

Linking Stream Restoration Success with Watershed and Design Characteristics

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The goal of this project is to improve understanding of the conditions under which stream restoration projects are “successful”

- Provide insight into selecting potential restoration sites with high probability of success
- Improve overall application, design and review of stream projects



What is project success?

**Channel
Stabilization**

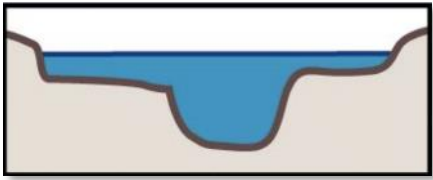


Mitigation

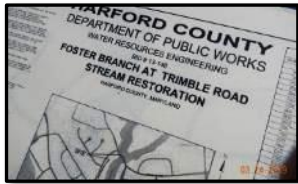
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Improve habitat

We developed three measures of project “success”



1. Field-based geomorphic function score
 - Floodplain access
 - Stable banks
 - Dense, native riparian vegetation
 - Region-appropriate bed material and bedforms



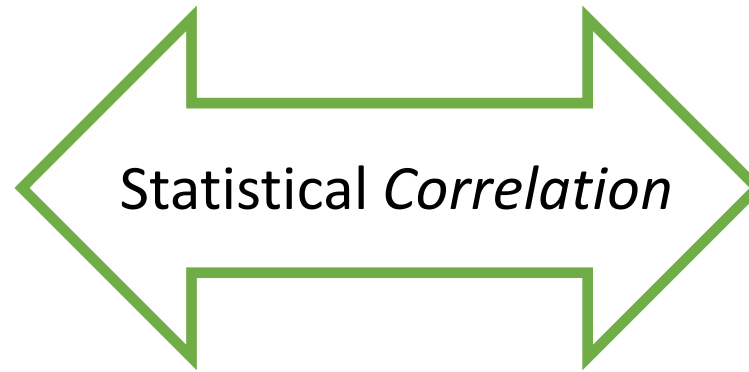
2. Field-based design score
 - Percentage of the original design still present
 - Are design features still functional



