

AASHTO PRACTITIONER'S HANDBOOK

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IMPLEMENTING ECO-LOGICAL: INTEGRATING TRANSPORTATION PLANNING AND ECOLOGICAL DECISION MAKING

This handbook is intended to introduce transportation practitioners to a method of integrating ecological interests into transportation planning to address natural resource conservation and restoration priorities at a regional scale, and to establish a more reliable and efficient delivery program for projects with partner agencies.

Issues covered in this Handbook include:

- Engaging resource and regulatory agencies as planning partners
- Adopting an ecological framework for planning
- Prioritizing resources for conservation and restoration
- Developing a future transportation program in partnership with agencies and stakeholders to minimize impacts and direct mitigation efforts
- Establishing programmatic agreements for project review, permitting, and mitigation crediting
- Maintaining the framework and the partnership

This Handbook has been produced through a cooperative agreement between the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) as part of the Second Strategic Highway Research Program (SHRP2). The Center for Environmental Excellence by AASHTO endorses this Handbook. The Center's Handbooks provide practical advice on a range of environmental issues that arise during the planning, development, and operations of transportation projects.

Each Handbook is developed in cooperation with an advisory group that includes representatives for the Federal Highway Administration (FHWA), state departments of transportation, and other agencies as appropriate.

The Handbooks are primarily intended for use by project managers and other who are responsible for coordinating compliance with a wide range of regulatory requirements. With their needs in mind, each Handbook includes:

- key issues to consider;
- a background briefing;
- practical tips for achieving compliance; and
- a list of reference materials.

In addition, key regulations, guidance materials, and sample documents for each Handbook are posted on the Center's web site at <http://environment.transportation.org>.



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Overview



This Handbook assists transportation agencies in defining a path and realistic goals for implementing the Eco-Logical process for their programs.

In 2006, a team of representatives from eight Federal agencies, including the Federal Highway Administration (FHWA), published *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*¹ to present a vision of early collaboration among transportation, natural resource, and regulatory agencies when planning infrastructure projects and programs. In that vision, the interagency collaboration during system-wide planning provides an opportunity for sustaining or restoring ecological systems and their functions and values on an ecosystem scale, while also identifying more context sensitive solutions for the transportation plan, and improving environmental compliance and documentation.

The goals of Eco-Logical are to:

- Help state and local transportation agencies improve decisionmaking;
- Minimize the time and costs associated with planning, environmental reviews, and permitting;
- Provide for more effective environmental mitigation;
- Capitalize on environmental enhancement opportunities; and
- Improve public perception of the transportation project delivery processes.

Many state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) have used some of the methods that make up the Eco-Logical approach. Eco-Logical broadens the scope of interagency cooperation with an overarching methodology to guide both transportation agencies (state DOTs and MPOs) and resource agencies in addressing natural resource issues system-wide. The Eco-Logical concepts for addressing natural resource avoidance, minimization, and mitigation on a broad scale have been organized into a systematic, step-wise process.

Background Briefing

There is a growing emphasis on resource conservation and planning at the regional level rather than the localized, project level. Recent studies recognize that consolidated, regional-level mitigation provides ecological economies of scale by lowering the cost per acre of restoration, improving the restoration success rate, and increasing the protection to resident species with larger, unfragmented habitats (Murcia 1995, Schwartz 1999, Drechsler and Watzold 2009).^{2,3,4}

Federal initiatives toward regional infrastructure planning include:

1. Since the late 1980s, there has been a trend toward watershed-level planning to address water quality in accordance with Sections 303 (impaired waters) and 402 (National Pollutant Discharge Elimination System) of the Clean Water Act (CWA)

1 Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects. DOT-VNTSC-FHWA-06-01, FHWA-HEP-06-011 (April 2006). https://www.environment.fhwa.dot.gov/ecological/eco_index.asp.

2 Murcia, C. 1995. "Edge effects in fragmented forests: implications for conservation." *Trends in Ecology and Evolution*. 10(2): 58-62. https://www.researchgate.net/publication/49757343_Edge_Effects_in_Fragmented_Forests_Implications_for_Conservation.

3 Schwartz, M.W. 1999. "Choosing the appropriate scale of reserves for conservation." *Annual Review of Ecology and Systematics*. 30:83-108. https://www.researchgate.net/publication/223995601_Choosing_the_Appropriate_Scale_of_Reserves_for_Conservation.

4 Drechsler, M. and F. Watzold. 2009. "Applying tradable permits to biodiversity conservation: Effects of space-dependent conservation benefits and cost heterogeneity on habitat allocation." *Ecological Economics*. 68(4): 1083-1092. https://www.researchgate.net/publication/23991071_Applying_Tradable_Permits_to_Biodiversity_Conservation_Effects_of_Space-Dependent_Conservation_Benefits_and_Cost_Heterogeneity_on_Habitat_Allocation.

at Federal, state, and local levels. Over the years, a number of Federal and state watershed management guidance documents have been published, such as the comprehensive Handbook for Developing Watershed Plans to Restore and Protect Our Waters (USEPA, 2008).⁵

