6 The Current Planning and Design Process

Stephen Tonjes, Sandra L. Jacobson, Raymond M. Sauvajot, Kari E. Gunson, Kevin Moody, and Daniel J. Smith

There are two states to any large project—
too early to tell and too late to stop.
—Ernest Fitzgerald 2010

6.1. Introduction

Road projects are like trains—slow to get rolling, averse to getting off track, and hard to slow down. As a result, the best opportunities to incorporate wildlife accommodations into a project are in the early stages of project development, where deadlines are more flexible and the larger issues of road corridor impacts on regional landscapes are usually considered. However, people concerned about the impacts of road projects are often frustrated trying to learn exactly what is being proposed, and how they can have their concerns addressed. Project managers are under pressure to deliver their projects on time and within budget, and the purpose and need of transportation projects are almost always defined solely in terms of the transportation goals. Hence, integrating ecological infrastructure into road planning, design, and operations requires a basic appreciation of the decision-making processes and administrative procedures that transportation agencies use.

Even if project managers are sympathetic to the impacts of roads on wildlife, they must be able to justify spending time and transportation money on elements that do not contribute directly to the transportation goals; therefore, it is helpful to ensure they are aware of environmental laws and public interests related to accommodating wildlife. Chapter 5 discusses various ways to generate public understanding of, and support for, wildlife issues. The road project development process is structured to obtain public input, and provides formal and informal opportunities for the public and resource professionals to offer education and demonstrate support for wildlife concerns; however, public input will have much more influence on project outcomes if it is provided to the right people at the right time.

Road projects usually proceed through distinct phases, distinguished by the kinds of information gathered and the professional disciplines involved. In the United States, development of state and federal transportation systems consists of three major phases: (1) preliminary planning; (2) project delivery (preliminary engineering / conceptual design and detailed design); and (3) construction, maintenance, and monitoring (discussed in Chapters 11 and 12). This chapter describes the first two phases and highlights the points at which people concerned about wildlife can most effectively engage with these efforts. The phases may have different names in different agencies and different countries, and may be combined or shortened depending on the complexity of the project, but most projects follow a similar sequence. Public input is most effective when it is addressed to the aspects of the project under consideration at the time.

6.2. Initial Considerations in Planning and Design

In the preliminary planning phase for federal and state highways in the United States, current and anticipated deficiencies are identified in the regional road network, and individual projects are proposed to correct them. This phase is usually conducted by professional planners working in the state departments of transportation (DOTs) and in regional transportation planning organizations, as described in 6.2.1. To most effectively integrate ecological infrastructure into road planning and design, any proposed mitigation measures should be well supported by documents, such as:

- scientific data,
- site-specific photos, and
- shared management goals and objectives among the agency and other relevant stakeholders.

When the above information is provided to decision makers, the chances are greater that measures will be adopted into the project plan. As part of this documentation and justification, information necessary to weigh trade-offs includes (1) what would result from no action (i.e., no mitigation measures implemented) versus what would result from implementation of preferred alternatives, including the ideal one; (2) what uncertainties exist; and (3) potential ways to assess effectiveness (i.e., performance measures). Throughout this process, the level and type of detail in the documentation and justification materials provided must be in line with the level of detail that the target audience can meaningfully integrate.

Decisions to integrate ecological infrastructure with transportation infrastructure should start with a discussion of the natural resources present in the transportation corridors. Ideally, the discussion will also include information about community areas (e.g., either a state or locally designated bird sanctuary or a wildlife viewing area would be considered a community value) and notable features (e.g., a natural wetland or forested area). Being equipped with this information, particularly if the proposed measure to maintain ecological infrastructure also connects community areas and notable features, can support the justification for the proposal offered to decision makers. The justification is further strengthened when community areas or notable features are associated with performance indicators (e.g., increases in wildlife diversity or maintenance of fish or wildlife populations as a result of the proposed mitigation measure).

6.2.1. Allocation of Funding

Federal transportation funding originates from federal gas tax and general fund tax dollars. These funds support the Federal-aid Highway Program (FAHP), and the Federal Lands Highway Program (FLHP). Summarized simply, the FAHP distributes tax dollars for the construction, operation, and maintenance of state highway systems, including interstates, primary highways, and secondary local roads (http://www.fhwa.dot.gov/federal-aidessentials/federalaid.cfm), and the FLHP provides funding for public roads on federally managed lands (http://flh.fhwa.dot.gov/).

FAHP funds are distributed to states according to a formula established by Congress. For large metropolitan areas, states are required to establish regional transportation planning organizations, which are intended to provide state DOTs with a balanced assessment of regional transportation needs and avoid arbitrary or inequitable distribution of funds. These regional organizations are known variously as metropolitan planning organizations, transportation planning organizations, transportation planning authorities, transportation councils, or councils of governments, among others. They are comprised of elected officials from the municipalities in the region and are supported by staff and by citizen and technical advisory committees. These planning organizations develop long range (20 year) transportation plans (LRTPs), and short range (5 year) transportation improvement programs (TIPs), both of which establish the region's transportation priorities. The state DOTs generally follow the priorities in these plans to develop their own long-range and short-range plans (work programs).

These plans are updated annually by adding new projects and adjustingpriorities of projects from the previous plan. New projects usually are added into the later years of the plan, which gives the agencies time to adjust their workloads. Sometimes, however, under political pressure, projects slated for later years may be initiated sooner, and new projects also may be crowded into earlier years, making it more difficult for agencies to give all of these projects the full time and resources they need.

6.2.2. Integrating Wildlife and Natural Resources Information during Planning

Wildlife and ecology professionals should participate in the development of these large-scale, proactive planning efforts. Planners need to know how the road network will interact with the surrounding ecological landscape. Interested citizens can work directly with the elected officials who are members of the regional transportation planning organization, or participate on a citizen advisory committee, to ensure that the regional transportation plan takes ecological infrastructure into account when roads are initially planned. Unfortunately, few people interested in environmental issues are even aware of the existence of the regional transportation planning agencies and the opportunities they offer.

In addition to public input, the early planning phase should include consultation with environmental resource agencies, such as the US Fish and Wildlife Service (USFWS) and state wildlife agencies, and should take into account the many sources of environmental resource information available in most states (e.g., state wildlife action plans, multispecies habitat conservation plans, natural heritage databases, land use plans, green infrastructure planning, watershed plans, historic resource inventories, special area management plans, GIS maps of resource corridors). But there is always political pressure to shorten the transportation development process, and early review by resource agencies is often a step that is compromised.

In 2005, the federal transportation funding bill mandated that states develop a formal process to be approved by the Federal Highway Administration (FHWA) in order to incorporate consultation with environmental resource agencies during early transportation planning. In response, the state of Florida developed a plan that was essentially a waiver based on their previously established Efficient Transportation Decision Making (ETDM) process. ETDM gathers and displays the best information available about the area that would be affected by a proposed road project. This information is distributed to resource agencies for formal comment and is also available to the public. Florida initiated the ETDM process because in the absence of early resource reviews, time and money were being invested in detailed development of projects that later became bogged down when controversial environmental impacts were identified. However, even this process is sometimes rushed by local pressure to complete a particular project; therefore, even when tools are available, it is important for citizens to insist on their effective use.

6.3. Project Delivery

After a project has been scheduled in the planning phase and adopted into a state DOT work program, it is assigned to internal or external consulting engineers for design. In most state DOTs, design occurs in two separate phases. The first stage of the project delivery phase is called preliminary engineering, or conceptual design; the second is called detailed design. In preliminary engineering, the scope of needed improvements and the way they will fit into the landscape are determined based largely on readily available information, such as topography, soil maps, and original plans (if the improvements are to an existing road). Conceptual plans are produced that show the general dimensions and locations of the proposed improvements. This preliminary engineering stage is where the research and documents required under the National Environmental Policy Act (NEPA) are generated (Section 6.3.1). In detailed design, extensive elevation and location surveys, soil testing, and other site data are obtained and made available to design project team members in several different engineering specialties (e.g., road, drainage, structures, and pavement). These engineers then design their respective elements and fit them together into a set of detailed plans that can be used for construction. Detailed design is covered in Section 6.7.

