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res

Water Resource Center
Southwestern Pennsylvania Commission

COST/BENEFIT COMPARISON OF THE COMMON MS4 BMPs

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NOVEMBER 15, 2022

AGENDA

- Intro to speakers
- BMP experiences
- Stream restoration
- BMP cost comparison
- Tips
- Q&A

RES INTRO

"RES", or Resource Environmental Solutions (www.res.us) is the largest ecological restoration company in the nation (and state)

Pioneered the ecological offset market in PA, though our full-delivery, guaranteed outcome business model

Ecological offsets include wetland/stream mitigation (and mitigation banking), endangered species banking, design-build-operate-maintain MS4 BMPs

Over 60 miles of stream and 400 acres of wetland restoration in PA alone, over 2,000 acres under active conservation and stewardship (in under 10 years)

What drives ecological offsets?

Compensatory Mitigation Requirements

"Classic" wetland, stream, endangered species offsets for project impacts

Environmental Lawsuits

Regulatory and/or legal settlements for compliance and enforcement actions

Water Quality/ Stormwater Offsets

Restoration to satisfy governmental (and DOT's) compliance for TMDL's, CSO Consent Decrees, MS4, etc.

Corporate Sustainability

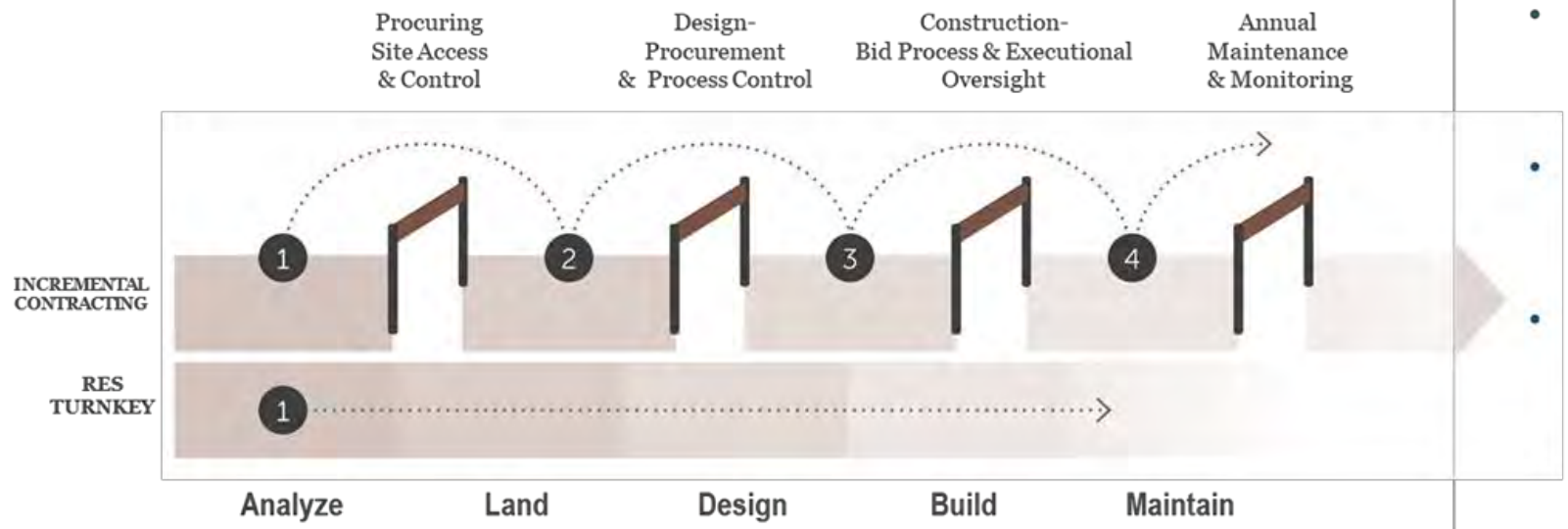
Private companies engaging in voluntary restoration for greater public good, creating positive environmental benefits.

The Power of RES' "Fully Scaled" Approach

Transfer of Financial and Regulatory Risk

- Single contract makes RES responsible for all phases
- Guarantee delivery, of the 'product,' on time, on budget

Each 'hurdle' adds cost and opportunity for error



Faster implementation and lower cost

Results = Top-notch restoration on the ground

- 607 miles of streams
- 75,000 acres of restoration
- 292 tons of nutrient/ water quality improvement
- 23 million trees planted

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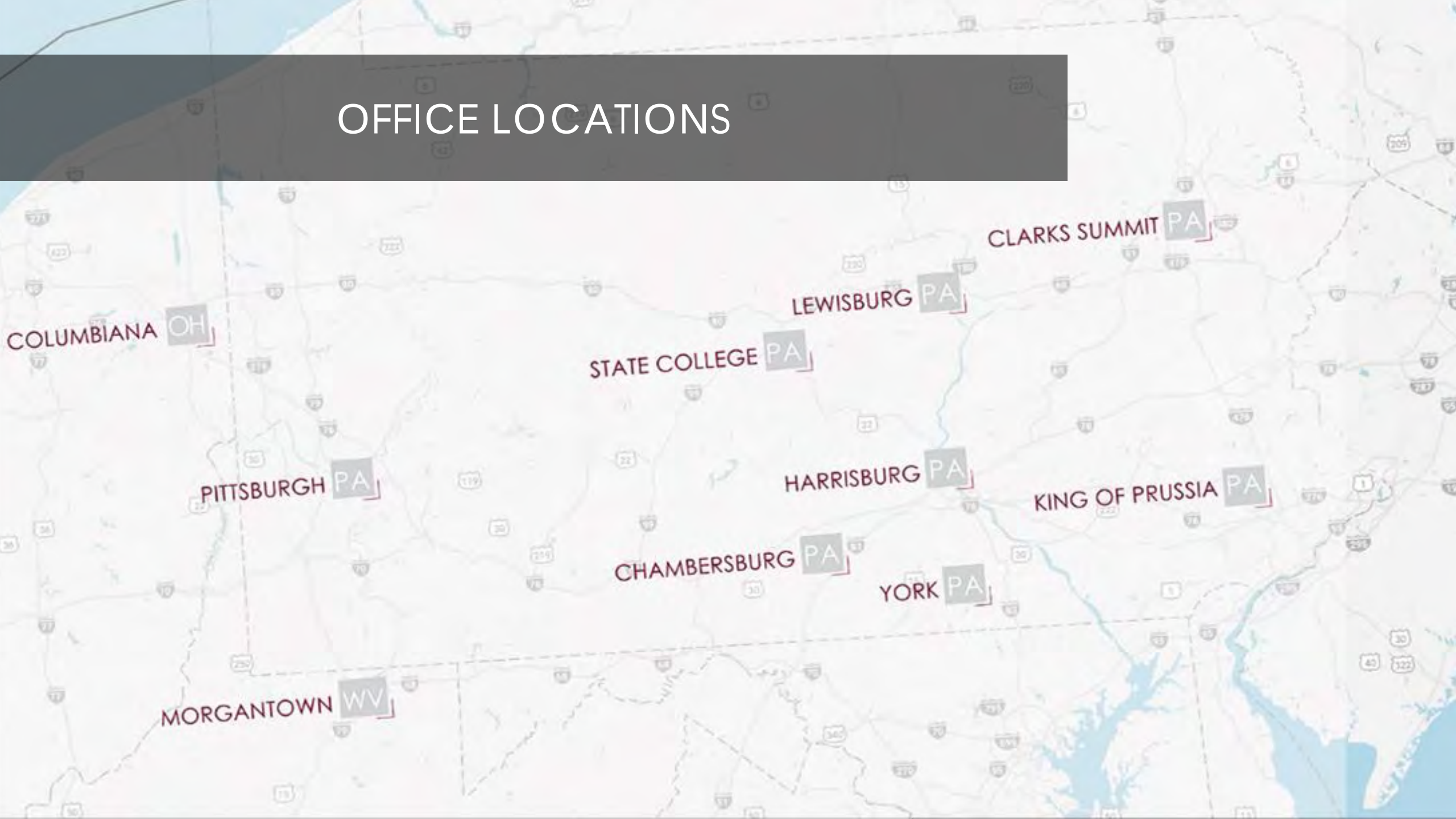
OFFICE LOCATIONS



