VISUAL COMMUNICATION FOR WILDLIFE VEHICLE COLLISION MITIGATION

by

ROGER GRIFFITH BLEDSOE

(Under the Direction of Brian Orland)

ABSTRACT

Wildlife-roadway conflict mitigation design is a multi-disciplinary process, and provides an opportunity to explore potential visual aids that can be used throughout the coordination process with different audiences. Landscape architects are trained in ecology, engineering, design, and multi-disciplinary, visual communication; and can help to translate information between different professions. This thesis will focus on determining how visual communication can aid in the design and management coordination process. Implementation, systems, experiential, evaluation, and management visual aids will be developed to evaluate their role in promoting multi-disciplinary, visual communication associated with the wildlife-roadway conflict mitigation design process.

INDEX WORDS: Visual Communication, Wildlife Vehicle Collision, Multidisciplinary, Conservation, Wildlife Crossing, Habitat Management, Landscape Architecture

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DEDICATION

This thesis is dedicated to my family and friends. I am grateful to have a wonderful support network, and in particular, from my wife Amy. You're the best!!!

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CHAPTER 1

INTRODUCTION

Wildlife are an integral component to the landscape, and their conservation benefits human systems such as agriculture and urban economic systems. For instance, insect pollinators provide $57 billion in ecosystem services a year (Losey and Vaughan 2006). Additionally, the economic value attributed to songbirds in urban settings is approximately 120 million USD a year in Seattle, Washington and 70 million USD a year in Berlin, Germany (Clucas, Rabotyagov, and Marzluff 2015). Wildlife are not static features on the landscape as they migrate locally, seasonally, and even geographically (e.g. in response to climate change). Landscape connectivity is important as it allows wildlife to access a variety of different habitats for resources, complete life cycle events/stages, and distribute genes between species metapopulations (Worboys, Francis, and Lockwood 2010). This mobility brings wildlife activity and human use of the landscape into conflict.

To resolve human-wildlife conflicts, groups of professionals from a range of fields collaborate to design mitigation strategies. The translation of ideas between different professional fields brings inherent communication challenges that may be alleviated through the use of visual aids. Landscape architects participate on these teams and can provide an array of visual aids to facilitate the visual communication needs in a multi-disciplinary working group. This thesis investigates the kinds of visual aids most

beneficial to various team participants at different stages of the design, implementation and management process of wildlife-roadway conflict mitigation systems.

One major byproduct of human land development is habitat loss and fragmentation. For instance, landscape connectivity can be disrupted by man-made features such as roads and their associated development. Habitat fragmentation restricts wildlife movement and increases conflicts between people and wildlife. As habitats are either destroyed or fragmented, the landscape matrix becomes divided into smaller patches of suitable habitat for wildlife (Dramstad, Forman, and Olson 1996). Wildlife populations become isolated from each other in these shrinking patches, thus reducing the health of the metapopulations. Moreover, disturbance events may adversely affect a population of wildlife, and there may be limited recruitment from the metapopulation to rebuild the population in the patch. Conversely, wildlife dispersing from a patch may be unable to complete this activity due to a landscape barrier such as a road (Worboys, Francis, and Lockwood 2010).

Roads have many harmful impacts on ecological systems and wildlife including noise pollution, chemical pollutants, and direct mortality from vehicles, which is referred to as wildlife vehicle collisions (WVCs) (Andrews, Nanjappa, and Riley 2015). In the United States, an estimated one to two million large mammal-vehicle collisions occur each year resulting in "…211 human fatalities, 29,000 human injuries and over one billion US dollars in property damage annually"(Huijser et al. 2009). While there is a financial reason to mitigate collisions with larger species such as deer that may not be the case for other wildlife species such as amphibians and reptiles as they pose little risk to human safety. An exception to this reduced risk from smaller wildlife would be from

drivers rescuing wildlife or intentionally swerving to avoid wildlife. Nevertheless, mitigating the potential driver risk and impacts to smaller wildlife species is important because these species are integral components to healthy ecosystems. For instance, amphibians constitute a large biomass and aid in converting insect biomass into energy that supports many other species (Semlitsch, O'Donnell, and Thompson 2014). Therefore, although amphibians pose little risk to vehicle safety, they are important taxa in ecosystems for energy transfer between trophic levels.

Methods to mitigate impacts along roadways include installing wildlife crossings and designing and managing wildlife habitat along roadsides. Wildlife crossing structures reduce wildlife vehicle collisions; therefore, wildlife crossings show great potential in alleviating the issue of WVCs (USDOT 2000). Crossing structure designs vary depending on the target species as different species have different requirements to promote successful crossings of roadways. Generally speaking, for aquatic and land mobile species, crossings consist of directional fencing along roadsides to funnel target species to crossing locations that consist of a crossing structure such as a bridge or culvert. However, not all species impacted by roadways require connectivity mitigation options, and may instead require roadside habitat management. For instance, species such as the diamondback terrapin (*Malaclemys terrapin*) utilize the roadside area as nesting habitat; therefore, increasing connectivity isn't the goal, but rather maintaining safe, suitable access to roadside habitat is the primary goal for managing the species. This thesis will focus on identifying visual aids that would apply to both the scenarios of roadside habitat management and increasing connectivity through crossing structures

with the diamondback terrapin roadside habitat best management practices (BMPs) serving as a case study of multi-disciplinary, visual communication.

Wildlife-roadway conflict mitigation is a multi-disciplinary process as it involves ecologists, planners, engineers, land managers, maintenance personnel, installation contractors, the public, and landscape architects. Landscape architects can guide the wildlife-roadway conflict mitigation process in relation to executing designs, selecting materials, providing construction documentation, oversight, and post construction evaluation, enhancing aesthetics, conducting public meetings, and producing maintenance plans, planting plans, and associated renderings. This thesis will investigate the role of the different kinds of visual aids commonly used by landscape architects in serving as intermediaries between the aforementioned disciplines and the public. Landscape architects can be especially effective in this role due to the cultivation of cross-disciplinary training and visual communication skills they regularly employ to enhance coordination between audiences of varying backgrounds. This thesis will investigate the applicability of different types of visual aids in the wildlife-roadway conflict mitigation process with the goal of increasing the effectiveness of visual communication between different audiences. The structure of the thesis is outlined below.

Thesis Outline

Chapter 1 – Introduction

- Thesis outline

Chapter 2 – Research Opportunity

- Role of landscape architects
- Existing range of visual aids
- The case for expanded visual aid usage
- Research questions

Chapter 3 – Case Study Introduction

- Case study context
- Identifying visual communication needs

Chapter 4 – Methods

- Development of visual communication goals, objectives, and principles
- Implementation of practitioner meetings and field reconnaissance
- Categorization of field data
- Development of visual aids
- Testing of visual aids

Chapter 5 – Research Findings

- Section 1: Existing information assessment results
- Section 2: Information category survey results
- Section 3: Post survey results
- New directions

Chapter 6 – Conclusions

- Rationale and benefits of visual communication
- Role of landscape architects
- Visual aids
- Rationale for BMP life cycle guidance visual aids
- Limitations
- Future research

CHAPTER 2

RESEARCH OPPORTUNITY

Role of Landscape Architects

Roadways are planned and developed in a multi-disciplinary process typically involving planners, engineers, ecologists, contractors and landscape architects. In fact, landscape architects have a long history of working on roadway projects starting with the construction of parkways in the late 19th century. In this capacity, landscape architects served as coordinators of multidisciplinary teams of engineers and architects (Fischer, Hohmann, and Marriot 2000). Additionally, landscape architects have a role in the process of wildlife-roadway conflict mitigation. For instance, the International Wildlife Crossing Infrastructure Design Competition (ARC Competition) is a high profile example of landscape architects working on wildlife crossings in multi-disciplinary teams (Apfelbaum, Rock, and Zoli 2012). The ARC Competition started in 2010 as method to "explore new materials, new methods, and new thinking about wildlife crossing infrastructure" (Lister 2012). Furthermore, the competition brought together interdisciplinary teams of ecologists, engineers, and landscape architects to solve specific wildlife-roadway design challenges. With these precedents for landscape architects working with ecologists and engineers on roadway design and wildlife-roadway conflict mitigation, it appears that landscape architecture offers opportunity for growth in exploiting the field's expertise.

One area of growth for landscape architects is aiding in the communication of design information between different professions. There appears to be a multi-disciplinary, visual opportunity as observed in the quotation below:

> "Translating road ecology research into design and construction guidance is a huge challenge. While a number of manuals and guidelines have been published, including this book, these are not always readily available to the transportation agency offices involved with individual projects. Further, it is daunting to convert conceptual drawings and examples from these publications into project-specific procedures and pay items (established list of construction procedures that can be contracted outside of departments of transportations [DOTs]). There are states that have developed true specifications (e.g. passage bench [a shelf used with bridges to allow terrestrial passage at peak flow], Minnesota Department of Transportation 2011; erosion netting, Box 11.1). Such standards should be applied where available, yet these applications remain uncommon despite availability. Accordingly, involving wildlife experts who can facilitate the application of research findings to design and construction in this stage and all stages of the transportation planning process can be mutually beneficial (Chapter 6)" (Andrews, Nanjappa, and Riley 2015).

The above quotation references the need and challenge of translating information between professions in a multi-disciplinary design context. Landscape architects are well-positioned to address communication content and process as they occupy a unique position in the design team by integrating ecological and engineering information, translating this information into a design, and communicating the information with other professions and the public primarily through visual aids. This translation opportunity is recognized as observed in the following quote:

> "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" (Andrews, Nanjappa, and Riley 2015).

The translation opportunity presented in this quotation involves several different types of information to communicate and professional point of view issues. First, the broad, conceptual information (systems) that each profession thinks about when designing a crossing is different. For instance, engineers think about hydrology for water conveyance and ecologists think about hydrology for the species life history requirements (e.g. habitat). Furthermore, the experiential component of the crossing is different for each profession as engineers primarily consider the anthropocentric functional utility and ecologists primarily consider the animal experience. Also, there are issues with the implementation of the crossings as wildlife-roadway conflict mitigation procedures are relatively novel and still being developed in contrast to the customary and long-term practice of road construction. Therefore, an opportunity is present in identifying new methods to translate design information to other professions such as engineering.

Existing Range of Visual Aids

First, a literature review of several wildlife crossing design manuals was conducted to determine the range of visual aids currently employed to visually communicate design information. An example of crossing recommendations for amphibians is shown in Figure 1 (Clevenger and Huijser 2011). The entirety of the crossing recommendations for amphibians is not included here; however, in the nine pages, the recommendations are presented primarily with textual descriptions supported

by a few photographs of techniques and implementation issues and tables (Clevenger and Huijser 2011).

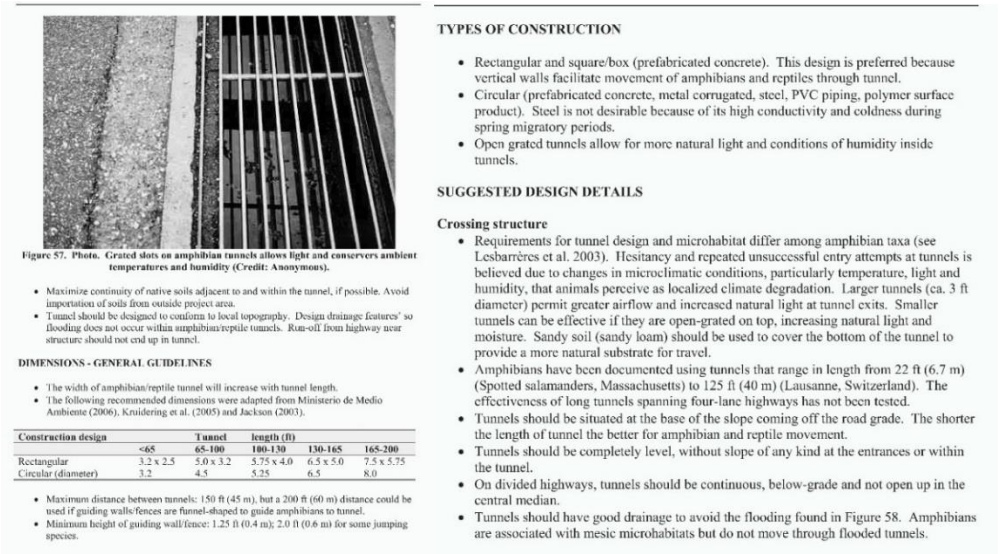


Figure 57. Photo. Grated slots on amphibian tunnels allows light and conservers ambient temperatures and humidity (Credit: Anonymous).

- Maximize continuity of native soils adjacent to and within the tunnel, if possible. Avoid importation of soils from outside project area.
- Tunnel should be designed to conform to local topography. Design drainage features' so flooding does not occur within amphibian/reptile tunnels. Run-off from highway near structure should not end up in tunnel.

DIMENSIONS - GENERAL GUIDELINES

- The width of amphibian/reptile tunnel will increase with tunnel length.
- The following recommended dimensions were adapted from Ministerio de Medio Ambiente (2006), Kruidering et al. (2005) and Jackson (2003).

Construction design	Tunnel length (ft)				
	<65	65-100	100-130	130-165	165-200
Rectangular	3.2 x 2.5	5.0 x 3.2	5.75 x 4.0	6.5 x 5.0	7.5 x 5.75
Circular (diameter)	3.2	4.5	5.25	6.5	8.0

- Maximum distance between tunnels: 150 ft (45 m), but a 200 ft (60 m) distance could be used if guiding walls/fences are funnel-shaped to guide amphibians to tunnel.
- Minimum height of guiding wall/fence: 1.25 ft (0.4 m); 2.0 ft (0.6 m) for some jumping species.

TYPES OF CONSTRUCTION

- Rectangular and square/box (prefabricated concrete). This design is preferred because vertical walls facilitate movement of amphibians and reptiles through tunnel.
- Circular (prefabricated concrete, metal corrugated, steel, PVC piping, polymer surface product). Steel is not desirable because of its high conductivity and coldness during spring migratory periods.
- Open grated tunnels allow for more natural light and conditions of humidity inside tunnels.

SUGGESTED DESIGN DETAILS

Crossing structure

- Requirements for tunnel design and microhabitat differ among amphibian taxa (see Lesbarrères et al. 2003). Hesitancy and repeated unsuccessful entry attempts at tunnels is believed due to changes in microclimatic conditions, particularly temperature, light and humidity, that animals perceive as localized climate degradation. Larger tunnels (ca. 3 ft diameter) permit greater airflow and increased natural light at tunnel exits. Smaller tunnels can be effective if they are open-grated on top, increasing natural light and moisture. Sandy soil (sandy loam) should be used to cover the bottom of the tunnel to provide a more natural substrate for travel.
- Amphibians have been documented using tunnels that range in length from 22 ft (6.7 m) (Spotted salamanders, Massachusetts) to 125 ft (40 m) (Lausanne, Switzerland). The effectiveness of long tunnels spanning four-lane highways has not been tested.
- Tunnels should be situated at the base of the slope coming off the road grade. The shorter the length of tunnel the better for amphibian and reptile movement.
- Tunnels should be completely level, without slope of any kind at the entrances or within the tunnel.
- On divided highways, tunnels should be continuous, below-grade and not open up in the central median.
- Tunnels should have good drainage to avoid the flooding found in Figure 58. Amphibians are associated with mesic microhabitats but do not move through flooded tunnels.

Figure 1. Example of visual aids utilized in a wildlife crossing design manual (Clevenger and Huijser 2011).

There are instances of different visual aids used in other manuals, but they are not consistently and widely used for the different types of crossings described in the manuals. An example of these alternative formats is below in Figure 2 (Meese, Shilling, and Quinn 2009):

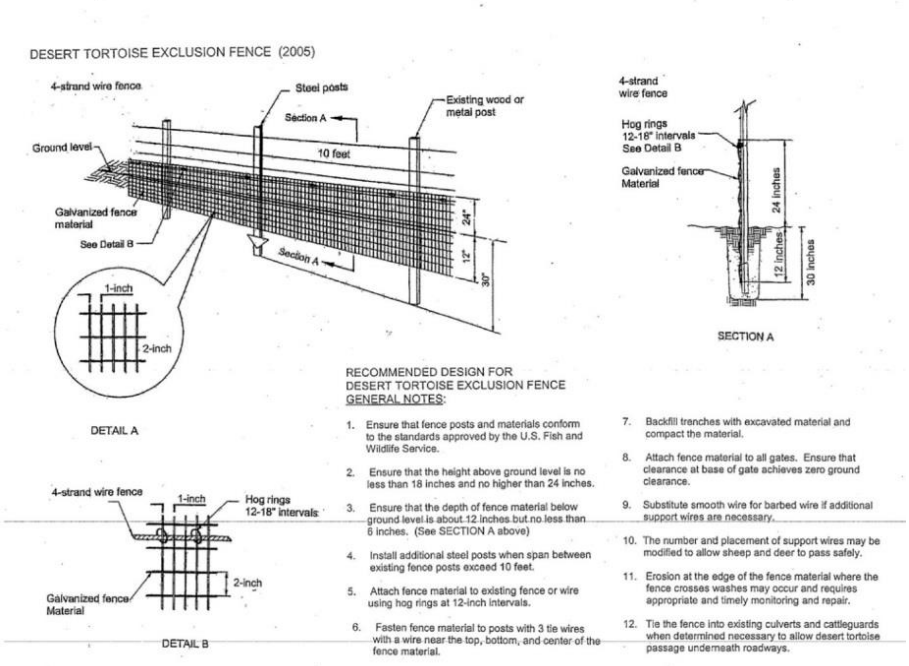


Figure 2. Example of a different visual aid (construction detail) (Meese, Shilling, and Quinn 2009).

Figures 1 and 2 are published in Department of Transportation (DOT) manuals for the United States, but the sources are different. The United States DOT Federal Highway Administration manual included the nine page amphibian crossing recommendations with table and photographic support (Clevenger and Huijser 2011), whereas the California DOT manual included the referenced construction detail (Meese, Shilling, and Quinn 2009). Therefore, there appears to be little consistency in the use of visual aids for communicating wildlife-roadway conflict mitigation information across DOT design manuals. Furthermore, a frequent issue observed is that the manuals rarely put the specifications for each type of wildlife crossing in consistently applied clear, detailed, visual aids for different life cycle components of mitigation feature (design, construction, post construction evaluation, and management). The most common approach is to

provide the recommendations in text, photo, and table; recommendations provided in a construction detail and diagram format are less common.

The Case for Expanded Visual Aid Usage

Information is more readily learned by new audiences if the textual information is supported by visual imagery; therefore, there is an opportunity to strengthen the content of the manuals as text plus visual aids provides a stronger format for presenting information (Pettersson and Pettersson 1993). Additionally, "Although research opinion varies, it seems generally accepted that 70 to 80 percent of what we learn is through sight" (Laseau 1980). In fact, "Man used signs and symbols long before written languages were adopted" (Laseau 1980), which supports the notion of using visual aids. There are fundamental differences between verbal and visual languages as seen in the following quote.

> "The symbols for verbal languages are largely restricted to words, whereas graphic languages include images, signs, numbers, and words. Much more significant, verbal language is sequential, it has a beginning, a middle and an end. Graphic language is simultaneous, all symbols and their relationships are considered at the same time. The simultaneity and complex interrelationship of reality accounts for the special strength of graphic language in addressing complex problems" (Laseau 1980).

Therefore, addressing wildlife vehicle collision mitigation through visual communication is warranted and would require additional exploration into new visual communication strategies.

A useful product for the numerous audiences associated with the life cycle of wildlife-roadway conflict mitigation practices would be the translation of design, construction and management materials into visual aids that portray each profession's perspective, goals, objectives, and other required information. Landscape architects

commonly employ a wide range of visual aids to communicate ideas to different audiences; and visual aids that would be useful for this bridging between the professions throughout the life cycle process are varied and include systems information (diagrams, siting plans), experiential information (e.g. perspectives, 3D models), construction information (e.g. construction details), post-construction evaluation information, and management/maintenance information. As a result, I propose to aggregate the roadway mitigation best management practices for the diamondback terrapin and explore how to visually communicate them to ecologists, engineers, land managers, planners, maintenance contractors, installation contractors, landscape architects, and the public. The visual aids identified may simplify and streamline the process of collaborating with different professionals. Furthermore, the process of incorporating visual aids into a wildlife-roadway conflict mitigation project would provide a model for future opportunities of multi-disciplinary coordination with other sites and species.

Research Questions

Landscape architects occupy a unique position to translate the goals of ecologists into the design and construction of wildlife-roadway conflict mitigation features as landscape architects have an ecological background, engage in design, and visually communicate with other professions such as engineers in regards to design, construction and management. The role of a landscape architect can involve several different areas in wildlife-roadway conflict mitigation design including executing designs, selecting materials, providing construction documentation, oversight and post construction evaluation, enhancing aesthetics, conducting public meetings, and producing maintenance plans, planting plans, and associated visual aids. This thesis will focus only

on one aspect of wildlife-roadway conflict mitigation, which involves the visual communication process between the different professions. A study site on Jekyll Island, Georgia has been selected to test the effectiveness of using different visual aids to assist the visual communication process between different professions for best management practices for diamondback terrapin turtles. The research question is as follows:

How effective are different visual aids for visually communicating various aspects of the wildlife-roadway conflict mitigation process?

Sub-question: What information is required to increase the effectiveness of the visual aids that might be needed for visually communicating different information (systems, experiential/promotional, construction, post-construction evaluation, maintenance/management)?

CHAPTER 3

CASE STUDY INTRODUCTION

It was necessary to select a study species and site in order to test the research questions. The study species chosen was the diamondback terrapin (*Malaclemys terrapin*) and the study site was on the Jekyll Island Causeway. The study species and site functioned well in testing the multi-disciplinary context of wildlife vehicle collision mitigation as practitioners from several fields (ecologists, a landscape architect, land managers, the public, and maintenance personnel) were involved in the development and implementation of the mitigation practices. Furthermore, the case study represented similar circumstances comparable to the development of wildlife mitigation practices for other species. Therefore, the case study represented a unique opportunity to test the effectiveness and applicability of different visual aids in communicating mitigation information to a wide range of professions that could be applied to other species and locations.

Case Study Context

The diamondback terrapin inhabits estuaries in brackish or saltwater in coastal areas stretching from Texas to Massachusetts (NatureServe 2017). In the state of Georgia, the diamondback terrapin is listed as state protected species (Unusual) and it is not listed as a federally protected species. The study area is located on Jekyll Island, which is a barrier island off of Georgia's coast located in Glynn County. The study area is located on the causeway (State Route 520) that connects Jekyll Island to the Georgia

coastline and is 5.73 mi in length (Figure 3). In particular, the study site focuses on areas that are actively managed for terrapins with BMPs, which ranges from the beginning of the causeway heading east from US 17 to the bridge that crosses Jekyll Creek. The speed limit on the causeway is 55 mph, and the roadway consists of two, 12-foot lanes with one travel lane in each direction. The right-of-way size varies between 105 feet to 335 feet. For the visual communication of the BMPs, the visual aids are based on these roadway dimensions in a general form. For instance, the roadway lanes are drawn at scale with the right-of-way depicted within the range limits (105 ft. to 335 ft.).

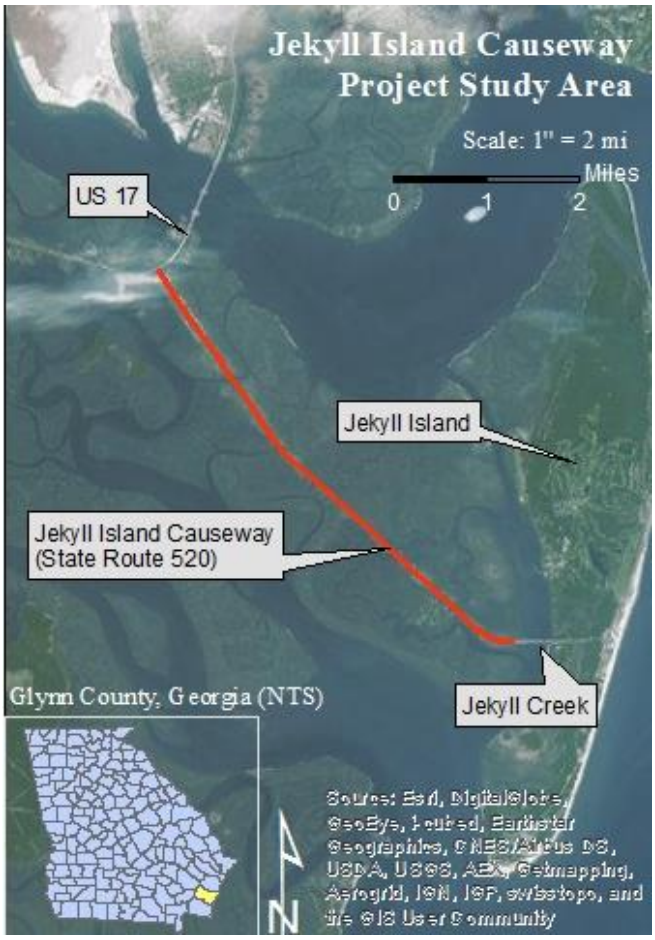


Figure 3. Map of the project study area.

Identifying Visual Communication Needs

While the challenge of communicating clearly between different disciplines occurs wherever wildlife-transportation mitigation is necessary, this section provides guidance as to how particular species characteristics result in specific needs for visual communication. An in-depth knowledge of the species and site helps facilitate the development of topics to convey in the visual aids. The focus here is on the diamondback terrapin but the principles of applying site and species information to visual communication topics are transferrable to other wildlife interaction settings.

Driver Data

The content of the visual aids rely on understanding the background information of the drivers along the causeway, which would also be applicable in developing visual aids for other wildlife species and locations. In 2016, the annual average daily traffic count along the causeway was 4,270 vehicles (2016). In addition, approximately 1.25 million visitors travel to Jekyll Island each year, and the permanent resident population is 805 people (Crawford, Poudyal, and Maerz 2015). The tourist season ranges between May and July, which also corresponds to the diamondback terrapin nesting season along the causeway (Crawford, Poudyal, and Maerz 2015). Approximately 100 – 400 turtles are killed by motorists each year (Crawford et al. 2014). Conveying the rhythms of the BMPs in association with the tourist and nesting seasons is important throughout the systems, experiential/promotional and management information categories.

Terrapin Physical Description

The visual aids in general depict an accurate portrayal of the target wildlife species to provide a sense of scale. In this case study, the scale of terrapins varies, adult

males range in size from 4 to 5.5 inches in carapace length and adult females range between 6 to 9 inches in carapace length (Dodd 2009); however, most image scales don't pick up on these size differences. The carapace ranges between black to gray to brown in coloration and has concentric age rings on the scutes. The dark speckled skin is gray to green to black in coloration, and the jaws are a light brown in color. Visual communication designed to energize roadway protection of wildlife may want to show the full-color beauty of the target species in realistic visual aids in the experiential/promotional information category (Figure 4).

Figure 4. Representative photograph of a diamondback terrapin (Rasmussen et al. 2011).

Terrapin Movement Behavior

Clearly communicating the movement issue affecting the wildlife species and the species roadway behavior is critical as it guides the mitigation practices chosen to alleviate the wildlife vehicle collisions. As previously discussed, roads fragment habitats, bring associated development, and augment pressure on wildlife populations by reducing available habitat area and increasing WVCs. While many species require connectivity across roads, some species such as the diamondback terrapins require safe access to

roadside habitat and not safe access across roadways. Access is not a primary issue because terrapins have high site fidelity, meaning they do not readily disperse into new territories (Brennessel 2006). Indeed, diamondback terrapins do cross the roadway for nesting purposes, but this activity is done for nest site selection as opposed to traveling into a new marsh area on the other side of the causeway (Jekyll Island Authority 2015). Therefore, the Jekyll Island Causeway doesn't represent a movement barrier to diamondback terrapins. The ecologists on Jekyll Island are reluctant to eliminate access to the causeway for terrapins through fencing because they believe that the causeway serves as important nesting habitat for the local population. As a result, the primary goals to visually communicate with the BMPs are the need to provide safe access to roadside nesting habitat and to reduce the occurrence of WVCs.

Causeway Nesting Habitat Suitability

For species utilizing roadside areas as habitat, it is valuable to visually communicate the uses of the habitat. For diamondback terrapins, roads create alternative, suitable nesting conditions as they provide open, elevated nesting areas that are above the normal tidal range (Crawford, Poudyal, and Maerz 2015). The elevated slopes of the causeway roadside indicate higher ground to female terrapins. The terrapins don't typically nest on the slopes as the females prefer flat terrain for nesting (Brennessel 2006). The replacement of natural habitat conditions with roadside nesting habitat places pressure on the diamondback terrapin population because WVCs increase as female terrapins cross the road in search of suitable nesting habitat. Therefore, the key concept to show is the terrapin perspective of roadsides as suitable nesting habitat.

Reproductive Information

In order to facilitate visual communication among the varied professions involved in the mitigation process, it is important to convey the behavior of the target species as it affects the responsibilities of each profession in the mitigation process and may alter the adopted mitigation practices. For the terrapin, the reproductive information is central to the BMP conceptualization as all of the BMP features relate to facilitating the reproductive process in the context of a busy causeway. To convey the dynamics of terrapin behavior within nesting areas demands clarity of the reproductive characteristics, and the pertinent reproductive behavior includes:

- Nesting commonly occurs during the daytime around high tide periods as the female turtles use the incoming water to float closer to nesting areas, which also provides a visual cue of areas that are above the normal tidal range.
- The nests are located above the normal high tide range to avoid tidal inundation of the eggs, which drowns the embryos (Brennessel 2006, Pike, Roznik, and Bell 2015).
- A female may select and abandon several nest sites before laying a clutch of eggs. Nesting females will return to the same nest sites in subsequent years.
- Females generally select areas with little vegetation to increase nest temperatures and lower the potential for roots to infiltrate and destroy the eggs. Diamondback terrapin nest sex ratios are temperature dependent.

For higher female sex ratios, the nest needs to have warmer temperatures, which occurs in sites without overhead vegetation and with sandy soils.

- Female terrapins typically lay two to three clutches with six to eight eggs in each clutch each year, and the clutches are spaced apart by 14 to 17 days (Brennessel 2006). Therefore, the nesting pattern of trying several nest sites and laying several clutches each nesting season increases the opportunity for WVCs along the causeway.
- Raccoons are one of the primary predators of diamondback terrapins, and raccoon populations expand in the presence of human development as the raccoons receive a steady supply of resources (termed 'subsidized predators') (Boarman 2003). As a result, these subsidized predators prey on diamondback terrapin nests, and nest depredation from raccoons can impact 50% – 90% of eggs (Crawford, Poudyal, and Maerz 2015). One study determined that the terrapin population on Jekyll Island could not be sustained without reductions in nest predation and WVCs, and increasing the number of female hatchlings (Crawford et al. 2014).

Therefore, the information critical to convey includes the methods to manipulate nesting success and the methods to mitigate driver behavior and terrapin mortality.

BMP Regulatory Context

Although regulations may not play an overt role in the visual aids developed, they are central to the wildlife mitigation practice development and coordination of the collaborative parties. Therefore, it is important to have a thorough understanding of the regulatory context in order to produce implementable visual aids. On Jekyll Island, the

causeway is subject to several federal and state regulations. The primary focus of regulatory compliance in regards to the BMPs centers on the vegetation management practices for the nest boxes vegetative screen, seasonal wildflowers, existing vegetation zones, invasive species, and roadside shoulders. The Jekyll Island Authority has an agreement with Georgia Department of Transportation (GDOT) to implement the vegetation management of the causeway (Andrews et al. 2016). Additionally, the turtle warning signage must comply with DOT standards, and the signage was installed by GDOT. During the interview with the JIA landscape architect, the regulations most pertinent to the BMPs include:

- Georgia Erosion and Sedimentation Act of 1975 - The act establishes a 25-foot protective buffer on water resources such as marshes, which is measured from the upland/marsh boundary. Vegetation maintenance can occur within the buffer for roadways as long as the vegetation isn't reduced enough to compromise water quality or marsh habitat (GADNR 2005).
- Coastal Marshlands Protection Act of 1970 - The act restricts activities that harm coastal marshlands in the state including draining, alteration, dredging, filling, and removal without a permit. This includes the alteration of marsh vegetation. Therefore, vegetation management cannot occur within the marsh adjacent to the causeway without a permit (GADNR 2005).
- Endangered Wildlife Act of 1973 – The act prohibits violating regulations concerning protected habitat, and the sale, killing or capture of any state protected species on state owned land (GADNR 2005). State protected species designations

include endangered, threatened, rare, and unusual. The diamondback terrapin is listed as unusual in Georgia (Dodd 2009).

- Wildflower Preservation Act of 1973 – The act prevents the collection of state protected plant species on state land without permission from the Georgia Department of Natural Resources and regulates the sale of state protected plants on private land (GADNR 2005). There are several state protected plant species along the causeway such as the state rare Florida wild privet (*Forestiera segregata*) (Andrews et al. 2016, AECOM 2011).
- GDOT Design Policy Manual - The GDOT Design Policy Manual requires a clear zone "free of fixed objects, with stable, flattened slopes which enhance the opportunity for reducing crash severity" (GDOT 2017). The AASHTO Roadside Design Guide specifies that the clear zone should be between 24 to 30 feet in width (AASHTO 2011). The Jekyll Island Authority maintains a maintenance agreement with GDOT that allows them to limit clearing along the causeway for habitat management purposes (Andrews et al. 2016).

Jekyll Island Causeway Best Management Practices

Wildlife vehicle collision mitigation involves site specific practices that are typically developed with several parties in a multi-disciplinary process. The inclusion of different parties in the mitigation process typically expands the single objective of wildlife vehicle collision mitigation to incorporate other pertinent objectives. On the Jekyll Island Causeway, the BMPs were initiated in the early 2000s, and the collaborative parties include the Georgia Sea Turtle Center on Jekyll Island, the Jekyll Island community, the Jekyll Island Authority, GDOT, the Georgia Department of Natural

Resources, advocacy groups, and University of Georgia researchers. The current BMPs for the nesting terrapins include the use of turtle crossing signage, nest boxes, mow strips, seasonal wildflowers, and the management of the existing vegetation. Several of the BMPs fulfill multiple objectives in addition to reducing terrapin roadway mortality and include improving causeway aesthetics, reducing maintenance costs and issues, increasing habitat value for other species, and managing stormwater runoff. The current BMPs are not the final iteration of roadside management techniques for diamondback terrapins. This is an on-going management issue across the entirety of the terrapin's range, and the BMPs instituted on Jekyll Island are tailored for that site and are still evolving. Nevertheless, the BMPs represent current efforts and appropriately function in the context of identifying suitable visual aids for wildlife vehicle collision mitigation multidisciplinary communication. In this context, the life cycle of the BMPs was mapped to enable a full visual characterization of the planning, design, construction, evaluation and management stages. A description of each BMP and their associated objectives is listed below.

- Turtle Crossing Signage – The BMP consists of DOT signage advertising turtle nesting, which is sited at the beginning of the nesting habitat in both roadway directions (Figure 5). The signs have flashing lights that are programmed weekly to flash 1 hour before the daytime high tide and 2 hours after the daytime high tide. The turtle message would be switched via a hinged sign to a non-wildlife message such as "have a safe trip" during the non-nesting season. The signage alerts drivers to the presence of turtles on the causeway. A generic message such

as turtle crossing vs. terrapin crossing may reach a wider audience. Also, the flashing lights and alternate, seasonal message help prevent driver sign fatigue.

Figure 5. Photographs of the Jekyll Island Causeway turtle crossing signage (Photographs by author 2016).

- Nest Boxes – The BMP consists of wooden nest boxes with directional silt fencing and predator exclusion electric fencing primarily for raccoons (Figure 6). The nest boxes are positioned to intercept female turtles in nesting hotspots along the causeway. The goal is to prevent female turtles from nesting on the roadside. Site the nest boxes at causeway nesting hotspot locations above the high tide line, behind a vegetative screen, and on a 3' sand mound (minimum 9' long). The directional fencing funnels turtles from the marsh into the nest boxes. Also, the nest boxes are designed to promote higher levels of females in the hatchlings through the elimination of vegetation from the nest boxes. The vegetative screen blocks drivers from viewing the nest boxes, which is done for aesthetics and turtle safety. The sand mound provides a visual cue for the turtles in the marsh of an

elevated area out of the normal tidal range (Buhlmann and Osborn 2011). The process can involve nest box relocation and expansion as needed.

Figure 6. Photograph of the terrapin nest boxes (Photograph by author 2016).

- Mow Strips – The BMP consists of 15' wide mowed grass zones adjacent to the roadway (Figure 7). The mow strips provide a safety shoulder for motorists and increase the visibility of the turtles to drivers. The mow strips are located adjacent to the roadway on both sides and are continuous along the causeway (Jekyll Island Authority N.D.-b).

Figure 7. Photograph of the roadside mow strips (Photograph by author 2016).

- Seasonal Wildflowers – The BMP consists of seasonal plantings of native wildflowers (Figure 8). The seasonal wildflowers provide aesthetic value for motorists and pollinator habitat. The seasonal wildflowers are planted between the mow strips and existing vegetation zones (Jekyll Island Authority).

Figure 8. Photograph of the seasonal wildflowers (Jekyll Island Authority N.D.-a).

- Existing Vegetation Management – The BMP consists of management of the existing causeway vegetation (Figure 9). The existing vegetation is managed to promote wildlife habitat, protect rare plant species, control invasive plant species, enhancing roadway aesthetics and water quality. The existing vegetation is managed between the mow strips and the marsh edge (Jekyll Island Authority).

Figure 9. Photograph of the existing causeway vegetation (Photograph by author 2016).

CHAPTER 4

METHODS

There were two main components to this study. The first component involved the development of a set of visual aids focused on the topic of terrapin accommodation and protection on the Jekyll Island Causeway. The second component involved a survey of practitioners to discover how each profession used the visual aids at different stages of a project or with various audiences. The approach involved drawing on a variety of information sources (interviews and field reconnaissance), producing visual aids in an iterative process, and evaluating the visual aids through internal and external review methods including review and feedback from the University of Georgia (UGA) College of Environment + Design and Lamar Dodd School of Art faculty. The following steps were completed to develop visual aids illustrating the best management practices on Jekyll Island for diamondback terrapins as a model for application to implementation of BMPs in other settings (Figures 10 and 11):

1. Development of visual communication goals, objectives, and principles
2. Implementation of practitioner meetings and field reconnaissance
3. Categorization of field data
4. Development of visual aids
5. Testing of visual aids

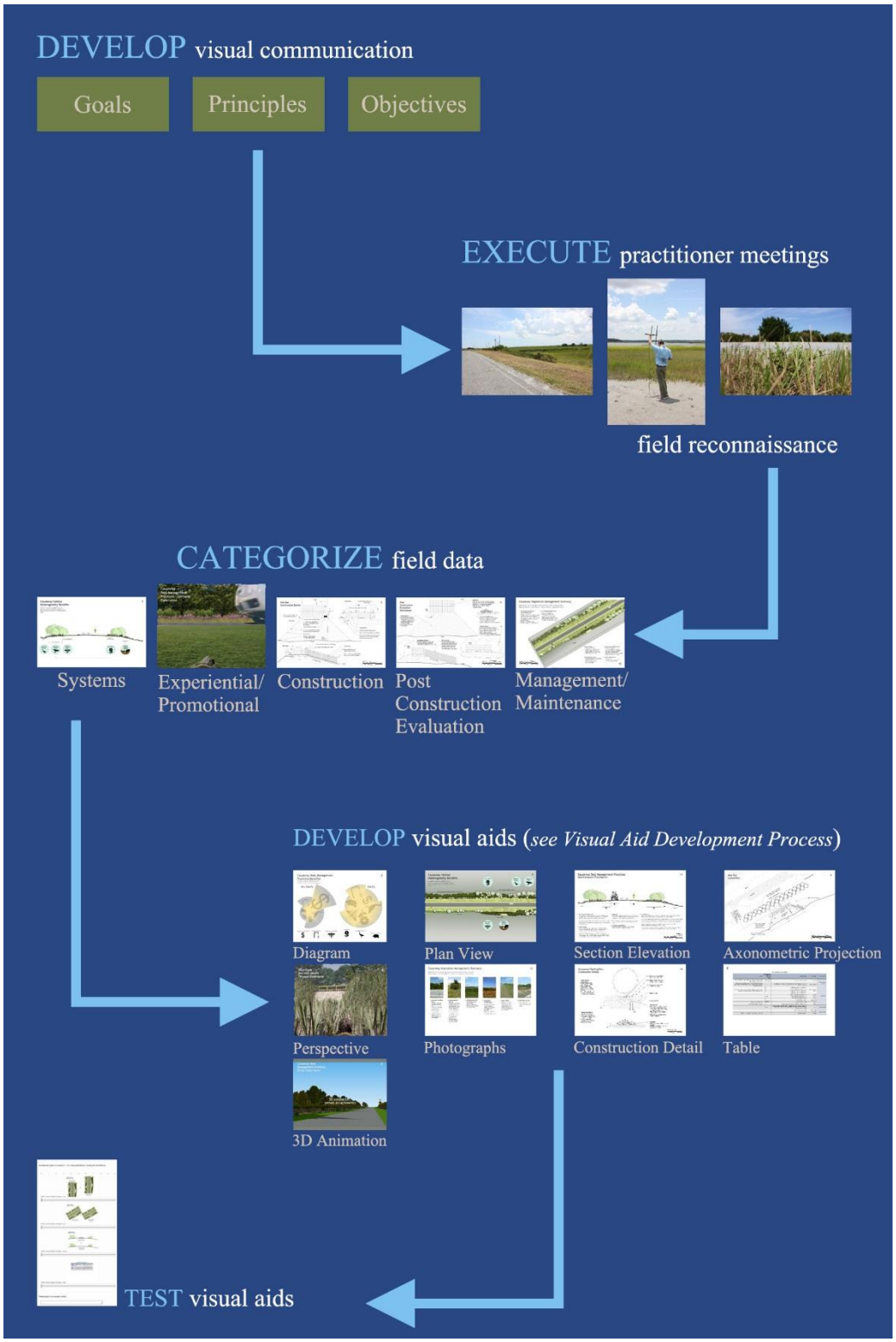


Figure 10. Methodology flowchart.

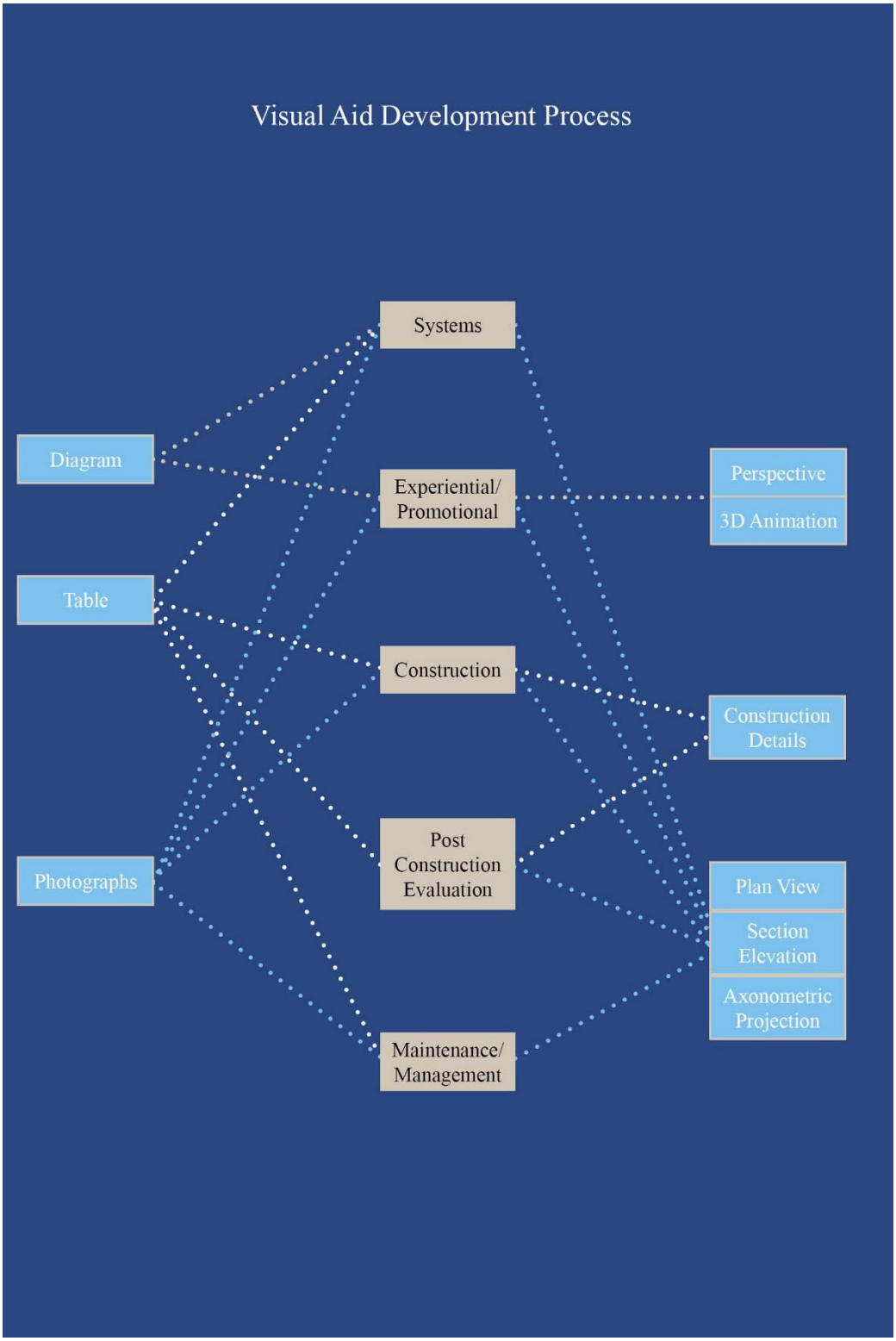


Figure 11. Methodology Flowchart: Visual Aid Development Process.

1. Visual communication goals, objectives, and principles

Prior to meeting with the professionals directing the BMPs on Jekyll Island, crossing design recommendations for many different wildlife species were evaluated to determine the information categories needed to convey information to different audiences involved in the wildlife-roadway conflict mitigation process (Beckmann 2010, Clevenger and Huijser 2011, Meese, Shilling, and Quinn 2009). Several different information categories were identified in relation to the wildlife-roadway conflict mitigation process and included conceptual/background information (systems), experiential/promotional information, implementation information, post-construction evaluation information, and long-term management/maintenance information. These categories were derived from information commonly conveyed by landscape architects throughout the design process. This project focused solely on information associated with design, advocacy and implementation of the constructed features and did not address other challenges such as monitoring long-term wildlife roadway mortality, terrapin nesting success, driver experience, etc. Goals, objectives and visual communication principles were established for the visual aids, which are listed below:

<u>Goals:</u>

1) To identify suitable methods of visually communicating ideas between different professions involved in the wildlife-roadway conflict mitigation process.
2) To provide a cohesive framework for visual communication strategies that can be applied elsewhere.

Objectives:

1) To identify the associated professional discipline perspectives/objectives in the wildlife-roadway conflict mitigation process and synthesize them together.
2) To illustrate a strategic process for selection of visual aids.

Visual Communication Principles:

1. The visual aids should be legible.
2. The visual aids should satisfy the fundamental communication needs of each discipline on both technical and general information fronts.
3. The rendering style used for each information category should be intentionally designed.
4. The visual aids should be within a skill range that is common practice within the landscape architecture profession.

2. Implementation of practitioner meetings and field reconnaissance

Initial information gathering included meetings with the primary responsible parties for the diamondback terrapin best management practices on Jekyll Island, comprising ecologists and the landscape architect (Andrews et al. 2016). The meetings identified the goals, objectives, background information, and strategies within the needs of each best management practice. The questions sought the information listed below:

- Goals and objectives
- Parties involved in the mitigation process
- Diamondback terrapin management history
- Diamondback terrapin population information, life history, and behavior

- Critical information to show with each BMP (conceptual/systems, experiential/promotional, construction, post-construction evaluation, and management/maintenance)
- Existing documents – planting plan
- Information needed to show the public
- Driver behavior management (BMP visibility and driver awareness)
- Causeway management legal requirements
- Preferred file formats

Field reconnaissance was conducted with a field ecologist in tandem with the meetings, and each BMP was visited, including the seasonal wildflowers, mow strips, causeway vegetation, signage, and nest boxes. Site information such as the dimensions of the BMPs, spatial relationships between all of the BMPs, materiality, ecological patterns such as the tidal range, representative photographs, sketches, and experiential views taken from the driver and terrapin perspective were collected from the study area (Figure 12). The photos were taken both at the driver height and at the eye level of a terrapin from different vantage points such as the roadside verge and the marsh nest boxes. The photos were taken at these vantage points to capture each users' view point. The causeway was both driven and walked.

Figure 12. View of the road from the driver (left) and terrapin (right) points' of view (Photographs by author 2016).

3. Categorization of field data

After the meetings with professionals and the field reconnaissance were complete, the first iteration of visual aids was produced. The visual aids produced covered topics that the professionals identified along with data and observations of issues recorded during the field reconnaissance and meetings. The topics were placed into the information categories of conceptual/systems information, experiential/promotional information, construction information, post construction evaluation information, and maintenance/management information. The information categories were defined based on common types of information landscape architects employ throughout the design process. A description of each information category is listed below:

- Systems Information Category: This type of information is also referred to as providing a comprehensive view, which is described as "In order to study designs as complete systems, we must have models which represent the whole from *some* viewpoint" (Laseau 1980). Systems information provided an overview and background information on the terrapin roadway issues and the associated causeway BMPs. The visual aids were visually abstracted and diagrammatic in

nature, and highlighted landscape features and systems, spatial and functional relationships of landscape elements, and strategic approaches to identified goals and objectives. The rendering style showed gross relationships through a hand-drawn rendering style with simple massing forms. The topics covered under this information category include:

  - Wildlife-Roadway Conflict Mitigation Strategies
  - Terrapin Causeway Use
  - Causeway BMP Siting and Function
  - Causeway Habitat Heterogeneity Benefits
  - Causeway BMP Multifunctionality

- Experiential/Promotional Information Category: This type of information is also referred to as providing a perceptual focus, which is described as "Trying to involve the viewer in the experience signified by the drawing" (Laseau 1980). Experiential/Promotional information conveyed an empathetic experience of the landscape, its elements, and the primary subjects of the image. The visual aids served as potential promotional materials for decision makers and stakeholders. The rendering style utilized more realistic and detailed imagery to capture a near representation of a realistic scene. The topics covered under this information category include:

  - Nest Boxes and Sand Mound - Terrapin Experience
  - Causeway BMPs – Driver Experience
  - Causeway BMPs – Terrapin Experience

- Construction Information Category: The visual aids in this information category "…are intended to instruct the builder or fabricator about the implementation or construction of a design" (Ching 2009). The visual aids detailed dimensions, materials and their quantities, landscape siting information, and installation notes and specifications to aid in the implementation of the constructed landscape features. The drafting style showed materials and dimensions of BMPs through black and white line work with a clear line weight hierarchy, standard construction symbols, language, scales, and dimensions. The topics covered under this information category include:
    - Nest Boxes Construction
    - Causeway Planting Plan
- Post Construction Evaluation Information Category: In the construction observation process, there is an opportunity to evaluate the constructed features for defects or improvement. If defects are found, the landscape architect would provide guidance to the installation contractor to resolve the construction issues and the landscape architect would re-inspect the features upon completion (The American Institute of Architects 1959). Post occupancy review provides a mechanism for improvement of constructed features by evaluating their performance over time (Rogers 2011). Similar to the construction information visual aids, these visual aids showed requirements for dimensions, landscape siting, and design features of BMPs such as nest box electric fencing. The drafting style showed materials and dimensions through black and white line work with a clear line weight hierarchy, standard construction symbols, language,

scales, and dimensions (same style as the construction graphics). The topics covered under this information category include:

- Nest Boxes Construction
- Causeway Planting Plan

- Maintenance/Management Information Category: This type of information is also referred to as providing a comprehensive view, which is described as "In order to study designs as complete systems, we must have models which represent the whole from *some* viewpoint" (Laseau 1980). The visual aids depicted summaries on vegetation communities and their management strategies, management requirements of the BMPs, and the maintenance procedures for the vegetation communities and BMPs. Furthermore, the visual aids showed management goals and objectives, spatial relationships, system strategies (e.g. invasive species management procedures), and guidelines for handling special circumstances such as encountering a terrapin while mowing the grass strips. The rendering style showed gross relationships through a hand-drafted style with simple massing forms (same style as the systems information visual aids). The topics covered under this information category include:
  - Causeway Vegetation Management Summary
  - Invasive Species Management
  - Causeway BMP Maintenance Procedures

4. Development of visual aids

Several different visual aids were employed to convey the information for each topic. The information was presented in the commonly utilized visual aids in wildlife

vehicle collision design manuals of text, table and photograph as well as in visual aids such as a diagram, plan view, section elevation, axonometric projection, perspective, three-dimensional model/animation, and construction detail. These visual aids were chosen as they are commonly used by landscape architects in communicating project related information. While other visual aids such as GIS resource maps or aerial photographs may be useful for wildlife vehicle collision mitigation, these visual aids were not included as the information was not necessary to illustrate the core focus of the causeway BMPs for diamondback terrapins. The function of each visual aid is listed below:

- Diagram – A visual aid that shows the components, function of the components, and their relationships (Figure 13). Diagrams may be abstractly, realistically, or semi-realistically rendered (Kasprisin and Pettinari 1995).

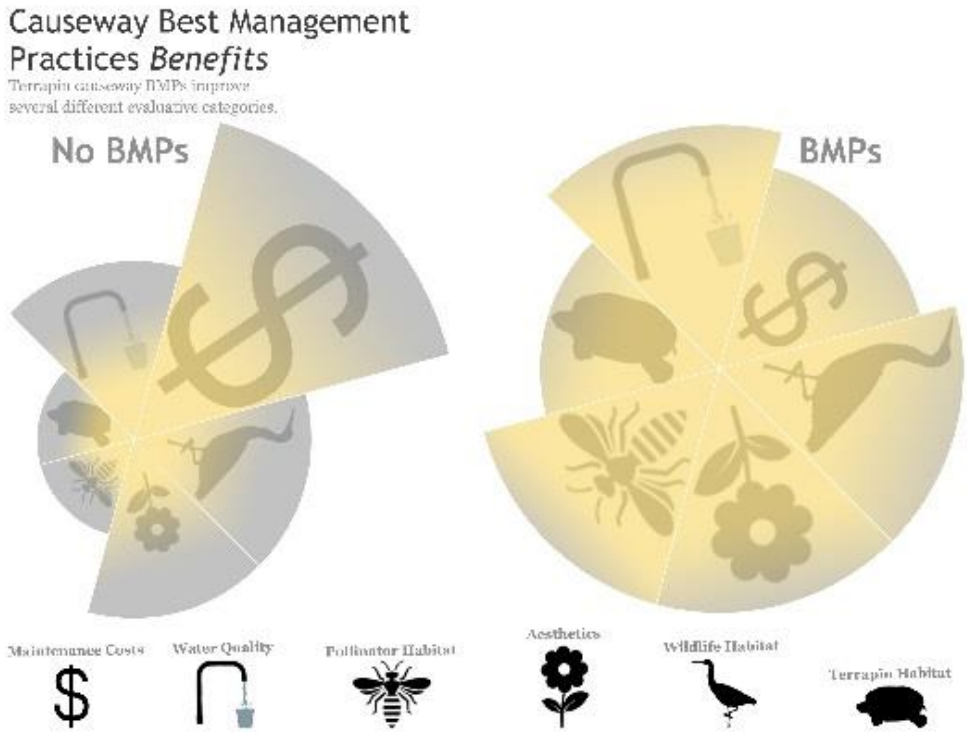


Figure 13. Example of a diagram of the causeway BMPs (Mizunoryu 2010).

