Project Report

White Clay Creek Wild and Scenic River Shad Restoration Project (Removal of Dam No. 1)

New Castle County
Wilmington, Delaware

Final Draft August 31, 2011

Prepared for:

FishAmerica Foundation
225 Reinekers Lane, Suite 420
Alexandria, VA 22314

Prepared by:

Gerald J. Kauffman, Director

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August 31, 2011

Mr. Patrick Egan, Grants Manager
FishAmerica Foundation
225 Reinekers Lane, Suite 420
Alexandria, Virginia 22314

Re: FAF 10025 - White Clay Creek Shad Restoration Project, Removal of Dam No. 1

Dear Mr. Egan:

Enclosed is the final project report that documents the following work completed under the terms of our grant for FAF 10025 White Clay Creek Shad Restoration Project, Removal of Dam No. 1.

- Final Report
- Receipts (to be forwarded) for approved expenses, timesheets, ledgers for salaries/benefits
- Invoice requesting reimbursement from FAF
- Project photographs (before, during, and after) in high resolution jpg quality
- Post - Project Match letter with supporting documentation
- Copies of all required permits/approvals/clearances
- Copy of Landowner Agreements
- 100% Design Plans
- Technical Design Report
- Hydrologic / Hydraulic Analysis
- Sediment Quality / Quality Analysis
- Stream Geomorphology / Habitat Survey
- Field Survey / Topographic Mapping

After receipt of permits, we look forward to removal of Dam No. 1 during fall 2011 in time for spawning of American shad during the spring 2012 cycle. On behalf of the White Clay Creek Wild and Scenic River Watershed Management Committee, thank you for the opportunity to work on this important project to restore the anadromous fishery to the White Clay Creek.

Warmly,

Gerald J. Kauffman, Director
Water Resources Agency
University of Delaware

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Chapter 1 – Project Description

Purpose

This report documents work completed under the terms of our FishAmerica Foundation grant for FAF 10025 White Clay Creek Shad Restoration Project (Removal of Dam No. 1). This work includes field studies, engineering design, and permit applications for the removal of White Clay Creek Dam No. 1 (RM 4.2) to reopen 3.5 miles of the creek for the passage of American shad and hickory shad in New Castle County, Delaware. This will be the first dam removal project for fish passage in the entire State of Delaware. Removal of downstream-most Dam No. 1 along the White Clay Creek Wild and Scenic River is the first and most critical step in a 5-year plan to remove an additional 6 upstream dams and reopen fish passage for 14 miles from tidewater inland to the Piedmont at the Delaware/Pennsylvania state line.

Table 1. Dams proposed for removal along the White Clay Creek

Dam	Miles above Mouth	Height of Dam (ft)
No. 1 (Delaware Park)	4.3	3-8
No. 2 (Red Mill Road)	7.6	3
No. 3 (Old Paper Mill Road)	9.5	4
No. 4 (Route 72 Paper Mill Road)	10.1	6
No. 5 (Newark Water Intake)	11.1	10
No. 6 (Creek Road), removed	11.6	3
No. 7 (Deerfield Golf Course)	12.7	6

Overview

The long-term conservation objective of this project is the first phase to of a 5-year plan to restore domestic and anadromous fish passage and spawning habitat in the 107 square mile White Clay Creek National Wild and Scenic River watershed by removing obsolete low, on-stream dams. The White Clay Creek was designated by President Clinton and Congress in 2000 based on legislation introduced by Senator Joe Biden as the first wild and scenic river in the nation protected on a comprehensive watershed basis instead of by river segment.

The University of Delaware Water Resources Agency prepared a feasibility study, funded by the National Fish and Wildlife Foundation (NFWF), to restore shad migration to the White Clay Creek. In Delaware, currently there are 7 low head dams along 13 miles of the White Clay Creek between tidewater and up into the Piedmont to 70 ft above sea level near Newark, Delaware. Dam No. 1 is a 100 ft long, 3 to 8 ft high crumbling low head rock fill, timber, and concrete cap structure constructed circa 1750 that pooled water for a long-defunct diversion raceway for a mill that once stood about a mile downstream at the Hale Byrnes House. Fish abundance surveys conducted in April and May 2010 by biologists from the Delaware Division of Fish and Wildlife confirmed that Dam No. 1 is indeed the upstream barrier to anadromous fish migration as up to 500 hickory shad were detected downstream from the dam and no anadromous fish were detected upstream from the barrier. The old rock fill and timber dam is

breached along the right stream bank (looking upstream) and was damaged by floods from Hurricane Floyd in September 1999, Tropical Storm Henri in September 2003, and lately by Hurricane Irene on August 28, 2011.

The low dam is surrounded by a golf course along the right bank of the creek and a forest on the left bank owned by the Delaware Park Country Club (a willing project proponent). This project site for the proposed removal of Dam No. 1 is privately owned by the Delaware (Horse) Racing Association and is located at the White Clay Creek Country Club and Delaware Park Horse Racing Track. According to deed research conducted at the New Castle County Recorder of Deeds, the Delaware Racing Association (owner of the White Clay Creek Country Club) owns the low dam. The White Clay Creek Wild and Scenic Shad Restoration Committee met with the White Clay Creek Country Club's Director of Grounds, John Mizikar, and discussed removing this dam to restore shad migration and to improve the habitat. The White Clay Creek Country Club has provided a letter of support expressing interest as a willing partner in removing this dam and restoring fish habitat to this stretch of the White Clay Creek.

With receipt of permits, we plan to work with the White Clay Creek Country Club to remove Dam No. 1 during a two week period in November 2011 in time to remove this impediment to fish passage before the spring 2012 anadromous fish spawning season which usually begins in late March or April. We propose to retain a contractor to utilize low impact hydraulic construction equipment and work from the stream bank to remove the stone and boulder-sized rocks and timber from the crumbling dam. The rocks will be repositioned along both stream banks at the site of the dam as part of a stream restoration. Snagged trees and concrete debris will be removed from the site. The dam will be removed from right to left (looking upstream) starting at an existing breach in the dam to allow for a gentle flushing of accumulated sediment. Important historic timber frame structure in the left side of the dam will be left intact as an example of 18th century engineering. Volunteers will plant trees to reforest the stream banks and increase effective shading area to reduce stream water temperatures. Characteristics of Dam No. 1 along the White Clay Creek at Delaware Park include:

- This will be the first dam removal project for fish passage in the State of Delaware.
- Relatively low dam, approximately 3 to 8 ft high.
- Stone and timber crib construction, breached in 2 places along right bank (looking upstream).
- Much of the deposited sediment has scoured over the dam during floods.
- Owned by Delaware Racing Association (White Clay Creek Country Club), a willing owner.
- Dam constructed circa 1750 to divert water to Hale Byrnes House situated mile downstream.
- Currently does not serve any purpose and has breached at least 2 locations.

Hurricane Irene

A field reconnaissance on September 1, 2011 indicates, with the exception of sediment movement and deposition downstream, Dam No. 1 (already badly breached) withstood the ravages of Hurricane Irene on August 28, 2011 that dumped over 7 inches of rain in 24 hours. The peak flow along the White Clay Creek near Newark USGS stream gage during Hurricane Irene was 16,700 cfs (greater than a 100-yr flood) and ranked second only to the 19,500 cfs flow

of Hurricane Floyd recorded on September 16, 1999. The USGS gage is just a few thousand feet upstream from Dam No. 1 and has recorded flows on the creek since 1943.

Table 2. Peak floods along White Clay Creek at Newark USGS stream gage 01479000

Date	Event	Peak Flow (cfs)	Frequency
9/16/99	Hurricane Floyd	19,500	>200 yr
8/28/11	Hurricane Irene	16,700	>100-yr
9/15/03	Tropical Storm Henri	13,900	>50-yr
7/05/89	4th of July Storm	11,600	>25 yr
1/19/96	Snow Melt Event	9,150	25 yr
7/22/72	Hurricane Agnes	9,080	25 yr

Benefits

Removal of Dam No. 1 will:

- Reopen 3.5 miles of White Clay Creek for anadromous fish passage.
- Restore 42 acres of the White Clay Creek substrate for anadromous fish spawning.

The Atlantic States Marine Fisheries Commission's Resolution on the Importance of Habitat Connectivity to Commission-Managed Species (November 2009) has resolved to work toward restoring diadromous with effective fish passage and suitable historic spawning and nursery habitat and that dam removal should be utilized whenever feasible. The White Clay Creek dam removal project is one component of a greater effort on the Atlantic coast to restore and maintain viable populations of diadromous fish. These efforts, occurring between the states and the Atlantic State Marines Fisheries Commission, aim to establish coast-wide fish passage targets by 2012.

Benefits to Sportfishing

About 17% of the watershed is protected open space, with two-thirds of that in Delaware. Open space is a major platform for recreation in the White Clay Creek watershed. The White Clay Creek State Park, managed by Delaware, and the White Clay Creek Preserve, managed by Pennsylvania, is maintained as natural areas accommodating passive recreation. Other parks in the watershed are designed for heavier uses including: sport fields, basketball courts, and picnic facilities. The streams of the White Clay Creek are an extremely popular fishing destination in the tri-state region. More than 20,000 brown and rainbow trout are stocked in the Pennsylvania portion of the White Clay Creek, while over 18,000 trout are stocked in the Delaware portion. The watershed is home to a wide variety of fish and wildlife. The waters of the White Clay Creek support over 24 species of fish and is considered Delaware's premier trout-fishing stream. This project will open an additional 3.5 miles of stream habitat and spawning habitat for anadromous and diadromous fish. This will provide additional recreational fishing opportunities for local and regional anglers. Public access points to the creek are located upstream and

downstream of the dam. Activities such as sport fishing, fly-fishing, kayaking, and canoeing can be enjoyed at three downstream points and two upstream points including:

- Churchman's Marsh (3.8 miles downstream)
- Hale Byrnes House (2.2 miles downstream)
- Old Route 7 Bridge (1.3 miles downstream)
- New Castle County Park (1.9 miles upstream)
- New Castle County Park (3 miles upstream)
- White Clay Creek State Park (5.2 miles upstream)

Partnerships

Project partners for the White Clay Creek dam removal project include:

- NOAA Coastal Restoration Center
- Delaware DNREC, Division of Fish and Wildlife
- Delaware DNREC, Division of Watershed Stewardship
- New Castle Conservation District
- Brandywine Conservancy
- Christina Conservancy
- White Clay Creek Country Club
- University of Delaware, Water Resources Agency (UDWRA)
- White Clay Creek Wild and Scenic Management Committee
- New Castle County

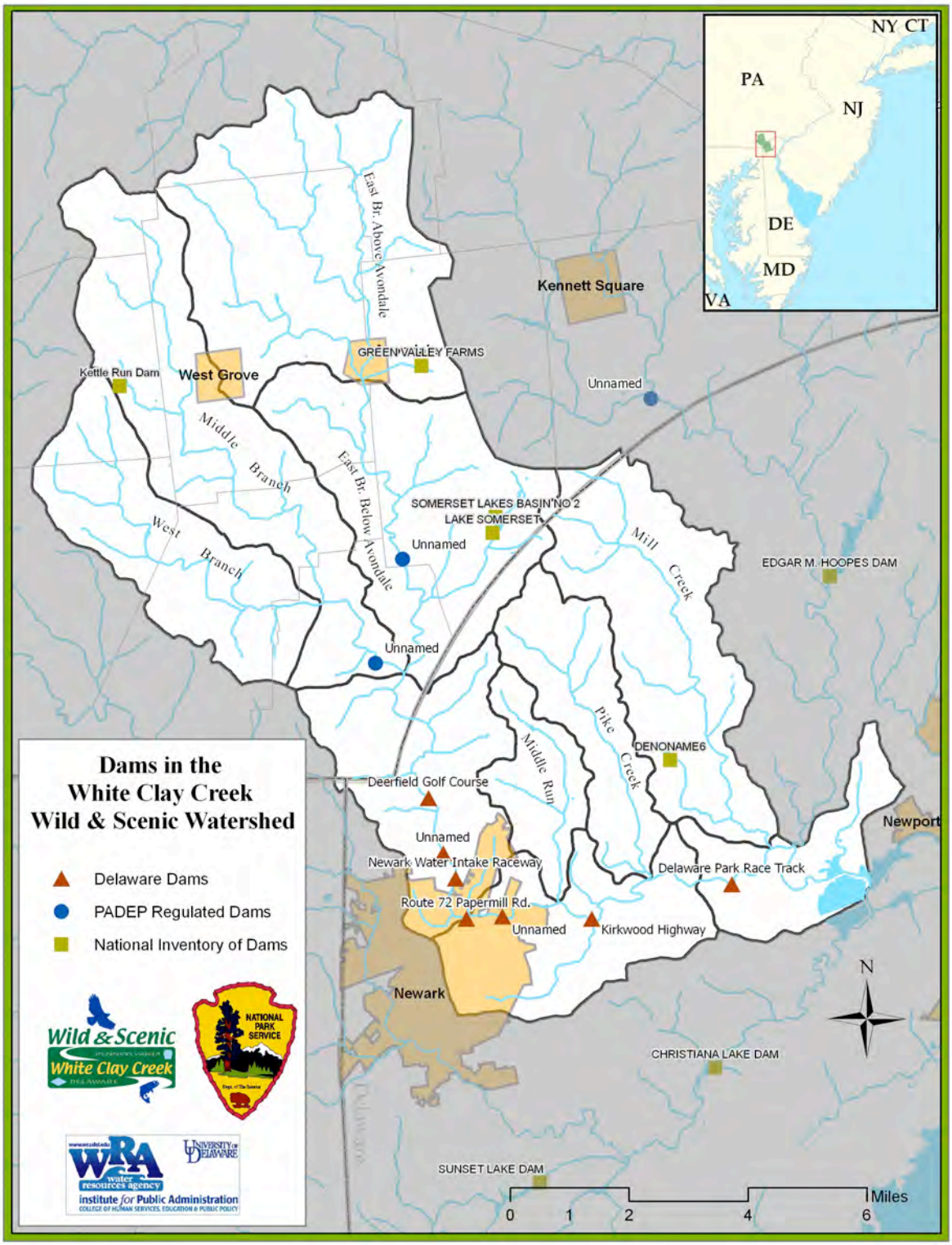


Figure 1. Dams proposed for removal along White Clay Creek in Delaware

Figure 2. Dam No. 1 proposed for removal along White Clay Creek at Delaware Park

Chapter 2 – Project Scope and Schedule

Scope

We conducted field studies, engineering design, and submitted permit applications for removal of Dam No. 1 in accordance with the following scope of work.

1. Project Management – Oversee the engineering design and permit process including:
- Monitor budget and schedule.
- Hold kickoff meeting and progress meetings.
- Hold technical meetings to present design options to technical team and community
- Coordinate public education and community outreach program.

2. Pre-project Stream Monitoring – The Delaware DNREC Division of Fish and Wildlife conducted pre-project fishery surveys in April and May 2010 that reported hickory shad abundance at 500 catch per unit effort (CPUE) downstream from Dam No. 1 and no evidence of anadromous fish upstream from the dam.

3. Field Survey/Topographic Mapping – Conduct a topographic survey and obtain stream cross-sections to collect data for hydraulic modeling, engineering design, and permit applications.
- Gather existing data, maps, aerial photographs, drawings, and FEMA mapping.
- Conduct a topographic survey and prepare a base map in the vicinity of the dam depicting site features, utilities, and property lines.
- Plot a longitudinal stream profile along the deepest part of the stream (thalweg) and delineate depth of fine grain sediment.
- Obtain 13 stream cross-sections including:
    - Cross-sections at 100 ft intervals for 700 ft downstream from dam.
    - Cross-section at toe of dam.
    - Cross-section along top of dam.
    - Cross-section just upstream from dam.
    - Cross-sections at 100 ft intervals for 700 ft upstream from dam.
- Delineate, map, and flag wetland boundaries.

4. Stream Geomorphology/Habitat Survey - Conduct stream surveys to document pre-project conditions and prepare dam removal design.
- Conduct a stream geomorphology survey using the Rosgen method for parameters such as pebble count/bedload characterization, stream sinuosity, channel width/depth ratio.
- Conduct a macroinvertebrate habitat survey using EPA rapid stream bioassessment technique.

5. Sediment Quality/Quantity - Conduct sediment sampling and prepare sediment control plan to assess potential for contaminants in sediment behind the dam and control sediment flow during dam removal.
- Define quantity (CY) and depth (ft) of fine grain sediment upstream from dam.
- Obtain 3 sediment sample cores upstream from dam.
- Analyze 3 sediment samples for heavy metals/organic chemicals at UD agriculture laboratory.
- Prepare sediment control plan.

6. Hydrologic/Hydraulic Analysis – Use the U. S. Army Corps of Engineers HECRAS Model and exceedance flow data from the White Clay Creek near Newark USGS stream gage to compare pre - and post - dam removal conditions for flow depth and flow velocity

7. Engineering Design/Specifications – Prepare engineering design plans and specifications for the proposed removal of Dam No. 1. including engineering plans design drawings

Engineering Drawings(24" x 36" and 8 ½" x 11") including plan sheets
- Existing site conditions
- Staging and access
- Dam removal plan
- Flow diversion plan
- Natural resources delineation
- Proposed plan view
- Cross-sections (existing/proposed)
- Soil Erosion and sediment Control
- Stream restoration/reforestation plan

Project Specifications:
- Construction equipment
- Material quantities
- Flow diversion and dewatering
- Project sequencing and staging
- Site access
- Construction equipment
- Material specifications and quantities
- Engineers estimate of quantities and cost estimate

8. Permits - Prepare and submit applications and obtain local, state, and Federal permits. Follow joint permit application process established by the State of Delaware and Federal government.
- File regulatory permits
- Attend public hearings
- Address public and regulatory comments
- Obtain permits

Permit and Permitting Agency
Subaqueous Lands Permit, DNREC Division of Water Resources, Dover, Delaware
Water Quality Certification (Sec. 401 CWA), DNREC Division of Water Resources, Dover, DE
Coastal Zone Consistency Review, DNREC Coastal Management Program, Dover, Delaware
Section 7 Wild & Scenic River Consistency Review, U. S. National Park Service Philadelphia, PA
Section 404 Wetland Permit, U.S. Army Corps of Engineers, Philadelphia, PA
Soil Erosion and Sediment Control Permit, New Castle Conservation District, Newark, DE
State Historic Preservation Officer (SHPO), Delaware Division of Cultural Affairs, Dover, DE
Floodplain Permit, New Castle County Department of Land Use, New Castle, DE

9. Prepare Technical Design Report

Schedule

We conducted the work in accordance with the following schedule.

Table 3. Schedule for completing work for removal of White Clay Creek Dam No. 1

Project Activity	Completion Date
Begin work	Jan 2010
1. Project Management	Jan 2011 – Sep 2011
2. Pre-project Stream Monitoring	Apr – May, 2010
3. Field Survey/Topographic Mapping	Jun 2011
4. Stream Geomorphology/Habitat Survey	May 2011
5. Sediment Quality/Quantity	Jul 2011
6. Hydrologic/Hydraulic Analysis	Jun 2011
7. Engineering Design 50% complete 100% complete	Jul 15, 2011 Aug 15, 2011
Permits - Submit Pre-application Joint Permit Committee Obtain Permits	Nov 2010 Jan 2010 Sep 2011 (planned)
FAF Funded Portion of the Project	Jul 31, 2011
8. Final Design Report	Aug 31, 2011
9. Agreement End Date	Sep 30, 2011
Future Work	
Award construction contract	Oct 2011
Remove Dam No. 1	Nov 2011
Stream Restoration/Reforestation	Mar 2012
Anadromous fish spawning period	Mar 15 - Jun 15, 2012
Post - project Stream Monitoring	Jul - Aug 2012

Budget

We completed the work in accordance with the following budget.

Table 4. Budget for completing work for removal of White Clay Creek Dam No. 1

Project Activity	Total Cost	FAF Funds Budgeted	Match UDWRA/ DNREC
Begin work			
1. Project Management	$4,000	$2,000	$2,000
2. Pre-project Stream Monitoring	$3,000	by DNREC	$3,000
3. Field Survey/Topographic Mapping	$7,000	$5,000	$2,000
4. Stream Geomorphology/Habitat Survey	$3,000	$2,000	$1,000
5. Sediment Quality/Quantity	$3,000	$3,000	
6. Hydrologic/Hydraulic Analysis	$4,000	$2,000	$2,000
7. Engineering Design - 50% complete 100% complete	$20,000	$20,000	
10. Permits - Submit Applications Obtain Permits	$8,000	$6,000	$2,000
9. Technical Design Report	$2,000	$1,000	$1,000
Supplies/Materials	$500	$500	
Print Reports	$300	$300	
Mileage/Travel	$200	$200	
Total	**$55,000**	**$42,000**	**$13,000**
Future Work			
Advertise/award construction bids			
Commence Removal of Dam No. 1			
Complete Removal of Dam No. 1			
Stream Restoration/Reforestation			
Anadromous fish spawning period			
Stream Cleanup			
Post-project Stream Monitoring			
Shad in Schools			

Chapter 3 – Pre-Project Fish Abundance Survey

Distribution

In April and May 2010, Delaware DNREC Fisheries Biologists conducted fish abundance sampling and electro-shocking along the lower portion of the White Clay Creek (near Dam No. 1) and collected the following data:

Sampling on 4/22/10

- Site 1- below Dam No. 1 (RM 4.6) to the Mill Creek confluence, water temp 14.2 C
- Site 2- Mill creek confluence to Hale Byrnes house (TCS inflatable dam was lowered)
- Site 3- Hale Byrnes to RM 0, water temp 16.7 C

Table 5. Fish abundance along White Clay Creek on April 22, 2010

Fish Species	CPU			Visual Count			Description
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	
Hickory Shad	Approx 500		70	1000	450	70	Very thick at Site 1, see notes below.
Alewives		71		0	350	130	Abundant
American Shad				1	0	0	One large female (unripe). See notes below.
Blueback Herring				0	0	0	None observed, could be coming later, typically follow alewives and hickory shad runs.
Sea Lamprey				0	1	0	
Eels				Present	Present	Present	Observed at all sites.

Hickory shad

- Hickory shad too numerous to net and hold in the live well. Very thick at Site 1 with densities tapering off as traveling downstream.
- The females ranged from unripe, to running, to spent which indicates their spawn is probably peaking right about now.
- Note: for a creek that averages 150 cfs this time of year DNREC fisheries biologists were very impressed with the hickory run.

American shad

- No other American shad were observed however a small American shad could have easily blended in with the numerous hickory shad.

Other species

- Other species that were observed that make a local migration upriver to spawn include the occasional white perch and lots of white suckers
- Other species noted - smallmouth bass, quillback, yellow perch, largemouth bass, redbreast sunfish, pumpkinseed sunfish, rainbow trout (Site 2), fallfish, carp, chubs and a tiger trout (Site 3).

Sampling on 5/13/10

- Launched at the Red Mill Dam site (Dam #2).
- Flows were 50% above normal. From Dam #2 to Dam #1 there were no anadromous fish present with 3390 seconds of effort. Water temp was 12.2 C.

Table 6. Fish abundance along White Clay Creek on May 13, 2010

Fish Species	Number of Fish Present
Hickory Shad	340
White Perch	1
Striped Bass	20
White Perch	1
Sea Lamprey (adult)	8
Alewives	0
American Shad*	0

Hickory Shad

- Below Dam #1 (water temp 14.4 C) there was a school of hickory shad bunched up by the dam, not able to pass, CPUE of 350.
- Hickory shad were still present in good numbers from Dam 1 to Hale Byrnes, the count was 340. This count is down from previous sampling efforts on 4/22/10, which is expected later in the year.

American Shad

- If there is a run of American shad in the White Clay we should have seen them this time of year in the section we did. Based on this and the one female at the previous sampling efforts (4/22/10) the American shad run, though present, is depressed.

Angler Log and Creek Survey

In March 2009 the University of Delaware Water Resources Agency (UDWRA), received the National Fish and Wildlife Foundation – Delaware Estuary Watershed Grant 2008 to fund the White Clay Creek Wild and Scenic Shad Restoration Project. Completing an angler log and creel survey along the White Clay Creek is Task 4 of the activities outlined in the grant proposal. UDWRA's graduate research assistants and staff worked in partnership with DNREC to conduct this survey on the White Clay Creek. Data was collected from April 19, 2009-May 29, 2009. Matt Fisher (Fisheries Biologist) with DNREC's Division of Fish and Wildlife provided the survey schedule, angler logs used for the interviews, and advisement. This data and analysis will be used to assist UDWRA's efforts to restore shad migration to the Wild and Scenic White Clay Creek.

The survey was conducted over a six-week period (April 19, 2009-May 29, 2009). Over the six-week survey period, the volunteer angler log and creel survey was conducted weekly on two randomly selected weekdays (Monday-Thursday), each Friday, and twice on one of the two weekend days. A total of 29 fish were reported caught and 25 of the 29 fish that were reported caught were released. The interview results indicate that the Hickory shad was the most commonly caught fish, totaling 12 of the 29, or 41% of the total fish. The second most commonly caught fish was the Smallmouth bass. According to the anglers' reports, 6 of the 29 (21%) total fish caught were Smallmouth bass. Overall, the anglers reported catching the following fish species.

- American shad
- Hickory shad
- Channel catfish
- Smallmouth bass
- Largemouth bass
- Sunny/Blue gill
- Striped bass
- Brown trout
- Carp

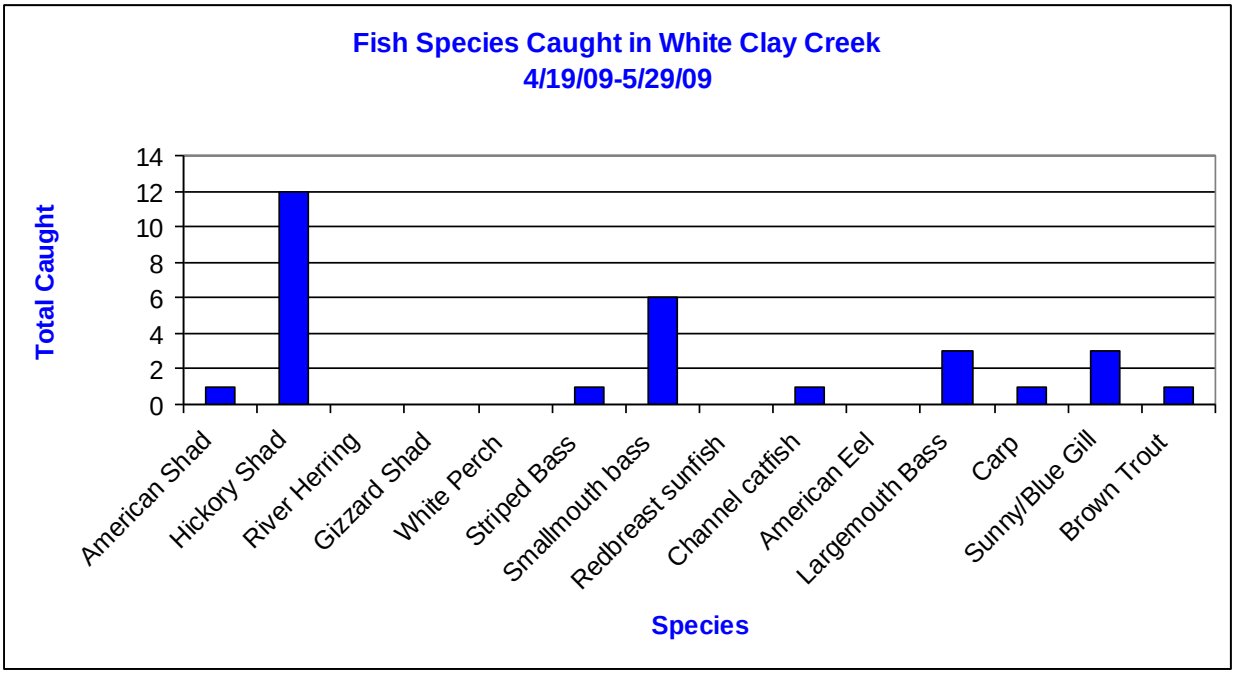


Figure 3. Fish species caught during angler survey in White Clay Creek, Apr 19-May 29, 2009

Historic Fish Distribution

According to historic reports there have been numerous diadromous fish species sighted in the White Clay Creek. According to the *Water Supply Plan for New Castle County Delaware, Supplemental Environmental Studies, Sampling Conducted Spring 1996* the following fish were cited at the lower White Clay Creek at Churchman's Marsh: striped bass, white perch, American eel, and gizzard shad. This same study analyzed the species identity of the ichthyoplankton at the lower White Clay Creek at

Churchman's Marsh and found the following species: alewife, gizzard shad, striped bass, and white perch.

According to the *Report on the Joint Task Force for Northern New Castle County, Phase 2, 7Q10 Assessment Sampling* conducted in the fall of 1995 the following fish species were identified as present in the White Clay Creek near Stanton (at United Water's surface water withdrawal): alewife, American eel, blueback herring, sea lamprey, largemouth bass, small mouth bass, and yellow perch. This same study sampled the White Clay Creek near Newark (at the City of Newark's water treatment plant at Paper Mill Rd.) and found the following fish species: American eel, sea lamprey, largemouth bass, and small mouth bass. Additional fishery survey results collected by Metcalf and Eddy in 1996 are included in Table 2 below.

Table 7. White Clay Creek Fishery Survey Results, Source: Metcalf and Eddy, 1996.