My Background

RAIN GARDEN THAT WENT BAD - 2017

RAIN GARDEN THAT WENT BAD - 2017

RAIN GARDEN THAT WENT BAD

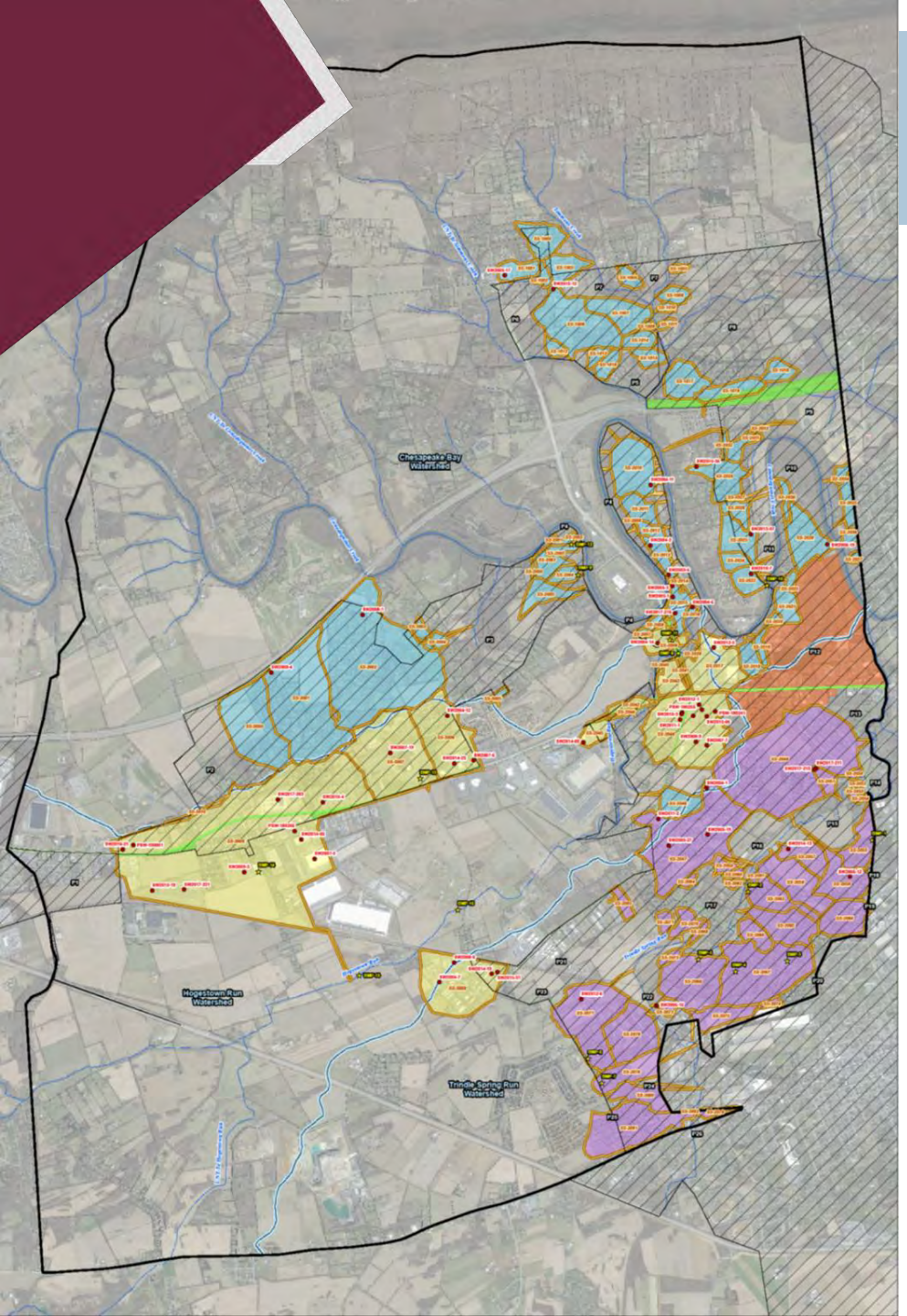
SHOPE GARDENS - 1 AC. DA

POST-CONSTRUCTION

GREENFIELD PARK BASIN RETROFIT - 20 AC. DA

GREENFIELD PARK RAIN GARDEN RETROFIT

GREENFIELD PARK RAIN GARDEN RETROFIT



MS4 Permit Requirements & Planning

- Must reduce sediment by 216,119 lbs per year by 2023

- Revise CBRP to
  - complete projects on township-owned properties where possible
  - Build in redundancy (so that adjustments can be made that meet reduction requirements)

