considered representative of pre-closure conditions (intermediate cover soil only) and post-closure conditions (final cover). The methods used to calculate these flow rates were described previously in Section 4.2.1 as HELP Model Scenario Nos. 1 and 2, respectively. Results were previously summarized in Table 4-1 (qualifications on the modeling approach and validity of output values were provided with the table; these are also relevant in the context of the use of these values here). Based on these values, a comparison of actual LCRS and LDS flow rates with modeled predictions can be made, which will facilitate critical assessment of the model's adequacy in predicting long-term leachate generation and, by association, leakage through the primary liner.

Similar to the method used for calculating apparent liner efficiency, EA (Section 5.1.1), the hydraulic efficiency of the primary liner system can be calculated as (Equation 5-2):

$$E_M(\%) = \left(1 - \frac{LDS\ Flow\ Rate\ from\ HELP}{LCRS\ Flow\ Rate\ from\ HELP}\right) \times 100 \qquad (5-2)$$

Where EM is the modeled liner efficiency calculated based on relative flow in the LDS and LCRS as predicted by the HELP Model.

5.2.2 Results

Using the methodology above, EM was calculated for the 13 unique design configurations reflecting different cover, primary liner, and LCRS/LDS drainage layers used in the construction of the 45 case study units (Table 5-4). Some qualifications regarding results presented in the table include:

- Design Configuration No. 4: The cover system for J-1 to J-3 is integrated with a liner for an overfill MSW landfill covering the entire surface area of the three units. Modeling infiltration through the final cover is not meaningful under these conditions, as the only source of infiltrating water is leakage through the overlying liner, which is negligible (the HELP Model analysis would show zero flow in the LCRS and LDS). Model results under intermediate cover suggest very high levels of hydraulic performance at this dry site.

- Design Configuration Nos. 9, 10, and 12: HELP Model output for Y-1 to Y-3 and D-1 shows higher flow in the LDS than LCRS after the final cover is placed, although it is important to note that flow values in both drainage layers are extremely low in all three units. This result is possibly due to a boundary constraint in the model in that the preferential flow path for a very small thickness of liquid above the GM in the LCRS layer is vertical (down through a hypothetical defect in the GM) rather than lateral. There is no head buildup over the primary liner as shown in HELP Model output files; therefore, the hydraulic performance of the primary liner is likely to be higher but cannot be calculated for post-closure conditions using the HELP Model method. The apparently low E_M values for these three units under conditions of intermediate cover should also be treated with caution given the limitations of the HELP Model described here.
- Design Configuration No. 11: Landfill M is located in an arid region and has a composite primary liner resulting in minimal flow in LDS when compared with LCRS. The study unit M-1 is not technically closed, but has been filled to final grades and is inactive under the intermediate cover soil. As such, hydraulic performance of the primary liner under intermediate cover represents current conditions.

Table 5-4. Modeled liner efficiency, E_M

Design configuration	Climate condition	Study unit(s)	Average annual flow from HELP Model (gpad)				Modeled liner efficiency, E_M	
			Intermediate cover		Final cover		Intermediate Cover	Final cover
			LCRS	LDS	LCRS	LDS (note 2)		
1	Wet	B-1 to B-6	1243	5E-01	5	4E-03	99.96%	99.93%
2	Wet	B-7 to B-8	1243	5E-01	5E-01	4E-04	99.96%	99.92%
3	Wet	T-1 to T-18	1319	8E-02	5E-05	2E-07	99.99%	99.58%
4 (note 1)	Dry	J-1 to J-3	0.2	4E-05	0	0	99.98%	Not Calculated
5	Dry	R-1	38	2E-03	1E-04	1E-05	99.99%	93.0%
6	Dry	R-2 to R-5	38	2E-05	1E-04	8E-07	100%	99.4%
7	Cusp	P-1	122	1E-02	3E-04	5E-06	99.99%	98.38%
8	Cusp	P-2 to P-4	122	1E-02	2E-04	4E-06	99.99%	97.54%
9	Dry	Y-1	5	9E-01	8E-07	1E-05	82.65%	Not Calculated
10	Dry	Y-2 to Y-3	5	9E-01	8E-07	1E-05	82.65%	Not Calculated
11 (note 3)	Dry	M-1	129	2E-04	22	2E-05	100%	Not Calculated
12	Wet	D-1 to D-2	504	15	5E-05	3E-04	96.94%	Not Calculated
13	Wet	F-1	559	16	2E-03	3E-04	97.16%	84.12%

Notes:
1). Landfill J has an overfill MSW landfill.
2). Landfills Y and D have more flow in the LDS than LCRS after the final cover is placed due to a boundary constraint in the HELP Model, see discussion below.
3). Final cover has not yet been placed at Landfill M.

Ignoring the HELP Model's limitations at accurately predicting LCRS and LDS flows at Landfills Y and D as discussed above, calculated values for EM exceed 99.9% at all but one other site (Landfill F, with calculated EM value of 97.2%).

5.3 Correcting Apparent Liner Efficiency Calculations

5.3.1 Technical Basis

Leachate chemistry data can be used to quantify the portion of liquids comprising total LDS flow that should be attributable to primary liner leakage as opposed to other sources (e.g., groundwater infiltration) by demonstrating a lack of hydraulic connection between the LCRS and LDS. This is done by distinguishing liquids with similar chemical signatures. The rationale is simple: if leakage through the primary liner is the main source of liquids in the LDS, then the concentrations of key indicator parameters in LDS liquids should be comparable to the concentrations of the same constituents in LCRS leachate for all samples collected concurrently in the two drainage layers. If the concentrations in LDS liquids are significantly lower than the corresponding concentrations in LCRS leachate, however, a lack of hydraulic connection can be inferred (i.e., dilution of LDS liquids from a non-leachate source is occurring). As discussed in more detail below, the preferred indicator parameter for comparing LCRS and LDS chemistry is chloride, a conservative (unattenuated) anion that does not take part in biochemical reactions and is typically found in elevated concentrations in leachate (Rowe, 1991). Comparison of LDS and LCRS chloride concentrations assumes that advective flow through pinhole defects in the GM is the only mechanism by which leakage through the primary liner occurs (i.e., diffusion through the GM, which is a potential transfer mechanism for volatile compounds, can be ignored). Potential adsorption of chloride to solids in the CCL or GCL component of a composite primary liner is also ignored, which is reasonable given the weak ion affinity of chloride and typically has low attenuation in clays (Pansu and Gautheyrou, 2006). Where chloride data are available, the apparent liner efficiencies calculated in Section 5.1 can be corrected. The main goal of this section is to demonstrate the presence (or lack thereof) of a hydraulic connection between the LCRS and LDS within a particular landfill unit.

Concentrations of Key Indicator Constituents

To initiate an evaluation of whether primary liner leakage had contributed to the observed LDS flows, the concentrations of key chemical constituents in LCRS and LDS flows were investigated. This included the four major cations (calcium, magnesium, potassium, and sodium) and three major anions (alkalinity, chloride, and sulfate), which typically are enough to calculate the ionic charge balance in environmental effluents, although in some regions nitrate and ammonium can be important (Andersen et al., 2014). Comparing the ionic composition of liquids from the LCRS and LDS allows the chemical signatures of the samples to be easily differentiated. There are several ways in which to graphically portray the ionic composition of liquid samples, including Stiff, Piper, or Schoeller diagrams or simple bivariate plots (Bonaparte et al., 2011). Even simpler, anion/cation ratios (e.g., chloride/sodium or chloride/calcium) can be calculated. If the shapes of these diagrams or values of ratios differ significantly between LDS liquids and LCRS leachate, this provides a strong indication that the source of liquids may be different. The chemistry database for this study was very limited as only a few of the parameters were available concurrently in both the LCRS and LDS at each site. Alkalinity has not been analyzed at any site. Therefore, Stiff or piper plots could not be constructed, leaving Schoeller diagrams or bivariate plots as an alternative method of portraying the data. As an example of this approach, chloride and magnesium concentrations in the LCRS and LDS for four study units at Landfill T were plotted (Figure 5-1).

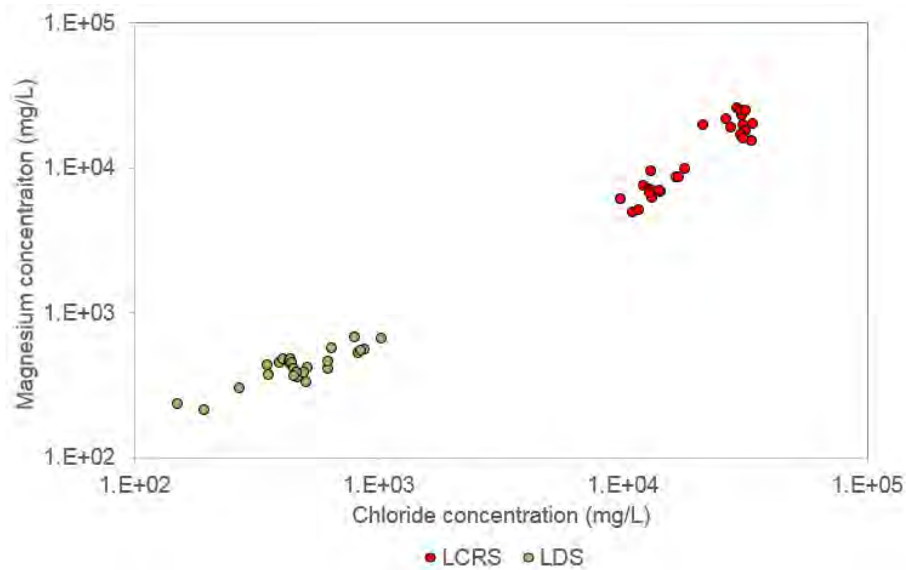

Figure 5-1. Chloride-magnesium bivariate plot, Landfill T

The bivariate plot of the data for Landfill T in Figure 5-1 shows that the chemical fingerprint of the LDS is significantly different from the LCRS. Concentrations of both analytes are two orders of magnitude different in all data. As another example, the chloride, sulfate, sodium, calcium, magnesium, and potassium concentrations for the LCRS, LDS, and vadose zone were available for three units at Landfill J. Simplified Schoeller diagrams were constructed to represent the ionic composition of liquids in these media (Figure 5-2).

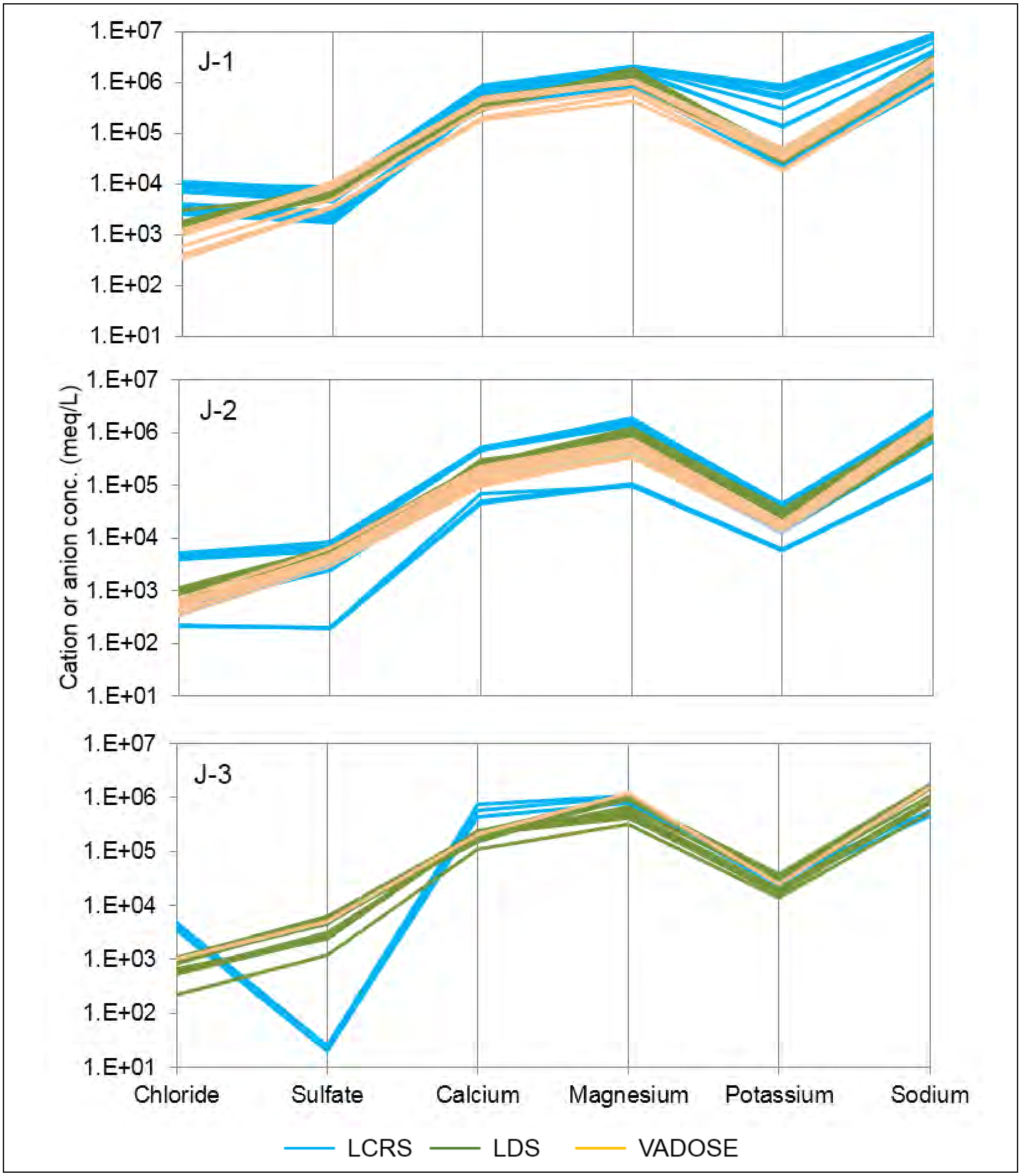

Figure 5-2. Ionic composition of liquids in the LCRS, LDS, and vadose zone, Landfill J

In all three units at Landfill J, the shape of the diagram for the LDS was much closer to the vadose zone than the LCRS, indicating that the chemical composition of liquids in the LDS are more closely related to data for the vadose zone than to leachate. The LCRS data exhibit significant variability between years, particularly in J-2, while the LDS and vadose zone data are very consistent over time. The two anions (chloride and sulfate) showed the most significant contrast between the LCRS and LDS datasets.

Selection of Chloride as Indicator Parameter

Examination of the ionic composition of liquids in the LCRS and LDS at Landfills T and J presented above appears to support the use of chloride as the indicator parameter with the most significant (generally, orders of magnitude) distinction between these two drainage layers. Chloride is a conservative ion that does not take part in biochemical reactions and is not physically altered by the leaching process in landfills (Rowe, 1991). Therefore, chloride concentrations should be fairly similar between the LCRS and the LDS if the source of liquids in the LDS is due to primary liner leakage and not dilution from groundwater or other sources.

To further validate the selection of chloride as a useful indicator parameter with which to correct liner efficiency calculations, all available chloride data from the case study units were plotted (Figure 5-3). Chloride concentrations in the LCRS range from 53 to 34,320 mg/L with a median value of 9,290 mg/L, whereas concentrations in the LDS range from 2 to 3,000 mg/L with a median value of 22 mg/L. As shown in the figure, the significant contrast in chloride concentrations between the LCRS and LDS is relatively constant (especially once the first few years of post-closure have been completed), confirming selection of chloride as the preferred indicator parameter with which to review the hydraulic performance of the primary liner.

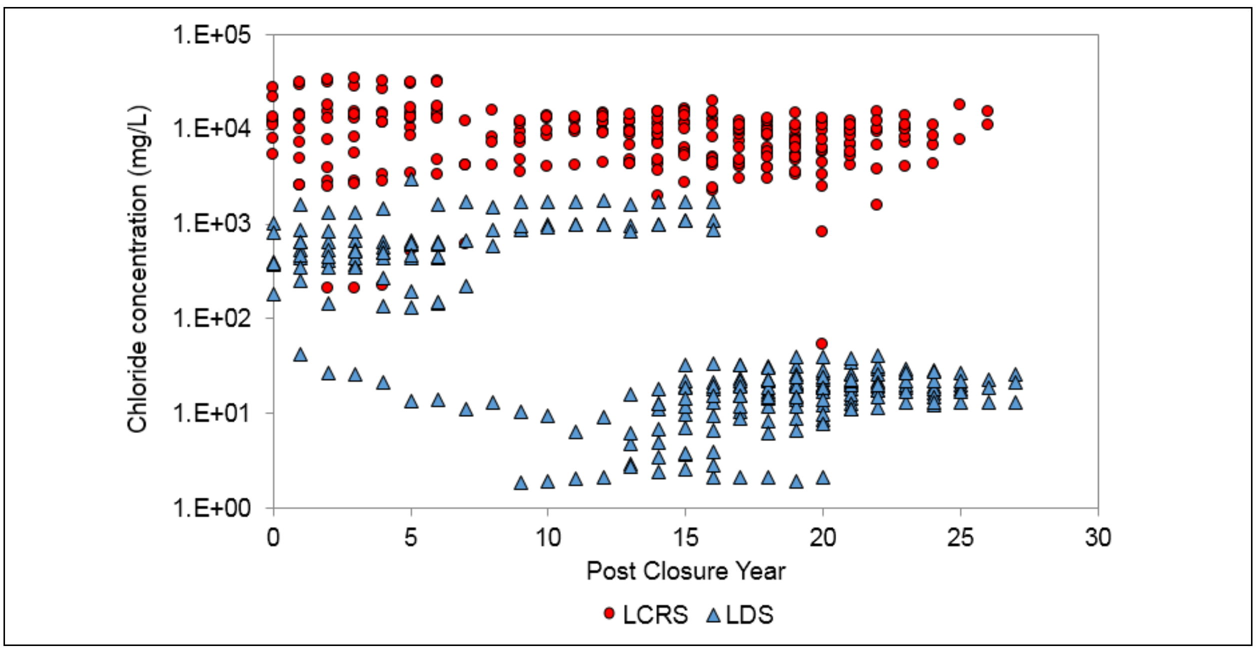

Figure 5-3. Comparison of chloride concentrations in LCRS and LDS liquids

5.3.2 Methodology

The LCRS and LDS chemical constituent data can be compared to estimate the portion of liquids in LDS which could be attributed to leakage through the primary liner only and separate this from liquids present in LDS due to construction water, consolidation of the primary liner, compression of drainage layer materials, and infiltration of groundwater (see Figure 1-2 and discussion in Section 1.5.3). For this comparison, chloride concentrations in the LCRS and LDS are used per the previous discussion.

A correction factor (CF) is first calculated as the ratio of chloride concentrations in the LDS and LCRS at a given time. CF is a dimensionless parameter as shown in Equation 5-3:

$$\mathrm{CF} = \frac{\text{Chloride Concentration in LDS}}{\text{Chloride Concentration in LCRS}} \qquad (5-3)$$

Equation 5-3 assumes that only leachate (i.e., LCRS liquids) contributes to the chloride concentration in the LDS and that chloride is not adsorbed to soils in the primary liner or drainage layers, or otherwise attenuated as it passes through the primary liner. Any contribution of chloride from other sources (e.g., brackish groundwater) would serve to increase the numerator in the expression and thus increase the magnitude of the CF value computed.

Using CF, a corrected liner efficiency, EC, can be derived using the simple expression in Equation 5-4:

$$E_c(\%) = \left(1 - \mathrm{CF}\frac{LDS\ Flow\ Rate}{LCRS\ Flow\ Rate}\right) \times 100 \qquad (5-4)$$

Note that chloride concentration and flow data must be temporally coincidental in the LCRS and LDS in order to calculate a corrected liner efficiency using Equation 5-4.

5.3.3 Results

The current leachate chemistry database has limited temporally coincidental chloride data in the LCRS and LDS. Overall, concurrent data are available for only 17 units at three sites (Landfills B, T, and J). A correction factor (CF) and corrected liner efficiency (EC) was calculated for each of these units as summarized in Table 5-5. The EC values shown in the table are average values for each unit, based on the number of data points indicated. The following observations are offered with respect to the performance of the primary liner based on the information shown in the table:

- CF values ranged over three orders of magnitude from 0.0004 (B-8) to 0.4 (J-1). Values less than 1.0 indicate that only a portion of the total flow in LDS should be attributed to primary liner leakage. This was the case for all 17 study units, which suggests that values of E_A at other sites could be correctable if applicable LCRS and LDS chemistry data were available. This represents a shortcoming on the part of site operators at collecting data that could help understand long-term liner performance.

- Both Landfills B and T receive above-average rainfall (>25 inches) each year and the top of groundwater is at/near the ground surface, which increases the probability of infiltration into the LDS from groundwater. This is borne out in the data: based on the CF calculations, only 1 to 3% of the liquids volume in the LDS is attributable to leachate leakage at Landfill T, and only 0.04 to 0.05% of the volume in the LDS is attributable to leachate leakage at Landfill B. Based on this, the corrected liner efficiency could be greater than 99% for all units at Landfill B and four of the six units at Landfill T.
- At Landfill J, concentrations of chloride in the LDS are similar to those in the vadose zone (Figure 5-2). The site is located in an arid climate with little to no LCRS flow. In most cases, the LDS flow volumes, while minor, exceeded LCRS flow volumes. Based on the CF value, it appears that 20 to 40% of the total LDS flow may be attributable to primary liner leakage at this site.
- There appears to be a positive correlation between the number of data available to calculate E_C and the magnitude of the value calculated. In general, more data mean higher corrections, which should incentivize site operators to collect these data.

Table 5-5. Corrected liner efficiency, E_C

Design configuration	Climate condition	Primary liner system	Study unit	Correction factor (CF)	Corrected liner efficiency (E_C)	Number of concurrent data available
1	Wet	80-mil HDPE GM over 60-in CCL	B-1	0.002	99.93%	12
			B-2	0.005	99.89%	16
			B-3	0.002	99.97%	16
			B-4	0.004	99.76%	14
			B-5	0.003	99.49%	16
			B-6	0.001	99.98%	16
2	Wet	80-mil HDPE GM over 60-in CCL	B-7	0.004	99.87%	7
			B-8	0.0004	99.99%	12
3	Wet	60-mil HDPE GM over 36-in CCL	T-1	0.01	91.99%	5
			T-2	0.02	99.50%	7
			T-3	0.01	99.42%	8
			T-5	0.03	99.08%	8
			T-6	0.03	98.47%	13
			T-7	0.03	99.57%	17
4	Dry	60-mil HDPE GM over 18-in CCL	J-1	0.4	71.79%	3
			J-2	0.2	79.03%	2
			J-3	0.3	71.79%	1

6. ANALYSIS OF LEACHATE QUALITY DATA

6.1 Overview

Chapter 6 presents an analysis of leachate chemistry data as background for understanding long-term leachate management at closed Subtitle C landfills. As discussed in Section 1.5.4, leachate chemistry from hazardous waste (HW) landfills has received relatively little scrutiny in recent years, although some research at a number of landfills for containment of mixed LLRW and HW from the nine facilities included in this study, this may be due in large part to a paucity of data, particularly with regard to the chemistry of liquids recovered from LDS drainage layers. This is primarily due to two reasons:

- Leachate chemistry data are most commonly collected semi-annually or annually at each site, thereby limiting the overall size of the dataset available for analysis at each site; and
- The leachate constituent list monitored is dependent on site-specific waste history and local practices for leachate treatment and disposal, thereby limiting the number of similar constituents for which data were available at all sites.

Intra-unit comparisons (i.e., comparison of leachate chemistry between the LCRS and LDS in the same unit) are dependent on the same constituents being monitored on the same date, while inter-unit comparisons (i.e., comparison of leachate chemistry between different units and sites) are dependent on the similarity of the leachate analyte lists.

6.1.1 Data Availability

The availability of leachate constituents of interest to this study in the LCRS and LDS at each case study landfill is shown in Table II-7 in Appendix II. The leachate chemistry database is included in full in Appendix IV. Data for 30 analytes were sought, where available; selection of these analytes mirrored that of EPA (2002). In summary:

- Within the available leachate chemistry dataset, the LCRS has been sampled far more frequently than the corresponding LDS;
- The highest levels of data availability are at wet Landfills B and T and dry Landfill J;
- Very limited leachate chemistry data are available at non-arid Landfills P and F;
- No data are available for dry Landfill Y due to low liquid volumes and difficulty in sample collection in both the LCRS and LDS; and
- Monitoring of leachate chemistry in the LDS is not performed at dry Landfills R and M because liquid volumes are too small for samples to be collected.

In the remainder of this chapter, available leachate chemistry data are evaluated with a focus on estimating the time that may be required for the concentrations of constituents of interest to decrease to asymptotic levels during PCC.

6.1.2 Temporal Analysis of Leachate Quality

The chemical composition of MSW landfill leachate has been well studied, with comprehensive data collected over multiple years from several sites as summarized by Kjeldsen et al. (2002), SWANA (2004), and Öman and Junestedt (2008). Longitudinal studies of MSW leachate data (e.g., Gibbons et al., 2014) have shown that concentrations of dissolved organic matter indicators tend to decrease rapidly after landfill closure. Statom et al. (2004) evaluated over 12 years of MSW leachate data from a site in Florida and found an overall declining trend in major ion chemistry, with data collected after closure capping showing an overall reduction in the amplitude of short-term variations. Conservative inorganic ions such as chloride, however, are released in leachate over time by flushing. Therefore, limiting infiltration post-closure curtails their removal in leachate (Rowe, 1991). Several processes affect long-term concentration trends for VOCs, including volatilization to gas (Kjeldsen and Christensen, 2001), diffusive loss through cover geosynthetics (Foose et al., 2002), sorption to or desorption from waste, or leaching and degradation (Lowry et al., 2008).

The fate of trace metals under various landfill operating and internal biochemical conditions has been extensively researched in MSW landfills (Gibbons et al., 2014). As a landfill ages, pH tends to increase causing a decrease in metal solubility. Thus, although accumulation of humic acid concentrations over the long term may be expected to mobilize metals, elevated metals concentrations are not typically observed in leachate from well decomposed waste (Barlaz et al., 2002), in part because trace metals are strongly attenuated by in situ sorption and precipitation (Christensen et al., 2001). This is consistent with reviews of leachate data from multiple landfills (e.g., Kjeldsen et al., 2002; SWANA, 2004) which generally reported trace metal concentrations at or below federal maximum contaminant levels (MCLs).

Relative to the well-documented leaching behavior within MSW landfills as summarized above, hazardous waste materials may not degrade, or only degrade very slowly, under landfill conditions. While leachate chemistry at HW landfills may share many of the trends of MSW leachate, this has received relatively little scrutiny in recent years. Tian (2015) analyzed leachate composition from four landfills constructed for containment of mixed LLRW and HW in the United States and compared concentrations of dissolved organic matter (measured as TOC), inorganic macro-components (including major cations and anions), and trace metals to values reported in the literature for MSW leachate, concluding that:

- Dissolved organic matter concentrations were insignificant when compared with MSW leachate;

- Concentrations of inorganic macro-components were broadly similar to MSW leachate;
- Trace metal concentrations were relatively lower than in MSW leachate and tended to exhibit steady or slightly increasing trends.

If current expectations for the time required for the concentrations of constituents of concern in leachate to decrease to asymptotic levels or meet regulatory standards such as MCLs are rooted in observations from MSW landfills, this may not be appropriate. Therefore, an important component of this study is to review concentration trends in leachate from Subtitle C landfills.

6.1.3 Leachate Chemistry Constituents

Consistent with EPA (2002), 30 chemical parameters were selected to represent leachate constituents of interest for this study. These include the following categories of analytes:

- Water quality indicator parameters (pH, specific conductance, TDS);
- Macro indicators of dissolved organic matter (COD, BOD_5, and TOC);
- Major inorganic cations (calcium, magnesium, potassium, and sodium) and anions (alkalinity, chloride, and sulfate);
- Trace metals (arsenic, cadmium, chromium, lead, and nickel); and
- Trace VOCs frequently observed to be present in landfill leachate, represented by a group of 12 aromatic hydrocarbons and chlorinated solvents (and their degradation products).

The minimum, maximum, median, and arithmetic mean values are summarized for LCRS and LDS liquids in Tables 6-1 and 6-2, respectively. The number of reporting landfills and units is also listed, along with the total number of data and non-detect (ND) values. Finally, MCLs for public drinking water from 40 CFR Part 141 are also listed in the table, if available, for specific analytes. The use of MCLs as comparison values is justified by the fact that potential leachate releases would most likely occur to groundwater rather than surface water or other environmental media.

Table 6-1. Summary of LCRS leachate concentrations in case study landfills

Chemical constituents	Units	Concentration				Data availability				MCL[(2)]
		Minimum	Maximum	Median	Mean	Landfills reporting	Units reporting	Total data	ND data[(1)]	
pH	s.u.	5.6	12.2	7.7	8.3	5	17	97	0	6.5-8.5[(3)]
Specific conductance	μmhos/cm	1,560	89,800	28,833	31,674	5	12	64	0	-
Total dissolved solids	mg/L	8,207	20,500	14,353	14,353	1	2	2	0	500[(3)]
COD[(5)]	mg/L									-
BOD[(5)]	mg/L									-
TOC[(5)]	mg/L	337	10,579	3,803	4,641	2	9	48	0	-
Alkalinity	mg/L									-
Chloride	mg/L	53	34,320	9,290	9,865	5	20	249	2	250[(3)]
Sulfate	mg/L	20	10,488	4,850	4,740	3	8	61	0	250
Calcium	mg/L	0.4	23,467	390	1,668	5	20	227	2	-
Magnesium	mg/L	0.6	2,100	68	354	4	14	179	8	-
Sodium	mg/L	6	25,760	5,064	6,552	3	9	80	0	-
Potassium	mg/L	17	8,700	795	1,860	2	5	52	0	-
Arsenic	μg/L	0.01	234,333	223	11,951	7	25	265	9	10
Cadmium	μg/L	0.001	26,000	6	318	5	19	212	51	5
Chromium	μg/L	0.01	4,750	130	283	5	21	196	18	100
Lead	μg/L	0.001	1,790	33	87	6	23	226	75	15[(4)]
Nickel	μg/L	0.13	30,000	509	1,295	6	19	123	13	-
Benzene	μg/L	0.0002	48,600	10	537	6	21	271	69	5
1,1-Dichloroethane	μg/L	0.0015	474,000	8	6,319	5	20	270	61	-
1,2-Dichloroethane	μg/L	0.0003	104,000	9	1,573	5	19	253	115	5
cis-1,2-Dichloroethene	μg/L	0.0002	68,300	2	1,164	2	10	174	80	70
trans-1,2-Dichloroethene	μg/L	0.0004	2,440	7	66	5	19	263	135	100
Ethylbenzene	μg/L	0.002	1.7E+06	15	19,361	5	20	271	55	700
Methylene chloride	μg/L	0.002	4.3E+06	20	81,928	5	20	254	88	-
1,1,1-Trichloroethane	μg/L	0.0002	739,000	6	11,605	5	20	265	125	200
Trichloroethylene	μg/L	0.0003	671,000	6	10,404	5	21	263	99	5
Toluene	μg/L	0.002	8.7E+06	43	94,022	5	19	263	43	1,000
Vinyl chloride	μg/L	0.0001	150,900	10	2,548	5	20	266	112	2
Xylenes (total)	μg/L	0.002	5.7E+06	36	56,998	4	14	222	27	10,000

Notes:
1). ND = non-detect (values reported between the method detection limit and reporting limit).
2). MCL = Maximum contaminant level per 40 CFR Part 141.
3). SMCL = secondary maximum contaminant level.
4). Action level required if 10% of the water exceeded 15 μg/L.
5). COD = chemical oxygen demand, BOD = biochemical oxygen demand, TOC = total organic carbon.

Table 6-2. Summary of LDS liquids concentrations in case study landfills

Chemical constituents	Units	Concentration				Data availability				MCL[2]
		Minimum	Maximum	Median	Mean	Landfills reporting	Units reporting	Total data	ND data[1]	
pH	s.u.	6.5	8.3	7.2	7.2	4	17	129	0	6.5-8.5[3]
Specific conductance	µmhos/cm	1,391	27,600	6,630	8,277	4	12	105	0	-
Total dissolved solids	mg/L	79	620	150	179	1	5	15	0	500[3]
COD[5]	mg/L									-
BOD[5]	mg/L									-
TOC[5]	mg/L	3	63	8	13	3	12	64	0	-
Alkalinity	mg/L									-
Chloride	mg/L	2	3,000	22	286	3	17	251	0	250[3]
Sulfate	mg/L	134	10,000	5,100	4,642	2	6	58	0	250
Calcium	mg/L	110	3,048	400	713	3	10	98	0	-
Magnesium	mg/L	310	1,800	1,000	1,031	2	3	48	0	-
Sodium	mg/L	13	667	37	178	2	7	76	0	-
Potassium	mg/L	550	3,200	1,600	1,650	1	3	48	0	-
Arsenic	µg/L	2.5	773	11	34	5	17	128	30	10
Cadmium	µg/L	0.5	15	3	4	2	9	84	4	5
Chromium	µg/L	9	190	17	36	2	13	65	28	100
Lead	µg/L	3	897	9	27	4	16	115	24	15[4]
Nickel	µg/L	6	1,200	110	151	3	11	89	37	-
Benzene	µg/L	0.0002	208	1	5	4	18	327	141	5
1,1-Dichloroethane	µg/L	0.0003	355	4	18	3	18	327	104	-
1,2-Dichloroethane	µg/L	0.0003	750	1	34	3	17	315	135	5
cis-1,2-Dichloroethene	µg/L	0.0002	421	0.2	28	1	9	169	66	70
trans-1,2-Dichloroethene	µg/L	0.2	100	2	8	3	18	286	153	100
Ethylbenzene	µg/L	0.002	306	2	8	3	18	327	201	700
Methylene chloride	µg/L	0.002	176	2	5	3	17	315	139	-
1,1,1-Trichloroethane	µg/L	0.0002	162	1	6	2	18	327	210	200
Trichloroethylene	µg/L	0.0003	81	1	11	3	18	327	143	5
Toluene	µg/L	0.002	255	2	6	3	16	318	145	1,000
Vinyl chloride	µg/L	0.0001	4,948	1	68	3	18	328	151	2
Xylenes (total)	µg/L	0.002	100	2	9	2	11	278	175	10,000

Notes:
1). ND = non-detect (values reported between method detection limit and reporting limit).
2). MCL = Maximum contaminant level per 40 CFR Part 141.
3). SMCL = secondary maximum contaminant level.
4). Action level required if 10% of the water exceeded 15 µg/L.
5). COD = chemical oxygen demand, BOD = biochemical oxygen demand, TOC = total organic carbon.

As shown in the tables, there is significant variability in the data for many constituents, particularly in the LCRS where differences between maximum and minimum observed values often span six or more orders of magnitude for cations/anions, trace metals, and

VOCs. For this reason, the median is considered more representative of overall leachate quality in both the LCRS and LDS than the mean, which is more sensitive to one or two significant outliers. The general water quality characteristics of liquids from the LCRS and LDS drainage layers are also significantly different, again by multiple orders of magnitude in many cases. This strengthens previous findings in Chapter 5 that additional sources of liquids rather than simply primary liner leakage are contributing to the liquid volumes measured in the LDS.

In the remainder of this section, select leachate data representing the five major categories of analytes of interest are reviewed. The purpose is twofold:

- Estimate when concentration trends may be asymptotic, and
- Compare concentrations to limit values (drinking water MCL or secondary MCL [SMCL]), where available.

In the latter regard, the focus of the comparison is LCRS concentrations as this represents characteristics of source leachate in the landfill. However, it is important to recognize that any potential leakage from the landfill to the subsurface will occur via the LDS since this underlies the LCRS across the base and side slope areas of the landfill. As such, LDS concentrations are of more significance than LCRS concentrations in an environmental setting, assuming the relationship between LCRS and LDS concentrations is understood and remains stable over the long term. In addition, rather than directly comparing leachate concentrations to a limit value, a universal dilution/attenuation factor (DAF) of 20 was applied to represent expected concentrations at the point of compliance (e.g., monitoring well) rather than in source leachate. This is consistent with the default DAF specified in the EPA's Soil Screening Guidance (EPA, 1996). As a potential release of leachate moves through soil and groundwater, constituent concentrations are attenuated by sorption, degradation, and dilution in clean groundwater. A DAF of 20 is deemed appropriate for contaminant sources up to 0.5 acres in size. While landfills are generally much larger than that, the potential release points (i.e., potential pinhole defects and tears in liner GM barriers) are collectively much smaller than 0.5 acres. As such, this approach is appropriate for the purposes of this portion of the study, which is to investigate whether leachate concentrations are exhibiting downward trends and/or reaching asymptotic levels that meet applicable limit values. Nevertheless, it is important to note that assigning this default DAF in this study does not imply any endorsement from EPA with regard to the universal application of this approach to assessing long-term leachate management and groundwater monitoring at Subtitle C landfills.

In keeping with the above-stated goals, the focus of the discussion presented in the next subsections is on general trends in the composite concentration data rather than absolute values for individual units at specific times. Therefore, the data selected for presentation are not identified by individual units, although the colors and shapes of data points direct the reader to commonality amongst datasets with regard to the represented landfill and drainage layer, respectively.4F[5] Insufficient flow data and waste manifests were available to accurately review leachate chemistry in terms of contaminant removal loads (e.g., cumulative mass of contaminant removal per ton of waste in place), although this would potentially have been advantageous in terms of normalizing the data between the different study units, climatic conditions, and cover/liner design configurations. No statistical analysis was conducted to eliminate outliers, test the significance of trends, assign correlation coefficients to trending data, or calculation of confidence limits. No correlations between leachate chemistry and flow rates were investigated, so it is not known whether the goal of excluding liquids from RCRA landfills in the post-closure period contributes to chemical changes or whether cover design and performance has a direct effect on leachate quality. Interested readers can review specific leachate flow and chemical characteristics from the blinded raw data provided in Appendices II and III.

6.1.4 Water Quality Indicators

pH

Leachate pH in the LCRS varied from 5.6 to 12.2 s.u., with a median value of 7.7 s.u. Temporal variability in the data is plotted in Figure 6-1. For the most part, readings are within the 6.5 to 8.5 s.u. the range specified under 40 CFR Part 141. If data from the first 5 years of PCC from Landfill T are ignored, the pH range would narrow further to 6.5 to 10 s.u, which is broadly consistent with the range of 7.6 to 9.4 s.u. and average 8.2 s.u. reported for HW landfills by EPA (2002). Temporal trends in pH appear stable based on the data plotted for each facility.

Most readings, particularly over the longer term, are above neutrality, which suggests that leachate at Subtitle C sites should be expected to be in the alkaline range. One possible explanation for the high pH values could be the relatively widespread practice of solidifying and stabilizing hazardous waste with cement, fly ash, or kiln dust prior to landfill disposal.

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[5] In all plots presented in Section 6.2, circular markers (●) are used to present LCRS data while triangular markers (▲) present LDS data. Markers are color-coded with a unique color representing each case study landfill, with colors grouped between geographic regions (SE = green, NE = blue, SW = red/pink, NW = orange/yellow).

Based on discussions with operators at case study sites, it appears that such stabilizers may occupy as much as 40% of the total airspace volume. The potential implications of an alkaline medium on limiting trace metals mobilization from the waste are important, as discussed in Section 6.2.4.

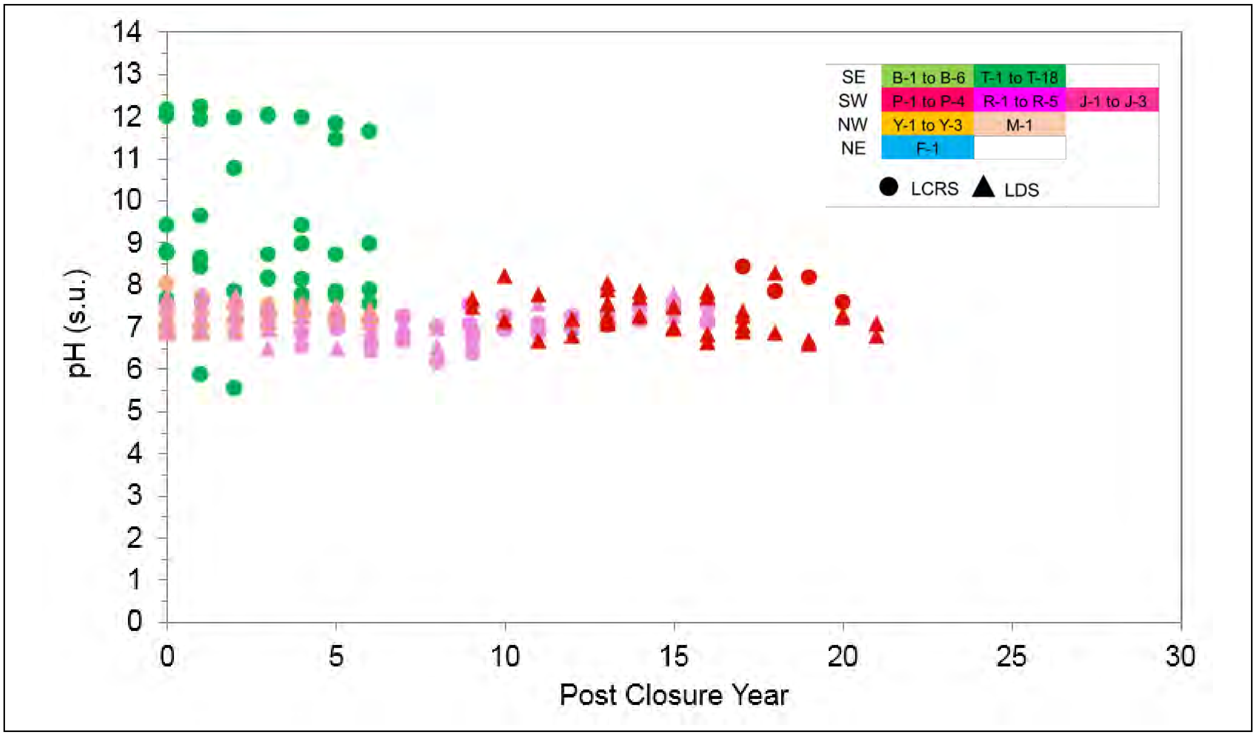

Figure 6-1. Temporal variability in pH

Specific Conductance

The specific conductance (or conductivity) of a solution is a measure of its ability to carry an electric current, which provides an estimate of the dissolved solids in solution. The mean conductivity of LCRS leachate samples from the case study units was about 31,700 µmhos/cm, with a median of 28,800 µmhos/cm, which is higher than the mean of about 22,100 µmhos/cm from three HW sites reported by EPA (2002) and substantially higher than the mean of 250 to 3,500 µmhos/cm reported for MSW landfills by Öman and Junestadt (2008). Values in the LCRS and LDS are of the same order of magnitude (Figure 6-2).

Overall, conductivity measurements are highly variable with no evidence of asymptotic behavior. A number of datasets (notably Landfill P) are exhibiting apparent upward trends with conductivity values approaching 100,000 µmhos/cm.

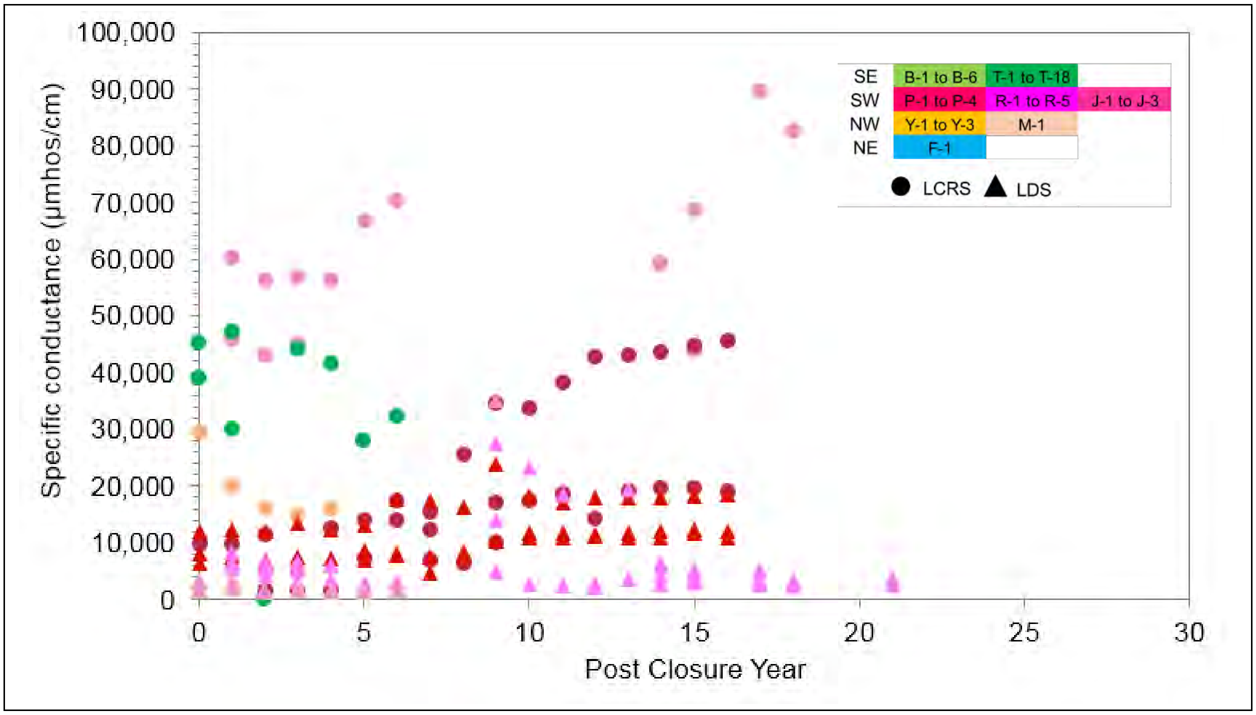

Figure 6-2. Temporal variability in specific conductance

Total Dissolved Solids (TDS)

Limited TDS data were available for the study and are not plotted, although it is expected that TDS trends would correlate closely with specific conductance in which case no evidence of declining or asymptotic behavior would be expected. TDS analysis was conducted on samples from the LCRS at Landfill R and the LDS at Landfill B. LCRS concentrations for two data points at Landfill R were 8,200 and 20,500 mg/L (mean 14,350 mg/L). Based on applying a DAF of 20 to the SMCL limit value of 500 mg/L, the mean is above but consistent with the modified benchmark of 10,000 mg/L. Overall concentrations in the LDS are one or two orders of magnitude lower than the LCRS.

6.1.5 Dissolved Organic Matter

Dissolved organic matter (DOM) in leachate is composed of a variety of constituents that are collectively expressed in terms of biochemical oxygen demand (BOD) and chemical oxygen demand (COD). A higher oxygen demand generally implies a higher organic loading, even though other constituents such as ammonia and nitrogen also exert an oxygen demand; therefore, COD and BOD are useful indicators of pollution potential posed to receiving systems such as surface water bodies. BOD is generally considered as a measure of biologically degradable organic materials and is measured as oxygen consumption over five days, hence the suffix BOD5 often used in the annotation for this parameter. COD, on the other hand, also includes recalcitrant compounds that are not easily biologically degradable; as such, COD concentrations are generally substantially higher in leachate than BOD concentrations. BOD and COD data are not collected at any case study site.

A measure of some of the constituents of DOM is provided by total organic carbon (TOC). TOC has been analyzed on a handful of occasions in both the LCRS and LDS at Landfills P and T. Values in Table 6-1 range from about 340 to 10,580 mg/L with a median concentration of 3,800 mg/L, which compares reasonably close to the mean of about 1,620 mg/L reported for two HW sites by EPA (2002). Mean and median TOC concentrations in the LDS are two to three orders of magnitude lower than in the LCRS. The maximum TOC concentration in MSW leachate reported by Kjeldsen et al. (2002) was 29,000 mg/L.

In summary, DOM data do not appear to be routinely analyzed in leachate at Subtitle C facilities. COD and BOD data were not reported for any HW landfill in the study by EPA (2002). The limited data available for this study generally support the finding by Tian (2015) that DOM concentrations are insignificant in HW leachate when compared with MSW leachate (although this does not imply that DOM concentrations in HW leachate are insignificant with respect to potential impacts to HHE). No MCL or SMCL is specified for any constituents of DOM listed above. Overall, beyond complying with potential influent limitations on COD/BOD imposed by off-site wastewater treatment facilities, it is assumed that concentrations of DOM in leachate are of little interest to Subtitle C landfill operators.

6.1.6 Major Cations and Anions

With the exception of alkalinity, which is not analyzed at any case study landfill, data for the other major cations (calcium, magnesium, potassium, and sodium) and anions (chloride, and sulfate) were available in both the LCRS and LDS at a number of case study sites. Given the nature of HW, they are also expected to be present in significant concentrations in leachate. Tian (2015) reported that concentrations of cation and anions in HW leachate are broadly similar to MSW leachate. These parameters offer a meaningful opportunity to estimate the time to reach asymptotic levels and/or MCL/SMCL limit values, which are specified for sulfate (MCL = 250 mg/L) and chloride (SMCL = 250 mg/L). Using a DAF of 20, as previously discussed, the modified benchmark for comparison of sulfate and chloride concentrations to limit values is 5,000 mg/L.

Chloride

As presented in Table 6-1, leachate chloride concentrations ranged widely from about 50 to 34,320 mg/L, with similar mean and median concentrations of 9,870 mg/L and 9,290 mg/L, respectively. This is higher than the range of 150 to 4,500 mg/L reported for MSW landfills by Kjeldsen et al. (2002). The mean LCRS chloride concentration reported for two HW landfills by EPA (2002) was 11,700 mg/L, which suggests that chloride concentrations have remained fairly constant in HW leachate over the intervening period. These values exceed the modified benchmark by a factor of about two. However, the temporal plot of LCRS chloride data (Figure 6-3) indicates that many datasets exhibit no downward trend or are even trending upwards, although several data points are below the modified benchmark (shown as the dashed line in the figure). Overall, it cannot be concluded that LCRS chloride concentrations should be expected to routinely meet the modified benchmark within 30 years of closure. However, LDS concentrations routinely exhibit stable trends and are all below the modified benchmark (most LDS concentrations meet the SMCL directly).

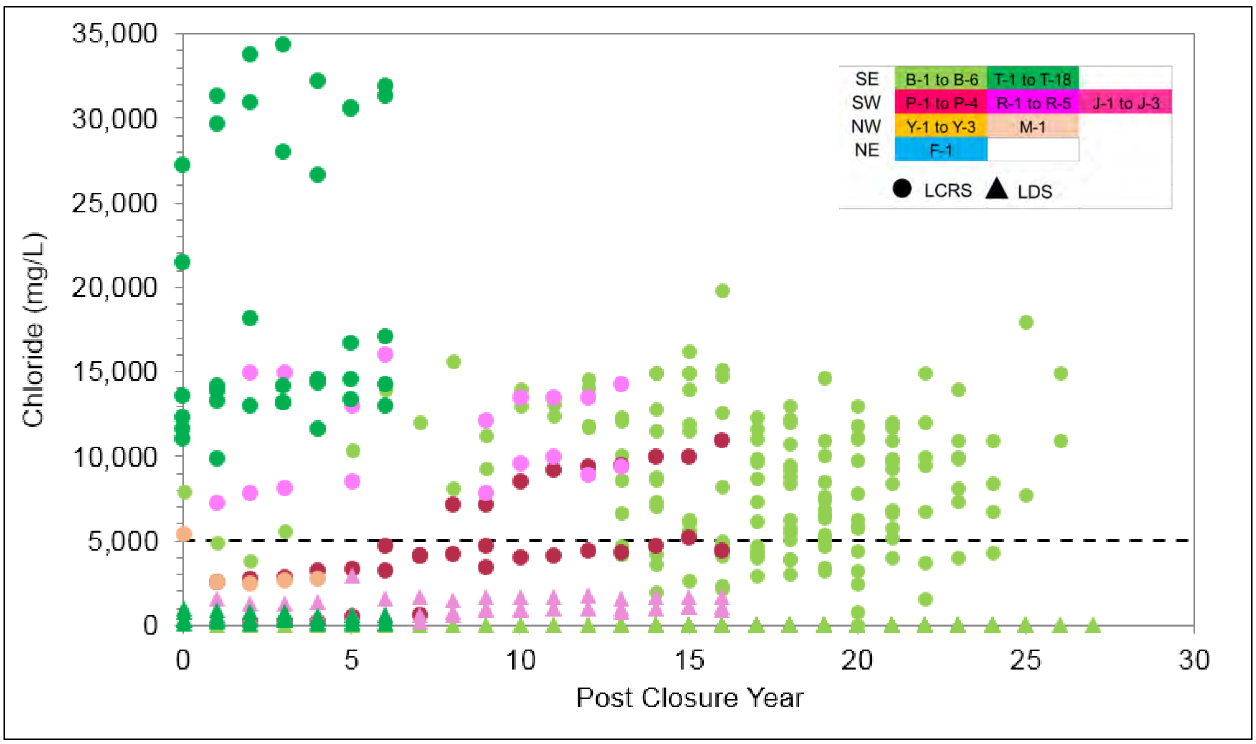

Figure 6-3. Temporal variability in chloride

Sulfate

Sulfate data availability at the case studies is limited to Landfills T, J, and R (Figure 6-4). LCRS concentrations range widely from 20 to 10,500 mg/L, although the median and mean values are similar at around 4,800 mg/L, which suggests the variability is limited to a few outliers. The mean/median concentration is slightly below the modified benchmark of 5,000 mg/L. The mean sulfate concentration reported for two HW landfills by EPA (2002) was below 3,000 mg/L. Concentrations of sulfate in the LDS are very similar to those in the LCRS. The median and mean concentrations in the LDS are 5,100 mg/L and 4,650 mg/L, close to the modified benchmark of 5,000 mg/L. There is no evidence of trending to asymptotic levels in either the LCRS or LDs dataset presented in the figure.

It is noted that the reasons why sulfate should persist at high concentrations in HW leachate are not well understood. It is possible that the waste contains a sulfate source such as gypsum-containing wallboard, although it is not known why significant quantities of this material would be disposed of in an (expensive) Subtitle C landfill rather than an MSW or a construction and demolition debris landfill facility. Sulfate would typically be reduced to sulfide under the anaerobic conditions assumed to be prevalent in closed landfills (Plaza et al., 2007). For example, Kjeldsen et al. (2002) reported sulfate concentrations in the range of 10 to 420 mg/L in methanogenic leachate. It is speculated that HW landfills have much lower DOM availability and thus reduced microbial activity relative to MSW landfills, and redox conditions may not reach a sulfate-reducing environment (i.e., Eh below -250 mV).

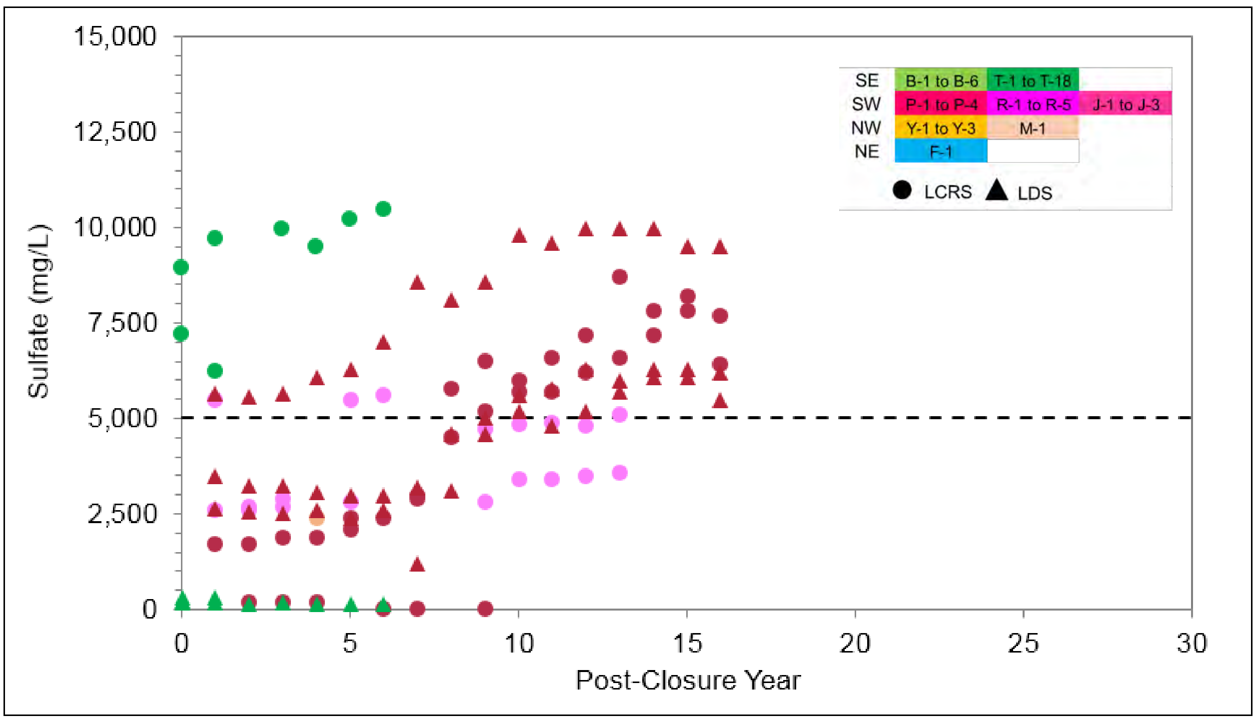

Figure 6-4. Temporal variability in sulfate

Ionic Charge Balance

Schoeller diagrams (absent alkalinity) were constructed to concurrently illustrate the concentrations of six cations and anions in LCRS leachate at Landfill R (Figure 6-5). Data are collected separately for R-1 and as a combined sample for R-2 to R-5. The figure provides a geochemical "fingerprint" of data collected over 13 years of PCC, with each line on the two graphs representing a single year. With the exception of sodium, and to a lesser extent chloride, the very close bunching of lines in the figure shows there has been no significant change in overall geochemical makeup of leachate over the 13 years of PCC. Although not discernable from these graphs, the variability in sodium, chloride, and sulfate values represents concentration fluctuations that are apparently random on a year-on-year basis rather than evidence of trend behavior.

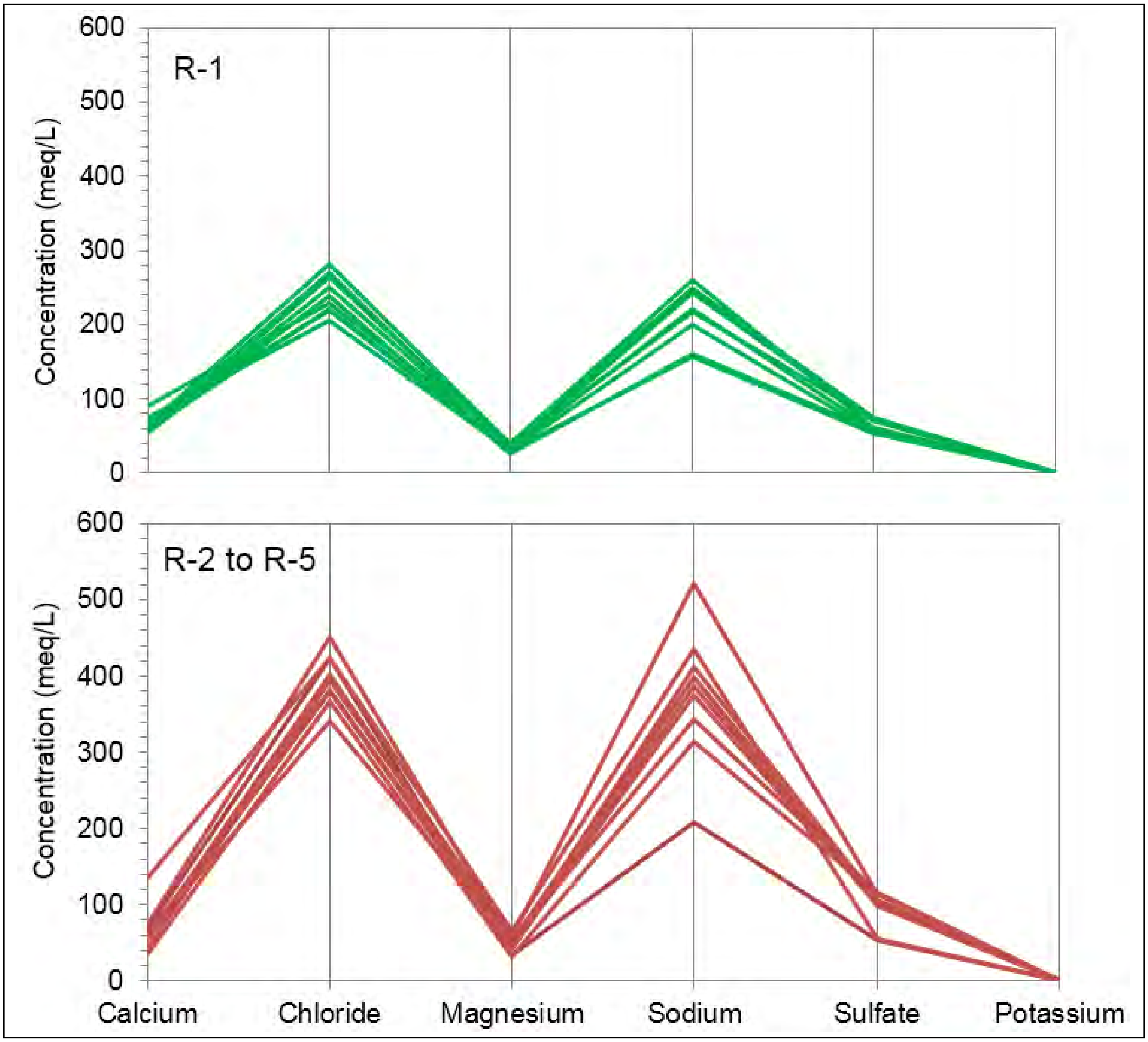

Figure 6-5. Schoeller diagrams for cations and anions, Landfill R

6.1.7 Trace Metals

Trace metals selected for this study comprise arsenic, cadmium, chromium, lead, and nickel. These five analytes were selected based on their inclusion in EPA (2002). As shown in Table 6-1, MCLs are specified for arsenic, cadmium, and chromium while a limit value for lead is provided as an action level. Using a DAF of 20 as previously discussed, modified benchmarks can be established for arsenic (200 μg/L), cadmium (100 μg/L), chromium (2,000 μg/L), and lead (300 μg/L).

Review of data from EPA (2002), which reported on leachate quality from three HW landfills, indicates that the mean concentration of all five trace metals in that study was similar (within the same order of magnitude) but slightly lower than the corresponding values reported in this study. This may reflect the reduced practice of co-disposing of MSW and other non-hazardous wastes with HW in the intervening period, as MSW has been shown to offer significant buffering capacity for adsorption of trace metals (Gibbons et al., 2014). Overall, however, the long-term similarity in concentrations over a long period suggests that trace metals in leachate may be relatively stable or increase only slightly over time. This is consistent with findings reported by Tian (2015) that trace metal concentrations were relatively lower in HW landfills than in MSW leachate and tended to exhibit steady or slightly increasing trends. Concentrations of trace metals in the LDS are universally lower than in the LCRS and typically meet limit values without the need for DAF modification.

Arsenic

Arsenic data are highly variable with no evidence of asymptotic behavior, particularly in the LCRS dataset (Figure 6-6, note log scale on y-axis). The variability observed is not dissimilar to the range of 10 to 1,000 μg/L reported for MSW landfills (Öman and Junestadt, 2008). Although a significant proportion of the data are below the modified benchmark limit of 200 μg/L (indicated by the dashed line in the figure), the relatively high concentrations of arsenic that persist long into the PCC period may be due to the relatively alkaline pH of leachate, potentially attributable to the practice of solidifying and stabilizing HW with cement, fly ash, or kiln dust prior to disposal. Arsenic is generally more mobile under alkaline conditions (Smedley and Kinniburgh, 2002). Another observation that is evident from inspection of the figure is the clustering of data according to sites. This suggests that arsenic concentrations in HW leachates are highly site-specific and dependent on the cover soils used and/or sources of waste placed in a particular unit.

