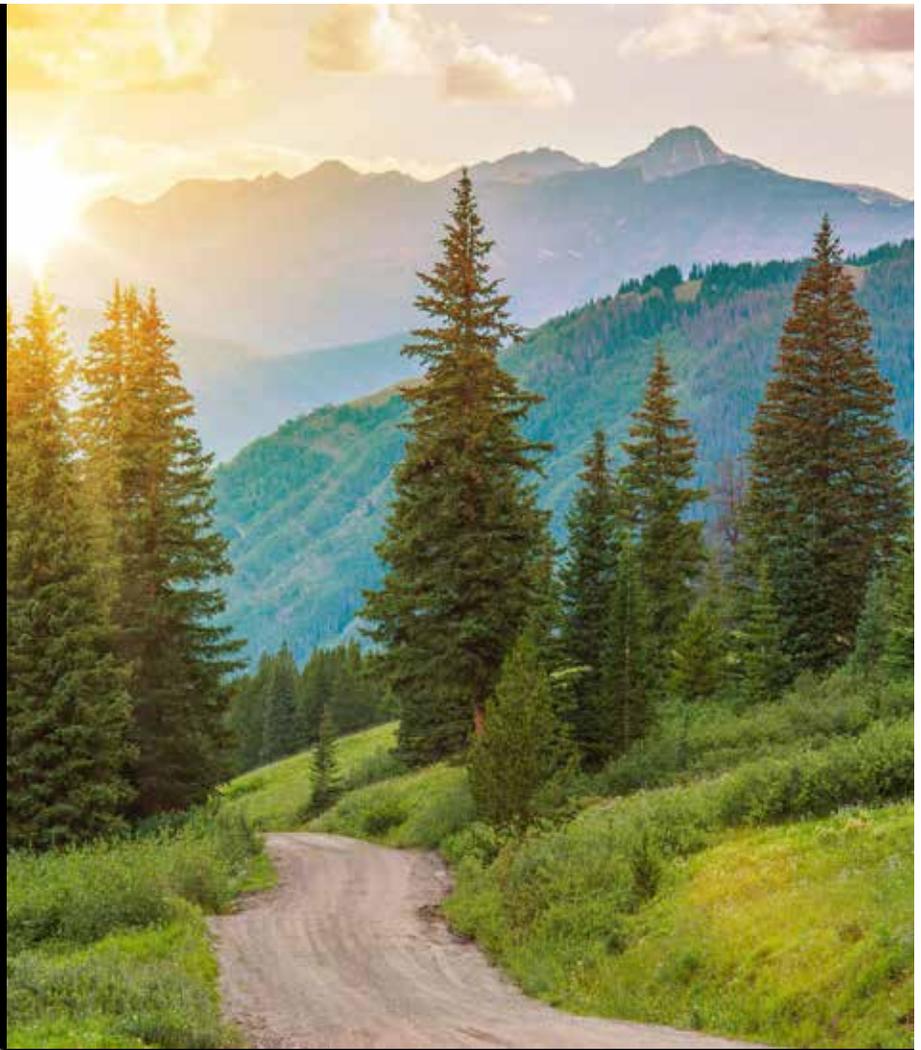FHWA Research
and Technology
Evaluation

Eco-Logical

Final Report
March 2018

Publication No. FHWA-HRT-17-036

U.S. Department of Transportation
Federal Highway Administration

Foreword

The Federal Highway Administration (FHWA) has initiated an effort to evaluate the Research and Technology (R&T) Development Program and communicate the full range of its benefits. The program helps FHWA assess how effectively it is meeting its goals and objectives and provides useful data to inform future project selections.

This report examines outcomes associated with the Eco-Logical Program, namely, (1) the extent to which FHWA has enabled transportation agencies to adopt the Eco-Logical approach, (2) the manner in which transportation agencies have incorporated the Eco-Logical approach into their business practices, and (3) the ways in which the Eco-Logical Program has contributed to improved project processes and environmental outcomes. This report should be of interest to FHWA staff, the Eco-Logical user community, and transportation professionals interested in advancing environmental mitigation.

<div align="right">

Hari Kalla, P.E.
Associate Administrator, Office of Research,
Development, and Technology

</div>

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation (USDOT) in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Cover photo: welcomia ©123RF.[1]

Technical Report Documentation Page

16. Abstract

This report documents an evaluation of Federal Highway Administration's (FHWA) Research and Technology Program's activities on the implementation of the Eco-Logical approach by State transportation departments and metropolitan planning organization recipients of FHWA Eco-Logical funding. The evaluation team collected information on FHWA's efforts to disseminate information to stakeholders, the extent to which stakeholders have adopted the Eco-Logical approach, and stakeholder-identified processes and environmental impacts obtained by agencies implementing the Eco-Logical approach. Data collected from literature reviews and stakeholder interviews (see main report for specific reference information) suggest that FHWA has consistently recognized the value of demonstrating its commitment to the Eco-Logical approach by providing funding and technical assistance to its stakeholders and encouraging practitioners to share results with their peers. FHWA research and funding has enabled its recipients to adopt the Eco-Logical approach sooner and more comprehensively. Funding recipients are building relationships with partners, sharing and using data in better ways, and incorporating information gathered to inform project prioritization and to develop integrated transportation plans. Most recipients focused their efforts on completing earlier planning-level steps and stages of the Eco-Logical approach. Few recipients identified, tracked, or quantified impacts related to project delivery or environmental mitigation. FHWA, partners, and stakeholders demonstrated a commitment to the Eco-Logical approach. Stakeholders adopted the Eco-Logical approach by building relationships, sharing and using data, integrating plans, and prioritizing project selection and mitigation.

Form DOT F 1700.7 (8-72)   Reproduction of completed page authorized.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

Table of Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Term
AASHTO	American Association of State Highway and Transportation Officials
ALIVE	A Landscape Level Inventory Valued of Ecosystem Components
AMBAG	Association of Monterey Bay Area Governments
ARC	Atlanta Regional Commission
BMP	best management practice
Caltrans	California Department of Transportation
CA-MPO	Charlottesville-Albemarle Metropolitan Planning Organization
CAPCOG	Capital Area Council of Governments
CDOT	Colorado Department of Transportation
CE	categorical exclusion
CPT	conservation planning tool
EIA	Ecological Integrity Assessment
EIS	environmental impact statement
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FWS	U.S. Fish & Wildlife Service
GIS	geographic information system
HEP	Federal Highway Administration's Office of Planning, Environment, and Realty
H-GAC	Houston-Galveston Area Council
HUD	U.S. Department of Housing and Urban Development
IAP	Implementation Assistance Program
IDFG	Idaho Department of Fish and Game
ILF	in-lieu fee
ITD	Idaho Transportation Department
ITEEM	Integrated Transportation and Ecological Enhancements for Montana
LOSRC	Land-of-Sky Regional Council
LRTP	long-range transportation planning
MaineDOT	Maine Department of Transportation
MARC	Mid-America Regional Council
MDC	Missouri Department of Conservation
MDOT	Michigan Department of Transportation
Michigan DNR	Michigan Department of Natural Resources
MoDOT	Missouri Department of Transportation
MOU	memorandum of understanding
MPO	metropolitan planning organization
NCDENR	North Carolina Department of Environment and Natural Resources
NCTCOG	North Central Texas Council of Governments

Abbreviation	Term
NEPA	*National Environmental Policy Act*
NHA	New Hampshire Audubon
NHDOT	New Hampshire Department of Transportation
NYSDOT	New York State Department of Transportation
OKICOG	Ohio-Kentucky-Indiana Regional Council of Governments
OSU	Oregon State University
PCED	Proctor Creek Environmental District
PPACOG	Pikes Peak Area Council of Governments
R&T	Research and Technology
REAP	regional ecological assessment protocol
REF	regional ecosystem framework
SCAG	Southern California Association of Governments
SHRP2	Second Strategic Highway Research Program
SWEEP	Stream and Wetland Ecological Enhancement Program
TAC	technical advisory committee
TCRPC	Tri-County Regional Planning Commission
TCSWCD	Tioga County Soil and Water Conservation District
TJPDC	Thomas Jefferson Planning District Commission
TRB	Transportation Research Board
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

Executive Summary

Purpose of the Evaluation

The Federal Highway Administration (FHWA) has initiated an effort to evaluate its Research and Technology (R&T) Program. In order to do so, an evaluation team was established, made up of non-FHWA third party evaluators not involved in the research programs and projects being evaluated. For this report, the evaluation team conducted a retrospective evaluation of FHWA's Office of Planning, Environment, and Realty Eco-Logical Program to understand the effects of FHWA's R&T activities on the implementation of the Eco-Logical approach (i.e., ecosystem-based infrastructure planning and mitigation) to transportation project delivery by State transportation department and metropolitan planning organization (MPO) recipients of Eco-Logical funding.

Program Description

The Eco-Logical Program encompasses a vision for an infrastructure development process that endorses ecosystem-based mitigation through integrating plans and data across agency and disciplinary boundaries. Eco-Logical and related Second Strategic Highway Research Program products offer multi-step procedures to conduct integrated planning and avoid, minimize, and mitigate negative environmental impacts. The goals of the Eco-Logical Program are to improve conservation and connectivity of ecosystems as well as predictability and transparency in project development. The mission of the Program is for State transportation departments and MPOs to adopt Eco-Logical principles and methods as standard business practice with the participation of resource and regulatory agencies.

Methodology

The evaluation sought to understand the effects of FHWA R&T activities on the implementation of the Eco-Logical approach to transportation project delivery by State transportation departments and MPOs. The evaluation team collected information on FHWA's efforts to disseminate information to stakeholders, the extent to which stakeholders have adopted the Eco-Logical approach, and stakeholder-identified process and environmental impacts obtained by agencies implementing the Eco-Logical approach. The following hypothesis was examined through this study: the Eco-Logical Program and approach have contributed to improved project delivery processes and environmental mitigation. Through this hypothesis, the following three evaluation questions were examined:

1. How has FHWA enabled State transportation departments and MPO stakeholders to adopt the Eco-Logical approach?

2. How are State transportation departments and MPO stakeholders incorporating the Eco-Logical approach into their business practices?

3. How have the Eco-Logical Program and approach contributed to improved project delivery processes and environmental mitigation?

The evaluation team used the following five data collection and analysis methodologies to inform this evaluation:

- Literature and document review.
- Participation in a program-sponsored peer exchange.
- Stakeholder interviews.
- Analysis of Eco-Logical steps completed by funding recipients.
- Qualitative coding analysis of stakeholder comments.

Findings

Evaluation Question 1: How has FHWA enabled State transportation departments and MPO stakeholders to adopt the Eco-Logical approach?

As detailed later in chapter 3, findings for the first evaluation question include the following:

- FHWA funding allowed grant recipients to pursue previously planned activities sooner, more comprehensively, and with broader stakeholder buy-in.

- FHWA funding helped attract additional funding.

Evaluation Question 2: How are State transportation departments and MPO stakeholders incorporating the Eco-Logical approach into their business practices?

Findings for the second evaluation question are as follows:

- Eco-Logical recipients focused their efforts on completing steps 1–4 (out of 9 steps in total) of the Eco-Logical approach, which are associated with collaborating, data sharing, mapping, and analyzing natural resources and transportation infrastructure. These steps are described in greater detail in chapter 2 of this report.

- Recipients reported newly established or improved relationships with partners and stakeholders as a result of their Eco-Logical projects.

- Agencies faced challenges working with their stakeholder partners due to different missions, goals, and responsibilities; varying levels of support for Eco-Logical activities from Federal agency staff at headquarters and regional levels; and staff turnover.

- Although agencies faced challenges in data acquisition, sensitivity, and compatibility as well as keeping their data current, data sharing has led to increased availability and use of data that was previously not accessible to other agencies.

- The Eco-Logical approach has led to improved integrated planning between environment, transportation, and land use. Additionally, many funding recipients have incorporated the Eco-Logical approach into their long-range transportation planning and project prioritization process.

> Evaluation Question 3: How have the Eco-Logical Program and approach contributed to improved project delivery processes and environmental mitigation?

Findings for the third evaluation question are as follows:

- Eco-Logical funding recipients reported few comments on quantifying and tracking changes in project delivery processes and environmental mitigation as part of their projects.

- Agencies reporting on project delivery and environmental mitigation impacts largely reported qualitative and anecdotal impacts, with some agencies noting that impacts are difficult to quantify and document.

Recommendations

Based on the findings of this evaluation, the following recommendations were made:

> Recommendation: Provide additional support in the form of peer exchanges, webinars, and case studies on the Eco-Logical approach.

Funding recipients noted in interviews (which are detailed further in the body of the report) that they would like to get more information on quantifying the impacts of the Eco-Logical approach, overcoming challenges in implementing the approach, and learning from other agencies that have formalized the approach into their transportation planning processes.

> Recommendation: Dedicate additional resources to the later project implementation steps of the Eco-Logical approach.

Transportation planning and project development processes occur over long time scales, and as the Eco-Logical Program reaches beyond its 10th yr, more agencies may have the ability to take on steps 5–9 of the Eco-Logical approach.

> Recommendation: Identify additional opportunities to engage regional-level staff about the Eco-Logical approach, build awareness within signatory agencies, and ensure consistent information is provided to stakeholders about the program and approach.

Funding recipients expressed concern that regional staff from FHWA and other signatory agencies either did not appear to be aware of or buy-in to the approach or that they were not able to provide sufficient assistance to the recipients due to heavy workloads. However, regional staff can be invaluable to support coordination among partner agencies, provide insight to improve

implementation, and lend credibility to the activity. FHWA should identify additional opportunities to engage regional-level staff in its program activities.

> **Recommendation: Investigate the challenges noted by recipients in obtaining buy-in for the Eco-Logical approach from local-level agencies that implement projects and share effective practices in overcoming these challenges.**

In order to help boost the success of the Eco-Logical approach in project development, FHWA should explore how to engage local municipalities to consider the impacts of their projects beyond their jurisdictional boundaries. FHWA could also provide technical resources to MPOs and State transportation departments to help them overcome the challenges they face when working with their local stakeholders and document effective practices to share nationwide.

> **Recommendation: Further support agencies in adopting quantifiable performance measures and tracking progress over time in order to justify the benefits and advance adoption of the Eco-Logical approach.**

Although FHWA has put more emphasis on tracking environmental and project delivery impacts over time, few agencies are tracking or quantifying the benefits of the Eco-Logical approach. Several funding recipients noted that quantified evidence of the benefits of an ecosystem-based approach would be useful to gain buy-in from stakeholders and justify the value of implementation. Agencies also should seek guidance on how to identify and track performance metrics.

> **Recommendation: Use a set of consistent questions or tracking methods to evaluate the progress of funding recipient agencies from year to year to ensure that overall progress on the Eco-Logical approach can be measured objectively in the long term.**

FHWA gathers a wealth of information from funding recipients through annual interviews, which the evaluation team uses as source data to identify trends, benefits, and challenges faced by the recipients as they implement their projects. While the interview questions used by FHWA each year are generally similar, the question format and emphasis has changed slightly from year to year as the program has matured, and discussion appeared to be more freeform rather than structured. These aspects of the interviews have made it challenging for the evaluation team to assess trends over time. FHWA should consider developing a set of consistent measures or questions to track long-term progress of the Eco-Logical approach in order to analyze and communicate trends in implementation.

Conclusions

FHWA has consistently recognized the value of demonstrating its commitment to the Eco-Logical approach by providing funding and technical assistance to its stakeholders and encouraging practitioners to share results with their peers. Evidence from recipients of FHWA Eco-Logical funding indicates that the program and approach have contributed to improved project delivery processes

and environmental mitigation. FHWA research and funding enabled recipients to adopt the Eco-Logical approach sooner and more comprehensively. In some instances, the agencies' Eco-Logical projects even positioned them to attract additional funding from other sources outside of FHWA. Agencies are building relationships with partners, sharing and using data in better ways, and incorporating information gathered to inform project prioritization and to develop integrated transportation plans.

While agencies found success in using the Eco-Logical approach in planning, few recipients pursued the later steps of the approach, and few recipients identified or quantified impacts related to project delivery or environmental mitigation. In order to address these challenges, the evaluation team recommends that FHWA continue to provide technical assistance to its stakeholders and focus that assistance on specific topics such as how to quantify impacts and how to apply the Eco-Logical approach in project development. FHWA should consider opportunities to engage regional level staff within FHWA and partner agencies and to direct some technical assistance to building awareness with local agencies that implement projects. FHWA should further support agencies in adopting performance measures and tracking progress to quantify time, cost, and environmental benefits. Finally, FHWA should consider using a consistent set of questions or measures to evaluate the progress of recipient agencies each year in order to measure overall progress of the approach in the long term.

1. Introduction

The Federal Highway Administration (FHWA) has initiated an effort to evaluate its Research and Technology (R&T) Program to help FHWA assess how effectively it is meeting its goals and objectives and to provide useful data to inform future project selections. Leaders of governmental transportation R&T programs need to be able to effectively communicate the impacts of their programs.

1.1 Evaluation Purpose

The evaluation team conducted a retrospective evaluation of FHWA's Office of Planning, Environment, and Realty (HEP) Eco-Logical Program to understand the effect of FHWA R&T activities on the implementation of the Eco-Logical approach (i.e., ecosystem-based[1] infrastructure planning and mitigation) to transportation project delivery by State transportation department and metropolitan planning organization (MPO) recipients of FHWA Eco-Logical funding.

The Eco-Logical Program supports transportation professionals by assessing and providing tools, technical assistance, and data to help State and local agencies perform effective transportation, environmental, and realty decisionmaking. The objectives of the Eco-Logical Program's research efforts described in FHWA's R&T agenda are as follows:[2]

- Promote more informed transportation decisionmaking to improve transportation planning, programming, operations, and coordination.

- Promote integrated planning that improves transportation safety and addresses environmental, social, and economic needs.

- Accelerate the project delivery process.

- Minimize environmental impacts of transportation investments.

- Improve the way transportation contributes to economic development and communities' quality of life.

- Promote transportation policy that supports multimodal transportation.

FHWA's Eco-Logical Program has developed a general toolkit of techniques to address each of these HEP objectives by conducting research and providing technical assistance for integrated ecosystem-based planning that avoids, minimizes, and mitigates impacts on habitats and ecosystems.

---

[1]The terms "ecosystem-based" and "landscape-scale approach" are used interchangeably throughout this report to mean a method for sustaining or restoring ecological systems that is based on a collaboratively developed vision that integrates ecological, economic, and social factors.[3]

1.2 Report Structure

This report is organized as follows:

- **Chapter 1. Introduction**: Provides an overview of the Eco-Logical Program and its timeline.

- **Chapter 2. Evaluation Design**: Describes the evaluation methodology and key hypotheses and provides a logic model for the Eco-Logical Program.

- **Chapter 3. Evaluation Findings**: Provides the findings and results of this evaluation.

- **Chapter 4. Recommendations**: Offers recommendations for FHWA based on the results of this evaluation.

- **Chapter 5. Conclusions:** Summarizes the findings and recommendations.

- **Appendix A. Eco-Logical Recipients:** Provides a list of recipients and their project descriptions.

- **Appendix B. Data Sources by Recipient:** Provides interviewee data available from 2008 to 2016.

- **Appendix C. Annual Report Interview Guides:** Provides lists of interview questions from each annual report from 2008 to 2015.

- **Appendix D. 2014 Program Questionnaire:** Provides questions from a program-sponsored (FHWA and American Association of State Highway and Transportation Officials (AASHTO)) questionnaire conducted in 2014 of 2007 grantee recipients.

- **Appendix E. 2015 IAP Peer Exchange:** Lists both the questions asked on October 14–15, 2015, by the evaluation team to peer exchange participants and the summary responses.

- **Appendix F. 2016 Evaluation Interview Guide:** Lists the questions asked in 2016 by the evaluation team to 2007–2013 Eco-Logical Funding recipients.

- **Appendix G. Evaluation Interviewee Agencies and Categories** Provides information on stakeholders interviewed by the evaluation team and how they are categorized.

- **Appendix H. Analysis of Eco-Logical Steps:** Provides an analysis of the Eco-Logical Program steps completed by 2007 MPO grand recipients.

- **Appendix I. Qualitative Coding Database:** Identifies the number of comments on benefits, challenges, and recommendations by evaluation theme and category.

1.3 Eco-Logical Program Background

The 2006 Eco-Logical guidebook (i.e., *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*) articulates a vision for an infrastructure development process that endorses ecosystem-based mitigation through integrating plans and data across agency and disciplinary boundaries.[3] Ecosystem-based mitigation includes evaluating alternatives for offsite mitigation and/or out-of-kind (i.e., different resource or ecological function as the impact) mitigation in the most ecologically important areas as defined by interagency partners and the public. Eco-Logical and related Second Strategic Highway Research Program (SHRP2) products offer multi-step procedures to conduct integrated planning as well as to avoid, minimize, and mitigate environmental impacts with the goal of improving conservation and connectivity of ecosystems as well as predictability and transparency in project development.

The Eco-Logical Program includes several tools and techniques to support State transportation departments, MPOs, and other planning agencies in implementing Eco-Logical practices. FHWA has funded two major rounds of pilot projects through the Eco-Logical Grant Program in 2007 and the SHRP2 Implementation Assistance Program (IAP) in 2013, which are the focus of this evaluation.[4,5]

FHWA's mission for the Eco-Logical Program is for State transportation departments and MPOs to adopt the principles and methods of the Eco-Logical approach as standard business practice with the participation of resource and regulatory agencies. Table 1 provides a timeline of the Eco-Logical Program's activities and publications.

Table 1. Timeline of Eco-Logical Program activities and publications.

