facility file A

Construction and Operation Permit Applications for

TOMOKA FARMS ROAD LANDFILL NORTH CELL VOLUSIA COUNTY, FLORIDA

August, 1992

VC 92067-6

BRILEY, WILD AND ASSOCIATES

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STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

CENTRAL FLORIDA DISTRICT
3319 MAGUIRE BOULEVARD
SUITE 232
ORLANDO, FLORIDA 32803-3767

APPLICATION FOR PERMIT TO CONSTRUCT [X]
OPERATE [X]

A SOLID WASTE RESOURCE RECOVERY AND MANAGEMENT FACILITY

GENERAL REQUIREMENTS

Solid Waste Resource Recovery and Management Facilities shall be permitted pursuant to Section 403.707, Florida Statutes, and in accordance with Florida Administrative Code Rule 17-7. A minimum of six copies of the application shall be submitted to the Department District Office having jurisdiction over the facility. Complete appropriate sections for the type of facility for which application is made. Entries should be typed or printed in ink. All blanks should be filled in or marked not applicable. The application shall include all information, drawings, and reports necessary to evaluate the facility. Information required to support the application is listed on the attached pages of this form.

Facility Type: Existing ____ Proposed X

Sanitary Landfill:
- X Class I,
- __ Class II,
- __ Class III: Trash/yard Trash
- __ Class III: Yard Trash Composting

Volume Reduction:
- __ Composting
- __ Shredder
- __ Incinerator/Trench Burner
- __ Resource Recovery:
  - __ Energy __Materials

Sludge Landspreading:
- __ Grade I
- __ Grade II
- __ Grade III
- __ Septage/Food Service

FACILITY NAME: Tomoka Farms Road Landfill - North Cell / (DER ID Number)

FACILITY LOCATION (main entrance): 1990 Tomoka Farms Road

S 4 (section), T 16S (township), R 32E (range) / Latitude 29 ° 08 ' 10 " Longitude 81 ° 06 ' 06 "

Applicant Name (operating authority): Volusia County Dept of Solid Waste Management

Street Address & P. O. Box: 123 West Indiana Avenue DeLand (City) Volusia (County) 32720 (Zip)

Contact Person: James L. Griffin, Director (Name) 904/736-5982 (Phone Number)

Authorized Agent/Consultant: Briley, Wild & Associates (Name) 904/672-5660 (Phone Number)

Contact Person: Lee Powell (Name) 1040 N. U.S. 1 (Street) 607 (P. O. Box) 904/672-5660 (Phone Number)

Ormond Beach (City) Volusia (County) Florida (State) 32174 (Zip)

Landowner (if different than applicant): Volusia County

Address of Landowner: same (Street, P. O. Box) (City) (State) (Zip)

Cities, Towns and Areas to be Served: All of Volusia County

Current and Projected Population to Served: 370,712 (1990) 473,133 (2000)

Acres within Waste Site Boundary: 50 Acres within Property Boundary: 2629

Volume of Solid Waste to be received: 1000 ~~xxxxxxx/day~~ tons/day ~~gallons/day~~

Date Site Ready to Received Solid Waste: June 1993 Estimated Life of Facility 5 years

Estimated Cost of Construction, Total: $ 4 million Estimated cost of Closing: $ 1.1 million

Anticipated Construction Starting and Completion Dates
From: Jan. 1993 To: June 1993

REQUIRED ATTACHEMENTS FOR CONSTRUCTION/OPERATION PERMIT FOR A RESOURCE RECOVERY AND MANAGEMENT FACILITY

GENERAL

Permit application and supporting information shall include the following (17-7.030(2), F.A.C.):

	Completeness Check
1. A letter of transmittal to the Department; (17-7.030(3)(a) F.A.C.)	X
2. A table of contents listing the main sections of the application: (17-7.030(3)(b), F.A.C.)	X
3. The permit fee specified in Florida Aministrative Code Rule 17-4.05 in check or money order payable to the Department: (17-7.030(3)(c), F.A.C.)	X
4. Six copies, at minimum, of the completed application form, all supporting data, and reports; (17-7.030(2), F.A.C.)	X
5. Engineer seal; (17-7.030(2)(d), F.A.C.)	X
6. Engineer's letter of appointment if applicable; (17-7.030(3)(e), F.A.C)	N/A
7. Copy of any lease agreement, transfer of property agreement with right of entry for long-term care, or any other agreement between operator and property owner by which the closing and long-term care of the facility may be affected; (17-7.030(3)(h)	N/A
8. Proof of publication of notice of application for the proposed activity in a newspaper of general circulation; (17-7.03(4), F.A.C)	

SPECIFICATION ATTACHMENT ITEMS

The following information items must be included in the application or an explanation given if they are not applicable.

Construction Permits:

A. Landfills - Submit items 1, 2, 3, 4, 5, 6, 7, 8, 10.
B. Volume Reduction - Submit items 1, 2, 3, 4, 5, 6, 7, 9, 10.
C. Sludge Landspreading - Submit items 2, 3, 4, 5, 6, 8, 10.

Operation Permits:

A. Landfills - All the items above.
B. Volume Reduction - All the items above.
C. Sludge Landspreading - All the items above.

NOTE: For facilities that have been satisfactorily constructed in accordance with their construction permit the information required for A, B, and C type facilities does not have to be resubmitted for an operation permit if the information has not changed during the construction period.

1. A foundation analysis (17-7.050(2)(b), F.A.C.)	Appendix A
2. Evidence that the facility is in conformance with local zoning (17-7.050(2)(c)4, F.A.C)	Section 2

3. Facility Design (17-7.050(3), F.A.C.:

NOTE: All maps, plan sheets, drawings, isometrics, cross-sections, or aerial photographs shall be legible; be signed and sealed by the registered professional engineer responsible for their preparation; be of appripriate scale to show clearly all required details; be numbered, referenced to narrative, titled, have a legend of symbols used, contain horizontal and vertical scales (where applicable), and specify drafting or origination dates; and use uniform scales as much as possible, contain a north arrow, and use NGVD for all elevations.

	Completeness Check
a. A map or aerial photograph of the area, no more than 1 year old, showing land use and zoning within 1 mile of the facility. (17-7.050(3)(a), F.A.C.)	Sheet 2
b. Plot Plan (17-7.050(3)(b), F.A.C.)	Section 3
NOTE: The plot plan on a scale not greater than 200 feet to the inch showing the following:	
(1) Dimensions and Legal Description of the site	Section 3
(2) Location and depth (NGVD) of soil borings	Appendix B, page 5
(3) Plan for trenching or disposal areas	Sheet 5
(4) Fencing or other measures to restrict access	Sheet 3
(5) Cross sections showing both original and propsed fill elevations	Sheet 7
(6) Location, depth, and construction details of monitoring wells	Appendix B, page 45
c. Topographic Maps (17-7.050(3)(c), F.A.C.)	—
NOTE: The topographic maps, which may be combined with the plot plan (item 4b), on a scale not greater than 200 feet to the inch showing the following:	
(1) Five foot contour intervals	Sheet 3
(2) Proposed fill areas	Sheet 3
(3) Borrow areas	Sheet 3
(4) Access roads	Sheet 3, 8
(5) Grades required for proper drainage	Sheet 6
(6) Typical cross sections of disposal site including lifts, borrow areas and drainage controls	Sheet 7
(7) Special drainage devices	Sheet 9
(8) Fencing	Sheet 3
(9) Equipment facilities	Sheet 3
(10) Other pertinent information based on intended use of facility	—
d. Report (17-7.050(3)(d), F.A.C.)	
(1) Estimated population and area served by the proposed site with basis for the estimate	Section 3d
(2) Anticipated type, annual quantity, and source of solid waste	Section 3d
(3) Anticipated life of site	Section 3d
(4) Source and characteristics of cover material	Appendix B
e. Ground Water Monitoring Plan (17-7.050(3)(e), F.A.C.)	
(1) Plan and hydrogeological survey, including foundation analysis, in accordance with 17-4.245(6), 17-7.030, and 17-7.050 F.A.C.; or	—
(2) A copy of a Department letter of approval of a previously submitted plan, if applicable.	N/A

	Completeness Check
4. Landfill Performance and Design Standards (17-7.050(4), F.A.C.)	
a. Liner performance (17-7.050(4)(a)(b), F.A.C.)	Section 4a
(1) Material type (soil, synthetic, other)	Section 4a
(2) Adequate base support	Section 4a
(3) Planned installation adequate to cover all surrounding earth	Appendix C
(4) Equivalency to design standards	Appendix D
b. Liner quality control plan (17-7.050(4)(c), F.A.C.)	Appendix D
(1) Specifications	Appendix D
(2) Construction/installation methods	Appendix D
(3) Sampling and testing	Appendix D
(4) Manufacturer's specifications and recommendations	Section 4c
c. Leachate control and removal system performance (17-7.050(4)(e), F.A.C.)	Section 4c
(1) Construction materials	Section 4c
(2) Strength and thickness	Section 4c
(3) Measures to prevent clogging	Section 4c
(4) Central collection point for treatment and disposal	Section 4c
(5) Leachate depth not to exceed one foot	Section 4c
(6) Equivalency to design standards	Section 4c
d. Surface water management system performance (17-7.050(4)(g), F.A.C)	Section 4d
(1) Prevention of surface water flow onto waste-filled areas	Section 4d
(2) Stormwater run-off controls; retention, detention ponds	Section 4d
(3) Equivalency to design standards	Section 4d
(4) Water management district approval	
e. Gas control system performance (17-7.050(4)(i), F.A.C.)	Section 4c
(1) Prevention of methane migration	Section 4c
(2) Prevention of damage to vegetation	Section 4c
(3) Prevention of objectionable odors off site	Section 4c
(4) Equivalency to design standards	Section 4c
5. Operations Plan (17-7.050(5)(b),(c)(d) & (e), F.A.C.)	Section 5
a. Designation of responsible person(s)	Section 5
b. Contingency operations	Section 5
c. Controlling the type of waste received at the site:	Section 5

	Completeness Check
d. Weighing or measuring incoming waste	Section 5
e. Vehicle traffic control and unloading	Section 5
f. Method and sequence of filling waste	Section 5
g. Waste compaction and application of cover	Section 5
h. Operations of gas, leachate, and storm water controls	Section 5
i. Ground water monitoring	Section 5
j. All weather access roads	Section 5
k. Effective barrier	Section 5
l. Signs indicating name of operating authority, traffic flow, hours of operation, and charges for disposal (if any)	Section 5
m. Dust control methods	Section 5
n. Litter control devices	Section 5
o. Fire protection and fire fighting facilities	Section 5
p. Attendant	Section 5
q. Communication facilities	Section 5
r. Adequate in-service and reserve equipment	Section 5
s. Safety devices on equipment to shield and protect operators	Section 5
6. Water Quality Standards (17-7.050(5)(g) & (h), F.A.C.)	Section 6
Describe how surface runoff and leachate will be handled to meet water quality standards of Florida Administrative Code Rules 17-3 and 17-4.	—
7. Closure (17-7.070(2), F.A.C.)	
a. Closure plan (17-7.073, F.A.C.)	Section 7
(1) Design	Section 7a
(2) Final use	Section 7b
(3) Closure operations	Section 7c
(4) Post-closure (17-7.075, F.A.C.)	Section 7d
(5) Financial responsibility(17-7.071, F.A.C.)	Section 7e
b. Closure plan schedule (17-7.071, F.A.C)	Section 7f
8. Solid Waste Disposal Facility Data Form	X
9. Solid Waste-Volume Reduction and Resource Recovery Facility Data Form	N/A
10. Certification by Applicant and Engineer or Public Officer	X

SOLID WASTE DISPOSAL FACILITY DATA FORM

Date Form Completed: _____

Permit No.: _____ Issue Date: _____ Expires: _____

DER ACTION: ___ Add ___ Delete ___ Change ___ Deactivate Site

1. DER IDENTIFICATION NUMBER	2. SITE NAME Tomoka Farms Road Landfill - North Cell
3. COUNTY Volusia	4. FACILITY ADDRESS (Road, cross road, street) 1990 Tomoka Farms Road
4a. Facility Phone Number: 904/239-7766	4b. Facility Site Supervisor Mr. Gene Palmetier
5a. 29 ° 08 ' 10 " (Latitude) 81 ° 06 ' 06 " (Longitude)	5b. 16S (Township) 32E (Range) 4 (Section)
6. Operating Authority Name Volusia County Department of Solid Waste Management 7. Phone Number 904/736-5982	8. Operating Authority Address 123 W. Indiana Avenue DeLand, FL 32720
9. Owner of Site Property (if different from operator) Same 10. Phone Number of Owner Same	11. Address of Owner Same

12. Facility Type
- X Class I, Sanitary Landfill
- __ Class II, Sanitary Landfill
- __ Class III, Trash/Yard Trash
- __ Class III Yard trash comp.

Sludge Landspreading:
- __ Grade I
- __ Grade II
- __ Grade III
- __ Septage

Type
- __ Other Facility

13. Month Year Begun Not yet started	14. Disposal Area 30 Acres	15. Population Served 370,712
16. Expected Useful Lifetime 5 Years	17. Weighing Scales X Yes __ No	18. Security to Prevent Unauthorized Used X Yes __ No
19. Depth of Water Table 26.0m Ft. (NGVD)	20. Quantity of Waste/Day 1,000 tons or Yd^3	21. Charge $ 25.00 ~~yd~~/ton

22. Surrounding Land Use Zoning
__ Residential __ None X Agricultural __ Commercial __ Industrial __ Other

23. Types of Waste Received

X Residential	X Agricultural	__ Yard Trash/Trash	__ Other: _____
X Commercial	__ Septic Tank	__ Sewage Sludge	
__ Incinerator Residue	X Industrial	__ Industrial Sludge	
__ Pathological/Infectious	__ Water/Air Treat Sludge	__ Hospital	

24. Number of Monitoring Wells 14, existing, 16 proposed 25. Number of Surface Monitoring Points 5

26. Gas Control / Recovery X Yes __ No / __ Yes X No	27. Salvaging Permitted __ Yes X No	28. Attendant X Yes __ No

29. Leachate Control Method - Liner Type: __ Natural __ Emplaced Clay X Synthetic __ None __ Other_____		
Collection Mehtod: __ Well Point __ Perimeter Ditch __ None X Under Site Drains __ Other_____		
Treatment Method: X Oxidation X Recirculated __ Chemical __ Advanced __ None __ Other_____		
30. Leachate Discharge __ Yes X No		Class of Receiving Water N/A
31. Site Located in __ Floodplain __ Wetlands X Other: Flatwoods - Uplands		
32. Surface Runoff Collected X Yes __ No	Type of Runoff Treatment Retention	Class of Receiving Waters III
33. Property Recoreded as a Solid waste Disposal Site in County Land Records X Yes __ No		
34. Days of Operation 7	Days of Cover 7	Hours of Operation See Below
35. Name, Title and Phone Number of Person Completing Form Lee A. Powell, P.E. 904/672-5660		

NOTE: All blanks must be filled or marked as not applicable.

Hours of Operation

Mon - Fri 7:00 a.m. - 5:30 p.m.
Sat - Sun 8:00 a.m. - 2:30 p.m.

SOLID WASTE VOLUME REDUCTION AND RESOURCE RECOVERY FACILITY DATA FORM

Permit No.: _____ Issue Date: _____ Expires: _____

Facility No. (DER Identification): _____

DER ACTION: ☐ Add ☐ Delete ☐ Change ☐ Deactivate Site ☐ Other

1. County	2. Site Name
3. Date Form Completed	4. Facility Address
4a. Facility Phone No.	4b. Facility Site Supervisor
5a. o ' " o ' " Latitude Longitude	5b. Township Range Section
6. Operating Authority Name	8. Operating Authority Address
7. Phone Number	
9. Owner of Site Property (if different from Operator)	11. Address of Owner
10. Phone Number of Owner	

12. Facility Type (check one or more)

☐ Incinerator Only ☐ Biomass Gas Production ☐ Pyrolysis ☐ Other:
☐ Sludge Concentration ☐ Baler (compactor) ☐ Composting Plant
☐ Transfer Station ☐ Waterwall Incinerator ☐ Shredder (pulverizer)

13. Month/Year Begun	14. Disposal Area Acres	15. Population Served
16. Expected Useful Lifetime Years	17. Weighing Scales ☐ Yes ☐ No	18. Waste Processed Per Operational Day tons/gal/yd
19. Charge/_____	20. Days Operated S M T W T F S	21. Hours/Day Operated

22. Maximum Processing Rate _____ tons/day

23. Material Recovered, Tons/Week

_____ Paper _____ Glass Other:
_____ Ferrous Metals _____ Non-Ferrous Metals
_____ Aluminum _____ Plastics

24. Energy Recovery, in units shown

_____ High Pressure Steam-lb/hr _____ Chilled Water-gal/hr _____ Gas-ft³/hr
_____ Low Pressure Steam-lb/hr _____ Oil-gal/hr _____ Gas-BTU/hr
_____ Electricity-kw/hr _____ Oil-BTU/hr Other:

25. Process Water Recycled ☐ Yes ☐ No	Treatment Method Used
Discharged to: ☐ Surface Waters ☐ Underground	Class Receiving Water
26. Final Residue is % of waste intake	Residue is disposed of at (Site Name)

27. Supplementary Fuel Used

Type	Quantity Used/Hour

28. Estimated Operating Costs Material – Energy Revenue $	Total Cost/Ton $	Net Cost/Ton $

29. Number of Staff	30. State Pollution Control Bond Financing Amount $	31. Estimated Amount of Tax Exemptions that will be Requested $

32. Name and Title of Person Completing Form

Note: All blanks must be filled or marked as not applicable.

CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

A. Applicant

The undersigned applicant or authorized representative of Volusia County is aware that statements made in this form and attached information are an application for a Construction and Operation Permit from the Florida Department of Environmental Regulation and certifies that the information in this application is true, correct and complete to the best of his knowledge and belief. Further, the undersigned agrees to comply with the provisions of Chapter 403, Florida Statutes, and all rules and regulations of the Department. It is understood that the Permit is not transferable, and, the Department will be notified prior to the sale or legal transfer of the permitted facility.

J. L. Griffin
Signature of Applicant or Agent

James Griffin, Director
Name and Title

Date: August 28, 1992

Attach letter of authorization if agent is not a governmental official, owner, or corporate officer.

B. Professional Engineer Registered in Florida or Public Officer as Required in Section 403.707 and 403.7075, Florida Statutes

This is to certify that the engineering features of this resource reocvery and management facility have been designed/examined by me and found to conform to engineering principals applicable to such facilities. In my professional judgement, this facility, when properly maintained and operated, will comply with all applicable statutes of the State of Florida and rules of the Department. It is agreed that the undersigned will provide the applicant with a set of instructions of proper maintenance and operation of the facility.

Lee A. Powell
Signature

Lee A. Powell, P.E.
Name and title (please type)

35992
Florida Registration Number
(please affix seal)

1040 N. U.S. Highway 1
Mailing Address

Ormond Beach, FL 32174
City, State, Zip Code

904/672-5660
Telephone Number

Date: 20 Aug 92

Lee A. Powell 20 Aug 92

Construction Cost Estimate: _____

Permit Number: _____ Issue Date: _____

Review Date: _____ Expiration Date: _____

1.0 FOUNDATION ANALYSIS

A foundation analysis was performed by Bechtol Engineering and Testing and is included in Appendix A.

2.0 ZONING

Existing zoning within a one mile radius of the proposed landfill is shown on Sheet 2 of the drawings. The County owned site and most of the adjacent area is zoned A-2 Agricultural. Volusia County does not have a separate zoning for landfill activity, but all landfill sites must be approved by the County Council. The Council approved the Tomoka Farms Road site for landfill activities in 1969. There is no incompatibility between agricultural activities and landfill activities.

3.0 FACILITY DESIGN

a. Aerial Photo

Sheet 2 of the drawings included in this application is an aerial photo taken in March, 1992. The aerial photo shows land use and zoning within one mile of the proposed facility, as well as property boundary. Following is a legal description of the site:

LEGAL DESCRIPTION

N 1/2 of Section 10; and all of the NE 1/4 of Section 9; and that part of the NW 1/4 of said Section 9, lying East of the Florida Power and Light Company power line right of way; and that part of the S 1/2 of Section 4, lying East of the said Florida Power and Light Company power line right of way; and that part of Section 3, lying West of a straight line drawn between the Southeast corner of the SW 1/4 of said Section 3 (being also the Northwest corner of the NE 1/4 of Section 10) and running Northwesterly to the point of intersection of the West line of said Section 3 with the Southeasterly right of way line of Interstate Highway #4 (S.R. 400); and the South 200 feet of the NW 1/4 of Section 11, lying West of the centerline of Tomoka Farms Road as now used.

All the foregoing being in Township 16 South, Range 32 East, Volusia County, Florida, and being more particularly described as:

Commencing at the concrete monument (Moody) marking the Northeast corner of Section 4, Township 16 South, Range 32 East, thence S 00°51'40" E, along the East line of said Section 4, a distance of 1076.35 feet to a point on the Southeasterly right of way line of Interstate Highway #4 (S.R. #400), said point being POINT OF BEGINNING; run thence continuing S 00°51'40" E, along said East line of Section 4, a distance of 1631.43 feet to the Northeast corner of the S 1/2 of said Section 4; thence S 88°52'54" W, along the North line of said S 1/2 of Section 4, a distance of 3190.12 feet to its intersection with the East right of way line of a 305 foot wide Florida Power and Light Company Easement (Official Records Book 678, page 605 also see Official Records Book 308, page 322); thence S 00°34'18" E, along said East right of way line of the Florida Power and Light Company Easement, a distance of 2671.94 feet to a point in the South line of said Section 4 that is S 89°17'43" W, a distance of 548.16 feet, from the concrete monument (Moody) marking the Southeast corner of the SW 1/4 of said Section 4; thence continuing S 00°34'18" E, along the said East line of the power line easement, a distance of 1111.44 feet to an intersection with the Easterly right of way line of a 170 foot wide Florida Power and Light Company Easement (Official Records Book 756, page 67); thence S 29°15'33" E, along the Easterly line of said Florida Power and Light Company Easement, a distance of 1160.31 feet, to its intersection with the West line of the NE 1/4 of Section 9, Township 16 South, Range 32 East; thence S 00°48'32" E, along said West line of the NE 1/4 of Section 9, a distance of 581.07 feet to a one inch iron pipe marking the center of said Section 9, being also the Southwest corner of the NE 1/4 of said Section 9; thence N 89°56'54" E, along the South line of said NE 1/4 of Section 9, a distance of 2633.40 feet to a concrete monument (Moody) marking the Southeast corner of said NE 1/4 of Section 9; thence N 86°26'59" E, along the South line of the N 1/2 of Section 10, Township 16 South, Range 32 East, a distance of 2659.75 feet to a half inch iron pipe; thence N 86°26'23" E, continuing along the South line of the N 1/2 of said Section 10, a distance of 2639.74 feet to the Southeast corner thereof; thence N 89°27'20" E, along the South line of the NW 1/4 of Section 11, Township 16 South, Range 32 East, a distance of 1135.08 feet to an intersection with the centerline of Tomoka Farms Road, as now laid out and used; thence N 17°23'11" W, along said centerline of Tomoka Farms Road, a distance of 208.96 feet to an intersection with a line that is 200 feet Northerly of, and parallel with, the said South line of the NW 1/4 of Section 11; thence S 89°27'20" W, along said last described line, a distance of 1074.06 feet to an intersection with the East line of the NE 1/4 of Section 10, Township 16 South, Range 32 East; thence N 00°24'26" W, along the said East line of the NE 1/4 of Section 10, a distance of 2440.79 feet to a two and one-half inch iron pipe marking the Northeast corner thereof; thence S 87°24'59" W, along the North line of said NE 1/4 of Section 10, a distance of 2643.84 feet to a six inch cypress post marking the Northwest corner thereof; thence N 32°43'54" W, a distance of 5013.52 feet, more or less, (through the W 1/2 of Section 3, Township 16 South, Range 32 East) to the POINT OF BEGINNING.

