MS4 Stream Restoration BMPs: A Turnkey Implementor's Perspective (and Creative Partnerships)

September 2022

Agenda

- Introduction to Alternative Project Delivery Approaches
  - “Full-delivery”, “Turnkey”, “Performance-based” terminology
  - Full-delivery implementors vs consultants and contractors
- Developing the Most Cost-effective BMPs
  - Top Things Implementors Look For
- Stream Restoration for MS4 Credit
- Sinking Spring Pilot MS4 Project Case Study
- Paxton Creek Municipal Partnership Case Study
- Creative Partnerships
- Question and Answer

Project Delivery Methods

- **Design–Bid–Build**
  - Traditional project delivery with multiple contracts = relatively intense administration
- **Design–Build** & **Engineering–Procurement–Construction (EPC)**
  - Separate contracts for land acquisition, design/construction, and operations
  - Can accelerate the project development phase
- **Full-Delivery**
  - A single contract to acquire the real estate (site), develop, and operate the project up to a future regulatory closeout
  - A "product" is delivered, in the form of a measure of performance
  - Guaranteed regulatory compliance, transfer of liability
  - Typically includes **5-10 years (or more)** of guaranteed performance

Full-Delivery Project Delivery is also referred to as:

- "Turnkey"
- **"Design, Build, Operate, Maintain (DBOM)"**
- "Pay for Performance"
- "Performance Based"

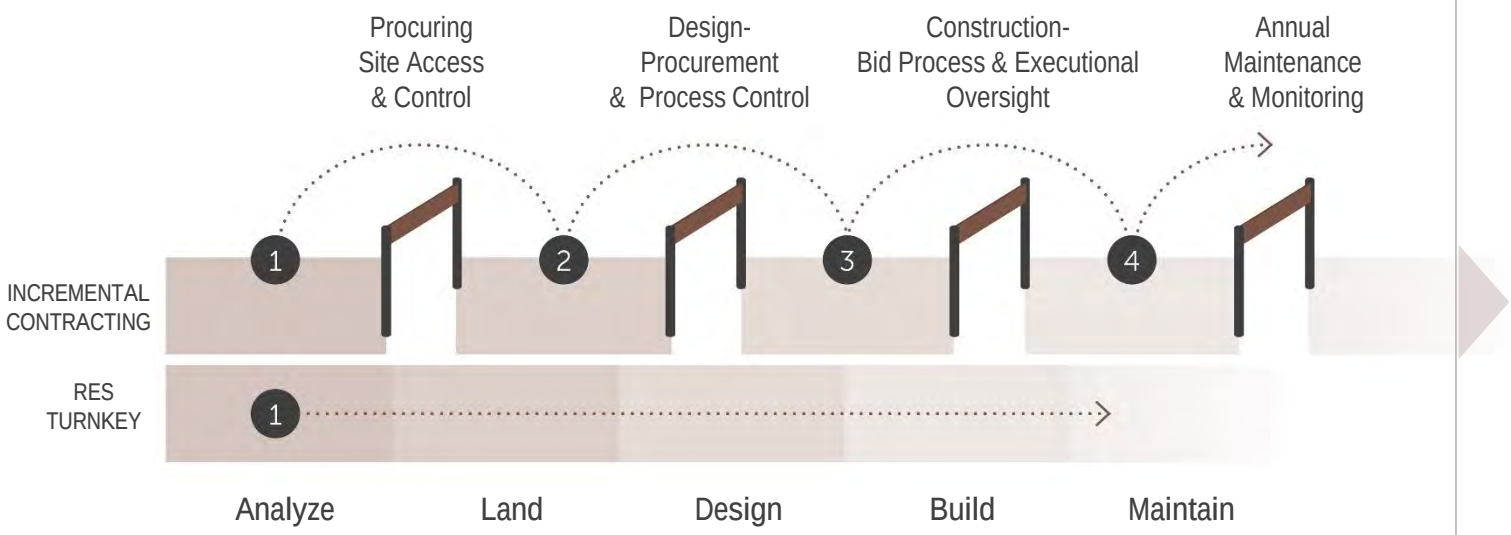
21st Century Challenge Requires 21st Century Solutions

