JN Ding Darling National Wildlife Refuge Road Safety Audit

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Prepared for:
U.S. Fish and Wildlife Service
National Wildlife Refuge System
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Executive Summary

JN Ding Darling National Wildlife Refuge Road Safety Audit

Jay Norwood Ding Darling (JN Ding Darling) National Wildlife Refuge is part of the Southwest Florida National Wildlife Refuge Complex and is located in Sanibel, Florida. The Refuge's mission is to protect endangered species and to provide refuge for migratory birds. Approximately 975,000 visitors per year come to the Refuge for wildlife watching, hiking, and biking. Currently, visitors travel through a one-way road along Wildlife Drive, however at some locations the road is narrow and sometimes difficult for vehicles and cycles to share the cross section of road. Some visitors get to the Refuge by using the shared use path along Sanibel Captiva Road that is part of an island wide trail system. Also, part of the Road Safety Audit (RSA) is located on Tarpon Bay Drive, a popular location for bike rentals, where many near misses occur between cars and bicyclists. The goal of this RSA is to assess the locations for potential safety improvements and make the Refuge safe and enjoyable for all visitors.

An onsite visit took place on July 27, 2022 by the Eastern Federal Lands team along with partners from the Refuge, City of Sanibel, Sanibel Police Department, and neighboring homeowner associations, Caloosa Shores and Sanctuary. The field team took pictures and field measurements which are used for the report where observations and potential safety alternatives are presented.

The goal of the Road Safety Audit is to assess the Refuge roads and recommend safety improvements to make JN Ding Darling National Wildlife Refuge SAFE and ENJOYABLE for its visitors.

Based on observations and data collected during the road safety audit, it is recommended that road widening, and shoulder stabilization be implemented along sections of Wildlife Drive to address the existing pavement drop offs. This would benefit cyclists at locations where the roadway is narrow and where there have been previous incidents of cyclists veering off the pavement edge. Other recommendations include "One Way" and shared-use pavement markings to indicate to visitors the correct direction to travel and that Wildlife Drive is a shared-use roadway. To address large vehicles having difficulty turning into the parking lot, a parking lot reconfiguration is recommended. The proposed reconfiguration would allow visitors to enter through what is now the employee parking entrance and be able to travel through the parking area with sufficient turning room. The parking lot exit is an egress only and experiences a lot of visitors trying to enter, going against traffic. At this location it is recommended the installation of a channelizing island with "Wrong Way" signage to deter wrong way entrances. At the fee booth it is suggested to provide a fee collection location for cyclists and walkers that is separate from vehicular fee collection. This would improve traffic flow for hikers, cyclists, and motorists at the fee booth and also make it clearer to visitors that hikers and cyclists also have to pay an entrance fee. Delineation and signage upgrades have been recommended for several priority locations due to their effectiveness in bringing attention to important roadway features, like the horizontal curve on Tarpon Bay Road.

The RSA team also discussed vegetation clearing around several locations to provide a clear line of sight between motorists and shared-use path users or in other locations to reduce the canopy effect, which

means shadows on the roadway from overhead trees. Reducing these shadows will improve visibility of the roadway users. Another recommendation is regarding trail connectivity between the Sanibel Captiva Road and the Refuge. Options included widening Wildlife Drive and creating a boardwalk from Tarpon Bay to Sanibel-Captiva Road. This would provide a safe, separate path for cyclists and pedestrians to travel to and from the existing shared-used path system. The following table provides a summary of the safety countermeasures recommended, the implementation term expected, and the sites where the recommendations are proposed, and the following map provides a reference of where the recommendations can be implemented.

