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| 16. Abstract The objective of this research project is to assess current mitigation policies and practices in comparison to resource agency objectives and to identify mitigation strategies and priorities that provide greater cost-benefit potential and implementation speed through strategic inter-resource agency planning. Mitigation for various actions associated with transportation development has been part of the process for decades. Although the science, practice, and technology may have advanced during this time, many of the processes and practices are rooted in traditional rules and regulations that require mitigation. The objective for this project is to assess mitigation policies and practices as a whole, looking at both the current and future of mitigation efforts in the transportation development process. This guide presents a summary of the Integrated Ecological Framework approach for mitigation in the transportation development process. | | | | | |
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**MAXIMIZING MITIGATION BENEFITS–MAKING A DIFFERENCE
WITH STRATEGIC INTER-RESOURCE AGENCY PLANNING: YEAR
TWO TECHNICAL REPORT**

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DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

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INTRODUCTION

This report presents the second year summary for *Maximizing Mitigation Benefits– Making a Difference with Strategic Inter-Resource Agency Planning*. The second year involved the following tasks generally described below:

- *Plan and Conduct Workshops with Stakeholders and Practitioners (Task 6)*. This task planned and conducted a series of workshops around the state to share the results of the research and seek input and feedback on potential strategies for improving mitigation management. The audience for the workshops included the Texas Department of Transportation (TxDOT), the Federal Highways Administration (FHWA), resource agencies, key stakeholders, and practitioners.
- *Prepare Strategies and Recommendations (Task 7)*. This task prepared strategies and recommendations that target improving current processes and practices in order to maximize mitigation benefits and links regional planning activities.

CHAPTER 1: WORKSHOPS WITH PRACTITIONERS

The purpose of this task was to plan and conduct a series of pilot workshops around the state to share the results of the research and seek input and feedback on potential strategies for improving mitigation management. The audience for the workshops included TxDOT practitioners at four TxDOT Districts.

Researchers from the Texas A&M Transportation Institute (TTI) have had success with pilot workshops that bring practitioners together to share feedback on promising strategies to improve mitigation practices and management and identifying training and resource needs from a District practitioner perspective.

The researchers conducted four regional pilot workshops with TxDOT Districts. The workshops were held at the Dallas, Pharr, Houston, and Lufkin Districts.

Table 1. Pilot Workshops.

| TxDOT District | Date | Number of Participants |
|-----------------------|-----------------|--|
| Dallas | June 10, 2014 | 11 |
| Pharr | July 23, 2014 | 8 |
| Houston | July 29, 2014 | 12 |
| Lufkin | August 20, 2014 | 5 participants including Lufkin, Tyler, and Atlanta Districts. |

The agenda generally followed a one-half day format, or approximately three hours. The pilot workshops included an introduction, followed by three lessons. The entire lesson plans are provided in Appendix A.

- Introduction involved participants describing their roles and experience with National Environmental Policy Act (NEPA) and mitigation processes at TxDOT.
- Lesson 1 included a broad overview of NEPA in the TxDOT project development process (PDP) followed by feedback on course content and current NEPA assignment processes.

- Lesson 2 included a review of mitigation in the TxDOT PDP followed by feedback and discussion on suggested improvements to the course materials and to current processes.
- Lesson 3 introduced the Integrated Ecological Framework followed by a discussion of how IEF may be applied in region.

These pilot workshops used a half-day format, however a full-day is recommended if the workshops are implemented. The difference between a half-day and full-day workshop will be the depth and quantity of examples and case studies presented. Half-day workshops will focus on potential strategies. Full-day workshops would provide greater depth in example practices and case studies. The workshop learning objectives are listed below.

PILOT WORKSHOP LEARNING OBJECTIVES

At the end of the workshop, participants should be able to:

- Describe NEPA concepts and documents.
- Describe mitigation in the project development process.
- Explain the Integrated Ecological Framework.

Lesson 1—Learning Objectives

At the end of the NEPA and PDP lesson, the participant should be able to:

- Describe NEPA and document classification.
- Describe how documents and mitigation fit into the TxDOT project development process.
- Identify resources for environmental documents in the TxDOT PDP.
- Explain risk assessment and scoping in the PDP.

Lesson 2—Learning Objectives

At the end of the Mitigation and PDP lesson, the participant will be able to:

- Describe common types of mitigation.
- Identify mitigation milestones in the PDP timeline.
- Describe costs associated with mitigation.
- Describe examples of mitigation best practices.
- Identify compliance issues in the mitigation and PDP.

Lesson 3—Learning Objectives

At the end of the Integrated Ecological Framework lesson, the participant will be able to:

- Explain the Integrated Ecological Framework (IEF).
- Describe the Regional Ecological Framework (REF).
- Identify IEF resources.
- List steps in the IEF process.

PILOT WORKSHOPS OBSERVATIONS

Based upon feedback from workshop participants, the workshop materials and content were well received. In general, the participants believed a one-day or half-day agenda would be the most convenient and result in greater attendance. Additionally, there was general recognition that although many District environmental staff may have the necessary skills and knowledge of NEPA and mitigation practices, there are significant benefits to be gained in the workshops through sharing experiences and lessons learned within their own Districts among other practitioners. Most importantly, Districts expressed interest in practices and experiences at other Districts on a wide range of environmental and mitigation processes.

The comments and suggestions from participants are summarized below.

Comments on the Workshop and Content

Workshop participants were asked to provide comments on the appropriateness of the workshop content and target audiences. The responses included:

- This workshop and content would be helpful if targeted to TxDOT designers, project managers, and local government agencies.
- Participants were not aware of the National Highway Institute (NHI) web-based training course: *Introduction to NEPA and Transportation Decision Making*, FHWA-NHI-142052 NEPA Tutorial. However, most expressed interest in completing the 4-hour on-line course and that a certificate of completion was available. Many participants suggested the NHI course be a pre-requisite for this workshop.

Comments on District Practices

Workshop participants were asked to provide comments on environmental clearance practices and processes in the project development process. The responses included:

- TxDOT environmental practitioners expressed the importance of working closely with designers and project managers, in particular, attending design concept conferences to identify and raise early awareness of environmental constraints.
- TxDOT District environmental staff expressed the importance of making project site visits with designers and project managers to identify environmental constraints.
- TxDOT District environmental staff indicated that designers should transition away from using box culverts as a standard practice and consider bridging streams and wetlands more often.
- Last minute design changes that require additional right-of-way (ROW), additional impacts, or changes to a permit are typically the most common cause of project delivery delays.
- Districts' experience with using consultants for environmental assessment and mitigation varies significantly.
 - Some Environmental Coordinators (ECs) expressed difficulty finding consultants with adequate qualification and experience and relied on in-house subject matter experts.
 - Some ECs expressed relative confidence in work conducted by consultants.
- Districts indicated a good working relationship with relevant resource agencies. Experience in working with U.S. Army Corps of Engineers (USACE), as well as other resource agencies varies by region. Some of the districts have very good relationships with resource agencies and experience few problems, whereas other districts indicated that the permitting process has not improved or evolved in many years.
- Environmental staff generally have limited interaction with metropolitan planning organizations (MPOs) on environmental issues and planning.
- Environmental staff (with a few exceptions) have only a general knowledge of the transportation planning and programming process. Several environmental practitioners indicated an interest in learning more about how and why transportation projects are developed and the transportation planning and programming process.

- Most of the workshop participants indicated that meeting District letting demands is the top priority and ultimately sets the priorities for project work tasks and work load. In some cases, longer term strategic work goals are displaced by the demands on meeting the letting schedule.
- Most of the districts expressed interest in expanding geographic information systems (GIS) and environmental constraints mapping, and a regional environmental framework (REF).

Comments on NEPA Assignment

Participants were asked to provide comments on NEPA assignment, and included:

- Environmental coordinators and staff have significant interest in meeting the self-assessment, compliance monitoring, and documentation practice goals.
- Nearly all of the participants had attended one of the NEPA Assignment training sessions in either May or July 2014. Many of the participants had comments and questions about specific processes and checklists associated with NEPA assignment. The questions about the processes were insightful and demonstrated a thorough understanding of NEPA Assignment issues.
- Nearly all of the participants demonstrated understanding of categorical exclusions (CE) and environmental assessments (EA) classification. In particular, participants understood differences between c-list and d-list CEs.
- Workshop participants generally welcome NEPA assignment as a significant improvement in transportation project development process.
- As expected, Districts reported that mitigation costs vary across and within TxDOT districts. Best value mitigation (using a procurement process) can be very difficult due to the absence of mitigation banks and valuation options.
- Districts are concerned that stream mitigation will become very difficult and very expensive so that an avoidance approaches by designers will become more common.
- Although most of the environmental practitioners indicated that using Environmental Compliance and Oversight System (ECOS) can be time consuming and frustrating at times, they recognize that the ECOS concept and the practice of paperless online NEPA

project tracking and environmental documentation is needed and a significant improvement over previous practices.

- Most of the participants expressed acceptance and satisfaction with new NEPA assignment practices and recognize the need for on-going improvements.

CHAPTER 2: STRATEGIES AND RECOMMENDATIONS

PROPOSED STRATEGIES

Researchers originally proposed to use the FHWA *Framework for Integrated Planning (I)* as part of the *Eco-Logical* program to identify recommendations. Some of the steps listed in the framework are on-going activities at TxDOT and do not occur in the numerical sequence listed below. The steps in the framework are not used as a strictly followed sequence but rather as a guide for types of activities:

1. Build and Strengthen Collaborative Partnerships.
2. Identify Management Plans.
3. Integrate Plans.
4. Assess Effects.
5. Establish and Prioritize Opportunities.
6. Document Agreements.
7. Design Projects Consistent with Regional Ecosystem Framework.
8. Balance Predictability and Adaptive Management.

STRATEGIC HIGHWAY RESEARCH PROGRAM

Based on the results of outreach conducted during the research project and on-going national research being published, the approach was refined to include research results from the Strategic Highway Research Program (SHRP2), which addresses some of the most pressing needs related to the nation's highway system. The Transportation Research Board of the National Academies administers SHRP2 for the Federal Highway Administration and the American Association of State Highway Officials.

