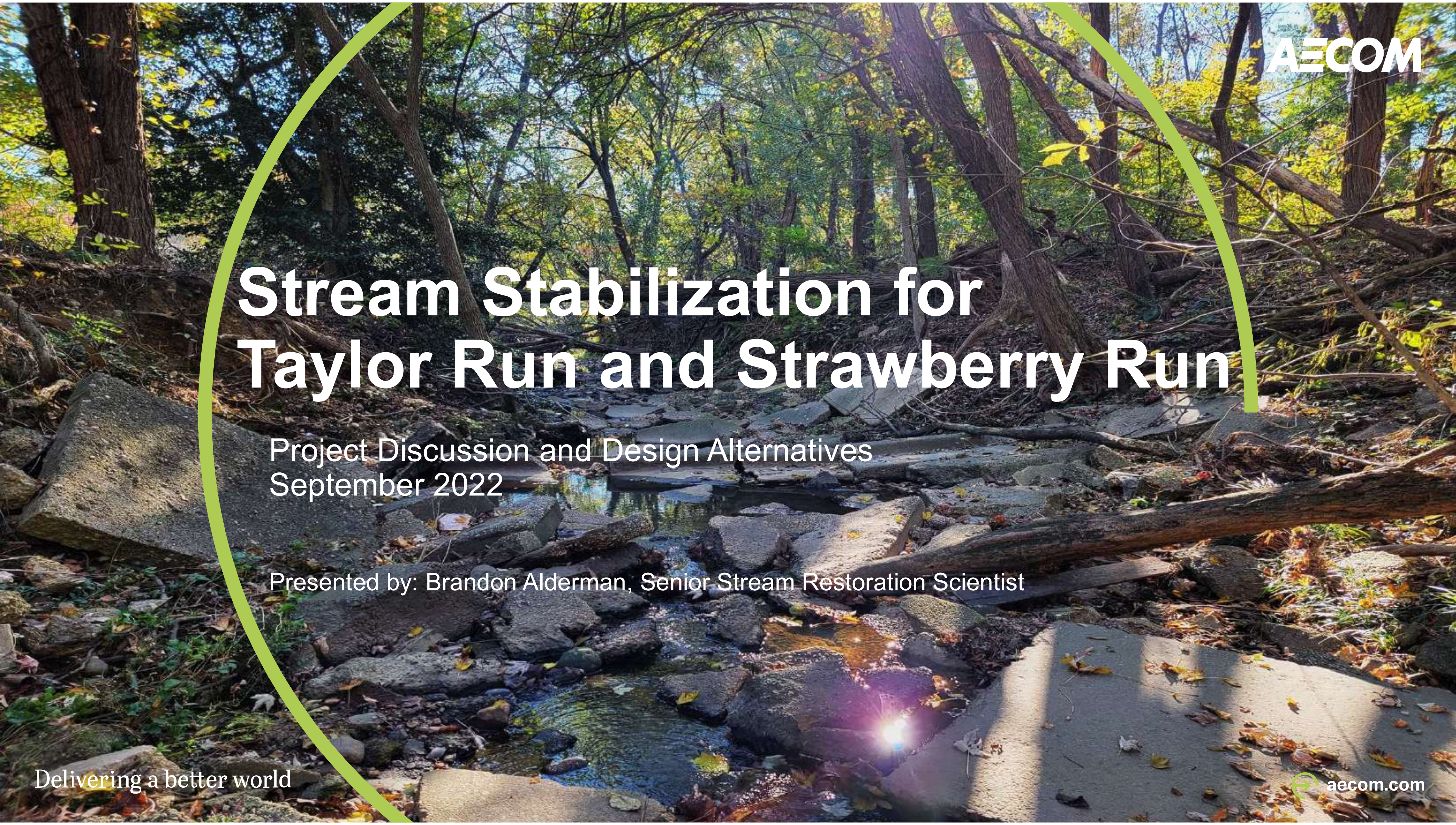

AECOM

Stream Stabilization for Taylor Run and Strawberry Run

Project Discussion and Design Alternatives
September 2022

Presented by: Brandon Alderman, Senior Stream Restoration Scientist

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Meeting Agenda

1. Design Techniques Overview
2. Taylor Run Alternative Design Details
3. Strawberry Run Alternative Design Details

1

Design Techniques Overview

Alternative Design Techniques

- Bioengineering
  - Engineering technique that uses a combination of hard-armoring and vegetation to stabilize banks

- Hard Armoring
  - Traditional engineering technique where banks are stabilized with rock, concrete or other nonerodable materials

- Minimal Intervention
  - Standard municipality utility repair that focuses on stabilizing infrastructure in place

Site Preparation Required (All Alternative Techniques)

- Construction access
- Grading limits
- Material Delivery and Haul Away
- Soil Compaction
- Safe Working Areas


Raleigh, NC
Source: AECOM


Raleigh, NC
Source: AECOM

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Bioengineering

Pros

- Robust armoring potential
- Vegetative solution
- Provides some habitat
- Stabilizes stream banks in large storm flows
- Protects infrastructure along stream banks
- Reduces grading footprint
- Less maintenance is required than with hard armoring

Cons

- Mitigation may or may not be required – depends on reviewing agency decision
- Slow and labor-intensive construction
- More detailed engineering and geotechnical design
- Requires clean, well draining imported backfill
- Steep slope remains
- Early plantings may require supplement planting or watering

Hard Armoring

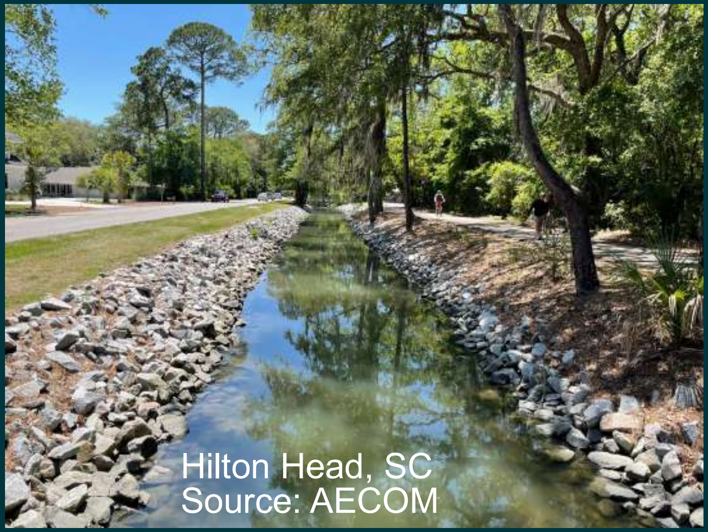
Pros

- Fast implementation
- No contractor special experience required
- Simple engineering design
- Easily sourced materials

Cons

- Permitting challenges, costly mitigation required
- Requires regular maintenance and after large storm events
- Lacks habitat, wildlife barrier
- Significant grading and clearing required