3. Monitoring report score – a mixture of function and design



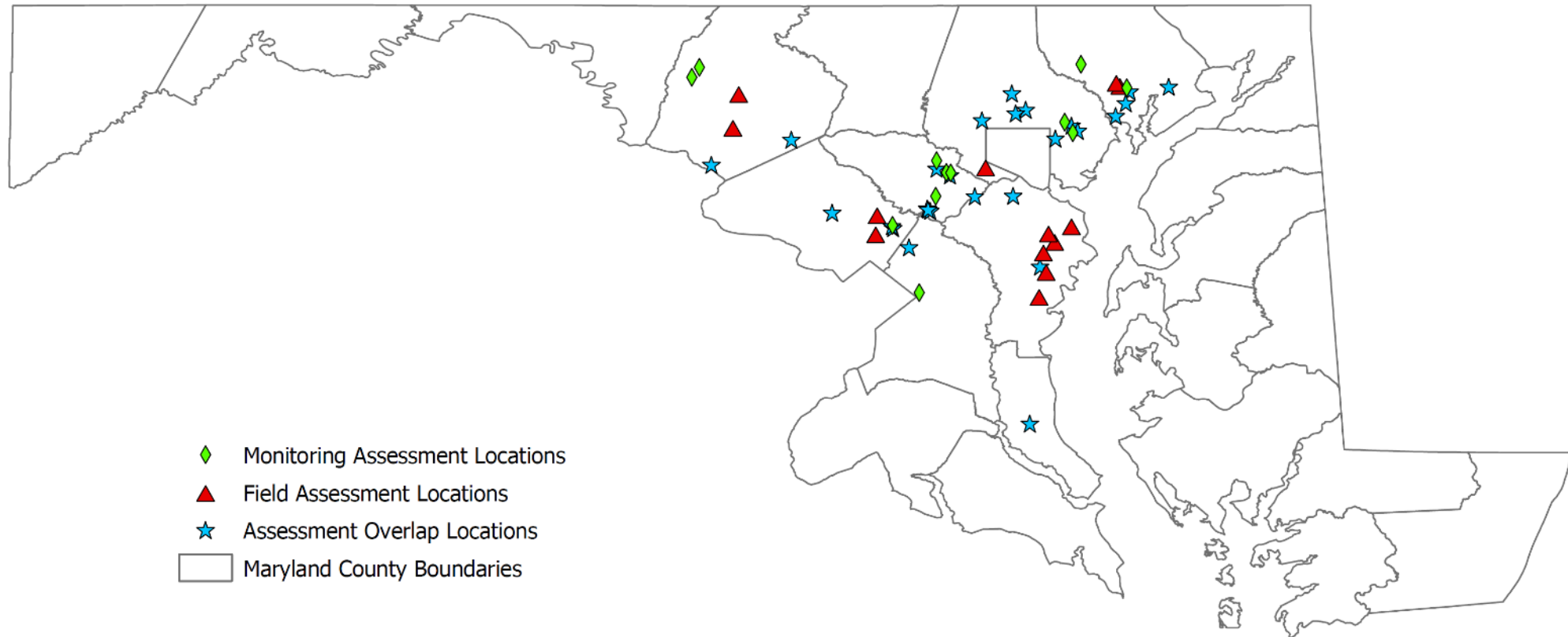
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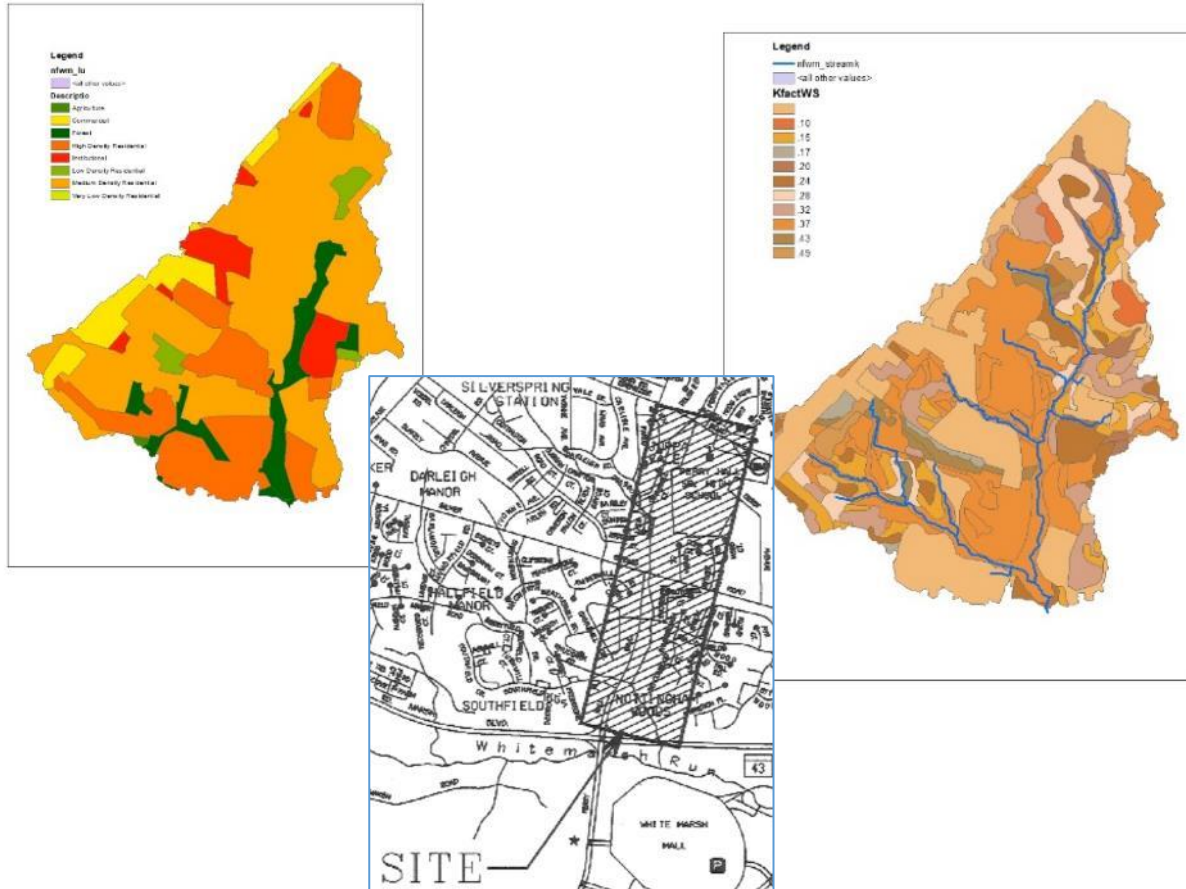
Parameters which indicate:

- **Flow energy**
- **Erosion resistance**
- **Design approach**

44 field and 40 desktop assessments completed



Watershed level data were collected using ArcGIS



Elevation data:

✓ 2-m DEMs from Maryland iMAP

USGS-NLCD land cover data:

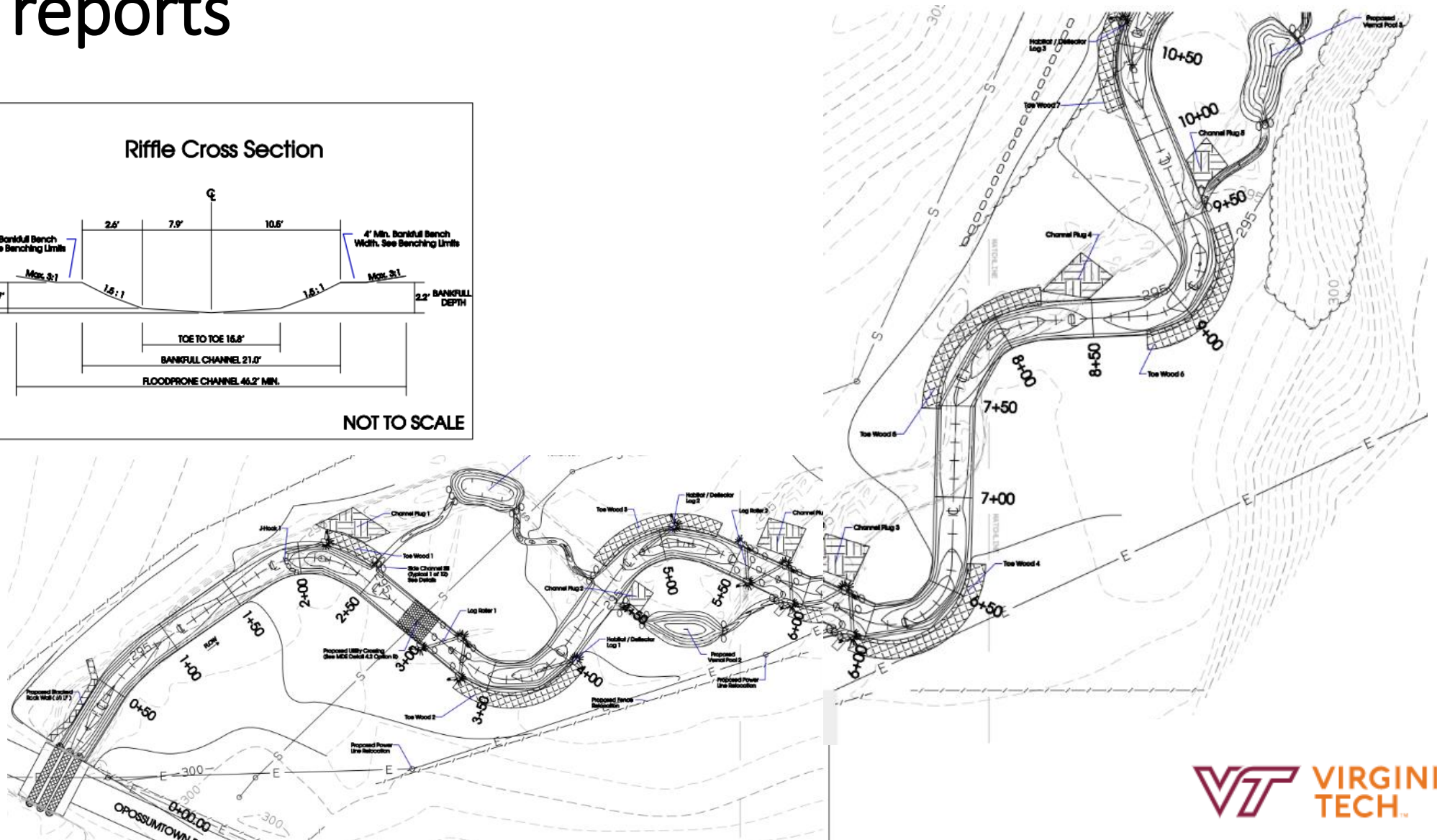
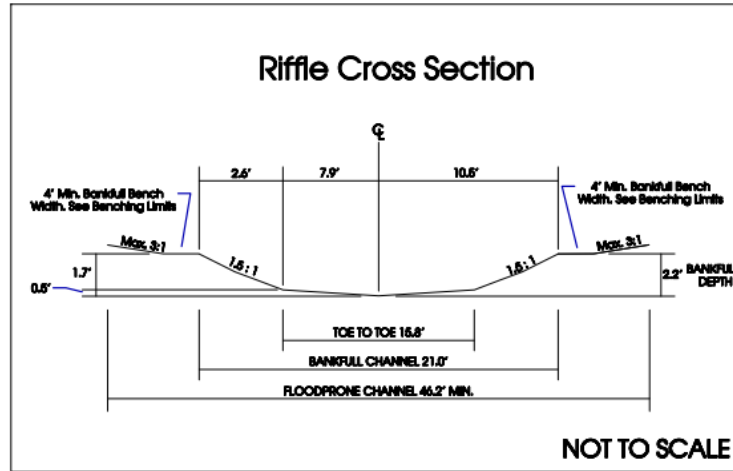
✓ 2001, 2006, 2011, 2016

