Design, Construction, & Benefits of Integrated Stream & Wetland Stormwater Restoration Projects

Presented By:
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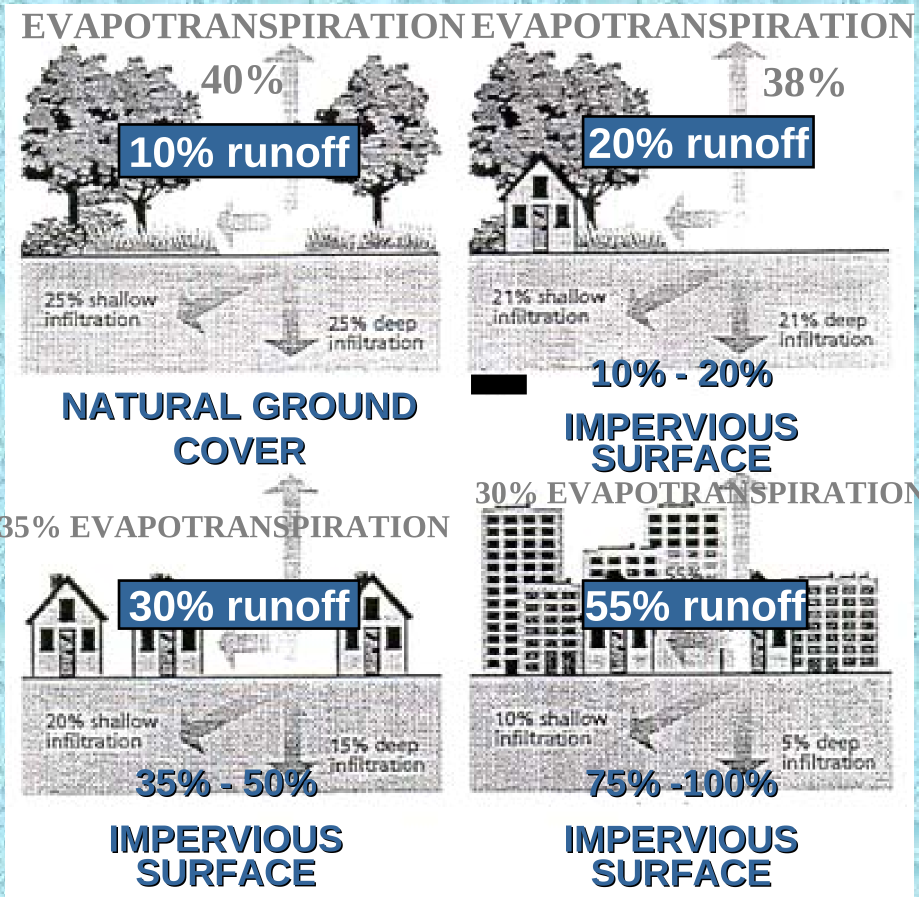
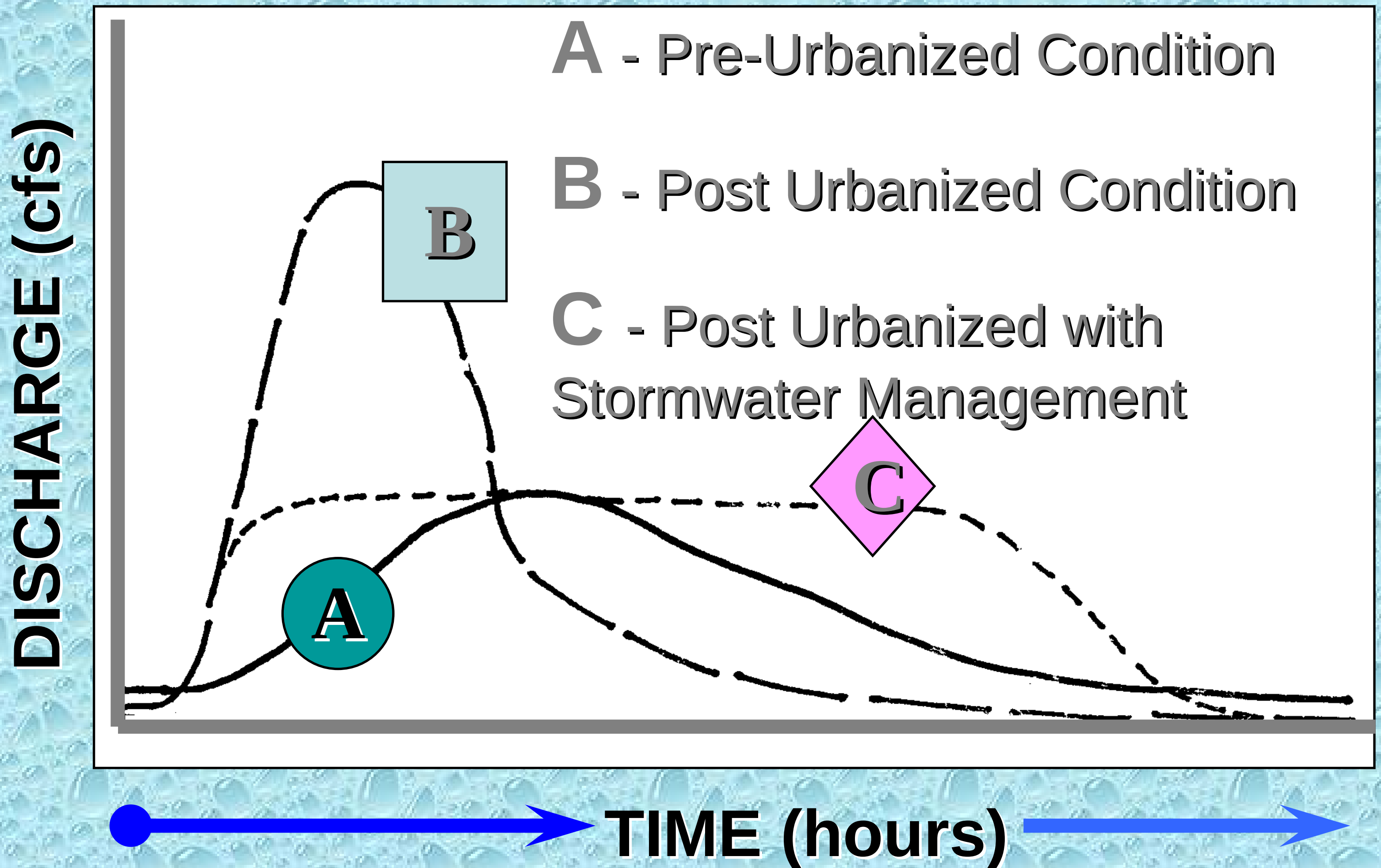
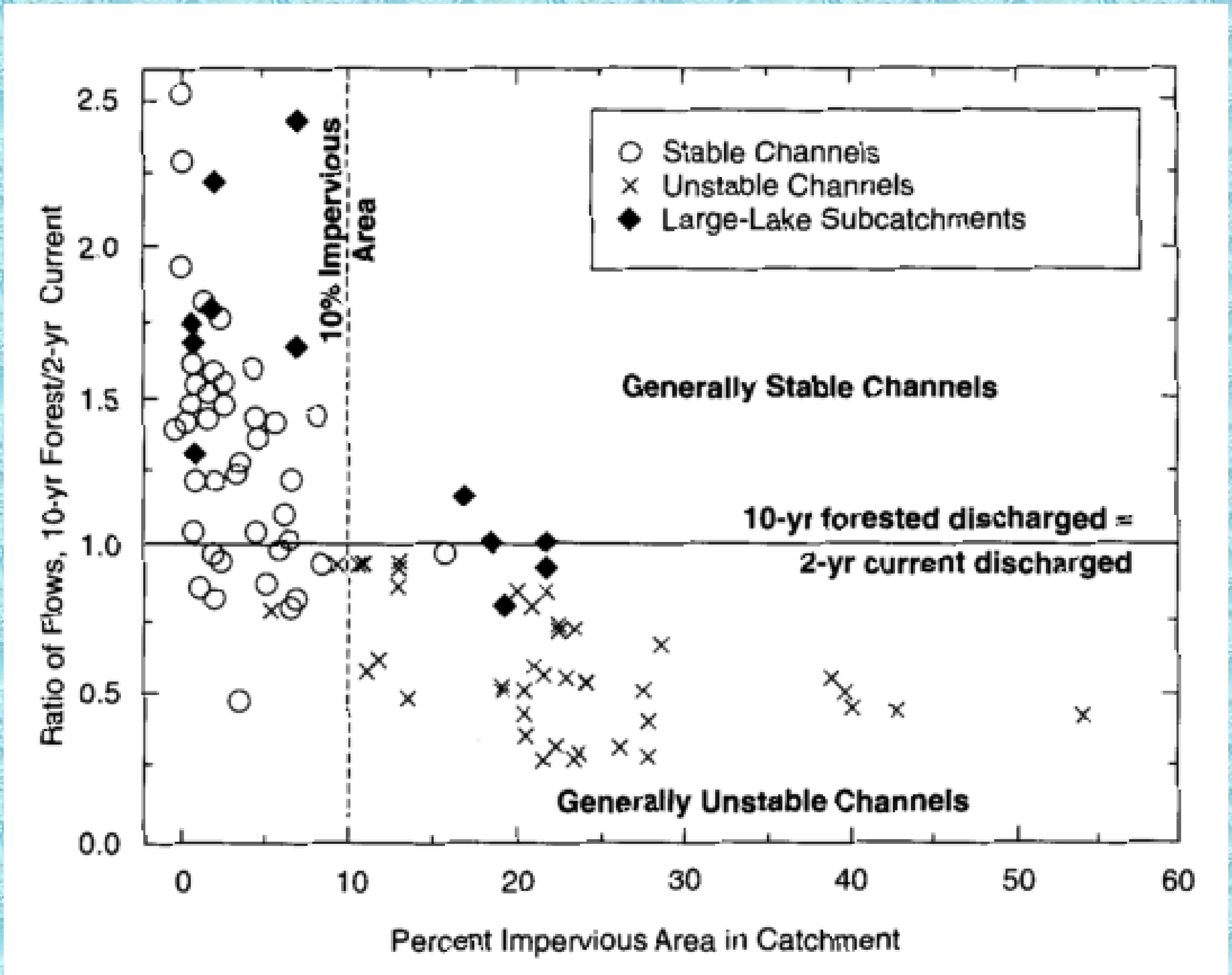
RELATIONSHIP BETWEEN IMPERVIOUS COVER AND SURFACE RUNOFF