Year	Inputs and Activities	Associated Materials
2002	• The Integrated Transportation and Ecological Enhancements for Montana (ITEEM) was initiated in response to Federal *Executive Order 13274: Environment Stewardship and Transportation Infrastructure Project Reviews*.[6] • National Eco-Logical effort began; an interagency team of eight Federal agencies (signatory agencies) started the development of Eco-Logical products.	None.
2005	Federal legislation (*Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*) passed; Section 6001 requires State transportation departments and MPOs to discuss potential environmental mitigation activities in their long range plans.[7]	None.
2006	The report, *Eco-Logical: An Ecosystems Approach to Developing Infrastructure Projects*, was published with support from the signatory agencies and four State transportation departments.[3]	*Eco-Logical: An Ecosystems Approach to Developing Infrastructure Projects*[3]

Year	Inputs and Activities	Associated Materials
2007	FHWA launched the Eco-Logical Grant Program. FHWA successfully advocated for the Eco-Logical approach's inclusion in SHRP2. It became the basis for implementing Eco-Logical, also known as SHRP2 product C06.[8]	None.
2008	• SHRP2 C06A and C06B research projects began and were managed by the Transportation Research Board (TRB).[7] • The U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (USEPA) released *Section 404 of the Clean Water Act: Compensatory Mitigation*, which encourages watershed-based decisions.[9]	None.
2009	FHWA organized a peer exchange on geographic information system (GIS) applications in Eco-Logical Grant Programs.	Reference 10
2010	• FHWA's Eco-Logical webinar series began.[11] • FHWA published *Evaluating Montana's ITEEM: Successes and Lessons for Eco-Logical*, which documents ITEEM's application of the Eco-Logical approach.[12]	References 12 and 13
2011	• FHWA participated in an SHRP2 capacity product needs identification workshop.[14] • SHRP2 C06A research project was completed.[14] • SHRP2 C21 pilot study began.[14] Four agencies were part of this pilot as a precursor to the SHRP2 IAP recipients.	References 15 and 16
2012	• Federal legislation (*Moving Ahead for Progress in the 21st Century Act*) was passed, which established streamlined and performance-based surface transportation programs and promoted accelerated project delivery.[17] • FHWA organized a peer exchange for five Eco-Logical Grant Program recipients.[14] • FHWA, AASHTO, and TRB held an SHRP2 implementation planning workshop for implementing Eco-Logical and established an implementation plan.[18]	References 19–24
2013	• TRB released research products SHRP2 C40A and C40B.[14] • FHWA and AASHTO formally launched the implementation of the Eco-Logical initiative.[14] • FHWA announced inaugural Eco-Logical IAP recipients.[14]	References 18 and 25–28 as well as an internal report entitled *A Framework for Assessing the Benefits of Applying the Eco-Logical Approach*

Year	Inputs and Activities	Associated Materials
2014	• FHWA and AASHTO developed technical assistance and implementation activities for implementing the Eco-Logical approach.[14] • FHWA and AASHTO conducted a business readiness evaluation in spring 2014.[25] • FHWA and AASHTO led sessions on implementing the Eco-Logical approach at AASHTO committee meetings in spring and summer 2014.[25] • FHWA and AASHTO founded the Implementing Eco-Logical On-Call Technical Assistance team (ongoing).[25] • FHWA and AASHTO established a "champions" team to promote the Eco-Logical Program (ongoing).[25] • FHWA and AASHTO convened the FHWA/AASHTO Implementing Eco-Logical team (ongoing).[25]	References 29–33
2015–Present	• FHWA and AASHTO held a peer exchange on mitigation approaches for State transportation departments in March 2015.[34] • FHWA and AASHTO facilitated an Eco-Logical technical assistance workshop with the Maine Department of Transportation (MaineDOT) in April 2015.[34] • FHWA funded a workshop on increasing the use of wildlife data in transportation plans and projects across the west in May 2015.[35] • FHWA and AASHTO held a peer exchange on mitigation approaches for MPOs in June 2015.[34] • FHWA and AASHTO held a peer exchange on establishing a regional ecosystem framework (REF) in July 2015.[34] • FHWA and AASHTO held an SHRP2 IAP peer exchange in October 2015.[35]	Peer exchange and workshop activity reports in references 36–43

2. Evaluation Design

This evaluation sought to understand the effects of FHWA R&T activities on the implementation of the Eco-Logical approach to transportation project delivery by State transportation departments and MPOs. This chapter includes a logic model to describe the Eco-Logical Program, the evaluation hypothesis and questions, and the methodology used to collect and analyze data to answer the evaluation questions.

The evaluation sought to determine how effective FHWA's efforts were in disseminating information to facilitate adoption, determine to what extent stakeholders have adopted the Eco-Logical approach, and identify business and environmental impacts obtained by agencies implementing the Eco-Logical approach.

2.1 Logic Model

A *logic model* is defined by the authors of this report as a series of statements linking program components (i.e., inputs, activities, outputs, outcomes, and impacts) in a causal chain. It describes the relationship between program resources, planned activities, and expected results. It is not intended to be a comprehensive or linear description of all program processes and activities but rather to make explicit how program stakeholders expect program activities to affect change. The logic model helps to explain the theories of change that drive the design of a program that can be tested in an evaluation (see figure 1).

Inputs

- Legislation, regulation, and policy
- FHWA R&T funding
- Signatory agencies
- Prior ecosystems research
- SHRP2 funding

FHWA Activities

- Signatory agency engagement
- FHWA Eco-Logical research, outreach, and technical assistance
- SHRP2 implementation of Eco-Logical research and outreach

FHWA Outputs

- *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*[3]
- *Evaluating Montana's ITEEM: Successes and Lessons for Eco-Logical*[12]
- Grants program
- Benefits assessment
- Outreach
- SHRP2 C06A and C06B[8]
- SHRP2 C40A and C40B[14]
- SHRP2 implementation assistance

State/MPO Activities

- Partner with other organizations
- Integrate natural resource plans and data
- Create REF
- Assess effects on resource conservations objectives
- Establish and prioritize ecological actions
- Develop crediting strategy
- Develop programmatic agreement or permit
- Implement agreements and deliver projects
- Update REF

State/MPO Outcomes

- Agencies have better transparency, predictability, and relationships
- Agencies avoid or minimize potential environmental impacts through integrated planning
- Agencies rectify, reduce, or compensate for environmental impacts of projects

Impacts

- Improved environmental mitigation
- Improved project delivery process

Source: FHWA.

Figure 1. Illustration. Eco-Logical evaluation logic model.

Inputs, Activities, and Outputs

The inputs, activities, and outputs in the logic model are described in table 1 in chapter 1. Several of the activities and outputs involved FHWA in collaboration with other agencies and organizations.

State Transportation Department/MPO Activities

FHWA stakeholders, including State transportation departments and MPOs, may choose to adopt any or all nine steps of the Eco-Logical approach (see subsequent section, State Transportation Department/MPO Outcomes, for a description of the steps). These nine implementation steps are activities that agencies can pursue to realize the outcomes and impacts described in the following two sections.

State Transportation Department/MPO Outcomes

The Eco-Logical Program provides strategies to help agencies meet transportation infrastructure needs without compromising the environment. The evaluation team identified three outcomes for the Eco-Logical Program and related them to the nine-step process for implementing the Eco-Logical approach. The outcomes and their accompanying steps are as follows:[2]

- **Outcome 1**: Agencies working together have better transparency and predictability in planning and project development processes and build stronger relationships founded on credibility and trust as follows:

    o **Step 1**: Build and strengthen collaborative partnerships among agencies.

- **Outcome 2**: Agencies avoid or minimize potential environmental impacts through integrated planning as follows:

    o **Step 2**: Integrate natural resource, transportation, and land use plans.

    o **Step 3**: Create an REF.

    o **Step 4**: Assess effects on conservation program objectives.

    o **Step 5**: Establish and prioritize ecological actions.

    o **Step 9**: Update REF and ecological data.

- **Outcome 3**: Agencies rectify, reduce, or compensate for environmental impacts of projects as follows:

    o **Step 6**: Develop a crediting strategy.

    o **Step 7**: Develop programmatic agreements and consultations with stakeholders.

---

[2]While step 9 appears under outcome 2, it is not out of order. The outcomes simply group related steps.

     o **Step 8**: Implement agreements and deliver projects utilizing Eco-Logical Program strategies.

The first outcome describes relationships with partners. The second and third outcomes combine the five types of mitigation into two groups. The Council on Environmental Quality regulations (40 CFR 1508.20) defines *mitigation* as follows:[44]

- Avoiding the impact altogether by not taking a certain action or parts of an action.

- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

- Compensating for the impact by replacing or providing substitute resources or environments.

The second outcome includes the two types of mitigation that can be accomplished in planning, and the third outcome includes the remaining three types of mitigation, which tend to occur in project development.

Impacts

The Eco-Logical Program is intended to achieve two overarching impacts: (1) improved environmental mitigation and (2) improved project delivery processes (see figure 2). The Eco-Logical Program encourages early identification and consideration of mitigation opportunities at the planning level (i.e., to identify and consider issues earlier) and at an ecosystem scale (i.e., to consider effects in a broader geographic context than at the project level).

Impacts of Improved Environmental Mitigation:	Impacts of Improved Project Delivery Process:
• Avoid or minimize impacts at a planning level. • Rectify, reduce, or compensate for impacts at an ecosystem scale.	• Save time. • Save money.

Source: FHWA.

Figure 2. Illustration. Impacts of improved environmental mitigation and project delivery process.[3]

2.2 Evaluation Hypothesis and Questions

The evaluation team identified the following hypothesis for the program evaluation:

> Hypothesis: The Eco-Logical Program and approach have contributed to improved project delivery processes and environmental mitigation.

Table 2 lists the key questions that link the evaluation research to the program logic model. The table also includes measures of effectiveness for each question.

Table 2. Eco-Logical Program evaluation research questions and key performance measures.

Evaluation Component	Evaluation Question	Key Performance Measures
FHWA activities and outputs	How has FHWA enabled State transportation departments and MPO stakeholders to adopt the Eco-Logical approach?	Key performance measures include training, technical assistance, and funding disseminated to State transportation departments and MPOs.
State transportation department/MPO activities and outcomes	How are State transportation departments and MPO stakeholders incorporating the Eco-Logical approach into their business practices?	Key performance measures include changing partnering; sharing data; analyzing effects on conservation program objectives; identifying key sites and actions; documenting, implementing, and evaluating ecological information; and ensuring increased transparency and predictability as well as better relationships.
Impacts to FHWA, State transportation departments, and MPOs	How have the Eco-Logical Program and approach contributed to improved project delivery processes and environmental mitigation?	Key performance measures include improved environmental mitigation and improved project delivery processes.

2.3 Evaluation Methodology

The evaluation team used the following five data collection and analysis methodologies to inform this evaluation:

- Conducted a literature and document review.
- Participated in a program-sponsored peer exchange.
- Performed stakeholder interviews.
- Analyzed the Eco-Logical approach steps completed by funding recipients.
- Performed a qualitative coding analysis of stakeholder comments.

The following subsections provide additional detail about these five data collection and analysis methodologies.

Literature and Document Review

The evaluation team conducted a literature review to gain an understanding of the Eco-Logical Program, its stakeholders and users, and FHWA outreach activities and outputs. The evaluation team also conducted a qualitative analysis.

Findings from the initial literature review are detailed in table 1 (see chapter 1) and used to answer evaluation question 1, how has FHWA enabled State transportation departments and MPO stakeholders to adopt the Eco-Logical approach?

The evaluation team determined it would be most appropriate to focus the evaluation on the effectiveness of implementation by recipients of FHWA funding through the 2007 Eco-Logical Grants Program and the 2013 SHRP2 IAP rather than attempt to identify and assess general awareness of the program and approach by hundreds of agencies around the United States.

A more extensive document review was used to provide detailed information for the qualitative coding analysis and as well as for the analysis of the Eco-Logical approach's steps completed by recipients of FHWA funding. Documents reviewed included the Eco-Logical Program's annual reports from 2008 to 2015 as well as notes from interviews that were conducted with recipients of FHWA funding that informed those annual reports. (See references 13, 15, 19, 25, 34, and 45.)

Appendix A includes a list of recipients and their project descriptions, appendix B shows interviewee data available from 2008 to 2016, appendix C provides lists of interview questions from each Eco-Logical annual report from 2008 to 2015, and appendix D includes questions from a program-sponsored (FHWA and AASHTO) 2014 questionnaire conducted for the 2007 grantee recipients.[25]

Participation in a Program-Sponsored Peer Exchange

On October 14–15, 2015, FHWA and AASHTO jointly held an Implementing Eco-Logical IAP Peer Exchange for SHRP2 IAP recipient agencies to share accomplishments and lessons learned from their projects with each other and with other transportation and resource agencies.[42] Participants included the following (asterisks denote IAP funding recipients):

- Alabama Department of Transportation.
- Atlanta Regional Commission (ARC).
- Charlottesville Albemarle MPO.*
- Federal Motor Carrier Safety Administration.*
- Louisiana Department of Transportation.
- MaineDOT.
- Michigan Department of Transportation (MDOT).*
- Mississippi Department of Transportation.*
- North Central Texas Council of Governments (NCTCOG).
- Ohio-Kentucky-Indiana Regional Council of Governments (OKICOG).*
- Tennessee Department of Transportation.*
- Wisconsin Department of Transportation.*
- USEPA.

- U.S. Forest Service.
- U.S. Fish & Wildlife Service (FWS).

A member of the evaluation team participated in the peer exchange to collect data from attendees through targeted listening sessions and general observations. Findings from the peer exchange helped the evaluation team to determine next steps for data collection, including conducting stakeholder interviews. Appendix E lists questions asked by the evaluation team to peer exchange participants and a summary of their responses.

Stakeholder Interviews

In 2016, the evaluation team interviewed recipients from both the 2007 Eco-Logical Grant Program and 2013 SHRP2 IAP. The purpose was to follow up on program-sponsored interviews and to ask targeted questions to inform the evaluation hypothesis and questions. The respondents included 10 MPOs, 6 State transportation departments, and 4 recipients categorized as "other" (see table 14 for a list of all interviewees). All respondents spoke with the evaluation team via a conference call except for one agency, which sent in written responses to the interview questions. Appendix F provides a list of 2016 evaluation interview questions.

To address the intricacies in R&T evaluation, the evaluation team interviewed many stakeholders. The team ensured all interviewees that their identities were to remain confidential to achieve more unbiased answers to questions that were asked. Throughout the document, when interviewees are quoted, the month and year of interview are noted as well as the name of the interviewer, but the interviewee names have been redacted. However, to maintain continuity and comparability between interviewee responses, a generic title is attributed to each interviewee. The aforementioned information is placed in a footnote for each interview.

The evaluation team also collected input from FHWA Eco-Logical Program's points of contact through interviews and participation in a program visioning session to understand FHWA's perspective on benefits and challenges, FHWA's role in encouraging stakeholder implementation, and FHWA's goals for the program's past, present, and future.

Analysis of Eco-Logical Steps Completed by Funding Recipients

Based on a review of program annual reports and follow-up evaluation interviews, the evaluation team determined which Eco-Logical approach steps recipients completed, both during and following their periods of performance. (See references 13, 15, 19, 25, 34, and 45.) The program has generally not tracked recipient implementation of the Eco-Logical approach by the nine-step approach except for one annual report.[45]

The purpose of this analysis was to gain insight into the areas where agencies tend to focus their efforts in order to inform evaluation question 2, how are State transportation departments and MPO stakeholders incorporating the Eco-Logical approach into their business practices? Section 3.2 in chapter 3 of this report provides results of the steps analysis. The analysis also helped to identify potential areas where the program may choose to focus attention in the future, as described in chapter 4 of this report. It should be noted that each agency did not necessarily have the goal of

completing all nine Eco-Logical steps, and the evaluation did not seek to appraise recipients based on the number of steps they completed.

Qualitative Coding Analysis of Stakeholder Comments

The evaluation team developed a database of stakeholder-identified benefits, challenges, and recommendations of the Eco-Logical Program. Information was gathered from interview notes that informed program annual reports from 2008 to 2015, responses from an Eco-Logical Grant Program questionnaire conducted by the program in 2014, input from the program-sponsored IAP peer exchange held in 2015, and interview notes from follow-up interviews conducted by the evaluation team in 2016. (See references 13, 15, 19, 25, 34, and 45.) Relevant statement(s) directly from interview notes were copied into the database with information on the data source, including agency, agency type, and year.[3] Each statement was then coded into a benefit, challenge, recommendation to FHWA, or recommendation to peer agencies. Each statement was also coded into a theme and category (or sub-theme). Coding the data makes it easier to search, make comparisons, and identify patterns that require further investigation.

Each theme and category was associated with an evaluation question, as provided in table 3. Themes and their associated categories are defined following the table. See appendix I for the number of comments assigned to the qualitative coding themes and categories.

---

[3]The evaluation team sought to remove duplicate statements where, for example, the same recipient repeated the same benefit during the same interview. A single occurrence of a statement is one agency (including one or more individuals) on an interview call in 1 yr within an evaluation theme-category combination.

Table 3. Qualitative coding themes and categories.

Theme	Category	Evaluation Question
Communication	Knowledge	1
Communication	Outreach	1
Resources	Funding	1 and 2[4]
Resources	Eco-Logical Grant Program or IAP	1
Resources	Staff (includes staff time)	2
Relationships	Credence	1
Relationships	Data sharing	2
Relationships	External stakeholders (includes buy-in)	2
Relationships	Internal stakeholders (includes buy-in)	2
Operations	Champion/leader	2
Operations	Data use	2
Operations	Environmental impacts	3
Operations	External factors	2
Operations	Process or process change	2
Operations	Process impacts	3
Operations	Staff turnover	2

Communication

The communication theme includes benefits, challenges, and recommendations related to the interchange or transmission of information about the Eco-Logical approach. Categories within this theme include the following:

- **Knowledge**: Knowledge comments are related to the level of awareness or familiarity with Eco-Logical.

- **Outreach**: Outreach comments are related to the branding of the Eco-Logical approach and the extent of its effectiveness between recipients and their stakeholders.

Resources

The resources theme includes benefits, challenges, and recommendations related to the critical assets for the Eco-Logical approach to function effectively in agencies. Categories within this theme include the following:

- **Funding**: Funding comments are related to the supply of money required to implement Eco-Logical.

---

[4]The evaluation team recognized that comments related to funding could describe either evaluation question 1 (how FHWA enabled agencies) or question 2 (factors that supported or were challenges to agencies' implementation of the Eco-Logical approach).

- **Eco-Logical Grant Program or IAP**: Eco-Logical Grant Program or IAP comments are related to the effectiveness of the Eco-Logical Program at the Federal level.

- **Staff**: Staff comments in this category are related to the people (and the time required) at the recipient level necessary to implement the Eco-Logical approach.

Relationships

The relationships theme includes benefits, challenges, and recommendations related to making connections between recipients and their stakeholders. Categories within this theme include the following:

- **Credence**: Credence comments are related to building trust and confidence in the Eco-Logical Program through legitimacy or creating value.

- **Data sharing**: Data sharing comments are related to the availability of data between recipients and their stakeholders, including whether and how to share data.

- **External stakeholders**: External stakeholder comments are related to the people, groups, agencies, or organizations outside the parent organization of the recipient that have an investment, share, or interest in the Eco-Logical Program. For example, if the recipient is a State transportation department, comments in this category would relate to those people or organizations outside of the State transportation department (i.e., Federal or State resource agencies, MPOs, etc.).

- **Internal stakeholders**: Internal stakeholder comments are related to the people and groups within the parent organization of the recipient that have an investment, share, or interest in the Eco-Logical Program. For example, if the recipient is a State transportation department, comments in this category would relate to other people or groups within the State transportation department (i.e., agency leadership, planning, environment, engineering, etc.).

Operations

The operations theme includes benefits, challenges, and recommendations related to the essential assets, functions, and considerations required to managing an organization or program effectively. Categories within this theme include the following:

- **Champion/leader**: Champion/leader comments are related to someone at the recipient level leading the Eco-Logical effort.

- **Data use**: Data use comments are related to the employment of readily available data from recipients and their stakeholders, including compatibility.

- **Environmental impacts**: Environmental impacts comments are related to the avoidance or mitigation of negative environmental impacts due to land development.

- **External factors**: External factors comments are related to those circumstances or situations outside of the recipient organization that the organization cannot control.

- **Process or process change**: Process or process change comments are related to the series of actions or steps involved in implementing Eco-Logical as part of the project delivery process.

- **Process impacts**: Process impacts comments are related to the time or cost savings in the project delivery process.

- **Staff turnover**: Staff turnover comments are related to the change or movement of people in, out, or through the organization receiving Eco-Logical Grant Program funding.

Evaluation Limitations and How They Were Addressed

This section describes considerations the evaluation team identified in the evaluation plan developed internally for this report that could impact data collection and analysis. The evaluation team identified several techniques to address each challenge, as described in table 4.

Table 4. Evaluation limitations and how they were addressed.

Consideration Identified in Evaluation Plan	How Challenge Was Addressed in Evaluation
Program impacts were difficult to measure because performance measures were limited, agencies may not have been collecting baseline data or information on time/cost savings, or those systems were not yet mature/robust. In addition, many organizations were controlling the process, and it was possible that no singular organization was tracking all elements of the process. Quantitative data may have been limited or may not exist to analyze project impacts.	The evaluation mostly relied on qualitative data and proximal measures from synthesis of program materials and stakeholder interviews to infer impacts, where appropriate.
Long-range planning to project development could take many years, so it was challenging to measure the impact of a program on such a long-term scale.	Findings from the evaluation confirmed that few agencies track impacts in terms of time/cost savings or improved environmental mitigation (see section 3.3 for more information on impacts).
There was a potential lack of stakeholder participation; the same organizations were contacted frequently in regard to this program.	The evaluation team pursued opportunities to leverage data collection in coordination with anticipated program activities to maximize responses and participation. In addition, many recipients were willing to share their successes and challenges through evaluation interviews in 2016 even if they were years beyond project completion (see appendix B for the responses).

Consideration Identified in Evaluation Plan	How Challenge Was Addressed in Evaluation
Outcomes and impacts from the Eco-Logical Program can affect many different levels of an agency, and implementation can occur in different ways for agencies adopting the approach as follows: • **Program/process level**: Organizing staff, trainings, and procedures. • **Planning/project level**: Implementing procedures in plans and projects. • **Individual steps or entire approach**: Taking on entire approach or elements of approach.	For this evaluation, impacts were strictly related to better environmental mitigation (e.g., avoiding impacts or compensating for impacts at an ecosystem scale) and improved project delivery processes as indicated by time and cost savings, and only for 2007 grant and 2013 IAP recipients. Findings on impacts were based on interviews from recipients (see section 3.3). In addition, the evaluation reported on implementation of procedures and how agencies used the Eco-Logical approach through an analysis of steps, benefits, challenges, and recommendations (evaluation question 2).
The evaluation team needed to determine whether change will be measured based on an agency compared to itself in the past or across the Nation over time.	The evaluation team determined that it was most appropriate to compare an agency to itself. The recipient agencies have a variety of Eco-Logical projects and goals, making them difficult to compare to each other or infer nationwide trends.
It may be difficult to attribute FHWA activity and outputs as the direct cause of State transportation department/MPO outcomes and impacts because these activities are diffuse in nature, extend over long time periods, vary widely across applications, and have expected outcomes that are long term.	The evaluation hypothesis and questions sought to understand program contributions, recognizing the variety of potential factors that may affect outcomes and impacts. Where appropriate, the evaluation team made inferences regarding effect of the program's contribution.