- Plan View – A top view of the landscape elements that highlights the horizontal relations between them (Figure 14). The objects can appear three-dimensional through the use of shadows, show seasonality and time of day, and represent the materiality of landscape elements (Wang 1996).

Figure 14. Example of a plan view of the causeway BMPs.

- Section Elevation – The section elevation shows elements both on the cut line of a plan and the elements visible behind it (Figure 15). The section elevation compliments the plan view by allowing the viewer to relate to the design through the addition of the vertical plane (Wang 1996).

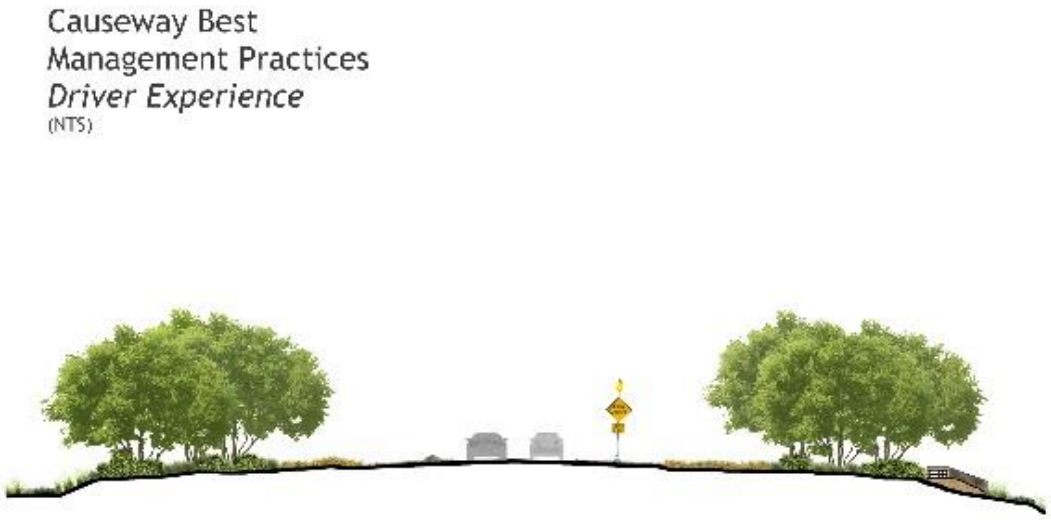


Figure 15. Example of a section elevation of the causeway BMPs.

- Axonometric Projection – The axonometric projection combines the elements of plan, section elevation, and linear perspective together into one visual aid (Figure 16). The axonometric projection is drawn to scale and provides a three dimensional view of a space, and can also can serve as an alternative to a bird's eye perspective (Ching 2009).

Figure 16. Example of an axonometric projection of the causeway BMPs.

- Perspective - A linear perspective shows a simplified version of how the eye perceives objects and only represent a view of a scene through one eye (Figure 17). The linear perspective is useful in portraying objects in space with volume and depth cues, which ultimately translates into an experiential view of the scene (Ching 2009). This project included both the driver and terrapin point of views of the causeway BMPs.

Figure 17. Example of a perspective of the causeway BMPs.

- 3D Model/Animation – Three-dimensional models and animations of the models present realistic spatial views of an area (Figure 18). The elements in the models can be enhanced with a realistic rendering style involving color, texture, and light conditions (Yee 1997). This project included animations of the causeway BMPs from both the driver's and terrapin's point of view.

Figure 18. Example of a 3D animation of the causeway BMPs.

- Construction Detail – Construction details provide information on the designed elements including "size and shape, quantities, locations, and relationships of physical elements to one another" as shown in Figure 19 (Design Workshop 2016).

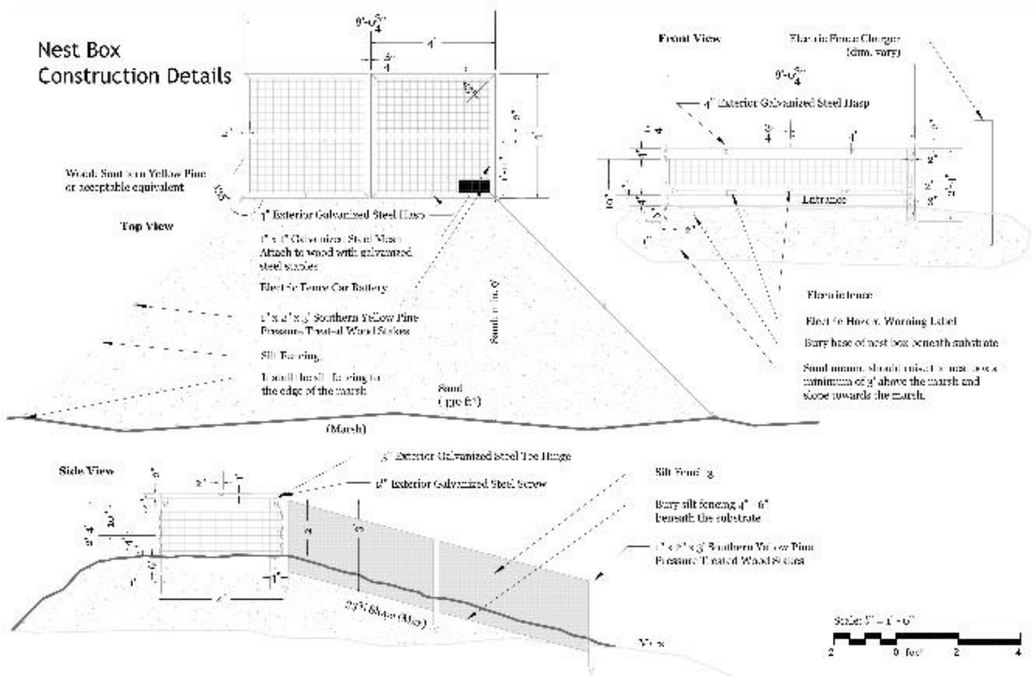


Figure 19. Example of a construction detail of the causeway BMPs.

- Table – The purpose of a table is to organize detailed information as shown in Figure 20. Tables do not show relationships or patterns between the data (Carr and Harrington 2011).

Nesting Box Materials List

Component	Material	Description	Quantity (for [illegible] 4' x 8' modular unit)	Notes
Directional Fencing	Fencing	[illegible] silt fencing	[illegible] per side	[illegible]
	Fencing stakes	1" x 2" x 3' Southern Yellow Pine (SYP) [illegible] or accepted equivalent	5	Stake fencing [illegible]
Nest Box	Pressure treated wood	1" x 2" SYP or acceptable equivalent	47	Make sure the chemicals used to treat the wood to prevent decay do not adversely affect [illegible]
		1" x 4" SYP or acceptable equivalent	31	
		1" x 6" SYP or acceptable equivalent	12	
		1" x 4" SYP or acceptable equivalent	1	
	Hinges	3" exterior galvanized steel tee hinge	4	
	Screws	[illegible] exterior galvanized steel screw	[illegible]	
	Latch	4" exterior galvanized steel hasp	2	
	Metal mesh	1" galvanized steel mesh	[illegible]	
	Staples	Galvanized steel staples	[illegible]	Staple steel mesh every [illegible]
	Labels	Laminated warning labels attached to the electric fence	[illegible]	Place on the electric fence line
Sand Mound	Sand	Calculate volume needed for a minimum 3' high mound to raise the nest box above the marsh [illegible]	[illegible]	
Electric Fence	Electric fence materials	Can be purchased as a kit	1	
	Battery	Automotive battery	1	Battery will need to be replaced every 4 - 6 weeks.

Figure 20. Example of a table of the causeway BMPs.

- Photo – Photographs are visual aids that represent physical objects and may function for a variety of purposes (Figure 21). In the context of the BMPs, the photographs functioned in an informative role (e.g. photo of roadside signage) and in a role of conveying an emotional message towards an object (Amare and Manning 2012).

Figure 21. Example of photos of the causeway BMPs.

The information was largely the same between each visual aid in order to identify which visual aids communicated the topic the best. There were some exceptions to this principle as some information was only able to be communicated effectively in one visual aid. For instance, the detailed dimensions of the nest boxes were depicted only in the traditional construction detail and not in another visual aid such as an axonometric projection as the information depicted would have been unclear. Also, each topic was drafted in each visual aid if the visual aid presented the information appropriately. For

example, a perspective was not utilized in depicting the spatial relationships of the causeway BMPs.

The visual aids were digitally drafted to allow for greater clarity, file format flexibility, and revision capability; and the visual aids were produced at a high resolution (300 dpi) for greater production quality. The page format was kept at 8.5 in. x 11 in. or 11 in. x 17 in. as those are the standard print sizes for most office settings. Also, the page sizes and orientation were kept consistent within each information category for legibility. The fonts chosen were Trebuchet MS and Georgia as these fonts are both highly legible on the web and in print (Strizver 2014). To support the drafting of construction visual aids for the seasonal wildflowers and nest box shrub screen, sources such as the Roadside Use of Native Plants (Harper-Lore and Wilson 2000) and the Time Saver Standards for Landscape Architecture: Design and Construction Data (Harris, Dines, and Brown 1998) were consulted.

Matrix Tool Preparation

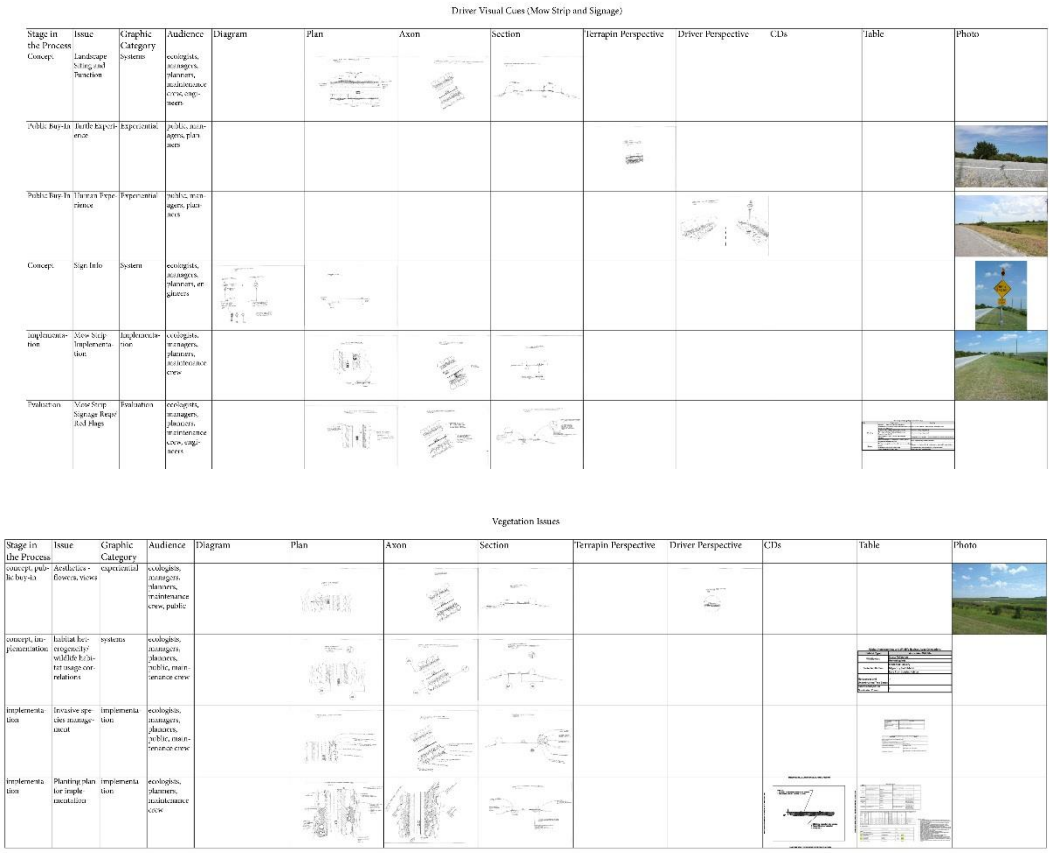
To aid in visual aid production, an evaluation matrix was compiled to track the completion of visual aids, identify their respective audiences, and serve as an internal evaluation tool (Figures 22-24). The evaluation matrix was intended to be a fluid document and was continuously revised. The first iteration of the evaluation matrix is below:

General Terrapin Issues

Stage in the Process	Issue	Graphic Category	Audience	Diagram	Plan	Axon	Section	Terrapin Perspective	Driver Perspective	CDs	Table	Photo
concept	Access to causeway for nesting habi tat	systems	ecologists, managers, planners, maintenance crew, engi- neers, public									
concept	terrapin num- bers pulsing with tides	systems	ecologists, managers, planners, maintenance crew, engi- neers, public									
concept	nesting sea- son correla- tion with tourist season	systems	ecologists, managers, planners, maintenance crew, engi- neers, public									
public buy-in	comprehen- sive system overview of BMPs siting	systems, im- plementation	ecologists, managers, planners, maintenance crew, engi- neers, public									
concept, im- plementation	comprehen- sive system of BMPs CDs	systems, im- plementation	ecologists, managers, planners, maintenance crew, engi- neers									
concept, im- plementation	Driver safe- ty value/ra- tionale (no swerving, stopping, im- pacts)	systems	ecologists, en- gineers, plan- ners, manag ers, public, maintenance crew									
concept	exclusion vs connectivity	systems	ecologists, en- gineers, plan- ners, manag- ers, public, maintenance crew									
concept	Bragging rights (is this linked to the multi- functional- ity graphic?) Link to road-	experiential	managers, planners, public, ecolo gists									
public buy-in	multifunc- tionality (helps other spp, storm- water, polli- nator, reduce maint., cost,	systems	ecologists, managers, planners, maintenance crew, public									
concept	Image to peek curi osity/im- age hook	experien- tial, sales	managers, planners, main- tenance crew, engi neers, pub-									
concept	Multi-ob- jective De- sign	Concept	managers, planners, ecologists, engineers									

Nest Box

Stage in the Process	Issue	Graphic Category	Audience	Diagram	Plan	Axon	Section	Terrapin Perspective	Driver Perspective	CDs	Table	Photo
Concept	Nesting Mound	Systems	ecologists, managers, planners, maintenance crew, engi- neers									
Concept	Landscape Siting and Function	Systems	ecologists, managers, planners									
Public Buy-In	Nesting Box Turtle Experi ence	Experiential	public, man- agers, plan ners									
Public Buy-In	Nesting Box Driver Expe- rience	Experiential	public, man- agers, plan- ners, public									
Construction	Nesting Box Construction Documents	Implementa- tion	ecologists, construction team									
Construction	Planting Plan	Implementa- tion	ecologists, landscape architects, construction team									
Maintenance	Nesting Box Maintenance	Maintenance	maintenance crew									
Management	Nesting Box Materials	Implementa- tion	managers, planners									
Evaluation	Nesting Box Require ments/Red Flags	Evaluation	ecologists, construction team									



Figures 22 - 24. Preliminary evaluation matrices.

5. Testing of visual aids

Pinup

Once the first iteration of visual aids and evaluation matrix was complete, a pinup review of the visual aids and matrix was conducted with faculty members from the UGA College of Environment and Design and Lamar Dodd School of Art. Before the pinup, the freehand drawings were digitally drafted into a working draft of digital drawings. The pinup process was intended to solicit feedback and generate ideas from the review team on the content, organization, and formatting. This step served as an external

preliminary evaluation on the visual aids and guided the evaluation matrix revision phase and second iteration of visual aids.

Evaluation Matrix Revision

The pinup identified the need to reduce the number of visual aids and combine topics together where applicable. The combining process involved determining whether the topic was linked or embedded within another topic or if it was an independent topic. For example, the landscape siting and function of the nest boxes, mow strips, signage, seasonal wildflowers, and existing vegetation were identified as linked topics since they are all designed landscape elements and would be depicted spatially together as one system intended to address terrapin roadway mortality. Another way to view the issue is that a typical landscape architecture residential site plan would not be visually separated into multiple plan views of landscape elements such as a pool, deck or lawn, but rather drafted together as a landscape system in plan view. The areas of convergence were color coded on the evaluation matrix as shown in Figures 25 – 27.

Systems Graphics

Graphic Category	BMP	Issue	Audience	Diagram	Plan	Axon	Section	Terrapin Perspective	Driver Perspective	CDs	Table	Photo
Systems	Nest Box	Nest Mound	ecologists, engineers, planners, landscape architects, managers, maintenance crew									
Systems	Nest Box	Landscape Siting and Function	ecologists, engineers, planners, landscape architects, managers, maintenance crew	Nest Box and Driver Visual Cues Siting and Function								
Systems	Driver Visual Cues	Landscape Siting and Function	ecologists, engineers, planners, landscape architects, managers, maintenance crew									
Systems	Driver Visual Cues	Signage	ecologists, engineers, planners, landscape architects, managers, public									
Systems	General Terrapin Issue	Access to Causeway for Nesting Habitat	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public	Wildlife Roadway Mitigation Strategies								
Systems	General Terrapin Issue	Terrapin Numbers Pulsing with the Tides	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public	Terrapin Causeway Use								
Systems	General Terrapin Issue	Nesting Season Correlation with the Tourist Season	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									
Systems	Vegetation Issue	Habitat Heterogeneity/ Wildlife Habitat Usage	ecologists, planners, landscape architects, managers, maintenance crew, public									
Systems	General Terrapin Issue	Multifunctionality (helps other spp, stormwater, pol-	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									
Systems	General Terrapin Issue	Exclusion vs. Connectivity	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									

Experiential/Sales Graphics

Graphic Category	BMP	Issue	Audience	Diagram	Plan	Axon	Section	Terrapin Perspective	Driver Perspective	CDs	Table	Photo
Experiential	Nest Box	Turtle Experience	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									
Experiential	Nest Box	Driver Experience	ecologists, planners, landscape architects, managers, maintenance crew, public						Terrapin Causeway Mgmt Driver Experience			
Experiential	Driver Visual Cues	Turtl Experience	ecologists, planners, landscape architects, managers, maintenance crew, public						Turtle Experience/Image Hook			
Experiential	Driver Visual Cues	Driver Experience	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									
Experiential/Sales	Vegetation Issue	Aesthetics - flowers, views	ecologists, planners, landscape architects, managers, maintenance crew, public									
Sales	General Terrapin Issue	Bragging Rights	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									
Sales	General Terrapin Issue	Image Hook	ecologists, engineers, planners, landscape architects, managers, maintenance crew, public									

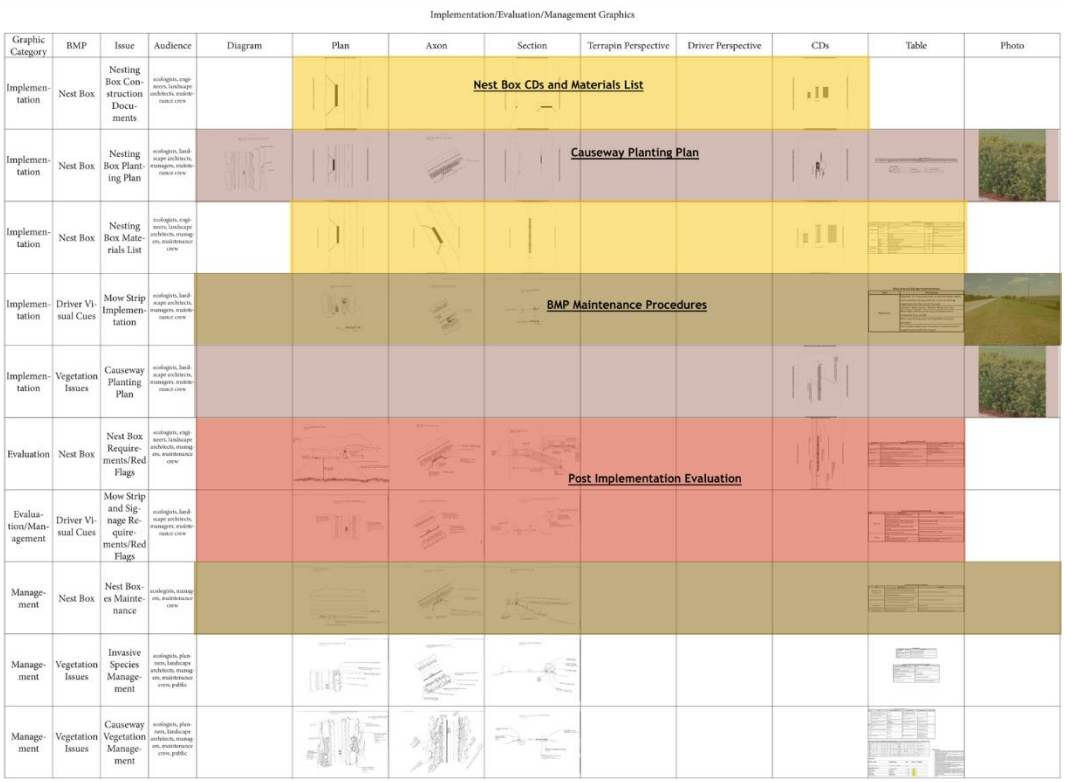


Figure 25 - 27. Evaluation matrix revision process.

Survey of Professionals

A team of national experts with prior experience concerning wildlife roadway issues/mitigation was assembled to qualitatively review the visual aids. The survey involved human subjects research and was approved by the UGA IRB (STUDY00004287). The expert panel members included 17 members from the fields of ecology (4), engineering (2), planning (2), landscape architecture (4), roadway maintenance (2), land management (2), and marketing and communication (1). Members of the expert review panel were employed with state, federal, academic, and/or private firms. The survey focused on testing and validating the information in the evaluation matrix such as the audiences associated with each information category, the suitability of the visual aids, and the visual information needed to convey the topics. Furthermore, the

intent of the survey was not an evaluation of whether the BMPs were adequate or to assess their specific content, but on the effectiveness of each visual aid in conveying the information to practitioners from different fields. The survey required each professional to assess and rate each visual aid independently for each topic. This survey format was chosen in order to assess the value of each visual aid and to control for the variances in information and rendering style between each visual aid for each topic. An example is provided below in Figure 28.

The survey is outlined below:

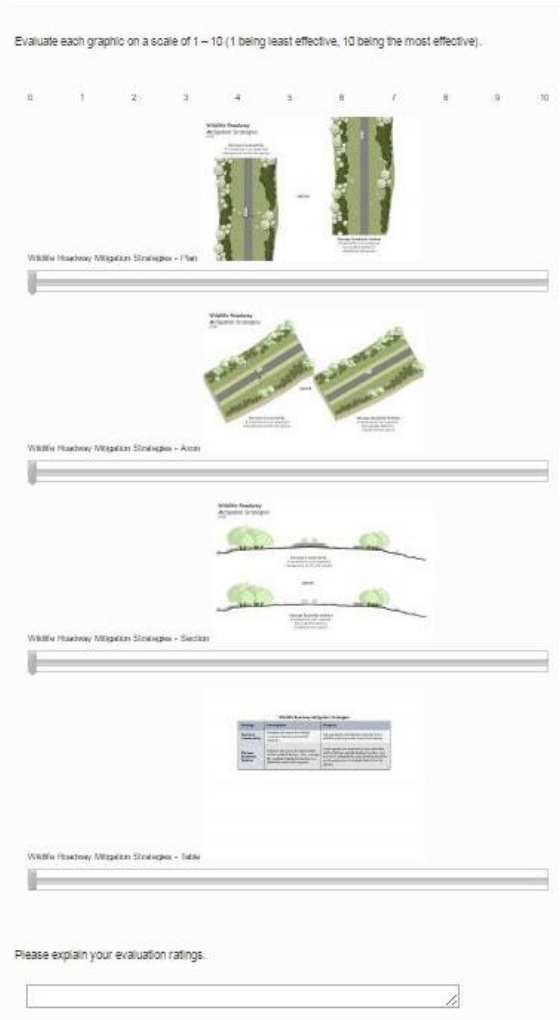


Figure 28. Example of an online survey question (Qualtrics 2005).

Survey Goals:

1) Identify the existing use of visual aids.
2) Find what types of visual aids are most beneficial for the different information categories (systems, etc.) and audience.

Survey Process:

30 minute online survey through Qualtrics software version April 2017 (Qualtrics 2005).

Graphic Use Assessment:

1. What types of illustrations do you currently use in your own work (photograph, sketch, table, etc.)?
2. Please feel free to upload any illustration formats or tools that you have found effective.
3. What determines these choices?
4. What other types of illustration are you familiar with?
5. Which are the most beneficial illustration types for you?
6. How are illustrations useful for you?
7. What purposes do the illustrations serve (sales tool, implementation/construction document, etc.)?
8. How often do you use illustrations for your work and in what circumstances?

Causeway BMPs Graphic Assessment:

1. Evaluate each graphic on a scale of 1 – 10 (1 being least effective, 10 being the most effective).
2. Please explain your evaluation ratings.
3. Please select the potential audience(s) for the illustrations.

4. Are there any additional audiences not listed that you think should view the graphics?
5. Are there any other graphic elements that should be included to help convey the information more appropriately? If so, what?
6. Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?
7. Among the graphics you've chosen, are there things that are distracting and/or not necessary to show?
8. Any additional comments?

Post-Illustration Assessment:

1. Has your perception of the usefulness of illustrations in communicating information changed since the last survey? If so, how?
2. Do the illustrations help to clarify the communication process? If so, how?
3. Are there any other illustrational formats or topics not included that could be useful?
4. Any additional comments?

CHAPTER 5

RESEARCH FINDINGS

Section 1: Existing Information Assessment Results

The first section of the study was an assessment of the visual communication strategies and usage for each of the professions included in the study and to determine any areas of convergence between them. Not all of the respondents completed this section, but representatives from each professional field provided answers to each question. Additionally, one planner from an academic background did not participate in this section, meaning the planning profession responses were only represented by one local government planning professional. Therefore, the responses were only intended to provide general guidance on existing visual communication strategies and usage for the expert advisory panel.

To better ascertain the value of visual aids in each profession, the respondents were asked to identify the key roles that different visual aids played in fulfilling their professional responsibilities (Table 1). The roles of visual aids varied between professions with little overlap between them; however, landscape architects shared with the ecologists the value of visual aids in showing spatial information. Additionally, land managers, ecologists, and the communications professional all valued visual aids for illustrating concepts and processes.

Table 1
Value of Visual Aids

Value of Visual Aids	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Persuasion							
Visualization							
Communication and collaboration							
Mapping							
Design							
Instruction							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Table 2 aggregates the responses to the question about the purpose visual aids in each professional's work. Interestingly, landscape architects listed the most purposes for visual aids in their work. The purpose of visual aids showed overlap in the areas as follows:

- Functioning as a sales tool (communications professional, ecologists, and landscape architects)
- Educating the public (communications professional, landscape architects, and land managers)
- Functioning as an explanatory tool (communications professional, landscape architects, and planner)
- Aiding in presentations to professionals (engineers and landscape architects)

- Serving as construction documents (landscape architects and maintenance professionals).

Table 2
Purpose of Visual Aids

Purpose of Visual Aids	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Sales tool	■	■		■			
Public education	■			■	■		
Teaching			■				
Explanatory tool	■			■			■
Construction documentation				■		■	
Assessment tool						■	
Scientific studies		■					
Design process				■			
Project documentation				■			
Schematics				■			
Broad application		■			■		■
Mapping					■		
Management planning					■		
Professional presentations			■	■			
Public relations							■

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

The frequency of use of specific visual aids varied across and within professions, but in general, visual aids were employed as a common communication technique. Each profession used presentation drawings at least on a weekly basis. Some fields used visual aids daily including landscape architects and land managers. Ecologists were the only profession to vary in usage frequency, and some ecologists used visual aids at least on a weekly basis while others used visual ais infrequently. There were a wide range of usage contexts identified that were grouped into several different categories including education, information sharing, persuasion, project related, and general use, as shown in the Table 3. Although not recorded in survey responses, specific contexts may well apply broadly across other professions.

Table 3
Visual Aid Usage Context

Visual Aid Usage Context	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Education							
Educational material development	■	■			■		
Academic education		■	■	■			
Public education	■	■					
Academic publication		■					
Information Sharing							
Informing the public	■						■
Informing professionals	■						

Table 3
Visual Aid Usage Context

Visual Aid Usage Context	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Persuasion							
Marketing							
Informing decision makers/clients							
Presentations - Non-specific							
Audience specific							
Project Related							
Project reporting							
Field research							
Regulatory coordination							
Brainstorming							
Project mapping							
Information gathering							
Public meetings							
Construction field meetings							
Project team meetings							
General Use							
Non-specific							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

To gain a perspective on the range of visual aids utilized, the professionals were surveyed to determine the types of the visual aids they currently use in their work. The responses showed significant overlap in the visual aids used by each profession. Interestingly, landscape architects identified use of nearly every visual aid employed by other professions. Photos and tables were the most ubiquitous types of visual aids utilized, but sketches, diagrams, and presentation drawings played a significant role for a majority of professions. The visual aids currently used by each profession are detailed in the Table 4.

Table 4
Visual Aids Currently Used by Each Profession

Visual Aid	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Photos	■	■	■	■	■	■	■
Tables		■	■	■	■	■	■
Sketches			■	■	■	■	■
Presentation Drawings	■	■	■	■			
Diagrams	■		■	■	■		
Aerial photos		■	■	■			
Charts	■	■	■				
GIS resource maps		■		■	■		
Technical drawings			■	■		■	
Illustrator graphics		■		■			
CAD graphics			■	■			
Photoshop graphics				■	■		
Modified photos				■			
Videos						■	
Maps			■				
3D models				■			
Non-specific drawings					■		

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

The most beneficial visual aids for each field are described in Table 5. The primary response by all professions was a preference to remain flexible in the type of visual aid utilized, and instead to focus on the message, context of use, and audience. Landscape architects, engineers, and the planner showed a wide range of beneficial visual aids. Engineers and planners preferred using several different visual aids to show the information from multiple perspectives, and engineers preferred visual aids that show detailed, temporal information. In addition, respondents from several professions listed photos as highly beneficial visual aids. Furthermore, photos were preferred by the planner as they are the most universally understood by the general public. Ecologists consistently stated that GIS based natural resource maps and aerial imagery are very useful types of visual aids. Additionally, ecologists described photos and presentation drawings handy for aesthetic enhancements or for illustrating a particular point.

Table 5
Most Beneficial Visual Aids by Profession

Visual Aid	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
No preferred format							
Photos							
GIS resource maps							
Tables							
Plan view							
Sketches							
Construction documents							
Diagrams							
Charts							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

The respondents were also asked to explain their selection criteria for a visual aid. The responses were varied and nuanced, but generally fell into three categories that are described below in Table 6. Across each profession, the need for the visual aid to have a persuasive component was a central theme in the selection criteria. The visual aid selected to act as an aid in persuading an audience was chosen with the consideration of the audience's demographics, presentation setting (e.g meeting, email), and persuasion objective. Project documentation and reporting was the second ranked selection criteria to address the demands of specific project types, processes, goals, regulatory

requirements, and deliverables. The third consideration was the expediency and efficiency of communications including both visual and verbal components over verbal alone.

Table 6
Visual Aid Selection Criteria

Selection Criteria	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Persuasive communication							
Project documentation/ reporting							
Expediency and efficiency							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Each respondent also identified their awareness of different visual aids. Maintenance professionals exhibited a smaller range of familiarity than other professions. Land managers identified a significant awareness of visual aids used in public engagement such as brochures and handouts and engineers were alone in using the layered PDF format. Each professions' awareness range of visual aids is described in Table 7.

Table 7
Additional Visual Aid Awareness Range

Additional Visual Aids	COMM	ECOL	ENG	LA	LAND MGR.	MAINT.	PP
Design Drawings							
Animations							
3D Models							
Photorealistic renderings							
GIS maps							
Diagrams							
Layered PDFs							
Movies							
Brochures/handouts							
Signage							
Phone apps							
Graphs							
Charts							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Section 2: Information Category Survey Results

Systems Information Category

Visual Aids that provided an overview and background information on the terrapin roadway issues and the associated causeway BMPs. The visual aids were visually abstracted and diagrammatic in nature, and highlighted landscape features and systems, spatial and functional relationships of landscape elements, and strategic approaches to identified goals and objectives. The rendering style showed gross relationships through a hand drafted style with simple massing forms. The respondents were asked to evaluate each visual aid (e.g plan view, section elevation, etc.) and rate each visual aid independently on its ability to convey the stated topic. The rankings of each visual aid by profession are shown in Figure 29.

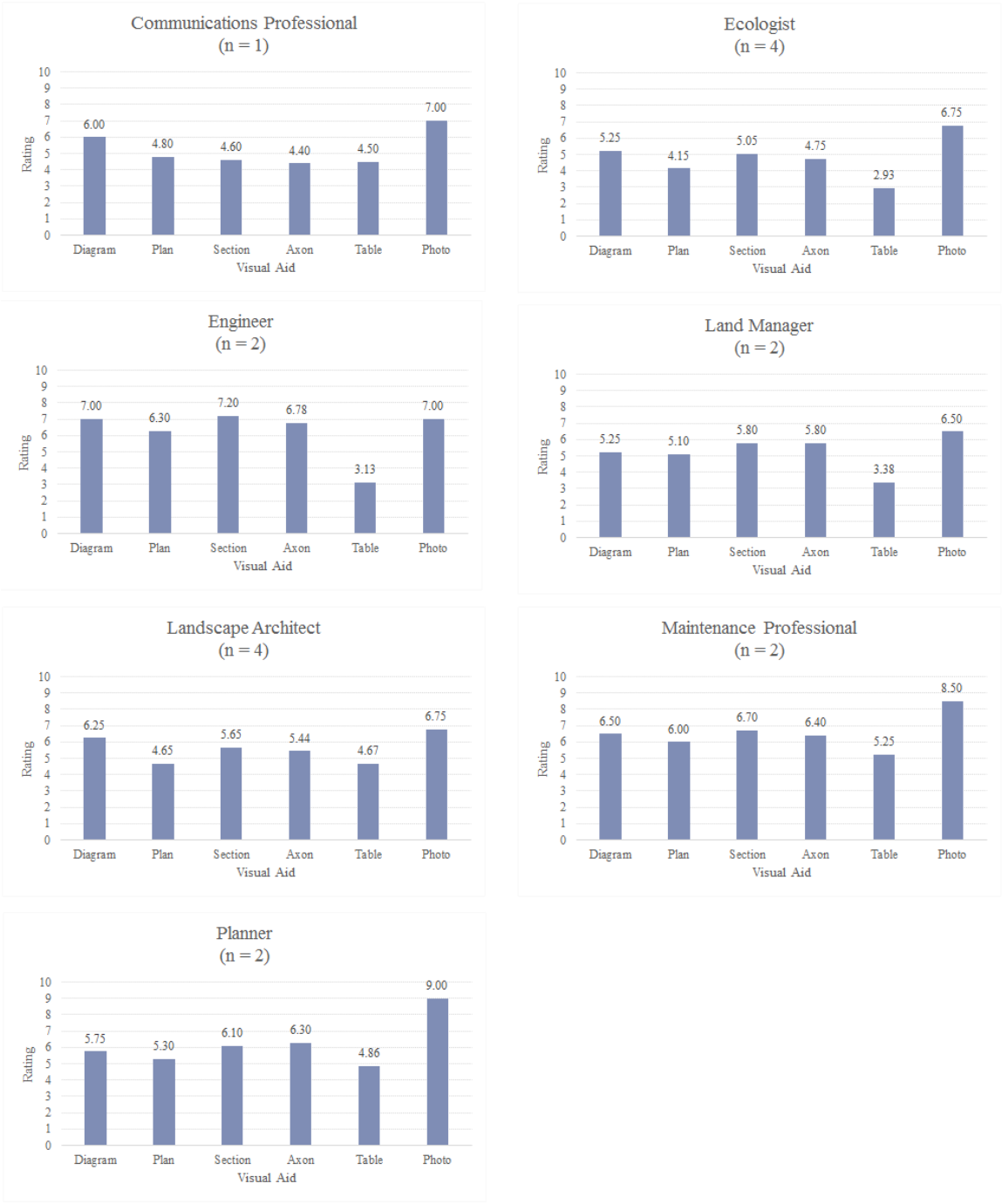


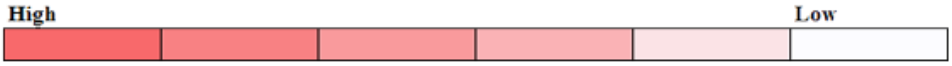
Figure 29. Systems information category visual aid rankings by profession.

All professions except engineers stated their strongest preference for photos (Table 8). Engineers showed a small preference for the section elevation in this role. The photos were valuable as they provided realistic detail and a reference example; and photos could be useful in presentations as they are relatable by a wide range of audiences. Furthermore, several reviewers expressed that photos are a more effective when paired with other drawing conventions that show a comprehensive and spatial view of the BMPs.

Respondents also stated that each systems topic was best shown through a combination of visual aids, but each new visual aid should add new information and not only repeat information. The plan view and table ranked as the least valuable visual aids for nearly all of the professions. Respondents stated tables function as good summary tools for organizing and presenting information, but they should be bolstered with supporting visual aids. The diagrams were valued as they functioned well in conveying the spatial and functional relationships, and management concepts. Moreover, the professions all stated that the addition of a vertical plane (section or elevation) or three-dimensional view (axonometric drawing) was important for comprehension, visualization, understanding the landscape from a human eye level, and for viewing the structure of landscape elements and their relationships. For instance, the section elevation was preferred for communicating habitat heterogeneity because the vegetation structure was important to link to the wildlife species. Other forms of topographic expression (contour lines, shading, etc.) were also stated as important visual cues and especially in drawing conventions expressing information best understood by depiction with a vertical plane (e.g. animals passing through a culvert or tidal flow).

Table 8
Systems Information Category - Visual Aid Rankings by Profession

Professionals	Diagram	Plan View	Section Elevation	Axonometric Projection	Table	Photo
Communications Professional						
Ecologists						
Engineers						
Landscape Architects						
Land Managers						
Maintenance Professionals						
Planners						



Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Across the professions, several areas of consensus emerged for systems information category. While they were valued as they represented spatial relationships effectively and aided in the comprehension of relationships between landscape elements, all felt that the visual aids missed their objective at times without supporting text to explain the concepts, graphic ideas, and connection between topics. Furthermore, the conceptual information would be bolstered with numerical data (e.g. maintenance costs, reduction in wildlife vehicle collision statistics). The respondents also requested additional systems information on the terrapin-roadway conflict and site context information in the form of site photos and maps. Additionally, the respondents provided visual aid production improvement suggestions, which are listed below.

Additional Production Guidelines

- Legends/keys are essential—don't assume all users will understand symbols in use.
- Thoroughly label landscape elements—to avoid ambiguity.
- Use word labels instead of number labels for clarity.
- Use readily identifiable icons—for instance, those used in infographics.
- Use universal, intuitive symbols over realistic representation (e.g. water color = blue instead of marsh color = green/grey).
- Represent landscape function icons literally (e.g. rainwater flow with arrows at ground surface).
- Exaggerate the scale of icons where needed for legibility.
- Illustrate movement of subjects with lines and arrows.
- Emphasize contrast in rendering style and symbols (e.g. between habitat types) for clarity, visibility, and variances in printer quality.
- Keep detail/texture in the visual aids minimal in diagrams
- Character example photos should represent desired conditions.

Audiences:

The landscape architect was ranked as the primary audience for the systems information category, but all audience types were deemed potential viewers by greater than 50 percent of the respondents (Figure 30).

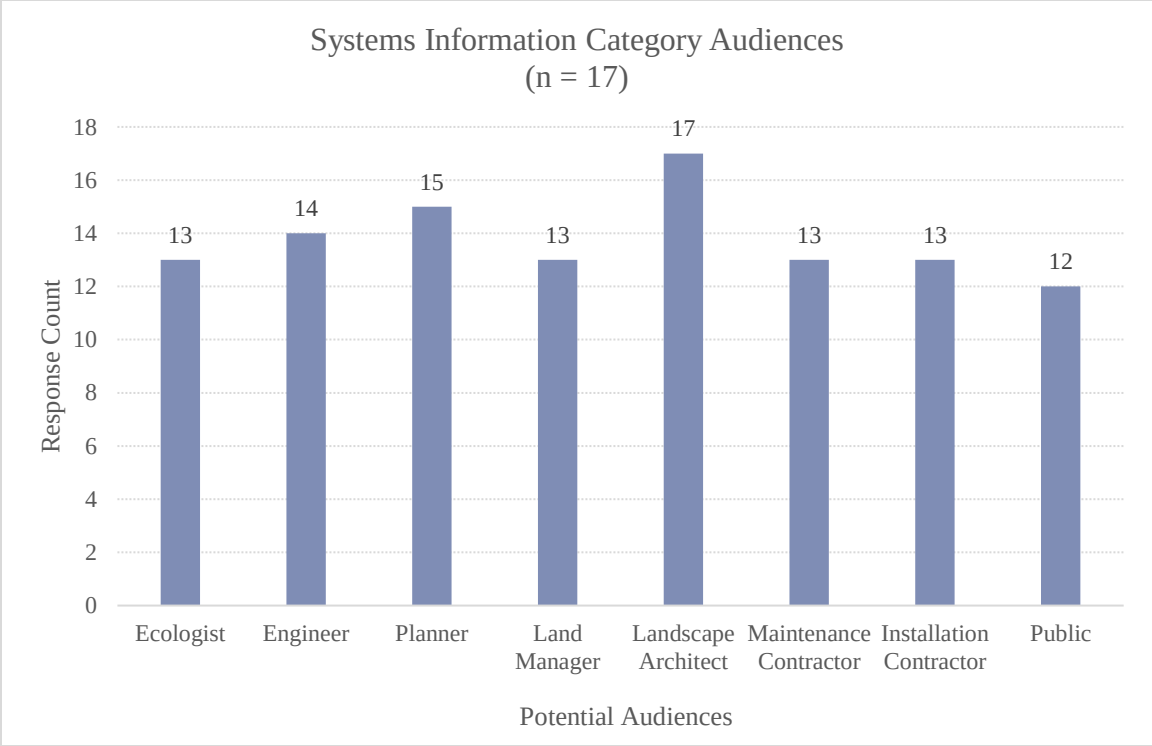


Figure 30. Systems information category audience rankings.

Additional Potential Audiences**:**

The respondents identified several other potential audiences that may view the visual aids in the systems information category. The additional audiences include: wildlife biologists/scientists, recreational drivers, media representatives, local organizations (e.g. Boy Scout troops), educational groups, DOT manager, advocacy groups, environmental groups, recreationists (e.g. bicycle clubs), decision makers, elected officials, and law enforcement.

One reviewer observed that the public could be either island residents or tourists, and the information shared with them would vary based on their needs and concerns. To another reviewer, recreationists would be an audience, but may not need complete information related to the BMPs.

Experiential/Promotional Information Category

Visual aids that conveyed an empathetic experience of the landscape, its elements, and the primary subjects of the image. The visual aids served as potential promotional materials for decision makers and stakeholders. The rendering style utilized more realistic and detailed imagery to capture a near representation of a realistic scene. The respondents were asked to evaluate each visual aid (e.g plan view, section elevation, etc.) and rate each visual aid independently on its ability to convey the stated topic.
The rankings of each visual aid by profession are shown in Figure 31.

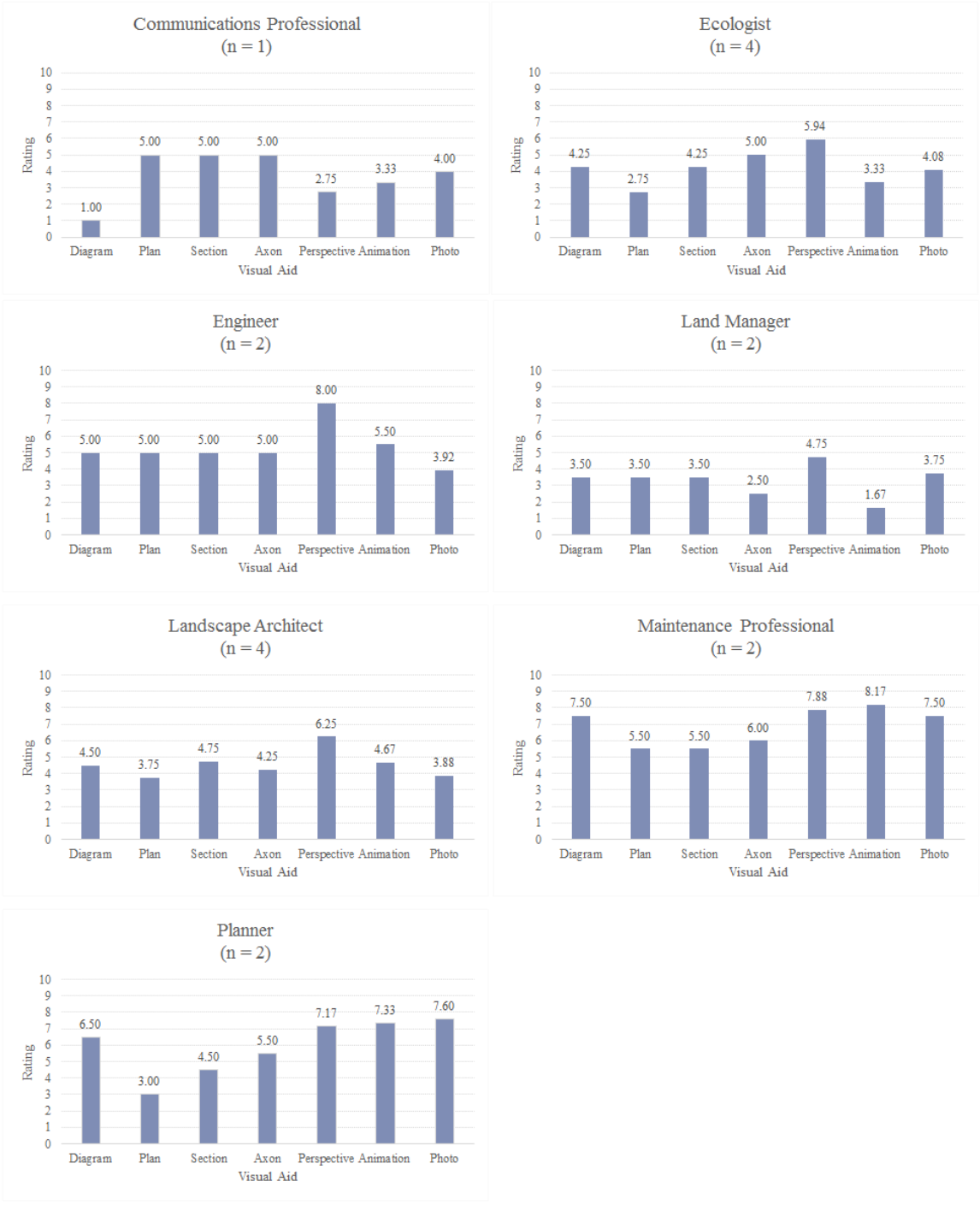


Figure 31. Experiential/promotional category visual aid rankings by profession.

In general, the professionals expressed a need for information to be shown in a variety of visual aids to function effectively (Table 9). The perspectives were rated highly by all professions except the communications professional. Respondents stated preference for the realistic rendering style and the viewpoints of the terrapin and driver. Furthermore, the addition of the terrapin head to the perspectives aided in giving identity to the subject of the perspectives, provided a sense of scale, and fostered empathy in the viewers with the subject of the perspective.

Overall, the photos were highly rated in the comments by all professions because they showed a realistic portrayal of site conditions as well as driver and terrapin perspectives and experiences. Some respondents requested more contextual information to clarify the goal of specific photos.

Animations that represented the driver and terrapin experience of the causeway BMPs and the terrapin experience of the nesting boxes were evaluated by the expert review panel. The animations were not preferred for conveying experiential/promotional information by any professions except the maintenance professionals and planners. Maintenance professionals and planners valued the three-dimensional component of the animation, realistic detail, and the journey aspect. However, nearly all respondents disliked the fast movement of the animation, and ecologists stated that the animations were too long for the information they conveyed. Land managers, engineers, and ecologists felt that lack of realism limited the credibility of the animations. One respondent suggested using real video footage of terrapins using the causeway.

Respondents stated that the credibility of diagrammatic graphics was limited due to a lack of data to support the benefits claims, and the intent behind the graphic was

unclear. Detailed, textual information to support the benefits was requested by reviewers. Also, the form of the radar diagram graphic was confusing as it was primarily viewed as a pie chart by respondents.

The section elevation was valued by several respondents including the landscape architects and communications professional as it provided an eye level view of the causeway. However, plan view and axonometric projection drawing conventions were not ranked highly as they weren't overly informative of the driver experience of the causeway and BMPs. The respondents provided visual aid production improvement suggestions, which are listed below.

Additional Production Guidelines

- Visually contrast and identify the subject of the visual aid for clarity.
- Add textual information to explain the visual aids, their components, and provide any data to support any claims.

Table 9
Experiential/Promotional Category Visual Aid Rankings by Profession

Professionals	Diagram	Plan View	Section Elevation	Axonometric Projection	Perspective	3D Animation	Photo
Communications Professional							
Ecologists							
Engineers							
Landscape Architects							
Land Managers							
Maintenance Professionals							
Planners							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Audiences:

Communication with the public was ranked as the primary focus for this information category (Figure 32). Other audiences deemed potential viewers by greater than 50 percent of the respondents included the ecologist, planner, land manager, and maintenance contractor.

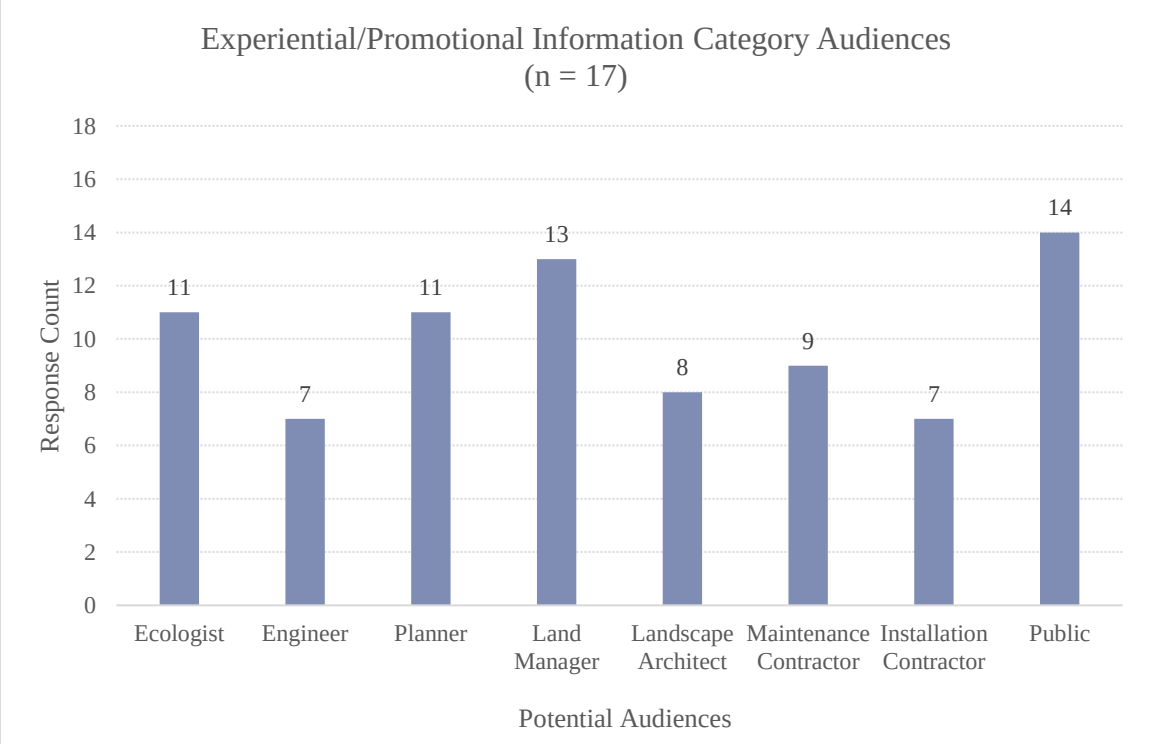


Figure 32. Experiential/promotional information category audience rankings.

Additional Potential Audiences:

The respondents identified several other potential audiences that may view the visual aids in the experiential/promotional information category. The additional audiences include wildlife biologists, community leaders, media representatives, local organizations (e.g. garden club), and elected officials.

Construction Information Category

The visual aid detailed dimensions, materials and their quantities, landscape siting information, and installation notes and specifications to aid in the implementation of the constructed landscape features. The drafting style showed materials and dimensions of BMPs through black and white line work with a clear line weight hierarchy, standard construction symbols, language, scales, and dimensions. The respondents were asked to evaluate each visual aid (e.g plan view, section elevation, etc.) and rate each visual aid independently on its ability to convey the stated topic. The rankings of each visual aid by profession are shown in Figure 33.

