PA COMPREHENSIVE MINE RECLAMATION STRATEGY

-SLIPPERY ROCK CREEK WATERSHED PROJECT-

DESIGN PLAN

SR 87 & SR 88

-AS PART OF THE FERRIS TREATMENT COMPLEX-

-This design plan is based on the topographic maps used in the Operation Scarlift deep mine seal areas developed by GWIN, DOBSON, & FOREMAN, Consulting Engineers 1973.

-A grid layout and topographic survey site specific to the construction area is currently in process.

-Funding provided by an EPA 104(b)(3) grant for the PA Comprehensive Mine Reclamation Strategy.

-Contracting and Accounting services provided by Penn's Corner Charitable Trust.

Roger D. Bowman, Mining Engineer
Department of Environmental Protection
Knox District Mining Office
September 1996

Revised: October 1996

MINERAL RESOURCES MANAGEMENT
BUREAU OF DISTRICT MINING OPERATONS - KNOX
PROJECT PLAN

DATE: September 12, 1996 **REQUESTED FUNDING:** $ 53,529.41

PROJECT SUBJECT: Remediation of Operation Scarlift Discharges SR 87 and SR 88 via EPA 104(b)(3) grant funding for the Slippery Rock Creek Watershed Project.

PROJECT OBJECTIVES/DESCRIPTION:
To retain metals and boost alkalinity in two AMD discharges in State Game Lands 95 on the Slippery Rock Creek. The project will consist of collecting both discharges and treating them by constructing a vertical flow compost cell/ retention basin/successuve alkaline-producing system as part of the Slippery Rock Creek Rehabilitation Plan of the Comprehensive Mine Reclamation Strategy (CMRS).

PROJECT START DATE: October 1, 1996

PROJECT LEADER (Include Tel. # & Office): Roger Bowman, (814) 797-1191
Knox District Mining Office

PROJECT PARTICIPANTS (% Time Required): *estimated over life of project - 3 years (12/95 - 11/98)

TECH STAFF		COMPLIANCE STAFF		SUPERVISORY		PENN'S CORNER R.C.&D.	
Roger Bowman	20%	Jim Plesakov	15%	Javed Mirza	<1%	Nevin Ulery	10%
Tim Gillen	10%			Lori Odenthal	<1%		
Tom Kovalchuk	5%			Tim Vandyke	2%		
				Phill Newell	<1%		

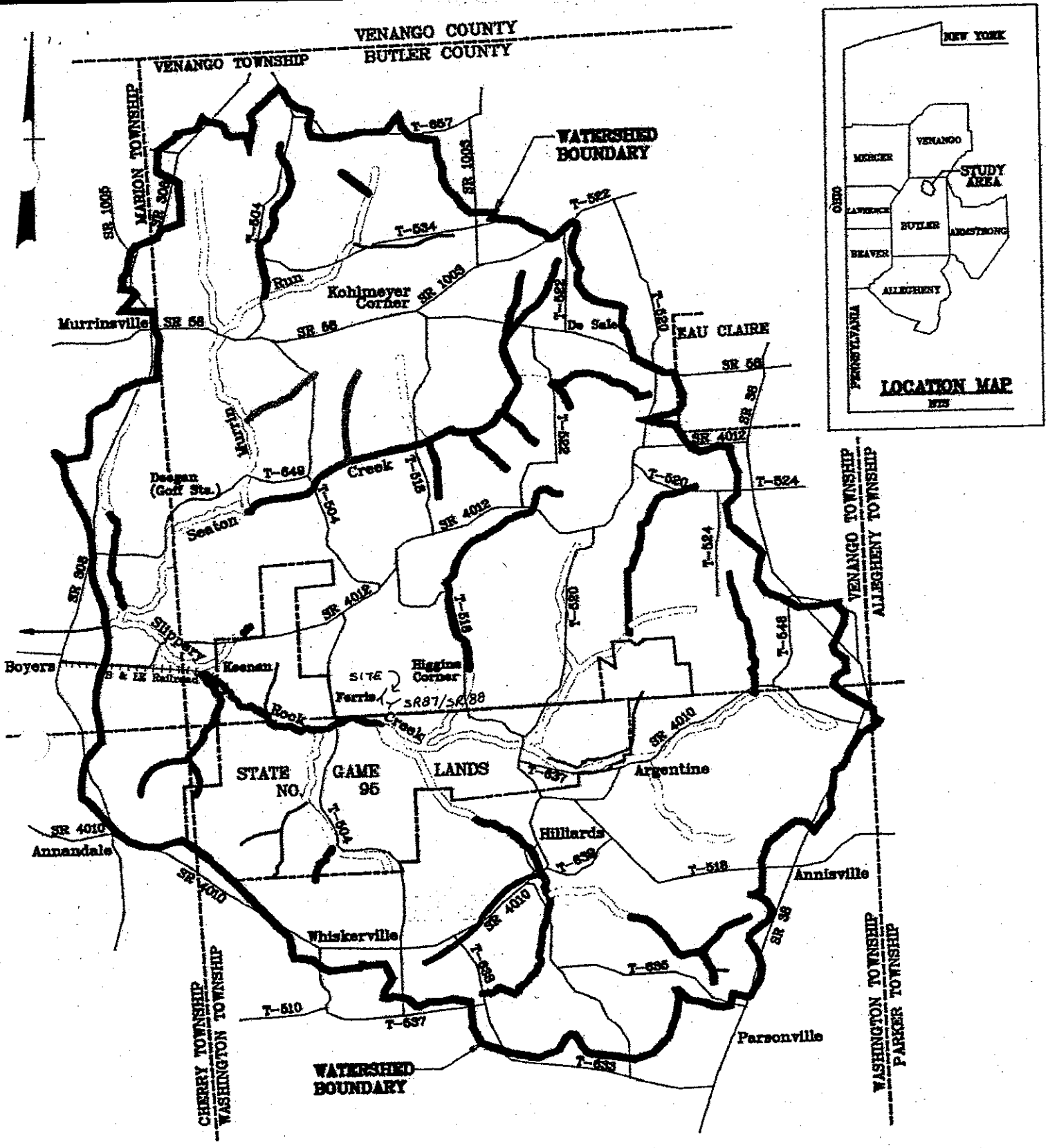
SCOPE OF WORK:
To construct passive treatment systems at SR 87 and SR 88 from Knox DMO design plans funded through an EPA 104(b)(3) grant with contracting and accounting services provided by Penn's Corner Charitable Trust.

SCHEDULE; MILESTONES; DELIVERABLES:
1. Develop design proposal for SR 87 and SR 88: 9/12/96
2. Penn's Corner R.C.&D. develops a "Scope of Work" proposal: 6/96 -10/96
3. Grid layout/Topographic survey of construction areas/Final design: 6/96 - 6/97
4. EPA 104(b)(3) holders in Harrisburg award contract to Penn's Corner Charitable Trust: 10/96 - 12/96
5. Contract bid time to construction industry: 1/97 - 3/97
6. Site construction of facilities: 5/97- 10/97
7. Construct asbuilts of facilities: 10/97
8. Monitor success of systems and report: 11/98

MEASURABLE OUTCOMES:

	APPROVALS:	**DATE:**
1. Draft design proposal:	Javed I. Mirza	1/16/96
2. Final design:		9/12/96
3. Construction completion:		
4. Report:		

STATUS (Include Date):
1. Completion of draft design proposal: 1/16/96
2. Completion of revised design proposal: 9/12/96



Key to Stream Quality Designations

- GOOD (pH > 6, acidity < alkalinity, iron < 1.0mg/l)
- MARGINAL/acid sensitive (pH 5 to 6, sulfates < 50mg/l)
- MARGINAL/acid drainage impacted (pH 5 to 6, sulfates > 50mg/l)
- POLLUTED (pH < 5, acidity > alkalinity, iron > 1.5mg/l)
- UNDESIGNATED

0 .5 1 2

GRAPHIC SCALE

STREAM QUALITY MAP

portion of

Slippery Rock Creek Watershed

(27 square miles)

