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Plum Run Restoration of the Culvert in the Gordon Natural Area

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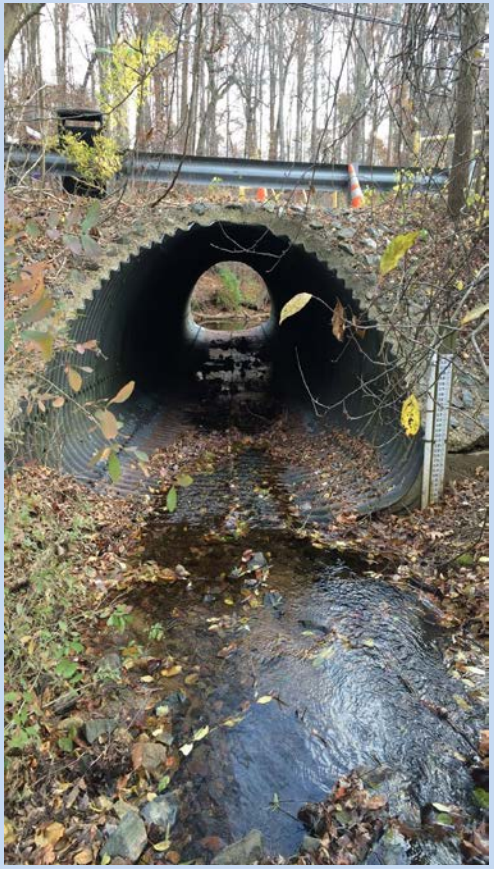
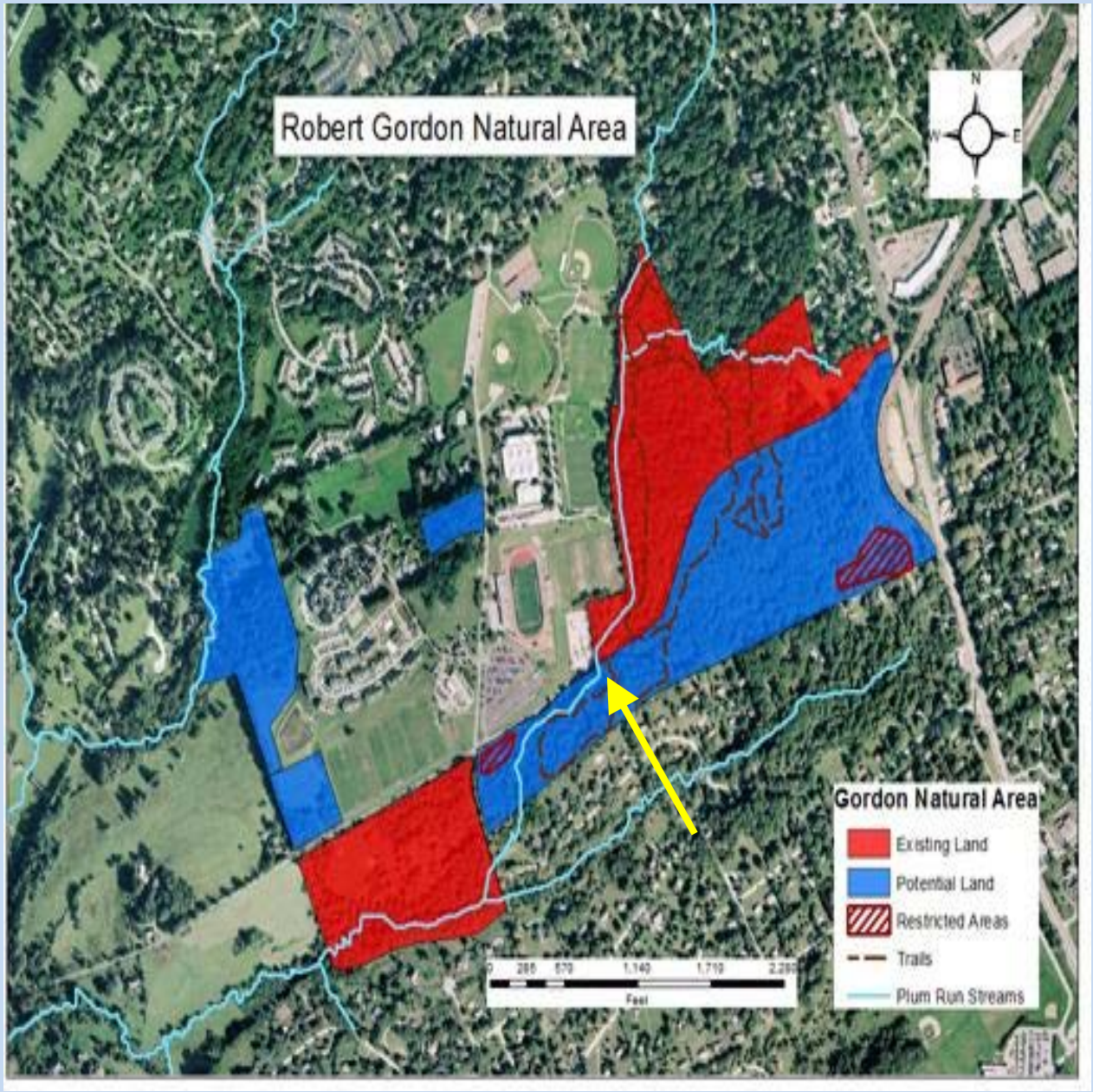
by Israel Berrios, Katie Walston and Kristen Koller