Towanda, PA
Source: bccdpa.com


Hilton Head, SC
Source: AECOM


PG County, MD
Source: AECOM


Gabion installation
Source: Halff.com

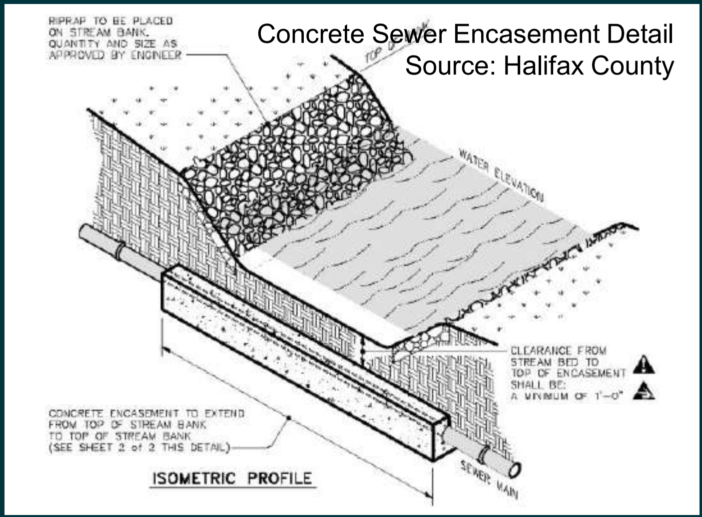
Minimum Intervention

Pros

- Very Fast implementation
- Minimizes tree impacts
- Simple engineering design
- Easily sourced materials
- Reduced access road and equipment needs

Cons

- Long term stability remains a concern
- Requires frequent maintenance and after large storm events
- Lacks habitat, wildlife barrier
- Does not stabilize trail infrastructure or prevent streambank erosion



Concrete Sewer Encasement Detail
Source: Halifax County


Manhole Stabilization
Source: Hazen & Sawyer


Delaware Outfall
Source: stormh20.com


Johnson County, KS
Source: wiedenmanninc.com

Sewer Re-Alignment

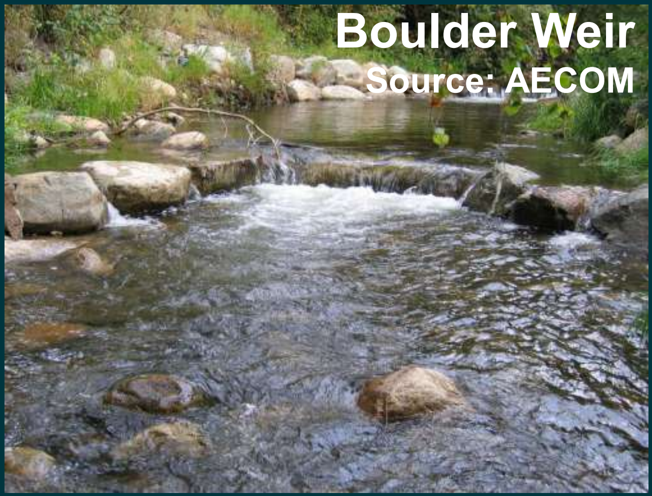
- Gravity sanitary sewers require a positive slope
- Substantial re-alignment length and structure impact
- Large equipment necessary for trenching/safe working
- Significant impacts to trees, wetlands, and trail
- Dismissed alternative due to large limits of disturbance and potential environmental impacts

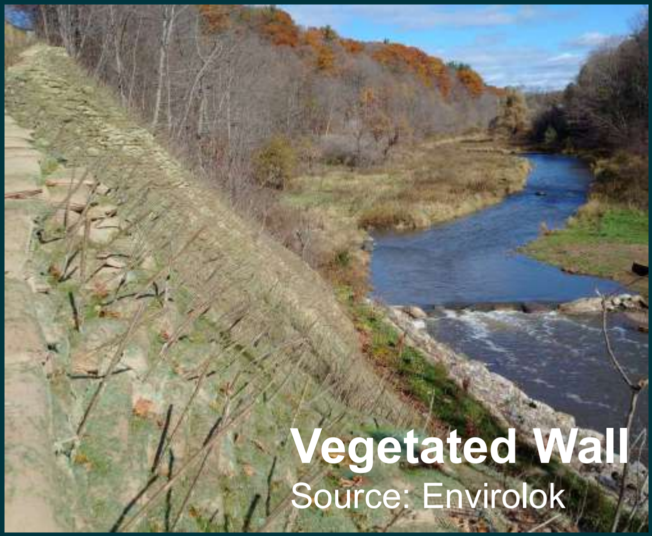
Delta, CO Sewer Realignment
Source: Skip Houston Construction

