SECTION 35

HYRDROLOGIC RECLAMATION PLAN

TABLE OF CONTENTS

SECTION 35

HYRDROLOGIC RECLAMATION PLAN

LIST OF TABLES

TABLE
NUMBER **TABLE TITLE**

SECTION 35

HYRDROLOGIC RECLAMATION PLAN

LIST OF FIGURES

FIGURE NUMBER	FIGURE TITLE

SECTION 35

HYRDROLOGIC RECLAMATION PLAN

LIST OF EXHIBITS

EXHIBIT NUMBER	EXHIBIT TITLE

SECTION 35

HYRDROLOGIC RECLAMATION PLAN

LIST OF APPENDICES

SECTION 35

HYRDROLOGIC RECLAMATION PLAN

LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

35 HYDROLOGIC RECLAMATION PLAN

The post mining hydrologic reclamation plan has been designed to:

- Minimize disturbances, to the extent possible, to the hydrologic balance within the permit and adjacent areas;
- To prevent material damage to the extent possible, to the hydrologic balance out side the permit area;
- To assure the protection or replacement of water rights; and
- To support the approved post mining land use.

In accordance with 780.21(h) the permit includes the components of the hydrologic reclamation plan and demonstrates compliance with 816.41 through 816.43. The preventive, remedial, or monitoring measures used to prevent to the extent possible material damage to the hydrologic balance within and outside the permit area are provided in the appropriate sections of the permit.

35.1 Groundwater Protection

The groundwater baseline and monitoring quality and quantity information is provided in Section 18 – Water Resources and Section 42 – Monitoring, Maintenance, Inspections and Examinations. The procedures used to protected the hydrogeology regime by handling materials in manner that minimizes impacts the groundwater regime is provided in Section 20 – Mining Operations and Section 32 – Temporary Structures and Facilities Removal and Reclamation ,. The PHC prediction of impacts to the hydrogeology from mining are found in Section 41 – Probable Hydrologic Consequences.

35.2 Surface Water Protection

The surface water baseline and monitoring quality and quantity information is provided in Section 10 – Land Use and Section 18 – Water Resources The procedures used to protect the surface water hydrologic balance by handling materials and runoff in manner that minimizes impacts is provided in Section 20 – Mining Operations, Section 22 – Support Facilities, and Section 40 – Environmental Protection. The PHC predictions of impacts to the surface water hydrology from mining are found in Section 41 – Probable Hydrologic Consequences.

35.2.1 *Drainage and Sediment Control Structures Removal and Reclamation*

All surface water controls will be reclaimed and drainages re-established according to the following procedures and the timetable in Table 30-3.

1. Sediment from ponds will be analyzed for potentially unsuitable constituents prior to removal and reclamation. Any unsuitable sediments from the ponds will be disposed of properly (Section 20 – Mining Operations). After a database has been established, a determination will be made as to whether future sediment analyses need to be made. In addition, in the process of reclamation, clay liners installed in certain ponds will be ripped and either (a)

covered in-place with 4 feet of suitable (root-zone) material or (b) physically removed and disposed of in the active pit or the ungraded spoils. In either case, the clay liner material will no longer hold water.

- Removal must occur at least 2 years after the last augmented seeding of the area;
- The area has been stabilized and revegetated (i.e. the entire disturbed area that drains into the siltation structure has been stabilized with enough vegetative growth to reduce sedimentation);
- The sediment load of the runoff from the area has reached normal premining sediment loads (i.e., the area is not contributing additional sediment to streamflow or to runoff outside the permit area)
- Runoff and discharges from the area will not cause or contribute to violation of the water quality standards of the receiving waters

2. The pond areas will be topsoiled and disced. Regraded areas will be sampled prior to topsoiling. (Year-round activities),
3. Seedbed preparation, mulching, and discing will take place as necessary (see Table 30-3),
4. Seeding will take place after seedbed preparation is completed, or as soon as an acceptable seeding time frame is reached,
5. Irrigation will begin immediately after seeding and continue through October, or until establishment has been achieved,
6. The area will be fenced as necessary during irrigation to protect the area from grazing and unauthorized activities, and
7. Vegetation will be sampled in the last two years prior to land release, and in previous years as needed.

The above reclamation activities are described in detail in Sections 30 – Post-Reclamation Land Use and 37 – Post-Reclamation Vegetation.

35.2.2 *Sedimentation Ponds and Siltation Structures Removal and Reclamation*

The ponds and impoundments will be removed at the following times:

1. The North Sewer Pond, North Ponds 1 and 5, Emma's Pond, and the North Pinto Pond will be removed after operations and reclamation in the North Area Industrial Complex are completed,
2. Pinto Pond 1 will be removed after mining has ceased and reclamation in the area is completed,
3. Barber and Lowe loadout ponds will be removed after mining and reclamation activities in these areas are completed, and water for dust suppression on roads is no longer needed,
4. Hosteen Stockpile Ponds 1, 2, and 3 and Barber Stockpile Ponds 1, 2, and 3 will be removed after coal haulage has ceased and the adjacent stockpile areas have been reclaimed,
5. The Area 3 Sewage Pond, the Area 3 Shop Detention Pond, and the Area 3 Complex Pond will be removed after activities in the Area 3 industrial complex have ceased and the area has been reclaimed,

6. The Lowe Stockpile Pond will be removed after coal haulage has ceased and the adjacent stockpile areas have been reclaimed,
7. The Southwest Dixon Pond, Northwest Dixon Pond, and South Dixon Ponds 1 and 2 will be removed after the adjacent spoil outslopes have been reclaimed, and
8. The various highwall impoundments which are adjacent to Yazzie, South Hosteen, Barber, Lowe, and Dixon Pits will be removed when stripping activities reach their locations.