2. In 2002, Executive Order 13274, “Environmental Stewardship and Transportation Infrastructure Project Reviews,” provided further direction for interagency coordination among Federal, state, tribal, and local governments. The order directs Federal agencies that conduct environmental reviews for transportation projects to implement administrative, policy, and procedural mechanisms that ensure completion of such reviews in a timely manner and advance environmental stewardship. The order created an interagency “Transportation Infrastructure Streamlining Task Force,” chaired by the U.S. DOT and including seven other Federal departments and agencies, to monitor and assist agencies in their efforts to expedite reviews of transportation infrastructure projects and issue permits, and to identify and promote policies to streamline the review and approval of transportation projects.
3. In 2005, FHWA issued guidance on linking the National Environmental Policy Act (NEPA) process with long-range transportation planning. In 2008, FHWA and the Federal Transit Administration (FTA) amended the transportation planning regulations to allow the adoption of transportation planning decisions and analyses for use in the NEPA process.⁶
4. In August 2005, Section 6001 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) amended 23 USC 134 and 135 to require every state and MPO to consult with state, tribal, and local resource agencies when developing long-range plans, and require this consultation to involve a “comparison of transportation plans with state and tribal conservation plans or maps, if available,” and a “comparison of transportation plans to inventories of natural or historic resources, if available.” Under Section 6001, statewide and metropolitan long-range plans must now include a discussion of “potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan.” This discussion must be developed “in consultation with Federal, state, and tribal wildlife, land management, and regulatory agencies.” The Eco-Logical regional approach to mitigation provides a mechanism for agencies to meet the SAFETEA-LU Section 6001 requirement related to identifying “activities that may have the greatest potential to restore and maintain the environmental functions.”
5. In 2008, the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency issued regulations clarifying the standards used for determining compensatory mitigation for impacts to waters of the United States.⁷ The regulations “establish performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects for activities authorized by Department of the Army permits”.
6. In 2011, FHWA published the *FHWA Scenario Planning Guidebook*.⁸ FHWA established its scenario planning program in 2004 to promote scenario planning as a technique to help citizens and stakeholders in the public and private sectors understand how demographic and land-use changes could potentially impact transportation networks in a state, community, region, or study area. It identifies land use, demographic, economic, political, and environmental factors as variables that affect transportation networks and operations. Scenario planning is a key element in regional transportation system planning.
7. In 2012, Section 1310 of Moving Ahead for Progress in the 21st Century Act (MAP-21) established 23 USC 168, which provides an additional framework (independent of the existing process in 23 CFR 450) for linking the transportation planning process and the NEPA process. MAP-21 included a new provision that identifies scenario planning as an optional part of the metropolitan planning process.
8. In 2012, MAP-21 Section 1311 (23 USC 169) provided for the development of programmatic mitigation plans as part of the statewide or metropolitan transportation planning process. Programmatic mitigation plans may be developed on a

5 U.S. EPA Report 841-B-08-002, *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (March 2008). <https://www.epa.gov/polluted-runoff-nonpoint-source-pollution/handbook-developing-watershed-plans-restore-and-protect>.

6 See 23 CFR 450.212 and 450.318, and 23 CFR Part 450 Appendix A; see also AASHTO’s Practitioners Handbook 10, *Using the Transportation Planning Process to Support the NEPA Process* (2008).

7 U.S. Army Corps of Engineers and U.S. Environmental Protection Agency, Final Compensatory Mitigation Rule, 73 Fed. Reg. 19670, Apr. 10, 2008 (codified in 33 CFR Part 332).

8 FHWA Report FHWA-HEP-11-004. *FHWA Scenario Planning Guidebook* (2011). https://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/.

regional, ecosystem, watershed, or statewide scale and address one or more resources, as decided by the transportation agency in consultation with the resource agencies.

9. In 2012, Executive Order 13604, “Improving Performance of Federal Permitting and Review of Infrastructure Projects,” reinforced that Federal permitting and review processes be conducted with maximum efficiency and effectiveness, ensuring the health, safety, and security of communities and the environment while supporting vital economic growth. The Executive Order also directs that these processes must be transparent, consistent, and predictable, and that agencies should set and adhere to timelines and schedules for completing reviews, as well as set and track progress against performance goals.
10. In 2016, Fixing America’s Surface Transportation Act (FAST ACT) Section 1305 (23 USC 168) “Integration of Planning and Environmental Review” assert that agencies may adopt or incorporate by reference and use a planning product or decision in proceedings relating to any class of action in the environmental review process of the project.

The Eco-Logical process is closely linked to FHWA’s Planning and Environment Linkages (PEL) initiative. The PEL is a collaborative and integrated approach to transportation decision making that 1) considers environmental, community, and economic goals early in the transportation planning process, and 2) uses the information, analysis, and products developed during planning to inform the environmental review process. PEL is applicable to any sensitive natural or man-made resource.

Eco-Logical Technical Guide. In 2011, the Transportation Research Board’s (TRB) Second Strategic Highway Research Program (SHRP2), in cooperation with FHWA and AASHTO, funded the additional development of the *Manager’s Guide to the Integrated Ecological Framework*,⁹ a step-by-step technical guide to implement the concepts laid out in Eco-Logical (Table 1). The Integrated Ecological Framework (IEF) is

*...a nine-step technical framework that supports transportation/infrastructure planners and resource specialists in the use of a standardized, science-based approach to identify and integrate ecological priorities into transportation and infrastructure decision making.*¹⁰

The IEF applies individual project planning protocols at the higher, system planning level. Essentially, the IEF includes the project development process steps of mapping resources, alternatives analysis, justification, impact analysis, and mitigation before the project-level analysis begins. The IEF initially supports mid- to long-range transportation and infrastructure planning by establishing efficient communication and information-sharing with the resource agencies. Geographic Information System (GIS) mapping tools provide agencies with a means to share and visually place natural resource and infrastructure data at an ecosystem scale to gain consensus on the region’s ecological conservation and restoration priorities. Overlaying the transportation improvement plans (and possibly other land-use plans), the stakeholders identify the specific resources to be avoided, make system-level adjustments to avoid and minimize the impacts, and agree on a regional or subarea approach to mitigating unavoidable impacts.

Early commitments evolve into agreements with resource agencies (Memorandums of Agreement, Programmatic Agreements, standard coordination procedures, standard designs) that define and direct coordination, avoidance, minimization, and mitigation requirements that apply at the project level, in a predictable manner, to help control costs and preserve project schedules. Through the process, the highest priority restoration opportunities and most suitable and desirable mitigation sites can be identified. In this way, the process aligns transportation expenditures for environmental compliance and mitigation with conservation needs, achieving significant benefits for the ecology of the planning region.