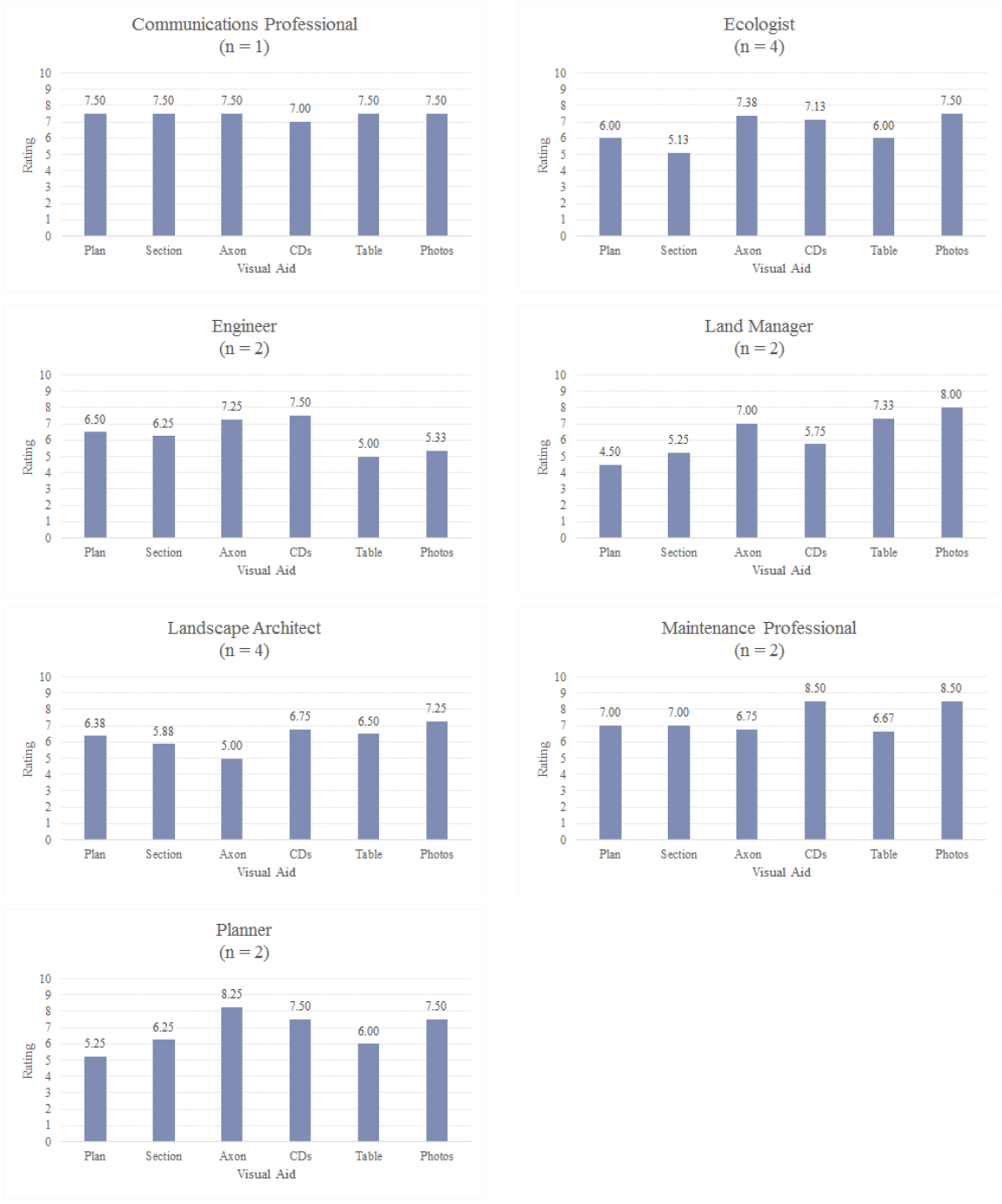


Figure 33. Construction information category visual aid rankings by profession.

In general, the professionals expressed a need for the information to be shown in a variety of visual aids to function adequately for constructing the BMP features (Table 10). Each profession varied in preference for the axonometric projection. The communications professional, ecologists, engineers, land managers and planners ranked it highly as the drawing convention clearly showed depth and landscape siting and layout relationships for both features. Furthermore, the ecologists and engineers felt that the axonometric projection worked best for the representation of a planting plan. In contrast, landscape architects ranked the axonometric projection as the least valuable drawing convention for both the nest boxes and planting plan. The plan view rankings varied across professions, and the ecologists, land managers and planners ranked the plan lower than other professions. Land managers stated that more detailed information needed to be provided with the plan view.

The section elevation was not ranked highly by the professions except for the communications professional and maintenance professionals. Reviewers stated that the section elevation did not function well in presenting information because it distorted objects such as the sand mound size, angles and dimension. The distortion occurred because the section elevation did not portray the dimensions of large landscape features such as the sand mound clearly.

The construction details were ranked highly by all professions; however, the land managers ranked them slightly lower in value, as they needed more detailed information. Furthermore, ecologists requested depiction of additional environmental data such as elevation and tidal ranges.

Respondents widely varied in their preference for the table, but its function in the construction information category was described as beneficial in the construction planning process. Photos were ranked highly by all professions except for the engineers. All professions described the photos as functioning well in this information category as display and character example tools because the photos showed the concepts and goals of the construction information category. Additionally, respondents stated that the photos could serve as a promotional tool to present to decision makers.

Table 10
Construction Information Category - Visual Aid Rankings by Profession

Professionals	Plan View	Section Elevation	Axonometric Projection	Construction Details	Table	Photo
Communications Professional						
Ecologists						
Engineers						
Landscape Architects						
Land Managers						
Maintenance Professionals						
Planners						

High Low

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Additional Production Guidelines

- Include information such as cost and suggested retailers.
- Include site data such as topography, road shoulders, and tidal range information.
- Test line weight hierarchy and symbols for maximum legibility.
- Provide consistency between visual aids to aid in referencing specific materials.
- Provide thoroughly detailed information on the constructed features
- Legends/keys are essential—don't assume all users will understand symbols in use.
- Thoroughly label landscape elements—to avoid ambiguity.
- Character example photos should represent desired conditions.

Audiences:

The installation contractor ranked as the primary audience for the construction information category (Figure 34). All the other audiences were deemed potential viewers by greater than 50 percent of the respondents except for the public.

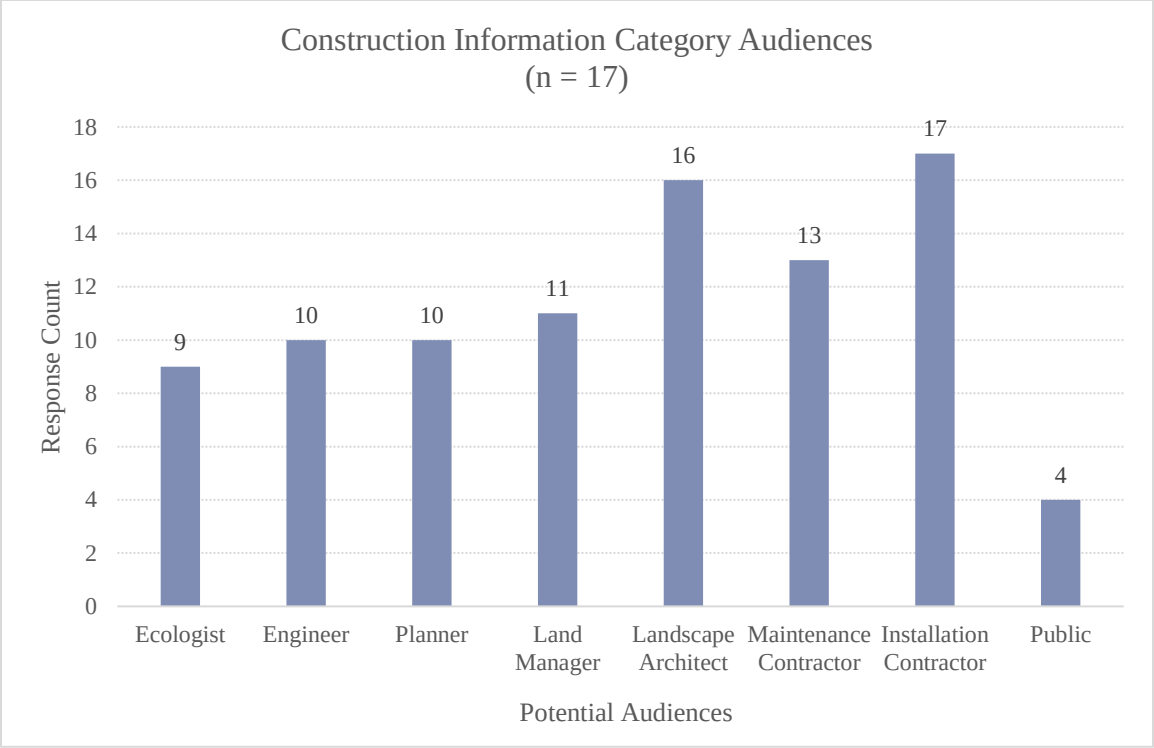


Figure 34. Construction information category audience rankings.

Additional Potential Audiences:

The respondents identified several other potential audiences that may view the visual aids in the construction information category. The additional audiences include volunteer groups (e.g. aiding in installation of features), wildlife officers, regulatory officials, community leaders, media representatives, and elected officials.

Post Construction Evaluation Information Category

Similar to the construction information category, these visual aids showed requirements for dimensions, landscape siting, and design features of BMPs such as nest box electric fencing. The drafting style showed materials and dimensions through black and white line work with a clear line weight hierarchy, standard construction symbols, language, scales, and dimensions (same style as the construction information category). The respondents were asked to evaluate each visual aid (e.g plan view, section elevation, etc.) and rate each format independently on its ability to convey the stated topic. The rankings of each visual aid by profession are shown in Figure 35.

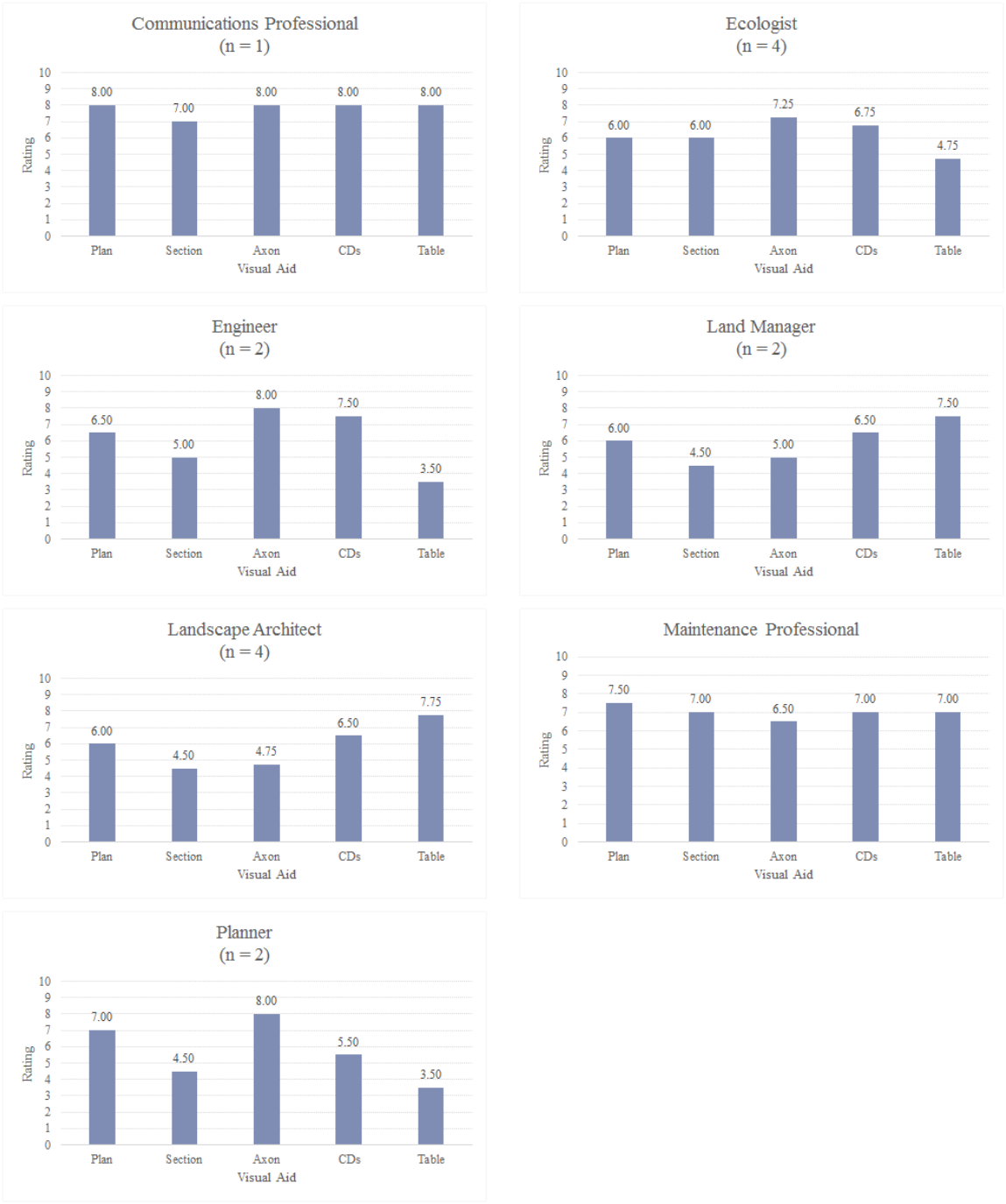


Figure 35. Post construction evaluation category visual aid rankings by profession.

In general, the professionals expressed a need for the information to be shown in a variety of visual aids to effectively evaluate the construction of the BMP features (Table 11). The construction details were stated as being useful by all professions except the planner. Construction details were useful in this application because the evaluation features were dimensioned. Respondents stated that the table functioned best as a checklist, and several reviewers suggested modifying the table into a checklist form with room for comments as well. Furthermore, the land managers stated that a table or a punchlist were the only visual aids required. The section elevation was not well received by most professions because the information was unclear. Instead, the axonometric projection and plan view were preferred for landscape spatial relationships. Photos were not included in the review process for this information category, but one reviewer suggested that photos be used as a documentation tool to add in future re-evaluation of the BMPs.

Table 11
Post Construction Evaluation Category Visual Aid Rankings by Profession

Professionals	Plan View	Section Elevation	Axonometric Projection	Construction Details	Table
Communications Professional					
Ecologists					
Engineers					
Landscape Architects					
Land Managers					
Maintenance Professionals					
Planners					

High Low

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Additional Production Guidelines

- Provide evaluation information in a checklist format with a comments section.
- Test line weight hierarchy and symbols for maximum legibility.

Audiences:

The maintenance contractor ranked as the primary audience for the post construction evaluation information category (Figure 36). All the other audiences were deemed potential viewers by greater than 50 percent of the respondents except for the planner and public.

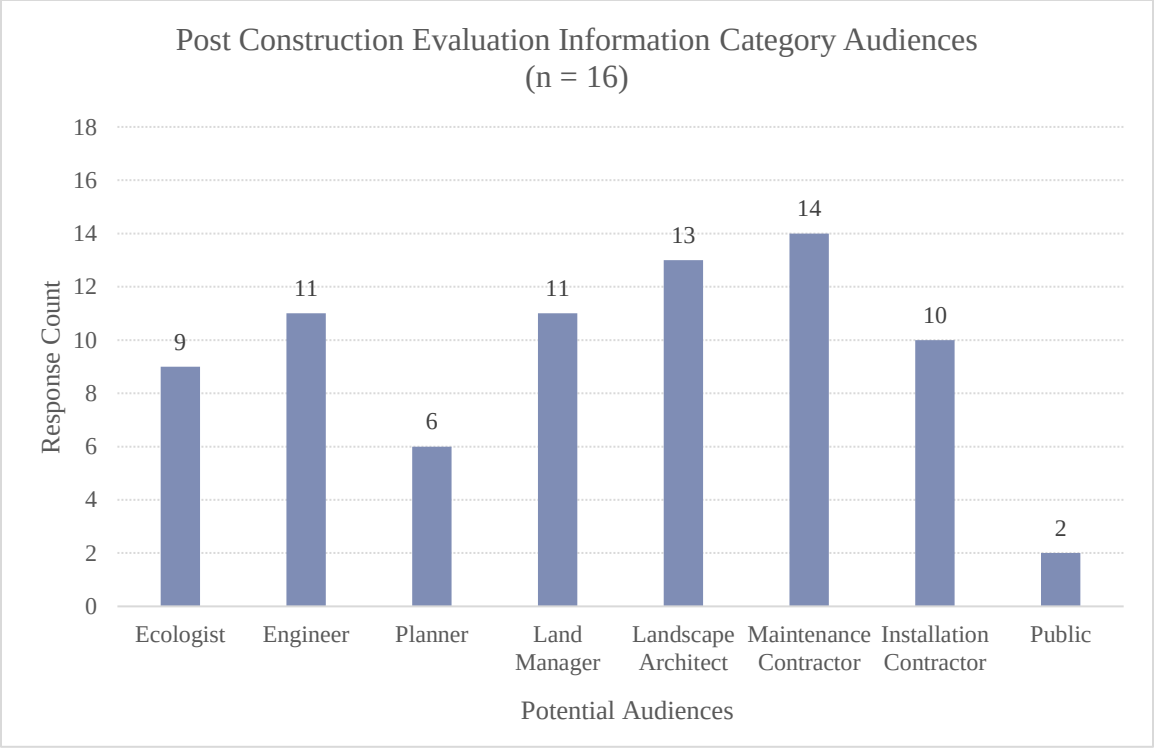


Figure 36. Post construction evaluation information category audience rankings.

Additional Potential Audiences:

The respondents identified several other potential audiences that may view the visual aids in the post construction evaluation information category. The additional audiences include scientists, wildlife technicians, and wildlife law enforcement.

Maintenance/Management Information Category

This information category depicted summaries on vegetation communities and their management strategies, management requirements of the BMPs, and the maintenance procedures for the vegetation communities and BMPs. Furthermore, the visual aids showed management goals and objectives, spatial relationships, system strategies (e.g. invasive species management procedures), and guidelines to handle special circumstances such as encountering a terrapin while mowing the grass strips. The rendering style showed gross relationships through a hand drafted style with simple massing forms (same style as the systems information category). The respondents were asked to evaluate each visual aid (e.g plan view, section elevation, etc.) and rate each visual aid independently on its ability to convey the stated topic. The rankings of each visual aid by profession are shown in Figure 37.

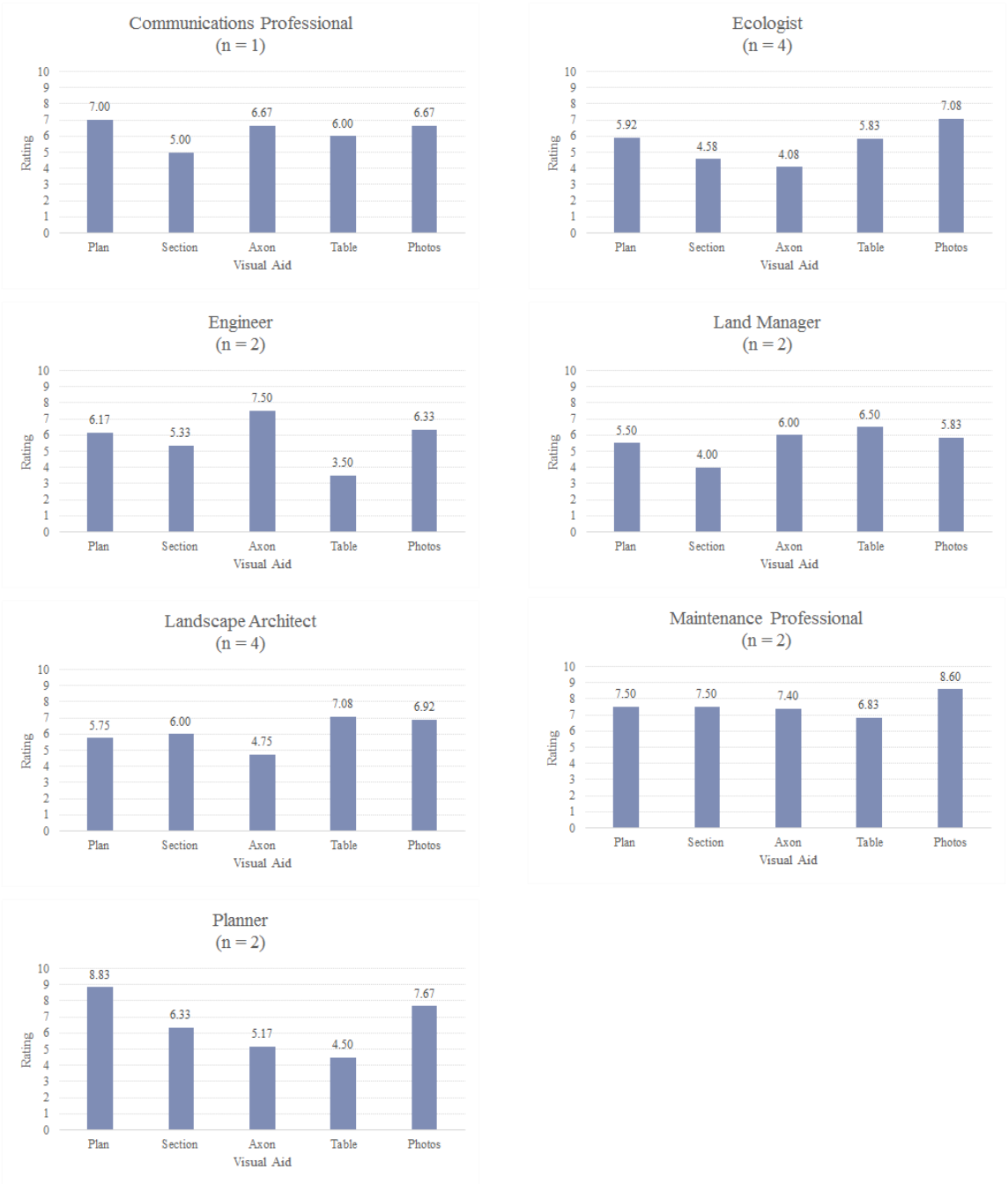


Figure 37. Maintenance/management category visual aid rankings by profession.

In general, the professionals expressed a need for the information to be shown in a variety of visual aids to gain a comprehensive understanding of the maintenance/management tasks (Table 12). Also, enhancing causeway safety for drivers should be listed as another guiding goal for the maintenance/management information category.

The table was viewed by all professions as providing an adequate summary of the maintenance/management actions. Adding a checklist and chart would aid in assigning tasks to personnel, showing seasonal tasks, and tracking the status of the tasks throughout the year. Photos were highly valued overall as they supplied plant identification information, character examples, end result goals, and public promotional tools. Photos could also be used as a tool to document before and after conditions associated with maintenance/management tasks. Also, one reviewer suggested adding photos of the rare plant species to protect along the causeway. To further improve the plant identification function, one reviewer suggested adding detailed plant descriptions and line drawings as plant characteristics can vary seasonally.

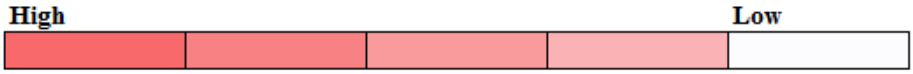
The land managers stated that the photos and tables were sufficient for management tasks, and the maintenance professionals were divided in their preferences as one professional only strongly preferred the photos and table. Furthermore, one maintenance professional viewed this information category as the primary focus of promotional and sales efforts in relation to the BMPs. Another maintenance professional expressed value of other visual aids such as the section elevation. The section elevation aided in presenting maintenance information at the human eye level, which aided in the comprehension of some landscape elements (e.g. slope of the causeway roadsides) The

planners also highly ranked the section elevation, and the landscape architects ranked the section elevation higher than other visual aids such as the plan view and axonometric projection. The section elevation was lower in value for the land managers, ecologists, engineers, and communications professional because the drawing convention compressed horizontal relationships.

The communications professional, ecologists, maintenance professionals, and planners all ranked the plan view highly. Respondents identified that the plan view shows landscape scale characteristics and spatial relationships. Engineers, land managers, and the communications professional highly ranked the axonometric projection, whereas the ecologists and landscape architects ranked it as the least useful visual aid. The axonometric projection was preferred by some professions as an alternate to the plan view in showing landscape scale characteristics and spatial relationships.

Table 12
Maintenance/Management Category Visual Aid Rankings by Profession

Professionals	Plan View	Section Elevation	Axonometric Projection	Table	Photo
Communications Professional					
Ecologists					
Engineers					
Landscape Architects					
Land Managers					
Maintenance Professionals					
Planners					



Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Additional Production Guidelines

- Utilize a color gradient to visually prioritize information in tables.
- Code callout areas with color fills instead of outlines.
- Provide thoroughly detailed information to guide field crews and prepare cost estimates.
- Legends/keys are essential—don't assume all users will understand symbols in use.
- Thoroughly label landscape elements—to avoid ambiguity.

- Use word labels instead of number labels for clarity.
- Use readily identifiable icons—for instance, those used in infographics.
- Use universal, intuitive symbols over realistic representation (e.g. water color = blue instead of marsh color = green/grey).
- Exaggerate the scale of icons where needed for legibility.
- Emphasize contrast in rendering style and symbols (e.g. between habitat types) for clarity, visibility, and variances in printer quality.
- Character example photos should represent desired conditions.

Audiences:

The land manager ranked as the primary audience for the maintenance/management information category (Figure 38). All the other audiences were deemed potential viewers by greater than 50 percent of the respondents except for the engineer, planner, landscape architect, and installation contractor.

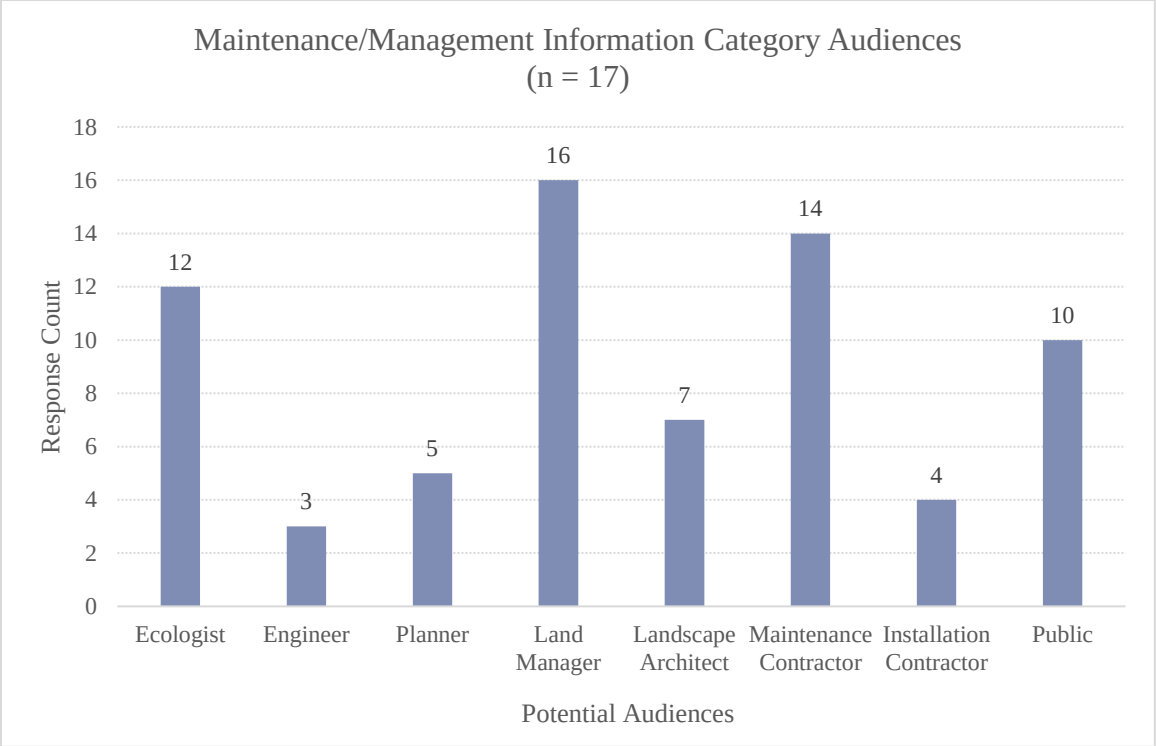


Figure 38. Maintenance/management information category audience rankings.

Additional Potential Audiences:

The respondents also identified students as a potential audience that may view the visual aids in the maintenance/management information category.

General Observations:

Respondents stated that providing several different visual aids to illustrate a topic was the best method for effective visual communication. Moreover, the complimentary visual aids should also strive to provide new information and not repeat information between visual aids. The rendering style preference throughout the survey was for realistic imagery as this style provided the most detail and visualization of the topics. Photos were listed as a primary visual aid in the information categories as they provide realistic detail and are universally understood by a range of audiences. If a landscape element was rendered, the preference was for literal representation unless the

representation of its natural state was not universally understood, and the color of the marsh is an example of this concept. For example, the survey drawing conventions showed the marsh as a green/grey color, which is a literal representation of the marsh coloration; however, respondents stated that the marsh should be depicted with a blue color as viewers may not readily identify the marsh with the green/grey coloration. Topography was another element that is critical to illustrate in every drawing convention. Also, the table functioned as a summary tool in every information category for respondents. Other formats identified for inclusion were the checklist and chart, which can aid in managing task completion and accountability.

Section 3: Post Survey Results

Question 1: Has your perception of the usefulness of illustrations in communicating information changed since the survey? If so, how?

Half of the respondents reported an improved change of perception in the usefulness of visual aids from the survey. Landscape architects reported that the survey expanded their notion of audiences to address when developing project visual aids (e.g. management professionals), and one landscape architect reaffirmed their notion that visual aids pertain to each profession (e.g. lists for maintenance professionals). Another landscape architect reported that it was helpful to compare the visual aids across information categories to view how the visual aids and rendering styles may differ in application. The ecologists and communications professional both noted that the survey had expanded their notion of visual aids available to visually communicate ideas in appropriate circumstances. Also, an ecologist reported that the survey aided in showing the value of incorporating visual aids throughout the life cycle of a project to thoroughly

visually communicate the different project stages. One engineer stated that the survey showed the benefit of a drawing convention (axonometric projection) in tandem with other visual aids to communicate information in appropriate circumstances. A planner stated that the survey showed how visual aids can make communication more efficient. Finally, a maintenance professional stated that the survey expanded their perception of the visual aids available for visually communicating information.

Question 2: Do the illustrations help to clarify the communication process? If so, how?

All the professions stated that the visual aids clarified the communication process, and their reasons are summarized in Table 13. However, their responses stipulated that the visual aids are only effective if they target the appropriate audience, utilize the best received visual aid for that audience, and communicate the information in a clear and concise manner.

Table 13
Communication Value of Visual Aids

Communication Value	COMM	ECOL	ENG	LA	LANG MGR.	MAINT.	PP
Aided in the visualization of the plan/project/goals							
Provided spatial scale and context							
Served as an explanatory tool							
Conveyed information quicker and more thoroughly than text, universal to different users							
Showed stakeholder perspectives (turtle and driver)							
Design tool							
Visual cue for textual information (to stop and read more)							

Key - COMM: communications professional; ECOL: ecologist, ENG: engineer; LA: landscape architect; LAND MGR: land manager; MAINT: maintenance professional; PP: professional planner

Question 3: Are there any other illustration formats or topics not included that could be useful?

The communications professional and an ecologist stated that more systems information on the terrapin-roadway conflict could be beneficial to include for both professional and public audiences. Also, the land managers stated that it would be useful to include public educational materials on the BMPs. The planners stated that aerial imagery would be useful to aid in the decision making process, and the land managers

requested maps showing habitat areas with documented nesting sites. An ecologist requested video footage of terrapins in their habitat as opposed to the animations. A landscape architect also suggested re-analyzing the use of the animations due to distribution problems. Finally, the communications professional suggested looking into utilizing visual aids such as Gantt charts and line art.

New Directions

Based on the responses gathered during the survey, expansion is warranted in the graphic information categories. Several respondents requested more information in the systems information category. For instance, more information could be presented describing the site context and wildlife vehicle collision issue utilizing visual aids such as location maps, site photos, and GIS resource maps.

Additionally, information geared towards educating the public could be included as a new information category. This information category would be linked to the maintenance/management information category as many comments from the land managers related to providing signage, maps, brochures, and other interpretative elements for the public. Information from other categories would feed into this education category such as systems or experiential information, but the goals and objectives would be different from those information categories and specifically relate to capitalizing on educational opportunities. Finally, investigation is needed into the use of other visual aids identified from this survey such as GIS resource maps, aerial imagery and charts.

CHAPTER 6

CONCLUSIONS

Rationale and Benefits of Visual Communication

The wildlife roadway mitigation process links together practitioners of human and environmental systems in a working relationship. Practitioners aim to reduce conflicts associated with competing landscape uses, which requires the synthesis of goals and objectives from several professions together in a cohesive format. This process requires effective multi-disciplinary communication, and the results from this thesis support the assertion that visual communication bolsters the coordination process. For instance, the post survey data did not reveal any increased value for the visual aids to members from each profession as they already valued visual aids and utilized them in their professional practice. Furthermore, the high frequency of visual aid use by almost all of the professionals indicates that visual communication play a central role in each field's coordination process and professional practice, and should be expanded accordingly in wildlife roadway mitigation projects. The post survey questions revealed that visual aids assisted the visualization of project plan goals, objectives, and strategies for nearly all professions. Moreover, a survey respondent stated that visual aids serve as visual cues that flag textual information for further investigation. Therefore, this survey supports the assertion that there is a need for increased use of visual aids in presenting information along with textual support.

The primary purpose of this thesis was to determine the effectiveness of different visual aids in communicating a variety of information to different professions. The visual aids selected by the expert review panel varied for each information category depending on the reviewer's profession and their responsibilities. Every profession valued flexibility in the range and choice of visual aids employed for a task, thereby supporting the premise of expanding beyond the standard visual aids of photo, text, and table. However, in the mitigation process, it is important to promote awareness of alternate visual aids that may be more suitable in presenting information than the standard visual aids as the participants may not be aware of the wide range of visual aid possibilities. Additionally, numerous comments reiterated the need for information to be presented in multiple visual aids; not to repeat the information, but to add additional, complementary details as allowed by the strengths of different visual aids. Moreover, the survey respondents identified a range of audiences that may view the visual aids in each information category, which reinforces the needs for a variety of visual aids to be utilized.

The visual aids shown in the survey offer different benefits for communicating wildlife roadway mitigation issues. Relationships expressed in diagrammatic graphics are valuable if clearly symbolized and supported with evidence. Tables primarily function as summary tools, but they should be coupled with other drawing conventions if required to convey spatial relationships. Construction information in the drawing convention of construction details are valuable as they provide spatial information critical to planning and design. Additionally, plan views represent horizontal relationships, section elevations illustrate vertical relationships, and axonometric projections portray

three-dimensional relationships. In general, since spatial relationships involve multiple planes, a range of drawing conventions including the vertical plane and three-dimensions should be included to aid in comprehension of the material. The drawing conventions address the same topic, but present new, interrelated information.

The experiential visual aids including photographs and presentation drawings varied in value to the expert review panel. Animations should be avoided unless they can provide realistic depictions. While photos don't simulate movement, photos are an efficient and expedient visual aid, universally understood, and portray existing site conditions with realistic imagery and detail. Furthermore, a basic tenet of information design is "If it's tangible, photograph it. If it's intangible, illustrate it." (Meyer 1997). Although photos are a valuable visual aid, perspectives serve several purposes as well. Perspectives can play an equivalent role to photos in appropriate circumstances if the drawings include photo-realistic imagery. Perspectives may be more appropriate for presenting new mitigation concepts without photographic character examples or in situations that require focus on site specific characteristics instead of a general, representative photo. In situations where it may be infeasible to present photographs of wildlife behavior, perspectives can provide an opportunity to present audiences with views from the animal perspective.

The value of visual communication is not new for landscape architects, but the results of this thesis expand on the roles of the visual aids in different facets of this use context. Additionally, the survey responses provide a persuasive rationale for utilizing a wider range of visual aids in other, similar, project settings. Finally, the presentation of

the BMPS in varied visual aids assist in expanding the role of landscape architects in visually communicating roadway mitigation.

Role of Landscape Architects

Landscape architects are uniquely positioned to present a range of visual communication strategies for wildlife roadway mitigation for several reasons identified in the survey. For example, landscape architects regularly use a wide range of visual aids that overlap with the visual aids used by other professions, which enables landscape architects to facilitate multi-disciplinary, visual communication related to the range of issues present in wildlife roadway mitigation. In addition, landscape architects' familiarity with a broad range of visual aids enables them to translate the visual communication needs of each profession into their preferred visual aids. The pre-assessment section of the survey aided in establishing the visual aid awareness range and typical use patterns of the participants. The visual aids commonly employed by each profession varied, but each profession was familiar with a wide range of visual aids, including those employed by landscape architects.

Another important role of landscape architects is to take the specific goals and objectives of each profession and synthesize them into visual communication strategies. Landscape architects commonly deal with a range of visual information throughout the design process; and the existing use assessment section of the survey illustrated the ready application of this visual information to other professions' information uses. For instance, survey respondents identified the purpose of visual aids to include functioning as explanatory tools (i.e. systems information category), sales tools (i.e. experiential/promotional information category), construction documentation, evaluation

tools, and management tools. As a result, the information categories and visual aids that landscape architects traditionally utilize readily apply to this multi-disciplinary design context of wildlife roadway mitigation.

Visual Aids

In association with identifying the role and benefits of different visual aids, a secondary focus of this thesis involved determining the production components required to effectively visually communicate the information required at each project stage from inception through maintenance of a project. Across each information category, respondents requested more detailed textual information and numerical data to support concepts and assertions. This is in contrast to the typical practice of landscape architecture to use limited amounts of explanatory text with visual aids; this practice may need to be adjusted when addressing professions that typically rely more heavily on text such as ecologists and those communicating non-graphic information.

The professionals consistently expressed a concern for how visual aids in systems and experiential/promotional information categories would be received by the public. For these visual aids, the preference for realistic depictions of information and literal symbols suggests that abstract representation is not a useful method for communicating across different audiences in this context. The visual aids chosen may need to deliver the information in more universal visual aids such as a photo when the public is involved.

Technical documents, including the construction and post construction information categories, should include as much information to assist in the execution of tasks as possible since the audiences are primarily engaged in application and not public presentation. The functional relationships requiring illustration include implementation

instructions, dimensions, spatial relationships, materials, performance tracking, and planning information (e.g. costs and suppliers). For technical documents, the drafting style should be simple line drawings with clearly depicted features and labels, and utilize standard construction symbols.

Maintenance/management visual aids are a hybrid of the previous information categories as there are requirements for both public involvement in the management/maintenance process and to deliver functional information to practitioners. Therefore, the concepts of applying literal symbols, realistic imagery in visual aids (e.g. perspectives and photos), implementation instructions, dimensions, functional relationships, spatial relationships, materials, performance tracking, and planning information (e.g. costs and suppliers) are applicable. Rendering styles should be continually developed and tested with feedback from audiences as information presentation needs and preferences may vary over time.

Rationale for BMP Life Cycle Guidance Visual Aids

The expansion of visual communication and visual aid variety is warranted in all information categories and may support the development of visual communication standards across all stages of BMP inception, implementation and maintenance. Throughout the survey, the presentation of visual information in different combinations and contexts prompted brainstorming by the professional reviewers, and identified many communication issues relevant to each professional's unique perspective, which caused thoughtful consideration of the BMPs practices and the interactions of those practices. For instance, one reviewer questioned how herbicide use in vegetation management (maintenance/management category) affects the siting of the nest boxes (systems

category). Throughout the survey, the arrays of visual aids presented catalyzed this brainstorming process of thinking across issues, strategies, goals, and objectives, which could lead to improved planning and design. This concept relates to the process of graphic thinking, which is described in the following quote:

> "Graphic thinking is a means of externalizing thought. It enables you to develop a store of material outside of the mind that can provide stimulus for further thinking. Because it eliminates the burden of having to hold several images in your memory at once, it allows you the opportunity to think freely and move from one thought to another. The drawings provide a path by which you can always find your way back to a previous idea (Laseau 1986)

Furthermore, the inclusion of multiple visual aids to explain a topic would aid in developing working guidance for practitioners that is somewhat in contrast with the rationale sometimes expressed that since all situations are different, then there is no place for uniform guidelines:

> "…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" (Andrews, Nanjappa, and Riley 2015).

While there are good reasons not to produce generic BMP visual communication guidelines as a one-size-fits-all approach, there is an opportunity to further enhance visual communication through offering a framework that is adaptable to fully represent consideration of a specific site and local species characteristics. In landscape architecture, there is precedence for these types of instructional visual aids in publications such as Time-Saver Standards for Landscape Architecture: Design and Construction Data (Harris, Dines, and Brown 1998). In this book, different types of landscape elements are specified to typical standards with a variety of visual aids. The use of these standards is

intended to be a starting place for design and construction. This is evidenced by the following quotes:

> "The publication of this handbook represents an historic event for the profession of landscape architecture. By scope and organization, it provides a broad practical definition of what landscape architecture is as an applied art and science. The data and standards it contains demonstrate how and where the profession interconnects with the efforts of many specialists from different sciences and technologies. In this way it is a book for the future as much as it is for the present; it recognizes the need for more interdependence between the various professions as specific tasks become larger and more complicated."

> "The reader is urged to consider using more optimal standards for specific situations. Contributors were asked to include both "low-tech" and "high-tech" standards and data. It is expected that the reader will adapt the data as necessary for a specific application….The reader is reminded that the data shown in this book cannot be considered a substitute for informed judgement based on careful consideration of all aspects of a specific problem" (Harris, Dines, and Brown 1998).

Therefore, there is a role for preliminary visual aids in design and these should be considered with wildlife roadway mitigation projects as equally as much as other projects. The visual aids function as a starting point to initiate design communication between ecologists and other professions, which is a role of graphic thinking "…the externalized thought structure provides an object for critical contemplation as well as a visible form that can be shared with a colleague…" (Laseau 1980). Furthermore, the visual aids would remain flexible for ecologists as they would be preliminary designs. A role for landscape architects as visual communication experts or consultants would be to aid ecologists in assessing the nature of each crossing location and local species characteristics and accordingly tailoring the visual aids produced for the systems, experiential/promotional, construction, post-construction evaluation, and maintenance/management information categories. Additionally, with a working

framework for visual aids, revisions to the visual communication standards from field experience could be incorporated to address future design problems.

Process and Evaluation Matrix Tool

To accomplish the development of guidance graphics or the application of visual aids for projects/target species in general, an evaluation matrix tool may be beneficial to utilize. The evaluation matrix adds organizational value by aiding in identifying potential audiences, usage contexts, information requirements, and visual aid needs. Furthermore, the visual layout of the visualization topics aids in the synthesis of project systems, goals, objectives and strategies. An example of an evaluation matrix is included in Table 14.

Table 14
Sample Evaluation Matrix

<table>
<tr><th rowspan="2">Information Category</th><th rowspan="2">BMP</th><th rowspan="2">Topic</th><th rowspan="2">Audience</th><th rowspan="2">Usage Context</th><th colspan="3">Visual Aids</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td rowspan="2">Example: Systems</td><td rowspan="2">Roadside signage</td><td rowspan="2">Purpose</td><td rowspan="2">Public</td><td rowspan="2">Public meeting</td><td>Photo</td><td>Section Elevation</td><td>Diagram</td></tr>
<tr><td colspan="3">Rendering Style: Diagrammatic with realistic imagery and literal symbols.</td></tr>
<tr><td rowspan="2">Example: Construction</td><td rowspan="2">Roadside signage</td><td rowspan="2">Design</td><td rowspan="2">Engineer</td><td rowspan="2">Construction documents</td><td>Plan View</td><td>Table</td><td>N/A</td></tr>
<tr><td colspan="3">Rendering Style: Drafted with standard construction symbols.</td></tr>
<tr><td>Add to table as needed</td><td></td><td></td><td></td><td></td><td colspan="3"></td></tr>
</table>

The evaluation matrix is intended to be flexible and customized based on the project requirements and feedback on the performance of the visual aids. For instance, feedback could redefine the audiences considered for each topic, the visual aids chosen for each audience, and the rendering style for each visual aid and information category. In this thesis, the evaluation matrix was applied to unpublished terrapin BMPs, but the visual aid development process with use of the evaluation matrix could also be applied to published material such as existing wildlife mitigation standards. Furthermore, the visual aids identified for each information category could be applied to a range of projects involving wildlife-roadway conflicts including roadside habitat management, wildlife overpasses, and wildlife underpasses.

Limitations

There were several limitations to this study. First, the total sample size and sample size from each professional group was limited. In addition, each survey population involved several subpopulations of different professional roles, and the visual aid selections may have varied based upon each individual's professional duties. Both of these factors limited the confidence in the findings as being widely applicable to each professional group; however, the intent of the sample size was to develop an expert review panel and the results function well in a preliminary findings and guidance role.

Future Research

Survey respondents repeatedly commented on the role of the public in viewing the visual aids. Therefore, future research should investigate what visual aids are beneficial for presenting wildlife roadway mitigation to the public. Additional studies should involve a larger sample size from each profession and across the spectrum of roles in

each field (e.g. academic, governmental, private practice). This survey also identified visual aids used by professionals other than were presented in this study such as Gantt charts and GIS resource maps; consequently, there is an opportunity to research the benefits of these visual aids in the information categories. Moreover, future studies could investigate applicable visual aids for education purposes, which was identified as an important component of the land managers' visual aid use. Finally, this thesis focused on a case study where the mitigation guidelines are actively being developed and have not been formally published; future studies could investigate the applicability of the visual communication strategies identified here to other situations with fully developed mitigation standards already in place.

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APPENDIX A

IRB SUBMISSION

Phone 706-542-3199

Office of the Vice President for Research
Institutional Review Board

APPROVAL OF PROTOCOL

January 24, 2017

Dear Brian Orland:

On 1/24/2017, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Graphic Communication for Wildlife Roadway Mitigation
Investigator:	Brian Orland
IRB ID:	STUDY00004287
Funding:	None
Documents Reviewed:	Protocol, Recruitment Materials, Consent Form, Data Collection Materials
Review Category:	Exempt 2

The IRB approved the protocol from 1/24/2017 to 1/23/2022.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Dr. Gerald E. Crites, MD, MEd
University of Georgia
Institutional Review Board Chairperson

Consent Letter

Date

Dear :

I am a graduate student under the direction of Professor Brian Orland in the College of Environment and Design at The University of Georgia. I invite you to participate in a research study entitled Graphic Communication for Wildlife Roadway Mitigation. The purpose of this study is to determine how different forms of graphic communication can be useful in the wildlife roadway mitigation process.

Your participation will involve completing two brief, online surveys of images typically used to illustrate mitigation designs and should only take about 15 minutes for each survey. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled. If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

To establish your credentials and expertise as an evaluator you will be generally referred to in the research paper as a state, federal, local, professional, or academic professional engineer, ecologist, planner, landscape architect, landscape maintenance professional, or land manager with experience with transportation or wildlife related issues (e.g. state ecologist). Any specific identifiers by name, location, specific job title or agency will not be included in the research paper. Your specific identifiers will only be accessible to me, Roger Bledsoe, the primary researcher. The data will be stored for a period of 12 months and used only for internal data tracking purposes. At the end of that period the electronic records will be erased. The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only.

The findings from this project may provide information on what types of graphic communication tools are most suitable for communicating the wildlife roadway mitigation process. There are no known risks or discomforts associated with this research.

If you have any questions about this research project, please feel free to call me at (770) 842-3256 or send an e-mail to rbledsoe@uga.edu. Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 609 Boyd GSRC, Athens, Georgia 30602; telephone (706) 542-3199; email address irb@uga.edu.

A link to the online questionnaire will be sent to your email address. By completing this online questionnaire, you are agreeing to participate in the above described research project.

Thank you for your consideration! Please keep this letter for your records.

Sincerely,

Roger Bledsoe

Hi XXXX,

I am a Master of Landscape Architecture student at UGA, and I completed my undergraduate degree in Wildlife Studies from the UGA Warnell School of Forestry and Natural Resources. I am working on my thesis that focuses on the wildlife roadway mitigation design communication process. After looking through many wildlife roadway mitigation manuals, I observed that there appears to be an opportunity for utilizing graphic communication in the design process between ecologists, engineers, landscape architects, planners, managers, and the public. As a landscape architect, I believe we have a role in the design process as we have been building wildlife crossings in major competitions (e.g. ARC competition), we design many crossing features such as walls, fences, plantings, and culverts, and we learn about ecology and engineering, which allows us to serve as an intermediary between both fields. Our position of being able to serve as an intermediary is important to me, and I want to investigate how our skills in graphic communication can aid the wildlife roadway mitigation design process between different professions. I am contacting you to see if you would be a resource for me throughout my thesis. Mainly, I would greatly appreciate it if you would participate in two, brief (15 minute) online surveys in February and March reviewing graphics. I am interested in discussing everything in greater detail as well if you are interested. I have attached my thesis proposal and expected deliverables write up as well. Please let me know if you would like to proceed.

Thank you,

Roger Bledsoe

APPENDIX B

EVALUATION SURVEY PACKAGE

Terrapin BMPs
Graphics Survey

• The graphics illustrate typical best management practices (BMP) modeled on those currently in place to address terrapin roadway mortality issues along the Jekyll Island causeway. This study is not an evaluation of whether the BMPs are adequate, but about the effectiveness of the graphic communication formats in each section.

Note: These graphics are intended as a survey tool only. The graphics are not intended for use, distribution, or representation as authoritative methods to manage roadside habitat for terrapins. The BMP information they contain has not been reviewed by professional practitioners.

Instructions:

Thank you for participating in the survey. The instructions for the survey are below.

- Please use the attached graphic visualization package to help fill out the online survey.
- Nothing needs to be returned via mail.
- The graphics were sent via mail to help facilitate the comparative process. The printed graphics were all produced on 8.5 x 11 or 11 x 17 page sizes to provide graphics in a manageable format.
- Several short animations (3) were also sent via email and are a part of the experiential/ promotional graphics section.

- Each question online refers to a numbered set of graphic visualizations.
- The graphics illustrate typical best management practices (BMPs) modeled on those currently in place to address terrapin roadway mortality issues along the Jekyll Island causeway.
- Information about typical BMPs is presented under different headings corresponding to important phases of the design, construction, review, and management process:

- Systems/Conceptual Information
- Experiential/Promotional Graphics
- Construction Graphics
- Post Construction Evaluation Graphics
- Management/Maintenance Graphics

- This study is not an evaluation of whether the BMPs are adequate, but rather about the effectiveness of the graphic communication formats in each section.
- Please review the numbered sets of hardcopy graphics in relation to the corresponding online survey questions. Each set of BMP related information is presented in multiple graphic formats.
- **Although there are many graphics, the information conveyed is the same between the different graphic formats.**
- Please review the graphics for their effectiveness in communicating the information relevant to each of the design, construction, review, and management phases above.

If you have any questions, please do not hesitate to contact me via email (rbledsoe@uga.edu) or phone (770-842-3256). I really appreciate all of your help and enthusiasm in this process. I will be emailing you in several days to verify that you received this package.

Thanks again,

Roger Bledsoe

Note: These graphics are intended as a survey tool only. The graphics are not intended for use, distribution, or representation as authoritative methods to manage roadside habitat for terrapins. The BMP information they contain has not been reviewed by professional practitioners.

IRB Consent Form

Consent Letter

2/21/17

Dear Survey Participant:

I am a graduate student under the direction of Professor Brian Orland in the College of Environment and Design at The University of Georgia. I invite you to participate in a research study entitled Graphic Communication for Wildlife Roadway Mitigation. The purpose of this study is to determine how different forms of graphic communication can be useful in the wildlife roadway mitigation process.

Your participation will involve completing one brief, online survey of images typically used to illustrate mitigation designs and should only take about 30 minutes for the survey. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled. If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

To establish your credentials and expertise as an evaluator you will be generally referred to in the research paper as a state, federal, local, professional, or academic professional engineer, ecologist, planner, landscape architect, landscape maintenance professional, or land manager with experience with transportation or wildlife related issues (e.g. state ecologist). Any specific identifiers by name, location, specific job title or agency will not be included in the research paper. Your specific identifiers will only be accessible to me, Roger Bledsoe, the primary researcher. The data will be stored for a period of 12 months and used only for internal data tracking purposes. At the end of that period the electronic records will be erased. The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only.

The findings from this project may provide information on what types of graphic communication tools are most suitable for communicating the wildlife roadway mitigation process. There are no known risks or discomforts associated with this research.

If you have any questions about this research project, please feel free to call me at (770) 842-3256 or send an e-mail to rbledsoe@uga.edu. Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 609 Boyd GSRC, Athens, Georgia 30602; telephone (706) 542-3199; email address irb@uga.edu.

A link to the online questionnaire will be sent to your email address. By completing this online questionnaire, you are agreeing to participate in the above described research project.

Thank you for your consideration! Please keep this letter for your records.

Sincerely,

Roger Bledsoe

Systems/Conceptual Graphics

Description:

• Graphics that provide overview and background information on the management of terrapin roadside habitat and the associated causeway best management practices.

