APPENDIX A

Geomorphic Assessment of Sediment and Soils along Walker Run, Berwick, PA

By: Dr. Dorothy Merritts
(F&M College)

Geomorphic Assessment of Sediment and Soils along Walker Run, Berwick, PA

Field work, analyses, and report by Dr. Dorothy Merritts
Geologist, Franklin and Marshall College

GIS assistance: Mike Rahnis
Field assistants: Matt Jenschke and Kevin Toenboehm
Lab assistants: Laura Kratz and Austin Reed

August to September, 2009

INTRODUCTION

Field investigation and laboratory analyses of sediment and organic samples from four trenches dug with a backhoe along Walker Run, a small tributary to the Susquehanna River near Berwick, PA, were used to assess the origin, depositional environment, and age of the sediments along the valley bottom. In addition, geologic maps and high-resolution topography from airborne laser swath mapping (lidar) were used to assess the sedimentologic and geomorphic attributes of the sedimentary deposits (Figures 1-4).

GEOLOGIC HISTORY OF THE AREA AND ORIGIN OF SEDIMENTARY DEPOSITS ALONG THE WALKER RUN VALLEY

The Walker Run/Berwick area is part of the Appalachian Mountain section of the Valley and Ridge physiographic province. This province is characterized by a distinctive series of linear ridges and valleys that are the result of differential erosion of folded sedimentary rocks with varying degrees of resistance to weathering and erosion. Less resistant rocks, particularly shale and limestone, form valleys, whereas more resistant rocks, particularly sandstone, form ridges and uplands. The Susquehanna River has incised into and crosses these ridges as it flows generally from north to south, and its numerous tributaries form a trellis drainage network pattern as they flow along the valleys with less resistant rocks.

Bedrock in the Walker Run watershed consists of layered sedimentary rocks that are Devonian in age (~416 to 359 million years old). The dominant rock types are gray sandstone, greenish-gray to grayish-red siltstone, and grayish red silty claystone of the Catskill Formation in the north (near Trench 3); dark gray sandstone, siltstone, and shale of the Trimmers Rock Formation (near Trenches 1 and 2); and dark gray silty claystone of the Mahantango Formation (near Trench 4).

During the past ~2 million years, the landscape has been modified by cyclical erosion and deposition associated with advancing and retreating ice sheets that flowed southward from the northern polar regions. These ice sheets were massive, up to several km thick in places, and the number of glaciations was probably at least a dozen. The most recent ice advance, known as the Wisconsinan, occurred about 45,000 to 15,000 years ago, and the more recent part of this advance is referred to in this region as the Woodfordian.

The most prominent glacial features in the Berwick area include a northwest-southeast trending Woodfordian terminal moraine complex that consists of boulder, poorly sorted sediment, and Woodfordian glaciofluvial (including kame) terraces along the Susquehanna River that consist of stratified sands and gravels (see Figures 1b and 1c). The terminal (end) and ground moraines deposited at the front of and beneath the ice sheet, respectively, are much coarser than the outwash sediments, and also are marked by kettles. Kettles are depressions on the ground surface that resulted from melting of ice blocks within the glacial deposits during deglaciation. Kettles are shown as red ovals on the geologic map in Figure 1b.

Kame deposits are described well at Wikipedia, as in this example:

> "Kame terraces are frequently found along the side of a glacial valley and are the deposits of meltwater streams flowing between the ice and the adjacent valley side. These kame terraces tend to look like long flat benches, with a lot of pits on the surface made by kettles. They tend to slope downvalley with gradients similar to the glacier surface along which they formed, and can sometimes be found paired on opposite sides of a valley."

After deglaciation, which began about 14,000 yrs ago and was completed within a few thousand years, the landscape along Walker Run was mantled with fresh glacial and near-glacial deposits (Inners, 1978). At Walker Run, the glacial deposits consist of kame terrace sediments that were deposited along the sides of river valleys adjacent to ice margins, and of various types of till and outwash that formed at the leading edge of the Woodfordian ice sheet. These deposits were found at the base of all four trenches, as discussed below. Drainage was poor as a result of the near-glacial and glacial deposits, which typically consist of sediment that ranges from clay- to boulder-size, and resulted in widespread swampy conditions as streams adjusted to deglacial conditions.

RESULTS OF TRENCHING AND GEOMORPHIC ANALYSIS

Details of the sediments sampled at four trenches, including color, texture, and structure) are provided in Table 1 and the field notes appended at the end of this report. Trenches 1, 2, and 3 revealed historic sediment (brown silt loam) that varies

from about 40 to 60 cm (1.3 to 2 ft) in thickness (Figures 5-8). It was derived from erosion of upland sediment on surrounding hill slopes, and then deposited along the valley bottom in a quiet-water, low energy environment. Evidence of this quiet-water environment consists of thin, draped sedimentary layers and soft-sediment deformation observed in the trenches.

It also is possible that a road downstream of Trenches 1 and 2, and a possible historic dam downstream of Trench 3, caused this deposition of fine sediment. The lidar reveals that a road crossing could be the cause of valley floor sedimentation at Trenches 1 and 2 (see Figures 1a and 3). The downstream road crossing appears to have resulted in about one to two feet of upstream sedimentation, and Trenches 1 and 2 reveal 1.3 ft of historic sediment. At trench 3, the historic sediment is 2 ft thick, and the lidar reveals possible remnants of a dam downstream that resulted in about 4-6 feet of sedimentation just upstream of the dam. Given that Trench 3 is about 300 yards upstream of the dam, and the stream is relatively steep, it is not surprising that only 2 ft of historic sediment exists at the trench site.

At the base of the stream bank near Trench 3 we found abundant charcoal and cut wood resting on the gravel (see Figure 8). This material is clearly the result of land clearing, timbering, etc., but did not appear in Trench 3. It is likely that the topography of the original ground surface in the vicinity of Trench 3 was much more irregular than what now exists. At present, the valley flat is smooth and level, but that is because of a possible dam (or other structure) that existed about 300 yards downstream. Under this drape of historic sediment is a hummocky surface that originally had poorly drained swampy spots.

Beneath the historic sediment at Trench 3 (below a depth of about 2 ft) is a thick clay-rich sandy unit with gleyed colors that indicate wet, reducing conditions at the time of deposition (see Figure 7). This sediment possibly was deposited in a wetland. The plant fragments in this unit appear to be those of wetland plants, although we did not do a seed or other macrofossil analysis. One of these plants, from a depth of about 5 feet (1.6 m), yielded a radiocarbon age of 3520 ± 40 yrs BP (3690 to 3900 Cal BP; dating by Beta Analytic, Inc.).

Small amounts of this same unit of light-colored clay-rich sediment with sand and vertical plant roots occur at Trenches 1 and 2, just below the historic darker colored silt loam (see Figure 6 and Table 1). A radiocarbon age on a small charcoal fragment from the top of this underlying clay-rich sediment yielded a radiocarbon age of 1280 ± 40 yrs BP (1140 to 1290 Cal BP; dating by Beta Analytic, Inc.). At Trenches 1 and 2, this late Holocene unit is not as thick as at Trench 3. At Trenches 1, 2, and 3, the light-colored clay with sand overlies an even sandier unit that varies in thickness in the different trenches, and even along the face of a single trench. This sand contains abundant evidence of high energy conditions, and at Trenches 1 and 2 appears to have been a relatively wide, shallow stream (see sediments below 76 cm in Figure 6). It had multiple

small bars that were highly mobile. The glacial sand is probably outwash in origin, and was deposited before the modern Holocene (interglacial) Epoch. Both Woodfordian (last glacial) outwash (Qwo) and kame terrace/outwash undivided (Qwkto) deposits are mapped in the vicinity (Inners, 1978; see Figures 1b and 1c). A very coarse, cobbly to bouldery deposit that underlies both Trenches 1 and 2 is glacial in origin, and probably has an age range of 14,000 to 50,000 years ago, which is the timing of the last glacial maximum. This bouldery deposit is mapped as part of an end or ground moraine (Qwem and Qwgm in Figures 1b and 1c).

The topography along the valley from east to west near Trench 4 has the characteristics of a poorly drained landscape consisting of poorly sorted glacial deposits, and indeed the area is mapped as consisting of glacial kame terrace sediments (see Figures 1b and 1c). A number of marshes and swampy areas exist near Trench 4, and our trenching revealed very little historic sediment. The valley becomes very wide in this region as well, and drainage goes in unexpected directions, as can be seen on the lidar terrain images (see Figures 1a and 3).

The landscape in the vicinity of Trench 4 is probably similar to that which existed prior to European settlement, although the modern channel appears to have been manipulated extensively at the site of Trench 4 as well as both upstream (to the east, along the low valley) and downstream of the trench. The modern channel has been straightened in places, and numerous long, straight, small channels reveal that the swampy areas were ditched. Raised bank/berm ponds are common on this low-relief, pitted part of the landscape (see Figures 1a and 3).

The swampy areas near Trench 4 might have been associated with beaver dams as well. Landscapes that are formed on glacial deposits commonly have pits that hold water as a result of the low permeability of glacial sediments, but beaver dams probably were common in this landscape once trees and shrubs became established after deglaciation. Trees appeared soon after deglaciation, although tree types changed with time as the modern interglacial climate was established from 14,000 to 8000 years ago.

REFERENCES

Inners, Jon D., 1978, Geology and mineral resources of the Berwick Quadrangle, Luzerne and Columbia Counties, PA: DER Bureau of Topographic and Geologic Survey Atlas 174c, 34 pp and 2 plates.

TABLE 1: Description of sedimentary strata and soils exposed in four trenches along Walker Run. Magnetic susceptibility measured in the laboratory indicates the potential of the sediment to be magnetized; higher values generally are indicative of sediment that has been disturbed by land clearing, burning, or plowing.

BWPPLT1 Trench 1	**8/12/2009**	**11:14:34 AM**	***Magnetic***
Depth (cm)	***Munsell Soil Color***	***Soil Color***	***Susceptibility (k)***
0-20	10YR, 3/4	Brown	18.5
20-40	10YR, 3/4	Brown	14.5
40-55	10YR 5/4	Yellowish brown	5
55-76	10YR 5/4	Yellowish brown	3.3
	and 7.5 YR 5/8	and strong brown	
76-130	10YR 5/4	Yellowish brown	4.7
	and 7.5 YR 5/8	and strong brown	
BWPPLT2 Trench 2	**8/12/2009**	**11:58:09**	***Magnetic***
Depth (cm)	***Munsell Soil Color***	***Soil Color***	***Susceptibility (k)***
40-60	10YR 5/4	Yellowish brown	6.1
BWPPLT3 Trench 3	**8/12/2009**	**17:18:37**	***Magnetic***
Depth (cm)	***Munsell Soil Color***	***Soil Color***	***Susceptibility (k)***
0-30	10YR 4/3	Brown	14.3
30-60	10YR 4/3	Brown	12.1
60-90	10YR 6/1	Gray and	2.7
	and 10 YR 4/6	dark yellowish brown	
90-130	10YR 5/1	Gray and	2.4
	and 10YR 4/6	dark yellowish brown	
125 (point sample)	10YR 5/1	Gray	3.5
130-160	10YR 5/1	Gray	2.1
145 (point sample)	10YR 5/1	Gray	3
190 (point sample)	10YR 3/1	Very dark gray	4.3
BWPPLT4 Trench 4	**8/13/2009**	**11:25:32**	***Magnetic***
Depth (cm)	***Munsell Soil Color***	***Soil Color***	***Susceptibility (k)***
0-35	10YR 4/2	Dark grayish brown	3.8
35-55	10YR 5/3	Brown	3.2
55-90	10YR 4/4	Dark yellowish brown	4.1
	and 10YR 2/2	and very dark brown	
90-170	10YR 3/1	Very dark gray	4.3
100-120 (from SW end T4)	10YR 3/1	Very dark gray	3.6
130-160 (from SW end T4)	10YR 3/1	Very dark gray	50.7 (high value typical of deeply weathered rocks below ground water)

Field notes from trenching at Berwick Bell Bend, along Walker Run; descriptions by Dr. Dorothy Merritts; Assistants: Matt Jenschke and Kevin Toenboehm, both F&M graduates, 2009; notes taken on 8/12/09 and 8/13/09

T1 = Trench 1; T2 = Trench 2; etc

General stratigraphic description half of the distance along length of T1, from bottom to top:

Bottom most visible unit > blue –gray – sandy clay, anoxic– 0.5 m thick

Yellow - orange oxidized sandy cobble gravel (10 cm – 50 cm particle size diameter)-- 0.5 m – 1 m thick

Yellow – orange clay rich silty sand w/ sub-angular – well rounded pebbles -- 0.5 m – 1 m thick

Organic – rich dark brown silt loam with thin organic soil at ground surface-- 0.25m – 0. 5 m thick

8/12/09 – BWPPL T-1 Description from ground surface down to bottom

Depth	**Notes**
	0-20 cm Plow zone, abundant corn stalks, Silt loam Charcoal sample at 45 cm: Sample # BWPPLT1_45cm 08122009 11:14:34 AM Possible addition of manure to soil - **10 YR 4/3 – Brown**
20 – 40 cm	No contact, some fine roots, possible fine bedding and/or laminations, some charcoal, stiff, increased clay relative to above, bottom contact irregular and abrupt, pieces of drain tile - **10 YR 4/3 – Brown**
40-55 cm	Discrete pieces of charcoal, some wood fragments; weakly mottled silty-fine sand. Charcoal abundant in upper 5 cm, some root casts with dark in fill from above, some small relict animal burrows, **10 YR 5/4 – Brown**
55- 76 cm	Silty- fine sand, frequent mottles, some vertical root casts, bottom contact undulatory and transitional, no charcoal. **10 YR 5/4 – Yellowish Brown – Mottled w /7.5 YR 5/8 Strong Brown**
76 cm – 1.3m	Thinly bedded, fine sand to pebble gravel, stratified, possible point bar, pebbles up to 3 cm on long axis, sub-rounded to well

rounded, strongly oxidized and weathered; pebbles can be crushed in hand, abundant sand fissures into overlying silty-fine sand, some graded bedding , bottom contact undulatory on poorly sorted boulder deposit. **10 Yr 5/4 – 7.5 Yr 5/8**

BWPPLT-2 T2 closer to modern stream than T1; strata similar to T-1; sampled from 40-60 cm --**10 YR 5/4 – Brown**

BWPPLT-3

Depth, cm

0-30 cm Silt Loam, abundant modern roots and charcoal flecks, massive, bioturbated, no pebbles, no gravel. Lower contact undulatory and gradational, marked by texture change-- **10 YR 4/5 – Brown**

30 - 60 cm Same as above, but modern roots not as abundant, possibly more clay rich, lower contact abrupt, some cobbles. Cobble layer, possibly layered @ 60 cm – **10 YR 4/3 - Brown**

60 – 90 cm Massive, silty clay , clay dominant, glade, multiple pine roots, clay varnish, oxidized root walls, abundant mottling throughout. Abundant fine rootlets, mostly vertical, no obvious laminations. **10 YR 6/1 – Gray – 10 YR 4/6 Dark** yellowish Brown

90-130 cm Same as above, not mottled, slightly more sandy. **YR 5/1 – Gray and**
10 YR 4/6 – Dark Yellowish Brown

130 – 160 cm Same as above, at bottom mottled and oxidized, becomes coarse sand above contact with gravel layer, crude sub-horizontal bedding of cobble and coarse sand at contact--**10 YR 5/1 - grey**

190 cm Right on cobble layer, dark-organic rich, possibly wetland soil. **10 YR 3/1 – Very Dark Gray**

BWPPLT4

Depth

0 – 35 cm	Silt loam, abundant modern roots, lower contact abrupt, but bioturbated, possible sedimentary load structures, burrows. **10 YR 4/2 – Dark Grayish Brown.**
35 – 55 cm	Mottled, some bioturbation from above, fine – med sand w/ < 10% clay, manganese oxide staining, lower contact irregular, numerous vertical roots from above. **10 YR 5/3 – Brown**
55 -90 cm	Mottled, deeply weathered, pebbly sand, pebbles increase into base. Manganese oxide staining. * Approx. ground water table. **10 YR – 4/4 - Dark Yellow Brown and 10 YR – 2/2 – Very Dark Brown**
90 – 170 cm	Most of stratum is reduced, cobbly, few small boulders, occasional thin lenses of fine pebbles, occasional sandy lenses, bedding sub-horizontal, matrix of med. Sand. Cobble lithologies: red mudstone, small pieces of flat shale – blue-grey mudstone. Some clasts well rounded. Upper contact abrupt, abundant roots, especially below 150 cm. Some clasts well rounded. **10 YR – 3/5 – Very Dark Gray**
90 – 170 cm	Poorly sorted – sampled matrix at 1.2 m
130-160cm	Sampled from farther SW in Trench **10 YR = 3/1 – Very Dark Gray**
100-120	4 m south along trench wall—clayey sand **10 YR 3/1 – Very Dark Gray**

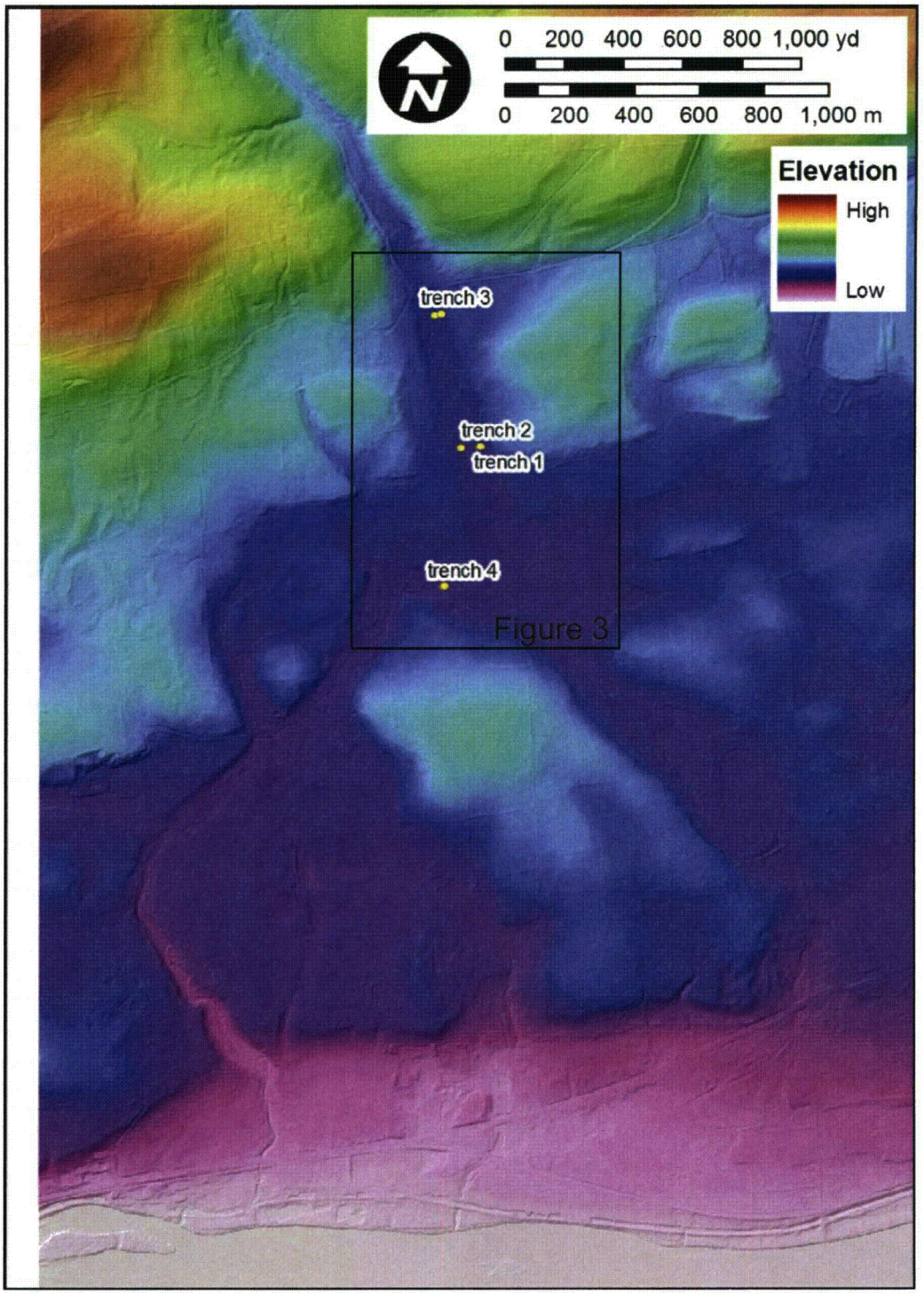


Figure 1. Shaded relief terrain from airborne laser swath mapping (lidar) of Bell Bend area near Berwick, PA. Susquehanna River is at bottom of image, flowing from right to left (east to west). Walker Run flows from north to south in center of image. Low-relief, hummocky topography between the location of Trenches 1 and 2 and the Susquehanna River is the result of glacial deposits that consist largely of ground moraines, end moraines, and kame and outwash terraces (see text). Higher elevation features to the north are bedrock ridges in the Appalachian Ridge and Valley, and consist of Devonian age sedimentary rocks (primarily shale, siltstone, and sandstone in this area).

Figure 2. Digital orthophoto of Bell Bend area, with Susquehanna River to south (bottom of image) flowing from right to left (east to west). Walker Run flows from north to south in center of image. This image illustrates the exact same area, at the same scale, as Figure 1.

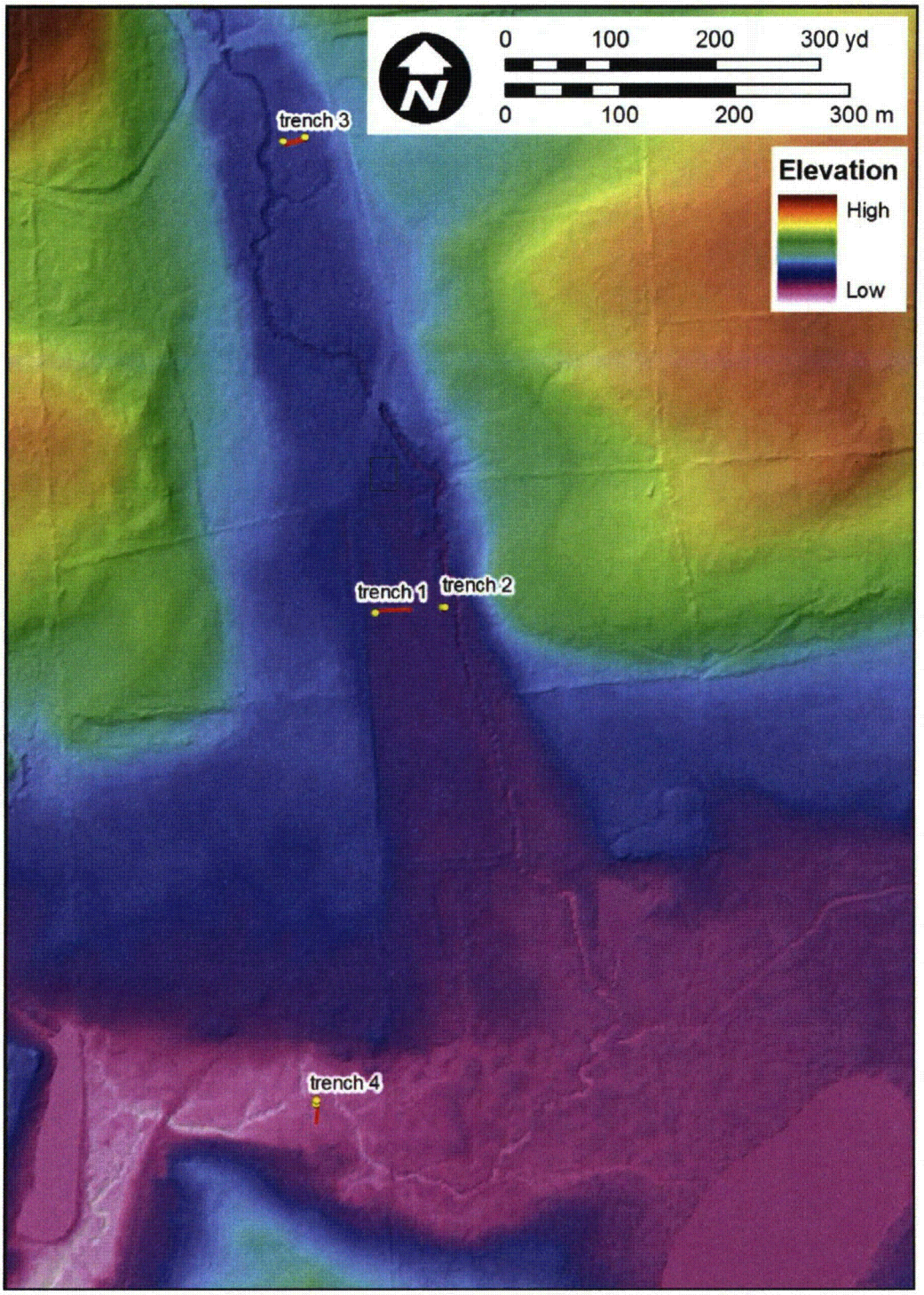


Figure 3. Close-up view of shaded relief terrain from airborne laser swath mapping (lidar) of Bell Bend area near Berwick, PA (see location in Figure 1). Walker Run flows from north to south in center of image. Low-relief, hummocky topography south of the location of Trenches 1 and 2 is the result of glacial deposits that consist largely of ground moraines, end moraines, and kame and outwash terraces (see text). Swampy area in lower right corner is a vegetated wetland that has been ditched for drainage (see Figure 4). Note smooth topography from overbank deposition between trenches 1 and 2 and road ~250 yards to south. The elevation of the valley floor increases 4-5 ft just north of trenches 1 and 2, possibly as the result of an older low-head dam that once existed near the road crossing (*). The road crossing itself might have served as a dam. Trench 3 was excavated into the sediment upstream of this possible structure.

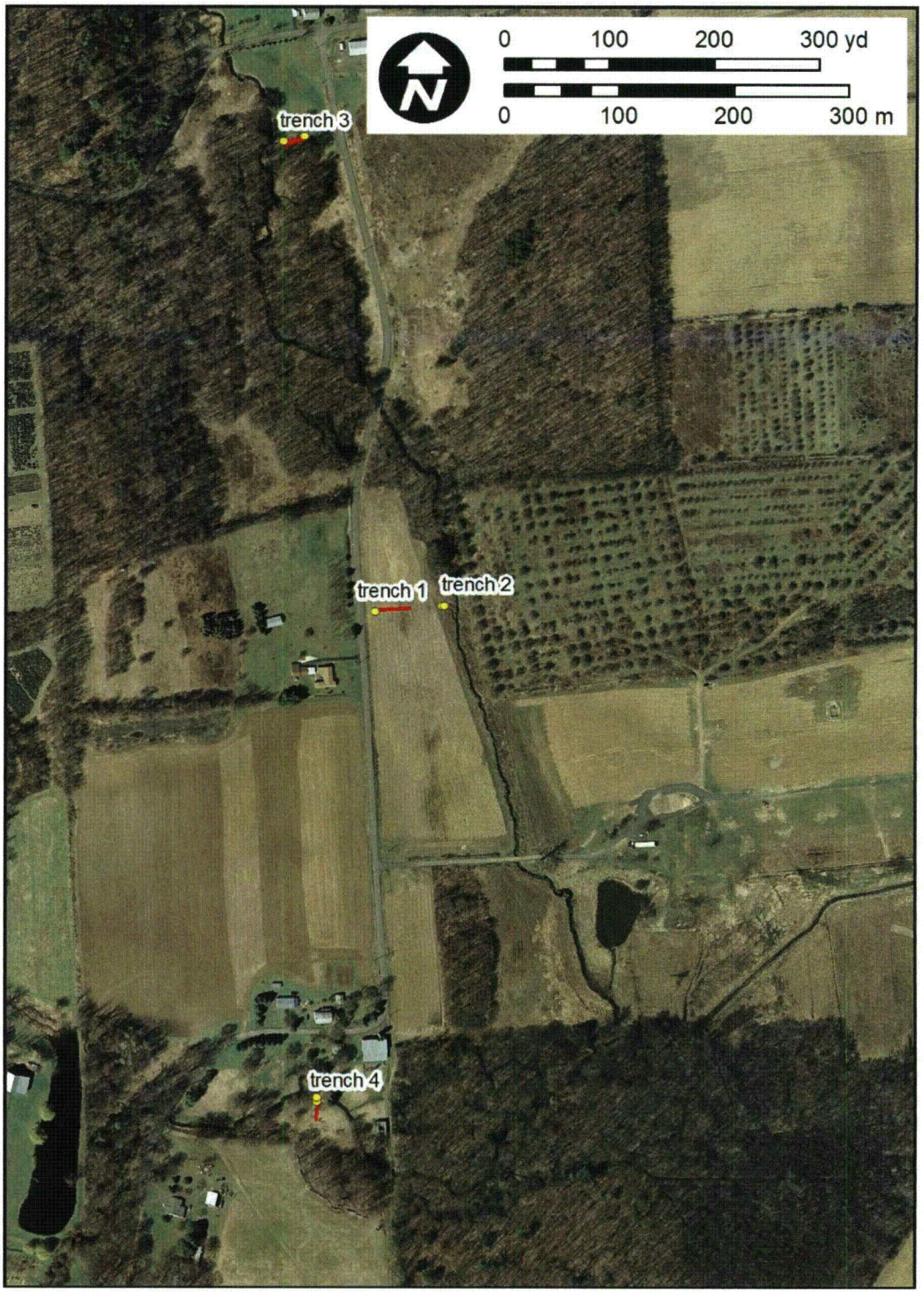


Figure 4. Digital orthophoto of Walker Run area. Walker Run flows from north to south in center of image. This image illustrates the exact same area, at the same scale, as the lidar shaded relief map in Figure 3. Heavily vegetated area in lower right corner is the ditched wetland described in Figure 3.

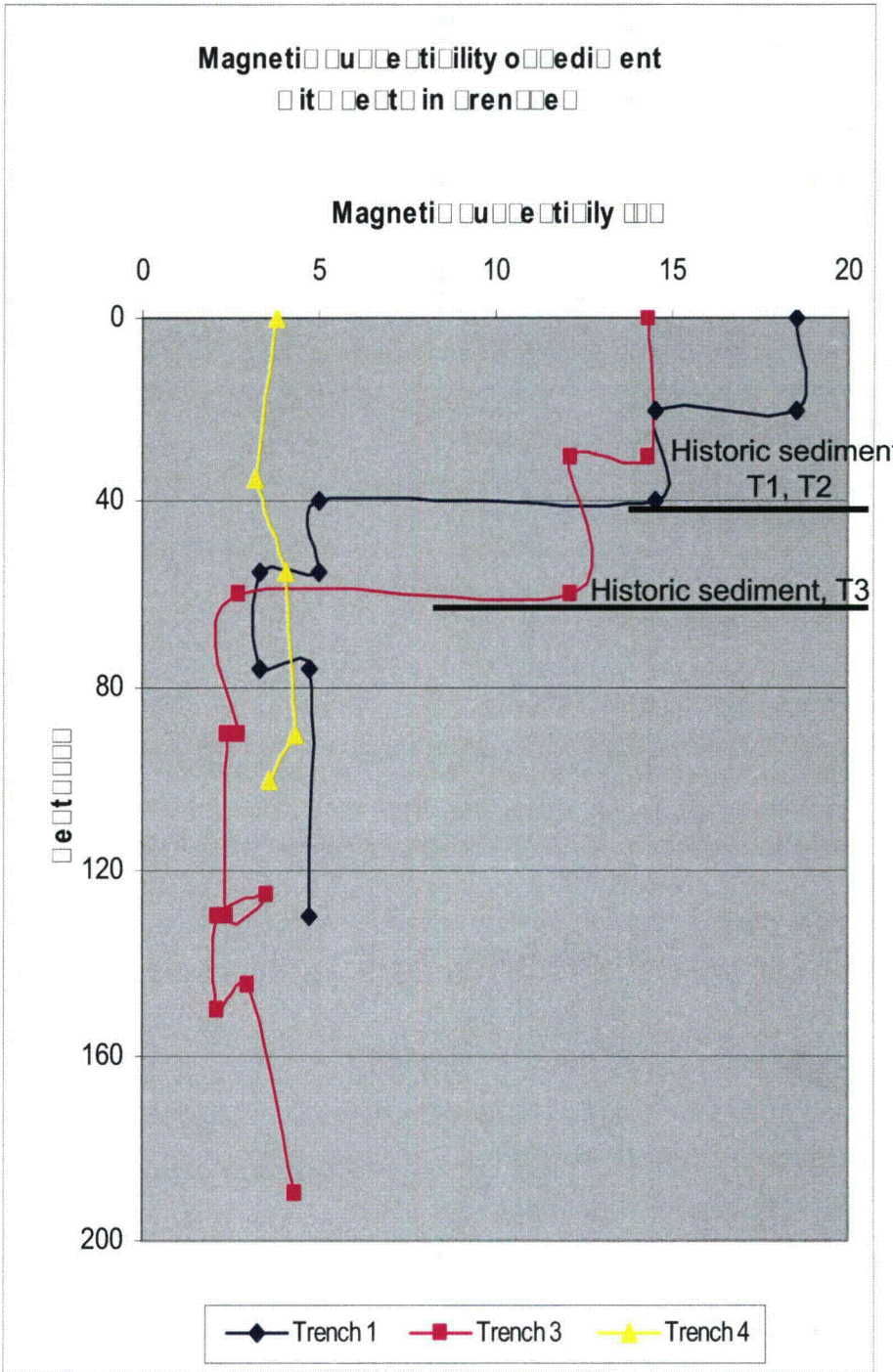
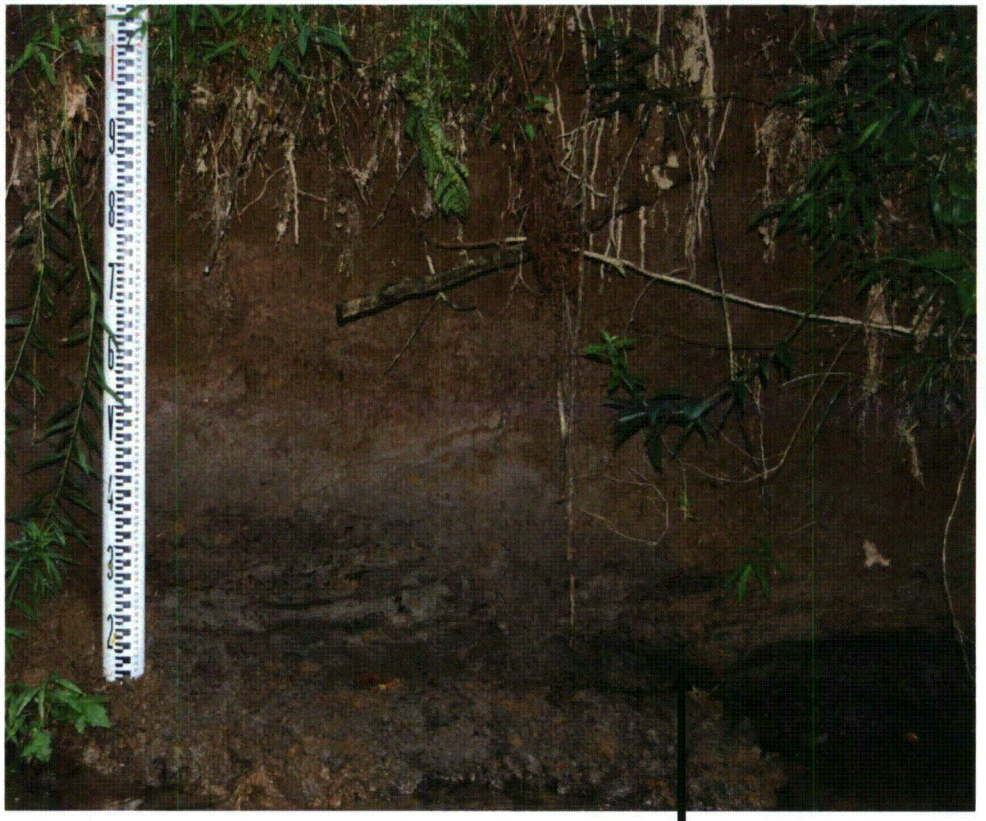


Figure 5. Magnetic susceptibility of sediments from trenches 1, 3, and 4 from Walker Run area. Marked increase in values at 40 cm in trenches 1 and 2, and at ~60 cm in trench 3, is indicative of the overlying sediment being much younger and historic in age. Sediment with such high values typically has been disturbed by landclearing, plowing, and/or burning, resulting in strongly oxidized soil. Low values at the surface in trench 4 are the result of wet, reducing conditions at and near the ground surface.

Figure 6. View of southeastern face of Trench 1 wall. Historic brown silt loam (0-40 cm) contains abundant charcoal and overlies a mottled yellowish brown Holocene (interglacial) silty fine sand (76 cm), which in turn overlies highly weathered, stratified yellowish brown to strong brown Pleistocene (glacial) sand and gravel. Note fine blue vertical lenses in basal gravel. These are lenses of clay that penetrated the sand and gravel when they rose upward during liquefaction, a common phenomenon in wet sediment that contains interbedded clay and sand. Historic sediment appears to have been draped across the pre-existing landscape after some soil erosion occurred. Original A horizon of soil was stripped off before deposition of the historic sediment, leaving truncated root structures just below 40 cm. The glacial sand coarsens downward to a cobbly boulder layer, with boulders up to several ft in long axis dimension. The glacial sand is probably outwash in origin. The bouldery deposit probably is part of an end or ground moraine.

Figure 7. Trench 3, facing west. Bottom unit (190 cm to base of trench) is highly reduced, very dark gray, deeply weathered, poorly sorted glacial gravel with some boulders up to 1-2 ft in long axis dimension. The top of this unit is organic rich, possibly a late glacial to early Holocene wetland soil? Overlying unit (130 to 160 cm) is coarse gray sand with numerous thick lenses of clay that thicken to the east (behind photographer). Clay is laminated in places and contains numerous well-preserved plant fragments that appear to be vertical wetland plants (e.g., rushes?). One of these plant fragments from the base of this unit yielded a late Holocene age of ~3900 yrs BP. Overlying unit (60-130 cm) is gray to dark yellowish brown laminated clay to fine sand. Uppermost unit (0-60 cm), a brown silt loam with abundant charcoal, is most likely historic in age (see Figure 8 and magnetic susceptibility results in Figure 5).



Note cut (axe) log.

Figure 8. Right stream bank near Trench 3 along Walker Run. Stratified sand, silt, wood (including planks and logs) and charcoal are the result of historic timbering and burning. Cut and fill sedimentary structures indicate that the Holocene pond sediments in this part of the valley were incised by flood flow (and possible beaver dam breaching?) and the historic sediment was deposited within the incised channel. Sedimentation occurred to a level that grades to a structure ~300 yards downstream that might be a historic low-head dam (now breached) that was 4 to 6 feet high. Note that the stream bed has incised to the level of the glacial gravel.

