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Indian Creek Watershed (Cobbs Creek) Habitat Improvement

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Project Location




Watershed Characterization

- Watershed is located in Southern Montgomery County & Western section of the City of Philadelphia along the eastern edge of Piedmont Physiographic province and is characterized by gently rolling to hilly topography.
- The total watershed area is 3.4 sq. miles.
- The upper portion of the watershed is characterized by hilly to steep topography with slopes ranging from 3% to 15% .
- Channel gradient varies from 1.4% to 3%.

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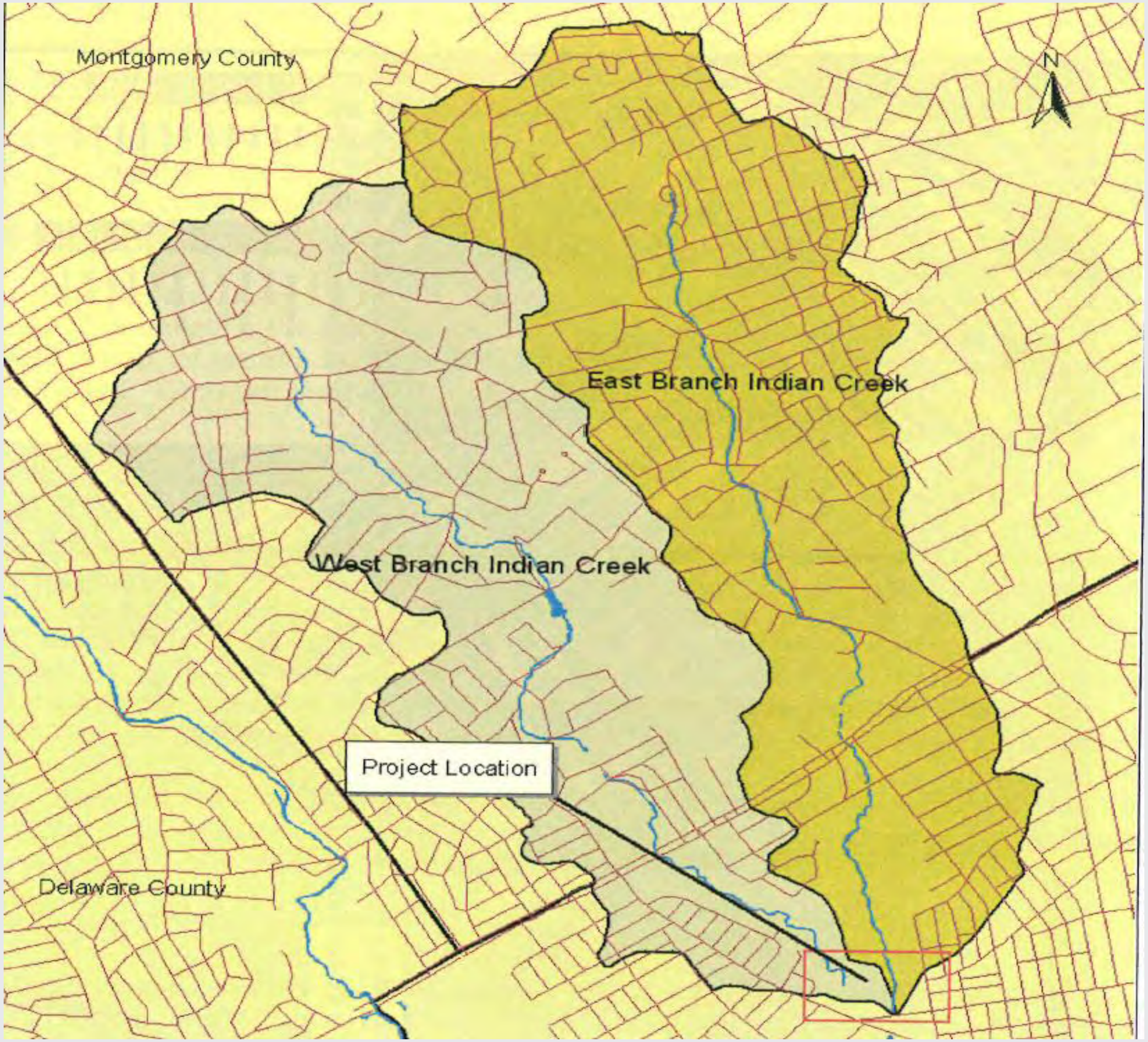
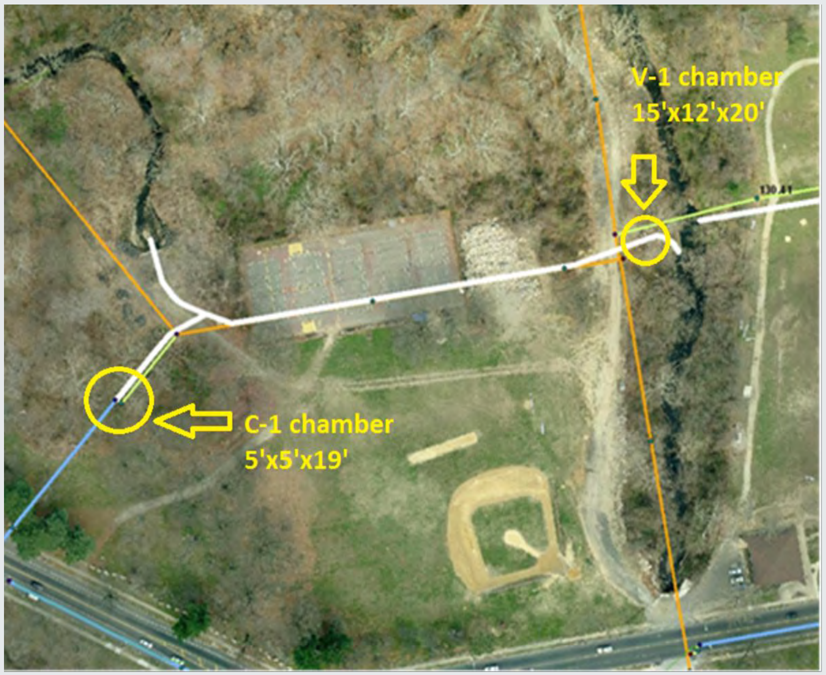


Background:

- 20% of Cobbs Creek watershed is serviced by combined sewers.
- City of Philadelphia has 38 regulator structures within the watershed.
- CSO discharges are the major source of fecal coliform in Cobbs Creek Watershed.


V-1 chamber
15'x12'x20'
C-1 chamber
5'x5'x19'


C05




Objective:

- Reduce and eliminate point source discharge
- Improve the Creeks water quality and reducing local overflow
- Stream bed and bank stabilization
- Wetland and habitat creation
- Elimination of debris accumulation

Problems & Issues

- Current conditions along East & West branch are characterized as very unstable.
- Sediment transport issues at downstream
- Stream bank erosion, lateral migration, channel blockages and stream bed aggradation & degradation are common throughout.
- CSO intake headwall clogging issues
- Accumulated sediment at CSO intake headwall
- Severe erosion at Haverford Avenue bridge

Debris accumulation

Intake head-wall of culvert (2000)

Accumulated sediment

Intake head-wall of culvert (2006)
Note opening is completely blocked by debris and accumulated sediment

Damages

Severe erosion at Haverford Avenue Bridge caused by August 1, 2004 storm




Urban Stream Restoration Challenges:

- Typically requires much greater degree of hydrologic & hydraulic analysis
- Sediment transport studies
- Bankfull indicator challenges
- Reduce base flow
- Increased flood flow
- Reduced Time of Concentration (Tc)

CSO Challenges:

- Infrastructure:
- a) Aged Pipes
- b) Aged Manholes
- c) Existing infrastructure information
- Maintenance:
- 4 chamber manhole
- Fire hydrant
- Manhole at upstream end of 6’x6’ box culvert
- Access manholes




Methods of Data Collection

- Existing data was collected, compiled and reviewed.
- Modeling and field studies were conducted to evaluate the current conditions along East & West branch.
- The data collected was utilized to determine structure type, size and location.
- Restoration and management recommendations, design concepts as well as preliminary cost estimates for restoration and management strategies were developed.
- The study included identification of significant plants and plantation of trees, HTRW studies and CSO inspection report




Achievements:

- Volume reduction:
- An average annual volume reduction from 2.9 to 1.2 million gallons (58% reduction) from regulator C_05
- CSO frequency reduction:
- An average annual reduction in CSO frequency reduction from 17 to 13 overflows per year from regulator C_05
- Pollutants removal
- Cost effective & Environment friendly:
- CSO reductions were achieved without the construction of new storage facilities
- Replaced aged infrastructure:
- New manhole C-1 and wellhole W-1




Hydrology

24-hour Peak Discharge		
Storm Event	East Branch	West Branch
Design Flow	802 CFS	297 CFS
1.5-YR	1080 CFS	350 CFS
2-YR	1350 CFS	450 CFS
10-YR	2430 CFS	850 CFS
50-YR	3390 CFS	1300 CFS
100-YR	3610 CFS	1500 CFS




Hydrology (cont..)

- Bankfull discharge estimates: Three methods were used to estimate the bankfull discharge

1. Regional regressions developed for use in urban watershed.
2. USGS regional regressions
3. Hydrologic model output provided by PWD
4. Manning's equation and field data




Hydrology (cont..)