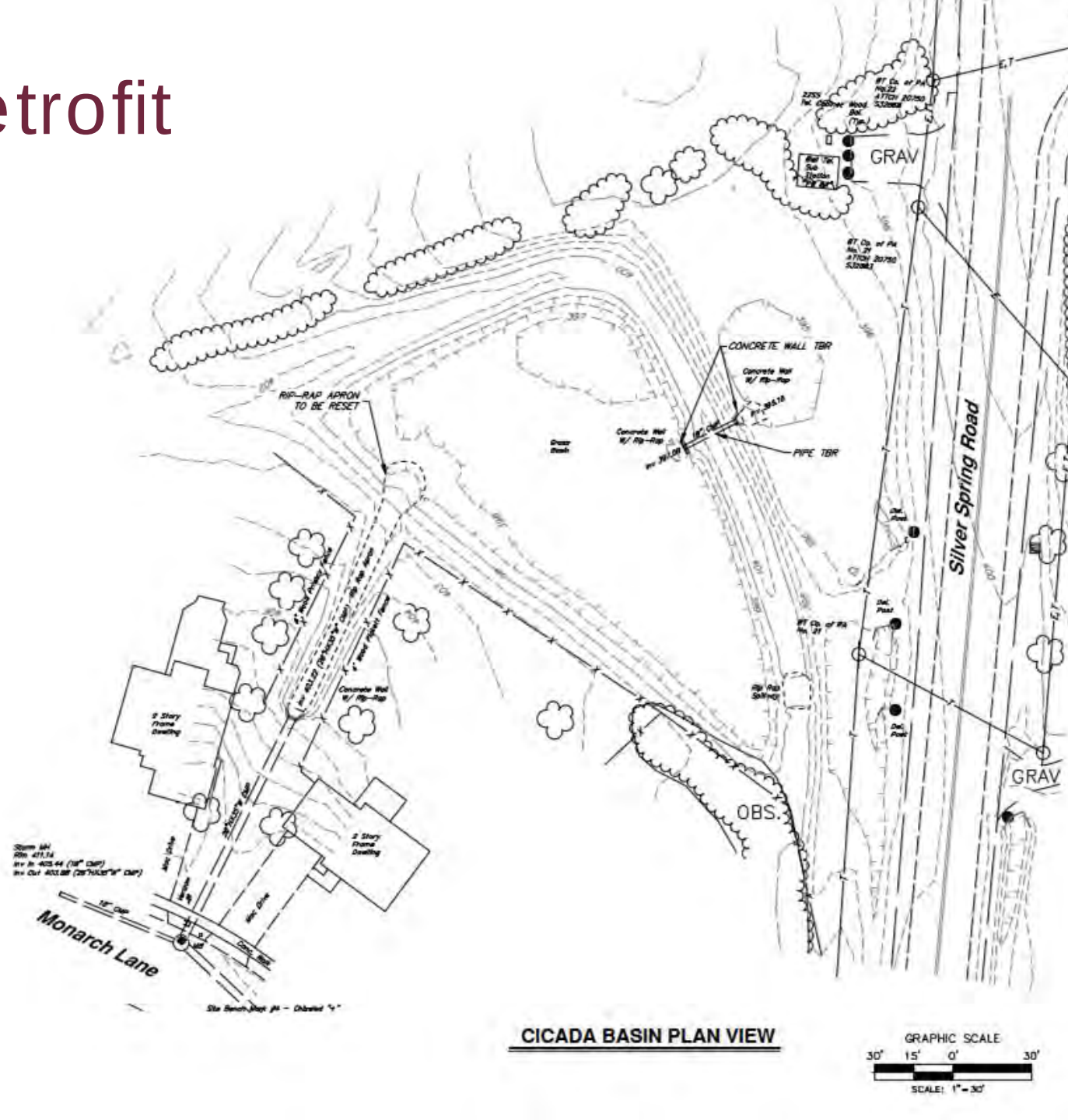
Chesapeake Bay Pollutant Reduction Plan

Table 7: Silver Spring Township Proposed BMP Summary

Project Site	BMP ID	BMP Type	Planning Area	Size (acres unless otherwise noted)	Drainage Area (acres)	Load Reduction TSS (lbs/yr)
Cicada Hill Detention Basin	BMP-1	Basin Retrofit	Trindle Spring Run	0.45	6.8	9,130
Konhaus Estates Royal Palm Drive N Detention Basin	BMP-6	Basin Retrofit	Trindle Spring Run	0.43	113.8	2,423
Konhaus Estates South Detention Basin	BMP-7	Basin Retrofit	Trindle Spring Run	0.32	12.19	3,759
Silver Spring Twp Building	BMP-11	Basin Retrofit	CBPRP	0.18	2.3	908