Butler County, Pennsylvania

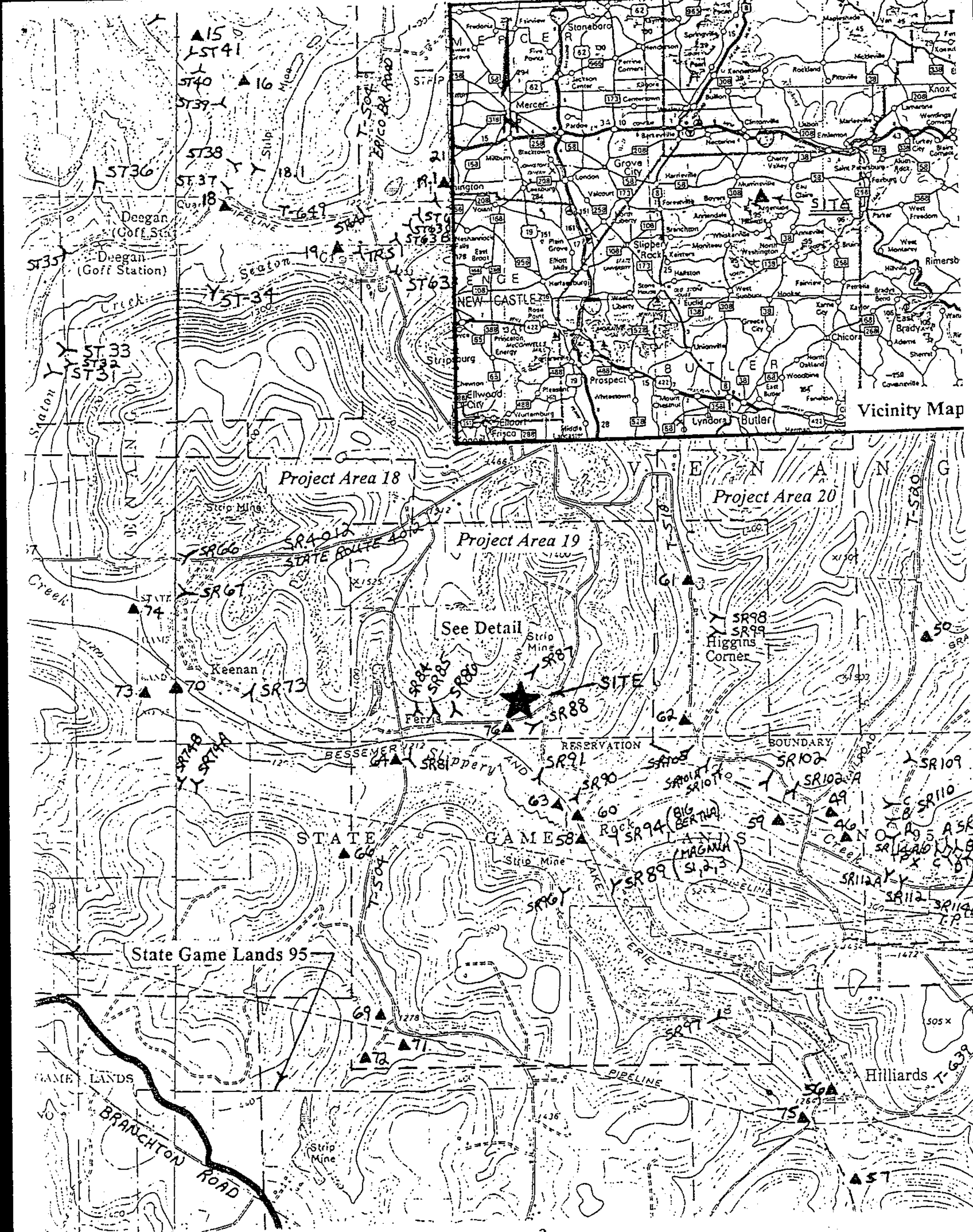
Scale: 1" = 1 mile Date: 12/94

Project Description:

The proposed plan to remediate Operation Scarlift discharges **SR 87** and **SR 88** is located in Venango township - Butler county, within PA State Game Lands No. 95. The project area is situated 1 mile south along T-504 from the S.R. 4012/T-504 intersection approximately 2500 feet east of T-504 on the north side of the main branch of Slippery Rock Creek. The project area also can be located by measuring 14.15 in. West by 18.70 in. North from the southeast corner (i.e. 41-00-00 lat./79-45-00 long.) of the Hilliards 7.5 minute topographic map. Geographic position of the construction site appears to be approximately 41-06-09 north latitude by 79-51-09 west longitude.

Construction of the passive system for **SR 87** and **SR 88** will be a portion of a combined remediation plan being referred to as the **"Ferris Treatment Complex"**. Discharges existing in this area are associated with abandoned deep mining activity on the Clarion coal seam and corresponding strip contour cuts near the crop. The following table represents the water quality for **SR 87** and **SR 88** sampled by the Knox DMO from 12/28/94 through 4/16/96:

		gpm	----------mg/l----------						lbs/day
Sample	Date	Flow	pH	iron	mang.	Al	SO_4	nt.acid	acid ld.
SR 87	3/01/95	122	3.80	1.43	2.20	3.32	109	40.0	58.52
SR 87	3/30/95	12	3.70	1.81	1.84	3.16	144	50.0	7.20
SR 87	5/25/95	36	3.70	1.19	1.54	2.62	114	40.0	17.27
SR 87	7/27/95	4	3.40	5.28	2.61	5.11	128	86.0	4.13
SR 87	11/02/95	11	3.50	1.35	3.45	4.22	188	60.0	7.91
SR 87	12/13/95	3	3.80	1.82	2.93	3.87	221	58.0	2.09
SR 87	1/10/96	6	3.70	3.30	3.15	6.49	217	62.0	4.46
SR 87	2/22/95	19	3.70	1.30	2.00	3.95	154	60.0	13.67
SR 87	4/16/95	9	3.40	1.58	1.28	4.18	159	58.0	6.26
SR 87	5/23/96	22	3.50	0.92	0.92	3.30	124	52.0	13.72
SR 87	6/26/96	10	3.30	1.85	1.53	5.26	148	240.0	28.78
SR 88	12/28/94	12	3.40	4.97	2.46	12.90	397	124.0	17.84
SR 88	3/01/95	15	3.40	2.71	1.41	6.24	209	78.0	14.03
SR 88	3/30/95	15	3.40	2.17	1.27	5.34	248	76.0	13.67
SR 88	5/25/95	28	3.50	2.14	1.40	5.84	265	70.0	23.50
SR 88	7/27/95	8	3.20	2.09	1.55	6.33	267	92.0	8.83
SR 88	8/30/95	5	3.10	4.75	2.17	9.17	275	124.0	7.44
SR 88	9/21/95	3	3.20	6.43	2.54	10.60	421	122.0	4.39
SR 88	10/12/95	4	3.20	7.35	2.76	11.10	339	152.0	7.29
SR 88	11/02/95	6	3.30	5.51	3.18	10.60	382	118.0	8.49
SR 88	1/25/96	16	3.50	3.66	2.41	8.92	283	112.0	21.49
SR 88	2/22/96	12	3.30	3.30	2.06	8.87	345	114.0	16.41
SR 88	3/19/96	18	3.40	2.22	1.40	6.16	234	96.0	20.72
SR 88	5/23/96	40	3.50	1.05	0.84	3.35	162	50.0	23.98
SR 88	6/26/96	14	3.30	2.31	1.67	7.41	277	344.0	57.75


Vicinity Map
Project Area 18
Project Area 19
Project Area 20
See Detail
SITE
State Game Lands 95
STATE GAME LANDS
Deegan (Goff Station)
Seaton Creek
STATE ROUTE 4012
Strip Mine
Keenan
Ferris
Higgins Corner
Hilliards
BESSEMER AND LAKE ERIE RAILROAD
RESERVATION BOUNDARY
Slippery Rock Creek
BRANCHTON ROAD
PIPELINE
Stripsburg
T-504
T-518
T-649
SR 94 (BIG BERTHA)
SR 89 (MAGMA S1, 2, 3)
Mercer
Grove City
Slippery Rock
New Castle
Butler
Ellwood City
Prospect
BUTLER
MERCER

The strategy behind passively treating Operation Scarlift discharges **SR 87** and **SR 88** has been divided into three phases of construction on State Game Lands No. 95 as follows:

I. Construct the **pre-treatment cell** (i.e. **CELL 1**) of the **vertical flow wetland** to retain aluminum and other metals present in both discharges.

II. Construct the **limestone basin** (i.e. **CELL 2**) of the **vertical flow wetland** to add alkalinity to the flow exitting from the pre-treatment cell.