Bankfull Discharge Estimates (West branch)			
Method	1-YR (cfs)	Bankfull (cfs)	2-YR (cfs)
Regional Regression	ND	296	ND
USGS	ND	ND	416
PWD	98	ND	450
Manning's Equation	ND	297.3	ND

Bankfull Discharge Estimates (East branch)			
Method	1-YR (cfs)	Bankfull (cfs)	2-YR (cfs)
Regional Regression	ND	294	ND
USGS	ND	ND	408
PWD	365	ND	1350
Manning's Equation	ND	296	ND




Bankfull Channel Geometry Comparision

Reach ID (Drainage Area) Data Source	Cross-sectional Area (ft^2)	Width (ft)	Depth (ft)
West Branch (1.71) Regional Regression	58.4	27.1	2.18
West Branch Measured	57.1 (55.0 – 59.1)	36.6 (25.4 – 48.1)	1.65 (1.1 – 2.3)
Upper East Branch (1.7) Regional Regression	58.2	27.0	2.17
Upper East Branch Measured	59.3 (58.9 – 60.1)	31.6 (27.5 - 34.1)	1.9 (1.8 – 2.2)
Lower East Branch (3.41) Regional Regression	94.5	38.3	2.54
Lower East Branch Measured	98.6 (94.5 – 102.3)	40.8 (35.7 – 45.9)	2.5 (2.1 – 2.9)

Table 5 – Indian Creek Bankfull Channel Geometry Comparison of Predicted Values to Field Data




Classification Summary Table

Reach	Bankfull Width (ft)	Bankfull Mean Depth (ft)	Bankfull XS Area (ft^2)	Width/Depth Ratio	Entrenchment Ratio	Slope (ft/ft)	D50 (mm)	Stream Type
West Branch 1	48.1	1.1	55.0	42	2.1	0.021	39	C4
West Branch 2	37.5	1.5	55.6	25.3	2.9	0.021	39	D4
West Branch 3	35.2	1.7	58.7	21.1	1.6	0.01	39	B4c
West Branch 4	25.4	2.3	59.1	10.9	5.2	0.01	39	E4
Upper East Branch 1	32.4	1.8	58.9	17.9	1.85	0.01	76	B3c
Upper East Branch 2	32.5	1.8	58.3	18.1	1.4	0.01	76	F3
Lower East Branch	45.9	2.1	94.9	22.2	1.1	0.01	76	F3

Table 6 – Indian Creek Reach Classification Summary Table




Hydraulic Analysis

- Analyze existing water surface elevations, channel velocities and other pertinent hydraulic parameters associated with the channel.

- US Army Corps of Engineers Hec-RAS computer modeling program was used to perform hydraulic analysis.




Functions of In-stream Structures

- Maintain stable W/D ratio
- Maintain necessary shear stress to move large particles
- Decrease near bank velocity, shear stress or stream power
- Ensure stability of structure during high flows (floods)
- Maintain fish passage at all flows
- Improves fish habitat and fish spawning
- Visibly compatible with natural channels
- Less costly than traditional structures

Considerations for In-stream structures

- Rock size is based on bankfull shear stress and stream size
- Footers are used in absence of bedrock
- Location of these structures is finalized after proper design of dimension, pattern and profile for the restored channel

Types of In-stream structures used

- Cross vanes
- Rock vanes
- J-hook vanes:
- Imbricated riprap wall
- Step pools

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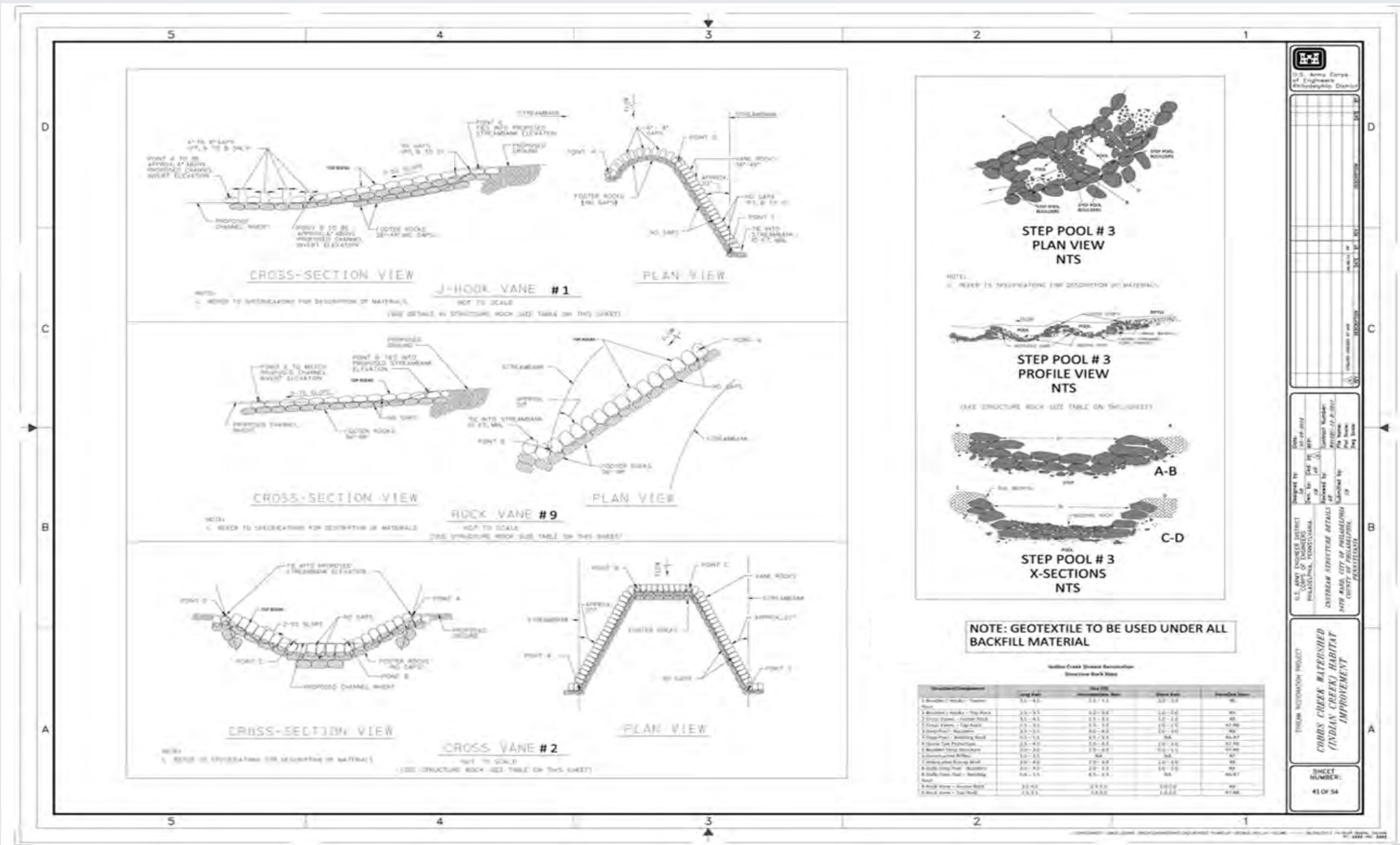
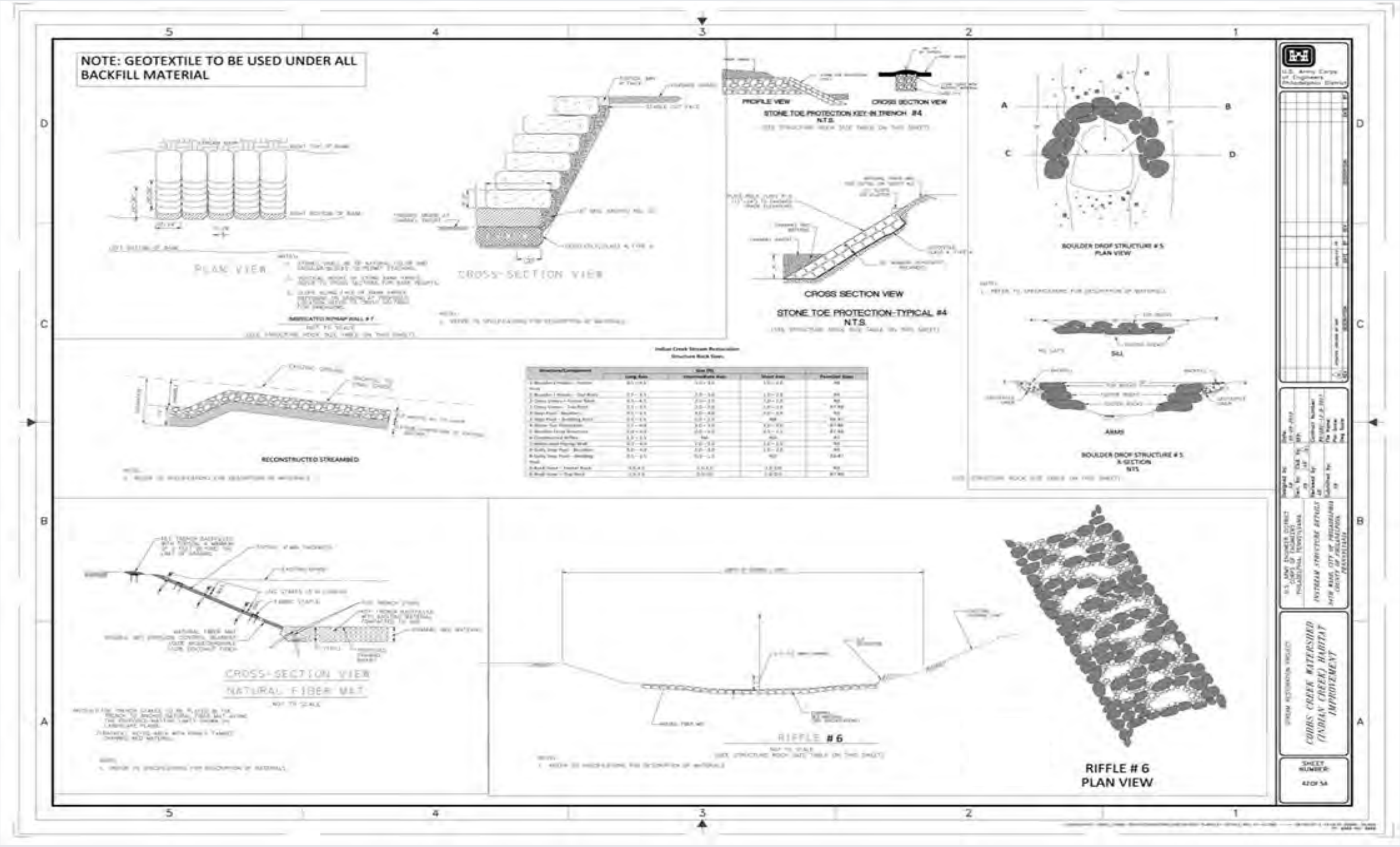
Instream Structure Details






Instream Structure Details



Under cutting in West branch

Eroding banks

Eroding bank, exposed manhole, old support columns along upstream end of Reach 1

Stormdrain relocation

- To ensure natural design
- Taking out hardened infrastructure such as RCP and headwall
- 18” RCP exposed along West branch will be reconstructed and relocated.

