OhioEPA
Division of Surface Water

Stream Mitigation Protocol Development

Application of Weighting Model Approach for Stream Mitigation Reviews in the 401 Water Quality Certification Process

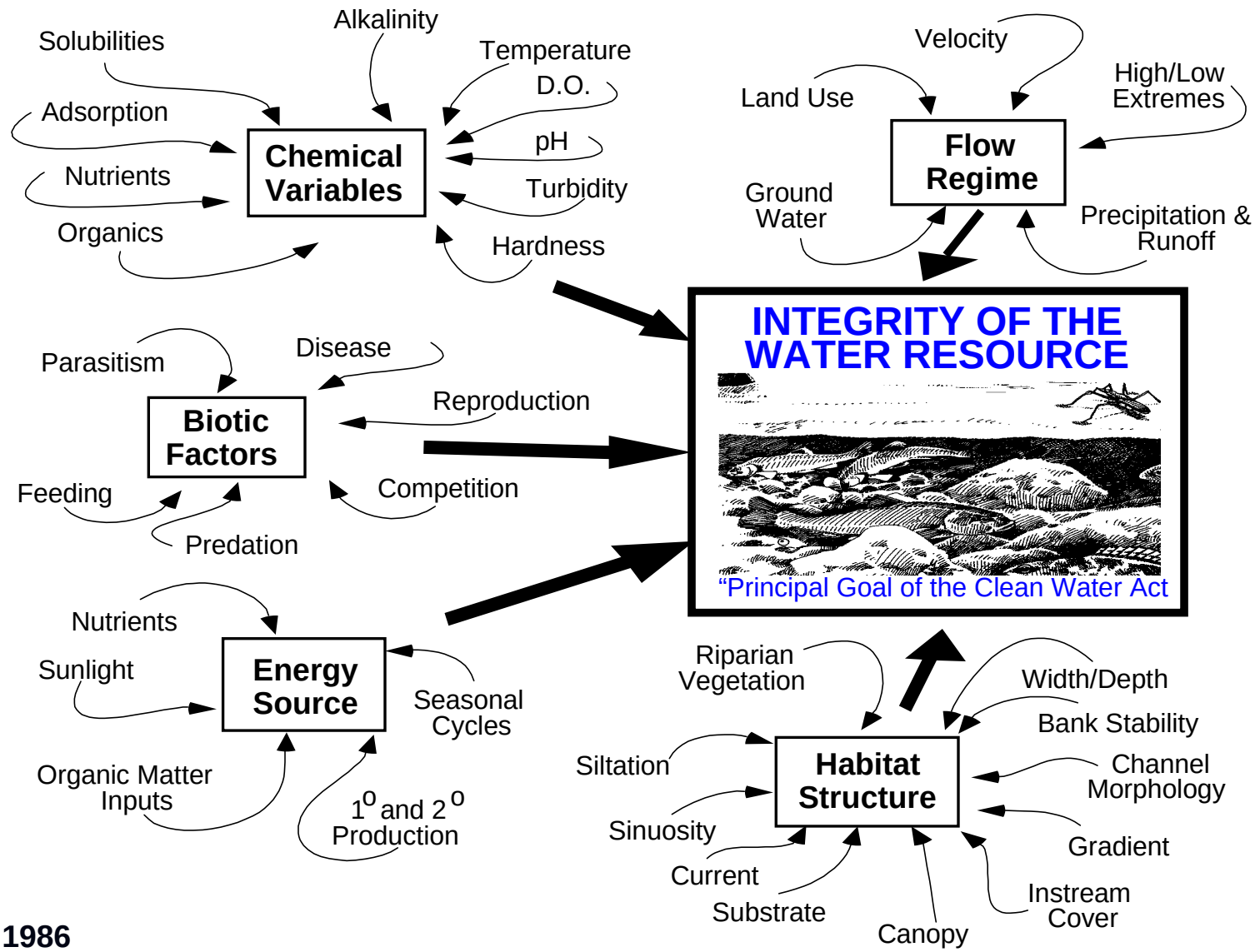
Vision Statement

To develop a scientifically sound and predictable methodology for assessing impacts to stream ecosystems and associated compensatory mitigation proposals under review by Ohio EPA through the 401 Water Quality Certification Program.

Goals for Protocol Development

- Protocol should be incorporated by reference into a stream mitigation rule promulgated in the OAC.
- Protocol must be able to account for varying types of stream impacts with respect to existing stream uses as well as the range of potential mitigation projects which may be proposed to compensate for these impacts.

The Five Major Factors Which Determine the Integrity of Aquatic Resources



after Karr *et al.* 1986

Goals for Protocol Development

- Protocol should provide predictability and uniformity to the 401 Water quality certification process.
- Protocol should emphasize the development of mitigation proposals which are scientifically sound and durable.
- Approved stream mitigation plans developed under the protocol must be adequate to compensate for lost or impaired in-stream uses.

Current Situation

- 401 Water Quality Certification reviews for stream impacts conducted under context of the anti-degradation rule.
- Linear foot ratios used as basis for the establishment of mitigation requirements.
- Currently no codified or standardized procedures for project review.

3 : 1 ???

Preservation?

Restoration??

1.5 : 1??

Consequences of Current Approach

- Processing of applications slowed because of case-by–case review procedures and lack of uniform guidance.
- Lack of predictability regarding the awarding of mitigation credits discourages the development of sound mitigation projects.
- Stream preservation becomes the most desirable mitigation approach because of costs and availability.

Consequences of Current Approach

- Mitigation projects may not adequately compensate for impacts approved through the 401 process.
- Resolution of disputes difficult because of the lack of uniform policy.

Alternative I: Ratio Model

- Use of wetland mitigation rule as model.
  - Mitigation ratios based upon stream classification (anti-degradation categories and aquatic life use).

Alternative I: Ratio Model

- Advantage: Apparent "simplicity"
  - Requires only a simple table placed in the mitigation rule.

Alternative I: Ratio Model

- Disadvantages:
  - All streams are not created equal. Application of model may result in loss of in-stream uses despite high mitigation ratios.
  - All impacts are not created equal. Some types of impacts are inherently more damaging to resource integrity. Many types of impacts have repercussions on both upstream and downstream uses.

Alternative I: Ratio Model

- Disadvantages:
  - All mitigation projects are not created equal. The use of the ratio model means economics drives process and not the replacement of function.
  - Model does not provide uniform guidance for awarding credit. Predictability absent. High potential for case-by-case disputes.

Alternative I: Ratio Model

- Conclusion: Model does not meet goals for protocol development.