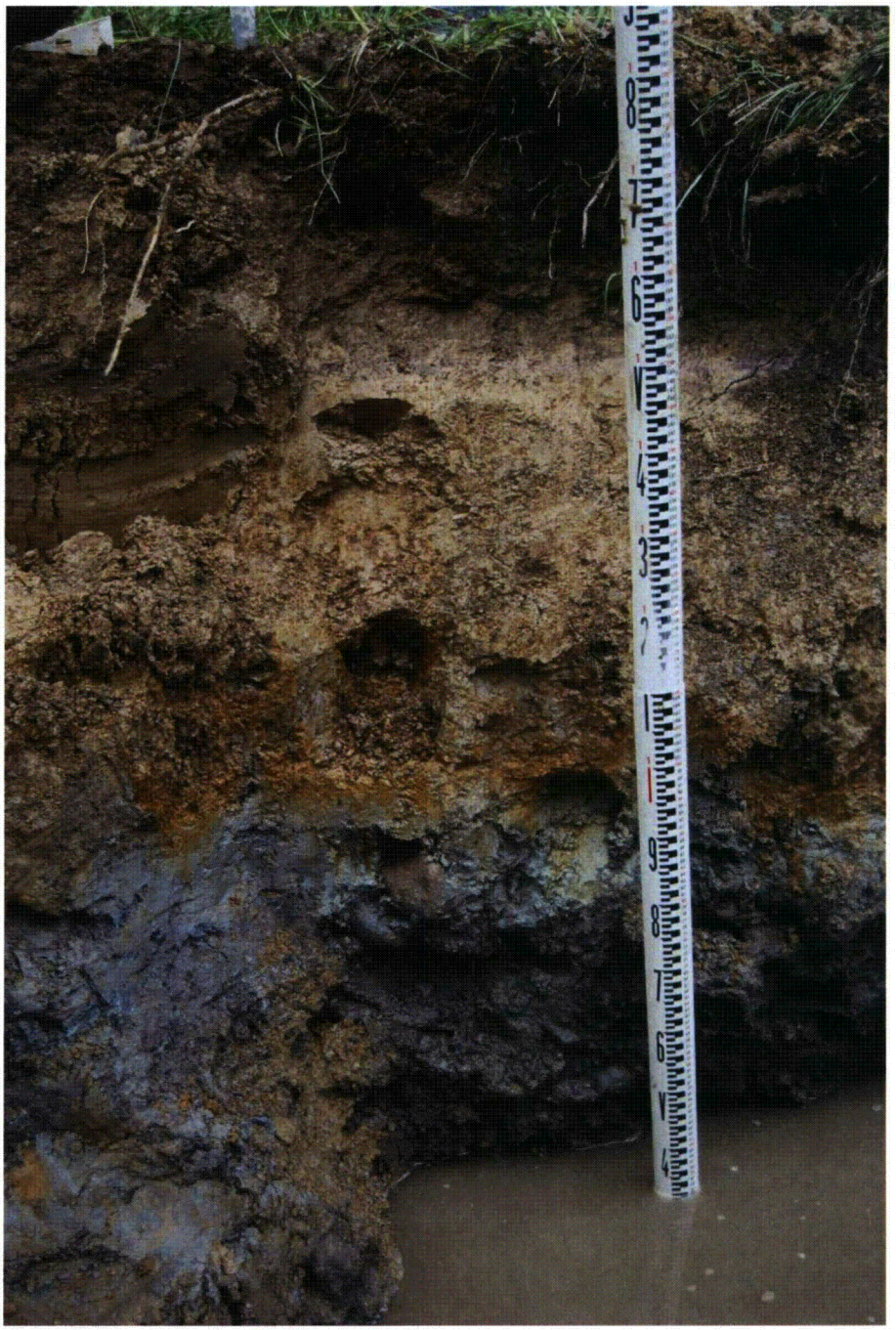


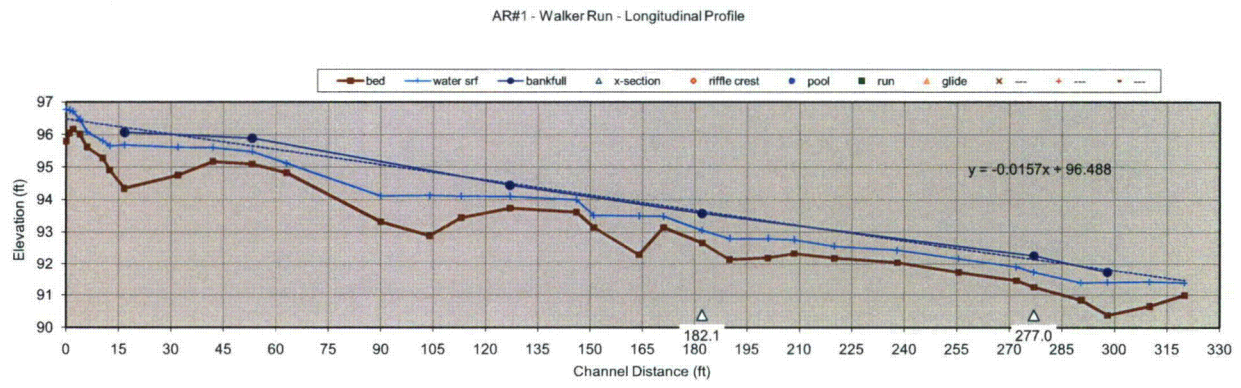
Figure 9. Stratigraphy exposed in Trench 4 along Walker Run. This trench appears to be mostly poorly sorted glacial gravel (pebble to boulder sized). These glacial sediments are mapped as undifferentiated kame and outwash terrace deposits on the Berwick 7.5' quadrangle geologic map (Jon D. Inners, 1978, Geology and mineral resources of the Berwick quadrangle, Luzerne and Columbia Counties, PA: PA Topographic and Geologic Survey Atlas 174c). Similarly to trenches 1, 2, and 3, the basal unit is poorly sorted bouldery glacial gravel and the unit immediately above is stratified sand with interbedded clay and pebbles (some rounded). At trench 3, the stratum above the bouldery layer is much finer grained and laminated, indicative of a pond. At trenches 1, 2, and 4 (this photo), the overlying stratum is sandier. In all trenches, the bouldery deposit is very reduced from extensive leaching in below the level of the groundwater table. In all trenches, mottling (reduction and oxidation) in the overlying sand and clay indicates frequent fluctuations of the groundwater table.

APPENDIX B

Existing Geomorphic Data:
Geomorphic Assessment Reach Survey Data

(Walker Run &Marsh Creek)

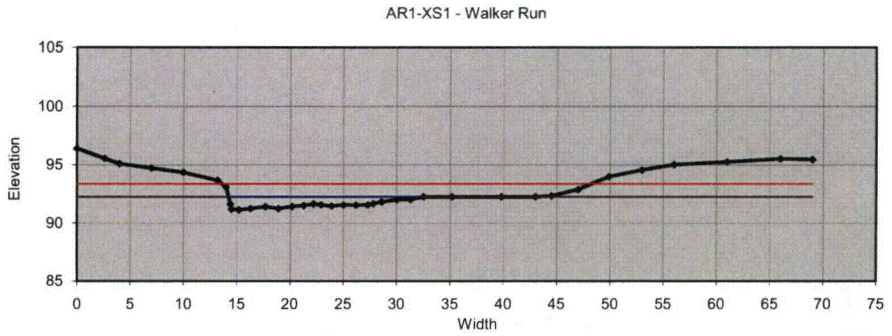
Longitudinal [illegible] Profile



	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	1.7	---	320.0 (20.5 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

notes	cross section ID	bed feature	station	station	Benchmark Elevation [illegible] Turning Points BS	HI	FS	FS bed	water	FS bankfull	user defined FS	FS	FS	azimuth AZ	ELEV bed	ELEV water srf	ELEV bankfull	ELEV ---	ELEV ---	ELEV ---
back sight to benchmark						100.78														
						100.78									95.8	96.78				
						100.78									96.05	96.75				
			2			100.78									96.17	96.71				
						100.78									96.02	96.47				
						100.78									95.62	96.08				
						100.78									95.28	95.81				
			2			100.78									94.91	95.65				
a						100.78									94.34	95.68	96.07			
			2			100.78									94.75	95.61				
			2			100.78									95.17	95.6				
			2			100.78									95.09	95.47	95.89			
						100.78		2							94.82	95.11				
						100.78									93.31	94.11				
a						100.78		2							92.88	94.12				
						100.78									93.44	94.1				
			2			100.78									93.73	94.09	94.44			
						100.78									93.61	93.98				
						100.78									93.14	93.5				
a						100.78									92.29	93.48				
						100.78									93.14	93.47				
2	2		2			100.78		2		2					92.66	93.04	93.57			
						100.78									92.14	92.79				
			2			100.78									92.19	92.79				
			2			100.78			2						92.33	92.75				
			22			100.78									92.18	92.55				
			2			100.78									92.04	92.43				
			2			100.78									91.73	92.16				
			2 2			100.78									91.47	91.9				
			2			100.78		2		2					91.26	91.73	92.26			
			2			100.78									90.85	91.39				
a			2			100.78			2						90.38	91.4	91.73			
						100.78		2							90.66	91.42				
			2			100.78									91	91.39				
						100.78														

ro□□ e□tion □



Bankfull Dimensions	
12.3	x-section area (ft.sq.)
18.3	width (ft)
0.7	mean depth (ft)
1.1	max depth (ft)
19.2	wetted parimeter (ft)
0.6	hyd radi (ft)
27.1	width-depth ratio

Flood Dimensions	
34.7	W flood prone area (ft)
1.9	entrenchment ratio
1.1	low bank height (ft)
1.0	low bank height ratio

Materials	
57	D50 Bed (mm)
140	D84 Bed (mm)
32	threshold grain size (mm):

Bankfull Flow	
2.4	velocity (ft/s)
29.3	discharge rate (cfs)
0.52	Froude number

Flow Resistance	
0.059	Manning's roughness
0.47	D'Arcy-Weisbach fric.
4.1	resistance factor u/u*
1.5	relative roughness

Forces & Power	
1.6	channel slope (%)
0.64	shear stress (lb/sq.ft.)
0.58	shear velocity (ft/s)
1.6	unit strm power (lb/ft/s)

□ro□□ □e□tion

reference ID □
instrument height □□□ ---
longitudinal station 2□□ ---

□an□ull □tage

FS □□□□ = 92.26 elev
elevation ---

Lo□ □an□ □eig□t

FS □□□□ = 92.26 elev
elevation ---

Flood Prone □rea

width fpa □□□□ 34.7

□□annel □lo□e

percent slope □□□ #REF!

Flo□ □e□□tan□e

Manning's "n" □□□□□ 0.059
D'Arcy - Weisbach "f" 0.47

□ote:

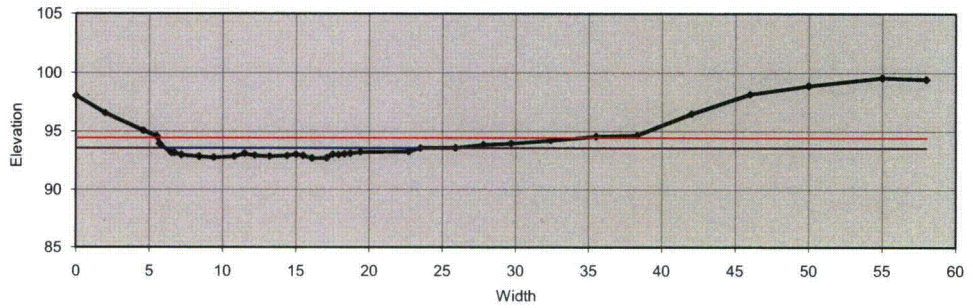
Assessment Reach #1 (AR#1) along Walker Run upstream of Beach Grove Road.

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
□		100	□□□□	96.39	□	
2□□		100	□□□□	95.53	□	
□		100	□□□□	95.09	□	
□		100	□2□	94.72	□	
□□		100	□□□□	94.35	□	
□□2		100	□□□□	93.65	□	LTOB
□□		100	□□2	93.08	□	
□□□□		100	□□□□	91.63	□	
□□□□		100	□□□□	91.21	□	
□□2		100	□□□□	91.15	□	
□□□□		100	□□□□	91.26	□	
□□□□		100	□□□□	91.42	□	
□□□□		100	□□□□	91.26	□	
2□2		100	□□□□	91.43	□	
2□□□		100	□□□□	91.52	□	
22 2		100	□□□□	91.65	□	
22□□		100	□□2	91.58	□	
2□□□		100	□□□□	91.47	□	
2□□		100	□□□□	91.56	□	
2 □2		100	□□□□	91.55	□	
2□□□		100	□□2	91.58	□	
2□□□		100	□□□□	91.69	□	REOW
2□□□		100	□□□□	91.83	□	
□□		100	□□□□	92.02	□	BKFL #1
□□□□		100	□□□□	92.04	□	
2□□		100	□□□□	92.26	□	BKFL #2
□□2		100	□□□□	92.26	□	
□□□□		100	□□□□	92.26	□	
□□		100	□□□□	92.26	□	
□□□□		100	□□□□	92.35	□	
□□		100	□□2	92.88	□	
□□□□		100	□□□□	93.97	□	RTOB
□□		100	□□□□	94.54	□	
□□		100	□□□□	95.01	□	
□□		100	□□□□	95.25	□	
□□		100	□□□□	95.51	□	
□□		100	□□□□	95.44	□	
					□	

□

ro e tion 2

AR1-XS2 - Walker Run



Bankfull Dimensions		Flood Dimensions		Materials	
9.8	x-section area (ft.sq.)	34.3	W flood prone area (ft)	57	D50 Bed (mm)
17.4	width (ft)	2.0	entrenchment ratio	140	D84 Bed (mm)
0.6	mean depth (ft)	0.9	low bank height (ft)	27	threshold grain size (mm):
0.9	max depth (ft)	1.0	low bank height ratio		
17.9	wetted parimeter (ft)				
0.5	hyd radi (ft)				
31.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.0	velocity (ft/s)	0.064	Manning's roughness	1.6	channel slope (%)
19.3	discharge rate (cfs)	0.58	D'Arcy-Weisbach fric.	0.55	shear stress (lb/sq.ft.)
0.47	Froude number	3.7	resistance factor u/u*	0.53	shear velocity (ft/s)
		1.2	relative roughness	1.11	unit strm power (lb/ft/s)

ro e tion

reference ID 2
instrument height 2 2
longitudinal station ---

an ull tage
FS = 93.57 elev
elevation ---

Lo an eig t
FS = 93.57 elev
elevation

Flood Prone rea
width fpa 29.0

annel lo e
percent slope #REF!

Flo e tan e
Manning's "n" 0.064
D'Arcy - Weisbach "f" 0.59

ote:
Assessment Reach #1 (AR#1) along Walker Run upstream of Beach Grove Road.

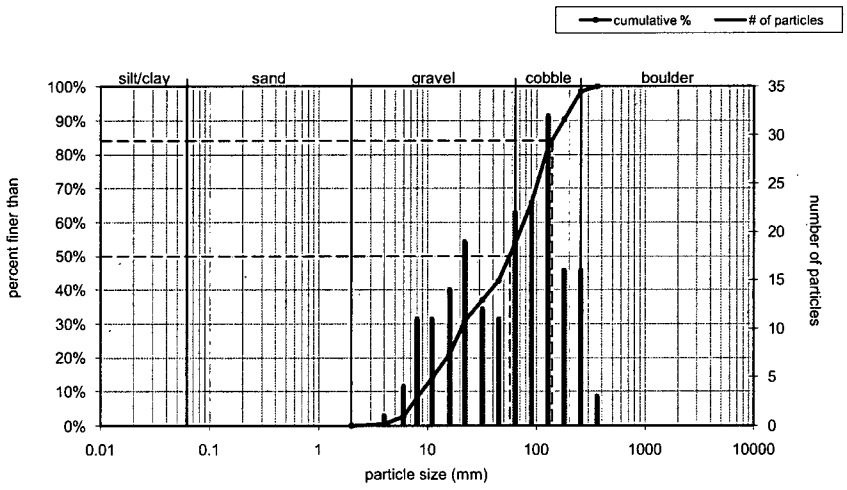
Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		102.21		98.02		
2		102.21		96.55		
		102.21		95.05		
		102.21		94.58		
		102.21	2	93.92		
		102.21		93.15		
		102.21		93.14		LEOW
2		102.21	2	92.98		
		102.21		92.84		
		102.21		92.75		
		102.21		92.85		
		102.21		93.08		
2 2		102.21	2	92.93		
2		102.21		92.85		
		102.21		92.91		
		102.21		93.02		
		102.21	2	92.92		
		102.21	2	92.69		
		102.21		92.71		
		102.21		93.02		
		102.21	22	92.99		
		102.21		93.06		REOW
		102.21		93.11		
		102.21		93.22		BKFL #1
22		102.21		93.26		
2		102.21		93.57		BKFL #2
2		102.21		93.58		
2		102.21		93.84		
2		102.21	2	93.96		
2		102.21		94.22		
		102.21		94.56		
		102.21		94.65		
2		102.21	2	96.49		
		102.21		98.15		
		102.21		98.88		
		102.21	2	99.56		
		102.21	2	99.43		

Bed Surface

Material	Size Range (mm	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	□
fine gravel	4 - 6	□
fine gravel	6 - 8	□□
medium gravel	8 - 11	□□
medium gravel	11 - 16	□□
coarse gravel	16 - 22	□□
coarse gravel	22 - 32	□2
very coarse gravel	32 - 45	□□
very coarse gravel	45 - 64	22
small cobble	64 - 90	2□
medium cobble	90 - 128	□2
large cobble	128 - 180	□□
very large cobble	180 - 256	□□
small boulder	256 - 362	□
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		195
bedrock ----------		□
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		196

Note: sampled at XS2

Bed Surface Pebble Count, AR1-XS2 - Walker Run

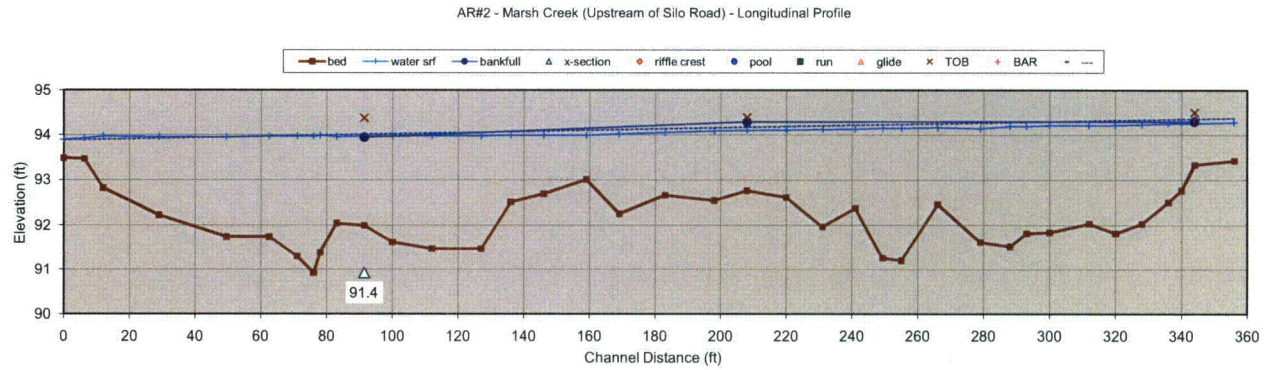


Size (mm)	
D16	12
D35	28
D50	57
D65	88
D84	140
D95	220

Size Distribution	
mean	41.0
dispersion	3.6
skewness	-0.14

Type			
silt/clay	0%	bedrock	1%
sand	0%		
gravel	54%		
cobble	44%		
boulder	2%		

Longitudinal [illegible] Profile

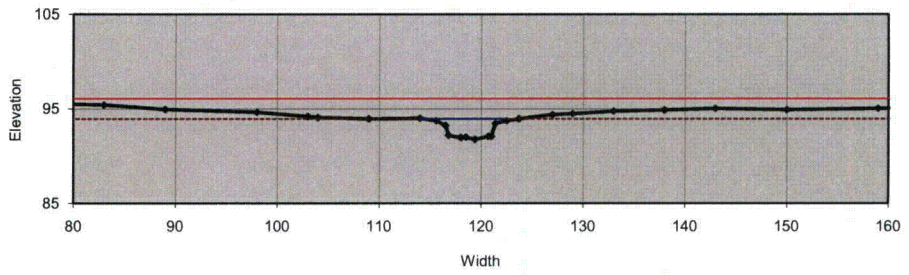


	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.11	---	356.0 (29.5 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

notes	cross section ID	bed feature	station	station	Benchmark Elevation [illegible] Turning Points BS	HI	FS	FS bed	water	FS bankfull	user defined FS TOB	FS BAR	FS	azimuth AZ	ELEV bed	ELEV water srf	ELEV bankfull	ELEV TOB	ELEV BAR	ELEV ---
back sight to benchmark						103.54														
u[illegible]ridge o[illegible]ening						103.54									93.49	93.9				
						103.54									93.47	93.93				
			2			103.54		2							92.82	93.97				
			2			103.54		2							92.22	93.96				
						103.54			2 2						91.74	93.95				
			2			103.54			2 2						91.74	93.97				
						103.54		2 2	2						91.3	93.97				
						103.54		2	2						90.92	93.97				
						103.54		2	2						91.39	93.99				
						103.54			2						92.04	93.96				
[illegible]ro[illegible]e[illegible]tion [illegible]	[illegible]					103.54				[illegible]	[illegible]				91.99	93.97	93.95	94.38		
						103.54		2	2						91.62	93.97				
			2			103.54		2	2						91.47	93.98				
			2			103.54		2	2						91.47	93.98				
						103.54									92.51	93.99				
						103.54									92.69	93.99				
						103.54									93.01	93.99				
						103.54		2							92.25	94.02				
						103.54									92.66	94.05				
						103.54									92.54	94.09				
			2			103.54				2					92.76	94.1	94.29	94.39		
			22			103.54									92.61	94.11				
			2			103.54			2						91.96	94.12				
			2			103.54									92.37	94.13				
			2			103.54		2 2	2						91.26	94.15				
			2			103.54		2	2						91.2	94.15				
			2			103.54									92.46	94.16				
			2			103.54		2	2 2						91.62	94.14				
			2			103.54		2 2	2						91.52	94.19				
			2			103.54		2	2						91.82	94.19				
						103.54			2						91.84	94.21				
			2			103.54			2						92.03	94.21				
			2			103.54		2	2						91.82	94.22				
			2			103.54			2 2						92.03	94.23				
						103.54									92.5	94.25				
						103.54									92.77	94.26				
[illegible]eginning o[illegible]a[illegible]ater						103.54		2	2	2	[illegible]	[illegible]			93.34	94.26	94.3	94.51	94.36	
						103.54									93.43	94.28				
						103.54														

ro e tion

AR2-XS1 - Marsh Creek



Bankfull Dimensions		Flood Dimensions		Materials	
10.0	x-section area (ft.sq.)	130.0	W flood prone area (ft)	0.062	D50 Riffle (mm)
8.1	width (ft)	16.0	entrenchment ratio	0.1	D84 Riffle (mm)
1.2	mean depth (ft)	2.2	low bank height (ft)	3	threshold grain size (mm):
2.2	max depth (ft)	1.0	low bank height ratio		
10.2	wetted parimeter (ft)				
1.0	hyd radi (ft)				
6.6	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
1.7	velocity (ft/s)	0.028	Manning's roughness	0.11	channel slope (%)
17.5	discharge rate (cfs)	0.09	D'Arcy-Weisbach fric.	0.07	shear stress (lb/sq.ft.)
0.31	Froude number	23.5	resistance factor u/u*	0.19	shear velocity (ft/s)
		3764.9	relative roughness	0.15	unit strm power (lb/ft/s)

ro e tion

reference ID
instrument height
longitudinal station

an ull tage

FS = 93.95 elev
elevation 94.01

Lo an eig t

FS = 93.95 elev
elevation

Flood Prone rea

width fpa 128.7

annel lo e

percent slope 0.11

Flo e tan e

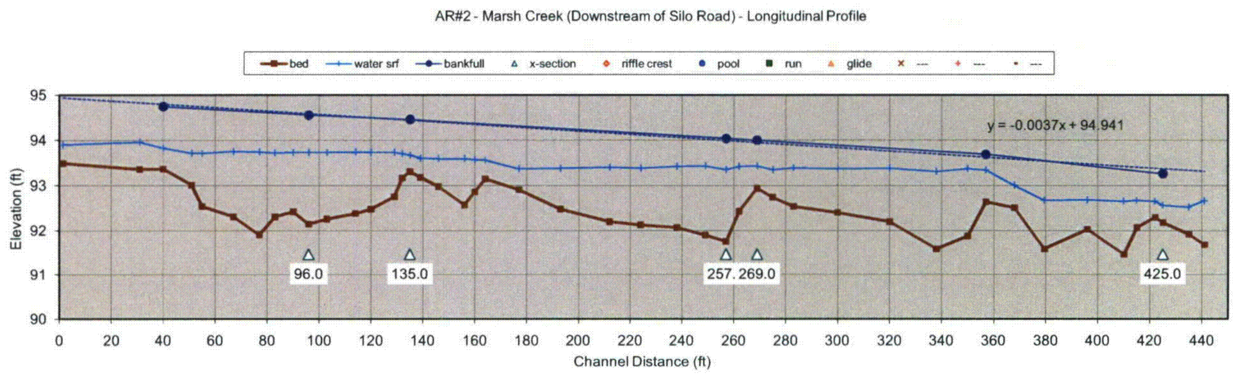
Manning's "n" 0.011
D'Arcy - Weisbach "f" 0.01

ote:

Cross-section #1 is through Marsh Creek reference reach 91.4' upstream of bridge crossing

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		103.54		98.84	☑	Lpin
		103.54	2	98.33	☑	
		103.54		98.43	☑	
2		103.54		98.04	☑	
		103.54		97.7	☑	
		103.54	2	97.31	☑	
		103.54	2	96.92	☑	
2		103.54	2	96.27	☑	
		103.54		95.53	☑	barbed wir
		103.54	2	95.42	☑	
		103.54		94.94	☑	
		103.54		94.65	☑	
		103.54		94.2	☑	
		103.54		94.09	☑	
		103.54		93.95	☑	
		103.54		94.01	☐	
		103.54		93.75	☐	LEW
		103.54		93.23	☐	
		103.54		92.19	☐	
		103.54		91.96	☐	
		103.54		92	☐	
		103.54		91.77	☐	T
2		103.54		92.09	☐	
2		103.54		92.09	☐	
2		103.54		93.45	☐	
22		103.54		93.75	☐	REW
2		103.54		93.95	☑	
2		103.54		94.38	☑	
2		103.54		94.49	☑	
		103.54		94.75	☑	
		103.54		94.87	☑	
		103.54		95.05	☑	
		103.54		94.9	☑	
		103.54		95.05	☑	
		103.54		95.24	☑	
		103.54		95.38	☑	
		103.54	2	95.25	☑	
2		103.54		95.41	☑	
2 2		103.54		95.57	☑	Rpin
					☐	

Longitudinal [illegible]lo[illegible]e Pro[illegible]ile

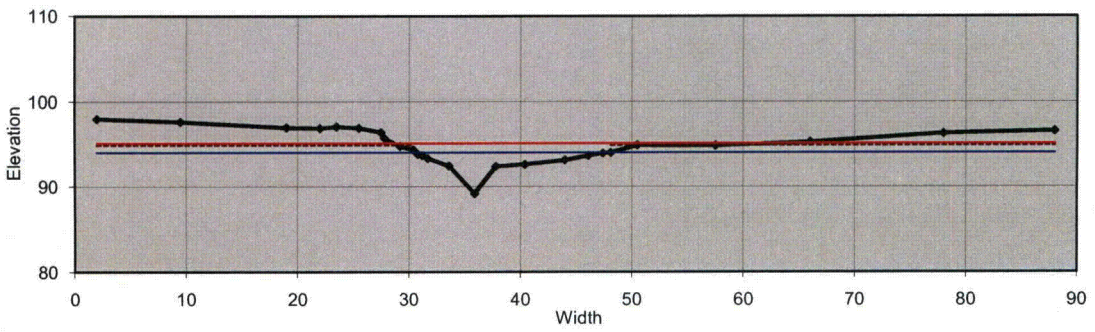


	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.28	---	441.0 (29.6 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

notes	cross section ID	bed feature	station	station	Benchmark Elevation [illegible] Turning Points BS	HI	FS	FS bed	water	FS bankfull	user defined FS	FS	FS	azimuth AZ	ELEV bed	ELEV water srf	ELEV bankfull	ELEV ---	ELEV ---	ELEV ---
back sight to benchmark					[illegible]	104.76														
u[illegible] [illegible]ridge o[illegible]ening			[illegible]			104.76		[illegible]	[illegible]						93.49	93.9				
d[illegible] [illegible]ridge o[illegible]ening			[illegible]			104.76		[illegible]	[illegible]						93.36	93.96				
			[illegible]			104.76		[illegible]	[illegible]	[illegible]					93.37	93.83	94.75			
			[illegible]			104.76		[illegible]	[illegible]						93.01	93.71				
			[illegible]			104.76		[illegible]	[illegible]						92.54	93.71				
			[illegible]			104.76		[illegible]	[illegible]						92.31	93.75				
			[illegible]			104.76		[illegible]	[illegible]						91.91	93.74				
			[illegible]			104.76		[illegible]	[illegible]						92.31	93.72				
			[illegible]			104.76		[illegible]	[illegible]						92.42	93.73				
[illegible]ro[illegible]e[illegible]tion [illegible]2 [illegible]ool[illegible]	[illegible]2		[illegible]			104.76		[illegible]	[illegible]	[illegible]2					92.15	93.73	94.56			
			[illegible]			104.76		[illegible]	[illegible]						92.26	93.73				
			[illegible]			104.76		[illegible]	[illegible]						92.38	93.74				
			[illegible]2[illegible]			104.76		[illegible]	[illegible]						92.48	93.73				
			[illegible]2[illegible]			104.76		[illegible]	[illegible]						92.75	93.73				
			[illegible]2			104.76		[illegible]	[illegible]						93.17	93.7				
[illegible]ro[illegible]e[illegible]tion [illegible]ri[illegible]le[illegible]	[illegible]		[illegible]			104.76		[illegible]	[illegible]	[illegible]					93.31	93.67	94.46			
			[illegible]			104.76		[illegible]	[illegible]						93.18	93.6				
			[illegible]			104.76		[illegible]	[illegible]						92.98	93.59				
			[illegible]			104.76		[illegible]	[illegible]						92.57	93.59				
			[illegible]			104.76		[illegible]	[illegible]						92.86	93.57				
			[illegible]			104.76		[illegible]	[illegible]						93.15	93.56				
			[illegible]			104.76		[illegible]	[illegible]						92.91	93.37				
			[illegible]			104.76		[illegible]	[illegible]						92.48	93.38				
[illegible]P[illegible] [illegible]le[illegible]t [illegible]in at [illegible]						104.76	[illegible]													
[illegible]P[illegible] [illegible]le[illegible]t [illegible]in at [illegible]					[illegible]	102.89														
			2[illegible]2			102.89		[illegible]	[illegible]						92.2	93.4				
			22[illegible]			102.89		[illegible]	[illegible]						92.13	93.38				
			2[illegible]			102.89		[illegible]	[illegible]						92.07	93.42				
			2[illegible]			102.89		[illegible]	[illegible]						91.9	93.43				
[illegible]ro[illegible]e[illegible]tion [illegible]ool[illegible]	[illegible]		2[illegible]			102.89		[illegible]	[illegible]	[illegible]					91.76	93.35	94.04			
			2[illegible]2			102.89		[illegible]	[illegible]						92.43	93.42				
[illegible]ro[illegible]e[illegible]tion [illegible]ri[illegible]le[illegible]	[illegible]		2[illegible]			102.89		[illegible]	[illegible]	[illegible]					92.94	93.43	94			
			2[illegible]			102.89		[illegible]	[illegible]						92.74	93.35				
			2[illegible]			102.89		[illegible]	[illegible]						92.54	93.39				
			[illegible]			102.89		[illegible]	[illegible]						92.4	93.37				
			[illegible]2[illegible]			102.89		[illegible]	[illegible]						92.2	93.38				
			[illegible]			102.89		[illegible]	[illegible]						91.59	93.31				
			[illegible]			102.89		[illegible]	[illegible]						91.88	93.37				
			[illegible]			102.89		[illegible]	[illegible]	[illegible]2					92.64	93.34	93.69			
			[illegible]			102.89		[illegible]	[illegible]						92.51	93				
			[illegible]			102.89		[illegible]	[illegible]						91.59	92.67				
			[illegible]			102.89		[illegible]	[illegible]						92.03	92.68				
			[illegible]			102.89		[illegible]	[illegible]						91.46	92.65				
			[illegible]			102.89		[illegible]	[illegible]						92.07	92.67				
			[illegible]22			102.89		[illegible]	[illegible]						92.3	92.65				
[illegible]ro[illegible]e[illegible]tion [illegible]ri[illegible]le[illegible]	[illegible]		[illegible]2[illegible]			102.89		[illegible]	[illegible]	[illegible]					92.18	92.56	93.26			
			[illegible]			102.89		[illegible]	[illegible]						91.92	92.52				
			[illegible]			102.89		[illegible]	[illegible]						91.68	92.66				
[illegible]P[illegible]2 [illegible]ta[illegible]o[illegible]						102.89	[illegible]													
[illegible]P[illegible]2 [illegible]ta[illegible]o[illegible]					[illegible]	102.63														
						102.63														

ro□□ e□tion □

AR2-XS2 - Marsh Creek (pool)



Bankfull Dimensions		Flood Dimensions		Materials	
25.8	x-section area (ft.sq.)	34.4	W flood prone area (ft)	16	D50 Bed (mm)
17.4	width (ft)	2.0	entrenchment ratio	72	D84 Bed (mm)
1.5	mean depth (ft)	5.7	low bank height (ft)	10	threshold grain size (mm):
4.9	max depth (ft)	1.2	low bank height ratio		
21.6	wetted parimeter (ft)				
1.2	hyd radi (ft)				
11.8	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.6	velocity (ft/s)	0.034	Manning's roughness	0.28	channel slope (%)
68.3	discharge rate (cfs)	0.12	D'Arcy-Weisbach fric.	0.21	shear stress (lb/sq.ft.)
0.43	Froude number	8.0	resistance factor u/u*	0.33	shear velocity (ft/s)
		6.3	relative roughness	0.68	unit strm power (lb/ft/s)

□ro□□ □e□tion

reference ID □
instrument height □□□□□
longitudinal station □□

□an□ull □tage

FS □□□2 = 94.04 elev
elevation 94.59

Lo□ □an□ □eig□t

FS □□□□ = 94.92 elev
elevation

Flood Prone □rea

width fpa □□□□ 34.4

□□annel □lo□e

percent slope 0.28

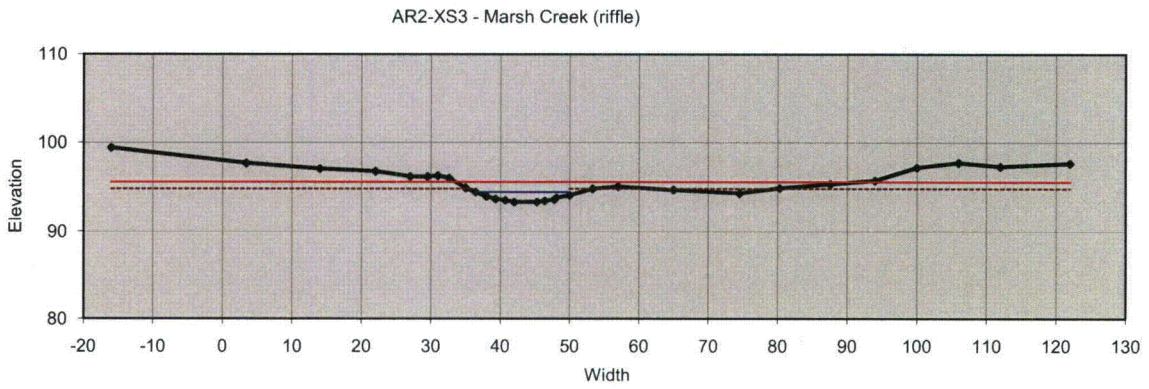
Flo□ □e□i□tan□e

Manning's "n" 0.034
D'Arcy - Weisbach "f" 0.12

□ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
2		104.76	□□□□	97.99	☐	Lpin
□□□		104.76	□□□	97.66	☐	
□□		104.76	□□□□	96.97	☐	
22		104.76	□□□□	96.9	☐	
2□□		104.76	□□□□	97.08	☐	
2□□		104.76	□□□□	96.92	☐	
2□□		104.76	□□□□	96.41	☐	
2□□		104.76	□□□□	95.72	☐	
2□2		104.76	□□□□	94.78	☐	LBKFL?
□□□		104.76	□□□□	94.38	☐	
□□□		104.76	□□□□	93.86	☐	
□□2		104.76	□□□□	93.7	☐	LEW
□□□		104.76	□□□□	93.35	☐	
□□□		104.76	2□2	92.44	☐	
□□□		104.76	□□□□	89.18	☐	
□□□		104.76	2□□	92.4	☐	
□□□		104.76	2□□	92.63	☐	burreed
□□		104.76	□□□□	93.16	☐	
□□□		104.76	□□□□	93.68	☐	REW
□□□		104.76	□□□□	93.97	☐	
□□□		104.76	□□□2	94.04	☐	RBKFL?
□□□		104.76	□□□□	94.92	☐	
□□□		104.76	□□□□	94.88	☐	
□□		104.76	□□□□	95.29	☐	
□□		104.76	□□□□	96.3	☐	
□□		104.76	□□□□	96.59	☐	
					☐	
					☐	

□ro□□ e□tion 2



Bankfull Dimensions		Flood Dimensions		Materials	
11.2	x-section area (ft.sq.)	58.1	W flood prone area (ft)	16	D50 Bed (mm)
13.6	width (ft)	4.3	entrenchment ratio	72	D84 Bed (mm)
0.8	mean depth (ft)	1.5	low bank height (ft)	9	threshold grain size (mm):
1.1	max depth (ft)	1.3	low bank height ratio		
13.8	wetted parimeter (ft)				
0.8	hyd radi (ft)				
16.5	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
1.9	velocity (ft/s)	0.041	Manning's roughness	0.37	channel slope (%)
21.5	discharge rate (cfs)	0.21	D'Arcy-Weisbach fric.	0.19	shear stress (lb/sq.ft.)
0.38	Froude number	6.2	resistance factor u/u*	0.31	shear velocity (ft/s)
		3.5	relative roughness	0.36	unit strm power (lb/ft/s)

□ro□□ e□tion

reference ID: 2
instrument height: □□□□□□ ---
longitudinal station: □□□ ---

□an□□ull □tage

FS: □□□□ = 94.46 elev
elevation: 94.44

Lo□ □an□ □eig□t

FS: □□□□ = 94.83 elev
elevation:

Flood Prone □rea

width fpa: □□□□ 58.1

□□annel □lo□e

percent slope: □□□□ 0.28

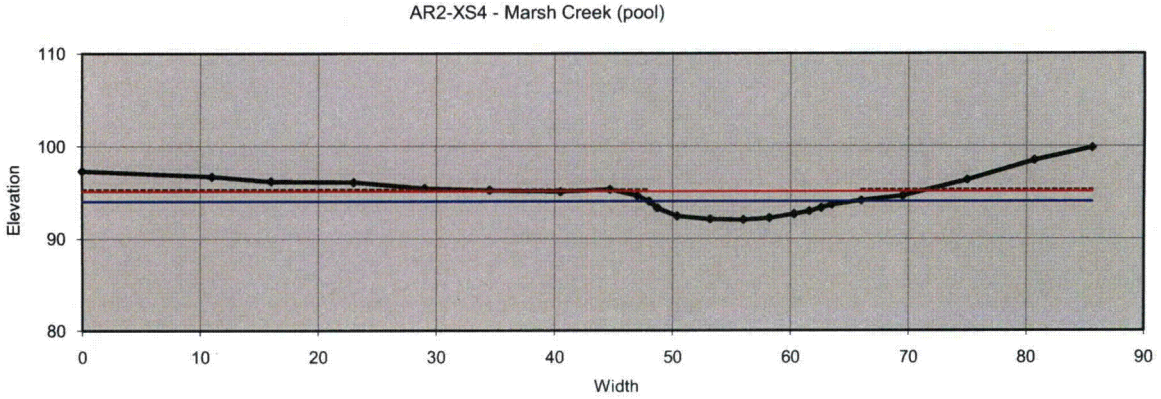
Flo□ □e□i□tan□e

Manning's "n": □□□□□ 0.041
D'Arcy - Weisbach "f": 0.21

□ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
□□□		104.76	□□□□	99.42	☑	Lpin
□□□		104.76	□□□□	97.69	☑	
□□		104.76	□□□□	97.07	☑	
22		104.76	□□□□	96.78	☑	
2□		104.76	□□□□	96.2	☑	
2□□□		104.76	□□□□	96.17	☑	
□□		104.76	□□□□	96.29	☑	
□2□□		104.76	□□□□	96.02	☑	
□□		104.76	□□□□	94.91	☑	LBFKL?
□□□□		104.76	□□□□	94.46	☐	LBKFL?
□□		104.76	□□□□□	93.95	☐	
□□□□		104.76	□□□□□	93.67	☐	LEW
□□□□		104.76	□□2□	93.53	☐	
□2		104.76	□□□□□	93.32	☐	
□□□□		104.76	□□□□□	93.33	☐	
□□□□		104.76	□□□□	93.46	☐	
□□□□		104.76	□□□□□	93.62	☐	REW
□□□□		104.76	□□□□□	93.82	☐	
□□		104.76	□□□□□	94.09	☐	RBKFL?
□□□□		104.76	□□□□	94.83	☑	
□□		104.76	□□□□	95.08	☑	
□□		104.76	□□□□□	94.7	☑	
□□□□		104.76	□□□□□	94.33	☑	
□□□□		104.76	□□□□	94.9	☑	
□□□□		104.76	□□□	95.36	☑	
□□		104.76	□□2	95.74	☑	
□□□		104.76	□□□□	97.21	☑	
□□□		104.76	□□□□	97.75	☑	
□□2		104.76	□□□□	97.31	☑	
22		104.76	□□□	97.66	☑	
					☐	

ro□□ e tion □



Bankfull Dimensions		Flood Dimensions		Materials	
23.8	x-section area (ft.sq.)	29.3	W flood prone area (ft)	16	D50 Bed (mm)
17.6	width (ft)	1.7	entrenchment ratio	72	D84 Bed (mm)
1.4	mean depth (ft)	3.3	low bank height (ft)	11	threshold grain size (mm):
2.0	max depth (ft)	1.6	low bank height ratio		
18.4	wetted parimeter (ft)				
1.3	hyd radi (ft)				
13.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.6	velocity (ft/s)	0.037	Manning's roughness	0.28	channel slope (%)
60.6	discharge rate (cfs)	0.14	D'Arcy-Weisbach fric.	0.23	shear stress (lb/sq.ft.)
0.40	Froude number	7.5	resistance factor u/u*	0.34	shear velocity (ft/s)
		5.7	relative roughness	0.6	unit strm power (lb/ft/s)