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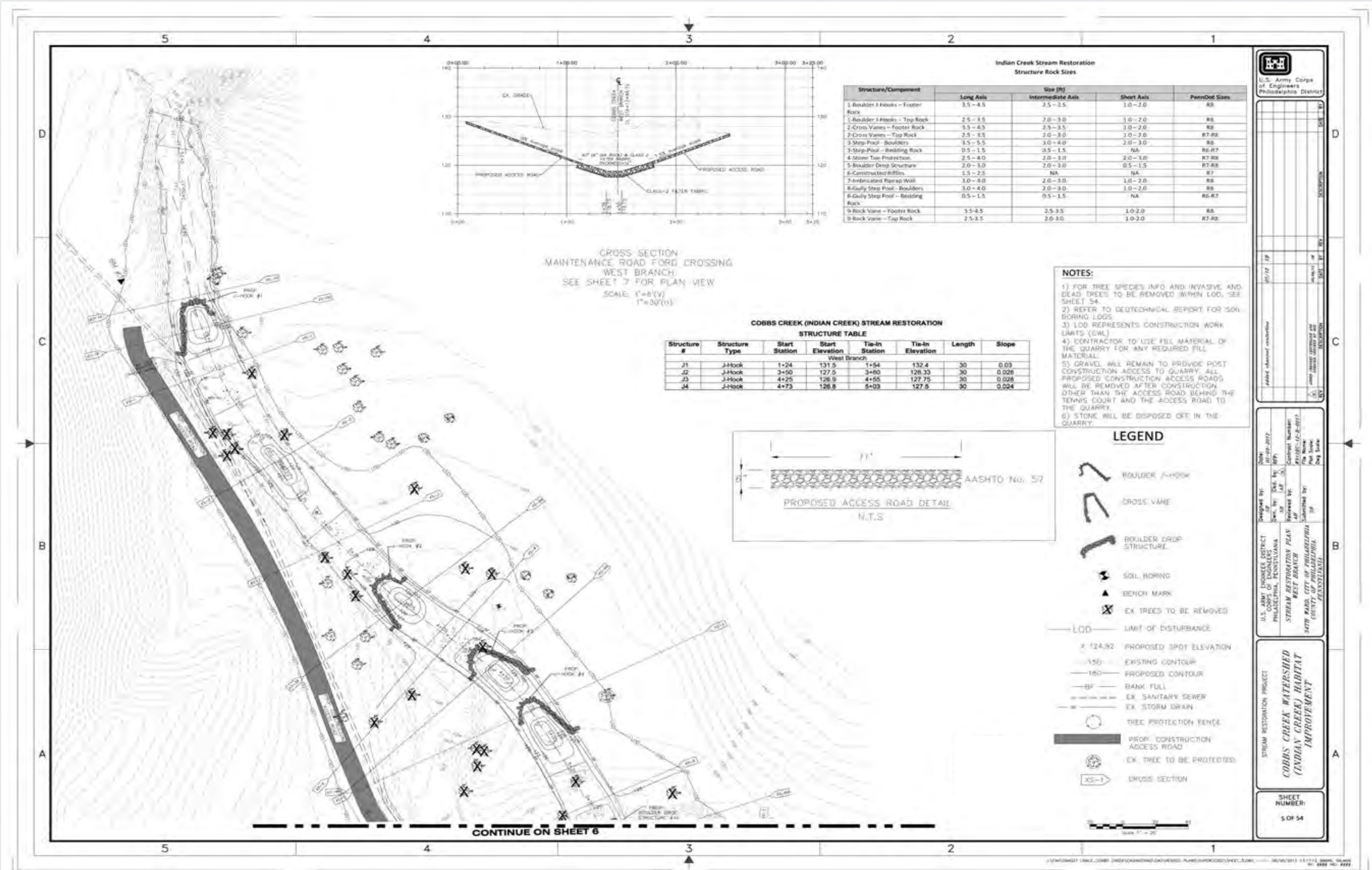

Indian Creek Stream Restoration
Structure Rock Sizes

Structure/Component	Size (ft) Long Axis	Size (ft) Intermediate Axis	Size (ft) Short Axis	PennDot Sizes
1-Boulder J-Hooks – Footer Rock	3.5 – 4.5	2.5 – 3.5	1.0 – 2.0	R8
1-Boulder J-Hooks – Top Rock	2.5 – 3.5	2.0 – 3.0	1.0 – 2.0	R8
2-Cross Vanes – Footer Rock	3.5 – 4.5	2.5 – 3.5	1.0 – 2.0	R8
2-Cross Vanes – Top Rock	2.5 – 3.5	2.0 – 3.0	1.0 – 2.0	R7-R8
3-Step-Pool - Boulders	3.5 – 5.5	3.0 – 4.0	2.0 – 3.0	R8
3-Step-Pool – Bedding Rock	0.5 – 1.5	0.5 – 1.5	NA	R6-R7
4-Stone Toe Protection	2.5 – 4.0	2.0 – 3.0	2.0 – 3.0	R7-R8
5-Boulder Drop Structure	2.0 – 3.0	2.0 – 3.0	0.5 – 1.5	R7-R8
6-Constructed Riffles	1.5 – 2.5	NA	NA	R7
7-Imbricated Riprap Wall	3.0 – 4.0	2.0 – 3.0	1.0 – 2.0	R8
8-Gully Step Pool - Boulders	3.0 – 4.0	2.0 – 3.0	1.0 – 2.0	R8
8-Gully Step Pool – Bedding Rock	0.5 – 1.5	0.5 – 1.5	NA	R6-R7
9-Rock Vane – Footer Rock	3.5-4.5	2.5-3.5	1.0-2.0	R8
9-Rock Vane – Top Rock	2.5-3.5	2.0-3.0	1.0-2.0	R7-R8

COBBS CREEK (INDIAN CREEK) STREAM RESTORATION
STRUCTURE TABLE

Structure #	Structure Type	Start Station	Start Elevation	Tie-In Station	Tie-In Elevation	Length	Slope
West Branch							
J1	J-Hook	1+24	131.5	1+54	132.4	30	0.03
J2	J-Hook	3+50	127.5	3+80	128.33	30	0.028
J3	J-Hook	4+25	126.9	4+55	127.75	30	0.028
J4	J-Hook	4+73	126.8	5+03	127.5	30	0.024

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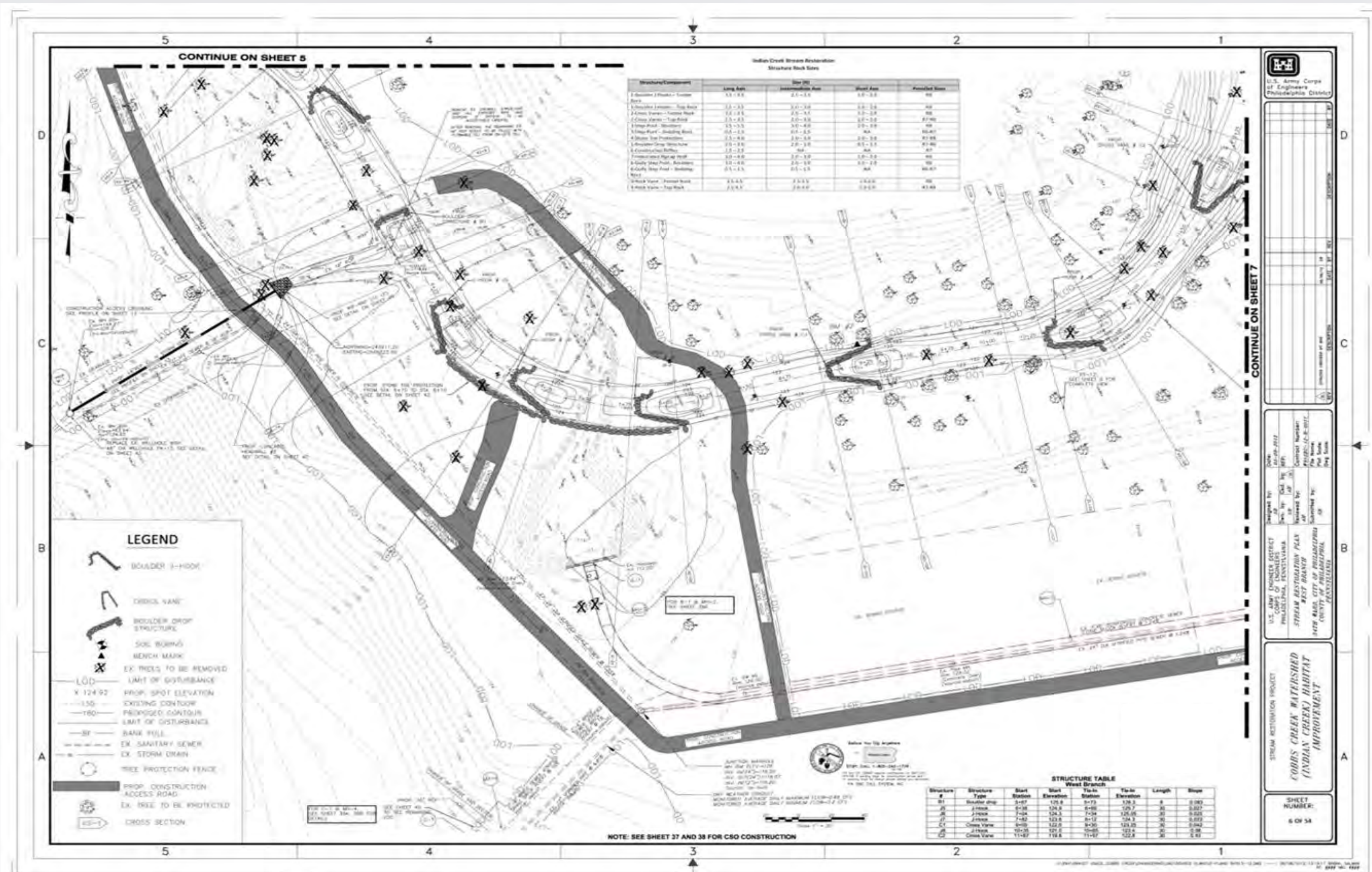