Graphics List:

1 Wildlife Roadway Mitigation Strategies (graphics numbered 1)
- Plan
- Section
- Axonometric
- Table

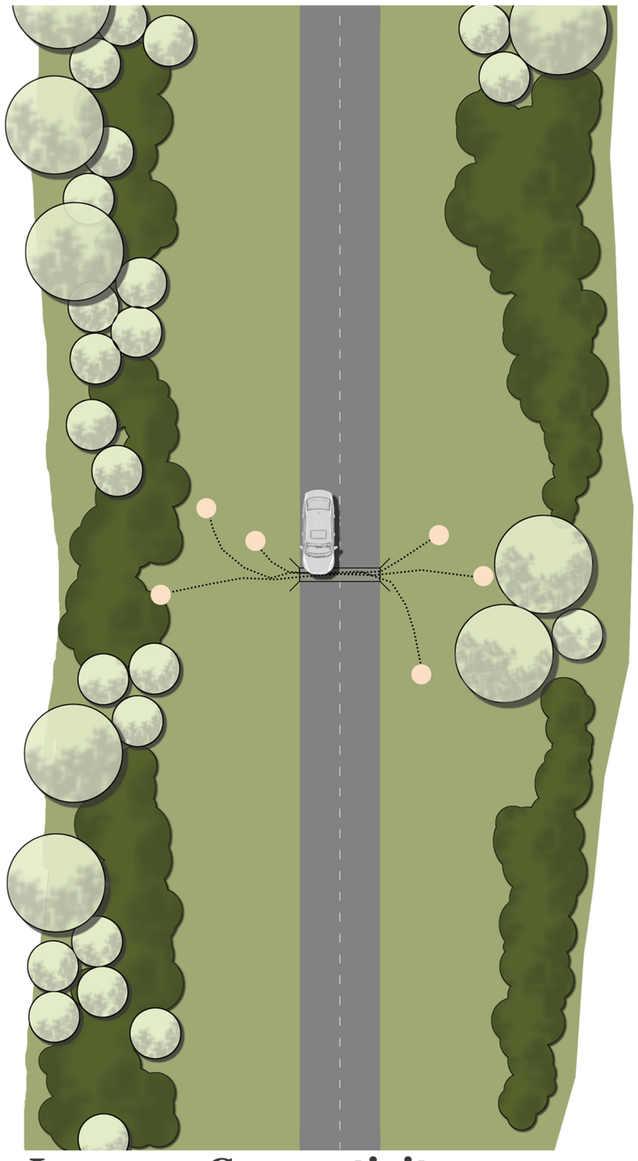
2 Terrapin Causeway Use (graphics numbered 2)
- Plan
- Section
- Axonometric
- Diagram

3 Causeway Best Management Practices Siting and Function (graphics numbered 3)
- Diagram
- Plan
- Section
- Axonometric
- Photos
- Table

4 Causeway Habitat Heterogeneity Benefits (graphics numbered 4)
- Plan
- Section
- Axonometric
- Table

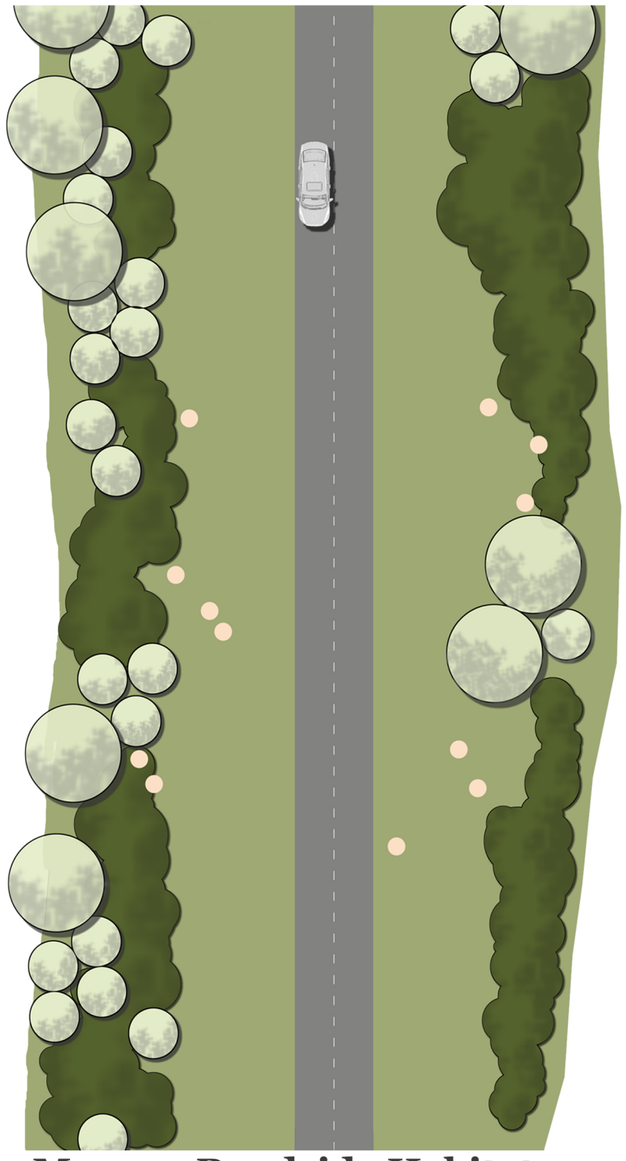
5 Causeway Best Management Practices Multifunctionality (graphics numbered 5)
- Plan
- Section
- Axonometric
- Table

Wildlife Roadway
Mitigation Strategies
(NTS)



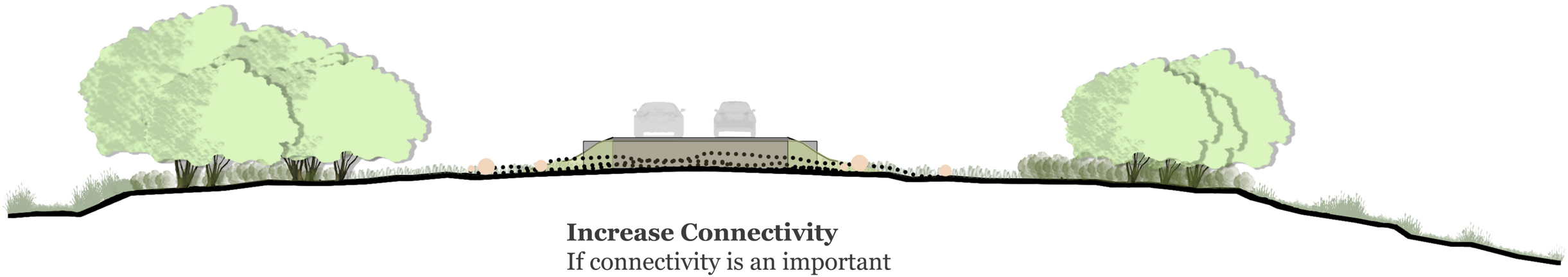
Increase Connectivity
If connectivity is an important management tool for the species.

AND/OR



Manage Roadside Habitat
If connectivity isn't required, but roadside habitat is valuable for the species.

Wildlife Roadway
Mitigation Strategies
(NTS)

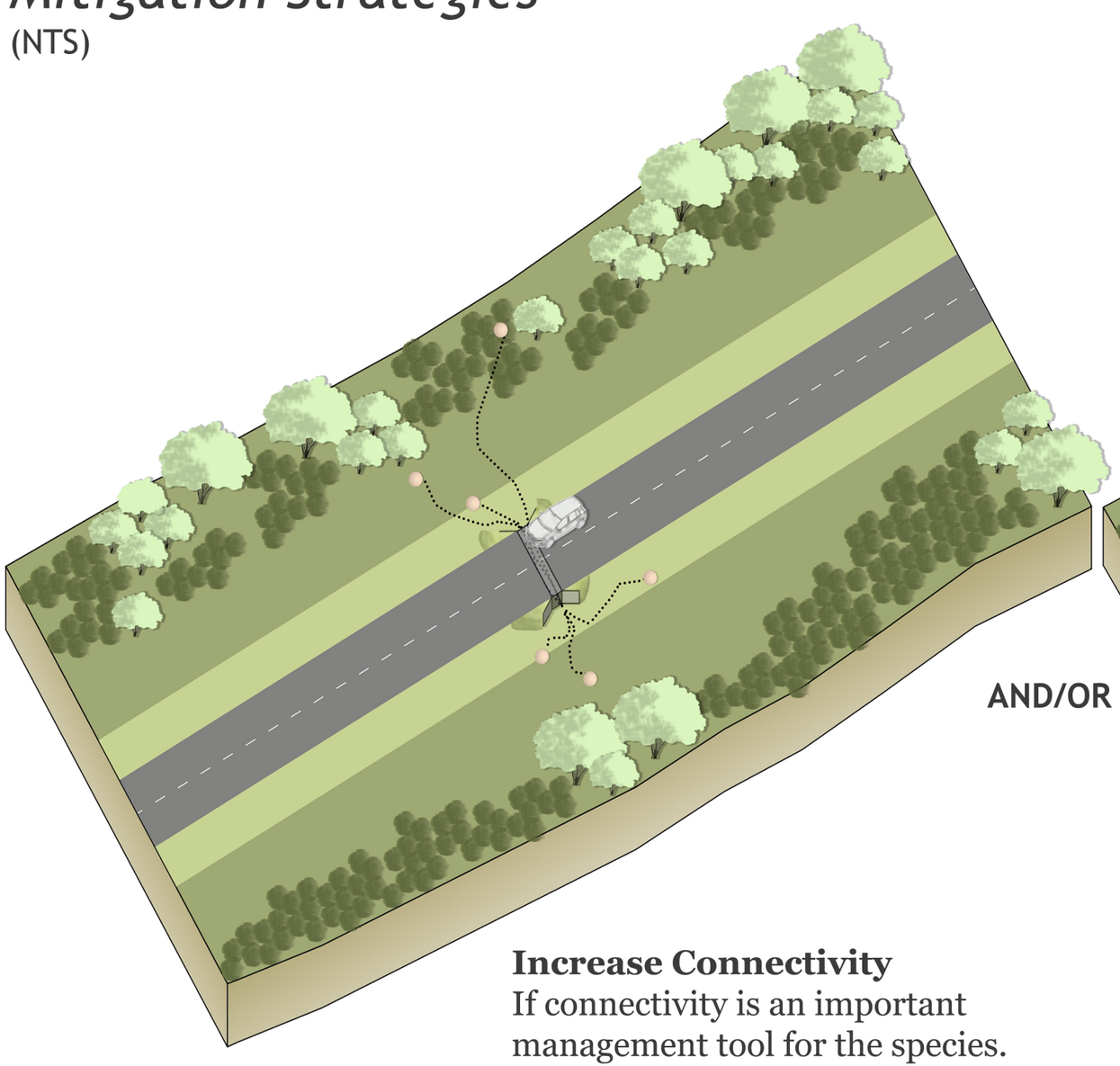


Increase Connectivity
If connectivity is an important management tool for the species.

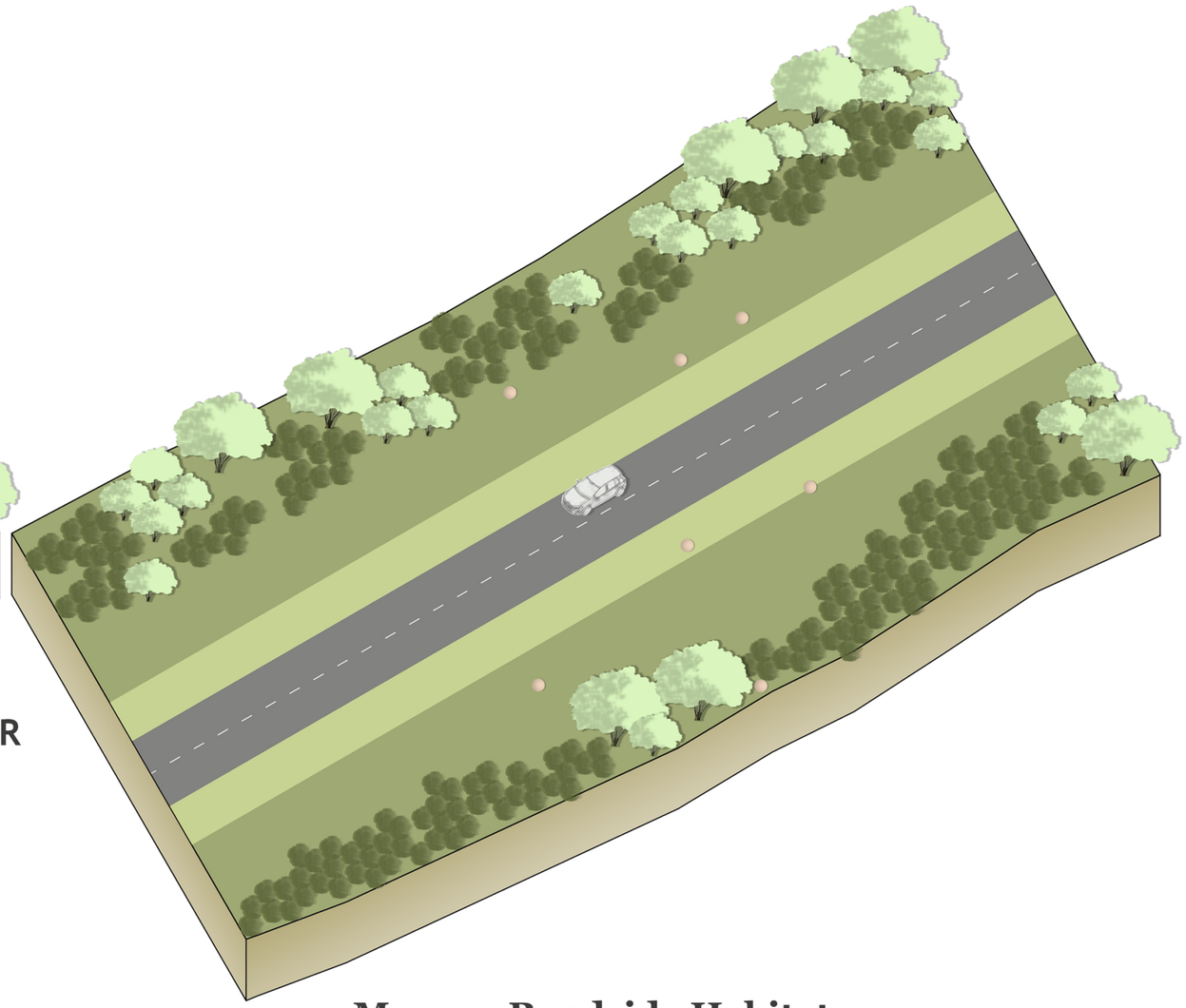
AND/OR

Manage Roadside Habitat
If connectivity isn't required, but roadside habitat is valuable for the species.

Wildlife Roadway
Mitigation Strategies
(NTS)



AND/OR



Increase Connectivity
If connectivity is an important management tool for the species.

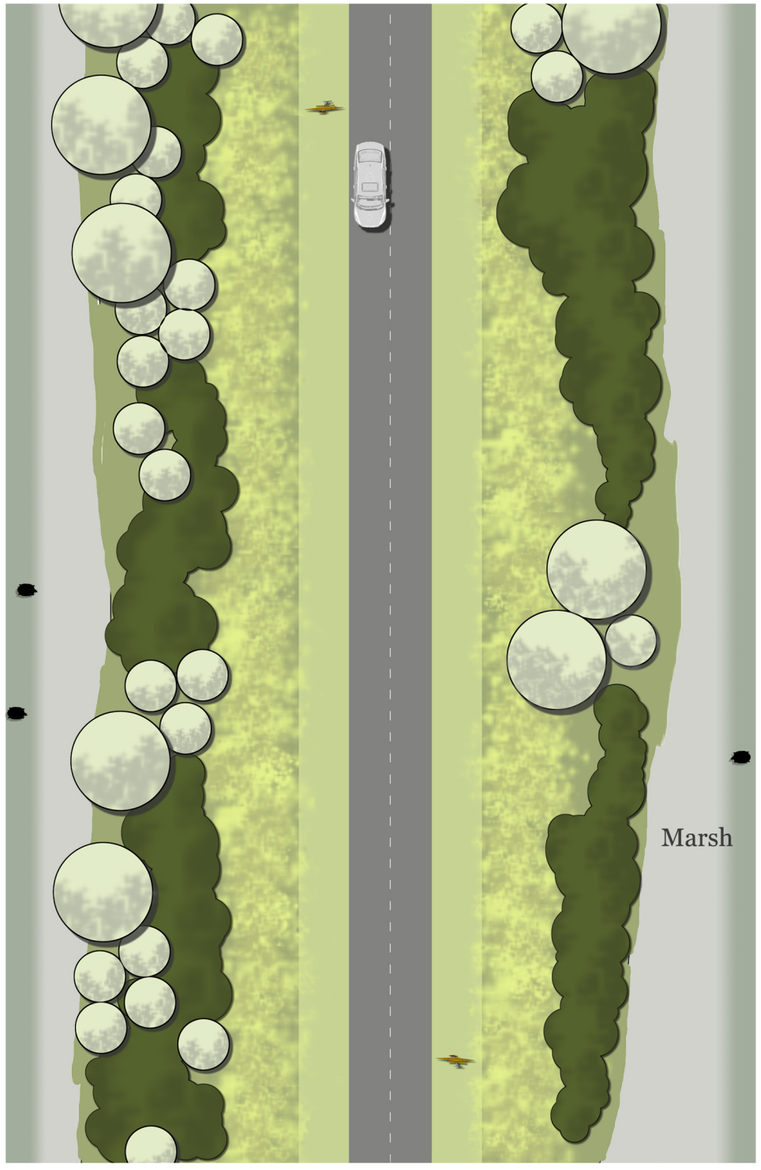
Manage Roadside Habitat
If connectivity isn't required, but roadside habitat is valuable for the species.

Wildlife Roadway Mitigation Strategies

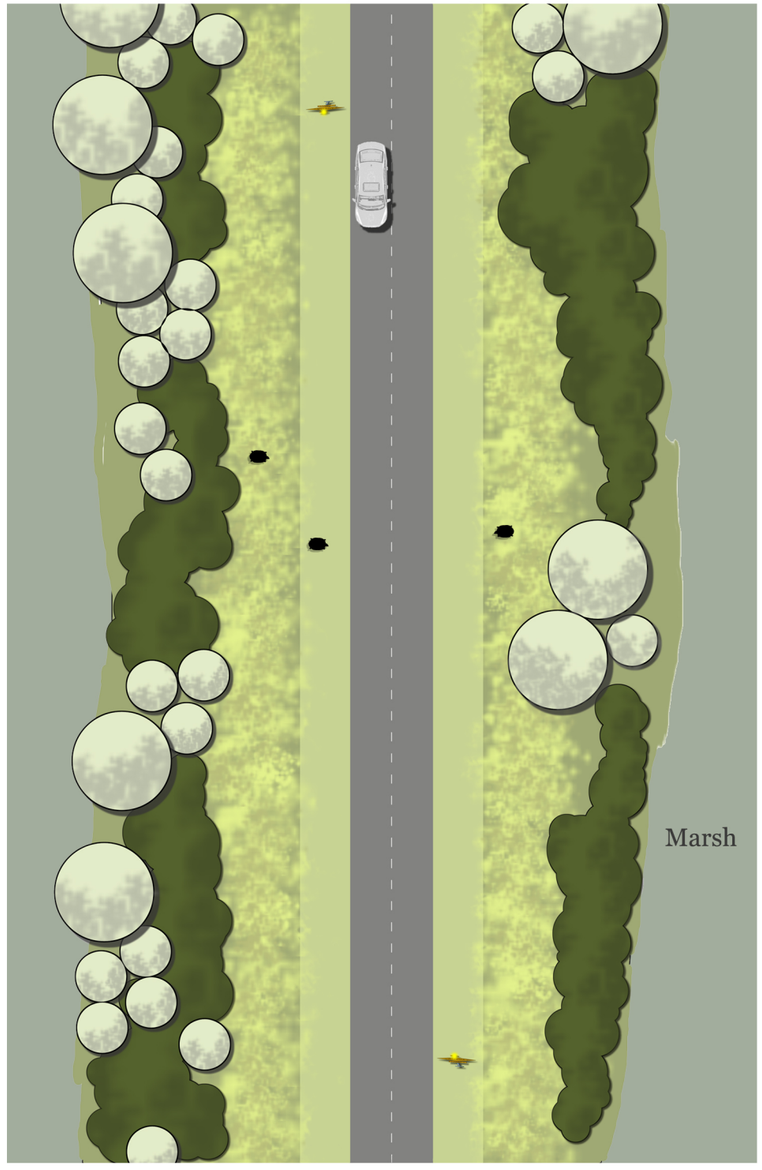
Strategy	Description	Purpose
Increase Connectivity	Increase safe access for wildlife requiring migration across the roadway.	Aid population and habitat connectivity for wildlife requiring access across the roadway.
Manage Roadside Habitat	Increase safe access for species that utilize roadside habitat. Also, manage the roadside habitat to function in a beneficial state for the species.	These species are impacted by road activities while utilizing roadside habitat, but they may not have a connectivity issue. Provide access to and management of roadside habitat for the species.

Terrapin Causeway Use

Terrapin causeway usage is based on tides. Generally, terrapins access the causeway for nesting 1 hour before the daytime high tide and 2 hours post the daytime high tide during the nesting season (May - August.
(NTS)



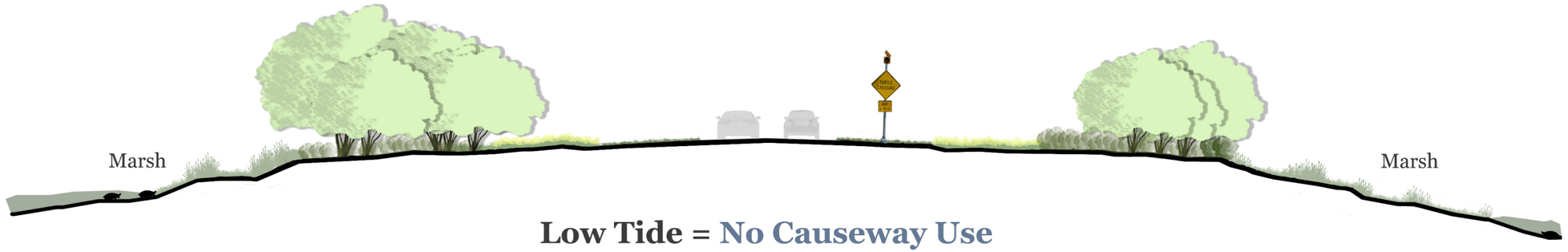
Low Tide = No Causeway Use



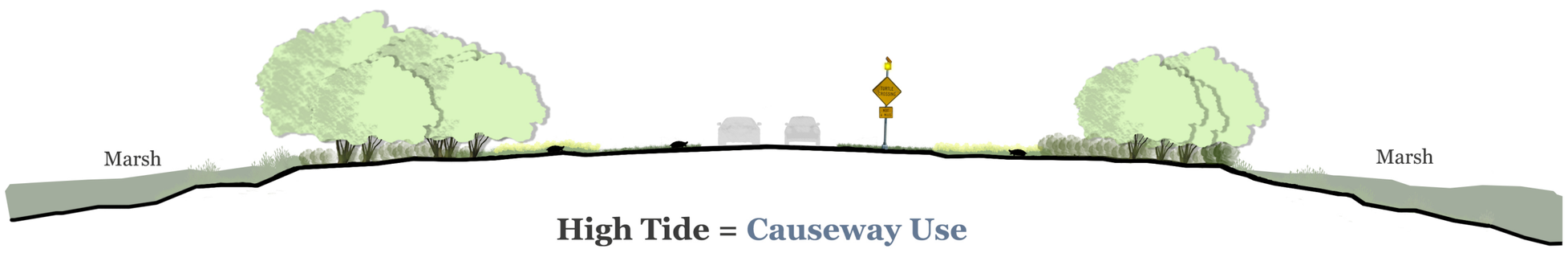
High Tide = Causeway Use

Terrapin Causeway Use

Terrapin causeway usage is based on tides. Generally, terrapins access the causeway for nesting 1 hour before the daytime high tide and 2 hours post the daytime high tide during the nesting season (May - August.
(NTS)



Low Tide = No Causeway Use



High Tide = Causeway Use

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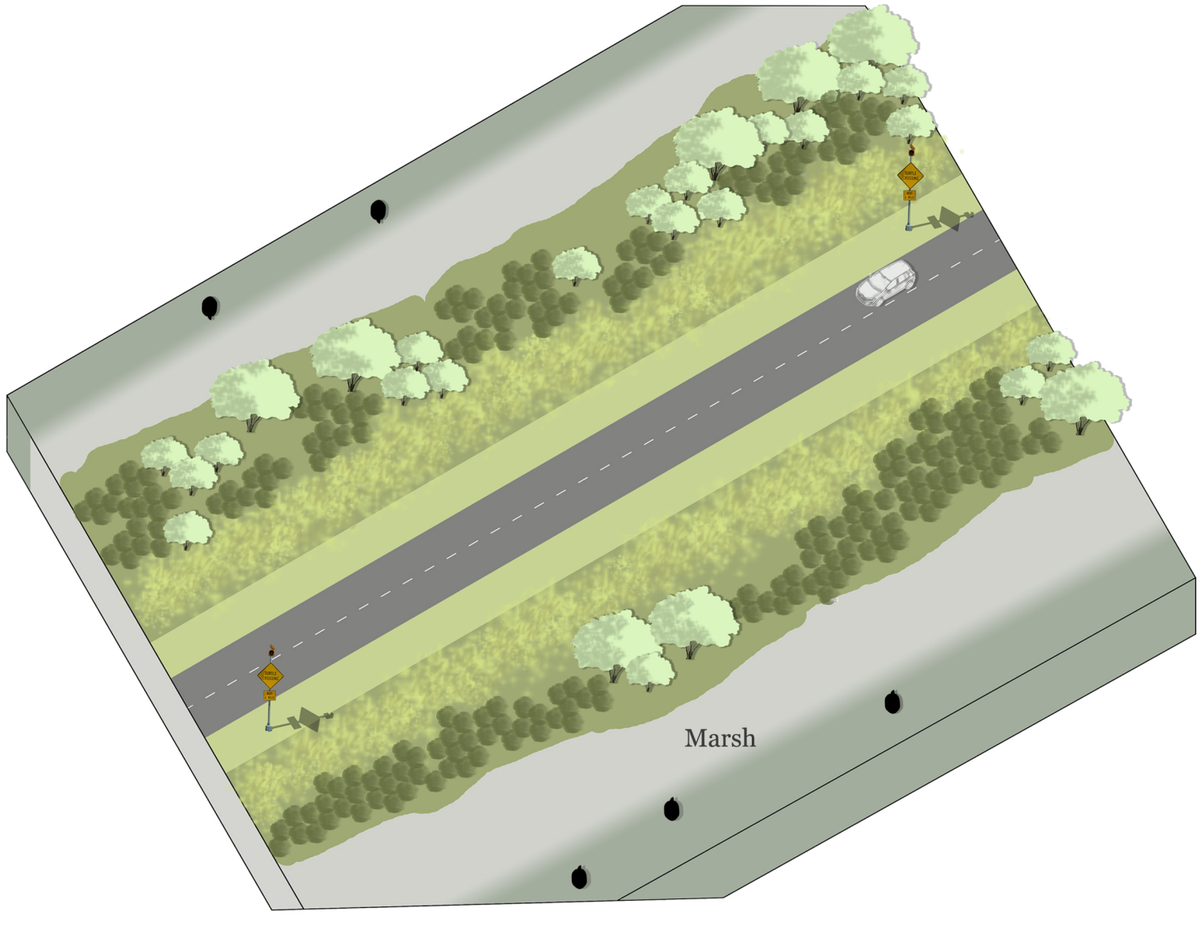
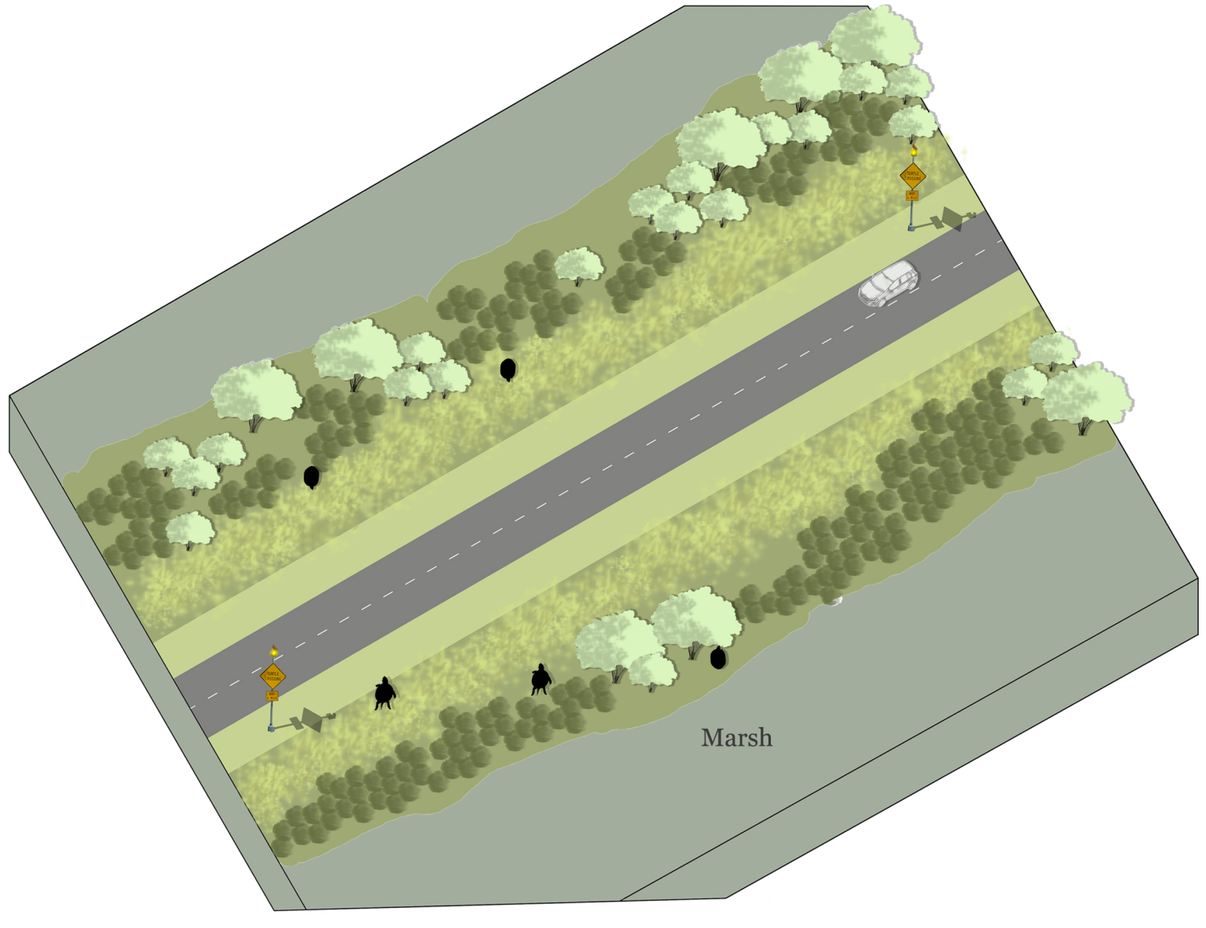


Low Tide = No Causeway Use



High Tide = Causeway Use

Terrapin Causeway
Signage Operation

Seasonality

Nesting Season
Driver Message
(May - August)

Non-Nesting Season
Driver Message
(August - May)

Notes
- Use the phrase “Turtle Crossing” instead of “Terrapin Crossing” to reach a wider audience.
- Add a hinge to the sign to allow for the message to be switched between the nesting and non-nesting season. This is important to help prevent sign fatigue.

Daily
Pattern

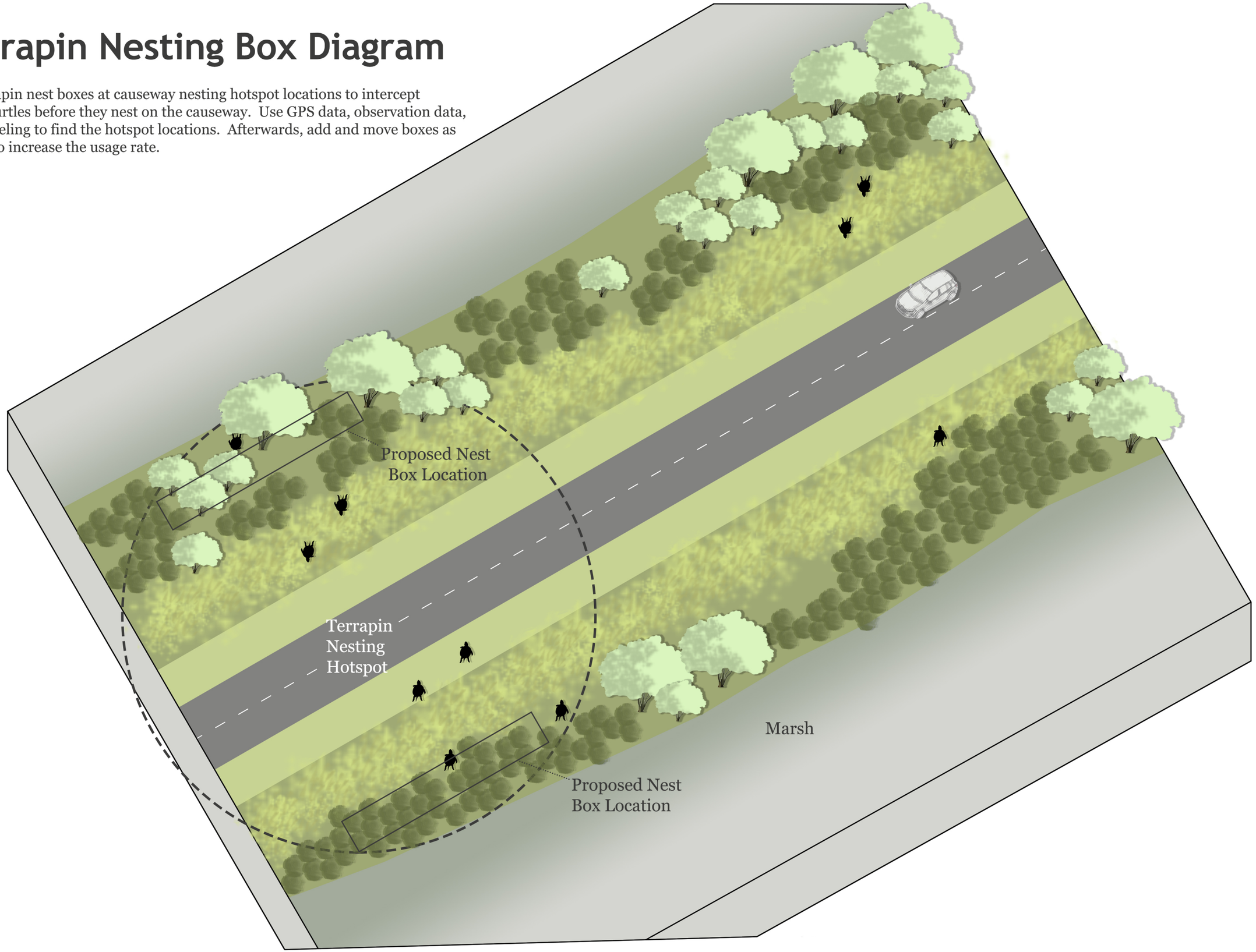
Non-Nesting Periods
(No Flashing Light)

Nesting Periods
(Flashing Light)

Notes
- Program the flashing light on a weekly basis.
- The sign should flash 1 hour before the daytime high tide and 2 hours after the daytime high tide.

Terrapin Nesting Box Diagram

Site terrapin nest boxes at causeway nesting hotspot locations to intercept female turtles before they nest on the causeway. Use GPS data, observation data, and modeling to find the hotspot locations. Afterwards, add and move boxes as needed to increase the usage rate.



Causeway Best Management Practices
Siting and Function

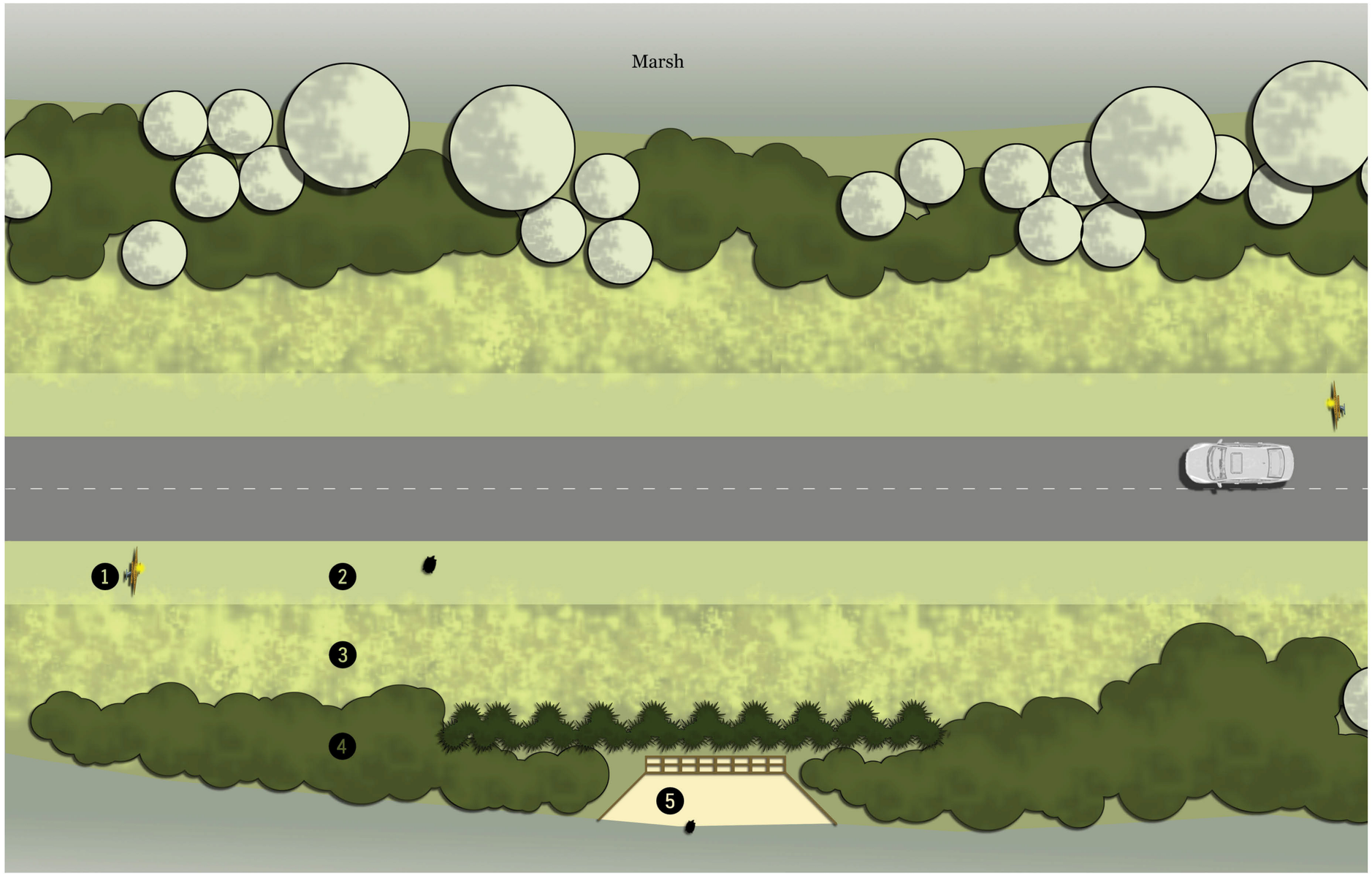
1 Signage
Site the flashing DOT signage at the beginning of the nesting habitat in each roadway direction to alert drivers to the presence of nesting female turtles. Use a generic message such as “turtle crossing” to reach a wider audience during the nesting season, flip the sign to a safety message during the non-nesting season, and program the lights to flash during peak nesting periods to prevent driver signage fatigue.

2 Mow Strips
Site the 15’ mow strips adjacent to the roadway to increase terrapin visibility to drivers, provide aesthetic beauty, reduce maintenance issues, and provide a safety shoulder for vehicles.

3 Seasonal Wildflowers
Seed the roadside between the mow strips and existing vegetation with native wildflowers to provide roadway beautification and pollinator habitat.

4 Existing Vegetation
Maintain the existing vegetation for wildlife, water quality, and roadway beautfication.

5 Nest Boxes
Site the nest boxes at nesting hotspot locations. Nest boxes may need to be relocated on a trial and error basis. Also, the amount of nest boxes installed can be scaled accordingly. Site the nest boxes above the high tide line and behind a vegetative screen. The vegetative screen blocks drivers from viewing the nest boxes, which is for aesthetics and turtle safety. The nest boxes should be approximately 3’ above the marsh on a sand mound (minimum 9’ long). The sand mound extends to the marsh edge to provide a visual cue for suitable nesting habitat (high ground) to the terrapins. Sand also helps produce more females as sex ratios are temperature dependent. The silt fencing directs turtles towards the nest boxes, and the electric fencing excludes predators.



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Siting and Function

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4 Signage
Site the flashing DOT signage at the beginning of the nesting habitat in each roadway direction to alert drivers to the presence of nesting female turtles. Use a generic message such as “turtle crossing” to reach a wider audience during the nesting season, flip the sign to a safety message during the non-nesting season, and program the lights to flash during peak nesting periods to prevent driver signage fatigue.

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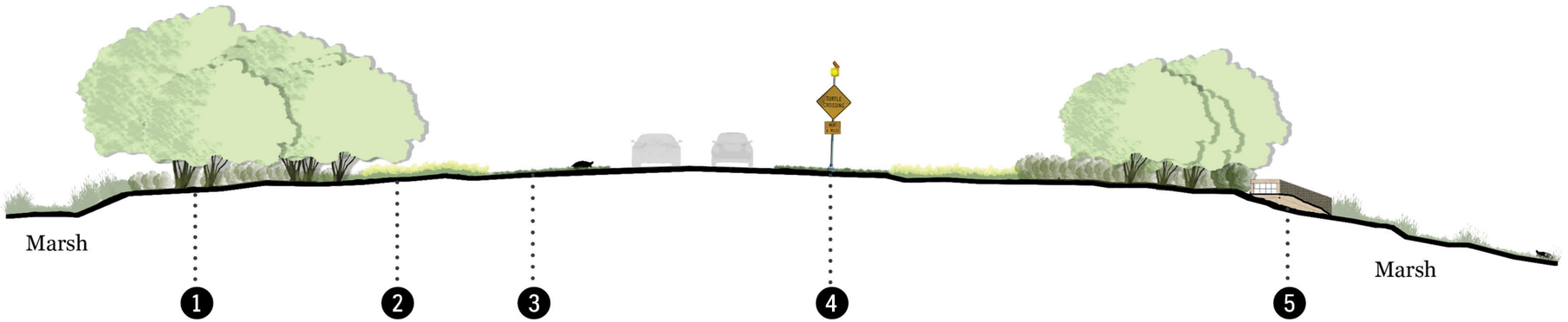

Scale: 1” = 15’ - 0”
15 0 feet 15 30

Causeway Best Management Practices
Siting and Function

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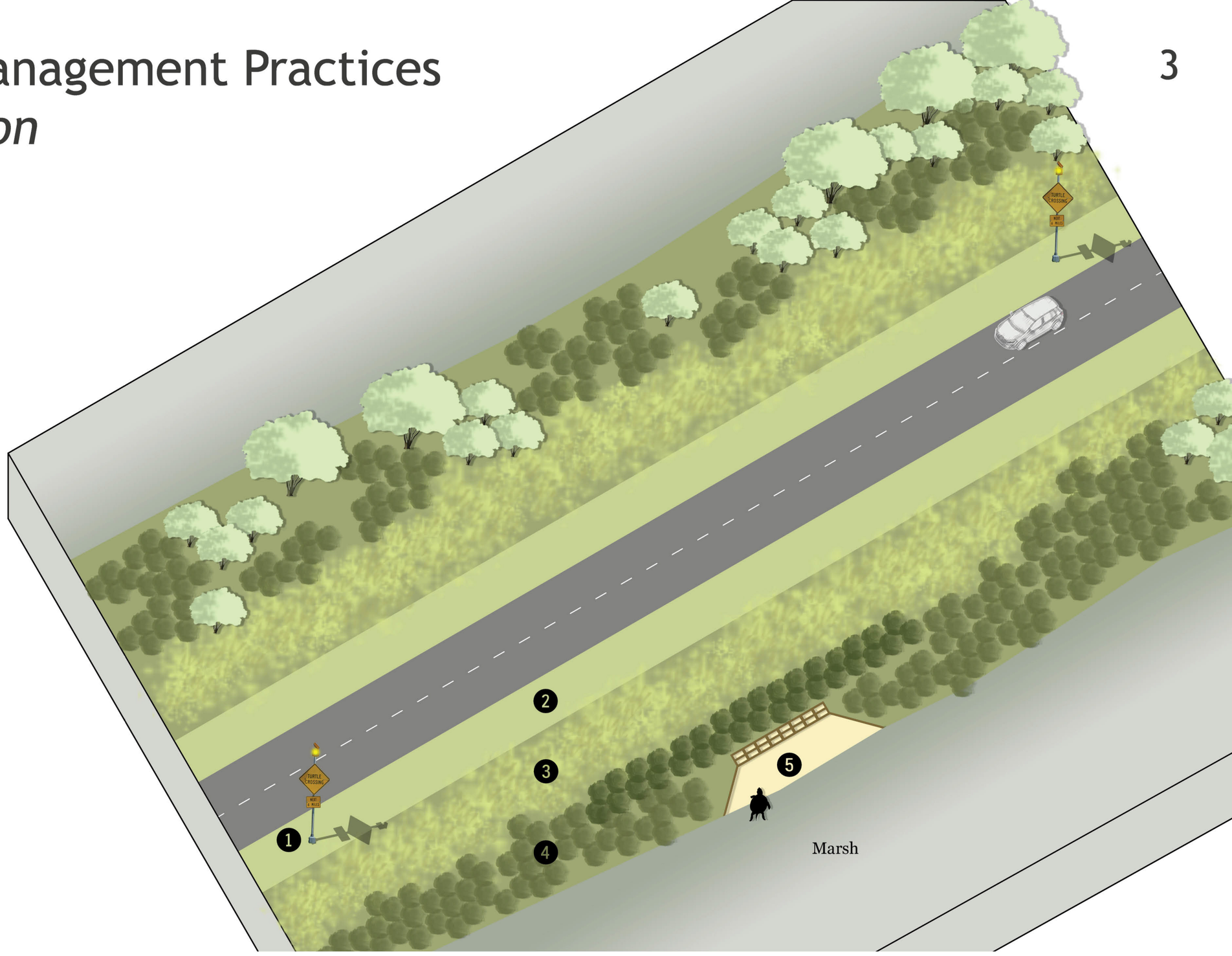
5 Nest Boxes
Site the nest boxes at nesting hotspot locations. Nest boxes may need to be relocated on a trial and error basis. Also, the amount of nest boxes installed can be scaled accordingly. Site the nest boxes above the high tide line and behind a vegetative screen. The vegetative screen blocks drivers from viewing the nest boxes, which is for aesthetics and turtle safety. The nest boxes should be approximately 3’ above the marsh on a sand mound (minimum 9’ long). The sand mound extends to the marsh edge to provide a visual cue for suitable nesting habitat (high ground) to the terrapins. Sand also helps produce more females as sex ratios are temperature dependent. The silt fencing directs turtles towards the nest boxes, and the electric fencing excludes predators.



Scale: 1” = 30’ - 0”

30 0 feet 30 60

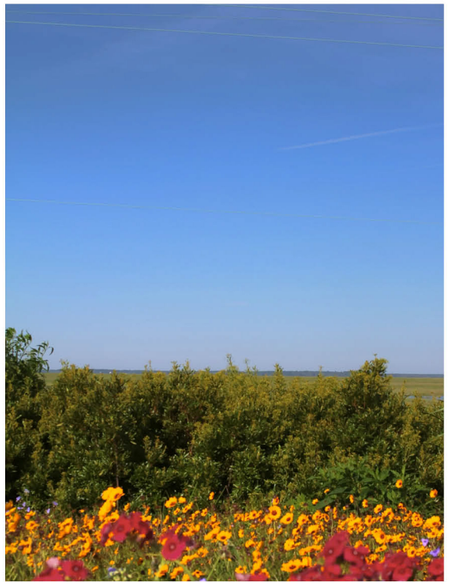
Causeway Best Management Practices
Siting and Function

1 Signage

Site the flashing DOT signage at the beginning of the nesting habitat in each roadway direction to alert drivers to the presence of nesting female turtles. Use a generic message such as “turtle crossing to reach a wider audience during the nesting season, flip the sign to a safety message during the non-nesting season, and program the lights to flash during peak nesting periods to prevent driver signage fatigue.

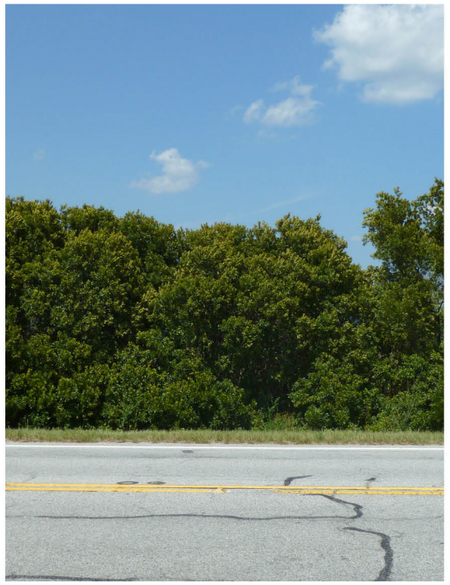
2 Mow Strips

Site the 15’ mow strips adjacent to the roadway to increase terrapin visibility to drivers, provide aesthetic beauty, reduce maintenance issues, and provide a safety shoulder for vehicles.



3 Seasonal Wildflowers

Seed the roadside between the mow strips and existing vegetation with native wildflowers to provide roadway beautification and pollinator habitat.



4 Existing Vegetation

Maintain the existing vegetation for wildlife, water quality, and roadway beautfication.

5 Nest Boxes

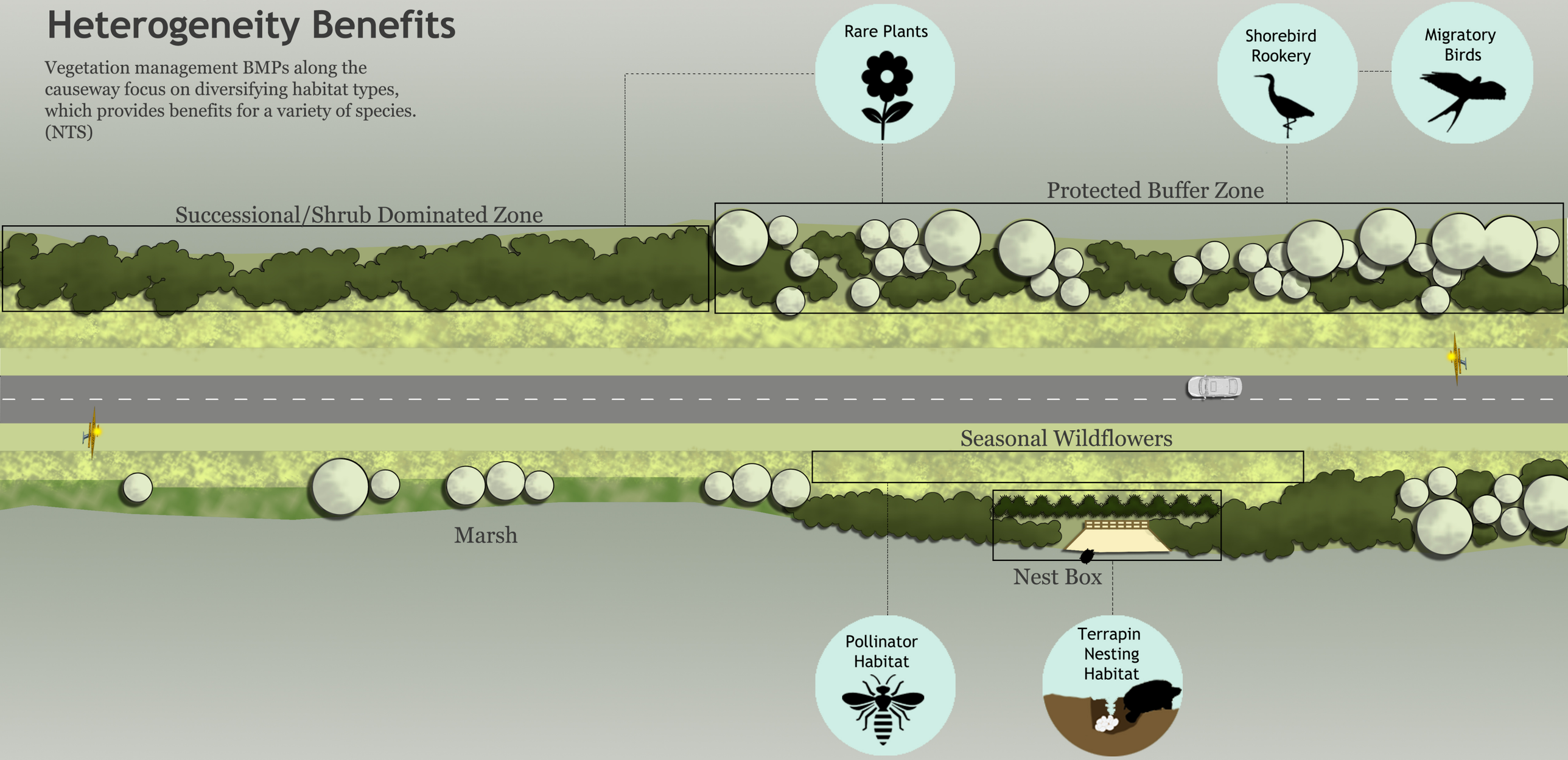
Site the nest boxes at nesting hotspot locations. Nest boxes may need to be relocated on a trial and error basis. Also, the amount of nest boxes installed can be scaled accordingly. Site the nest boxes above the high tide line and behind a vegetative screen. The vegetative screen blocks drivers from viewing the nest boxes, which is for aesthetics and turtle safety. The nest boxes should be approximately 3’ above the marsh on a sand mound (minimum 9’ long). The sand mound extends to the marsh edge to provide a visual cue for suitable nesting habitat (high ground) to the terrapins. Sand also helps produce more females as sex ratios are temperature dependent. The silt fencing directs turtles towards the nest boxes, and the electric fencing excludes predators.

Causeway Best Management Practices *Siting and Function*

BMP	Description	Purpose	Siting Location
Nest Box	Wooden nest boxes with directional silt fencing and predator exclusion electric fencing. The directional fencing funnels turtles from the marsh into the nest boxes. The nest boxes are positioned to intercept female turtles in nesting hotspots along the causeway.	The goal is to prevent female turtles from nesting on the roadside. Also, the nest boxes are designed to promote higher levels of females in the hatchlings through the elimination of vegetation from the nest boxes. The vegetative screen blocks drivers from viewing the nest boxes, which is done for aesthetics and turtle safety. The sand mound provides a visual cue for the turtles in the marsh.	Site the nest boxes at causeway nesting hotspot locations above the high tide line, behind a vegetative screen, and on a 3' sand mound (minimum 9' long). The process can involve nest box relocation and expansion as needed.
Signage	DOT signage advertising turtle nesting. Signs have flashing lights that are programmed weekly to flash 1 hour before the daytime high tide and 2 hours post daytime high tide. The turtle message would be switched via a hinged sign to a non-wildlife message such as "have a safe trip" during the non-nesting season.	The signage alerts drivers to the presence of turtles on the causeway. A generic message such as turtle nesting vs. terrapin nesting may reach a wider audience. Also, the flashing lights and alternate message help prevent driver sign fatigue.	Site at the beginning of the nesting habitat in both roadway directions.
Mow Strips	15' wide mowed grass zones adjacent to roadway.	The mow strips provide a safety shoulder for motorists and increase the visibility of the turtles.	The mow strips are located adjacent to the roadway on both sides and are continuous along the causeway.
Seasonal Wildflowers	Seasonal plantings of native wildflowers.	The seasonal wildflowers provide aesthetic value for motorists and pollinator habitat.	The seasonal wildflowers are planted between the mow strips and existing vegetation zones.
Vegetation Management	Management of the existing causeway vegetation.	The existing vegetation is managed to promote wildlife habitat, roadway aesthetics, and water quality.	The existing vegetation is managed between the mow strips and the marsh edge.