Soils data:

✓ NRCS web soil survey

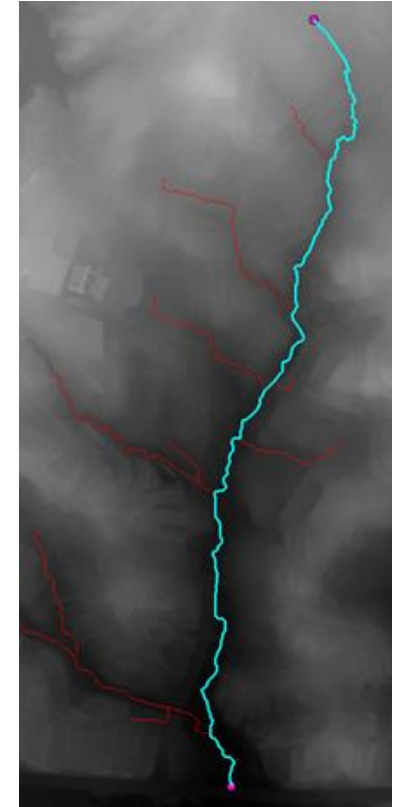
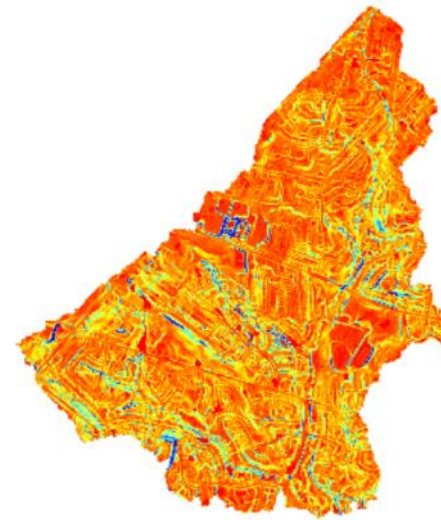