III. Install the **collection system.** (consisting of:)

- Excavate the **collection ditch** and install the **culvert crossing** under the existing jeep trail to direct **SR 88** discharge to Cell 1.

- Excavate the **collection ditch** and construct the **check dam** to direct **SR 87** discharge to Cell 1.

-DESIGN SPECIFICATIONS-

Phase I: Pre-treatment Cell - CELL 1

- construct Cell 1 of **vertical flow wetland**

A. Excavation: Cut/Fill to design specifications
   1. Cut: (approximately) **4300 cubic yards**
   2. Fill: (approximately) **165 cubic yards**

B. Cell 1 Dimensions:
   1. Pond Bottom: **160 feet** by **10 feet**
   2. Bottom Elevation: **1222 feet**
   3. Top of embankment: **232 feet** by **50 feet**
   4. Top Elevation: **1234 feet**
   5. Depth: **12 feet**
   6. Inside Slopes: **3 : 1** (length) **1.7 : 1** (width - average)

- Install dewatering and discharge pipes in Cell 1.

  A. Dewatering Device
     1. **6" Schedule 40 PVC** Approximate Length: **125 feet**
     2. **6" Gate Valve** Quantity: **(1)**
     3. Dewatering Elevation: **1223 feet**

  B. Discharge Pipes (2 locations - combined amounts)
     1. **6" Schedule 40 PVC** Approximate Length: **115 feet**
     2. **6" Gate Valve** Quantity: **(2)**
     3. Discharge Elevation: **1230 feet**

  C. Lateral Pipes
     1. **6" perforated Schedule 40 PVC**
     2. Approximate Length: **450 feet**
        - (3) rows on 5 foot centers, 150 feet each

- Embed lateral pipes with **river gravel** at bottom of Cell 1

  A. **River Gravel** ($92.3\ yd^3$) **131 tons**
  B. Depth: (from pond bottom) **1.25 feet**

- Layer **AASHTO NO. 1/Spent Mushroom Compost** to a **2** foot depth above the river gravel (4 parts compost - 1 part AASHTO)

  A. AASHTO NO. 1: ($46\ yd^3$) **60 tons**
  B. Spent Mushroom Compost amount: ($183\ yd^3$) **124 tons**

Phase II: Limestone Basin - CELL 2

- construct Cell 2 of **vertical flow wetland**

A. Excavation: Cut/Fill to design specifications
   1. Cut: (approximately) **1185 cubic yards**
   2. Fill: (approximately) **5100 cubic yards**

B. Cell dimensions:
   1. Pond Bottom: **120 feet** by **18 feet**
   2. Bottom Elevation: **1220 feet**
   3. Top of embankment: **192 feet** by **66 feet**
   4. Top Elevation: **1232 feet**
   5. Depth: **12 feet**
   6. Inside Slopes: **3 : 1** (length) **2 : 1** (width)
   7. Outside Slopes: **3 : 1**

- Install dewatering and discharge pipes in Cell 2.

A. Dewatering Device
   1. **6" Schedule 40 PVC** Approximate Length: **100 feet**
   2. **6" Gate Valve** Quantity: **(1)**
   3. Dewatering Elevation: **1223 feet**

B. Discharge Pipe: **(Inline Water Level Control Structure)**
   1. **6" Schedule 40 PVC** Approximate Length: **100 feet**
   2. Install **Inline Water Level Control Structure** in embankment
      - Pipe Size: **6"** Height: **12 feet**

C. Lateral Pipes
   1. **6" perforated Schedule 40 PVC**
   2. Approximate Length: **330 feet**
      - (3) rows on 5 foot centers, 110 feet each

- Embed lateral pipes with **AASHTO No. 1** Graded Limestone to **5 foot** depth in **CELL 2**.
   1. AASHTO No. 1 - washed, graded limestone, 80% $CaCO_3$.
   2. Volume: (670 yd^3) **900 tons**

♦ Phase III: SR 87/SR 88 Collection System

A. Excavate collection ditch to direct **SR 88** discharge to Cell 1 of vertical flow wetland.
   1. Vee type ditch, 3.75 feet in depth, excavation: 40 yd^3 (approx.)
   2. 100 feet in length at a 2% slope, Inlet elevation: **1232 feet**
   3. Channel lining: R-5 (9" avg.) Rip-R ap, Volume: 35 tons (approx.)
   4. Install **15" diameter CMP culvert crossing** to direct SR 88 discharge under existing jeep trail. Length: **30 feet** (approx.)

B. Excavate collection ditch to direct **SR 87** discharge to Cell 1 of vertical flow wetland.
   1. Vee type ditch, 3.75 feet in depth, excavation: 40 yd^3 (approx.)
   2. 100 feet in length at a 1% slope, Inlet elevation: **1232 feet**
   3. Channel lining: R-5 (9"avg.) Rip-Rap, Volume: 35 tons (approx.)

C. Install **SR 87 CHECK DAM**
   1. Fill volume: **121 cubic yards**
   2. Top elevation: **1235 feet**
   3. Inside slope: **2 : 1** Outside slope: **3 : 1**
   4. Emergency Spillway
      - Top width: **10 feet**
      - Depth: **2 feet**
      - Bottom width: **6 feet**
      - Channel lining: R-5 (9"avg.) Rip-Rap, Volume: 30 tons approx.

CUT/FILL SUMMARY TABLE

Cut		**Fill**	
Cell 1:	4300 yd^3	Cell 1:	165 yd^3
Cell 2:	1185 yd^3	Cell 2:	5100 yd^3
Rock Channels:	80 yd^3	Check Dam:	121 yd^3
TOTAL:	5565 yd^3	TOTAL:	5386 yd^3

Excess Cut: 179 yd^3

- **Erosion and Sedimentation Control Plan**

1. E&S plan will be prepared by Knox DMO and submitted to Butler County Conservation District for their approval.

2. 25 PA Code Chapter 105.12.(a)(16) waiver for restoration activities for the entire Ferris Treatment Complex will be submitted by Knox DMO to Meadville D.E.P. for their approval.

3. E&S plan constists of:
   a. **Diversion Ditch DD2**: existing roadside ditch on north side of jeep trail.
   b. installing **filter fence**:
      - 400 ft. of 24" wide fabric
      - 3 ft. wooden stakes, quantity 100

- **Revegetation Plan**

1. Seed and mulch affected area (i.e. approximately 2 acres) with **Mixture II** plan. This seed plan was approved by the Pa Game Commission for the SR 114 ALD's constructed by Hedin Environmental near Argentine.

MIXTURE II

a. bird's foot trefoil ↓↑(double strength/innocculated)	10 lbs/ac	d. winter wheat cover	120 lbs/ac
		e. ag lime	10 tons/ac
b. white dutch clover	4 lbs/ac	f. 10-20-20 fertilizer	1000lbs/ac
c. reed canarygrass	10 lbs/ac	g. mulch (straw)	3 tons/ac


PLAN VIEW
VERTICAL FLOW WETLAN
SR 87 & SR 88
MINE
AREA
1250
1275
1300
26
27
SR 87
Check Dam
CELL 1
CELL 2
FILTER FENCE
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
1225
DIVERSION DITCH DD2
15" CMP
SR 88
JEEP TRAIL
GROUT LINE
SCALE: 1" = 100 FEET

SR 87/SR 88 V.F.W.