Causeway Habitat Heterogeneity Benefits

Vegetation management BMPs along the causeway focus on diversifying habitat types, which provides benefits for a variety of species. (NTS)



Causeway Habitat Heterogeneity Benefits

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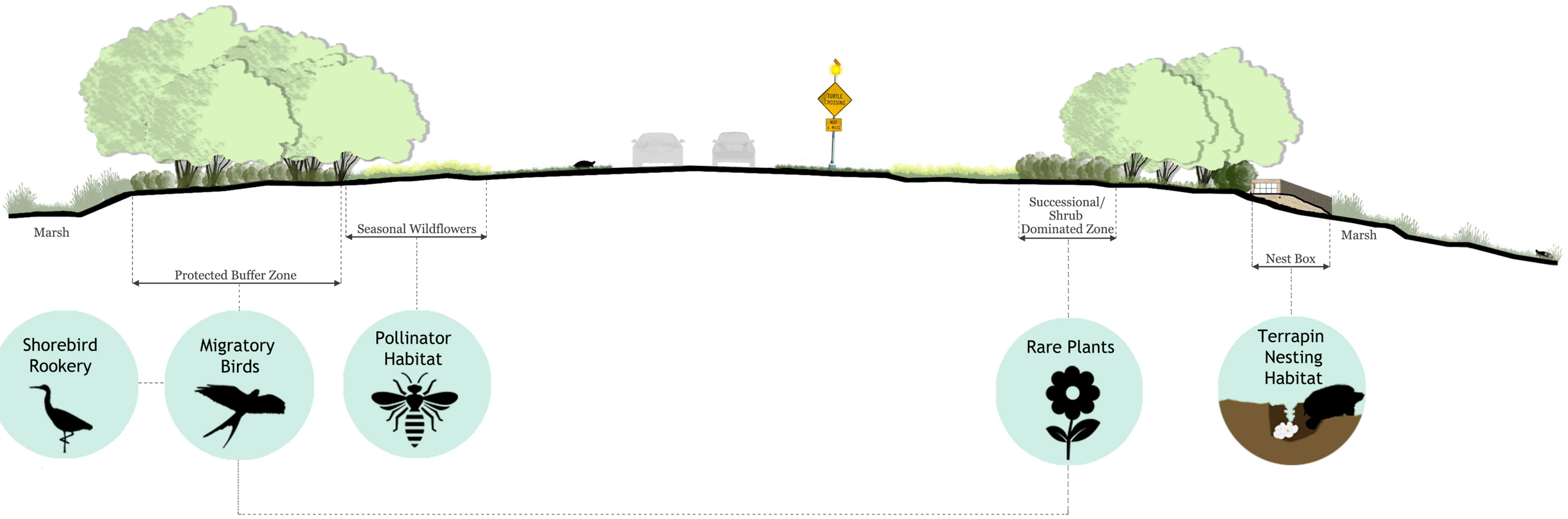

Causeway Habitat Heterogeneity Benefits

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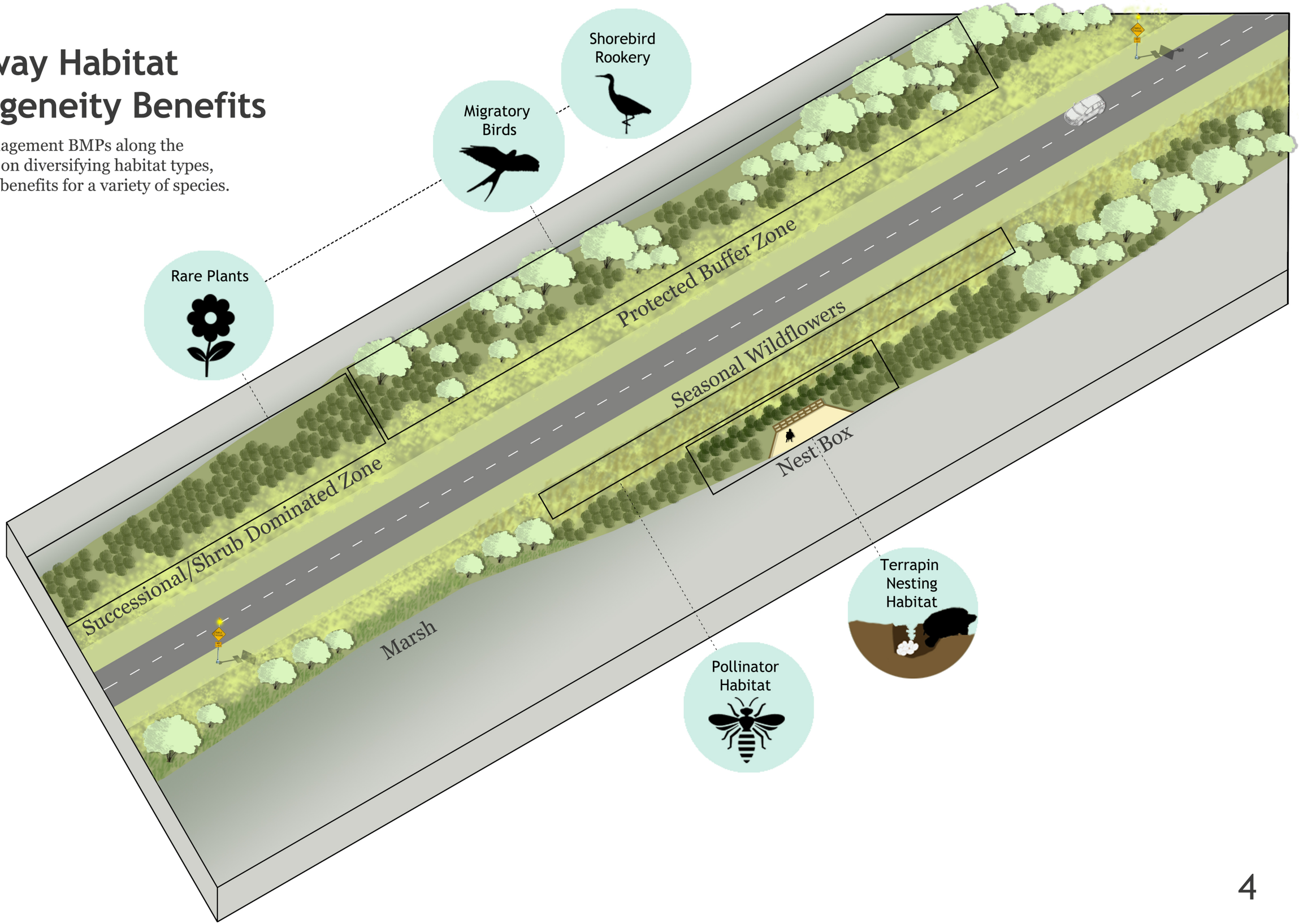


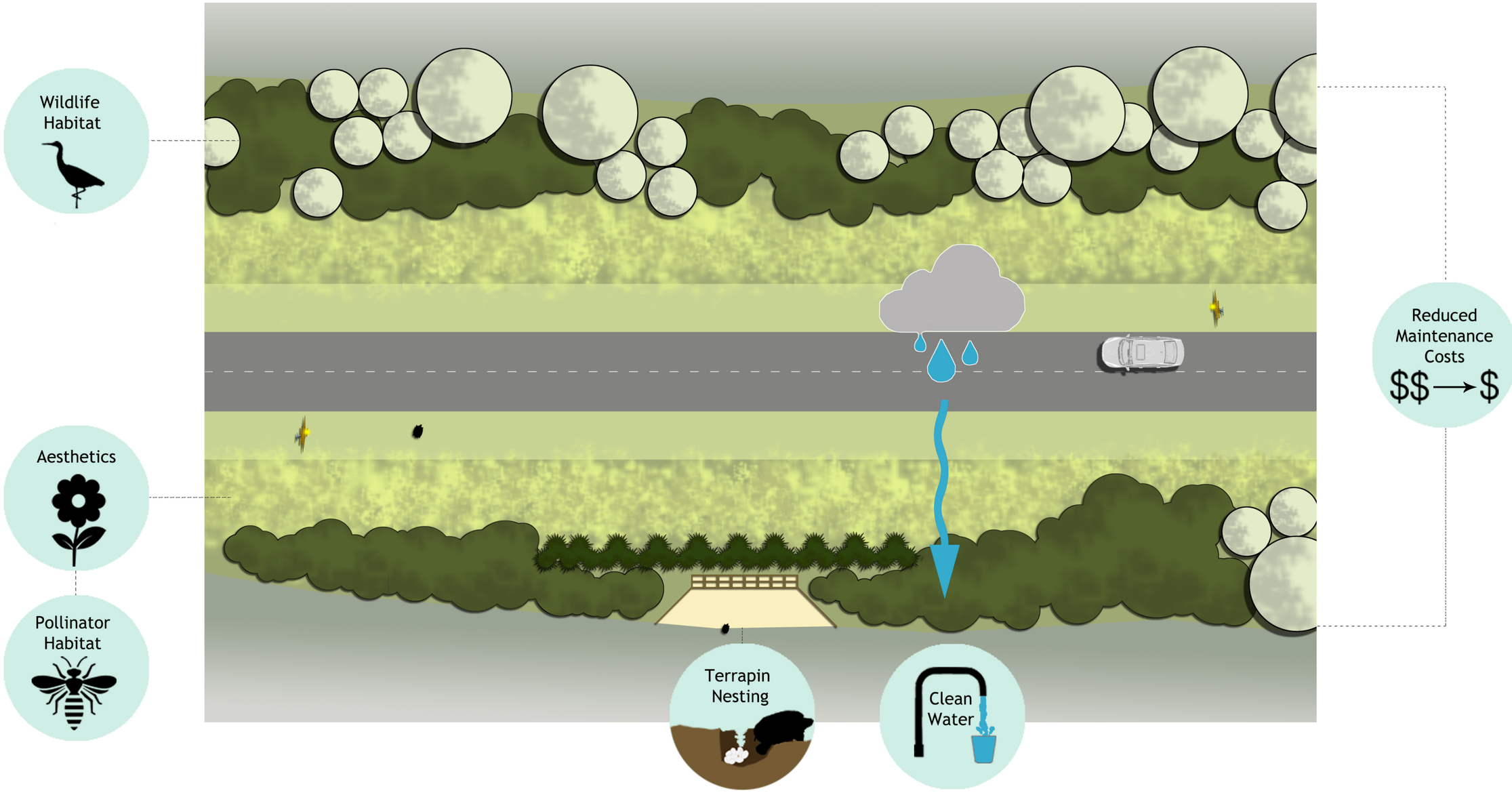
Causeway Vegetation Management for Habitat Heterogeneity - Species Benefits

Habitat Type	Benefiting Species
Seasonal Wildflowers	Insect pollinators
	Hummingbirds
Protected Buffers	Shorebird rookery
	Migratory birds
	Rare plant species
Successional/Shrub Dominated Zones	Rare plant species
Nest Boxes	Terrapins

Causeway Best Management Practices

Multifunctionality

Terrapin causeway BMPs provide benefits for a variety of issues. (NTS)



Causeway Best Management Practices

Multifunctionality

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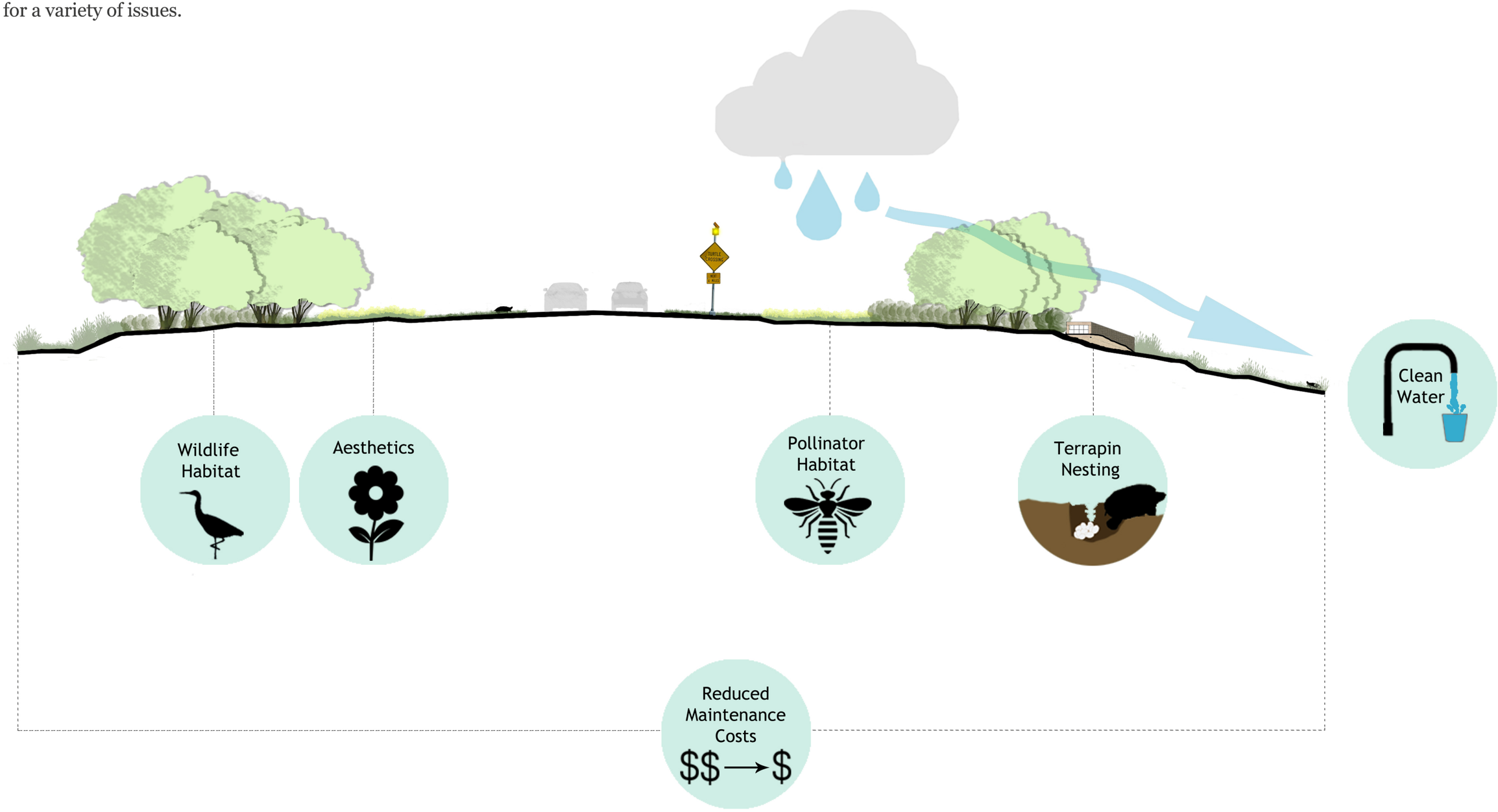
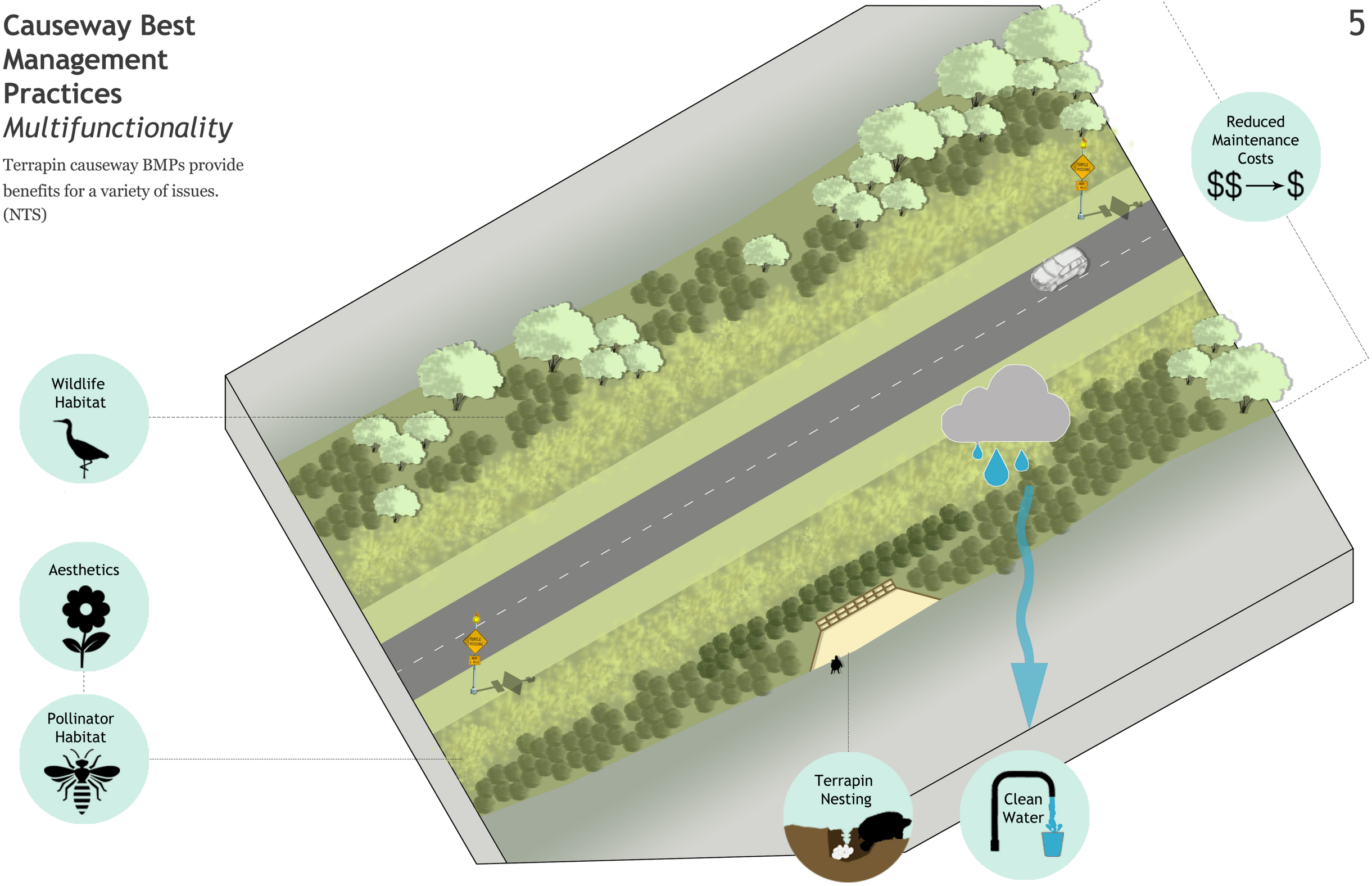


Causeway Best Management Practices

Multifunctionality

Terrapin causeway BMPs provide benefits for a variety of issues. (NTS)



Causeway Best Management Practices Multifunctionality

BMP Benefits
Wildlife Habitat
Terrapin Protection
Pollinator Habitat
Reduced Maintenance Costs
Aesthetics
Water Quality

Experiential/Promotional Graphics

Description:

• Graphics that are emotive and show different perspectives related to the causeway best management practices.

Graphics List:

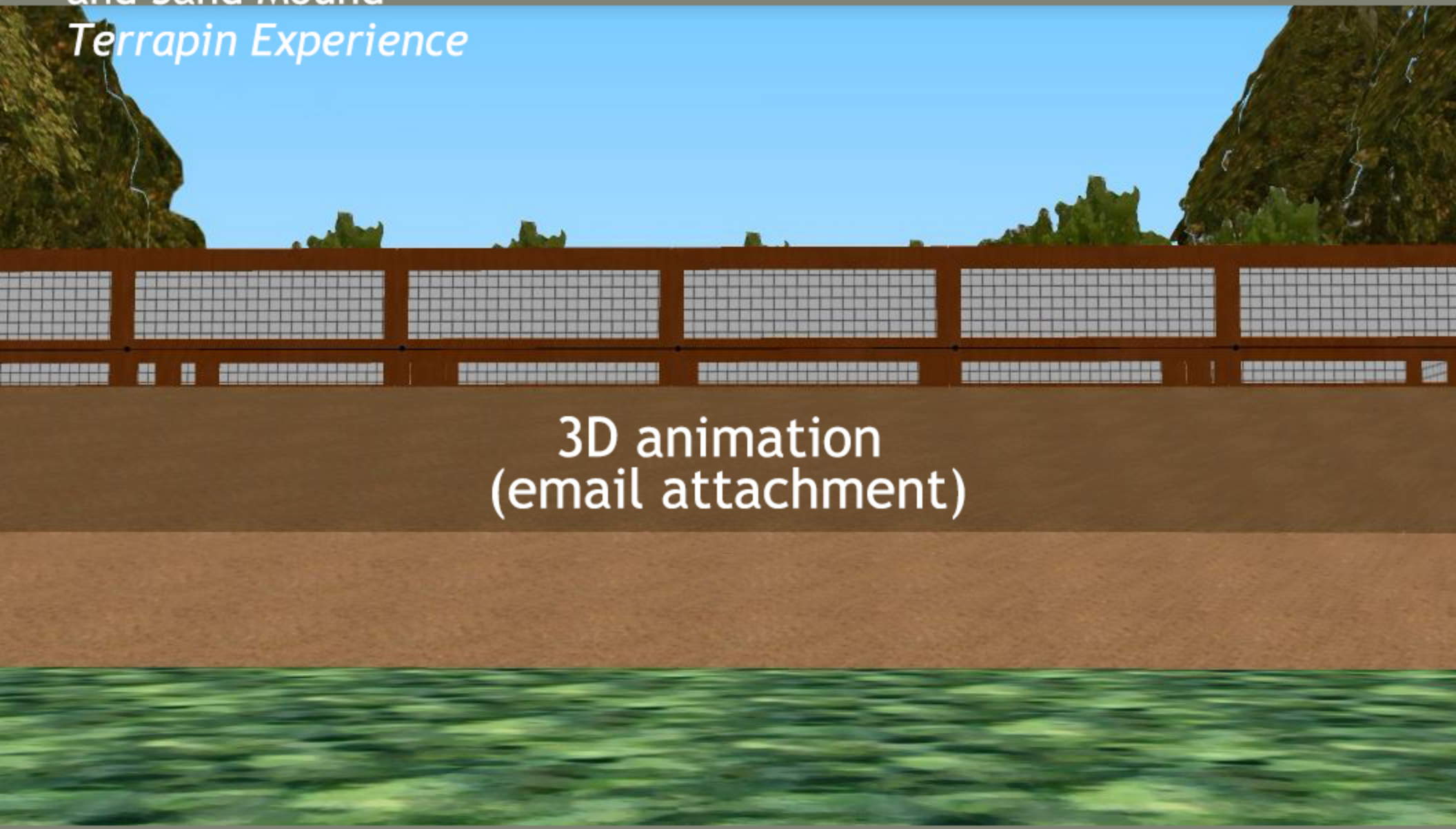
6 Nest Boxes and Sand Mound - Terrapin Experience (graphics numbered 6)
• Perspective
• 3D Animation (see email attachment)
• Photo

7 Causeway Best Management Practices - Driver Experience (graphics numbered 7)
• Plan
• Section
• Axonometric
• Diagram
• Perspective 1 (Driver View - Aesthetics)
• Perspective 2 (BMP Driver Experience)
• 3D Animation (see email attachment)
• Photo

8 Causeway Best Management Practices - Terrapin Experience (graphics numbered 8)
• Perspective (Roadway Terrapin Experience)
• 3D Animation (see email attachment)
• Photos


Nest Boxes
and Sand Mound -
Terrapin Experience
6

Nest Boxes and Sand Mound - *Terrapin Experience*



Nest Boxes and Sand Mound

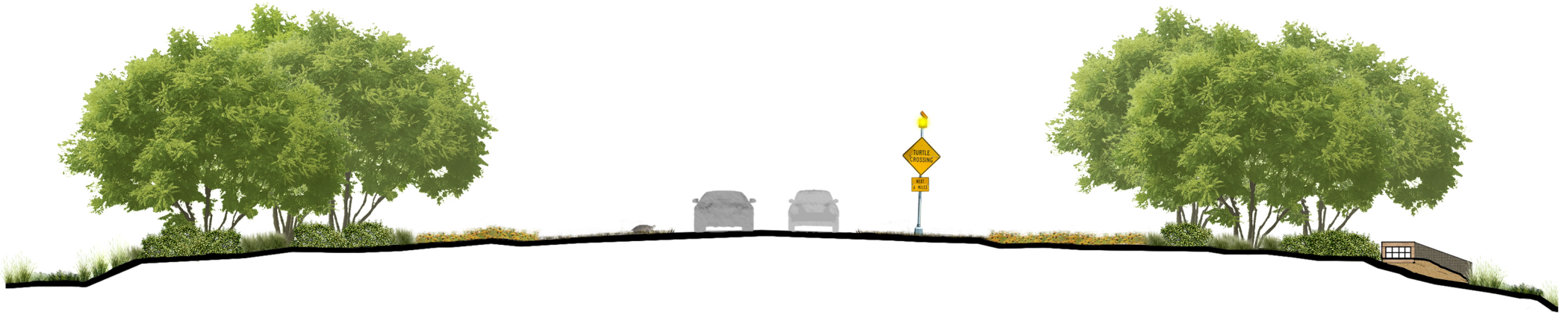
Turtle Experience

Causeway Best Management Practices

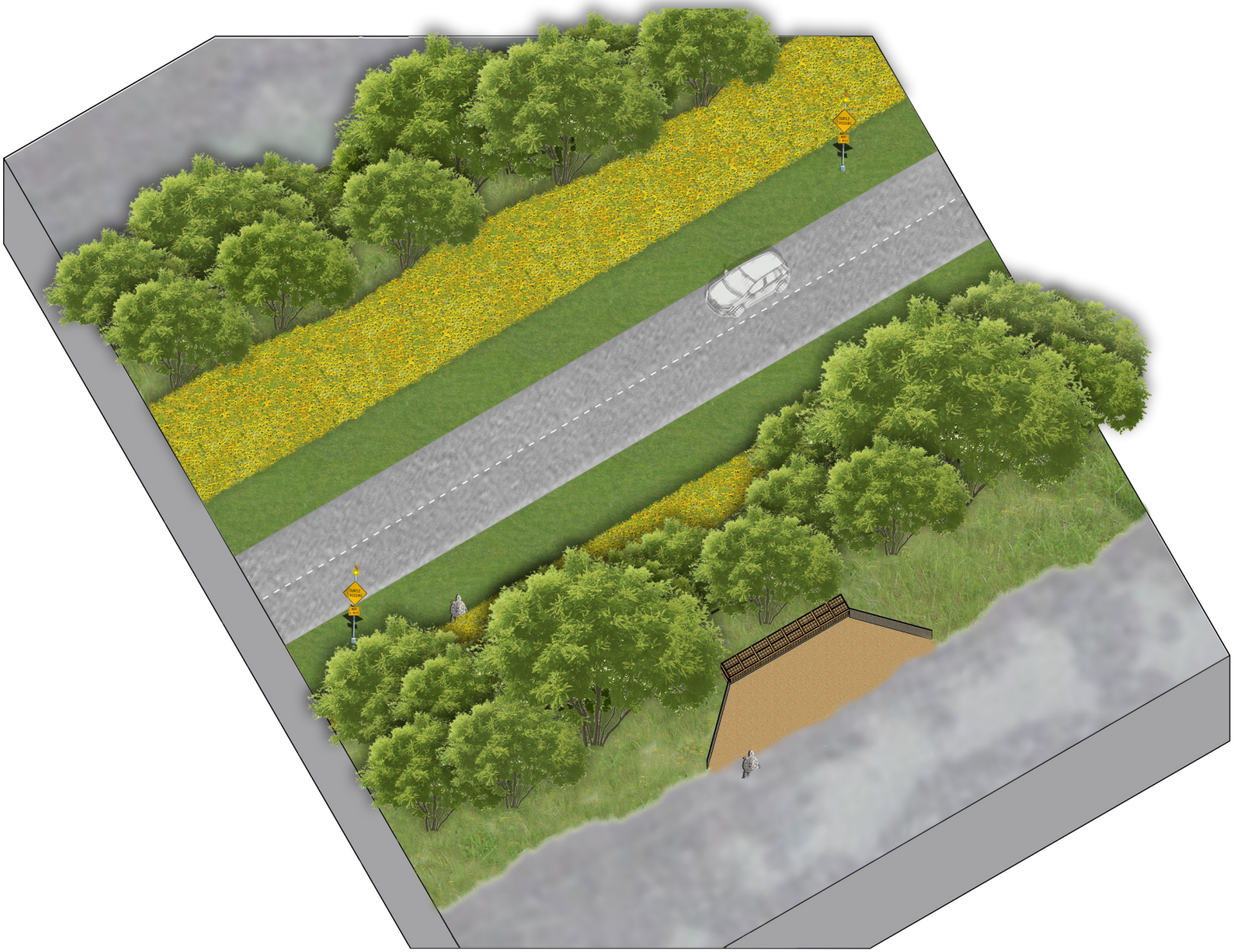
Driver Experience

(NTS)

Causeway Best Management Practices
Driver Experience
(NTS)

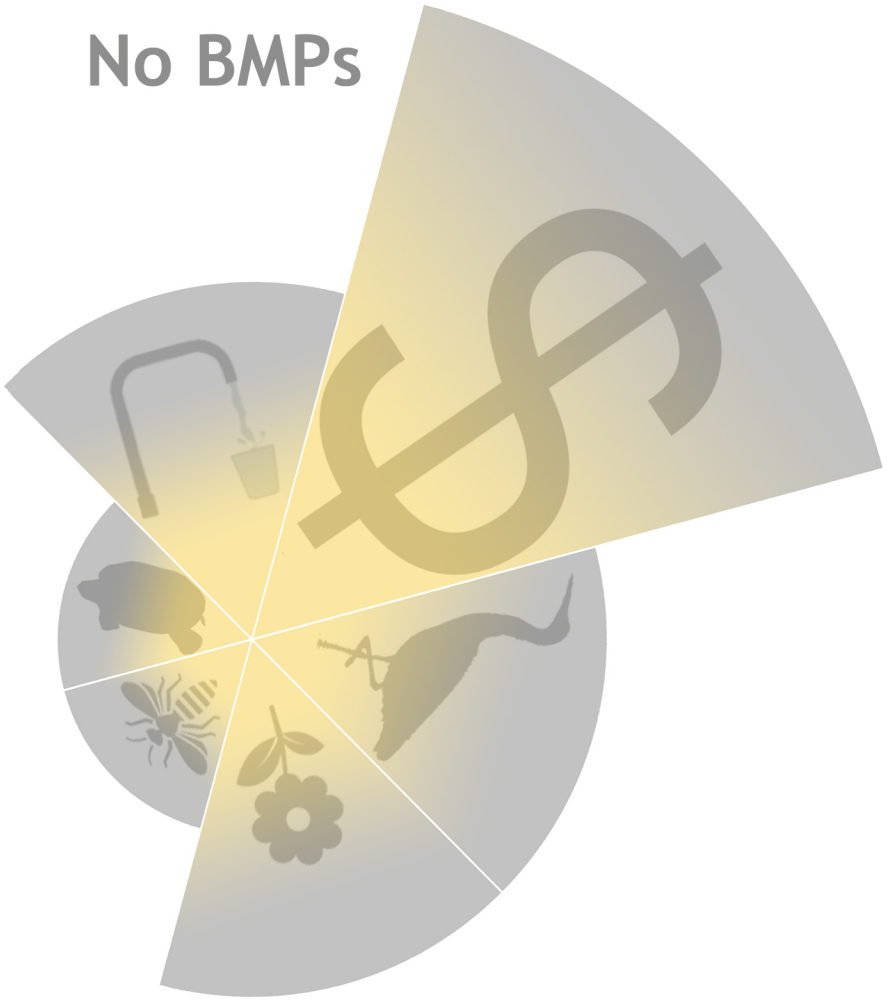


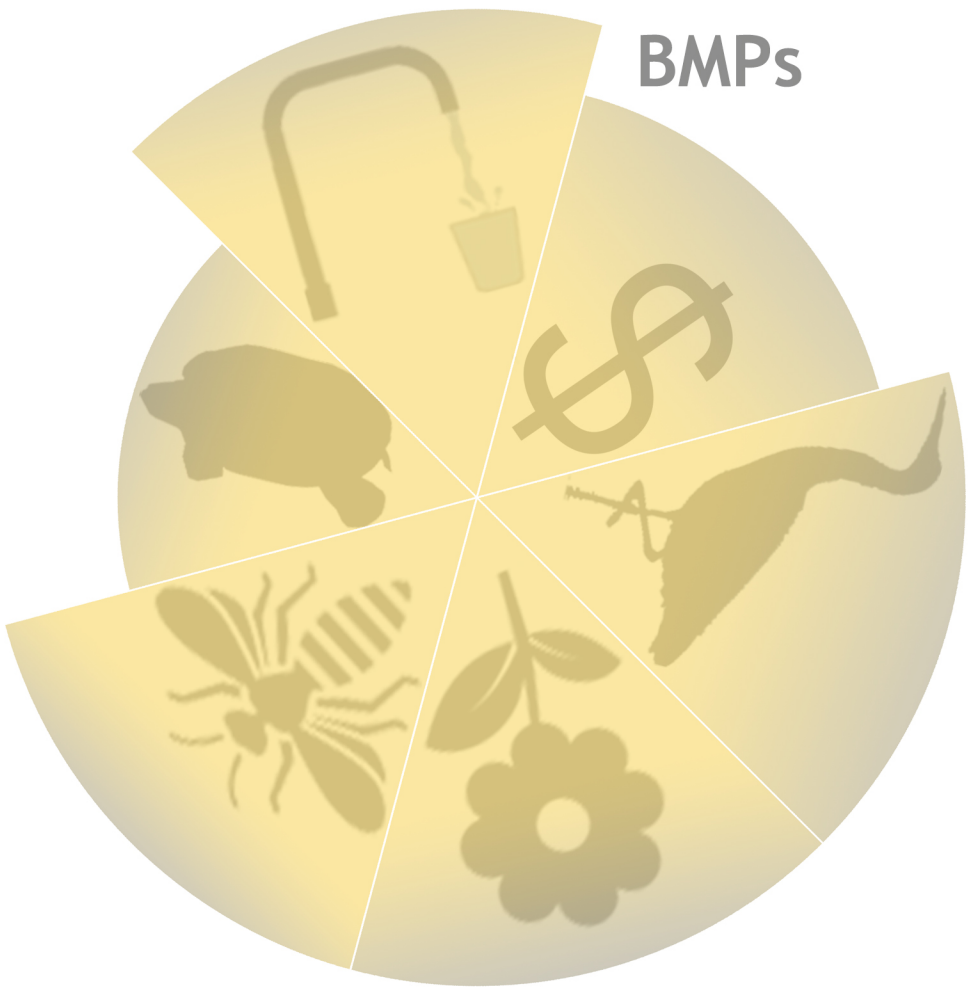
Causeway Best Management Practices
Driver Experience
(NTS)



Causeway Best Management Practices *Benefits*

Terrapin causeway BMPs improve several different evaluative categories.





Maintenance Costs

Water Quality

Pollinator Habitat

Aesthetics

Wildlife Habitat

Terrapin Habitat

Causeway Best Management Practices

Driver View - Aesthetics

Causeway Best Management Practices - *Driver Experience*

Causeway Best Management Practices

Driver Experience

Causeway Best Management Practices
Driver Experience

Aesthetics and Seasonal Wildflowers

Mow Strips and Signage

Nest Boxes (hidden)


Causeway
Best Management
Practices - *Terrapin*
Experience
8

Causeway Best Management Practices - *Terrapin Experience*


Causeway *Terrapin*
Experience
8

Causeway *Terrapin Experience*

Construction Graphics

Description:

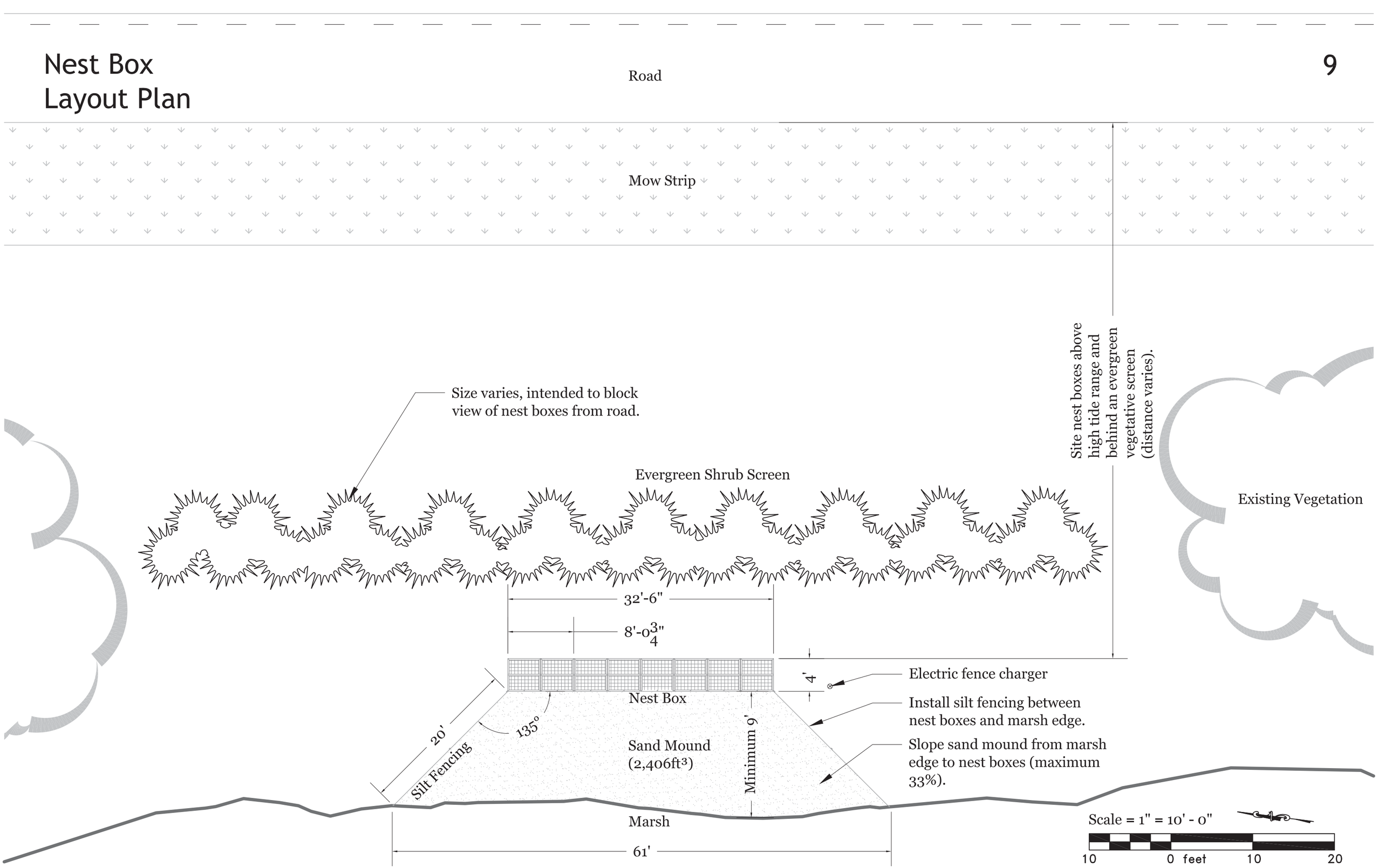
• Graphics that provide information on the implementation of the nest boxes and causeway planting plan.

Graphics List:

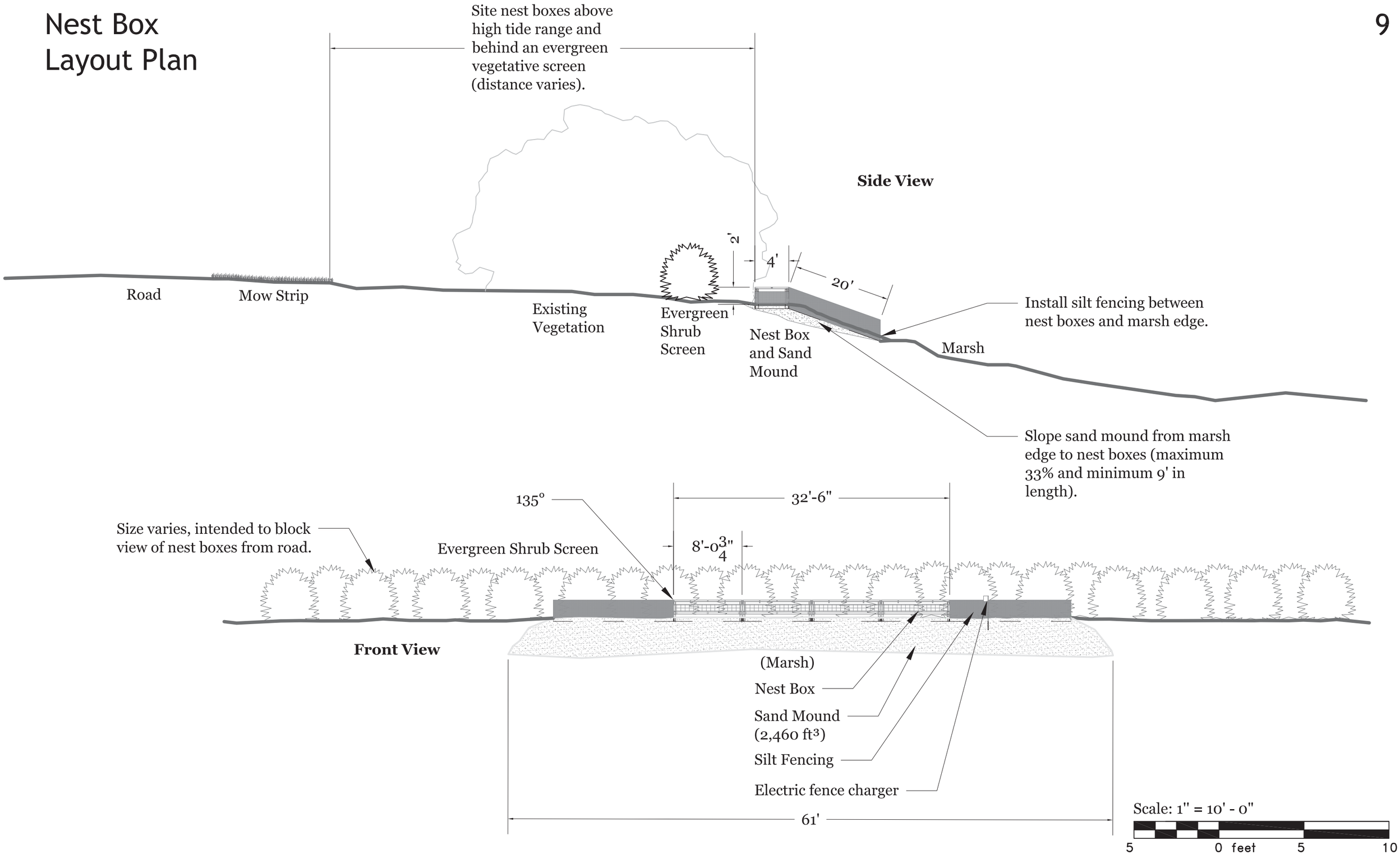
9 Nest Box Construction Information (graphics numbered 9)
- Plan
- Section
- Axonometric
- Construction Details
- Table
- Photos

10 Causeway Planting Plan (graphics numbered 10)
- Plan
- Section
- Axonometric
- Construction Details
- Tables
- Photos

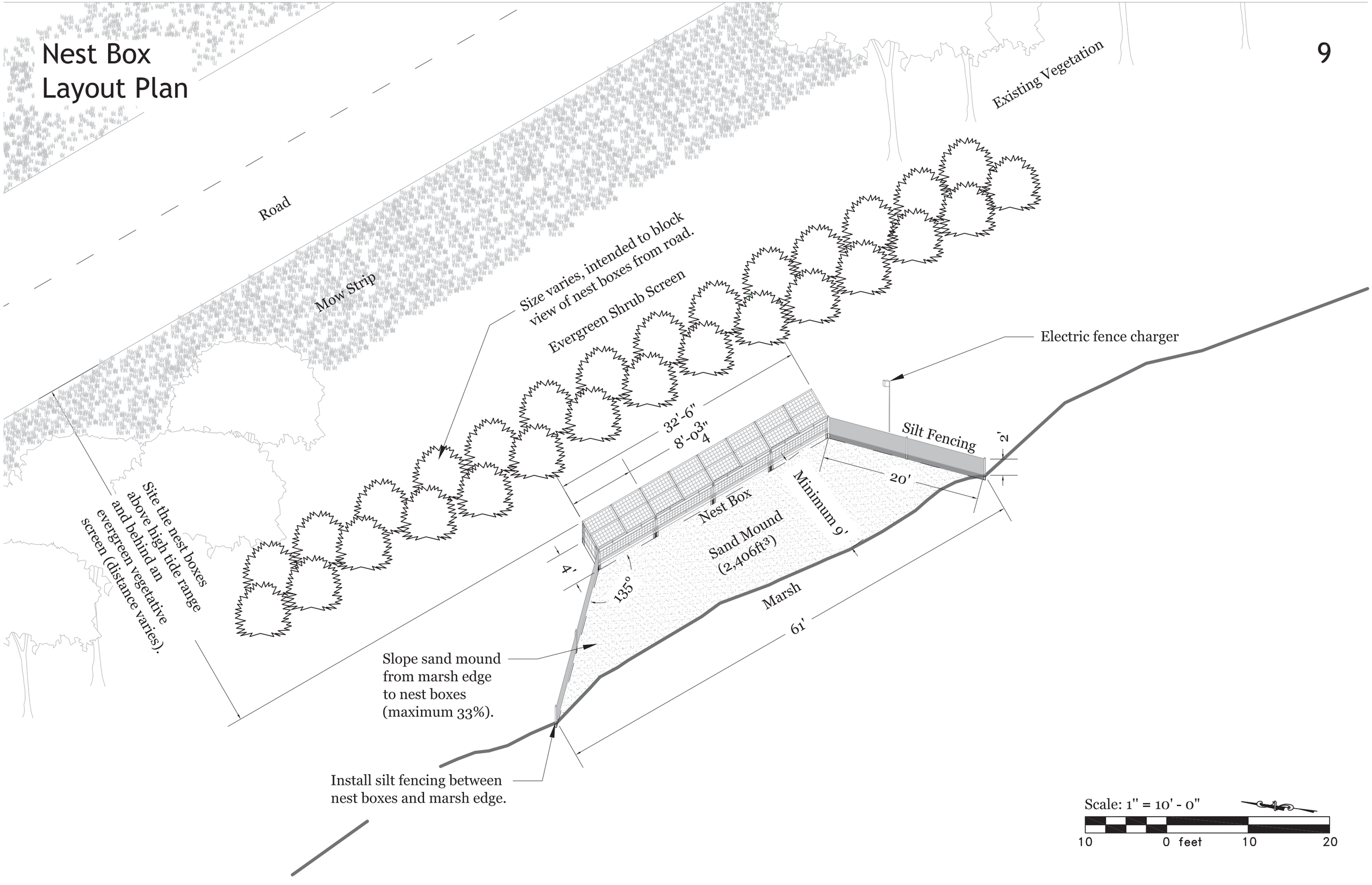
Nest Box Layout Plan



Nest Box Layout Plan

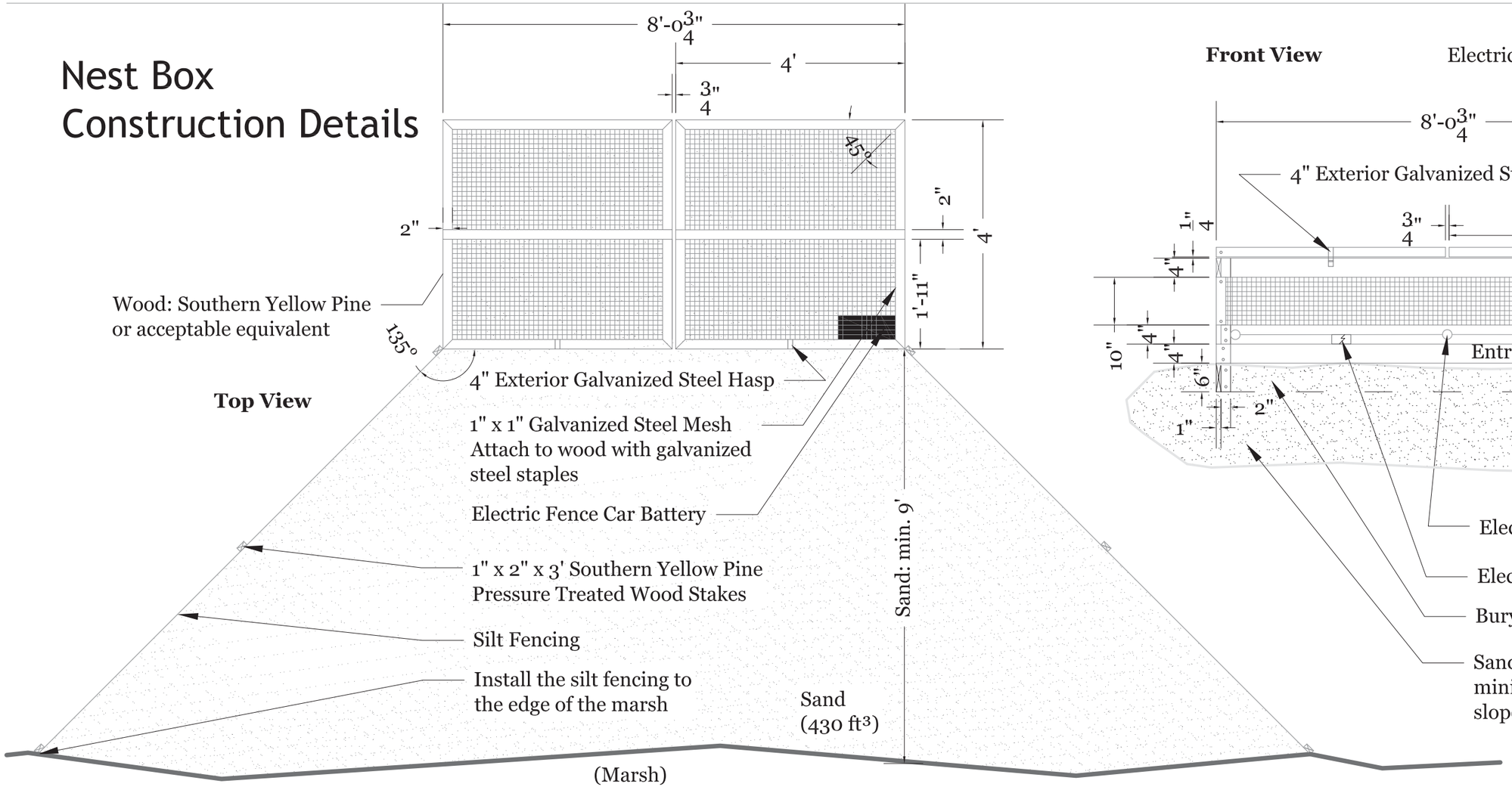


Nest Box Layout Plan

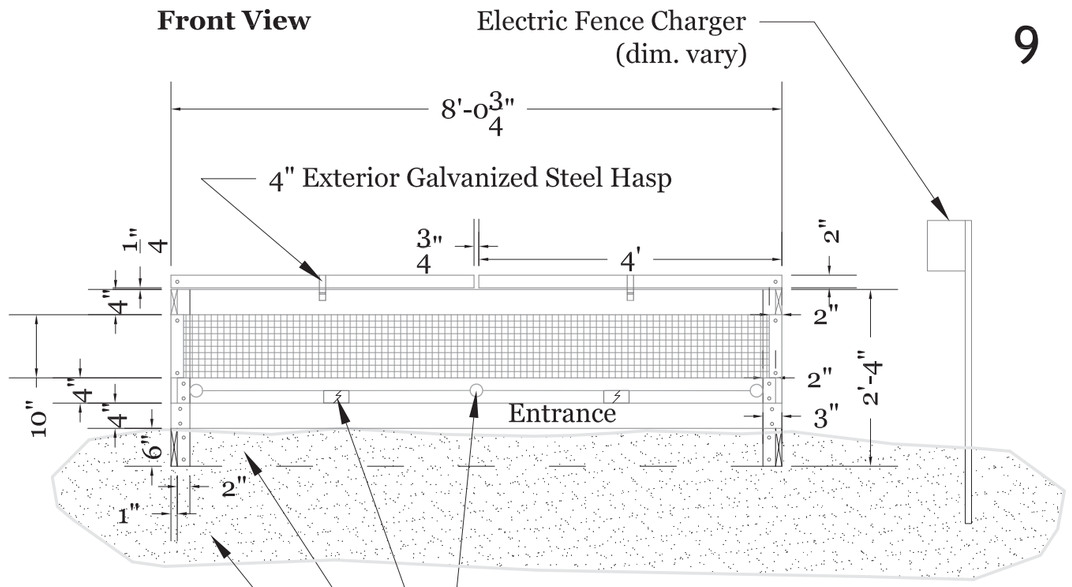


Nest Box Construction Details

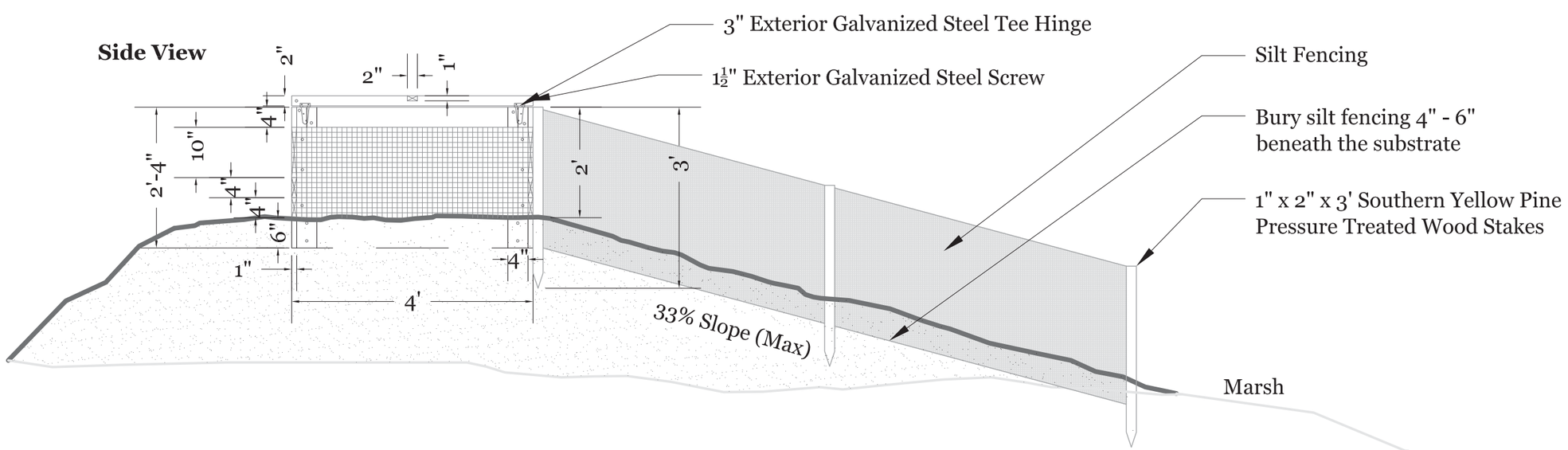
Top View



Front View



Side View



Scale: ½" = 1' - 0"

2 0 feet 2 4

Nesting Box Materials List

Component	Material	Description	Quantity (for (1) 4' x 8' modular unit)	Notes
Directional Fencing	Fencing	Opaque 2' tall silt fencing	Varies, min. 10' per side	Procure enough fencing to cover the distance between the nest box and marsh at a 45˚ angle.
	Fencing stakes	1" x 2" x 3' Southern Yellow Pine (SYP) pressure treated wooden stakes or accepted equivalent	6	Stake fencing cloth every 6'. Make sure the chemicals used to treat the wood to prevent decay do not adversely affect terrapin neonatal development.
Nest Box	Pressure treated wood	1" x 2" SYP or acceptable equivalent	47'	Make sure the chemicals used to treat the wood to prevent decay do not adversely affect terrapin neonatal development.
		2" x 4" SYP or acceptable equivalent	23'	
		1" x 6" SYP or acceptable equivalent	12'	
		1" x 4" SYP or acceptable equivalent	1'	
	Hinges	3" exterior galvanized steel tee hinge	4	
	Screws	1.5" exterior galvanized steel screw	1 lb box	
	Latch	4" exterior galvanized steel hasp	2	
	Metal mesh	1" galvanized steel mesh	28'	
	Staples	Galvanized steel staples	(1) 100 ct. box	Staple steel mesh every 2".
	Labels	Laminated warning labels attached to the electric fence	2	Place on the electric fence line.
Sand Mound	Sand	Calculate volume needed for a minimum 3' high mound to raise the nest box above the marsh/high tide zone, minimum 9' horizontal distance, and at a slope not to exceed 33%	430 ft^3	
Electric Fence	Electric fence materials	Can be customized or a kit	1	
	Battery	Automotive battery	1	Battery will need to be replaced every 4 - 6 weeks.