The Power of the “Full-Delivery” 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

Pennsylvania-alone

- Over 60 miles of stream
- Over 400 acres of wetland
- Over 600 acres of species habitats

Ecological Offset Markets using Full-delivery

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, often with performance 'scores' from investors

Key Topics for Full-delivery MS4 BMPs

- What are you paying for? Scope (sediment reduction credits vs services)
- Public vs. private land
  - Goal= most cost-effective BMP
- Duration of contract vs. life of the BMP
- Typical BMPs for sediment reductions
- Easement vs. maintenance agreement
- Payment milestones vs. monthly invoices
- Financial assurances
- Provisions for long-term maintenance

Developing Cost-effective BMPs

- **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 often is better than ‘free’ public land
  - Asset-protection project is probably not the best sediment reduction project
- **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
  - Who’s paying to fix the restoration if it gets blown out during a fall hurricane?
  - The right stream restoration project is likely the most resilient BMP, with the lowest long-term management costs
- **Ideal Stream BMP looks like…**
  - At least 1,000-2,000 linear feet in length (a 100-200 foot stream bank stabilization may NOT COUNT!)
  - The ‘right’ amount to impairment (routine 3-5 foot eroding vertical banks)
  - But not too large (mainstem of Chartiers Creek for example)

Developing Cost-effective BMPs, continued

- **The Right Team for the Entire Project**
  - Include construction experts in site selection and BMP cost development so you know the BMP is buildable and avoid the engineer vs contractor dynamic
  - Identify infrastructure that will impact design/construction with the utilities
- **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 can have major implications on the BMP's reductions
  - Example: October 2019 DEP guidance allowed flexibility watershed-specific SDR, making some BMP's much more cost-effective
  - Different restoration approaches can lead to different efficiencies

Stream Restoration BMPs for MS4 Credit

- **Regulatory Framework**
  - PA DEP PRP Instructions
    - Existing Loading Calculation Methodology for Planning Area
      - Simplified Method vs. local watershed scale models
      - Chesapeake Bay Expert Panel Protocols vs Default Rate
        - Site-specific load reduction calculated using Expert Panel Protocols
  - Stream Restoration Project Checklists
    - Minimum criteria for eligibility
  - Expert Panel Protocols
    - Methods and Guidance for calculating site-specific loading and potential reduction for restoration BMP