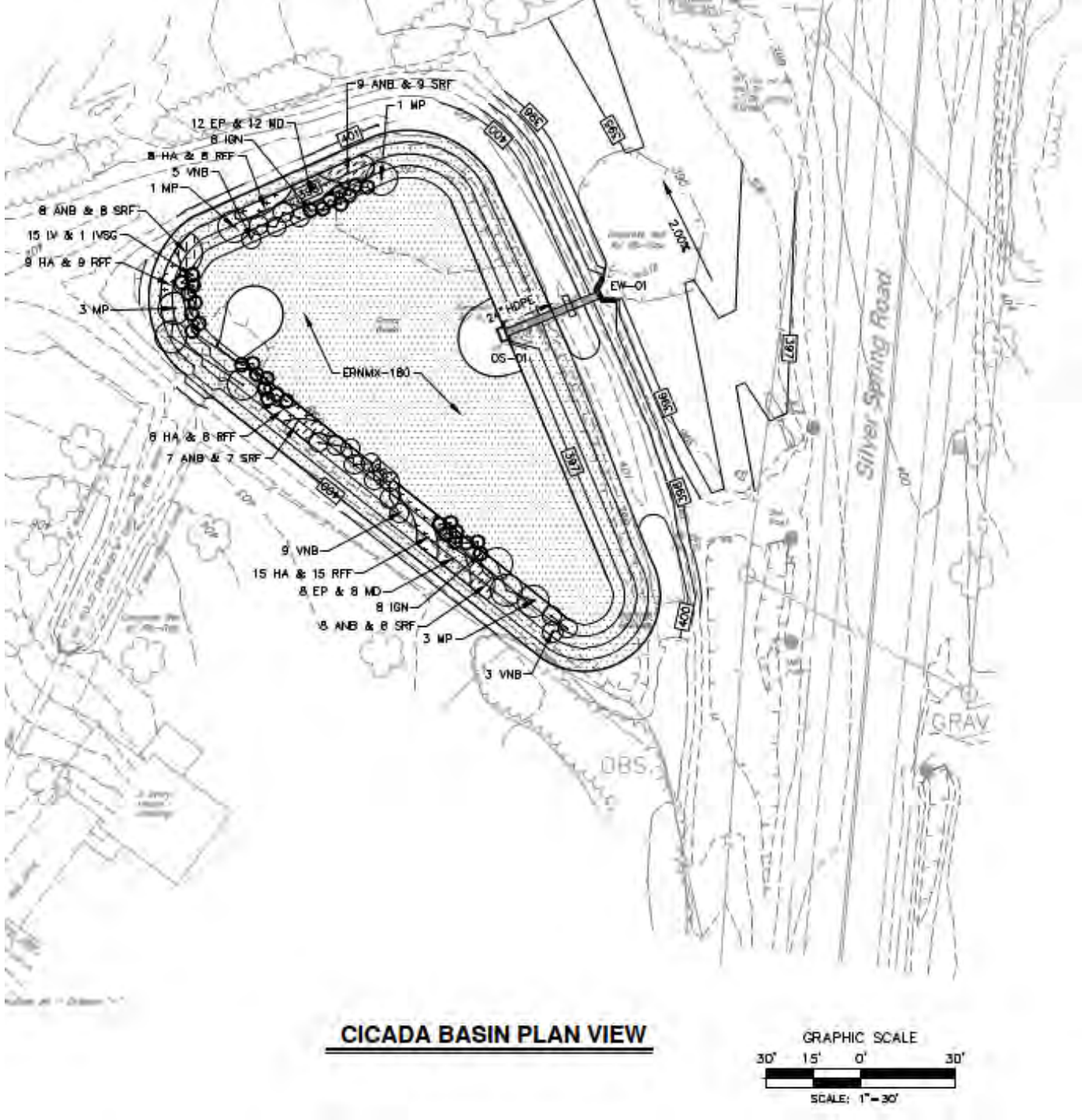
Cicada Basin Retrofit

- Existing basin in a residential subdivision
- Concrete end wall with no orifice plate (no small storm rate/volume control)
- Minor sediment reduction potential (10% reduction)
- Issues with no positive drainage at outlet
- Spillway discharges to access point off Silver Spring Road



Cicada Basin Retrofit

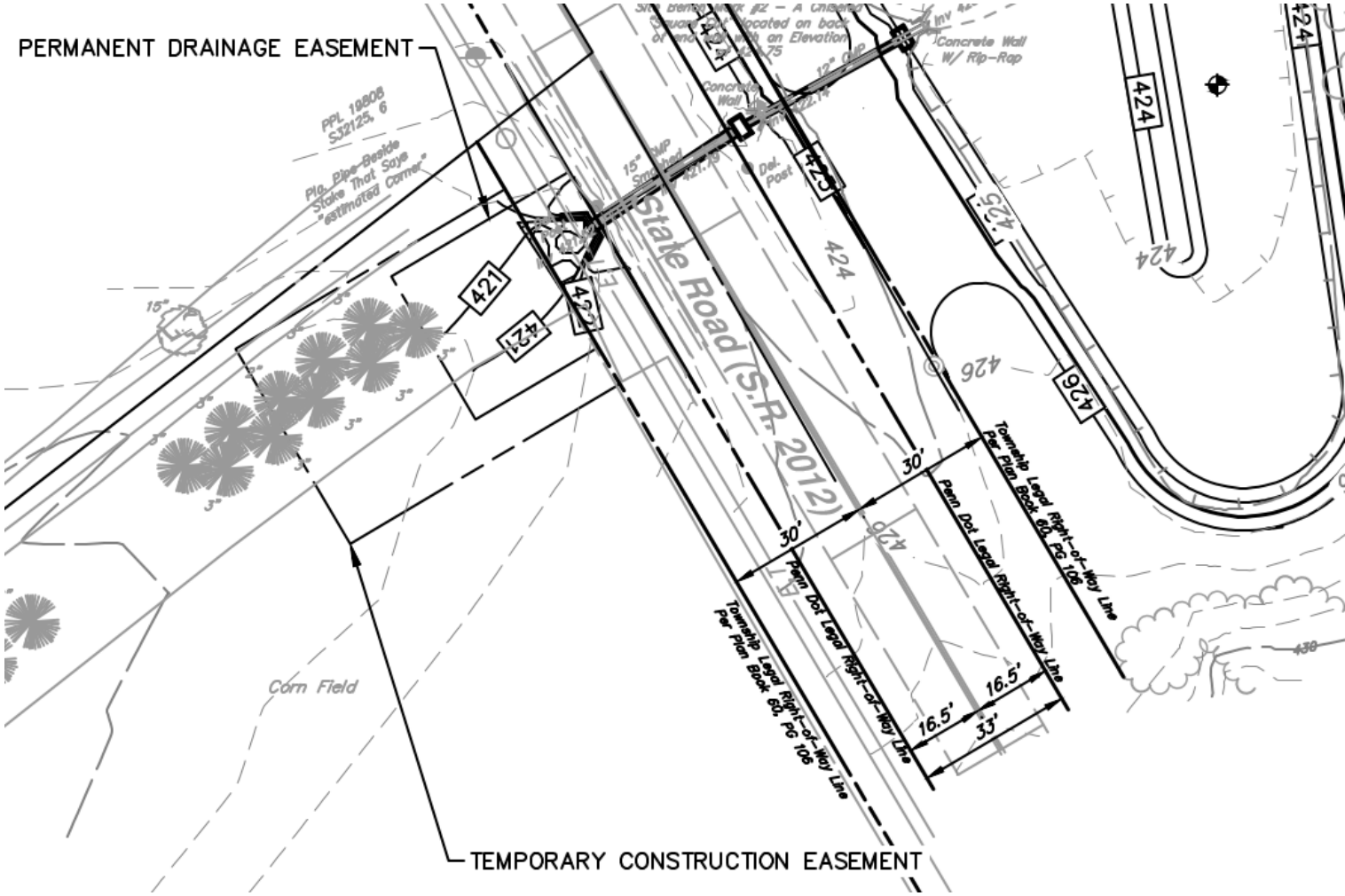
- Improve spillway and shift to a more favorable discharge location
- Add outlet structure
- Increase storage in basin
- Restore positive drainage
- Amended soils and landscape plantings



Cicada Basin Retrofit

Lessons Learned: Easement Acquisition

Work through all required easements as early in the process as you can (preferably as soon as the concept is finalized).



RIPARIAN BUFFER PLANTINGS

- Pros
  - Inexpensive upfront
  - Good opportunity for community engagement
  - Substantial long-term benefit from improved, diverse riparian buffers (pollinators, biodiversity, etc.)