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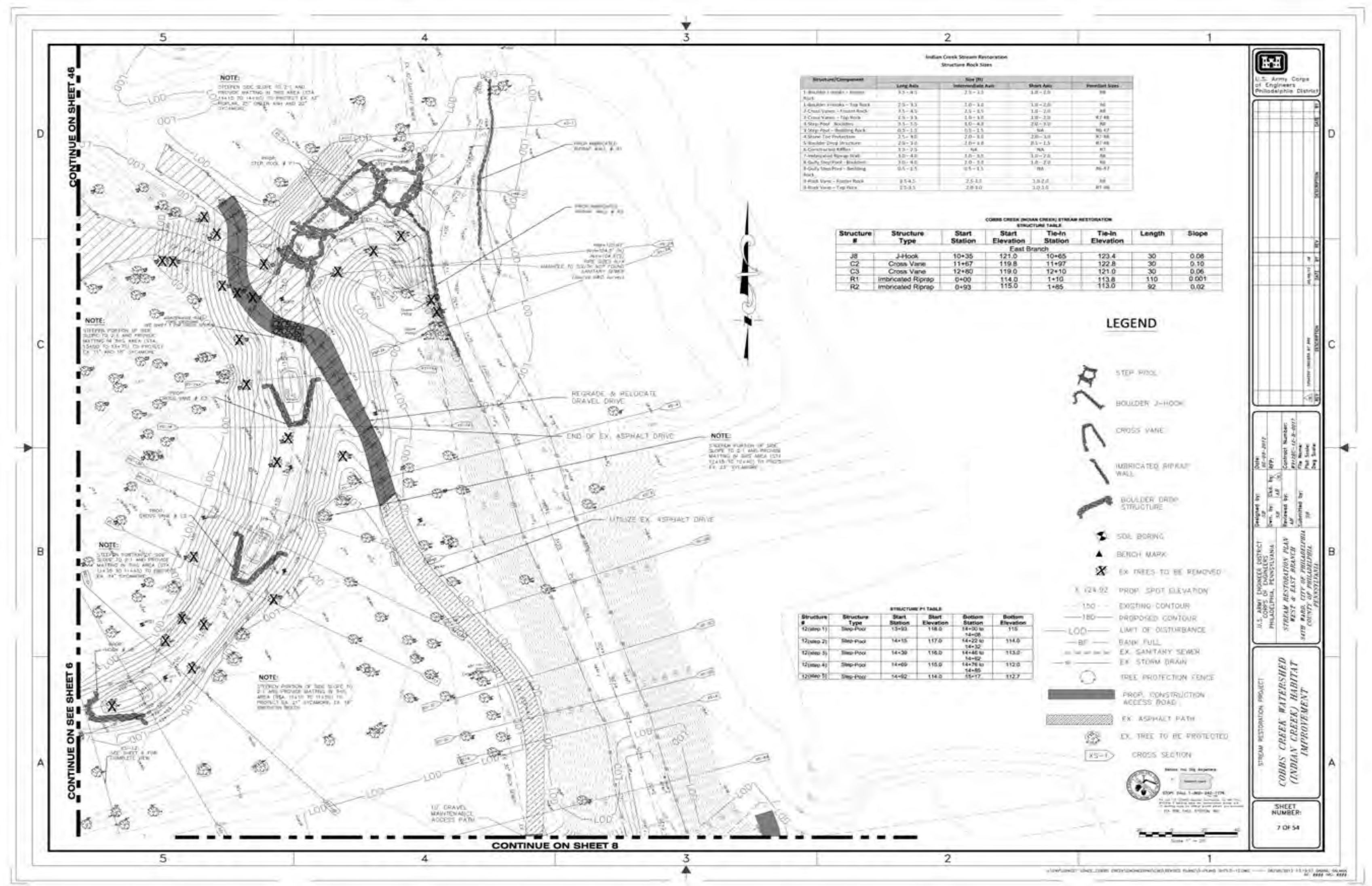
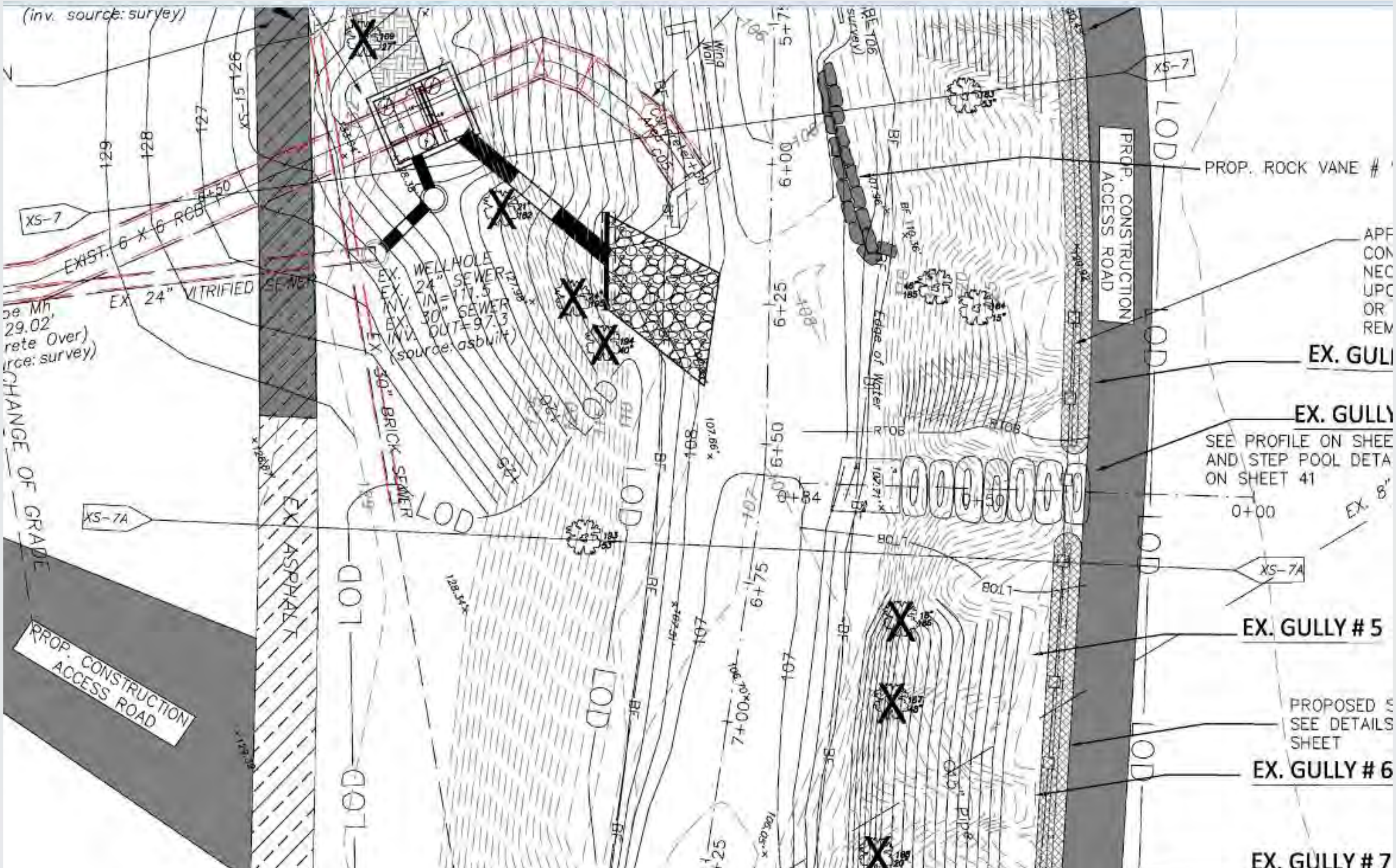
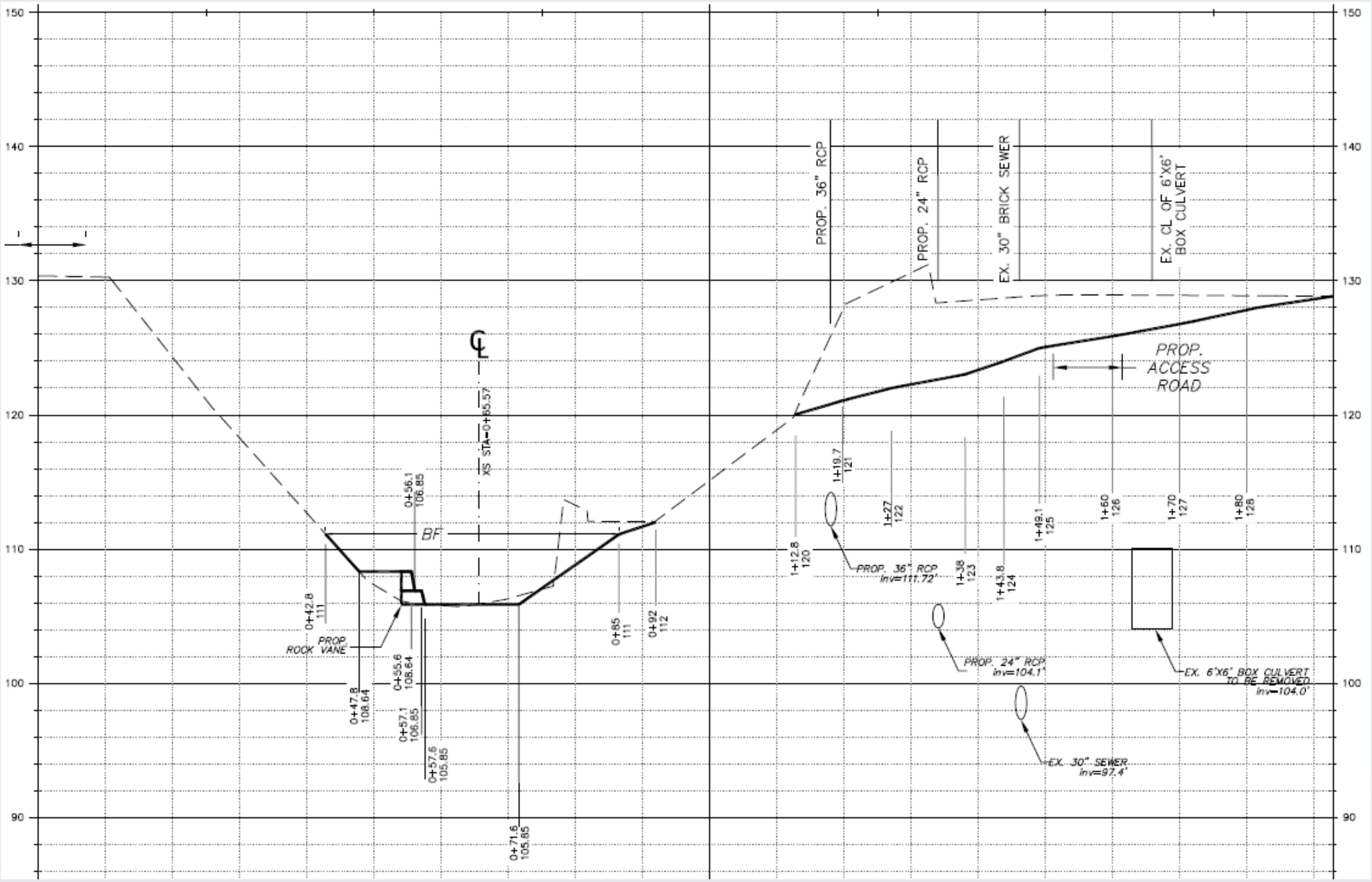