2

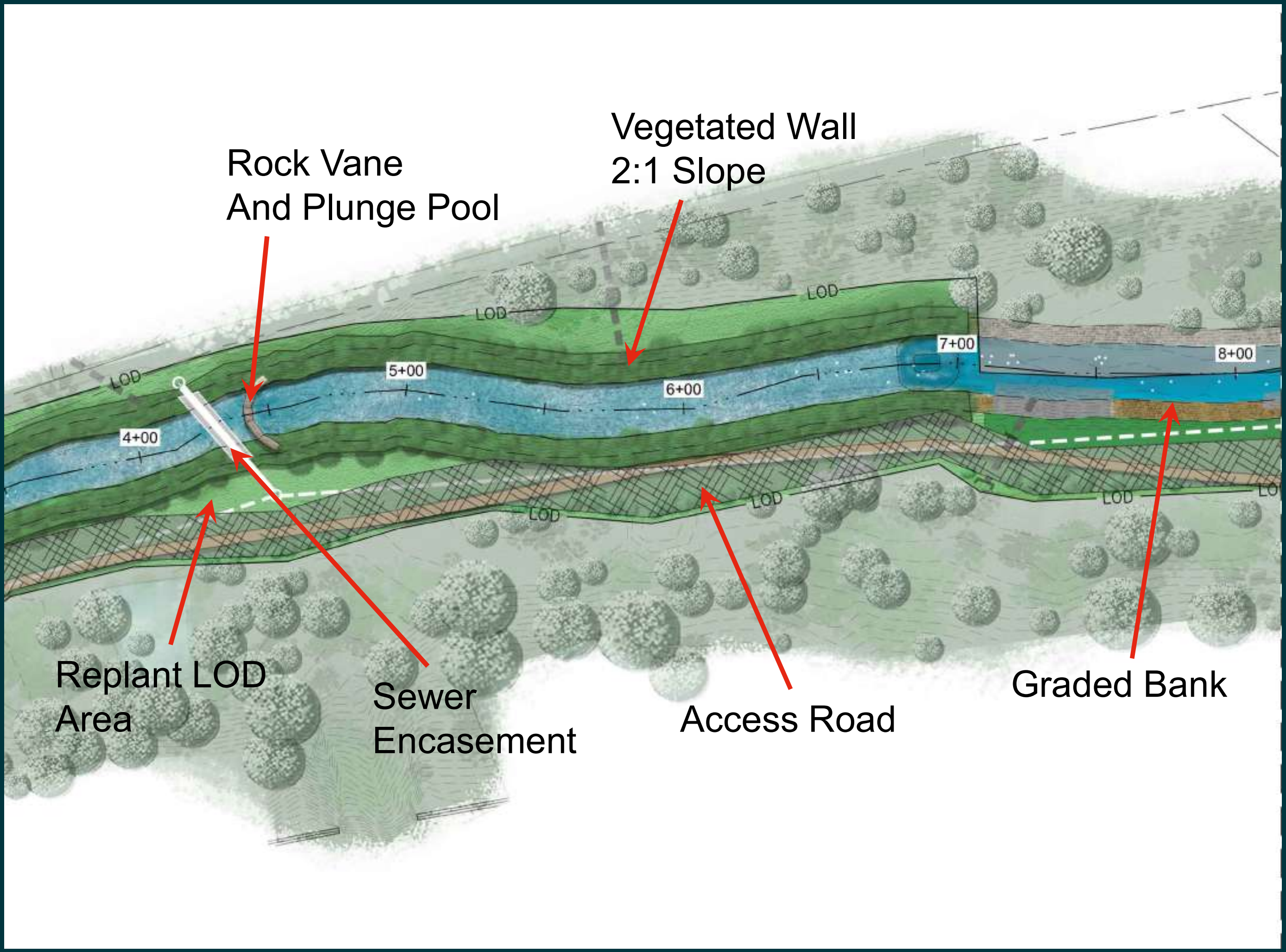
Taylor Run Design Details

Taylor Run Design Options – Bioengineering Design Elements

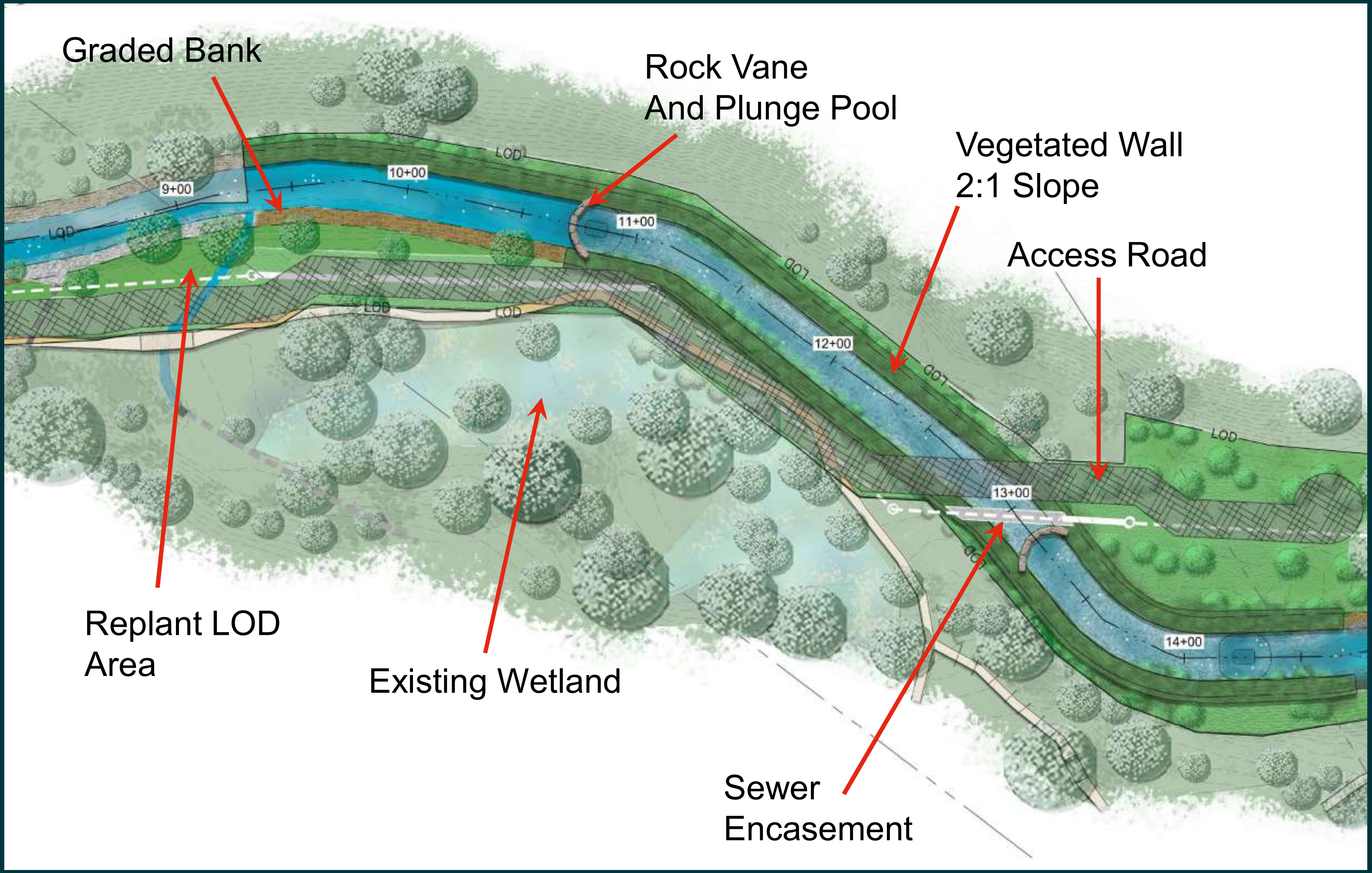




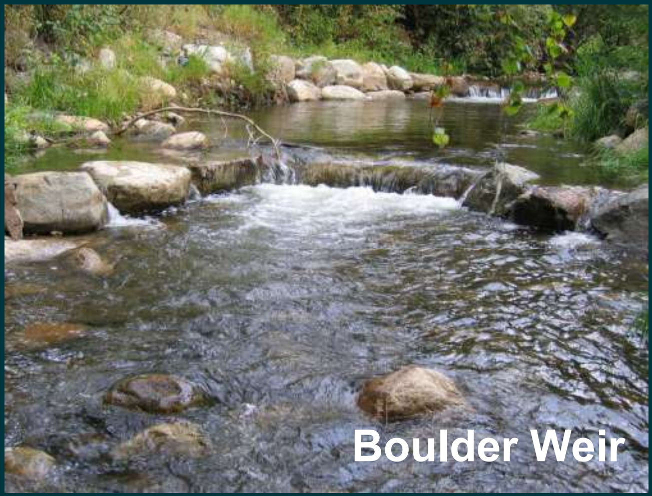
Taylor Run Design Options – Bioengineering



