Prepared for:

Talen Energy
835 Hamilton St., Suite 150
Allentown, PA 18101

RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

Per Requirements of 40 CFR §257.81

Montour SES Ash Landfill 3
Washingtonville, Pennsylvania

Prepared by:

Geosyntec consultants

10211 Wincopin Circle, Floor 4
Columbia, Maryland 21044

Project Number ME1207A

October 2016

Geosyntec consultants

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1. INTRODUCTION

1.1 Organization and Terms of Reference

Geosyntec Consultants (Geosyntec) has prepared this Run-on and Run-off Control Systems Plan for Talen Generation, LLC (Talen) to demonstrate compliance of the existing Montour SES Ash Landfill 3 (Ash Landfill 3) in Washingtonville, Pennsylvania with the operating criteria of the Federal Coal Combustion Residuals (CCR) Rule. On 17 April 2015, the USEPA published the final rule for disposal of CCR from electric power utilities under Subtitle D of the Resource Conservation and Recovery Act (RCRA), contained in Section 257 of Title 40 of the Code of Federal Regulations (40 CFR 257 Subpart D), referred to here as the CCR Rule. Section 257.81 contains the requirements for run-on and run-off controls of CCR landfills. In this Run-on and Run-off Control System Plan, the specific requirements of §257.81 are identified and addressed.

This Run-on and Run-off Control Systems Plan was prepared by Mr. Mike Nolden, E.I.T., and it was reviewed in accordance with Geosyntec's internal review policy by Mr. Michael Houlihan, P.E. and Mr. Thomas Ramsey, P.E., all of Geosyntec. Mr. Ramsey is a registered Professional Engineer in the Commonwealth of Pennsylvania.

1.2 Site Location

Montour SES is located in Washingtonville, Montour County, Pennsylvania. The site can be found on a United State Geological Survey 7.5-minute topographic map for the Washingtonville Quadrangle (Figure 1). Ash Landfill 3 is located within the Montour SES site, southeast of the generating station.

1.3 Landfill Description

Ash Landfill 3, also called Ash Area 3 or Ash Storage Area 3, is a CCR landfill constructed in 1990 to accept coal combustion residuals produced by the Montour SES, as described by Form R of the Pennsylvania Department of Environmental Protection (PADEP) Class II Residual Waste Disposal Facility permit renewal (PADEP Permit) application package (PPL 2007). Ash Landfill 3 has been in service since 1991 (PPL 2007, Attachment 1 to Form 1R).

Ash Landfill 3 is regulated under the Pennsylvania Residual Waste Regulations of Title 25 PA Code, Chapters 287 and 288. The unit is permitted as a PADEP Residual Waste Disposal Facility. Ash Landfill 3 was constructed and is operated under a renewal of Permit No. 300987 for a Landfill—Class I, II, or III (PADEP 2007), which was issued in August 2007.

Ash Landfill 3 was designed as a two-phase landfill with each phase comprising three levels, as shown on drawing E-195972-3 in Appendix A. Currently, landfilling operations have only been performed in Phase I. The portion of the permit area designated for Phase II remains undeveloped.

2. CCR RULE REQUIREMENTS FOR RUN-ON/ RUN-OFF CONTROLS (§257.81)

2.1 Run-On and Run-Off Control Requirements for CCR Landfills (§257.81)

As described in §257.81, an existing CCR landfill must design, construct, operate, and maintain run-on/run-off controls to prevent flow onto and from active cells from a 24-hr, 25-yr storm event. The rule requires that the CCR landfill be designed, constructed, operated, and maintained to collect and control at least the water volume resulting from a 24-hour, 25-year storm (§257.81(a)). Additionally, the CCR landfill must comply with 40CFR§257.3-3 which regulates discharge of pollutants into the waters of the United States (§257.81(b)). Section 257.81(c) of the rule requires that the owner or operator of a CCR landfill prepare an initial run-on and run-off control system plan documenting, with supporting engineering calculations, how the control systems have been designed and constructed to meet the requirements of §257.81(a). Pages 21389-21390 of the Preamble to the CCR rule describe the type of documentation that is expected to be included in the Run-On and Run-Off Control System Plan.

2.2 Compliance with Run-On and Run-Off Controls Requirements

Part 3 of this document presents the demonstration of compliance with the requirements of §257.81. Section 257.81(a) addresses the performance requirement of the run-on and run-off control system, which is satisfied by the identification of the design storm in Section 3.3. The requirement of §257.81(b), which addresses the handling requirements of run-off collected from the landfill, is satisfied by and monitored under the facility’s National Pollutant Discharge Elimination System (NPDES) permit program.

The specific documentation that is expected to be provided in the Run-on and Run-Off Control System Plan is described in the Preamble at pages 21389-21390.The table below summarizes the minimum CCR Rule requirements for a run-on and run-off control system plan from §257.81(c) and the Preamble, and the location in this document where those requirements are addressed.

RULE SECTION	RULE REQUIREMENT	LOCATION WHERE ADDRESSED IN DOCUMENT
§257.81(c)(1)	Owner or operator must prepare initial and periodic run-on and run-off control system plans for the unit	Part 3
	Document how the run-on and run-off controls have been designed and constructed.	Section 3.2
Preamble Pages 21389-21390	Identification of 24-hr, 25-yr Storm	Section 3.3
	Characterization of Rainfall Abstractions	Section 3.4
	Selection and Basis of Run-Off Model	Section 3.5
	Selection and Basis of Run-On and Run-Off Routing Model	Section 3.6
	Selection and design Run-On and Run-Off Management System	Section 3.7
	Supporting Engineering Calculations.	Section 3.8
§257.81(c)(5)	Written Certification from qualified professional engineer that initial Run-On and Run-Off Control System Plan meets the requirements of §257.81(c).	Section 4

3. RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

3.1 Introduction

The information presented in the following sections demonstrates the Montour SES Ash Landfill 3 is in compliance with the run-on and run-off control system with the requirements of the CCR Rule §257.81(c)(1) and preamble.

The CCR Rule (preamble Page 21389) defines *run-on* to mean any liquid that drains overland onto any part of a CCR landfill. Conversely, the CCR Rule defines *run-off* to mean any liquid that drains overland from any part of the CCR landfill.

3.2 Description of Run-On and Run-Off Controls Design and Construction

The design for the Run-On and Run-Off Control System for Ash Landfill 3 is provided in the approved Erosion and Sedimentation Control Plan (PPL 2007, Attachment 1 to Form I) and the unit's Design Concept and Operating Plan document (PPL 2007, Attachment 1 to Form 1R) (Appendix B). The design and construction of these controls are described below.

Design of Run-On and Run-Off Controls

The location of Ash landfill 3 is such that overland flow of stormwater run-on is intercepted by a bordering tributary or by a perimeter access road and diverted to culverts beneath the Ash Landfill 3 (Attachment 1 to Form I).

Run-off from Ash Landfill 3 will be handled in one of two ways (Attachment 1 to Form I):

- Run-off from active or unvegetated portions of the landfill will be directed to the leachate basin for treatment and discharge
- Run-off from vegetated or covered portions of the landfill will be directly to perimeter drainage ditches for discharge to the tributary.

A dirty run-off ditch, constructed first, intercepts dirty runoff from active portions of the landfill and conveys the run-off as described above (Attachment 1 to Form 1R). Once a portion of the landfill is vegetated, a clean run-off ditch is constructed between the landfill slope and the dirty run-off ditch (Attachment 1 to Form 1R). As the landfill expands vertically, bench ditches are constructed to intercept flow down the side slopes and discharge it to one of the appropriate ditch (i.e., either clean or dirty) through slope pipes.

Plan and details of the run-off control system, as designed, is shown on the following drawings in Appendix A:

- E-195969 (Sheets 1, 2, and 3)
- E-195970 (Sheets 1 and 2)
- E-195971
- E-195972

Construction of Run-On and Run-Off Controls

The dirty run-off ditches were constructed and, where appropriate, are in the process of being converted to clean run-off ditches once all of the stormwater controls are in place and design elevation of waste materials are achieved. All stormwater is collected in the dirty run-off ditches and routed to the leachate basin for treatment and discharge (Benjamin Wilburn, personal communication, 30 November 2015).

No additional as-built or construction documentation was located to verify that the run-on and run-off controls were constructed per the design.

Specific requirements for the Run-On and Run-Off Control Systems Plan, as outlined by the CCR Rule preamble (Pages 21389 and 21390), are identified and addressed below.

3.3 Identification of the Design Storm

The identification of the design storm is not explicitly described in the available documentation. The introduction to Attachment 1 to Form I of PPL (2007) states that the original stormwater calculations have been verified to show that that run-on and run-off control system can accommodate a 24-hour, 25-year storm event.

Stormwater run-off calculation appended to Attachment 1 to Form I show that the original design storm was selected to be a 24-hour, 10-year storm and that the calculations were revised to consider a 24-hour, 25-year storm. The calculations show that a rainfall intensity of 5.0 inches per hour was selected for design.

3.4 Characterization of Rainfall Abstractions

Stormwater run-off calculations appended to Attachment 1 to Form I show that rainfall abstractions are characterized by a runoff curve number (CN). The calculations show that CN used was a weighted CN based on the post-development conditions of Ash landfill 3 and the adjacent features (e.g., access roads and run-off ditches).

3.5 Selection and Basis of Run-Off Model

The calculations appended to Attachment 1 to Form 1R show that the calculations were performed based on methods presented in the Soil Conservation Service (SCS). The calculations show that the peak discharges were calculated from figures published by SCS for the calculation of peak rates of discharge for small watersheds. The calculations show that additional hydrologic information such as hydrographs, CN, and times of concentration were calculated using HydroCAD software Quick TR-55.

3.6 Selection and Basis of Run-On and Run-Off Routing Model

The selection and basis of the run-on and run-off routing model was not identified in the documentation reviewed.

3.7 Selection and Design of Run-on and Run-Off Management System

Design of the run-on and run-off management system is shown in Calculations appended to Attachment 1 to Form I. The calculations show shat the ditches were analyzed and designed as trapezoidal open channels using software developed by Haestad Methods Inc.

3.8 Supporting Engineering Calculations

Engineering calculations supporting the design of the run-on and run-off controls at Ash Landfill 3 are appended to Attachment 1 to Form I of PPL (2007) (Appendix C).

4. Certification by Qualified Professional Engineer

Per §257.81(c)(5), the owner or operator of the unit must obtain a written certification from a qualified professional engineer that the run-on and run-off control system plan meets the requirements of the CCR Rule.

Certification for Run-On and Run-Off Control System Plan

CCR Unit: Montour SES Ash Landfill 3

Certification

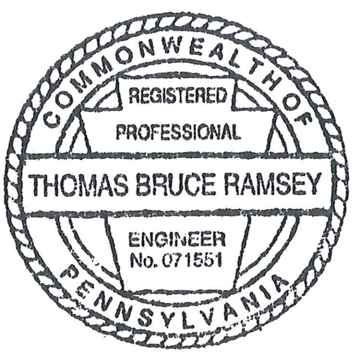
I, **Thomas B. Ramsey**, a registered professional engineer in the Commonwealth of Pennsylvania certify that the Run-On and Run-Off Control System Plan for the Montour SES Ash Landfill 3 is in compliance with requirements of 40 CFR §257.81(c). This certification is based on my review of information described in this certification report.

Printed Name Thomas B. Ramsey

PE License Number PA071551 **State** Pennsylvania

Signature **Date** 12 OCTOBER 2016

Seal



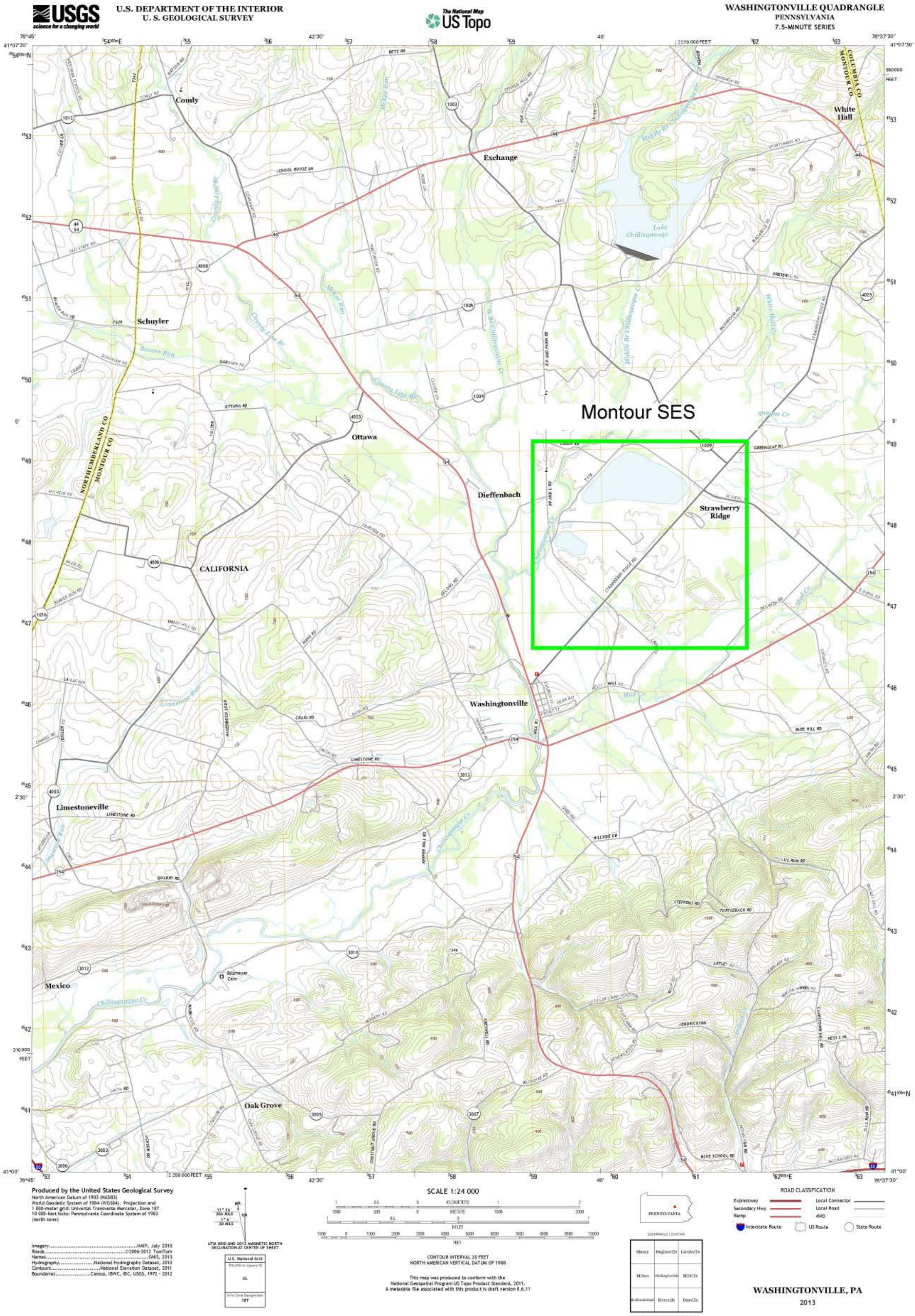
5. REFERENCES

PADEP (2007). “Permit for Solid Waste Disposal and/or Processing Facility FORM NO. 8.” Pennsylvania Department of Environmental Protection, Bureau of Land Recycling and Waste Management. August 2007.

PPL (2007). “PPL Montour, LLC – Ash Area #3 Permit Renewal Application – SWP 300987.” PPL Services Corporation. Allentown, PA. March 2007.

United States Environmental Protection Agency (USEPA) (2015). “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule.” Chapter 40 Code of Federal Regulations, Parts 257 and 261. 17 April 2015.

FIGURES



SITE LOCATION
MONTOUR SES

WASHINGTONVILLE, PA

Geosyntec consultants

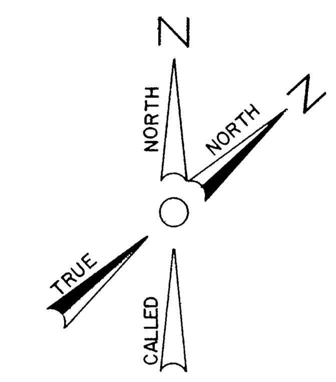
FIGURE

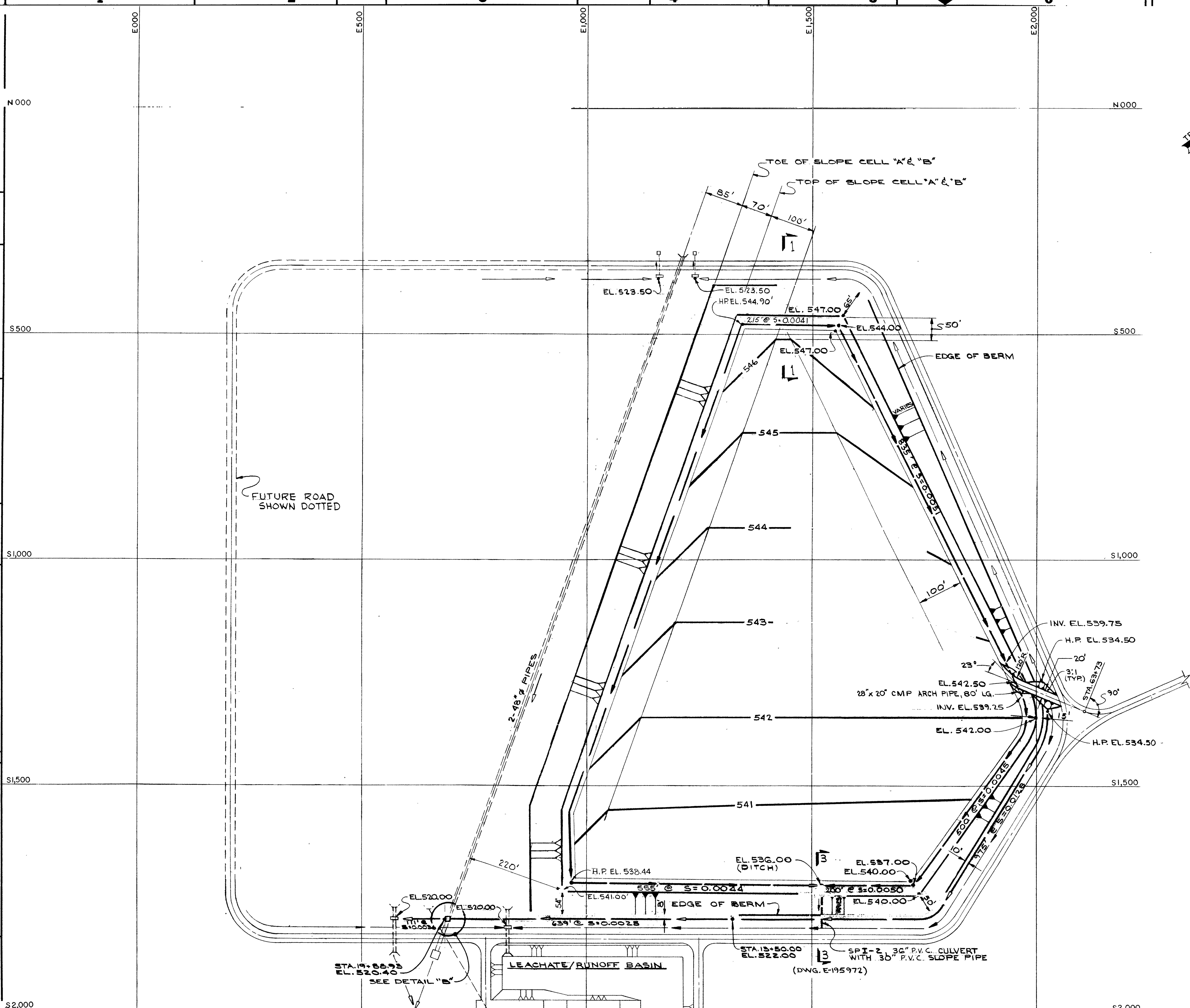
1

Columbia, MD | 12 April 2016

APPENDIX A

Drawings

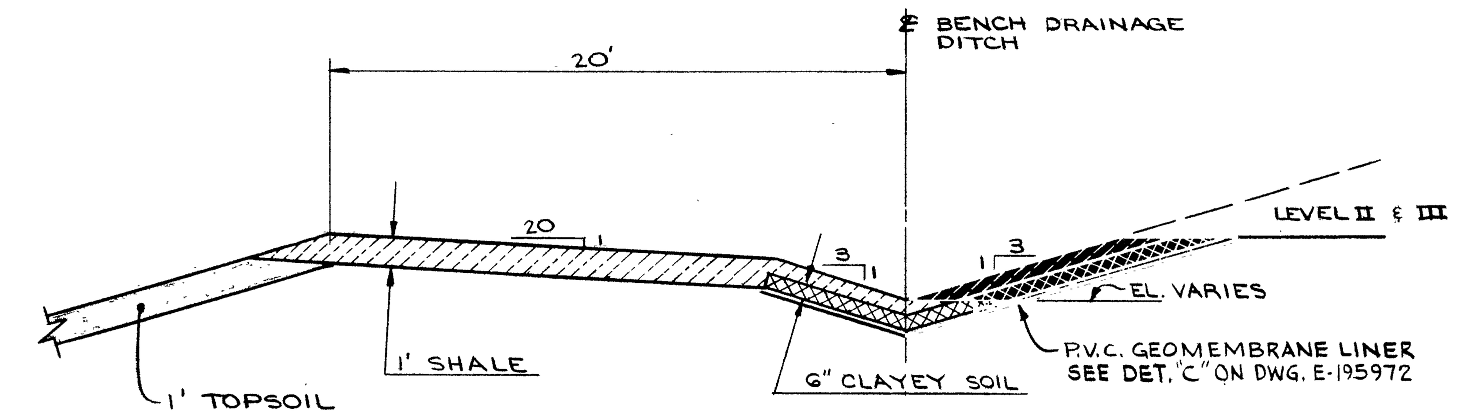




NOTE:
1. WORK THIS DRAWING WITH DRAWING E-195965 - CONSTRUCTION DEVELOPMENT SEQUENCE PLANS.
2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)

PLAN - PHASE I
CELL DEVELOPMENT - LEVEL I

SCALE: 1"=100'



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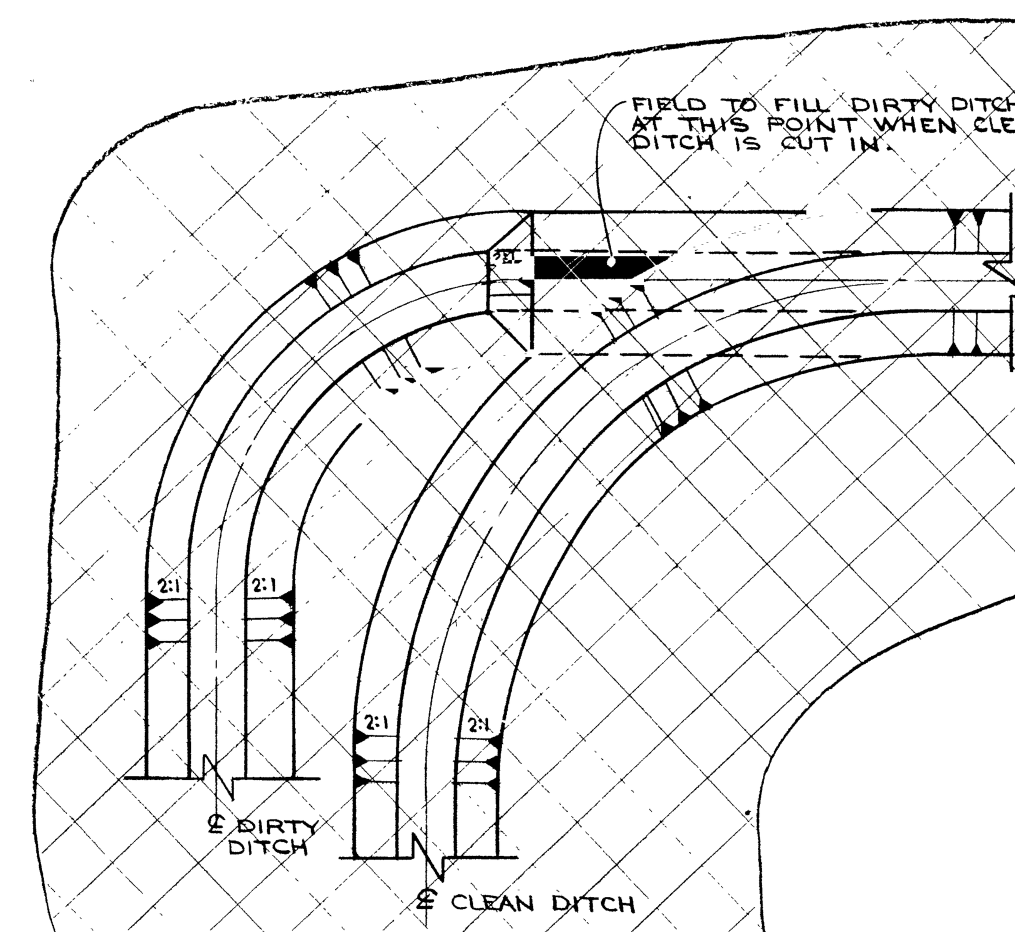

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FUTURE NOT INSTALLED

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- 544 — FINISHED GRADE CONTOUR
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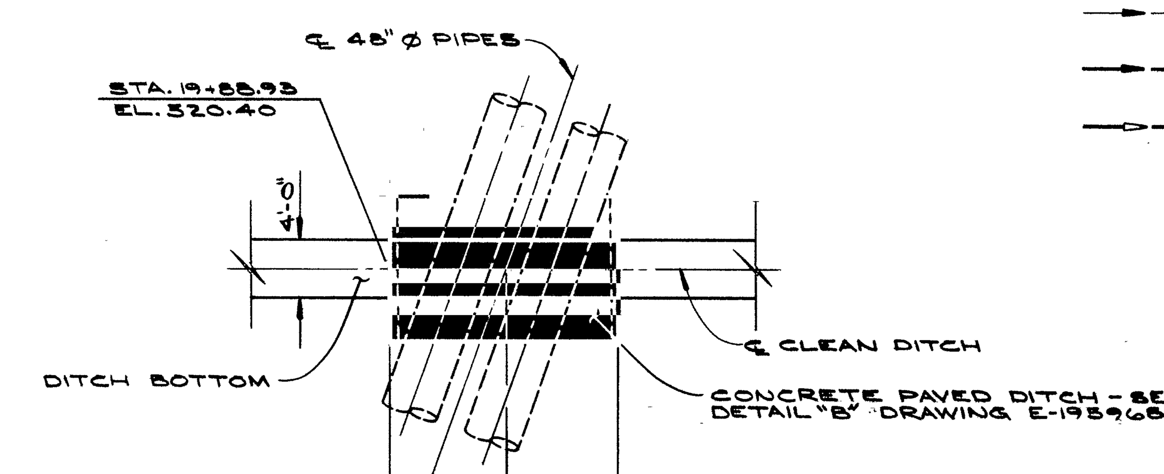
- EXISTING DIRTY RUNOFF DITCH
- NEW DIRTY RUNOFF DITCH
- NEW CLEAN RUNOFF DITCH



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PRELIMINARY GRADING, STREAM DIVERSION & ROADWAY - PLAN	E-195966-SHT. 1	INTERMEDIATE DEVELOPMENT - PHASE II - LEVEL III	E-195971
LEACHATE UNDERDRAIN SYSTEM	E-195966-SHT. 2	INTERMEDIATE CELL DEVELOPMENT - SLOPE PIPE DETAILS	E-195972
STREAM PROFILE, SECTIONS, AND DETAILS	E-195968	BILL OF MATERIAL	A-195980

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
2	4-18-86	750501	REVISE GRADING AND UP DATE TITLE	D.M.		JMX
1	6-6-85	103069	CHANGED SLOPE PIPE LOCATION.	SHC	A.L.M.	K.L.M.

LOC CODE: H-H70
DESCRIPTION: CELL DEVELOPMENT LEVEL I
SORT: L

ER- 480230
ER-
SCALE- AS SHOWN
DATE- 1-19-84
DRAWN- TEC
CHECKED- FAC
LEADER- A.L.M.
APPR'D- WJB
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
INTERMEDIATE DEVELOPMENT - PHASE I LEVEL I

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 1 OF 3

APPROVED 1/20/84 John A. Stefanik

E-195969-2

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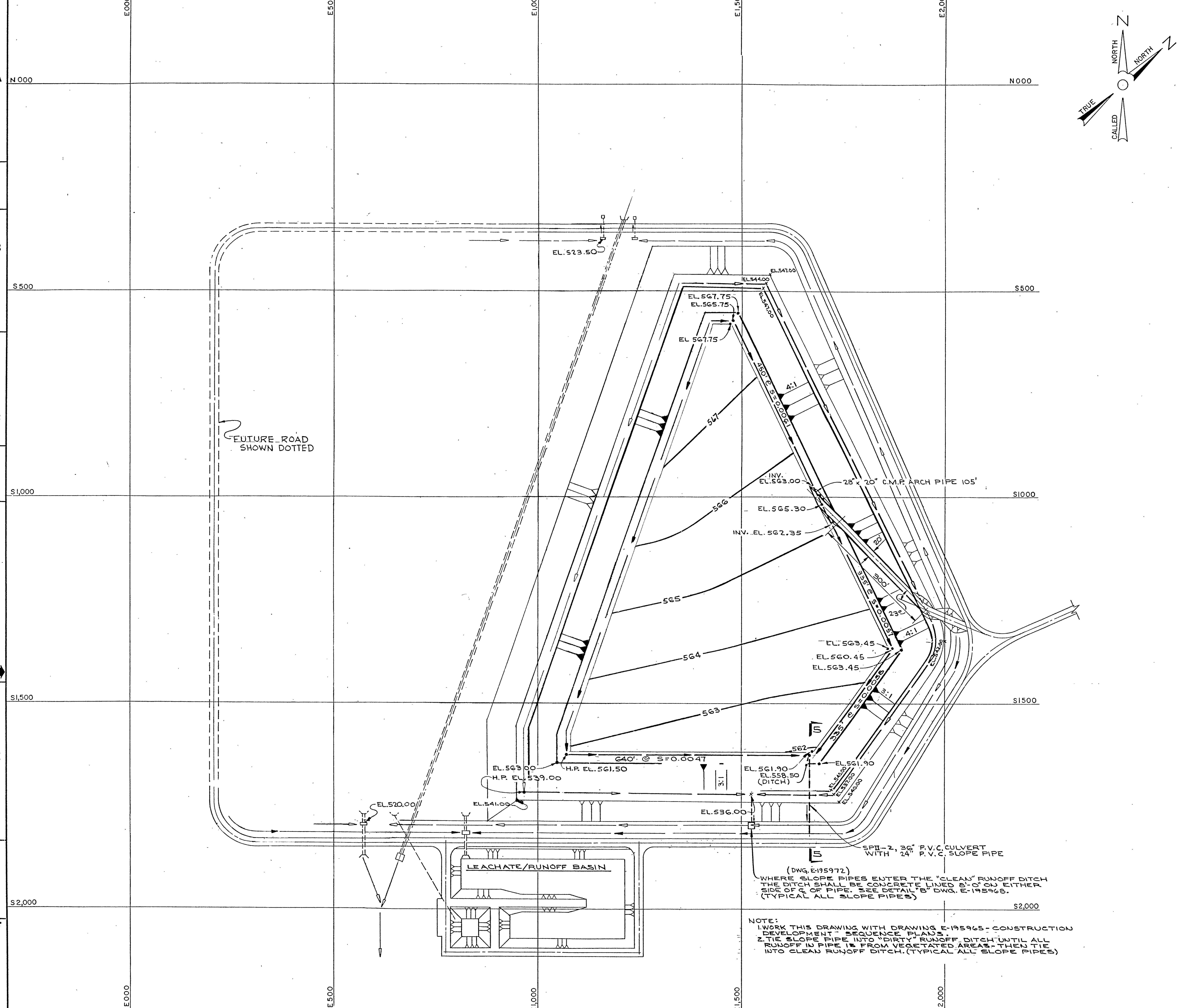

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2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)

PLAN - PHASE I
CELL DEVELOPMENT - LEVEL II
SCALE: 1"=100'

LEGEND

• EL.565.50	FINISHED GRADE SPOT ELEVATION
565	FINISHED GRADE CONTOUR
	EXISTING CLEAN RUNOFF DITCH
	EXISTING DIRTY RUNOFF DITCH
	NEW DIRTY RUNOFF DITCH
	NEW CLEAN RUNOFF DITCH
x EL.542.50	EXISTING GRADE SPOT ELEVATION

WORK THIS DRAWING WITH E-195965

REFERENCE TITLE	NUMBER
INTERMEDIATE DEVELOPMENT - PHASE II	E-195970

ER- 750501
ER-
SCALE- AS SHOWN
DATE-
DRAWN- DM
CHECKED-
LEADER-
APPR'D-
APPR'D-

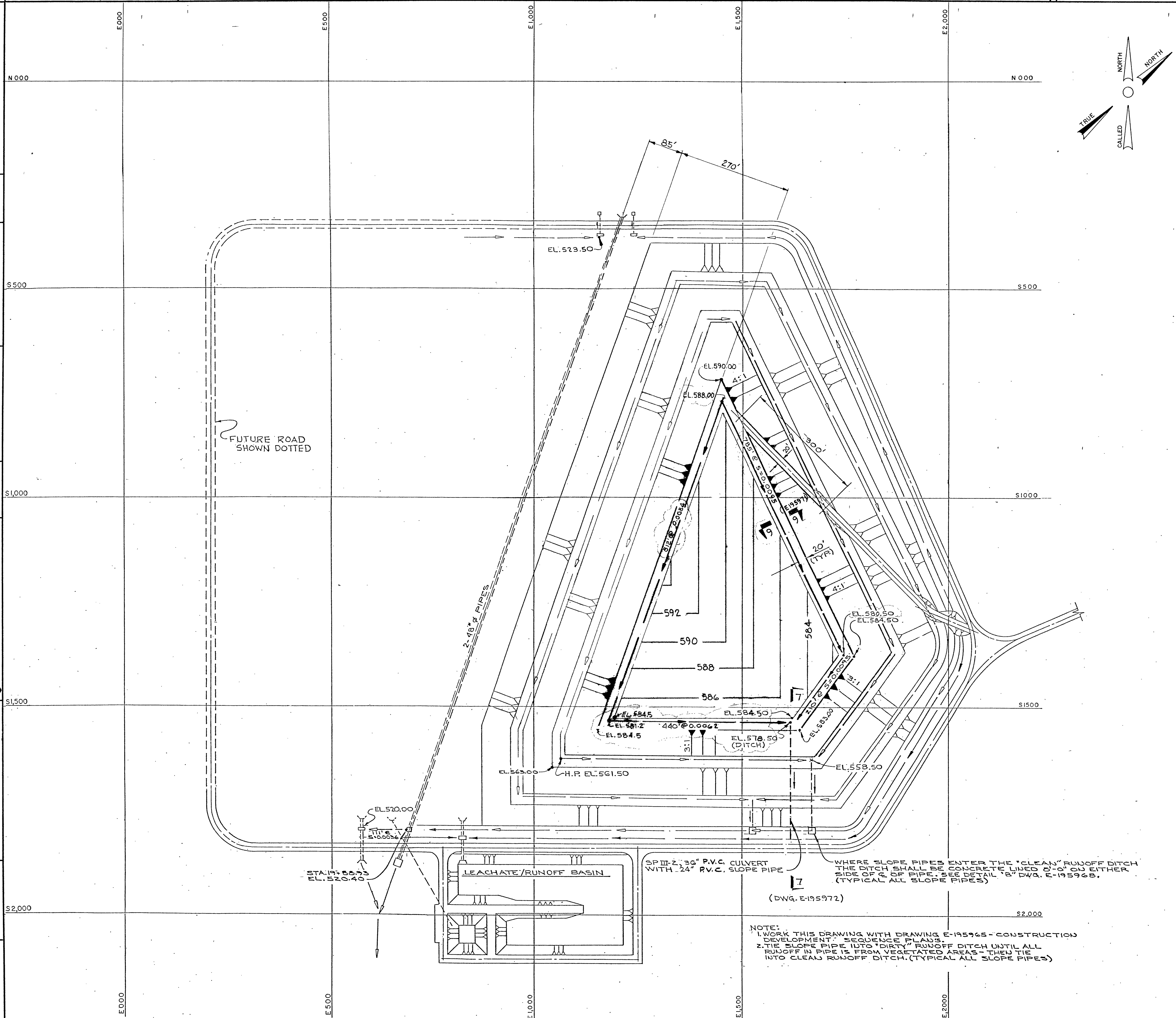
MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
INTERMEDIATE DEVELOPMENT - PHASE I LEVEL II