PARCEL "A"

A PORTION OF SECTION 11, TOWNSHIP 16 SOUTH, RANGE 32 EAST, VOLUSIA COUNTY, FLORIDA, DESCRIBED AS FOLLOWS; FROM THE NORTHWEST CORNER OF SAID SECTION 11, AS THE POINT OF BEGINNING, RUN NORTH 88 DEGREES 46 MINUTES 25 SECONDS EAST, ALONG THE NORTH LINE OF SAID SECTION 11, A DISTANCE OF 298.89 FEET TO THE MAINTAINED WESTERLY RIGHT-OF-WAY LINE OF TOMOKA FARMS ROAD; THENCE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 16 DEGREES 22 MINUTES 16 SECONDS EAST, A DISTANCE OF 190.06 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHEAST, HAVING A RADIUS OF 33320.93 FEET, A CENTRAL ANGLE OF 01 DEGREES 44 MINUTES 50 SECONDS, AND A CHORD BEARING OF SOUTH 17 DEGREES 14 MINUTES 41 SECONDS EAST; THENCE RUN SOUTHERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1016.06 FEET; THENCE SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1335.88 FEET; THENCE, DEPARTING SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 88 DEGREES 35 MINUTES 09 SECONDS WEST, A DISTANCE OF 1021.53 FEET TO THE WEST LINE OF SAID SECTION 11, THENCE NORTH 01 DEGREES 07 MINUTES 19 SECONDS WEST, ALONG THE WEST LINE OF SAID SECTION 11, A DISTANCE OF 2441.63 FEET TO THE POINT OF BEGINNING.

CONTAINING 36.57 ACRES.

SUBJECT TO: A 30 FOOT WIDE EASEMENT FOR NATURAL GAS TRANSMISSION LINE PER OFFICIAL RECORDS BOOK 669, PAGE 2, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA.

A PORTION OF SECTIONS 4, 5, 8, 9, 10, 11, 15 AND 16, TOWNSHIP 16 SOUTH, RANGE 32 EAST, VOLUSIA COUNTY, FLORIDA, DESCRIBED AS FOLLOWS; FROM THE NORTHWEST CORNER OF SAID SECTION 11, RUN NORTH 88 DEGREES 46 MINUTES 25 SECONDS EAST, ALONG THE NORTH LINE OF SAID SECTION 11, A DISTANCE OF 298.89 FEET TO THE MAINTAINED WESTERLY RIGHT-OF-WAY LINE OF TOMOKA FARMS ROAD; THENCE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 16 DEGREES 22 MINUTES 16 SECONDS EAST, A DISTANCE OF 190.06 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHEAST, HAVING A RADIUS OF 33320.93 FEET, A CENTRAL ANGLE OF 01 DEGREES 44 MINUTES 50 SECONDS, AND A CHORD BEARING OF SOUTH 17 DEGREES 14 MINUTES 41 SECONDS EAST; THENCE RUN SOUTHERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1016.06 FEET; THENCE SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1544.70 FEET TO THE POINT OF BEGINNING; THENCE CONTINUE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1272.87 FEET TO THE NORTHERLY RIGHT-OF-WAY LINE OF SHUNZ ROAD, A 200.00 FOOT RIGHT-OF-WAY, AS DESCRIBED IN OFFICAL RECORD BOOK 2806, PAGE 1370, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA; THENCE RUN ALONG SAID NORTHERLY RIGHT-OF-WAY LINE THE FOLLOWING COURSES AND DISTANCES; SOUTH 88 DEGREES 45 MINUTES 25 SECONDS WEST, A DISTANCE OF 1625.50 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE SOUTHEAST, HAVING A RADIUS OF 2100.00 FEET, A CENTRAL ANGLE OF 47 DEGREES 55 MINUTES 13 SECONDS, AND A CHORD BEARING OF SOUTH 64 DEGREES 47 MINUTES 48.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1756.36 FEET; THENCE SOUTH 40 DEGREES 50 MINUTES 13 SECONDS WEST, A DISTANCE OF 4479.76 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHWEST, HAVING A RADIUS OF 1900.00 FEET, A CENTRAL ANGLE OF 36 DEGREES 08 MINUTES 05 SECONDS, AND A CHORD BEARING OF SOUTH 58 DEGREES 54 MINUTES 14.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1198.27 FEET; THENCE SOUTH 76 DEGREES 58 MINUTES 17 SECONDS WEST, A DISTANCE OF 1787.41 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHWEST, HAVING A RADIUS OF 2100.00 FEET, A CENTRAL ANGLE OF 15 DEGREES 53 MINUTES 15 SECONDS, AND A CHORD BEARING OF SOUTH 84 DEGREES 54 MINUTES 54.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 582.31 FEET; THENCE NORTH 87 DEGREES 08 MINUTES 28 SECONDS WEST, A DISTANCE OF 2475.99 FEET TO THE WEST LINE OF SAID SECTION 16; THENCE NORTH 01 DEGREES 54 MINUTES 16 SECONDS WEST, ALONG THE WEST LINE OF SAID SECTION 16, A DISTANCE OF 3118.32 FEET TO THE NORTHWEST CORNER THEREOF; THENCE SOUTH 88 DEGREES 42 MINUTES 23 SECONDS WEST, ALONG THE SOUTH LINE OF SAID SECTION 8, A DISTANCE OF 2630.86 FEET; THENCE NORTH 01 DEGREES 15 MINUTES 35 SECONDS WEST, ALONG THE WEST LINE OF THE EAST 1/2 OF SAID SECTION 8, A DISTANCE OF 5336.69 FEET; THENCE NORTH 02 DEGREES 20 MINUTES 05 SECONDS WEST ALONG THE WEST LINE OF THE EAST 1/2 OF SAID SECTION 5, A DISTANCE OF 285.75 FEET TO THE SOUTHERLY RIGHT-OF-WAY LINE OF INTERSTATE NO. 4 (S.R. NO. 400), AND A POINT ON THE ARC OF A CURVE, CONCAVE SOUTHEAST, HAVING A RADIUS OF 8970.66 FEET (8952.75 D.O.T.), A CENTRAL ANGLE OF 15 DEGREES 51 MINUTES

29 SECONDS, AND A CHORD BEARING OF NORTH 55 DEGREES 37 MINUTES 22.5 SECONDS EAST; THENCE RUN NORTHERLY ALONG THE ARC OF SAID CURVE, AND SAID RIGHT-OF-WAY LINE, A DISTANCE OF 2482.90 FEET; THENCE NORTH 63 DEGREES 33 MINUTES 07 SECONDS EAST, ALONG SAID RIGHT-OF-WAY LINE, A DISTANCE OF 2513.95 FEET TO THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 4; THENCE NORTH 88 DEGREES 04 MINUTES 28 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 4, A DISTANCE OF 390.88 FEET TO THE EASTERLY EASEMENT LINE OF A 305.00 FEET WIDE FLORIDA POWER & LIGHT COMPANY EASEMENT AS DESCRIBED IN OFFICIAL RECORD BOOK 678, PAGE 605, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA; THENCE SOUTH 01 DEGREES 18 MINUTES 08 SECONDS EAST, ALONG SAID EASEMENT LINE, A DISTANCE OF 3783.65 FEET; THENCE SOUTH 30 DEGREES 00 MINUTES 42 SECONDS EAST, ALONG THE EASTERLY EASEMENT LINE OF A 170.00 FOOT WIDE FLORIDA POWER & LIGHT COMPANY EASEMENT AS DESCRIBED IN OFFICIAL RECORD BOOK 756, PAGE 67, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA, A DISTANCE OF 1160.33 FEET TO THE EAST LINE OF THE NORTHWEST 1/4 OF SAID SECTION 9; THENCE SOUTH 01 DEGREES 35 MINUTES 31 SECONDS EAST, ALONG THE EAST LINE OF THE NORTHWEST 1/4 OF SAID SECTION 9, A DISTANCE OF 560.82 FEET TO THE CENTER OF SAID SECTION 9; THENCE NORTH 89 DEGREES 12 MINUTES 07 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTHEAST 1/4 OF SAID SECTION 9, A DISTANCE OF 2633.10 FEET TO THE EAST 1/4 CORNER OF SAID SECTION 9; THENCE NORTH 85 DEGREES 42 MINUTES 46 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 10, A DISTANCE OF 2658.95 FEET; THENCE NORTH 85 DEGREES 42 MINUTES 28 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 10, A DISTANCE OF 2640.42 FEET TO THE EAST 1/4 CORNER OF SAID SECTION 10; THENCE NORTH 86 DEGREES 35 MINUTES 09 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 11, A DISTANCE OF 1082.57 FEET TO THE POINT OF BEGINNING.

CONTAINING 1746.57 ACRES.

SUBJECT TO: FLORIDA POWER AND LIGHT COMPANY EASEMENTS AS FOLLOWS: A 305 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 678, PAGE 605; A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 678, PAGE 605, AND OFFICIAL RECORDS BOOK 238, PAGE 539; A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 756, PAGE 67, AND A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 1664, PAGE 448, ALL OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA.

b. Plot Plan

The drawings attached to this application show existing and proposed elevations and features, including fencing, monitor well locations, borrow areas, access roads, equipment maintenance facilities, and other pertinent information based on the intended use of the facility.

c. Topographic Map

The drawings attached to this application show existing and proposed elevations and features, including fencing, monitor well locations, borrow areas, access roads, equipment maintenance facilities, and other pertinent information based on the intended use of the facility.

d. Report

(1) Estimated Population to be Served:

The proposed landfill will be the only Class 1 landfill serving Volusia County. For design purposes, the landfill's service area was assumed to be all of Volusia County. Out-of-county wastes are accepted at the landfill, but we have not attempted to assign an equivalent population to represent these waste sources.

The 1990 census reported the population of Volusia County to be 370,712. According to the University of Florida Population Program, Volusia County's population is anticipated to grow as follows:

1991	376,695
1995	425,887
2000	473,133
2005	518,326
2010	561,121

(2) Anticipated Waste Loading:

The quantity of waste to be disposed of in the proposed landfill is dependent on the: 1) population and character of the service area; 2) solid waste management practices; and 3) economic conditions.

The service area for the proposed landfill is Volusia County. The projected population growth for Volusia County was discussed previously.

In recent years there have been several significant changes in Volusia County's solid waste management, including initiation of curbside recycling and separation of yard debris from household waste. These changes have reduced the quantity of waste that would otherwise be disposed of in the Class 1 landfill.

Economic conditions also effect the total quantity of solid waste that is generated.

Based on County records, we have estimated the amount of waste disposed of in the existing Class 1 landfill over a recent ten-month period to be as follows:

Month	Tons/Month
May 1991	28,709.16
June 1991	26,774.05
July 1991	29,829.47
Aug. 1991	27,438.71
Sept. 1991	23,767.18
Oct. 1991	25,877.73
Nov. 1991	22,126.59
Dec. 1991	23,193.06
Jan. 1992	23,181.69
Feb. 1992	23,013.10
Total	**253,910.74**
Average	**25,391.00 tons/month**

Using the University of Florida population projections previously reported and the above solid waste quantities, we have estimated the total solid waste loading to be as follows:

Year	Population	Solid Waste (tons)
1991	376,695	304,692
1992	388,993	314,639
1993	401,291	324,587
1994	413,589	334,534
1995	425,887	344,481
1996	435,336	354,124
1997	444,785	359,767
1998	454,235	367,411
1999	463,683	375,053
2000	473,133	382,696

An increase in the percent of solid waste that is recycled will result in lower quantities of solid waste to be disposed of in the proposed landfill. A reduction in the per capita solid waste generation rate or an economic downturn would also lower the actual quantities of solid waste generated.

(3) Anticipated Life of Site:

The proposed landfill will have a total volume of approximately 2.26 million cubic yards. Assuming 20 percent of this is used for daily and final cover, 1.8 million cubic yards would be available for solid waste. Assuming an in place density of 1,000 lb. per cubic yard and an average loading of 334,000 tons per year results in an estimate of the life of the proposed lined cell of 2.7 years.

The above landfill volume is based on the County constructing a pyramid as shown on the drawings. As adjacent areas are permitted and developed, the volume of solid waste that would be placed over the liner and facilities constructed under this permit will increase, and we estimate that the actual site life will be in excess of 5 years.

(4) Source and Characteristics of Cover Material:

Soil used for daily, intermediate, and final cover is taken from borrow areas adjacent to the landfill that are located on County property. The County proposes to construct a new borrow area north of the proposed landfill as shown on the site plan. Future borrow areas may be located west of the landfill on County-owned property.

The borrow areas are constructed to a depth of 15 feet below land surface. The on-site soils consist of a few feet of fine sand underlain by a silty and clayey sand.

e. Groundwater Monitoring Plan

The proposed groundwater monitoring plan is described in Dr. David Gomberg's May, 1992 report, included as Appendix B.

4.0 Landfill Performance and Design Standards

a. Liner System

The liner system for the proposed landfill is a composite liner consisting of three components: native soil, a bentonite geosynthetic, and a high density polyethylene (HDPE) geo membrane.

Native Soil - As indicated in Dr. Gomberg's September 1986 "Hydrologic Evaluation of a 53-Acre Section of Tomoka Landfill", the soil underlying the proposed landfill is clayey sand with a permeability of 2.1×10^{-7} cm/sec. The area was previously excavated to approximately 14-feet below grade for use as a borrow pit. Due to the low permeability of the soil, pumping for dewatering was infrequent, except following substantial rainfall. Construction of the landfill with subsequent leachate removal will cause an inward hydraulic gradient, further preventing leachate from escaping to groundwater.

Geosynthetic Clay Liner - A layer of prefabricated clay blankets will be constructed over the compacted subgrade. These blankets, marketed under trade names such as Bentomat and Claymax, are factory manufactured dry bentonite clay layers sandwiched between geotextiles or attached to a geomembrane. This layer is approximately 0.2 inches thick with hydraulic conductivity of $3 \times 10^{-}$

$10^{}$ cm/sec. As demonstrated in Appendix C, this layer is hydraulically equivalent to a three foot clay layer with a hydraulic conductivity of 1×10^{-7} cm/sec.

Geomembrane - The upper portion of the composite liner is a 60 mil HDPE liner with a maximum water vapor transmission rate of 0.003 grams per hour per square meter (ASTM E96).

b. Liner Quality Control Plan

The Construction Quality Assurance Plan for the liner systems proposed for the landfill and for the leachate holding ponds is included in Appendix D. The Plan includes specifications and testing requirements. After the project is bid and the Contractor is selected, this plan will be revised to include the name of the Contractor, the manufacturer, the installer and the independent quality assurance inspector.

c. Leachate System

The leachate system consists of three components: the leachate collection system, the leachate storage system, and the leachate disposal system.

Leachate Collection - The purpose of the leachate collection system is to collect and remove leachate that collects on the liner to prevent the hydraulic head on the liner from exceeding 12-inches. The system begins with the 24-inch thick sand drainage layer and the profiled mesh high density polyethylene geonet. The high transmissivity geonet is placed directly above the HDPE geomembrane liner. The liner slopes at a 2% grade to direct leachate through the geonet to the perforated leachate collection laterals. The laterals are six inch diameter perforated HDPE pipe wrapped with filter sock, with a slope of approximately one percent to the eight-inch diameter leachate main. The leachate header mains are located on the north and south edges of the landfill and drain into two leachate sumps located on the west side of the landfill. At each sump, a 10 Hp 400 gpm submersible leachate pump will remove the leachate that collects in the sumps and direct it into either of two lined storage basins.

All leachate pipes buried in the landfill will have cleanouts at each end to permit mechanical cleaning.

Leachate Storage - Each of the two leachate basins is constructed with a double liner and a leak detection system. The lower liner is a composite clay/HDPE liner to further assure that leachate will not escape into the groundwater. Each basin has a normal storage capacity of 3.3 million gallons, when filled to the normal high water level of 32.0. An additional three feet of freeboard is available in the basin. Approximately 11-inches of this freeboard will be used to retain the 25 year 24 hour design storm, leaving over two feet of freeboard remaining.

Two basins will be constructed so that either basin may be taken out of service for inspection and repair. The bottom of the basin will be at elevation 25.0, the high groundwater level, to prevent uplift of the liner.

Leachate Disposal - The HELP Model (Appendix E) indicates that very little leachate will be generated after the site is closed and a low permeability clay cap is constructed. The greatest demand on the leachate disposal system will occur when the landfill is newly constructed. Before solid waste is placed the rainwater falling on the sand drainage layer may be pumped to the stormwater system. When the first layer of solid waste has been placed, evaporation will take place on the surface of the exposed solid waste and on the daily and intermediate soil cover. Some precipitation will also be adsorbed by the solid waste. The remaining water will percolate through the solid waste and be collected as leachate in the leachate collection system. This flow is estimated to be 23,000 gallons per day. Three methods for disposing of this leachate are proposed: leachate evaporation, leachate recirculation, and off-site treatment.

Leachate Evaporation - A certain amount of leachate will evaporate from the leachate basins. Unfortunately the average annual evaporation rate is ten inches less than the average annual precipitation, and the evaporation rate applies only to the area of water surface whereas the precipitation will fall on the entire area of lined basin. To increase the amount of water that will be evaporated in the basin a spray irrigation system including a 480 gpm 40 horsepower submersible leachate pump will be installed along the outside of the basins to irrigate the exposed portion of the basin liner. This will increase the surface exposed for evaporation and will help reduce thermal expansion of the liner during exposure to direct sunlight. The total losses expected to be achieved in the basin are dependent on the amount of precipitation, the number of sunny days, and the number of hours the spray irrigation system is operated. Assuming operation for 8 hours per day, 150 days per year, the net loss to evaporation in the basins is estimated to be up to 9.2 million gallons per year.

Leachate Recirculation - Although the leachate basins are designed to evaporate more than the total estimated annual leachate production, there will be rainy periods when evaporation will not be practical and when it will be necessary to draw down the leachate basins. During these periods leachate will be recirculated back over the landfill.

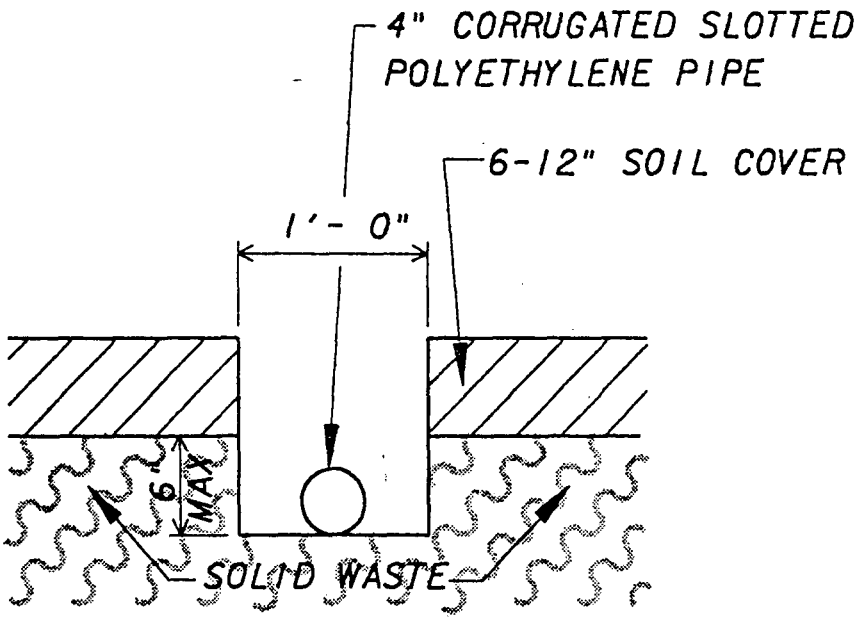
Recirculating leachate to bring the moisture content of the buried waste to an optimum level promotes and accelerates the natural decomposition of the waste. It allows the landfill to stabilize more rapidly reducing post closure settlement, and allows leachate production to be maximized when the liner system is new.

To prevent recirculated leachate from damaging vegetative growth or being concentrated in surface areas where it could become mingled with stormwater runoff it is proposed to add the recirculated leachate directly to the solid waste through perforated pipe. Shallow trenches 6-12 inches deep will be constructed (as shown on Figure 1) through the daily or intermediate soil cover in areas removed from the active face. The recirculated leachate will be pumped from the leachate basin to a moveable HDPE manhole placed on top of the ground in the area where the leachate is to be applied (as shown on Figure 2). Four-inch diameter corrugated slotted polyethylene pipe will drain the leachate from the manhole along the length of the trench. As the working face advances across the landfill the leachate recirculation piping will be relocated to avoid interference with landfill operations. The leachate may also be trucked to areas of the landfill for recirculation.

The constructed landfill is non-uniform in solid waste material distribution, density, and moisture content, and the quantity of recirculated leachate to be applied to any specific area will vary. The leachate recirculation trenches will not always be constructed at a uniform grade and it is anticipated that some areas will receive more leachate than others. It will be up to the operator to ensure that the leachate is applied reasonably evenly over the entire landfill and that parts of the landfill are not allowed to become super-saturated. If too much leachate is applied to an area the excess leachate will percolate through the saturated solid waste and be collected in the leachate collection system.

Off-site Treatment - If necessary, leachate from the basins may be trucked to an off-site treatment facility for treatment and disposal.

VC 92067-6E



TEMPORARY LANDFILL IRRIGATION PIPE DETAIL

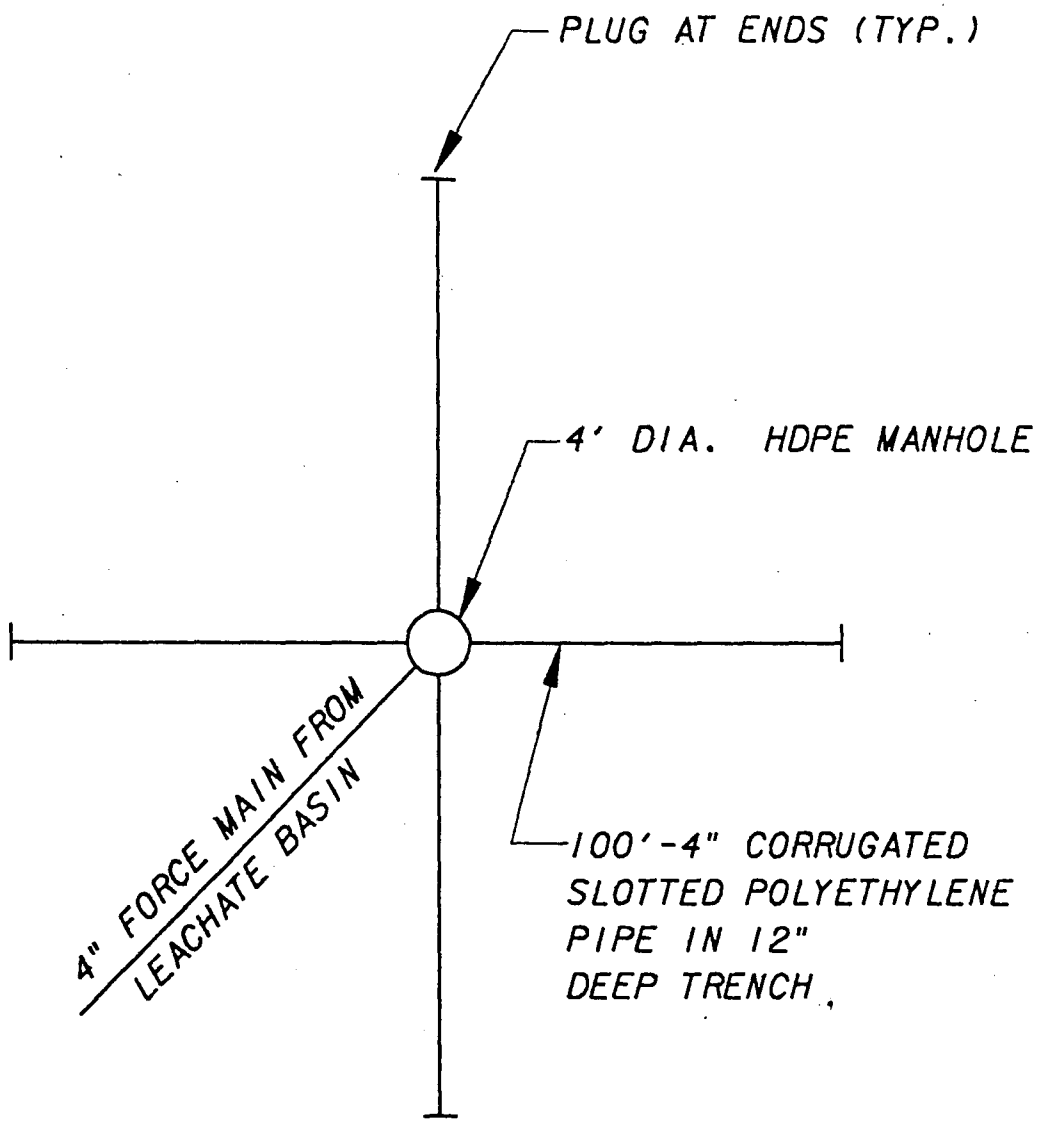
SCALE 1" = 1'-0"

R-932

Prepared by
BRILEY, WILD & ASSOCIATES, INC.
Consulting Engineers & Planners

FIGURE 1

VC 92067-6E



PLAN

TEMPORARY LANDFILL IRRIGATION SYSTEM

R-932

Prepared by
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Consulting Engineers & Planners

FIGURE 2

d. Surface Water Management System

Surface runoff will be collected in a retention pond that will surround the proposed landfill. Surface runoff from the landfill will be kept separate from runoff from other parts of the overall site, and from leachate.