Countermeasure	Potential Crash Reduction[7]	Countermeasure Implementation Applicable to:						Implementation Term*
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	
Widen pavement (1' widening)	3% injury crashes	X						long
Safety Edge	11% total crashes	X						long
Concrete Pavers (2' wide)	N/A	X				X		medium
Arrow/ ONLY Pavement Markings	N/A	X	X	X	X	X	X	medium
High Visibility Crosswalks[6] with trail crossing sign	40% veh/ ped crashes	X	X	X	X	X	X	medium
Speed hump	50% all crash types/ all injury severities			X	X	X	X	long
Chevrons with reflective post	27.5% non-intersection type crashes, all severities			X				short
Shared-Use Path Pavement Markings	N/A	X	X	X	X	X	X	medium
One Way/ Wrong Way Sign Assembly	N/A	X	X	X	X	X	X	short
Shared-Use Path (8 ft wide)	25% veh/ bicycle crashes			X			X	long
Reconfigure Parking Lot	N/A	X						long
Install additional fee booth	N/A		X					long
Fee booth kiosk	N/A		X					long
delineators	N/A		X		X			short
Upgrade existing signage (retroreflectivity)	15% injury crashes	X	X	X	X	X	X	short
Tree and Shrub maintenance	N/A	X					X	short
Channelizing Island	N/A	X						long
Wetlands Mitigation	N/A			X			X	long
*Implementation Terms:								
short term <6 months mid-term >6 months to 1 year long term >1 year								


Wulfert Keys Trail
Shell Mound Trail
Site 6
Site 5 (Observation Tower)
Site 4
Cross Dike Trail
Wildlife Dr
Sanibel- Captiva Conservation Foundation Marine Lab
Tarpon Bay
Site 2
Indigo Trail
Tarpon Bay Explorers
Site 3
Site 1
Visitor's Center
Sanibel Island
Sanibel Captiva Rd
Tarpon Bay Rd
Legend:
Shared Use Path
Trail
Google Earth

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Acronyms

Acronym or Abbreviation	Meaning
AADT	Annual Average Daily Traffic
FHWA	Federal Highway Administration
HOA	Homeowners' Association
MPH	Miles per hour
RIP	Road Inventory Program
RSA	Road Safety Audit
USFWS	United States Fish & Wildlife Service
VPD	Vehicles Per Day

The Road Safety Audit Team

Name	Title	Organization
Yanira Rivera	Safety Engineer	FHWA - EFLHD
Enid Colon Torres	Safety Engineer	FHWA - EFLHD
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Erin Myers	Deputy Project Leader	USFWS
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Wendy Kindig	Caloosa Shores HOA president	Caloosa Shores HOA
Diane Knight	Sanctuary HOA president	Sanctuary HOA
Laura Denick	Caloosa Shores HOA board secretary	Caloosa Shores HOA

1. Introduction

1.1 Project Overview

Jay Norwood Ding Darling (JN Ding Darling) National Wildlife Refuge is part of the Southwest Florida National Wildlife Refuge Complex and is located in Sanibel, Florida, see Figure 1. The Refuge's mission is to protect endangered species and to provide refuge for migratory birds. Approximately 975,000 visitors per year come to the refuge for wildlife watching, hiking and biking. The Refuge is open 7 days a week and is adjacent to a shared-use path that stretches east to west along the island.

Wildlife Drive is a one-way roadway that traverses through the Refuge with locations for parking close to wildlife viewing areas. The one-way roadway is shared with cyclists, both pedal and motorized, as well as pedestrians. The Refuge has identified priority locations, locations where safety and traffic operational improvements are needed. These locations are identified and discussed in more detail in the following sections.