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 2 OF 3

APPROVED John A. Stefanik 4/18/96

E-195969-0

H-H70 CELL DEVELOPMENT LEVEL II



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2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)

PLAN – PHASE I
CELL DEVELOPMENT – LEVEL III
SCALE: 1"=100'

LEGEND

• EL. 588.50	FINISHED GRADE SPOT ELEVATION
—586—	FINISHED GRADE CONTOUR
	EXISTING CLEAN RUNOFF DITCH
	EXISTING DIRTY RUNOFF DITCH
	NEW DIRTY RUNOFF DITCH
	NEW CLEAN RUNOFF DITCH
x EL. 563.45	EXISTING GRADE SPOT ELEVATION

WORK THIS DRAWING WITH E-195965

REFERENCE TITLE	NUMBER
INTERMEDIATE DEVELOPMENT - PHASE II, LEVEL III	E-195971
INTERMEDIATE DEVELOPMENT - PHASE II	E-195970
BILL OF MATERIAL	A-195980

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
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LOC CODE: H-H70
DESCRIPTION: CELL DEVELOPMENT LEVEL III
SORT: C

ER- 750501
ER-
SCALE- AS NOTED
DATE-
DRAWN- DM
CHECKED-
LEADER-
APPR'D-
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
INTERMEDIATE DEVELOPMENT-PHASE I LEVEL III

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.
SHEET 3 OF 3

APPROVED John A. Stefanick 4/18/96

E-195969

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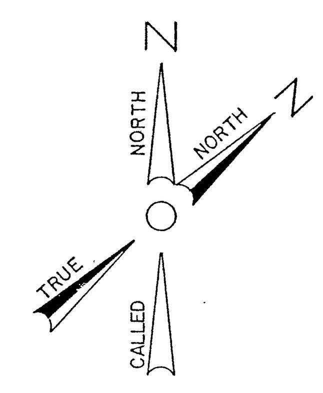

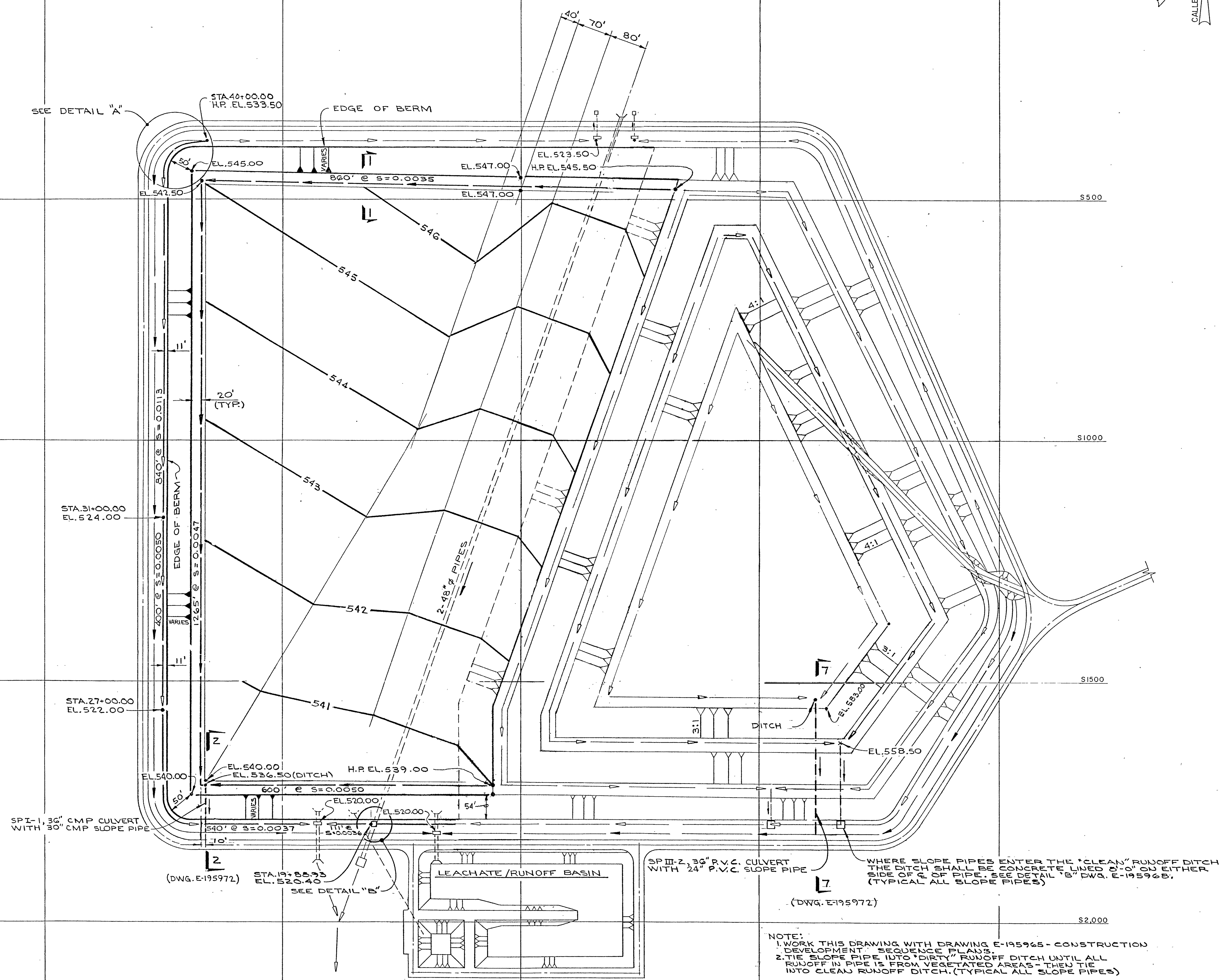

PLAN – PHASE II
CELL DEVELOPMENT – LEVEL I

SCALE: 1"=100'

NOTE:
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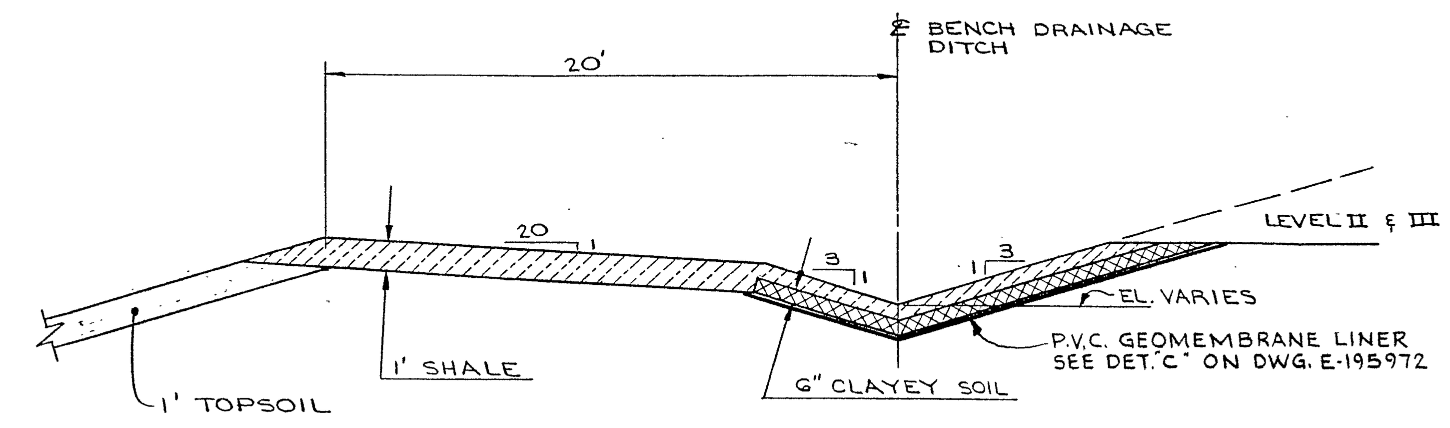
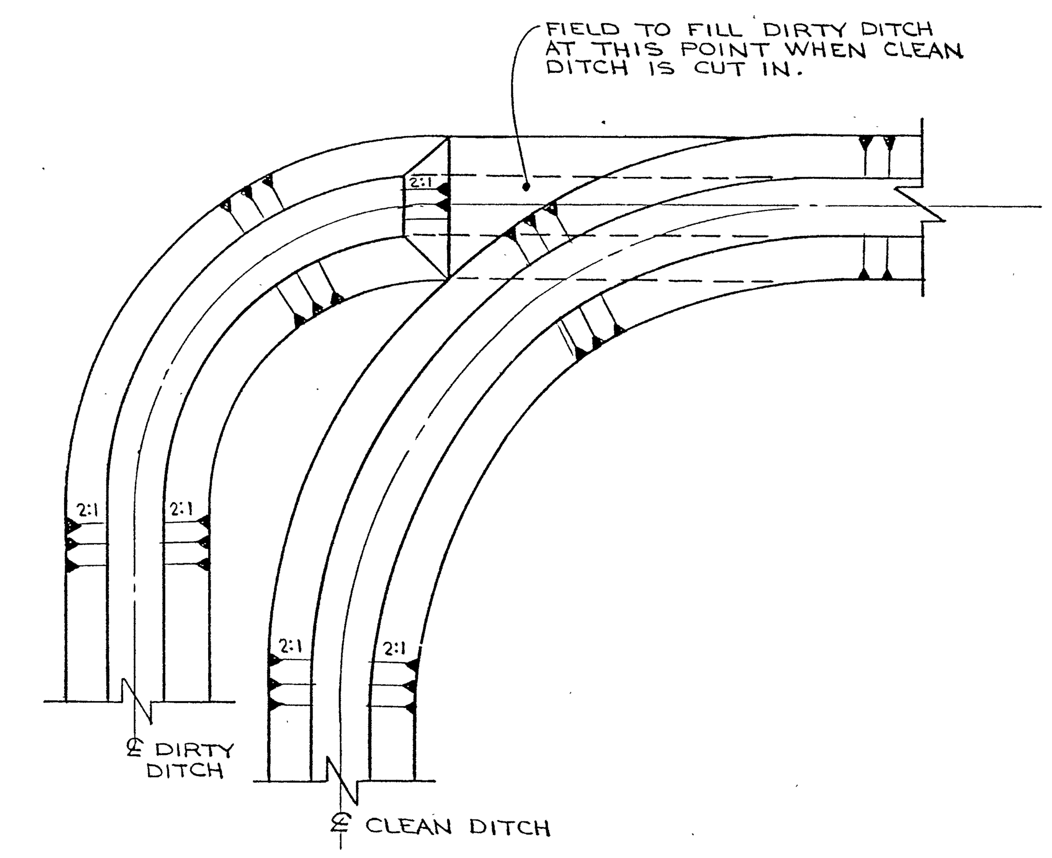
2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)



SECTION 1-1
TYPICAL BENCH DETAIL

NO SCALE

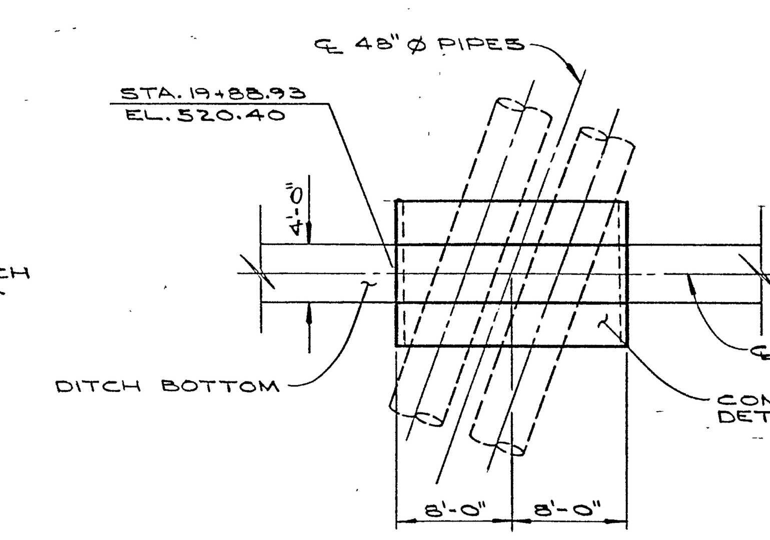


DETAIL "A"

NO SCALE

LEGEND

• EL. 542.50	FINISHED GRADE SPOT ELEVATION
——544——	FINISHED GRADE CONTOUR
	EXISTING CLEAN RUNOFF DITCH
	EXISTING DIRTY RUNOFF DITCH
	NEW DIRTY RUNOFF DITCH
	NEW CLEAN RUNOFF DITCH



DETAIL "B"

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WORK THIS DRAWING WITH E-195965

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PRELIMINARY GRADING, STREAM DIVERSION & ROADWAY - PLAN	E-195966-SHT.1	INTERMEDIATE DEVELOPMENT - PHASE II LEVEL III	E-195971
LEACHATE UNDERDRAIN SYSTEM	E-195966-SHT.2	INTERMEDIATE CELL DEVELOPMENT - SLOPE PIPE DETAILS	E-195972
STREAM PROFILE, SECTIONS, AND DETAILS	E-195968	BILL OF MATERIAL	A-195980
REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
H-H	T	O	CELL DEVELOPMENT LEVEL I			

ER- 750501
ER-
SCALE-AS SHOWN
DATE-
DRAWN- DM
CHECKED-
LEADER-
APPR'D-
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO.3
INTERMEDIATE DEVELOPMENT-PHASE II LEVEL I

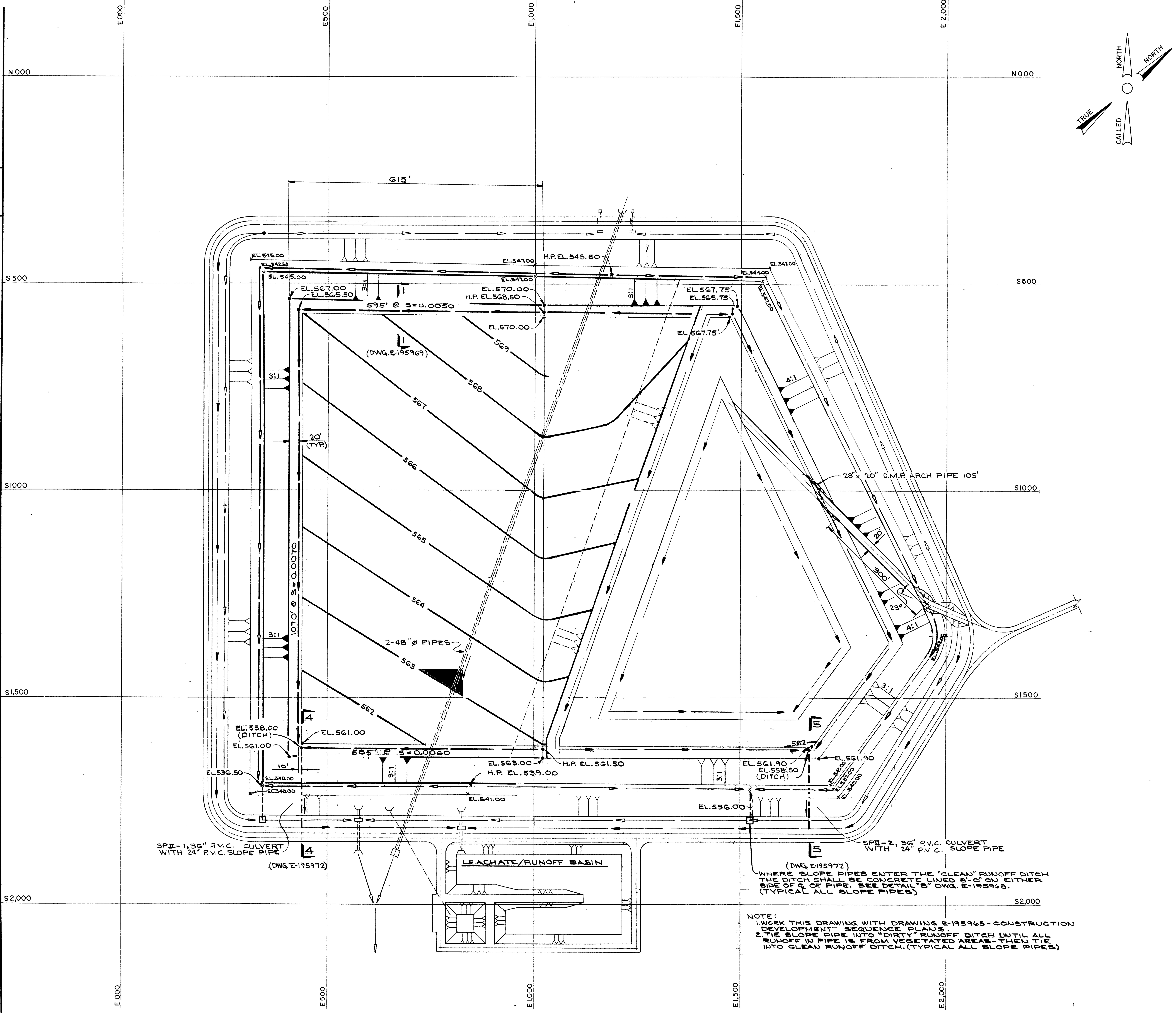
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.
SHEET 1 OF 2

APPROVED John A. Stefanik 4/18/96

E-195970-0

PP&L 895-E 34"X44" PP&L Letter-Height Drafting Standard: Dwg. No. - 3/8", Title - 3/16", Subtitle - 5/32", Letter figures - 1/8" Min.

ADD'L. LOC. CODES



NOTE:
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2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)

PLAN - PHASE II
CELL DEVELOPMENT - LEVEL II

SCALE: 1"=100'

LEGEND

- • EL.565.50 — FINISHED GRADE SPOT ELEVATION
- —565— — FINISHED GRADE CONTOUR
- EXISTING CLEAN RUNOFF DITCH
- EXISTING DIRTY RUNOFF DITCH
- NEW DIRTY RUNOFF DITCH
- NEW CLEAN RUNOFF DITCH
- x EL.542.50 — EXISTING GRADE SPOT ELEVATION

REFERENCE TITLE	NUMBER
INTERMEDIATE DEVELOPMENT - PHASE I	E-195969
INTERMEDIATE DEVELOPMENT - PHASE II LEVEL III	E-195971
BILL OF MATERIAL	A-195980

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
2	4-18-96	750501	REVISE GRADING AND UP DATE TITLE	D.M.		JAS
1	6-6-85	103069	CHANGED SLOPE PIPE LOCATIONS.	G.H.C.	A.L.M.	A.L.M. RHM JAS

WORK THIS DRAWING WITH E-195965
W.O. 045155-000

ER-480230
ER-
SCALE- AS SHOWN
DATE- 1-19-84
DRAWN- TEC
CHECKED- FAC
LEADER- A.L.M.
APPR'D- WJB
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
INTERMEDIATE DEVELOPMET - PHASE II LEVEL II

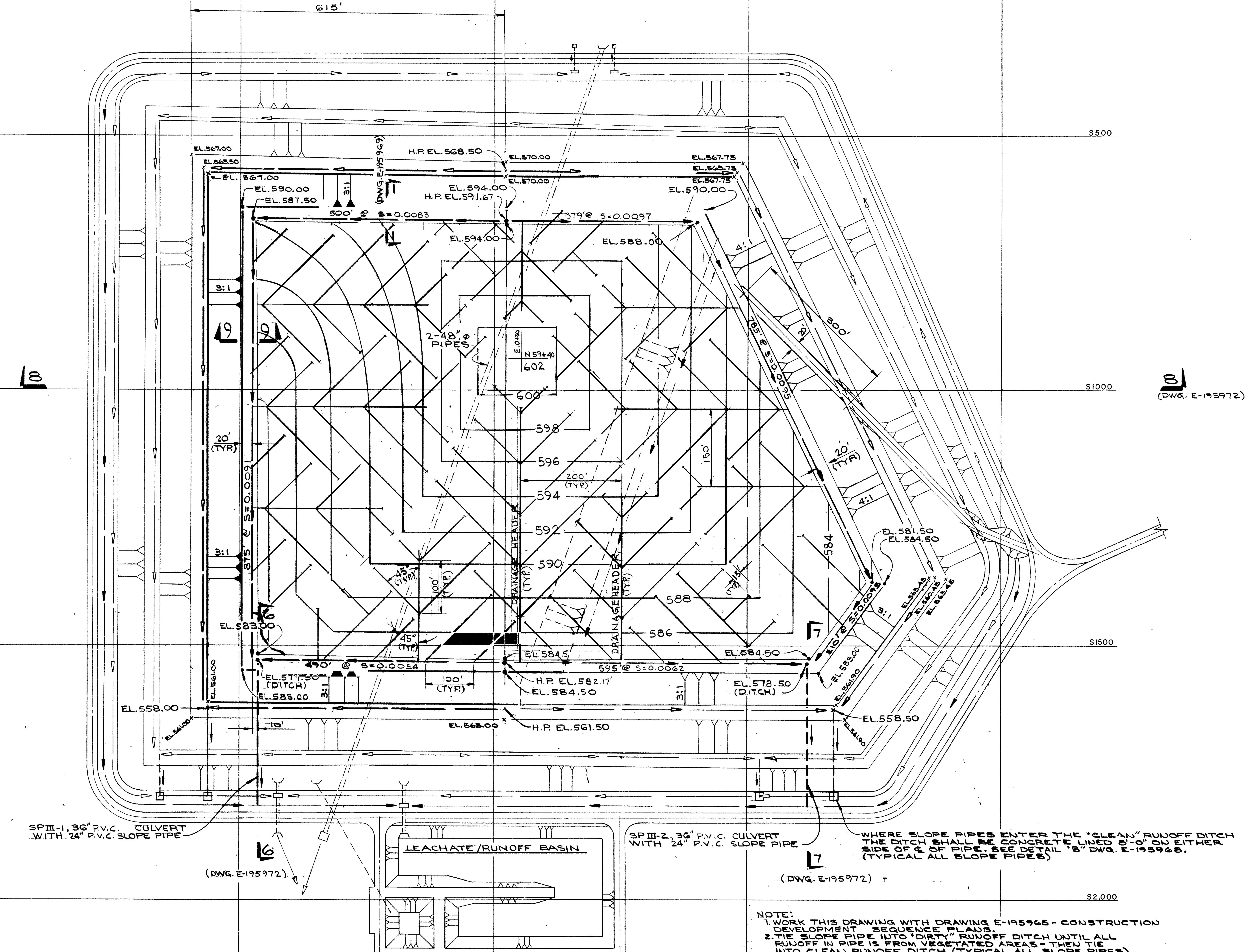
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 2 OF 2

APPROVED 1/30/84 John A. Stefanik

E-195970-2

LOC CODE: H-H70
DESCRIPTION: CELL DEVELOPMENT LEVEL II
SORT: C

PP&L Letter-Height Drafting Standard: Dwg. No. - 3/8"; Title - 3/16"; Subtitle - 5/32"; Letter figures - 1/8" Min.



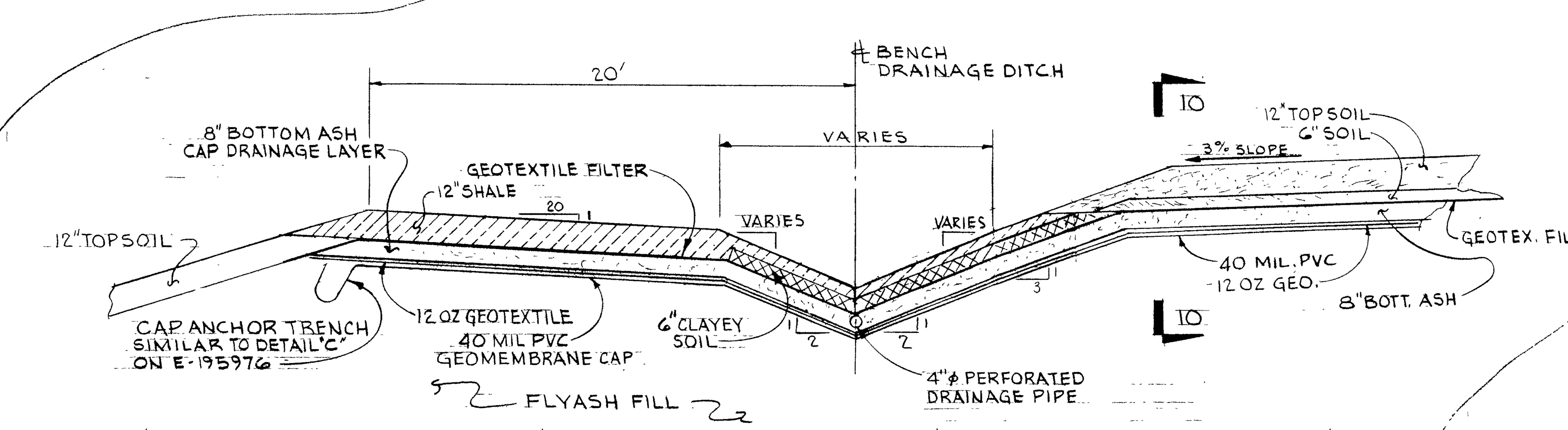
NOTE:
1. WORK THIS DRAWING WITH DRAWING E-195965 - CONSTRUCTION DEVELOPMENT SEQUENCE PLANS.
2. TIE SLOPE PIPE INTO "DIRTY" RUNOFF DITCH UNTIL ALL RUNOFF IN PIPE IS FROM VEGETATED AREAS - THEN TIE INTO CLEAN RUNOFF DITCH. (TYPICAL ALL SLOPE PIPES)

LEGEND

• EL. 588.50	FINISHED GRADE SPOT ELEVATION
—— 586 ——	FINISHED GRADE CONTOUR
	EXISTING CLEAN RUNOFF DITCH
	EXISTING DIRTY RUNOFF DITCH
	NEW DIRTY RUNOFF DITCH
	NEW CLEAN RUNOFF DITCH
x EL. 563.45	EXISTING GRADE SPOT ELEVATION

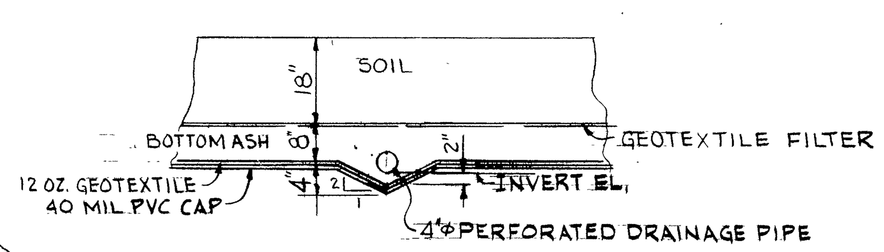
PLAN - PHASE II
CELL DEVELOPMENT - LEVEL III

SCALE: 1"=100'



SECTION 9-9
LEVEL III BENCH DETAIL

NO SCALE



SECTION 10-10

NO SCALE

WORK THIS DRAWING WITH E-195965

REFERENCE TITLE	NUMBER
INTERMEDIATE DEVELOPMENT - PHASE I	E-195969
INTERMEDIATE DEVELOPMENT - PHASE II	E-195970
BILL OF MATERIAL	A-195980

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
3	4-15-97	750501	REVISE GRADING AND ADDED CAP & COVER	DM		
2	4-11-96	750501	REVISE GRADING AND UP DATE TITLE	D.M.		
1	6-6-85	103069	CHANGED SLOPE PIPE LOCATIONS.	G.H.C.	A.L.M.	A.L.M.

LOC CODE: H-H70
DESCRIPTION: CELL DEVELOPMENT LEVEL III
SORT: C

W.O. 045155-000
ER-480230
ER-
SCALE-AS NOTED
DATE-1-19-84
DRAWN-TEC
CHECKED-FAC
LEADER-A.L.M.
APPR'D-WJB
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
INTERMEDIATE DEVELOPMENT - PHASE II LEVEL III

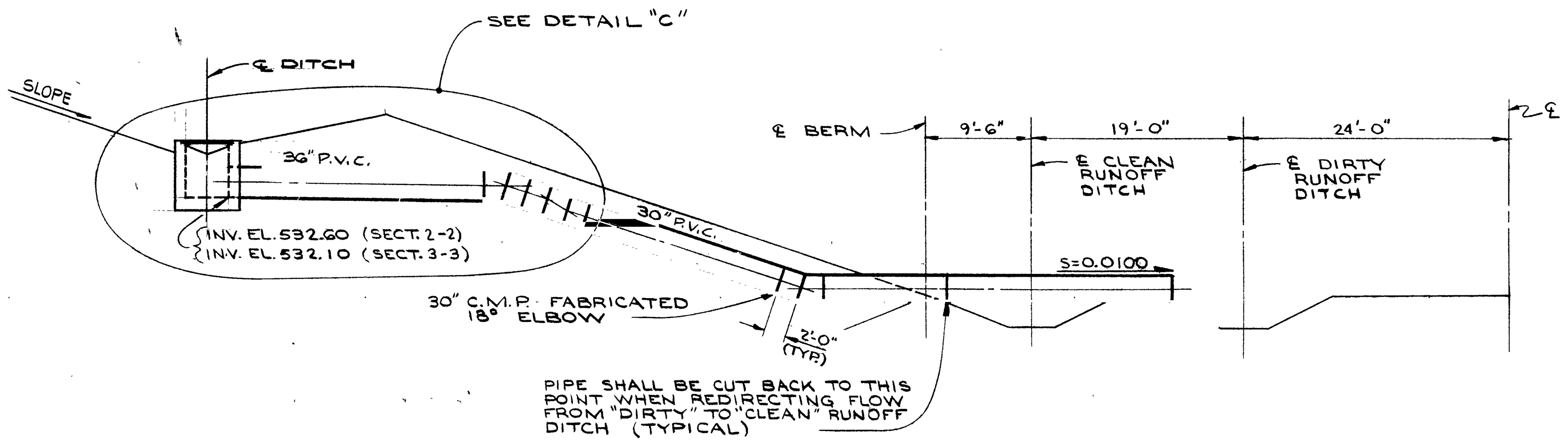
PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

APPROVED 1/20/84 John A. Stefford

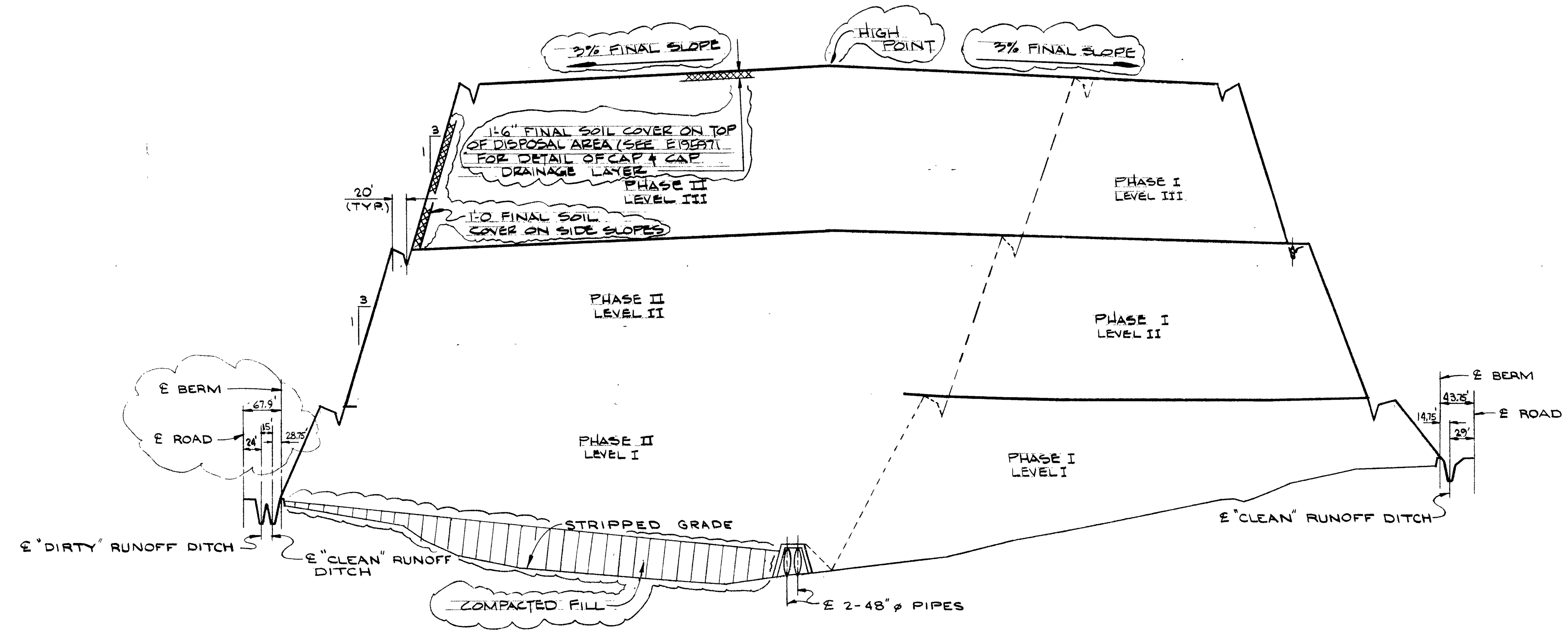
E-195971-3

FRACTIONAL SCALE
DECIMAL SCALE

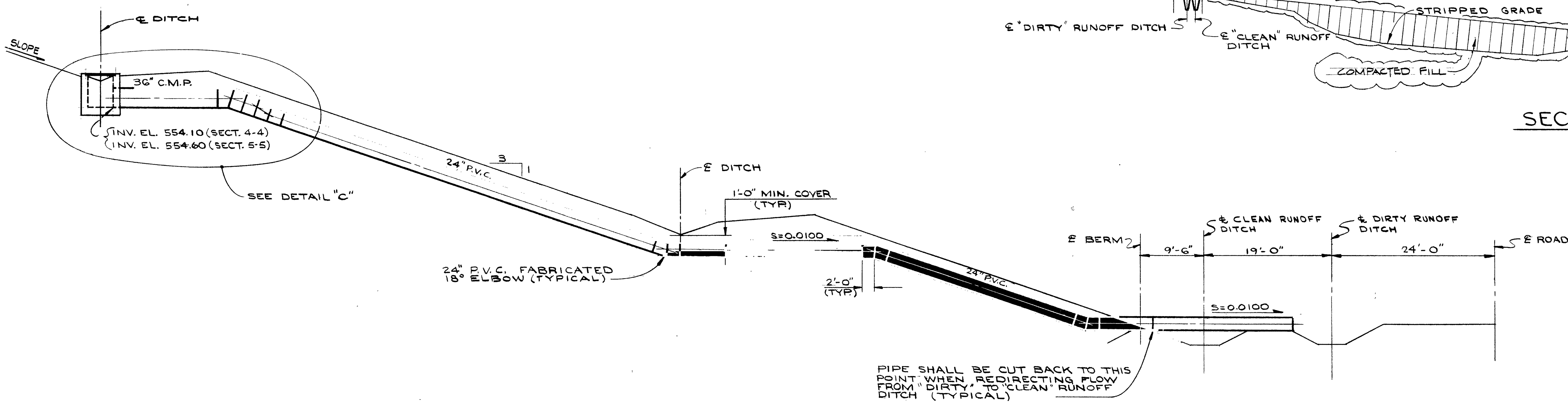
PP&L Letter-Height Drafting Standard: Dwg. No. - 3/8"; Title - 3/16"; Subtitle - 5/32"; Letter figures - 1/8" Min.