9 TRB SHRP 2 Report S2-C06-RW-4, *Manager’s Guide to the Integrated Ecological Framework* (2014).
<http://www.trb.org/Main/Blurbs/170422.aspx>.

10 Ibid, p. 5.

Table 1. Summary of the Steps of the Integrated Ecological Framework¹¹

Step	Purpose
Step 1: Build and strengthen collaborative partnerships and vision	Build support among relevant stakeholders to achieve a statewide or regional vision and planning process that integrates conservation and transportation/infrastructure planning.
Step 2: Characterize resource status and integrate natural environment plans	Develop an overall environmental conservation strategy that integrates conservation priorities, data, and plans, with input from and adoption by all conservation and natural resource stakeholders identified in Step 1, addressing all species, habitats, and relevant environmental issues.
Step 3: Create a regional ecosystem framework (conservation strategy + transportation plan)	Integrate the conservation and restoration strategy (data and plans) prepared in Step 2 with transportation and land-use data and plans (Long-Range Transportation Plan [LRTP], State Transportation Improvement Program [STIP], and an MPO's Transportation Improvement Plan [TIP]) to create the spatial database known as the Regional Ecosystem Framework (REF).
Step 4: Assess effects on conservation objectives	Identify scenarios that meet both transportation/infrastructure and conservation goals by analyzing transportation and/or other land-use scenarios in relation to resource conservation objectives and priorities using the REF spatial database developed in Step 3 and models of priority resources.
Step 5: Establish and prioritize ecological actions	Establish mitigation and conservation priorities and rank action opportunities using assessment results from Steps 3 and 4.
Step 6: Develop crediting strategy	Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long-term performance for all projects to promote progressive restoration and mitigation, and more-accurate accounting of results.
Step 7: Develop programmatic consultation, biological opinion, or permits	Take advantage of identified regional conservation and restoration objectives to develop Memoranda of Agreement, programmatic agreements (404 permits or Endangered species Act (ESA) Section 7 consultations), or other CWA agreements for transportation/infrastructure projects in a way that documents the goals and priorities identified in Step 6 and the parameters for achieving these goals.
Step 8: Implement agreements, adaptive management, and deliver projects	Design transportation/infrastructure projects in accordance with ecological objectives and goals identified in previous steps (i.e., keeping planning decisions linked to project decisions), incorporating as appropriate programmatic agreements, performance measures, and ecological metric tools to improve the project.
Step 9: Update regional ecosystem framework and plan	Maintain a current REF spatial database that reflects the most recent knowledge of natural resources, conservation priorities, and mitigation opportunity areas that can support periodic updates to scenarios, and regional cumulative effects assessments.

It is likely that the transportation agency (e.g., state DOT or MPO) will initiate and lead the process because of the transportation agency's resources, as well as its interest in expediting the environmental review and permitting for transportation projects. But, in fact, the resource agencies or other entities could also initiate and lead the process. In any case, the transportation agency will be a key party because of its interests, its capacity for wide geographic implementation, and its potential to influence other transportation or other infrastructure agencies. In many cases, the transportation agency will also provide an important funding source for the Eco-Logical effort.

Key Issues to Consider

The following series of questions are posed to assist a practitioner in assessing available information and resources and to develop a strategy for implementing the IEF. Ideally, these questions will reveal priority information and administrative needs that must be addressed to engage the important stakeholders and make the IEF as efficient and functional as possible.

¹¹ TRB SHRP 2 Report S2-C06-RW-2, *An Ecological Approach to Integrating Conservation and Highway Planning*, Volume 2 (2012). <http://www.trb.org/Main/Blurbs/166938.aspx>.

The Scale of the Planning Area and Geographic Data Needs

- What is the geographic extent of the planning area?
- Have you considered an area sufficient to address the cumulative effects of your program?
- Based on the geographic extent and jurisdictions, who should be stakeholders/partners?
- What level of precision is needed for the mapping information to support the necessary decisions?
- What natural resource information is already available in the transportation agency database? Other databases? What is the resolution of the available data? What is the update frequency of the available data?
- Have priority conservation or restoration areas been previously identified by the resource agencies?
- What infrastructure layers are available that can be initially added to the base map?
- What other resource mapping is available and should be considered in evaluating alternatives?
- What tools are available for resource mapping?
- Do any of the partner agencies have a mapping tool that could be adopted by all partners?

Establishing a Vision and Engaging Upper-Level Management, Stakeholders, and Elected Officials

- What is the extent of proposed improvements in the long-range transportation plan?
- To what extent does the long-range plan involve construction of new roadways or other new transportation facilities on new alignments versus reconstruction of existing roadways? To what extent does it involve reconstruction of existing roadways/railways?
- Are the purposes of proposed improvements in the long-range transportation program well-defined and understandable? Are there disagreements on how the purposes should be defined?
- What are the greatest obstacles in the current system to efficient program and project planning and compliance?
- Are there known problem areas associated with the transportation network that could be addressed in future projects as a retrofit?
- Are there particular recurring issues that can be addressed from a programmatic level? What agencies are involved in those issues?
- Are there current construction projects that could also benefit and that could take priority because of outstanding ecological issues?
- Can other transportation plans and land use plans (such as Comprehensive Plans) be incorporated into the IEF process to maximize its value?
- Who are the managers that must be involved in decision making?

Potential Stakeholders/Users

- What agencies are routinely involved in transportation project review and permitting at a Federal level? State level? Local level?
- What role have the prospective partners had in transportation planning or permitting to date?
- Who are the core agencies whose upper-level management must ensure compliance with the agreements and procedures incorporated in the IEF process?
- Are there non-profit agencies or other non-governmental organizations that should be involved?
- How will the public be involved?

Resources—Staff Time and Funding

- What is the availability of transportation and partner agency staff?
- What funding sources are available to develop the IEF process from each of the partner agencies?