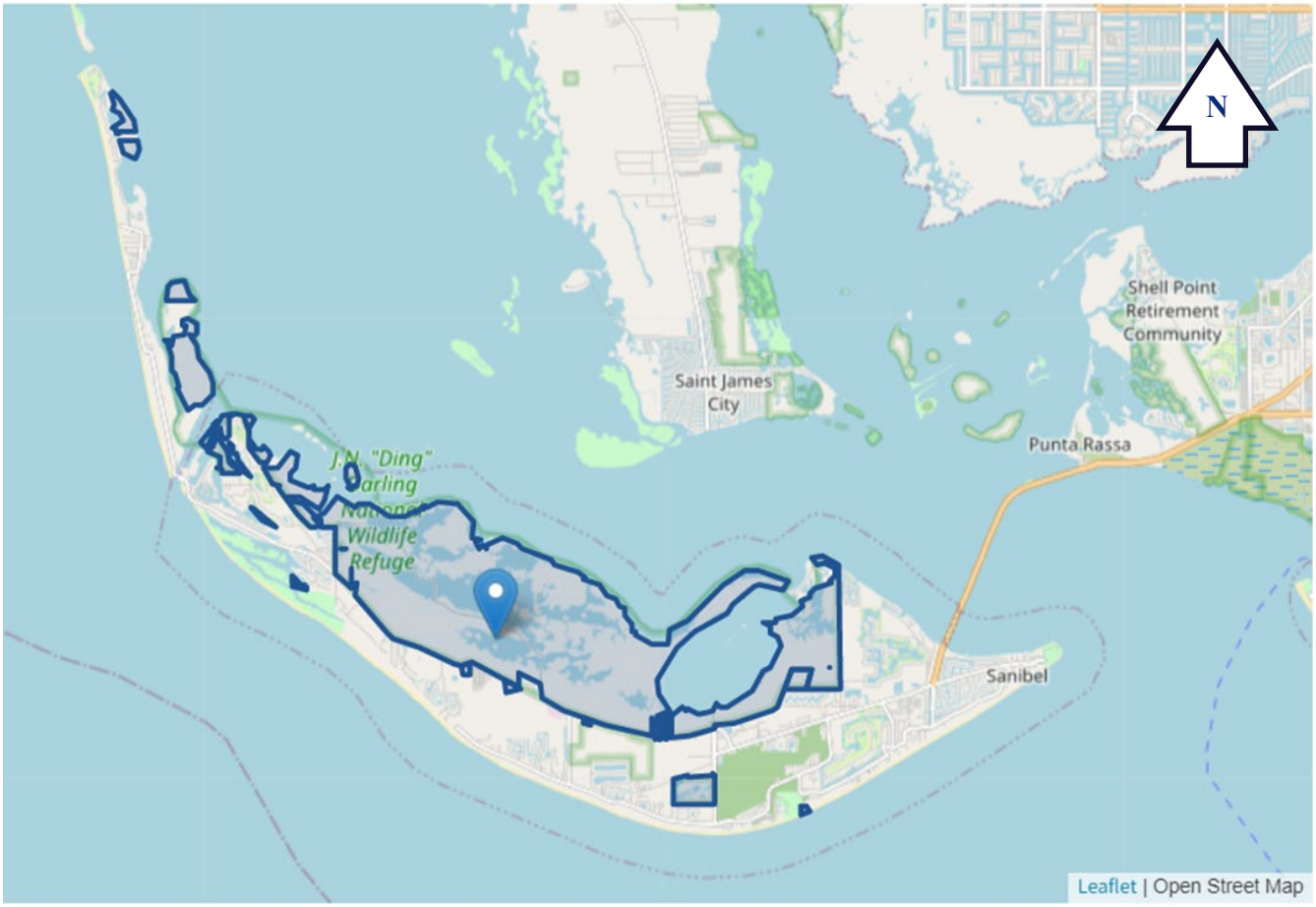


Figure 1. Map View of JN Ding Darling NWR

1.2 Road Safety Audit Process

The RSA process is an 8-step process as shown in Figure 2. It starts off by the owner identifying locations to be assessed. These can be locations where there is a high incidence of crashes or conflicts between

vehicles and vulnerable users. Next a multidisciplinary team is invited to participate in the RSA to provide their unique perspective on the priority locations. Then, a kickoff meeting is conducted with the RSA team, followed by the field review. At the field review, the design team takes notes and measurements for analysis that will be presented to the Refuge in a report. The draft report is provided for comments and then the final report is presented to the Refuge.