6.3.1. Preliminary Engineering

All actions, approvals, and funding issuing from federal agencies are governed by NEPA. This legislation established a formal process to evaluate all the environmental impacts of federal or federally funded actions, and to disclose the results of its evaluation to the public. Whenever a federal agency proposes to fund, approve, or build a road project, it must undertake a study and prepare a document in which it develops alternatives that balance the traffic benefits, costs, and impacts to the environment (both the human and natural resource environment) of the proposed project. It is actually the state DOT that designs the road and prepares the document, but the project must be developed according to explicit federal rules and the document must be approved and signed by FHWA as satisfying the requirements of NEPA.

Depending on the significance of the expected impacts, the primary NEPA document may be (1) an environmental impact statement (EIS); (2) an environmental assessment (EA), leading either to an EIS or to a finding of no significant impact (FONSI); or (3) a type II, type I, or programmatic categorical exclusion (CE), in descending order of complexity (Box 6.1). The process of assigning the class of action to a project is not always consistent among or even within agencies. Building a major highway in a new location generally requires an EIS, and upgrading traffic signals on an existing road generally is categorically excluded, but for projects of an intermediate nature, establishing the significance of impacts has been debated since NEPA was enacted. Therefore, a project that would be developed with an EA in one jurisdiction may go straight to an EIS in another. Nevertheless, the process of evaluating project alternatives for environmental impacts is the same, and the difference in the documents is only in the degree of detail and extent of review by other agencies and the public.

NEPA has produced many benefits, including the requirement for the agencies to consider a much wider range of factors than cost and engineering. It also acts as an "umbrella" to ensure compliance with a number of laws protecting many different kinds of resources. A similar process has been adopted in many states for projects that have no federal involvement (e.g., California Environmental Quality Act [CEQA] in California, and State Environmental Impact Report [SEIR] in Florida).

The opportunity for stakeholders to provide input is a unique aspect of NEPA. The EIS is the only document for which a formal public hearing is required by NEPA, but many state DOTs include public involvement, with or without formal hearings, for all projects at or above the level of a type II CE to identify potential controversy that could delay the project later. However, large road projects are very complex and before a project can be formally presented to the public, considerable effort and money are usually expended in developing and evaluating proposed alternatives, and in preliminary coordination with resource and permitting agencies. The public hearing is the official opportunity to comment on the adequacy of the alternatives analysis and bring to light impacts and public sentiment that might not have been identified or given sufficient attention. Projects have indeed been redirected as a result of input from the public hearing provided by NEPA. However, any substantial changes at this stage have the disadvantage of requiring the revision of work in which time and effort have already been invested. Effective avoidance and mitigation of environmental impacts is better assured if the potential impacts have been identified during the planning phase, and if wildlife experts are involved in development of the alternatives before they are presented at the public hearing, as discussed in the next section.

Box 6.1. Key Terms from the National Environmental Protection Act (NEPA)

Environmental Impact Statement (EIS)
A full disclosure document that details the process through which a federal project was developed (e.g., actions planned and decisions made), includes consideration of a range of reasonable alternatives, analyzes the potential impacts resulting from the alternatives, and demonstrates compliance with other applicable environmental laws and executive orders (adapted from 40 CFR 1502.1; see also 23 CFR 771.123–125).

Categorical Exclusion (CE)
A category of [federal] actions that do not individually or cumulatively have a significant effect on the human environment . . . and . . . for which, therefore, neither an environmental assessment nor an environmental impact statement are required (adapted from 40 CFR 1508.4; see also 23 CFR 771.117).

6.3.1.1. Early Involvement with the Project Team during the NEPA Study

A more effective way to influence a project during the NEPA study is to become involved early in the development of the environmental analyses. It has become more common for project teams to hold informal public workshops or information meetings (prior to the official public hearing) early in the process of alternatives analysis. If these opportunities are not offered, then individuals or organizations should contact the road project manager as early as possible and ask how they can be involved.

6.3.1.2. Early Involvement with Wildlife Resource Agencies during the NEPA Study

For wildlife issues, it may be most effective for wildlife experts to get involved in the transportation project through the state and local fish and wildlife divisions and other environmental or natural resource agencies. By law, the project sponsor and lead transportation agencies must invite the participation of relevant agencies (including wildlife and natural resource agencies) during the development of various portions of the reports (http://www.fhwa.dot.gov/hep/section6002/1.htm). External stakeholder input, particularly when supported by data, can be a valuable supplement to that of the state fish and wildlife agencies.

Reviewers at the agencies are likely to welcome input from specialists in road ecology and experts on the species that will be affected by the project. The biologists who present the transportation agency's assessment of wildlife impacts and the biologists who are consulted for comment at the resource agencies come from a variety of backgrounds and specialties and may or may not be current with the rapidly evolving field of road ecology. Therefore, not all biologists may understand how to translate the biology of organisms to the need for accommodations or the specific requirements of the target species in relation to engineering and design specifications. Furthermore, as discussed below, not all biologists are likely to be familiar enough with the engineering process in the detailed design stage (Section 6.7), which follows the NEPA study, to be able to suggest commitments in the NEPA documents that are specific enough to ensure that wildlife accommodations will be designed to function as intended.

Specialized biological impact analyses and other supporting technical documents (e.g., noise study, cultural resources assessment, contamination assessment) are produced in support of the primary NEPA document (EIS, EA/FONSI, or CE). These technical documents are reviewed by specialists on staff at FHWA along with the primary document, but only the primary NEPA document is routinely consulted by the state DOT engineers in the subsequent design phase. Therefore, any recommendations made in the biological impact analyses must be translated into specific commitments, or agreed-upon actions, in the primary NEPA document. In making this translation, ecologists and engineers must be aware of important differences in the approaches of their respective sciences, which are discussed in more detail in Section 6.7.

For example, when wildlife scientists recommend crossing structures, they may assume that fencing to guide the animals to the structures will be included as part of a good design, but most engineers in the design phase will be surprised at this "extra" request if fencing has not explicitly been specified in the NEPA documents. There are also misconceptions about where wildlife fencing may be installed. Sometimes a wildlife corridor occurs on both public and private land. If the private land use will continue to allow wildlife movement, some states have routinely installed fencing in the road right-of-way adjacent to both the public and private land, coordinating with the land owner to maintain access with gates or other devices. In other states, engineers are reluctant to install fencing adjacent to any private land, even next to physical features already precluding access (S. Tonjes, Florida DOT, personal observation).

Design errors that compromise the functioning of wildlife accommodations are common (Sections 6.8 and Section 1.3.4). The final NEPA decision document should identify the target species, and the conceptual design should include the locations, types, and dimensions of the wildlife crossing structures, any special characteristics of the substrate and landscaping leading up to the structures, and locations and types of fencing. These become "commitments" that are similar to contractual agreements. The commitments should require continued involvement in, and review of, both concepts and detailed plans by wildlife experts during the design phase, and during pre- and post-construction monitoring and adaptive management as described in Chapter 12 (Section 12.2.2).

6.3.1.3. Case Study: Proactive Planning and Interagency Collaboration

Stephen Tonjes and Daniel J. Smith

State Road (SR) 40 runs east and west through the middle of Ocala National Forest (ONF) in central Florida and connects major cities in the eastern and central parts of the state, as well as two interstates. Established in 1908 as one of the first national forests east of the Mississippi River, ONF protects many significant archaeological, historical, geological, and botanical resources, including the world's largest contiguous sand pine scrub forest. It supports a diverse wildlife community, including the threatened Florida scrub jay (*Aphelocoma coerulescens*), Florida sand skink (*Plestiodon reynoldsi*), and wide-ranging species such as the Florida black bear (*Ursus americanus floridanus*) and the threatened eastern indigo snake (*Drymarchon couperi*).

To accommodate projected traffic volumes, the closest alternative east-west connectors outside ONF would require major upgrades, with their own environmental impacts and would substantially lengthen the travel distances between the cities now served by SR 40. The Florida Department of Transportation (FDOT) began the preliminary engineering process to add lanes to SR 40 three times between 1988 and 1998. However, several state and federal resource agencies had identified the Greater Ocala National Forest Area as being especially susceptible to the negative consequences of fragmentation and habitat loss as a result of the widening of SR 40. Each attempt led to a stalemate over the impact of widening a road that was already perceived as splitting ONF in half.