□ro□□ □e□tion

reference ID □
instrument height □2□□
longitudinal station 2□□

□an□□ull □tage

FS □□□□ = 94.04 elev
elevation 93.99

Lo□ □an□ □eig□t

FS □□□□ = 95.32 elev
elevation

Flood Prone □rea

width fpa 29.3

□□annel □lo□e

percent slope 0.28

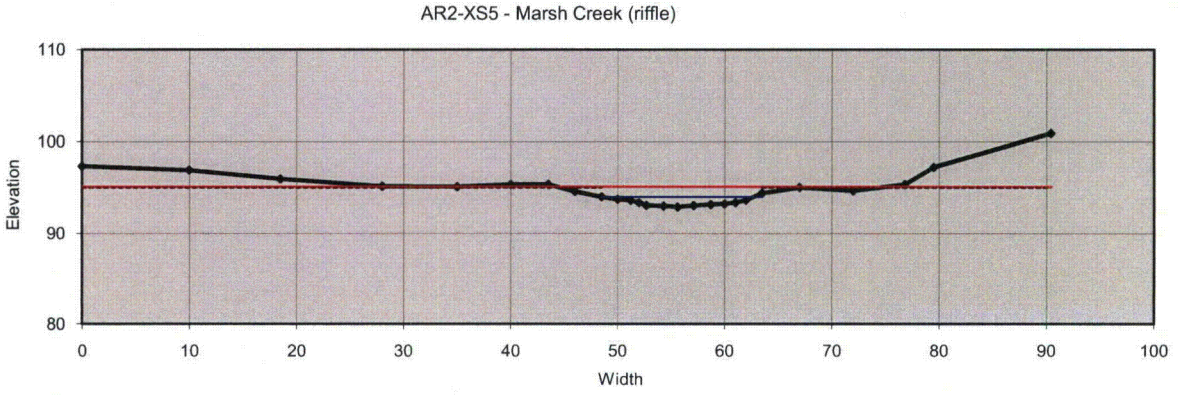
Flo□ □e□i□tan□e

Manning's "n" 0.037
D'Arcy - Weisbach "f" 0.14

□ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
□		102.89	□□□□	97.32	■	Lpin
□□		102.89	□2	96.69	■	
□□		102.89	□□□□	96.18	■	
2□		102.89	□□□	96.09	■	
2□		102.89	□□□□	95.45	■	
□□□		102.89	□□□□	95.25	■	
□□□□		102.89	□□□	95.09	■	
□□□□		102.89	□□□□	95.32	■	
□□		102.89	□2□	94.62	■	
□□		102.89	□□□□	94.04	■	LBKFL?
□□□□		102.89	□□□□	93.3	■	LEW
□□□□		102.89	□□□□	92.42	■	
□□2		102.89	□□□□	92.1	■	
□□		102.89	□□□□	92.02	■	
□□2		102.89	□□□□	92.22	■	
□□□□		102.89	□□2	92.65	■	
□□□□		102.89	□□□□	92.96	■	
□2□□		102.89	□□□□	93.35	■	REW
□□□□		102.89	□2□	93.66	■	RBKFL?
□□		102.89	□□□□	94.12	■	RBKFL?
□□□□		102.89	□2□	94.62	■	
□□		102.89	□□□□	96.35	■	
□□□□		102.89	□□□□	98.48	■	
□□□□		102.89	□□□□	99.84	■	Rpin
					■	
					■	
					■	
					■	

ro e tion



Bankfull Dimensions		Flood Dimensions		Materials	
9.8	x-section area (ft.sq.)	32.9	W flood prone area (ft)	16	D50 Bed (mm)
14.2	width (ft)	2.3	entrenchment ratio	72	D84 Bed (mm)
0.7	mean depth (ft)	2.1	low bank height (ft)	8	threshold grain size (mm):
1.1	max depth (ft)	1.9	low bank height ratio		
14.5	wetted parimeter (ft)				
0.7	hyd radi (ft)				
20.6	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
1.7	velocity (ft/s)	0.042	Manning's roughness	0.37	channel slope (%)
16.3	discharge rate (cfs)	0.23	D'Arcy-Weisbach fric.	0.16	shear stress (lb/sq.ft.)
0.36	Froude number	5.9	resistance factor u/u*	0.28	shear velocity (ft/s)
		2.9	relative roughness	0.26	unit strm power (lb/ft/s)

ro e tion

reference ID
instrument height 2
longitudinal station 2

an ull tage

FS = 94 elev
elevation 93.95

Lo an eig t

FS = 95.01 ele
elevation

Flood Prone rea

width fpa 2 32.9

annel lo e

percent slope 0.28

Flo e i tan e

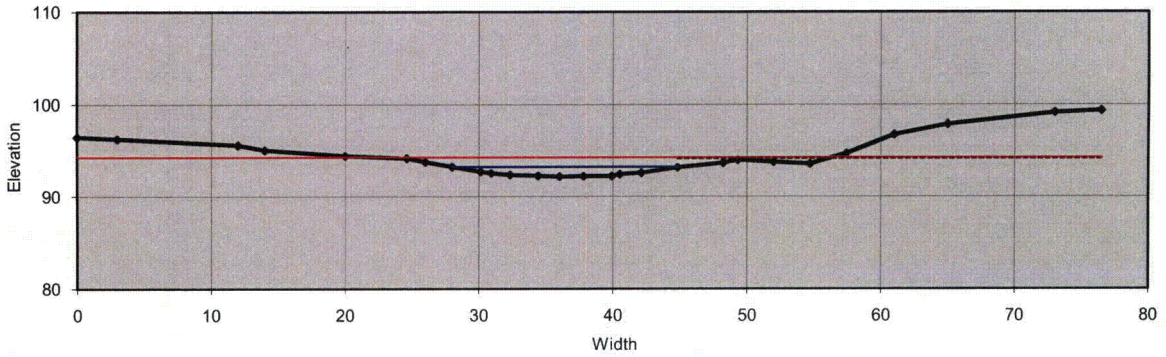
Manning's "n" 2 0.042
D'Arcy - Weisbach "f" 0.23

ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		102.89		97.32	☑	Lpin
		102.89		96.9	☑	
		102.89		95.94	☑	
2		102.89		95.14	☑	
		102.89		95.1	☑	
		102.89		95.32	☑	
		102.89		95.34	☑	
		102.89		94.59	☑	
		102.89		94	☐	LBKFL?
		102.89		93.73	☐	LBKFL?
2		102.89	2	93.62	☐	
2		102.89	2	93.37	☐	LEW
2		102.89		93.08	☐	
		102.89		93	☐	
		102.89		92.89	☐	
		102.89		93.05	☐	
		102.89		93.16	☐	
		102.89		93.23	☐	
		102.89	2	93.37	☐	REW
2		102.89	2	93.63	☐	RBKFL?
		102.89		94.4	☐	RBKFL?
		102.89		95.01	☑	
2		102.89	22	94.67	☑	
		102.89		95.34	☑	
		102.89		97.22	☑	
		102.89	2	100.89	☑	Rpin
					☐	
					☐	

ro e tion

AR2-XS6 - Marsh Creek (riffle)



Bankfull Dimensions	
12.6	x-section area (ft.sq.)
16.8	width (ft)
0.7	mean depth (ft)
1.1	max depth (ft)
17.0	wetted parimeter (ft)
0.7	hyd radi (ft)
22.5	width-depth ratio

Flood Dimensions	
34.3	W flood prone area (ft)
2.0	entrenchment ratio
2.0	low bank height (ft)
1.9	low bank height ratio

Materials	
16	D50 Bed (mm)
72	D84 Bed (mm)
8	threshold grain size (mm):

Bankfull Flow	
1.8	velocity (ft/s)
22.7	discharge rate (cfs)
0.37	Froude number

Flow Resistance	
0.041	Manning's roughness
0.22	D'Arcy-Weisbach fric.
6.0	resistance factor u/u*
3.2	relative roughness

Forces & Power	
0.37	channel slope (%)
0.17	shear stress (lb/sq.ft.)
0.30	shear velocity (ft/s)
0.31	unit strm power (lb/ft/s)

ro e tion

reference ID
instrument height 2
longitudinal station 2

an ull tage

FS = 93.26 elev
elevation 93.37

Lo an eig t

FS 2 = 94.21 elev
elevation

Flood Prone rea

width fpa 34.3

annel lo e

percent slope 0.28

Flo e i tan e

Manning's "n" 0.041
D'Arcy - Weisbach "f" 0.22

ote:

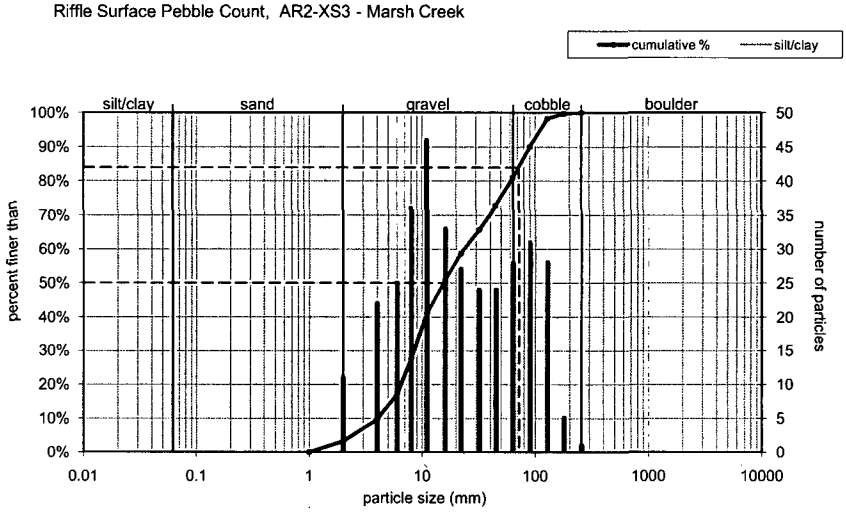
Cross-section #6 is downstream-most riffle at sta. 4+25. Surveyed after TP#2.

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		102.63		96.5	☑	Lpin
		102.63		96.29	☑	
2		102.63		95.63	☑	
		102.63		95.09	☑	
2		102.63		94.46	☑	
2		102.63	2	94.21	☑	
2		102.63		93.79	☑	LBKFL?
2		102.63		93.26	☐	LBKFL?
		102.63		92.72	☐	
		102.63		92.56	☐	LEW
2		102.63	2	92.38	☐	
		102.63		92.26	☐	
		102.63		92.18	☐	
		102.63		92.22	☐	
		102.63		92.24	☐	
		102.63		92.45	☐	
2		102.63	2	92.61	☐	REW
		102.63		93.19	☐	
2		102.63		93.7	☑	
		102.63		94.02	☑	
2		102.63	2	93.81	☑	
		102.63		93.59	☑	
		102.63		94.73	☑	
		102.63		96.78	☑	
		102.63	2	97.91	☑	
		102.63		99.15	☑	
		102.63	2	99.37	☑	Rpin
					☐	

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	□□
very fine gravel	2 - 4	22
fine gravel	4 - 6	2□
fine gravel	6 - 8	□□
medium gravel	8 - 11	□□
medium gravel	11 - 16	□□
coarse gravel	16 - 22	2□
coarse gravel	22 - 32	2□
very coarse gravel	32 - 45	2□
very coarse gravel	45 - 64	2□
small cobble	64 - 90	□□
medium cobble	90 - 128	2□
large cobble	128 - 180	□
very large cobble	180 - 256	□
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		341
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		341

Note: sampled at XS3 (riffle) d/s of bridge



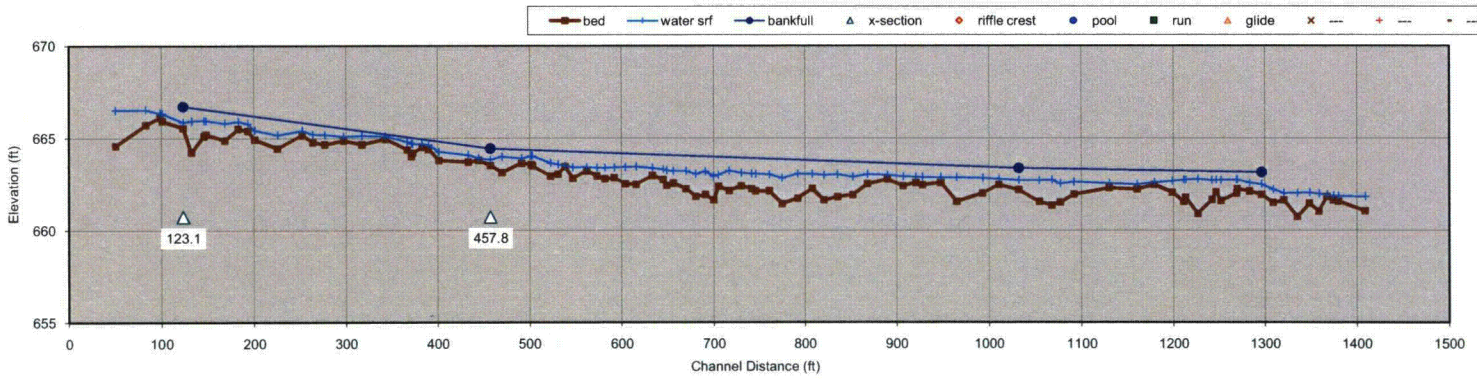
Size (mm)	
D16	5.7
D35	9.5
D50	16
D65	31
D84	72
D95	110

Size Distribution	
mean	20.3
dispersion	3.7
skewness	0.10

Type	
silt/clay	0%
sand	3%
gravel	78%
cobble	19%
boulder	0%

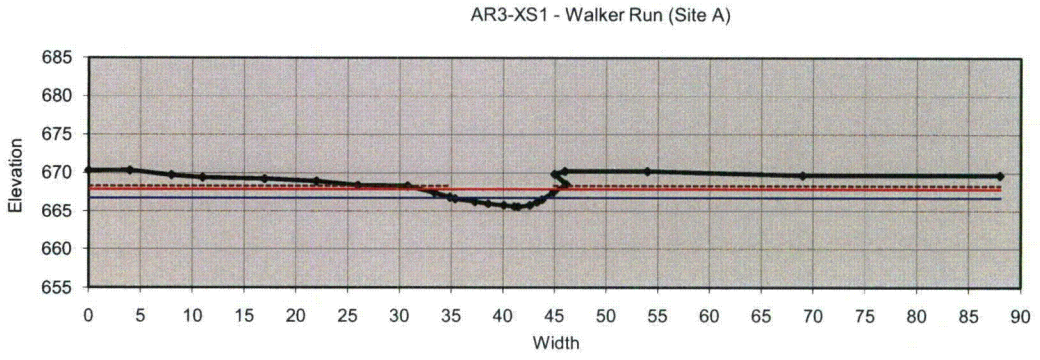
Longitudinal Profile

AR#3 - Walker Run (Site A) - Existing Longitudinal Profile



	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.34	---	1409.3 (137.4 channel widths	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

ro e tion



Bankfull Dimensions	
6.0	x-section area (ft.sq.)
8.9	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
9.3	wetted parimeter (ft)
0.6	hyd radi (ft)
13.0	width-depth ratio

Flood Dimensions	
13.4	W flood prone area (ft)
1.5	entrenchment ratio
2.8	low bank height (ft)
2.4	low bank height ratio

Materials	
0.13	D50 Bed (mm)
0.24	D84 Bed (mm)
7	threshold grain size (mm):

Bankfull Flow	
3.3	velocity (ft/s)
19.6	discharge rate (cfs)
0.71	Froude number

Flow Resistance	
0.020	Manning's roughness
0.05	D'Arcy-Weisbach fric.
20.1	resistance factor u/u*
864.9	relative roughness

Forces & Power	
0.34	channel slope (%)
0.14	shear stress (lb/sq.ft.)
0.27	shear velocity (ft/s)
0.47	unit strm power (lb/ft/s)

ro e tion

reference ID
instrument height
longitudinal station 2

an ull tage

FS = 666.73 elev
elevation 666.15

Lo an eig t

FS = 668.32 elev
elevation

Flood Prone rea

width fpa 13.4

annel lo e

percent slope 0.34

Flo e i tan e

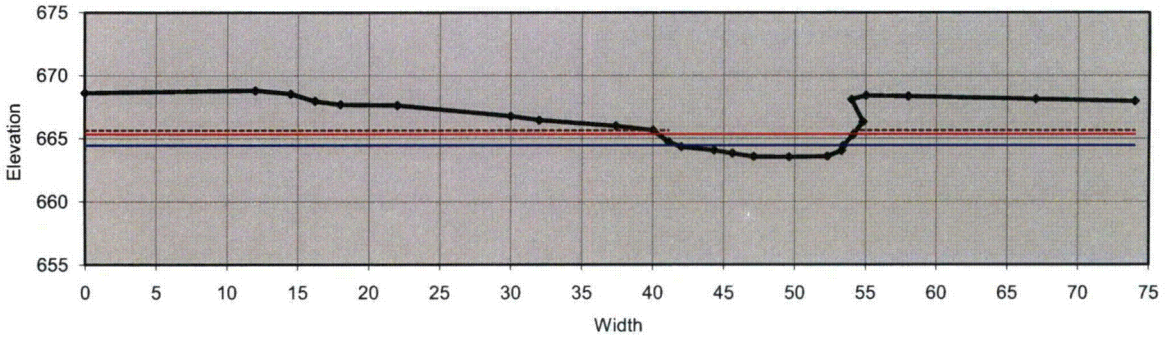
Manning's "n" 2 0.012
D'Arcy - Weisbach "f" 0.02

ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		677.88		670.3		L Pin
		677.88		670.33		
		677.88		669.7		
		677.88		669.41		
		677.88		669.24		
22		677.88		668.9		
2		677.88		668.4		
		677.88		668.32		LTOB
		677.88		667.44		
		677.88		666.84		LBKFL
		677.88	2	666.64		LEW
		677.88		666.27		
		677.88		665.98		
		677.88	2 2	665.76		
		677.88	2 2	665.61		
		677.88	2 2	665.56		Thalweg
2		677.88	2	665.77		R Toe
		677.88		666.17		REW
		677.88		666.53		BP (bot.)
		677.88		667.5		BP (mid.)
		677.88		668.51		BP (top)
		677.88		669.83		RTOB
		677.88		670.19		
		677.88		670.19		
		677.88	2	669.67		
		677.88		669.69		R Pin

ro e tion 2

AR3-XS2 - Walker Run (Site A)



Bankfull Dimensions		Flood Dimensions		Materials	
7.7	x-section area (ft.sq.)	13.8	W flood prone area (ft)	0.13	D50 Bed (mm)
11.7	width (ft)	1.2	entrenchment ratio	0.24	D84 Bed (mm)
0.7	mean depth (ft)	2.1	low bank height (ft)	7	threshold grain size (mm):
0.9	max depth (ft)	2.3	low bank height ratio		
12.2	wetted parimeter (ft)				
0.6	hyd radi (ft)				
17.8	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.6	velocity (ft/s)	0.025	Manning's roughness	0.34	channel slope (%)
19.6	discharge rate (cfs)	0.08	D'Arcy-Weisbach fric.	0.13	shear stress (lb/sq.ft.)
0.57	Froude number	19.9	resistance factor u/u*	0.26	shear velocity (ft/s)
		834.7	relative roughness	0.36	unit strm power (lb/ft/s)

ro e tion

reference ID 2
instrument height
longitudinal station

an ull tage

FS = 664.44 elev
elevation 665.19

Lo an eig t

FS = 665.65 elev
elevation

Flood Prone rea

width fpa 13.8

annel lo e

percent slope 0.34

Flo e i tan e

Manning's "n" 0.012
D'Arcy - Weisbach "f" 0.02

ote:

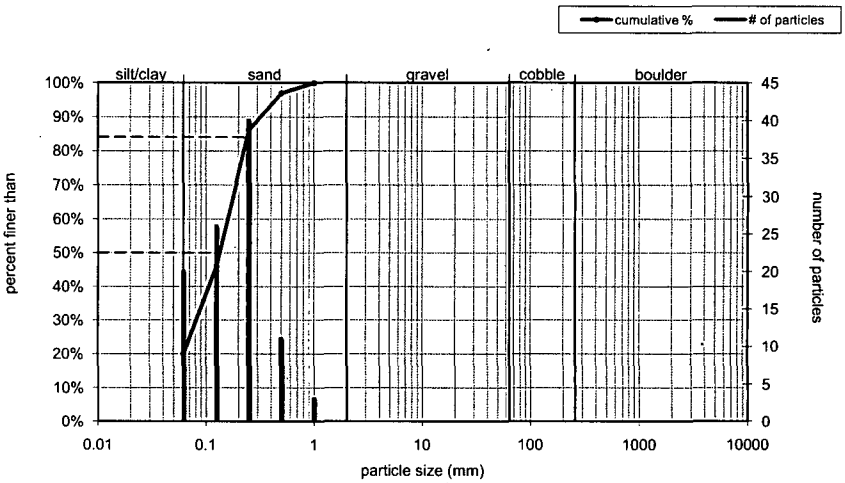
Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		673.44	2	668.62		L Pin
2		673.44		668.8		
		673.44		668.53		
2		673.44		667.95		
		673.44		667.69		
22		673.44	2	667.62		
		673.44		666.77		
2		673.44		666.45		
		673.44		665.99		
		673.44		665.65		LTOB
		673.44	2	664.72		LBKFL?
2		673.44		664.34		LBKFL?
		673.44		664.06		LEW
		673.44	2	663.82		
		673.44		663.55		
		673.44	2	663.52		Thalweg
2		673.44		663.58		R Toe
		673.44		664.03		REW
		673.44		664.4		BP (bot.)
		673.44		665.28		BP (mid.)
		673.44		666.33		BP (top)
		673.44		668.09		RTOB
		673.44		668.39		
		673.44		668.34		
		673.44		668.13		
		673.44		667.96		R Pin

Bed Surface

Material	Size Range (mm	Count
silt/clay	0 - 0.062	2□
very fine sand	0.062 - 0.125	2□
fine sand	0.125 - 0.25	□□
medium sand	0.25 - 0.5	□□
coarse sand	0.5 - 1	□
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	
fine gravel	6 - 8	
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: rereresentative riffle - sampled on 4-7-10

Bed Surface Pebble Count, AR3 - Walker Run (Site A)



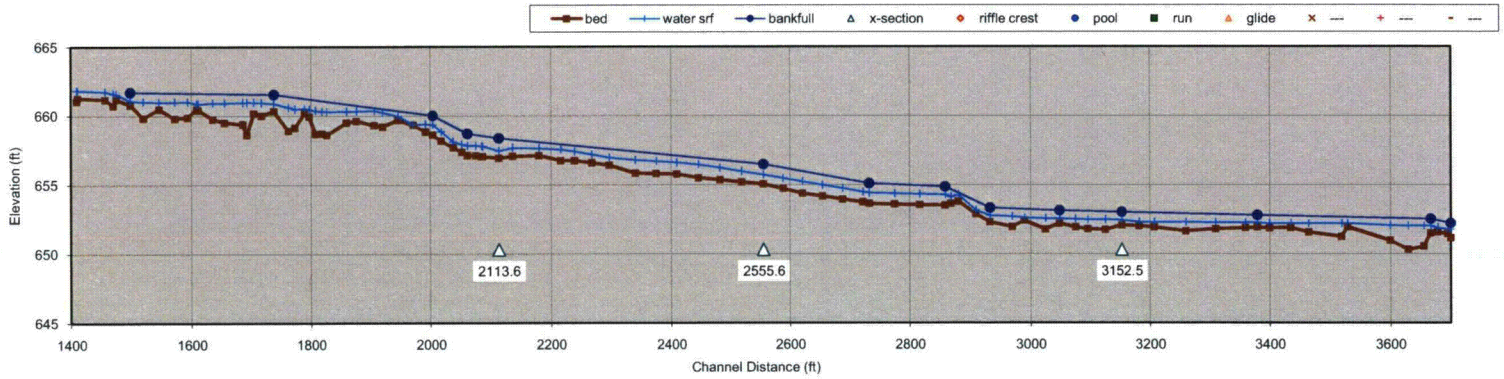
Size (mm)	
D16	0.062
D35	0.093
D50	0.13
D65	0.17
D84	0.24
D95	0.44

Size Distribution	
mean	0.1
dispersion	2.0
skewness	-0.04

Type	
silt/clay	20%
sand	80%
gravel	0%
cobble	0%
boulder	0%

Longitudinal Profile

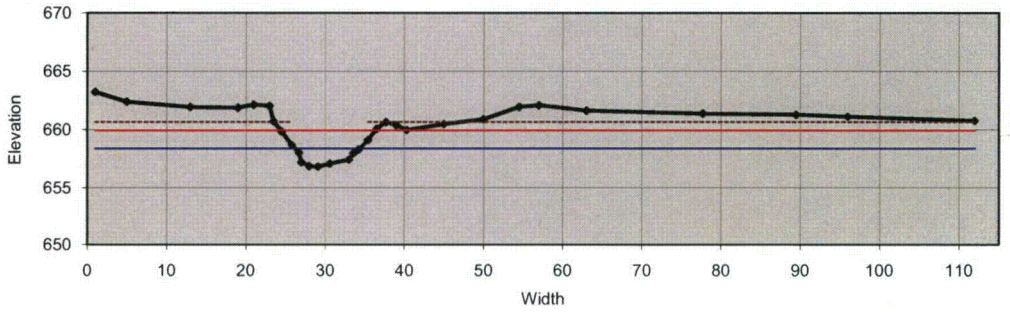
AR#3 - Walker Run (Site B) - Existing Longitudinal Profile



	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.44	---	3700.0 (410.7 channel width	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

ro e tion

AR3-XS3 - Walker Run (Site B)



Bankfull Dimensions	
8.8	x-section area (ft.sq.)
8.2	width (ft)
1.1	mean depth (ft)
1.6	max depth (ft)
9.3	wetted parimeter (ft)
0.9	hyd radi (ft)
7.6	width-depth ratio

Flood Dimensions	
12.0	W flood prone area (ft)
1.5	entrenchment ratio
3.8	low bank height (ft)
2.4	low bank height ratio

Materials	
6.2	D50 Bed (mm)
50	D84 Bed (mm)
13	threshold grain size (mm):

Bankfull Flow	
2.7	velocity (ft/s)
24.0	discharge rate (cfs)
0.49	Froude number

Flow Resistance	
0.035	Manning's roughness
0.14	D'Arcy-Weisbach fric.
7.7	resistance factor u/u*
6.6	relative roughness

Forces & Power	
0.44	channel slope (%)
0.26	shear stress (lb/sq.ft.)
0.37	shear velocity (ft/s)
0.81	unit strm power (lb/ft/s)

ro e tion

reference ID
instrument height
longitudinal station 2

an ull tage

FS = 658.38 elev
elevation 658.67

Lo an eigt

FS = 660.65 elev
elevation

Flood Prone rea

width fpa 12.0

annel lo e

percent slope 0.44

Flo e i tan e

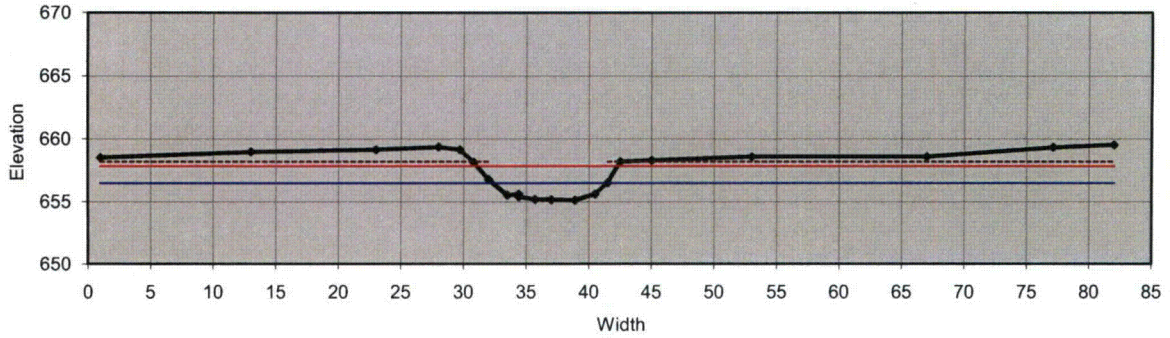
Manning's "n" 0.034
D'Arcy - Weisbach "f" 0.14

ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		665.98	2	663.22		L Pin
		665.98		662.39		
		665.98		661.95		
		665.98		661.88		
2		665.98		662.14		
2		665.98		662.04		LTOB
2		665.98	2	660.72		
2		665.98		659.85		
2		665.98		658.67		
2		665.98		658		LEW
2		665.98		657.2		
2		665.98	2	656.86		
2		665.98		656.81		thalweg
		665.98		657.08		
		665.98		657.42		
		665.98		657.99		REW
2		665.98		658.27		
		665.98		659.1		
		665.98		660.07		
		665.98		660.65		RTOB
		665.98		660.37		
		665.98		659.97		
		665.98		660.48		
		665.98		660.91		
		665.98	2	661.96		
		665.98		662.09		
		665.98		661.64		
		665.98		661.39		
		665.98		661.29		R Pin
		665.98		661.12		cornfield
2		665.98	2	660.77		

ro e tion 2

AR3-XS4 - Walker Run (Site B)



Bankfull Dimensions		Flood Dimensions		Materials	
9.4	x-section area (ft.sq.)	11.2	W flood prone area (ft)	6.2	D50 Bed (mm)
9.1	width (ft)	1.2	entrenchment ratio	50	D84 Bed (mm)
1.0	mean depth (ft)	3.0	low bank height (ft)	12	threshold grain size (mm):
1.4	max depth (ft)	2.3	low bank height ratio		
10.1	wetted parimeter (ft)				
0.9	hyd radi (ft)				
8.9	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.7	velocity (ft/s)	0.035	Manning's roughness	0.44	channel slope (%)
25.1	discharge rate (cfs)	0.15	D'Arcy-Weisbach fric.	0.25	shear stress (lb/sq.ft.)
0.49	Froude number	7.5	resistance factor u/u*	0.36	shear velocity (ft/s)
		6.2	relative roughness	0.75	unit strm power (lb/ft/s)

ro e tion

reference ID: 2
instrument height:
longitudinal station: 2

an ull tage

FS: = 656.48 elev
elevation: 656.56

Lo an eig t

FS: = 658.17 elev
elevation:

Flood Prone rea

width fpa: 11.2

annel lo e

percent slope: 0.44

Flo e i tan e

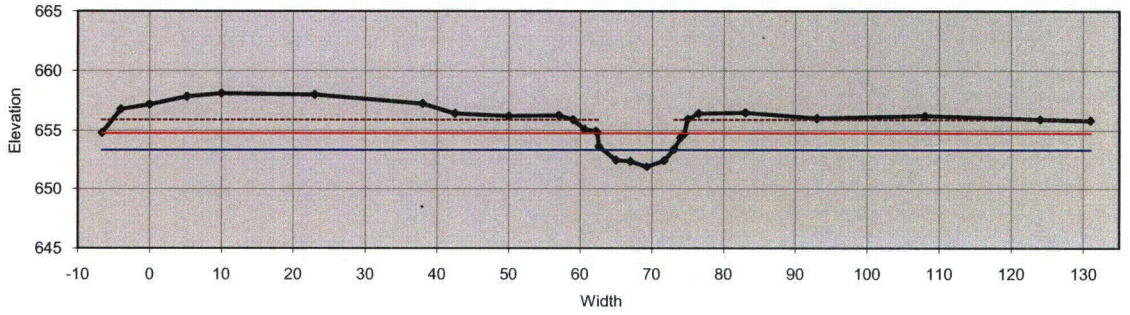
Manning's "n": 0.035
D'Arcy - Weisbach "f": 0.14

ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		665.98		658.49		L Pin
		665.98		658.94		
2		665.98		659.13		
2		665.98		659.34		
2		665.98		659.13		LTOB
		665.98		658.13		
2		665.98	22	656.76		
		665.98		655.52		
		665.98		655.61		LEW
		665.98		655.4		
		665.98		655.19		
		665.98	2	655.16		
		665.98		655.13		thalweg
		665.98		655.61		REW
		665.98		656.51		
2		665.98		658.17		RTOB
		665.98		658.27		
		665.98	2	658.56		
		665.98	2	658.56		
		665.98		659.31		R Pin
2		665.98		659.52		

□ro□□ □e□tion □

AR3-XS5 - Walker Run (Site B)



Bankfull Dimensions		Flood Dimensions		Materials	
8.7	x-section area (ft.sq.)	12.1	W flood prone area (ft)	6.2	D50 Bed (mm)
9.7	width (ft)	1.2	entrenchment ratio	50	D84 Bed (mm)
0.9	mean depth (ft)	4.0	low bank height (ft)	11	threshold grain size (mm):
1.4	max depth (ft)	2.8	low bank height ratio		
10.3	wetted parimeter (ft)				
0.8	hyd radi (ft)				
10.9	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.5	velocity (ft/s)	0.035	Manning's roughness	0.44	channel slope (%)
21.9	discharge rate (cfs)	0.15	D'Arcy-Weisbach fric.	0.23	shear stress (lb/sq.ft.)
0.48	Froude number	7.4	resistance factor u/u*	0.35	shear velocity (ft/s)
		5.4	relative roughness	0.62	unit strm power (lb/ft/s)

□ro□□ □e□tion

reference ID □
instrument height □□□□□□ ---
longitudinal station □□□2□ ---

□an□ull □tage

FS □□□□ = 653.33 elev
elevation 653.70

Lo□ □an□ □eig□t

FS □□□2 = 655.91 elev
elevation

Flood Prone □rea

width fpa 12.1

□□annel □lo□e

percent slope □□□□ 0.44

Flo□ □e□i□tan□e

Manning's "n" □□□□□ 0.035
D'Arcy - Weisbach "f" 0.15

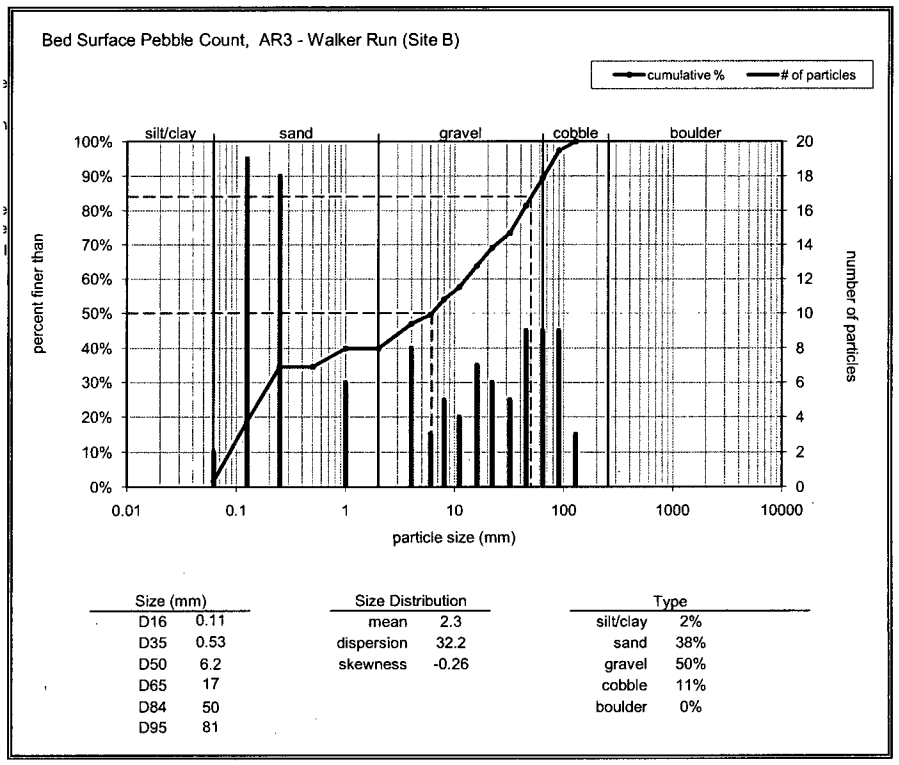
□ote:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
□□□□		666.83	□2□□	654.8	□	Pond WS
□□		666.83	□□□□□	656.79	□	
□		666.83	□□□□	657.18	□	
□2		666.83	□	657.83	□	L Pin
□□		666.83	□□□2	658.11	□	
2□		666.83	□□□□	658	□	
□□		666.83	□□□□	657.25	□	
2□□		666.83	□□□□	656.43	□	
□□		666.83	□□□□2	656.21	□	
□□		666.83	□□□□□	656.26	□	
□□		666.83	□□□□2	655.91	□	
□□□□		666.83	□□□□□	655.1	□	
2 2		666.83	□□□□	654.93	□	
2□□		666.83	2□□□	654.82	□	LEW
2□□		666.83	□□□□□	653.65	□	
□□		666.83	□□□□□	652.48	□	
□□		666.83	□□□□□	652.36	□	
□□□□		666.83	□□□□□	651.9	□	thalweg
□□□□		666.83	□□□□	652.43	□	
□□□□		666.83	□□□2	653.41	□	
□□		666.83	2□2	654.41	□	
□□□□		666.83	2□□2	654.71	□	REW
□□		666.83	□□□□□	655.95	□	RTOB
□□□□		666.83	□□□□	656.43	□	
□□		666.83	□□□□□	656.49	□	
□□		666.83	□□□□□	656.02	□	
□□□		666.83	□□□□	656.23	□	
2□		666.83	□□□□	655.93	□	
□□□		666.83	□□	655.83	□	R Pin
					□	

Bed Surface

Material	Size Range (mm	Count
silt/clay	0 - 0.062	2
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	
fine gravel	6 - 8	
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		113
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		113

Note: representative riffle - sampled at on 4-7-10



Size (mm)	
D16	0.11
D35	0.53
D50	6.2
D65	17
D84	50
D95	81

Size Distribution	
mean	2.3
dispersion	32.2
skewness	-0.26

Type	
silt/clay	2%
sand	38%
gravel	50%
cobble	11%
boulder	0%

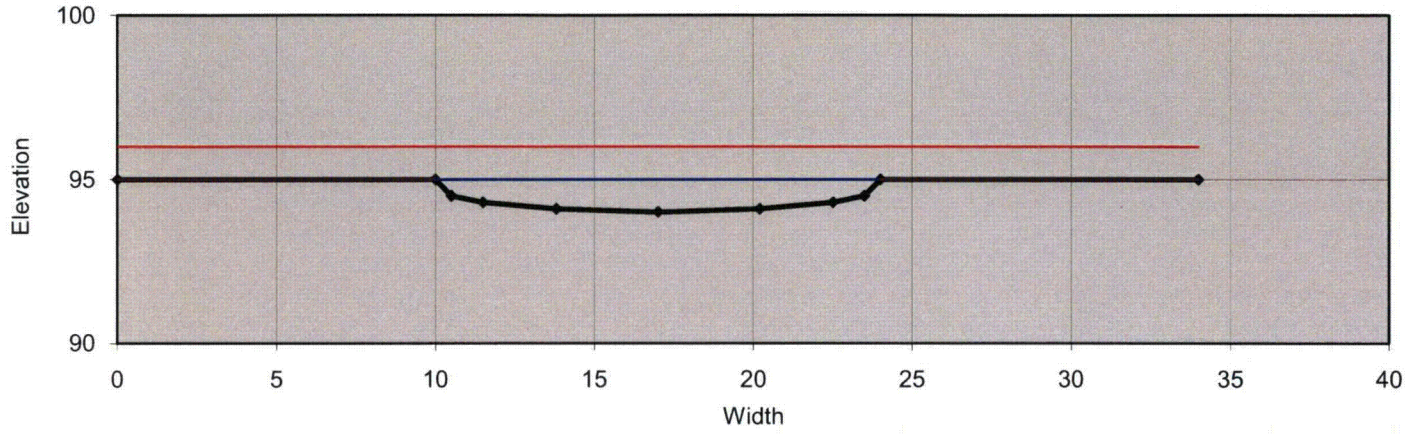
APPENDIX C

Proposed Geomorphic Data:
Typical Proposed Cross-Sections,
Proposed Longitudinal Profiles,
Proposed Bed Materials