Prior to submitting an application to the regulatory authority for the removal of a siltation structure, Navajo Mine will consult with the Navajo Nation to assess the structure's retention value to meet the postmining land use.

Small depressions may be included in the final surface configuration as discussed in Section 34 – Post Reclamation Topography.

Backfilling and Grading – preexisting stockponds disturbed by mining will be reconstructed after mining. All livestock ponds impacted by mining will be replaced as part of reclamation (Section 16 – Fish and Wildlife, Exhibit 16-3). Ponds P2, P3, and P4, which have already been disturbed to date, will be reconstructed in nearby areas during reclamation. The original pond locations are designated as P2a, P3a, and P4a. The approximate postmining locations are designated as P2b, P3b, and P4b. Ponds P5, P6, P7, and P8, which have not yet been impacted, will be reconstructed on or near their original locations. Only pond P1 will not be disturbed by mining. All the reconstructed ponds will be built to accommodate the similar volume as estimated in Table 39-1. The orientation of the ponds will be dependent on the final slope and drainage pattern created during reclamation.

35.2.3 *Permanent Impoundments*

Location of post mining permanent impoundments should be constructed on or near original pre-mining locations as specified in this section. Consideration to placing post mining permanent impoundments in pre-mining locations will depend on watershed and surrounding topography suitability. Permanent impoundment location selection will be based on sufficient watershed size, to provide runoff for optimum water retention.

Permanent impoundments will be designed to not exceed a capacity of 10 acre-feet. Due to variability in watershed size, soil composition and slopes, impoundments will not be designed to retain runoff from a specific storm event. Fifty percent (50%) of pond side slopes will be designed to a 4:1 grade or less to facilitate wildlife and livestock access.

Impoundments will be constructed in spoil material (clay) that will aid in water retention through low permeability rates. Permanent impoundments will blend in with the post mining topography and incorporate topographic diversity to the extent possible. The supporting design data for permanent impoundments are presented in Appendix 35.A.

Inlet and outlet structures will be designed to remain stable during 25 year-6 hour precipitation events at peak discharge. Riprap material will be placed at the pond inlets and spillways if hydrologic analysis indicates that a protective lining is required to minimize and control erosion. Inlet / outlet structures must be designed to safely contain the 100 year-6 hour event at peak discharge while maintaining one foot of freeboard.

35.2.4 *Reclamation of Diversion Structures*

All temporary diversion structures will be reclaimed as per the guidelines outlined this section and Section 36 – Post-Reclamation Soil and Section 37 – Post-Reclamation Vegetation. The structures will be graded to the surrounding terrain, topdressed, and seeded.

Area 3 Temporary Diversion is located east of Lowe Pit and begins from the northern end of Lowe Pit traversing south and southwest towards Dixon Pit. As mining progresses to the east in Lowe Pit, this temporary diversion will eventually be mined through. The southern half of the temporary diversion will be mined through by the year 2005 according to the current mine plan. The northern section will be mined out by the year 2021. Thereafter, the area will be reclaimed to the FSC.

Lowe Dixon Diversion is along the eastern lease boundary of Area 3 east of Lowe Pit going from north to south. This diversion will be mined through in the year 2011 according to the current mine plan. The area will be regraded to the FSC and reclaimed after mining ceases in this area.

35.2.5 *Reclamation of Other Support Facilities*

Upon completion of mining, the mine support facilities will become the property of the Navajo Nation, as specified in Navajo Mine's lease agreement. Any facilities that the Navajo Nation does not want to maintain will be removed. Following removal, the affected areas will be regraded, topdressed, and revegetated.

35.3 Water Rights and Replacement

The arroyos flowing through the mine permit and the livestock watering ponds found within the permit are ephemeral in nature and are usually dry most of the year. The use of these ponds and arroyos is live stock watering, but is very limited by the availability of sufficient water from precipitation events and the naturally poor quality of the runoff waters. Section 35.2 addresses the replacement of existing livestock watering ponds. The PHC predictions for impacts to the water resources are found in Section 41 – Probable Hydrologic Consequences.

Appendix 35.A

Permanent Impoundments

Appendix 35.A

Permanent Impoundments

Due to reformatting of the Navajo Mine PAP, the following references in this appendix have been changed, deleted or renumbered:

NM-0003F Paper Reference	NM-0003F Electronic Permit
Exhibit 11-13D	Exhibit 26-11
Exhibit 11-13E	Exhibit 26-12
Exhibit 11-77	Exhibit 41-7
Exhibit 12-43	Exhibit 41-22
Text 12.3.4	Part 5 Sec. 35.2.1 and 35.2.2

TABLE OF CONTENTS

LOWE PERMANENT IMPOUNDMENT #1

TABLE OF CONTENTS

INTRODUCTION

Lowe Permanent Impoundment 1 is proposed as a 9.67 acre-foot permanent impoundment replacing the temporary impoundment Lowe Hole 3 Pond 1, see Exhibit 11-13D (Area II Impoundment and Pond Locations/Watershed Areas) and Exhibit 11-13E (Area III Impoundment and Pond Locations/Watershed Areas). Lowe Hole 3 Pond 1 was established in 1997 within the BHP Navajo Coal Company (BNCC) permanent program reclamation lands. BNCC intends to utilize Lowe Permanent Impoundment 1 as one of the eight (8), NM-0003E permanent impoundments to facilitate the post-mining livestock and wildlife resources. Please refer to Section 12.3.4, Reclamation of Surface Water Controls for impoundment location and watershed information and Exhibit 12-43, for design specific construction details.

This information is specific to Lowe Permanent Impoundment 1. Slope stability, hydrology methodology, and analytical data are found on the following pages. Typical design, construction and reclamation information is available in the Reclamation Surface Stabilization Handbook for Navajo Coal Company.