The retention pond is designed to retain the runoff from both the 25 year 24 hour storm, and the 100 year storm as shown in Appendix F.

e. Gas Control System

The proposed landfill is a high rise composite lined landfill surrounded by stormwater ditches which extend to the base of the fill. It is not possible for gas formed in the landfill to migrate off site. During landfill construction, gas will be vented naturally through the landfill soil cover. The site is remote and odors attributable to landfill gas have not been a problem in areas adjacent to the existing landfill.

As the proposed clay cap is installed for final cover over closed out portions of the landfill, the natural venting of gas will be restricted. To prevent the buildup of gas which could cause fissures in the clay cap and damage to vegetation, gas vents will be installed on 200-foot centers. These are shown on the drawings.

The County is actively investigating uses for the landfill gas, and it is anticipated that a program of extracting the gas and processing it for beneficial uses will be proposed in the near future.

5.0 OPERATION PLAN

The purpose of this Operation Plan is to provide a written description of the daily operation of the landfill, in accordance to the requirements of Chapter 17-701.050 (5) (b) of the Florida Administrative Code.

The Tomoka Farms Road Landfill is a solid waste management facility including the following operations:

A Class I landfill
A construction and demolition debris disposal site
A tire and white goods storage facility
A municipal wastewater sludge storage facility
A recycling drop off facility
A household hazardous waste collection facility
A sludge land farming operation

This Operation Plan describes the operation of the proposed new Class I landfill.

It is recognized that landfills are dynamic systems under constant development. Changes in the type of material brought to the site, the quantity and rate of refuse delivery, surface topography of the landfill, and administrative and regulatory requirements may all result in changes in the way the landfill may be best operated to conserve landfill space, protect the environment, and provide safe and efficient operation for users of the landfill. It is the intent of this Operation Plan to be kept as an accurate description of the actual operation and procedures. This plan should be modified as required to reflect changes in the landfill operation as they occur.

a. Designation of Responsible Persons

A Foreman IV has been assigned supervisory responsibility over both the Tomoka Farms Road Landfill and the Plymouth Avenue Landfill in DeLand. Routine operation of the Tomoka Landfill is under the direction of a Foreman III. When he is absent from the site, a Foreman II or a Foreman I is designated as being in charge of the site. A Foreman is present at all times during the hours of operation.

At the beginning of each working day the site foreman tells the spotter at the working face where the various types of waste (refuse, sludge, tires) should be placed that day. The spotter is responsible for telling each customer where to dump his waste.

b. Contingency Operations

The landfill has four compactors, seven dozers, six four wheel drive dump trucks, one water wagon, two backhoes, one grader, two front end loaders, and two mowing tractors. Should any one piece of equipment be disabled the landfill could continue to operate. In addition, Volusia County's Roads and Bridges Section has equipment which could be loaned to the Solid Waste Department for use during an emergency.

The landfill is large enough that if a portion of the site had to be closed due to emergency (fire, chemical spill, storm damage, etc.) it is likely that some other area of the site could remain open. If on-site roads became impassable the County has an agreement with private contractors to provide roll-off containers near the scale.

c. Controlling the Type of Waste Received at the Site

The landfill specifically excludes hazardous wastes, toxic waste, pathological/infectious wastes, and liquid or chemical wastes. The first defense against these wastes is the clerk at the scale house. Normally, these wastes are not allowed to enter the site. The second line of defense is the spotters at the working face. The third line of defense is the equipment operators who spread, compact, and cover the waste.

An on-site household hazardous waste facility is provided to accommodate Volusia County homeowners. This service is free of charge to the homeowner to encourage separation of this material from the household waste.

All employees have been trained to look for liquid waste, drums, waste in sealed containers, waste with unusual odors or fumes, and waste with an unusual appearance such as hospital waste or waste with strange markings. Waste with suspicious appearance is kept on the trucks until the site environmentalist has approved its dumping. If the material has already been dumped it is kept separate from other wastes. If the material is suspicious to the site foreman he is instructed to call on-site environmental specialist, who will identify the material and determine its suitability for landfilling.

The ultimate decision on whether to accept or reject the material is made by the site environmentalist.

d. Weighing or Measuring Waste

All vehicles taking waste to the landfill are weighed at the scale house. After dumping their wastes the vehicles are again weighed on their way out. Those vehicles whose tare weights are on record are weighed entering the landfill but are not required to weigh when leaving.

Not all vehicles are charged based on weight. Cars and pickup trucks are charged a standard per load charge and many larger vehicles are charged based on their cubic yard capacity. Regardless of how the charges are made all refuse is weighed on entering.

e. Vehicle Traffic Control and Unloading

Signs clearly indicate the way to the working face. A spotter assists in directing vehicles to the active area and in screening wastes. A second spotter at the working face tells each driver where to unload. The working face is approximately 100-feet wide and is organized to allow smooth flow of traffic for vehicles arriving, unloading, and departing. The on-site roads are adequate for two-way traffic and speed limits are clearly marked.

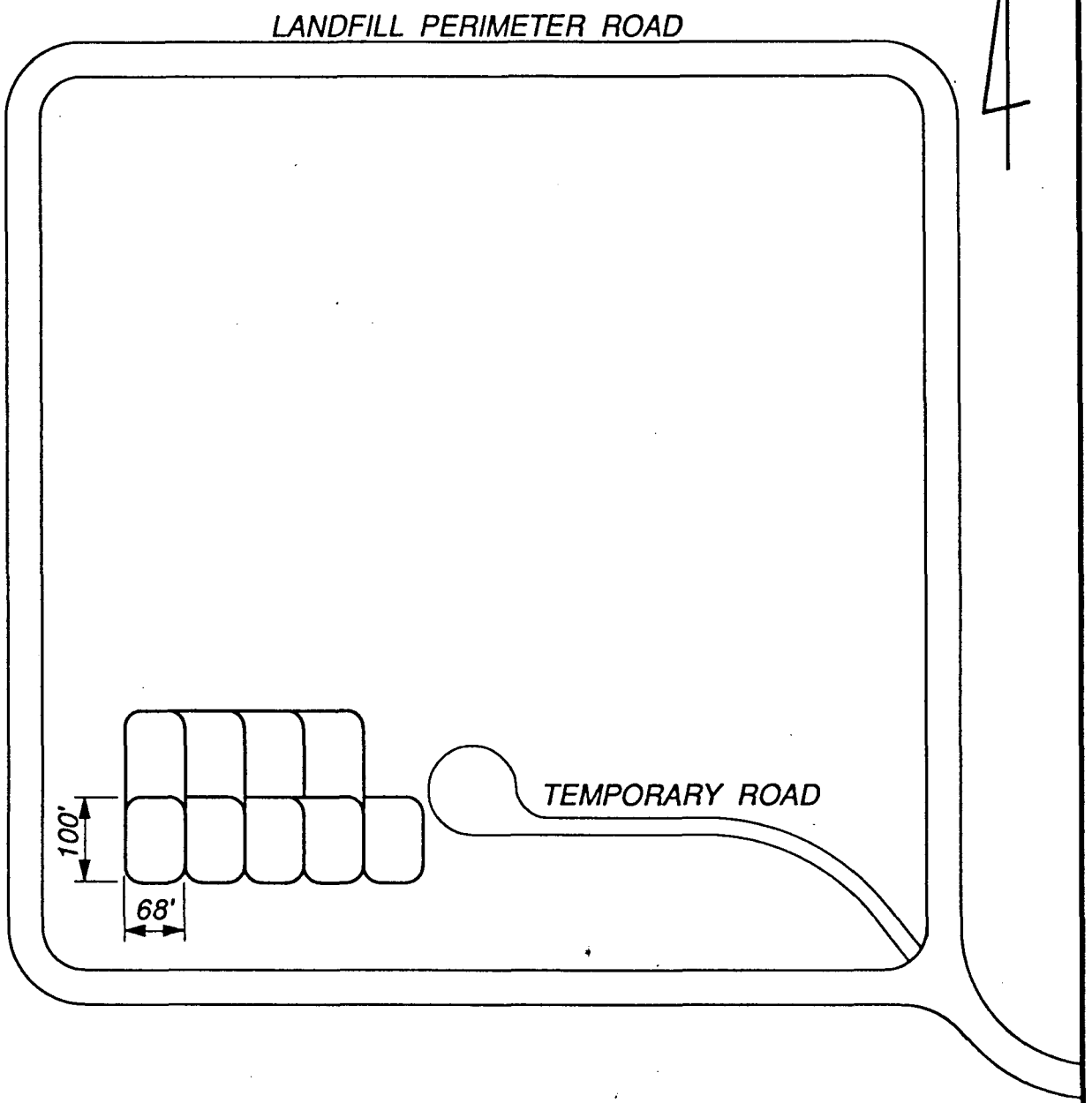
Traffic control on the on-site roads and at the working face is the responsibility of the spotters.

Scavenging, the uncontrolled retrieval of materials at the working face by individuals, is strictly forbidden and is prevented by the spotters.

f. Method and Sequence of Filling Waste

The site is operated as a vertical, "high rise" landfill with wastes being placed, spread, compacted, and covered with material from the adjacent borrow pit. County surveyors are used to provide spot elevations to measure the landfill's progress.

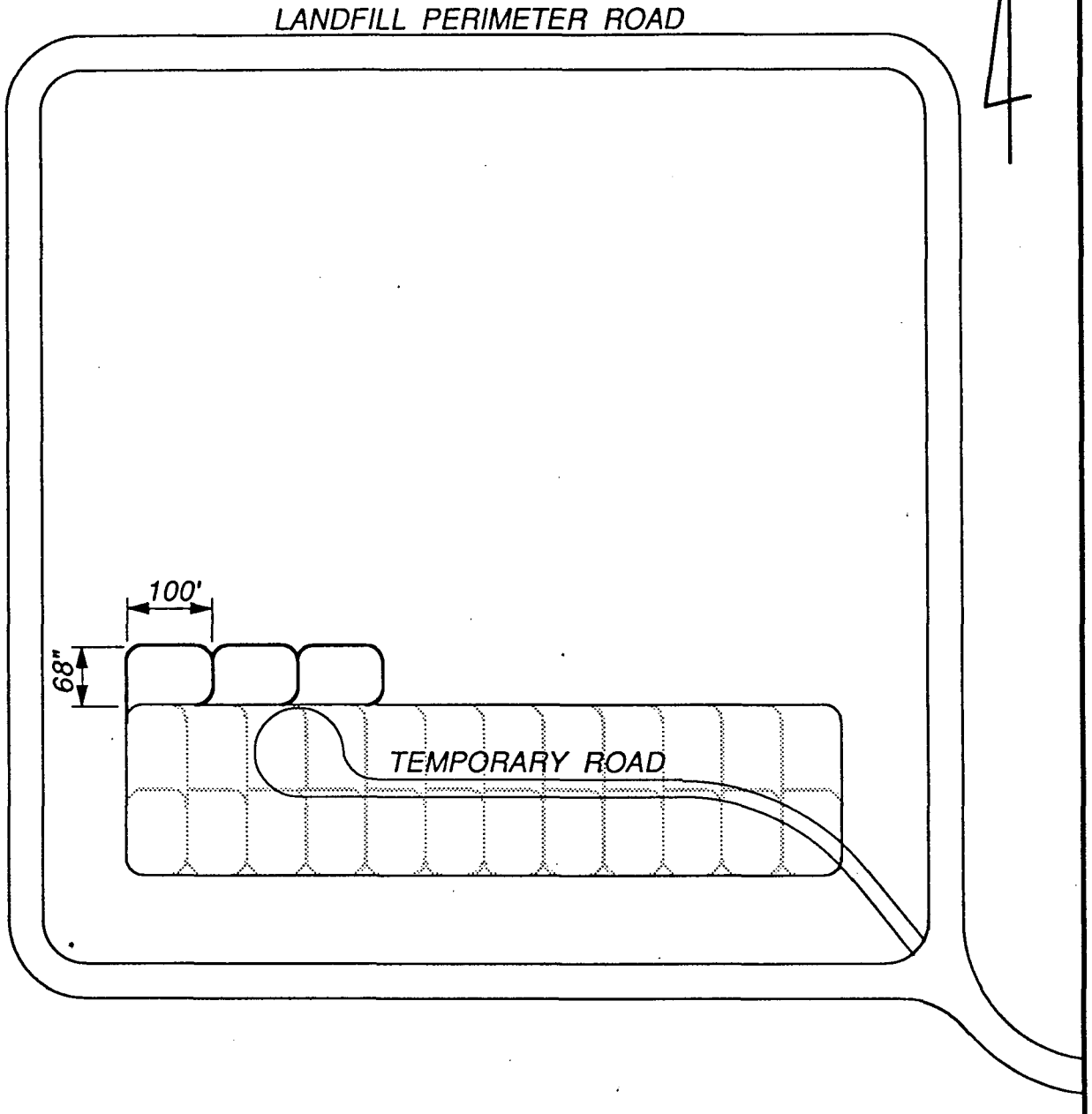
The site foreman is responsible for selecting the location of each day's working face based on the approved design and on the most efficient utilization of available space. Lifts of 10-feet are placed so as to best utilize on-site roads, provide adequate working room for refuse and landfill vehicles, and to provide drainage of surface water away from the working face.



INITIAL CELL DEVELOPMENT

Prepared by
Briley, Wild & Associates, Inc.
Consulting Engineers & Planners

Figure No. 5 -1



CONTINUING CELL DEVELOPMENT

Prepared by
Briley, Wild & Associates, Inc.
Consulting Engineers & Planners

Figure No. 5 -2

g. Waste Compaction and Application of Cover

The incoming waste is deposited at the working face as directed by the spotters. The working face is approximately 100-feet wide and 10-feet high. The refuse is spread into thin layers approximately 1-foot thick by the dozers, and then compacted by the compactors. At the end of the day cover material is spread by the dozers until 6-inch (minimum) layer of compacted soil completely covers the completed cell. On Saturdays, and Sundays very little material is placed and the cover is often completed on Monday.

Cover material is taken from the borrow pit, north of the landfill and hauled to the working face with four wheel drive dump trucks.

h. Gas, Leachate, and Stormwater Control

The site environmentalist is responsible for proper operation of gas, leachate and stormwater control systems.

The landfill is a high-rise landfill with a liner, and is surrounded by stormwater ditches which extend to the base of the fill. It is not possible for gas formed in the landfill to migrate off the site. Initially, the gas will escape out through the cover material and be dissipated in the atmosphere.

Leachate is collected by a network of perforated leachate collection pipes located directly above the liner. The collected leachate is pumped to lined holding basins west of the landfill. The leachate collection system is designed to keep the level of leachate collected in the landfill from rising to higher than one foot above the liner.

Leachate in the lined leachate holding basins is allowed to evaporate to reduce the volume of leachate to be disposed of. Leachate is also pumped back to the lined landfill to be added to the solid waste. Wetting the buried waste over the liner helps to promote more rapid degradation of the solid waste and further reduces the quantity of leachate to be disposed of. Leachate not removed by evaporation or recirculation is transported by tanker truck to off-site wastewater treatment and disposal facilities.

i. Ground Water Monitoring

Ground water is monitored at the site to ensure that the landfill operations are not adversely affecting ground water resources. Monitoring requirements were presented in the operating permit issued by the State in August 5, 1981. This monitoring program has been modified by subsequent changes in the rules and regulations governing ground water monitoring and by the Department of Environmental Regulation modifications to the County permit.

At the present time 12 shallow wells and two Floridan wells are sampled for water quality analysis. The wells, screened intervals, and DER numbers are listed below.

Existing Monitoring Wells

Well	Year Installed	Screened or Open Interval (ft.)	DER Number
B-1B	1987	28-33	3064A14965
B-2	1980	19-24	3064A12081
B-3B	1987	17-22	3064A14966
B-4	1980	20-25	3064A12087
B-5	1980	18-23	3064A12082
B-6	1980	25-30	3064A12090
B-7	1980	27-32	3064A14970
B-8	1987	43-48	3064A14971
B-9	1987	28-33	3064A14972
B-10	1988	15-25	3064A15206
B-11	1990	4-10	3064A15502
MO5B	1987	27-32	3064A14964
FA-1B	1987	91-92	3064A14968
FA-2C	1991	94-100	3064A14969

j. All Weather Access Roads

The on-site roads from the entrance gate to the landfill are paved roads. The roads on the landfill used as haul roads for transporting cover material from the borrow pit, and for service roads for the refuse vehicles are well build, well drained, heavy duty roads built of construction

debris and shell. The roads are slightly elevated above surrounding grade and are crowned to assist in providing good drainage.

Shell and construction debris suitable for road construction are stockpiled separately. This material is available at the site for the landfill staff to use to repair, maintain or relocate on-site access roads.

k. Effective Barrier

The entire property is surrounded by a fence and patrol road to prevent unauthorized entry to the site. Vehicular traffic must pass the scale house to get to the landfill. When the landfill is not in operation, the gates are kept locked and a night watchman assists in preventing unauthorized entry.

l. Signs

A large sign at the entrance gate proclaims the landfill to be run by Volusia County and gives the hours of operation.

There are many signs throughout the landfill to indicate traffic flow, where specific wastes may be placed, safety instructions, etc.

m. Dust Control

During dry periods it is occasionally necessary to control dust on the unpaved haul roads utilized by the refuse vehicles and by the vehicles hauling cover material. When the site foreman determines that dust control is required, water from the external stormwater ditch is pumping into a 7,000 gallon tank trailer, equipped with spray nozzles. This trailer is used to spray down the roads requiring dust control. As these roads are all on-site, any runoff from this operation is captured in the stormwater and leachate collection systems.

n. Litter Control

Litter at landfills is caused by: a) refuse being unloaded at the working face or refuse previously unloaded at the working face, but not yet covered, being caught by the wind and transported away from the working face; b) refuse falling from improperly covered refuse vehicles; and c) dumping of refuse in unauthorized locations.

To control wind borne litter refuse unloaded at the working face is spread and compacted continuously throughout the working day. Proper orientation of the working face by the site foreman also reduces the incidence of wind blown litter. On windy days refuse could be placed at the bottom of the working face to shield it from the wind. During times of high wind some litter does escape from the working face. This fugitive litter is collected along the sides of the stormwater ditches that surround the landfill and does not leave the property. Work-release parties from the correctional institute are utilized in retrieving and collecting this material.

Transporting refuse in an open truck with the tailgate down or without proper cover is against County ordinances. Spotters and the gate house clerk report vehicles in violation to the litter control officer, who issues the appropriate citations.

With signs clearly indicating the way to the appropriate working face and with spotters enforcing traffic control and directing the unloading of refuse from vehicles, improper dumping is kept under control.

o. Fire Protection and Fire Fighting Facilities

Landfill fires are particularly hazardous, due to the presence of methane gas, Chemicals in the waste, such as discarded cleansers, gasoline cans, etc., can also make landfill fires particularly dangerous. Fires may be caused by spontaneous combustion in refuse containers or refuse vehicles, by reaction of waste fuel, or chemicals, or by hot coals or ashes. Daily cover assists in preventing the fire from spreading from cell to cell.

If a fire is observed during operating hours, the burning material is separated from other refuse and is covered with soil. In addition, each vehicle and building is equipped with fire extinguishers to allow small fires to be dealt with as they occur. Whenever a fire does take place, the landfill staff calls the Florida State Division of Forestry, which classifies landfill fires as brush fires. The Division of Forestry notifies the County Sheriff and the Halifax Fire Department.The Halifax Fire Department is trained to deal with landfill fires and is equipped with self contained breathing devices and chemical masks which could be needed.

Fires that occur outside of the normal hours of operation are considerably more difficult to control due to the fact that the fire could be well developed before it is reported. Nighttime visibility restrictions also make these fires considerably more dangerous than daytime fires. In the event that a fire is observed or reported during the hours the landfill is closed, the Sheriff's office and 911 are

instructed to call the Division of Forestry. The Division of Forestry notifies the Halifax Fire Department and will call the landfill staff members who are on call at that time.

p. Attendant

A clerk is present at the scale house during all hours the landfill is open. Spotters and equipment operators are also present. During evening hours when the landfill is not in operation, a night watchman helps restrict unauthorized access to the site.

q. Communication Facilities

The scale house and the office/maintenance building are equipped with telephones. The two spotters and supervisory personnel are assigned vehicles with radios that communicate with the County's Central Control network. Through this network, the spotters can communicate directly with each other and with the site foreman, and can relay messages to the Sheriff's office and other emergency services.

r. In-Service and Reserve Equipment

The landfill has two compactors, three dozers, and two four wheel drive dump trucks. Also at the landfill are 1 dragline, 1 backhoe, 1 loader, and 1 grader. Should any one piece of equipment be disabled the landfill could continue to operate. In addition, the Volusia County Department of Public Works Division of Roads and Bridges also has equipment which could be loaned to the Division of Solid Waste for use during an emergency.

s. Safety Devices

All landfill vehicles are equipped with roll bars to protect operators. Each vehicle also is equipped with fire extinguishers to assist in preventing small fires from spreading out of control. Site employees are also equipped with safety boots, rain gear, gloves, and goggles for personal protection while working at the landfill.

6.0 Water Quality Standards

Surface runoff from the site is retained in a perimeter pond that surrounds the proposed landfill. The pond is designed to hold the runoff from both the 25 year and the 100 year design

storms. During rainfall events exceeding the 100 year storm surface runoff will overflow to the flatwoods east of the landfill.

The landfill will be constructed with a composite liner to restrict leachate from escaping to groundwater. The landfill will also have a leachate collection system designed to keep the level of leachate in the landfill from exceeding 12-inches. The groundwater level outside the landfill will be several feet higher than the landfill liner, and leaks in the liner will result in groundwater flowing into the landfill, not leachate flowing out into groundwater.

Leachate will be disposed of on-site by evaporation, recirculation into the landfill, or by trucking off-site for treatment and disposal.

7.0 Closure Plan

a. Design

In accordance with the requirements of 17-701.071, a closure schedule will be submitted to the DER one year prior to cessation of waste acceptance. The proposed final configuration of the landfill is shown on the plans accompanying this application. Side slopes are 4:1 with 20-foot wide terraces located after every 20-foot of rise. Final cover shall include a minimum of 6-inches of daily cover, 6-inches of compacted clay, 6-inches of protective soil cover, and 6-inches of top soil to provide a root zone for the vegetative growth. Much of this final cover will be placed prior to the time of closure as individual portions of the landfill are compacted.

b. Final Use

It is the County's intent to utilize Tomoka Farms Road site for the processing and disposal of solid waste throughout the foreseeable future. As long as the site is active, closed out portions of the landfill will be used to provide screening and buffer for the portions of the site that remain active. When the site is no longer active as a solid waste site, current plans call for the site to be available for passive recreation.

c. Closure Operations

1. Construct landfill to the grades shown on the approved drawings and the construction permit issued by the FDER.

2. Install final cover as shown on the approved drawings, including the low permeability clay cap. Much of this cover may already be in place at the time of closure.
3. Install gas vents as shown on the approved drawings.
4. Properly seed and mulch to establish a vegetative cover over the closed landfill.

All required ditches, retention areas, groundwater monitor wells, and fencing will be in place prior to placing the landfill in operation and no other work is expected to be required at the time of closure.

d. Post Closure

Post closure responsibilities include continuing with the approved groundwater monitoring plan, maintenance of the surface water and leachate collection and disposal system, maintenance of vegetative cover, repair of erosion and other damage to the final cover, and gas monitoring.

e. Financial Responsibility

Probable costs for closure and post-closure costs are presented in the following tables.