Alternative II: Weighting Factors Model

- Projects evaluated based upon a series of weighting factors. Both the proposed impacts and compensatory mitigation are evaluated.
- Rather than assessing projects based upon linear feet, stream "debits" and "credits" are calculated.

Alternative II: Weighting Factors Model

- Mitigation requirements met when mitigation credits equal or exceed those calculated based upon the impact.
- Evaluation process governed by protocol referenced in stream mitigation rule.

Alternative II: Weighting Factors Model

- Disadvantage: Apparent "complexity"
  - Requires detailed procedure governing application and scoring.
  - Requires adequate training to interpret and apply use attainability data to the model.
  - May require the acquisition of data beyond that currently used in the 401 review process.

Alternative II: Weighting Factors Model

- Procedural Advantages:
  - Use of uniform policy lends predictability to program.
  - Weighting factor approach allows for better pre-application alternatives analysis.
  - Less likelihood for disputes since adequate data support is required for the evaluation.

Alternative II: Weighting Factors Model

- Procedural Advantages:
  - Provides applicant with much greater flexibility in the development of mitigation options.
  - Addition of default mitigation requirements for specific impact types simplifies the review process.

Alternative II: Weighting Factors Model

- Stream Resource Integrity Advantages:
  - Multiple factor weighting analysis improves the analysis of overall impact. The system provides better protection for existing uses.
  - Weighting factors used to reward sound design of mitigation projects.
  - Inherent flexibility allowed under the scoring system encourages the development of innovative alternatives.

Recommended Approach

- Ohio EPA Stream Mitigation Work Group:
  - 401 Unit staff
  - EAU staff
  - Legal
  - PHWH Work Group
  - Representatives of other state agencies (ODNR and ODOT).
- Recommendation to proceed with weighting factors approach.

Weighting Factors Model

- Model developed based upon a draft stream mitigation system used by the Savannah District of the Army Corps of Engineers.
- Model "Ohio-ized" to reflect Ohio EPA methodologies, anti-degradation categories, aquatic life use designations, and other important measures of stream resource integrity.

Weighting Factors Model

- Factors selected for weighting emphasize readily available data or data already required under current 401 procedures wherever possible.
- Use of multiple weighting factors ensures that no one attribute of the impact or mitigation will drive the evaluation. Provides a comprehensive measure of degree of impact and benefit.

Weighting Factors Model

- Scoring of weighting factors based upon relative importance of characteristic to stream resource integrity and anti-degradation considerations.
- Base scores based upon "average case" criteria established in the policy for each weighting factor. Ratio of the sum of factors for impacts vs. mitigation set to equal 1.5 (relates to current practice).

Weighting Factor Assessment Overview

- Impact Assessment
  - Proposed impacts to streams evaluated based upon six criteria. Each criterion assigned a score based upon proposed project and site-specific conditions.
  - Weighting factor scores for individual criteria are added, and the sum is multiplied by the linear feet of impact to determine the number of mitigation credits needed for the proposed impacts.

Weighting Factor Assessment Overview

- Impact Assessment (cont.)
  - Impact weighting factors:
    - Existing Aquatic Life Use (1.5 – 3.2 pts)
    - Existing Habitat Quality (0.2 – 1.5 pts)
    - Priority Area (0.1 – 1.0 pts)
    - Existing Geomorphic Integrity (0.2 – 1.5 pts)
    - Existing Flood Plain Quality (0.2 – 1.5 pts)
    - Impact Category (0.2 – 2.0 pts)
  - Debit Scoring Range: 1.5 – 12.2

Ohio EPA 401 Water Quality Certification
FORM A. ADVERSE IMPACT WEIGHTING TABLE FOR STREAM IMPACTS

Project Name:_____ Page_____ of _____

Stream Segment:_____Use Designation: _____

Impact Summary:_____

Circle appropriate response for each of the factors listed below and enter the numerical value in the column on the right.

Impact Factors	Options						Impact Factor Value
Existing Aquatic Life Use **Section 5.2.1**	LRW Class I PHWH Protection of Downstream Uses, skip remaining analysis	MWH Class II PHWH Enter **3.0** for (I) in Box 1 below, calculate mitigation credits needed	WWH **1.5**	EWH **2.5**	CWH Class III PHWH **3.0**	SSH Add **0.2** to score for June-September Aquatic life Use	
Existing Habitat Quality **Section 5.2.2**	Analysis for these weighting factors is not necessary for default procedures (see Section 2.1.3.2)		Poor **0.2**	Fair **0.6**	Good **1.0**	Excellent **1.5**	
Priority Area **Section 5.2.3**			Tertiary **0.1**	Secondary **0.5**	Primary **1.0**		
Existing Geo-morphic Integrity **Section 5.2.4**			Poor **0.2**	Fair **0.5**	Good **1.0**	Excellent **1.5**	
Existing Flood Plain Quality **Section 5.2.5.1**			Poor **0.2**	Fair **0.8**	Good **1.0**	Excellent **1.5**	
Impact Category **Section 5.2.6**			Minimal **0.2**	Moderate **1.0**	High **1.5**	Severe **2.0**	

To Calculate the mitigation credits required, sum all Impact Factor row values and enter the result in Box 1.	**Box 1. Sum of Impact Factors (I) =**	
Enter the proposed length of stream to be impacted into Box 2.	**Box 2. Length of Impact (D) =**	
Multiply the values of Box 1 and Box 2 and enter the result in Box 3. **The value of Box 3 equals the total number of stream impact debits for the assessed impacts.**	**Box 3. Total Stream Impact Debits (I x D) =**	

Weighting Factor Assessment Overview

- Stream Mitigation Assessment
  - 12 weighting factors used to score proposed stream mitigation projects.
  - Individual weighting factors may not apply in all cases (e.g. projects which involve only stream preservation get no "stream restoration" credit).
  - Weighting factors designed to encourage and reward excellent projects, avoidance of the export of resource integrity, and the improvement of water quality.