Project-level data were collected from project design plans and reports



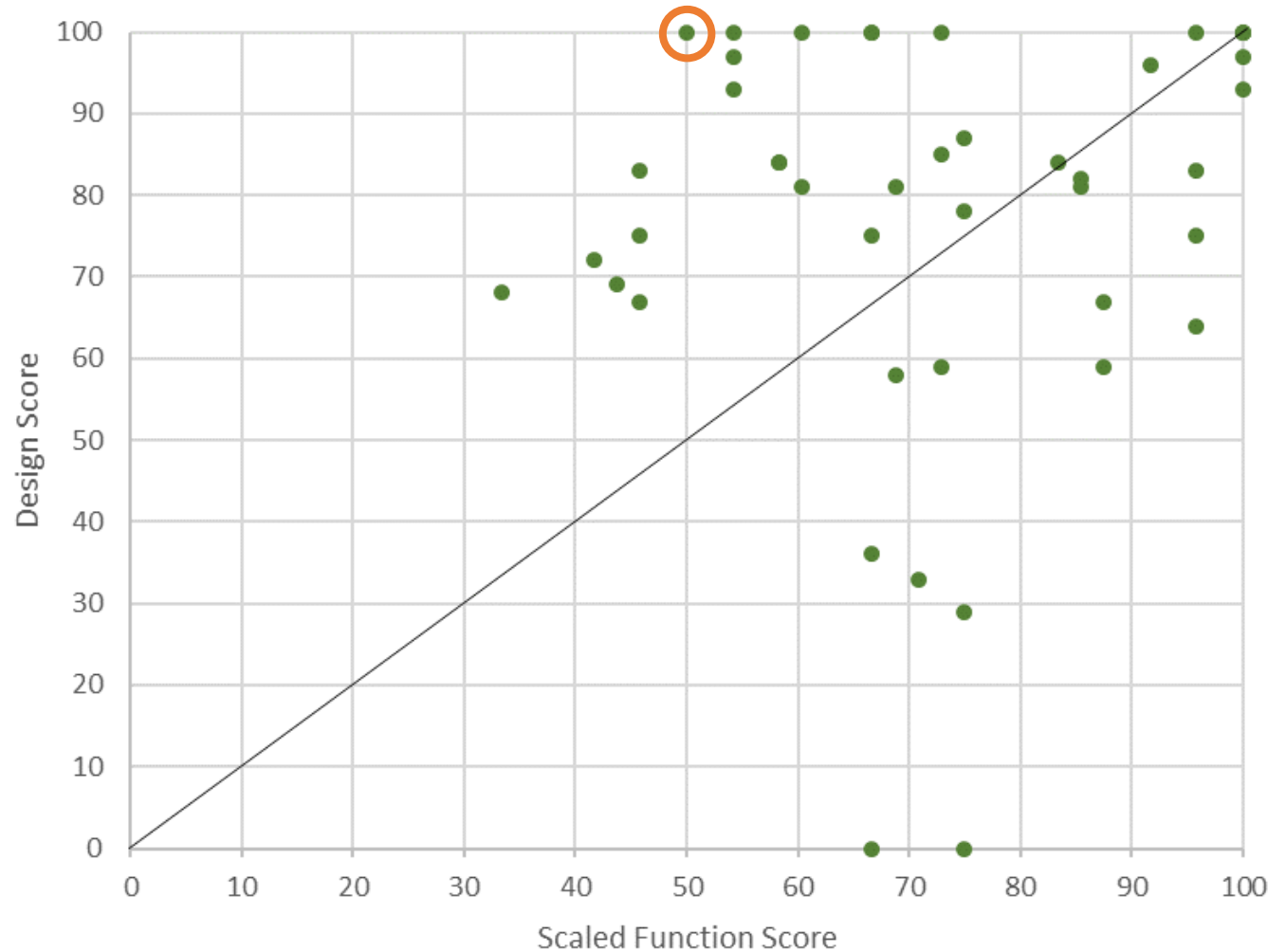
Example explanatory variables:

- **Flow energy**
 - Land cover
 - Discharge/watershed area
 - Unit stream power
- **Erosion resistance**
 - Soil erodibility
 - D_{50} /bankfull depth
- **Design approach**
 - Channel width:depth
 - Channel sinuosity



Results...

Projects assessed in the field scored differently in the function and design assessments