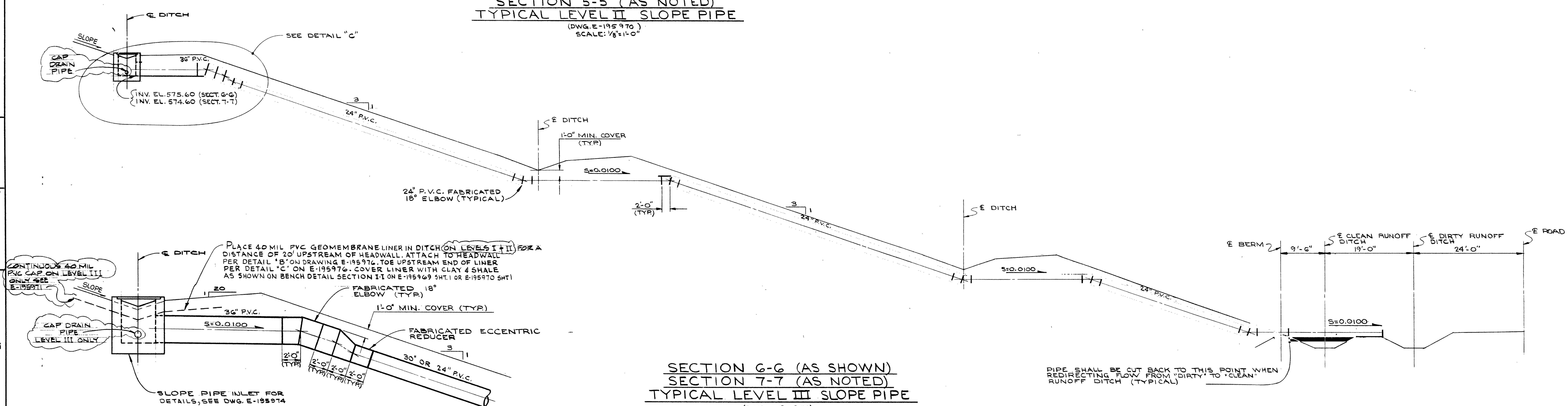
SECTION 2-2 (AS SHOWN)
SECTION 3-3 (AS NOTED)
TYPICAL LEVEL I SLOPE PIPE
(DWG. E-195969)
SCALE: 1/8"=1'-0"



SECTION 8-8
(DWG. E-195971)
NO SCALE



SECTION 4-4 (AS SHOWN)
SECTION 5-5 (AS NOTED)
TYPICAL LEVEL II SLOPE PIPE
(DWG. E-195970)
SCALE: 1/8"=1'-0"



SECTION 6-6 (AS SHOWN)
SECTION 7-7 (AS NOTED)
TYPICAL LEVEL III SLOPE PIPE
(DWG. E-195971)
SCALE: 1/8"=1'-0"

DETAIL "C"
TYPICAL SLOPE PIPE
INSTALLATION WITH INLET

WORK THIS DRAWING WITH E-195965

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER
INTERMEDIATE CELL DEVELOPMENT - LEVEL I	E-195969	DROP INLET, SLOPE PIPE INLET, PRECAST MH'S AND SUMP	E-195974
INTERMEDIATE CELL DEVELOPMENT - LEVEL II	E-195970		
INTERMEDIATE CELL DEVELOPMENT - LEVEL III	E-195971		
BILL OF MATERIAL	A-195980		

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
3	4-18-97	150501	CHGD SECT 8-8, ADDED PIPE TO DET. C & CHGD LINER NOTES	JTE		
2	4-18-96	150501	CHANGED TITLE AND UPDATED DWG	JTE		
1	6-6-86	103069	CHANGED SLOPE PIPE INLET & INVERT ELEV'S.	G.H.C.	A.L.M.	A.L.M.

LOC CODE: H-H70
DESCRIPTION: SLOPE PIPE SECTS. & DETS
SORT: C

W.O. 045155-000
ER-480230
ER-
SCALE- AS NOTED
DATE- 1-19-84
DRAWN- T.E.C.
CHECKED- FAC
LEADER- A.L.M.
APPR'D- WJB
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO.3
INTERMEDIATE CELL DEVELOPMENT - SLOPE PIPE
SECTIONS AND DETAILS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

APPROVED 1/20/84 John R. Stefanik

E-195972-3

APPENDIX B

Design Concept and Operating Plan

(Attachment 1 to Form 1R of PPL 2007)

Attachment 1 to Forms 1R and 12R

SPECIFICATION PPC-2006

DESIGN CONCEPT AND OPERATING PLAN FOR ASH DISPOSAL AREA NO. 3

MONTOUR STEAM ELECTRIC STATION
ASH DISPOSAL AREA NO. 3
ER 103069

PENNSYLVANIA POWER & LIGHT COMPANY
POWER PLANT ADDITIONS ENGINEERING
JANUARY 27, 1984

APPROVED: John A. Stefanik
Responsible Engineer

Revised for Permit Renewal Application	Revision 11 - 3/20/07
Revised per DEP Comments	Revision 10 – 9/12/06
Revised for Residual Waste Permit Minor Modification	Revision 9 – 3/27/06
Revised for Residual Waste Permit Minor Modification	Revision 8 – 7/08/04
Revised for Residual Waste Permit Minor Modification	Revision 7 – 3/31/04
Revised for Application for Residual Waste Disposal Permit Modification	Revision 6 – 2/8/99
	Revision 5 - 4/22/97
	Revision 4 - 6/10/96
	Revision 3 - 9/26/86
	Revision 2 - 4/30/86
	Revision 1 - 5/28/85

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MONTOUR STEAM ELECTRIC STATION
ASH DISPOSAL AREA NO. 3
DESIGN CONCEPT AND OPERATING PLAN

General Operational Concept

Ash Disposal Area No. 3 is an existing captive residual waste disposal facility owned and operated by PPL Montour, LLC. The landfill serves Montour Steam Electric Station, a coal fired electrical generating station located in Derry Township, Montour County Pennsylvania. Ash Area No. 3 went into operation in 1991 to replace Ash Area No. 2 that was filled to capacity. Ash Area No. 3 is a lined landfill that is used primarily for the disposal of fly ash and other coal combustion products generated from burning coal at the plant. Smaller quantities of other plant residual wastes are also approved for disposal in Ash Area 3

Fly ash is collected from the station's electrostatic precipitators and pneumatically conveyed in an above-ground pipeline to two steel storage silos located approximately 3,000 feet to the southeast of the plant site. From the storage silos the fly ash is either removed dry or amended with hydrated lime for beneficial use as stabilized product or for mine reclamation. It is PPL's intent to beneficially use as much ash as possible thereby minimizing the amount that needs to be disposed. Fly ash that is not beneficially used is moistened and trucked to the disposal area, end-dumped and then spread and compacted. Other approved wastes sent to the disposal facility are handled in a similar manner trucked, end-dumped, spread and compacted in the landfill.

Up to 54,000 tons of synthetic gypsum, a co-product of stack gas scrubber operation, may be temporarily stored on-site on Level 2 of the landfill until it can be transported off-site for mine reclamation as defined under a PA General Beneficial Use Permit and other beneficial uses authorized under 25 PA Code Chapter 287. The 54,000 tons represents approximately 15 days of the annual gypsum production total, and will consist of non-conforming material not acceptable as a raw product for wallboard manufacturing.

PPL also plans to dispose of wastewater treatment plant sludge beginning in 2008 after the stack gas scrubber operation begins. At full load capacity it is expected that up 100 tons per day of sludge would be disposed of in Ash Area No.3. The sludge will be a mixture of calcium sulfate solids and precipitated heavy metals from the water treatment plant process.

Design Concept

Site Development

The boundaries of the disposal area were determined by topographic features and structures such as roads and transmission lines. The site is divided into eastern and western segments by a small stream that flows across the site. This stream is now carried in twin four-foot diameter pipes that were installed as part of the site development. These pipes were designed to handle the runoff from a 100-year/24-hour storm event.

The disposal area will have three levels each approximately 25 feet in height with three horizontal to one vertical side slopes. Each level will have a 20-foot-wide bench. The first level covers 50.6 acres and will be divided into four disposal cells of approximately the same size. The A and B disposal cells totaling 28.9 acres are on the east side of the stream enclosure pipes and the C and D disposal cells totaling 21.7 acres are on the west side. At this time only the A and B cells have been developed and used for disposal. The C and D cells will not be developed until the A and B cells have reached their design capacity.

Topsoil is stripped from each cell prior to preparing the subgrade and constructing the liner system. Stripped topsoil is stockpiled at the site for later use in covering the ash pile.

Drainage Blanket and Leachate Underdrain System (Leachate Collection System)

A drainage blanket and leachate underdrain system was constructed at the base of the landfill to collect and remove any water that may enter the pile and reduce its stability. This water comes from rainwater that has infiltrated the pile. The drainage blanket consists of a pervious, compacted layer of bottom ash having a depth of two feet. The underdrain system consists of a network of perforated pipe. The underdrain system discharges directly into the Leachate/Runoff Basin sump. A geotextile filter fabric was placed over the bottom ash to prevent the fly ash from entering and clogging the drainage blanket and underdrain system.

Type of Liner System

Solid and liquid wastes are prevented from contacting the site ground water through the use of impervious liners. A polyvinyl chloride (PVC) geomembrane 30 mils in thickness is placed under the landfill as the cells are developed. The geomembrane is placed over a six-inch layer of bottom ash sand. The sand provides a base free from rocks, rubble and other debris that could puncture the geomembrane. Upon completion of the geomembrane installation, all seams are tested to ensure that they are properly bonded. The geomembrane is protected on the top by a geotextile 110 mils thick. This geotextile protects the PVC geomembrane from being abraded or punctured during placement of the drainage blanket material.

To maintain a minimum four-foot separation between the bottom of the liner and the seasonal high ground water table, a system of stone filled drains and collector pipes was installed to artificially dewater the site by gravity drainage. This system discharges to a small unnamed tributary of Mud Creek that drains the site. Fill was used in selected areas to maintain the required separation where it was not provided by the drains alone. Based on a detailed study of the acid producing potential of the subsurface materials at the site which might be exposed to oxidation as a result of excavating the drains, the discharge from the site dewatering systems does not require treatment.

Additional protection against seepage into ground water is provided by the site soils that are fine grained silt-clay soils. These soils have an in-place permeability ranging from 2 x 10 E-6 to 1 x 10 E-8 cm/sec. The soils vary in thickness from one and one-half feet to six feet. The soils serve as a secondary liner system.

Dirty runoff ditches are lined with concrete or clay. The dirty runoff ditch along the south side of the ash pile was lined with concrete. The ditch in this section receives most of the runoff from the ash pile. Concrete provides the erosion resistance and impermeability required of a liner. It also allows the ditch to be cleaned of fly ash sediment without damaging the integrity of the liner. In most areas the ditches are cut in impervious soils. If they were cut in rock, they were over-excavated and lined with one foot of clay.

Leachate/Runoff Basin

A Leachate/Runoff Basin approximately three acres in size was constructed for the disposal area. All runoff from the active A and B cells, and from intermediate construction activities is directed to the basin for sediment removal as will be construction runoff from the future C and D cells when developed. All leachate collected in the underdrain system is also directed to the basin, but into the basin sump. The Leachate/Runoff Basin has a double liner. A polyvinyl chloride (PVC) geomembrane 30 mils in thickness is the primary liner. It is covered with the silt-clay soils at the site to form a soil liner with a permeability of 1 x 10 E-7 cm/sec or less. The soil liner has a minimum thickness of one foot

The Leachate/Runoff Basin is divided into two sections. The larger portion is designed primarily for sediment removal and control of storm water flows. The smaller section contains the pumping station and sump into which the larger section discharges. A ramp permits excavating equipment to enter the larger section and remove any accumulations of fly ash sediment. The sediment removed from the basin is re-deposited on the ash pile. Runoff and leachate that have entered the Leachate/Runoff Basin is pumped to the Detention Basin at the power plant for treatment in existing wastewater treatment facilities.

Because of the high groundwater table, the Leachate/Runoff Basin has been provided with an underdrain system to draw down the groundwater to below the bottom of the basin. This system consists of a stone drainage blanket with six-inch diameter drainage tubing draining by gravity to the natural stream to the south of the disposal area.

During normal conditions, when the underdrain system is free flowing, there is no uplift pressure on the geomembrane liner because the groundwater is kept below it. During flood events, the groundwater underdrain outlet is submerged by the floodwaters, and the groundwater may rise and exert an upward pressure on the geomembrane. A one-foot depth of water will be maintained in the basin at its lowest point, the polishing pond section, to provide stability (no net uplift pressure) for all flood events up to and including the 100-year flood. The stability calculations did not take advantage of the head provided by storm runoff that would enter the basin.

Hydrologic calculations show that the duration of flood flows for the various frequency events are on the order of six to eight hours. It would take approximately 22 hours to pump the runoff from the two-year frequency storm out of the Leachate/Runoff Basin and 72 hours to pump the runoff from the 100-year storm. This indicates that there will be water in the pond for a lengthy period after the flood waters peak. This head provides additional assurance that there will not be a net uplift on the geomembrane. It also provides time for the underdrain system to draw down the water table to the before-flood elevations.

The Leachate/Runoff Basin slopes are 3 horizontal to 1 vertical. They are stable under both dry and saturated conditions.

Storm Water Handling

To reduce storm water handling requirements, runoff is segregated into "clean" runoff and "dirty" runoff. Clean runoff is runoff from undisturbed areas and from disturbed areas that have been covered with topsoil and revegetated. Dirty runoff is runoff from unvegetated areas (including the stripped subgrade during construction), from the active ash cells on the ash disposal pile, and from inactive cells that have been covered with topsoil and seeded, but on which the vegetation has not yet been established.

Clean and dirty runoff ditches are constructed in parallel around the disposal pile (except between perimeter access road stations 40+00 and 63+00). The dirty runoff ditch is constructed first and intercepts dirty runoff from the ash pile and conveys it to the Leachate/Runoff Basin for treatment. After vegetation has been established on the completed ash cells, a clean runoff ditch is constructed between the pile and the dirty runoff ditch. This ditch intercepts the clean runoff before it enters the dirty runoff ditch and diverts it around the Leachate/Runoff Basin to the natural stream at the south end of the site.

Between perimeter access road stations 40+00 and 63+00, the dirty runoff ditch will be cleaned and then converted to a clean runoff ditch. Clean runoff will be discharged beneath the access road to the inlet end of the stream enclosure. Dirty runoff from the top of the pile will be directed to the south. The working surface of active cells will be sloped at approximately one percent towards dirty runoff ditches at the south end of the ash pile. This will minimize erosion of the ash slopes. Any slope erosion that may occur will be remedied prior to covering with topsoil and seeding. Straw bales will be placed at the toe of the ash pile slopes to prevent excessive sedimentation of the dirty runoff ditch and the runoff basin.

When a cell reaches its 25-foot height, the permanent bench and bench drainage ditch is established by sloping the outer 20 feet of the ash cell away from the edge. The bench and ditch are then covered with shale or some other non-erodable material. The bench drainage ditch intercepts runoff from the top of the pile preventing further erosion of the ash slopes. The outside slopes of the completed cell are then covered with topsoil and seeded. Discharge from the bench drainage ditches is through slope pipes which discharge into either the clean or dirty runoff ditches, as applicable, at the base of the pile. Runoff is considered to be dirty until vegetation is established on the slopes of the cell on the above level. Slope pipes will discharge on concrete splash pads to prevent scouring of the ditch.

The Leachate/Runoff Basin was originally sized to handle the runoff from a 24-hour rainfall of 10-year frequency. The new Residual Waste Management Regulations require that it be designed for the 24-hour rainfall of 25-year frequency. There should be no discharge to the natural stream near the landfill for rainfalls up to this magnitude.

The existing Ash Area 3 storm water handling system design played a major factor in the decision to locate the temporary synthetic gypsum storage pile on top of Level 2. Storm water runoff from the gypsum pile will be handled by the existing dirty runoff conveyance system. Fabric filter silt fence will be placed around the temporary storage piles to contain any gypsum mobilized during storm events. Storm water runoff will enter the existing storm water channels and be conveyed to the Leachate/Runoff Basin. This will eliminate any solids deposition in streams and natural drainage channels outside of the landfill. No additional storm water controls are required to accommodate temporary synthetic gypsum storage.

Borrow Areas

A soil borrow area has been developed on nearby property west of the site to provide soil for final cover and other construction purposes when there is a deficit of suitable on-site soils. The first probable use of the borrow area will be to provide cover soil for side slopes and the top of Level 3 of the A and B cells. When and if construction of the C and D cells is needed, fill material will also be required to bring the subgrade to design elevation. The borrow area will also be the source of some of the final cover material for the C and D cells.

Site Roadways and Access Control

The existing access road from highway LR 414 (PA 876) to the ash storage silo area is an asphalt-paved roadway 20 feet in width. The haul road from the silo area to the Area No. 3 landfill and the leachate/runoff basin is also paved. The haul road is now complete adjacent to the A and B cells and will loop around the entire landfill when the C and D cells are constructed. The road is 22 feet in width and asphalt-paved except for the segment on the west side of the C and D cells. That segment will be a gravel-surfaced road since it will not be used for daily hauling operations but for maintenance access. The road will be approximately 6,900 feet long at completion of which 5,300 feet will be paved and about 1,600 feet will be gravel-surfaced.

The silo area is fenced and gated to prevent access from public highway LR 414. Access to the landfill and leachate/runoff collection basin from the silo area is also controlled via a gate in the silo area fence on the west side. The temporary ends of the loop road around the landfill have also been gated. All gates are padlocked to prevent unauthorized access when the site is unattended.

Grid Markers

Although the loop roadway clearly defines the limits of waste disposal, grid markers and benchmarks have been installed at the landfill. The markers are located near the corners of the loop road and near the ends of the stream enclosure. The markers are labeled with the Montour plant (local) grid coordinates and the elevation of the benchmark based on USGS datum. The grid markers and benchmarks are used to control waste placement and to control facility construction activities.

Buildings and Other Structures

The silos, administration building, maintenance buildings and other facilities needed to support the operation of Ash Area No. 3 existed at the time the landfill was constructed. Located at the ash silo area to the east of the landfill are two 2,500 ton capacity steel silos that store the fly ash until it is unloaded for beneficial use or disposal. Located near the silos are two buildings. The 62 foot x 42 foot building adjacent to the silos, houses the silo auxiliary equipment and silo electrical switchgear. Across the road from this building is the 142 foot x 58 foot crew and maintenance building. This building contains three vehicular bays for storage and maintenance of construction equipment used for waste disposal operations as well as offices and washroom facilities for the disposal contractor and the PPL Ash Site Coordinator. Both buildings are of steel-framed, metal-sided construction.

A scale is located off of the entrance road to the silo area. The scale has a capacity of 60 tons and is used to weigh both the waste sent to the disposal area as well as fly ash and bottom ash that is shipped off-site for beneficial use.

Temporary storage of gypsum on Level 2 requires that the gypsum be diverted from its normal route on the conveyor to the U.S. Gypsum wall board plant. A transfer tower will be constructed at the northern edge of the landfill to direct the gypsum to a stackout conveyor. This stackout conveyor will be about 400 feet long and take the gypsum up to Level 2 of the landfill. Several conveyor support bents and foundations will be located on the landfill slopes and several will be located on Level 2.

The transfer tower will be located just outside of the landfill so that none of its foundations will bear on or penetrate the landfill's PVC liner or leachate collection pipes. The conveyor bent foundations will be founded in the disposed fly ash well above the liner and leachate collection system and will also not have any impact on them.

The conveyor to the wallboard plant will be located just outside of the boundary of Ash Area #3. The conveyor foundations will be outside of the landfill waste area and will not impact the liner or leachate collection system.

The locations of the transfer tower and conveyor to the wallboard plant were dictated by the need to avoid wetlands located just north of the landfill.

Utilities

Potable water and sanitary facilities are available at the silo area for use by the landfill operations contractor.

Construction Sequence Plan

The detailed sequence of construction and ash disposal is shown on Drawing E-195965, Construction Development Sequence Plans. This sequence plan presents the sequential steps to be followed in the construction and operation of the landfill.

This plan is to be worked with the following drawings:

Drawing No.	Title
E-195966, Sht. 1	Preliminary Grading, Stream Diversion, and Roadway - Plan
E-195966, Sht. 2	Leachate and Ground water Underdrain Systems
E-195967	Roadway Profile
E-195968	Preliminary Grading, Stream Diversion, and Roadway - Selections and Details
E-195969	Intermediate Cell Development - Level I
E-195970	Intermediate Cell Development - Level II
E-195971	Intermediate Cell Development - Level III
E-195972	Intermediate Cell Development - Slope Pipe Sections and Details
E-195973	Headwalls - Plan, Sections and Details

Drawing No.	Title
E-195974	Inlets, Manholes and Sump - Plan, Sections and Details
E-195975	Leachate/ Runoff Basin - Enlarged Plan
E-195976	Leachate/ Runoff Basin - Sections and Details
E-195977	Energy Dissipater - Plan, Sections and Details
E-195978	Erosion and Sedimentation Control Plan
E-195979	Isopach of Fill Required
E-195980	Bill of Material
E-195981	List of Reinforcing
E-195982	Geomembrane Liner Installation - Plan and Details
PPC-1990	Ash Disposal Area No. 3 - Erosion and Sedimentation Control Plan Narrative
PPC-2007	Ash Disposal Area No. 3 - Site Development Specification
PPC-2016	Ash Disposal Area No. 3 - Specification for PVC Geomembrane
E-324155	Gypsum Storage Facilities Plan
C-324285	Gypsum Transfer Tower – Cross Section at Landfill and Liner

Waste Type and Quantity

Waste Type and Origin

The predominant waste that would I be disposed of in the landfill is fly ash collected in the precipitators of the Montour Steam Electric Station. Fly ash is collected from the station's electrostatic precipitators and pneumatically conveyed in an above-ground pipeline to two steel storage silos located approximately 3,000 feet to the southeast. From the storage silos the fly ash is either removed dry or amended with hydrated lime for beneficial use as stabilized product or for mine reclamation. Fly ash that is not beneficially used is moistened and trucked to the disposal area, end-dumped and then spread and compacted. PPL Ash Operations staff has beneficially utilized all available fly ash produced by the Montour station since the mid 1990's, and no material has been disposed in Ash Area 3.

Other coal combustion products such as boiler bottom ash and coal mill rejects, and smaller amounts of miscellaneous residual and construction/demolition wastes generated at Montour SES are also approved for disposal in the landfill. This includes wastes such as blasting sand, asbestos cement boards from plant cooling towers, refractory material, and demineralizer resin. Bottom ash and mill rejects generated by the Montour Station are presently sluiced to Ash Basin 1 on the plant site. PPL plans to modify bottom ash and mill rejects handling at Basin No.1 in 2007 and 2008. PPL will begin to dispose of Montour mill rejects in Ash Area No. 3 upon completion of these new handling systems.

The largest waste stream currently disposed in Ash Area 3 is mill rejects trucked to Ash Area 3 from PPL's Brunner Island Steam Electric Station in York County, Pennsylvania. Brunner Island mill rejects were a waste stream listed in PPL's Ash Area 3 Form R approved by the Department with issuance of the Ash Area 3 residual waste permit on March 9, 1998. In 2003, PPL requested approval from the Department to temporarily transport Brunner Island mill rejects to Montour Ash Area 3 for disposal. The Department approved this request on April 16, 2003 subject to PPL's submittal of a minor permit modification request if PPL anticipated continued Brunner mill rejects disposal beyond April 16, 2004. The permit application was submitted and approved by the Department on October 20, 2004.

Brunner Island is in the process of designing a new landfill and expects to submit a permit application to the PADEP Southcentral Office later in 2007. Once the department approves the new landfill at Brunner Island and construction is complete the Brunner Island mill rejects will no longer be disposed at Montour.

Beginning in 2008 Montour anticipates up to 100 tons per day of wastewater treatment plant sludge will be disposed in Ash Area No. 3. The current plans are to transport the sludge to the ash area via a dump trailer or dumpster. PPL will also investigate potential beneficial uses of this material in lieu of disposal.

Synthetic gypsum is a co-product of the power plant flue gas scrubbing operation. Finely ground limestone is mixed with water and sprayed into the power plant flue gas stream. The limestone reacts with the SO_2 in the flue gas to form calcium sulfite ($CaSO_3$), which falls into a reaction tank at the bottom of the scrubber absorber vessel. Oxygen is bubbled through the calcium sulfite forming calcium sulfate ($CaSO_4$) or gypsum. Gypsum is the primary component of wall board. The gypsum is removed from the absorber, dewatered and sent to an adjacent plant via conveyor for the manufacture of wall board. Off-specification gypsum will be temporarily stored on Ash Area No. 3 Level 2 until it can be hauled off site for mine reclamation or other use.

A complete listing of the wastes expected to be disposed of at the landfill can be found in the Form R, Waste Analysis and Classification Plan, submitted with the residual waste permit application. No reactive, unstable, or combustible materials will be disposed of in the landfill.

Waste Composition

Fly ash would be the predominant waste stream for the landfill if beneficial ash use programs were suspended. Fly ash consists primarily of metal oxides such as silica (SiO_2), alumina (Al_2O_3), iron oxide (Fe_2O_3), calcium oxide or lime (CaO), and magnesium oxide (MgO), along with other minor constituents such as potassium oxide (K_2O), sodium oxide (Na_2O), manganese dioxide (MnO_2), sulfur trioxide (SO_3), and unburned carbon. The iron and aluminum oxides and manganese dioxide have high affinities for many trace metals. The specific composition of the fly ash depends upon the type of coal being burned at the plant.

Brunner Island and Montour mill rejects are comprised largely of mineral rich rock containing the normal compliment of elements dominated by silicon, aluminum and iron. This material is ejected during the coal milling process to protect equipment and avoid reductions in the BTU content of boiler fuel. Leachate produced by fresh mill rejects is benign with metals content well below hazardous or problem concentrations. Oxidized mill rejects produce a leachate rich in iron and manganese oxides, and minimizing oxidation of mill rejects is a key aspect of managing this waste material.

Wastewater treatment plant sludge is generated during the metals treatment of the Flue Gas Absorber Gypsum dewatering process. The wastewater is treated by standard metals precipitation process and the solids generated from this process is blowdown to a filter press which dewaters the sludge to allow for transportation to Ash Area No. 3 for disposal.

A complete listing and composition of the wastes expected to be sent to Ash Area 3 is included in the facility Form R, Waste Analysis and Classification Plan.

Waste Quantities

The predominant Ash Area 3 waste would be fly ash if PPL cannot utilize this material beneficially. Montour's recent fly ash production has ranged between 270,000 and 345,000 tons per year. The average amount of ash disposed prior to full initiation of beneficial ash use programs had been approximately 225,000 tons per year. What determines annual production is the amount of ash in the coal, the amount of coal burned, and the amount ash used beneficially. The other potential large volume waste streams are bottom ash and coal mill rejects. Montour SES produces over 100,000 tons of bottom ash per year. All bottom ash sluiced to Basin 1 is now sold and none is sent to Ash Area No. 3, however, the potential exists for disposal.

Montour produces an estimated 3,000 tons of coal mill rejects yearly and expects to begin disposing of this material in Ash Area No.3 in 2007 or 2008 upon completion of the new handling system planned at Ash Basin No.1 along with an estimated 3,000 tons of mill rejects from PPL's Brunner Island Station.

Sludge produced by the scrubber wastewater treatment plant is estimated to be as much as 100 tons per day when the generating units are operating at maximum load. The scrubbers and treatment plant are expected to begin operation in early 2008.

Up to 54,000 tons of synthetic gypsum may be temporarily stored for off-site transport for mine reclamation or, in some situations, possible transfer to the wall board plant. The 54,000 tons represents approximately 15 days of the annual gypsum production total and consists primarily of non-conforming material not acceptable as a raw product for wallboard manufacturing. This is the probable maximum amount of non-conforming product expected to be produced each year and the actual amount is anticipated to be significantly less.

Proposed Capacity of Landfill

Ash Area No. 3 capacity was determined by cross-sectioning the landfill and performing volume calculations. The capacities of the various cells and levels are as follows:

	A and B Cells	C and D Cells
Level 1	536,628 CY	724,696 CY
Level 2	590,286 CY	737,016 CY
Level 3	330,794 CY	636,293 CY
Total	1,457,708 CY	2,098,005 CY

Total Landfill 3,555,713 CY

The landfill has been in operation since February 1991 and some of the capacity has been expended. In the A and B Cells, Level 1 and part of Level 2 have been filled. Approximately 1,061,000 tons or 756,000 cubic yards of capacity have been used through the end of 2005.

Total Landfill	3,555,713 CY	
Capacity Used	756,000 CY	
Remaining	2,767,713 CY	as of 12/05

Expected Life of Facility

The expected lives of the various cells and levels are shown below. The calculations assumed a fly ash density of 91 pounds per cubic foot and an average disposal rate of 225,000 tons per year at 15 percent moisture content or about 160,000 cubic yards per year. The fly ash disposal rate is very dependent on beneficial use demand in addition to the amount of coal burned and the ash content of the coal.

	A and B Cells	C and D Cells
Level 1	40 Months	54 Months
Level 2	44 Months	55 Months
Level 3	25 Months	48 Months
Total	109 Months	157 Months

Total Landfill 266 Months or 22 Years and 2 Months (assuming no beneficial use of fly ash)

Approximately 756,000 cubic yards of capacity have been used through the end of 2005. Only Level 1 of the A and B Cells has been completely filled. Approximately 50% of Level 2 capacity has been used.

The most recent capacity report (for 2005 report year) lists a remaining capacity of 3,928,000 tons and an indefinite remaining life because of the small, actual annual disposal volumes.

The synthetic gypsum temporary storage facilities will not impact the disposal of wastes from PPL generating station operations because the area that will be utilized is inactive and not needed for the small volume of wastes being disposed of in the landfill.

If approved for disposal starting in 2008 and if beneficial use of the fly ash continues, wastewater treatment plant sludge will be the largest waste stream (up to 36,000 cubic yards per year) taken to Ash Area No. 3. This annual disposal volume will accelerate the filling of the A and B cells over current rates but the total volume of all wastes will only be about 25% of the originally expected fly ash disposal rate. Level 2 may be filled within 8 years. Level 3 disposal will then have to be reconfigured so that the necessary area is still reserved for the temporary storage of gypsum while providing for continued disposal of approved wastes in the A and B Cells.

Waste Disposal Operations

Operating Plan

The disposal operation will be of the controlled-fill type. Moistened fly ash and other approved wastes will be trucked to the cell and end-dumped. The cell development sequence is as depicted on Development Sequence Plan drawing E-195965. The waste is spread by a bulldozer in one-foot loose layers, and then compacted by a smooth-wheel vibratory roller. The fly ash is delivered to the site at or as near the optimum water content as possible for thorough compaction. Compaction is a minimum of 90 percent of Modified Proctor (ASTM D1557) maximum density. If this value proves to be unfeasible due to variability of the ash, moisture content or poor weather, it is reviewed by the PPL Disposal Site Coordinator and adjusted as necessary; however, as a minimum, four passes of the vibratory roller is required. The ash is spread and compacted as soon after delivery to the landfill as possible. All unnecessary traffic will be kept off finished fly ash surfaces that are completed to final or temporary grade. The outside slopes of each level are covered with soil and seeded as the landfill height increases. The top of Level 3 will be covered with soil and seeded when it reaches design elevation.

The leachate underdrain system will be checked for blockage prior to the start of fill operations and when the compacted fly ash fill reaches a height of three feet. If any blockages are encountered, they shall be cleared/repaired before the disposal of ash continues. This check is made so that blockages are detected before the height of waste over the drains becomes too large to allow correction.

Montour Ash Area 3 receives up to 110 tons per week (five truckloads) of Brunner Island mill rejects with the average being around 60 tons per week. A similar amount of Montour mill rejects is expected to be disposed of in Ash Area No. 3 beginning in late 2007 or 2008. Trucks transporting mill rejects are tarped to minimize oxidation of mill rejects during transport to Montour. Trucks arriving at Ash Area 3 are weighed, and the rejects dumped into specially prepared sites atop level 2 in cells A and B. The mill rejects are spread, and immediately covered with a layer of lime amended fly ash. This seals the mill rejects in lime amended fly ash at the bottom, top and sides eliminating oxidation and providing a lime- rich environment to mitigate any acidic leachate produced by oxidized mill rejects.

Montour Ash Area No. 3 will also begin to receive up to 100 tons per day of wastewater treatment sludge in 2008. Trucks will transport the sludge by tarped dumpster or dump trailer. Trucks arriving at Ash Area 3 are weighed, and the waste sludge will be dumped into prepared cells similar to the proposed methods to handle the disposal of fly ash. The same procedure will be followed as depicted on Development Sequence Plan drawing E-195965. If changes are required PPL will make the appropriate changes and update the 1R and 12R plan.

Active areas of the landfill will be kept as small as possible in order to minimize infiltration of rainfall, limit erosion and prevent dusting problems. In order to prevent storm water ponding, the surface of wastes placed in a disposal cell will be graded to provide positive drainage of storm runoff toward the landfill perimeter where the runoff can be collected by the bench drainage ditches. Particular attention will be given to wastes placed against interior slopes to ensure that water is not trapped against the slope. As described in the Design Concept, the "dirty" runoff from active disposal cells and any other unvegetated area flows to the landfill's Leachate/Runoff basin for sediment removal. From this basin it is then pumped to the power plant's wastewater treatment basin where it is combined with other plant wastewater and treated. If any temporary storm water handling measure is required at an active cell and not shown on the design plans, such as installing a temporary culvert pipe, the Department will be contacted before the measure is implemented.

The active area is outlined on the most recent annual mapping drawing (currently drawing E-324263, 2006 Topographic Mapping). Areas of the landfill that are expected to be inactive for more than six months will have intermediate soil cover placed over it and then be vegetated with the seed mixture approved in the permit.

A portion of the active area will include an area that will be reserved for temporary storage of Stabil-Fill™. This area is also identified on the latest mapping drawing. Stabil-Fill is fly ash that has had a small percentage of lime added to bring the pH of the fly ash within the limits required for disposal and for beneficial use. Stabil-Fill from overloaded trucks will be off-loaded to bring the trucks under the maximum allowable highway gross vehicle weight. Also, when Stabil-Fill intended for offsite beneficial use cannot be hauled to the jobsite because of inclement weather, it will be stockpiled in this temporary storage area. When the weather conditions improve, the Stabil-Fill will be reloaded onto the trucks and hauled off site. In the case of material removed from overloaded trucks, the stockpiled Stabil-Fill will be reloaded onto trucks and hauled off site approximately every two weeks. The total amount of material in temporary storage due to inclement weather will not exceed 2,000 tons and material removed from overloaded trucks will not accumulate above 1,000 tons before it is removed.

Typically, gypsum is conveyed directly from the Montour SES generating units to the U.S. Gypsum manufacturing facility via conveyor. Should testing indicate production of off-specification gypsum unsuitable for wallboard manufacture, the non-conforming material will be directed via a special stackout conveyor to Ash Area 3 Level 2 for off-loading onto a temporary gypsum storage stockpile. A conical pile at the end of the stackout conveyor will accommodate 18,000 tons of gypsum. If a larger quantity of gypsum has to be stockpiled, it will be removed from the conical pile and placed in an adjacent pile. Up to 36,000 tons of gypsum will be placed in this adjacent pile.