- Impervious cover in a watershed results in increase surface runoff.
- As little as 10 percent impervious cover in a watershed can result in stream degradation.



URBAN HYDROGRAPH

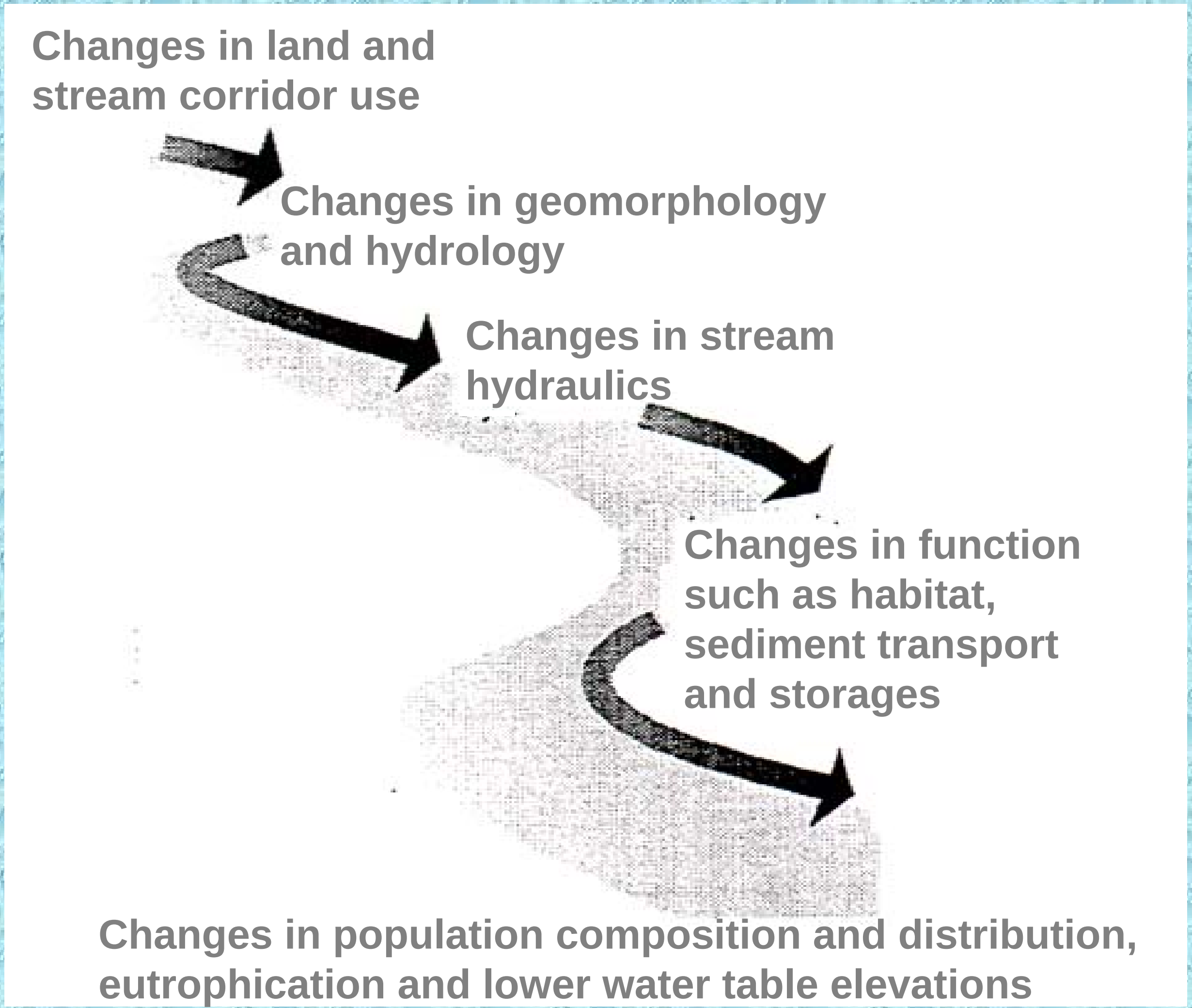


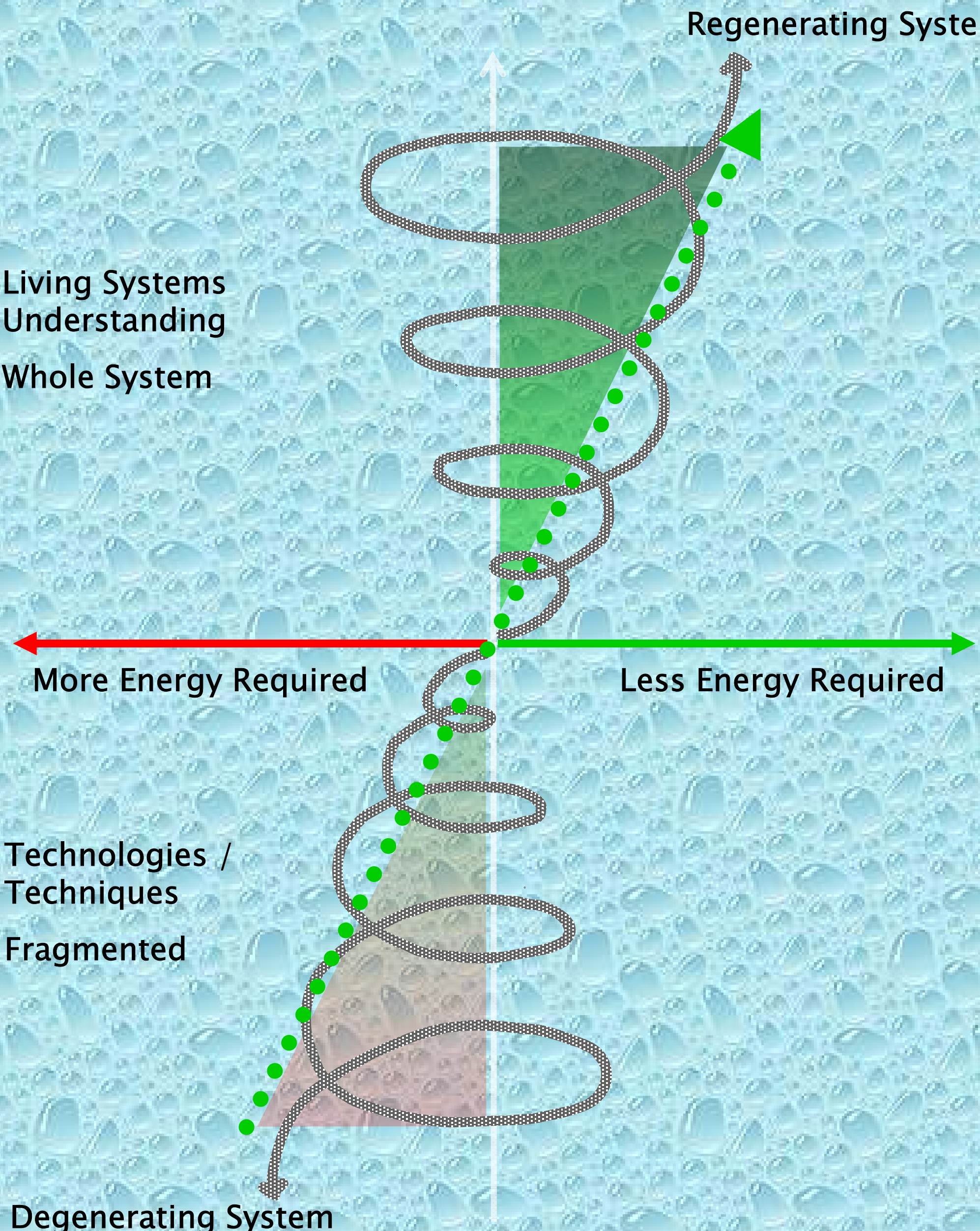


Channel Stability as Function of Imperviousness (Booth and Reinelt, 1993)

CHAIN OF EVENTS DUE TO DISTURBANCE

Disturbance to a stream corridor system typically results in a causal chain of alterations to stream corridor structure and function.





