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AQUATIC RESOURCES NEWS

A REGULATORY NEWSLETTER

Headquarters, U.S. Army Corps of Engineers, Regulatory Branch

A Note from Headquarters

One component of the National Wetlands Mitigation Action Plan is development of a stream assessment technical manual. This manual will outline the various assessment models currently available across the country and identify their strengths and weaknesses. It is scheduled for completion by the end of this calendar year. Volunteers from the Corps districts will be provided the opportunity to comment on the draft document, as well as other action items for the National Wetlands Mitigation Action Plan. We hope this manual will provide the districts with information useful in developing stream assessment tools as necessary in the future. In addition, some districts are drafting stream mitigation success criteria that we will present in upcoming issues of this newsletter as they become available.

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Regulatory Developments: A Note from the Editor

This issue focuses on examples of field efforts to develop stream mitigation assessment procedures. Compensatory mitigation of stream impacts is receiving increasing attention by the public as well as government agencies. The last issue examined stream impacts and briefly discussed the Federal Interagency Mitigation Action Plan effort that identifies improving stream impact assessment as an important task.

Furthermore, the recently released Compensatory Mitigation Regulatory Guidance Letter (RGL 02-02) discusses the requirement of compensatory mitigation for stream impacts and calls for careful consideration of alternative approaches to stream functional assessment in order to improve upon stream compensatory mitigation performance.

This newsletter presents four efforts, starting with the Savannah District stream mitigation assessment standard operating procedures. A second article returns to the Louisville District to examine stream mitigation after looking at stream impact assessment protocol in the last newsletter. A third article examines stream mitigation in the St. Louis District--two banks near the Mississippi River. Finally, the newsletter visits an updated Wilmington District website to look at district compensatory mitigation guidelines. Some readers will note that the examples discussed in this newsletter are in humid environments and all in the eastern half of the nation. As pointed out in the last newsletter, some stream functions in ephemeral environments may differ in nature and importance from perennial streams, especially in semi-arid regions of the western U.S.

Distribution of Aquatic Resources News

The *Aquatic Resources News* will be distributed to field staff by email. The Newsletter will also be available on the IWR website within the month at:
http://www.iwr.usace.army.mil/iwr/regulatory/regulintro.htm
Or you may contact the Editor, Bob Brumbaugh, CEIWR-PD (703) 428-7069 Robert.w.brumbaugh@usace.army.mil. HQ point-of-contact for the newsletter is Katherine Trott, CECW-OR (202) 761-4617 Katherine.l.trott@usace.army.mil

Savannah District SOP for Stream Mitigation

Alan Miller

Introduction

The Savannah District has developed a compensatory mitigation Standard Operating Procedure (SOP), which addresses stream impacts. The intent of the SOP is to provide a basic written framework that will provide predictability and consistency for the development, review, and approval of compensatory mitigation plans. The SOP can be viewed on the Savannah District's web site at http://www.sas.usace.army.mil/permit.htm.

Savannah District's SOP may be used as a guide in determining compensatory mitigation requirements for projects or for enforcement actions. The SOP addresses categories of ecological effects and compensatory mitigation. It does not address mitigation for other categories of effects (e.g., historic, cultural, aesthetic) or types of mitigation (e.g., avoidance and minimization). The SOP does not obviate or modify any requirements given in the 404(b)(1) Guidelines or other applicable documents regarding avoidance, minimization, etc. Such requirements are evaluated during consideration of permit applications.

A key element of the SOP is the establishment of a method for calculating project impact credits required and compensatory mitigation credits generated. While this method is not intended for use as project design criteria, appropriate application of the method should minimize uncertainty in the development and approval of mitigation plans and allow expeditious review of applications. The SOP identifies several factors to be used for computing credits required for activities affecting streams. These include stream size, significance (i.e., T&E species habitat, etc.), existing condition, type and duration of impact, and the size of the impact. These factors are each assigned a numerical value that is summed and then multiplied by the length of affected stream. This results in a numerical value referred to as credits. In order to compensate for impacts, credits can be generated by a variety of activities that involve the improvement and protection of riparian systems. Each of the mitigation methods listed below is assigned a numerical value, that when multiplied by the linear distance of the activity results in the number of credits generated.

Types of Compensatory Stream Mitigation

Stream restoration refers to actions taken to correct previous alterations that have destroyed, diminished, or impaired the character and function of riverine systems. Restoration is the process of converting an unstable, altered, or degraded stream channel to its natural or referenced stable condition, considering recent and future watershed conditions. This process may include restoration of the stream's geomorphic dimension, pattern and profile, and/or biological and chemical integrity in order to achieve dynamic equilibrium.

Riparian buffer restoration refers to stream rehabilitation within a riparian buffer zone to improve water quality and/or ecological function. Buffer restoration may include increasing or improving upland buffers or wetlands within or adjacent to riverine systems. Riparian Buffers serve to enhance aquatic functions and increases the overall ecological functioning of stream mitigation. In most cases, stream restoration plans must include a vegetated buffer because they are necessary for the stream mitigation to perform its physical, chemical, or biological functions. Riparian buffers that do not meet the appropriate minimum width requirements cannot be included in calculating credits.

Stream Relocation is moving a stream to a new location to allow a project to be constructed in the stream's former location. Relocated streams should reflect the dimension, pattern and profile of natural, referenced, stable conditions.

Preservation is the conservation, in its naturally occurring or present condition, of a stream, its banks, and riparian buffers, in perpetuity, to prevent their destruction, degradation, or alteration in any manner not authorized by the governing authority. To assist in meeting the national policies of "no net loss" of aquatic function, the majority of the stream mitigation credits required for an authorized project must be from stream and/or riparian restoration. Conversely, it is only under special circumstances that the majority of stream mitigation credits required for an authorized project can be generated from riparian buffer and/or stream preservation.