Weighting Factor Assessment Overview

- Stream Mitigation Assessment (cont.)
  - Mitigation Weighting Factors
    - Stream Restoration/Relocation Design (0.0 – 3.0)
    - Riparian/Floodplain Preservation (0.0 – 1.0)
    - Riparian Restoration and Enhancement (0.0 – 1.0)
    - Resulting Aquatic Life Use (0.1 – 1.0)
    - Resulting Habitat Quality (0.1 – 1.0)
    - Priority Area (0.0 – 0.5)
    - Watershed Location (0.0 – 1.0)

Weighting Factor Assessment Overview

- Stream Mitigation Assessment (cont.)
  - Mitigation Weighting Factors (cont.)
    - Control (0.0 – 0.5)
    - Impact/Mitigation Relationship (0.1 - 0.5)
    - Implementation Schedule (-0.1 – 0.3)
    - Supplemental Water Quality Activities (0.0 – 0.3)
    - Threat to Stream Segment (0.0 – 0.3)

Weighting Factor Assessment Overview

- **Stream Mitigation Assessment (cont.)**
  - **Credit Scoring Ranges:**
    - Preservation: 1.3-7.4
    - Relocation: 0.7-10.1
    - Restoration: 2.3-10.4

Ohio EPA 401 Water Quality Certification
Form B. STREAM MITIGATION WEIGHTING FACTORS

Project Name:_____ Page: ____ of _____

Stream Segment:_____ Use Designation:_____

Project Summary:_____

_____

Circle appropriate response for each of the factors listed below and enter the numerical value in the column on the right.

Mitigation Factors	Options					Mitigation Factor Value
Stream Restoration/ Relocation Design (Section 5.2.7)	None (Preservation Only Projects) **0.0**	Minimal (Relocation Projects Only) **0.5**	Moderate **1.0**	Good **2.0**	Excellent **3.0**	
Riparian/ Floodplain Preservation (Section 5.2.5)	Minimal (Relocation Projects Only) **0.0**	Low **0.2**	Moderate **0.4**	Good **0.7**	Excellent **1.0**	
Riparian Restoration and Enhancement (Section 5.2.8)	None **0.0**	Minimal **0.2**	Moderate **0.4**	Good **0.7**	Excellent **1.0**	
Resulting Aquatic Life Use (Section 5.2.1)	MWH or Class II PHWH **0.1**		WWH **0.6**	EWH **0.8**	CWH or Class III PHWH **1.0**	
Resulting Habitat Quality (Section 5.2.2)	Fair (Relocation Projects Only) **0.1**		Good **0.5**		Excellent **1.0**	
Priority Area (Section 5.2.3)	Tertiary **0.0**		Secondary **0.1**		Primary **0.5**	
Watershed Location (Section 5.2.9)	Outside Watershed **0.0**	Within HUC 8 Digit Watershed **0.3**	Within HUC 11 Digit Watershed **0.5**	Within HUC 14 Digit Watershed **0.8**	Onsite **1.0**	
Control (Section 5.2.10)	Deed Restriction **0.0**		Conservation Easement **0.3**		Fee Simple **0.5**	
Impact/ Mitigation Relationship (Section 5.2.11)	Out-of-Kind **0.1**			In-Kind **0.5**		
Implementation Schedule (Section 5.2.12)	Schedule 5 **-0.1**	Schedule 4 **0.0**	Schedule 3 **0.1**	Schedule 2 **0.2**	Schedule 1 **0.3**	
Supplemental Water Quality Activities (Section 5.2.13)	None **0.0**	Moderate **0.1**	Good **0.2**		Excellent **0.3**	
Threat to Stream Segment (section 5.2.14)	NA or Low **0.0**	Moderate **0.1**	High **0.2**		Very High **0.3**	

To calculate the preservation credits allocated, add all mitigation factor values in the right-hand column and enter the result in Box 1.
Enter the proposed length to be preserved into Box 2.
Multiply the values of Box 1 and Box 2 and enter the result in Box 3. The value in Box 3 equals the mitigation credits allocated for the assessed project. (Note: Preservation Credits can only equal 70% of the total mitigation credits required after the requirements of OAC 3745-1-05 are met.)

Box 1. Sum of Factor Values (P) =	
Box 2. Mitigation Length (D) =	
Box 3. Mitigation Credits (P x D) =	

Weighting Factor Model: Non-Designated Streams

- The mitigation protocol requires a use attainability analysis for streams not designated in the OAC.

  (note: this is <u>NOT</u> a new requirement)

- Current protocols used for sites with drainage areas > 1 mi^2 . Consists of use attainability analysis (QHEI and biological assessment, if necessary).

Weighting Factor Model: Non-Designated Streams

- For streams < 1 mi^2 , applicants will use PHWH protocols, if applicable. Weighting factor tables adjusted for these existing uses.
  - If PHWH protocols not used, evaluation criteria default to General High Quality Water (WWH use).
- Ohio EPA plans to promulgate PHWH use designations in rule in the near future

Weighting Factor Model: Default Mitigation Requirements

- Many small streams have very limited aquatic life functions (Limited Resource Waters, Class I PHWH).
- In these cases use of Best Management Practices are called for to protect upstream and downstream stream uses and functions.