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?	☐	☐

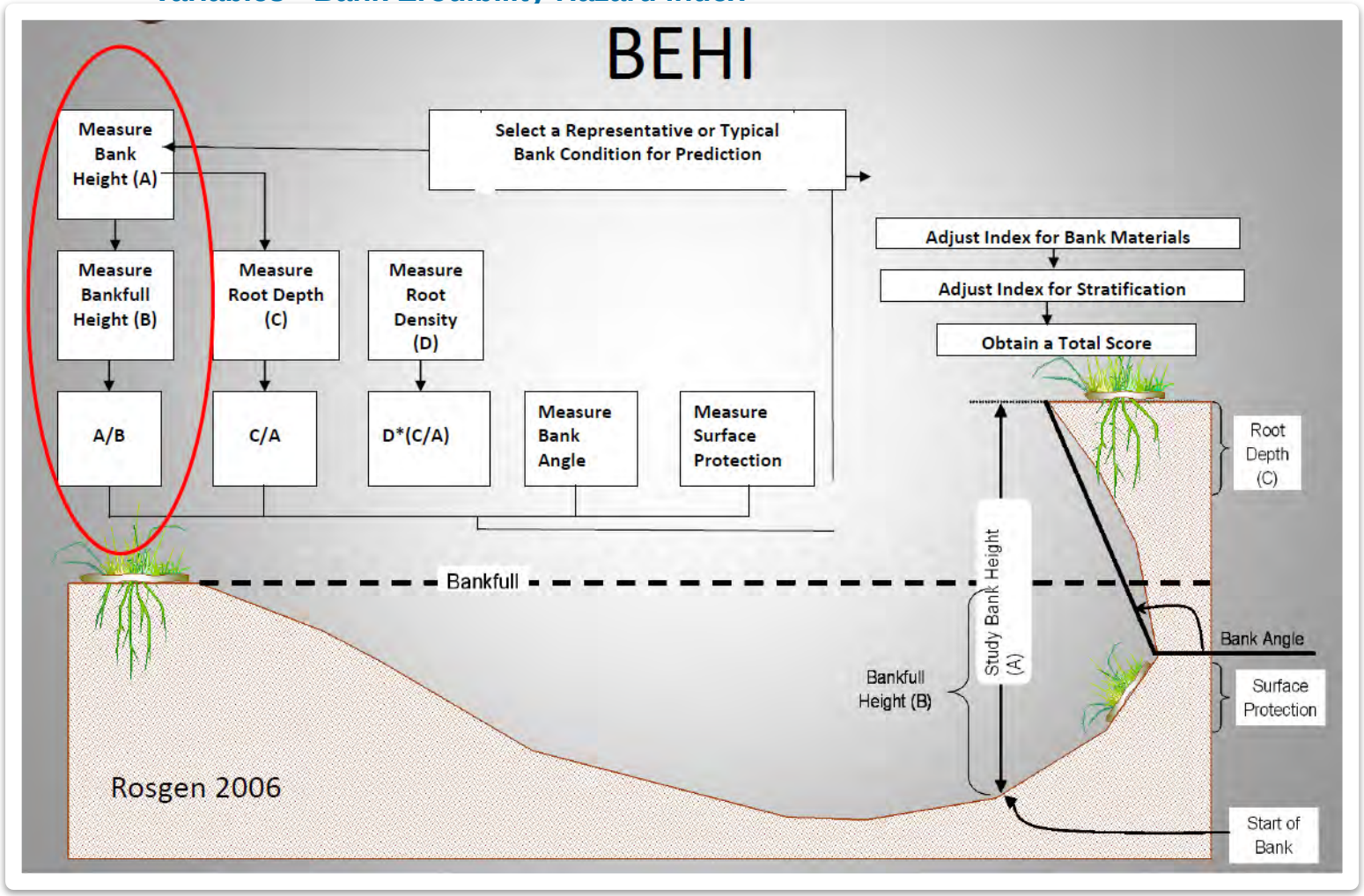
Note: Stream restoration projects that satisfy all the siting and techniques criteria listed above may be credited as an MS4 BMP. If a restoration project does not satisfy all the eligibility criteria, DEP may still approve credit for a project if it can be demonstrated that the project will have long-term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

Comments:

Site Selection for Expert Panel Protocols

Rosegen's BANCS Model

Variables - Bank Erodibility Hazard Index



Site Selection for Expert Panel Protocols

Variables Near Bank Stress

- Estimation of bank stress associated with bankfull flows
- Method depends on site conditions

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1) Transverse and/or central bars-short and/or discontinuous.....NBS = High / Very High
Extensive deposition (continuous, cross-channel).....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

(2)				
Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)	

(3)				
Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)	Dominant Near-Bank Stress