For mine reclamation use the gypsum must be blended with lime-amended fly ash. This blending will not take place at Ash Area 3 but at the mine site.

The existing temporary access road to Level 2 (see drawing E324155) will be used to get to the gypsum storage area from the perimeter road.

Temporary access roads are required on the landfill to get the waste from the main landfill entrance point to the active disposal cell. The roads are constructed of coarse, broken shale and segments are abandoned in place when the disposal cell is filled. To prevent leachate from using the more permeable shale as a conduit and breaking out on the slope, all portions of a temporary road within 20 feet of the landfill perimeter will be removed and replaced with compacted, fine-grained Stabil-Fill when it is abandoned. Additionally, an 8'-10' length of an abandoned segment will be removed every 150 feet along its length for its full depth and replaced with compacted Stabil-Fill to interrupt potential seepage flow paths.

Vegetation test plots were established on the landfill at two inactive areas in late 1999. They are identified on the annual topographic mapping drawing. There are plots located on the Level 2 plateau and on an interior slope. These locations are representative of the final plateau and side slopes of the landfill. An evaluation of the vegetative growth on the plots will be made and submitted to the Department. These test plots will remain in place until the plot area is needed for disposal operations or for temporary gypsum storage. At that time the vegetation will be stripped and the soil will be removed and stockpiled for use as cover material. Any synthetic liner and underdrain pipe that was included in the test plot construction will be removed. The surface of the exposed waste will be tracked by disposal equipment before new waste is placed in order to provide a bonding surface.

For gypsum storage the fly ash surface does not need to be tracked after removal of the intermediate cover since a bonding surface is not required. When the gypsum stockpile is removed, the intermediate soil cover will be replaced and vegetation will be re-established.

No salvage of ash placed in the landfill is anticipated at this time.

Sequence and Timing of Solid Waste Disposal Operations

The cell development sequence is as depicted on Development Sequence Plan drawing E-195965. This sequence plan presents the steps to be followed in the construction and operation of the landfill.

Disposal of fly ash is on-going and usually is done three to five days per week. Montour's historical fly ash production is between 270,000 and 345,000 tons per year. What regulates this is the amount of ash in the coal, the amount of coal burned and ash used beneficially. The average amount of ash disposed prior to full initiation of beneficial ash use programs has been approximately 225,000 tons per year. Fly ash is stored in the steel storage silos when ash disposal operations do not occur, including over weekends and on holidays, with disposal operations continuing on the next workday.

Ash disposal Area No. 3 is a captive facility. It accepts only approved wastes produced by PPL Montour or other PPL facilities and none from other generators. Hence there is no need to post hours of operation.

Temporary gypsum storage will be required only when the material does not conform to the requirements for commercial wallboard. This may occur on initial start-up of the stack gas scrubber units or during scrubber malfunction. Overall it is expected to be an infrequent occurrence.

Disposal of wastewater treatment plant sludge will also be a daily occurrence. Trucks will transport the sludge from the plant area by tarped dumpster or dump trailer.

Disposal Operation Equipment

The following equipment is used in the disposal operations:

- Dual-axle dump trucks, 25-ton capacity, to haul ash from the silos to the disposal area.
- Rubber-tired bulldozer, Caterpillar Model 824B or equal, to spread the dumped ash in loose lifts of one-foot maximum thickness prior to compaction.
- Vibratory smooth-wheel roller, 20-ton applied force, Hyster Model C625B or equal, to compact the fly ash to the maximum practicable density.
- Truck-mounted hydroseeder, 2,500 gallon capacity, with long-distance and fan-type nozzles, and front and rear water bars. The hydroseeder will be used to spray the compacted ash with water or a dust suppressant in order to minimize dusting and to seed the completed ash cells once they are covered with topsoil.

For emergencies, pumps, generators, backhoes, bulldozers, and other earthmoving equipment are located at the PPL construction crew quarters at Strawberry Ridge or are readily available through other PPL construction offices. Maintenance procedures for all equipment will follow the manufacturer's recommendations. Because of the type of wastes being disposed there are no possible emergencies which would require equipment decontamination and, therefore, no decontamination equipment is necessary.

Erosion and Sedimentation Control

As explained in detail above and on Drawing E-195978, the following measures will be taken to limit erosion and sedimentation:

- All runoff from unvegetated areas will be directed to the Leachate/Runoff Basin for sediment removal.
- Straw bales will be placed at the toe of bare ash slopes if necessary to intercept fly ash and prevent excessive sedimentation of the dirty runoff ditch and runoff basin.
- Immediately after completion of a cell, all outside slopes will be covered with topsoil and seeded.
- Ditches will be grassed or lined with concrete, or other nonerodible material where required by hydraulic or field conditions.
- Discharge from bench drainage ditches to the runoff ditches at the base of the pile will be through slope pipes to prevent erosion of slopes. Discharge will be on splash pads to prevent scour.
- Development of the disposal area on a level-by-level and cell-by-cell basis will minimize the exposed areas to as small an area as possible.
- The top of the final level of ash cells will be covered with topsoil and seeded to completely restore the site to environmentally acceptable conditions.

Fabric filter silt fence will be placed around all temporary gypsum storage stockpiles.

Dust Control

The conditioned fly ash, which will have a water content of 14 to 25 percent, is hauled in 25-ton dump trucks a maximum of 3,000 feet from the storage silos to the disposal area. There it is deposited and spread by a bulldozer in one-foot layers and compacted by a 20-ton vibratory roller to 90 percent of its maximum density. Compared to loose disposal methods, compaction of the ash in the disposal area will greatly reduce the amount of dusting. The smooth, tight surface of the fill produced by the smooth-wheel roller greatly reduces any dusting potential. Further, the fly ash is spread and compacted as soon after delivery to the landfill as possible. No uncompacted ash surfaces are permitted. All ash surfaces in the active cells will be rolled smooth by the end of each day's operation and only necessary traffic is permitted on any unprotected ash surfaces.

When the cell height is 75 feet, the top surface will be covered with topsoil and seeded. An active cell area is expected to be four to five acres. Fly ash surfaces, which are completed, but not to final grade, are sprayed with a dust control agent or covered with bottom ash if the ash surface is disturbed or begins to dust.

The roadways comprising the access and haul roads and silo area consist of approximately 6,300 feet of paved roads and 1,600 feet of gravel-surfaced roads. The paved roads are used most frequently. Dust is controlled in these areas and in the disposal area by cleaning, watering, application of dust control agents, and dust removal. By the end of each workday the areas are clean and free of ash. The dust control equipment, which is intended to be able to perform under all weather conditions, is dedicated to the disposal area and is available for emergency dust control. This equipment consists of:

- A 2,500 gallon truck-mounted hydroseeder equipped with a top-mounted spray gun with long-distance and fan-type nozzles, front and rear mounted water bars controlled from the cab, and a hose and remote nozzle. The pump capacity will be 175 gpm at 100 psi.

A truck wash station at the silo unloading area is used as necessary to wash trucks being loaded with ash. The silo unloading and disposal areas are checked periodically throughout the day. Under emergency (windy) conditions the site coordinator has someone on call at all times, will be notified and will take all measures necessary to control fugitive dusting.

The operation of the disposal area as planned minimizes fugitive dusting.

Dusting from the temporary storage of synthetic gypsum will also be controlled during short-term storage and handling. The gypsum will contain substantial moisture. A moisture content of 10% is the target for synthetic gypsum destined for wallboard manufacture. This moisture content should be sufficient to prevent dusting of materials during the short-term storage period. However, if dusting would still become a problem, the 2,500 gallon capacity truck mounted hydro-seeder equipped with a top-mounted spray gun, and front and rear mounted water bars will be used to wet down the pile as needed. PPL Ash Operations staff will examine the gypsum stockpiles to be sure the material is sufficiently wetted to avoid fugitive dusting. The access drive to the gypsum storage and blending area will also be wetted to minimize dusting.

Litter Control

There is no litter associated with facility as it predominantly processes coal combustion wastes.

Traffic Control

Most of the residual waste placed in the landfill is hauled over private roads constructed from the storage silo area. Public roads will not be affected. The roadway width is 22 feet, which permits two way traffic flow to and from the landfill.

Sales of fly ash from Ash Area No. 3 and bottom ash from Ash Basin No. 1 or the trucking of Stabil-Fill for beneficial use may generate traffic on the order of 50 trucks per day. Trucking required to haul synthetic gypsum from the temporary storage stockpiles on Level 2 will increase total traffic by approximately 15% assuming that the maximum quantity of 54,000 tons of gypsum is in the storage stockpiles. Nearly all of this traffic will leave the silo area where it is weighed, proceed west on T-414, south on the Washingtonville bypass road (LR 47015), west on PA 254, and south on PA 54. The intent is to reduce the traffic through the local community to the minimum practicable.

Traffic will also be generated during construction of the C and D cells and especially for the drainage blanket construction when bottom ash is hauled from the plant's Ash Basin No. 1 to the landfill. This traffic is estimated to be on the order of 60 trips per day for several weeks for each of the cells. This traffic will be generated only during the drainage blanket construction for the landfill. It is not expected to impact significantly on the disposal operation or on the local community.

Safety

No reactive, unstable, or combustible materials will be disposed of in the landfill. All chemical reagents for the treatment of the leachate will be stored and fed at the power plant and not at the landfill.

The contractor responsible for the disposal operations is familiar with the operation of the heavy equipment required in the daily operations. The compacted fly ash will provide stable surfaces for the equipment. Embankment slopes are relatively flat.

All equipment and buildings will be equipped with functional fire extinguishers.

Should an accident occur at the landfill, trained personnel capable of administering first aid are available at the power plant.

Records

A daily log of all ash placed in the disposal area is kept by the ash disposal contractor. A daily log of all dry ash sales activity is also kept. The logs are given to the PPL Disposal Site Coordinator at the end of each day's operation.

A topographic survey of the landfill is also made annually. The purpose is to reconcile the volume of wastes placed in the landfill with the tonnage figures from the daily logs and to verify that the residual wastes are being placed in the landfill in accordance with the design drawings.

Communications

A telephone is available at the storage silo area for external communications. The power plant public address system has been extended to the silo area for internal communications with plant personnel. The landfill's emergency response plan lists the telephone numbers of agencies to be contacted in an emergency.

Employee Training Program

A general environmental education and training program is in place at the Montour SES for all plant personnel. In addition to this program, the contractor responsible for operation of the disposal site is familiar with the safety practices required for that operation and instructs his employees in those procedures. The PPL Site Coordinator is responsible for providing the contractor with specific instructions designed to insure that all environmental concerns are adequately addressed.

Post-Closure Use of Land and Structures and Site Maintenance

PPL discussed the post-closure use of the land with the PA Department of Agriculture. This has led to a decision to return the land to no-till agricultural production. The Department has recommended that warm season grasses, switchgrass in particular, be grown on the landfill. This use will accomplish two things: it will mitigate the loss of farmland that resulted from the construction of the facility and the switchgrass will provide small game habitat desired by the Game Commission. Only the top of the final lift will be farmed. The side slopes of the landfill are too steep for agriculture and will be open space. Agriculture will be no-till to avoid the possibility of damaging the cap and cap drainage layer.

All ash surfaces will have a topsoil and vegetative cover. This runoff from the site will be discharged to the stream via the clean runoff ditches, while all leachate will continue to be directed to the sump and then pumped to the power plant for treatment. The Leachate/Runoff Basin and the remaining dirty runoff ditches will be filled in, topsoiled, and seeded.

The landfill will require little maintenance after closure; however, inspections of the completed fill will be made and the necessary maintenance performed. The landfill inspections will be covered under an existing formalized inspection program. Inspections will be performed twice per year by qualified personnel. They will also be made after unusually heavy rainfalls. The top of the pile and slopes will be inspected for sinkholes, erosion, cracking, slumping, sliding and the condition of the vegetation. Drainage ditches and culverts will be checked for erosion, pipe blockages, sediment and other debris. The leachate collection system and cap drainage layer system will be checked to make sure that they are functioning. The leachate pumps will be inspected to ensure that they are in operating condition.

It is not known if Ash Area No. 3 will last the life of the Montour Steam Electric Station. If it does not, the fly ash silos, silo area buildings and the weigh scale will remain as part of ash disposal operations supporting a future waste disposal landfill site. This future landfill may be on adjacent power plant property or may be at an off site location. If it does last the life of the power plant, the silos, buildings and scale will be demolished along with the other power plant structures.

Site roadways will remain indefinitely to provide access to the landfill and the leachate pumping facility for maintenance purposes. The leachate pumping system will remain in place and be maintained until leachate quality improves to the point where it can be discharged directly from the landfill without treatment and agency approval is obtained to do so.

APPENDIX C

Design Calculations

(Attachment 1 to Form I of PPL 2007)

Cat. #973401

Dept. ______ Date 1/5 1984 Designed by JAS Approved by ______ REVISED 5/96 FOR Q_{25}	PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET PROJECT Montour Ash Area #3 Expansion (AREA NO. 3)	ER No. 480238 Sht. No. 1 of 2

Site Runoff - Before + After Development

Before Development - Ref: SCS Engrg Field Manual

44 acres Class C soils, row crops, straight row: CN = 88
17 acres Class D soils, meadow: CN = 78
2 % slopes

Weighted CN: $\frac{44(88) + 17(78)}{61} \approx 85$

design storm: 10 yr - 24 hr $i = 4.50"$
25 YR - 24 HR $i_{25} = 5.00"$

$Q_{10} = 135$ cfs flat slopes (1 %) $Q_{25} = 150$ CFS
$Q_{10} = 185$ cfs moderate slopes (4 %) $Q_{25} = 220$ CFS

from SCS Fig 2-1

$Q_{10} = \underline{160}$ cfs for 2 % slopes $Q_{25} = 178$ CFS

runoff am't = $\frac{2.92"}{12''/ft} \times 61$ acres $\times 43,560$ ft²/ac $= 646,575$ ft³
FOR Q_{25} = $\frac{3.37}{12} \times 61 \times 43,560 = 746,217$ FT³

After Development

Ash pile - 50 acres
23.8 acres, 33 % slopes, vegetated CN = 78
26.2 acres, 1 % slopes, vegetated CN = 78

Roads + runoff ditches
4 acres clean, 1 % slopes CN = 90
4 acres dirty, 1 % slopes CN = 90
3 acres road, 1 % slopes, CN = 92

Weighted CN: $\frac{50(78) + 8(90) + 3(92)}{61} = 80.26 \rightarrow 80$

Weighted slope = $\frac{23.8(33) + 37.2(1)}{61} = 13.5$ %

PP&L Form 2454 (9-79)
Cat. # 973401

Dept. ______ **PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET** ER No. 480230

Date 1/5 1984

Designed by JAS PROJECT Montour SES Sht. No. 2 of 2

Approved by

Ash Area #2 Expansion

REVISED 5/86 FOR Q_{25} (AREA NO. 3)

25 YR - 24 HR $i_{25} = 5.00"$

design storm : 10 yr - 24 hr $i = 4.50"$

$Q_{25} = 165$ CFS $Q_{10} = 135$ cfs moderate slopes (4%)

$Q_{25} = 210$ CFS $Q_{10} = 175$ cfs steep slopes (16%)

from SCS Fig 2-1

$Q_{25} = 205$ $Q_{10} = \underline{170}$ cfs for 13.5% slopes

runoff amt = $\frac{2.46"}{12} \times 61$ acres $\times 43{,}560$ ft³/ac $= 544{,}717$ ft³

FOR Q_{25} $= \frac{2.89"}{12} \times 61 \times 43{,}560 = 639{,}932$ FT³

Change in runoff rate (peak)

205 CFS - 178 CFS = 27 CFS INCREASE FOR Q_{25}

170 cfs - 160 cfs = +10 cfs <u>increase</u>

$\frac{10}{160} \times 100 = +6.25\%$

$\frac{27}{178} \times 100 = +15.17\%$ FOR Q_{25}

Change in runoff amount

FOR Q_{25} 639,932 ft³ - 746,219 FT³ = -106,287 FT³ DECREASE

544,717 ft³ - 646,575 ft³ = -101,858 ft³ <u>decrease</u>

$\frac{101{,}858 \text{ ft}^3}{646{,}575 \text{ ft}^3} \times 100 = -15.75\%$

$\frac{106{,}287 \text{ FT}^3}{746{,}219 \text{ FT}^3} \times 100 = -14.24\%$ FOR Q_{25}

The 10 cfs increase in peak runoff rate is judged to be too small to have any effect downstream.

FOR THE 25 YEAR STORM, THE PEAK RUNOFF RATE INCREASE IS 27 CFS. Q_{25} FOR MUD CREEK JUST DOWNSTREAM FROM ASH AREA NO. 3 AT THE LR 47015 BRIDGE IS APPROXIMATELY 3,100* CFS. ASSUMING SIMULTANEOUS PEAKS:

$\frac{27 \text{ CFS}}{3{,}100 \text{ CFS}} \times 100 = 0.87\%$ INCREASE IN FLOW JUDGED TO BE NEGLIGIBLE

* MUD CREEK FREQ-DISCHARGE

2a/2

10 year storm
i = 4.5 in
A = 61 acres
undeveloped : CN = 85, S = 2%
developed : CN = 80, S = 13.5%

25 YEAR
i_{25} = 5.0 IN.

Q_{25} = 178 CFS UNDEVELOPED
Q_{10} = 160 cfs undeveloped
Q_{25} = 205 CFS DEVELOPED
Q_{10} = 170 cfs developed

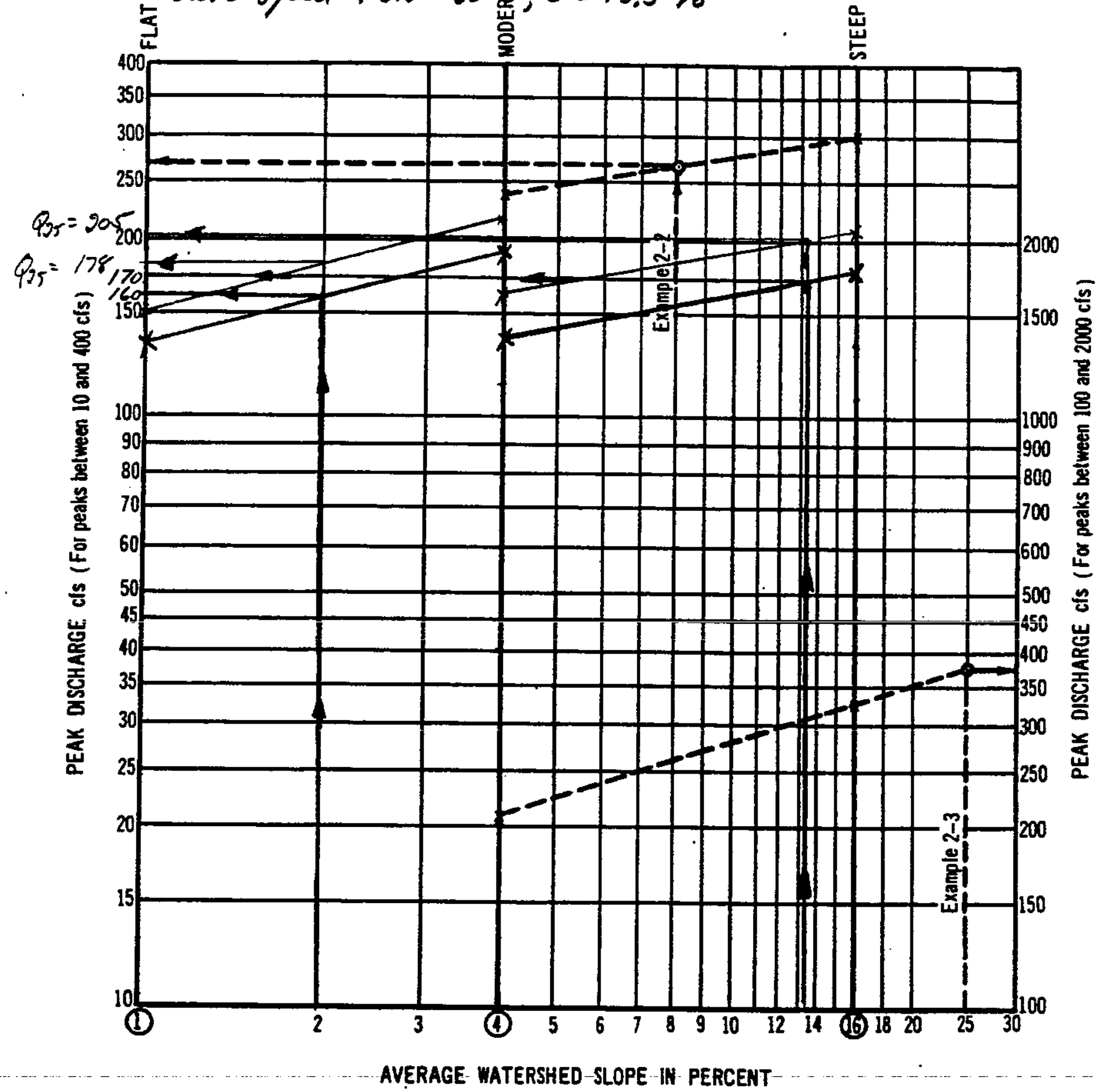


Figure 2-1.--Examples of interpolating peak discharge for average watershed slopes between and greater than Flat, Moderate, and Steep

2b/2

PEAK RATES OF DISCHARGE FOR SMALL WATERSHEDS
TYPE II STORM DISTRIBUTION

10 yr storm
i = 4.5 in
A = 61 acre undeveloped
Q_{10} = 135 cfs - flat slopes
Q_{25} = 150 CFS

25 YEAR STORM
i = 5.0. IN

SLOPES - FLAT
CURVE NUMBER - 85

24 HOUR RAINFALL FROM US WB TP-40

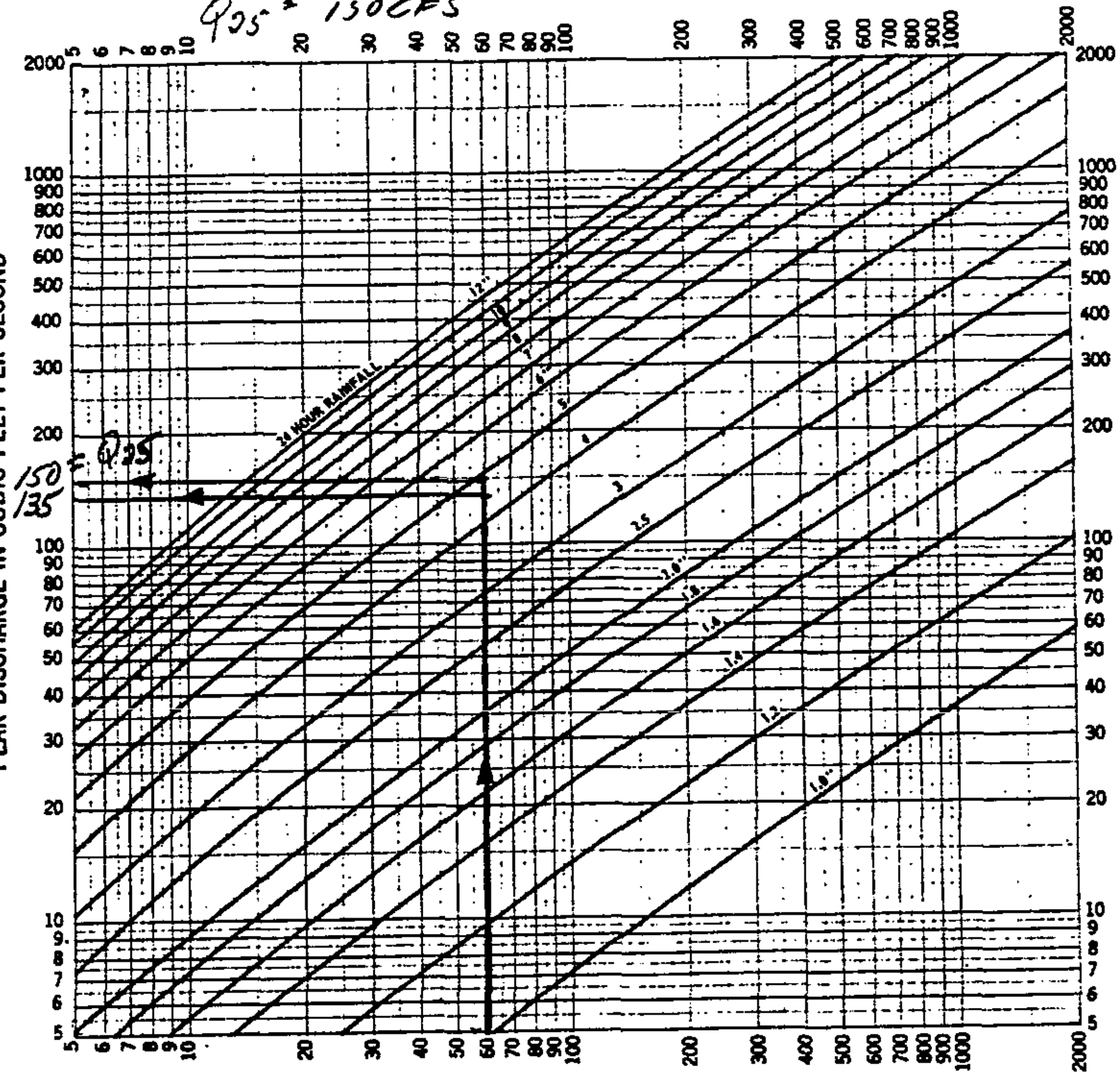


Exhibit 2-9

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - HYDROLOGY BRANCH	STANDARD DWG. NO. ES- 1027 SHEET 6 OF 21 DATE 4-1-66

2a/o

PEAK RATES OF DISCHARGE FOR SMALL WATERSHEDS
TYPE II STORM DISTRIBUTION

10 yr storm — 25 YEAR STORM

i = 4.5 in — i = 5.0 IN.

A = 61 acres undeveloped

Q_{10} = 185 cfs - moderate slopes

Q_{25} = 220 CFS

SLOPES – MODERATE

CURVE NUMBER – 85

24 HOUR RAINFALL FROM US WB TP-40

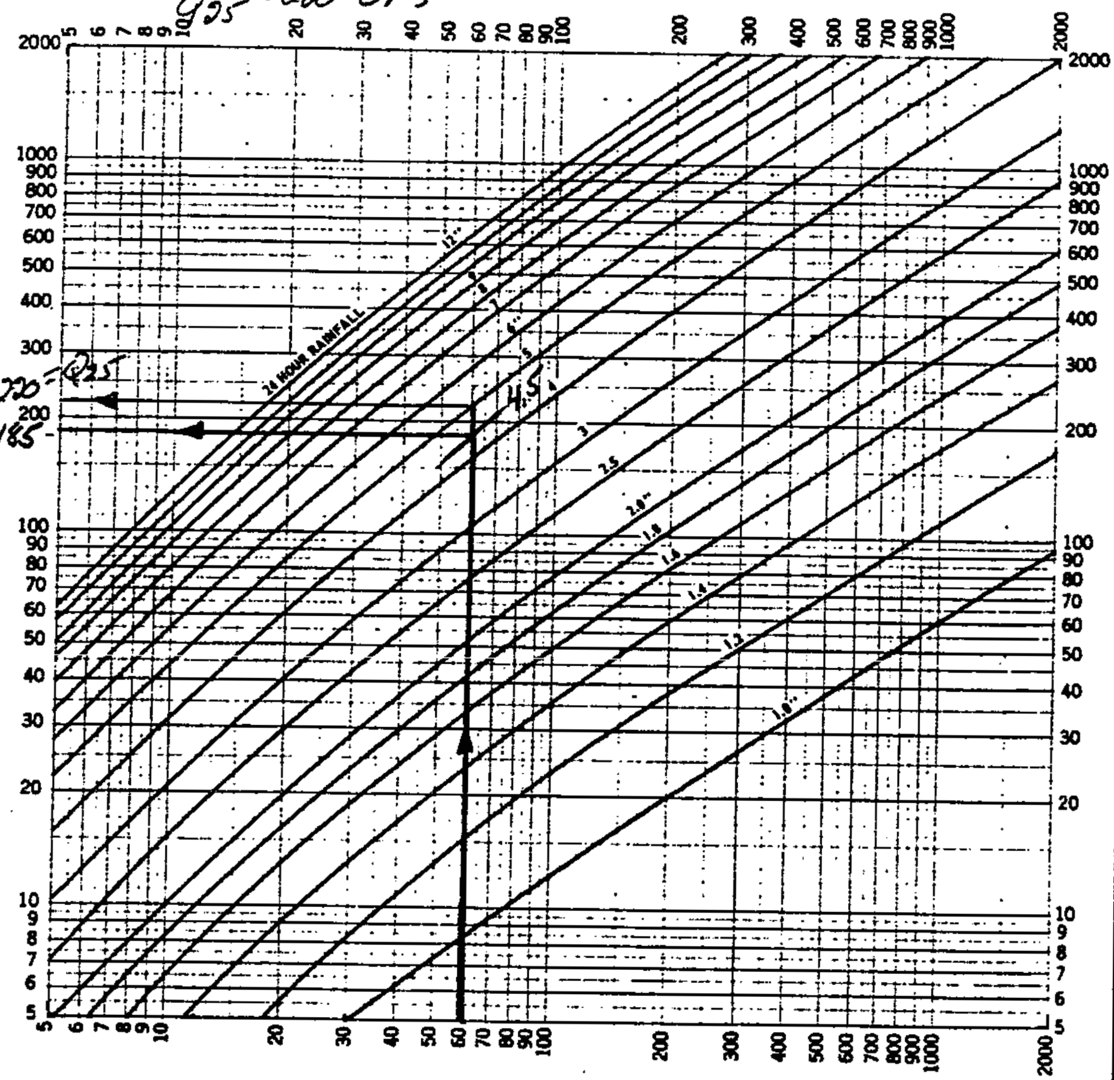


Exhibit 2-9

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - HYDROLOGY BRANCH	STANDARD DWG. NO. ES- 1027 SHEET 13 OF 21 DATE 4-1-66

2d/2

PEAK RATES OF DISCHARGE FOR SMALL WATERSHEDS
TYPE II STORM DISTRIBUTION

10 yr storm 25 YEAR STORM
i = 4.5 in i = 5.0 IN.
A = 61 acres developed
Q_{10} = 135 cfs - moderate slopes
Q_{25} = 165 CFS

SLOPES - MODERATE
CURVE NUMBER - 80

24 HOUR RAINFALL FROM US WB TP-40

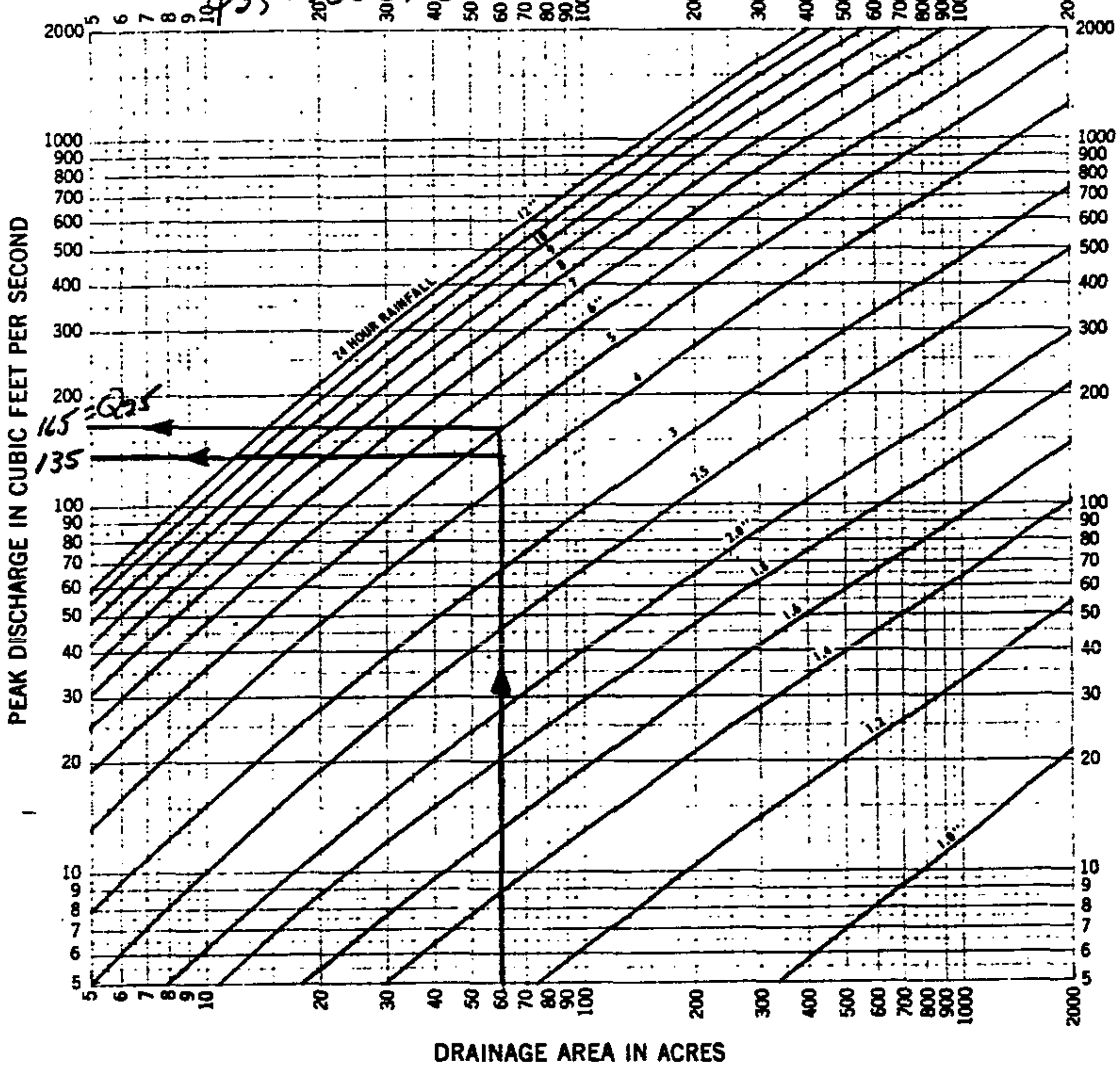


Exhibit 2-9

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - HYDROLOGY BRANCH	STANDARD DWG. NO. ES- 1027 SHEET 12 OF 21 DATE 4-1-66

2c/.