In 2003, FDOT finally convened a task force consisting of all stakeholders who had an interest in the road, and who wanted ONF to take a broader perspective and discuss what alternatives might be feasible to improve transportation and to avoid or mitigate the wildlife impacts of the road. The task force meetings were professionally facilitated and aerial photography and Geographic Information Systems (GIS) data were used to develop consensus among the stakeholders concerning the general locations and priority of all wildlife crossings, and concerning other measures that would be needed to satisfactorily mitigate effects of widening the road. These conclusions were documented and used as the starting point of another preliminary engineering NEPA study in 2006.

The preliminary engineering study continued to involve the stakeholders in several advisory committees, including a Wildlife Crossings Task Force that met frequently to decide on the sizes and locations of the crossing structures. A commitment was made in the NEPA document to reconvene this task force during design to review the precise placement of the structures and other parameters (e.g., substrates, lighting, landscaping, and interior cover).

Because of these commitments, the engineering firms that were selected for the design phase had added in-house or subcontracted wildlife ecologists to their usual design teams; these scientists worked with the engineers from the beginning. They collaborated early and met in person to discuss concepts before time and money was spent developing finished plans. Further, the teams looked beyond the usual boundaries of their own project phase by developing a maintenance protocol for each crossing to ensure that important features such as substrates, interior cover, fencing, and landscaping, which could vary among crossings and change over time, would be maintained properly. The advantages of including wildlife experts early in the detailed design process are discussed in more detail in Section 6.7. The benefits of establishing specific maintenance protocols are discussed in Chapter 11.

This case study is an example of effective collaboration between a transportation agency and a range of stakeholders to develop a major road-widening project through a sensitive ecosystem. It illustrates the value of the following:

- Stakeholder and wildlife expert participation in the planning and preliminary engineering phases. Large, complex projects have a much greater chance of successful outcomes if they are planned and designed under the guidance of a formal process to engage all stakeholders, collect and analyze all relevant information, facilitate and document decisions, and monitor implementation and results. (See Section 6.4.2 for examples of formal models to guide early stakeholder collaboration.)
- Strong and specific commitments in the NEPA documents.
- Participation and review by wildlife experts in the detailed design phase. The need for collaboration with wildlife experts in the latter stages of project development is not as well recognized as the need to do so in the early stages, but it is just as important, as illustrated in Section 6.7.

6.4. Public Lands

When taken as a whole, federally owned lands encompass nearly 25% of the United States and provide habitat for almost two-thirds of all endangered and threatened species (White and Ernst 2004). While public lands are thought to be scenic landscapes and pristine sanctuary for wildlife, they are not exempt from the many impacts of roads (Andrews et al. 2006). The US Bureau of Transportation Statistics (www.transtats.bts.gov, 2004) defines an urban area as "a municipality . . . with a population of 5,000 or more." By this definition, many national parks and wildlife refuges have daily visitation levels equivalent to that of small urban areas and during months of peak visitation have traffic volumes comparable to some cities (www.nps.gov, 2004). Furthermore, an estimated 10% of all roads in the United States occur in national forests (~611,420 km, Forman 2000), a length that could encircle the earth approximately 15 times. In an analysis of road fragmentation in national parks by Schonewald-Cox and Buechner (1992), even the largest parks (up to 9,000 km^2) encompass few areas that lie more than 10 km from roads. Additionally, 30% of the land area within highly fragmented parks is within 1 km of a road, and all land parcels comprising 100 km^2 were within 500 m of roads.

6.4.1. Environmentally Sensitive Areas on Public Lands—Roads in National Parks

Most federal agencies that manage public land also have legal mandates and policies that delineate procedures for allowing significant developments on their land, including roads. Thus, in addition to the standard federal requirements of NEPA and other broadly applicable federal laws (e.g., Endangered Species Act [ESA], Clean Water Act [CWA]), specific agency mandates and policies can have significant influence on if, when, where, and how roads are developed. Understanding these policies and procedures, and participating early in the planning and development process, can result in important design improvements for roads in environmentally sensitive areas on public lands.

From the early years of the national park system and particularly during the 1950s and 1960s, facilitating access to national parks was an important priority and a driving factor in the creation of improved visitor facilities and infrastructure. Park visitation expanded rapidly as more campgrounds, lodges, hotels, visitor centers, and other services became available. Through this development, roads became the key arteries for bringing people into the parks, and the design of roads was even seen as a way to enhance visitor experience. National park roads therefore not only facilitated access, but also contributed to the park experience due to stunning and dramatic roads developed at sites of impressive vistas and other notable natural features. In general, however, little knowledge or consideration was given to the potential wildlife impacts of roads and their role in fragmenting habitat.

Bumper-to-bumper traffic is now a common situation in many national parks. Most federal parks have a low speed limit of about 45 mph (70 kph), and because people are typically looking around for wildlife, traffic jams caused by animals near the roads are common. This fairly slow speed and attention to wildlife does not guarantee a lack of vehicle-caused mortality, and for small animals that are essentially invisible to drivers, the mortality impact can be comparable with other roads in urban areas. The high traffic volume of many parks can lead to a complete barrier for many small species (anurans, Hels and Buchwald 2001; snakes, Andrews and Gibbons 2005; turtles, Aresco 2005).

The National Park Service (NPS) is part of the US Department of the Interior and provides an example of how agency specific policies can influence road development and provide opportunities to reduce impacts on wildlife. Nearly 400 units are managed by the NPS in the United States, including well-known sites (e.g., Yellowstone and Yosemite National Parks) as well as those lesser known (e.g., Lewis and Clark National Historical Park). Overall, the NPS owns and operates close to 8,900 km (5,500 mi) of paved public roads and over 1,400 associated structures such as bridges, culverts, and tunnels (NPS and FHWA 2008). Funds to develop, maintain, and improve park roads come from many sources, including federal appropriations from transportation programs, NPS facility maintenance funds, and even from private and nonprofit donations. In the last 20 to 30 years, NPS road developments have received NEPA reviews consistent with other federal agencies, and similarly were required to abide by other federal environmental laws and regulations. However, as an agency focused on resource preservation with a clear mandate to protect those values in perpetuity, additional standards and expectations have become incorporated into the planning and design expectations for NPS roads. In general, infrastructure priorities for individual park units are articulated in their General

Management Plans and in site-specific designs, such as Development Concept Plans for visitor use areas or park access routes. The mission of the agency becomes a key driving factor in influencing these planning documents and development priorities, and activities that have the potential to permanently impair resource values are prohibited by law and policy.

As knowledge of road ecology and the threats posed by habitat fragmentation have advanced, NPS road planning and design have become more responsive to reducing impacts on wildlife. For example, transportation planners at the NPS Denver Service Center, which provides design and engineering support for national parks, have been compiling road and wildlife mitigation materials when road projects are contemplated or envisioned. Consequently, new opportunities to influence road developments in parks are advancing, motivated less by government-wide environmental regulations (e.g., NEPA) and more by the mission, policies, and mandates of the agency. Because of this, commitments to wildlife-oriented road designs can be incorporated at earlier levels of infrastructure design and planning, from the broadest management policies of the agency at the national level, to park-specific General Management Plans and location-specific development plans and designs.

To help ensure that heightened levels of wildlife sensitivity are included in park roadway plans, designs, and construction, the NPS developed a reference manual in collaboration with the FHWA. The manual articulates environmental review procedures, mission goals, and policies of the NPS so that road development projects under the FLHP (Section 6.2.1) proceed in a manner consistent with NPS-specific requirements (NPS and FHWA 2008). In addition to providing substantial program administration details, the reference manual lays out communication expectations to promote mutual understanding between NPS and FHWA when working together on road projects in national parks. This approach has far-reaching implications for park roads because most major road projects in the parks are implemented as part of FLHP using federal transportation funds. Indeed, FLHP projects have occurred or are underway in many national parks, from the old growth forests of Mount Rainier to the deserts of Death Valley, with formal agreements in place that combine NPS-specific resource preservation priorities with park visitor transportation needs. Individual projects implemented in this way are also subject to review by stakeholders and the public through the NEPA process, so significant opportunities are available to incorporate wildlife accommodations with FHWA and NPS.