Table 1
Estimate of Probable Closure Cost
Tomoka Farms Road Landfill

1.	Grading and Surface Preparation 145,000 sy x $0.50/sy	$72,500.00
2.	Clay Layer (six inches) 145,000 sy x $3.50/sy	507,500.00
3.	Soil Cover (six inches) 145,000 sy x $0.65/sy	94,250.00
4.	Topsoil (six inches) 145,000 sy x $1.50/sy	217,500.00
5.	Seeding and Mulching 145,000 sy x $0.30/sy	43,500.00
6.	Gas Vents 25 vents x $1,000/vent	25,000.00
7.	Miscellaneous Closure Costs Survey, signs, etc.	17,500.00
	Subtotal	$977,750.00
	Contingency	146,250.00
	TOTAL	$1,124,000.00

Table 2
Estimate of Probable Post-Closure
Annual Cost
Tomoka Farms Road Landfill

Ground and Surface Water Monitoring 6 sites x 4 qtr/yr x $800.00	$19,200.00
Inspection and Gas Monitoring	1,600.00
Final Cover Repair and Reseeding	7,500.00
Mowing and Groundskeeping	4,000.00
Leachate Pumping	15,000.00
TOTAL ANNUAL COST	$47,300.00

f. Closure Plan Schedule

The following is an estimated closure schedule and list of closure operations:

1 Year Prior to Cessation of Accepting Waste:
- notify DER
- prepare schedule for closing

120 Days Prior to Cessation of Accepting Waste
- advise users by posting signs

90 Days Prior to Cessation of Accepting Waste
- submit closure permit application

10 Days Prior to Cessation of Accepting Waste
- publish a legal notice of proposed closure

180 Days After Cessation of Accepting Waste
- place final cover

After Completion of Closure
- install concrete survey monuments
- final survey and as-built report
- file a "declaration to the public"

10 Years After Closure
- County may request DER to reduce long term care period

20 Years After Closure
- end of long term care period

APPENDIX A
FOUNDATION ANALYSIS

BECHTOL ENGINEERING
AND TESTING, inc.

May 31, 1992
Project No. 92100

TO: LEE POWELL, P.E.
BRILEY, WILD & ASSOCIATES
P.O. BOX 607
ORMOND BEACH, FL 32175-0607

RE: General Geotechnical Evaluations, Tomoka Landfill, Volusia County, Florida.

Dear Mr. Powell:

As requested, we have conducted general geotechnical evaluations relative to existing and proposed expansions of refuse embankment fills at the subject site.

The following report summarizes the background of the site, proposed expansions, and general site subsurface conditions, and provides general geotechnical related evaluations and discussion.

For the purpose of this report, we have relied solely on subsurface information and landfill design data published by other entities noted herein. No site-specific subsurface data was compiled by Bechtol Engineering and Testing, Inc.. The following report is intended only to provide general geotechnical related evaluations, and should not be construed as a comprehensive geotechnical study. We do trust however, that the information presented is sufficient for your immediate needs.

Bechtol Engineering and Testing, inc. appreciates the opportunity to provide our services on this project. In the event you should have any questions, or require any additional services, please do not hesitate to call.

Respectfully,

Bechtol Engineering and Testing, inc.

5/31/92

Thomas Bechtol, P.E.
President
Florida Registration No. 38538
TB/rr
0766

3 cc: Client

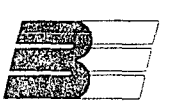
Consulting Geotechnical and Construction Materials Testing Engineers
114A S. Alabama Avenue • DeLand, FL 32724-5524 • Telephone (904) 734-8444
FAX (904) 734-8541

SITE BACKGROUND

The Tomoka Landfill property consists of nearly 850 acres located west of Tomoka Farms Road and the Tomoka River, and south of Interstate No. 4 in Sections 3,4,9, and 10, Township 16 South, Range 32 East, Volusia County, Florida. According to various sources, the County of Volusia has operated a refuse landfill on this property, or portions thereof, for over 20 years.

The active portion of the landfill consists of a generally rectangular area, about 2500' x 2000' in size, located in the southwest portion of the site, or more specifically in the northeast quadrant of Section 9, Township 16 South, Range 32 East. Prior to it's inception as a landfill, we envision that the site existed primarily as pine/palmetto flatwoods, with average ground surface elevations on the order of +27' NGVD, and average groundwater levels within a few feet of ground surface.

We understand that all or portions of the active landfill area may have been excavated to about elevation +15' NGVD prior to refuse filling, in order to provide cover material for other landfill areas on site. In reference to Tomoka Farms Road Landfill Report (Briley, Wild & Associates, August, 1980), the fill design for the area was based on compacted refuse lifts of 8 feet in thickness with a 6-inch soil cover. Currently, the existing refuse embankment is being filled, with proposed finish top-of-embankment elevation on the order of +110' NGVD. Average side slopes are estimated to be about 6 horizontal to 1 vertical.



PROPOSED EXPANSION

As discussed with Lee Powell, P.E., it is proposed to expand the active portion of the landfill area. The proposed area of expansion includes a 1,400'± x 700'± borrow area (lake) and an adjacent 1,400'± x 700'± partially excavated area, located north of, and adjacent to the existing active landfill embankment. We understand that the bottom of the existing borrow area is at about +15' NGVD and that the remainder of the proposed embankment area will be excavated to a similar bottom elevation. Proposed top-of-embankment elevation is reported to be +134' NGVD. We envision that the fill design will be generally consistent with the existing embankment. Proposed average side slopes for the new embankment are reported to be 4 horizontal to 1 vertical.

GENERAL SITE SUBSURFACE CONDITIONS

In reference to a recent Hydrogeologic Evaluation (David N. Gomberg, Ph.D., September, 1986) a generalized hydrogeologic cross section below the active landfill can be summarized as follows:

ELEVATION (NGVD)	PREDOMINANT SOIL DESCRIPTION	HYDROGEOLOGIC FORMATION
+27 to +15	*Sands, Silty Sands	Shallow Non-Artesian Aquifer
+15 to +6	Clayey Sands	Semi-Confining Layer
+6 to -2	Sands	Semi-Unconfined Layer
-2 to -12	Sandy Clays	Confining Layer

ELEVATION (NGVD)	PREDOMINANT SOIL DESCRIPTION	HYDROGEOLOGIC FORMATION
-12 to -26	Sands and Shell	Secondary Artesian Aquifer
-26 to -36	Clay	Confining Layer
-36 to -53	Silty Sands and Shell	Upper Artesian Aquifer
-53 to -300+	Limestone	Artesian (Floridan) Aquifer

* May be partially or completely excavated and replaced with refuse fill.

Based on our previous experience in the site vicinity, we envision that the various deposits of sand, silty sand, clayey sand and sand/shell underlying the site are relatively dense. Testing of clay deposits similar to those anticipated below the site indicate that these deposits generally are normally consolidated and exist in a medium stiff to stiff condition.

Normal average groundwater levels associated with the shallow non-artesian aquifer would be expected at elevations on the order of +25' NGVD when not artificially lowered. Actual groundwater elevations may be substantially lower due to artificial drainage or dewatering which may be associated with the landfill operations. Recent USGS Potentiometric Surface Maps (May, 1989) indicate the piezometric surface level of the Floridan Aquifer below the site to be on the order of +10' NGVD.

GEOTECHNICAL EVALUATIONS

From a geotechnical standpoint, the primary concerns associated with the proposed landfill embankment construction are:

1. Bearing capacity of the underlying geologic formations for support of the induced embankment surcharge loading.

2. Consolidation of refuse fill and underlying geologic sediments.

3. Slope stability of the refuse embankment.

Bearing Capacity

Based on an estimated compacted refuse density of 1000 pcy, a cover material density of 100 pcf, the proposed average 12' excavation, the fill design of 6-inch cover for 8 feet of refuse, and the proposed top-of-embankment elevation of +134' NGVD, the average net surcharge loading imposed by the refuse fill on the underlying materials would be on the order of 4,500 psf or 2.25 tsf. With respect to the overall lateral limits of the refuse embankment fill and conservative estimates of subsurface soil properties, calculations using Terzaghi, Meyerhoh, and Hansen bearing capacity equations all indicate ultimate bearing capacity of the subsurface formations to be well in excess of 50 tsf. We therefore feel there is essentially no risk of shear failure or bearing capacity failure due to the existing or proposed refuse embankment.

Consolidation and Settlement

The proposed refuse embankment will induce soils stresses nearly equal to the total surcharge loading throughout the thickness of the geological formations overlying bedrock (limestones of the Floridan Aquifer). Due to these induced soil stresses, a certain degree of consolidation of these formations, and subsequent settlement of the overlying refuse embankment, can be expected.

Certain degrees of both short-term elastic settlement due primarily to deformation and compression of granular deposits, and long-term plastic settlement due primarily to compression of plastic clay deposits are likely. Short-term and long-term settlement can be expected with additional refuse application. Insufficient data is available to provide specific calculations of potential consolidation of the subsurface deposits, however, we envision that overall long-term consolidation of 1 to 2 feet is not unlikely.

In addition, certain degrees of additional settlement are likely due to consolidation of the refuse fill itself due to stresses induced by overlying refuse applications and decomposition within. Refuse consolidation may vary dramatically throughout the embankment fill area, and average long-term settlement of several feet is possible. Potential settlements should be carefully considered for any future developments associated with planned recreational facilities.

Slope Stability

Due to the potential variability of refuse characteristics, placement of refuse and cover material and drainage characteristics, the ultimate stability of refuse embankment slopes may vary widely. Generally, if the average 4:1 side slopes are maintained throughout, we envision that the potential for significant slope failure is very low. Past performance of existing slopes should provide insight as to potential stability problems which may exist. If deemed necessary, certain methods such as slope flattening, benching, ditching, and construction of fill buttresses may be considered. Effective means of surface and subsurface drainage and surface treatment such as seeding or geotextile application may be a consideration in order to minimize potential erosion and seepage related problems.

APPENDIX B
GROUNDWATER MONITORING PLAN

APPENDIX B

The proposed Groundwater Monitoring Plan for this site was prepared by Dr. David Gomberg and submitted to the Department of Environmental Regulation for review on May 26, 1992.

The DER prepared a comment letter dated June 23, 1992. We are now in the process of addressing those comments. The revised Grondwater Monitoring Plan will be submitted after those comments have been addressed.

APPENDIX C
CLAY LINER EQUIVALENCY CALCULATIONS

APPENDIX C

CLAY LINER EQUIVALENCY CALCULATIONS

Florida regulations FAC 17-701.050 (5) requires the clay portion of a composite liner system to be a minimum of 18-inches thick and to have a maximum hydraulic conductivity of 1×10^{-7} cm/sec. In the proposed new regulations, FAC 17-701.400, the required thickness of the clay is determined by its hydraulic conductivity of 1×17^{-7} cm/sec three feet is required. Two feet of clay with a hydraulic conductivity of 5×10^{-8} or one foot of clay with a hydraulic conductivity of 1×10^{-8} cm/sec are also allowed.

To determine the equivalency of the proposed geosynthetic clay liner to the ones described in the regulations it is necessary to calculate the seepage rate through each of the two clay layers.

Steady-state seepage calculations for fluid flow through a clay layer are performed using Darcy's equation: $q = k\,i$

where: q = steady-state flow per unit area in ft/s; k = hydraulic conductivity in ft/s; and i = hydraulic gradient (dimensionless).

The hydraulic gradient i, is defined by: $i = (h + T)/T$

where h = head of liquid on top of clay layer in ft. and T = thickness of clay layer in ft. Combining the equations gives: $q = k\,(h + T)/T$

For the basic case of a hydraulic head, h, of 1 ft on a clay layer which has thickness, T, of 3 ft and a hydraulic conductivity, k, of 1×10^{-7} cm/s (3.28×10^{-9} ft/s) (i.e., the reference clay layer), the calculation of steady-state flow per unit area is as follows:

$$q = k\,(h + T)/T$$
$$q = 3.28 \times 10^{-9} \times (1 + 3)\,/3$$
$$= 4.373 \times 10^{-9} \text{ ft/s}$$
$$= 0.138 \text{ ft/year}$$

Therefore, the steady-state flow per unit area for the basic case is 0.138 ft/year.

Substituting a geosynthetic clay layer with a thickness, T, of 0.2 in. (0.0167 ft) and a hydraulic conductivity of 3×10^{-10} cm/s (9.843×10^{-12} ft/s) in place of the 3 ft. of clay in the above calculation gives:

$q = k (h + T) / T$
$q = 9.843 \times 10^{-12} (1 + 0.0167) / 0.0167$
$q = 6.0 \times 10^{-10}$ ft/s
$q = 0.0189$ ft/year

Therefore, the steady-state flow per unit area when the proposed clay layer is used instead of the 3 ft. of clay is 0.0189 ft/year.

The properties of the proposed geosynthetic clay liner used in the above calculation were based on a confining stress of 30 psi which is considered representative of the average confining stress that the layer would be subjected to during the active life of a typical landfill. A more conservative approach would be to select properties that are based on a confining stress on the order of 2 psi which is considered representative of the confining stress that the layer would be subjected to prior to waste placement. For this case, the selected properties of the proposed geosynthetic liner are a thickness of 0.35 in. (0.029 ft) and a hydraulic conductivity of 2×10^{-9} cm/s (6.56×10^{-11} ft/s) and the calculation of steady-state flow per unit is as follows:

$q = k (h + T) / T$
$q = 6.56 \times 10^{-11} (1 + 0.029) / 0.029$
$q = 2.328 \times 10^{-9}$ ft/s
$q = 0.073$ ft/year

Therefore, when more conservative properties for the proposed geosynthetic clay liner are used, the steady-state flow per unit area is calculated to be 0.073 ft/year.

The analysis shows that for the basic case of a hydraulic head of 1 ft. on the reference clay layer (3 ft. thick with a hydraulic conductivity of 1×10^{-7} cm/s) the calculated steady-state flow per unit area is 0.138 ft/year. When a geosynthetic clay liner is substituted for the 3 ft. of clay, the calculated steady-state flow per unit area with the same 1 ft. hydraulic head is 0.0189 ft/year which is a seven-fold reduction in calculated steady-state flow when compared to the basic case. Even if the most conservative property values for the geosynthetic clay liner are used in the analysis, the

APPENDIX D
CONSTRUCTION QUALITY ASSURANCE PLAN

APPENDIX D

TOMOKA LANDFILL
CONSTRUCTION QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

1.0 GENERAL

1.1 Purpose

The purpose of this construction Quality Assurance Plan is to provide the construction quality assurance personnel with adequate information to achieve continuous compliance with the liner construction requirements of this Project.

1.2 Description of the Project

This Project consists of the construction of a 30 acre composite landfill liner and two double lined two acre leachate holding basins.

The landfill liner is a composite liner, with 60 mil high density polyethylene (HDPE) membrane overlaying geosynthetic clay liner (GCL).

The leachate pond double liner system consists a 60 mil HDPE membrane overlaying a geonet drainage layer and leak detection system, a secondary 60 mil HDPE membrane, and a geosynthetic clay liner.

2.0 RESPONSIBILITY

The Owner, Volusia County, is responsible for complying with the provisions and conditions of the permits issued to the County by the regulatory agencies, and with any applicable laws and regulations.

The Contractor will be selected using the County's procedures for competitive bidding, with the lowest responsible bidder being selected as the Contractor. A construction contract will be entered into with the selected Contractor to complete the Project in accordance with the plans and specifications.

The Contractor is responsible for constructing the liner in accordance with the requirements of the plans and specifications, including all quality control measures needed for successful completion of the Project. He is also responsible for complying with applicable codes, ordinances, and regulations of all governing bodies.

The Owner shall hire an independent quality assurance firm to provide an Inspector to observe all quality control procedures. The Inspector will check material certifications, observe all testing, and monitor construction compliance with the plans and specifications. The Inspector will conduct field testing procedures and will arrange for independent laboratory testing where required. He will also prepare daily logs of all construction activity, including the time, location, identification, number, and results of all field tests and samples.

The firm to be selected to provide quality assurance inspection shall be a professional firm having quality assurance inspection as a significant part of their regular professional practice. The firm shall have at least two years of experience in construction quality assurance, testing and shall employ licensed professional engineers.

3.0 SPECIFICATIONS

The specifications for the HDPE membrane liner and for the geosynthetic clay liner are attached at the back of this section.

4.0 SUBGRADE PREPARATION QUALITY ASSURANCE

The Inspector shall provide field density tests using ASTM D2922 at a frequency of one per acre to verify the compaction of the subgrade. The Inspector shall visually observe the subgrade during GCL installation to confirm that the surface on which the liner is to be placed is maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.

5.0 GEOSYNTHETIC CLAY LINER QUALITY ASSURANCE

5.1 Off-Site Quality Assurance

The GCL manufacturer shall allow the Inspector to visit the manufacturing facility in order to:

- observe the quality control testing facilities;
- meet and review the manufacturer's quality control and production personnel;
- observe that the quality control procedures being followed are in strict accordance wit those outlined in the manufacturer's Quality Control Manual;

- arrange for a sample or samples to be sent to an independent laboratory for testing.

5.2 On-Site Quality Assurance

The Inspector shall cut a one-foot wide sample from delivered rolls of GCL for independent testing to confirm compliance with the project specifications.

Each day the installer's superintendent and the Owner's Inspector shall inspect and the installer shall provide written certification that the subgrade for the GCL has been prepared in accordance with the specifications and the manufacturer's.

As each panel is being deployed, the installer superintendent and Owner's Inspector shall provide 100% inspection of the installation. Inspection should consist of:

- the recording of each roll number and lot number as panels are deployed, along with a general description of the location of each panel;
- inspection of overlap;
- visual inspection of geotextile quality, bentonite uniformity, and the degree of hydration, if any, on the clay. Mark any areas as appropriate for repair;
- inspection of anchoring and sealing around penetrations and structures.

6.0 HDPE LINER QUALITY ASSURANCE

6.1 Off-Site Quality Assurance

The HDPE membrane manufacturer shall allow the Owner's Inspector to visit the manufacturing facility in order to:

- observe the quality control testing facilities;
- meet and interview the manufacturers quality control and production personnel;

- observe that the quality control procedures being followed are in strict accordance with those outlined in the manufacturer's quality control manual;

- arrange for a sample or samples to be sent to an independent laboratory for testing.

6.2 On-Site Quality Assurance

Subgrade

Each day, the installer's superintendent and the Owner's Inspector shall inspect and the installer shall provide written certification that the subgrade for the HDPE liner has been prepared in accordance with the specifications and the manufacturer's recommendations.

Material

The Inspector shall be present when rolls are off-loaded at the site. Damaged rolls will be stored separately and inspected to determine acceptability. The Inspector will receive the manufacturer's certifications for all rolls delivered to the site. The Inspector shall observe all areas of the installed liner for defects, holes, blisters, or contamination.

Seams

With the Inspector present, the installer will conduct field test seams on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each clay, and at least once each 4 hours, for each seaming apparatus used that day.

All test seams shall be made at a location selected by the Inspector in the area of the seaming and in contact with the subgrade. The test seam samples shall be 10-feet long for hot shoe welding and 3-feet long for extrusion welding with the seam centered lengthwise. Specimens 1-inch wide shall be cut form each opposite end of the test seam by the Inspector. The Inspector shall use a tensionmeter to test these specimens for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved.

The Inspector shall conduct non-destructive tests on all field seams over the full length. In addition, Installer shall provide the Inspector with a minimum of one destructive test sample per 500-feet of seam length from a location specified by the Inspector. The Installer shall not be informed in advance of the sample location.

Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as the seaming progresses. Sampling times and locations shall be determined by the Inspector. The Inspector must witness the obtainment of all field test samples and the Installer shall mark all samples with their location roll and seam number. The Installer shall also record in written form the date, time, location, roll seam number, ambient temperatures, and pass or fail description. A copy of the information must be attached to each sample portion. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.

Size and Disposition of Samples

The samples shall be 12-inches wide by 24-inches long with the seam centered lengthwise. The sample shall be cut into two equal length pieces, half to be given to the Inspector and the other half to be given to the Owner's Representative. If the Installer desires a sample the size should be increased to 12-inches wide by 36-inches long.

Field Laboratory Testing

The Inspector shall cut ten 1-inch wide replicate specimens from his sample and these shall be tested by the Inspector. The Inspector shall test five specimens for seam strength and five for peel strength. To be acceptable, four out of the five replicate test specimens must pass. Any specimen that fails through the weld or by adhesion at the weldsheet interface is a non-film tear break.

7.0 FINAL REPORT

The Inspector shall prepare a Final Quality Assurance Summary Report certifying that the liner system has been installed in substantial conformance with the plans and specifications for the liner system. The report shall include testing results, record drawings, and the location of repairs and patches.

SECTION 02776
GEOSYNTHETIC CLAY LINER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Furnish all labor, materials, equipment and incidentals required to install the geosynthetic clay liner.

Related Work Specified Elsewhere.

Section 02200 - Earthwork
Section 02777 - High Density Polyethylene Liner

1.02 QUALITY ASSURANCE

The liner manufacturer shall provide a qualified representative to observe the installation of the liner. The representative shall remain on site during construction until, in his opinion, the Contractor can adequately complete the installation in strict accordance with these Specifications and manufacturers installation procedures.

The Owners quality assurance inspector will be on site during construction to observe the installation procedures.

Available Manufacturers. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to the following:

American Colloid Co. "Bentomat"
Gundle Lining Systems, Inc. "Gundseal"
James Clem Corp. "Claymax"
National Seal Co. "Bentofix"

1.03 SUBMITTALS

Include at least the following:

Certificate of Compliance

Manufacturer's quality control program and manual or descriptive documentation (submit to Engineer for submission to DER);

a set of installation drawings indicating the layout of the liner, as well as any variance or additional details which deviate from the Drawings shall be submitted for installation inspection and Record purposes; and

record drawings showing actual layout of sheets and locations of field seams.

1.04 PRODUCT HANDLING

The rolls or panels of liner shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Contractor.

Materials shall be shipped and delivered to the site only after the required submittals have been received and approved by the Engineer. Off-loading and storage of the liner is the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner. No off-loading shall be done unless the Inspector is present. Damage during off-loading shall be documented by the Inspector and Contractor. The Engineer shall be the final authority on determination of damage.

The liner shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The Contractor will be allocated sufficient space by the Owner to store the liner upon its arrival. On-site handling of the liner is the responsibility of the Contractor. Appropriate handling equipment shall be used when loading or moving rolled liner from one place to another. Appropriate equipment includes spreader and roll bars for deployment, cloth chokers and spreader bar for off-loading. Procedures for handling the liner shall be approved by the Inspector.

Liner damaged during transit, off-loading, handling, etc., shall be so identified and set aside. During the unrolling of the liner, the Contractor shall visually inspect the liner surface in the presence of the Inspector. Faulty or suspect areas shall be marked for testing and/or repair, as determined by the Inspector. Liner stock that is faulty (requires more than one patch per 5,000 square feet), shall be replaced by the Contractor at the Contractor's expense.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIAL SPECIFICATIONS

Liner Material. The clay liner shall be manufactured with not less than one pound per square foot of sodium bentonite adhered to a support fabric.

The liner material shall be so produced as to be free of holes, thin areas, damage, or any sign of contamination by foreign matter.

The lining material shall be manufactured to a minimum of 12-ft. width. Labels on the roll shall identify the product name, name of the manufacturer, lot number, and time of production.

The liner material shall meet the following physical characteristics:

Clay Mass/Unit Area	1.0 lb/ft.^{2}
Clay Thickness (Dry)	± 5mm
Hydraulic Conductivity	1 x 10 $^{-9}$ cm/sec (max)
Roll Width	12-ft. (min.)
Roll Length	82-ft. (min.)
Moisture Content	12 percent (max.)
Tensile Strength of Backing	78 lb/in. (min.)

2.02 FACTORY QUALITY

Raw Material. The manufacturer shall test the bentonite clay to ensure the consistency of the raw material quality. The manufacturer shall test for the following properties:

Montmorillonite Content
Moisture Content (ASTM D4643)
Percent Passing No. 200 Sieve
Swell USP-NF-XVII

The manufacturer shall also test the fabric backing for:

Mass Per Unit Area (ASTM D3776)
Thickness (ASTM D1777)
Grab Tensile Strength (ASTM D4632)
Trapezoidal Tear Strength (ASTM D4533)
Puncture Resistance (ASTM D4833)
Burst Strength (ASTM D3786)

As a result of this testing, the manufacturer shall certify as to the quality of the raw material as defined by the physical specifications.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects or debris of any kind. The surface shall provide a firm, unyielding foundation for the liner with no sudden sharp or abrupt changes or breaks.