Specifically, SHRP2 Project C06, *Integration of Conservation, Highway Planning, and Environmental Permitting Using an Outcome-Based Ecosystem Approach*, produced a two-volume report and companion guides on addressing mitigation using an ecosystem approach. The SHRP2 C06 project developed the *Integrated Ecological Framework (IEF)* and companion guidebooks as the basis for introducing IEF processes to practitioners. The detailed guidance on the IEF process are contained in the SHRP2 research products listed below:

- *An Ecological Approach to Integrating Conservation and Highway Planning*, Volume 1, http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-Rw-1.pdf (2).
- *Manager's Guide to the Integrated Ecological Framework: Publication Draft*, http://oregonstate.edu/inr/sites/default/files/documents_reports/Draft_IEF_Mgrs_Guide_Oct2013.pdf (3).
- *Practitioner's Guide to the Integrated Ecological Framework*, http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-3.pdf (4).
- *Manager's Guide to the Integrated Ecological Framework*, http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-4.pdf (5).

Integrated Ecological Framework

The IEF is a science-based approach, used by transportation planners and natural resource specialists, to identify ecological priorities and integrate them into transportation and infrastructure decision making. The purpose of the IEF process is to:

- Conduct analyses and make decisions within a regional ecosystem context.
- Clearly identify and prioritize the important resources and their conservation requirements.
- Use spatial and quantitative assessment methods.
- Start very early in the transportation planning process.

The output and products from the IEF process are:

- Regional maps of conservation and restoration priorities.
- Regional maps identifying affected resources and the impacts from transportation development.
- A process for keeping these maps, databases, and agreements up-to-date (3).

IEF is intended to support both natural resources and transportation infrastructure development and to integrate the vision, goals, and objectives for each. By working together, instead of separately, state departments of transportation (DOTs), metropolitan planning organizations, and resource agencies can achieve transportation/infrastructure needs and environmental goals. The IEF complements the FHWA's *Eco-Logical: An Ecosystem Approach to Developing Infrastructure* (6), which was signed by eight federal agencies.

Researchers used the IEF as the basis for adapting it to practices at TxDOT. The IEF was also used as the basis for the research product guide book. The IEF developers use a nine-step process as listed and shown in Figure 1:

- **Step 1:** Build a strong collaborative partnership of transportation and natural resource specialists. Create a shared vision representing the environmental and transportation goals for the planning region. Develop the collaborative framework necessary for cooperative decision making, data development and management, analyses, planning, and implementation.
- **Step 2:** Gather data, expertise, and other inputs about the natural and built environment. Represent all high priority conservation and restoration areas and goals (regional ecosystem framework [REF]). Represent an initial plan to meet transportation goals.
- **Step 3:** Integrate the conservation and transportation information and goals into a regional ecosystem and infrastructure development framework (REIDF).
- **Step 4:** Characterize scenarios of transportation and other land use. Assess the effects of transportation scenarios on conservation objectives, create a preferred scenario, and create an ecosystem-based mitigation strategy to address remaining impacts.
- **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, with the goal of having the analyses be in the same language throughout the life of the project.
- **Step 7:** Develop programmatic consultation, biological opinion, or permit. Develop memoranda of understanding (MOUs), agreements, programmatic Clean Water Act (CWA) Section 404 permits, or Endangered Species Act (ESA) Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Steps 5 and 6 and the parameters for achieving these goals.
- **Step 8:** Implement agreements and adaptive management. Deliver conservation and transportation projects. Design transportation 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:** Continue to develop and maintain dynamic information on environmental and transportation needs and goals, access to cutting-edge conservation, and assessment methods, and mitigation monitoring results in order to support both a viable partnership vision and future planning at the local, watershed, eco-regional, or state level.

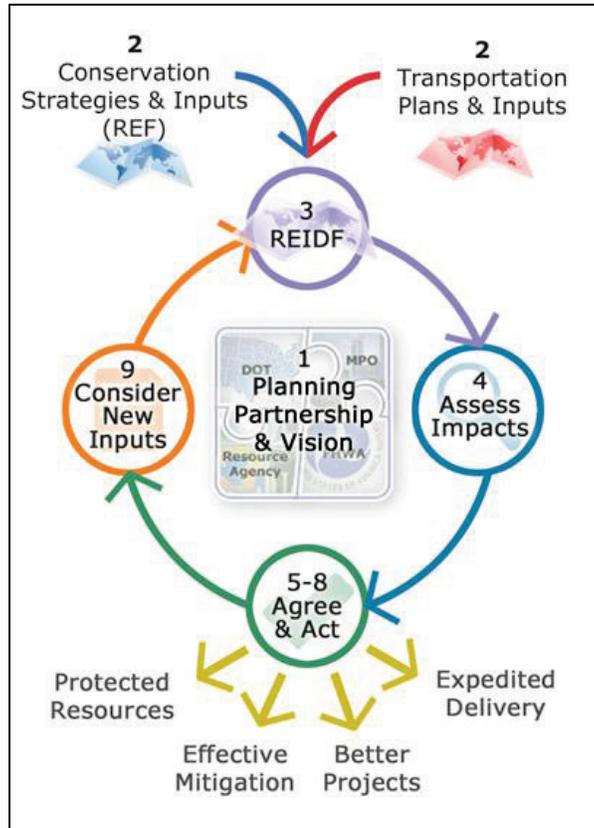


Figure 1. Integrated Ecological Framework (2).

Introductory Guide to IEF

The IEF process was modified from its original nine-step format for this application to TxDOT practices and condensed into six steps (combining Steps 5–8 in the original nine-step process) for the research product 0-6762-P1: *Introductory Guide to Integrated Ecological Framework*. This introductory IEF process is presented in a condensed format to serve as an introductory guide more suitable for new practitioners.

The steps in the guide represent a process that is needed to achieve the desired IEF outcomes. Not every step needs to occur in sequence and more than one step may occur at the same time. The modified IEF steps were condensed into two parts consisting of what to do and

what are the outcomes. The modified IEF modified steps follow the original, and more detailed step descriptions found in the SHRP2 guides (3, 4).

Table 2 shows the IEF steps. The *Introductory Guide to Integrated Ecological Framework* is in Appendix B.

Table 2. Condensed Integrated Ecological Framework Steps.

| IEF STEPS (Condensed) | Outcomes |
|---|--|
| Step 1: Build collaborative partnerships and regional vision. | Stakeholders agree on vision, roles and responsibilities. |
| Step 2: Create a regional ecosystem framework (REF). | Define your ecosystem and its important elements. |
| Step 3: Define transportation and infrastructure scenarios. | Define your transportation plan's effect on the region. |
| Step 4: Create a regional ecosystem and infrastructure development framework (REIDF). | Describe the transportation system intersecting with the ecosystem. |
| Step 5: Implement agreements, permits, crediting strategies, programmatic mitigation, and prioritize ecological actions. | Stakeholder agreements that preserve both ecosystem and transportation system. |
| Step 6: Monitor and update the REF and REIDF. | Keep score and measure progress. |

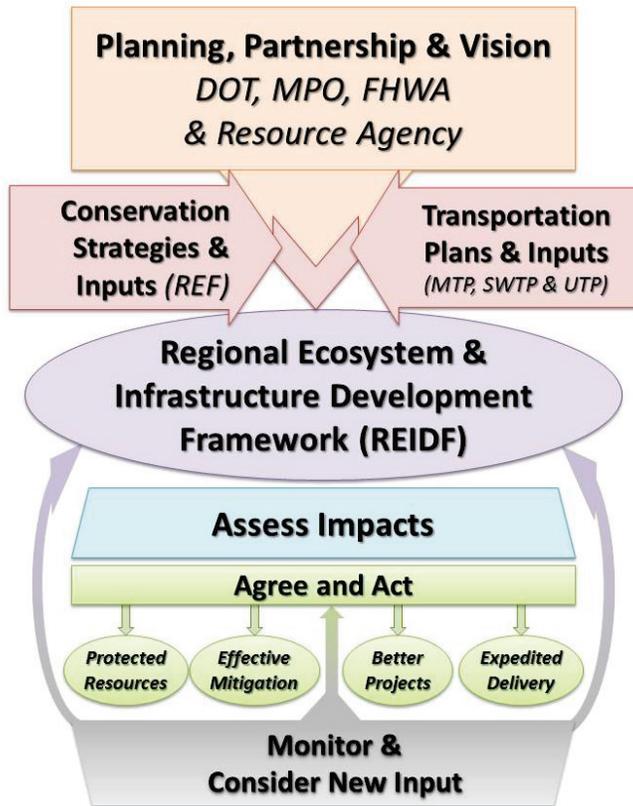


Figure 2. Modified IEF.

SUMMARY OF STRATEGIES

Table 3 provides a summary list of the strategies. The description of the strategies follows. This list was also used to solicit feedback during workshops developed in Task 6 - *Plan and Conduct Workshops with Stakeholders and Practitioners*.

Table 3. Summary of Strategies.

| High-Priority Recommendations | |
|--|--|
| 1 | Track Mitigation Costs |
| 2 | Mitigation Cost Guidance |
| 3 | Identify Pilot Projects/Corridors at MPOs for Regional Mitigation Pilot Projects |
| 4 | Comprehensive Development Agreements (CDA) Mitigation Inventory |
| Long-Term Strategies | |
| 1 | Improve Data Sharing, Information Management, and Databases |
| 2 | Continue to Fund Positions at Resource Agencies |
| 3 | Early Coordination and Outreach with Local Agencies and Co-Sponsors |
| 4 | Develop Integrated Permits |
| Compilation of Key Transition Points | |
| 1 | Project Environmental Constraints Evaluation Process. |
| 2 | Environmental Permits and Commitments (EPIC) Monitoring |
| 3 | Corridor/Project Coordination between TPP and ENV |
| 4 | Mitigation Cost Coordination between ROW and ENV |
| Identification of Capacity Building Opportunities | |
| 1 | Stream and Wetland Mitigation Awareness Education for District Staff |
| 2 | Develop Mitigation Outreach Materials |
| 3 | Provide Cross-Discipline Training for Environmental and Planning Personnel |

High-Priority Recommendations

This section provides a list of high priority elements the research team recommends that should be the focus of TxDOT implementation activities in the short term. Recommendations in this category could lead to implementation process with a high predicted stakeholder pay-off based on wide stakeholder consensus (i.e., having little or no anticipated resistance to its implementation by process stakeholders).