SITE DESCRIPTION

LAND USE

Lowe Permanent Impoundment 1 has an 825.6-acre drainage area and is located in a tributary to the Lowe Arroyo. The watershed is classified as 99.3 % undisturbed lands and 0.7 % permanent program reclaimed land. Lowe Permanent Impoundment 1 will benefit the permitted post-mining land use of livestock grazing by providing a year-round water source.

DESIGN ANALYSIS

GENERAL

Lowe Permanent Impoundment 1 was designed under the supervision of a Registered Professional Engineer from Navajo Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and includes a review of available project files. The most current information contained in the Navajo Coal

Company files includes topographic maps developed from aerial photography flown in 2000 for Navajo Coal Company and used in analysis of the structure.

STABILITY

Lowe Permanent Impoundment 1 is completely incised and does not incorporate an embankment. All regraded (incised) side slopes are designed to a general 5:1 (horizontal to vertical) slope when possible (approximately 50%) and are no greater than a 3.5:1 slope. Given the side slopes are flatter than the recommended final reclamation slopes, the slopes will be stable.

WATER PERSISTENCE

The watershed draining into Lowe Permanent Impoundment 1 consists of undisturbed (820.2 acres) and reclaimed lands (5.4 acres). A total of 825.6 acres drains into this impoundment, this has resulted in standing water occurring in the pond all year. Lowe Permanent Impoundment 1 will be incised into spoil material with 5.03×10^{-7} cm/sec. permeability rates (Appendix 11-K) allowing negligible loss due to infiltration. Predictive water depths range from approximately 6 to 8 feet, with respective volumes of 6.45 to 9.67 acre-feet.

The temporary impoundment has retained water since being established in 1997, demonstrating that the impoundment will provide a persistent water source.

WATER QUALITY

Water contained in Lowe Permanent Impoundment 1 will originate from the surface water runoff of undisturbed and reclaimed lands. Given that the top four feet of all reclaimed lands (either a combination of spoil and topsoil or all topsoil) does not contain material that could adversely affect the quality of the surface runoff, BNCC does not anticipate water quality issues in Lowe Permanent Impoundment I. Testing to-date indicates that none of the livestock standards for potentially toxic constituents has been exceeded. The only standard exceeded during testing was the pH level, and this was only periodically. To substantiate this, four full suite water quality analyses have been performed on water samples collected from Lowe Permanent Impoundment 1 and presented in Table 1. In addition, a comparison of chemical constituents with respect to federal livestock drinking water standards is included in Table 1. Based on the above-referenced chemical analysis, the water in Lowe Permanent Impoundment I is well suited for its intended use as a livestock and wildlife impoundment.

TABLE 1
Navajo Coal Company
Lowe Hole 3 Pond - Water Quality Statistics

Sample Date		Quality Data for Reservoir Station				Livestock Standard CL609[a]
		4/5/2000	6/15/2000	8/22/2000	12/4/2000	
pH (Lab)	(S.U.)	8.29	8.79	8.54	8.05	6.0-8.0
TDS (180 deg C)	(mg/l)	1150	1360	1620	1490	2000-4000
Boron	(mg/l)	0.1	0.2	0.2	0.2	NA
Fluoride	(mg/l)	1.2	1.3	1.6	1.2	2
Major Ions						
Bicarbonate as HCO3	(mg/l)	150	119	138	188	NA
Carbonate as CO3	(mg/l)	-10	14	14	-10	NA
Hydroxide as OH	(mg/l)	-10	-10	-10	-10	NA
Chloride	(mg/l)	40	52	66	56	NA
Sulfate	(mg/l)	620	820	1000	860	1000
Calcium	(mg/l)	61	54	50	60	NA
Magnesium	(mg/l)	10	13	15	13	NA
Potassium	(mg/l)	6.8	11	8.2	6.6	NA
Sodium	(mg/l)	260	380	450	400	4,999
Major Cations	(meq/l)	15.35	20.57	23.51	21.63	NA
Major Anions	(meq/l)	16.5	20.96	25.41	22.57	NA
Charge Balance	(percent)	3.6	0.92	3.88	2.12	NA
Lab Determined Ion Balance	(percent)	4.55	0.8	3.92	2.56	NA
Trace Metals (Dissolved)						
Aluminum	(mg/l)	N	N	N	-0.083	5
Arsenic	(mg/l)	N	-0.005	N	N	0.2
Cadmium	(mg/l)	N	-0.005	N	N	0.05
Chromium	(mg/l)	N	-0.01	N	N	1
Cobalt	(mg/l)	N	N	N	N	1
Copper	(mg/l)	N	-0.01	N	N	0.5
Iron	(mg/l)	-0.05	-0.05	-0.05	-0.05	no limit
Lead	(mg/l)	N	-0.002	N	N	0.1
Manganese	(mg/l)	-0.01	-0.01	0.09	0.06	no limit
Mercury	(mg/l)	N	-0.0002	N	N	0.001
Selenium	(mg/l)	-0.025	-0.005	0.006	-0.005	0.05
Zinc	(mg/l)	N	-0.05	N	N	0.01
Trace Metals (Total)						
Total Iron	(mg/l)	0.26	0.57	0.25	0.83	NA
Total Manganese	(mg/l)	0.01	0.01	0.17	0.1	NA

Note: N = No Trace

a. CL609 Cooperative Extension System, 1995. Analysis of Water Quality for Livestock. Cattle Producers Library

DIMINUTION OF ADJACENT WATER QUANTITY AND QUALITY

No pre-existing ponds or wells have been documented adjacent or immediately downstream of Lowe Permanent Impoundment 1. Additionally, the 825.6 acres draining into the impoundment comprise of only 11.7% of the total Lowe Arroyo watershed system. Furthermore, Lowe Permanent Impoundment 1 is a pass-through structure retaining less than 10 acre-feet of capacity. Diminution of adjacent water quantity and quality is negligible.

