

Applied Techniques Webinar Series

Case studies and tools: Assessing the performance of stream and wetland restoration

Presented by: Kimberly Brewster Senior Project Manager Chagrin River Watershed Partners, Inc.







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TODAY'S SPEAKER

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Case Studies and Tools: Assessing the Performance of Stream and Wetland Restoration

Kimberly Brewster Chagrin River Watershed Partners, Inc.

October 24, 2018

Webinar overview

- Review of existing literature
- Research questions
- Methods
- Summary of results and case studies
- Lessons learned
- Feedback gathered and potential next steps

Chagrin River Watershed Partners

- Nonprofit organization in northeast Ohio
- Formed in 1996
- 34 member communities, counties, park districts







What Does CRWP Do?

- Model ordinances and adoption and implementation assistance
- Nature-based green infrastructure projects
- Stream and wetland restoration projects
- Comprehensive planning for balanced growth
- Direct landowner assistance
- Research and monitoring







Stream and Wetland Restoration Performance Assessment Project

- Developed in response to a request for more information by member communities and project partners
 - What is the long term performance of restoration projects?
- Funded through the ODNR Coastal Management Assistance Grant Program







Collins, M., Lucey, K., Lambert, B., Kachmar, J., Turek, J., Hutchins, E., Purinton, T., Neils, D. (2007). *Stream Barrier Removal Monitoring Guide*. Gulf of Maine Council on the Marine Environment.

Evans, J.E., Mackey, S.D., Gottgens, J.F., Gill, W.M. 2000. Lessons from a Dam Failure. Ohio Journal of Science.

McDonald, T., Gann, G.D., Jonson, J., Dixon, K.W. (2016). *International Standards for the Practice of Ecological Restoration – Including Principles and Key Concepts*. Society for Ecological Restoration.

Mecklenburg, D.E., Fay, L.A. (2011). A Functional Assessment of Stream Restoration in Ohio. Ohio Department of Natural Resources, Division of Soil and Water Resources.

Phillips, S. (n.d.) *How long is long enough to make a Water Quality improvement?* Oxbow River & Stream Restoration, Inc.

Sherer, E. (n.d.) Assimilative Capacity of Riparian Zones, Floodplains and Channels for Phosphorus. Ohio EPA Division of Surface Water. Available at: http://www.epa.ohio.gov/portals/35/lakeerie/ptaskforce/AssimilativeCapacityofRiparianZones.pdf

Literature Review

Mecklenburg, D.E., Fay, L.A. (2011). *A Functional Assessment* of Stream Restoration in Ohio. Ohio Department of Natural Resources, Division of Soil and Water Resources.

- Evaluated 51 Ohio stream restoration projects
 - Lack of floodplain connectivity
 - Poor riffle function
 - Poor soil quality

"The success of the observed stream restoration projects, as measured by several aspects of physical condition, varied widely despite meeting required permit performance criteria. The results of this study demonstrate a need for physical standards for restoration projects that physically reconfigure streams."



Literature Review

Phillips, S. (n.d.). *How long is long enough to make a Water Quality improvement?* Oxbow River & Stream Restoration, Inc.

- Reviewed outcomes of four Ohio restoration projects
- A variety of variables must be considered in the design of restoration projects and these are important to consider when assessing performance
- Some assessment methods can skew overall project results
- "The ultimate test of success for stream ecosystem restoration is attaining the aquatic life goals set forth in Ohio's WQS and the measurable sub-components of that process. As with any activity-based planning approach, there is a natural tendency to measure success in terms of the activity and structural inputs of that process, which stops short of measuring the ultimate outcome (i.e., the biology) of the same process."



Upper Main Branch of the Chagrin River, Village of Chagrin Falls, Ohio

Literature Review

McDonald, T., Gann, G.D., Jonson, J., Dixon, K.W. (2016). *International Standards for the Practice of Ecological Restoration – Including Principles and Key Concepts.* Society for Ecological Restoration.

- Effort to develop standards
- Performance assessment should begin at the planning stage
- Progress should be assessed against the targets, goals, and objectives of the project
- Results should be used to inform ongoing management



Literature Review – Information Gaps

- How do you assess the long-term success of a restoration project?
- How are restoration projects completed in the Chagrin River watershed doing?





Research Questions

- Is project meeting long-term goals? Why or why not?
- If necessary, what are remedies, costs and funding sources to fix?
- What are some common themes and lessons learned that may be helpful for future implementers?