Willingness to Make a Long-Term Commitment

- Who will be the champion of the IEF process at the transportation agency?
- Who will be the champion at each of the partners?
- Who are the decision makers for each of the partners?
- What is the best method of communication to keep partners involved?
- How will agreements between the transportation agency and the resource agencies be documented? Is a Memorandum of Agreement (MOA) required?
- Have you considered how the decisions in your planning work could be carried forward into the NEPA process for future projects?

Regulatory Requirements

- What agreements with resource agencies are already in place?
- Are there opportunities to establish programmatic mitigation?
- Do the mitigation opportunities offset the cumulative effects?
- Are there established/codified mitigation ratios or other requirements?

Practical Tips

This section provides a discussion of the main concepts of each of the IEF steps, with recommendations and considerations in approaching each step. The IEF is intended to be flexible to fit the user's program, geography, and resources. The IEF is a step-by-step process, and ideally the users would proceed through all of the steps to address a wide array of ecological issues on a regional, program-wide basis. The team building and data gathering of the earlier steps are pre-requisites for the later steps.

Step 1 | Build and Strengthen Collaborative Partnerships and Vision

The goals of this step are to:

1. Break down organizational barriers.
2. Take an inventory of each stakeholder's goals, priorities, processes, and major areas of concern within a specified planning region.
3. Document significant issues that may affect agency goals and mitigation needs.
4. Create a shared regional planning vision.
5. Obtain and document formal agreements on roles, responsibilities, processes, and timelines that establish or reinforce partnerships.
6. Document criteria and opportunities for using programmatic agreements to better address transportation and conservation planning needs.
7. Identify initial funding options.

The transportation agency, as the responsible party for transportation planning and implementation, typically initiates the IEF process by developing a basic vision and committing an initial investment of resources toward the process. At this stage, the transportation agency begins outreach to other planning organizations and resource agencies in the planning area. The goal of this initial step is to begin identifying the most critical resource conservation needs and creating a shared regional planning vision that addresses all needs and common interests, while also communicating the benefits of the process to all stakeholders.

The Geographic Extent and Scale of the Planning Area. Agencies should jointly consider their overall goals and regional vision in setting a scale for the planning area. Agencies may also consider their own technical capabilities and data availability in selecting a planning area and level of effort. The geographic extent of the planning area and scale of the planning effort

will determine the resolution of the mapping data that is relevant. In other words, a broader brush planning effort would not necessarily require high resolution data. On the other hand, evaluating certain ecological resources may require a finer scale that cannot be understood at a large regional scale. The scale of the planning area and the level of detail shown in the mapping should be determined through discussion among the participants in the IEF process.

Planning Area Subdivision. At this step, the transportation agency may wish to subdivide the planning area to facilitate the analysis of ecological issues. Subdividing the planning area has advantages such as reducing the amount of mapping information that must be managed at one time (such as, when computer processing demands exceed capacity), focusing on resources or issues that are localized, or increasing the mapping resolution in select areas. Dividing areas by hydrologic units (hydrologic unit codes or watersheds) is a convenient method, as GIS layers for hydrologic units at different levels (8-digit, 10-digit, 12-digit) are readily available nationwide from the Natural Resource Conservation Service. Hydrologic units are referenced in some regulations (such as in CWA regulations) and may also correspond to the distribution of particular habitat types, for example, rare species ranges. In any case, it is a convenient starting point. The transportation agency may also subdivide the planning areas by soil type, land cover, vegetation, habitat, or other ecological feature mapping that is available, depending on which geographic subdivision fits with overall regional goals.

Terms to Remember

IEF—Integrated Ecological Framework

The nine-step process to help planners integrate ecological priorities into transportation and infrastructure decision making.

REF—Regional Ecosystem Framework

The geospatial database that overlays sensitive ecological resources with land use and long-range transportation plans.

Stakeholders/Partners. Based on the planning area, the transportation agency should develop the list of partners. The core stakeholders are the same agencies consulted in project-level ecological coordination. Commonly these stakeholders include Federal agencies such as the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and their state counterparts. These agencies can cover the majority of ecological issues at the Federal and state level, including both the resources protected by law and those that require sensitive approaches.

The list of additional stakeholders depends on the scale of the IEF process. Candidates may include organizations with a local or sub-regional interest, such as county agencies, MPOs, cities, park districts, and non-governmental organizations (NGOs).

Communications. At the initial meeting of the stakeholders, it is important to charter the team, establish the goals of the IEF, identify the value to each of the stakeholders, and gain commitment for continued cooperation. For that reason, a face-to-face meeting or live webinar is recommended for the kick-off and some interim meetings. At the initial meeting, the protocol for future communication to keep all parties engaged should be a priority agenda item. Depending on the timing, the meeting could be preceded with a questionnaire to identify available mapping data/format, current software, and conservation/restoration priorities as a beginning point of discussion. The communication will likely be a balance of written communications and face-to-face meetings to provide partners the greatest flexibility to stay involved.

Established methods of agency and public involvement that are used at the project level can be applied to this activity. It is important at this early stage to establish a process for documenting agreements. Changing personnel between the planning and implementation phases of a program poses a real risk of losing track of decisions made during the planning phases.

Team Responsibilities. During Step 1, partners should establish and document responsibilities and roles for all participants. Depending on the scope of the planning effort, the planning group for a long-term partnership could be divided into:

- **The Partners Team** provides leadership and direction to the other teams to ensure that their common and accepted objectives are met. Partners represent the agencies and organizations investing in the plan. Upper-level management engagement is needed not only to provide resources, but to enforce the agreements made among the stakeholders in each agency's policies.
- **The Science Team** ensures that the REF spatial database (developed in Step 3) represents best available scientific knowledge, makes recommendations about the natural resources that should be included in the REF, and populates the REF with information about the resources' conservation requirements and response to stressors that would appear in the transportation and land-use scenarios. Because all knowledge cannot be integrated into the REF, the team should also be engaged to review and validate assessments and inform decisions. The team itself is composed of subject matter experts for the resources and may be drawn from state and Federal agencies, universities, and NGOs, among others.