Date of Sampling	**June 6**	**June 6**	**June 7**	**June 28**
Location	WCA	WCB	TT	CK
Seconds Shocked	2319	3232	1585	815
Common Name	Number of Fish			
American Eel	4	8	3	4
Am. Brook Lamprey	7	1	2	
Margined Madtom		2		
White Sucker	69	54	40	4
Rosyside Dace		65	88	59
Satinfin Shiner	24	23	1	1
Cutlips Minnow	6	11		
Common Shiner	15	35	23	
Spottail Shiner	3	14		
Swallowtail Shiner	38	15		
Bluntnose Minnow	2	1	1	
Blacknose Dace	23	23	42	48
Longnose Dace	1	52		
Creek Chub	21	14	28	21
Tesselated Darter	44	31		1
Rainbow Trout		1		
Rock Bass		4		
Redbreast Sunfish	1			
Pumpkinseed	1			
Bluegill	1		2	
Total Fish	260	354	230	138
Number of Species	16	17	10	7
TT - Thompson Station Tributary				
CK - Corner Ketch Tributary				
WCA - White Clay Creek at Hopkins Bridge				
WCB - White Clay Creek below confluence of Thompson Station Tributary				

Water Quality

Water quality along the White Clay Creek at Stanton (just downstream from Dam No. 1) has improved between 1995 and 2009 for dissolved oxygen, phosphorus, and bacteria

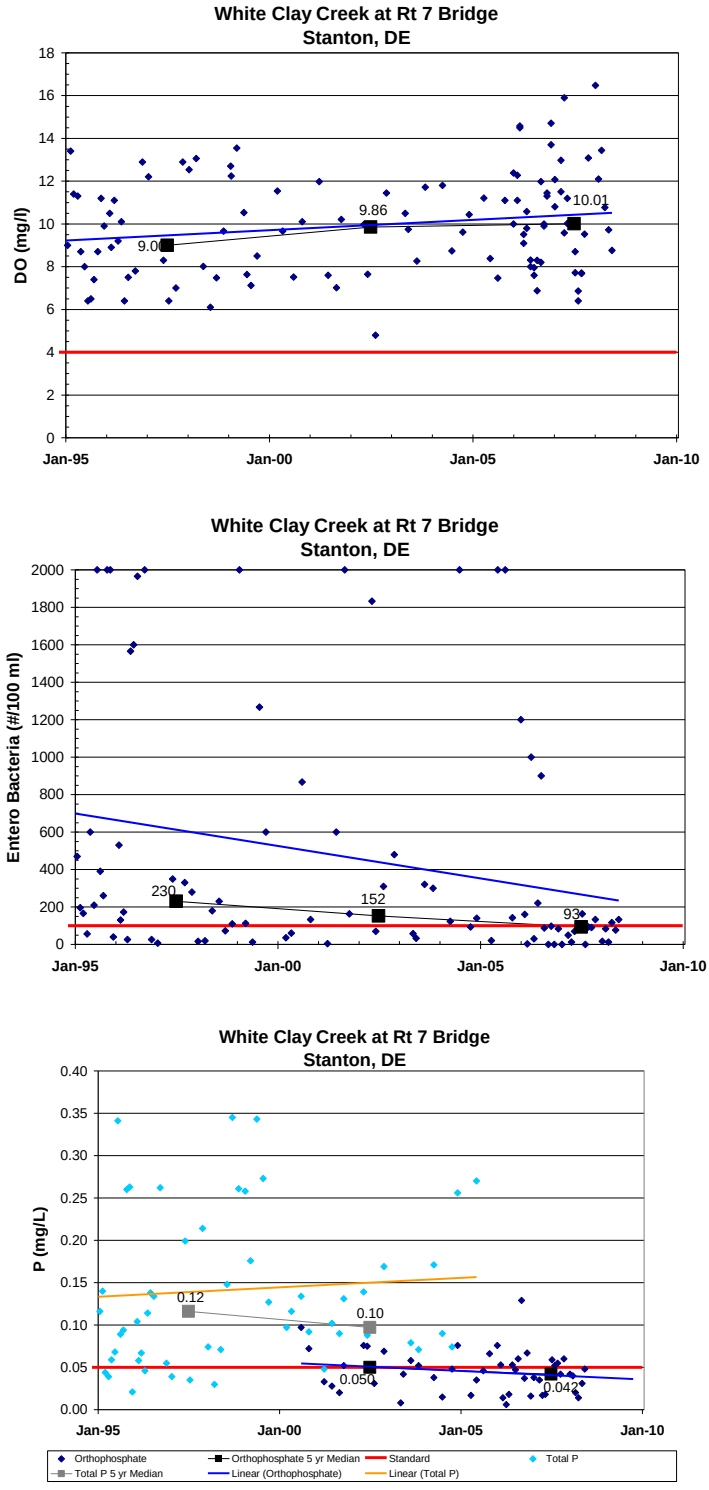


Figure 4. Dissolved oxygen, bacteria, and phosphorus along White Clay Creek at Stanton, 1995-2009

Chapter 4 – Field Survey/Topographic Mapping

Civil and environmental engineering students from the University of Delaware conducted the field survey to obtain stream cross-sections using a survey level with tripod, 25 foot level rod, 200 foot measuring tape, field book, and three person crew. First, the height of the leveled instrument was determined by back sighting on a known benchmark. The back sight reading is added to the benchmark elevation to calculate the height of instrument. Cross-sections used in this field survey were +7+00, +6+00, +3+00, +2+00, +1+00, +0+10, 0+00 (sill of dam), -0+60, -1+00, -2+00, -3+00, -4+00, -5+00, and -6+00. The (-) values designate downstream distances from the dam. Horizontal distance for each cross-section is laid out perpendicular to water flow using the measuring tape. Rod readings are taken every 10 feet horizontally or at locations where the elevation noticeably changes. The rod reading is subtracted from the height of instrument to obtain the ground elevation

Figure 5. Stream cross-sections along White Clay Creek at Dam No. 1

Table 8 - Field survey data along White Clay Creek at Dam No. 1

	Station		BS	FS	IFS	(Feet)
	7.5		27.5			20.0
(Concrete Wing Wall of Bridge)	BM_5	0.5	25.3	2.7		24.8
(Spot on Top of Rock Wall)	BM_1				5.0	20.3
(Spot on Bottom of Rock Wall)	BM_3				11.5	13.8
(Crack in Sidewalk)	BM_4				8.3	17.0
	Left Bank Horizontal					

	Station		Height of		Elevation
(Concrete Wing Wall of Bridge)	BM_5	0.2			24.8
			25.0		
+7+00					
(Edge of Bank)	0			5.1	19.9
	7			6.5	18.5
(Edge of Water)	13			12.6	12.4
	23			13.5	11.5
	33			14.1	10.9
	43			14.2	10.8
	53			13.7	11.3
	63			13.7	11.3
	73			14.0	11.0
	84			13.1	11.9
(Edge of Water)	85			12.0	13.0
(Edge of Bank)	93			6.8	18.2
(Golf Course)	100			4.8	20.2
(Spot on Bottom of Rock Wall)	BM_3	11.5			13.8
			25.3		
+6+00					
	0			5.9	19.4
	18			5.3	20.0
	34			11.1	14.2
(Edge of Bank)	43			11.0	14.3
(Edge of Water)	46			12.8	12.5
	58			13.5	11.8
	78			14.5	10.8
	98			14.6	10.7
	112			15.0	10.3
(Edge of Water)	114			12.7	12.6
(Edge of Bank)	129			5.5	19.8
(Spot on Top of Rock Wall)	BM_1	2.9			20.3
			23.2		
+3+00					
	0			3.9	19.3
	38			5.0	18.2
	58			5.3	17.9
	71			10.7	12.5
(Top of Bank)	100			10.6	12.6
(Bottom of Bank)	100			11.7	11.5
(Edge of Water)	111			12.7	10.5
	121			13.0	10.2
	131			13.6	9.6
	141			13.9	9.3
	150			13.4	9.8
	159			13.5	9.7
	166			13.3	9.9
(Edge of Water)	168			11.8	11.4
(Edge of Bank)	173			5.3	17.9
	Flat				Flat
(Spot on Top of Rock Wall)	BM_1	2.9			20.3
			23.2		
+2+00					
	0			1.5	21.7
	38			4.3	18.9

	58			4.8	18.4
	78			9.6	13.6
	98			9.8	13.4
(Edge of Bank)	111			10.2	13.0
(Edge of Water)	113			11.9	11.3
	123			12.9	10.3
	133			13.4	9.8
	143			13.4	9.8
	153			13.5	9.7
	163			14.6	8.6
	173			14.7	8.5
	179			15.0	8.2
(Edge of Water)	183			11.7	11.5
(Edge of Bank)	191			5.0	18.2
	Flat				Flat
(Spot on Top of Rock Wall)	BM_1	2.8			20.3
			23.1		
+1+00					
	0			4.1	19.0
(Edge of Bank)	12			4.5	18.6
	20			9.1	14.0
	35			9.6	13.5
	40			7.6	15.5
	65			10.1	13.0
(Water Edge)	75			11.5	11.6
	90			12.8	10.3
	100			13.0	10.1
	110			13.6	9.5
	120			15.1	8.0
	130			15.0	8.1
	136			13.8	9.3
(Water Edge)	140			11.6	11.5
(Edge of Bank)	142			4.9	18.2
	156			5.3	17.8
(Spot on Top of Rock Wall)	BM_1	2.24			20.3
			22.54		
(10 Feet Upstream of Dam	+0+10				
	0			7.40	15.14
(Top of Left Bank)	18			8.25	14.29
	24			10.64	11.90
	28			12.13	10.41
(Left Side of Down Tree)	39			13.19	9.35
	47			12.68	9.86
	58			12.23	10.31
	67			11.34	11.20
	73			12.35	10.19
	96			12.72	9.82
	110			11.72	10.82
(Edge of water)	118			12.40	10.14
(In-line with Edge of Wall)	125			10.86	11.68
	153			8.43	14.11
(Spot on Top of Rock Wall	BM_1	2.24			20.3
			22.54		
0+00					
	0			8.32	14.22

(Top of Left Bank)	24			8.15	14.39
(Edge of Water Left Side)	29			11.77	10.77
	34			12.67	9.87
	37			12.01	10.53
	38			11.22	11.32
(Water Edge)	55			11.30	11.24
(Left Side of Down Tree)	63			10.12	12.42
	70			9.33	13.21
(Rock)	82			9.66	12.88
	87			11.81	10.73
(Sill of the Dam)	107.5			11.26	11.28
	109.5			12.02	10.52
	118			12.86	9.68
	119			11.32	11.22
(Edge of Water Right Side)	129			11.16	11.38
(Next to Wall)	151			9.80	12.74
(Spot on Bottom of Rock Wall)	BM_3	5.0			13.8
			18.8		
-0+60					
	0			0.8	18.0
	16			5.0	13.8
	34			4.8	14.0
(Top of Bank)	48			3.0	15.8
(Bottom of Bank)	61			7.6	11.2
	98			7.8	11.0
(Edge of Water)	103			9.0	9.8
	118			11.4	7.4
	128			12.5	6.3
	138			11.7	7.1
	148			11.5	7.3
	154			11.0	7.8
	160			9.7	9.1
	165			9.8	9.0
	173			8.5	10.3
(Bottom of Bank)	183			9.6	9.2
(Edge of Water)	185			8.6	10.2
(Top of Bank)	189			6.3	12.5
(Spot on Bottom of Rock Wall)	BM_3	8.9			13.8
			22.7		
	-1+00				
	0			3.8	18.9
	20			3.5	19.2
	60			4.5	18.2
	80			5.4	17.3
	100			5.0	17.7
(Top of Left Bank)	106			5.3	17.4
(Bottom of Left Bank)	114			9.1	13.6
	126			10.3	12.4
(Edge of Water)	129			11.8	10.9
	139			3.3	19.4
	150			3.2	19.5
	165			13.3	9.4
	176			12.6	10.1
	192			13.0	9.7
	196			12.9	9.8
(Edge of Water)	199			11.9	10.8

	206				9.4	13.3
(Top of Right Bank)	210				4.7	18.0
	231				3.7	19.0
	251				4.3	18.4
	267				3.4	19.3
	276				4.6	18.1
	292				4.7	18.0
(Spot on Bottom of Rock Wall)	BM_3	8.9				13.8
			22.7			
	-2+00					
	0				3.9	18.8
	29				2.8	19.9
	50				3.7	19.0
	67				3.1	19.6
	85				3.2	19.5
(Top of Left Bank)	100				3.9	18.8
	110				8.8	13.9
(Edge of Water)	117				12.1	10.6
	120				13.7	9.0
	134				12.5	10.2
	142				12.9	9.8
	160				13.6	9.1
	175				13.6	9.1
(Edge of Water)	180				12.1	10.6
	183				10.5	12.2
(Top of Right Bank)	193				4.9	17.8
	202				4.1	18.6
	217				5.0	17.7
	230				4.6	18.1
	239				2.7	20.0
	245				4.0	18.7
	253				6.6	16.1
	276				6.6	16.1
	300				5.0	17.7
(Spot on Bottom of Rock Wall)	BM_3	8.9				13.8
			22.7			
TP_1		2.9		2.4		20.3
			23.2			
(Crack in Sidewalk)	BM_4			5.9		17.3
-3+00						
	0				5.3	17.9
	20				4.7	18.5
	40				5.1	18.1
	60				5.0	18.2
	80				4.8	18.4
(Top of Left Bank)	100				4.5	18.7
(Edge of Water)	106				13.5	9.7
	123				15.5	7.7
	134				14.0	9.2
	147				12.8	10.4
(High Part of Land)	163				11.1	12.1
	177				12.0	11.2
	189				12.8	10.4
(Top of Right Bank)	199				5.7	17.5
	212				4.3	18.9
	232				5.7	17.5

	252			4.0	19.2
	-4+00				
	0			5.3	17.9
	20			5.3	17.9
	40			6.1	17.1
	60			5.2	18.0
	80			5.3	17.9
(Top of Left Bank)	100			5.3	17.9
(Bottom of Left Bank)	119			12.4	10.8
	132			12.6	10.6
(Edge of Water)	139			13.7	9.5
	154			14.1	9.1
	164			16.2	7.0
(Strong Current/High Water) *Estimate*	172			21.5	7.7
	180			15.1	8.1
(Edge of Water)	183			13.0	10.2
(Top of Right Bank)	197			6.9	16.3
	220			5.7	17.5
(Cart Path)	240			5.5	17.7
(Crack in Sidewalk)	BM_4	4.6			17.0
			21.6		
-5+00					
	0			3.9	17.7
	20			4.3	17.3
	40			4.9	16.7
	60			5.5	16.1
	70			5.2	16.4
	76			8.3	13.3
	85			9.2	12.4
(Top of Left Bank)	91			9.7	11.9
(Edge of Water)	96			12.2	9.4
	107			13.8	7.8
	118			14.5	7.1
	136			16.3	5.3
(Edge of Water)	140			12.2	9.4
	147			9.2	12.4
(Top of Right Bank)	160			4.0	17.6
	190			3.1	18.5
-6+00					
	0			5.0	16.6
	20			4.2	17.4
	40			3.6	18.0
	53			3.4	18.2
(Top of Left Bank)	60			3.4	18.2
	64			7.1	14.5
(Edge of Water)	72			12.2	9.4
	78			14.6	7.0
	88			15.0	6.6
	98			15.5	6.1
	106			14.9	6.7
	115			13.0	8.6
	118			12.4	9.2
	125			14.2	7.4
(Edge of Water)	132			12.2	9.4
	146			8.3	13.3
(Top of Right Bank)	172			4.3	17.3
	200			3.3	18.3

Chapter 5 – Stream Geomorphology/Habitat Survey

We conducted a pre-project survey of stream geomorphology according to the Rosgen method. The Rosgen stream classification system was developed to create reproducible and quantitative descriptions of the morphology of a stream. Main objectives of the Rosgen classification system are to predict the streams behavior from its appearance, to develop specific hydraulic and sediment relationships for a given stream type, to provide a mechanism to extrapolate site-specific data to stream reaches having similar characteristics, and to provide a consistent frame of reference for communicating stream morphology and condition among a variety of disciplines and interested parties.

The Rosgen model uses six characteristics to classify streams as described in *Stream Restoration: A Natural Channel Design Handbook*, prepared by the North Carolina Stream Restoration Institute. The following flow chart is used to classify streams according to the Rosgen Model.

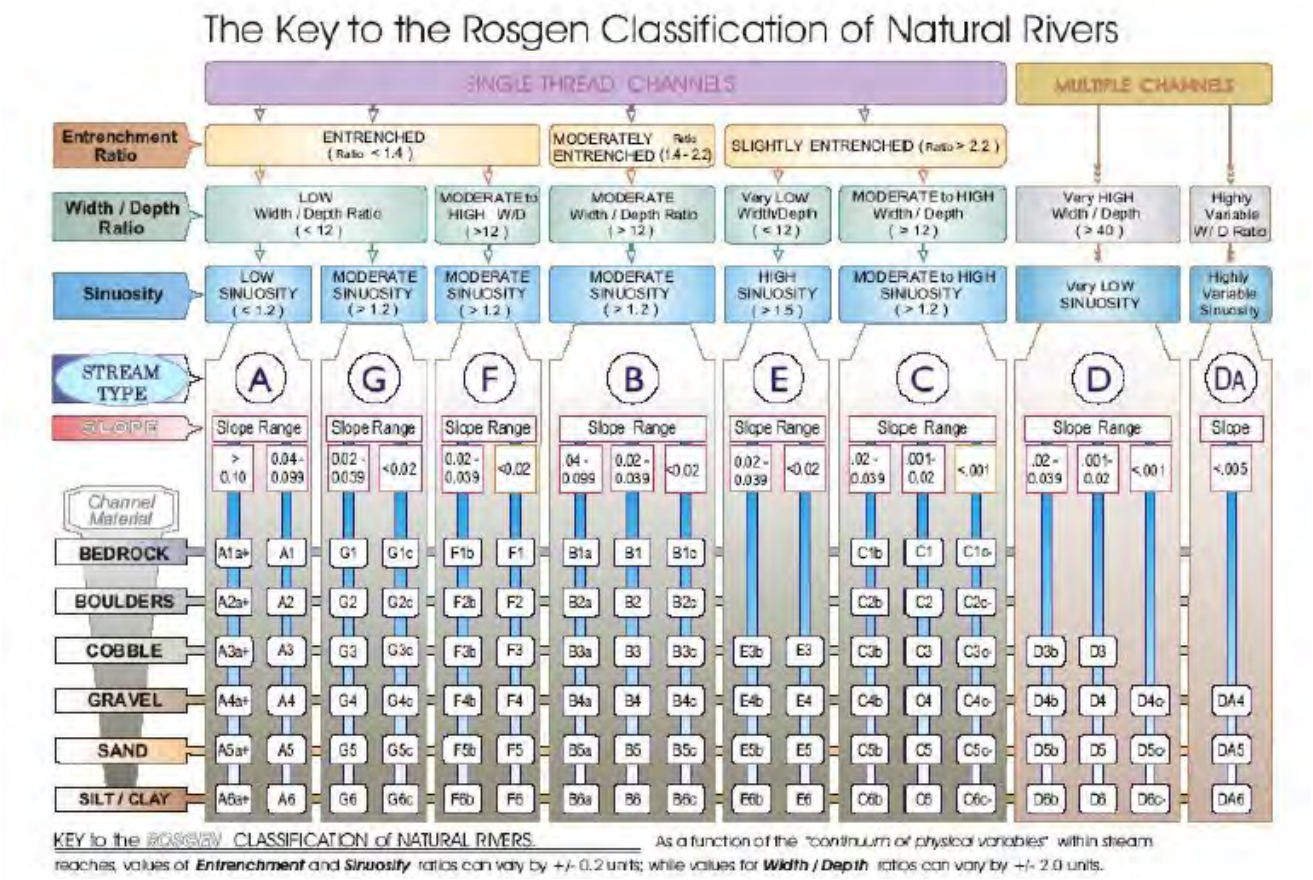


Figure 6. Rosgen classification of natural rivers

Single or Multiple Channels

The first step in the Rosgen model is to determine the number of stream channels. A stream with multiple or braided channels must have at least three distinguishable channels over the observed length of the stream. This stage of the classification can be made with aerial photographs or field observation. White Clay Creek is a classic single thread stream channel

Entrenchment Ratio

Entrenchment ratio is the flood-prone width along the channel divided by the bankfull depth. The bankfull depth of the White Clay Creek upstream and downstream of Dam No. 1 varies significantly, so the HEC-RAS model was used to determine the 10 year flood plain width. Large entrenchment ratios indicate a well developed flood plain, while low entrenchment ratios indicate channel incision.

Table 9. Entrenchment ratio along White Clay Creek at Dam No. 1

Station	Single/ Multiple	Max Depth	Floodprone Width	Entrenchment Ratio
7+00	single	9.2	472	51
6+00	single	9.7	450	46
3+00	single	8.6	667	78
2+00	single	10	351	35
1+00	single	11.2	345	31
0+10	single	4.7	392	83
0+00	single	4.7	375	80
- 0+60	single	6.2	394	64
- 1+00	single	8	423	53
- 2+00	single	8.8	721	82
- 3+00	single	9.8	859	88
- 4+00	single	14.6	1079	74
- 5+00	single	12.3	401	33
- 6+00	single	11.2	95	8

Width to Depth Ratio

The width to depth ratio is the bankfull width divided by the average bankfull depth. These measurements are taken by field survey.

Table 10. Width to depth ratio along White Clay Creek at Dam No. 1

Station	Surface Width	Avg Depth	W/D Ratio
7+00	100	4.6	22
6+00	97	4.85	20
3+00	115	4.3	27
2+00	133	5	27
1+00	130	5.6	23
0+10	135	2.35	57
0+00	127	2.35	54
- 0+60	141	3.1	45
- 1+00	104	4	26
- 2+00	93	4.4	21
- 3+00	132	4.9	27
- 4+00	97	7.3	13
- 5+00	389	6.15	63
- 6+00	112	5.6	20

Sinuosity

Sinuosity measures the degree of meandering and is the distance measured along the centerline of the stream divided by the straight line distance between two points along the stream. A perfectly straight or channelized stream would have a sinosity = 1.

Table 11. Sinuosity along White Clay Creek at Dam No. 1

Station	Curvy Dist	Straight Dist	Sinuosity
7+00	1400	819	1.71
6+00	1400	819	1.71
3+00	1400	819	1.71
2+00	1400	819	1.71
1+00	1400	819	1.71
0+10	1400	819	1.71
0+00	1400	819	1.71
- 0+60	1400	819	1.71
- 1+00	1400	819	1.71
- 2+00	1400	819	1.71
- 3+00	1400	819	1.71
- 4+00	1400	819	1.71
- 5+00	1400	819	1.71
- 6+00	1400	819	1.71

Slope

The slope of the stream is measured by the elevation of the thalweg (lowest point in the channel) at the upstream station minus the elevation of the thalweg at the downstream station divided by the distance between the two stations.

Table 12. Slope along White Clay Creek at Dam No. 1

Station	Top Elev	Bot Elev	Run	Slope
7+00	10.8	10	100	0.008
6+00	10.8	9.3	400	0.004
3+00	10	8.2	400	0.005
2+00	9.3	8	200	0.007
1+00	8.2	9.7	200	-0.008
0+10	8.2	9.7	200	-0.008
0+00	8	9.4	200	-0.007
- 0+60	8	9.4	200	-0.007
- 1+00	9.7	9	200	0.004
- 2+00	9.4	7.7	200	0.009
- 3+00	9	1.7	200	0.037
- 4+00	7.7	5.3	200	0.012
- 5+00	1.7	6.1	200	-0.022
- 6+00	5.3	6.1	100	-0.008

Substrate

Substrate at the bottom of the channel is classified as sand, gravel, or cobble ased on the median (50^{th} percentile) diameter of the material.

Table 13. Substrate and Rosgen stream class along White Clay Creek at Dam No. 1

Station	Channel Substrate	Stream Type	Rosgen Class
7+00	sand	C	C5
6+00	sand	C	C5
3+00	sand	C	C5
2+00	sand	C	C5
1+00	cobble	C	C3
0+10	cobble	C	C3
0+00	cobble	C	C3
- 0+60	gravel	C	C4
- 1+00	sand	C	C5
- 2+00	sand	C	C5
- 3+00	sand	C	C5
- 4+00	sand	C	C5
- 5+00	sand	C	C5
- 6+00	sand	C	C5

Rosgen Classification

The Rosgen class varies from C3 at the dam to C5 upstream and downstream from the dam. Post dam removal monitoring will be conducted to assess the changes in stream geomorphology as the stream change to a natural pool and riffle system.

Sediment

Sediment samples were collected along the centerline of White Clay Creek at 1 ft below the streambed at -20, +20, +200, and +700 ft from Dam No. 1. The samples were analyzed for metals and textural class at the University of Delaware Soil Testing Laboratory at the College of Agriculture and Natural Resources.

The following table summarizes the results of the sediment quality analysis with values compared to Delaware default background remediation standards (DNREC 1999). Sediment metal levels are below the Delaware background remediation standards. The results of the soil textural analysis indicates the sediment is over 94% sand.

Table 14. Sediment metal analysis at White Clay Creek Dam No. 1

Parameter	Date of Analysis	Station -20 ft (mg/kg)	Station +20 ft (mg/kg)	Station +200 ft (mg/kg)	Station +700 ft (mg/kg)	Sediment Background Standard[1] (mg/kg)
Aluminum	7/26/11	151.10	97.07	127.62	185.81	7800
Copper	7/26/11	0.83	0.39	0.56	1.02	34
Iron	7/26/11	135.99	140.33	179.16	395.68	2300
Manganese	7/26/11	77.80	65.97	86.91	125.45	180
Zinc	7/26/11	11.65	7.97	10.04	14.20	150

1. Delaware DNREC, 1999. Remediation Standards Guidance Under the Delaware Hazardous Substance Cleanup Act.

Table 15. Sediment textural class at White Clay Creek Dam No. 1

Sample ID	**Sand (%)**	**Silt (%)**	**Clay (%)**	**Textural Class**
- 20 ft	96	2	2	Sand
+ 20 ft	96	2	2	Sand
+ 200 ft	92	6	2	Sand
+ 700 ft	96	2	2	Sand

The approximate depth of sediment (sand) behind the dam ranges from 2 to 3 feet. The width of the stream upstream from the dam ranges from 80 to 100 feet. The length of the pool behind the dam is 700 feet. The volume of sediment behind the dam is approximately 5,000 cubic yards.

Stream Bioassessment

We conducted a pre-project EPA rapid stream bioassessment of the White Clay Creek at Dam No. 1. We plan to conduct the same assessment after the dam is removed to track changes in stream health as the stream returns to closer to a natural pool and riffle system.

Table 16. EPA rapid stream bioassemment of the White Clay Creek at Dam No. 1

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/cover Upstream: 10 Downstream: 13	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat and at stage to allow full colonization potential 20 19 18 17 16	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall but no yet prepared for colonization (may rate at high end scale) 15 14 13 12 11	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed 10 9 8 7 6	Less than 10% stable habitat; lack of habitat is obvious; substrate is unstable or lacking 5 4 3 2 1 0
Pool substrate characterization Upstream:11 Downstream:12	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common 20 19 18 17 16	Mixture of soft sand, mud, clay; mud may be dominant; some root mats and submerged vegetation present 15 14 13 12 11	All mud or clay or sand bottom; little or no root mat; no submerged vegetation 10 9 8 7 6	Hard-pan clay or bedrock; no root mat or vegetation 5 4 3 2 1 0
Pool Variability Upstream:14 Downstream:12	Even mix of large-shallow, large-deep, small shallow, small-deep pools present 20 19 18 17 16	Majority of pools large-deep, very few shallow 15 14 13 12 11	Shallow pools much more prevalent than deep pools 10 9 8 7 6	Majority of pools small or polls absent 5 4 3 2 1 0
Sediment Deposition Upstream:12 Downstream:8	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition 20 19 18 17 16	Some new increase in bar formation mostly from gravel sand or fine sediment; 20-50% of bottom affect; slight deposition in pools 15 14 13 12 11	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected, sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent 10 9 8 7 6	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition 5 4 3 2 1 0
Channel Flow Status Upstream:10 Downstream:14	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed 20 19 18 17 16	Water fills >75% of the available channels or <25% of channel substrate is exposed 15 14 13 12 11	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed 10 9 8 7 6	Very little water in channel and mostly present as standing pools 5 4 3 2 1 0
Channel Alteration Upstream:16 Downstream:12	Channelization or dredging absent or minial; stream with normal pattern 20 19 18 17 16	Some channelization present, usually in areas of bridge abutments; evidence of past channelization i.e. dredging (greater than past	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% of	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream

		20yr) may be present but recent channelization is not present 15 14 13 12 11	stream reach channelized and disrupted 10 9 8 7 6	habitat greatly altered or removed entirely 5 4 3 2 1 0
Channel Sinuosity Upstream:14 Downstream:18	The bends in the stream increase the stream length 3-4 times longer than if it was in straight line. (Note-channel braiding is considered normal in coastal plains or other low-lying areas. This parameter is not easily rated in these areas.) 20 19 18 17 16	The bends in the stream increase the stream length 1 to 2 tines longer than if it was in a straight line 15 14 13 12 11	The bends in the stream increase the stream length to 1 to 2 times longer that if it was in a straight line 10 9 8 7 6	Channel straight; waterway has been channelized for a long distance 5 4 3 2 1 0
Bank Stability Left Bank: Upstream: 8 Downstream: 5 Right Bank: Upstream:8 Downstream:8	Banks stable; evidence of erosion of bank failure absent of minimal; little potential for future problems. <5% of bank affected 20 19 18 17 16	Moderately stable; infrequent small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion 15 14 13 12 11	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods 10 9 8 7 6	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; obvious bank sloughing 60-100% of bank has erosional scars 5 4 3 2 1 0
Vegetative Protection Left Bank: Upstream:8 Downstream:8 Right Bank: Downstream:8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally 10 9 10 9	70-90% of the streambank surfaces covered by native vegetation but one class of plants Is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining 8 7 6 8 7 6	50-70% of the streambank surfaces covered by vegetation disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining 5 4 3 5 4 3	Less than 50% of the streambank surfaces covered by vegetation; disruption of strambank vegetation is very high; vegetation has been removed to 5 cm or less in average stubble height. 2 1 0 2 1 0
Riparian Vegetative zone Left Bank: Upstream:6 Downstream: 2 Right Bank: 6 Downstream: 2	Width of riparian zone >18m; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone 10 9 10 9	Width of riparian zone 12-18m; human activities have impacted zone only minimally 8 7 6 8 7 6	Width of riparian zone 6-12m; human activities have impacted zone a great deal 5 4 3 5 4 3	Width of riparian zone <6m; little or no riparian vegetation due to human activities 2 1 0 2 1 0
Upstream: 131/200 Downstream: 122/200 Upstream:65.5% Downstream: 61%				

Water Quality

We obtained the following baseline water quality data at Dam No. 1. We plan to record water quality data during and after the dam is removed.

Date:	Jul 20, 2011
Time:	10:15
Temp:	29 deg C
Flow:	44 cfs
Water Temp:	25.6 deg C
pH:	7.95
TDS:	235 mg/l
Salinity:	0.15 ppt
\Conductivity:	350 µS
Dissolved Oxygen:	8.1 ppm

Chapter 6 – Hydrologic/Hydraulic Analysis

Hydraulic Analysis

We conducted a hydraulic analysis using the U.S. Army Corps of Engineers HECRAS computer model to estimate changes in flow depth and velocity with and without White Clay Creek Dam No. 1 in place. Field survey crews obtained stream cross-sections at stations -600, -500,-400,-300, -200, -100, -60, -20, 0, 10, 100, 200, 300, 600, 700 ft from the dam (Figure 7). The HECRAS model was assembled, verified, and calibrated. We conducted a hydraulic analysis for the with (existing) and without (proposed) dam condition for a range of low to high flow profiles using data from White Clay Creek near Newark stream gage 01479000 situated just upstream from Dam No. 1.

Table 17. Flow profiles modeled using HECRAS at White Clay Creek Dam No. 1

Flow Profile	Q (cfs)
7 Q10	14.4
98% Exceedance	19.4
90% Exceedance	32.3
50% Exceed. (Oct Median)	76.1
April Median	154
10% Exceed	196
2 yr	3830
10 yr	7840
50 yr	12600
100 yr	19200

Low Flow Conditions

The following table summarizes flow depth and velocity for the stream cross sections for the April median flow during the critical spring spawning period. Removal of Dam No. 1 is projected to reduce median April flow depths by -0.1 to -0.9 ft upstream from the dam and increase flow depth by 0.4 ft at the dam. Flow depths are expected to remain unchanged downstream since flow goes through supercritical depth in the hydraulic jump in the plunge pool at the foot of Dam No. 1. After the dam is removed, median April flow depths are projected to range from 1.2 to 4.5 ft, sufficient for anadromous species such as the American and hickory shad.

Flow velocity will increase by 0.4 to 0.7 fps upstream from the dam and decrease by -2.5 fps at the dam site. After the dam is removed, velocities will range from 1.4 to 3.0 fps upstream from the dam site to 2.2 to 5.7 fps down stream from the dam site. Increased velocities after dam removal are expected to carve a new streambed in the sandy sediments that now lie at the bottom of the shallow impoundment.