The subgrade shall be compacted to a minimum of 90 percent modified proctor density (ASTM D1557) and sealed with a smooth drum or vibratory roller.

The installer shall certify in writing that the surface on which the liner will be installed is acceptable. After the supporting soil has been accepted by the manufacturer, it shall be the installer's responsibility to indicate to the Engineer any change in the supporting soil condition caused by natural conditions or occurrences that may require repair work. The installer shall provide for dewatering and for drying of the subgrade, as required during construction. Special care shall be taken to maintain the prepared soil surface. Any damage to the subgrade caused by this installation shall be repaired by the Contractor in accordance with the requirements of the applicable Earthwork specifications.

3.02 INSTALLATION

The installer shall be responsible for inspection of the panel rolls at the job site. Should rolls show damage from transit, they will be so identified and set aside. During the unrolling of the panel rolls, the installer shall visually inspect the sheet surface. Any faulty areas shall be marked and repaired in an approved manner by the installer.

The method used to unroll the panels shall not cause damage to the liner or to the supporting soil.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Wrinkles shall be identified as to proper location and compensation shall be identified on the Contractor's and Inspector's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

Adequate loading (e.g. sand bags, tires, or similar items that will not damage the liner) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

Direct contact with the liner shall be minimized, i.e., in traffic areas it shall be protected by extra liner or other suitable materials.

Liner Placement and Layout. The panels shall be laid out according to approved engineering plans and shall not deviate from the approved plans except with the prior approval of the Owner and the Engineer. Panels shall be overlapped as required for seaming.

The number of panels to be deployed in any day shall be limited to the number of panels which can be anchored, inspected, repaired, and covered with High Density Polyethylene Liner (HDPE) that same day. The panels must be dry when installed and dry when covered.

No equipment used shall damage the liner by handling, trafficking, wetting, or other means.

No personnel working on the liner shall smoke, wear damaging shoes, or engage in other activities that could damage the liner.

Liner clamps or other metal tools shall be padded, must have rounded corners, and shall never be tossed or thrown.

Field Seaming. Once the first run has been laid, adjoining runs shall be laid with a 6-inch minimum overlap on longitudinal seams, and 12-inches on the panel end seams. All dirt, gravel or other debris shall be removed from the overlap area of the liner.

Seam overlaps shall be placed such that the direction of flow is from the top sheet to the bottom sheet to form a shingle effect.

The free end at the crest shall be locked into the anchor trench as shown on the drawings.

If "Bentomat" or "Bentofix" is used, a 2-inch wide continuous strip of bentonite powder or granules shall be placed on top of the unrolled mat approximately 4-inches from the edge prior to completing the overlap seam. The bentonite shall be applied at the rate of 1/4 lb. per linear foot.

Patching and Repairs. Irregular shapes, cuts, or tears in installed bentonite liner should be covered with sufficient liner to provide a 12-inch overlap on all adjoining liner.

3.03 ACCEPTANCE

The Contractor shall retain all ownership and responsibility for the liner until acceptance by the Owner and Engineer.

END OF SECTION
02776-4

SECTION 02777
HIGH DENSITY POLYETHYLENE LINER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Furnish all labor, materials, equipment and incidentals required to install the high density polyethylene liner.

Related Work Specified Elsewhere.

Section 02200 - Earthwork
Section 02710 - Subdrainage System
Section 03300 - Concrete
Section 02776 - Geosynthetic Clay Liner

1.02 QUALITY ASSURANCE

The liner shall be installed by the manufacturer or manufacturer approved Contractor under the direction of a qualified supervisor and who shall be in absolute charge of this installation and responsible for the work performed.

Available Manufacturers. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to following:

Gundle Lining Systems, Inc.
SLT
National Seal Co.
PolyAmerica, Inc.

1.03 SUBMITTALS

Include at least the following:

Certificate of Compliance

Manufacturer's quality control program and manual or descriptive documentation (submit to Engineer for submission to DER);

a set of installation drawings indicating the layout of the liner, as well as any variance or additional details which deviate from the Drawings shall be submitted for installation inspection and Record purposes; and

record drawings showing actual layout of sheets and locations of field seams.

1.04 PRODUCT HANDLING

The rolls or panels of liner shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Contractor.

Materials shall be shipped and delivered to the site only after the required submittals have been received and approved by the Engineer. Off-loading and storage of the liner is the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner. No off-loading shall be done unless the Inspector is present. Damage during off-loading shall be documented by the Inspector and Contractor. The Engineer shall be the final authority on determination of damage.

The liner shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The Contractor will be allocated sufficient space by the Owner to store the liner upon its arrival. On-site handling of the liner is the responsibility of the Contractor. Appropriate handling equipment shall be used when loading or moving rolled liner from one place to another. Appropriate equipment includes spreader and roll bars for deployment, cloth chokers and spreader bar for off-loading. Procedures for handling the liner shall be approved by the Inspector.

Liner damaged during transit, off-loading, handling, etc., shall be so identified and set aside. During the unrolling of the liner, the Contractor shall visually inspect the sheet surface in the presence of the Inspector. Faulty or suspect areas shall be marked for testing and/or repair, as determined by the Inspector. Liner stock that is faulty (requires more than one patch per 5,000 square feet), shall be replaced by the Contractor at the Contractor's expense.

1.05 WARRANTY

A written warranty shall be obtained from the Contractor as part of the contract documents. This document shall warrant both the quality of the material and workmanship. The Contractor shall certify in writing that the installed liner product meets the requirements of these specifications and the project plans and under normal weathering the sheet material is warranted for a period of 20 years and that the sheet will not fail due to seam failure, environmental stress cracking, or flex fatigue within 20 years of installation.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIAL SPECIFICATIONS

Liner Material. The membrane liner shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.

The liner material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired using the extrusion welding technique in accordance with the manufacturer's recommendations.

The lining material shall be manufactured to a minimum of 22-ft. width. Labels on the roll shall identify the thickness, length, width, and manufacturer's mark number. There shall be no factory seams.

The fabricated seams (if applicable) and field seams shall meet the following specifications:

Shear Strength	(ASTM D3083)	Minimum 90% of Film Tear Bond
Peel Strength	(ASTM D413	Minimum of 50% of Film Tear Bond

The liner material shall meet the following typical physical characteristics:

Density	(ASTM D1505)	0.940 G/cc Min.
Melt Index	(ASTM D1238)	0.4 G/10 min. Max.
Sheet Thickness, 60 mil	(ASTM D1593)	±10%
Tensile Strength (Yield)	(ASTM D638)	140 lb./in.
Tensile Strength (Break)	(ASTM D 638)	240 lb./in.
Elongation at Yield	(ASTM D638)	13%
Elongation at Break	(ASTM D638)	700%
Modulus of Elasticity	(ASTM D638)	90,000 psi
Tear Resistance, Min.	(ASTM D1004 DIE C)	45 lb.
Puncture Resistance	(FTMS 101 Method 2065)	80 lb.
Resistance to Soil Burial Max. Change	(ASTM D3083)	± 10%

Dimensional Stability (Each Direction Max. Change)	(ASTM D1204 212 Deg. F, 15 Min.)	± 3%
Environmental Stress	(ASTM D1693)	1,500 hours
Carbon Black Content		(ASTM D1603) 2-3%

Extrusion Resin. Resin used for extrusion welding shall be HDPE produced from the same material as the liner resin. Physical properties shall be the same as those of the resin used in the manufacture of the HDPE liner. Extrusion resin shall be supplied in black.

2.02 FACTORY QUALITY

Raw Material. The manufacturer shall test the resin to ensure the consistency of the raw material quality. The manufacturer shall test for the following properties:

Density	(ASTM D1505)	1/resin batch
Melt Index	(ASTM D1238)	1/resin batch

The results of this testing shall be evaluated and, if the physical specifications are not satisfied, the resin batch in question shall not be accepted for extruding the liner. As a result of this testing, the manufacturer/installer shall be prepared to certify as to the quality of the raw material as defined by the physical specifications.

Fabrication. The carbon black for ultraviolet protection shall be added to the otherwise pure HDPE resin as part of the sheet extrusion process. The manufacturer/installer shall perform testing to maintain the specific carbon black content and to determine if adequate dispersion is being achieved.

Automatic monitoring of controlling parameters shall be an integral part of the extrusion process. Surface appearance and sheet thickness shall be monitored continuously during the extrusion process. The sheet thickness shall be continuously monitored by electronic methods and/or periodically inspected manually. An acceptable sheet thickness shall be ± 10% of the specified thickness. Sheets in excess of +10% of the specified thickness shall be acceptable; those in excess of -10% of the specified thickness shall be rejected.

Finished goods shall be periodically tested to evaluate its stress-deformation characteristics.

The following test program shall be conducted at least twice per shift:

Tensile and Elongation property
Thickness of Material
Carbon Black content
Environmental Stress Cracking test
Puncture Resistance

The above tests shall be conducted in accordance with ASTM methods as listed in Paragraph 2.01 - MATERIAL SPECIFICATIONS, to ensure that the finished products meet the minimum Specifications. Finished products shall be sampled at least twice per shift. Samples shall be taken even if they cannot be tested until a later date. Sampling shall be done by production personnel.

All factory control tests shall be properly recorded and shall be made available to the Engineer for his review, if required.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects or debris of any kind. The surface shall provide a firm, unyielding foundation for the liner with no sudden sharp or abrupt changes or breaks.

The installer shall certify in writing that the surface on which the liner will be installed is acceptable. After the supporting soil has been accepted by the installer, it shall be the installer's responsibility to indicate to the Engineer any change in the supporting soil condition caused by natural conditions or occurrences that may require repair work. The installer shall provide for dewatering and for drying of the subgrade, as required during construction. Special care shall be taken to maintain the prepared soil surface. Any damage to the subgrade caused by this installation shall be repaired at the installer's expense in accordance with the requirements of the applicable Earthwork specifications.

3.02 INSTALLATION

Installation of liner shall be performed by the liner manufacturer or certified installer. The installer shall be responsible for inspection of the panel rolls at the jobsite. Should rolls show damage from transit, they will be so identified by the installer and set aside. During the unrolling of the panel rolls, the installer shall visually inspect the sheet surface. Any faulty areas shall be marked and repaired in an approved manner by the installer.

The method used to unroll the panels shall not cause scratches or crimps in the liner and shall not damage the supporting soil.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Wrinkles shall be identified as to proper location and compensation shall be identified on the Contractor's and Inspector's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

Adequate loading (e.g. sand bags, tires, or similar items that will not damage the liner) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

Direct contact with the liner shall be minimized, i.e., in traffic areas it shall be protected by extra liner or other suitable materials.

Liner Placement and Layout. The HDPE panels shall be laid out according to approved engineering plans and shall not deviate from the approved plans except with the prior approval of the Owner and the Engineer. Panels shall be overlapped sufficiently to permit welding without having to splice small sections of materials.

The number of panels to be deployed in any day shall be limited to the number of panels which can be seamed.

No equipment used shall damage the liner by handling, trafficking, leakage of hydrocarbons, or other means.

No personnel working on the liner shall smoke, wear damaging shoes, or engage in other activities that could damage the liner.

Liner clamps or other metal tools shall be padded, must have rounded corners, and shall never be tossed or thrown.

Field Seaming. All areas to be seamed shall be cleaned of dust and dirt and completely dry prior to seaming.

All sheeting shall be welded together by means of the manufacturer's approved method, including hot wedge, hot shoe, or extrusion welding process. The composition of extrudate shall be identical to the lining material.

All seams on side slope shall run vertically to the center line of the dike. Seams parallel with center line of the dike on the side slope shall not be allowed.

No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap extrusion weld shall be applied. All welds on completion of the work shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.

Unless authorized in writing by the Engineer, welding shall be performed between 20°F and 104°F as measured 6-inches above liner surface. No welding shall be performed in the presence of free moisture.

Between 20°F and 40°F, seaming shall be allowed if the liner is preheated by a hot air device and if there is not excessive cooling resulting from wind.

Seam Tests, Sampling and Quality Control. A test weld three-feet long from each welding machine shall be made twice during each shift. Samples from weld shall be tested in shear and peel, and no welder may start work until sample weld has been approved. The test weld shall be marked with date, ambient temperature, and welding machine number.

Specimens of weld 1/2-inch to 1-inch wide shall be cut from the test weld and tested in shear and peel. Shear and peel test shall be based on ASTM D638 test standards.

Random weld samples shall be removed from the installed welded sheeting at a frequency of one sample per 400-feet weld. All weld samples shall be marked with their location roll and seam number. The installer shall also record in written form, the date, time, ambient temperature, seaming unit, number, name of seamer, welding apparatus, temperatures and pressures. Destructive shear and peel tests shall be done on weld samples based on ASTM D638 test standards.

In addition to random weld sampling, visual examination of the seam shall be conducted by the installer to detect any suspect areas, breaks, or holes in the weld for ensuring watertightness.

As required by the Engineer to verify the factory seam quality, non-destructive air pressure test and/or vacuum test shall be conducted by the installer to test up to 20% of factory seams and field seams. Defective seams shall be marked and repaired in accordance with repair procedure approved by the Engineer.

All field installation quality control tests shall be properly recorded and shall be made available for Engineer's review, if required.

3.03 ACCEPTANCE

The Contractor shall retain all ownership and responsibility for the liner until acceptance by the Owner and Engineer.

END OF SECTION

APPENDIX E
LEACHATE FLOW CALCULATIONS

APPENDIX E

DESCRIPTION OF THE HELP PROGRAM
(Hydrologic Evaluation of Landfill Performance)

The Hydrologic Evaluation of Landfill Performance (HELP) model was developed to help hazardous waste landfill designers and regulators evaluate the hydrologic performance of proposed landfill designs. This quasi-two-dimensional deterministic water-budget model was adapted from the HSSWDS (Hydrologic Simulation Model for Estimating Percolation at Solid Waste Disposal Sites) model of the U.S. Environmental Protection Agency (Perrier and Gibson, 1980; Schroeder and Gibson, 1982) and the CREAMS (Chemical Runoff and Erosion from Agricultural Management Systems) and SWRRB (Simulator for Water Resources in Rural Basins) models of the U.S. Agricultural Research Service (Knisel, 1980; Arnold et al., 1986). From daily climatological data, the HELP model computes daily runoff, evapotranspiration, percolation, and lateral drainage for the landfill (cap, waste cell, leachate collection system and liner). Results are expressed as daily, monthly, annual and long-term average water budgets.

The HELP program simulates daily water movement into, through and out of a landfill. In general, the hydrologic processes modelled by the program can be divided into two categories: surface processes and subsurface processes. The surface processess modelled is, interception of rainfall by vegetation, surface runoff and surface evaporation. The subsurface processes modelled are soil evaporation, plant transpiration, vertical unsaturated drainage, barrier-layer percolation and lateral saturated drainage.

Daily infiltration into the landfill is determined indirectly from a surface-water balance. Each day, infiltration is assumed to equal the sum of rainfall and snowmelt, minus the sum or runoff and surface evaporation. No liquid water is held in surface storage from one day to the next. A rainfall-runoff relationship is used to determine the runoff resulting from the combined snowmelt and rainfall. Surface evaporation is then computed. Surface evaporation is not allowed to exceed the intercepted rainfall. The rainfall that does not run off or evaporate is assumed to infiltrate into the landfill.

The first subsurface processes considered are soil evaporation and plant transpiration from the evaporative zone of the upper subprofile. These are computed on a daily basis. The evapotranspirative demand is distributed among the seven modelling segments in the evaporative zone.

The other subsurface processes are modelled one subprofile at a time, from top to bottom, using a six-hour time step. If the subprofile contains a barrier layer, the sum of the lateral drainage and barrier-layer percolation is first estimated. A storage-routing procedure is then used to redistribute the soil water among the modelling segments that comprise the subprofile. This procedure accounts for the external inflows and outflows computed or estimated previously (infiltration or percolation into the top segment, evaporatranspiration from the segments in the evaporative zone, lateral drainage and barrier-layer percolation) and vertical unsaturated drainage within the sub-profile. The routing calculations, which proceed from top to bottom, yield estimates of lateral drainage and barrier-layer percolation. If the sum of these two outflows is not sufficiently close to the initial estimate, then the routing calculations are repeated using the improved estimate. Iteration continues until acceptable convergence is achieved. If the subprofile contains no barrier layer, lateral drainage and percolation are zero, so no iteration is needed.

For this project the following data was used as input to the computer model:

Precipitation - The climatological data was obtained from the National Oceanic and Atmospheric Administration (NOAA). The data used was from the Daytona Beach AP station. This station is only a few miles from the landfill site.

Manual options were used for the Tomoka Landfill as follows:

Layer #1: Top soil, 6-inch thick, vertical percolation layer type.
Layer #2: Sandy drainage, 6-inch thick, lateral drainage layer type.
Layer #3: Compacted clay, 6-inch thick, barrier soil liner layer type.
Layer #4: Soil 6-inch thick, vertical percolation layer type.
Layer #5: Solid Waste, 1,308-inches thick, vertical percolation layer type.
Layer #6: Sandy drainage, 24-inches thick layer type, vertical percolation layer type.
Layer #7: Geonet, 1/8-inch thick layer type, lateral drainage layer type.
Layer #8: Liner HDPE/Clay Composite, 60 mil barrier liner with a flexible membrane liner.

The default options were used for the following:

Runoff curve number.
Soil testure class and characteristics.
Initial soil water content.

Leakage fraction for synthetic membrane.

Summary of results from the HELP program is as follows:

Peak daily values for years 87 through 91		
SCS runoff curve number	=	63.71
Precipitation	=	5.27 inches
Runoff	=	4.31 inches
Percolation from layer 3	=	0.0010 inches
Percolation from layer 8	=	0.0000 inches
Head on layer 8	=	0.0 inches

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VOLUSIA COUNTY
TOMOKA LANDFILL EXPANSION
5-19-92

****
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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.003000000026 CM/SEC

LAYER 2

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.3339 VOL/VOL
FIELD CAPACITY	=	0.0529 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0529 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000289999996 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	550.0 FEET

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.3808 VOL/VOL
FIELD CAPACITY	=	0.1924 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1924 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000026000000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	1308.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2324 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 6

LATERAL DRAINAGE LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.3339 VOL/VOL
FIELD CAPACITY	=	0.0529 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0529 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000289999996 CM/SEC

LAYER 7

LATERAL DRAINAGE LAYER

THICKNESS	=	0.12 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.005799999926 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	550.0 FEET

LAYER 8

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	0.25 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00001000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	63.71
TOTAL AREA OF COVER	=	1263240. SQ FT
EVAPORATIVE ZONE DEPTH	=	22.00 INCHES
UPPER LIMIT VEG. STORAGE	=	4.7454 INCHES
INITIAL VEG. STORAGE	=	3.6909 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	310.0520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR DAYTONA FLORIDA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
65.20	65.60	70.10	73.80	77.60	80.40
82.00	82.50	81.40	77.30	71.60	67.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 87 THROUGH 91

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.81	1.70	1.16	8.66	6.28
	5.22	5.13	8.73	5.69	5.31	3.90
STD. DEVIATIONS	3.08	1.75	0.80	0.39	5.73	2.54
	3.73	2.43	3.86	2.95	3.82	2.42
RUNOFF						
TOTALS	1.529	0.067	0.052	0.000	1.376	0.402
	0.000	0.000	2.192	0.721	1.710	1.458
STD. DEVIATIONS	2.505	0.150	0.116	0.000	1.887	0.554
	0.000	0.000	3.190	1.272	3.779	1.867
EVAPOTRANSPIRATION						
TOTALS	1.407	1.962	3.609	1.814	5.045	6.547
	5.926	4.793	5.344	4.724	3.012	2.431
STD. DEVIATIONS	0.616	0.609	0.825	0.761	2.200	1.072
	3.005	2.015	0.777	0.312	0.217	0.806
LATERAL DRAINAGE FROM LAYER 2						
TOTALS	0.0681	0.0470	0.0294	0.0014	0.0150	0.0232
	0.0134	0.0139	0.0423	0.0507	0.0559	0.0666
STD. DEVIATIONS	0.0309	0.0213	0.0242	0.0016	0.0245	0.0242
	0.0158	0.0241	0.0373	0.0218	0.0317	0.0391
PERCOLATION FROM LAYER 3						
TOTALS	0.0252	0.0214	0.0188	0.0027	0.0071	0.0129
	0.0111	0.0085	0.0167	0.0224	0.0219	0.0249
STD. DEVIATIONS	0.0030	0.0026	0.0053	0.0029	0.0089	0.0085
	0.0092	0.0105	0.0076	0.0023	0.0063	0.0045
LATERAL DRAINAGE FROM LAYER 7						
TOTALS	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008
	0.0009	0.0010	0.0010	0.0010	0.0010	0.0011
STD. DEVIATIONS	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009
PERCOLATION 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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 87 THROUGH 91

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	56.93 (7.808)	5992599.	100.00
RUNOFF	9.507 (5.243)	1000838.	16.70
EVAPOTRANSPIRATION	46.615 (3.995)	4907127.	81.89
LATERAL DRAINAGE FROM LAYER 2	0.4268 (0.0901)	44931.	0.75
PERCOLATION FROM LAYER 3	0.1935 (0.0087)	20374.	0.34
LATERAL DRAINAGE FROM LAYER 7	0.0107 (0.0086)	1122.	0.02
PERCOLATION FROM LAYER 8	0.0000 (0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.366 (1.207)	38581.	0.64

PEAK DAILY VALUES FOR YEARS 87 THROUGH 91

	(INCHES)	(CU. FT.)
PRECIPITATION	5.27	554772.9
RUNOFF	4.311	453857.7
LATERAL DRAINAGE FROM LAYER 2	0.0043	452.9
PERCOLATION FROM LAYER 3	0.0010	109.7
HEAD ON LAYER 3	12.7	
LATERAL DRAINAGE FROM LAYER 7	0.0001	8.3
PERCOLATION FROM LAYER 8	0.0000	0.0
HEAD ON LAYER 8	0.0	
SNOW WATER	0.00	0.0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3954	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0401	

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FINAL WATER STORAGE AT END OF YEAR 91

LAYER	(INCHES)	(VOL/VOL)
1	2.60	0.4331
2	2.00	0.3339
3	2.40	0.4000
4	1.34	0.2233
5	304.38	0.2827
6	1.84	0.0767
7	0.02	0.1657
8	0.10	0.4000
SNOW WATER	0.00	

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SCS PROGRAM

PROJECT NAME . . . . . :TOMOKA LANDFILL INITIAL EXPANSION
REVIEWER . . . . . :MIGUEL B. DELGADO
PROJECT AREA . . . . . : 45.29 ACRES
GROUND STORAGE . . . . : 5.00 INCHES
TERMINATION DISCHARGE : .01 CFS
DISTRIBUTION TYPE . . : ORANGE COUNTY
RETURN FREQUENCY . . . : 25.00 YEARS
RAINFALL DURATION . . : 1-DAY
24-HOUR RAINFALL . . . : 9.00 INCHES
REPORTING SEQUENCE . . : INCREMENTAL

STAGE (FT)	STORAGE (AF)
19.00	.00
29.00	138.10

PUMP NO.	PUMP ON ELEVATION (FEET)	PUMP OFF ELEVATION (FEET)	PUMP DISCHARGE (GPM)	PUMP DESCRIPTION
1	19.80	19.80	800.00	LEACHATE PUMP