Terrapin Nest Boxes
Character Examples

View of the nest boxes from the marsh.

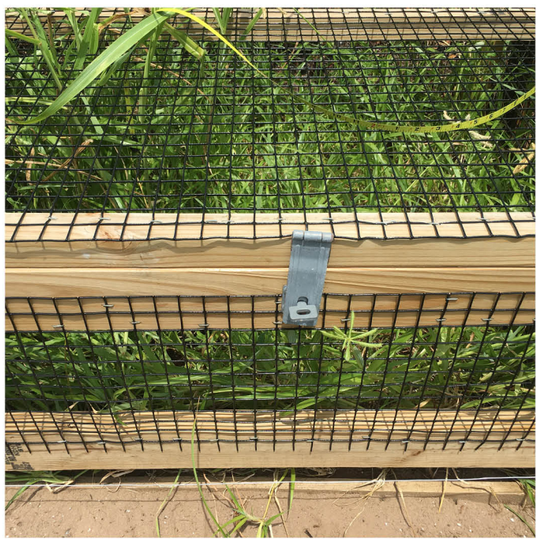
View of the nest boxes and sand mound.

View of the vegetative screen behind the nest boxes.

View of the battery for the electric fence.

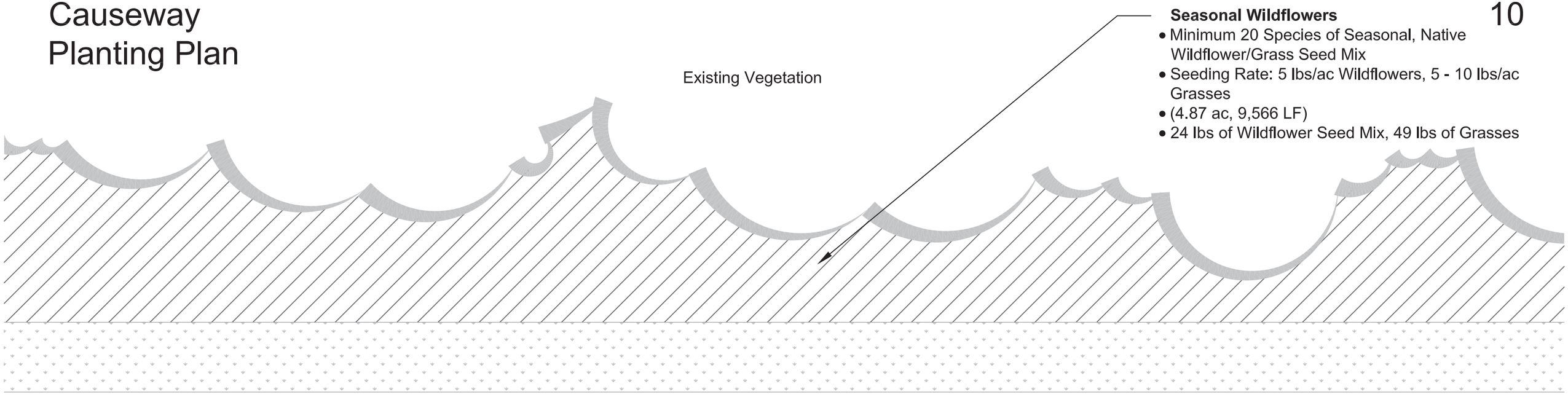
View of the 4” opening, electric fencing, and electric hazard warning signage.

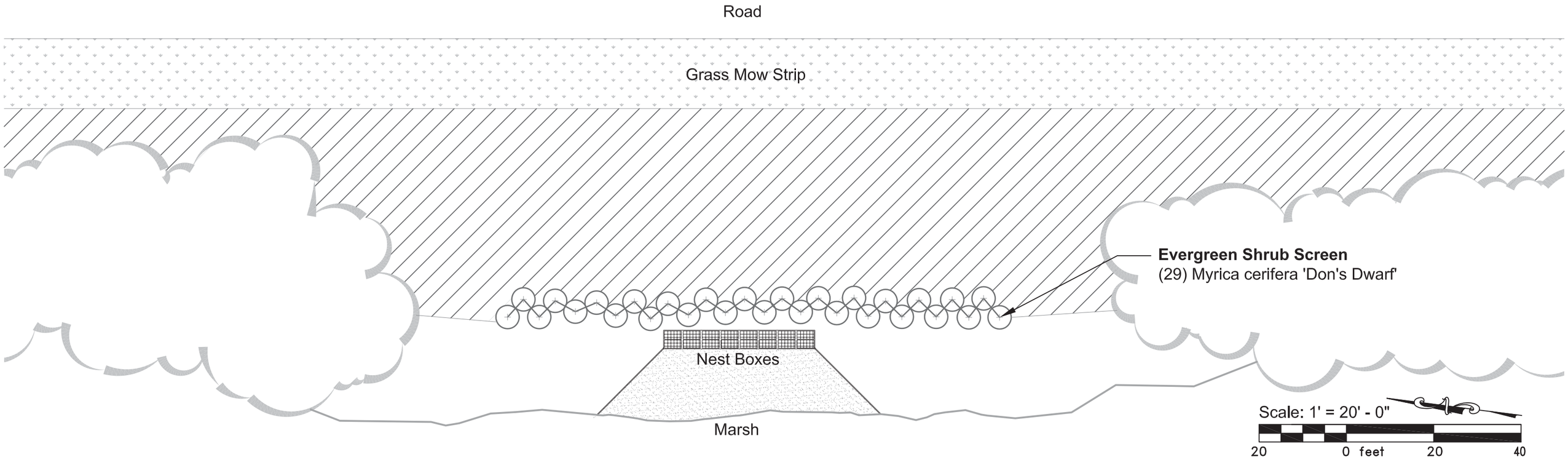
View of the base of the nest boxes buried in the substrate.



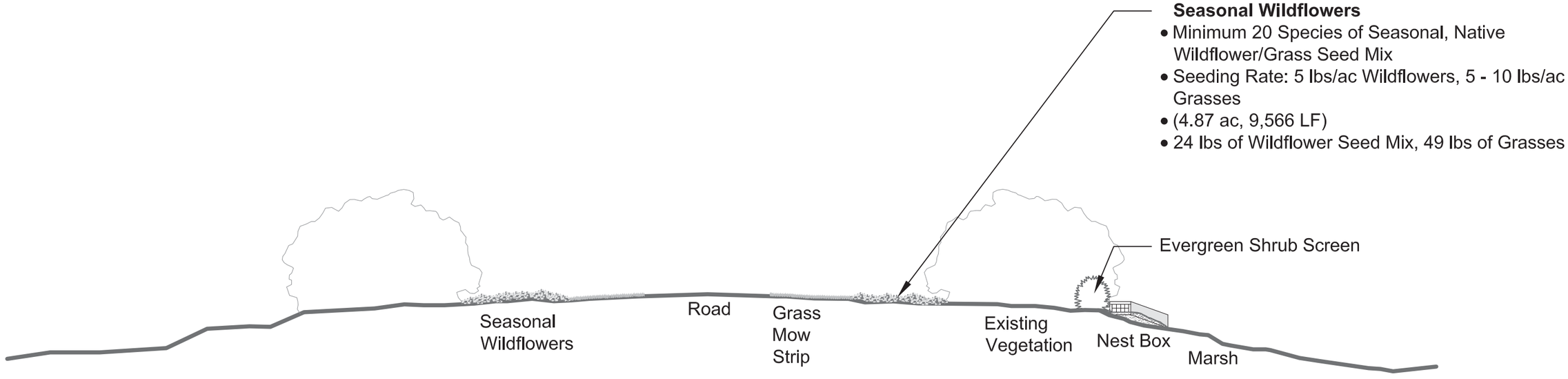
View of the mesh siding and hasp.

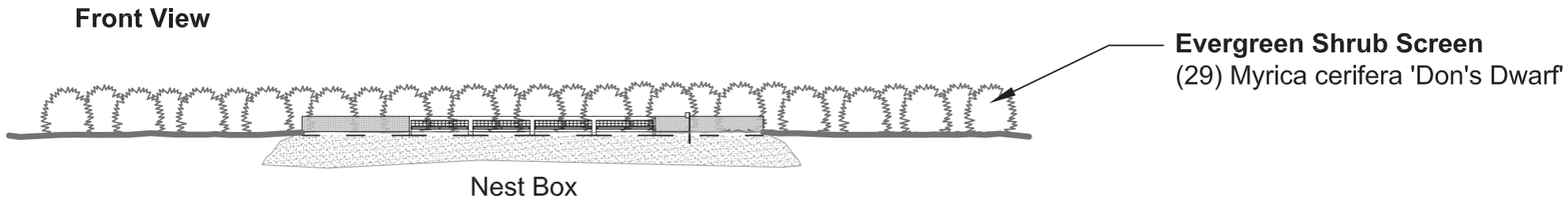
Causeway
Planting Plan





Causeway
Planting Plan

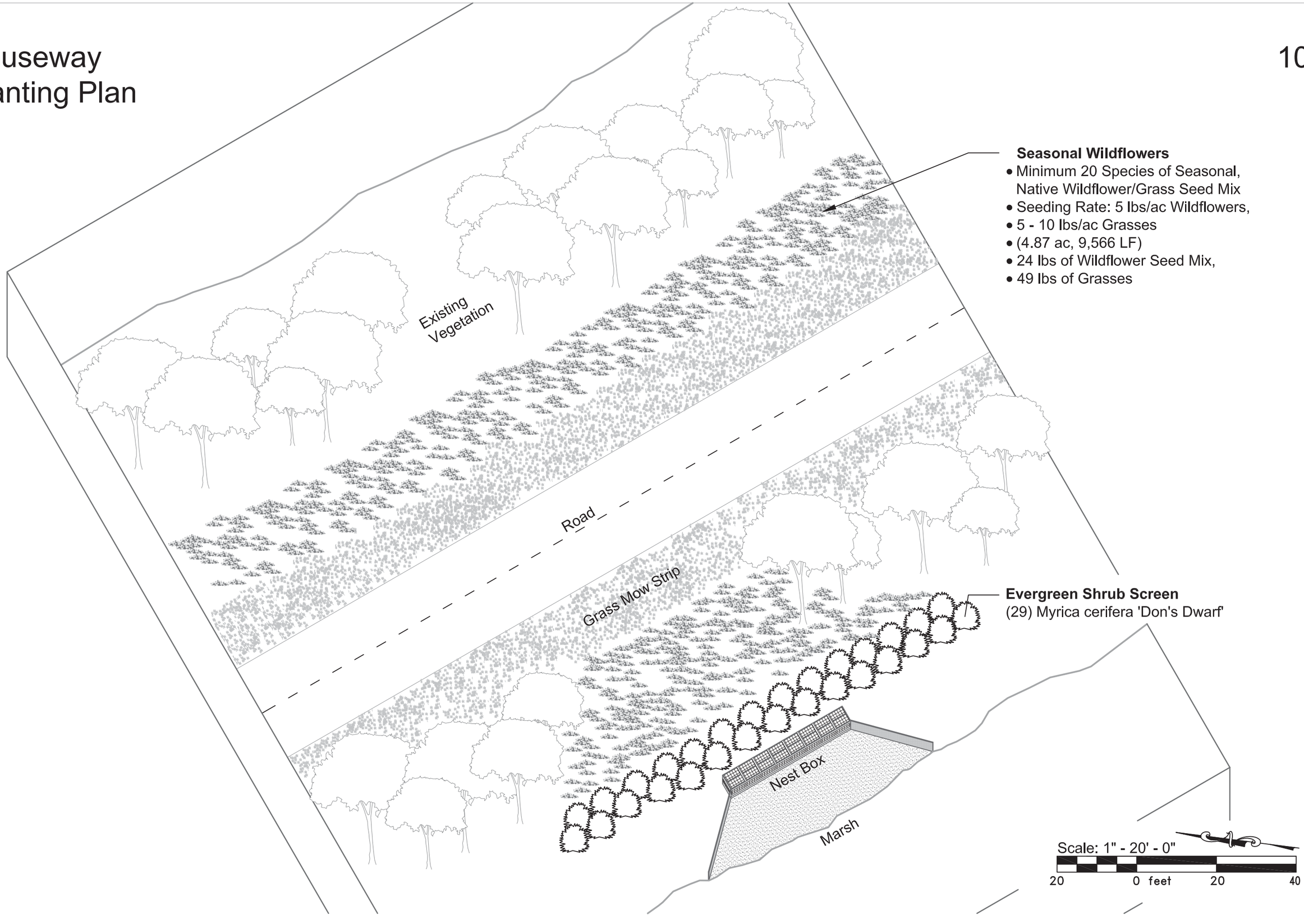




Scale: 1" = 20' - 0"

20 0 feet 20 40

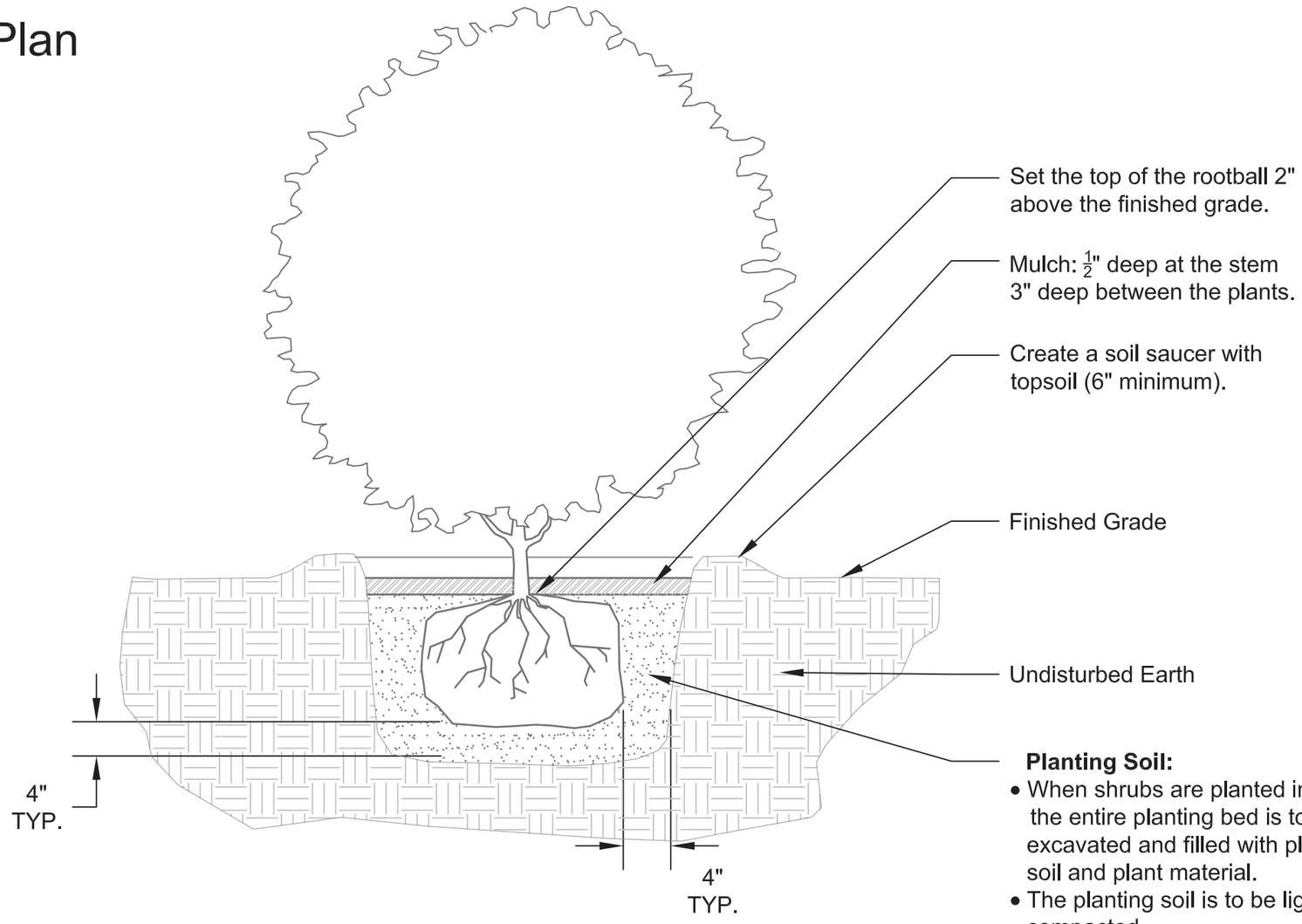
Causeway
Planting Plan



Causeway Planting Plan
Construction Details

Shrub Planting Instructions:

- Prune damaged roots and limbs before planting.
- Soak in water the night before planting.
- Keep roots moist during planting.
- Root spread should be at "American Standards for Nursery Stock" minimums.



Planting Soil:

- When shrubs are planted in mass, the entire planting bed is to be excavated and filled with planting soil and plant material.
- The planting soil is to be lightly compacted.
- The bottom of the hole is to be scarified at least 6".

Seasonal Wildflower Planting Instructions:

- Plant in mid-December.
- Kill existing vegetation with a non-residual herbicide.
- Rake or mow away vegetation to a 2" height.
- Scarify soil ½" deep.

Seed Mix:

- Minimum 20 native wildflower/grass species.
- Seeding rate: wildflowers: 5 lbs/ac, grasses: 5 - 10 lbs/ac

Scale: ¾" = 1' - 0"

Sample Plant Attribute Table

Common Name	Species Name	Quantity	Installation Size	Planting Spacing	Mature Height	Mature Spread	Hardiness Zone	Sun/Shade Tolerance	Spring Color	Summer Color	Fall Color	Winter Color	Design Function
Don's Dwarf Southern Wax Myrtle	*Myrica cerifera* 'Don's Dwarf'	29	3 gal. container	6' O.C.	3' to 5'	3' to 5'	7b to 11	Full Sun - Partial Shade	Green	Green	Green	Green	Evergreen Screen
Lanceleaf Blanketflower	*Gaillardia aestivalis*	2.44 lbs	N/A	1/2 lb/ac	1' to 1.5'	0.75' to 1'	5 to 9	Full Sun	Green	Yellow-Purple	Yellow-Purple	None	Aesthetics, Pollinator Value
Blanket Flower	*Gaillardia pulchella*	2.44 lbs	N/A	1/2 lb/ac	1' to 1.5'	0.5' to 1'	2 to 11	Full Sun	Green	Red-Yellow	Red-Yellow	None	Aesthetics, Pollinator Value
Annual Phlox	*Phlox drummondii*	2.44 lbs	N/A	1/2 lb/ac	0.5' to 1'	0.5' to 1'	2 to 11	Full Sun - Partial Shade	Green	Red	Green	None	Aesthetics, Pollinator Value, Attracts Hummingbirds
Moss Phlox	*Phlox subulata*	2.44 lbs	N/A	1/2 lb/ac	0.25' to 0.5'	1' to 2'	3 to 9	Full Sun	Red, Purple, Pink, White	Green	Green	None	Aesthetics, Pollinator Value
Black-eyed Susan	*Rudbeckia fulgida*	2.44 lbs	N/A	1/2 lb/ac	2' to 3'	2' to 2.5'	3 to 9	Full Sun	Green	Yellow	Brown	Brown Seed Heads	Aesthetics, Pollinator Value
Virginia Spiderwort	*Tradescantia virginiana*	2.44 lbs	N/A	1/2 lb/ac	1.5' to 3'	1' to 1.5'	4 to 9	Partial Shade - Full Shade	Green	Violet-Blue	None	None	Aesthetics

Sample Plant Schedule

Qty.	Botanical Name	Common Name	Size	Spacing	Comments
Shrubs:					
29	*Myrica cerifera 'Don's Dwarf'*	Don's Dwarf Southern Wax Myrtle	3 gal.	6' O.C.	
Groundcovers, vines, and perennials:					
73 lbs	Seed mix of the following species:		N/A	15 lbs./ac	
2.44 lbs	*Gaillardia aestivalis*	Lanceleaf Blanketflower			
2.44 lbs	*Gaillardia pulchella*	Blanket Flower			
2.44 lbs	*Phlox drummondii*	Annual Phlox			
2.44 lbs	*Phlox subulata*	Moss Phlox			
2.44 lbs	*Rudbeckia fulgida*	Black-eyed Susan			
2.44 lbs	*Tradescantia virginiana*	Virginia Spiderwort			

Causeway Planting Plan
Plant Character Examples

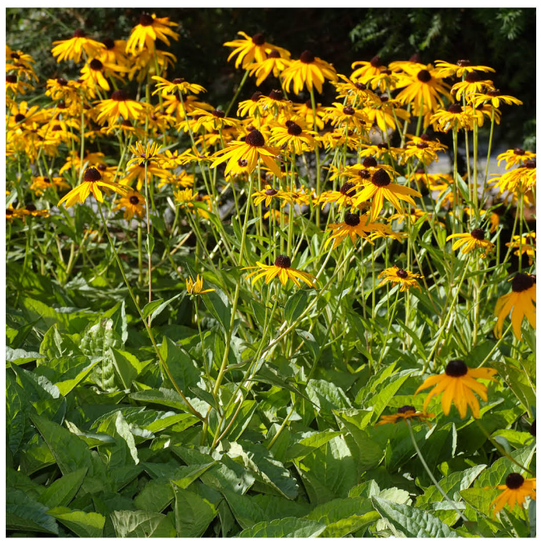
Don's Dwarf Southern Wax Myrtle
(*Myrica cerifera* 'Don's Dwarf')

Lanceleaf Blanketflower
(*Gaillardia aestivalis*)

Blanket Flower
(*Gaillardia pulchella)*

Annual Phlox
(*Phlox drummondii*)

Moss Phlox
(*Phlox subulata*)



Black-eyed Susan
(*Rudbeckia fulgida*)

Virginia Spiderwort
(*Tradescantia virginiana*)

Post Construction Evaluation Graphics

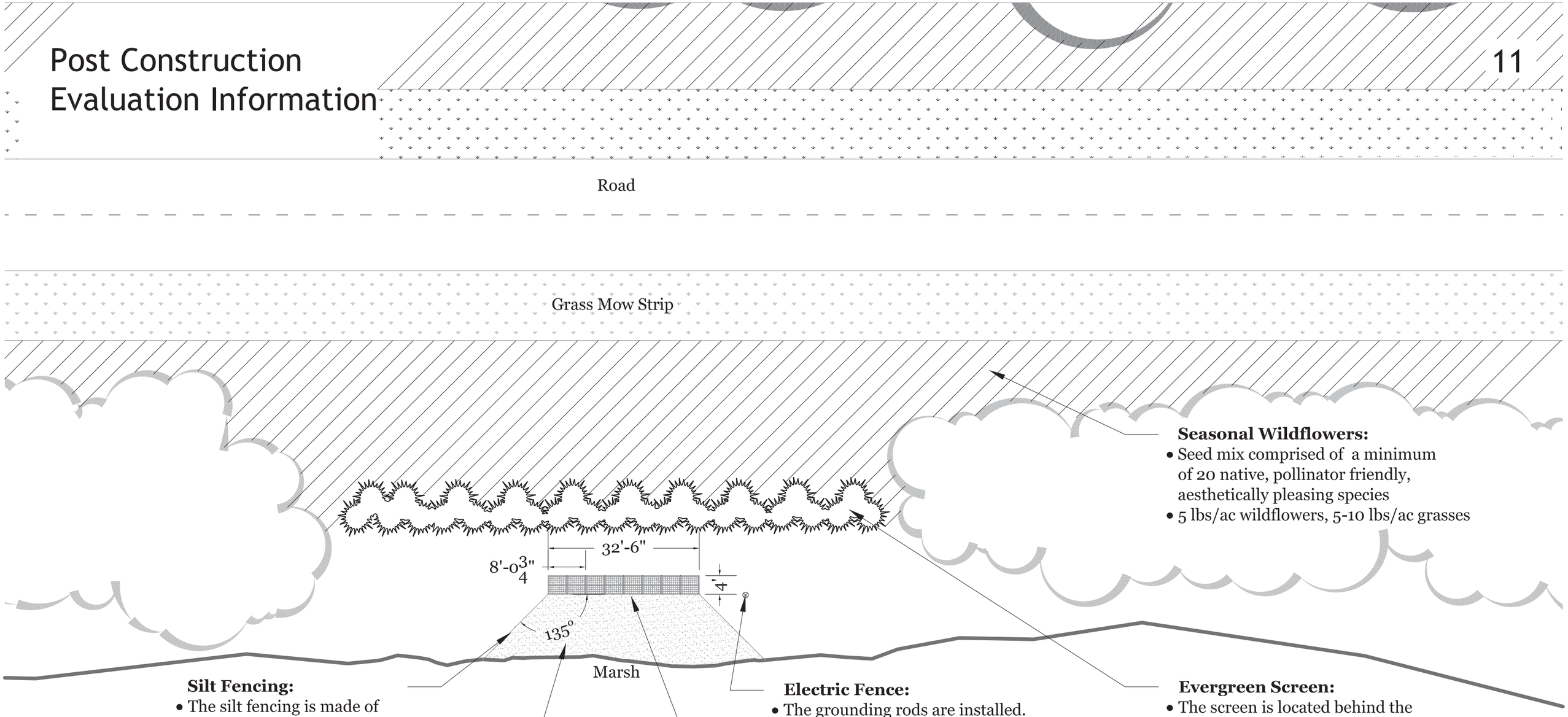
Description:

• Graphics that aid in assessing the implementation of the nest boxes and causeway planting plan.

Graphics List:

11 Post Construction Evaluation Information (graphics numbered 11)
- Plan
- Section
- Axonometric
- Construction Details
- Table

Post Construction Evaluation Information



Seasonal Wildflowers:
- Seed mix comprised of a minimum of 20 native, pollinator friendly, aesthetically pleasing species
- 5 lbs/ac wildflowers, 5-10 lbs/ac grasses

Silt Fencing:
- The silt fencing is made of durable and opaque material.
- The silt fencing is buried and staked beneath the subrate.
- The silt fencing extends to the marsh edge at a 45° angle.

Sand Mound:
- The sand mound elevates the nest boxes a minimum 3' high for at least 9 - 10' at a maximum slope of 33% to the marsh edge.
- The sand mound is free of vegetation.

Electric Fence:
- The grounding rods are installed.
- The electric wire is free of vegetation.
- The electric wire is labeled with electric hazard signage.
- The electric wire is situated close to the 4" opening (to exclude predators).

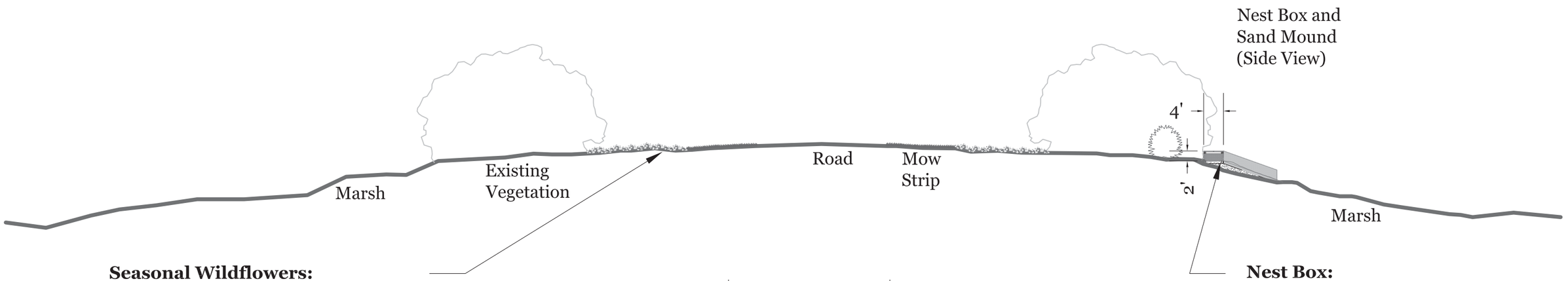
Nest Box:
- The nest box interior is free of vegetation.
- The nest box interior has a sand substrate.
- There is a 4" opening for the turtles.
- The nest box is sited above the high tide range.

Evergreen Screen:
- The screen is located behind the nest boxes to block the drivers' view of the nest boxes from the road.

Scale = 1" = 20' - 0"

20 0 feet 20 40

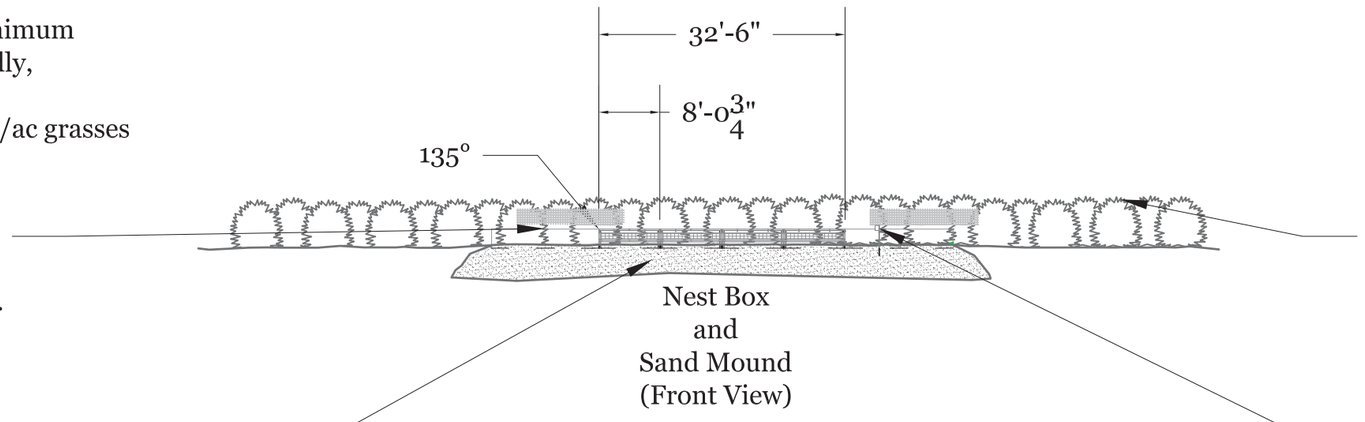
Post Construction Evaluation Information



Seasonal Wildflowers:
- Seed mix comprised of a minimum of 20 native, pollinator friendly, aesthetically pleasing species
- 5 lbs/ac wildflowers, 5-10 lbs/ac grasses

Silt Fencing:
- The silt fencing is made of durable and opaque material.
- The silt fencing is buried and staked beneath the subrate.
- The silt fencing extends to the marsh edge at a 45° angle.

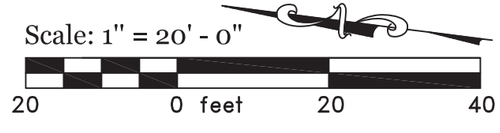
Sand Mound:
- The sand mound elevates the nest boxes a minimum 3' high for at least 9 - 10' at a maximum slope of 33% to the marsh edge.
- The sand mound is free of vegetation.



Nest Box:
- The nest box interior is free of vegetation.
- The nest box interior has a sand substrate.
- There is a 4" opening for the turtles.
- The nest box is sited above the high tide range.

Evergreen Screen:
- The screen is located behind the nest boxes to block the drivers' view of the nest boxes from the road.

Electric Fence:
- The grounding rods are installed.
- The electric wire is free of vegetation.
- The electric wire is labeled with electric hazard signage.
- The electric wire is situated close to the 4" opening (to exclude predators).



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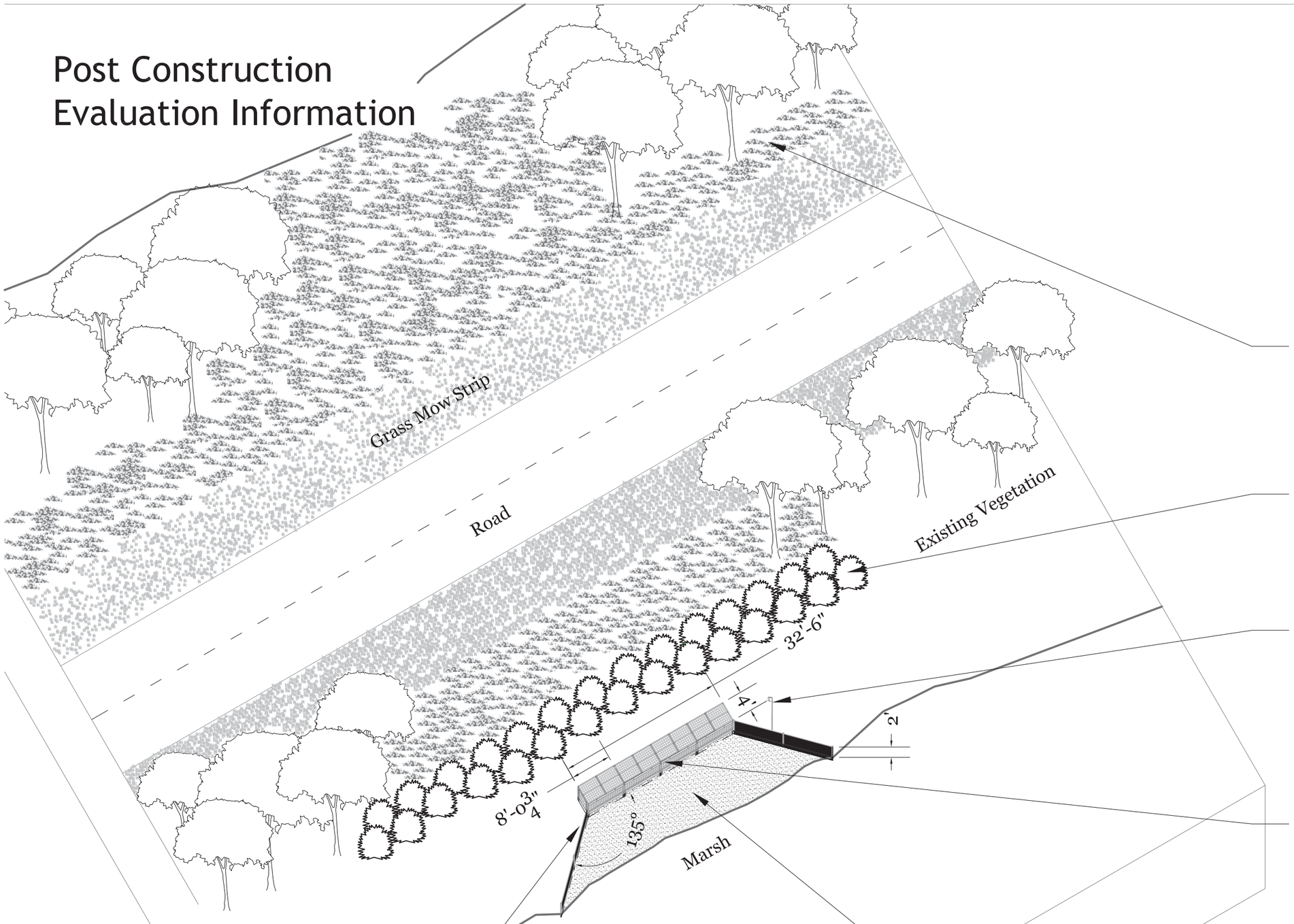

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Silt Fencing:
- The silt fencing is made of durable and opaque material.
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- The silt fencing extends to the marsh edge at a 45° angle.

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- The sand mound elevates the nest boxes a minimum 3' high for at least 9 - 10' at a maximum slope of 33% to the marsh edge.
- The sand mound is free of vegetation.

Scale: 1" = 20' - 0"

20 0 feet 20 40

Post Construction Evaluation Information

Top View

8'-0 3/4"

Nest Box:
- The nest box interior is free of vegetation.
- The nest box interior has a sand substrate.
- There is a 4" opening for the turtles.
- The nest box is sited above the high tide range.

Seasonal Wildflowers:
- Seed mix comprised of a minimum of 20 native, pollinator friendly, aesthetically pleasing species
- 5 lbs/ac wildflowers, 5-10 lbs/ac grasses

Sand Mound:
- The sand mound elevates the nest boxes a minimum 3' high for at least 9 - 10' at a maximum slope of 33% to the marsh edge.
- The sand mound is free of vegetation.

135°

Electric Fence:
- The grounding rods are installed.
- The electric wire is free of vegetation.
- The electric wire is labeled with electric hazard signage.
- The electric wire is situated close to the 4" opening (to exclude predators).

Marsh

Evergreen Screen:
- The screen is located behind the nest boxes to block the drivers' view of the nest boxes from the road.

Silt Fencing:
- The silt fencing is made of durable and opaque material.
- The silt fencing is buried and staked beneath the subrate.
- The silt fencing extends to the marsh edge at a 45° angle.

Side View

2'

4'

33% Slope (Max)

Marsh

Front View

Entrance

Scale: 1/2" = 1' - 0"

2 0 feet 2 4

Post Construction Evaluation Table

Feature	Evaluation Requirements
Nest Box Construction Evaluation	
Nest Boxes	The nest box is free of vegetation.
	The nest box interior has a sand substrate
	There is a 4" opening for the turtles.
	The nest box is sited above the high tide range.
Electric Fence	The grounding rods are installed.
	The electric wire is free of vegetation.
	The electric wire is labeled with electric hazard signage.
	The electric wire is situated close to the 4" opening (to exclude predators).
Silt Fencing	The silt fencing is made of durable and opaque material.
	The silt fencing is buried and staked beneath the substrate.
	The silt fencing extends to the marsh edge at a 45˚.
Sand Mound	The sand mound elevates the nest boxes a minimum of 3' high for at least 9-10' at a maximum slope of 33% to the marsh edge.
	The sand mound is free of vegetation.
Planting Plan Implementation Evaluation	
Seasonal Wildflowers	The seed mix is comprised of a minimum of 20 native, pollinator friendly, aesthetically pleasing species.
	Plant 5 lbs/ac wildflowers and 5-10 lbs/ac grasses.
Nest Box Evergreen Screen	The screen is located behind the nest boxes to block the drivers' view of the nest boxes from the road.

Management/Maintenance Graphics

Description:

• Graphics that aid in the management/maintenance of the causeway best management practices.

Graphics List:

12 Causeway Vegetation Management Summary (graphics numbered 12)
- Plan
- Section
- Axonometric
- Photos
- Table

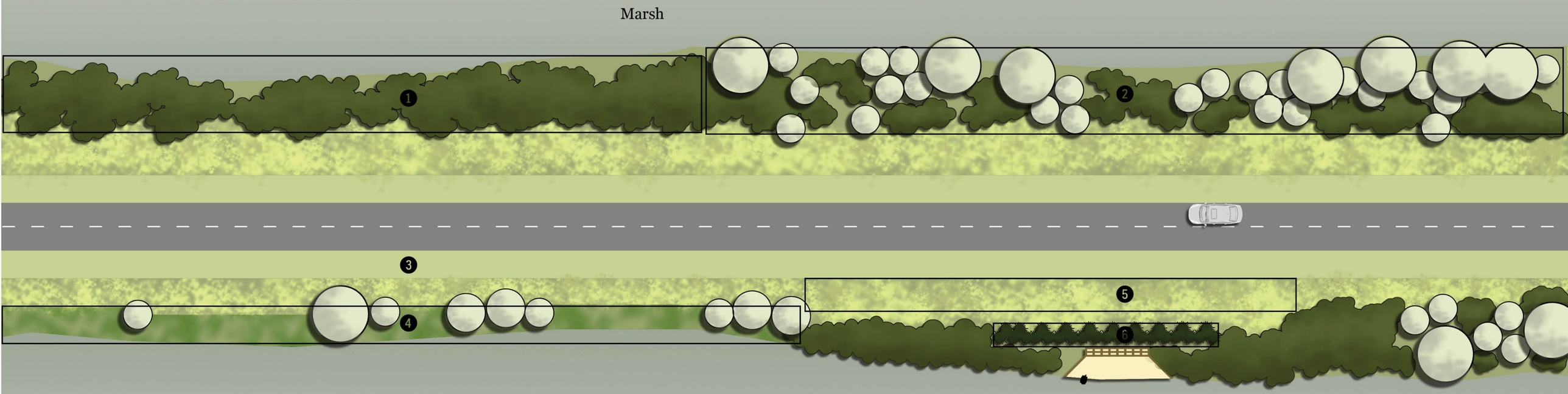
13 Invasive Species Management (graphics numbered 13)
- Plan
- Section
- Axonometric
- Photos
- Tables

14 Causeway Best Management Practices - Maintenance Procedures (graphics numbered 14)
- Plan
- Section
- Axonometric
- Photos
- Table

Causeway Vegetation Management Summary

Goals: The goals are to manage vegetation areas for aesthetics, wildlife, and rare plant species.

Note: Vegetation zone sizes listed below do not represent actual zone sizes along the causeway.



1 Successional/Shrub Dominated Zone

(5.34 ac, 12,255 LF)

- Rotational cut (1.3 mi/year) in the fall and winter (before the songbird and turtle nesting season) to mimic periodic disturbance. Clear the vegetation to the marsh edge.
- Manage for secondary views.
- Manage habitat for rare plant species.

Scale: 1” = 50’ - 0”

50 0 feet 50 100

2 Protected Buffer Zone

(11.92 ac, 23,640 LF)

- Maintain at existing size.
- Clear sight lines along road by hand and deadfall debris unless it poses an aesthetic issue.
- Manage habitat for migratory birds, shorebirds, and rare plant species.

3 Mow Strips

(10.91 ac, 31,680 LF)

- Maintain a 15’ strip during the nesting season, and mow the seasonal wildflower zone as well during the rest of the year.

4 Herbaceous and Underbrushed Tree Zone

(7.47 ac, 14,266 LF)

- Maintain as the primary view of the marsh.

5 Seasonal Wildflowers

(4.87 ac, 9,566 LF)

- Use native, pollinator friendly, attractive wildflowers, and plant the seeds in mid-December.
- Mow this zone during the non-nesting season/non-wildflower season.

6 Nest Box Screen

(0.01 ac, 80 LF)

- Maintain an evergreen visual screen of the nest boxes.

Causeway Vegetation Management Summary

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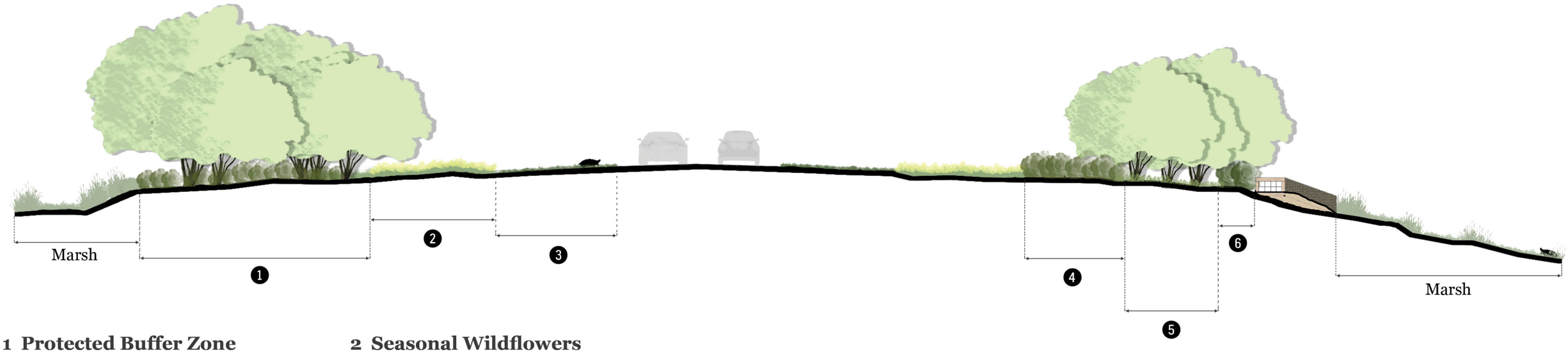

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Scale: 1" = 15' - 0"

15 0 feet 15 30

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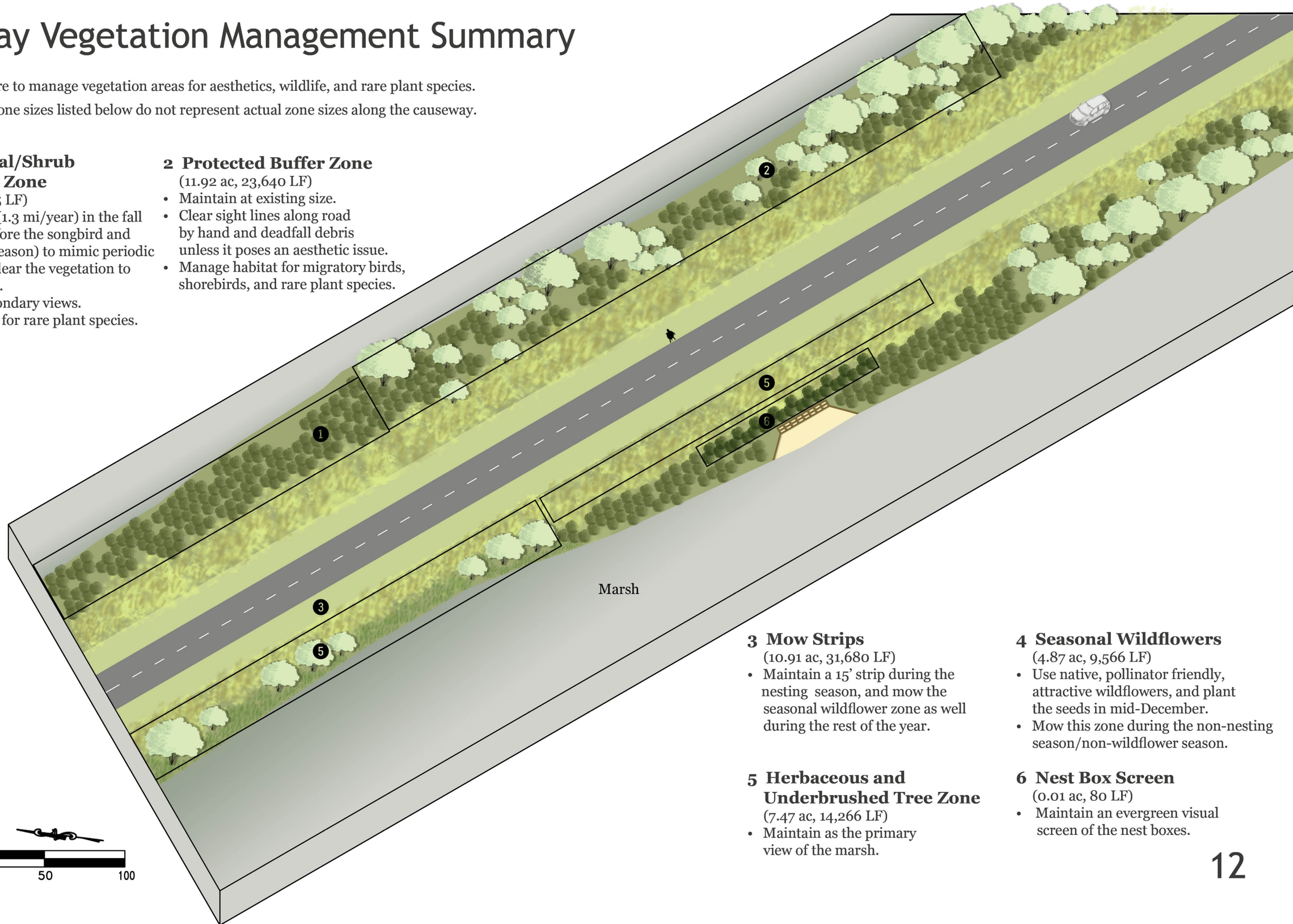

Scale: 1” = 50’ - 0”

50 0 feet 50 100

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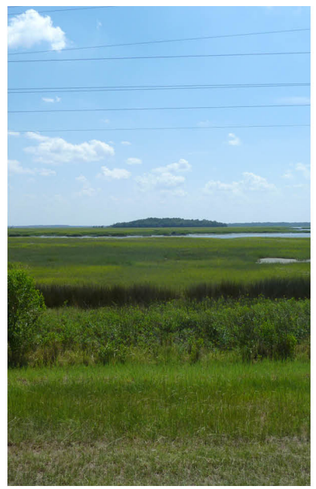

3 Herbaceous and Underbrushed Tree Zone

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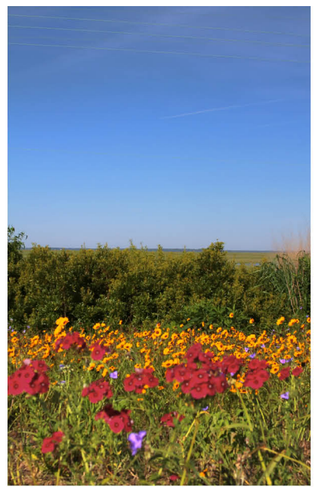


4 Seasonal Wildflowers

(4.87 ac, 9,566 LF)

- Use native, pollinator friendly, attractive wildflowers, and plant the seeds in mid-December.
- Mow this zone during the non-nesting season/ non-wildflower season.

5 Mow Strips

(10.91 ac, 31,680 LF)

- Maintain a 15' strip during the nesting season, and mow the seasonal wildflower zone as well during the rest of the year.

6 Nest Box Screen

(0.01 ac, 80 LF)

- Maintain an evergreen visual screen of the nest boxes.

Causeway Vegetation Management Summary

Vegetation Management Zone	Size (acre, linear feet)	Description	Vegetation Management Priorities	Management Techniques	Special Conditions/Notes
Nest Box	(0.01, 80)	Existing vegetation or planted shrubs that act as a screen blocking the view of the nest boxes from the roadway.	1. Aesthetics 2.Wildlife Safety	Maintain existing vegetation or plant a shrub screen and maintain it.	Hand clear and don't use herbicides.
Seasonal Wildflowers	(4.87, 9,566)	Seasonal (summer) perennial and annual wildflowers visible from the roadway.	1. Aesthetics 2. Wildlife Habitat Value (pollinators, caterpillars)	Seed with a mix of native perennials and annuals, reseed as necessary.	Choose species beneficial for pollinators as well. Mow in the non-nesting/non-wildflower season.
Mow Strips	(10.91, 31,680)	Grass strip adjacent to the roadway.	1. Aesthetics 2. Driver Safety 3. Maintenance Efficiency 4. Wildlife Safety	Mowed area adjacent to roadway, varies in width by season (summer: 15', rest of year: include the seasonal wildflower zone)	Nesting Season: mow during early morning low tides and set the mower height at 6".
Protected Buffers	(11.92, 23,640)	Areas with a mature overstory and species rich understory.	1. Aesthetics 2. Habitat Value	Maintain to existing size.	Shorebird rookery, migratory bird and rare plant species habitat.
Herbaceous and Underbrushed Tree Zones	(7.47, 14,266)	Disturbed areas, herbaceous dominated vegetation with underbrushed trees, and viewsheds of significance.	1. Aesthetics 2. Habitat Value	Maintain as open areas for primary views of the marsh.	Green manure debris, leave deadfall unless it's an aesthetic issue, and clear sight lines by hand.
Successional/Shrub Dominated Zones	(5.34, 12,255)	Areas with shrubs as the dominant layer and early successional vegetation.	1. Aesthetics 2. Habitat Value	Rotational cut areas each year, manage for rare plant species, and manage for secondary views.	Rotational cut for varied successional states of habitat, green manure debris, leave deadfall unless it's an aesthetic issue, and clear sight lines by hand.

Goals: The goals are to manage vegetation areas for aesthetics, wildlife, are rare plant species.

Note: Vegetation zone sizes listed above do not represent actual zone sizes along the causeway.

Sample Area, (TYP)

Green Manure

Cut and Herbicide Painted Stumps

Protected Species

Marsh Edge

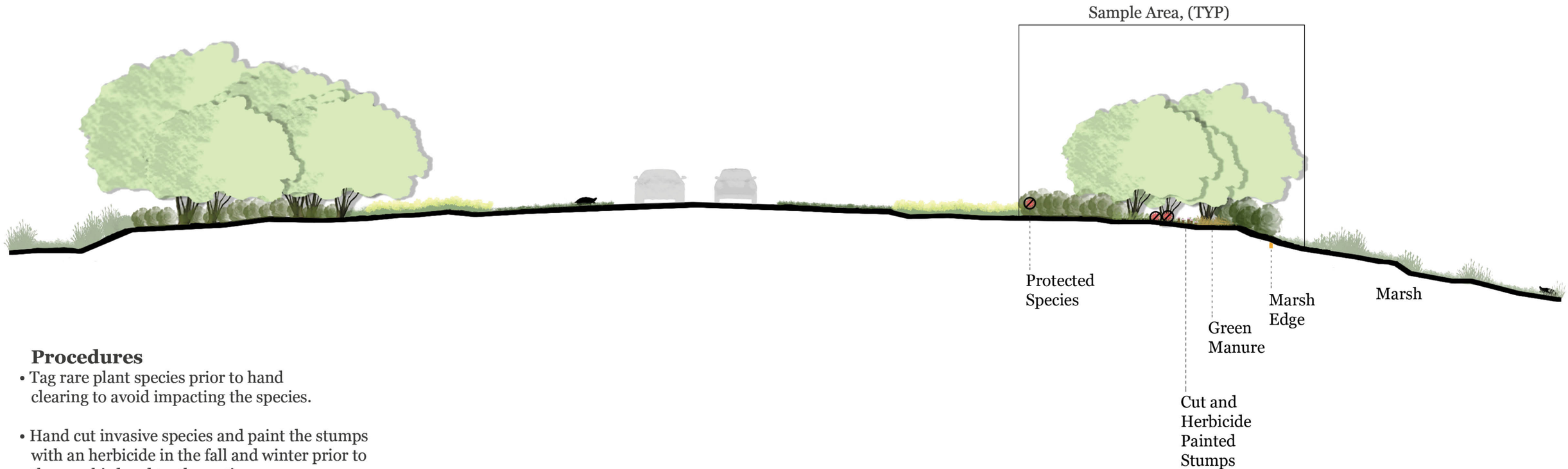
Marsh

Procedures

- Tag rare plant species prior to hand clearing to avoid impacting the species.
- Hand cut invasive species and paint the stumps with an herbicide in the fall and winter prior to the songbird and turtle nesting seasons.
- Clear invasive plant species in the management zones to the marsh edge.
- Green manure the handcut debris, and place the debris out of the driver's view to avoid impacting aesthetics.