General Requirements

In most cases, mitigation sites must be protected by a Declaration of Covenants and Restrictions, whereby the owner of the property places permanent conservation restrictions on the mitigation property. The restrictive covenant prevents development and requires that the land be managed for its conservation values. Property owners should make allowances for any foreseeable circumstances (e.g., utility lines, power lines, road crossings, ditch maintenance, etc.) that may conflict with recording a restrictive covenant on mitigation property. Once a property is protected by restrictive covenant, further impacts to that property are strongly discouraged by the Savannah District.

Compensatory mitigation should be completed concurrent with a project's authorized impacts to the extent practicable. Advance or concurrent mitigation can reduce temporal losses of aquatic functions and facilitate compliance. However, it is recognized that because of equipment utilization it may be necessary to perform the mitigation concurrent with the overall project. This is usually acceptable provided the time lag between the impacts and mitigation is minimized and the mitigation is completed within one growing season following commencement of the adverse impacts. In general, when impacts to aquatic resources are authorized to proceed before an approved mitigation plan can be initiated, the permittee will be required to secure the mitigation site and record a restrictive covenant.

The applicant may be required to monitor the mitigation area for success and to provide written reports describing the findings of the monitoring efforts. Such reports will normally involve photographic documentation, information on survival rates of planted vegetation, and information on the monitored hydrology. Because of the many variables involved, no specific standards are set forth as a part of this policy. Instead, a monitoring plan should be submitted as a part of the mitigation proposal for review. Monitoring efforts should usually include periodic reviews in the first year and annually thereafter. For most mitigation projects, the plan should include contingency measures specifying remediation procedures that will be followed should the success criteria or scheduled performance criteria not be fully satisfied.

Table 1. Adverse Impact Table

	Options								
									1st or 2nd Order Perennial Stream 0.7
									Primary 0.4
		Impaired 0.1			Somewhat Impaired.............................. 0.5			Fully Functional 0.8	
									> 1 Year 0.2
							-		Fill 3.0
							-	-	>5000 N/A

Credit Computation Example

A hypothetical industrial park development requests NWP 39 for 80 feet of fill for a building pad and 110 feet of culvert pipe for a road crossing--two areas of impact. Area 1 on Table 2 refers to filling an intermittent stream and area 2 for piping a 1st order perennial stream for a road crossing. For type of stream, the two areas are assigned a factor of 0.3 and 0.7 for impacts to the intermittent and perennial stream, respectively. Next are the relevant conditions of the streams. Area 1 is not ranked as a stream that has special consideration so it gets a factor of 0.1 (tertiary) and Area 2 is found on the state's list of 303(d) streams so it gets a factor of 0.4 for being a primary priority. Additionally, the existing conditions of these streams are found on the continuum from impaired to fully functional (0.1 to 0.8). Our example streams are 0.1 and 0.4 respectively. Since these impacts are expected to be permanent, both get a duration factor of 0.2 for greater than a year. The dominant impact is fill and piping respectively, which are assigned factors of 3.0 and 2.5 (because the road's culvert is longer than 100 feet, we assigned piping instead of road crossing). There is a linear distance factor added for the magnitude of the impact. In this case these are 0.0 for the 80 feet of fill and 0.05 for 110 linear feet of pipe. Using the SOP formula to determine the appropriate compensatory mitigation for this example, the total mitigation credits required for impacts would be 774.5. Tables 1 and 2 on this page illustrate the factors considered and their corresponding numerical indices used to compute the mitigation credits required.

Table 2. Example Adverse Impact Computation

		Area 2
Lost Type	0.3	0.7
		0.4
Existing Condition	0.1	0.5
		0.2
Dominant Impact	3.0	2.5
		0.05
Sum of Factors M	3.7	4.35
		110
M X A	296	478.5
Total Mitigation Credits Required	774.5	

Mitigation Proposed

For compensation the applicant is proposing to restore a section of riparian corridor and the stream channel within this corridor, which are identified on Table 4 as Area 1 and Area 2, respectively. The definitions for the minimal activity that will qualify for each of these levels of restoration is described in the Definition of Factors that accompany these tables in the Savannah District's Mitigation SOP.

Table 3. Stream and Riparian Restoration Mitigation Factors For Riverine Systems

	Options			
Net Benefit	Riparian Restoration		Stream Restoration	
				Excellent 3.0
Monitoring/ Contingency	Minimal 0.1	Moderate 0.2	Substantial 0.3	Excellent 0.4
				Primary 0.15
Location	Outside Watershed 0.1		Offsite 0.5	Onsite 1.0
				Conservancy 0.2
Kind	Out-of-Kind 0		In-Kind 0.1	
				Schedule 1 0.1

The riparian restoration proposed will provide for fencing out live stock that currently have access to this stream and replanting deep rooted, native, trees and shrubs to a minimum width of 100 feet on either side of this stream.

		Area 2
		1.6
		0.3
		0.15
		0.5
		0.2
		0.0
		0.08
		2.83
		140
		396.2
Total Restoration Credit	806.4	

This results in "Good Riparian Restoration" and earns a Net Benefit Factor of 1.7. The stream component of this plan will entail stream bank stabilization, using bioengineering techniques, and culverting an existing road crossing within the flood plain to allow more natural flood flows. These activities will result in a Net Benefit Factor of 1.6. A number of other mitigation project attributes are evaluated also. The proposed monitoring and contingency plan is considered substantial. In addition, this is a priority stream due the presence of an endangered mussel, and the site is within the same watershed as the impacts but somewhat distant from the impacts The property will be protected in perpetuity by a restrictive covenant on the deed, and the stream is different than the ones impacted. Finally, the work will be performed before and concurrently with the impacts. For these attributes, the plan is assigned factors of 0.3, 0.15, 0.5, 0.2, 0.0, and 0.08 respectfully. These are then totaled and multiplied by the linear footage of the stream section (140 linear feet in this case). Using the SOP, the total restoration credit associated with the restoration example is 806.4 (see Table 4).