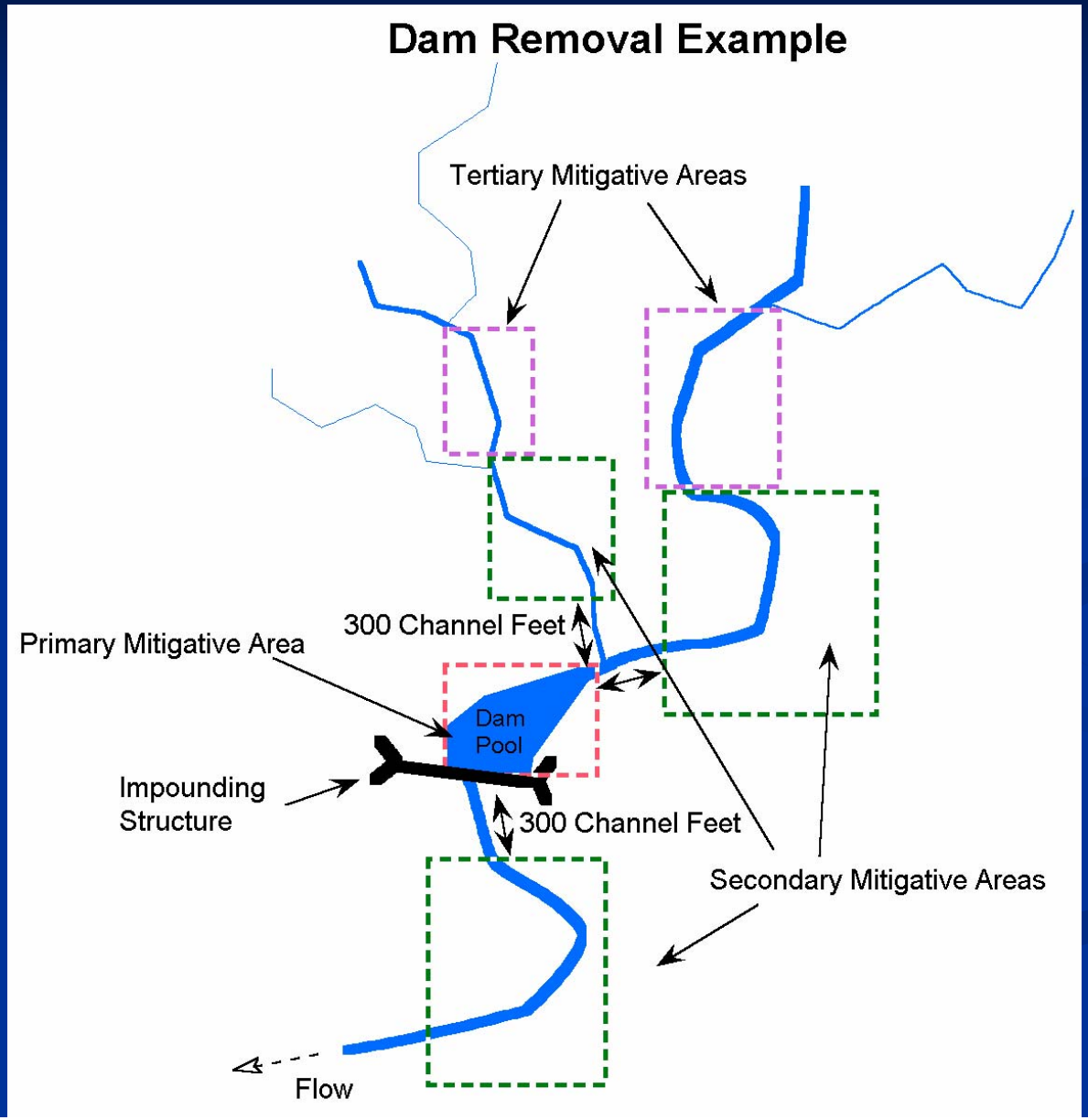
Weighting Factor Model: Default Mitigation Requirements

- For streams with lower quality aquatic life functions (MWH, LWH, and Class II PWHW), a default debit factor score of 2.0 is assigned.
- System will improve staff efficiency, simplify the process, and improve timeliness for projects with less environmental impact.

Collateral Benefit

- In special cases, the policy gives the Agency discretion to award "secondary" and "tertiary" mitigation credits for projects which will result in significant improvement to stream resource integrity upstream and/or downstream of the project.
- Would encourage the development of larger-scale beneficial stream restoration projects potentially funded through the 401 process.
- Could be used for "stream mitigation bank" development.
- Bar would be set high. Credits should only be awarded where significant additional benefit can be justified by quality data.

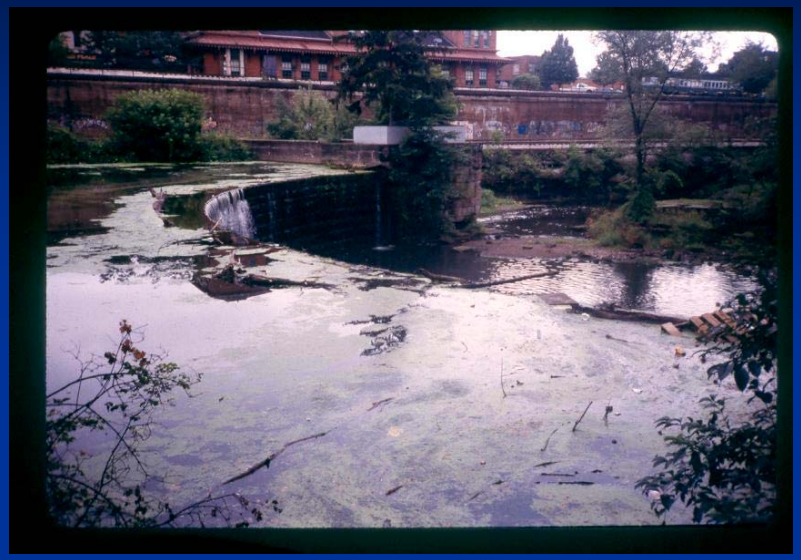
Collateral Benefit



Case Studies

Middle Cuyahoga River
Dam Removal Projects

Kent Dam

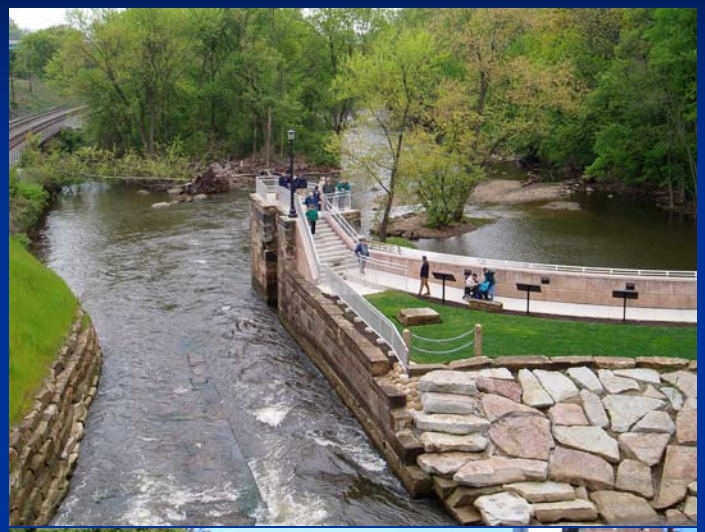


- Ohio EPA surveys found that the dam in Kent on the Cuyahoga River was a cause of non-attainment of the biological water quality criteria in the Cuyahoga River.
  - Impairments to fish passage
  - Low dissolved oxygen
  - Reduced habitat quality

Kent Dam

- The TMDL for the Middle Cuyahoga called for the removal of the Kent Dam
- Analysis of potential mitigation credits if this project had been used for stream mitigation
- Both primary and secondary mitigation credit scenarios would have existed for this project.

Kent Dam



- Partial removal of the dam provided for fish passage and resulted in immediate improvements in water quality
- Upstream habitat quality also significantly improved.

Ohio EPA 401 Water Quality Certification
Form B. STREAM MITIGATION WEIGHTING FACTORS

Project Name: Kent Dam Removal Page: 1 of 1

Stream Segment: Cuyahoga River Use Designation: WWH

Project Summary: Remove dam and stabilize banks and riparian

Circle appropriate response for each of the factors listed below and enter the numerical value in the column on the right.