- **The Technical Team** manages and conducts the technical work of the IEF process. The Technical Team will manage the technical aspects of the mapping and analysis to verify layer alignments and resolution and manage updates.

A single project team member may have more than one of the necessary skill sets; for example, a staff member managing the project may also facilitate the partnership. However the team is constructed, the best outcome is that all partners share in a practical benefit, the mapping product, and standard procedures that they might apply across their organizations.

Funding. State DOTs have the authority to enter funding agreements with other Federal and state agencies. Therefore, state DOTs may be able to use transportation funds for both their own participation and the participation of other agencies, as this process is carried out as part of transportation planning and has the potential to expedite environmental reviews.¹² As projects are implemented and on-the-ground mitigation activities take place, funding may be shared by the transportation agency through cost-sharing responsibilities such as a funding match or in-kind contributions (such as land donation, management services, materials, equipment, or facilities). Third party in-kind contributions may be accepted as the match for Federal funds in accordance with the provisions of 49 CFR 18.24. Partners may also be willing to contribute funds or in-kind support, especially if they believe the process will bring tangible value to their organizations.

Documentation. The transportation agency should document all agencies who are invited, the participants, any Memoranda of Understanding, roles and responsibilities, communication protocols, and potential funding sources.

Step 2 | Characterize Resource Status and Integrate Natural Environment Plans

The goals of this step are to:

1. Compile the existing available data and plans into a refined map that identifies locations of all resources of interest and areas for conservation and mitigation action.
2. Understand historical/long-term trends, priorities, and concerns related to aquatic and terrestrial species and habitats in the region.
3. Identify data gaps that need to be addressed to achieve a complete and reliable product at the appropriate level of resolution and accuracy.
4. Identify past impacts at critical locations, such as stream crossings and migration corridors (especially if retrofitting will be a mitigation option).
5. Arrive at an agreed-upon set of conservation and mitigation goals.

During Step 2, partner agencies identify, assemble, and combine data into a map that can start to guide planning efforts.

Mapping Tools. Web-based mapping tools are available that reference a number of national datasets. Some also allow users to add more-detailed local layers to the database and share that data.

The most effective mapping platform is one that is compatible with and accessible by all potential users, including the stakeholder agencies, planning consultants, agency and consulting design engineers, and construction managers. If the IEF process will be the new mode of operation, all who are expected to follow it must have easy access and be able to integrate their data and plans.

Ecological systems are dynamic and will continue to change over time. The transportation plan will evolve with changing transportation needs. The GIS mapping of resources and infrastructure must be able to be updated easily, with input from each stakeholder. The more integrated the base map is with the resource agencies' own products, the more likely it will be a living database. Ideally, the transportation agency's planned improvements will interface readily and automatically update as the plans are modified. Systems that are "shared" with management responsibilities divided among the stakeholders will be more useful and valuable to project partners.

Important Resources to be Included. Stakeholders should work together to define the list of sensitive resources that will be considered. Recognizing that agencies have unique interests in prioritizing certain types of natural resources, all stakeholders

¹² Federal law allows states to enter into funding agreements with Federal agencies (including U.S. DOT), state agencies, and Indian tribes, under which the state provides funds to "support activities that directly and meaningfully contribute to expediting and improving transportation project planning and delivery for projects in that State." See 23 USC 139(j).

should consider factors like regulations, habitat uniqueness, water quality assessments, or rare species habitat requirements. Using available data, stakeholders can identify features and categorize them with a weighting system. The weighting system could be as straightforward as assigning points for location, habitat features, historical protection, and restoration potential. A consolidated score identifies the more “valuable” habitats. The sites can also be separately scored for a number of habitat features with different intent, such as a separate score for a particular species or for wetlands. The weighting and habitat categorization is at the discretion of the stakeholders and will depend on the quality and resolution of the data available.

The GIS mapping with categorized habitats provides the basis for assessing the current resources, historical impacts, data gaps, and conservation and restoration goals.

Documentation. It is important to establish a clear history of the sources of information and basis for prioritization of priority resources. Document the objectives, decisions, data sources, and methods based on stakeholder input, and the technical and scientific methods used.

Step 3 | Create a Regional Ecosystem Framework (Conservation Strategy + Transportation Plan)

The goals of this step are to:

1. Create the regional ecosystem framework geospatial database, based on mapping and prioritization of resources and transportation and land-use plans.
2. Create transportation program scenarios that address short- and long-term improvements and include all features that may cause impacts to natural resources.
3. Obtain a shared understanding of the current and planned/proposed locations, quantities, and patterns of all development, uses, and resource impacts in the region.

The purpose of Step 3 is to overlay transportation plans and projects with conservation priorities and land uses. This can help partners clearly see where there are areas that may be potentially impacted by transportation projects and where opportunities may exist for conservation.

The Regional Ecosystem Framework (REF). The REF is a geospatial database that includes the data collected in Step 2, as well as land-use plans and the long-range transportation plan. Using the mapping tool(s) selected in Step 2, the stakeholders collect and organize the available natural resource information to understand the ecosystem and to gain consensus on the most important areas for conservation and restoration potential.

Planning Scenarios. At this step, the stakeholders overlay the current transportation plans with resources. Alternative scenarios could be developed depending on factors such as near-term versus long-term, low growth versus high growth, and various program funding assumptions. The concepts of scenario planning in the FHWA Scenario Planning Guidebook are directly applicable here. The transportation agency would provide the transportation plan for the planning region, including identification of transportation projects that should be included the scenarios. The scenarios also could include assumptions about future land use changes based on community land use and management plans from the major local, state, and Federal regulatory, land management, and planning agencies in the region. The combination of the transportation projects and anticipated land use changes would define the “footprint” of future development for the purposes of each scenario; the footprint would provide the basis for estimating environmental impacts under each scenario. Partners should collaboratively define the planning scenarios and then ensure that the REF is designed to illustrate those scenarios. The alternate scenarios can be overlaid on the resource mapping, which will likely show locations where planned improvements overlie important resources.