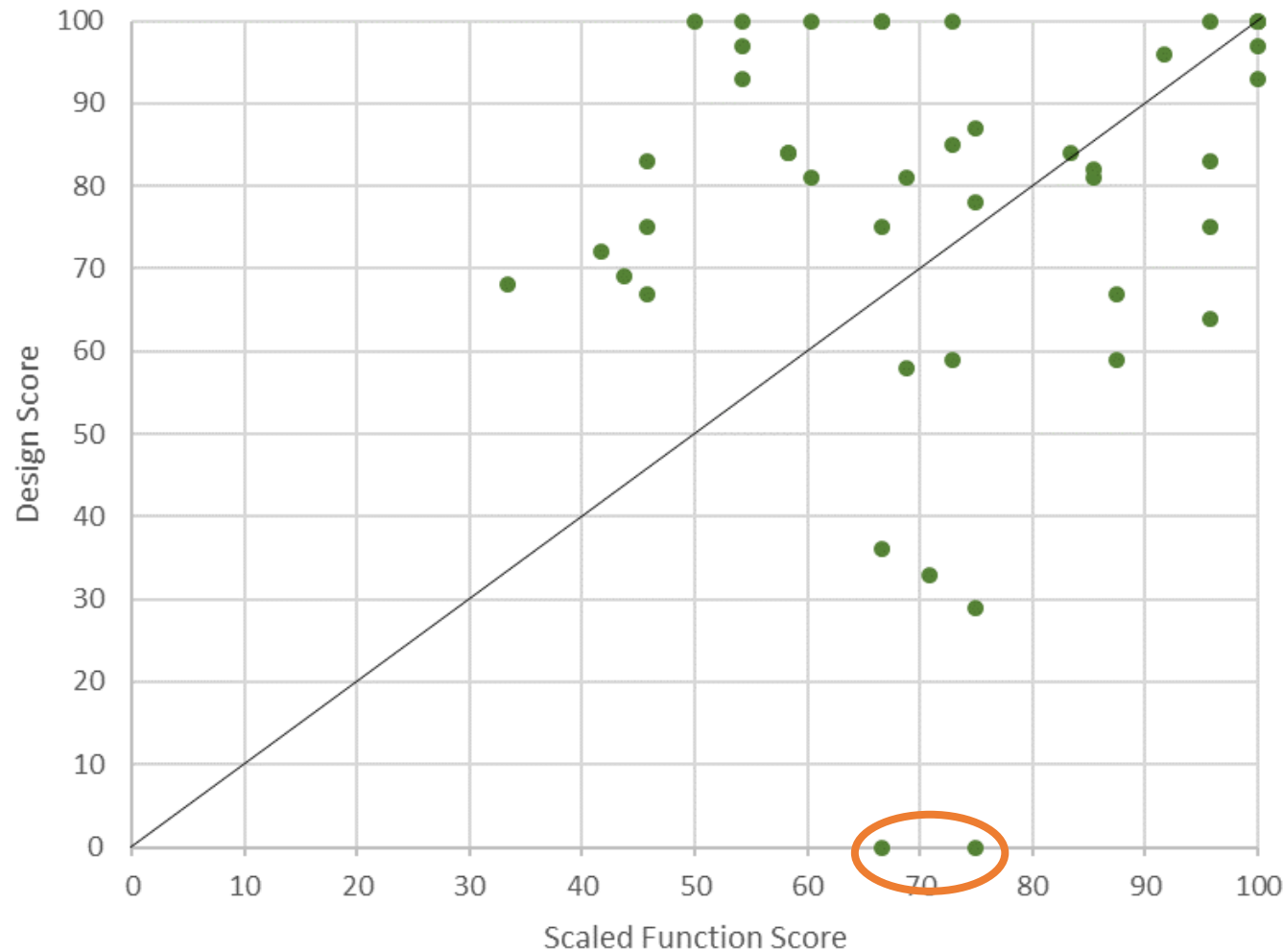
Example: Project 42

- 100% design score
- 50% function score
- Confined - urban subdivision
- Step-pool channel
- Rock-lined



03.12.

Projects assessed in the field scored differently in the function and design assessments



Projects 7 and 39 scored 0% on the design assessment but maintained high scores in the bedforms, substrate and cover categories.