- 1. Track Mitigation Costs.** Mitigation tracking in general has been difficult for all types of mitigation. Mitigation tracking strategies and efforts are also not well-known on strategic projects—projects within the Strategic Projects Office. These projects include Public-Private Partnership (P3s) program, design-build, and Comprehensive Development

Agreements. There is concern that developers are motivated to streamline projects, including mitigation, to save costs but may also shortcut environmental stewardship. Tracking annual mitigation/compliance costs is not precise. Such costs are not separated as a part of doing business. Monitoring is also controversial in terms of investment and outcome and return on investment. Cost-tracking needs to include post-construction costs as well.

One approach could include developing a method to use Right of Way Information System (ROWIS) to track mitigation costs. TxDOT's Right-of-Way Division (ROW) tracks the mitigation purchases as if they are parcels of land in the ROWIS. By statutory law, the remedy of environmental impact is considered a right-of-way acquisition cost. Simultaneously, while TxDOT's Environmental Affairs Division (ENV) evaluates the need, ROW delineates appropriate remedy and appropriateness of value. The ROW Division is often given options for mitigation, with different costs for each option. The USACE often prescribes these options through their published regulatory requirements. The selected option is referred to ENV to ensure it meets environmental requirements. ROW sets up the mitigation as a parcel in ROWIS coded with an "m" for mitigation or "w" for wetland. ROW then funds the parcel or credit.

- 2. Mitigation Cost Estimating Practices Guidance.** Mitigation cost estimating practices may vary by the resource to be mitigated, by region, project and markets. A guide with regional and resource specific valuations, typical cost ranges, or typical unit prices would be helpful in predicting project mitigation costs.

- 3. Identify Pilot Project/Corridors at MPOs for Regional Mitigation.** The metropolitan planning organizations for the Dallas-Fort Worth (DFW) area and Houston-Galveston region account for the largest mitigation efforts and expenditures in the state. Additionally, the North Central Texas Council of Governments (NCTCOG) and Houston-Galveston Area Council (HGAC) have both participated in Eco-logical grants from FHWA and have a baseline and experience in regional mitigation implementation. Among the many projects in these regions, Loop 9 in the DFW area and State Highway 36A in the HGAC offer potential pilot project for regional mitigation. Other opportunities

exist with the corridors identified by the Transportation Planning and Programming Division (TPP) as “5 for 25” (corridors are along major interstate highways). Coordination and selection of corridors or projects can be made with concurrence from TPP, NCTCOG, and HGAC.

- 4. Comprehensive Development Agreements Inventory.** Several CDA projects in Texas are underway or nearing completion. This strategy aims to conduct an inventory of mitigation and associated cost associated with one or two of the projects to identify practices used by concessionaires (e.g., LBJ Freeway, DFW Connector, DFW Horseshoe).

Long-Term Strategies

This section provides a series of strategic recommendations predicted to provide a high return over the long term but unlikely to be implemented without significant modifications to current business processes, such as regulatory changes and changes to external or internal organizational structures. These recommendations are based on the results of Tasks 2, 3, and 4 and provide guidance to TxDOT on how to overcome estimated implementation barriers and achieve stakeholder buy-in.

- 1. Improve Data Sharing, Information Management, and Databases.** Success depends on good data, and good data are not always readily available for good mitigation decision making. Improved mitigation tracking data would improve mitigation prioritization and decision making. Improved environmental information is needed on the front end of the project delivery process. Under the current process, DOTs retrieve environmental data from a variety of sources and then assess environmental impacts and constraints. A central data clearinghouse—similar to those that MPOs developed in the Eco-Logical grants—could improve assessment processes and mitigation outcomes. Some partners find it difficult to separate planning scale from project scale data.

Better tracking of mitigation efforts and costs is needed. The responsibility for implementing, paying, and maintaining the many and various permits, mitigations and environmental commitments involves coordination between the district offices and the

ENV. The Districts are generally responsible for permits and commitments, but there is not a single statewide repository or tracking for mitigation and environmental permits. The Districts conduct information gathering and dissemination and tracking to ENV, and ENV provides technical assistance and oversight.

- 2. Continue to Fund Positions at Resource Agencies.** TxDOT has benefited from funding positions at resource agencies to advance and expedite environmental reviews, permitting, and coordination for TxDOT projects. Other state DOTs and MPOs that have funded positions have also experienced significant time savings. TxDOT currently funds positions with USFWS and Texas Parks and Wildlife Department (TPWD) within TxDOT offices statewide. Coordination among agencies has reduced processing times and helped prioritize projects. These relationships have also given TxDOT personnel a “go to” person for questions with a good response time.
- 3. Early Coordination with Stakeholders, Local Agencies, and Co-Sponsors.** Early and continued stakeholder involvement benefits projects by facilitating inter-agency coordination and institutional relationships. Involvement needs to occur on two fronts – one with resource agencies and the second with local governments and sponsors. Increasing turnover at partner agencies makes continuity difficult with long-duration projects. Regular meetings with key agencies such as the USACE help maintain the knowledge base and institutional memory. Improve agency coordination and consultation to foster a team approach to the identification of solutions, while minimizing contention about the need for transportation projects. Continuing the use of Memorandums of Understanding (MOU) provide stakeholder communication and coordination. Outreach to local agencies and project co-sponsors on the need for early environmental mitigation planning can be facilitated through Metropolitan Planning Organizations and TxDOT Districts using education and outreach material.
- 4. Develop integrated permits.** Coordination with other agencies is needed—consider developing integrated permits. Improvements to permit information (permit tables, description, etc.) need to have more clarity to facilitate processing across agencies.
- 5. Provide Cross-Discipline Training for Environmental and Planning Personnel.** This approach is designed to provide a process to fill in the training gaps for a better understating of the overall process. Cross-discipline training can be provided as

workshops to share understanding of issues such as data collection, terminology, goals, and processes of each discipline.

Compilation of Key Transition Points

This section provides a summary of key elements and transition points in the project development process, from current process activities to recommended new activities. The recommendations on transition points also include affected stakeholders, timing considerations, and rationale.

- 1. Project *Environmental Constraints Evaluation Process*.** Focused *Environmental Constraints* evaluations during project development enable the identification of key project issues before the start of the preliminary design phase, the development of better scopes of services, better staff and resource allocations, and time and cost savings.
- 2. Environmental Permits and Commitments (EPIC) Monitoring.** Each affected district should provide monitoring of EPICs and inclusion of EPICs into the Environmental Compliance and Oversight System (ECOS).
- 3. Coordination between TPP and ENV.** High priority corridors have been identified within TPP for future development. Increased coordination between TTP and ENV would help identify and avoid future potential mitigation within these high priority corridors.
- 4. Mitigation Cost Coordination between ROW and ENV.** The purpose is to enable monitoring of mitigation costs.

Identification of Capacity Building Opportunities

In addition to process recommendations, the research team provides an overview of capacity-building opportunities that may develop as a result of recommended process updates. These opportunities include potential audiences and potential methods to transfer the knowledge from this research to process stakeholders using the products developed by the research.

- 1. Stream and Wetland Mitigation Awareness Education for District Staff.** Specialized expertise in stream and wetland assessment and mitigation within TxDOT Districts has

been replaced in many instances by the use of outside consultants and contractors. However, District environmental coordinators still need stream and wetland mitigation knowledge to anticipate and manage potential mitigation contracts.

- 2. Develop Mitigation Outreach Materials.** Clear, concise communication and coordination are key to implementation of a successful project. The mitigation process can be complex and sometimes frustrating to stakeholders that may be under-informed or misinformed regarding expectations and reality.
- 3. Provide Cross-discipline Placement Opportunities for TxDOT Personnel.** The placement of TxDOT personnel in alternative divisions can help expedite the processes. For example, this may consist of personnel from ENV being placed in TPP and personnel from TPP placed in ROW, etc., to provide insight into each division's processes, facilitate communication among divisions, and integrate each division's knowledge base. This process may also be able to provide a broader contact and professional relationship within and outside of TxDOT.

MAP-21 PLANNING RULES AND PROGRAMMATIC MITIGATION

States and MPOs may develop programmatic mitigation plans to address potential environmental impacts of future transportation projects as part of the statewide or metropolitan transportation planning process. Proposed transportation planning rules §450.214 and §450.320 *Development of Programmatic Mitigation Plans*, jointly issued by FHWA and the Federal Transit Administration, provide a statutory framework for the optional development of programmatic mitigation plans as part of the statewide and metropolitan planning process. This document is available at: <https://www.federalregister.gov/articles/2014/06/02/2014-12155/statewide-and-nonmetropolitan-transportation-planning-metropolitan-transportation-planning> (6). The proposed rule includes the following:

A programmatic mitigation plan on a local, regional, ecosystem, watershed, statewide or similar scale that may:

- Encompass multiple environmental resources within a defined geographic area(s) or may focus on a specific type(s) of resource(s) such as aquatic resources, parkland, or wildlife habitat.

- Address or consider impacts from all projects in a defined geographic area(s) or may focus on a specific type(s) of project(s).

The programmatic mitigation plan may include an:

- Assessment of the existing condition of natural and human environmental resources within the area covered by the plan, including an assessment of historic and recent trends and/or any potential threats to those resources.
- Identification of economic, social, natural, and human environmental resources within the geographic area that may be impacted and considered for mitigation.
- Inventory of existing or planned environmental resource banks for the impacted resource categories such as wetland, stream, habitat, species, and an inventory of federally, state, or locally approved in-lieu-of-fee programs.
- Assessment of potential opportunities to improve the overall quality of the identified environmental resources through strategic mitigation for impacts of transportation projects, which may include the prioritization of parcels or areas for acquisition and/or potential resource banking sites.
- Adoption or development of standard measures or operating procedures for mitigating certain types of impacts; establishment of parameters for determining or calculating appropriate mitigation for certain types of impacts, such as mitigation ratios, or criteria for determining appropriate mitigation sites.
- Adaptive management procedures, such as protocols or procedures that involve monitoring actual impacts against predicted impacts over time and adjusting mitigation measures in response to information gathered through the monitoring.
- Acknowledgment of specific statutory or regulatory requirements that must be satisfied when determining appropriate mitigation for certain types of resources.