(4)			
Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

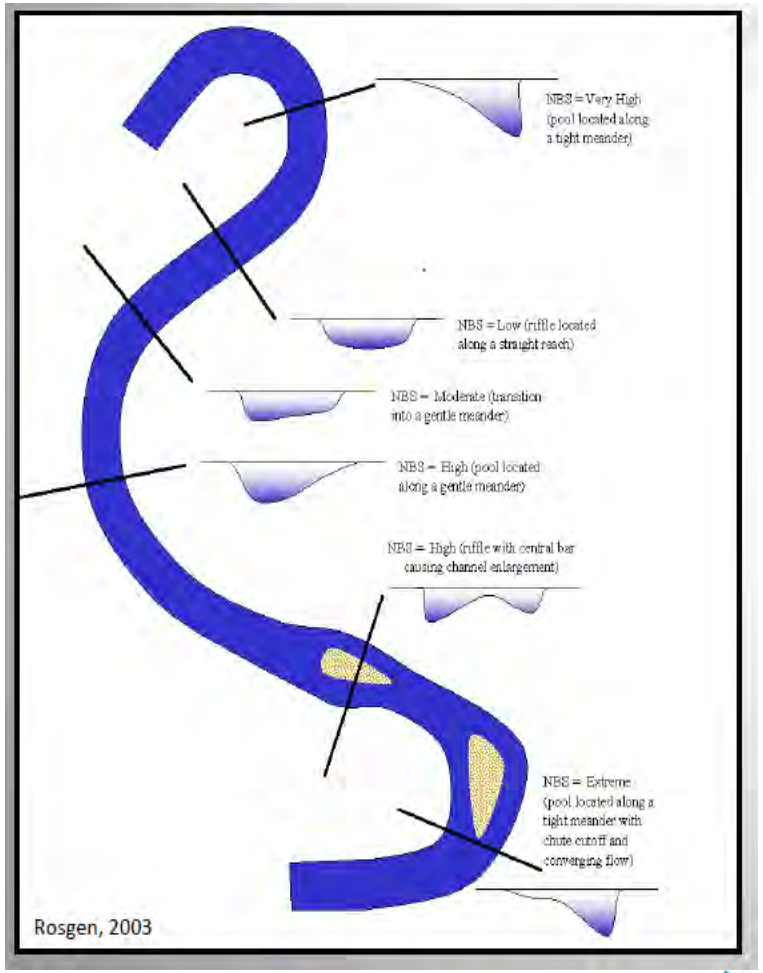
Level III

(5)			
Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)							
Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