Regenerative

Humans (Hominids) PARTICIPATING AS nature – Co-evolution of the Whole System

Restorative

Humans DOING THINGS TO nature – assisting the evolution of Sub-Systems

Sustainable

Neutral – "100% less bad" (McDonough)

Green

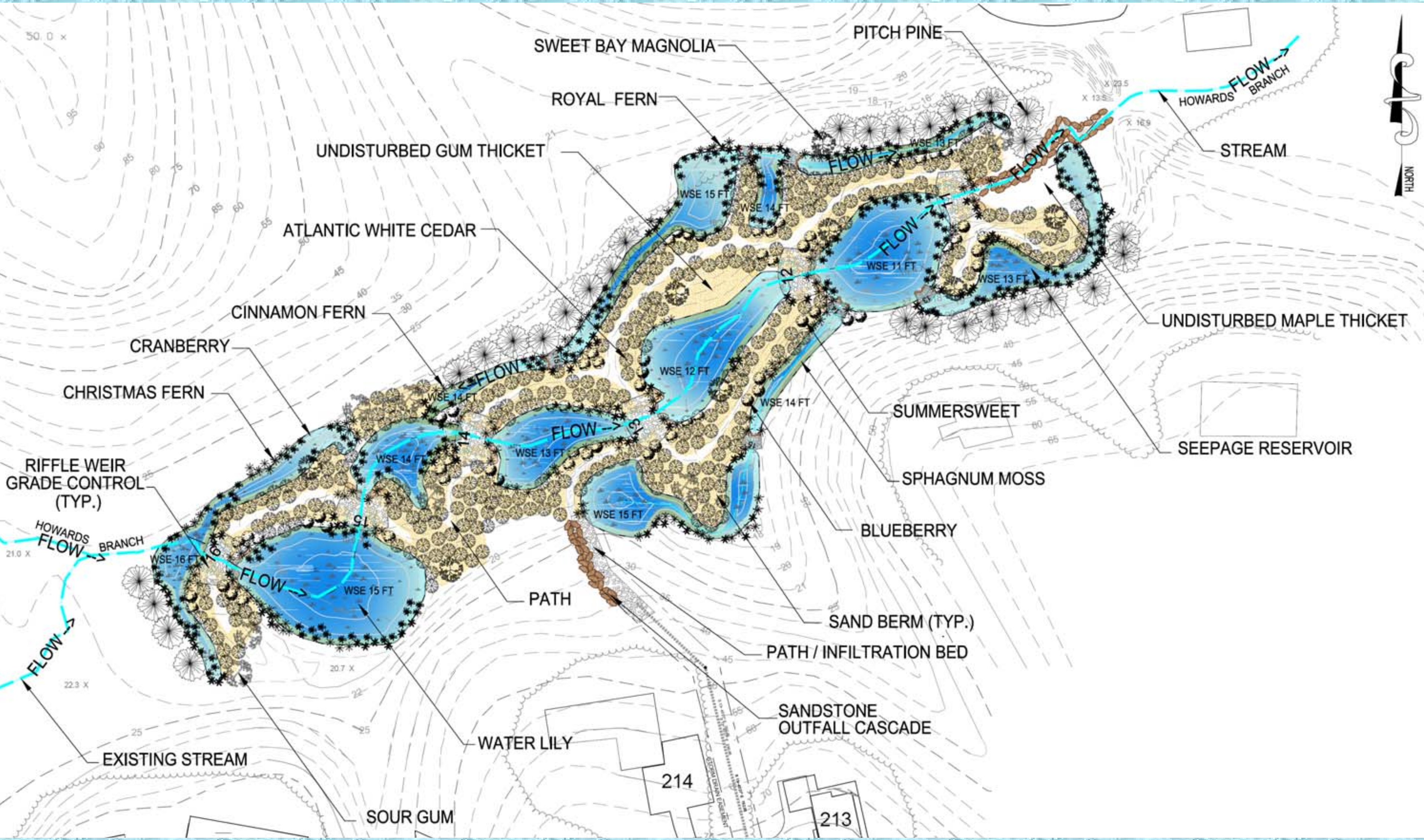
Relative Improvement
(LEED, GB Tool, Green Globe, etc.)

Conventional Practice

"One step better than breaking the law" (Croxton)

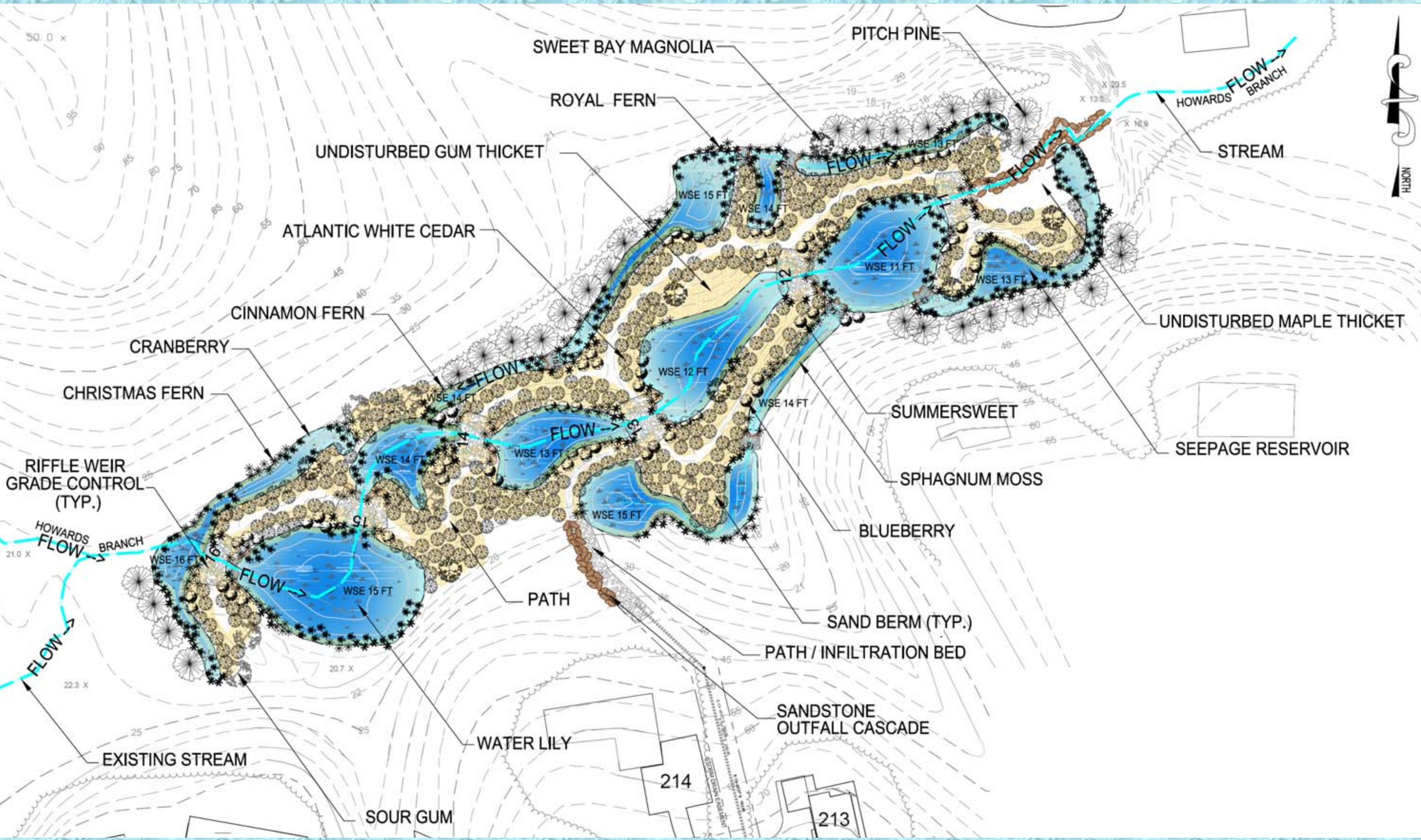
Trajectory of Environmentally Responsible Design