Mitigation Factors	Options					Mitigation Factor Value
Stream Restoration/ Relocation Design (Section 5.2.7)	None (Preservation Only Projects) 0.0	Minimal (Relocation Projects Only) 0.5	Moderate 1.0	Good 2.0	Excellent 3.0	2.0
Riparian/ Floodplain Preservation (Section 5.2.5)	Minimal (Relocation Projects Only) 0.0	Low 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.0
Riparian Restoration and Enhancement (Section 5.2.8)	None 0.0	Minimal 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.4
Resulting Aquatic Life Use (Section 5.2.1)	MWH or Class II PHWH 0.1		WWH 0.6	EWH 0.8	CWH or Class III PHWH 1.0	0.6
Resulting Habitat Quality (Section 5.2.2)	Fair (Relocation Projects Only) 0.1		Good 0.5		Excellent 1.0	1.0
Priority Area (Section 5.2.3)	Tertiary 0.0		Secondary 0.1		Primary 0.5	0.1
Watershed Location (Section 5.2.9)	Outside Watershed 0.0	Within HUC 8 Digit Watershed 0.3	Within HUC 11 Digit Watershed 0.5	Within HUC 14 Digit Watershed 0.8	Onsite 1.0	0.3
Control (Section 5.2.10)	Deed Restriction 0.0		Conservation Easement 0.3		Fee Simple 0.5	0.5
Impact/ Mitigation Relationship (Section 5.2.11)	Out-of-Kind 0.1			In-Kind 0.5		0.5
Implementation Schedule (Section 5.2.12)	Schedule 5 -0.1	Schedule 4 0.0	Schedule 3 0.1	Schedule 2 0.2	Schedule 1 0.3	0.1
Supplemental Water Quality Activities (Section 5.2.13)	None 0.0	Moderate 0.1	Good 0.2		Excellent 0.3	0.0
Threat to Stream Segment (section 5.2.14)	NA or Low 0.0	Moderate 0.1	High 0.2		Very High 0.3	0.0

To calculate the preservation credits allocated, add all mitigation factor values in the right-hand column and enter the result in Box 1.
Enter the proposed length to be preserved into Box 2.
Multiply the values of Box 1 and Box 2 and enter the result in Box 3. The value in Box 3 equals the mitigation credits allocated for the assessed project. (Note: Preservation Credits can only equal 70% of the total mitigation credits required after the requirements of OAC 3745-1-05 are met.)

Box 1. Sum of Factor Values (P) =	5.5
Box 2. Mitigation Length (D) =	1,000
Box 3. Mitigation Credits (P x D) =	5,500

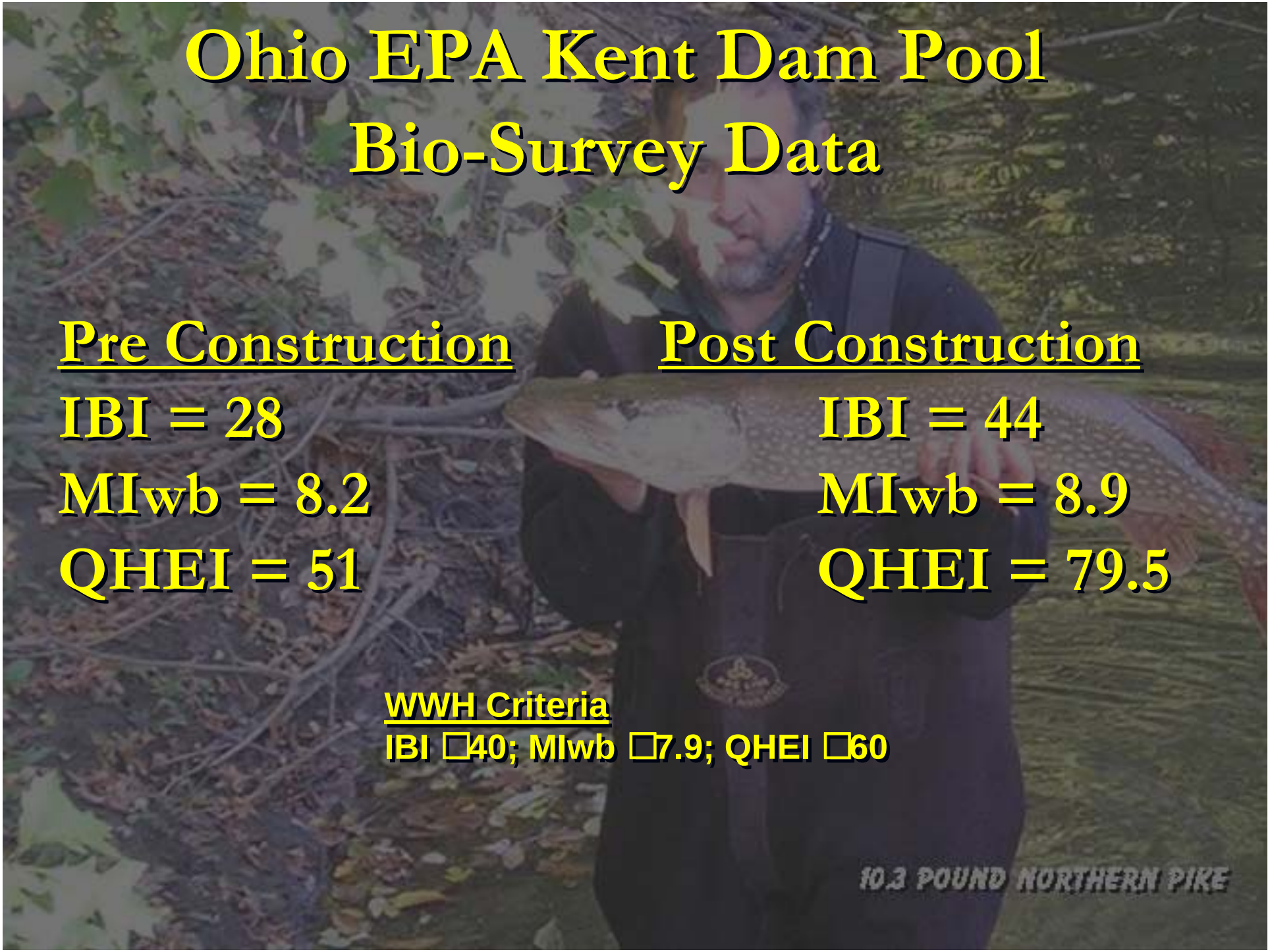
Kent Dam: Secondary Benefits

Upstream Conditions Following Dam Removal

Ohio EPA Kent Dam Pool Bio-Survey Data

Pre Construction	Post Construction
IBI = 28	IBI = 44
MIwb = 8.2	MIwb = 8.9
QHEI = 51	QHEI = 79.5