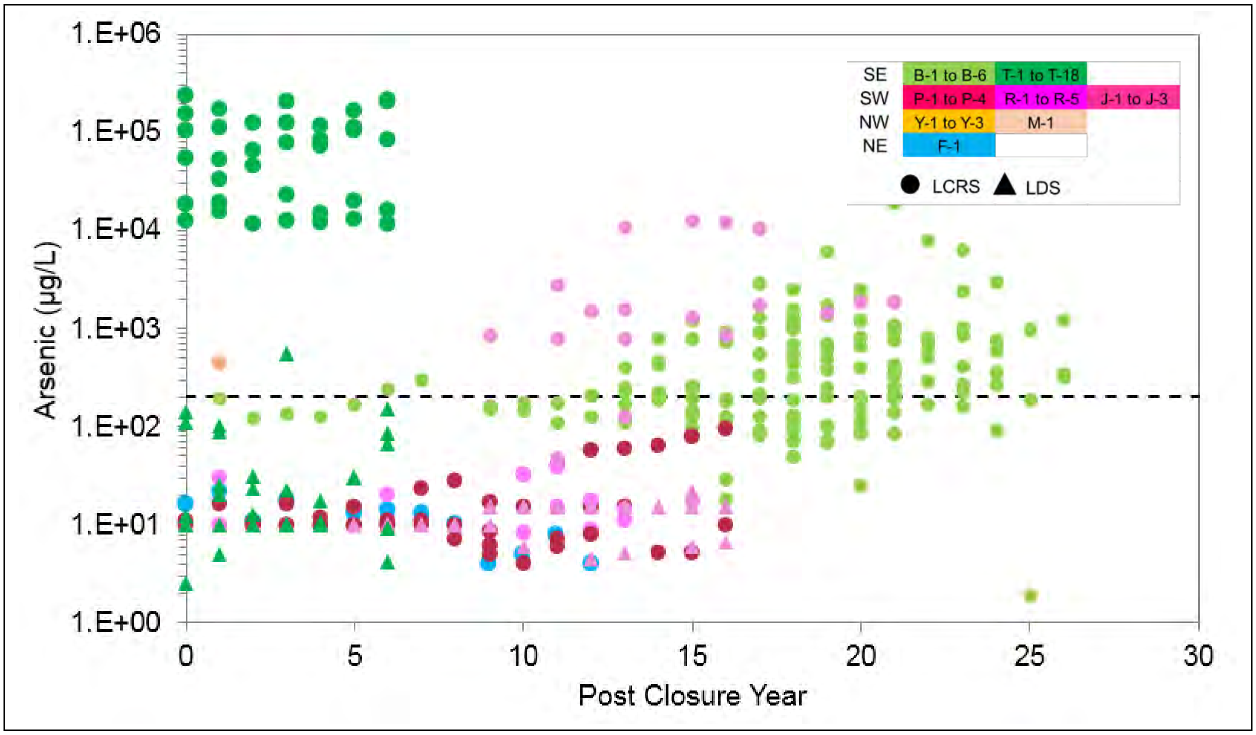

Figure 6-6. Temporal variability in arsenic

The marked difference between mean and median values of arsenic in the LCRS dataset suggests that a few data are skewing the overall results; as such, the median value (220 µg/L in the LCRS, 11 µg/L in the LDS) is considered a better representation of leachate quality. The median concentration of arsenic in LCRS leachate slightly exceeds the modified benchmark.

Total Chromium

Chromium (as total chromium) data from the case studies are highly variable with concentrations ranging over six orders of magnitude. The data do not suggest a trend to asymptotic behavior (Figure 6-7), although almost all data are below the modified benchmark limit of 2,000 µg/L indicated by the dashed line in the figure. The majority of data are not dissimilar to the range of 20 to 1,500 µg/L reported for MSW landfills (Öman and Junestadt, 2008).

The similarity between mean (282 µg/L) and median (130 µg/L) concentrations of chromium in leachate suggests that the variability in data is extensive and not limited to a few data points. The median value in the LCRS (130 µg/L) slightly exceeds direct comparison to the MCL of 100 µg/L but easily meets the modified benchmark. The median value in the LDS (17µg/L) is slightly above the MCL. The low concentrations of chromium in leachate may be due to the relatively alkaline pH, which may be attributable to the practice of solidifying and stabilizing HW with cement, fly ash, or kiln dust prior to disposal.

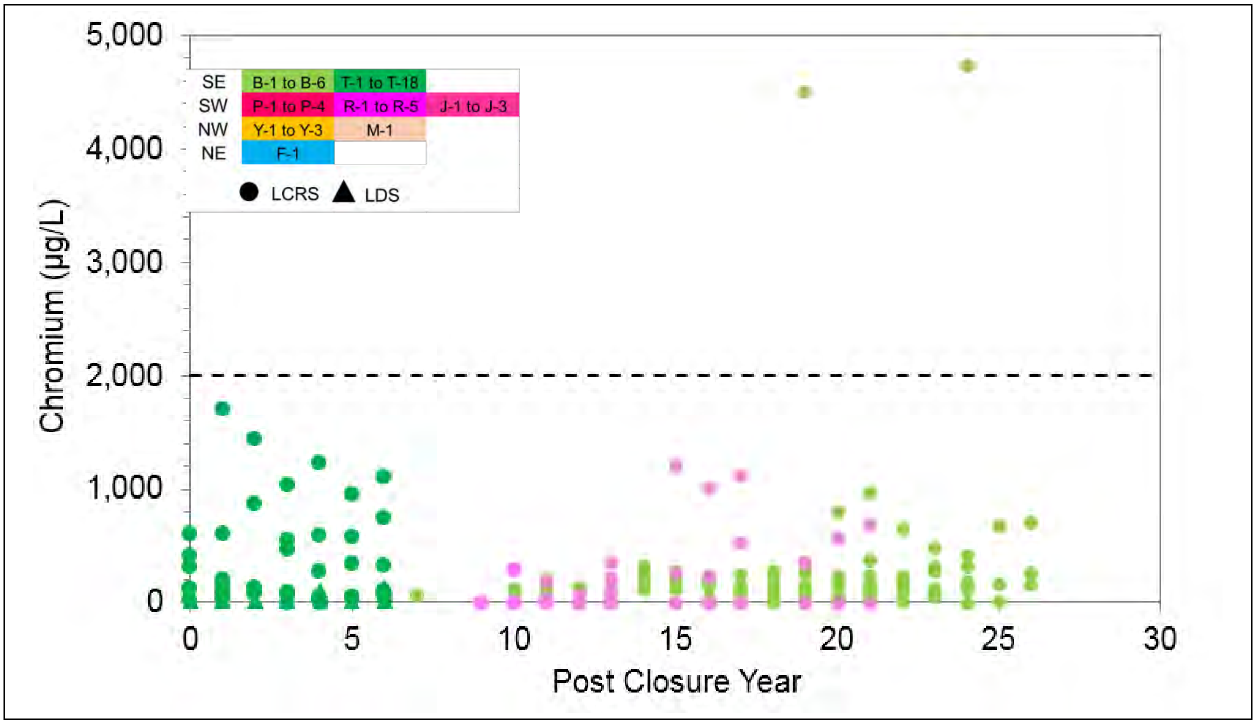

Figure 6-7. Temporal variability in total chromium

Lead

Similar to chromium data, lead concentrations in leachate are highly variable with no evidence of asymptotic behavior (Figure 6-8). However, with the notable exception of recent data from Landfill B, most data are below the modified benchmark indicated by the dashed line in the figure. Concentrations are generally below the upper-bound value of 5,000 µg/L reported for MSW leachate by Öman and Junestadt (2008).

Like chromium, the similarity between mean and median values of lead in leachate suggests that the variability in data is extensive. The median value in the LCRS (33 µg/L) slightly exceeds direct comparison to the action level of 15 µg/L, while the median value in the LDS (15 µg/L) equals the action level. Overall, this appears promising in terms of trace metal concentrations in leachate from Subtitle C landfills meeting acceptable limit values within the presumptive 30-year PCC period. The low concentrations of lead in leachate may again be due to the relatively alkaline pH.

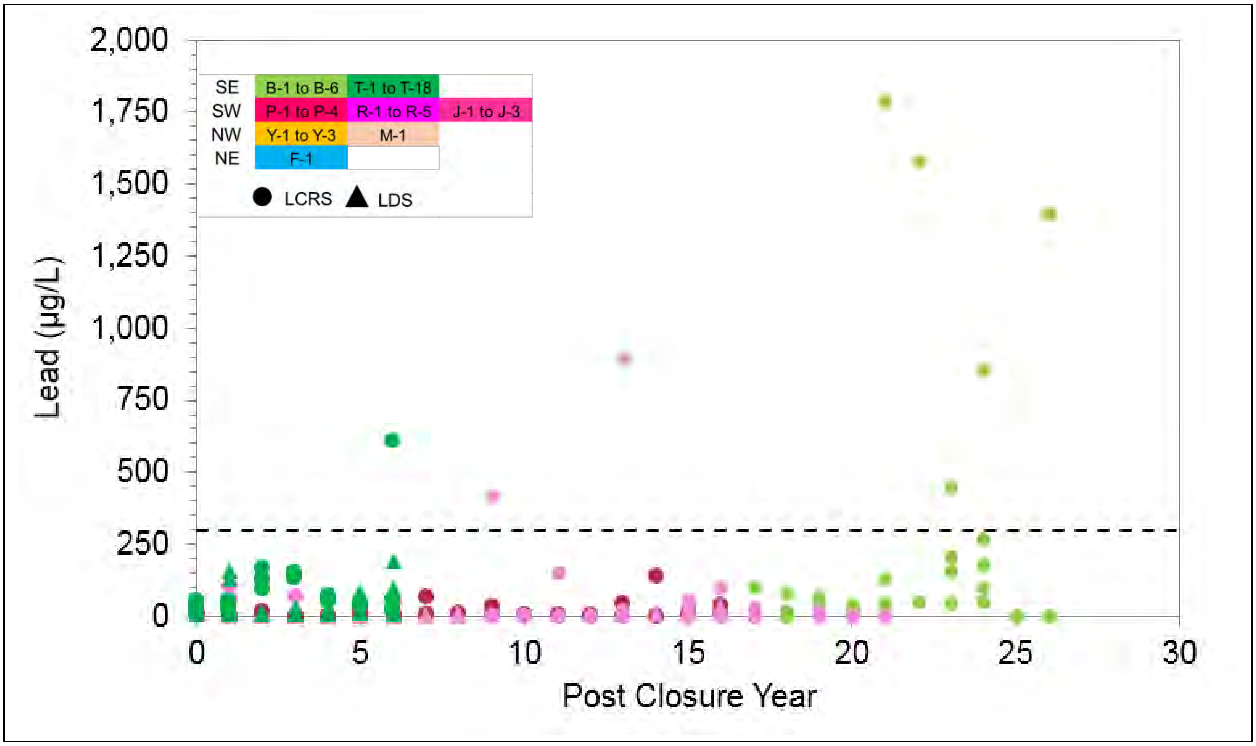

Figure 6-8. Temporal variability in lead

6.1.8 *Volatile Organic Compounds*

For this study, trace VOCs—represented by a group of 12 aromatic hydrocarbons and chlorinated solvents (and degradation products) frequently observed to be present in landfill leachate—were selected as constituents of interest. Of all the groups of chemical constituents considered in this study, VOCs exhibited the most variability in concentration between different landfill units, and sometimes between different sumps within the same unit.

As indicated in Table 6-1, the variability among the LCRS data is significant for all VOCs, with reported concentrations ranging over six or more orders of magnitude. LDS data exhibit far less variability than LCRS, with similar median and mean concentrations for all but one VOC (trichloroethylene). The wide discrepancy between median and mean values in the LCRS suggests that the data are skewed by a few outliers; as such, the median is considered to be more representative of "typical" concentrations. This is supported by comparison of LCRS data to values for VOCs reported for MSW leachate. Median values of all VOCs from this study fall within the concentration range reported by Kjeldsen et al. (2002) and Öman and Junestadt (2008) but mean values significantly exceed the reported range for MSW leachate.

MCLs are specified for all but two of the VOCs selected. The median value of VOCs in the LCRS in this study only exceeds the MCL in four out of ten cases, although the four failing parameters easily meet the DAF-adjusted benchmark. The median LDS concentration directly meets the MCL in eight of the ten cases, the failures being trichloroethylene and vinyl chloride. Again, these two parameters easily meet the DAF-adjusted benchmark.

Review of data from EPA (2002), which it should be noted included data from only two HW landfills, indicates that mean concentration of all VOCs were slightly higher in that report than the median values calculated in this study. This may be suggestive of an overall downward trend in the VOC content of HW in the intervening years.

Temporal variability and trends within the VOC category of leachate constituents are illustrated using benzene (Figure 6-9, note log scale on y-axis). Overall, the data are somewhat variable, although with the exception of Landfill B there is evidence of downward trending behavior. A significant number of data are below the DAF-adjusted benchmark (20 × MCL), which is indicated by the dashed line in the figure.

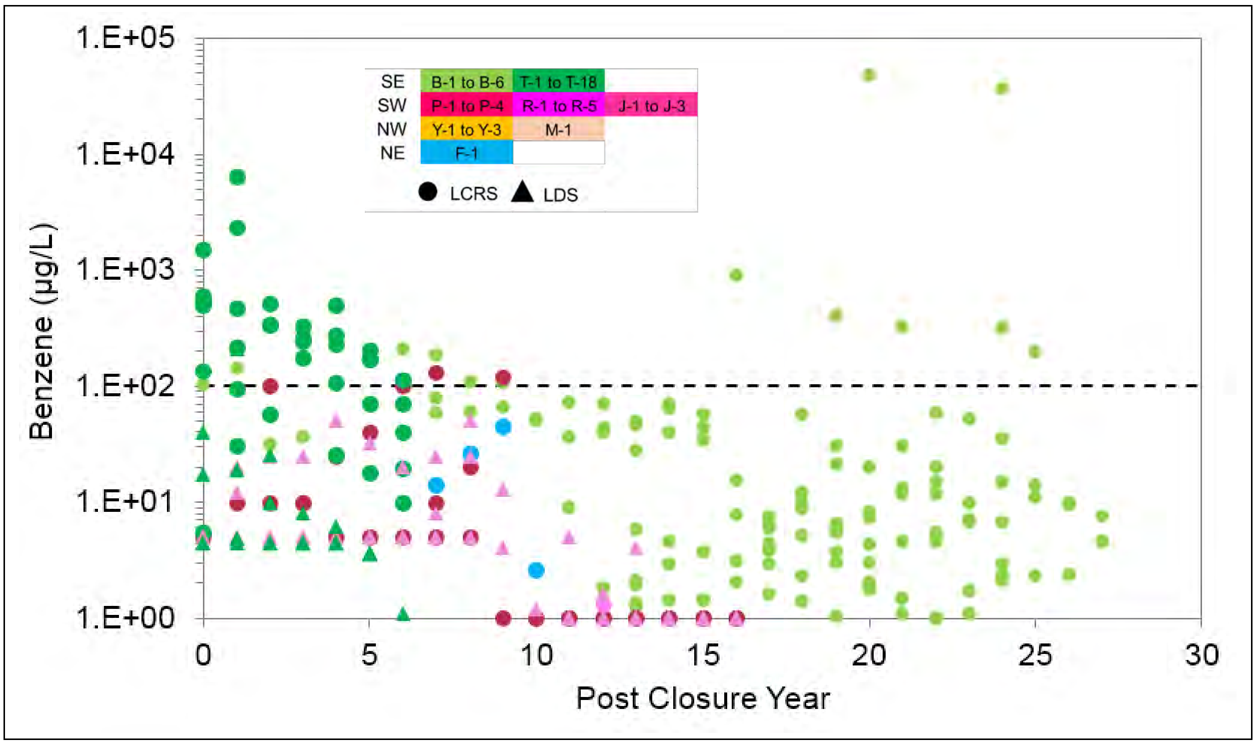

Figure 6-9. Temporal variability in benzene

7. SUMMARY AND CONCLUSIONS

7.1 Study Implications on Understanding Long-Term Landfill Performance

The purpose of this section is to summarize findings from analysis of liquids management data for double-lined hazardous waste landfills located throughout the United States. Specifically, LCRS and LDS flow rate and flow chemistry data were evaluated for 45 landfill units at nine closed Subtitle C sites. Design and operational characteristics of the study units were summarized in Chapter 3 of this report along with post-closure data availability. These data were used to evaluate:

- Long-term trends in leachate generation rates;
- Leakage rates and hydraulic efficiency of primary liner systems; and
- Leachate chemistry data, including time for constituents of interest to degrade and potentially reach asymptotic levels or water quality limit values.

The primary aims of this assessment are to understand whether existing regulations for containment system design and performance evaluation at Subtitle C landfill facilities are appropriate and what main issues or shortcomings in data collection are evident that could be addressed.

7.1.1 Leachate Flow Rate and Trends

The focus of this discussion is to address the following two key research questions: How much leachate is generated in closed Subtitle C landfills and what are the potential effects of site location (climatic region), cover system design and construction, facility operation or waste type, and other factors on leachate generation rates? How do predictions of leachate generation using the HELP Model compare to observed generation rates at these sites?

General Observations Based on Field Data

Flow data in the LCRS and LDS at the case study sites were summarized in Section 4.1. In general, LCRS and LDS flow volumes declined soon after closure with a steady or decreasing trend behavior thereafter. Discrepancies or short-term deviations from general trends were generally attributable to known O&M issues affecting cover system performance. For example:

- Landfill B: A spike in the LCRS flow rate from unit B-6 was attributed to a localized cap failure. This has since been repaired and the flow rate has returned to similar levels as recorded for other units at the landfill.

- Landfill T: Unit T-16 exhibited an increase in LCRS flow rate between years 7 and 16 of PCC that was finally traced to a localized cover system failure. The cover was repaired in year 16, which resulted in rapid reduction in LCRS flow to rates similar to other units.
- Landfill D: Liquid volumes in the LDS for D-2 were observed to increase for the first 4 years after closure before exhibiting a declining trend thereafter. This cell had a short operational period of only 1 year, during which time the contractor reported difficulties in fully eliminating rainwater from the unit during construction and waste filling. As such, LDS volumes could be attributable to the potential this excess water contributing to construction, compression, and consolidation water rather than leakage through the primary liner. The LDS flow volumes are anticipated to continue to lessen as this excess water works its way out of the unit.

Erosion damage to cover systems is a key factor affecting landfill performance in the PCC period, with higher costs and effort associated with repairs needed during initial years of PCC before cover vegetation is fully established which helps stabilize the system. Breaches in the cover system may result in relatively long-term setbacks in terms of returning LCRS flow rates in affected landfill units to expected levels once the cover is repaired. In this regard, it may be beneficial to maintain hydraulic separation between the liners of different units, and potentially minimize the size of individual units which may assist in isolating the impacts of a potential cover damage.

This further highlight the importance of routine cover inspection in identifying problems related to erosion damage, water ponding on the cover system, or other issues, as this facilitates timely maintenance and repair to minimize the likelihood of water seeping back into the cell. Furthermore, as weather patterns seem to be changing, it is advisable that routine inspections be supplemented with non-routine cover ones following an extreme weather (e.g., flood, excessive precipitation, drought, or tsunami) or seismic event. The largest challenge at one of the examined sites was erosion control and protection of the cover specifically due to high rainfall following a long spell of dry weather, particularly in the first few years of closure before cover vegetation has matured.

Potential Factors Affecting Leachate Flow in the LCRS and LDS

All liner and cover system construction at the 45 landfill units included in this study was performed under a program of third-party CQA; therefore, the potential effects of construction in the absence of CQA cannot be examined.

The potential effects on relative LCRS and LDS flow were qualitatively examined with regard to several variables as summarized in Table 7-1, including:

- Time in post-closure;

- Climatic and hydrogeologic conditions at the site (average annual rainfall, average annual snowfall, depth to groundwater, and types of subsurface soils); and
- Containment system design and material specifications (cover type, primary liner type, and secondary liner type).

Consistent with previous report sections, the table is structured around the 13 unique configurations for the containment system design that are represented amongst the 45 study units. Although it is important to recognize the limitations in the small sample size and non-random nature of the case studies, the following observations are made:

- The table clearly illustrates that rainfall has an effect on leachate generation, with higher LCRS flows recorded at the four wet sites (Landfills B, T, D, and F) and very low or negligible flows recorded at dry sites (Landfills J, R, and Y). Landfill M is excluded from this comparison since only intermediate cover had been installed at this site. It is noted also that Landfill J is a special case at which a landfill overfill liner is integrated with the cover; as such, leakage through the cover system would be expected to be very low, independent of rainfall. Overall, the incidence of precipitation as rainfall versus snowfall does not appear to affect leachate generation.
- Ignoring Landfills J and M as unrepresentative, the performance of three different final cover system designs was evaluated as part of this study. Six units at Landfill B feature a reversed CCL/GM cover design, while nine units at four sites (Landfills P, Y, D, and F) feature a composite GM/GCL rather than GM/CCL cover barrier design at the other 27 units. For final cover systems, the units in this study with the GM/GCL design had slightly better overall performance in terms of flow reduction than GM/CCL. The reversed CCL/GM design was leakiest for the units evaluated here.
- In all cases, placement of cover leads to a reduction in the LCRS flow rate, including Landfill M which has only 12-inchs of intermediate cover soil in place. Although LCRS flows are an order of magnitude higher at Landfill M than the other three dry sites.
- In general, LDS flows are affected by LCRS flows (as would be expected). But, depth to groundwater may significantly affect relative LDS flows, with higher flows recorded at wet sites with shallow groundwater (Landfills B, T, D, and, to some extent, P). Hydraulic connection between groundwater and the secondary liner has not been established at any site. Thus, it cannot be concluded that groundwater rather than infiltration of rainwater is the main alternative source of LDS liquids.
- Four sites (Landfills P, Y, D, and F) feature a GM-only barrier in the primary liner, while all other designs feature a composite GM/CCL barrier. With the exception of Landfill P, the primary liner design also does not appear to affect LDS flows.

Table 7-1. Summary of potential factors affecting relative flow in the LCRS and LDS

Design configuration	Study unit(s)	Years in post-closure	Site details				Containment system design[1][2]			LCRS flow[3]				LDS flow[3]			
			Geographic Region	Annual precipitation (in.)	Depth to groundwater (feet)	Subsurface soil type	Cover barrier design	Primary liner barrier design	Secondary liner barrier design	>100 gpad	11-100 gpad	1-10 gpad	<1 gpad	>10 gpad	1-10 gpad	0.1-1 gpad	<0.1 gpad
1	B-1 to B-6	22-29	SE	47	<5	Claystone	CCL/GM-H30	GM-H80/CCL	GM-H80/CCL		3	3			4	2	
2	B-7 and B-8	11-17					GM-H60/CCL			1		1		2			
3	T-1 to T-18	7-23	SE	70	<5	Sandy silt, clay	GM-H60/CCL	GM-H60/CCL	GM-H60/CCL		8	8	2	8	8	2	
4	J-1 to J-3	17	SW	11	300	Clays, sandstone	Landfill overfill liner	GM-H60/CCL	GM-H60/CCL				3			3	
5	R-1	13	SW	6.5	250	Sands, clays	GM-H80/CCL	GM-P40/CCL	GM-P40/CCL			1					1
6	R-2 to R-5							GM-H80/CCL	GM-H80/CCL			4					4
7	P-1	21	SW	28	40	Clay	GM-H60/CCL	GM-H60	GM-H60/CCL				1	1			
8	P-2 to P-4	13					GM-H60/GCL					1	2	1	2		
9	Y-1	10	NW	10	120	Gravelly sands, silty clays	GM-H40/GCL	GM-H60	GM-H40/CCL			1					1
10	Y-2 and Y-3							GM-H80	GM-H60/CCL			2					2
11	M-1	4	NW	9.5	200	Clays	Soil	GM-H60/CCL	GM-H60/CCL		1					1	
12	D-1 and D-2	6-9	NE	42 (17)[4]	10	Clays, gravelly sands	GM-L40/GCL	GM-H60	GM-H60/GCL		1	1		1	1		
13	F-1	12	NE	40 (60)[4]	90	Sands, silty loam	GM-L40/GCL	GM-H60	GM-H80/CCL		1				1		

Notes:
1). GM = geomembrane, -H = high density polyethylene, -P = polyvinyl chloride, -L = linear low density polyethylene. The number denotes GM thickness (mil).
2). CCL = compacted clay liner, GCL = geosynthetic clay liner.
3). The number of units with the average annual flow in the range shown over last 3 years of post-closure. Gpad = gallons per acre per day.
4). Average annual snowfall in inches shown in parenthesis.

Predicted vs. Observed Trends in Leachate Flow

Although it is reasonable to expect that leachate generation rates generally trend downwards after cover placement, it may not be reasonable to expect that flow rates will decline at such a significant rate over the long term.

In order to better understand behavioral trends in leachate generation based on field observations, annual LCRS flow measurements were compared to annual flow rates predicted using the HELP Model. If the model provides an accurate prediction of long-term leachate flow post-capping, it should be expected that LCRS flow rates would decrease exponentially to a value approximating the quasi-steady state flow rate predicted by the model, after allowing for a reasonable time lag for water already in the waste body prior to capping to percolate down to the LCRS and be removed.

Overall, the HELP Model appeared to be better suited to predicting long-term LCRS flow at wet rather than dry sites, consistent with previous findings (e.g., Vorster, 2001). The model predicts zero or near-zero LCRS flows at dry sites, whereas some LCRS flow was observed at all four dry case study landfills (although three had no/negligible LDS flow). Although this study did not focus in detail on this aspect of the model's application, it is suggested that the model significantly underestimates lateral flow where the thickness of liquids on the primary liner is very small. This manifests as a predicted LDS flow that exceeds the corresponding LCRS flow, although in both cases the volumes are very low (this issue was observed where modeled flows were in the range of 10-4 to 10-7 gpad).

Selected results from 6 of the 13 design configurations (different cover, primary liner, and LCRS/LDS drainage layer) represented by the 45 case study units were reviewed in detail in Section 4.2.2. The selected results featured four of the case study sites: wet Landfills B and F and dry Landfills R and Y. Based on these results, if the requirement under §264.310(b)(2) that operation of the LCRS should be continued "until leachate is no longer detected" is interpreted strictly to mean that LCRS operation must continue until leachate flow is at or near zero, then this cannot reasonably be achieved, even at extremely dry sites. Therefore, it is more appropriate to apply the performance-based standard implicit in 40 CFR §264.117 that PCC is required until a demonstration that the absence of care would not pose a threat to water quality at the POC. Such demonstrations could be made on the basis of leachate flow and concentrations having reached quasi-steady-state, predictable, and non-impacting conditions, albeit at a non-zero flow rate.

Data from this study suggest the rate at which LCRS flow rate declines post-closure may be three to five times slower at most Subtitle C landfills than previously suggested by EPA (2002). The dataset utilized in this study was more comprehensive (45 individual units with up to 29 years of post-closure data) than the 2002 study (33 units with up to 9 years of post-closure data). In particular, the lack of data from many units beyond year six of PCC in the earlier study, and the very low flow rates reported for a few units after year six suggests that the dataset may have been skewed by a small number of very dry or high performing sites. If current industry projections of post-closure leachate generation are based on EPA (2002), expectations may need to be reset in terms of the rate of decline in LCRS flow. Rather than an order of magnitude decrease every 5 years, it may be more reasonable to expect an order of magnitude decrease every 15−20 years. However, more field studies are needed to validate this finding before recommendations for adjusting current industry projections and accruals for leachate management are made. Since the rate of decrease also appears to be linked to maximum leachate generation at closure, this emphasizes the importance of good stormwater control during the latter stages of operation and competent cover design and construction performed under strict CQA procedures so as to minimize leachate generation immediately after closure.

7.1.2 Liner Design and Performance

The focus of this discussion is to address the following key research question: What conclusions can be drawn regarding the hydraulic efficiencies of double-liner systems (i.e., leakage rates through primary liners) at Subtitle C landfills based on available LCRS and LDS data? It should be made clear that all case study sites reported competent CQA programs during liner and cover construction events. As such, the effect of CQA practices on long-term containment system performance cannot be assessed. The findings in this section are thus predicated on the assumption that good CQA will be employed during liner and cover system installation.

Apparent Hydraulic Efficiency of the Primary Liner

The "apparent" hydraulic efficiency, EA, of the primary liner can be calculated as the flow in the LDS relative to the flow in the LCRS (Section 5.1.1). The higher the value of EA, the smaller the flow rate from the LDS compared to the LCRS flow rate. Based on the data provided only 5% of the evaluated data demonstrated an effective efficiency greater than 99% with the bulk of the data (73%) exhibiting an efficiency that is less than 90%. It is noteworthy to mention that the leachate flow from some of the LDS of some units was greater than that from the LCRS. With the data provided, it is unclear if the source of the increased in the liquid flow from the LDS(s) is an external source (e.g. groundwater) or a major defect in the liner system. The liner efficiencies are significantly higher at dry than at wet sites: 79% of the data from dry sites produced E_A values exceeding 99% (Table 5-1B), whereas only 5% of the data from wet sites did so (Table 5-1).

Modeled Hydraulic Efficiency of the Primary Liner

There is a high degree of uncertainty associated with using the HELP Model to calculate efficiency as the method does not utilize the site-specific available data. As described in Section 5.2.1, expected leachate generation rates in the post-closure period were simulated by the HELP Model using default input assumptions, including the number of geomembrane defects. This allowed the modeled hydraulic efficiency, EM, of a liner system to be calculated using model output values as substitutes for field data of LCRS and LDS flow. Values for EM were calculated for the 13 unique design configurations reflecting the study units. Results were summarized in Table 5-2. Calculated EM values varied from 93 to 99.9%, close to corrected E_C.

Corrected Hydraulic Efficiency of the Primary Liner

By distinguishing liquids with similar chemical signatures, leachate chemistry data can potentially be used to quantify the portion of liquids comprising total LDS flow that should be attributable to primary liner leakage as opposed to other sources. This approach has two major limitations:

1. Only leachate (i.e., LCRS liquids) contributes to the chloride concentration in the LDS. Any contribution of chloride from other sources (e.g., brackish groundwater) would serve to increase the numerator in the expression and thus increase the magnitude of the CF value computed.
2. Chlorides are not adsorbed to soils in the primary liner or drainage layers, or otherwise attenuated as it passes through the primary liner.
3. It is noted that this analysis may overestimation of the liner efficiency since it assumes no attenuation in the liner system.
4. The concentration of the indicator chemical and flow data must be temporally coincidental in the LCRS and LDS in order to calculate a corrected liner efficiency, E_C.
5. Specific to this study, data available for calculating E_C were limited to 173 sets of readings at 17 units from only three sites (Landfills B, T, and J).

Landfill J is located in an arid climate with little to no LCRS flow. In most cases, the LDS flow volumes, while minor, exceeded LCRS flow volumes. Based on the E_C value calculated only 20–40% of the total LDS flow could be attributed to primary liner leakage at the site. The E_C calculations for the other two sites (B and T) that receive more than 25 inches of rain per year, showed that less than 3% of the liquids generated from the LDS are attributable to leachate leakage through the liner. This is a significant improvement over E_A values of 63 to 93% calculated for corresponding units in Landfill B and E_A values of 54 to 95% calculated for corresponding units in Landfill T. However, we note again that these E_c values are most likely an overestimation of the actual liner efficiency as stated above.

Comparison between Apparent, Modeled, and Corrected Liner Efficiencies

The results for liner efficiencies computed using the three methods discussed in this report are compared in Table 7-2 for the three sites (Landfills B, T, and J) for which values from all three methods could be calculated. Modeled liner efficiency (E_M) values shown in the table are directly copied from results in Table 5-2. Corrected liner efficiency (E_C) values are average values for each different design configuration based on the values for individual units shown in Table 5-3. Finally, apparent liner efficiency (E_A) was calculated based on monthly average LCRS and LDS flow data for units where concurrent chloride concentration data were also available for calculation of an E_C value. This allows direct comparison of corresponding values for E_A, E_M, and E_C.

For all design configurations listed in the table, E_C is greater than E_A. Although this data set is very limited and does not include the high values for E_A calculated for a number of units in dry Landfills R and Y, this nevertheless suggests that true liner efficiency is potentially higher than the simple value calculated as the LDS flow volume relative to the LCRS flow volume. Values of E_M and E_C are very close. This suggests that E_M may be a useful representation of liner efficiency where field data with which to estimate E_A or E_C are not available. For landfills constructed with good CQA, this may suggest the use of the HELP Model with default assumptions as a method of estimating the liner efficiency after the closure of a landfill.

Table 7-2. Comparison of liner efficiency calculations

Design	Climate condition	Study units	Apparent liner efficiency (E_A)	Modeled liner efficiency (E_M)	Corrected liner efficiency (E_C)	Number of data used to calculate E_C
1	Wet	B-1 to B-6	82.8%	99.93%	99.84%	90
2	Wet	B-7 and B-8	84.9%	99.92%	99.95%	19
3	Wet	T-1 to T-18	73.2%	99.58%	98.57%	64
4	Dry	J-1 to J-3	9.1%	99.98%(1)	74.2%	6

Note:
1). E_M cannot be calculated under conditions of final cover at units J-1 to J-3 due to the fact that Landfill J resides beneath an overfill landfill. Therefore, E_M was calculated for intermediate cover conditions.

7.1.3 Trends in Leachate Chemistry

A review of the technical literature revealed that leachate chemistry from HW landfills has received relatively little scrutiny in recent years. Tian (2015) analyzed leachate composition from four landfills constructed for containment of mixed LLRW and HW and compared concentrations of dissolved organic matter (measured as TOC), inorganic macro-components (including major cations and anions), and trace metals to values reported in the literature for MSW leachate, concluding that:

- Dissolved organic matter concentrations were insignificant when compared with MSW leachate;
- Concentrations of inorganic macro-components were broadly similar to MSW leachate; and
- Trace metal concentrations were relatively lower than in MSW leachate and tended to exhibit steady or slightly increasing trends.

If current expectations for the time required for the concentrations of constituents of concern in leachate to decrease to asymptotic levels or meet regulatory standards such as maximum contaminant levels (MCLs) are rooted in observations from MSW landfills, this may not be appropriate. Therefore, an important component of this study is to review concentration trends in leachate from Subtitle C landfills.

From the above, the focus of this discussion is to address two key research questions: What is the leachate chemistry at the case study sites, and does it exhibit asymptotic behavioral trends over the long-term? How does leachate chemistry at Subtitle C landfills compare with water quality limit values such as drinking water MCLs? Addressing these questions is intended to broaden an understanding of long-term leachate management at closed Subtitle C landfills in the context of the performance standard implicit in 40 CFR §264.117.

Parameter Selection and Evaluation Approach

Thirty chemical parameters were selected to represent leachate constituents of interest, based on those investigated by EPA (2002). These included water quality indicator parameters (pH, specific conductance, TDS), macro indicators of dissolved organic matter (COD, BOD, and TOC), major inorganic cations (calcium, magnesium, potassium, and sodium) and anions (calcium, chloride, and sulfate), trace metals (arsenic, cadmium, chromium, lead, and nickel), and trace VOCs frequently observed to be present in landfill leachate (represented by a group of 12 aromatic hydrocarbons and chlorinated solvents).

The general approach to the evaluation was as follows:

- Where available, leachate concentrations were compared to federal water quality standards (MCL or SMCL). However, rather than directly comparing leachate concentrations to a limit value, a universal dilution/attenuation factor (DAF) of 20 was applied to represent concentration increases that would be expected prior to detection at a POC monitoring well. This is consistent with the default DAF specified in the EPA's Soil Screening Guidance (EPA, 1996), for which a DAF of 20 is deemed protective of contaminant sources up to 0.5 acres in size. While landfills are generally much larger than that, the potential release points (i.e., potential pinhole defects and tears in liner GM barriers) are collectively much smaller than 0.5 acres. As such, this approach is appropriate for the purposes of this study. Nevertheless, it is important to note that assigning this default DAF in this way does not imply any endorsement from EPA with regard to the universal application of this approach to assessing long-term leachate management and groundwater monitoring at Subtitle C landfills.

- The availability of leachate chemistry data at the case study landfills was limited in most cases, which restricted the level of analysis that could be completed in this study. Data availability and gaps are discussed in further detail in Section 7.2.

Summary of Main Findings

There is significant variability in the data for many constituents, particularly in the LCRS where differences between maximum and minimum observed values often span six or more orders of magnitude for cations/anions, trace metals, and VOCs. For this reason, the median may be considered more representative of overall leachate quality, which is more sensitive to one or two significant outliers. The general water quality characteristics of liquids from the LCRS and LDS drainage layers are also significantly different, again by multiple orders of magnitude in many cases.

Observations from the evaluation of leachate chemistry data with regard to the five categories of interest are summarized as follows:

- Water Quality Indicators: Temporal trends in leachate pH appear relatively stable, with most readings within the range of 6.5 to 8.5 s.u. The majority of readings were alkaline mainly as a result of solidifying and stabilizing hazardous waste with cement, fly ash, or kiln dust prior to disposal. Overall, conductivity measurements were highly variable with no evidence of asymptotic behavior. Values in the LCRS and LDS are of the same order of magnitude.
- Dissolved Organic Matter: The DOM content of leachate cannot be extensively commented on in this report since these data were not routinely collected at any case study site, although TOC has been analyzed on a handful of occasions in both the leachate and the LDS at Landfills P and T. TOC concentrations were significantly lower than those reported for MSW leachate. The mean and median TOC concentrations in the LDS were two to three orders of magnitude lower than in the LCRS. The limited data available for this study generally support the finding by Tian (2015) that DOM concentrations are insignificant in HW leachate when compared with MSW leachate.
- Major Cations and Anions: With the exception of alkalinity, which is not analyzed at any case study landfill, data for the other major cations (calcium, magnesium, potassium, and sodium) and anions (chloride, and sulfate) were available in both the LCRS and LDS at a number of case study sites. Based on the literature, they are also

expected to be present in significant concentrations in HW leachate at concentrations broadly similar to MSW leachate. Overall, the cation/anion data are highly variable with no consistent evidence of asymptotic behavior or downward trends. With the exception of sodium, and to a lesser extent chloride, there has been no significant change in the overall geochemical makeup of leachate over the 13 years of PCC. Using chloride as an example of behavioral trends, concentrations ranged widely over three orders of magnitude, with a median concentration higher than the range reported for MSW landfills but broadly consistent with that reported for two HW landfills by EPA (2002).

- Trace Metals: Generally, the median concentrations of trace metals in the studies HW landfill leachate from was above the DAF-modified benchmark. Specifically, arsenic was measured at a median concentration of approximately 12 mg/L. Concentrations of trace metals in the LDS were universally lower than in the LDS. However, a review of data from EPA (2002), which reported on leachate quality from three HW landfills, indicates that mean concentration of trace metals were slightly lower than corresponding values reported in this study. The order-of-magnitude similarity in concentrations over the 15-year intervening period suggests that trace metal concentrations in leachate are relatively stable over the long term.

- Volatile Organic Compounds: Of all the groups of chemical constituents considered in this study, VOCs exhibited the most variability in concentration between different landfill units, and sometimes between different sumps within the same unit. The variability among the LCRS data was significant for all VOCs, with reported concentrations ranging over six or more orders of magnitude. LDS data exhibited far less variability, with similar median and mean concentrations for all but one VOC (trichloroethylene). The wide discrepancy between median and mean values in the LCRS suggests that the data could potentially be skewed by outliers. This is supported by comparison of LCRS data to values for VOCs reported for MSW leachate: median values of all VOCs from this study fall within the concentration range reported for MSW landfills but mean values significantly exceed the reported range for MSW leachate. MCLs are specified for all but two of the selected VOCs.

The long-term outlook for leachate management based on observations of behavioral trends amongst selected leachate data from this study is mixed. Water quality indicators and major cations/anions suggest that the materials contained in Subtitle C landfill may not degrade under landfill conditions, or only degrade very slowly, such that observations based on leachate data from non-hazardous Subtitle D landfills cannot be extrapolated to characterize the expected performance of Subtitle C landfills. On the other hand, data for trace metals and VOCs, while highly variable, thus site-specific considerations are important when evaluating these parameters.

7.2 Data Availability and Limitations

The unavailability of some critical site information and monitoring data limited the extent to which evaluations could be completed or even performed in this study. Data gaps and their effects were identified throughout Chapters 4 to 6. The focus of the discussion in this section is to reiterate key data limitations and discuss their effect on limiting the study. The goal is to provide some guidance to site operators and regulators as to what data that are not routinely collected would be valuable in demonstrating that one or more components of PCC at Subtitle C landfills could be scaled back or terminated over the long term. This is intended to provide motivation, rather than an obligation, for additional data collection. Indeed, it is important to emphasize here that this discussion is not concerned with data collection and reporting for compliance purposes. Rather, this section seeks to address the following key research question: How could current monitoring, reporting, and recordkeeping requirements be improved to better ensure that the data necessary for performance demonstrations are collected?

7.2.1 General Site Information

Overall, this study included 45 individual double-lined units at nine separate landfill facilities. Significant variability existed between the units, which is beneficial to a study of this nature. For example, individual units ranged in size by an order of magnitude from 1.4 acres to 11.3 acres, time of post-closure from 6 to 29 years (Landfill M is not closed, but has been inactive for 4 years pending final capping after waste was filled to final grades), and various LCRS and LDS flow measuring devices. In terms of variability in construction details, 11 different liner system designs and a further 11 different cover system designs were featured amongst the study units featured, combining to provide 13 unique containment system design configurations. Major variables in cover system design were represented: CCL/GM (an apparently accidental "upside down" design), GM/CCL, GM/GCL, and all soil. However, primary liner designs essentially comprised only two variables: GM/CCL and GM only. No case study units were constructed having a GM/GCL composite primary liner, although one site (Landfill D) utilizes a GCL in the secondary liner. As such, the efficacy of a GM/GCL primary liner design cannot be evaluated in this study, an important limitation, given the widespread use of GCLs in the liner systems at both Subtitle C and D landfills.

In terms of facility operations, seven of the nine landfills are commercial TSDFs accepting HW from a wide range of generators, while two are industrial facilities providing disposal for a single HW generator or as part of site remediation). As such, an original research question from this study (does waste type affect leachate concentrations?) cannot be addressed, as the commercial facilities accepted waste from multiple sources thereby making it difficult to compare waste chemistry for these sites, while there were insufficient data from non-commercial TSDFs against which to gauge variability between commercial and non-commercial operations. Further, waste manifests were not made available by any site operator, which meant that although some findings appeared to support the hypothesis that facility/waste type would affect leachate characteristics, this could not be confirmed. For example, arsenic concentrations appeared to cluster according to a unit, suggesting that arsenic concentrations in HW leachates are highly site-specific and dependent on the waste source or sources disposed of in a particular unit. In addition, the relatively high concentrations of arsenic and low concentrations of heavy metals that persist long into the PCC period may be due to the relatively alkaline pH of leachate, potentially attributable to the practice of solidifying and stabilizing HW with cement, fly ash, or kiln dust prior to disposal. Details and data regarding these practices are needed in order to fully understand the long-term leaching behavior of disposed HW.

7.2.2 Leachate Flow Data

For all case study landfills, leachate flow data were normalized to an annual average and a peak flow in terms of gallons per acre per day (gpad) to provide a common unit for comparison between sites. Attempts were made to collect data from the date of closure (i.e., time zero for PCC) through to the current time in order to obtain a complete timeline of post-closure flow from each unit. However, the availability and level of granularity amongst the data varied considerably between sites. Available leachate data for Landfill T, for example, includes annual total LCRS and LDS flow volumes for up to 7 years in some units and daily flow volumes for years 10 through 23 of PCC in other units. Respective earlier and later records were not available. Leachate data for Landfill Y included weekly LCRS and LDS flow volumes for all three study units for the duration of PCC, except the first year (an important data point in terms of assessing trends in leachate generation post-closure). Fuller LCRS and LDS datasets would have expanded the level of detail to which cover and liner system performance could be evaluated and would likely have enabled a clearer picture of long-term stable leachate generation to be gathered.

An important limitation regarding the use of LCRS and LDS leachate chemistry to correct EA values is the need for concurrent chemistry data to be available in both the LCRS and LDS. Overall, such data were available for only 17 units at three sites (Landfills B, T, and J). This represents a shortcoming on the part of site operators at collecting data that could help understand long-term liner performance.

7.2.3 Leachate Chemistry Data

It is noted through the discussions in this report that the leachate chemistry database is limited in terms of its completeness and the duration of monitoring, although it is important to acknowledge that “completeness” in this context refers to the availability of the full suite of 30 parameters targeted in this study and not to data requirements specified for compliance. Many targeted leachate constituents are poorly represented in the LCRS dataset, while LDS chemistry is not monitored at all at many sites. In the latter case, it is noted that three sites (Landfills R, Y, and M) have zero flow in the LDS, which negates the ability to collect samples for analysis. In the context of this data assessment, therefore, this should not be construed as a data gap as these site operators have effectively achieved a goal of PCC, which is to end monitoring and management of liquids in the LCRS and LDS. An issue of importance identified in the process of collecting leachate chemistry data for this study is that site operators are only required to keep records for three years; as such, many older data are no longer available. If this lack of data at the case study landfills is representative of that at other Subtitle C facilities, which seems likely, this represents an important limitation on assessing the long-term performance of containment systems and potential modifications to existing PCC programs.

Intra-unit comparisons (i.e., comparison of leachate chemistry between the LCRS and LDS in the same unit) are dependent on the same constituents being monitored on the same date, while inter-unit comparisons (i.e., comparison of leachate chemistry between different units and sites) are dependent on the similarity of the leachate analyte lists. Both intra and inter-unit comparisons, which can provide important operational insights into relative cover system infiltration and other indicators of landfill performance, are obviously hampered by a lack of data. The general paucity of leachate chemistry data at Subtitle C landfills, particularly with regard to the chemistry of liquids recovered from LDS drainage layers, may be due to two reasons:

- Leachate chemistry data are most commonly collected semi-annually or annually at each site, thereby limiting the overall size of the dataset available for analysis; and
- The leachate constituent list monitored is dependent on site-specific waste history and local practices for leachate treatment and disposal (i.e., non-compliance data), thereby limiting the number of similar constituents for which data were available at all sites (i.e., constituent lists vary between different wastewater treatment facilities).

Anecdotal information received from site operators was that leachate volumes and chemistry have not deviated from acceptance criteria for treatment and disposal, such that leachate management has not been an issue or represented a higher-than-expected cost. Operators did not complain of any significant problems related to leachate treatment and disposal, which suggests that this is not an issue at Subtitle C facilities. As noted previously, the strong focus on containment and reducing leachate flow volumes under RCRA is likely a contributing factor to the lack of LDS data. Certainly, data availability was highest at two wet sites (Landfills B and T), which may be reflective of the level of concern operators have on managing leachate treatment and disposal costs (in other words, low leachate flows attract little interest, because disposal costs are modest for small volumes). The fact that many of the data used to support the performance demonstrations made in this study rely on non-compliance data is borne out that very limited leachate chemistry data were available at wet Landfill F, for which data were obtained directly from the state rather than from the operator. As such, the chemistry dataset would not be expected to include non-compliance leachate chemistry data collected only to meet influent limits imposed by the receiving wastewater treatment plant (WWTP). This has implications in terms of being able to assess site performance independent of the operator, which would be important if, say, an operator was unable to continue providing care.

In terms of specific availability of individual analytes from the list of 30 targeted for this study, data were available for all analytes with the exception of COD, BOD, and alkalinity, although many analytes were available only in LCRS and not LDS datasets. The lack of COD and BOD data may not be important, as concentrations of dissolved organic matter in leachate are not a primary concern to Subtitle C landfill operators beyond complying with potential influent limitations imposed by a receiving WWTP. However, it should be recognized that long-term changes in leachate management may require consideration of effluent discharge to receiving water bodies, in which case BOD may become a critical analyte. More important in the context of this study is the absence of alkalinity data, as data for the other major cations (calcium, magnesium, potassium, and sodium) and anions (chloride, and sulfate) that make up the majority of the ionic charge balance were available in both the LCRS and LDS at a number of case study sites. This prevented the construction of Stiff or Piper plots, which are effective methods of portraying the data.

7.3 Recommendations for Future Research and Development

This study identified a number of areas in which further research could be beneficial in understanding the long-term performance of Subtitle C landfills. In the longer term, this could potentially facilitate the development of guidance on improving long-term performance, reducing the duration and costs of PCC, and allowing more flexibility in the manner in which the regulation is applied (which may be appropriate recognizing that that end goals for PCC are defined in terms of performance). Better understanding and improved predictability of long-term performance could allow more innovation and creativity enclosure system designs. Ultimately, performance data from studies such as this could be used to assign risk-based evaluation criteria and procedures for demonstrating long-term protection of HHE and completion of PCC.

Two short-term suggestions for further research include the following:

- Multi-site evaluation of leachate chemistry data: This study focused on leachate flow and containment system performance. While leachate chemistry data were examined, for various reasons identified in the report these examinations were not sufficiently detailed nor were the dataset extensive enough to draw firm conclusions regarding the interrelated factors affecting long-term trend behavior and leachate quality. Insufficient flow data and waste manifests were available to accurately review leachate chemistry in terms of contaminant removal loads (e.g., cumulative mass of contaminant removal per ton of waste in place), although this would potentially have been advantageous in terms of normalizing the data between the different study units, climatic conditions, and cover/liner design configurations. The effects of facility operations and waste types on leachate chemistry were not examined. No statistical analysis was conducted to eliminate outliers, test the significance of trends, or assign correlation coefficients to trend data. No correlations between leachate chemistry and flow rates were investigated, so it is not known whether the goal of excluding liquids from RCRA landfills in the post-closure period contributes to chemical changes or whether cover design and performance has a direct effect on leachate quality.

- The vulnerability of Subtitle C landfills to short and long-term hazards: Currently, landfills are designed and operated assuming that future climate and precipitation intensity will be similar to historical records. In addition, seismic design requirements are not explicitly cited for Subtitle C landfills. Some hazardous waste management units in place today may thus be vulnerable to future conditions. This could have serious consequences for the integrity of hazardous waste disposal facilities and protection of HHE. Therefore, the resilience of hazardous waste disposal facilities should be evaluated with regard to both long-term hazards (e.g., inundation due to sea level rise, elevated temperatures, seismic events, and/or groundwater elevation rise) and short-term hazards (e.g., possible increase in precipitation and associated flooding, increases in storm flooding/surges, and changes in waves, currents, king tides, or El Niño effects). To date, little research has been published on the long-term vulnerability of closed landfills to short and long-term hazards. As such, this represents an important research need in terms of assessing the long-term performance of landfill containment systems.

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9. APPENDIX I

LANDFILL DATA FORM

FACILITY NAME:

LOCATION:

1. CRITICAL ATTRIBUTES CHECKLIST

SUBTITLE C SITE ONLY		YES/NO	
AT LEAST ONE CLOSED (I.E., CAPPED) SUBTITLE C UNIT AT SITE:		YES/NO	--> IF NO, STOP HERE
NO. OF CLOSED SUBTITLE C UNITS WITH DOUBLE LINER SYSTEM WITH LCS AND LDS:	*BOX1A*		--> IF NONE, STOP HERE
LCS AND LDS FLOW DATA AT CLOSED SUBTITLE C UNITS IS RECORDED INDEPENDENTLY OF ACTIVE UNITS AND NON-SUBTITLE C UNITS:		YES/NO	--> IF NO, CONTACT PROJECT TEAM TO DISCUSS BEFORE PROCEEDING --> IF YES, CONTINUE TO ITEM (2) NEXT

2. GENERAL SITE INFORMATION

LCS FLOW DATA	ALL/SOME CLOSED UNITS HAVE SEPARATE DATA COLLECTION	or	DATA IS COMBINED ACROSS ALL CLOSED UNITS
LDS FLOW DATA	ALL/SOME CLOSED UNITS HAVE SEPARATE DATA COLLECTION	or	DATA IS COMBINED ACROSS ALL CLOSED UNITS
LCS (LEACHATE) CHEMISTRY DATA	ALL/SOME CLOSED UNITS HAVE SEPARATE DATA COLLECTION	or	DATA IS COMBINED ACROSS ALL CLOSED UNITS

ON-SITE WEATHER DATA: PRECIPITATION: YES/NO

TEMPERATURE: YES/NO IF YES, PROJECT TEAM WILL FOLLOW UP TO OBTAIN DATA

3. DATA MANAGEMENT MATRIX

PLEASE COMPLETE DATA MANAGEMENT MATRIX BELOW FOR EACH CLOSED UNIT

THE NUMBER OF COLUMNS SHOULD MATCH THE NUMBER IN BOX 1A ABOVE - PLEASE ADD ADDITIONAL COLUMNS IF NECESSARY

FOR EACH UNIT, ANSWER QUESTIONS 1-26 OR INDICATE "YES" IF DATA ARE AVAILABLE, "U/K" IF UNKNOWN, "NO" IF DATA ARE NOT AVAILABLE, "N/A" IF NOT APPLICABLE

FOR EACH YES ENTRY, PROJECT TEAM WILL FOLLOW UP TO OBTAIN DATA

			CLOSED SUBTITLE C UNIT																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		UNIT ID #																				
Liner Construction	1	UNIT SIZE (LINER PLAN AREA) (ACRES)																				
	2	CONSTRUCTION DETAILS (LINER, LCS, AND LDS CROSS-SECTIONS)																				
	3	LINER PLAN LAYOUT DRAWING AVAILABLE																				
	4	AVERAGE LINER BASE SLOPES (%)																				
	5	3RD PARTY CQA PROGRAM FOR LINER CONSTRUCTION																				
	6	END OF LINER CONSTRUCTION DATE																				
Operations	7	START OF OPERATING PERIOD																				
	8	END OF OPERATING PERIOD																				
	9	PREDOMINANT WASTE TYPE																				
	10	WASTE RECEIPTS/PLACEMENT RECORDS AVAILABLE																				
	11	TOTAL VOLUME/MASS OF WASTE IN PLACE																				
	12	MAXIMUM WASTE HEIGHT (FEET)																				
Closure Construction	13	CLOSURE CONSTRUCTION DETAILS (COVER CROSS-SECTIONS)																				
	14	GAS MANAGEMENT SYSTEM (VENTS, WELLS)																				
	15	COVER PLAN LAYOUT DRAWING AVAILABLE																				
	16	FINAL COVER TOP SLOPES (%)																				
	17	FINAL COVER SIDE SLOPES (H:V)																				
	18	3RD PARTY CQA PROGRAM FOR COVER CONSTRUCTION																				
	19	END OF COVER CONSTRUCTION DATE																				
Leachate and LDS Liquids Data	20	LCS FLOW DATA																				
	21	NO. OF INDEPENDENT LCS FLOW MEASUREMENT LOCATIONS																				
	22	METHOD(S) OF LCS FLOW MEASUREMENT[1]																				
	23	LDS FLOW DATA																				
	24	NO. OF INDEPENDENT LCS FLOW MEASUREMENT LOCATIONS																				
	25	METHOD(S) OF LCS FLOW MEASUREMENT[1]																				
	26	LEACHATE CHEMISTRY DATA																				
	27	NUMBER OF INDEPENDENT LEACHATE SAMPLING POINTS																				
	28	LEACHATE DATA QA/QC PROTOCOL																				
	29	ADDITIONAL OBSERVATIONS/EXPLAINATION OF LCS/LDS DATA[2]																				
Post-Closure	30	COVER SYSTEM O&M / REPAIR RECORDS																				
	31	COVER SYSTEM SETTLEMENT DATA																				
	32	TOPOGRAPHIC SURVEYS																				

Notes:

1 CODES FOR METHOD FOR FLOW MEASUREMENT:

- A AUTOMATIC PUMPING SYSTEM, LIQUID VOLUME RECORDED FROM ACCUMULATING FLOW METER
- B PERIODIC PUMPING IF LIQUID IS PRESENT, VOLUME RECORDED FROM ACCUMULATING FLOW METER
- C PERIODICALLY MEASURE TIME TO FILL A KNOWN VOLUME
- D PERIODIC PUMPING IF LIQUID IS PRESENT IN SUMP TO A HOLDING TANK, VOLUME TRANSFERRED FROM HOLDING TANK MEASURED
- E PERIODIC PUMPING IF LIQUID PRESENT IN SUMP, VOLUME ESTIMATED FROM CHANGE IN LIQUID LEVEL
- F AUTOMATIC PUMPING SYSTEM, LIQUID VOLUME ESTIMATED BY MULTIPLYING PUMP CAPACITY x TIME
- G OTHER (PLEASE SPECIFY)

2 FOR EXAMPLE, STUDIES HAVE BEEN CONDUCTED INTO STORMWATER INFILTRATION ISSUES, EQUIPMENT PROBLEMS, METER CALIBRATION/TOLERANCES, DATA GAPS, ETC.

PLEASE RECORD ADDITIONAL NOTES AND COMMENTS ON NEXT TAB (IF APPLICABLE)

10. APPENDIX II

Table II-1. Landfill construction details

Landfill designation	Total number of study units	Total area of all units included in study (acres)	Dates of waste placement in study units[1]	Dates of closure of study units[1]	Total waste in place (million cubic yards)	Average duration of study unit operation (years)	Maximum waste thickness (feet)	Average base liner slope (%)	Average final cover slope, top area (%)	Average final cover slope, side slopes (H:V)	Third-party CQA performed on liner	Third-party CQA performed on cover	Flow measurement method for LCRS and LDS[2]
B	8	50	M-1980s to L-1990s	L-1980s to M-2000s	3.3	3	110	2	2	3:1	Yes	Yes	i
T	18	48	L-1980s to M-1990s	M-1980s to M-1990s	4.6	3	80	2.5	5	5:1	Yes	Yes	ii
J	3	31	M-L 1980s	M-L 1990s	3.0	9	90	2	2	NA	Yes	Yes	ii
R	5	31	M-1980s to E-1990s	E-2000s	2.2	10	100	2	5	3:1	Yes	Yes	iii
P	4	40	L-1980s to E-1990s	M-1990s to E-2000s	1.7	7	50	2	0.5	20:1	Yes	Yes	iv
Y	3	5	M-1980s	M-2000s	0.24	19	55	1	4	3:1	Yes	Yes	ii
M	1	9	M-1990s	M-2010s	0.8	21	110	2	5	3:1	Yes	NA	iv
D	2	9	M-2000s	M-L 2000s	0.7	3	100	4.5	10	3:1	Yes	Yes	iv
F	1	6	L-1980s	E-2000s	0.31	14	50	2	10	3:1	Yes	Yes	ii

Notes:
1). E = early, M = mid, L = late.
2). i = automatic pumping system, liquid volume recorded from accumulating flow meter; ii = periodic pumping if liquid is present, volume recorded from accumulating flow meter; iii = periodic pumping if liquid present in sump, volume estimated from change in liquid level; iv = periodic pumping if liquid is present in sump to a holding tank, volume transferred from holding tank measured.
NA: not applicable. Landfill J is situated below an MSW overfill landfill and has no sideslopes. The unit at Landfill M has intermediate cover soil only.

Table II-4A. Annual average LCRS and LDS flow rate (gpad) at Landfills B, J, and R

Landfill unit		Sampling		Years into post-closure care program																												
ID	Layer	Interval	Total Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
B-1	LCRS	Monthly	641										21	19	17	16	13	13	12	10	13	9.1	6.5	8.0	8.3	13	6.8	10	9.1	9.5	8.2	7.6
	LDS		536										4.1	5.2	4.5	3.4	3.1	3.1	2.0	3.7	3.1	3.0	1.5	2.6	2.5	3.1	2.6	2.9	3.0	3.5	2.2	2.8
B-2	LCRS	Monthly	644								13	12	8.3	9.4	8.2	7.2	7.9	7.1	8.9	5.6	2.5	5.7	5.1	4.1	2.6	8.4	4.6	4.7	5.4	5.4		
	LDS		452								3.0	4.2	5.3	4.0	3.9	3.8	4.0	4.6	2.6	1.7	0.8	1.1	0.9	0.9	1.2	1.1	1.0	0.8	0.9	0.9		
B-3	LCRS	Monthly	675							31	30	23	20	18	15	14	8.5	6.1	4.3	3.0	6.6	7.3	5.9	15	13	13	13	12	10			
	LDS		401							3.9	4.0	4.4	3.2	3.0	2.8	1.9	3.0	1.3	2.6	1.2	0.9	1.2	1.6	0.9	0.9	1.2	1.6	1.4	1.9			
B-4	LCRS	Monthly	669					30	27	22	21	19	17	14	12	14	12	13	8.2	7.6	9.1	7.8	13.0	9.2	10	8.8	8.5					
	LDS		205					1.6	2.8	2.5	2.0	3.9	2.2	2.8	2.1	1.3	0.4	0.2	1.2	1.2	0.5	0.7	0.8	0.9	0.9	1.0	0.8					
B-5	LCRS	Monthly	663				10	8.9	9.1	6.5	5.6	5.3	4.2	2.8	5.5	11	7.4	5.6	3.8	4.1	1.8	2.8	2.0	2.0	1.7	2.0						
	LDS		370				4.4	15	12	11	6.6	7.6	10	11	6.5	3.4	3.0	3.2	3.3	4.7	2.7	4.5	4.6	7.9	5.5	7.7						
B-6	LCRS	Monthly	675			70	78	69	36	39	37	48	68	331	338	237	142	91	67	66	54	41	30	29	25							
	LDS		207			19	14	10	6.9	6.8	5.0	5.5	7.6	7.5	5.7	3.7	3.6	1.7	2.5	2.2	1.3	1.3	1.8	1.0	1.8							
B-7	LCRS	Monthly	420	630	692	599	496	479	84	112	98	100	111	122	106	115	118	129	126	120												
	LDS		228	7.7	4.4	5.2	3.0	3.1	3.4	3.6	4.5	5.2	13	21	17	19	19	29	18	23												
B-8	LCRS	Monthly	138	41	24	14	14	17	21	21	15	10	3.7	2.5																		
	LDS		126	2.3	2.1	2.4	3.0	10	13	12	11	37	52	86																		
J-1	LCRS	Monthly	20	0.3	0.1	0.3	0.2	0.3	0.0	0.1	0.2	0.6	0.8	0.7	0.8	0.3	0.5	0.9	0.7	0.0												
	LDS		85	0.5	0.3	0.3	0.2	0.2	0.4	2.0	4.1	4.8	5.1	3.2	2.8	1.9	1.7	0.8	1.2	0.8												
J-2	LCRS	Monthly	21	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.3	0.0	0.0	0.6	0.0												
	LDS		21	0.4	0.3	0.2	0.2	0.1	0.2	0.0	0.2	0.0	0.8	0.5	0.5	0.5	0.6	0.0	0.6	0.0												
J-3	LCRS	Monthly	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.4	0.0	0.0	0.0	0.0												
	LDS		26	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.6	0.7	0.5	1.1	0.3	0.4	0.3	0.4	0.3	0.0												
R-1	LCRS	Monthly	148	9.7	7.1	5.3	4.7	4.2	2.5	2.7	2.5	3.3	4.1	2.2	1.0	2.0																
	LDS		148	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0																
R-2	LCRS	Monthly	156	7.1	6.0	6.2	5.5	5.1	4.7	4.8	3.9	4.2	3.8	3.9	3.7	4.2																
	LDS		156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-3	LCRS	Monthly	156	3.8	3.7	3.8	3.0	3.1	3.0	2.4	2.3	2.4	2.0	1.9	2.2	2.0																
	LDS		156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-4	LCRS	Monthly	156	5.0	5.2	4.4	4.2	3.9	3.8	3.7	3.6	3.7	3.1	3.4	3.3	3.5																
	LDS		156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-5	LCRS	Monthly	156	3.4	3.2	2.3	2.2	2.4	2.0	2.5	1.6	2.2	1.9	1.5	1.5	1.5																
	LDS		156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																

Table II-2. Landfill base liner system details

Designation		Area	LCRS		Primary liner				LDS		Secondary liner[4]			
Landfill	Sub-group	Liner area of landfill units (acres)	Drainage layer material[1]	Soil thickness (inches)	Type of liner system[2]	Geomembrane material[3]	Geomembrane thickness (mil)	Compacted clay liner thickness (inches)	Drainage layer material[1]	Soil thickness (inches)	Type of liner system[2]	Geomembrane material[3]	Geomembrane thickness (mil)	Compacted clay liner thickness (inches)
B	B-1 to B-8	4 – 9	S	12	GM/CCL	HDPE	80	60	S	12	GM/CCL	HDPE	80	36
T	T-1 to T-18	1.5 – 4	S	12	GM/CCL	HDPE	60	36	S	12	GM/CCL	HDPE	60	36
J	J-1 to J-3	9.5 – 11.5	S	12	GM/CCL	HDPE	60	18	G/GN	12	GM/CCL	HDPE	60	36
R	R-1	5 – 7.5	GN	--	GM/CCL	PVC	40	36	GN	--	GM/CCL	PVC	40	36
	R-2 to R-5		GC	--	GM/CCL	HDPE	80	36	GC	--	GM/CCL	HDPE	80	36
P	P-1 to P-4	10	GN	--	GM	HDPE	60	--	GN	--	GM/CCL	HDPE	60	36
Y	Y-1	1.5 – 2	S	12	GM	HDPE	60	--	S	12	GM/CCL	HDPE	40	36
	Y-2 and Y-3		S	12	GM	HDPE	80	--	S/GC	12	GM/CCL	HDPE	60	36
M	M-1	9	S/GC	12	GM/CCL	HDPE	60	18	GN	--	GM/CCL	HDPE	60	36
D	D-1 and D-2	3 – 6	GC	--	GM	HDPE	60	--	GC	--	GM/GCL	HDPE	60	--
F	F-1	6	GN	--	GM	HDPE	80	--	GN	--	GM/CCL	HDPE	80	36

Notes:
1). GN = geonet, GT = geotextile, GC = geocomposite, G = gravel, S = sand
2). GM = geomembrane, GCL = geosynthetic clay liner, CCL = compacted clay liner
3). HDPE = high-density polyethylene, PVC = polyvinyl chloride
4). The LDS for Landfill P is overlain by a tertiary liner and drainage layer, not listed in the table die to space constraints. As such, Landfill P features two LDS layers from which data are available: LDS1 (upper LDS above tertiary liner and LDS2) and LDS2 (lower LDS above secondary liner).