Methods



- Assess at least 15 past stream and wetland restoration sites
- Review original project goals and objectives
- Use appropriate standardized protocols to assess performance
 - Habitat assessments
 - Other customized assessment criteria based on project goals
- Develop model assessment checklist
- Share results with communities



Assessed Stream and Wetland Restoration Sites

PROJECT	YEAR OF COMPLETION
Silver Creek Stream Restoration (Geauga Park District, Russell Township)	2003
Shadybrook Run Stream Restoration (Holden Arboretum, Kirtland Hills)	2009
Kenston Lake Dam Modification and Stream Restoration (Bainbridge Township)	2011
Pleasant Valley Park Floodplain Restoration (Lake Metroparks, Willoughby Hills)	2011
Chagrin River Green Bank Stabilization (Hunting Valley)	2011
Ivex of Ohio, Lower Dam Modification and Stream Restoration (Chagrin Falls Village)	2012
Sulphur Springs Stream Restoration (Cleveland Metroparks, Solon)	2012
Harmon Homestead Stream and Wetland Restoration (Aurora)	2013
East Branch Chagrin River Stream Restoration Project at Riverwood (Holden Arboretum, Chardon Township)	2013
Chagrin River Bendway Weir Restoration Demonstration Project (Willoughby)	2013
Ward Creek Stream Restoration (Willoughby)	2013
Forest Ridge Preserve Headwater Stream Restoration (Moreland Hills)	2013
Pierson Creek Headwater Stream Restoration (Holden Arboretum, Kirtland)	2014
Wisner Road Headwater Stream Restoration (Chardon Township)	2014
Ursuline College Stream Restoration (Pepper Pike)	2014
Aurora Branch Chagrin River Restoration (Aurora)	2015



Assessed Stream and Wetland Restoration Sites

- 16 sites including stream restoration or streambank stabilization
- 4 sites including wetland restoration
- 7 sites including primary headwater stream restoration (draining <1 mi²)
- 9 publicly owned sites
- 7 privately owned sites
- All sites restored with support from state and federal grant funds



Pre-Assessment Guide

PROJECT ADMINISTRATION

PROJECT NAME: RESTORATION FUNDING SOURCE: AMOUNT OF FUNDING AWARDED: LOCAL MATCH AMOUNT/SOURCE PROVIDED FOR PROJECT: TOTAL COST OF PROJECT INSTALLATION: YEAR OF FUNDING APPLICATION: YEAR FUNDING AWARDED: YEAR(S) OF PROJECT CONSTRUCTED: FUNDING APPLICANT: **GRANT ADMINISTERED BY:** DESIGN, DESIGN/BUILD, OR CONSTRUCTION FIRMS INVOLVED IN PROJECT:

Pre-Assessment Guide

PROJECT LOCATION AND SITE CHARACTERISTICS

PROJECT LOCATION DESCRIPTION OR ADDRESS: MUNICIPALITY NAME: COUNTY NAME: LANDOWNER NAME: LANDOWNER CONTACT INFORMATION: LANDOWNER CHANGES SINCE PROJECT COMPLETION? NEW PARTNERS TO INVOLVE? PERMISSION GRANTED TO ACCESS FOR ASSESSMENT? YES OR NO SITE ACCESS INFORMATION (e.g. park at pulloff along Township Road 251 and walk down path to site) PROJECT LATITUDE/LONGITUDE COORDINATES: USGS QUAD NAME: 12-DIGIT HUC WATERSHED CODE: 12-DIGIT HUC WATERSHED NAME: WATERWAY NAME: RIVER MILES (RM): DRAINAGE AREA OF RESTORED STREAM/WETLAND: PRE-CONSTRUCTION AQUATIC LIFE USE (ALU) STATUS (ATTACH ASSESSMENT FORMS) OHIO EPA SAMPLING LOCATION: LOCATION IN RELATION TO RESTORATION SITE: YEAR ASSESSED: ALU DESIGNATION (e.g. WWH): ALU ATTAINMENT STATUS (FULL, PARTIAL, NON): IBI SCORE: ICI SCORE: OHEI TOTAL SCORE AND NARRATIVE RANGE: Metric 1 score: Metric 2 score: Metric 3 score: Metric 4 score: Metric 5 score:

RESTORATION GOALS (check box and provide description)

IMPROVEMENT IN ALU ATTAINMENT STATUS MAINTENANCE OF ALU ATTAINMENT STATUS WATER QUALITY IMPROVEMENTS **BIOLOGICAL IMPROVEMENTS** HABITAT IMPROVEMENTS **RESTORE NATURAL FLOW** IMPROVED FLOODPLAIN CONNECTIVITY SOCIAL/CULTURAL PUBLIC SAFETY IMPROVE RECREATIONAL ACCESS LAND PRESERVATION OTHER **RESTORATION OBJECTIVES** LINEAR FEET RESTORED:

WETLAND ACRES RESTORED:

RIPARIAN ACRES VEGETATED:

ACRES PRESERVED (INDICATE LAND USE TYPES PRESERVED)

- How do you assess all projects consistently?
- Stated goals vary widely, and can even vary by project partner
- Attainment/maintenance of ALU ultimate goal

Metric 6 score:

Pre-Assessment Guide

RESTORATION ASSESSMENT

AGE OF PROJECT: DESIGNED LIFESPAN OF PROJECT: POST-CONSTRUCTION AQUATIC LIFE USE (ALU) STATUS (ATTACH ASSESSMENT FORMS) OHIO EPA SAMPLING LOCATION: LOCATION IN RELATION TO RESTORATION SITE: YEAR ASSESSED: ALU DESIGNATION (e.g. WWH): ALU ATTAINMENT STATUS (FULL, PARTIAL, NON): IBI SCORE: ICI SCORE: QHEI TOTAL SCORE AND NARRATIVE RANGE: Metric 1 score: Metric 2 score: Metric 3 score: Metric 3 score: Metric 4 score:	DID PROJECT MEET GOALS DURING PROJECT MONITORING PERIOD? (LIST DATA AND SOURCE) ASSESSMENT PLANNED BY OUTSIDE AGENCY (LIST ASSESSING ENTITY, TYPE OF ASSESSMENT, AND PLANNED DATE OF ASSESSMENT): APPROPRIATE METHODS FOR CURRENT ASSESSMENT (CHECK ALL THAT APPLY, PROVIDE AS ATTACHMENTS) QHEI HHEI BIOLOGICAL ASSESSMENTS (IBI/ICI) BEHI PLANT SURVIVAL PHOTOGRAPHS (COMPARE TO PRE- AND POST-CONSTRUCTION PHOTOGRAPHS) CURRENT AERIAL MAPS ASSESSMENT LOCATIONS: WILL DOWNSTREAM OHIO EPA SAMPLING LOCATIONS ALSO BE ASSESSED? SHOULD PROJECT BE OBSERVED DURING HIGH FLOW TO ASSESS FLOODPLAIN CONNECTIVITY? ADDITIONAL ASSESSMENT NOTES:
Metric 5 score:	
Metric 6 score:	DOES PROJECT CURRENTLY MEET ORIGINAL GOALS?
	SURROUNDING LAND USE CHANGES?
	WHAT IS IMPERVIOUS COVER IN AREA DRAINING TO RESTORATION PROJECT? HAS THIS CHANGED?
	OTHER PROJECTS BEING IMPLEMENTED UPSTREAM THAT MAY CONTRIBUTE TO GOALS NOT MET?
	OTHER LANDOWNER CONSIDERATIONS

Model Restoration Checklist –Stream Restoration

STREAM RESTORATION PERFORMANCE ASSESSMENT FIELD CHECKLIST		
PROJECT NAME:		
NAME OF STREAM/WATER BODY AND RIVER MILE:		
ASSESSMENT LOCATION DESCRIPTION:		
ASSESSMENT LOCATION LATITUDE/LONGITUDE:		
NAME(S) AND AFFILIATIONS OF FIELD PERSONNEL:		
DATE/TIME:		
WEATHER CONDITIONS: <i>(check one)</i> _X Clear Overcast Rain showers Air temperature _~85 degrees (°) Fahrenheit (F)		
PRECIPITATION DURING LAST 24 HOURS? YES or NO (circle one)		
WATER LEVEL/FLOW CONDITIONS: HIGH AVERAGE LOW (circle one)		
ADDITIONAL VISIT REQUIRED? (Provide explanation)		

Model Restoration Checklist –Stream Restoration

Project Goals	Assessment	Score/Measurement	Notes
Meet/maintain attainment of Aquatic Life Use designation	Index of Biotic Integrity (IBI)		
	Invertebrate Community Index (ICI)		
Improve habitat	Qualitative Habitat Evaluation Index (QHEI)		
	Headwater Habitat Evaluation Index (HHEI)		
Stabilize streambanks	Bank Erosion Hazard Index		
	Downstream sedimentation? (Downstream QHEI)		
Improve water quality	Temperature (° Celsius)		
	рН		
	Specific Conductivity (μS/cm)		
	Total Dissolved Solids (ppm)		
	Dissolved oxygen (mg/L and %)		
	Water column transparency		
	Visible water pollution?		
Decrease nutrient enrichment	Evidence of nutrient enrichment (e.g. algal blooms?)		
	Nitrate/Nitrite/Phosphorus concentration or loading		
	Presence of stream characteristics conducive to nutrient assimilation (e.g. vegetated riparian buffer >100ft, floodplain access, and natural channels/coarse substrates/flow velocity		
	diversity)?		