Bankfull benches



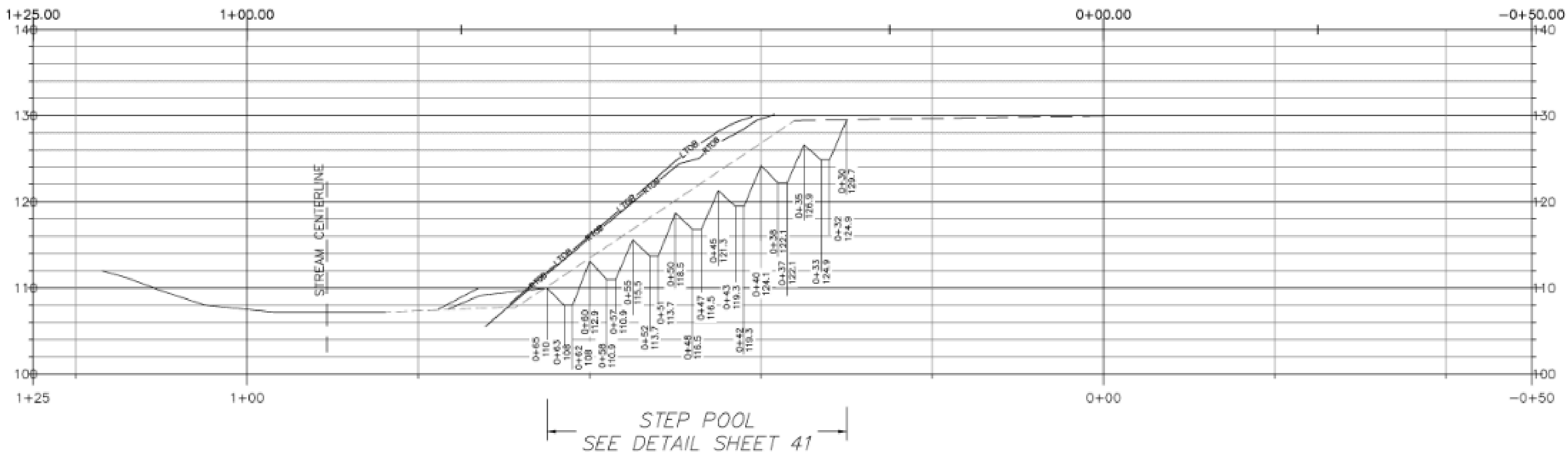
Bankfull benches



East branch

Boulders dumped over slope to repair gully erosion along Reach 1

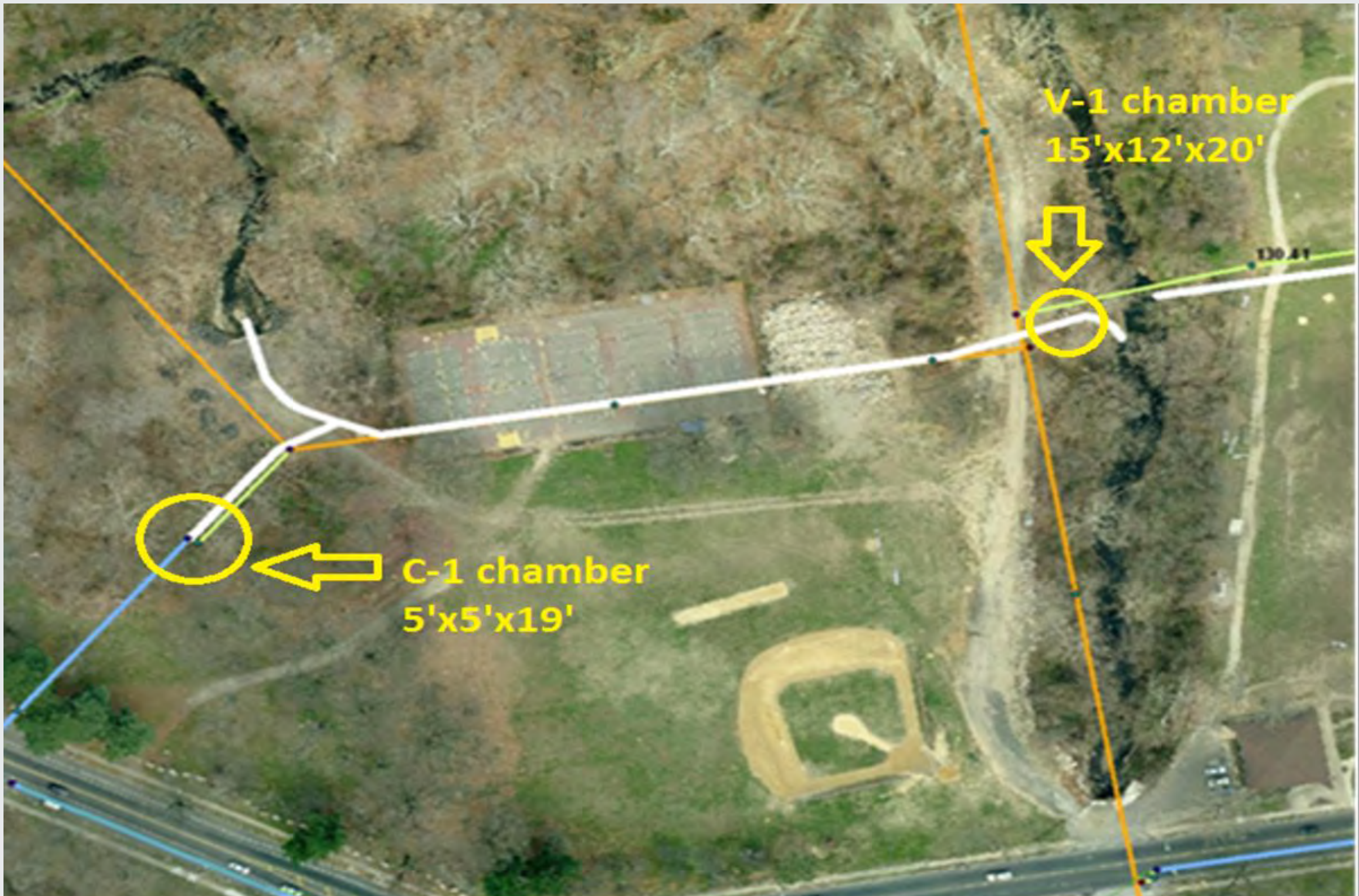


EAST BRANCH GULLY NO. 4 PROFILE

SEE PLAN SHEET 8

Scale: 1"=10' (V)
1"=10' (H)


V-1 chamber
15'x12'x20'
C-1 chamber
5'x5'x19'