The proposed rule also details the process should the state decide to develop a programmatic mitigation plan as part of the statewide transportation planning process. The state will be required to consider the following process prior to adopting a programmatic mitigation plan:

- Consult with each agency with jurisdiction over the environmental resources considered in the programmatic mitigation plan.

- Make available a draft of the programmatic mitigation plan for review and comment by appropriate environmental resource agencies and the public.
- Consider comments received from such agencies and the public on the draft plan.
- Address such comments in the final programmatic mitigation plan.

Rule § 450.214 also proposes that a state may integrate a programmatic mitigation plan with other plans, including, watershed plans, ecosystem plans, species recovery plans, growth management plans, State Wildlife Action Plans, and land use plans. If a state develops a programmatic mitigation plan, any federal agency responsible for environmental reviews, permits, or approvals for a transportation project may use the recommendations in the programmatic mitigation plan when carrying out its NEPA responsibilities and any other environmental laws and regulations. The rule also states that it does not limit the use of programmatic approaches for reviews under NEPA (5).

TXDOT NEPA ASSIGNMENT

Federal law allows states to obtain the authority from FHWA to review and approve environmental documents required under the NEPA. This passing of authority from the FHWA to states is referred to as “NEPA Assignment.” Texas Senate Bill 466 waived Texas’ sovereign immunity from suit in federal court for NEPA decisions and enabled TxDOT to obtain NEPA Assignment. TxDOT NEPA assignment began in Summer 2014.

NEPA assignment practices at TxDOT complement the IEF process by standardizing early coordination with resources agencies, early environmental project scoping and risk assessments to determine NEPA class of action, and documentation requirements. The importance of conducting scoping and risk assessments early in project development pays dividends. The total project cost is more than just the direct cost of time and materials at the time of scoping. One should also consider the cost of delay in letting, delays in construction, the time value of money, the lost opportunity cost not using a new facility, and waiting for its completion.

FHWA CATEGORICAL EXCLUSION (CE) MOU MONITORING BEST PRACTICES

FHWA conducted a review of the CE MOU with TxDOT in July 2014. The FHWA review encompassed ECOS project file reviews and interviews with TxDOT management and

staff located in ENV division and several District Offices. The FHWA CE MOU review identified best practices, including:

- *Environmental certification* for TxDOT staff to ensure competency and a standard knowledge base; continuing education for staff to ensure their skills continue to be adequate to review and approve NEPA documentation.
- Quality control using an *audit file checklist* to ensure completeness of the ECOS project file as a step before making a CE determination.
- *Environmental staff resource sharing* among district staff to effectively use subject matter expertise spread across rural and urban districts.
- *Small-scale workshops* at districts to share advice and expertise and to promote networking among district co-workers.
- *On-going project plan reviews through final PS&E* to ensure all environmental commitments made during design and the environmental process are included. The plan reviews are intended to ensure that EPIC (Environmental Permits, Issues, & Commitments) sheets and notes in plans are correctly included and implemented.
- *Batching multiple projects* in ECOS (projects grouped by type of activities for planning purposes) with identical scopes under a single CE determination/approval. Using a “Parent”/Control CSJ and having “Child”/Associated CSJs listed in ECOS by reference for projects of identical scope.

REFERENCES

1. Federal Highway Administration. *Eco-Logical* (2014). Accessed April 2014. Available at: http://www.environment.fhwa.dot.gov/ecological/eco_entry.asp.
2. Marie Venner Consulting and URS Corporation (2014). An Ecological Approach to Integrating Conservation and Highway Planning, Volume 1. SHRP 2 Research Report S2-C06-RW-1. Transportation Research Board of the National Academies, Washington D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-Rw-1.pdf.
3. Crist, Patrick, Marie Venner, Jimmy Kagan, Shara Howie, and Lisa Gaines (2014). Manager's Guide to the Integrated Ecological Framework: Publication Draft. SHRP 2 Capacity Project C06. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://oregonstate.edu/inr/sites/default/files/documents_reports/Draft_IEF_Mgrs_Guide_Oct2013.pdf.
4. Marie Venner Consulting and URS Corporation (2014). Practitioner's Guide to the Integrated Ecological Framework. SHRP 2 Research Report S2-C06-RW-3. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-3.pdf.
5. Crist, P.J., M. Venner, J.S. Kagan, S. Howie, and L. Gaines (2014). Manager's Guide to the Integrated Ecological Framework. SHRP 2 Research Report S2-C06-RW-4. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-4.pdf.
6. Federal Register, The Daily Journal of the United States Government (2014). *Statewide and Nonmetropolitan Transportation Planning; Metropolitan Transportation Planning*, "Section 450.214 Development of Programmatic Mitigation Plans." Available at: <https://www.federalregister.gov/articles/2014/06/02/2014-12155/statewide-and-nonmetropolitan-transportation-planning-metropolitan-transportation-planning#h-10>

APPENDIX A. WORKSHOP LESSON PLAN

Introduction to NEPA and Mitigation for TxDOT PDP

NEPA and Environmental Mitigation in the
TxDOT Project Development Process

by

John H. Overman

Product 0-6762-P2
Project 0-6762

September 2014

Workshop Materials and Instructor Guide

Lesson Plan Summary

| | |
|---|--|
| <p>Overview and Purpose</p> | <p>The purpose of this workshop is to provide transportation planners, engineers, environmental practitioners, and local officials with an introduction to National Environmental policy Act (NEPA), mitigation, and the project development process (PDP) at TxDOT. The workshop can be presented in a 3- or 6-hour format.</p> |
| <p>Time Allocation</p> | <p><u>Option 1: 3-hour workshop (morning or afternoon)</u> The 3-hour workshop includes two lessons with 1) an introduction to NEPA and the PDP and 2) an introduction to mitigation and TxDOT PDP.</p> <p><u>Option 2: 6-hour workshop (approximately 9:00 a.m.–3:00 p.m.)</u> Option 2 is a 6-hour workshop and more in-depth discussions, and includes an additional lesson on the Integrated Ecological Framework (IEF) for environmental mitigation. The extended format allows for additional time for activities, and more in-depth discussion on environmental mitigation for TxDOT projects.</p> |
| <p>Workshop Learning Objectives (Specify skills/information that will be learned.)</p> | <p><u>Workshop Objectives</u> At the end of the workshop, participants should be able to:</p> <ul style="list-style-type: none"> • Describe NEPA concepts and documents • Describe mitigation in the project development process • Explain the Integrated Ecological Framework <p><u>Lesson 1—Learning Objectives</u> At the end of the NEPA and PDP lesson, the participant should be able to:</p> <ul style="list-style-type: none"> • Describe NEPA and document classification • Describe how documents and mitigation fit into the TxDOT project development process • Identify resources for environmental documents in the TxDOT PDP • Explain risk assessment and scoping in the PDP • Identify compliance issues <p><u>Lesson 2—Learning Objectives</u> At the end of the Mitigation and PDP lesson, the participant will be able to:</p> <ul style="list-style-type: none"> • Describe common types of mitigation • Identify mitigation milestones in the PDP timeline • Describe costs associated with mitigation • Describe examples of mitigation best practices • Identify compliance issues in the mitigation and PDP <p><u>Lesson 3—Learning Objectives</u> At the end of the Integrated Ecological Framework lesson, the participant will be able to:</p> <ul style="list-style-type: none"> • Explain the Integrated Ecological Framework (IEF) • Describe the Regional Ecological Framework (REF) • Describe the project development process • Identify IEF resources • List steps in the IEF process |

| | |
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| Instructional Method | The instructor will use a combination of lecture and participant activities to achieve learning objectives. Each lesson will include a participant or learning activity that reinforces the learning objectives. These activities may include group or individual exercises. |
| Verification | Verification will be accomplished by reviewing learning objectives at the end of each lesson, conducting learning activities, and discussing with participants. |
| Activities | A variety of participant activities will be used to support learning outcomes. |
| References | The primary content source material is TxDOT RMC Project 0-6762. |
| Materials Needed | At least two flip charts for class activities. Projector. |

Lesson Time Allocation

| | | |
|---|--|--------------------------|
| Workshop Time Allocation Summary | <ul style="list-style-type: none"> • Introduction = 30 minutes • Lesson 1 = 90 minutes • Lesson 2 = 90 minutes • Lesson 3 = 90 minutes | |
| Introduction and Overview | 30 minutes | 8:30 a.m.– 9:00 a.m. |
| Lesson 1 NEPA and the PDP | <ul style="list-style-type: none"> • 60 minutes instruction and participation activities • 15 minutes of break time • 15 minutes of review and assessment • Total 90 minutes from approximately 8:30 a.m.– 10:30 a.m. | 9:00 a.m.– 10:30 a.m. |
| Lesson 2 Mitigation Process and Practice | <ul style="list-style-type: none"> • 10 minutes of lesson background and introduction • 60 minutes instruction and participation activities • 20 minutes of review and assessment • Total 90 minutes from approximately 10:30 a.m.– noon | 10:30 a.m.– noon |
| Lunch Break | 60 minutes | Noon– 1:00 p.m. |
| Lesson 3 Introduction to IEF | <ul style="list-style-type: none"> • 10 minutes of lesson background and introduction • 40 minutes instruction and participation activities • 15 minutes of break time • 25 minutes of lesson and workshop review and assessment • Total 90 minutes from approximately 1:00 p.m.– 2:30 p.m. | 1:00 p.m.– 2:30 p.m. |