Model Restoration Checklist –Stream Restoration

Enhancement of riparian vegetation	Riparian vegetative cover (% cover)	
	Tree/shrub/livestake survival (% survival)	
	Presence/absence of planted species	
	Invasive plant species present? (Provide approx. % cover and list species present)	
Improve floodplain connectivity	Visual inspection during or immediately after storm event (provide notes and photos)	
	Comparison of pre- and post-construction cross sectional surveys	
	Is there evidence that stream has access to floodplain? (e.g. note any entrenchment, steep banks, etc)	
Land preservation	Compliance with deed restrictions	
Social/cultural	Public safety maintained/improved?	
	Recreational access maintained/improved?	
Visual	Current photos attached for comparison with pre- and post-construction conditions?	
Other	Trash/Debris/Illegal dumping within project site	

Other notes:

Model Restoration Checklist – Wetland Restoration

WETLAND RESTORATION PERFORMANCE ASSESSMENT FIELD CHECKLIST		
PROJECT NAME:		
ASSESSMENT LOCATION DESCRIPTION:		
ASSESSMENT LOCATION LATITUDE/LONGITUDE:		WETLAND SIZE (ACRES):
NAME(S) AND AFFILIATIONS OF FIELD PERSONNEL:		•
DATE/TIME:		
WEATHER CONDITIONS: (check one) Clear Overcast Rain showers Air temperature degrees (°) Fahrenheit (F) or Celsius (C) (circle one)		
PRECIPITATION DURING LAST 24 HOURS? YES or NO (circle one)		
WATER LEVEL/FLOW CONDITIONS: HIGH AVERAGE LOW (circle one)		
ADDITIONAL VISIT REQUIRED? (Provide explanation)		

Model Restoration Checklist –Wetland Restoration

Project Goals	Assessment	Score/Measurement	Notes
Improve function and quality of wetland	Ohio Rapid Assessment Method for Wetlands (ORAM)		
Enhancement of wetland vegetation	Vegetative cover in planting area (% cover)		
	Tree/shrub/livestake survival (% survival)		
	Presence/absence of planted species		
	Invasive plant species present? (Provide approx. % cover and list species present)		
Improved floodplain connectivity to wetlands	Visual inspection during or immediately after storm event (provide notes and photos)		
	Comparison of pre- and post-construction cross sectional surveys		
	Is there evidence that stream has access to floodplain? (e.g. note any entrenchment, steep		
	banks, etc)	Y or N	
Creation of vernal pools	Does vernal pool dry up once throughout the year?	Y or N	
Land preservation	Compliance with deed restrictions	Y or N	
Social/cultural	Public safety maintained/improved?		
	Recreational access maintained/improved?		
Visual	Current photos attached for comparison with pre- and post-construction conditions?	Y or N	
Other	Trash/Debris/Illegal dumping within project site	Y or N	

Summary of Results



- Projects generally successful
- 15/16 of restored stream reaches assessed with QHEI indicated good/excellent scores
- 4/5 of restored wetlands assessed with ORAM indicated Category 2 or higher wetlands
- No significant erosion within or directly adjacent to project reach at 63% of sites
- 69% of sites with evidence of floodplain access
- Vegetative cover within restoration reach >95% for 100% of sites
- ~18% average invasive plant species cover
- No significant trash/dumping at 100% of sites

What Worked Well?

What Worked Well?

- Reconnection of streams to floodplains
- Improved habitat quality
- Facilitation of native species establishment
- Establishment of stream characteristics conducive to nutrient assimilation





Restoration completed in 2011/2012



- Pre-construction status
 - Partial WWH at 2 downstream sampling locations
 - State Scenic Chagrin River
 - Poor floodplain access
- Project goals
 - Increase floodplain storage
 - Enhanced water quality treatment
 - Wetland restoration
 - Improved wildlife habitat
- Project objectives to help reach goals
 - Levee removal (650 feet)
 - Wetlands restoration through drain tile and gravel road removal (3.5 acres)
 - Creation of vernal pools
 - Invasive species removal (11.4 acres)
 - Floodplain restoration to forest and meadow (17 acres)

- Project goals met during project monitoring period?
 - Post-construction QHEI of 73.0 ("Good") at RM 11.10 (OEPA, 2014)
- How to assess for this project?
 - Replicate post-construction QHEI
 - ORAMs at restored wetlands and vernal pools
 - Percent vegetative cover in riparian zone
 - Percent cover of invasive plants
 - Visual assessment of floodplain access