HYDROLOGY / HYDRAULICS

Hydrologic analysis was completed using SEDCAD 4 software (see attached report). Lowe Permanent Impoundment 1 is classified as a Class A, low hazard structure. Inlet and outlet structures were designed to remain stable during a 25 year-6 hour precipitation event at peak discharge. Riprap material is placed at the pond inlets as protective lining to minimize erosion. Inlet and outlet structures were designed to safely contain a 100 year-6 hour storm event at peak discharge.

The following hydrology parameters were used in the hydrologic analysis:

Storm Type	NRCS Type II-60
Design Storm / Rainfall Depth	25 year – 6 hour / 1.60 inches
Design Storm / Rainfall Depth	100 year – 6 hour / 2.00 inches
Watershed Area	825.6 acres

The following impoundment parameters were used as in the hydrologic analysis in the 25 year-6 hour storm event:

Peak Flow	320.72 cubic feet per second
Peak Volume	46.13 acre-feet
Initial Elevation	5342.00 feet
Peak Elevation	5344.54 feet
Free Board	2.54 feet
Dewater time	0.62 days

IMPOUNDMENT SUITABILITY

Lowe Permanent Impoundment 1 was designed for future use as a livestock and wildlife resource. Design considerations of this impoundment include an adequate watershed insuring water persistence and quality with no diminution of adjacent or downstream land users. Additionally, the impoundments 9.67 acre-feet of capacity, shallow design and irregular outline provide livestock and wildlife suitability.

Lowe Permanent Impoundment #1

The Lowe Arroyo post-mine hydrology model was used to determine the peak flows. Refer to Exhibit 11-77 for the Sedcad hydrology model. Structure 14 represents the impoundment.

LR

BHP Navajo Coal Company
Navajo Mine
PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

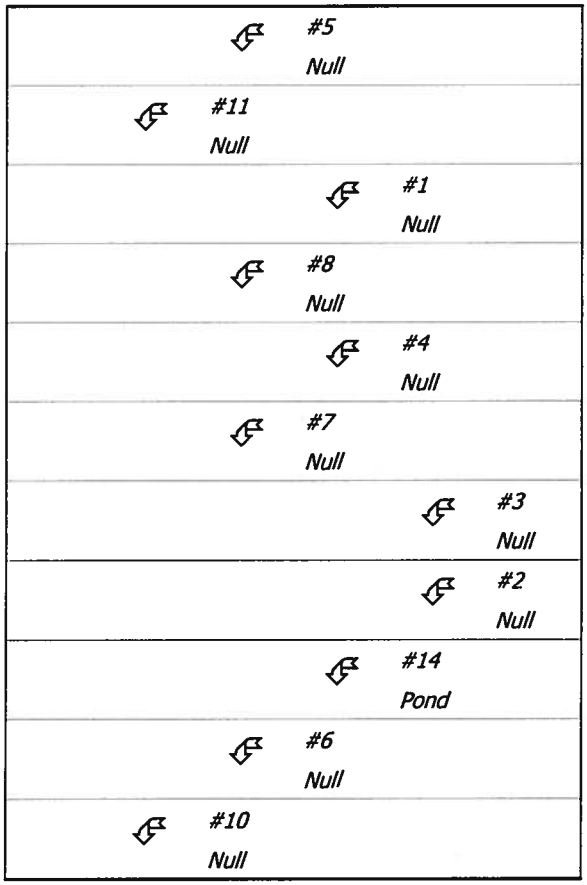
General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#8	0.419	0.337	
Null	#2	==>	#14	0.052	0.343	North Inlet
Null	#3	==>	#14	0.000	0.453	East Inlet
Null	#4	==>	#7	0.517	0.328	
Null	#5	==>	#11	5.868	0.239	
Null	#6	==>	#10	0.469	0.325	
Null	#7	==>	#10	0.469	0.325	
Null	#8	==>	#10	0.274	0.337	
Null	#9	==>	#12	0.000	0.000	
Null	#10	==>	#12	0.000	0.000	
Null	#11	==>	#12	0.000	0.000	
Null	#12	==>	#13	1.302	0.306	
Null	#13	==>	End	0.000	0.000	
Pond	#14	==>	#6	0.365	0.327	Lowe Permanent Impoundment #1



	#9 Null
#12 Null	
#13 Null	

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.38	73.00	5,307.00	3.51	0.419
#1	**Muskingum K:**					**0.419**
#2	8. Large gullies, diversions, and low flowing streams	1.55	11.00	710.00	3.73	0.052
#2	**Muskingum K:**					**0.052**
#3	8. Large gullies, diversions, and low flowing streams	30.00	3.00	10.00	16.43	0.000
#3	**Muskingum K:**					**0.000**
#4	8. Large gullies, diversions, and low flowing streams	1.16	70.00	6,012.00	3.23	0.517
#4	**Muskingum K:**					**0.517**
#5	5. Nearly bare and untilled, and alluvial valley fans	0.33	38.00	11,449.23	0.57	5.579
	8. Large gullies, diversions, and low flowing streams	1.92	83.00	4,330.00	4.15	0.289
#5	**Muskingum K:**					**5.868**
#6	8. Large gullies, diversions, and low flowing streams	1.12	60.00	5,360.01	3.17	0.469
#6	**Muskingum K:**					**0.469**
#7	8. Large gullies, diversions, and low flowing streams	1.12	60.00	5,360.00	3.17	0.469
#7	**Muskingum K:**					**0.469**
#8	8. Large gullies, diversions, and low flowing streams	1.38	48.00	3,479.00	3.52	0.274
#8	**Muskingum K:**					**0.274**
#12	8. Large gullies, diversions, and low flowing streams	0.81	102.00	12,617.00	2.69	1.302
#12	**Muskingum K:**					**1.302**
#14	8. Large gullies, diversions, and low flowing streams	1.14	48.00	4,214.00	3.20	0.365
#14	**Muskingum K:**					**0.365**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#5		386.400	386.400	83.16	17.31
#11		1,459.300	1,845.700	199.75	84.72
#1		384.000	384.000	82.66	14.90
#8		224.900	608.900	150.02	24.61
#4		1,417.400	1,417.400	420.23	76.93
#7		669.200	2,086.600	564.56	109.89
#3		825.600	825.600	320.72	46.13
#2		798.200	798.200	147.88	30.91
#14	In	0.000	1,623.800	438.72	77.04
	Out			408.35	77.04
#6		131.700	1,755.500	414.50	81.60
#10		208.400	4,659.400	1,068.16	230.83
#9		541.300	541.300	340.11	39.46
#12		0.000	7,046.400	1,347.54	355.02
#13		808.700	7,855.101	1,334.40	405.34