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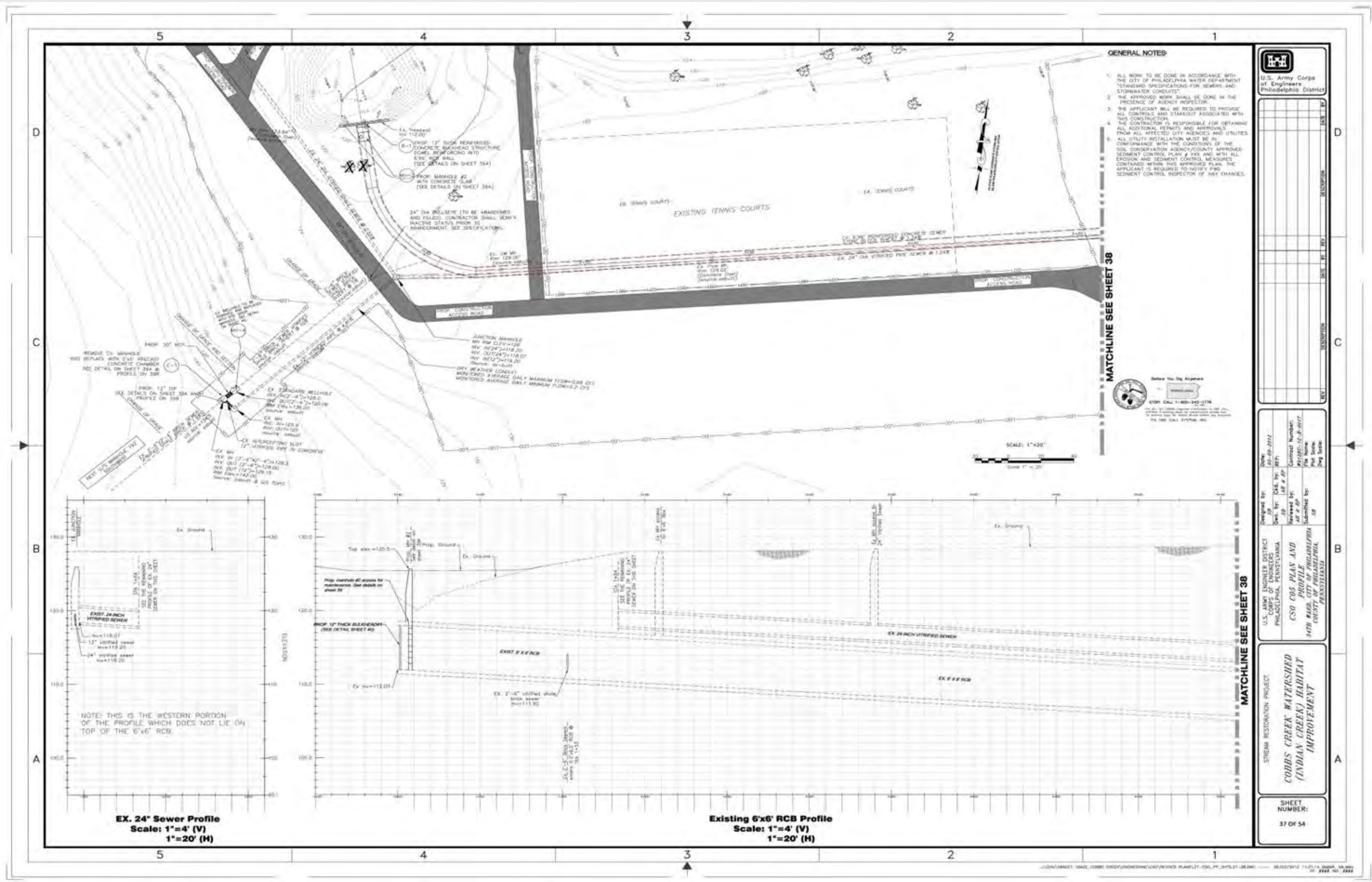
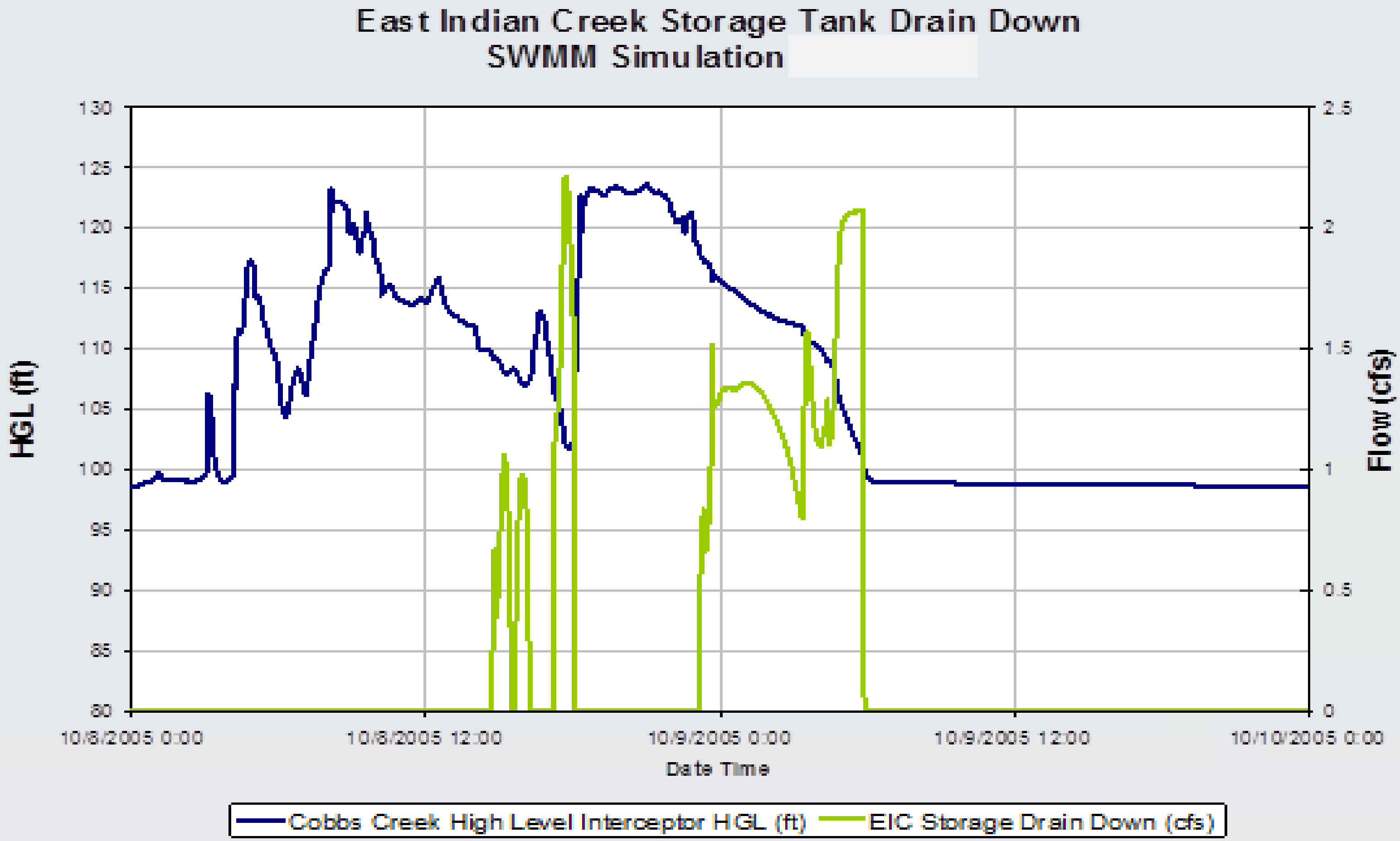


Routing between sewer interceptor & regulator:



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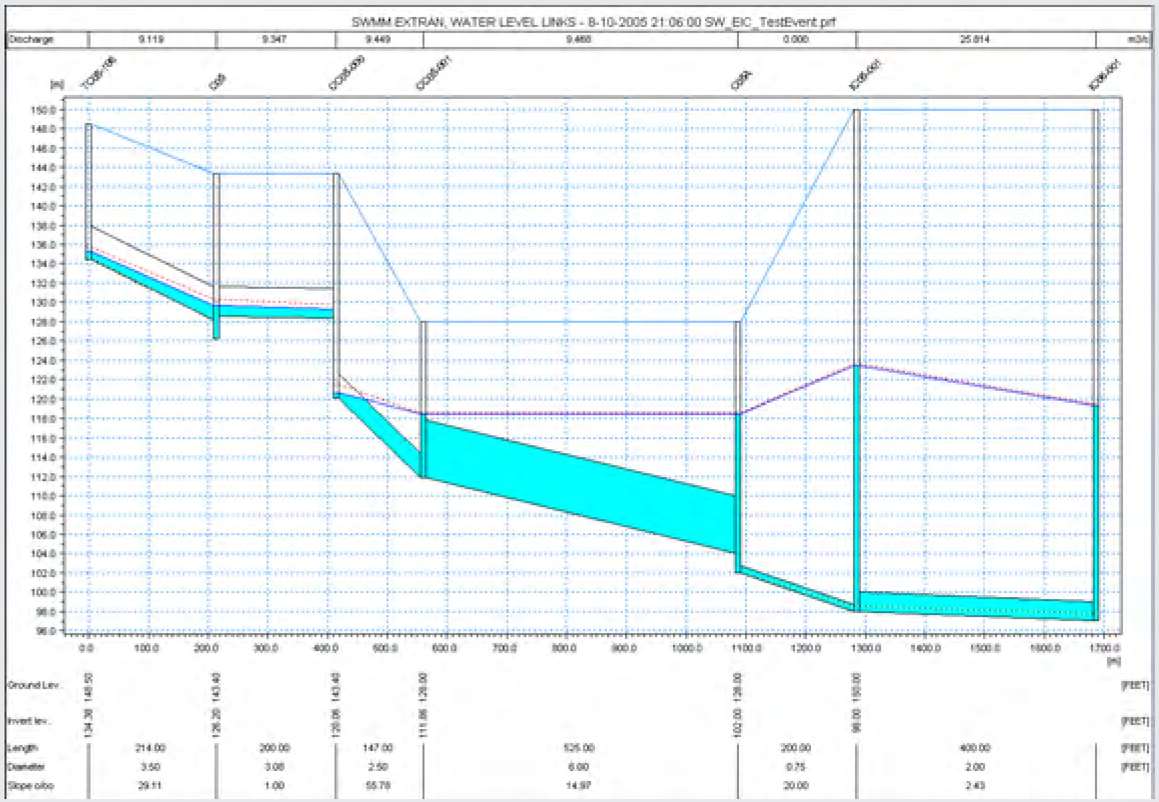
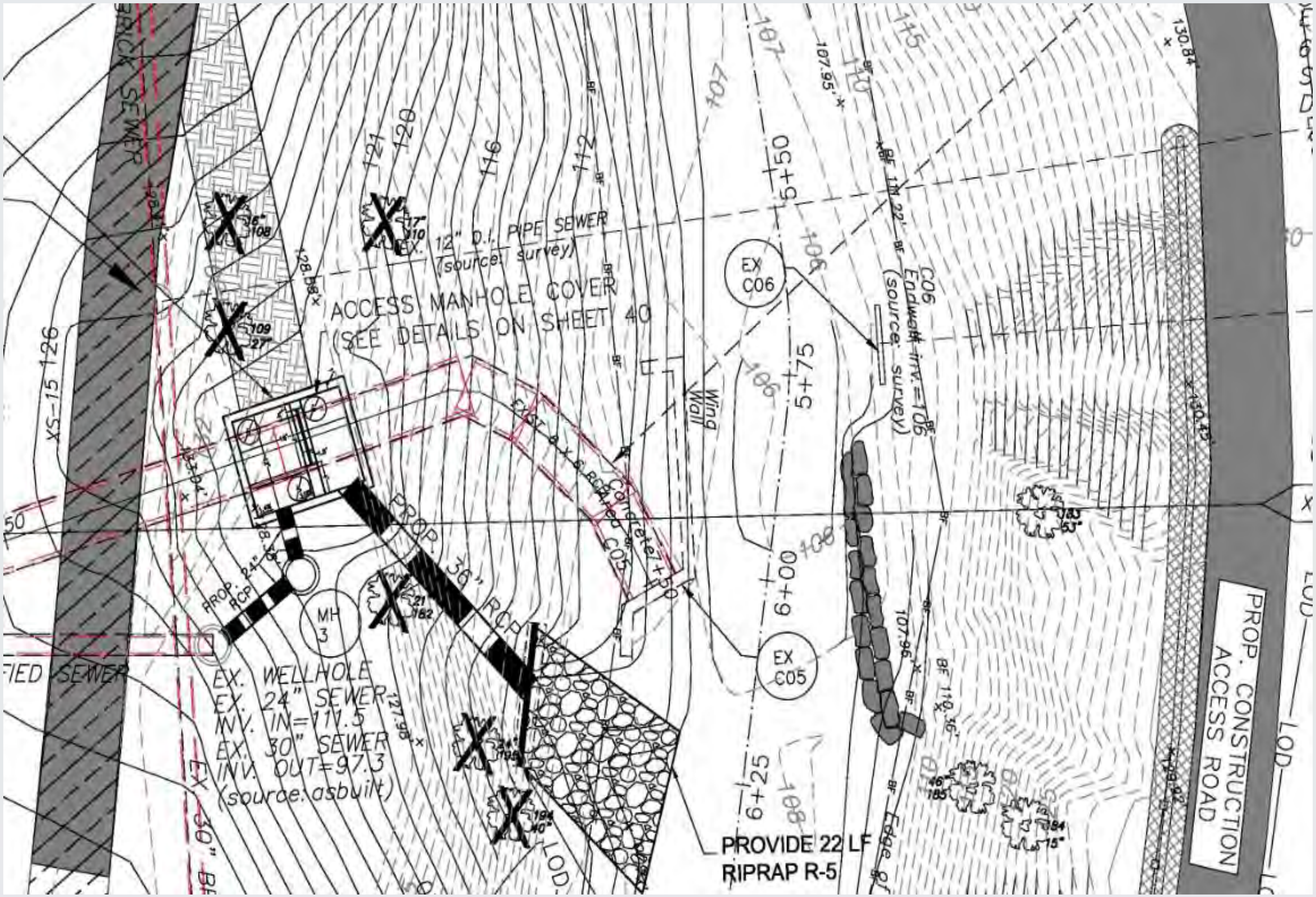
Representation of drainage connection to Interceptor