6.4.2. Public Highways through Public Lands

A congressional report on wildlife-vehicle collisions found that rural, two-lane highways with speed limits of 55 mph (90 kph) or greater have the highest rate of wildlife-vehicle collisions (Huijser, McGowen, Fuller, et al. 2008). Although this finding was based on large rather than small animals, these roads probably constitute a formidable threat to small animals as well. Rural highways of this description are the most common roads on public lands. These roads traverse the best remaining wildlife habitat in the nation, often in large core tracts. As described above for the NPS, agency-specific missions, mandates, and goals can supplement NEPA requirements to help promote road designs that reduce impacts to wildlife.

Planning for wildlife features on highways through public lands, however, is complicated by the need to know whose jurisdiction covers the highway. Often it can be federal, state, and local, with different authorities for different aspects of planning, construction, and maintenance. In areas of the rural west, the US Forest Service (USFS) and US Bureau of Land Management (BLM) manage vast acreages of contiguous lands, so working on a highway development project may have fewer stakeholders than highways across federal lands in the eastern states where private inholdings are common. Highway projects through public lands are usually led by the state DOT, and the federal land management agencies take a supportive role. Although it is becoming more common for land management agencies to take a more assertive approach toward highway development on their land, it is highly inconsistent across the country and some state and federal agencies have yet to understand the issues and available mitigation measures for wildlife.

All of the federal land and resource management agencies must follow federal laws, including NEPA, during highway development projects. However, different agencies have different regulations for implementing

Box 6.2. The Rapid Assessment Process
Daniel J. Smith and William Ruediger

If cost and time are significant limiting factors to conducting an in-depth ecological planning assessment, a Rapid Assessment Process (RAP) can be a practical and effective approach (see www.rapidassessment.net for more information). In many instances, particularly when early engagement did not occur, the timeline available for conducting more extensive (multi-year or replicated) ecological assessments is insufficient. Here, the choice is to neglect the ecological planning aspect of the project or to employ a more rapid, yet still integrated, assessment. To understand the expected outcomes from a RAP, it is important to recognize the different perspectives of the stakeholders (e.g., project managers, engineers, scientists, regulatory agencies, nongovernmental organizations [NGOs]) and their knowledge of the elements involved in the problem and evaluation of effective and feasible solutions. For example, a project manager might be focused on types, quantities, and the quality of information needed to properly guide an assessment of linkages, structures, or other mitigation measures. Transportation engineers will seek what information is available or critical for decision making and will be acutely aware of cost elements and the practicality of which design structures will work best with the immediate landscape. Biologists can assist with gathering existing information, informing stakehholders, and providing recommendations for additional ecological assessments. All stakeholders need to focus on how to minimize the amount of funds spent on (a) data collection and assessment, and (b) structures or other mitigation measures without compromising the integrity and objective of the project.

Given the varying backgrounds of stakeholders, it is important that all of these perspectives convene for the RAP. Specifically, a comprehensive list of what relevant information exists should be compiled with the project manager. This information should then be used as guidance in assessing what and how much information is needed given the available time and financial resources. For example, a valid need for new information could include confirming the presence of target species or groups, or collecting data on hydrology that would affect design specifications of road infrastructure features. In other words, new information is considered necessary if it directly influences the timing or design of the construction project.

NEPA. This difference in approach and pace can lead to misunderstandings whereby land management and transportation agencies, with quite different missions, and personnel with different academic training, find their agencies at odds. For example, the USFS has an agency-specific list of "sensitive" species that must be analyzed in its environmental documents; consultants who have worked for state transportation agencies but not on projects on national forest lands may be surprised to find they have an additional list of species to assess in a schedule that does not allocate the time to do an adequate biological evaluation.

To be effective, stakeholders and the transportation agency must be informed about the resource conservation policies of the agency, understand the infrastructure planning and decision-making process, and participate in the process with this knowledge in mind in order to ensure that road plans and designs reflect commitments to wildlife conservation. The project development process should include regular meetings with consistent points of contact and careful documentation of decisions. A formal model to guide collaboration among stakeholders involved with transportation projects is provided below as an example, and there are also others available (Brown 2006; CEE 2009; CRAFT 2012). By engaging at the earliest conceptual stages of infrastructure planning (e.g., the General Management Plan stage for NPS) when project-specific design features such as wildlife crossing structures are proposed (e.g., as part of an EIS process), the value of such measures will already be established as important and consistent with agency policies and priorities.

6.5. County, Municipal, Industrial, Commercial, or Residential Roads

Local roads can have substantial impacts on wildlife. Many local roads have traffic volumes comparable to major state and federal highways, and even roads with low volumes have been documented as a formidable threat for smaller and slower animals (Hels and Buchwald 2001; Chapters 3 and 4; Andrews et al. 2008).

6.5.1. Development Process

Local public and private roads are subject to most of the same laws protecting natural resources, such as the Endangered Species Act, that govern state and federal highways. However, since NEPA applies only to federal actions, there is usually no comparable umbrella environmental process that comprehensively monitors for compliance and provides opportunities for public input. An important exception is a local road that receives federal funding or has another federal nexus, such as US Army Corps of Engineers permits or other impacts on a federal interstate highway. Some larger municipalities in the United States also may have a more comprehensive local process to engage the public and document compliance with environmental laws.

In Canada, the regional and local governments have a process similar to NEPA, known as Class Environmental Assessments (CEA). CEAs are divided into three schedules: A, B, and C. They vary in scale, potential impacts on the environment, and level of consultation required. Schedule A projects are typically small-scale routine projects, such as maintenance activities on roads. Schedule B projects are required to undertake a screening process that involves mandatory contact with the public, individuals, and entities who are directly affected; relevant government agencies are also contacted to ensure that all are aware of the project and that their concerns are addressed. An example of a schedule B project is improvements to an existing road, such as addition of culverts. Schedule C projects have the potential for significant environmental effects and must proceed under the full planning and documentation procedures specified in the Class EA document, which includes the development of an Environmental Study Report. Road extensions and upgrades are generally Schedule C projects.

6.5.2. Incorporating Wildlife Concerns into Local Projects

For roads not subject to NEPA or a similar process, concerned citizens or environmental groups who want to integrate wildlife concerns with road plans must first learn about the local procedure for planning and designing roads, along with agencies that have review and permitting authority. For example, some counties and large municipalities have their own long range transportation plans that are periodically advertised for public comment. An interested citizen or agency could identify potential points of conflicts where planned county roads might affect wildlife resources; they could do this either when the transportation plan is advertised, or, even better, in early conversations with staff in the county planning department. This opportunity is similar to that available for federally and state funded projects through the regional planning organizations described in Section 6.2.1. However, when county projects begin the engineering phase, there is no formal opportunity similar to NEPA for public review of individual project designs. As discussed below, this process requires finding and meeting with appropriate staff members.

As with the NEPA process, earlier is better. Most municipalities have a planner or a planning department with staff who should be able to explain how public road improvements are planned, how private roads are permitted, and where the opportunities are to address environmental concerns. Some municipalities may be more progressive, and may have an existing environmental review process or may be more open to addressing ways to maintain ecological infrastructure. Opportunities do not have to be formal. In fact, it may be more effective to work with a sympathetic staff person who will help navigate the planning phase and then perhaps identify a helpful contact in the road engineering department when the project is ready for design.

6.5.3. The Role of Resource Agencies

Like state and federal highways, any local road project that affects wetlands will require permits, and wildlife habitat is an important consideration in wetland permit reviews. The US Army Corps of Engineers (COE) reviews projects with impacts to wetlands that fall under their jurisdiction, and in fact must follow the NEPA process in order to issue its federal wetland permit. Many states, some counties, and other municipalities may also have their own wetland permit requirements or ordinances in addition to COE compliance requirements. The COE and the state wetland permitting agencies issue public notices for individual permit applications. These permits are another opportunity for input from wildlife experts, especially if the municipality planning the road has been unresponsive. Sometimes municipal wetland ordinances can also present opportunities for proactive measures.

6.5.4. Case Study: Effective Community Design to Maintain Ecological Infrastructure

David A. Mifsud

The growth and development of the City of Novi located in Oakland County, Michigan, has been driven by environmentally focused planning that protects and reduces impacts to wildlife habitat. The City of Novi was a pioneer in developing local-level regulations and innovative community planning to protect their natural resources. They were one of the first municipalities with a local wetland ordinance (adopted in 1986) and are still one of the few communities in Michigan with a woodland protection ordinance. The City of Novi was also one of the first communities to develop conservation easements on sensitive land, and wetland setback ordinances. Through proactive conservation strategies and incentives for responsible planning that promote road minimization, this community has preserved large tracts of land, reduced wildlife habitat fragmentation, and promoted the desired growth of their community.