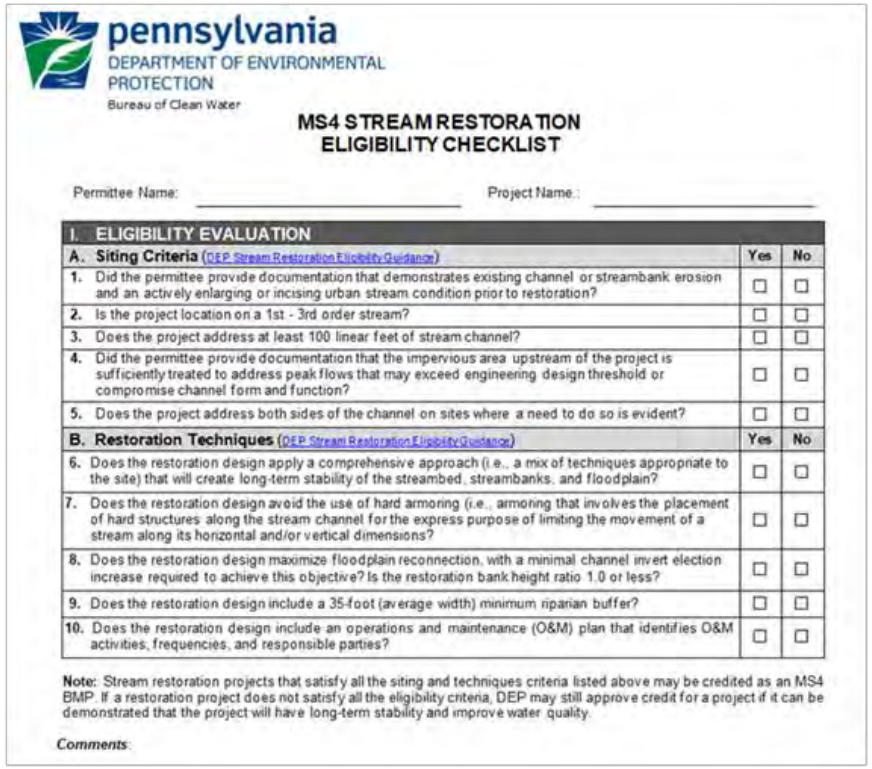
RIPARIAN BUFFER PLANTINGS

- Cons
  - Produces relatively little MS4 credit
  - May require land or easement acquisition
  - Invasive species, deer browse, flooding, mowing all present challenges to success
  - Requires extensive maintenance and replanting to achieve success
  - Plantings/tubes are unable to stabilize highly eroded/impaired watersheds

RIPARIAN BUFFER PLANTINGS

STREAM RESTORATION

- Stream Restoration Project Checklists
  - Minimum criteria for eligibility
  - Default or Expert Panel Checklists to guide MS4 credit eligibility



