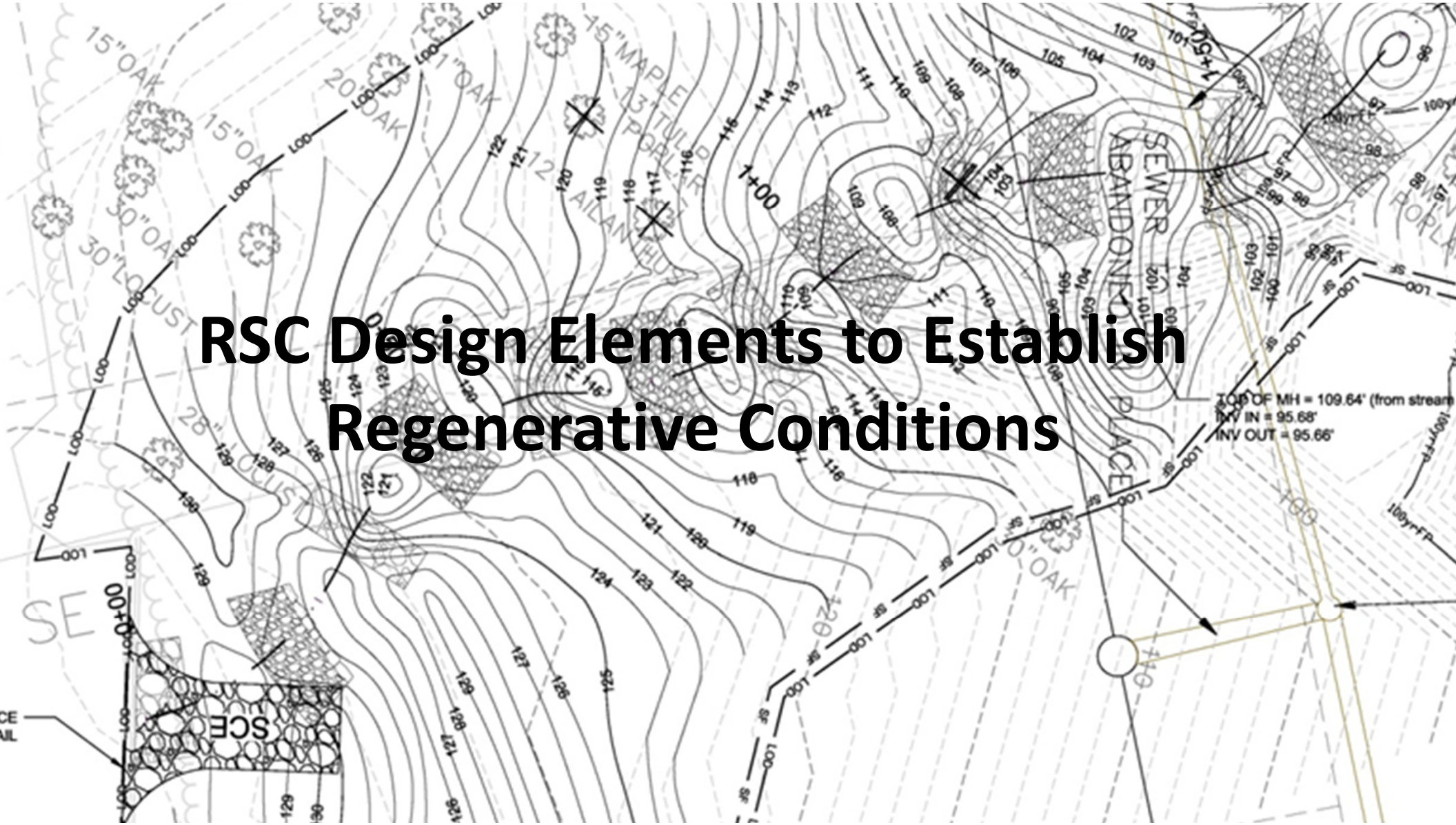
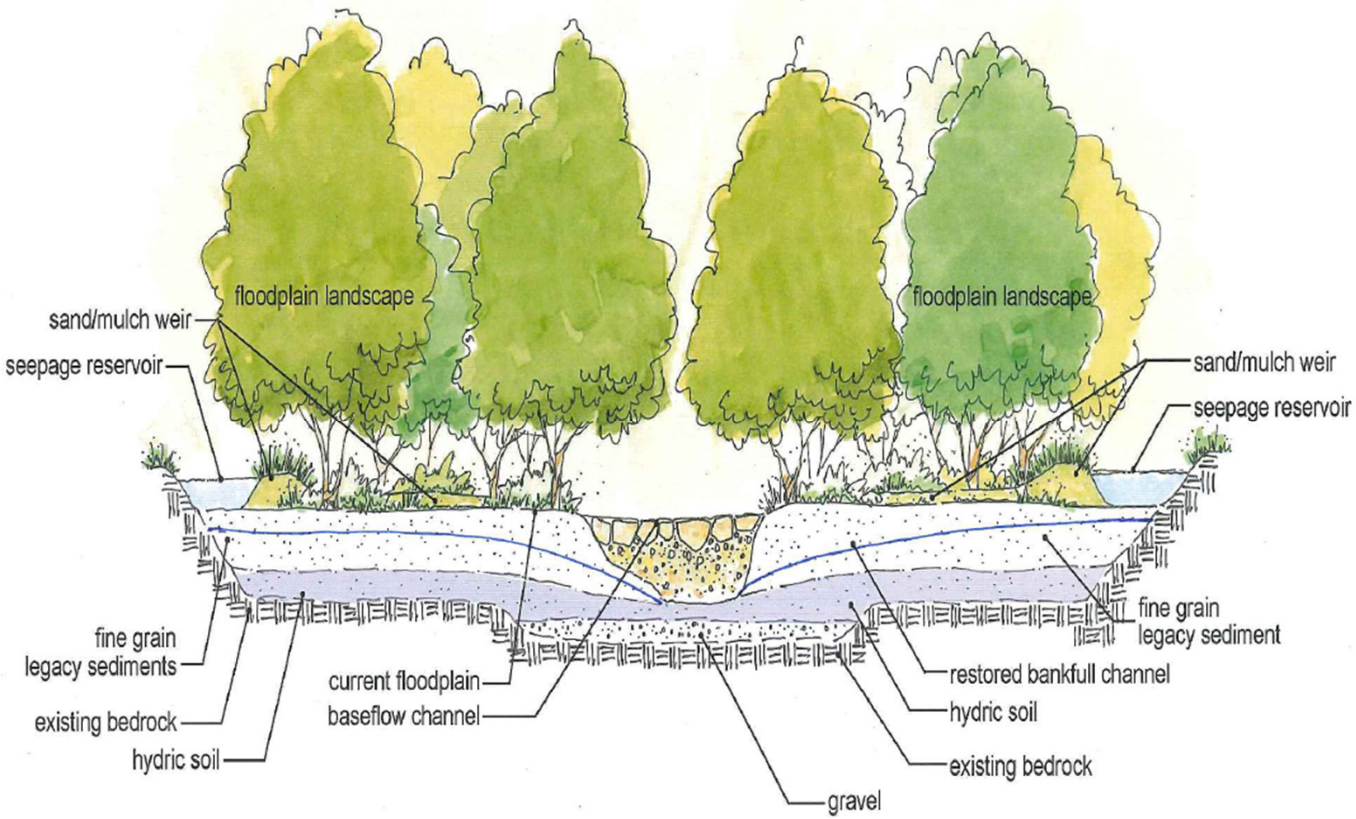

RSC Design Elements to Establish Regenerative Conditions
TOP OF MH = 109.64' (from stream
INV IN = 95.68'
INV OUT = 95.66'
SCE
SEWER ABANDONED
1+00
0+00

Questions I'll try to answer…..

- How does Ecological Restoration principles inform the design of an RSC?
- What are the basic components of an RSC, how are they designed, how does each relate to functional goals?
- Where in the landscape are RSCs appropriately applied? How does landscape position effect design?
- How are RSC design elements translated into construction documents?

How does Ecological Restoration principles inform the design of an RSC?



Goals must be objective and quantifiable.

Defining the “success” of ecological restoration projects include many considerations:

-Employing **aesthetics** to create pleasing human experiences with **multiple** benefits and ecosystem services;

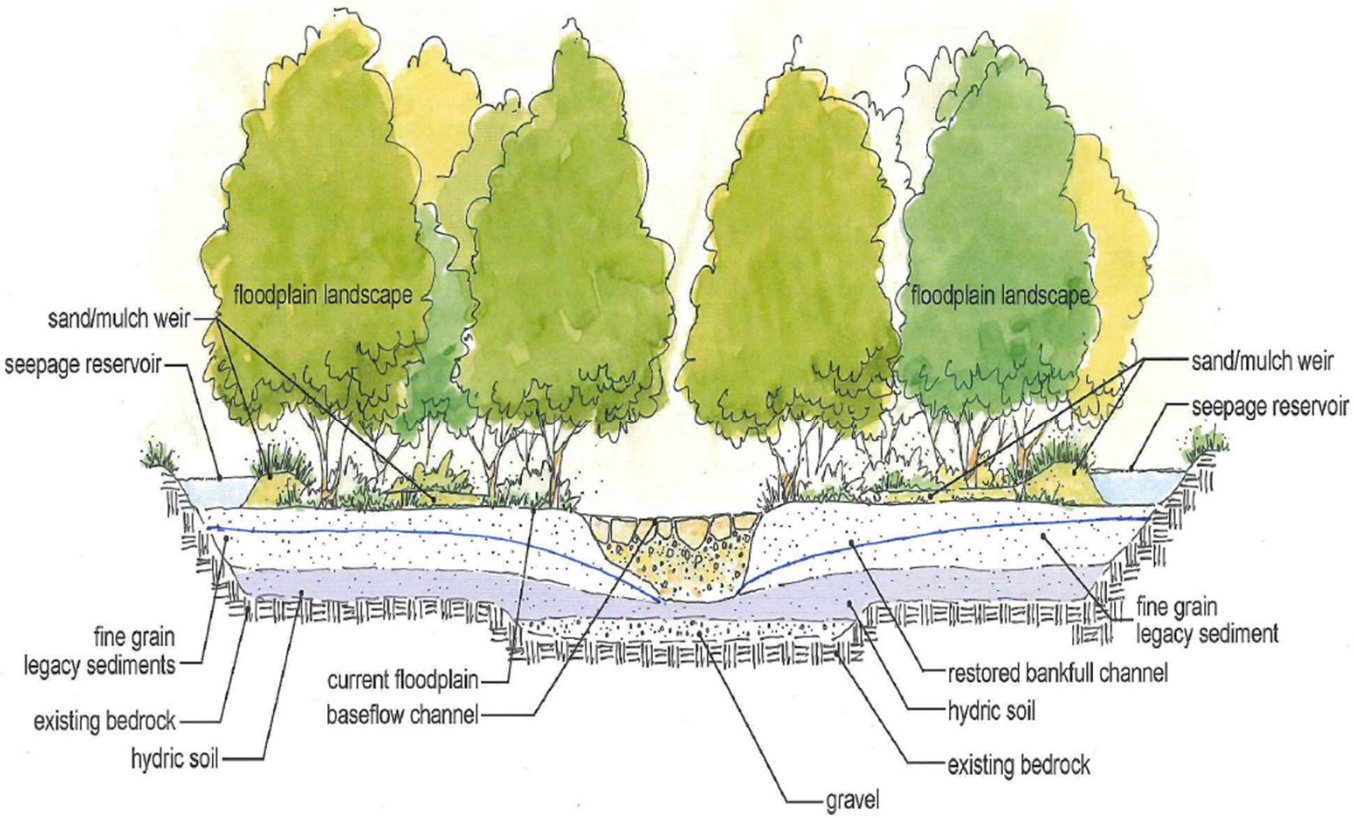
-Creating projects which are **highly acceptable** to clients, stakeholders, and the public;