Structure Detail:

Structure #5 (Null)

Structure #11 (Null)

Structure #1 (Null)

Structure #8 (Null)

Structure #4 (Null)

Structure #7 (Null)

Structure #3 (Null)

East Inlet

Structure #2 (Null)

North Inlet

Structure #14 (Pond)

Lowe Permanent Impoundment #1

Pond Inputs:

Initial Pool Elev:	5,342.50
Initial Pool:	7.08 ac-ft

Pond Results:

Peak Elevation:	5,344.95
Dewater Time:	0.64 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
5,334.20	0.000	0.000	0.000	
5,334.21	0.001	0.000	0.000	
5,335.00	0.070	0.020	0.000	
5,335.20	0.094	0.037	0.000	
5,336.00	0.210	0.155	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,336.20	0.252	0.202	0.000		
5,337.00	0.440	0.475	0.000		
5,337.20	0.496	0.568	0.000		
5,338.00	0.740	1.059	0.000		
5,338.20	0.788	1.212	0.000		
5,339.00	0.990	1.922	0.000		
5,339.20	1.041	2.125	0.000		
5,340.00	1.250	3.040	0.000		
5,340.20	1.303	3.295	0.000		
5,341.00	1.520	4.423	0.000		
5,341.20	1.583	4.734	0.000		
5,342.00	1.840	6.101	0.000		
5,342.20	1.931	6.478	0.000		
5,342.50	2.070	7.078	0.000		
5,343.00	2.210	8.148	23.100	11.00	
5,343.20	2.294	8.599	50.667	0.95	
5,344.00	2.640	10.570	160.800	2.45	
5,344.20	2.749	11.110	212.851	0.30	
5,344.95	3.173	13.344	408.347	0.60	Peak Stage
5,345.00	3.200	13.487	420.800		
5,345.20	3.312	14.138	500.438		
5,346.00	3.770	16.968	818.600		

Detailed Discharge Table

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,334.20	0.000	0.000
5,334.21	0.000	0.000
5,335.00	0.000	0.000
5,335.20	0.000	0.000
5,336.00	0.000	0.000
5,336.20	0.000	0.000
5,337.00	0.000	0.000
5,337.20	0.000	0.000
5,338.00	0.000	0.000
5,338.20	0.000	0.000
5,339.00	0.000	0.000

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,339.20	0.000	0.000
5,340.00	0.000	0.000
5,340.20	0.000	0.000
5,341.00	0.000	0.000
5,341.20	0.000	0.000
5,342.00	0.000	0.000
5,342.20	0.000	0.000
5,342.50	0.000	0.000
5,343.00	23.100	23.100
5,343.20	50.667	50.667
5,344.00	160.800	160.800
5,344.20	212.851	212.851
5,345.00	420.800	420.800
5,345.20	500.438	500.438
5,346.00	818.600	818.600

Structure #6 (Null)

Structure #10 (Null)

Structure #9 (Null)

Structure #12 (Null)

Structure #13 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#5	1	87.500	0.590	1.287	0.200	91.500	M	56.22	6.224
	2	298.900	1.434	0.000	0.000	83.200	M	51.84	11.084
	Σ	**386.400**						**83.16**	**17.307**
#11	1	412.100	2.888	0.734	0.325	84.300	M	46.24	16.747
	2	221.700	1.474	0.639	0.330	88.400	M	59.55	12.474
	3	446.000	1.668	0.377	0.347	84.900	M	80.77	19.036
	4	379.500	1.000	0.000	0.000	87.000	M	119.66	19.153
	Σ	**1,845.700**						**199.75**	**84.717**
#1	1	293.800	1.413	0.000	0.000	81.200	M	42.47	9.168
	2	90.200	0.263	0.000	0.000	90.000	M	74.49	5.733
	Σ	**384.000**						**82.66**	**14.900**
#8	1	87.100	0.557	0.211	0.323	83.200	M	28.46	3.230
	2	137.800	0.553	0.000	0.000	86.100	M	58.80	6.477
	Σ	**608.900**						**150.02**	**24.608**
#4	1	470.600	1.256	0.387	0.350	87.000	M	126.21	23.751
	2	166.700	1.396	0.534	0.354	81.100	M	24.07	5.156
	3	66.500	0.818	0.534	0.354	82.600	M	16.05	2.344
	4	96.300	0.766	0.389	0.341	90.200	M	47.35	6.214
	5	54.100	0.199	0.389	0.341	93.000	M	59.34	4.301
	6	112.200	0.398	0.332	0.342	92.700	M	96.70	8.725
	7	56.900	0.238	0.183	0.333	93.000	M	59.95	4.524
	8	89.500	0.413	0.183	0.333	91.900	M	71.59	6.558
	9	226.200	0.610	0.000	0.000	87.500	M	102.54	11.871
	10	78.400	0.397	0.000	0.000	85.400	M	37.84	3.484
	Σ	**1,417.400**						**420.23**	**76.927**
#7	1	388.800	1.318	0.089	0.330	86.100	M	93.13	18.276
	2	207.300	1.094	0.089	0.330	86.900	M	60.86	10.381
	3	73.100	0.360	0.000	0.000	89.000	M	49.72	4.306
	Σ	**2,086.600**						**564.56**	**109.890**
#3	1	256.900	2.055	0.510	0.336	83.500	M	34.98	9.769
	2	138.800	0.315	0.510	0.336	89.900	M	106.86	8.755
	3	54.800	0.221	0.510	0.336	93.000	M	58.85	4.357
	4	98.200	0.277	0.176	0.362	89.900	M	79.20	6.194
	5	111.900	0.466	0.176	0.362	92.700	M	89.73	8.701