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Clean Water

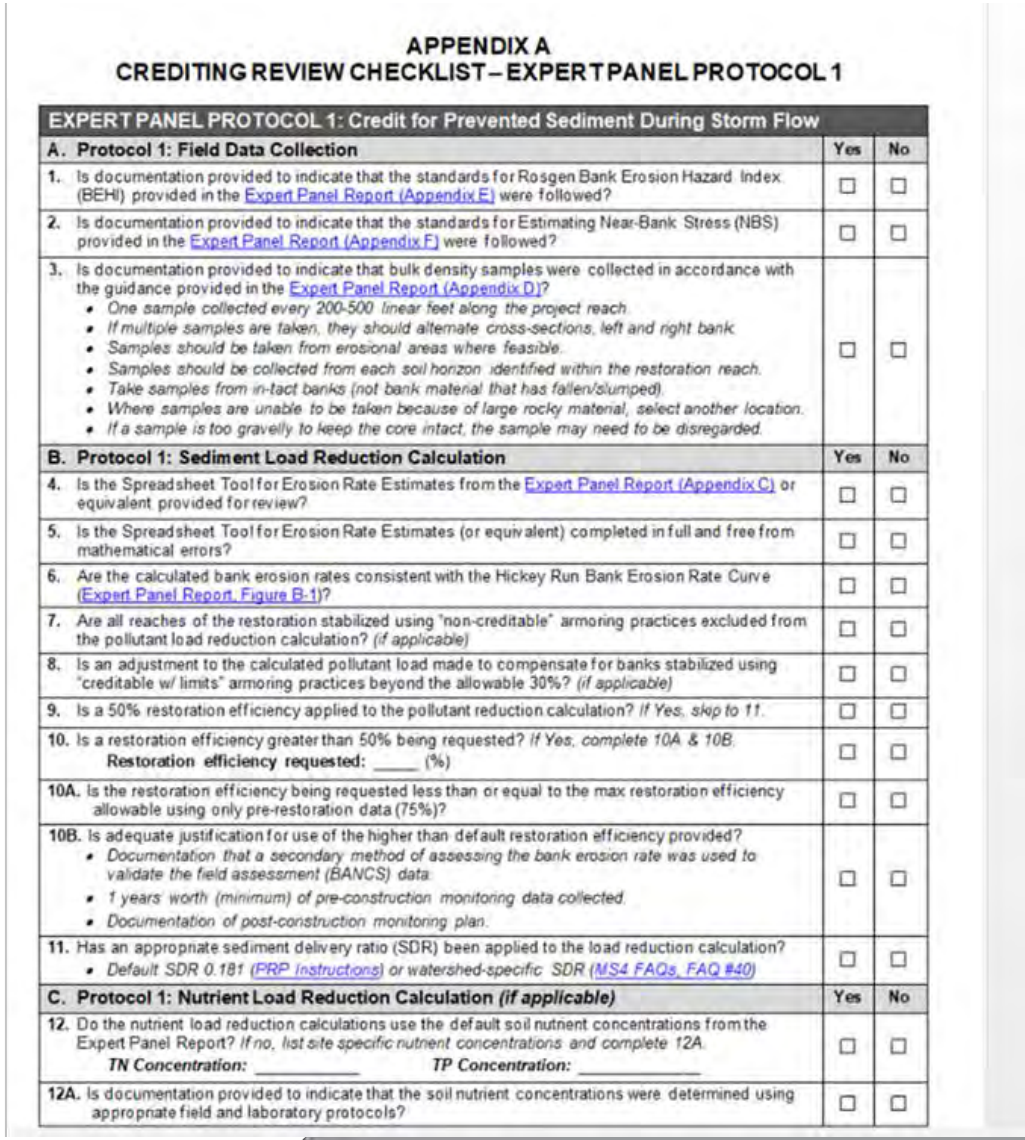
MS4 STREAM RESTORATION ELIGIBILITY CHECKLIST

Permittee Name: _____ Project Name: _____

I. ELIGIBILITY EVALUATION		
A. Siting Criteria (DEP Stream Restoration Eligibility Guidance)	**Yes**	**No**
1. Did the permittee provide documentation that demonstrates existing channel or streambank erosion and an actively enlarging or incising urban stream condition prior to restoration?	☐	☐
2. Is the project location on a 1st - 3rd order stream?	☐	☐
3. Does the project address at least 100 linear feet of stream channel?	☐	☐
4. Did the permittee provide documentation that the impervious area upstream of the project is sufficiently treated to address peak flows that may exceed engineering design threshold or compromise channel form and function?	☐	☐
5. Does the project address both sides of the channel on sites where a need to do so is evident?	☐	☐
B. Restoration Techniques (DEP Stream Restoration Eligibility Guidance)	**Yes**	**No**
6. Does the restoration design apply a comprehensive approach (i.e., a mix of techniques appropriate to the site) that will create long-term stability of the streambed, streambanks, and floodplain?	☐	☐
7. Does the restoration design avoid the use of hard armoring (i.e., armoring that involves the placement of hard structures along the stream channel for the express purpose of limiting the movement of a stream along its horizontal and/or vertical dimensions?	☐	☐
8. Does the restoration design maximize floodplain reconnection, with a minimal channel invert election increase required to achieve this objective? Is the restoration bank height ratio 1.0 or less?	☐	☐
9. Does the restoration design include a 35-foot (average width) minimum riparian buffer?	☐	☐
10. Does the restoration design include an operations and maintenance (O&M) plan that identifies O&M activities, frequencies, and responsible parties?	☐	☐

Note: Stream restoration projects that satisfy all the siting and techniques criteria listed above may be credited as an MS4 BMP. If a restoration project does not satisfy all the eligibility criteria, DEP may still approve credit for a project if it can be demonstrated that the project will have long-term stability and improve water quality.

Comments:



APPENDIX A
CREDITING REVIEW CHECKLIST – EXPERT PANEL PROTOCOL 1

EXPERT PANEL PROTOCOL 1: Credit for Prevented Sediment During Storm Flow		
A. Protocol 1: Field Data Collection	**Yes**	**No**
1. Is documentation provided to indicate that the standards for Rosgen Bank Erosion Hazard Index (BEHI) provided in the Expert Panel Report (Appendix E) were followed?	☐	☐
2. Is documentation provided to indicate that the standards for Estimating Near-Bank Stress (NBS) provided in the Expert Panel Report (Appendix F) were followed?	☐	☐
3. Is documentation provided to indicate that bulk density samples were collected in accordance with the guidance provided in the Expert Panel Report (Appendix D)? • *One sample collected every 200-500 linear feet along the project reach.* • *If multiple samples are taken, they should alternate cross-sections, left and right bank.* • *Samples should be taken from erosional areas where feasible.* • *Samples should be collected from each soil horizon identified within the restoration reach.* • *Take samples from in-tact banks (not bank material that has fallen/slumped).* • *Where samples are unable to be taken because of large rocky material, select another location.* • *If a sample is too gravelly to keep the core intact, the sample may need to be disregarded.*	☐	☐
B. Protocol 1: Sediment Load Reduction Calculation	**Yes**	**No**
4. Is the Spreadsheet Tool for Erosion Rate Estimates from the Expert Panel Report (Appendix C) or equivalent provided for review?	☐	☐
5. Is the Spreadsheet Tool for Erosion Rate Estimates (or equivalent) completed in full and free from mathematical errors?	☐	☐
6. Are the calculated bank erosion rates consistent with the Hickey Run Bank Erosion Rate Curve (Expert Panel Report, Figure B-1)?	☐	☐
7. Are all reaches of the restoration stabilized using "non-creditable" armoring practices excluded from the pollutant load reduction calculation? *(if applicable)*	☐	☐
8. Is an adjustment to the calculated pollutant load made to compensate for banks stabilized using "creditable w/ limits" armoring practices beyond the allowable 30%? *(if applicable)*	☐	☐
9. Is a 50% restoration efficiency applied to the pollutant reduction calculation? *If Yes, skip to 11.*	☐	☐
10. Is a restoration efficiency greater than 50% being requested? *If Yes, complete 10A & 10B.* **Restoration efficiency requested:** _____ (%)	☐	☐
10A. Is the restoration efficiency being requested less than or equal to the max restoration efficiency allowable using only pre-restoration data (75%)?	☐	☐
10B. Is adequate justification for use of the higher than default restoration efficiency provided? • *Documentation that a secondary method of assessing the bank erosion rate was used to validate the field assessment (BANCS) data.* • *1 years worth (minimum) of pre-construction monitoring data collected.* • *Documentation of post-construction monitoring plan.*	☐	☐
11. Has an appropriate sediment delivery ratio (SDR) been applied to the load reduction calculation? • *Default SDR 0.181 (PRP Instructions) or watershed-specific SDR (MS4 FAQs, FAQ #40)*	☐	☐
C. Protocol 1: Nutrient Load Reduction Calculation *(if applicable)*	**Yes**	**No**
12. Do the nutrient load reduction calculations use the default soil nutrient concentrations from the Expert Panel Report? *If no, list site specific nutrient concentrations and complete 12A.* ***TN Concentration:*** _____ ***TP Concentration:*** _____	☐	☐
12A. Is documentation provided to indicate that the soil nutrient concentrations were determined using appropriate field and laboratory protocols?	☐	☐

STREAM RESTORATION - FLOODPLAIN APPROACH

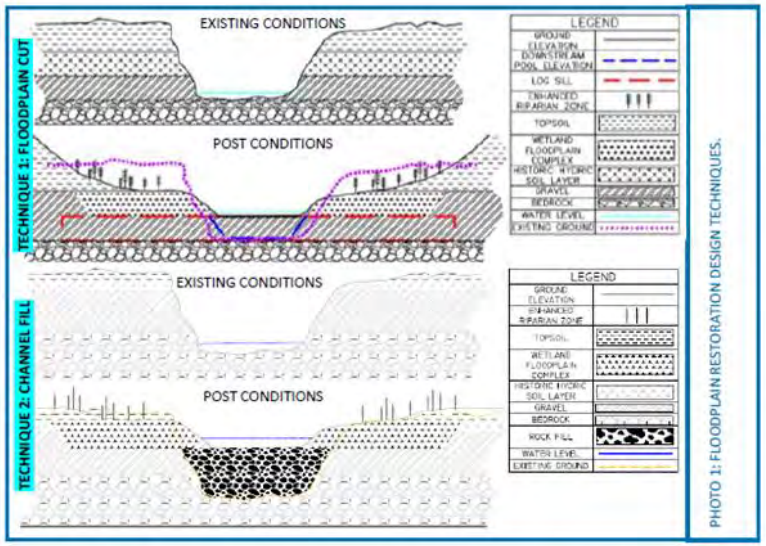


PHOTO 1: FLOODPLAIN RESTORATION DESIGN TECHNIQUES.