-Initiating **sustainability** of the restored site by promoting the system’s capacity to adapt to its particular setting;

-Properly designing and implementing projects by using **appropriate references** and specifying **appropriate materials**; employing appropriate tools and techniques, and ensuring that project sites are enjoyed and cared for over the **long term**;

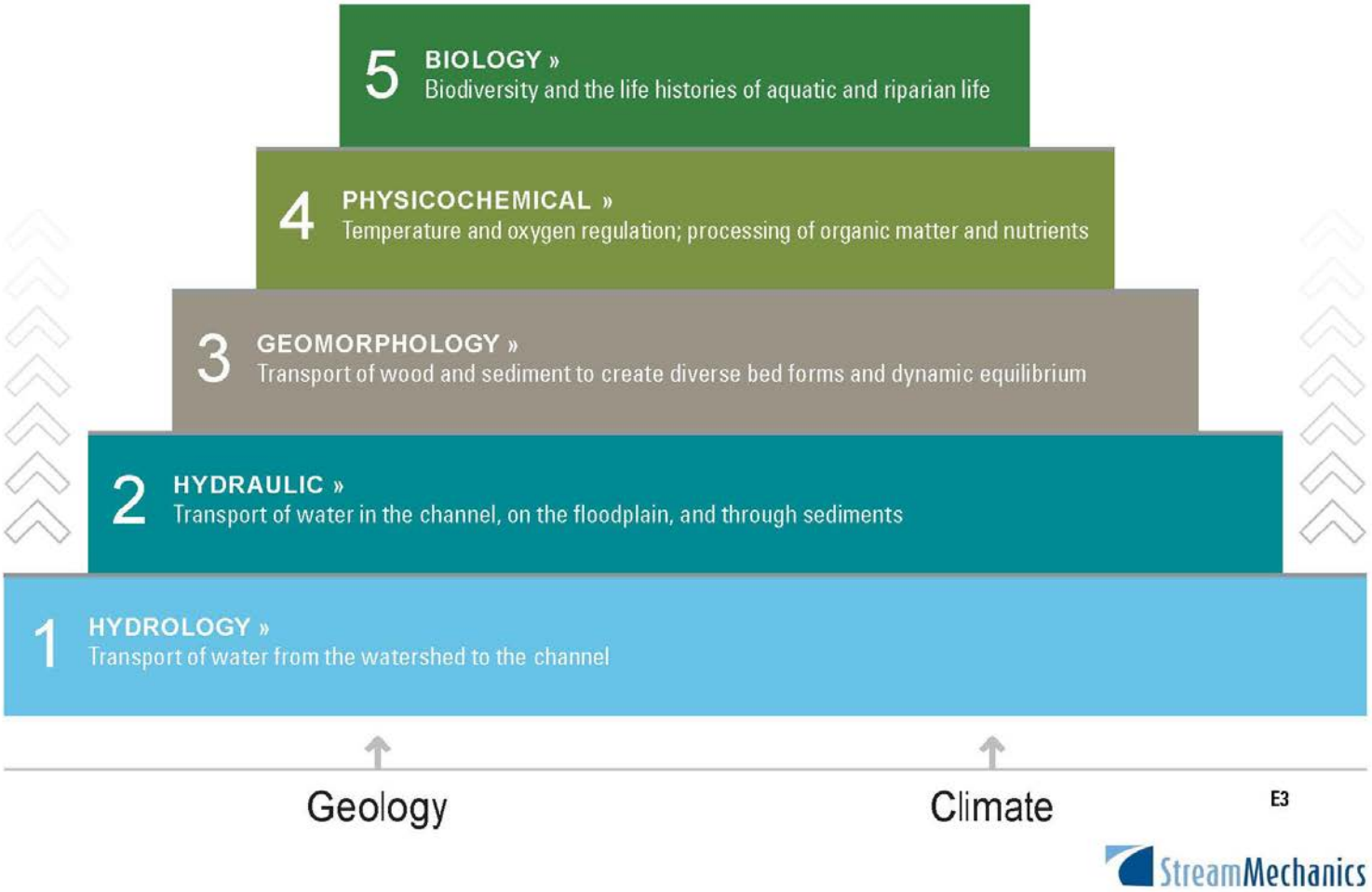
-Utilizing resources (ecological, cultural, and financial) efficiently and wisely.

Goals must be objective and quantifiable.