Table II-3. Landfill cover system details

Designation		Protective soil thickness (inches)	Drainage layer(s)		Barrier layer			
Landfill	Sub-group of study units		Type[1]	Soil thickness (inches)	Type[2]	Material[3]	Thickness (mil)	Compacted clay liner thickness (inches)
B	B-1 to B-6	6	S	18	CCL/GM	HDPE	30	24
	B-7 to B-8	6	S	18	GM/CCL	HDPE	60	24
T	T-1 to T-18	24	GN	--	GM/CCL	HDPE	60	24
J[4]	J-1 to J-3	24	GC	--	GM	HDPE	60	--
R	R-1 to R-5	24	GT	--	GM/CCL	HDPE	80	24
P	P-1	36	GN	--	GM/CCL	HDPE	60	24
	P-2 to P-4	36	GN	--	GM/GCL	HDPE	60	--
Y	Y-1 to Y-3	30	GC	--	GM/GCL	HDPE	40	--
M[5]	M-1	-	GF	18	--	--	--	--
D	D-1 to D-2	24	GC	--	GM/GCL	LLDPE	40	--
F	F-1	12	S	12	GM/GCL	LLDPE	40	--

Notes:
1). GN = geonet, GT = geotextile, GC = geocomposite, S = sand, GF = general fill
2). GM = geomembrane, GCL = geosynthetic clay liner, CCL = compacted clay liner
3). HDPE = high-density polyethylene, LLDPE = linear low density polyethylene
4). Landfill J is situated below an MSW overfill landfill; the liner system of the overfill landfill is integrated with the cover system of Landfill J units.
5). Landfill M unit is currently inactive with intermediate soil cover pending final cover system construction; the final cover will comprise a 36-inch all-soil evapotranspirative cover system.

Table II-4B. Annual average LCRS and LDS flow rate (gpad) at Landfill T

Landfill unit		Sampling		Years into post-closure care program																												
ID	Layer	Interval	Total Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
T-1	LCRS	Monthly	58	16	9.1	0.3	0.3	0.3	0.1	0.1																						
	LDS		58	2.5	2.7	3.0	4.4	2.4	0.8	0.5																						
T-2	LCRS	Monthly	57	69	34	23	14	5.1	6.4	4.0																						
	LDS		63	4.1	3.6	2.7	1.5	1.3	1.7	1.2																						
T-3	LCRS	Monthly	55	34	8	51	43	19	12	6.5																						
	LDS		70	8.7	10	5.3	5.3	3.1	4.3	3.9																						
T-4	LCRS	Monthly	51	50	7.1	17	7.3	1.4	0.1	0.2																						
	LDS		54	5.9	4.3	4.6	3.6	2.4	0.1	0.2																						
T-5	LCRS	Monthly	48	352	125	73	48	30	1.0	0.1																						
	LDS		70	5.9	4.5	7.0	10	13	15	16																						
T-6	LCRS	Monthly	59	21	12	6.8	7.5	4.0	3.7	0.9																						
	LDS		50	12	6.4	4.3	3.2	2.7	1.3	0.0																						
T-7	LCRS	Daily	1591	40									24	52	60	51	40	34	28	43	21	28	24									
	LDS		390	7.7									4.5	5.2	4.9	3.3	1.4	3.9	0.4	17	4.7	7.1	7.6									
T-8	LCRS	Daily	1519	33									31	42	95	100	180	95	72	105	15	91	13									
	LDS		1356	26									77	50	81	91	57	30	41	85	52	137	119									
T-9	LCRS	Daily	1365										79	90	139	121	44	32	34	87	81	69	21									
	LDS		979										19	27	38	30	30	27	24	39	14	31	46									
T-10	LCRS	Daily	937													79	90	139	121	44	32	34	87	81	69	21						
	LDS		1108													19	27	38	30	30	27	24	39	14	31	46						
T-11	LCRS	Daily	1615										67	86	82	64	72	60	66	63	48	34	18									
	LDS		1047										27	24	37	27	25	25	24	34	3.1	26	24									
T-12	LCRS	Daily	1497										34	46	80	74	48	62	43	37	17	4.5	2.0									
	LDS		592										0.4	5.2	4.8	4.1	3.2	2.4	5.8	17	12	22	23									
T-13	LCRS	Daily	1457									60	46	13	1.1	0.9	1.2	16	29	4.1	35	3.2										
	LDS		401									0.2	0.6	1.5	1.2	4.5	6.3	14	6.1	5.8	3.8	2.9										
T-14	LCRS	Daily	1276									32	46	45	124	91	96	36	23	3.6	3.8	2.0										
	LDS		587									14	8.1	8.3	7.3	5.1	7.2	9.0	20	7.1	14	11										
T-15	LCRS	Daily	1322									3.8	3.6	2.1	1.9	1.6	1.1	0.8	0.8	1.2	1.3	1.3										
	LDS		235									1.4	1.2	1.1	2.0	0.6	0.5	0.5	11	7.4	0.3	1.8										
T-16	LCRS	Daily	1535									167	230	185	281	196	367	228	402	386	171	57										
	LDS		1008									64	40	58	48	39	43	45	51	29	32	61										
T-17	LCRS	Daily	1535				86	185	184	73	31	67	66	63	41	37	33															
	LDS		175				5.0	0.1	7.8	3.3	0.4	2.6	0.2	1.0	6.8	0.0	1.2															
T-18	LCRS	Daily	1310				28	25	17	12	6.9	19	47	41	74	12	27															
	LDS		309				2.7	1.1	1.6	1.9	2.5	3.0	1.8	3.7	0.2	1.7	2.1															

Table II-4C. Annual average LCRS and LDS flow rate (gpad) at Landfills P, Y, M, D, and F

Landfill unit		Sampling		Years into post-closure care program																												
ID	Layer	Interval	Total Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
P-1	LCRS	Weekly	1909				5.9	3.5	2.0	1.8	2.0	1.5	1.9	1.9	1.6	1.8	0.7	0.4	0.7	0.6	0.5	0.8	0.4	0.2								
	LDS1		3577				11	19	23	18	14	24	34	32	6.5	37	33	26	30	15	20	11	10	4.9								
	LDS2		3258				12	17	19	13	17	11	22	16	5.6	27	19	18	16	6.4	11	6.8	13	12								
P-2	LCRS	Weekly	1793	8.1	4.8	2.7	2.2	3.6	1.8	1.0	0.2	0.1	0.1	0.0	0.2	0.3	0.5	0.6	0.2	0.1												
	LDS1		3399	21	18	11	6.3	6.4	8.4	10	1.8	15	14	11	15	8.2	8.6	8.8	8.0	3.4												
	LDS2		3266	17	27	18	25	16	27	17	5	21	20	15	14	6.0	8.4	8.9	8.8	10												
P-3	LCRS	Weekly	1520	7.0	3.8	3.9	2.4	2.4	2.2	2.0	1.6	1.3	1.1	1.0	0.8	1.0	0.7	0.8	0.6	0.6												
	LDS1		3389	3.7	2.8	3.4	1.8	1.1	3.1	1.5	0.8	2.8	1.3	1.9	6.5	2.0	4.9	4.0	2.4	1.6												
	LDS2		3160	4.7	8.0	8.3	10	5.4	10	5.2	1.1	8.4	10	7.2	6.1	2.7	5.3	6.1	5.9	5.7												
P-4	LCRS	Weekly	1157	19	13	8.2	6.9	6.6	3.9	2.4	3.6	3.6	2.1	3.1	2.0	2.5																
	LDS1		3239	2.4	1.4	3.9	3.9	1.9	1.0	0.8	0.8	2.0	1.5	1.8	2.2	1.7																
	LDS2		3211	4.2	8.7	6.6	1.2	11	4.8	7.5	6.6	2.2	6.2	5.9	5.1	5.5																
Y-1	LCRS	Monthly	99		4.4	3.8	3.3	2.4	2.7	2.3	2.3	2.8	2.5																			
	LDS		99		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																			
Y-2	LCRS	Monthly	102		5.9	5.0	4.4	3.6	4.1	2.6	2.2	2.3	2.1																			
	LDS		102		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																			
Y-3	LCRS	Monthly	101		5.1	4.3	3.4	2.3	3.4	2.2	2.1	2.3	2.2																			
	LDS		101		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																			
M-1	LCRS	Monthly	48	20	14	14	12																									
	LDS		6	0.1	0.1	0.1	0.1																									
D-1	LCRS	Monthly	103	40	40	25	22	30	23	22	21	20																				
	LDS		19	1.7	0.0	0.0	0.8	5.9	4.3	1.8	3.5	2.6																				
D-2	LCRS	Monthly	72	14	6.0	3.4	5.1	4.5	3.6																							
	LDS		72	27	29	31	24	20	17																							
F-1	LCRS	Monthly	288	179	310	164	160	148	126	275	206	100	49	58	24																	
	LDS		141	58	27	33	13	12	7.2	2.4	2.1	1.8	1.6	2.3	5.0																	

Table II-5A. Annual peak LCRS and LDS flow rate (gpad) at Landfills B, J, and R

Landfill unit		Years into post-closure care program																												
ID	**Layer**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
B-1	LCRS										22	22	24	18	16	16	15	13	36	16	7.3	10	10	51	19	15	12	10	8.8	7.9
	LDS										4.6	6.7	6.3	4.4	4.6	4.7	3.9	5.6	4.3	10.2	3.0	6.1	3.3	4.6	3.6	5.5	6.3	6.9	4.0	3.8
B-2	LCRS								13	14	11	12	10	12	17	16	27	10	6.3	9.0	6.9	6.5	5.7	20	5.5	5.7	5.6	6.4		
	LDS								4.5	7.7	9.4	7.2	8.9	6.0	10	5.7	4.1	5.6	2.4	3.1	1.2	1.6	2.8	1.7	1.7	2.1	2.0	1.1		
B-3	LCRS							32	31	29	22	26	20	17	12	11	10	7	9	9	9	18	17	15	16	14	11			
	LDS							7.0	8.5	10	4.8	4.9	6.4	4.4	5.4	5.1	10	5.3	3.4	2.6	3.2	2.5	2.5	2.6	3.0	3.2	3.1			
B-4	LCRS					31	33	26	24	23	19	17	17	19	20	22	10	11	17	17	22	10	11	10	8.7					
	LDS					4.8	6.3	6.7	10	13	10	8.0	5.2	8.0	4.0	1.6	10	4.0	1.9	2.5	2.0	2.6	1.8	2.0	1.0					
B-5	LCRS				12	12	12	9.4	8.3	9.4	5.6	5.1	11	14	11	6.8	4.6	8.4	7.6	5.3	3.3	6.1	3.6	3.8						
	LDS				8.2	50	43	25	21	17	26	22	24	8.8	8.9	6.5	8.1	10	5.7	12	10	19	11	14						
B-6	LCRS			75	94	101	69	42	49	85	184	836	429	264	202	118	79	79	70	47	33	31	28							
	LDS			30	28	23	19	22	19	7.6	32	24	12	5.8	11	8.3	10	8.2	4.6	4.3	7.6	3.5	3.0							
B-7	LCRS	1495	1147	771	1018	718	179	131	142	118	122	163	119	129	124	144	137	132												
	LDS	23	7.5	19	5.8	6.7	6.7	11	13	22	46	37	58	48	60	60	39	41												
B-8	LCRS	76	34	16	16	28	58	24	21	15	4.2	3.4																		
	LDS	5.7	5.5	5.2	6.5	73	67	54	34	103	188	188																		
J-1	LCRS	2.3	1.3	4.0	2.7	3.5	0.0	1.7	2.6	6.8	9.1	8.7	9.3	4.2	5.8	10.3	8.4	0.0												
	LDS	3.2	2.2	2.9	2.3	2.3	2.4	4.5	5.7	8.4	19.3	5.4	6.2	5.6	5.7	5.4	5.0	5.0												
J-2	LCRS	0.0	0.0	0.8	0.2	0.1	0.0	0.0	0.0	0.0	4.9	0.0	0.0	3.2	0.0	0.0	7.0	0.0												
	LDS	2.2	2.3	2.5	1.9	1.8	1.9	0.3	2.7	0.0	5.9	6.3	6.5	5.4	7.0	0.0	7.0	0.0												
J-3	LCRS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.8	4.5	0.0	0.0	0.0	0.0												
	LDS	2.2	2.1	2.5	2.2	2.1	2.2	2.0	3.3	4.3	3.5	4.6	3.7	4.3	4.0	4.2	3.8	0.0												
R-1	LCRS	15	12	7.1	9.3	6.2	4.4	3.9	3.1	11	7.7	5.7	2.7	3.2																
	LDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0																
R-2	LCRS	8.7	7.2	7.2	7.3	6.2	5.9	9.6	4.2	7.7	6.3	5.6	4.0	12																
	LDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-3	LCRS	4.4	7.6	7.9	3.9	3.7	4.8	3.0	3.5	4.7	2.6	2.3	3.3	4.1																
	LDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-4	LCRS	6.2	6.5	5.6	4.8	4.6	4.7	4.6	4.3	6.3	4.8	6.6	3.9	4.5																
	LDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																
R-5	LCRS	4.4	7.7	3.5	2.9	4.4	2.5	5.3	2.0	3.2	6.0	1.8	3.3	1.8																
	LDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																

Table II-5B. Annual peak LCRS and LDS flow rate (gpad) at Landfill T

Landfill unit		Years into post-closure care program																												
ID	Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
T-1	LCRS	70	14	2.4	4.5	2.2	0.4	0.2																						
	LDS	4.4	3.3	4.8	11	7.2	4.9	4.5																						
T-2	LCRS	123	65	37	44	12	13	11																						
	LDS	6.5	4.8	4.6	4.5	3.0	2.9	5.0																						
T-3	LCRS	51	22	95	86	59	97	75																						
	LDS	12	15	16	7.7	6.0	7.6	11																						
T-4	LCRS	307	40	51	12	12	1.0	0.4																						
	LDS	10	5.4	8.3	4.5	4.6	0.2	1.0																						
T-5	LCRS	593	193	148	82	112	6.2	0.2																						
	LDS	14	7.2	18	18	26	25	33																						
T-6	LCRS	83	20	9.2	17	11	13	4.5																						
	LDS	18	8.8	10	4.0	5.8	14	0.2																						
T-7	LCRS	57									62	69	80	68	49	38	37	59	25	37	65									
	LDS	16									15	21	21	14	11	31	4.7	61	19	23	49									
T-8	LCRS	44									43	59	337	353	521	116	122	148	57	142	52									
	LDS	50									157	157	196	243	132	215	99	287	178	338	446									
T-9	LCRS										592	563	206	329	90	102	107	234	271	235	188									
	LDS										71	69	96	79	59	62	60	74	61	121	236									
T-10	LCRS													592	563	206	329	90	102	107	234	271	235	188						
	LDS													71	69	96	79	59	62	60	74	61	121	236						
T-11	LCRS										83	99	98	89	78	72	86	84	60	50	45									
	LDS										49	50	86	64	48	50	60	63	17	156	88									
T-12	LCRS										69	81	89	89	68	88	72	52	34	8.8	7.8									
	LDS										3.6	20	13	10	7.6	4.2	19	89	65	126	88									
T-13	LCRS									253	76	42	1.7	1.3	7.0	26	36	18	104	8.7										
	LDS									1.8	1.3	4.6	7.5	16	31	57	20	19	39	22										
T-14	LCRS									84	120	181	289	284	218	74	33	21	8.7	10										
	LDS									32	28	27	21	12	22	23	63	50	57	37										
T-15	LCRS									6.2	4.7	2.8	2.4	2.2	1.3	1.0	1.3	6.6	5.8	7.2										
	LDS									4.4	3.9	3.1	7.8	2.8	2.0	2.3	125	68	1.9	8.3										
T-16	LCRS									530	888	283	693	441	1216	529	1149	1387	934	325										
	LDS									146	93	139	116	80	104	107	171	134	199	276										
T-17	LCRS				225	240	663	172	56	113	143	122	187	109	92															
	LDS				61	1	81	12	3	10	1	4	47	0	6															
T-18	LCRS				56	60	53	34	13	48	86	105	276	64	101															
	LDS				9.1	2.4	4.3	11	13	11	7.6	12	2.0	12	11															

Table II-5C. Annual peak LCRS and LDS flow rate (gpad) at Landfills P, Y, M, D, and F

Landfill unit		Years into post-closure care program																												
ID	Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
P-1	LCRS				12	5.5	3.4	3.4	2.9	2.4	5.1	6.7	3.0	6.5	2.3	2.3	2.7	2.2	1.8	1.5	2.0	0.9								
	LDS1				24	36	36	36	32	51	68	101	11	99	50	49	37	26	32	19	16	8.9								
	LDS2				33	30	27	25	34	22	44	35	15	52	29	33	27	18	20	15	19	15								
P-2	LCRS	12	13	5.1	6.7	21	6.0	2.2	0.7	1.6	0.8	0.0	0.9	1.2	1.4	1.3	0.6	0.5												
	LDS1	42	28	23	15	11	21	25	3.2	38	19	21	22	19	15	16	11	5.5												
	LDS2	44	39	45	51	32	55	33	17	40	31	36	27	21	17	20	14	13												
P-3	LCRS	10	5.9	7.9	3.4	4.0	3.2	4.5	2.5	1.8	2.3	3.6	2.9	2.9	1.4	1.7	1.1	2.0												
	LDS1	5.5	3.9	10	3.5	2.4	11	4.6	1.6	6.9	2.6	7.4	12	4.9	8.5	10	5.6	2.5												
	LDS2	6.5	17	21	22	13	24	18	3.2	15	20	16	10	12	12	13	9.5	8.6												
P-4	LCRS	38	21	13	14	10	15	5.2	11	6.1	3.9	6.1	5.1	4.3																
	LDS1	3.8	4.0	10	8.5	3.4	2.3	2.3	3.1	3.4	2.6	3.4	4.4	2.9																
	LDS2	11	15	14	3.1	24	8.5	16	15	6.3	13	11	10	13																
Y-1	LCRS		5.3	4.6	4.0	4.8	6.9	3.7	5.3	4.4	5.2																			
	LDS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																			
Y-2	LCRS		7.2	5.9	5.5	5.7	7.2	6.5	4.5	3.7	4.4																			
	LDS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																			
Y-3	LCRS		6.3	5.6	5.2	3.6	9.1	4.4	4.7	3.9	4.6																			
	LDS		0.1	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.0																			
M-1	LCRS	34	25	14	14																									
	LDS	1.6	0.8	0.8	0.8																									
D-1	LCRS	104	65	67	39	46	45	35	32	33																				
	LDS	21	0.0	0.0	9.3	20	22	19	15	11																				
D-2	LCRS	23	13	5.1	9.2	9.2	8.2																							
	LDS	33	35	34	31	26	42																							
F-1	LCRS	214	536	200	220	193	142	333	290	121	90	107	34																	
	LDS	129	49	248	19	17	9.2	3.7	2.5	2.9	1.8	3.0	19																	

Table II-6. Summary of leachate data availability for constituents of interest

Chemical constituent	Data availability at landfill[2]																		
	B		T		J		R		P			Y		M		D		F	
	LCRS	LDS	LCRS	LDS	LCRS	LDS	LCRS	LDS	LCRS	LDS1	LDS2	LCRS	LDS	LCRS	LDS	LCRS	LDS	LCRS	LDS
pH	N	N	Y	Y	Y	Y	Y	NF	Y	Y	Y	N	NF	Y	NF	N	N	N	N
Specific conductance	N	N	Y	Y	Y	Y	Y	NF	Y	Y	Y	N	NF	Y	NF	N	N	N	N
Total dissolved solids	N	Y	N	N	N	N	Y	NF	N	N	N	N	NF	N	NF	N	N	N	N
COD[1]	N	N	N	N	N	N	N	NF	N	N	N	N	NF	N	NF	N	N	N	N
BOD[1]	N	N	N	N	N	N	N	NF	N	N	N	N	NF	N	NF	N	N	N	N
Total organic carbon	N	N	Y	Y	N	N	N	NF	Y	Y	Y	N	NF	N	NF	N	N	N	N
Alkalinity	N	N	N	N	N	N	N	NF	N	N	N	N	NF	N	NF	N	N	N	N
Chloride	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Sulfate	N	N	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	N	NF	N	N	N	N
Calcium	Y	N	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	N	NF	N	N	Y	Y
Magnesium	Y	N	N	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Sodium	N	N	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	N	NF	N	N	N	N
Potassium	N	N	N	N	Y	Y	Y	NF	N	N	N	N	NF	N	NF	N	N	N	N
Arsenic	Y	N	Y	Y	Y	Y	Y	NF	Y	Y	Y	N	NF	Y	NF	N	N	Y	Y
Cadmium	Y	N	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Chromium	Y	N	Y	Y	N	N	Y	NF	Y	Y	N	N	NF	Y	NF	N	N	N	N
Lead	Y	N	Y	Y	Y	Y	Y	NF	Y	Y	Y	N	NF	Y	NF	N	N	N	N
Nickel	Y	N	N	N	Y	Y	Y	NF	Y	Y	N	N	NF	Y	NF	N	N	Y	Y
Benzene	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	Y	Y
1,1-Dichloroethane	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
1,2-Dichloroethane	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
cis-1,2-Dichloroethene	Y	Y	N	N	N	N	N	NF	N	N	N	N	NF	Y	NF	N	N	N	N
trans-1,2-Dichloroethene	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Ethylbenzene	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Methylene chloride	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
1,1,1-Trichloroethane	Y	N	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Trichloroethylene	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Toluene	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Vinyl chloride	Y	Y	Y	Y	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N
Xylenes (total)	Y	Y	N	N	Y	Y	Y	NF	N	N	N	N	NF	Y	NF	N	N	N	N

Notes:
1). COD = chemical oxygen demand, BOD = biochemical oxygen demand.
2). Data availability: Y = leachate data are available (these cells are colored green for ease of identification), N = leachate data are not collected, although sufficient flow in the LCRS and/or LDS exists to enable a sample to be collected, NF = no flow in the LDS, which means sample collection and analysis cannot be conducted (these cells are colored gray for ease of identification).

11. APPENDIX III

Landfill		Landfill B						
Cells								
Years into PCC		19	19	19	20	20	20	21
Modules		B11	B12	B13	B11	B12	B13	B11
Parameter	Units							
pH	pH units							
Specific Conductance	µmhos/cm							
TDS	mg/L							
COD	mg/L							
BOD5	mg/L							
TOC	mg/L							
Alkalinity	mg/L							
Chloride	mg/L	14700		6860	11200	53.2	5750	9860
Sulfate	mg/L							
Calcium	mg/L				16.7	2280	811	55.9
Magnesium	mg/L				15.3	263	81.7	18.1
Sodium	mg/L							
Potassium	mg/L							
Arsenic	µg/l				2440	201	646	426
Cadmium	µg/l							ND
Chromium	µg/l							138
Lead	µg/l							ND
Nickel	µg/l							
Benzene	µg/l	ND	ND	ND	ND	48600	ND	324
1,1-Dichloroethane	µg/l	ND	ND	ND	ND	453000	194	1050
1,2-Dichloroethane	µg/l	ND	ND	914	ND	104000	726	ND
cis-1,2-Dichloroethylene	µg/l	1980	ND	ND	470	68300	121	3900
trans-1,2-Dichloroethylene	µg/l	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/l	1690	4510	ND	ND	1090000	101	189
Methylene Chloride	µg/l	ND	289000	13600	ND	3490000	6730	ND
1,1,1-Trichloroethane	µg/l	ND	4130	ND	ND	481000	ND	ND
Trichloroethylene	µg/l	ND	ND	ND	ND	561000	69	ND
Toluene	µg/l	14800	28900	123	388	8670000	230	10600
Vinyl Chloride	µg/l	ND	ND	ND	ND	ND	75.1	850
Xylenes (total)	µg/l	16300	21300	154	ND	5040000	444	ND

				B-1				
21	**21**	**22**	**22**	**22**	**23**	**23**	**23**	**24**
B12	**B13**	**B11**	**B12**	**B13**	**B11**	**B12**	**B13**	**B11**
9340	6680			1580			7310	
2090	592	45.5	2190	263	9.15	ND	677	9.7
253	70.9	8.22	253	19.2	ND	ND	88.7	1.1
216	85.4	821	ND	ND	2420	ND	266	585
1120	6160	10.2	1020	1570	ND	ND	137	10
107	969	174	239	25.5	315	ND	111	4750
1790	ND	51.3	1580	ND	ND	ND	ND	854
ND	ND	ND	ND	ND	ND	ND	6.7	320
15200	116	4.77	202000	ND	486	6600	109	300
ND	307	1.91	ND	ND	27	3880	108	250
ND	43.9	7.45	ND	20	1690	ND	142	1540
ND	ND	ND	ND	ND	ND	ND	ND	300
3070	22.2	ND	1670000	24.7	2210	11400	13.4	5710
351000	2270	6.9	1510000	ND	ND	168000	755	2000
6750	ND	ND	296000	ND	131	3080	ND	325
5400	20.5	8.36	454000	ND	194	4650	147	250
34300	63	0.431	5210000	123	25700	40600	28.2	58900
ND	29.7	0.952	ND	ND	233	ND	15.9	500
10900	104	2.01		194	13600	58000	40	38100

24	24	25	25	25	26	26	26	17
B12	**B13**	**B11**	**B12**	**B13**	**B11**	**B12**	**B13**	**B21**
	6760	18000		7700	15000	11000		11,600
0.5	671				19	2900	660	
1.1	86.7				15	340	93	
90.5	264	980	1.9	190	1200	320	340	
10	169	6	0.12	6300	0.006	930	26000	
411	182	160	14	680	170	260	710	
269	33	19	2.3	19	0.019	1400	0.019	
		1100	1.2	2100	1100	3000	2600	
37000	15	200		11	0.1	10	10	5.87
474000	138	300		210	340	140000	200	6.02
86000	436	300		200	0.15	15	280	ND
30000	124	420		94	0.98	21	0.12	ND
	15	400		20	0.2	20	0.008	ND
1350000	20.5	1700		85	0.85	85	0.034	11.8
4260000	2600	1700		380	1.7	3400000	5000	25.5
739000	16.3	200		10	0.1	78000	0.04	ND
671000	86	300		110	0.15	51	0.84	ND
5950000	115	1700		85	1600	340000	58	85.9
50000	34.5	100		48	100	5	40	ND
5660000	68	2500		85	1000	160000	34	38.7

17	17	18	18	18	19	19	19	20	20
B22	**B23**	**B21**	**B22**	**B23**	**B21**	**B22**	**B23**	**B21**	**B22**
7,330	4,470	8,450	6,310	3,900	8,560	5,150	3,290	11,800	802
		11.6	137	653	10.5	85.6	509	12.8	19
		30.1	136	290	30.3	49	273	38.4	6.83
		675	1550	1260	500	203	6120	404	25.3
					ND	ND	14.5	ND	ND
					270	97	ND	171	11.5
					ND	ND	ND	ND	ND
ND	ND	5.18	57.8	10.2	3.02	21.5	6.52	2.98	2.04
192	ND	4.8	207	65	2.21	197	49.7	2.76	20.5
ND	ND	ND	12.4	ND	ND	ND	ND	ND	ND
ND	ND	19.4	16.2	5.7	ND	8.71	2.33	ND	1.49
ND	ND	ND	ND	ND	ND	2.58	ND	ND	ND
130	138	15	186	163	5.21	51.2	63	7.53	1.54
449	ND	ND	313	5.36	4.04	10.4	6.57	ND	ND
ND	ND	ND	8.76	1.37	ND	9.55	0.946	ND	0.412
ND	ND	ND	10	3.97	ND	1.47	1.14	ND	0.275
737	136	91.6	1050	112	56.8	295	45.8	51.9	13.3
ND	ND	ND	21.5	2.53	ND	22.5	ND	ND	2.49
519	415	57.8	767	539	17.4	202	108	24.8	12.9

B-2

20	21	21	21	22	22	22	23	23	23
B23	**B21**	**B22**	**B23**	**B21**	**B22**	**B23**	**B21**	**B22**	**B23**
2,500	11,700	6,910	4,080	9,480	6,740	3,750	10,000	8,100	4,000
421	6.89	94.5	659	8.4	79.6	596			
223	33.2	72.4	359	26.3	55.9	282			
2040	331	194	19100	723	166	7700	410	160	6200
38.8	ND	ND	132	10	10	16.4	6	6	25
7	382	127	15.4	660	105	18.1	280	120	79
ND	ND	ND	ND	33	33	33	19	46	19
							1100	840	20000
1.76	ND	ND	13.2	15	60	4.54	10	52	1.1
29	3.2	226	843	15	188	120	15	270	38
ND	ND	ND	ND	12.5	50	0.6	15	60	0.6
1	ND	86	ND	15	70	4.04	10	48	0.97
ND	ND	ND	ND	15	60	0.6	20	80	0.8
11.9	4.1	106	153	12.5	88	66	85	340	23
ND	ND	ND	48.4	100	400	6.24	85	340	3.4
0.961	ND	ND	26	16.3	65	1.2	10	40	1.9
0.51	ND	ND	5.6	12.5	50	2.26	15	60	1.6
9.24	6.6	396	126	54.5	374	34.5	85	890	16
0.519	ND	ND	19.2	25	100	1.28	5	20	0.98
16.6	23.5	356	387	15	378	140	85	650	64

24	24	24	16	16	16	17	17	17	18
B21	B22	B23	B31	B32	B33	B31	B32	B33	B31
11,000	8,400	4,300	12,600	4,180	14,800	12,300	8,760	9,720	10,800
11	100	610				34.7	167	1.89	81.9
30	72	270				26.2	84.6	1.07	36.2
760	360	3000				1310	2910	554	550
0.006	0.006	59							ND
320	120	0.021							277
54	100	180							79.2
1400	850	30000							
2.9	35	2.1	2.03	ND	ND	2.97	3.86	ND	ND
7.6	200	52	5.64	15.4	ND	9.47	16.5	ND	ND
0.0015	3.3	0.0015	ND	ND	ND	ND	ND	ND	ND
0.0012	0.047	0.0031	4.8	ND	ND	ND	8.97	ND	ND
0.002	0.0058	0.002	ND	ND	ND	1.7	0.841	ND	ND
0.0085	130	13	2.06	ND	47.8	7.54	14.4	6.98	13.9
0.0085	0.0085	0.0085	ND	363	14.6	ND	ND	16	ND
0.01	7.3	1.7	ND	ND	ND	ND	ND	ND	ND
0.0015	0.014	0.0015	ND	ND	ND	1.51	0.994	ND	ND
14	500	9.6	16.1	ND	25.8	40.2	45.9	16.3	33.4
0.8	13	2.5	4.72	ND	ND	8.48	7.34	ND	ND
12	670	29	8.68	64.4	350	34.6	39.9	87	60.1

B-3									
18	18	19	19	19	20	20	20	21	21
B32	B33	B31	B32	B33	B31	B32	B33	B31	B32
9,190	9,490	ND	6,540	7,610	ND	9,750	11,100	12,000	8,420
107	28.6	353	0.542	249	2.23	160	0.654	80.6	209
69.4	19.1	158	80	ND	ND	85.4	2.16	34.8	84.4
2490	983	1370	718	612	90.4	1230	189	362	957
ND	ND	31.3	16.4	ND	ND	155	ND	10	85.4
33.8	157	52.7	23.3	123	ND	20.4	171	150	25
ND	ND	ND	ND	ND	ND	ND	ND	33	33
2.31	ND	402	1.03	ND	ND	ND	ND	30	1.5
5.42	ND	364	4.64	ND	ND	5.64	ND	30	3.7
ND	ND	ND	ND	ND	ND	ND	ND	25	1.25
1.8	ND	ND	0.929	ND	ND	1.58	ND	30	1.5
ND	ND	ND	ND	ND	ND	ND	ND	30	1.5
8.04	3.39	2460	3.51	18.4	ND	ND	6.15	25	2.1
ND	ND	ND	ND	ND	ND	154	27	200	21.2
ND	ND	ND	ND	ND	ND	ND	ND	32.5	1.63
0.382	ND	347	0.375	ND	ND	0.86	ND	25	1.25
9.49	8.42	7930	7.67	37.2	141000	ND	9.6	71	2.7
ND	ND	ND	ND	ND	ND	ND	ND	50	2.5
15.6	20.8	10000	12.4	145	ND	4.82	58.2	30	5.7

21	22	22	22	23	23	23	14	14	14
B33	**B31**	**B32**	**B33**	**B31**	**B32**	**B33**	**B41**	**B42**	**B43**
9,680	15,000	10,000	12,000	14,000	9,900	11,000	7,340	7,030	8,620
1.44				51	190	ND			
2.38				25	90	0.6			
263	290	630	510	220	1000	850			
10	6	73	30	0.006	43	0.03			
242	160	200	190	480	54	280			
33	19	19	95	160	210	450			
	1500	1700	950	1400	1300	600			
1.5	20	1	1	1.7	0.71	0.001	0.72	0.351	ND
1.5	30	3.8	1.5	8.3	3.1	0.0015	1.53	0.659	2.94
1.55	30	1.5	1.5	0.0015	0.0003	0.0015	ND	ND	ND
1.5	20	1	1	0.0042	0.00075	0.001	0.747	ND	ND
1.5	40	2	2	0.002	0.0004	0.002	ND	ND	ND
5.75	170	8.5	8.5	0.0085	0.0017	0.0085	4.81	1.67	ND
31.2	170	180	23	12	62000	21	12.9	2.38	12.4
1.63	20	1	1	0.001	0.3	0.001	ND	ND	ND
1.25	30	1.5	1.5	0.0016	0.0011	0.0015	ND	ND	ND
6	170	8.5	8.5	17	2.3	0.0085	6.24	ND	1.58
2.5	10	0.5	0.5	0.97	0.31	0.0005	ND	ND	ND
52.7	170	8.5	46	24	3.1	36	32.6	8.74	1.73

B-4

15	15	15	16	16	16	17	17	17	18
B41	**B42**	**B43**	**B41**	**B42**	**B43**	**B41**	**B42**	**B43**	**B41**
6,080	5,580	11,900	4,620	5,030	8,220	3,990	4,210		5,520
52.3	97.9	20.2	50	144	43.1	0.369	52.2	26.2	41.1
30.8	57	22.8	26.6	59.8	21.4	27.4	51	13.2	28.9
779	125	1230	919	115	725	908	91.6	206	1140
			14.1	ND	ND	22	3.15	ND	15.8
			23.5	ND	243	24	20.1	121	35.6
			ND	ND	36.6	ND	ND	ND	ND
0.386	0.367	0.874	0.6	ND	ND	ND	ND	ND	0.93
1.88	1.93	4.51	1.57	0.37	ND	1.11	0.31	7.14	1.82
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3.12	5.15	1.57	2.08	0.818	ND	0.607	0.478	ND	2.64
ND	ND	ND	ND	ND	ND	ND	ND	ND	5.25
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.375	ND	ND	0.347	ND	ND	0.277	ND	ND	0.92
1.15	0.474	20.9	0.956	ND	ND	ND	ND	3.39	5.71
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25.8	29.3	8.31	16.2	4.13	ND	4.73	1.77	ND	8.59

18	18	19	19	19	20	20	20	21	21
B42	**B43**	**B41**	**B42**	**B43**	**B41**	**B42**	**B43**	**B41**	**B42**
5,820	12,200	4,750	5,390	10,100	5,900	6,300	13,000	5,200	5,800
157	9.46	27.2	97.5	13.2				23	150
61.1	12.9	24.7	49.7	16.8				21	64
131	446	1740	101	652	820	140	1200	760	140
ND	ND	30.3	10	10	25	6	6	25	0.006
19.8	95.1	81.5	30	351	76	810	230	71	46
ND	ND	33	33	33	19	19	19	38	49
					2700	1200	560	2500	910
ND	0.74	0.3	0.3	30	0.2	0.4	20	0.24	0.0002
0.48	2.22	1.96	0.43	30	2.2	5.2	30	2.3	3.5
ND	ND	0.25	0.25	25	0.3	0.3	30	0.0003	0.0003
ND	ND	0.3	0.3	30	0.2	0.2	20	0.0002	0.0002
ND	ND	0.3	0.3	30	0.4	0.4	40	0.0004	0.0004
0.78	1.56	1.65	0.83	46	2.8	1.7	170	2.8	0.0017
ND	5.62	7.22	2	200	1.7	1.7	170	3	0.0017
ND	ND	0.325	0.325	32.5	0.2	0.2	20	0.0002	0.0002
ND	ND	0.73	0.25	25	1.4	0.3	30	0.0012	0.0003
ND	6.16	0.26	0.25	110	1.7	1.7	170	3.3	0.0017
ND	ND	0.5	0.5	50	0.1	0.1	10	0.0001	0.0001
ND	12.2	9.19	0.3	314	9.7	1.7	170	11	0.0017

21	13	13	13	14	14	14	15	15	15
B43	**B51**	**B52**	**B53**	**B51**	**B52**	**B53**	**B51**	**B52**	**B53**
11,000	8,650	6,700	4,760	8,830	1,960	4,260	6,240	2,670	11,500
20				96.6	361	354	673	341	162
30				40.2	67.9	49.4	54.5	75.5	43.7
1100				783	434	189	253	96.6	80.1
0.006							52.7	10.3	ND
230							ND	ND	ND
130							ND	29	ND
560									
0.001	1.36	ND	1.29	0.535	ND	2.97	ND	ND	1.45
1.9	3.53	ND	1.51	1.8	1.14	2.79	0.646	0.407	1.71
0.0015	ND	ND	ND	ND	0.286	ND	ND	ND	ND
0.001	1.08	ND	ND	ND	ND	ND	ND	ND	ND
0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.0085	1.07	ND	15.2	0.254	ND	17.4	ND	ND	4.16
0.0085	5.05	10.5	ND	ND	ND	ND	ND	ND	ND
0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.0015	ND	ND	0.341	ND	ND	0.341	ND	ND	ND
0.0085	4.2	ND	6.43	1.6	0.3	11.2	0.887	ND	2.47
0.0005	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.0085	7.24	5.89	282	1.45	1.01	140	0.756	0.557	41.8

B-5

16	16	16	17	17	17	18	18	18	19
B51	B52	B53	B51	B52	B53	B51	B52	B53	B51
4,820	2,220	2,360	6,230	2,950	4,720	8,780	3,030	3,910	7,500
645	396	149	1030	520	187	705	456	82.3	
51.2	68	26.6	77.7	78.5	49.5	55.9	96.1	46	
126	29.2	18.1	81.1	85.9	125	110	50	71.8	68
53.2	7.73	11	170	ND	ND	178	10	10	130
15.1	6.08	12	10.9	ND	34.5	6.98	31.5	34.6	4500
ND	10.4	ND	ND	102	ND	3.3	33	33	1.9
									1400
ND	ND	ND	ND	ND	ND	0.3	0.3	0.3	0.45
0.558	0.517	0.485	11.7	30.8	5.65	2.13	8.05	4.6	4.3
ND	ND	ND	ND	28.4	ND	0.25	13.5	0.25	0.3
ND	ND	ND	ND	2.32	ND	0.3	0.3	0.3	0.2
ND	ND	ND	ND	ND	ND	0.3	0.3	0.3	0.4
ND	ND	0.604	0.42	ND	ND	0.31	0.25	0.25	1.7
ND	ND	ND	9.3	ND	ND	2.04	2	2	1.7
ND	ND	ND	ND	ND	ND	0.325	0.325	0.325	0.2
ND	ND	ND	2.82	0.5	0.93	0.56	0.25	0.43	1.3
0.314	ND	ND	0.28	0.7	ND	0.25	0.36	0.25	2.7
ND	ND	ND	ND	0.51	ND	0.5	0.5	0.5	0.1
ND	ND	3.98	3.15	ND	0.97	0.47	0.3	0.3	6.4

19	19	20	20	20	11	12	12	12	13
B52	**B53**	**B51**	**B52**	**B53**	**B61**	**B61**	**B62**	**B63**	**B61**
3,500	5,200	7,800	3,300	4,400		14,600	11,700	11,800	4,230
		790	360	82					126
		69	81	43					65.6
380	74	86	180	110					396
6	6	120	0.006	0.006					
33	76	33	0.021	38					
70	19	13	42	31					
350	220	630	280	180					
6.2	0.8	0.34	7.4	1.9	9.01	ND	0.694	68.9	2.14
29	3.8	2.6	19	5.6	3.46	ND	0.694	ND	11.4
29	0.3	0.0003	23	0.0003	ND	ND	ND	ND	ND
5.3	0.2	0.0002	0.004	0.0002	ND	ND	ND	ND	ND
0.4	0.4	0.0004	0.0004	0.0004	ND	ND	ND	ND	ND
1.8	1.7	0.0017	0.0017	0.0017	91.4	91.2	1.38	66	10.7
1.7	1.7	0.0017	0.0017	0.0017	ND	ND	2.04	ND	ND
0.2	0.2	0.0002	0.0002	0.0002	ND	ND	ND	ND	ND
0.77	0.98	0.00066	0.00052	0.001	ND	ND	ND	ND	ND
3.1	1.7	2	0.0017	0.0017	19.8	51.2	4.33	2480	21
1	0.1	0.0001	0.5	0.17	ND	ND	ND	ND	1.2
2.9	95	3.3	0.0017	95	1290	4120	3.62	118	221

							B-6		
13	**13**	**14**	**14**	**14**	**15**	**15**	**15**	**16**	**16**
B62	**B63**	**B61**	**B62**	**B63**	**B61**	**B62**	**B63**	**B61**	**B62**
10,100	12,100	3,640	11,500	12,800	5,580	16,200	15,000		19,800
25.4	21.9	110	25.6	25.8	49.8	93	14.4	1.42	30.5
11.8	13.2	58	13.6	16.7	45	17.6	16.5		20.6
226	248	463	219	212	255	148	193	ND	194
		ND	ND	ND	ND	ND	ND	ND	ND
		327	237	142	280	257	232	188	181
		ND	ND	ND	ND	ND	ND	ND	ND
5.77	46.9	ND	4.52	39.9	ND	3.67	33.7	918	7.71
4.45	ND	5.45	2.49	5.27	ND	2.39	6.36	1140	5.8
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	2.84	ND	ND	2.54	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	30	11	1.55	29	5.35	1.97	23.1	8660	2.35
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3.94	ND	ND	ND	0.354	ND	ND	ND	ND	0.32
18.4	1140	10.1	7.76	338	11	5.36	110	55900	10.7
ND	ND	ND	ND	2.15	ND	ND	ND	ND	1.27
7.14	65.8	191	4.31	51.9	51.4	5.85	38	60100	7.22

16	17	17	17	18	18	18	19	19	19
B63	**B61**	**B62**	**B63**	**B61**	**B62**	**B63**	**B61**	**B62**	**B63**
15,200		9,930	11,100	5,100	12,000	13,000	11,000	5,100	6,400
37.3	72.9	26.5	28.2				93	83	46
23.1	40.5	18.9	18.6				34	41	30
183	330	195	213	320	90	190	100	380	250
ND	1	1	1	0.6	0.6	0.6	0.003	9.8	0.003
135	250	143	111	220	72	250	76	270	150
ND	5.25	3.3	23.8	1.9	1.9	20	24	12	52
				1400	230	270	350	2000	350
15.2	7.4	7.56	6.5	12	1.4	8.9	3.7	5.4	5.6
8.94	6.7	3.13	5	8.8	3.2	5.9	3.4	7	6.6
ND	2.5	0.25	1.25	3	0.3	1.5	0.0015	0.0015	0.0015
1.23	3	0.3	1.5	4.1	0.37	1.6	0.001	0.001	0.001
ND	3	0.3	1.5	4	0.4	2	0.002	0.002	0.002
10.6	13.3	2.89	6.6	17	1.7	8.5	0.0085	13	0.0085
ND	20	2	10	17	1.7	8.5	0.0085	0.0085	0.0085
ND	3.25	0.325	1.63	2	9.7	1	0.001	0.001	0.001
0.62	2.5	0.25	1.25	3	0.7	1.5	0.0015	0.0015	0.0015
53.9	58	8.48	24.6	87	3.1	21	0.0085	54	15
1.88	5	0.5	2.5	9.5	0.1	2.8	1.1	1.5	1.2
24.9	166	7.33	16.6	99	4.7	16	0.0085	150	11

								B-7	
7	**7**	**8**	**8**	**9**	**9**	**10**	**10**	**11**	**11**
B71	**B72**	**B71**	**B72**	**B71**	**B72**	**B71**	**B72**	**B71**	**B72**
		15,600	8,180	9,290	11,300	13,000	14,000	13,100	12,400
				70.2	27.6	18.5	15.5	64	43.5
				4.5	6.76	6.95	5.26	7.84	5.89
				163	149	176	148	177	109
						ND	ND	ND	ND
						120	93.8	214	124
						ND	ND	155	ND
78.1	58.4	60.6	109	108	65.4	52	50.5	36.1	73.5
ND	ND	ND	ND	ND	ND	0.695	6.09	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	5.43	4.94	ND	ND
ND	ND	ND	ND	ND	ND	0.338	ND	ND	ND
76.6	52.7	61	83.3	41.2	72.8	46.1	72.4	29.5	97.5
ND	ND	ND	51.5	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	1.03	1.75	ND	ND
4940	1890	3230	1160	1700	3720	2610	4450	1540	4580
ND	ND	ND	ND	ND	ND	0.861	5.28	ND	ND
105	273	111	455	123	383	89.2	529	49.9	483

12	12	13	13	14	14	15	15	0	1
B71	**B72**	**B71**	**B72**	**B71**	**B72**	**B71**	**B72**	**B81**	**B81**
14,100	9,340	12,300	12,200	15,000	15,000	15,000	14,000	7,900	4,940
16.8	15.6	19.1	15.5			33	23		1140
9.15	7.49	9.7	8.56			12	6.6		1.13
212	125	168	111	220	200	260	240		195
ND	ND	1	1	0.6	0.6	3.1	0.003		
142	120	134	86.9	200	130	190	130		
ND	ND	3.3	3.3	4.8	1.9	19	32		
				320	280	580	480		
39.3	43.5	48.8	27.5	70	65	57	43	105	144
ND	ND	7.5	7.5	7.5	7.5	0.006	0.006	ND	4.02
ND	ND	6.25	6.25	7.5	7.5	0.006	0.006	ND	ND
ND	ND	7.5	7.5	16	5	0.012	0.0078	ND	ND
ND	ND	7.5	7.5	10	10	0.008	0.008	ND	ND
33	53.5	45.3	51	43	71	38	61	33.9	44.9
ND	ND	50	50	43	43	0.034	0.034	29.6	ND
ND	ND	8.13	8.13	5	5	0.004	0.004	ND	ND
ND	ND	6.25	6.25	7.5	7.5	0.006	0.006	ND	ND
1920	2710	2620	1470	2900	2300	2600	1400	477	724
ND	ND	12.5	12.5	2.5	2.5	0.002	3	ND	ND
58.8	289	74.3	286	74	420	66	360	156	183

						Landfill F			
B-8									
2	**3**	**4**	**5**	**6**	**7**	**0**	**1**	**2**	**3**
B81	**B81**	**B81**	**B81**	**B81**	**B81**				
3,880	5,560	11,600	10,400	14,000	12,000				
73.5	81.4	228	302		120	614	586	440	439
ND	ND	ND	0.6		ND				
123	136	127	167	240	300	16.1	21.8	10.9	17.3
ND	ND	ND	0.328	0.6	4.7				
ND	ND	43.5	44.8	55	64				
ND	ND	ND	3.3	1.9	21				
				620	990	ND	ND	ND	ND
31.7	37	254	206	210	190	ND	ND	ND	ND
0.92	ND	ND	6	6	3.7	ND	ND	ND	ND
ND	ND	ND	5	6	0.003				
0.724	ND	ND	6	4	0.0049	ND	ND	ND	ND
ND	ND	ND	6	8	0.004	ND	ND	ND	ND
12.5	11.8	74	72.6	63	65	ND	ND	ND	ND
2.14	ND	ND	40	34	0.017				
ND	ND	ND	6.5	4	0.002	ND	ND	ND	ND
0.455	ND	ND	5	6	0.003	ND	ND	ND	ND
161	162	1130	1060	820	700	ND	ND	ND	ND
ND	ND	ND	10	2	0.001	ND	ND	ND	ND
64.9	47.4	319	290	280	280				

									Landfill J
		F-1							
4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**0**
								7	7.6
									9750
676	650	552	287	354	342	380	333	386	
ND	13.2	14	13	10	4	5	8	4	10
									5
ND	ND	ND	ND	18	ND	3	ND	ND	
ND	ND	ND	14	26	44	2.6	ND	ND	5
ND	ND	ND	ND	ND	ND	ND	ND	ND	12.0
									5
ND	ND	ND				ND	ND	ND	
ND	ND	ND	ND	ND	ND	ND	ND	ND	10
ND	ND	ND	ND	ND	ND	ND	ND	ND	5
									5
ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1
ND	ND	ND	ND	ND	ND	ND	ND	ND	3.7
ND	ND	ND	ND	ND	ND	ND	ND	ND	5
ND	ND	ND	ND	ND	ND	ND	ND	ND	10
									10

J-1

1	2	3	4	5	6	7	8	9	10
7.6	7.2	7.1	6.9	7.1	6.6	7.3	6.2	6.8	6.9
9890	11360		12640	13938	17410	15324	25509	34700	33810
2540	2770	2840	3300	3400	3300	4100	7200	7200	8500
1730	1710	1880	1900	2100	2400	2900	4500	5200	6000
352	390	439	480	460	400	410	630	530	640
823	830	952	930	1000	920	1100	1800	1600	1900
22	22	25	29	29	36	45	130	140	300
952	936	1190	1400	1400	1500	1900	4200	3800	5800
10	10	10	10	10	10	11	28	9	32
5	5	5	5	5	5	5	5	1	3
3	8	3	3	18	5	8	15	9	5
40	40	40	42	270	340	160	230	260	330
10	10	10	5	5	5	5	5	1	1
13.0	25.0	31.0	18.0	23.0	12.0	5.0	15.0	13.0	11.0
10	10	10	5	5	5	5	5	1	1
20	20	20	10	10	10	10	10	1	1
10	10	10	5	5	5	5	5	1	1
10	10	10	5	5	5.0	5.0	5.0	5.0	5.0
10	10	10	5	5	5.0	5.0	5.0	1.0	1.0
10	10	10	5	5	5.3	5.0	6.3	5.4	6.2
10	10	10	5	5	5	5	5	1	1
20	20	20	10	10	10	10	10	1	1
20	20	20	10	10	10	10	10	2	2

11	12	13	14	15	16	0	1	2	3
6.9	7.3	7.1	7.2	7.5	7.1			7.5	7.4
38400	42900	43161	43700	44748	45563			1630	1675
9200	9400	9500	10000	10000	11000			209	207
6600	7200	8700	7800	7800	7700			203	200
760	810	860	840	810	790			69.4	50.7
2000	2000	2000	2100	2100	2100			94.4	104
480	560	740	720	800	890			5.58	5.94
7300	8600	7800	8000	8700	8600			143	159
40	57	60	63	80	96			10	10
1	4	25	10	6	4			5	5
9	9	45	140	13	43			21	5
240	380	1100	2100	1000	410			219	55
1	1	1	1	1	1			100	10
3.5	7.1	7.7	5.0	8.2	5.9			100	24
1	1	1	1	1	1			100	10
1	1	1	1	1	1			200	20
1	1	1	1	1	1			100	10
5.0	0.6	2.0	2.0	2.0	2.9			100	10
1.0	1.0	1.0	1.0	1.0	1.0			100	10
	0.9	1.1	1.3	2.1	1.5			100	41
1	1	1	1	0.57	1			100	10
1	1	1	1	1	1			200	20
2	2	2		2	2			200	20

J-2

4	5	6	7	8	9	10	11	12	13
7.6	7.0		7.2	7.0	6.4	7.3	7.1	7.0	7.3
1560	7374		6966	6356	17134	17450	18500	14190	19186
220	510		610	4200	4700	4000	4100	4400	4300
190	2400		3000	5800	6500	5700	5700	6200	6600
45	170		130	520	500	510	470	500	480
100	470		600	1800	1600	1600	1400	1800	1900
6	13		16	46	40	31	38	34	39
160	690		900	2300	2000	2000	2100	2100	2400
10	10		10	10	6	15	6	15	15
5	5		5	5	2	2	2	2	1
3	3		68	8	34	9	9	3	9
40	220		3700	590	480	250	290	510	990
25	40		10	20	0	1	1	1	1
25	40		10	20	6	4	3	3	4
25	40		10	20	1	1	1	1	1
50	80		20	40	1	1	1	1	1
25	40		10	20	1	1	1	1	1
25	40		10	20	1	0	5	5	1
25	40		10	20	1	1	1	1	1
43	40		10	72	5	5	5	6	8
25	40		10	20	1	1	1	1	1
50	80		20	40	1	1	1	1	1
50	80		20	40	2	2	2	2	2

14	15	16	0	1	2	3	4	5	6
7.5	7.4	7.5							6.5
19760	19676	19009							14070
4700	5200	4400							4700
7200	8200	6400							25
450	510	490							760
1800	1700	1600							1100
38	37	39							29
2500	2600	2500							570
5	5	10							10
1	5	1							5
4	9	14							3
950	1300	1200							370
1	1	1							100
3	6	3							100
1	1	1							100
1	1	1							200
1	1	1							100
2	2	2							100
1	1	1							100
7	12	8							100
1	1	1							100
1	1	1							200
2	2	2							200

	J-3								
7	8	9	10	11	12	13	14	15	16
6.8		6.7							
12286		10040							
4100		3500							
25		20							
560		430							
1000		770							
34		23							
540		450							
23		17							
5		1							
3.5		9							
510		400							
130		120							
130		36							
130		20							
270		20							
130		6							
130		9							
130		20							
130		20							
130		8							
270		20							
270		9							

Landfill M					Landfill P			
		M-1						
0	1	2	3	4	5	6	7	8
8.0	7.7	7.5	7.5	7.5				
29615	19891	16387	14948	15994	66,900	70,500		
					546	516	2,010	337
5423	2544	2431	2625	2783				
				2400				
			322.5	340				
	440							
	1.5							
	33							
	290							
	0.35							
	6.3							
	1.1							
	0.82							
	16							
	0.22							
	0.57							

P-1

9	10	11	12	13	14	15	16	17	18
								8.4	7.9
								89,800	82,500
								1,750	
								534	
								ND	
								974	

19	20	21	1	2	3	4	5	6	7
8.2	7.6	6.8							
			45,800	43,000	45,200				
2,950			2,380	1,630	1,460				
1,430	1,890	1,830							
356	566	701							
ND	ND	ND							
715	1,050	1,560							

	P-2								
8	9	10	11	12	13	14	15	16	17
					9.5	9.9	9.0	9.4	
						59,200	43,900		
							2,210		
					781		1,290	830	
					219		262	233	
					ND		55		
					955		1,550	1,290	

								P-3	
1	2	3	4	5	6	7	8	9	10
60,300	56,400	57,000	56,400						
2,800	2,580	1,820							

									P-4
11	**12**	**13**	**14**	**15**	**16**	**17**	**9**	**10**	**11**
		9.1	8.7	9.4	9.1	9.1	9.8	8.3	8.2
			59,400	68,900					18,760
		10,700		12,300	12,000	10,600	843		2,800
		108		1,210	1,020	1,120	ND		ND
		ND		40	ND	ND	422		152
		508		661	722	625	3,670		2,300

		Landfill R							
								R-1	
12	**13**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
7.6	8.1								
		7300	7800	8100		8500			
		2600	2700	2900		2800			
		1500	1400	1800		1100			
		360	360	470		310			
		3,600	4,600	6,000		3,700			
		24.0	19.0	20.0		22.0			
1,520	1,550	30	ND	ND		0.01			
		ND	ND	ND		10			
75	356	ND	ND	ND		50			
ND	27	60	ND	ND		ND			
8,210	5,450	110	100	130		130			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			
		ND	ND	ND		ND			

9	10	11	12	13	1	2	3	4	5
7.6									
35,300									
20,500									
7,850	9,600	10,000	8,900	9,400	14,000	15,000	15,000		13,000
2,810	3,400.00	3,400	3,500	3,600	5,500	2,600	2,700		5,500
1,200	1,200.00	1,300	1,100	1,100	880	1,400	2,700		710.00
382	390	490	430	460	690	400	780		390
5,070	5,600	5,700	5,000	5,700	12,000	4,800	10,000		7,200
16.8	18.0	20.0	22.0	20.0	39	34	36		30
0	8.20	15	9	11	10	ND	ND		0.03
0	1	1	1	ND	ND	ND	ND		10
0	290	8	2	11	ND	ND	ND		50
0	ND	ND	ND	ND	110	ND	67		ND
0	180	140	180	170	110	ND	ND		130
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	1	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND
ND	ND	ND	ND	ND	ND	ND	ND		ND

								Landfill T	
R-2 to R-5									
6	7	8	9	10	11	12	13	0	1
			7.0					8.8	8.5
			14,131					39004	47100
			8,207						
								2167	3508
16,000			12,100	13,500	13,500	13,500	14,250	11590	14120
5,600			4,730	4,850	4,875	4,825	5,100	8933	9700
1,500			1,211	1,140	1,210	1,105	1,095	4270	2283
620			620	505	600	530	555		
7,900			9,153	8,875	9,150	8,600	9,450		
42			23	51	33	38	37		
20			0.04	32.00	39.00	17.75	14.15	102467	112550
10			0.01	7.90	9.45	4.65	4.76	549	483
50			0.02	2.17	6.70	1.80	2.39	407	143
50			0.00	3.95				50	ND
78			0.13	113.50	121.75	116.25	119.50		
ND			ND	0.40	0.79	1.30	ND	5	31
ND			ND	0.44	0.50	0.37	0.35	7	ND
ND								3	ND
ND									
ND								ND	ND
ND			ND	ND	ND	ND	ND	ND	ND
ND								718	307
ND								ND	ND
ND								11	35
ND			ND	ND	ND	ND	ND		
ND								2020	4424
ND			ND	ND	0.54	ND	ND		

	T-1							T-2
2	**3**	**4**	**5**	**6**	**0**	**1**	**2**	**3**
	8.7	9.0	8.7	9.0	7.7	5.9	5.6	8.2
	44000	41500	28050	32250				
	2925	8373	1352	702	4,498	3,818	3,438	3,311
	13200	14500	14500	14275	27,233	29,620	30,933	28,025
	9970	9505	10215	10488				
	1110	3895	4450	3658	4,557	17,482	23,467	14,150
					23,600	25,760	22,900	18,900
	78000	71750	109425	82800	154,333	52,580	63,933	125,000
	ND	ND	ND	11	935	186	321	110
	460	275	334	328	610	1,706	1,440	555
	ND	51	ND	610	35	51	92	151
	ND	26	18	10	135	95	56	176
	ND	1020	73	35	117	74	25	189
	ND	ND	16	ND	94	62	35	120
	ND	ND	5	ND	37	23	7	64
	ND	ND	ND	ND	168	113	45	288
	ND	38	37	ND	193	156	20	125
	ND	1708	344	ND	89	55	18	152
	ND	ND	4	ND	68	28	9	76
					224	146	91	240
	3590	4434	421	38	245	146	47	880

			T-3				
4	5	6	0	1	2	3	4
7.8	7.8	7.9	8.8	8.6	7.8	8.1	8.1
3,719	2,955	2,097	7,053	5,061	4,957	4,840	5,891
26,575	30,550	31,867	21,448	31,300	33,733	34,320	32,150
15,400	16,600	19,167	7,397	6,592	9,363	9,722	9,063
21,600	24,800	24,567	19,667	19,480	15,100	19,780	17,800
83,400	103,975	214,667	234,333	171,140	121,733	200,200	112,950
2	5	9	1,208	585	831	124	4
598	582	747	310	604	873	1,030	1,233
60	36	21	28	55	167	151	60
105	69	19	541	219	335	248	495
114	79	83	499	174	345	267	603
67	45	27	521	106	205	158	315
38	32	45	170	67	118	90	180
170	111	26	883	366	619	405	810
108	48	47	1,647	654	334	195	315
90	62	31	393	137	279	214	428
46	29	20	429	87	145	107	215
143	93	18	1,224	816	727	405	827
238	155	49	5,476	1,582	733	876	5,800

		T-5						
5	6	0	1	2	3	4	5	6
7.7	7.5	12.1	11.9	12.0	12.0	12.0	11.8	11.7
3,787	3,199	8,356	7,144	7,323	7,542	10,579	8,739	7,739
30,625	31,300	12,233	13,300	12,918	13,133	14,375	13,325	12,975
5,723	5,300	4,743	5,878	9,028	9,668	10,205	7,798	8,643
16,675	15,900	7,483	6,168	7,013	9,420	6,813	6,873	6,613
164,025	201,250	12,167	15,160	11,450	12,250	11,975	13,000	11,438
27	14	56	49	34	17	2	5	17
948	1,104	117	84	78	85	51	54	101
36	58	13	43	126	151	60	44	35
170	39	1,496	6,257	508	260	276	200	69
195	99	1,615	6,806	1,107	629	1,373	369	395
105	26	3,945	4,388	403	158	88	140	75
75	46	544	2,440	175	90	85	106	144
275	31	2,448	10,224	744	405	225	318	119
110	49	1,338	12,612	301	158	143	153	156
153	32	1,292	5,396	390	214	119	187	100
65	23	662	2,766	296	107	223	89	81
230	25	2,096	8,892	1,528	745	1,420	601	105
385	65	22,154	150,900	24,350	17,530	28,425	3,350	408

T-6							T-7	
0	1	2	3	4	5	6	0	1
12.0	12.2	10.8	12.1	9.4	11.5	11.7	9.4	9.6
							45250	30100
5,745	6,933	7,664	7,694	8,275	9,962	8,799	6,438	4,928
11,000	9,850	18,092	14,150	11,629	16,700	17,100	13,525	13,850
							7,215	6,235
3,300	4,710	7,516	7,545	5,483	7,198	7,928	6,970	7,338
4,930	5,998	9,706	6,953	5,058	8,515	8,575		
18,500	19,050	44,460	22,575	14,593	19,975	16,100	53,500	32,247
4	72	54	26	2	5	17		
17	40	128	61	26	50	66	122	201
5	45	126	134	72	39	15	55	20
490	2,361	340	328	224	170	113	584	460
470	2,438	285	324	172	225	565		
4,000	1,880	644	385	146	179	144	160	
160	827	89	110	58	125	256		
720	3,720	389	495	262	250	178	170	145
2,720	5,117	1,115	204	102	354	273	777	
380	1,963	199	261	139	169	176		
190	1,029	161	131	126	73	129		53
1,200	3,350	1,063	544	478	214	113		
15,100	19,000	9,660	5,658	3,881	4,580	733	1,027	435