PEAK RATES OF DISCHARGE FOR SMALL WATERSHEDS
TYPE II STORM DISTRIBUTION

SLOPES - STEEP
CURVE NUMBER - 80
24 HOUR RAINFALL FROM US WB TP-40

10 yr storm 25 YEAR STORM
i = 4.5 in i = 5.0 in
A = 61 acres developed
Q_{10} = 175 cfs - steep slopes
Q_{25} = 210 CFS

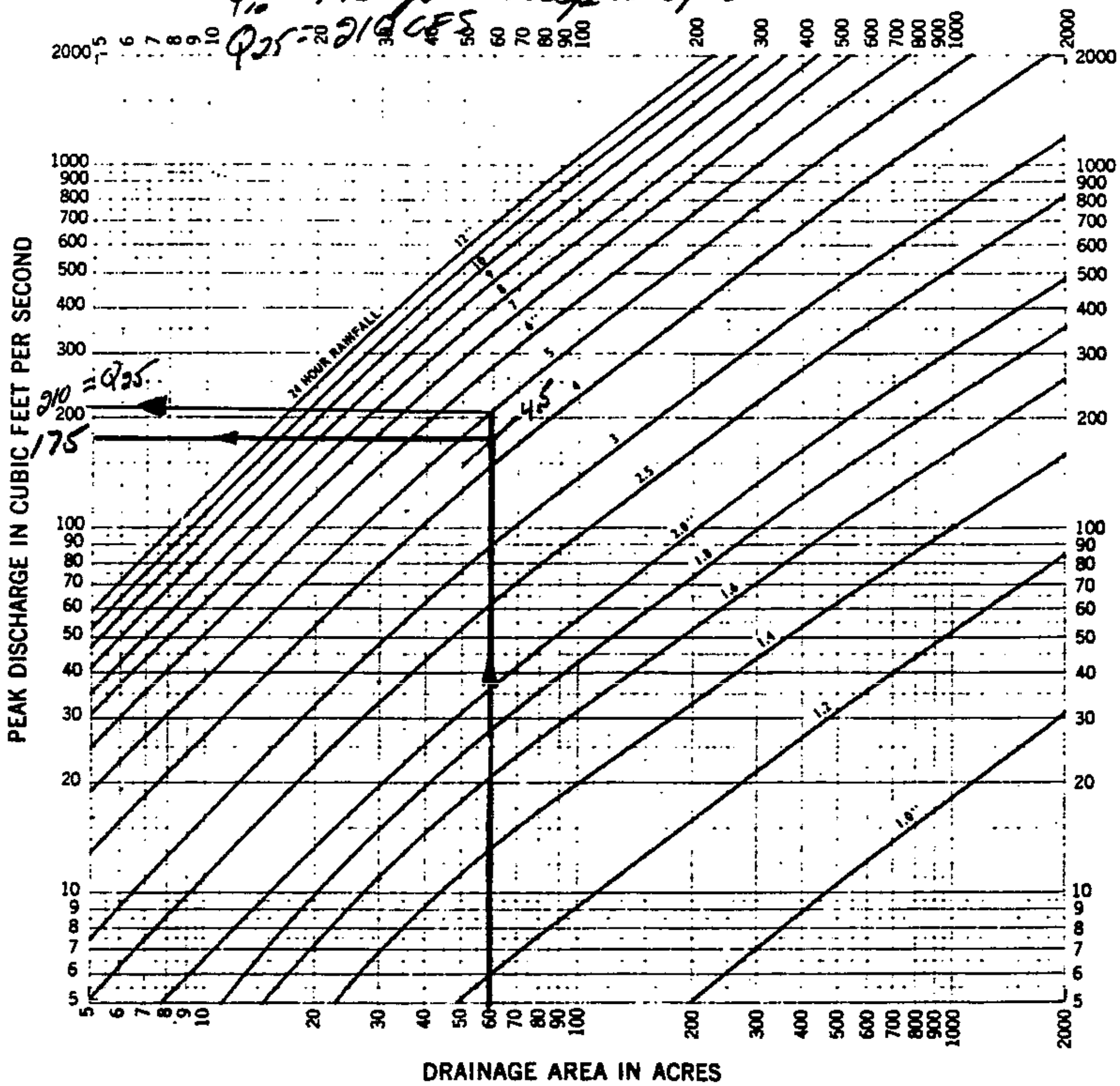
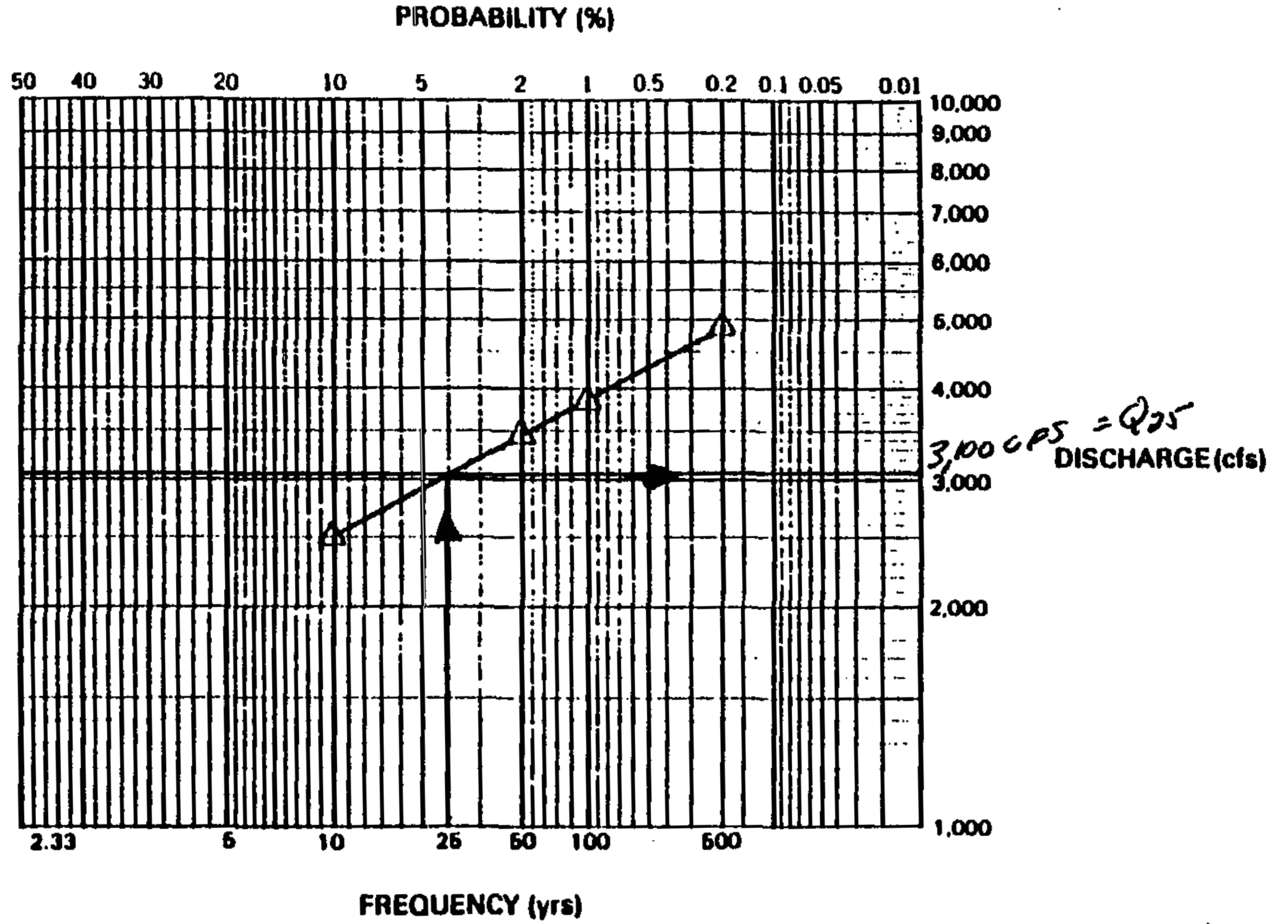


Exhibit 2-9

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - HYDROLOGY BRANCH	STANDARD DWG. NO. ES- 1027 SHEET 19 OF 21 DATE 4-1-66



DRAINAGE AREA = 15.34 SQ. MI.

2F/2

FIGURE 1	RELOCATION OF LR 47015 DERRY TOWNSHIP MONTOUR COUNTY, PA	FREQUENCY-DISCHARGE RELATIONSHIP MUD CREEK

PP&L Form 2454 (9-79)
Cat. # 973401

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

Dept. ______
Date 12/28 19 83
Designed by JAB
Approved by ______
REVISED 5/96 FOR
NEW DEVELOPMENT SEQUENCE

PROJECT Montour
Ash Area #2 Expansion
(ASH AREA NO. 3)

ER No. 480230
Sht. No. 1 of 16

Culvert + Ditch Designs

Summary of Runoff Flows

Design Storm	Rainfall	Site Before Development	(2) Site After Development South Pond	(2) Site After Development North Pond	(3) Worst Case Ditty During Operation (Level I)	(4) Upstream (Culvert)	Ditty Runoff from West below Level I
2 yr-24 hr	2.75 in	75 cfs	60 cfs	5 cfs	~~118~~ cfs	46 cfs	1.6 cfs
10 yr-24 hr	4.50 in	160 cfs	142 cfs	14 cfs	125 ~~215~~ cfs	120 cfs	11 cfs
25 yr-24 hr	5.0 in	185 cfs	172 cfs	17 cfs	143 ~~240~~ cfs	150 cfs	15 cfs
50 yr-24 hr	5.5 in	215 cfs	196 cfs	19 cfs	~~270~~ cfs	180 cfs	18 cfs
100 yr-24 hr	6.3 in	250 cfs	246 cfs	23 cfs	~~310~~ cfs	220 cfs	23 cfs

Basis for Calculations Using SCS Method

(1) 61 acres, Weighted CN = 85, Weighted slope = 2%

(2) 50 acres - S, 4 acres - N, Weighted CN = 79, Weighted slope = 16%

(3) 28.7 A+B CELLS ~~51.4 acres~~, Weighted CN = 90, Weighted slope = 6.5%

51.4 AC NOT POSSIBLE WITH A+B CELLS DEVELOPED BEFORE C+D CELLS.
JAB 5/96

(4) 95 acres, Weighted CN = 77, Weighted slope = 2.3%

(5) 13.8 acres, Weighted CN = 53, Weighted slope = 5.6%

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Dept.
Date 12/29 1983
Designed by JAB
Approved by
REVISED 5/96 FOR Q_{25}

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion
(ASH AREA NO. 3)

ER No. 480230

Sht. No. 2 of 16

Runoff to West Dirty Runoff
Culvert Below Level I

Assume cell C prepared + half filled with ash. All runoff from fly ash except for side slopes is directed to perimeter ditche. Approximate size of Cell C is 800'x600'.

Runoff To Culvert
Fly Ash Side Slopes 1000' x 75' = 1.7 acres CN = 90 S = 33%
Bottom Ash 800'x600' - 1.7ac = 9.3 acres CN = 53 S = 2%
In cell D Area Between Clean
Runoff Ditch + Stream Enclosure 2.8 acres CN = 78 S = 1%

CN for bottom ash

$$CN = \frac{1000}{10+S}$$

S = rainfall retention in inches

void ratio = 0.375

for 24" deep layer S = 0.375 x 24" = 9"

$$CN = \frac{1000}{10+9} = 52.6 \rightarrow 53$$

Total drainage area = 13.8 acres

$$\text{Weighted CN} = \frac{1.7(90) + 9.3(53) + 2.8(78)}{13.8} = 62.6 \rightarrow 63$$

$$\text{Weighted Slope} = \frac{1.7(33) + 9.3(2) + 2.8(1)}{13.8} = 5.6\ \%$$

Using SCS manual Q_{10} = 11 cfs

Q_{25} = 15 CFS

Cat #973401

Dept. ____

Date 12/13 19 83

Designed by JHB

Approved by ____

VERIFIED 5/86 FOR Q25

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion
(ASH AREA NO. 3)

ER No. 480230

Sht. No. 4 of 16

PROJECT: ____

DESIGNER: ____

DATE: ____

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 142 cfs Q_{10} TW$_1$ = 2.25'

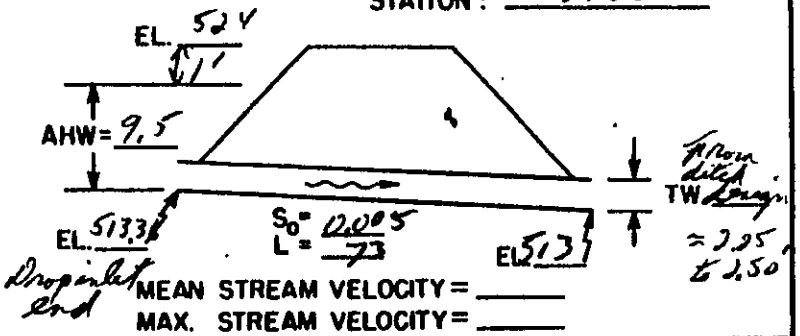
Q_2 = 172 cfs Q_{25} TW$_2$ = 2.50'

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

Clean Runoff Culvert

STATION : 2+00



MEAN STREAM VELOCITY = ____

MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	INLET CONT. HW	OUTLET CONTROL $HW = H + h_0 - LS_0$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-CMP's w/Headwall	142	36"	2.0	7.0	0.5	5.5	2.7	2.85	2.25	2.85	0.36	7.99	7.99	14.0		Outlet control
"	172		2.8	8.4		8.0	2.8		2.50			10.49	10.49	12.1		"
2 RCP's w/Headwall	142		2.0	7.0		3.0	2.7		2.25			7.0	7.0	10.0		Inlet control
	172		2.8	8.4		4.3	2.8		2.50			8.4	8.4	12.1		"

SUMMARY & RECOMMENDATIONS: Use 2-36"ϕ RCP's
Will handle 10 yr + 25 yr storms

PPAL Form 2454 (8-79)
Cat #973401

Dept. ______
Date 12/13 1983
Designed by JHB
Approved by ✓
REVISED 5/96 FOR Q25 FROM NEW DEVELOPMENT SEQ.

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion
(ASH AREA NO. 3)

ER No. 480230
Sht. No. 5 of 16

PROJECT: ______ DESIGNER: ______

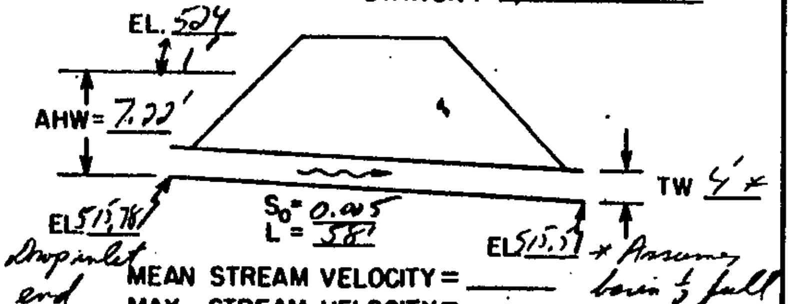
DATE: ______

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 125 ~~215~~ cfs Q_{10} TW$_1$ = ______
Q_2 = 143 ~~240~~ cfs Q_{25} TW$_2$ = ______

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH: Dusty Run of Culvert
STATION: 18+50



MEAN STREAM VELOCITY = ______
MAX. STREAM VELOCITY = ______

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-CMP's w/ headwall	125 ~~215~~	~~36"~~	~~3.4~~	~~14.8~~	~~0.5~~	~~14.8~~	~~3.0~~	~~3.0~~	~~4.0~~	~~4.0~~	~~0.28~~	~~14.52~~	~~14.52~~	~~15.2~~		Outlet control
"	143 ~~215~~	~~42"~~	~~2.1~~	~~7.4~~	~~0.5~~	~~5.5~~	~~3.5~~	~~3.5~~	~~4.0~~	~~4.0~~	~~0.28~~	~~9.22~~	~~9.22~~	~~11.1~~		Outlet control
2-RCP's w/ headwall	125 ~~215~~	~~36"~~	~~3.4~~	~~11.7~~	0.5	6.9	3.0	3.0	4.0	4.0	0.28	10.63	11.7	15.2		Inlet control
"	125 ~~215~~	42"	1.2 ~~2.2~~	4.2 ~~7.7~~	0.5	1.15 3.5	2.5 3.5	3.0 3.5	4.0	4.0	0.28	4.87 7.22	4.87 7.7	6.45 11.1		Outlet ~~Inlet~~ control
"	143 240	42"	~~2.5~~	~~8.8~~	0.5	1.65 4.3	2.7 3.5	3.1 3.5	4.0	4.0	0.28	5.37 6.02	5.37 8.8	7.38 12.1		Outlet ~~Inlet~~ control

SUMMARY & RECOMMENDATIONS: Use 2-42" φ RCP for 10 yr storm
Will ~~not~~ handle 25 yr storm HW < AHW, 5.37 < 7.22' ∴ OK

Form 2454 (9-79)
Cat. # 973401

Dept. ______ Date 12/29 1983 Designed by JAB Approved by ______

REVIEWED 5/96 FOR Q_{25}

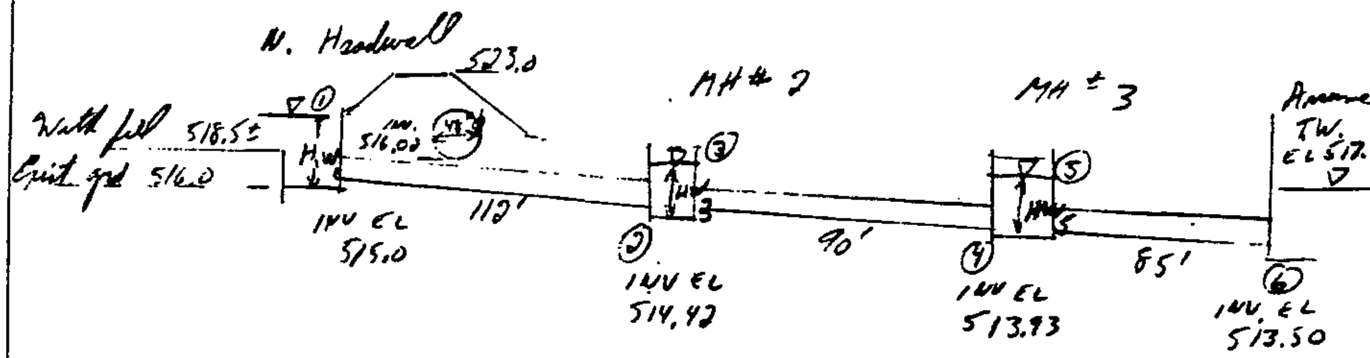
PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion
(ASH AREA NO. 3)

ER No. 480230

Sht. No. 6 of 16

Dirty Runoff Culvert for West Half of Disposal Area



$Q_{10} = 11$ cfs $\quad Q_{25} = 15$ CFS

Preliminary sizing 2-12" ϕ PVC to get under culvert

$$\frac{P_5}{\gamma} + \frac{V_5^2}{2g} + Z_5 = \frac{P_6}{\gamma} + \frac{V_6^2}{2g} + Z_6 + \underbrace{0.5\frac{V_6^2}{2g}}_{\text{entrance}} + \underbrace{1.0\frac{V_6^2}{2g}}_{\text{exit}} + \underbrace{0.011\frac{85}{1}\frac{V_6^2}{2g}}_{\text{friction}}$$

$$V = \frac{11/2}{0.78} = 7.05$$

$$0 + 0 + Z_5 = 4 + 2.43\frac{7.05^2}{2(32.2)} + 513.50$$

$$Z_5 = 519.37 \quad HW_4 = \frac{P_4}{\gamma} = 519.37 - 513.93 = 5.44'$$

$$Z_3 = 5.44 + 2.49\frac{7.05^2}{2(32.2)} + 513.93$$

$$Z_3 = 521.29 \quad H.W_3 = \frac{P_2}{\gamma} = 521.29 - 514.42 = 6.87'$$

$$Z_1 = 6.87 + 2.73\frac{7.05^2}{2(32.2)} + 514.42$$

$$Z_1 = 523.39' \quad H.W_1 = 523.39 - 515.0 = 8.39'$$

523.39 > 523.0 ∴ Can't handle peak FOR Q

Cat. #973401

Dept. ______	**PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET**
Date ______ 19 ____	ER No. 480230
Designed by JHB	PROJECT Montour Ash Area #2 Expansion (ASH AREA NO. 3)
Approved by	Sht. No. 7 of 16

REVISED 5/96 FOR Q_{25}

Repeat using 1 - 24"ϕ PVC below MH #2

$V_{24} = \frac{11}{3.14} = 3.50$ ft/sec.   FOR Q_{25} $V = \frac{15}{3.14} = 4.77$ FT/SEC

$Z_5 = 4 + 2.43 \frac{3.50^2}{2(32.2)} + 513.50$

FOR Q_{10} $Z_5 = 517.96$ $H.W._4 = \frac{P_4}{\gamma} = 517.96 - 513.93 = 4.03'$

FOR Q_{25} $Z_5 = 518.35$ $HW_4 = 518.35 - 513.93 = 4.43'$

FOR Q_{10} $Z_3 = 4.03 + 2.49 \frac{3.50^2}{2(32.2)} + 513.93$

FOR Q_{10} $Z_3 = 518.43$ $H.W_3 = \frac{P_2}{\gamma} = 518.43 - 514.42 = 4.01'$

FOR Q_{25} $Z_3 = 519.24$ $HW_3 = 519.24 - 514.42 = 4.82'$

FOR Q_{10} $Z_1 = 4.01 + 2.73 \frac{3.50^2}{2(32.2)} + 514.42$

FOR Q_{10} $Z_1 = 518.95$ $H.W._1 = 518.95 - 515.0 = 3.95'$

$518.95 < 523.0$ ∴ O.K.

Use 2-12"ϕ from headwall to MH #2 and 24"ϕ from MH #2 to sump.

FOR Q_{25} $Z_1 = 4.82 + 2.73 \frac{(4.77)^2}{2(32.2)} + 514.42$

$Z_1 = 520.20 < 523.0$ ∴ OK FOR Q_{25}

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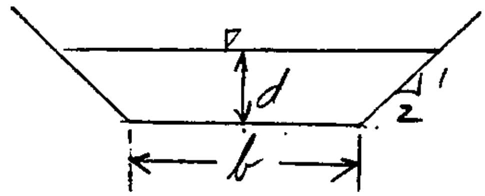
Dept.	**PENNSYLVANIA POWER & LIGHT COMPANY** CALCULATION SHEET	ER No. 480230
Date 19		
Designed by JAB	PROJECT Montour Ash Area #2 Expansion (ASH AREA No. 3)	Sht. No. 8 of 16
Approved by		

Trapezoidal ditch designs below Culverts



$$Q = \frac{1.486\, A\, s^{1/2}\, r^{2/3}}{n}$$

area $A = bd + zd^2$
perimeter $p = b + 2d\sqrt{z^2+1}$
$r = \frac{A}{p}$, $v = \frac{Q}{A}$

for $b = 6'$, $z = 2$, $s = 0.005$, $n = 0.023$

Assumed d	A	p	r	Q	v
0.5	3.50	8.24	0.42	9.00	2.57
1.0	8.00	10.47	0.76	30.40	3.80
1.5	13.50	12.70	1.02	62.63	4.64
2.0	20.00	14.94	1.34	111.16	5.56
2.5	27.50	17.17	1.60	172.22	6.26
3.0	36.00	19.41	1.85	248.78	6.90

for $b = 10'$, $z = 2$, $s = 0.005$, $n = 0.023$

Assumed d	A	p	r	Q	v
0.5	5.50	12.23	0.45	14.70	2.67
1.0	12.00	14.47	0.83	48.36	4.06
1.5	19.50	16.71	1.17	98.81	5.07
2.0	28.00	18.94	1.47	165.59	5.91
2.5	37.50	21.17	1.77	251.25	6.70

Cat. # 973401

Dept.	PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET	ER No. 480230
Date 19		
Designed by JAB	PROJECT Montour Ash Area #2 Expansion (ASH AREA NO. 3)	Sht. No. 9 of 16
Approved by		

for $b = 16'$, $z = 2$, $S = 0.001$, $n = 0.023$

Assumed d	A	P	R	Q	v
0.5'	8.50	18.23	0.47	10.41	1.23
1.0'	18.00	20.47	0.88	33.74	1.87
1.5'	28.50	22.71	1.25	67.80	2.38
2.0'	40.00	24.94	1.60	112.15	2.80
2.5'	52.50	27.17	1.93	166.77	3.17
3.0'	66.00	29.41	2.24	231.76	3.51
3.5'	80.50	31.65	2.54	307.13	3.81

Ditch Section	Q_{25}	Channel Width	Slope	Depth of Flow	Velocity
Clean Runoff	172 cfs	10'	0.005	2.1'	6.0 ft/sec
Below Stream Enclosure	150 cfs	16'	0.001	2.4'	3.1 ft/sec
Below junction of above	322 cfs	16'	0.001	3.6'	3.9 ft/sec

Cat. # 973401

Dept.	**PENNSYLVANIA POWER & LIGHT COMPANY** **CALCULATION SHEET**	ER No. 480230
Date 19		
Designed by JAB	PROJECT Montour	Sht. No. 10 of 16
Approved by	Ash Area #2 Expansion	

Channel Protection Downstream of Culverts @ South End of Site

Reference: "Design of Roadside Drainage Channels" FHWA

Outlet velocity of culverts : 10 ft/sec (Culvert calcs)

from Fig. 21 $D_{50} = 0.8$ ft $\approx 10''$

from Fig 24 use the following gradation

100 % passing 18" screen (by weight)
60-75 % passing 12" screen "
35-55 % passing 9" screen "
15-30 % passing 6" screen "
0-10 % passing 3" screen "

Sht 11 of 14

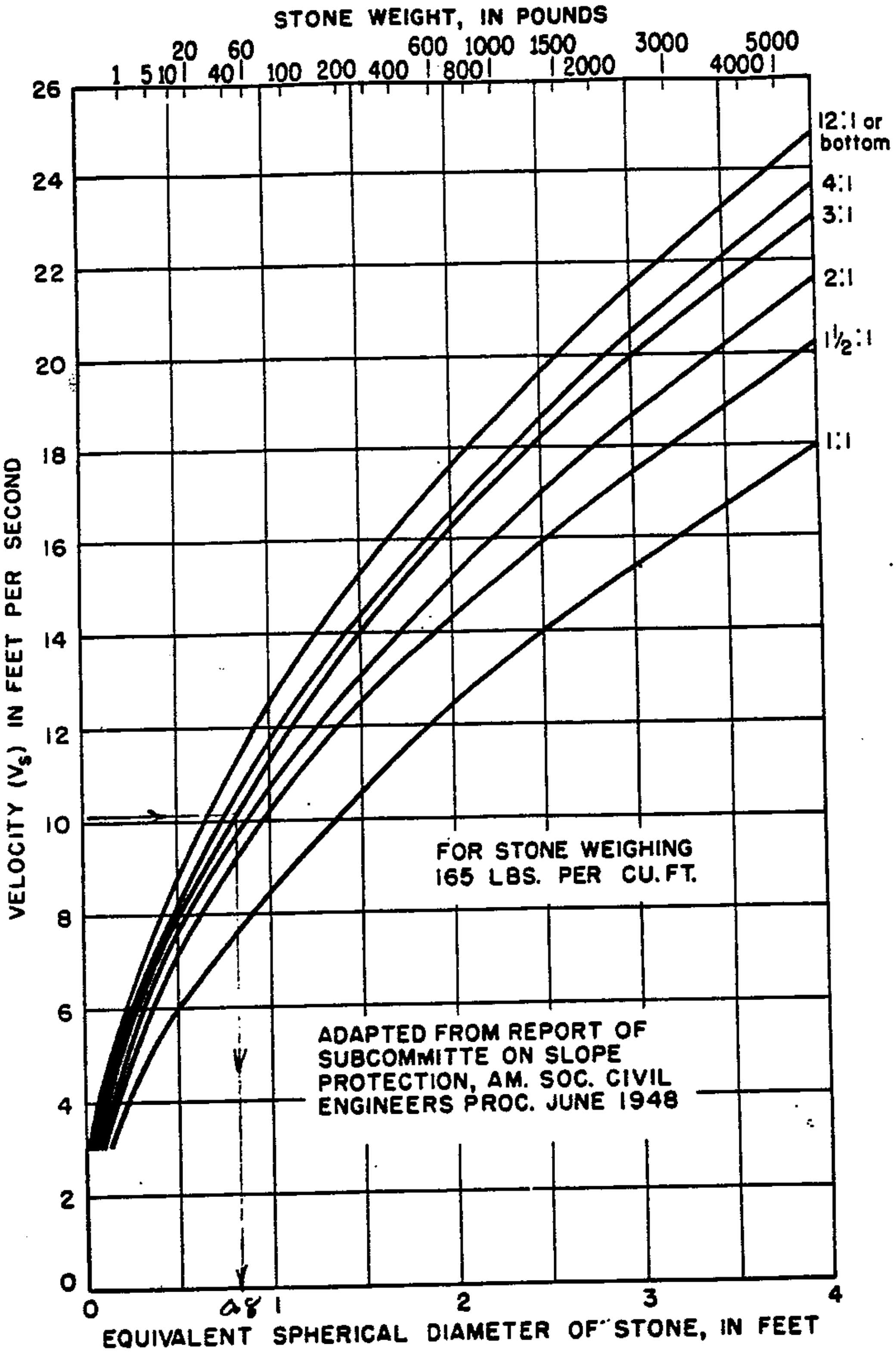


Figure 21.—Size of stone that will resist displacement for various velocities and side slopes.

and of fairly uniform thickness are much easier to place than irregular stones. Stones of a flat stratified nature should be placed with the principal bedding planes normal to the slope. Openings to the subsurface should be filled with rock fragments; however, enough voids or openings should be left to vent the subsurface properly.

5.8 Ditch checks. Ditch checks must be firmly anchored into the banks of the drainage channels. The choice of material determines the methods used, but all checks should have a suitable apron at the toe of the drop and a cutoff wall at the downstream end of the apron. The apron should have a depression or a sill at the downstream edge so that a pool will be created to dissipate the energy of the falling water. If clay is available, local stone can be laid up in a rich clay mortar. This makes the check almost watertight and results in less maintenance than if the stones are laid up loose with the expectation that the check will become impermeable in time.

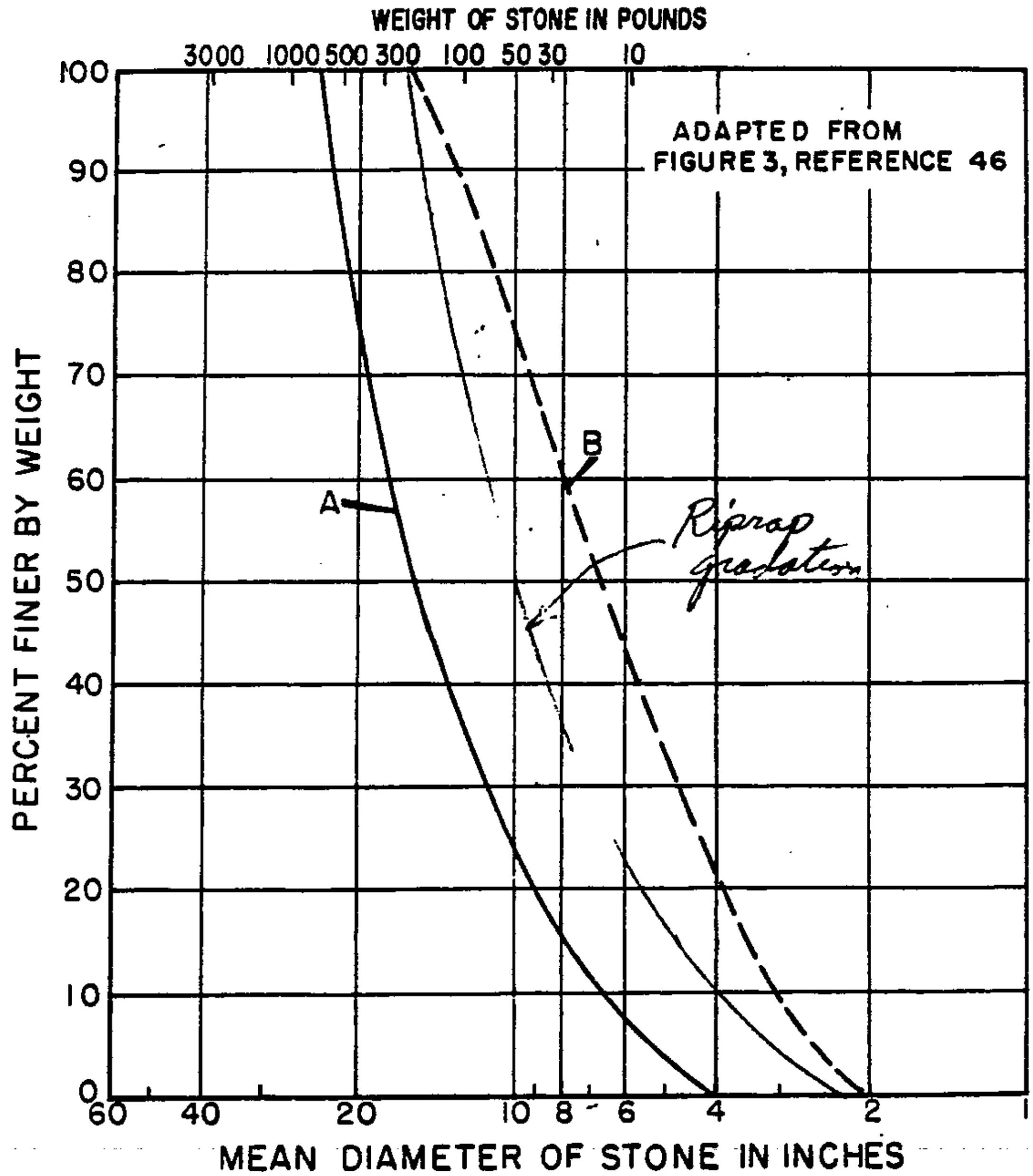


Figure 24.—Gradation curves for dumped-stone protection.

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Dept. ____
Date ____ 19__
Designed by JAB
Approved by ____

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion

ER No. 480230

Sht. No. 13 of 16

Filter Design for Riprap

Soil (Samples 10A+13A)		Riprap
D_{10}	0.004 mm	100 mm
D_{15}	0.008 mm	125 mm
D_{50}	0.04 mm	250 mm
D_{60}	0.045 mm	300 mm
D_{85}	0.05 mm	375 mm
$C_u = \frac{D_{60}}{D_{10}} = 11.25$		$C_u = \frac{300}{100} = 3$

Requirements

1) To avoid head loss: $\frac{D_{15F}}{D_{15B}} > 4$

2) To avoid piping: $\frac{D_{15F}}{D_{85B}} < 5$, $\frac{D_{50F}}{D_{50B}} < 25$, $\frac{D_{15F}}{D_{15B}} < 20$

if base $C_u < 1.5$ $\quad \frac{D_{15F}}{D_{85B}} < 6$

if base $C_u > 4$ $\quad \frac{D_{15F}}{D_{15B}} < 40$

3) No size in filter > 3" and not more than 5% passing #200.

Is a filter required?

$$\frac{D_{15}\text{ riprap}}{D_{85}\text{ soil}} = \frac{125}{0.05} = 2100 > 5 \quad \therefore \text{Yes}$$

PP&L Form 2454 (9-79)
Cat. # 973401

Dept. ______	**PENNSYLVANIA POWER & LIGHT COMPANY**	ER No. 480230
Date ______ 19 ____	**CALCULATION SHEET**	
Designed by JAS	PROJECT Montour	Sht. No. 14 of 16
Approved by	Ash Area #2 Expansion	

$\frac{D_{15} \text{ filter}}{D_{15} \text{ soil}} > 4$, D_{15} filter $> 4(0.008)$ or 0.032 mm <u>lower limit</u>

$\frac{D_{15} \text{ filter}}{D_{85} \text{ soil}} < 5$, D_{15} filter $< 5(0.05)$ or 0.25 mm <u>upper limit</u> * Controls

$\frac{D_{50} \text{ filter}}{D_{50} \text{ soil}} < 25$, D_{50} filter $< 25(0.04)$ or 1.0 mm <u>upper limit</u>

$\frac{D_{15} \text{ filter}}{D_{15} \text{ soil}} < 40$, D_{15} filter $< 40(0.008)$ or 0.32 mm. <u>upper limit</u>

$\frac{D_{15} \text{ riprap}}{D_{85} \text{ filter}} < 5$, D_{85} filter $> \frac{125}{5}$ or 25 mm <u>lower limit</u>

$\frac{D_{50} \text{ riprap}}{D_{50} \text{ filter}} < 25$, D_{50} filter $> \frac{250}{25}$ or 10 mm <u>lower limit</u>

$\frac{D_{15} \text{ riprap}}{D_{15} \text{ filter}} < 20$, D_{15} filter $> \frac{125}{20}$ or 6 mm <u>lower limit</u>

Two filter layers will be required.