COST TABLE

1. Contracting/Accounting: (5.5% of grant projection)	$ 2944.12
2. Mobilization: (5.00% of grant projection)	$ 2676.47
2. Excavation: 11000 yd^3 @ $1.50/$yd^3$	$ 16500.00
3. AASHTO No. 1 Graded Rip-Rap: 960 ton @ $18.00/ton	$ 17280.00
4. Spent Mushroom Compost: 124 tons @ $ 19.41/ton	$ 2406.84
5. River Gravel: 131 tons @ $ 11.00/ton	$ 1441.00
7. 6" Schedule 40 PVC (smooth): 385 ft @ $2.28/ft	$ 877.80
a. Installation:	$ 500.00
8. 6" Schedule 40 PVC (perforated): 780 ft @ $3.28/ft	$ 2558.40
a. Installation:	$ 500.00
9. R-5 Graded Rip-Rap: 100 tons @ $ 11.00/ton	$ 1100.00
10. 15" CMP: 30 ft @ $ 10.00/ft	$ 300.00
a. Installation:	$ 500.00
11. Inline Water Level Control Structure: 6" dia., 12 ft height	$ 485.00
a. Installation:	$ 1000.00
12. Revegetation Plan: 2 acres @ $ 1600/ac.	$ 3200.00
13. 6" Brass Gate Valves: Quantity: (2) @ $ 1000 a piece	$ 2000.00
14. Miscellaneous Fittings:	$ 250.00
14. Diversion Ditch: 250 ft. @ $3.50/ft.	$ 875.00
15. Filter Fabric for E&S: 400 ft. @ $3.00/ft.	$ 1200.00
SUBTOTAL:	$ 58,594.63
*** PERCENT FUND:**	$ 53,529.41
*** ADDITIONAL FUNDING:**	$ 5,000.00
*** TOTAL FUNDING:**	**$ 58,529.41**

* Knox DMO requested $170,000 and received $130,000 which is *76.47%* of the requested amount. *Slippery Rock* requested *$70,000* and Little Toby $100,000. *76.47% of the requested $70,000 for Slippery Rock is $53,529.41*

* Additional funding under grant to *Slippery Rock: $5,000.00*

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA GAME COMMISSION

FIELD REGIONS

August 14, 1996

To: Slippery Rock Watershed Coalition:

Approval is granted to work to clean up the mine discharges on sites SR 85, 86, 87, 88 on State Game Lands #095, approval is granted with the understanding that there needs to be some mechanism in place to take care of the cost of maintaining and recharging the increasing number of mine drainage nuetralization and containment sites on Game Lands #095.

Dale E. Hockenberry
Land Management Group
Supervisor Group I
Northwest Region

Northwest Region
1509 Pittsburgh Road
Franklin, PA 16323
1-800-533-6764

Southwest Region
339 West Main Street
Ligonier, PA 15658
1-800-243-8519

Northcentral Region
P.O. Box 5038
Jersey Shore, PA 17740
1-800-422-7551

Southcentral Region
P.O. Box 537
Huntingdon, PA 16652
1-800-422-7554

Northeast Region
Box 220, R.D. 5
Dallas, PA 18612
1-800-228-0789

Southeast Region
R.D. 2, Box 2584
Reading, PA 19605
1-800-228-0791

Anoxic Limestone Drain Sizing

(calculations based on 15 hour retention time, expected effluent alkalinity, and flow rate)

(equation from Hedin and Watzlaf, 1994)

County:	Butler
Township:	Venango
Discharge ID:	SR87&88

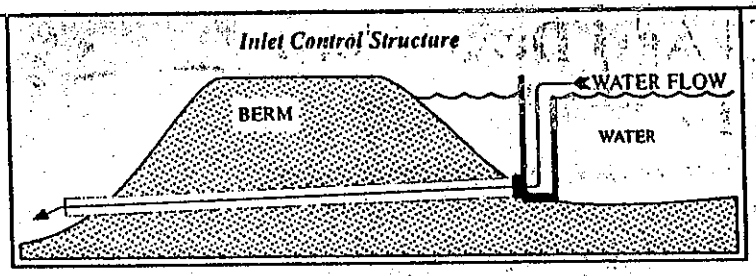
Mass of Limestone necessary = mass required for 15 hour retention time
+ mass required for dissolutional losses over life of treatment

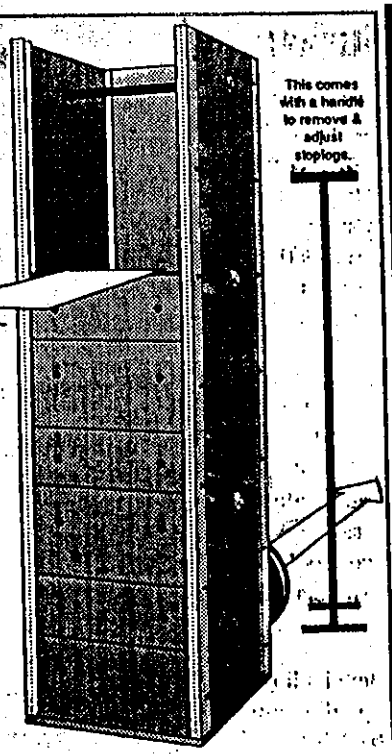
Mass = [flow (l/min) * (60 min/hr) * Bulk Density (1600 kg/m^3) * (1 m^3/1000 l)
* (1mt/1000kg) * 15 hr retention time] / bulk void volume (0.50)
+ [(l/min) * (60 min/hr) * effl. alk. conc. (mg/l) * (1 mt/10^9 mg)
* ALD life (yrs.)*(8766 hrs/1 yr)]/ CaCO3 content (dec.)

Flow Rate (gpm) =	60
Flow Rate (l/min) =	227
Expected effluent alk. (1-300) (mg/l) =	50
Expected Life (yrs) of ALD =	25
CaCO3 Content =	90%
Volume of Limestone (m^3) =	512.52
Volume of Limestone (yds^3) =	670.35
Mass of Limestone (kg) =	820,034
Mass of Limestone for 15 hour retention (metric tons) =	654
Mass of Limestone for dissolution (metric tons) =	166
Total Mass of Limestone (metric tons) =	820
Total Mass of Limestone (short tons) =	904
Cost of limestone ($/ton) =	$10.00
Total Cost of Limestone =	$9,039.31

INLET WATER LEVEL CONTROL STRUCTURE

- Rugged 1/2" PVC structure.
- Stainless steel screws and custom anodized aluminum corner extrusions are used for strength and durability.
- Soft rubber is attached to the stoplogs for a near perfect seal.
- 5" & 7" stoplogs for adjustability.
- Flexible couplers allow PVC, plastic pipe, or other materials to be easily attached. ***(Please specify type of pipe when ordering)***
- Affordable for any project.
- Heavy steel handle included.

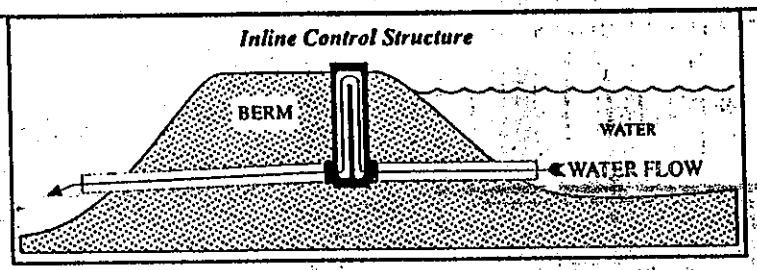


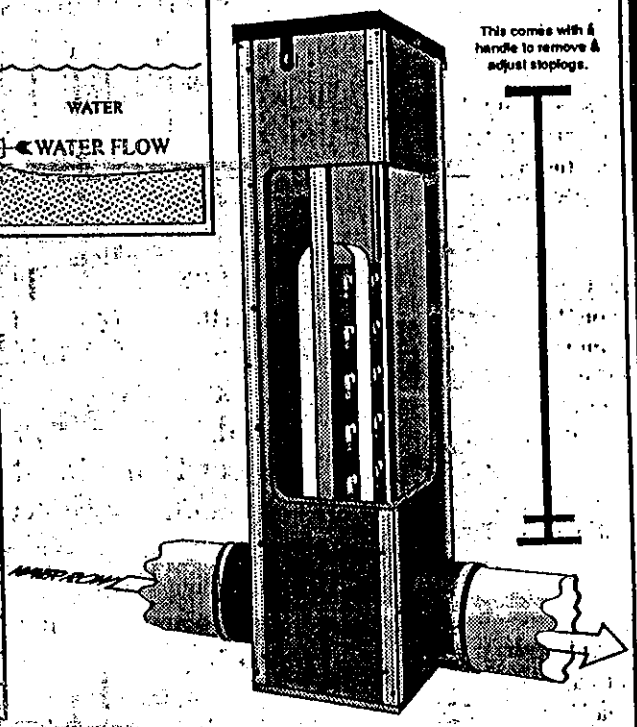


PIPE SIZE	HEIGHT												
	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'
4"	$175	$190	$205	$220	$235	$250	$265	$330	$345	$360	$375	$390	$405
6"	180	195	210	225	240	255	270	335	350	365	380	395	410
8"	185	205	225	245	265	285	305	375	395	415	435	455	475
10"	190	215	235	255	275	295	315	385	405	425	445	465	485
12"	225	250	275	300	325	350	375	450	475	500	525	550	575
15"	245	275	305	335	365	395	425	505	535	565	595	625	655
18"	270	300	330	360	395	425	460	545	580	615	650	685	720

INLINE WATER LEVEL CONTROL STRUCTURE

- Rugged 1/2" PVC structure.
- Stainless steel screws and custom anodized aluminum corner extrusions are used for strength and durability.
- Soft rubber is attached to the stoplogs for a near perfect seal.
- 5" & 7" stoplogs for adjustability.
- Flexible couplers allow PVC, plastic pipe, or other materials to be easily attached. ***(Please specify type of pipe when ordering)***
- Affordable for any project.
- Heavy steel lockable top and handle included.