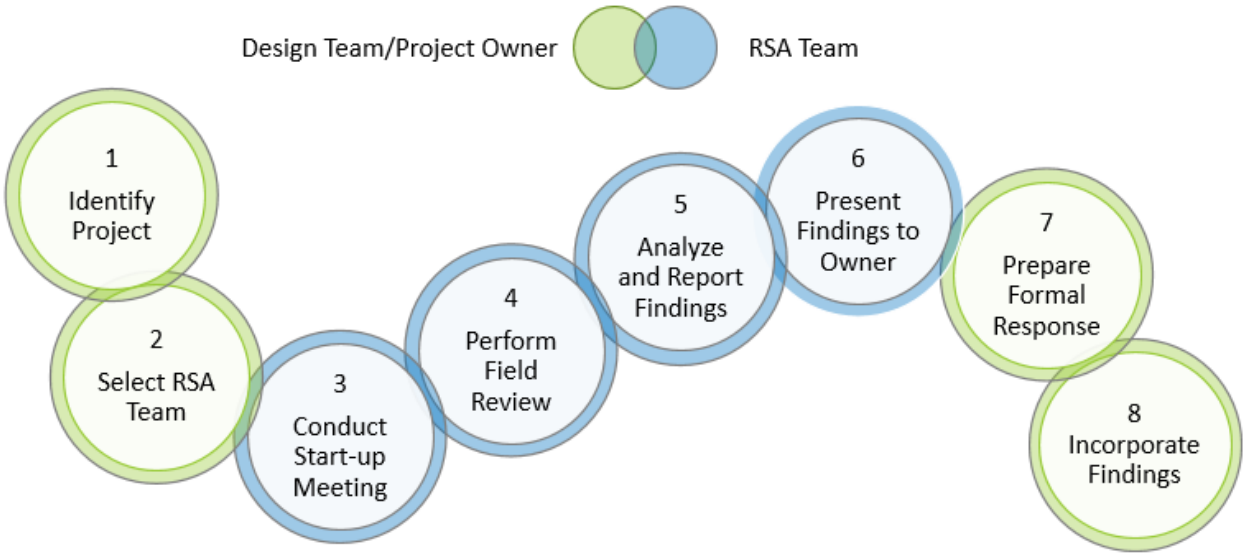


Figure 2. The Road Safety Audit Process

1.3 Stakeholder Coordination

Stakeholders that attended the RSA Kickoff Meeting:

Name	Title	Organization
Yanira Rivera	Safety Engineer	FHWA - EFLHD
Enid Colon Torres	Safety Engineer	FHWA - EFLHD
Kevin Godsea	Project Leader	USFWS
Erin Myers	Deputy Project Leader	USFWS
Donald Swingle	Maintenance Supervisor and Safety Officer	USFWS
Bob Gerwig	Wildlife Refuge Specialist	USFWS
Vincent Ziols	National Transportation Planner & Analyst	USFWS-HQ
Thomas Egland	Acting Regional Transportation Coordinator IR2/4, LR4	USFWS
Wendy Schnapps	Tarpon Bay Explorers	Tarpon Bay Explorers
Wendy Kindig	Caloosa Shores HOA president/ member	Caloosa Shores HOA/ Ding Darling Wildlife Society
Laura Denick	Caloosa Shores HOA board secretary	Caloosa Shores HOA

Stakeholders that attended the RSA Field Visit

Name	Title	Organization
Yanira Rivera	Safety Engineer	FHWA - EFLHD
Enid Colon Torres	Safety Engineer	FHWA - EFLHD
Kevin Godsea	Project Leader	USFWS
Erin Myers	Deputy Project Leader	USFWS
Donald Swingle	Maintenance Supervisor and Safety Officer	USFWS
Bob Gerwig	Wildlife Refuge Specialist	USFWS
Laura Denick	Caloosa Shores HOA board secretary	Caloosa Shores HOA
Scott Krawczuk	Public Works City of Sanibel	City of Sanibel
David W. Schmitt	Public Works City of Sanibel	City of Sanibel
Elizabeth Buikema	Officer	Sanibel Police Department

2. Existing Conditions

The following describes the existing conditions of the site. This section begins with the refuge entrance and parking area. Then it is followed by the existing conditions along Wildlife Drive and Tarpon Bay Drive. The road that fronts the Refuge is Sanibel Captiva Road. This road has an Average Annual Daily Traffic (AADT) of 21,000 Vehicles Per Day (VPD) reported from 2021[1]. The speed limit on Sanibel Captiva Road is 35 mph, while for Wildlife Drive is 15 mph. The section of Wildlife Drive, between the Refuge exit and Sanibel Captiva Road, is posted at 30 mph. Tarpon Bay Drive has an advisory speed limit of 20 mph as shown in Figure 3.