Characteristics of Regenerative Stormwater Systems



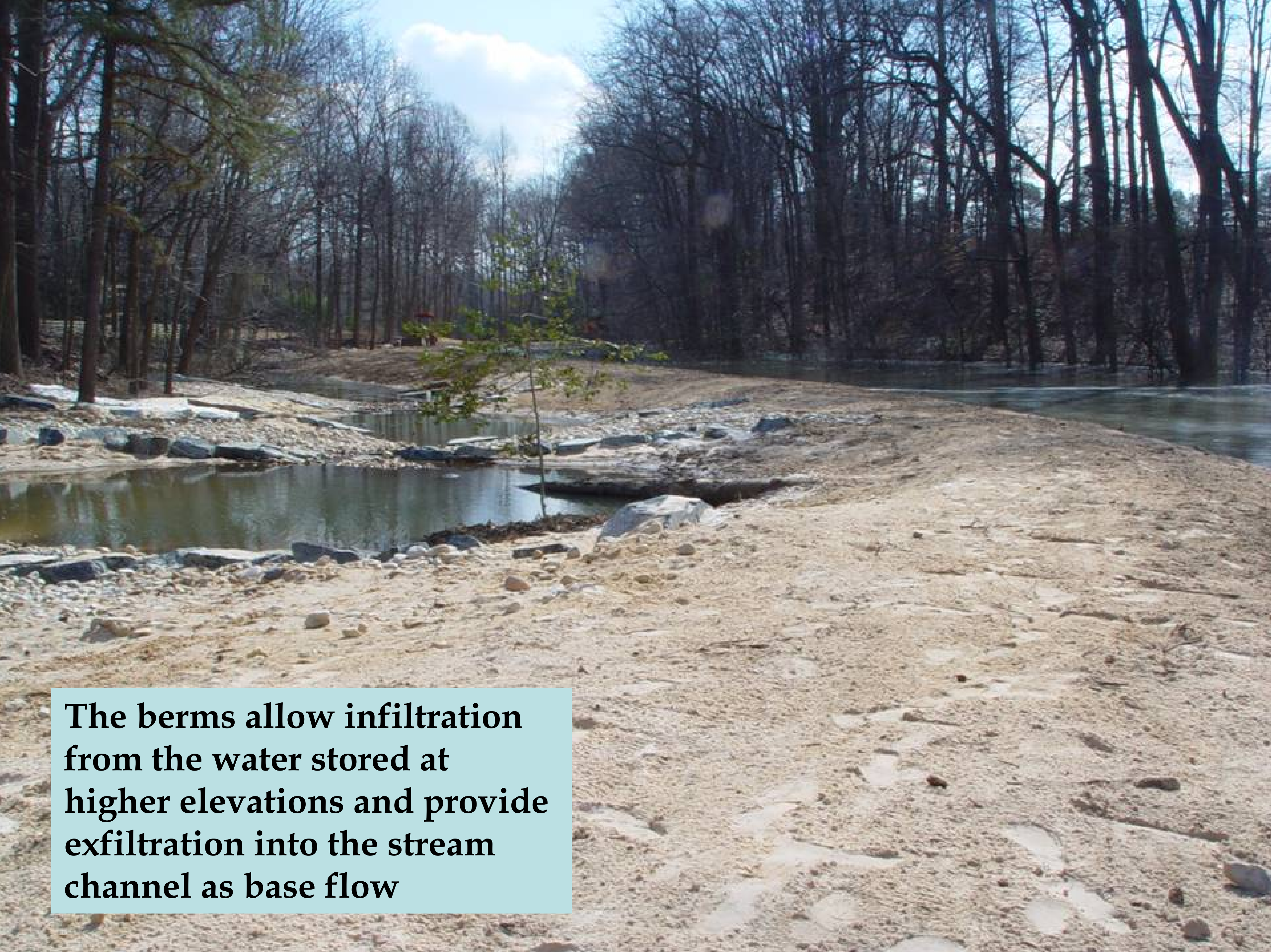
Howard's Branch Stream & Wetlands Restoration


Conventional bank stabilization
(e.g. Rosgen-type methods)