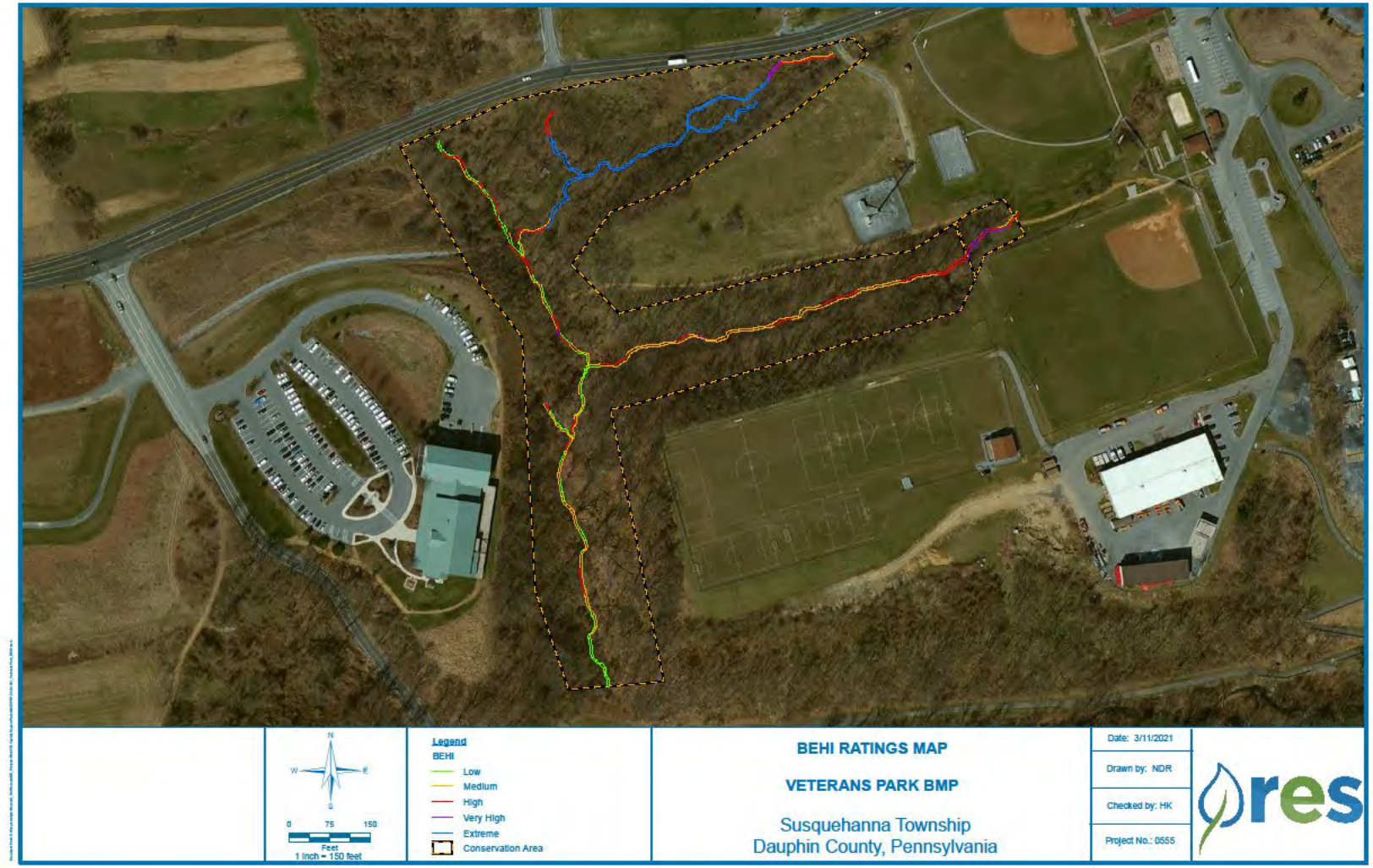
Level IV

(7)		
Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)	
		Rosgen, 2006



Site Selection for Expert Panel Protocols

Erosion Rates to Calculate Site-specific Loading



Site Selection for Expert Panel Protocols

Supporting Documentation for Increased Efficiency

- 12 months pre-construction data
- Bulk Density
- Secondary data supporting erosion rates
- 12 months post-construction validation

Floodplain Restoration Approach

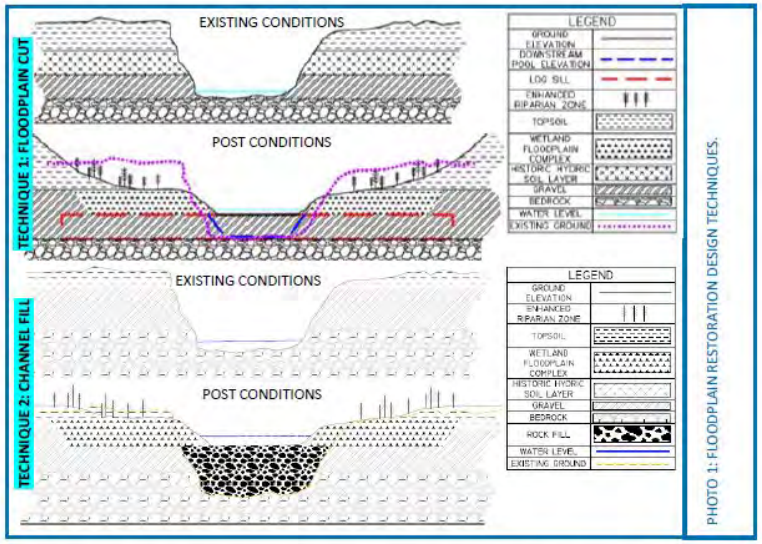


PHOTO 1: FLOODPLAIN RESTORATION DESIGN TECHNIQUES.