Background

- Plum Run is separated into two main branches: The West Branch and the East Branch
- Our site of concern is located within the East Branch adjacent to the Gordon Natural Area entrance and athletic fields on south campus
- Site picked due to rapidly increasing impairment



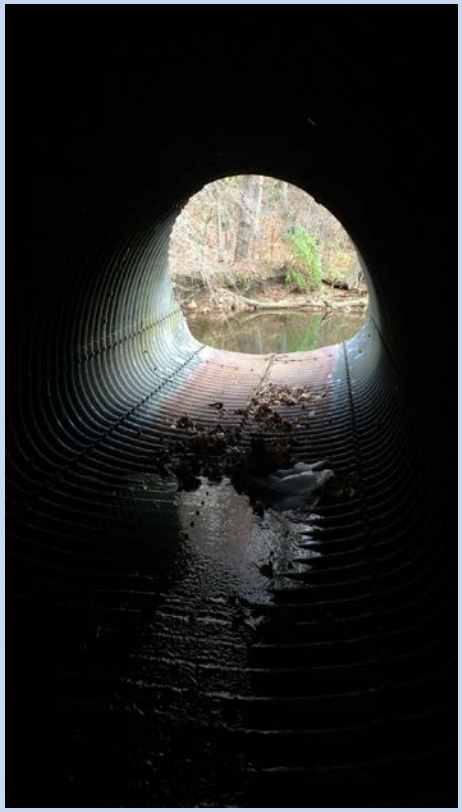

Robert Gordon Natural Area
N
W
E
S
Gordon Natural Area
Existing Land
Potential Land
Restricted Areas
Trails
Plum Run Streams
0
285
570
1,140
1,710
2,280
Feet

3 Problems

- Culvert and Stream Connectivity
- Banks and Sediment Deposition
- Salt Barn and Drain