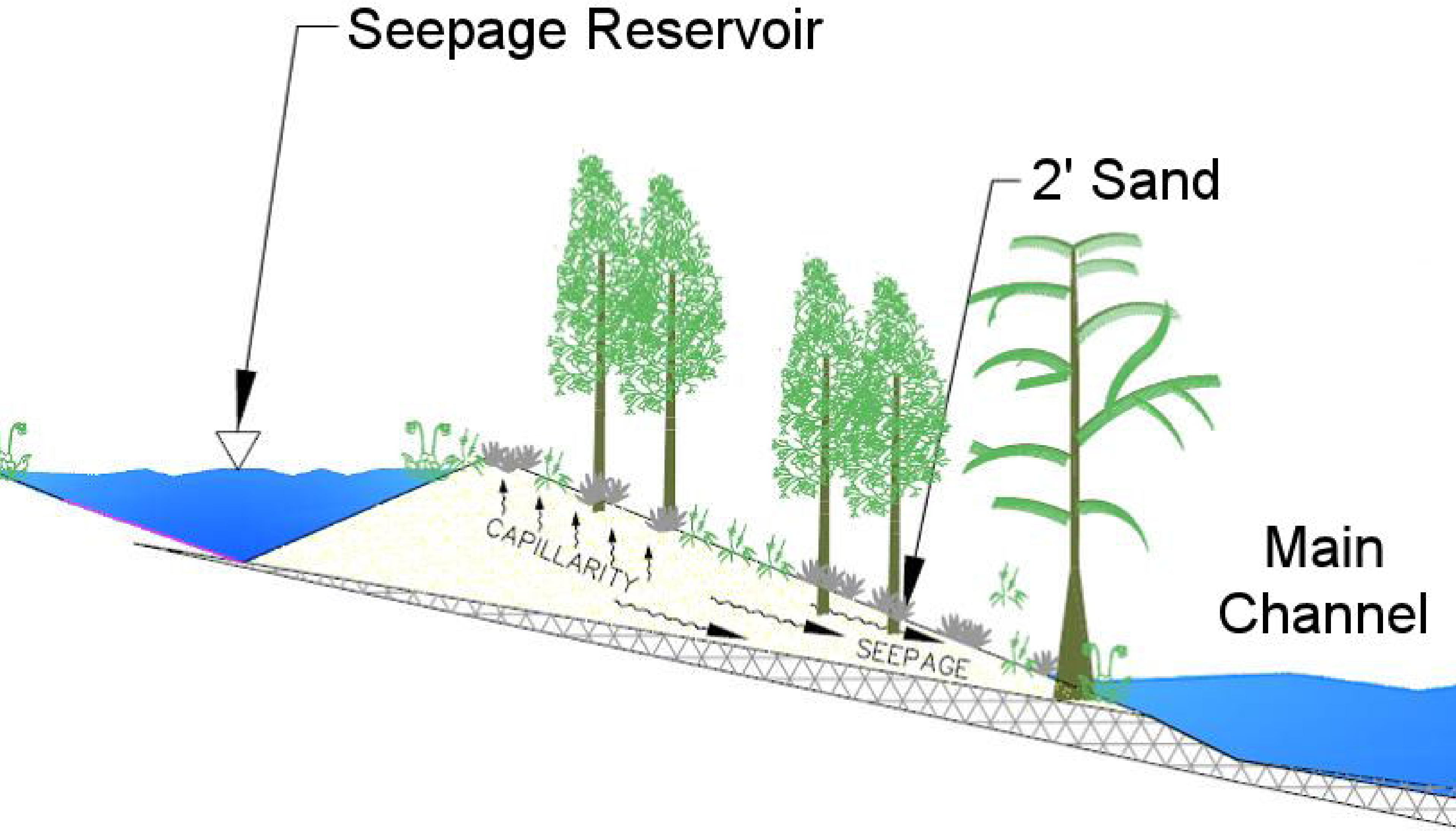


Howard's Branch Stream & Wetlands Restoration

Finished sand berm haul road at Howard's Branch



The berms allow infiltration from the water stored at higher elevations and provide exfiltration into the stream channel as base flow



Infiltration through the seepage reservoir converts surface water to ground water as it passes through the sand berm and into the main channel