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	6	37.900	0.159	0.418	0.309	93.000	M	43.46	3.013
	7	127.100	0.386	0.000	0.000	84.700	M	58.62	5.337
	Σ	**825.600**						**320.72**	**46.128**
#2	1	549.100	2.696	0.436	0.369	80.300	M	44.78	15.806
	2	191.400	0.472	0.000	0.000	88.300	M	107.38	10.686
	3	57.700	0.205	0.000	0.000	92.500	M	60.83	4.421
	Σ	**798.200**						**147.88**	**30.913**
#14	Σ	**1,623.800**						**438.72**	**77.041**
#6	1	131.700	0.434	0.000	0.000	82.400	M	46.30	4.562
	Σ	**1,755.500**						**414.50**	**81.603**
#10	1	179.300	0.676	0.000	0.000	91.200	M	103.47	12.471
	2	29.100	0.311	0.000	0.000	92.700	M	27.57	2.263
	Σ	**4,659.400**						**1,068.16**	**230.835**
#9	1	274.600	0.559	0.179	0.345	90.600	M	169.32	18.260
	2	266.700	0.484	0.000	0.000	93.000	M	214.67	21.204
	Σ	**541.300**						**340.11**	**39.463**
#12	Σ	**7,046.400**						**1,347.54**	**355.016**
#13	1	130.600	0.245	1.141	0.305	91.800	M	125.71	9.499
	2	101.000	0.160	1.048	0.302	92.300	M	111.02	7.624
	3	133.900	0.165	0.948	0.300	90.500	M	131.32	8.837
	4	443.200	1.345	0.000	0.000	88.100	M	124.25	24.367
	Σ	**7,855.101**						**1,334.40**	**405.343**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	1.14	50.00	4,385.00	1.060	1.149
		8. Large gullies, diversions, and low flowing streams	3.18	162.00	5,088.00	5.350	0.264
#1	**1**	**Time of Concentration:**					**1.413**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.30	10.00	434.00	1.510	0.079
		8. Large gullies, diversions, and low flowing streams	3.70	142.00	3,834.00	5.770	0.184
#1	**2**	**Time of Concentration:**					**0.263**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	0.77	60.00	7,840.00	0.870	2.503
		8. Large gullies, diversions, and low flowing streams	1.22	28.00	2,301.00	3.300	0.193
#2	**1**	**Time of Concentration:**					**2.696**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	3.97	23.00	580.00	1.990	0.080
		8. Large gullies, diversions, and low flowing streams	2.60	178.00	6,838.00	4.840	0.392
#2	**2**	**Time of Concentration:**					**0.472**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	13.68	45.00	329.00	3.690	0.024
		8. Large gullies, diversions, and low flowing streams	3.12	108.00	3,466.00	5.290	0.181
#2	**3**	**Time of Concentration:**					**0.205**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	0.79	46.00	5,799.00	0.890	1.809
		8. Large gullies, diversions, and low flowing streams	3.31	160.00	4,837.00	5.450	0.246
#3	**1**	**Time of Concentration:**					**2.055**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	4.93	75.00	1,521.00	2.220	0.190
		8. Large gullies, diversions, and low flowing streams	2.98	70.00	2,345.00	5.180	0.125
#3	**2**	**Time of Concentration:**					**0.315**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	6.42	83.00	1,293.00	2.530	0.141
		8. Large gullies, diversions, and low flowing streams	3.21	50.00	1,559.00	5.370	0.080
#3	**3**	**Time of Concentration:**					**0.221**
#3	4	5. Nearly bare and untilled, and alluvial valley fans	8.98	60.00	668.00	2.990	0.062
		8. Large gullies, diversions, and low flowing streams	2.82	110.00	3,900.00	5.030	0.215
#3	**4**	**Time of Concentration:**					**0.277**
#3	5	5. Nearly bare and untilled, and alluvial valley fans	4.11	50.00	1,216.00	2.020	0.167
		8. Large gullies, diversions, and low flowing streams	1.86	82.00	4,404.00	4.090	0.299
#3	**5**	**Time of Concentration:**					**0.466**
#3	6	5. Nearly bare and untilled, and alluvial valley fans	9.01	53.00	588.00	3.000	0.054
		8. Large gullies, diversions, and low flowing streams	1.64	24.00	1,463.00	3.840	0.105
#3	**6**	**Time of Concentration:**					**0.159**
#3	7	5. Nearly bare and untilled, and alluvial valley fans	3.83	50.00	1,304.00	1.950	0.185