PIPE SIZE	HEIGHT												
	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'
4"	$230	$250	$270	$290	$310	$330	$350	$420	$440	$460	$480	$500	$520
6"	235	255	275	295	315	335	355	425	445	465	485	505	525
8"	250	280	310	340	370	400	430	510	540	570	600	630	660
10"	270	300	330	360	390	420	450	530	560	590	620	650	680
12"	325	360	395	425	460	495	525	605	635	665	695	725	755
15"	350	395	425	460	495	525	560	645	680	715	750	785	820
18"	380	420	460	500	540	580	620	710	750	790	830	870	910

Notes:

Call to request your free catalog of water management products

1-800-232-4742

Department of Environmental Resources
Bureau of Mining and Reclamation

Permit No PA CMRS - SLIPPERY ROCK - EPA 104(b)(3)
Pond SR87/SR88
Township VENANGO
County BUTLER
Engineer/Land Surveyor
Date SEPTEMBER 11, 1996

POND CERTIFICATION INSTRUCTIONS

Complete first page and submit with permit application. Use both pages to certify completed impoundment.

Sedimentation ponds and other impoundments must be constructed in accordance with the approved permit before any disturbance of the area to be drained into the pond. Impoundment must be inspected during construction under the supervision of, and certified to the Department upon completion of construction by a registered professional engineer.

Any enlargement, reduction in size, reconstruction, or other modification, that may affect the stability or operation must be approved by the Department. Pond must be certified and approved prior to the start of any other mining activities.

Unless otherwise specified in your permit, use this form for the sedimentation pond and other impoundment certification. Submit 1 original and 2 copies to the appropriate District Mining Office. All information must be provided, otherwise it will be returned for completion.

U.S.G.S. Quadrangle: HILLIARDS Location (point of discharge): Latitude 41-06-09 ; Longitude 79-51-09
Location from **Bottom Right** corner of U.S.G.S. Quadrangle: HILLIARDS inches North: 18.70 inches West: 14.15
HYDROLOGY: Drainage Area NA acres Design Storm NA Soil Type NA Curve Number NA Average Watershed Slope NA Peak Discharge 60 gpm
Land Use NA

	SR87/SR88 INLET ELEVATION: 1232 FEET		CELL 1	CELL 2
Embankment	Top width (Minimum)		10 FEET	10 FEET
	Outside Slope (Maximum) (___H: ___V)		2:1	3:1
	Inside Slope (Maximum)		3:1 (LENGTH), 1.7:1 (WIDTH)	3:1 (LENGTH), 2:1 (WIDTH)
	Top Elevation		1234 FEET	1232 FEET
	Bottom Elevation		1222 FEET	1220 FEET
	Upstream Toe Elevation		1234 FEET	1224 FEET
	Downstream Toe Elevation		1222 FEET	1217 FEET
	Amount Allowed for Settlement		0 FEET.	1 FEET
	Type of Cover		PGC MIXTURE II WILD LIFE COVER	PGC MIXTURE II
	Incised Slope (if any)		~	~
	Inside Slope (Maximum) (___H: ___V)		1H : 0.8V	2H : 1V
	Top Elevation		1248	1230 FEET
	Bottom Elevation		1222	1220 FEET
Principal Spillway	Type		SCHEDULE 40 PVC SMOOTH	SCHEDULE 40 PVC SMOOTH
	Conduit Diameter (if barrel/riser give both)		6" DIA. PLUMBING SYSTEM	6" DIA. PLUMBING SYSTEM
	Inlet Elevation		1230 FEET (2)	1228 FEET VARIABLE
	Outlet Protection		R-5 RIP-RAP (9" AVG)	R-5 RIP-RAP (9" AVG)
	Spillway ~~Capacity~~ REGULATOR		6" GATE VALVE (2)	VARIABLE: INLINE WATER LEVEL CONTROL STRUCTURE
Dewatering Device	Type/Size		6" SCHEDULE 40 PVC (SMOOTH)	6" SCHEDULE 40 PVC (SMOOTH)
	Inlet Elevation		1223	1221'
	Discharge Regulation (ie. self draining or valved)		6" GATE VALVE	INLINE WATER LEVEL CONTROL STRUCTURE
	Discharge Capacity (cubic feet/second)		1 CFS	1 CFS
	Time to Dewater Full Pond		REGULATED: 2-10 DAYS, WIDE OPEN: 8 HRS	11.2 HOURS FULL FLOW
Emergency Spillway	Type CHECK DAM:		TRAPEZOIDAL	TRAPEZOIDAL
	Width		6 FEET	6 FEET
	Depth ~~(with 2 feet of freeboard)~~		2 FEET	2 FEET
	Length		70 FEET	70 FEET
	Sideslopes		1:1	1:1
	Crest Elevation		1233 FEET	1233 FEET
	~~Slope~~ TOP ELEVATION:		1235 FEET	1235 FEET
	Type of Lining/Protection		R-5 RIP-RAP (9" AVG.)	R-5 RIP-RAP (9" AVG)
	Spillway Capacity (provide design calculations)		50 CFS	50 CFS
Storage Capacity	Length @ Bottom		160 FEET	120 FEET
	Width @ Bottom		10 FEET	18 FEET
	Length @ Crest of Principal Spillway		210 FEET	180 FEET
	Width @ Crest of Principal Spillway		40 FEET	58 FEET
	Length @ ~~Crest of Emergency Spillway~~ TOP EMBANKMENT:		232 FEET	192 FEET
	Width @ ~~Crest of Emergency Spillway~~ TOP EMBANKMENT:		50 FEET	66 FEET
	Volume @ Crest of ~~Emergency~~ PRINCIPAL Spillway		27,776.0 CU. FT.	40,350 CU. FT.

DIMENSIONS | REC MIX/COMPOST CELL | KNOX DMO

CELL 1

- RIVER GRAVEL

$\frac{(160' \times 10') + (167.50' \times 14.25')}{2} (1.25') = 2,491.8\ ft^3$

$= 192.3\ yds^3$ 343 TONS

BOTTOM DIMENSIONS: 160' X 10'

RIVER GRAVEL DEPTH: 1.25' 161.2 yds^3 228 TONS

TOP OF RIVER GRAVEL: 167.50' x 14.25'

- AASHTO No. 1 / SPENT MUSHROOM COMPOST LAYER

$\frac{(167.50' \times 14.25') + (179.5' \times 21.05')}{2} (2') = 6,165.4\ ft^3 = 229\ yds^3$

- PLACE AND SPREAD REC-MIX/COMPOST MIXTURE TO 2 FT DEPTH IN CELL 1 (4 PARTS COMPOST - 1 PART AASHTO)

AASHTO No. 1: $\frac{(4)}{60}$ TONS (46 yds^3)

SPENT MUSHROOM COMPOST: 124 TONS (183 yds^3)

229 yds^3

RETENTION VOLUME

$\frac{(179.5' \times 21.05') + (208' \times 37.2')}{2} (4.75') = 27,350.7\ ft^3$

RETENTION TIME

$27,350.7\ ft^3 * 7.48052\ gal/ft^3 = 204,597\ gal \div 86,400\ gal/day = 2.4$ DAYS

(REVISED: 10/29/96)

SK01/ SK00 DIMENSIONS | VERTICAL FLOW [illegible] LIMESTONE CELL | ROGER DOWNING KNOX DMO

CELL 2

$\frac{120 \times 18 + (150 \times 38)}{2} (5) = 18,090\ ft^3$

$18,750\ ft^3 >= 18,090\ ft^3$ (670 yd^3 OF LIMESTONE)

$\frac{(150 \times 38) + (180 \times 58)}{2} (5) = \underline{40,350\ ft^3}$ RETENTION VOLUME