3. Evaluation Findings

This chapter discusses key findings of the evaluation framed by the three evaluation questions described previously. The findings were shaped by the evaluation team's literature and document review, participation in a program-sponsored peer exchange, stakeholder interviews, analysis of Eco-Logical approach steps completed by funding recipients, and qualitative coding analysis of stakeholder comments.

3.1 Dissemination

> Evaluation Question 1: How has FHWA enabled State transportation departments and MPO stakeholders to adopt the Eco-Logical approach?

Some of the outputs of FHWA's Eco-Logical Program include a resource document published in 2006 as well as multiple follow-on technical resources documents, 2 rounds of funding, 31 webinars, 8 peer exchanges, multiple case studies, and annual reports. (See references 3, 46, 4, 5, 11, 36–43, 47, 48, 12, 49, 13, 15, 18, 25, 34, and 45.) Outreach has engaged approximately 94 agencies across at least 37 States. Funding to recipients has totaled $3,385,319 for a total of 29 allocations made to 28 MPOs, State transportation departments, and other agencies (see figure 3).

The evaluation team's review of past interviews of recipients and more recent interviews conducted in 2016 resulted in two key findings for evaluation question 1. Overall, the FHWA funding and knowledge/outreach events were effective in enabling stakeholders to adopt the Eco-Logical approach; however, it was not the primary driver for adoption in all cases.[35] In addition, FHWA funding helped agencies attract additional funding to support implementation of the Eco-Logical approach.

Eco-Logical Program Profile

2007 Grant Program
- $1,518,330 awarded
- 7 MPOs
- 1 State DOT
- 7 Other Agencies

2013 SHRP2 IAP
- $1,866,989 awarded
- 7 Lead Adopters
  4 MPOs and 3 State DOTs
- 7 User Incentives
  3 MPOs and 4 State DOTs

29 Awards

$3,385,319 total awarded
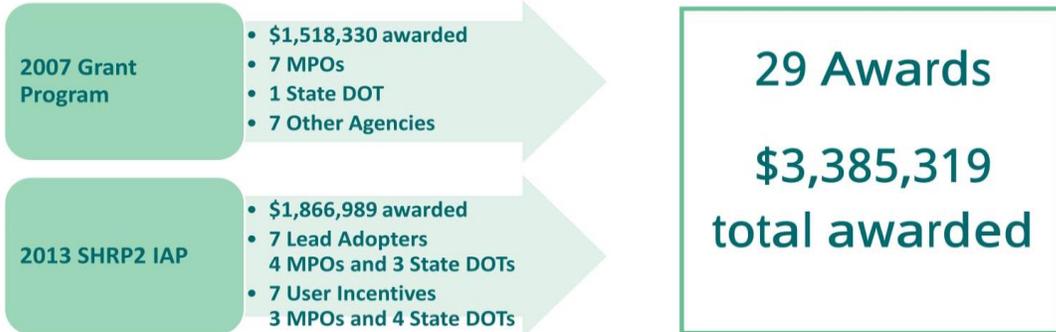
Eco-Logical Outreach Activities

FHWA HAS SUPPORTED **43** ECO-LOGICAL OUTREACH EVENTS SINCE 2009

31 Webinars

8 Peer Exchanges

4 Technical Assistance Workshops

Participating Organizations
- State DOTs — 27
- MPOs — 20
- Federal Agencies — 16
- Other Groups — 16
- State Agencies — 8, 7
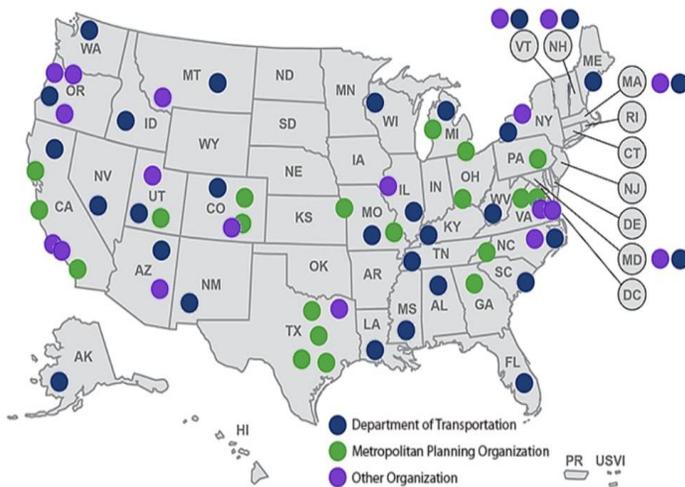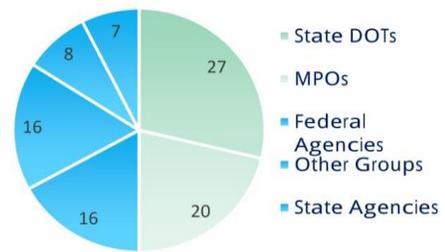
The Eco-Logical approach has reached (at least) 94 unique organizations...

...Across 37 States

Map legend:
- Department of Transportation
- Metropolitan Planning Organization
- Other Organization

Source: FHWA.
Note: This graphic generated from a combination of published FHWA materials, and data referenced in the report adapted into a visual format.[50] Source information is described in greater detail in Section 3.1. (See references 3, 46, 4, 5, 11, 36–43, 47, 48, 12, 49, 13, 15, 18, 25, 34, and 45.)

Figure 3. Illustration. Eco-Logical Program profile.

> Finding 1: FHWA funding allowed agencies to pursue previously planned activities sooner, more comprehensively, and with broader stakeholder buy-in.

In 2009, the 2007 Eco-Logical grant recipients were asked two related questions: (1) without the FHWA Eco-Logical Grant Program funding, would you have pursued the type of work you are currently doing? (all seven respondents answered "yes") and (2) did the Eco-Logical Grant Program solicitation inspire you to attempt the Eco-Logical approach, or was this something your organization was considering or involved with prior to the grant? (all six respondents answered "no"). Respondents to the first question clarified their responses to explain that the work would not have been done to the same extent or with the same spirit without the FHWA funding. For the second question, respondents clarified that the grant broadened or expanded their scope and helped to get buy-in.

Early interview responses in 2009 indicated that recipients would have done their Eco-Logical work without the funding. This implies that the grant was not the primary driver for the work, although the funding did have an effect on it. One reason that all grant recipients might have already been performing Eco-Logical approach-type work could have been that the 2007 Eco-Logical Grant Program appealed to agencies that were already engaged in ecosystem-level planning. For the second round of funding through IAP in 2013, responses were not as consistent.

In 2016, the evaluation team asked the following questions to all funding recipients (both 2007 and 2013 recipients):

- How has FHWA enabled your agency to adopt the Eco-Logical approach?

- Would you have done this project anyway?

- If you would have done this project anyway, how has it been different because of the Eco-Logical funding?

Of 19 responses, 12 agencies indicated that they would have completed their project anyway, 5 indicated that they would not have done the project without the funding, and 2 agencies indicated that they were unsure.

The 12 agencies that said they would have done the project anyway explained that they would not have completed the project so quickly or as thoroughly without funding. For the five agencies that responded no, their explanations included lack of time and resources to do the work without the help of the FHWA funding. Of those five agencies in the 2016 interviews, one of them was a 2007 recipient that originally responded differently when asked a similar question in 2009. One possible explanation for this discrepancy might be that different staff were interviewed in 2016 than originally in 2009. The other four agencies that said they would not have done the work without funding were 2013 funding recipients.

The following direct quotes, which describe how Eco-Logical funding supported agencies' activities, are from funding recipients who were interviewed as a part of this evaluation in 2016:

> *"We were doing Eco-Logical before we received the grants...but what we were not doing, was integrating that information properly into the decisionmaking process."[5]*

> *"The grant has allowed us to increase our technical capacity, without [it] we would not have time or money to do this... the grant allowed us to look at it in more detail than we would have been able to do otherwise."[6]*

> *"[It had been our] goal to gather more info... to make decisions to be better environmental stewards; haven't been able to do it due to lack of resources and other priorities; grant helped us to overcome these obstacles."[7]*

> *"This gave us the resources to branch out and acquire some of the tools and data, and to reach out to sponsor agencies such as FWS... If we didn't have the grant, we would have done some environmental analysis but not to the extent that Eco-Logical enabled."[8]*

> *"But if we hadn't had the funding we wouldn't have gotten as far. We did have rudimentary maps that we would include in past MTPs [medium term plans] but this project really allowed us to advance the conservation objectives with the REF."[9]*

Some agencies commented that having their projects associated with a Federal program and with Federal research funding added legitimacy to their work. They also mentioned that other staff within the agency as well as other partner agencies could see the value in the Eco-Logical approach because of their projects.

The following quotes from 2007 and 2013 funding recipients describe the credence that the FHWA Eco-Logical Program offered agencies who sought to implement an ecosystem-based approach to infrastructure planning and environmental mitigation:

---

[5]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

[6]State transportation department employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in May 2016.

[7]State transportation department employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

[8]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

[9]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

> *"[Our agency] was trying to do this, but were not quite there - one thing that was very helpful was having the Eco-Logical document as FHWA resource so [we] can create buy in from additional agencies – this has helped [us] to push the Eco-Logical approach."*[10]

> *"SHRP2 money made it feel important."*[11]

> *"The thing with grants is that it lends legitimacy to an idea or initiative—that's what Eco-Logical grant did, and with the eight agencies adopting [the approach] that helped too."*[12]

> *"It was difficult to talk about grant to stakeholders since it was for a pilot level project, but since we said it was SHRP2 that gave us more credence since it was at the Federal level."*[13]

Finding 2: FHWA funding helped attract additional funding.

Although both 2007 and 2013 funding recipients were never specifically asked if the work performed under the FHWA Eco-Logical Program funding assisted them in attracting additional funding, eight recipients mentioned that this was the case. These agencies indicated that their Eco-Logical work positioned them to apply and be selected for additional funding opportunities, either to further their Eco-Logical work or due to their success with that grant or award. Additional funding sources that agencies mentioned included the National Association of Regional Councils, a local MPO, the Sustainable Communities Regional Planning Grant Program through the U.S. Department of Housing and Urban Development (HUD), the Z. Smith Reynolds Foundation, and the U.S. Forest Service. (See references 51–54.)

Quotes from two of the recipients are as follows:

> *"[We] pulled together small amounts from other places, but Eco-Logical grant made the difference and helped attract other funding."*[14]

> *"Without the Eco-Logical plan, we wouldn't have been positioned for HUD… So Eco-Logical allowed us to use the HUD funding to examine other important areas in our region and have a greater impact through planning."*[15]

---

[10]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

[11]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

[12]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

[13]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

[14]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

[15]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

It is a positive testimony to the Eco-Logical Program that several of the recipients built upon their Eco-Logical work and received additional funding from other sources or that their Eco-Logical work was received well and positioned them to be strong candidates for other funding programs.

3.2 Incorporation Into Business Practices

Evaluation Question 2: How are State transportation departments and MPO stakeholders incorporating the Eco-Logical approach into their business practices?

The nine-step Eco-Logical approach can be applied in different ways and tailored to the needs of specific agencies and their partners. The evaluation team sought to understand how recipient agencies chose to apply the Eco-Logical approach and identify where they found benefits and challenges to implementation. The majority of interview responses focused on how agencies were implementing the Eco-Logical approach into their projects, so there was a wealth of data on how agencies were incorporating (or meeting challenges to incorporate) the approach into their business practices.

Findings 3 through 7 relate to this second evaluation question. Finding 3 indicates that most recipients followed the earlier steps (e.g., 1–4) of the Eco-Logical approach, which build the foundation of Eco-Logical and the focus on planning-level analysis. Findings 4 through 7 explore the successes and challenges that recipients faced in seeking to implement the Eco-Logical approach, summarized as follows:

- Findings 4 and 5 relate to step 1 in the Eco-Logical approach. Recipients experienced both new and improved relationships with partners while also facing difficulties in coordinating with internal and external stakeholders.

- Finding 6 relates to steps 2 and 3 in the Eco-Logical approach. Recipients benefited from new data sharing, though they indicated experiencing challenges with acquiring and updating data.

- Finding 7 relates to steps 4 and 5 in the Eco-Logical approach. Recipients benefited from a more integrated approach to transportation planning, and several had incorporated Eco-Logical into their long-range transportation planning (LRTP).

The following subsections provide a more detailed look at findings 3 through 7 and their results.

Finding 3: 2007 Eco-Logical Grant Program recipients focused their efforts on completing steps 1–4 of the Eco-Logical approach, which are associated with collaboration, data sharing, and mapping and analysis of natural resources and transportation infrastructure.

The evaluation team analyzed published reports (see appendix A for a full list of reports) related to the Eco-Logical approach as well as notes from interviews of recipients to determine which Eco-Logical steps recipients completed or pursued (see appendix B). The evaluation team found that all

recipients pursued step 1, and the majority of recipients pursued steps 2–4. However, relatively few recipients completed steps 5–9. Table 5 provides a summary of the number of recipients that completed each step. A detailed summary of the analysis of the nine Eco-Logical steps by recipient is provided in appendix H.

Table 5. Number of recipients who completed or pursued each Eco-Logical step by recipient type.

Type of Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
MPO (14 total)	14	13	12	11	2	0	0	0	4
State transportation department (7 total)	7	7	4	3	3	1	4	1	1
Other* (7 total)	7	7	6	4	3	1	1	2	1
All (28 total)	28	27	22	18	8	2	5	3	6

*Other recipients include a city transportation department, environmental non-profits, a State-level department of natural resources, a county-level soil and water conservation agency, and the USEPA.

The majority of the recipients who were classified as MPOs completed Eco-Logical steps 1–4, which focus on collaboration, data sharing, and mapping and analysis of natural resources and transportation infrastructure. These steps are more in line with an MPO's role and responsibilities in planning than the later Eco-Logical steps. The MPO recipients did not complete steps 6–8, which are more applicable to State transportation departments and State-level agencies who are responsible for project design, construction, and mitigation of impacts.

State Transportation Department Recipients

All of the State transportation department recipients pursued steps 1 and 2. At least one State transportation department pursued each of the other Eco-Logical steps, as the responsibilities usually undertaken by State transportation departments include planning, project development, construction, and remediation. Four State transportation departments developed programmatic agreements.

Other Recipients

The 2007 Eco-Logical Grant Program recipients included a range of other agencies, including a city transportation department, environmental non-profits, a State-level department of natural resources, a county-level soil and water conservation agency, and the USEPA. The grant projects undertaken by these recipients varied more than the projects undertaken by the MPO and State transportation department recipients. In addition, these agencies all have different roles and levels of authority in the transportation planning and environmental mitigation processes. All of the agencies in this category, however, completed steps 1 and 2, with the majority of agencies also completing steps 3 and 4.

Implementation of the steps is a long-term iterative process. While an agency's completion of a particular step does not guarantee achievement of the step's related outcome, incorporating steps into an agency's business practices can contribute to better outcomes.

In summary, agencies may be pursuing the earlier steps of Eco-Logical based on the following two factors:

- **How long they have been implementing the approach**: Agencies that are newer to the approach are more likely to start with earlier steps.

- **Type of agency, roles, and authority**: Planning agencies such as MPOs focus on steps of the approach related to planning. The later steps relate to project development, which is typically outside of an MPO's authority.

> **Finding 4: Recipients reported newly established or improved relationships with partners and stakeholders as a result of their Eco-Logical project.**

Nearly all recipients (26 out of 28 total (93 percent)) reported that their relationships with external stakeholders and partners benefitted from their work on their Eco-Logical projects. In fact, some recipients reported strengthened relationships with partners among the main benefits of their Eco-Logical project (8 out of 28 total (29 percent)). The Eco-Logical projects provided recipients with specific reasons to reach out to partners and stakeholders and to work together in a way that they may not have in the past. Collaboration is the first step of the Eco-Logical approach, and sound relationships with partners are needed to make progress in the other steps. The quantifiable impacts of the Eco-Logical approach will take longer to evaluate, and so it makes sense that recipients reported relationships as a benefit of the Eco-Logical approach early on and throughout their projects. Through creating the REF or working on other aspects of the Eco-Logical approach, recipients reported strengthened or improved relationships with partners for a number of reasons, including the following four:

- The Eco-Logical approach provided a reason to reach out to partners and stakeholders, establishing or reestablishing contact and becoming more comfortable working together.

- By working with partner agencies, recipients are able to gain a better understanding of their partner's and stakeholder's missions.

- Agencies implemented their projects in a collaborative way, and partners appreciated being involved in the process.

- The Eco-Logical approach (and REF in particular) provided a more transparent, data-driven approach that helped increase trust among agencies involved in transportation planning.

The following direct quotes highlight these themes, capturing what agencies reported over the years about their relationships with partners:

> *"….The product that we develop isn't as important as the relationships you developed. There may be no major revelations from the grant itself, but now you're more comfortable addressing issues with your new partners. I believe that there are ever-strengthening relationships between [our agency] and the resource agencies as a result of this project. It has helped us further the relationship with the resource agencies significantly here."[16]*

> *"….These three agencies established joint work plans in the early stages of the project. The work plans have been helpful in defining roles and establishing the framework for collaboration."[17]*

> *"….benefits thus far include much improved communication between agencies. The Eco-Logical work has been the impetus for further important collaboration, far beyond data delivery. Through continued and consistent communication, [the partner agencies] have found areas where we can partner and a have greater understanding of each other's missions."[18]*

The Eco-Logical projects provided an avenue for recipients to reach out to partners and stakeholders in transportation and environmental planning. The collaboration can also yield success beyond the initial project. Four recipients noted that they were involved in additional projects with partners after the success of working together on Eco-Logical.

Although many recipients reported that relationships with partners improved through working on their Eco-Logical projects, they also reported on the challenges they faced when seeking to work with partners, as well as internal staffing issues. Finding 5 details the different aspects of these challenges.

> Finding 5: Recipients faced challenges working with their partners due to different missions, goals, and responsibilities; varying levels of support for Eco-Logical activities from Federal agency staff at the headquarters and regional levels; and staff turnover.

While 26 out of 28 recipients (93 percent) reported on improved and strengthened relationships with external stakeholders, 23 recipients (82 percent) reported on the challenges they faced when working with their partners.

Different Missions, Goals, and Responsibilities

Most of the Eco-Logical Grant Program funding recipients were State transportation departments and MPOs, so they had to coordinate projects with each other; with local governments; and with local, State, and Federal resource agencies, among others. Each recipient involved in infrastructure

---

[16]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[17]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[18]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

planning and projects had its own interests, mission, and goals, and the political reality is that one recipient's agenda did not always align with that of its partners.

The goal of Eco-Logical approach is to reduce the impacts of infrastructure projects and conserve or mitigate on a landscape scale. Recipients sometimes found challenges with getting local partners to consider impacts on a scale that extended beyond their jurisdiction. Recipients also reported challenges working with environmental and other resource agencies charged with issuing permits, as staff at these agencies do not typically focus on planning, on a larger scale or on a longer timeframe. The following quotes highlight challenges recipients faced working with their stakeholders, based on the different missions and responsibilities of all the organizations:

> *"….Local jurisdictions are very resistant to green concepts, mostly because jurisdictions are willing to trade some negative environmental impacts for the sake of growth. Our area saw some really bad recessions and are sensitive to economic challenges."*[19]

> *"The single largest challenge has been overcoming entrenched political opposition to transportation projects. We discovered that no amount of planning and outreach can overcome political obstacles, especially when dealing with multiple jurisdiction[s] with very different approaches and visions of transportation systems."*[20]

The Eco-Logical approach targets State transportation departments and MPOs, which are responsible for considering the impacts of projects on a State or regional level. State transportation departments and MPOs can influence what happens at the local level and encourage municipalities to think beyond their boundaries, but, ultimately, they cannot control what happens in on-the-ground implementation. This gap between the planning and project development and local level implementation is inherent to the transportation planning process in general. There are challenges that extend beyond the implementation of the Eco-Logical approach.

Varying Levels of Support for Eco-Logical Activities

A total of 13 out of 28 recipients reported challenges with varying levels of support for their Eco-Logical activities from headquarters-level staff at FHWA and other signatory agencies, such as the USEPA and FWS, compared with division- or regional-level staff from those same agencies. Headquarters-level staff from FHWA and other signatory agencies strongly support the Eco-Logical approach, are knowledgeable of the approach, and want to promote it. However, some recipients reported that the support for the Eco-Logical approach did not always trickle down effectively to the division- or regional-level staff. Division- and regional-level staff are charged with many duties, and they may be more focused on legal requirements and the specific responsibilities of their jobs than supporting award projects. The following quotes illustrate these points:

---

[19]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[20]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

> *"A disappointment with FHWA is that their comments are almost all about technical NEPA [National Environmental Policy Act] side of things; [we'd] like to see more involvement on the bigger picture planning side. FHWA Division office seems more concerned with making sure this stands up in court rather than "real planning work." Even the Division Planners are primarily involved in environmental document review."[21]*

> *"The high workload of [resource agency] staff also prevents the agency from working on the ...programmatic agreement; [resource agency's] participation in bi-weekly meetings with [State transportation department] has been limited; [State transportation department] is frustrated by the delays in working with [resource agency]."[22]*

Additionally, some resource agencies may encourage a landscape-scale approach for conservation and mitigation but do not necessarily call it "Eco-Logical." Such resource agency initiatives accomplish the same goals as the Eco-Logical approach but use different branding, which could affect awareness of similarities among programs.

Staff Turnover

In addition to the challenges working with external stakeholders described above, 12 out of 28 recipients (43 percent) reported that staff turnover posed a challenge to implementing the Eco-Logical approach. Some of the recipients reported that one person or just a few people at their agency implemented the award project. If that person or those people left, the knowledge and determination for implementing the approach would also leave. The following quotes illustrate these points:

> *"The success of the Eco-Logical process depends on the personality and mentality of the champion. Someone must really believe in it and dedicate themselves to its success. It cannot be mandated or rely on data alone."[23]*

> *"It has taken so much time and if I wasn't doing this, there would be nobody else who would do it. How to institutionalize it- what if I left? How would the work continue?"[24]*

> *"There was a lot of staff turnover at [multiple agencies] after Eco-Logical was completed; So people that were champions retired or moved on, and there wasn't anyone that was sufficiently energized about this process to promote it."[25]*

---

[21]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[22]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[23]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[24]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[25]Other Organization Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in May 2016.