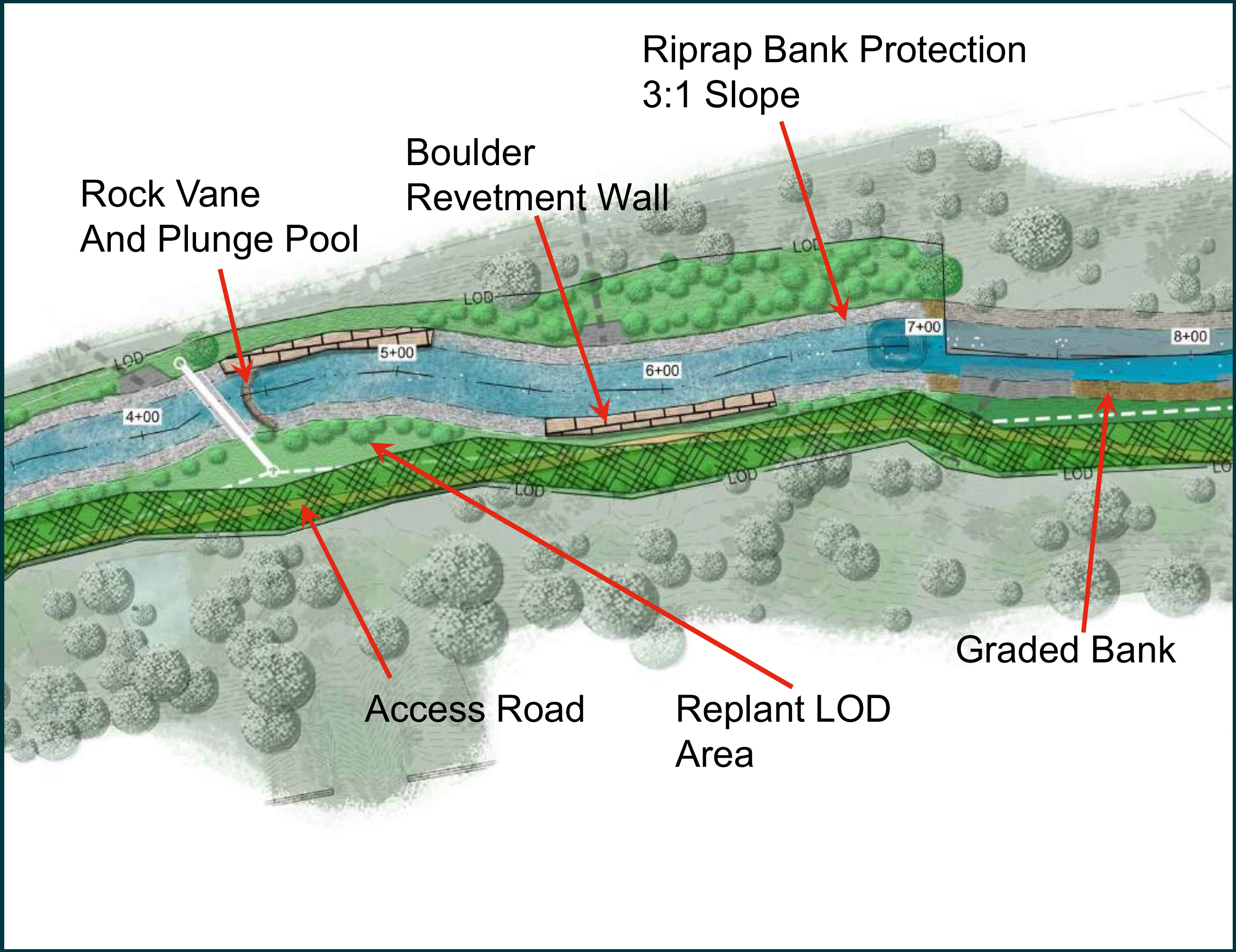
Taylor Run Design Options – Bioengineering



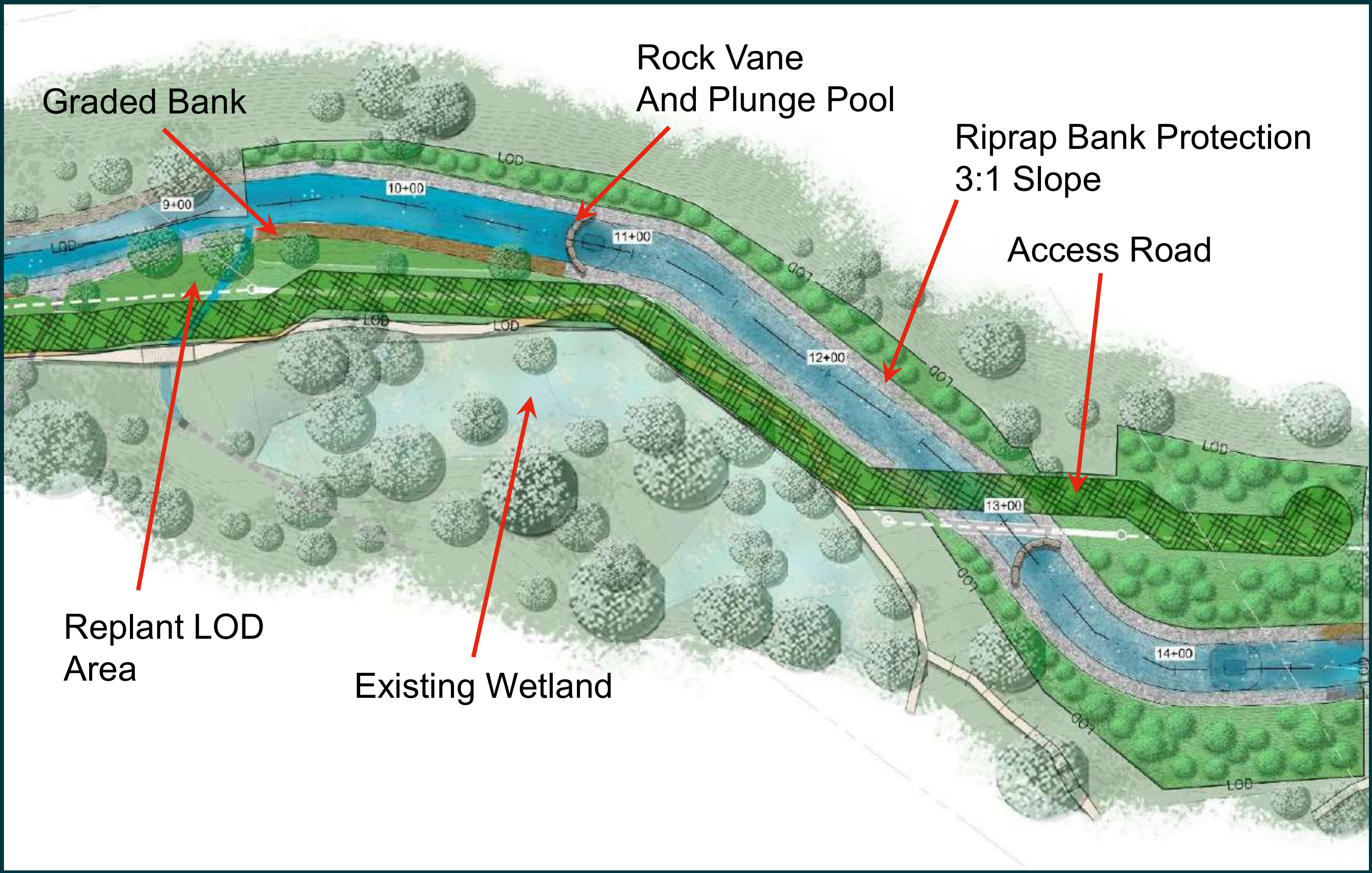
Taylor Run Design Options – Hard Armoring Design Elements