Lesson Plan for NEPA and the TxDOT PDP

| Lesson 1 | NEPA for TxDOT PDP | Time |
|--|--|--------------------------|
| Introduction and Overview | <p>Learning Outcomes</p> <p>At the end of this introduction, the participant will be able to:</p> <ul style="list-style-type: none"> • Describe the workshop learning objectives. • Describe workshop expectations. | 8:30 a.m.– 9:00 a.m. |
| | <p>Instructional Method</p> <ul style="list-style-type: none"> • Instructor welcomes participants, introduces him/herself, and leads participants through introductions. Participants introduce themselves, and provide a brief description of their role and experience with NEPA and mitigation in the project development processes and their expectation for the workshop (30 min.). • Instructor provides an overview of the workshop objectives, outcomes, agenda, and reference materials (10 min.). • Instructor discusses ground rules, sign-in sheet, feedback forms, and other housekeeping items as needed (5 min.). • Instructor provides an overview and information on the National Highway Institute (NHI) online course NHI-142052 NEPA Tutorial. Introduction to NEPA and the Transportation Decision-Making Process. | 30 min. |
| Lesson 1 NEPA and the TxDOT PDP | <p>Learning Outcomes</p> <p>At the end of this lesson, the participant will be able to:</p> <ul style="list-style-type: none"> • Describe NEPA and document classification. • Describe how documents and mitigation fit into TxDOT project development process (PDP). • Identify resources and forms for completing documents in the TxDOT PDP. • Explain risk assessment and scoping in the PDP. • Identify compliance issues. <p>Time Allocation</p> <p>Lesson 1 includes approximately:</p> <ul style="list-style-type: none"> • 60 minutes instruction and participation activities. • 15 minutes of break time. • 15 minutes of review and assessment. • Total 90 minutes from approximately 8:30 a.m.–10:30 a.m. | 9:00 a.m.– 10:00 a.m. |
| | <p>Instructional Method</p> <p>Instructor provides an overview of NEPA, document classification for Categorical Exclusions (CE) and Environmental Assessments (EA), common terms, and TxDOT resources. This includes an overview of CE and EA document classification and NEPA class of action, including introduction to TxDOT forms, funding and products (30 min.).</p> <p>Instructor provides an overview of TxDOT project development process, including NEPA assignment, risk assessment, scoping, and project management process. The</p> | 30 min. |

| | | |
|-------------------------------|--|---|
| | <p>participants should be able to answer: “Who does what and when? Where do projects come from?”</p> <p>Instructional Method (continued)</p> <ul style="list-style-type: none"> • Instructor discusses best practices in the TxDOT project development process. • Ask participants to share experience with document preparation and lessons learned, and ECOS. • Ask participants to identify and describe current “deficiency areas” in CE and EA process. <p>Activity 1: Questions and Answers (10 min.) NEPA Jeopardy. Instructor uses Jeopardy-style answers to solicit questions about NEPA and documents to assess participant knowledge.</p> | |
| | <p>Break 10:00 a.m.–10:15 a.m.</p> | <p>10:00 a.m.– 10:15 a.m. 15 min.</p> |
| | <p>Instructor continues with NEPA lesson after break. Instructor then uses a variety of activities to assess learning.</p> <p>Activity 2: Instructor leads participants in assigning class of action for sample projects.</p> <p>Activity 3: Participants are presented with an example project in a suburban setting, and must decide on the class of action and NEPA document. Participants share their results, and the form is reviewed with the entire class.</p> <p>Activity 4: Participants are provided a more complicated example section of Interstate access road through an urban setting. The class discusses challenges and issues with the example project. The purpose of the Interstate section is to share experiences and discuss strategies for scoping and risk assessment. Instructor should review common deficiencies that have previously occurred in the project development process. These deficiencies may include discussion of document preparation, ECOS, and general compliance in the NEPA assignment processes. Instructor should seek input and comments on current deficiencies, and seek consensus from participants on how to resolve the issues. Instructor should seek presentation of results and discussion of compliance issues from participants.</p> | <p>30 min.</p> |
| <p>Lesson 1 Review</p> | <p>Activity 5: Instructor conducts a brief review of the Lesson 1—NEPA and assesses learning outcomes through question-and-answer session (15 min.). Included in the evaluation is an opportunity to list deficiency and compliance issues. The purpose of the activity is to collect practitioner feedback on deficiencies and issues affecting the process.</p> | <p>10:15 a.m.– 10:30 a.m. 15 min.</p> |

Lesson Plan for Mitigation Process and Practice

| Lesson 2 | Mitigation 101 | |
|---|---|-----------------------|
| | The 3-hour workshop is intended to follow-on after the NEPA 101 morning session. It is a stand-alone workshop. Attending NEPA 101 is recommended, but is not a prerequisite. | Time |
| Introduction and Overview <i>OPTIONAL</i> | Learning Outcomes <ul style="list-style-type: none"> • Describe the workshop learning objectives. • Describe workshop expectations. | 10:30 a.m.–noon |
| | Instructional Method (optional for new participants) This introduction is needed ONLY if there are new workshop participants. Instructor welcomes <i>NEW</i> participants, introduces him/herself, and leads participants through introductions. <i>NEW</i> participants introduce themselves and provide a brief description of their role and experience in the project development processes and their expectation for the workshop (20 min.). Instructor leads discussion on mitigation, and provides an overview of the workshop objectives, outcomes, agenda, and reference materials ground rules, sign-in sheet, feedback forms, and other housekeeping items as needed (10 min.) | 10 min. |
| Lesson 2 Mitigation (Mitigation Concepts for PDP) | Learning Outcomes At the end of this lesson, the participant will be able to: <ul style="list-style-type: none"> • Describe common types of mitigation. • Identify mitigation milestones in the PDP timeline. • Describe costs associated with mitigation. • Describe examples of mitigation best practices. • Identify ENV compliance issues in the PDP. Time Allocation Lesson 2 includes approximately: <ul style="list-style-type: none"> • 10 minutes of lesson background and introduction. • 60 minutes instruction and participation activities. • 20 minutes of review and assessment. • Total 90 minutes from approximately 10:30 a.m.–noon. | 10:40 a.m.–11:40 a.m. |
| | Instructional Method Instructor provides a quick review of mitigation concepts and issues, and leads discussion on the following: <ul style="list-style-type: none"> • Where mitigation activities occur in the project development process. • Best practices in mitigation. • Most common resource agency requirements and coordination. • Common mitigation requirements and common “project killers.” Activity 1: Questions and Answers (10 min.) Mitigation Jeopardy. Instructor should assess knowledge through Q&A. | 60 min. |

| | | |
|---|--|-----------------------------------|
| Mitigation Practices Research Findings | <p>Instructional Method (continued)</p> <p>Instructor provides a review of recent mitigation costs, and how mitigation is funded.</p> <p>Instructor provides example practices from TxDOT and other states/MPOs, and regional mitigation efforts.</p> <p>Roles and responsibilities: Who does what and when? Where do projects come from? Why? What are the benefits?</p> <p>Instructor leads a discussion using a list of issues to help participants identify and rank compliance problems.</p> <p>The instructor leads a discussion on the role of EPICs and mitigation.</p> <p>Activity 2: Using actual project examples ask participant what mitigation may be necessary. A bridge replacement and frontage road project will be reviewed.</p> <p>Activity 3: Participants are presented with an example bridge replacement project in a rural suburban setting. A schematic may be provided to assist in determining what mitigation may be required. Participants also may be provided with an example section of Interstate/Frontage road through an urban setting. The class discusses challenges and issues with the example project. The purpose of the Interstate section is to share experiences, and discuss strategies to avoid-minimize-compensate.</p> | |
| Lesson 2 Review | <p>Activity 4: Instructor conducts a brief review of the lesson and assesses learning outcomes through Q&A.</p> | 11:40 a.m.– Noon |
| Break | Lunch break | Noon– 1:00 p.m. 60 min. |

Lesson Plan for Integrated Ecological Framework (IEF)

| Lesson 3 | Introduction to IEF | Time |
|----------------------------|---|-------------------------|
| Introduction to IEF | Background and Introduction to IEF. Describe literature, citations and context of IEF with Planning and Environmental Linkages (PEL), and FHWA's <i>Eco-Logical</i> Program | 10 min. |
| Lesson 3 | <p>Learning Objectives: At the end of the Integrated Ecological Framework lesson, the participant will be able to:</p> <ul style="list-style-type: none"> • Explain the Integrated Ecological Framework. • Describe the Regional Ecological Framework. • Describe the project development process. • Identify IEF resources. • List steps in the IEF process. <p>Time Allocation Lesson 3 includes approximately:</p> <ul style="list-style-type: none"> • 10 minutes of lesson background and introduction. • 40 minutes instruction and participation activities. • 15 minutes of break time. • 25 minutes of lesson and workshop review and assessment. | 1:10 p.m.– 2:10 p.m. |
| | <p>Instructional Method Instructor provides a review of how the IEF was developed, and leads discussion on the following:</p> <ul style="list-style-type: none"> • Include discussion on how IEF fits with NEPA assignment, and how NEPA scoping contributes to IEF. • Describe each step in the IEF process, and ask participants to provide examples for each step. • Ask participants to provide examples of how to scale the IEF process to project, corridors, etc. • Review lessons learned from IEF when it was piloted at other state DOTs. • Describe MAP 21 rules for programmatic mitigation, and ask participants to provide examples of where programmatic mitigation can be applied in their regions. <p>Activity: Questions and Answers (10 min.) Instructor should assess knowledge through Q&A.</p> | 60 min. |

| | | |
|--|--|---------------------------------|
| <p>Lesson 3 Review Workshop Review and Wrap-Up</p> | <p>Lesson Review Instructor conducts a brief review of Lesson 3—The IEF Process to assess learning outcomes through Q&A.</p> <p>Workshop Review Instructor should review and assess learning object of the workshop.</p> <ul style="list-style-type: none"> • Describe NEPA concepts and documents. • Describe mitigation in the project development process. • Explain the Integrated Ecological Framework. <p>Participants are given an opportunity to complete evaluations (15 min.). Included in the evaluation is an opportunity to list deficiency and compliance issues. The purpose of the activity is to collect practitioner feedback on deficiencies and issues affecting the process.</p> | <p>2:10 p.m.– 2:35 p.m.</p> |
| | | <p>25 min.</p> |

APPENDIX B. INTRODUCTORY GUIDE TO IEF



INTRODUCTORY GUIDE TO INTEGRATED ECOLOGICAL FRAMEWORK



August 2014

Product 0-6762-P1

Project 0-6762

*Maximizing Mitigation
Benefits—Making a Difference
with Strategic Inter-Resource
Agency Planning*



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Product 0-6762-P1

Project 0-6762

*Maximizing Mitigation Benefits–Making a Difference
with Strategic Inter-Resource Agency Planning*

Authors: John H. Overman, Beverly Storey, Edgar Kraus,
Kristi Miller, and Zachary Elgart

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CHAPTER **1** Introduction – Why This Guide?