Stream Functions Pyramid

A Guide for Assessing & Restoring Stream Functions » OVERVIEW

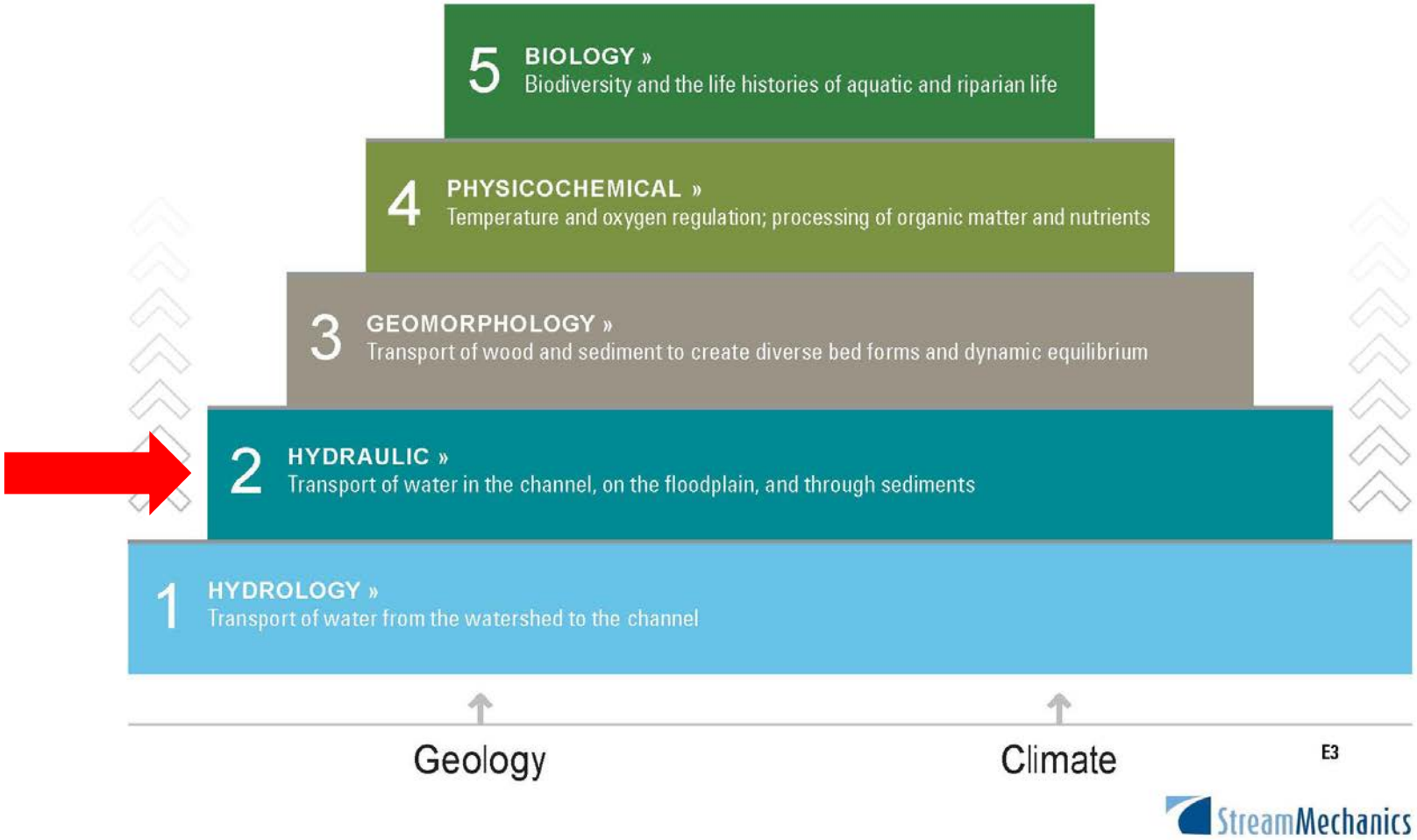


E3

StreamMechanics

Stream Functions Pyramid

A Guide for Assessing & Restoring Stream Functions » OVERVIEW

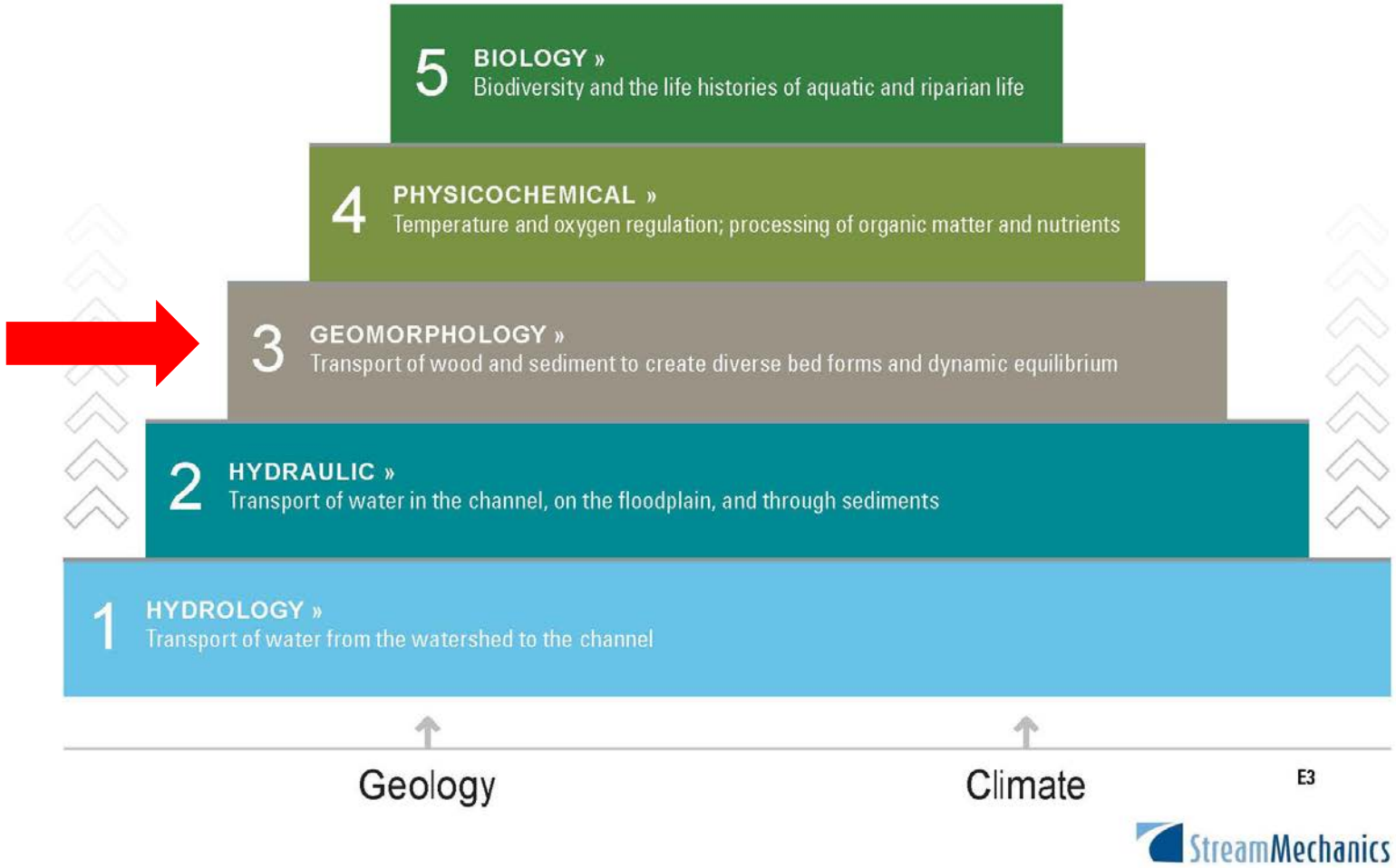


E3

StreamMechanics

Stream Functions Pyramid

A Guide for Assessing & Restoring Stream Functions » OVERVIEW

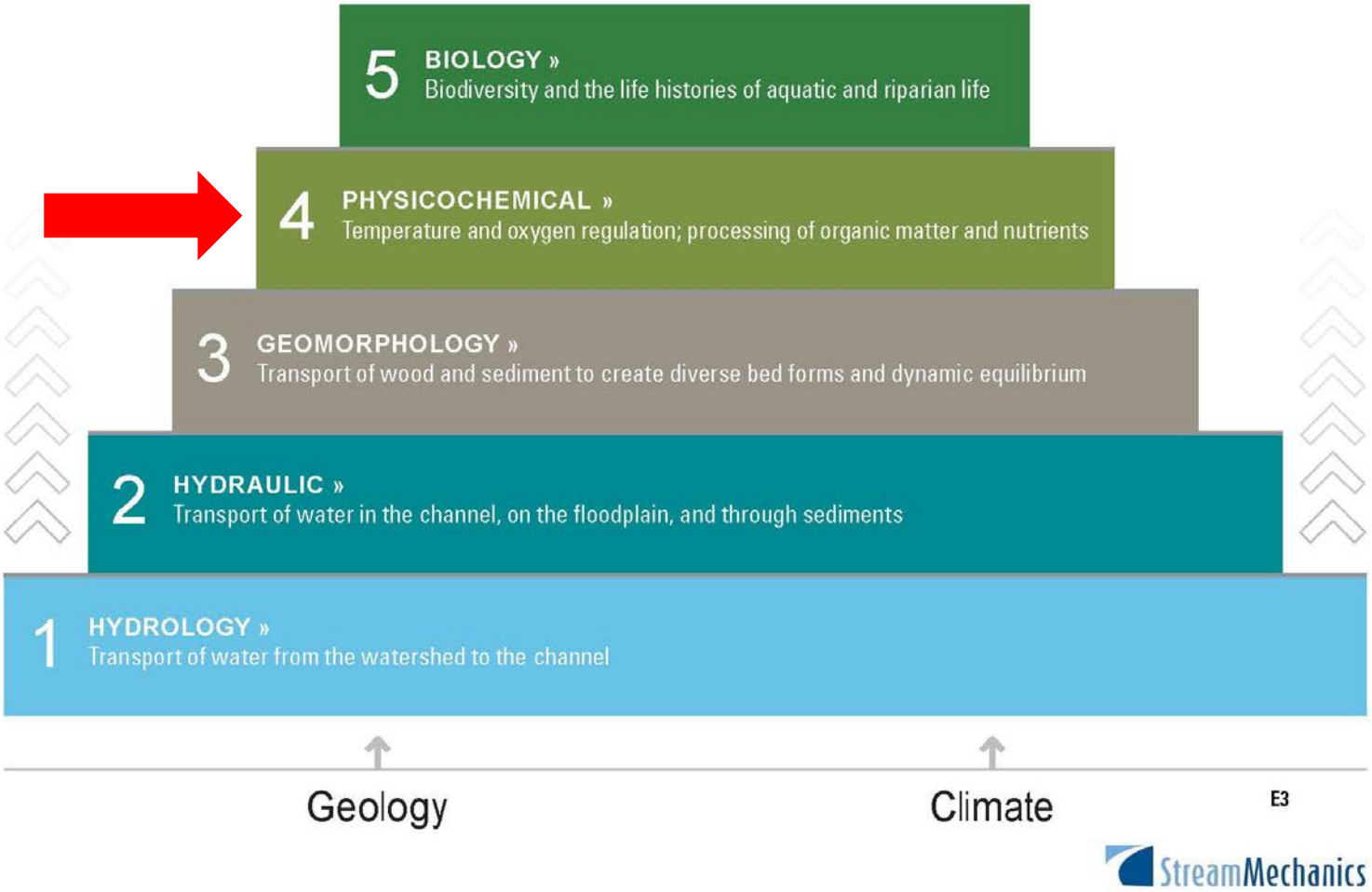


E3

StreamMechanics

Stream Functions Pyramid

A Guide for Assessing & Restoring Stream Functions » OVERVIEW

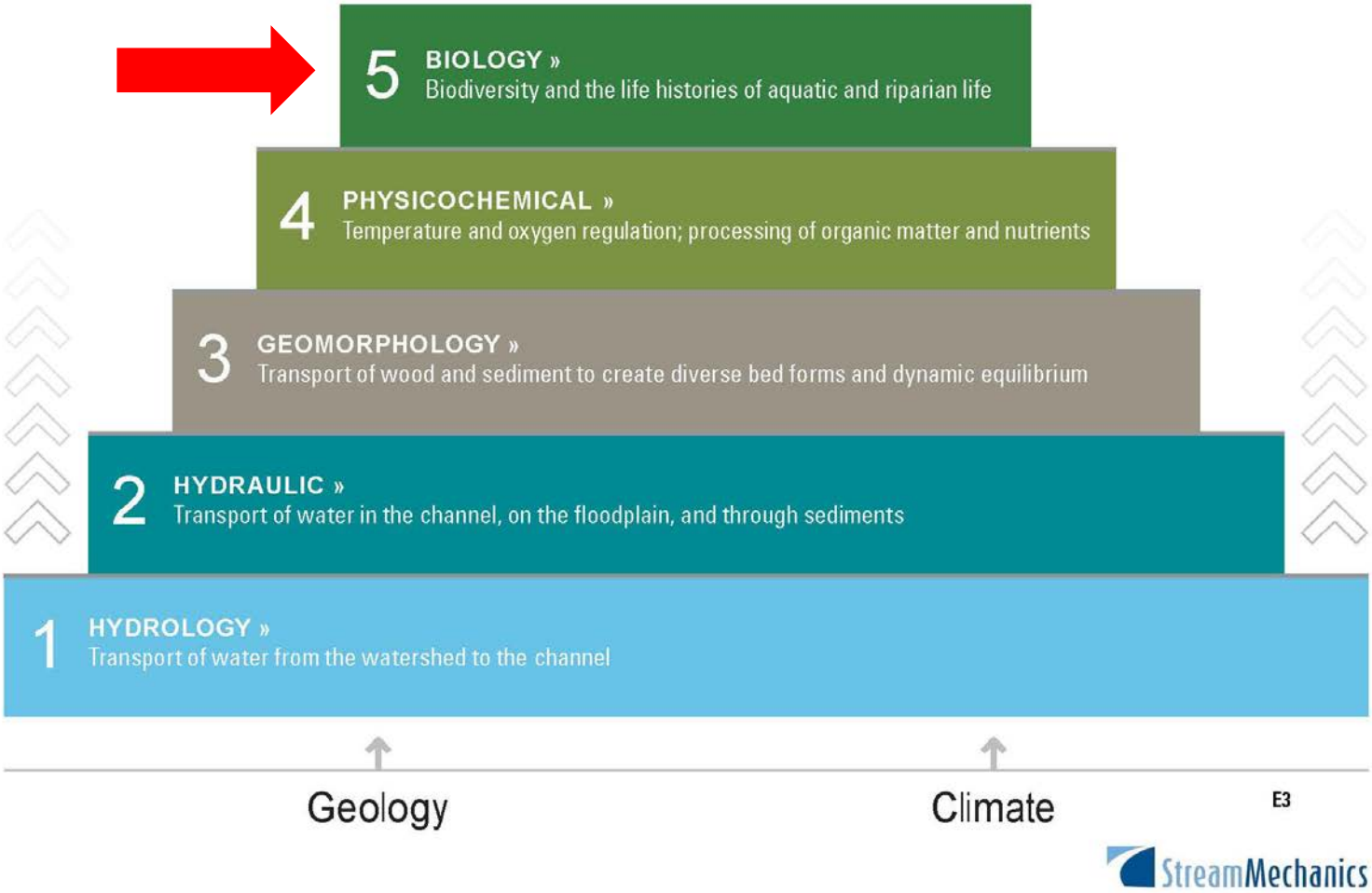


E3

StreamMechanics

Stream Functions Pyramid

A Guide for Assessing & Restoring Stream Functions » OVERVIEW



E3

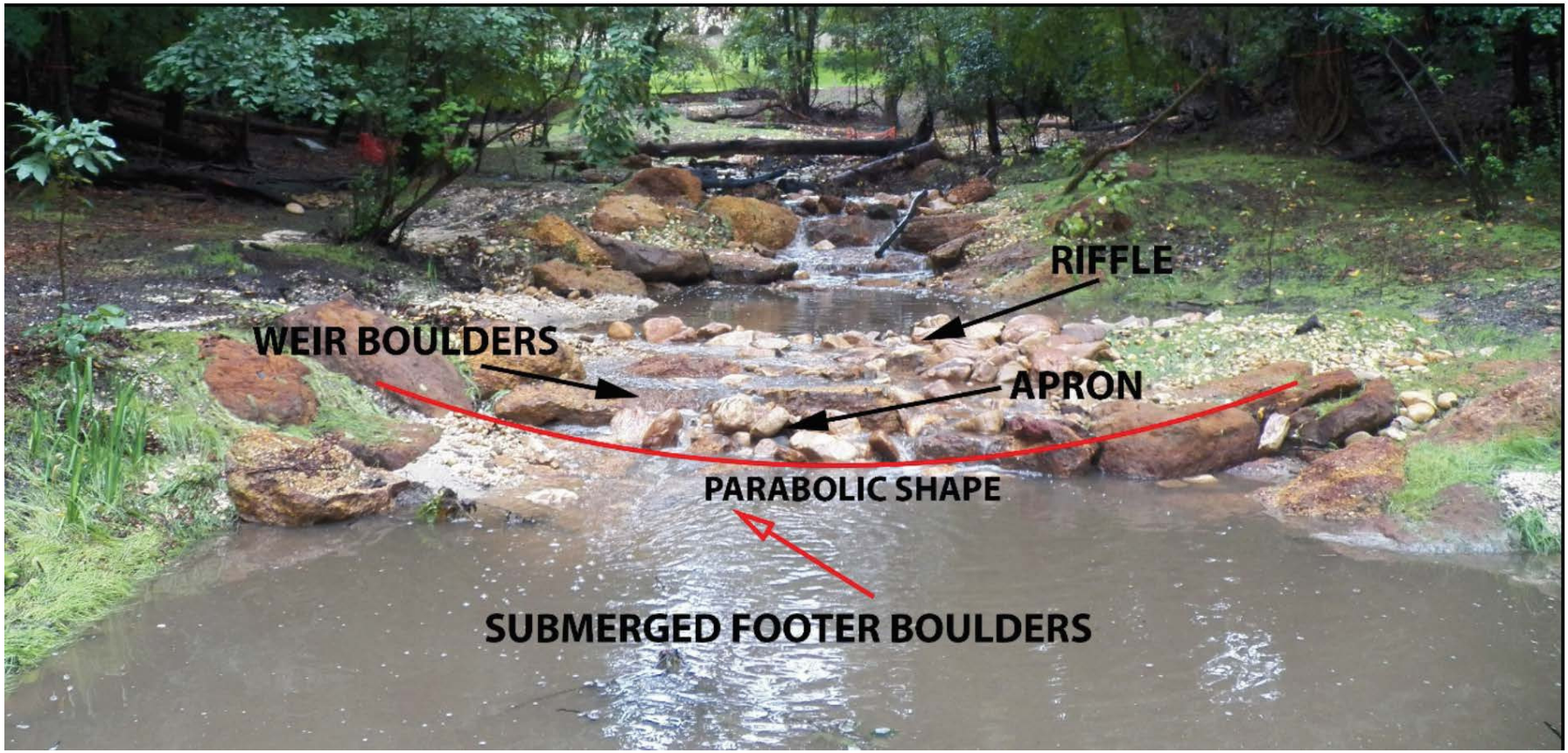
StreamMechanics

What are the basic components of an RSC, how are they designed, how does each relate to functional goals?