12. APPENDIX IV

APPENDIX IV

LANDFILL B

CELLS B-1 TO B-6

INTERMEDIATE COVER

```
1
**********************************************************************************
**********************************************************************************
**                                                                              **
**                                                                              **
**              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                 **
**                                                                              **
**                                                                              **
**********************************************************************************
**********************************************************************************

PRECIPITATION DATA FILE:      C:\1_IICNC\DATA4.D4
TEMPERATURE DATA FILE:        C:\1_IICNC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\1_IICNC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\1_IICNC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\1_IICNC\DATA10.D10
OUTPUT DATA FILE:             C:\1_IICNC\OUT.OUT

TIME: 16:52     DATE:  8/16/2016

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

     TITLE:  B1-without cover

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

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

                                  LAYER  1
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   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  =      0.2257 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  18
         THICKNESS                   =    540.00    INCHES
                                    Page 1
```

```
         POROSITY                    =      0.6710 VOL/VOL
         FIELD CAPACITY              =      0.2920 VOL/VOL
         WILTING POINT               =      0.0770 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.3079 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC

                                  LAYER  3
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   5
         THICKNESS                   =     12.00    INCHES
         POROSITY                    =      0.4570 VOL/VOL
         FIELD CAPACITY              =      0.1310 VOL/VOL
         WILTING POINT               =      0.0580 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.1313 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC

                                  LAYER  4
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   1
         THICKNESS                   =     12.00    INCHES
         POROSITY                    =      0.4170 VOL/VOL
         FIELD CAPACITY              =      0.0450 VOL/VOL
         WILTING POINT               =      0.0180 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.0574 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  9.99999978000E-02 CM/SEC
         SLOPE                       =      2.00    PERCENT
         DRAINAGE LENGTH             =     50.0     FEET

                                  LAYER  5
                                  --------

                       TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
         THICKNESS                   =      0.08    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.   =  0.199999996000E-12 CM/SEC
         FML PINHOLE DENSITY         =      2.00    HOLES/ACRE
         FML INSTALLATION DEFECTS    =      2.00    HOLES/ACRE
         FML PLACEMENT QUALITY       =  4 - POOR

                                  LAYER  6
                                  --------

                       TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  16
         THICKNESS                   =     60.00    INCHES
         POROSITY                    =      0.4270 VOL/VOL
         FIELD CAPACITY              =      0.4180 VOL/VOL
                                    Page 2
```

```
         WILTING POINT               =      0.3670 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC

                                  LAYER  7
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   5
         THICKNESS                   =     12.00    INCHES
         POROSITY                    =      0.4570 VOL/VOL
         FIELD CAPACITY              =      0.1310 VOL/VOL
         WILTING POINT               =      0.0580 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.1311 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
         SLOPE                       =      2.00    PERCENT
         DRAINAGE LENGTH             =     50.0     FEET

                                  LAYER  8
                                  --------

                       TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
         THICKNESS                   =      0.08    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.   =  0.199999996000E-12 CM/SEC
         FML PINHOLE DENSITY         =      2.00    HOLES/ACRE
         FML INSTALLATION DEFECTS    =      2.00    HOLES/ACRE
         FML PLACEMENT QUALITY       =  4 - POOR

                                  LAYER  9
                                  --------

                       TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  16
         THICKNESS                   =     36.00    INCHES
         POROSITY                    =      0.4270 VOL/VOL
         FIELD CAPACITY              =      0.4180 VOL/VOL
         WILTING POINT               =      0.3670 VOL/VOL
         INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC

                   GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                   ----------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
             FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
             AND A SLOPE LENGTH OF   50. FEET.

      SCS RUNOFF CURVE NUMBER                  =     69.10
                                    Page 3
```

```
         FRACTION OF AREA ALLOWING RUNOFF     =   100.0    PERCENT
         AREA PROJECTED ON HORIZONTAL PLANE   =     7.440  ACRES
         EVAPORATIVE ZONE DEPTH               =    22.0    INCHES
         INITIAL WATER IN EVAPORATIVE ZONE    =     4.915  INCHES
         UPPER LIMIT OF EVAPORATIVE STORAGE   =    10.054  INCHES
         LOWER LIMIT OF EVAPORATIVE STORAGE   =     1.276  INCHES
         INITIAL SNOW WATER                   =     0.000  INCHES
         INITIAL WATER IN LAYER MATERIALS     =   218.178  INCHES
         TOTAL INITIAL WATER                  =   218.178  INCHES
         TOTAL SUBSURFACE INFLOW              =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH  100
----------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.47	4.15	4.75	3.69	3.50	4.71
	5.63	5.57	4.85	3.05	3.49	3.30
STD. DEVIATIONS	2.35	2.14	2.41	1.99	1.91	2.16
	2.49	3.00	3.17	2.24	1.59	1.55
RUNOFF						
TOTALS	0.020	0.014	0.019	0.011	0.008	0.003
	0.030	0.031	0.071	0.029	0.002	0.003
STD. DEVIATIONS	0.062	0.050	0.056	0.040	0.045	0.015
	0.127	0.090	0.198	0.127	0.010	0.017
EVAPOTRANSPIRATION						
TOTALS	1.547	1.895	2.616	2.818	4.209	4.588
	4.706	4.465	3.013	1.503	0.979	1.172
STD. DEVIATIONS	0.247	0.359	0.668	0.849	0.925	1.504
	1.471	1.317	1.011	0.421	0.186	0.203
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	1.0642	1.2159	1.7930	2.0576	2.3677	2.0733
	1.5524	0.9776	0.7194	0.7925	0.8897	1.0847
STD. DEVIATIONS	0.7307	0.6740	0.8203	0.7773	0.9710	1.0354
	1.1735	0.9764	0.7065	0.7515	0.9411	0.9924
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0004	0.0005	0.0007	0.0008	0.0009	0.0008
	0.0006	0.0004	0.0003	0.0003	0.0004	0.0004
STD. DEVIATIONS	0.0003	0.0002	0.0003	0.0003	0.0003	0.0004
	0.0004	0.0003	0.0003	0.0003	0.0004	0.0004
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0005	0.0004	0.0005	0.0005	0.0006	0.0006
	0.0007	0.0006	0.0006	0.0005	0.0005	0.0005
STD. DEVIATIONS	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

Page 4

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	1.5041	1.8790	2.5000	2.9467	3.2444	2.9412
	2.1392	1.3659	1.0773	1.1179	1.4290	1.5143
STD. DEVIATIONS	1.0202	1.0153	1.0973	1.0597	1.2614	1.4055
	1.5756	1.2822	1.0147	1.0476	1.3296	1.3531

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0068	0.0068	0.0073	0.0080	0.0089	0.0095
	0.0097	0.0092	0.0084	0.0076	0.0072	0.0070
STD. DEVIATIONS	0.0026	0.0025	0.0025	0.0024	0.0023	0.0024
	0.0026	0.0029	0.0029	0.0027	0.0025	0.0026

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	50.13	(8.394)	1354302.9	100.00
RUNOFF	0.241	(0.2987)	6511.62	0.481
EVAPOTRANSPIRATION	33.312	(3.6434)	899934.00	66.419
LATERAL DRAINAGE COLLECTED FROM LAYER 4	16.70790	(5.45715)	451233.625	33.31860
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00671	(0.00197)	181.138	0.01337
AVERAGE HEAD ON TOP OF LAYER 5	1.977	(0.620)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00665	(0.00169)	179.550	0.01326
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00005	(0.00001)	1.360	0.00010
AVERAGE HEAD ON TOP OF LAYER 8	0.008	(0.002)		
CHANGE IN WATER STORAGE	-0.114	(4.5321)	-3077.20	-0.227

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	6.01	162318.281
RUNOFF	1.207	32603.9727
DRAINAGE COLLECTED FROM LAYER 4	0.14838	4007.25708
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000050	1.36097
AVERAGE HEAD ON TOP OF LAYER 5	5.032	
MAXIMUM HEAD ON TOP OF LAYER 5	6.989	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	23.3 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00003	0.93585
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00654
AVERAGE HEAD ON TOP OF LAYER 8	0.013	
MAXIMUM HEAD ON TOP OF LAYER 8	0.030	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.6 FEET	
SNOW WATER	4.02	108576.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3837	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	3.3683	0.1403
2	157.6800	0.2920
3	3.4387	0.2032
4	0.7313	0.0609
5	0.0000	0.0000
6	25.6200	0.4270
7	1.5740	0.1312
8	0.0000	0.0000
9	15.3770	0.4270
SNOW WATER	0.000	

FINAL COVER

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1
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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:\2_IICC\DATA4.D4
TEMPERATURE DATA FILE:      C:\2_IICC\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\2_IICC\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\2_IICC\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\2_IICC\DATA10.D10
OUTPUT DATA FILE:           C:\2_IICC\OUT.OUT

TIME: 16:57    DATE:  3/16/2016

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     TITLE: B1-With 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.

                           LAYER  1
                           --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   5
    THICKNESS                     =     6.00   INCHES
    POROSITY                      =     0.4570 VOL/VOL
    FIELD CAPACITY                =     0.1310 VOL/VOL
    WILTING POINT                 =     0.0580 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.1692 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                           LAYER  2
                           --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   1
    THICKNESS                     =    18.00   INCHES
                              Page 1
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```
    POROSITY                      =     0.4170 VOL/VOL
    FIELD CAPACITY                =     0.0450 VOL/VOL
    WILTING POINT                 =     0.0180 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.2690 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.999999978000E-02 CM/SEC
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                           LAYER  3
                           --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
    THICKNESS                     =    24.00   INCHES
    POROSITY                      =     0.4270 VOL/VOL
    FIELD CAPACITY                =     0.4180 VOL/VOL
    WILTING POINT                 =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

                           LAYER  4
                           --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.06   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  4 - POOR

                           LAYER  5
                           --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    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    =     0.1337 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC

                           LAYER  6
                           --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
    THICKNESS                     =   340.00   INCHES
    POROSITY                      =     0.6710 VOL/VOL
    FIELD CAPACITY                =     0.2920 VOL/VOL
                              Page 2
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    WILTING POINT                 =     0.0770 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.2920 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC

                           LAYER  7
                           --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   5
    THICKNESS                     =    12.00   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

                           LAYER  8
                           --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   1
    THICKNESS                     =    12.00   INCHES
    POROSITY                      =     0.4170 VOL/VOL
    FIELD CAPACITY                =     0.0450 VOL/VOL
    WILTING POINT                 =     0.0180 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.0450 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.999999978000E-02 CM/SEC
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                           LAYER  9
                           --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.06   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  4 - POOR

                           LAYER 10
                           --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
    THICKNESS                     =    60.00   INCHES
    POROSITY                      =     0.4270 VOL/VOL
    FIELD CAPACITY                =     0.4180 VOL/VOL
    WILTING POINT                 =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
                              Page 3
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```
    EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

                           LAYER 11
                           --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   5
    THICKNESS                     =    12.00   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
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                           LAYER 12
                           --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.06   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  4 - POOR

                           LAYER 13
                           --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
    THICKNESS                     =    36.00   INCHES
    POROSITY                      =     0.4270 VOL/VOL
    FIELD CAPACITY                =     0.4180 VOL/VOL
    WILTING POINT                 =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF   50. FEET.

  SCS RUNOFF CURVE NUMBER              =     68.10
  FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE   =      7.440  ACRES
                              Page 4
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EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.039	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.414	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.636	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	221.686	INCHES
TOTAL INITIAL WATER	=	221.686	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.47	4.15	4.75	3.69	3.30	4.71
	5.83	5.57	4.85	3.05	2.49	3.30
STD. DEVIATIONS	2.35	2.14	2.41	1.99	1.91	2.16
	2.49	3.00	3.17	2.24	1.30	1.55
RUNOFF						
TOTALS	0.016	0.011	0.017	0.009	0.007	0.003
	0.027	0.028	0.064	0.026	0.001	0.002
STD. DEVIATIONS	0.054	0.041	0.057	0.033	0.041	0.012
	0.108	0.082	0.182	0.112	0.008	0.013
EVAPOTRANSPIRATION						
TOTALS	1.372	1.910	2.633	2.817	3.686	4.014
	4.464	4.217	2.885	1.510	1.008	1.203
STD. DEVIATIONS	0.263	0.375	0.678	0.846	1.119	1.485
	1.415	1.304	1.049	0.459	0.224	0.222
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	2.6080	2.4807	2.3439	1.4679	1.0320	0.5618
	0.8330	1.0717	1.3365	1.6036	1.1624	1.4877
STD. DEVIATIONS	1.6882	1.8222	1.7014	0.9755	0.8907	0.5050
	1.0707	1.1218	1.4497	1.7115	1.2405	1.1549
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0067	0.0061	0.0066	0.0061	0.0062	0.0059
	0.0061	0.0062	0.0061	0.0064	0.0060	0.0063
STD. DEVIATIONS	0.0005	0.0005	0.0004	0.0003	0.0003	0.0002
	0.0003	0.0003	0.0004	0.0005	0.0004	0.0004
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0058	0.0052	0.0059	0.0059	0.0061	0.0061
	0.0062	0.0061	0.0058	0.0059	0.0058	0.0060
STD. DEVIATIONS	0.0012	0.0010	0.0012	0.0012	0.0012	0.0012
	0.0012	0.0012	0.0011	0.0011	0.0010	0.0011
PERCOLATION/LEAKAGE THROUGH LAYER 10						

Page 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 13						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	3.3077	3.4446	3.0100	2.0551	1.4157	0.8100
	1.1046	1.4271	1.7347	2.0469	1.6017	2.0075
STD. DEVIATIONS	1.8738	2.1144	1.8448	1.2604	1.1312	0.6997
	1.2418	1.3564	1.6740	1.9767	1.5709	1.4674
DAILY AVERAGE HEAD ON TOP OF LAYER 9						
AVERAGES	0.0082	0.0082	0.0084	0.0087	0.0089	0.0090
	0.0089	0.0086	0.0085	0.0084	0.0085	0.0085
STD. DEVIATIONS	0.0017	0.0016	0.0017	0.0017	0.0017	0.0017
	0.0017	0.0016	0.0016	0.0016	0.0015	0.0015
DAILY AVERAGE HEAD ON TOP OF LAYER 12						
AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	50.15	(8.594)	1354507.9	100.00
RUNOFF	0.211	(0.2718)	5700.79	0.421
EVAPOTRANSPIRATION	31.920	(3.6089)	862064.81	63.644
LATERAL DRAINAGE COLLECTED FROM LAYER 2	17.98918	(5.93241)	485857.437	35.86882
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.07468	(0.00170)	2016.872	0.14890
AVERAGE HEAD ON TOP OF LAYER 3	1.997	(0.599)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.07098	(0.01107)	1916.882	0.14152
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00005	(0.00001)	1.443	0.00011
AVERAGE HEAD ON TOP OF LAYER 9	0.009	(0.002)		
LATERAL DRAINAGE COLLECTED FROM LAYER 11	0.00005	(0.00001)	1.384	0.00010
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.00000	(0.00000)	0.093	0.00001
AVERAGE HEAD ON TOP OF LAYER 12	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.038	(1.2376)	-1026.50	-0.076

Page 6

Page 7 (continued)

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	6.01	162313.281
RUNOFF	1.107	29905.2129
DRAINAGE COLLECTED FROM LAYER 2	0.88222	23826.28170
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000356	9.61437
AVERAGE HEAD ON TOP OF LAYER 3	21.196	
MAXIMUM HEAD ON TOP OF LAYER 3	24.007	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	35.7 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00025	6.65668
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00486
AVERAGE HEAD ON TOP OF LAYER 9	0.011	
MAXIMUM HEAD ON TOP OF LAYER 9	0.022	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.4 FEET	
DRAINAGE COLLECTED FROM LAYER 11	0.00000	0.00429
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.000000	0.00023
AVERAGE HEAD ON TOP OF LAYER 12	0.000	
MAXIMUM HEAD ON TOP OF LAYER 12	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 11 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.02	108576.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4062
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0289

Page 7

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	0.2504	0.0584
2	1.3563	0.0754
3	10.2480	0.4270
4	0.0000	0.0000
5	3.4297	0.1429
6	157.6800	0.2920
7	1.7136	0.1428
8	0.5433	0.0453
9	0.0000	0.0000
10	25.6200	0.4270
11	1.5770	0.1310
12	0.0000	0.0000
13	15.3720	0.4270
SNOW WATER	0.000	

Page 8

30-YEAR DURATION

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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:\B10\U\DATA4.D4
TEMPERATURE DATA FILE:        C:\B10\U\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\B10\U\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\B10\U\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\B10\U\DATA10.D10
OUTPUT DATA FILE:             C:\B10\U\OUT.OUT

TIME: 17:16    DATE:  7/24/2016

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     TITLE:  B1 Pre-closure

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

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

                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   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   =       0.2257 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  18
        THICKNESS                    =     540.00   INCHES
```

Page 1

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        POROSITY                     =       0.6710 VOL/VOL
        FIELD CAPACITY               =       0.2920 VOL/VOL
        WILTING POINT                =       0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.3079 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                  LAYER  3
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   5
        THICKNESS                    =      12.00   INCHES
        POROSITY                     =       0.4570 VOL/VOL
        FIELD CAPACITY               =       0.1310 VOL/VOL
        WILTING POINT                =       0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.2313 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                  LAYER  4
                                  --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =      12.00   INCHES
        POROSITY                     =       0.4170 VOL/VOL
        FIELD CAPACITY               =       0.0450 VOL/VOL
        WILTING POINT                =       0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.0574 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  9.99999978000E-02 CM/SEC
        SLOPE                        =       2.00   PERCENT
        DRAINAGE LENGTH              =      50.0    FEET

                                  LAYER  5
                                  --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
        THICKNESS                    =       0.08   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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =       2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS     =       2.00   HOLES/ACRE
        FML PLACEMENT QUALITY        =  4 - POOR

                                  LAYER  6
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  16
        THICKNESS                    =      60.00   INCHES
        POROSITY                     =       0.4270 VOL/VOL
        FIELD CAPACITY               =       0.4180 VOL/VOL
```

Page 2

```
        WILTING POINT                =       0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

                                  LAYER  7
                                  --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   5
        THICKNESS                    =      12.00   INCHES
        POROSITY                     =       0.4570 VOL/VOL
        FIELD CAPACITY               =       0.1310 VOL/VOL
        WILTING POINT                =       0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.1311 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
        SLOPE                        =       2.00   PERCENT
        DRAINAGE LENGTH              =      50.0    FEET

                                  LAYER  8
                                  --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
        THICKNESS                    =       0.08   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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =       2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS     =       2.00   HOLES/ACRE
        FML PLACEMENT QUALITY        =  4 - POOR

                                  LAYER  9
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  16
        THICKNESS                    =      36.00   INCHES
        POROSITY                     =       0.4270 VOL/VOL
        FIELD CAPACITY               =       0.4180 VOL/VOL
        WILTING POINT                =       0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER              =     69.10
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   FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE   =      7.440  ACRES
   EVAPORATIVE ZONE DEPTH               =     22.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE    =      4.913  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE   =     10.054  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.276  INCHES
   INITIAL SNOW WATER                   =      0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS     =    218.178  INCHES
   TOTAL INITIAL WATER                  =    218.178  INCHES
   TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	56.48	1523366.620	100.00
RUNOFF	0.106	2852.938	0.19
EVAPOTRANSPIRATION	37.945	1024792.870	67.18
DRAINAGE COLLECTED FROM LAYER 4	18.4016	496975.281	32.58
PERC./LEAKAGE THROUGH LAYER 5	0.007350	198.516	0.01
AVG. HEAD ON TOP OF LAYER 5	2.1870		
DRAINAGE COLLECTED FROM LAYER 7	0.0064	173.190	0.01
PERC./LEAKAGE THROUGH LAYER 9	0.000049	1.322	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0077		
CHANGE IN WATER STORAGE	0.021	571.167	0.04
SOIL WATER AT START OF YEAR	218.178	5892381.000	
SOIL WATER AT END OF YEAR	218.199	5892952.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.083	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	58.55	1581271.500	100.00
RUNOFF	0.334	9010.979	0.57
EVAPOTRANSPIRATION	37.012	999596.187	63.21
DRAINAGE COLLECTED FROM LAYER 4	28.8562	779325.062	49.29

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	(INCHES)	(CU. FT.)	PERCENT
PERC./LEAKAGE THROUGH LAYER 6	0.011029	297.865	0.02
AVG. HEAD ON TOP OF LAYER 5	3.3561		
DRAINAGE COLLECTED FROM LAYER 7	0.0094	254.020	0.02
PERC./LEAKAGE THROUGH LAYER 9	0.000068	1.839	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0113		
CHANGE IN WATER STORAGE	-7.662	-206916.469	-13.09
SOIL WATER AT START OF YEAR	218.199	5892952.000	
SOIL WATER AT END OF YEAR	210.538	5686035.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.164	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	3.94	3.86	4.71	3.07	8.35
	6.88	3.96	6.47	4.06	2.47	5.45
STD. DEVIATIONS	0.91	0.20	1.23	5.42	0.82	0.06
	1.04	4.34	2.74	3.03	1.26	1.94
RUNOFF						
TOTALS	0.000	0.000	0.083	0.002	0.005	0.001
	0.009	0.000	0.117	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.121	0.003	0.007	0.002
	0.009	0.000	0.019	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.325	2.036	2.792	2.803	4.045	6.232
	6.300	4.534	3.370	1.689	1.069	1.084
STD. DEVIATIONS	0.148	0.038	0.046	1.681	0.345	0.003
	0.255	1.369	0.069	0.242	0.088	0.128
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	1.4600	2.7211	2.1891	2.5321	2.8612	3.1170
	1.9411	1.9238	1.6020	1.1901	1.2510	0.8383
STD. DEVIATIONS	0.0029	0.3865	0.4278	0.5228	0.1829	0.9827
	1.6806	2.3730	1.6130	0.9896	0.5435	0.3185
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0006	0.0010	0.0009	0.0010	0.0011	0.0011

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	0.0008	0.0007	0.0006	0.0005	0.0005	0.0004
STD. DEVIATIONS	0.0000	0.0001	0.0001	0.0002	0.0001	0.0007
	0.0006	0.0009	0.0007	0.0004	0.0002	0.0002
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0004	0.0004	0.0006	0.0006	0.0007	0.0008
	0.0008	0.0008	0.0008	0.0007	0.0007	0.0007
STD. DEVIATIONS	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
	0.0001	0.0002	0.0003	0.0004	0.0004	0.0003
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	2.0659	4.1035	5.0571	3.6005	3.9188	4.3084
	3.6586	2.5695	2.2626	1.6869	1.8335	1.1930
STD. DEVIATIONS	0.0039	0.5087	0.5395	0.6453	0.2385	1.1921
	2.2451	3.1392	2.5343	1.3988	0.7864	0.7378
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0053	0.0067	0.0081	0.0089	0.0102	0.0113
	0.0118	0.0115	0.0111	0.0104	0.0099	0.0093
STD. DEVIATIONS	0.0017	0.0013	0.0006	0.0005	0.0007	0.0007
	0.0018	0.0033	0.0050	0.0034	0.0053	0.0041

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.51 (1.464)	1553319.1	100.00
RUNOFF	0.220 (0.1612)	5931.96	0.382
EVAPOTRANSPIRATION	37.479 (0.6597)	1012194.50	65.163
LATERAL DRAINAGE COLLECTED FROM LAYER 4	23.62889 (7.39252)	638150.187	41.08301
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00919 (0.00760)	248.191	0.01598
AVERAGE HEAD ON TOP OF LAYER 5	2.772 (0.827)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00791 (0.00212)	213.606	0.01375
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00006 (0.00001)	1.580	0.00010
AVERAGE HEAD ON TOP OF LAYER 8	0.010 (0.003)		
CHANGE IN WATER STORAGE	-3.820 (5.4325)	-103172.65	-6.642

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 2

	(INCHES)	(CU. FT.)
PRECIPITATION	3.57	96415.703
RUNOFF	0.171	4612.6060
DRAINAGE COLLECTED FROM LAYER 4	0.14588	3939.87842
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000050	1.34738
AVERAGE HEAD ON TOP OF LAYER 5	5.768	
MAXIMUM HEAD ON TOP OF LAYER 5	6.903	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	23.2 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00003	0.90709
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00636
AVERAGE HEAD ON TOP OF LAYER 8	0.015	
MAXIMUM HEAD ON TOP OF LAYER 8	0.029	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.5 FEET	
SNOW WATER	1.55	41878.1719
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3146
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0580

*** 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 2

LAYER	(INCHES)	(VOL/VOL)
1	6.2819	0.2617
2	158.6528	0.2938
3	7.3600	0.1967
4	0.6755	0.0563
5	0.0000	0.0000
6	25.6200	0.4270
7	1.5756	0.1313
8	0.0000	0.0000
9	15.3720	0.4270
SNOW WATER	0.000	

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

PRECIPITATION DATA FILE:     C:\B11\U\DATA4.D4
TEMPERATURE DATA FILE:       C:\B11\U\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\B11\U\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\B11\U\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\B11\U\DATA10.D10
OUTPUT DATA FILE:            C:\B11\U\OUT.OUT

TIME: 16:51     DATE:  7/24/2016

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

     TITLE: B1 Post-closure

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

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.

                                 LAYER  1
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
        THICKNESS                   =     6.00   INCHES
        POROSITY                    =     0.4570 VOL/VOL
        FIELD CAPACITY              =     0.1310 VOL/VOL
        WILTING POINT               =     0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.1692 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000005000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER  2
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
        THICKNESS                   =    18.00   INCHES
                                  Page 1
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```
        POROSITY                    =     0.4170 VOL/VOL
        FIELD CAPACITY              =     0.0450 VOL/VOL
        WILTING POINT               =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.2699 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.999999978000E-02 CM/SEC
        SLOPE                       =     2.00   PERCENT
        DRAINAGE LENGTH             =    50.0    FEET

                                 LAYER  3
                                 --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
        THICKNESS                   =    24.00   INCHES
        POROSITY                    =     0.4270 VOL/VOL
        FIELD CAPACITY              =     0.4180 VOL/VOL
        WILTING POINT               =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000001000E-06 CM/SEC

                                 LAYER  4
                                 --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        THICKNESS                   =     0.05   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.   = 0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS    =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY       = 4 - POOR

                                 LAYER  5
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         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  =     0.2617 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000005000E-02 CM/SEC

                                 LAYER  6
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
        THICKNESS                   =   340.00   INCHES
        POROSITY                    =     0.6710 VOL/VOL
        FIELD CAPACITY              =     0.2920 VOL/VOL
                                  Page 2
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        WILTING POINT               =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.2938 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000005000E-02 CM/SEC

                                 LAYER  7
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
        THICKNESS                   =    12.00   INCHES
        POROSITY                    =     0.4570 VOL/VOL
        FIELD CAPACITY              =     0.1310 VOL/VOL
        WILTING POINT               =     0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.1967 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000005000E-02 CM/SEC

                                 LAYER  8
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
        THICKNESS                   =    12.00   INCHES
        POROSITY                    =     0.4170 VOL/VOL
        FIELD CAPACITY              =     0.0450 VOL/VOL
        WILTING POINT               =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.0563 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.999999978000E-02 CM/SEC
        SLOPE                       =     2.00   PERCENT
        DRAINAGE LENGTH             =    50.0    FEET

                                 LAYER  9
                                 --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        THICKNESS                   =     0.09   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.   = 0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS    =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY       = 4 - POOR

                                 LAYER 10
                                 --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
        THICKNESS                   =    60.00   INCHES
        POROSITY                    =     0.4270 VOL/VOL
        FIELD CAPACITY              =     0.4180 VOL/VOL
        WILTING POINT               =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.4270 VOL/VOL
                                  Page 3
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```
        EFFECTIVE SAT. HYD. COND.   = 0.100000001000E-06 CM/SEC

                                 LAYER 11
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   5
        THICKNESS                   =    12.00   INCHES
        POROSITY                    =     0.4570 VOL/VOL
        FIELD CAPACITY              =     0.1310 VOL/VOL
        WILTING POINT               =     0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.1313 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000005000E-02 CM/SEC
        SLOPE                       =     2.00   PERCENT
        DRAINAGE LENGTH             =    50.0    FEET

                                 LAYER 12
                                 --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        THICKNESS                   =     0.09   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.   = 0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS    =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY       = 4 - POOR

                                 LAYER 13
                                 --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
        THICKNESS                   =    36.00   INCHES
        POROSITY                    =     0.4270 VOL/VOL
        FIELD CAPACITY              =     0.4180 VOL/VOL
        WILTING POINT               =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT  =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.   = 0.100000001000E-06 CM/SEC

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
            FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF   50. FEET.

        SCS RUNOFF CURVE NUMBER            =    60.10
        FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =     7.440  ACRES
        EVAPORATIVE ZONE DEPTH             =    22.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =     5.332  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =     9.414  INCHES
                                  Page 4
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LOWER LIMIT OF EVAPORATIVE STORAGE  =     0.636  INCHES
INITIAL SNOW WATER                  =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =   226.656  INCHES
TOTAL INITIAL WATER                 =   226.656  INCHES
TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR
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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	56.48	1525366.620	100.00
RUNOFF	0.102	2755.089	0.18
EVAPOTRANSPIRATION	36.545	986987.500	64.70
DRAINAGE COLLECTED FROM LAYER 2	19.7503	533399.312	34.97
PERC./LEAKAGE THROUGH LAYER 4	0.075341	2034.753	0.13
AVG. HEAD ON TOP OF LAYER 3	2.2283		
DRAINAGE COLLECTED FROM LAYER 8	4.0460	109272.320	7.16
PERC./LEAKAGE THROUGH LAYER 10	0.001839	49.660	0.00
AVG. HEAD ON TOP OF LAYER 9	0.3020		
DRAINAGE COLLECTED FROM LAYER 11	0.0048	129.340	0.01
PERC./LEAKAGE THROUGH LAYER 13	0.000038	1.024	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0058		
CHANGE IN WATER STORAGE	-3.969	-107178.234	-7.03
SOIL WATER AT START OF YEAR	226.656	6121342.500	
SOIL WATER AT END OF YEAR	222.687	6014164.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.348	0.00

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	58.55	1581271.500	100.00
RUNOFF	0.281	7576.345	0.48
EVAPOTRANSPIRATION	35.376	955399.187	60.42

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 2	23.3669	631075.125	39.91
PERC./LEAKAGE THROUGH LAYER 4	0.076230	2058.771	0.13
AVG. HEAD ON TOP OF LAYER 3	2.3368		
DRAINAGE COLLECTED FROM LAYER 8	0.3962	10701.043	0.68
PERC./LEAKAGE THROUGH LAYER 10	0.000242	6.535	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0480		
DRAINAGE COLLECTED FROM LAYER 11	0.0007	19.521	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000009	0.242	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0009		
CHANGE IN WATER STORAGE	-0.870	-23499.842	-1.49
SOIL WATER AT START OF YEAR	222.687	6014164.000	
SOIL WATER AT END OF YEAR	221.817	5990664.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.189	0.00

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	67.70	1828387.370	100.00
RUNOFF	1.424	38471.645	2.10
EVAPOTRANSPIRATION	35.262	952326.000	52.09
DRAINAGE COLLECTED FROM LAYER 2	32.5133	878091.937	48.03
PERC./LEAKAGE THROUGH LAYER 4	0.078408	2117.592	0.12
AVG. HEAD ON TOP OF LAYER 3	3.3029		
DRAINAGE COLLECTED FROM LAYER 8	0.2169	5858.557	0.32
PERC./LEAKAGE THROUGH LAYER 10	0.000142	3.834	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0262		
DRAINAGE COLLECTED FROM LAYER 11	0.0002	5.481	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000005	0.123	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0002		
CHANGE IN WATER STORAGE	-1.717	-46367.113	-2.54

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	INCHES	CU. FEET	PERCENT
SOIL WATER AT START OF YEAR	221.817	5990664.500	
SOIL WATER AT END OF YEAR	220.100	5944297.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.802	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.27	1195608.870	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	34.300	926338.187	77.48
DRAINAGE COLLECTED FROM LAYER 2	11.3829	307421.562	25.71
PERC./LEAKAGE THROUGH LAYER 4	0.072920	1969.610	0.16
AVG. HEAD ON TOP OF LAYER 3	1.3285		
DRAINAGE COLLECTED FROM LAYER 8	0.1487	4016.373	0.34
PERC./LEAKAGE THROUGH LAYER 10	0.000102	2.750	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0179		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	3.149	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000004	0.101	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.561	-42170.727	-3.53
SOIL WATER AT START OF YEAR	220.100	5944297.500	
SOIL WATER AT END OF YEAR	218.539	5902126.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.230	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT

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	INCHES	CU. FEET	PERCENT
PRECIPITATION	60.46	1632854.870	100.00
RUNOFF	0.040	1068.238	0.07
EVAPOTRANSPIRATION	34.301	926361.500	56.73
DRAINAGE COLLECTED FROM LAYER 2	24.4389	660025.125	40.42
PERC./LEAKAGE THROUGH LAYER 4	0.076681	2070.947	0.13
AVG. HEAD ON TOP OF LAYER 3	2.7156		
DRAINAGE COLLECTED FROM LAYER 8	0.1180	3187.295	0.20
PERC./LEAKAGE THROUGH LAYER 10	0.000093	2.246	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0143		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	2.332	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.093	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	1.563	42211.527	2.59
SOIL WATER AT START OF YEAR	218.539	5902126.500	
SOIL WATER AT END OF YEAR	220.102	5944338.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.199	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	52.54	1418958.370	100.00
RUNOFF	0.003	87.101	0.01
EVAPOTRANSPIRATION	35.420	956604.375	67.42
DRAINAGE COLLECTED FROM LAYER 2	16.9560	457934.375	32.27
PERC./LEAKAGE THROUGH LAYER 4	0.074589	2014.451	0.14
AVG. HEAD ON TOP OF LAYER 3	1.9850		
DRAINAGE COLLECTED FROM LAYER 8	0.1000	2700.373	0.19
PERC./LEAKAGE THROUGH LAYER 10	0.000072	1.944	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0121		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.981	0.00

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	INCHES	CU. FEET	PERCENT
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.090	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.060	1629.432	0.11
SOIL WATER AT START OF YEAR	220.102	5944338.000	
SOIL WATER AT END OF YEAR	220.162	5945967.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.714	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.71	1207492.250	100.00
RUNOFF	0.112	3012.303	0.25
EVAPOTRANSPIRATION	29.743	803264.437	66.52
DRAINAGE COLLECTED FROM LAYER 2	15.0012	405140.281	33.55
PERC./LEAKAGE THROUGH LAYER 4	0.073894	1995.664	0.17
AVG. HEAD ON TOP OF LAYER 3	1.7547		
DRAINAGE COLLECTED FROM LAYER 8	0.0873	2357.103	0.20
PERC./LEAKAGE THROUGH LAYER 10	0.000064	1.728	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0105		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.717	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.087	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.233	-6284.070	-0.52
SOIL WATER AT START OF YEAR	220.162	5945967.500	
SOIL WATER AT END OF YEAR	219.930	5939683.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.451	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	50.52	1364405.620	100.00
RUNOFF	0.204	5512.480	0.40
EVAPOTRANSPIRATION	31.615	853829.687	62.58
DRAINAGE COLLECTED FROM LAYER 2	18.5893	502037.969	36.79
PERC./LEAKAGE THROUGH LAYER 4	0.074918	2023.321	0.15
AVG. HEAD ON TOP OF LAYER 3	2.0135		
DRAINAGE COLLECTED FROM LAYER 8	0.0830	2240.498	0.16
PERC./LEAKAGE THROUGH LAYER 10	0.000061	1.654	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0100		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.596	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.086	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.030	801.117	0.06
SOIL WATER AT START OF YEAR	219.930	5939683.500	
SOIL WATER AT END OF YEAR	219.959	5940484.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.228	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	71.59	1933446.000	100.00
RUNOFF	0.545	14721.951	0.76
EVAPOTRANSPIRATION	37.424	1010719.100	52.28
DRAINAGE COLLECTED FROM LAYER 2	32.9703	890436.000	46.05
PERC./LEAKAGE THROUGH LAYER 4	0.078748	2126.770	0.11
AVG. HEAD ON TOP OF LAYER 3	3.4595		

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 8	0.0792	2139.944	0.11
PERC./LEAKAGE THROUGH LAYER 10	0.000059	1.589	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0096		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.514	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.085	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.571	15426.445	0.80
SOIL WATER AT START OF YEAR	219.959	5940484.500	
SOIL WATER AT END OF YEAR	220.530	5955911.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.553	0.00

ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	51.10	1380067.750	100.00
RUNOFF	0.307	8283.198	0.60
EVAPOTRANSPIRATION	32.624	881073.125	63.84
DRAINAGE COLLECTED FROM LAYER 2	19.0704	515688.094	37.32
PERC./LEAKAGE THROUGH LAYER 4	0.074676	2016.787	0.15
AVG. HEAD ON TOP OF LAYER 3	1.9935		
DRAINAGE COLLECTED FROM LAYER 8	0.0756	2040.616	0.15
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.526	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.481	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.926	-25018.832	-1.81
SOIL WATER AT START OF YEAR	220.530	5955911.000	
SOIL WATER AT END OF YEAR	219.604	5930892.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

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	INCHES	CU. FEET	PERCENT
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.023	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.65	1205872.000	100.00
RUNOFF	0.220	5939.685	0.49
EVAPOTRANSPIRATION	34.174	922947.437	76.54
DRAINAGE COLLECTED FROM LAYER 2	11.4359	308852.094	25.61
PERC./LEAKAGE THROUGH LAYER 4	0.072674	1962.718	0.16
AVG. HEAD ON TOP OF LAYER 3	1.3114		
DRAINAGE COLLECTED FROM LAYER 8	0.0751	2028.768	0.17
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.518	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.431	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.255	-33897.879	-2.81
SOIL WATER AT START OF YEAR	219.604	5930892.000	
SOIL WATER AT END OF YEAR	218.349	5896994.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.101	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.18	1031135.000	100.00
RUNOFF	0.000	11.453	0.00
EVAPOTRANSPIRATION	25.340	684374.437	66.37

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 2	11.4778	309983.719	30.06
PERC./LEAKAGE THROUGH LAYER 4	0.072984	1971.097	0.19
AVG. HEAD ON TOP OF LAYER 3	1.3494		
DRAINAGE COLLECTED FROM LAYER 8	0.0758	2046.769	0.20
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.530	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.441	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	1.285	34717.125	3.37
SOIL WATER AT START OF YEAR	218.349	5896994.500	
SOIL WATER AT END OF YEAR	219.634	5931711.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.017	0.00

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.14	1192097.750	100.00
RUNOFF	0.959	25904.738	2.17
EVAPOTRANSPIRATION	27.143	733057.437	61.49
DRAINAGE COLLECTED FROM LAYER 2	17.5593	474227.156	39.78
PERC./LEAKAGE THROUGH LAYER 4	0.074276	2005.982	0.17
AVG. HEAD ON TOP OF LAYER 3	1.8603		
DRAINAGE COLLECTED FROM LAYER 8	0.0766	2069.697	0.17
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.544	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0093		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.450	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.598	-43162.645	-3.62

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	INCHES	CU. FEET	PERCENT
SOIL WATER AT START OF YEAR	219.634	5931711.500	
SOIL WATER AT END OF YEAR	218.036	5888549.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.334	0.00

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.17	1300936.870	100.00
RUNOFF	0.001	22.173	0.00
EVAPOTRANSPIRATION	32.998	891184.875	68.50
DRAINAGE COLLECTED FROM LAYER 2	10.7953	291551.469	22.41
PERC./LEAKAGE THROUGH LAYER 4	0.072631	1961.557	0.15
AVG. HEAD ON TOP OF LAYER 3	1.2922		
DRAINAGE COLLECTED FROM LAYER 8	0.0764	2062.090	0.16
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.540	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0092		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.468	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	4.299	116114.641	8.93
SOIL WATER AT START OF YEAR	218.036	5888549.000	
SOIL WATER AT END OF YEAR	221.897	5992828.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.438	11835.506	0.91
ANNUAL WATER BUDGET BALANCE	0.0000	0.121	0.00

ANNUAL TOTALS FOR YEAR 15

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	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.52	1310389.120	100.00
RUNOFF	0.400	10811.490	0.83
EVAPOTRANSPIRATION	28.861	779448.812	59.48
DRAINAGE COLLECTED FROM LAYER 2	21.2566	574080.187	43.81
PERC./LEAKAGE THROUGH LAYER 4	0.075678	2043.858	0.16
AVG. HEAD ON TOP OF LAYER 3	2.3409		
DRAINAGE COLLECTED FROM LAYER 8	0.0745	2012.351	0.15
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.508	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0090		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.424	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-2.072	-55964.934	-4.27
SOIL WATER AT START OF YEAR	221.897	5992828.000	
SOIL WATER AT END OF YEAR	220.263	5948698.500	
SNOW WATER AT START OF YEAR	0.438	11835.506	0.90
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.444	0.00

ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.50	1012770.120	100.00
RUNOFF	0.069	1868.316	0.18
EVAPOTRANSPIRATION	26.077	704257.750	69.54
DRAINAGE COLLECTED FROM LAYER 2	12.8859	348010.844	34.36
PERC./LEAKAGE THROUGH LAYER 4	0.073392	1982.120	0.20
AVG. HEAD ON TOP OF LAYER 3	1.4860		
DRAINAGE COLLECTED FROM LAYER 8	0.0751	2027.876	0.20
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.518	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.446	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.607	-43396.719	-4.28
SOIL WATER AT START OF YEAR	220.263	5948698.500	
SOIL WATER AT END OF YEAR	218.657	5905302.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.510	0.00

ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.31	1250703.250	100.00
RUNOFF	0.297	8016.974	0.64
EVAPOTRANSPIRATION	28.419	767511.875	61.37
DRAINAGE COLLECTED FROM LAYER 2	16.3856	442528.375	35.38
PERC./LEAKAGE THROUGH LAYER 4	0.074281	2006.119	0.16
AVG. HEAD ON TOP OF LAYER 3	1.8809		
DRAINAGE COLLECTED FROM LAYER 8	0.0715	1932.198	0.15
PERC./LEAKAGE THROUGH LAYER 10	0.000054	1.456	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0086		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.382	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.083	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	1.137	30713.189	2.46
SOIL WATER AT START OF YEAR	218.657	5905302.000	
SOIL WATER AT END OF YEAR	219.794	5936015.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.809	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.91	1455958.000	100.00
RUNOFF	0.336	9068.000	0.62
EVAPOTRANSPIRATION	34.469	930915.875	63.94
DRAINAGE COLLECTED FROM LAYER 2	18.6420	503468.656	34.58
PERC./LEAKAGE THROUGH LAYER 4	0.074416	2009.778	0.14
AVG. HEAD ON TOP OF LAYER 3	1.9061		
DRAINAGE COLLECTED FROM LAYER 8	0.0757	2044.586	0.14
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.528	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0092		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.422	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.387	10459.438	0.72
SOIL WATER AT START OF YEAR	219.794	5936015.000	
SOIL WATER AT END OF YEAR	220.181	5946474.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.035	0.00

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.55	1149156.000	100.00
RUNOFF	0.109	2932.117	0.26
EVAPOTRANSPIRATION	27.217	735053.937	63.96
DRAINAGE COLLECTED FROM LAYER 2	15.0091	405354.375	35.27
PERC./LEAKAGE THROUGH LAYER 4	0.073903	1995.921	0.17
AVG. HEAD ON TOP OF LAYER 3	1.7369		

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DRAINAGE COLLECTED FROM LAYER 8	0.0725	1958.538	0.17
PERC./LEAKAGE THROUGH LAYER 10	0.000055	1.477	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0088		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.408	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.143	3855.581	0.34
SOIL WATER AT START OF YEAR	220.181	5946474.500	
SOIL WATER AT END OF YEAR	220.324	5950330.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	72.40	1955321.500	100.00
RUNOFF	0.151	4089.245	0.21
EVAPOTRANSPIRATION	39.927	1078306.750	55.15
DRAINAGE COLLECTED FROM LAYER 2	32.3141	872713.625	44.63
PERC./LEAKAGE THROUGH LAYER 4	0.079128	2137.033	0.11
AVG. HEAD ON TOP OF LAYER 3	3.4950		
DRAINAGE COLLECTED FROM LAYER 8	0.0746	2014.877	0.10
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.509	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0090		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.415	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.067	-1804.573	-0.09
SOIL WATER AT START OF YEAR	220.324	5950330.000	
SOIL WATER AT END OF YEAR	220.257	5948525.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

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SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.63	1259345.870	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	30.521	824299.000	65.45
DRAINAGE COLLECTED FROM LAYER 2	16.0171	432576.531	34.35
PERC./LEAKAGE THROUGH LAYER 4	0.074253	2005.373	0.16
AVG. HEAD ON TOP OF LAYER 3	1.8606		
DRAINAGE COLLECTED FROM LAYER 8	0.0728	1965.933	0.16
PERC./LEAKAGE THROUGH LAYER 10	0.000055	1.478	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0088		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.418	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	0.019	503.171	0.04
SOIL WATER AT START OF YEAR	220.257	5948525.500	
SOIL WATER AT END OF YEAR	220.276	5949028.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.289	0.00

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	55.27	1492687.750	100.00
RUNOFF	0.031	829.172	0.06

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EVAPOTRANSPIRATION	35.638	962488.062	64.48
DRAINAGE COLLECTED FROM LAYER 2	20.7108	559341.625	37.47
PERC./LEAKAGE THROUGH LAYER 4	0.075618	2042.235	0.14
AVG. HEAD ON TOP OF LAYER 3	2.3610		
DRAINAGE COLLECTED FROM LAYER 8	0.0732	1977.807	0.13
PERC./LEAKAGE THROUGH LAYER 10	0.000055	1.485	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0088		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.388	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.083	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.183	-31949.482	-2.14
SOIL WATER AT START OF YEAR	220.276	5949028.500	
SOIL WATER AT END OF YEAR	219.093	5917079.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.883	0.00

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	58.95	1592074.500	100.00
RUNOFF	0.138	3737.917	0.23
EVAPOTRANSPIRATION	34.128	921700.375	57.89
DRAINAGE COLLECTED FROM LAYER 2	22.5316	608509.812	38.22
PERC./LEAKAGE THROUGH LAYER 4	0.075735	2045.388	0.13
AVG. HEAD ON TOP OF LAYER 3	2.3955		
DRAINAGE COLLECTED FROM LAYER 8	0.0764	2062.848	0.13
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.540	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0092		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.434	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		

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	INCHES	CU. FEET	PERCENT
CHANGE IN WATER STORAGE	2.076	56061.699	3.52
SOIL WATER AT START OF YEAR	219.093	5917079.000	
SOIL WATER AT END OF YEAR	221.168	5973141.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.355	0.00

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	51.98	1403834.500	100.00
RUNOFF	0.026	690.024	0.05
EVAPOTRANSPIRATION	33.007	891431.375	63.50
DRAINAGE COLLECTED FROM LAYER 2	17.7308	478858.344	34.11
PERC./LEAKAGE THROUGH LAYER 4	0.074842	2021.260	0.14
AVG. HEAD ON TOP OF LAYER 3	2.0048		
DRAINAGE COLLECTED FROM LAYER 8	0.0740	1999.192	0.14
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.500	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0089		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.430	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	1.142	30853.715	2.20
SOIL WATER AT START OF YEAR	221.168	5973141.000	
SOIL WATER AT END OF YEAR	222.311	6003994.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.264	0.00

ANNUAL TOTALS FOR YEAR 25

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	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.72	1126740.370	100.00
RUNOFF	0.165	4450.080	0.39
EVAPOTRANSPIRATION	29.395	793887.312	70.46
DRAINAGE COLLECTED FROM LAYER 2	13.4695	363773.344	32.29
PERC./LEAKAGE THROUGH LAYER 4	0.073312	1979.963	0.18
AVG. HEAD ON TOP OF LAYER 3	1.5277		
DRAINAGE COLLECTED FROM LAYER 8	0.0760	2053.565	0.18
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.534	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0092		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.435	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.388	-37425.840	-3.32
SOIL WATER AT START OF YEAR	222.311	6003994.500	
SOIL WATER AT END OF YEAR	220.925	5966568.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.435	0.00

ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.66	1260156.000	100.00
RUNOFF	0.225	6088.497	0.48
EVAPOTRANSPIRATION	27.321	737855.875	58.55
DRAINAGE COLLECTED FROM LAYER 2	19.5419	527771.000	41.88
PERC./LEAKAGE THROUGH LAYER 4	0.074630	2015.542	0.16
AVG. HEAD ON TOP OF LAYER 3	1.9948		
DRAINAGE COLLECTED FROM LAYER 8	0.0763	2060.945	0.16
PERC./LEAKAGE THROUGH LAYER 10	0.000057	1.538	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0092		

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.432	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.504	-13621.460	-1.08
SOIL WATER AT START OF YEAR	220.925	5966568.500	
SOIL WATER AT END OF YEAR	220.421	5952947.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.417	0.00

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	55.71	1504571.120	100.00
RUNOFF	0.100	2689.318	0.18
EVAPOTRANSPIRATION	37.275	1006689.750	66.91
DRAINAGE COLLECTED FROM LAYER 2	19.7414	533160.312	35.44
PERC./LEAKAGE THROUGH LAYER 4	0.075301	2033.682	0.14
AVG. HEAD ON TOP OF LAYER 3	2.2257		
DRAINAGE COLLECTED FROM LAYER 8	0.0732	1977.938	0.13
PERC./LEAKAGE THROUGH LAYER 10	0.000055	1.485	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0088		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.423	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-1.479	-39947.465	-2.66
SOIL WATER AT START OF YEAR	220.421	5952947.000	
SOIL WATER AT END OF YEAR	218.942	5912999.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.217	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.76	1100813.870	100.00
RUNOFF	0.156	4202.913	0.38
EVAPOTRANSPIRATION	29.804	804926.312	73.12
DRAINAGE COLLECTED FROM LAYER 2	11.3126	305521.000	27.75
PERC./LEAKAGE THROUGH LAYER 4	0.072818	1966.620	0.18
AVG. HEAD ON TOP OF LAYER 3	1.2807		
DRAINAGE COLLECTED FROM LAYER 8	0.0780	2107.257	0.19
PERC./LEAKAGE THROUGH LAYER 10	0.000058	1.569	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0094		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.468	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.590	-15947.749	-1.45
SOIL WATER AT START OF YEAR	218.942	5912999.500	
SOIL WATER AT END OF YEAR	218.351	5897052.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.189	0.00

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.38	1306608.370	100.00
RUNOFF	0.001	20.141	0.00
EVAPOTRANSPIRATION	31.817	859298.000	65.77
DRAINAGE COLLECTED FROM LAYER 2	13.9241	376051.750	28.78
PERC./LEAKAGE THROUGH LAYER 4	0.073474	1984.320	0.15

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AVG. HEAD ON TOP OF LAYER 3	1.5822		
DRAINAGE COLLECTED FROM LAYER 8	0.0741	2000.544	0.15
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.500	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0090		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.428	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	2.564	69236.859	5.30
SOIL WATER AT START OF YEAR	218.351	5897052.000	
SOIL WATER AT END OF YEAR	220.915	5966289.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.397	0.00

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.79	1155630.120	100.00
RUNOFF	0.042	1128.536	0.10
EVAPOTRANSPIRATION	25.465	687740.875	59.51
DRAINAGE COLLECTED FROM LAYER 2	18.0346	487063.000	42.15
PERC./LEAKAGE THROUGH LAYER 4	0.074946	2024.075	0.18
AVG. HEAD ON TOP OF LAYER 3	2.1033		
DRAINAGE COLLECTED FROM LAYER 8	0.0753	2033.229	0.18
PERC./LEAKAGE THROUGH LAYER 10	0.000056	1.521	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		
DRAINAGE COLLECTED FROM LAYER 11	0.0001	1.432	0.00
PERC./LEAKAGE THROUGH LAYER 13	0.000003	0.084	0.00
AVG. HEAD ON TOP OF LAYER 12	0.0001		
CHANGE IN WATER STORAGE	-0.827	-22329.480	-1.93
SOIL WATER AT START OF YEAR	220.915	5966289.000	
SOIL WATER AT END OF YEAR	220.088	5943959.500	

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SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.441	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.49	3.61	4.54	4.00	3.24	5.06
	1.47	6.10	4.78	3.38	2.50	3.61
STD. DEVIATIONS	2.71	1.43	2.68	2.37	2.03	2.13
	2.70	3.18	2.69	2.55	1.61	1.79
RUNOFF						
TOTALS	0.015	0.001	0.024	0.015	0.006	0.001
	0.038	0.027	0.039	0.045	0.003	0.001
STD. DEVIATIONS	0.029	0.004	0.066	0.044	0.022	0.003
	0.132	0.071	0.143	0.178	0.014	0.004
EVAPOTRANSPIRATION						
TOTALS	1.545	1.853	2.498	2.853	3.437	4.291
	4.409	4.367	3.098	1.498	1.022	1.182
STD. DEVIATIONS	0.259	0.326	0.697	0.912	1.230	1.324
	1.478	1.217	0.955	0.503	0.202	0.247
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	3.0841	1.9603	2.2722	1.5016	1.1177	0.5673
	0.6872	1.3087	1.4737	1.7763	1.1669	1.5761
STD. DEVIATIONS	2.1303	1.2149	1.9219	0.8822	1.0480	0.4995
	0.9197	1.4903	1.5986	1.7769	1.1494	1.1252
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0068	0.0060	0.0066	0.0062	0.0062	0.0059
	0.0061	0.0063	0.0061	0.0064	0.0060	0.0064
STD. DEVIATIONS	0.0006	0.0004	0.0003	0.0003	0.0003	0.0002
	0.0003	0.0004	0.0004	0.0005	0.0004	0.0004
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0221	0.0613	0.0388	0.0191	0.0147	0.0124
	0.0116	0.0107	0.0097	0.0096	0.0091	0.0091
STD. DEVIATIONS	0.0738	0.2927	0.1655	0.0591	0.0340	0.0233
	0.0190	0.0158	0.0131	0.0117	0.0100	0.0093
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 13						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	3.7930	2.8666	2.8838	2.1093	1.5053	0.8195
	0.9129	1.6877	1.9412	2.2530	1.6273	2.1337
STD. DEVIATIONS	2.2735	1.6143	2.0372	1.1740	1.2990	0.6976
	1.0970	1.7052	1.8803	1.9779	1.5024	1.4487
DAILY AVERAGE HEAD ON TOP OF LAYER 9						
AVERAGES	0.0315	0.0962	0.0552	0.0280	0.0209	0.0182
	0.0166	0.0153	0.0143	0.0137	0.0134	0.0130
STD. DEVIATIONS	0.1050	0.4598	0.2355	0.0870	0.0483	0.0343
	0.0271	0.0224	0.0192	0.0167	0.0148	0.0132
DAILY AVERAGE HEAD ON TOP OF LAYER 12						
AVERAGES	0.0005	0.0004	0.0004	0.0004	0.0003	0.0003
	0.0003	0.0002	0.0002	0.0002	0.0002	0.0001
STD. DEVIATIONS	0.0010	0.0017	0.0017	0.0015	0.0013	0.0011
	0.0009	0.0007	0.0006	0.0005	0.0004	0.0004

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	50.77 (9.061)	1371151.6	100.00
RUNOFF	0.215 (0.3043)	5799.64	0.423
EVAPOTRANSPIRATION	32.058 (3.9314)	865675.94	63.135
LATERAL DRAINAGE COLLECTED FROM LAYER 2	18.49214 (6.06449)	499421.031	36.42337

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PERCOLATION/LEAKAGE THROUGH LAYER 4	0.07482 (0.00171)	2020.776	0.14738
AVERAGE HEAD ON TOP OF LAYER 3	2.044 (0.603)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.22827 (0.72388)	6165.050	0.44962
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00013 (0.00033)	3.458	0.00025
AVERAGE HEAD ON TOP OF LAYER 9	0.028 (0.090)		
LATERAL DRAINAGE COLLECTED FROM LAYER 11	0.00024 (0.00087)	6.557	0.00048
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.00000 (0.00001)	0.123	0.00001
AVERAGE HEAD ON TOP OF LAYER 12	0.000 (0.001)		
CHANGE IN WATER STORAGE	-0.219 (1.6160)	-5912.77	-0.431

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.01	162313.281
RUNOFF	0.949	25624.2383
DRAINAGE COLLECTED FROM LAYER 2	0.88143	23804.86330
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000356	9.61024
AVERAGE HEAD ON TOP OF LAYER 3	21.177	
MAXIMUM HEAD ON TOP OF LAYER 3	24.893	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	35.7 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.07212	1947.80872
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000029	0.77906
AVERAGE HEAD ON TOP OF LAYER 9	3.151	
MAXIMUM HEAD ON TOP OF LAYER 9	4.052	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	18.2 FEET	
DRAINAGE COLLECTED FROM LAYER 11	0.00002	0.67435
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.000000	0.00492
AVERAGE HEAD ON TOP OF LAYER 12	0.011	

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MAXIMUM HEAD ON TOP OF LAYER 12              0.022

LOCATION OF MAXIMUM HEAD IN LAYER 11
      (DISTANCE FROM DRAIN)                  0.6 FEET

SNOW WATER                                   1.97        33212.68/?

MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4058

MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0289

 ***  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	1.2883	0.2147
2	2.6262	0.1459
3	10.2480	0.4270
4	0.0000	0.0000
5	7.4256	0.1427
6	157.6800	0.2920
7	1.7123	0.1427
8	0.5433	0.0453
9	0.0000	0.0000
10	25.6200	0.4270
11	1.5770	0.1310
12	0.0000	0.0000
13	15.3720	0.4270
SNOW WATER	0.000	

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CELLS B-7 AND B-8

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\DATA4.D4
TEMPERATURE DATA FILE:        C:\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\DATA10.D10
OUTPUT DATA FILE:             C:\OUT.OUT

TIME: 20:19     DATE:  9/ 9/2015

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     TITLE:  B7-without 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.

                                 LAYER  1
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        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   =     0.2257 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER  2
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
         THICKNESS                    =  1164.00   INCHES
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Page 1

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         POROSITY                     =     0.6710 VOL/VOL
         FIELD CAPACITY               =     0.2920 VOL/VOL
         WILTING POINT                =     0.0770 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.2998 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                 LAYER  3
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
         THICKNESS                    =    12.00   INCHES
         POROSITY                     =     0.4570 VOL/VOL
         FIELD CAPACITY               =     0.1310 VOL/VOL
         WILTING POINT                =     0.0580 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.2235 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                 LAYER  4
                                 --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
         THICKNESS                    =    12.00   INCHES
         POROSITY                     =     0.4170 VOL/VOL
         FIELD CAPACITY               =     0.0450 VOL/VOL
         WILTING POINT                =     0.0180 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.0815 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  9.99999978000E-02 CM/SEC
         SLOPE                        =     2.00   PERCENT
         DRAINAGE LENGTH              =    45.0    FEET

                                 LAYER  5
                                 --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
         THICKNESS                    =     0.08   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.    =  0.199999996000E-12 CM/SEC
         FML PINHOLE DENSITY          =     2.00   HOLES/ACRE
         FML INSTALLATION DEFECTS     =     2.00   HOLES/ACRE
         FML PLACEMENT QUALITY        =  4 - POOR

                                 LAYER  6
                                 --------

                      TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
         THICKNESS                    =    60.00   INCHES
         POROSITY                     =     0.4270 VOL/VOL
         FIELD CAPACITY               =     0.4180 VOL/VOL
```

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```
         WILTING POINT                =     0.3670 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

                                 LAYER  7
                                 --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
         THICKNESS                    =    12.00   INCHES
         POROSITY                     =     0.4170 VOL/VOL
         FIELD CAPACITY               =     0.0450 VOL/VOL
         WILTING POINT                =     0.0180 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
         SLOPE                        =     2.00   PERCENT
         DRAINAGE LENGTH              =    45.0    FEET

                                 LAYER  8
                                 --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
         THICKNESS                    =     0.08   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.    =  0.199999996000E-12 CM/SEC
         FML PINHOLE DENSITY          =     2.00   HOLES/ACRE
         FML INSTALLATION DEFECTS     =     2.00   HOLES/ACRE
         FML PLACEMENT QUALITY        =  4 - POOR

                                 LAYER  9
                                 --------

                      TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
         THICKNESS                    =    36.00   INCHES
         POROSITY                     =     0.4270 VOL/VOL
         FIELD CAPACITY               =     0.4180 VOL/VOL
         WILTING POINT                =     0.3670 VOL/VOL
         INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
         EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
             FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
             AND A SLOPE LENGTH OF   45. FEET.

      SCS RUNOFF CURVE NUMBER                =    69.30
```

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```
         FRACTION OF AREA ALLOWING RUNOFF      =   100.0    PERCENT
         AREA PROJECTED ON HORIZONTAL PLANE    =     3.870  ACRES
         EVAPORATIVE ZONE DEPTH                =    22.0    INCHES
         INITIAL WATER IN EVAPORATIVE ZONE     =     4.915  INCHES
         UPPER LIMIT OF EVAPORATIVE STORAGE    =    10.054  INCHES
         LOWER LIMIT OF EVAPORATIVE STORAGE    =     1.276  INCHES
         INITIAL SNOW WATER                    =     0.000  INCHES
         INITIAL WATER IN LAYER MATERIALS      =   399.547  INCHES
         TOTAL INITIAL WATER                   =   399.547  INCHES
         TOTAL SUBSURFACE INFLOW               =     0.00   INCHES/YEAR

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

       AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
----------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.47	4.15	4.75	3.69	3.50	4.73
	5.63	5.57	4.85	3.05	3.49	3.30
STD. DEVIATIONS	2.35	2.14	2.41	1.99	1.91	2.16
	2.49	3.00	3.17	2.24	1.59	1.55
RUNOFF						
TOTALS	0.021	0.015	0.019	0.011	0.009	0.008
	0.031	0.032	0.073	0.030	0.002	0.009
STD. DEVIATIONS	0.064	0.051	0.058	0.041	0.046	0.016
	0.124	0.092	0.202	0.124	0.011	0.017
EVAPOTRANSPIRATION						
TOTALS	1.547	1.896	2.618	2.815	4.209	4.383
	4.709	4.468	3.013	1.503	0.980	1.170
STD. DEVIATIONS	0.243	0.355	0.666	0.849	0.923	1.563
	1.470	1.319	1.031	0.430	0.387	0.206
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.9957	1.0656	1.5189	1.7614	2.1423	2.0768
	1.8184	1.2882	1.0272	0.8464	1.0017	1.0647
STD. DEVIATIONS	0.6545	0.5592	0.6856	0.6460	0.7656	0.8992
	1.1564	1.1110	0.9539	0.8284	0.8712	0.9240
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0004	0.0004	0.0006	0.0006	0.0008	0.0007
	0.0006	0.0005	0.0004	0.0004	0.0004	0.0004
STD. DEVIATIONS	0.0002	0.0003	0.0002	0.0002	0.0002	0.0003
	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0004	0.0004	0.0005	0.0006	0.0007	0.0007
	0.0007	0.0005	0.0004	0.0004	0.0004	0.0004
STD. DEVIATIONS	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002
	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003

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PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	1.2689	1.4907	1.9239	2.2971	2.6787	2.6698
	2.2545	1.6081	1.3277	1.1988	1.3082	1.3426
STD. DEVIATIONS	0.8253	0.7702	0.8466	0.8179	0.9247	1.1225
	1.4050	1.3613	1.2180	1.0346	1.1223	1.1445

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0005	0.0005	0.0007	0.0008	0.0009	0.0010
	0.0009	0.0007	0.0005	0.0005	0.0003	0.0005
STD. DEVIATIONS	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	0.0004	0.0005	0.0004	0.0004	0.0003	0.0004

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	50.15 (8.594)	704559.9	100.00
RUNOFF	0.249 (0.3055)	3505.00	0.497
EVAPOTRANSPIRATION	33.312 (3.6091)	467972.22	66.421
LATERAL DRAINAGE COLLECTED FROM LAYER 4	16.70163 (5.31745)	234626.156	33.30109
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00614 (0.00178)	86.242	0.01224
AVERAGE HEAD ON TOP OF LAYER 5	1.781 (0.551)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00613 (0.00178)	86.152	0.01223
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00001 (0.00000)	0.106	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.001 (0.000)		
CHANGE IN WATER STORAGE	-0.118 (5.1706)	-1629.64	-0.231

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	6.01	84429.078
RUNOFF	1.223	17178.6309
DRAINAGE COLLECTED FROM LAYER 4	0.12559	1764.31433
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000041	0.57056
AVERAGE HEAD ON TOP OF LAYER 5	4.598	
MAXIMUM HEAD ON TOP OF LAYER 5	5.504	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	19.9 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00004	0.54597
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00052
AVERAGE HEAD ON TOP OF LAYER 8	0.002	
MAXIMUM HEAD ON TOP OF LAYER 8	0.003	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.02	56477.0273
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3831	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	3.3719	0.1405
2	339.8880	0.2920
3	2.4386	0.2032
4	0.7161	0.0597
5	0.0000	0.0000
6	25.6200	0.4270

Page 6

7	0.5401	0.0450
8	0.0000	0.0000
9	15.3770	0.4270
SNOW WATER	0.000	

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FINAL COVER

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1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          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                  **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************

PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\DATA10.D10
OUTPUT DATA FILE:           C:\OUT.OUT

TIME: 18:42    DATE:  9/ 9/2015

------------------------------------------------------------------------------

     TITLE:  B7-with cover

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

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

                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
      THICKNESS                  =     6.00   INCHES
      POROSITY                   =     0.4570 VOL/VOL
      FIELD CAPACITY             =     0.1310 VOL/VOL
      WILTING POINT              =     0.0580 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.1692 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
      THICKNESS                  =    18.00   INCHES
                                  Page 1
```

```
      POROSITY                   =     0.4170 VOL/VOL
      FIELD CAPACITY             =     0.0410 VOL/VOL
      WILTING POINT              =     0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.2602 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =     2.00   PERCENT
      DRAINAGE LENGTH            =    45.0    FEET

                                  LAYER  3
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
      FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
      FML PLACEMENT QUALITY      =  4 - POOR

                                  LAYER  4
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                  =    24.00   INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                                  LAYER  5
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        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

                                  LAYER  6
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
      THICKNESS                  =  1164.00   INCHES
      POROSITY                   =     0.6710 VOL/VOL
      FIELD CAPACITY             =     0.2920 VOL/VOL
                                  Page 2
```

```
      WILTING POINT              =     0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                                  LAYER  7
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
      THICKNESS                  =    12.00   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

                                  LAYER  8
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
      THICKNESS                  =    12.00   INCHES
      POROSITY                   =     0.4170 VOL/VOL
      FIELD CAPACITY             =     0.0450 VOL/VOL
      WILTING POINT              =     0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0451 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =     2.00   PERCENT
      DRAINAGE LENGTH            =    45.0    FEET

                                  LAYER  9
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
      FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
      FML PLACEMENT QUALITY      =  4 - POOR

                                  LAYER 10
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                  =    60.00   INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
                                  Page 3
```

```
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                                  LAYER 11
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
      THICKNESS                  =    12.00   INCHES
      POROSITY                   =     0.4170 VOL/VOL
      FIELD CAPACITY             =     0.0450 VOL/VOL
      WILTING POINT              =     0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =     2.00   PERCENT
      DRAINAGE LENGTH            =    45.0    FEET

                                  LAYER 12
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =     0.09   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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
      FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
      FML PLACEMENT QUALITY      =  4 - POOR

                                  LAYER 13
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                  =    36.00   INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
           AND A SLOPE LENGTH OF   45. FEET.