Table 18. Existing/proposed hydraulics at White Clay Creek Dam No. 1, April median flow (154 cfs)

Station	Exist. Depth (ft)	Prop. Depth (ft)	Change (ft)		Exist. Vel. (ft)	Prop. Vel. (ft)	Change (ft)
700	1.3	1.2	-0.1		2.6	3.0	0.4
600	2.0	1.7	-0.3		2.0	2.6	0.6
300	2.5	1.8	-0.7		1.3	2.0	0.7
200	3.6	2.8	-0.8		1.0	1.5	0.5
100	3.8	2.9	-0.9		1.1	1.8	0.7
10	2.3	2.1	-0.2		1.0	1.4	0.4
0 (Dam No. 1)	1.7	2.1	0.4		4.1	1.6	-2.5
-60	4.5	4.5	0		0.7	0.7	0
-100	1.3	1.3	0		2.2	2.2	0
-200	1.5	1.5	0		2.6	2.6	0
-300	2.3	2.3	0		3.6	3.6	0
-400	1.8	1.8	0		5.7	5.7	0
-500	3.1	3.1	0		2.7	2.7	0
-600	1.4	1.4	0		5.3	5.3	0

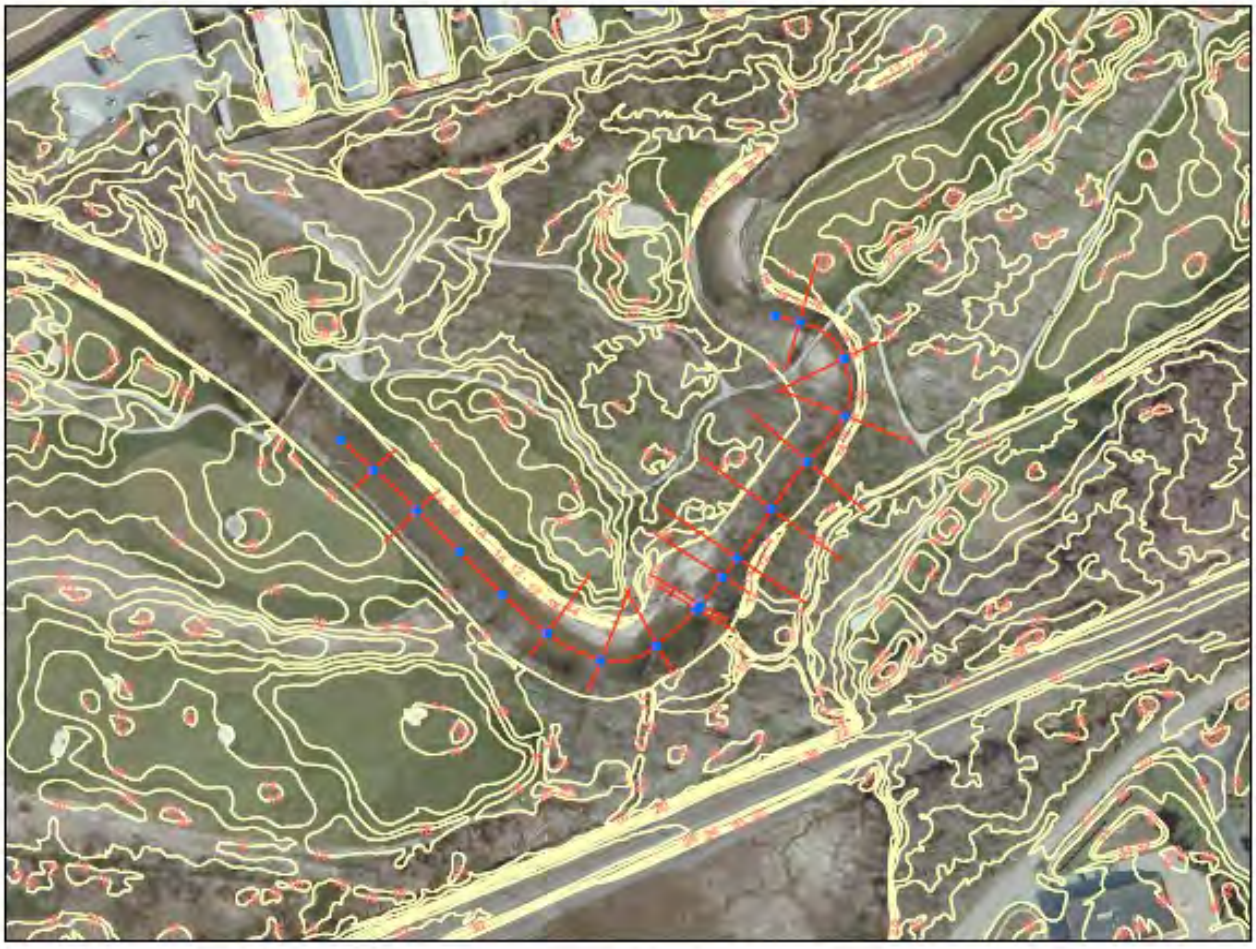


Figure 7. Stream cross sections at White Clay Creek Dam No. 1

High Flow Conditions

The following table compares 100-year flood elevations for the with and without dam condition. Since the 3 to 8 ft high dam is so small, little or no change in the 100-yr floodplain elevation or velocity is expected after the dam removal

Table 19. Existing/proposed hydraulics for 100-yr flow (19,200 cfs) at White Clay Creek Dam No. 1.

Station	Exist. W.S. (ft)	Prop. W.S. (ft)	Change W.S. (ft)		Exist. Depth (ft)	Prop. Depth (ft)	Change Depth (ft)		Exist. Vel. (fps)	Prop. Vel. (fps)	Change Vel. (fps)
700	25.8	25.8	0		15	15	0		6.2	6.2	0
600	25.7	25.7	0		15.7	15.7	0		6.4	6.4	0
300	25.7	25.7	0		16.4	16.4	0		4.4	4.4	0
200	24.8	24.8	0		16.6	16.6	0		8.8	8.8	0
100	24.4	24.5	0.1		16.4	16.5	0.1		9.4	9.4	0
10	24.4	24.3	-0.1		15	15.6	0.6		8.4	9.1	0.7
0 (Dam No. 1)	24.4	24.4	0		14.7	15.7	1		8.6	8.3	-0.3
-60	24.4	24.4	0		18.1	18.1	0		7.5	7.5	0
-100	22.3	22.3	0		12.9	12.9	0		13.9	13.9	0
-200	23.3	23.3	0		14.3	14.3	0		10	10	0
-300	23.3	23.3	0		15.6	15.6	0		8.5	8.5	0
-400	23.6	23.6	0		16.6	16.6	0		4.8	4.8	0
-500	23.5	23.5	0		18.2	18.2	0		4.1	4.1	0
-600	21.5	21.5	0		15.4	15.4	0		12.2	12.2	0

Table 20. Summary of hydraulic analysis existing/proposed at White Clay Creek Dam No. 1

Profile	Q (cfs)	Exist W.S. El. (ft)	Prop. W.S. El. (ft)	Change W.S. El. (ft)	Exist. Depth (ft)	Prop. Depth (ft)	Change Depth (ft)	Exist. Vel. (fps)	Prop. Vel. (fps)	Change Vel. (fps)
Sta. 7+00										
7 Q10	14.4	11.2	11.2	0	0.4	0.4	0	1.9	2.4	0.5
98% Exceed	19.4	11.2	11.2	0	0.4	0.4	0	2.5	2.3	-0.2
90% Exceed	32.3	11.3	11.4	0.1	0.5	0.6	0.1	2.6	2.2	-0.4
50% (Oct Median)	76.1	11.7	11.6	-0.1	0.9	0.8	-0.1	2.4	2.6	0.2
April Median	154	12.1	12	-0.1	1.3	1.2	-0.1	2.6	3	0.4
10% Exceed	196	12.3	12.2	-0.1	1.5	1.4	-0.1	2.7	3.1	0.4
2 yr	3830	18	18	0	7.2	7.2	0	7.4	7.4	0
10 yr	7840	20.8	20.8	0	10	10	0	8.6	8.6	0
50 yr	12600	23.3	23.3	0	12.5	12.5	0	7.5	7.5	0
100 yr	19200	25.8	25.8	0	15	15	0	6.2	6.2	0
Sta. 6+00										
7 Q10	14.4	10.7	10.7	0	0.7	0.7	0	1.3	1.1	-0.2
98% Exceed	19.4	10.8	10.8	0	0.8	0.8	0	1.3	1.3	0
90% Exceed	32.3	11	10.9	-0.1	1	0.9	-0.1	1.3	1.6	0.3
50% (Oct Median)	76.1	11.5	11.2	-0.3	1.5	1.2	-0.3	1.5	2.1	0.6
April Median	154	12	11.7	-0.3	2	1.7	-0.3	2	2.6	0.6
10% Exceed	196	12.1	11.9	-0.2	2.1	1.9	-0.2	2.2	2.8	0.6
2 yr	3830	18.1	18.1	0	8.1	8.1	0	5.8	5.8	0
10 yr	7840	21	21	0	11	11	0	6.3	6.2	-0.1
50 yr	12600	23.3	23.3	0	13.3	13.3	0	6.4	6.4	0
100 yr	19200	25.7	25.7	0	15.7	15.7	0	6.4	6.4	0
Sta.3+00										
7 Q10	14.4	10.6	10	-0.6	1.3	0.7	-0.6	0.3	1.2	0.9
98% Exceed	19.4	10.7	10	-0.7	1.4	0.7	-0.7	0.4	1.2	0.8
90% Exceed	32.3	11	10.2	-0.8	1.7	0.9	-0.8	0.5	1.4	0.9
50% (Oct Median)	76.1	11.4	10.6	-0.8	2.1	1.3	-0.8	0.8	1.7	0.9
April Median	154	11.8	11.1	-0.7	2.5	1.8	-0.7	1.3	2	0.7
10% Exceed	196	12	11.4	-0.6	2.7	2.1	-0.6	1.5	2.1	0.6
2 yr	3830	17.8	17.8	0	8.5	8.5	0	5.1	5.1	0
10 yr	7840	21	21	0	11.7	11.7	0	4.4	4.4	0
50 yr	12600	23.4	23.4	0	14.1	14.1	0	4.2	4.2	0
100 yr	19200	25.7	25.7	0	16.4	16.4	0	4.4	4.4	0
Sta. 2+00										
7 Q10	14.4	10.6	9.9	-0.7	2.4	1.7	-0.7	0.2	0.4	0.2
98% Exceed	19.4	10.7	10	-0.7	2.5	1.8	-0.7	0.2	0.5	0.3
90% Exceed	32.3	11	10.2	-0.8	2.8	2	-0.8	0.3	0.7	0.4
50% (Oct Median)	76.1	11.4	10.6	-0.8	3.2	2.4	-0.8	0.6	1.1	0.5
April Median	154	11.8	11.1	-0.7	3.6	2.9	-0.7	1	1.5	0.5
10% Exceed	196	11.9	11.3	-0.6	3.7	3.1	-0.6	1.2	1.6	0.4
2 yr	3830	17.7	17.7	0	9.5	9.5	0	4.9	4.9	0
10 yr	7840	20.5	20.5	0	12.3	12.3	0	6.4	6.4	0
50 yr	12600	22.6	22.7	0.1	14.4	14.5	0.1	7.5	7.5	0
100 yr	19200	24.8	24.8	0	16.6	16.6	0	8.8	8.8	0
Sta. 1+00										
7 Q10	14.4	10.6	9.9	-0.7	2.6	1.9	-0.7	0.2	0.4	0.2
98% Exceed	19.4	10.7	10	-0.7	2.7	2	-0.7	0.3	0.5	0.2
90% Exceed	32.3	10.9	10.1	-0.8	2.9	2.1	-0.8	0.4	0.7	0.3
50% (Oct Median)	76.1	11.4	10.5	-0.9	3.4	2.5	-0.9	0.7	1.2	0.5
April Median	154	11.8	10.9	-0.9	3.8	2.9	-0.9	1.1	1.8	0.7
10% Exceed	196	11.9	11.1	-0.8	3.9	3.1	-0.8	1.3	2	0.7
2 yr	3830	17.5	17.5	0	9.5	9.5	0	5.2	5.2	0
10 yr	7840	20.3	20.3	0	12.3	12.3	0	6.3	6.3	0

50 yr	12600	22.4	22.5	0.1	14.4	14.5	0.1	7.6	7.6	0
100 yr	19200	24.4	24.5	0.1	16.4	16.5	0.1	9.4	9.4	0
Sta. 0+10										
7 Q10	14.4	10.6	9.9	-0.7	1.2	1.2	0	0.3	0.4	0.1
98% Exceed	19.4	10.7	10	-0.7	1.3	1.3	0	0.4	0.4	0
90% Exceed	32.3	10.9	10.1	-0.8	1.5	1.4	-0.1	0.5	0.6	0.1
50% (Oct Median)	76.1	11.4	10.4	-1	2	1.7	-0.3	0.7	1.1	0.4
April Median	154	11.7	10.8	-0.9	2.3	2.1	-0.2	1	1.7	0.7
10% Exceed	196	11.9	11	-0.9	2.5	2.3	-0.2	1.2	1.9	0.7
2 yr	3830	17.4	17.3	-0.1	8	8.6	0.6	4.1	4.8	0.7
10 yr	7840	20.3	20.2	-0.1	10.9	11.5	0.6	5.4	6.1	0.7
50 yr	12600	22.4	22.3	-0.1	13	13.6	0.6	6.6	7.3	0.7
100 yr	19200	24.4	24.3	-0.1	15	15.6	0.6	8.4	9.1	0.7
Sta. 0+00 (Dam 1)										
7 Q10	14.4	10.4	9.9	-0.5	0.7	1.2	0.5	3.2	0.3	-2.9
98% Exceed	19.4	10.5	10	-0.5	0.8	1.3	0.5	3.5	0.4	-3.1
90% Exceed	32.3	10.7	10.1	-0.6	1	1.4	0.4	4.1	0.6	-3.5
50% (Oct Median)	76.1	11.1	10.4	-0.7	1.4	1.7	0.3	4.3	1.1	-3.2
April Median	154	11.4	10.8	-0.6	1.7	2.1	0.4	4.1	1.7	-2.4
10% Exceed	196	11.5	11	-0.5	1.8	2.3	0.5	4.3	1.9	-2.4
2 yr	3830	17.4	17.4	0	7.7	8.7	1	4.7	4.2	-0.5
10 yr	7840	20.2	20.3	0.1	10.5	11.6	1.1	5.8	5.5	-0.3
50 yr	12600	22.4	22.4	0	12.7	13.7	1	7	6.7	-0.3
100 yr	19200	24.4	24.4	0	14.7	15.7	1	8.6	8.3	-0.3
Sta. -0+60										
7 Q10	14.4	9.9	9.9	0	3.6	3.6	0	0.1	0.1	0
98% Exceed	19.4	10	10	0	3.7	3.7	0	0.1	0.1	0
90% Exceed	32.3	10.1	10.1	0	3.8	3.8	0	0.2	0.2	0
50% (Oct Median)	76.1	10.4	10.4	0	4.1	4.1	0	0.4	0.4	0
April Median	154	10.8	10.8	0	4.5	4.5	0	0.7	0.7	0
10% Exceed	196	11	11	0	4.7	4.7	0	0.8	0.8	0
2 yr	3830	17.4	17.4	0	11.1	11.1	0	3.2	3.2	0
10 yr	7840	20.3	20.3	0	14	14	0	4.5	4.5	0
50 yr	12600	22.4	22.4	0	16.1	16.1	0	5.9	5.9	0
100 yr	19200	24.4	24.4	0	18.1	18.1	0	7.5	7.5	0
Sta. -1+00										
7 Q10	14.4	9.9	9.9	0	0.5	0.5	0	1	1	0
98% Exceed	19.4	9.9	9.9	0	0.5	0.5	0	1.1	1.1	0
90% Exceed	32.3	10.1	10.1	0	0.7	0.7	0	1.3	1.3	0
50% (Oct Median)	76.1	10.4	10.4	0	1	1	0	1.8	1.8	0
April Median	154	10.7	10.7	0	1.3	1.3	0	2.2	2.2	0
10% Exceed	196	10.9	10.9	0	1.5	1.5	0	2.4	2.4	0
2 yr	3830	16.9	16.9	0	7.5	7.5	0	6.2	6.2	0
10 yr	7840	19.3	19.3	0	9.9	9.9	0	8.7	8.7	0
50 yr	12600	21.1	21.1	0	11.7	11.7	0	10.7	10.7	0
100 yr	19200	22.3	22.3	0	12.9	12.9	0	13.9	13.9	0
Sta. -2+00										
7 Q10	14.4	9.4	9.4	0	0.4	0.4	0	2.4	2.4	0
98% Exceed	19.4	9.4	9.4	0	0.4	0.4	0	2.4	2.4	0
90% Exceed	32.3	9.6	9.6	0	0.6	0.6	0	2.4	2.4	0
50% (Oct Median)	76.1	10	10	0	1	1	0	2.4	2.4	0
April Median	154	10.5	10.5	0	1.5	1.5	0	2.6	2.6	0
10% Exceed	196	10.7	10.7	0	1.7	1.7	0	2.7	2.7	0
2 yr	3830	16.4	16.4	0	7.4	7.4	0	7.7	7.7	0
10 yr	7840	19.3	19.3	0	10.3	10.3	0	8.4	8.4	0
50 yr	12600	21.5	21.5	0	12.5	12.5	0	8.7	8.7	0
100 yr	19200	23.3	23.3	0	14.3	14.3	0	10	10	0
Sta. -3+00				0						

7 Q10	14.4	8.7	8.7	0	1	1	0	1.9	1.9	0
98% Exceed	19.4	8.8	8.8	0	1.1	1.1	0	2	2	0
90% Exceed	32.3	9	9	0	1.3	1.3	0	2.3	2.3	0
50% (Oct Median)	76.1	9.5	9.5	0	1.8	1.8	0	3	3	0
April Median	154	10	10	0	2.3	2.3	0	3.6	3.6	0
10% Exceed	196	10.2	10.2	0	2.5	2.5	0	3.9	3.9	0
2 yr	3830	16.3	16.3	0	8.6	8.6	0	6.9	6.9	0
10 yr	7840	19.3	19.3	0	11.6	11.6	0	7.3	7.3	0
50 yr	12600	21.5	21.5	0	13.8	13.8	0	7.3	7.3	0
100 yr	19200	23.3	23.3	0	15.6	15.6	0	8.5	8.5	0
Sta. – 4+00				0						
7 Q10	14.4	7.7	7.7	0	0.7	0.7	0	3.4	3.4	0
98% Exceed	19.4	7.8	7.8	0	0.8	0.8	0	3.6	3.6	0
90% Exceed	32.3	8	8	0	1	1	0	3.9	3.9	0
50% (Oct Median)	76.1	8.3	8.3	0	1.3	1.3	0	4.8	4.8	0
April Median	154	8.8	8.8	0	1.8	1.8	0	5.7	5.7	0
10% Exceed	196	9	9	0	2	2	0	5.9	5.9	0
2 yr	3830	15.8	15.8	0	8.8	8.8	0	7.6	7.6	0
10 yr	7840	19.4	19.4	0	12.4	12.4	0	5.3	5.3	0
50 yr	12600	21.8	21.8	0	14.8	14.8	0	4.5	4.5	0
100 yr	19200	23.6	23.6	0	16.6	16.6	0	4.8	4.8	0
Sta.-5+00										
7 Q10	14.4	7	7	0	1.7	1.7	0	0.9	0.9	0
98% Exceed	19.4	7.1	7.1	0	1.8	1.8	0	1.1	1.1	0
90% Exceed	32.3	7.4	7.4	0	2.1	2.1	0	1.4	1.4	0
50% (Oct Median)	76.1	7.9	7.9	0	2.6	2.6	0	2	2	0
April Median	154	8.4	8.4	0	3.1	3.1	0	2.7	2.7	0
10% Exceed	196	8.7	8.7	0	3.4	3.4	0	3	3	0
2 yr	3830	13.3	13.3	0	8	8	0	12.7	12.7	0
10 yr	7840	18	18	0	12.7	12.7	0	10.5	10.5	0
50 yr	12600	21.7	21.7	0	16.4	16.4	0	4.2	4.2	0
100 yr	19200	23.5	23.5	0	18.2	18.2	0	4.1	4.1	0
Sta.- 6+00										
7 Q10	14.4	6.6	6.6	0	0.5	0.5	0	2.9	2.9	0
98% Exceed	19.4	6.7	6.7	0	0.6	0.6	0	3.1	3.1	0
90% Exceed	32.3	6.8	6.8	0	0.7	0.7	0	3.5	3.5	0
50% (Oct Median)	76.1	7.1	7.1	0	1	1	0	4.4	4.4	0
April Median	154	7.5	7.5	0	1.4	1.4	0	5.3	5.3	0
10% Exceed	196	7.7	7.7	0	1.6	1.6	0	5.6	5.6	0
2 yr	3830	12.4	12.4	0	6.3	6.3	0	11.8	11.8	0
10 yr	7840	15.3	15.3	0	9.2	9.2	0	13.9	13.9	0
50 yr	12600	17.7	17.7	0	11.6	11.6	0	15.3	15.3	0
100 yr	19200	21.5	21.5	0	15.4	15.4	0	12.2	12.2	0

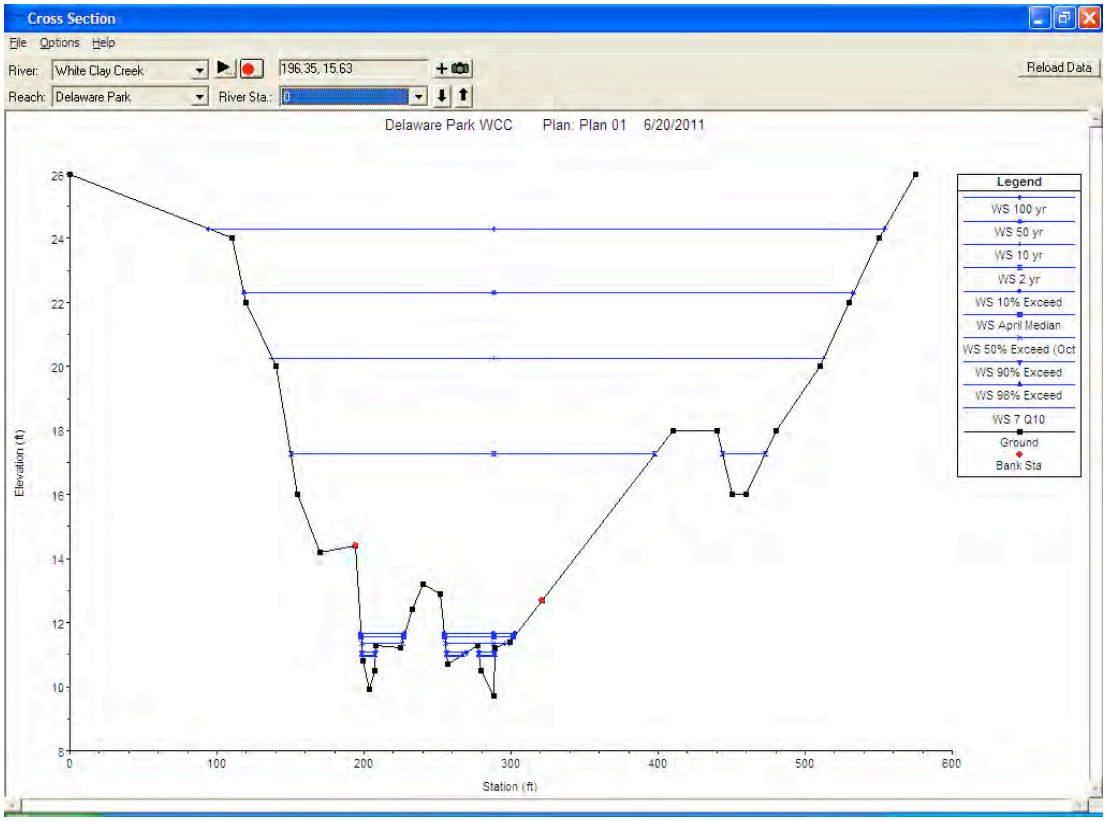


Figure 8. White Clay Creek HECRAS cross section existing station 0+00 (Dam No. 1 in place)

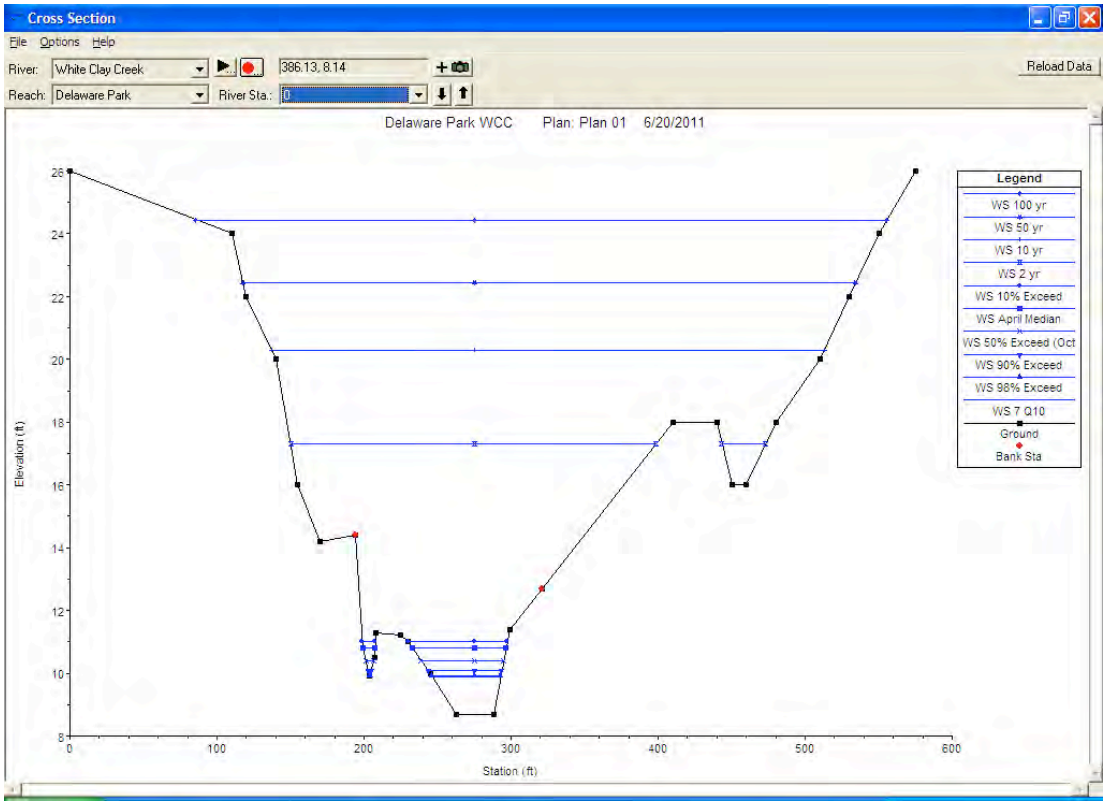


Figure 9. White Clay Creek HECRAS cross section proposed station 0+00 (Dam No. 1 removed)

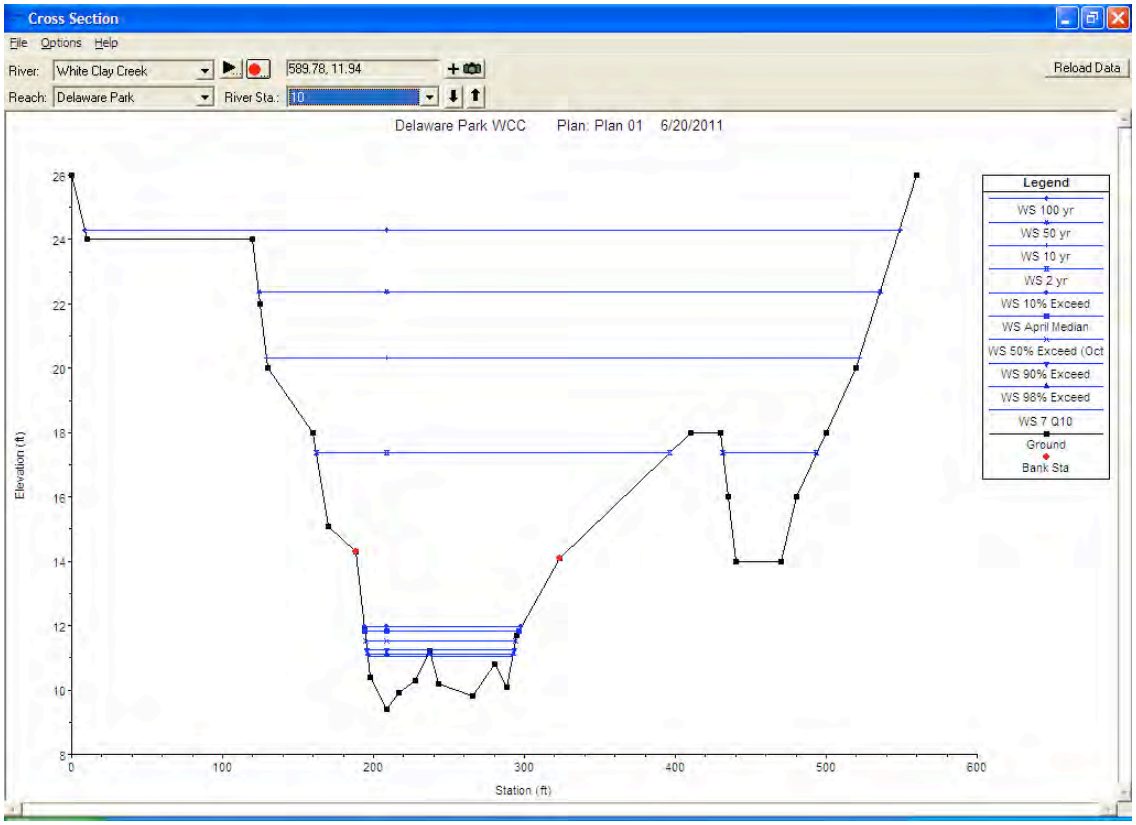


Figure 10. White Clay Creek HECRAS cross section existing station 0+10 (Dam No. 1 in place)

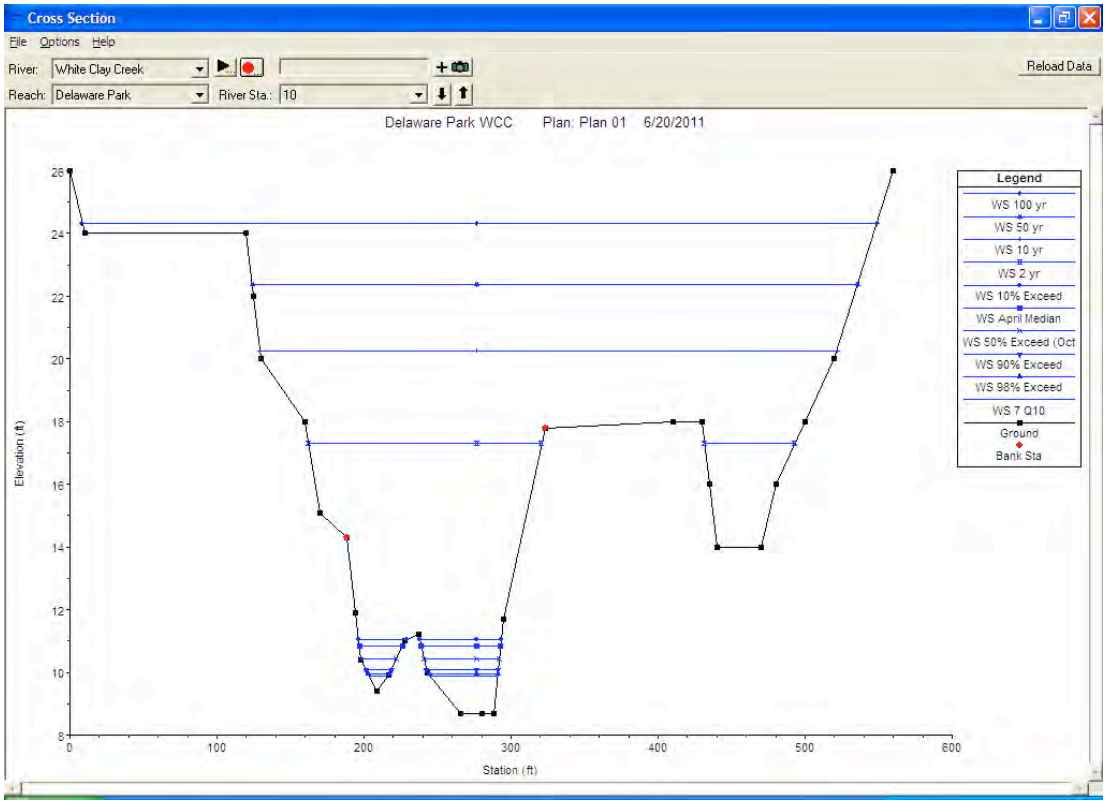


Figure 11. White Clay Creek HECRAS cross section proposed station 0+10 (Dam No. 1 removed)