Channel Fill


In-Stream Structures

Riffle Structure



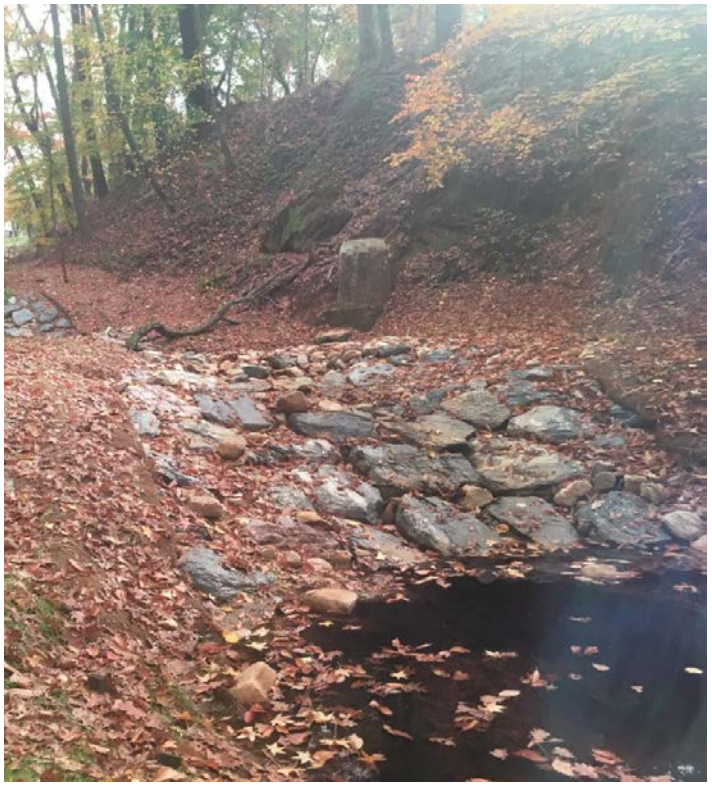
Riffle Structures

Riffle Structures

Cascade Structure

Cascade Structures

Cascade Structures



Preliminary Cross Section Design

Parabolic Weir

Alger Park Middle Reach
Riffle

Design Q, cfs	1-yr Q, cfs	10-yr Q, cfs	100-yr Q, cfs	Project Length, ft	Overall Change in Elev.
20	64	126	173	1514	97

Reach Length, ft	Reach Change in Elev.	Reach WS Slope (ft/ft)	Project Overall slope (ft/ft)
850	55	0.064	0.064

top width, ft	constr. d, ft.	t/d (target is >=10)	drop, ft.	length, ft.	structure s, ft/ft
45	1.700	26.471	1.0	10.0	0.100

d50, in.	Max. Perm. v, fps	thickness of rock, ft.	Wp, ft	Vol. rock, c.y.
9.0	6.0	1.6875	45.171	14

Design Q

depth of flow, ft.	top width at depth, ft.	n
0.50	24.455	0.087

Area, ft2	Wp, ft	Rh, ft.	v, fps	Q, cfs	
8.135	24.432	0.333	2.58	21.02	structure slope used

v max, fps	Q req'd, cfs
6.0	20.00

1 year storm

depth of flow, ft.	top width at depth, ft.	n
0.75	29.890	0.068

Area, ft2	Wp, ft	Rh, ft.	v, fps	Q, cfs	
14.945	29.940	0.499	4.34	64.91	structure slope used

v max, fps	Q req'd, cfs
6.0	64.00

10 year storm

depth of flow, ft.	top width at depth, ft.	n
1.00	34.513	0.060

Area, ft2	Wp, ft	Rh, ft.	v, fps	Q, cfs	
23.009	34.591	0.665	5.48	125.98	reach WS slope used

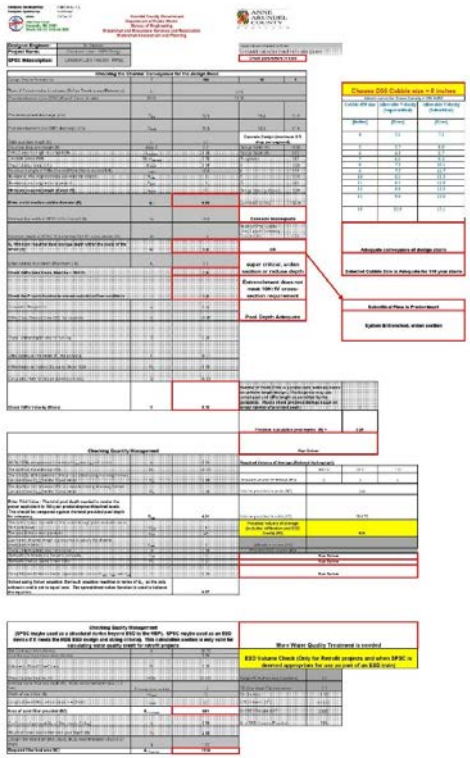
v max, fps	Q req'd, cfs
6.0	126.00

100 year storm

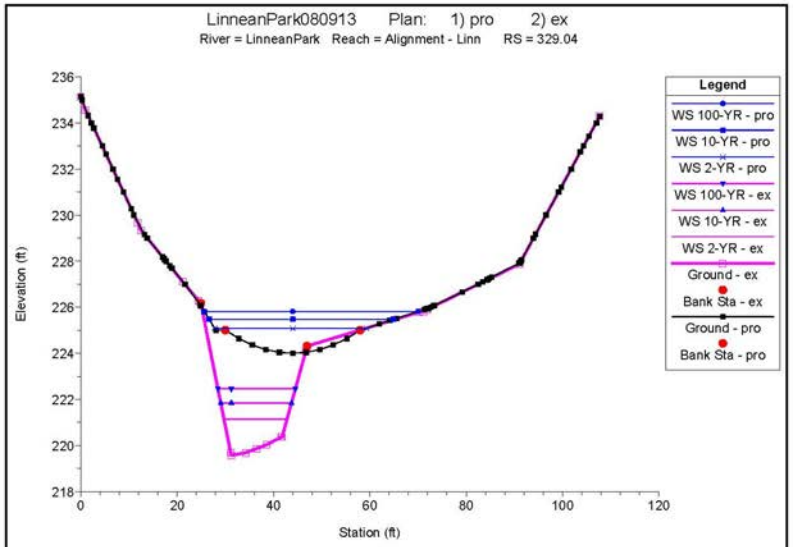
depth of flow, ft.	top width at depth, ft.	n
1.13	36.688	0.057

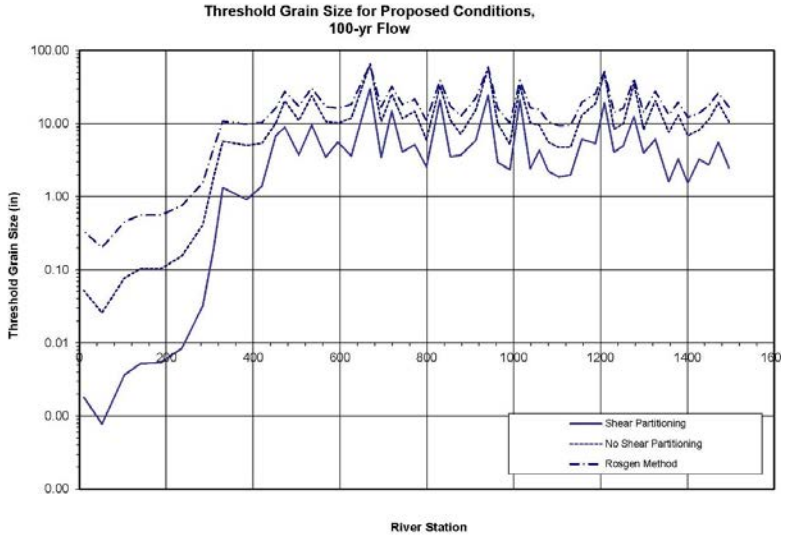
Area, ft2	Wp, ft	Rh, ft.	v, fps	Q, cfs	
27.638	36.781	0.751	6.22	171.87	reach WS slope used