(Walker Run)

ro e tion

Walker Run Site A (Sta. 0+00 to 8+49) - Proposed Riffle Cross Section (typical)



Bankfull Dimensions	
11.2	x-section area (ft.sq.)
14.0	width (ft)
0.8	mean depth (ft)
1.0	max depth (ft)
14.5	wetted parimeter (ft)
0.8	hyd radi (ft)
17.5	width-depth ratio

Flood Dimensions	
115.0	W flood prone area (ft)
8.2	entrenchment ratio
1.0	low bank height (ft)
1.0	low bank height ratio

Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
7	threshold grain size (mm):

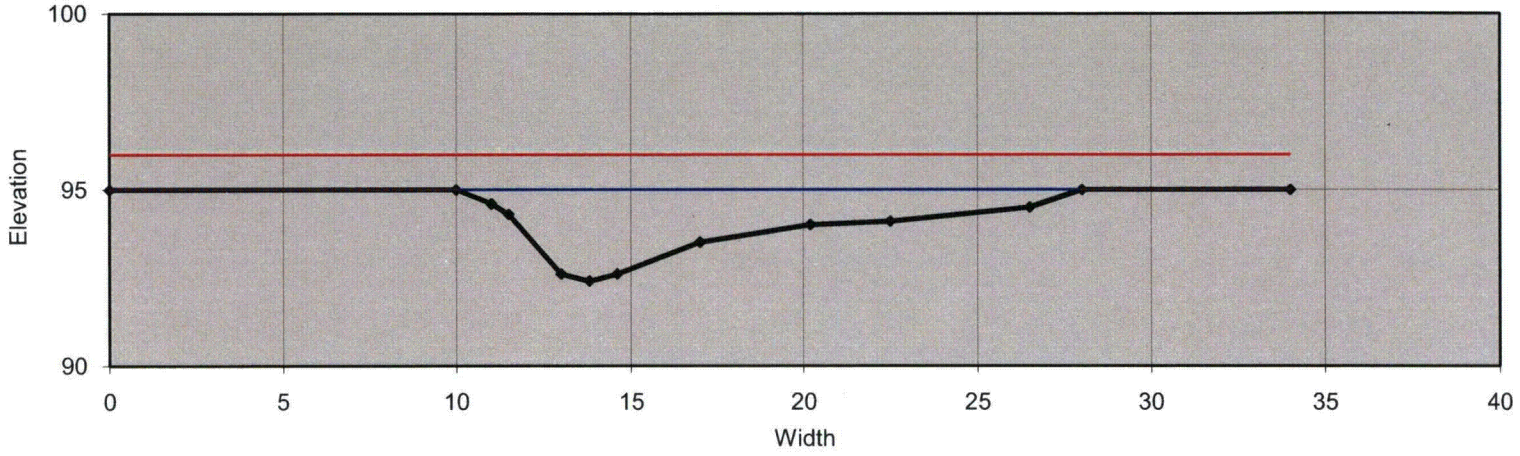
Bankfull Flow	
2.3	velocity (ft/s)
25.3	discharge rate (cfs)
0.45	Froude number

Flow Resistance	
0.030	Manning's roughness
0.11	D'Arcy-Weisbach fric.
6.0	resistance factor u/u*
3.4	relative roughness

Forces & Power	
0.29	channel slope (%)
0.14	shear stress (lb/sq.ft.)
0.27	shear velocity (ft/s)
0.33	unit strm power (lb/ft/s)

ro e tion 2

Walker Run Site A (Sta. 0+00 to 8+49) - Proposed Pool Left Cross Section (typical)



Bankfull Dimensions	
20.8	x-section area (ft.sq.)
18.0	width (ft)
1.2	mean depth (ft)
2.6	max depth (ft)
19.3	wetted parimeter (ft)
1.1	hyd radi (ft)
15.5	width-depth ratio

Flood Dimensions	
115.0	W flood prone area (ft)
6.4	entrenchment ratio
2.6	low bank height (ft)
1.0	low bank height ratio

Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
---	threshold grain size (mm):

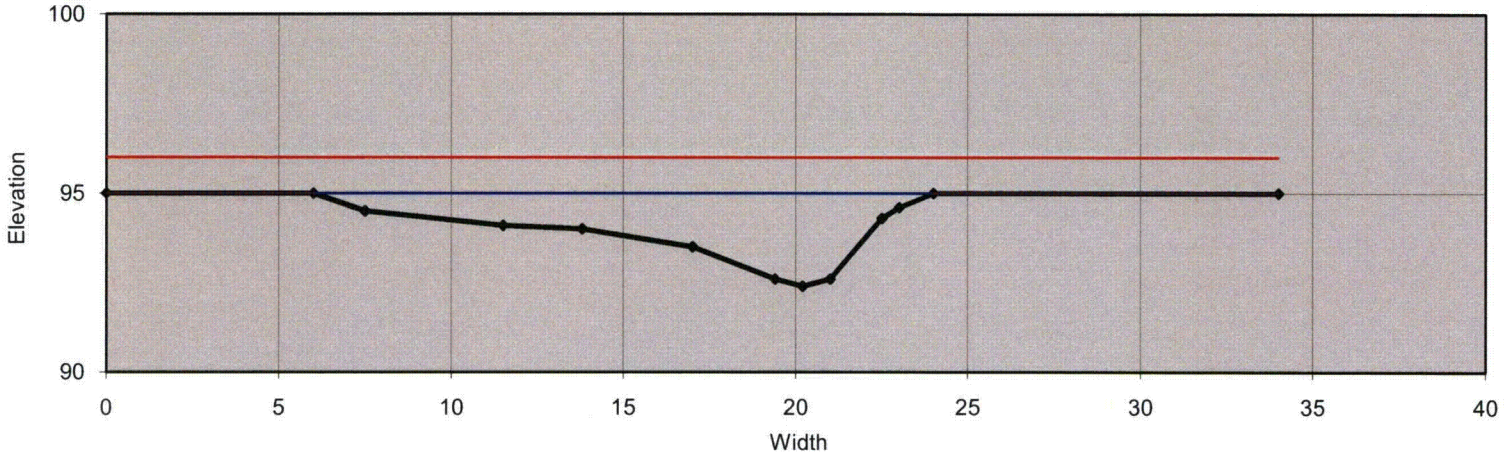
Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.030	Manning's roughness
0.10	D'Arcy-Weisbach fric.
7.4	resistance factor u/u*
4.9	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

ro e tion

Walker Run Site A (Sta. 0+00 to 8+49) - Proposed Pool Right Cross Section (typical)



Bankfull Dimensions	
20.8	x-section area (ft.sq.)
18.0	width (ft)
1.2	mean depth (ft)
2.6	max depth (ft)
19.3	wetted parimeter (ft)
1.1	hyd radi (ft)
15.5	width-depth ratio

Flood Dimensions	
115.0	W flood prone area (ft)
6.4	entrenchment ratio
2.6	low bank height (ft)
1.0	low bank height ratio

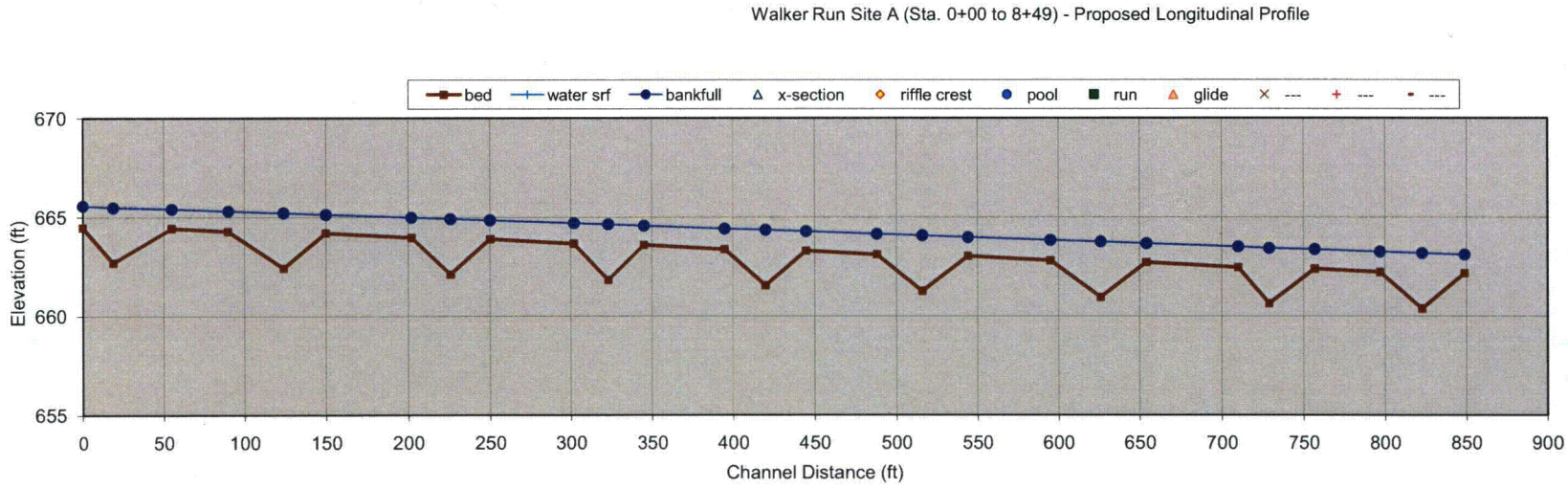
Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
---	threshold grain size (mm):

Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.030	Manning's roughness
0.10	D'Arcy-Weisbach fric.
7.4	resistance factor u/u*
4.9	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

Longitudinal Profile

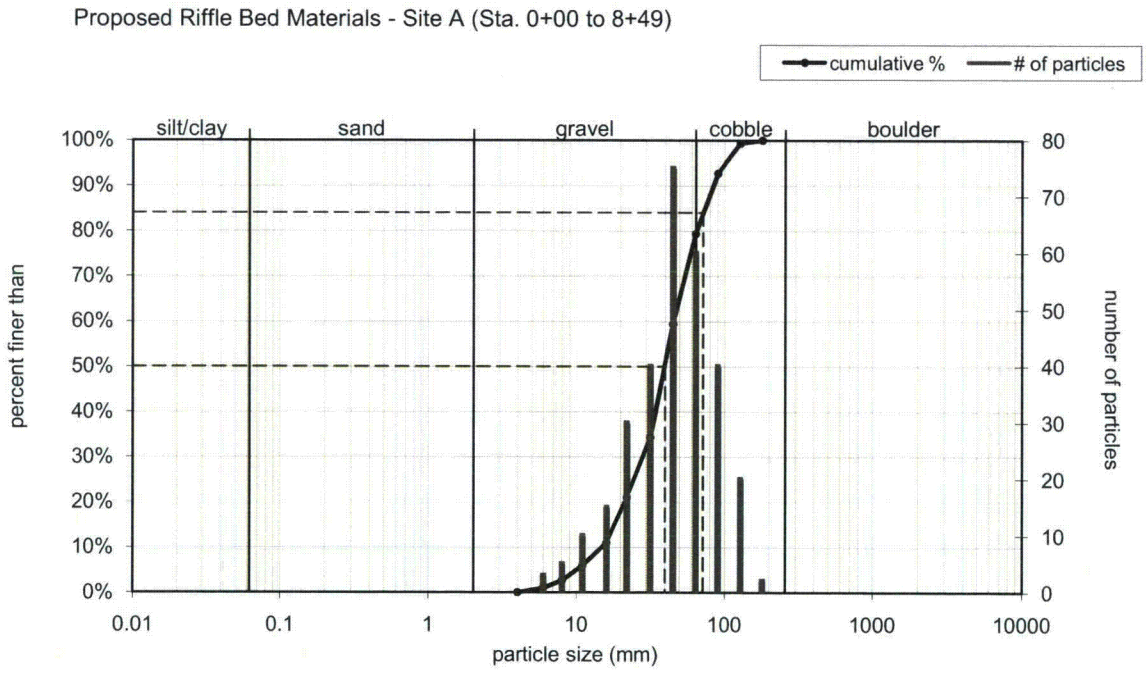


	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.27	---	849.0 (60.6 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

Riffle Surface

Material	Size Range (mm	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	
fine gravel	6 - 8	
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	2
large cobble	128 - 180	2
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		300
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		300

Note: distribution is approximate



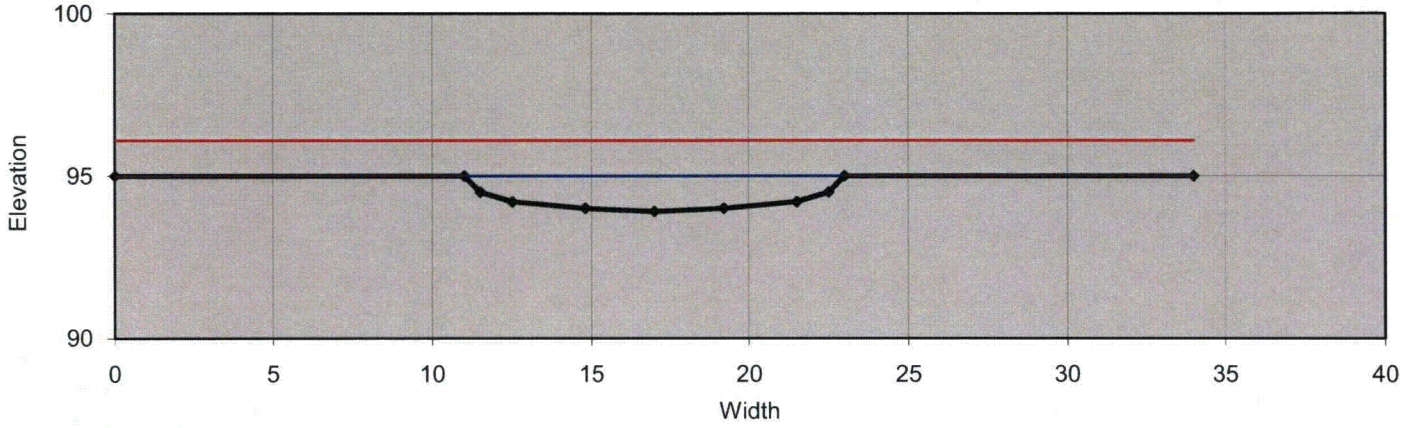
Size (mm)	
D16	19
D35	32
D50	40
D65	50
D84	72
D95	100

Size Distribution	
mean	37.0
dispersion	2.0
skewness	-0.04

Type	
silt/clay	0%
sand	0%
gravel	79%
cobble	21%
boulder	0%

ro e tion

Walker Run Site B (Sta. 0+00 to 7+40) - Proposed Riffle Cross-Section (typical)



Bankfull Dimensions	
10.3	x-section area (ft.sq.)
12.0	width (ft)
0.9	mean depth (ft)
1.1	max depth (ft)
12.5	wetted parimeter (ft)
0.8	hyd radi (ft)
14.0	width-depth ratio

Flood Dimensions	
165.0	W flood prone area (ft)
13.8	entrenchment ratio
1.1	low bank height (ft)
1.0	low bank height ratio

Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
8	threshold grain size (mm):

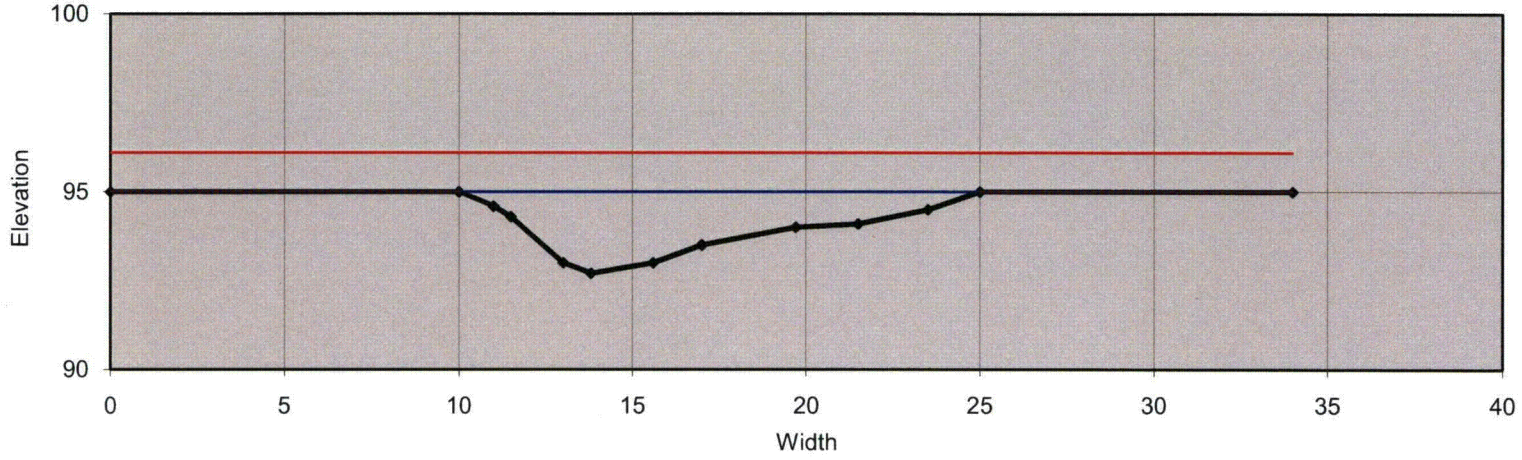
Bankfull Flow	
2.5	velocity (ft/s)
25.8	discharge rate (cfs)
0.49	Froude number

Flow Resistance	
0.030	Manning's roughness
0.11	D'Arcy-Weisbach fric.
6.2	resistance factor u/u*
3.6	relative roughness

Forces & Power	
0.33	channel slope (%)
0.17	shear stress (lb/sq.ft.)
0.30	shear velocity (ft/s)
0.44	unit strm power (lb/ft/s)

Cross Section 2

Walker Run Site B (Sta. 0+00 to 7+40) - Proposed Pool Left Cross Section (typical)



Bankfull Dimensions	
17.4	x-section area (ft.sq.)
15.0	width (ft)
1.2	mean depth (ft)
2.3	max depth (ft)
16.0	wetted parimeter (ft)
1.1	hyd radi (ft)
12.9	width-depth ratio

Flood Dimensions	
165.0	W flood prone area (ft)
11.0	entrenchment ratio
2.3	low bank height (ft)
1.0	low bank height ratio

Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
---	threshold grain size (mm):

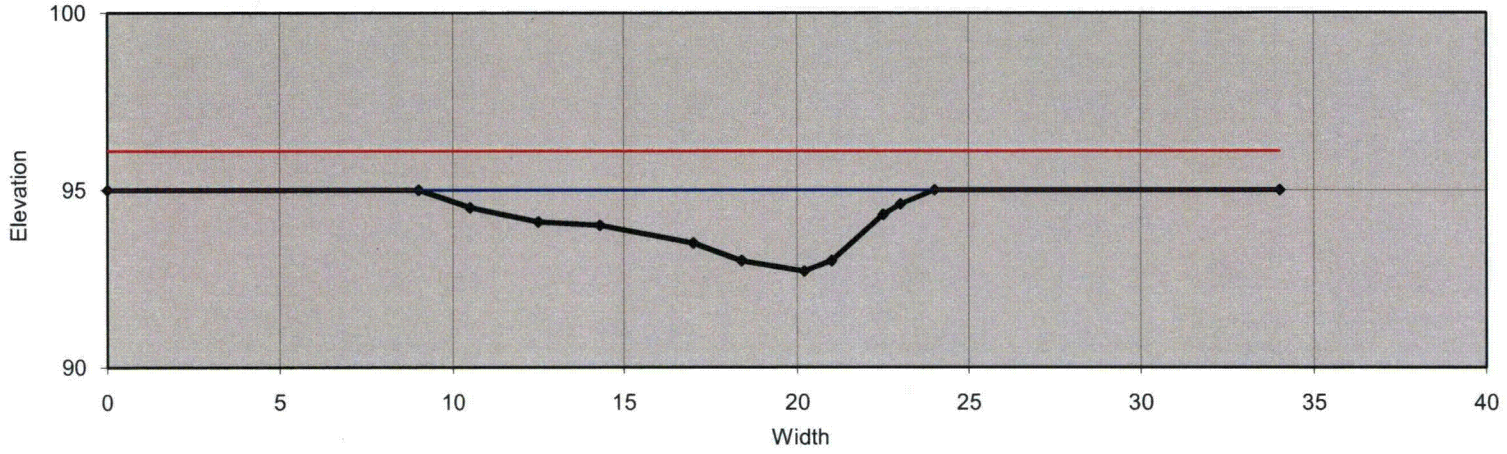
Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.030	Manning's roughness
0.10	D'Arcy-Weisbach fric.
7.3	resistance factor u/u*
4.9	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

ro e tion

Walker Run Site B (Sta. 0+00 to 7+40) - Proposed Pool Right Cross Section (typical)



Bankfull Dimensions	
17.4	x-section area (ft.sq.)
15.0	width (ft)
1.2	mean depth (ft)
2.3	max depth (ft)
16.0	wetted parimeter (ft)
1.1	hyd radi (ft)
12.9	width-depth ratio

Flood Dimensions	
165.0	W flood prone area (ft)
11.0	entrenchment ratio
2.3	low bank height (ft)
1.0	low bank height ratio

Materials	
40	D50 Riffle (mm)
72	D84 Riffle (mm)
---	threshold grain size (mm):

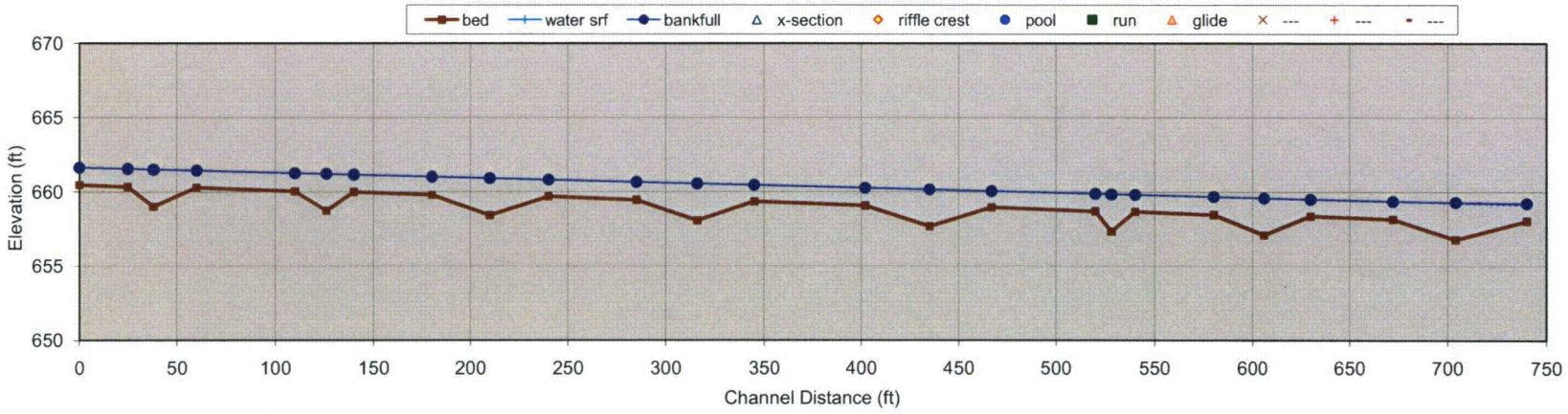
Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.030	Manning's roughness
0.10	D'Arcy-Weisbach fric.
7.3	resistance factor u/u*
4.9	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

Longitudinal Profile

Walker Run Site B (Sta. 0+00 to 7+40) - Proposed Longitudinal Profile



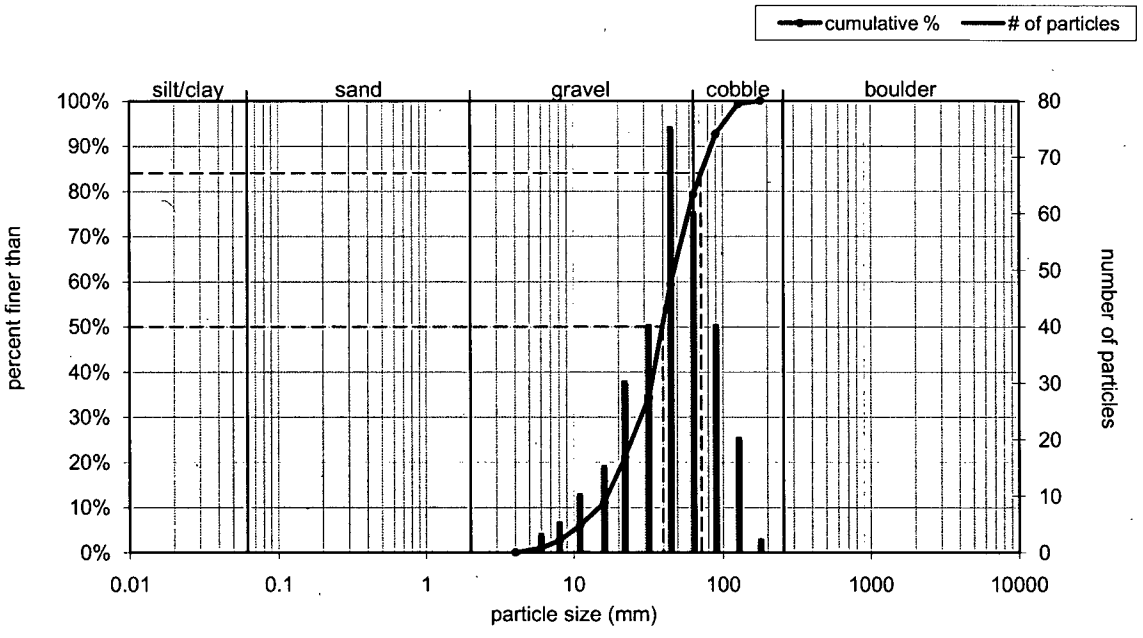
	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.33	---	740.0 (61.7 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	□
fine gravel	6 - 8	□
medium gravel	8 - 11	□□
medium gravel	11 - 16	□□
coarse gravel	16 - 22	□□
coarse gravel	22 - 32	□□
very coarse gravel	32 - 45	□□
very coarse gravel	45 - 64	□□
small cobble	64 - 90	□□
medium cobble	90 - 128	2□
large cobble	128 - 180	2
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		300
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		300

Note: distribution is approximate

Proposed Riffle Bed Materials - Site B (Sta. 0+00 to 7+40)

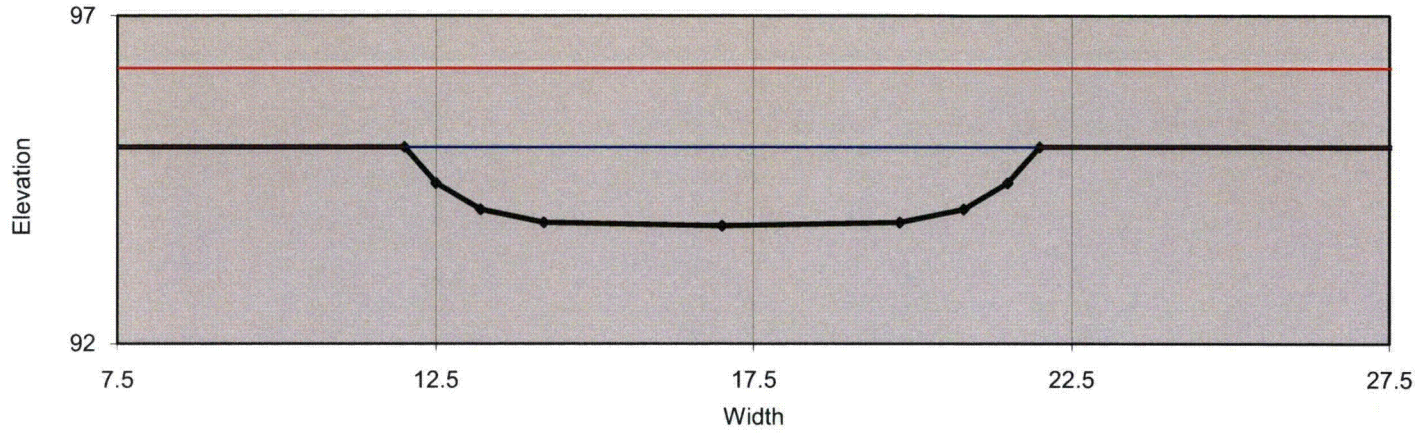


Size (mm)	
D16	19
D35	32
D50	40
D65	50
D84	72
D95	100

Size Distribution	
mean	37.0
dispersion	2.0
skewness	-0.04

Type	
silt/clay	0%
sand	0%
gravel	79%
cobble	21%
boulder	0%

Walker Run Site B (Sta. 7+40 to 33+10) - Proposed Riffle Cross Section (typical)



Bankfull Dimensions	
10.0	x-section area (ft.sq.)
10.0	width (ft)
1.0	mean depth (ft)
1.2	max depth (ft)
10.7	wetted parimeter (ft)
0.9	hyd radi (ft)
10.0	width-depth ratio

Flood Dimensions	
250.0	W flood prone area (ft)
25.0	entrenchment ratio
1.2	low bank height (ft)
1.0	low bank height ratio

Materials	
---	D50 (mm)
---	D84 (mm)
7	threshold grain size (mm):

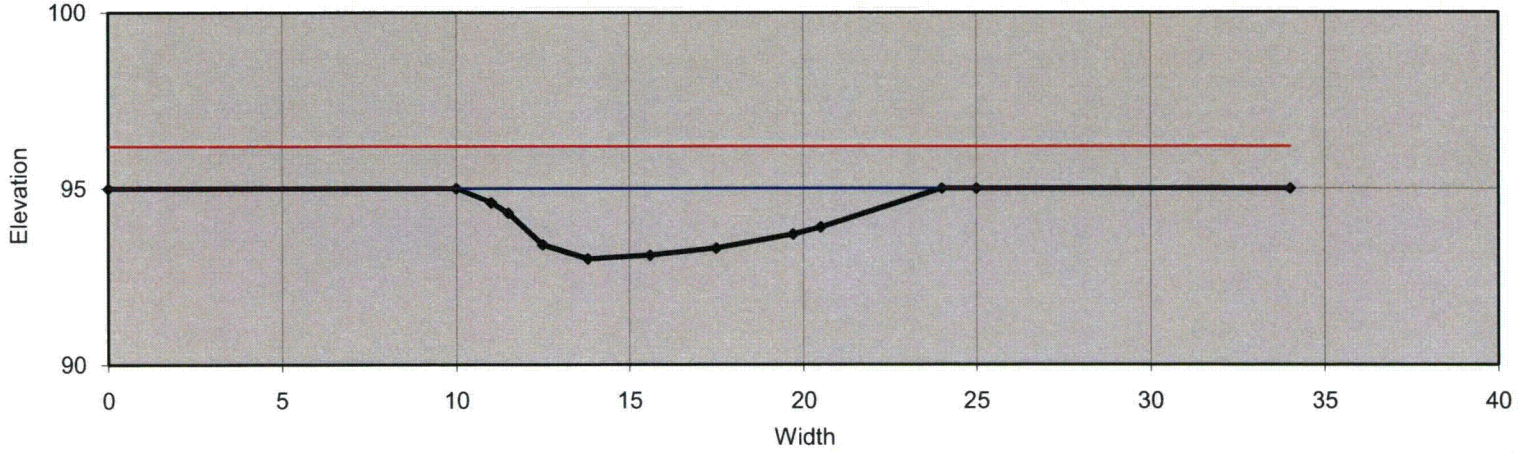
Bankfull Flow	
2.3	velocity (ft/s)
23.2	discharge rate (cfs)
0.42	Froude number

Flow Resistance	
0.030	Manning's roughness
0.11	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power	
0.24	channel slope (%)
0.14	shear stress (lb/sq.ft.)
0.27	shear velocity (ft/s)
0.35	unit strm power (lb/ft/s)

ro e tion 2

Walker Run Site B (Sta. 7+40 to 33+10) - Proposed Pool Left Cross Section (typical)



Bankfull Dimensions	
17.1	x-section area (ft.sq.)
14.0	width (ft)
1.2	mean depth (ft)
2.0	max depth (ft)
14.8	wetted parimeter (ft)
1.2	hyd radi (ft)
11.5	width-depth ratio

Flood Dimensions	
250.0	W flood prone area (ft)
17.9	entrenchment ratio
2.0	low bank height (ft)
1.0	low bank height ratio

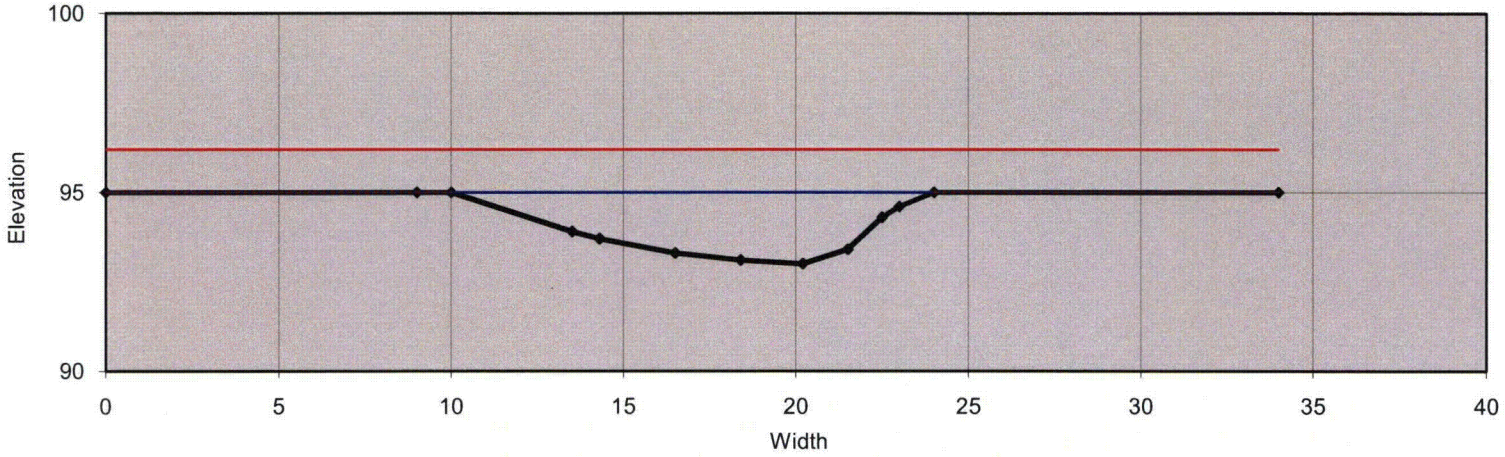
Materials	
---	D50 (mm)
---	D84 (mm)
---	threshold grain size (mm):

Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.030	Manning's roughness
0.10	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

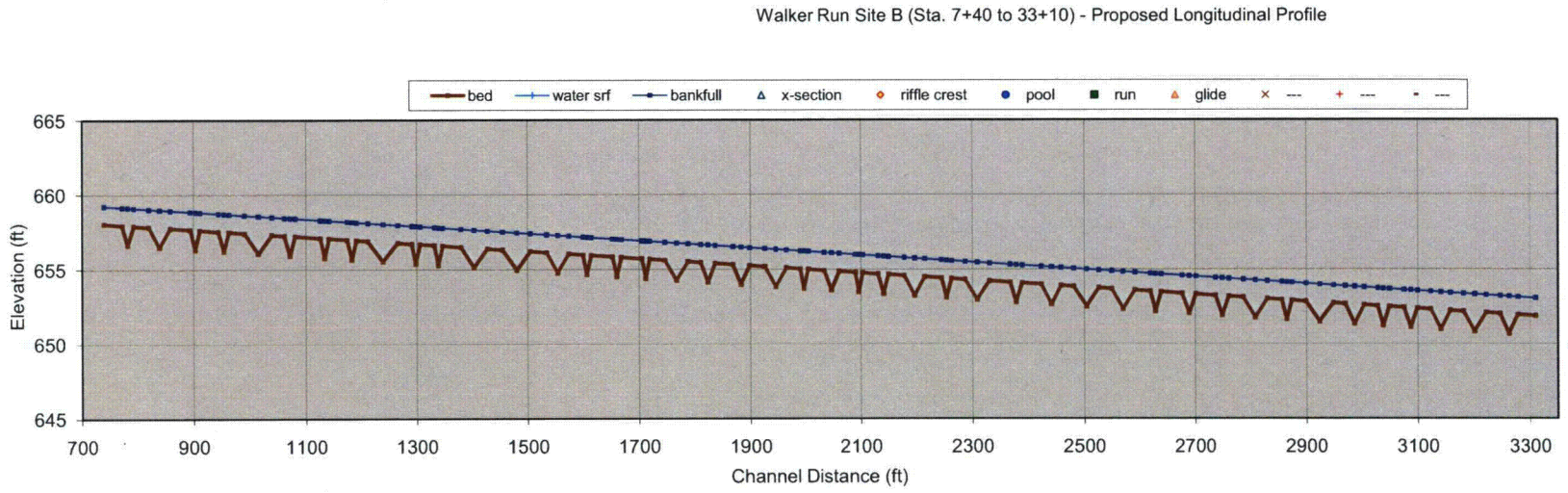
Walker Run Site B (Sta. 7+40 to 33+10) - Proposed Pool Right Cross Section (typical)



Bankfull Dimensions		Flood Dimensions		Materials	
17.1	x-section area (ft.sq.)	250.0	W flood prone area (ft)	---	D50 (mm)
14.0	width (ft)	17.9	entrenchment ratio	---	D84 (mm)
1.2	mean depth (ft)	2.0	low bank height (ft)	---	threshold grain size (mm):
2.0	max depth (ft)	1.0	low bank height ratio		
14.8	wetted parimeter (ft)				
1.2	hyd radi (ft)				
11.5	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	0.030	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	0.10	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Longitudinal Profile



	slope (%)	slope ratio	length (ft)	length ratio	pool-pool spacing (ft)	p-p ratio
reach	0.24	---	3310.0 (331 channel widths)	---	---	---
riffle	---	---	---	---	---	---
pool	---	---	---	---	---	---
	---	---	---	---	---	---
	---	---	---	---	---	---

APPENDIX D

Morphological Characteristics Summary for
Existing and Proposed Conditions

WALKER RUN – SITE A

MORPHOLOGICAL CHARACTERISTICS SUMMARY OF EXISTING AND PROPOSED CONDITIONS

Restoration Reach: Walker Run, Salem Township, Luzerne County, PA
Assessment Reach #1 (AR1): Walker Run, Salem Township, Luzerne County, PA
Assessment Reach #2 (AR2): Marsh Creek, Ross Township, Luzerne County, PA
USGS Regional Curve: Pennsylvania and selected areas in Maryland[1]

	VARIABLES	EXISTING REACH: (Site A)	USGS CURVE DATA	AR#1 (Walker Run)[1]	AR#2 (downstream of Silo Road)[2]	PROPOSED REACH (Site A: Sta. 0+00 to 8+49)
1	Stream Type	F4/F5	—	B4c	C4	C4/C5
2	Drainage Area – mi^2	2.0-2.3	2.0	2.0	2.8	2.0-2.3
3	Bankfull Width (W_{bkf}) – ft.	8.9-11.7^	20.1	17.4-18.3	13.6-16.8	12.0-14.0
4	Bankfull Mean Depth (d_{bkf}) – ft.	0.7^	1.1	0.6-0.7	0.7-0.8	0.7-0.9
5	Width/Depth Ratio (W_{bkf}/d_{bkf})	13.0-17.8^	18.3	27.1-31.0	16.5-22.5	13.3-20
6	Bankfull Cross-Sectional Area (A_{bkf}) – ft^2	6.0-7.7^	21.1	9.8-12.3	9.8-12.6	8.4-12.6
7	Bankfull Mean Velocity ($V_{bkf} = Q/A$) – ft/sec.	2.6-3.3^	3.8	2.0-2.4	1.7-1.9	2.3
8	Bankfull Discharge (Q_{bkf}) - cfs	19.6^	79.5	19.3-29.3	16.3-22.7	19.3–29.0
9	Bankfull Maximum Depth (d_{max}) – ft.	0.9-1.2^	—	0.9-1.1	1.1	1.0-1.4

[1] Chaplin, Jeffrey J. "Development of Regional Curves Relating Bankfull-Channel Geometry and Discharge to Drainage Area for Streams in Pennsylvania and Selected Areas of Maryland". United States Geological Survey (USGS) Scientific Investigations Report 2005-5147.

NOTE: The drainage area to the upstream limit of Site A (2.0 square miles) was inserted into the USGS regional curve regression equations presented in this report to calculate the values listed in the USGS Curve Data column.