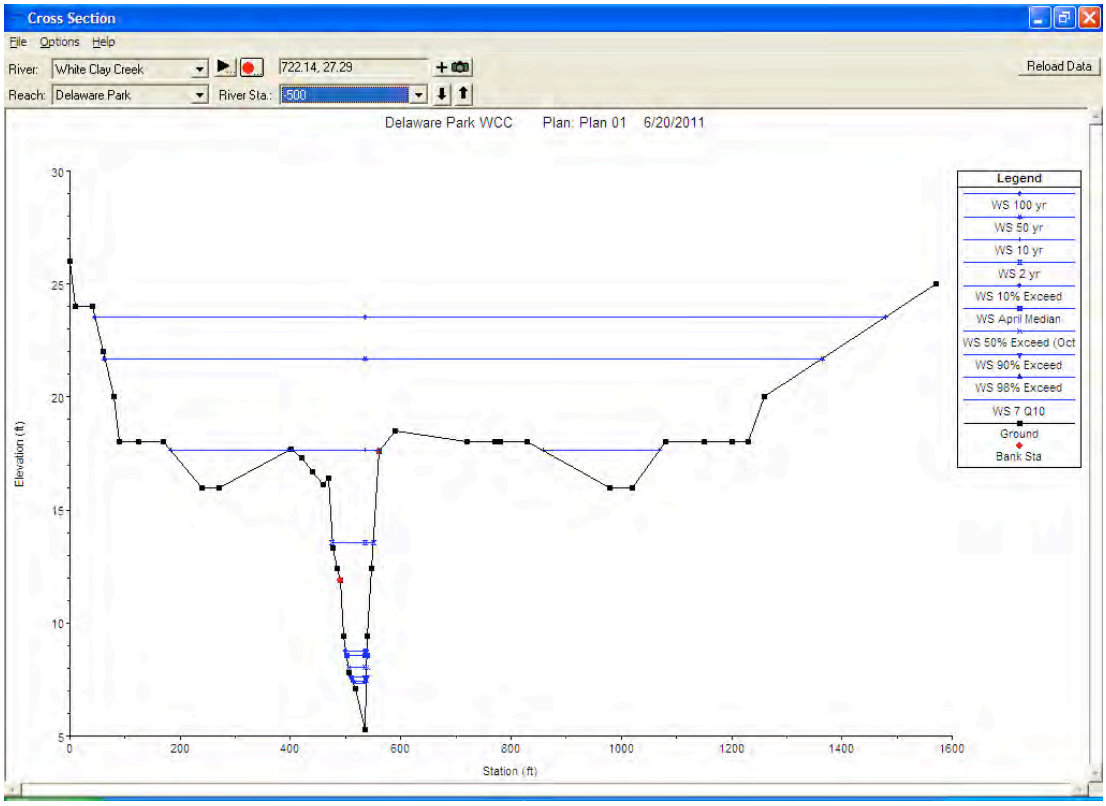


Figure 12. White Clay Creek HECRAS cross section existing station -5+00

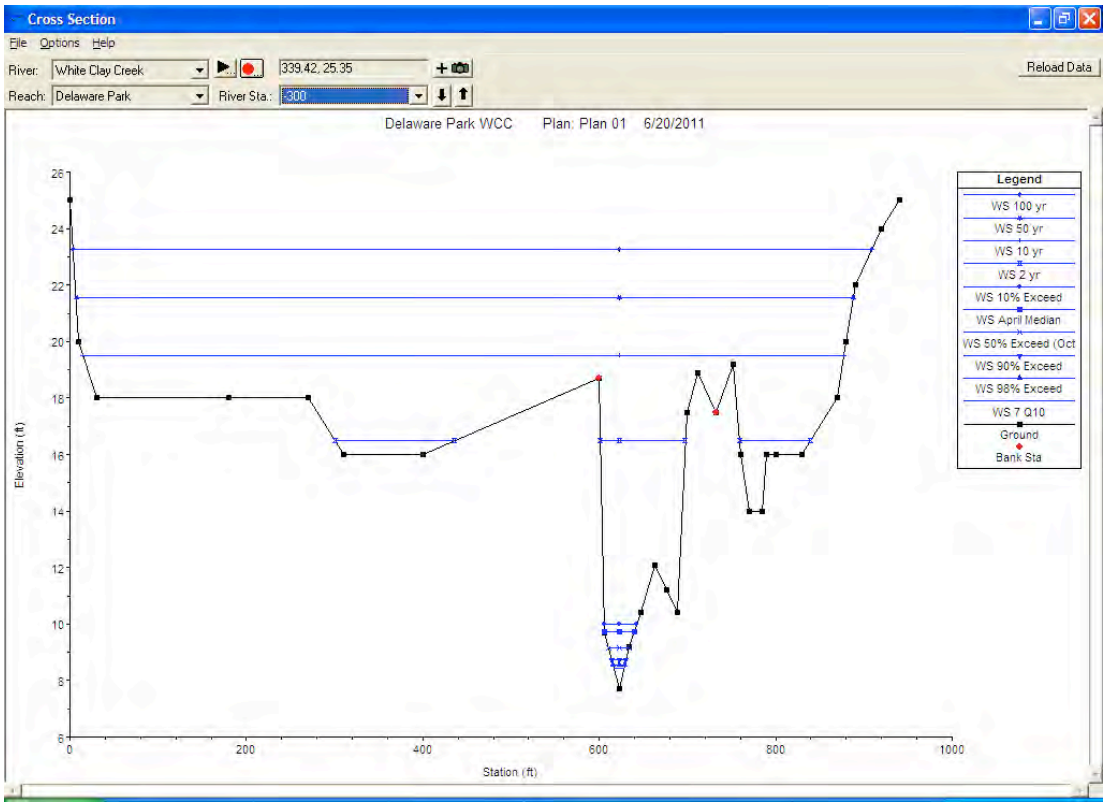


Figure 13. White Clay Creek HECRAS cross section existing station -3+00

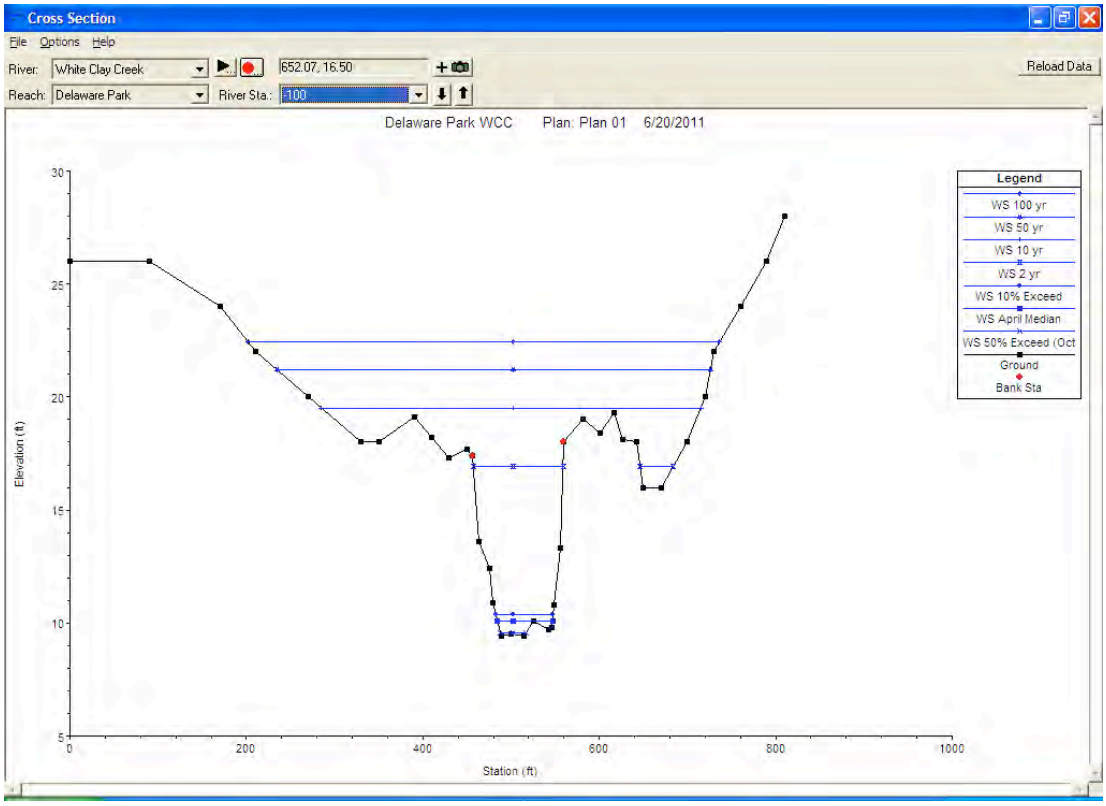


Figure 14. White Clay Creek HECRAS cross section existing station -1+00

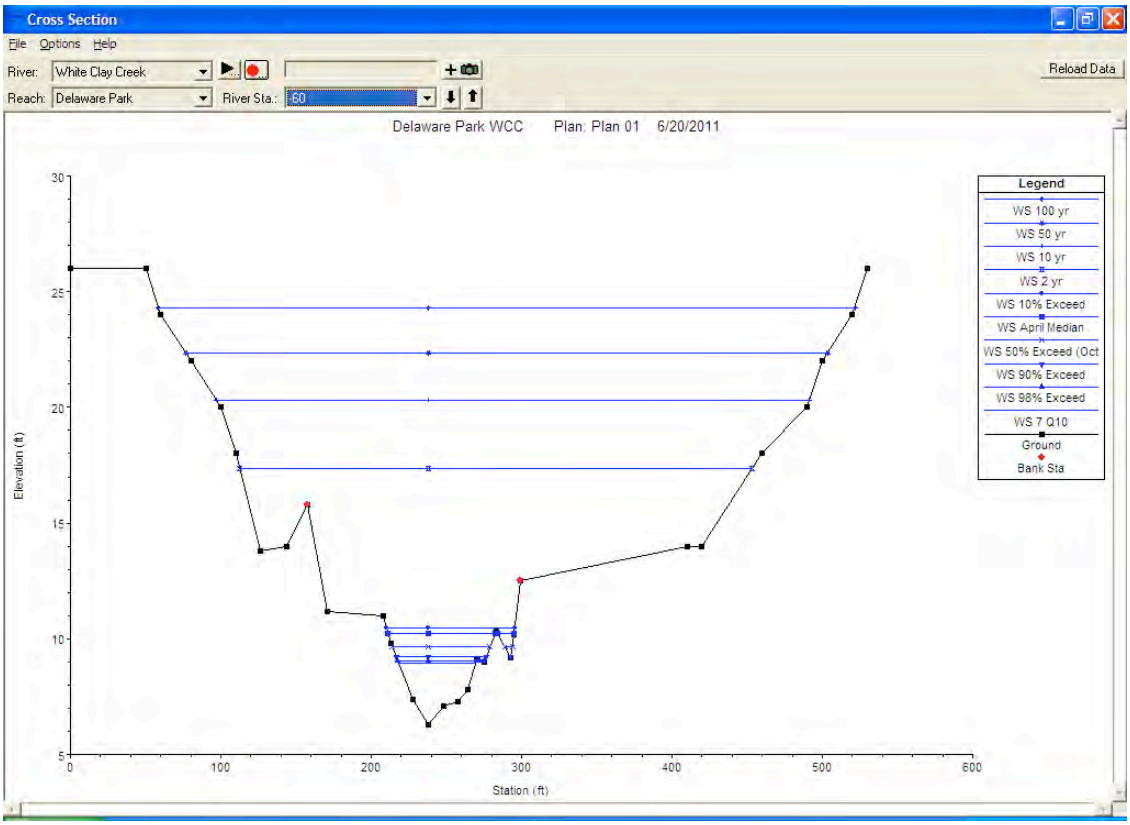


Figure 15. White Clay Creek HECRAS cross section existing station. 0+60

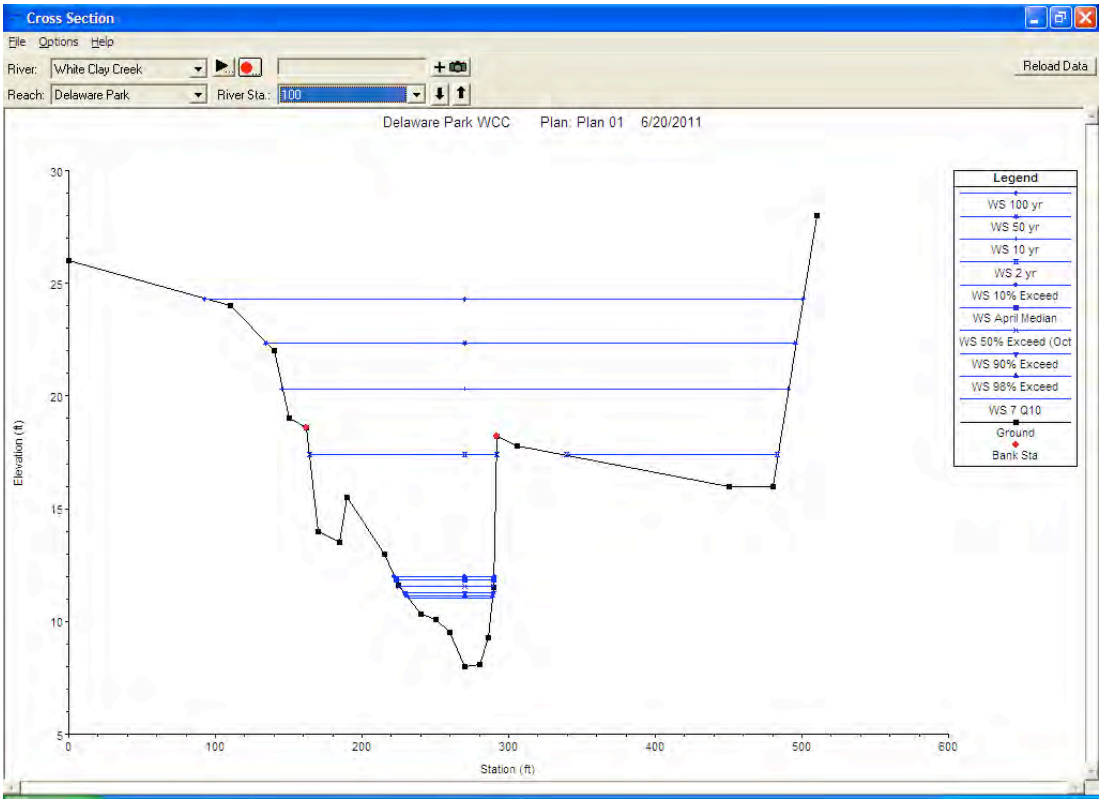


Figure 16. White Clay Creek HECRAS cross section existing station 1+00

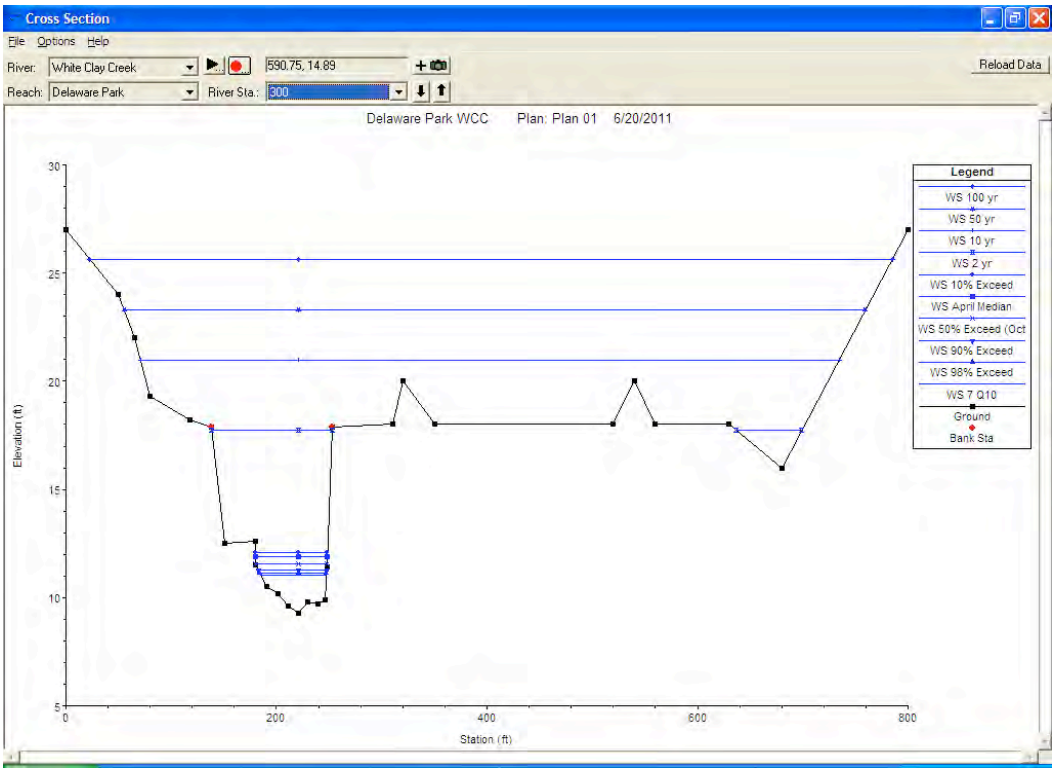


Figure 17. White Clay Creek HECRAS cross section existing station 3+00

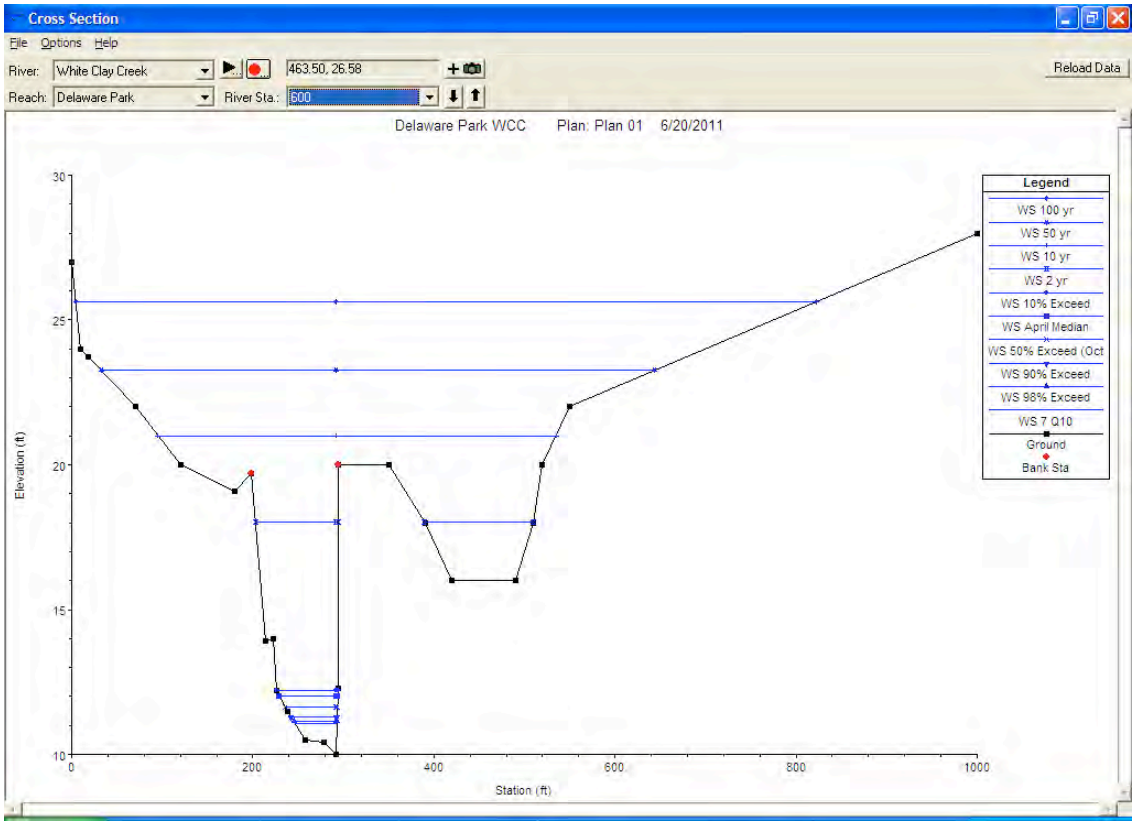


Figure 18. White Clay Creek HECRAS cross section existing station. 6+00

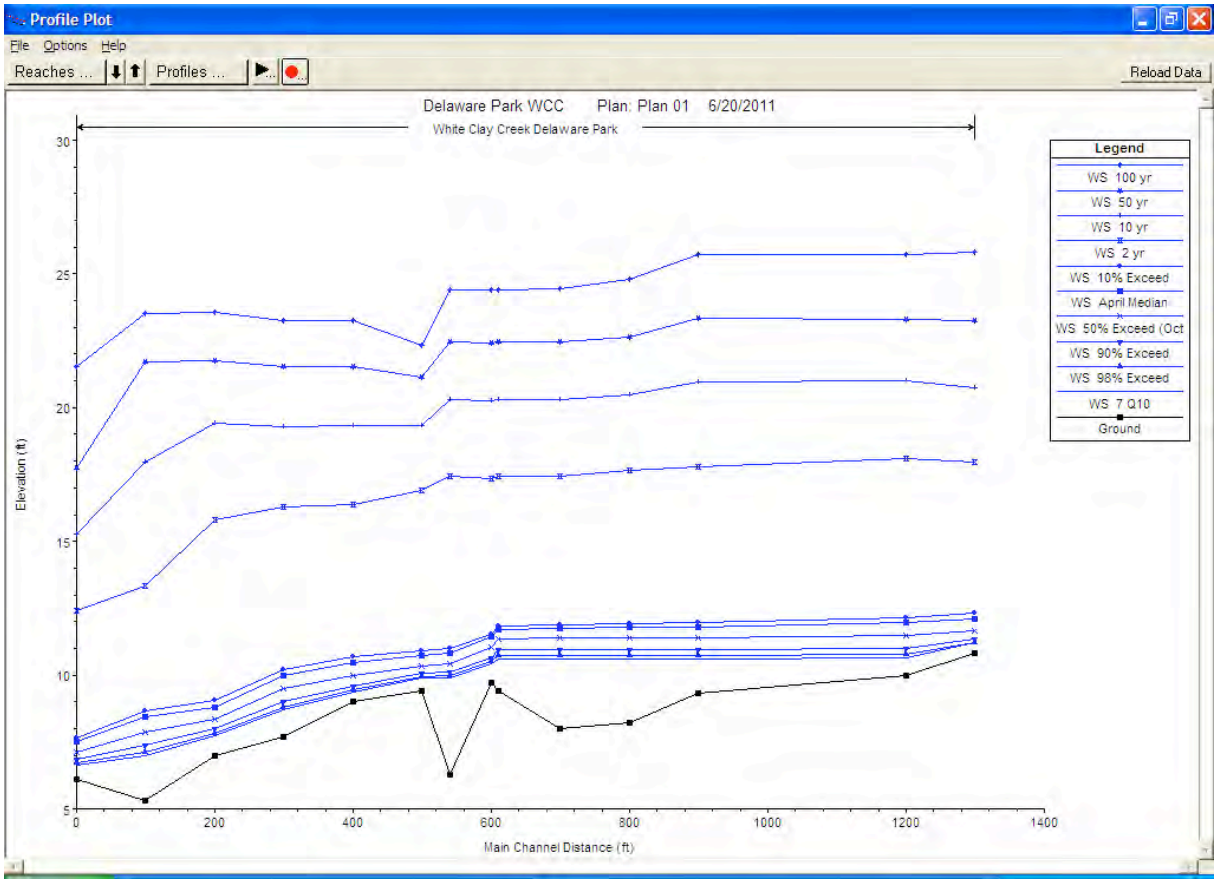


Figure 19. Existing water surface profile of White Clay Creek with Dam No. 1 in place.

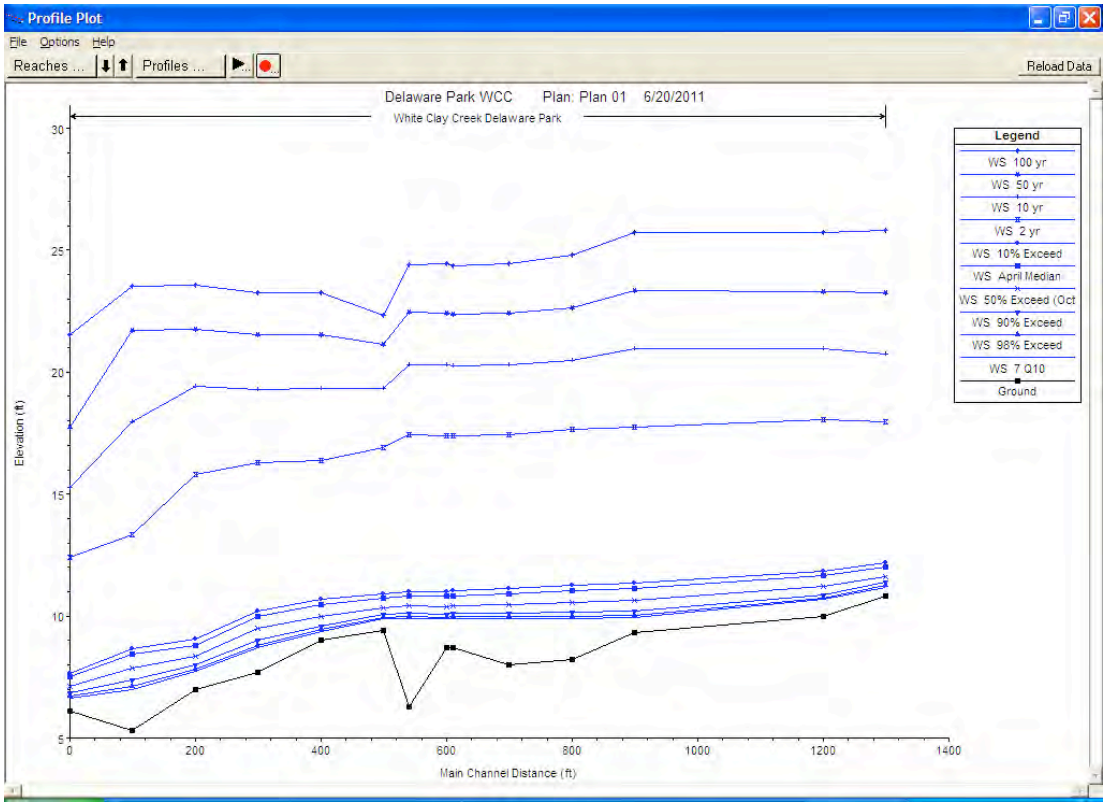


Figure 20. Proposed water surface profile of White Clay Creek with Dam No. 1 removed

Chapter 7 – Engineering Design

Duffield Associates prepared the following engineering drawings and specifications for the removal of Dam No. 1 along the White Clay Creek.

Sheet 1 - Cover Sheet
Sheet 2 - Stream Profile and Existing Conditions
Sheet 3 - Existing Stream Cross Sections
Sheet 4 - Existing Stream Cross Sections
Sheet 5 - Mobilization, Sediment and Erosion Control, and Dewatering
Sheet 6 - Phase III Restoration Design
Sheet 7 - Details

Dam No. 1 will be removed in three phases:
Phase I - Mobilization, Sediment Control, and Dewatering
Phase II - Dam Removal
Phase III – Restoration

Working from the northerly streambank, 50 ft of debris and sediment will be removed after notching and breaching the dam. The vestiges of the historic 18th century timber frame dam along the southerly stream bank will be left intact. Approximately 200 cy of material will be excavated and removed from the dam.

The following materials are specified for restoration:

- 90 ft 12 in Premium Coir Fiber Logs
- 3 rolls 6.5 ft by 164 ft coir mat 700 Matting
- 110 Hardwood Stakes
- 2 BoxesWire Stakes
- 200 ft Degradeable Tie Down Rope
- 12 sheets ¾ in Plywood
- 145 LF Silt Fence

PHASE III - RESTORATION SEQUENCE:

1. INSPECT THE COIR FIBER LOGS FOR STABILITY AND ANCHORAGE.

2. USING A PORTION OF THE STAGED STONE, PLACE STONE ON CHANNEL SIDE OF THE COIR FIBER LOGS FOR ADDITIONAL ANCHORAGE AND TO START ESTABLISHING THE LOWER PORTION OF THE STREAM BANK. THE STONE SHOULD BE PLACED LOOSELY AND RANDOMLY WITH SPACING NOT EXCEEDING 36 INCHES OFF CENTER BETWEEN EDGES OF STONE.

3. THE REMAINING CONCRETE (FREE OF REBAR) IS TO BE PLACED IN DEEP BANK CUT AREAS.

4. ALL WOOD AND METAL IS TO BE REMOVED FROM THE SITE AND DISPOSED OF APPROPRIATELY BY THE CONTRACTOR.

5. COVER THE CONCRETE ALONG THE DEEP CUT BANKS WITH CLEAN SOIL. THE CONCRETE SHOULD BE COVERED WITH A MINIMUM OF 12 INCHES OF SOIL.

6. THE FINAL GRADE OF THE BANK SHOULD NOT EXCEED A SLOPE GREATER THAN THREE TO ONE (3:1).

7. FOLLOWING THE GRADING OF THE FINAL SLOPE, THE SLOPE SHOULD BE LIGHTLY TAMPED WITH THE BUCKET OF THE EXCAVATOR.

8. FOLLOWING LIGHT COMPACTION, ALL HEAVY EQUIPMENT IS TO VACATE THE SITE, REPAIRING RUTS AND TEMPORARY ACCESS FILLS AS THE EGRESS CONTINUES.

9. FOLLOWING THE EGRESS OF HEAVY EQUIPMENT, THE CREATED SLOPE IS TO BE SEEDED WITH NATIVE GRASS SEED MIX AND $\frac{1}{2}$ OF WILDFLOWER SEED MIX. JUTE MATTING IS TO BE PLACED ATOP THE CREATED SLOPE (SEE DETAILS ON SHEET 7 OF 7).

10. PLANT ALL AREAS AS DESCRIBED ON SHEET 6 OF 7. IN AREAS HAVING JUTE MATTING, CUT OPENINGS IN THE JUTE MATTING TO PLANT THE VEGETATION.

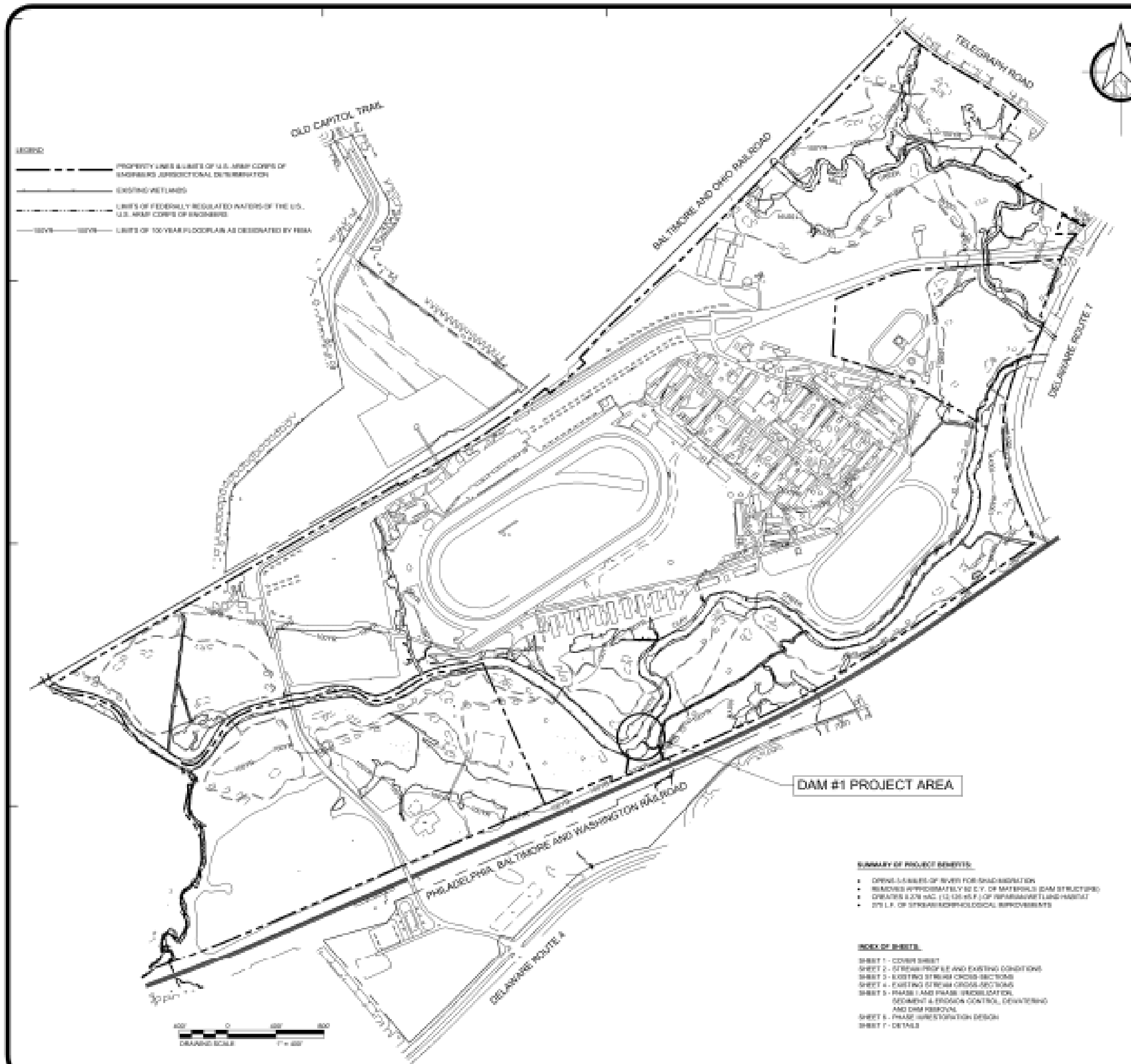
11. SPREAD REMAINDER OF WILDFLOWER SEED MIX WITHIN THE LOW LYING AREAS. RAKE SEEDS INTO SOIL. NO MULCHING OR MATTING.