The 806.4 credits are greater than the 774.5 credits generated by the proposed impacts. Therefore this mitigation plan would be acceptable for this permit action.

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Eastern Kentucky Stream Assessment Protocol: Utility in Making Mitigation Decisions

Jerry Sparks, Todd E. Hagman,
Darvin Messer, and James M. Townsend

In the last issue of *Aquatic Resources News*, the authors described a rapid stream assessment protocol that presented a simple ecosystem model regionally calibrated to estimate the overall integrity of headwater streams in the Eastern Kentucky Coalfield[1]. Reference conditions are used to scale the assessment to the "least disturbed" conditions. This approach is critical to the assessment of stream function(s)

[1] Sparks,E.J., Townsend, J.M., Hagman, T., and D. Messer. Spring 2003. Stream assessment protocol for headwater streams in the Eastern Kentucky Coalfield region. Aquatic Resources News. Vol 2, Issue 1.

because stream characteristics will vary dramatically across different stream types and different regions (Barbour and Stribling 1991)[2]. The output of the Eastern Kentucky stream assessment protocol is an ecological integrity index (EII) ranging between 0 – 1. The EII value indicates the degree of similarity comparing an assessed headwater stream ecosystem to that of least disturbed headwater streams in the region. The EII is then multiplied by the length of the stream reach representative of the assessed condition to yield ecological integrity units (EIUs).

The recommended protocol consists of characterization, assessment, and analysis components. The characterization component is largely embodied by the current requirements of the EPA's Rapid Bioassessment Protocol (RBP) and involves using a checklist and describing the physical characteristics of the headwater stream ecosystem and the surrounding landscape. The characterization component is specific to the Section 404 program and includes potential consequences of the proposed project on the aquatic environment. The assessment component involves the application of the developed models and the calculation of ecological integrity indices for a defined headwater stream ecosystem under existing (i.e., pre-project) conditions, and if appropriate, predicted (post-project) conditions. The analysis component involves the application of the assessment results to the following: 1) description of the potential impacts of a proposed project, 2) description of the actual impacts of a completed project, 3) identification of ways to avoid and minimize impact of a proposed project, 4) determination of the least damaging alternative for a proposed project, 5) determination of compensatory mitigation needs for a proposed project, 6) determination of restoration potential for headwater streams, 7) development of design criteria for stream restoration projects, 8) planning, monitoring and managing stream mitigation or restoration projects, 9) evaluation of performance standards or success criteria for headwater stream mitigation efforts, 10) comparison of stream management alternatives or results, 11) determination of appropriate in-lieu-fee ratios, and 12) identifying priorities for in-lieu-fee mitigation projects

This article will elaborate on the use of this stream assessment protocol during the analysis for the purposes of mitigating impacts to aquatic functions and values as required by existing law and program policy.

[2] Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. *In* George Gibson, editor. *Biological criteria: Research and regulation, proceedings of a symposium, 12-13 December 1990, Arlington, Virginia.* Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA-440-5-91-005.

Mitigation Sequence: Avoidance, Minimization, & Compensation

To illustrate the utility of this stream assessment protocol for use in each step of the mitigation sequence the following example is offered. A surface coal-mining project is proposed and an alternatives analysis evaluating the potential to use contained upland disposal sites has exhausted opportunities to completely avoid impacts to "waters of the United States". The proposed project would necessitate the discharge of fill material into headwater streams for the construction of two valley fills to dispose of excess overburden. The stream assessment protocol is applied to each of these streams and yields the results documented in Table 1.

Table 1: Application of the Eastern Kentucky Stream Assessment protocol to a hypothetical surface coal-mining project involving two valley fills—An initial proposal.

					EIUs Lost Due to Project
					400
					1300

Lets look at this proposal and see what information becomes apparent from the use of the stream assessment protocol. If the project was authorized as initially proposed it would result in a total loss of 1300 ecological integrity units. During preapplication discussions with the applicant it was brought to their attention that of the two streams, Stream "B" is very similar to least disturbed headwater streams in the region and ideally should be avoided. This would serve to protect the aquatic environment and also lower the mitigation costs for which the applicant would be responsible during compensation. The company indicated that they absolutely had to have a place to dispose of overburden but could revise the mine plan to place this material into the valley containing Stream A. Applying the assessment protocol to this revised proposal yields the results documented in Table 2.

Table 2: Application of the Eastern Kentucky Stream Assessment protocol to a hypothetical surface coal-mining project involving two valley fills—A revised proposal.

					EIUs Lost Due to Project
					600
					600

The stream assessment protocol provided a tool to recognize and subsequently avoid the highest quality stream in the project area. This is an example of how the protocol aids in the first step of the mitigation sequence, i.e., avoidance. In addition, the revised project, while avoiding the highest quality aquatic resource also reduced the initial proposal's loss of 1300 EIUs down to the revised proposal's loss of only 600 EIUs. Thus, this is an example of how the assessment protocol may be used to demonstrate the second step in the mitigation sequence, i.e., minimization of impacts. If both of these proposals were presented as alternatives, then the assessment protocol would aid in identifying the least environmentally damaging of the practicable alternatives.

The final step in the mitigation sequence is a requirement for compensation of unavoidable adverse impacts. Full compensation would require increases in aquatic functions and values to be provided by the compensatory stream mitigation project that sufficiently make up for the decline or loss in aquatic functions and values from the proposed project. Therefore, compensation requirements must involve a comparison between the aquatic functions and values expected to be accrued from the required mitigation project to those observed being lost with the impacts of the proposed project seeking authorization. The unavoidable loss of 600 EIUs resulting from the example project becomes the target goal for an appropriate compensatory mitigation project to achieve "no net loss" of functions and values. Functional replacement requires balancing functions lost by the proposed impacts with functions gained by the proposed mitigation. For this comparison to be meaningful, the same methodology must be applied to both the project impacts and the proposed improvements on the mitigation stream. The next step of the process is to use the assessment protocol and identify a suitable compensatory mitigation stream that would offer appropriate opportunities for ecological improvement. A stream characterized with an EII of 1.0 would show no opportunities for improvements based on the stream assessment protocol, whereas a stream that scores 0.1 may show ample room for functional gains. When a low EII is obtained the next step is to break down the assessment model and diagnose the components that contributed to the low score. For example, if the total habitat score is low it may be because several of the 10 parameters leading to the total score are dissimilar to least disturbed conditions.