v max, fps	Q req'd, cfs
6.0	173.00

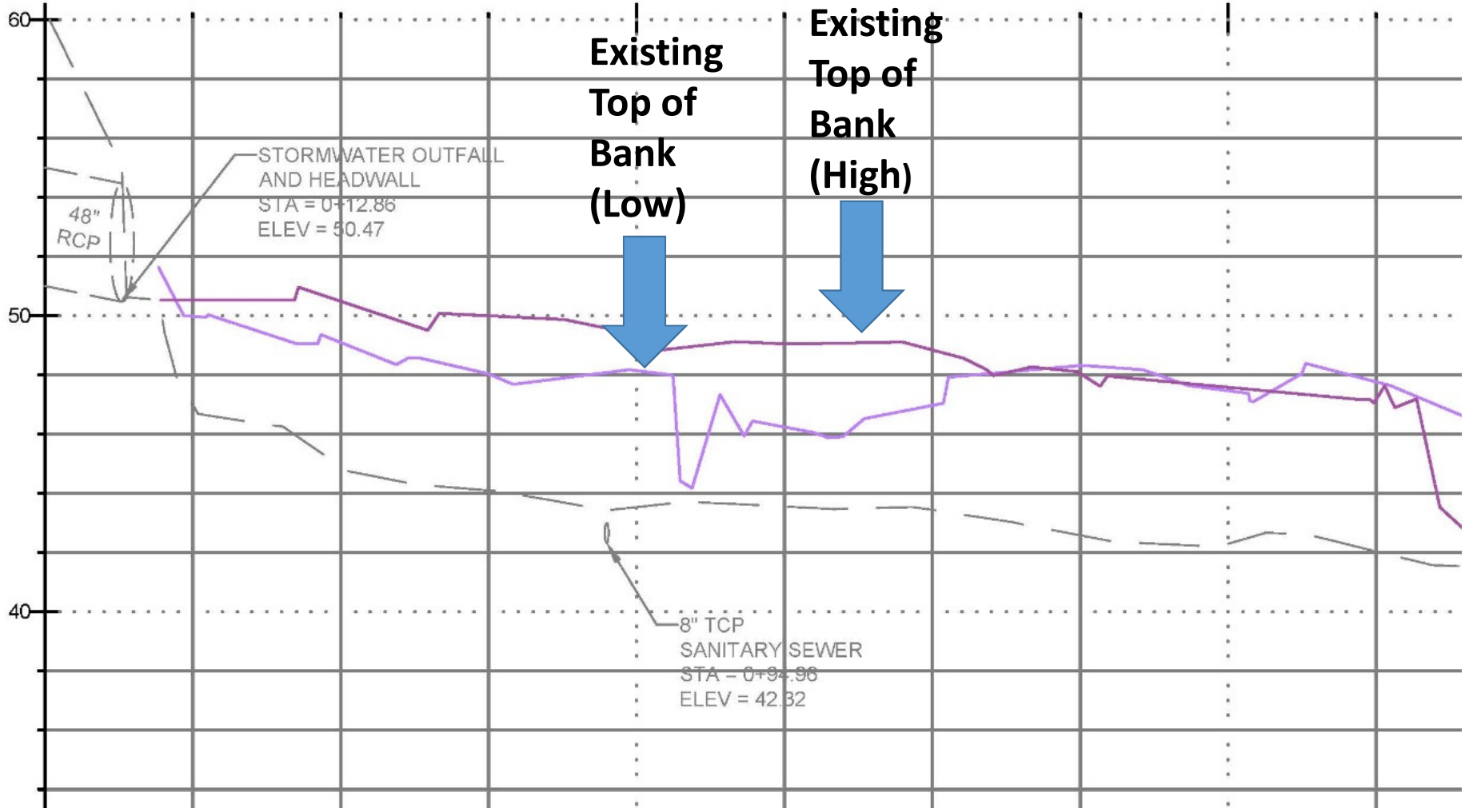


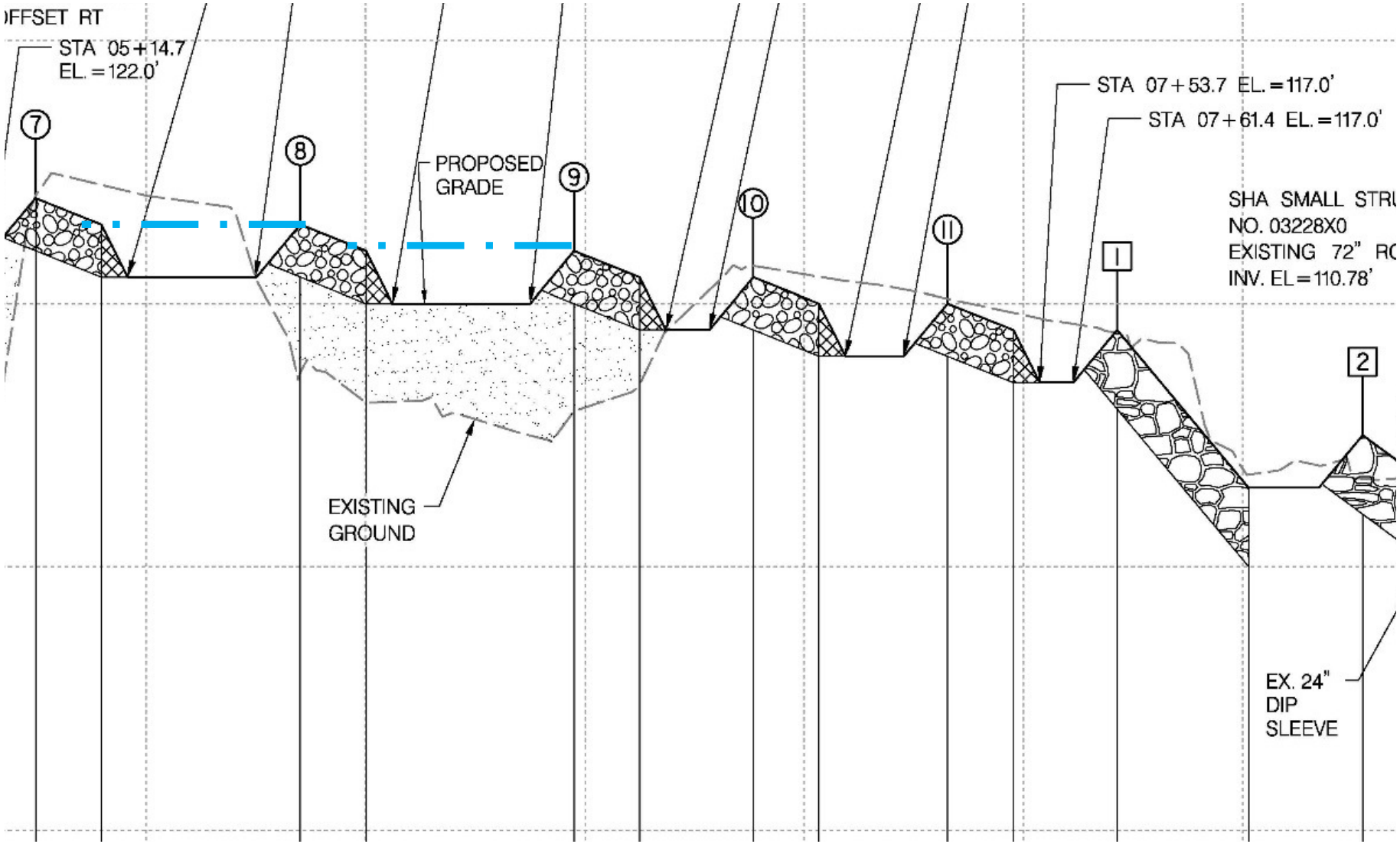
Validation of Design

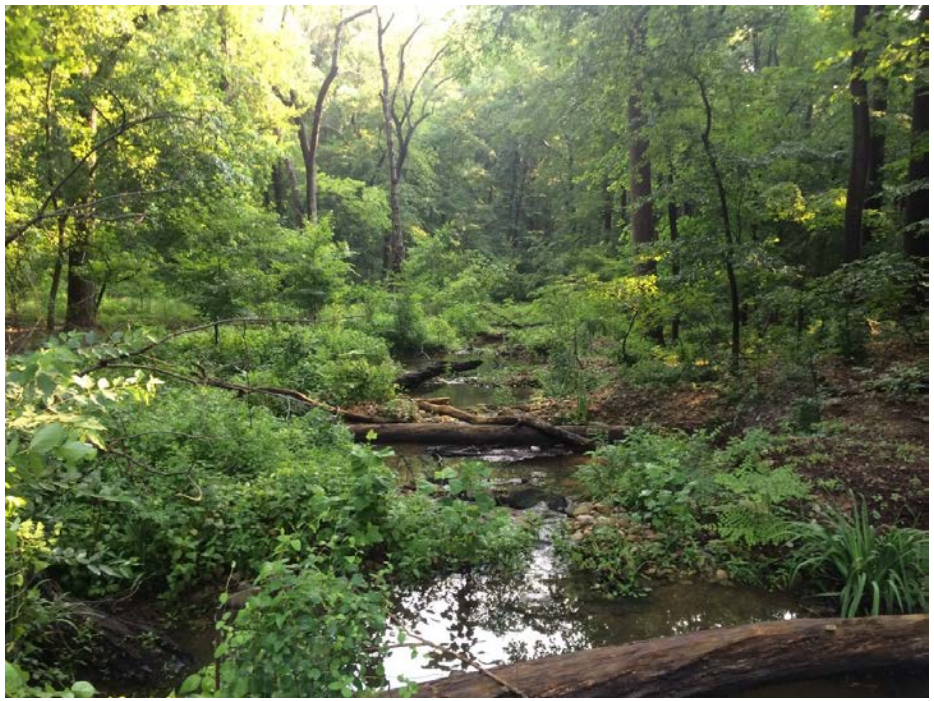




Determine Target Elevation of Proposed Structures



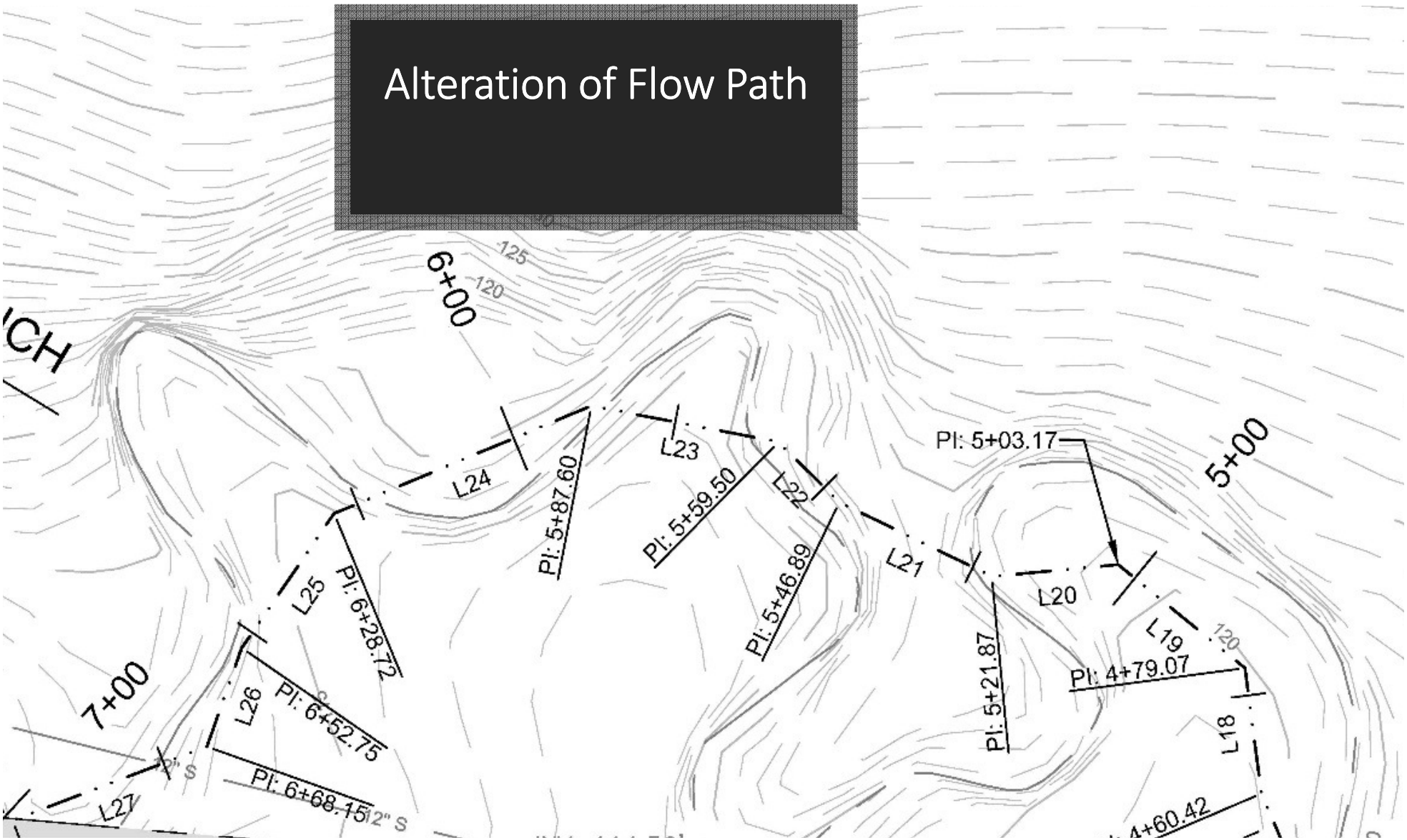

)FFSET RT
STA 05+14.7
EL.=122.0'
7
8
PROPOSED
GRADE
9
10
11
STA 07+53.7 EL.=117.0'
STA 07+61.4 EL.=117.0'
SHA SMALL STRU
NO. 03228X0
EXISTING 72" RC
INV. EL=110.78'
1
2
EXISTING
GROUND
EX. 24"
DIP
SLEEVE