    SCS RUNOFF CURVE NUMBER              =    68.30
    FRACTION OF AREA ALLOWING RUNOFF     =   100.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE   =     3.870  ACRES
                                  Page 4
```

```
EVAPORATIVE ZONE DEPTH                   =    22.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE        =     4.865  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE       =     9.414  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE       =     0.636  INCHES
INITIAL SNOW WATER                       =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS         =   402.624  INCHES
TOTAL INITIAL WATER                      =   402.624  INCHES
TOTAL SUBSURFACE INFLOW                  =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
-------------------------------------------------------------------------------

                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------
PRECIPITATION
-------------
  TOTALS                  4.47     4.15     4.75     3.69     3.30     4.71
                          5.82     5.57     4.85     3.05     2.49     3.30

  STD. DEVIATIONS         2.35     2.14     2.41     1.99     1.91     2.16
                          2.49     3.00     3.17     2.24     1.30     1.55

RUNOFF
------
  TOTALS                 0.016    0.012    0.017    0.009    0.007    0.003
                         0.028    0.029    0.066    0.026    0.001    0.003

  STD. DEVIATIONS        0.055    0.042    0.055    0.035    0.042    0.013
                         0.109    0.083    0.185    0.114    0.008    0.013

EVAPOTRANSPIRATION
------------------
  TOTALS                 1.372    1.908    2.636    2.817    3.679    4.001
                         4.455    4.207    2.876    1.509    1.011    1.205

  STD. DEVIATIONS        0.264    0.377    0.677    0.847    1.116    1.484
                         1.416    1.297    1.050    0.459    0.225    0.223

LATERAL DRAINAGE COLLECTED FROM LAYER  3
----------------------------------------
  TOTALS                2.0511   2.4806   2.3375   1.4425   1.0250   0.5629
                        0.8581   1.0980   1.3699   1.6058   1.1559   1.3059

  STD. DEVIATIONS       1.7378   1.8452   1.7320   0.9725   0.9119   0.5192
                        1.0536   1.1540   1.4933   1.7171   1.2488   1.1701

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
  TOTALS                0.0008   0.0008   0.0008   0.0005   0.0004   0.0002
                        0.0003   0.0004   0.0004   0.0005   0.0004   0.0005

  STD. DEVIATIONS       0.0004   0.0005   0.0004   0.0003   0.0003   0.0002
                        0.0003   0.0003   0.0004   0.0005   0.0004   0.0004

LATERAL DRAINAGE COLLECTED FROM LAYER  8
----------------------------------------
  TOTALS                0.0007   0.0008   0.0008   0.0006   0.0005   0.0003
                        0.0003   0.0003   0.0004   0.0005   0.0004   0.0005

  STD. DEVIATIONS       0.0003   0.0004   0.0004   0.0003   0.0003   0.0002
                        0.0002   0.0003   0.0003   0.0004   0.0004   0.0003

PERCOLATION/LEAKAGE THROUGH LAYER 10
------------------------------------
                                 Page 5
```

```
  TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

LATERAL DRAINAGE COLLECTED FROM LAYER 11
----------------------------------------
  TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

PERCOLATION/LEAKAGE THROUGH LAYER 13
------------------------------------
  TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

-------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES              3.0017   3.0835   2.6827   1.8096   1.2597   0.7277
                        1.0169   1.3077   1.5829   1.8317   1.4259   1.8194

  STD. DEVIATIONS       1.7154   1.9168   1.6726   1.1224   1.0333   0.6407
                        1.1413   1.2468   1.5261   1.7643   1.4136   1.3270

DAILY AVERAGE HEAD ON TOP OF LAYER  9
-------------------------------------
  AVERAGES              0.0009   0.0011   0.0010   0.0008   0.0006   0.0004
                        0.0003   0.0004   0.0005   0.0007   0.0006   0.0006

  STD. DEVIATIONS       0.0004   0.0003   0.0003   0.0004   0.0003   0.0002
                        0.0003   0.0004   0.0004   0.0003   0.0003   0.0004

DAILY AVERAGE HEAD ON TOP OF LAYER 12
-------------------------------------
  AVERAGES              0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

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

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

  AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH  100
-------------------------------------------------------------------------------
                                  INCHES               CU. FEET     PERCENT
                            -------------------     ------------  ---------
PRECIPITATION                 30.15   (   8.594)      708559.9     100.00

RUNOFF                         0.217  (  0.2756)        3046.09      0.432

EVAPOTRANSPIRATION            31.878  (  3.3992)      447819.34     63.560

LATERAL DRAINAGE COLLECTED    18.09307 (  5.94648)    254173.187    36.07545
                                 Page 6
```

```
  FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH    0.00611 (  0.00169)       85.812     0.01218
  LAYER  4

AVERAGE HEAD ON TOP            1.796 (    0.535)
  OF LAYER  3

LATERAL DRAINAGE COLLECTED     0.00611 (  0.00165)       85.788     0.01218
  FROM LAYER  8

PERCOLATION/LEAKAGE THROUGH    0.00001 (  0.00000)        0.105     0.00001
  LAYER 10

AVERAGE HEAD ON TOP            0.001 (    0.000)
  OF LAYER  9

LATERAL DRAINAGE COLLECTED     0.00000 (  0.00000)        0.070     0.00001
  FROM LAYER 11

PERCOLATION/LEAKAGE THROUGH    0.00000 (  0.00000)        0.035     0.00000
  LAYER 13

AVERAGE HEAD ON TOP            0.000 (    0.000)
  OF LAYER 12

CHANGE IN WATER STORAGE       -0.040   (  1.2024)      -564.72     -0.080

*******************************************************************************
1
*******************************************************************************

          PEAK DAILY VALUES FOR YEARS    1 THROUGH  100
-------------------------------------------------------------------------------
                                                   (INCHES)      (CU. FT.)
                                                  ----------   -------------
    PRECIPITATION                                    6.08        84429.078

    RUNOFF                                           1.117       15689.1709

    DRAINAGE COLLECTED FROM LAYER  2                 0.96273     13524.47270

    PERCOLATION/LEAKAGE THROUGH LAYER  4             0.000158        2.21551

    AVERAGE HEAD ON TOP OF LAYER  3                 19.368

    MAXIMUM HEAD ON TOP OF LAYER  3                 23.044

    LOCATION OF MAXIMUM HEAD IN LAYER  2
          (DISTANCE FROM DRAIN)                     32.7 FEET

    DRAINAGE COLLECTED FROM LAYER  8                 0.00008         1.18887

    PERCOLATION/LEAKAGE THROUGH LAYER 10             0.000000        0.00093

    AVERAGE HEAD ON TOP OF LAYER  9                  0.003

    MAXIMUM HEAD ON TOP OF LAYER  9                  0.007

    LOCATION OF MAXIMUM HEAD IN LAYER  8
          (DISTANCE FROM DRAIN)                      0.0 FEET

    DRAINAGE COLLECTED FROM LAYER 11                 0.00000         0.00064

    PERCOLATION/LEAKAGE THROUGH LAYER 13             0.000000        0.00010

    AVERAGE HEAD ON TOP OF LAYER 12                  0.000
                                 Page 7
```

```
    MAXIMUM HEAD ON TOP OF LAYER 12                  0.000

    LOCATION OF MAXIMUM HEAD IN LAYER 11
          (DISTANCE FROM DRAIN)                      0.0 FEET

    SNOW WATER                                       4.02         56477.0273

    MAXIMUM VEG. SOIL WATER (VOL/VOL)                     0.3927

    MINIMUM VEG. SOIL WATER (VOL/VOL)                     0.0289

     ***  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  100
-------------------------------------------------------------------------------
              LAYER        (INCHES)       (VOL/VOL)
              -----        --------       ---------
                1           0.2506         0.0584
                2           1.3294         0.0739
                3           0.0000         0.0000
                4          10.2480         0.4270
                5           3.1440         0.1310
                6         339.6880         0.2920
                7           1.5770         0.1310
                8           0.5401         0.0450
                9           0.0000         0.0000
               10          25.6200         0.4270
               11           0.5400         0.0450
               12           0.0000         0.0000
               13          15.3720         0.4270
           SNOW WATER       0.000

*******************************************************************************
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                                 Page 8
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LANDFILL T

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\DATA4.D4
TEMPERATURE DATA FILE:        C:\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\DATA10.D10
OUTPUT DATA FILE:             C:\OUT.OUT

TIME: 16:47      DATE:  8/13/2015

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

     TITLE:  T1-without cover

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

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

                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
       THICKNESS                  =   840.00   INCHES
       POROSITY                   =     0.6710 VOL/VOL
       FIELD CAPACITY             =     0.2920 VOL/VOL
       WILTING POINT              =     0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.2991 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.61
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  1
       THICKNESS                  =    12.00   INCHES
                                  Page 1

       POROSITY                   =     0.4170 VOL/VOL
       FIELD CAPACITY             =     0.0410 VOL/VOL
       WILTING POINT              =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0578 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
       SLOPE                      =     2.50   PERCENT
       DRAINAGE LENGTH            =    50.0    FEET

                                  LAYER  3
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
       THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
       FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
       FML PLACEMENT QUALITY      =  3 - GOOD

                                  LAYER  4
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
       THICKNESS                  =    36.00   INCHES
       POROSITY                   =     0.4270 VOL/VOL
       FIELD CAPACITY             =     0.4180 VOL/VOL
       WILTING POINT              =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                                  LAYER  5
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  1
       THICKNESS                  =    12.00   INCHES
       POROSITY                   =     0.4170 VOL/VOL
       FIELD CAPACITY             =     0.0450 VOL/VOL
       WILTING POINT              =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
       SLOPE                      =     2.50   PERCENT
       DRAINAGE LENGTH            =    50.0    FEET

                                  LAYER  6
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
       THICKNESS                  =     0.06   INCHES
                                  Page 2

       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.  =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
       FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
       FML PLACEMENT QUALITY      =  3 - GOOD

                                  LAYER  7
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
       THICKNESS                  =    36.00   INCHES
       POROSITY                   =     0.4270 VOL/VOL
       FIELD CAPACITY             =     0.4180 VOL/VOL
       WILTING POINT              =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
            GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.%
            AND A SLOPE LENGTH OF  100. FEET.

     SCS RUNOFF CURVE NUMBER             =    50.10
     FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =     1.400  ACRES
     EVAPORATIVE ZONE DEPTH              =    22.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =     6.096  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =    14.762  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =     1.694  INCHES
     INITIAL SNOW WATER                  =     0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS    =   283.227  INCHES
     TOTAL INITIAL WATER                 =   283.227  INCHES
     TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH  100
----------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.89 6.73	5.34 6.09	4.16 3.47	4.05 2.72	4.78 3.80	4.47 5.66
STD. DEVIATIONS	2.38 2.28	2.72 2.68	2.53 2.79	2.71 1.90	2.68 2.26	2.05 1.91
RUNOFF						
TOTALS	0.001 0.000	0.007 0.000	0.002 0.006	0.003 0.000	0.002 0.001	0.000 0.006
STD. DEVIATIONS	0.008 0.000	0.036 0.001	0.015 0.045	0.017 0.000	0.017 0.005	0.000 0.024
EVAPOTRANSPIRATION						
TOTALS	1.215 3.478	1.961 5.420	3.312 4.317	4.673 2.532	4.735 1.174	4.594 0.925
STD. DEVIATIONS	0.142 1.278	0.193 1.134	0.474 1.111	0.901 0.806	1.555 0.273	1.664 0.114
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.1633 1.7876	1.5142 0.9904	2.1794 0.6386	2.8773 0.7800	2.8623 0.7051	2.1335 0.7112
STD. DEVIATIONS	0.5098 1.4061	0.5876 1.1673	0.6981 0.8724	0.8748 1.0788	1.1137 0.9627	1.3818 0.6693
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0001 0.0001	0.0001 0.0001	0.0001 0.0000	0.0002 0.0001	0.0002 0.0000	0.0001 0.0000
STD. DEVIATIONS	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0001 0.0001	0.0001 0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.0001 0.0001	0.0001 0.0001	0.0001 0.0000	0.0002 0.0000	0.0002 0.0000	0.0001 0.0000
STD. DEVIATIONS	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0001 0.0001	0.0001 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

Page 3

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	1.3245 1.4330	1.8894 0.9971	2.4743 0.7497	2.3492 0.8967	3.2218 0.8282	2.4810 0.8097
STD. DEVIATIONS	0.5800 1.5774	0.7215 1.3170	0.7846 1.0216	0.9425 1.1680	1.2349 1.1294	1.5993 0.7572
DAILY AVERAGE HEAD ON TOP OF LAYER 6						
AVERAGES	0.0001 0.0001	0.0001 0.0001	0.0001 0.0001	0.0002 0.0001	0.0002 0.0001	0.0002 0.0001
STD. DEVIATIONS	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0001 0.0001	0.0001 0.0001

Page 4

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	58.14	(9.060)	295475.6	100.00
RUNOFF	0.028	(0.0656)	143.80	0.049
EVAPOTRANSPIRATION	40.377	(4.0899)	205194.06	69.445
LATERAL DRAINAGE COLLECTED FROM LAYER 2	17.73285	(6.31681)	90118.336	30.49941
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00112	(0.00038)	5.690	0.00193
AVERAGE HEAD ON TOP OF LAYER 3	1.706	(0.598)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00112	(0.00037)	5.675	0.00192
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.014	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.003	(5.6122)	13.73	0.005

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	6.14	31203.479
RUNOFF	0.436	2216.3398
DRAINAGE COLLECTED FROM LAYER 2	0.16734	850.44690
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000009	0.04794
AVERAGE HEAD ON TOP OF LAYER 3	5.591	
MAXIMUM HEAD ON TOP OF LAYER 3	6.861	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	20.9 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00001	0.04627
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	

Page 5

SNOW WATER	5.71	29026.4746
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4972
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	251.1384	0.2990
2	1.0752	0.0896
3	0.0000	0.0000
4	15.3720	0.4270
5	0.5400	0.0450
6	0.0000	0.0000
7	15.3720	0.4270
SNOW WATER	0.000	

Page 6

FINAL COVER

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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:\TIC\DATA4.D4
TEMPERATURE DATA FILE:       C:\TIC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\TIC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\TIC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\TIC\DATA10.D10
OUTPUT DATA FILE:            C:\TIC\OUT.OUT

TIME: 21:25    DATE:  3/21/2016

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    TITLE:  T1-with 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.

                             LAYER  1
                             --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                    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 =     0.0955 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                             LAYER  2
                             --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  34
       THICKNESS                  =     0.20   INCHES
```

Page 1

```
       POROSITY                   =     0.8500 VOL/VOL
       FIELD CAPACITY             =     0.0100 VOL/VOL
       WILTING POINT              =     0.0050 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0109 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
       SLOPE                      =     5.00    PERCENT
       DRAINAGE LENGTH            =    50.0     FEET

                             LAYER  3
                             --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
       THICKNESS                  =     0.06    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.  =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY      =  3 - GOOD

                             LAYER  4
                             --------

                   TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
       THICKNESS                  =    24.00    INCHES
       POROSITY                   =     0.4270 VOL/VOL
       FIELD CAPACITY             =     0.4180 VOL/VOL
       WILTING POINT              =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                             LAYER  5
                             --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
       THICKNESS                  =   840.00    INCHES
       POROSITY                   =     0.6710 VOL/VOL
       FIELD CAPACITY             =     0.2920 VOL/VOL
       WILTING POINT              =     0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                             LAYER  6
                             --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   1
       THICKNESS                  =    12.00    INCHES
       POROSITY                   =     0.4170 VOL/VOL
       FIELD CAPACITY             =     0.0450 VOL/VOL
```

Page 2

```
       WILTING POINT              =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
       SLOPE                      =     2.50    PERCENT
       DRAINAGE LENGTH            =    50.0     FEET

                             LAYER  7
                             --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  33
       THICKNESS                  =     0.06    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.  =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY      =  3 - GOOD

                             LAYER  8
                             --------

                   TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
       THICKNESS                  =    36.00    INCHES
       POROSITY                   =     0.4270 VOL/VOL
       FIELD CAPACITY             =     0.4180 VOL/VOL
       WILTING POINT              =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                             LAYER  9
                             --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   1
       THICKNESS                  =    12.00    INCHES
       POROSITY                   =     0.4170 VOL/VOL
       FIELD CAPACITY             =     0.0450 VOL/VOL
       WILTING POINT              =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
       SLOPE                      =     2.50    PERCENT
       DRAINAGE LENGTH            =    50.0     FEET

                             LAYER 10
                             --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  33
       THICKNESS                  =     0.06    INCHES
       POROSITY                   =     0.0000 VOL/VOL
       FIELD CAPACITY             =     0.0000 VOL/VOL
```

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```
       WILTING POINT              =     0.0000 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY      =  3 - GOOD

                             LAYER 11
                             --------

                   TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
       THICKNESS                  =    36.00    INCHES
       POROSITY                   =     0.4270 VOL/VOL
       FIELD CAPACITY             =     0.4180 VOL/VOL
       WILTING POINT              =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
           GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.%
           AND A SLOPE LENGTH OF  100. FEET.

    SCS RUNOFF CURVE NUMBER            =    62.40
    FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
    EVAPORATIVE ZONE DEPTH             =    22.0    INCHES
    INITIAL WATER IN EVAPORATIVE ZONE  =     1.835  INCHES
    UPPER LIMIT OF EVAPORATIVE STORAGE =    10.054  INCHES
    LOWER LIMIT OF EVAPORATIVE STORAGE =     1.276  INCHES
    INITIAL SNOW WATER                 =     0.000  INCHES
    INITIAL WATER IN LAYER MATERIALS   =   289.647  INCHES
    TOTAL INITIAL WATER                =   289.647  INCHES
    TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                     JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                     -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS             4.89     5.44     4.16     4.05     4.76     4.47
                      6.73     6.09     5.47     2.72     3.80     5.66

   STD. DEVIATIONS    2.58     2.72     2.53     2.71     2.48     2.05
                      2.28     2.68     2.78     1.90     2.26     2.91

 RUNOFF
 ------
   TOTALS             0.007    0.019    0.005    0.011    0.008    0.009
                      0.000    0.001    0.010    0.000    0.003    0.013
```

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STD. DEVIATIONS	0.029	0.109	0.035	0.055	0.030	0.002
	0.001	0.010	0.054	0.004	0.019	0.051

EVAPOTRANSPIRATION

TOTALS	0.510	0.700	0.765	0.608	0.777	0.887
	1.153	1.028	0.816	0.372	0.331	0.462
STD. DEVIATIONS	0.437	0.577	0.716	0.479	0.587	0.394
	0.394	0.449	0.516	0.209	0.289	0.301

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	4.2640	4.5157	3.7356	3.4848	3.9391	3.6596
	5.3164	5.0445	4.7234	2.4210	3.3539	5.0160
STD. DEVIATIONS	2.2608	2.2437	2.1840	2.3500	2.1759	1.7431
	1.9662	2.2830	2.3752	1.6228	2.0249	2.5229

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 11

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

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AVERAGES	0.0008	0.0009	0.0007	0.0006	0.0007	0.0007
	0.0010	0.0009	0.0009	0.0004	0.0006	0.0009
STD. DEVIATIONS	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
	0.0003	0.0004	0.0004	0.0003	0.0004	0.0004

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

DAILY AVERAGE HEAD ON TOP OF LAYER 10

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	58.14 (9.060)	21105402.0	100.00
RUNOFF	0.078 (0.1510)	28207.20	0.134
EVAPOTRANSPIRATION	8.390 (2.5747)	3045605.75	14.430
LATERAL DRAINAGE COLLECTED FROM LAYER 2	49.67404 (7.70858)	18031676.000	85.43630
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	1.346	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.001 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.246	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.900	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 9	0.00000 (0.00000)	0.005	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.00000 (0.00000)	0.899	0.00000
AVERAGE HEAD ON TOP OF LAYER 10	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.000 (0.8200)	-87.85	0.000

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	6.14	2228820.000
RUNOFF	0.762	276776.1560
DRAINAGE COLLECTED FROM LAYER 2	3.92077	1423239.62000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.07281
AVERAGE HEAD ON TOP OF LAYER 3	0.021	
MAXIMUM HEAD ON TOP OF LAYER 3	0.042	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.2 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00308
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00247
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 9	0.00000	0.00004
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000000	0.00247
AVERAGE HEAD ON TOP OF LAYER 10	0.000	
MAXIMUM HEAD ON TOP OF LAYER 10	0.002	
LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.71	2073319.6200

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3220
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

*** 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 100

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LAYER	(INCHES)	(VOL/VOL)
1	2.2682	0.0945
2	0.0021	0.0106
3	0.0000	0.0000
4	10.2480	0.4270
5	243.2800	0.2920
6	0.5400	0.0450
7	0.0000	0.0000
8	13.3720	0.4270
9	0.5400	0.0450
10	0.0000	0.0000
11	15.3720	0.4270
SNOW WATER	0.000	

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LANDFILL J

INTERMEDIATE COVER

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1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**             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              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\JNC\DATA4.D4
TEMPERATURE DATA FILE:        C:\JNC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\JNC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\JNC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\JNC\DATA10.D10
OUTPUT DATA FILE:             C:\JNC\OUT.OUT


TIME: 15:18     DATE:  4/26/2016


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

  TITLE:  J) without 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.


                               LAYER  1
                               --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
   THICKNESS                  =  1440.00   INCHES
   POROSITY                   =     0.0710 VOL/VOL
   FIELD CAPACITY             =     0.2920 VOL/VOL
   WILTING POINT              =     0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.2873 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
 NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
        FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                               LAYER  2
                               --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  1
   THICKNESS                  =    12.00   INCHES
```

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```
   POROSITY                   =     0.4170 VOL/VOL
   FIELD CAPACITY             =     0.0410 VOL/VOL
   WILTING POINT              =     0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.0629 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC


                               LAYER  3
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER  1
   THICKNESS                  =    12.00   INCHES
   POROSITY                   =     0.4170 VOL/VOL
   FIELD CAPACITY             =     0.0450 VOL/VOL
   WILTING POINT              =     0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.0435 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
   SLOPE                      =     2.00   PERCENT
   DRAINAGE LENGTH            =    50.0    FEET


                               LAYER  4
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
   THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
   FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
   FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER  5
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
   THICKNESS                  =    18.00   INCHES
   POROSITY                   =     0.4270 VOL/VOL
   FIELD CAPACITY             =     0.4180 VOL/VOL
   WILTING POINT              =     0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


                               LAYER  6
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER  1
   THICKNESS                  =    12.00   INCHES
   POROSITY                   =     0.4170 VOL/VOL
   FIELD CAPACITY             =     0.0450 VOL/VOL
```

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```
   WILTING POINT              =     0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
   SLOPE                      =     2.00   PERCENT
   DRAINAGE LENGTH            =    50.0    FEET


                               LAYER  7
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
   THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
   FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
   FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER  8
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
   THICKNESS                  =    36.00   INCHES
   POROSITY                   =     0.4270 VOL/VOL
   FIELD CAPACITY             =     0.4180 VOL/VOL
   WILTING POINT              =     0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  3.%
         AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER              =    61.90
   FRACTION OF AREA ALLOWING RUNOFF     =   100.0     PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE   =   100.000   ACRES
   EVAPORATIVE ZONE DEPTH               =    32.0     INCHES
   INITIAL WATER IN EVAPORATIVE ZONE    =     2.558   INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE   =    21.472   INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE   =     2.464   INCHES
   INITIAL SNOW WATER                   =     0.000   INCHES
   INITIAL WATER IN LAYER MATERIALS     =   438.593   INCHES
   TOTAL INITIAL WATER                  =   438.593   INCHES
   TOTAL SUBSURFACE INFLOW              =     0.00    INCHES/YEAR

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

   AVERAGE MONTHLY VALUES IN INCHES FOR YEARS   1 THROUGH  100
```

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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.10	1.13	0.93	0.72	0.24	0.08
	0.01	0.05	0.14	0.27	0.70	0.65
STD. DEVIATIONS	0.65	0.82	0.61	0.56	0.28	0.23
	0.04	0.20	0.22	0.45	0.64	0.45
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.621	0.932	1.416	1.401	0.404	0.077
	0.021	0.047	0.126	0.155	0.381	0.415
STD. DEVIATIONS	0.218	0.259	0.471	0.544	0.446	0.209
	0.084	0.201	0.194	0.236	0.282	0.195
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002
STD. DEVIATIONS	0.0012	0.0010	0.0010	0.0009	0.0009	0.0008
	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
```

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AVERAGES	0.0004	0.0004	0.0004	0.0004	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003
STD. DEVIATIONS	0.0017	0.0015	0.0014	0.0013	0.0012	0.0011
	0.0011	0.0010	0.0010	0.0009	0.0009	0.0008

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	6.00	(1.635)	2176875.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.991	(1.5815)	2174683.00	99.899
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00319	(0.00930)	1157.340	0.05317
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00000)	0.621	0.00003
AVERAGE HEAD ON TOP OF LAYER 4	0.000	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000	(0.00000)	0.178	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000	(0.00000)	0.448	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.003	(0.7491)	1033.79	0.047

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.62	588060.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.00036	131.56136
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.01866
AVERAGE HEAD ON TOP OF LAYER 4	0.016	

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MAXIMUM HEAD ON TOP OF LAYER 4	0.032	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.6 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.01734
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00247
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.73	266455.3750
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2355	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	414.1883	0.2876
2	0.3511	0.0439
3	0.5403	0.0450
4	0.0000	0.0000
5	7.6960	0.4270
6	0.5400	0.0450
7	0.0000	0.0000
8	15.3720	0.4270
SNOW WATER	0.000	

Page 6

LANDFILL R

CELL R-1

INTERMEDIATE COVER

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          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                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\DATA4.D4
TEMPERATURE DATA FILE:        C:\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\DATA10.D10
OUTPUT DATA FILE:             C:\OUT.OUT


TIME: 13: 5      DATE:  8/14/2013


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

     TITLE:  #1-without cover

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


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


                               LAYER  1
                               --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  18
      THICKNESS                    =   828.00    INCHES
      POROSITY                     =     0.0710 VOL/VOL
      FIELD CAPACITY               =     0.2920 VOL/VOL
      WILTING POINT                =     0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT   =     0.2838 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                               LAYER  2
                               --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
      THICKNESS                    =     0.20    INCHES
                                  Page 1
```

```
      POROSITY                     =     0.8500 VOL/VOL
      FIELD CAPACITY               =     0.0100 VOL/VOL
      WILTING POINT                =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT   =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
      SLOPE                        =     2.00    PERCENT
      DRAINAGE LENGTH              =    15.0     FEET


                               LAYER  3
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  37
      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.    =  0.199999999000E-10 CM/SEC
      FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY        =  5 - GOOD


                               LAYER  4
                               --------

                  TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
      THICKNESS                    =    36.00    INCHES
      POROSITY                     =     0.4270 VOL/VOL
      FIELD CAPACITY               =     0.4180 VOL/VOL
      WILTING POINT                =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                               LAYER  5
                               --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
      THICKNESS                    =     0.20    INCHES
      POROSITY                     =     0.8500 VOL/VOL
      FIELD CAPACITY               =     0.0100 VOL/VOL
      WILTING POINT                =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT   =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
      SLOPE                        =     2.00    PERCENT
      DRAINAGE LENGTH              =    15.0     FEET


                               LAYER  6
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  37
      THICKNESS                    =     0.04    INCHES
                                  Page 2
```

```
      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.    =  0.199999999000E-10 CM/SEC
      FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY        =  3 - GOOD


                               LAYER  7
                               --------

                  TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
      THICKNESS                    =    36.00    INCHES
      POROSITY                     =     0.4270 VOL/VOL
      FIELD CAPACITY               =     0.4180 VOL/VOL
      WILTING POINT                =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF  9.%
           AND A SLOPE LENGTH OF  100. FEET.

    SCS RUNOFF CURVE NUMBER            =    61.30
    FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE =     6.300  ACRES
    EVAPORATIVE ZONE DEPTH             =    32.0    INCHES
    INITIAL WATER IN EVAPORATIVE ZONE  =     2.519  INCHES
    UPPER LIMIT OF EVAPORATIVE STORAGE =    21.477  INCHES
    LOWER LIMIT OF EVAPORATIVE STORAGE =     2.464  INCHES
    INITIAL SNOW WATER                 =     0.000  INCHES
    INITIAL WATER IN LAYER MATERIALS   =   265.699  INCHES
    TOTAL INITIAL WATER                =   265.699  INCHES
    TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS              1.10     1.11     0.93     0.72     0.24     0.08
                        0.01     0.05     0.14     0.27     0.70     0.65

    STD. DEVIATIONS     0.85     0.82     0.61     0.56     0.28     0.22
                        0.04     0.20     0.22     0.45     0.64     0.43

  RUNOFF
  ------
    TOTALS             0.000    0.000    0.000    0.000    0.000    0.000
                                  Page 3
```

```
                       0.000    0.000    0.000    0.000    0.000    0.000

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

  EVAPOTRANSPIRATION
  ------------------
    TOTALS             0.631    0.927    1.326    1.059    0.305    0.074
                       0.021    0.049    0.116    0.157    0.390    0.425

    STD. DEVIATIONS    0.222    0.251    0.479    0.710    0.308    0.201
                       0.085    0.192    0.190    0.236    0.285    0.215

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS            0.0709   0.1146   0.2141   0.1207   0.0087   0.0017
                      0.0007   0.0015   0.0020   0.0022   0.0053   0.0110

    STD. DEVIATIONS   0.1058   0.2113   0.3048   0.1434   0.0111   0.0049
                      0.0046   0.0097   0.0039   0.0031   0.0076   0.0286

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

  LATERAL DRAINAGE COLLECTED FROM LAYER  5
  ----------------------------------------
    TOTALS            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  ------------------------------------
    TOTALS            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

  DAILY AVERAGE HEAD ON TOP OF LAYER  6
  -------------------------------------
    AVERAGES          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

                                  Page 4
```

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	6.00	(1.633)	137143.1	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.478	(1.2370)	125271.71	91.344
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.51375	(0.59714)	11748.908	8.56690
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00002	(0.00001)	0.469	0.00034
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00002	(0.00001)	0.452	0.00033
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.017	0.00001
AVERAGE HEAD ON TOP OF LAYER 6	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.005	(0.7180)	121.99	0.089

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.62	37047.781
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.12675	2898.70117
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000001	0.01500
AVERAGE HEAD ON TOP OF LAYER 3	0.001	
MAXIMUM HEAD ON TOP OF LAYER 3	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00000	0.01540
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	

Page 5

SNOW WATER	0.73	16786.6875
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.1874
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	235.4840	0.2844
2	0.0020	0.0100
3	0.0000	0.0000
4	15.3720	0.4270
5	0.0020	0.0100
6	0.0000	0.0000
7	15.3720	0.4270
SNOW WATER	0.000	

Page 6

FINAL COVER

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          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                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************

PRECIPITATION DATA FILE:     C:\OR1C\DATA4.D4
TEMPERATURE DATA FILE:       C:\OR1C\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\OR1C\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\OR1C\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\OR1C\DATA10.D10
OUTPUT DATA FILE:            C:\OR1C\OUT.OUT

TIME: 17:57    DATE:  8/17/2016

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

     TITLE: #1-with cover

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

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

                               LAYER  1
                               --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   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 =     0.0687 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                               LAYER  2
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
```

Page 1

```
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.1250 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     4.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                               LAYER  3
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08    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.  = 0.199999998000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 5 - GOOD

                               LAYER  4
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    24.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC

                               LAYER  5
                               --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =   828.00    INCHES
        POROSITY                   =     0.6710 VOL/VOL
        FIELD CAPACITY             =     0.2920 VOL/VOL
        WILTING POINT              =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC

                               LAYER  6
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
```

Page 2

```
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     2.00    PERCENT
        DRAINAGE LENGTH            =    15.0     FEET

                               LAYER  7
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  37
        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.  = 0.199999999000E-10 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 3 - GOOD

                               LAYER  8
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    36.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC

                               LAYER  9
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     2.00    PERCENT
        DRAINAGE LENGTH            =    15.0     FEET

                               LAYER 10
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  37
        THICKNESS                  =     0.04    INCHES
        POROSITY                   =     0.0000 VOL/VOL
        FIELD CAPACITY             =     0.0000 VOL/VOL
```

Page 3

```
        WILTING POINT              =     0.0000 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.199999999000E-10 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 3 - GOOD

                               LAYER 11
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    36.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
            FAIR STAND OF GRASS, A SURFACE SLOPE OF  9.%
            AND A SLOPE LENGTH OF  100. FEET.

        SCS RUNOFF CURVE NUMBER            =    68.20
        FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =     6.300  ACRES
        EVAPORATIVE ZONE DEPTH             =    24.2    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =     1.674  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =    11.138  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE =     1.393  INCHES
        INITIAL SNOW WATER                 =     0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS   =   284.446  INCHES
        TOTAL INITIAL WATER                =   284.446  INCHES
        TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS              1.10     1.13     0.93     0.72     0.24     0.08
                       0.01     0.05     0.14     0.27     0.70     0.65

   STD. DEVIATIONS     0.65     0.80     0.61     0.56     0.28     0.23
                       0.04     0.20     0.22     0.45     0.64     0.43

 RUNOFF
 ------
   TOTALS              0.000    0.000    0.000    0.000    0.000    0.000
                       0.000    0.000    0.000    0.000    0.000    0.000
```

Page 4

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

EVAPOTRANSPIRATION

TOTALS	0.073	0.096	0.108	0.142	0.063	0.026
	0.013	0.022	0.033	0.027	0.058	0.045
STD. DEVIATIONS	0.052	0.071	0.069	0.104	0.067	0.056
	0.016	0.061	0.045	0.044	0.059	0.095

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	1.0148	1.0400	0.8227	0.5814	0.1776	0.0548
	0.0031	0.0310	0.0909	0.2282	0.6356	0.6046
STD. DEVIATIONS	0.5931	0.7575	0.3441	0.4635	0.2224	0.1741
	0.0282	0.1374	0.1666	0.3951	0.5820	0.4019

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 11

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

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AVERAGES	0.0044	0.0050	0.0036	0.0026	0.0008	0.0002
	0.0000	0.0001	0.0004	0.0010	0.0029	0.0026
STD. DEVIATIONS	0.0026	0.0036	0.0024	0.0021	0.0010	0.0008
	0.0001	0.0006	0.0007	0.0017	0.0026	0.0017

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

DAILY AVERAGE HEAD ON TOP OF LAYER 10

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.00 (1.635)	137143.1	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	0.706 (0.2081)	16147.19	11.774
LATERAL DRAINAGE COLLECTED FROM LAYER 2	5.29083 (1.48810)	120995.891	88.22600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.050	0.00004
AVERAGE HEAD ON TOP OF LAYER 3	0.002 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.042	0.00003
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.007	0.00001
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 9	0.00000 (0.00000)	0.003	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.00000 (0.00000)	0.004	0.00000
AVERAGE HEAD ON TOP OF LAYER 10	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.000 (0.0047)	0.00	0.000

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.62	37047.781
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	1.27306	29113.53120
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00080
AVERAGE HEAD ON TOP OF LAYER 3	0.172	
MAXIMUM HEAD ON TOP OF LAYER 3	0.327	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	2.3 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00870
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00020
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 9	0.00000	0.00010
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000000	0.00010
AVERAGE HEAD ON TOP OF LAYER 10	0.000	
MAXIMUM HEAD ON TOP OF LAYER 10	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.73	16786.6875

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.1118

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0655

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	1.6488	0.0687
2	0.0250	0.1250
3	0.0000	0.0000
4	10.2480	0.4270
5	241.7760	0.7920
6	0.0020	0.0100
7	0.0000	0.0000
8	15.3720	0.4270
9	0.0020	0.0100
10	0.0000	0.0000
11	15.3720	0.4270
SNOW WATER	0.000	

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Page 8

CELLS R-2 TO R-5

INTERMEDIATE COVER

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1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\DATA4.D4
TEMPERATURE DATA FILE:        C:\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\DATA10.D10
OUTPUT DATA FILE:             C:\OUT.OUT


TIME: 13:33     DATE:  8/14/2015


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

     TITLE:  R2-without cover

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


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


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
      THICKNESS                     =  1272.00    INCHES
      POROSITY                      =     0.6710 VOL/VOL
      FIELD CAPACITY                =     0.2920 VOL/VOL
      WILTING POINT                 =     0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT    =     0.2866 VOL/VOL
      EFFECTIVE SAT. HYD. COND.     = 0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
      THICKNESS                     =     0.20    INCHES
                                   Page 1
```

```
      POROSITY                      =     0.8500 VOL/VOL
      FIELD CAPACITY                =     0.0100 VOL/VOL
      WILTING POINT                 =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.     =  33.0000000000      CM/SEC
      SLOPE                         =     2.00    PERCENT
      DRAINAGE LENGTH               =    15.0     FEET


                                  LAYER  3
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                     =     0.08    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.     = 0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY           =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS      =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY         = 3 - GOOD


                                  LAYER  4
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                     =    36.00    INCHES
      POROSITY                      =     0.4270 VOL/VOL
      FIELD CAPACITY                =     0.4180 VOL/VOL
      WILTING POINT                 =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.     = 0.100000001000E-06 CM/SEC


                                  LAYER  5
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
      THICKNESS                     =     0.20    INCHES
      POROSITY                      =     0.8500 VOL/VOL
      FIELD CAPACITY                =     0.0100 VOL/VOL
      WILTING POINT                 =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.     =  33.0000000000      CM/SEC
      SLOPE                         =     2.00    PERCENT
      DRAINAGE LENGTH               =    15.0     FEET


                                  LAYER  6
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                     =     0.08    INCHES
                                   Page 2
```

```
      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.     = 0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY           =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS      =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY         = 3 - GOOD


                                  LAYER  7
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                     =    36.00    INCHES
      POROSITY                      =     0.4270 VOL/VOL
      FIELD CAPACITY                =     0.4180 VOL/VOL
      WILTING POINT                 =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.     = 0.100000001000E-06 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF  100. FEET.

   SCS RUNOFF CURVE NUMBER            =    60.30
   FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE =    24.400  ACRES
   EVAPORATIVE ZONE DEPTH             =    32.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE  =     2.519  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE =    21.472  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE =     2.464  INCHES
   INITIAL SNOW WATER                 =     0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS   =   393.347  INCHES
   TOTAL INITIAL WATER                =   393.347  INCHES
   TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                  JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                  -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS           1.10     1.11     0.93     0.72     0.24     0.08
                    0.00     0.05     0.14     0.27     0.70     0.65

   STD. DEVIATIONS  0.85     0.82     0.61     0.56     0.28     0.22
                    0.04     0.20     0.22     0.45     0.64     0.43

 RUNOFF
 ------
   TOTALS          0.000    0.000    0.000    0.000    0.000    0.000
                                   Page 3
```

```
                   0.000    0.000    0.000    0.000    0.000    0.000

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

 EVAPOTRANSPIRATION
 ------------------
   TOTALS          0.631    0.927    1.326    1.059    0.305    0.074
                   0.021    0.046    0.116    0.157    0.390    0.425

   STD. DEVIATIONS 0.222    0.251    0.479    0.710    0.308    0.201
                   0.085    0.192    0.190    0.236    0.285    0.215

 LATERAL DRAINAGE COLLECTED FROM LAYER  2
 ----------------------------------------
   TOTALS          0.0709   0.1146   0.2141   0.1209   0.0097   0.0017
                   0.0007   0.0015   0.0020   0.0022   0.0057   0.0110

   STD. DEVIATIONS 0.1055   0.2113   0.3015   0.1436   0.0111   0.0049
                   0.0046   0.0097   0.0039   0.0031   0.0076   0.0286

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
   TOTALS          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

 LATERAL DRAINAGE COLLECTED FROM LAYER  5
 ----------------------------------------
   TOTALS          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

 PERCOLATION/LEAKAGE THROUGH LAYER  7
 ------------------------------------
   TOTALS          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  3
 -------------------------------------
   AVERAGES        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

 DAILY AVERAGE HEAD ON TOP OF LAYER  6
 -------------------------------------
   AVERAGES        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

   STD. DEVIATIONS 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                                   Page 4
```

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.00 (1.633)	531137.4	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.478 (1.2370)	485179.31	91.344
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.51377 (0.59715)	45505.492	8.56723
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.020	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00000 (0.00000)	0.020	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.001	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.005 (0.7180)	472.46	0.089

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.62	143486.641
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.12744	11287.60210
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00078
AVERAGE HEAD ON TOP OF LAYER 3	0.001	
MAXIMUM HEAD ON TOP OF LAYER 3	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.6 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00000	0.00077
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00015
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	

Page 5

SNOW WATER	0.73	65015.1094
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.1874
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	385.1320	0.2871
2	0.0020	0.0100
3	0.0000	0.0000
4	15.3720	0.4270
5	0.0020	0.0100
6	0.0000	0.0000
7	15.3720	0.4270
SNOW WATER	0.000	

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FINAL COVER

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1
*******************************************************************************
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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:\DATA4.D4
TEMPERATURE DATA FILE:       C:\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\DATA10.D10
OUTPUT DATA FILE:            C:\OUT.OUT

TIME: 12:20     DATE:  8/14/2015

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

     TITLE:  R2-With 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.

                              LAYER  1
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                      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 =     0.0687 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY   3.00
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
                                 Page 1
```

```
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.1250 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     4.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                              LAYER  3
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08    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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      =  5 - GOOD

                              LAYER  4
                              --------

                      TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    24.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                              LAYER  5
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =  1272.00    INCHES
        POROSITY                   =     0.6710 VOL/VOL
        FIELD CAPACITY             =     0.2920 VOL/VOL
        WILTING POINT              =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                              LAYER  6
                              --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
                                 Page 2
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```
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     2.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                              LAYER  7
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08    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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD

                              LAYER  8
                              --------

                      TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    36.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                              LAYER  9
                              --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20    INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
        SLOPE                      =     2.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                              LAYER 10
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08    INCHES
        POROSITY                   =     0.0000 VOL/VOL
        FIELD CAPACITY             =     0.0000 VOL/VOL
                                 Page 3
```

```
        WILTING POINT              =     0.0000 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD

                              LAYER 11
                              --------

                      TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    36.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
         AND A SLOPE LENGTH OF  100. FEET.

        SCS RUNOFF CURVE NUMBER            =    67.40
        FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =    24.400  ACRES
        EVAPORATIVE ZONE DEPTH             =    24.2    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =     1.674  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =    11.138  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE =     1.393  INCHES
        INITIAL SNOW WATER                 =     0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS   =   414.094  INCHES
        TOTAL INITIAL WATER                =   414.094  INCHES
        TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS   1 THROUGH  100
-------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS               1.10     1.13     0.93     0.72     0.24     0.08
                        0.01     0.05     0.14     0.27     0.70     0.65

   STD. DEVIATIONS      0.65     0.80     0.61     0.56     0.28     0.23
                        0.04     0.20     0.22     0.45     0.64     0.43

 RUNOFF
 ------
   TOTALS              0.000    0.000    0.000    0.000    0.000    0.000
                       0.000    0.000    0.000    0.000    0.000    0.000
                                 Page 4
```

```
 STD. DEVIATIONS          0.000    0.000    0.000    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.000

EVAPOTRANSPIRATION
------------------
 TOTALS                   0.073    0.096    0.108    0.142    0.063    0.026
                          0.013    0.022    0.033    0.027    0.058    0.045

 STD. DEVIATIONS          0.052    0.071    0.069    0.104    0.067    0.056
                          0.016    0.061    0.045    0.044    0.059    0.095

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
 TOTALS                   1.0148   1.0400   0.8227   0.5814   0.1776   0.0548
                          0.0031   0.0310   0.0969   0.2282   0.6356   0.6046

 STD. DEVIATIONS          0.5931   0.7575   0.3441   0.4635   0.2224   0.1741
                          0.0282   0.1374   0.1666   0.3951   0.5820   0.4019

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
 TOTALS                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

LATERAL DRAINAGE COLLECTED FROM LAYER  6
----------------------------------------
 TOTALS                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

PERCOLATION/LEAKAGE THROUGH LAYER  8
------------------------------------
 TOTALS                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

LATERAL DRAINAGE COLLECTED FROM LAYER  9
----------------------------------------
 TOTALS                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

PERCOLATION/LEAKAGE THROUGH LAYER 11
------------------------------------
 TOTALS                   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

-------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
```

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```
 AVERAGES                 0.0044   0.0050   0.0036   0.0026   0.0008   0.0002
                          0.0000   0.0001   0.0004   0.0010   0.0029   0.0026

 STD. DEVIATIONS          0.0026   0.0036   0.0024   0.0021   0.0010   0.0009
                          0.0001   0.0006   0.0007   0.0017   0.0026   0.0017

DAILY AVERAGE HEAD ON TOP OF LAYER  7
-------------------------------------
 AVERAGES                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

DAILY AVERAGE HEAD ON TOP OF LAYER 10
-------------------------------------
 AVERAGES                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

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

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

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS   1 THROUGH  100
-------------------------------------------------------------------------------
                                       INCHES            CU. FEET     PERCENT
                                 -------------------   ----------   ---------
PRECIPITATION                      6.00    (  1.635)    531137.4     100.00

RUNOFF                             0.000   (  0.0000)       0.00       0.000

EVAPOTRANSPIRATION                 0.706   (  0.2081)   62538.32      11.774

LATERAL DRAINAGE COLLECTED         5.29083 (  1.48810)  468618.969    88.22600
  FROM LAYER  2

PERCOLATION/LEAKAGE THROUGH        0.00000 (  0.00000)       0.192     0.00004
  LAYER  4

AVERAGE HEAD ON TOP                0.002 (    0.001)
  OF LAYER  3

LATERAL DRAINAGE COLLECTED         0.00000 (  0.00000)       0.191     0.00004
  FROM LAYER  6

PERCOLATION/LEAKAGE THROUGH        0.00000 (  0.00000)       0.001     0.00000
  LAYER  8

AVERAGE HEAD ON TOP                0.000 (    0.000)
  OF LAYER  7

LATERAL DRAINAGE COLLECTED         0.00000 (  0.00000)       0.005     0.00000
  FROM LAYER  9

PERCOLATION/LEAKAGE THROUGH        0.00000 (  0.00000)       0.001     0.00000
  LAYER 11

AVERAGE HEAD ON TOP                0.000 (    0.000)
  OF LAYER 10

CHANGE IN WATER STORAGE            0.000   (  0.0147)       0.00       0.000
*******************************************************************************
```

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```
*******************************************************************************

          PEAK DAILY VALUES FOR YEARS   1 THROUGH  100
------------------------------------------------------------------------
                                              (INCHES)      (CU. FT.)
                                             ----------   -------------
 PRECIPITATION                                  1.62        143486.641

 RUNOFF                                         0.000            0.0000

 DRAINAGE COLLECTED FROM LAYER  2               1.27306     112757.17200

 PERCOLATION/LEAKAGE THROUGH LAYER  4           0.000000         0.03451

 AVERAGE HEAD ON TOP OF LAYER  3                0.172

 MAXIMUM HEAD ON TOP OF LAYER  3                0.337

 LOCATION OF MAXIMUM HEAD IN LAYER  2
          (DISTANCE FROM DRAIN)                 2.3 FEET

 DRAINAGE COLLECTED FROM LAYER  6               0.00000          0.03449

 PERCOLATION/LEAKAGE THROUGH LAYER  8           0.000000         0.00003

 AVERAGE HEAD ON TOP OF LAYER  7                0.000

 MAXIMUM HEAD ON TOP OF LAYER  7                0.002

 LOCATION OF MAXIMUM HEAD IN LAYER  6
          (DISTANCE FROM DRAIN)                 0.0 FEET

 DRAINAGE COLLECTED FROM LAYER  9               0.00000          0.00003

 PERCOLATION/LEAKAGE THROUGH LAYER 11           0.000000         0.00001

 AVERAGE HEAD ON TOP OF LAYER 10                0.000

 MAXIMUM HEAD ON TOP OF LAYER 10                0.000

 LOCATION OF MAXIMUM HEAD IN LAYER  9
          (DISTANCE FROM DRAIN)                 0.0 FEET

 SNOW WATER                                     0.73         65015.1094

 MAXIMUM VEG. SOIL WATER (VOL/VOL)                     0.1118

 MINIMUM VEG. SOIL WATER (VOL/VOL)                     0.0655

  ***  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  100
         ----------------------------------------------------------
                  LAYER        (INCHES)        (VOL/VOL)
                  -----        --------        ---------
```

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```
                    1           1.6488          0.0687
                    2           0.0250          0.1250
                    3           0.0000          0.0000
                    4          10.2480          0.4270
                    5         371.4240          0.7920
                    6           0.0020          0.0100
                    7           0.0000          0.0000
                    8          13.3720          0.4270
                    9           0.0020          0.0100
                   10           0.0000          0.0000
                   11          15.3720          0.4270
              SNOW WATER        0.000
*******************************************************************************
*******************************************************************************
```

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30-YEAR DURATION

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          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                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************

PRECIPITATION DATA FILE:      C:\R20\DATA4.D4
TEMPERATURE DATA FILE:        C:\R20\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\R20\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\R20\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\R20\DATA10.D10
OUTPUT DATA FILE:             C:\R20\OUT.OUT

TIME: 19:37    DATE:  7/24/2016

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

   TITLE: R2 Pre-closure

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

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

                              LAYER  1
                              --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
      THICKNESS                  =  1272.00    INCHES
      POROSITY                   =     0.6710 VOL/VOL
      FIELD CAPACITY             =     0.2920 VOL/VOL
      WILTING POINT              =     0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.2866 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER  34
      THICKNESS                  =     0.20    INCHES
                                Page 1
```

```
      POROSITY                   =     0.8500 VOL/VOL
      FIELD CAPACITY             =     0.0100 VOL/VOL
      WILTING POINT              =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =   33.0000000000      CM/SEC
      SLOPE                      =     2.00    PERCENT
      DRAINAGE LENGTH            =    15.0     FEET

                              LAYER  3
                              --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =     0.08    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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY      =  3 - GOOD

                              LAYER  4
                              --------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
      THICKNESS                  =    36.00    INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

                              LAYER  5
                              --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER  34
      THICKNESS                  =     0.20    INCHES
      POROSITY                   =     0.8500 VOL/VOL
      FIELD CAPACITY             =     0.0100 VOL/VOL
      WILTING POINT              =     0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =   33.0000000000      CM/SEC
      SLOPE                      =     2.00    PERCENT
      DRAINAGE LENGTH            =    15.0     FEET

                              LAYER  6
                              --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =     0.08    INCHES
                                Page 2
```

```
      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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
      FML PLACEMENT QUALITY      =  3 - GOOD

                              LAYER  7
                              --------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
      THICKNESS                  =    36.00    INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF  100. FEET.

   SCS RUNOFF CURVE NUMBER               =    60.30
   FRACTION OF AREA ALLOWING RUNOFF      =   100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE    =    24.400  ACRES
   EVAPORATIVE ZONE DEPTH                =    32.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE     =     2.519  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE    =    21.472  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE    =     2.464  INCHES
   INITIAL SNOW WATER                    =     0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS      =   395.347  INCHES
   TOTAL INITIAL WATER                   =   395.347  INCHES
   TOTAL SUBSURFACE INFLOW               =     0.00   INCHES/YEAR

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

                     ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                      INCHES        CU. FEET      PERCENT
                                     --------      ----------     -------
 PRECIPITATION                         4.52        400345.469     100.00

 RUNOFF                                0.000            0.000       0.00

 EVAPOTRANSPIRATION                    4.306       381367.094      95.26

 DRAINAGE COLLECTED FROM LAYER  2      0.2137       18926.408       4.73

 PERC./LEAKAGE THROUGH LAYER  4        0.000000         0.016       0.00

 AVG. HEAD ON TOP OF LAYER  3          0.0000
                                Page 3
```

```
 DRAINAGE COLLECTED FROM LAYER  5      0.0000           0.015       0.00

 PERC./LEAKAGE THROUGH LAYER  7        0.000000         0.001       0.00

 AVG. HEAD ON TOP OF LAYER  6          0.0000

 CHANGE IN WATER STORAGE               0.001           51.337       0.01

 SOIL WATER AT START OF YEAR         395.347     35016640.000

 SOIL WATER AT END OF YEAR           395.347     35016692.000

 SNOW WATER AT START OF YEAR           0.000            0.000       0.00

 SNOW WATER AT END OF YEAR             0.000            0.000       0.00

 ANNUAL WATER BUDGET BALANCE           0.0000           0.512       0.00

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                     ANNUAL TOTALS FOR YEAR    2
------------------------------------------------------------------------------
                                      INCHES        CU. FEET      PERCENT
                                     --------      ----------     -------
 PRECIPITATION                         5.78        511946.336     100.00

 RUNOFF                                0.000            0.000       0.00

 EVAPOTRANSPIRATION                    5.646       500076.875      97.68

 DRAINAGE COLLECTED FROM LAYER  2      0.1892       16759.598       3.27

 PERC./LEAKAGE THROUGH LAYER  4        0.000000         0.015       0.00

 AVG. HEAD ON TOP OF LAYER  3          0.0000

 DRAINAGE COLLECTED FROM LAYER  5      0.0000           0.014       0.00

 PERC./LEAKAGE THROUGH LAYER  7        0.000000         0.001       0.00

 AVG. HEAD ON TOP OF LAYER  6          0.0000

 CHANGE IN WATER STORAGE              -0.055        -4892.436      -0.96

 SOIL WATER AT START OF YEAR         395.347     35016692.000

 SOIL WATER AT END OF YEAR           395.292     35011800.000

 SNOW WATER AT START OF YEAR           0.000            0.000       0.00

 SNOW WATER AT END OF YEAR             0.000            0.000       0.00

 ANNUAL WATER BUDGET BALANCE           0.0000           2.130       0.00

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                     ANNUAL TOTALS FOR YEAR    3
                                Page 4
```

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.30	823719.687	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	8.096	717039.687	87.05
DRAINAGE COLLECTED FROM LAYER 2	0.3096	27418.133	3.33
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.017	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.017	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.001	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.895	79262.859	9.62
SOIL WATER AT START OF YEAR	395.292	35011800.000	
SOIL WATER AT END OF YEAR	396.187	35091060.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.983	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.59	406545.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	5.151	456219.844	112.22
DRAINAGE COLLECTED FROM LAYER 2	0.2495	22095.949	5.44
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.018	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.018	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.001	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	-0.810	-71770.133	-17.65
SOIL WATER AT START OF YEAR	396.187	35091060.000	
SOIL WATER AT END OF YEAR	395.377	35019292.000	

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	INCHES	CU. FEET	PERCENT
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.144	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.83	693519.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.536	667437.750	96.24
DRAINAGE COLLECTED FROM LAYER 2	0.2479	21955.844	3.17
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.015	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.015	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.001	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.047	4124.782	0.59
SOIL WATER AT START OF YEAR	395.377	35019292.000	
SOIL WATER AT END OF YEAR	395.423	35023416.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.337	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.08	449945.656	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	4.961	439396.531	97.66
DRAINAGE COLLECTED FROM LAYER 2	0.1739	15402.391	3.42

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	INCHES	CU. FEET	PERCENT
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.017	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.016	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.001	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	-0.055	-4854.593	-1.08
SOIL WATER AT START OF YEAR	395.423	35023416.000	
SOIL WATER AT END OF YEAR	395.368	35018560.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.130	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.83	604946.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.401	566989.312	93.73
DRAINAGE COLLECTED FROM LAYER 2	0.1394	12344.782	2.04
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.012	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.011	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.289	25613.656	4.23
SOIL WATER AT START OF YEAR	395.368	35018560.000	
SOIL WATER AT END OF YEAR	395.658	35044176.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.024	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.78	334802.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	3.597	318590.375	95.16
DRAINAGE COLLECTED FROM LAYER 2	0.1021	9046.835	2.70
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.012	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.011	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.001	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.081	7165.661	2.14
SOIL WATER AT START OF YEAR	395.658	35044176.000	
SOIL WATER AT END OF YEAR	395.738	35051340.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.767	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.47	395916.906	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	4.795	424739.312	107.28
DRAINAGE COLLECTED FROM LAYER 2	0.1210	10718.074	2.71
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.009	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.008	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	-0.446	-39542.230	-9.99

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SOIL WATER AT START OF YEAR	395.738	35011340.000	
SOIL WATER AT END OF YEAR	395.292	35011800.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.791	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.18	0.77	1.10	0.55	0.17	0.04
	0.00	0.00	0.01	0.26	1.19	0.35
STD. DEVIATIONS	0.61	0.63	0.75	0.48	0.27	0.08
	0.01	0.00	0.02	0.37	0.78	0.31
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.935	0.998	1.012	0.701	0.213	0.041
	0.007	0.000	0.005	0.139	0.792	0.765
STD. DEVIATIONS	0.349	0.484	0.782	0.473	0.258	0.075
	0.014	0.000	0.016	0.295	0.426	0.327
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0340	0.0323	0.0375	0.0334	0.0044	0.0015
	0.0001	0.0000	0.0001	0.0042	0.0132	0.0313
STD. DEVIATIONS	0.0473	0.0189	0.0425	0.0459	0.0064	0.0022
	0.0002	0.0000	0.0004	0.0122	0.0141	0.0496
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 6						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.80 (1.834)	513520.7	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.610 (1.4817)	496873.00	96.758
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.19403 (0.06791)	17185.363	3.34658
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.015	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00000 (0.00000)	0.014	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.001	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.006 (0.4683)	-537.90	-0.105

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 9

	(INCHES)	(CU. FT.)
PRECIPITATION	0.97	85914.844
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.04235	3751.24855
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00068
AVERAGE HEAD ON TOP OF LAYER 3	0.000	
MAXIMUM HEAD ON TOP OF LAYER 3	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00000	0.00065
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.14	12427.9756
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1414	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770	

*** 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 9

LAYER	(INCHES)	(VOL/VOL)
1	364.5439	0.2866
2	0.0020	0.0100
3	0.0000	0.0000
4	15.3720	0.4270
5	0.0020	0.0100

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LAYER	(INCHES)	(VOL/VOL)
6	0.0000	0.0000
7	15.3720	0.4270
SNOW WATER	0.000	

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1
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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:\R21\DATA4.D4
TEMPERATURE DATA FILE:       C:\R21\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\R21\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\R21\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\R21\DATA10.D10
OUTPUT DATA FILE:            C:\R21\OUT.OUT

TIME: 19:43     DATE:  7/24/2016

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

    TITLE: R2 Post-closure

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    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
           WERE SPECIFIED BY THE USER.

                              LAYER  1
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      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     =       0.0687 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
   THICKNESS                      =       0.20    INCHES
                                 Page 1
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```
   POROSITY                       =       0.8500 VOL/VOL
   FIELD CAPACITY                 =       0.0100 VOL/VOL
   WILTING POINT                  =       0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.1250 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   33.0000000000      CM/SEC
   SLOPE                          =       4.00    PERCENT
   DRAINAGE LENGTH                =      50.0     FEET

                              LAYER  3
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
   THICKNESS                      =       0.08    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.      =   0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY            =       2.00    HOLES/ACRE
   FML INSTALLATION DEFECTS       =       2.00    HOLES/ACRE
   FML PLACEMENT QUALITY          =   5 - GOOD

                              LAYER  4
                              --------

                 TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
   THICKNESS                      =      24.00    INCHES
   POROSITY                       =       0.4270 VOL/VOL
   FIELD CAPACITY                 =       0.4180 VOL/VOL
   WILTING POINT                  =       0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.100000001000E-06 CM/SEC

                              LAYER  5
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
   THICKNESS                      =    1272.00    INCHES
   POROSITY                       =       0.6710 VOL/VOL
   FIELD CAPACITY                 =       0.2920 VOL/VOL
   WILTING POINT                  =       0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.2866 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.100000005000E-02 CM/SEC

                              LAYER  6
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
   THICKNESS                      =       0.20    INCHES
   POROSITY                       =       0.8500 VOL/VOL
   FIELD CAPACITY                 =       0.0100 VOL/VOL
                                 Page 2
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```
   WILTING POINT                  =       0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.0100 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   33.0000000000      CM/SEC
   SLOPE                          =       2.00    PERCENT
   DRAINAGE LENGTH                =      50.0     FEET

                              LAYER  7
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
   THICKNESS                      =       0.08    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.      =   0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY            =       2.00    HOLES/ACRE
   FML INSTALLATION DEFECTS       =       2.00    HOLES/ACRE
   FML PLACEMENT QUALITY          =   3 - GOOD

                              LAYER  8
                              --------

                 TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
   THICKNESS                      =      36.00    INCHES
   POROSITY                       =       0.4270 VOL/VOL
   FIELD CAPACITY                 =       0.4180 VOL/VOL
   WILTING POINT                  =       0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.100000001000E-06 CM/SEC

                              LAYER  9
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
   THICKNESS                      =       0.20    INCHES
   POROSITY                       =       0.8500 VOL/VOL
   FIELD CAPACITY                 =       0.0100 VOL/VOL
   WILTING POINT                  =       0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.0100 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   33.0000000000      CM/SEC
   SLOPE                          =       7.00    PERCENT
   DRAINAGE LENGTH                =      50.0     FEET

                              LAYER 10
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
   THICKNESS                      =       0.08    INCHES
   POROSITY                       =       0.0000 VOL/VOL
   FIELD CAPACITY                 =       0.0000 VOL/VOL
                                 Page 3
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```
   WILTING POINT                  =       0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY            =       2.00    HOLES/ACRE
   FML INSTALLATION DEFECTS       =       2.00    HOLES/ACRE
   FML PLACEMENT QUALITY          =   3 - GOOD

                              LAYER 11
                              --------

                 TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
   THICKNESS                      =      36.00    INCHES
   POROSITY                       =       0.4270 VOL/VOL
   FIELD CAPACITY                 =       0.4180 VOL/VOL
   WILTING POINT                  =       0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT     =       0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.      =   0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
         AND A SLOPE LENGTH OF  100. FEET.