This guide introduces the *Integrated Ecological Framework* (IEF) to Texas Department of Transportation (TxDOT) engineers and planners. IEF is step-by-step approach to integrating ecological and transportation planning with the goal of avoiding impacts, minimizing mitigation costs, conserving resources, and improving project delivery. Transportation agencies do their best to avoid and minimize any impacts to the environment, but some impacts are unavoidable. Compensatory mitigation is used to offset these unavoidable impacts to the environment. The environmental permitting process under federal and state legislation constitutes a major component of the transportation project development and delivery process. Over \$3.3 billion is spent annually on compensatory mitigation under the Clean Water Act and Endangered Species Act programs (1), so there are significant incentives to minimize the cost of mitigation from transportation impacts.

Strategic Highway Research Program

The Strategic Highway Research Program (SHRP2) addresses some of the most pressing needs related to the nation's highway system. The Transportation Research Board of the National Academies administers SHRP2 for the Federal Highway Administration (FHWA) and the American Association of State Highway Officials. SHRP2 Project C06, *Integration of Conservation, Highway Planning, and Environmental Permitting Using an Outcome-Based Ecosystem Approach*, produced a two-volume report and companion guides. This guide relies heavily on the SHRP2 C06 research, the IEF, and companion guidebooks as the basis for introducing IEF processes to practitioners at TxDOT. For more detailed guidance on the IEF, please refer to these SHRP2 research products:

- *An Ecological Approach to Integrating Conservation and Highway Planning*, Volume 1, http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-Rw-1.pdf (2).
- *Manager's Guide to the Integrated Ecological Framework: Publication Draft*, http://oregonstate.edu/inr/sites/default/files/documents_reports/Draft_IEF_Mgrs_Guide_Oct2013.pdf (3).
- *Practitioner's Guide to the Integrated Ecological Framework*. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-3.pdf (4).
- *Manager's Guide to the Integrated Ecological Framework*. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-4.pdf (5).

CHAPTER 2 What Is Integrated Ecological Framework?

The IEF is a science-based approach, used by transportation planners and natural resource specialists, to identify ecological priorities and integrate them into transportation and infrastructure decision making.

The purpose of the IEF process is to:

- Conduct analyses and make decisions within a regional ecosystem context.
- Clearly identify and prioritize the important resources and their conservation requirements.
- Use spatial and quantitative assessment methods.
- Start very early in the transportation planning process.

The output and products from the IEF process are:

- Regional maps of conservation and restoration priorities.
- Regional maps identifying affected resources and the impacts from transportation development.
- A process for keeping these maps, databases, and agreements up-to-date (3).

IEF is intended to support both natural resources and transportation infrastructure development and to integrate the vision, goals, and objectives for each. By working together, instead of separately, state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and resource agencies can achieve transportation/infrastructure needs and environmental goals. The IEF complements the FHWA's *Eco-Logical: An Ecosystem Approach to Developing Infrastructure* (6), which was signed by eight federal agencies.

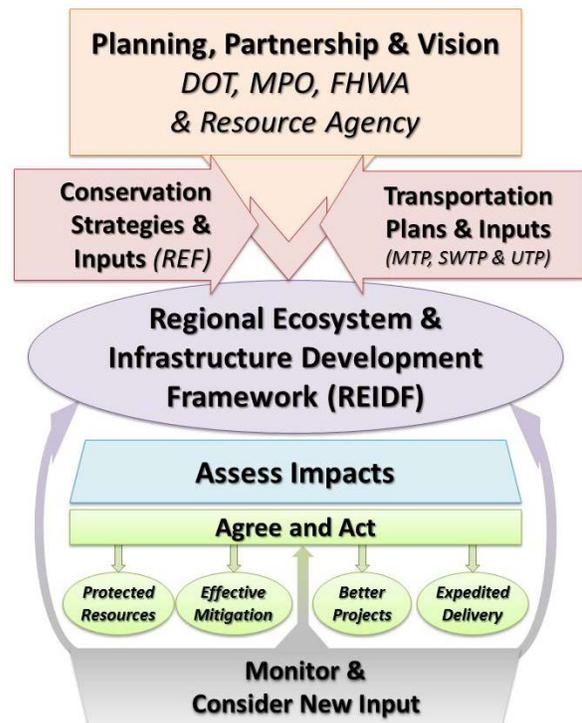


Figure 1. Integrated Ecological Framework (3,4).

Does TxDOT NEPA Assignment Fit in the IEF Process?

Federal law allows states to obtain the authority from FHWA to review and approve environmental documents required under the National Environmental Policy Act (NEPA). This passing of authority from the FHWA to states is referred to as “NEPA Assignment.” Texas Senate Bill 466 waived Texas’ sovereign immunity from suit in federal court for NEPA decisions and enabled TxDOT to obtain NEPA Assignment. TxDOT NEPA assignment began in summer 2014.

NEPA assignment practices at TxDOT complement the IEF process by standardizing early coordination with resources agencies, early environmental project scoping and risk assessments to determine NEPA class of action, and documentation requirements. The importance of conducting scoping and risk assessments early in project development pays dividends. The total project cost is more than just the direct cost of time and materials at the time of scoping. One should also consider the cost of delay in letting, delays in construction, the time value of money, the lost opportunity cost not using a new facility, and waiting for its completion.

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States and MPOs may develop programmatic mitigation plans to address potential environmental impacts of future transportation projects as part of the statewide or metropolitan transportation planning process. Proposed transportation planning rules, §450.214 and §450.320 *Development of Programmatic Mitigation Plans*, jointly issued by FHWA and the Federal Transit Administration, provide a statutory framework for the optional development of programmatic mitigation plans as part of the statewide and metropolitan planning process. This document is available at:

<https://www.federalregister.gov/articles/2014/06/02/2014-12155/statewide-and-nonmetropolitan-transportation-planning-metropolitan-transportation-planning>.

Programmatic mitigation plans can identify options for mitigating impacts to environmental resources early in project development. Examples of resources that the programmatic mitigation plan might identify include wetlands, streams, rivers, stormwater, parklands, cultural resources, historic resources, farmlands, threatened and endangered species or other environmental resource mitigation sites, and resource areas of high value or concern. The plans may adopt or develop standard measures or operating procedures for mitigating certain types of impacts, and include development of mitigation or conservation banks, in-lieu-fee programs, or consolidated mitigation areas. The proposed rule also includes processes for consultation resource agencies and the integrating the programmatic mitigation plan with other plans, including watershed plans, ecosystem plans, species recovery plans, growth management plans, State Wildlife Action Plans, and land use plans.

The Transportation Planning and Project Development Process

Ideally, the IEF process is integrated into the planning process when transportation agencies are preparing goals, transportation plans, programming, and developing projects. The IEF builds on existing metropolitan transportation plans (MTPs) and statewide long-range plans that result from the ongoing transportation planning process and plan updates.



In practical terms, the success of the IEF process depends on implementing conservation strategies and agreements into the stages of the transportation project delivery process. The project development process consists of: project planning, preliminary design, detailed design (preparing PS&E), letting, and construction. Figure 2 represents a generic project delivery process for traditional design-bid-build highway projects. The IEF process can be scaled to the project development process early to begin in project planning stages or in preliminary design.

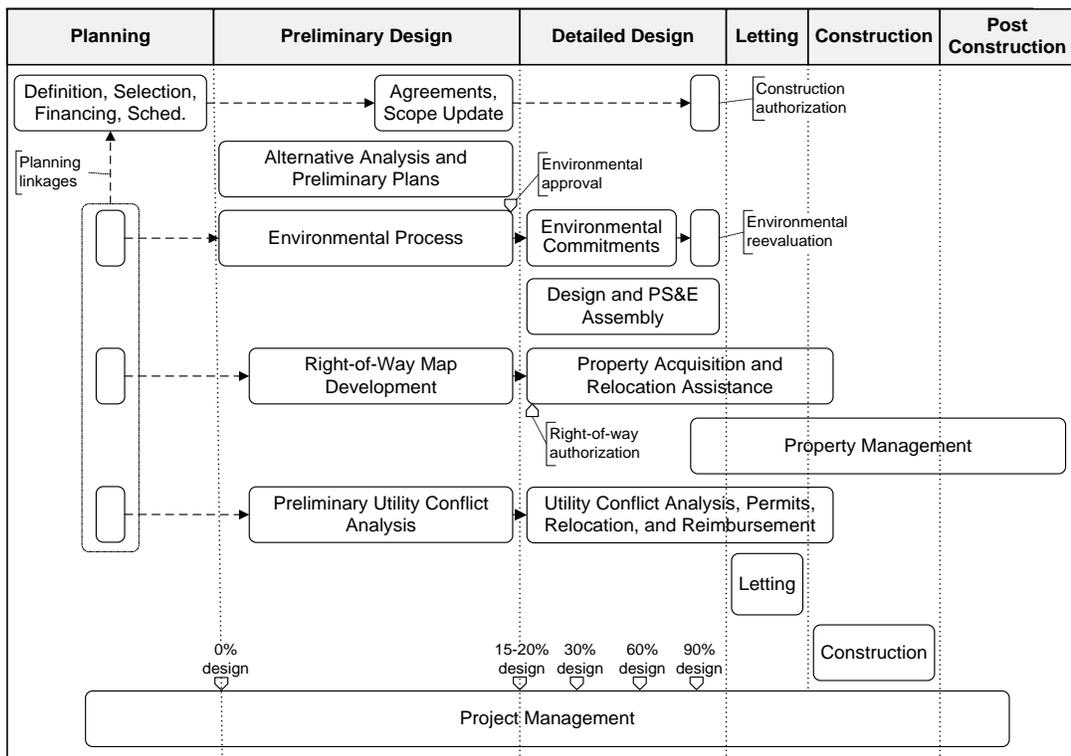


Figure 2. Project Delivery Process.

CHAPTER 3 How to Use IEF Process

The IEF was designed by its developers as a nine-step process. For this guide, the IEF has been condensed into six steps (combining Steps 5–8 in the original nine-step process). This IEF process guide is presented in a condensed format to serve as an introductory guide more suitable for new practitioners. Table 1 shows the IEF steps.