Recipients noted that staff turnover, coupled with the issue that there is no legal or funding mandate for the Eco-Logical approach, can make it difficult for recipients and their partners to continue dedicating resources to updating the REF data and making progress in the Eco-Logical approach.

Nearly all of the recipients who reported experiencing benefits to relationships with external stakeholders also reported challenges when working with partners. Findings 4 and 5 highlight the complexities of relationships within and between different agencies but also the complexities inherent in the transportation and environmental planning processes. While recipients reported that a main benefit of the Eco-Logical approach is that it provides a process and framework for partners and stakeholders to work through together, the different missions and goals of agencies involved in the transportation planning process may include political realities that cannot automatically be resolved through the planning and collaboration that the Eco-Logical approach promotes.

Some recipients shared suggestions for their peers who want to overcome challenges described in finding 5, which is indicative of the motivation to achieve this aspect of the Eco-Logical approach. These suggestions include the following:

- Have early and regular coordination with the right stakeholders impacted by the data, analyses, and decisions.

- Be transparent about goals and expectations.

- Recognize that partners are busy and try to make coordination easy and worthwhile for them.

- Make decisionmakers understand the trade-offs among options.

Challenges with Data Acquisition, Use, and Updates

> Finding 6: Although agencies faced challenges in data acquisition, sensitivity, and compatibility as well as in keeping data current, data sharing led to increased availability and use of data that were previously not accessible to other agencies.

Several recipients found it challenging and time consuming to get data from other agencies. Some agencies were hesitant to share sensitive material or data that were not already publicly available. One recipient shared that a partner agency was concerned about compromising data subjects (e.g., threatened or endangered species) if the location of a sensitive habitat could be located because of the scale of data being shared. It was a challenge to find a level of detail at which partner agencies felt comfortable sharing data that still provided sufficient detail to inform transportation planning. If transportation agencies could not acquire data in planning, they had to base early decisions on limited information that was not conducive to early mitigation and early consultation. Some recipients noted it was helpful to build understanding among the agencies on how each agency would benefit from sharing and how each agency would use the data.

Some recipients also faced challenges with data use and compatibility. Even within an agency, during the beginning stage of developing an REF, staff first needed to define the purpose of the data and how they would be used. This helped determine the kind of data the agency needed. For

example, one recipient explained that understanding how the data would be used and by whom helped determine which data layers were necessary and at what level of detail. Compatibility between datasets also posed a challenge for some agencies both legally and technologically. For example, it was difficult to merge differently formatted State and regional data. It was also difficult to put data into a user-friendly format. This particularly applied to online tools where a user outside the agency would want to easily navigate and draw upon the dataset effectively in their own projects.

The most common challenge that recipients encountered with data (mentioned seven times) was keeping them current. Maintaining data costs time and money. Three recipients explained that they would only be able to update their data on an ongoing basis with additional funding and staffing. This implies that the data effort from their projects was possibly a one-time exercise. One recipient related that the region was experiencing a rise in development and, consequently, habitat loss. Unless the data were updated continuously, they would no longer reflect current environmental conditions with any accuracy. The following quotes illustrate this point:

> *"The ongoing challenge is to keep all data current. The new wildlife data will be difficult to maintain. In the future, [we] will need funding (and staffing) to keep data current unless [we] can develop a change detection process."*[26]

> *"On the data end, realized [we] will have a great data set, but if [we] look long term, [we] need to figure out a way to calculate the REAP [Regional Ecological Assessment Protocol] on the fly, so [we] don't have to have a major calculation event every year."*[27]

> *"The time lag between the planning phase and implementation of NEPA document creates a challenge because data changes a lot in 20 years."*[28]

> *"Another challenge is to keep the data and application tool up to date so the tool and application can grow with this data. The project team tried to build in some mechanisms to update the data. With the pace of technology change, this might be a challenge."*[29]

Benefits of Data Sharing

Despite the challenges surrounding data, recipients reported several benefits of data sharing. Their Eco-Logical projects helped them acquire data that had not previously been available publicly and to layer it with other data for more comprehensive mapping tools and REFs. A couple of recipients

---

[26]Other Organization Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in May 2016.

[27]Other Organization Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in May 2016.

[28]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

[29]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

created new online databases to share with the public and other agencies who might benefit from accessing and using the data.[55–57]

Data sharing allowed recipients and their partners to use data for more informed decisionmaking, as described in finding 7. One recipient reported that data sharing spawned communication between other partners for potential additional data sharing opportunities. Prior to the award to a State transportation department, a resource agency had been collecting data on highway culverts but had neither entered the data into a statewide database, nor had a system in place to share the data with the State transportation department. After the Eco-Logical collaboration, the two agencies were able to share data with one another. The following quotes illustrate this point:

> *"The methodology developed by [our agency] with its ranking system, data elements, etc. did a good job of putting weighed values on the ecosystem present in all the different areas of the region. This is the greatest value out of the Eco-Logical grant project. [Our] Eco-Logical ranking system used a raster system to get a greater level of detail, which made the product stronger than the approach previously used in the green infrastructure study."[30]*

> *"All this data is being put into Google Maps, so we'll have a database that people can …click on the project and look at what the different types of impacts are. And based upon those impacts, we're hoping to prioritize areas both on-site… and offsite, what are areas outside of the traditional transportation project where we want to look at mitigation."[31]*

> *"As far as we're aware, this is the first time that there's been a comprehensive regional view mapping project. In terms of taking all these different datasets and combining them, and making it available on our website and available to people…Conservation agencies will be able to use it for their own work."[32]*

> Finding 7: The Eco-Logical approach led to improved integrated planning between environment, transportation, and land use. Additionally, many recipients have incorporated the Eco-Logical approach into their LRTPs and project prioritization processes.

The earlier and more integrated planning reported by recipients relates directly to the evaluation finding on external stakeholders. Working with a range of diverse stakeholders is an early step in the Eco-Logical process and is what led to greater integration between environmental, transportation, and land use planning. Many recipients found value in cross-disciplinary collaboration occurring early in planning through identifying shared goals, data, and plans. In some cases, that integration between disciplines did not happen previously. Oregon State University's (OSU) Eco-Logical grant

---

[30]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

[31]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in March 2016.

[32]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

project is an example of integrated environmental and transportation planning.[58] As part of the project, the university worked with all three of Oregon's MPOs to develop an integrated ecological and transportation plan, which grew into a large plan called Intertwine.[59]

Some recipients stated that their Eco-Logical work had informed their project prioritization process. One recipient explained that the Eco-Logical approach was being used as one of many performance measures, or lenses, that they could use to review and analyze a project. Project prioritization was affected in ways such as an MPO changing their evaluation criteria to include scoring for environmental considerations. One MPO recipient explained that it used the REF to analyze and review projects and to quantify potential environmental aspects. While recipients did not always directly attribute project prioritization to impacts, early identification of issues allowed for the avoidance and minimization of environmental impacts, which could improve environmental mitigation and yield time and cost savings later in project development (see findings 8 and 9 for more information on impacts).

Nine agencies explicitly mentioned that they used the Eco-Logical approach as part of their LRTP process. This means that the work done under the award helped them to integrate environmental considerations into their thinking about the future of their region. It also ensured continued earlier coordination since the Eco-Logical approach was being incorporated years in advance of actual project implementation. One recipient remarked that the strongest benefit of Eco-Logical approach had been the ability to adopt an action plan that raised the profile of environmental considerations in planning work earlier in the process. Additional quotes about the benefits of the Eco-Logical approach from recipients are as follows:

> *"[The award] brought the Eco-Logical approach to the forefront of [the] planning process; Eco-Logical principles are being directly incorporated into the MTP process."[33]*

> *"Eco-Logical has become a foundation for reviewing projects for the TIP, STIP and LRTP."[34]*

> *"The Eco-Logical approach has now been adopted by the policy board and is a part of the long range planning structure. It will provide for similar collaboration in the future. We have a real rationale to spend meaningful time on this now."[35]*

Despite these successes at the regional planning level, several MPO recipients remarked on their lack of authority when it came to ecosystem-level decisions made at the local project-level scale. This relates to finding 5 on the challenges in thinking beyond an agency's jurisdictional boundaries and the handoff between planning and project implementation. Even if an MPO uses the Eco-Logical approach for region-wide planning, municipalities are not required to align their goals or use Eco-Logical data at the project level. Since regional planning agencies do not have the authority beyond planning, they depend on their local authorities to take on data, analyses, or decisions identified in

---

[33]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April, 2016.

[34]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April, 2016.

[35]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

planning and carry it into project implementation. One MPO recipient explained that its role is to pass along data and awareness but not to implement, and several other MPOs remarked on their lack of authority for land use planning. This dependence on municipalities and counties to take on the Eco-Logical approach for implementation is an

inherent challenge related to the roles and jurisdictions of different agencies. The following quotes illustrate the challenges:

> *"Only other challenge is a lack of teeth that [our MPO] has for enforcement. In terms of implementing and trying to get jurisdictions to do these more progressive things, in [State], there is little ability for a regional planning commission to require those sorts of things. Ultimately you have to come back to education and outreach and push that as hard as you can."[36]*

> *"On moving from planning to implementation—our responsibilities are limited and [we] can't do land use planning—need to rely on local partners to take on an implementation role and use the REF data in their decisions."[37]*

3.3 Impacts

Evaluation Question 3: How have the Eco-Logical Program and approach contributed to improved project delivery processes and environmental mitigation?

The third evaluation question examines the planning process, project delivery, and environmental impacts reported by recipients while implementing their Eco-Logical projects. The Eco-Logical projects reviewed typically spanned 2–3 yr. Given the long time scale of transportation and infrastructure projects, the evaluation team found that, overall, there was little reporting on impacts (whether qualitative or quantitative time and cost savings) associated with the planning process and project delivery or improved environmental mitigation. Recipients were not required to track any cost, time, or environmental impacts as part of their Eco-Logical funding (although the SHRP2 IAP funding recipients used performance measures related to their projects), and

the Eco-Logical funding did not necessarily provide resources to track these items. While few impacts were reported, some recipients did note that having examples of the time, cost, and environmental improvements that the Eco-Logical approach may afford would be useful in furthering adoption and implementation of the approach.

The evaluation team's review of notes from past interviews with recipients for annual reports and more recent interviews conducted by the evaluation team in 2016 resulted in a few key findings for evaluation question 3. Overall, the evaluation team found that reporting on project delivery process improvements and environmental mitigation was limited and that of the agencies that did report any impacts, they were mostly qualitative in nature.

---

[36]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.
[37]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

> Finding 8: Recipients reported few comments on quantifying and tracking changes in project delivery processes and environmental mitigation as part of their projects.

The evaluation team coded 31 out of 767 comments (4 percent) as process impacts or environmental impacts. The process impacts category includes comments that indicate time or cost savings in the project delivery process, while the environmental impacts category includes comments that discuss avoiding or minimizing environmental impacts of development through integrated planning or comments that identify that agencies took steps to rectify, reduce, or compensate for environmental impacts if they could not be avoided.

The 31 environmental impacts and process impacts comments (29 benefits and 2 challenges) are attributed to 14 out of the 28 recipients. Table 6 shows the agencies that reported benefits and challenges in this area as categorized by the evaluation team. Overall, 8 comments are from 2007 Eco-Logical Grant Program recipients, 17 are from SHRP2 IAP lead adopters, and 6 are from the SHRP2 IAP user incentive recipients.

Table 6. Number of comments from recipient agencies by type of impact.

Agency Type	Agency Name	Number of Comments on Environmental Impacts	Number of Comments on Process Impacts
MPO	Charlottesville-Albemarle MPO (CA-MPO)	2	4
MPO	Mid-America Regional Council (MARC)	1	0
MPO	NCTCOG	2	1
MPO	OKICOG	1	1
MPO	Pikes Peak Area Council of Governments (PPACOG)	2	0
MPO	Southern California Association of Governments (SCAG)	2	0
MPO	Thomas Jefferson Planning District Commission (TJPDC)	0	1
State transportation department	California Department of Transportation (Caltrans)	0	1
State transportation department	Colorado Department of Transportation (CDOT)	0	2
State transportation department	MaineDOT	0	3
State transportation department	MDOT	1	2
State transportation department	Missouri Department of Transportation (MoDOT)	0	1
Other	Envision Utah	2	0
Other	USEPA	2	0
Total	—	15	16

—Not applicable.

The Eco-Logical Grant Program recipients may have reported few overall comments related to process impacts and environmental impacts due to the following reasons:

- Agencies may have not have been implementing the Eco-Logical approach for long enough to determine environmental or process impacts from using this approach.

- It may be difficult for agencies to determine if any observed process or environmental impacts are due to the Eco-Logical approach specifically or general state-of-the-practice shifts.

- The interviews and peer exchanges that the Eco-Logical Program held with recipients over the years were not as focused on this topic as much as the actual implementation of the Eco-Logical steps such as partnering, gathering data, and creating an REF.

- In general, tracking cost/time savings in an agency as well as tracking improvements in environmental outcomes is challenging. Additionally, it may not have been in a recipient's

scope of responsibilities to track and quantify such environmental outcomes (e.g., for some MPOs and 2007 grantees such as universities, environmental non-profits).

Trends in Reported Environmental Impacts

Finding 9: Recipients reporting on project delivery and environmental mitigation impacts largely reported qualitative and anecdotal impacts, with some agencies noting that impacts were difficult to quantify and document.

For the 9 out of 28 agencies that reported environmental impacts, the comments generally dealt with the REF or similar GIS tool and the benefits that these tools provided for the agencies and their partners. This finding is consistent with the evaluation team's inventory of the Eco-Logical steps, as it was found that the majority of agencies completed steps 1–4 of the Eco-Logical approach. Most agencies reported the following four qualitative benefits:

- The REF helps agencies map and prioritize the most ecologically sensitive areas and helps agencies and stakeholders understand the potential environmental impacts of a project (eight comments from recipients).

- The REF assists agencies in quantifying the acres of land that would be impacted by a project and provides information needed for the *National Environmental Policy Act* (NEPA) process (two comments from recipients).[60]

- The REF helps agencies evaluate the distribution of mitigation sites and can assist agencies in focusing mitigation in concentrated areas instead of over disconnected sites (one comment from a recipient).

- The REF can be used in analyzing potential growth scenarios to see the impacts on resources and ecologically sensitive areas (one comment from a recipient).

The evaluation team also identified two quantitative comments related to environmental mitigation. One MPO directly attributed the Eco-Logical approach to avoiding impacts at a planning level through projected preservation of greenfield lands, which improved environmental mitigation. Another MPO developed a decision-support tool to quantify environmental mitigation and encourage avoiding and minimizing impacts at a planning level. Comments are as follows:

> *"The land use strategies in the [regional transportation plan], which were informed by the work completed with Implementing Eco-Logical, is expected to avoid growth on 36 square miles of greenfield lands (23 percent savings from baseline)…The Implementing Eco-Logical work created the technical foundation for [our MPO] to develop its first Natural/Farm Lands Appendix to accompany the [plan]."[38]*

---

[38]Eco-Logical Deployer; FHWA Eco-Logical Annual Report Team, phone interviews conducted 2008–2015.

> *"We introduced a new grant criterion that was derived from the ecosystem framework for all transportation projects from all funding sources; on the environmental side, [projects] get points for looking at the environmental map, and get points for doing avoidance, conserving, etc. We just finished scoring 100 projects, and …half embraced the criterion and are using it."[39]*

While most of the comments in this area discuss the environmental benefits associated with the Eco-Logical approach, a challenge was also noted that likely applies to other agencies. Although one agency was able to track the growth that was avoided on Greenfield land, other agencies may find the concept of avoidance difficult to track. Two of the 2013 recipients noted at the 2015 peer exchange that it was difficult to track environmental damage avoided by using the Eco-Logical approach because it was difficult to track what did not occur. The agencies' representatives noted that they were not required to track what did not happen, and without additional funding or a mandate, this was not something that they have time to do.

Trends in Reported Process Impacts

For the nine agencies that reported process impacts, the comments generally dealt with how the Eco-Logical approach assisted them in improving the planning or project delivery process through activities such as centralizing data or encouraging stakeholders to communicate more often throughout the planning process. While most of the benefits are qualitative, some agencies noted that savings of staff time can be translated to cost savings in terms of reduced labor costs. The qualitative benefits reported by recipients include the following four:

- The REF reduces time spent gathering environmental data by centralizing it in one place. For some agencies, this included streamlining data collection needed for the NEPA documentation process (six comments from recipients).[60]

- The Eco-Logical approach and associated tools can help improve the quality of projects that are selected for implementation, and this can result in reduced labor costs through reducing the likelihood of making costly changes later in the project process (six comments from recipients).

- The partnerships that the Eco-Logical approach fosters, and the associated tools, can result in time savings on projects through encouraging collaboration and addressing concerns early in the planning process. When concerns are addressed early in the planning process, this can help reduce having to make more timely and costly changes to a project later in the process (seven comments from recipients).

- The Eco-Logical approach and REF help validate certain project decisions and assist in communicating to staff and partners why the decisions are made (three comments from recipients).

---

[39]MPO Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas in April 2016.

Additionally, the evaluation team noted one quantitative process impact reported by a State transportation department as follows:

> *"With improvements made to the…website tool through the…User Incentive [award], users can now do a preliminary screen for sensitive resource or species areas in five minutes, where it would take the…environmental coordinator 30 days due to the volume of applications. If the preliminary screen does not result in any known concerns, the applicant has completed [state resource agency's] review process."*[40]

The comment discusses the time savings achieved through using an online screening tool developed with SHRP2 IAP user incentive funding. The preliminary environmental resources screen can save up to 30 days in reviews per project as well as substantial labor time savings.

---

[40]State Transportation Department Employee; phone interview conducted by evaluation team members Heather Hannon and Jessica Baas In April 2016.

4. Recommendations

The findings provided in chapter 3 highlight the successes and challenges that the recipients experienced while implementing their Eco-Logical projects. While recipients found success in using the Eco-Logical approach in planning, few pursued the subsequent steps of the approach, and few recipients identified or quantified impacts related to project delivery or environmental mitigation.

Based on these findings, as well as input from recipients (see section 2.3, Evaluation Methodology), the evaluation team developed recommendations pertaining to each evaluation question. The purpose of the recommendations is to help FHWA target its efforts and resources for future support of agencies in their adoption of the Eco-Logical approach.

> Recommendation 1: Provide additional support in the form of peer exchanges, webinars, and case studies on the Eco-Logical approach.

Recipients noted that over their years of involvement with the Eco-Logical Program, additional support and resources in targeted subject areas would be helpful in implementing the Eco-Logical approach. Recipients noted that resources to support activities on the following three topics would be beneficial:

- Quantifying the impacts of the Eco-Logical approach.

- Overcoming challenges in implementing the Eco-Logical approach.

- Learning more from agencies that have formalized the Eco-Logical approach or REF into their transportation planning process.

Recipients also reported that it was useful to hear about and learn from the experiences of peer agencies when FHWA or other agencies held peer events. Other agencies interested in adopting the Eco-Logical approach would also likely benefit from similar exchanges with peers. FHWA already coordinates a champions group to highlight and track agencies implementing a landscape-scale approach and can draw upon this group to help leverage the benefits of learning about the Eco-Logical approach from their peers.[34] Practitioners promoting the Eco-Logical approach, alongside FHWA, help increase the legitimacy of the on-the-ground implementation of the approach.

FHWA holds regular webinars, produces quarterly newsletters, hosts peer exchanges, and produces case studies on the Eco-Logical approach. (See references 11, 61, 35, 12, and 47–49.) The evaluation confirms that these materials are useful, that agencies are interested in more technical assistance, and that perhaps FHWA should ensure its outreach strategies make practitioners aware of the resources that are already available.

> **Recommendation 2: Dedicate additional resources to the later project implementation steps (steps 5–9) of the Eco-Logical approach.**

Most recipients have completed steps 1–4 of the Eco-Logical approach, as described in finding 3. However, few recipients have completed steps 5–9. The evaluation team recommends that it would be useful to devote more resources and assistance to the later steps of the Eco-Logical approach, which are more focused on the implementation of transportation projects. Transportation planning and project development processes occur over long time scales, and as the Eco-Logical Program reaches beyond its 10th yr, more agencies may have the desire to take on the later steps of the approach.

> **Recommendation 3: Identify additional opportunities to engage regional-level staff about the Eco-Logical Program to build awareness within signatory agencies and to ensure consistent information is provided to stakeholders about the program and approach.**

As described in finding 5, recipients commented over the years that they faced challenges working with regional-level staff from FHWA division offices and regional resource agencies such as USEPA, USACE, and other local organizations. The challenges were related to staff at the regional levels not fully buying into or being aware of the Eco-Logical approach or being unable to provide the level of assistance that the recipients requested due to heavy workloads. Recipients noted that the Eco-Logical approach is a priority for headquarters staff but that this does not necessarily trickle down to staff at the regional level. Regional staff have many responsibilities and may not have time to provide support for the Eco-Logical approach on top of all of their other responsibilities, particularly because there is no legal or funding requirement for the Eco-Logical approach.

Going forward, the evaluation team recommends that FHWA should consider additional opportunities to engage regional-level staff in their program activities. Regional-level staff may provide valuable insight into the process of adopting this approach and may also help in facilitating relationships among these agencies. In addition, it would be helpful to build awareness about different agencies' programs that have similar goals in order to address the issue of program branding and help agencies identify common ground.

> **Recommendation 4: Investigate the challenges to obtaining buy-in for the Eco-Logical approach from local level agencies that implement projects and share effective practices in overcoming these challenges.**

As noted in findings 5 and 6, recipients reported on the challenges they faced with getting buy-in for the Eco-Logical approach from local level agencies. MPOs and State transportation departments are responsible for considering the impacts of transportation at a regional level, and it is logical that FHWA targets agencies at this level for adopting the Eco-Logical approach. In order to help boost the success of the approach in project implementation, however, it may be beneficial to engage local municipalities to help them consider the impacts of their projects beyond their jurisdictional boundaries. FHWA could also provide technical resources to MPOs and State transportation

departments to help them overcome the challenges they face when working with their local stakeholders and document effective practices to share nationwide.

> **Recommendation 5: Further support agencies in adopting quantifiable performance measures and tracking progress over time in order to justify the benefits of the Eco-Logical approach and advance its adoption.**

As noted in findings 8 and 9, there were few quantitative environmental or process impacts reported by recipient agencies. This is partly due to agencies being in the early stages of implementing Eco-Logical. While the program is 10 yr old, the transportation planning and project delivery processes can last decades for a project to move from concept to construction. On-the-ground implementation of the approach gained momentum through the 2007 grants and 2013 SHRP2 IAP funding. The SHRP2 IAP funneled more resources into the program, and FHWA put more of an emphasis on having agencies track environmental and process impacts of the Eco-Logical Grant Program funding, which is evident in the evolution of the annual reports. (See references 13, 15, 19, 23, 34, and 45.)