CSO Design

- CSO design includes a weir wall with 24" orifice inside concrete vault structure.
- The 24" orifice is used to divert the flow from the vault into the existing sewer interceptor.
- The 24" orifice size was selected to reduce the likelihood of clogging.
- The existing 700LF of underground reinforced concrete box (RCB) serves as storage during large storm events.
- The downstream portion of the existing reinforced concrete box (RCB) will be removed.


BRICK SEWER
XS-15 126
12" D.I. PIPE SEWER
(source: survey)
ACCESS MANHOLE COVER
(SEE DETAILS ON SHEET 40
EX C06
C06
Endwall inv.=106
(source: survey)
Wing Wall
5+50
5+75
6+00
6+25
PROP. 36" RCP
PROP. 24" RCP
MH 3
EX C05
Concrete
EX. WELLHOLE
EX. 24" SEWER
INV. IN=111.5
EX. 30" SEWER
INV. OUT=97.3
(source: asbuilt)
PROVIDE 22 LF
RIPRAP R-5
PROP. CONSTRUCTION
ACCESS ROAD
LOD
Edge of

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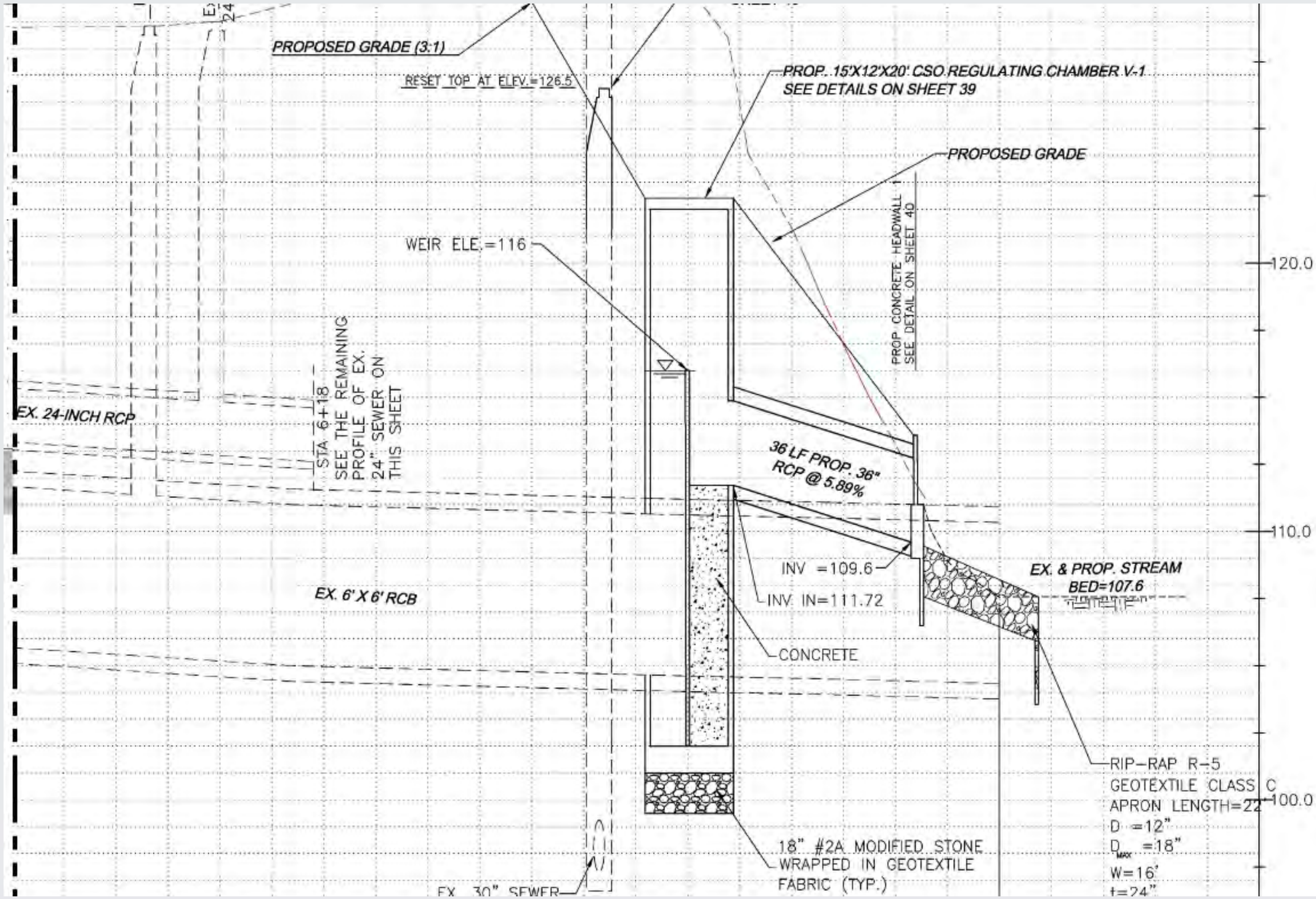
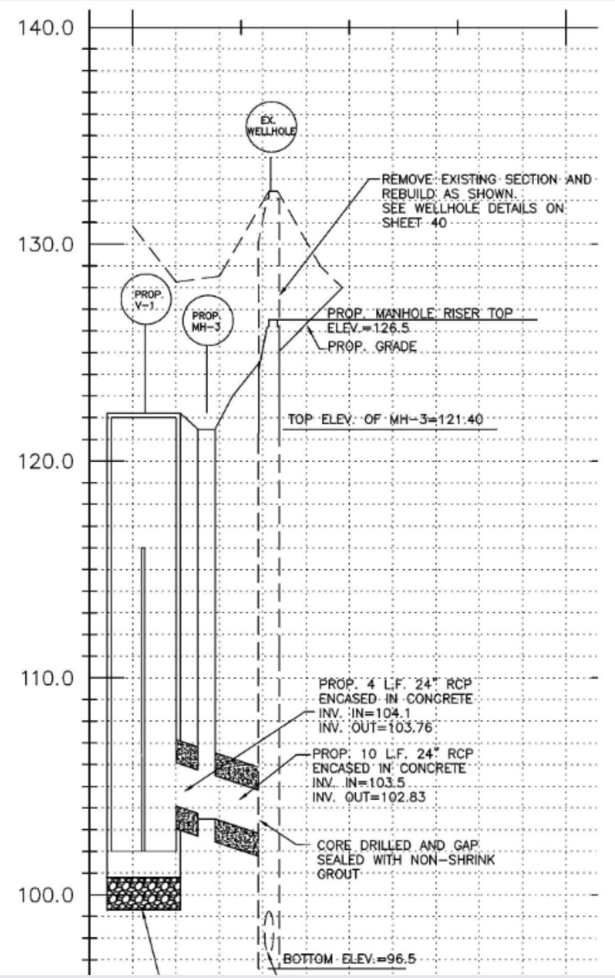
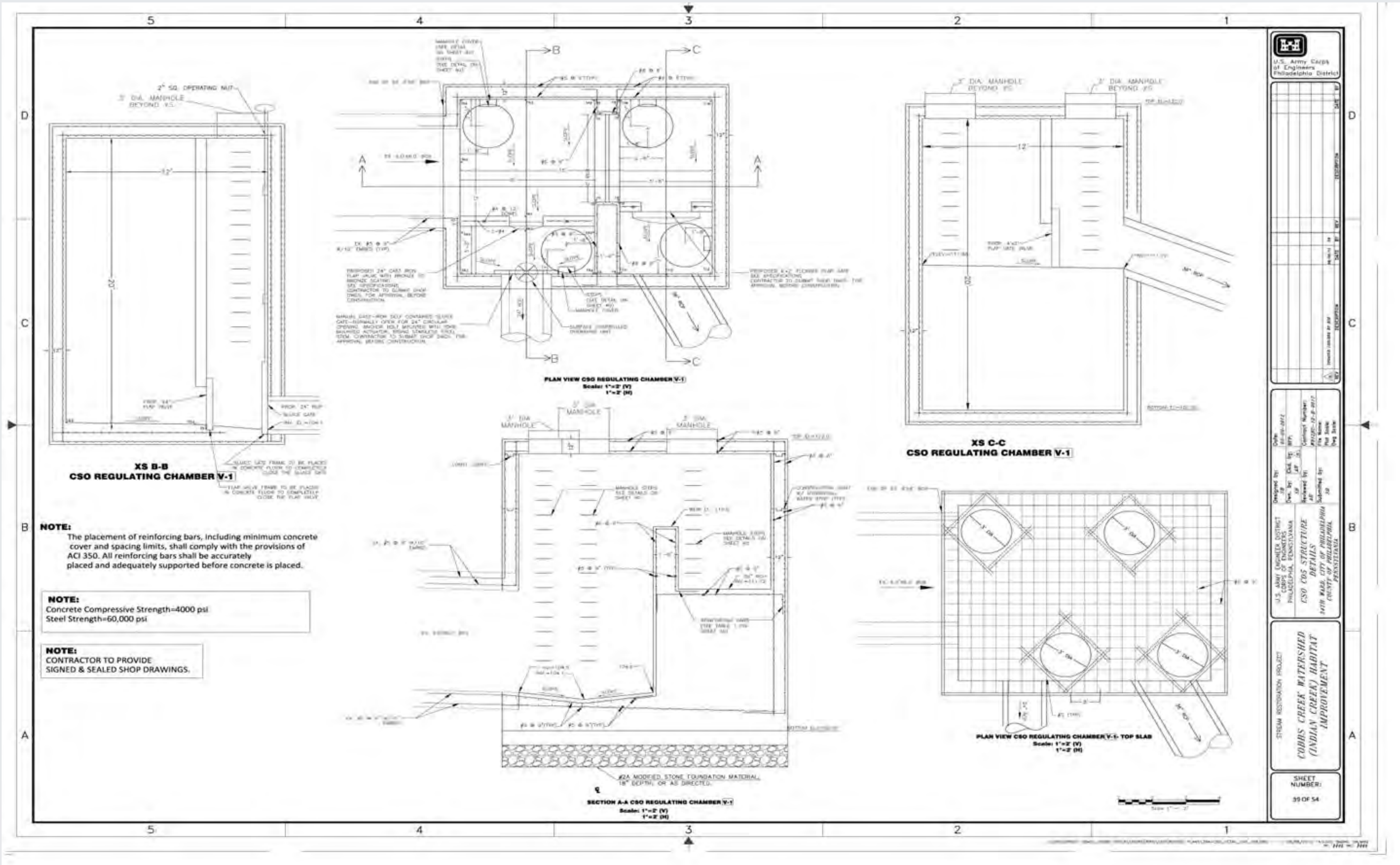
Connection between regulator & overflow