$40,350\ ft^3 * 7.48052\ gal/ft^3 = 301,839\ gal \div 86,400\ gal/DAY = 3.49$ DAY

RETENTION TIME: 3.49 DAYS

BOTTOM DIMENSIONS: 120' X 18'

LIMESTONE DEPTH: 5' 670 yds^3 OR 900 TONS

TOP OF LIMESTONE: 150' X 38'

RETENSION DEPTH: 5'

RETENTION VOLUME: 40,350 ft^3

INSIDE SLOPES: 2:1 WIDTH 3:1 LENGTH

OUTSIDE SLOPES: 3:1

TOP OF POND: 192' X 66'

TOTAL DEPTH: 12'

- AASHTO NO. 1 GRADED LIMESTONE TO 5 FOOT DEPTH IN CELL 2, WASHED, 80% $CACO_3$

900 TONS (670 yds^3)

(REVISED: 10/29/91)

CUT/FILL CALCS	CELL 1 VOLUMES	ROGER BOWMAN KNOX DMO

CUT

$1 \rightarrow 2: \frac{(6+174.24)}{2}(40) = 133.5\ yd^3$

$2 \rightarrow 3: \frac{(174.24+522.72)}{2}(20) = 258.13\ yd^3$

$3 \rightarrow 4: \frac{(522.72+479.16)}{2}(12) = 222.64\ yd^3$

$4 \rightarrow 5: \frac{(479.16+479.16)}{2}(10) = 177.47\ yd^3$

$5 \rightarrow 6: \frac{(479.16+696.96)}{2}(40) = 871.20\ yd^3$

$6 \rightarrow 7: \frac{(696.96+435.60)}{2}(98) = 2,055.39\ yd^3$

$7 \rightarrow 8: \frac{(435.60+304.92)}{2}(25) = 342.83\ yd^3$

$8 \rightarrow 9: \frac{(304.92+6)}{2}(40') = 230.31\ yd^3$

$9 \rightarrow 10: \frac{(6+6)}{2}(10') = 2.22\ yd^3$

$10 \rightarrow 0: \frac{(6+0)}{2}(50') = 5.56\ yd^3$

TOTAL CUT CELL 1: $4,299.25\ yd^3 \approx \underline{4300\ yd^3}$

FILL

$6 \rightarrow 7: \frac{(0+45)}{2}(95) = 79.17\ yd^3$

$7 \rightarrow 8: \frac{(45+43.56)}{2}(25) = 41.00\ yd^3$

$8 \rightarrow 9: \frac{(43.56+10)}{2}(40) = 39.67\ yd^3$

$9 \rightarrow 10: \frac{(10+10)}{2}(10) = 3.70\ yd^3$

TOTAL FILL CELL 1: $\approx \underline{165\ yd^3}$

Cut / Fill Calcs	Cell 2 Volumes	Roger Bowman Knox DMO

Cut

$5 \rightarrow 6: \frac{(0 + 174.24)}{2}(40) = 129.07\ yd^3$

$6 \rightarrow 7: \frac{(174.24 + 217.80)}{2}(95) = 689.70\ yd^3$

$7 \rightarrow 8: \frac{(217.80 + 217.80)}{2}(25) = 201.67\ yd^3$

$8 \rightarrow 9: \frac{(217.80 + 0)}{2}(40) = 161.33\ yd^3$

Total Cut Cell 2: $1181.77\ yd^3 \approx \underline{1185\ yd^3}$

Fill:

$2 \rightarrow 3: \frac{(0 + 304.92)}{2}(18) = 101.64\ yd^3$

$3 \rightarrow 4: \frac{(304.92 + 871.20)}{2}(12) = 261.36\ yd^3$

$4 \rightarrow 5: \frac{(871.20 + 827.64)}{2}(10) = 314.60\ yd^3$

$5 \rightarrow 6: \frac{(827.64 + 544.50)}{2}(40) = 1,016.40\ yd^3$

$6 \rightarrow 7: \frac{(544.50 + 392.04)}{2}(95) = 1,647.62\ yd^3$

$7 \rightarrow 8: \frac{(392.04 + 348.48)}{2}(25) = 342.83\ yd^3$

$8 \rightarrow 9: \frac{(348.48 + 566.28)}{2}(40) = 677.60\ yd^3$

$9 \rightarrow 10: \frac{(566.28 + 566.28)}{2}(10) = 209.73\ yd^3$

$10 \rightarrow 0: \frac{(566.28 + 0)}{2}(50) = 524.33\ yd^3$

Total Fill Cell 2: $5096.11\ yd^3 \approx \underline{5100 yd^3}$

Cut/Fill Calcs	Summary Table SR87/SR88 VFW	Roger Bowman Knox DMO

Cuts

Cell 1:	4300 yd^3
Cell 2:	1185 yd^3
SR87/SR88 Collection Ditches:	80 yd^3
Total:	5565 yd^3

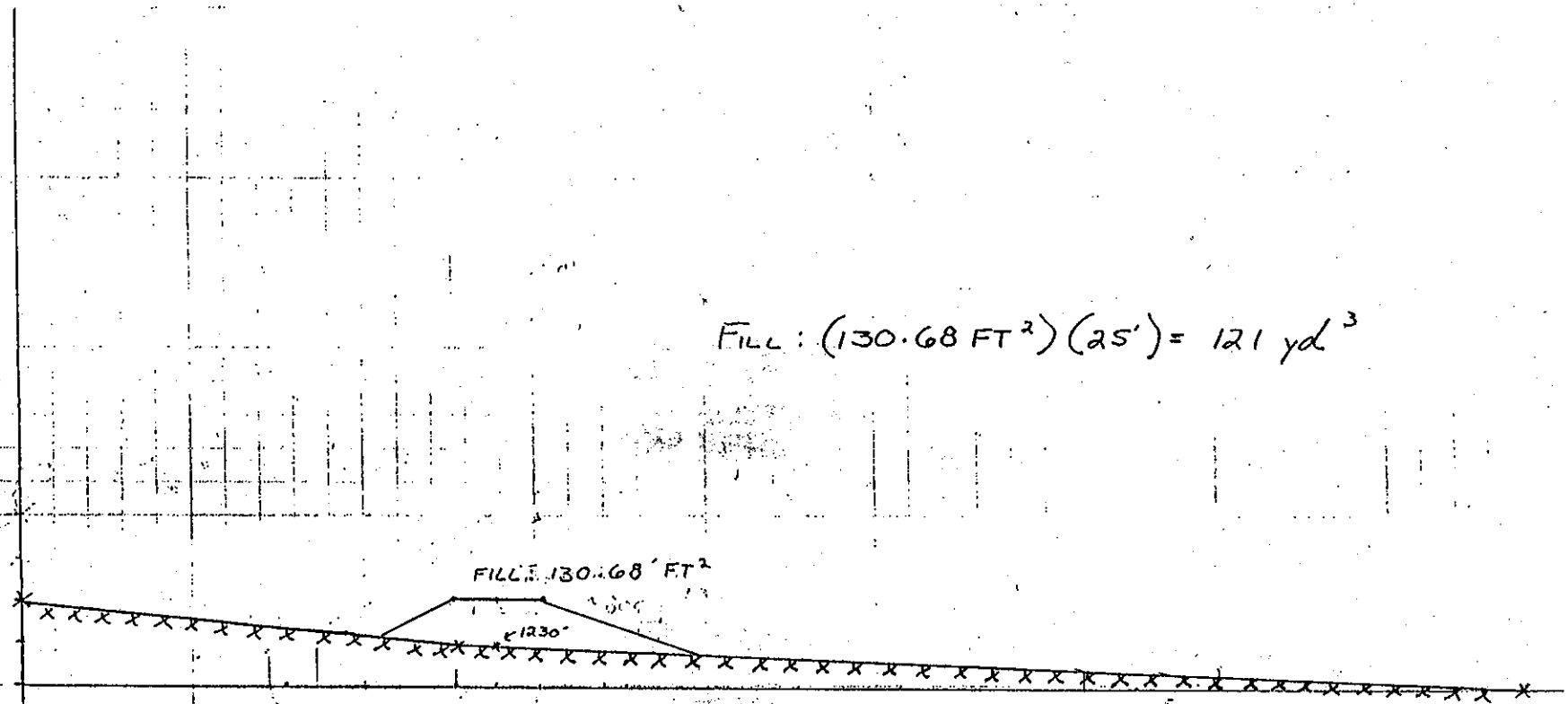
Fills

Cell 1:	165 yd^3
Cell 2:	5100 yd^3
SR 87 Check Dam:	121 yd^3
Total:	5386 yd^3

179 yd^3 (excess)