While it is clear FHWA has put more effort into developing performance measures over the years, recipients still noted that it would be beneficial to have case studies or examples of the cost and time savings as well as environmental benefits that agencies have observed through adopting the Eco-Logical approach. Quantified evidence of the benefits of using a landscape-scale approach would be useful in getting more buy-in from MPOs, State transportation departments, and their partners. In addition, as performance-based planning is becoming a standard practice, it is important for agencies to quantify their progress and justify the value of implementing the Eco-Logical approach.

In 2016, FHWA began developing a business case for the Eco-Logical approach based on the experience of one of the recipient agencies.[34] The business case will help address the need expressed by agencies for studies on the cost effectiveness or economic value of the Eco-Logical approach. The business case, coupled with more case studies or examples of performance measures and metrics to track, will help make a stronger case for adopting Eco-Logical.

> **Recommendation 6: Use a set of consistent questions or tracking methods to evaluate the progress of recipient agencies from year to year to ensure that overall progress on the Eco-Logical approach can be measured objectively long term.**

FHWA gathers information from recipients through annual interviews, which serve the purpose of tracking each recipient's progress toward implementing their projects and also characterizing the state of the practice of the Eco-Logical approach. The evaluation team used the wealth of information in the interview notes as source data for the evaluation to identify trends, benefits, and challenges faced by the recipients as they implemented their projects (see appendix C for annual report interview guides).

While the interview questions used by FHWA each year are generally similar, the evaluation team found it difficult to analyze trends over time because the question format and emphasis changed slightly from year to year. The interview questions evolved through the years as the themes and

topics of the annual reports changed, which is a logical outcome as the program matures and recipients are farther along in their implementation of the Eco-Logical approach. (See references 13, 15, 19, 25, 34, and 45.) However, from the standpoint of long-term evaluation, it was challenging to assess trends over time because the questions changed or the format of the interview was more freeform rather than structured.

Recognizing these issues, the evaluation team recommends ensuring there is a subset of consistent questions or measures that FHWA asks recipients, or other Eco-Logical adopters, each year to enable tracking of trends over time. This may include a balanced approach of offering open-ended questions to gather detail and insight on progress and questions that have discrete answers (i.e., yes/no), which are easier to analyze. As an alternative to directly asking interview participants the same questions, the program could develop a survey for interviewers to evaluate each interview in a consistent way. Consistent tracking and analysis of trends could be a benefit to FHWA in communicating the value of Eco-Logical to agencies interested in adopting the Eco-Logical approach.

5. Conclusions

FHWA's intention for providing grants in 2007 was to incentivize practitioners to put the principles defined in the 2006 guidebook into practice.[3] FHWA recognized the value of demonstrating its commitment to the approach by providing funding and technical assistance to its stakeholders and encouraging practitioners to share results with their peers.

The purpose of SHRP2 implementation assistance in 2013 was to further operationalize the Eco-Logical approach through additional resources to lead adopters and early users of the approach. SHRP2 also allowed FHWA and its partners to further define and provide more technical assistance to Eco-Logical users.

Evidence from the Eco-Logical Grant Program funding recipients indicates that the FHWA Eco-Logical Program and approach have contributed to improved project delivery processes and environmental mitigation. FHWA research and funding have enabled recipients to adopt the Eco-Logical approach sooner and more comprehensively. In some instances, the agencies' Eco-Logical projects positioned them to attract additional funding from other sources. Agencies are building relationships with partners, sharing and using data in better ways, and using information gathered to inform project prioritization and to develop integrated transportation plans. Most agencies pursued the earlier steps of the Eco-Logical approach, which are more focused on planning rather than project development.

Recipients also experienced common challenges as they sought to implement the Eco-Logical approach. While agencies found success in using the Eco-Logical approach in planning, few recipients pursued the later steps of the approach, and few recipients identified or quantified impacts related to project delivery or environmental mitigation. Possible reasons include the following:

- **Timeframes for planning and project development**: While the program is 10 yr old, the transportation planning and project delivery processes can last decades for a project to move from concept to construction. It will require more time for the 2007 and 2013 recipients to see the on-the-ground impacts of decisions made during the planning process.

- **Agency missions, goals, and responsibilities**: The Eco-Logical Program targets outreach and assistance to State transportation departments and MPOs in coordination with resource agencies. However, there is a gap between the planning conducted by these agencies and local agency project-level implementation, where some Eco-Logical recipients do not have jurisdiction over land use planning or transportation project delivery and cannot track results of other agencies' actions.

- **Diverse metrics and uses**: State transportation departments and MPOs may not be collecting baseline data or information on time/cost savings or environmental benefits likely because they are not required to collect data and lack the necessary resources and guidance. If they do measure, they may have different metrics or different uses for metrics than FHWA due to

different roles and goals. For example, a planning agency will not have information on project development timeframes.

In order to address these challenges, the evaluation team recommends that FHWA continue to provide technical assistance to its stakeholders and focus that assistance on specific topics such as how to quantify impacts and how to apply the Eco-Logical approach in project development. FHWA should consider opportunities to engage regional level staff within FHWA and partner agencies and to direct some technical assistance to building awareness with local agencies that implement projects. FHWA should further support agencies in adopting performance measures and tracking progress to quantify time, cost, and environmental benefits. Finally, FHWA should consider using a consistent set of questions or measures to evaluate the progress of recipient agencies each year in order to measure overall progress of the approach in the long term.

Appendix A. Eco-Logical Recipients

The following table lists the Eco-Logical grant recipients, the performance period, amount of funding received, and project descriptions.

Table 7. 2007 Eco-Logical Program MPO grant recipients and project information.

Grant Recipient	Performance Period	Funding	Project Description
Capital Area Council of Governments (CAPCOG)	3/2008– 5/2010	$113,882	CAPCOG created a "greenprint" for the central Texas region to help planners and transportation agencies plan for future growth. With input from regional and local stakeholder groups, CAPCOG's Greenprint for Growth plan prioritized the protection of water quality, ecological resources, farm and ranch lands, recreational and cultural resources, and scenic corridors.[62,63]
Houston-Galveston Area Council (H-GAC)	3/2008– 6/2010	$100,000	H-GAC created a GIS-based product to identify environmental resource priority areas and allow transportation planners to consider environmental impacts in the project prioritization process. Since completing the project, H-GAC developed several mechanisms to promote local government and NGO use of the tool within the region, including a brochure for local governments, an interactive website, and a smartphone application.[64,55,65]
Land-of-Sky Regional Council (LOSRC)	3/2008– 3/2010	$104,000	LOSRC developed a green infrastructure framework to identify priority ecological resources and areas suited for future development in a four-county region of Western North Carolina. LOSRC created several publicly available resource maps and datasets that addressed water quality, agricultural suitability, wildlife habitat, and biodiversity.[56] The agency used the data in resource assessments that were incorporated into its LRTP and developed possible future scenarios related to economic growth and land development patterns.[56,66]
MARC	3/2008– 3/2010	$90,000	MARC developed an action plan with the goals of formalizing collaboration with regional partners, creating a regional mitigation strategy, and aligning transportation decisionmaking with a regional sustainability vision, which was later integrated into its 2040 LRTP for the Greater Kansas City region.[3] MARC revised project selection criteria for the agency's planning and programming processes to include environmental considerations.[67]

Grant Recipient	Performance Period	Funding	Project Description
NCTCOG	5/2008–6/2011	$188,750	NCTCOG developed an REF to help agencies assess environmental impacts of proposed infrastructure projects and to enhance multi-agency understanding of critical resource protection areas. NCTCOG analyzed and aggregated GIS data developed by USEPA Region 6's Eco-Logical grant project to the sub-watershed level for the entire metropolitan planning area.[68] As a result of the data and analysis capabilities in the REF, NCTCOG was able to devote a chapter of its 2011 Metropolitan Transportation Plan to environmental considerations.[69] The products of NCTCOG's grant project supported the agency's IAP Lead Adopter project, through which the agency updated and applied the REF.[34,70]
TJPDC	5/2008–5/2011	$77,833	TJPDC developed a green infrastructure plan that integrated transportation, development, and natural resource plans in the five-county planning district.[71] TJPDC developed two GIS-based methodologies to help transportation planners prioritize mitigation projects for streams and wetlands.[72] TJPDC also created a Least Environmental Cost Analysis framework to use in developing alternatives in construction projects. CA-MPO, which is located within TJPDC, used data from the framework to establish a weighted ranking system for evaluating the impacts of the proposed project alternatives on ecosystem and recreation resources connected to the Rivanna River watershed as part of its IAP Lead Adopter project.[73,74]
Tri-County Regional Planning Commission (TCRPC)	4/2008–4/2010	$109,447	TCRPC developed strategies for improving the sustainability of the transportation system with respect to ecosystems in the Peoria, IL, region. The strategies included regional priorities for land use and infrastructure development, policy concepts, GIS-based scenario planning models, and technical implementation focused on five themes: agricultural preservation, balanced growth, economic development, environmental stewardship, and transportation infrastructure. TCRPC's grant project helped it move forward in establishing a collaborative culture across jurisdictions and disciplines and involving a broader range of stakeholders in the planning process.[75]

Table 8. 2007 Eco-Logical Program State transportation department grant recipient and project information.

Grant Recipient	Performance Period	Funding	Project Description
CDOT	5/2008–9/2011	$152,500	CDOT collaborated with a group of partner agencies to draft a Programmatic Environmental Impact Statement (EIS) to cover projects in the I-70 corridor and established a memorandum of understanding (MOU) for A Landscape Level Inventory of Valued Ecosystem Components (ALIVE), which is a CDOT-led interagency program to promote environmental streamlining in the I-70 corridor.[76] CDOT and its partners also created an REF matrix for the corridor that incorporated wildlife habitat and crossing data into a GIS database to help CDOT implement mitigation projects along the corridor.[77]

Table 9. 2007 Eco-Logical Program other agency grant recipients and project information.

Grant Recipient	Performance Period	Funding	Project Description
Chicago Department of Transportation	8/2008–11/2010	$73,313	The Chicago Department of Transportation Eco-Logical Grant Program project supported outreach and education activities related to the agency's construction of a sustainable streetscape pilot in the Pilsen neighborhood of Chicago, IL, using Leadership in Energy and Environmental Design (LEED) principles and featuring sustainable elements such as stormwater catchments and solar-powered streetlights.[78] The project resulted in the creation of a sustainable design manual, a series of educational kiosks, and other products that inform regional governments and the public about the benefits of sustainable infrastructure investment.[79,80]
Envision Utah	6/2008–6/2009	$85,000	The project team, coordinated by the public-private partnership Envision Utah, produced the Blueprint Jordan River vision document to guide development and restoration along the Jordan River.[81] Envision Utah helped Salt Lake County establish the Jordan River Commission, which oversees implementation of the Blueprint's vision. Envision Utah has also integrated Eco-Logical principles into other projects, such as Wasatch Canyons Tomorrow, which addresses transportation challenges and environmental impacts unique to the canyons of the Wasatch Mountains.[82]
New Hampshire Audubon (NHA)	9/2008–4/2010	$24,464	NHA developed a GIS-based wildlife connectivity framework to integrate transportation and land-use planning by evaluating the impact of transportation projects on wildlife species. NHA and the New Hampshire Fish and Game Department convened an interagency working group that developed an impact assessment framework that rated the resistance for 16 wildlife species by measuring how natural and unnatural barriers impacted the species' abilities to move across the landscape. MPOs and Regional Planning Associations can use this framework for environmental screening of transportation projects before they submit their projects to the New Hampshire Department of Transportation (NHDOT).[83]
North Carolina Department of Environment and Natural Resources (NCDENR)	4/2008–4/2010	$136,689	NCDENR identified high-priority, unfragmented wildlife habitats in North Carolina to help enhance the State Wildlife Action Plan and other conservation efforts.[84] The data developed during this project were included in the North Carolina Conservation Planning Tool (CPT), which is a statewide tool used by a variety of Government agencies, regional councils of governments, conservation organizations, and other partners to inform planning and decisionmaking for land use, conservation, watershed, parks and recreation, and transportation projects.[85,86]
OSU	6/2008–2/2010	$49,962	OSU used its Eco-Logical grant to identify Oregon's conservation priority areas and to consolidate disparate data from different regions of the State into an online REF tool. The REF helps agencies throughout the State plan conservation efforts associated with transportation projects. As a result of the project, the Oregon Department of Transportation and other State agencies have been working to integrate the Eco-Logical approach into streamlining communications and project reviews between environmental and transportation agencies.[58]

Grant Recipient	Performance Period	Funding	Project Description
Tioga County Soil and Water Conservation District (TCSWCD)	3/2008–12/2012	$112,490	TCSWCD worked with the FHWA New York Division Office and New York State Department of Transportation (NYSDOT) staff to develop an REF of the county's watersheds. The project team assisted in developing an in-lieu fee (ILF) program in the Upper Susquehanna River Basin. In 2012, TCSWCD completed the first version of an online mapping tool for its REF and drafted a report on the project, which details conservation opportunities for a range of keystone species within the Susquehanna Basin.[87] The report and the REF enable environmental planners at NYSDOT to consider habitats that may otherwise fall outside the scope of the transportation planning process. As a result of this project, transportation agencies such as NYSDOT can manage and fund one collective mitigation site for multiple transportation projects by purchasing credits for a transportation project and then selecting a high-priority mitigation site, as identified in the REF, to mitigate impacts from several different transportation projects.
USEPA Region 6	5/2008–4/2011	$100,000	USEPA Region 6 developed a Regional Ecological Assessment Protocol (REAP) that uses GIS analysis to classify land on the basis of its ecological significance. This project expanded upon the Texas Ecological Assessment Protocol, which collected and analyzed data for the State of Texas.[88] The REAP now includes all five States in Region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). All MPOs in those States have access to the REAP, and USEPA reports that planners have used the REAP to identify potential impacts of and mitigation for transportation projects in early planning.[88]

Table 10. 2013 SHRP2 IAP lead adopter recipients and project information.

2013 SHRP2 IAP Recipient	Performance Period	Funding	Project Description
ARC	6/2013–12/2015	$250,000	ARC developed and implemented an REF and created a strategic framework for the Proctor Creek Environmental District (PCED)—a key watershed in the Atlanta, GA, metropolitan area—to expand the types of ecological and economic data used for prioritizing new transportation projects.[5]
CA-MPO	6/2013–10/2015	$250,000	CA-MPO tested the application of an existing REF in transportation projects and conservation prioritization throughout its region in Virginia.[5]
NCTCOG	7/2013–12/2015	$224,000	NCTCOG updated its REF to build a priority sub-watershed map and identify focus areas for potential mitigation and enhancement. NCTCOG then applied the REF to a pilot corridor feasibility study and implemented a pilot regional shared mitigation program.[89,5]
PPACOG	6/2013–7/2015	$218,000	PPACG established an Integrated Regional Mitigation Plan to improve mitigation projects in the Pikes Peak area and apply it to project evaluation in its regional transportation plan.[5]

2013 SHRP2 IAP Recipient	Performance Period	Funding	Project Description
Idaho Transportation Department (ITD)	6/2013–3/2016	$250,000	ITD worked with the Idaho Department of Fish and Game (IDFG) to improve data delivery and data-sharing via the IPLAN portal.[90,5]
MaineDOT	6/2013–3/2016	$250,000	MaineDOT applied its REF to categorical exclusion (CE) projects, including gap analysis, procedural changes, preferred construction practices, and programmatic agreements.[5]
MDOT	6/2013–9/2015	$250,000	MDOT implemented the Integrated Ecosystem Framework steps in the I-75 corridor in the southeast Michigan/Lake Erie coastal zone.[5]

Table 11. 2013 SHRP IAP2 user incentives recipients and project information.

2013 SHRP2 IAP Recipient	Performance Period	Funding	Project Description
Association of Monterey Bay Area Governments (AMBAG)	6/2013–7/2014	$25,000	AMBAG gathered transportation and natural resource data and developed a new REF.[5]
OKICOG	6/2013–6/2014	$24,992	OKICOG integrated and mapped data from three State natural heritage databases with its regionally significant environmental resource data to inform the OKI Regional LRTP.[91,92,5]
SCAG	6/2013–1/2015	$25,000	SCAG developed a regional open space database and an assessment methodology to identify important areas for conservation.[57,5]
Caltrans	7/2013–12/2015	$25,000	Caltrans expanded its Highway 89 Stewardship Team to address animal/vehicle collisions through mentoring new groups and providing training and technical assistance.[5]
ITD	6/2013–3/2016	$25,000	ITD updated and revised a current MOU with IDFG to improve data delivery and data sharing.[93,5]
MoDOT	6/2013–9/2015	$25,000	MoDOT worked with the Missouri Department of Conservation (MDC) to identify and incorporate new information, technologies, and best management practices (BMPs) that will be used to update the Missouri Natural Heritage Review website to provide better applications for transportation planning and deliver enhanced benefits for natural resources.[94,5]
NHDOT	6/2013–6/2015	$24,997	NHDOT, in partnership with the New Hampshire Natural Heritage Bureau, implemented a pilot project to assess wetlands impacted by roadway projects using a standardized wetland assessment methodology called an Ecological Integrity Assessment (EIA) and comparing the EIA to its currently used wetland assessment method, the USACE Highway Methodology.[95,96,5]

Appendix B. Data Sources by Recipient

The following tables list the Eco-Logical grant recipients, the type of agency, and if they responded to the survey listed.

Table 12. 2007 Eco-Logical Program recipient data collected by the Eco-Logical Program staff and evaluation team.

Type of Agency	Agency	2008 Interview	2009 Interview	2010 Interview	2011 Interview	2012 Interview	2014 Interview	2014 Questionnaire	2015 Interview	2015 Peer Exchange	2016 Evaluation Interview
MPO	CAPCOG	X	X	X	—	X	—	—	—	—	—
MPO	H-GAC	X	X	X	—	X	—	X	—	—	X
MPO	LOSRC	X	X	X	—	X	—	X	—	—	X
MPO	MARC	X	X	X	—	X	—	X	—	—	X
MPO	NCTCOG	X	X	X	X	X	—	—	—	—	X
MPO	TJPDC	X	X	X	X	X	—	—	—	—	—
MPO	TCRPC	X	X	X	—	X	—	X	—	—	X
State transportation department	CDOT	X	X	X	X	X	—	—	—	—	X
Other	Chicago Department of Transportation	X	X	X	X	X	—	X	—	—	X
Other	Envision Utah	X	X	X	—	X	—	—	—	—	—
Other	NHA	X	X	X	—	X	—	X	—	—	—
Other	NCDENR	X	X	X	X	X	—	—	—	—	—
Other	OSU	X	X	X	X	X	—	X	—	—	X
Other	TCSWCD	X	X	X	X	X	—	X	—	—	X
Other	USEPA Region 6	X	X	X	X	X	—	X	—	—	X

—No data were collected.

X = data were collected.

Table 13. 2013 SHRP2 IAP recipient data collected by the Eco-Logical Program staff and evaluation team.

Type of Agency	Agency	2008 Interview	2009 Interview	2010 Interview	2011 Interview	2012 Interview	2014 Interview	2014 Questionnaire	2015 Interview	2 015 Peer Exchange	2016 Evaluation Interview
Lead adopter—MPO	ARC	—	—	—	—	—	X	—	X	X	X
Lead adopter—MPO	CA-MPO	—	—	—	—	—	X	—	X	X	X
Lead adopter—MPO	NCTCOG	—	—	—	—	—	X	—	X	X	X
Lead adopter—MPO	PPACOG	—	—	—	—	—	X	—	X	—	X
Lead adopter—State transportation department	ITD	—	—	—	—	—	X	—	X	—	X
Lead adopter—State transportation department	MaineDOT	—	—	—	—	—	X	—	X	X	X
Lead adopter—State transportation department	MDOT	—	—	—	—	—	X	—	X	X	X
User incentive—MPO	AMBAG	—	—	—	—	—	X	—	X	—	X
User incentive—MPO	OKICOG	—	—	—	—	—	X	—	X	X	X
User incentive—MPO	SCAG	—	—	—	—	—	X	—	X	—	—
User incentive—State transportation department	Caltrans	—	—	—	—	—	X	—	X	—	X
User incentive—State transportation department	ITD	—	—	—	—	—	X	—	X	—	X
User incentive—State transportation department	MoDOT	—	—	—	—	—	X	—	X	—	X
User incentive—State transportation department	NHDOT	—	—	—	—	—	X	—	X	—	—

—No data were collected.

X = data were collected.

Appendix C. Annual Report Interview Guides

This appendix lists questions asked verbatim from 2008 to 2015 by the Eco-Logical Program to recipients of Eco-Logical funding. The recipient type, year asked, and year reported are provided.

C.1. 2007 Grant Recipients

2007 Grant Recipients: 2008 Interview Guide (for 2008 Eco-Logical Annual Report)

Project:

- Please briefly describe your project if there have been any modifications to your grant application.

- How does your project meet the goals of Eco-Logical? In what way?

- What milestones have you achieved?

- What milestones would you like to achieve in the next six months?

- Are you facing any obstacles/challenges in implementing the grant?

- Are you facing any obstacles/achieving your milestones?

- What sort of feedback, if any, have you received from your stakeholders about your Eco-Logical Project?

- In what ways could you or FHWA market the lessons you have learned from your work on this project?

Contracting Process:

- One a scale of 1 to 5, please rate how easy the FHWA contracting process was, where 1 represents easy and 5 represents difficult.

- What could improve the contracting process? Are there any materials or knowledge that could have improved your experience?

Kick-off Call:

- One a scale of 1 to 5, please rate how useful the kick off call was, where 1 represents not useful and 5 represents very useful?

- What was most useful?

- What was least useful?

AOTR:

- Describe your working relationship with your AOTR?

- Since the start of your project, how many times have communicated with your AOTR? 0, 1–3, 4–7, more than 7.

- How could the working relationship with your AOTR be improved?

- In what areas would you appreciate more support, materials, and information?

Other Comments:

- Do you have any additional thoughts as to how the Eco-Logical grant program could be improved?

- Would you be interested in networking with other grantees? If yes, through what method?

2007 Grant Recipients: 2009 Interview Guide (for 2009 Eco-Logical Annual Report)

Project:

- Please briefly describe the status of your project.

- What milestones have you achieved?

- What milestones are planned in the next 6 months?

- What have been some of the initial outcomes of your grant project?