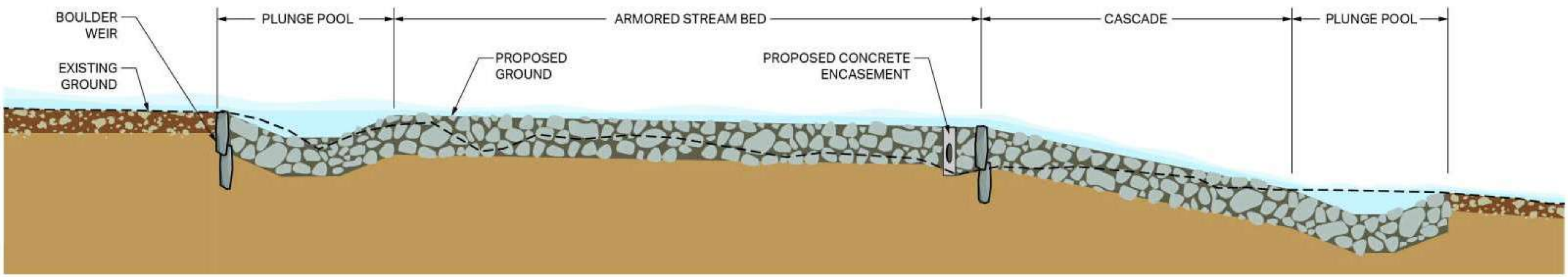
Taylor Run Design Options – Hard Armoring



Taylor Run Design Options – Hard Armoring



Taylor Run Design Options – Profile (Both Bioengineering and Hard Armoring)



TYPICAL SANITARY SEWER PROTECTION LONGITUDINAL PROFILE – BIOENGINEERING / HARD ARMORING

- Both design techniques will require armoring in the stream bed to cover the exposed sewer.
- Boulder weirs and plunge pools used to minimize changes to the profile and provide long term stability

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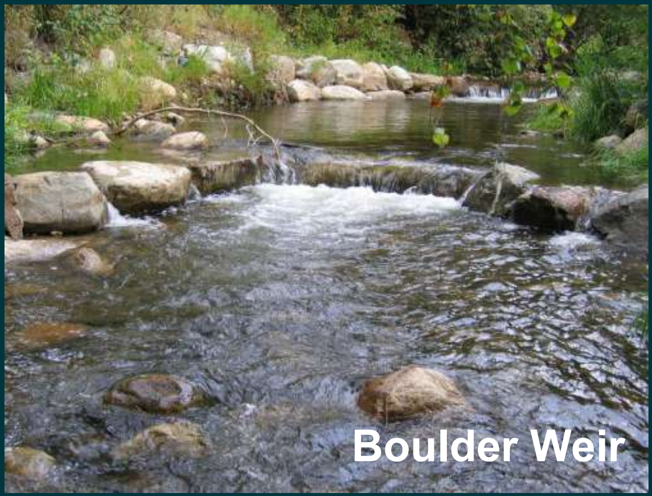
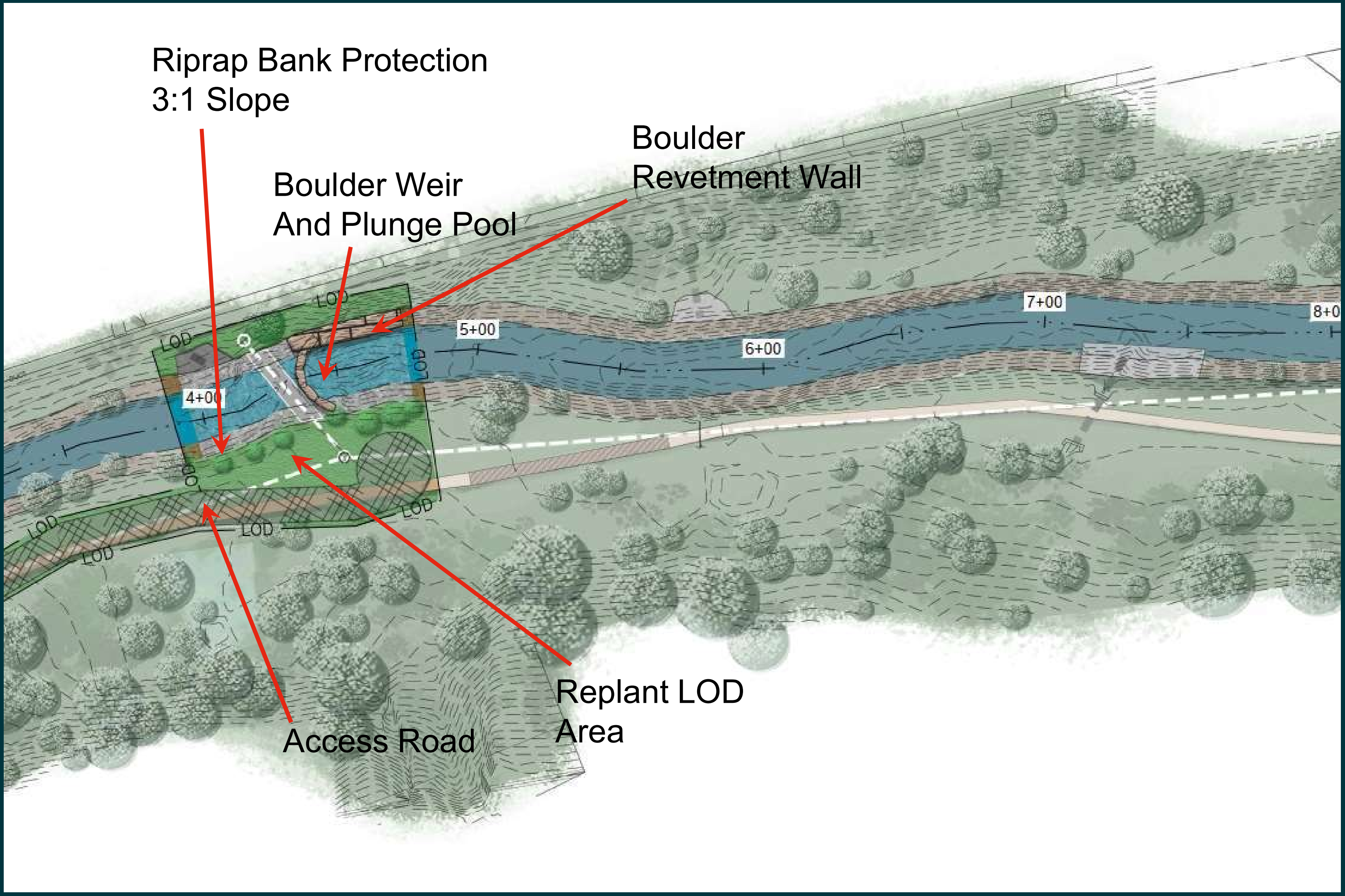
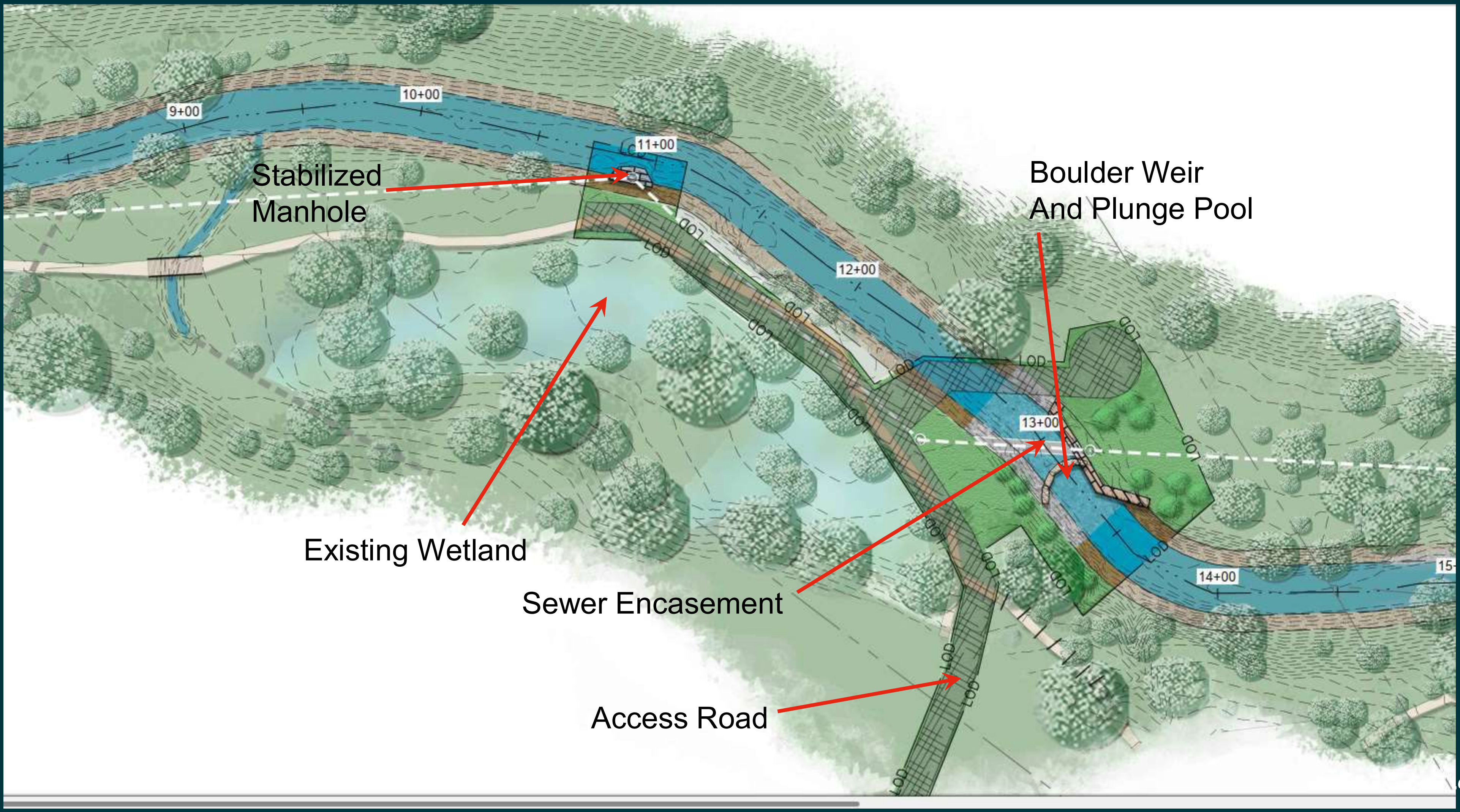
Taylor Run Design Options – Minimal Intervention Design Elements