WWH Criteria
IBI □40; MIwb □7.9; QHEI □60



Ohio EPA 401 Water Quality Certification
Form D. SECONDARY AND TERTIARY MITIGATIVE BENEFITS WORKSHEET

Project Name: Kent Dam Removal - Cuyhaoga River Page: 1 of 1

Primary Mitigation Segment: Dam site and upstream dam pool

Sum of Mitigation Weighting Factors for Primary Mitigation Area (Form B, Box 1): 5.50 = M_p

Project Summary (attach additional sheets as necessary):

Removal of Kent dam with stream bank stabilization at dam site and in dam pool

INSTRUCTIONS: provide a brief summary of information for each stream segment for which secondary or tertiary mitigation credits are requested. Identify each segment using a short descriptor in the left hand column. Under the "reference" column, provide the section number for the appropriate report where the justification and data supporting the listing can be found. Under the basis for listing, one or more of the following categories should be entered: "Aquatic Life", "Habitat", "Geomorphic Integrity", or "Endangered or Threatened Species" (see text for criteria).

Secondary Benefit Segments:

Secondary Benefit Segment ID	Reference	Basis for Listing	Linear Feet
1. Cuyahoga River upstream of dam pool	Ohio EPA	>+4 IBI, >+10 QHEI	4,300
2.			
3.			
4.			
5.			

Total Footage for Secondary Benefit L_s: 4,300

Tertiary Benefit Segments:

Secondary Benefit Segment ID	Justification	Data Reference	Linear Feet
1.			
2.			
3.			
4.			
5.			

Total Footage for Tertiary Benefit L_t: 0

Additional Credit Calculation:

1. Primary Mitigation Credits C_p (Form B, Box 3): 5,500
2. Secondary Mitigation Credits C_s: $C_s = L_s * M_p * 0.1$ 2,365
3. Tertiary Mitigation Credits C_t: $C_t = L_t * M_p * 0.01$ 0
4. Total Mitigation credits for Project (sum of lines 1-3): 7,865

Munroe Falls Dam

- Middle Cuyahoga TMDL also identified the Munroe Falls dam as a cause of Non-Attainment in the Cuyahoga River.
- Impairments included poor habitat quality, low D.O., and impediments to fish passage.
- Two WWTP's upstream faced significant reductions in effluent limits if dam left in place.

Phase 1 – Dam Modification (removal)

Ohio EPA 401 Water Quality Certification
Form B. STREAM MITIGATION WEIGHTING FACTORS

Project Name: Munroe Dam Removal Page: 1 of 2

Stream Segment: Cuyahoga River Use Designation: WWH

Project Summary: Dam removal and adjacent banks stabilization

Circle appropriate response for each of the factors listed below and enter the numerical value in the column on the right.

Mitigation Factors	Options					Mitigation Factor Value
Stream Restoration/ Relocation Design (Section 5.2.7)	None (Preservation Only Projects) 0.0	Minimal (Relocation Projects Only) 0.5	Moderate 1.0	Good 2.0	Excellent 3.0	3.0
Riparian/ Floodplain Preservation (Section 5.2.5)	Minimal (Relocation Projects Only) 0.0	Low 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.0
Riparian Restoration and Enhancement (Section 5.2.8)	None 0.0	Minimal 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.4
Resulting Aquatic Life Use (Section 5.2.1)	MWH or Class II PHWH 0.1		WWH 0.6	EWH 0.8	CWH or Class III PHWH 1.0	0.6
Resulting Habitat Quality (Section 5.2.2)	Fair (Relocation Projects Only) 0.1		Good 0.5		Excellent 1.0	0.5
Priority Area (Section 5.2.3)	Tertiary 0.0		Secondary 0.1		Primary 0.5	0.1
Watershed Location (Section 5.2.9)	Outside Watershed 0.0	Within HUC 8 Digit Watershed 0.3	Within HUC 11 Digit Watershed 0.5	Within HUC 14 Digit Watershed 0.8	Onsite 1.0	0.3
Control (Section 5.2.10)	Deed Restriction 0.0		Conservation Easement 0.3		Fee Simple 0.5	0.5
Impact/ Mitigation Relationship (Section 5.2.11)	Out-of-Kind 0.1			In-Kind 0.5		0.5
Implementation Schedule (Section 5.2.12)	Schedule 5 -0.1	Schedule 4 0.0	Schedule 3 0.1	Schedule 2 0.2	Schedule 1 0.3	0.1
Supplemental Water Quality Activities (Section 5.2.13)	None 0.0	Moderate 0.1	Good 0.2		Excellent 0.3	0.0
Threat to Stream Segment (section 5.2.14)	NA or Low 0.0	Moderate 0.1	High 0.2		Very High 0.3	0.0

To calculate the preservation credits allocated, add all mitigation factor values in the right-hand column and enter the result in Box 1.
Enter the proposed length to be preserved into Box 2.
Multiply the values of Box 1 and Box 2 and enter the result in Box 3. The value in Box 3 equals the mitigation credits allocated for the assessed project. (Note: Preservation Credits can only equal 70% of the total mitigation credits required after the requirements of OAC 3745-1-05 are met.)

Box 1. Sum of Factor Values (P) =	6.0
Box 2. Mitigation Length (D) =	250
Box 3. Mitigation Credits (P x D) =	1,500

Phase 2 – Stream Bank Stabilization

Ohio EPA 401 Water Quality Certification
Form B. STREAM MITIGATION WEIGHTING FACTORS

Project Name: Munroe Dam Removal Page: 2 of 2

Stream Segment: Cuyahoga River Use Designation: WWH

Project Summary: Stabilize banks and riparian enhancement following upstream dam removal