Figure 3. Speed Limit Data Map

2.1 Refuge Entrance and Parking Area

Refuge Entrance

The road that intersects with the main entrance is Sanibel Captiva Road. The main entrance has two driveways as shown in Figure 4. Immediately upon entering, visitors cross an 8 feet wide shared-use path, then the driveway starts narrowing from 25 feet wide to approximately 12 feet wide. Some visitors park their vehicles at the entrance to take a picture in front of the JN Ding Darling Refuge sign, which causes congestion and potentially hinders visibility of the path users. At this location the shared-use path is signed with stop signs, however cyclists seldom stop. Also, vegetation blocks the view of the vehicles entering from westbound making it challenging for path users and drivers to see each other, see Figure 5. The Refuge reports that this location experiences many near misses between cyclists and motorists.

Figure 4. Refuge Entrance Facing Towards Sanibel Captiva Road

Figure 5. Shared-use Path View (see arrow above)

The entrance driveway narrows towards the parking area. The narrow road width does not allow for a vehicle and a cyclist to travel side by side. There is a noticeable road edge drop off that ranges from 5 to 8 inches high, which can be hazardous to both vehicles and non-motorized travelers. Cyclists are very likely to encounter the drop off if they choose to move out of the way to allow for a vehicle to pass. The Refuge states there have been multiple incidents of cyclists veering off the pavement and needing first aid or medical attention.

Figure 6. Refuge Entrance and Edge of Pavement Drop Off

As drivers come into the parking area, some do not anticipate the entrance of the parking area to be shortly after they turn right, due to vegetation obstructing the line of sight, see Figure 7. This and the tight radius cause some vehicles to have to back up so that they can make the turn. This is especially true of larger vehicles such as buses and RVs. When this happens, it causes a backup while the driver makes their adjustments.

Refuge Parking Area

Figure 7. Refuge Visitor Parking Lot Entrance

The parking exit area is frequently full of cyclists or groups of visitors trying to figure out which direction to go, causing backups for motorists trying to enter the refuge or exit the parking lot.

Figure 8. Refuge Visitor Parking Lot Exit Area

Parking Area Exit

The parking area exit towards Sanibel Captiva Road is egress only, however despite the "Do Not Enter" signage, it is oftentimes mistakenly used as an entrance. The actual entrance is located approximately 625 feet east as depicted in Figure 11. One observation is during our visit, when using Google Maps for directions to the site, the Google Maps directions directed us to the exit. If this happens for other mapping app users, this could explain why some people are entering at the exit. This causes conflicts between exiting vehicles and trail goers using the shared-use path. Like the entrance, this location experiences near misses between vehicles and cyclists. The shared-use path crossing is stop controlled for its users, however path users tend not to not obey the signs. In addition, vehicles exiting at this location may have difficulty seeing eastbound path users due to the vegetation obstructing the view, as shown in Figures 9 and 10.

Figure 9. Vegetation Obstructing View of Shared-Use Path at Parking Area Exit

Figure 10. Vegetation Obstructing View at Parking Area Exit Facing West Towards Path

Figure 11. Map View of Refuge Entrance and Parking Area, and Parking Exit

2.2 Wildlife Drive at Fee Booth

The fee booth is used for all visitors, motorists, cyclists, and pedestrians, to pay the entrance fee and to get directions on how to travel through the Refuge. The Refuge reports that oftentimes cyclists skip the line and move ahead of the waiting cars. Feedback from cyclists indicate that they move ahead of the line to avoid exhaust smoke, or they had not realized that cyclists are also required to pay an entrance fee. Traffic cones have been placed to keep non-vehicular guests from bypassing the booth. There is also a trail crossing in front of the fee booth that sometimes creates a bottleneck. It also lacks the area to get around the primary line of traffic, either for law enforcement to pass through, or for vehicles to turn

around upon discovering the fee requirement, as shown in Figure 12. In one instance it was reported enforcement was stuck at the booth for 20 minutes before being able to head towards the crash location. During peak season, fee booth queues can go as far back as the entrance. Previously the fee booth used to be at the entrance but was moved to this location to contain the queues inside the Refuge.