(16.9' x 16.9' x 16.9')

COLLECTION SYSTEM | ROGER BOWMAN
SR 87 CHECK DAM | KNOX DMO
CROSS-SECTION



FILL: $(130.68\ FT^2)(25') = 121\ yd^3$

SCALE: 1 in. = 20 ft. HOR/VER

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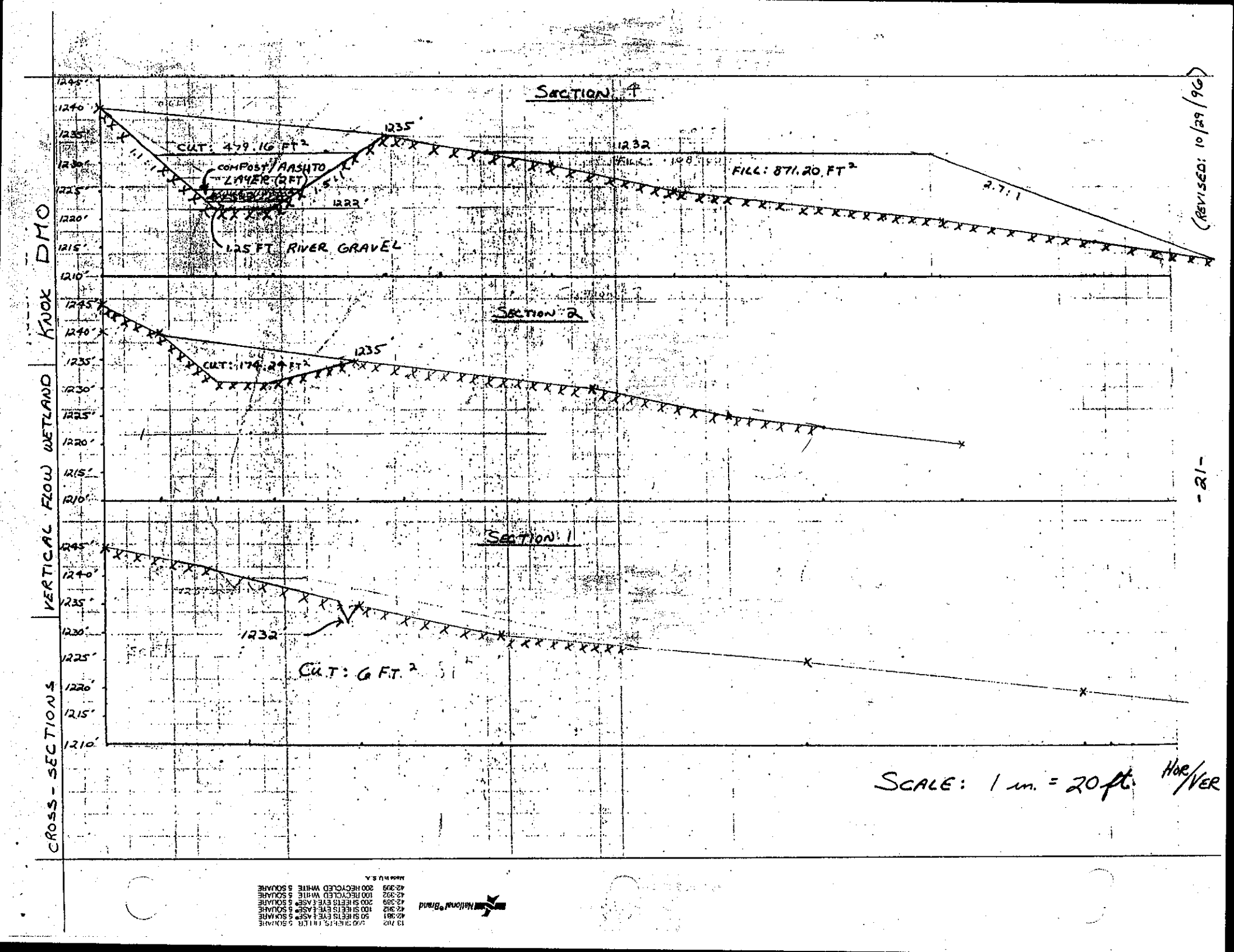
CROSS-SECTIONS
VERTICAL FLOW WETLAND
KNOX DMO
SECTION 4
CUT: 479.16 FT²
COMPOST/AASHTO LAYER (2FT)
1.25 FT RIVER GRAVEL
1235'
1232'
1223'
FILL: 871.20 FT²
2.7:1
1.5:1
1:1
SECTION 2
CUT: 174.24 FT²
1235'
SECTION 1
1232'
CUT: 6 FT²
1245'
1240'
1235'
1230'
1225'
1220'
1215'
1210'
SCALE: 1 in. = 20 ft. HOR/VER
(REVISED: 10/29/96)
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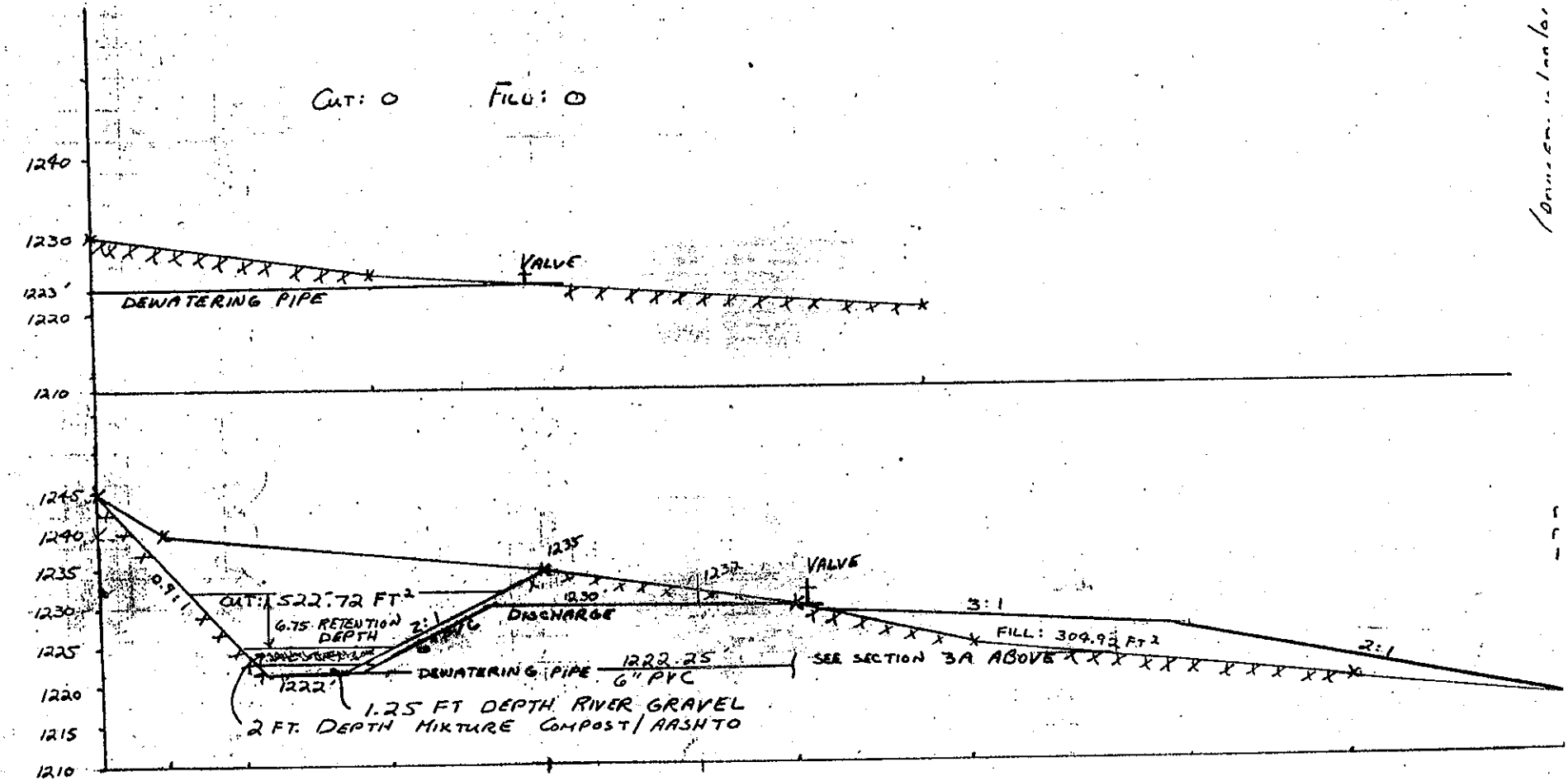
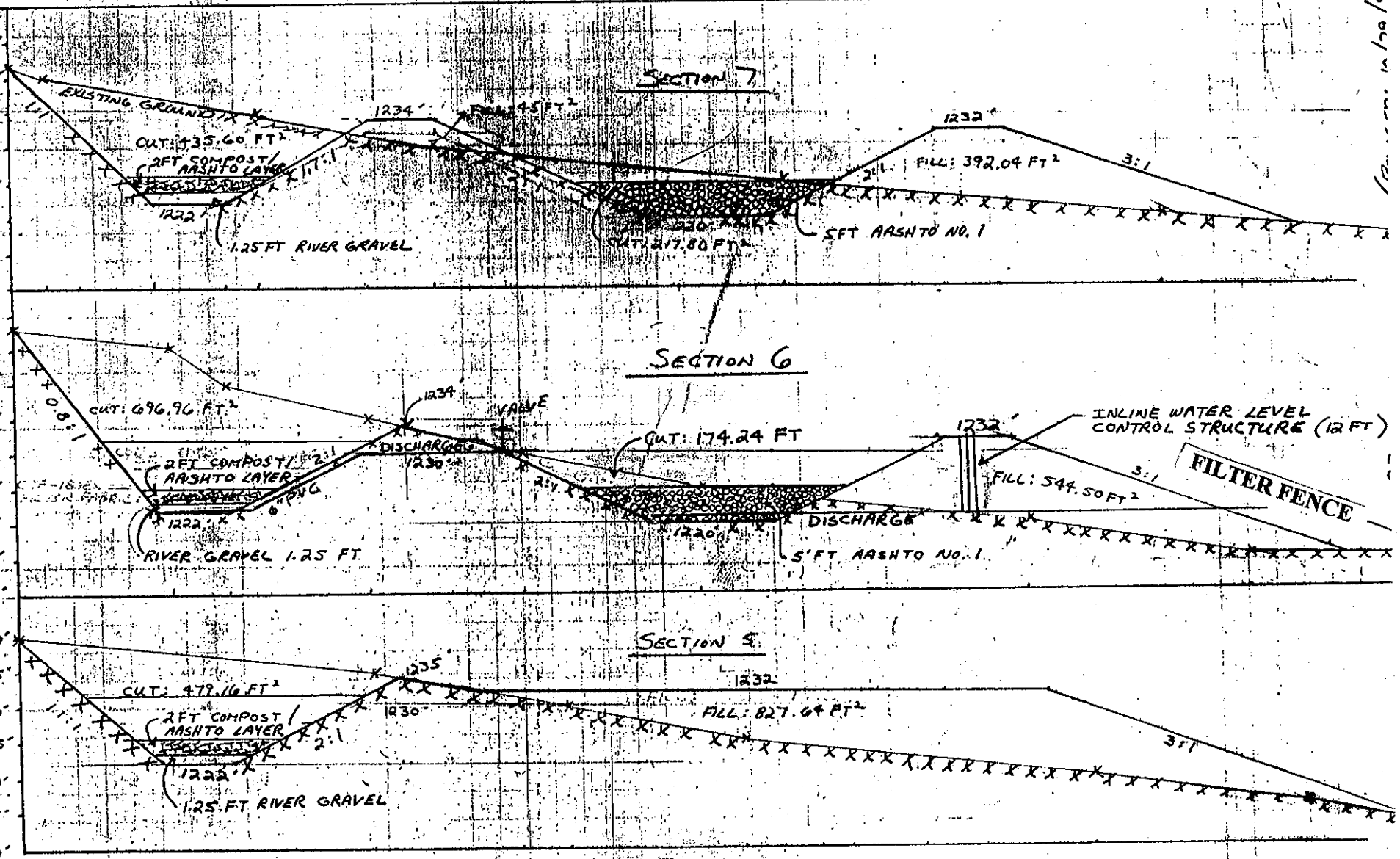
CROSS - SECTION 33 23A | CELL 1 DEWATERING | KNOX DMO