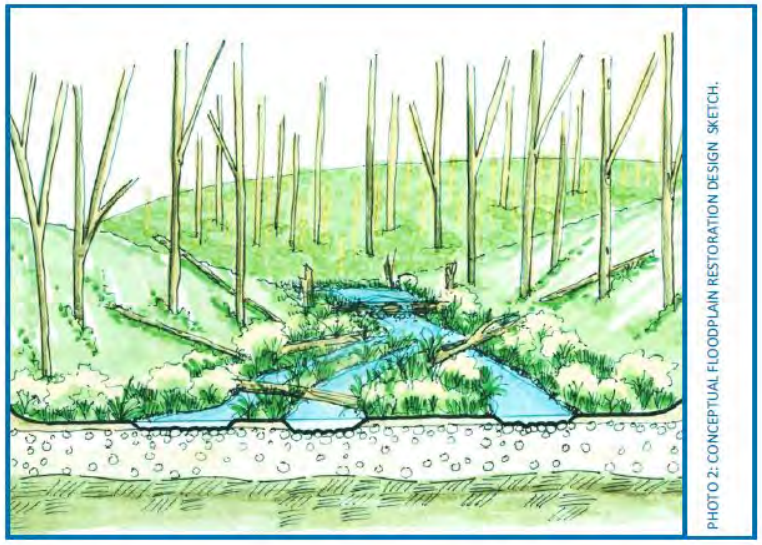


PHOTO 2: CONCEPTUAL FLOODPLAIN RESTORATION DESIGN SKETCH.