10	Max d_{riff}/d_{bkf} Ratio	1.3-1.7^	—	1.3-1.8	1.4-1.6	1.1-2.0
11	Low Bank Height to Max. d_{bkf} Ratio	2.3-2.4^	—	1.0	1.3-1.9	1.0
12	Width of Flood Prone Area (W_{fpa}) – ft.	13.4-13.8^	—	34.3-34.7	32.9-58.1	80.0-150.0
13	Entrenchment Ratio (W_{fpa}/W_{bkf})	1.2-1.5^	—	1.9-2.0	2.0-4.3	5.7-10.7
14	Meander Length (L_m) – ft.	80.0-240.0*	—	—	—	143.0-175.0
15	Ratio of Meander Length to Bankfull Width (L_m/W_{bkf})	6.8-27.0 *	—	—	—	10.2-14.6
16	Radius of Curvature (R_c) – ft.	10.0-57.0*	—	—	—	35.0-42.0**
17	Ratio of Radius of Curvature to Bankfull Width (Rc/ W_{bkf})	0.9-6.4*	—	—	—	2.5-3.0**
18	Belt Width (W_{blt}) – ft.	38.0-57.0*	—	—	—	45.0-72.0
19	Meander Width Ratio (W_{blt}/W_{bkf})	3.2-6.4*	—	—	—	3.2-6.0
20	Sinuosity (k) (stream length/valley distance)	1.4*	—	1.1	1.1	1.3
21	Valley Slope (V_s) - ft/ft.	0.0043*	—	0.0207-0.0286	0.0041	0.0038
22	Average Slope (S_{bkf}) – ft/ft.	0.0034*	—	0.0160	0.0037	0.0029
23	Pool Slope (S_{pool}) – ft/ft.	0.0012-0.0030*	—	—	0.0012-0.0024	0.0006-0.0015**
24	Ratio of Pool Slope to Average Slope (S_{pool}/S_{bkf})	0.4-0.9*	—	—	0.4-0.9	0.2-0.5**
25	Maximum Pool Depth (d_{pool}) – ft.	1.0-2.5*	—	—	2.0-4.9	1.8-3.2**
26	Ratio of Pool Max. Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	1.4-3.6*	—	—	2.5-7.0	2.5-3.5**
27	Pool Width (W_{pool}) – ft.	9.0-15.0*	—	—	17.4-17.6	13.2-19.6**

28	Ratio of Pool Width to Bankfull Width (W_{pool}/W_{bkf})	0.8-1.7*	—	—	1.0-1.3	1.1-1.4**
29	Pool Cross-Sectional Area (A_{pool}) - ft^2	9.0-30.0*	—	—	23.8-25.8	15.5-23.3
30	Ratio of Pool Area to Bankfull Area ($A_{pool}A_{bkf}$)	1.2-5.0*	—	—	1.9-2.6	1.9
31	Pool to Pool Spacing (p-p) - ft.	46.0-177.0*	—	—	30-100	70.0-98.0**
32	Ratio of P-P Spacing to Bankfull Width (p-p/W_{bkf})	3.9-19.9*	—	—	1.8-7.4	5.0-7.0**

^ Existing conditions values were based on 2 typical riffle cross-sections surveyed along the project reach (see *Appendix B*). Please note that these listed values are intended to describe existing conditions, which are not stable. These values were not used in developing proposed design parameters.

* Values were based on measurements of the existing conditions in the field, from plan views generated from survey data, and/or from USGS quadrangles. Please note that these listed values are intended to describe existing conditions, which are not stable. These values were not used in developing proposed design parameters.

[1] Values were based on 2 typical riffle cross-sections, a longitudinal profile, and other field measurements surveyed along a relatively stable reach of Walker Run upstream from the Beach Grove Road bridge. The bankfull discharge was calibrated along this reach and applied to the project reach.

[2] Values were based on 3 typical riffle cross-sections, 2 typical pool cross-sections, a longitudinal profile, and other field measurements surveyed along a relatively stable reach of Marsh Creek. Many of these values served as a guide for developing design parameters of the proposed project reach.

** Values were calculated based on dimensionless ratios developed from reference conditions for C stream type (see *attached table*) because the existing channel and reference reach did not clearly exhibit these geomorphic characteristics.

MATERIALS:	**EXISTING CHANNEL (Site A)**	**AR#1 (Walker Run)**	**AR#2 (downstream of Silo Road)**	**PROPOSED REACH (Site A: Sta. 0+00 to 8+49)**
1. Particle size distribution of riffle bed material				
D_{16}	0.093	12	5.7	16-24
D_{35}	0.19	28	9.5	27-37
D_{50}	4.6	57	16	30-50
D_{65}	15	88	31	45-55
D_{84}	130	140	72	67-77
D_{95}	210	220	110	95-105

WALKER RUN – SITE B

MORPHOLOGICAL CHARACTERISTICS SUMMARY OF EXISTING AND PROPOSED CONDITIONS

Restoration Reach: Walker Run, Salem Township, Luzerne County, PA
Assessment Reach #1 (AR1): Walker Run, Salem Township, Luzerne County, PA
Assessment Reach #2 (AR2): Marsh Creek, Ross Township, Luzerne County, PA
Reference Reach: Mount Rock Spring Creek, Cumberland County, PA
USGS Regional Curve: Pennsylvania and selected areas in Maryland[1]

	VARIABLES	EXISTING REACH: (Site B)	USGS CURVE DATA	AR#1 (Walker Run)[1]	AR#2 (upstream of Silo Road)[2]	AR#2 (downstream of Silo Road)[3]	REFERENCE REACH (Mount Rock Spring Creek)[4]	PROPOSED REACH (Site B: Sta. 0+00 to 7+40)	PROPOSED REACH (Site B: Sta. 7+40 to 33+10)
1	Stream Type	G4c/F5	—	B4c	E5	C4	E4	C4/C5	E4/E5
2	Drainage Area – mi^2	2.3-2.4	2.4	2.0	2.8	2.8	4.1	2.3	2.3-2.4
3	Bankfull Width (W_{bkf}) – ft.	8.2-9.7^	21.6	17.4-18.3	8.1	13.6-16.8	11.5-12.3	12.0-14.0	8.0-12.0
4	Bankfull Mean Depth (d_{bkf}) – ft.	0.9-1.1^	1.2	0.6-0.7	1.2	0.7-0.8	1.6-1.7	0.8-1.0	0.9-1.2
5	Width/Depth Ratio (W_{bkf}/d_{bkf})	7.6-10.9^	18.0	27.1-31.0	6.6	16.5-22.5	6.6-7.8	12.0-17.5	6.7-13.3
6	Bankfull Cross-Sectional Area (A_{bkf}) – ft^2	8.7-9.4^	24.0	9.8-12.3	10.0	9.8-12.6	19.9-19.5	9.6-14.0	7.2-14.4
7	Bankfull Mean Velocity ($V_{bkf} = Q/A$) – ft/sec.	2.5-2.7^	3.8	2.0-2.4	1.7	1.7-1.9	1.5-1.8	2.5	2.3
8	Bankfull Discharge (Q_{bkf}) - cfs	21.9-25.1^	91.3	19.3-29.3	17.5	16.3-22.7	48.0-55.0	24.0-35.0	16.6-33.1
9	Bankfull Maximum Depth (d_{max}) – ft.	1.4-1.6^	—	0.9-1.1	2.2	1.1	2.8-2.9	1.0-1.4	1.0-1.4

[1] Chaplin, Jeffrey J. "Development of Regional Curves Relating Bankfull-Channel Geometry and Discharge to Drainage Area for Streams in Pennsylvania and Selected Areas of Maryland". United States Geological Survey (USGS) Scientific Investigations Report 2005-5147.

NOTE: The drainage area to the downstream limit of Site B (2.4 square miles) was inserted into the USGS regional curve regression equations presented in this report to calculate the values listed in the USGS Curve Data column.

10	Max d_{riff}/d_{bkf} Ratio	1.3-1.8^	—	1.3-1.8	1.8	1.4-1.6	1.6-1.8	1.2-1.4	1.0-1.2
11	Low Bank Height to Max. d_{bkf} Ratio	2.3-2.8^	—	1.0	1.0	1.3-1.9	1.0-1.1	1.0	1.0
12	Width of Flood Prone Area (W_{fpa}) – ft.	11.2-12.1^	—	34.3-34.7	130.0	32.9-58.1	100.0+	80.0-250.0	190-310
13	Entrenchment Ratio (W_{fpa}/W_{bkf})	1.2-1.5^	—	1.9-2.0	16.0	2.0-4.3	>8.0	6.7-20.8	19.0-31.0
14	Meander Length (L_m) – ft.	—	—	—	—	—	88.0-97.0	114.0-185.0	70.0-190.0
15	Ratio of Meander Length to Bankfull Width (L_m/W_{bkf})	—	—	—	—	—	7.7-9.0	8.1-15.4	5.8-23.8
16	Radius of Curvature (R_c) – ft.	—	—	—	—	—	52.0-62.0	30.0-36.0	16.0-30.0
17	Ratio of Radius of Curvature to Bankfull Width (Rc/ W_{bkf})	—	—	—	—	—	4.2-4.9	2.5-3.0	2.0-3.0
18	Belt Width (W_{blt}) – ft.	—	—	—	—	—	30.0-31.0	75.0-100.0	20.0-102.0
19	Meander Width Ratio (W_{blt}/W_{bkf})	—	—	—	—	—	2.5	5.4-8.3	1.7-12.8
20	Sinuosity (k) (stream length/valley distance)	1.1*	—	1.1	1.1	1.1	1.1-1.4	1.5	2.0
21	Valley Slope (V_s) - ft/ft.	0.0048*	—	0.0207-0.0286	0.0013	0.0041	0.0030-0.0040	0.0049	0.0047
22	Average Slope (S_{bkf}) – ft/ft.	0.0044*	—	0.0160	0.0011	0.0037	0.0020-0.0030	0.0033	0.0024
23	Pool Slope (S_{pool}) – ft/ft.	0.0001-0.0049*	—	—	0.0005-0.0010	0.0012-0.0024	0.0007-0.0008	0.0007-0.0017	0.0019-0.0022
24	Ratio of Pool Slope to Average Slope (S_{pool}/S_{bkf})	0.02-1.11*	—	—	0.5-1.0	0.4-0.9	0.2-0.3	0.2-0.5**	0.8-0.9**
25	Maximum Pool Depth (d_{pool}) – ft.	1.3-3.0*	—	—	3.1	2.0-4.9	2.2-2.4	2.0-3.5**	1.4-3.0**
26	Ratio of Pool Max. Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	1.2-3.3*	—	—	2.6	2.5-7.0	1.8-2.2	2.5-3.5**	1.5-2.5**
27	Pool Width (W_{pool}) – ft.	8.0-15.0*	—	—	—	17.4-17.6	12.3-12.4	13.2-19.6**	8.0-14.4**

28	Ratio of Pool Width to Bankfull Width (W_{pool}/W_{bkf})	0.8-1.8*	----	----	----	1.0-1.3	1.0	1.1-1.4**	1.0-1.2**
29	Pool Cross-Sectional Area (A_{pool}) - ft^2	12.6-36.0*	----	----	----	23.8-25.8	25.0-27.0	16.2-23.6	12.2-24.3
30	Ratio of Pool Area to Bankfull Area ($A_{pool}A_{bkf}$)	1.3-4.1*	----	----	----	1.9-2.6	1.3-1.4	1.2-2.5	0.9-3.4
31	Pool to Pool Spacing (p-p) - ft.	52.0-1149.0*	----	----	----	30-100	61.0-76.0	54.0-84.0**	32.0-70.0**
32	Ratio of P-P Spacing to Bankfull Width (p-p/W_{bkf})	5.3-140.1*	----	----	----	1.8-7.4	5.1-6.2	4.5-7.0**	4.0-7.0**

^ Existing conditions values were based on 3 typical riffle cross-sections surveyed along the project reach (see *Appendix B*). Please note that these listed values are intended to describe existing conditions, which are not stable. These values were not used in developing proposed design parameters.

* Values were based on measurements of the existing conditions in the field, from plan views generated from survey data, and/or from USGS quadrangles. Please note that these listed values are intended to describe existing conditions, which are not stable. These values were not used in developing proposed design parameters.

[1] Values were based on 2 typical riffle cross-sections, a longitudinal profile, and other field measurements surveyed along a relatively stable reach of Walker Run upstream from the Beach Grove Road bridge. The bankfull discharge was calibrated along this reach and applied to the project reach.

[2] Values were based on 1 typical riffle cross-section, a longitudinal profile, and other field measurements surveyed along a relatively stable E stream type reach of Marsh Creek. Many of these values served as a guide for developing design parameters of the proposed project reach.

[3] Values were based on 3 typical riffle cross-sections, 2 typical pool cross-sections, a longitudinal profile, and other field measurements surveyed along a relatively stable C stream type reach of Marsh Creek. Many of these values served as a guide for developing design parameters of the proposed project reach.

[4] Values were based on past survey data of this reach, which exhibited many characteristics of an E stream type. Some of these values were used as further reference for developing design parameters of the proposed project reach. Note that the drainage area is roughly double that of the project reach.

** Values were calculated based on dimensionless ratios developed from reference conditions for both C stream types (see *attached table*) and E stream type because the existing channel and reference reach did not clearly exhibit these geomorphic characteristics.

MATERIALS:	**EXISTING CHANNEL (Site B)**	**AR#1 (Walker Run)**	**AR#2 (upstream of Silo Road)**	**AR#2 (downstream of Silo Road)**	**PROPOSED REACH (Site B: Sta. 0+00 to 7+40)**	**PROPOSED REACH (Site B: Sta. 7+40 to 33+10)**
1. Particle size distribution of riffle bed material						
D_{16}	0.11	12	----	5.7	16-24	variable
D_{35}	0.53	28	----	9.5	27-37	variable
D_{50}	6.2	57	----	16	30-50	variable
D_{65}	17	88	----	31	45-55	variable
D_{84}	50	140	----	72	67-77	variable
D_{95}	81	220	----	110	95-105	variable

C4 Reference Reach Data (Average Values)

Pools	Ratio Pool Slope/Average Slope	=	0.20 – 0.30	0.2-0.5 *
	Ratio Pool Max Depth/Riffle Mean Depth	=	2.5 – 3.5 (3.0)	
	Ratio Pool Width/Average Riffle Width	=	1.3 – 1.7 (1.5)	1.1 - 1.4 *
Riffles	Ratio Riffle Slope/Average Slope	=	1.5 – 2.0	1.2 - 1.5 *
	Ratio Riffle Max Depth/Riffle Mean Depth	=	1.2 – 1.4	
Runs	Ratio Run Slope/Average Slope	=	0.5 – 0.8	
	Ratio Run Max Depth/Riffle Mean Depth	=	1.9 – 2.2	
	Ratio of Run W/D ratio/Riffle W/D ratio	=	0.4 – 0.5	
Glides	Ratio of Glide Slope/Average Slope	=	0.3 – 0.5	
	Ratio of Max Glide Depth/Riffle Mean Depth	=	1.4 – 1.8	
	Ratio of Glide Width/Average Riffle Width	=	1.5 – 1.7	
	Ratio of Glide W/D ratio/Riffle W/D ratio	=	1.1 – 1.3	

	C3	C4	B3
W/D	12 – 25 (ave=20)	12 – 18 (ave=15)	12 – 20 (ave = 16)
R_c/W	3.0 – 3.5	2.5 – 3.0	N/A
R_c/W **(High bedload, very coarse composite banks)**	3.5 – 4.5	3.0 – 4.0	N/A
Pool to Pool Spacing	7 – 8W	5 – 7W	B_c 1-2% 4 - 5W 2-4% 3 - 4W 4-6% 2 – 3W 6-8% 1.5 – 2W 8+% 1 – 1.5W
L_m/W	12 - 14	9 - 14	N/A
L_m/W **(High Bedload)**	12	11- 12	N/A

* Ratio values that have been refined based on numerous reference pools and riffles surveyed throughout Southeast Pennsylvania and Maryland.

Source: River Restoration and Natural Channel Design - Field Guide. Level II Rosgen Short Course. Wildland Hydrology, Inc. 2002.

Development of Regional Curves Relating Bankfull-Channel Geometry and Discharge to Drainage Area for Streams in Pennsylvania and Selected Areas of Maryland

By Jeffrey J. Chaplin

In cooperation with the Pennsylvania Department of Environmental Protection, the Canaan Valley Institute, and the Susquehanna River Basin Commission

Scientific Investigations Report 2005-5147

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2005

For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: http://www.usgs.gov/

Suggested citation:
Chaplin, J.J., 2005, Development of regional curves relating bankfull-channel geometry and discharge to drainage area for streams in Pennsylvania and selected areas of Maryland: U.S. Geological Survey Scientific Investigations Report 2005-5147, 34 p.

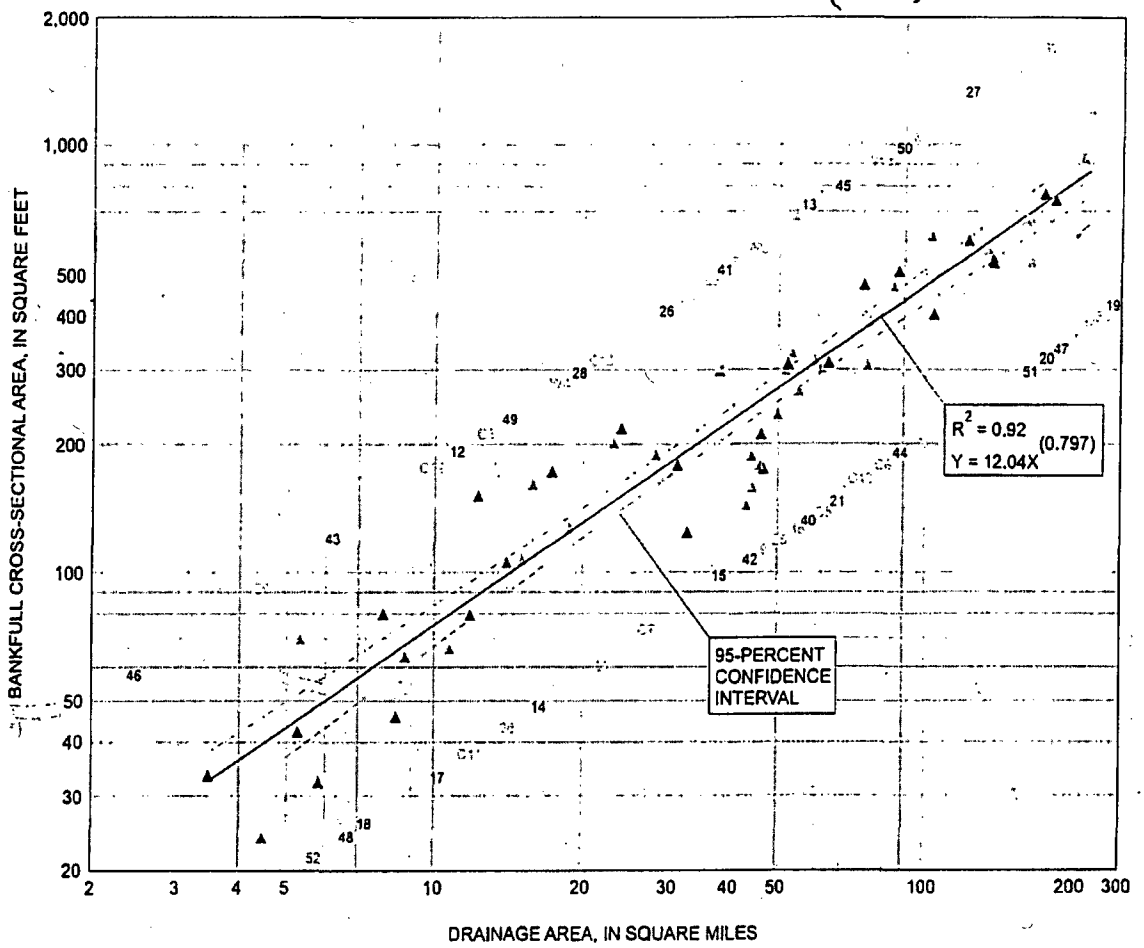
Contents

Figures

Figures—Continued

Tables

Bankfull Cross-Sectional Area (ft^2)



EXPLANATION

▲	STATION REPRESENTING THE PIEDMONT PHYSIOGRAPHIC PROVINCE	11 STATIONS
▲	STATION REPRESENTING THE RIDGE AND VALLEY PHYSIOGRAPHIC PROVINCE	17 STATIONS
▲	STATION REPRESENTING THE APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCE	24 STATIONS
▲	STATION REPRESENTING THE CENTRAL LOWLAND PHYSIOGRAPHIC PROVINCE	1 STATION
▲	STATION REPRESENTING THE NEW ENGLAND PHYSIOGRAPHIC PROVINCE	2 STATIONS

Figure 5. Regional curve representing the relation between bankfull cross-sectional area and drainage area in noncarbonate settings of Pennsylvania and selected areas of Maryland. See table 1 for information associated with cross-reference numbers identifying each station in this figure.

Walker Run Drainage Area = 2.02 mi^2 (upstream end) ; 2.37 mi^2 (downstream end)

Calculations: $Y = 12.04 X^{(0.797)}$

upstream end:

$Y = 12.04 (2.02)^{(0.797)}$

$Y = 12.04 (1.75)$

$Y = 21.09\ ft^2$

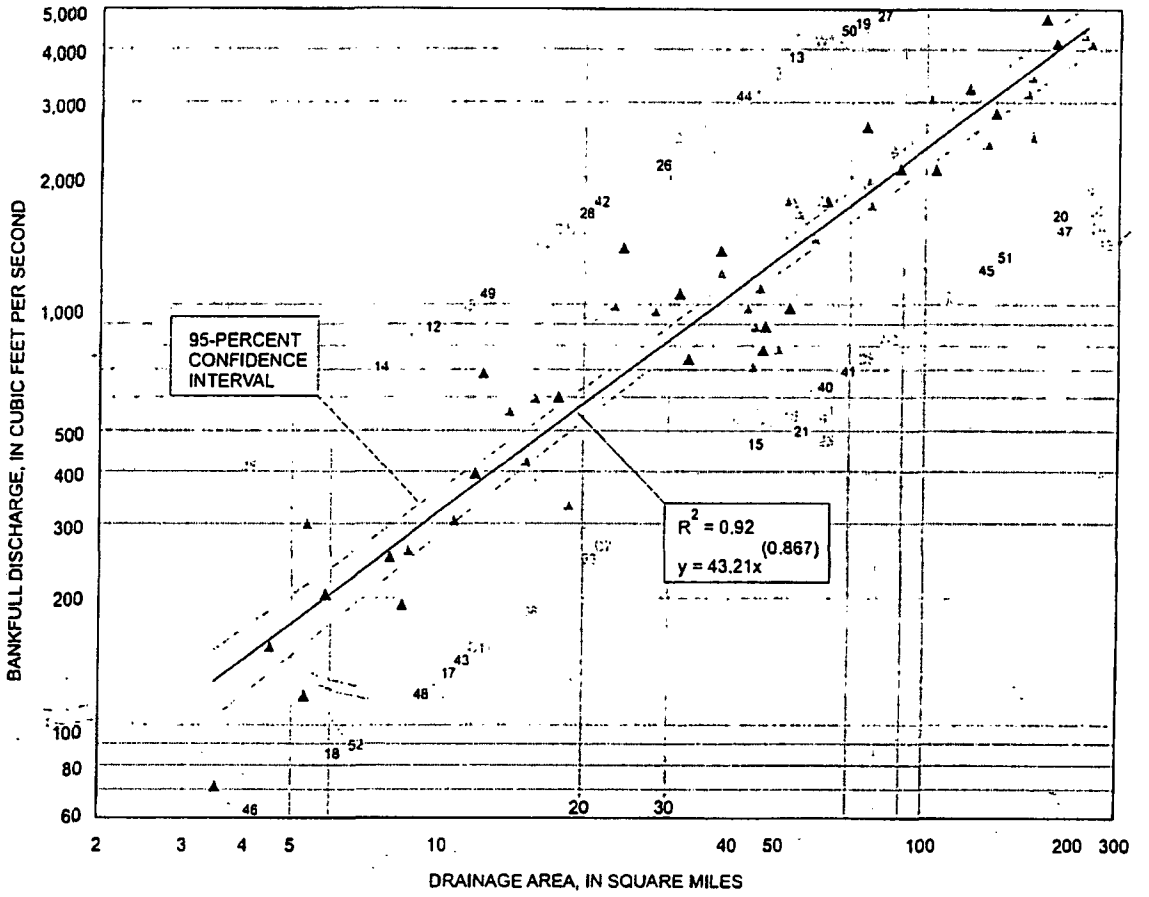
downstream end:

$Y = 12.04 (2.37)^{(0.797)}$

$Y = 12.04 (1.99)$

$Y = 23.95\ ft^2$

Bankfull Discharge (cfs)



EXPLANATION

▲	STATION REPRESENTING THE PIEDMONT PHYSIOGRAPHIC PROVINCE	11 STATIONS
▲	STATION REPRESENTING THE RIDGE AND VALLEY PHYSIOGRAPHIC PROVINCE	17 STATIONS
▲	STATION REPRESENTING THE APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCE	24 STATIONS
▲	STATION REPRESENTING THE CENTRAL LOWLAND PHYSIOGRAPHIC PROVINCE	1 STATION
▲	STATION REPRESENTING THE NEW ENGLAND PHYSIOGRAPHIC PROVINCE	2 STATIONS

Figure 6. Regional curve representing the relation between bankfull discharge and drainage area in noncarbonate settings of Pennsylvania and selected areas of Maryland. See table 1 for information associated with cross-reference numbers identifying each station shown in this figure.

Walker Run Drainage Area = 2.02 mi^2 (upstream end) ; 2.37 mi^2 (downstream end)

Calculations: $Y = 43.21x^{(0.867)}$

upstream end:

$Y = 43.21 (2.02)^{(0.867)}$

$Y = 43.21 (1.84)$

$Y = 79.49$ cfs

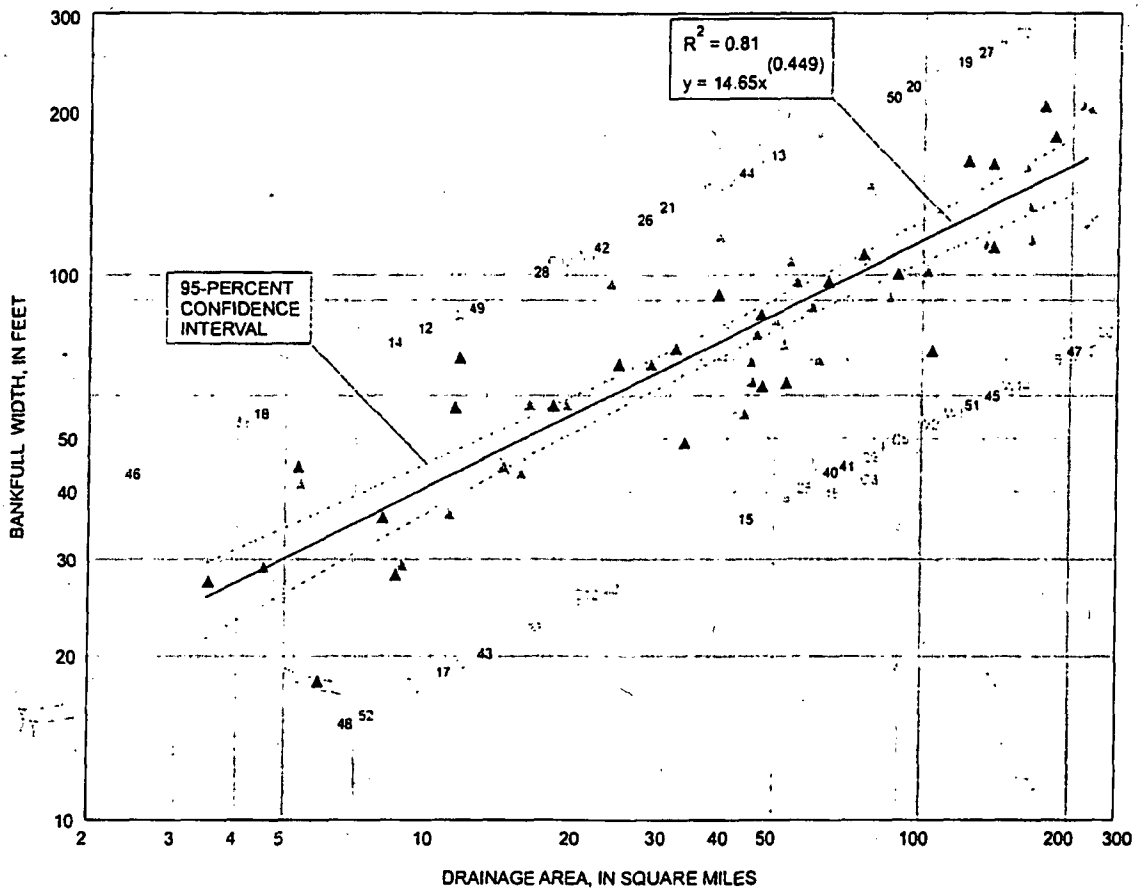
downstream end:

$Y = 43.21 (2.37)^{(0.867)}$

$Y = 43.21 (2.11)$

$Y = 91.30$ cfs

Bankfull Width (ft.)



EXPLANATION

▲	STATION REPRESENTING THE PIEDMONT PHYSIOGRAPHIC PROVINCE	11 STATIONS
▲	STATION REPRESENTING THE RIDGE AND VALLEY PHYSIOGRAPHIC PROVINCE	17 STATIONS
▲	STATION REPRESENTING THE APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCE	24 STATIONS
▲	STATION REPRESENTING THE CENTRAL LOWLAND PHYSIOGRAPHIC PROVINCE	1 STATION
▲	STATION REPRESENTING THE NEW ENGLAND PHYSIOGRAPHIC PROVINCE	2 STATIONS

Figure 7. Regional curve representing the relation between bankfull width and drainage area in noncarbonate settings of Pennsylvania and selected areas of Maryland. See table 1 for information associated with cross-reference numbers identifying each station shown in this figure.

Walker Run Drainage Area = 2.02 mi^2 (upstream end) ; 2.37 mi^2 (downstream end)

Calculations: $Y = 14.65 \times^{(0.449)}$

upstream end:

$Y = 14.65 (2.02)^{(0.449)}$

$Y = 14.65 (1.37)$

$Y = 20.09$ ft.

downstream end:

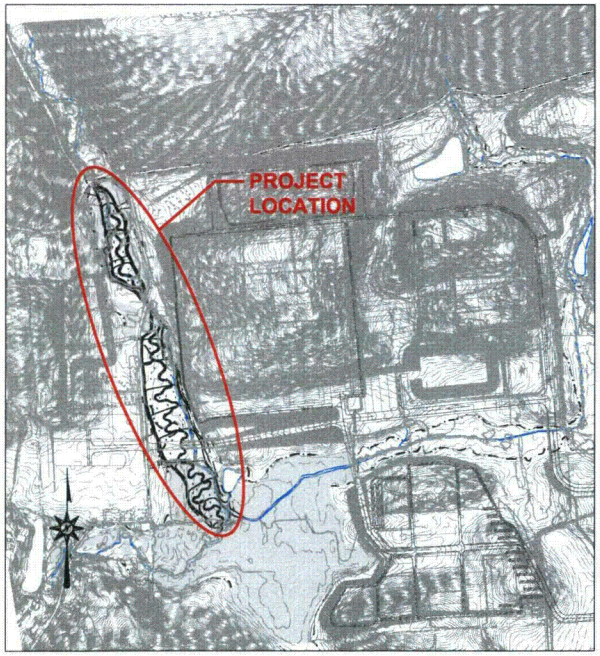
$Y = 14.65 (2.37)^{(0.449)}$

$Y = 14.65 (1.47)$

$Y = 21.58$ ft.

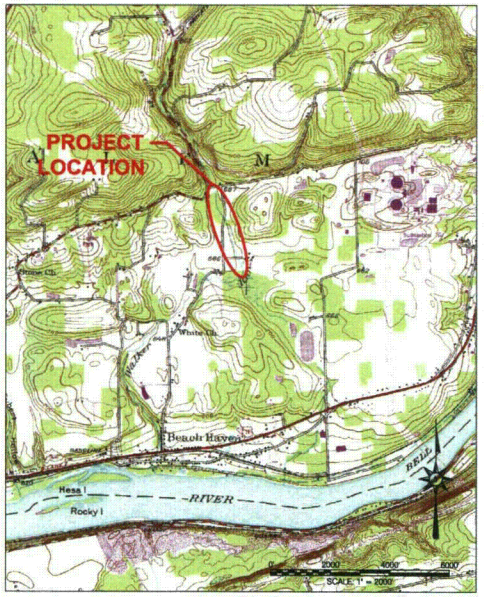
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
BELL BEND NUCLEAR POWER PLANT
SALEM TOWNSHIP, LUZERNE COUNTY, PENNSYLVANIA

PLAN DATE: OCTOBER 29, 2010
REVISION 1: AUGUST 12, 2011



SITE MAP
1" = 500'

TABLE OF CONTENTS

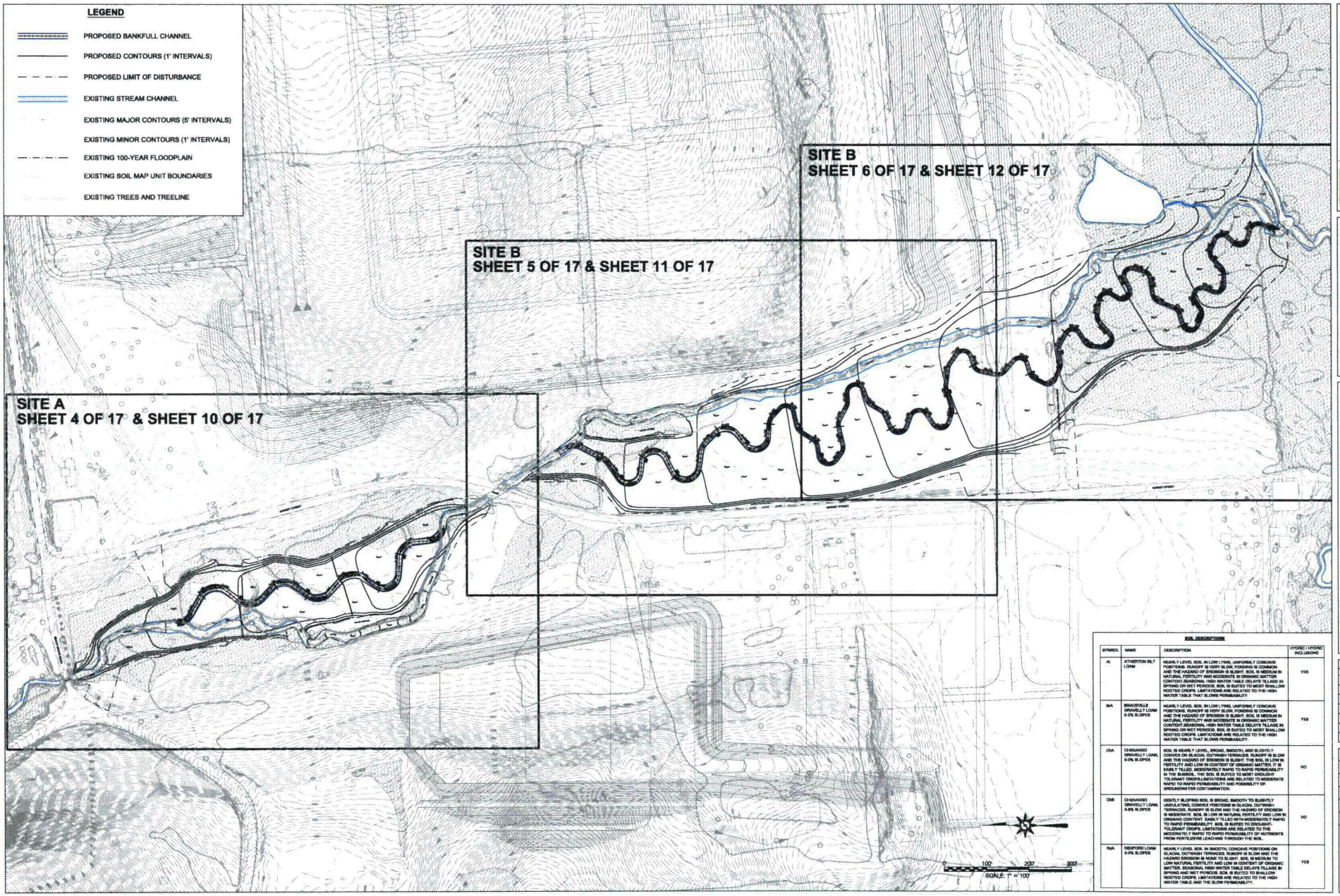


LOCATION MAP
1" = 2,000'

CLIENT ADDRESS:
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603
PHONE: (570) 802-5636
FAX: (570) 802-5639

Land Studies
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
PA 042324

PROJECT: STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
PROJECT #: E-758-L9 | DRAWING #: MITIGA01 | DATE: OCTOBER 29, 2010
COUNTY: LUZERNE COUNTY | REVISION: 1 | DATE: 8/12/2011



SOIL DESCRIPTIONS

SYMBOL	NAME	DESCRIPTION	HYDRIC / HYDRIC INCLUSIONS
At	ATHERTON SILT LOAM	NEARLY LEVEL SOIL IN LOW LYING, UNIFORMLY CONCAVE POSITIONS. RUNOFF IS VERY SLOW, PONDING IS COMMON AND THE HAZARD OF EROSION IS SLIGHT. SOIL IS MEDIUM IN NATURAL FERTILITY AND MODERATE IN ORGANIC MATTER CONTENT.SEASONAL HIGH WATER TABLE DELAYS TILLAGE IN SPRING OR WET PERIODS. SOIL IS SUITED TO MOST SHALLOW ROOTED CROPS. LIMITATIONS ARE RELATED TO THE HIGH WATER TABLE THAT SLOWS PERMEABILITY.	YES
BrA	BRACEVILLE GRAVELLY LOAM 0-3% SLOPES	NEARLY LEVEL SOIL IN LOW LYING, UNIFORMLY CONCAVE POSITIONS. RUNOFF IS VERY SLOW, PONDING IS COMMON AND THE HAZARD OF EROSION IS SLIGHT. SOIL IS MEDIUM IN NATURAL FERTILITY AND MODERATE IN ORGANIC MATTER CONTENT.SEASONAL HIGH WATER TABLE DELAYS TILLAGE IN SPRING OR WET PERIODS. SOIL IS SUITED TO MOST SHALLOW ROOTED CROPS. LIMITATIONS ARE RELATED TO THE HIGH WATER TABLE THAT SLOWS PERMEABILITY.	YES
ChA	CHENANGO GRAVELLY LOAM, 0-3% SLOPES	SOIL IS NEARLY LEVEL, BROAD, SMOOTH, AND SLIGHTLY CONVEX ON GLACIAL OUTWASH TERRACES. RUNOFF IS SLOW AND THE HAZARD OF EROSION IS SLIGHT. THE SOIL IS LOW IN FERTILITY AND LOW IN CONTENT OF ORGANIC MATTER. IT IS EASILY TILLED. MODERATELY RAPID TO RAPID PERMEABILITY IN THE SUBSOIL. THE SOIL IS SUITED TO MOST DROUGHT TOLERANT CROPS.LIMITATIONS ARE RELATED TO MODERATE RAPID TO RAPID PERMEABILITY AND POSSIBILITY OF GROUNDWATER CONTAMINATION.	NO
ChB	CHENANGO GRAVELLY LOAM, 3-8% SLOPES	GENTLY SLOPING SOIL IS BROAD, SMOOTH TO SLIGHTLY UNDULATING, CONVEX POSITIONS IN GLACIAL OUTWASH TERRACES. RUNOFF IS SLOW AND THE HAZARD OF EROSION IS MODERATE. SOIL IS LOW IN NATURAL FERTILITY AND LOW IN ORGANIC CONTENT. IT IS EASILY TILLED WITH MODERATELY RAPID TO RAPID PERMEABILITY. SOIL IS SUITED TO DROUGHT-TOLERANT CROPS. LIMITATIONS ARE RELATED TO THE MODERATELY RAPID TO RAPID PERMEABILITY OF NUTRIENTS FROM FERTILIZERS LEACHING THROUGH THE SOIL.	NO
RsA	REDFORD LOAM 0-3% SLOPES	NEARLY LEVEL SOIL IN SMOOTH, CONCAVE POSITIONS ON GLACIAL OUTWASH TERRACES. RUNOFF IS SLOW AND THE HAZARD EROSION IS NONE TO SLIGHT. SOIL IS MEDIUM TO LOW NATURAL FERTILITY AND LOW IN CONTENT OF ORGANIC MATTER. SEASONAL HIGH WATER TABLE DELAYS TILLAGE IN SPRING AND WET PERIODS. SOIL IS SUITED TO SHALLOW ROOTED CROPS. LIMITATIONS ARE RELATED TO THE HIGH WATER TABLE AND THE SLOW PERMEABILITY.	YES

PA 043524
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWLBY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
KEY MAP
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER: E-726-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=100'
DRAWING NUMBER: MIT-WR-002

SHEET NUMBER:
2
OF 17

SHEET TITLE:

EXISTING LONGITUDINAL PROFILE

STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE

SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/1/2011	

PROJECT NUMBER: E-726-L9
DRAWN BY: BRU
CHECKED BY: BLE; AWD
DATE: OCTOBER 29, 2010
SCALE: AS NOTED
DRAWING NUMBER: MIT-WR-003
SHEET NUMBER: 3 OF 17

PROJECT:

BELL BEND NUCLEAR POWER PLANT

PPL BELL BEND, LLC.