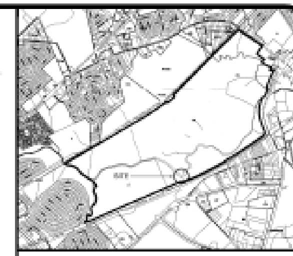
12. INSPECT THE SITE FOR TRASH AND WORK COMPLETION.

PLANT SELECTION:

BOTANICAL NAME	COMMON NAME	STATUS	% BY WT.
WILDFLOWER SEED MIX: 2.5 LBS			
ASCLEPIAS TUBEROSE	BUTTERFLY WEED	NATIVE	25%
BAPTISTA AUSTRALIS	BLUE FALSE INDAGO	NATIVE	10%
COREOPSIS TINTORIA	COREOPSIS	NATIVE	25%
ECHINACEA PURPUREA	PURPLE CONE FLOWER	NATIVE	25%
LOBELIAS CARDINALIS	CARDINAL FLOWER	NATIVE	15%
NATIVE GRASS SEED ALONG SLOPE: 4 LBS			
ELYMUS RIPARIUS	RIVERBANK WILD RYE	NATIVE	50%
ELYMUS VIRGINICUS	VIRGINIA WILD RYE	NATIVE	50%
GRASS SEED ALONG MAINTAINED PORTION OF ACCESS ROUTE: TBD			
SELECTED GOLF COURSE STOCK GRASS SEED		(COMMERCIAL)	100%

SHRUB/POTTED/PLUG PLANT LIST:			NUMBER	CONTAINER	LOCATION
L1 - *VIBURNUM DENTATUM*	ARROWWOOD	NATIVE	9	2 GAL	LOW LAND
L2 - *SAMBUCUS CANADENSIS*	ELDERBERRY	NATIVE	9	2 GAL	LOW LAND
L3 - *CEPHALANTHUS OCCIDENTALIS*	BUTTONBUSH	NATIVE	7	1 GAL	LOW LAND
S1 - *PLATANUS OCCIDENTALIS*	SYCAMORE	NATIVE	19	2 GAL (MIN)	SLOPE
S2 - *FRAXINUS PENNSYLVANICA*	GREEN ASH	NATIVE	17	2 GAL	SLOPE
L4 - *JUNCUS EFFUSES*	SOFT RUSH	NATIVE	38	PLUG	LOW LAND
L5 - *SCIRPUS VALIDUS*	SOFT-STEM BULRUSH	NATIVE	38	PLUG	LOW LAND
L6 - *SCIRPUS CYPERINUS*	WOOLGRASS	NATIVE	38	PLUG	LOW LAND





LOCATION MAP SCALE: 1" = 1,000'

NOTES:

1. THIS DRAWING IS ADAPTED FROM THE UNTITLED AND UNDATED AS-BUILT TOPO OF WHITE CLAY CREEK GOLF CLUB AT DELAWARE PARK PREPARED BY VANDEMARK & LYNCH, INC., RECEIVED BY DUFFIELD ASSOCIATES IN JULY 2004 AND INCORPORATES AN EXISTING CONDITION SURVEY PERFORMED BY VANDEMARK & LYNCH, INC. IN OCTOBER 2010. SEE NOTE SHEETS 3 AND 4 REGARDING CROSS-SECTIONS.
2. THE WETLANDS LOCATIONS SHOWN ON THIS DRAWING WERE APPROVED BY THE U.S. ARMY CORPS OF ENGINEERS IN 2007. REFER TO: CENAP-OP-R-[illegible] (JD). THERE ARE NO WETLANDS IN THE PROJECT AREA (OPEN WATER BODIES ONLY).
3. TAX PARCEL NOS.: [illegible]

GENERAL NOTES:

1. THIS PROJECT WILL BE COMPLETED IN THREE (3) PHASES:
   - PHASE 1 - MOBILIZATION, SEDIMENT AND EROSION CONTROL, AND DEWATERING
   - PHASE 2 - DAM REMOVAL
   - PHASE 3 - RESTORATION
2. WORK SCHEDULES WILL BE COORDINATED WITH THE DIRECTOR OF GROUNDS AS TO MINIMIZE IMPACT TO THE GOLF COURSE OPERATIONS AND MAINTAIN SAFETY TO BOTH THE WORK CREWS AND THE PUBLIC.
3. ALL WORK WILL INITIATE TO THE GREATEST EXTENT POSSIBLE AT THE SOUTHERN END OF THE DAM AND WORK TOWARD THE NORTHERN END.
4. ACCESS WILL BE ESTABLISHED AND THE DAM WILL BE NOTCHED. TIME WILL BE ALLOWED AS NEEDED FOR WATER LEVEL UPSTREAM OF THE DAM TO SLOWLY LOWER.
5. DAM REMOVAL WILL BE COMPLETED PRIOR TO THE START OF RESTORATION EFFORTS.
6. RESTORATION WILL OCCUR ALONG THE NORTHERN SHORELINE OF THE WHITE CLAY CREEK AS IDENTIFIED IN THE DESIGN.
7. THE ACCESS ROUTE WILL BE RESTORED FOLLOWING THE EXIT OF HEAVY EQUIPMENT.
8. ALTHOUGH WORK IN THE CHANNEL CANNOT BE AVOIDED, ALL EFFORTS WILL BE MADE TO LIMIT WORK WITHIN THE CHANNEL BEYOND THAT WHICH IS NECESSARY.
9. OTHER THAN THAT IDENTIFIED IN THIS PLAN, NO STAGING, FILLING, OR DISTURBANCE WILL OCCUR CHANNELWARD OF THE STATE OR FEDERAL JURISDICTIONAL LINE.
10. PRIOR TO A WORK DAY, THE MATERIALS NEEDED FOR THAT DAY OF WORK WILL BE IDENTIFIED/PREPARED. NO STAGING OF MATERIAL AT THE WORK SITE WILL BE PERMITTED WITHOUT PRIOR APPROVAL FROM THE DIRECTOR OF GROUNDS.
11. WORK ON-SITE WILL BE OVERSEEN BY AN INDIVIDUAL EXPERIENCED IN STREAM STABILIZATION PROJECTS.
12. NO EARTH DISTURBANCE WILL OCCUR UNTIL DNREC WATER QUALITY CERTIFICATION, CZM CONSISTENCY CERTIFICATION, SUBAQUEOUS LANDS AUTHORIZATION AND USAGE AUTHORIZATION ARE ACQUIRED.
13. A COPY OF THE STATE SUBAQUEOUS LANDS PERMIT, THE U.S. ARMY CORPS OF ENGINEERS AUTHORIZATION, AND APPROVED PLANS ARE TO BE MAINTAINED AT THE WORK SITE AT ALL TIMES.
14. CONTRACTOR IS RESPONSIBLE FOR WORK SITE SAFETY AND COMPLIANCE WITH ALL FEDERAL AND STATE WORK SITE SAFETY REGULATIONS.
15. CONTRACTOR IS RESPONSIBLE FOR LOCATING AND VERIFYING THE LOCATIONS OF ANY UTILITIES THAT COULD BE AFFECTED BY THE PROPOSED WORK.

SUMMARY OF PROJECT BENEFITS:

- OPENS 3.5 MILES OF RIVER FOR SHAD MIGRATION
- REMOVES APPROXIMATELY 92 C.Y. OF MATERIALS (DAM STRUCTURE)
- CREATES 0.278 AC. (12,120 S.F.) OF RIPARIAN/WETLAND HABITAT
- 275 L.F. OF STREAM/MORPHOLOGICAL IMPROVEMENTS

INDEX OF SHEETS:

SHEET 1 - COVER SHEET
SHEET 2 - STREAM PROFILE AND EXISTING CONDITIONS
SHEET 3 - EXISTING STREAM CROSS-SECTIONS
SHEET 4 - EXISTING STREAM CROSS-SECTIONS
SHEET 5 - PHASE I AND PHASE II MOBILIZATION, SEDIMENT & EROSION CONTROL, DEWATERING AND DAM REMOVAL
SHEET 6 - PHASE III RESTORATION DESIGN
SHEET 7 - DETAILS

MATERIAL VOLUME ESTIMATES:

- 90 FEET OF 12-INCH PREMIUM COIR FIBER LOGS
- 3 ROLLS OF 6.5 FT. X 164 FT. COIR MAT 700 MATTING
- 118 HARDWOOD STAKES FOR COIR FIBER LOGS
- 3 BOXES WIRE STAPLES
- 200 FEET OF DEGRADABLE TIE-DOWN ROPE FOR COIR FIBER LOGS
- 12 SHEETS OF 3/4" PLYWOOD
- 145 L.F. SILT FENCE

NOTES:
1) ALSO SEE PLANTING LIST ON PAGE 6 OF 7.
2) CLEAN TOP SOIL WILL BE OBTAINED FROM EXISTING ON-SITE SOURCE.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

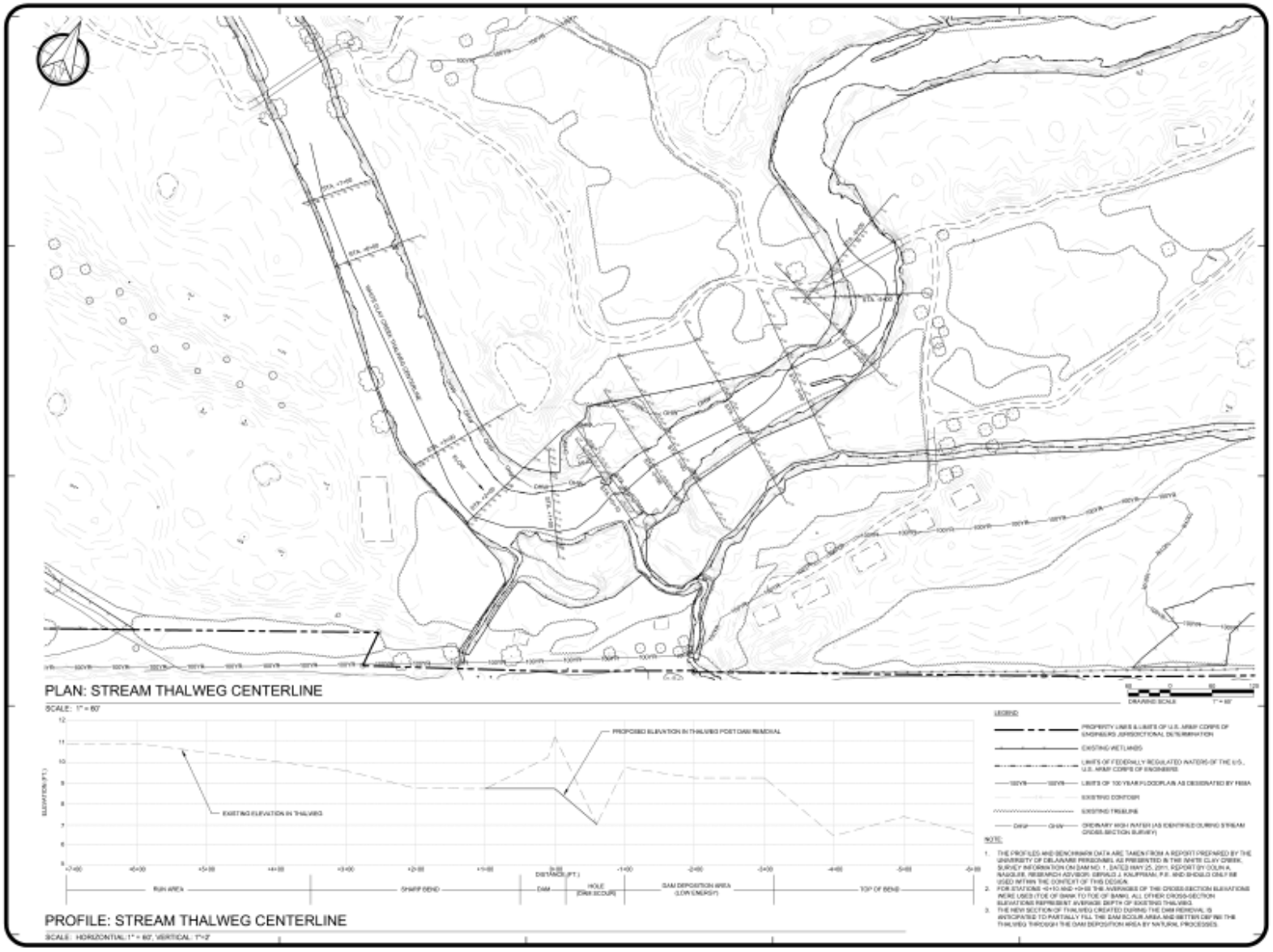
OWNER:
DELAWARE RACING ASSOCIATION
777 DELAWARE PARK BLVD.
WILMINGTON, DE 19804

COVER SHEET

DAM NO. 1 REMOVAL
WHITE CLAY CREEK COUNTRY CLUB

NEW CASTLE COUNTY – DELAWARE

DATE:	9 AUGUST 2011
SCALE:	1" = 400'
PROJECT NO.	8849.WA
SHEET:	1 OF 7



DUFFIELD ASSOCIATES

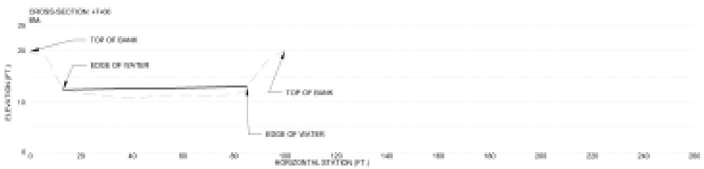
STREAM PROFILE AND EXISTING CONDITIONS

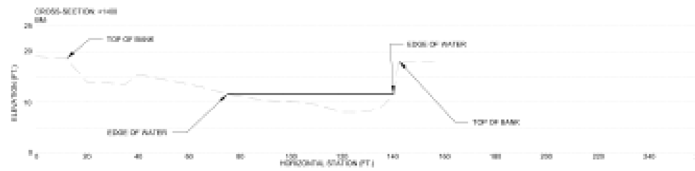
DAM NO. 1 REMOVAL DESIGN

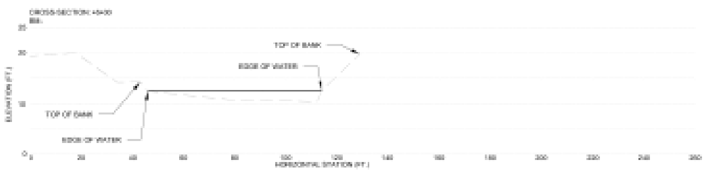
WHITE CLAY CREEK COUNTRY CLUB

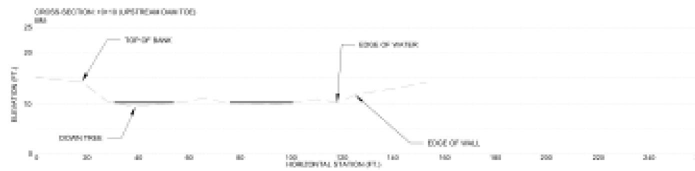
WILMINGTON–NEW CASTLE COUNTY – DELAWARE

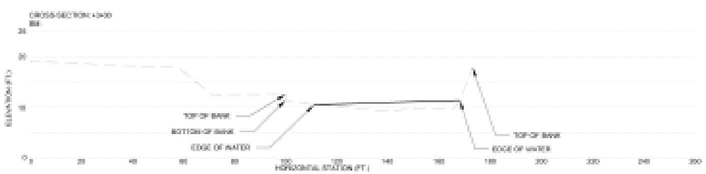
DATE: 9 AUGUST 2011
SCALE: 1"=60'
PROJECT NO. 8849.WA
SHEET: 2 OF 7

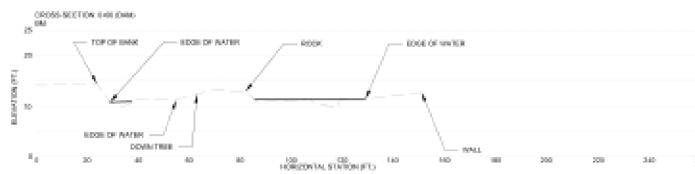


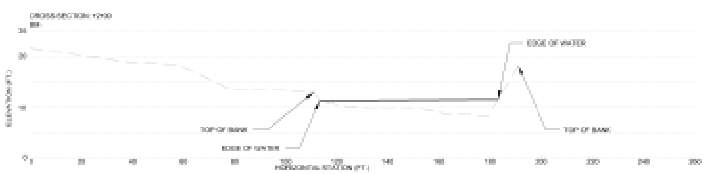


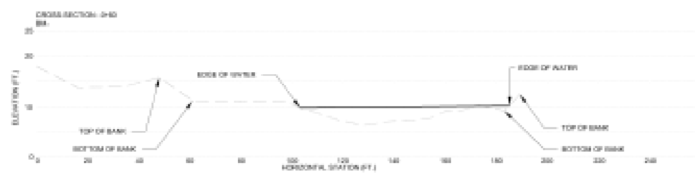












BENCHMARK ELEVATION SUMMARY:

DESCRIPTION	STATION	BS	HEIGHT OF INSTRUMENT	FS	IFS	ELEVATION (FEET)
TOPOGRAPHIC LINE		7.5	27.5			20.0
CONCRETE WING WALL OF BRIDGE	BM	0.5	25.3	2.7		24.6
SPOT OF TOP OF ROCK WALL	BM				5.0	20.3
SPOT OF BOTTOM OF ROCK WALL	BM				11.5	13.8
CRACK IN SIDEWALK	BM				8.2	17.0

NOTE:
THE PROFILES AND BENCHMARK DATA ARE TAKEN FROM A REPORT PREPARED BY THE UNIVERSITY OF DELAWARE PERSONNEL AS PRESENTED IN THE WHITE CLAY CREEK, SURVEY INFORMATION ON DAM NO. 1, DATED MAY 25, 2011, REPORT BY COLIN A. NAUGLE, RESEARCH ADVISOR: GERALD J. KAUFFMAN, P.E. AND SHOULD ONLY BE USED WITHIN THE CONTEXT OF THIS DESIGN.

NOTE:
EDGE OF WATER ELEVATIONS BASED ON FIELD WORK PERFORMED PRIOR TO COMPLETION OF MAY 25, 2011 REPORT. ELEVATIONS MAY VARY DEPENDING ON SEASON AND RAINFALL.

LEGEND
EXISTING GROUND
EXISTING WATER SURFACE
BM BENCHMARK (SEE BENCHMARK TABLE, THIS SHEET)

SCALE
VERTICAL: 1"=10'
HORIZONTAL: 1"=20'

DUFFIELD ASSOCIATES

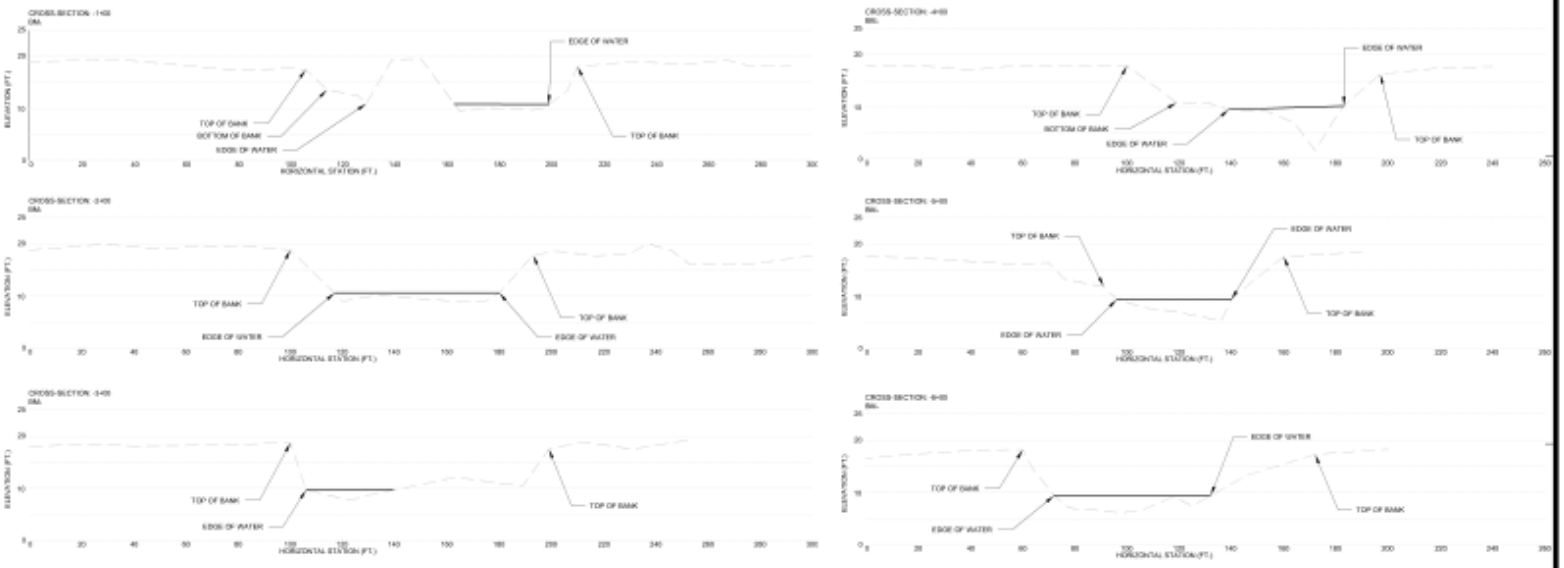
EXISTING STREAM CROSS-SECTIONS

DAM NO. 1 REMOVAL DESIGN

WHITE CLAY CREEK COUNTRY CLUB

WILMINGTON–NEW CASTLE COUNTY–DELAWARE

DATE: 4 AUGUST 2011
SCALE: AS NOTED
PROJECT NO. 8849.WA
SHEET: 3 OF 7



BENCHMARK ELEVATION SUMMARY

DESCRIPTION	STATION	BS	HEIGHT OF INSTRUMENT	FS	IFS	ELEVATION (FEET)
TOPOGRAPHIC LINE		7.5	27.5			20.0
CONCRETE WING WALL OF BRIDGE	DAM	0.5	26.3	2.7		24.6
SPOT OF TOP OF ROCK WALL	BM				5.8	20.3
SPOT OF BOTTOM OF ROCK WALL	BM				11.5	13.8
CRACK IN SIDEWALK	BM				8.3	17.5

NOTE:
THE PROFILES AND BENCHMARK DATA ARE TAKEN FROM A REPORT PREPARED BY THE UNIVERSITY OF DELAWARE PERSONNEL AS PRESENTED IN THE WHITE CLAY CREEK, SURVEY INFORMATION ON DAM NO. 1 DATED MAY 25, 2011, REPORT BY COLIN A. MAUDLEY, RESEARCH ADVISOR, GERALD J. KAUFFMAN, P.E. AND SHOULD ONLY BE USED WITHIN THE CONTEXT OF THIS DESIGN.

NOTE:
EROSION WATER ELEVATIONS WERE TAKEN ON MAY 25, 2011 PERFORMED PRIOR TO COMPLETION OF DAM 25, 2011 REPORT. ELEVATIONS MAY VARY DEPENDING ON SEASON AND RAINFALL.

LEGEND
EXISTING GROUND
EXISTING WATER SURFACE
BM BENCHMARK (SEE BENCHMARK TABLE, THIS SHEET)

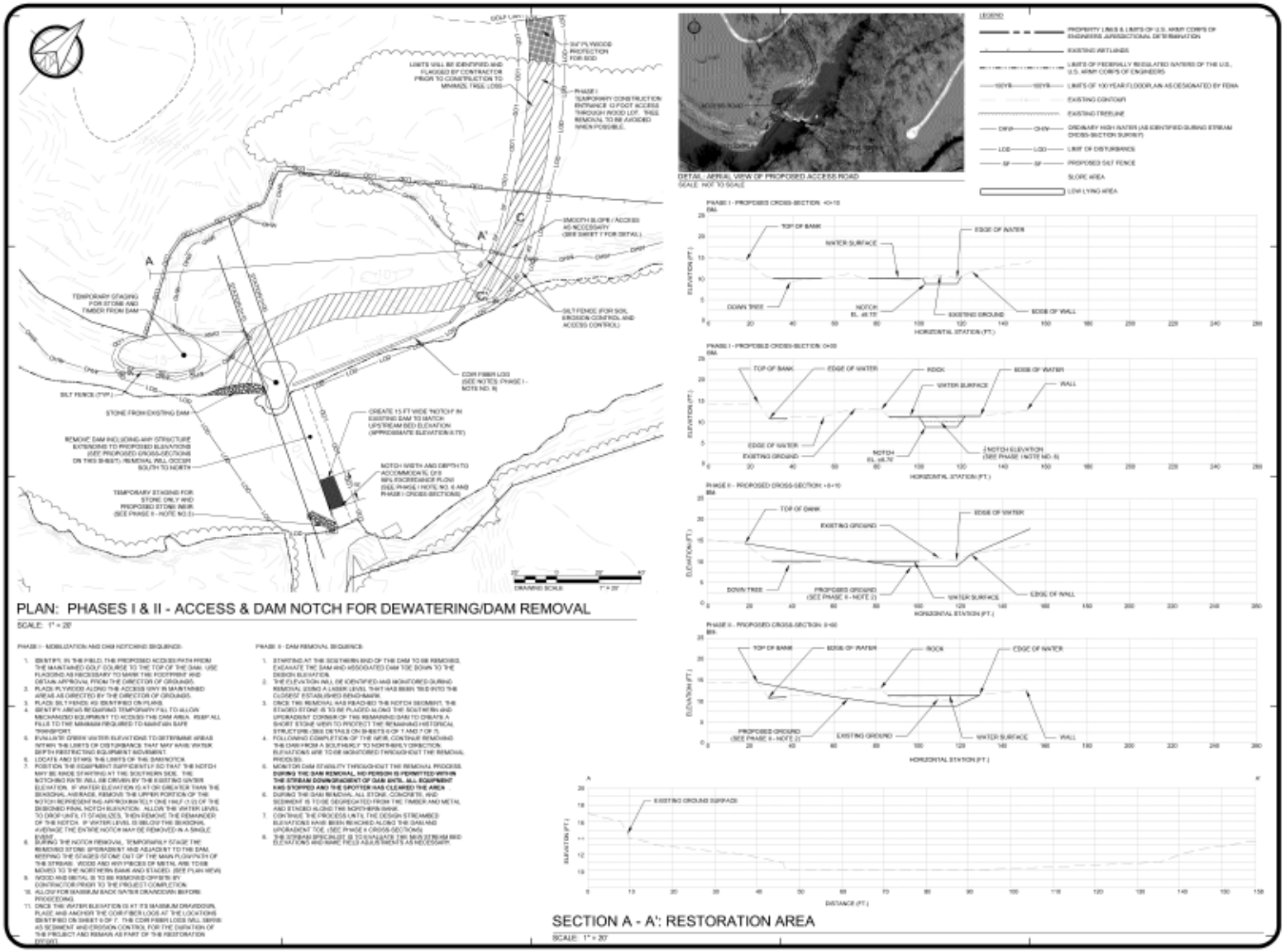
SCALE
VERTICAL: 1"=10'
HORIZONTAL: 1"=20'

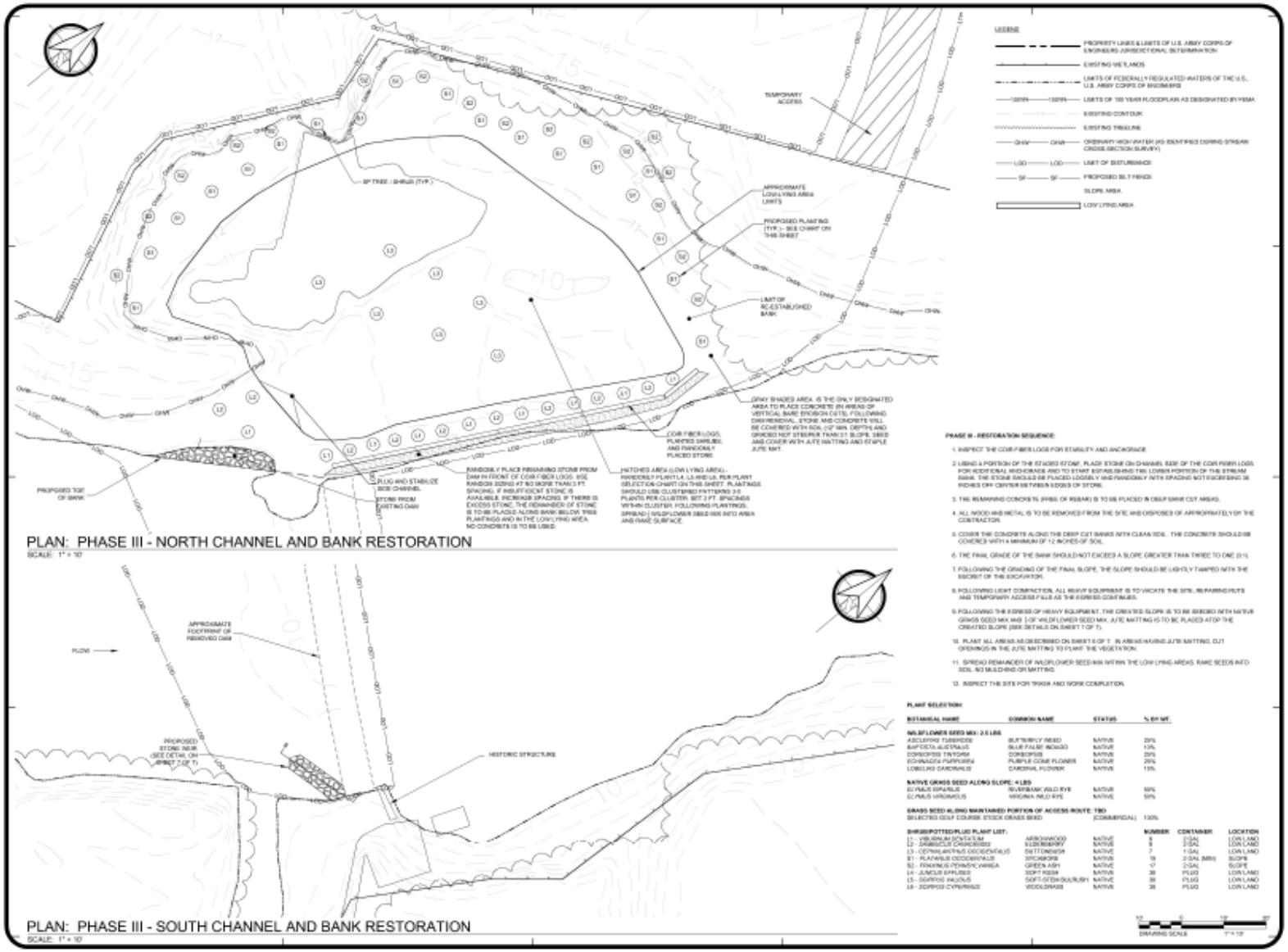
DUFFIELD ASSOCIATES

EXISTING STREAM CROSS-SECTIONS

DAM NO. 1 REMOVAL DESIGN
WHITE CLAY CREEK COUNTRY CLUB
WILMINGTON-NEW CASTLE COUNTY-DELAWARE

DATE: 9 AUGUST 2011
SCALE: AS NOTED
PROJECT NO. 03649.30A
SHEET: 4 OF 7

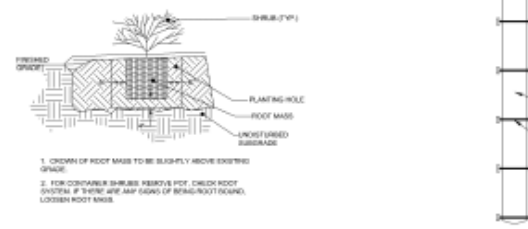

PLAN: PHASES I & II - ACCESS & DAM NOTCH FOR DEWATERING/DAM REMOVAL
SCALE: 1" = 20'
SECTION A - A': RESTORATION AREA
SCALE: 1" = 20'
DETAIL: AERIAL VIEW OF PROPOSED ACCESS ROAD
SCALE: NOT TO SCALE
LEGEND
PROPERTY LINES & LIMITS OF U.S. ARMY CORPS OF ENGINEERS JURISDICTIONAL DETERMINATION
EXISTING WETLANDS
LIMITS OF FEDERALLY REGULATED WATERS OF THE U.S., U.S. ARMY CORPS OF ENGINEERS
LIMITS OF 100 YEAR FLOODPLAIN AS DESIGNATED BY FEMA
EXISTING CONTOUR
EXISTING TREELINE
ORDINARY HIGH WATER (AS IDENTIFIED DURING STREAM CROSS-SECTION SURVEY)
LIMIT OF DISTURBANCE
PROPOSED SILT FENCE
SLOPE AREA
LOW LYING AREA
PHASE I - PROPOSED CROSS-SECTION: A+10
PHASE I - PROPOSED CROSS-SECTION: A+00
PHASE II - PROPOSED CROSS-SECTION: I+10
PHASE II - PROPOSED CROSS-SECTION: I+00
HORIZONTAL STATION (FT.)
ELEVATION (FT.)
PHASE I AND PHASE II
MOBILIZATION, SEDIMENT & EROSION CONTROL, DEWATERING AND DAM REMOVAL
DAM NO. 1 REMOVAL DESIGN
WHITE CLAY CREEK COUNTRY CLUB
WILMINGTON-NEW CASTLE COUNTY - DELAWARE
DUFFIELD ASSOCIATES
DATE: 9 AUGUST 2011
SCALE: AS NOTED
PROJECT NO: 8849.WA
SHEET: 5 OF 7