Riffle Weir Grade
Control Structure

These systems are designed to mimic beaver dams

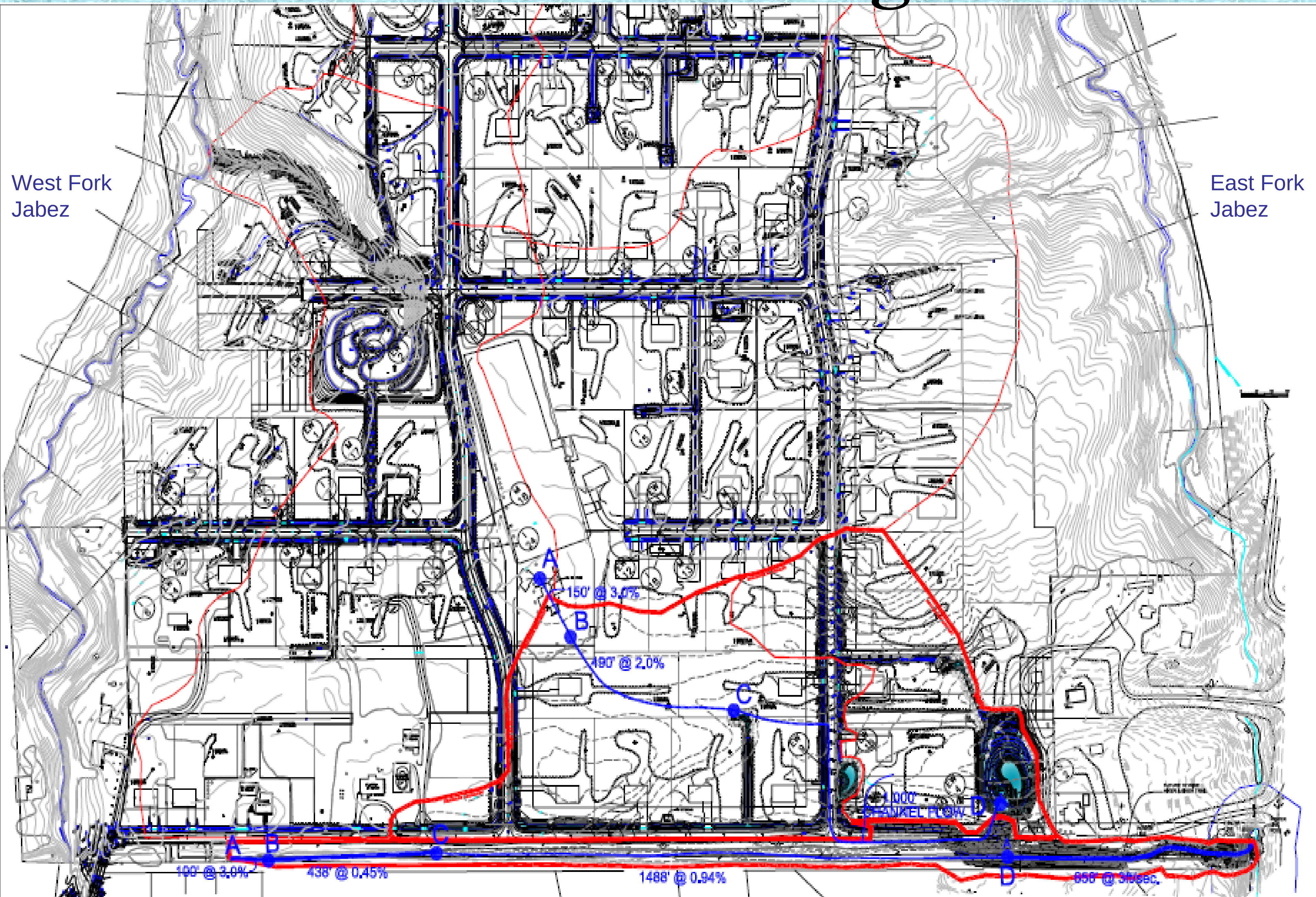

Shallow aquatic bed
impounded by a weir


Seepage Reservoir

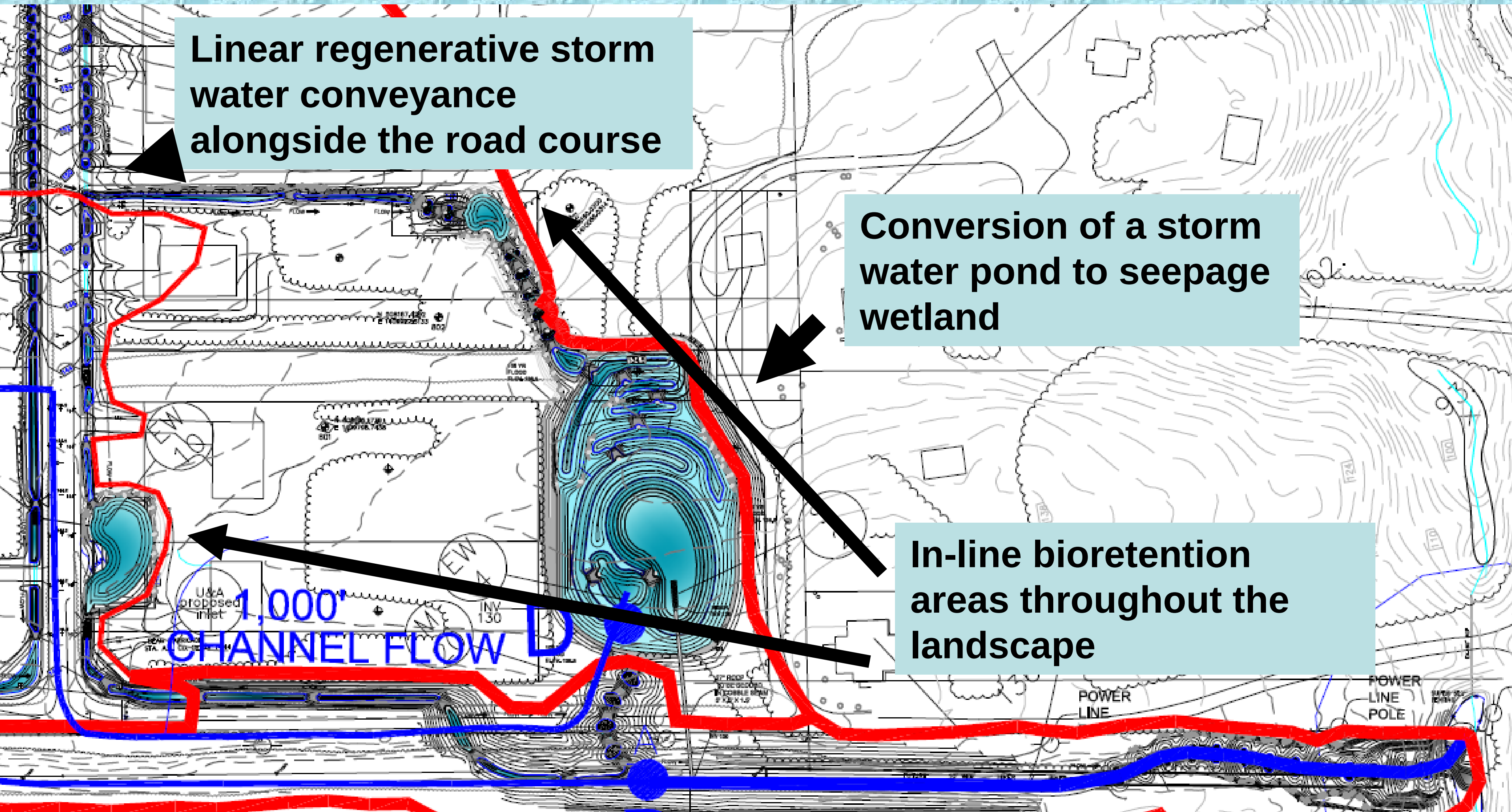
Pitcher plants on a mat of Sphagnum moss