 Indicators of improved floodplain access





 Restored forested floodplain, wetland, vernal pool, and meadow habitats



- 2017 Results
 - QHEI score = 80.5 ("Excellent")
 - ORAM scores = Category 2
 - Riparian vegetative cover >95%
 - ~ 10% cover of invasive plants
 - Phragmites
 - Narrowleaf cattail
 - Japanese knotweed
 - Butterbur
 - Purple loosestrife
 - Other, well established invasives
 - Visual evidence of floodplain access
- Partial attainment of WWH at 2 downstream sampling locations







Restoration completed 2011/2012

- Pre-construction status
 - Non-attainment of WWH at project site (RM 30.4)
 - Pre-construction (2008) QHEI score: 59.5 ("Fair")
- Project goals
 - Attainment of WWH at project site
 - Restore natural stream flow
 - Floodplain connectivity
 - Improved aquatic habitat upstream of dam
 - Moderation of water temperatures
 - Lower risk of spillway failure (reduce amount of water impounded)
- Project objectives to help reach goals
 - Lower earthen dam and concrete spillway ~ 10ft
 - Reestablish natural stream corridor
 - Revegetate former lake bed



Construction, 2011



- Project goals met during project monitoring period?
 - Post-construction QHEI scores (OEPA, 2014) indicated "good" narrative ratings within restoration reach (74.75) and downstream of restoration (72)
- How to assess for this project?
 - Replicate post-construction QHEIs
 - Percent vegetative cover in riparian zone
 - Percent cover of invasive plants
 - Visual assessment of floodplain access



• 2017 Results

- QHEI scores
 - Within restoration reach: 70 "Good"
 - Downstream: 81 "Excellent"
- Riparian vegetative cover >95%
- ~ 25% cover of invasive plants
 - Phragmites
 - Narrowleaf cattail
 - Other, well established invasives
- Floodplain access not optimal upstream of modified spillway
- Nonattainment of WWH within restoration reach (IBI/ICI assessed by OEPA 2008)
- Full attainment of WWH at downstream of restoration (IBI/ICI assessed by OEPA 2014)



Upper Main Branch of the Chagrin River, upstream of restoration project, 2017





Restoration Start (upstream)
 Restoration End (downstream)
 OHELAssessment Reach (200 m)
 Dhio EPA Assessment Point
 Eull attainment GWH



Restoration completed 2013

- Pre-construction status
 - East Branch full attainment of CWH
 - Pre-construction QHEIs (OEPA, 2012)
 - RM 12.1 (upstream of project site)=67.0
 - RM 11.75 (project site)=81.5
 - RM 11.4 (downstream of project site)=67.8
- Project goals
 - Restore eroding streambanks
 - Restore floodplain access
 - Establish forested floodplain
- Project objectives to help reach goals
 - Remove levee
 - Restore headwater stream and stabilize a second headwater stream
 - Native plantings ("relay floristics")







- Project goals met during project monitoring period?
 - Post-construction QHEI scores (OEPA, 2015) indicated "excellent" narrative ratings within restoration reach (score = 85)
- How to assess for this project?
 - Replicate post-construction QHEI and HHEIs
 - Percent vegetative cover in riparian zone
 - Percent cover of invasive plants
 - Visual assessment of floodplain access



- 2017 Results
 - QHEI scores
 - Within restoration reach: 75.75 "Excellent"
 - Riparian vegetative cover >95%
 - Floodplain access good
 - <5% cover of invasive plants
 - Facilitation of native species establishment very good





Establishment of Stream Characteristics Conducive to Nutrient Assimilation





Aurora Branch Chagrin River Restoration (Aurora) - 2015



Lessons Learned

Some Initial Invasive Species Management May Be Necessary





Best Landscape Management Practices Are Important





Downstream Consequences of Hardening Streambanks





Other Lessons Learned

- Avoid assessing at high or very low flow
- Use at least two monitoring locations (especially for large sites)
- Set realistic expectations with landowners about natural aesthetics
- In general, projects very successful



Feedback gathered in 2018

- Public perception may be the ultimate measure of project's success
- Ongoing management of invasive plant species is difficult to achieve with limited staff and funding
- Important to consider the overall effect of multiple restoration projects within a watershed
- Important to consider the degree of impervious cover in the area draining to a restoration site
- Simple and rapid restoration assessment tool tailored for the northeast Ohio region is valuable to facilitate consistent measurement of project success
- Suggested creation of a restoration roundtable group



Thank you! Questions?

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