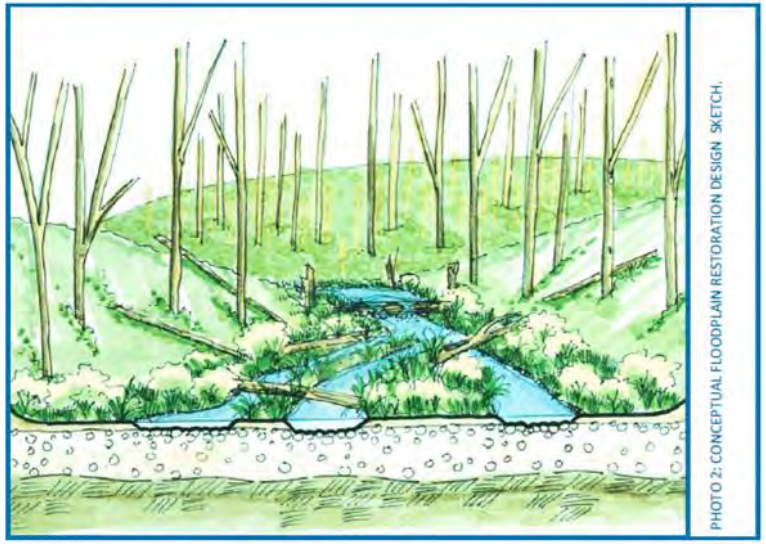


PHOTO 2: CONCEPTUAL FLOODPLAIN RESTORATION DESIGN SKETCH.


PHOTO 3: RES LARGE SCALE RESTORATION PROJECT OVERVIEW PERSPECTIVE USING FLOODPLAIN RESTORATION DESIGN TECHNIQUES.


PHOTO 4: RES LARGE SCALE RESTORATION PROJECT HABITAT PERSPECTIVE USING FLOODPLAIN RESTORATION DESIGN TECHNIQUES.

CONCEPTUAL DESIGN STRATEGIES/APPEARENCE

- Revised channel geometry through designing a new valley bottom and a new stream channel in all areas
- Low bank heights will result in regular overbank events into the floodplain
  - → Reduced shear stress and velocity values
  - → Reduced erosion
  - → Increased resiliency, storage and filtration during high flow events
  - → Increased habitat diversity (instream and floodplain)
- Maximizes sediment reduction potential and retention in wetlands

STREAM RESTORATION - FLOODPLAIN APPROACH

STREAM RESTORATION

- Pros
  - Cost-effective (highest credit producing BMP)
  - Lower-cost long-term operations and maintenance (if designed/constructed well)
  - Secondary benefits: recreational, ecological, educational

- Cons
  - Typically higher design/construction costs compared to other BMPs
  - Challenging to site correctly (if good sites exist in your muni!)
  - Land acquisition often required, and can get sticky
  - Requires specialized contractors, IE the low-bidder may not be qualified

DEER RUN STREAM RESTORATION

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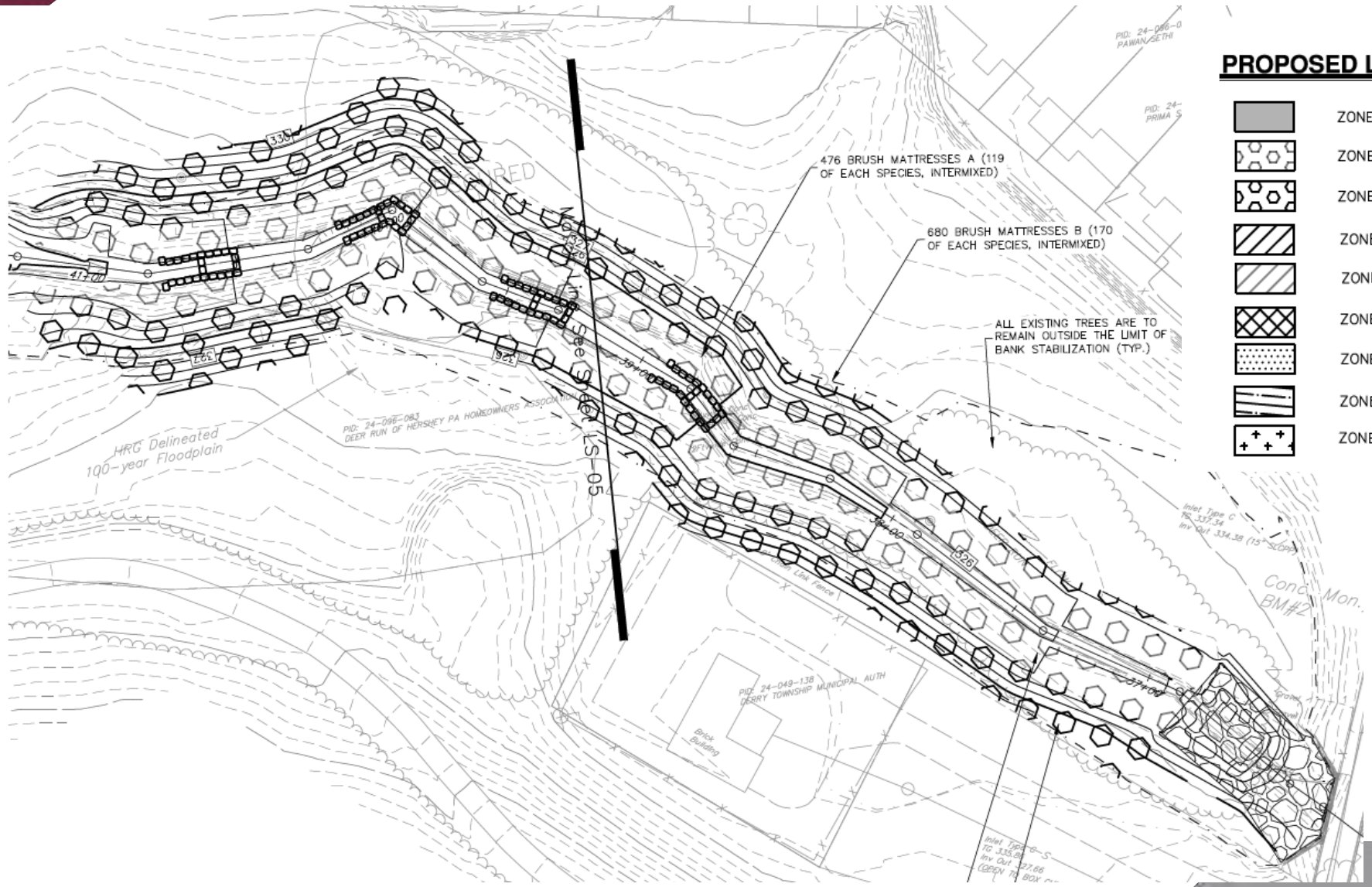