  SCS RUNOFF CURVE NUMBER             =    67.40
  FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE  =    24.400  ACRES
  EVAPORATIVE ZONE DEPTH              =    24.2    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE   =     1.674  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE  =    11.138  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE  =     1.393  INCHES
  INITIAL SNOW WATER                  =     0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS    =   407.225  INCHES
  TOTAL INITIAL WATER                 =   407.225  INCHES
  TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

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

                    ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                        INCHES        CU. FEET     PERCENT
                                       --------      ----------   --------
  PRECIPITATION                          4.52        400345.469    100.00

  RUNOFF                                 0.000            0.000      0.00

  EVAPOTRANSPIRATION                     0.730        64620.973     16.14

  DRAINAGE COLLECTED FROM LAYER  2       3.7904      335721.375     83.86

  PERC./LEAKAGE THROUGH LAYER  4         0.000002         0.135      0.00

  AVG. HEAD ON TOP OF LAYER  3           0.0018

  DRAINAGE COLLECTED FROM LAYER  8       0.0000           0.000      0.00
                                 Page 4
```

PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	2.703	0.00
SOIL WATER AT START OF YEAR	407.225	36068736.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.438	0.00

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.78	511946.156	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.618	54732.137	10.69
DRAINAGE COLLECTED FROM LAYER 2	5.1621	457213.781	89.31
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.191	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0019		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL WATER BUDGET BALANCE	0.0000	0.253	0.00

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.30	823719.687	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.988	87499.555	10.62
DRAINAGE COLLECTED FROM LAYER 2	8.3109	736111.750	89.36
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.295	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.001	108.170	0.01
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.226	36068848.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.280	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.59	406543.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.582	51560.590	12.68
DRAINAGE COLLECTED FROM LAYER 2	4.0091	355092.562	87.34

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PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.132	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0015		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	-0.001	-105.417	-0.03
SOIL WATER AT START OF YEAR	407.226	36068848.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-2.201	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.83	693518.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.864	76541.133	11.04
DRAINAGE COLLECTED FROM LAYER 2	6.9658	616977.187	88.96
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.247	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0026		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	

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SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.433	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.08	449941.656	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.557	49359.320	10.97
DRAINAGE COLLECTED FROM LAYER 2	4.5227	400586.250	89.03
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.167	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0017		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.090	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT

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PRECIPITATION	6.83	604946.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.571	50583.484	8.36
DRAINAGE COLLECTED FROM LAYER 2	6.2469	553299.937	91.46
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.219	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0023		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.012	1062.280	0.18
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.237	36069804.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.019	0.00

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.78	334802.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.530	46957.109	14.03
DRAINAGE COLLECTED FROM LAYER 2	3.2266	285790.281	85.36
PERC./LEAKAGE THROUGH LAYER 4	0.000001	0.121	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0012		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00

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PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.023	2054.282	0.61
SOIL WATER AT START OF YEAR	407.237	36069804.000	
SOIL WATER AT END OF YEAR	407.260	36071856.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.449	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.47	395916.906	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.311	27571.871	6.96
DRAINAGE COLLECTED FROM LAYER 2	4.1937	371445.906	93.82
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.157	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0015		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	-0.035	-3100.344	-0.78
SOIL WATER AT START OF YEAR	407.260	36071856.000	
SOIL WATER AT END OF YEAR	407.225	36068756.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.523	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.54	579260.937	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.723	64042.914	11.06
DRAINAGE COLLECTED FROM LAYER 2	5.8171	515234.219	88.95
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.212	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0021		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	-16.219	0.00
SOIL WATER AT START OF YEAR	407.225	36068756.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.011	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.71	505746.062	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.577	51107.449	10.11
DRAINAGE COLLECTED FROM LAYER 2	5.1330	454638.531	89.89
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.185	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0019		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00

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PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.084	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.09	539403.437	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.703	62287.086	11.55
DRAINAGE COLLECTED FROM LAYER 2	5.3868	477116.250	88.45
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.193	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0020		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL WATER BUDGET BALANCE	0.0000	0.111	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.58	405059.719	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.583	51622.996	12.73
DRAINAGE COLLECTED FROM LAYER 2	3.9972	354036.656	87.27
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.155	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0015		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.223	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.053	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.34	738690.562	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.801	70929.266	9.60

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DRAINAGE COLLECTED FROM LAYER 2	7.5392	667761.000	90.40
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.271	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.317	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.88	343659.312	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.778	68927.977	20.06
DRAINAGE COLLECTED FROM LAYER 2	3.1018	274731.187	79.94
PERC./LEAKAGE THROUGH LAYER 4	0.000001	0.113	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0011		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00

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SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.143	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.47	484488.937	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.566	50116.070	10.34
DRAINAGE COLLECTED FROM LAYER 2	4.9042	434372.562	89.66
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.175	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0018		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.306	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT

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PRECIPITATION	4.84	428688.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.710	62918.406	14.68
DRAINAGE COLLECTED FROM LAYER 2	4.1296	365769.844	85.32
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.154	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0015		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.280	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.80	425145.562	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.560	49572.629	11.66
DRAINAGE COLLECTED FROM LAYER 2	4.2401	375572.844	88.34
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.154	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0016		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00

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	INCHES	CU. FEET	PERCENT
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	2.703	0.00
SOIL WATER AT START OF YEAR	407.223	36068740.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-2.597	0.00

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.19	459688.687	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.458	40535.770	8.82
DRAINAGE COLLECTED FROM LAYER 2	4.7323	419152.719	91.18
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.177	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0018		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.193	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.10	274573.156	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.364	32246.084	11.74
DRAINAGE COLLECTED FROM LAYER 2	2.7359	242326.969	88.26
PERC./LEAKAGE THROUGH LAYER 4	0.000001	0.103	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0010		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.108	0.00

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.93	348087.906	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.459	40694.238	11.69
DRAINAGE COLLECTED FROM LAYER 2	3.4706	307393.567	88.31
PERC./LEAKAGE THROUGH LAYER 4	0.000001	0.126	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0013		

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.106	0.00

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.65	500431.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.649	57493.078	11.49
DRAINAGE COLLECTED FROM LAYER 2	5.0009	442938.594	88.51
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.178	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0018		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

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	INCHES	CU. FEET	PERCENT
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.090	0.00

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.64	410974.094	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.778	68917.062	16.77
DRAINAGE COLLECTED FROM LAYER 2	3.8619	342056.937	83.23
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.150	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0015		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.116	0.00

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.59	583689.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.797	70612.555	12.10

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DRAINAGE COLLECTED FROM LAYER 2	5.7928	513076.687	87.90
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.201	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0022		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.232	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.43	835233.875	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	1.002	88718.125	10.63
DRAINAGE COLLECTED FROM LAYER 2	8.4279	746475.437	89.37
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.288	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00

SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.396	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.69	415402.687	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.428	37909.023	9.13
DRAINAGE COLLECTED FROM LAYER 2	4.2620	377493.625	90.87
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.146	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0016		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.042	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.52	400345.375	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.744	65898.930	16.46
DRAINAGE COLLECTED FROM LAYER 2	3.7760	334446.250	83.54
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.149	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0014		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.216	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.66	678461.562	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.888	78641.695	11.59
DRAINAGE COLLECTED FROM LAYER 2	6.7721	599819.500	88.41
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.238	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		

DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068744.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.317	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.59	406545.437	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.443	39193.602	9.64
DRAINAGE COLLECTED FROM LAYER 2	4.1471	367354.312	90.36
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.155	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0016		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.000	-2.703	0.00
SOIL WATER AT START OF YEAR	407.225	36068744.000	
SOIL WATER AT END OF YEAR	407.225	36068740.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.235	0.00

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ANNUAL TOTALS FOR YEAR 30	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.80	602289.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	0.664	58830.984	9.77
DRAINAGE COLLECTED FROM LAYER 2	6.1284	542808.875	90.12
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.213	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0023		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 8	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0000		
CHANGE IN WATER STORAGE	0.007	651.424	0.11
SOIL WATER AT START OF YEAR	407.225	36068740.000	
SOIL WATER AT END OF YEAR	407.232	36069392.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.774	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.15	0.78	0.99	0.62	0.24	0.02
	0.00	0.03	0.09	0.25	0.97	0.50
STD. DEVIATIONS	0.70	0.61	0.61	0.42	0.32	0.06
	0.01	0.10	0.18	0.46	0.74	0.35
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.077	0.065	0.110	0.132	0.063	0.014
	0.008	0.017	0.027	0.023	0.071	0.038
STD. DEVIATIONS	0.053	0.031	0.066	0.090	0.080	0.023
	0.006	0.033	0.046	0.050	0.056	0.032
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.0736	0.7122	0.8766	0.4901	0.1803	0.0145
	0.0000	0.0700	0.0583	0.2210	0.8814	0.4649
STD. DEVIATIONS	0.6607	0.5630	0.5456	0.3338	0.2427	0.0456
	0.0000	0.0621	0.1293	0.4050	0.6921	0.3267
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

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AVERAGES	0.0047	0.0034	0.0038	0.0022	0.0008	0.0001
	0.0000	0.0001	0.0003	0.0010	0.0040	0.0020
STD. DEVIATIONS	0.0029	0.0027	0.0024	0.0015	0.0011	0.0002
	0.0000	0.0003	0.0006	0.0018	0.0031	0.0014
DAILY AVERAGE HEAD ON TOP OF LAYER 7						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 10						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.64 (1.614)	499605.2	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	0.648 (0.1779)	57356.06	11.480
LATERAL DRAINAGE COLLECTED FROM LAYER 2	4.99286 (1.49139)	442227.187	88.51334
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.181	0.00004
AVERAGE HEAD ON TOP OF LAYER 3	0.002 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 9	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.00000 (0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 10	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.000 (0.0082)	21.89	0.004

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	1.54	136400.875
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	1.28431	113753.82800
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.03481
AVERAGE HEAD ON TOP OF LAYER 3	0.173	
MAXIMUM HEAD ON TOP OF LAYER 3	0.330	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	2.3 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 9	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 10	0.000	
MAXIMUM HEAD ON TOP OF LAYER 10	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.14	12427.9756

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.0786

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0612

*** 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)

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1	1.6558	0.0690
2	0.0254	0.1268
3	0.0000	0.0000
4	20.2480	0.4270
5	364.5553	0.2806
6	0.0020	0.0100
7	0.0000	0.0000
8	15.3720	0.4270
9	0.0020	0.0100
10	0.0000	0.0000
11	15.3720	0.4270
SNOW WATER	0.000	

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LANDFILL P

CELL P-1

INTERMEDIATE COVER

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


PRECIPITATION DATA FILE:     C:\P1NC\DATA4.D4
TEMPERATURE DATA FILE:       C:\P1NC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\P1NC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\P1NC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\P1NC\DATA10.D10
OUTPUT DATA FILE:            C:\P1NC\OUT.OUT


TIME: 16:21     DATE:  4/18/2016


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

     TITLE: P1-ON 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.


                                  LAYER 1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
                                  Page 1
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```
  THICKNESS                  =    480.00   INCHES
  POROSITY                   =      0.6710 VOL/VOL
  FIELD CAPACITY             =      0.2920 VOL/VOL
  WILTING POINT              =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.2860 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.20   INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =   33.0000000000     CM/SEC
  SLOPE                      =      2.00   PERCENT
  DRAINAGE LENGTH            =     50.0    FEET


                          LAYER  3
                          --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.08   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.  = 0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD


                          LAYER  4
                          --------
                           Page 2
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               TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   1
  THICKNESS                  =     24.00   INCHES
  POROSITY                   =      0.4170 VOL/VOL
  FIELD CAPACITY             =      0.0450 VOL/VOL
  WILTING POINT              =      0.0180 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0450 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  = 0.999999978000E-02 CM/SEC


                          LAYER  5
                          --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.20   INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =   33.0000000000     CM/SEC
  SLOPE                      =      2.00   PERCENT
  DRAINAGE LENGTH            =     50.0    FEET


                          LAYER  6
                          --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.06   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.  = 0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD


                          LAYER  7
                           Page 3
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               TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.20   INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =   33.0000000000     CM/SEC
  SLOPE                      =      2.00   PERCENT
  DRAINAGE LENGTH            =     50.0    FEET


                          LAYER  8
                          --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.06   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.  = 0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD


                          LAYER  9
                          --------

               TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  16
  THICKNESS                  =     37.20   INCHES
  POROSITY                   =      0.4270 VOL/VOL
  FIELD CAPACITY             =      0.4180 VOL/VOL
  WILTING POINT              =      0.3670 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.4270 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC


                           Page 4
```

```
            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
              SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
              FAIR STAND OF GRASS, A SURFACE SLOPE OF  1.%
              AND A SLOPE LENGTH OF   50. FEET.

     SCS RUNOFF CURVE NUMBER              =    59.50
     FRACTION OF AREA ALLOWING RUNOFF     =   100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE   =   100.000  ACRES
     EVAPORATIVE ZONE DEPTH               =    22.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE    =     3.530  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE   =    14.762  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE   =     1.694  INCHES
     INITIAL SNOW WATER                   =     0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS     =   154.236  INCHES
     TOTAL INITIAL WATER                  =   154.236  INCHES
     TOTAL SUBSURFACE INFLOW              =     0.00   INCHES/YEAR


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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH  100
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
PRECIPITATION
-------------
  TOTALS                   1.05     1.36     2.12     3.11     4.91     4.02
                           2.89     2.48     3.20     2.48     1.50     1.20

  STD. DEVIATIONS          0.68     0.89     1.20     1.91     3.01     2.06
                           1.76     1.61     1.84     1.95     1.23     0.91

RUNOFF
------
  TOTALS                  0.001    0.011    0.000    0.000    0.007    0.001
                          0.000    0.000    0.000    0.001    0.000    0.002

  STD. DEVIATIONS         0.009    0.044    0.000    0.004    0.036    0.011
                          0.000    0.000    0.002    0.000    0.000    0.016

EVAPOTRANSPIRATION
```

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```
-------------------
  TOTALS                  1.128    1.318    2.051    2.599    4.832    4.912
                          3.288    2.485    2.286    1.498    1.214    1.099

  STD. DEVIATIONS         0.406    0.468    0.773    1.051    1.373    1.963
                          1.080    1.557    1.078    0.675    0.421    0.372

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS                 0.1210   0.0613   0.0552   0.0929   0.2194   0.3847
                         0.1472   0.0100   0.0084   0.1106   0.2100   0.2170

  STD. DEVIATIONS        0.3392   0.1635   0.1285   0.2624   0.4681   0.8137
                         0.3339   0.0524   0.0305   0.3366   0.4800   0.5290

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0001
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

LATERAL DRAINAGE COLLECTED FROM LAYER  5
----------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

PERCOLATION/LEAKAGE THROUGH LAYER  6
------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

LATERAL DRAINAGE COLLECTED FROM LAYER  7
----------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

PERCOLATION/LEAKAGE THROUGH LAYER  9
------------------------------------
```

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```
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

------------------------------------------------------------------------------
           AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES               0.0001   0.0000   0.0000   0.0000   0.0001   0.0002
                         0.0001   0.0000   0.0000   0.0000   0.0001   0.0001

  STD. DEVIATIONS        0.0001   0.0001   0.0001   0.0001   0.0007   0.0004
                         0.0002   0.0000   0.0000   0.0001   0.0002   0.0002

DAILY AVERAGE HEAD ON TOP OF LAYER  6
-------------------------------------
  AVERAGES               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

DAILY AVERAGE HEAD ON TOP OF LAYER  8
-------------------------------------
  AVERAGES               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

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


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   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS     1 THROUGH  100
------------------------------------------------------------------------------
                                    INCHES            CU. FEET      PERCENT
                              -------------------   ------------   ---------
PRECIPITATION                  38.34   (   6.245)   11014725.0     100.00

RUNOFF                          0.024  (  0.0593)       8668.29      0.079
```

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```
EVAPOTRANSPIRATION             28.689  (  4.5956)   10414245.00     94.548

LATERAL DRAINAGE COLLECTED      1.63760 (  1.91724)   594447.562     5.39684
  FROM LAYER  2

PERCOLATION/LEAKAGE THROUGH     0.00033 (  0.00036)      119.801     0.00109
  LAYER  3

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  3

LATERAL DRAINAGE COLLECTED      0.00020 (  0.00022)       71.326     0.00065
  FROM LAYER  5

PERCOLATION/LEAKAGE THROUGH     0.00013 (  0.00013)       48.477     0.00044
  LAYER  6

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  6

LATERAL DRAINAGE COLLECTED      0.00013 (  0.00013)       48.444     0.00044
  FROM LAYER  7

PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.033     0.00000
  LAYER  9

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  8

CHANGE IN WATER STORAGE        -0.008  (  2.0736)     -2759.34      -0.025
******************************************************************************


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

         PEAK DAILY VALUES FOR YEARS     1 THROUGH  100
----------------------------------------------------------------------
                                                  (INCHES)      (CU. FT.)
                                                  ----------    -------------
  PRECIPITATION                                     5.36       1945680.000

  RUNOFF                                            0.249        90220.3516

  DRAINAGE COLLECTED FROM LAYER  2                  0.16219      58873.65620
```

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PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000028	10.19121
AVERAGE HEAD ON TOP OF LAYER 3	0.002	
MAXIMUM HEAD ON TOP OF LAYER 3	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00001	3.61064
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000006	2.00181
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00001	2.00045
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00232
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.009	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.31	837825.8120

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4650
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	136.5074	0.2844
2	0.0020	0.0100
3	0.0000	0.0000
4	1.0000	0.0450
5	0.0020	0.0100
6	0.0000	0.0000
7	0.0020	0.0100
8	0.0000	0.0000
9	15.8844	0.4270
SNOW WATER	0.000	

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FINAL COVER

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

PRECIPITATION DATA FILE:     C:\P1C\DATA4.D4
TEMPERATURE DATA FILE:       C:\P1C\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\P1C\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\P1C\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\P1C\DATA10.D10
OUTPUT DATA FILE:            C:\P1C\OUT.OUT

TIME: 11:56     DATE:  4/18/2016

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

    TITLE: P1-COVER

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

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

                              LAYER  1
                              --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   1
                               Page 1
```

```
  THICKNESS                 =    36.00   INCHES
  POROSITY                  =     0.4170 VOL/VOL
  FIELD CAPACITY            =     0.0450 VOL/VOL
  WILTING POINT             =     0.0180 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.0499 VOL/VOL
  EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  34
  THICKNESS                 =     0.20   INCHES
  POROSITY                  =     0.8500 VOL/VOL
  FIELD CAPACITY            =     0.0100 VOL/VOL
  WILTING POINT             =     0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.0136 VOL/VOL
  EFFECTIVE SAT. HYD. COND. =  33.0000000000     CM/SEC
  SLOPE                     =     0.50   PERCENT
  DRAINAGE LENGTH           =    50.0    FEET

                              LAYER  3
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
  THICKNESS                 =     0.06   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. = 0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY       =     2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS  =     2.00   HOLES/ACRE
  FML PLACEMENT QUALITY     = 3 - GOOD

                              LAYER  4
                              --------
                               Page 2
```

```
                   TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
  THICKNESS                 =    24.00   INCHES
  POROSITY                  =     0.4270 VOL/VOL
  FIELD CAPACITY            =     0.4180 VOL/VOL
  WILTING POINT             =     0.3670 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.4270 VOL/VOL
  EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC

                              LAYER  5
                              --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
  THICKNESS                 =   480.00   INCHES
  POROSITY                  =     0.6710 VOL/VOL
  FIELD CAPACITY            =     0.2920 VOL/VOL
  WILTING POINT             =     0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.2920 VOL/VOL
  EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

                              LAYER  6
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  34
  THICKNESS                 =     0.20   INCHES
  POROSITY                  =     0.8500 VOL/VOL
  FIELD CAPACITY            =     0.0100 VOL/VOL
  WILTING POINT             =     0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND. =  33.0000000000     CM/SEC
  SLOPE                     =     2.00   PERCENT
  DRAINAGE LENGTH           =    50.0    FEET

                              LAYER  7
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                               Page 3
```

```
                    MATERIAL TEXTURE NUMBER  35
  THICKNESS                 =     0.06   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. = 0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY       =     2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS  =     2.00   HOLES/ACRE
  FML PLACEMENT QUALITY     = 3 - GOOD

                              LAYER  8
                              --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   1
  THICKNESS                 =    24.00   INCHES
  POROSITY                  =     0.4170 VOL/VOL
  FIELD CAPACITY            =     0.0450 VOL/VOL
  WILTING POINT             =     0.0180 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.0450 VOL/VOL
  EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC

                              LAYER  9
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  34
  THICKNESS                 =     0.20   INCHES
  POROSITY                  =     0.8500 VOL/VOL
  FIELD CAPACITY            =     0.0100 VOL/VOL
  WILTING POINT             =     0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =    0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND. =  33.0000000000     CM/SEC
  SLOPE                     =     2.00   PERCENT
  DRAINAGE LENGTH           =    50.0    FEET

                              LAYER 10
                              --------
                               Page 4
```

```
            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                     =     0.06   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.     = 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
FML PLACEMENT QUALITY         = 3 - GOOD


                        LAYER 11
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  34
THICKNESS                     =     0.20   INCHES
POROSITY                      =     0.8500 VOL/VOL
FIELD CAPACITY                =     0.0100 VOL/VOL
WILTING POINT                 =     0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  33.0000000000     CM/SEC
SLOPE                         =     2.00   PERCENT
DRAINAGE LENGTH               =    50.0    FEET


                        LAYER 12
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                     =     0.06   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.     = 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
FML PLACEMENT QUALITY         = 3 - GOOD
```

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```
                        LAYER 13
                        --------

              TYPE 3 - BARRIER SOIL LINER
               MATERIAL TEXTURE NUMBER  16
THICKNESS                     =    37.20   INCHES
POROSITY                      =     0.4270 VOL/VOL
FIELD CAPACITY                =     0.4180 VOL/VOL
WILTING POINT                 =     0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.     = 0.100000001000E-06 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
       SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
       FAIR STAND OF GRASS, A SURFACE SLOPE OF  1.%
       AND A SLOPE LENGTH OF   50. FEET.

SCS RUNOFF CURVE NUMBER            =    46.40
FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
EVAPORATIVE ZONE DEPTH             =    22.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =     0.396  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =     9.174  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =     0.396  INCHES
INITIAL SNOW WATER                 =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =   169.176  INCHES
TOTAL INITIAL WATER                =   169.176  INCHES
TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR


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

       AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------
```

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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.05	1.36	2.12	3.11	4.91	4.02
	2.83	2.40	3.20	2.40	1.50	1.20
STD. DEVIATIONS	0.60	0.83	1.20	1.91	3.01	2.06
	1.76	1.61	1.84	1.95	1.28	0.91
RUNOFF						
TOTALS	0.001	0.012	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.002
STD. DEVIATIONS	0.009	0.047	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.016
EVAPOTRANSPIRATION						
TOTALS	0.700	0.898	1.400	1.988	3.285	3.195
	2.971	1.940	1.961	1.357	0.904	0.852
STD. DEVIATIONS	0.437	0.489	0.734	0.943	1.308	1.419
	1.411	1.300	1.008	0.806	0.566	0.479
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.3840	0.3498	0.5617	0.8358	1.6498	1.1770
	0.8374	0.5808	0.6986	0.9904	0.6794	0.4853
STD. DEVIATIONS	0.2308	0.1897	0.3162	0.7921	1.5970	0.7865
	0.6709	0.3562	0.6070	0.8874	0.6189	0.3887
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 13						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
------------------------------------------------------------------------------
           AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  3
```

Page 8

```
--------------------------------------------------------
  AVERAGES            0.0007  0.0007  0.0010  0.0016  0.0048  0.0021
                      0.0016  0.0010  0.0012  0.0018  0.0012  0.0008

  STD. DEVIATIONS     0.0004  0.0004  0.0005  0.0020  0.0116  0.0014
                      0.0025  0.0006  0.0011  0.0070  0.0011  0.0007

DAILY AVERAGE HEAD ON TOP OF LAYER  7
--------------------------------------------------------
  AVERAGES            0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
                      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

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

DAILY AVERAGE HEAD ON TOP OF LAYER 10
--------------------------------------------------------
  AVERAGES            0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
                      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

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

DAILY AVERAGE HEAD ON TOP OF LAYER 12
--------------------------------------------------------
  AVERAGES            0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
                      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

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

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


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

  AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH  100
-------------------------------------------------------------------------------
                                INCHES             CU. FEET        PERCENT
                          -------------------    -------------    ---------
PRECIPITATION              30.34    (  6.245)    11014725.0       100.00

RUNOFF                      0.015   ( 0.0496)        5352.84        0.049

EVAPOTRANSPIRATION         21.091   ( 3.9916)     7655878.50       69.506

LATERAL DRAINAGE COLLECTED  9.23906 ( 2.87653)   3351601.500      30.42837
  FROM LAYER  2

                                  Page 9
```

```
PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        1.474     0.00001
  LAYER  4

AVERAGE HEAD ON TOP             0.002 (    0.001)
  OF LAYER  3

LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)        1.430     0.00001
  FROM LAYER  6

PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.044     0.00000
  LAYER  7

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  7

LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)        0.000     0.00000
  FROM LAYER  9

PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.044     0.00000
  LAYER 10

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER 10

LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)        0.023     0.00000
  FROM LAYER 11

PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.021     0.00000
  LAYER 13

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER 12

CHANGE IN WATER STORAGE         0.005   (  0.8367)      1892.60      0.017
*******************************************************************************


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

             PEAK DAILY VALUES FOR YEARS     1 THROUGH  100
-------------------------------------------------------------------------------
                                                  (INCHES)      (CU. FT.)
                                                 ----------   -------------
     PRECIPITATION                                  5.36       1945680.000

                                  Page 10
```

```
RUNOFF                                        0.243       88170.7812

DRAINAGE COLLECTED FROM LAYER  2              2.45000    889675.75000

PERCOLATION/LEAKAGE THROUGH LAYER  4          0.000002          0.72651

AVERAGE HEAD ON TOP OF LAYER  3               1.414

MAXIMUM HEAD ON TOP OF LAYER  3               1.198

LOCATION OF MAXIMUM HEAD IN LAYER  2
       (DISTANCE FROM DRAIN)                 19.2 FEET

DRAINAGE COLLECTED FROM LAYER  6              0.00000           0.72554

PERCOLATION/LEAKAGE THROUGH LAYER  7          0.000000          0.00037

AVERAGE HEAD ON TOP OF LAYER  7               0.000

MAXIMUM HEAD ON TOP OF LAYER  7               0.096

LOCATION OF MAXIMUM HEAD IN LAYER  6
       (DISTANCE FROM DRAIN)                  0.0 FEET

DRAINAGE COLLECTED FROM LAYER  9              0.00000           0.00003

PERCOLATION/LEAKAGE THROUGH LAYER 10          0.000000          0.00004

AVERAGE HEAD ON TOP OF LAYER 10               0.000

MAXIMUM HEAD ON TOP OF LAYER 10               0.000

LOCATION OF MAXIMUM HEAD IN LAYER  9
       (DISTANCE FROM DRAIN)                  0.0 FEET

DRAINAGE COLLECTED FROM LAYER 11              0.00000           0.00004

PERCOLATION/LEAKAGE THROUGH LAYER 13          0.000000          0.00010

AVERAGE HEAD ON TOP OF LAYER 12               0.000

MAXIMUM HEAD ON TOP OF LAYER 12               0.000

LOCATION OF MAXIMUM HEAD IN LAYER 11
       (DISTANCE FROM DRAIN)                  0.0 FEET

SNOW WATER                                    2.31        837825.8120

                                  Page 11
```

```
   MAXIMUM VEG. SOIL WATER (VOL/VOL)                         0.2100

   MINIMUM VEG. SOIL WATER (VOL/VOL)                         0.0180

    ***  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  100
    ---------------------------------------------------------------------
              LAYER        (INCHES)        (VOL/VOL)
              -----        --------        ---------
                1            2.3172          0.0644

                2            0.0021          0.0105

                3            0.0000          0.0000

                4           10.2480          0.4270

                5          140.1600          0.2920

                6            0.0020          0.0100

                7            0.0000          0.0000

                8            1.0000          0.0450

                9            0.0020          0.0100

               10            0.0000          0.0000

               11            0.0020          0.0100

               12            0.0000          0.0000

                                  Page 12
```

```
          13          15.8844          0.4270

          SNOW WATER      0.000

********************************************************************************
********************************************************************************
```

Page 13

CELLS P-2 TO P-4

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\P2NC\DATA4.D4
TEMPERATURE DATA FILE:        C:\P2NC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\P2NC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\P2NC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\P2NC\DATA10.D10
OUTPUT DATA FILE:             C:\P2NC\OUT.OUT

TIME:  16:54     DATE:   4/18/2016

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

    TITLE:  P2-INT COVER

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

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

                            LAYER  1
                            --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  18
                             Page 1
```

```
    THICKNESS                     =   600.00   INCHES
    POROSITY                      =     0.6710 VOL/VOL
    FIELD CAPACITY                =     0.2920 VOL/VOL
    WILTING POINT                 =     0.0770 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.2872 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
 NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
        FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                            LAYER  2
                            --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  34
    THICKNESS                     =     0.20   INCHES
    POROSITY                      =     0.8500 VOL/VOL
    FIELD CAPACITY                =     0.0100 VOL/VOL
    WILTING POINT                 =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =   33.0000000000     CM/SEC
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                            LAYER  3
                            --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.08   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  3 - GOOD

                            LAYER  4
                            --------
                             Page 2
```

```
                 TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER   1
    THICKNESS                     =    24.00   INCHES
    POROSITY                      =     0.4170 VOL/VOL
    FIELD CAPACITY                =     0.0450 VOL/VOL
    WILTING POINT                 =     0.0180 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.0450 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.999999978000E-02 CM/SEC

                            LAYER  5
                            --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  34
    THICKNESS                     =     0.20   INCHES
    POROSITY                      =     0.8500 VOL/VOL
    FIELD CAPACITY                =     0.0100 VOL/VOL
    WILTING POINT                 =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =   33.0000000000     CM/SEC
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                            LAYER  6
                            --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.06   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  3 - GOOD

                            LAYER  7
                             Page 3
```

```
                            --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  34
    THICKNESS                     =     0.20   INCHES
    POROSITY                      =     0.8500 VOL/VOL
    FIELD CAPACITY                =     0.0100 VOL/VOL
    WILTING POINT                 =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.0100 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =   33.0000000000     CM/SEC
    SLOPE                         =     2.00   PERCENT
    DRAINAGE LENGTH               =    50.0    FEET

                            LAYER  8
                            --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
    THICKNESS                     =     0.06   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.     =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS      =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY         =  3 - GOOD

                            LAYER  9
                            --------

                 TYPE 3 - BARRIER SOIL LINER
                  MATERIAL TEXTURE NUMBER  16
    THICKNESS                     =    37.20   INCHES
    POROSITY                      =     0.4270 VOL/VOL
    FIELD CAPACITY                =     0.4180 VOL/VOL
    WILTING POINT                 =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT    =     0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

                             Page 4
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 50. FEET.

SCS RUNOFF CURVE NUMBER	=	59.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	100.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.530	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	14.782	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.694	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	189.276	INCHES
TOTAL INITIAL WATER	=	189.276	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.86	1.36	2.12	3.11	4.91	4.02
	2.83	2.48	3.20	2.48	1.58	1.20
STD. DEVIATIONS	0.68	0.83	1.20	1.91	3.01	2.86
	1.76	1.61	1.84	1.95	1.28	0.91
RUNOFF						
TOTALS	0.001	0.011	0.000	0.000	0.007	0.001
	0.000	0.000	0.000	0.001	0.000	0.002
STD. DEVIATIONS	0.009	0.044	0.000	0.004	0.037	0.011
	0.000	0.000	0.002	0.000	0.000	0.016
EVAPOTRANSPIRATION						
TOTALS	1.129	1.319	2.052	2.606	4.810	4.918
	3.290	2.483	2.287	1.499	1.215	1.079
STD. DEVIATIONS	0.407	0.468	0.768	1.055	1.379	1.566
	1.882	1.558	1.029	0.676	0.420	0.372
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.1182	0.0645	0.0583	0.0846	0.2190	0.3762
	0.1545	0.0118	0.0005	0.1089	0.2047	0.2195
STD. DEVIATIONS	0.3288	0.1663	0.1302	0.2389	0.4675	0.7937
	0.5527	0.0655	0.0382	0.3358	0.4753	0.5302
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0001	0.0000	0.0000	0.0000	0.0001	0.0002
	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0002	0.0004
	0.0002	0.0000	0.0000	0.0001	0.0002	0.0002
DAILY AVERAGE HEAD ON TOP OF LAYER 6						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.34 (6.245)	11014725.0	100.00
RUNOFF	0.024 (0.0597)	8708.25	0.079
EVAPOTRANSPIRATION	28.697 (4.6018)	10417129.00	94.575
LATERAL DRAINAGE COLLECTED FROM LAYER 2	1.62975 (1.90959)	591598.375	5.37090
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00033 (0.00036)	119.544	0.00109
AVERAGE HEAD ON TOP OF LAYER 3	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00020 (0.00022)	71.081	0.00065
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00013 (0.00013)	48.463	0.00044
AVERAGE HEAD ON TOP OF LAYER 6	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00013 (0.00013)	48.430	0.00044
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.033	0.00000
AVERAGE HEAD ON TOP OF LAYER 8	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.008 (2.0754)	-2827.68	-0.026

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	5.36	1945680.000
RUNOFF	0.249	90220.3516

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DRAINAGE COLLECTED FROM LAYER 2	0.16026	58173.95220
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000027	9.64625
AVERAGE HEAD ON TOP OF LAYER 3	0.002	
MAXIMUM HEAD ON TOP OF LAYER 3	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	2.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00001	3.60925
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000007	2.50565
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00001	2.50466
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00155
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.31	837825.8120

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4649
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	171.5269	0.2859
2	0.0020	0.0100
3	0.0000	0.0000
4	1.0800	0.0450
5	0.0020	0.0100
6	0.0000	0.0000
7	0.0020	0.0100
8	0.0000	0.0000
9	15.2344	0.4270
SNOW WATER	0.000	

****

****

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FINAL COVER

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**          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                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\P4C\DATA4.D4
TEMPERATURE DATA FILE:       C:\P4C\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\P4C\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\P4C\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\P4C\DATA10.D10
OUTPUT DATA FILE:            C:\P4C\OUT.OUT


TIME: 11:43     DATE:  4/26/2016


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

     TITLE: P2-with cover

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


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


                               LAYER  1
                               --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =    36.00   INCHES
        POROSITY                   =     0.4170 VOL/VOL
        FIELD CAPACITY             =     0.0450 VOL/VOL
        WILTING POINT              =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0499 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                               LAYER  2
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20   INCHES
                                 Page 1
```

```
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0176 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
        SLOPE                      =     0.50   PERCENT
        DRAINAGE LENGTH            =    50.0    FEET


                               LAYER  3
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER  4
                               --------

                      TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  17
        THICKNESS                  =     0.29   INCHES
        POROSITY                   =     0.7500 VOL/VOL
        FIELD CAPACITY             =     0.7470 VOL/VOL
        WILTING POINT              =     0.4000 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.7500 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.300000003000E-08 CM/SEC


                               LAYER  5
                               --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =   600.00   INCHES
        POROSITY                   =     0.6710 VOL/VOL
        FIELD CAPACITY             =     0.2920 VOL/VOL
        WILTING POINT              =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                               LAYER  6
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20   INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
                                 Page 2
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```
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
        SLOPE                      =     2.00   PERCENT
        DRAINAGE LENGTH            =    50.0    FEET


                               LAYER  7
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER  8
                               --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =    24.00   INCHES
        POROSITY                   =     0.4170 VOL/VOL
        FIELD CAPACITY             =     0.0450 VOL/VOL
        WILTING POINT              =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC


                               LAYER  9
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20   INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
        SLOPE                      =     2.00   PERCENT
        DRAINAGE LENGTH            =    50.0    FEET


                               LAYER 10
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.06   INCHES
        POROSITY                   =     0.0000 VOL/VOL
        FIELD CAPACITY             =     0.0000 VOL/VOL
                                 Page 3
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```
        WILTING POINT              =     0.0000 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER 11
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.20   INCHES
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
        SLOPE                      =     2.00   PERCENT
        DRAINAGE LENGTH            =    50.0    FEET


                               LAYER 12
                               --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD


                               LAYER 13
                               --------

                      TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =    37.20   INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
             FAIR STAND OF GRASS, A SURFACE SLOPE OF  1.8
                                 Page 4
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AND A SLOPE LENGTH OF 50. FEET.

SCS RUNOFF CURVE NUMBER	=	46.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	100.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.396	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.174	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.396	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	194.118	INCHES
TOTAL INITIAL WATER	=	194.118	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.05	1.36	2.12	3.11	4.91	4.02
	2.93	2.48	3.20	2.48	1.58	1.20
STD. DEVIATIONS	0.68	0.83	1.20	1.91	3.01	2.08
	1.76	1.61	1.84	1.95	1.28	0.91
RUNOFF						
TOTALS	0.001	0.012	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.002
STD. DEVIATIONS	0.009	0.047	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.016
EVAPOTRANSPIRATION						
TOTALS	0.780	0.898	1.480	1.988	3.285	3.195
	2.371	1.940	1.961	1.317	0.984	0.852
STD. DEVIATIONS	0.437	0.489	0.734	0.943	1.308	1.419
	1.411	1.300	1.008	0.806	0.566	0.499
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.3940	0.3498	0.5617	0.8358	1.6438	1.1770
	0.8374	0.5808	0.6986	0.9994	0.6794	0.4853
STD. DEVIATIONS	0.2305	0.1897	0.3162	0.7981	1.5970	0.7865
	0.6709	0.3562	0.6070	0.8874	0.6189	0.3887
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 13						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0007	0.0007	0.0010	0.0016	0.0048	0.0021
	0.0016	0.0010	0.0012	0.0018	0.0012	0.0008
STD. DEVIATIONS	0.0004	0.0004	0.0005	0.0020	0.0116	0.0014
	0.0025	0.0006	0.0011	0.0020	0.0011	0.0007
DAILY AVERAGE HEAD ON TOP OF LAYER 7						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 10						

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AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 12						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.34 (6.245)	11014725.0	100.00
RUNOFF	0.015 (0.0496)	5352.84	0.049
EVAPOTRANSPIRATION	21.091 (3.9916)	7655878.50	69.506
LATERAL DRAINAGE COLLECTED FROM LAYER 2	9.23309 (2.87653)	3351601.750	30.42837
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.899	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.002 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.857	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.042	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 9	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.041	0.00000
AVERAGE HEAD ON TOP OF LAYER 10	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 11	0.00000 (0.00000)	0.021	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.00000 (0.00000)	0.020	0.00000
AVERAGE HEAD ON TOP OF LAYER 12	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.005 (0.8367)	1892.55	0.017

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	5.36	1945680.000
RUNOFF	0.243	88170.7812
DRAINAGE COLLECTED FROM LAYER 2	2.45090	889676.43700
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000001	0.22513
AVERAGE HEAD ON TOP OF LAYER 3	1.414	
MAXIMUM HEAD ON TOP OF LAYER 3	1.138	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	19.2 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.22467
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00046
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.003	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 9	0.00000	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00045
AVERAGE HEAD ON TOP OF LAYER 10	0.000	
MAXIMUM HEAD ON TOP OF LAYER 10	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 11	0.00000	0.00036
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.000000	0.00009
AVERAGE HEAD ON TOP OF LAYER 12	0.000	
MAXIMUM HEAD ON TOP OF LAYER 12	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 11 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.31	837825.8120
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2103	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180	

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

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas

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ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	2.3172	0.0644
2	0.0021	0.0105
3	0.0000	0.0000
4	0.1500	0.7500
5	175.2000	0.2920
6	0.0020	0.0100
7	0.0000	0.0000
8	1.0800	0.0450
9	0.0020	0.0100
10	0.0000	0.0000
11	0.0020	0.0100
12	0.0000	0.0000
13	15.8844	0.4270
SNOW WATER	0.000	

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LANDFILL Y

CELL Y-1

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\OY1NC\DATA4.D4
TEMPERATURE DATA FILE:        C:\OY1NC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\OY1NC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\OY1NC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\OY1NC\DATA10.D10
OUTPUT DATA FILE:             C:\OY1NC\OUT.OUT

TIME: 18:37     DATE:  8/17/2016

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

     TITLE:  Y1-without cover

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

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

                               LAYER  1
                               --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
     THICKNESS                    =   660.00   INCHES
     POROSITY                     =     0.6710 VOL/VOL
     FIELD CAPACITY               =     0.2920 VOL/VOL
     WILTING POINT                =     0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =     0.2837 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                               LAYER  2
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
```

Page 1

```
     THICKNESS                    =    12.00   INCHES
     POROSITY                     =     0.4170 VOL/VOL
     FIELD CAPACITY               =     0.0450 VOL/VOL
     WILTING POINT                =     0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.999999978000E-02 CM/SEC
     SLOPE                        =     1.00   PERCENT
     DRAINAGE LENGTH              =    50.0    FEET

                               LAYER  3
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
     THICKNESS                    =     0.06   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.    = 0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY          =     1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS     =     1.00   HOLES/ACRE
     FML PLACEMENT QUALITY        = 5 GOOD

                               LAYER  4
                               --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
     THICKNESS                    =    12.00   INCHES
     POROSITY                     =     0.4170 VOL/VOL
     FIELD CAPACITY               =     0.0450 VOL/VOL
     WILTING POINT                =     0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.999999978000E-02 CM/SEC
     SLOPE                        =     1.00   PERCENT
     DRAINAGE LENGTH              =    50.0    FEET

                               LAYER  5
                               --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
     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.    = 0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY          =     1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS     =     1.00   HOLES/ACRE
     FML PLACEMENT QUALITY        = 3 - GOOD

                               LAYER  6
                               --------
```

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                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
     THICKNESS                    =    36.00   INCHES
     POROSITY                     =     0.4270 VOL/VOL
     FIELD CAPACITY               =     0.4180 VOL/VOL
     WILTING POINT                =     0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.100000001000E-06 CM/SEC

             GENERAL DESIGN AND EVAPORATIVE ZONE DATA
             ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER             =    62.30
   FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE  =     1.600  ACRES
   EVAPORATIVE ZONE DEPTH              =    32.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE   =     3.842  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE  =    21.472  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE  =     2.464  INCHES
   INITIAL SNOW WATER                  =     0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS    =   203.670  INCHES
   TOTAL INITIAL WATER                 =   203.670  INCHES
   TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

******************************************************************************
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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	1.08	1.01	1.13	1.05	0.99
	0.32	0.42	0.57	0.81	1.25	1.34
STD. DEVIATIONS	0.86	0.59	0.45	0.55	0.56	0.52
	0.31	0.46	0.65	0.41	0.61	0.65
RUNOFF						
TOTALS	0.057	0.088	0.014	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.003
STD. DEVIATIONS	0.116	0.173	0.041	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.017
EVAPOTRANSPIRATION						
TOTALS	0.338	0.501	1.401	1.870	1.490	2.602
	0.404	0.386	0.472	0.607	0.339	0.547
STD. DEVIATIONS	0.131	0.178	0.286	0.469	0.380	1.166
	0.370	0.494	0.508	0.275	0.180	0.146

LATERAL DRAINAGE COLLECTED FROM LAYER 2

Page 3

TOTALS	0.0000	0.0009	0.0091	0.0213	0.0182	0.0100
	0.0060	0.0018	0.0005	0.0001	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0091	0.0406	0.0726	0.0593	0.0255
	0.0147	0.0048	0.0014	0.0004	0.0001	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0001	0.0013	0.0031	0.0029	0.0026
	0.0014	0.0006	0.0002	0.0001	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0014	0.0055	0.0093	0.0080	0.0042
	0.0028	0.0012	0.0005	0.0002	0.0001	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0004	0.0018	0.0026	0.0024
	0.0020	0.0013	0.0007	0.0004	0.0002	0.0001
STD. DEVIATIONS	0.0001	0.0003	0.0022	0.0053	0.0074	0.0062
	0.0044	0.0028	0.0015	0.0008	0.0003	0.0002
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0000	0.0028	0.0258	0.0623	0.0518	0.0293
	0.0171	0.0052	0.0015	0.0004	0.0001	0.0000
STD. DEVIATIONS	0.0000	0.0278	0.1151	0.2119	0.1681	0.0749
	0.0418	0.0136	0.0041	0.0011	0.0003	0.0001
DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	0.0001	0.0001	0.0012	0.0048	0.0074	0.0070
	0.0058	0.0038	0.0021	0.0010	0.0005	0.0002
STD. DEVIATIONS	0.0002	0.0008	0.0062	0.0156	0.0211	0.0181
	0.0126	0.0079	0.0043	0.0022	0.0010	0.0005

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******************************************************************************
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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.68 (2.082)	67825.5	100.00
RUNOFF	0.160 (0.2379)	929.05	1.370
EVAPOTRANSPIRATION	11.437 (1.6744)	66426.09	97.940

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LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.06804 (	0.19935)	395.178	0.38266
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.01175 (	0.02891)	68.249	0.10066
AVERAGE HEAD ON TOP OF LAYER 3	0.016 (	0.048)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.01175 (	0.02881)	68.293	0.10063
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (	0.00000)	0.018	0.00003
AVERAGE HEAD ON TOP OF LAYER 5	0.003 (	0.007)		
CHANGE IN WATER STORAGE	0.001 (	1.2113)	4.89	0.007

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.68	9757.439
RUNOFF	0.547	3176.8064
DRAINAGE COLLECTED FROM LAYER 2	0.02898	168.29578
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.002846	16.53049
AVERAGE HEAD ON TOP OF LAYER 3	2.389	
MAXIMUM HEAD ON TOP OF LAYER 3	2.910	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	21.5 FEET	
DRAINAGE COLLECTED FROM LAYER 4	0.00847	8.72515
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00095
AVERAGE HEAD ON TOP OF LAYER 5	0.125	
MAXIMUM HEAD ON TOP OF LAYER 5	0.225	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	4.9 FEET	
SNOW WATER	3.10	17978.0039
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.2879
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0770

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	187.3020	0.2838
2	0.5400	0.0450
3	0.0000	0.0000
4	0.5401	0.0450
5	0.0000	0.0000
6	15.3720	0.4270
SNOW WATER	0.000	

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FINAL COVER

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1
**********************************************************************************
**********************************************************************************
**                                                                              **
**                                                                              **
**              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                 **
**                                                                              **
**                                                                              **
**********************************************************************************
**********************************************************************************

PRECIPITATION DATA FILE:      C:\V1C\DATA4.D4
TEMPERATURE DATA FILE:        C:\V1C\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\V1C\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\V1C\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\V1C\DATA10.D10
OUTPUT DATA FILE:             C:\V1C\OUT.OUT

TIME: 11:25      DATE:   8/22/2016

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

     TITLE:  T1-with cover

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

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

                                 LAYER  1
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    30.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0446 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER  2
                                 --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER  34
        THICKNESS                    =     0.25    INCHES
                                    Page 1
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```
        POROSITY                     =     0.8500 VOL/VOL
        FIELD CAPACITY               =     0.0100 VOL/VOL
        WILTING POINT                =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0433 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
        SLOPE                        =     4.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                 LAYER  3
                                 --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  3 - GOOD

                                 LAYER  4
                                 --------

                         TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  17
        THICKNESS                    =     0.25    INCHES
        POROSITY                     =     0.7500 VOL/VOL
        FIELD CAPACITY               =     0.7470 VOL/VOL
        WILTING POINT                =     0.4000 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.7500 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC

                                 LAYER  5
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
        THICKNESS                    =   660.00    INCHES
        POROSITY                     =     0.6710 VOL/VOL
        FIELD CAPACITY               =     0.2920 VOL/VOL
        WILTING POINT                =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                 LAYER  6
                                 --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    12.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
                                    Page 2
```

```
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
        SLOPE                        =     1.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                 LAYER  7
                                 --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        THICKNESS                    =     0.06    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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  3 - GOOD

                                 LAYER  8
                                 --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    12.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
        SLOPE                        =     1.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                 LAYER  9
                                 --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
        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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  3 - GOOD

                                 LAYER 10
                                 --------

                         TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
                                    Page 3
```

```
        THICKNESS                    =    36.00    INCHES
        POROSITY                     =     0.4270 VOL/VOL
        FIELD CAPACITY               =     0.4180 VOL/VOL
        WILTING POINT                =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

               GENERAL DESIGN AND EVAPORATIVE ZONE DATA
               ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF   50. FEET.

        SCS RUNOFF CURVE NUMBER            =    51.70
        FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
        EVAPORATIVE ZONE DEPTH             =    30.2    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =     1.350  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =    12.723  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE =     0.541  INCHES
        INITIAL SNOW WATER                 =     0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS   =   210.709  INCHES
        TOTAL INITIAL WATER                =   210.709  INCHES
        TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
----------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                  1.71     1.08     1.01     1.13     1.05     0.99
                           0.51     0.42     0.57     0.81     1.25     1.34

   STD. DEVIATIONS         0.86     0.50     0.45     0.55     0.56     0.52
                           0.81     0.46     0.65     0.45     0.61     0.65

 RUNOFF
 ------
   TOTALS                 0.050    0.098    0.017    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.002

   STD. DEVIATIONS        0.125    0.191    0.033    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.016

 EVAPOTRANSPIRATION
 ------------------
   TOTALS                 0.435    0.467    0.904    0.320    0.264    0.272
                          0.115    0.131    0.110    0.095    0.173    0.372

   STD. DEVIATIONS        0.141    0.275    0.505    0.283    0.146    0.150
                          0.111    0.122    0.141    0.052    0.094    0.161

 LATERAL DRAINAGE COLLECTED FROM LAYER  2
 ----------------------------------------
   TOTALS                0.1939   0.4691   1.2109   0.9371   0.8363   0.7111
                         0.2967   0.2776   0.4116   0.6554   1.0218   0.7818
                                    Page 4
```

STD. DEVIATIONS	0.3997	0.5643	0.5736	0.4477	0.4310	0.3970
	0.2297	0.2928	0.5175	0.4026	0.5345	0.5743

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0008	0.0022	0.0032	0.0042	0.0036	0.0032
	0.0013	0.0012	0.0018	0.0029	0.0046	0.0034
STD. DEVIATIONS	0.0017	0.0027	0.0025	0.0020	0.0019	0.0018
	0.0010	0.0013	0.0023	0.0017	0.0024	0.0023

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

DAILY AVERAGE HEAD ON TOP OF LAYER 9

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	11.68	(2.082)	4238969.0	100.00
RUNOFF	0.176	(0.2638)	63917.73	1.508
EVAPOTRANSPIRATION	3.699	(0.8479)	1342587.37	31.672
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.80342	(1.51341)	2832640.500	66.82381
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.817	0.00002
AVERAGE HEAD ON TOP OF LAYER 3	0.003	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000	(0.00000)	0.004	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.813	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000	(0.00000)	0.059	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000	(0.00000)	0.755	0.00002
AVERAGE HEAD ON TOP OF LAYER 9	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.001	(0.5099)	-197.19	-0.005

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.68	609840.000
RUNOFF	0.622	225919.6870
DRAINAGE COLLECTED FROM LAYER 2	1.83384	665683.62500
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.03125
AVERAGE HEAD ON TOP OF LAYER 3	0.246	

Page 6

MAXIMUM HEAD ON TOP OF LAYER 3	0.862	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	3.0 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00072
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00998
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00091
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00247
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	3.10	1123625.2500
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.1807
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0179

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	1.2849	0.0428
2	0.0108	0.0433
3	0.0000	0.0000
4	0.1875	0.7500
5	192.7200	0.2920
6	0.5400	0.0450
7	0.0000	0.0000
8	0.5400	0.0450
9	0.0000	0.0000
10	15.3720	0.4270
SNOW WATER	0.000	

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Page 8

CELLS Y-2 AND Y-3

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\OY2NC\DATA4.D4
TEMPERATURE DATA FILE:        C:\OY2NC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\OY2NC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\OY2NC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\OY2NC\DATA10.D10
OUTPUT DATA FILE:             C:\OY2NC\OUT.OUT

TIME: 19: 5     DATE:  3/17/2016

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

     TITLE:  r2 without 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.

                                 LAYER 1
                                 --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER 18
      THICKNESS                  =   660.00   INCHES
      POROSITY                   =     0.6710 VOL/VOL
      FIELD CAPACITY             =     0.2920 VOL/VOL
      WILTING POINT              =     0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.2937 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER 2
                                 --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  1
```



```
      THICKNESS                  =    12.00   INCHES
      POROSITY                   =     0.4170 VOL/VOL
      FIELD CAPACITY             =     0.0450 VOL/VOL
      WILTING POINT              =     0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =     1.00   PERCENT
      DRAINAGE LENGTH            =    50.0    FEET

                                 LAYER 3
                                 --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER 35
      THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     1.00   HOLES/ACRE
      FML INSTALLATION DEFECTS   =     1.00   HOLES/ACRE
      FML PLACEMENT QUALITY      =  5  GOOD

                                 LAYER 4
                                 --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  1
      THICKNESS                  =    12.00   INCHES
      POROSITY                   =     0.4170 VOL/VOL
      FIELD CAPACITY             =     0.0450 VOL/VOL
      WILTING POINT              =     0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =     1.00   PERCENT
      DRAINAGE LENGTH            =    50.0    FEET

                                 LAYER 5
                                 --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER 35
      THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =     1.00   HOLES/ACRE
      FML INSTALLATION DEFECTS   =     1.00   HOLES/ACRE
      FML PLACEMENT QUALITY      =  [illegible]

                                 LAYER 6
                                 --------
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                       TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER 16
      THICKNESS                  =    36.00   INCHES
      POROSITY                   =     0.4270 VOL/VOL
      FIELD CAPACITY             =     0.4180 VOL/VOL
      WILTING POINT              =     0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

               GENERAL DESIGN AND EVAPORATIVE ZONE DATA
               ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF  [illegible]
           AND A SLOPE LENGTH OF   50. FEET.

    SCS RUNOFF CURVE NUMBER             =   62.30
    FRACTION OF AREA ALLOWING RUNOFF    =  100.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE  =    1.910  ACRES
    EVAPORATIVE ZONE DEPTH              =   32.0    INCHES
    INITIAL WATER IN EVAPORATIVE ZONE   =    3.842  INCHES
    UPPER LIMIT OF EVAPORATIVE STORAGE  =   21.472  INCHES
    LOWER LIMIT OF EVAPORATIVE STORAGE  =    2.464  INCHES
    INITIAL SNOW WATER                  =    0.000  INCHES
    INITIAL WATER IN LAYER MATERIALS    =  203.670  INCHES
    TOTAL INITIAL WATER                 =  203.670  INCHES
    TOTAL SUBSURFACE INFLOW             =    0.00   INCHES/YEAR

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	1.08	1.01	1.13	1.05	0.99
	0.32	0.42	0.57	0.81	1.25	1.34
STD. DEVIATIONS	0.86	0.50	0.45	0.55	0.56	0.52
	0.31	0.46	0.65	0.41	0.61	0.65
RUNOFF						
TOTALS	0.057	0.088	0.014	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.003
STD. DEVIATIONS	0.116	0.173	0.041	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.017
EVAPOTRANSPIRATION						
TOTALS	0.338	0.501	1.401	1.870	1.490	2.682
	0.404	0.386	0.472	0.607	0.339	0.547
STD. DEVIATIONS	0.131	0.178	0.286	0.469	0.380	1.166
	0.370	0.404	0.308	0.275	0.180	0.146
LATERAL DRAINAGE COLLECTED FROM LAYER 2						

TOTALS	0.0000	0.0009	0.0091	0.0213	0.0182	0.0100
	0.0060	0.0018	0.0003	0.0001	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0091	0.0406	0.0726	0.0593	0.0255
	0.0147	0.0048	0.0014	0.0004	0.0001	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0001	0.0013	0.0031	0.0029	0.0026
	0.0014	0.0006	0.0002	0.0001	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0014	0.0055	0.0093	0.0080	0.0042
	0.0028	0.0012	0.0003	0.0002	0.0001	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0004	0.0016	0.0026	0.0024
	0.0020	0.0013	0.0007	0.0004	0.0002	0.0001
STD. DEVIATIONS	0.0001	0.0003	0.0022	0.0053	0.0074	0.0062
	0.0044	0.0028	0.0015	0.0008	0.0003	0.0007
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0000	0.0028	0.0258	0.0623	0.0518	0.0293
	0.0171	0.0052	0.0015	0.0004	0.0001	0.0000
STD. DEVIATIONS	0.0000	0.0278	0.1151	0.2119	0.1681	0.0749
	0.0418	0.0136	0.0041	0.0011	0.0003	0.0001
DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	0.0001	0.0001	0.0012	0.0048	0.0074	0.0070
	0.0058	0.0038	0.0021	0.0010	0.0005	0.0002
STD. DEVIATIONS	0.0002	0.0008	0.0062	0.0156	0.0211	0.0181
	0.0126	0.0079	0.0043	0.0022	0.0010	0.0005

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	11.68	(2.082)	80964.3	100.00
RUNOFF	0.160	(0.2375)	1109.06	1.370
EVAPOTRANSPIRATION	11.437	(1.6744)	79296.15	97.940

LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.06804 (	0.19935)	471.744	0.58266
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.01175 (	0.02891)	81.493	0.10066
AVERAGE HEAD ON TOP OF LAYER 3	0.016 (	0.048)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.01175 (	0.02881)	81.477	0.10063
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (	0.00000)	0.022	0.00003
AVERAGE HEAD ON TOP OF LAYER 5	0.003 (	0.007)		
CHANGE IN WATER STORAGE	0.001 (	1.2113)	5.84	0.007

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.68	11647.943
RUNOFF	0.547	3792.3125
DRAINAGE COLLECTED FROM LAYER 2	0.02898	200.90370
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.002846	19.75282
AVERAGE HEAD ON TOP OF LAYER 3	2.389	
MAXIMUM HEAD ON TOP OF LAYER 3	2.910	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	21.5 FEET	
DRAINAGE COLLECTED FROM LAYER 4	0.00142	9.81860
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00108
AVERAGE HEAD ON TOP OF LAYER 5	0.125	
MAXIMUM HEAD ON TOP OF LAYER 5	0.225	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	4.9 FEET	
SNOW WATER	3.10	21461.2422

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2879

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** 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

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Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	187.3020	0.2838
2	0.5400	0.0450
3	0.0000	0.0000
4	0.5401	0.0450
5	0.0000	0.0000
6	15.3720	0.4270
SNOW WATER	0.000	

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FINAL COVER

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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:\Y2C\DATA4.D4
TEMPERATURE DATA FILE:        C:\Y2C\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\Y2C\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\Y2C\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\Y2C\DATA10.D10
OUTPUT DATA FILE:             C:\Y2C\OUT.OUT

TIME: 11:30     DATE:  8/22/2016

------------------------------------------------------------------------------

     TITLE:  y2 with 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.

                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    30.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0446 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER  34
        THICKNESS                    =     0.25    INCHES
                                    Page 1
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```
        POROSITY                     =     0.8500 VOL/VOL
        FIELD CAPACITY               =     0.0100 VOL/VOL
        WILTING POINT                =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0433 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
        SLOPE                        =     4.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                  LAYER  3
                                  --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
        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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  5 - GOOD

                                  LAYER  4
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  17
        THICKNESS                    =     0.25    INCHES
        POROSITY                     =     0.7500 VOL/VOL
        FIELD CAPACITY               =     0.7470 VOL/VOL
        WILTING POINT                =     0.4000 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.7500 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC

                                  LAYER  5
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  18
        THICKNESS                    =   660.00    INCHES
        POROSITY                     =     0.6710 VOL/VOL
        FIELD CAPACITY               =     0.2920 VOL/VOL
        WILTING POINT                =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                  LAYER  6
                                  --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                           MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    12.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
                                    Page 2
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```
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
        SLOPE                        =     1.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                  LAYER  7
                                  --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
        THICKNESS                    =     0.08    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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  3 - GOOD

                                  LAYER  8
                                  --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                           MATERIAL TEXTURE NUMBER   1
        THICKNESS                    =    12.00    INCHES
        POROSITY                     =     0.4170 VOL/VOL
        FIELD CAPACITY               =     0.0450 VOL/VOL
        WILTING POINT                =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
        SLOPE                        =     1.00    PERCENT
        DRAINAGE LENGTH              =    50.0     FEET

                                  LAYER  9
                                  --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
        THICKNESS                    =     0.08    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.    =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY        =  3 - GOOD

                                  LAYER 10
                                  --------

                        TYPE 3 - BARRIER SOIL LINER
                          MATERIAL TEXTURE NUMBER  16
                                    Page 3
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```
        THICKNESS                    =    36.00    INCHES
        POROSITY                     =     0.4270 VOL/VOL
        FIELD CAPACITY               =     0.4180 VOL/VOL
        WILTING POINT                =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
            FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
            AND A SLOPE LENGTH OF   50. FEET.

        SCS RUNOFF CURVE NUMBER             =    51.70
        FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =   100.000  ACRES
        EVAPORATIVE ZONE DEPTH              =    30.2    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE   =     1.350  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =    12.723  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =     0.541  INCHES
        INITIAL SNOW WATER                  =     0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =   210.709  INCHES
        TOTAL INITIAL WATER                 =   210.709  INCHES
        TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

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

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS              1.71     1.08     1.01     1.13     1.05     0.99
                        0.51     0.42     0.57     0.81     1.25     1.34

    STD. DEVIATIONS     0.86     0.50     0.43     0.55     0.56     0.52
                        0.51     0.46     0.65     0.43     0.61     0.63

  RUNOFF
  ------
    TOTALS              0.058    0.098    0.017    0.000    0.000    0.000
                        0.000    0.000    0.000    0.000    0.000    0.002

    STD. DEVIATIONS     0.125    0.191    0.033    0.000    0.000    0.000
                        0.000    0.000    0.000    0.000    0.000    0.016

  EVAPOTRANSPIRATION
  ------------------
    TOTALS              0.455    0.467    0.904    0.320    0.264    0.272
                        0.115    0.131    0.150    0.095    0.173    0.372

    STD. DEVIATIONS     0.141    0.275    0.505    0.203    0.146    0.150
                        0.111    0.122    0.141    0.052    0.094    0.161

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS              0.1939   0.4693   1.2109   0.9371   0.8363   0.7111
                        0.2967   0.2776   0.4116   0.6554   1.0218   0.7818
                                    Page 4
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STD. DEVIATIONS	0.3997	0.5643	0.5736	0.4477	0.4310	0.3970
	0.2297	0.2928	0.5175	0.4026	0.5345	0.5743

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0008	0.0022	0.0032	0.0042	0.0036	0.0032
	0.0013	0.0012	0.0018	0.0029	0.0046	0.0034
STD. DEVIATIONS	0.0017	0.0027	0.0025	0.0020	0.0019	0.0018
	0.0010	0.0013	0.0023	0.0017	0.0024	0.0023

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

DAILY AVERAGE HEAD ON TOP OF LAYER 9

Page 5

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.68 (2.082)	4238969.0	100.00
RUNOFF	0.176 (0.2638)	63927.73	1.508
EVAPOTRANSPIRATION	3.699 (0.8479)	1342587.37	31.672
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.80342 (1.51341)	2832640.500	66.82381
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.817	0.00002
AVERAGE HEAD ON TOP OF LAYER 3	0.003 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.004	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.813	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000 (0.00000)	0.059	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.755	0.00002
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.001 (0.5099)	-197.19	-0.005

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.68	609840.000
RUNOFF	0.622	225919.6870
DRAINAGE COLLECTED FROM LAYER 2	1.83384	665683.62500
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.03125
AVERAGE HEAD ON TOP OF LAYER 3	0.246	

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MAXIMUM HEAD ON TOP OF LAYER 3	0.862	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	3.0 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00072
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00998
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00091
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00247
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	3.10	1123625.2500
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1807	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0179	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	1.2849	0.0428
2	0.0108	0.0433
3	0.0000	0.0000
4	0.1875	0.7500
5	192.7200	0.2920
6	0.5400	0.0450
7	0.0000	0.0000
8	0.5400	0.0450

Page 7

LAYER	(INCHES)	(VOL/VOL)
9	0.0000	0.0000
10	15.3720	0.4270
SNOW WATER	0.000	

Page 8

30-YEAR DURATION

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1
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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:\V10\DATA4.D4
TEMPERATURE DATA FILE:        C:\V10\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\V10\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\V10\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\V10\DATA10.D10
OUTPUT DATA FILE:             C:\V10\OUT.OUT

TIME: 12: 2     DATE:   7/26/2016

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

     TITLE:  Y2 Pre-closure

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

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

                                 LAYER  1
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =    600.00   INCHES
        POROSITY                   =      0.6710 VOL/VOL
        FIELD CAPACITY             =      0.2920 VOL/VOL
        WILTING POINT              =      0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2837 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER  2
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =     12.00   INCHES
                                   Page 1
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```
        POROSITY                   =      0.4170 VOL/VOL
        FIELD CAPACITY             =      0.0410 VOL/VOL
        WILTING POINT              =      0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
        SLOPE                      =      1.00   PERCENT
        DRAINAGE LENGTH            =     50.0    FEET

                                 LAYER  3
                                 --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =      0.08   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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =      1.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  5 - GOOD

                                 LAYER  4
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =     12.00   INCHES
        POROSITY                   =      0.4170 VOL/VOL
        FIELD CAPACITY             =      0.0450 VOL/VOL
        WILTING POINT              =      0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
        SLOPE                      =      1.00   PERCENT
        DRAINAGE LENGTH            =     50.0    FEET

                                 LAYER  5
                                 --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =      0.06   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.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =      1.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  5 - GOOD

                                 LAYER  6
                                 --------
                                   Page 2
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```
                    TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
        THICKNESS                  =     36.00   INCHES
        POROSITY                   =      0.4270 VOL/VOL
        FIELD CAPACITY             =      0.4180 VOL/VOL
        WILTING POINT              =      0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
             FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
             AND A SLOPE LENGTH OF   50. FEET.