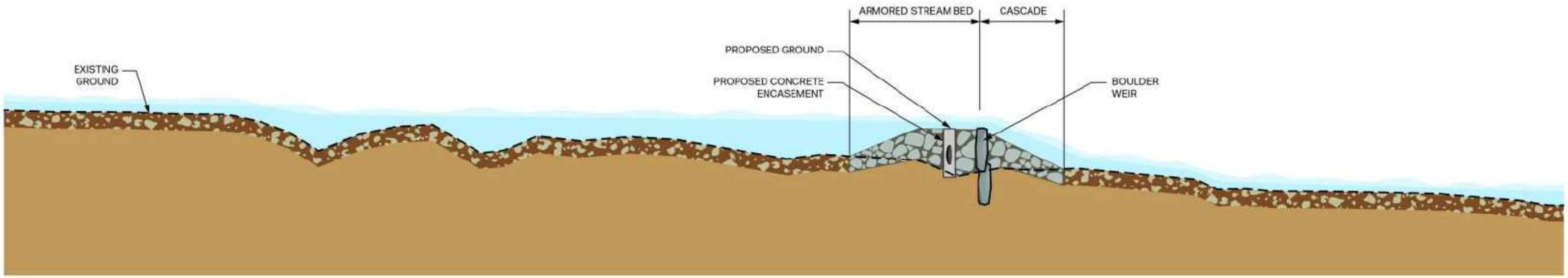
Taylor Run Design Options – Minimal Intervention



Taylor Run Design Options – Minimal Intervention



Taylor Run Design Options – Profile (Minimal Intervention)



TYPICAL SANITARY SEWER PROTECTION LONGITUDINAL PROFILE – MINIMAL INTERVENTION

- Minimized targeted riprap placement
- Boulder weir used as a grade control below encasement
- Backwater effects caused by structure height

Taylor Run - Tree Impact

Tree Impacts	Hard Armoring	Bioengineering	Minimum Intervention
Limit of Disturbance	2.82 acres	2.63 acres	1.06 acres
Total Trees Cleared for Project Implementation*	202	190	53
Total Trees To Be Planted**	1,692	1,578	636
Net Trees Gained	**+1,490**	**+1,388**	**+583**

*Tree count conducted in 2018/2019
**Site shall be replanted at 600 stems/acre

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Taylor Run – Probable Project Cost

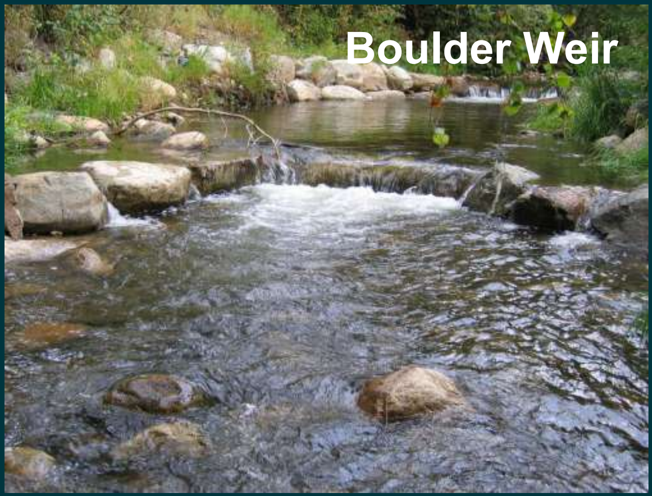
Cost Estimate	Minimum Intervention	Hard Armoring	Bioengineering
Construction	$915,000	$2.6 million	$3.4 million
Mitigation*	$193,600 (220 LF)	$1.2 million (1,410 LF)	$930,600 (1,410 LF)
Maintenance (>10YR Storm)**	$395,000	$130,000	$51,000
Grand Total	**$1.5 million**	**$3.9 million**	**$4.4 million**

*Mitigation estimated from the USACE USM Compensation Calculation and a credit purchase rate of $800/credit
**Maintenance Costs are average costs. Actual costs and frequency necessary may differ.