The conclusion of Step 3 is a good time for the team to share the collection of the natural resource information and overlay of the proposed land use and transportation system improvements with the public. This also provides an opportunity to gather additional information from the public about natural resources in the planning area.

Documentation. The stakeholders should document the development of scenarios. The FHWA Scenario Planning Guidebook recommends visual documentation of scenarios along with a narrative or set of assumptions to describe the developed or modeled scenarios. Documentation will help communicate with partners and the public about how the REF was developed, which data was included, and how planning scenarios were selected.

Step 4 | Assess Effects on Conservation Objectives

The goals of this step are to:

1. Create a regional-scale picture of potential and cumulative impacts on natural resources based on transportation scenarios.
2. Agree on preferences regarding avoidance, minimization, potential conservation, and restoration investments to support selection of the best transportation plan scenario.
3. Identify and quantify mitigation needs.

The purpose of Step 4 is to assess the impacts of transportation plans and proposed land uses (to the extent that proposed land use is incorporated) on priority resources at the regional scale.

Impacts Assessment and Alternatives. The stakeholders evaluate the planning scenarios and jointly review and prioritize the affected resources, not unlike a project-level alternatives analysis, to optimize the transportation/infrastructure objectives and minimize adverse environmental impacts. The Science Team (resource experts) will play a significant role in quantifying the important elements of the affected resources, conservation needs (including the high-priority core habitats, minimum habitat sizes, connectivity), and the potential impacts. The team may also identify and prioritize sites for retrofitting existing infrastructure, such as replacing culverts that limit aquatic life passage with structures that allow passage. At this point, scenarios may be modified to avoid and minimize impacts. The scale of the quantification of impacts, avoidance, and minimization will depend on the resolution of the data. The need for mitigation for unavoidable impacts can be identified by type/resource and the quantity approximated. The goal is to obtain an estimate of the total mitigation needs of the program by habitat type.

Documentation. Document the process of avoidance and minimization, and quantifying impacts and mitigation requirements. The documentation could include a matrix of impacts of various scenarios, by habitat type, with some documents showing concurrence by the resource agencies.

Step 5 | Establish and Prioritize Ecological Actions

The goals of this step are to:

1. Create a regional conservation, restoration, recovery, and mitigation strategy, with quantitative and qualitative valuation of mitigation sites.
2. Identify the preferred conservation and restoration actions needed to achieve the priority conservation goals.
3. Develop strategies and actions that consider regulatory requirements and programmatic implementation opportunities.
4. Designate a lead agency or agencies for each strategy and a method for achieving each strategy.

In previous steps, the resource agencies identified the habitats in most need of conservation and restoration in the planning area. Step 5 evaluates these areas and others in the planning region to achieve the mitigation goals defined in Step 4.

This step could include the creation of Programmatic Mitigation Plans as laid out in MAP-21 (23 U.S.C. 169). The statute provides that a state DOT or MPO may develop one or more programmatic plans to address the potential environmental impacts of future transportation projects as a part of the statewide or metropolitan transportation planning process. The scope of a plan is determined by the state DOT or MPO in consultation with the resource agencies that have jurisdiction over the resources. MAP-21 also requires that a draft of the plan be available to the public for review and comment and that the public's comments be addressed in the final plan.

Mitigation Plan. This step involves the stakeholders creating a mitigation plan to meet the needs of the transportation program at a regional level. These collaborative, holistic, regional-scale approaches allow transportation and resource agencies to eliminate redundant investments, share data, and identify potential mitigation sites more effectively. The process is expected to:

1. Reduce the degree of coordination required on a particular project.
2. Reduce the uncertainty at the initiation of any project, for the transportation agency and the resource agencies, as to the potential ecological impacts and likely level of effort needed to address those impacts.
3. Provide the opportunity for stakeholders to pool their financial resources to achieve the greatest benefit.

Operating principles are to identify sites with greatest conservation value, the most “credits” per invested dollar amount, and long-term sustainability.

Based on the resource mapping available, mitigation plan “scenarios” can also be developed to meet the program needs and conservation priorities. The assessment of mitigation opportunities would include field efforts to verify the conditions of the targeted sites along with an evaluation of the potential sites based on various criteria, such as:

1. Their anticipated contributions to cumulative effects.
2. Their presence in priority conservation/restoration areas.
3. Their ability to contribute to long-term ecological goals.
4. The likelihood of viability in the regional context.
5. Cost.
6. Eventual management (ownership) by a resource agency to insure sustainability.
7. Potential to expand or improve the mitigation site in the future.
8. Other criteria determined by the stakeholders.

In addition, the stakeholders may be asked to rank the sites based on their ability to meet these criteria.

For impacts that do not appear practicable to mitigate in-kind, the transportation agency may wish to review with the resource agency partners the feasibility of mitigating out-of-kind (for example, by helping secure a high-priority conservation area supporting other resource objectives).

The stakeholders will jointly review the mitigation scenarios. Once adopted, the transportation agency can move to secure sites in advance as a “bank” or consolidated mitigation site for foreseeable projects.

This exercise is consistent with the in-lieu fee wetland mitigation programs in some states (for example, in North Carolina and Florida). In these programs, rather than requiring site-by-site mitigation for CWA or state wetlands/waterways permits, the applicant instead pays a fee, correlated with the amount of impact, to the resource agency charged with performing mitigation at a state level. The resource agency may identify areas with the greatest mitigation/restoration need and sites with the greatest chance of success and ecological value.

Performing this step in concert with the resource agencies helps to minimize the level of effort spent on a project-by-project basis identifying suitable mitigation sites, defining mitigation goals, and ensuring mitigation success. In addition, the process could help to consolidate funds from various sources to undertake a restoration/mitigation project that meets the needs of the transportation agency as well as the goals of the resource agency. Performed at a statewide level, this effort could have the additional value of providing a guide to mitigation prioritization and siting for all public (including county and city transportation officials, who often follow the state DOT guidelines and policies, and other agencies that oversee infrastructure, such as public utilities) and private permittees.