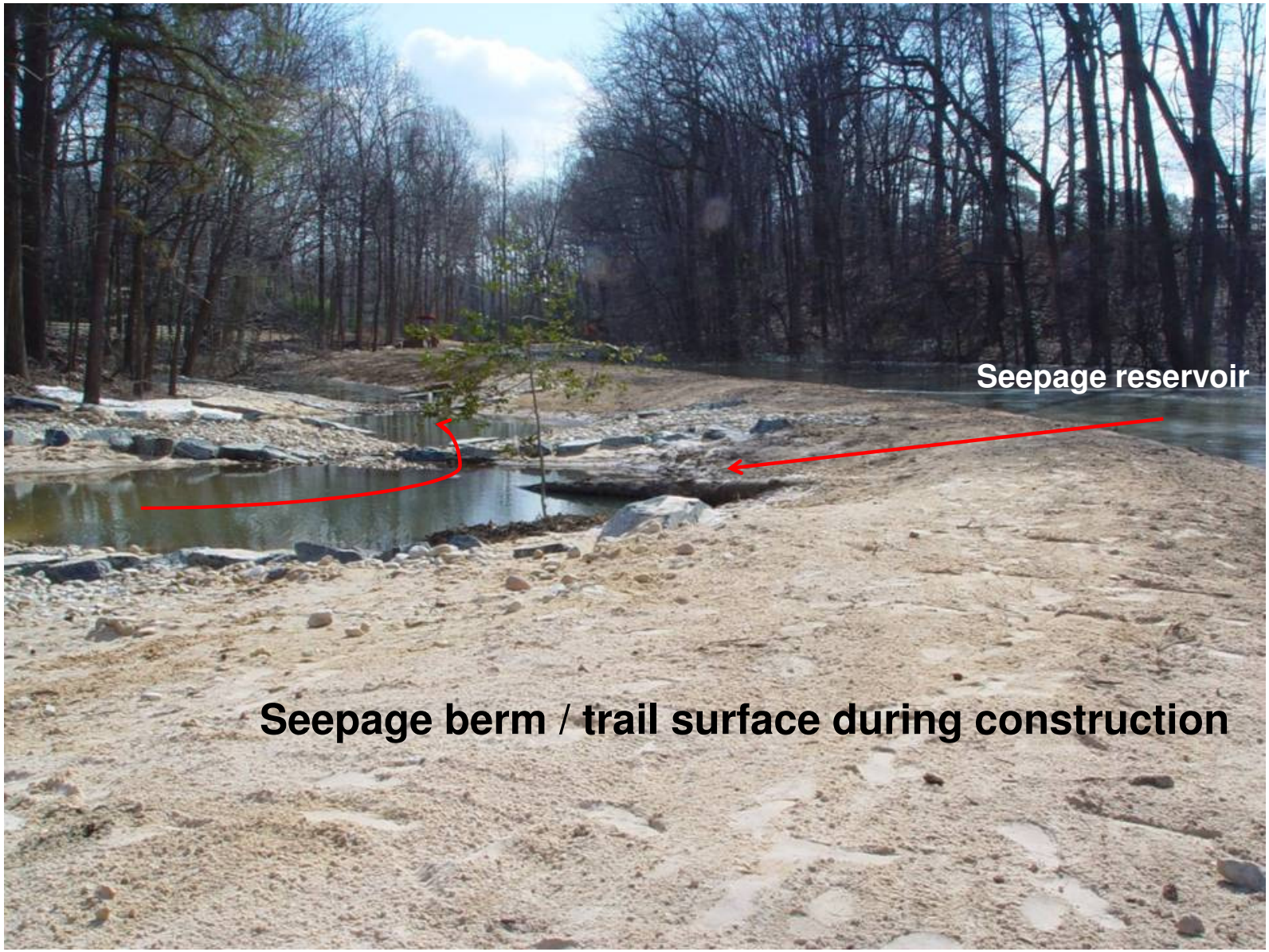
Riffles - 4 Years After Construction

Pools

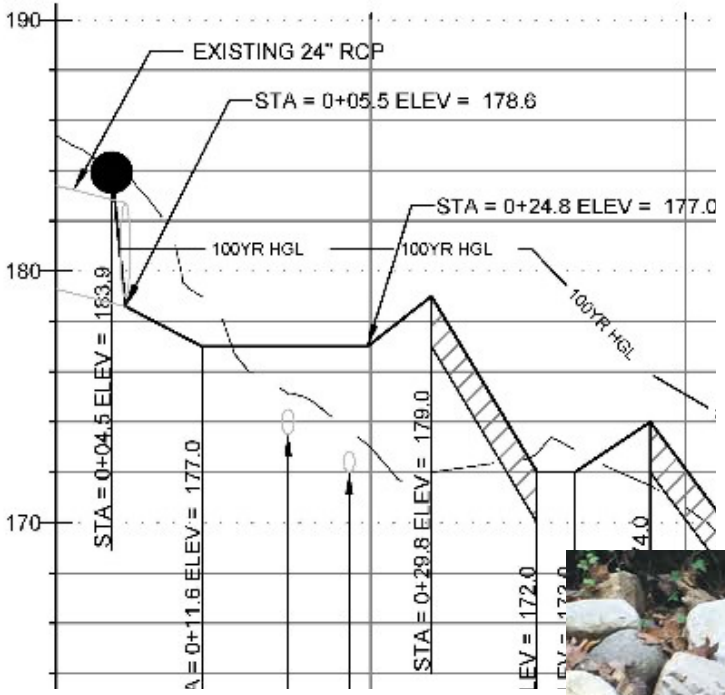
Alteration of Flow Path

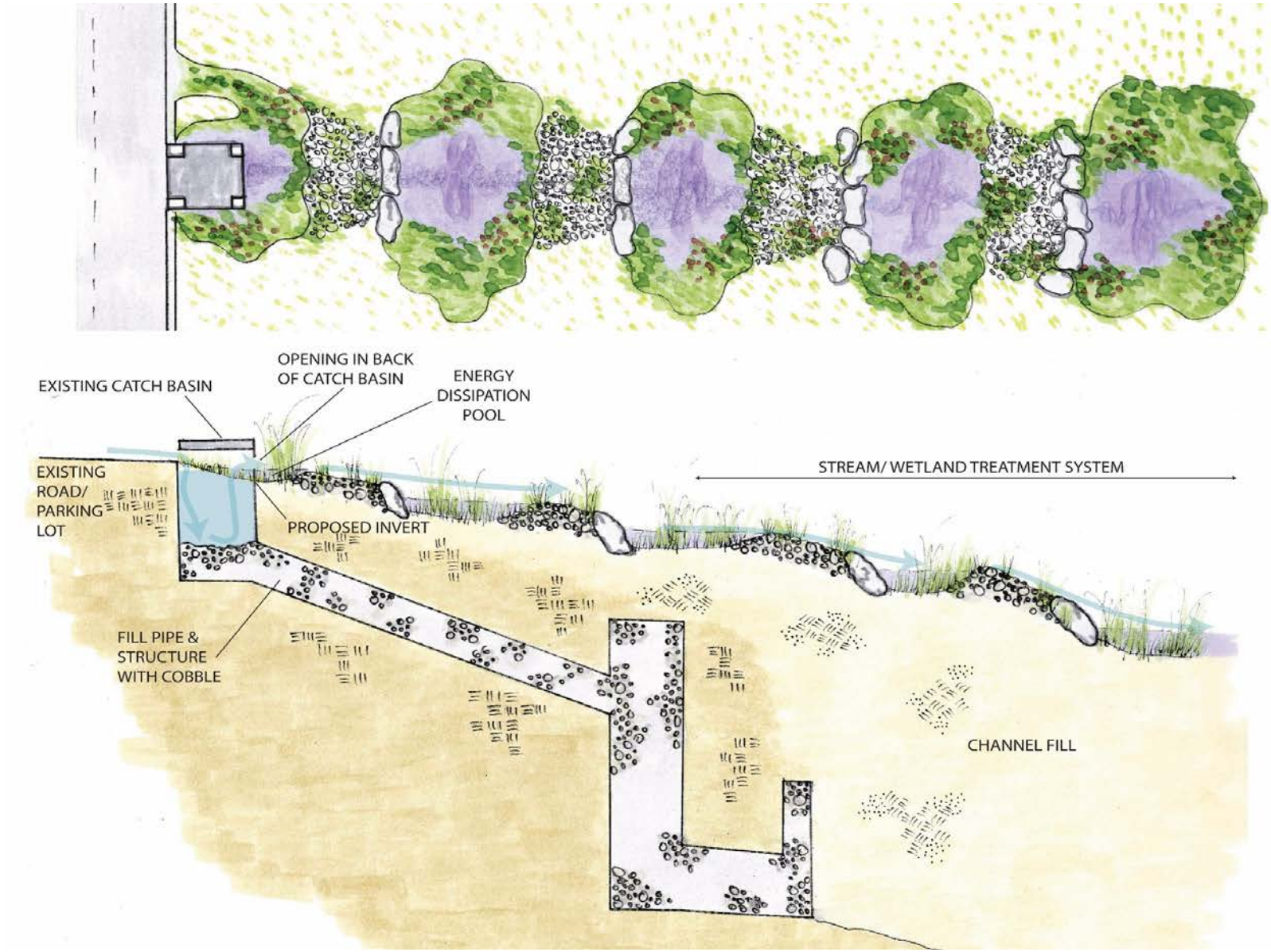


Floodplain Structures/Features

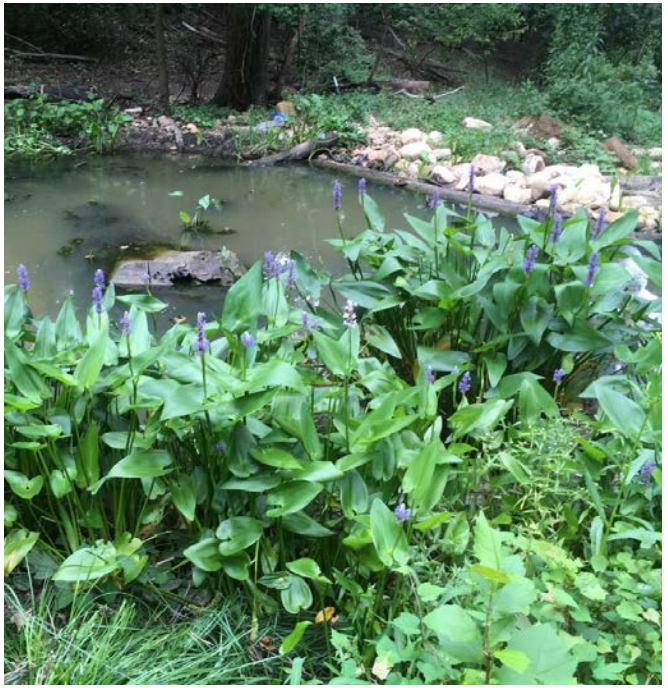

Seepage reservoir
Seepage berm / trail surface during construction

Inflow Devices/Practices



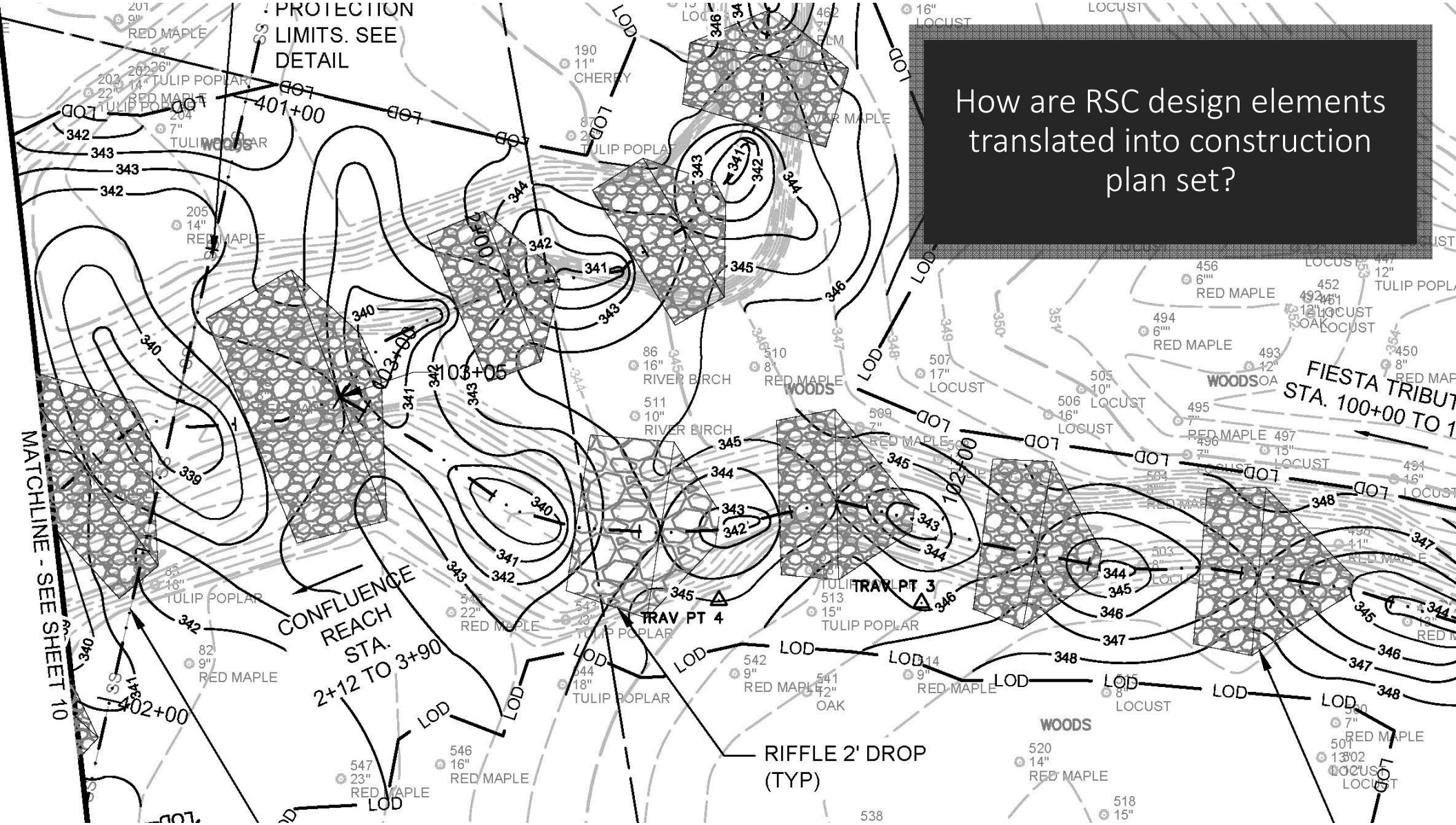

EXISTING CATCH BASIN
OPENING IN BACK OF CATCH BASIN
ENERGY DISSIPATION POOL
STREAM/ WETLAND TREATMENT SYSTEM
EXISTING ROAD/ PARKING LOT
PROPOSED INVERT
FILL PIPE & STRUCTURE WITH COBBLE
CHANNEL FILL

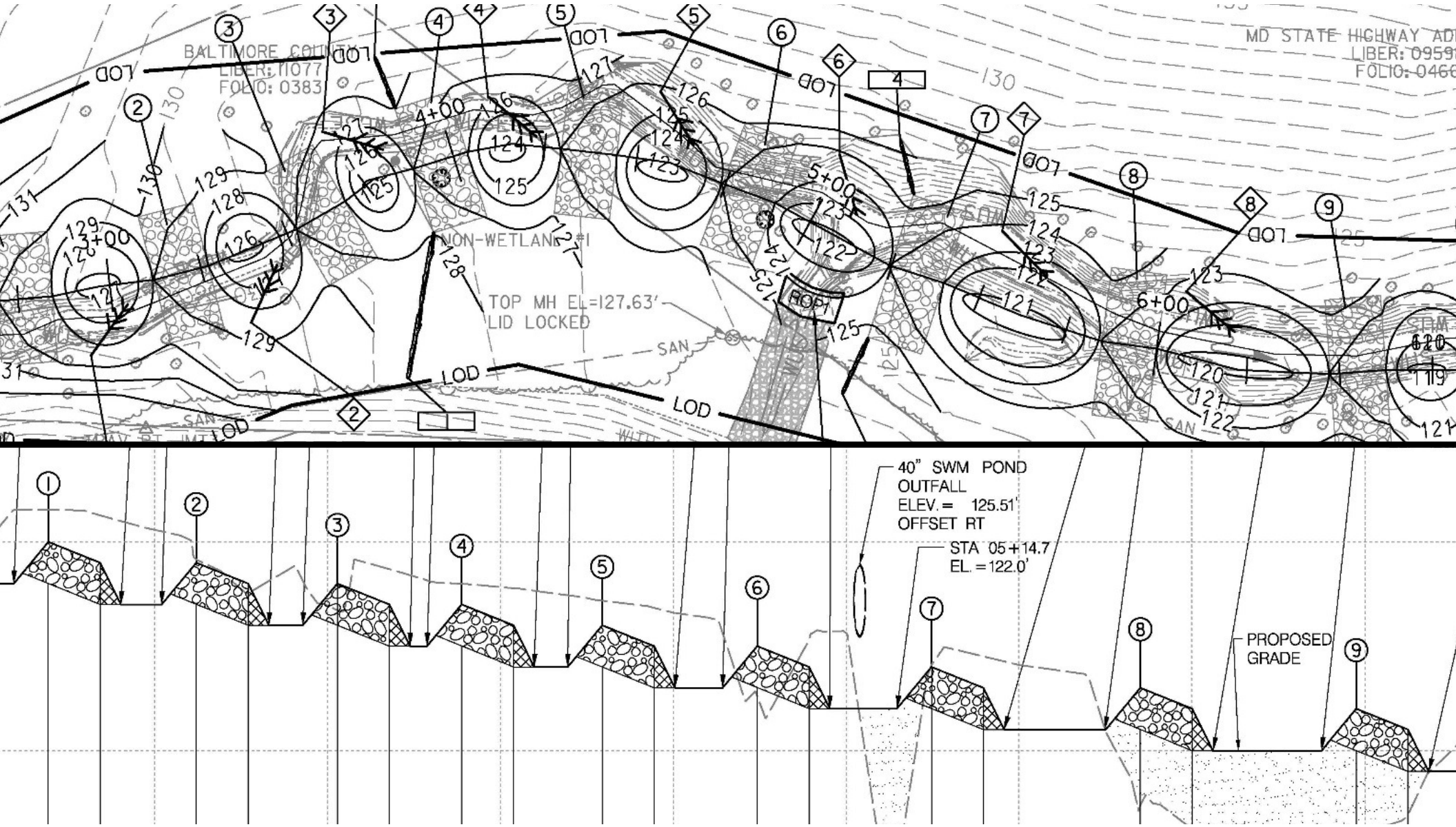