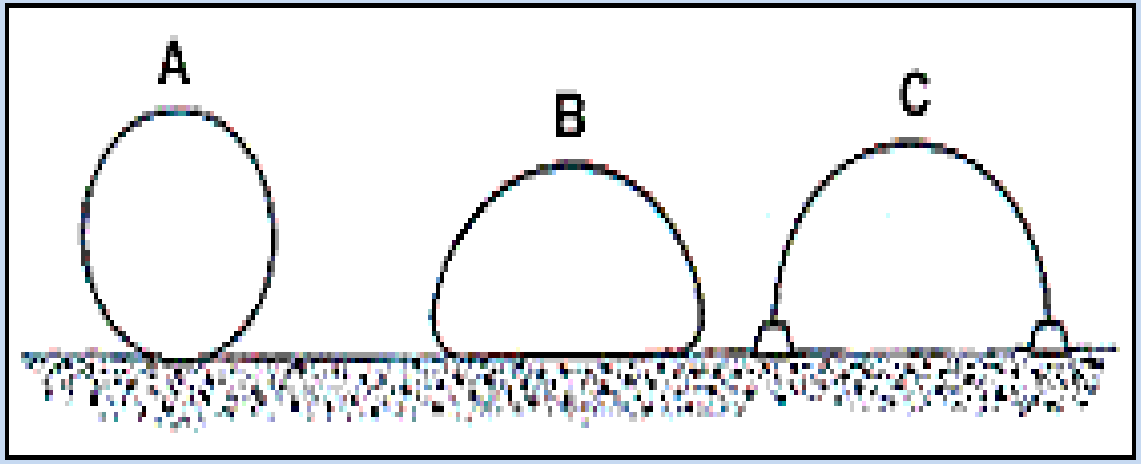
Problem: Culvert

- The water flows around and under the culvert rather than through it
- Connectivity is greatly reduced
- Discharge has decreased (the culvert acts as a dam, which is not the original purpose)
- Only during heavy rain events is water level high enough to flow through



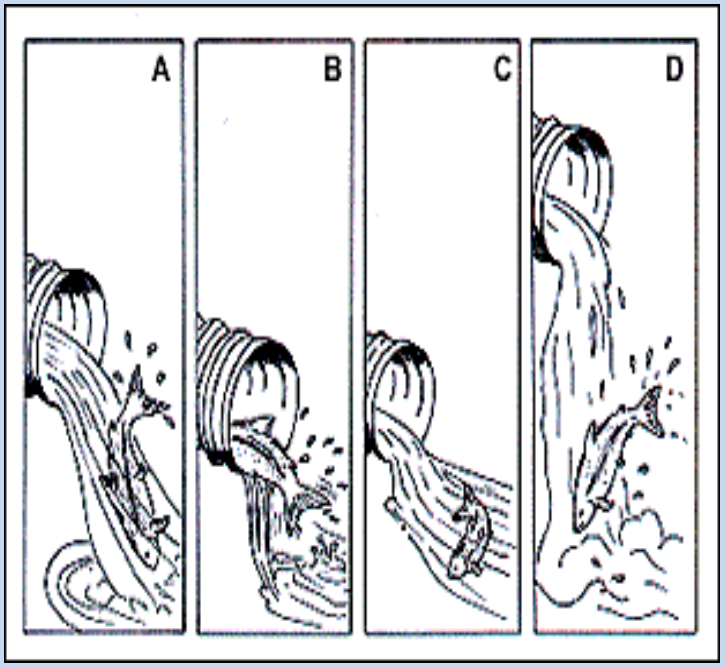
Solution

Taking out the corrugated round culvert (A) and replacing it with a structural plate-arch (C).



Round Culvert Issues for Fish

- Width constriction (Not so much in this case)
- Most culverts are elevated at the outlet end which creates an outfall barrier for the fish



Benefits to Using a Structural Plate Arch

- Natural streambed is left mostly unchanged so there are no issues with water flowing under or around the culvert
- Little to no significant change to water velocity so sediment deposition won't be that big of an issue on the inlet end of the culvert

Solution #2

- Taking out the culvert and have the stream naturally flow underneath the bridge
- Similar to the structural plate arch but less of a restriction to width

Hypotheses

- If we replace/repair the culvert connectivity will be re-established to allow fish to move freely up and down the stream
- It will also reestablish original discharge which will reduce sediment deposition upstream of the culvert

Estimated Cost

- The estimated cost of replacing the existing round corrugated culvert with a structural plate arch would be around $30,000 - $35,000

Problem #2: Banks and Sediment Deposition

- Banks are heavily eroded and sediment has been deposited upstream before the culvert
  - Because the culvert is slowing down the flow, sediment has settled out of the water and has been deposited onto the bottom creating a very shallow habitat
  - Erosion of the banks has contributed excess sediment input

Hypothesis

- If banks are re-established, the severity of erosion will decreased, decreasing the amount of sediment inputs to the stream and enhancing habitat quality
- Increasing depths and in stream habitats may promote fish communities