38 BOWBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

Land Studies

315 North Street | Lititz, PA 17543

717-627-4440
fax: 717-627-4660

landstudies.com
land@landstudies.com

PA 042334

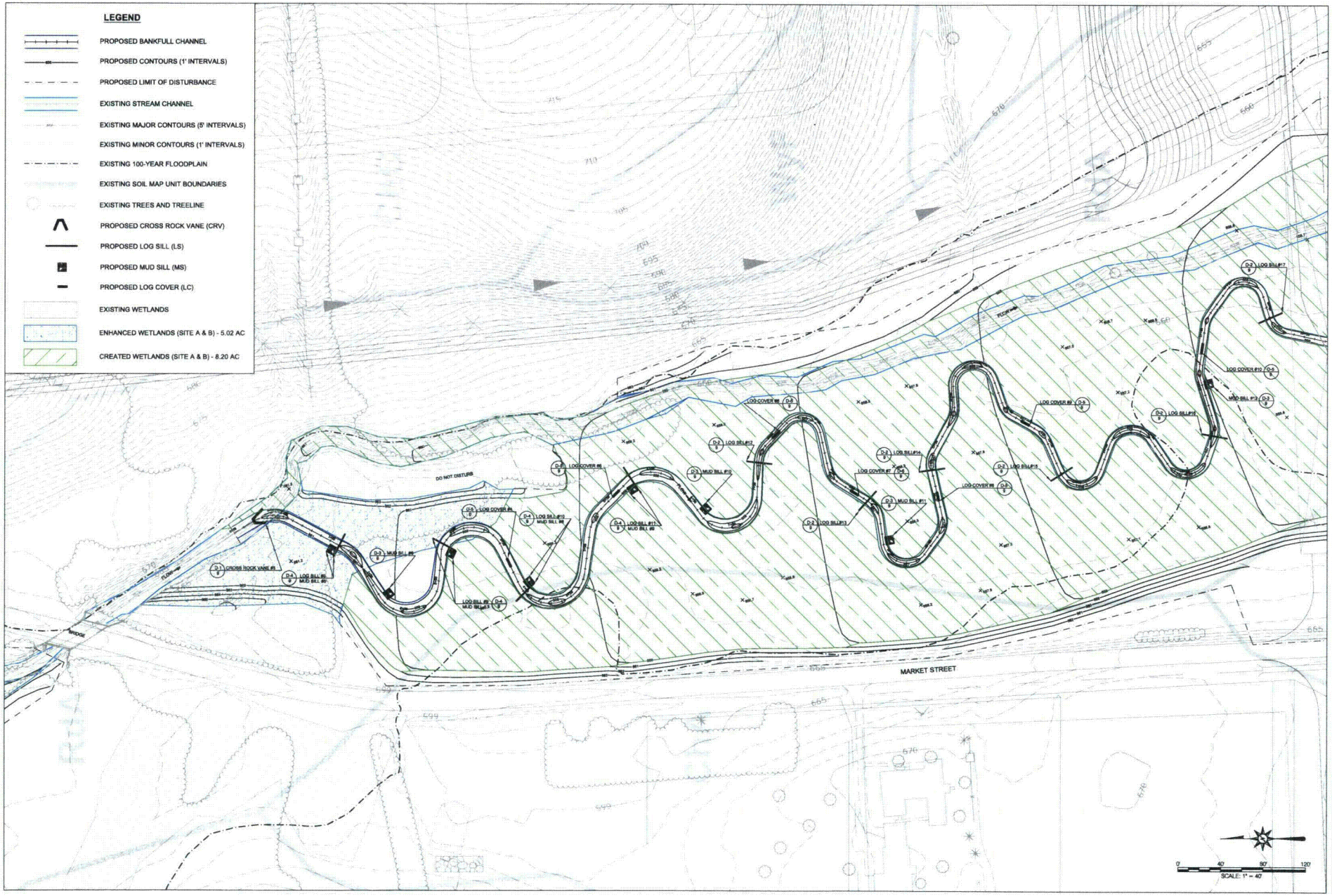
PA 043324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWDOY LANE SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
GRADING PLAN - SITE A
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER:	E-728-L8
DRAWN BY:	BRU
CHECKED BY:	BJE; AWD
DATE:	OCTOBER 29, 2010
SCALE:	1"=40'
DRAWING NUMBER:	MIT-WR-004
SHEET NUMBER:	4 OF 17



PA 042324
717-827-4440
fax: 717-827-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWSBY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
GRADING PLAN - SITE B
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION
1	8/12/11	ADD DRAINAGE NUMBER

PROJECT NUMBER: E-728-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=40'
DRAWING NUMBER: MIT-WR-005
SHEET NUMBER: 5 OF 17

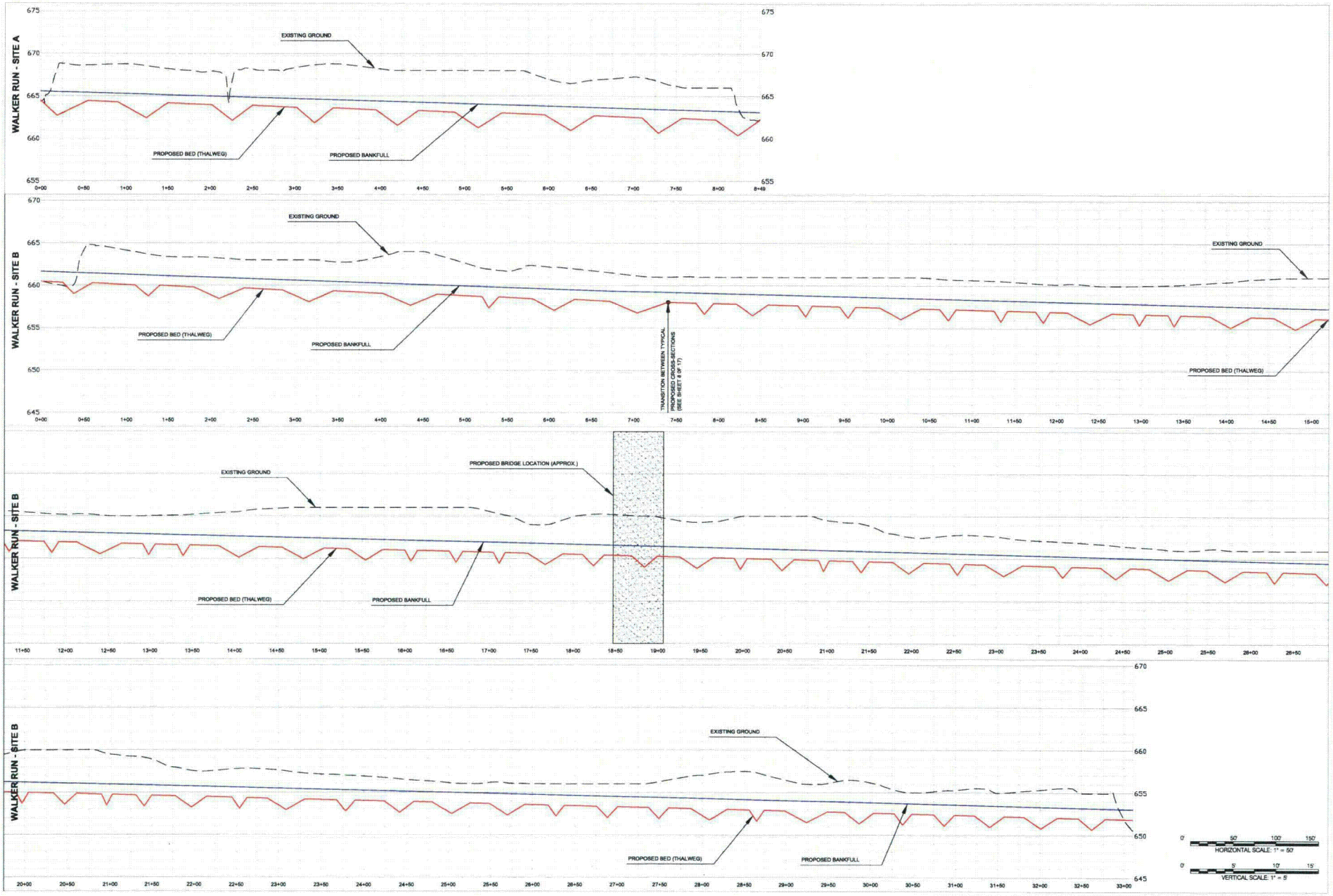
PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWSBY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
GRADING PLAN - SITE B
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER: E-728-L8
DRAWN BY: SRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=40'
DRAWING NUMBER: BIT-WR-006
SHEET NUMBER: 6 OF 17



PA 043324
717-827-4440
fax: 717-827-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

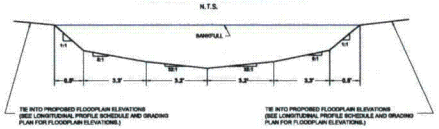
SHEET TITLE:
PROPOSED LONGITUDINAL PROFILES
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION
1	8/12/11	ADD DRAWING NUMBER

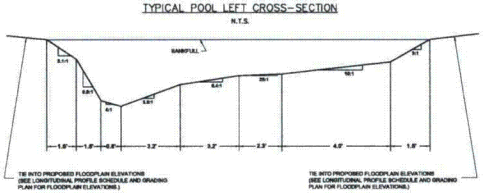
PROJECT NUMBER: E-729-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: AS NOTED
DRAWING NUMBER: MIT-WR-007
SHEET NUMBER: 7
OF 17

TYPICAL CROSS-SECTIONS - SITE A (STA.0+00 TO STA. 8+49)

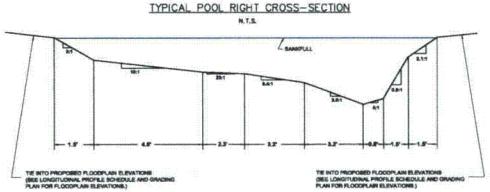
TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL LEFT CROSS-SECTION



TYPICAL POOL RIGHT CROSS-SECTION

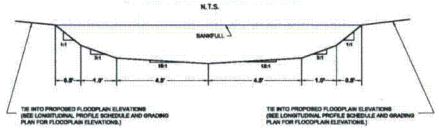


CROSS-SECTION SCHEDULE

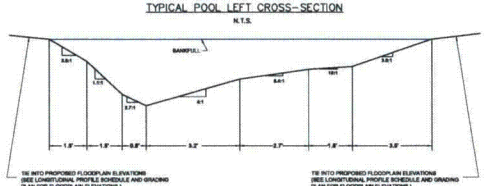
CROSS SECTION TYPE	BANKFULL AREA (SQ.FT.)	BANKFULL WIDTH (FT.)	MEAN DEPTH (FT.)	MAXIMUM DEPTH (FT.)
RIFFLE	8.4-12.6	12.0-14.0	0.7-0.9	1.0-1.4
POOL	15.5-23.3	13.2-19.8	NA	1.8-3.2

TYPICAL CROSS-SECTIONS - SITE B (STA.0+00 TO STA. 7+40)

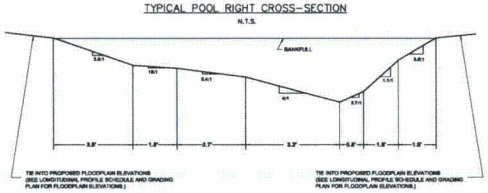
TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL LEFT CROSS-SECTION



TYPICAL POOL RIGHT CROSS-SECTION

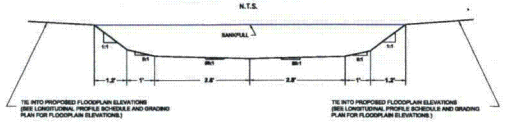


CROSS-SECTION SCHEDULE

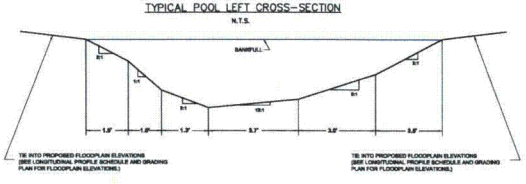
CROSS SECTION TYPE	BANKFULL AREA (SQ.FT.)	BANKFULL WIDTH (FT.)	MEAN DEPTH (FT.)	MAXIMUM DEPTH (FT.)
RIFFLE	8.6-14.0	12.0-14.0	0.8-1.0	1.0-1.4
POOL	16.2-23.8	13.2-19.6	NA	2.0-3.5

TYPICAL CROSS-SECTIONS - SITE B (STA 7+40 TO STA. 33+10)

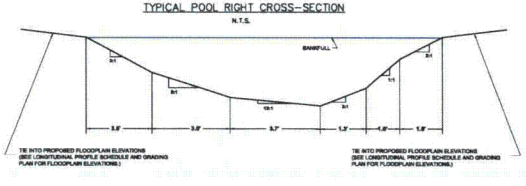
TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL LEFT CROSS-SECTION



TYPICAL POOL RIGHT CROSS-SECTION



CROSS-SECTION SCHEDULE

CROSS SECTION TYPE	BANKFULL AREA (SQ.FT.)	BANKFULL WIDTH (FT.)	MEAN DEPTH (FT.)	MAXIMUM DEPTH (FT.)
RIFFLE	7.2-14.4	8.0-12.0	0.9-1.2	1.0-1.4
POOL	12.2-24.3	8.0-14.4	NA	1.4-3.0

PROPOSED LONGITUDINAL PROFILE SCHEDULE - SITE A

STATION	STATION	STREAM FACET	BED ELEVATION	BANKFULL ELEVATION
0+00	0	TAIL OF RIFFLE	664.47	665.57
0+19	19	POOL MAX DEPTH	662.89	665.49
0+55	55	HEAD OF RIFFLE	664.44	665.41
0+90	90	TAIL OF RIFFLE	664.28	665.31
1+24	124	POOL MAX DEPTH	662.42	665.22
1+50	150	HEAD OF RIFFLE	664.19	665.13
2+02	202	TAIL OF RIFFLE	663.96	664.98
2+26	226	POOL MAX DEPTH	662.11	664.91
2+50	250	HEAD OF RIFFLE	663.89	664.84
3+02	302	TAIL OF RIFFLE	663.66	664.69
3+23	323	POOL MAX DEPTH	661.83	664.63
3+45	345	HEAD OF RIFFLE	663.60	664.57
3+95	395	TAIL OF RIFFLE	663.38	664.42
4+20	420	POOL MAX DEPTH	661.55	664.35
4+45	445	HEAD OF RIFFLE	663.30	664.28
4+88	488	TAIL OF RIFFLE	663.11	664.15
5+16	516	POOL MAX DEPTH	661.27	664.07
5+44	544	HEAD OF RIFFLE	663.03	663.96
5+95	595	TAIL OF RIFFLE	662.81	663.84
6+26	626	POOL MAX DEPTH	660.96	663.76
6+54	654	HEAD OF RIFFLE	662.72	663.67
7+10	710	TAIL OF RIFFLE	662.47	663.51
7+29	729	POOL MAX DEPTH	660.64	663.44
7+57	757	HEAD OF RIFFLE	662.40	663.37
7+97	797	TAIL OF RIFFLE	662.22	663.26
8+23	823	POOL MAX DEPTH	660.38	663.18
8+49	849	HEAD OF RIFFLE	662.17	663.11

PROPOSED LONGITUDINAL PROFILE SCHEDULE - SITE B

STATION	STATION	STREAM FACET	BED ELEVATION	BANKFULL ELEVATION
0+00	0	HEAD OF RIFFLE	660.47	661.85
0+25	25	TAIL OF RIFFLE	660.34	661.57
0+38	38	POOL MAX DEPTH	659.01	661.51
0+80	80	HEAD OF RIFFLE	660.29	661.45
1+10	110	TAIL OF RIFFLE	660.04	661.28
1+26	126	POOL MAX DEPTH	658.73	661.23
1+40	140	HEAD OF RIFFLE	660.01	661.17
1+80	180	TAIL OF RIFFLE	659.80	661.04
2+10	210	POOL MAX DEPTH	658.44	660.94
2+40	240	HEAD OF RIFFLE	659.70	660.83
2+85	285	TAIL OF RIFFLE	659.47	660.68
3+16	316	POOL MAX DEPTH	658.08	660.58
3+45	345	HEAD OF RIFFLE	659.37	660.48
4+02	402	TAIL OF RIFFLE	659.08	660.28
4+35	435	POOL MAX DEPTH	657.67	660.17
4+67	467	HEAD OF RIFFLE	658.97	660.06
5+20	520	TAIL OF RIFFLE	658.70	659.88
5+28	528	POOL MAX DEPTH	657.35	659.85
5+40	540	HEAD OF RIFFLE	658.67	659.81
5+80	580	TAIL OF RIFFLE	658.46	659.68
6+06	606	POOL MAX DEPTH	657.09	659.59
6+30	630	HEAD OF RIFFLE	658.38	659.51
6+72	672	TAIL OF RIFFLE	658.16	659.37
7+04	704	POOL MAX DEPTH	656.80	659.30
7+40	740	HEAD OF RIFFLE	658.05	659.23
7+73	773	TAIL OF RIFFLE	657.95	659.15
7+83	783	POOL MAX DEPTH	656.63	659.13
7+94	794	HEAD OF RIFFLE	657.91	659.10
8+21	821	TAIL OF RIFFLE	657.84	659.03
8+40	840	POOL MAX DEPTH	656.49	658.99
8+59	859	HEAD OF RIFFLE	657.76	658.94
8+94	894	TAIL OF RIFFLE	657.66	658.86
9+03	903	POOL MAX DEPTH	656.34	658.84
9+11	911	HEAD OF RIFFLE	657.63	658.82
9+44	944	TAIL OF RIFFLE	657.54	658.74
9+54	954	POOL MAX DEPTH	656.22	658.72
9+63	963	HEAD OF RIFFLE	657.51	658.69
9+91	991	TAIL OF RIFFLE	657.43	658.63
10+16	1016	POOL MAX DEPTH	656.07	658.57
10+40	1040	HEAD OF RIFFLE	657.32	658.51
10+62	1062	TAIL OF RIFFLE	657.26	658.46
10+72	1072	POOL MAX DEPTH	656.93	658.43
10+81	1081	HEAD OF RIFFLE	657.23	658.41
11+26	1126	TAIL OF RIFFLE	657.11	658.30
11+34	1134	POOL MAX DEPTH	655.78	658.28
11+42	1142	HEAD OF RIFFLE	657.08	658.26
11+75	1175	TAIL OF RIFFLE	656.99	658.19
11+84	1184	POOL MAX DEPTH	655.67	658.17
11+92	1192	HEAD OF RIFFLE	656.95	658.14
12+13	1213	TAIL OF RIFFLE	656.90	658.09
12+40	1240	POOL MAX DEPTH	655.53	658.03
12+66	1266	HEAD OF RIFFLE	656.78	657.97
12+91	1291	TAIL OF RIFFLE	656.71	657.91
12+98	1298	POOL MAX DEPTH	655.39	657.89
13+06	1306	HEAD OF RIFFLE	656.68	657.87
13+32	1332	TAIL OF RIFFLE	656.61	657.81
13+39	1339	POOL MAX DEPTH	655.29	657.79
13+47	1347	HEAD OF RIFFLE	656.58	657.77
13+81	1381	TAIL OF RIFFLE	656.49	657.69
14+05	1405	POOL MAX DEPTH	655.13	657.63
14+29	1429	HEAD OF RIFFLE	656.39	657.58
14+56	1456	TAIL OF RIFFLE	656.31	657.51
14+81	1481	POOL MAX DEPTH	654.95	657.45
15+05	1505	HEAD OF RIFFLE	656.21	657.39
15+34	1534	TAIL OF RIFFLE	656.13	657.32
15+54	1554	POOL MAX DEPTH	654.78	657.28
15+74	1574	HEAD OF RIFFLE	656.04	657.23
16+00	1600	TAIL OF RIFFLE	655.97	657.17
16+07	1607	POOL MAX DEPTH	654.65	657.15
16+15	1615	HEAD OF RIFFLE	655.94	657.13
16+53	1653	TAIL OF RIFFLE	655.84	657.04
16+61	1661	POOL MAX DEPTH	654.52	657.02
16+69	1669	HEAD OF RIFFLE	655.81	657.00
17+05	1705	TAIL OF RIFFLE	655.72	656.91
17+12	1712	POOL MAX DEPTH	654.40	656.90
17+19	1719	HEAD OF RIFFLE	655.69	656.88
17+46	1746	TAIL OF RIFFLE	655.61	656.81
17+67	1767	POOL MAX DEPTH	654.28	656.76
17+88	1788	HEAD OF RIFFLE	655.53	656.71
18+11	1811	TAIL OF RIFFLE	655.46	656.66
18+24	1824	POOL MAX DEPTH	654.13	656.63
18+37	1837	HEAD OF RIFFLE	655.41	656.60
18+69	1869	TAIL OF RIFFLE	655.32	656.52
18+84	1884	POOL MAX DEPTH	653.98	656.48
18+99	1899	HEAD OF RIFFLE	655.26	656.45
19+26	1926	TAIL OF RIFFLE	655.18	656.38
19+46	1946	POOL MAX DEPTH	653.84	656.34
19+65	1965	HEAD OF RIFFLE	655.10	656.29
19+90	1990	TAIL OF RIFFLE	655.03	656.23
19+97	1997	POOL MAX DEPTH	653.71	656.21
20+05	2005	HEAD OF RIFFLE	655.00	656.19
20+34	2034	TAIL OF RIFFLE	654.92	656.12
20+47	2047	POOL MAX DEPTH	653.59	656.09
20+61	2061	HEAD OF RIFFLE	654.87	656.06
20+90	2090	TAIL OF RIFFLE	654.79	655.99
20+96	2096	POOL MAX DEPTH	653.47	655.97
21+03	2103	HEAD OF RIFFLE	654.77	655.96
21+31	2131	TAIL OF RIFFLE	654.69	655.89
21+41	2141	POOL MAX DEPTH	653.37	655.87
21+50	2150	HEAD OF RIFFLE	654.65	655.85
21+78	2178	TAIL OF RIFFLE	654.58	655.78
21+97	2197	POOL MAX DEPTH	653.23	655.73
22+15	2215	HEAD OF RIFFLE	654.50	655.69
22+45	2245	TAIL OF RIFFLE	654.42	655.62
22+54	2254	POOL MAX DEPTH	653.10	655.60
22+63	2263	HEAD OF RIFFLE	654.38	655.57
22+87	2287	TAIL OF RIFFLE	654.31	655.52
23+09	2309	POOL MAX DEPTH	652.96	655.46
23+31	2331	HEAD OF RIFFLE	654.22	655.41
23+68	2368	TAIL OF RIFFLE	654.12	655.32
23+79	2379	POOL MAX DEPTH	652.80	655.30
23+90	2390	HEAD OF RIFFLE	654.08	655.27
24+24	2424	TAIL OF RIFFLE	653.99	655.19
24+42	2442	POOL MAX DEPTH	652.66	655.15
24+59	2459	HEAD OF RIFFLE	653.92	655.10
24+81	2481	TAIL OF RIFFLE	653.85	655.05
25+04	2504	POOL MAX DEPTH	652.50	655.00
25+26	2526	HEAD OF RIFFLE	653.76	654.94
25+49	2549	TAIL OF RIFFLE	653.69	654.89
25+70	2570	POOL MAX DEPTH	652.34	654.84
25+91	2591	HEAD OF RIFFLE	653.60	654.79
26+19	2619	TAIL OF RIFFLE	653.52	654.72
26+28	2628	POOL MAX DEPTH	652.20	654.70
26+38	2638	HEAD OF RIFFLE	653.49	654.67
26+76	2676	TAIL OF RIFFLE	653.38	654.58
26+89	2689	POOL MAX DEPTH	652.05	654.55
27+01	2701	HEAD OF RIFFLE	653.33	654.52
27+37	2737	TAIL OF RIFFLE	653.24	654.44
27+46	2746	POOL MAX DEPTH	651.91	654.41
27+61	2761	HEAD OF RIFFLE	653.19	654.38
27+87	2787	TAIL OF RIFFLE	653.12	654.32
28+09	2809	POOL MAX DEPTH	651.77	654.27
28+30	2830	HEAD OF RIFFLE	653.03	654.21
28+56	2856	TAIL OF RIFFLE	652.96	654.15
28+65	2865	POOL MAX DEPTH	651.63	654.13
28+74	2874	HEAD OF RIFFLE	652.92	654.11
28+99	2899	TAIL OF RIFFLE	652.85	654.05
29+24	2924	POOL MAX DEPTH	651.49	653.99
29+49	2949	HEAD OF RIFFLE	652.74	653.93
29+70	2970	TAIL OF RIFFLE	652.68	653.88
29+87	2987	POOL MAX DEPTH	651.34	653.84
30+04	3004	HEAD OF RIFFLE	652.60	653.80
30+28	3028	TAIL OF RIFFLE	652.54	653.74
30+38	3038	POOL MAX DEPTH	651.21	653.71
30+49	3049	HEAD OF RIFFLE	652.49	653.68
30+75	3075	TAIL OF RIFFLE	652.43	653.63
30+87	3087	POOL MAX DEPTH	651.10	653.60
30+99	3099	HEAD OF RIFFLE	652.38	653.57
31+23	3123	TAIL OF RIFFLE	652.31	653.51
31+41	3141	POOL MAX DEPTH	650.97	653.47
31+58	3158	HEAD OF RIFFLE	652.23	653.43
31+81	3181	TAIL OF RIFFLE	652.17	653.37
32+01	3201	POOL MAX DEPTH	650.82	653.32
32+21	3221	HEAD OF RIFFLE	652.09	653.27
32+46	3246	TAIL OF RIFFLE	652.02	653.21
32+62	3262	POOL MAX DEPTH	650.68	653.18
32+78	3278	HEAD OF RIFFLE	651.95	653.14
33+10	3310	TAIL OF RIFFLE	651.86	653.06

PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWMAN LANE, SUITE 1
BERWICK, PENNSYLVANIA 18603

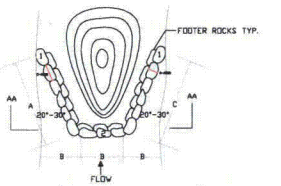
SHEET TITLE:
TYPICAL CROSS-SECTIONS & LONGITUDINAL PROFILE SCHEDULES
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

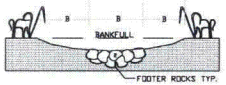
PROJECT NUMBER: E-728-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: NTS
DRAWING NUMBER: MIT-WR-008
SHEET NUMBER: 8
OF 17

D-1 / 9 CROSS-ROCK VANE DETAILS (TYPICAL)
NTS

PLAN VIEW

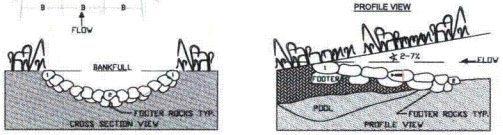


CROSS-SECTION VIEW (AA-AA)



NOTE:
SEE GENERAL IN-STREAM STRUCTURE NOTES FOR SPECIFIC ROCK SIZES.

PROFILE VIEW



GENERAL IN-STREAM ROCK STRUCTURE NOTES

1. ALL IN-STREAM STRUCTURES SHALL BE CONSTRUCTED UNDER THE DIRECT SUPERVISION OF AND SUBJECT TO THE APPROVAL OF AN ENGINEER EXPERIENCED IN THE PRINCIPLES OF FLUVIAL GEOMORPHOLOGY AND THE DESIGN AND CONSTRUCTION OF IN-STREAM STRUCTURES. IF NOT IS ACCORDANCE WITH THE DETAILS AND SPECIFICATIONS, THE IN-STREAM STRUCTURE SHALL BE RE-SET OR RECONSTRUCTED IN ACCORDANCE WITH THE DESIGN DETAILS AND SPECIFICATIONS.

2. IN-STREAM STRUCTURES AND BEDDING SHALL BE INSTALLED IN ACCORDANCE WITH THE DETAILS SHOWN AND SHALL ACHIEVE THE FOLLOWING MINIMUM FLUVIAL GEOMORPHOLOGIC OBJECTIVES: 1) TO ALLOW NORMAL BED LOAD SEDIMENT TRANSPORT TO OCCUR, 2) TO ALLOW AQUATIC ORGANISMS (FISH FISH) TO HAVE FREE MIGRATION ACCESS ACROSS THE STRUCTURE, 3) TO MINIMIZE STREAM BANK AND BED STABILIZATION, 4) TO PROVIDE HABITAT FOR FISH AND OTHER AQUATIC ORGANISMS, AND 5) TO REDIRECT FLOW VELOCITY VECTORS AWAY FROM THE STREAM BANK TO PREVENT EROSIVE FORCES AT THE BANK. THE CONTRACTOR IS RESPONSIBLE FOR MEETING THESE FLUVIAL GEOMORPHOLOGIC OBJECTIVES.

3. IN-STREAM STRUCTURES SHALL BE CONSTRUCTED OF ANGULAR, FLAT, OR CUBED ROCK. INDIVIDUAL ROCK FRAGMENTS SHALL BE DENSE, SOUND, AND FREE FROM CRACKS, SEAMS AND OTHER DEFECTS CONDUCIVE TO ACCELERATED WEATHERING. THE DRY WEIGHT DENSITY OF EACH ROCK SHALL BE 150 POUNDS PER CUBIC FOOT OR GREATER. NO CONCRETE, MAN-MADE ROCKS, OR SOFT ROCKS (SUCH AS SHALE) SHALL BE USED FOR THE CONSTRUCTION OF THE IN-STREAM STRUCTURES.

4. CONSTRUCTION OF THE IN-STREAM STRUCTURES REQUIRES MINIMUM, SELECTION AND PLACEMENT OF EACH ROCK IN EACH STRUCTURE.

5. FOOTER ROCKS SHALL BE PLACED INDIVIDUALLY AND KEYED INTO CHANNEL BED AND BANK AS SHOWN IN THE CROSS ROCK VANE DETAIL. THE TOP SURFACE OF THE CROSS ROCK VANE THROAT (SR, CENTER) SHALL BE PLACED AT THE STREAM BED INVERT ELEVATION.

6. THE TOP ROCKS SHALL BE PLACED INDIVIDUALLY ABOVE AND UPSTREAM OF THE FOOTER ROCKS AS SHOWN. THE TOP ROCKS IN THE CROSS ROCK VANE ARMS SHALL BE PLACED TO CREATE A RELATIVELY UNIFORM TOP PLANE SURFACE SLOPING UP TO THE BANKFULL ELEVATION FROM THE STREAM BED INVERT ELEVATION. THE TOP ROCKS SHALL BE PLACED LINEARLY WITH TIGHT, CONTINUOUS SURFACE CONTACT WITH ADJACENT TOP ROCKS.

7. THE DOWNSTREAM ENDS OF THE CROSS ROCK VANE ARMS SHALL EXTEND A MINIMUM OF 5 FEET INTO THE STREAM BANK.

8. NO SIGNIFICANT VOIDS SHALL EXIST BETWEEN ADJOINING FOOTER ROCKS, AND BETWEEN ADJOINING FOOTER AND TOP ROCKS. IN ORDER TO PREVENT WATER-PIPING BETWEEN STRUCTURE ROCKS, THE CONTRACTOR SHALL CHINK BY HAND ALL UNDESIRABLE VOIDS WITH SMALL BOULDERS, COBBLE, ROCK FRAGMENTS, SAND, AIR/DRY CLAY, CHIPMUNK SHALL BE CONDUCTED FOR ALL VOIDS GREATER THAN OR EQUAL TO 3 INCHES IN SIZE FOR COBBLE AND GRAVEL BASED STREAMS, AND ¾ INCH FOR SAND AND CLAY BASED STREAMS.

9. FOR SAND OR SILT/CLAY STREAM CHANNELS, A GEOTEXTILE FABRIC SHALL BE USED TO SUPPLEMENT THE CHINKING. THE GEOTEXTILE FABRIC SHALL BE PLACED ON THE UPSTREAM FACE OF THE FOOTER AND TOP ROCKS. THE GEOTEXTILE FABRIC SHALL ALSO BE BURIED A MINIMUM OF 12 INCHES INTO THE STREAMBED AND EXTENDED A MINIMUM OF 12 INCHES UPSTREAM.

10. MATERIAL EXCAVATED FOR THE FOOTER ROCKS MAY BE USED MINIMALLY (AT THE DISCRETION OF THE ENGINEER) FOR FILL ON THE UPSTREAM SIDE OF THE CROSS ROCK VANE ARMS. THE CONTRACTOR SHALL REGRADE OR REGRAVEL THE CHANNEL AFTER THE CONSTRUCTION OF THE IN-STREAM STRUCTURE TO PROVIDE THE PROPER DESIGN DIMENSIONS.

11. IF DIRECTED BY THE SUPERVISING ENGINEER, LIVE STAKES, SHRUBS, AND SMALL TREES SHALL BE PLANTED IN A DIAGONAL PATTERN ON THE STREAM BANK WHERE THE CROSS ROCK VANE ARMS TIES INTO THE BANK. PLANTING SHALL CONTINUE A MINIMUM OF ONE-HALF VANE ARM LENGTH BOTH UPSTREAM AND DOWNSTREAM OF THE STRUCTURE ALONG THE STREAM BANKS.

12. INDIVIDUAL ROCKS USED FOR THE CONSTRUCTION OF THE IN-STREAM STRUCTURES SHALL CONFORM TO THE FOLLOWING DIMENSION SPECIFICATIONS.

PROPOSED ROCK SIZE DIMENSIONS – VALLICER RUN

	A-AXIS	B-AXIS	C-AXIS
MINIMUM (FT)	1.0	1.0	0.5
MAXIMUM (FT)	2.0	2.0	3.0

14. DIMENSIONS OF IN-STREAM STRUCTURES (DIMENSIONS A, B, AND C) ARE SHOWN IN THE IN-STREAM STRUCTURES SCHEDULE.

GRADE CONTROL STRUCTURE SCHEDULE - SITE A

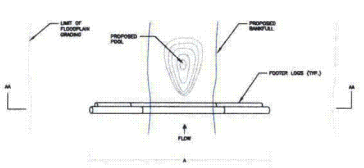
STRUCTURE ID	PROPOSED STATION	LENGTHS IN FEET (SEE DETAIL) A	B	C	INV. ELEV.	BANKFULL ELEV.
CRVR1	0+00	12.0-15.0	4.0-5.0	12.0-15.0	684.47	685.37
LSR1	0+80	20.0+	N/A	N/A	684.39	685.31
LSR2	2+02	20.0+	N/A	N/A	683.56	684.96
LSR3	3+02	20.0+	N/A	N/A	683.66	684.69
LSR4	3+85	20.0+	N/A	N/A	683.39	684.42
LSR5	4+88	20.0+	N/A	N/A	683.11	684.13
LSR6	5+85	20.0+	N/A	N/A	682.81	683.84
LSR7	7+10	20.0+	N/A	N/A	682.47	683.31
CRVR2	7+87	12.0-15.0	4.0-5.0	12.0-15.0	682.22	683.26

GRADE CONTROL STRUCTURE SCHEDULE - SITE B

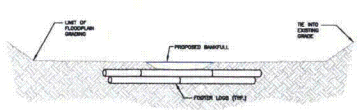
STRUCTURE ID	PROPOSED STATION	LENGTHS IN FEET (SEE DETAIL) A	B	C	INV. ELEV.	BANKFULL ELEV.
CRVR3	0+23	10.0-13.0	4.0-5.0	10.0-15.0	699.34	691.37
LSR8	1+19	20.0+	N/A	N/A	698.94	691.28
LSR9	2+03	20.0+	N/A	N/A	698.47	692.68
LSR10	4+02	20.0+	N/A	N/A	698.09	693.29
LSR11	5+60	20.0+	N/A	N/A	696.46	699.68
LSR12	7+13	20.0+	N/A	N/A	697.95	699.13
LSR13	9+44	20.0+	N/A	N/A	697.54	698.74
LSR14	11+26	20.0+	N/A	N/A	697.11	698.39
LSR15	13+81	20.0+	N/A	N/A	696.49	697.68
LSR16	15+80	20.0+	N/A	N/A	696.97	697.17
LSR17	18+11	20.0+	N/A	N/A	696.40	696.68
LSR18	19+90	20.0+	N/A	N/A	695.65	696.23
LSR19	21+70	20.0+	N/A	N/A	694.98	695.78
LSR20	24+24	20.0+	N/A	N/A	693.98	695.19
LSR21	26+10	20.0+	N/A	N/A	693.62	694.72
LSR22	27+47	20.0+	N/A	N/A	693.12	694.32
LSR23	30+28	20.0+	N/A	N/A	692.54	693.74
LSR24	31+81	20.0+	N/A	N/A	692.17	693.37
CRVR4	33+10	8.5-9.0	3.0-4.0	8.0-9.0	691.86	693.06

D-2 / 9 LOG SILL DETAILS (TYPICAL)
NTS

PLAN VIEW



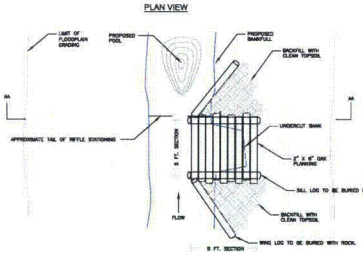
CROSS-SECTION VIEW (AA-AA)



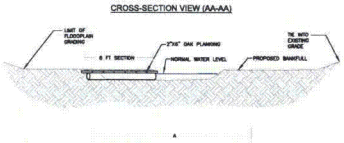
NOTE: LOGS (8-14" DIAMETER) SHALL BE HARVESTED FROM TIMBER CLEARED ON-SITE. LOGS SHALL BE A MINIMUM OF 20 FEET IN LENGTH. TOTAL LENGTH OF LOG SILL MAY VARY DEPENDING ON LOCATION (SEE PLAN VIEW).

D-3 / 9 MUD SILL DETAILS (TYPICAL)
NTS

PLAN VIEW



CROSS-SECTION VIEW (AA-AA)

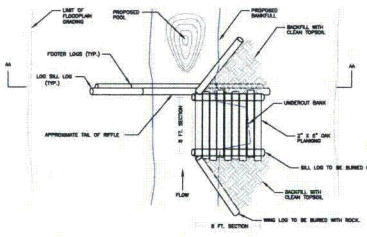


EXAMPLE PHOTO

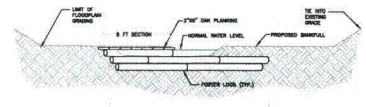
NOTE: 1. LOGS 8"-14" DIAMETER SHALL BE HARVESTED FROM TIMBER CLEARED ON-SITE.
2. MUD SILL TO BE COVERED WITH CLEAN TOPSOIL AND BACKFILLED ON EACH OUTSIDE EDGE.
3. WING LOG AND SILL LOGS TO BE BURIED IN TRENCH WITH ROCK.
4. MUD SILL PLACEMENT IS BASED UPON HABITAT STRUCTURE SCHEDULE AND IS LOCATED BASED UPON DOWNSTREAM EXTENT OF HABITAT STRUCTURE.