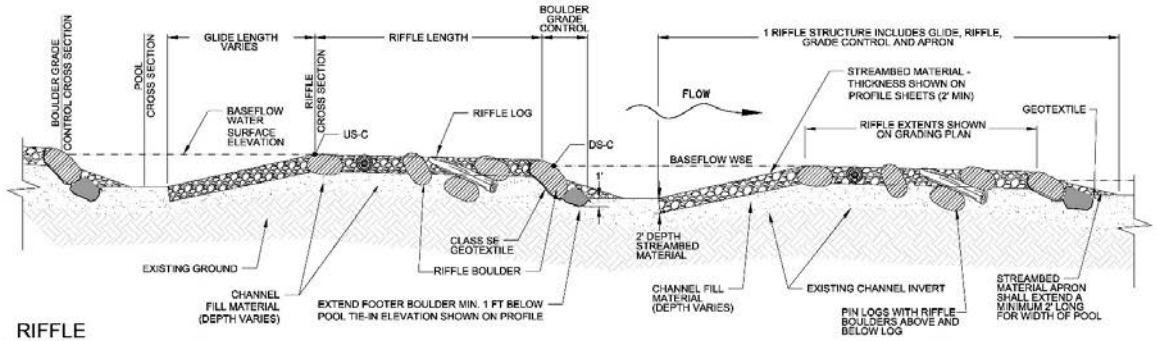
Planting Plans


Where in the landscape are RSCs appropriately applied? How does landscape position effect design?


How are RSC design elements translated into construction plan set?
PROTECTION LIMITS. SEE DETAIL
401+00
402+00
103+05
CONFLUENCE REACH STA. 2+12 TO 3+90
TRAV PT 3
TRAV PT 4
RIFFLE 2' DROP (TYP)
MATCHLINE - SEE SHEET 10
FIESTA TRIBUT
STA. 100+00 TO 1
LOD
WOODS

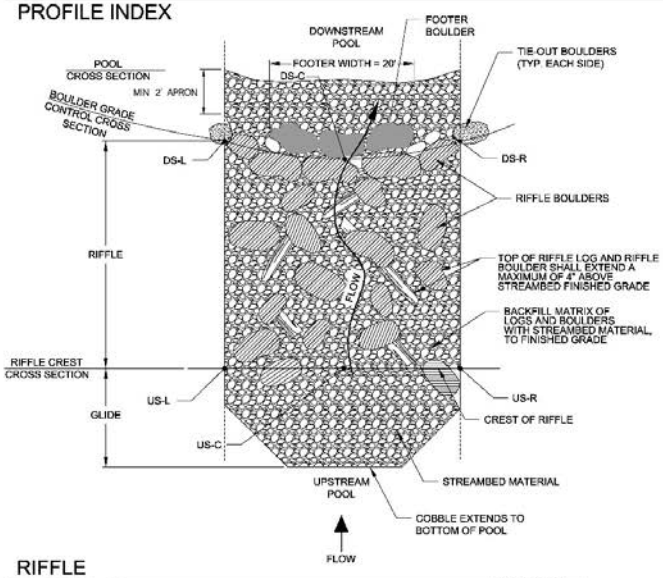

BALTIMORE COUNTY
LIBER: 11077
FOLIO: 0383
MD STATE HIGHWAY AD
LIBER: 0959
FOLIO: 0466
LOD
NON-WETLAND #1
TOP MH EL=127.63'
LID LOCKED
ROAD
SAN
STM
WATER
4+00
5+00
6+00