        SCS RUNOFF CURVE NUMBER            =    62.30
        FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
        EVAPORATIVE ZONE DEPTH             =    32.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =     3.842  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =    21.472  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE =     2.464  INCHES
        INITIAL SNOW WATER                 =     0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS   =   203.670  INCHES
        TOTAL INITIAL WATER                =   203.670  INCHES
        TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

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

                       ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                        INCHES       CU. FEET     PERCENT
                                       --------     ----------   --------
  PRECIPITATION                          8.87      3219810.250   100.00

  RUNOFF                                 0.000           0.000     0.00

  EVAPOTRANSPIRATION                     8.689     3154203.750    97.96

  DRAINAGE COLLECTED FROM LAYER  2       0.0001         35.062     0.00

  PERC./LEAKAGE THROUGH LAYER  3         0.000103       37.436     0.00

  AVG. HEAD ON TOP OF LAYER  3           0.0000

  DRAINAGE COLLECTED FROM LAYER  4       0.0002        87.188     0.00

  PERC./LEAKAGE THROUGH LAYER  6         0.000003        0.919     0.00

  AVG. HEAD ON TOP OF LAYER  5           0.0001

  CHANGE IN WATER STORAGE                0.180       65461.355     2.03

  SOIL WATER AT START OF YEAR          204.210    74128192.000

  SOIL WATER AT END OF YEAR            204.390    74193672.000

  SNOW WATER AT START OF YEAR            0.000           0.000     0.00

  SNOW WATER AT END OF YEAR              0.000           0.000     0.00
                                   Page 3
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  ANNUAL WATER BUDGET BALANCE            0.0000          2.149     0.00
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******************************************************************************
                       ANNUAL TOTALS FOR YEAR    2
------------------------------------------------------------------------------
                                        INCHES       CU. FEET     PERCENT
                                       --------     ----------   --------
  PRECIPITATION                         12.50      4537500.500   100.00

  RUNOFF                                 0.772      280315.187     6.18

  EVAPOTRANSPIRATION                    12.704     4611459.000   101.63

  DRAINAGE COLLECTED FROM LAYER  2       0.0000          4.561     0.00

  PERC./LEAKAGE THROUGH LAYER  3         0.000019        6.955     0.00

  AVG. HEAD ON TOP OF LAYER  3           0.0000

  DRAINAGE COLLECTED FROM LAYER  4       0.0000          6.507     0.00

  PERC./LEAKAGE THROUGH LAYER  6         0.000001        0.422     0.00

  AVG. HEAD ON TOP OF LAYER  5           0.0000

  CHANGE IN WATER STORAGE               -0.976     -354281.719    -7.81

  SOIL WATER AT START OF YEAR          204.390    74193672.000

  SOIL WATER AT END OF YEAR            203.414    73839392.000

  SNOW WATER AT START OF YEAR            0.000           0.000     0.00

  SNOW WATER AT END OF YEAR              0.000           0.000     0.00

  ANNUAL WATER BUDGET BALANCE            0.0000         -3.312     0.00
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                       ANNUAL TOTALS FOR YEAR    3
------------------------------------------------------------------------------
                                        INCHES       CU. FEET     PERCENT
                                       --------     ----------   --------
  PRECIPITATION                         10.37      3764310.250   100.00

  RUNOFF                                 0.033       12120.292     0.32

  EVAPOTRANSPIRATION                     8.838     3208079.750    85.22

  DRAINAGE COLLECTED FROM LAYER  2       0.0000          1.008     0.00

  PERC./LEAKAGE THROUGH LAYER  3         0.000006        2.332     0.00

  AVG. HEAD ON TOP OF LAYER  3           0.0000
                                   Page 4
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DRAINAGE COLLECTED FROM LAYER 4	0.0000	2.246	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.468	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	1.499	544101.562	14.45
SOIL WATER AT START OF YEAR	203.414	73839392.000	
SOIL WATER AT END OF YEAR	203.745	73959264.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.169	424227.844	11.27
ANNUAL WATER BUDGET BALANCE	0.0000	4.839	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.09	4025670.750	100.00
RUNOFF	0.999	362484.344	9.00
EVAPOTRANSPIRATION	11.183	4059512.000	100.84
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.563	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000004	1.391	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	1.119	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.272	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-1.092	-396331.094	-9.85
SOIL WATER AT START OF YEAR	203.745	73959264.000	
SOIL WATER AT END OF YEAR	203.747	73960112.000	
SNOW WATER AT START OF YEAR	1.169	424227.844	10.54
SNOW WATER AT END OF YEAR	0.075	27054.846	0.67
ANNUAL WATER BUDGET BALANCE	0.0000	3.583	0.00

ANNUAL TOTALS FOR YEAR 5

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	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.81	3924031.250	100.00
RUNOFF	0.079	28726.516	0.73
EVAPOTRANSPIRATION	9.864	3580531.500	91.25
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.005	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.021	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.001	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.020	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.867	314750.969	8.02
SOIL WATER AT START OF YEAR	203.747	73960112.000	
SOIL WATER AT END OF YEAR	204.595	74268136.000	
SNOW WATER AT START OF YEAR	0.075	27054.846	0.69
SNOW WATER AT END OF YEAR	0.093	33779.789	0.86
ANNUAL WATER BUDGET BALANCE	0.0000	2.238	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.72	4617360.000	100.00
RUNOFF	0.154	55743.414	1.21
EVAPOTRANSPIRATION	13.271	4817264.500	104.33
DRAINAGE COLLECTED FROM LAYER 2	0.0943	34246.254	0.74
PERC./LEAKAGE THROUGH LAYER 3	0.022457	8151.960	0.18
AVG. HEAD ON TOP OF LAYER 3	0.0227		
DRAINAGE COLLECTED FROM LAYER 4	0.0224	8125.165	0.18
PERC./LEAKAGE THROUGH LAYER 6	0.000005	1.743	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0054		
CHANGE IN WATER STORAGE	-0.821	-298020.469	-6.45
SOIL WATER AT START OF YEAR	204.595	74268136.000	
SOIL WATER AT END OF YEAR	203.867	74003896.000	

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SNOW WATER AT START OF YEAR	0.093	33779.789	0.73
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.265	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.14	4769821.000	100.00
RUNOFF	0.060	21632.699	0.45
EVAPOTRANSPIRATION	12.359	4486355.500	94.06
DRAINAGE COLLECTED FROM LAYER 2	0.0000	12.541	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000043	15.519	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0001	39.003	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.823	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.721	261781.406	5.49
SOIL WATER AT START OF YEAR	203.867	74003896.000	
SOIL WATER AT END OF YEAR	204.589	74265672.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.810	0.00

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.65	4228951.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.917	4325939.500	102.29
DRAINAGE COLLECTED FROM LAYER 2	0.0494	17915.570	0.42

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PERC./LEAKAGE THROUGH LAYER 3	0.013978	5073.911	0.12
AVG. HEAD ON TOP OF LAYER 3	0.0119		
DRAINAGE COLLECTED FROM LAYER 4	0.0139	5057.207	0.12
PERC./LEAKAGE THROUGH LAYER 6	0.000004	1.545	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0033		
CHANGE IN WATER STORAGE	-0.330	-119962.375	-2.84
SOIL WATER AT START OF YEAR	204.589	74265672.000	
SOIL WATER AT END OF YEAR	204.258	74145712.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	4.819	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.69	4243470.500	100.00
RUNOFF	0.621	225547.562	5.32
EVAPOTRANSPIRATION	12.103	4393321.000	103.54
DRAINAGE COLLECTED FROM LAYER 2	0.0268	9728.867	0.23
PERC./LEAKAGE THROUGH LAYER 3	0.008118	2946.788	0.07
AVG. HEAD ON TOP OF LAYER 3	0.0065		
DRAINAGE COLLECTED FROM LAYER 4	0.0081	2953.331	0.07
PERC./LEAKAGE THROUGH LAYER 6	0.000004	1.316	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0020		
CHANGE IN WATER STORAGE	-1.070	-388279.719	-9.15
SOIL WATER AT START OF YEAR	204.258	74145712.000	
SOIL WATER AT END OF YEAR	203.189	73757432.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.937	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.07	4744410.500	100.00
RUNOFF	0.085	31009.840	0.65
EVAPOTRANSPIRATION	9.873	3583736.000	75.54
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.001	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.015	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	12.631	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.422	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.112	1129647.120	23.81
SOIL WATER AT START OF YEAR	203.189	73757432.000	
SOIL WATER AT END OF YEAR	205.169	74476304.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.132	410775.781	8.66
ANNUAL WATER BUDGET BALANCE	0.0000	4.520	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.79	4279771.000	100.00
RUNOFF	0.416	150909.594	3.53
EVAPOTRANSPIRATION	12.844	4662245.000	108.94
DRAINAGE COLLECTED FROM LAYER 2	0.2939	106696.281	2.49
PERC./LEAKAGE THROUGH LAYER 3	0.056944	20670.834	0.48
AVG. HEAD ON TOP OF LAYER 3	0.0708		
DRAINAGE COLLECTED FROM LAYER 4	0.0567	20587.648	0.48
PERC./LEAKAGE THROUGH LAYER 6	0.000009	3.181	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0138		
CHANGE IN WATER STORAGE	-1.820	-660665.250	-15.44

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SOIL WATER AT START OF YEAR	205.169	74476304.000	
SOIL WATER AT END OF YEAR	204.369	74186080.000	
SNOW WATER AT START OF YEAR	1.132	410775.781	9.60
SNOW WATER AT END OF YEAR	0.111	40334.402	0.94
ANNUAL WATER BUDGET BALANCE	0.0000	-5.346	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.87	3945811.000	100.00
RUNOFF	0.118	42802.867	1.08
EVAPOTRANSPIRATION	10.939	3970880.500	100.64
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.487	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000003	1.225	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0002	80.640	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.578	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	-0.187	-67962.641	-1.72
SOIL WATER AT START OF YEAR	204.369	74186080.000	
SOIL WATER AT END OF YEAR	204.293	74158456.000	
SNOW WATER AT START OF YEAR	0.111	40334.402	1.02
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	8.474	0.00

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.94	3608220.500	100.00
RUNOFF	0.090	32689.752	0.91

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EVAPOTRANSPIRATION	10.403	3776395.250	104.66
DRAINAGE COLLECTED FROM LAYER 2	0.0002	64.191	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000152	55.292	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0002	54.650	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.532	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-0.554	-200986.000	-5.57
SOIL WATER AT START OF YEAR	204.293	74158456.000	
SOIL WATER AT END OF YEAR	203.740	73957464.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.173	0.00

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.60	2758800.750	100.00
RUNOFF	0.126	45904.789	1.66
EVAPOTRANSPIRATION	7.857	2852091.250	103.38
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.133	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000001	0.454	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.324	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.241	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-0.383	-139199.109	-5.05
SOIL WATER AT START OF YEAR	203.740	73957464.000	
SOIL WATER AT END OF YEAR	203.356	73818264.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.154	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.59	4207170.500	100.00
RUNOFF	0.095	34389.539	0.82
EVAPOTRANSPIRATION	8.928	3240857.000	77.03
DRAINAGE COLLECTED FROM LAYER 2	0.0000	5.398	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000022	7.909	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	7.074	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.243	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	2.567	931744.312	22.15
SOIL WATER AT START OF YEAR	203.356	73818264.000	
SOIL WATER AT END OF YEAR	205.384	74554304.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.539	195707.687	4.65
ANNUAL WATER BUDGET BALANCE	0.0000	-8.837	0.00

ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.93	3967590.750	100.00
RUNOFF	0.038	13733.185	0.35
EVAPOTRANSPIRATION	11.661	4232905.000	106.69
DRAINAGE COLLECTED FROM LAYER 2	0.0000	1.420	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000008	2.785	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	2.851	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.432	0.00

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AVG. HEAD ON TOP OF LAYER  5           0.0000
CHANGE IN WATER STORAGE               -0.769     -279057.656      -7.03
SOIL WATER AT START OF YEAR          205.384    74554304.000
SOIL WATER AT END OF YEAR            205.154    74470952.000
SNOW WATER AT START OF YEAR            0.539      195707.687       4.93
SNOW WATER AT END OF YEAR              0.000           0.000       0.00
ANNUAL WATER BUDGET BALANCE            0.0000          5.566       0.00
*******************************************************************************

*******************************************************************************
                    ANNUAL TOTALS FOR YEAR   17
-------------------------------------------------------------------------------
                                      INCHES        CU. FEET     PERCENT
                                     --------     -----------   ---------
PRECIPITATION                         10.76      3905881.000     100.00
RUNOFF                                 0.568      206032.922       5.27
EVAPOTRANSPIRATION                    10.605     3849732.250      98.56
DRAINAGE COLLECTED FROM LAYER  2       0.0665      24123.768       0.62
PERC./LEAKAGE THROUGH LAYER  3         0.016555     6009.398       0.15
AVG. HEAD ON TOP OF LAYER  3           0.0100
DRAINAGE COLLECTED FROM LAYER  4       0.0165       5992.232       0.15
PERC./LEAKAGE THROUGH LAYER  6         0.000004        1.510       0.00
AVG. HEAD ON TOP OF LAYER  5           0.0040
CHANGE IN WATER STORAGE               -0.496     -179998.953      -4.61
SOIL WATER AT START OF YEAR          205.154    74470952.000
SOIL WATER AT END OF YEAR            204.658    74290952.000
SNOW WATER AT START OF YEAR            0.000           0.000       0.00
SNOW WATER AT END OF YEAR              0.000           0.000       0.00
ANNUAL WATER BUDGET BALANCE            0.0000         -2.550       0.00
*******************************************************************************

*******************************************************************************
                    ANNUAL TOTALS FOR YEAR   18
-------------------------------------------------------------------------------
                                      INCHES        CU. FEET     PERCENT
                                     --------     -----------   ---------
```

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PRECIPITATION                         10.93      3967590.000     100.00
RUNOFF                                 0.118       42763.758       1.08
EVAPOTRANSPIRATION                    10.739     3898088.250      98.25
DRAINAGE COLLECTED FROM LAYER  2       0.0000          0.000       0.00
PERC./LEAKAGE THROUGH LAYER  3         0.000000        0.002       0.00
AVG. HEAD ON TOP OF LAYER  3           0.0000
DRAINAGE COLLECTED FROM LAYER  4       0.0000         15.326       0.00
PERC./LEAKAGE THROUGH LAYER  6         0.000001        0.431       0.00
AVG. HEAD ON TOP OF LAYER  5           0.0000
CHANGE IN WATER STORAGE                0.074       26717.652       0.67
SOIL WATER AT START OF YEAR          204.658    74290952.000
SOIL WATER AT END OF YEAR            204.476    74224920.000
SNOW WATER AT START OF YEAR            0.000           0.000       0.00
SNOW WATER AT END OF YEAR              0.256       92752.898       2.34
ANNUAL WATER BUDGET BALANCE            0.0000          4.765       0.00
*******************************************************************************

*******************************************************************************
                    ANNUAL TOTALS FOR YEAR   19
-------------------------------------------------------------------------------
                                      INCHES        CU. FEET     PERCENT
                                     --------     -----------   ---------
PRECIPITATION                          9.00      3267000.250     100.00
RUNOFF                                 0.026        9268.788       0.28
EVAPOTRANSPIRATION                     9.841     3572275.500     109.34
DRAINAGE COLLECTED FROM LAYER  2       0.0000          0.804       0.00
PERC./LEAKAGE THROUGH LAYER  3         0.000005        1.807       0.00
AVG. HEAD ON TOP OF LAYER  3           0.0000
DRAINAGE COLLECTED FROM LAYER  4       0.0000          1.506       0.00
PERC./LEAKAGE THROUGH LAYER  6         0.000001        0.301       0.00
AVG. HEAD ON TOP OF LAYER  5           0.0000
CHANGE IN WATER STORAGE               -0.867     -314543.156      -9.63
SOIL WATER AT START OF YEAR          204.476    74224920.000
SOIL WATER AT END OF YEAR            203.865    74003128.000
SNOW WATER AT START OF YEAR            0.256       92752.898       2.84
```

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SNOW WATER AT END OF YEAR              0.000           0.000       0.00
ANNUAL WATER BUDGET BALANCE            0.0000         -3.486       0.00
*******************************************************************************

*******************************************************************************
     AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH   19
-------------------------------------------------------------------------------
                     JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                     -------  -------  -------  -------  -------  -------
PRECIPITATION
-------------
  TOTALS              1.80     1.20     0.68     0.95     0.95     0.84
                      0.19     0.49     0.48     0.64     1.25     1.35

  STD. DEVIATIONS     0.79     0.47     0.41     0.48     0.58     0.46
                      0.20     0.46     0.60     0.39     0.53     0.82

RUNOFF
------
  TOTALS              0.083    0.136    0.012    0.000    0.000    0.000
                      0.000    0.000    0.000    0.000    0.000    0.001

  STD. DEVIATIONS     0.170    0.204    0.029    0.000    0.000    0.000
                      0.000    0.000    0.000    0.000    0.000    0.004

EVAPOTRANSPIRATION
------------------
  TOTALS              0.479    0.514    1.494    1.682    1.229    2.454
                      0.272    0.465    0.391    0.610    0.596    0.585

  STD. DEVIATIONS     0.122    0.239    0.287    0.592    0.454    1.217
                      0.223    0.430    0.424    0.315    0.220    0.165

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS              0.0000   0.0000   0.0030   0.0067   0.0082   0.0064
                      0.0027   0.0008   0.0002   0.0000   0.0000   0.0000

  STD. DEVIATIONS     0.0000   0.0000   0.0130   0.0197   0.0166   0.0152
                      0.0066   0.0020   0.0005   0.0001   0.0000   0.0000

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS              0.0000   0.0000   0.0005   0.0014   0.0018   0.0014
                      0.0007   0.0003   0.0001   0.0000   0.0000   0.0000

  STD. DEVIATIONS     0.0000   0.0000   0.0023   0.0034   0.0034   0.0030
                      0.0016   0.0008   0.0002   0.0001   0.0000   0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER  4
----------------------------------------
  TOTALS              0.0000   0.0000   0.0001   0.0007   0.0013   0.0015
                      0.0012   0.0007   0.0004   0.0002   0.0001   0.0000

  STD. DEVIATIONS     0.0000   0.0000   0.0005   0.0023   0.0028   0.0030
                      0.0026   0.0016   0.0008   0.0004   0.0002   0.0001

PERCOLATION/LEAKAGE THROUGH LAYER  6
------------------------------------
  TOTALS              0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```

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```
  STD. DEVIATIONS     0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

-------------------------------------------------------------------------------
       AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES            0.0000   0.0000   0.0085   0.0198   0.0234   0.0187
                      0.0075   0.0022   0.0006   0.0001   0.0000   0.0000

  STD. DEVIATIONS     0.0000   0.0000   0.0369   0.0550   0.0473   0.0443
                      0.0189   0.0057   0.0016   0.0004   0.0001   0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER  5
-------------------------------------
  AVERAGES            0.0001   0.0000   0.0003   0.0020   0.0037   0.0043
                      0.0035   0.0021   0.0011   0.0005   0.0002   0.0001

  STD. DEVIATIONS     0.0001   0.0000   0.0014   0.0068   0.0081   0.0088
                      0.0074   0.0045   0.0024   0.0012   0.0005   0.0002
*******************************************************************************

*******************************************************************************
  AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS     1 THROUGH   19
-------------------------------------------------------------------------------
                                  INCHES           CU. FEET       PERCENT
                            -------------------  -------------  ---------
PRECIPITATION                11.02    (  1.447)    3999114.3     100.00
RUNOFF                        0.231   ( 0.2945)      84013.42      2.101
EVAPOTRANSPIRATION           10.769   ( 1.5546)    3909267.25     97.753
LATERAL DRAINAGE COLLECTED    0.02796 ( 0.06993)     10149.317    0.25379
  FROM LAYER  2
PERCOLATION/LEAKAGE THROUGH   0.00623 ( 0.01403)      2262.412    0.05657
  LAYER  3
AVERAGE HEAD ON TOP           0.007 (   0.017)
  OF LAYER  3
LATERAL DRAINAGE COLLECTED    0.00624 ( 0.01397)      2264.297    0.05662
  FROM LAYER  4
PERCOLATION/LEAKAGE THROUGH   0.00000 ( 0.00000)         0.811    0.00002
  LAYER  6
AVERAGE HEAD ON TOP           0.001 (   0.003)
  OF LAYER  5
CHANGE IN WATER STORAGE      -0.018   ( 1.2755)     -6382.30     -0.165
*******************************************************************************
*******************************************************************************
        PEAK DAILY VALUES FOR YEARS      1 THROUGH   19
-------------------------------------------------------------------------------
                                            (INCHES)      (CU. FT.)
                                           ----------   -------------
```

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```
PRECIPITATION                                1.68        609840.000

RUNOFF                                       0.542       196579.5470

DRAINAGE COLLECTED FROM LAYER  2             0.00426       1545.09365

PERCOLATION/LEAKAGE THROUGH LAYER  3         0.000679       246.55217

AVERAGE HEAD ON TOP OF LAYER  3              0.376

MAXIMUM HEAD ON TOP OF LAYER  3              0.611

LOCATION OF MAXIMUM HEAD IN LAYER  2
      (DISTANCE FROM DRAIN)                  9.3 FEET

DRAINAGE COLLECTED FROM LAYER  4             0.00039        140.31860

PERCOLATION/LEAKAGE THROUGH LAYER  6         0.000000         0.01840

AVERAGE HEAD ON TOP OF LAYER  5              0.034

MAXIMUM HEAD ON TOP OF LAYER  5              0.065

LOCATION OF MAXIMUM HEAD IN LAYER  4
      (DISTANCE FROM DRAIN)                  2.0 FEET

SNOW WATER                                   2.62        949783.3120

MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.2509

MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.0770

 ***  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   19
   ---------------------------------------------------------------------------
              LAYER          (INCHES)        (VOL/VOL)
              -----          --------        ---------
                1            186.8734          0.2851
                2              0.5400          0.0450
                3              0.0000          0.0000
                4              0.5400          0.0450
                5              0.0000          0.0000
                6             35.7720          0.4370
             SNOW WATER        0.000

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

PRECIPITATION DATA FILE:      C:\V11\DATA4.D4
TEMPERATURE DATA FILE:        C:\V11\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\V11\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\V11\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\V11\DATA10.D10
OUTPUT DATA FILE:             C:\V11\OUT.OUT

TIME: 11:48    DATE:  7/26/2016

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

    TITLE:  Y2 Post-closure

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

      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
             WERE SPECIFIED BY THE USER.

                               LAYER  1
                               --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =    30.00    INCHES
        POROSITY                   =     0.4170 VOL/VOL
        FIELD CAPACITY             =     0.0450 VOL/VOL
        WILTING POINT              =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0446 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.999999978000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.63
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                               LAYER  2
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
        THICKNESS                  =     0.25    INCHES
                                 Page 1
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```
        POROSITY                   =     0.8500 VOL/VOL
        FIELD CAPACITY             =     0.0100 VOL/VOL
        WILTING POINT              =     0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0443 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
        SLOPE                      =     4.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                               LAYER  3
                               --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        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.  = 0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 5 - GOOD

                               LAYER  4
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  17
        THICKNESS                  =     0.25    INCHES
        POROSITY                   =     0.7500 VOL/VOL
        FIELD CAPACITY             =     0.7470 VOL/VOL
        WILTING POINT              =     0.4000 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.7500 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.300000003000E-08 CM/SEC

                               LAYER  5
                               --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =   660.00    INCHES
        POROSITY                   =     0.6710 VOL/VOL
        FIELD CAPACITY             =     0.2920 VOL/VOL
        WILTING POINT              =     0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.2831 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC

                               LAYER  6
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =    12.00    INCHES
        POROSITY                   =     0.4170 VOL/VOL
        FIELD CAPACITY             =     0.0450 VOL/VOL
                                 Page 2
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```
        WILTING POINT              =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.999999978000E-02 CM/SEC
        SLOPE                      =     1.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                               LAYER  7
                               --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.08    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.  = 0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 3 - GOOD

                               LAYER  8
                               --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   1
        THICKNESS                  =    12.00    INCHES
        POROSITY                   =     0.4170 VOL/VOL
        FIELD CAPACITY             =     0.0450 VOL/VOL
        WILTING POINT              =     0.0180 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.0450 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.999999978000E-02 CM/SEC
        SLOPE                      =     1.00    PERCENT
        DRAINAGE LENGTH            =    50.0     FEET

                               LAYER  9
                               --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =     0.06    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.  = 0.199999990000E-12 CM/SEC
        FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
        FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
        FML PLACEMENT QUALITY      = 3 - GOOD

                               LAYER 10
                               --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
                                 Page 3
```

```
        THICKNESS                  =    36.00    INCHES
        POROSITY                   =     0.4270 VOL/VOL
        FIELD CAPACITY             =     0.4180 VOL/VOL
        WILTING POINT              =     0.3670 VOL/VOL
        INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC

              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
             FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
             AND A SLOPE LENGTH OF   50. FEET.

        SCS RUNOFF CURVE NUMBER            =   51.70
        FRACTION OF AREA ALLOWING RUNOFF   =  100.0     PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE =  100.000   ACRES
        EVAPORATIVE ZONE DEPTH             =   30.2     INCHES
        INITIAL WATER IN EVAPORATIVE ZONE  =    1.349   INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE =   12.723   INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE =    0.541   INCHES
        INITIAL SNOW WATER                 =    0.000   INCHES
        INITIAL WATER IN LAYER MATERIALS   =  204.835   INCHES
        TOTAL INITIAL WATER                =  204.835   INCHES
        TOTAL SUBSURFACE INFLOW            =    0.00    INCHES/YEAR

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

                    ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
```

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.87	3219810.250	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	3.725	1352346.620	42.00
DRAINAGE COLLECTED FROM LAYER 2	5.1415	1866358.620	57.96
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.798	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0029		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.003	1102.249	0.03
SOIL WATER AT START OF YEAR	205.375	74550968.000	
SOIL WATER AT END OF YEAR	205.378	74552064.000	

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SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.856	0.00

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.50	4537500.500	100.00
RUNOFF	0.819	297119.531	6.55
EVAPOTRANSPIRATION	4.296	1559339.500	34.37
DRAINAGE COLLECTED FROM LAYER 2	7.6734	2785431.250	61.39
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.790	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.288	-104409.023	-2.30
SOIL WATER AT START OF YEAR	205.378	74552064.000	
SOIL WATER AT END OF YEAR	205.090	74447656.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.541	0.00

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.37	3764310.250	100.00

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RUNOFF	0.041	14781.594	0.39
EVAPOTRANSPIRATION	3.222	1169686.120	31.08
DRAINAGE COLLECTED FROM LAYER 2	5.3646	1947352.120	51.73
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.807	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0020		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.742	632309.187	16.80
SOIL WATER AT START OF YEAR	205.090	74447656.000	
SOIL WATER AT END OF YEAR	205.663	74655736.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.169	424227.844	11.27
ANNUAL WATER BUDGET BALANCE	0.0000	1.283	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.09	4025670.750	100.00
RUNOFF	1.161	421472.125	10.47
EVAPOTRANSPIRATION	4.378	1589300.000	39.48
DRAINAGE COLLECTED FROM LAYER 2	6.6017	2396414.500	59.53
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.801	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00

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AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.051	-381514.437	-9.48
SOIL WATER AT START OF YEAR	205.663	74655736.000	
SOIL WATER AT END OF YEAR	205.706	74671400.000	
SNOW WATER AT START OF YEAR	1.169	424227.844	10.54
SNOW WATER AT END OF YEAR	0.075	27054.846	0.67
ANNUAL WATER BUDGET BALANCE	0.0000	-1.363	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.81	3924031.250	100.00
RUNOFF	0.124	45111.922	1.15
EVAPOTRANSPIRATION	4.658	1690916.000	43.09
DRAINAGE COLLECTED FROM LAYER 2	6.3431	2302539.750	58.68
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.791	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0023		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.316	-114539.078	-2.92
SOIL WATER AT START OF YEAR	205.706	74671400.000	
SOIL WATER AT END OF YEAR	205.372	74550136.000	
SNOW WATER AT START OF YEAR	0.075	27054.846	0.69
SNOW WATER AT END OF YEAR	0.093	33779.789	0.86
ANNUAL WATER BUDGET BALANCE	0.0000	2.199	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.72	4617360.000	100.00
RUNOFF	0.154	55849.484	1.21
EVAPOTRANSPIRATION	4.103	1489544.620	32.26
DRAINAGE COLLECTED FROM LAYER 2	8.8362	3207542.500	69.47
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.841	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0032		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.373	-135574.437	-2.94
SOIL WATER AT START OF YEAR	205.372	74550136.000	
SOIL WATER AT END OF YEAR	205.092	74448336.000	
SNOW WATER AT START OF YEAR	0.093	33779.789	0.73
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-2.710	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.14	4769821.000	100.00
RUNOFF	0.066	23991.518	0.50
EVAPOTRANSPIRATION	4.138	1501959.000	31.49
DRAINAGE COLLECTED FROM LAYER 2	8.8033	3195589.250	67.00
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.801	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0032		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00

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AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.133	48277.406	1.05
SOIL WATER AT START OF YEAR	205.092	74448336.000	
SOIL WATER AT END OF YEAR	205.225	74496616.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	4.038	0.00

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.65	4228951.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	2.266	822665.687	19.45
DRAINAGE COLLECTED FROM LAYER 2	8.9531	3249987.750	76.85
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.948	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0033		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.431	156297.828	3.70
SOIL WATER AT START OF YEAR	205.225	74496616.000	
SOIL WATER AT END OF YEAR	205.655	74652912.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.087	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.69	4243470.500	100.00
RUNOFF	0.797	289415.400	6.82
EVAPOTRANSPIRATION	3.777	1370959.370	32.31
DRAINAGE COLLECTED FROM LAYER 2	7.7501	2813283.750	66.30
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.775	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.634	-230187.281	-5.42
SOIL WATER AT START OF YEAR	205.655	74652912.000	
SOIL WATER AT END OF YEAR	205.021	74422728.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.736	0.00

ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.07	4744410.500	100.00
RUNOFF	0.088	32097.225	0.68
EVAPOTRANSPIRATION	3.464	1257361.120	26.50
DRAINAGE COLLECTED FROM LAYER 2	8.1215	2948089.500	62.14

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PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.809	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0030		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.396	506859.781	10.68
SOIL WATER AT START OF YEAR	205.021	74422728.000	
SOIL WATER AT END OF YEAR	205.286	74518808.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.132	410775.781	8.66
ANNUAL WATER BUDGET BALANCE	0.0000	2.840	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.79	4279771.000	100.00
RUNOFF	0.435	157860.141	3.69
EVAPOTRANSPIRATION	4.419	1604037.370	37.48
DRAINAGE COLLECTED FROM LAYER 2	8.0703	2929521.250	68.45
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.827	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0030		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.134	-411651.125	-9.62
SOIL WATER AT START OF YEAR	205.286	74518808.000	

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SOIL WATER AT END OF YEAR	205.172	74477600.000	
SNOW WATER AT START OF YEAR	1.132	410775.781	9.60
SNOW WATER AT END OF YEAR	0.111	40334.402	0.94
ANNUAL WATER BUDGET BALANCE	0.0000	3.289	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.87	3945811.000	100.00
RUNOFF	0.114	41563.367	1.05
EVAPOTRANSPIRATION	3.604	1308392.170	33.16
DRAINAGE COLLECTED FROM LAYER 2	7.3959	2684697.750	68.04
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.811	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0027		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.245	-88844.445	-2.25
SOIL WATER AT START OF YEAR	205.172	74477600.000	
SOIL WATER AT END OF YEAR	205.039	74429088.000	
SNOW WATER AT START OF YEAR	0.111	40334.402	1.02
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.977	0.00

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.94	3608220.500	100.00

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	INCHES	CU. FEET	PERCENT
RUNOFF	0.112	40553.973	1.12
EVAPOTRANSPIRATION	4.026	1461300.370	40.50
DRAINAGE COLLECTED FROM LAYER 2	5.6309	2044011.500	56.65
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.766	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0021		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.172	62357.391	1.73
SOIL WATER AT START OF YEAR	205.039	74429088.000	
SOIL WATER AT END OF YEAR	205.211	74491448.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.699	0.00

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.60	2758800.750	100.00
RUNOFF	0.129	46736.363	1.69
EVAPOTRANSPIRATION	3.214	1166800.620	42.29
DRAINAGE COLLECTED FROM LAYER 2	4.3889	1593186.500	57.75
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.787	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0016		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00

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	INCHES	CU. FEET	PERCENT
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.132	-47928.453	-1.74
SOIL WATER AT START OF YEAR	205.211	74491448.000	
SOIL WATER AT END OF YEAR	205.079	74443520.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.804	0.00

ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.59	4207170.500	100.00
RUNOFF	0.115	41834.809	0.99
EVAPOTRANSPIRATION	3.257	1182131.000	28.10
DRAINAGE COLLECTED FROM LAYER 2	7.1702	2602784.750	61.87
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.802	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0026		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.048	380420.281	9.04
SOIL WATER AT START OF YEAR	205.079	74443520.000	
SOIL WATER AT END OF YEAR	205.587	74628232.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.539	195707.687	4.65
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.93	3967590.750	100.00
RUNOFF	0.043	15581.319	0.39
EVAPOTRANSPIRATION	3.384	1228352.870	30.96
DRAINAGE COLLECTED FROM LAYER 2	8.5152	3091007.000	77.90
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.813	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.012	-367353.906	-9.26
SOIL WATER AT START OF YEAR	205.587	74628232.000	
SOIL WATER AT END OF YEAR	205.115	74456584.000	
SNOW WATER AT START OF YEAR	0.539	195707.687	4.93
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.485	0.00

ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.76	3905881.000	100.00
RUNOFF	0.604	219121.906	5.61
EVAPOTRANSPIRATION	3.644	1322710.370	33.86
DRAINAGE COLLECTED FROM LAYER 2	6.5985	2395253.250	61.32
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.853	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00

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	INCHES	CU. FEET	PERCENT
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.086	-31206.391	-0.80
SOIL WATER AT START OF YEAR	205.115	74456584.000	
SOIL WATER AT END OF YEAR	205.029	74425376.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.861	0.00

ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.93	3967590.000	100.00
RUNOFF	0.127	46126.937	1.16
EVAPOTRANSPIRATION	3.611	1310614.370	33.03
DRAINAGE COLLECTED FROM LAYER 2	6.5577	2380456.000	60.00
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.761	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.635	230395.562	5.81
SOIL WATER AT START OF YEAR	205.029	74425376.000	
SOIL WATER AT END OF YEAR	205.408	74563024.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.256	92752.898	2.34

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ANNUAL WATER BUDGET BALANCE	0.0000	-2.678	0.00

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.00	3267000.250	100.00
RUNOFF	0.027	9906.940	0.30
EVAPOTRANSPIRATION	2.921	1060197.370	32.45
DRAINAGE COLLECTED FROM LAYER 2	6.4033	2324415.250	71.15
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.756	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.351	-127520.828	-3.90
SOIL WATER AT START OF YEAR	205.408	74563024.000	
SOIL WATER AT END OF YEAR	205.312	74528256.000	
SNOW WATER AT START OF YEAR	0.256	92752.898	2.84
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.386	0.00

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.60	4936800.500	100.00
RUNOFF	0.056	20227.537	0.41
EVAPOTRANSPIRATION	4.198	1523979.870	30.87
DRAINAGE COLLECTED FROM LAYER 2	9.4697	3437513.750	69.63

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PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.857	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0035		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.124	-44920.809	-0.91
SOIL WATER AT START OF YEAR	205.312	74528256.000	
SOIL WATER AT END OF YEAR	205.188	74483336.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.019	0.00

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.43	3786090.500	100.00
RUNOFF	0.004	1479.972	0.04
EVAPOTRANSPIRATION	2.757	1000633.810	26.43
DRAINAGE COLLECTED FROM LAYER 2	7.7027	2796081.250	73.85
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.884	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.033	-12102.585	-0.32
SOIL WATER AT START OF YEAR	205.188	74483336.000	

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SOIL WATER AT END OF YEAR	205.155	74471232.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-2.113	0.00

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.29	4461270.000	100.00
RUNOFF	0.004	1283.439	0.03
EVAPOTRANSPIRATION	3.425	1243428.000	27.87
DRAINAGE COLLECTED FROM LAYER 2	8.5298	3096324.750	69.40
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.868	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.331	120231.141	2.69
SOIL WATER AT START OF YEAR	205.155	74471232.000	
SOIL WATER AT END OF YEAR	205.189	74483720.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.297	107746.367	2.42
ANNUAL WATER BUDGET BALANCE	0.0000	2.390	0.00

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT

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PRECIPITATION	11.78	4276140.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	3.338	1211679.750	28.34
DRAINAGE COLLECTED FROM LAYER 2	8.6862	3153073.750	73.74
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.872	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0032		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.244	-88614.023	-2.07
SOIL WATER AT START OF YEAR	205.189	74483720.000	
SOIL WATER AT END OF YEAR	205.055	74434936.000	
SNOW WATER AT START OF YEAR	0.297	107746.367	2.52
SNOW WATER AT END OF YEAR	0.187	67913.789	1.59
ANNUAL WATER BUDGET BALANCE	0.0000	0.498	0.00

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.23	4802491.000	100.00
RUNOFF	0.155	56225.254	1.17
EVAPOTRANSPIRATION	4.158	1509430.620	31.43
DRAINAGE COLLECTED FROM LAYER 2	8.7728	3184510.250	66.31
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.824	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0032		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00

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PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.144	52319.988	1.09
SOIL WATER AT START OF YEAR	205.055	74434936.000	
SOIL WATER AT END OF YEAR	205.386	74553168.000	
SNOW WATER AT START OF YEAR	0.187	67913.789	1.41
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	5.009	0.00

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.39	4134570.500	100.00
RUNOFF	0.375	135974.062	3.29
EVAPOTRANSPIRATION	4.162	1510924.120	36.54
DRAINAGE COLLECTED FROM LAYER 2	6.6188	2402625.750	58.11
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.756	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.234	85050.539	2.06
SOIL WATER AT START OF YEAR	205.386	74553168.000	
SOIL WATER AT END OF YEAR	205.247	74504696.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.373	135521.359	3.28
ANNUAL WATER BUDGET BALANCE	0.0000	-3.916	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.66	4232580.000	100.00
RUNOFF	0.116	41943.816	0.99
EVAPOTRANSPIRATION	3.692	1340081.000	31.66
DRAINAGE COLLECTED FROM LAYER 2	8.4308	3060373.750	72.31
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.866	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.578	-209820.703	-4.96
SOIL WATER AT START OF YEAR	205.247	74504696.000	
SOIL WATER AT END OF YEAR	205.042	74430400.000	
SNOW WATER AT START OF YEAR	0.373	135521.359	3.20
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.169	0.00

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.52	4907760.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	2.642	959202.562	19.54
DRAINAGE COLLECTED FROM LAYER 2	10.7989	3919983.250	79.87
PERC./LEAKAGE THROUGH LAYER 4	0.000003	0.933	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0040		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00

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PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.079	28575.395	0.59
SOIL WATER AT START OF YEAR	205.042	74430400.000	
SOIL WATER AT END OF YEAR	205.121	74458976.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.697	0.00

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.06	5829780.000	100.00
RUNOFF	0.006	2292.627	0.04
EVAPOTRANSPIRATION	4.253	1543786.250	26.48
DRAINAGE COLLECTED FROM LAYER 2	10.5482	3828994.000	65.68
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.877	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0039		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.253	454701.281	7.80
SOIL WATER AT START OF YEAR	205.121	74458976.000	
SOIL WATER AT END OF YEAR	205.905	74743512.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.469	170165.891	2.92

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ANNUAL WATER BUDGET BALANCE	0.0000	5.568	0.00

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.88	4675440.500	100.00
RUNOFF	0.558	202423.906	4.33
EVAPOTRANSPIRATION	4.527	1643203.120	35.15
DRAINAGE COLLECTED FROM LAYER 2	8.8553	3214474.250	68.75
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.793	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0032		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.060	-384661.062	-8.23
SOIL WATER AT START OF YEAR	205.905	74743512.000	
SOIL WATER AT END OF YEAR	205.077	74442808.000	
SNOW WATER AT START OF YEAR	0.469	170165.891	3.64
SNOW WATER AT END OF YEAR	0.237	86208.375	1.84
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.89	3227070.500	100.00
RUNOFF	0.022	7892.003	0.24
EVAPOTRANSPIRATION	3.789	1375341.500	42.62

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DRAINAGE COLLECTED FROM LAYER 2	5.0190	1821907.370	56.46
PERC./LEAKAGE THROUGH LAYER 4	0.000002	0.771	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0018		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.060	21927.988	0.68
SOIL WATER AT START OF YEAR	205.077	74442808.000	
SOIL WATER AT END OF YEAR	205.168	74475976.000	
SNOW WATER AT START OF YEAR	0.237	86208.375	2.67
SNOW WATER AT END OF YEAR	0.207	74969.187	2.32
ANNUAL WATER BUDGET BALANCE	0.0000	1.576	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.70	1.16	0.97	1.08	0.99	0.84
	0.27	0.51	0.55	0.76	1.28	1.39
STD. DEVIATIONS	0.68	0.44	0.44	0.56	0.53	0.40
	0.25	0.52	0.70	0.50	0.57	0.78
RUNOFF						
TOTALS	0.066	0.115	0.026	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATIONS	0.159	0.189	0.062	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.003
EVAPOTRANSPIRATION						
TOTALS	0.448	0.471	1.056	0.307	0.234	0.240
	0.081	0.144	0.113	0.089	0.163	0.393
STD. DEVIATIONS	0.135	0.291	0.471	0.253	0.128	0.115
	0.084	0.130	0.112	0.054	0.086	0.194
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.2324	0.3630	1.2702	0.9167	0.7725	0.5085
	0.2705	0.3582	0.4139	0.6229	1.0267	0.7464
STD. DEVIATIONS	0.3251	0.5810	0.5381	0.4852	0.3925	0.2921
	0.1912	0.3371	0.5851	0.4425	0.5188	0.5357
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0010	0.0017	0.0055	0.0041	0.0033	0.0027
	0.0012	0.0016	0.0019	0.0027	0.0046	0.0037
STD. DEVIATIONS	0.0023	0.0028	0.0023	0.0022	0.0017	0.0013
	0.0008	0.0015	0.0026	0.0019	0.0021	0.0021
DAILY AVERAGE HEAD ON TOP OF LAYER 7						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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DAILY AVERAGE HEAD ON TOP OF LAYER 9						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.50 (1.712)	4175105.7	100.00
RUNOFF	0.208 (0.2950)	75628.23	1.811
EVAPOTRANSPIRATION	3.702 (0.5901)	1343683.37	32.183
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.59177 (1.59155)	2755793.500	66.00536
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.821	0.00002
AVERAGE HEAD ON TOP OF LAYER 3	0.003 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.000 (0.7037)	-0.75	0.000

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	1.68	609840.000
RUNOFF	0.622	225919.8590
DRAINAGE COLLECTED FROM LAYER 2	1.40566	510210.37500
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.02487

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AVERAGE HEAD ON TOP OF LAYER 3	0.196	
MAXIMUM HEAD ON TOP OF LAYER 3	0.372	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	2.5 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.62	949783.3120
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1682	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0285	

*** 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	1.1316	0.0377
2	0.0109	0.0434
3	0.0000	0.0000
4	0.1875	0.7500
5	196.8461	0.2881
6	0.5400	0.0450
7	0.0000	0.0000

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             8            0.5400        0.0450
             9            0.0000        0.0000
            10           15.3720        0.4270
        SNOW WATER        0.207
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LANDFILL M

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\MC\DATA4.D4
TEMPERATURE DATA FILE:        C:\MC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\MC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\MC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\MC\DATA10.D10
OUTPUT DATA FILE:             C:\MC\OUT.OUT

TIME: 15:58    DATE:  6/ 3/2016

------------------------------------------------------------------------------

     TITLE: M1-without 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.

                                LAYER  1
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   1
      THICKNESS                   =     18.00    INCHES
      POROSITY                    =      0.4170 VOL/VOL
      FIELD CAPACITY              =      0.0450 VOL/VOL
      WILTING POINT               =      0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.0353 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  2.49
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                LAYER  2
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
      THICKNESS                   =   1320.00    INCHES

                                 Page 1
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      POROSITY                    =      0.6710 VOL/VOL
      FIELD CAPACITY              =      0.2920 VOL/VOL
      WILTING POINT               =      0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.2909 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC

                                LAYER  3
                                --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
      THICKNESS                   =     12.00    INCHES
      POROSITY                    =      0.4170 VOL/VOL
      FIELD CAPACITY              =      0.0450 VOL/VOL
      WILTING POINT               =      0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.0635 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC

                                LAYER  4
                                --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
      THICKNESS                   =      0.30    INCHES
      POROSITY                    =      0.8500 VOL/VOL
      FIELD CAPACITY              =      0.0100 VOL/VOL
      WILTING POINT               =      0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =   33.0000000000      CM/SEC
      SLOPE                       =      2.00    PERCENT
      DRAINAGE LENGTH             =     50.0     FEET

                                LAYER  5
                                --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                   =      0.06    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.   =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY         =      2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS    =      2.00    HOLES/ACRE
      FML PLACEMENT QUALITY       =  3 - GOOD

                                LAYER  6
                                --------

                   TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                   =     18.00    INCHES
      POROSITY                    =      0.4270 VOL/VOL
      FIELD CAPACITY              =      0.4180 VOL/VOL

                                 Page 2
```

```
      WILTING POINT               =      0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-08 CM/SEC

                                LAYER  7
                                --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
      THICKNESS                   =      0.20    INCHES
      POROSITY                    =      0.8500 VOL/VOL
      FIELD CAPACITY              =      0.0100 VOL/VOL
      WILTING POINT               =      0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =   33.0000000000      CM/SEC
      SLOPE                       =      2.00    PERCENT
      DRAINAGE LENGTH             =     50.0     FEET

                                LAYER  8
                                --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
      THICKNESS                   =      0.06    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.   =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY         =      2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS    =      2.00    HOLES/ACRE
      FML PLACEMENT QUALITY       =  3 - GOOD

                                LAYER  9
                                --------

                   TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
      THICKNESS                   =     36.00    INCHES
      POROSITY                    =      0.4270 VOL/VOL
      FIELD CAPACITY              =      0.4180 VOL/VOL
      WILTING POINT               =      0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-08 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
           AND A SLOPE LENGTH OF   50. FEET.

  SCS RUNOFF CURVE NUMBER            =    51.80

                                 Page 3
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```
      FRACTION OF AREA ALLOWING RUNOFF     =   100.0    PERCENT
      AREA PROJECTED ON HORIZONTAL PLANE   =   100.000  ACRES
      EVAPORATIVE ZONE DEPTH               =    32.0    INCHES
      INITIAL WATER IN EVAPORATIVE ZONE    =     3.228  INCHES
      UPPER LIMIT OF EVAPORATIVE STORAGE   =    16.900  INCHES
      LOWER LIMIT OF EVAPORATIVE STORAGE   =     1.402  INCHES
      INITIAL SNOW WATER                   =     0.000  INCHES
      INITIAL WATER IN LAYER MATERIALS     =   408.429  INCHES
      TOTAL INITIAL WATER                  =   408.429  INCHES
      TOTAL SUBSURFACE INFLOW              =     0.00   INCHES/YEAR

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

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                  JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                  -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS           1.82     1.12     1.09     1.08     1.01     0.79
                    0.33     0.54     0.56     0.98     1.57     1.68

   STD. DEVIATIONS  0.70     0.58     0.47     0.52     0.51     0.55
                    0.31     0.42     0.44     0.62     0.58     0.61

 RUNOFF
 ------
   TOTALS           0.074    0.044    0.008    0.000    0.000    0.000
                    0.000    0.000    0.000    0.000    0.000    0.001

   STD. DEVIATIONS  0.104    0.172    0.042    0.000    0.000    0.000
                    0.000    0.000    0.000    0.000    0.000    0.010

 EVAPOTRANSPIRATION
 ------------------
   TOTALS           0.810    0.869    1.337    1.023    0.997    1.060
                    0.738    0.809    0.534    0.757    0.975    0.933

   STD. DEVIATIONS  0.288    0.495    0.486    0.471    0.483    0.361
                    0.549    0.465    0.347    0.412    0.272    0.224

 LATERAL DRAINAGE COLLECTED FROM LAYER  4
 ----------------------------------------
   TOTALS           0.2570   0.2776   0.3042   0.2995   0.1429   0.0806
                    0.0507   0.0344   0.0269   0.0279   0.0619   0.1651

   STD. DEVIATIONS  0.3281   0.4072   0.3971   0.4502   0.1298   0.0586
                    0.0269   0.0151   0.0106   0.0144   0.0826   0.2731

 PERCOLATION/LEAKAGE THROUGH LAYER  6
 ------------------------------------
   TOTALS           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                    0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

 LATERAL DRAINAGE COLLECTED FROM LAYER  7
 ----------------------------------------
   TOTALS           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                    0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

                                 Page 4
```

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

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

DAILY AVERAGE HEAD ON TOP OF LAYER 8

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.56 (1.887)	4558664.0	100.00
RUNOFF	0.086 (0.2199)	31317.74	0.687
EVAPOTRANSPIRATION	10.731 (1.5385)	3895526.00	85.453
LATERAL DRAINAGE COLLECTED FROM LAYER 4	1.72858 (1.11502)	627475.687	13.76447
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.884	0.00002
AVERAGE HEAD ON TOP OF LAYER 5	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00000 (0.00000)	0.846	0.00002
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.038	0.00000
AVERAGE HEAD ON TOP OF LAYER 8	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.012 (1.3384)	4342.97	0.095

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.15	417450.000
RUNOFF	1.567	568671.6870
DRAINAGE COLLECTED FROM LAYER 4	0.16126	58537.45310
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00515
AVERAGE HEAD ON TOP OF LAYER 5	0.002	
MAXIMUM HEAD ON TOP OF LAYER 5	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	2.2 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.00502
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00011
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.58	935137.4370
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2436	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0438	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	2.9002	0.1611
2	382.8594	0.2900
3	0.8029	0.0669
4	0.0030	0.0100
5	0.0000	0.0000
6	7.6860	0.4270

Page 6

7	0.0020	0.0100
8	0.0000	0.0000
9	55.3770	0.4270
SNOW WATER	0.000	

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FINAL COVER

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1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**            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                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\MC\DATA4.D4
TEMPERATURE DATA FILE:       C:\MC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\MC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\MC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\MC\DATA10.D10
OUTPUT DATA FILE:            C:\MC\OUT.OUT


TIME: 12: 7     DATE:  7/21/2016


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

    TITLE: Landfill m-with cover

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


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


                                LAYER  1
                                --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  13
     THICKNESS                  =    36.00   INCHES
     POROSITY                   =     0.4750 VOL/VOL
     FIELD CAPACITY             =     0.3780 VOL/VOL
     WILTING POINT              =     0.2650 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.3289 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.170000003000E-04 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  2.49
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                LAYER  2
                                --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  1
     THICKNESS                  =    18.00   INCHES
                                  Page 1
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```
     POROSITY                   =     0.4170 VOL/VOL
     FIELD CAPACITY             =     0.0410 VOL/VOL
     WILTING POINT              =     0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.0620 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC


                                LAYER  3
                                --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
     THICKNESS                  =  1320.00   INCHES
     POROSITY                   =     0.6710 VOL/VOL
     FIELD CAPACITY             =     0.2920 VOL/VOL
     WILTING POINT              =     0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.2920 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                LAYER  4
                                --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  1
     THICKNESS                  =    12.00   INCHES
     POROSITY                   =     0.4170 VOL/VOL
     FIELD CAPACITY             =     0.0450 VOL/VOL
     WILTING POINT              =     0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.0539 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC


                                LAYER  5
                                --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
     THICKNESS                  =     0.30   INCHES
     POROSITY                   =     0.8500 VOL/VOL
     FIELD CAPACITY             =     0.0100 VOL/VOL
     WILTING POINT              =     0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
     SLOPE                      =     2.00   PERCENT
     DRAINAGE LENGTH            =    50.0    FEET


                                LAYER  6
                                --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
     THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
                                  Page 2
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```
     FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
     FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
     FML PLACEMENT QUALITY      =  3 - GOOD


                                LAYER  7
                                --------

                        TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  15
     THICKNESS                  =    18.00   INCHES
     POROSITY                   =     0.4270 VOL/VOL
     FIELD CAPACITY             =     0.4180 VOL/VOL
     WILTING POINT              =     0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


                                LAYER  8
                                --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
     THICKNESS                  =     0.20   INCHES
     POROSITY                   =     0.8500 VOL/VOL
     FIELD CAPACITY             =     0.0100 VOL/VOL
     WILTING POINT              =     0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
     SLOPE                      =     2.00   PERCENT
     DRAINAGE LENGTH            =    50.0    FEET


                                LAYER  9
                                --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
     THICKNESS                  =     0.06   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.  =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
     FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
     FML PLACEMENT QUALITY      =  3 - GOOD


                                LAYER 10
                                --------

                        TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
     THICKNESS                  =    36.00   INCHES
     POROSITY                   =     0.4270 VOL/VOL
     FIELD CAPACITY             =     0.4180 VOL/VOL
     WILTING POINT              =     0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
                                  Page 3
```

```
     EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-08 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #15 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER            =    91.00
   FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
   EVAPORATIVE ZONE DEPTH             =    36.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE  =    11.841  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE =    17.100  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE =     9.540  INCHES
   INITIAL SNOW WATER                 =     0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS   =   422.108  INCHES
   TOTAL INITIAL WATER                =   422.108  INCHES
   TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR
******************************************************************************

     AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                    JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                    -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS             1.82     1.12     1.09     1.08     1.01     0.79
                      0.33     0.54     0.56     0.88     1.57     1.68

   STD. DEVIATIONS    0.70     0.58     0.47     0.52     0.55     0.55
                      0.31     0.42     0.44     0.62     0.58     0.61

 RUNOFF
 ------
   TOTALS            0.200    0.228    0.042    0.002    0.005    0.003
                     0.000    0.001    0.009    0.003    0.013    0.037

   STD. DEVIATIONS   0.369    0.408    0.152    0.009    0.014    0.010
                     0.001    0.005    0.019    0.011    0.031    0.109

 EVAPOTRANSPIRATION
 ------------------
   TOTALS            0.640    0.725    1.785    1.584    1.176    2.513
                     0.875    0.505    0.401    0.471    0.589    0.656

   STD. DEVIATIONS   0.134    0.350    0.267    0.567    0.540    0.574
                     0.586    0.393    0.306    0.295    0.160    0.121

 LATERAL DRAINAGE COLLECTED FROM LAYER  5
 ----------------------------------------
   TOTALS           0.0134   0.0196   0.0419   0.0407   0.0374   0.0268
                    0.0246   0.0220   0.0189   0.0175   0.0154   0.0147

   STD. DEVIATIONS  0.0100   0.0707   0.1527   0.1011   0.0732   0.0451
                    0.0326   0.0255   0.0196   0.0164   0.0132   0.0117

 PERCOLATION/LEAKAGE THROUGH LAYER  7
 ------------------------------------
                                  Page 4
```

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0001	0.0003	0.0002	0.0001	0.0001
	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 9

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.56 (1.887)	4558664.0	100.00
RUNOFF	0.545 (0.6679)	197961.64	4.343
EVAPOTRANSPIRATION	11.717 (1.4322)	4253096.00	93.297
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.29436 (0.45884)	106854.383	2.34398
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.107	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000 (0.00000)	0.075	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.028	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.002 (1.2019)	751.64	0.016

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	1.15	417450.000
RUNOFF	2.251	817192.6870
DRAINAGE COLLECTED FROM LAYER 5	0.09434	34245.99610
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00214
AVERAGE HEAD ON TOP OF LAYER 6	0.006	
MAXIMUM HEAD ON TOP OF LAYER 6	0.003	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00203
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00011
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.58	935137.4370

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4249

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2650

*** 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 100

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LAYER	(INCHES)	(VOL/VOL)
1	32.0277	0.5341
2	1.0259	0.0570
3	385.4400	0.2920
4	0.7581	0.0692
5	0.0030	0.0101
6	0.0000	0.0000
7	7.6860	0.4270
8	0.0070	0.0100
9	0.0000	0.0000
10	15.3720	0.4270
SNOW WATER	0.000	

Page 7

LANDFILL D

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:      C:\d1nc\DATA4.D4
TEMPERATURE DATA FILE:        C:\d1nc\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\d1nc\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\d1nc\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\d1nc\DATA10.D10
OUTPUT DATA FILE:             C:\d1nc\OUT.OUT

TIME: 11:41     DATE:  4/21/2016

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

   TITLE: D1-without cover

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

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

                          LAYER  1
                          --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  18
   THICKNESS                  =  1200.00    INCHES
   POROSITY                   =     0.6710 VOL/VOL
   FIELD CAPACITY             =     0.2920 VOL/VOL
   WILTING POINT              =     0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.2931 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                          LAYER  2
                          --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  3
   THICKNESS                  =    12.00    INCHES
```

Page 1

```
   POROSITY                   =     0.4570 VOL/VOL
   FIELD CAPACITY             =     0.1310 VOL/VOL
   WILTING POINT              =     0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.2724 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC

                          LAYER  3
                          --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  34
   THICKNESS                  =     0.30    INCHES
   POROSITY                   =     0.8500 VOL/VOL
   FIELD CAPACITY             =     0.0100 VOL/VOL
   WILTING POINT              =     0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.0109 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =   33.0000000000      CM/SEC
   SLOPE                      =     4.00    PERCENT
   DRAINAGE LENGTH            =    50.0     FEET

                          LAYER  4
                          --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
   THICKNESS                  =     0.08    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.  = 0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
   FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
   FML PLACEMENT QUALITY      = 3 - GOOD

                          LAYER  5
                          --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  34
   THICKNESS                  =     0.30    INCHES
   POROSITY                   =     0.8500 VOL/VOL
   FIELD CAPACITY             =     0.0100 VOL/VOL
   WILTING POINT              =     0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =   33.0000000000      CM/SEC
   SLOPE                      =     4.00    PERCENT
   DRAINAGE LENGTH            =    50.0     FEET

                          LAYER  6
                          --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
   THICKNESS                  =     0.08    INCHES
```

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```
   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.  = 0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY        =     2.00    HOLES/ACRE
   FML INSTALLATION DEFECTS   =     2.00    HOLES/ACRE
   FML PLACEMENT QUALITY      = 3 - GOOD

                          LAYER  7
                          --------

                TYPE 3 - BARRIER SOIL LINER
                  MATERIAL TEXTURE NUMBER  17
   THICKNESS                  =     0.24    INCHES
   POROSITY                   =     0.7500 VOL/VOL
   FIELD CAPACITY             =     0.7470 VOL/VOL
   WILTING POINT              =     0.4000 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.7500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.300000003000E-08 CM/SEC

                          LAYER  8
                          --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  13
   THICKNESS                  =    12.00    INCHES
   POROSITY                   =     0.4750 VOL/VOL
   FIELD CAPACITY             =     0.3780 VOL/VOL
   WILTING POINT              =     0.2650 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.3439 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.170000003000E-04 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
       SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
       FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
       AND A SLOPE LENGTH OF   50. FEET.

SCS RUNOFF CURVE NUMBER             =    62.80
FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =   100.000  ACRES
EVAPORATIVE ZONE DEPTH              =    20.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =     7.158  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =    13.420  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =     1.540  INCHES
INITIAL SNOW WATER                  =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =   358.701  INCHES
TOTAL INITIAL WATER                 =   358.701  INCHES
TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

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

  AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
```

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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.88	2.32	3.65	3.47	3.44	3.30
	3.84	3.44	2.68	2.58	2.43	2.71
STD. DEVIATIONS	1.10	0.89	1.06	1.28	1.56	1.20
	1.61	1.77	1.45	1.23	0.95	1.00
RUNOFF						
TOTALS	0.340	0.830	1.839	0.168	0.000	0.000
	0.002	0.000	0.000	0.000	0.000	0.061
STD. DEVIATIONS	0.543	0.812	1.342	0.395	0.000	0.000
	0.009	0.004	0.000	0.000	0.000	0.278
EVAPOTRANSPIRATION						
TOTALS	0.599	0.482	0.987	3.411	3.574	4.561
	4.212	3.214	2.126	1.478	1.098	0.773
STD. DEVIATIONS	0.141	0.132	0.536	0.584	1.110	0.957
	1.356	1.346	0.895	0.297	0.187	0.175
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.6100	0.2708	0.1035	0.8148	1.1584	1.3341
	0.4182	0.1486	0.1042	0.1056	0.1651	0.3407
STD. DEVIATIONS	0.8793	0.4737	0.1431	0.6532	0.6030	0.9760
	0.6093	0.1157	0.1213	0.1863	0.3254	0.4740
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0189	0.0124	0.0085	0.0192	0.0471	0.0327
	0.0174	0.0116	0.0093	0.0087	0.0092	0.0126
STD. DEVIATIONS	0.0124	0.0092	0.0039	0.0119	0.0089	0.0143
	0.0098	0.0031	0.0022	0.0037	0.0064	0.0097
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.0189	0.0124	0.0085	0.0192	0.0471	0.0327
	0.0174	0.0116	0.0093	0.0087	0.0092	0.0125
STD. DEVIATIONS	0.0124	0.0092	0.0039	0.0119	0.0089	0.0147
	0.0099	0.0031	0.0023	0.0037	0.0064	0.0095
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0007	0.0006	0.0006	0.0005	0.0007	0.0006
	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005
STD. DEVIATIONS	0.0019	0.0015	0.0014	0.0014	0.0015	0.0014
	0.0013	0.0013	0.0012	0.0011	0.0009	0.0009

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0001	0.0001	0.0000	0.0002	0.0005	0.0003
	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0001	0.0001	0.0000	0.0001	0.0001	0.0002
	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001

DAILY AVERAGE HEAD ON TOP OF LAYER 6

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	36.72	(4.356)	13329905.0	100.00
RUNOFF	3.236	(1.7185)	1174655.37	8.812
EVAPOTRANSPIRATION	26.512	(2.9560)	9623941.00	72.198
LATERAL DRAINAGE COLLECTED FROM LAYER 3	6.77366	(2.01345)	2458837.500	18.44602
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.20695	(0.03887)	75121.352	0.56356
AVERAGE HEAD ON TOP OF LAYER 4	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.20695	(0.03887)	75121.328	0.56355
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.019	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00729	(0.01549)	2646.523	0.01985
CHANGE IN WATER STORAGE	-0.015	(1.9985)	-5294.97	-0.040

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.44	1611720.000
RUNOFF	3.629	1317258.2500
DRAINAGE COLLECTED FROM LAYER 3	0.17254	62632.38670
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.002417	877.45715
AVERAGE HEAD ON TOP OF LAYER 4	0.001	
MAXIMUM HEAD ON TOP OF LAYER 4	0.002	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	2.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.00242	877.45703
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000	
MAXIMUM HEAD ON TOP OF LAYER 6	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000553	200.85625
SNOW WATER	5.36	1947431.6200
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5691	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770	

Page 5

Page 6

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	351.7254	0.2931
2	1.9172	0.1598
3	0.0010	0.0100
4	0.0000	0.0000
5	0.0010	0.0100
6	0.0000	0.0000
7	0.1800	0.7500
8	3.3983	0.2832
SNOW WATER	0.015	

Page 7

FINAL COVER

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\D1C\DATA4.D4
TEMPERATURE DATA FILE:       C:\D1C\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\D1C\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\D1C\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\D1C\DATA10.D10
OUTPUT DATA FILE:            C:\D1C\OUT.OUT

TIME: 11:21     DATE:  4/21/2016

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

    TITLE:  D1-with cover

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

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

                            LAYER  1
                            --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   1
  THICKNESS                  =     24.00    INCHES
  POROSITY                   =      0.4170 VOL/VOL
  FIELD CAPACITY             =      0.0450 VOL/VOL
  WILTING POINT              =      0.0180 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0658 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                            LAYER  2
                            --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.30    INCHES
                            Page 1
```

```
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0101 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
  SLOPE                      =      3.00    PERCENT
  DRAINAGE LENGTH            =     50.0     FEET

                            LAYER  3
                            --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  36
  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.  =  0.399999993000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00    HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00    HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD

                            LAYER  4
                            --------

              TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  17
  THICKNESS                  =      0.24    INCHES
  POROSITY                   =      0.7500 VOL/VOL
  FIELD CAPACITY             =      0.7470 VOL/VOL
  WILTING POINT              =      0.4000 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.7500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.300000003000E-08 CM/SEC

                            LAYER  5
                            --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  15
  THICKNESS                  =     12.00    INCHES
  POROSITY                   =      0.4750 VOL/VOL
  FIELD CAPACITY             =      0.3780 VOL/VOL
  WILTING POINT              =      0.2650 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.3780 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.170000003000E-04 CM/SEC

                            LAYER  6
                            --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  18
  THICKNESS                  =   1200.00    INCHES
  POROSITY                   =      0.6710 VOL/VOL
  FIELD CAPACITY             =      0.2920 VOL/VOL
                            Page 2
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```
  WILTING POINT              =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.2920 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                            LAYER  7
                            --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   5
  THICKNESS                  =     12.00    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

                            LAYER  8
                            --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.30    INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
  SLOPE                      =      4.00    PERCENT
  DRAINAGE LENGTH            =     50.0     FEET

                            LAYER  9
                            --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.06    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.  =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00    HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00    HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD

                            LAYER 10
                            --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  34
  THICKNESS                  =      0.30    INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
                            Page 3
```

```
  EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
  SLOPE                      =      4.00    PERCENT
  DRAINAGE LENGTH            =     50.0     FEET

                            LAYER 11
                            --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.06    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.  =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00    HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00    HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD

                            LAYER 12
                            --------

              TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  17
  THICKNESS                  =      0.24    INCHES
  POROSITY                   =      0.7500 VOL/VOL
  FIELD CAPACITY             =      0.7470 VOL/VOL
  WILTING POINT              =      0.4000 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.7500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.300000003000E-08 CM/SEC

                            LAYER 13
                            --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  15
  THICKNESS                  =     12.00    INCHES
  POROSITY                   =      0.4750 VOL/VOL
  FIELD CAPACITY             =      0.3780 VOL/VOL
  WILTING POINT              =      0.2650 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.3423 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.170000003000E-04 CM/SEC

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF   50. FEET.