DUFFIELD ASSOCIATES

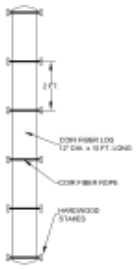
PHASE III
RESTORATION DESIGN
DAM NO. 1 REMOVAL DESIGN
WHITE CLAY CREEK COUNTRY CLUB
WILMINGTON-NEW CASTLE COUNTY - DELAWARE

DATE: 9 AUGUST 2011
SCALE: AS NOTED
PROJECT NO. 8849.WA
SHEET: 6 OF 7



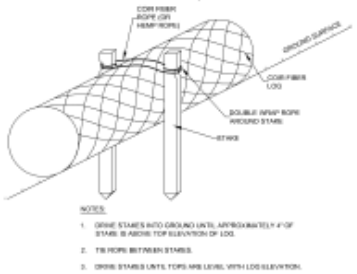
DETAIL: SHRUB PLANTING DETAIL

SCALE: NOT TO SCALE



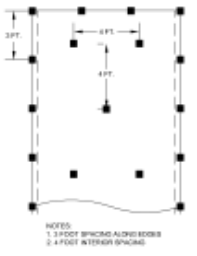
DETAIL: BIO-LOG DETAIL

SCALE: NOT TO SCALE



DETAIL: BIO-LOG DETAIL

SCALE: NOT TO SCALE

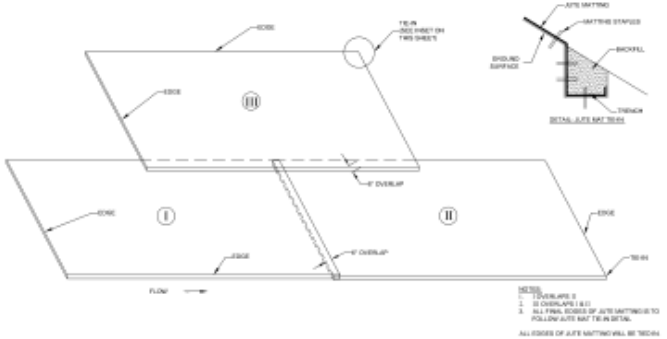


DETAIL: JUTE MATTING STAPLE PATTERNS

SCALE: NOT TO SCALE

DETAIL: STONE WEIR CROSS-SECTION

SCALE: NOT TO SCALE



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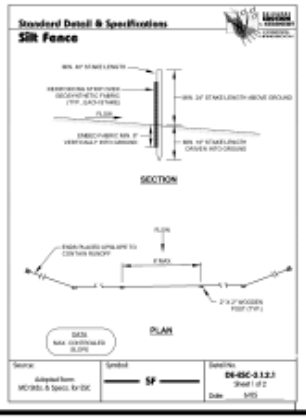
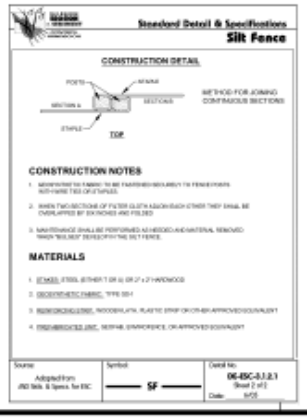
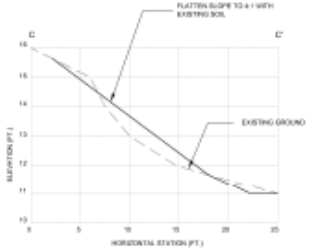
SCALE: NOT TO SCALE

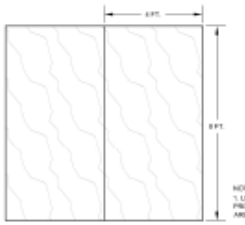






DETAIL: ACCESS ROAD SLOPE C-C'

SCALE: HORIZ: 1"=10', VERT.: 1"=2'



DETAIL: ACCESS ROAD DETAIL

SCALE: NOT TO SCALE

DUFFIELD ASSOCIATES

DETAILS

DAM NO. 1 REMOVAL DESIGN

WHITE CLAY CREEK COUNTRY CLUB

WILMINGTON-NEW CASTLE COUNTY-DELAWARE

DATE: 9 AUGUST 2011
SCALE: AS NOTED
PROJECT NO. 03649.W/A
SHEET: 7 OF 7

Chapter 8 –Permits

In November 2010, we submitted a pre-application permit package to the following Federal, State, and local agencies. In December 2010, we attended a Federal/State joint permit application meeting in Dover, Delaware. Copies of the permit application letters and responses are included in this report.

Table 21. Permitting agencies for removal of White Clay Creek Dam No. 1

Permit and Permitting Agency	Agency Contact
Subaqueous Lands Permit, DNREC Division of Water Resources	State of Delaware Joint Permit Officer Dover, Delaware
Water Quality Certification, DNREC Div. of Water Resources	State of Delaware Joint Permit Officer Dover, Delaware
Coastal Zone Consistency Review, DNREC Coastal Mgmt. Program	State of Delaware Joint Permit Officer Dover, Delaware
Section 7 Review, U. S. National Park Service	Chuck Barscz US National Park Service Philadelphia, PA
Section 404 Wetland Permit, U.S. Army Corps of Engineers	State of Delaware Joint Permit Officer Dover, Delaware
Soil Erosion and Sediment Control Permit, New Castle Conservation District	Kevin Donnelly, District Coordinator,
State Historic Preservation Officer (SHPO)	
Floodplain Permit, New Castle County Department of Land Use	New Castle County Land Use Department New Castle County

The two primary permits required are issued by DNREC Division of Water Resources, Subaqueous Lands section and the U. S. Army Corps of Engineers. Local stormwater, floodplain, and soil erosion/sedimentation control permits will be necessary for dam-related construction activities from the New Castle Conservation District and New Castle County Land Use Department. Federal and state permit applications are reviewed monthly by a Joint Permit Review Committee in Dover, Delaware. The Committee coordinates permit applications and policies and includes representatives from state and federal regulatory and advisory agencies. We prepared the joint permit application for review by the Joint Permit Review Committee in Dover, Delaware at the December 2010 meeting.

The Delaware State Historic Preservation Officer (SHPO) responded with review comments and notified that Dam No. 1 was likely constructed circa 1750 to divert the creek into a raceway that flowed for about a mile to a mill at the Hale Byrnes House which is on the National Register of Historic Places. A field reconnaissance by SHPO indicates the timber frame underpinning in the dam may date back to1750 and it may have historic value as an example of colonial engineering. At the recommendation by SHPO, we retained the University of Delaware Center for Historic Architecture and Design (CHAD) to conduct a Phase I - Cultural Survey (see scope) which is scheduled for completion in September 2011. The survey will be sent to SHPO for review.

Agreement between
University of Delaware, Center for Historic Architecture and Design and
White Clay Creek Wild and Scenic River Program

Period Covered: May 2, 2011 - September 30, 2011

WCCWS Contact: Jennifer Egan, River Administrator
White Clay Creek Wild and Scenic River Program
Newark, DE 19711

CHAD Contact: Rebecca J. Sheppard, Associate Director
Center for Historic Architecture and Design
University of Delaware Newark, DE 19716

Introduction

The Center for Historic Architecture and Design (CHAD) at the University of Delaware proposes to conduct a historic survey and documentation of White Clay Creek Dam No. 1 at Delaware Park. This work is necessary to obtain approval from the Delaware State Historic Preservation Office to remove Dam No. 1 and provide passage for anadromous fish populations such as the American shad and hickory shad along the White Clay Creek National Wild and Scenic River.

Program

CHAD proposes the following program components to complete the scope of work:

1. Complete Cultural Resource Survey form. Obtain photographs of the dam and raceway.

2. Record narrative history of dam. Evaluate eligibility for National Register of Historic Places.

3. Prepare physical documentation in the form of a measured site plan showing the dam and raceway and a section drawing showing the construction features of the timber dam. Prepare sequence of maps/site plans showing changes in creek/raceway and relationship to mill near Hale-Byrnes House.

Budget

The estimated budget is $5,000. CHAD will invoice the White Clay Creek Wild and Scenic River Program in two installments, each to occur after 50% and 100% completion of work.

Schedule

Fieldwork	April - June, 2011
Documentation	July, 2011
Final Report	Sept 30, 2011

We assembled the following chronology that traces the history of Dam 1 since its likely construction in 1750.

Chronology

1750 – Samuel Hale, a potter from Philadelphia, builds Hale-Byrnes House along tidal White Clay Creek.

Jan 16, 1773 - Daniel Byrnes acquires deed for Hale-Byrnes House property that includes mill seat and mill race associated with Dam No. 1 along White Clay Creek (Attachment 1). During this time, Daniel Byrnes operated a grist mill with water power also capable of spinning twine or flax thread and was developing a plan for drawing wire.

September 6, 1777 – Three days after the Battle of Cooch's Bridge along the Christina River south of Newark, General George Washington holds a council of war at the Hale-Byrnes House with the Marquis De Lafayette, General Anthony Wayne, and General Nathaniel Greene. To defend Wilmington from the advancing British Army, George Washington ordered the placement of cannon in front of the Hale-Byrnes House "for a half a mile as thick as they could stand". General Washington orders Daniel Byrnes to remove wheat and flour from the Hale-Byrnes House mill stores so the British could not seize these provisions.

1790 – Daniel Byrnes sells the mill to Blair McClenahan, a Philadelphia merchant.

1844 – Mill burns down while owned by Andrew Gray, a lawyer and Democratic Party leader.

1868 – Beer's Atlas depicts mill race flowing east from White Clay Creek under the P.W. & B. railroad to Independence Mill (Attachment 2).

1905 – U. Lawrence and W. Truxton Boyce purchase Hale-Byrnes House.

1906 – USGS topographic map shows mill race flowing east from dam along White Clay Creek, under Baltimore and Washington Railroad to the Hale Byrnes House at Stanton (Attachment 3).

1930s – State of Delaware erects historic marker at Hale-Byrnes House.

1937 – Aerial photograph depicting Dam No. 1 and mill race that flows east through open land and then meandering through forest along the southerly bank of White Clay Creek then under the railroad in a straight line to the Hale Byrnes House (Attachment 4).

1954 - Aerial photograph depicting Dam No. 1 and mill race that flows east through increasingly wooded land and then meandering through forest along the southerly bank of White Clay Creek, then under the railroad in a straight line to the Hale Byrnes House (Attachment 5). Notice new horse training track constructed between 1937 and 1954.

1961 – State Highway Department files plans to improve Route 7 and demolish Hale-Byrnes House.

1962 – Delaware Society for the Preservation of Antiquities purchases and preserves Hale-Byrnes House, saving it from demolition.

1968 - Aerial photograph depicting Dam No. 1 and mill race barely discernable through heavily wooded land along the southerly bank of White Clay Creek, then under the railroad in a straight line to the Hale Byrnes House (Attachment 6).

1972 – Application filed for placing Hale-Byrnes House on National Register of Historic Places (Attachment 7). The NRHP designation refers to the Hale-Brynes House itself and mentions that Daniel Byrnes built a mill nearby about 1772.

1992 - Aerial photograph depicting Dam No. 1 and mill race barely discernable through heavily wooded land along the southerly bank of White Clay Creek. (Attachment 8).

2002 - Aerial photograph depicting Dam No. 1 and path of mill race apparent through heavily wooded land between the dam along the southerly bank of White Clay Creek. (Attachment 9).

2002 - Aerial photograph depicting Dam No. 1 and path of mill race through the new golf course fairway entering the White Clay Creek just southeast of the horse training track. (Attachment 10).

2007 – LIDAR imagery (2 ft contour interval) delineates path of mill race in 2 segments (Attachment 11). Segment 1 flows from Dam No. 1 east through forest and fairway before joining the White Clay Creek just southwest of the horse training track. Segment 2 depicts the remnants of the mill race that flows east from the creek near the southeast corner of the horse track and then under the AMTRAK railroad and new Route 7 entering the creek just north of the Hale-Byrnes House.

1773 Indenture

This Indenture made the sixteen day of the first month in the year of our Lord, one thousand seven hundred and seventy three …

Between David Finney of the Town and County of New Castle on Delaware Esqr and Ann his wife of the one part and David Byrnes of the Borough of Wilmington and County afsd [aforesaid] Miller of the other part. Whereas the said David Finney is law fully seized in fee of and in a certain Tract of Land and Plantation situate on the Southerly side of White Claycreek in White Clay Creek Hundred and County afsd [aforesaid] and bounded to the Northward and Eastward by the said Creek to the Southward by Land of Thomas Adams and others & containing [erased number] Acres more or less

Now this indenture witnesseth that the said David Finney and Ann his wife for and in consideration of the sum of three hundred pounds current lawfull money of this Government to them in hand paid at or before the Sealing and Delivery hereof by the said Daniel Byrnes the receipt whereof they do hereby Acknowledge and confes themselves therewith fully satisfied contented and paid and thereof and of and from every part and parcel thereof do release acquit exonerate and forever discharge the said Daniel Byrnes his Heirs & assigns by these presents have granted. Bargained, and sold alined … released and confirmed and by these presents do Grant Bargain and sell alin release and confirm unto the said Daniel Byrnes his Heirs and Assigns. The following described lot or price of Land situate and being as afsd [aforesaid] and part of the above mentioned Tract of Land (for a Mill seat & Race) and bounded in Manner following that is to say BEGINNING at a Corner Stone set by the side of the said Creek from thence South seventy-four Degrees and a half West six perches to a Stone with a hole in it and set in the Earth by the south Easterly side of the Provincial Road leading from Wilmington to Christiana Bridge (and at the distance of ten perches and four tenths of a perch from the South Westerly corner of their Brick Mefsuage or Tennement by the side of the said Road), from thence continuing the same Course sixty feet to the North Westerly side of said Road thence with the side of the said road.

Road North fifteen degrees and a half west eight perches and seven tenths of a perche to a post from thence North seventy five degrees West sixty Nine perches to a post then South forty eight Degrees West Nineteen perches and three tenths of a perch to a post South fifty seven Degrees and a half West twenty six perches to a post thence South forty five degrees West about twenty three perches to the s^{d} [aforesaid] Thomas Adams line thence with the same line North Westlery about three perches to the side of the said Creek thence down the Creek about twenty four perches to a post at three perches distance from the other line. North fifty seven degrees and a half lasat twenty four perches North forty eight Degrees Past twenty perches to a post fro thence South seventy five degrees East and pafing (??) at the distance of two perches and five tenths of a perch from the other line sixty nine perches to a post by the side of the said Road thence with the said Road North fifteen degrees and a half west ten, perches to a post by the said Road thence North seventy four Degrees and a half Past sixty feet to the North East side of the s^{d} [aforesaid] road and from thence continuing the same Course Twenty perches to the said Creek and from thence down the same and binding theron about twenty two erches to the place of Beginning. Containing within those bounds for Acres and twenty perches of land be the same more or less

Together with all and singular the Rights, Liberties, Priviledges, ways, waters, water Courses, Easments, profits, Hereditaments,and Appurtinances whatsoever to the s^{d} [aforesaid] Lot or peice [sic] of Land belonging or in anyway appertaining and the Reversion **or** reversions. Remainder and Remainders, Rents and Issues and all the Estate Right, Tille, Interest, property, Claim, and Demand of the said David Finney and from his Wife and his Heirs of in and to the same and of in and to every part and parcel thereof TO HAVE AND TO HOLD ALL and singular that the above described ot or piece of land for a Mill seat and Race and the waters of the said White ClayCreek to the s^{d} [aforesaid]Daniel Byrnes his Heirs and Assigns to the only proper use and behoof (??) of the said Daniel Byrnes his Heirs and Assigns forever. Under the Yearly Quil Rents hereafter accruing for the same to the Chief Lord or Lords of the set and the s^{d} [aforesaid]David Finney for himself his Heirs, Executors and Administrators Noth (??) Covenant to and with the said Daniel Byrnes his Heirs and Assigns by these presents that he the said David Finney his heirs, Executors and Administrators and all and every other person or persons whomsoever having or Claiming or shall or may at any Time hereafter lawfully Claim the above described Lot or piece of Land herebyGranted or mentioned or intended so be or any part or parcel thereof or any Estate Right or Tille therein shall and whill upon the reasonable Request and at the propaCosts (??) and Changes in the Law of the said Daniel Byrnes and his Heirs or Assigns make do execute and Acknowledge or cause so to be made done, Executed and Acknowledged all and every such other further and reasonable Act and Acts thing and things, deeds, devises and Assuraces in the Case whatsoever needfill and necessary for the further and better asfsu rance of the said bargained Lot water and Premises to the said Daniel Byrnes his heirs and assigns as by turn or them or by his or their Counsel learned in the Law shall be thereunto reasonably advised devised or required And we do hereby require the President of the Court for the time being to acknowledge and Deliver these presents as our Act and deed in Open (??) according to law, IN WITNESS wereof (as well the Above) we have hereunto put our hands and Seals and dated the day and year first above written …

SEALED AND DELIVERED in the presence of — DAVID FINNEY (sealed)
John Montison — ANN FINNEY (sealed)

(followed by a list of witnesses)

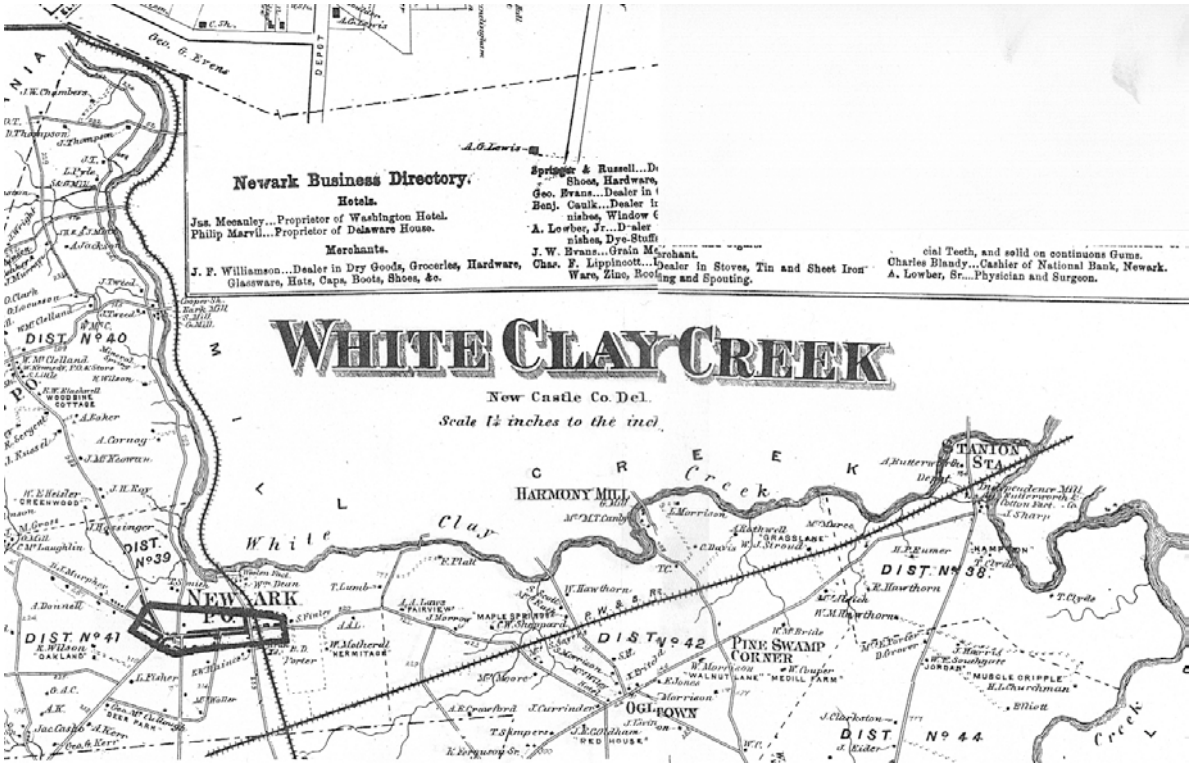


Figure 21. 1868 Beers Atlas

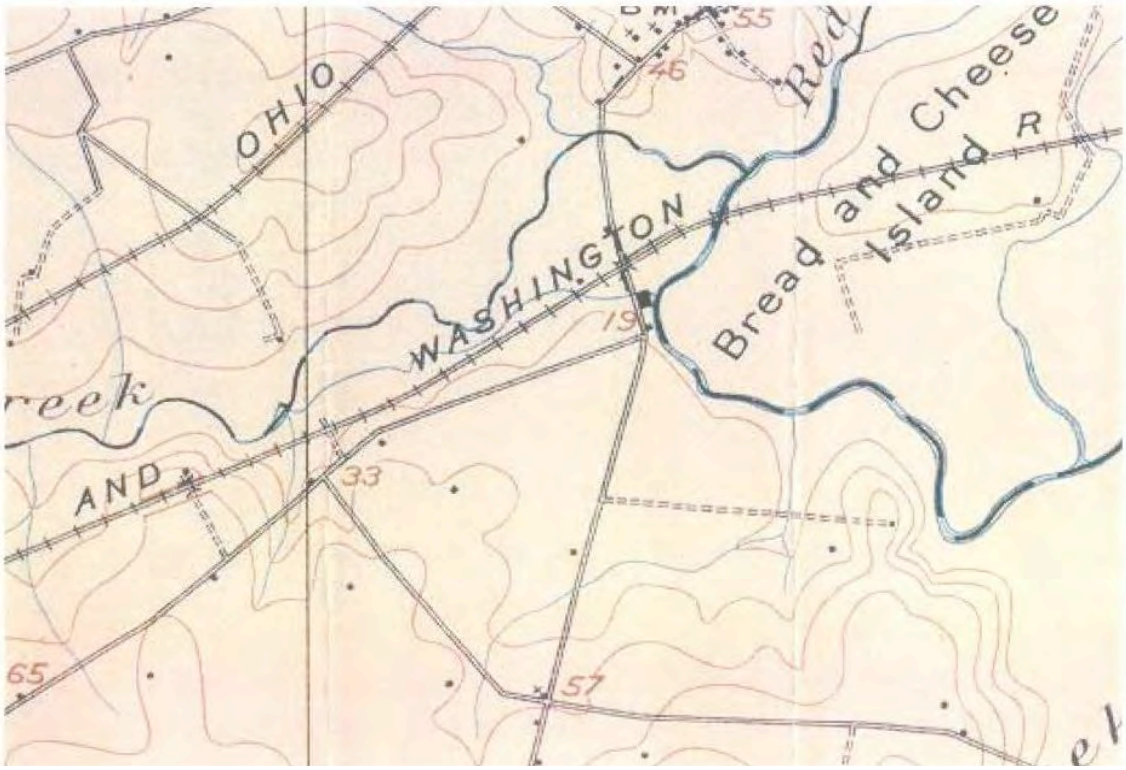


Figure 22. USGS Topo Map 1906

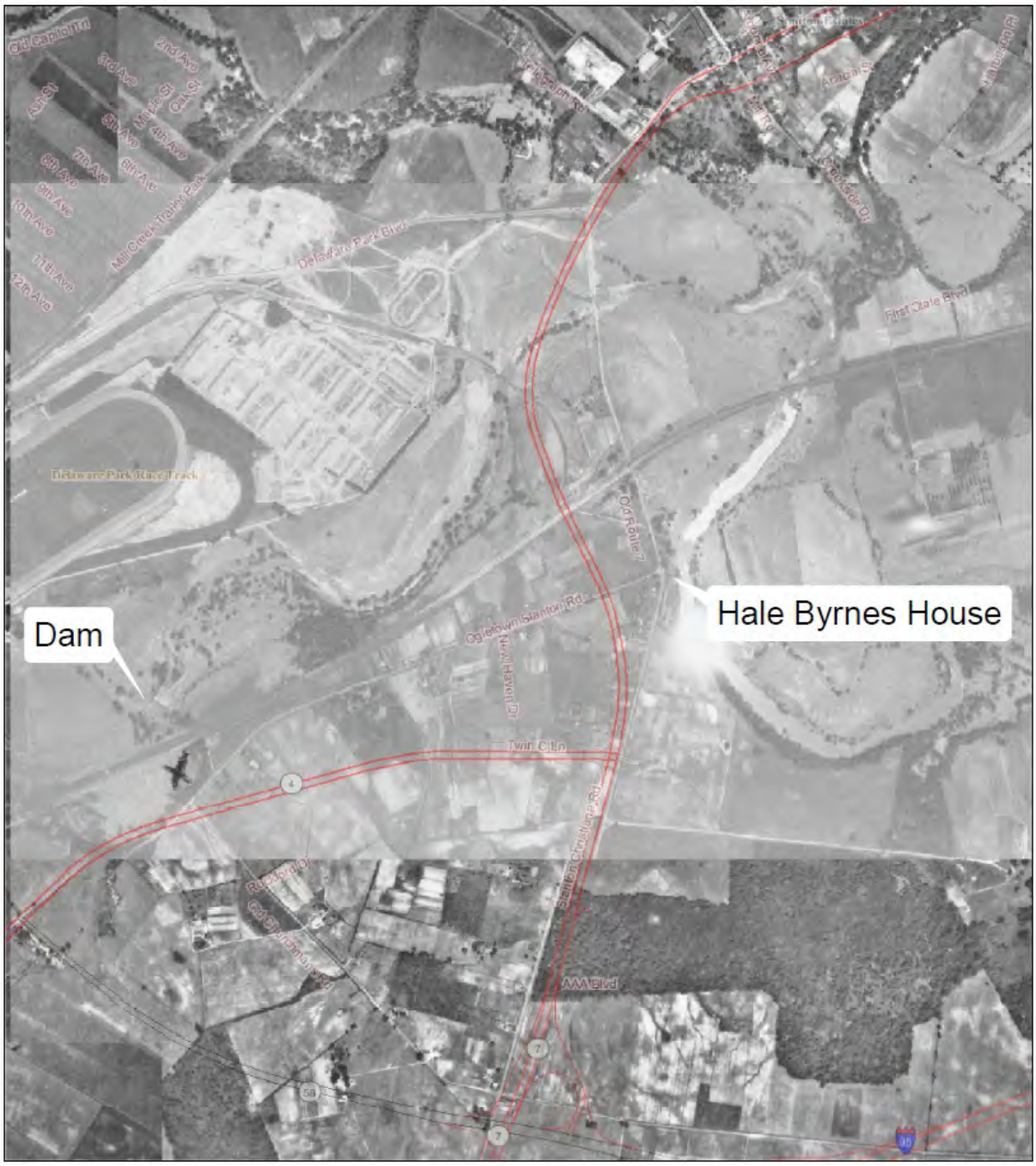

Dam
Hale Byrnes House
Delaware Park Dam to Hale Byrnes House
1937
0.5
0.25
0
0.5
Miles

Figure 23.