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

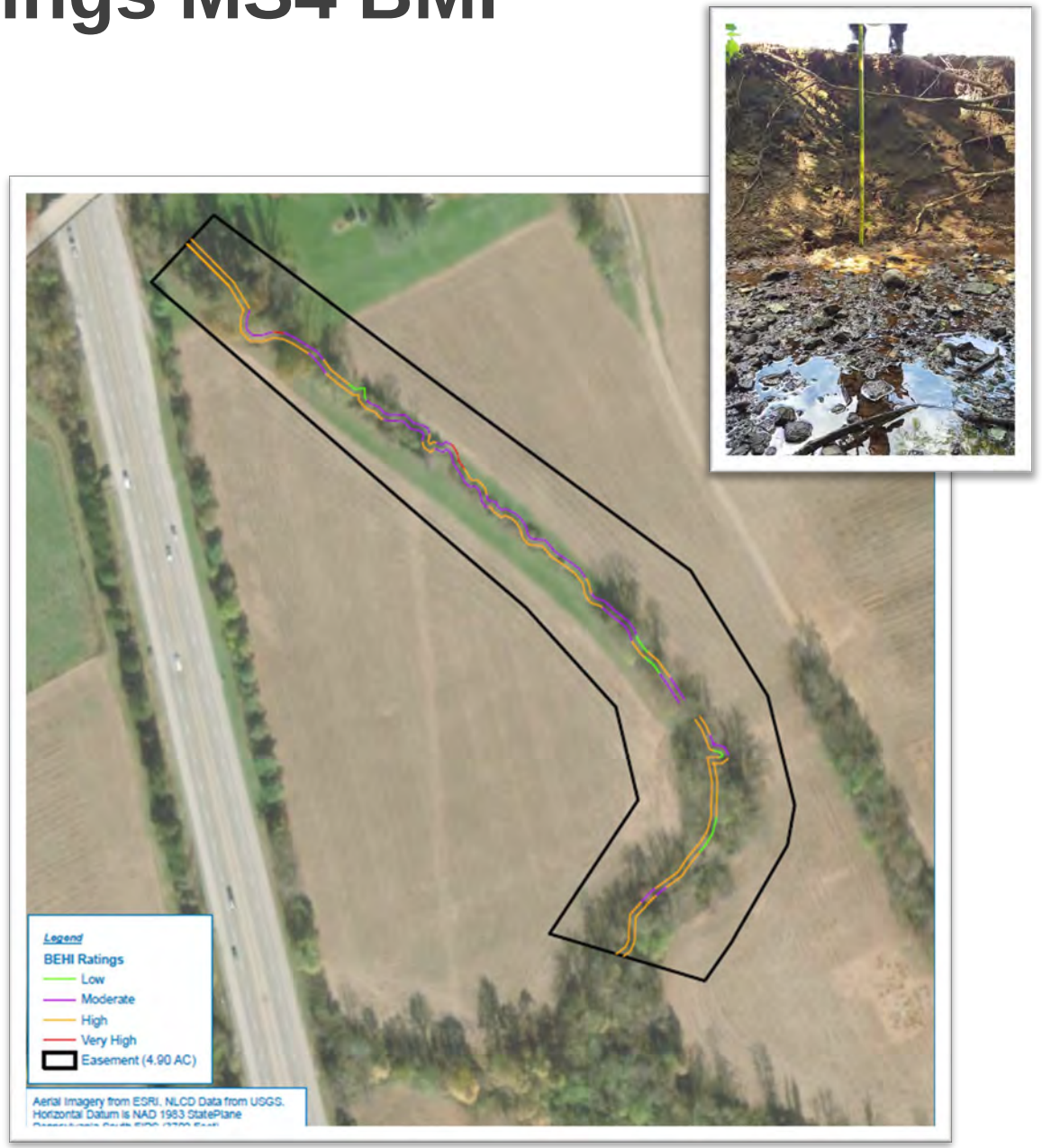

PHOTO 4: RES LARGE SCALE RESTORATION PROJECT HABITAT PERSPECTIVE USING FLOODPLAIN RESTORATION DESIGN TECHNIQUES.

CONCEPTUAL DESIGN STRATEGIES/APPEARENCE

- Revised channel geometry through designing a new valley bottom and a new stream channel in all areas
- The valley will be filled – allowing for the construction of a wider and more uniform valley slope
- 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)
- Final design profiles will require subsurface investigations to determine the optimal elevation of the valley and stream.

PennDOT Sinking Springs MS4 BMP

- “Design-build-operate-maintain” contract 167,000 lbs. sediment reduction
- Proposed unit costs ranged from $4.48/lb to $29.99/lb, with RES the low-bid
- RES acquired rights on private land to build and maintain project
- RES’ scope; siting, design, permitting, acquisition of property interests, construction, inspection, operation, maintenance and post-construction
- Shared with York County Planning Comm.
- **Contracted late 2018**
- **Designed/permitting/constructed in 2019**
- **Post-construction (1-yr) reductions validated December 2020**