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHGE (CFS)	RESERVOIR AVERAGE DISCHGE (CFS)	RESERVOIR STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	19.00
.50	.01	.00	.0	.0	.0	.0	.0	.0	19.00
1.00	.02	.00	.0	.0	.0	.0	.0	.0	19.00
1.50	.04	.00	.0	.0	.0	.0	.0	.0	19.00
2.00	.06	.00	.0	.0	.0	.0	.0	.0	19.00
2.50	.12	.00	.0	.0	.0	.0	.0	.0	19.00
3.00	.19	.00	.0	.0	.0	.0	.0	.0	19.00
3.50	.31	.00	.0	.0	.0	.0	.0	.0	19.00
4.00	.44	.00	.0	.0	.0	.0	.0	.0	19.00
4.50	.63	.00	.0	.0	.0	.0	.0	.0	19.00
5.00	.82	.00	.0	.0	.0	.0	.0	.0	19.00
5.50	1.02	.00	.2	.0	.0	.0	.0	.0	19.00
6.00	1.22	.01	1.2	.0	.0	.0	.0	.0	19.00
6.50	1.77	.10	10.7	.4	.4	.0	.0	.0	19.02
7.00	2.32	.18	17.5	1.1	1.1	.0	.0	.0	19.06
7.50	2.90	.32	24.8	2.0	2.0	.0	.0	.0	19.13
8.00	3.47	.62	33.7	3.1	3.1	.0	.0	.0	19.22
8.50	4.41	1.38	54.0	5.3	5.3	.0	.0	.0	19.44
9.00	4.81	1.44	24.5	7.3	7.3	.0	.0	.0	19.44
9.50	5.99	2.30	58.3	9.5	9.5	.0	.0	.0	19.63
10.00	6.62	2.96	44.8	11.3	11.3	.0	.0	.0	19.79

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHGE (CFS)	RESERVOIR AVERAGE DISCHGE (CFS)	RESERVOIR STAGE (FT)
10.50	6.65	3.23	23.5	12.3	12.3	.0	1.0	1.3	19.87
11.00	7.28	3.50	24.6	13.3	13.2	.1	1.0	1.3	19.94
11.50	7.49	3.66	15.4	14.0	13.9	.2	1.0	1.3	19.99
12.00	7.69	3.83	14.9	14.5	14.3	.3	1.0	1.3	20.02
12.50	7.88	3.99	15.0	15.2	14.9	.3	1.0	1.3	20.06
13.00	8.08	4.15	15.1	15.8	15.4	.4	1.0	1.3	20.10
13.50	8.22	4.26	10.3	16.2	15.8	.4	1.0	1.3	20.13
14.00	8.34	4.37	9.7	16.6	16.1	.5	1.0	1.3	20.15
14.50	8.48	4.41	4.2	16.8	16.2	.6	1.0	1.3	20.17
15.00	8.45	4.46	4.2	17.0	16.3	.7	1.0	1.3	20.18
15.50	8.50	4.50	3.5	17.1	16.3	.8	1.0	1.3	20.18
16.00	8.54	4.53	3.5	17.3	16.4	.9	1.0	1.3	20.19
16.50	8.58	4.56	2.8	17.4	16.5	1.0	1.0	1.3	20.19
17.00	8.62	4.60	3.5	17.5	16.5	1.0	1.0	1.3	20.19
17.50	8.67	4.64	3.5	17.7	16.6	1.1	1.0	1.3	20.20
18.00	8.71	4.68	3.5	17.8	16.7	1.1	1.0	1.3	20.20
18.50	8.75	4.71	2.8	17.9	16.7	1.2	1.0	1.3	20.21
19.00	8.79	4.74	2.8	18.0	16.8	1.2	1.0	1.3	20.21
19.50	8.91	4.76	2.1	18.1	16.8	1.3	1.0	1.3	20.21
20.00	8.85	4.79	2.8	18.2	16.8	1.4	1.0	1.3	20.22
20.50	8.86	4.81	1.4	18.3	16.8	1.5	1.0	1.3	20.22
21.00	8.89	4.83	2.1	18.4	16.8	1.6	1.0	1.3	20.22
21.50	8.91	4.85	1.4	18.5	16.8	1.7	1.0	1.3	20.22
22.00	8.94	4.87	2.1	18.5	16.8	1.7	1.0	1.3	20.22
22.50	8.95	4.88	1.4	18.6	16.8	1.8	1.0	1.3	20.22
23.00	8.98	4.91	2.1	18.7	16.8	1.9	1.0	1.3	20.22
23.50	8.99	4.92	.7	18.7	16.8	1.9	1.0	1.3	20.21
24.00	9.00	4.92	.7	18.7	16.7	2.0	1.0	1.3	20.21
24.50	9.00	4.92	.0	18.7	16.6	2.1	1.0	1.3	20.21
25.00	9.00	4.92	.0	18.7	16.6	2.1	1.0	1.3	20.20
25.50	9.00	4.92	.0	18.7	16.5	2.2	1.0	1.3	20.19
26.00	9.00	4.92	.0	18.7	16.4	2.3	1.0	1.3	20.19
26.50	9.00	4.92	.0	18.7	16.4	2.3	1.0	1.3	20.18
27.00	9.00	4.92	.0	18.7	16.3	2.4	1.0	1.3	20.16
27.50	9.00	4.92	.0	18.7	16.2	2.5	1.0	1.3	20.17
28.00	9.00	4.92	.0	18.7	16.1	2.6	1.0	1.3	20.17
28.50	9.00	4.92	.0	18.7	16.1	2.6	1.0	1.3	20.16
29.00	9.00	4.92	.0	18.7	16.0	2.7	1.0	1.3	20.16
29.50	9.00	4.92	.0	18.7	15.9	2.8	1.0	1.3	20.15
30.00	9.00	4.92	.0	18.7	15.8	2.9	1.0	1.3	20.15
30.50	9.00	4.92	.0	18.7	15.8	2.9	1.0	1.3	20.14
31.00	9.00	4.92	.0	18.7	15.7	3.0	1.0	1.3	20.14
31.50	9.00	4.92	.0	18.7	15.6	3.1	1.0	1.3	20.13
32.00	9.00	4.92	.0	18.7	15.5	3.2	1.0	1.3	20.13

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	- - - - - - R E S E R V O I R - - - - - VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
32.50	9.00	4.92	.0	18.7	15.5	3.2	1.0	1.0	20.12
33.00	9.00	4.92	.0	18.7	15.4	3.3	1.0	1.0	20.11
33.50	9.00	4.92	.0	18.7	15.3	3.4	1.0	1.0	20.11
34.00	9.00	4.92	.0	18.7	15.2	3.5	1.0	1.0	20.10
34.50	9.00	4.92	.0	18.7	15.2	3.5	1.0	1.0	20.10
35.00	9.00	4.92	.0	18.7	15.1	3.6	1.0	1.0	20.09
35.50	9.00	4.92	.0	18.7	15.0	3.7	1.0	1.0	20.09
36.00	9.00	4.92	.0	18.7	15.0	3.7	1.0	1.0	20.08
36.50	9.00	4.92	.0	18.7	14.9	3.8	1.0	1.0	20.08
37.00	9.00	4.92	.0	18.7	14.8	3.9	1.0	1.0	20.07
37.50	9.00	4.92	.0	18.7	14.7	4.0	1.0	1.0	20.07
38.00	9.00	4.92	.0	18.7	14.7	4.0	1.0	1.0	20.06
38.50	9.00	4.92	.0	18.7	14.6	4.1	1.0	1.0	20.06
39.00	9.00	4.92	.0	18.7	14.5	4.2	1.0	1.0	20.05
39.50	9.00	4.92	.0	18.7	14.4	4.3	1.0	1.0	20.05
40.00	9.00	4.92	.0	18.7	14.4	4.3	1.0	1.0	20.04
40.50	9.00	4.92	.0	18.7	14.3	4.4	1.0	1.0	20.03
41.00	9.00	4.92	.0	18.7	14.2	4.5	1.0	1.0	20.03
41.50	9.00	4.92	.0	18.7	14.1	4.6	1.0	1.0	20.02
42.00	9.00	4.92	.0	18.7	14.1	4.6	1.0	1.0	20.02
42.50	9.00	4.92	.0	18.7	14.0	4.7	1.0	1.0	20.01
43.00	9.00	4.92	.0	18.7	13.9	4.8	1.0	1.0	20.01
43.50	9.00	4.92	.0	18.7	13.8	4.9	1.0	1.0	20.00
44.00	9.00	4.92	.0	18.7	13.8	4.9	1.0	1.0	20.00
44.50	9.00	4.92	.0	18.7	13.7	5.0	1.0	1.0	19.99
45.00	9.00	4.92	.0	18.7	13.6	5.1	1.0	1.0	19.99
45.50	9.00	4.92	.0	18.7	13.6	5.1	1.0	1.0	19.98
46.00	9.00	4.92	.0	18.7	13.5	5.2	1.0	1.0	19.98
46.50	9.00	4.92	.0	18.7	13.4	5.3	1.0	1.0	19.97
47.00	9.00	4.92	.0	18.7	13.3	5.4	1.0	1.0	19.97
47.50	9.00	4.92	.0	18.7	13.3	5.4	1.0	1.0	19.96
48.00	9.00	4.92	.0	18.7	13.2	5.5	1.0	1.0	19.95
48.50	9.00	4.92	.0	18.7	13.1	5.6	1.0	1.0	19.95
49.00	9.00	4.92	.0	18.7	13.0	5.7	1.0	1.0	19.94
49.50	9.00	4.92	.0	18.7	13.0	5.7	1.0	1.0	19.94
50.00	9.00	4.92	.0	18.7	12.9	5.8	1.0	1.0	19.93
50.50	9.00	4.92	.0	18.7	12.9	5.8	1.0	1.0	19.93
51.00	9.00	4.92	.0	18.7	12.7	5.9	1.0	1.0	19.92
51.50	9.00	4.92	.0	18.7	12.7	6.0	1.0	1.0	19.92
52.00	9.00	4.92	.0	18.7	12.6	6.1	1.0	1.0	19.91
52.50	9.00	4.92	.0	18.7	12.5	6.2	1.0	1.0	19.91
53.00	9.00	4.92	.0	18.7	12.4	6.3	1.0	1.0	19.90
53.50	9.00	4.92	.0	18.7	12.4	6.3	1.0	1.0	19.90
54.00	9.00	4.92	.0	18.7	12.3	6.4	1.0	1.0	19.89

1

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHGE (CFS)	RESERVOIR AVERAGE DISCHGE (CFS)	RESERVOIR STAGE (FT)
54.50	9.00	4.92	.0	18.7	12.2	6.5	1.8	1.8	19.89
55.00	9.00	4.92	.0	18.7	12.2	6.5	1.8	1.8	19.89
55.50	9.00	4.92	.0	18.7	12.1	6.6	1.8	1.8	19.87
56.00	9.00	4.92	.0	18.7	12.0	6.7	1.8	1.8	19.87
56.50	9.00	4.92	.0	18.7	11.9	6.8	1.8	1.8	19.86
57.00	9.00	4.92	.0	18.7	11.9	6.8	1.8	1.8	19.86
57.50	9.00	4.92	.0	18.7	11.8	6.9	1.8	1.8	19.85
58.00	9.00	4.92	.0	18.7	11.7	7.0	1.8	1.8	19.85
58.50	9.00	4.92	.0	18.7	11.6	7.1	1.8	1.8	19.84
59.00	9.00	4.92	.0	18.7	11.6	7.1	1.8	1.8	19.84
59.50	9.00	4.92	.0	18.7	11.5	7.2	1.8	1.8	19.83
60.00	9.00	4.92	.0	18.7	11.4	7.3	1.8	1.8	19.83
60.50	9.00	4.92	.0	18.7	11.3	7.4	1.8	1.8	19.82
61.00	9.00	4.92	.0	18.7	11.3	7.4	1.8	1.8	19.82
61.50	9.00	4.92	.0	18.7	11.2	7.5	1.8	1.8	19.81
62.00	9.00	4.92	.0	18.7	11.1	7.6	1.8	1.8	19.81
62.50	9.00	4.92	.0	18.7	11.0	7.7	.3	1.3	19.80

SUMMARY INFORMATION

MAXIMUM STAGE WAS 20.22 FEET AT 20.25 HOURS
MAXIMUM DISCHARGE WAS 1.8 CFS AT 10.25 HOURS

PUMPING HISTORY

PUMP 1 "ON " AT 10.25 HOURS
PUMP 1 "OFF" AT 62.50 HOURS

APPENDIX F
STORMWATER FLOW CALCULATIONS

APPENDIX F

STORMWATER FLOW CALCULATIONS

The drainage facilities for this project were designed to keep surface runoff from the proposed landfill separate from runoff from other parts of the site and to provide complete retention of stormwater on-site.

The proposed landfill will be constructed with side slopes not greater than 4 to 1 and with terraces after every 20-feet of vertical rise. The maximum runoff will occur when the landfill has been closed and a clay cap constructed. The clay layer will be covered with soil and grass. The landfill will be surrounded by a perimeter retention pond. The pond will be designed to regain full capacity for a design storm within 72 hours of the onset of the storm by percolation.

The computer program used in this application is titled "Basin Runoff Networking" (BRN), created by James J. Boyd, Dade City, Florida. This program is being used by several engineering firms and applications with data generated by this program have been used by F.D.E.R., SJRWMD, SWFWMD, Hillsborough County, FDOT, Sarasota County, Pinellas County, Pasco County, Hernando County and other regulatory agencies.

All computer modeling and hand calculations required in the design analysis are contained in this report.

Assumptions:

1. Curve number for capped landfill is 89.16. This curve number is reflective of the impermeable cover and 12-inch of top soil with grass. This situation is not directly referenced in the SJRWMD Technical Publication No. SJ 85-5, but was assumed based on previous landfill design.

2. Ground water elevation data was gathered from several months of monitoring and the seasonal high water table was determined to be at el. 23.0 NGVD.

3. The design storm used in the design of the proposed stormwater facilities is a 25 year, 24-hour 9-inch intensity using SCS Type II (Florida Modified) distribution curve.

The following calculations show that the 25 year storm will raise the water level in the retention pond to 28.09, well below the overflow elevation. They also show that the 100 year 24 hour storm of 11-inches will raise the water level to 28.56. By setting the overflow weir elevation at 28.6 the runoff from both the 25 year storm and the 100 year storm will be retained on site.

TOMOKA LANDFILL EXPANSION
DRAINAGE CALCULATIONS

Proposed Conditions - 25 yr. storm, 24-hour duration, 9-inch rainfall
(Refer to proposed drainage plan)

Contributing Areas:	1	Pond
Acreage:	31.77	18.07
Length (ft.)	1,100	N/A
ground slope (%)	12.91	N/A

	AREA	% Area	CN	CN
Proposed Landfill	31.77	63.74	83	52.90
Proposed Pond	18.07	36.26	100	36.26
	49.84	100.00		89.16

$S = 1000/89.16 - 10 = 1.22$ $\quad Q = (9 - .2 \times 1.22)^2/(9 + .8 \times 1.22) = 7.69"$

Total Storage Volume Required $\quad \frac{7.69"}{12}(49.84) = 31.94$ ac. ft.

Design High Water (DHW) EL. 29.0

Pre-Development Discharge

Contributing Areas:	1
Acreage:	49.84
Length (ft.)	1,100
Ground Slope (%)	0.70
Curve Number:	69

Composite Discharge: 132.31 CFS

Pond Drawdown Calculations

Soil Permeabilities

Soil Type	Depth (feet)	k permeability (cm/sec.)
Brown to Gray fine sand	2 - 10	10^{-2} to 10^{-4}
Gray silty sand	3 - 20	1.7×10^{-5}
Olive-Gray Clayey sand	0 - 19	2.5×10^{-5}
Olive-Gray to Yellow Gray very fine sand	0 - 14	2.6×10^{-4}

Average K (min.) = 2.58×10^{-3} cm/sec (0.30 ft/hr)

Use one third of permeability rate to account for saturated conditions
i.e. K = 0.10 ft/hr

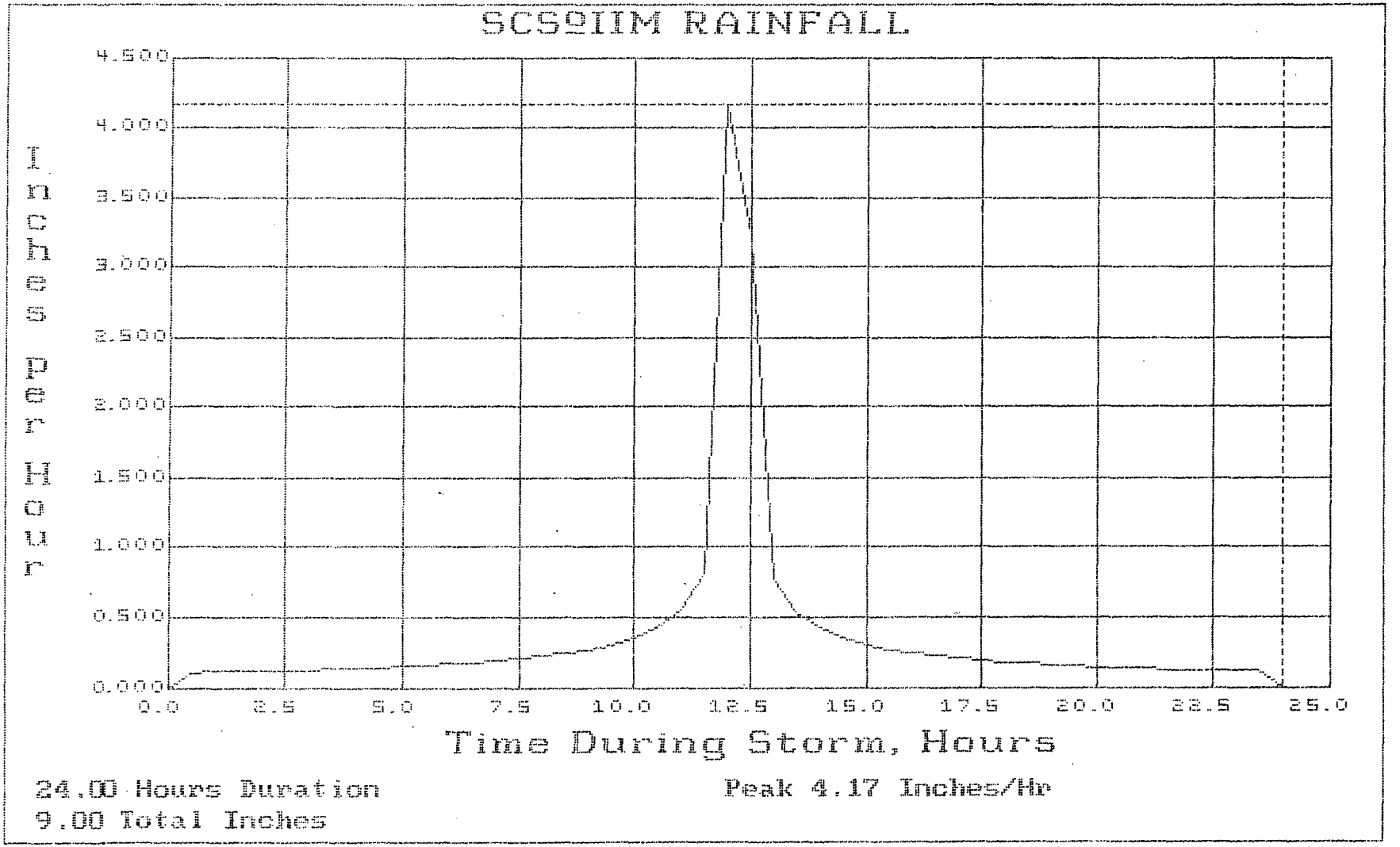
Criteria: Retention basins shall again provide the capacity for the given volume of stormwater within 72-hours following the storm event. (SJRWMD A.H.)

Retention Volume = 31.94 ac. ft. x 43560 $ft.^2/ac$ = 1,391,306.40 $ft.^3$

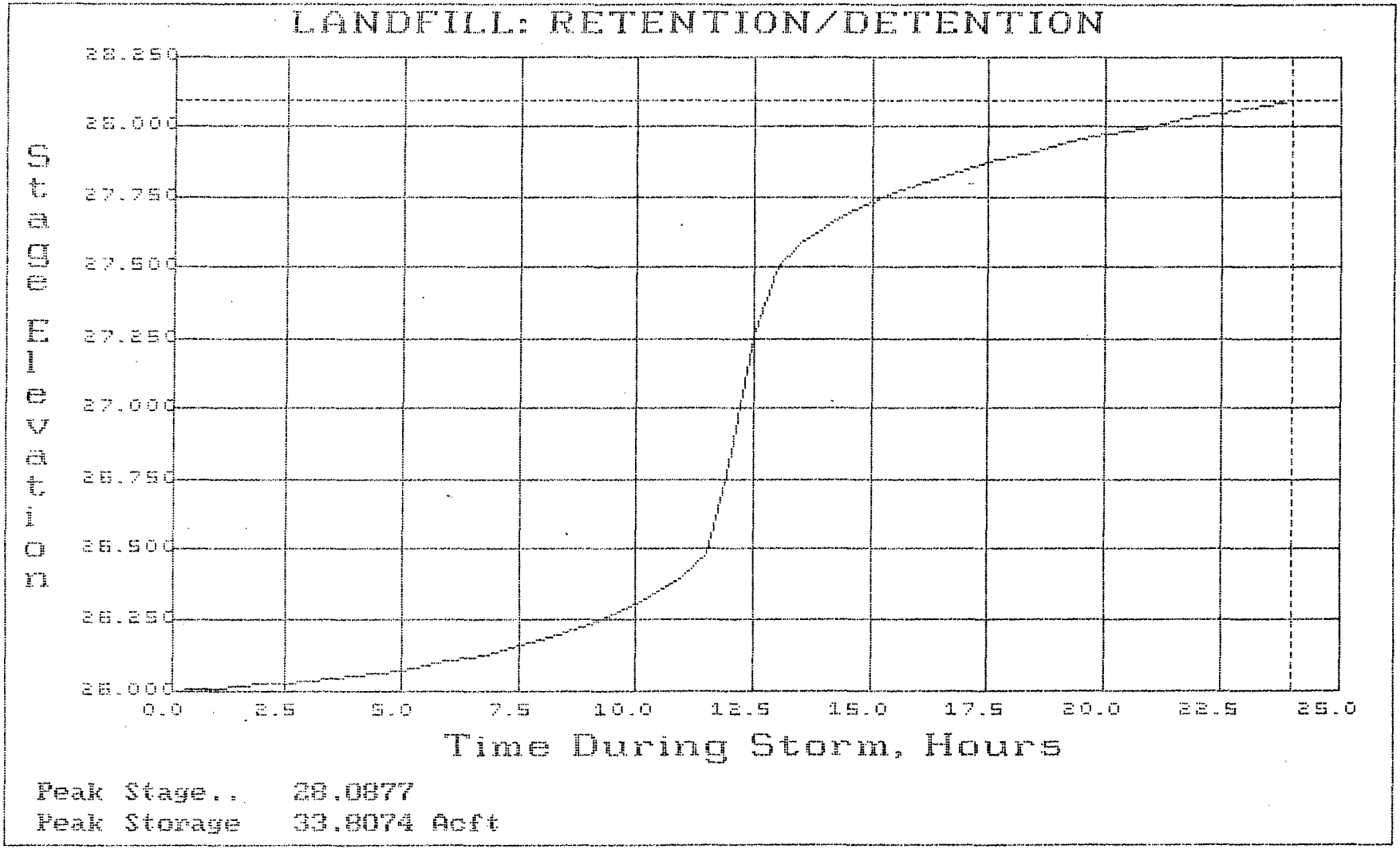
Surface area of pond bottom = 661,676.40 $ft.^2$ at El. 26.0