PP&L Form 2454 (9-79)
Cat. # 973401

Dept.
Date 19
Designed by JAS
Approved by

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT Montour
Ash Area #2 Expansion

ER No. 480230

$$\frac{D_{15}\ \text{filter 2}}{D_{85}\ \text{filter 1}} < 5, \quad D_{15}\ \text{filter 2} < 5(8) \text{ or } 40\ \text{mm}$$

upper limit
* Controls

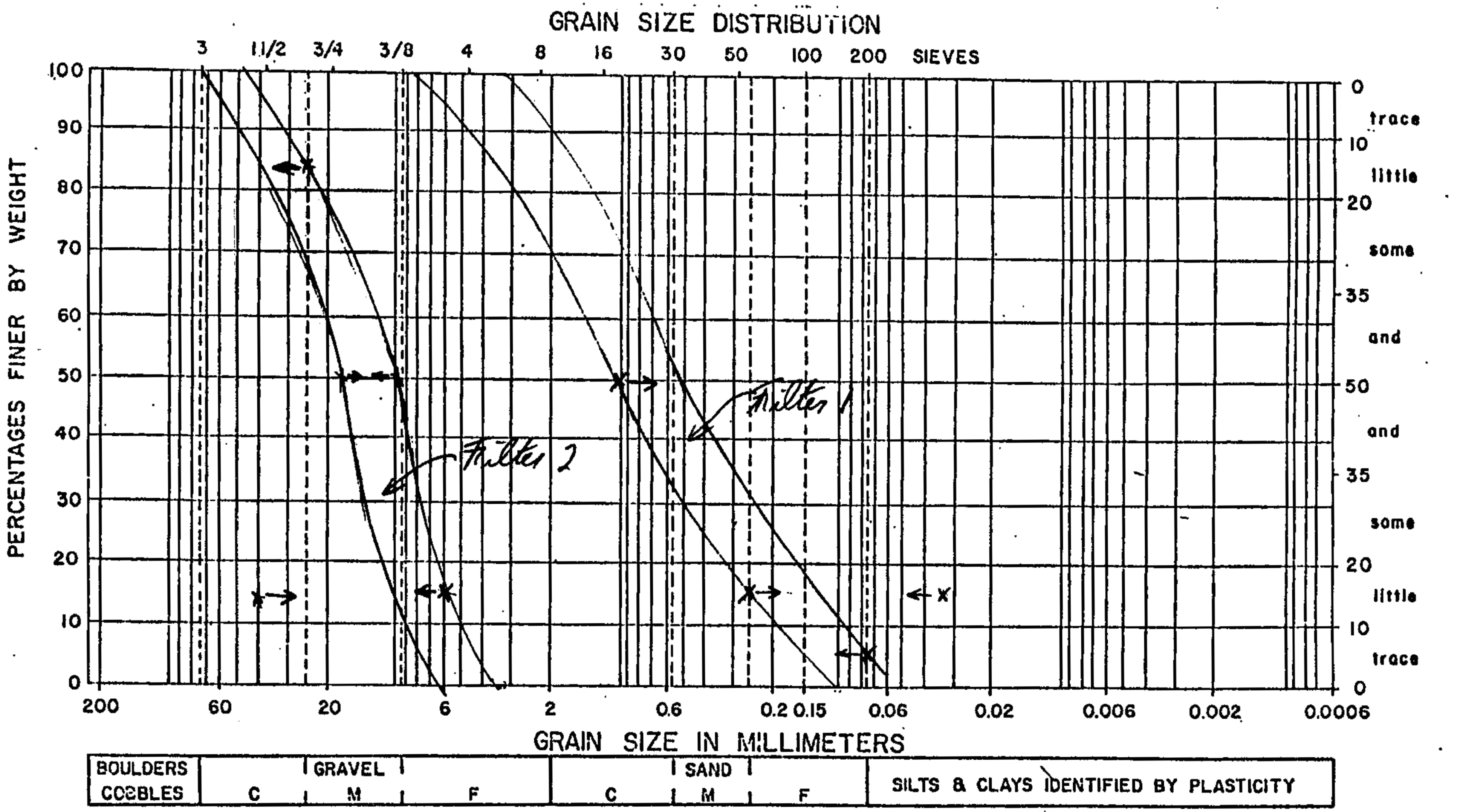
$$\frac{D_{50}\ \text{filter 2}}{D_{85}\ \text{filter 1}} < 25, \quad D_{50}\ \text{filter 2} < 25(0.7) = 17.5\ \text{mm}$$

upper limit

$$\frac{D_{15}\ \text{filter 2}}{D_{85}\ \text{filter 1}} < 40, \quad D_{15}\ \text{filter 2} < 40(8) \text{ or } 320\ \text{mm}$$

upper limit

Filter 1 + Filter 2 shown on attached grain size distribution plot.


GRAIN SIZE DISTRIBUTION
SIEVES
3
1 1/2
3/4
3/8
4
8
16
30
50
100
200
PERCENTAGES FINER BY WEIGHT
100
90
80
70
60
50
40
30
20
10
0
trace
little
some
35
and
Filter 1
Filter 2
200
60
20
6
2
0.6
0.2
0.15
0.06
0.02
0.006
0.002
0.0006
GRAIN SIZE IN MILLIMETERS
BOULDERS
COBBLES
GRAVEL
C
M
F
SAND
SILTS & CLAYS IDENTIFIED BY PLASTICITY

Sht. 16 of 16

PP&L Form 2454 (9-79)
Cat. #973401

Dept. PPA
Date 12/9 1983
Designed by WJB
Approved by

JMB REVISED 3/96 FOR Q25

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT MONTOUR SES
(ASH AREA NO. 3)
ASH DISPOSAL AREA 5-6

ER No.
Sht. No. 19 of 22

Q10 EXCE[illegible] AS NOTE[illegible]

LEVEL	DITCH/PIPE TO BE SIZED	CONTRIBUTING AREA	SLOPE %	CN	AREA (AC)	TOTAL AREA	WEIGHTED S	WEIGHTED CN	DESIG[illegible] Q[illegible]
I	SLOPE PIPE WEST SIDE	WEST SIDE TOP OF PILE	1	90	20.8	20.8	1	90	78[illegible] Q25 = 6[illegible]
I	WEST DITCH	HAUL ROAD & SLOPE	1 33	92 90	1.0 3.4	4.4	26	90	22 Q25 = [illegible]
I	SOUTH WEST DITCH	HAUL ROAD PILE SLOPE TOP OF PILE	1 33 1	92 90 90	1.3 4.7 20.8	26.8	7	90	Q25 = 1[illegible] 116
I	EAST SIDE SLOPE PIPE	EAST SIDE TOP OF PILE	1	90	19.7	19.7	1	90	Q25 = [illegible] 78
I	EAST SIDE DITCH	HAUL ROAD SLOPE	1 33	92 90	.9 3.4	4.3	26	90	Q25 = [illegible] 22
I	SOUTH EAST DITCH	HAUL ROAD PILE SLOPE TOP OF PILE	1 33 1	92 90 90	1.1 3.8 19.7	24.6	6	90	Q25 = 1[illegible] 10[illegible]
II	SLOPE PIPE WEST SIDE	WEST SIDE TOP OF PILE	1	90	14.75	14.75	1	90	Q25 = 5[illegible] 62
I	WEST SIDE BENCH DITCHES	WEST SLOPE LEVEL II BENCH LEVEL I	33 1	78 90	4.2 1.2	5.4	26	80	Q25 = [illegible] 1[illegible]
II	SLOPE PIPE EAST SIDE	EAST SIDE TOP OF PILE	1	90	15.5	15.5	1	90	Q25 = 5[illegible] 6[illegible]
I	EAST SIDE BENCH DITCHES	EAST SLOPE II EAST BENCH I	33 1	78 90	4.1 1.0	5.2			Q25 = [illegible] < 1[illegible]
III	WEST SIDE SLOPE PIPE	WEST SIDE TOP OF PILE	1	90	10.7	10.7	1	90	Q25 = 4[illegible]
III	EAST SIDE SLOPE PIPE	EAST SIDE TOP OF PILE	1	90	11.24	11.24	1	90	Q25 = 4[illegible]
ALL	SOUTH WEST CLEAN DITCH	TOP LEVEL III SLOPE LEVEL III BENCH II SLOPE II BENCH I SLOPE I	1 33 1 33 1 33	78 78 90 78 90 78	10.70 3.51 1.04 4.2 1.2 4.7	25.35	16	79	Q25 = 7[illegible]

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LEVEL	DITCH/PIPE TO BE SIZE	CONTRIBUTING AREA	SLOPE %	CN	AREA (Ac)	TOTAL AREA	WEIGHTED S	WEIGHTED CN	DESI Q c
ALL	SOUTHEAST CLEAN DITCH	EAST TOP LEVEL III	1	78	11.24				
		SLOPE LEVEL III	33	78	3.48				
		BENCH II	1	90	1.04				
		SLOPE II	33	78	4.10				Q_{25} =
		BENCH I	1	90	1.0				
		SLOPE I	33	78	3.8	24.66	16	79	7.
ALL	CLEAN RUNOFF CULVERTS	WEST TOP III	1	78	10.70				
		EAST TOP III	1	78	11.24				
		W SLOPE III	33	78	3.51				
		E SLOPE III	33	78	3.48				
		BENCH II, W	1	90	1.04				
		BENCH II, E	1	90	1.04				
		W. SLOPE II	33	78	4.2				
		E. SLOPE II	33	78	4.10				
		W. BENCH I	1	90	1.2				
		E. BENCH I	1	90	1.0				Q_{25} =
		W. SLOPE I	33	78	4.7				
		E. SLOPE I	33	78	3.8	50.01			142

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Sht. No. 2 of 22

WEST SLOPE PIPE —

DESIGN STORM ~~10 yr - 24 hr.~~ 25 YR - 24 HR, TYPE II

$i = 4.5$ IN. from Exhibit 2-3 sht 3
$i = 5.0$ IN FOR Q_{25}

PEAK Q:

$Q_{25} = 65$ CFS ←

for flat slopes $Q = 78$ cfs ~~←~~

WEST DITCH —

WEIGHTED S: $\dfrac{1.0(1) + 3.4(33)}{4.4} = 25.7$ say 26

WEIGHTED CN: $\dfrac{1.0(92) + 3.4(90)}{4.4} = 90.5$ say 90

DETERMINE PEAK Q:

for Moderate Slope (4%) $Q = 22$ cfs $Q_{25} = 23$ CFS

for steep Slope (16%) $Q = 22$ cfs $Q_{25} = 23$ CFS

$\therefore$ ~~$Q = 22$ cfs ←~~
$Q_{25} = 23$ CFS ←

WEST SOUTH DITCH —

WEIGHTED S: $\dfrac{1.3(1) + 4.7(33) + 20.8(1)}{26.8} = 6.6$ say 7%

WEIGHTED CN: $\dfrac{1.3(92) + 4.7(90) + 20.8(90)}{26.8} = 90.1$ say 90

DETERMINE PEAK Q:

for Moderate Slope (4%) $Q = 115$ cfs $Q_{25} = 125$ CFS

for steep Slope (16%) $Q = 118$ cfs $Q_{25} = 145$ CFS

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Sht. No. 3 of 22

EAST SLOPE PIPE —

DESIGN STORM ~~10 yr - 24 hr~~ 25 YEAR - 24 HOUR TYPE II

$i = 4.5$

$i = 5.0$ IN FOR Q_{25}

PEAK Q: for flat slopes $Q = 78$ cfs X $\quad Q_{25} = 64$ CFS

EAST DITCH —

WEIGHTED S $\quad \dfrac{.9(1) + 3.4(33)}{4.3} = 26.3$ say 26

WEIGHTED CN $\quad \dfrac{.9(92) + 3.4(90)}{4.3} = 90.4$ say 90

DETERMINE PEAK Q

for Moderate Slope (4%) $\quad Q = 22 \quad Q_{25} = 23$ CFS

for steep Slope (16%) $\quad Q = 22 \quad Q_{25} = 23$ CFS

for 26% slope: $\quad Q = 22$ cfs ~~XXXXXX~~ $\quad Q_{25} = 23$ CFS ←

SOUTHEAST DITCH

WEIGHTED S: $\quad \dfrac{1.1(1) + 3.8(33) + 19.7(1)}{24.6} = 5.9$ say 6

WEIGHTED CN: $\quad \dfrac{1.1(92) + 3.8(90) + 19.7(90)}{24.6} = 90$

DETERMINE PEAK Q

for Moderate Slope (4%) $\quad Q = 108$ cfs $\quad Q_{25} = 115$ CFS

for steep Slope (16%) $\quad Q = 110$ cfs $\quad Q_{25} = 125$ CFS

from Fig 2.1 for 6% $\quad Q = 109$ cfs ~~XXXXXX~~

$Q_{25} = 120$ CFS ←

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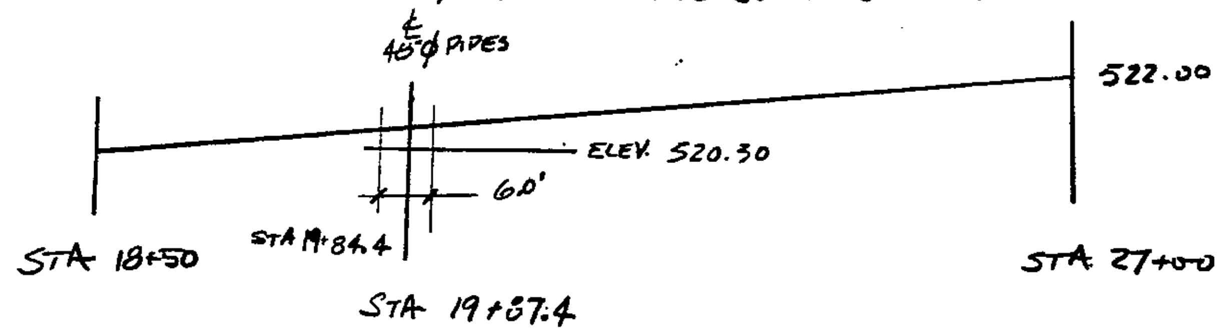
SIZE EAST DITCH

MIN. SLOPE OCCURS FROM STA 18+50 TO STA 27+00



ASSUME MIN. CONCRETE COVER OVER 48"ϕ PIPES IS 3"

∴ @ STA 19+84.4 MIN. DITCH ELEV = 520.46

$$\text{MAX SLOPE OF DITCH} = \frac{522.00 - 520.55}{2700 - 1984.4} = .0020$$

DETERMINE DEPTH OF FLOW –

(REF. TABLE 12 pg 255 SCHAUM'S OUTLINE - FLUID MECH. & HYD)

$$Q = (K'/n)\, b^{8/3} S^{1/2}$$

$$22 = K'/.023\ (4)^{8/3} (.002)^{1/2}$$

$$K' = .2806 \implies y/b = .32 = \frac{y}{4} \quad \therefore y = 1.28\ ft.$$

TRY S = .0015

$$Q = (K'/n)\, b^{8/3} S^{1/2}$$

$$22 = K'/.023\ (4)^{8/3} (.0015)^{1/2}$$

$$K' = .324 \implies y/b = .344$$

$$y = 1.376$$

OK

$$\frac{x - .34}{.02} = \frac{.008}{.037}$$

$$x = .344$$

.34	.316
x	.324
.36	.353

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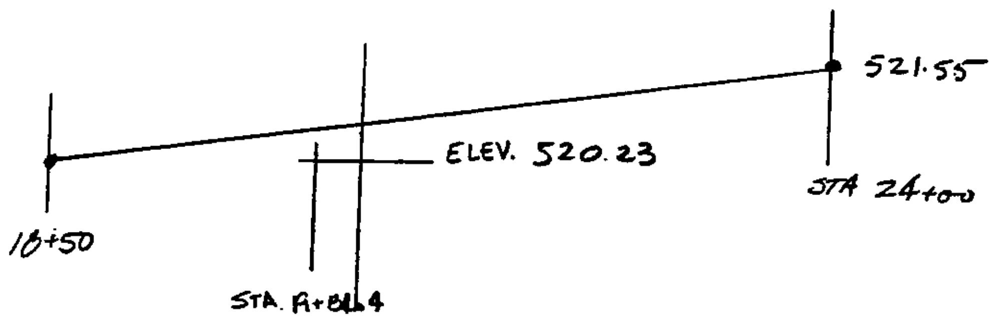
SIZE SOUTH DITCH –

ELEV. DITCH @ STA 24+00 = 521.55



MIN CONCRETE COVER 1.5" ∴ ELEV @ STA 19+84.4 = 520.36

$$\text{MAX SLOPE} = \frac{521.55 - 520.36}{2400 - 1984.4} = .00286$$

ELEV @ 18+50 — 520.

$$\therefore \quad \text{SLOPE} = \frac{521.55 - 520.00}{2400 - 1850} = .00282 \leftarrow \text{USE}$$

DETERMINE DEPTH OF FLOW – NOTE – DITCH CONCRETE LINED

$$Q = (K'/n)\, b^{8/3} s^{1/2}$$

$$116 = K'/.013 \; (4)^{8/3} (.00282)^{1/2}$$

$$K' = .7043$$

.679	.5
.704	x
.826	.55

$$\frac{x - .5}{.05} = \frac{.025}{.147}$$

$$x = .509$$

$$y/b = .509 \Rightarrow y = 2.04' \text{ OK}$$

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SOUTH EAST DITCH

$$SLOPE = \frac{522 - 520}{18+50 - 13+50} = .004 \quad (\text{CONCRETE LINED})$$

$$SLOPE = \frac{532 - 522}{13+50 - 6+60} = .0145 \quad (\text{NATURAL SOIL})$$

DETERMINE DEPTH OF FLOW –

$$Q = (k'/n)\, b^{8/3}\, S^{1/2}$$

$$109 = (k'/.013)\ (4)^{8/3}\,(.004)^{1/2}$$

$K' = .556$

.525	.44
.556	x
.574	.46

$$\frac{x - .44}{.02} = \frac{.031}{.049}$$

$x = .453$

$y/b = .453$

$y = 1.812'$ (Concrete)

$$109 = (k'/.023)\,(4)^{8/3}\,(.0145)^{1/2}$$

$K' = .516$

.478	.42
.516	x
.525	.44

$$\frac{x - .42}{.02} = \frac{.038}{.047}$$

$x = .436$

$y/b = .436$

$y = 1.744'$ (Soil)

EAST SIDE DITCH

BY INSPECTION DITCH OK

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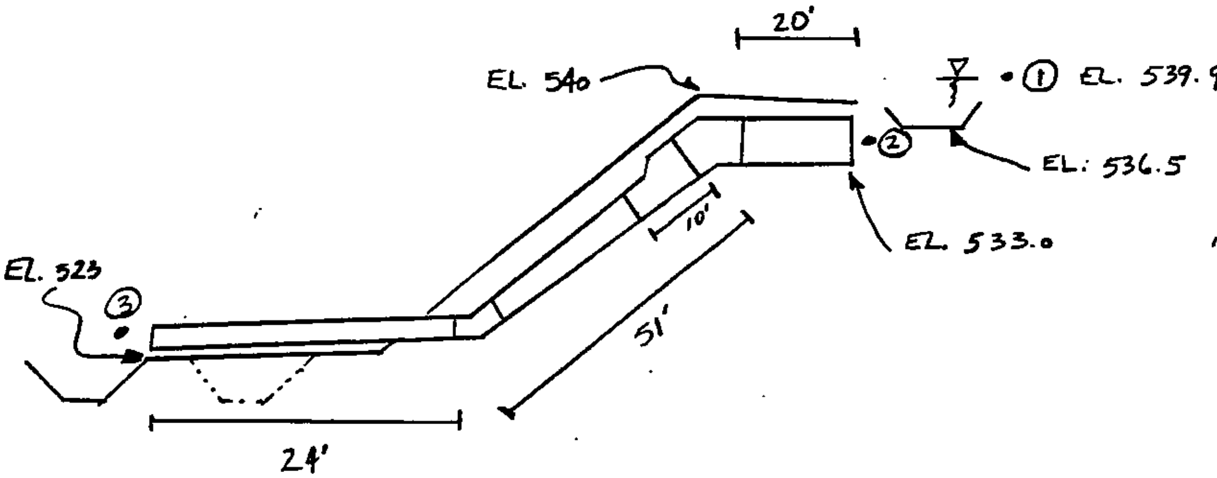
SIZE LEVEL I SLOPE PIPES



∴ HEAD WATER DE = 6.9' OK FOR INLET CONTRO w/ 36"ϕ INL

ASSUME 36"ϕ ; 30"ϕ SLOPE PIPE

$$Q_2 = Q_3$$

$$V_{36} A_{36} = V_{30} A_{30}$$

$$V_{36}(7.069) = V_{30}(4.909)$$

$$V_{36} = .6944 V_{30}$$

BERNOULLI Eq:

$$\cancel{\frac{V_1^2}{2g}}^{0} + \cancel{\frac{P_1}{\gamma}}^{0} + Z_1 = \frac{V_3^2}{2g} + \cancel{\frac{P_3}{\gamma}}^{0} + Z_3 + \Sigma h_l$$

$$539.9 = \frac{V_3^2}{2g} + 524.25 + \Sigma h_l$$

$$15.65 = \frac{V_3^2}{2g} + \Sigma h_l \quad (1)$$

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MINOR LOSSES:

ENTRANCE $\frac{.5 V_{36}^2}{2g} = \frac{.24 V_{30}^2}{2g}$

1ST BEND $\frac{.17 V_{36}^2}{2g} = \frac{.08 V_{30}^2}{2g}$

CONTRACTION $\frac{.08 V_{30}^2}{2g}$

2ND BEND $\frac{.17 V_{30}^2}{2g}$

$$h_m = \frac{.57 V_{30}^2}{2g}$$

FROM (1) $15.65 = \frac{V_{30}^2}{2g} + \frac{.57 V_{30}^2}{2g} + h_f$

$15.65 = 1.57 \frac{V_{30}^2}{2g} + h_f$

ASSUMING $Q = 78$ cfs
& USING ASCE SEWER DESIGN MA

$h_{f_{36}} = \frac{35}{1000} \times 30 = 1.05$

$15.65 = 1.57 \frac{V_{30}^2}{2g} + 5.93$

$h_{f_{30}} = \frac{75}{1000} \times 65 = 4.88$

$\overline{5.93}$

$V_{30} = 19.97$ f/s

$Q = VA$

$= 19.97 (4.909)$

$= 98$ cfs > 78 cfs $\therefore$ OK

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WEST SLOPE PIPE LEVEL II

DESIGN STORM ~~10 yr - 24 hr~~ 25 YR - 24 HOUR, TYPE II
i = 4.5 IN from Exhibit 2-3 sht 3
i = 5.0 IN FOR Q_{25}

PEAK Q — Q_{25} = 50 CFS
for flat slopes Q = 62 cfs X

WESTSIDE BENCH DITCHES —

WEIGHTED S: $\frac{4.2(33) + 1.2(1)}{5.4}$ = 25.9 say 26

WEIGHTED CN: $\frac{4.2(75) + 1.2(90)}{5.4}$ = 80.7 say 80 (SEEDED)

DETERMINE PEAK Q

for moderate slope (4%) Q = 16 Q_{25} = 21
for steep slope (16%) Q = 16 Q_{25} = 21
Q_{25} = 21 CFS
∴ Q = 16 cfs @ 26% slope

CHECK LEVEL I BENCH DITCH —

CRITICAL DITCH HAS S = .00441 d_{max} = 2.5'

FOR "V" - DITCH n = .023 S = .00441 - ASSUME d = 1.5' Q_{DES} = 16 cfs

TRIAL	assumed d	A (ft²)	p	r	V (ft/s)	Q (cfs)
1	1.5	6.75	9.49	.711	3.4	22.95 > 16 ∴ OK

CHECK DITCH FOR CAPACITY PRIOR TO LEVEL II
ASSUME Q = ½ Q_{max} = ½(78) = 39 cfs (ONLY ½ AREA CONTRIBUTES TO CRITICAL DITCH)

TRIAL	assumed d	A (ft²)	p	r	V (ft/s)	Q (cfs)
2	2.0	12.00	12.65	.949	4.05	48.6 > 39 ∴ OK

BENCH DITCH OK - DOESN'T EXCEED d_{max} = 2.5

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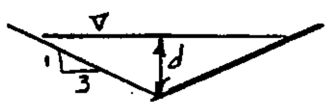
CHECK LEVEL II BENCH DITCH –

CRITICAL DITCH HAS $S = .0048$ $d_{max} = 2.0'$

CHECK DITCH CAPACITY PRIOR TO LEVEL III
ASSUME $Q = \frac{1}{2} Q_{MAX} = \frac{1}{2}(63) = 31.5$ cfs



$n = 0.023$

$$Q = \frac{1.486 \, A \, s^{1/2} r^{2/3}}{n}$$

TRIAL	ASSUMED d	A	p	r	v (f/s)	Q (cfs)
1	2.0	12	12.65	.949	4.2	50.4

$31.5 < 50.4$ ∴ OK

NOTE: ALTHOUGH DITCH WILL FLOW RELATIVELY FULL THIS IS A TEMPORARY DITCH AND WILL NOT BE IN USE FOR MANY YEARS. WHEN LEVEL III IS CONSTRUCTED RUNOFF WILL BE SIGNIFICANTLY LESS.

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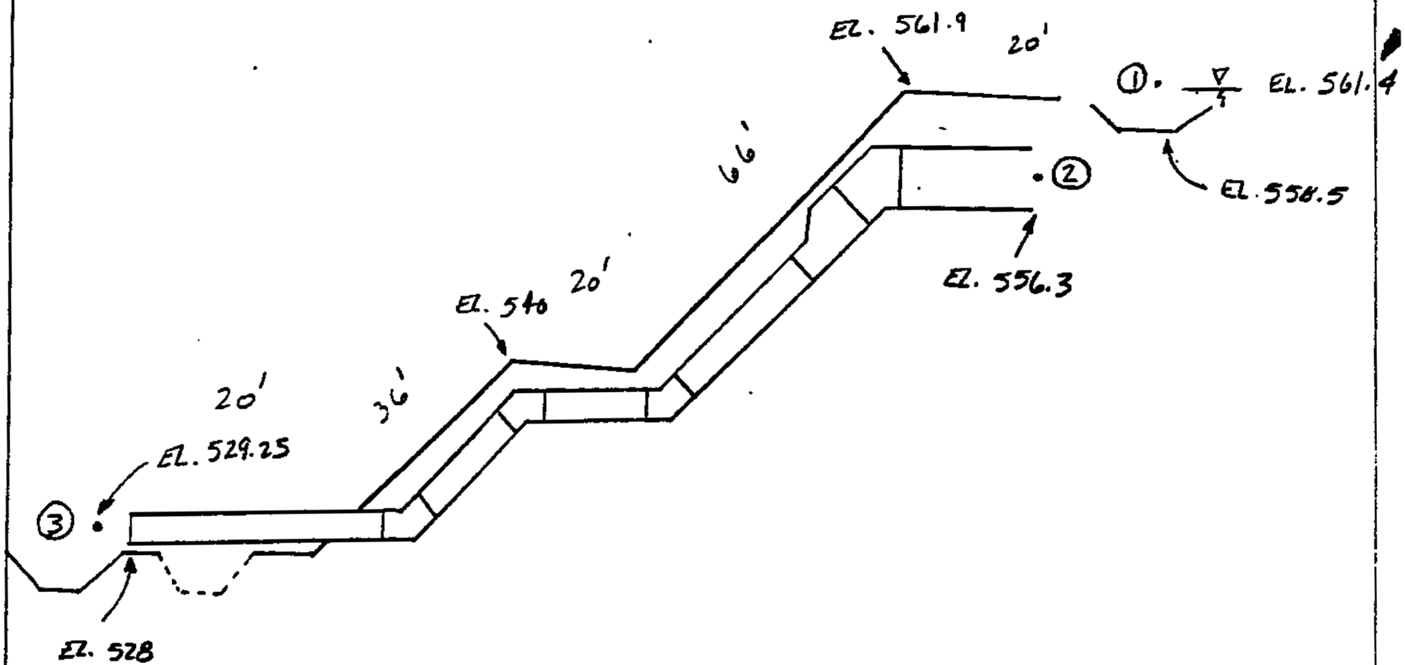
SIZE LEVEL II SLOPE PIPES –

HEAD WATER DEPTH = 5.1'
WHICH IS OK FOR
INLET CONTROL W/36"ϕ PIPE



ASSUME 36"ϕ & 30"ϕ

$$Q_{36} = Q_{30}$$

$$V_{36} A_{36} = V_{30} A_{30}$$

$$V_{36}(7.069) = V_{30}(4.909)$$

$$V_{36} = .6944\, V_{30}$$

BERNOULLI Eq: ① → ③

$$\cancel{\frac{V_1^2}{2g}}^{0} + \cancel{\frac{P_1}{\gamma}}^{0} + Z_1 = \frac{V_3^2}{2g} + \cancel{\frac{P_2}{\gamma}}^{0} + Z_2 + \Sigma h_\ell$$

$$561.4 = \frac{V_{30}^2}{2g} + 529.25 + h_m + h_f$$

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MINOR LOSSES:

$$\text{ENTRANCE} = \frac{.5\,V_{36}^2}{2g} \equiv \frac{.24\,V_{30}^2}{2g}$$

$$1^{ST}\ \text{BEND} = \frac{.17\,V_{36}^2}{2g} \equiv \frac{.08\,V_{30}^2}{2g}$$

$$\text{CONTRACTION} = \frac{.08\,V_{30}^2}{2g}$$

$$3\ \text{BENDS} = \frac{3\,(.17\,V_{30}^2)}{2g} \equiv \frac{.51\,V_{30}^2}{2g}$$

$$\frac{.91\,V_{30}^2}{2g}$$

FRICTION LOSSES:

ASSUMING $Q = 63$ cfs ; USING ASCE SEWER DESIGN MANUAL

$$h_{f_{36}} = \frac{25}{1000} \times 30 = .75$$

$$h_{f_{30}} = \frac{55}{1000} \times 132 = 7.26$$

$$8.01$$

$$\therefore\ 561.4 = \frac{V_{30}^2}{2g} + 529.25 + \frac{.91\,V_{30}^2}{2g} + 8.01$$

$$24.14 = \frac{1.91\,V_{30}^2}{2g}$$

$$V_{30} = 28.5 \Rightarrow Q = 28.5(4.909) = 140 > 63 \therefore OK$$

THIS IS TOO MUCH EXCESS CAPACITY – TRY 24"ϕ SLOPE PIPE

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ASSUME 36"ϕ INLET & 24"ϕ SLOPE PIPE

$$Q_{36} = Q_{24}$$

$$V_{36} A_{36} = V_{24} A_{24}$$

$$V_{36} (7.069) = V_{24} (3.142)$$

$$V_{36} = .444 \, V_{24}$$

BERNOULLI EQ: ① → ③

$$\cancel{\frac{V_1^2}{2g}} + \cancel{\frac{P_1}{\gamma}} + Z_1 = \frac{V_3^2}{2g} + \cancel{\frac{P_3}{\gamma}}^{0} + Z_2 + \Sigma h_\ell$$

$$561.4 = \frac{V_{24}^2}{2g} + 529 + h_m + h_f$$

MINOR LOSSES:

$$\text{ENTRANCE} = \frac{.5 V_{36}^2}{2g} \equiv \frac{.10 V_{24}^2}{2g}$$

$$\text{1ST BEND} = \frac{.17 V_{36}^2}{2g} \equiv \frac{.03 V_{24}^2}{2g}$$

$$\text{CONTRACTION} = \frac{.22 V_{24}^2}{2g}$$

$$\text{3 BENDS} = 3\left(\frac{.17 V_{24}^2}{2g}\right) = \frac{.51 V_{24}^2}{2g}$$

$$\frac{.86 V_{24}^2}{2g}$$

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FRICTION LOSSES:

ASSUMING $Q = 63$ cfs ; USING ASCE SEWER DESIGN MANUAL

$$h_{f_{36}} = \frac{25}{1000} \times 30 = .75$$

$$h_{f_{24}} = \frac{150}{1000} \times 132 = 19.8$$

$$20.55$$

$$\therefore \quad 561.4 = \frac{V_{24}^2}{2g} + 529 + \frac{.86\, V_{24}^2}{2g} + 20.55$$

$$11.85 = 1.86 \frac{V_{24}^2}{2g}$$

$$V_{24} = 20.26 \qquad \therefore Q = 20.26(3.142) = 63.6 > 63 \therefore OK$$

ALTHOUGH THE CAPACITY IS CLOSE, THIS WILL WORK OK SINCE THE QUANTITY OF RUNOFF IS CONSERVATIVE AND THE AREA WILL BE OPEN ONLY A FEW YEARS.

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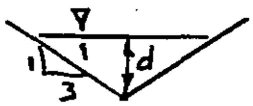
Approved by		

CHECK LEVEL III BENCH DITCH–

CRITICAL DITCH HAS $S = .0086$ $d_{max} = 2.0$

CHECK USING DIRTY RUNOFF, SINCE THIS WILL YIELD LARGER Q

Assume $Q = \frac{1}{2} Q_{max} = \frac{1}{2}(47) = 23.5$ cfs



$n = .023$ $Q = \dfrac{1.486 A s^{1/2} r^{2/3}}{n}$

TRIAL	ASSUMED d	A	P	r	V (f/s)	Q (cfs)
1	1.5	6.75	9.49	.711	4.7	31.7 > 23.5 ∴ OK

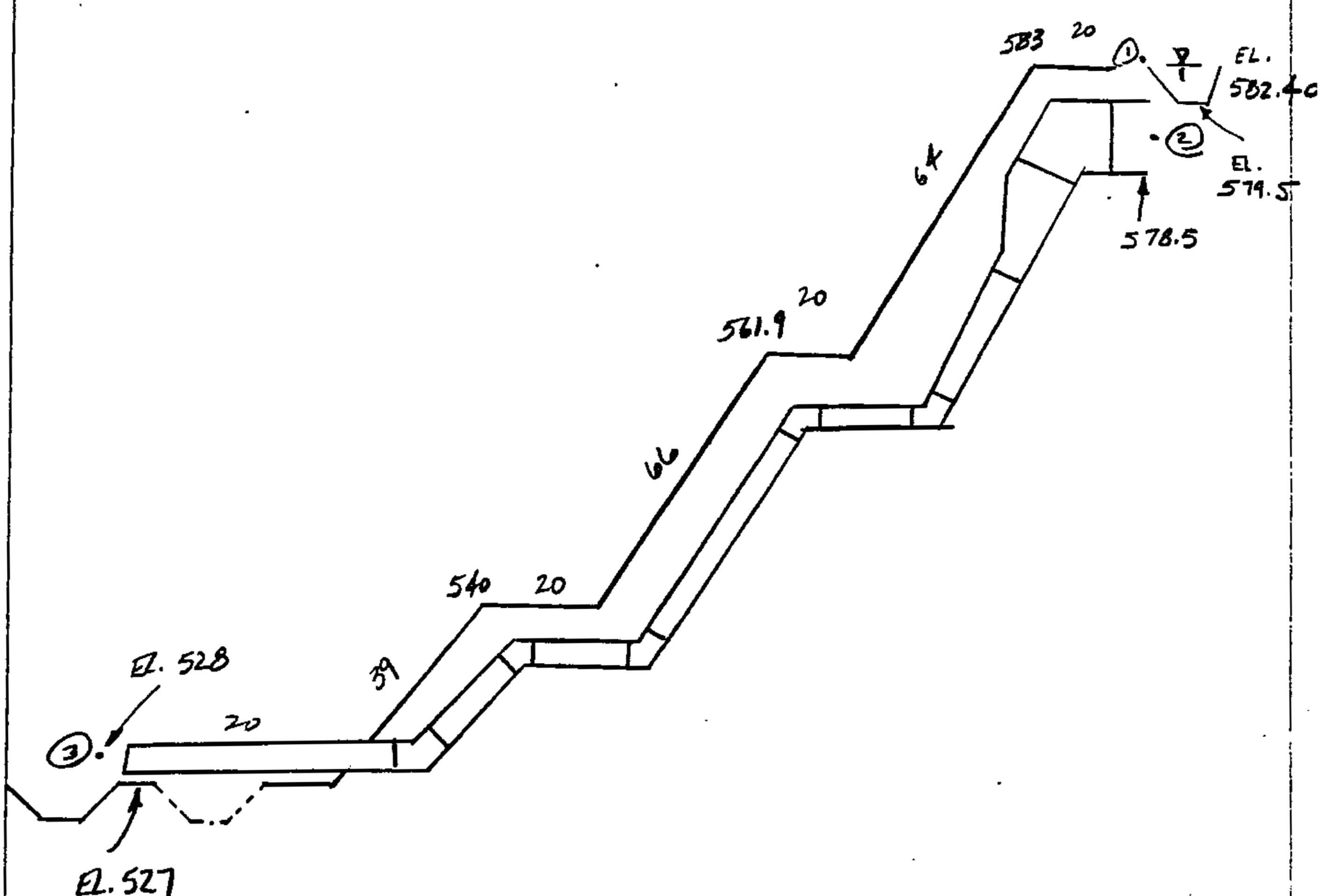
NOTE: DITCH WILL FLOW EVEN LESS FULL WHEN LEVEL III IS SEEDED.