PennDOT Sinking Springs MS4 BMP

Pre-Construction

PennDOT Sinking Springs MS4 BMP

Post Construction- December 2019 and April 2020

PennDOT Sinking Springs MS4 BMP

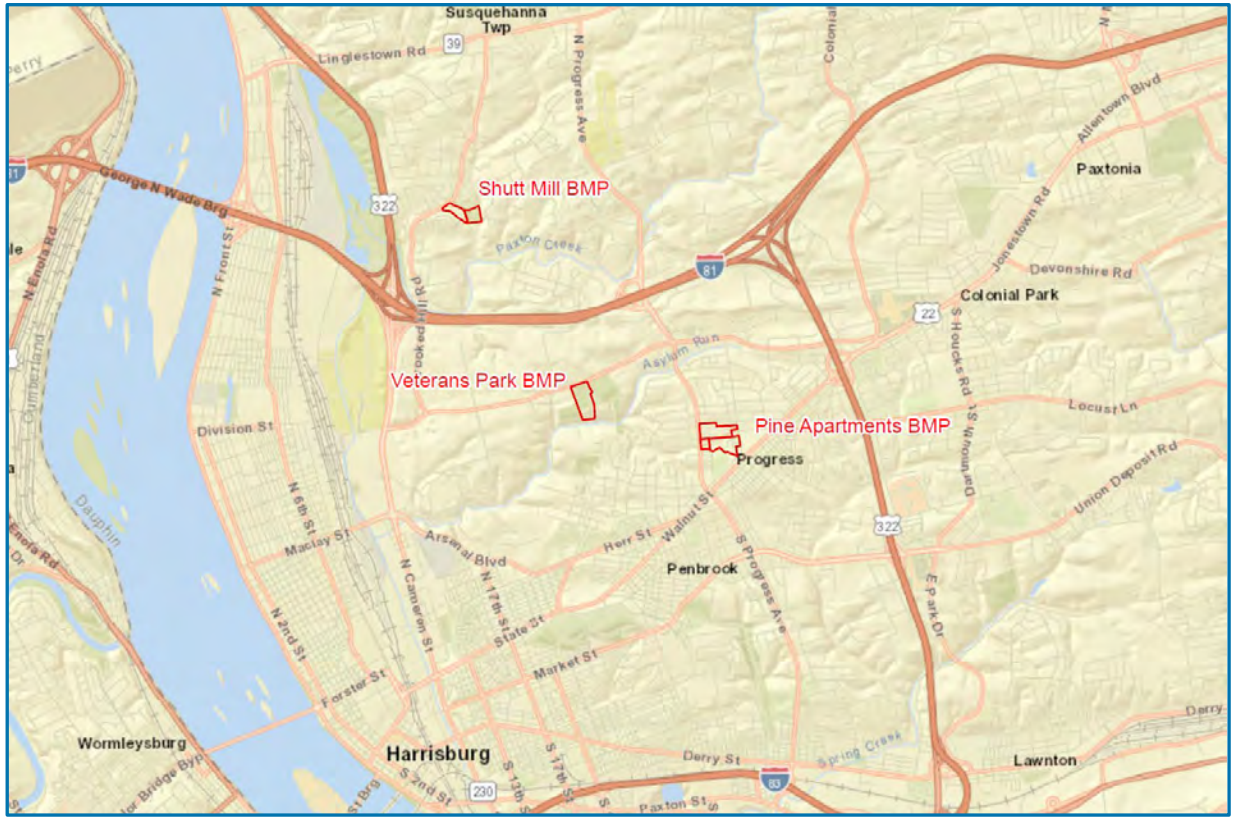
September 2021

PennDOT Sinking Springs MS4 BMP

September 2021 (bottom of project, looking at restored vs un-restored)

Paxton Creek Municipal Partnership

- “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**



Paxton Creek Municipal Partnership

- Three different BMPs
- One township park, one private HOA within a townhome community, one combo township park/state-owned property (different landowner-agreements for each)
- Aggregating all three projects under one contract lead to volume-savings/cost-efficiencies
- Partnerships!!!! The municipal partnership was started years in advance, leading to great efficiencies on the part of all parties
- First time a MS4 contract was co-funded by multiple municipal partners and PennDOT, with PennDOT facilitating the contracting and procurement

Veterans Park MS4 BMP

Pre-Construction

Veterans Park MS4 BMP

Post-construction

Veterans Park MS4 BMP

Post-construction

Just because it’s forested, doesn’t mean it’s high quality

PA Site: Example Larger Stream Reach

PA Site: Example Mid-size Stream Reach

PA Site: Example Headwater Stream Reach

Creative Partnerships

- **PennDOT!**
  - While PennDOT's capacity may be limited due to existing relationships and projects, they are the state's largest MS4 permittee (every watershed, every municipality)
  - They've 'cracked the code' with DBOM procurement, saving PennDOT (IE the residents of PA and purchasers of gasoline/ drivers of our roads, several $M with this procurement approach)
- **Each other!**
  - Multi-municipal partnerships focused on watersheds vs. individual municipal can help identify the most cost-effective projects, share the cost, share the credit
  - Can be formal partnerships with Joint PRPs, or can be project (BMP) specific
- **Others (though the two above are the best we're aware of)**
  - Farmers and other landowners doing something else water-related (farm pond example)
  - Touchy one, but developers? Yes, this could work. Solar?
  - Other environmental offset programs, including ESG/CSR for large organizations, many of which have 'water' related initiatives

Full Delivery in Maryland: County MS4s

- **Anne Arundel County Full Delivery of Turnkey Water Quality Improvements FY17**
  - Three outfall stabilization projects for pollutant reductions which produce Impervious Acre Credits (IACs)
  - Private land; evidence of property control required
  - Lowest *cost per credit*, geared towards certain BMPs

Before – Anne Arundel County

- **Montgomery County Water Quality Improvement Credits (2017-2021)**
  - Up to 5 stream restorations, est. $8-12M spend
  - Private land, permanent easement required
  - Highest combination of Proposal + Interview (min. 140 pts – max. 200 pts)

After – Anne Arundel County

Question and Answer

- Why that location/project for the Pilot Project?
- What's the largest area of risk for a full-delivery implementor?
- Full-delivery procurement and traditional municipal procurement challenges?
- Questions from audience?

THANKS FOR YOUR TIME!!!!

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