Banks and Sediment Deposition

Upstream

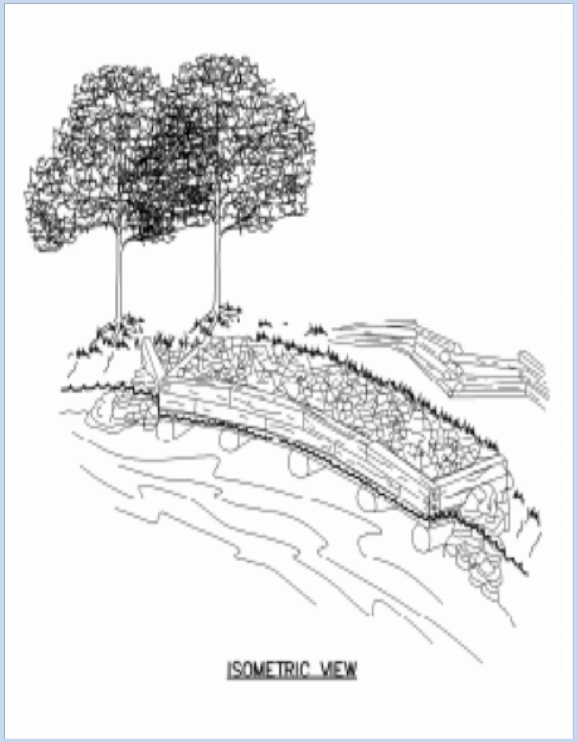
- Low flow, very shallow
- Dredge some areas to restore flow rates and reduce sediment build up
- By adding bends it will reduce heavy flow during storms that create erosion downstream
- Reinforcing with stakes

Banks

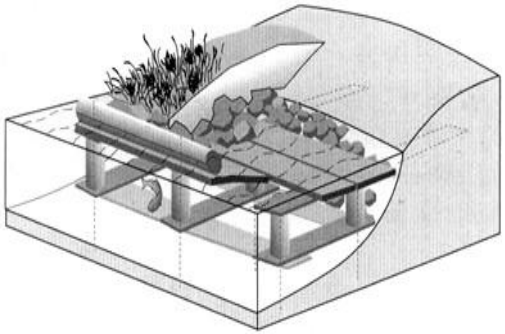
- Create gradual banks (pull back if possible)
- Erosion blankets
- Plant native vegetation, remove invasives
- Not much room to work with due to road and forest

Other techniques

- J hooks and rock dams
- Increased fish habitats



Lunker Structures



Cells constructed of heavy wooden planks and blocks which are imbedded into the toe of streambanks at channel bed level to provide covered compartments for fish shelter, habitat, and prevention of streambank erosion.

Other techniques

- Cleaning up fallen trees
- Leave some branches and leaf patches

Estimated Cost

- $100 per stream foot
- Working with about 300 feet
- About half the site needs these alterations

Problem #3: Salt Barn and Drainage

Solution

- Place some funding into research of effects
- Consult with university on moving the barn location to an area that will have less effect on the stream
- Replace open barn with a barn that can hold salt without allowing it to run into the stream

Stream Protection

- Keep as many trees as possible during restoration and removing any invasive species
- Replace invasive species with native shrubs and erosion mats.
- Use soft armor like branches to add stability to banks

Assessment and Monitoring Techniques Before and After

- WCU students can collect stream data as an educational experience, probes.
  - Collect data of water chemistry
    - ph, conductivity, temperature, hardness, alkalinity, DO%
  - Collect physical
    - Depth, discharge, turbidity, velocity, channel units, species richness fish tracking methods and invertebrate sampling

Monitoring sites and Frequency

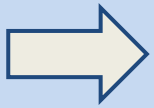
- Work with WCU professors to incorporate monitoring into labs performed at least 1 or 2 times each semester.
- 4 sites for fixed sampling
  - better for trends over time

Monitoring sites and Frequency

- Probes and Automated sampling devices to collect the water chemistry parameters
- Data entry in tables and graphs for easy analysis
- Habitat Score before restoration and once every year

Selling Point

- Education as means of monitoring
- Connectivity for invertebrate and fish movement
- Improving a moderately impaired stream into a healthy stream cheaper to fix now than later



Conclusion

- Replacing the culvert is our main focus to restore connectivity
- Education/monitoring will play a major role in protecting and maintaining stream health
- Bank/sediment stabilization and salt barn relocation are a secondary concern as only so much progress can be made in the limited space

Citations

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