- Have any of the outcomes been unexpected?

- Has this grant helped you cultivate relationships with agencies or groups that you did not have any or positive relationships with before the grant? Who? How do you know?

Challenges:

- Please describe any challenges you have faced or are currently facing in implementing the Eco-Logical approach.

- If you have overcome any of these challenges, please describe how.

- Based on your experience, do you see broader challenges in implementing the Eco-Logical approach?

Future Work:

- After you complete your grant, will you continue work related to your project?

- Will you continue to use this work in the next steps in the transportation development process, including mitigation and environmental permitting?

- How do you see the work you have done during your grant project playing a role in the future works of your organization?

Eco-Logical Program:

- Thinking back to your initial decision to apply for an Eco-Logical grant, would you still have applied for this Eco-Logical grant?

- Would you recommend the Eco-Logical grant program to other potential grant applicants?

- Without the FHWA Eco-Logical grant funding, would you have pursued the type of work you are currently doing?

- Did the Eco-Logical grant solicitation inspire you to attempt the Eco-Logical approach, or was this something your organization was considering or involved with prior to the grant?

Other Comments:

- Have you presented your grant project at meetings, conferences, peer exchanges, etc.? If so, please list.

- In what ways could FHWA facilitate the success of your grant project?

2007 Grant Recipients: 2010 Interview Guide (for 2010 Eco-Logical Annual Report)

Project:

- Please briefly describe the current status of your project, and how it has changed since the last time we spoke.

- What have been the outcomes of your grant project since the last time we spoke?

- Have any of the outcomes been unexpected?

Future Work:

- Has your agency continued to use the results of your Eco-Logical project after the grant period has concluded? If not, why? What is its staying power within your agency/organization? Does Eco-Logical have staying power within the region?

- How are you/will you continue to use the outcomes of this work in the transportation project development process, including mitigation and environmental permitting?

Eco-Logical in Grant Recipient Organization:

- How would you characterize the general level of awareness/education about the outcomes of the Eco-Logical project within your agency? How did it get to that point (if high awareness)? Any ideas why it's not more known (if low awareness)?

- How many staff from your agency were/are involved in the Eco-Logical project?

- What, if any, funding or personnel resources are available at your agency to support ongoing Eco-Logical implementation efforts?

- If the results of your Eco-Logical project has been or will be adopted by your agency or organization, how will the project information, responsibility and information be passed from outgoing staff to incoming staff when staffing changes are made at your agency/organization?

Relationships:

- Has this grant helped you cultivate new or more positive relationships with other agencies or groups? Who? How do you know?

- Can you describe if or how new or improved relationships have changed the way your agency or organization does business?

Challenges:

- Please describe any challenges you have faced or are currently facing in implementing the Eco-Logical approach.

- If you have overcome any of these challenges, please describe how.

Eco-Logical Program/Evaluation:

- What were your expectations of the purpose and planned outcomes of your Eco-Logical grant when you entered the grant program? Did they change, and if so, how?

- What metrics are you using or would you use to evaluate your application of the Eco-Logical approach to your project?

- In your view, could the Eco-Logical approach be applied successfully elsewhere? Why or why not? What circumstances would make the Eco-Logical approach successful elsewhere?

- Would you associate any risk with attempting the Eco-Logical approach?

- Do you think that the Eco-Logical process can lead to the development of an effective mitigation program prior to project development and implementation (prior to the completion of NEPA and/or construction)? What would that look like? Who would/should be responsible for funding this program?

- Did your agency view the Eco-Logical process as "transportation-centric" or do you believe that other agencies can benefit from the Eco-Logical approach? What actions/changes would make Eco-Logical less "transportation-centric," and help other agencies to benefit from Eco-Logical?

- Whose interests are best served by the Eco-Logical process as it exists now?

Other Comments:

- Have you presented your grant project at meetings, conferences, peer exchanges, etc.? If so, please list.

- In what ways could or could have FHWA facilitate(d) the success of your grant project?

- What tools, products, or services from FHWA or others (i.e., resource agencies) would help you continue the implementation of your project? What would have been helpful while you were working on your project?

2007 Grant Recipients: 2011 Interview Guide (for 2011 Eco-Logical Annual Report)

Project:

- Please briefly describe the current status of your project and how it has changed since the last time we spoke.

- What have been the outcomes of your grant project in the past year? Have any of the outcomes been unexpected?

- What tools or resources have been critical to the progress and implementation of your project?

Future Work:

- How have you integrated Eco-Logical into your organization? Has the way in which your organization does business changed?

- How are you/will you continue to use the outcomes of this work in the transportation project development process, including mitigation and environmental permitting?

- In what other ways will your organization continue to use the products of your Eco-Logical project after the grant period has concluded?

Relationships:

- How have your relationships with partner organizations changed in the past year? Have you developed any new or strengthened relationships? Have you signed any formal agreements?

- Can you describe if or how new or improved relationships have changed the way your agency or organization does business?

Measuring Success:

- Based on your responses in the online questionnaire, you noted several measures of Eco-Logical implementation that your organization has accomplished (list questionnaire responses). Can you describe how these measures have or have not helped advance your project?

- What are the other ways that your organization has evaluated the performance of your project, either in the past year or planned for the future?

Applicability of Grant Projects:

- What elements of your grant project would be most valuable for streamlining environmental review and permitting of transportation project? How might other organizations adopt these elements to achieve better environmental outcomes?

- Have other organizations or regions used products or tools from your project? Would it be feasible to scale up your project to apply to other parts of the State or U.S.? If so, what suggestions would you have for applying your project at a national level?

Other Comments:

- Have you presented your grant project at meetings, conferences, peer exchanges, etc.? If so, please list.

- Please elaborate on your response from the online questionnaire about ways that FHWA could (have) better facilitate(d) the success of your grant project. Include explanation of any tools, products, or services that would be useful.

2007 Grant Recipients: 2012 Interview Guide (for 2012 Eco-Logical Annual Report)

Status and Activities in 2012:

- Please briefly describe the current status of your project and any significant activities related to the project over the past year.

- Which project partners remain active in your project or are currently using grant products (reports, data, tools, etc.)?

- What have been the most successful elements of your Eco-Logical project to date?

- What tools or resources have been critical to the progress and implementation of your project?

- Do you plan to continue working on your Eco-Logical project in the future? What are your planned next steps either directly or indirectly related to your Eco-Logical project? If you do not have continued work planned, why not?

- What events are taking place within your region that may take advantage of your Eco-Logical work or benefit from similar research?

Integration into Agency Practices:

- To what degree are products from your Eco-Logical project integrated into your organization's decisionmaking processes (such as for long-range transportation planning, project selection, mitigation, funding, etc.)?

- What is Eco-Logical's staying power within your organization? Within other organizations in the region?

- How would you characterize the general level of awareness about the outcomes of the Eco-Logical project among staff in your agency? How is knowledge about Eco-Logical shared among staff (including passing knowledge to new staff)? How is this product shared among your partners/neighbors?

- What, if any, funding or personnel resources are available at your agency to support ongoing Eco-Logical implementation efforts?

Eco-Logical Grant Project/Evaluation:

- What elements of your Eco-Logical project have you found to be the most effective in encouraging the Eco-Logical approach?

- What have been the greatest overall benefits/costs of the Eco-Logical project for your organization, your staff, or your region?

- What events have adversely affected the performance of your Eco-Logical project over the past four years?

- What have been the key takeaways for your agency or organization in implementing your Eco-Logical project?

Eco-Logical Program/Evaluation:

- How have your expectations or perspectives of the Eco-Logical Program changed since the start of your period of performance?

- Are there challenges or risks associated with the Eco-Logical Program? If so, what are these challenges or risks? What could FHWA or others do to mitigate these risks?

- What steps or resources would be needed to transform the Eco-Logical approach into a "business as usual" activity for your agency? Would these be the same for other organizations in your region?

- Whose interests are best served by the Eco-Logical approach (as promoted by FHWA in the grant program)?

Other Comments:

- Have you recently presented your grant project or shared information about it in a public forum? If so, please describe.

- How can FHWA continue to support past and future Eco-Logical grant projects?

C.2. 2013 IAP Recipients

2013 IAP Recipients: 2014 Interview Guide (for 2013-2014 Annual Report)

Project Status and Activities:

- Please briefly describe the current status of your Implementing Eco-Logical project and any significant activities related to the project over the past year.

- What have been the most successful elements of your Implementing Eco-Logical project to date?

- What challenges, if any, have delayed or adversely affected the development of your Implementing Eco-Logical project over the past year?

- What tools or resources have been critical to the progress and implementation of your project? Would you suggest that any of these should be shared with other DOTs or MPOs that are also implementing Eco-Logical?

- When do you expect to complete your Implementing Eco-Logical project? What are your planned next steps and upcoming milestones for the project? Do you consider your next steps to have any specific challenges?

Performance Measures and Deliverables

Focus Area	Performance Measure	December 2013 Status
Regional Ecological Framework (REF) in decisionmaking	Performance Measure #1	Performance Measure Status
Integration between agencies	Performance Measure #2	Performance Measure Status
Agency culture and management adoption	Performance Measure #3	Performance Measure Status

- What is the status of the performance measure(s) developed during your initial kick-off call, as listed above?

- What next steps do you plan to take toward the completion of each performance measure?

- Have the intended outcomes of each performance measure changed in any way since your initial kick-off call?

REF in Decisionmaking:

- Have you seen a shift in how decisions are made within your agency based upon your REF or Implementing Eco-Logical project? Among partner agencies? Within the region?

- What practices or next steps have you found, or do you think would be, useful in integrating the REF or Eco-Logical approach into your agency's decisionmaking processes?

Project Partners and External Communications:

- How have you worked with partners since the start of your Implementing Eco-Logical project? Have new partnerships or unanticipated challenges emerged?

- What outreach forums, materials, or strategies (e.g., meetings, brochures, presentations, etc.) have you found helpful in promoting your Implementing Eco-Logical project?

Incorporating the Eco-Logical Approach into Agency Culture and Management:

- Has the level of awareness about your Implementing Eco-Logical project changed in your agency since last summer, particularly with staff not directly involved in the project?

- What steps are you taking or do you anticipate taking to further integrate the Eco-Logical approach into "business-as-usual" practices within your agency?

Perspectives on Participation in Implementing Eco-Logical and Eco-Logical Grant Program:

- How does your Implementing Eco-Logical project relate to your prior Eco-Logical grant project? What differences, if any, have you observed between the projects or processes used for each project?

- What lessons have applied to your Implementing Eco-Logical project from your experiences as an Eco-Logical grant recipient?

- What advice or recommendations would you offer agencies interested in using the Eco-Logical approach and potentially facing challenges related to partnerships, data-sharing, agency resources, etc.? Would you be interested in sharing these with other MPOs or DOTs as part of a peer exchange?

Evaluating the Implementing Eco-Logical Assistance Funding Program:

- What type of support from FHWA would be helpful to you as you continue your Implementing Eco-Logical project (e.g., webinars, guidance materials, targeted expertise, coordination, workshops, etc.)? May something be useful pertaining to any challenges in your "next steps," as outlined in Question E?

- Do you have any other suggestions or feedback for FHWA regarding Implementing Eco-Logical?

2013 IAP Recipients: 2015 Interview Guide (for 2014-2015 Annual Report)

Project Status and Activities:

- Please briefly describe the current status of your Implementing Eco-Logical project and any significant activities related to the project over the past year.

- What have been the most successful elements of your Implementing Eco-Logical project to date?

- What tools or resources have been critical to the progress and implementation of your project? Would you suggest that any of these should be shared with other DOTs or MPOs that are also implementing Eco-Logical?

- What challenges affected your project over the past year? Did these challenges cause delays or changes in scope/trajectory? If the timeline for your project changed, what were the reasons behind this?

- When do you expect to complete your Implementing Eco-Logical project? What are your planned next steps and upcoming milestones?

Performance Measures and Deliverables

Focus Area	Performance Measure	December 2014 Status
Regional Ecological Framework (REF) in decisionmaking	Performance Measure #1	Performance Measure Status
Integration between agencies	Performance Measure #2	Performance Measure Status
Agency culture and management adoption	Performance Measure #3	Performance Measure Status

- What is the status of the performance measure(s) developed during your initial kick-off call, as listed above?

- Has the use of performance measures for your Implementing Eco-Logical project been helpful in tracking its progress? Are you happy with the measures that you chose and how you are tracking them? Are any changes to the measures needed?

Reflecting back on when you chose your performance measures two years ago, do you have any recommendations for how we could improve the process?

Deliverable	December 2014 Status	Evaluation team Received Copy
Deliverable #1	Reported deliverable status	Y/N
Deliverable #2	Reported deliverable status	Y/N
Deliverable #3	Reported deliverable status	Y/N

The table above lists the deliverables included in your Statement of Work.

a. Is the status of each deliverable accurate?

b. Can you provide Volpe with copies of any missing deliverables?

c. Can we feature or link to any of these deliverables from the FHWA Eco-Logical website?

REF in Decisionmaking:

- Have you seen a shift in how decisions are made within your agency based upon your REF or Implementing Eco-Logical project? Among partner agencies? Within the region?

- What practices or next steps have you found, or do you think would be, useful in integrating the REF or Eco-Logical approach into your agency's decisionmaking processes?

Incorporating the Eco-Logical Approach into Agency Culture and Management:

- In the past year, has your agency or partner agencies initiated or implemented new organizational structures or policy support (e.g., training, peer guidance, and technical support; MOUs; policy and engineering directives; and standard operating procedures)?

- To what degree are products from your Eco-Logical project integrated into your organization's decisionmaking processes (such as for long-range transportation planning, project selection, mitigation, funding, etc.)? Has the level of awareness among staff changed?

- What steps are you taking or do you anticipate taking to further integrate the Eco-Logical approach into "business-as-usual" practices within your agency?

Project Partners and External Communications:

- How have you worked with partners throughout your Implementing Eco-Logical project? What types of partnerships or unanticipated challenges have emerged?

- How have you promoted your Implementing Eco-Logical project (e.g., meetings, webinars, brochures, and websites)?

Perspectives as an Implementing Eco-Logical Recipient:

- What have been the greatest overall benefits/costs of the Eco-Logical project for your organization, your staff, or your region to date? Have you seen any quantitative benefits relating to expedited project delivery, reduced project costs, limited environmental impacts, etc.?

- What elements of your Eco-Logical project have you found to be the most effective in encouraging the Eco-Logical approach?

Perspectives on the FHWA Eco-Logical Program/Implementing Eco-Logical Initiative:

- How have your expectations or perspectives of the FHWA Eco-Logical Program and/or Implementing Eco-Logical IAP changed since the start of your IAP project?

- Are there challenges or risks associated with participating in Eco-Logical? If so, what are these challenges or risks? What could FHWA or others do to mitigate these risks?

- What type of support from FHWA would be helpful to you as you continue your implementing Eco-Logical project (e.g., webinars, guidance materials, targeted expertise, technical assistance, etc.)?

- Do you have any other suggestions or feedback for FHWA regarding Implementing Eco-Logical?

Appendix D. 2014 Program Questionnaire

This appendix lists questions verbatim from an optional electronic questionnaire used in spring 2014 as part of the 2013–2014 annual report and was the last time that the program contacted 2007 grantees. FHWA received responses from the following agencies:

- USEPA Region 6.
- Institute for Natural Resources.
- H-GAC.
- Chicago Department of Transportation.
- Land of Sky Regional Council.
- MARC.
- NHA.
- Tioga County Soil & Water Conservation District.
- TCRCP.

The evaluation team selected a subset of questions from the questionnaire based on relevance to the evaluation questions and coded the responses into the qualitative coding database. Questions used by the evaluation team include the following:

- Q6: Have you been able to measure the benefits of your Eco-Logical grant project, whether quantitatively or qualitatively, for planning, NEPA, and/or permitting processes?

- Q13: In hindsight, how has your Eco-Logical grant project continued to bring value to your organization, staff, and/or region?

- Q14: Looking back, what were the biggest challenges you faced in your Eco-Logical grant project, and how did you address and overcome these challenges?

- Q15: Based on your experiences, what advice would you offer to agencies interested in using the Eco-Logical approach?

- Q17: How can FHWA continue to support past and future projects and programs advancing the Eco-Logical approach?

Appendix E. 2015 IAP Peer Exchange

This appendix lists questions asked verbatim on October 14–15, 2015 by the evaluation team to peer exchange participants as well as summary responses. The questions were mounted on boards and answered with sticker dots or written in on Post-It notes. Informal conversations with attendees also contributed to data collection.

1. What changes have you seen as a result of adopting an ecosystem approach?

2. Stickers: Green = YES, Red = NO

	MPO	DOT
Faster project delivery	2Y; 1half/half	3Y; 1N
More transparency	3Y	4Y
Better relationships within agency	1Y; 1N	3Y; 1 half/half
Better relationships with partners	2Y; 1N	3Y; 1 half/half
Streamlined data	3Y	2Y; 1N; 1 half/half
Better environmental outcomes	1Y; 1half/half	4Y

3. Which of these steps has your agency used to minimize or avoid potential environmental impacts of transportation projects?

4. Stickers: Green = YES, Red = NO

+	MPO	DOT
Partner with other organizations	3Y	6Y
Integrate spatial data for natural resources, transportation, and land use	3Y	4Y; 2N
Look at different planning scenarios and outcomes based on current land use and transportation plans, and also alternatives	3Y	4Y; 2N
Evaluate the alternatives and select options with your partners that minimize environmental impacts	2Y; 1N	4Y; 1N
Develop a mitigation plan	1Y; 2N	7Y
Identified areas of land that can be used to mitigate impacts of projects taking into consideration ecosystem conservation/ different habitats	2Y; 1N	6Y
Outlined roles, responsibilities, and agreements at the project level, and performance standards for mitigation	2N; 1Y	5Y; 1N
Track ecological data in the sites that have been set aside for mitigation/ in the project area	3N	6Y

Y = yes and N = no.

5. What have been your challenges in attempting to reduce the environmental impacts of transportation projects?

   (Write in with Post-It notes)

   • More value placed on human environment impacts versus natural resources.

   • Politicians and politics.

   • Politics.

   • Schedules.

   • Budgets (bridge versus culverts).

   • Purpose and need—sometimes fulfilling this makes impacts unavoidable.

   • Strong focus on regulatory framework, such as permitting process, which limits ability to implement creative solutions from a broader ecosystem perspective.

   • Lack clear direction from the 404 regulator ([State] DEQ) at times.

- Lack of flexibility in using Federal funds for innovation—bureaucratic hoops—love the idea of FHWA HQ looking for solutions on interagency contracting.

- Also need to allot enough time in project schedules for innovation.

6. What would you want to see in the program for the future?

(Write in with Post-It notes)

- Webinars that are more technical instead of relaying basic information on topics.

- For my State DOT:

    o More NEPA professionals involved in planning/feasibility studies.

    o Real environmental considerations in planning/feasibility.

7. Board for non-adopters: Why has your agency not adopted the specific Eco-Logical Program?

(Write in with Post-It notes)

- Need reliable transportation funding source (more money).

- Need more time for NEPA.

- Lack of awareness of program.

- Lack of exposure.

- Lack of more indepth technical assistance (webinars specifically).

- Lack of upper management understanding and "buy-in."

- Disconnection between planning and environmental groups which limits collaboration and ability to implement Eco-Logical across entire agency.

Appendix F. 2016 Evaluation Interview Guide

This appendix lists the questions verbatim the evaluation team asked 2007–2013 Eco-Logical Grant Program funding recipients. Questions include the following:

1. Has your agency completed any ongoing activities related to the Eco-Logical approach or grant/award since the project period ended?

2. How has FHWA enabled your agency to adopt the Eco-Logical approach?

   - Would you have done this project anyway? If you would have done this project anyway, how has it been different because of the Eco-Logical grant/award?

3. How is your agency incorporating the Eco-Logical approach into its business practices?

   - Increases in partnering?

   - Sharing data and integrating plans?

   - Creating Regional Ecosystem Framework (GIS map layers)?

   - Analyzing effects on conservation objectives?

   - Establishing and prioritizing sites for potential development and broad scale mitigation?

   - Developing a crediting strategy (mitigation goals and measures for mitigation banks, programmatic permitting, and other mitigation tools)

   - Developing programmatic agreements and consultations?

   - Implementing agreements, incorporating planning information into project development, and tracking commitments?

   - Updating Regional Ecosystem Framework and ecological data?

4. How has the Eco-Logical Program and approach contributed to improved project delivery processes?

   - Reduced project delivery times?

   - Cost savings?

   - More effective collaboration and better relationships?

- Improved transparency?

5. How has the Eco-Logical Program and approach contributed to improved environmental mitigation?

  - Do you have anecdotal or quantitative evidence of this? (e.g., avoids/minimizes impacts in planning or compensates for impacts through broad scale mitigation approaches)

  - What ideas do you have for how users of Eco-Logical could start to track and quantify environmental benefits or minimized impacts?

6. Eco-Logical Steps Completed—please review and confirm accuracy. See Q.2 for a description of each of the nine eco-logical steps. More information can also be found here.

Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF

7. Are there any other general benefits or challenges you would like to share that were not covered in the previous questions?

Table 14 below notes which types of agencies were interviewed for the 2016 evaluation of Eco-Logical, the specific agency, and the interviewee category attributed to their specific responses.

Appendix G. Evaluation Interviewee Agencies and Categories

Table 14 shows the interviewee agencies and categories the evaluation team used to categorize the interviews.

Table 14. 2016 Evaluation interviewee agencies and categories.

Type of Agency	Agency	Interviewee Category	Interview Date
MPO	H-GAC	MPO Employee	May 19, 2016
MPO	LOSRC	MPO Employee	May 16, 2016
MPO	MARC	MPO Employee	May 17, 2016
MPO	NCTCOG	MPO Employee	April 25, 2016
MPO	TCRPC	MPO Employee	May 23, 2016
Lead adopter—MPO	ARC	MPO Employee	March 31, 2016
Lead adopter—MPO	CA-MPO	MPO Employee	March 29, 2016
Lead adopter—MPO	PPACOG	MPO Employee	March 28, 2016
User incentive—MPO	AMBAG	MPO Employee	April 11, 2016
User incentive—MPO	OKICOG	MPO Employee	April 13, 2016
State transportation department	CDOT	State Transportation Department Employee	May 18, 2016
Lead adopter—State transportation department	ITD	State Transportation Department Employee	April 21, 2016
Lead adopter—State transportation department	MaineDOT	State Transportation Department Employee	April 13, 2016
Lead adopter—State transportation department	MDOT	State Transportation Department Employee	April 6, 2016
User incentive—State transportation department	Caltrans	State Transportation Department Employee	April 4, 2016
User incentive—State transportation department	MoDOT	State Transportation Department Employee	April 20, 2016
Other	Chicago Department of Transportation	Other Organization Employee	May 18, 2016
Other	OSU	Other Organization Employee	May 5, 2016
Other	TCSWCD	Other Organization Employee	May 19, 2016
Other	USEPA Region 6	Other Organization Employee	May 16, 2016

Appendix H. Analysis of Eco-Logical Steps

This appendix provides the 2007 grant recipients and how they addressed the individual steps of the Eco-Logical approach.