40" SWM POND
OUTFALL
ELEV.= 125.51'
OFFSET RT
STA 05+14.7
EL.=122.0'
PROPOSED
GRADE



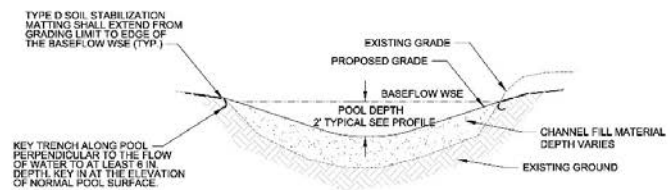
RIFFLE
PROFILE INDEX

NOT TO SCALE



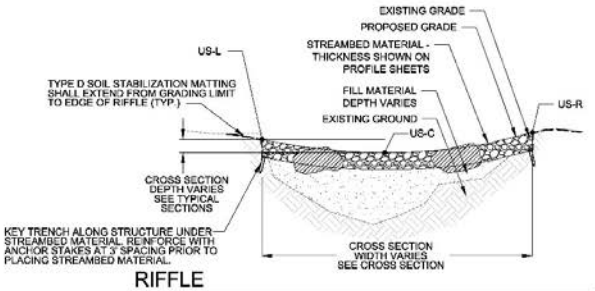
RIFFLE
PLAN VIEW

NOT TO SCALE



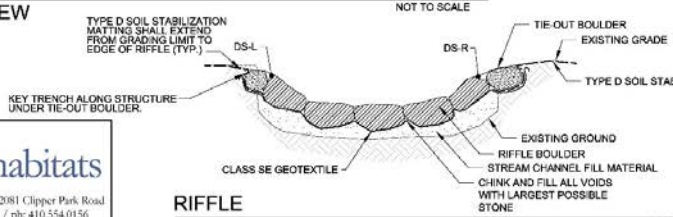
RIFFLE
POOL CROSS SECTION

NOT TO SCALE



RIFFLE
RIFFLE CREST CROSS SECTION

NOT TO SCALE



RIFFLE
BOULDER GRADE CONTROL CROSS SECTION

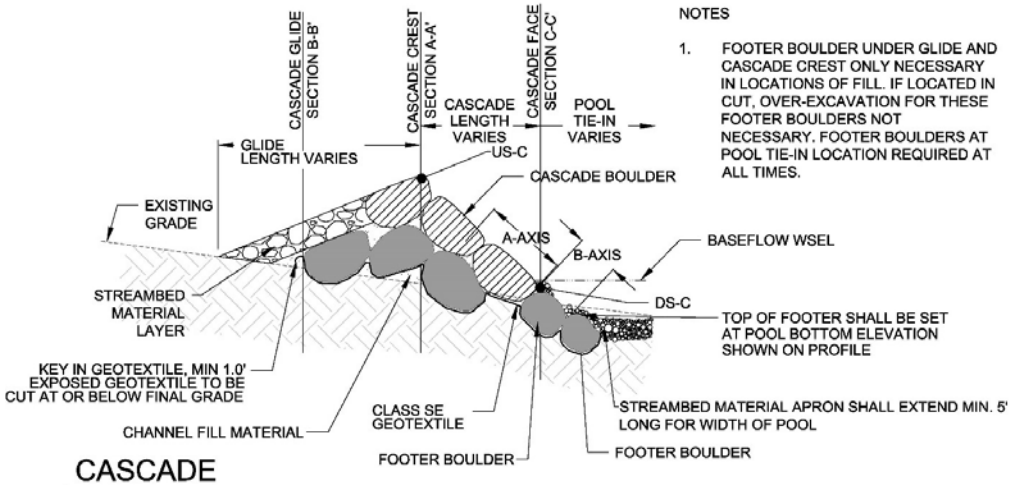
NOT TO SCALE

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

CROSS REFERENCE		RW PLAT NUMBER
ITEM	SHEET NOs.	
NOTES AND ABBREVIATIONS	2	
GEOMORPH PLAN	3	
TYPICAL SECTIONS	4	
TYPICAL DETAILS	5-7	
STREAM STABILIZATION PLAN	8	
STREAM PROFILE	9	
E&S NOTES, PLAN AND DETAILS	10-12	
LANDSCAPE PLAN AND DETAILS	13-14	
STREAM CROSS SECTIONS	15-17	

RIFFLE STRUCTURE TABLE

STRUCTURE ID	NODES	NORTHING	EASTING	ELEV	QTY. [EA]
1	US R	625321.91	1458584.23	~~131~~ 130.5	3
	US L	625323.35	1458601.67	~~131~~ 130.5	
	DS R	625305.53	1458568.02	130	1
	DS L	625308.40	1458602.90	130	
2	US R	625275.20	1458572.94	130	1
	US L	625283.88	1458606.85	130	
	DS R	625260.67	1458576.66	129	
	DS L	625269.34	1458610.56	129	
3	US R	625232.46	1458588.35	129	1
	US L	625249.94	1458618.67	129	
	DS R	625219.46	1458595.84	128	
	DS L	625236.94	1458626.17	128	
4	US R	625204.38	1458602.54	128	1
	US L	625214.79	1458635.96	128	
	DS R	625190.06	1458607.00	127	
	DS L	625200.46	1458640.42	127	
5	US R	625171.92	1458607.76	127	1
	US L	625167.99	1458642.54	127	
	DS R	625157.02	1458606.08	126	
	DS L	625153.08	1458640.86	126	
6	US R	625132.56	1458599.38	126	1
	US L	625120.41	1458632.20	126	
	DS R	625118.49	1458594.17	125	
	DS L	625106.34	1458626.99	125	
7	US R	625087.42	1458574.55	125.6	1
	US L	625075.25	1458612.65	125.6	
	DS R	625073.13	1458569.99	124.6	
	DS L	625060.96	1458608.09	124.6	
8	US R	625027.13	1458553.57	124.6	1
	US L	625021.81	1458593.21	124.6	
	DS R	625012.26	1458551.57	123.6	
	DS L	625006.94	1458591.21	123.6	
9	US R	624961.51	1458544.64	123.6	1
	US L	624964.43	1458584.53	123.6	
	DS R	624946.55	1458545.73	122.6	
	DS L	624949.47	1458585.62	122.6	
10	US R	624920.61	1458545.71	122.6	1
	US L	624923.53	1458585.60	122.6	
	DS R	624905.65	1458546.80	121.6	
	DS L	624908.57	1458586.70	121.6	
11	US R	624880.47	1458547.11	121.6	1
	US L	624875.27	1458586.77	121.6	
	DS R	624865.60	1458545.16	120.6	
	DS L	624860.40	1458584.82	120.6	

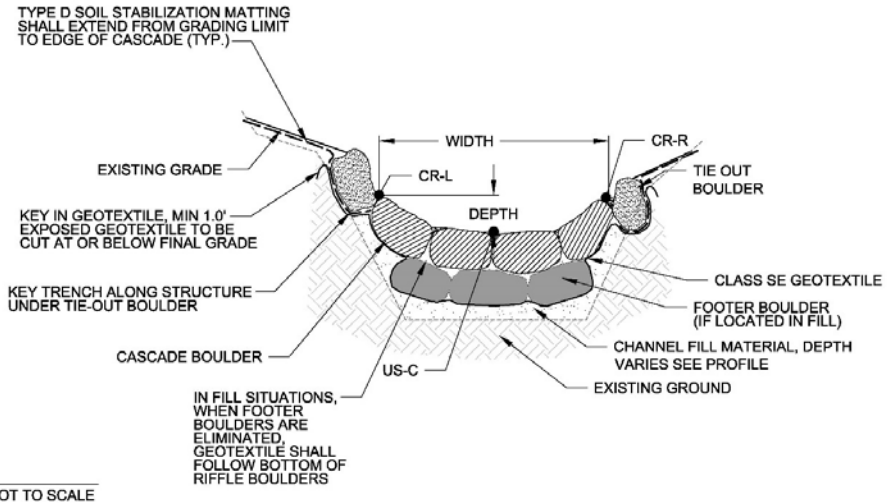


NOTES

1. FOOTER BOULDER UNDER GLIDE AND CASCADE CREST ONLY NECESSARY IN LOCATIONS OF FILL. IF LOCATED IN CUT, OVER-EXCAVATION FOR THESE FOOTER BOULDERS NOT NECESSARY. FOOTER BOULDERS AT POOL TIE-IN LOCATION REQUIRED AT ALL TIMES.

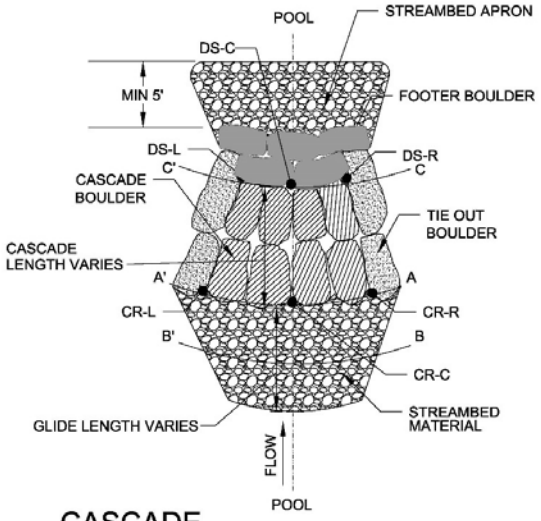
CASCADE
CENTERLINE PROFILE

NOT TO SCALE



CASCADE CREST
SECTION A-A'

NOT TO SCALE



NOTES:

1. GAPS BETWEEN BOULDERS SHALL BE CHINKED WITH STREAMBED MATERIAL.
2. TYPICALLY, CASCADE BOULDER A-AXIS WILL BE ORIENTED IN DIRECTION OF FLOW AND FOOTER BOULDER A-AXIS WILL BE ORIENTED PERPENDICULAR TO FLOW.
3. STREAMBED MATERIAL TO MEET GRADATION FOR D50=6", FOLLOWING GRADATION SHOWN ON RIFFLE DETAIL.
4. SEE TYPICAL SECTION FOR DEPTH AND WIDTH AT CASCADE CREST.
5. TYPICAL SECTION TO BE APPLIED THROUGHOUT LENGTH OF CASCADE.
6. NATURAL CHANNEL MATERIAL (IMPORTED OR SALVAGED MATERIAL) SHALL BE MIXED, WORKED IN, OR WASHED INTO THE FULL DEPTH OF THE STREAMBED MATERIAL TO THE SATISFACTION OF THE ENGINEER.
7. NATURAL CHANNEL MATERIAL SHALL MEET REQUIREMENTS PROVIDED IN SPECIFICATION.

CASCADE
PLAN VIEW

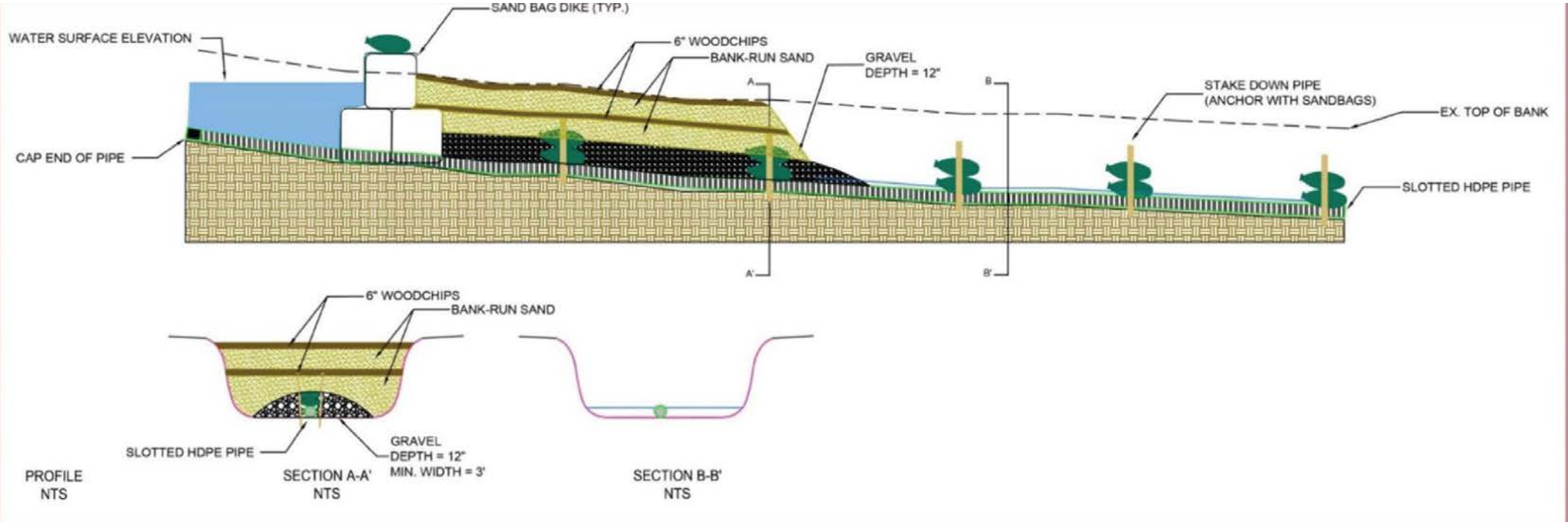
NOT TO SCALE

KEY IN GEOTEXTILE, MIN
EXPOSED GEOTEXTILE T
CUT AT OR BELOW FINAL

BOULDER DIMENSIONS (FT)			
	A-AXIS	B-AXIS	C-AXIS
CASCADE	4.2-4.7	3.8-4.3	2.6-3.1
FOOTER	4.2-4.7	3.8-4.3	2.6-3.1
TIE-OUT	3.8-4.3	3.2-3.7	2.0-2.5

CASCADE

Construction Access - Sequencing is critical for sites with only one way in



What did I miss?

Specifications

Cost Estimates

Construction Coordination and Adaptive Management

Questions?