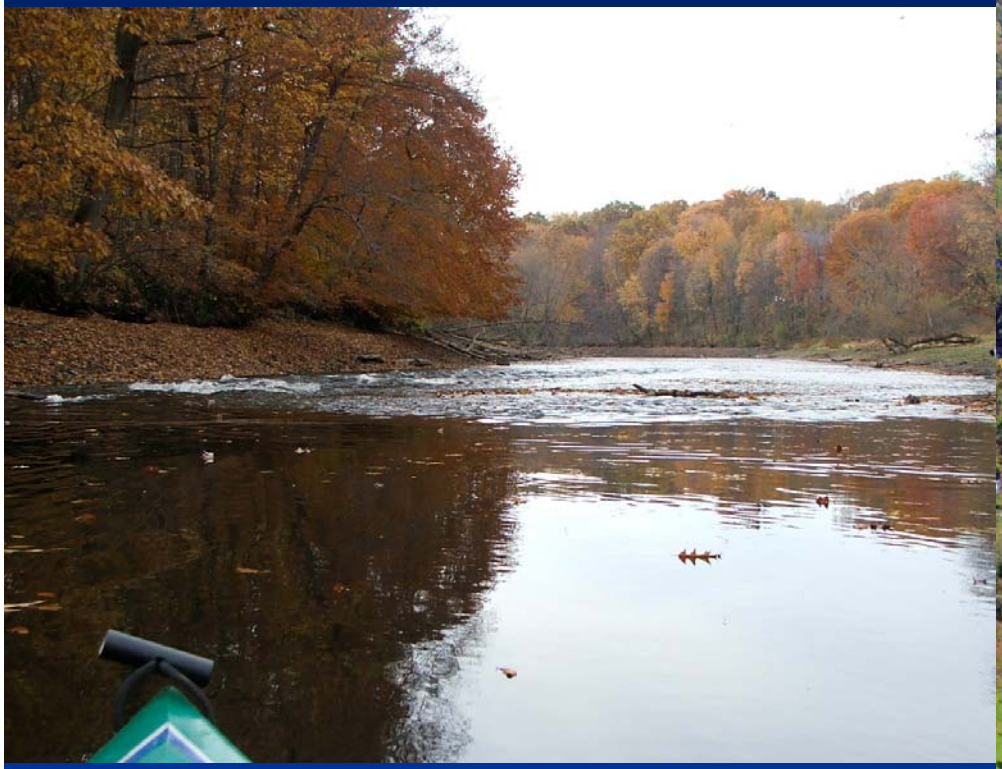
Circle appropriate response for each of the factors listed below and enter the numerical value in the column on the right.

Mitigation Factors	Options					Mitigation Factor Value
Stream Restoration/ Relocation Design (Section 5.2.7)	None (Preservation Only Projects) 0.0	Minimal (Relocation Projects Only) 0.5	Moderate 1.0	Good 2.0	Excellent 3.0	0.5
Riparian/ Floodplain Preservation (Section 5.2.5)	Minimal (Relocation Projects Only) 0.0	Low 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.0
Riparian Restoration and Enhancement (Section 5.2.8)	None 0.0	Minimal 0.2	Moderate 0.4	Good 0.7	Excellent 1.0	0.4
Resulting Aquatic Life Use (Section 5.2.1)	MWH or Class II PHWH 0.1		WWH 0.6	EWH 0.8	CWH or Class III PHWH 1.0	0.6
Resulting Habitat Quality (Section 5.2.2)	Fair (Relocation Projects Only) 0.1		Good 0.5		Excellent 1.0	0.5
Priority Area (Section 5.2.3)	Tertiary 0.0		Secondary 0.1		Primary 0.5	0.1
Watershed Location (Section 5.2.9)	Outside Watershed 0.0	Within HUC 8 Digit Watershed 0.3	Within HUC 11 Digit Watershed 0.5	Within HUC 14 Digit Watershed 0.8	Onsite 1.0	0.3
Control (Section 5.2.10)	Deed Restriction 0.0		Conservation Easement 0.3		Fee Simple 0.5	0.5
Impact/ Mitigation Relationship (Section 5.2.11)	Out-of-Kind 0.1			In-Kind 0.5		0.5
Implementation Schedule (Section 5.2.12)	Schedule 5 -0.1	Schedule 4 0.0	Schedule 3 0.1	Schedule 2 0.2	Schedule 1 0.3	0.1
Supplemental Water Quality Activities (Section 5.2.13)	None 0.0	Moderate 0.1	Good 0.2		Excellent 0.3	0.0
Threat to Stream Segment (section 5.2.14)	NA or Low 0.0	Moderate 0.1	High 0.2		Very High 0.3	0.0

To calculate the preservation credits allocated, add all mitigation factor values in the right-hand column and enter the result in Box 1.
Enter the proposed length to be preserved into Box 2.
Multiply the values of Box 1 and Box 2 and enter the result in Box 3. The value in Box 3 equals the mitigation credits allocated for the assessed project. (Note: Preservation Credits can only equal 70% of the total mitigation credits required after the requirements of OAC 3745-1-05 are met.)

Box 1. Sum of Factor Values (P) =	3.5
Box 2. Mitigation Length (D) =	1,500
Box 3. Mitigation Credits (P x D) =	5,250

Munroe Falls: Secondary and Tertiary Benefits



Ohio EPA 401 Water Quality Certification
Form D. SECONDARY AND TERTIARY MITIGATIVE BENEFITS WORKSHEET

Project Name: Munroe Falls Dam Removal - Cuyhaoga River Page: 1 of 1

Primary Mitigation Segment: Dam site and upstream dam pool

Sum of Mitigation Weighting Factors for Primary Mitigation Area (Form B, Box 1): 3.50 = M_p

Project Summary (attach additional sheets as necessary):

Removal of Munroe Falls dam with stream bank stabilization at dam site and in dam pool

INSTRUCTIONS: provide a brief summary of information for each stream segment for which secondary or tertiary mitigation credits are requested. Identify each segment using a short descriptor in the left hand column. Under the "reference" column, provide the section number for the appropriate report where the justification and data supporting the listing can be found. Under the basis for listing, one or more of the following categories should be entered: "Aquatic Life", "Habitat", "Geomorphic Integrity", or "Endangered or Threatened Species" (see text for criteria).

Secondary Benefit Segments:

Secondary Benefit Segment ID	Reference	Basis for Listing	Linear Feet
1. Cuyahoga River upstream of dam pool	Ohio EPA	>+4 IBI, >+10 QHEI	7,500
2.			
3.			
4.			
5.			