PP&L Form 2454 (9-79)
Cat. # 973401

Dept. ______ PENNSYLVANIA POWER & LIGHT COMPANY ER No. ______
CALCULATION SHEET
Date ______ 19__
Designed by WJB PROJECT ______ Sht. No. 16 of 22
Approved by ______

SIZE LEVEL III SLOPE PIPES –

HEAD WATER DEPTH = 3.
WHICH IS OK FOR
INLET CONTROL W/36"ϕ PIPE



ASSUME 36"ϕ INLET & 24"ϕ SLOPE PIPE

$$Q_{36} = Q_{24}$$

$$\therefore \quad V_{36} = .444\, V_{24}$$

BERNOULLI Eq: ① ⟶ ③

$$\cancel{\frac{V_1^2}{2g}}^{\,0} + \cancel{\frac{P_1}{\gamma}}^{\,0} + Z_1 = \frac{V_3^2}{2g} + \cancel{\frac{P_3}{\gamma}}^{\,0} + Z_3 + \Sigma h_\ell$$

PP&L Form 2454 (9-79)
Cat. # 973401

Dept.	
Date 19	
Designed by WJB	
Approved by	

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT

ER No.

$$583 = \frac{V_{24}^2}{2g} + 528 + h_m + h_f$$

MINOR LOSSES:

$$\text{ENTRANCE} = \frac{.5 V_{36}^2}{2g} = \frac{.10 V_{24}^2}{2g}$$

$$1^{ST} \text{ BEND} = \frac{.17 V_{36}^2}{2g} = \frac{.03 V_{24}^2}{2g}$$

$$\text{CONTRACTION} = \frac{.22 V_{24}^2}{2g}$$

$$5 \text{ BENDS} = 5\left(\frac{.17 V_{24}^2}{2g}\right) = \frac{.85 V_{24}^2}{2g}$$

$$\frac{1.2 V_{24}^2}{2g}$$

FRICTION LOSSES:

ASSUMING $Q = 47$ cfs

$$h_{f_{36}} = \frac{14}{1000} \times 30 = .42$$

$$h_{f_{24}} = \frac{95}{1000} \times 229 = 21.76$$

22.18

$$583 = \frac{V_{24}^2}{2g} + 528 + \frac{1.2 V_{24}^2}{2g} + 22.18$$

$$32.82 = \frac{2.2 V_{24}^2}{2g}$$

$V_{24} = 30.99$ $\quad Q = 30.99(3.142) = 97$ cfs > 47 $\therefore$ OK

Cat. #973401

Dept.	PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET	ER No.
Date 19		
Designed by VJB	PROJECT	Sht. No. 18 of 92
Approved by		
HAB REVISED 5/96 FOR Q_{25}		

SOUTH WEST CLEAN DITCH — AREA = 25.35 ACRES

WEIGHTED S: $\dfrac{10.7(1) + 3.51(33) + 1.04(1) + 4.2(33) + 1.2(1) + 4.7(33)}{25.35}$

S = 16.6 say 16%

WEIGHTED CN: $\dfrac{10.7(78) + 3.51(78) + 1.04(90) + 4.2(78) + 1.2(90) + 4.7(78)}{25.35}$

CN = 79

DETERMINE PEAK Q:

for steep slope (16%) CN = 75 — Q_{25} = 77 CFS; Q = 63 cfs

for steep slope (16%) CN = 80 — Q_{25} = 90 CFS; Q = 78 cfs

CN	Q
75	63
79	x
80	78

$$\frac{79-75}{80-75} = \frac{x-63}{78-63}$$

x = 75

∴ for CN = 79 Q = 75 cfs

Q_{25} = 87 CFS

PP&L Form 2454 (9-79)
Cat. # 973401

Dept. ____________ Date ________ 19____ Designed by W J B Approved by ____
JAS REVISED 5/96 FOR Q_{25}

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ____________

ER No. ____________

Sht. No. 19 of 22

SOUTH EAST CLEAN DITCH — AREA = 24.66 ACRES

WEIGHTED S: $\dfrac{11.24(1) + 3.48(33) + 1.04(1) + 4.10(33) + 1.0(1) + 3.8(33)}{24.66}$

S = 15.8 say 16%

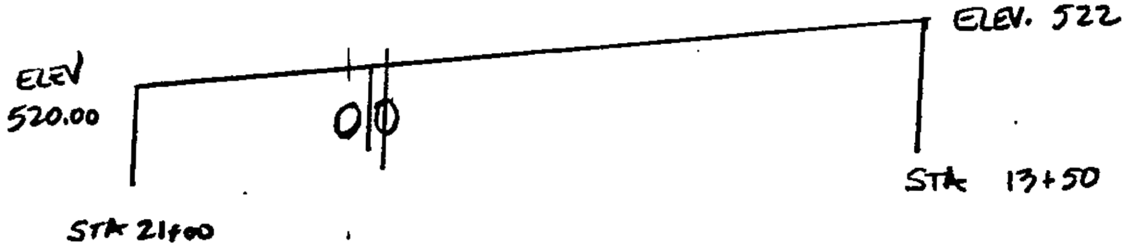
WEIGHTED CN: $\dfrac{11.24(78) + 3.48(78) + 1.04(90) + 4.1(78) + 1(90) + 3.8(78)}{24.66}$

CN = 79 Q_{25} = 87 CFS

FROM PREVIOUS PAGE Q = 75 cfs for 16% slope & CN=79

CHECK SOUTH DITCH CAPACITY

EAST SIDE



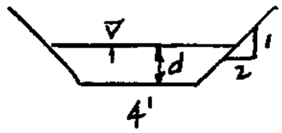
STA 19+84.4
ELEV 520.30 TOP OF PIPE
+ .16 2" CONCRETE COVER
520.46

S = $\dfrac{522 - 520.46}{19+84.4 - 13+50}$ = .0024 ⟵ CRITICAL

WEST SIDE

S = $\dfrac{522 - 520}{2700 - 2100}$ = .0033

$$Q = \frac{1.486\, A s^{1/2} r^{2/3}}{n}$$



$S = .0024$
$n = .023$ (EARTH CHANNEL)

TRIAL	ASSUMED d	A	P	r	v	Q
1	2	16.0	12.94	1.24	3.6	57.6 cfs
2	2.5	22.5	15.18	1.48	4.1	92.25 cfs

$$Q = (k'/n)\, b^{8/3} s^{1/2}$$

$$75 = (k'/.023)(4)^{8/3}(.0024)^{1/2}$$

$$k' = .873$$

.55	.826
x	.873
.60	.990

$$\frac{x - .55}{.05} = \frac{.047}{.164}$$

$$x = .564$$

$$y/b = .564 \Rightarrow y = 2.26'$$

PP&L Form 2454 (9-79)
Cat. # 973401

Dept. ______ Date ______19____ Designed by W J B Approved by ______

JAB REVISED 5/96 FOR Q_{25}

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ______

ER No. ______

CLEAN RUNOFF CULVERTS AREA = 50.01 ACRES

WEIGHTED S:
$$\frac{1(10.7+11.24+1.04+1.04+1.2+1.0)+33(3.51+3.48+4.2+4.1+4.7+3.8)}{50.01}$$

S = 16.22 say 16%

WEIGHTED CN:
$$\frac{78(10.70+11.24+3.51+3.48+4.2+4.1+4.7+3.8)+90(1.04+1.04+1.2+1.0)}{50.01}$$

CN: 79

for steep slope (16%) CN 75 — Q_{25} = 135 CFS, Q = 110 cfs

for steep slope (16%) CN 80 — Q_{25} = 170 CFS, Q = 150 cfs

for S = 16% CN 79

75	110
79	Q
80	150

$$\frac{79-75}{80-75} = \frac{Q-110}{150-110}$$

→ Q = 142 cfs

Q_{25} = 163 CFS

PP&L Form 248 (9-79)
Cat. # 973401

Dept. ______
Date ______ 19___
Designed by WJB
Approved by ______

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ______

ER No. ______

DETERMINE DESIGN Q FOR CLEAN RUNOFF CULVERTS FOR THE STORMS SHOWN

$S = 16\%$ $A = 50.01$ Ac.

STORM	i	Q CN 75	Q CN 80	Q CN 79
5yr-24hr.	3.75	75	110	103
10yr-24hr.	4.5	110	150	142
25yr-24hr.	5.0	138	180	172
50yr-24hr.	5.5	160	205	196
100yr-24hr.	6.3	210	255	246

MONTOUR ASH AREA NO. 3

EVALUATE EXISTING DITCHES FOR Q_{25}

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SW Dirty Base Ditch JAS 5/96

Comment: Concrete Lined, with freeboard

Solve For Depth

Given Input Data:

Bottom Width.....	4.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.013
Channel Slope....	0.0028 ft/ft
Discharge........	135.00 cfs

Computed Results:

Depth............	2.20 ft
Velocity.........	7.33 fps
Flow Area........	18.42 sf
Flow Top Width...	12.78 ft
Wetted Perimeter.	13.82 ft
Critical Depth...	2.28 ft
Critical Slope...	0.0024 ft/ft
Froude Number....	1.08 (flow is Supercritical)

MONTOUR ASH AREA NO. 3

EVALUATE EXISTING DITCHES FOR Q_{25}

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SW Dirty Base Ditch JAB 5/96

Comment: Concrete Lined, No freeboard

Solve For Discharge

Given Input Data:

Bottom Width.....	4.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.013
Channel Slope....	0.0028 ft/ft
Depth...........	3.00 ft

Computed Results:

Discharge........	260.75 cfs
Velocity.........	8.69 fps
Flow Area........	30.00 sf
Flow Top Width...	16.00 ft
Wetted Perimeter.	17.42 ft
Critical Depth...	3.17 ft
Critical Slope...	0.0022 ft/ft
Froude Number....	1.12 (flow is Supercritical)

MONTOUR ASH AREA NO.3

EVALUATE EXISTING DITCHES FOR Q25

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SW Clean Base Ditch JHS 5/96

Comment: Grassed WITH FREEBOARD

Solve For Depth

Given Input Data:

Bottom Width.....	4.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.027
Channel Slope....	0.0037 ft/ft
Discharge........	87.00 cfs

Computed Results:

Depth............	2.36 ft
Velocity.........	4.22 fps
Flow Area........	20.62 sf
Flow Top Width...	13.45 ft
Wetted Perimeter.	14.57 ft
Critical Depth...	1.81 ft
Critical Slope...	0.0109 ft/ft
Froude Number....	0.60 (flow is Subcritical)

MONTOUR ASH AREA NO. 3
EVALUATE EXISTING DITCHES FOR Q_{25}

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SW Clean Base Ditch   JAB 5/96

Comment: Grassed, NO FREEBOARD

Solve For Discharge

Given Input Data:

Bottom Width.....	4.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.027
Channel Slope....	0.0037 ft/ft
Depth...........	3.00 ft

Computed Results:

Discharge........	144.32 cfs
Velocity.........	4.81 fps
Flow Area........	30.00 sf
Flow Top Width...	16.00 ft
Wetted Perimeter.	17.42 ft
Critical Depth...	2.36 ft
Critical Slope...	0.0103 ft/ft
Froude Number....	0.62 (flow is Subcritical)

MONTOUR ASH AREA NO. 3

EVALUATE EXISTING DITCHES FOR Q_{25}

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Bench ditch   JAS 5/94

Comment: Lined with shale, WITH FREEBOARD

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.025
Channel Slope....	0.0047 ft/ft
Discharge........	25.00 cfs

Computed Results:

Depth............	1.58 ft
Velocity.........	3.36 fps
Flow Area........	7.45 sf
Flow Top Width...	9.45 ft
Wetted Perimeter.	9.97 ft
Critical Depth...	1.34 ft
Critical Slope...	0.0112 ft/ft
Froude Number....	0.67 (flow is Subcritical)

MONTOUR ASH AREA NO. 3

EVALUATE EXISTING DITCHES FOR Q_{25}

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Bench ditch JAB 5/94

Comment: Lined with shale, NO FREEBOARD

Solve For Discharge

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.025
Channel Slope....	0.0047 ft/ft
Depth............	2.50 ft

Computed Results:

Discharge........	85.60 cfs
Velocity.........	4.57 fps
Flow Area........	18.75 sf
Flow Top Width...	15.00 ft
Wetted Perimeter.	15.81 ft
Critical Depth...	2.19 ft
Critical Slope...	0.0095 ft/ft
Froude Number....	0.72 (flow is Subcritical)

7/8

MONTOUR ASH AREA NO. 3
EVALUATE EXISTING DITCHES FOR Q25

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Ditch to Stream JAB 5/96

Comment: Riprap, WITH FREEBOARD

Solve For Depth

Given Input Data:

Bottom Width.....	16.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0010 ft/ft
Discharge........	322.00 cfs

Computed Results:

Depth............	4.15 ft
Velocity.........	3.20 fps
Flow Area........	100.72 sf
Flow Top Width...	32.58 ft
Wetted Perimeter.	34.54 ft
Critical Depth...	2.12 ft
Critical Slope...	0.0115 ft/ft
Froude Number....	0.32 (flow is Subcritical)

MONTOUR ASH AREA NO.3
EVALUATE EXISTING DITCHES FOR Q25

8/8

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Ditch to Stream JAS 5/96

Comment: Riprap , NO FREEBOARD

Solve For Discharge

Given Input Data:

Bottom Width.....	16.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0010 ft/ft
Depth...........	4.50 ft

Computed Results:

Discharge........	375.79 cfs
Velocity.........	3.34 fps
Flow Area........	112.50 sf
Flow Top Width...	34.00 ft
Wetted Perimeter.	36.12 ft
Critical Depth...	2.33 ft
Critical Slope...	0.0112 ft/ft
Froude Number....	0.32 (flow is Subcritical)

Stormwater Routing Calculations

Application for Residual Waste Minor Permit Modification

Storm Routing Calculations

Pennsylvania Power and Light Company
Montour Steam Electric Station
Ash Area No. 3 Leachate Runoff Basin

STORM ROUTING w/ PUMPS 1/9

POND-2 Version: 5.17 S/N: Page 1
EXECUTED: 06-08-1995 12:54:52 Return Freq: 25 years

```
**********************************************************************
*                                                                    *
*        Multiple Storms Routed thru Leachate/Runoff Basin           *
*             Ponding Behind L/R Basin Inlet Culvert                 *
*  Pumps in Operation: 2700 GPM at el 517.00, 4500 GPM at el. 520.0  *
*                                                                    *
*                                                                    *
**********************************************************************
```

≈ 6 cfs ≈ 10 cfs

Inflow Hydrograph: AB25YRIN.HYD
Rating Table file: PUMPS-ON.PND

----INITIAL CONDITIONS----
Elevation = 517.00 ft
Outflow = 6.00 cfs
Storage = 0.58 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
517.00	6.0	0.577	139.7	145.7
517.33	6.0	0.989	239.4	245.4
517.67	6.0	1.423	344.4	350.4
518.00	6.0	1.880	455.0	461.0
518.33	6.0	2.364	572.1	578.1
518.67	6.0	2.880	697.0	703.0
519.00	6.0	3.429	829.8	835.8
519.33	6.0	4.012	970.8	976.8
519.66	6.0	4.629	1120.3	1126.3
520.00	6.0	5.282	1278.3	1284.3
520.33	6.0	5.969	1444.6	1450.6
520.66	6.0	6.688	1618.5	1624.5
521.00	8.4	7.438	1800.0	1808.4
521.33	10.0	8.221	1989.6	1999.6
521.66	10.0	9.038	2187.2	2197.2
522.00	10.0	9.889	2393.1	2403.1
522.33	19.4	10.796	2612.7	2632.1
522.66	37.7	11.785	2852.1	2889.8
522.99	62.4	12.860	3112.2	3174.6
523.33	93.1	14.024	3393.8	3486.9
523.66	129.3	15.280	3697.9	3827.2
523.99	171.0	16.633	4025.2	4196.2
524.00	171.9	16.663	4032.4	4204.3

Time increment (t) = 0.100 hrs.

STORM ROUTING W/PUMPS 2/9

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB25YRIN.HYD
Outflow Hydrograph: AB25PUMP.HYD

Starting Pond W.S. Elevation = 517.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 148.00 cfs
Peak Outflow = 6.00 cfs PUMPS (NO OVERFLOW)
Peak Elevation = 520.63 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.58 ac-ft
Peak Storage From Storm = 6.05 ac-ft

Total Storage in Pond = 6.62 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>> Warning, initial pond outflow > 1st inflow ordinate. <<<<<

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

STORM ROUTING
W/PUMPS 3/9

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

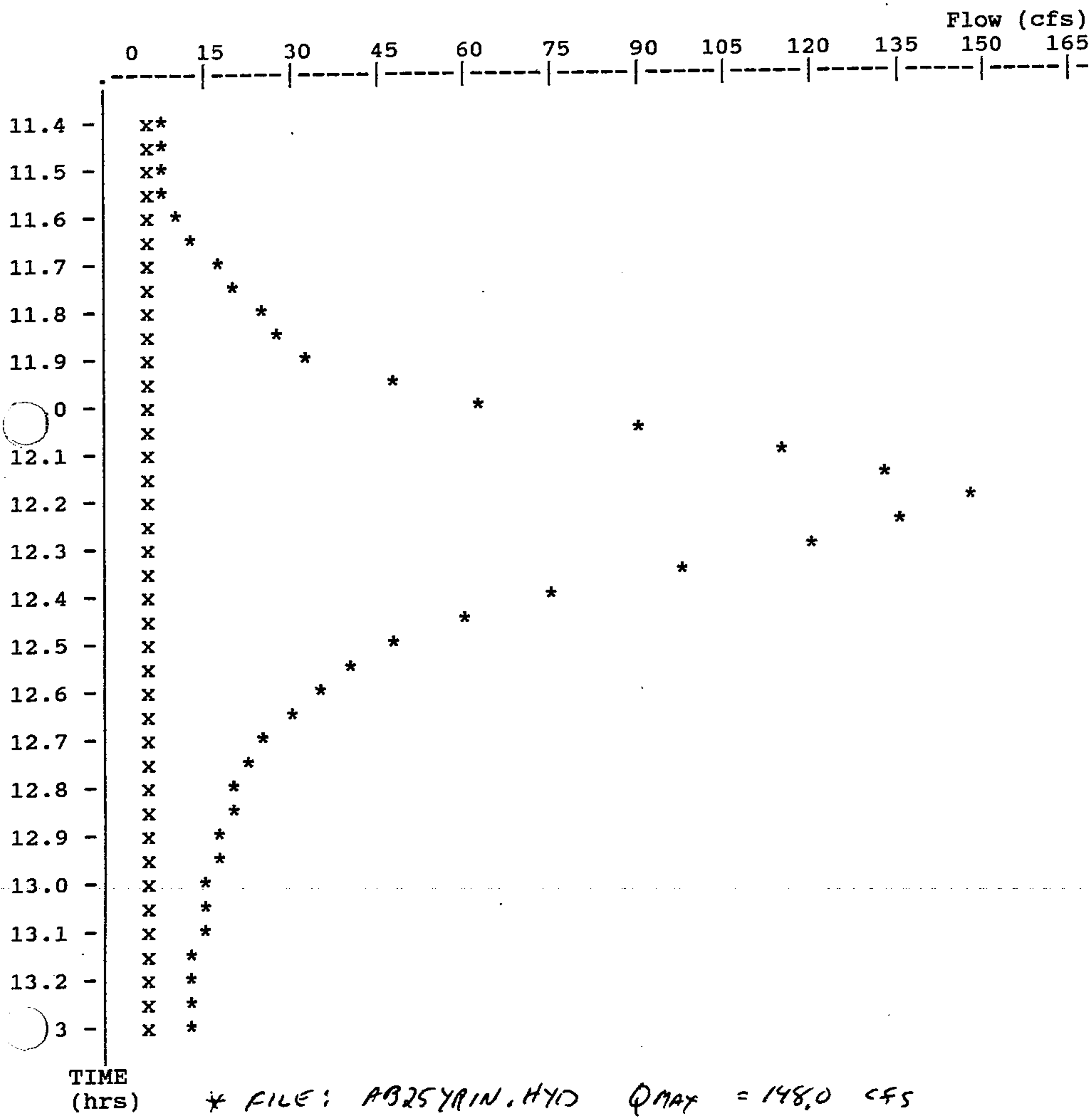
Page 3

Return Freq: 25 years

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB25YRIN.HYD
Outflow Hydrograph: AB25PUMP.HYD

EXECUTED: 06-08-1995
12:54:52

Peak Inflow = 148.00 cfs
Peak Outflow = 6.00 cfs
Peak Elevation = 520.63 ft



* FILE: AB25YRIN.HYD QMAX = 148.0 cfs

X FILE: AB25PUMP.HYD QMAX = 6.0 cfs

STORM ROUTING w/ PUMPS 4/9

EXECUTED: 06-08-1995 12:54:52 Return Freq: 50 years

```
**********************************************************************
*                                                                    *
*       Multiple Storms Routed thru Leachate/Runoff Basin            *
*            Ponding Behind L/R Basin Inlet Culvert                  *
* Pumps in Operation: 2700 GPM at el 517.00, 4500 GPM at el. 520.0   *
*                                                                    *
*                                                                    *
**********************************************************************
```

Inflow Hydrograph: AB50YRIN.HYD
Rating Table file: PUMPS-ON.PND

----INITIAL CONDITIONS----
Elevation = 517.00 ft
Outflow = 6.00 cfs
Storage = 0.58 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
517.00	6.0	0.577	139.7	145.7
517.33	6.0	0.989	239.4	245.4
517.67	6.0	1.423	344.4	350.4
518.00	6.0	1.880	455.0	461.0
518.33	6.0	2.364	572.1	578.1
518.67	6.0	2.880	697.0	703.0
519.00	6.0	3.429	829.8	835.8
519.33	6.0	4.012	970.8	976.8
519.66	6.0	4.629	1120.3	1126.3
520.00	6.0	5.282	1278.3	1284.3
520.33	6.0	5.969	1444.6	1450.6
520.66	6.0	6.688	1618.5	1624.5
521.00	8.4	7.438	1800.0	1808.4
521.33	10.0	8.221	1989.6	1999.6
521.66	10.0	9.038	2187.2	2197.2
522.00	10.0	9.889	2393.1	2403.1
522.33	19.4	10.796	2612.7	2632.1
522.66	37.7	11.785	2852.1	2889.8
522.99	62.4	12.860	3112.2	3174.6
523.33	93.1	14.024	3393.8	3486.9
523.66	129.3	15.280	3697.9	3827.2
523.99	171.0	16.633	4025.2	4196.2
524.00	171.9	16.663	4032.4	4204.3

Time increment (t) = 0.100 hrs.

STORM ROUTING w/ PUMPS 5/9

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB50YRIN.HYD
Outflow Hydrograph: AB50PUMP.HYD

Starting Pond W.S. Elevation = 517.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	167.00 cfs
Peak Outflow	=	8.21 cfs
Peak Elevation	=	520.97 ft

PUMPS (NO OVERFLOW)

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.58 ac-ft
Peak Storage From Storm	=	6.80 ac-ft
Total Storage in Pond	=	7.38 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>> Warning, initial pond outflow > 1st inflow ordinate. <<<<<

STORM ROUTING
w/ PUMPS 4/9

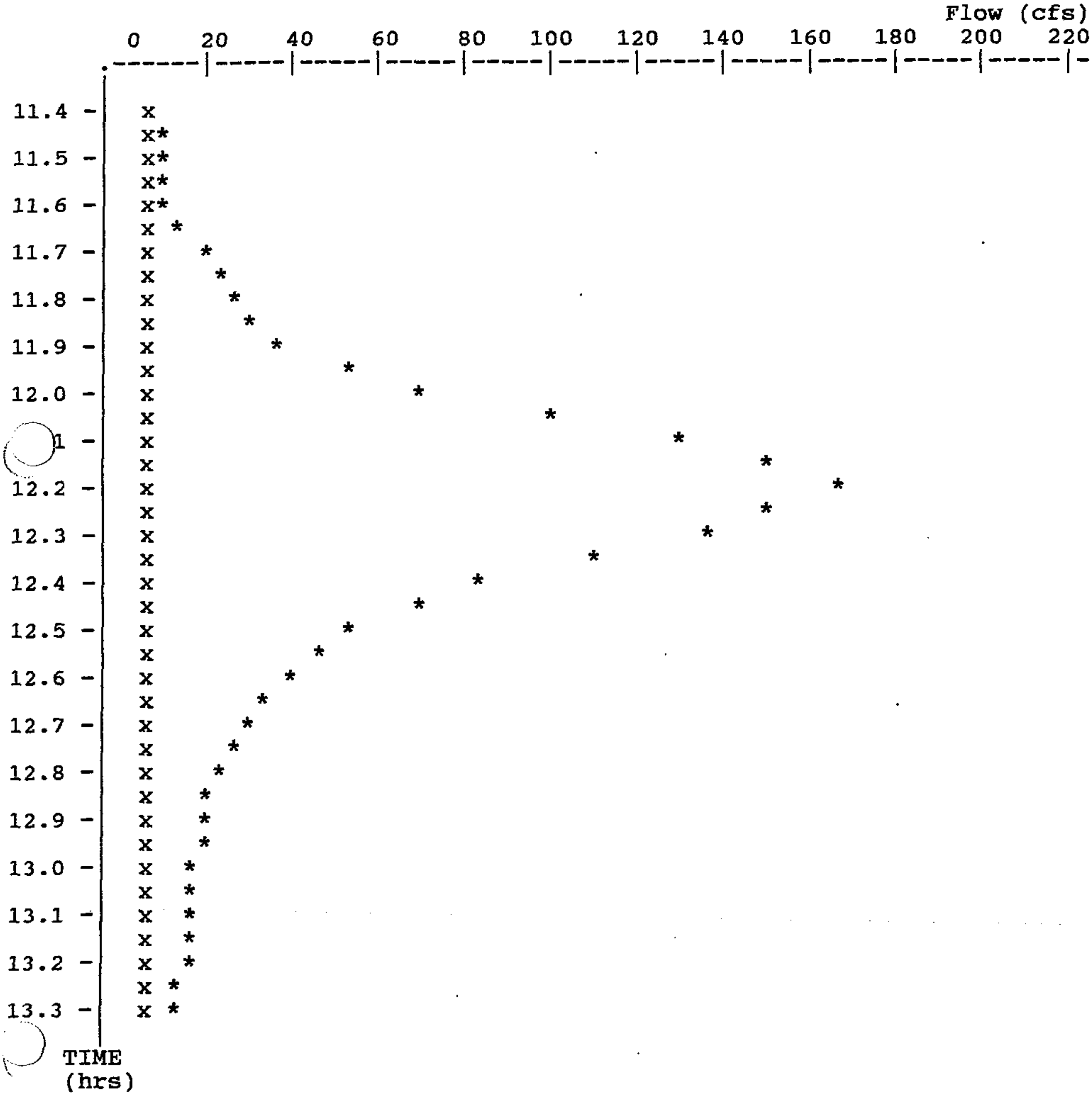
POND-2 Version: 5.17 S/N:

Return Freq: 50 years

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB50YRIN.HYD
Outflow Hydrograph: AB50PUMP.HYD

EXECUTED: 06-08-1995
12:54:52

Peak Inflow = 167.00 cfs
Peak Outflow = 8.21 cfs
Peak Elevation = 520.97 ft



* File: AB50YRIN.HYD Qmax = 167.0 cfs
x File: AB50PUMP.HYD Qmax = 8.2 cfs

STORM ROUTING w/PUMPS 7/9

Multiple Storms Routed thru Leachate/Runoff Basin
Ponding Behind L/R Basin Inlet Culvert
Pumps in Operation: 2700 GPM at el 517.00, 4500 GPM at el. 520.0

Inflow Hydrograph: AB100YIN.HYD
Rating Table file: PUMPS-ON.PND

----INITIAL CONDITIONS----
Elevation = 517.00 ft
Outflow = 6.00 cfs
Storage = 0.58 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
517.00	6.0	0.577	139.7	145.7
517.33	6.0	0.989	239.4	245.4
517.67	6.0	1.423	344.4	350.4
518.00	6.0	1.880	455.0	461.0
518.33	6.0	2.364	572.1	578.1
518.67	6.0	2.880	697.0	703.0
519.00	6.0	3.429	829.8	835.8
519.33	6.0	4.012	970.8	976.8
519.66	6.0	4.629	1120.3	1126.3
520.00	6.0	5.282	1278.3	1284.3
520.33	6.0	5.969	1444.6	1450.6
520.66	6.0	6.688	1618.5	1624.5
521.00	8.4	7.438	1800.0	1808.4
521.33	10.0	8.221	1989.6	1999.6
521.66	10.0	9.038	2187.2	2197.2
522.00	10.0	9.889	2393.1	2403.1
522.33	19.4	10.796	2612.7	2632.1
522.66	37.7	11.785	2852.1	2889.8
522.99	62.4	12.860	3112.2	3174.6
523.33	93.1	14.024	3393.8	3486.9
523.66	129.3	15.280	3697.9	3827.2
523.99	171.0	16.633	4025.2	4196.2
524.00	171.9	16.663	4032.4	4204.3

Time increment (t) = 0.100 hrs.

STORM ROUTING 8/9
W/ PUMPS

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB100YIN.HYD
Outflow Hydrograph: AB100PUM.HYD

Starting Pond W.S. Elevation = 517.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	199.00 cfs
Peak Outflow	=	10.00 cfs PUMPS (NO OVERFLOW
Peak Elevation	=	521.50 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.58 ac-ft
Peak Storage From Storm	=	8.06 ac-ft
Total Storage in Pond	=	8.64 ac-ft

Warning: Inflow hydrograph truncated on left side.

STORM ROUTING
w/ PUMPS 9/9

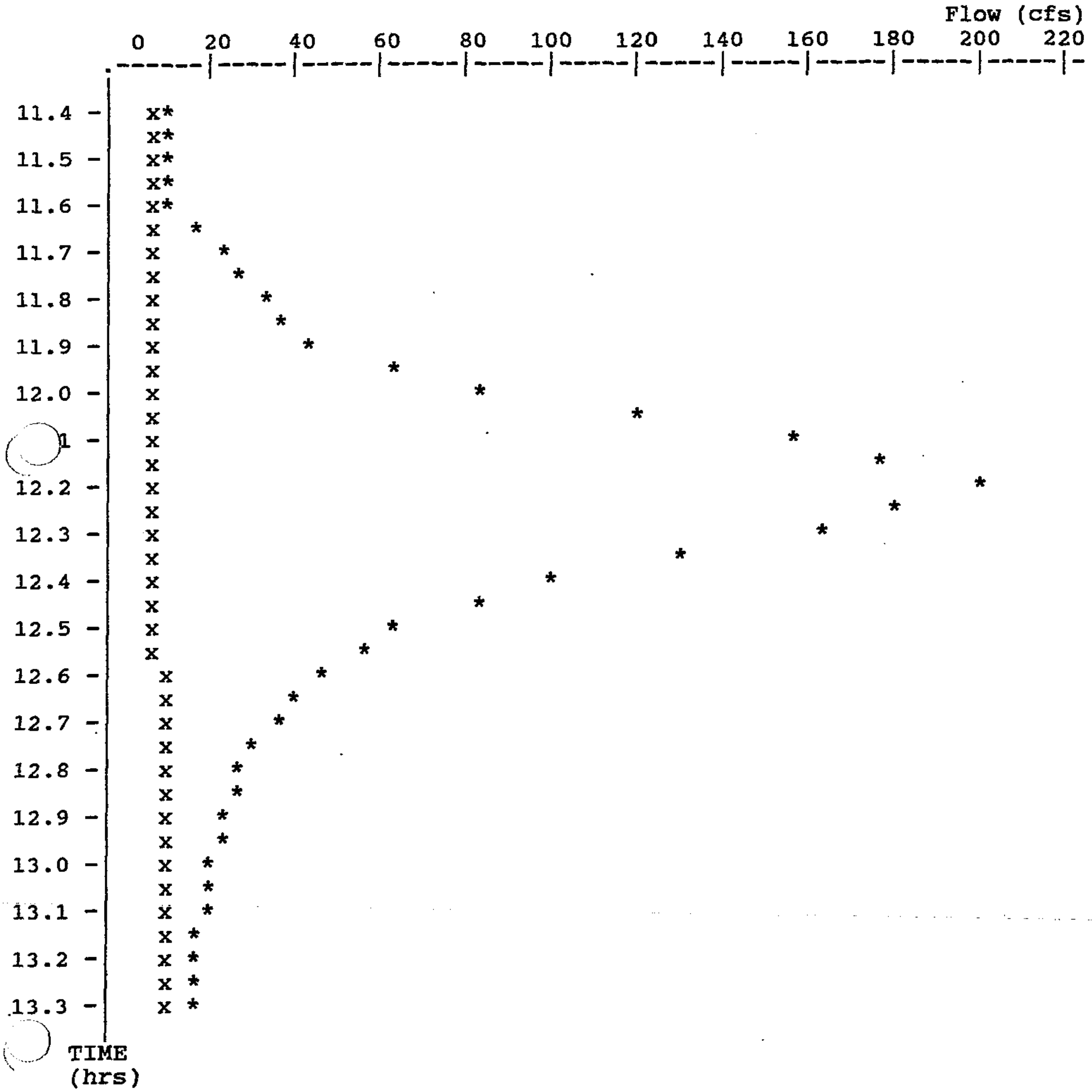
POND-2 Version: 5.17 S/N:

Page 3
Return Freq: 100 years

Pond File: PUMPS-ON.PND
Inflow Hydrograph: AB100YIN.HYD
Outflow Hydrograph: AB100PUM.HYD

EXECUTED: 06-08-1995
12:54:52

Peak Inflow = 199.00 cfs
Peak Outflow = 10.00 cfs
Peak Elevation = 521.50 ft



* File: AB100YIN.HYD Qmax = 199.0 cfs
x File: AB100PUM.HYD Qmax = 10.0 cfs

STORM ROUTING
W/O PUMPS 1/9

EXECUTED: 06-08-1995 12:33:36 Return Freq: 25 years

```
**********************************************************************
*                                                                    *
*          Multiple Storms Routed thru Leachate/Runoff Basin         *
*  Ponding Behind L/R Basin Inlet Culvert Included in Basin Capacit  *
*                                                                    *
*                                                                    *
*                                                                    *
**********************************************************************
```

PUMP FAILURE

Inflow Hydrograph: AB25YRIN.HYD
Rating Table file: TRAP16 .PND

----INITIAL CONDITIONS----
Elevation = 522.00 ft
Outflow = 0.00 cfs
Storage = 9.90 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
522.00	0.0	9.902	2396.2	2396.2
522.25	6.2	10.576	2559.5	2565.7
522.50	18.0	11.297	2733.8	2751.8
522.75	33.7	12.064	2919.5	2953.2
523.00	52.9	12.880	3117.0	3169.9
523.25	75.5	13.747	3326.7	3402.2
523.50	101.2	14.665	3548.9	3650.1
523.75	130.0	15.637	3784.0	3914.0
524.00	161.9	16.663	4032.4	4194.3

Time increment (t) = 0.100 hrs.