Table 1. Integrated Ecological Framework Steps.

| IEF STEPS (Condensed) | Outcomes | |
|---|--|---|
| Step 1: Build collaborative partnerships and regional vision. | Stakeholders agree on vision, roles and responsibilities. |  |
| Step 2: Create a regional ecosystem framework (REF). | Define your ecosystem and its important elements. |  |
| Step 3: Define transportation and infrastructure scenarios. | Define your transportation plan's effect on the region. |  |
| Step 4: Create a regional ecosystem and infrastructure development framework (REIDF). | Describe the transportation system intersecting with the ecosystem. |  |
| Step 5: Implement agreements, permits, crediting strategies, programmatic mitigation, and prioritize ecological actions. | Stakeholder agreements that preserve both ecosystem and transportation system. |  |
| Step 6: Monitor and update the REF and REIDF. | Keep score and measure progress. |  |

The steps in the guide represent a process that is needed to achieve the desired IEF outcomes. Not every step needs to occur in sequence and more than one step may occur at the same time. The IEF steps in detail follow.

Step 1: Build Collaborative Partnerships and Regional Vision

Build support among relevant stakeholders to achieve a statewide or regional vision and planning process that integrates conservation and transportation/infrastructure planning (3, 4).

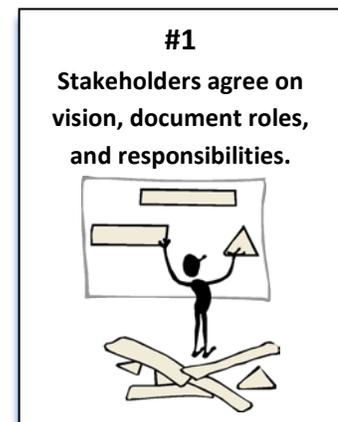
What Do I Do in Step 1?

- **Define the geographic planning area.**
Identify the planning region using watersheds, ecoregions, or political boundaries. These are typically going to be MPO boundaries or ecoregions, but the area can be on a smaller, corridor, or watershed scale if you are concerned about a particular project or resource.
- **Identify the stakeholders, transportation planning agencies, and resource agencies.**
Identify the major government and planning agencies. The agencies involved may depend on how your planning area is defined. For example, which U.S. Army Corps of Engineers district, MPO and member cities, or TxDOT district are going to be involved and represented. In many cases, these functions can be performed by an existing technical committee at the MPO or Council of Governments.

Step 1: Outcomes

A memorandum of understanding with:

- Stakeholder and agency goals.
- Resource priorities and major areas of concern.
- Anticipated mitigation needs.
- Roles responsibilities, processes, and timelines.

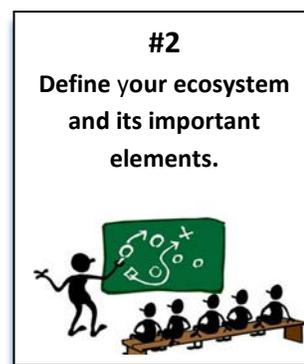


Step 2: Create a Regional Ecosystem Framework (REF)

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 that addresses species, habitats, and relevant environmental issues and regulatory requirements agreed upon by the stakeholders (3, 4).

What Do I Do in Step 2?

- Identify the spatial data needed to create current (baseline) conditions.
- Prioritize ecological resources and issues to be addressed.
- Prepare data and resource sharing agreements to avoid, minimize, and conduct advance mitigation.
- Identify important data gaps.
- Define priority areas for conservation and mitigation.
- Stakeholders review team.



What Is a Regional Environmental Framework?

Regional Ecological Framework is a spatial database of the priority resources in a pre-defined area and includes pre-identified priority areas to avoid or to invest in mitigation (ecological improvement) or restoration actions. The REF represents natural resources, the values of partners and stakeholders, and may include other concerns besides ecological resources such as cultural resources and environmental justice.

Step 2: Outcomes

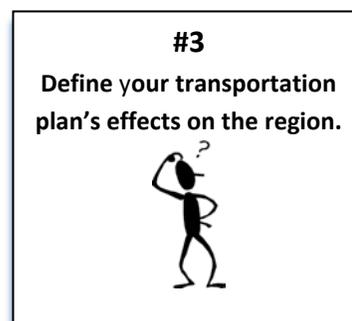
- A map that identifies resources of interest and areas for conservation and mitigation action.
- A thorough understanding of the region's natural resources.
- Data and information gap.
- An agreed upon set of conservation and mitigation goals.

Step 3: Define Transportation and Infrastructure Scenarios

Integrate existing, proposed, and forecasted development, transportation, and, optionally, other plans into one or more scenarios to assess cumulative effects on resources (3, 4).

What Do I Do in Step 3?

MPOs prepare a long-range MTP for their planning regions to guide transportation development and address issues on safety, infrastructure condition, reliability, economic vitality, environmental sustainability, and project delivery. State DOTs also prepare a long-range statewide transportation plan to address these issues on a statewide basis. Step 3 should use these transportation plans (and other planning data) to define your transportation network's future. The future infrastructure scenarios are prepared by asking the question "What if?" For example, what if the region grows mostly along our coastal highway? How will that affect coastal resources? Or what if population growth continues or declines?



Step 3: Outcomes

- Future transportation system scenarios and possible impacts on resources.
- Areas and resources affected by transportation development.
- Cumulative effects on the region.
- Regional mitigation areas for the region.
- Aggregated mitigation needs to maximize ecological benefits.

REF Data Resources

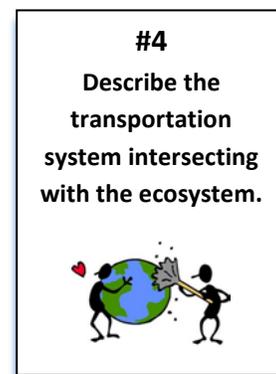
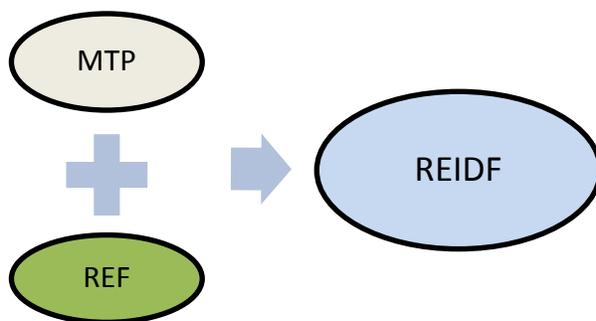
Natural resources databases and plans at state and federal resource agencies provide an abundance of data needed to build your REF. Examples include: state wildlife action plans, watershed protection plans, special area management plans, and coastal management plans. (See example REF and IEF from the Houston Galveston Area Council [HGAC] and the North Central Texas Council of Governments [NCTCOG] after Step 6.)

Step 4: Create a Regional Ecosystem and Infrastructure Development Framework (REIDF)

Integrate environmental conservation (REF) and transportation/infrastructure data and plans to support creation of an ecosystem and infrastructure development framework (REIDF). Assess effects of transportation/infrastructure on natural resource objectives. Identify preferred scenarios that meet both transportation/infrastructure and conservation goals by using the REIDF and predictive models of priority resources to analyze transportation scenarios in relation to natural resource conservation objectives (3, 4).

What Do I Do in Step 4?

Describe what would happen if you were to overlay (intersect) the transportation network and accompanying land uses onto your REF ecosystem. What does it look like now and in the future? This will be your REIDF.



Step 4 Outcomes

The outcome of creating the REIDF should be a representation of what the region will look like in the future scenario. The representation should use maps, graphics, and supporting data to communicate the potential and cumulative impacts on natural resources. Additionally, this step should include agreement among stakeholders on:

- The priority resources to be avoided.
- The resources where impacts should be minimized.
- Locations for conservation areas.
- Locations for restoration areas.
- Identified and quantified regional mitigation needs and demands.

Step 5: Implement Agreements, Permits, Crediting Strategies, Programmatic Mitigation, and Prioritize Ecological Actions

In this condensed IEF guide, Step 5 includes four sub-steps that implement the IEF framework:

- *Establish and prioritize ecological actions.*
- *Develop crediting strategy.*
- *Develop programmatic consultation, biological opinion, or permit.*
- *Deliver conservation and transportation projects.*

What Do I Do in Step 5?

Step 5 puts it all together; it encompasses an ongoing process of reaching consensus and preparing agreements that enable the IEF to be effective. The ultimate goal is to accomplish all of the sub-steps described above. This could take years to accomplish, but many of the sub-steps may already be in place in the form of existing memorandums of understanding and programmatic agreements with various resource agencies. This can also be the step in which to use pilot projects to test crediting strategies.

Step 5 Outcomes

- A regional conservation, restoration, recovery, and mitigation strategy, with quantitative and qualitative valuation of mitigation sites.
- Conservation and mitigation preferences and priorities.
- Measures and metrics to track progress toward regional ecosystem goals and objectives.
- Agreement on resource management roles and methods.

#5
Stakeholder
agreements that
preserve both
ecosystem and
transportation
system.



Step 6: Monitor and Update the REF and REIDF

Maintain a current REF that reflects the most recent distribution and knowledge of natural resources, conservation priorities, and mitigation opportunity areas that can support periodic updates to scenarios, and regional cumulative effects assessments (3,4).

What Do I Do in Step 6?

Step 6 involves measuring, monitoring, and updating the REIDF.

IEF and REF Examples

There are several examples of where the IEF has been deployed as a pilot program. SHRP2 funded four pilot projects in California, Colorado, Oregon, and West Virginia to test the IEF. The results of these pilot projects are in *An Ecological Approach to Integrating Conservation and Highway Planning, Volumes 1 and 2* (2).

In Texas, similar efforts are underway at NCTCOG and HGAC.

North Central Texas Council of Governments

The North Texas REF consists of 10 Vital Ecosystem Information Layers focused on three central ecological parameters: Green Infrastructure, Water Quality and Flooding, and Ecosystem Value. The REF provides a foundation for using the watershed approach when considering the conservation and ecosystem based priorities during development of infrastructure projects (Figure 3). See the NCTCOG REF website: http://www.nctcog.org/traces/Reg_Ecosystem_Framework.asp.