Total Footage for Secondary Benefit L_s: 7,500

Tertiary Benefit Segments:

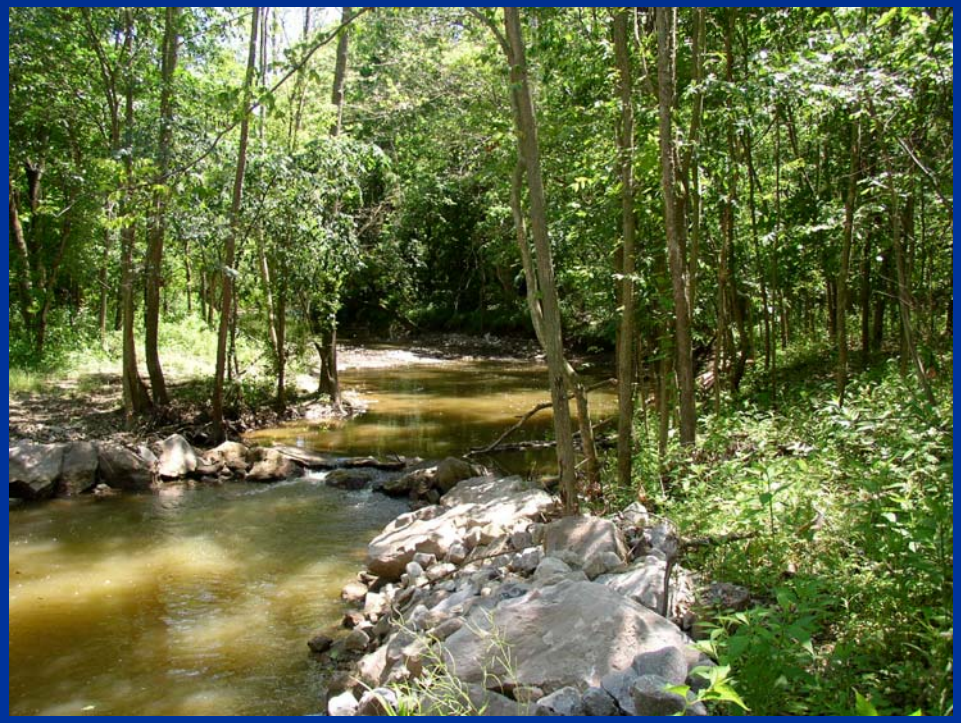
Secondary Benefit Segment ID	Justification	Data Reference	Linear Feet
1. Improved spawning habitat, mouth of Fish Creek	Ohio EPA	Spawning, <+4 IBI	200
2.			
3.			
4.			
5.			

Total Footage for Tertiary Benefit L_t: 200

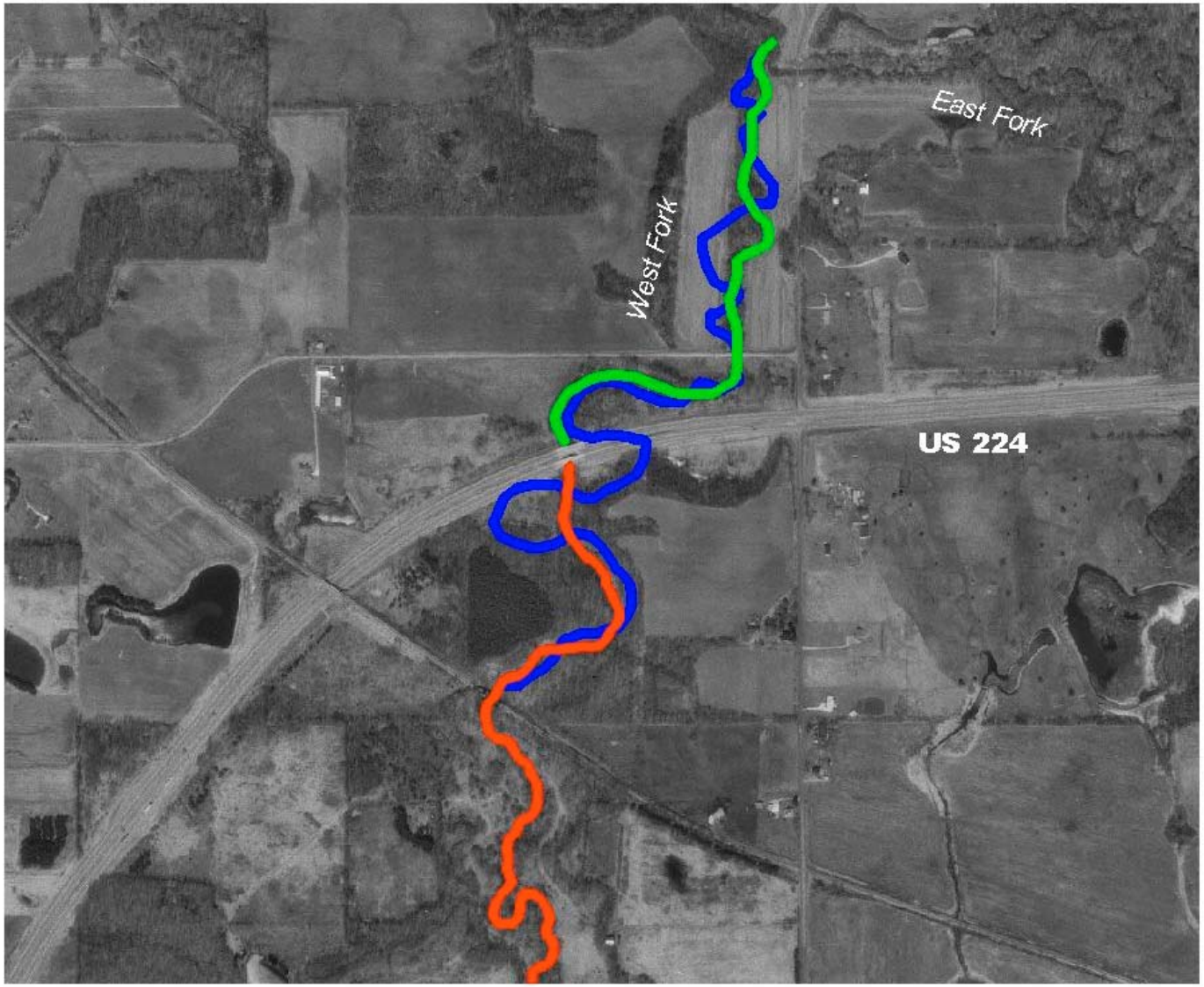
Additional Credit Calculation:

1. Primary Mitigation Credits C_p (Form B, Box 3): 1,500
2. Secondary Mitigation Credits C_s: $C_s = L_s * M_p * 0.1$ 2,625
3. Tertiary Mitigation Credits C_t: $C_t = L_t * M_p * 0.01$ 7
4. Total Mitigation credits for Project (sum of lines 1-3): 4,132

West Fork E. Br. Black River, Medina County



West Fork East Branch Black River



Current Channel Location
Downcutting Channel
Historical Channel

0.4 0 0.4 0.8 Miles

N
W E
S

East Fork E. Br. Black River, Medina County - Before

East Fork – After Restoration

Silver Creek, Geauga County

Woodiebrook, Geauga County

Woodiebrook