Scale: 1" = 50' - 0"

50 0 feet 50 100



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Scale: 1" = 15' - 0"

15 0 feet 15 30

Invasive Species Management

Procedures

- Tag rare plant species prior to hand clearing to avoid impacting the species.
- Hand cut invasive species and paint the stumps with an herbicide in the fall and winter prior to the songbird and turtle nesting seasons.
- Clear invasive plant species in the management zones to the marsh edge.
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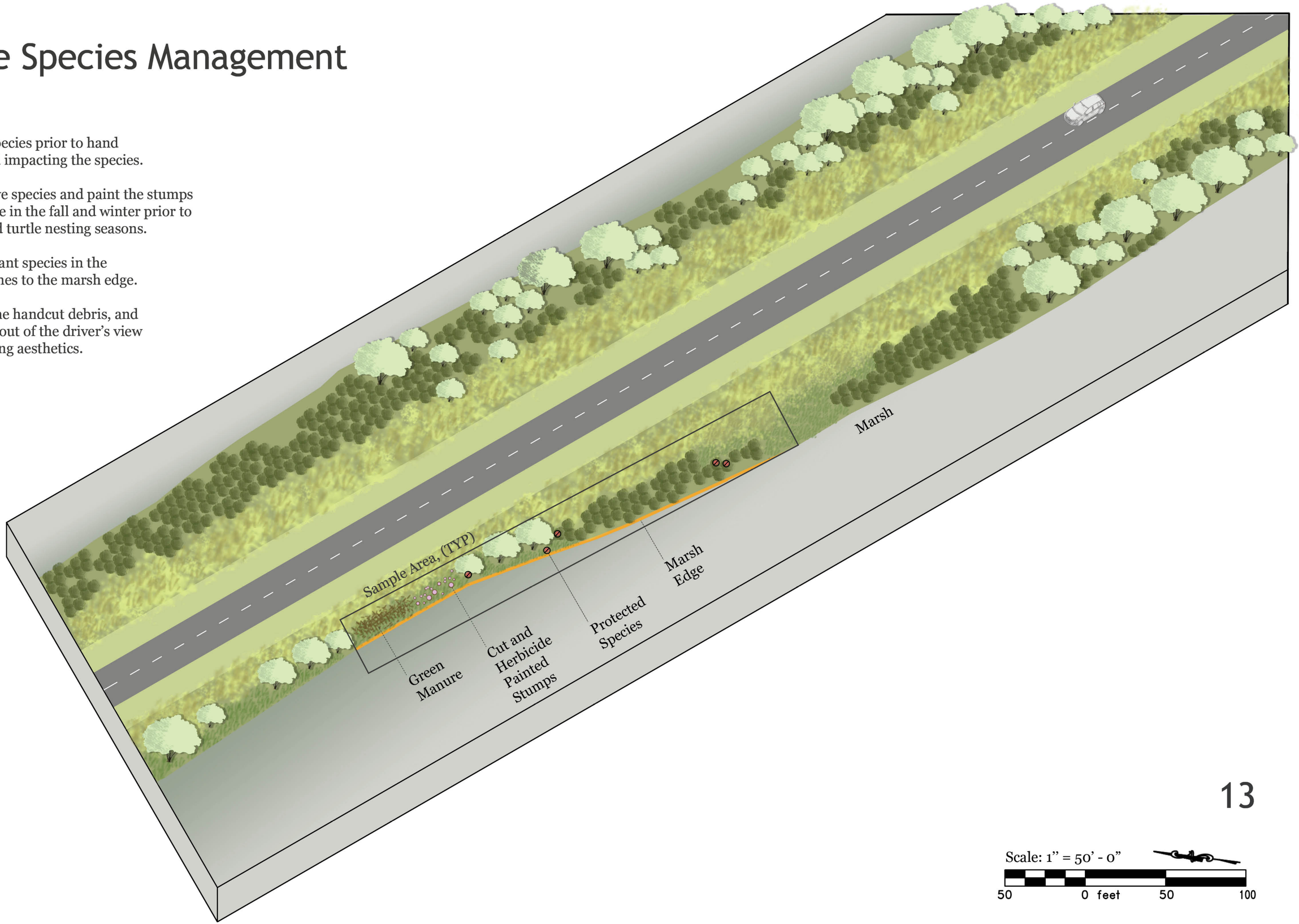

Scale: 1" = 50' - 0"

50 0 feet 50 100

Invasive Species Management
Sample Species List

Chinaberry (*Melia azedarach*)
- Priority Level: High
- Habitat Type: Successional/Shrub Dominated Zone

Salt Cedar (*Tamarix spp.*)
- Priority Level: Medium
- Habitat Type: Successional/Shrub Dominated Zone

White Mulberry (*Morus alba*)
- Priority Level: Low
- Habitat Type: Successional/Shrub Dominated Zone

Sawtooth Oak (*Quercus acutissima*)
- Priority Level: Low
- Habitat Type: Successional/Shrub Dominated Zone

Invasive Species Management Procedures
- Tag rare plant species prior to hand clearing to avoid impacting the species.
- Hand cut invasive species and paint the stumps with an herbicide in the fall and winter prior to the songbird and turtle nesting seasons.
- Clear invasive plant species in the management zones to the marsh edge.
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Tag rare plant species prior to hand clearing to avoid impacting the species.
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Sample Invasive Species List

Plant Species	Priority	Habitat Type
Chinaberry (*Melia azedarach*)	High	Successional/Shrub Dominated Zones
Salt Cedar (*Tamarix spp.*)	Medium	Successional/Shrub Dominated Zones
White Mulberry (*Morus alba*)	Low	Successional/Shrub Dominated Zones
Sawtooth Oak (*Quercus acutissima*)	Low	Successional/Shrub Dominated Zones

Causeway Best Management Practices *Maintenance Procedures*

1 Existing Vegetation

- Maintain vegetation as specified on the vegetation and invasive species management plans.
- Tag rare plant species prior to management activities to avoid impacting the species. Verify that the management activities do not impact wildlife species associated with the management zone.
- Manage vegetation only to the marsh edge.

2 Signage

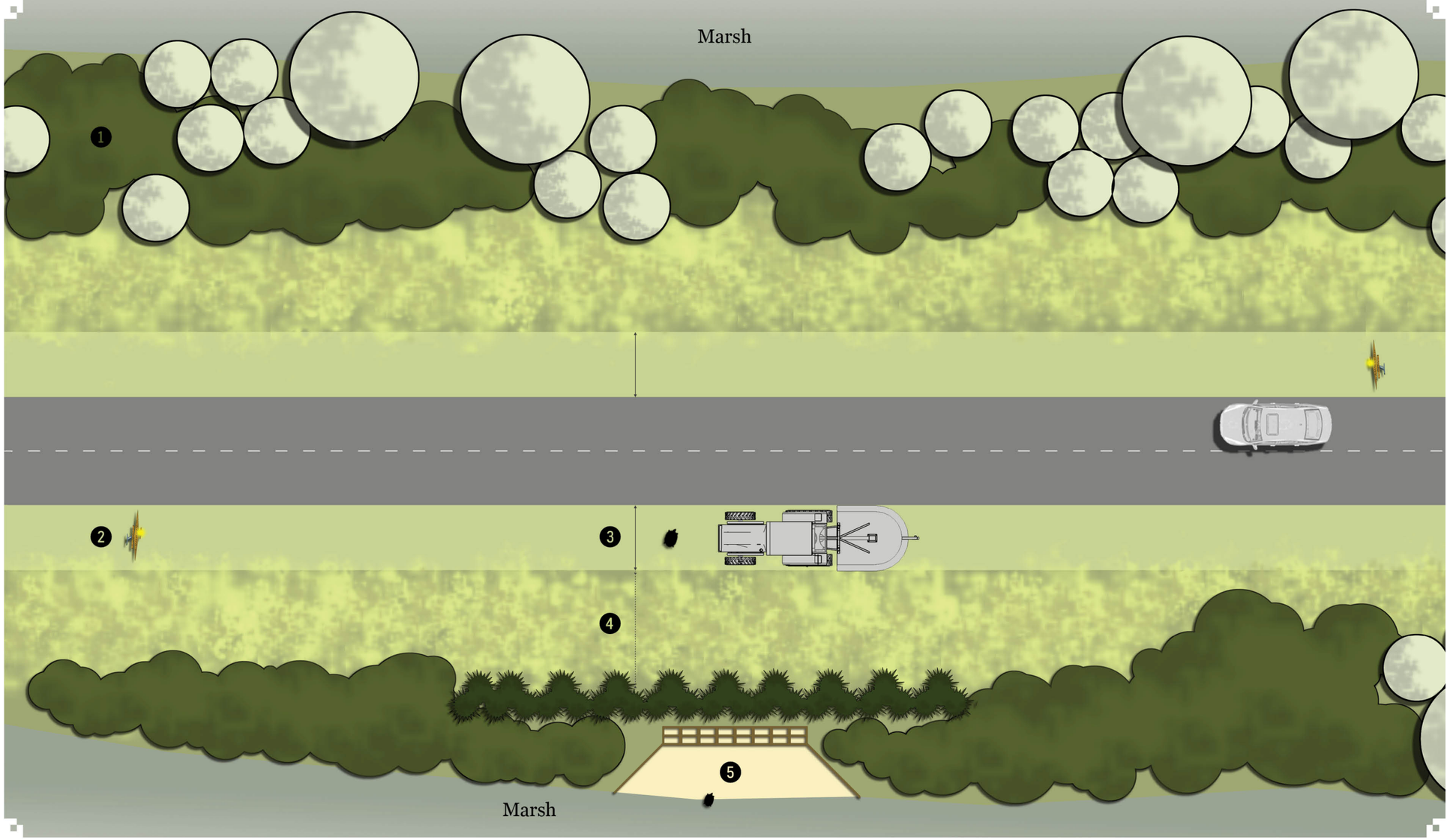
- Flip the sign's message during the nesting and non-nesting season. The message should be turtle crossing from May to August, and a safety message from August to May.
- Each week during the nesting season, program the signs to flash 1 hour before and 2 hours after the daytime high tide period.

3 Mow Strips

- Mow during the early morning low tides to avoid the turtles and set the mower blade height at 6" as a further precaution. If a terrapin is spotted in the mow path, move it out of the way.
- Mow a 15' strip along the roadside during the nesting season (May-August), and to the existing vegetation zones during the non-nesting season. Mow along the roadside monthly and high visibility areas such as the visitor's center on a weekly basis.

Scale: 1" = 50' - 0"

50 0 feet 50 100



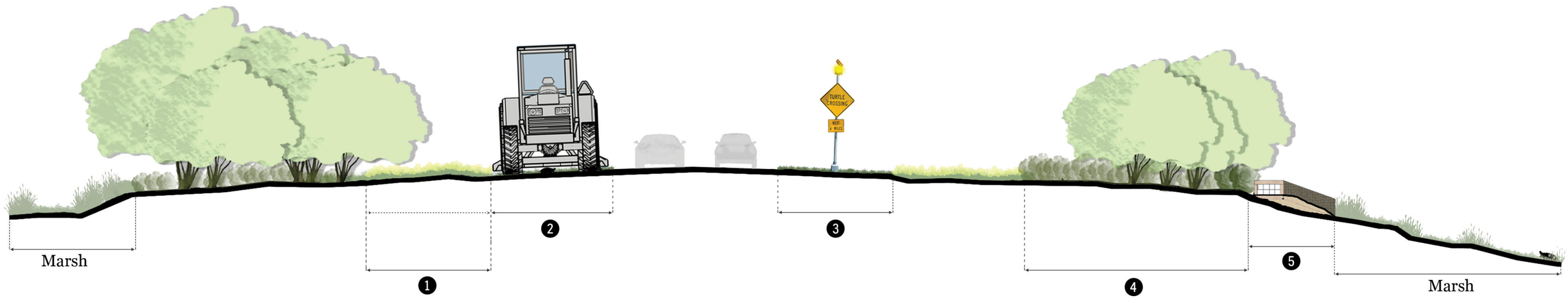
4 Seasonal Wildflowers

- Plant wildflower seed between the 15' mow strips and the existing vegetation zones. The seeds should be planted in mid-December and consist of native, pollinator-friendly, attractive species.
- After the wildflower season, mow the vegetation on a monthly basis and treat as an extension of the mow strip zone. The mowing area would extend between the existing 15' mow strips and the existing vegetation management zones.

5 Nest Boxes

- Maintain an evergreen, native vegetative screen to block drivers' views of the nest boxes. This is done to improve roadway aesthetics and protect nesting turtles.
- Prior to each nesting season (before May), check the nest boxes, electric fence system and silt fencing for damage. Roto till/hand pull vegetation from the nest mound and nest boxes. Also, check the sand mound for erosion issues and maintain it at the intended height/size.
- Test the electric fence system on a monthly basis to verify proper functioning. The battery may need to be replaced every 4 - 6 weeks.
- Maintain the nest mound and nest boxes vegetation free during the nesting season (May - August), and only hand pull the vegetation from the nesting and mound area.

Causeway Best Management Practices
Maintenance Procedures



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- Mow during the early morning low tides to avoid the turtles and set the mower blade height at 6" as a further precaution. If a terrapin is spotted in the mow path, move it out of the way.
- Mow a 15' strip along the roadside during the nesting season (May-August), and to the existing vegetation zones during the non-nesting season. Mow along the roadside monthly and high visibility areas such as the visitor's center on a weekly basis.

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Scale: 1" = 15' - 0"

15 0 feet 15 30

Causeway Best Management Practices
Maintenance Procedures

1 Existing Vegetation
- Maintain vegetation as specified on the vegetation and invasive species management plans.

- Tag rare plant species prior to management activities to avoid impacting the species. Verify that the management activities do not impact wildlife species associated with the management zone.

- Manage vegetation only to the marsh edge.

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- Flip the sign's message during the nesting and non-nesting season. The message should be turtle crossing from May to August, and a safety message from August to May.

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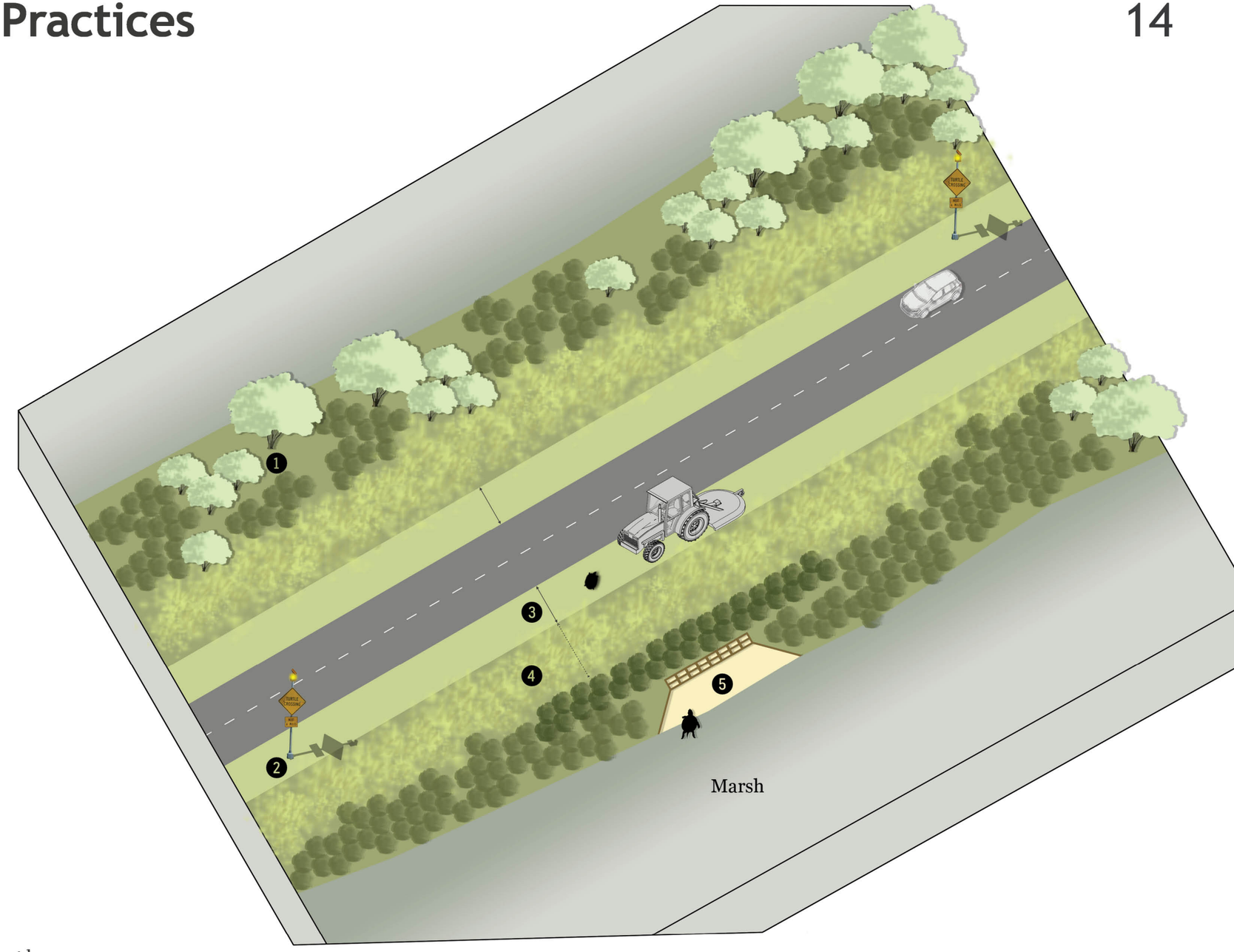
- Test the electric fence system on a monthly basis to verify proper functioning. The battery may need to be replaced every 4 - 6 weeks.

- Maintain the nest mound and nest boxes free of vegetation during the nesting season (May -August), and only hand pull the vegetation from the nesting boxes and mound area.



Scale: 1" = 50' - 0"

50 0 feet 50 100

Causeway Best Management Practices
Maintenance Procedures

1 Existing Vegetation

- Maintain vegetation as specified on the vegetation and invasive species management plans.
- Tag rare plant species prior to management activities to avoid impacting the species. Verify that the management activities do not impact wildlife species associated with the management zone.
- Manage vegetation only to the marsh edge.

2 Signage

- Flip the sign's message during the nesting and non-nesting season. The message should be turtle crossing from May to August, and a safety message from August to May.
- Each week during the nesting season, program the signs to flash 1 hour before and 2 hours after the daytime high tide period.
intended height/size.

3 Mow Strips

- Mow during the early morning low tides to avoid the turtles and set the mower blade height at 6" as a further precaution. If a terrapin is spotted in the mow path, move it out of the way.

4 Seasonal Wildflowers

- Plant wildflower seed between the 15' mow strips and the existing vegetation zones. The seeds should be planted in mid-December and consist of native, pollinator-friendly, attractive species.
- After the wildflower season, mow the vegetation on a monthly basis and treat as an extension of the mow strip zone. The mowing area would extend between the existing 15' mow strips and the existing vegetation management zones.

5 Nest Boxes

- Maintain an evergreen, native vegetative screen to block drivers' views of the nest boxes. This is done to improve roadway aesthetics and protect nesting turtles.
- Prior to each nesting season (before May), check the nest boxes, electric fence system and silt fencing for damage. Roto till/hand pull vegetation from the nest mound and nest boxes. Also, check the sand mound for erosion issues and maintain it at the intended height/size.
- Test the electric fence system on a monthly basis to verify proper functioning. The battery may need to be replaced every 4 - 6 weeks.
- Maintain the nest mound and nest boxes free of vegetation during the nesting season (May -August), and only hand pull the vegetation from the nesting boxes and mound area.

Causeway Best Management Practices - Maintenance Procedures

Management Feature	Task	Frequency	Additional Notes
Seasonal Wildflowers	Plant wildflower seed between the 15' mow strips and the existing vegetation zones.	The seeds should be planted in mid-December.	Use native, pollinator-friendly, aesthetically pleasing wildflower species.
Mow Strips	Mow a 15' grass strip along the roadside during the nesting season (May - August), and include the seasonal wildflower zone during the non-nesting/non-flowering season (August - May).	Mow along the roadside monthly and high visibility areas such as the visitor's center on a weekly basis.	Mow during the early morning low tides to avoid the turtles.
			If a terrapin is spotted in the mowing path, move it out of the way.
			Set the mower height at 6" to avoid harming turtles in the way of the mower.
Signage	Flip the sign's message between the nesting and non-nesting season. The message should say "turtle crossing" from May to August, and a safety message from August to May.	Seasonally between the nesting and non-nesting seasons.	
	Program the flashing lights on the signs to correspond with the turtle crossing periods.	Each week during the nesting season, program the signs to flash 1 hour before and 2 hours after the daytime high tide period.	
Existing Vegetation	Maintain the existing vegetation as specified on the invasive species and vegetation management plans.	As specified on the vegetation management plans.	
Nest Boxes	Maintain an evergreen, native, vegetative screen to block drivers from viewing the nest boxes. This is done to provide roadway aesthetics and protect nesting turtles.	Maintain as needed.	
	Check the nest boxes, electric fence system, and silt fencing for damage.	Prior to each nesting season (before May).	
	Roto till/hand pull vegetation from the nest mound and nest boxes.	Prior to each nesting season (before May).	
	Check the sand mound for erosion and maintain it at the intended height/size.	Prior to each nesting season (before May).	
	Test the electric fence system and replace the battery.	Check the fence during the nesting season, and replace the battery every 4 - 6 weeks.	
	Maintain the nest boxes and sand mound vegetation free during the nesting season (May - August).	Check each month.	Only hand pull the vegetation from the nest boxes and sand mound.

APPENDIX C

EVALUATION SURVEY RESPONSES

SURVEY RESPONSES

EXISTING INFORMATION ASSESSMENT

Profession	What types of illustrations do you currently use in your own work (photograph, sketch, table, etc.)?
Ecologist 1	photographs, tables (Excel), maps (ESRI ArcMap or orthophotos), and illustrations (usually original art work)
Ecologist 2	photographs and illustrator
Ecologist 3	Primarily photographs, aerial images,LIDAR, DEMs, topographic maps, resources maps (e.g. wetlands, hydrology, and soils) and ArcGIS maps
Ecologist 4	Mostly tables, graphs, charts and other visuals that describe the relationships of variables to one another. I use illustrations rarely in my work, though I certainly see them often peripheral to work; e.g. looking through an aviation journal to read an article, I'll see ads for a product in which I might have interest.
Landscape Architect 1	Plan view, sections and sketches primarily, then modified photographs
Landscape Architect 2	photos, sketches, 3-d modeling, schematic drawings, construction drawings, section-elevations, tables, GIS modeling, etc.
Landscape Architect 3	Photos, sketching, laminated aerial plans, sketchUp models, Morpholio sketch app on iPad
Landscape Architect 4	CAD details, photos, photoshop illustrative renderings, Illustrator diagrams, spreadsheets, hand sketches, 3D digital models
Planner	Primarily photographs, charts and tables, and occasionally sketches
Maintenance Professional 1	Photo, plans, sketch and table.
Maintenance Professional 2	Photos and tables
Land Manager 1	I typically use photographs, GIS mapping software, Adobe Photoshop for interpretive panels or JPEG creation, design diagrams and hand-drawn sketches to convey work observations and formulate interpretive materials.
Land Manager 2	Various photos, drawings, spreadsheets, databases, POS systems.
Engineer 1	Tables, visual renderings, CADD drawings (plans, profiles, section views), photographs
Engineer 2	Many types - maps, graphs, conceptual diagrams, networks, photographs, sketches, bubble plans, detailed engineering drawings
Communications Professional	photographs, infographics, diagrams, charts, timelines (gantt), illustrations etc.

Profession	What determines these choices?
Ecologist 1	I use multiple types when creating PowerPoints for talks at professional or public meetings, or published articles or books. Tables and maps for PowerPoints have to be rather simple but can be more complex for written works.
Ecologist 2	the best method to reach the target audience
Ecologist 3	I think you're asking what determines my choice to use the types of illustrations I mentioned above. If so, the answer is that these types of illustrations convey a lot of information in a compact form. I, myself, do not often produce or create or determine what illustrations are used in my work.
Ecologist 4	The project deliverables and regulatory requirements determine the graphics presentations.
Landscape Architect 1	Client (audience)
Landscape Architect 2	project type (design, construction, planning), facility type (roads, buildings, parks, natural ecosystems), and project goals
Landscape Architect 3	what I am trying to communicate, who the audience is, format of presentation
Landscape Architect 4	1. The project and process 2.Expertise level of participants/audience - community presentation or DOT Engineers? 3. Time! 4. Desired outcome - ie, design standard voting would need lots of photos for decision making 5.
Planner	Illustration shows context and people. Color is typically preferred for visual interest, although sometimes black and white is used for historical projects
Maintenance Professional 1	What information is readily available when it is needed, and the formats it is available in that best convey the required information.
Maintenance Professional 2	My main duties at GDOT is to inspect potential hazardous trees/vegetation along the R/W. Photos and sometimes video assist my work in determining if this vegetation poses any hazards to the traveling public.
Land Manager 1	Ease of conveying the message to the audience. Diagrams, maps and photographs give an overall picture and framework for whatever supporting text is necessary. Maps also help visitors and partners with orientation and understanding spatial relationships between habitats, use areas, etc.
Land Manager 2	Target audience, determined outcome.
Engineer 1	Typically the intended audience. Public meetings typically got with a more visuals, photos, renderings, aerial photography or USGS quad map as a background with proposed project superimposed. Construction drawings are more of a technical setting in black & white line work with many details. Technical reports or presentations will include a mix of illustrations to show examples and plan details at the level the target audience will understand.
Engineer 2	File was too large to upload in previous question: see http://www.sfei.org/sites/default/files/biblio_files/Tijuana%20River%20Valley%20Historical%20Ecology%20Investigation%20-%20medium%20resolution_0.pdf Multiple visual perspectives, conveys temporal dynamics, data rich yet parsimonious, data-ink ratio
Communications Professional	We consider the objective of the message (what are we trying to communicate) and the audience (to whom we are trying to communicate the message). We also consider the methods of delivery (will we have the chance to meet in person, can we share a short video, do we need to rely on printed materials only etc.).

Profession	What other types of illustrations are you familiar with?
Ecologist 1	
Ecologist 2	sketchup, cad, and hand drawings
Ecologist 3	I commonly see/use illustrations and diagrams in scientific journals, aviation publications, financial documents, art and architectural documents.
Ecologist 4	Enigineering design drawings and specs, usually CAD formats. When it is available, which is not often, LIDAR.
Landscape Architect 1	Photo realistic sketches
Landscape Architect 2	animations, visualizations, movies, etc.
Landscape Architect 3	I feel like the answer is "all of them"
Landscape Architect 4	Photoshop and other 2D/3D software
Planner	3-D animation. Architectural drawings including plan, elevation and axonimetrics
Maintenance Professional 1	
Maintenance Professional 2	graphs and charts
Land Manager 1	Some engineering plans for park projects such as bike-trail construction and property survey maps. Schematics of proposed visitor use areas and interpretive design elements.
Land Manager 2	brochures, handouts, mobile apps, interpretive signage
Engineer 1	3D models, layered PDF images
Engineer 2	That mostly covers it
Communications Professional	We are producing more animated gifs for some projects and we continue to receive a variety of styles from architects, landscape architects and exhibit designers which show various angles and views.

Profession	Which are the most beneficial illustration types for you?
Ecologist 1	I mostly use tables and maps. Photos or illustrations are added sometimes for esthetics or to illustrate a particular characteristic.
Ecologist 2	they all serve a purpose
Ecologist 3	I don't have a favorite type.
Ecologist 4	Natural resource data overlaid on aerials or LIDAR
Landscape Architect 1	plan view
Landscape Architect 2	all of the above listed are useful; depends on the application
Landscape Architect 3	I like diagrams (Adobe Illustrator) and construction details.
Landscape Architect 4	Sketching - it's quick and one can do it on the fly, whether a site visit or an impromptu question & answer session.
Planner	Combination of illustrations to depict the 'whole picture.' I do like photographs since most people understand the media whereas some of the other types may not be universally understood by the general public.
Maintenance Professional 1	Ones that effectively convey the desired information.
Maintenance Professional 2	Photos
Land Manager 1	Visual, simple, convey perspective succinctly, good legends and color-oriented.
Land Manager 2	photos and charts
Engineer 1	Any format as long as it conveys information clearly
Engineer 2	Multiple visual perspectives, conveys spatial and or temporal dynamics as appropriate, data rich yet parsimonious, data-ink ratio
Communications Professional	The key is to match the style to the message and audience. You should not use all types for all content. For example, a table of materials with specifications for each material is great as a companion to diagrams and illustrations indicating how to install or build an item. Isometrics and aerial images help show the big picture and placement along with cross-sections and bird's eye views.

Profession	How are illustrations useful for you?
Ecologist 1	Most of my work is on distribution of species or movement/home range of individual animals so I use a lot of maps at various scales from a couple acre parcel to entire U.S.
Ecologist 2	illustrating and ecological concept or process graphically
Ecologist 3	They convey information clearly and succinctly, sometimes providing information or demonstrating relationships that otherwise would be difficult to recognize or evaluate. Illustrations, as opposed to charts and graphs, are also better at evoking an emotional response.
Ecologist 4	Illustrations are useful to present habitat cross sections (e.g. wetlands and streams) and connectivity.
Landscape Architect 1	Convey spatial information
Landscape Architect 2	- Illustrations are excellent analytical tools that help solve complex design and planning problems - Illustrations enable designers and planners to analyze current conditions, creatively visualize alternative environments, and understand impacts (visual,
Landscape Architect 3	Communicating design intent and implementation. A picture is worth a thousand words.
Landscape Architect 4	Engages participants to work collaboratively towards the best solution(s).
Planner	Providing information that is difficult to explain in narrative form
Maintenance Professional 1	They are the most effective way of conveying concepts clearly to an audience.
Maintenance Professional 2	Capturing the potential hazards posed.
Land Manager 1	Explaining complex concepts and instructing visitors and volunteers.
Land Manager 2	Illustrations are useful for communication between agencies, among staff and when proposing changes.
Engineer 1	Providing examples to support text, something to point at to demonstrate a point when talking/presenting
Engineer 2	They visually communicate things and ideas that may not exist or be available as a photo
Communications Professional	Again, we use them for various reasons often to help communicate steps in a process as well as the end product or layout.

Profession	What purposes do the illustrations serve (sales tool, implementation/construction document, etc.)?
Ecologist 1	scientific investigations of plants and wildlife
Ecologist 2	conveying information quickly (without paragraphs of text)
Ecologist 3	
Ecologist 4	Probably sales and marketing would be the most common.
Landscape Architect 1	Schematic drawings and CDs
Landscape Architect 2	noted above...use illustrations in schematics, construction drawings, trainings or conference presentations, public presentations, etc.
Landscape Architect 3	graphic communication during design workshops, schematic design review, construction documents, construction observation, project documentation and marketing
Landscape Architect 4	Project design process, informs audience, construction documents.
Planner	PR value; Explaining importance of proposed public policy; explaining a project design/construction; providing detailed information in concise form
Maintenance Professional 1	They would typically be implementation / construction documents.
Maintenance Professional 2	Mainly as assessment tools.
Land Manager 1	Typically used in interpretive materials, field instructional guides, maps and land management planning.
Land Manager 2	Varied purposes, depends upon the task at hand.
Engineer 1	
Engineer 2	presenting findings of research, research proposals, teaching
Communications Professional	We rely more and more on infographics to tell a story that needs to be "sold" as a success or benefit. This gives the chance to use iconography and facts but in ways to make them relatable to the audience. This does sometimes include illustrations as well. The majority of illustrations and graphic design we use are to support education to the public (i.e. content on flyers, publications, the website and social media campaigns) or processes and development of projects to staff and vendors (i.e. installation of park signage or exhibits).

Profession	How often do you use illustrations for your work and in what circumstances?
Ecologist 1	Weekly. I use them for developing study plans, presenting data for progress reports and final reports, journal articles and books. I also use them for lectures to college classes and to citizen groups such as various herp or bird clubs, land trusts, and public lectures.
Ecologist 2	Not often, but as needed. Graphics are a tool I use in marketing or educational materials
Ecologist 3	Probably weekly I am exposed to illustrations, mostly in sales and marketing material.
Ecologist 4	I use illustrations for 90% of my work projects as an ecologist and regulatory specialist.
Landscape Architect 1	Daily for students and clients
Landscape Architect 2	As project manager, designer and planner for over 40 national parks in the National Capital Region of NPS, I use illustrations in a wide range of forms on a daily basis.
Landscape Architect 3	every project. every situation.
Landscape Architect 4	All the time, from planning meetings and Venn Diagrams to field meetings with contractors to detail out finer construction points.
Planner	I work primarily in public policy so illustrations are not central to my work. When a policy is under review it is useful in explaining concepts to have clear illustrations providing information to the public and decision-makers. Also to promote our area for heritage tourism photos and maps are essential. Historic Preservation efforts rely on photos (historic and current) of buildings.
Maintenance Professional 1	Probably at least once daily, either to obtain the required information from the illustration or to accurately convey the desired information to the target audience.
Maintenance Professional 2	A few times a week.
Land Manager 1	On a daily basis for interpretive materials, instructional tools, mapping projects and field research photography and sketches.
Land Manager 2	Daily, varied circumstances.
Engineer 1	Regularly in technical reports, presentations, public and project team meetings
Engineer 2	Multiple times per week - brainstorming, teaching mostly
Communications Professional	We frequently use illustrations to communicate education and information to the public (i.e. content on flyers, publications, the website and social media campaigns) and processes, policies and the development of projects to staff and vendors (i.e. installation of park signage or exhibits).

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

SYSTEMS INFORMATION CATEGORY

Systems Category - Visual Aid Rankings by Profession - Communications Professional

Graphic Package No.	Diagram	Plan	Section	Axon	Table	Photo	Comments
1		6	5	7	5		Showing the difference between individual species and the connectivity (if required) and how this relates to the roadway was best shown in the isometric examples. A suggestion for improvement would be to add habitat ranges to the individual species to show how those who need connectivity have a larger range which requires crossing the road and those who do not are not affected by the roadway. A dot with a shaded circle may work well.
2	6	5	7	6			One of the crucial elements to why the terrapins are in the roadways is related to the water level in the marsh. I think although these three sets show the change in water level, it is easier to distinguish the volume change in the section image. I would suggest adding to the high tide image shadowed turtles in the marsh with dashed lines with arrows to indicate turtle movement from the marsh to the causeway to further show they move upland at this time. As for the causeway signage, I would suggest indicating on the right pair these are for the "nesting season" and then it will not be confusing that it says non-nesting periods and nesting periods within the season compared to the "non-nesting season" of the left pair showing August - May.
3	6	6	5	6	7	7	For the nesting box diagram, perhaps one less turtle on the right would help support the case the 7 turtles on the left are in the "hot spot". For the BMP Siting and Function Plan, consider white labels (circles with numbers) for easier viewing on dark backgrounds like the existing vegetation. Also, since both sides of the road are managed, label 1-4 on the top road side as well. I'd add back the same total 7 turtles near #5 to show this is the "hot spot" versus another spot along the road. I'd also label the marsh on both sides (add it to the bottom). The BMP Siting and Function Section is helpful for different reasons. It does to support the hot spot theory, but as a cross section shows layout. Again, 1-4 should be labeled for each the left and right road sides. Otherwise you think they aren't on both sides or can be confused by the text. These are the same issues with the isometric view. And it is ok it doesn't show hot spots, but it could where the section could not as successfully. The photos are a good companion to a diagram. Just consider these showing optimal conditions. i.e. I think you mention no vegetation in the sand apron or the nesting boxes is ideal later, and this image shows plants growing there. The table is always good to organize this type of information, but consider adding a different column for siting location and timing of siting. This would separate the signage siting prior to the season start and could give a place for added timing for wildflower planting, vegetation management etc.
4		5	2	2	4		The plan view is better with the icons than the other illustrative diagrams because with the dashed line to both the successional/shrub and the protected buffer zone, you realize rare plants are in both but know the rookery and the migratory birds are only in the protected zone. The section and the axonometric are confusing with the dashed lines to the icons for the Successional/Shrub and Protected Buffer not being clear on which are supported where. I think you loose the idea that rare plants are in both unless you add the icon to the protected buffer. Otherwise you could think all three icons are in both areas. The table would be the simplest way to represent this information but needs an easier way to see how the benefits compare from one habitat type to another if you placed the specific benefits across the top in a subheader for columns in Benefiting Species and then placed an "x" or confirmation in the associated row for the habitat type. So Seasonal Wildflowers would get an "x" under insect pollinators and an "x" under hummingbirds".
5		2	4	1	2		This information is fine for an illustrative format, but would be just as informative as a list of benefits if this is all the detail you have or in an infographic with additional statistics. The site map component of the illustrations in not essential to the story. Save those for where it is needed.

Post Systems Category Evaluation Questions - Communications Professional

Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
I hope it as clear in the notes, to explain what you are doing and why- the "hot spot" graphic shows the need for species connectivity across the road best and explains your strategy for signage and designated nesting areas. The tidal influence is also important here. An infographic of "the benefits" would help get local buy-in.
Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?
I believe these comments were captured after each set. Consistency on an illustration (labels etc,) and between illustrations is key for clearly communicating the same message with specific details. Illustrations are not always needed, some details are fine as a list and unless there is more to say about them, do not necessarily need to be shown on a layout of the site. The silhouette icon turtle may need to be explained. Sometimes it is hard to see clearly and may need to be enlarged (not to scale) as a representative icon. Does it represent one turtle, or each one is equal to 5 nesting turtles in a season?
Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?
Some of the 3D elements help (with isometric /axonomtric) angles but sometimes 2D line art can communicate clearly with sections, plans and other views.
Any additional comments?
I will share some examples since I do not have access to them while taking the survey.

Systems Category - Visual Aid Rankings by Profession- Ecologists

Visual Aid Package No.	Professional	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Ecologist 1		2	3	4	2		THe circle symbol is not best choice to indicate a critter. use a turtle image. The third pair is best because it indicates 3D better than the first 2. In this case the table doesn't give clear indication of issue. OK, but better with illustration,
1	Ecologist 2		4	3	5	5		The axonometric graphic is the easiest to understand the safe movement of turtles to increase connectivity. I can't see any changes between the graphics that illustrate changes in vegetation management to provide safe roadside habitat. It wasn't until I read the table that I understood what the graphics could be illustrating.
1	Ecologist 3		3	9	3	7		The cross section communicated the roadside habitat management and value more clearly than the aerials. It was easier to associate the types of habitat with use and infer importance of each structural component. The connectivity message was equal across all figures.
1	Ecologist 4		8	7	9	3		The third graphic is best because it combines the plan and profile view. All three would have scored higher if the "manage roadside habitat" would have placed more focus on the dots. As it was, the dots were not easy to see so it wasn't always immediately clear what I was looking for. The table scored low because it only described the "what," not the "how" of increasing connectivity and managing roadside habitat. For that reason, it is not a fair comparison to simply say that the illustrations were better than the table. For a fair comparison, there should have been text in the table describing the connectivity structure.
2	Ecologist 1	8	4	4	5			3D quality of third illustration makes it better, all could eb improved by making the the marsh a more distinct color (blue). The signs are good but adding a profile of a turtle would be better. Telling drivers to watch for 6 miles will not keep them alert. Additional signs along the 6 mile stretch would be better.
2	Ecologist 2	6	2	7	4			I think an improved description would be helpful on this one. Are the turtles actually "using" the causeway or are they just cross to access new mates, habitat, etc.? The color fade takes a minute before I realized that it represented the tide. That is much more clearly represented in section drawing.
2	Ecologist 3	6	2	4	8			The depiction of low and high tide were difficult to distinguish until I read the text below the figures. The terrapin icons were difficult to see except for the 3rd image. That one was more clear, bolder and seemed to have more contrast (possibly just a printing issue) between low and high tide and the terrapins were larger and bolder. Colors should be adjusted for aquatic habitats as this is not clear or intuitive with the grays or greens used in the graphics. The nesting period flashing lights signage needs to communicate an appropriate response should a driver see a turtle in its path. Be alert, slow, avoid, stop? It may alert drivers but doesn't tell them what to do if there are terps on the road.
2	Ecologist 4	9	5	4	6			The third graphic was best because it combined plan and profile views, and made clearer that the objects on the sides of the roads were road signs and turtles. The illustration of the signs alone was clear and concise.

Systems Category - Visual Aid Rankings by Profession- Ecologists

Visual Aid Package No.	Professional	Diagram	Plan	Section	Axon	Table	Photo	Comments
3	Ecologist 1	5	5	4	7	6	10	I really like the last one in this series. Each consideration nicely illustrated and fairly well explained. One thing missing on illustrations of where nest boxes are placed is a north arrow. Boxes have to be placed so taller shrubs and trees do not place the nest in shadow for a significant portion of the daylight hours. As before make marsh/water a blue color.
3	Ecologist 2	1	8	4	5	2	7	The strongest combination would be to add the photos with the plan, section or axonometric.The nest box diagram doesn't add much value in terms of context. It is the descriptions that make the graphics meaningful.
3	Ecologist 3	2	3	2	5	2	5	The BMP order made an impression on me as it was easier to comprehend the signage to nest box BMPs and the terrapin on the nest box sand mound. The other illustrations and the table with text took too much effort. The photos with BMP description was very clear and concise.
3	Ecologist 4	5	6	4	8	4	5	In the first illustration, the nest boxes should have been a different color to make them more visible. The second illustration better shows what the nest boxes look like, but still suffers from being a vertical-only view. The third illustration is good if a profile view is important, but the turtles are not very visible. The fourth is the best since it combines the plan and profile views and still conveys significant information in text form. The table suffers from a lack of visual information that ties together the information. The photos with text are useful for catching the eye, but do not tie together the information along the roadway like the first three illustrations do.
4	Ecologist 1		8	5	5	3		I like the first illustration best here. The presentation has explained many things that the audience shoudl knwo by now and the simple 2D illustration is best way to add the additional info. The table does not work well with out illustrations.
4	Ecologist 2		5	7	1	1		the plan and section graphics are the easiest to understand the distribution in space of different habitat types and who might use them. If you use the section, I would add small example photos of each habitat type.
4	Ecologist 3		2	6	2			The cross section communicated the vegetation management and associated wildlife species best. The rectangles on the other figures were confusing. On the cross section it would be good to see the habitats identified on both sides of the causeway and also to identify the mown area to alert drivers that this is a potential crossing point to look for terrapins. I don't know what the purpose of the table.
4	Ecologist 4		7	7	7	2		The illustrations all provide fairly similar information. The profile view does a better job of accentuating the width of the habitat components. The table suffers from not having an illustration or an explanation of the habitat in place of the illustration.
5	Ecologist 1		5	5	5	2		The clean water symbol doesn't work for me. Needs different explanation. I don't understand the reduced maintenance costs. what are we comparing? An additional benefit of the shore line vegetation is protection from storm surges.
5	Ecologist 2		2	4	2	1		The section is the best at illustrating water quality, but the water flow should be underground. The table adds no additional information.
5	Ecologist 3		0	8	2			Again the cross section more clearly communicated BMPs and multiple benefits of implementing the BMPs. There is more dimensionality to this figure making it easier to connect structure to function. I might add the marsh habitat to make the connection more clear.
5	Ecologist 4		2	4	2	1		None of these did an effective job of explaining how terrapin BMPs are related to clean water or reduced maintenance costs. The illustration of the cloud above the road was only effective in the profile view, but a sentence was needed in all cases to explain how the BMPs provide benefits.

Post Systems Category Evaluation Questions - Ecologists

Professional	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Ecologist 1	For presentations to the public I would suggest using more photographs and for the contractor more detailed drawings. The thing missing at the beginning is "WHY?" Need to explain the impact on the terrapins and other wildlife of not adopting these best management practices.
Ecologist 2	Additional context and background about the turtles and why this is a problem. For example, I'm a biologist but I'm unfamiliar with the nesting habitats of terrapins. If I don't know them, certainly engineers, planners, and the public are not likely to have the context either.
Ecologist 3	I would use more distinct colors for various habitat components and select a different icon for the terrapins. For example one looked like a Roman warrior carrying a shield. I would also exaggerate the terrapin size. For the cross sections it may help to identify habitats and functions on both sides of the causeway. The icons for species could be smaller.
Ecologist 4	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Ecologist 1	color and symbols mentioned earlier.
Ecologist 2	increase level of detail in the descriptions.
Ecologist 3	Recommend contrasting colors to distinguish between vegetation communities and also between terrestrial and aquatic habitats. In terms of detail, recommend connecting all of the habitats with the icons. The cross sections seemed to work best across the board for the communicating messages. Change in aspect helped for the illustrations but I still preferred the cross sections. Also, I'd show movement (dots or dashes) for how/direction the terps traveled and maybe get one on the road from the marsh.
Ecologist 4	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Ecologist 1	No
Ecologist 2	I would have changed the order. I learned al lot about the BMPs in #3 that would have been helpful in 1 and 2.
Ecologist 3	The overhead illustrations were not intuitive. The rectangles for habitats were confusing. Try a legend with polygons and shading.
Ecologist 4	
Professional	**Any additional comments?**
Ecologist 1	
Ecologist 2	none.
Ecologist 3	Overall the causeway best management practices were communicated effectively. I might add terp size or actual terp photos as icons. For example, I don't know what size turtle may be crossing or what species. I would hesitate to show nest boxes as it could encourage folks to raid the boxes and maybe add no collecting to signage, if it is prohibited.
Ecologist 4	

Systems Category - Visual Aid Rankings by Profession - Engineers

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Engineer 1		8	10	7	4		My work as an engineer is typically in plan and section views so these two made the most sense in conveying the information.
1	Engineer 2		4	7	7	3		Confusing because managing roadside veg picture has same veg as other picture. Plan view without relief is less understandable for connectivity
2	Engineer 1	10	9	8	7			Plan and section tell me the story clearly. The additional graphic details the signs and how they can be changed was very effective in demonstrating its use.
2	Engineer 2	4	5	7	5			This one seems better from driver's perspective - sign could help with the few people who are actually paying attention and alert
3	Engineer 1	7	10	8	7	4	8	Plan and section paired together with the photographs provides a level of detail and real world examples that effective convey the information. The table would make a good summary, but do not provide the visual keys.
3	Engineer 2	7	4	5		2	6	I like the first one, but nesting box location needs to be more clear. I think the first one could be used in combination with photos and driver perspective to reach most people
4	Engineer 1		9	9	7	6		Not a big difference between plan and axonometric plan, but pairing either with the section view helps to show how the species connects with the habitat. Again the table would be a good end of report summary, but I do not see it as being as effective to a tourist flipping through a guide book.
4	Engineer 2		5	3	8	1		Plan and axo views convey spatial diversity better than section. Plan and axo similarly effective in this case as driver perspective less relevant in this case.
5	Engineer 1		5	9	6	4		I did not realize it was a rain cloud until I saw the section view. The axonometric view made more sense than plan because of the more vertical feature of a cloud in the sky. The table again as a summary, but this one would be just as effective as bullet points.
5	Engineer 2		4	6	7	1		Without having marsh labeled, it's not apparent why the clean water matters. The spigot and bucket connotes drinking water but that's not the case if it's marsh. A combination of section and axo seem most effective here. I think that's because the topo helps me at least think about runoff. It's a little odd that the big blue runoff arrow is in the air as opposed to near the ground where it happens.

Post Systems Category Evaluation Questions - Engineers

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Engineer 1	Photography of the site
Engineer 2	I think they should be used in combination -- presume that is the intention.
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Engineer 1	Axonometric view - shading adjustment to portray the roadway embankment at a higher elevation than the marsh
Engineer 2	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Engineer 1	None
Engineer 2	Show where the runoff is going. See previous comments
Professional	**Any additional comments?**
Engineer 1	
Engineer 2	

Systems Category - Visual Aid by Profession - Landscape Architects

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Landscape Architect 1		7	9	8	5		The sections put the concept in typical human eye-level perspective, making it easier to understand in my opinion. The intent of over/under is most easily understood in this graphic type. Some people have a more difficult time with plan view graphics and meanings like connectivity (through an undercrossing) are inferred rather than illustrated. Yet, plan views are valuable as well in establishing scale and relationship of the project/existing components. Last, the Axonometrix are a nice combination of the other two styles IF only one type of graphic can be used.
1	Landscape Architect 2		8	6	1	1		Plan then sections were most useful to rapidly conveying design intent
1	Landscape Architect 3		4	5	6	6		Plan view symbols/graphics not well developed. Animal/terrapin symbol is light pink dot, trees are not conventional tree symbol (pale green tree circles compared to dark green shrubs), animal migration dash line is very faint. Connectivity diagram should be stronger. Roadside habitat is not called out graphically. No labels or text to supplement graphic. Road elevation is shown as high profile compared to adjacent landscape..more light pink circles for animals. Axonometric has features drawn in plan view, which looks flat and very odd.
1	Landscape Architect 4		3	5	6	7		The graphics images are a bit hard to interpret without a legend or labels. Do the pink dots represent tortoises? I get the tunnel, but what about the habitat images communicates that roadside habitat IS being managed?
2	Landscape Architect 1	9	5	7	7			Traffic signage is familiar to American drivers, so may be the most effective communication graphic. The Axo and Section are more graphically understandable than the plan view is.
2	Landscape Architect 2	4	1	3	2			Section and plan graphics showing inundation are too muted (unclear at first glance), but the axon is more helpful because it shows consistent inundation. Sign "diagram" conveys intent.
2	Landscape Architect 3	7	5	6	7			Graphic description doesn't relate well to the graphic itself. Font size of paragraph very small. Graphic relies on visuals without labels or key. Not clear what black dots (terrapins) are. Marsh / tidal zone shown in flat gray instead of an immediately recognizable color like pale blue that would distinguish it just like the tree/shrub vegetation.
2	Landscape Architect 4	9	4	3	5			The terrapins are hard to see in the images. Maybe scale them up, reduce the visual "noise" of the vegetation. The sign is very familiar and understandable.
3	Landscape Architect 1	9	5	9	9	8	10	The Axo graphics, again, are a useful combination of plan view and section graphics. The plan view is least effective in this scenario, in terms of understanding the intent. The photos of BMPs are very helpful to show what the written descriptions are, for clarity.
3	Landscape Architect 2	2	2	2	3	1	2	Independently, none of the graphics conveyed the intent. However, when using illustrations together, they were more useful
3	Landscape Architect 3	6	7	7		7	7	Diagram is half-axonometric / half-plan view instead of one or other, which reads strangely. No symbol or much graphic differentiation for marsh. Spider turtles could be replaced with better (more readable/defined) terrapin symbol. In general, there are varying levels of graphic detail and symbology applied to the various elements. Human elements such as cars show detail, while vegetation and the turtles themselves tend to be more "blob-like." Call-out rectangle for nesting sites doesn't read as such. Later illustrations show trapezoidal shape. Plan views can be labeled in addition to numbered/described so less translation is required. In general, having the mix of illustration types (photos, tables, plans, section-elevations, etc.) is very useful; be sure that each is contributing additional information however, and not just duplicating/replicating without adding something new.
3	Landscape Architect 4	4	8	7	7	7	8	The nestbox diagram is clear enough, but I'm not sure what additional information it is adding beyond the text intro. The terrapins kind of look like ticks. The text on the BMP graphics is very helpful - I think the plan view is clearest, the others get a bit visually cluttered. Table is good but, takes longer to interpret. Photos are good but need to be paired with the plan for context

Systems Category - Visual Aid by Profession - Landscape Architects

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
4	Landscape Architect 1		7	9	8	8		Similarly, the section is most effective, followed by the Axo, then the plan view. The table categorizes the components well but is not as effective in illustrating WHAT the components are.
4	Landscape Architect 2		3	1	5	1		Axon with flyouts were most useful to conveying info.
4	Landscape Architect 3		4	4		5		This whole section was unclear and undefined as to how zones, benefits, and species relationships worked together.
4	Landscape Architect 4		4	6	5	4		image is clear enough but I am not sure what the purpose is. Analysis of existing conditions? Instructions for future management? I like the icons for the different benefits.
5	Landscape Architect 1		7	10	8	5		The Section is far more effective in this scenario, with the added dimension of rainwater and water flow direction. The Plan & Axo views are good for relationship, but water flow direction is more difficult to understand. The Table is simply a list here and is not very effective other than listing component.
5	Landscape Architect 2		1	4	2	1		Section best conveyed functions
5	Landscape Architect 3		4	4	5			Not sure how this section is exactly communicating benefits, or why some zones are shown as providing some benefits but not other benefits. Example: wildlife habitat would benefit from flower/tree-shrub and marsh zones but is only shown in tree-shrub zone. Some symbols are a little odd - water drops falling with arrow flowing/pointing in sky toward marsh, instead of water drops hitting pavement and running off as surface run-off. Table is just a list. Generally, benefits are not just a list, and some benefits may also be quantified and graphically depicted.
5	Landscape Architect 4		4	6	4	4		The elevation definitely works best for this info, particularly the clean water benefit.

Post Systems Category Evaluation Questions - Landscape Architects

Professionals	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Landscape Architect 1	animations would be useful
Landscape Architect 2	- Topography, grading, elevation seem to be important element(s) not communicated graphically. Axonometrics and Section-Elevations especially need to show grades-elevations for functionality, design, and construction purposes, and your graphics would read
Landscape Architect 3	If this is going into some kind of manual, I think you need photos of terrapins and off these features to provide some baseline of knowledge. Also need to explain the purpose of each (or all as a whole) of the diagrams.
Landscape Architect 4	
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Landscape Architect 1	More clarity and avoiding "violations" of graphic rules would further design intent.
Landscape Architect 2	- Noted above - terrapins/animals and vegetation should be shown in more detail; marsh zone currently has no detail plus tidal zones could be pale blue to show low/high tide differences. - sand-nest boxes need work - shown in some graphics but not in ot
Landscape Architect 3	I think there is too much detail/texture in the vegetation. Also the signage icon is to "realistic" I think you could go with an icon. I think the terrapin graphics are too small and in plan look too much like a tick. I think you should take some liberty with scale.
Landscape Architect 4	No.
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Landscape Architect 1	Signs showing in plan view, signs not perpendicular to roadway, flat axon trees, tortoise shadows, lost keys in plan (ex "4" disspears into forest). tortoises seems muddy or hard to find in section
Landscape Architect 2	- blurry car graphics or windshield details are distracting - recommend replacing black spider turtles with a better symbol that honors your mascot - "Benefits" package not clear or coherent. Floating symbols. - Axon drawings are too flat and not true
Landscape Architect 3	covered above
Landscape Architect 4	No.
Professionals	**Any additional comments?**
Landscape Architect 1	
Landscape Architect 2	I like the videos but the flowers are caricatures compared to more accurate marsh grasses - consistency and level of detail need more work - need a system for organizing this information - matrix or flow chart - rather than separate packets - Great project!Take it to the next level.
Landscape Architect 3	
Landscape Architect 4	No.