For example, the riparian zone may be absent, the banks may lack vegetative protection, the substrate may be embedded, there may be a paucity or lack of diversity for epifaunal substrate or velocity/depth regimes, the frequency of riffles may not be indicative of a stable stream efficiently dissipating energy. Once the limiting factors are identified these become the focal points for designing a compensatory mitigation plan for improving the compensatory mitigation stream's level of functions. The assumption behind this approach is that by improving and making the structural attributes of the compensatory mitigation stream similar to those of least disturbed streams in the region one is also improving and making the level of function and values similar. This is measured by change in the EII comparing preexisting conditions on the mitigation stream (Figure 1) to predicted post-mitigation conditions (Figure 2). The level of credit given to the compensatory mitigation project is directly proportional to the amount of functional gains offered by the mitigation plan (Figure 3).

Figure 1: Eastern Kentucky Headwater Stream conditions on a proposed compensatory mitigation stream.

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (VERSION 2002.6)
(Genus/species Level Taxonomy - Riffle Only Sample)

Project ID: Application of the Eastern Kentucky Stream Assessment Protocol to a Hypothetical Coal Mining Project involving two Valley Fills & Proposed Mitigation

Stream/Reach: Compensatory Mitigation Stream

Assessment Objectives: Diagnose the preexisting condition & restoration potential of proposed mitigation. Identify targets variables for improvement

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.50	Ecological Integrity Index (Habitat Integrity + Conductivity)		
Variables	Measure	Units	
>>>>>>> *Enter quantitative or categorical measure from Field Data Sheet in shaded cells*			
RBP Habitat Parameters			
1. Epifaunal Substrate	2	no units (0-20)	
2. Embeddedness	2	no units (0-20)	
3. Velocity/Depth Regime	4	no units (0-20)	
4. Sediment Deposition	3	no units (0-20)	
5. Channel Flow Status	15	no units (0-20)	
6. Channel Alteration	15	no units (0-20)	
7. Freq. Of Riffles (bends)	5	no units (0-20)	
8. Bank stability (both combined)	13	no units (0-20)	
9. Veg. Protection (both combined)	0	no units (0-20)	
10. Riparian Width (both combined)	0	no units (0-20)	
Total Habitat Score	59	no units	Subindex
Habitat Integrity			0.10
Macroinvertebrate Data - *Genus/species Level*			
11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	185	microMHOs	0.90

It is important to stress here that attempts to improve these structural variables should not be done in a haphazard manner. One should incorporate sound principles of fluvial geomorphology (Leopold, et al 1964[3]) and design the mitigation based on reference reaches that simultaneously provide a template for good habitat and stream stability (Rosgen 1998[4]). Complex physical habitat is not only the template upon which a vigorous and healthy biota can develop; it simultaneously provides structure to stream channels that breaks up erosive flows. The least disturbed conditions for habitat variables such as epifaunal substrate, embeddedness, sediment deposition, velocity/depth regimes, frequency of riffles, channel alteration, channel flow status and bank stability are all manifested when the

[3] Leopold, L.B., G.M. Wolman, and J.P. Miller, 1964. Fluvial Processes in Geomorphology W.H. Freeman and Co. San Francisco 522pp.

[4] Rosgen, David L. 1998. The Reference Reach – A Blueprint for Natural Channel Design. In Proceedings of ASCE Specialty Conference on Restoration, Denver, Colorado.

channel is found in its most probable form[5] or in a state of dynamic equilibrium (Figure 4). The structural attributes assessed within the model are maintained in least disturbed conditions when the pattern, profile, and dimension of the stream are adjusted to efficiently transport sediment and water. Since the stream assessment model is calibrated to the least disturbed conditions for these variables, it is in essence, also calibrated to "stable" stream conditions in the region. The reason that these structural variables score low is often because the stream channel is not stable and sediment is either aggrading or degrading (Figure 5). When the mitigation project design has concomitant goals of improving physical, chemical, and biological aquatic functions by creating a channel that will efficiently transport water and sediment without aggrading or degrading then complex structure and function may be put in place that will be sustainable over time. Any attempt to improve structural parameters without taking into account the channel morphology needed to accommodate sustainable balances between stream width, depth, slope, roughness, flow velocity, discharge, sediment particle size and sediment load would be short-lived and predicted functional gains would not be sustainable (Rosgen 1996)[6].

Identifying the target variables that would provide for improvement and functional lift also aids in identifying monitoring needs and project specific success criteria or performance standards. For example, if embeddedness is diagnosed as a variable needing improvement then pebble counts may be an appropriate metric to establish a success criterion. Establishing clear connections between compensatory mitigation success criteria and indicators of aquatic functions will help clarify mitigation requirements and provide ecologically significant measurements tying legally required compliance with permit conditions to ecological success. The final comparison would be one comparing the functional losses associated with the proposed project with the functional gains offered by the proposed compensatory mitigation (Figure 6). Using the assessment protocol allows one to gauge the appropriateness of the compensatory mitigation in terms of "no net loss" of functions and values using EIUs as the currency for this comparison. It is important to note the information contained in Figure 6 comparing watersheds and stream orders for project impacts and proposed mitigation. Appropriate mitigation would replace functions lost by the authorized project in the same watershed with mitigation being performed on similar stream types. This supports Corps policy[7] of using a watershed-based approach and providing a holistic view of different integrated compositional elements of aquatic resources in a watershed based on changes manifested along a river continuum. This is also supportive of the recommendations offered by the

Figure 2: Eastern Kentucky Headwater Stream assessment spreadsheet documenting predicted conditions on a proposed compensatory mitigation stream after mitigation is successfully completed.

EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield (VERSION 2002.6)
(Genus/species Level Taxonomy - Riffle Only Sample)

Project ID: Application of the Eastern Kentucky Stream Assessment Protocol to a Hypothetical Coal Mining Project involving two Valley Fills & Proposed Mitigation

Stream/Reach: Compensatory Mitigation Stream

Assessment Objectives: Predict the post-mitigation condition of proposed mitigation stream. Quantify improvements to targets variables

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.95	Ecological Integrity Index (Habitat Integrity + Conductivity)

>>>>>>> *Enter quantitative or categorical measure from Field Data Sheet in shaded cells*

Variables	Measure	Units	
RBP Habitat Parameters			
1. Epifaunal Substrate	16	no units (0-20)	
2. Embeddedness	15	no units (0-20)	
3. Velocity/Depth Regime	18	no units (0-20)	
4. Sediment Deposition	27	no units (0-20)	
5. Channel Flow Status	15	no units (0-20)	
6. Channel Alteration	18	no units (0-20)	
7. Freq. Of Riffles (bends)	17	no units (0-20)	
8. Bank stability (both combined)	18	no units (0-20)	
9. Veg. Protection (both combined)	20	no units (0-20)	
10. Riparian Width (both combined)	20	no units (0-20)	
Total Habitat Score	184	no units	Subindex
Habitat Integrity			1.00
Macroinvertebrate Data - *Genus/species Level*			
11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	185	microMHOs	0.90

Figure 3: Comparison of ecological integrity indices and ecological integrity units for pre-existing conditions and post-mitigation conditions on a proposed compensatory mitigation stream.

Project ID: Application of the Eastern Kentucky Stream Assessment Protocol to a Hypothetical Coal Mining Project involving two Valley Fills & Proposed Mitigation

Stream/Reach: Compensatory Mitigation Stream

Assessment Objectives: Compare Ecological Integrity Indices and Units (Preexisting vs Post-mitigation Conditions) Document mitigation gains of functions and values

	EII	Project Length	EIUs
Preexisting	0.5	1350	675
Post-mitigation	0.95	1350	1282.5

Net Loss of EIUs =	NA
Net Gain of EIUs =	607.5

* Enter data generated from the Ecological Integrity Calculation spreadsheets into the gray shaded boxes.
**NA = Nonapplicable

[5] Leopold, L.B. 1994. A View of the River. Harvard University Press, Cambridge, Massachusetts 298 pp.
[6] Rosgen, David L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, Colorado.

[7] United States Army Corps of Engineers, Regulatory Guidance Letter 02-2. Guidance on compensatory mitigation projects for aquatic resource impacts under the Corps regulatory program pursuant to section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899. [December 24, 2002].

Figure 4: Eastern Kentucky headwater stream indicative of least disturbed conditions.

National Research Council regarding ways to improve compensatory mitigation under the Clean Water Act[8].

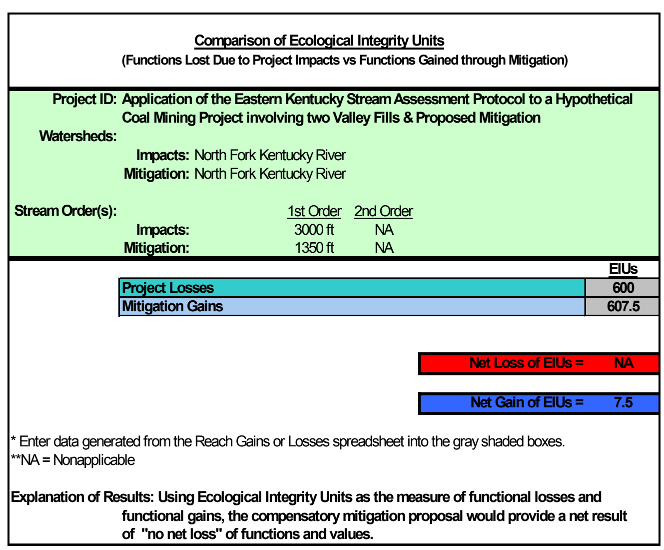
Temporal Loss and Risk

The approach outlined above simply involved a comparison of functions lost to expected functions gained with compensatory mitigation (i.e., the level of functional replacement). Two other factors may also be deemed important on a case-by-case basis: 1) temporal losses of function or the speed at which functional replacement is achieved and 2) risk that the compensatory mitigation project will not perform as expected. One may take these factors into account using the stream assessment protocol and the derived EIIs in concert with concepts presented by the U. S. Fish and Wildlife Service (1980)[9] and King and Adler (1992)[10]. The Engineer Research and Development Center has developed a spreadsheet that may be utilized to generate an appropriate compensatory mitigation ratio that takes the speed of functional replacement and risk into account[11] for wetland compensation. The authors have adapted his spreadsheet for use in generating an appropriate ratio for compensatory stream mitigation[12]. Five key parameters are considered: 1) the level of aquatic functions

Figure 5: Eastern Kentucky headwater stream not efficiently transporting sediment. Note the structural habitat homogeneity.

per linear foot of the compensatory mitigation stream prior to the compensation project (i.e., equivalent to the preexisting estimates of EIIs in the previous example); 2) the maximum sustainable level of function that the compensatory mitigation stream will reach (i.e., equivalent to the post-mitigation estimates of EIIs in the previous example); 3) how many years will it take for the compensatory mitigation stream to achieve maximum functional capacity; 4) timing of the onset of compensatory mitigation work and associated functional gains with authorized project impacts and associated functional losses; and, 5) the percent likelihood that the mitigation project will fail to provide the expected gains in functional capacity.

Figure 6: Comparison of aquatic functions lost as a consequence of authorized project versus aquatic functions gained by required compensatory mitigation.