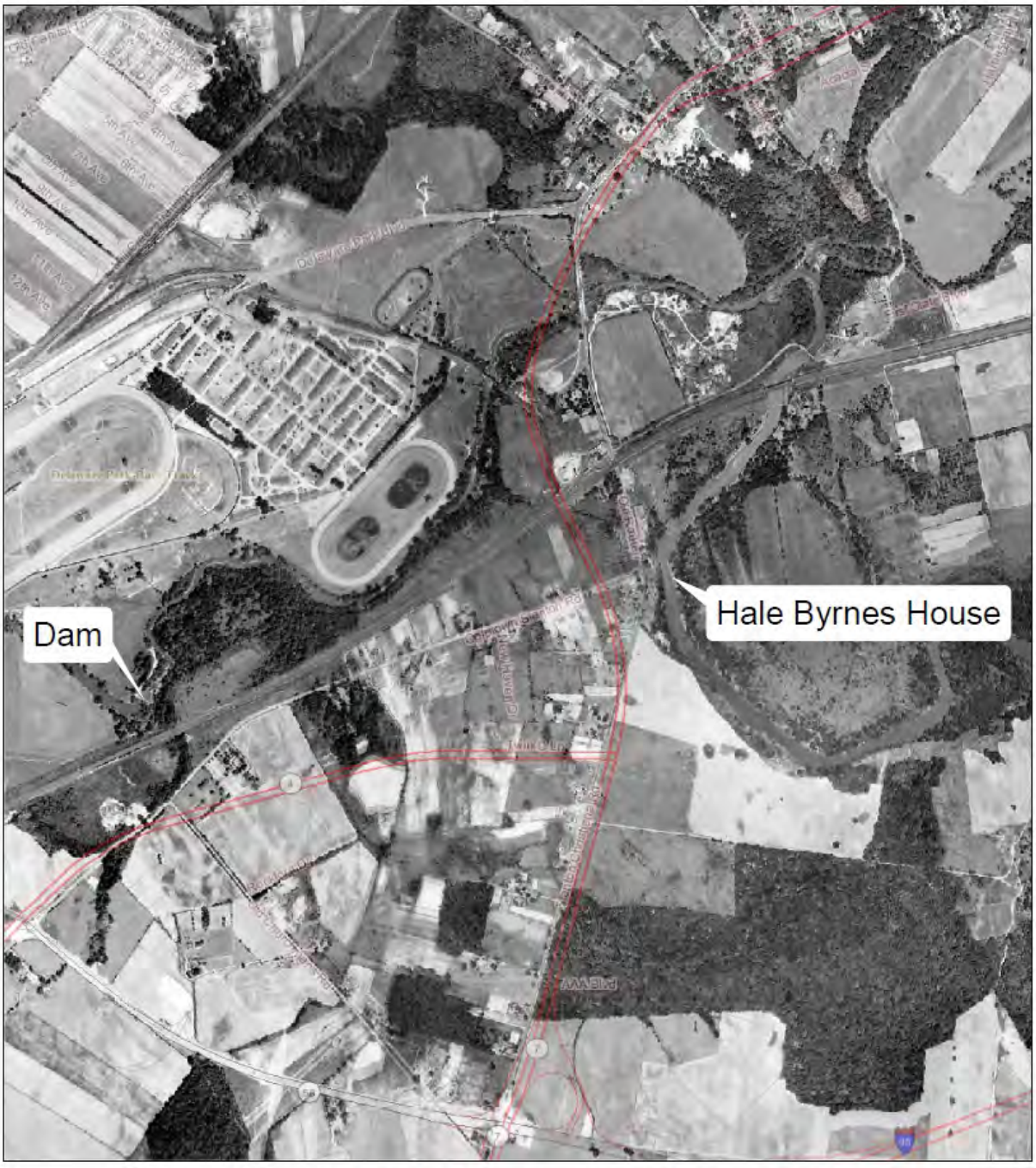
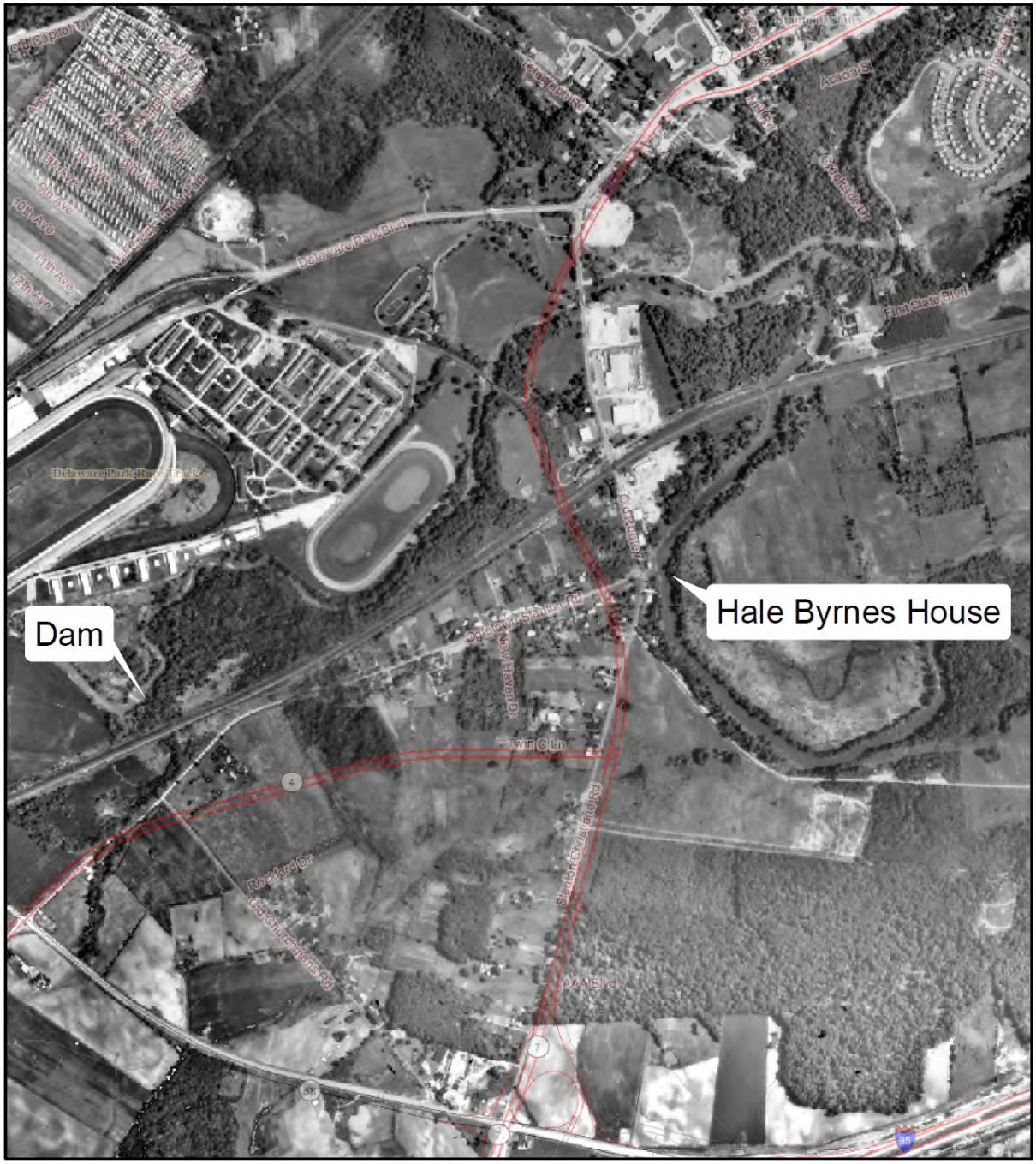

Dam
Hale Byrnes House
Delaware Park Dam to Hale Byrnes House
1954
0.5
0.25
0
0.5
Miles

Figure 24.



Delaware Park Dam to Hale Byrnes House

1968

Figure 25.

PH00215 63

Form 10-300
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

STATE: Delaware
COUNTY: New Castle
FOR NPS USE ONLY: JUN 2 1972
ENTRY NUMBER: 9-1-70-347 DATE: 9-1-70

RECEIVED JUN 9 1972 NATIONAL REGISTER

SEE INSTRUCTIONS

1. NAME

COMMON: Boyce
AND/OR HISTORIC: Hale-Byrnes House

2. LOCATION

STREET AND NUMBER: Corner of Route 7 and Route 4
CITY OR TOWN: Stanton
STATE: Delaware — CODE: 10 — COUNTY: New Castle — CODE: 003

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☒ Building ☐ Site ☐ Structure ☐ Object	☒ Public ☐ Private ☐ Both	Public Acquisition: ☐ In Process ☐ Being Considered	☒ Occupied ☐ Unoccupied ☐ Preservation work in progress	Yes: ☒ Restricted ☐ Unrestricted ☐ No

PRESENT USE (Check One or More as Appropriate)

☐ Agricultural	☐ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other (Specify)	
☒ Educational	☐ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY

OWNER'S NAME: State of Delaware, Division of Historical & Cultural Affairs, Department of State
STREET AND NUMBER: Hall of Records
CITY OR TOWN: Dover — STATE: Delaware — CODE: 10

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.: New Castle County Courthouse
STREET AND NUMBER: Rodney Square
CITY OR TOWN: Wilmington — STATE: Delaware — CODE: 10

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY: Historic American Building Survey
DATE OF SURVEY: 1936 ☒ Federal ☐ State ☐ County ☐ Local
DEPOSITORY FOR SURVEY RECORDS: Library of Congress
STREET AND NUMBER:
CITY OR TOWN: Washington, D.C. — STATE: — CODE:

FOR NPS USE ONLY — COUNTY — ENTRY NUMBER — DATE

7. DESCRIPTION

(Check One)						
☒ Excellent	☐ Good	☐ Fair	☐ Deteriorated	☐ Ruins	☐ Unexposed	

(Check One)		(Check One)	
☒ Altered	☐ Unaltered	☐ Moved	☒ Original Site

DESCRIBE THE PRESENT AND ORIGINAL (if known) PHYSICAL APPEARANCE

The Hale-Byrnes house sits on the west bank of White Clay Creek where route 7 from Stanton to Christiana meets route 4 to Ogletown. It is a five bay brick house built upon stone. There are two stories with attic on the road side. The sharp slope of the bank allows the basement to be fully exposed on the creek side.

The house was built in two sections. The south section has been dated 1750, and the north section is somewhat later. The larger south end was designed in the William Penn style. That is, two small rooms off one large main entrance room which takes in the entire width of the house. During restoration, only one of these small rooms, the "Miller's Office" on the creek side, has been retained. These two south end rooms had a triangular chimney in common. The fireplaces with curved reveals and the floors are original. All other architectural features, such as chair rails, doors, panelled walls, iron fixtures, belong to the restoration. The stair is old, and installed in the location of the original stairway.

The second floor above this part has three rooms with small fireplaces in each. There is a main door on this floor opening out over the creek onto probably what was once a landing. This may have been used to facilitate moving of furniture to the second story as the stairway, narrow and circular, restricted movement. The attic does not ran across the entire building, but is divided where the two original sections were joined. Original pegs and numbers in the rafters can be seen.

The north, later section of the house is divided into two rooms. The west, road side has a handsome large brick fireplace 5'4" high that takes up almost all of one side of the wall. There is evidence of a former bee hive oven in the back of the fireplace. Two pintels, both on the right side of the fireplace, are original. The other iron work has been added recently to fit the style and period of the building. The room next to this and the second floor above have been adapted for the needs of the present caretaker's quarters. Again each of the two rooms above has the original small fireplace. The flooring and stairs have the original boards of Delaware red pine.

Within, the house has been tastefully restored. Outside, the Georgian brick work remains. There is a belt course and a water table and the roof, now new, replaces the original as it was. Modern landscaping and parking area adapt the setting to meet the present purpose of the house, that is for civic, patriotic societies, and public visitation. This is enhanced by the natural beauty of the creek, several handsome, old sycamore trees, and an old spring house to be restored. The professional architect who assisted in the restoration was Mr. Albert Kruse.

SEE INSTRUCTIONS

SEE INSTRUCTIONS

8. SIGNIFICANCE

PERIOD (Check One or More as Appropriate)

☐ Pre-Columbian	☐ 16th Century	☒ 18th Century	☐ 20th Century
☐ 15th Century	☒ 17th Century	☐ 19th Century	

SPECIFIC DATE(S) (If Applicable and Known) c.1750

AREAS OF SIGNIFICANCE (Check One or More as Appropriate)

Aboriginal	☐ Education	☐ Political	☐ Urban Planning
☐ Prehistoric	☐ Engineering	☒ Religion/Philosophy	☐ Other (Specify)
☐ Historic	☒ Industry	☐ Science	
☐ Agriculture	☐ Invention	☐ Sculpture	
☒ Architecture	☐ Landscape Architecture	☐ Social/Humanitarian	
☐ Art	☐ Literature	☐ Theater	
☒ Commerce	☒ Military	☐ Transportation	
☐ Communications	☐ Music		
☐ Conservation			

STATEMENT OF SIGNIFICANCE

The Hale-Byrnes House had a significant role in local industrial history and was a specific scene for an important encounter of the American Revolutionary War. Still in its original site, it remains a handsome example of 18th century architecture with its exterior Georgian brick work and interior original fireplaces.

First mention of the Hale-Byrnes House on White Clay Creek appears in 1752. The south end built in the William Penn plan was probably constructed by Samuel Hale after he purchased the property in 1750. Samuel Hale, from Philadelphia, was a potter and used the long cellar opening onto the creek as storage space for his pottery. It was conveniently near the creek's landing described by a contemporary source (1752) as the "most frequented landing on said creek." White Clay Creek empties one mile south into the Christiana River, then a major artery of northern Delaware.

The property changed hands and was bought by Daniel Byrnes who built a mill nearby about 1772. As he moved his family to live there at this time it is surmised that the north wing was added then to extend the living area and allow a separate kitchen area. Byrnes, a native of Kent County, was a devout Quaker and a spiritual leader in the Society of Friends when he moved to Philadelphia in 1784. While still in Delaware it is said that he held Quaker meetings in his home at White Clay Creek. Byrnes also invented a wooden instrument (later produced in brass) for the purpose of taking lunar observations to measure the angular distance between the sun and moon including the attitudes of both at the same time.

On September 3, 1777, a few days previous to the Battle of the Brandywine, the first battle between the invading British and Hessians and the defending light infantry of the Continentals had taken place at Cooches Bridge, less than five miles away from the Byrnes residence. This house is at the intersection of the Ogletown Road from Newark and the King's Highway from Christiana, and since the British under Lord William Howe were only a few miles down both roads, everyone knew a battle might occur at any time. General George Washington had ordered the Continental cannon to be placed directly in front of the house so that the artillerymen could cover both roads if the British came up either of them. The cannon

9. MAJOR BIBLIOGRAPHICAL REFERENCES

Coghlan, Jill M., "Chain of Title Old Boyce House." Unpublished manuscript, N.D.

Delaware Advertiser, July 30, 1829.

Delaware Gazette, September 21, 1821.

Delaware Journal, September 12, 1828.

Delaware Military Archives, III, 1863.

Scharf, J. Thomas, History of Delaware, 1609-1888, 2 vols., Richards & Co., Philadelphia, 1888.

The Pennsylvania Magazine of History and Biography, LIV, 106; VI, 343 XLVII, 275.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY						OR	LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES					
CORNER	LATITUDE			LONGITUDE				LATITUDE			LONGITUDE	
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
NW								75°	40'	00"	39°	42'	30"
NE													
SE													
SW													

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 1.004

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE:
Mr. Rea Wilkie, Historic Registrar

ORGANIZATION: Div. of Historical & Cultural Affairs — DATE: 1/14/72

STREET AND NUMBER: Hall of Records

CITY OR TOWN: Dover — STATE: Delaware — CODE: 10

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☐ State ☑ Local ☐

Name: E. Berkeley Tompkins
Dr. E. Berkeley Tompkins

Title: State Liaison Officer

Date: 1-26-72

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register.

Robert Ross Tatum
Chief, Office of Archeology and Historic Preservation

Date: 4/2/72

ATTEST:

Keeper of the National Register

Date:

SEE INSTRUCTIONS

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE	
Delaware	
COUNTY	
New Castle	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE
	JUN 8 1972

(Number all entries)

8. SIGNIFICANCE (cont'd.) -- Page 2

were placed on this rise of ground as thick as they could stand. General Washington, Marquis de la Fayette, General Anthony Wayne, General Nathaniel Greene and other high ranking officers including Captain Robert Kirkwood of near Newark, had arranged earlier in the day for Daniel Byrnes to make his house available for a council of war. It was decided to move picket lines a few miles closer to the British who were at this time still south of Christiana.

In 1790 Byrnes sold the house and it passed through several owners including Andrew C. Gray, the distinguished lawyer and democratic leader. The property eventually was acquired by the Delaware Society for the Preservation of Antiquities who were responsible for the restoration. On August 31, 1971, the property was generously given to the Division of Historical and Cultural Affairs of the State of Delaware.

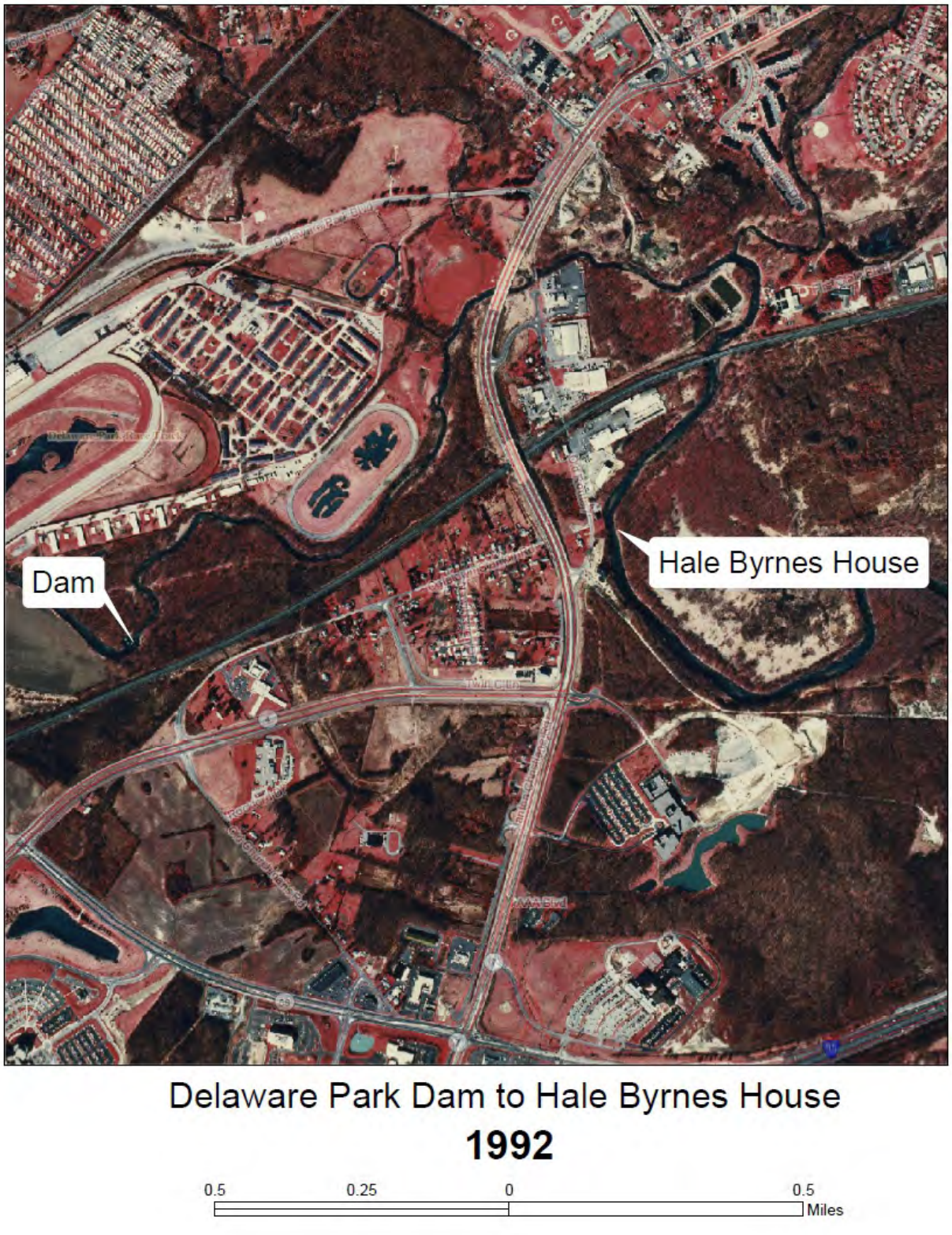
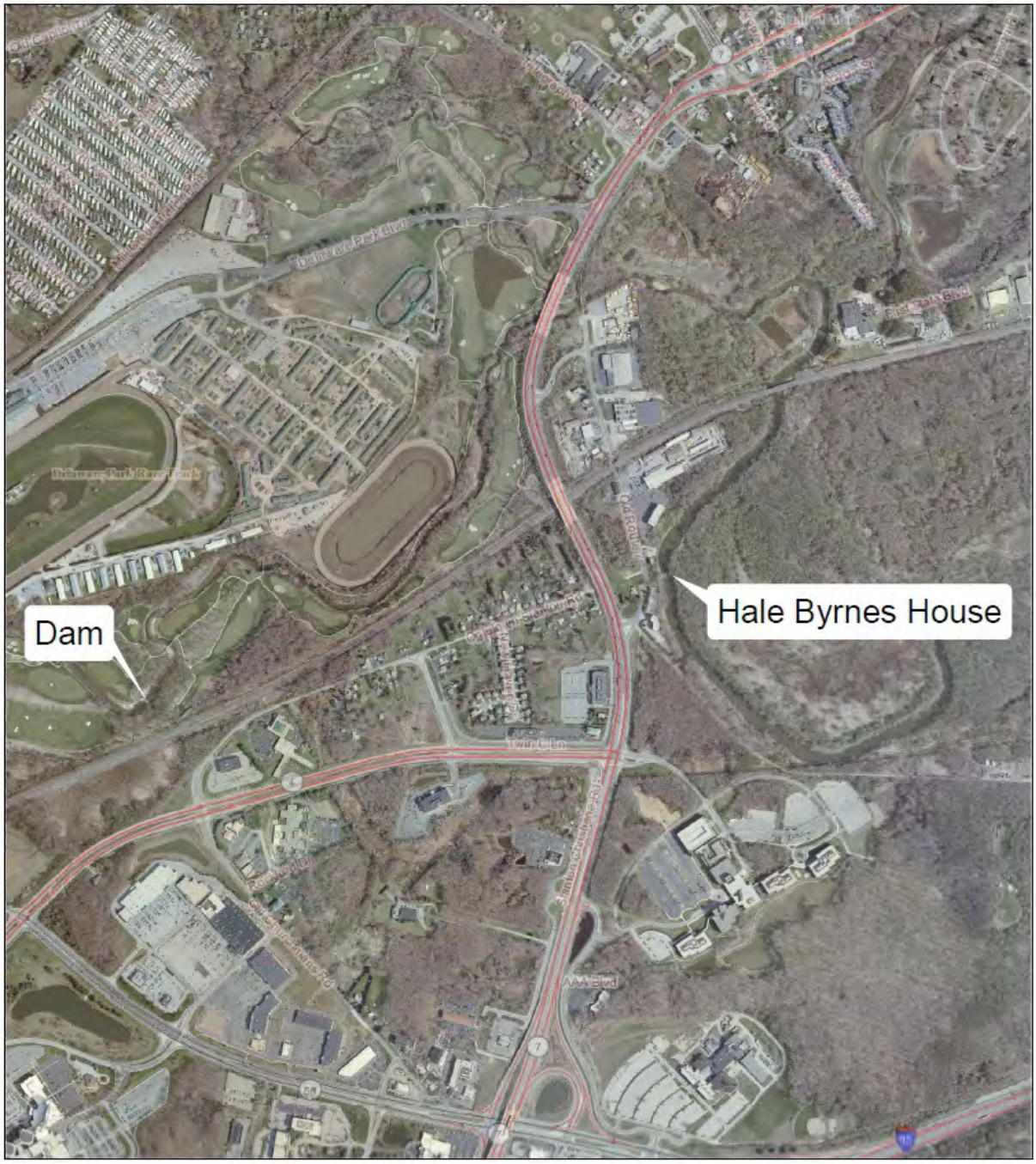

Dam
Hale Byrnes House
Delaware Park Dam to Hale Byrnes House
1992
0.5
0.25
0
0.5
Miles

Figure 26.



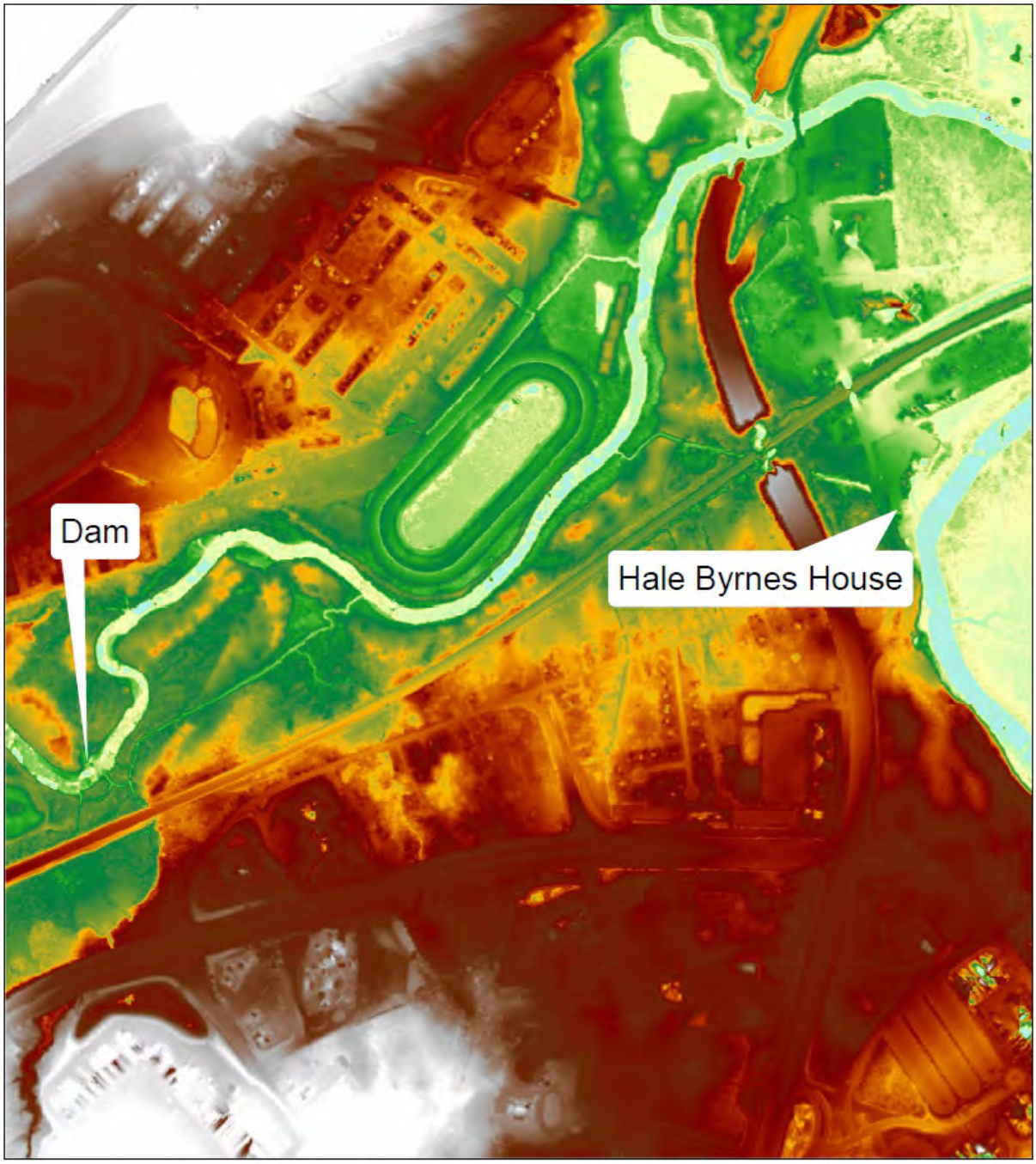
Delaware Park Dam to Hale Byrnes House

2007

0.5 0.25 0 0.5

Miles

Figure 27.



Delaware Park Dam to Hale Byrnes House

2007 LIDAR

0.3 0.15 0 0.3

Miles

Figure 28.

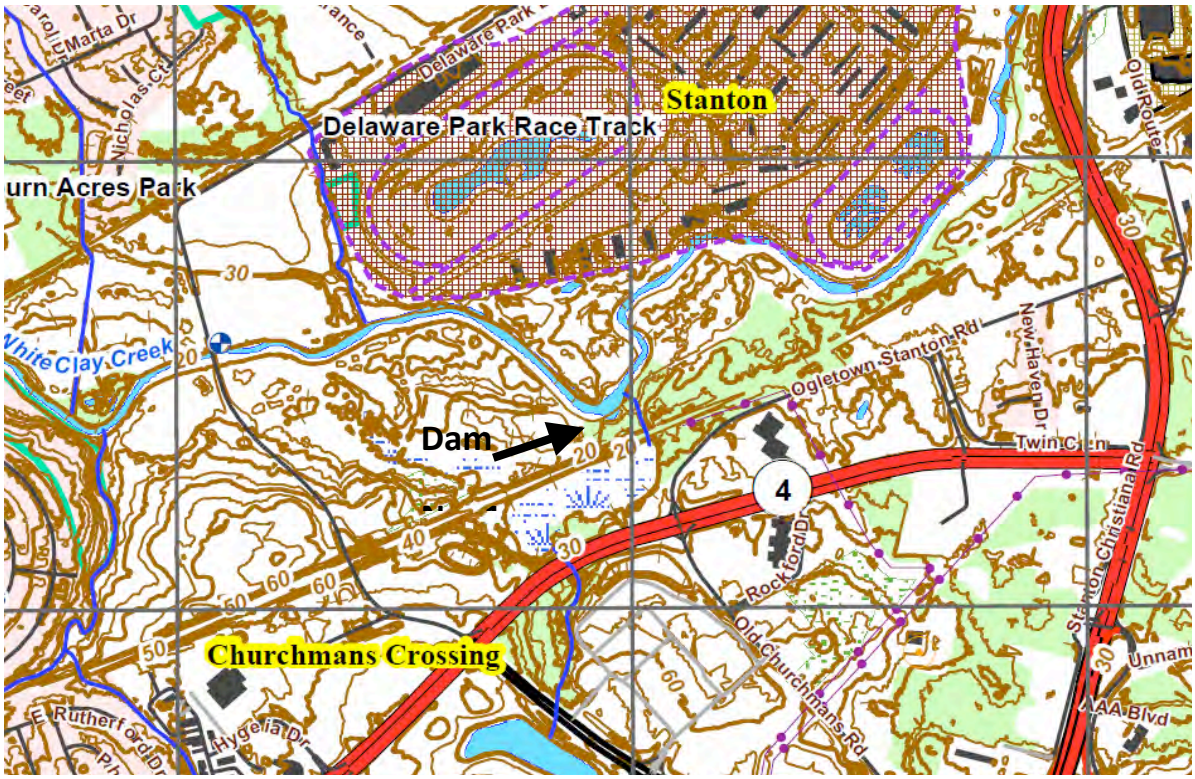


Figure 29. Location of Dam No. 1 along the White Clay Creek (USGS Quad Newark East)

Map Unit Legend

New Castle County, Delaware (DE003)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DaB	Delanco silt loam, 3 to 8 percent slopes	46.6	25.8%
EnB	Elsinboro silt loam, 3 to 8 percent slopes	3.6	2.0%
ErB	Elsinboro-Delanco-Urban land complex, 0 to 8 percent slopes	66.2	36.7%
Hw	Hatboro-Codorus complex, 0 to 3 percent slopes, frequently flooded	53.6	29.7%
W	Water	10.5	5.8%
Totals for Area of Interest		**180.5**	**100.0%**

Figure 30. Location of Dam No. 1 along the White Clay Creek (New Castle County Soil Survey 2010)

Figure 31. Dam No. 1 Removal design plan and construction details at Delaware Park

Photographs

Photo 1. Looking south at Dam No. 1 (April 2011).

Photo 2. Looking upstream at Dam No. 1 (April 2011).

Photo 3. Plan view of White Clay Creek Dam No. 1. Note breach along overbank to left.

Photo 4. Dam No. 1 along the White Clay Creek (RM 4.2) at Delaware Park looking upstream

Photo 5. Dam No. 1 along White Clay Creek (RM 4.2) at Delaware Park, note timber frame

Photo 6. Dam No. 1 along White Clay Creek looking upstream at partial breach

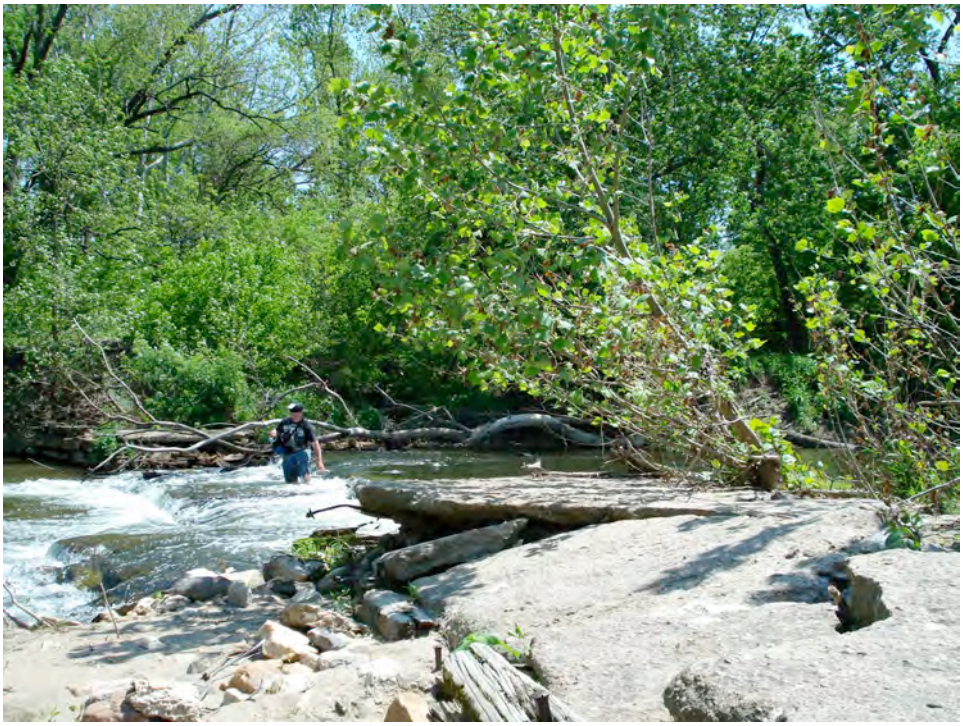


Photo 7. Dam No. 1 along White Clay Creek at Delaware Park looking toward left bank.

Photo 8. Dam No. 1 along White Clay Creek at Delaware Park upstream at partial breach

Photo 9. Dam No. 1 looking upstream (April 2011).