Armed with these guidelines and a firm strategy for environmentally sensitive site design, the City of Novi Planning Department and their team of environmental consultants guided a residential development project in 2001 to avoid fragmentation of critical wildlife habitat. The proposed Maybury Park Estates was a 54.63 ha parcel located between high-end subdivisions, single-family homes, active agriculture, and a state park. Prior to development, the site contained portions of active agricultural land and natural areas. During the City's Environmental Review and Site Plan Approval process, the area was identified as an important community natural resource because it was part of a large designated wildlife linkage in the municipality and part of a core habitat reserve. Further investigation revealed several high-quality beech, maple, and oak-hickory woodlands and an assortment of wetlands (emergent marsh, open water ponds, and numerous vernal pools) that supported a diverse assemblage of amphibians and reptiles (i.e., herpetofauna). Herpetofauna richness was high for the area, with 17 observed species and 5 additional species likely present based on habitat availability. Herpetofauna observed at this site and in the immediate vicinity included five species of salamanders, nine species of frogs, seven species of snakes, and one species of turtle.

Due to the high quality of portions of the site and the historic analysis conducted by the city identifying this region as part of a critical habitat corridor, measures were taken to minimize negative ecological effects from the proposed development. The project was submitted under the Residential Unit Development category (RUD), one of several ecologically responsible development options offered by the city, which allows the developer to create smaller lot sizes and increase the number of lots available if habitat preservation and impact minimization criteria are fulfilled. This strategy also reduces negative impacts to habitat by encouraging smaller overall development footprints. These and similar planning options encourage developers to minimize impacts and improve wildlife habitat by increasing potential profits. The developer and the City of Novi worked together to capitalize on this mutually beneficial opportunity, resulting in a total of 106 lots on the 54.63 ha site, with approximately 38.8% of the site (20.04 ha) permanently preserved (Figure 6.1).

Habitat fragmentation and mortality resulting from roads bisecting wildlife habitat can significantly affect herpetofauna and other wildlife populations (Chapter 4 and references therein). Roads create permanent barriers and introduce environmental disturbances that can reduce a biological community's diversity, increase genetic isolation, and increase species competition, thereby resulting in potential extirpations (e.g., Fahrig et al. 1995; Findlay and Bourdages 2000; Gibbs and Shriver 2002; Beaudry et al. 2010; Gunson et al. 2012; Sarver 2012).

One of the goals of development planning was to maintain the connectivity and ecosystem integrity,

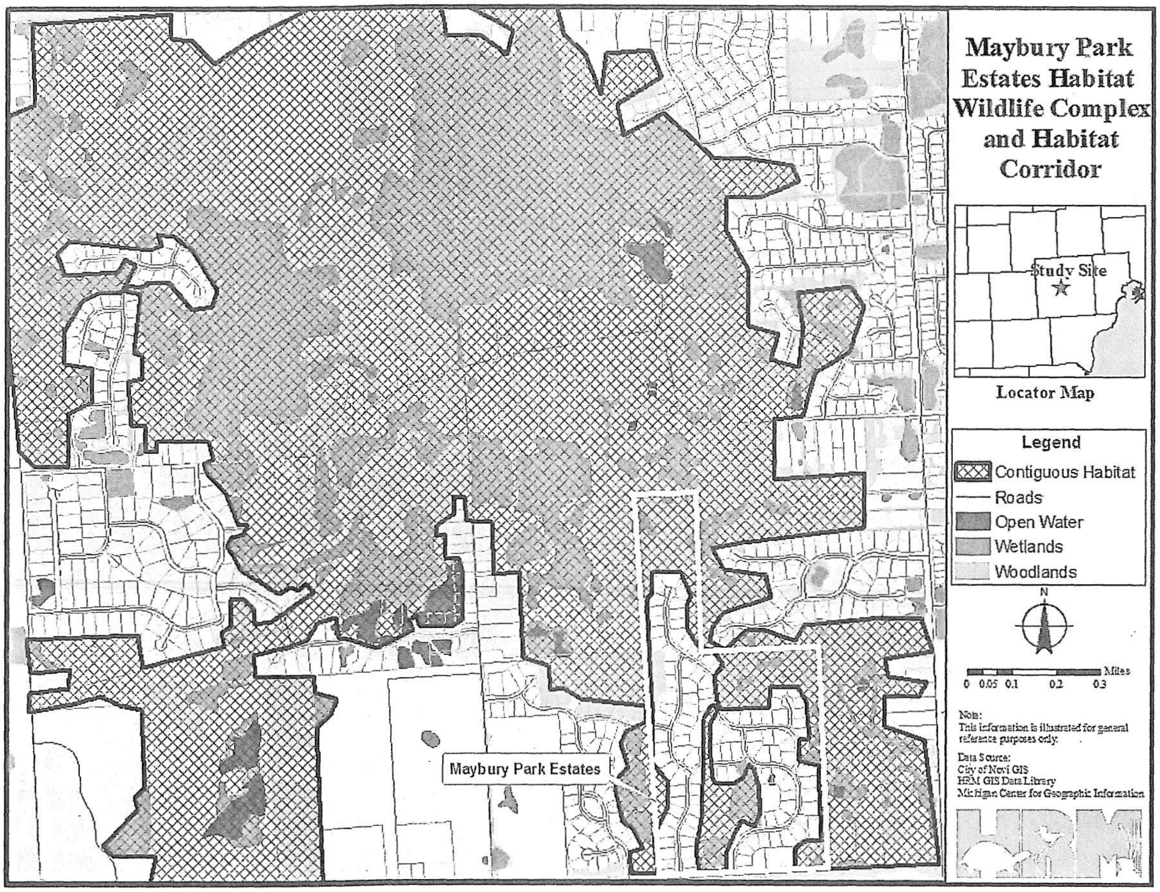

Figure 6.1. Location of Maybury Park Estates in proximity to contiguous protected habitat complex and adjacent residential developments. *Credit: Herpetological Resource and Management, LLC.*

thus maintaining ecological infrastructure. The road network within Maybury Park Estates was configured to avoid the highest-quality habitat in order to meet habitat connectivity goals, while also addressing traffic flow and emergency vehicle access. This alignment allowed for public infrastructure needs to be met without disregarding ecological infrastructure. To further reduce potential fragmentation resulting from road placement, low rolled curbs with gradual slopes, which small frogs and turtles could easily traverse, were used throughout the subdivision (Figure 6.2; Section 9.2.7). Additionally, to help minimize road-related mortality at critical herpetofauna movement corridors, wildlife signs were designed and located to alert residents of locations where wildlife would likely cross. Use of wildlife road-crossing culverts was also evaluated, but due to the road grade, these structures were not suitable for this site.

As a condition of plan approval, the developer enhanced existing wetlands and restored several wetlands onsite that had been invaded by exotic invasive plants or littered with decades of residential and agricultural debris. Restoration plans were created to remove invasive plants and establish a long-term management plan for control of these species. At the time of development (2001), the usual practice was to vegetate detention ponds intended for stormwater collection with turf grass and possibly some landscape plants along the border to provide screening; however, these ponds then had very little ecological value. Maybury Park Estates was different; the detention basins were vegetated with native plants to maximize the functionality of the landscape as both a means of flood mediation and wildlife habitat. In addition, the aquatic plants were selected for their ability to remove nutrients and improve water quality. Maybury Park Estates also supported a