[8] National Research Council. 2001. Compensating for wetland losses under the Clean Water Act. National Academy Press, Washington D.C. 322 pp.
[9] U. S. Fish and Wildlife Service. (1980). "Habitat Evaluation Procedures", Ecological Services Manual 102, Washington, DC.
[10] King, D. M. and Adler, K. J. (1992). "Scientifically Defensible Compensation Ratios for Wetland Mitigation". *Effective Mitigation: Mitigation Banks and Joint Projects in the Context of Wetland Management Plans*. Association of State Wetland Managers, 64-73.
[11] http://www.wes.army.mil/el/wetlands/readcomp.html
[12] http://155.80.93.250/orf/info/EKYStreamAssess/eastkystreamassessment.htm

Figure 7. Calculating an appropriate compensatory mitigation ratio.
(http://www.wes.army.mil/el/wetlands/readcomp.html)

Stream Compensation Ratio Calculator Version 3.3

Inputs — Time Horizon: 75 yrs; Discount Rate: 0.00 %

Function Name	Relative Importance (e.g., 0 to 10)	Impacted Site (Impact Year: 2003) Ecological Integrity Index: Pre-Impact	Post-Impact	Mitigation Site — Mitigation Work Timing & Risk: Year Started	Year Matured	Failure Risk	Ecological Integrity Index: Pre-Work	Immediately After Work	At Maturity
Ecological Integrity	1.0	0.20	0.00	2003	2033	20 %	0.50	0.73	0.95

Outputs

Function Name	Function-for-Function Compensation Ratios: Impact Site Per-linear foot Loss	Mitigation Site Per-linear foot Gain	Ratio (mitigation site feet per impact site feet)	Overall Ratio with Trade-Offs Among Importance-Weighted Functions: Impact Site Per-Linear foot Loss	Mitigation Site Per-Linear foot Gain	Net Surplus or (Deficit) (@ mitigation site Overall-Ratio feet per impact site foot)
Ecological Integrity	15.00	27.81	>= 0.54	15.00	27.81	0.00
				15.00	27.81	0.00
					Overall Ratio with Trade-offs =	0.54

For illustrative purposes, lets use the information contained in the previous example. In addition, lets assume it would take 30 years for the compensatory mitigation project to reach maximum sustainable levels of functions (For practical purposes, this is usually estimated by how long it would take to get a mature riparian community established.). Lets assume that compensatory mitigation begins concurrently with the project impacts (i.e., functional loss is synchronous with the onset of compensatory restoration of function), and that the compensatory mitigation plan has an estimated 20% chance of failure (This is also the same as saying that it has an estimated 80% chance of success). Using this approach one could calculate a ratio necessary to insure that the compensatory mitigation requirements would satisfy the policy of "no net loss" of functions and values. Let's look at this example in more detail and see whether or not the results of the model matches our professional judgment and intuition for what would constitute appropriate requirements. After using the assessment protocol and going through steps to avoid high quality streams and minimize impacts, the revised proposed project would fill Stream "A" as an unavoidable adverse impact. The assessment protocol estimated the ecological integrity index for Stream "A" to be 0.2. This is an estimate of the quality of this resource or the degree of functional capacity per linear foot. The impact within the footprint of a valley fill would be to totally eliminate this stream or result in a total loss of this functional capacity. When one uses the protocol to assess for how much improvements are being proposed at the compensatory mitigation stream the predicted functional gain is the functional "lift" from a preexisting EII of 0.5 (Figure 1) to a predicted post-mitigation EII of 0.95 (Figure 2). This translates into a functional EII gain of 0.45. The estimated project loss of functional capacity per linear foot is less than half the predicted gain from the compensatory mitigation project (i.e., One is losing ecological integrity and functional capacity at a rate of 0.2 per running foot on the impact stream and gaining ecological integrity and functional capacity at a rate of 0.45 per running foot with the compensatory stream mitigation.). Using this alone the appropriate mitigation ratio would be 0.2/0.45 or 0.44:1 (i.e., functional losses / functional gains). After temporal losses and risk are taken into account this ratio gets adjusted up to 0.54:1 (Figure 7). This makes intuitive sense if one is using these three factors in assessing for the appropriateness of compensatory mitigation, i.e., level of functional replacement, speed of functional replacement, and risk of failure. This approach also provides incentives for advanced compensatory stream mitigation or stream mitigation banks that may provide functional gains prior to projects that accrue functional losses by assigning more "credit" per linear foot of stream mitigation as the compensatory mitigation project matures toward maximum sustainable functional capacity.

In-Lieu-Fee Mitigation

As a last option for compensatory mitigation, if it is determined that the use of an in-lieu-fee (ILF) is appropriate then one may use the stream assessment protocol to insure that the fees required are kept proportional to the quality of the resource being impacted. In order to be fair and reasonable, the assessment of fees should be adequate to sufficiently fund compensatory mitigation projects that would provide for "no net loss" of functions and values. In these instances, there is no immediate compensatory mitigation project for comparison so one must determine a compensatory mitigation ratio based on professional judgment and historical project requirements. The

Louisville District has done this and set the fee schedule at $100 per linear foot based on a public notice that solicited information regarding typical costs for stream mitigation projects. The required ratio is kept directly proportional to the quality of the aquatic resource (as estimated by the EII) and is adjusted upward by a factor of 20% to provide funds to offset cumulative impacts in the region. To complete the use of the above example, if ILF was deemed appropriate as the means of satisfying the applicant's mitigation requirements, the Louisville District's ILF calculator[13] would assess the required mitigation ratio to be 1.13:1 and the consequent fee requirement to be $405,000 for the loss of 3000 linear feet of intermittent stream after yielding an EII of 0.2 and adjusting to offset cumulative impacts (Figure 8). It is illustrative to compare this ILF requirement to that which would have resulted from the initial proposal involving the same linear footage of impact but impacting the high quality reach of Stream "B". The initial proposal would have resulted in an ILF requirement of $498,000 (Table 3).