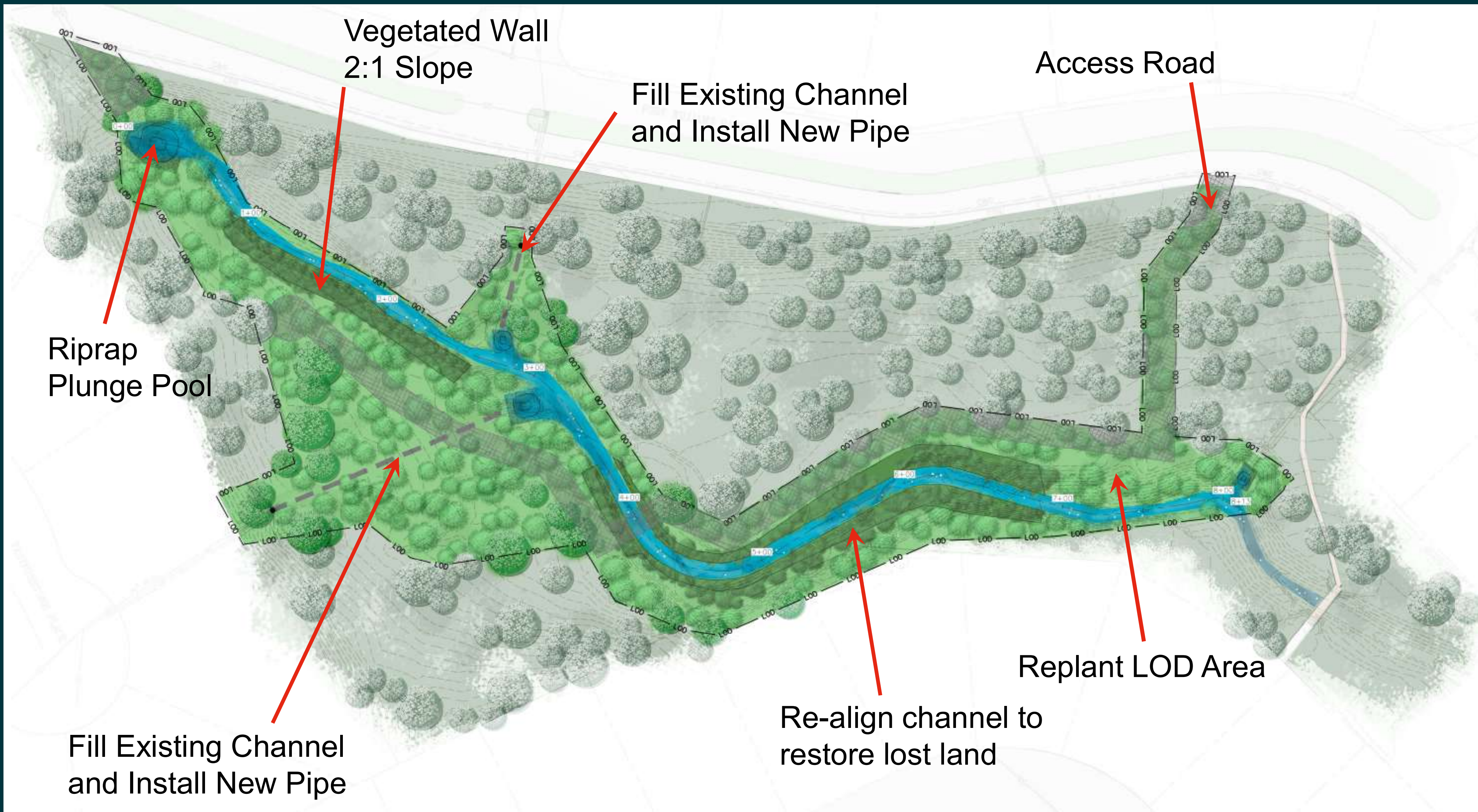
3

Strawberry Run Design Details

Strawberry Run Design Options – Bioengineering Design Elements



Strawberry Run Design Options – Bioengineering



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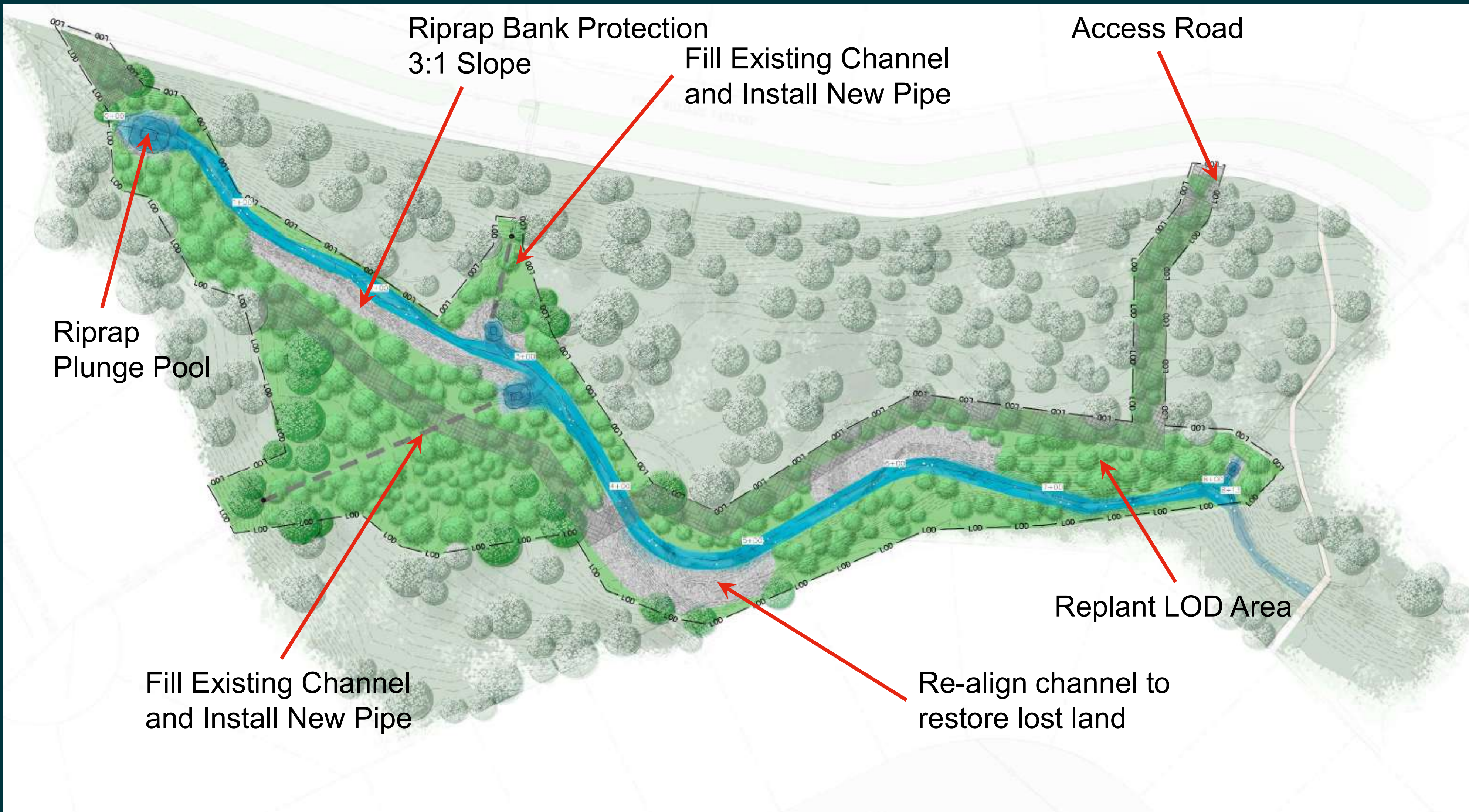
Strawberry Run Design Options – Hard Armoring Design Elements