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.42	37.00	2,598.00	3.580	0.201
#3	**7**	**Time of Concentration:**					**0.386**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	1.08	35.00	3,237.00	1.030	0.872
		8. Large gullies, diversions, and low flowing streams	2.41	155.00	6,442.00	4.650	0.384
#4	**1**	**Time of Concentration:**					**1.256**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	0.86	37.00	4,286.00	0.920	1.294
		8. Large gullies, diversions, and low flowing streams	4.10	92.00	2,243.00	6.070	0.102
#4	**2**	**Time of Concentration:**					**1.396**
#4	3	5. Nearly bare and untilled, and alluvial valley fans	0.93	23.00	2,478.00	0.960	0.717
		8. Large gullies, diversions, and low flowing streams	3.83	82.00	2,141.00	5.870	0.101
#4	**3**	**Time of Concentration:**					**0.818**
#4	4	5. Nearly bare and untilled, and alluvial valley fans	0.63	10.00	1,582.00	0.790	0.556
		8. Large gullies, diversions, and low flowing streams	3.62	157.00	4,332.00	5.710	0.210
#4	**4**	**Time of Concentration:**					**0.766**
#4	5	5. Nearly bare and untilled, and alluvial valley fans	8.38	73.00	871.00	2.890	0.083
		8. Large gullies, diversions, and low flowing streams	2.64	54.00	2,043.00	4.870	0.116
#4	**5**	**Time of Concentration:**					**0.199**
#4	6	5. Nearly bare and untilled, and alluvial valley fans	4.90	80.00	1,632.02	2.210	0.205
		8. Large gullies, diversions, and low flowing streams	2.57	86.00	3,346.04	4.800	0.193
#4	**6**	**Time of Concentration:**					**0.398**
#4	7	5. Nearly bare and untilled, and alluvial valley fans	12.89	70.00	543.00	3.590	0.042
		8. Large gullies, diversions, and low flowing streams	1.40	35.00	2,508.00	3.540	0.196
#4	**7**	**Time of Concentration:**					**0.238**
#4	8	5. Nearly bare and untilled, and alluvial valley fans	3.98	30.00	754.00	1.990	0.105
		8. Large gullies, diversions, and low flowing streams	1.87	85.00	4,548.00	4.100	0.308
#4	**8**	**Time of Concentration:**					**0.413**
#4	9	5. Nearly bare and untilled, and alluvial valley fans	2.53	40.00	1,584.00	1.580	0.278
		8. Large gullies, diversions, and low flowing streams	1.61	73.00	4,546.00	3.800	0.332
#4	**9**	**Time of Concentration:**					**0.610**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	10	5. Nearly bare and untilled, and alluvial valley fans	3.26	50.00	1,536.00	1.800	0.237
		8. Large gullies, diversions, and low flowing streams	1.21	23.00	1,901.00	3.290	0.160
#4	**10**	**Time of Concentration:**					**0.397**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	2.32	75.00	3,231.00	1.520	0.590
#5	**1**	**Time of Concentration:**					**0.590**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	1.37	83.00	6,044.00	1.170	1.434
#5	**2**	**Time of Concentration:**					**1.434**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	2.93	22.00	752.00	1.710	0.122
		8. Large gullies, diversions, and low flowing streams	1.52	63.00	4,146.00	3.690	0.312
#6	**1**	**Time of Concentration:**					**0.434**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	1.93	102.00	5,288.00	1.380	1.064
		8. Large gullies, diversions, and low flowing streams	1.09	31.00	2,857.00	3.120	0.254
#7	**1**	**Time of Concentration:**					**1.318**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	1.54	55.00	3,561.00	1.240	0.797
		8. Large gullies, diversions, and low flowing streams	1.40	53.00	3,788.00	3.540	0.297
#7	**2**	**Time of Concentration:**					**1.094**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	3.26	60.00	1,842.00	1.800	0.284
		8. Large gullies, diversions, and low flowing streams	0.98	8.00	817.00	2.960	0.076
#7	**3**	**Time of Concentration:**					**0.360**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	3.08	75.00	2,436.00	1.750	0.386
		8. Large gullies, diversions, and low flowing streams	1.53	35.00	2,291.00	3.700	0.171
#8	**1**	**Time of Concentration:**					**0.557**
#8	2	5. Nearly bare and untilled, and alluvial valley fans	5.25	60.00	1,142.00	2.290	0.138
		8. Large gullies, diversions, and low flowing streams	1.88	115.00	6,130.00	4.100	0.415
#8	**2**	**Time of Concentration:**					**0.553**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	130.00	2,477.00	2.290	0.300
		8. Large gullies, diversions, and low flowing streams	2.40	104.00	4,333.00	4.640	0.259
#9	**1**	**Time of Concentration:**					**0.559**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	7.24	80.00	1,105.00	2.690	0.114