Connection between Interceptor and regulator

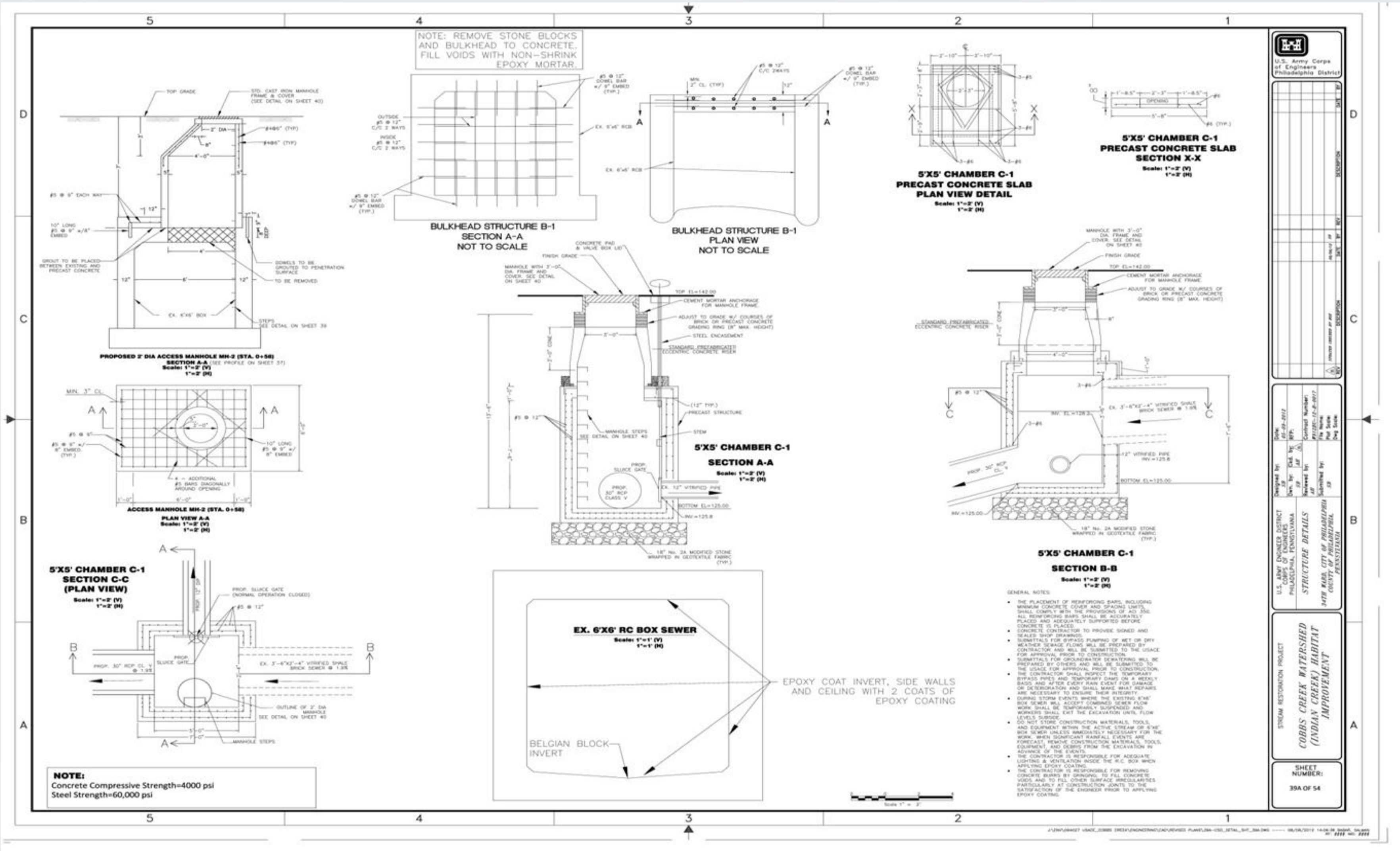


CSO regulating chamber V-1 details



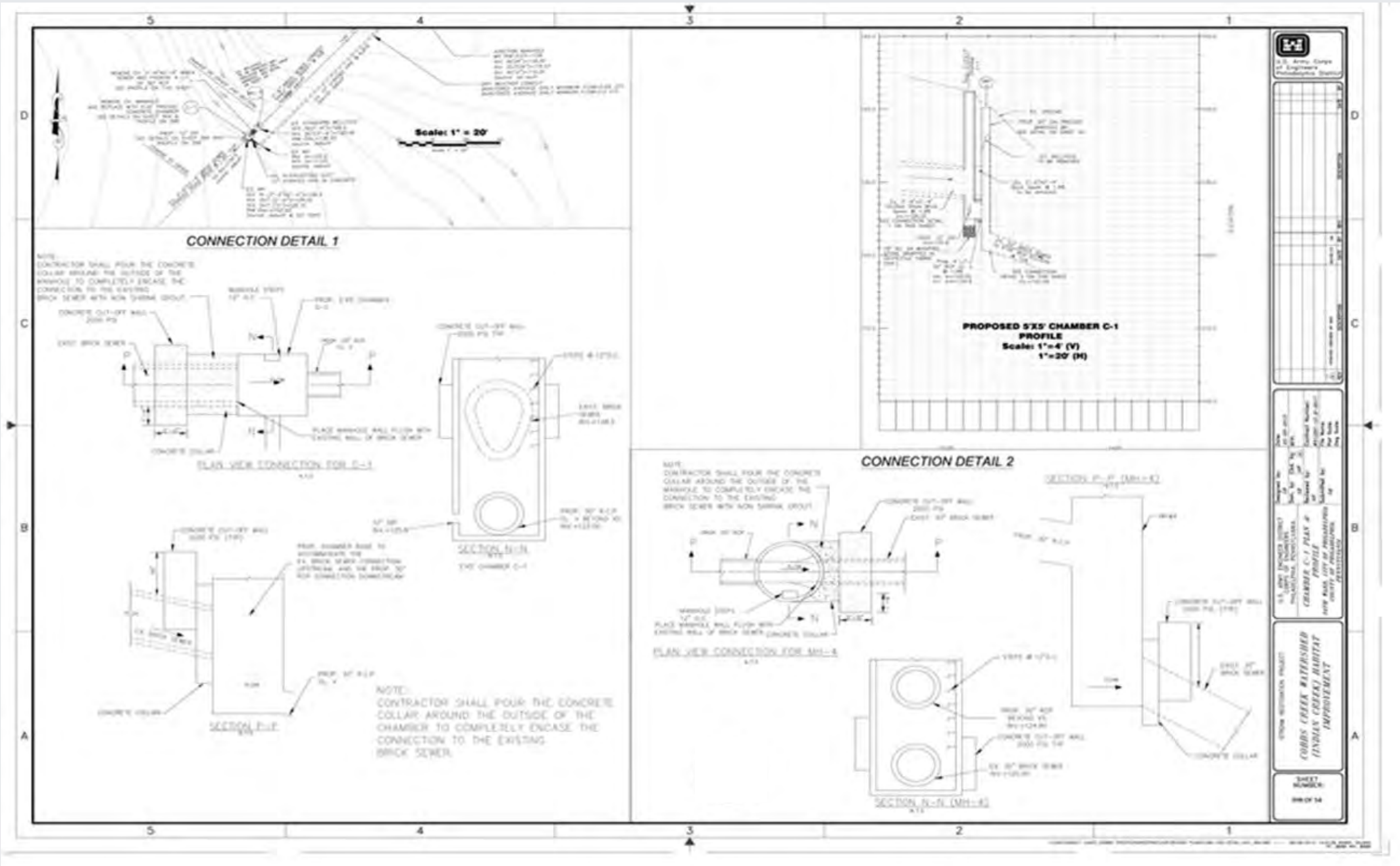



CSO regulating chamber C-1 details






Connection details



Thank You!

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