Systems Category - Visual Aid Rankings by Profession - Land Managers

Graphic Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Land Manager 1		3	6	7	4		No keys, legends. i,e. what are tan circles? Unsure initially of raised corridor in first graphic. More spatial diagramming helped clarify in subsequent panels.
1	Land Manager 2		6	7	8	3		
2	Land Manager 1	7	5	6	6			Clearer with turtle icon. Suggestion of changing sign during off season good. Complications could arise with lighting timing and tide variability and programming issues. Flashing during nesting season at all times when cars approach may be safer may to prevent strikes.
2	Land Manager 2	1	4	1	7			Plan-hard to determine what the black spots are; Section-again hard to see black spots and does not provide much information; Axonometric-has the most impact on me, easy to understand what the black spots are; Diagram-seems like these signs would require a large amount of manpower to operate/update.
3	Land Manager 1	4	6	7	3	2	6	Diagram of cross-section most readable and explicative of all concepts. Photographs provide concrete demonstration of practices and illustrate example to make the message more real-world based.
3	Land Manager 2	9	10	6	9	9	7	All graphic seem effective, except for the Section. I did not feel the section provided enough information.
4	Land Manager 1		5	8	4	3		Cross section shows the plant community and zones for increasing biodiversity most clearly.
4	Land Manager 2		8	5	9	1		The section and table do not seem to provide a lot of information.
5	Land Manager 1		2	5	4	4		Prefer cross-sectional for same reasons. Table also more succinct and readable with list-like benefits.
5	Land Manager 2		2	7	1	1		The rain cloud looks like an oil spill in the Plan, Axonometric graphics and the table does not really provide much information.

Post Systems Category Evaluation Questions - Land Managers

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Land Manager 1	Legend with icons, plant type/species labels/descriptions, low-tide is not readily apparent as 'exposed sand' is white rather than yellow, Photographs of working examples are necessary to support ideas in diagrams, synopsis of success-achieved from similar systems (e.g. how many strikes are prevented, how much maintenance $ is saved), Distances for buffers, ideal vegetation heights/composition, explanation of refining nest-box site placement and how to relocate
Land Manager 2	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Land Manager 1	Icons and see above. Also, road sign signs look like avian siloheuttes from aerial-view diagrams. Circles also confusing to convey plant coverage to non-design/engineer.
Land Manager 2	The trees in most of the overhead graphics look like moons to me :) The color scheme is effective to me but having the water/marsh areas a blue tint would help those who are not familiar with the marsh ecosystem.
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Land Manager 1	No
Land Manager 2	The trees were distracting to me.
Professional	**Any additional comments?**
Land Manager 1	see above box
Land Manager 2	

Post Systems Category Evaluation Questions - Maintenance Professionals

Professionals	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Maintenance Professional 1	
Maintenance Professional 2	None that I can think of.
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Maintenance Professional 1	No.
Maintenance Professional 2	No
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Maintenance Professional 1	No.
Maintenance Professional 2	No
Professionals	**Any additional comments?**
Maintenance Professional 1	No.
Maintenance Professional 2	

Systems Category - Visual Aid Rankings by Profession - Maintenance Professionals

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Maintenance 1		5	7	9	4		A 3D situation is best portrayed in a 3D illustration. The table is the least effective method.
1	Maintenance 2		6	7	5	5		Determining design for wildlife in my opinion is difficult due to the abundance and frequency of wildlife in this habitat situation.
2	Maintenance 1	7	5	9	5			The section best conveys the vertical aspect of the different tidal conditions.
2	Maintenance 2	7	5	5	5			Signage can be helpful for warnings of certain wildlife especially with flashing warning lights.
3	Maintenance 1	7	6	5	7	4	8	More personal preference than anything else.
3	Maintenance 2	5	5	5	5	5	9	Again I am a huge proponent of live shot features like photos. It's real world imagery.
4	Maintenance 1		7	6	7	5		The higher rated illustrations better convey the spatial depth and distribution of the species.
4	Maintenance 2		8	8	8	8		I do like illustrations and tables to identify benefits of the proposal.
5	Maintenance 1		7	9	7	5		The section best conveys the vertical aspect of the clouds and the rainfall.
5	Maintenance 2		6	6	6	6		I feel that functionality is tough to illustrate or predict unless research helps prove function.

Systems Category - Visual Aid Rankings by Profession - Planners

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Table	Photo	Comments
1	Planner 1		3	9	7	6		I think the section view depicts the connectivity design best
1	Planner 2		5	5	7	5		I think that the axonometric is the most effective way to convey both concepts (connectivity and roadside habitat) , particularly because the concept of connectivity in the other two figures tend to be weak. Ideally, the axonometric and the table would be the optimal solution, given that the table also provides other important information to the reader.
2	Planner 1	10	7	6	9			I think the terrapin symbol is easiest to see on axonometric. The signage looks good
2	Planner 2	3	2	3	5			Once again the axonometric provides a better understanding of the change of tides that you are trying to convey. In general, the use of gray for marshes does not help in general to convey this concept. In the first two images (plan and section) the graphic is barely indicative of the notion of change.
3	Planner 1	8	8	7	9	6	10	I think the photos have visual interest. While the table conveys information it may be that some persons don't read it carefully
3	Planner 2	2	1	3	5	5	8	I think that in this case, the use of photos may be more effective. In this case, the plan view does not help with visualization of the BMPs, but rather the section or the axonometric.
4	Planner 1		8	6	9	6		The plan and axonometric better depict the linear progression of the succession/shrub dominated zone and the protected buffer zone
4	Planner 2		9	8	3	1		In this case, the first two images are the best ones in conveying spatial distribution associated to each of these species. The section view provides a good sense of distribution associated with elevation, including the marsh and the protected buffer zone, so the use can make a better association to species.
5	Planner 1		7	9	8	5		The rain cloud is easier to see in the section view. The table maybe could utilize color for visual interest
5	Planner 2		3	5	1			None of these graphics were very explicit to me on the multifunctional benefits, so the last table may as well do the job of conveying this information. At a certain level, the section does a better job that the third because it conveys a little better the clean water connection.

Post Systems Category Evaluation Questions - Planners

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Planner 1	
Planner 2	Read next comment
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Planner 1	Perhaps have a different symbol for rare plants and aesthetics?
Planner 2	I think that the notion of connectivity and water, as well as the colors to convey marshes are too weak in these graphics. Better choice of colors, and bolder symbols to represent connectivity are needed in this type of graphics.
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Planner 1	None
Planner 2	Group 1: the pink dots are very unclear and tend to confuse. Group 2: the symbols for signs in the first image are also unclear and distracting. Also, lighter color for turtles is suggested. Group 5: symbol to represent clean water benefits should be improved
Professionals	**Any additional comments?**
Planner 1	None
Planner 2	

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

EXPERIENTIAL/PROMOTIONAL INFORMATION CATEGORY

Experiential/Promotional Category - Visual Aid Rankings by Profession - Communications Professional

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Communications Professional					3		4	7		Who is the audience for these illustrations and animations? I think an ecologist would be the most interested, but probably the first view is too simple for them. The animation is interesting, but not sure what the purpose is. It feels incomplete. Should it show nesting and then leaving and how easy it is for the terrapin? Would an animation of how to check the nesting box be more useful for those monitoring nesting activities? The photo is something I would use for the public to communicate the "behind the scenes" what they don't see which is happening along the road sides.
7	Communications Professional	1	5	5	5	4	3	4	6		The first three illustrations equally provide the same information regarding the layout for the driver. The message may be, you do not see it from the road, but we are using nesting boxes to help you and the turtles share this space safely. For me, the animation stops short of giving a 180 degree view of what to expect which is what I would want to see in an animation. The benefits diagram would be better in a different format. The purpose of a pie chart is to show % of a whole and how this changes. For this information, a before the project and after the project would be better to show on a scale the difference between low and high maintenance costs or other facts as they change. Again, infographics and simple icons could work well. The driver experience perspective is good, but I don't think as clear that the nesting boxes are hidden (although labeled hidden) and the placement looks too close to mowed area-there is not vegetation screen shown which confused me. The photos do a fine and simple job of showing what to expect.
8	Communications Professional						1	2	2	3	I am not clear what the purpose of this series would be. I know fatality is an issue. If this is the reason to highlight what terrapins experience without the nesting boxes, then again it needs to clearly show with and without the nesting box scenario and the impacts. If not, I am not sure how these alone explain the terrapin perspective completely. I do think the image of what I assume is a terrapin which has been hit by a car, would be a useful tool with some additional relevant description of how you can help or how this system is expected to decrease mortality by X % etc...

Post Experiential/Promotional Category Evaluation Questions - Communications Professional

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Communications Professional	Switch benefits to an infographic and consider how to take the terrapin perspective images to use in a publication or other specific presentation.
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Communications Professional	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Communications Professional	
Professional	**Any additional comments?**
Communications Professional	Only a few of these feel relevant.

Experiential/Promotional Category - Visual Aid Rankings by Profession - Ecologist

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Ecologist 1					8		0	8		The video clip added nothing for me, maybe my computer was too slow but movement was jerky and distracting. The turtle eye views were good.
6	Ecologist 2					4		2	7		Again,a description on what the turtles are looking for in a nest site. The photo illustrates the real view perfectly. The animation is too long and too busy. I get motion sick pretty easily and running through the grass was unpleasant.
6	Ecologist 3					6		7	9		The 3-D animation was too fast and long (getting out of the marsh).
6	Ecologist 4					5		7	6		I like the idea of the animation from the terrapin's perspective. It might do the best job of identifying issues with that type of design.
7	Ecologist 1	1	6	3	7	4	1	0	7		The video clip added nothing for me, maybe my computer was too slow but movement was jerky and distracting. Pie chart not useful without more explanation. For instance, without having to do BMP's shouldn't maintenance be cheaper?
7	Ecologist 2	5	1	4	3	6	6	1	1		the overhead view doesn't really capture the driver experience. The photos don't really do it justice either. The animation moves way, way too fast.
7	Ecologist 3	7	3	8	8	9	9	6	8		On the animation, I'd highlight the terrapin with a more "alarming" graphic or icon (e.g. arrows) as it is difficult to discern. also it was very fast when I viewed the animation so slowing it down would be good.
7	Ecologist 4	4	1	2	2	7	7	5	4		The driver experience illustrations did not do a good job of truly depicting the driver experience because they were views from above or in profile, rather than being from just above the road. The photos appearing after the pie chart did a better job of that. The pie chart did a good job of showing the qualitative differences between the variables.
8	Ecologist 1						9	0	1	0	First figure is good. The video clip added nothing for me, maybe my computer was too slow but movement was jerky and distracting. The last 2 figures don't provide any inofrmation.
8	Ecologist 2						5	1	6	4	The photo of the dead turtle is pretty powerful. The actual photo of the roadway would be the best if there was a car in it.
8	Ecologist 3						4	6	8	7	Animations were to fast. Difficult to discern what the last photo is (assume road kill).
8	Ecologist 4						5	5	0	0	The first illustration with the car out of focus does the best job of conveying "ouch!" The 3D simulation was good, but would have needed to have the sounds of the car and skidding tires to convey the same information as the photo. The photo of the empty road was not effective. I eventually figured out the last photo, but again it did not convey information in a flash like the first illustration did.

Post Experiential/Promotional Category Evaluation Questions - Ecologist

Professionals	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Ecologist 1	No
Ecologist 2	The animations were too much.
Ecologist 3	
Ecologist 4	
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Ecologist 1	NO
Ecologist 2	
Ecologist 3	
Ecologist 4	
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Ecologist 1	No
Ecologist 2	the pie charts were a little hard to understand the comparison because I don't understand what the actual BMPs are.
Ecologist 3	Slow the animations and maybe an inset showing overhead path.
Ecologist 4	
Professionals	**Any additional comments?**
Ecologist 1	NO
Ecologist 2	
Ecologist 3	
Ecologist 4	

Experiential/Promotional Category - Visual Aid Rankings by Profession - Engineer

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Engineer 1					9		4	9		The rendering and photo provided the POV of the terrapin in a much more realistic view than the animation.
6	Engineer 2					8		7	7		The animation seemed like mostly meandering through grass with the chance encounter of the boxes / mound. I might suggest a contrast of two perspectives- with and without built habitat (without one sees the cars that will squash the turtle) - based on the first image, with the third image being a close second.
7	Engineer 1	5	8	6	5	9	9	5	7		The benefits pie chart was a little confusion with the oversized wedges verses the typical proportional slice. The use of the image to represent the BMP was great. Driver Experience photos was a good supplemental graphic to provide a real world example of the rendering.
7	Engineer 2	5	2	4	5	7	6	5	4		I think audience will be confused by how $ is less with more benefits. Aesthetics perspective seems most "real" Turtles move slow, animations move fast -- immediate lack of realism make affect credibility
8	Engineer 1						8	5	6	2	The lab photo is a little depressing. Showing the terrapin head immediately helps the view understand what is important in the image.
8	Engineer 2						8	7	5	1	The third one would be effective if cars were really going by - movie. See the turtle's head helps user understand that they are essentially seeing it from a near turtle perspective. I t gives it immediacy that one can see the animal and its perspective simultaneously

Post Experiential/Promotional Category Evaluation Questions - Engineer

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Engineer 1	
Engineer 2	Let turtle move slowly through grass for short distance to happen upon seen.
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Engineer 1	The .avi files were a little jumpy
Engineer 2	no
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Engineer 1	All good
Engineer 2	no
Professionals	**Any additional comments?**
Engineer 1	None
Engineer 2	

Experiential/Promotional Category - Visual Aid Rankings by Profession - Landscape Architect

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Landscape Architect 1					9		3	7		The first graphic shows relative surrounding and the subject size, which is helpful in determining scale. The 3D doesn't capture it for me. The last photo is a good close up, but doesn't give me the scale to understand the overall scene.
6	Landscape Architect 2					1		2	6		Photo was most realistic
6	Landscape Architect 3					8		7	8		photo and video simulations are very effective and dynamic
6	Landscape Architect 4					7		7	4		the perspective is good. Add a "halo" around the terrapins head so that is more easily distinguished from the veg. animation is cool, and effective the photo works for folks that are familiar with nest boxes, otherwise it looks like a trap or a cage.
7	Landscape Architect 1	9	6	9	7	9	9	5	7		The Section is illustrative on many dimensions. The windshield photos all give relative scale and realistic views of what you're trying to convey. The graphic is good at showing $$ relative to BMPs. Again, the 3D just doesn't do it well.
7	Landscape Architect 2	2	1	1	1	3	2	4	4		Photos and beginning of video conveyed experience best
7	Landscape Architect 3	4	5	6	5	6	8	7	8		Several points about graphics Noted in above comments. Plan view needs labels to understand what elements such as turtle sign or sand-nesting boxes. Remove distracting, non-contributing elements. - Benefits diagrams not particularly communicative of benefits. - Photos and video simulations very effective at communicating concepts. - Plan, axon, Section elevation can complement one another very well, but be sure they are distinctive and read alone without the other illustration to translate.
7	Landscape Architect 4	3	3	3	4	7	8	5	5		In the benefits diagram - it is confusing that the $ slice of the pie is more desirable the smaller it is (I assume) while the others are more desirable the bigger they are. The animation was a little confusing appears to go offroad.
8	Landscape Architect 1						9	2	5	5	The 3D are difficult to download and view - so usability is an issue (especially from a government network...). The photo at the end is open to interpretation, but perhaps effective if you want the viewer to think. The terrapin view shows relationship of scale, from the terrapin's perspective thus was rated highest here.
8	Landscape Architect 2						3	4	1	1	animation (minus the last few seconds) was more useful; unsure of lab photo (DOA?)
8	Landscape Architect 3						4	5	5	1	Road profile is proportionally too narrow in this illlustration (as well as others) - Lab photo is strange and out of place - photo of turtle at or near nexting box or in marsh would be more appropriate
8	Landscape Architect 4						7	5	5		Provide a little halo around the terrapin head for clarity. I think the animation needs moving cars. second terraping experience phpoto needs the terrapin head. the autopsy photo requires some imagination. I think a roadkill photo would be more effective.

Post Experiential/Promotional Category Evaluation Questions - Landscape Architect

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Landscape Architect 1	Not that I can think of.
Landscape Architect 2	Why not have a 'twerp cam' real animation
Landscape Architect 3	quantifiable information for Benefits Section may also be appropriate, example stormwater gallons incepted, or terrapin nesting days of year
Landscape Architect 4	mentioned in the comments
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Landscape Architect 1	Pretty good here.
Landscape Architect 2	Photo "real" aerial was helpful
Landscape Architect 3	Noted above
Landscape Architect 4	mentioned in the comments
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Landscape Architect 1	No, was pretty good.
Landscape Architect 2	lab photo not necessary, just show mortality in situ if conveying experience
Landscape Architect 3	Noted above
Landscape Architect 4	mentioned in the comments
Professionals	**Any additional comments?**
Landscape Architect 1	
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	

Experiential/Promotional Category - Visual Aid Rankings by Profession - Land Manager

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Land Manager 1					5		3	7		As a biologist, a photograph conveys to me what the terrapin would experience the best. It is the most accurate rendering of their encounter with the nest box and I get a better feel of what benefits they could provide. Also demonstrates the true habitat components of spartina, shrubs, etc.. 3D Animation was a bit pixelated and distracting in my opinion.
6	Land Manager 2					1		0	7		Anyone unfamiliar with terrapins is going to have a hard time understanding what the turtle is in the first photos, the 3D animation does not seem necessary to me and seems a little hokey and made me feel dizzy. Of the three graphics, I like the photo. The photo also shows warning signage for the electric which makes me feel better as a manager!
7	Land Manager 1	1	2	6	4	7	6	3	8		Illustration with 3 Photographs most effective at summarizing impacts to drivers (what they'll see). 3D visualization stop and start and panning were difficult to follow. Pie-chart seems skewed and lacks figures to back up presentation of benefits.
7	Land Manager 2	6	5	1	1	8	8	0	4		Turtles get lost on the plan and it does not give me an idea of how the area will look as I drive by, the animation is not effective for me but the photos give a good idea of how the site should look.
8	Land Manager 1						2	3	3	4	Too obscure and again, find 3D experience jolting and distracting and pixelated. Prefer the picture with terrapin in the vet's office or pictures of strike-impacts, mortality stats, etc... or even diagram showing their travel speed vs. vehicle speed and likelihood of collision, etc..
8	Land Manager 2						1	1	1	1	Again with the perspective it is hard to tell what the terrapin is, the animation is not realistic to me and the photos would need more context to make sense.

Post Experiential/Promotional Category Evaluation Questions - Land Manager

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Land Manager 1	more terrapin pictures of existing roadside perils and stats about strike frequency in nesting areas and how populations are threatened and/or declining
Land Manager 2	
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Land Manager 1	3D animations need better detail and less stop-and-go and panning
Land Manager 2	
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Land Manager 1	3D animations were distracting in my opinion. Photographs and simple, cross-sectional diagrams are preferred as they seem to convey the actual experience better.
Land Manager 2	
Professionals	**Any additional comments?**
Land Manager 1	
Land Manager 2	

Experiential/Promotional Category - Visual Aid Rankings by Profession - Maintenance Professional

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Maintenance 1					7		7	9		The photo better conveys the information.
6	Maintenance 2					8		7	7		Gives views from the turtle prospective.
7	Maintenance 1	8	6	6	6	9	9	10	9		The 3D video best conveys the 3D aspect of the real world.
7	Maintenance 2	7	5	5	6	8	7	7	9		Again the use of photography is hard to beat.
8	Maintenance 1						7	10	6	6	Same answer as question 7.
8	Maintenance 2						8	8	8	8	

Post Experiential/Promotional Category Evaluation Questions - Maintenance Professional

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Maintenance Professional 1	No.
Maintenance Professional 2	None
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Maintenance Professional 1	No.
Maintenance Professional 2	No
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Maintenance Professional 1	No.
Maintenance Professional 2	None
Professionals	**Any additional comments?**
Maintenance Professional 1	No.
Maintenance Professional 2	

Experiential/Promotional Category - Visual Aid Rankings by Profession - Planner

Visual Aid Package No.	Profession	Diagram	Plan	Section	Axon	Perspective	Perspective	Animation	Photo	Photo	Comments
6	Planner 1					8		9	7		3 D animation depicts the journey of wildlife and is more interesting that a still photo. Depending on the setting/audience the photos do convey the information but if time allows the animation works better
6	Planner 2					6		5	2		The 3D animation is a great concept but it tends to be too long at the beginning. However the last part is very helpful is communicating the idea of the nest box. The perspective is good to deliver the overall idea, probably slightly better than the photo (although the photo is taking from a different perspecctive.
7	Planner 1	10	5	8	7	7	7	7	8		I really like the BMP diagram. I think the section and the photos depict best the perspective of the driver
7	Planner 2	3	1	1	4	7	7	7	7		The last images are the ones that provide a better idea of the driver's perspective. I don't think that the 3rd diagram (on $ benefits) is very explicit, as compared with the others. And once again, in the last image, photos can be as effective to deliver this information.
8	Planner 1						8	10	7	9	The 3 D animation of the terrapin experience is very good as it provides the perspective of the wildlife. The photo of the forensics lab is important, but it would need to be used only when it could be explained/discussed
8	Planner 2							6			Good animation. Not sure or not not clear about the other ones.

Post Experiential/Promotional Category Evaluation Questions - Planner

Professionals	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Planner 1	None
Planner 2	
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Planner 1	None
Planner 2	Animations should be shorter. The speed in some of these should be adjusted.
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Planner 1	The animation that is over 40 seconds could be shortened and would still be effective
Planner 2	As I mentioned the meaning or the relevance of some of these images was not clear to me in # 8
Professionals	**Any additional comments?**
Planner 1	None
Planner 2	

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

CONSTRUCTION INFORMATION CATEGORY

Construction Category - Visual Aid Rankings by Profession - Communications Professional

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Communication Professional	8	8	9	7	7	8	These types of drawing are good to go with the chart or table of materials and help with planning and constructing the nest boxes. The plan should be consistent with other materials and show the expected signage by the road as part of the bigger picture. The front view on the section illustration should not show the angle details such as the sand mound, silt fencing and electric fencing since this view does not support it. Can the axonometric view address how far apart the nesting boxes are? It is great to show how to design and build one set, but if you have a stretch of roadway and need to know how many sets you need, then how is this determined? Are these shrub screen evergreens to scale for when fully grown or planted? The construction details and table must be together like a crosswalk. Consider the labeling the construction details with letters or numbers (like on most instructions- think IKEA bookshelf), where there is a clean and simple drawing with A1 and then the table shows A1 as a particular piece of hardware or has the description for the wood size, type and specs. The construction details do not explain how far the wood stakes go into the ground and do not point to all of the items listed- i.e. there are two steel hasps, but only one has a line to it. Move (for (1) 4' x 8' modular unit) to the title after Nesting Box Materials List on the table. The table does not include type or grade of sand, any other details about how to keep the battery protected from the weather (I saw plastic tubs in the photos) and the metal gal steel mesh looked in the photos like to was plastic coated. Is is a particular width? on a roll or comes in sheets? Any other dimensions to be shared? The photos are great- but must match the specs-i.e. no vegetation on sand or in the boxes as a BMP, the sticker for electric fence warning is not placed in the same location as specs in table or construction details states. Use white arrows to indicate if needed on the photos- i.e. the vegetative screen behind the nest boxes - although these look like a difference plant species than specs state.
10	Communication Professional	7	7	6	7	8	7	These are helpful diagrams for this purpose. They show layout well and placement. For the plan, either use a legend to explain the diagonal stripes and grass clumps and speckled sand area, or consistently label them. (Doing both is even better-think trail map legend with words and patterns and colors). There is only one arrow pointing to the seasonal wildflower area when it exists on both sides of the road. For the section label existing veg, seasonal wildflowers and grass mowed on both sides of the road. Consider a bracket to indicate the spaces too. The shrub screen looks not to scale on the axonometric view. The Planting construction details are the first time mulch is mentioned. On the sample plant table, consider a clear separation between the wax myrtle and the "mix" since these are examples of some items in a typical mix, but the wax myrtle is specifically identified. Having a suggested retailer for wildflower mix on the table may help.

Construction Category Evaluation Questions - Communications Professional

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Communications Professional	From a bigger picture, how frequently the nesting boxes are planned and how often the road signs will be placed along the roadway would be helpful.
Professionals	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Communications Professional	Provided in previous comments.
Professionals	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Communications Professional	Provided in previous comments.
Professionals	**Any additional comments?**
Communications Professional	

Construction Category - Visual Aid Rankings by Profession - Ecologist

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Ecologist 1	9	9	8	9	8	9	This is a good set of plans for the engineer and the contractor. Missing measurement is what is minimum height that nest box should be above high tide. Don't want them built where 10 year storm surge could wipe out nest box.
9	Ecologist 2	2	5	5	7	4	5	The additional angles of the section, axonometric, and construction detail is helpful in tandem.
9	Ecologist 3	7	3	9	7	4	5	
9	Ecologist 4	8	8	9	9	9	9	As a group, these illustrations and photos are what professionals would need in order to implement these BMPs. The photos are helpful for as-built examples.
10	Ecologist 1	8	2	8	8	9	9	Good set of figures and table except the section drawing not needed.
10	Ecologist 2	2	2	6	7	5	6	spatial detail is best on the axonometric view.
10	Ecologist 3	4	4	6	2	1	9	
10	Ecologist 4	8	8	8	8	8	8	As a group, these are good for use by landscaping technicians.

Construction Category Evaluation Questions - Ecologist

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Ecologist 1	No
Ecologist 2	
Ecologist 3	
Ecologist 4	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Ecologist 1	No
Ecologist 2	
Ecologist 3	
Ecologist 4	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Ecologist 1	
Ecologist 2	No
Ecologist 3	
Ecologist 4	
Professional	**Any additional comments?**
Ecologist 1	The contractor shouldn't need the details on how to plant the vegetation but better to specify it up front.
Ecologist 2	Thiss is taking way, way longer than 30 minutes
Ecologist 3	
Ecologist 4	

Construction Category - Visual Aid Rankings by Profession - Engineer

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Engineer 1	9	9	7	7	4	6	Dimensions are clean and accurate. The electric fence charger is a little confusion when seeing the car battery in other figures. Silt fence line style may help define this feature better.
9	Engineer 2	5	5	7	7	2	4	This is where the info needs are perhaps most variable by audience. Several of these are need for construction. Some of the info is vague "above high tide" - is that current king tide? Future? 3' above marsh? where at in the marsh?
10	Engineer 1	7	6	8	9	8	6	Landscaping details well laid out. The table would be a good supplement to easily see what and how much is needed for construction. The axonometric view works well with this to show more depth and changes in the different areas. Use of photos would be more appropriate for a display graphic than construction.
10	Engineer 2	5	5	7	7	6		Really depends on audience. Axo, detail and table cover it well.

Construction Category Evaluation Questions - Engineer

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Engineer 1	Well laid out
Engineer 2	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Engineer 1	Good use of grey shades in axonometric.
Engineer 2	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Engineer 1	Good plans for construction
Engineer 2	
Professional	**Any additional comments?**
Engineer 1	
Engineer 2	

Construction Category - Visual Aid Rankings by Profession - Landscape Architect

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Landscape Architect 1	9	9	6	10	9	10	As design practice has shown thru the ages, plan, sections and details are the best at illustrating concepts for construction (when used together). The photos are a nice way to show what the product is supposed to look like. The table is effective at listing materials for the contractor in particular. The Axo was more confusing in this scenario, thus rated lower.
9	Landscape Architect 2	4	1	0	1	0	1	Plan conveyed design intent best
9	Landscape Architect 3	6	7	7	8	8	9	- level of graphic detail appropriate to detailed construction use - line weights are not always applied in a way that enhances readability - more descriptive text and labels applied to this section, resulting in clearer communication - topography/ele
9	Landscape Architect 4	9	9	8	9	9	9	All clear and useful graphics
10	Landscape Architect 1	7	7	8	10	10	10	The plan and section here didn't give me relationships as the Axo did. The detail is good for the finer points. The photos are a perfect way to visually show the seed mix plants. The table is helpful as a materials list.
10	Landscape Architect 2	2	0	0	1	0	2	Photos are pretty, but how is this a "plan" and axon was unhelpful in this case
10	Landscape Architect 3	5	5	7	7	7	8	Planting Plan view symbology seems too generic, and needs labels or key - Cross-Section Elevations should be lableled as such, and are not very compellling/readable (some issues with detail level, sizing, line weights, etc.) - this axon drawing is more developed than some of the others but still shown in flattened view
10	Landscape Architect 4	9	9	4	8	9	9	the planting plan axon is unnecessary.

Construction Category Evaluation Questions - Landscape Architect

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Landscape Architect 1	no
Landscape Architect 2	more notes
Landscape Architect 3	
Landscape Architect 4	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Landscape Architect 1	no
Landscape Architect 2	showing road shoulder would be better representation
Landscape Architect 3	
Landscape Architect 4	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Landscape Architect 1	
Landscape Architect 2	dimensions were not sized correctly for sheet
Landscape Architect 3	
Landscape Architect 4	
Professional	**Any additional comments?**
Landscape Architect 1	Design professionals relate to construction drawings much better than the general public, in my experience, so the audiences above should be limited.
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	I think you need more information on the planting details sheet, there are better tree planting details out there, and certainly more guidance on the wildflower installation is needed.

Construction Category - Visual Aid Rankings by Profession - Land Manager

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Land Manager 1	5	3	7	7	7	7	Diagrams and supply-list helpful for design, planning and construction of nest-box structures. Example photographs help make them tangible. Suggest using dots/gray-scale some color or pattern variation to delineate substrates and materials in diagrams.
9	Land Manager 2	8	9	10	9	9	10	All seem pretty effective to me because I am familiar with looking at construction plans, the axonometric seems to give the best perspective.
10	Land Manager 1	4	5	4	6	6	7	Planting instructions with ground prep most useful. Pictures and diagram of plant descriptors show the results of planting efforts best.
10	Land Manager 2	1	4	7	1			Plan and details drawings are to basic and do not provide enough information, All others seem effective and I like all the information in the table.

Construction Category Evaluation Questions - Land Manager

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Land Manager 1	cost per acre of planting and any associated maintenance costs
Land Manager 2	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Land Manager 1	no
Land Manager 2	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Land Manager 1	no
Land Manager 2	
Professional	**Any additional comments?**
Land Manager 1	no
Land Manager 2	

Construction Category - Visual Aid Rankings by Profession - Maintenance Professional

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Maintenance 1	9	9	9	10	6	9	The dimensions appeal to the engineer in me.
9	Maintenance 2	7	8	7	8	7	9	Again i like the photos.
10	Maintenance 1	7	6	6	8	7	8	Provided more detaidng
10	Maintenance 2	5	5	5	8		8	Tables assist in determining planting times and seeding rates.

Construction Category Evaluation Questions - Maintenance Professional

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Maintenance Professional 1	No
Maintenance Professional 2	No
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Maintenance Professional 1	No.
Maintenance Professional 2	No
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Maintenance Professional 1	No.
Maintenance Professional 2	None
Professional	**Any additional comments?**
Maintenance Professional 1	No.
Maintenance Professional 2	

Construction Category - Visual Aid Rankings by Profession - Planner

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Photos	Comments
9	Planner 1	8	8	9	8	9	8	Axonometric shows the entire layout very clearly. The Materials list shows what a builder will need and is important. The photos clearly show the nesting boxes and are good general information. I do have a question--is the electric fence always needed? Is this to prevent wildlife predators or humans?
9	Planner 2	2	8	8	7	5	7	Good graphic material for this target (constructors, engineers, etc.)
10	Planner 1	8	6	9	8	8	10	Very beautiful wildflower photos! These could help convince decision makers to support the project
10	Planner 2	3	3	7	7	2	5	Good graphic material for this target (landscape architects)> Middle two and last one probably better.

Construction Category Evaluation Questions - Planner

Professional	**Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?**
Planner 1	None
Planner 2	
Professional	**Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?**
Planner 1	None
Planner 2	
Professional	**Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?**
Planner 1	None
Planner 2	
Professional	**Any additional comments?**
Planner 1	None
Planner 2	

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

POST CONSTRUCTION EVALUATION INFORMATION CATEGORY

Post Construction Evaluation Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Comments
11	Communication Professional	8	7	8	8	8	The information is grouped and easier to see in these views.
11	Ecologist 1	7	6	6	5	4	Questions I had are: is the electricity provided from solar screens or utility company wire or battery? What voltage? Is the 4" opening for turtles the height or width of opening? Is there a monitoring protocol for measuring success of nest boxes in producing hatchling turtles?
11	Ecologist 2	2	2	8	8	2	
11	Ecologist 3	7	8	7	6	5	
11	Ecologist 4	8	8	8	8	8	As a group, these provide the needed information for professionals involved in planning, construction and evaluation.
11	Engineer 1	8	7	9	8	6	Table would make a good supplemental checklist feature. Good use of text as bullets associated with each area.
11	Engineer 2	5	3	7	7	1	Axo and detail seem to do the job
11	Land Manager 1	5	5	4	6	6	Post-construction check-list doesn't necessarily need more than a punch-list as in table format but last illustration most inclusive and succinct.
11	Land Manager 2	7	4	6	7	9	Plan gives a lot of information, the section is difficult to understand, the axonometric is busy but provides a lot of information

Post Construction Evaluation Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Professional	Plan	Section	Axon	CDs	Table	Comments
11	Landscape Architect 1	8	7	8	8	10	The table is a good checklist, particularly as a post construction tool. The plans and sections are not quite as informative as the Axo. Details are always good for clarification.
11	Landscape Architect 2	2	1	0	1	6	Not sure how any of graphis besid the table benefit Post Occ Eval
11	Landscape Architect 3	6	7	8	8	7	In general, these graphics are well-developed and readable, and supplemented with text as needed
11	Landscape Architect 4	8	3	3	9	8	I think the plan, detail and table are a good package for monitoring, although it needs to be reformatted into a checklist with room for observations etc.
11	Maintenance Professional 1	8	7	6	7	5	The dimensions provide the additional detail.
11	Maintenance Professional 2	7	7	7	7	9	The use of the table assists the user in determining the appropriate evaluation.
11	Planner 1	7	7	8	6	6	In the top view diagrams, the drawing of the sand mound takes a lot of space on the page. As shown the center of the page appears virtually empty. Consider using a cut line to minimize the space of the drawing, or experiment with adding the text into the space depicting the sand mound. Best to depict spatial requirements (45 degrees for silt fence, 33% maximum slope of sand mound) with graphics General question: could there be an alternative to the electric fence? Perhaps a barrier with barbed wire or some other exclusionary feature? The cost of battery and potential for environmental degradation if it were to leak or explode (due to excessive heat for instance) is concerning.
11	Planner 2	7	2	8	5	1	one and three are the best images in providing context and relevant information for post-construction evaluation. Table does not provide all necessary information.

Post Construction Evaluation Category Questions

Professional	Are there any additional audiences not listed that you think should view the graphics?
Communication Professional	
Ecologist 1	No
Ecologist 2	I;m not sure who would use these
Ecologist 3	
Ecologist 4	
Engineer 1	None
Engineer 2	no
Land Manager 1	no
Land Manager 2	
Landscape Architect 1	no
Landscape Architect 2	Scientist, wildlife techs
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	no
Planner 1	Wildlife law enforcement officials
Planner 2	

Professional	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Communication Professional	
Ecologist 1	No
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	Well done
Engineer 2	
Land Manager 1	no
Land Manager 2	
Landscape Architect 1	no
Landscape Architect 2	check box on table would be useful
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	Post-construction photos to document condition of installation. This would allow record to determine changes/ deterioration over time. It may be useful to document any site specifics that vary in order to analyse data.
Planner 2	

Post Construction Evaluation Category Questions

Professional	Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?
Communication Professional	
Ecologist 1	I don't understand the placement of the electric wire? It runs above the bottom board of the nest box but then it looks like it circles under the sand slope in front of the box?
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	Good us of patterns and shading
Engineer 2	
Land Manager 1	wildflower icon in one of illustrations a bit distracting, dark
Land Manager 2	
Landscape Architect 1	no
Landscape Architect 2	drawings need good redline and editing
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	None
Planner 2	

Professional	Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?
Communication Professional	
Ecologist 1	Why is a nest box 8'-3/4" ?
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	None
Engineer 2	
Land Manager 1	see above
Land Manager 2	
Landscape Architect 1	no
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	None
Planner 2	

Post Construction Evaluation Category Questions

Professional	Any additional comments?
Communication Professional	This entire section should be used at the beginning of the project to show the purpose and objectives of the project- each design element has a purpose and then to revisit this after the project means you can test these objectives were met.
Ecologist 1	no
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	None
Engineer 2	
Land Manager 1	
Land Manager 2	
Landscape Architect 1	
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	
Planner 1	Could the nest boxes be moved to a safe location is a tropical storm is forecast to impact the area? Then returned for hatching?
Planner 2	

SURVEY RESPONSES

CAUSEWAY BMPS GRAPHIC ASSESSMENT

MAINTENANCE/MANAGEMENT INFORMATION CATEGORY

Maintenance/Management Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Profession	Plan	Section	Axon	Table	Photos	Comments
12	Communications Professional	8	7	7	7	8	The plan, photos and chart together provide a complete story. The chart has some edits for improvement. The section does not show linear vegetation patterns.
13	Communications Professional	6	4	6	5	5	This seems to focus on procedures for vegetation management which would mean the plan and axonometric are helpful but the actual procedures could also be easy to review in a chart or table.
14	Communications Professional	7	4	7	6	7	Like invasive species management content, the maintenance procedures benefit from a clearly identified location (shown in plan or axonometric view) followed by more details in the photos and table or chart.
12	Ecologist 1	9	1	3	8	9	figure 1 plus the photos and the table present all the info needed in best format.
12	Ecologist 2	2	6	3	1	5	again use the picture in combination with the section view
12	Ecologist 3	3	4	2	5	7	The use of a legend with color coded polygons representing different habitats may be more useful as there are multiple locations for single habitats. This way the entire image is defined. For example, use the same color for the wildflower, a different color for the mown strip etc... The rectangles are not very clear and confuse the message.
12	Ecologist 4	8	8	8	8	8	This package is effective for a manager who oversees the work of others.
13	Ecologist 1	9	1	2	2	9	All the info needed is on figure 1 and the photos. I do question whether fall and winter is best time to apply herbicide for all the target species. Depending on how much vegetation is cut maybe should allow option of green manure or removal from site.
13	Ecologist 2	1	1	1	4	2	you don't need graphics for this. people who implement invasive species management won't use these
13	Ecologist 3	4	7	6	7	9	
13	Ecologist 4	8	8	8	8	8	This package is effective for those technicians conducting the work in the field, though I question whether there is sufficient detail in the package to guide the workers.
14	Ecologist 1	9	1	1	8	9	Figure 1 plus photos and table provide all info needed in best format. I don't think there is a need to operate electric fence once hatchlings have emerged and the following nesting season. Vegetation within the nest box should not be pulled until after hatchlings emerge. Maybe add trail cameras inside of nest box to record nesting success.
14	Ecologist 2	4	6	3	5	2	
14	Ecologist 3	6	4	4	6	9	The photos communicated the messages more clearly. The other illustrations, for all series seem to exclude areas so that it is not necessarily intuitive that there are wildflower areas or grass strips on both sides.
14	Ecologist 4	8	8	8	8	8	As a package, these are effective for both maintenance staff and their managers.
12	Engineer 1	7	9	9	5	6	Similar to previous set, good use of bulleted text to define the needs for each area. The section view is very effective here. The table would be a good supplemental checklist. Photos would be more appropriate for the public than the person doing the maintenance.
12	Engineer 2	5	5	7	2	3	If plant performance significantly depends on elevation / moisture regime then section seems critical. Otherwise axo seems to stand alone best.
13	Engineer 1	9	6	8	6	9	The section view does not work as well as the plan or axonometric view. The photographs would help the maintenance worker identify the invasive species as well as the public awareness. Table most effective as a supplementary checklist to the graphics.
13	Engineer 2	5	1	7	2	7	Axo and invasive photos seem to cover it.
14	Engineer 1	8	9	7	5	6	The section view is favorable here to easily identify the BMP features in each area. Photographs would be good for public awareness.
14	Engineer 2	3	2	7	1	7	Axo plus photos convey essential info.

Maintenance/Management Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Profession	Plan	Section	Axon	Table	Photos	Comments
12	Land Manager 1	6	7	4	6	6	1st diagram effective and table for maintenance planning purposes
12	Land Manager 2	5	3	9	10	9	The moons on the plan are truly distracting to me. too many boxes. Section does not give enough perspective and the turtles are hard to see. As a manager the photos and the table are most useful to understand what the end result should be and how we can get there.
13	Land Manager 1	5	4	3	5	5	Make sure care is taken to remove seeds/fruits prior to green manure process to avoid continued infestation.
13	Land Manager 2	3	2	7	3	4	These graphic do not seem to have enough information for someone unfamiliar with exotic species. I am skeptical of photos for plant id since blooms, seeds, flowers, ect. are not present year round. Drawings and descriptions are more useful.
14	Land Manager 1	5	7	4	6	8	Photographs that detail each maintenance process is visually most-appealing and succinct to me. Table also useful for tracking progress and setting time/date goals.
14	Land Manager 2	9	1	9	9	3	These are all good for continued maintenance, the section and the photos do not give enough perspective to see how the area should be maintained.

Maintenance/Management Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Profession	Plan	Section	Axon	Table	Photos	Comments
12	Landscape Architect 1	10	10	1	10	10	The plan and sections are outstanding for a manager to use, not so with the Axo in this case. The table is handy as a list, a checklist and to have all components on one page. The photos are good at illustrating the zones. I do think these should be used together to have the most effective package (true for other packages as well)., less the axo in this case.
12	Landscape Architect 2	4	2	1	4	2	Management seems to follow checklist approach, table is superior
12	Landscape Architect 3	7	8	8	8	8	- in general, these graphics are well-developed illustrations with supplemental text and sufficient level of detail as needed - since there are only 5-6 zones, may as well label the drawings accordingly so one doesn't have to 'translate' from the text de
12	Landscape Architect 4	6	7	5	8	7	I think the section works the best. Plan could work well although the text needs to be linked to the zones better (graphically)
13	Landscape Architect 1	8	9	7	10	10	The plan and section work better than the axo here. Thee table and photos are great for clarification and a listing.
13	Landscape Architect 2	0	1	1	2	4	Photo of material to remove is preferred, merging table with photo would be most useful
13	Landscape Architect 3	6	7	7	7	7	- symbols for tagged / preserved vegetation and/or painted stumps and/or green manor are too indistinguishable - very small and not boldly colored or patterned - consider details for some of these plan views in all sets - herbicide use in aquatic zone?
13	Landscape Architect 4	2	2	2	8	8	the plan graphics don't add much to this topic. It would be good to have a sheet of photos of the rare plants too.
14	Landscape Architect 1	9	9	9	9	9	I think all these do a pretty good job of illustrating maintenance, and the table and photos should be used in concert with the plans!
14	Landscape Architect 2	1	2	0	3	1	
14	Landscape Architect 3	8	8	8	8	8	- good level of detailed information - graphics supplemented by text - adding labels to zones would help, and illustrating marsh zone - the note "only hand-pull vegetation from nesting and mound area" should also be added to preceding section re: invasi
14	Landscape Architect 4	8	7	8	8	9	These are all pretty good and easy to read. Definitely link the text and zone together graphically to make it easier to read.
12	Maintenance Professional 1	7	8	7	6	8	
12	Maintenance Professional 2	8	8	7	8	8	Is the the most important feature of any proposal. this is were the sale is closed.
13	Maintenance Professional 1	7	7	8	6	9	The section best conveys the vertical slopes.
13	Maintenance Professional 2	7	7		8	8	Photos and tables tell the story.
14	Maintenance Professional 1	9	8	8	6	10	The information is still there and the margin notes add additional info.
14	Maintenance Professional 2	7	7	7	7		Photos and tables tell the story!!!

Maintenance/Management Category - Visual Aid Rankings by Profession

Visual Aid Package No.	Profession	Plan	Section	Axon	Table	Photos	Comments
12	Planner 1	9	7	7	9	10	Good to show special conditions in table. Also photos are easy to understand the variety of vegetation types. I think the plan view conveys this information as well as axonometric, and since a simpler drawing I ranked it higher.
12	Planner 2	9	4	2	1	3	Images 1 and 2 provide a good synthesis of all information needed, and that is not well conveyed in a table. The axonometric in this case feels distorted and does not provide the scale and other information needed
13	Planner 1	9	8	7	7	10	General comment- Be consistent in drawings that show cars. If one shown in plan view, show the same for other drawings. General question- Would the location of invasive species determine the nesting box locations, since I assume even treating a stump with herbicide could have some impact on the nests?
13	Planner 2	9	2	2	1	9	Same comments from previous apply to this group.
14	Planner 1	8	9	9	8	8	Seasonal wildflower mowing note states "after the season" .....could a month be specified to begin mowing? Would this be prior to May nesting season? Is the Mow Strip photo showing a building typical of area? I was surprised at structure--is this a gate or Visitor's Center? Nesting boxes photo looks different than marsh depicted in drawings since down slope appears to be sod? Perhaps use dashed lines to indicate area that would be moved following wildflower season
14	Planner 2	9	8	4	1	6	Same comments from the two previous groups.

Maintenance/Management Category Evaluation Questions

Professional	Are there any other graphic elements that should be included to help convey the systems graphics information more appropriately? If so, what?
Communications Professional	For the maintenance procedures, consider a grant chart to show a year cycle and the tasks on the left so the "nesting season" is indicated and those items needing to be done prior to the season are marked in duration of time to complete task beforehand and then those on a frequency cycle during season are also shown for planning and staff scheduling. This chart allows a person to be named specifically if it is known or at least a position (whether volunteer or paid).
Ecologist 1	no
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	The section view pairs well with any of them
Engineer 2	
Land Manager 1	Calendar chart for annual maintenance processes, anticipated costs, budget planner
Land Manager 2	
Landscape Architect 1	
Landscape Architect 2	Combining elements would have greatest effect
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	None
Planner 2	

Maintenance/Management Category Evaluation Questions

Professional	Are there any elements that need to be changed (color, level of detail, etc.)? If so, what?
Communications Professional	For the vegetation management: The plan and axonometric only need a few edits for ease of reading, such as changing the color of the labels from dark to light on dark backgrounds (can't see 1, 2 or 4 well). Why is safety not a factor for debris in the protected zone? Should the nest box screen language include why the wax myrtle was selected as the choice for this area? The goal is great at the top of the photo page, but please add safety. For the vegetation management chart, please consider columns with 1-4 aesthetics, wildlife safety, habitat value, maintenance efficiency and wildlife habitat value- these need to numbered and consistent and then you can place "x" under each category for the zone it supports. These items also lend themselves to being part of the master maintenance plan on a gantt chart- these tasks are all for managing the site vegetation- why separate them? This will allow timelines to be shared. For the invasive species the plan and axonometric are ok but this is really a function which takes place along the entire roadway, so it seems combining the content on the sample species list and the procedures and species chart will consolidate things. The content is the same on the priority level, location choices for habitat type and typical sample species- but a red, yellow green, high, medium and low indicator could be used on an implementation chart for the roadway where a date surveyed, by whom, mile marker section and actions taken with this date could help staff and volunteers implement maintenance tasks.. For the maintenance procedures, if you have the original causeway plan, you don't need a new diagram so long as the marsh edge is clear, but a gannt chart to go with it to say when to do the associated tasks for the 5 areas on a timeline. The before and after photo of the vegetation removed from the nesting box is really helpful. The chart is most helpful withteh photos from what has been prepared.
Ecologist 1	no as long as consistent throughout.
Ecologist 2	
Ecologist 3	Addition of colors and more realizing vegetation (e.g. tree icons) would be helpful.
Ecologist 4	
Engineer 1	The dimension lines on 3 make more sense in the section view.
Engineer 2	
Land Manager 1	Photographs could have labels/identifiers for reference purposes
Land Manager 2	
Landscape Architect 1	I would increase the size of the protected species circle/slash in package 13 so its more visible.
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	None
Planner 2	

Maintenance/Management Category Evaluation Questions

Professional	Among the graphics you've chosen, are there elements that are distracting and/or not necessary to show?
Communications Professional	
Ecologist 1	no
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	Dimension lines in 3
Engineer 2	
Land Manager 1	no
Land Manager 2	
Landscape Architect 1	no
Landscape Architect 2	
Landscape Architect 3	
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	No
Planner 1	None
Planner 2	
Professional	**Any additional comments?**
Communications Professional	
Ecologist 1	no
Ecologist 2	
Ecologist 3	
Ecologist 4	
Engineer 1	None
Engineer 2	
Land Manager 1	
Land Manager 2	
Landscape Architect 1	Comprehensive, nice work.
Landscape Architect 2	
Landscape Architect 3	should mowing be avoided during high tides / high terrapin crossing times?
Landscape Architect 4	
Maintenance Professional 1	No
Maintenance Professional 2	
Planner 1	Consider if bike lanes could be depicted on drawings (if existing road does not include at least consider adding "Share the Road" signage during the safety sign phrase.
Planner 2	

SURVEY RESPONSES

POST SURVEY ASSESSMENT

Profession	Has your perception of the usefulness of illustrations in communicating information changed since the survey? If so, how?
Ecologist 1	No
Ecologist 2	yes, too many different graphics. try to combine to convey information to similar groups
Ecologist 3	Yes, I can understand the importance of graphics for communicating processes throughout a project (pre-, during implementation, post-).
Landscape Architect 1	solidified that graphics probably follow disciplines (ie engineer likes details, maint folks like lists)
Landscape Architect 2	No, not particularly as I use these tools regularly in all design/planning projects, and have used them specifically in wildife crossing design projects. It is helpful to see how using all the graphic tools to communicate one project phase, e.g., management/maintenance, may differ compared to another project phase, e.g., construction drawings.
Landscape Architect 3	Yes, in addressing managers and maintenance folks - two groups that are critical but are not in the forefront quite often.
Planner	I think I generally value illustrations so I don't think there has been significant change.
Maintenance Professional 1	Yes, it made me realize types of illustrations available for use that I haven't typically used.
Maintenance Professional 2	No
Land Manager 1	No
Land Manager 2	No, I use illustrations all the time in my work so I am a fan of using them for communications.
Engineer 1	Not significantly - work with them regularly and understood the benefit they would be to conveying the information for this project.
Engineer 2	I realized I like axonometric in combination with other graphics depending on context / audience
Communications Professional	Seeing the same information in various formats reminds me there are many ways to choose from, but some are clearer than others for a specific purpose.

Profession	Do the illustrations help to clarify the communication process? If so, how?
Ecologist 1	Yes, but selection of illustrations will vary with intended audiences.
Ecologist 2	yes, they provide the spatial scale and context
Ecologist 3	Illustrations are carefully produced, they are very effective for communications as they can instantly or quickly communicate a message to a wide audience, including different age groups, across cultures and amongst professionals). Many people are visual communicators (I am in this group) and may not take the time to read lengthy text. So the figures help me to understand where I need more information and focus on these areas as far as narrative explanations or text.
Landscape Architect 1	
Landscape Architect 2	Absolutely. Information may be quickly conveyed visually as compared to reading long text narrative. Illustrations are useful for communicating design intent, explaining proposals to public audience, instructing contractor on installation procedures and construction practices, and/or ensuring that long-term management practices maintain the effectiveness of wildlife crossings. Spatial and functional relationships on the land are depicted in illustrations that aren't easily conveyed in text.
Landscape Architect 3	Yes, other than noted. The variety of photos, text, plan and section will get to different abilities of viewers.
Planner	Yes illustrations allow the reader to better understand and visualize the project
Maintenance Professional 1	Yes
Maintenance Professional 2	Yes, in visualizing the plan
Land Manager 1	Absolutely, they explain the concepts and logistics and footprint of the plan in succinct and spatial as well as temporal terms
Land Manager 2	Yes, allow the user to see the goal.
Engineer 1	Absolutely. The tables were consistently the lowest scores because of the lack of visuals to tell the story.
Engineer 2	Yes, I think visuals are powerful in general but they become more powerful when combined effectively with animal and driver perspectives
Communications Professional	Most of the time, yes. They usually reinforce what could be described in copy or text easier and clearer. If they have too much information, or try to show information which is not best shown from that angle or view, then it can actually become more confusing.

Profession	Are there any other illustration formats or topics not included that could be useful?
Ecologist 1	AS I mentioned earlier I think, need some introductory information about why this project is being done geared to the public and geared to the land managers, engineers and landscape architects involved
Ecologist 2	
Ecologist 3	May consider replacing the animations with real life footage in habitat. The terrapin views could use a more accurate scale as the scale or perspective seemed off. For a small terp, if they "see" a vehicle, it would be much larger than depicted.
Landscape Architect 1	Consider having the respondents sort the illustrations into disciplinary bins would have saved respondents time (a cardinal rule for survey design)
Landscape Architect 2	
Landscape Architect 3	I struggled with the 3D animations on my network computer, and this could be a problem for others as well.
Planner	GIS utilizing aerial photos could be useful to decision making process
Maintenance Professional 1	No
Maintenance Professional 2	Not sure.
Land Manager 1	Map overlays and habitat boundaries/ecotones with documented nesting sites tagged. Visitor signage/interpretive panel to explain the roadway mitigation techniques and why the benefit terrapins and the entire ecosystem.
Land Manager 2	
Engineer 1	None
Engineer 2	
Communications Professional	Please see notes about infographics, gannt charts and line art as well as the application of some of these illustrations for materials for the public in particular.

Profession	Any additional comments?
Ecologist 1	no
Ecologist 2	you lost me at about 8 rounds of graphics. Too many to review at once. It took me about 2 hours to complete.
Ecologist 3	The format for the survey was well thought and organized.
Landscape Architect 1	Wish I could be more helpful Roger, but still unclear on the survey objective. Did learn some info about 'twerps' tho! Realistic reporting on time to take survey is necessary
Landscape Architect 2	- great topic, keep going with it! - suite of graphic tools is helpful...more 3-d modeling and visualization along with wildlife camera technology, could be explored - don't forget text is part of graphic communication! - need a matrix or flowchart or
Landscape Architect 3	
Planner	I may not understand the Terrapin behavior well, yet as I have noted I have concerns about the battery in the project design. I would prefer a system to exclude predators without relying on the battery if possible.
Maintenance Professional 1	No
Maintenance Professional 2	
Land Manager 1	
Land Manager 2	
Engineer 1	Overall, very well thought out and produced.
Engineer 2	
Communications Professional	