Photo 10. Dam No. 1 looking upstream (April 2011).

Photo 11. Dam No. 1 looking upstream (April 2011).

Photo 12. Dam No. 1 on Sep 1, 2011 just 4 days after Hurricane Irene (Aug 28, 2011).

Photo 13. Bald Eagle in White Clay Creek just downstream from Dam No. 1.

Photo 14. Osprey with prey in White Clay Creek just downstream from Dam No. 1.

Photo 15. DNREC fisheries conducting fish survey along White Clay Creek May 2010.

Photo 16. Delaware DNREC fisheries biologist with hickory shad sampled during fish abundance survey just downstream from Dam No. 1 along the White Clay Creek, May 2010

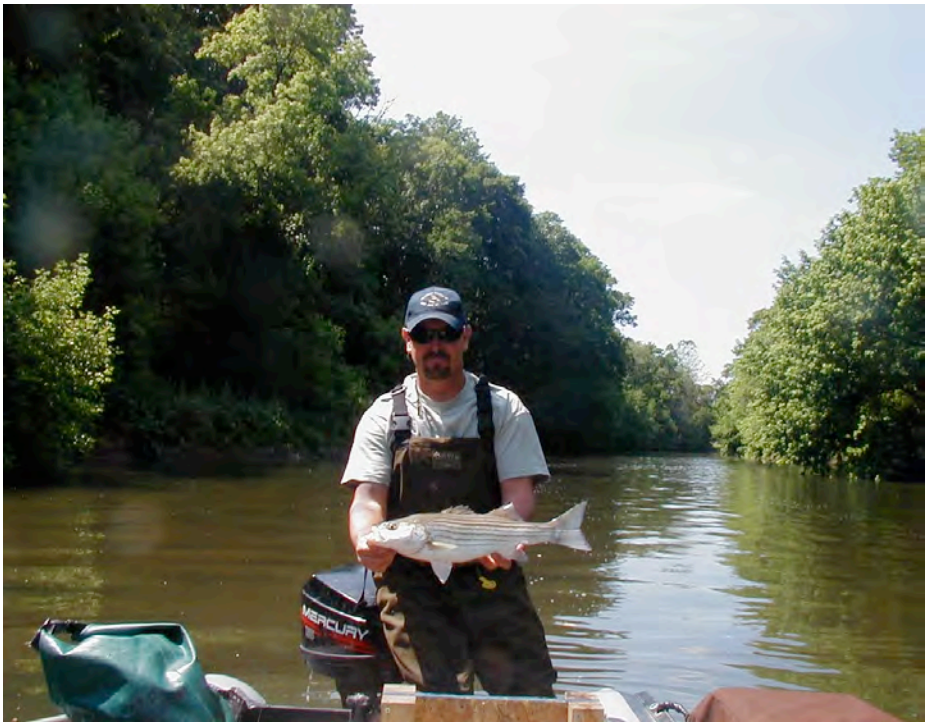


Photo 17. Delaware DNREC fisheries biologist with striped bass sampled during fish abundance survey just downstream from Dam No. 1 along the White Clay Creek, May 2010

Photo 18. Delaware DNREC fisheries biologist conducting fish abundance survey just downstream from Dam No. 1 along the White Clay Creek, May 2010

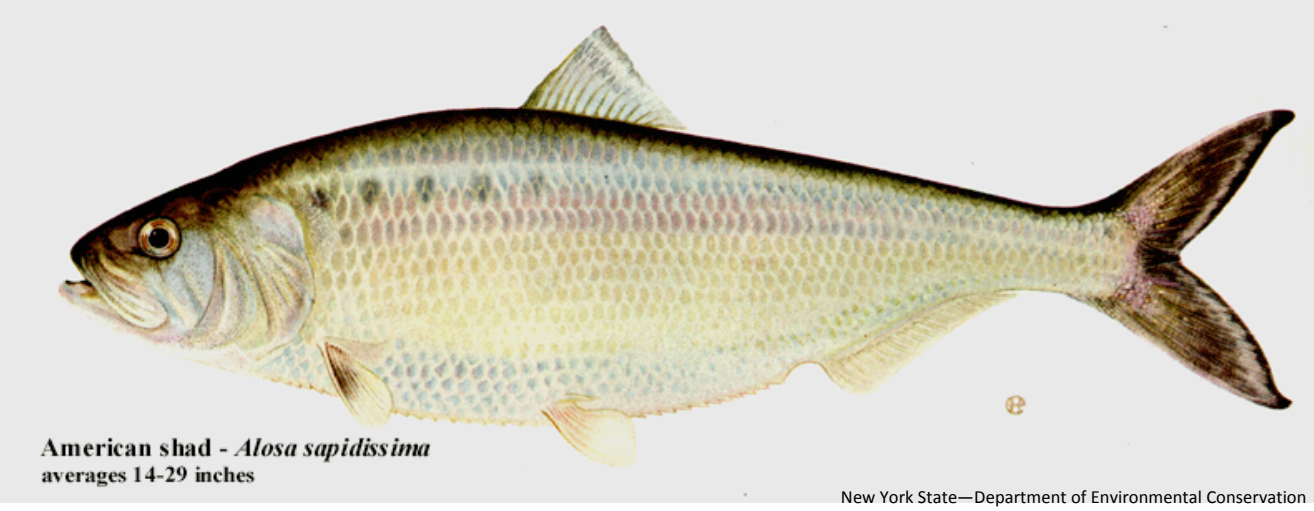


Photo 19. American Shad (Alosa sapidissima)

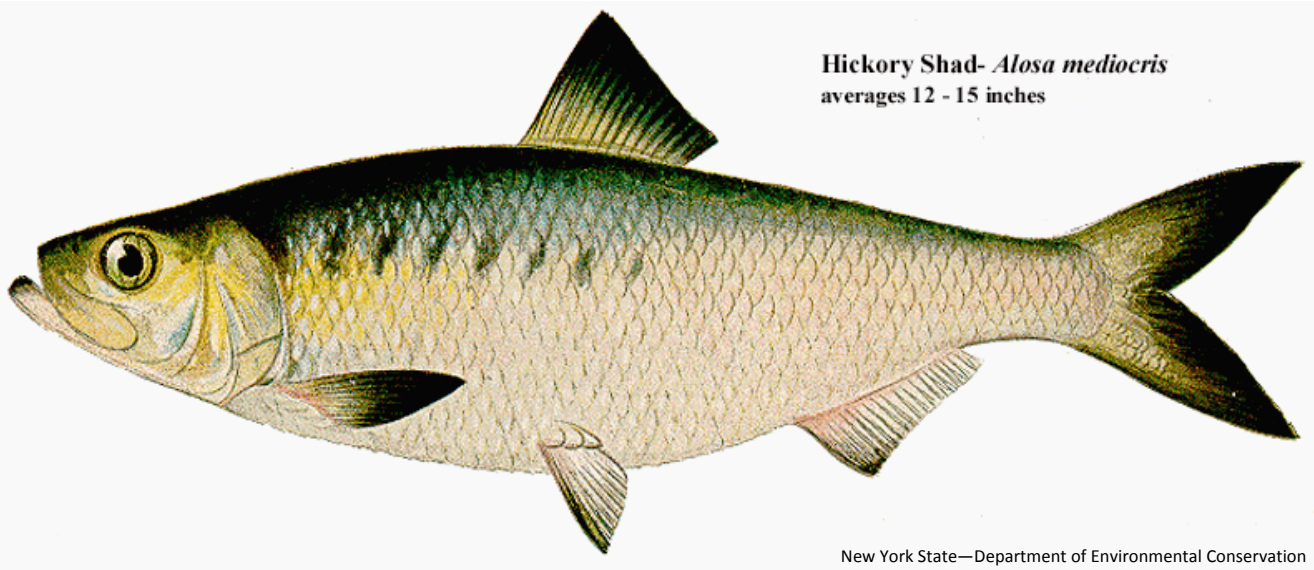


Photo 20. Hickory Shad (Alosa mediocris)

Correspondence

Bethany M. Bearmore, P.E.
Coastal Restoration Engineer
NOAA Restoration Center
James J. Howard Marine Fisheries Laboratory
74 Magruder Road
Highlands, New Jersey 07732

August 26, 2010

Re: FAF 10025 White Clay Creek Shad Restoration Project – Removal of Dam No. 1
Engineering Design and Permits Scope

Dear Ms. Bearmore:

I am writing this letter in support of the University of Delaware's Institute for Public Administration, Water Resources Agency (UDWRA) project proposed for funding under the FishAmerica Foundation. The proposed project will complete the engineering design and permit applications for removing Dam No. 1. The intended outcome of this project is to restore fish passage on the Wild and Scenic White Clay Creek.

The White Clay Creek watershed was federally designated a Wild and Scenic River in 2000 and lies in the 565 square mile Christina River Basin and spans 107 square miles in Pennsylvania and Delaware. The White Clay Creek watershed is an extremely significant watershed locally, nationally, and regionally. The White Clay Creek is the first National Wild and Scenic River designated as such on a watershed basis rather than as a single river corridor.

This preliminary step (engineering design and permit applications) is critical to achieve the ultimate goal, removing Dam No. 1. Situated at the head of tide, 4.2 miles above the creek mouth, Dam No. 1 is the first and most critical obstacle to fish passage. Removal of Dam No. 1 will be the first dam removal project in the State of Delaware, will restore upstream and downstream habitat, and will open an additional 3.5 miles of stream to shad and anadromous fish migration. Funding for the design and permit applications for Dam No. 1 should launch the systematic removal of all 7 fish passage barriers on the Wild and Scenic White Clay Creek along 14 miles between sea level and the stateline at Pennsylvania.

This project also has the potential to initiate the systematic shad restoration efforts at a new level of awareness in a broader community and to bring new partners and funding sources into both the Brandywine Creek watershed and the White Clay Creek watershed shad restoration efforts. As property owner, I support this effort on the White Clay Creek. Thank you for the opportunity to support this application.

If you have any questions concerning my support for this project, please contact me at (302) 994-2521 ext. 7307

Sincerely,

John Mizikar, CGCS
Director of Grounds
White Clay Creek Country Club @ Delaware Park

August 31, 2010

Erica George
Grants Manager
FishAmerica Foundation

Re: FAF 10025 White Clay Creek Shad Restoration Project – Removal of Dam No. 1
Engineering Design and Permits Scope and Budget Narrative

Dear Ms. George:

Enclosed is our engineering scope of work that includes a revised budget narrative and schedule for the design and permitting of the removal of Dam No. 1 to restore the passage of shad and anadromous fish to the White Clay Creek Wild and Scenic River. Under separate cover, we have forwarded a letter of permission from the property owner (Delaware Park) for the removal of Dam No. 1. Should you have any questions, please do not hesitate to contact me at 302-831-4929 or at jerryk@udel.edu.

Warmly,

Gerald J. Kauffman, P.E., Director
Water Resources Agency
Institute for Public Adminsitration
University of Delaware

September 29, 2010

Ms. Erica George
Grants Manager
FishAmerica Foundation
225 Reinekers Lane, Suite 420
Alexandria, Virginia 22314

Dear Ms. George:

Please accept this letter as the University of Delaware Water Resources Agency's confirmation of an available non-federal match for the White Clay Creek Shad Restoration Project – Removal of Dam No. 1 (FAF 10025).

If the University of Delaware Water Resources Agency receives a $42,000 grant award from the FishAmerica Foundation (FAF) through its partnership with the NOAA Restoration Center (NOAA) for the White Clay Creek Shad Restoration Project – Removal of Dam No. 1 (FAF 10025), the University of Delaware Water Resources Agency will provide $13,000 as a non-federal match for the FAF/NOAA grant award.

The $13,000 non-federal match will be provided by University of Delaware Water Resources Agency in the form of in-kind services. The provided non-federal match from the University of Delaware Water Resources Agency will be used for Tasks: (1) Project Management = $2,000 (50 hr), (2) Pre-project Stream Monitoring = $3,000 (75 hr), (3) Field Survey/Topographic Mapping = $2,000 (50 hr), (4) Stream Geomorphology/Habitat Survey = $1,000 (25 hr), (6) Hydrologic/Hydraulic Analysis = $2,000 (50 hr), (8) Obtain Permits = $2,000 (50 hr), and (9) Technical Design Report = $1,000 (25 hr). The non-federal match will not be used to match any other federal money received for this project.

The $13,000 in in-kind match from University of Delaware Water Resources Agency was secured on October 1, 2010 and will be utilized by University of Delaware Water Resources Agency for project-related activities no later than March 1, 2011. I will submit the needed documentation for this in-kind donation with the post-award match letter in the event project funding is secured.

If you have any questions, please contact me at 302-831-4929 or jerryk@udel.edu.

Sincerely,

Gerald J. Kauffman, P.E., Director
Water Resources Agency
Institute for Public Administration
University of Delaware

November 23, 2010

Ms. Edna Stetzar
Delaware DNREC
Natural Heritage Program
Division of Fish and Wildlife
4876 Hay Point Landing Road
Smyrna, Delaware 19977

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Ms. Stetzar:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

The White Clay Creek watershed, which drains 107 mi^2, is one of the four major watersheds in the 565 mi^2 Christina River Basin. The Christina River Basin is part of the larger 13,000 mi^2 Delaware River Basin and its streams constitute the second largest tributary to the Delaware Estuary. The long-term conservation objective of this project is to restore domestic and anadromous fish passage and spawning habitat in the White Clay Creek watershed by removing obsolete low, on-stream dams. In 2010 UDWRA developed a feasibility study, funded by the National Fish and Wildlife Foundation (NFWF), to restore shad migration to the White Clay Creek. In Delaware, currently there are 6 low head dams along 13 miles of the White Clay Creek between tidewater and up into the Piedmont to 70 feet above sea level near Newark, Delaware. The waters of the White Clay Creek support over 24 species of fish and the White Clay Creek is an extremely popular fishing destination in the tri-state region. Fish abundance surveys through electroshocking conducted in April and May 2010 by biologists from Delaware DNREC's Division of Fish and Wildlife indicate Dam No. 1 is indeed the upstream barrier to anadromous fish migration as up to 500 hickory shad were detected downstream from the dam and no anadromous fish were detected upstream from the barrier.

Dam No. 1, an old rock fill and timber dam, is breached along the right stream bank (looking upstream) and was heavily damaged by floods from Hurricane Floyd in September 1999 and Tropical Storm Henri in September 2003 and continues to be damaged by more recent storms

such as Tropical Storm Nicole earlier this fall. The low dam is now surrounded by White Clay Creek Golf Course at Delaware Park. Delaware Park, the owner of the dam, is a willing project proponent. A forest, also within Delaware Park, lines the left bank.

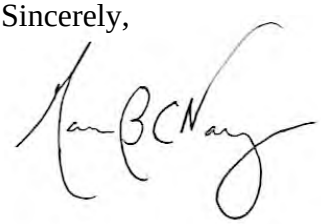
UDWRA will work on behalf of project partners at the Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park (dam owner), New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee to remove the first and most critical obstacle to fish passage, Dam No. 1, situated at the head of tide 4.2 miles above the creek mouth. Removal of this fish passage barrier will be the first dam removal project in the State of Delaware, will restore upstream and downstream habitat, and will open an additional 3.5 miles of stream to shad and anadromous fish migration.

We have commenced the design phase of this restoration project and plan to submit the joint permit application to you for review in December 2010. Our schedule calls for completion of design and permitting in February 2011 and removal of the dam by March 15, 2011. We have been advised by DNREC fisheries biologists that work in the stream should not occur during the March 15-June 15 spawning period.

It is our intent to present the project, removal of Dam No. 1 at Delaware Park, at the Joint Permit Processing Meeting on December 16, 2010. Enclosed you will find the Joint Permit Processing Meeting form, its associated materials, and additional supporting information. Prior to the meeting you will receive all necessary documents that are not currently available and not enclosed in this letter as noted on the meeting form.

If you have any questions please do not hesitate to contact me at mcorrozi@udel.edu or 302-831-4931.

Sincerely,



Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware

November 23, 2010

Mr. Craig Shirey
Delaware DNREC
Division of Fish and Wildlife
4876 Hay Point Landing Rd
Smyrna, DE 19977

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Shirey:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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Creek Golf Course at Delaware Park. Delaware Park, the owner of the dam, is a willing project proponent. A forest, also within Delaware Park, lines the left bank.

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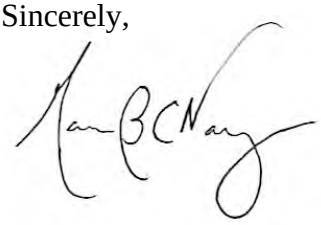

Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware

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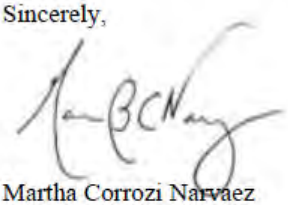

Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware

UNIVERSITY OF DELAWARE

COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY

INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Mr. Devin Ray
U.S. Fish and Wildlife Service
177 Admiral Cochrane Drive
Annapolis, Maryland 21401

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Ray:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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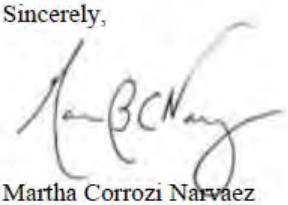

Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware

UNIVERSITY OF DELAWARE
COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY
INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Ms. Joan Larrivee
Delaware State Historic Preservation Office
21 The Green
Dover, Delaware 19901

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Ms. Larrivee:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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UNIVERSITY OF DELAWARE
COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY
INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Mr. William Jenkins
U.S. Army Corps of Engineers
Regulatory Branch
100 Penn Square East
Wanamaker Building
Philadelphia, PA 19107-3390

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Jenkins:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

The White Clay Creek watershed, which drains 107 mi^2, is one of the four major watersheds in the 565 mi^2 Christina River Basin. The Christina River Basin is part of the larger 13,000 mi^2 Delaware River Basin and its streams constitute the second largest tributary to the Delaware Estuary. The long-term conservation objective of this project is to restore domestic and anadromous fish passage and spawning habitat in the White Clay Creek watershed by removing obsolete low, on-stream dams. In 2010 UDWRA developed a feasibility study, funded by the National Fish and Wildlife Foundation (NFWF), to restore shad migration to the White Clay Creek. In Delaware, currently there are 6 low head dams along 13 miles of the White Clay Creek between tidewater and up into the Piedmont to 70 feet above sea level near Newark, Delaware. The waters of the White Clay Creek support over 24 species of fish and the White Clay Creek is an extremely popular fishing destination in the tri-state region. Fish abundance surveys through electroshocking conducted in April and May 2010 by biologists from Delaware DNREC's Division of Fish and Wildlife indicate Dam No. 1 is indeed the upstream barrier to anadromous fish migration as up to 500 hickory shad were detected downstream from the dam and no anadromous fish were detected upstream from the barrier.

Dam No. 1, an old rock fill and timber dam, is breached along the right stream bank (looking upstream) and was heavily damaged by floods from Hurricane Floyd in September 1999 and Tropical Storm Henri

UNIVERSITY OF DELAWARE

COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY

INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Ms. Laura Herr
DNREC, Division of Water Resources
Wetlands and Subaqueous Lands Section
89 Kings Highway
Dover, Delaware 19901

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Ms. Herr:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY
INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Mr. George Haggerty
New Castle County
Department of Land Use
NCC Government Center
87 Read's Way
New Castle, DE 19720

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Haggerty:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY
INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Ms. Karen Greene
National Marine Fisheries Service
Habitat Conservation Division
Howard Lab
74 Macgruder Rd
Highlands, NJ 07732

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Ms. Greene:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Mr. Matthew Fisher
Delaware DNREC
Division of Fish and Wildlife
4876 Hay Point Landing Rd
Smyrna, DE 19977

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Fisher:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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INSTITUTE FOR PUBLIC ADMINISTRATION

November 23, 2010

Ms. Sarah Cooksey
Delaware DNREC
Coastal Zone Management Program
Wetlands and Subaqueous Lands Section
89 Kings Highway
Dover, Delaware 19901

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Ms. Cooksey:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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November 23, 2010

Mr. Chuck Barscz
National Park Service
Customs House, Room 260
2nd and Chestnut Streets
Philadelphia, PA 19106

RE: Preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park

Dear Mr. Barscz:

This is to initiate the preapplication process to obtain Federal, state, and local permits and regulatory approval for the removal of Dam No. 1 at Delaware Park to restore passage of anadromous fish along the White Clay Creek National Wild and Scenic River in New Castle County, Delaware.

The University of Delaware's Water Resources Agency has begun working on the restoration project for the dam removal design of Dam No. 1 in the Federally designated White Clay Creek Wild and Scenic River watershed. This will be the first dam removal project for fish passage and habitat restoration in the State of Delaware. This project is funded by the FishAmerica Foundation and NOAA Restoration Center and project partners include Delaware DNREC's Division of Fish and Wildlife, Duffield Associates, Delaware Park, New Castle Conservation District, and the White Clay Creek Wild and Scenic Management Committee.

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State of Delaware
Historical and Cultural Affairs

21 The Green
Dover, DE 19901-3611

Phone: (302) 736-7400 Fax: (302) 739-5660

December 3, 2010 Review Code: 2010.11.23.01

Martha Corrozi Narvaez
Water Resource Agency
Institute for Public Administration
University of Delaware
DGS Annex, Academy St.
Newark, DE 19716

Project: Removal of Dam No. 1 at Delaware Park
New Castle County, DE

Dear Ms. Narvaez:
The above referenced project was reviewed for potential effects on historic properties as required under Section 106 of the National Historic Preservation Act of 1966, as amended. The Area of Potential Effect should be the area inside the limits of construction around the dam and millrace, the staging area, and the disposal area.

The dam and associated millrace may be contributing elements to the Hale-Byrnes House, a historic property that is owned by the Division of Historical and Cultural Affairs. While the Hale-Byrnes House is known for its association with the events of the Revolutionary War, it was part of a milling complex. A millrace connecting Dam No. 1 with the Hale Mill can be seen on the 1906 U.S.G.S. topographic map and an early aerial photograph. It is our recommendation that a Phase II evaluation study should be performed on the dam and millrace by a qualified investigator. Also, a Native American archaeological site (7NC-E-119) has been recorded in the wooded slope along the south bank of the dam. This area should be excluded from construction or staging activities.

As a part of the Section 106 process, the client must seek out consulting parties who are individuals and/or organizations that have a demonstrated interest in the undertaking due to their legal or economic relation to the undertaking or affected (800.2(c)(5)). This Office can provide assistance in identifying any other individuals or organizations that may wish to be invited to be consulting parties on the project (800.3(f)).

Sincerely

Craig Lukezic
Archaeologist, Division of Historical and Cultural Affairs

Cc Stephen Marz, Deputy Director, DHCA

SAVING DELAWARE HISTORY

December 20, 2010

Craig Lukezic, Archaeologist
Division of Historic and Cultural Affairs
21 The Green
Dover, DE 19901-3611

RE: Removal of Dam No. 1 at Delaware Park, Review Code: 2010.11.23.01

Dear Mr. Lukezic:

Thank you for taking the time to review the Dam No. 1 project at Delaware Park for potential effects on historic properties. Based on our project plan the removal of the dam should not have an adverse impact on the historic registration of the Hale-Byrnes House. Additionally, based on our records the race and dam are not registered components of the Hale-Byrnes and thus this project will not be impacting a registered property or structure.

As mentioned in your letter, the Area of Potential Effect for this project is the area inside the limits of construction. I have attached our Proposed Limit of Disturbance so that you are aware of the extent of this project. As shown in this sketch, this project will not disturb the east bank and all access and work will occur in the stream channel, along the west bank, and on the Delaware Park golf course property. We understand the possible connection of the dam and mill race to the Hale-Byrnes House and its secondary significance relative to the focus of the interpretation of this historic structure. Our preliminary research on the historic description of the Hale-Byrnes House has revealed little concerning the mill, its operation, and amenities. Currently, the dam is failing and the mill race is disconnected and dysfunctional. As such, based upon our proposed limit of construction, we would like clarification regarding your request for a Phase II evaluation. Specifically, what is the area you are interested in relative to the project's proposed limit of disturbance, and what are your specific concerns relative to the dam or other historic/archaeological resources.

To follow-up, I would like to invite you to visit the project site so that our project team can show you the location of the dam, the proposed area of construction, and to discuss any concerns you may have about this project. As mentioned in my previous letter, this dam removal project, which will restore fish migration to a portion of the White Clay Creek National Wild and Scenic River, will be the first of its kind in Delaware. We look forward to working with you and the Division of Historic and Cultural Affairs in order to complete this project with consideration to all aspects of it. I will contact you in the next few days to discuss this project in more detail. If you have any questions prior to that please do not hesitate to contact me at 302-831-4931 or mcorrozi@udel.edu.

Sincerely,

Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF FISH & WILDLIFE
NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM
4876 Hay Point Landing Road
Smyrna, Delaware 19977
Phone: 302-735-8651
Fax: 302-653-3431

December 30, 2010
(*Request received November 23, 2010*)

Martha Corrozi Narvaez
Water Resources Agency
Institute for Public Administration
University of Delaware
Newark, DE 19716

RE: Removal of Dam #1 on White Clay Creek at Delaware Park, Newark, DE

Dear Ms Narvaez:

Thank you for contacting the Natural Heritage and Endangered Species program about information on rare, threatened and endangered species, unique natural communities, and other significant natural resources as they relate to the above referenced project.

Bog Turtle

Phase I surveys in the vicinity of Dam #1 revealed that there is no habitat that would support the federally threatened bog turtle (*Glyptemys muhlenbergii*). Although there is no habitat at this project site, White Clay Creek is a potential migration corridor between habitats. Because dam #1 is likely an impediment to migratory activities and given the high energy of flow at the dam and distance from potential habitats, it is unlikely turtles would occur within the project area. Therefore, a time of year restriction for in-water work is not being requested.

Fisheries Concerns

White Clay Creek supports important resident and migratory fish species. The protection of spawning and nursery habitats and migratory corridors during the spawning season is important in maintaining these fisheries resources. American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), and alewife (*Alosa pseudoharengus*) collectively known as alosines, utilize the river during spawning and then as a nursery habitat for young-of-the-year. Habitat degradation is one factor leading to a decline in the populations of these species. American shad numbers have indicated serious declines along the East Coast and is a species currently undergoing restoration efforts. Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), often collectively referred to as 'river herring', are listed by the National Marine Fisheries Service as a Species of Concern[1]. These species are

important to both commercial and recreational fisheries and form an important forage base for other fish and animal species. In addition, the following state-rare fish species were observed in White Clay Creek during recent sampling efforts: *Noturus insignis* (margined madtom) and *Lampetra appendix* (American brook lamprey). These state-rare fish species are also listed as Species of Greatest Conservation Need[2] in the Delaware Wildlife Action Plan.

This project will largely benefit all the fish species listed above because it involves the removal of an impediment to upstream migration. In order to minimize direct impacts to spawning adults and developing fry, we recommend in-water project activities not take place March 1st -June 30th.

State Natural Heritage Site Determination

This project is expected to improve habitat for species of conservation concern by removal of an impediment to upstream migration. At present, this project does not lie within a State Natural Heritage Site, nor does it lie within a Delaware National Estuarine Research Reserve which are two criteria used to identify "Designated Critical Resource Waters" in the Army Corps of Engineers (ACOE) Nationwide Permit General Condition No. 19. A copy of this letter shall be included in any permit application or pre-construction notification submitted to the Army Corps of Engineers for activities on this property.

White Clay Creek Wild and Scenic

This project is within the area designated as the White Clay Creek Wild and Scenic River as administered by the National Park Service (NPS). Contact Charles Barscz, Program Leader at NPS for more information: (215) 597-6482 or e-mail charles_barscz@nps.gov.

We are continually updating records on Delaware's rare, threatened and endangered species, unique natural communities and other significant natural resources. If the start of the project is delayed more than a year past the date of this letter, please contact us again for the latest information. If you have any questions, please contact me at (302) 735-8654 or Edna.Stetzar@state.de.us.

Sincerely,

Edna J. Stetzar

Edna J. Stetzar
Biologist/Environmental Review Coordinator

CC: Andy Moser, Endangered Species Biologist, Chesapeake Bay Field Office, USFWS

[2] Species of greatest conservation need are indicative of the overall diversity and health of the State's wildlife resources. Some may be rare or declining, others may be vital components of certain habitats, and still others may have a significant portion of their population in Delaware. SGCN are identified in the Delaware Wildlife Action Plan (DEWAP) which is a comprehensive strategy for conserving the full array of native wildlife and habitats-common and uncommon- as vital components of the state's natural resources. Congress challenged the states to demonstrate comprehensive wildlife conservation. Delaware, along with all of the other states and provinces throughout the country are working to implement their wildlife action plans. This document

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INSTITUTE FOR PUBLIC ADMINISTRATION

180 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-8971
Fax: 302-831-3488
Email: ipa@udel.edu

April 22, 2011

Mr. Patrick Egan
Grants Manager
FishAmerica Foundation
225 Reinekers Lane, Suite 420
Alexandria, Virginia 22314

RE: FAF 10025 - White Clay Creek Shad Restoration Project Removal of Dam No. 1

Dear Mr. Egan:

I am writing to request an extension of the grant for FAF 10025 - White Clay Creek Shad Restoration Project, Removal of Dam No. 1. Due to snow and rain and high stream flows this winter and spring, we have experienced weather-related delays in our field survey and historic investigations. We request extension of the grant in accordance with the following schedule. We remain on track to complete the field survey, design drawings, and permitting this summer in time to engage a contractor to remove Dam No. 1 during Fall 2011 in time for the Spring 2012 anadromous fish spawning season.

Milestone	Agreement Date	Revised Date
FAF Funded Portion of the Project Completion	Apr 29, 2012	Jul 31, 2011
Final Report	May 31, 2011	Aug 31, 2011
Agreement End Date	Jun 30, 2011	Sep 30, 2011

Thank you for your consideration. Should you have any questions, please contact me at 302-831-4929 or jerryk@udel.edu.

Warmly,

Gerald J. Kauffman, P.E., Director
Water Resources Agency
University of Delaware

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180 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-8971
Fax: 302-831-3488
Email: ipa@udel.edu

July 29, 2011

Mr. Patrick Egan
Grants Manager
FishAmerica Foundation
225 Reinekers Lane, Suite 420
Alexandria, Virginia 22314

Re: FAF-10025 White Clay Creek Shad Restoration Program - Removal of Dam No.1.

Dear Mr. Egan:

Enclosed please find an interim progress report on work completed to date for FAF-10025 White Clay Creek Shad Restoration Program - Removal of Dam No.1. In accordance with our grant, we plan to submit the following 100% deliverables by August 31, 2011.

- Final Report
- Copies of receipts for FAF approved expenses/timesheets/financial ledgers for salaries/benefits
- Invoice requesting reimbursement from FAF using template
- Project photographs (before, during, and after) in high resolution jpg quality
- Post - Project Match letter with supporting documentation
- Copies of all required permits/approvals/clearances
- Copy of Landowner Agreements
- 100% Design Plans
- Technical Design Report
- Hydrologic/Hydraulic Analysis
- Sediment Quality /Quality Analysis
- Stream Geomorphology / Habitat Survey
- Field Survey / Topographic Mapping

Please do not hesitate to contact me at jerryk@udel.edu or by phone at 302-831-4929 (office) or 302-893-8605 (cell).

Warmly,

Gerald J. Kauffman, P.E., Director
Water Resources Agency
University of Delaware

Progress Report
FAF-10025 White Clay Creek Shad Restoration Program - Removal of Dam No.1.
July 29, 2011

Deliverable	% Complete
Final Report	50%
Receipts for expenses/timesheets/financial ledgers for salaries/benefits	90%
Invoice requesting reimbursement from FAF using template	90%
Project photographs (before, during, and after) in high resolution jpg quality	90%
Post - Project Match letter with supporting documentation	75%
Copies of all required permits/approvals/clearances	50%
Copy of Landowner Agreements	100%
100% Design Plans	90%
Technical Design Report	50%
Hydrologic/Hydraulic Analysis	100%
Sediment Quality/ Quality Analysis	100%
Stream Geomorphology/Habitat Survey	100%
Field Survey/Topographic Mapping	100%