  SCS RUNOFF CURVE NUMBER             =     51.80
  FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE  =    100.000  ACRES
                            Page 4
```

EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.249	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.740	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.360	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	362.364	INCHES
TOTAL INITIAL WATER	=	362.364	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.88	2.32	3.65	3.47	3.44	3.30
	3.84	3.44	2.60	2.56	2.43	2.71
STD. DEVIATIONS	1.10	0.89	1.06	1.29	1.58	1.20
	1.61	1.77	1.45	1.23	0.95	1.00
RUNOFF						
TOTALS	0.318	0.811	1.838	0.168	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.055
STD. DEVIATIONS	0.533	0.815	1.323	0.400	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.213
EVAPOTRANSPIRATION						
TOTALS	0.349	0.467	0.998	2.493	1.126	0.837
	1.009	0.956	0.681	0.443	0.366	0.491
STD. DEVIATIONS	0.100	0.134	0.375	0.713	0.738	0.313
	0.699	0.749	0.668	0.351	0.269	0.181
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.2939	0.0653	1.8791	2.8641	2.6027	2.4475
	2.7951	2.4299	2.0838	2.1293	1.9664	1.5399
STD. DEVIATIONS	0.4573	0.2333	1.4011	1.3431	1.1023	0.9285
	1.0819	1.0511	1.0024	0.9598	0.7329	0.9063
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						

Page 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 12						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 13						
TOTALS	0.0007	0.0006	0.0007	0.0006	0.0006	0.0006
	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005
STD. DEVIATIONS	0.0017	0.0014	0.0013	0.0014	0.0015	0.0012
	0.0012	0.0012	0.0011	0.0011	0.0010	0.0010

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0001	0.0000	0.0005	0.0006	0.0005	0.0005
	0.0005	0.0005	0.0004	0.0004	0.0004	0.0003
STD. DEVIATIONS	0.0001	0.0000	0.0004	0.0004	0.0002	0.0002
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
DAILY AVERAGE HEAD ON TOP OF LAYER 9						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAILY AVERAGE HEAD ON TOP OF LAYER 11						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT

Page 6

	INCHES	(STD. DEV.)	CU. FEET	PERCENT
PRECIPITATION	36.72	(4.356)	13329905.0	100.00
RUNOFF	3.189	(1.7079)	1157736.00	8.685
EVAPOTRANSPIRATION	10.416	(1.7402)	3780964.25	28.365
LATERAL DRAINAGE COLLECTED FROM LAYER 2	23.09707	(3.15494)	8384236.000	62.89785
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	1.629	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000	(0.00000)	0.251	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000	(0.00000)	1.377	0.00001
AVERAGE HEAD ON TOP OF LAYER 9	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 10	0.00000	(0.00000)	1.337	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 12	0.00000	(0.00000)	0.020	0.00000
AVERAGE HEAD ON TOP OF LAYER 11	0.000	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.00715	(0.01495)	2597.124	0.01948
CHANGE IN WATER STORAGE	0.012	(1.2126)	4371.39	0.033

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.44	1611720.000
RUNOFF	3.596	1305284.1200
DRAINAGE COLLECTED FROM LAYER 2	3.76134	1365364.75000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.01378
AVERAGE HEAD ON TOP OF LAYER 3	0.040	
MAXIMUM HEAD ON TOP OF LAYER 3	0.040	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.1 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00214
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00792
AVERAGE HEAD ON TOP OF LAYER 9	0.000	

Page 7

MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 10	0.00000	0.00784
PERCOLATION/LEAKAGE THROUGH LAYER 12	0.000000	0.00006
AVERAGE HEAD ON TOP OF LAYER 11	0.000	
MAXIMUM HEAD ON TOP OF LAYER 11	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 10 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 13	0.000490	177.79172
SNOW WATER	5.36	1947431.6200
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3428	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	3.4845	0.1452
2	0.0030	0.0100
3	0.0000	0.0000
4	0.1800	0.7500
5	4.5360	0.3780
6	350.3999	0.2920
7	1.5720	0.1310
8	0.0030	0.0100
9	0.0000	0.0000
10	0.0030	0.0100
11	0.0000	0.0000
12	0.1800	0.7500

Page 8

```
            13            3.3916         0.2826
          SNOW WATER      0.015
*****************************************************************************
*****************************************************************************
```

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LANDFILL F

INTERMEDIATE COVER

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

PRECIPITATION DATA FILE:     C:\FNC\DATA4.D4
TEMPERATURE DATA FILE:       C:\FNC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\FNC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\FNC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\FNC\DATA10.D10
OUTPUT DATA FILE:            C:\FNC\OUT.OUT

TIME: 15:24      DATE:  6/ 3/2016

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

   TITLE: F1-without cover

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

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

                                LAYER  1
                                --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
     THICKNESS                  =    600.00   INCHES
     POROSITY                   =      0.6710 VOL/VOL
     FIELD CAPACITY             =      0.2920 VOL/VOL
     WILTING POINT              =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT =      0.2965 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                LAYER  2
                                --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
     THICKNESS                  =      0.20   INCHES
                                  Page 1
```

```
     POROSITY                   =      0.8500 VOL/VOL
     FIELD CAPACITY             =      0.0100 VOL/VOL
     WILTING POINT              =      0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT =      0.0155 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =   33.0000000000     CM/SEC
     SLOPE                      =      2.00   PERCENT
     DRAINAGE LENGTH            =     50.0    FEET

                                LAYER  3
                                --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
     THICKNESS                  =      0.08   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.  =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
     FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
     FML PLACEMENT QUALITY      =  5 - GOOD

                                LAYER  4
                                --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER  34
     THICKNESS                  =      0.20   INCHES
     POROSITY                   =      0.8500 VOL/VOL
     FIELD CAPACITY             =      0.0100 VOL/VOL
     WILTING POINT              =      0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =   33.0000000000     CM/SEC
     SLOPE                      =      2.00   PERCENT
     DRAINAGE LENGTH            =     50.0    FEET

                                LAYER  5
                                --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
     THICKNESS                  =      0.08   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.  =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
     FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
     FML PLACEMENT QUALITY      =  5 - GOOD

                                LAYER  6
                                --------
                                  Page 2
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```
                     TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  16
     THICKNESS                  =     36.00   INCHES
     POROSITY                   =      0.4270 VOL/VOL
     FIELD CAPACITY             =      0.4180 VOL/VOL
     WILTING POINT              =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER            =     63.60
   FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE =    100.000  ACRES
   EVAPORATIVE ZONE DEPTH             =     20.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE  =      7.400  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE =     13.420  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE =      1.540  INCHES
   INITIAL SNOW WATER                 =      0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS   =    103.262  INCHES
   TOTAL INITIAL WATER                =    103.262  INCHES
   TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR

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

     AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH  100
------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS               2.43     2.36     3.19     3.00     3.33     3.10
                        2.90     3.23     3.35     2.99     3.09     3.00

   STD. DEVIATIONS      1.03     1.06     1.72     1.16     1.35     1.34
                        1.02     1.37     1.80     1.64     1.27     1.34

 RUNOFF
 ------
   TOTALS              0.099    0.494    3.208    0.589    0.080    0.000
                       0.000    0.000    0.002    0.001    0.009    0.079

   STD. DEVIATIONS     0.257    0.784    1.882    0.864    0.001    0.000
                       0.000    0.000    0.018    0.008    0.092    0.170

 EVAPOTRANSPIRATION
 ------------------
   TOTALS              0.560    0.503    0.566    2.648    3.476    5.841
                       4.215    2.967    2.111    1.440    0.927    0.534

   STD. DEVIATIONS     0.081    0.089    0.236    0.706    0.905    1.018
                       1.190    0.955    0.718    0.307    0.163    0.102

 LATERAL DRAINAGE COLLECTED FROM LAYER  2
 ----------------------------------------
                                  Page 3
```

```
   TOTALS             0.7074   0.0767   0.0217   0.9933   2.6072   1.1118
                      0.1365   0.0106   0.0289   0.2363   0.5934   0.9757

   STD. DEVIATIONS    1.0316   0.3458   0.0801   0.7147   0.7004   0.9871
                      0.5093   0.0819   0.1176   0.4156   0.6928   0.7507

 PERCOLATION/LEAKAGE THROUGH LAYER  3
 ------------------------------------
   TOTALS             0.0182   0.0019   0.0008   0.0256   0.0692   0.0298
                      0.0044   0.0004   0.0011   0.0081   0.0194   0.0204

   STD. DEVIATIONS    0.0266   0.0088   0.0027   0.0197   0.0176   0.0254
                      0.0132   0.0021   0.0040   0.0133   0.0205   0.0215

 LATERAL DRAINAGE COLLECTED FROM LAYER  4
 ----------------------------------------
   TOTALS             0.0182   0.0018   0.0008   0.0296   0.0692   0.0298
                      0.0044   0.0004   0.0011   0.0081   0.0194   0.0304

   STD. DEVIATIONS    0.0266   0.0088   0.0027   0.0197   0.0176   0.0258
                      0.0132   0.0021   0.0040   0.0133   0.0205   0.0215

 PERCOLATION/LEAKAGE THROUGH LAYER  6
 ------------------------------------
   TOTALS             0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

------------------------------------------------------------------------------
           AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  3
 -------------------------------------
   AVERAGES           0.0003   0.0000   0.0000   0.0004   0.0011   0.0005
                      0.0001   0.0000   0.0000   0.0001   0.0003   0.0004

   STD. DEVIATIONS    0.0004   0.0002   0.0000   0.0003   0.0003   0.0004
                      0.0002   0.0000   0.0001   0.0002   0.0003   0.0003

 DAILY AVERAGE HEAD ON TOP OF LAYER  5
 -------------------------------------
   AVERAGES           0.0001   0.0000   0.0000   0.0001   0.0002   0.0001
                      0.0000   0.0000   0.0000   0.0000   0.0001   0.0001

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

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

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    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------
                                   INCHES            CU. FEET     PERCENT
                             -------------------   ----------   ---------
 PRECIPITATION                36.01   (  4.686)    13070655.0    100.00

 RUNOFF                        4.482  (  2.2596)    1626878.37    12.447

 EVAPOTRANSPIRATION           23.787  (  2.3898)    8634780.00    66.062

 LATERAL DRAINAGE COLLECTED    7.51880 (  2.18816)  2729142.000   20.87992
                                  Page 4
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```
  FROM LAYER  2

PERCOLATION/LEAKAGE THROUGH     0.23327 (  0.06097)    77417.992     0.59230
  LAYER  3

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  3

LATERAL DRAINAGE COLLECTED      0.23327 (  0.06097)    77417.898     0.59250
  FROM LAYER  4

PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.082     0.00000
  LAYER  6

AVERAGE HEAD ON TOP             0.000 (    0.000)
  OF LAYER  5

CHANGE IN WATER STORAGE         0.007   (  2.7107)      2430.83      0.019

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

          PEAK DAILY VALUES FOR YEARS    1 THROUGH  100
      ------------------------------------------------------------------------
                                                   (INCHES)      (CU. FT.)
                                                  ----------    -------------
      PRECIPITATION                                  4.86       1764180.000

      RUNOFF                                         4.412      1601438.5000

      DRAINAGE COLLECTED FROM LAYER  2               0.18017      65402.45700

      PERCOLATION/LEAKAGE THROUGH LAYER  3           0.003490      1266.87085

      AVERAGE HEAD ON TOP OF LAYER  3                0.002

      MAXIMUM HEAD ON TOP OF LAYER  3                0.005

      LOCATION OF MAXIMUM HEAD IN LAYER  2
             (DISTANCE FROM DRAIN)                   1.3 FEET

      DRAINAGE COLLECTED FROM LAYER  4               0.00349       1268.87061

      PERCOLATION/LEAKAGE THROUGH LAYER  6           0.000000         0.00132

      AVERAGE HEAD ON TOP OF LAYER  5                0.000

      MAXIMUM HEAD ON TOP OF LAYER  5                0.001

      LOCATION OF MAXIMUM HEAD IN LAYER  4
             (DISTANCE FROM DRAIN)                   0.0 FEET

      SNOW WATER                                    10.70       3884699.2500

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                        0.5587

      MINIMUM VEG. SOIL WATER (VOL/VOL)                        0.0770

      ***  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.

                                   Page 5
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*******************************************************************************
*
*******************************************************************************

          FINAL WATER STORAGE AT END OF YEAR  100
      ----------------------------------------------------------------------
              LAYER        (INCHES)       (VOL/VOL)
              -----        --------       ---------
                1          174.9037         0.2915

                2            0.0020         0.0100

                3            0.0000         0.0000

                4            0.0020         0.0100

                5            0.0000         0.0000

                6           15.3720         0.4270

           SNOW WATER        3.651

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

                                   Page 6
```

FINAL COVER

```
1
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\FC\DATA4.D4
TEMPERATURE DATA FILE:       C:\FC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\FC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\FC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\FC\DATA10.D10
OUTPUT DATA FILE:            C:\FC\OUT.OUT

TIME:  15:17     DATE:   6/ 3/2016

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

     TITLE:  F1-with cover

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

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

                              LAYER  1
                              --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =    12.00    INCHES
       POROSITY                     =     0.4170 VOL/VOL
       FIELD CAPACITY               =     0.0450 VOL/VOL
       WILTING POINT                =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.2672 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY   3.00
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =    12.00    INCHES
                                 Page 1
```

```
       POROSITY                     =     0.4170 VOL/VOL
       FIELD CAPACITY               =     0.0410 VOL/VOL
       WILTING POINT                =     0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.0909 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
       SLOPE                        =    10.00    PERCENT
       DRAINAGE LENGTH              =    50.0     FEET

                              LAYER  3
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  36
       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.    =  0.399999993000E-12 CM/SEC
       FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY        =  3 - GOOD

                              LAYER  4
                              --------

                     TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  17
       THICKNESS                    =     0.24    INCHES
       POROSITY                     =     0.7500 VOL/VOL
       FIELD CAPACITY               =     0.7470 VOL/VOL
       WILTING POINT                =     0.4000 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.7500 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC

                              LAYER  5
                              --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
       THICKNESS                    =   600.00    INCHES
       POROSITY                     =     0.6710 VOL/VOL
       FIELD CAPACITY               =     0.2920 VOL/VOL
       WILTING POINT                =     0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.2920 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                              LAYER  6
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
       THICKNESS                    =     0.20    INCHES
       POROSITY                     =     0.8500 VOL/VOL
       FIELD CAPACITY               =     0.0100 VOL/VOL
                                 Page 2
```

```
       WILTING POINT                =     0.0050 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.0100 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
       SLOPE                        =     2.00    PERCENT
       DRAINAGE LENGTH              =    50.0     FEET

                              LAYER  7
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
       THICKNESS                    =     0.08    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.    =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY        =  3 - GOOD

                              LAYER  8
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  34
       THICKNESS                    =     0.20    INCHES
       POROSITY                     =     0.8500 VOL/VOL
       FIELD CAPACITY               =     0.0100 VOL/VOL
       WILTING POINT                =     0.0050 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.0100 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  33.0000000000      CM/SEC
       SLOPE                        =     2.00    PERCENT
       DRAINAGE LENGTH              =    50.0     FEET

                              LAYER  9
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
       THICKNESS                    =     0.08    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.    =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY          =     2.00    HOLES/ACRE
       FML INSTALLATION DEFECTS     =     2.00    HOLES/ACRE
       FML PLACEMENT QUALITY        =  3 - GOOD

                              LAYER 10
                              --------

                     TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
                                 Page 3
```

```
       THICKNESS                    =    36.00    INCHES
       POROSITY                     =     0.4270 VOL/VOL
       FIELD CAPACITY               =     0.4180 VOL/VOL
       WILTING POINT                =     0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.%
           AND A SLOPE LENGTH OF   50. FEET.

    SCS RUNOFF CURVE NUMBER             =    38.40
    FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE  =   100.000  ACRES
    EVAPORATIVE ZONE DEPTH              =    20.0    INCHES
    INITIAL WATER IN EVAPORATIVE ZONE   =     4.135  INCHES
    UPPER LIMIT OF EVAPORATIVE STORAGE  =     8.340  INCHES
    LOWER LIMIT OF EVAPORATIVE STORAGE  =     0.360  INCHES
    INITIAL SNOW WATER                  =     0.000  INCHES
    INITIAL WATER IN LAYER MATERIALS    =   195.053  INCHES
    TOTAL INITIAL WATER                 =   195.053  INCHES
    TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

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

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                 JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                 -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS          2.43     2.36     3.19     3.00     3.33     3.10
                   2.93     3.23     5.35     2.99     3.09     3.00

   STD. DEVIATIONS 1.03     1.06     1.32     1.16     1.35     1.34
                   1.02     1.37     1.80     1.64     1.27     1.34

 RUNOFF
 ------
   TOTALS          0.112    0.557    3.560    0.659    0.000    0.000
                   0.000    0.000    0.000    0.000    0.010    0.098

   STD. DEVIATIONS 0.288    0.865    2.017    0.949    0.000    0.000
                   0.000    0.000    0.000    0.000    0.095    0.197

 EVAPOTRANSPIRATION
 ------------------
   TOTALS          0.560    0.502    0.552    2.071    1.773    2.976
                   2.819    2.788    2.045    1.500    0.993    0.547

   STD. DEVIATIONS 0.081    0.090    0.127    0.704    0.758    1.004
                   1.014    0.925    0.737    0.394    0.198    0.114

 LATERAL DRAINAGE COLLECTED FROM LAYER  2
 ----------------------------------------
   TOTALS          0.0242   0.0000   0.8243   4.0221   0.6125   0.5080
                   0.2392   0.2433   0.7719   1.2802   1.3615   1.0877
                                 Page 4
```

STD. DEVIATIONS	0.0742	0.0000	1.5663	1.6387	0.7115	0.5302
	0.2864	0.3237	0.9086	1.4482	1.1085	0.9998

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0069	0.0000	0.2364	1.1872	0.1759	0.1508
	0.0087	0.0699	0.2173	0.3679	0.4043	0.2923
STD. DEVIATIONS	0.0213	0.0000	0.4492	0.4815	0.2045	0.1574
	0.0823	0.0930	0.2698	0.4161	0.3291	0.2873

DAILY AVERAGE HEAD ON TOP OF LAYER 7

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

DAILY AVERAGE HEAD ON TOP OF LAYER 9

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.01 (4.686)	13070655.0	100.00
RUNOFF	4.994 (2.4105)	1812754.62	13.869
EVAPOTRANSPIRATION	20.130 (2.2028)	7307047.00	55.904
LATERAL DRAINAGE COLLECTED FROM LAYER 2	10.86420 (2.80777)	3943703.000	30.17219
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00006 (0.00001)	21.696	0.00017
AVERAGE HEAD ON TOP OF LAYER 3	0.263 (0.068)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00002 (0.00001)	8.477	0.00006
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00004 (0.00001)	13.269	0.00010
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00004 (0.00001)	13.236	0.00010
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.033	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.020 (1.9579)	7124.30	0.055

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.86	1764180.000
RUNOFF	4.507	1636222.0000
DRAINAGE COLLECTED FROM LAYER 2	1.48375	538602.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000010	3.80575
AVERAGE HEAD ON TOP OF LAYER 3	11.235	

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MAXIMUM HEAD ON TOP OF LAYER 3	17.345	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	16.5 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00001	2.47299
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000004	1.33276
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	1.33265
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00011
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.008	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	10.70	3884699.2500
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3495	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180	

*** 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 100

LAYER	(INCHES)	(VOL/VOL)
1	2.0464	0.1705
2	0.1619	0.0468
3	0.0000	0.0000
4	0.1800	0.7500
5	175.2000	0.2920
6	0.0020	0.0100
7	0.0000	0.0000
8	0.0020	0.0100

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9	0.0000	0.0000
10	15.3720	0.4270
SNOW WATER	3.651	

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30-YEAR DURATION

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

PRECIPITATION DATA FILE:      C:\FNC\DATA4.D4
TEMPERATURE DATA FILE:        C:\FNC\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\FNC\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\FNC\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\FNC\DATA10.D10
OUTPUT DATA FILE:             C:\FNC\OUT.OUT

TIME: 18:40     DATE:  9/ 3/2016

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

    TITLE: F Pre-closure

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

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

                                 LAYER 1
                                 --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER 18
    THICKNESS                  =   600.00   INCHES
    POROSITY                   =     0.6710 VOL/VOL
    FIELD CAPACITY             =     0.2920 VOL/VOL
    WILTING POINT              =     0.0770 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.2965 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                 LAYER 2
                                 --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER 34
    THICKNESS                  =     0.20   INCHES
```

Page 1

```
    POROSITY                   =     0.8500 VOL/VOL
    FIELD CAPACITY             =     0.0100 VOL/VOL
    WILTING POINT              =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.0156 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
    SLOPE                      =     2.00   PERCENT
    DRAINAGE LENGTH            =    50.0    FEET

                                 LAYER 3
                                 --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER 35
    THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY      =  5 - GOOD

                                 LAYER 4
                                 --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER 34
    THICKNESS                  =     0.20   INCHES
    POROSITY                   =     0.8500 VOL/VOL
    FIELD CAPACITY             =     0.0100 VOL/VOL
    WILTING POINT              =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
    SLOPE                      =     2.00   PERCENT
    DRAINAGE LENGTH            =    50.0    FEET

                                 LAYER 5
                                 --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER 35
    THICKNESS                  =     0.08   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.  =  0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY        =     2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS   =     2.00   HOLES/ACRE
    FML PLACEMENT QUALITY      =  5 - GOOD

                                 LAYER 6
                                 --------
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                  TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER 16
    THICKNESS                  =    36.00   INCHES
    POROSITY                   =     0.4270 VOL/VOL
    FIELD CAPACITY             =     0.4180 VOL/VOL
    WILTING POINT              =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

             GENERAL DESIGN AND EVAPORATIVE ZONE DATA
             ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER            =    63.60
   FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE =   100.000  ACRES
   EVAPORATIVE ZONE DEPTH             =    20.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE  =     7.399  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE =    13.420  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE =     1.540  INCHES
   INITIAL SNOW WATER                 =     0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS   =   193.301  INCHES
   TOTAL INITIAL WATER                =   193.301  INCHES
   TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR

****************************************************************************
```

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.09	13100673.000	100.00
RUNOFF	4.219	1531430.870	11.69
EVAPOTRANSPIRATION	24.096	8746710.000	66.77
DRAINAGE COLLECTED FROM LAYER 2	7.5251	2731605.500	20.85
PERC./LEAKAGE THROUGH LAYER 3	0.212660	77195.064	0.59
AVG. HEAD ON TOP OF LAYER 3	0.0003		
DRAINAGE COLLECTED FROM LAYER 4	0.2127	77195.394	0.59
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.062	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.038	13731.033	0.10
SOIL WATER AT START OF YEAR	193.303	70168824.000	
SOIL WATER AT END OF YEAR	193.340	70182552.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL WATER BUDGET BALANCE	0.0000	0.040	0.00

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.59	14008175.000	100.00
RUNOFF	6.721	2440591.000	17.42
EVAPOTRANSPIRATION	22.017	7992187.000	57.05
DRAINAGE COLLECTED FROM LAYER 2	10.1858	3697431.500	26.39
PERC./LEAKAGE THROUGH LAYER 3	0.277576	100760.016	0.72
AVG. HEAD ON TOP OF LAYER 3	0.0004		
DRAINAGE COLLECTED FROM LAYER 4	0.2776	100759.883	0.72
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.084	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	-0.614	-222798.937	-1.59
SOIL WATER AT START OF YEAR	193.340	70182552.000	
SOIL WATER AT END OF YEAR	191.922	69667864.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.804	291892.500	2.08
ANNUAL WATER BUDGET BALANCE	0.0000	0.436	0.00

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.66	16574580.000	100.00
RUNOFF	6.250	2268714.000	13.69
EVAPOTRANSPIRATION	27.262	9896217.000	59.71
DRAINAGE COLLECTED FROM LAYER 2	11.9678	4344309.500	26.21
PERC./LEAKAGE THROUGH LAYER 3	0.326491	118516.344	0.72
AVG. HEAD ON TOP OF LAYER 3	0.0004		

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	INCHES	CU. FEET	PERCENT
DRAINAGE COLLECTED FROM LAYER 4	0.3265	118516.258	0.72
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.073	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	-0.146	-53177.398	-0.32
SOIL WATER AT START OF YEAR	191.922	69667864.000	
SOIL WATER AT END OF YEAR	190.266	69066712.000	
SNOW WATER AT START OF YEAR	0.804	291892.500	1.76
SNOW WATER AT END OF YEAR	2.314	839867.375	5.07
ANNUAL WATER BUDGET BALANCE	0.0000	0.490	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.34	11739421.000	100.00
RUNOFF	5.433	1972777.120	16.80
EVAPOTRANSPIRATION	19.229	6980003.000	59.46
DRAINAGE COLLECTED FROM LAYER 2	6.8429	2483965.750	21.16
PERC./LEAKAGE THROUGH LAYER 3	0.195291	70890.594	0.60
AVG. HEAD ON TOP OF LAYER 3	0.0002		
DRAINAGE COLLECTED FROM LAYER 4	0.1953	70890.531	0.60
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.063	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.639	231778.687	1.97
SOIL WATER AT START OF YEAR	190.266	69066712.000	
SOIL WATER AT END OF YEAR	191.880	69652576.000	
SNOW WATER AT START OF YEAR	2.314	839867.375	7.15
SNOW WATER AT END OF YEAR	1.338	485781.250	4.14
ANNUAL WATER BUDGET BALANCE	0.0000	6.282	0.00

ANNUAL TOTALS FOR YEAR 5

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	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.14	10940819.000	100.00
RUNOFF	3.665	1330323.250	12.16
EVAPOTRANSPIRATION	23.674	8593752.000	78.55
DRAINAGE COLLECTED FROM LAYER 2	5.6595	2054412.870	18.78
PERC./LEAKAGE THROUGH LAYER 3	0.153775	55820.301	0.51
AVG. HEAD ON TOP OF LAYER 3	0.0002		
DRAINAGE COLLECTED FROM LAYER 4	0.1538	55820.258	0.51
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.051	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-3.012	-1093488.500	-9.99
SOIL WATER AT START OF YEAR	191.880	69652576.000	
SOIL WATER AT END OF YEAR	189.637	68838384.000	
SNOW WATER AT START OF YEAR	1.338	485781.250	4.44
SNOW WATER AT END OF YEAR	0.569	206485.797	1.89
ANNUAL WATER BUDGET BALANCE	0.0000	-2.825	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.88	13024440.000	100.00
RUNOFF	4.499	1633230.500	12.54
EVAPOTRANSPIRATION	22.806	8278609.000	63.56
DRAINAGE COLLECTED FROM LAYER 2	7.7172	2801326.250	21.51
PERC./LEAKAGE THROUGH LAYER 3	0.228493	82940.102	0.64
AVG. HEAD ON TOP OF LAYER 3	0.0003		
DRAINAGE COLLECTED FROM LAYER 4	0.2285	82940.047	0.64
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.062	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.629	228335.953	1.75
SOIL WATER AT START OF YEAR	189.637	68838384.000	
SOIL WATER AT END OF YEAR	189.854	68916864.000	

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	INCHES	CU. FEET	PERCENT
SNOW WATER AT START OF YEAR	0.569	206485.797	1.59
SNOW WATER AT END OF YEAR	0.982	356340.500	2.74
ANNUAL WATER BUDGET BALANCE	0.0000	-1.463	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.17	15307713.000	100.00
RUNOFF	2.261	820702.312	5.36
EVAPOTRANSPIRATION	28.290	10269233.000	67.09
DRAINAGE COLLECTED FROM LAYER 2	9.1079	3306184.250	21.60
PERC./LEAKAGE THROUGH LAYER 3	0.285997	103816.953	0.68
AVG. HEAD ON TOP OF LAYER 3	0.0003		
DRAINAGE COLLECTED FROM LAYER 4	0.2860	103816.891	0.68
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.081	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	2.225	807777.062	5.28
SOIL WATER AT START OF YEAR	189.854	68916864.000	
SOIL WATER AT END OF YEAR	190.806	69262576.000	
SNOW WATER AT START OF YEAR	0.982	356340.500	2.33
SNOW WATER AT END OF YEAR	2.255	818404.687	5.35
ANNUAL WATER BUDGET BALANCE	0.0000	-0.048	0.00

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.45	14683348.000	100.00
RUNOFF	3.262	1184259.000	8.07
EVAPOTRANSPIRATION	26.223	9519058.000	64.83
DRAINAGE COLLECTED FROM LAYER 2	8.5039	3086916.500	21.02

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	INCHES	CU. FEET	PERCENT
PERC./LEAKAGE THROUGH LAYER 3	0.238386	86534.102	0.59
AVG. HEAD ON TOP OF LAYER 3	0.0003		
DRAINAGE COLLECTED FROM LAYER 4	0.2384	86534.016	0.59
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.073	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	2.222	806591.062	5.49
SOIL WATER AT START OF YEAR	190.806	69262576.000	
SOIL WATER AT END OF YEAR	194.331	70541976.000	
SNOW WATER AT START OF YEAR	2.255	818404.687	5.57
SNOW WATER AT END OF YEAR	0.952	345600.187	2.35
ANNUAL WATER BUDGET BALANCE	0.0000	-10.735	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.33	11735792.000	100.00
RUNOFF	2.517	913644.750	7.79
EVAPOTRANSPIRATION	24.679	8958360.000	76.33
DRAINAGE COLLECTED FROM LAYER 2	9.3429	3391477.000	28.90
PERC./LEAKAGE THROUGH LAYER 3	0.260325	94498.070	0.81
AVG. HEAD ON TOP OF LAYER 3	0.0003		
DRAINAGE COLLECTED FROM LAYER 4	0.2603	94497.977	0.81
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.075	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	-4.469	-1622201.120	-13.82
SOIL WATER AT START OF YEAR	194.331	70541976.000	
SOIL WATER AT END OF YEAR	189.975	68960896.000	
SNOW WATER AT START OF YEAR	0.952	345600.187	2.94
SNOW WATER AT END OF YEAR	0.839	304478.531	2.59
ANNUAL WATER BUDGET BALANCE	0.0000	13.121	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.62	11478065.000	100.00
RUNOFF	1.602	581706.125	5.07
EVAPOTRANSPIRATION	24.803	9003416.000	78.44
DRAINAGE COLLECTED FROM LAYER 2	3.2992	1197622.370	10.43
PERC./LEAKAGE THROUGH LAYER 3	0.097550	35410.762	0.31
AVG. HEAD ON TOP OF LAYER 3	0.0001		
DRAINAGE COLLECTED FROM LAYER 4	0.0976	35410.711	0.31
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.041	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	1.818	659901.300	5.75
SOIL WATER AT START OF YEAR	189.975	68960896.000	
SOIL WATER AT END OF YEAR	188.879	68563024.000	
SNOW WATER AT START OF YEAR	0.839	304478.331	2.65
SNOW WATER AT END OF YEAR	3.753	1362247.620	11.87
ANNUAL WATER BUDGET BALANCE	0.0000	8.283	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.18	9503341.000	100.00
RUNOFF	2.033	737964.437	7.77
EVAPOTRANSPIRATION	19.691	7147921.000	75.21
DRAINAGE COLLECTED FROM LAYER 2	5.3231	1932298.120	20.33
PERC./LEAKAGE THROUGH LAYER 3	0.158371	57488.504	0.60
AVG. HEAD ON TOP OF LAYER 3	0.0002		
DRAINAGE COLLECTED FROM LAYER 4	0.1584	57488.453	0.60
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.059	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-1.026	-372338.312	-3.92

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	INCHES	CU. FEET	PERCENT
SOIL WATER AT START OF YEAR	188.879	68563024.000	
SOIL WATER AT END OF YEAR	191.129	69379896.000	
SNOW WATER AT START OF YEAR	3.753	1362247.620	14.33
SNOW WATER AT END OF YEAR	0.477	173037.433	1.82
ANNUAL WATER BUDGET BALANCE	0.0000	7.076	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	27.74	10069622.000	100.00
RUNOFF	3.230	1172659.500	11.65
EVAPOTRANSPIRATION	70.890	7582819.500	75.30
DRAINAGE COLLECTED FROM LAYER 2	5.3579	1944932.250	19.31
PERC./LEAKAGE THROUGH LAYER 3	0.149812	54381.930	0.54
AVG. HEAD ON TOP OF LAYER 3	0.0002		
DRAINAGE COLLECTED FROM LAYER 4	0.1498	54381.887	0.54
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.052	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	-1.888	-685269.125	-6.81
SOIL WATER AT START OF YEAR	191.129	69379896.000	
SOIL WATER AT END OF YEAR	189.010	68610680.000	
SNOW WATER AT START OF YEAR	0.477	173037.433	1.72
SNOW WATER AT END OF YEAR	0.708	256983.094	2.55
ANNUAL WATER BUDGET BALANCE	0.0000	-2.070	0.00

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.02	10897262.000	100.00
RUNOFF	3.166	1149357.620	10.55

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	INCHES	CU. FEET	PERCENT
EVAPOTRANSPIRATION	21.992	7983247.000	73.26
DRAINAGE COLLECTED FROM LAYER 2	4.6694	1694988.620	15.55
PERC./LEAKAGE THROUGH LAYER 3	0.126928	46074.844	0.42
AVG. HEAD ON TOP OF LAYER 3	0.0002		
DRAINAGE COLLECTED FROM LAYER 4	0.1269	46074.816	0.42
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.035	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.065	23591.926	0.22
SOIL WATER AT START OF YEAR	189.010	68610680.000	
SOIL WATER AT END OF YEAR	189.783	68891256.000	
SNOW WATER AT START OF YEAR	0.708	256983.094	2.36
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.409	0.00

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.63	11844692.000	100.00
RUNOFF	1.856	673743.312	5.69
EVAPOTRANSPIRATION	23.185	8415987.000	71.05
DRAINAGE COLLECTED FROM LAYER 2	6.0291	2188564.000	18.48
PERC./LEAKAGE THROUGH LAYER 3	0.177158	64308.305	0.54
AVG. HEAD ON TOP OF LAYER 3	0.0902		
DRAINAGE COLLECTED FROM LAYER 4	0.1772	64308.246	0.54
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.062	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	1.383	502088.687	4.24
SOIL WATER AT START OF YEAR	189.783	68891256.000	
SOIL WATER AT END OF YEAR	101.051	69352800.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.112	40545.383	0.34
ANNUAL WATER BUDGET BALANCE	0.0000	0.227	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	2.60	2.96	3.19	3.28	3.02
	2.82	2.77	2.97	2.89	3.42	2.50
STD. DEVIATIONS	0.92	0.91	1.26	1.39	1.38	1.17
	1.13	0.93	1.72	1.42	1.50	1.25
RUNOFF						
TOTALS	0.129	0.542	2.531	0.308	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.112
STD. DEVIATIONS	0.225	0.694	1.701	0.471	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.293
EVAPOTRANSPIRATION						
TOTALS	0.551	0.504	0.617	2.889	3.418	3.869
	4.079	2.743	1.955	1.367	0.974	0.525
STD. DEVIATIONS	0.122	0.094	0.229	0.535	0.986	0.698
	1.021	0.905	0.752	0.264	0.157	0.105
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.6280	0.0333	0.0586	1.7177	2.5461	0.9501
	0.2358	0.0013	0.0581	0.0991	0.4177	1.0066
STD. DEVIATIONS	1.0179	0.1246	0.1494	0.6797	0.6789	1.1456
	0.6573	0.0019	0.1802	0.2015	0.4954	0.7093
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0160	0.0008	0.0020	0.0358	0.0678	0.0258
	0.0063	0.0001	0.0023	0.0039	0.0145	0.0311
STD. DEVIATIONS	0.0260	0.0030	0.0048	0.0186	0.0170	0.0294
	0.0170	0.0001	0.0069	0.0076	0.0161	0.0201
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0160	0.0008	0.0070	0.0358	0.0678	0.0758
	0.0063	0.0001	0.0023	0.0039	0.0145	0.0311
STD. DEVIATIONS	0.0260	0.0030	0.0048	0.0186	0.0170	0.0294
	0.0170	0.0001	0.0069	0.0076	0.0161	0.0701
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0005	0.0000	0.0000	0.0005	0.0011	0.0004
	0.0001	0.0000	0.0000	0.0000	0.0002	0.0004
STD. DEVIATIONS	0.0004	0.0001	0.0001	0.0003	0.0003	0.0005
	0.0003	0.0000	0.0001	0.0001	0.0002	0.0003

DAILY AVERAGE HEAD ON TOP OF LAYER 5

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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 14

	INCHES		CU. FEET	PERCENT
PRECIPITATION	34.42	(5.650)	12493425.0	100.00
RUNOFF	3.623	(1.6225)	1315078.75	10.526
EVAPOTRANSPIRATION	23.488	(2.6689)	8526259.00	68.246
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.25227	(2.39103)	2632573.500	21.07167
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.20634	(0.06662)	74902.602	0.59954
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.20634	(0.06602)	74902.539	0.59954
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.067	0.00000
AVERAGE HEAD ON TOP OF LAYER 5	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.153	(1.9543)	-55390.96	-0.443

PEAK DAILY VALUES FOR YEARS 1 THROUGH 14

	(INCHES)	(CU. FT.)
PRECIPITATION	2.80	1016400.000
RUNOFF	2.295	833121.5620

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DRAINAGE COLLECTED FROM LAYER 2	0.17344	62957.89060
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.003435	1247.01677
AVERAGE HEAD ON TOP OF LAYER 3	0.002	
MAXIMUM HEAD ON TOP OF LAYER 3	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	2.3 FEET	
DRAINAGE COLLECTED FROM LAYER 4	0.00344	1247.01611
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00146
AVERAGE HEAD ON TOP OF LAYER 5	0.000	
MAXIMUM HEAD ON TOP OF LAYER 5	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.37	1947561.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3147	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770	

*** 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 14

LAYER	(INCHES)	(VOL/VOL)
1	171.6756	0.2928
2	0.0029	0.0146
3	0.0000	0.0000
4	0.0020	0.0100
5	0.0000	0.0000
6	15.3720	0.4270
SNOW WATER	0.112	

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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:\FC\DATA4.D4
TEMPERATURE DATA FILE:       C:\FC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\FC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\FC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\FC\DATA10.D10
OUTPUT DATA FILE:            C:\FC\OUT.OUT

TIME: 18:46     DATE:  9/ 2/2016

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

     TITLE:  P Post-closure

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.

                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   1
      THICKNESS                  =      12.00    INCHES
      POROSITY                   =       0.4170 VOL/VOL
      FIELD CAPACITY             =       0.0450 VOL/VOL
      WILTING POINT              =       0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.2672 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                LAYER  2
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
      THICKNESS                  =      12.00    INCHES
                                 Page 1
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      POROSITY                   =       0.4170 VOL/VOL
      FIELD CAPACITY             =       0.0410 VOL/VOL
      WILTING POINT              =       0.0180 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.0909 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
      SLOPE                      =      10.00    PERCENT
      DRAINAGE LENGTH            =      50.0     FEET

                                LAYER  3
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  36
      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.  =  0.399999993000E-12 CM/SEC
      FML PINHOLE DENSITY        =       2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS   =       2.00    HOLES/ACRE
      FML PLACEMENT QUALITY      =  5 - GOOD

                                LAYER  4
                                --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  17
      THICKNESS                  =       0.24    INCHES
      POROSITY                   =       0.7500 VOL/VOL
      FIELD CAPACITY             =       0.7470 VOL/VOL
      WILTING POINT              =       0.4000 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.7500 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.300000003000E-08 CM/SEC

                                LAYER  5
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
      THICKNESS                  =     600.00    INCHES
      POROSITY                   =       0.6710 VOL/VOL
      FIELD CAPACITY             =       0.2920 VOL/VOL
      WILTING POINT              =       0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.2928 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                                LAYER  6
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER  34
      THICKNESS                  =       0.20    INCHES
      POROSITY                   =       0.8500 VOL/VOL
      FIELD CAPACITY             =       0.0100 VOL/VOL
                                 Page 2
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      WILTING POINT              =       0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.0146 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
      SLOPE                      =       2.00    PERCENT
      DRAINAGE LENGTH            =      50.0     FEET

                                LAYER  7
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =       0.08    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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =       2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS   =       2.00    HOLES/ACRE
      FML PLACEMENT QUALITY      =  3 - GOOD

                                LAYER  8
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER  34
      THICKNESS                  =       0.20    INCHES
      POROSITY                   =       0.8500 VOL/VOL
      FIELD CAPACITY             =       0.0100 VOL/VOL
      WILTING POINT              =       0.0050 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.0100 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  33.0000000000      CM/SEC
      SLOPE                      =       2.00    PERCENT
      DRAINAGE LENGTH            =      50.0     FEET

                                LAYER  9
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
      THICKNESS                  =       0.08    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.  =  0.199999996000E-12 CM/SEC
      FML PINHOLE DENSITY        =       2.00    HOLES/ACRE
      FML INSTALLATION DEFECTS   =       2.00    HOLES/ACRE
      FML PLACEMENT QUALITY      =  3 - GOOD

                                LAYER 10
                                --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
                                 Page 3
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      THICKNESS                  =      36.00    INCHES
      POROSITY                   =       0.4270 VOL/VOL
      FIELD CAPACITY             =       0.4180 VOL/VOL
      WILTING POINT              =       0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT =       0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC

           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.%
          AND A SLOPE LENGTH OF   50. FEET.

   SCS RUNOFF CURVE NUMBER              =    58.40
   FRACTION OF AREA ALLOWING RUNOFF     =   100.0     PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE   =   100.000   ACRES
   EVAPORATIVE ZONE DEPTH               =    20.0     INCHES
   INITIAL WATER IN EVAPORATIVE ZONE    =     3.934   INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE   =     8.340   INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE   =     0.360   INCHES
   INITIAL SNOW WATER                   =     0.000   INCHES
   INITIAL WATER IN LAYER MATERIALS     =   195.534   INCHES
   TOTAL INITIAL WATER                  =   195.534   INCHES
   TOTAL SUBSURFACE INFLOW              =     0.00    INCHES/YEAR

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                    ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                      INCHES         CU. FEET     PERCENT
                                     --------      ----------     -------
 PRECIPITATION                         36.09      13100673.000    100.00

 RUNOFF                                 4.777      1733901.250     13.24

 EVAPOTRANSPIRATION                    20.160      7318011.500     55.86

 DRAINAGE COLLECTED FROM LAYER  2      11.1530     4049163.250     30.90

 PERC./LEAKAGE THROUGH LAYER  4         0.000062        22.530      0.00

 AVG. HEAD ON TOP OF LAYER  5           0.2728

 DRAINAGE COLLECTED FROM LAYER  6       0.4776      173365.422      1.32

 PERC./LEAKAGE THROUGH LAYER  7         0.003381      1231.007      0.01

 AVG. HEAD ON TOP OF LAYER  7           0.0002

 DRAINAGE COLLECTED FROM LAYER  8       0.0034        1231.077      0.01

 PERC./LEAKAGE THROUGH LAYER 10         0.000000         0.036      0.00

 AVG. HEAD ON TOP OF LAYER  9           0.0000

 CHANGE IN WATER STORAGE               -0.479      -174000.281     1.33

 SOIL WATER AT START OF YEAR          195.537    70979928.000

 SOIL WATER AT END OF YEAR            195.058    70805979.000
                                 Page 4
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SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.606	0.00

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.59	14008173.000	100.00
RUNOFF	7.358	2671035.250	19.07
EVAPOTRANSPIRATION	18.418	6685715.500	47.73
DRAINAGE COLLECTED FROM LAYER 2	14.3040	5192364.500	37.07
PERC./LEAKAGE THROUGH LAYER 4	0.000077	28.075	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3502		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	10.906	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000047	17.170	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	17.136	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.490	-540970.312	-3.86
SOIL WATER AT START OF YEAR	195.058	70805928.000	
SOIL WATER AT END OF YEAR	192.763	69973072.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.804	291892.500	2.08
ANNUAL WATER BUDGET BALANCE	0.0000	-0.402	0.00

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.66	16574580.000	100.00

RUNOFF	6.850	2486712.000	15.00
EVAPOTRANSPIRATION	22.509	8170741.500	49.30
DRAINAGE COLLECTED FROM LAYER 2	14.4116	5232129.500	31.57
PERC./LEAKAGE THROUGH LAYER 4	0.000077	27.998	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3523		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	10.556	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000048	17.435	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	17.403	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.032	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.887	684964.000	4.13
SOIL WATER AT START OF YEAR	192.763	69973072.000	
SOIL WATER AT END OF YEAR	193.141	70110056.000	
SNOW WATER AT START OF YEAR	0.804	291892.500	1.76
SNOW WATER AT END OF YEAR	2.314	839867.375	5.07
ANNUAL WATER BUDGET BALANCE	0.0000	4.831	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.34	11739421.000	100.00
RUNOFF	5.981	2170961.000	18.49
EVAPOTRANSPIRATION	16.116	5850067.500	49.83
DRAINAGE COLLECTED FROM LAYER 2	9.9821	3623487.250	30.87
PERC./LEAKAGE THROUGH LAYER 4	0.000056	20.304	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2456		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.446	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000033	12.059	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	12.028	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.031	0.00

AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.261	94889.320	0.81
SOIL WATER AT START OF YEAR	193.141	70110056.000	
SOIL WATER AT END OF YEAR	194.378	70559032.000	
SNOW WATER AT START OF YEAR	2.314	839867.375	7.15
SNOW WATER AT END OF YEAR	1.338	485781.250	4.14
ANNUAL WATER BUDGET BALANCE	0.0000	-4.234	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.14	10940819.000	100.00
RUNOFF	4.014	1457151.000	13.32
EVAPOTRANSPIRATION	19.691	7147920.000	65.33
DRAINAGE COLLECTED FROM LAYER 2	8.7504	3176383.750	29.03
PERC./LEAKAGE THROUGH LAYER 4	0.000049	17.932	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2144		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	7.099	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000030	10.833	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	10.802	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.031	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-2.316	-840644.875	-7.68
SOIL WATER AT START OF YEAR	194.378	70559032.000	
SOIL WATER AT END OF YEAR	192.831	69997680.000	
SNOW WATER AT START OF YEAR	1.338	485781.250	4.44
SNOW WATER AT END OF YEAR	0.569	206485.797	1.89
ANNUAL WATER BUDGET BALANCE	0.0000	-8.873	0.00

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.88	13024440.000	100.00
RUNOFF	5.156	1871631.120	14.37
EVAPOTRANSPIRATION	19.109	6936499.500	53.26
DRAINAGE COLLECTED FROM LAYER 2	11.0050	3994814.250	30.67
PERC./LEAKAGE THROUGH LAYER 4	0.000062	22.472	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2695		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	9.018	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000037	13.454	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	15.420	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.610	221467.672	1.70
SOIL WATER AT START OF YEAR	192.831	69997680.000	
SOIL WATER AT END OF YEAR	193.028	70069296.000	
SNOW WATER AT START OF YEAR	0.569	206485.797	1.59
SNOW WATER AT END OF YEAR	0.982	356340.500	2.74
ANNUAL WATER BUDGET BALANCE	0.0000	5.158	0.00

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.17	15307713.000	100.00
RUNOFF	2.555	927632.375	6.06
EVAPOTRANSPIRATION	24.753	8985311.000	58.70
DRAINAGE COLLECTED FROM LAYER 2	13.2269	4801360.000	31.37
PERC./LEAKAGE THROUGH LAYER 4	0.000068	24.844	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3222		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.599	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000045	16.245	0.00

AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	16.210	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.635	593380.875	3.88
SOIL WATER AT START OF YEAR	193.028	70069296.000	
SOIL WATER AT END OF YEAR	193.390	70200616.000	
SNOW WATER AT START OF YEAR	0.982	356340.500	2.33
SNOW WATER AT END OF YEAR	2.255	818404.687	5.35
ANNUAL WATER BUDGET BALANCE	0.0000	-1.953	0.00

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.45	14683348.000	100.00
RUNOFF	3.703	1344239.500	9.15
EVAPOTRANSPIRATION	23.100	8385412.000	57.11
DRAINAGE COLLECTED FROM LAYER 2	15.4420	5605446.000	38.18
PERC./LEAKAGE THROUGH LAYER 4	0.000084	30.316	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3782		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	12.025	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000050	18.291	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0001	18.257	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.796	-651817.500	-4.44
SOIL WATER AT START OF YEAR	193.390	70200616.000	
SOIL WATER AT END OF YEAR	192.897	70021608.000	
SNOW WATER AT START OF YEAR	2.255	818404.687	5.57
SNOW WATER AT END OF YEAR	0.952	345600.187	2.35
ANNUAL WATER BUDGET BALANCE	0.0000	-2.367	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.33	11735792.000	100.00
RUNOFF	2.579	936225.312	7.98
EVAPOTRANSPIRATION	21.763	7899934.000	67.31
DRAINAGE COLLECTED FROM LAYER 2	7.8120	2835759.000	24.16
PERC./LEAKAGE THROUGH LAYER 4	0.000043	15.584	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1921		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	5.692	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000027	9.892	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	9.859	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.176	63852.320	0.54
SOIL WATER AT START OF YEAR	192.897	70021608.000	
SOIL WATER AT END OF YEAR	193.186	70126584.000	
SNOW WATER AT START OF YEAR	0.952	345600.187	2.94
SNOW WATER AT END OF YEAR	0.839	304478.531	2.59
ANNUAL WATER BUDGET BALANCE	0.0000	5.944	0.00

ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.62	11478063.000	100.00
RUNOFF	1.962	712141.875	6.20
EVAPOTRANSPIRATION	21.613	7845503.500	68.35
DRAINAGE COLLECTED FROM LAYER 2	5.7661	2093106.000	18.24

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PERC./LEAKAGE THROUGH LAYER 4	0.000034	12.386	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1389		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	4.907	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000021	7.484	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	7.450	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	2.279	827299.375	7.21
SOIL WATER AT START OF YEAR	193.186	70126584.000	
SOIL WATER AT END OF YEAR	192.551	69896112.000	
SNOW WATER AT START OF YEAR	0.839	304478.531	2.65
SNOW WATER AT END OF YEAR	3.753	1362247.620	11.87
ANNUAL WATER BUDGET BALANCE	0.0000	2.132	0.00

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.18	9503541.000	100.00
RUNOFF	2.458	892432.500	9.39
EVAPOTRANSPIRATION	18.519	6722490.000	70.74
DRAINAGE COLLECTED FROM LAYER 2	8.0572	2924777.000	30.78
PERC./LEAKAGE THROUGH LAYER 4	0.000046	16.651	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1937		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.407	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000028	10.245	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	10.211	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-2.855	-1036379.750	-10.91
SOIL WATER AT START OF YEAR	192.551	69896112.000	

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SOIL WATER AT END OF YEAR	192.972	70048944.000	
SNOW WATER AT START OF YEAR	3.753	1362247.620	14.33
SNOW WATER AT END OF YEAR	0.477	173037.453	1.82
ANNUAL WATER BUDGET BALANCE	0.0000	4.293	0.00

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	27.74	10069622.000	100.00
RUNOFF	3.755	1363030.370	13.54
EVAPOTRANSPIRATION	17.435	6328927.500	62.85
DRAINAGE COLLECTED FROM LAYER 2	7.2583	2634762.250	26.17
PERC./LEAKAGE THROUGH LAYER 4	0.000043	15.445	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1781		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.307	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000025	9.138	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	9.105	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.708	-257114.609	-2.55
SOIL WATER AT START OF YEAR	192.972	70048944.000	
SOIL WATER AT END OF YEAR	192.033	69707880.000	
SNOW WATER AT START OF YEAR	0.477	173037.453	1.72
SNOW WATER AT END OF YEAR	0.708	256983.094	2.55
ANNUAL WATER BUDGET BALANCE	0.0000	1.020	0.00

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.02	10897262.000	100.00

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RUNOFF	3.588	1302482.000	11.95
EVAPOTRANSPIRATION	18.466	6703061.000	61.51
DRAINAGE COLLECTED FROM LAYER 2	7.7160	2800922.500	25.70
PERC./LEAKAGE THROUGH LAYER 4	0.000044	16.151	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1871		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.398	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000027	9.753	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	9.719	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.250	90779.273	0.83
SOIL WATER AT START OF YEAR	192.033	69707880.000	
SOIL WATER AT END OF YEAR	192.991	70055640.000	
SNOW WATER AT START OF YEAR	0.708	256983.094	2.36
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.790	0.00

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.63	11844692.000	100.00
RUNOFF	2.182	792193.187	6.69
EVAPOTRANSPIRATION	18.583	6745509.500	56.95
DRAINAGE COLLECTED FROM LAYER 2	11.7137	4252074.000	35.90
PERC./LEAKAGE THROUGH LAYER 4	0.000062	22.362	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2866		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	7.803	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000040	14.557	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	14.523	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00

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AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.151	54891.334	0.46
SOIL WATER AT START OF YEAR	192.991	70055640.000	
SOIL WATER AT END OF YEAR	193.030	70069992.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.112	40545.383	0.34
ANNUAL WATER BUDGET BALANCE	0.0000	1.793	0.00

ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.31	11002530.000	100.00
RUNOFF	2.311	838907.687	7.62
EVAPOTRANSPIRATION	18.146	6587124.500	59.87
DRAINAGE COLLECTED FROM LAYER 2	9.7693	3546291.250	32.23
PERC./LEAKAGE THROUGH LAYER 4	0.000053	19.168	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2397		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.064	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000034	12.203	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	12.169	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.083	30223.951	0.27
SOIL WATER AT START OF YEAR	193.030	70069992.000	
SOIL WATER AT END OF YEAR	193.023	70067432.000	
SNOW WATER AT START OF YEAR	0.112	40545.383	0.37
SNOW WATER AT END OF YEAR	0.202	73322.781	0.67
ANNUAL WATER BUDGET BALANCE	0.0000	3.131	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.34	15732416.000	100.00
RUNOFF	4.935	1791411.000	11.39
EVAPOTRANSPIRATION	22.138	8035998.500	51.08
DRAINAGE COLLECTED FROM LAYER 2	13.6742	4963723.500	31.55
PERC./LEAKAGE THROUGH LAYER 4	0.000074	26.739	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3337		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	10.222	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000046	16.518	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	16.483	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	2.593	941258.187	5.98
SOIL WATER AT START OF YEAR	193.023	70067432.000	
SOIL WATER AT END OF YEAR	193.406	70206528.000	
SNOW WATER AT START OF YEAR	0.202	73322.781	0.47
SNOW WATER AT END OF YEAR	2.412	875492.625	5.56
ANNUAL WATER BUDGET BALANCE	0.0000	-2.225	0.00

ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.94	9779221.000	100.00
RUNOFF	5.436	1973401.250	20.18
EVAPOTRANSPIRATION	17.026	6180601.000	63.20
DRAINAGE COLLECTED FROM LAYER 2	5.9479	2159073.500	22.08
PERC./LEAKAGE THROUGH LAYER 4	0.000038	13.675	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1433		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.008	0.00

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PERC./LEAKAGE THROUGH LAYER 7	0.000021	7.868	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	7.833	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.035	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.471	-533867.125	-5.46
SOIL WATER AT START OF YEAR	193.406	70206528.000	
SOIL WATER AT END OF YEAR	193.007	70061304.000	
SNOW WATER AT START OF YEAR	2.412	875492.625	8.95
SNOW WATER AT END OF YEAR	1.341	486646.062	4.98
ANNUAL WATER BUDGET BALANCE	0.0000	-1.429	0.00

ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.57	15815913.000	100.00
RUNOFF	7.974	2894512.250	18.30
EVAPOTRANSPIRATION	23.186	8416373.000	53.21
DRAINAGE COLLECTED FROM LAYER 2	11.4177	4144446.000	26.20
PERC./LEAKAGE THROUGH LAYER 4	0.000062	22.516	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2791		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.701	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000038	13.815	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	13.784	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.031	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.993	360361.219	2.28
SOIL WATER AT START OF YEAR	193.007	70061304.000	
SOIL WATER AT END OF YEAR	193.749	70330744.000	
SNOW WATER AT START OF YEAR	1.341	486646.062	3.08
SNOW WATER AT END OF YEAR	1.592	577970.500	3.65

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ANNUAL WATER BUDGET BALANCE	0.0000	-2.351	0.00

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.23	13151488.000	100.00
RUNOFF	5.965	2165161.750	16.46
EVAPOTRANSPIRATION	18.521	6722982.500	51.12
DRAINAGE COLLECTED FROM LAYER 2	10.6940	3882148.500	29.52
PERC./LEAKAGE THROUGH LAYER 4	0.000059	21.580	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2609		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.317	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000036	13.063	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	13.030	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.050	381176.156	2.90
SOIL WATER AT START OF YEAR	193.749	70330744.000	
SOIL WATER AT END OF YEAR	193.628	70286960.000	
SNOW WATER AT START OF YEAR	1.592	577970.500	4.39
SNOW WATER AT END OF YEAR	2.763	1002926.440	7.63
ANNUAL WATER BUDGET BALANCE	0.0000	-1.978	0.00

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.93	13042587.000	100.00
RUNOFF	5.920	2149006.500	16.48
EVAPOTRANSPIRATION	22.969	8337578.500	63.93
DRAINAGE COLLECTED FROM LAYER 2	10.5748	3838661.500	29.43

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PERC./LEAKAGE THROUGH LAYER 4	0.000058	20.950	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2584		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	7.897	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000036	13.033	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	13.022	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.032	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-3.534	-1282676.120	-9.83
SOIL WATER AT START OF YEAR	193.628	70286960.000	
SOIL WATER AT END OF YEAR	192.857	70007208.000	
SNOW WATER AT START OF YEAR	2.763	1002926.440	7.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-4.333	0.00

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.18	14222341.000	100.00
RUNOFF	3.977	1443510.120	10.15
EVAPOTRANSPIRATION	22.429	8141737.000	57.25
DRAINAGE COLLECTED FROM LAYER 2	11.5880	4206447.000	29.58
PERC./LEAKAGE THROUGH LAYER 4	0.000062	22.407	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2839		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.049	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000040	14.359	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	14.324	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.035	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.186	430627.781	3.03
SOIL WATER AT START OF YEAR	192.857	70007208.000	

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SOIL WATER AT END OF YEAR	192.853	70003696.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.190	432145.437	3.04
ANNUAL WATER BUDGET BALANCE	0.0000	-2.675	0.00

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.89	14480071.000	100.00
RUNOFF	7.232	2625045.000	18.13
EVAPOTRANSPIRATION	20.330	7379801.500	50.97
DRAINAGE COLLECTED FROM LAYER 2	9.6039	3486208.750	24.08
PERC./LEAKAGE THROUGH LAYER 4	0.000054	19.537	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2349		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	7.673	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000033	11.864	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	11.831	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	2.725	988998.000	6.83
SOIL WATER AT START OF YEAR	192.853	70003696.000	
SOIL WATER AT END OF YEAR	192.961	70044768.000	
SNOW WATER AT START OF YEAR	1.190	432145.437	2.98
SNOW WATER AT END OF YEAR	3.807	1382066.250	9.54
ANNUAL WATER BUDGET BALANCE	0.0000	-1.796	0.00

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT

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PRECIPITATION	31.85	11488951.000	100.00
RUNOFF	4.556	1653820.870	14.39
EVAPOTRANSPIRATION	19.933	7235750.500	62.98
DRAINAGE COLLECTED FROM LAYER 2	10.2929	3736310.000	32.52
PERC./LEAKAGE THROUGH LAYER 4	0.000058	21.166	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2514		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	8.827	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000034	12.340	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	12.308	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.032	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-3.132	-1136951.870	-9.90
SOIL WATER AT START OF YEAR	192.961	70044768.000	
SOIL WATER AT END OF YEAR	193.213	70136304.000	
SNOW WATER AT START OF YEAR	3.807	1382066.250	12.03
SNOW WATER AT END OF YEAR	0.423	153583.391	1.34
ANNUAL WATER BUDGET BALANCE	0.0000	0.654	0.00

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.30	14265900.000	100.00
RUNOFF	5.108	1853514.500	12.99
EVAPOTRANSPIRATION	20.322	7376887.000	51.71
DRAINAGE COLLECTED FROM LAYER 2	13.3601	4849734.000	34.00
PERC./LEAKAGE THROUGH LAYER 4	0.000072	26.075	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3265		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	9.886	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000045	16.190	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	16.157	0.00

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PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.512	185734.250	1.30
SOIL WATER AT START OF YEAR	193.213	70138304.000	
SOIL WATER AT END OF YEAR	194.148	70473640.000	
SNOW WATER AT START OF YEAR	0.423	153583.391	1.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.859	0.00

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.87	11205809.000	100.00
RUNOFF	6.311	2290773.250	20.44
EVAPOTRANSPIRATION	16.146	5861120.000	52.30
DRAINAGE COLLECTED FROM LAYER 2	6.9745	2531681.500	22.59
PERC./LEAKAGE THROUGH LAYER 4	0.000042	15.362	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1695		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.856	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000023	8.303	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	8.473	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.032	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.439	522216.406	4.66
SOIL WATER AT START OF YEAR	194.148	70473640.000	
SOIL WATER AT END OF YEAR	193.077	70086792.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.510	911061.125	8.13
ANNUAL WATER BUDGET BALANCE	0.0000	7.727	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.53	13986391.000	100.00
RUNOFF	3.609	1310219.870	9.37
EVAPOTRANSPIRATION	21.375	7759068.000	55.48
DRAINAGE COLLECTED FROM LAYER 2	14.3441	5206906.000	37.23
PERC./LEAKAGE THROUGH LAYER 4	0.000075	27.310	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3494		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	10.010	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000048	17.309	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	17.277	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.032	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.798	-289828.375	-2.07
SOIL WATER AT START OF YEAR	193.077	70086792.000	
SOIL WATER AT END OF YEAR	193.700	70313224.000	
SNOW WATER AT START OF YEAR	2.510	911061.125	6.51
SNOW WATER AT END OF YEAR	1.088	394800.844	2.82
ANNUAL WATER BUDGET BALANCE	0.0000	-1.918	0.00

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.55	12178651.000	100.00
RUNOFF	3.247	1178635.500	9.68
EVAPOTRANSPIRATION	17.895	6495875.000	53.34
DRAINAGE COLLECTED FROM LAYER 2	14.7917	5369370.500	44.09
PERC./LEAKAGE THROUGH LAYER 4	0.000079	28.679	0.00
AVG. HEAD ON TOP OF LAYER 3	0.3620		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	10.802	0.00

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PERC./LEAKAGE THROUGH LAYER 7	0.000049	17.877	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	17.844	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-2.394	-865261.750	-7.10
SOIL WATER AT START OF YEAR	193.700	70313224.000	
SOIL WATER AT END OF YEAR	192.404	69842768.000	
SNOW WATER AT START OF YEAR	1.088	394800.844	3.24
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.646	0.00

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.19	12410972.000	100.00
RUNOFF	3.314	1203028.120	9.69
EVAPOTRANSPIRATION	20.349	7386711.000	59.52
DRAINAGE COLLECTED FROM LAYER 2	9.1201	3310587.750	26.67
PERC./LEAKAGE THROUGH LAYER 4	0.000050	18.032	0.00
AVG. HEAD ON TOP OF LAYER 3	0.2239		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.560	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000032	11.471	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	11.438	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.407	510620.562	4.11
SOIL WATER AT START OF YEAR	192.404	69842768.000	
SOIL WATER AT END OF YEAR	193.128	70105360.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.683	248024.953	2.00

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ANNUAL WATER BUDGET BALANCE	0.0000	7.045	0.00

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	11630520.000	100.00
RUNOFF	1.858	674348.437	5.80
EVAPOTRANSPIRATION	20.726	7523651.000	64.69
DRAINAGE COLLECTED FROM LAYER 2	7.6310	2770051.250	23.82
PERC./LEAKAGE THROUGH LAYER 4	0.000040	14.578	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1841		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	4.668	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000027	9.910	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	9.876	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.034	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.825	662456.062	5.70
SOIL WATER AT START OF YEAR	193.128	70105360.000	
SOIL WATER AT END OF YEAR	192.857	70007048.000	
SNOW WATER AT START OF YEAR	0.683	248024.932	2.13
SNOW WATER AT END OF YEAR	2.779	1008797.190	8.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.795	0.00

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.48	10338241.000	100.00
RUNOFF	3.206	1196406.120	11.57
EVAPOTRANSPIRATION	17.390	6312486.000	61.06

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DRAINAGE COLLECTED FROM LAYER 2	8.1219	2948973.750	28.32
PERC./LEAKAGE THROUGH LAYER 4	0.000046	16.593	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1978		
DRAINAGE COLLECTED FROM LAYER 6	0.0000	6.847	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000028	10.131	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	10.118	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.033	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.330	-119641.109	-1.10
SOIL WATER AT START OF YEAR	192.857	70007048.000	
SOIL WATER AT END OF YEAR	195.063	70807928.000	
SNOW WATER AT START OF YEAR	2.779	1008797.190	9.70
SNOW WATER AT END OF YEAR	0.243	88269.594	0.85
ANNUAL WATER BUDGET BALANCE	0.0000	-0.842	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.05	2.39	3.25	2.95	3.28	2.98
	2.87	2.76	3.09	2.89	3.07	2.71
STD. DEVIATIONS	0.84	1.06	1.32	1.19	1.25	1.29
	1.01	0.99	2.05	1.56	1.35	1.18
RUNOFF						
TOTALS	0.114	0.468	3.757	0.451	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.109
STD. DEVIATIONS	0.223	0.639	1.856	0.653	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.234
EVAPOTRANSPIRATION						
TOTALS	0.568	0.508	0.593	2.131	2.709	2.957
	2.788	2.587	2.043	1.471	1.058	0.549
STD. DEVIATIONS	0.096	0.081	0.235	0.691	0.735	0.849
	0.998	0.821	0.726	0.383	0.168	0.127
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0132	0.0000	0.8628	3.9282	0.5470	0.4945

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	0.1757	0.1531	0.9005	1.1667	1.4379	0.8039
STD. DEVIATIONS	0.0754	0.0000	1.6215	1.7853	0.7144	0.5141
	0.1612	0.1359	1.0665	1.1595	1.2192	0.5471
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0159	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0872	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0038	0.0000	0.2479	1.1610	0.5372	0.1468
	0.0505	0.0440	0.2674	0.3353	0.4270	0.2310
STD. DEVIATIONS	0.0102	0.0000	0.4659	0.5263	0.2053	0.1526
	0.0463	0.0390	0.3167	0.3332	0.3620	0.1572
DAILY AVERAGE HEAD ON TOP OF LAYER 7						
AVERAGES	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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DAILY AVERAGE HEAD ON TOP OF LAYER 9						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.86 (5.272)	12654665.0	100.00
RUNOFF	4.399 (1.7367)	1596782.25	12.618
EVAPOTRANSPIRATION	19.971 (2.2634)	7249296.00	57.286
LATERAL DRAINAGE COLLECTED FROM LAYER 2	10.48357 (2.78428)	3805536.750	30.07220
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00006 (0.00001)	20.921	0.00017
AVERAGE HEAD ON TOP OF LAYER 3	0.256 (0.068)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.01394 (0.08719)	5786.589	0.04573
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00015 (0.00061)	53.484	0.00042
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00015 (0.00061)	53.430	0.00042
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.033	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.008 (1.7405)	-2791.03	-0.022

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.20	1161600.000
RUNOFF	2.416	876898.8120
DRAINAGE COLLECTED FROM LAYER 2	1.26441	458989.56200
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000009	3.42517

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AVERAGE HEAD ON TOP OF LAYER 3	10.434	
MAXIMUM HEAD ON TOP OF LAYER 3	15.432	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	15.4 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.13515	49058.25390
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000692	251.13902
AVERAGE HEAD ON TOP OF LAYER 7	0.018	
MAXIMUM HEAD ON TOP OF LAYER 7	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00069	251.13890
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00013
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.59	2192710.2500
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3276	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180	

*** 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	3.2263	0.2689
2	1.0779	0.0898
3	0.0000	0.0000
4	0.1800	0.7500
5	175.2000	0.2920
6	0.0020	0.0100
7	0.0000	0.0000

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            8            0.0020          0.0100
            9            0.0000          0.0000
           10           15.3720          0.4270
       SNOW WATER        0.243
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