Table 15. Analysis of steps completed by 2007 MPO grant recipients.

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
CAPCOG[63]	Partnered with regional and local stakeholders.	Eco-Logical grant expanded on a previous Greenprint plan to include three more counties and integrated GIS and other data for these counties.	Integrated data into a GIS model/ REF.	Met with stakeholders to inform regional conservation priorities in REF.	Prioritized conservation opportunity areas in a region with a quickly growing population.	—	—	—	—
H-GAC[65]	Partnered with stakeholders to map resources and also performed outreach to get more partners to use the mapping tool.[10]	Defined resources to be included in the mapping tool.	Created a GIS-based product to identify environmental resource priority areas.	Prioritized conservation needs based on resource type.	—	—	—	—	Updated the Eco-Logical tool.

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
LOSRC[66]	Worked with various stakeholders to create resource maps and encouraged local government to use the maps.	Compiled various information to create maps and green infrastructure framework.	Developed resource assessments and a Regional Green Infrastructure map using State and local GIS data and national spatial data integration tools.	Used maps and tools to assess possible development patterns in LRTP and also as baseline data for GroWNC, an HUD Sustainable Communities Grant.	—	—	—	—	—
MARC[67]	Worked with existing partners and formed new relationships with State and Federal agencies.	Identified strategies for integrating environmental data earlier into transportation planning processes.	Incorporated an action plan into LRTP and revised project selection criteria.[3]	—	—	—	—	—	—

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
NCTCOG[70]	Worked with partners and improved relationship with resource agencies.	Used regional data to develop 10 base maps and 1 composite map of resource priorities by watershed.[12]	Utilized a watershed-scale approach to integrate regional conservation data and infrastructure planning into an REF dataset.[12] Developed 10 base maps and 1 composite map of resource priorities by watershed.	Worked with partner agencies to refine the priority weightings assigned to different criteria in the REF methodology.	—	—	—	—	Update the REF every 4–5 yr.
TJPDC[74]	Coordinated 33 stake-holders in a facilitated engagement process to build consensus for the Free Bridge Area Congestion Relief Project.[97]	Finalized a Green Infrastructure Study that compiled existing natural resource data from 12 data layers.[71]	Created an REF for the six locality region.	Developed tools that use the REF to assess the impacts of transportation projects on natural resources.	—	—	—	—	—

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
TCRPC[75]	Developed partnerships and collaborated with regional stakeholders.	Gathered environmental, transportation, and other data to create GIS maps.	Created GIS maps.	Considered various strategies in plan for improving environmental/ conservation outcomes and transportation planning.	Determined regional priorities and strategies for land use and infrastructure development.	—	—	—	—

—No data were collected/steps were not completed.

Table 16. Analysis of steps completed by 2007 State transportation department grant recipient.

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
CDOT[77]	Worked with partners and created committees for project consisting of local, State, Federal, private, and non-profit stakeholders.	Gathered environmental data to create an REF.	Created an REF matrix for the corridor that incorporated wildlife habitat and crossing data into a GIS database, which was also listed on the Eco-Logical website.[77,29]	Assessed REF to prioritize minimizing impacts to wildlife crossing areas.	Agreed to use the REF to prioritize conservation areas and followed up with a programmatic EIS.	—	Established and Stream and Wetland Ecological Enhancement Program (SWEEP) MOUs and coordinated with ALIVE and SWEEP committees.[47]	Completed twin tunnels environmental assessment matrices to track more than 100 commitments from environmental review process to project implementation.	Performed a reassessment of record of decision every 2 yr and maintained CDOT 1-70 Context Sensitive Solutions website.[98]

—No data were collected/steps were not completed.

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
Chicago Department of Transportation [80]	Partnered with local and regional entities on the creation of the guidelines.[79]	Integrated data and plans on sustainable streetscapes.	—	—	Prioritized sustainable streetscapes and used quantitative measures to justify the principles.	—	—	Created sustainable streets guidelines and a demonstration project.[79,78]	—
Envision Utah [81]	Partnered with multiple stakeholders on visioning process for the Jordan River.	Created maps and identified priorities as part of creating the Jordan River Blue Print Plan.[81]	Combined map analyses to create regional vision for the Jordan River.	—	Identified priorities in plan and created a commission to oversee implementation.	—	—	Implemented projects with better understanding of impacts due to the Blue Print Plan.	—
NHA [83]	Convened interagency workgroup as part of the project.	Defined resources to be included in the mapping tool.	Developed a GIS-based wildlife connectivity framework to evaluate the impact of transportation projects on wildlife species.	Used tools to look at impacts of transportation projects on wildlife species.	—	—	—	—	—

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
NCDENR[86]	Worked with NCDOT and other stakeholders throughout grant process.	Provided data on upland and non-riparian wetland habitats that enhance the State Wildlife Action Plan.[84] Digitized cultural resource features to demonstrate their role in the State's ecosystems. Integrated data into a comprehensive statewide conservation planning tool.[85]	Integrated data into a GIS-based CPT that is available to the public.[85]	Used the data created for the tool to help identify high-priority, unfragmented wildlife habitats based on occurrence data for indicator species and digital aerial photography. MPOs/regional planning organizations, NCDOT, and other agencies can use these data.	—	—	—	—	—
OSU[58]	Worked with partners to consolidate disparate data; partnerships continued as OSU showed agencies how to use REF.	Compiled data from various places into an internal database to serve as the basis for maps and the REF.	Established an REF to identify conservation priority areas in Oregon and compile these data across the State.[58]	Identified priority conservation areas as part of the REF development; agencies use this information when evaluating impacts of transportation projects.	—	—	—	—	—

2007 Grant Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
TCSWCD[87]	Worked with various partners to develop an REF.	Collected natural resource and transportation data to populate an online mapping tool for the REF, which was created for use by NYSDOT.[87]	Created an REF for NYSDOT.	Worked with stakeholders to identify priority areas for keystone species and other key conservation areas.	Worked with Upper Susquehanna Coalition so that USC could administer the ILF program.	Assisted developing the ILF, Program which has helped implement the REF.	Improved working relationships with State agencies to make it possible to streamline funding mechanisms.	—	Update the REF every 4–5 yr.
USEPA Region 6.[88]	Coordinated with six States that are included in REAP.	Gathered environmental data and characterized priority areas for conservation.	Developed a REAP that uses a GIS analysis to classify land on the basis of its ecological significance.	—	—	—	—	—	—

—No data were collected/steps were not completed.

Table 18. Analysis of steps completed by 2013 SHRP2 IAP MPO lead adopters.

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
ARC[5]	Worked with internal and external partners to identify information priorities for developing the Proctor Creek REF.	Analyzed fiscal, economic, and environmental impacts of implementing REF for PCED.	Adapted regional REF for more detailed, local area for Proctor Creek.	Used REF data to create draft maps and decision criteria for inclusion in ARC's future regional transportation plans.	—	—	—	—	—
CA-MPO (part of TJDPC)[5]	Worked with stakeholder committee to identify and screen project alternatives for the Free Bridge Area Congestion Relief Project.[97]	Collected data for REF as part of TJDPC's 2007 Eco-Logical grant project.	Created and updated REF for TJPDC's 2007 grant project.	Piloted use of REF in evaluating proposed alternatives at the planning phase of project development for the Free Bridge Area Congestion Relief Project.[97] Incorporated REF into a weighted ranking system to evaluate impacts of seven proposed project alternatives. Each project alternative was assigned a score that quantified its environmental impact.	—	—	—	—	Developed REF under 2007 grant updated under 2013 IAP.

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
NCTCOG[5]	Worked with 18 stakeholders to identify priority watershed and potential mitigation areas.	Updated REF with current information to ensure it reflects regional conservation priorities.	Developed with previous 2007 grant.	Applied the REF to a pilot corridor, the Loop 9 Southeast Corridor, to determine the feasibility of using the REF for corridor-level conservation and mitigation.	—	—	—	—	Gathered information on priority areas to update REF.
PPACOG[5]	Worked with stakeholder group and committee to identify conservation and mitigation targets.	Gathered data on transportation projects and potential impacts on conservation and mitigation areas.	Developed a spatial database with a list of mitigation targets and associated acreage.[99]	Developed a Conservation Value Summary and related conservation ranking for proposed transportation projects.[99]	—	—	—	—	Updated existing REF to reflect new data developed since SHRP2 C18 project ended.[100]

—No data were collected/steps were not completed.

**Table 19. Analysis of steps completed by 2013 SHRP2 IAP State transportation department lead adopters.**

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
ITD[5]	Worked with IDFG and other Federal partners on the project.[101]	Developed species of greatest conservation need data layers to improve interagency coordination, streamline transportation project development, and facilitate stewardship of natural resources.	Developed a web service that allows ITD to view real-time IDFG data in a cloud-based portal for spatial data.[101]	—	—	—	—	—	—

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
MaineDOT[5]	Worked with partner agencies such as FWS.	Completed gap analysis comparing Integrated Ecological Framework with MaineDOT's existing environmental screening process, analyzed internal workflow for Endangered Species Act (ESA) consultations, and made changes to increase efficiency and improve collaboration with FWS and other agencies using a risk assessment matrix.[102]	Developed a GIS-based corridor-level decision support tool that will score projects based on the level of risk.[103]	Applied REF to CE projects to create a streamlined ESA Section 7 review process in Maine.	Used GIS-based corridor-level decision support tool to score projects based on the level of risk.	Completed draft ILF mitigation instrument for Atlantic salmon.	Worked with FWS to develop and implement a Programmatic Biological Assessment for Atlantic salmon.	—	—

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
MDOT[5]	Established a technical advisory committee (TAC) from 10+ resource, regulatory, and planning agencies to help develop REF and executed an agreement with Michigan Department of Natural Resources (DNR) in May 2015 on interagency collaboration.	Worked with TAC to target conservation study areas and create stakeholder groups to evaluate threats in targeted conservation areas. Executed a statewide cooperative GIS agreement in January 2015 with the Michigan DNR to facilitate data sharing between the two agencies.	Finalized REF and Conservation Action Plan.[104]	Used finalized REF to inform activities for other transportation projects.	Used REF and Conservation Action Plan to prioritize sites for mitigation and make more informed decisions.	—	—	—	—

—No data were collected/steps were not completed.

Table 20. Analysis of steps completed by 2013 SHRP2 IAP MPO user incentives.

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
AMBAG[(5)]	Worked with State and Federal resource agencies, counties, and non-government organizations to gather data for the REF.	Compiled data on sensitive natural resources near locations of planned regional transportation projects.	Developed an REF and web-based tool for a three-county area.[(105)]	—	—	—	—	—	—
OKICOG[(5)]	Worked with State agencies in Ohio, Kentucky, and Indiana.	Collected and compiled natural heritage data for three State region for regionally significant environmental resources.	Implemented data sharing agreements with State agencies in Ohio, Kentucky, and Indiana. Applied the data to produce updated maps of regionally significant environmental resources in the Cincinnati region.	—	—	—	—	—	—
SCAG[(5)]	Worked with stakeholders to identify important conservation areas.	Gathered data to feed into an regional open space GIS inventory.	Compiled an inventory of 75+ GIS data sources related to open space in the SCAG region.	Developed a methodology for identifying and prioritizing important areas for conservation efforts in the report, *Conservation Framework and Assessment*.[(106)]	—	—	—	—	—

—No data were collected/steps were not completed.

Table 21. Analysis of steps completed by 2013 SHRP2 IAP State transportation department user incentives.

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
Caltrans[5]	Worked with the interagency Highway 89 Stewardship Team to expand teams to make a northern and southern team.	Held trainings for the new northern and southern agency teams on transportation ecology and strategic planning for mitigation of animal/vehicle collisions.	—	—	—	—	—	—	—
ITD[5]	Worked with IDFG and other Federal partners on project.	—	—	—	—	—	Updated an MOU with IDFG to improve data delivery and data sharing, which helps implementation of protocols under the ITD-IDFG IAP Lead Adopter project.[93,90]	—	—
MoDOT[5]	Coordinated with State and Federal agencies and collaborated with MDC.	Revised 26 existing BMPs for species on MD's Natural Heritage Review website.[94] MoDOT incorporated transportation-specific language into BMPs that MoDOT contractors use.	—	—	—	—	Signed a Memorandum of Agreement with MDC for MDC's support of the MoDOT project.	—	—

2013 SHRP2 Recipient	Step 1: Collaboration	Step 2: Eco Status	Step 3: Develop REF	Step 4: Assess REF	Step 5: Prioritize	Step 6: Crediting	Step 7: Agreements	Step 8: Implement	Step 9: Update REF
NHDOT[5]	Collaborated with partners to create a standardized wetland assessment methodology, the EIA.[95]	Developed a streamlined scorecard for EIA wetland assessments and completed final report that compares EIA to existing highway methodology.	—	—	—	—	Signed an MOU with the New Hampshire Natural Heritage Bureau to implement a pilot project for a standardized wetland assessment methodology.[107]	—	—

—No data were collected/steps were not completed.

Appendix I. Qualitative Coding Database

Figure 4 shows the total number of benefits, challenges, and recommendations that the evaluation team coded under each evaluation theme and category (see section 2.3 for definitions). This information was used to identify evaluation findings, not necessarily to rank the categories.
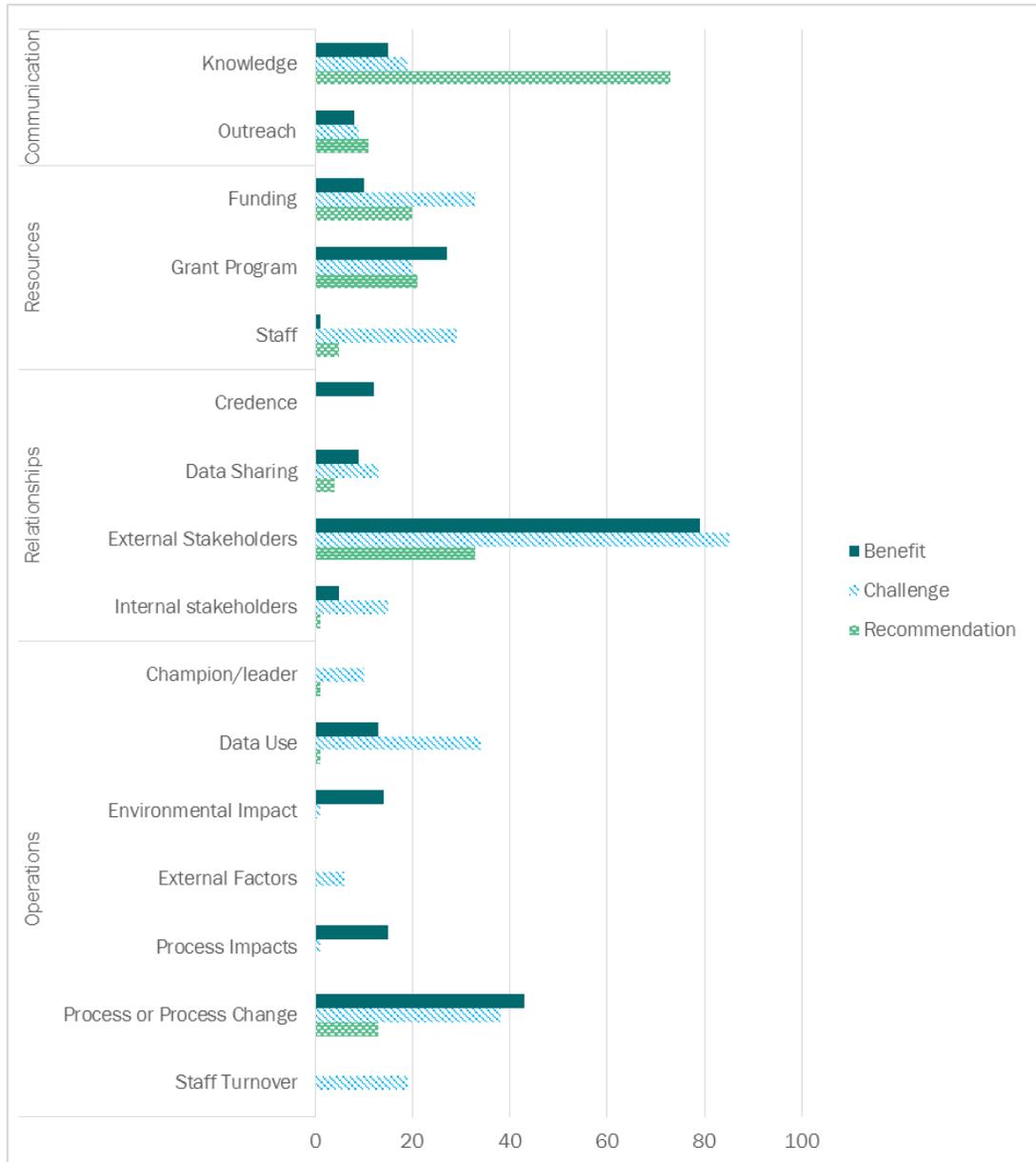
Source: FHWA.

Figure 4. Graph. Number of recipient comments on benefits, challenges, and recommendations organized by evaluation theme and category.

The evaluation team identified 766 comments in total with 251 benefits, 332 challenges, and 183 recommendations. The evaluation category "External Stakeholders" received the most comments under both benefits and challenges. Some categories were inherently positive (e.g., "Credence"), while others were inherently negative (e.g., "Staff Turnover"). As a result, those categories only had benefits or challenges, respectively. The categories "Grant or IAP Program," "Credence," "Process or Process Change," Process Impacts," and "Environmental Impacts" had a higher ratio of benefits to challenges, while other categories had more challenges than benefits listed. Recommendations were either geared toward FHWA or peer agencies and were primarily in the categories "Knowledge," "Outreach," "Grant or IAP Program," "Funding," "External Stakeholders," and "Process or Process Change."

Figure 4 is not intended to rank any category as inherently more valuable than another, but it is meant to show the relative frequency of the comments coded in each category.

Acknowledgments

References

1.   welcomia. "Stock Photo – Mountain Landscape. Colorado Wilderness Back Road" (digital image). Available online: https://www.123rf.com/stock-photo/colorado.html?imgtype=0&oriSearch=road&sti=m70yguooydjbt79zee|&mediapopup=31326651 Last Accessed: January 30th, 2018. Licensed under agreement between 123RF and performing organization. Full license available at: https://www.123rf.com/license.php?type=standard.

2.   FHWA Research and Technology Agenda. (No Date). "Meeting the Challenge: Planning, Environment, and Realty," (website) Federal Highway Administration, Washington, DC. Available online: https://www.fhwa.dot.gov/research/fhwaresearch/agenda/researchareas.cfm?urlanchor=planningEnvironmentRealty#, last accessed June 1, 2017.

3.   Brown, J. (2006). *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*, U.S. Department of Transportation, Washington, DC.

4.   Federal Highway Administration. (No Date). "2007 Grant Program for 15 Eco-Logical Projects," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Grant_Program_Projects.asp, last accessed June 1, 2017.

5.   Federal Highway Administration. (No Date). "2013 Implementation Award Program Recipients: Lead Adopter and User Incentives," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/IAP_Recipients_2013.asp, last accessed June 1, 2017.

6.   Federal Register. (2002). *Executive Order 13274: Environmental Stewardship and Transportation Infrastructure Project Reviews*, Homeland Security Digital Library, Washington, DC. Available online: https://www.hsdl.org/?abstract&did=462816, last accessed June 1, 2017.

7.   Federal Highway Administration. (2005). *SAFETEA-LU Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users*, U.S. Department of Transportation, Washington, DC. Available online: https://www.fhwa.dot.gov/safetealu/legis.htm, last accessed June 12, 2017.

8.   Second Strategic Highway Research Program. (No Date). "Better Environmental and Highway Outcomes through Integrated Planning: Implementing Eco-Logical (C06)," (website) Federal Highway Administration, Washington, DC. Available online: https://www.fhwa.dot.gov/goshrp2/Solutions/all/C06/Implementing_citeEcoLogicalcite/, last accessed June 13, 2017.

9. U.S. Environmental Protection Agency. (No Date). "Section 404 of the Clean Water Act: Compensatory Mitigation," (website) U.S. Environmental Protection Agency, Washington, DC. Available online: https://www.epa.gov/cwa-404/compensatory-mitigation, last accessed June 1, 2017.

10. John A. Volpe National Transportation Systems Center. (2009). *GIS Applications in Eco-Logical Grant Projects: Peer Exchange Summary Report*, U.S. Department of Transportation, Washington, DC.

11. Federal Highway Administration. (No Date). "Webinar Series," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Webinar _Series.asp, last accessed June 1, 2017.

12. Federal Highway Administration. (2011). *Evaluating Montana's ITEEM: Successes and Lessons for Eco-Logical*, U.S. Department of Transportation, Washington, DC.

13. Federal Highway Administration. (2011). *Eco-Logical Grant Program Annual Report*, U.S. Department of Transportation, Washington, DC.

14. Federal Highway Administration. (2014). "2013/2014 Eco-Logical Program Annual Report (Detailed Image Description of Figure 2)," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/AnnualReport2013- 14/annualreport_fig2desc.asp, last accessed June 1, 2017.

15. John A. Volpe National Transportation Systems Center. (2012). *Eco-Logical Grant Program Annual Report*, U.S. Department of Transportation, Washington, DC.

16. Federal Highway Administration. (2011). *Eco-Logical Successes*, First Edition, U.S. Department of Transportation, Washington, DC.

17. Government Printing Office. (2012). *Moving Ahead for Progress in the 21st Century Act*, Public Law 112-141, Washington, DC. Available online: https://www.gpo.gov/fdsys/pkg/PLAW- 112publ141/pdf/PLAW-112publ141.pdf, last accessed June 13, 2017.

18. SHRP2 Solutions. (2013). *Implementation Plan: Implementing Eco-Logical*, U.S. Department of Transportation, Washington, DC.

19. John A. Volpe National Transportation Systems Center. (2013). *Eco-Logical Grant Program Annual Report*, U.S Department of Transportation, Washington, DC.