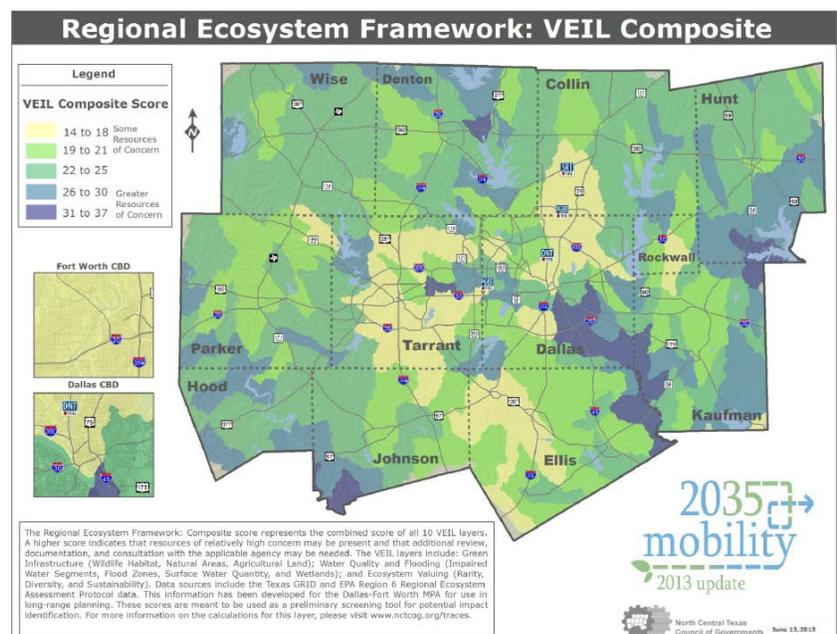
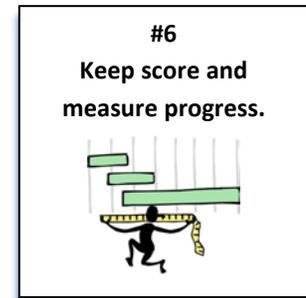


Figure 3. NCTCOG Regional Ecological Framework.

Houston-Galveston Area Council

HGAC developed the Regional Decision-Support System. HGAC organized an Eco-Logical Advisory Committee to guide in the development of the tool and included federal and state environmental resource agencies and other conservation organizations. The Geographic Information System (GIS) database is accessible both in-house and publicly through an online portal. The tool has over 12,000 mapped features that transportation planners can use to evaluate the potential impacts of proposed projects. See <http://www.h-gac.com/community/environmental-stewardship/eco-logical/>.

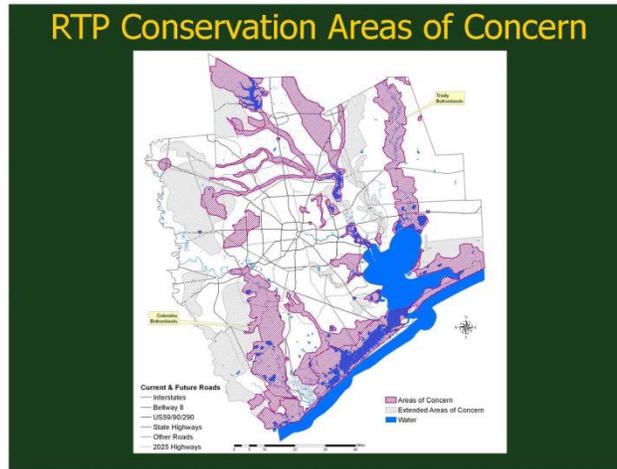


Figure 4. HGAC Publications Supporting Regional Environmental Framework.

CHAPTER 4 Things You Can Do

Scaling IEF

You can scale the IEF to a project, or a resource, or both. You can also scale the IEF to a small region, corridor, or for a particular species across the state. It may be easier to begin the IEF process by using one of the individual steps for a particular project or corridor.

For example, scaling **Step 1** to a **project level** can be made using an in-house project team consisting of planners, environmental specialist, design engineers, and resource agency representatives. Districts can use opportunities such as the design concept conference and planning meetings to accomplish this step. Completing scoping documents are an excellent way to begin this step. Scaling Step 1 on a **regional level** may be accomplished using MPO technical committees.

Use Existing Transportation Plans

TxDOT's Statewide Long-Range Transportation 2035 Plan and ongoing updates to the statewide plan include priority corridors and strategies for mitigation, and potential areas for mitigation. MPO's MTPs also contain priority projects, priority corridors, environmental frameworks, and GIS data needed to support the framework.

Compare the Estimated Cost of Avoidance versus Mitigation

Compensatory mitigation occurs when impacts are unavoidable. In some cases, the compensatory mitigation costs can be significant. Figures 5 and 6 present mitigation purchase data from TxDOT's Right-of Way Information System (ROWIS) from 2003–2013. The cost and quantity of mitigation parcels and fees are increasing. Stream mitigation costs can range from \$100 to \$1000 per linear foot depending on the impacts and restoration costs. In some cases, it may be less expensive to avoid impacts rather than to mitigate or compensate for impacts. Compare the cost to see if it is less expensive to avoid a wetland or stream by bridging over the stream rather than using a box culvert and incurring costs from impacts and permitting. The extra cost to design and build a bridge to avoid wetlands or stream may be less than the cost of mitigation, permitting, and resulting project delays.

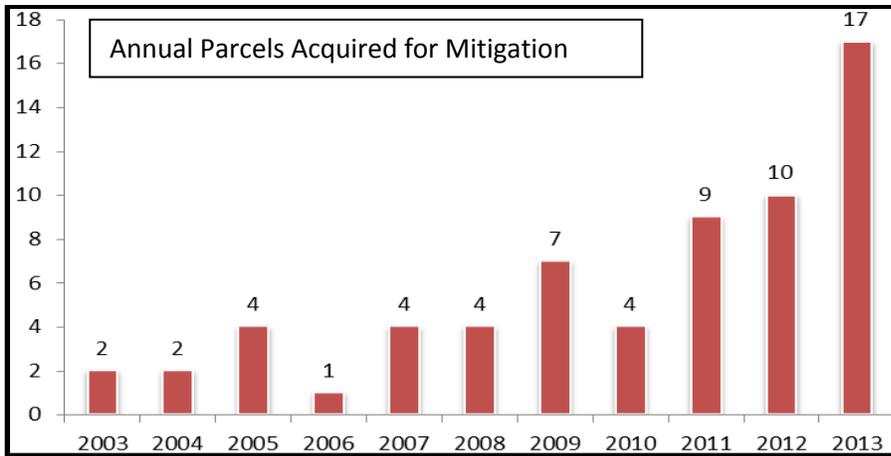


Figure 5. Annual Parcel Acquired by TxDOT.

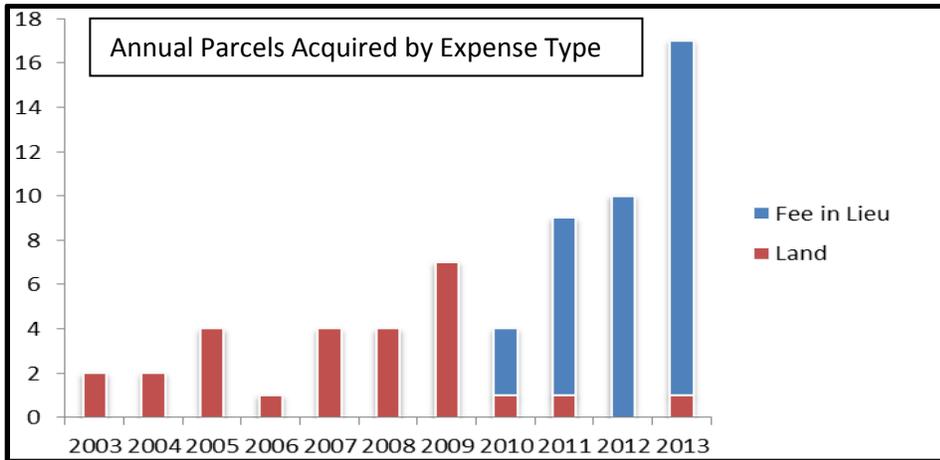


Figure 6. Annual Parcels Acquired by Expense Type.

Track Project Mitigation Cost

Tracking project-level mitigation costs can provide the data and evidence needed to help prioritize mitigation decisions for future projects. ROWIS tracks the mitigation purchases as if they are parcels of land. By statutory law, the remedy of environmental impact is considered a right-of-way acquisition cost. The ROW Division sets up the mitigation as a parcel in ROWIS coded with an “m” for mitigation or “w” for wetland. However, ROWIS does not capture mitigation costs that are part of construction costs, or ongoing maintenance at the district. Mitigation cost tracking at the district can provide the financial information needed to prioritize the next project mitigation decision to avoid or mitigate.

References

1. Environmental Law Institute. (2007). *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities*. Environmental Law Institute. Available at: http://www.eli.org/sites/default/files/eli-pubs/d17_16.pdf.
2. Marie Venner Consulting and URS Corporation (2014). *An Ecological Approach to Integrating Conservation and Highway Planning, Volume 1*. SHRP 2 Research Report S2-C06-RW-1. Transportation Research Board of the National Academies, Washington D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-Rw-1.pdf.
3. Crist, Patrick, Marie Venner, Jimmy Kagan, Shara Howie, and Lisa Gaines (2014). *Manager's Guide to the Integrated Ecological Framework: Publication Draft*. SHRP 2 Capacity Project C06. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://oregonstate.edu/inr/sites/default/files/documents_reports/Draft_IEF_Mgrs_Guide_Oct2013.pdf.
4. Marie Venner Consulting and URS Corporation (2014). *Practitioner's Guide to the Integrated Ecological Framework*. SHRP 2 Research Report S2-C06-RW-3. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-3.pdf.
5. Crist, P.J., M. Venner, J.S. Kagan, S. Howie, and L. Gaines. 2014. *Manager's Guide to the Integrated Ecological Framework*. SHRP 2 Research Report S2-C06-RW-4. Transportation Research Board of the National Academies, Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C06-RW-4.pdf.
6. Brown, J. W. (2006). *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*. FHWA, U.S. Department of Transportation. Available at: <http://www.environment.fhwa.dot.gov/ecological/ecological.pdf>.