Pond drawdown capacity
0.10 ft/hr x 661,676.40 $ft.^2$ = 66,167.64 $ft.^3/hr$

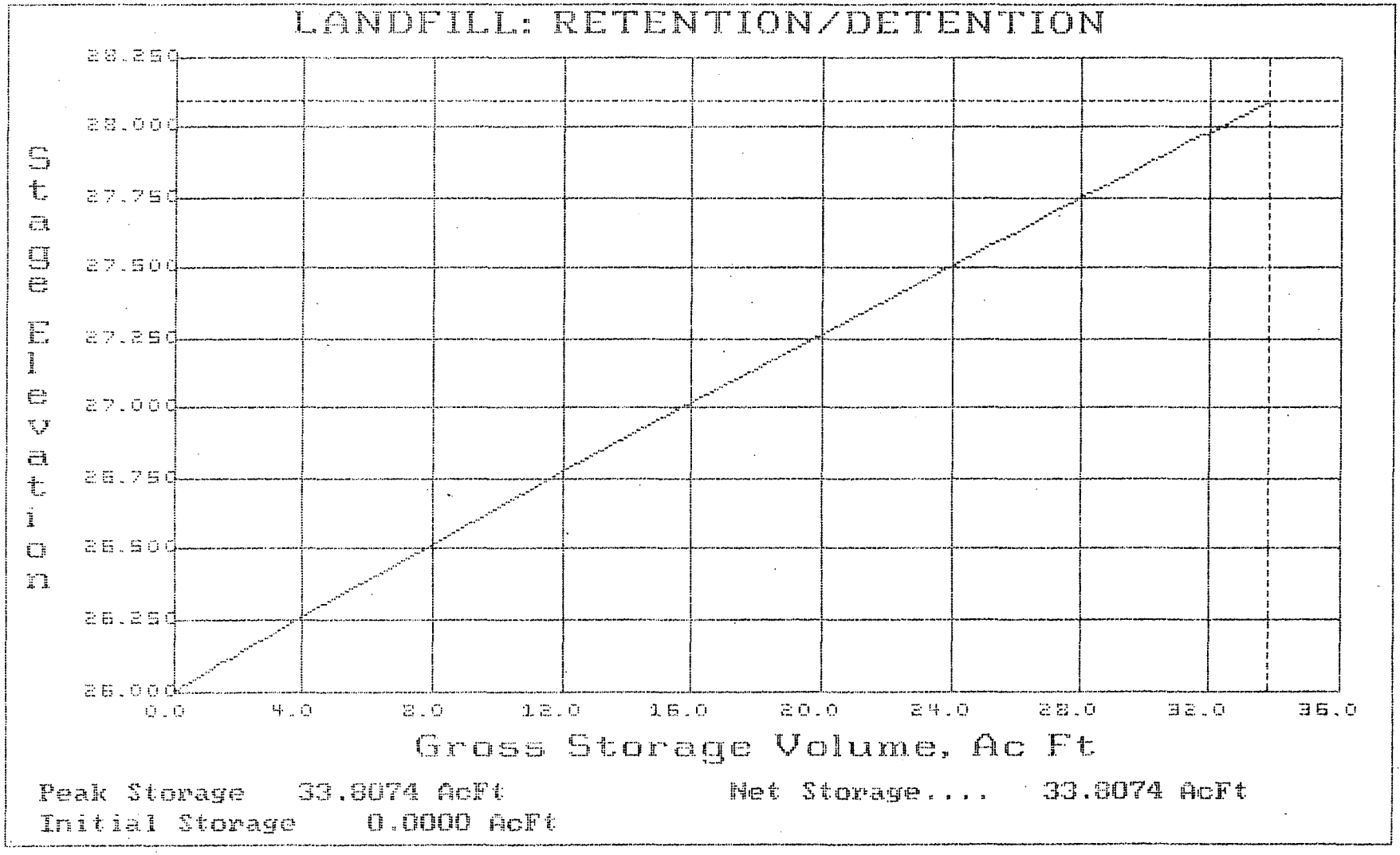
$$Tp \text{ (ponding time)} = \frac{1,391,306.40}{66,167.64} = 21.03 \text{ hours} << 72 \text{ hours}$$



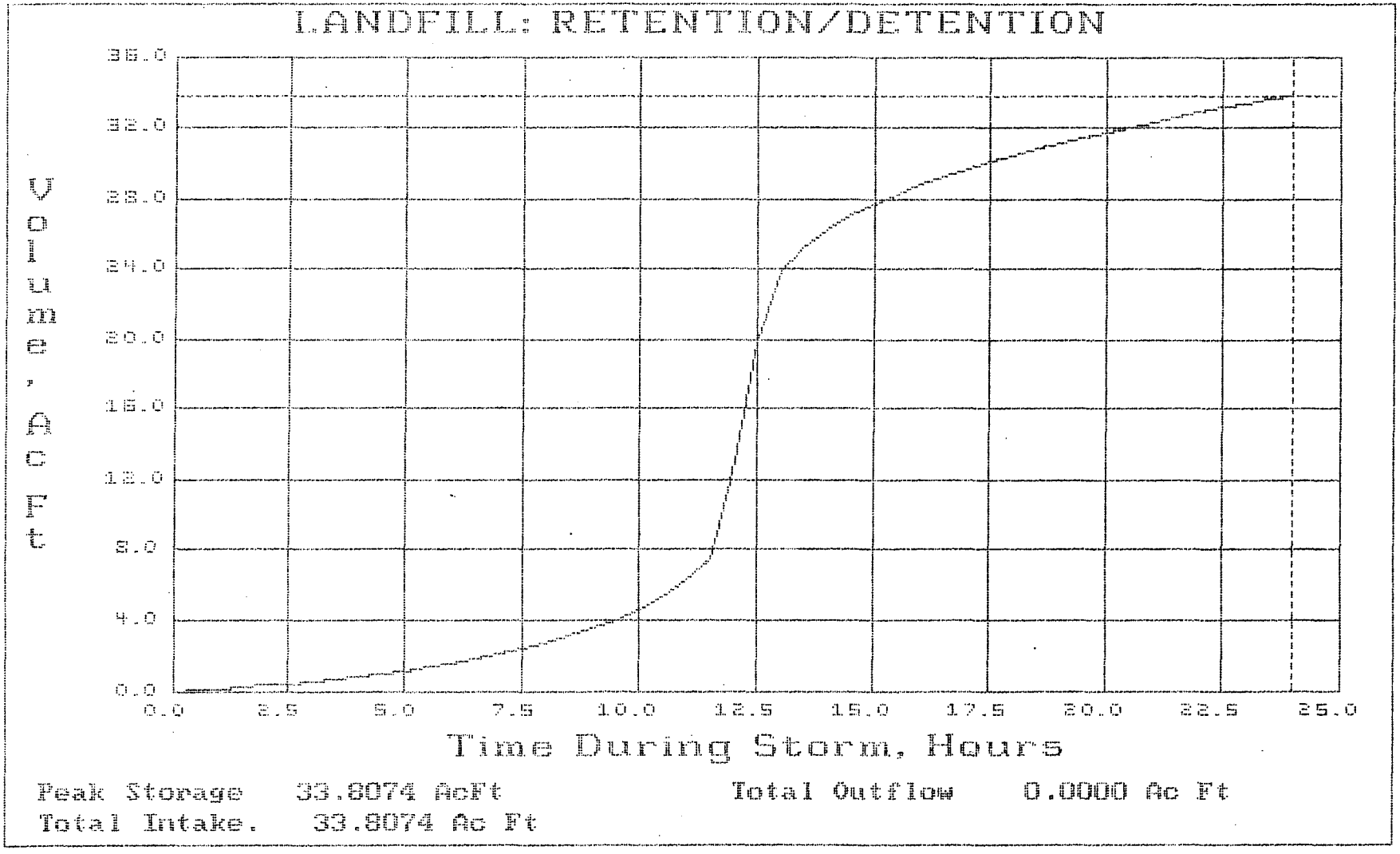
BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



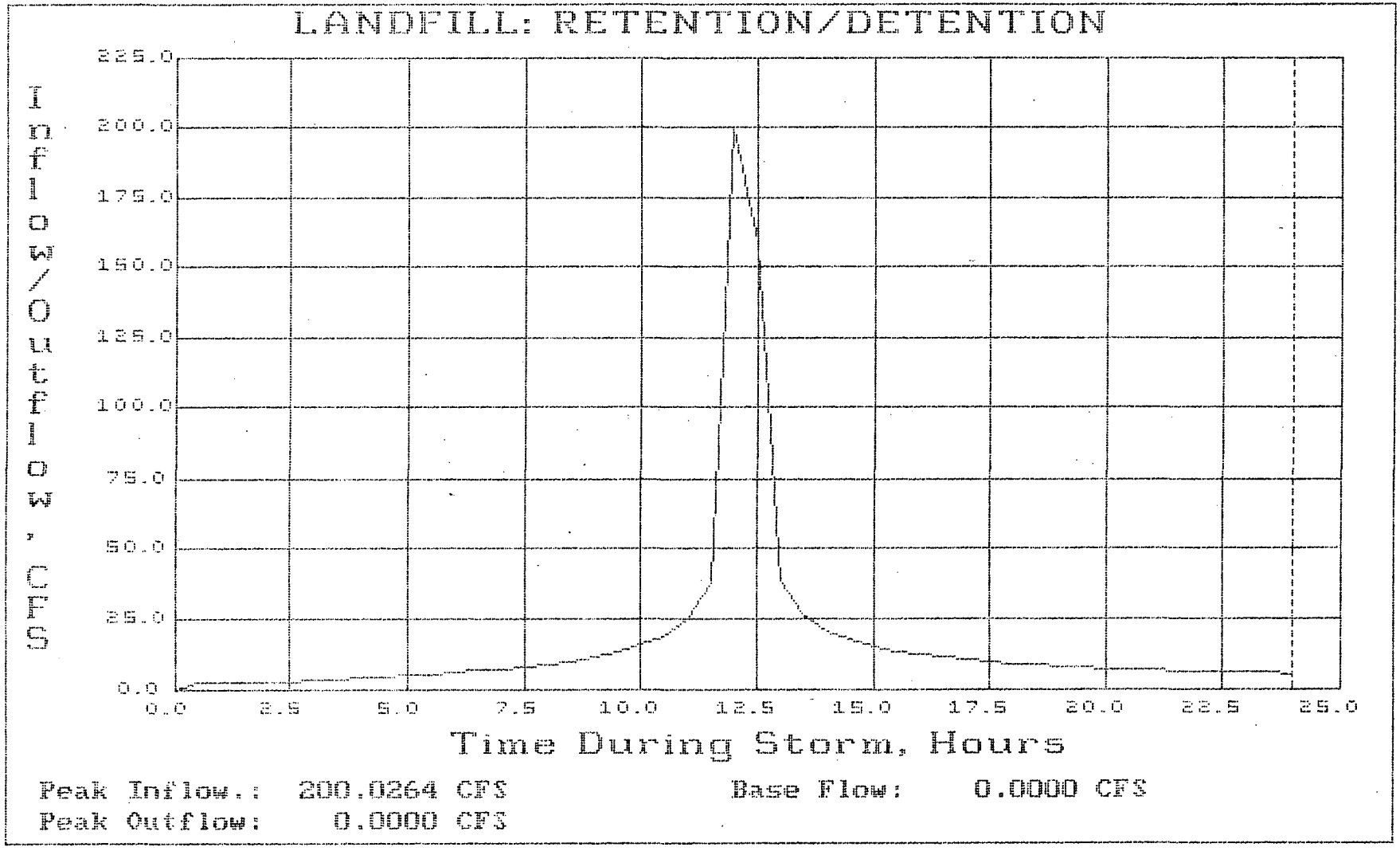
BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



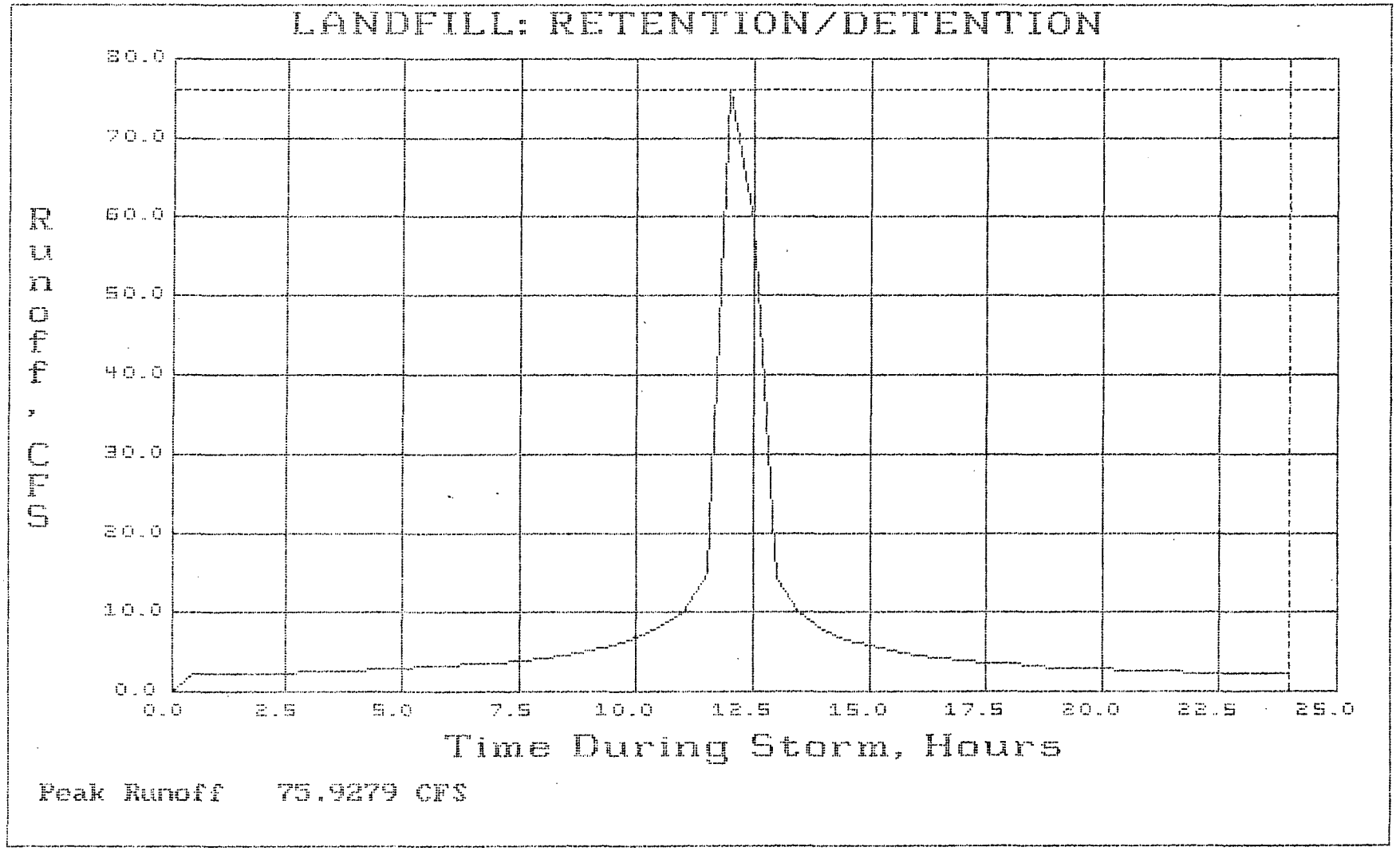
BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES

LANDFILL: RETENTION/DETENTION, [POND]

Time	Rain	Runoff	Stage	CFS In	CFS Out	ACFT In	Storage	ACFT Out
0.000	0.000	0.000	26.000	0.000	0.000	0.000	0.000	0.000
0.500	0.053	1.946	26.003	1.946	0.000	0.040	0.040	0.000
1.000	0.108	2.008	26.008	2.008	0.000	0.122	0.122	0.000
1.500	0.165	2.075	26.013	2.075	0.000	0.206	0.206	0.000
2.000	0.224	2.147	26.018	2.147	0.000	0.293	0.293	0.000
2.500	0.285	2.226	26.025	2.317	0.000	0.386	0.386	0.000
3.000	0.349	2.312	26.032	2.763	0.000	0.491	0.491	0.000
3.500	0.415	2.407	26.040	3.228	0.000	0.614	0.614	0.000
4.000	0.484	2.512	26.050	3.698	0.000	0.758	0.758	0.000
4.500	0.556	2.628	26.060	4.181	0.000	0.920	0.920	0.000
5.000	0.632	2.758	26.072	4.684	0.000	1.103	1.103	0.000
5.500	0.711	2.904	26.086	5.216	0.000	1.308	1.308	0.000
6.000	0.796	3.070	26.100	5.789	0.000	1.535	1.535	0.000
6.500	0.885	3.261	26.117	6.415	0.000	1.788	1.788	0.000
7.000	0.981	3.483	26.135	7.113	0.000	2.067	2.067	0.000
7.500	1.083	3.745	26.156	7.907	0.000	2.377	2.377	0.000
8.000	1.195	4.059	26.178	8.830	0.000	2.723	2.723	0.000
8.500	1.317	4.446	26.203	9.935	0.000	3.111	3.111	0.000
9.000	1.452	4.934	26.232	11.300	0.000	3.550	3.550	0.000
9.500	1.605	5.572	26.264	13.055	0.000	4.053	4.053	0.000
10.000	1.782	6.453	26.302	15.440	0.000	4.642	4.642	0.000
10.500	1.995	7.765	26.348	18.952	0.000	5.352	5.352	0.000
11.000	2.269	9.976	26.407	24.827	0.000	6.257	6.257	0.000
11.500	2.675	14.796	26.489	37.566	0.000	7.546	7.546	0.000
12.000	4.759	75.928	26.800	200.026	0.000	12.455	12.455	0.000
12.500	6.371	58.774	27.257	158.515	0.000	19.863	19.863	0.000
13.000	6.757	14.057	27.503	38.136	0.000	23.926	23.926	0.000
13.500	7.023	9.687	27.583	26.317	0.000	25.257	25.257	0.000
14.000	7.232	7.604	27.641	20.677	0.000	26.228	26.228	0.000
14.500	7.406	6.350	27.688	17.279	0.000	27.012	27.012	0.000
15.000	7.557	5.499	27.728	14.972	0.000	27.679	27.679	0.000
15.500	7.691	4.879	27.762	13.288	0.000	28.263	28.263	0.000
16.000	7.812	4.403	27.793	11.996	0.000	28.785	28.785	0.000
16.500	7.922	4.025	27.821	10.971	0.000	29.260	29.260	0.000
17.000	8.024	3.717	27.847	10.132	0.000	29.696	29.696	0.000
17.500	8.119	3.459	27.871	9.433	0.000	30.100	30.100	0.000
18.000	8.208	3.240	27.893	8.839	0.000	30.477	30.477	0.000
18.500	8.292	3.052	27.914	8.328	0.000	30.832	30.832	0.000
19.000	8.371	2.888	27.933	7.881	0.000	31.167	31.167	0.000
19.500	8.446	2.744	27.952	7.488	0.000	31.485	31.485	0.000
20.000	8.518	2.616	27.970	7.140	0.000	31.787	31.787	0.000
20.500	8.587	2.500	27.987	6.827	0.000	32.075	32.075	0.000
21.000	8.652	2.397	28.003	6.545	0.000	32.352	32.352	0.000
21.500	8.716	2.303	28.018	6.290	0.000	32.617	32.617	0.000
22.000	8.776	2.218	28.033	6.058	0.000	32.872	32.872	0.000
22.500	8.835	2.138	28.048	5.844	0.000	33.118	33.118	0.000
23.000	8.892	2.068	28.061	5.649	0.000	33.355	33.355	0.000
23.500	8.947	2.001	28.075	5.467	0.000	33.585	33.585	0.000
24.000	9.000	1.940	28.088	5.300	0.000	33.807	33.807	0.000

Node	Name	Type	Inflow	Outflow	Stage	Storage
# 1	LANDFILL EXPANSION	SUBAREA	124.099	124.099	25.000	0.000
# 2	RETENTION/DETENTION	POND	200.026	0.000	28.088	33.807