20. Federal Highway Administration. (2012). *Eco-Logical Successes*, Second Edition, U.S. Department of Transportation, Washington, DC.

21. Federal Highway Administration. (2012). *Eco-Logical Successes*, Third Edition, U.S. Department of Transportation, Washington, DC.

22. Federal Highway Administration. (2012). *Eco-Logical Grant Recipient Peer Exchange Report*, U.S. Department of Transportation, Washington, DC.

23. National Academies of Sciences, Engineering, and Medicine. (2013). *An Ecological Approach to Integrating Conservation and Highway Planning*, SHRP 2 Report, *2*, Federal Highway Administration, Washington, DC.

24. The National Academies of Science, Engineering, and Medicine. (2013). *Expedited Planning and Environmental Review of Highway Projects*, SHRP2 Report, Federal Highway Administration, Washington, DC.

25. John A. Volpe National Transportation Systems Center. (2014). *Eco-Logical Program Annual Report*, U.S. Department of Transportation, Washington, DC.

26. Federal Highway Administration. (2013). *Eco-Logical Successes*, Fourth Edition, U.S. Department of Transportation, Washington, DC.

27. Crist, P., Gaines, L., Howie, S., and Kagan, J. (2014). *Integrated Ecological Framework Outreach Project*, Transportation Research Board, Washington, DC.

28. Kagan, J. and Gaines, L. (2013). *Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies*, Institute for Natural Resources Publications, Portland, OR.

29. Federal Highway Administration. (No Date). "Implementing the Eco-Logical Approach," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/default.a sp, last accessed June 2, 2017.

30. National Academies of Science, Engineering, and Medicine. (2013). *An Ecological Approach to Integrating Conservation and Highway Planning*, SHRP2 Report, *1*, Federal Highway Administration, Washington, DC.

31. Marie Venner Consulting, URS Corporation, NatureServe, Oregon State University, and Parmetrix. (2014). *A Practitioner's Guide to the Integrated Ecological Framework*, SHRP2 Report S2-C06-RW-3, Transportation Research Board, Washington, DC.

32. Crist, P., Venner, M., Kagan, J., Howie, S., and Gaines, L. (2013). *A Manager's Guide to the Integrated Ecological Framework*, SHRP2 Report, *4*, Transportation Research Board, Washington, DC.

33. Federal Highway Administration (2015). *Implementing Eco-Logical Use of Performance Measures Shows Tangible Benefits and Progress of Eco-Logical in State DOTs and MPOs*, Presented at the Transportation Research Board 2015 Annual Meeting, Washington, DC.

34. John A. Volpe National Transportation Systems Center. (2015). *Eco-Logical Program Annual Report*, U.S. Department of Transportation, Washington, DC.

35. Federal Highway Administration. (No Date. "Technical Assistance Activities," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Technical_Assistance_Activities.asp, last accessed June 1, 2017.

36. Federal Highway Administration. (2013). *Eco-Logical Grant Recipient Peer Exchange Report*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/researchprods/grant_recip_peer_ex.asp, last accessed June 2, 2017.

37. Federal Highway Administration. (No Date) "Eco-Logical Technical Assistance Workshop: MaineDOT | April 1–2, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/workshop_MaineDOT_April2015.asp, last accessed June 2, 2017.

38. Federal Highway Administration(No Date) "Eco-Logical Peer Exchange: Mitigation Approaches for State DOTs March 11–12, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/mitigation_peer_exchange_March2015.asp, last accessed June 2, 2017.

39. Federal Highway Administration. (No Date) "Eco-Logical Peer Exchange: Mitigation Approaches for MPOs June 2–3, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/mitigation_peer_exchange_June2015.asp, last accessed June 2, 2017.

40. Federal Highway Administration. (No Date) "Eco-Logical Peer Exchange: Establishing a Regional Ecosystem Framework (REF) July 6, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/mitigation_peer_exchange_July2015.asp, last accessed June 2, 2017.

41. Federal Highway Administration (No Date) "Eco-Logical at TRB—San Diego | September 22, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/TRB_SanDiego_Sept2015.asp, last accessed June 2, 2017.

42. Federal Highway Administration. (No Date) "Implementing Eco-Logical Implementation Assistance Program (IAP) Peer Exchange | October 14–15, 2015," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/IAP_peer _exchange_Oct2015.asp, last accessed June 2, 2017.

43. Multimodal Systems Research and Analysis, John A. Volpe National Transportation Systems Center, and Research and Innovative Technology Administration. (2009). *GIS Applications in Eco-Logical Grant Projects: Peer Exchange summary Report*, Federal Highway Administration, Washington, DC. Available online: https://www.gis.fhwa.dot.gov/documents/PeerEx_report_72209.asp, last accessed June 2, 2017.

44. U.S. Government Publishing Office. (2010). *Code of Federal Regulations (Annual Edition)*, U.S. Government Publishing Office, Washington, DC.

45. John A. Volpe National Transportation Systems Center. (2010). *Eco-Logical Grant Program Annual Report*, U.S. Department of Transportation, Washington, DC.

46. Federal Highway Administration. (No Date) "Library," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Library.a sp, last accessed June 2, 2017.

47. Singer, D. and Williams, D. (2015). *FHWA Eco-Logical Case Studies Series: Example of Implementing Eco-Logical Steps 7–9*, Report No. FHWA-HEP-15-050, Federal Highway Administration, Washington, DC.

48. Baumgartner, T. and Williams, D. (2016). *FHWA Eco-Logical Case Studies Series: Example of Implementing Eco-Logical Steps 5–6*, Report No. FHWA-HEP-17-033, Federal Highway Administration, Washington, DC.

49. Hudson, W. and Williams, D. (2015). *FHWA Eco-Logical Case Studies Series: Example of Implementing Eco-Logical Steps 1–4*, Report No. FHWA-HEP-16-005, Federal Highway Administration, Washington, DC.

50. Federal Highway Administration. (2015). *Implementing Eco-Logical 2014/2015 Annual Report*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/AnnualReport2014-15/2014-2015_Eco-Logical_Annual_Report.pdf, last accessed June 6, 2017.

51. National Association of Regional Councils. (No Date) "National Association of Regional Councils Homepage," (website) National Association of Regional Councils, Washington, DC. Available online: http://narc.org/, last accessed June 2, 2017.

52. U.S. Department of Housing and Urban Development. (No Date) "Sustainable Communities Regional Planning Grants," (website) U.S. Department of Housing and Urban Development, Washington, DC. Available online: https://portal.hud.gov/hudportal/HUD?src=/program_offices/economic_development/sustainable_communities_regional_planning_grants, last accessed June 2, 2017.

53. Z. Smith Reynolds Foundation. (No Date) "Z. Smith Reynolds Foundation Homepage," (website) Z. Smith Reynolds Foundation, Winston-Salem, NC. Available online: https://www.zsr.org/, last accessed June 2, 2017.

54. U.S. Forest Service. (No Date) "U.S. Forest Service Homepage," (website) U.S. Forest Service, Washington, DC. Available online: https://www.fs.fed.us/, last accessed June 2, 2017.

55. Houston-Galveston Area Council. (No Date) "Eco-Logical," (website) Houston-Galveston Area Council, Houston, TX. Available online: http://www.h-gac.com/community/eco-logical/, last accessed June 1, 2017.

56. GroWNC. (No Date) "Maps," (website) GroWNC, Asheville, NC. Available online: http://www.gro-wnc.org/maps.html, last accessed June 1, 2017.

57. Esri®. (2016). "Protected Open Space Areas—SCAG Region," (website) Esri®, Redlands, CA. Available online: https://www.arcgis.com/home/item.html?id=8e65cdb093504f3a827badab2325b1b6, last accessed June 1, 2017.

58. Federal Highway Administration. (2010). *Using the Eco-Logical Approach to Develop and Implement Conservation and Mitigation Priorities for Oregon*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/osu_2011.asp, last accessed June 1, 2017.

59. The Intertwine. (No Date) "The Intertwine Homepage," (website) The Intertwine, Portland, OR. Available online: http://www.theintertwine.org/, last accessed June 2, 2017.

60. U.S. Environmental Protection Agency. (No Date) "National Environmental Policy Act," (website) U.S. Environmental Agency, Washington, DC. Available online: https://www.epa.gov/nepa, last accessed December 19, 2017.

61. Federal Highway Administration. (No Date) "FHWA Resource Center: Newsletters and Publications," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.fhwa.dot.gov/resourcecenter/teams/environment/publications.cfm, last accessed June 2, 2017.

62. Hart, K., et al. (2009). The Central Texas Greenprint for Growth: A Regional Action Plan for Conservation and Economic Opportunity, The Trust for Public Land, San Francisco, CA.

63. Federal Highway Administration. (2010). *Central Texas Greenprint for Growth: A Tool for Balancing Sustainable Conservation Goals with the Infrastructure Needs of Our Rapidly Urbanizing Region*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/capcog_2011.asp, last accessed June 1, 2017.

64. Houston-Galveston Area Council. (2010). *Eco-Logical: Interactive Decision-Making Tool for Long-Range Transportation Planning*, Houston-Galveston Area Council, Houston, TX. Available online: http://www.h-gac.com/community/eco-logical/documents/eco-logical-brochure.pdf, last accessed June 1, 2017.

65. Federal Highway Administration. (2010). *Developing a Regional Decision-Support System for the Houston-Galveston Region*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/hgac_2011.asp, last accessed June 2, 2017.

66. Federal Highway Administration. (2010). *Linking Lands and Communities in the Land-of-Sky Region*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/losrc_2011.asp, last accessed June 1, 2017.

67. Federal Highway Administration. (2010). *An Eco-Logical Approach to Transportation Planning in the Kansas City Region*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/marc_2011.asp, last accessed June 1, 2017.

68. U.S. Environmental Protection Agency. (No Date) "Ecoregion Download Files by State—Region 6," (website) U.S. Environmental Protection Agency, Washington, DC. Available online: https://www.epa.gov/eco-research/ecoregion-download-files-state-region-6, last accessed June 1, 2017.

69. Regional Transportation Council. (2011). *Mobility 2035: The Metropolitan Transportation Plan for North Central Texas*, North Central Texas Council of Governments, Arlington, TX.

70. Federal Highway Administration. (2011). *North Central Texas Regional Ecosystem Framework*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/nctcog_2011.asp, last accessed June 1, 2017.

71. Thomas Jefferson Planning District Commission. (2009). *Green Infrastructure Study*, Thomas Jefferson Planning District Commission, Charlottesville, VA.

72. Thomas Jefferson Planning District Commission. W*hat is Eco-Logical?*, Thomas Jefferson Planning District Commission, Charlottesville, VA. Available online: http://campo.tjpdc.org/eco-logical/, last accessed June 1, 2017.

73. Rivanna River Basin Commission. (2012). *2012 Rivanna Snapshot*, Rivanna River Basin Commission, Charlottesville, VA. Available online: http://www.rivannariverbasin.org/Rivanna-snapshot.php, last accessed June 1, 2017.

74. Federal Highway Administration. (2011). *Integrating Green Infrastructure and Transportation Planning*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/tjpdc_2011.asp, last accessed June 1, 2017.

75. Federal Highway Administration. (2010). *Regional Transportation, Ecosystem, and Land-Use Integration Plan,* U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/tcrpc_2011.asp, last accessed June 1, 2017.

76. Colorado Department of Transportation. (2011). *I-70 Mountain Corridor Record of Decision and Final Programmatic Environmental Impact Statement*, Colorado Department of Transportation, Denver, CO. Available online: https://www.codot.gov/projects/i-70mountaincorridor/final-peis, last accessed June 1, 2017.

77. Federal Highway Administration. (2011). Developing a Regional Ecosystem Framework for Terrestrial and Aquatic Resources along the I-70 Corridor: An Eco-Logical Field Test, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/col_2011.asp, last accessed June 1, 2017.

78. Chicago Department of Transportation. (No Date) "Chicago Complete Streets: Pilsen Sustainable Streetscape (Cermak/Blue Island)," (website) Chicago Department of Transportation, Chicago, IL. Available online: http://chicagocompletestreets.org/portfolio/pilsen-sustainable-streetscape-cermakblue-island/, last accessed June 1, 2017.

79. Chicago Department of Transportation. (2013). *Sustainable Urban Infrastructure,* Chicago Department of Transportation, Chicago, IL.

80. Federal Highway Administration. (2011). *Sustainable Infrastructure Standards for Urban Ecology*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/chi_2011.asp, last accessed June 1, 2017.

81. Blueprint Jordan River Steering Committee. (2008). *Blueprint Jordan River*, Envision Utah, Salt Lake City, UT.

82.   Federal Highway Administration. (2009). *Blueprint Jordan River: A Lake-to-Lake Vision*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/bpjr_2011.asp, last accessed June 1, 2017.

83.   Federal Highway Administration. (2010). *Creating Tools to Support Integrated Transportation and Resource Planning in New Hampshire*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/nha_2011.asp, last accessed June 1, 2017.

84.   North Carolina Wildlife Resources Commission. (2015). *2015 North Carolina Wildlife Action Plan*, North Carolina Wildlife Resources Commission, Raleigh, NC. Available online: http://www.ncwildlife.org/Portals/0/Conserving/documents/2015WildlifeActionPlan/NC-WAP-2015-All-Documents.pdf, last accessed June 1, 2017.

85.   North Carolina Department of Environmental Quality. (2013) "North Carolina Conservation Planning Tool," (website) North Carolina Department of Environmental Quality, Raleigh, NC. Available online: http://portal.ncdenr.org/web/cpt/, last accessed June 1, 2017.

86.   Federal Highway Administration. (2010). *Integration of North Carolina's Conservation and Transportation Planning*. U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/ncdenr_2011.asp, last accessed June 1, 2017.

87.   Federal Highway Administration. (2011). *Opportunities for Highway Programs to Remediate Natural Resource Concerns in New York*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/tcswcd_2011.asp, last accessed June 1, 2017.

88.   Federal Highway Administration. (2011). *A Regional Ecological Assessment Protocol for the South Central United States*, U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/ecological/grantProgram_rpt/grants/reap_2011.asp, last accessed June 1, 2017.

89.   North Central Texas Council of Governments. (2011). *Regional Outer Loop Corridor Feasibility Study*, North Central Texas Council of Governments, Arlington, TX.

90.   Idaho Transportation Department. (No Date) "IPLAN: A Collaborative Information Site Brought to You by ITD," (website) Idaho Transportation Department, Boise, ID. Available online: http://iplan.maps.arcgis.com/home/index.html, last accessed June 1, 2017.

91.   Ruth, M., et al. (2014). *Natural Heritage Data*, Kentucky Indiana Regional Council of Governments, Cincinnati, OH. Available online: http://www.oki.org/wp-

content/uploads/2015/12/OKI-Natural-Heritage-Data_SHRP2-Report.pdf, last accessed June 1, 2017.

92. Ohio Kentucky Indiana Regional Council of Governments. (No Date) "Environmental Resources Viewer," (website) Ohio Kentucky Indiana Regional Council of Governments, Cincinnati, OH. Available online: http://www.oki.org/portfolio-items/environmental-resources-viewer/, last accessed June 1, 2017.

93. Idaho Transportation Department and Idaho Department of Fish and Game. (2015). *Memorandum of Understanding Between the Idaho Transportation Department and the Idaho Department of Fish and Game*, Idaho Transportation Department and Idaho Department of Fish and Game, Boise, ID. Available online: http://islandparkus20.com/wp-content/uploads/2017/01/IDFG-ITD-MOU-7-15-15.pdf, last accessed June 1, 2017.

94. Missouri Department of Conservation. (No Date) "Welcome to the Missouri Natural Heritage Review Website," (website) Missouri Department of Conservation, Jefferson City, MO. Available online: https://naturalheritagereview.mdc.mo.gov/, last accessed June 1, 2017.

95. New Hampshire Natural Heritage Bureau. (2015). *Ecological Integrity Assessment Method Applied to Wetland Systems in New Hampshire*, New Hampshire Natural Heritage Bureau, Concord, NH.

96. U.S. Army Corps of Engineers. (1993). *The Highway Methodology Workbook*, U.S. Army Corps of Engineers, Concord, MA.

97. Thomas Jefferson Planning Commission. (No Date) "Eco-Logical Pilot Project: Free Bridge Congestion Relief," (website) Thomas Jefferson Planning Commission, Charlottesville, VA. Available online: http://campo.tjpdc.org/eco-logical/eco-logical-pilot-project/, last accessed June 2, 2017.

98. Colorado Department of Transportation. (No Date) "I-70 Mountain Corridor Context Sensitive Solutions (CSS)," (website) Colorado Department of Transportation, Denver, CO. Available online: https://www.codot.gov/projects/contextsensitivesolutions, last accessed June 2, 2017.

99. Federal Highway Administration. (No Date) "Pennsylvania Environmental Review Toolkit," (website) U.S. Department of Transportation, Washington, DC. Available online: https://www.environment.fhwa.dot.gov/strmlng/searchresults.aspx?id=7&keyword=&StateSelect=Pennsylvania&ShowNewPractices=&CategorySelect=all&startrow=1&ResultsSelect=10&ShowDescription=&print=false&InnovativePract=false#R7, last accessed June 14, 2017.

100. National Academies of Sciences, Engineering, and Medicine. (2013). *Assessment of Pikes Peak Area Council of Governments Use of TCAPP in Developing a Long-Range Transportation Plan*, The National Academies Press, Washington, DC.

101. Bowen, E. (2013). *Using SHRP2 Technologies to Achieve Success—Idaho's Approach*, Federal Highway Administration, American Association of State Highway and Transportation Officials,

and Transportation Research Board, Washington, DC. Available online:
http://shrp2.transportation.org/Documents/Presentations/AASHTO-WASHTO_Bowen.pdf, last
accessed June 13, 2017.

102. U.S. Environmental Protection Agency. (No Date). "Summary of the Endangered Species Act: 16
U.S.C. §1531 et seq. (1973)," (website) U.S. Environmental Protection Agency, Washington,
DC. Available online: https://www.epa.gov/laws-regulations/summary-endangered-species-act,
last accessed June 2, 2017.

103. Maine Department of Environmental Protection. (No Date) "GIS Maps and Other Data Files,"
(website) Maine Department of Environmental Protection, Augusta, ME. Available online:
https://www1.maine.gov/dep/gis/datamaps/, last accessed June 13, 2017.

104. Southeast Michigan Council of Governments. (No Date) "Environmental Topics in
Transportation Planning," (website) Southeast Michigan Council of Governments, Detroit, MI.
Available online: http://www.semcog.org/Environmental, last accessed June 13, 2017.

105. Federal Highway Administration. No Date "CHRP2 C19 Expediting Project Delivery," (website)
U.S. Department of Transportation, Washington, DC. Available online:
https://www.environment.fhwa.dot.gov/strmlng/shrp2-c19/caseStudies/AMBAG_12-
2016.asp, last accessed June 13, 2017.

106. O'Neill, T. and Bohannon, J. (2015). *Conservation Framework and Assessment*, Southern
California Association of Governments, Los Angeles, CA.

107. Federal Highway Administration. (2013). *Memorandum of Understanding: New Hampshire
Department of Transportation and Federal Highway Administration Post-Construction Funding
of Environmental Commitments*, U.S. Department of Transportation, Washington, DC. Available
online: https://www.environment.fhwa.dot.gov/strmlng/pdfs/nh_mou_Mar2013.asp, last
accessed June 13, 2017.

Bibliography

Over the course of the Eco-Logical Program, FHWA has created technical resources, annual progress reports, and other materials in support of the Eco-Logical Program. FHWA has also held peer exchanges, webinars, and presented Eco-Logical at relevant conferences and meetings. The items here informed the evaluation team's analysis and are included in the program timeline (see table 1) and program profile (see figure 3).

American Association of State Highway and Transportation Officials. (2015). *AASHTO Conference on 21st Century Mobility for Freight and Passenger Transportation*, American Association of State Highway and Transportation Officials, Washington, DC.

Barondess, M. (2014) *I-75 Corridor Conservation Plan,* Michigan Department of Transportation, Lansing, MI. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Documents/SCOE_2014_MDOT.pdf, last accessed August 4, 2017.

Garrett, M. (2013). *Accelerating Project Delivery: The Next Generation of Environmental Streamlining*, Oregon Department of Transportation, Salem, OR. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogical Approach/Documents/AASHTO_2013_ODOT.pdf, last accessed August 4, 2017.

Gates, J. (2014). *Implementing Eco-Logical in a World of Schedules and Salmon*, Maine Department of Transportation, Augusta, ME. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogical Approach/Documents/SCOE_2014_MaineDOT.pdf, last accessed August 4, 2017.

Mester, L. (2013). *Improving the Health of the Western Lake Erie Coastal Zone,* Michigan Department of Transportation, Lansing, MI. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/ Documents/AASHTO_2013_MichiganDOT.pdf, last accessed August 4, 2017.

North Carolina Department of Transportation. (2015). *The 2015 International Conference on Ecology & Transportation: Program Proceedings*, International Conference on Ecology & Transportation, Raleigh, NC. Available online: http://www.icoet.net/ICOET_2015/program-proceedings.asp, last accessed August 4, 2017.

Simmons, D. (2013). *Streamlining Project Development Through the Watershed Resources Registry*, Maryland Department of Transportation and State Highway Administration, Hanover, MD. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Documents/AASHTO_2013_MarylandDOT.pdf, last accessed August 4, 2017.

Second Strategic Highway Research Program. (2014). *Integrated Ecological Framework Outreach Project*, Federal Highway Administration, Washington, DC. Available online:

http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_C06_OutreachReport.pdf, Site last accessed August 4, 2017.

Sutliff, K. (2013). *Success in Partnership and Planning Along Three Highway Corridors in California*, California Department of Transportation, Sacramento, CA. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogicalApproach/Documents/AASHTO_2013_Caltrans.pdf, last accessed August 4, 2017.

Wendling, K. (2014). *Implementing Eco-Logical in North Central Texas (SHRP2 C06)*, North Central Texas Council of Governments, Arlington, TX. Available online: https://www.environment.fhwa.dot.gov/ecological/ ImplementingEcoLogicalApproach/Documents/SCOE_2014_NCTCOG.pdf, last accessed August 4, 2017.

Williams, T. (2014) *Eco-Logical and Integration of Geospatial Tools and Data*, Arizona Department of Transportation, Phoenix, AZ. Available online: https://www.environment.fhwa.dot.gov/ecological/ImplementingEcoLogical Approach/Documents/SCOE_2014_AZDOT.pdf, last accessed August 4, 2017.