Figure 8. Example using In-Lieu-Fee Calculator.

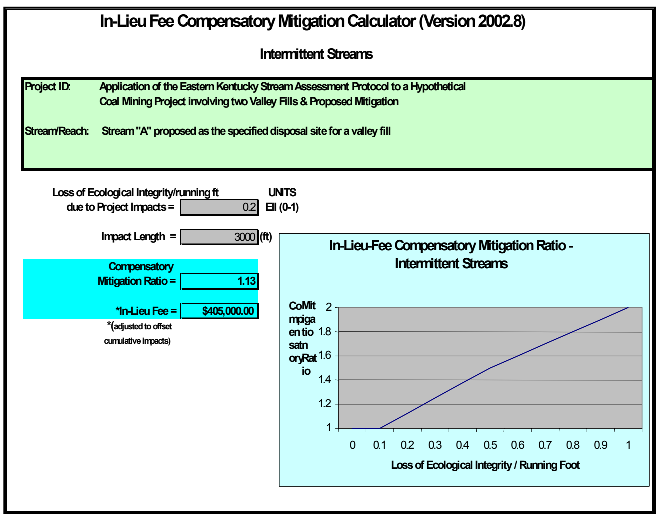


Table 3: Calculation of an appropriate In-Lieu-Fee for initial surface mining proposal involving two valley fills affecting two eastern Kentucky headwater streams using the Louisville District's ILF calculator. (Version 2002.8)

				In-Lieu Fee
				$270,000
				$498,000

13 http://155.80.93.250/orf/Mitigation/EKYStreamAssess/eastkystreamassessment.htm

Once again, the stream assessment protocol provided a means to avoid, minimize, and compensate for unavoidable impacts that serve to protect the aquatic environment while providing a planning tool for an applicant that provides a rapid predictable mechanism to reduce their mitigation requirements. Protecting the aquatic environment and reducing project costs are not mutually exclusive issues.

Conclusion

The article illustrates how the Eastern Kentucky stream assessment protocol may be used in making better permit decisions that are scientifically and technically defensible and provides a tool to help regulators and applicants protect the aquatic environment. At the same time the tool provides predictability, fairness and flexibility to the process so that the requirements imposed on the applicants are kept proportional and commensurate with what is at stake for the aquatic environment. With this scientifically based, rapid functional assessment procedure applicants and regulators have a tool and a predictable way to protect the aquatic environment and simultaneously reduce mitigation costs and requirements by systematically avoiding and reducing impacts to aquatic functions and values.

For more details on this subject, please contact Jerry Sparks (606) 642-3053. For more information of this assessment protocol, please visit: http://155.80.93.250/orf/info/EKYStreamAssess/eastkystreamassessment.htm

Editor's note: Jerry Sparks is a biologist and team leader for the Louisville District Eastern Kentucky Regulatory Office. Todd Hagman is a biologist and Darvin Messer is a physical scientist in the District's Eastern Kentucky Regulatory Office. James Townsend is Chief of the Louisville District Regulatory Branch.

St. Louis District Stream Mitigation Banks

Craig Litteken

Compensating for stream impacts is often a difficult task. For the most part, creating a new stream to replace an impacted or lost stream is not a viable option. Therefore, the only option to mitigate for permitted impacts is to take an existing stream in a degraded state, and restore or enhance it. As such, the St. Louis District has worked to create two stream mitigation banks.

The Fox Creek Stream Mitigation Bank was the first approved stream mitigation bank in the nation.

The first bank was a partnering effort with the U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Missouri Department of Conservation, the Missouri Department of Natural Resources, the bank sponsor Mr. Don Breckenridge, and SCI Engineering, Inc. The Fox Creek Stream Mitigation Bank was approved on May 30, 2000, making it the first stream mitigation bank in the country.

The Fox Creek Stream Mitigation Bank is located along the border of St. Louis and Franklin Counties, Missouri. Even though the Missouri Department of Conservation lists Fox Creek as a high-quality urban stream, the portion of Fox Creek that is enrolled under this banking initiative is in a severely degraded state. Figure 1 shows Fox Creek before plantings and construction. The bank consists of approximately three miles of Fox Creek from Interstate 44 to its confluence with the Meramec River. Developmental encroachment at this portion of Fox Creek could compromise the integrity of the entire stream. As such, the bank will have a minimum 100-foot corridor of trees placed along both banks of the stream, with some portions of the corridor reaching 400-feet. There will be additional in-stream structures for stabilization purposes and upland waterway enhancement by revegetation of warm and cool season grasses. Due to the success of the Fox Creek Stream Mitigation Bank, the bank sponsors are considering the establishment of a wetland mitigation bank immediately adjacent to the stream mitigation bank. Of the 196.3 total credits in the bank, 37.9 have been sold to date, or approximately 19 percent. The service area for the bank covers portions of three counties in Missouri, within the Meramec and Big River Watersheds.

Figure 1. Fox Creek

The Fox Creek Stream Mitigation Bank has approximately 13,800 linear feet (LF) of stream. The original bank instrument stated that 70 LF averaging 300 LF width of corridor would be equal to one credit. Therefore, the total credits available were originally set at 197.2 (13,800 LF divided by 70 LF is equal to 197.2 credits). However, as credits starting selling, the district noticed that the bank debiting scheme, based on linear feet, was somewhat confusing and possibly inaccurate. While Fox Creek is a perennial stream, many of the proposed projects were on intermittent or ephemeral streams. If impacts are proposed on 1000 LF of an intermittent or ephemeral stream, is it justifiable to have those impacts compensated by purchasing 1000 LF (i.e. 14.29 credits) from the bank, which is a perennial stream? Another question was how to consider whether affected stream had a limited or absent riparian corridor? The functions and values of the affected stream may not necessarily correspond to the quality and quantity of functions and values provided by the bank.