Project File: LANDFILL, NETWORK TOKENS

```
00001: Number of Paths   1
00002: Path Number   1
00003: From Node..   1
00004: To Node....   2
00005: Path Type..   1
00006: *
00007: Number of Flow Controls.          0
00008: ************************************
00009: Number of Nodes   2
00010: Node   1
00011: LANDFILL EXPANSION
00012: Type 1
00013: SCS_484
00014: Total acres.............    31.7700
00015: Weighted curve number...    89.1600
00016: Hydraulic length, feet..   400.0000
00017: Ground slope, percent...     4.0000
00018: Percent impervious cover    90.0000
00019: Initial abstraction k...     0.2000
00020: Flood elevation.........    40.0000
00021: Dry Weather Base CFS....     0.0000
00022: Initial Water Elevation.    25.0000
00023: ************************************
00024: Node   2
00025: RETENTION/DETENTION
00026: Type 2
00027: Number of data points...          2
00028: Stage    29.0000  Acres    18.0700
00029: Stage    26.0000  Acres    15.1900
00030: Rational coefficient....     1.0000
00031: Initial water...........    25.0000
00032: Dry Weather Base CFS....     0.0000
00033: ************************************
00034: Checksum 3
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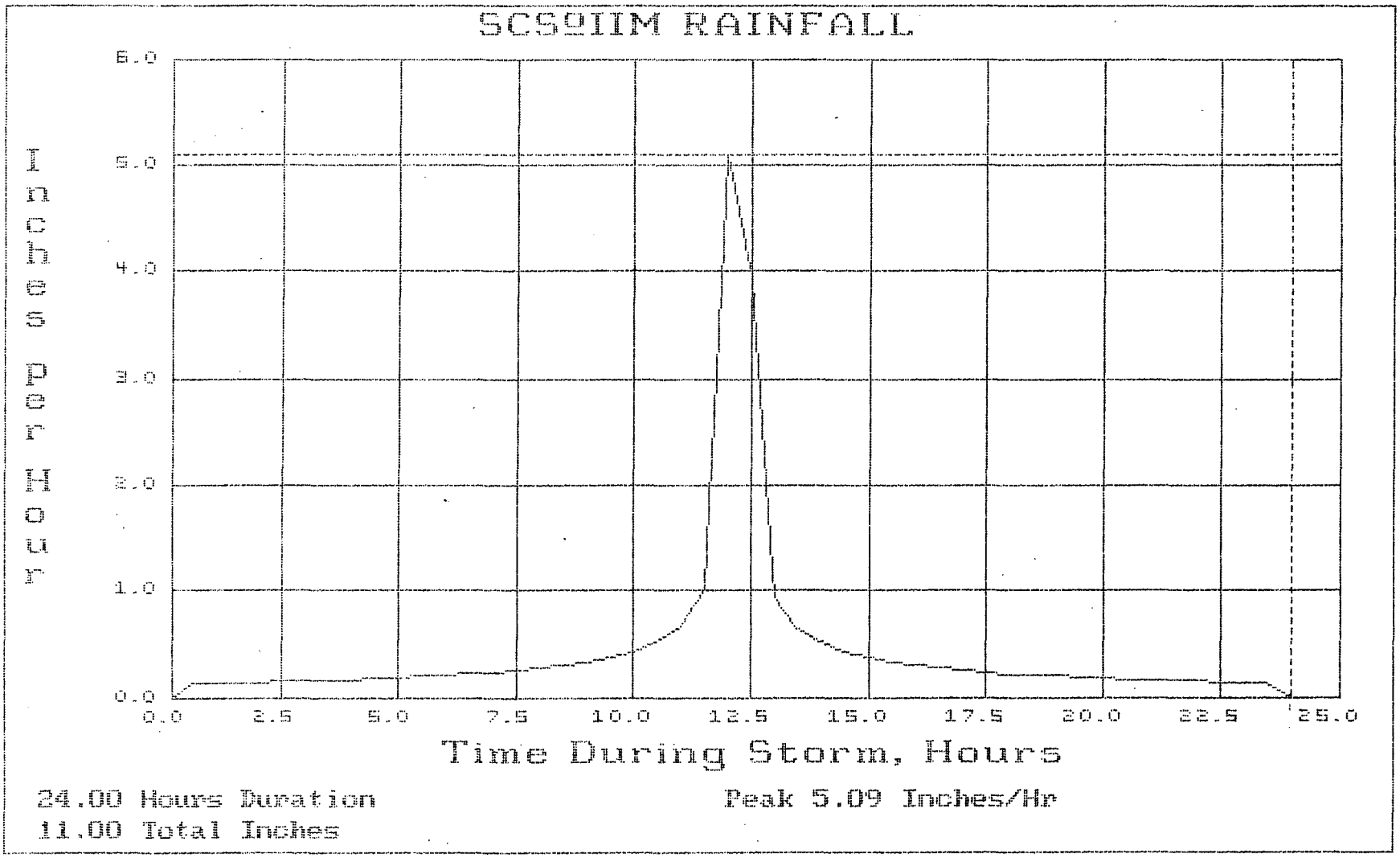
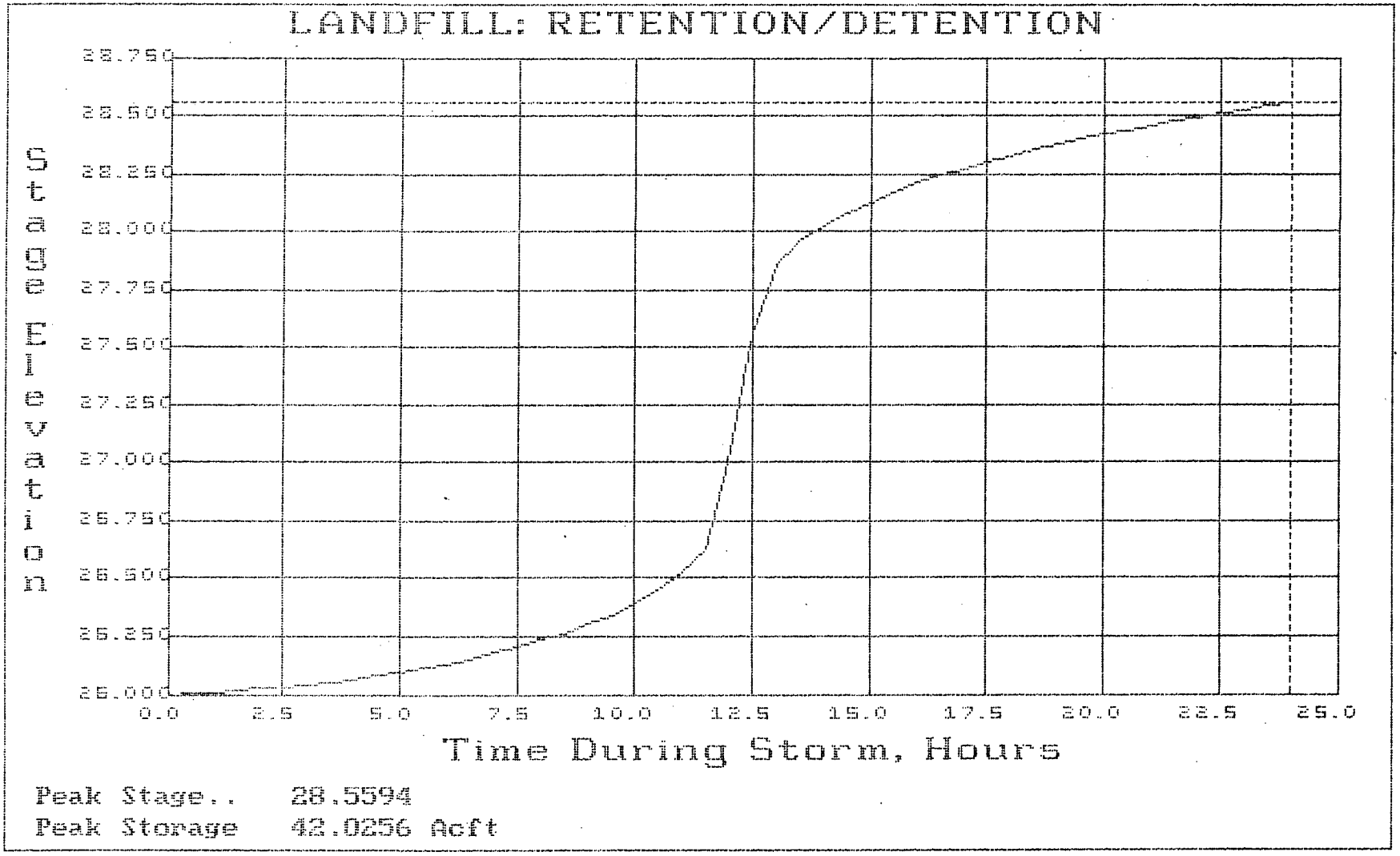


BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



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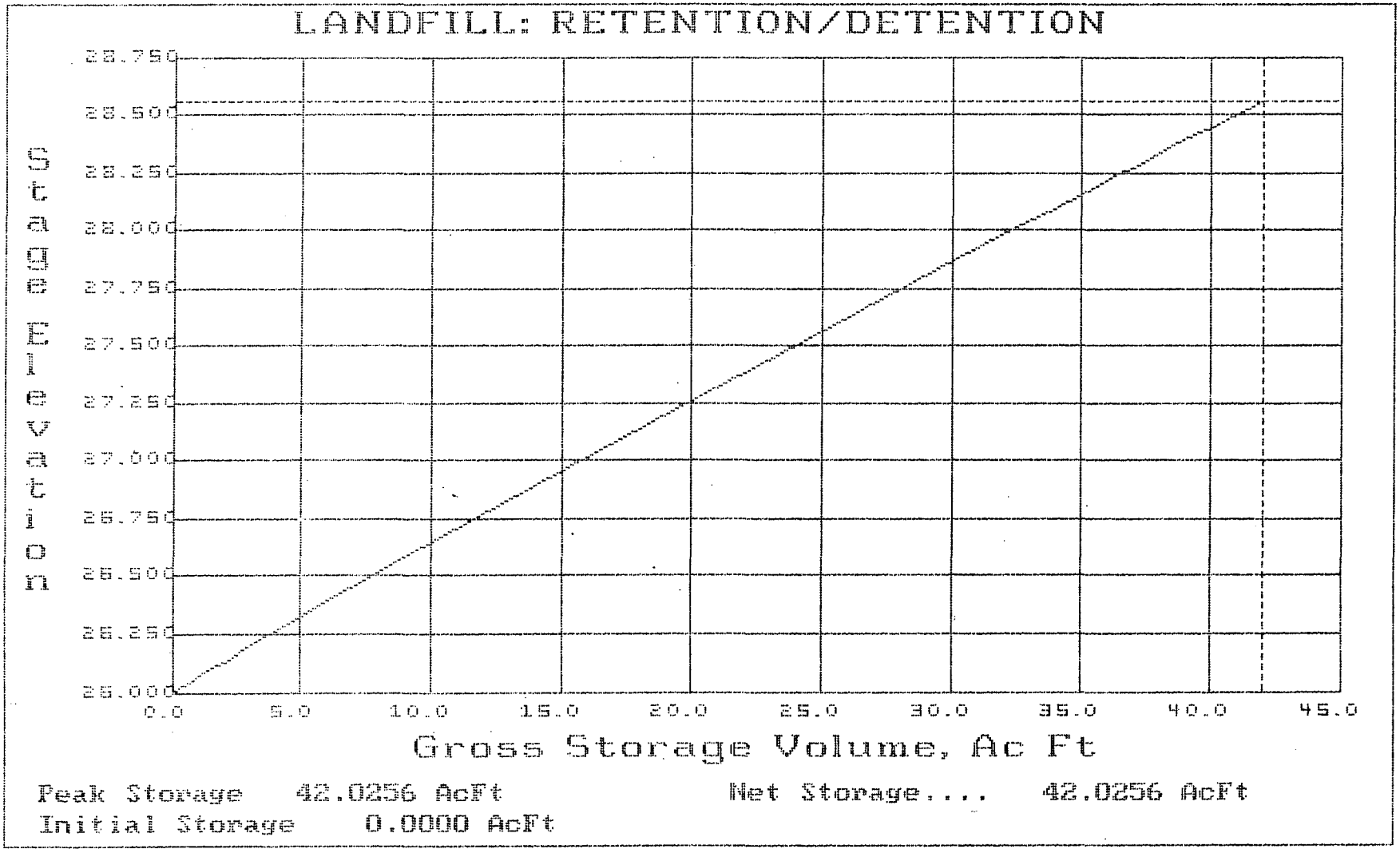

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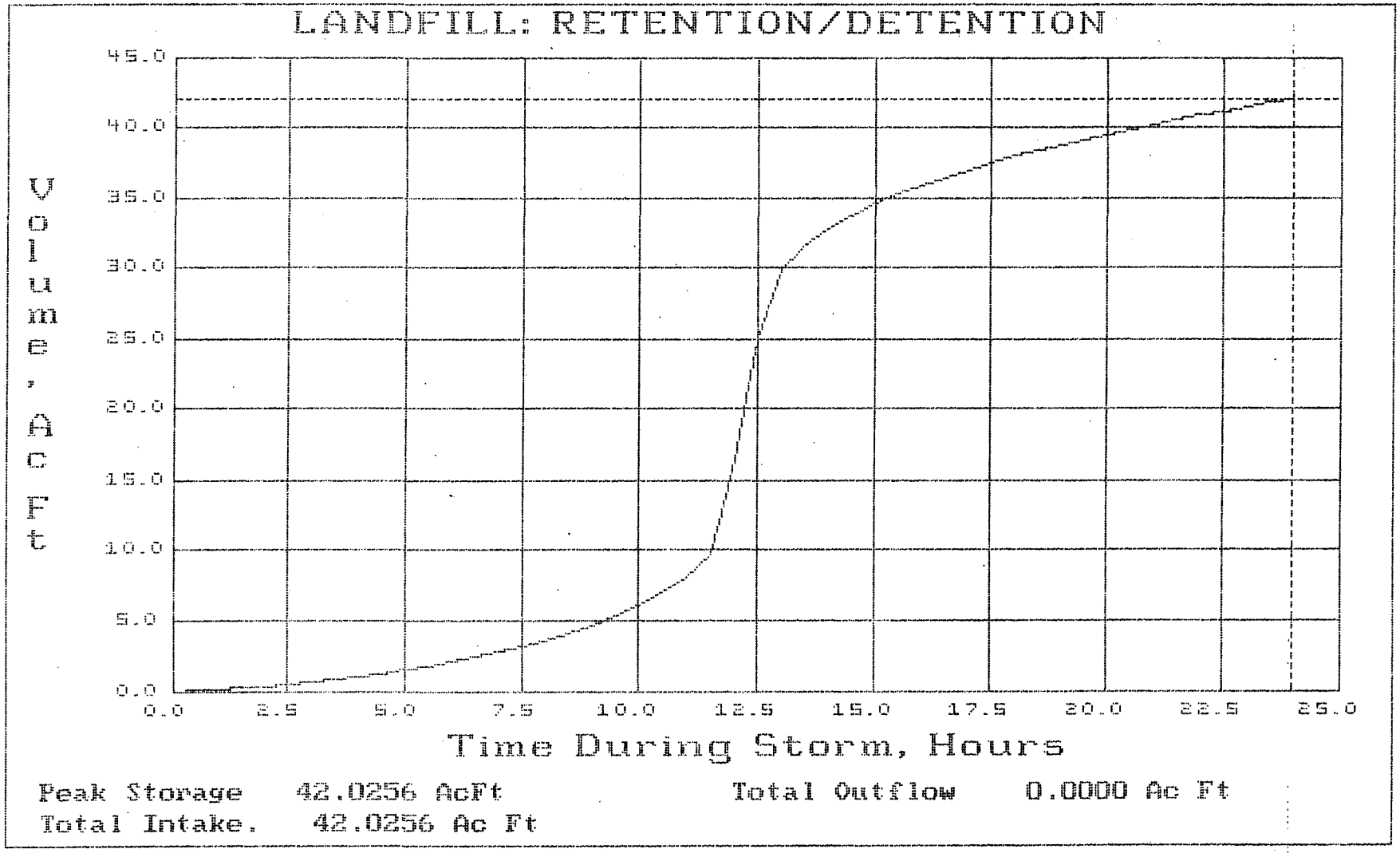

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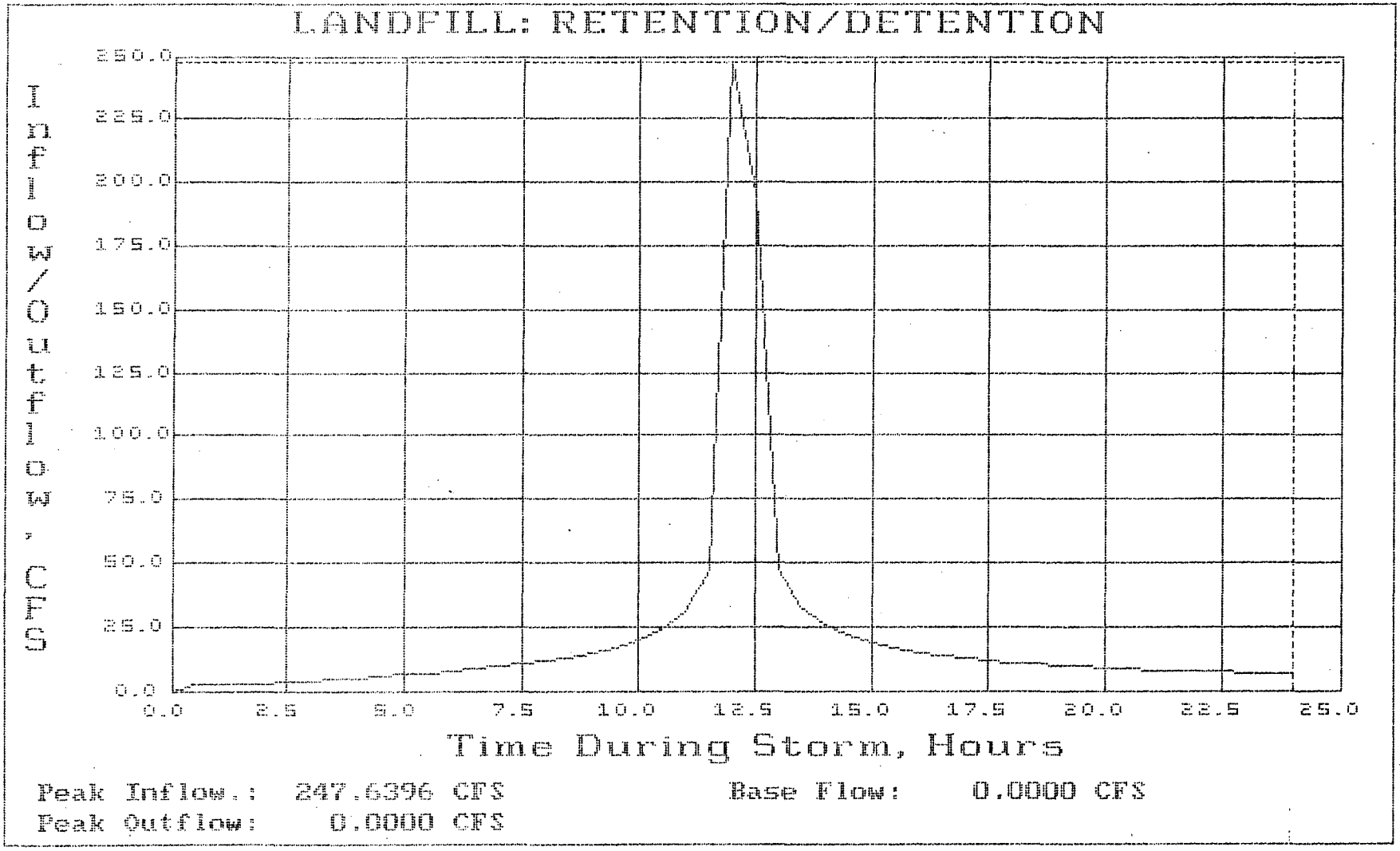

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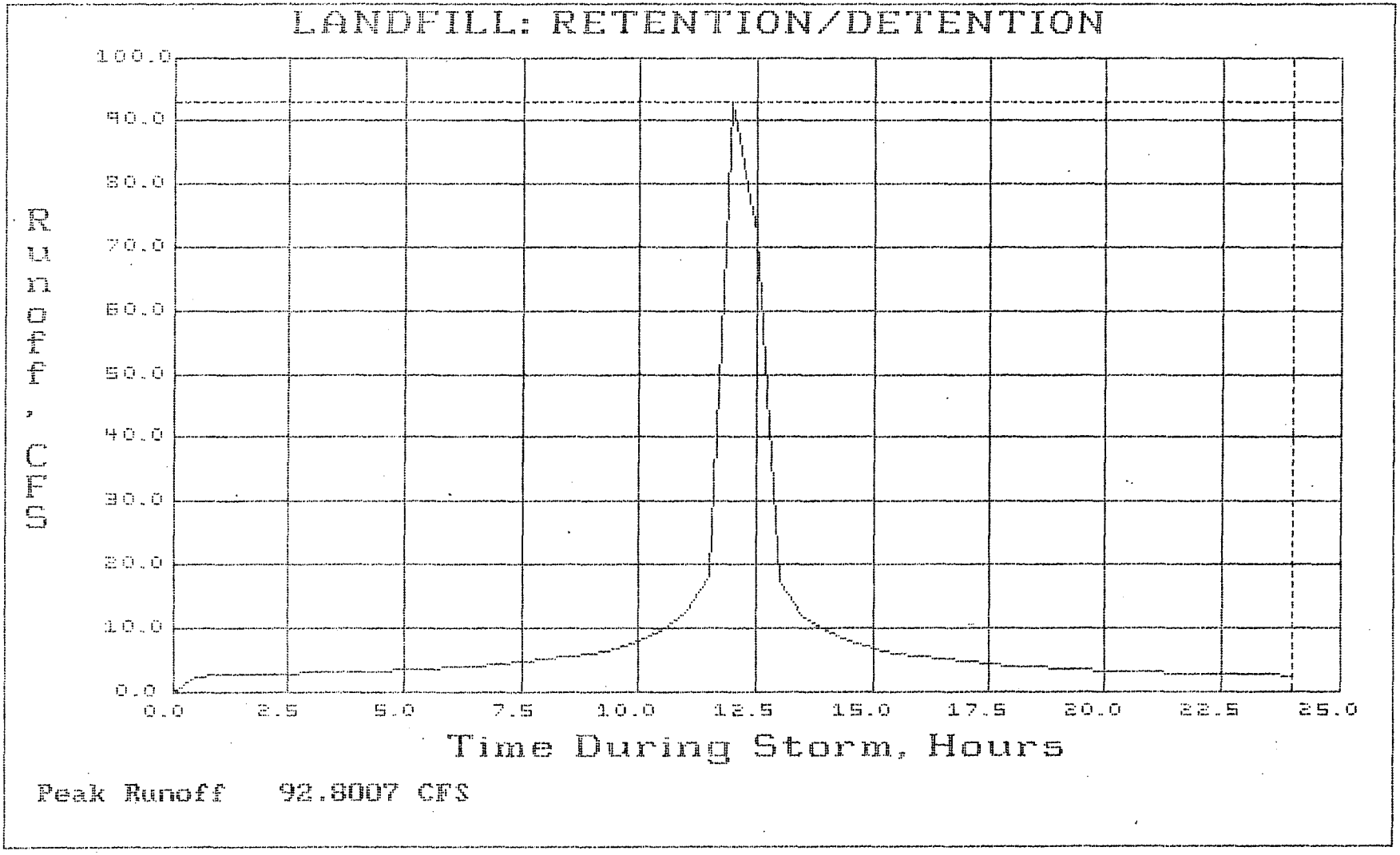

BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES

LANDFILL: RETENTION/DETENTION, [POND]

Time	Rain	Runoff	Stage	CFS In	CFS Out	ACFT In	Storage	ACFT Out
0.000	0.000	0.000	26.000	0.000	0.000	0.000	0.000	0.000
0.500	0.065	2.378	26.003	2.378	0.000	0.049	0.049	0.000
1.000	0.133	2.454	26.010	2.454	0.000	0.149	0.149	0.000
1.500	0.202	2.536	26.017	2.536	0.000	0.252	0.252	0.000
2.000	0.274	2.624	26.023	2.673	0.000	0.360	0.360	0.000
2.500	0.349	2.721	26.032	3.213	0.000	0.481	0.481	0.000
3.000	0.428	2.826	26.041	3.822	0.000	0.627	0.627	0.000
3.500	0.507	2.942	26.052	4.422	0.000	0.797	0.797	0.000
4.000	0.591	3.070	26.065	5.020	0.000	0.992	0.992	0.000
4.500	0.679	3.212	26.079	5.629	0.000	1.212	1.212	0.000
5.000	0.772	3.370	26.095	6.258	0.000	1.458	1.458	0.000
5.500	0.869	3.549	26.113	6.918	0.000	1.730	1.730	0.000
6.000	0.972	3.752	26.133	7.628	0.000	2.031	2.031	0.000
6.500	1.082	3.986	26.154	8.402	0.000	2.362	2.362	0.000
7.000	1.199	4.257	26.178	9.262	0.000	2.727	2.727	0.000
7.500	1.324	4.577	26.205	10.241	0.000	3.130	3.130	0.000
8.000	1.460	4.961	26.234	11.379	0.000	3.576	3.576	0.000
8.500	1.609	5.434	26.266	12.741	0.000	4.075	4.075	0.000
9.000	1.775	6.030	26.302	14.426	0.000	4.636	4.636	0.000
9.500	1.962	6.810	26.343	16.592	0.000	5.277	5.277	0.000
10.000	2.178	7.887	26.392	19.541	0.000	6.023	6.023	0.000
10.500	2.439	9.490	26.449	23.886	0.000	6.921	6.921	0.000
11.000	2.773	12.194	26.522	31.158	0.000	8.058	8.058	0.000
11.500	3.269	18.084	26.624	46.931	0.000	9.671	9.671	0.000
12.000	5.816	92.801	27.005	247.640	0.000	15.758	15.758	0.000
12.500	7.787	71.835	27.562	195.037	0.000	24.904	24.904	0.000
13.000	8.259	17.180	27.859	46.845	0.000	29.901	29.901	0.000
13.500	8.584	11.840	27.955	32.314	0.000	31.537	31.537	0.000
14.000	8.839	9.294	28.025	25.383	0.000	32.729	32.729	0.000
14.500	9.052	7.762	28.081	21.208	0.000	33.692	33.692	0.000
15.000	9.236	6.721	28.128	18.372	0.000	34.509	34.509	0.000
15.500	9.400	5.963	28.170	16.304	0.000	35.226	35.226	0.000
16.000	9.547	5.381	28.207	14.718	0.000	35.867	35.867	0.000
16.500	9.682	4.920	28.241	13.458	0.000	36.449	36.449	0.000
17.000	9.807	4.542	28.271	12.429	0.000	36.984	36.984	0.000
17.500	9.923	4.228	28.300	11.570	0.000	37.480	37.480	0.000
18.000	10.032	3.960	28.327	10.840	0.000	37.943	37.943	0.000
18.500	10.134	3.731	28.352	10.213	0.000	38.378	38.378	0.000
19.000	10.231	3.530	28.375	9.664	0.000	38.788	38.788	0.000
19.500	10.323	3.354	28.397	9.183	0.000	39.178	39.178	0.000
20.000	10.411	3.197	28.419	8.755	0.000	39.548	39.548	0.000
20.500	10.495	3.056	28.439	8.370	0.000	39.902	39.902	0.000
21.000	10.575	2.930	28.458	8.025	0.000	40.241	40.241	0.000
21.500	10.652	2.815	28.476	7.712	0.000	40.566	40.566	0.000
22.000	10.727	2.711	28.494	7.427	0.000	40.879	40.879	0.000
22.500	10.798	2.615	28.511	7.164	0.000	41.180	41.180	0.000
23.000	10.868	2.527	28.528	6.925	0.000	41.471	41.471	0.000
23.500	10.935	2.446	28.544	6.702	0.000	41.753	41.753	0.000
24.000	11.000	2.371	28.559	6.497	0.000	42.026	42.026	0.000

Node #	Name	Type	Inflow	Outflow	Stage	Storage
1	LANDFILL EXPANSION	SUBAREA	154.839	154.839	25.000	0.000
2	RETENTION/DETENTION	POND	247.640	0.000	28.559	42.026

Project File: LANDFILL, NETWORK TOKENS

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00001: Number of Paths   1
00002: Path Number   1
00003: From Node..   1
00004: To Node....   2
00005: Path Type..   1
00006: *
00007: Number of Flow Controls.          0
00008: ************************************
00009: Number of Nodes   2
00010: Node   1
00011: LANDFILL EXPANSION
00012: Type 1
00013: SCS_484
00014: Total acres.............    31.7700
00015: Weighted curve number...    89.1600
00016: Hydraulic length, feet..   400.0000
00017: Ground slope, percent...    12.9100
00018: Percent impervious cover    90.0000
00019: Initial abstraction k...     0.2000
00020: Flood elevation.........    40.0000
00021: Dry Weather Base CFS....     0.0000
00022: Initial Water Elevation.    25.0000
00023: ************************************
00024: Node   2
00025: RETENTION/DETENTION
00026: Type 2
00027: Number of data points...           2
00028: Stage    29.0000  Acres    18.0700
00029: Stage    26.0000  Acres    15.1900
00030: Rational coefficient....     1.0000
00031: Initial water...........    25.0000
00032: Dry Weather Base CFS....     0.0000
00033: ************************************
00034: Checksum 3
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