Strawberry Run Design Options – Hard Armoring



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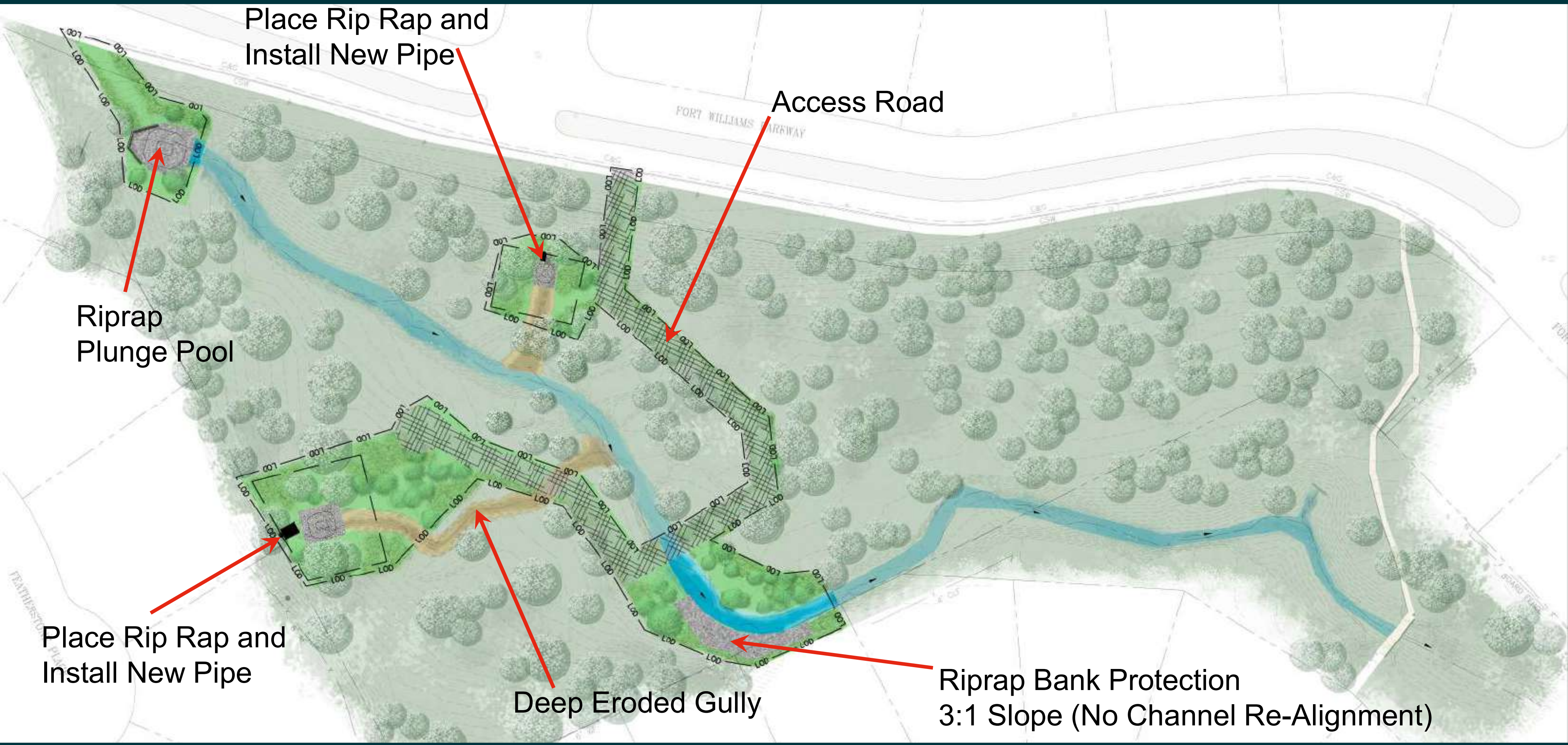
Strawberry Run Design Options – Minimal Intervention Design Elements

Strawberry Run Design Options – Minimal Intervention



Strawberry Run - Tree Impact

Tree Impacts	Hard Armoring	Bioengineering	Minimum Intervention
Limit of Disturbance	1.72 acres	1.72 acres	0.68 acres
Total Trees Cleared for Project Implementation*	52	46	36
Total Trees To Be Planted**	906	882	320
Net Trees Gained	**+854**	**+836**	**+284**

*Tree count conducted in 2018/2019
**Site shall be replanted at 600 stems/acre

Strawberry Run – Probable Project Cost

Cost Estimate	Minimal Intervention	Hard Armoring	Bioengineering
Construction	$604,750	$1.5 million	$1.8 million
Mitigation*	$372,000 (465 LF)	$853,600 (970 LF)	$640,200 (970 LF)
Maintenance (>10YR Storm)**	$228,250	$74,000	$26,000
Grand Total	**$1.2 million**	**$2.4 million**	**$2.5 million**

*Mitigation estimated from the USACE USM Compensation Calculation and a credit purchase rate of $800/credit
**Maintenance Costs are average costs. Actual costs and frequency necessary may differ.

Habitat Considerations/Conclusions

- Replacement of riparian/riverine habitat
  - Where hard-armoring replaces in-stream or riparian habitat, it can have negative ecological impacts (Fischenich, 2003)
  - Impacts of riprap vary with stream characteristics (Fischenich, 2003)
  - Large rock can be beneficial in sand-bed streams where hard substrate is lacking (Fischenich, 2003)
  - Weirs created from minimal intervention structures often create barriers to fish passage
- Sediment Reduction Benefits
  - Sedimentation from stream erosion can have negative impacts on fish and benthics
  - Sediment reduction can improve habitat in eroding streams (Fischenich, 2003)
  - Inability to establish lasting vegetation with hard-armoring techniques results in short-term stabilization improvements
- Uplift Potential
  - Ecological uplift potential in urban streams is usually minimal regardless of restoration technique (Hildenbrand, Chesapeake Bay Trust)
  - Uplift depends on which species are targeted – most studies focus on fish habitat rather than other forms of wildlife

References and Resources

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2. Strawberry Run Stream restoration Project Overview Website; https://www.alexandriava.gov/stormwater-management/project/strawberry-run-stream-restoration
3. Phase III Assessment Stream Restoration and Outfall Stabilization Feasibility Study; 2019; https://media.alexandriava.gov/docs-archives/tes/stormwater/phaseiiistreamassessmentfebruary2019mainbody.pdf
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Thank You!

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