Documentation. Document the process of ranking mitigation sites, the quantities to be retained/restored in each area, and the agency and mechanisms for conducting the mitigation.

Step 6 | Develop Crediting Strategy

The goals of this step are to:

1. Identify practical habitat measurements that can be used to set mitigation goals.
2. Establish habitat measurements on which to base tools such as advanced mitigation banks, programmatic permitting, and ESA Section 7 consultation.
3. Create agreements on the use of offsite mitigation and out-of-kind mitigation where necessary.
4. Provide a process for informed adaptive management and updates of the cumulative effects analyses.
5. Enable measurement of gains and losses of ecological functions, and benefits and values associated with categories of transportation improvements or specific project-related impacts.

6. Characterize project mitigation benefits related to currently unregulated services, such as carbon storage or late season water provision.
7. Provide a means to track progress toward regional ecosystem goals and objectives.

Mitigation can seldom be accomplished as a clear one-for-one replacement for lost habitats. Although a proposed mitigation may ultimately provide the same functions and values of the lost habitat over time, there is a temporary loss of the existing habitat while the new habitat establishes, and a certain unpredictability in the trajectory of the newly established habitat. Consequently, resource agencies often establish replacement ratios for mitigation to compensate for these potential losses. The goal of Step 6 is to establish the credit (mitigation) ratios for each of the sensitive habitats affected by the transportation program. Establishing these ratios in advance provides a guide for the transportation and resource agencies and helps to expedite future permitting or consultation.

Mitigation Credit Precedents. This step requires a clear understanding of the habitat needs of affected species and definition of measures of the functions and values of the habitats to be mitigated.

This step begins by gathering existing mitigation crediting protocols, such as for wetlands or stream mitigation where the mitigation ratios are specified based on functions and values according to state law (for example, wetland rapid assessment methods). Also, the team should collect precedent mitigation approaches/ratios for as many of the priority habitats identified in Steps 2 through 4 as possible, such as from NEPA documents and Section 7 ESA consultation documents (e.g., incidental take statements in Biological Opinions). Preferably these precedents originate within the state or planning region, but also search adjacent areas if none are available. (Depending on the variability of the ecosystem, the applicability of the protocols borrowed from other regions may need to be tested for applicability to local conditions.) The resource agencies ought to be able to provide these precedents and policies within their jurisdiction. The point is to identify measurement criteria for each affected resource on which to base the mitigation credit system. For example, wetlands may be categorized using a rapid assessment method, and mitigation ratios established based on the categories. Also, the density of suitable habitat trees may determine the value of a habitat for a particular rare species and define mitigation ratios.

Mitigation Credit Agreement. The transportation agency confirms with the resource agencies their commitment to establish rules for mitigation crediting for each priority resource and to enter into an MOA. The signing of this MOA or other formal interagency agreement will likely require support from leadership and management at each of the agencies to ensure implementation and enforcement.

Resource agencies may be conflicted about setting mitigation ratios for particular species in perpetuity, given changing ecological knowledge and habitat conditions. Therefore, mitigation MOAs may compensate for lack of knowledge by setting ratios higher, and may have expiration dates, much like CWA Section 404 Nationwide Permit conditions. Even mandated mitigation ratios, such as for wetlands according to state law, can change.

Thus, practitioners may not be able to remove all of the future unpredictability from the process. Still, it is reasonable to assume that they can forge agreements with the resource agencies (at least for foreseeable short-term mitigation requirements, such as for projects in the state transportation improvements program or transportation improvement plan), provided the mitigation plan can meet regulatory requirements and conservation priorities.

Documentation. Document regulatory assurances to grant credits and long-term agreements.

Step 7 | Develop Programmatic Consultation, Biological Opinion, or Permits

The goals of this step are to:

1. Reach agreement on resource management roles and methods.
2. Incorporate outcome-based performance standards within programmatic agreements.
3. Create programmatic ESA Section 7 agreement, Special Area Management Plan for wetlands, Regional General Permit, or agreements that enable the transportation agency to proceed with conservation or restoration action with maximum assurance that their investments will count and will be sufficient.

This step is about developing the MOAs and project-level permitting procedures in concert with the resource agencies. MOAs are legal agreements that must be signed by a representative of each participating agency. MOAs and standard procedures will provide a substantial benefit for expediting project-level permitting and consultation, making these processes and outcomes

more predictable. The predictability will also improve project-level scheduling, and likely have a positive financial impact on the agencies involved by reducing their level of effort at the project level.

There are numerous MOAs between Federal and state agencies and resource agencies for management of natural resources, rare species, waterways permitting, cultural resources, and other subjects that can be referenced as templates. The MOAs or other agreements may include:

1. Specifying coordination protocols for the regulated resources, such as procedures for Section 404 permitting and Section 7 consultation. These protocols will define responsibilities, document agreements at the project level, and set performance standards for mitigation.
2. Developing standard procedures and designs for projects to minimize impacts.
3. Specifying mitigation ratios and priority sites (where possible).
4. Monitoring protocols of mitigation sites.
5. Specifying responsibilities for long-term mitigation site ownership and management.

Documentation. Document all long-term management arrangements, coordination protocols, and standard procedures in programmatic agreements.

Step 8 | Implement Agreements, Adaptive Management, and Deliver Projects

The goals of this step are to:

1. Link the early planning processes to the project implementation phase.
2. Incorporate tools and approaches from previous steps into a monitoring and adaptive management strategy.
3. Provide accurate recordkeeping and tracking of all commitments by the transportation agency in project delivery.

In Step 8, the focus shifts somewhat from a programmatic view to the project level. Transportation agencies apply the MOAs and other programmatic agreements in permitting and mitigating for specific projects.