DEER RUN STREAM RESTORATION

PENNDOT PARTNERSHIP – PAXTON CREEK, DAUPHIN COUNTY

- "Design-build-operate-maintain" contract seeking most lbs of sediment reduction for $2M contract value
- Proposed unit costs ranged from $3.49/lb to $12.77/lb, with RES the low-bid (equating to 573,066 lbs)
- Funded by PennDOT and three municipal partners (Susquehanna and Lower Paxton Townships, and Capital Region Water)
- Contracted September 2020
- Designed/permitting/constructed in 2021

PENNDOT PARTNERSHIP – PAXTON CREEK, DAUPHIN COUNTY

Pre-Construction

PENNDOT PARTNERSHIP – PAXTON CREEK, DAUPHIN COUNTY

Post-construction

BMP OVERALL COST COMPARISON

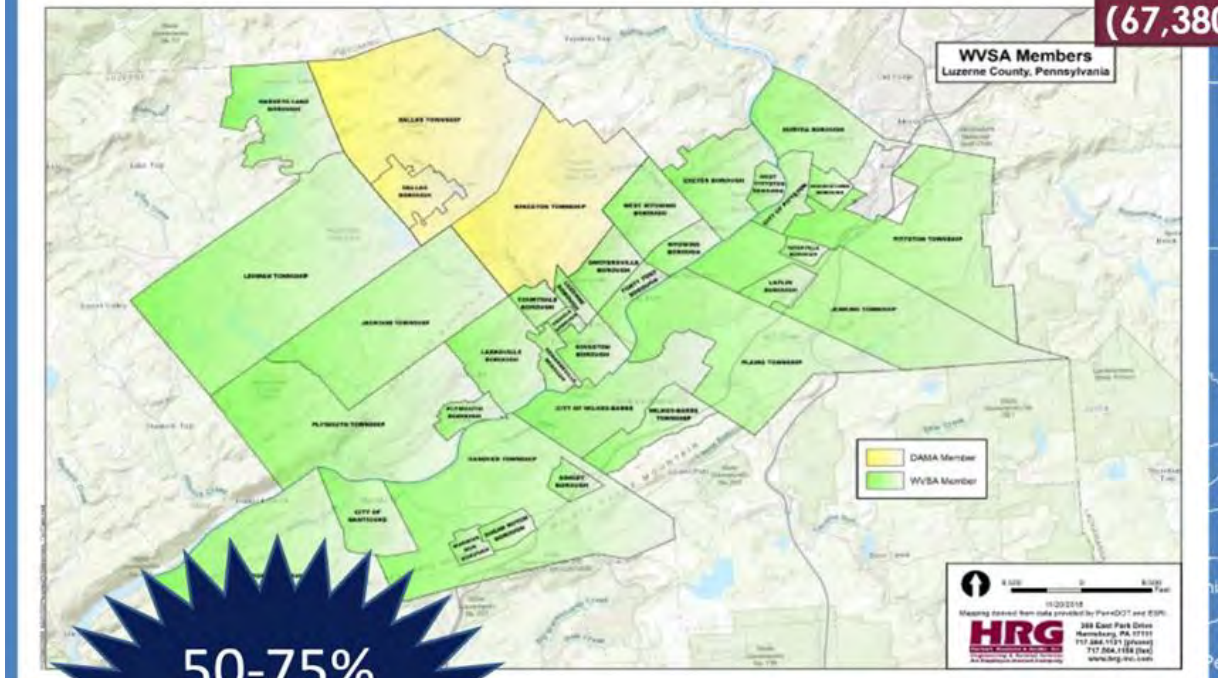
Project	BMP Type	Pounds	Cost	$/lb
Shope Gardens	Rain Garden	1,500	$160,000	$106
Greenfield	Detention Basin Retrofit	4,500	$120,000	$27
Cicada Hill	Detention Basin Retrofit	9,100	$110,000	$12
Konhaus North	Detention Basin Retrofit	2,400	$130,000	$54
Konhaus South	Detention Basin Retrofit	3,800	$103,000	$27
Township Building	Detention Basin Retrofit	900	$5,000	$6
Deer Run	Stream Restoration - one off	483,000	$2.5M	$5.18
Ohio Watershed	Stream Restoration	484,485	$1.73 M	$5.21
Paxton Creek	Stream Restoration - large scale	573,066	$2.0 M	$3.49
Delaware Watershed	Stream Restoration	1,013,650	$4.0 M	$2.05
Chesapeake Bay	Stream Restoration - large scale	1,282,051	$2.5 M	$1.95

Thank you!

REGIONAL STORMWATER

THIRTY-TWO MUNICIPALITIES SAVE

Average Residential Monthly Fee - $4.80
(67,380) Residential Accounts)



50-75% cost savings

Wyoming Valley Sanitary Authority
Established in 2019
Annual Revenue: $8.4M
5-Year CIP: $21M

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COST-EFFECTIVE BMP TIPS

- Site Selection
  - Stream and floodplain restoration is the most cost-effective BMP to obtain large scale sediment reductions
  - Paying a private landowner for an easement can be better than 'free' public land
- Know the Life-Cycle of the Project
  - What is the true cost of 1-2 years of design/permitting and then 5 years of maintenance, and what is the long-term management cost? A sustainable restoration BMP should require minimal/no long-term management
  - Avoid paying to 'replace' that BMP in your next MS4 permit cycle
- **What does the Ideal BMP looks like…**
  - At least 1,000-2,000 linear feet in length (a 100-200 foot stream bank armoring to protect sewerline may NOT COUNT!)
  - The 'right' amount to impairment (routine 3-5 foot eroding vertical banks) but not too large
- The Right Team for the Entire Project
  - Include construction experts in site selection and BMP cost development so you know the BMP will work
  - Include qualification requirements or bonding in construction procurement?
- Know the Evolving Regulations
  - The fundamental calculation of load reduction for stream restoration = (average bank height) x (average lateral erosion rate) x (bulk density) x (sediment delivery ratio, or SDR) x (reduction efficiency) (EACH VARIABLE IS IMPORTANT!)

CONTACT INFO

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Thank you!