Howard's Branch
3/28/02

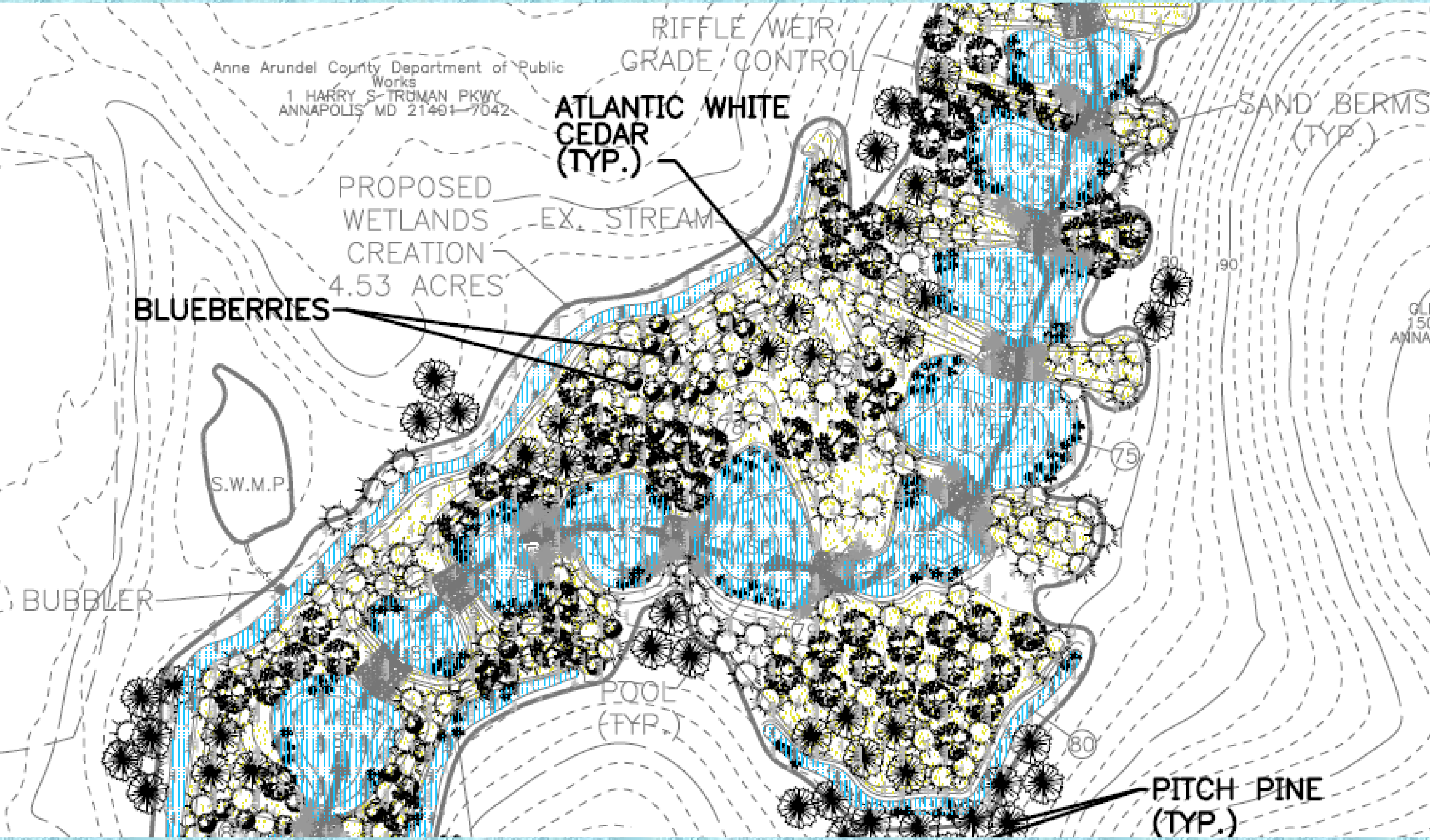
Good Site Design



Good Site Design



A Suite of Native Plants



Benefits of Regenerative Stormwater Conveyance

Convert Stormwater to Groundwater

Placing weirs as grade controls in-stream prevents further incision of the stream channel and impounds water throughout the landscape. This, in turn, will create valuable shallow, aquatic habitat, as well as re-charge the adjacent sandy soils with groundwater, providing additional cool, clean base flow to the downstream reach.

(Westbrook, C., Cooper, D. & Baker, B. (2006). Beaver dams and overbank floods influence groundwater–surface water interactions of a Rocky Mountain riparian area. ***Water Resources Research, vol.*** **42.)**


Infiltration increases baseflow

There is research which suggests both that while beaver dams may provide some downstream warming, they also dampen downstream temperature fluctuations, and that significant groundwater inflow, can dampen impoundment warming further.

(McCrae, G, & Edwards, C. (1994). Thermal Characteristics of Wisconsin Headwater Streams Occupied by Beaver: Implications for Brook Trout Habitat. *Transactions of the American Fisheries Society, 123*, 641–656.)

Dissipate Erosive Energy of Stormwater

The creation of detention pools in the landscape, connecting the upper reaches of the stream to its floodplain provides substantial sediment and nutrient reduction.

Groffman, P, Dorsey, A and Mayer, P. (2005). N processing within geomorphic structures in urban streams. ***Journal of the North American Benthological Society, 24*****: 613-625.**

Fennessy, M and Cronk, J. (1997). The effectiveness and restoration potential of riparian ecotones for the management of nonpoint source pollution, particularly nitrate. ***Critical Reviews in Environmental Science and Technology, 27*****: 285-317.**

Improved water quality is achieved through filtration & nutrient uptake, helping to address TMDLs.

These pools, as well as the sand berms along their edges, are loaded with woody, carboniferous material to provide additional benthic habitat and enhance nitrogen removal from the system.

Kasahara, T and Hill, A. (2006). Effects of riffle–step restoration on hyporheic zone chemistry in N-rich lowland streams. ***Canadian Journal of Fisheries and Aquatic Sciences, 63*****: 120-133.**

Reduce Permitting Time

Cost Competitive vs. Convention

Sand Seepage Wetland Cost/Benefit Example

Project	Cost	Benefits	Value*
Howard's Branch	$386,940	2.5 acres of wetland restoration	$437,500
		798 LF of stream restoration	$119,700
		49,594 cf of water storage	$495,940
Total	*$386,940*		*$1,053,140*
Cost/Benefit ratio: 1:3			

***Value is calculated based on a conventional cost of: $175k/acre wetland; $150 lf/stream; and, $10 cf of water storage.**

Less Intrusive/More Environmentally Sensitive
Community Amenity/Aesthetics

Dynamic, not Static

Promoting Stewardship

Call to Action/Questions

- We need to stop the bleeding, allowing storm water to runoff and cause a host of other problems (e.g., stream channel degradation).
- No net surface discharge from new development sites.
- Could be tied to groundwater withdrawal permits.
- Storm **water** is a resource

Questions? Comments?

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