SCALE: 1 in. = 20 ft. HOR/VER

ROGER DOWMAN
KNOX DMO
SR 87 / SR 88
VERTICAL FLOW WETLAND
CROSS - SECTIONS



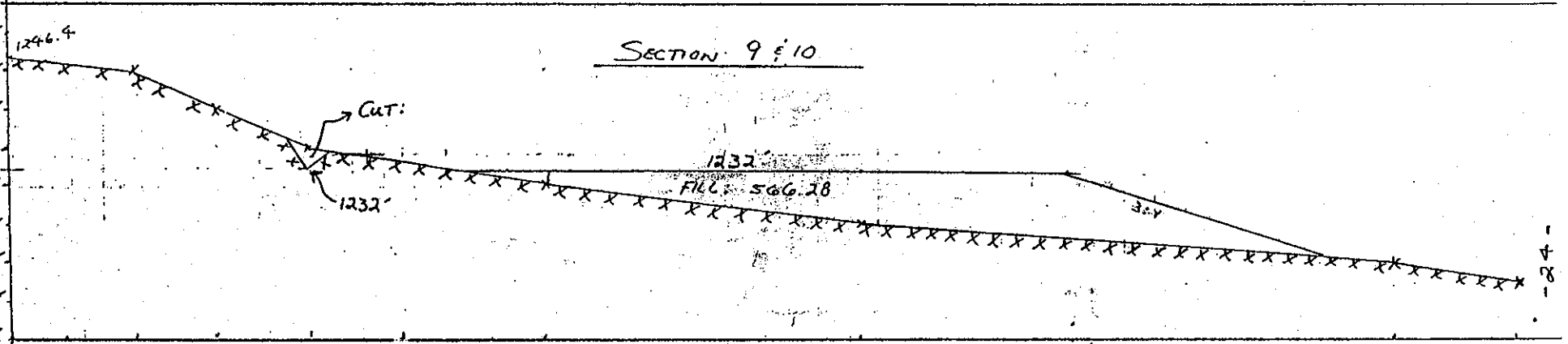
SCALE: 1 in. = 20 ft. HOR/VE

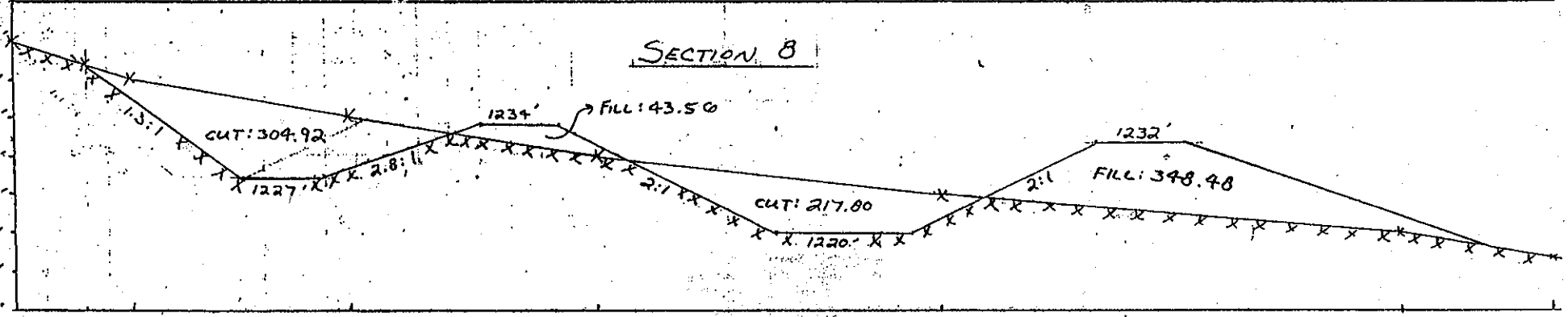
KNOX DMO

VERTICAL FLOW WETLAND

CROSS-SECTIONS

SECTION 10 - (SAME AS SECTION 9)





SCALE: 1 in. = 20 ft. HOR/VER