The MOAs and other agreements provide the transportation agency a view of mitigation requirements for foreseeable projects and priority sites. With this knowledge, the transportation agency can pursue advanced mitigation, acquiring and restoring/improving mitigation sites in preparation for obtaining permits for specific projects, and expediting the project-level permitting process. While the basic assumptions and requirements of the mitigation sites are laid out in the MOA, coordination will still occur between the cooperating agencies on management, ownership, and long-term maintenance of the specific sites. Priority sites that may not be accessible by the transportation agency alone may be accessible in concert with other stakeholders.

While MOAs may open the door to advance mitigation, analysis of alternatives for avoidance and minimization must still be practiced at the project level, in accordance with agreements and protocols established in Step 7. The commitments and agreements must be translated to the project level. Design standards to minimize impact must be included in the project design. It is likely that many design standards will be incorporated as environmental commitments in the NEPA documents for individual projects, as well as conditions of regulatory authorizations and permits. The transportation agency will ideally have a system for recording all mitigation requirements by project, actions taken, and monitoring completion that is available to the regulatory agencies for verification.

Stakeholders can contribute to the success of the process by monitoring the outcomes of mitigation, design standards, and other specifications for opportunities to improve the benefits to the ecosystem.

Documentation. The documentation from Step 8 will be focused on how stipulations of MOAs and other agreements are implemented for individual projects, and the establishment of specific mitigation sites. Compliance with avoidance and minimization measures will likely be included in NEPA documents. The documentation may include correspondence between cooperating agencies on specific mitigation sites; permitting documents; balance sheets showing which projects used credits from a particular consolidated mitigation site, and the number of credits remaining; and mitigation site monitoring reports.

Step 9 | Update REF and Plan

The goals of this step are to:

1. Maintain a current REF spatial database consistent with best available data and expert knowledge.
2. Update the analysis of cumulative effects as conditions and knowledge change.
3. Update conservation and restoration priorities as new information is received to ensure the integrated plan is reflective of current conditions.

Ecological conditions and the knowledge base will change over time, and ideally the agreements and priorities developed through the IEF process will change with them. Species distributions, land development, climate, and even conservation priorities will change. The conditions at priority sites and the base mapping of resources, including successful mitigation efforts, will need to be updated from time to time. The accessibility of an interagency system will make this updating as seamless as possible and the new information readily available. This change may alter the availability or utility of some mitigation sites that were previously identified. Mitigation strategies going forward may need to be updated.

Therefore, regular progress reviews between the transportation agency and the resource agencies are needed to verify the effectiveness of the program in promoting conservation goals, mitigation strategy, and programmatic agreements.

Conclusion

Employing the Eco-Logical approach requires a shared vision and investment by the transportation agency, each of the partner/cooperating agencies, and the public. Transportation planning aided by area-wide mapping of priority habitats, cooperative agreements for impact assessment, and organized inter-agency mitigation site selection and implementation is becoming more common. For a number of state DOTs and regional transportation agencies, elements of Eco-Logical have already been integrated into their planning processes. For others, the Eco-Logical approach may amount to a sea change in their normal mode of operation.

Agencies do not need to follow all of the steps of the Integrated Ecological Framework in order to use an Eco-Logical approach. Agencies may apply only some of the steps to realize some of the benefits as described in *Eco-Logical*, including the predictability of transportation delivery programs, efficiency in environmental compliance, and better decision making for preservation and mitigation planning for natural systems. By implementing Eco-Logical, the transportation and resource agencies can find a balance between infrastructure needs and environmental compliance and preservation.

Appendix A

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
CWA	Clean Water Act
DOTs	Departments of Transportation
ESA	Endangered Species Act
FAST	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
IEF	Integrated Ecological Framework
L RTP	Long Range Transportation Plan
MAP-21	Moving Ahead for Progress in the 21st Century Act
MOA	Memorandum of Agreement
MPOs	Metropolitan Planning Organizations
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
PEL	Planning and Environmental Linkages
REF	Regional Ecosystem Framework
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SHRP2	Second Strategic Highway Research Program
STIP	State Transportation Improvement Plan
TIP	Transportation Improvement Plan
TRB	Transportation Research Board
USEPA	U.S. Environmental Protection Agency

Reference Materials

Statutes, regulations, and guidance documents cited in this handbook, along with additional materials and sample documents, are available on the Center for Environmental Excellence by AASHTO web site: <http://environment.transportation.org>.

ADDITIONAL RESOURCES

PRACTITIONER'S HANDBOOKS AVAILABLE FROM THE CENTER FOR ENVIRONMENTAL EXCELLENCE BY AASHTO

- 1 Maintaining a Project File and Preparing an Administrative Record for a NEPA Study
- 2 Responding to Comments on an Environmental Impact Statement
- 3 Managing the NEPA Process for Toll Lanes and Toll Roads
- 4 Tracking Compliance with Environmental Commitments/Use of Environmental Monitors
- 5 Utilizing Community Advisory Committees for NEPA Studies
- 6 Consulting under Section 106 of the National Historic Preservation Act
- 7 Defining the Purpose and Need and Determining the Range of Alternatives for Transportation Projects
- 8 Developing and Implementing an Environmental Management System in a State Department of Transportation
- 9 Using the SAFETEA-LU Environmental Review Process (23 U.S.C. § 139)
- 10 Using the Transportation Planning Process to Support the NEPA Process
- 11 Complying with Section 4(f) of the U.S. DOT Act
- 12 Assessing Indirect Effects and Cumulative Impacts under NEPA
- 13 Developing and Implementing a Stormwater Management Program in a Transportation Agency
- 14 Applying the Section 404(b)(1) Guidelines in Transportation Project Decision-Making
- 15 Complying with Section 7 of the Endangered Species Act

For additional Practitioner's Handbooks, please visit the Center for Environmental Excellence by AASHTO web site at: <http://environment.transportation.org>

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