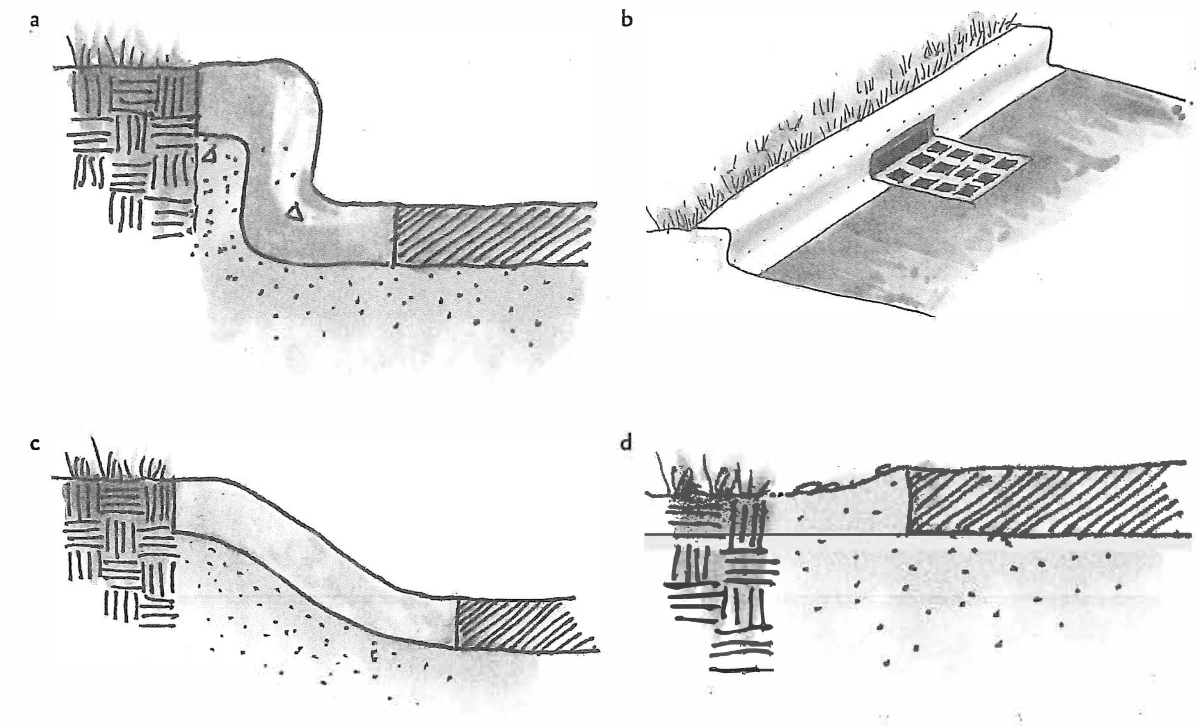

Figure 6.2. Traditional curb systems (a) typically limit or inhibit movement of many species of amphibian and reptile and can serve as a wildlife barrier and sink. This is especially true when curb and gutter systems are in place (b). When possible, modifying design for a more gradual slope (c) or elimination of a curb (d) can help facilitate small animal passage and reduce road-related mortality. *Credit: Herpetological Resource and Management, LLC.*

regional detention pond designed to address larger storm events and provide wildlife and water quality benefits. Best management practices (BMPs), including establishment of the shoreline in native aquatic plants and placement of logs for reptile basking, were incorporated into the pond design (Mifsud 2014). The regional detention pond was also situated adjacent to existing wetlands to enhance connectivity and expand the mosaic of habitat types available for wildlife. Incorporating these landscape features between existing high-quality habitat (i.e., ecological infrastructure) and road infrastructure reduced the impacts of road pollution on wildlife.

The willingness of the developer to work with the City of Novi to implement novel, ecologically friendly design solutions helped move the project through planning phases quickly in comparison to similar projects with complex environmental issues. These expedited design and review phases allowed for earlier project completion and higher sales. Lots adjacent to natural features sold for 20% more than interior lots, demonstrating that natural features are desirable and homebuyers are willing to pay more for these aesthetics. Additionally, the project was also recognized by the city for its environmentally sound design.

Maybury Park Estates is an excellent example of how thoughtful long-term community planning and environmentally responsible design can facilitate cost-effective and profitable development, or public infrastructure, while preserving large tracts of wildlife habitat, or ecological infrastructure, and avoiding increased wildlife habitat fragmentation from roads. This project continues to serve as a benchmark for ecologically sound, community-driven development and demonstrates the importance of strategic road planning to minimize the negative effects of development on wildlife while facilitating community growth. As with any project the mark of success is demonstrated through careful evaluation. Follow-up assessments would be warranted to determine how the species are faring and how the overall ecosystem is responding 10 years later.

6.6. Correcting Deficiencies When No Project Is Planned

One of the permissible uses of federal road funds is to initiate projects to mitigate environmental damage from existing roads. Wildlife advocates could request such projects in the transportation planning phase (Section 6.2.2), either through the citizen advisory committee, their elected representatives serving on the regional planning body, or through the state DOT. However, a mitigation project would need strong public support in order to compete against road capacity projects.

Support and credibility could be gained by coordinating with the resource agencies and by using any of the conservation tools mentioned in Section 6.2.2 to demonstrate where roads are in conflict with natural systems. Also, projects might be identified from deficiencies discovered in monitoring and adaptive management of previous projects, as described in Chapter 12. As discussed in Chapter 7, other funding sources are available and partial support from another source might be useful as leverage to encourage decision makers to allocate funding for these deficiencies.

6.7. Detailed Design

6.7.1. Integrating Wildlife Accommodations into the Detailed Design Process

The integration of road ecology into the transportation development process has naturally brought together two scientific disciplines — ecology and engineering. However, there are fundamental differences between how practitioners in these two disciplines think and apply practical solutions to a road project. Engineers focus on cost, motorist safety, and hydrology, while ecologists focus on the abiotic and biotic environments in relation to a road. Engineers make recommendations based on well-developed algorithms that have been utilized and tested throughout a long history of road building, whereas road ecologists make recommendations that are still undergoing testing and validation in an underfunded research arena. An excellent example here is using the openness ratio for design of wildlife crossing structures (see Clevenger and Huijser 2011). Ideally, engineers desire a well-defined height, width, and length of a structure for each target wildlife species; however, this relationship has not been experimentally tested, especially for small animals, and enhancements such as light through openings in the upper structure may or may not compensate for longer tunnels.

Complicating matters further, an engineer has well-established protocols and design drawings to build a road in challenging landscapes, and often a road ecologist will add layers of complexity to a well-established procedure. In addition, a road ecologist desires more flexibility in the road building process to allow for an adaptive and experimental approach for mitigation. Luckily, because roads are often built in phases due to funding constraints, lessons learned from environmental measures on one road segment could be applied to others if the agency can be persuaded to entertain the changes.

Budgets also greatly affect the way ecologists and engineers think and operate. Engineers typically have large budgets for proven technologies, while ecologists are grappling for ways to measure the effectiveness of new and untested mitigation designs. Road ecology research is often underfunded because of a disparity in how research is directed. Most agencies that manage or administer funding for land or facilities (e.g., local and state wildlife and conservation agencies, FHWA, state DOTs, USFS, NPS, BLM) respond more favorably when funding is directed toward solving a concrete issue. Conversely, regulatory and review agencies tend to focus on the collection, analysis, and review of scientifically defensible data to justify mitigation requirements (e.g., US Environmental Protection Agency and USFWS). Universities and others involved in research and data collection tend to emphasize these latter aspects also. Too often, scientific findings are not translated back to management agencies in ways that can be readily applied or implemented. This pattern has resulted in ecological research being deemed a lower priority, and these agencies consequently have fewer avenues for funding scientific investigation.

The contrasts between ecological and engineering approaches are most evident in the detailed design