As a result, the bank instrument was amended to change the total credits to reflect acreage. The total credits in the bank are now set at 196.3. The bank includes a total of 98.149 acres (stream plus riparian corridor). Thus, 300 LF (average width of corridor) multiplied by 70 LF (initial credit base) and divided by 43,560 square feet (one acre) is equal to 0.48 acres. Therefore, 0.5 acres (rounded for simplicity) is equal to one credit. Proposed project impacts (stream plus corridor) can now be calculated in acres, and credits purchased from the bank will also be debited in acres. So, for the same 1000 LF intermittent or ephemeral stream (assuming 5 LF wide and no riparian corridor), the total area impacted is equal to 0.11 acres. Then, 0.11 acres divided by 0.5 acres per credit is equal to 0.22 credits (at a one to one ratio).

The St. Louis District has approved a second bank that offers stream mitigation credits—this time in Illinois--the Richland Creek Mitigation Bank, which was approved on December 17, 2001. Mitigation Bank Review Team (MBRT) members included the Corps, the U.S. Fish and Wildlife Service, the Illinois Department of Natural Resources, and the bank sponsor, Mr. Leland Nollau. The bank is located near Smithton, St. Clair County, Illinois and is on and immediately adjacent to the West Fork of Richland Creek, which is a primary tributary to Richland Creek. Richland Creek is listed by the Illinois Environmental Protection Agency as a Section 303d impaired water. Figure 2 shows Richland Creek before plantings and construction. The Richland Creek Mitigation Bank has both wetland and stream mitigation components. The stream bank consists of 2,110 linear feet of creek bank and will have a 100-foot riparian corridor on the east side of the creek, as well as some minor in-stream stabilization structures. A 50-foot riparian corridor on the west side of the creek is currently included in a separate conservation easement as part of an adjacent residential subdivision and wastewater treatment facility. This conservation easement is not included in the mitigation bank. The surrounding area is rapidly being developed with residential subdivisions, which could possibly pose a threat to the integrity of the entire Richland Creek watershed. This bank also includes a 19.8-acre wetland bank (8.2-acres emergent, 2.3-acres scrub-shrub, 9.3-acres forested) immediately adjacent to the stream bank. The Richland Creek Mitigation Bank has 19.8 total wetland credits and 21.1 total stream credits. To date, 1.15 wetland credits have been sold, however no stream mitigation credits have been debited from the Richland Creek Mitigation Bank. The wetland credits are calculated such that one acre is equal to one credit. The bank service area for both stream and wetland credits is the major part of the Lower Kaskaskia River watershed.

Figure 2. Richland Creek

This bank has 21.1 stream credits for the 2110 linear feet of creek bank. The bank instrument states that one credit is equal to 100 LF for an average 100 LF corridor. The West Fork of Richland Creek is also a perennial stream. At this time, the total credits have not been amended to reflect an acreage basis. However, the MBRT will likely consider an amendment in the future, since the bank is available for credits to mitigate for impacts to intermittent and ephemeral streams.

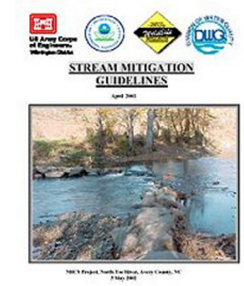
Both the Fox Creek Stream Mitigation Bank and the Richland Creek Mitigation Bank provide significant environmental benefits to each immediate area, as well as their respective watersheds.

For more information on banks in the St. Louis District, please contact Craig Litteken (314-331-8579) or go to http://www.mvs.usace.army.mil/permits/Banks.htm#where

Editor's note: Craig Litteken is a project manager for the St. Louis District.

Also of Interest

Wilmington District Stream Mitigation Guidelines



The Wilmington District and the North Carolina Division of Water Quality in cooperation with Region IV of the Environmental Protection Agency, Natural Resources Conservation Service, and the North Carolina Wildlife Resources Commission recently published Stream Mitigation Guidelines to provide individuals with information on mitigation requirements for impacts to streams in North Carolina.

The interagency document provides general guidance on determining appropriate compensatory mitigation for impacts to streams. Factors used to determine mitigation requirements include evaluation of the quality and condition of the existing channel (to be affected by the proposed project) and the method or mitigation type proposed (restoration, enhancement, or preservation). The mitigation requirements identified recognize that in general, for a given impact, compensatory mitigation requirements will be greatest for preservation and least for restoration to account for the variation in functional improvements in aquatic habitat and water quality expected to occur with the three types of mitigation. The table below summarizes the range of mitigation requirements for *100 LF* of impact based on the *quality* of the stream being impacted and the *type of mitigation* proposed to compensate for the authorized impacts.

Affected Stream Quality	Restoration (LF)	Enhancement*\((LF)	Preservation (LF)
Poor to Fair	100	100 to 250	250 to 500
	200	200 to 500	500 to 1000
	300	300 to 750	750 to 1500

*The guidance provides a range of mitigation requirements for enhancement activities depending on the type of improvements proposed.

This document defines terminology, provides guidance on mitigation site selection, mitigation plans, buffer widths and riparian restoration, protection requirements and methods, and monitoring and success criteria. The document can be found by clicking on the report cover above or at http://www.saw.usace.army.mil/wetlands/mitigation/stream_mitigation.html

Soil Sampling: A *Note from the Field on a quick and not-so-dirty method.*

Eddie Paulsgrove, an Albuquerque District project manager relays the simple and inexpensive method for obtaining a soil sample in areas that are inundated. It is just a big coffee can without the top or bottom, set firmly into the clayey soil. Then the water inside is bailed leaving a nice dry sampling point. This is a way to obtain geotechnical and HTRW soil samples as well.

We welcome other notes to the editor.

Newsletter Communication

To comment on the newsletter, suggest topics, submit an article, or suggest events or articles of interest, please contact Bob Brumbaugh at:

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