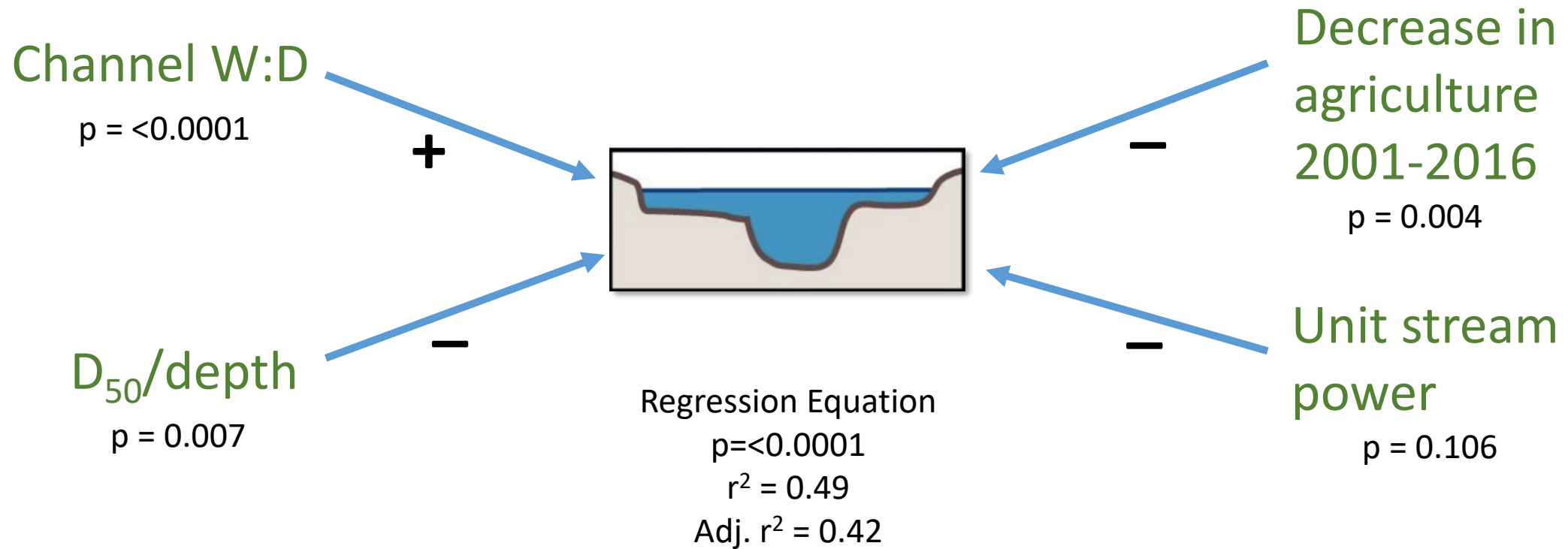


Project 7
(1995)

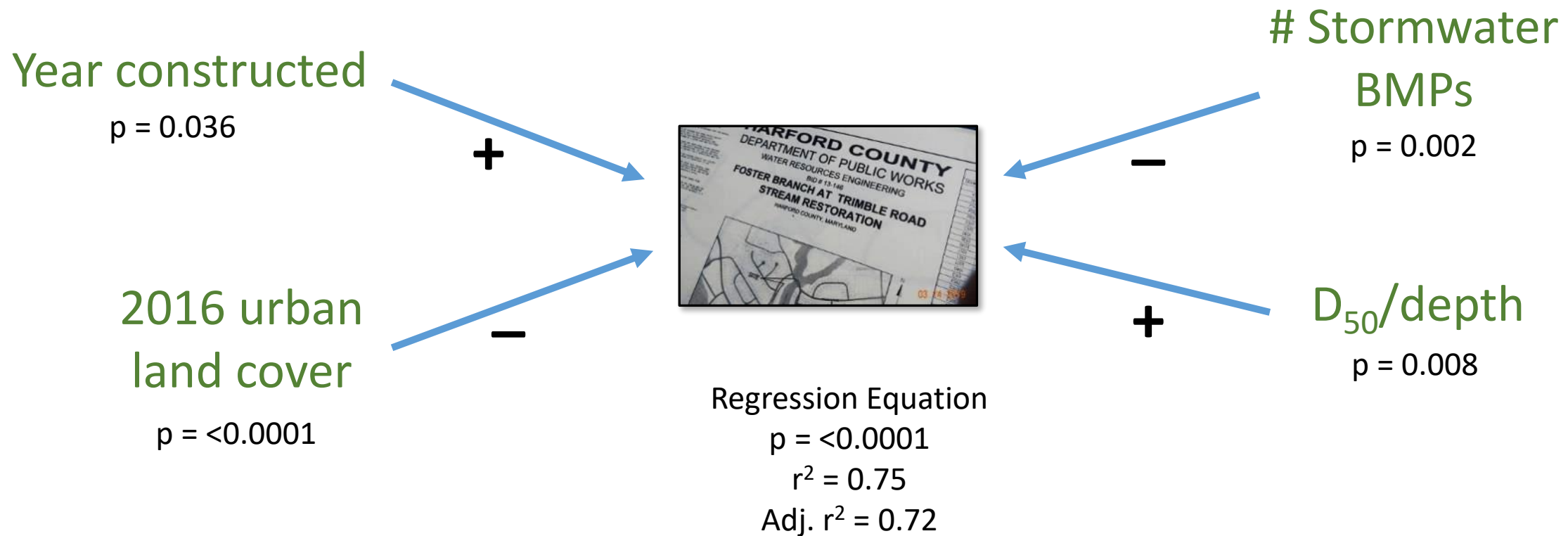


Project 39
(1999)

Geomorphic function was correlated with land cover change, channel width:depth, bed sediment size, and stream power.