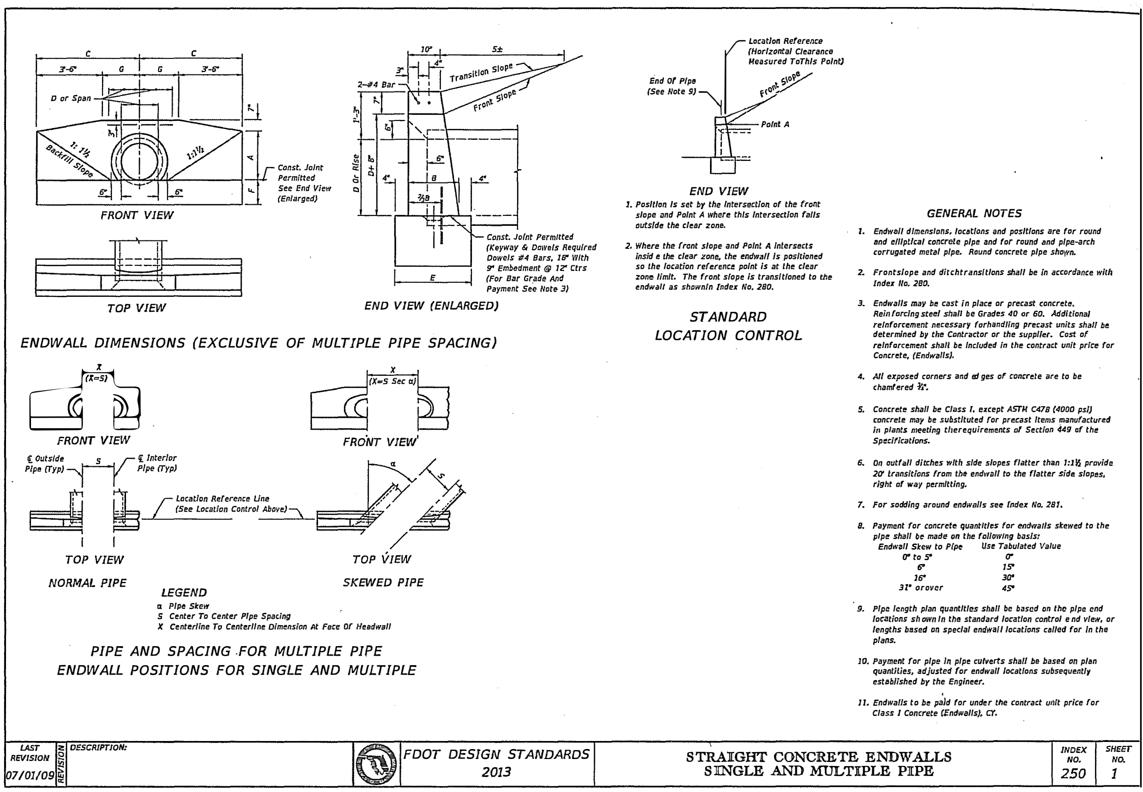

Figure 6.3. Example of a design specification for projects in Florida, United States. *Credit: Florida Department of Transportation.*

phase. In the state transportation agencies, preliminary engineering and design are even separate departments. Consultant engineering firms sometimes have engineers who do both, but rarely on the same project. When transportation agencies hire consulting engineers for a project, preliminary engineering and design are each established through separate contracts. In preliminary engineering, the engineers evaluate the surrounding environment and consider alternatives to find a balance between engineering and environmental constraints, whereas detailed designs are governed by formally established standards, as noted previously, which prescribe every detail of each individual structural element that goes into the road (for an example, see Figure 6.3). Designs from each specialty are more or less independently incorporated into a set of draft plans, which are then circulated among the different specialized professionals and among peers for review and comment. The comments are then incorporated into the next, more detailed, iteration of plans until a final set is approved for construction. Each discipline can work independently on these standard designs because only structural elements that have been proven to work in combination with others over years of application become standards in the first place; therefore, different combinations of the elements, such as pavements, bridges, and drainage structures, may be mixed and matched with confidence.

Unfortunately, wildlife accommodations don't lend themselves to this typical approach. Incorporating structural wildlife accommodations into road projects is relatively new in the United States, so there are very few standards available. It's also more difficult because the behavior and requirements of wildlife are much more complex and unpredictable than the behavior and requirements of vehicles and flowing water, and the functioning of wildlife structures can be seriously compromised by neglecting any of a multitude of details that do not have to be considered in road structures (e.g., substrate, light, noise, moisture, cover, approaches). There have been several helpful manuals and best practices guides published in the last few years

(Carsignol 2005; SETRA 2005; Huijser, McGowen, Clevenger, et al. 2008; Road and Delivery Performance Division 2010; Clevenger and Huijser 2011), but none that could be applied without the help of trained wildlife biologists. In fact, these guidelines are still changing as more research is done. An important example is the wire mesh size for wildlife fencing specified in Clevenger and Huijser 2011; in "Hot Sheet" 13, they recommend a "standard" mesh size for small vertebrates of 0.5 in (1.27 cm) or larger, depending on the target species. But in preliminary trials of small animal containment by different mesh sizes conducted in Florida, two different species of snakes entangled themselves in 0.5 in (1.27 cm) mesh and could only be extricated by cutting the mesh away (Smith and Noss 2011). Therefore, even if a larger mesh size would be adequate for a chosen target species, a smaller size should be used to avoid a hazard to smaller fauna. Clevenger and Huijser's handbook (2011) also recommends a height of 1.25 feet (0.38 m) for drift fences leading to amphibian and reptile tunnels, but in the Florida trials above, 3 feet (0.91 m) of height was needed to effectively contain most frogs and snakes. The fencing was largely ineffective for lizards because of their climbing ability. These examples demonstrate that there is no universal set of standards that can be uniformly applied to all locations and species. Geographic and biological variability require the adaptation of standards for particular places and species. Even if there were established standards effective for all small animals, engineers could not be expected to apply them appropriately to a project, just as drainage engineers would not be expected to apply structural or pavement engineering standards.

Planning and preliminary engineering have been evolving toward greater stakeholder and biologist participation, but engineers in the detailed design phase are not accustomed to including biologists when developing detailed plans. Hence, design teams seldom involve biologists with adequate experience in road ecology or the target wildlife species to guide detailed design of wildlife accommodations. Biologists are often employed in design, but only for the purpose of acquiring permits for wetland impacts or for mitigation of impacts to individual protected species.

At the permit agencies, the details of project drainage structures are scrutinized by agency drainage engineers to ensure that they have been properly designed to perform their stormwater functions. However, the details of wildlife mitigation measures seldom are examined to ensure that they have been properly designed to perform their wildlife functions. As in the project design teams, there are few biologists in the permit agencies who have enough specialized knowledge to comment on design details, or who even understand that critical details may be neglected during the usual design process. Similarly, post-construction monitoring reports are almost always required by permit conditions when projects include wetland creation or enhancement, and these reports are scrutinized by the permitting agency for progress in meeting specified success criteria, but post-construction monitoring requirements for wildlife accommodations are rare.

In Section 6.8, we describe some unintended outcomes in one Florida DOT district where wildlife structures were designed and permitted without adequate input from road or wildlife ecologists after the preliminary engineering phase. In response to these errors, the district initiated a biological review of wildlife crossing designs by adding the in-house environmental department to the plan reviews. But the formal review-comment-response procedure was still too cumbersome to allow for adjusting the standard designs to the unfamiliar needs of wildlife. An adjustment made by one specialty would induce a change by another specialty, which would create a different obstruction to wildlife, but the new obstruction wouldn't be detected until the next iteration of plans. Projects were approaching critical deadlines and still did not have functional accommodations.

The district finally convened an in-house Wildlife Crossing Design Team, which employed a more flexible, collaborative approach and a higher degree of involvement by road and wildlife ecologists than had usually been practiced in design. The team included not just roadway, structural, and drainage engineers, but also included an engineer from the maintenance department, an engineer from the construction department, an engineer and a biologist from preliminary engineering, and an experienced road ecologist.

Instead of passing finished draft drawings from office to office, all members of the team first met together with the design project manager to discuss early concept sketches. With all the specialized professionals in the same room, unintended consequences of design features and changes could be addressed immediately. Issues that had stalled in formal plan reviews over periods of months could be resolved in one or two meetings and some e-mail exchanges.

The Ocala National Forest case study (Section 6.3.1.3) describes how this approach was independently adopted by consultant design teams working on projects with major wildlife crossing structures; this took place as a result of commitments made in the preliminary engineering phase that mandated the involvement of wildlife experts during the design phase (see Sections 6.3.1 and 12.2.1). In spite of the differing approaches of ecologists and engineers discussed earlier, when both disciplines were engaged from the beginning to pursue the same goal (i.e., a fully functional wildlife structure), a mutual understanding and a better product resulted.

It is important to note that agency biologists must also participate in the scoping, contract writing, selection process, and staff-hours negotiations when consultant engineering firms are engaged to design a project with wildlife accommodations. Early and continued collaboration with wildlife experts must be included in the schedule and in the budget of the project.

6.7.2. Value Engineering

Transportation agencies often employ a formal process called value engineering, whereby staff from several different disciplines who have *not* been involved in developing the project examine it to determine if there might be changes in the design that would save money or improve performance. It has usually been employed near the end of the detailed design phase, but is becoming more common in preliminary engineering. It is also very common in the construction phase for the selected construction contractor to propose similar value engineering suggestions, as discussed in Section 11.2. After its examination, the value engineering team (or the construction contractor) submits a list of suggestions, which are reviewed by the original design team for acceptance, modification, or rejection.