D-4 / 9 MUD SILL/LOG SILL COMBINATION DETAILS (TYPICAL)
NTS

PLAN VIEW



CROSS-SECTION VIEW (AA)

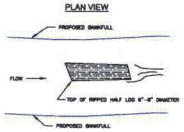


NOTE: LOGS 8"-14" DIAMETER SHALL BE HARVESTED FROM TIMBER CLEARED ON-SITE. LOGS SHALL BE A MINIMUM OF 20 FEET IN LENGTH. TOTAL LENGTH OF LOG SILL MAY VARY DEPENDING ON LOCATION (SEE PLAN VIEW)

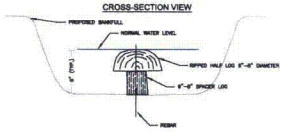
NOTE: 1. LOGS 8"-14" DIAMETER SHALL BE HARVESTED FROM TIMBER CLEARED ON-SITE. LOGS SHALL BE A MINIMUM OF 20 FEET IN LENGTH. TOTAL LENGTH OF LOG SILL MAY VARY DEPENDING ON LOCATION (SEE PLAN VIEW).
2. SEE GRADE CONTROL STRUCTURE SCHEDULE FOR LOG SILL DESIGN ELEVATIONS.
3. MUD SILL TO BE COVERED WITH CLEAN TOPSOIL AND BACKFILLED ON EACH OUTSIDE EDGE.
4. MUD SILL TO BE KEYED INTO LOG SILL STRUCTURE AND PLACED AS SHOWN ON PLAN VIEW.
5. WING LOG AND SILL LOGS TO BE BURIED IN TRENCH WITH ROCK.
6. MUD SILL PLACEMENT IS BASED UPON HABITAT STRUCTURE SCHEDULE AND IS LOCATED BASED UPON DOWNSTREAM EXTENT OF HABITAT STRUCTURE.

D-5 / 9 LOG COVER HABITAT DETAILS (TYPICAL)
NTS

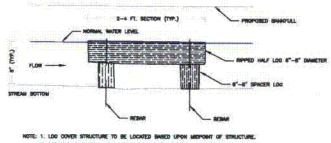
PLAN VIEW



CROSS-SECTION VIEW



PROFILE VIEW



NOTE: 1. LOG COVER STRUCTURE TO BE LOCATED BASED UPON MIDPOINT OF STRUCTURE.
2. SEE HABITAT STRUCTURE SCHEDULE FOR LOCATION OF STRUCTURE.

EXAMPLE PHOTO

MUD SILL HABITAT STRUCTURE SCHEDULE - SITE A

STRUCTURE ID	PROPOSED STATION	THALWEG ELEV.	TOP OF STRUCTURE
MSR1	2+52	693.39	694.86
MSR2	3+92	693.36	694.42
MSR3	5+95	692.91	693.84
MSR4	7+10	692.47	693.51

MUD SILL HABITAT STRUCTURE SCHEDULE - SITE B

STRUCTURE ID	PROPOSED STATION	THALWEG ELEV.	TOP OF STRUCTURE
MSR5	1+10	693.04	691.29
MSR6	1+80	693.80	691.54
MSR7	2+65	693.47	692.68
MSR8	4+52	693.08	693.29
MSR9	5+60	695.46	699.68
MSR10	6+72	695.19	699.37
MSR11	8+81	697.43	699.63
MSR12	10+53	695.64	697.54
MSR13	21+31	694.69	695.89
MSR14	29+85	693.95	694.15
MSR15	30+75	692.43	693.93

LOG COVER HABITAT STRUCTURE SCHEDULE - SITE A

STRUCTURE ID	PROPOSED STATION	LENGTH OF LOG COVER	THALWEG ELEV.	TOP OF STRUCTURE
LCR1	2+75	3-5 FT (TYP.)	693.79	694.28
LCR2	4+70	3-5 FT (TYP.)	693.18	693.79
LCR3	6+89	3-5 FT (TYP.)	692.80	693.20

LOG COVER HABITAT STRUCTURE SCHEDULE - SITE B

STRUCTURE ID	PROPOSED STATION	LENGTH OF LOG COVER	THALWEG ELEV.	TOP OF STRUCTURE
LCR4	3+70	3-5 FT (TYP.)	699.24	699.64
LCR5	5+88	3-5 FT (TYP.)	698.38	698.76
LCR6	8+05	3-5 FT (TYP.)	697.58	698.46
LCR7	9+30	3-5 FT (TYP.)	697.38	698.19
LCR8	11+00	3-5 FT (TYP.)	697.18	697.79
LCR9	13+20	3-5 FT (TYP.)	696.64	697.24
LCR10	16+83	3-5 FT (TYP.)	695.76	696.36
LCR11	20+29	3-5 FT (TYP.)	694.96	695.56
LCR12	24+12	3-5 FT (TYP.)	694.60	694.60
LCR13	26+69	3-5 FT (TYP.)	693.42	694.32
LCR14	27+28	3-5 FT (TYP.)	693.28	693.88
LCR15	31+10	3-5 FT (TYP.)	692.20	692.80

LOG COVER HABITAT STRUCTURE SCHEDULE - SITE B

STRUCTURE ID	PROPOSED STATION	LENGTH OF LOG COVER	THALWEG ELEV.	TOP OF STRUCTURE
LCR4	3+70	3-5 FT (TYP.)	699.24	699.64
LCR5	5+88	3-5 FT (TYP.)	698.38	698.76
LCR6	8+05	3-5 FT (TYP.)	697.58	698.46
LCR7	9+30	3-5 FT (TYP.)	697.38	698.19
LCR8	11+00	3-5 FT (TYP.)	697.18	697.79
LCR9	13+20	3-5 FT (TYP.)	696.64	697.24
LCR10	16+83	3-5 FT (TYP.)	695.76	696.36
LCR11	20+29	3-5 FT (TYP.)	694.96	695.56
LCR12	24+12	3-5 FT (TYP.)	694.60	694.60
LCR13	26+69	3-5 FT (TYP.)	693.42	694.32
LCR14	27+28	3-5 FT (TYP.)	693.28	693.88
LCR15	31+10	3-5 FT (TYP.)	692.20	692.80

PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

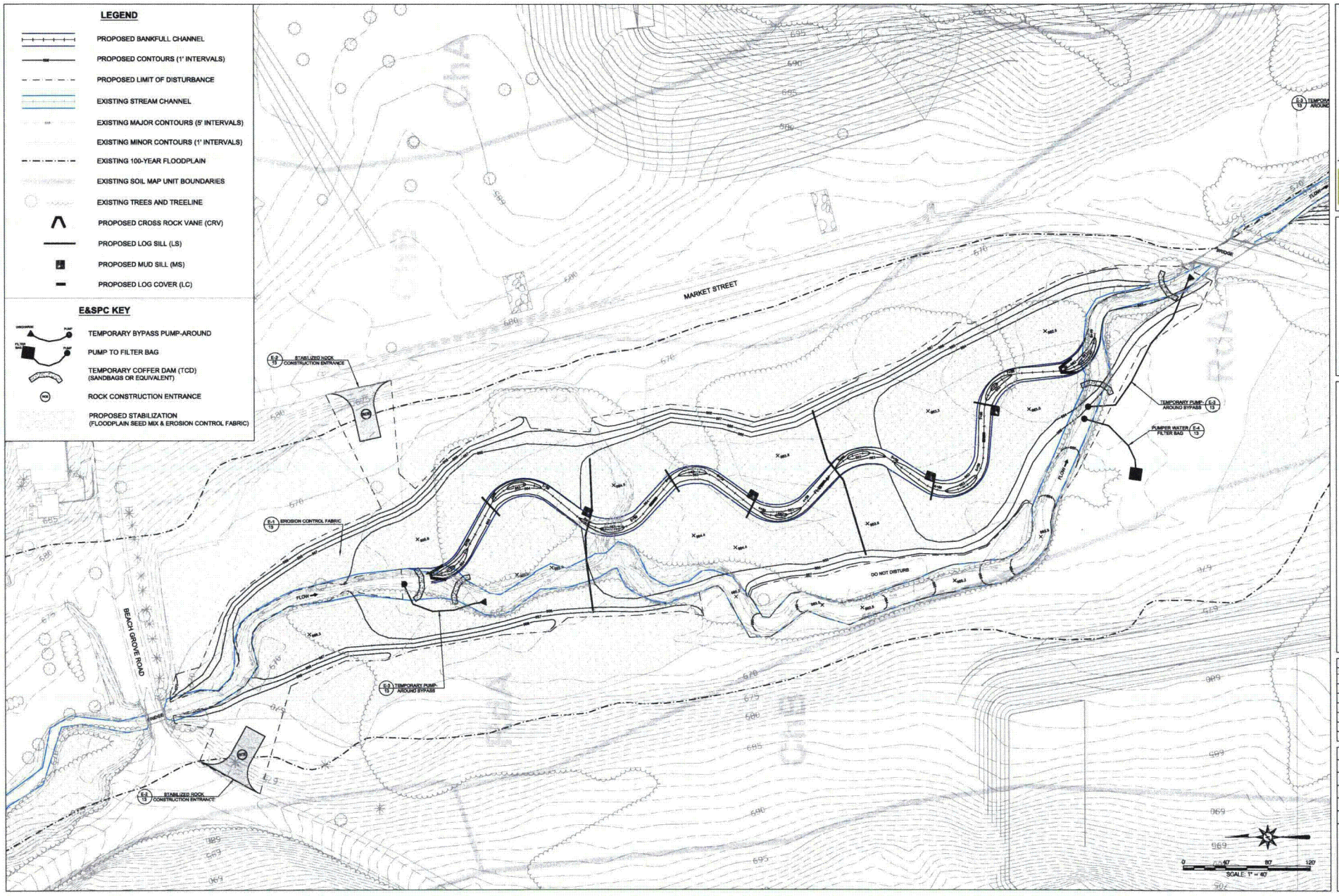
PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
DESIGN DETAILS & SCHEDULES
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS

NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER: E-729-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: NTS
DRAWING NUMBER: MIT-WR-009
SHEET NUMBER: 9 OF 17



PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWDOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
E&SPC PLAN - SITE A
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION AND DRAWING NUMBER
1	8/1/2011	

PROJECT NUMBER:	E-725-L8
DRAWN BY:	BRU
CHECKED BY:	BJE; AWD
DATE:	OCTOBER 29, 2010
SCALE:	1"=40'
DRAWING NUMBER:	BBT-WR-010
SHEET NUMBER:	10 OF 17

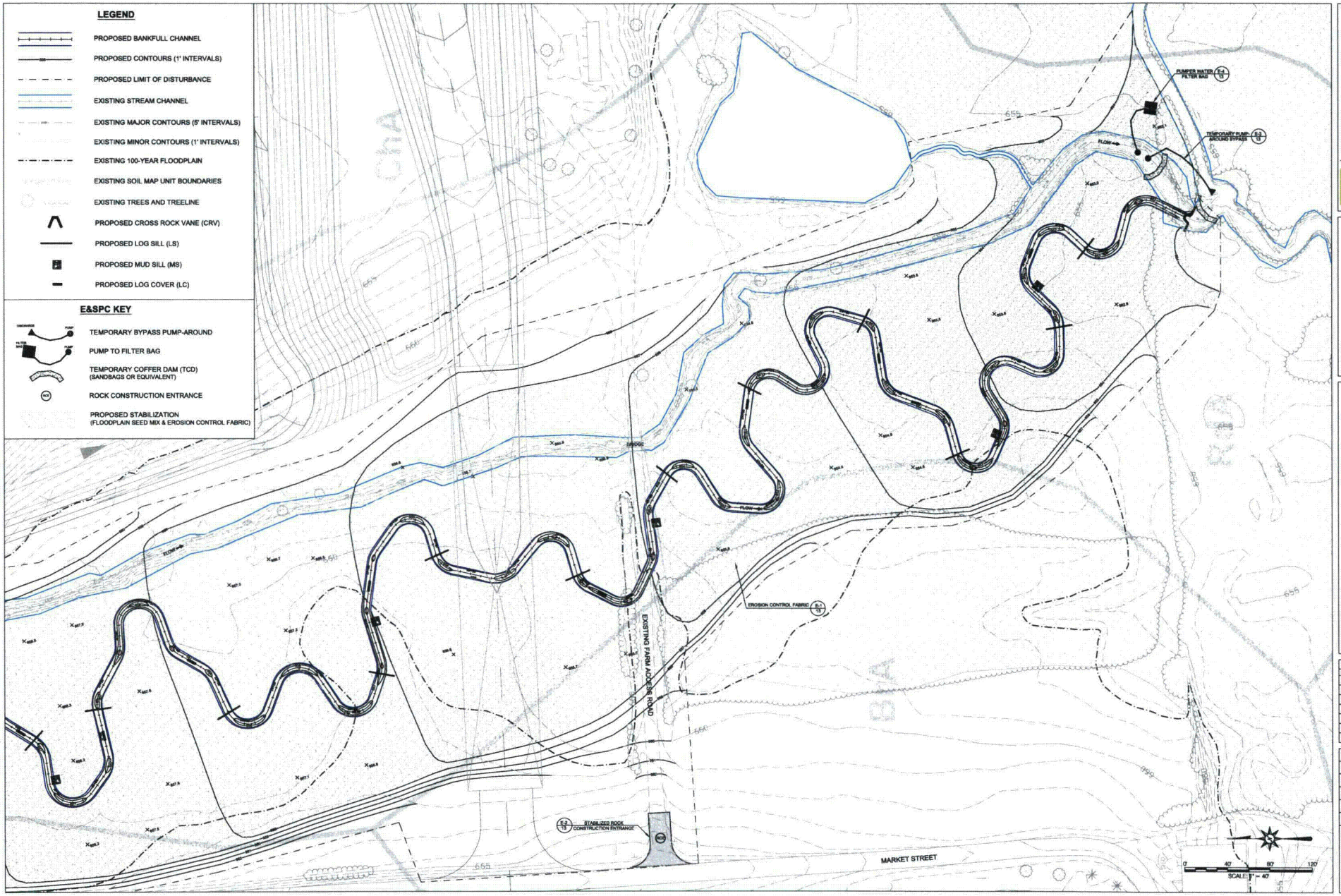
PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
E&SPC PLAN - SITE B
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION
1	8/12/11	ADD DRAINAGE NUMBERS

PROJECT NUMBER:	E-728-L8
DRAWN BY:	BRU
CHECKED BY:	BJE; AWD
DATE:	OCTOBER 29, 2010
SCALE:	1"=40'
DRAWING NUMBER:	MIT-WR-011
SHEET NUMBER:	11 OF 17



PA 042524
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOWLBY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

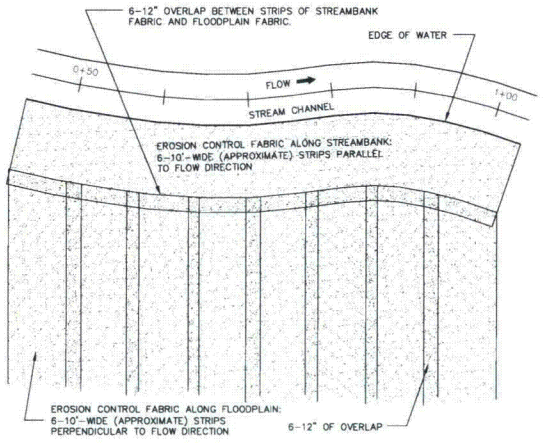
SHEET TITLE:
E&SPC PLAN - SITE B
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS			
NO.	DATE	DESCRIPTION	ADD DRAWING NUMBER
1	8/12/11		

PROJECT NUMBER: E-728-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=40'
DRAWING NUMBER: BBT-WR-012
SHEET NUMBER: 12 OF 17

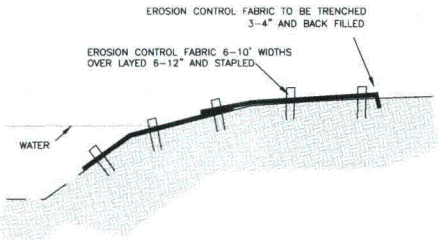
E-1 13 EROSION CONTROL FABRIC
NTS

PLAN VIEW



NOTE: EROSION CONTROL FABRIC SHALL EXTEND TO GRADING LIMIT AND SHALL BE TRENCHED INTO EXISTING GROUND.

CROSS-SECTION VIEW



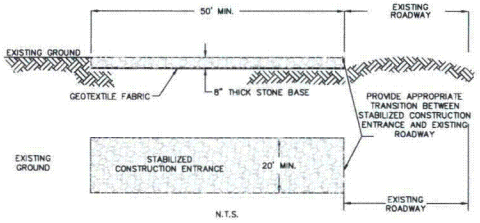
Erosion Control Fabric, (Rolanka BioD-Mat 70 or an equivalent) shall be used to stabilize all graded streambanks and floodplain areas. All slopes 3:1 and steeper that are not within the graded floodplain area shall also be stabilized with erosion control fabric.

SPECIFICATIONS
Rolanka BioD-Mat 70:

Roll size:	9.84' x 165'
Area:	180 SY
Weight:	29oz/SY
Thread:	N/A
Matrix:	100% woven bristle coir twine

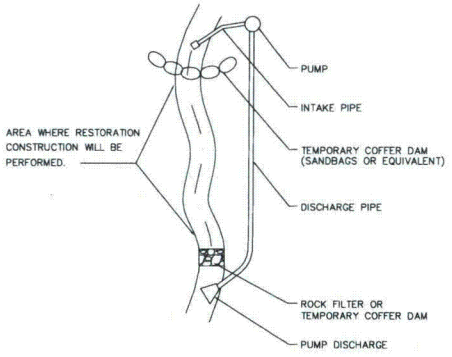
For more information, see www.rolanka.com

E-2 13 STABILIZED ROCK CONSTRUCTION ENTRANCE
NTS



1. STONE SIZE – AASHTO #1.
2. LENGTH – AS REQUIRED TO BE EFFECTIVE, BUT NOT LESS THAN 50'.
3. THICKNESS – NOT LESS THAN 8".
4. WIDTH – FULL WIDTH OF ALL POINTS OF INGRESS OR EGRESS, BUT NOT LESS THAN 20'.
5. WASHING – WHEELS SHALL BE CLEAN PRIOR TO ENTRANCE ONTO EXISTING ROADWAY. WHEN WASHING IS REQUIRED IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE WHICH DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH, OR WATERCOURSE THROUGH USE OF SAND BAGS, GRAVEL, BOARDS, OR OTHER APPROVED METHODS.
6. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO EXISTING ROADWAY, THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEAN OUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO EXISTING ROADWAYS MUST BE REMOVED IMMEDIATELY. CONSTRUCTION ENTRANCE MUST BE INSPECTED DAILY.

E-3 13 TEMPORARY PUMP-AROUND BYPASS
NTS



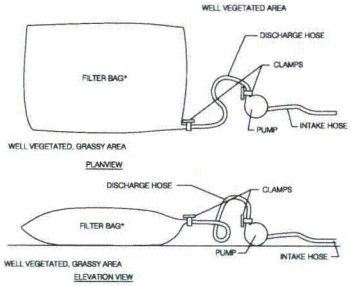
E-4 13 PUMPED WATER FILTER BAG
NTS

Filter bags may be used to filter water pumped from disturbed areas prior to discharging to water of the Commonwealth. They may also be used to filter water pumped from the sediment storage areas of sediment basins.

The pumping rate should be specified on the plan drawings next to the typical detail. Pumping rates will vary depending on the size of the filter bag, and the type and amount of sediment discharged to the bag.

Filter bags should be installed according to the details shown in Standard Construction Detail #26.

STANDARD CONSTRUCTION DETAIL #26
PUMPED WATER FILTER BAG



Filter bags shall be made from non-woven geotextile material sewn with high strength, double stitched "J" type seams. They shall be capable of trapping particles larger than 150 micros.

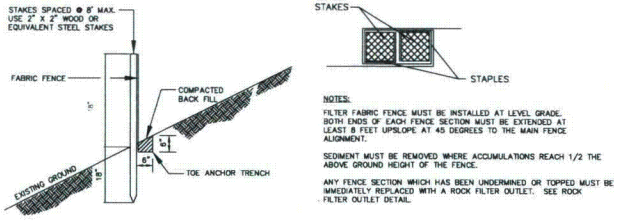
A suitable means of accessing the bag with machinery required for disposal purposes must be provided. Filter bags shall be replaced when they become ½ full. Spare bags shall be kept available for replacement of those that have failed or are filled.

Bags shall be located in well-vegetated (grassy) area, and discharge onto stable, erosion resistant areas. Where this is not possible, a geotextile flow path shall be provided. Bags shall not be placed on slopes greater than 5%.

the pump discharge hose shall be inserted into the bags in a manner specified by the manufacturer and securely clamped.

The pumping rate shall be no greater than 750 gpm or ½ the maximum specified by the manufacturer, whichever is less. Pump intakes should be floating and screened.

E-5 13 FILTER FABRIC FENCE
NTS



NOTES:

FILTER FABRIC FENCE MUST BE INSTALLED AT LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST BE EXTENDED AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.

SEDIMENT MUST BE REMOVED WHERE ACCUMULATIONS REACH 1/2 THE ABOVE GROUND HEIGHT OF THE FENCE.

ANY FENCE SECTION WHICH HAS BEEN UNDERMINED OR TOPPED MUST BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET. SEE ROCK FILTER OUTLET DETAIL.

PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
E&SPC PLAN - DETAILS
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD SEDIMENT NUMBER
1	8/12/11	

PROJECT NUMBER: E-726-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: NTS
DRAWING NUMBER: MIT-WR-013
SHEET NUMBER: 13 OF 17

A. GENERAL EROSION AND SEDIMENTATION CONTROL GUIDELINES

CONTRACTORS RESPONSIBILITIES

1. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT THE LUZERNE COUNTY CONSERVATION DISTRICT (LCCD) 72 HOURS PRIOR TO CONSTRUCTION AND 72 HOURS PRIOR TO LEAVING THE SITE. ALSO, AT LEAST 3 DAYS BEFORE STARTING ANY EARTH DISTURBANCE ACTIVITIES, ALL CONTRACTORS INVOLVED IN THOSE ACTIVITIES SHALL NOTIFY THE PENNSYLVANIA ONE CALL SYSTEM INCORPORATED AT 1-800-242-1776 FOR BURIED UTILITIES LOCATIONS.
   LUZERNE COUNTY CONSERVATION DISTRICT
   485 SMITHS POND ROAD
   SHAVERTOWN, PA 18708
   (570) 674-7991
2. A COPY OF THIS E&SC PLAN SHALL BE KEPT AVAILABLE FOR INSPECTION ON THE CONSTRUCTION SITE AT ALL TIMES DURING EARTH MOVING ACTIVITY AND UNTIL THE SITE IS STABILIZED.
3. THE CONTRACTOR SHALL MINIMIZE MUD OR SEDIMENT-LADEN WATER EXITING THE CONSTRUCTION SITE TO THE GREATEST EXTENT POSSIBLE. THE CONTRACTOR IS RESPONSIBLE FOR ANY AND ALL DAMAGES TO DOWNSTREAM PROPERTIES AS A RESULT OF HIS/HER FAILURE TO PREVENT SUCH DAMAGES.
4. THE INTENT OF THIS PLAN/NARRATIVE IS TO INDICATE GENERAL MEANS OF COMPLIANCE WITH THE REQUIREMENTS OF THE RULES AND REGULATIONS OF CHAPTER 102 OF THE PENNSYLVANIA CLEAN STREAMS LAW. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO IMPLEMENT THESE METHODS PLUS ADDITIONAL METHODS AS MAY BE NECESSARY BECAUSE OF THE CONDITIONS, AND/OR CONSTRUCTION PROCEDURES IN ORDER TO ASSURE COMPLIANCE WITH APPLICABLE LAW. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN ALL SEDIMENT AND EROSION CONTROL FACILITIES SO THAT THEY PERFORM AS REQUIRED BY LAW.
5. THE CONTRACTOR IS ADVISED TO BECOME THOROUGHLY FAMILIAR WITH THE PROVISIONS OF THE APPENDIX 64, EROSION CONTROL RULES AND REGULATIONS, TITLE 25, PART 1, DEPARTMENT OF ENVIRONMENTAL PROTECTION, SUBPART C, PROTECTION OF NATURAL RESOURCES, ARTICLE III, WATER RESOURCES, CHAPTER 102, EROSION CONTROL.
6. BEFORE INITIATING ANY REVISIONS TO THE APPROVED EROSION AND SEDIMENT CONTROL PLAN OR REVISIONS TO OTHER PLANS WHICH MAY AFFECT THE EFFECTIVENESS OF THE APPROVED E&S CONTROL PLAN, THE OPERATOR MUST RECEIVE APPROVAL OF THE REVISIONS FROM THE LUZERNE COUNTY CONSERVATION DISTRICT.
7. THE CONTRACTOR WILL BE RESPONSIBLE FOR PROVIDING A PREPAREDNESS, PREVENTION, AND CONTIGENCY (PPC) PLAN DESCRIBING ANY POTENTIAL HAZARDOUS MATERIALS THAT MAY BE STORED OR USED ON SITE AND EMERGENCY CLEAN-UP OR SPILL REMEDIATION PROCEDURES. THE PPC PLAN SHALL BE KEPT ON THE CONSTRUCTION SITE AT ALL TIMES.

B. GENERAL SEDIMENT AND EROSION CONTROL METHODS/PROCEDURES

1. ALL RELATED SEDIMENT AND EROSION CONTROL FACILITIES SHALL BE IN PLACE AND CAPABLE OF FUNCTIONING AS INTENDED PRIOR TO EARTH MOVING ACTIVITY WITHIN THEIR CONTRIBUTING WATERSHED AREAS. ALL SEDIMENT AND EROSION CONTROL FACILITIES SHALL REMAIN SO UNTIL UNIFORM OF THE UPLAND DRAINAGE AREA IS STABILIZED WITH PERMANENT GROUND COVER.
2. REDUCE BY THE GREATEST EXTENT PRACTICABLE THE AREA AND DURATION OF EXPOSURE OF READILY ERODIBLE SOILS.
3. EXCAVATED MATERIAL (SPOIL) SHALL BE HAULED AWAY FROM THE MITIGATION SITE AND DISPOSED OF WITHIN THE BELL BEND NUCLEAR POWER PLANT PROJECT AREA.
4. EXISTING WETLAND VEGETATION WILL BE PROTECTED TO THE GREATEST EXTENT POSSIBLE.
5. UPON COMPLETION OF EARTH MOVING, DISTURBED AREAS SHALL BE IMMEDIATELY SEEDED, MULCHED, OR OTHERWISE PROTECTED FROM ACCELERATED EROSION AND SEDIMENTATION.
6. THE CONTRACTOR SHALL PROVIDE PROTECTION AGAINST DISCHARGE OF POLLUTANTS SUCH AS CHEMICALS, FUEL, LUBRICANTS, SEWAGE, ETC. INTO STREAMS OR STORM WATER FACILITIES.
7. CONSTRUCTION ACCESS INTO UNPAVED AREAS FROM PAVED AREAS OR STREETS (PUBLIC OR PRIVATE) SHALL BE VIA A STABILIZED CONSTRUCTION ENTRANCE.
8. SEDIMENT SPILLED, DROPPED OR TRACKED ONTO PAVED SURFACES SHALL BE REMOVED IMMEDIATELY.
9. STOCKPILE HEIGHTS MUST NOT EXCEED 35 FEET. STOCKPILE SLOPES MUST BE 2:1 OR FLATTER.
10. IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE, THE OPERATOR SHALL STABILIZE ANY AREAS DISTURBED BY THE ACTIVITIES. DURING NON-GERMINATING PERIODS, MULCH MUST BE APPLIED AT THE SPECIFIED RATES. DISTURBED AREAS WHICH ARE NOT AT FINISHED GRADE AND WHICH WILL BE REDISTURBED WITHIN 1 YEAR MUST BE STABILIZED IN ACCORDANCE WITH THE TEMPORARY VEGETATIVE STABILIZATION SPECIFICATIONS. DISTURBED AREAS WHICH ARE AT FINISHED GRADE OR WHICH WILL NOT BE REDISTURBED WITHIN 1 YEAR MUST BE STABILIZED IN ACCORDANCE WITH THE PERMANENT VEGETATIVE STABILIZATION SPECIFICATIONS.
11. AN AREA SHALL BE CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM 70% UNIFORM PERENNIAL VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED SURFACE EROSION AND SUBSURFACE CHARACTERISTICS SUFFICIENT TO RESIST SLIDING AND OTHER MOVEMENTS.
12. AFTER FINAL SITE STABILIZATION HAS BEEN ACHIEVED, TEMPORARY EROSION AND SEDIMENT BMPS CONTROLS MUST BE REMOVED. AREAS DISTURBED DURING REMOVAL OF THE BMPS MUST BE STABILIZED IMMEDIATELY.

C. MAINTENANCE OF SEDIMENT AND EROSION CONTROL FACILITIES

1. UNTIL THE SITE ACHIEVES FINAL STABILIZATION, THE OPERATOR SHALL ASSURE THAT THE BEST MANAGEMENT PRACTICES ARE IMPLEMENTED, OPERATED, AND MAINTAINED PROPERLY AND COMPLETELY. MAINTENANCE SHALL INCLUDE INSPECTIONS OF ALL BEST MANAGEMENT PRACTICE FACILITIES. THE OPERATOR WILL MAINTAIN AND MAKE AVAILABLE TO LUZERNE COUNTY CONSERVATION DISTRICT COMPLETE, WRITTEN INSPECTION LOGS OF ALL THOSE INSPECTIONS. ALL MAINTENANCE WORK, INCLUDING CLEANING, REPAIR, REPLACEMENT, REGRADING AND RESTABILIZATION SHALL BE PERFORMED IMMEDIATELY.
2. UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENT BMPS MUST BE MAITAINED PROPERLY. MAINTENANCE MUST INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENT CONTROL BMPS AFTER EACH RUNOFF EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEAN OUT, REPAIR, REPLACEMENT, RE-GRADING, RE-SEEDING, RE-MULCHING, AND RE-NETTING, MUST BE PERFORMED IMMEDIATELY. IF EROSION AND SEDIMENT CONTROL BMPS FAIL TO PERFORM AS EXPECTED, REPLACEMENT BMPS, OR MODIFICATIONS OF THOSE INSTALLED WILL BE REQUIRED.
3. ALL SEDIMENT AND EROSION CONTROL FACILITIES MUST BE MAINTAINED IN OPERATING CONDITION UNTIL UPSTREAM AREAS ARE OF UNIFORM 70% STABILIZED WITH UNIFORM PERENNIAL VEGETATIVE COVER.
4. SEDIMENT REMOVED FROM BMPS SHALL BE DISPOSED OF IN LANDSCAPED AREAS OUTSIDE OF STEEP SLOPES, WETLANDS, FLOODPLAINS OR DRAINAGE SWALES AND IMMEDIATELY STABILIZED, OR PLACED IN TOPSOIL STOCKPILES.
5. ALL NON-USABLE MATERIAL AND DEBRIS SHALL BE REMOVED FROM THE SITE AND DISPOSED OF IN A LEGAL MANNER IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.
6. IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, THE OPERATOR SHALL IMPLEMENT APPROPRIATE BEST MANAGEMENT PRACTICES TO ELIMINATE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION.

D. RECYCLING AND DISPOSAL OF WASTE MATERIALS

1. THE OPERATOR SHALL REMOVE FROM THE SITE, RECYCLE, OR DISPOSE OF ALL BUILDING MATERIALS AND WASTES IN ACCORDANCE WITH THE DEPARTMENT'S SOLID WASTE MANAGEMENT REGULATIONS AT 25 PA. CODE 260.1 ET SEQ., 271.1 ET SEQ., AND 287.1 ET SEQ. THE CONTRACTOR SHALL NOT ILLEGALLY BURY, DUMP, OR DISCHARGE ANY BUILDING MATERIAL OR WASTES AT THE SITE.
2. THE OPERATOR SHALL ASSURE THAT AN EROSION AND SEDIMENT CONTROL PLAN HAS BEEN PREPARED, APPROVED BY THE LUZERNE COUNTY CONSERVATION DISTRICT, AND IS BEING IMPLEMENTED AND MAINTAINED FOR ALL SOIL AND/OR ROCK SPOIL AND BORROW AREAS, REGARDLESS OF THEIR LOCATIONS.
3. RE-USE OR RECYCLE SANDBAGS, CULVERTS, AND FLEXIBLE PIPE.
4. PROPERLY DISPOSE OF SEDIMENT FILTER BAGS, SILT FENCE, STAKES, AND FILTER SOCK MATERIAL.
5. DISPERSE COMPOST MATERIAL FROM FILTER SOCKS ON SITE, AS DIRECTED.

E. RESTORATION OF PLANTING AREAS

1. FINAL RESTORATION SHALL BE PERFORMED NO LATER THAN THE START OF THE NEXT PLANTING SEASON FOLLOWING CONSTRUCTION. THE PLANTING SEASON SHALL BE AS ESTABLISHED BY THE U.S. AGRICULTURAL SERVICE FOR THE AREA OF CONSTRUCTION.
2. TOPSOIL SHALL BE FREE FROM SUBSOIL, BRUSH, WEEDS, OR OTHER LITTER, CLAY LUMPS AND STONES, BUT MAY CONTAIN DECAYING VEGETABLE MATTER AS IS PRESENT IN GOOD TOPSOIL.
3. TOPSOIL SHALL BE IMPORTED FROM OFF-SITE IF NECESSARY AS DETERMINED BY PROJECT DESIGNER.
4. PRECAUTIONS SHALL BE EXERCISED AS NECESSARY TO CONFORM WITH LAWS RELATING TO EROSION AND SEDIMENT CONTROL.
5. SEED SHALL NOT HAVE LESS THAN 90% GERMINATION. GERMINATION TESTS OF SEEDS SHALL BE MADE NOT MORE THAN SIX (6) MONTHS PRIOR TO SEEDING. SEED WHICH HAS BECOME WET, MOLDY, OR OTHERWISE DAMAGED SHALL NOT BE USED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE TO PRODUCE A STAND OF GRASS OR WETLAND VEGETATION IN ALL SEEDED OR SODDED AREAS. EROSION, DROUGHT, OR ANY OTHER CONDITION ENCOUNTERED SHALL NOT RELIEVE THE CONTRACTOR OF THIS REQUIREMENT.

F. SITE STABILIZATION

1. EROSION CONTROL FABRIC (ROLANKA BIO-D-MAT 70 OR AN EQUIVALENT) SHALL BE USED TO STABILIZE GRADED STREAM BANKS AND FLOODPLAIN AS SHOWN IN DETAILS. EROSION CONTROL FABRIC SHALL BE OVERLAPPED IN STRIPS THAT ARE PERPENDICULAR TO THE EXISTING STREAM CHANNEL. THE PROPOSED FLOODPLAIN SEED MIX OR AN APPROVED EQUIVALENT SHALL BE APPLIED TO THE GRADED STREAMBANKS AND FLOODPLAIN PRIOR TO INSTALLING EROSION CONTROL FABRIC. ALL GRADED STREAM BANKS SHALL BE STABILIZED BEFORE ACTIVE FLOW IS INTRODUCED INTO THE NEWLY CONSTRUCTED STREAM CHANNEL.
2. ALL DISTURBED AREAS OUTSIDE OF THE PROPOSED FLOODPLAIN SHALL BE SEEDED WITH THE PROPOSED STABILIZATION SEED MIX AND MULCHED UPON THE COMPLETION OF EARTH MOVING ACTIVITIES.
3. MULCH AND STRAW WILL BE SPREAD AT 3 TONS/ACRE. STRAW MULCH SHALL BE APPLIED IN LONG STRANDS, NOT CHOPPED OR FINELY BROKEN.
4. MULCH WITH MULCH CONTROL NETTING OR EROSION CONTROL BLANKETS MUST BE INSTALLED ON ALL SLOPES 3:1 AND STEEPER.

SEEDING RESTORATION TABLE

LOCATION	TOPSOIL	STARTER FERTILIZER	LIME	SEED MIX
STREAMBANKS AND FLOODPLAIN (WETLAND AREAS)	YES	N/A	N/A	FLOODPLAIN SEED MIX SEE BELOW FOR COMPOSITION
UPLAND AREAS	NO	N/A	N/A	CONSERVATION SEED MIX SEE BELOW FOR COMPOSITION
OTHER DISTURBED AREAS	NO	N/A	N/A	STABILIZATION SEED MIX SEE TEMPORARY STABILIZATION MIX FOR APPROPRIATE SPECIES (BASED ON SEEDING WINDOW) AND APPLICATION RATES

NOTE: FERTILIZER AND/OR LIME SHALL NOT BE APPLIED TO THE GRADED STREAM BANKS OR FLOODPLAIN DUE TO THE CLOSE PROXIMITY OF PROPOSED ELEVATIONS TO THE WATER TABLE. IT IS ANTICIPATED THAT THE SPREADING OF TOPSOIL AND THE CLOSE PROXIMITY TO THE EXISTING WATER TABLE WILL PROMOTE RAPID SEED GERMINATION.

Floodplain Seed Mix

%	Botanical Name	Common Name	I.S.
10	*Elymus virginicus, PA*	Virginia Wild Rye, PA Ecotype	FACW
10	*Panicum rigidulum, PA*	Redtop Panic Grass, PA Ecotype	FACW+
8	*Elymus canadensis, PA*	Canada Wild Rye, PA Ecotype	FACU
5	*Carex vulpinoidea, PA Ecotype*	Fox Sedge, PA Ecotype	OBL
5	*Panicum clandestinum*	Deer Tongue 'Tioga', PA Ecotype	FAC+
5	*Elymus riparius, PA*	Riverbank Wild Rye, PA Ecotype	FACW
5	*Agrostis perennans, APB*	Autumn Bentgrass, APB	FACU
5	*Agrostis scabra, PA*	Tickllegrass, PA Ecotype (rough bentgrass)	FAC
5	*Carex scoparia*	Blunt Broom Sedge	FACW
5	*Festuca rubra*	Creeping Red Fescue	FACU
4	*Carex comosa*	Bristly Sedge	OBL
4	*Chasmanthium latifolium, PA*	River Oats, PA Ecotype	FACU
3	*Carex stipata*	Awl Sedge	OBL
3	*Elymus hystrix, PA*	Bottlebrush Grass, PA Ecotype	NI
3	*Juncus effusus, PA*	Soft Rush, PA Ecotype	FACW+
2	*Asclepias incarnata*	Swamp Milkweed	OBL
2	*Bidens aristosa*	Bur Marigold, 'Sather' NC Ecotype	FACW-
2	*Carex lurida*	Lurid Sedge	OBL
2	*Juncus tenuis*	Path Rush	FAC-
2	*Poa palustris*	Fowl Bluegrass	FACW
1	*Aster prenanthoides*	Zigzag Aster	FAC
1	*Aster laevis*	Smooth Blue Aster	NI
1	*Aster novae-angliae*	New England Aster	FACW-
1	*Carex crinita*	Fringed Sedge	OBL
1	*Iris versicolor*	Blue Flag Iris	OBL
1	*Lobelia cardinalis*	Cardinal Flower	FACW+
1	*Lobelia siphilitica*	Great Blue Lobelia	FACW+
1	*Scirpus validus*	Soft-stem Bulrush	OBL
1	*Solidago riddellii*	Riddell's Goldenrod	OBL
1	*Solidago rugosa*	Wrinkle Leaf Goldenrod	FAC
100		*Application Rate: 15-20 lbs/acre*	

Conservation Seed Mix

%	Botanical Name	Common Name	I.S.
15	*Schizachyrium scoparium, PA*	Little Bluestem, PA	FACU
10	*Elymus virginicus, PA*	Virginia Wild Rye, PA Ecotype	FACW
8	*Panicum rigidulum, PA*	Redtop Panic Grass, PA Ecotype	FACW+
5	*Agrostis perennans, APB*	Autumn Bentgrass, APB	FACU
5	*Agrostis scabra, PA*	Tickllegrass, PA Ecotype (rough bentgrass)	FAC
5	*Carex scoparia*	Blunt Broom Sedge	FACW
5	*Elymus canadensis, PA*	Canada Wild Rye, PA Ecotype	FACU
5	*Festuca rubra*	Creeping Red Fescue	FACU
5	*Panicum clandestinum*	Deer Tongue 'Tioga', PA Ecotype	FAC+
4	*Chasmanthium latifolium, PA*	River Oats, PA Ecotype	FACU
4	*Eupatorium perfoliatum*	Boneset	FACW+
3	*Carex vulpinoidea, PA Ecotype*	Fox Sedge, PA Ecotype	OBL
3	*Elymus hystrix, PA*	Bottlebrush Grass, PA Ecotype	NI
3	*Elymus riparius, PA*	Riverbank Wild Rye, PA Ecotype	FACW
3	*Juncus effusus, PA*	Soft Rush, PA Ecotype	FACW+
2	*Asclepias incarnata*	Swamp Milkweed	OBL
2	*Asclepias tuberosa*	Butterfly Milkweed	NI
2	*Helianthus helianthoides*	Ox Eye Sunflower	NI
2	*Juncus tenuis*	Path Rush	FAC
2	*Poa palustris*	Fowl Bluegrass	FACW
2	*Vernonia noveboracensis*	New York Ironweed	FACW+
1	*Aster novae-angliae*	New England Aster	FACW
1	*Aster prenanthoides*	Zigzag Aster	FAC
1	*Bidens aristosa*	Bur Marigold, 'Sather' NC Ecotype	FACW
1	*Onoclea sensibilis*	Sensitive Fern	FACW
1	*Solidago rugosa*	Wrinkle Leaf Goldenrod	FAC
100		*Application Rate: 15-20 lbs/acre*	

Temporary Stabilization Seed Mix

%	Botanical Name	Common Name	Seeding Window	Application Rate
100	*Secale cereale*	Cereal Rye	Sep. 1 - Oct. 16	30 lbs/acre
100	*Avena sativa*	Oats	May 1 - Sept. 15	30 lbs/acre

SERIAL NUMBER: 20103051639

PA 042324
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
E&SPC PLAN - NOTES
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER: E-728-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: NTS
DRAWING NUMBER: MIT-WR-014
SHEET NUMBER: 14 OF 17

CONSTRUCTION SCHEDULES

GENERAL CONSTRUCTION NOTES

- AT LEAST 7 DAYS BEFORE STARTING ANY EARTH DISTURBANCE ACTIVITIES THE OPERATOR SHALL INVITE ALL CONTRACTORS INVOLVED IN THOSE ACTIVITIES INCLUDING BUT NOT LIMITED TO: THE LANDOWNER, ALL APPROPRIATE MUNICIPAL OFFICIALS, AND A REPRESENTATIVE FROM THE LUZERNE COUNTY CONSERVATION DISTRICT FOR AN ON-SITE PRE-CONSTRUCTION MEETING. ALSO, AT LEAST 3 DAYS BEFORE STARTING ANY EARTH DISTURBANCE ACTIVITIES, ALL CONTRACTORS INVOLVED IN THOSE ACTIVITIES SHALL NOTIFY THE PENNSYLVANIA ONE CALL SYSTEM INCORPORATED AT 1-800-242-1776 FOR BURIED UTILITIES LOCATIONS.

- IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT THE LUZERNE COUNTY CONSERVATION DISTRICT (LCCD) 72 HOURS PRIOR TO CONSTRUCTION AND 72 HOURS PRIOR TO LEAVING THE SITE.

- ALL BMPS WILL BE INSTALLED AT THE APPROPRIATE LOCATIONS BEFORE WORK BEGINS.

- THE PROPOSED STREAM & WETLAND MITIGATION PLAN WILL BE PERFORMED ALONG TWO SEPARATE SEGMENTS INCLUDING: *SITE A - WALKER RUN NORTH MARKET STREET* AND *SITE B - WALKER RUN SOUTH MARKET STREET*. BECAUSE THE TWO RESTORATION SEGMENTS ARE SEPARATE FROM ONE ANOTHER, CONSTRUCTION MAY BE PERFORMED WITH TWO SEPARATE CREWS WORKING AT BOTH RESTORATION SEGMENTS SIMULTANEOUSLY.

- WHENEVER POSSIBLE, STREAM & FLOODPLAIN GRADING AND STABILIZATION SHALL BE COMPLETED IN PORTIONS ACCORDING TO A DAILY DISTURBANCE ZONE ESTABLISHED AT THE BEGINNING OF EACH WORK DAY TO MINIMIZE THE AMOUNT OF TOTAL DISTURBANCE.

- STREAM & FLOODPLAIN EXCAVATION SHALL BE SEQUENCED IN A MANNER THAT WORK WILL BE COMPLETED IN THE DRY AND TIME SPENT IN ACTIVE FLOW SHALL BE REDUCED TO THE GREATEST EXTENT POSSIBLE. ALL FLOW DIVERSIONS SHALL INTRODUCE FLOWS INTO NEWLY CONSTRUCTED CHANNELS SLOWLY, AND IN-STREAM WORK SHALL OCCUR ONLY DURING LOW FLOW CONDITIONS.

- EXCAVATED SPOIL MATERIAL SHALL BE STOCKPILED ON-SITE IN APPROVED STOCKPILE LOCATIONS AND/OR TRANSPORTED TO AN APPROVED OFF-SITE SPOIL AREA. THE HAUL TRUCKS SHALL ACCESS THE PROJECT SITE VIA ROCK CONSTRUCTION ENTRANCES. THE HAUL TRUCKS SHALL REMAIN ON UNDISTURBED GROUND, GRAVEL, OR PAVED ROADWAYS FOR THE DURATION OF THE HAULING PROCESS. IF MATERIAL IS GENERATED FASTER THAN THE HAUL TRUCK CAN REMOVE IT, THE EXCAVATED MATERIAL SHALL BE MOVED TO THE TEMPORARY STOCKPILE LOCATIONS SHOWN ON THE PLAN WHERE IT MAY BE LOADED INTO THE HAUL TRUCKS AS NECESSARY.

- TOPSOIL EXCAVATION SHALL BE LIMITED TO AREAS THAT ARE DISTURBED DURING EACH WORK DAY. IN OTHER WORDS, TOPSOIL SHALL NOT BE EXCAVATED FROM AREAS BEYOND THE LIMIT OF EACH DAY'S DISTURBANCE ZONE. EXCAVATED TOPSOIL SHALL BE STOCKPILED SEPARATE FROM OTHER EXCAVATED MATERIAL WITHIN TEMPORARY STOCKPILE AREAS. A 4-6" THICK LAYER OF TOPSOIL SHALL BE SPREAD THROUGHOUT PROPOSED FLOODPLAIN AREA TO ACHIEVE FINAL GRADE. UNUSED TOPSOIL WILL BE TRANSPORTED TO THE APPROVED OFF-SITE SPOIL AREA.

- 18" FILTER FABRIC FENCE SHALL BE INSTALLED AROUND THE BASE OF ALL STOCKPILES AS SHOWN ON PLAN.

- AN AREA SHALL BE CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% PERENNIAL VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED SURFACE EROSION AND SUBSURFACE CHARACTERISTICS SUFFICIENT TO RESIST SLIDING AND OTHER MOVEMENT.

- ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING SEQUENCE. EACH STAGE SHALL BE COMPLETED BEFORE ANY FOLLOWING STAGE IS INITIATED. CLEARING AND GRUBBING SHALL BE LIMITED ONLY TO THOSE AREAS DESCRIBED IN EACH STAGE AND ARE NECESSARY TO PERFORM GRADING AND TO PROVIDE SUITABLE ACCESS.

SITE A: WALKER RUN-NORTH MARKET STREET

CONSTRUCTION NOTES:

A. CHANNEL AND FLOODPLAIN EXCAVATION ALONG SEGMENT A WILL TAKE PLACE IN THE DRY. AN 8- TO 10-FOOT WIDE (APPROXIMATE) SWATH ALONG THE STREAMBANKS OF EACH COMPLETED PORTION SHALL BE STABILIZED WITH ROLANKA BIOD-MAT 70 (OR EQUIVALENT) EROSION CONTROL FABRIC. THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE (OR EQUIVALENT) SHALL BE APPLIED PRIOR TO INSTALLING EROSION CONTROL FABRIC. ALL GRADED BANKS SHALL BE PROPERLY STABILIZED BEFORE FLOW IS DIRECTED INTO THE RELOCATED CHANNEL.

B. TEMPORARY COFFER DAMS (SANDBAGS OR AN EQUIVALENT) SHALL BE INSTALLED IN THE STREAM AS NECESSARY AT THE UPSTREAM AND DOWNSTREAM LOCATIONS WHERE THE RELOCATED CHANNEL TIES INTO THE EXISTING CHANNEL. THESE TEMPORARY COFFER DAMS WILL DIRECT FLOW AROUND EACH TIE-IN LOCATION WORK AREA UNTIL THE AREA IS GRADED AND PROPERLY STABILIZED. TEMPORARY PUMP AROUND OF BASE FLOW CONDITIONS WILL OCCUR TO REDUCE WORKING IN ACTIVE FLOW CONDITIONS

C. AFTER FLOW HAS BEEN DIRECTED INTO THE STABILIZED RELOCATED CHANNEL, A FILTER BAG SHALL BE INSTALLED AT THE DOWNSTREAM END OF THE ABANDONED CHANNEL SEGMENT TO FILTER ANY REMAINING SEDIMENT-LADEN WATER THAT IS PUSHED OUT OF THE ABANDONED CHANNEL WHILE IT IS BEING FILLED.

D. GRADED AREAS WITHIN THE PROPOSED FLOODPLAIN OF SEGMENT A SHALL BE SEEDED WITH THE PROPOSED WETLAND SEED MIX AS SPECIFICED IN THE SEEDING RESTORATION TABLE (OR AN APPROVED EQUIVALENT) AND STABILIZED WITH AN EROSION CONTROL FABRIC AS SPECIFIED IN THE DETAILS WITHIN 48 HOURS OF COMPLETING FINAL GRADE OR BY THE END OF THE WORK DAY PRIOR TO ANY FORCASTED RAIN EVENT. THE EROSION CONTROL FABRIC WILL BE LAID OUT IN OVERLAPPING STRIPS PERPENDICULAR TO THE DIRECTION OF FLOOD FLOWS WITHIN THE EXISTING VALLEY.

E. ALL REMAINING DISTURBED AREAS OUTSIDE OF THE PROPOSED FLOODPLAIN OF EACH RESTORATION SEGMENT WILL BE STABILIZED WITH THE PROPOSED STABILIZATION SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND MULCH.

CONSTRUCTION SEQUENCE:

1. THE PROPOSED LIMIT OF DISTURBANCE WILL BE IDENTIFIED ON-SITE PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES.
2. INSTALL ROCK CONSTRUCTION ENTRANCES.
3. PERFORM CLEARING AND GRUBBING AS NECESSARY.
4. ALL CONSTRUCTION WORK ON THE PROPOSED CHANNEL WILL BE CONSTRUCTED UNDER DRY CONDITIONS AND SEPARATE FROM THE EXISTING CHANNEL.
5. STRIP TOPSOIL FROM PROPOSED FLOODPLAIN EXCAVATION AREA AND STOCKPILE IN DESIGNATED AREAS AS SHOWN ON GRADING PLAN.
6. IN A DOWNSTREAM TO UPSTREAM DIRECTION, EXCAVATE FLOODPLAIN TO DESIGN SUBGRADE ELEVATIONS LEAVING AN EARTHEN BERM FROM STA. 8+05 TO STA. 8+20 AND FROM STA. 0+00 TO STA. 0+15 ALONG THE PROPOSED CHANNEL.
7. IN A DOWNSTREAM TO UPSTREAM DIRECTION, CONSTRUCT NEW STREAM CHANNEL TO DESIGN ELEVATIONS AND DIMENSIONS AS SPECIFIED IN STREAM DESIGN SCHEDULES LEAVING THE EARTHEN BERMS AT THE UPSTREAM AND DOWNSTREAM TIE-IN LOCATION TO PREVENT FLOW FROM ACCESSING THE NEW CHANNEL PRIOR TO STABILIZATION.
8. INSTALL HABITAT AND GRADE CONTROL STRUCTURES AS SPECIFIED IN HABITAT AND GRADE CONTROL STRUCTURE SCHEDULE, EXCEPT CROSS ROCK VANE AT STA. 0+00. THIS STRUCTURE WILL BE INSTALLED DURING THE TIE-IN OF THE OLD CHANNEL TO THE NEW CHANNEL.
9. STABILIZE BANKS OF RELOCATED CHANNEL WITH EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
10. APPLY TOPSOIL AS NECESSARY TO GRADED FLOODPLAIN AREAS AS DIRECTED BY ON-SITE STREAM DESIGNER IF SUITABLE GROWTH MEDIUM IS NOT PRESENT DURING FLOODPLAIN EXCAVATION.
11. STABILIZE GRADED FLOODPLAIN WITH THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
12. REPEAT STAGES 5-11 ACCORDING TO EACH ESTABLISHED DAILY DISTURBANCE ZONE.
13. INSTALL TEMPORARY COFFER DAM AT DOWNSTREAM TIE-IN LOCATION AND INSTALL PUMP AROUND AS SHOWN ON PLAN.
14. CONSTRUCT AND GRADE STREAM CHANNEL AND FLOODPLAIN AT DOWNSTREAM TIE-IN LOCATION TO DESIGN ELEVATIONS AND DIMENSIONS WHERE EARTHEN BERM WAS LOCATED. STABILIZE GRADED BANKS AT TIE-IN LOCATION WITH WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN THE DETAILS.
15. INSTALL TEMPORARY COFFER DAM AT UPSTREAM TIE-IN LOCATION AND INSTALL PUMP AROUND.
16. INSTALL CROSS ROCK VANE AT STA. 0+00 AND GRADE STREAM CHANNEL AND FLOODPLAIN AT UPSTREAM TIE-IN LOCATION TO DESIGN ELEVATIONS AND DIMENSIONS WHERE EARTHEN BERM WAS LOCATED. STABILIZE GRADED BANKS AT TIE-IN LOCATION WITH WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN THE DETAILS..
17. REMOVE TEMPORARY COFFER DAM AT UPSTREAM TIE-IN LOCATION AND DIVERT FLOW INTO STABILIZED RELOCATED CHANNEL.
18. REMOVE TEMPORARY COFFER DAM.
19. INSTALL FILTER BAG AT DOWNSTREAM END IN THE ABANDONED STREAM CHANNEL TO PUMP AND COLLECT SEDIMENT LADEN WATER DURING BACKFILLING OF ABANDONED CHANNEL TO DESIGN ELEVATIONS.
20. COMPLETE ANY REMAINING FLOODPLAIN GRADING.
21. STABILIZE GRADED FLOODPLAIN WITH THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
22. REMOVE ROCK CONSTRUCTION ENTRANCES.
23. STABILIZE ALL REMAINING DISTURBED AREAS OUTSIDE THE FLOODPLAIN AREA WITH PROPOSED STABILIZATION SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND MULCH.
24. INSTALL PROPOSED RIPARIAN VEGETATION ALONG GRADED STREAM BANKS AND WITHIN GRADED FLOODPLAIN.

SITE B: WALKER RUN-SOUTH MARKET STREET

CONSTRUCTION NOTES:

A. CHANNEL AND FLOODPLAIN EXCAVATION ALONG SEGMENT B WILL TAKE PLACE IN THE DRY. AN 8- TO 10-FOOT WIDE (APPROXIMATE) SWATH ALONG THE STREAMBANKS OF EACH COMPLETED PORTION SHALL BE STABILIZED WITH ROLANKA BIOD-MAT 70 (OR EQUIVALENT) EROSION CONTROL FABRIC. THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE (OR EQUIVALENT) SHALL BE APPLIED PRIOR TO INSTALLING EROSION CONTROL FABRIC. ALL GRADED BANKS SHALL BE PROPERLY STABILIZED BEFORE FLOW IS DIRECTED INTO THE RELOCATED CHANNEL.

B. TEMPORARY COFFER DAMS (SANDBAGS OR AN EQUIVALENT) SHALL BE INSTALLED IN THE STREAM AS NECESSARY AT THE UPSTREAM AND DOWNSTREAM LOCATIONS WHERE THE RELOCATED CHANNEL TIES INTO THE EXISTING CHANNEL. THESE TEMPORARY COFFER DAMS WILL DIRECT FLOW AROUND EACH TIE-IN LOCATION WORK AREA UNTIL THE AREA IS GRADED AND PROPERLY STABILIZED. TEMPORARY PUMP AROUND OF BASE FLOW CONDITIONS WILL OCCUR TO REDUCE WORKING IN ACTIVE FLOW CONDITIONS

C. AFTER FLOW HAS BEEN DIRECTED INTO THE STABILIZED RELOCATED CHANNEL, A FILTER BAG SHALL BE INSTALLED AT THE DOWNSTREAM END OF THE ABANDONED CHANNEL SEGMENT TO FILTER ANY REMAINING SEDIMENT-LADEN WATER THAT IS PUSHED OUT OF THE ABANDONED CHANNEL WHILE IT IS BEING FILLED.

D. GRADED AREAS WITHIN THE PROPOSED FLOODPLAIN OF SEGMENT A SHALL BE SEEDED WITH THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE (OR AN APPROVED EQUIVALENT) AND STABILIZED WITH AN EROSION CONTROL FABRIC AS SPECIFIED IN THE DETAILS WITHIN 48 HOURS OF COMPLETING FINAL GRADE OR BY THE END OF THE WORK DAY PRIOR TO ANY FORCASTED RAIN EVENT. THE EROSION CONTROL FABRIC WILL BE LAID OUT IN OVERLAPPING STRIPS PERPENDICULAR TO THE DIRECTION OF FLOOD FLOWS WITHIN THE EXISTING VALLEY.

E. ALL REMAINING DISTURBED AREAS OUTSIDE OF THE PROPOSED FLOODPLAIN OF EACH RESTORATION SEGMENT WILL BE STABILIZED WITH THE PROPOSED STABILIZATION SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND MULCH.

F. CONSTRUCTION OF ACCESS ROAD BRIDGE ABUTMENTS SHOULD OCCUR DURING THE CONSTRUCTION ACTIVITY OF THE PROPOSED STREAM CHANNEL TO AVOID IMPACTS AND DISTURBANCES TO RESTORED WETLANDS AND STREAM CHANNEL ALONG WALKER RUN.

CONSTRUCTION SEQUENCE:

1. THE PROPOSED LIMIT OF DISTURBANCE WILL BE IDENTIFIED ON-SITE PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES.
2. INSTALL ROCK CONSTRUCTION ENTRANCES.
3. PERFORM CLEARING AND GRUBBING AS NECESSARY.
4. ALL CONSTRUCTION WORK ON THE PROPOSED CHANNEL WILL BE CONSTRUCTED UNDER DRY CONDITIONS AND SEPARATE FROM THE EXISTING CHANNEL.
5. STRIP TOPSOIL FROM PROPOSED FLOODPLAIN EXCAVATION AREA AND STOCKPILE IN DESIGNATED AREAS AS SHOWN ON GRADING PLAN.
6. IN A DOWNSTREAM TO UPSTREAM DIRECTION, EXCAVATE FLOODPLAIN TO DESIGN SUBGRADE ELEVATIONS LEAVING AN EARTHEN BERM FROM STA. 32+70 TO STA. 32+85 AND STA. 0+00 TO STA. 0+15 ALONG THE PROPOSED CHANNEL.
7. IN A DOWNSTREAM TO UPSTREAM DIRECTION, CONSTRUCT NEW STREAM CHANNEL TO DESIGN ELEVATIONS AND DIMENSIONS AS SPECIFIED IN STREAM DESIGN SCHEDULES LEAVING THE EARTHEN BERMS AT THE UPSTREAM AND DOWNSTREAM TIE-IN LOCATION TO PREVENT FLOW FROM ACCESSING THE NEW CHANNEL PRIOR TO STABILIZATION.
8. INSTALL HABITAT AND GRADE CONTROL STRUCTURES AS SPECIFIED IN HABITAT AND GRADE CONTROL STRUCTURE SCHEDULE, EXCEPT CROSS ROCK VANE AT STA. 33+10 AND STA. 0+25. THESE STRUCTURES WILL BE INSTALLED DURING THE TIE-IN OF THE OLD CHANNEL TO THE NEW CHANNEL.
9. STABILIZE BANKS OF RELOCATED CHANNEL WITH EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
10. APPLY TOPSOIL AS NECESSARY TO GRADED FLOODPLAIN AREAS AS DIRECTED BY ON-SITE STREAM DESIGNER IF SUITABLE GROWTH MEDIUM IS NOT PRESENT DURING FLOODPLAIN EXCAVATION.
11. STABILIZE GRADED FLOODPLAIN WITH THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
12. REPEAT STAGES 5-11 ACCORDING TO EACH ESTABLISHED DAILY DISTURBANCE ZONE.
13. INSTALL TEMPORARY COFFER DAM AT DOWNSTREAM TIE-IN LOCATION AND PUMP AROUND AS SHOWN ON PLAN.
14. CONSTRUCT AND INSTALL CROSS ROCK VANE GRADE CONTROL STRUCTURE AT STA. 33+10 AND GRADE STREAM CHANNEL AND FLOODPLAIN AT DOWNSTREAM TIE-IN LOCATION TO DESIGN ELEVATIONS AND DIMENSIONS WHERE EARTHEN BERM WAS LOCATED. STABILIZE GRADED BANKS AT TIE-IN LOCATION WITH WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
15. INSTALL TEMPORARY COFFER DAM AT UPSTREAM TIE-IN LOCATION AND PUMP AROUND.
16. INSTALL CROSS ROCK VANE AT STA. 0+25 AND GRADE STREAM CHANNEL AND FLOODPLAIN AT UPSTREAM TIE-IN LOCATION TO DESIGN ELEVATIONS AND DIMENSIONS WHERE EARTHEN BERM WAS LOCATED. STABILIZE GRADED BANKS AT TIE-IN LOCATION WITH WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
17. REMOVE TEMPORARY COFFER DAM AT UPSTREAM TIE-IN LOCATION AND DIVERT FLOW INTO STABILIZED RELOCATED CHANNEL.
18. REMOVE TEMPORARY COFFER DAM.
19. INSTALL FILTER BAG AT DOWNSTREAM END IN THE ABANDONED STREAM CHANNEL TO PUMP AND COLLECT SEDIMENT LADEN WATER DURING BACKFILLING OF ABANDONED CHANNEL TO DESIGN ELEVATIONS.
20. COMPLETE ANY REMAINING FLOODPLAIN GRADING.
21. STABILIZE GRADED FLOODPLAIN WITH THE PROPOSED WETLAND SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND EROSION CONTROL FABRIC AS SPECIFIED IN DETAILS.
22. REMOVE ROCK CONSTRUCTION ENTRANCES.
23. STABILIZE ALL REMAINING DISTURBED AREAS OUTSIDE THE FLOODPLAIN AREA WITH PROPOSED STABILIZATION SEED MIX AS SPECIFIED IN THE SEEDING RESTORATION TABLE AND MULCH.
24. INSTALL PROPOSED RIPARIAN VEGETATION ALONG GRADED STREAM BANKS AND WITHIN GRADED FLOODPLAIN.

PA 043324
717-827-4440
fax: 717-827-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
E&SPC PLAN - CONSTRUCTION SCHEDULES
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION
1	8/12/11	ADD DRAWING NUMBER

PROJECT NUMBER: E-726-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: NTS
DRAWING NUMBER: MIT-WR-015
SHEET NUMBER: 15 OF 17

Herbaceous

Key	%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
WM1	15.00%	*Boltonia asteroides*	Thousand-flowered Aster	Quart	88	24"	FACW	
	20.00%	*Carex crinita*	Fringed Sedge	Quart	118	24"	OBL	
	15.00%	*Juncus effusus*	Soft Rush	Quart	88	24"	OBL	
	10.00%	*Scirpus validus*	Soft Stemmed Bullrush	Quart	59	24"	OBL	
	30.00%	*Iris versicolor*	Blue Flag	Quart	177	24"	OBL	
	10.00%	*Pontederia cordata*	Pickerelweed	Quart	59	24"	OBL	
	100.00%				590			
WM2	15.00%	*Asclepias incarnata*	Swamp Milkweed	Quart	118	24"	FACW+	
	20.00%	*Carex crinita*	Fringed Sedge	Quart	157	24"	OBL	
	20.00%	*Juncus effusus*	Soft Rush	Quart	157	24"	OBL	
	10.00%	*Lobelia siphilitica*	Great Blue Lobelia	Quart	79	24"	FACW+	
	15.00%	*Aster novae-angliae*	New England Aster	Quart	118	24"	FACW	
	20.00%	*Chelone glabra*	White Turtlehead	Quart	157	24"	FACW	
	100.00%				738			
WM3	20.00%	*Eupatorium perfoliatum*	Common Boneset	Quart	144	24"	FACW+	
	20.00%	*Carex lurida*	Lurid Sedge	Quart	144	24"	OBL	
	15.00%	*Scirpus validus*	Soft Stemmed Bullrush	Quart	108	24"	OBL	
	15.00%	*Carex vulpinoidea*	Fox Sedge	Quart	108	24"	OBL	
	10.00%	*Peltandra virginica*	Arrow Arum	Quart	72	24"	OBL	
	20.00%	*Veronia novenboracensis*	New York Ironweed	Quart	144	24"	FACW	
	100.00%				770			
CM1	30.00%	*Carex crinita*	Fringed Sedge	Quart	575	24"	FACW+	
	15.00%	*Carex lurida*	Lurid Sedge	Quart	287	24"	OBL	
	20.00%	*Carex stipata*	Awl-Fruited Sedge	Quart	383	24"	OBL	
	10.00%	*Carex stricta*	Tussock Sedge	Quart	192	24"	OBL	
	25.00%	*Carex vulpinoidea*	Fox Sedge	Quart	479	24"	OBL	
	100.00%				1916			

Trees

Key	%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
AR	20.00%	*Acer rubrum*	Red Maple	#15	20	20-30'	FAC	
AS	12.00%	*Acer saccharinum*	Silver Maple	#15	12	20-30'	FACW	
CO	10.00%	*Carya ovata*	Shagbark Hickory	#15	10	20-30'	FACU	Upland areas only
NS	8.00%	*Nyssa sylvatica*	Black Gum	#15	8	20-30'	FAC	Do not plant in areas with frequent standing water
PO	10.00%	*Platanus occidentalis*	American Sycamore	#15	10	20-30'	FACW	
QB	10.00%	*Quercus bicolor*	Swamp White Oak	#15	10	20-30'	FACW	
QP	30.00%	*Quercus palustris*	Pin Oak	#15	30	20-30'	FACW	
	100.00%				100			

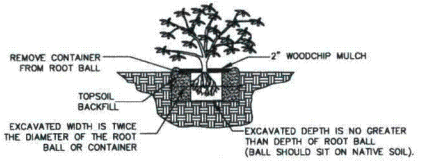
Shrubs

Key	%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
	10.00%	*Alnus rugosa*	Speckled Alder	#5	49	4-6'	FACW	
	15.00%	*Alnus serrulata*	Smooth Alder	#5	73	4-6'	OBL	
	5.00%	*Aronia arbutifolia*	Red Chokeberry	#5	24	4-6'	FACW	
	5.00%	*Cephalanthus occidentalis*	Buttonbush	#5	24	4-6'	OBL	
	5.00%	*Cornus amomum*	Silky Dogwood	#5	24	4-6'	FACW	
	12.00%	*Cornus racemosa*	Grey Dogwood	#5	58	4-6'	FAC-	
	10.00%	*Ilex verticillata*	Winterberry	#5	49	4-6'	FACW	1 male for every 8 females
	15.00%	*Lindera benzoin*	Spicebush	#5	73	4-6'	FACW	
	8.00%	*Vaccinium corymbosum*	Highbush Blueberry	#5	39	4-6'	FACW	
	7.00%	*Viburnum dentatum*	Arrowwood	#5	34	4-6'	FAC	
	8.00%	*Viburnum trilobum*	Cranberry Bush	#5	39	4-6'	FACW	
	100.00%				485			

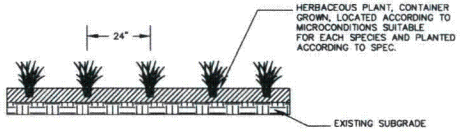
Wetland Mix 1 (WM1) | Wetland Mix 3 (WM3) | Proposed Tree
Wetland Mix 2 (WM2) | Channel Mix 1(CM1) | Proposed Shrub

BEACH GROVE ROAD

SCALE: 1" = 50'



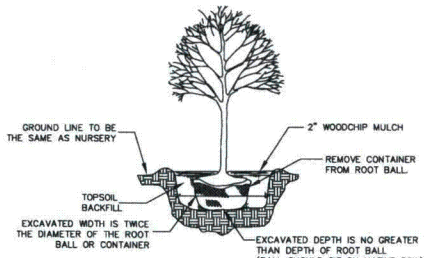
L-1 16 TYPICAL SHRUB PLANTING - CONTAINER
N.T.S.



L-2 16 HERBACEOUS QUART PLANTING DETAIL
N.T.S.

PLANT SPECIFICATIONS :

1. ALL PLANTS SHALL BE NURSERY GROWN IN A CLIMATE SIMILAR TO THAT OF THE LOCALITY OF THE PROJECT.
2. SET PLANTS AT SAME FINISHED GRADE AS GROWN IN THE NURSERY.
3. ALL PLANTS SHALL HAVE A NORMAL HABIT OF GROWTH AND SHALL BE SOUND, HEALTHY AND VIGOROUS, THEY SHALL BE FREE FROM DISEASE, INSECTS, INSECT EGGS, AND LARVAE.
4. ALL PLANTING SHALL BE PERFORMED IN CONFORMANCE WITH GOOD NURSERY AND LANDSCAPE PRACTICE.



L-3 16 TREE PLANTING DETAIL
N.T.S.

PA 045324
717-427-4440
fax: 717-427-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543

PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 SCHOOLEY LANE, SUITE 1
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
LANDSCAPE PLAN - SITE A
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION ADD DRAWING NUMBER
1	8/12/11	

PROJECT NUMBER: E-726-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=50'
DRAWING NUMBER: BBT-WR-016
SHEET NUMBER: 16 OF 17

Herbaceous

Key	%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
WM1	15.00%	*Boltonia asteroides*	Thousand-flowered Aster	Quart	579	0.25	FACW	
	20.00%	*Carex crinita*	Fringed Sedge	Quart	772	0.25	OBL	
	15.00%	*Juncus effusus*	Soft Rush	Quart	579	0.25	OBL	
	10.00%	*Scirpus validus*	Soft Stemmed Bullrush	Quart	386	0.25	OBL	
	30.00%	*Iris versicolor*	Blue Flag	Quart	1158	0.25	OBL	
	10.00%	*Pontederia cordata*	Pickerelweed	Quart	386	0.25	OBL	
	100.00%				3860			
WM2	15.00%	*Asclepias incarnata*	Swamp Milkweed	Quart	334	0.25	FACW+	
	20.00%	*Carex crinita*	Fringed Sedge	Quart	446	0.25	OBL	
	20.00%	*Juncus effusus*	Soft Rush	Quart	446	0.25	OBL	
	10.00%	*Lobelia siphilitica*	Great Blue Lobelia	Quart	223	0.25	FACW+	
	15.00%	*Aster novae-angliae*	New England Aster	Quart	334	0.25	FACW	
	20.00%	*Chelone glabra*	White Turtlehead	Quart	446	0.25	FACW	
	100.00%				2367			
WM3	20.00%	*Eupatorium perfoliotum*	Common Boneset	Quart	778	0.25	FACW+	
	20.00%	*Carex lunda*	Lurid Sedge	Quart	778	0.25	OBL	
	15.00%	*Scirpus validus*	Soft Stemmed Bullrush	Quart	584	0.25	OBL	
	15.00%	*Carex vulpinoidea*	Fox Sedge	Quart	584	0.25	OBL	
	10.00%	*Peltandra virginica*	Arrow Arum	Quart	389	0.25	OBL	
	20.00%	*Veronia novenboracensis*	New York Ironweed	Quart	778	0.25	FACW	
	100.00%				3754			
CM1	30.00%	*Carex crinita*	Fringed Sedge	Quart	1555	0.25	FACW+	
	15.00%	*Carex lunda*	Lurid Sedge	Quart	777	0.25	OBL	
	20.00%	*Carex stipata*	Awl-Fruited Sedge	Quart	1036	0.25	OBL	
	10.00%	*Carex stricta*	Tussock Sedge	Quart	518	0.25	OBL	
	25.00%	*Carex vulpinoidea*	Fox Sedge	Quart	1295	0.25	OBL	
	100.00%				5182			

Trees

%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
20.00%	*Acer rubrum*	Red Maple	#15	45	20-30'	FAC	
12.00%	*Acer saccharinum*	Silver Maple	#15	27	20-30'	FACW	
10.00%	*Carya ovata*	Shagbark Hickory	#15	23	20-30'	FACU	Upland areas only
8.00%	*Nyssa sylvatica*	Black Gum	#15	18	20-30'	FAC	Do not plant in areas with frequent standing water
10.00%	*Platanus occidentalis*	American Sycamore	#15	23	20-30'	FACW	
10.00%	*Quercus bicolor*	Swamp White Oak	#15	23	20-30'	FACW	
30.00%	*Quercus palustris*	Pin Oak	#15	68	20-30'	FACW	
100.00%				225			

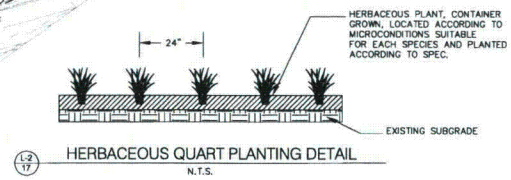
Shrubs

%	Botanical Name	Common Name	Size	Qty.	Spacing	I.S.	Notes
10.00%	*Alnus rugosa*	Speckled Alder	#5	109	4-6'	FACW	
15.00%	*Alnus serrulata*	Smooth Alder	#5	163	4-6'	OBL	
5.00%	*Aronia arbutifolia*	Red Chokeberry	#5	54	4-6'	FACW	
5.00%	*Cephalanthus occidentalis*	Buttonbush	#5	54	4-6'	OBL	
5.00%	*Cornus amomum*	Silky Dogwood	#5	54	4-6'	FACW	
12.00%	*Cornus racemosa*	Grey Dogwood	#5	130	4-6'	FAC-	
10.00%	*Ilex verticillata*	Winterberry	#5	109	4-6'	FACW	1 male for every 8 females
15.00%	*Lindera benzoin*	Spicebush	#5	163	4-6'	FACW	
8.00%	*Vaccinium corymbosum*	Highbush Blueberry	#5	87	4-6'	FACW	
7.00%	*Viburnum dentatum*	Arrowwood	#5	76	4-6'	FAC	
8.00%	*Viburnum trilobum*	Cranberry Bush	#5	87	4-6'	FACW	
100.00%				1086			

Wetland Mix 1 (WM1) | Wetland Mix 3 (WM3) | Proposed Tree
Wetland Mix 2 (WM2) | Channel Mix 1(CM1) | Proposed Shrub

0 60' 120' 180
SCALE: 1" = 60'

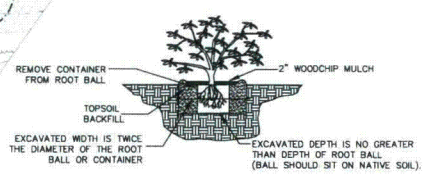
MARKET STREET



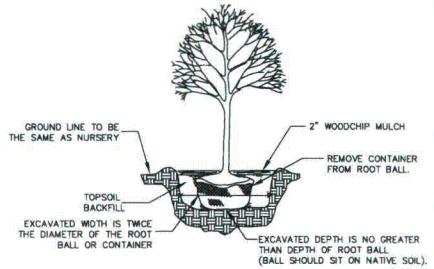
L-2 / 17 HERBACEOUS QUART PLANTING DETAIL
N.T.S.

PLANT SPECIFICATIONS :

1. ALL PLANTS SHALL BE NURSERY GROWN IN A CLIMATE SIMILAR TO THAT OF THE LOCALITY OF THE PROJECT.
2. SET PLANTS AT SAME FINISHED GRADE AS GROWN IN THE NURSERY.
3. ALL PLANTS SHALL HAVE A NORMAL HABIT OF GROWTH AND SHALL BE SOUND, HEALTHY AND VIGOROUS. THEY SHALL BE FREE FROM DISEASE, INSECTS, INSECT EGGS, AND LARVAE.
4. ALL PLANTING SHALL BE PERFORMED IN CONFORMANCE WITH GOOD NURSERY AND LANDSCAPE PRACTICE.



L-1 / 17 TYPICAL SHRUB PLANTING - CONTAINER
N.T.S.



L-3 / 17 TREE PLANTING DETAIL
N.T.S.

PA 042334
717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543
Land Studies

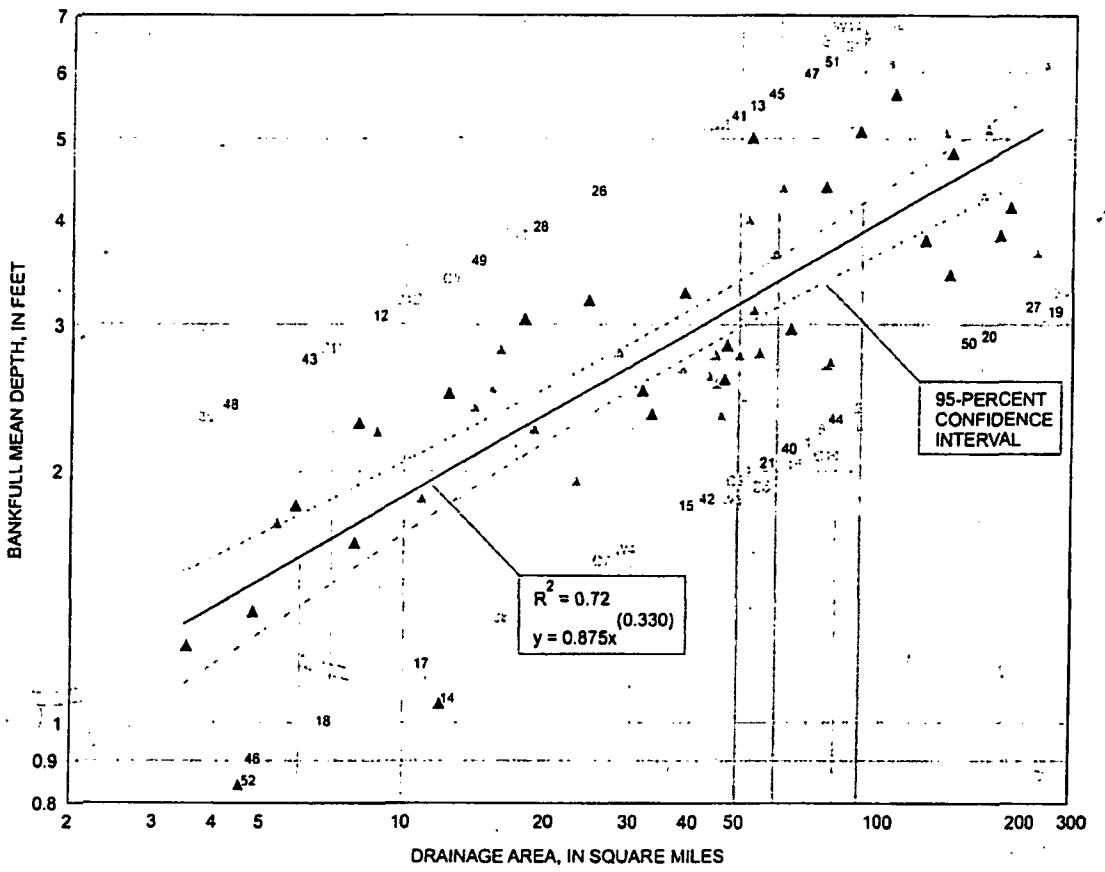
PROJECT:
BELL BEND NUCLEAR POWER PLANT
PPL BELL BEND, LLC.
38 BOMBOY LANE, SUITE 2
BERWICK, PENNSYLVANIA 18603

SHEET TITLE:
LANDSCAPE PLAN - SITE B
STREAM & WETLAND MITIGATION PLAN - WALKER RUN SITE
SALEM TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

REVISIONS		
NO.	DATE	DESCRIPTION
1	8/12/11	ADD DRAWING NUMBER

PROJECT NUMBER: E-728-L8
DRAWN BY: BRU
CHECKED BY: BJE; AWD
DATE: OCTOBER 29, 2010
SCALE: 1"=60'
DRAWING NUMBER: MIT-WR-017
SHEET NUMBER: 17 OF 17

Bankfull Mean Depth (ft.)



EXPLANATION

▲	STATION REPRESENTING THE PIEDMONT PHYSIOGRAPHIC PROVINCE	11 STATIONS
▲	STATION REPRESENTING THE RIDGE AND VALLEY PHYSIOGRAPHIC PROVINCE	17 STATIONS
▲	STATION REPRESENTING THE APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCE	24 STATIONS
▲	STATION REPRESENTING THE CENTRAL LOWLAND PHYSIOGRAPHIC PROVINCE	1 STATION
▲	STATION REPRESENTING THE NEW ENGLAND PHYSIOGRAPHIC PROVINCE	2 STATIONS

Figure 8. Regional curve representing the relation between bankfull mean depth and drainage area in noncarbonate settings of Pennsylvania and selected areas of Maryland. See table 1 for information associated with cross-reference numbers identifying each station shown in this figure.

Walker Run Drainage Area = 2.02 mi^2 (upstream end) ; 2.37 mi^2 (downstream end)

Calculations: $Y = 0.875x^{(0.330)}$

upstream end:

$Y = 0.875 (2.02)^{(0.330)}$

$Y = 0.875 (1.26)$

$Y = 1.10$ ft.

downstream end:

$Y = 0.875 (2.37)^{(0.330)}$

$Y = 0.875 (1.33)$

$Y = 1.16$ ft.