Design success was correlated with project age, urban land cover, bed sediment size, and stormwater BMPs in watershed.

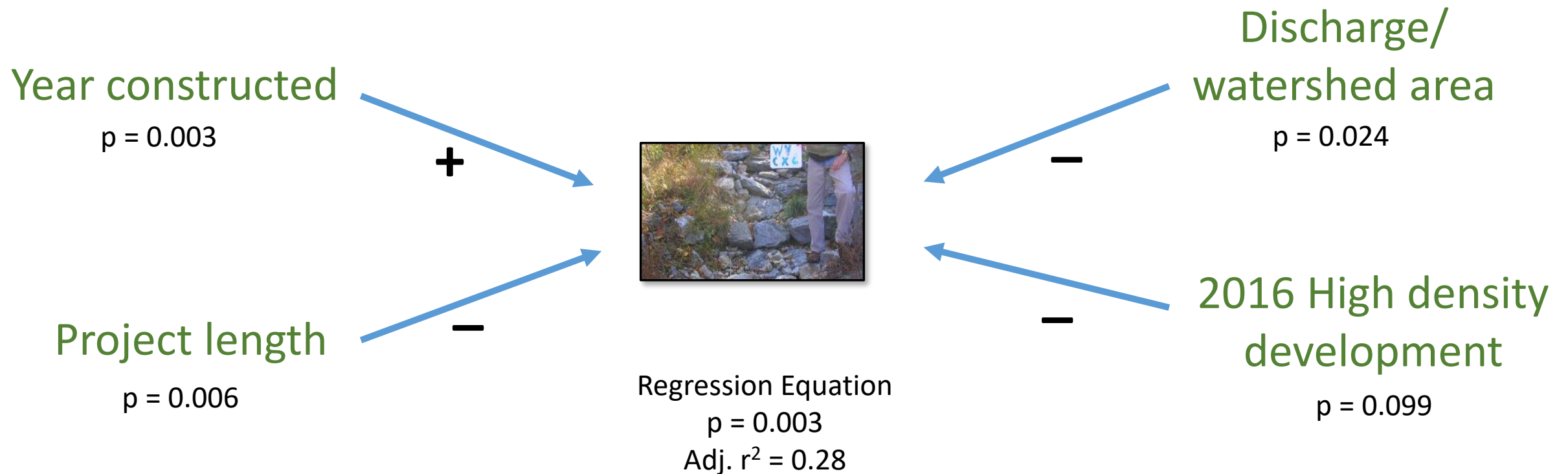


Design success was also correlated with:

- Distance to downstream grade control
- + Entrenchment ratio (floodplain width/
bankfull width)
- Channel slope at project

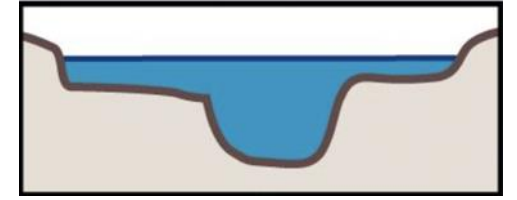


Project scores based on monitoring reports were correlated with project age and length, stream discharge, and 2016 high density development.



Research take-aways...

- Site selection is critical to restoring geomorphic function.
- Choose sites with...
 - Rural watersheds or watersheds without recent development
 - No constraints to decreasing bank height (increasing floodplain access)



Research take-aways...



- Expect stream restoration design features to fail over time (~ 20 yrs.)
- Design in urban watersheds is challenging
- Design failure \neq stream function loss
- If failure is not an option (e.g. infrastructure protection):
 1. Design with large bed particle size relative to channel depth
 2. Create as much floodplain access as possible
 3. Install grade control at the downstream end of the project

Research take-aways...

Suggestions for monitoring reports

- Project goals should be clearly stated and measurable
- Post-project monitoring requirements should assess project goals
- Do not measure what will not assess project goals



*Channel
Stabilization*

Mitigation

Improve habitat

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Ongoing research...

- Insights into structure design
- 1-D versus 2-D HEC-RAS modeling



01.

Wynn-Thompson Translation Slides

Translation Slides by Ari Engelberg (Maryland DNR)

- Overview and take-home points
- What do I take from this if I am a practitioner
- What do I take from this if I am a regulator