STORM ROUTING
W O / PUMPS 2/9

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: TRAP16 .PND
Inflow Hydrograph: AB25YRIN.HYD
Outflow Hydrograph: 25TRAPOU.HYD

Starting Pond W.S. Elevation = 522.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 148.00 cfs
Peak Outflow = 64.71 cfs
Peak Elevation = 523.13 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 9.90 ac-ft
Peak Storage From Storm = 3.43 ac-ft

Total Storage in Pond = 13.33 ac-ft

Warning: Inflow hydrograph truncated on left side.

STORM ROUTING
w/o PUMPS 3/9

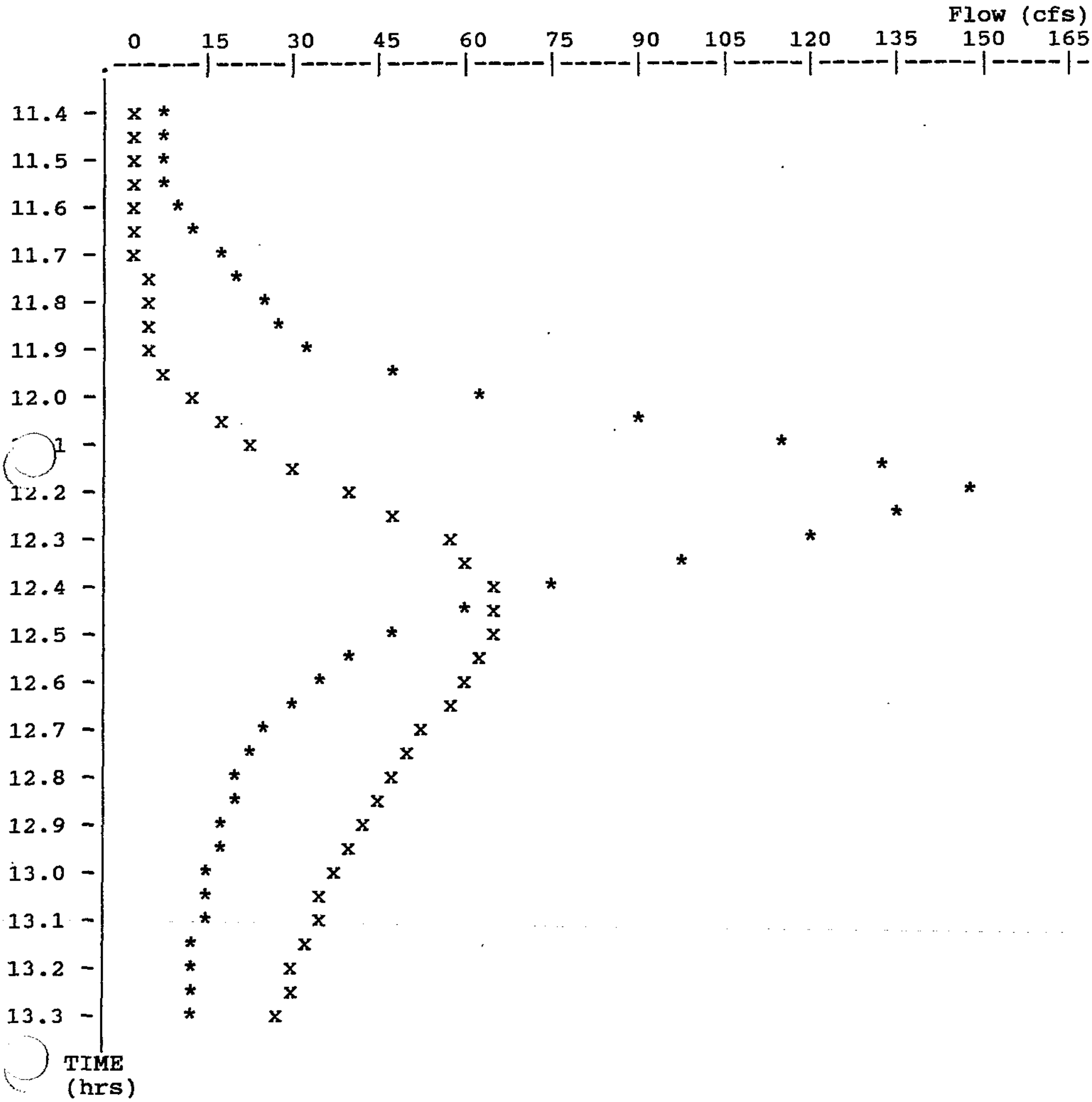
POND-2 Version: 5.17 S/N:

Return Freq: 25 years

Pond File: TRAP16 .PND
Inflow Hydrograph: AB25YRIN.HYD
Outflow Hydrograph: 25TRAPOU.HYD

EXECUTED: 06-08-1995
12:33:36

Peak Inflow = 148.00 cfs
Peak Outflow = 64.71 cfs
Peak Elevation = 523.13 ft



* File: AB25YRIN.HYD Qmax = 148.0 cfs
x File: 25TRAPOU.HYD Qmax = 64.7 cfs

STORM ROUTING
W/O PUMPS 4/9

EXECUTED: 06-08-1995 12:33:36 Return Freq: 50 years

```
*************************************************************************
*                                                                       *
*         Multiple Storms Routed thru Leachate/Runoff Basin             *
*  Ponding Behind L/R Basin Inlet Culvert Included in Basin Capacit     *
*         PUMP FAILURE                                                  *
*                                                                       *
*                                                                       *
*************************************************************************
```

Inflow Hydrograph: AB50YRIN.HYD
Rating Table file: TRAP16 .PND

----INITIAL CONDITIONS----
Elevation = 522.00 ft
Outflow = 0.00 cfs
Storage = 9.90 ac-ft

GIVEN POND DATA / INTERMEDIATE ROUTING COMPUTATIONS

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
522.00	0.0	9.902	2396.2	2396.2
522.25	6.2	10.576	2559.5	2565.7
522.50	18.0	11.297	2733.8	2751.8
522.75	33.7	12.064	2919.5	2953.2
523.00	52.9	12.880	3117.0	3169.9
523.25	75.5	13.747	3326.7	3402.2
523.50	101.2	14.665	3548.9	3650.1
523.75	130.0	15.637	3784.0	3914.0
524.00	161.9	16.663	4032.4	4194.3

Time increment (t) = 0.100 hrs.

STORM ROUTING
WO/PUMPS 5/9

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: TRAP16 .PND
Inflow Hydrograph: AB50YRIN.HYD
Outflow Hydrograph: 50TRAPOU.HYD

Starting Pond W.S. Elevation = 522.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 167.00 cfs
Peak Outflow = 74.82 cfs
Peak Elevation = 523.24 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	9.90 ac-ft
Peak Storage From Storm	=	3.82 ac-ft
Total Storage in Pond	=	13.72 ac-ft

Warning: Inflow hydrograph truncated on left side.

STORM ROUTING
WO/PUMPS 6/9

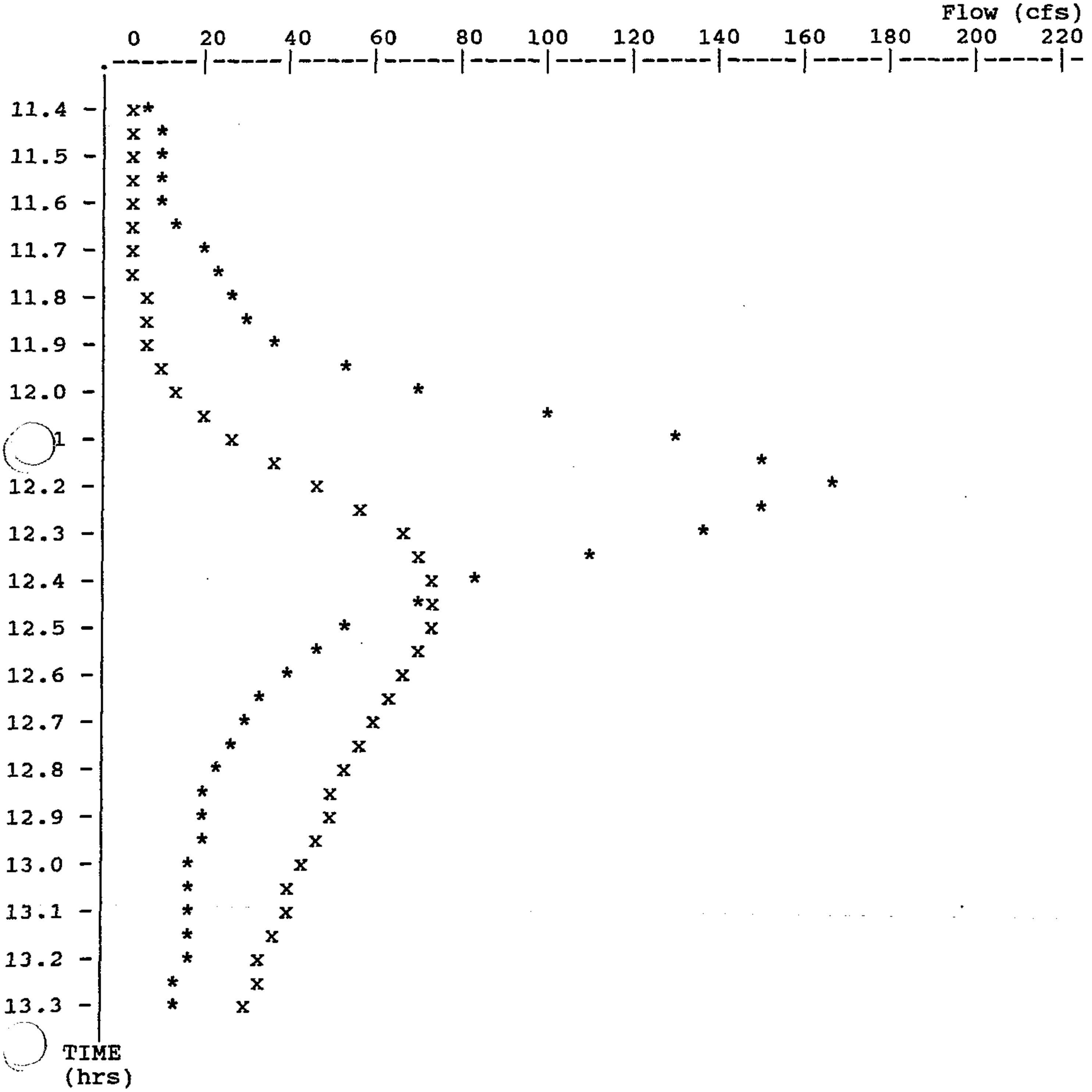
POND-2 Version: 5.17 S/N:

Return Freq: 50 years

Pond File: TRAP16 .PND
Inflow Hydrograph: AB50YRIN.HYD
Outflow Hydrograph: 50TRAPOU.HYD

EXECUTED: 06-08-1995
12:33:36

Peak Inflow = 167.00 cfs
Peak Outflow = 74.82 cfs
Peak Elevation = 523.24 ft



* File: AB50YRIN.HYD Qmax = 167.0 cfs
x File: 50TRAPOU.HYD Qmax = 74.8 cfs

STORM ROUTING
WO /PUMPS 7/9

Multiple Storms Routed thru Leachate/Runoff Basin
Ponding Behind L/R Basin Inlet Culvert Included in Basin Capacit

PUMP FAILURE

Inflow Hydrograph: AB100YIN.HYD
Rating Table file: TRAP16 .PND

----INITIAL CONDITIONS----
Elevation = 522.00 ft
Outflow = 0.00 cfs
Storage = 9.90 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
522.00	0.0	9.902	2396.2	2396.2
522.25	6.2	10.576	2559.5	2565.7
522.50	18.0	11.297	2733.8	2751.8
522.75	33.7	12.064	2919.5	2953.2
523.00	52.9	12.880	3117.0	3169.9
523.25	75.5	13.747	3326.7	3402.2
523.50	101.2	14.665	3548.9	3650.1
523.75	130.0	15.637	3784.0	3914.0
524.00	161.9	16.663	4032.4	4194.3

Time increment (t) = 0.100 hrs.

STORM ROUTING
W/O PUMPS 8/9

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: TRAP16 .PND
Inflow Hydrograph: AB100YIN.HYD
Outflow Hydrograph: 100TRAPO.HYD

Starting Pond W.S. Elevation = 522.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 199.00 cfs
Peak Outflow = 92.41 cfs
Peak Elevation = 523.41 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 9.90 ac-ft
Peak Storage From Storm = 4.45 ac-ft

Total Storage in Pond = 14.35 ac-ft

Warning: Inflow hydrograph truncated on left side.

STORM ROUTING
WO/PUMPS 9/9

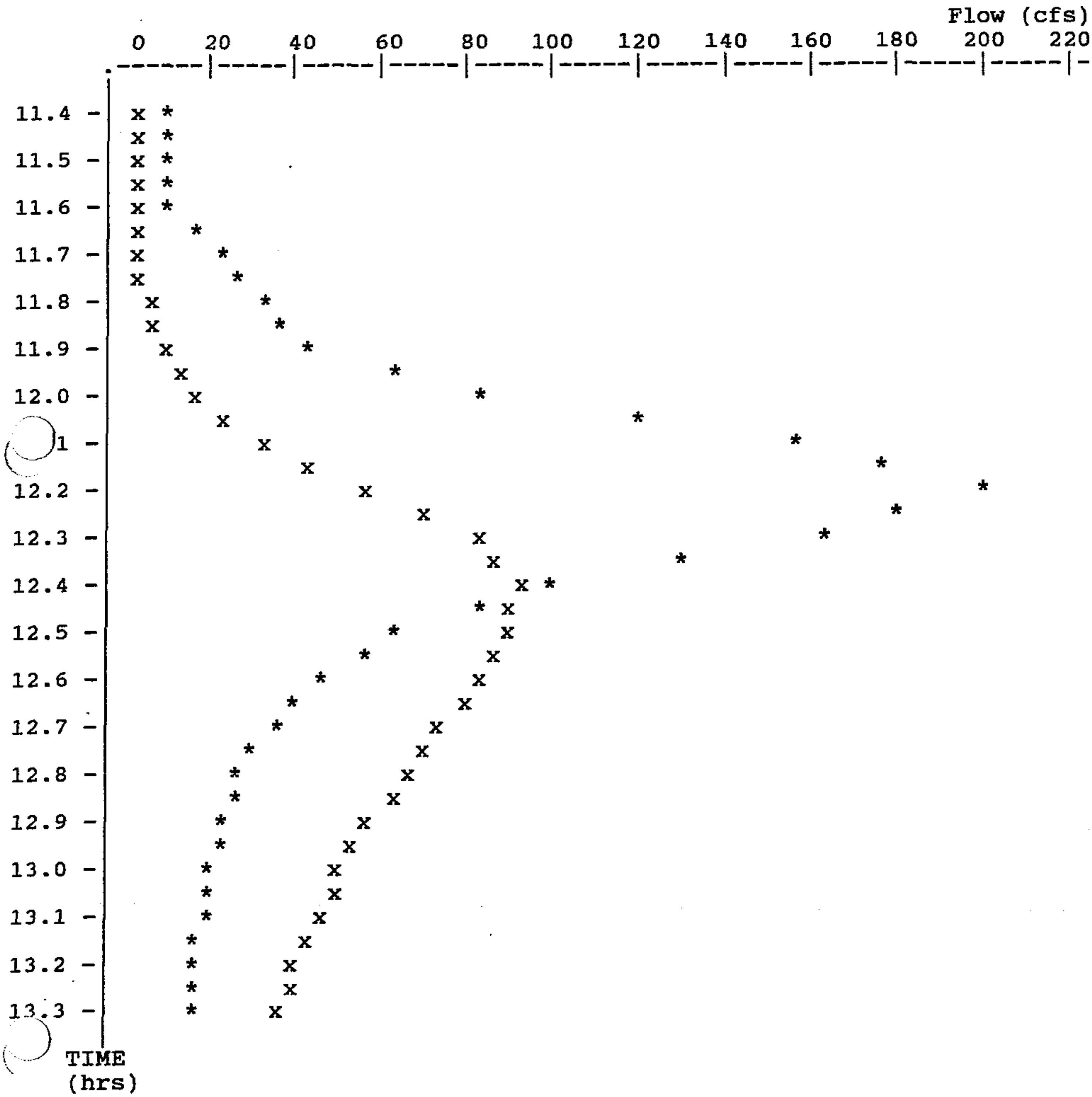
POND-2 Version: 5.17 S/N:

Page 3
Return Freq: 100 years

Pond File: TRAP16 .PND
Inflow Hydrograph: AB100YIN.HYD
Outflow Hydrograph: 100TRAPO.HYD

EXECUTED: 06-08-1995
12:33:36

Peak Inflow = 199.00 cfs
Peak Outflow = 92.41 cfs
Peak Elevation = 523.41 ft



* File: AB100YIN.HYD Qmax = 199.0 cfs
x File: 100TRAPO.HYD Qmax = 92.4 cfs

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB25YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Ash Pile Top	22.00	85.0	0.30	0.00	5.00	3.37	I.07	.10
Pile sides/base	14.00	91.0	0.20	0.00	5.00	3.98	I.04	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 36.00 acres or 0.05625 sq.mi
Peak discharge = 148 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Ash Pile Top	0.33	0.00	0.30	0.00	No	Computed Ia/p < .1
Pile sides/base	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB25YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Ash Pile Top	78	12.2
Pile sides/base	70	12.2
Composite Watershed	148	12.2

STORM HYDROGRAPHS 3/9

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB25YR.HYD

A&B Cells Only, C&D Cells Not Developed

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Ash Pile Top	2	3	5	14	27	52	78	78	53
Pile sides/base	2	3	4	18	35	64	70	42	22
Total (cfs)	4	6	9	32	62	116	148	120	75

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Ash Pile Top	33	23	17	13	9	8	7	6	5
Pile sides/base	14	11	9	7	6	5	5	4	4
Total (cfs)	47	34	26	20	15	13	12	10	9

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Ash Pile Top	5	4	4	4	3	3	3	2	2
Pile sides/base	3	3	3	3	2	2	2	2	2
Total (cfs)	8	7	7	7	5	5	5	4	4

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Ash Pile Top	2	2	2	1	0
Pile sides/base	2	1	1	1	0
TOTAL (CFS)	4	3	3	2	0

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB50YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Ash Pile Top	22.00	85.0	0.30	0.00	5.50	3.83	I.06	.10
Pile sides/base	14.00	91.0	0.20	0.00	5.50	4.47	I.04	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 36.00 acres or 0.05625 sq.mi
Peak discharge = 167 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Ash Pile Top	0.33	0.00	0.30	0.00	No	Computed Ia/p < .1
Pile sides/base	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB50YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Ash Pile Top	89	12.2
Pile sides/base	78	12.2
Composite Watershed	167	12.2

STORM HYDROGRAPHS 6/9

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB50YR.HYD

A&B Cells Only, C&D Cells Not Developed

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Ash Pile Top	3	4	5	16	31	59	89	89	60
Pile sides/base	2	3	5	20	39	72	78	47	24
Total (cfs)	5	7	10	36	70	131	167	136	84

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Ash Pile Top	37	26	19	15	11	9	8	7	6
Pile sides/base	16	13	10	8	7	6	5	5	4
Total (cfs)	53	39	29	23	18	15	13	12	10

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Ash Pile Top	6	5	4	4	4	3	3	3	3
Pile sides/base	4	3	3	3	3	2	2	2	2
Total (cfs)	10	8	7	7	7	5	5	5	5

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Ash Pile Top	2	2	2	2	0
Pile sides/base	2	2	1	1	0
TOTAL (cfs)	4	4	3	3	0

STORM HYDROGRAPHS 7/9

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB100YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Ash Pile Top	22.00	85.0	0.30	0.00	6.30	4.59	I.06	.10
Pile sides/base	14.00	91.0	0.20	0.00	6.30	5.25	I.03	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 36.00 acres or 0.05625 sq.mi
Peak discharge = 199 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Ash Pile Top	0.33	0.00	0.30	0.00	No	Computed Ia/p < .1
Pile sides/base	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

STORM HYDROGRAPHS 8/9

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB100YR.HYD

A&B Cells Only, C&D Cells Not Developed

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Ash Pile Top	107	12.2
Pile sides/base	92	12.2
Composite Watershed	199	12.2

STORM HYDROGRAPHS 9/9

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 06-08-1995 14:15:41
Watershed file: --> C:\PONDPACK\ABCELLS .MOP
Hydrograph file: --> C:\PONDPACK\AB100YR.HYD

A&B Cells Only, C&D Cells Not Developed

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Ash Pile Top	3	4	6	19	37	71	107	107	72
Pile sides/base	3	4	5	24	46	85	92	55	29
Total (cfs)	6	8	11	43	83	156	199	162	101

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Ash Pile Top	45	31	23	18	13	10	9	8	7
Pile sides/base	19	15	12	10	8	7	6	6	5
Total (cfs)	64	46	35	28	21	17	15	14	12

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Ash Pile Top	7	6	5	5	4	4	3	3	3
Pile sides/base	5	4	4	3	3	3	2	2	2
Total (cfs)	12	10	9	8	7	7	5	5	5

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Ash Pile Top	3	3	2	2	0
Pile sides/base	2	2	1	1	0
TOTAL (cfs)	5	5	3	3	0

CN + TC 1/6

TABULAR HYDROGRAPH METHOD MULTIPLE RUN OPTIONS {.MOP}

ABCELLS <-- This File .WSD File -->

Note: Don't input .WSD file if CN & Tc/Tt files are entered below titles.

Title: A&B Cells Only, C&D Cells Not Developed

ABCELLS <--.RCN File   Tc File: ABCELLS .TCT   Tt File: .

Specify TCT or TCM extension in the field after the Tc File and in the field after the Tt File.

Return Frequency (years):	2	25	50	100
24-hr Precip. (inches):	2.75	5.00	5.50	6.3
Hydrograph Files (.HYD):	AB2YR	AB25YR	AB50YR	AB100YR

SCS Distribution Type? II

Interpolate Ia/P (y/n)? Y

OUTPUT OPTIONS

* Input Data   * Peaks   * Hydrograph Summary   Hydrographs

<Esc> Exit   <F5> Compute

CN & TC 2/6

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:59 06-08-1995

RUNOFF CURVE NUMBER DATA

Composite Area: Ash Pile Top

SURFACE DESCRIPTION	AREA (acres)	CN	
Fly/bottom ash, not vegetated	22.00	85	
COMPOSITE AREA --->	22.00	85.0	(85)

Composite Area: Pile sides/base

SURFACE DESCRIPTION	AREA (acres)	CN	
Ash pile slopes, topsoil & veg.	5.50	85	
Haul Roads & Drainage Ditches	5.50	92	
Runoff pond	3.00	100	
COMPOSITE AREA --->	14.00	91.0	(91)

CN+TC 3/6

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:59 06-08-1995

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
Ash Pile Top	22.00	85
Pile sides/base	14.00	91

CN + TC 4/6

Quick TR-55 Ver.5.46 S/N:
Executed: 14:52:01 06-08-1995 c:\pondpack\ABCELLS.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Subarea descr.	Tc or Tt	Time (hrs)
Top of Pile	Tc	0.33
Pile Sides/Botm	Tc	0.20

CN+TC 5/6

Quick TR-55 Ver.5.46   S/N:
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Tc COMPUTATIONS FOR: Top of Pile

SHEET FLOW (Applicable to Tc only)

Segment ID		Top	
Surface description		Fly/botm ash	
Manning's roughness coeff., n		0.0230	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.750	
Land slope, s	ft/ft	0.0100	
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.12	= 0.12

SHALLOW CONCENTRATED FLOW

Segment ID		Top	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1000.0	
Watercourse slope, s	ft/ft	0.0100	
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.6135	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.17	= 0.17

CHANNEL FLOW

Segment ID		Bot Dit	
Cross Sectional Flow Area, a	sq.ft	10.50	
Wetted perimeter, Pw	ft	10.70	
Hydraulic radius, r = a/Pw	ft	0.981	
Channel slope, s	ft/ft	0.0040	
Manning's roughness coeff., n		0.0130	
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	7.1583	
Flow length, L	ft	900	
T = L / (3600*V)	hrs	0.03	= 0.03

:::

TOTAL TIME (hrs)   0.33

CN+TC 6/6

Quick TR-55 Ver.5.46   S/N:
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Tc COMPUTATIONS FOR: Pile Sides/Botm

SHEET FLOW (Applicable to Tc only)

Segment ID		Sides	
Surface description		Topsoil& Veg	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	75.0	
Two-yr 24-hr rainfall, P2	in	2.750	
Land slope, s	ft/ft	0.3300	
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.07	= 0.07

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		Bot Dit	
Cross Sectional Flow Area, a	sq.ft	8.00	
Wetted perimeter, Pw	ft	10.47	
Hydraulic radius, r = a/Pw	ft	0.764	
Channel slope, s	ft/ft	0.0029	
Manning's roughness coeff., n		0.0230	
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.9158	
Flow length, L	ft	1450	
T = L / (3600*V)	hrs	0.14	= 0.14

::

TOTAL TIME (hrs)   0.20

OUTLETS 1/6

DETENTION POND RATING TABLE (.PND)

TRAP16 — Pond File 522.00 — W.S. Elev. TRAP16 — Output File

Titles:Leachate/Runoff Basin Overflow
Trapezoidal Weir 16 ft wide with 2:1 side slopes

No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)	No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)
1	522.00	0.0	9.90185	12			
2	522.25	6.2	10.57635	13			
3	522.50	18.0	11.29659	14			
4	522.75	33.7	12.06408	15			
5	523.00	52.9	12.88032	16			
6	523.25	75.5	13.74681	17			
7	523.50	101.2	14.66505	18			
8	523.75	130.0	15.63655	19			
9	524.00	161.9	16.66281	20			
10				21			
11				22			

Esc —► Exit F1 —► Insert Line Ctrl-X —► Delete Line PgDn —► Page Ahead

DETENTION POND RATING TABLE (.PND)

PIPERISR — Pond File 522.00 — W.S. Elev. PIPERISR — Output File

Titles:Existing 48" diameter CMP riser overflow
Ash Area No. 3 L/R Basin

No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)	No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)
1	522.00	0.0	9.90185	12			
2	522.25	5.2	10.57635	13			
3	522.50	14.8	11.29659	14			
4	522.75	27.2	12.06408	15			
5	523.00	41.8	12.88032	16			
6	523.25	57.3	13.74681	17			
7	523.50	69.4	14.66505	18			
8	523.75	80.0	15.63655	19			
9	524.00	85.6	16.66281	20			
10				21			
11				22			

Esc —► Exit F1 —► Insert Line Ctrl-X —► Delete Line PgDn —► Page Ahead

OUTLETS 2/

DETENTION POND RATING TABLE {.PND}

PUMPS-ON — Pond File 517.00 — W.S. Elev. PUMPS-ON — Output File

Titles:One 2700 GPM Pump on at el 517.00
2nd 2700 GPM pump on at el 520.00

No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)	No.	Elevation (ft)	Outflow (cfs)	Storage (acre-ft)
1	517.00	6.0	0.5774	12	520.66	6.0	6.68784
2	517.33	6.0	0.98907	13	521.00	8.4	7.43815
3	517.67	6.0	1.42311	14	521.33	10.0	8.22134
4	518.00	6.0	1.88012	15	521.66	10.0	9.038
5	518.33	6.0	2.36425	16	522.00	10.0	9.8888
6	518.67	6.0	2.88026	17	522.33	19.4	10.79609
7	519.00	6.0	3.42907	18	522.66	37.7	11.78537
8	519.33	6.0	4.0117	19	522.99	62.4	12.86021
9	519.66	6.0	4.62914	20	523.33	93.1	14.02414
10	520.00	6.0	5.28242	21	523.66	129.3	15.28048
11	520.33	6.0	5.96945	22	523.99	171.0	16.63323

Esc —▸ Exit F1 —▸ Insert Line Ctrl-X —▸ Delete Line PgDn —▸ Page Ahead

OUTLETS 3/6

DETENTION POND VOLUMES {.VOL}

This File —► POND-DIT Scale (ft/in) —► 30 Screen No. 1

Titles: Leachate/Runoff Basin Storage Capacity
Ponding Behind Inlet Culvert Included in Capacity

	Elevation (ft)	Planimeter (sq.in.)	Area (acres)	(acres) $A1+A2+\sqrt{A1*A2}$	Volume (acre-ft)	ΣVolume (acre-ft)
	516.5	53.58	1.11	0.00	0.00	0.00
	518.0	68.13	1.41	3.76	1.88	1.88
	520.0	97.65	2.02	5.11	3.41	5.29
	522.0	126.25	2.61	6.92	4.61	9.90
	524.0	204.08	4.22	10.14	6.76	16.66

Esc —► Exit to Menu F1 —► Insert Line Ctrl-X —► Delete Line
PgUp —► Screen Back PgDn —► Screen Ahead Ctrl-P —► Print Data

OUTLETS 4/6

Outlet Structure File: TRAP16WR.STR

POND-2 Version: 5.17 S/N:
Date Executed: Time Executed:

****
Leachate/Runoff Basin Overflow
Trapezoidal Weir 16 ft wide with 2:1 side slopes

****

Outflow Rating Table for Structure #1
WEIR-XY Weir - Defined by X, Y Coordinates

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages	
522.00	0.0	E = Y min= 522	
522.25	6.2	W(ft)=17.0	Max. D(ft)=.25
522.50	18.0	W(ft)=18.0	Max. D(ft)=.5
522.75	33.7	W(ft)=19.0	Max. D(ft)=.750
523.00	52.9	W(ft)=20.0	Max. D(ft)=1.0
523.25	75.5	W(ft)=21.0	Max. D(ft)=1.25
523.50	101.2	W(ft)=22.0	Max. D(ft)=1.5
523.75	130.0	W(ft)=23.0	Max. D(ft)=1.75
524.00	161.9	W(ft)=24.0	Max. D(ft)=2.0

OUTLETS 5

Outlet Structure File: PIPERISR.STR

POND-2 Version: 5.17 S/N:
Date Executed: Time Executed:

****
Existing 48" diameter CMP riser overflow
Ash Area No. 3 L/R Basin

****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

STAND PIPE
Stand Pipe with weir or orifice flow

E1 elev.(ft)?	522.00
E2 elev.(ft)?	524.01
Crest elev.(ft)?	522.00
Diameter (ft)?	4
Weir coefficient?	3.33
Orifice coefficient?	0.6
Start transition elev.(ft) @ ?	
Transition height (ft)?	0.5

OUTLETS 4

Outlet Structure File: PIPERISR.STR

POND-2 Version: 5.17 S/N:
Date Executed: Time Executed:

****
Existing 48" diameter CMP riser overflow
Ash Area No. 3 L/R Basin

****

Outflow Rating Table for Structure #1
STAND PIPE Stand Pipe with weir or orifice flow

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation	Messages
522.00	0.0	Weir:	H =0.0
522.25	5.2	Weir:	H =.25
522.50	14.8	Weir:	H =.5
522.75	27.2	Weir:	H =.750
523.00	41.8	Weir:	H =1.0
523.25	57.3	Transition:	H =1.25
523.50	69.4	Transition:	H =1.5
523.75	80.0	Orifice:	H =1.75
524.00	85.6	Orifice:	H =2.0

Weir Cw = 3.33 Weir length = 12.56637 ft
Orifice Co = .6 Orifice area = 12.56637 sq.ft.
Q (cfs) = (Cw * L * H**1.5) or (Co * A * sqr(2*g*H))
Transition interpolated between elev. 523.1959 and 523.6959 ft
Weir equation = Orifice equation @ elev.= 523.4459 ft

Stream Enclosure Design Calculations

Cat. # 973401

Dept. ______	**PENNSYLVANIA POWER & LIGHT COMPANY**	ER No. 480230
Date ______ 19____	**CALCULATION SHEET**	
Designed by SEH	PROJECT ______	Sht. No. 1 of ____
Approved by ______	stream enclosure	

design stream enclosure
for upstream runoff

100 yr flood per 105.201
Dam Safety & Waterway Mgmt.
SCS method

tributary areas

		CN	slope
A1	45	83	2.%
A2	28	71	2.5
A6	22	71	1.9
	Σ 95		

$CN_{wtd} = 77$

avg. slope = %.3

100 yr 24 hr storm $i = 6.3$ inches
U.S. Weather Bureau

Hdbk. of Applied Hydrology
Fig 9-57 p 9-56

$Q_{mod} = 230 + .4(90) = 266$

$Q_{flat} = 135 + .4(70) = 163$

$Q_{2.3} = 220$ cfs

Cat. # 973401

Dept. ______	**PENNSYLVANIA POWER & LIGHT COMPANY** **CALCULATION SHEET**	ER No. ______
Date ______ 19____		
Designed by SEH	PROJECT ______	Sht. No. 2 of ____
Approved by ______	stream enclosure	

Stream enclosure

$d_c = 3.2'$ $\quad Q = 115$ cfs $\quad$ dia $= 48''$

slope $= \dfrac{521.5 - 516.0}{1630} = 0.0034$ $\quad n = 0.009$

$$Q_{full} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$= \frac{1.49}{.009}(12.56)(1)^{2/3}(.0034)^{1/2}$$

$$= 121 \text{ cfs}$$

$$Q_{115} = \frac{1.49}{.009} 10.78 (1.22)^{2/3} (S^{1/2})$$

$$S = \left[.0645/1.140\right]^2 = 0.0032 \quad \text{critical slope}$$

Cat. #973401

Dept. ______

Date ______ 19____

Designed by SEH

Approved by ______

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ______

stream enclosure

ER No. ______

Sht. No. 3 of ______

PROJECT: Montour SES
Ash Disposal Area 5-6

DESIGNER: SEH

DATE: 11·17·83

HYDROLOGIC AND CHANNEL INFORMATION

$Q_{100\,yr}$ 24 hr

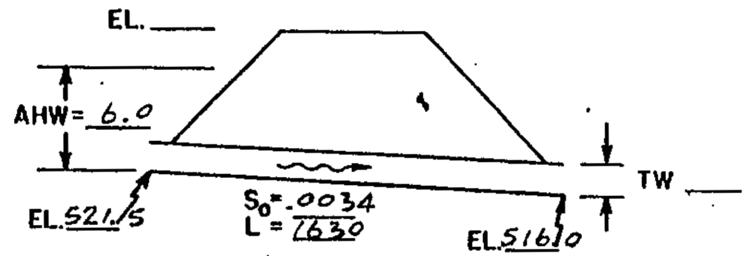
Q_1 = 220 cfs TW_1 = ______

Q_2 = ______ TW_2 = ______

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 48+61.97



MEAN STREAM VELOCITY = ______

MAX. STREAM VELOCITY = ______

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	INLET CONT. HW	OUTLET CONTROL $HW=H+h_0-LS_0$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
headwall	115	48	1.5	6.0	.5	7.2	3.2	3.6	3.6	3.6	5.5	5.3	6.0	11		2-48" ɸ

SUMMARY & RECOMMENDATIONS:

$n = 0.009\sqrt{\frac{1630}{500}} = 0.016$

$n = .012$ $H = 4.6$

$n = .024$ $H = 12.5$

$H_{.016} = 7.2$