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.34	143.00	6,113.00	4.580	0.370
#9	**2**	**Time of Concentration:**					**0.484**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	3.67	68.00	1,855.00	1.910	0.269
		8. Large gullies, diversions, and low flowing streams	1.16	55.00	4,740.00	3.230	0.407
#10	**1**	**Time of Concentration:**					**0.676**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	4.40	103.00	2,342.00	2.090	0.311
#10	**2**	**Time of Concentration:**					**0.311**
#11	1	5. Nearly bare and untilled, and alluvial valley fans	0.70	60.00	8,630.00	0.830	2.888
#11	**1**	**Time of Concentration:**					**2.888**
#11	2	5. Nearly bare and untilled, and alluvial valley fans	1.08	59.00	5,468.00	1.030	1.474
#11	**2**	**Time of Concentration:**					**1.474**
#11	3	5. Nearly bare and untilled, and alluvial valley fans	0.89	50.00	5,647.00	0.940	1.668
#11	**3**	**Time of Concentration:**					**1.668**
#11	4	5. Nearly bare and untilled, and alluvial valley fans	1.48	47.00	3,181.00	1.210	0.730
		8. Large gullies, diversions, and low flowing streams	1.98	81.00	4,100.00	4.210	0.270
#11	**4**	**Time of Concentration:**					**1.000**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	25.00	778.00	1.790	0.120
		8. Large gullies, diversions, and low flowing streams	3.74	98.00	2,620.00	5.800	0.125
#13	**1**	**Time of Concentration:**					**0.245**
#13	2	5. Nearly bare and untilled, and alluvial valley fans	9.77	50.00	512.00	3.120	0.045
		8. Large gullies, diversions, and low flowing streams	3.65	87.00	2,386.00	5.720	0.115
#13	**2**	**Time of Concentration:**					**0.160**
#13	3	5. Nearly bare and untilled, and alluvial valley fans	19.02	85.00	447.00	4.360	0.028
		8. Large gullies, diversions, and low flowing streams	3.12	82.00	2,627.00	5.300	0.137
#13	**3**	**Time of Concentration:**					**0.165**
#13	4	5. Nearly bare and untilled, and alluvial valley fans	3.51	105.00	2,995.00	1.870	0.444
		8. Large gullies, diversions, and low flowing streams	0.72	60.00	8,278.00	2.550	0.901
#13	**4**	**Time of Concentration:**					**1.345**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	8. Large gullies, diversions, and low flowing streams	1.36	87.00	6,414.00	3.490	0.510
#3	**1**	**Muskingum K:**					**0.510**
#3	2	8. Large gullies, diversions, and low flowing streams	1.36	87.00	6,414.00	3.490	0.510
#3	**2**	**Muskingum K:**					**0.510**
#3	3	8. Large gullies, diversions, and low flowing streams	1.36	87.00	6,414.03	3.490	0.510
#3	**3**	**Muskingum K:**					**0.510**
#3	4	8. Large gullies, diversions, and low flowing streams	2.20	62.00	2,822.00	4.440	0.176
#3	**4**	**Muskingum K:**					**0.176**
#3	5	8. Large gullies, diversions, and low flowing streams	2.20	62.00	2,822.00	4.440	0.176
#3	**5**	**Muskingum K:**					**0.176**
#3	6	8. Large gullies, diversions, and low flowing streams	0.84	35.00	4,143.48	2.750	0.418
#3	**6**	**Muskingum K:**					**0.418**
#4	1	8. Large gullies, diversions, and low flowing streams	1.76	98.00	5,553.00	3.980	0.387
#4	**1**	**Muskingum K:**					**0.387**
#4	2	8. Large gullies, diversions, and low flowing streams	1.90	151.00	7,950.00	4.130	0.534
#4	**2**	**Muskingum K:**					**0.534**
#4	3	8. Large gullies, diversions, and low flowing streams	1.90	151.00	7,950.00	4.130	0.534
#4	**3**	**Muskingum K:**					**0.534**
#4	4	8. Large gullies, diversions, and low flowing streams	1.49	76.00	5,117.00	3.650	0.389
#4	**4**	**Muskingum K:**					**0.389**
#4	5	8. Large gullies, diversions, and low flowing streams	1.49	76.00	5,117.00	3.650	0.389
#4	**5**	**Muskingum K:**					**0.389**
#4	6	8. Large gullies, diversions, and low flowing streams	1.50	66.00	4,388.00	3.670	0.332
#4	**6**	**Muskingum K:**					**0.332**
#4	7	8. Large gullies, diversions, and low flowing streams	1.29	29.00	2,252.00	3.400	0.183
#4	**7**	**Muskingum K:**					**0.183**
#4	8	8. Large gullies, diversions, and low flowing streams	1.29	29.00	2,252.00	3.400	0.183
#4	**8**	**Muskingum K:**					**0.183**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	68.00	5,236.00	1.130	1.287
#5	**1**	**Muskingum K:**					**1.287**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	1	8. Large gullies, diversions, and low flowing streams	1.22	13.00	1,067.00	3.310	0.089
#7	**1**	**Muskingum K:**					**0.089**
#7	2	8. Large gullies, diversions, and low flowing streams	1.22	13.00	1,067.00	3.310	0.089
#7	**2**	**Muskingum K:**					**0.089**
#8	1	8. Large gullies, diversions, and low flowing streams	1.06	25.00	2,356.04	3.090	0.211
#8	**1**	**Muskingum K:**					**0.211**
#9	1	8. Large gullies, diversions, and low flowing streams	1.59	39.00	2,446.00	3.780	0.179
#9	**1**	**Muskingum K:**					**0.179**
#11	1	8. Large gullies, diversions, and low flowing streams	1.11	93.00	8,350.00	3.160	0.734
#11	**1**	**Muskingum K:**					**0.734**
#11	2	8. Large gullies, diversions, and low flowing streams	1.22	93.00	7,626.00	3.310	0.639
#11	**2**	**Muskingum K:**					**0.639**
#11	3	8. Large gullies, diversions, and low flowing streams	1.67	88.00	5,265.04	3.870	0.377
#11	**3**	**Muskingum K:**					**0.377**
#13	1	8. Large gullies, diversions, and low flowing streams	0.79	87.00	10,974.00	2.670	1.141
#13	**1**	**Muskingum K:**					**1.141**
#13	2	8. Large gullies, diversions, and low flowing streams	0.75	73.00	9,772.00	2.590	1.048
#13	**2**	**Muskingum K:**					**1.048**
#13	3	8. Large gullies, diversions, and low flowing streams	0.72	63.00	8,709.00	2.550	0.948
#13	**3**	**Muskingum K:**					**0.948**

Outflow Channel - Stability Design for 25 yr - 6 hr Storm Event

Material: Spoils - shale w/sandstone cobbles

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	5.0:1	11.0:1	0.5	0.0300	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	408.00 cfs	
Depth:	2.27 ft	3.27 ft
Top Width:	56.32 ft	72.32 ft
Velocity:	4.71 fps	
X-Section Area:	86.62 sq ft	
Hydraulic Radius:	1.530	
Froude Number:	0.67	