This additional perspective often results in significant cost savings and improved designs, but it also necessitates detailed input and review by agency biologists because the need for wildlife features and their design requirements are usually the least understood aspects of a road project. It is very important and mutually beneficial for wildlife experts and agency biologists to be a part of the review team when the project includes accommodations for wildlife.

6.8. Lessons Learned

If wildlife experts are not included in the detailed design of wildlife accommodations, roads will be built with accommodations whose functioning is impaired or completely ineffective. An unfortunate example is two major state roads in Florida, which were developed at approximately the same time for widening from two to four lanes. Both roads traversed kilometers of largely undeveloped rangeland, and extensive coordination with wildlife agencies during the projects' preliminary engineering phases had resulted in commitments to wildlife accommodations.

The preliminary engineering concept plans provided for retrofitting existing bridges and culverts at major riparian wildlife corridors with wildlife ledges and shelves. A total of seven structures were modified between the two projects. Of those seven, only two were constructed without major design flaws that seriously impaired or completely eliminated the wildlife connections. The problem was not with any single engineering firm or transportation agency project manager; the errors were distributed among three different design contractors and occurred on both roads. The problem was in the traditional process, which failed to incorporate wildlife expertise beyond the preliminary engineering phase. Examples of these problems were presented in a poster at the International Conference on Ecology and Transportation (ICOET; Tonjes 2006; Figure 6.4).

The structures were never inspected and the design flaws were never noted by any of the resource agencies—an example of the lack of understanding and lack of resources available in most agencies to ensure mitigation of this kind is effective. The problems were discovered by an environmental scientist (author, S. Tonjes) in the state DOT, not because of any explicit monitoring requirement but rather in conjunction with wildlife research he had initiated on his own to investigate the efficacy of the accommodations. Three years after construction, design was started on a project to correct the major errors. Design and permitting of

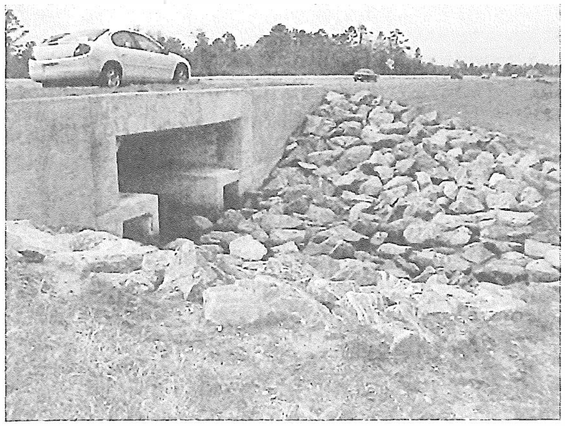

Figure 6.4. Constructed wildlife ledges with no connection to adjacent habitat. *Credit: Stephen Tonjes.*

the retrofits were much more complicated than they would have been if incorporated into a standard road project at the beginning. The project was finally completed five years later.

These mistakes could be prevented by proactive policies in state DOTs to employ wildlife experts throughout the project development process, and by permit conditions from the resource agencies that require post-construction monitoring of wildlife accommodations and adaptive management, as discussed in Chapter 12. Citizens interested in reducing wildlife impacts could make a difference by advocating for such conditions (see Chapter 5).

6.9. Key Points

- The development of most road projects proceeds in identifiable phases. The first two are preliminary planning and project delivery (preliminary engineering / conceptual design and detailed design). There are opportunities in each phase to ensure that wildlife considerations are included in road projects. The best and most effective opportunities occur earlier.
- The planning phase is when needs for improvement in, and expansion of, the regional road network are evaluated, and individual road projects are proposed. This phase is where planners need to be informed of how the road network will interact with the surrounding ecological landscape, and where inclusion and funding of wildlife accommodations are most appropriate.
- Roads that are federally funded, approved, or built on federal lands must comply with NEPA. This act requires evaluation of alternative actions and public disclosure of their impacts on the environment. The NEPA process is usually accomplished in the preliminary engineering phase and provides another opportunity for influencing the inclusion and conceptual design of wildlife accommodations.
- Wildlife agencies must be provided the opportunity to comment during the NEPA process; this presents another chance to promote inclusion of wildlife accommodations.
- Transportation engineers, biologists working in transportation agencies, and biologists working in wildlife agencies all need technical help from wildlife and road ecology experts in order to ensure that wildlife accommodations are designed to function effectively.
- Roads in national parks can carry significant volumes of traffic. The NPS has its own procedures and manuals that provide opportunities to incorporate wildlife accommodations, in addition to those resulting from the NEPA process.
- Projects on public roads traversing public lands must comply with the procedures of the agency managing the public land, in addition to NEPA. Different agencies may need to be consulted, depending on how the land is managed; therefore, there are opportunities to work within their procedures to ensure wildlife concerns are addressed.
- Unless state and local roads have a federal nexus, they are not subject to NEPA; however, they still must comply with various environmental laws and also receive permits from environmental resource agencies. Wildlife advocates must learn the local process for road planning, design, and permitting, and can work with the environmental resource agencies to ensure wildlife concerns are addressed.
- Wildlife mitigation projects independent of planned road projects may be identified through wildlife resource agency plans or transportation

Box 6.3. Once Upon a Time

Chapter the First, the Castle of Dreams

Once upon a time, there was an overcrowded little road that crossed a pretty little stream flowing through a full little culvert. The road builders and the gamekeepers and the local citizenry were called together to decide what to do. The GIS wizards had earlier helped the gamekeepers make maps of the lands that were needed to preserve good hunting for the king, and the gamekeepers saw that the stream and its floodplain provided for the movement of many valuable animals. They also knew that many animals were being killed or turned back as they moved along the riverbanks and tried to cross the road. And if the road was made wider, it would be even worse for them.

The assembly decided that the movement of the animals under the bridge was important; therefore, they decided to replace the full little culvert with a new bigger bridge that would be long enough to both cross the stream and leave dry banks on either side for the animals to walk on. The nice new bridge was put into the Dream Book, and everybody thought they would live happily ever after.

Chapter the Second, the Castle of Drawings

But the wicked wizard Murphy had other ideas. He had worked his evil magic to undo the good intentions of the Castle of Dreams before. He knew that the Castle of Drawings had different towers—Roadway, Structures, Drainage—each of which would fashion a part of the bridge. And he knew that each had its own Book of Rules and that none of the Books had any spells for animal crossings. When Drainage designed special culverts with wildlife ledges, Murphy saw to it that neither they nor Roadway would consider how the animals would reach the ledges. When Structures made a longer bridge for both water and animals to pass underneath, Drainage lined the extra space with impassable boulders to protect the ends of the bridge from damage by floods. And nobody noticed the willy-nilly placement of Roadway's fences that were supposed to keep the animals off the road and guide them to the openings.

The gamekeepers in the Castle of Dreams had been dismayed to see how their plans had gone awry, and went to the Castle of Drawings.

"No problem!" said the project manager. "I'll put you on the perusal of plans mailing list."

"A good start," said Wiley Cologist, the head gamekeeper.

But he remembered when Murphy had deleted the gamekeepers from the mailing list during an update. He also knew that the makers of drawings labored long hours to produce even a preliminary set of plans. They were far more willing to change concept sketches than finished drawings, and the best time for emissaries from the towers to meet together was before the plans were drawn up.

So the gamekeepers met with emissaries from each of the towers in the Castle of Drawings, and from the Castle of the Builders and the Castle of the Groundskeepers as well, and they made a treaty that whenever a project was to have a wildlife crossing, they would first convene at the Round Table and discuss concept sketches among themselves, before any plans were drawn, so that there would be no more unpleasant surprises during the perusal of plans. And *then* they lived (somewhat more) happily ever after.

agency adaptive management procedures. Federal road funds may be used for this purpose and various grants may be available.

- Transportation engineers are generally unfamiliar with wildlife accommodations and there are few standards available for guidance. There are design details that are critical for effective wildlife accommodations but are not ordinarily considered in road design. Wildlife and road ecology experts must be included throughout the preliminary engineering and design phases to ensure these details are addressed. Without this involvement, projects have been built with accommodations whose functioning is impaired or completely ineffective.

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