Figure 12. Map View and Picture Facing South of Wildlife Drive at Fee Booth

2.3 Tarpon Bay Road

The next priority location is Tarpon Bay Road which is located north of Sanibel Captiva Road and leads up to Tarpon Bay Explorers. The road is a narrow two-way roadway with no shoulder and in some locations with steep shoulder drop offs. There is a 90-degree curve coming into Tarpon Bay Explorers causing a visibility issue. Tarpon Bay Explorers is a concessionaire and marine lab that offers bike rentals. This makes the road very popular for renters who are sharing the road with vehicles until they reach the shared-use path. Motorists sometimes come speeding around the sharp corner contributing to near misses between vehicles and cyclists. In one instance, it was reported a vehicle drove off the road hitting the trees near the curve.

Figure 13. Map and Street View of Tarpon Bay Road Near Rental Concession

2.4 Wildlife Drive at Cross Dike Trail Crossing

There are two crosswalks at this priority location. As you drive down Wildlife Drive, the first crosswalk encountered connects two wildlife observation areas. Approximately 50 feet from this crosswalk is a speed hump. Another 75 feet forward is another crosswalk connecting Cross Dike Trail to Wildlife Drive. This is a frequently visited stop by the Refuge visitors. There are restrooms located near the crossing along Cross Dike Trail, and visitors park their vehicles along the right side of Wildlife Drive to access the facilities. At these crossings, there is no connectivity between the crosswalks and there are visitors crossing on foot and bike. There are instances when visitors on bike use the restroom and then turn against traffic causing confusion, congestion, and near-misses at this crossing location. Vehicles also drive against traffic, and this occurs more often where the roadway widens near the trail.

Figure 14. Map View and Picture Facing West Wildlife Drive at Cross Dike Trail

2.5 Wildlife Drive at Observation Tower

Along Wildlife Drive near the observation tower, there is limited parking at this popular attraction. The gravel parking is first come, first serve and offers enough space along the approximately 1160 feet long tangent portion of the road for approximately 60 vehicles, plus the tram, and two accessible parking spots. This is the location of one of two tram stops. The tram stops across the road and the visitors cross the street to the observation tower. This section of road is approximately 22 feet wide with an additional 7 feet of gravel parking area. The available roadway space narrows with the parked cars and tram car. The road is shared by cyclists and hikers and is a high point of congestion. This location is adjacent to wetlands or water on both sides.

Figure 15. Map View and Picture Facing South of Wildlife Drive at Observation Tower

2.6 Wildlife Drive from Alligator Bend to Refuge Exit

Before Alligator Bend

The refuge exit, beginning at the series of curves nicknamed "Alligator Bend" through Refuge exit is another area of concern. This area has very narrow sections, 12 foot wide at its narrowest, where there is not enough space for a cyclist and a tram or bus to ride side by side.

Figure 16. Map View of Wildlife Drive

Figure 17. Narrowest Section Approaching Alligator Bend Adjacent to Walker's Preserve

Source: GoogleEarth

After Alligator Bend

Coming out of the Refuge exit the area residents report that Refuge visitors, cyclists and motorists, coming from the one-way portion of Wildlife Drive and continue driving in the middle of the roadway where it turns into a two-way road. Figure 19 shows an example of cyclists going down Wildlife Drive against traffic. It was also reported that drivers speed through, even around the horizontal curves that have limited visibility causing crashes and near misses.

Figure 18. Refuge Exit from Wildlife Drive to Refuge Exit Before and After the Exit Gate

Source: GoogleEarth

Figure 19. Bicycle Riders Going Against Traffic on Wildlife Drive

2.7 Connectivity to Sanibel-Captiva Road Shared-Use Path System

During the RSA, the possibility of connecting the Refuge to the existing Sanibel Captiva Road shared-use path system was discussed. The existing shared-use path system connects residents and visitors throughout the island, see Figure 20 for reference map. Since there is a high bicycle use at the Refuge, it would be beneficial to its visitors to have trail connectivity from the Refuge to the existing shared path system so that they can travel safely, separated from motorized traffic.

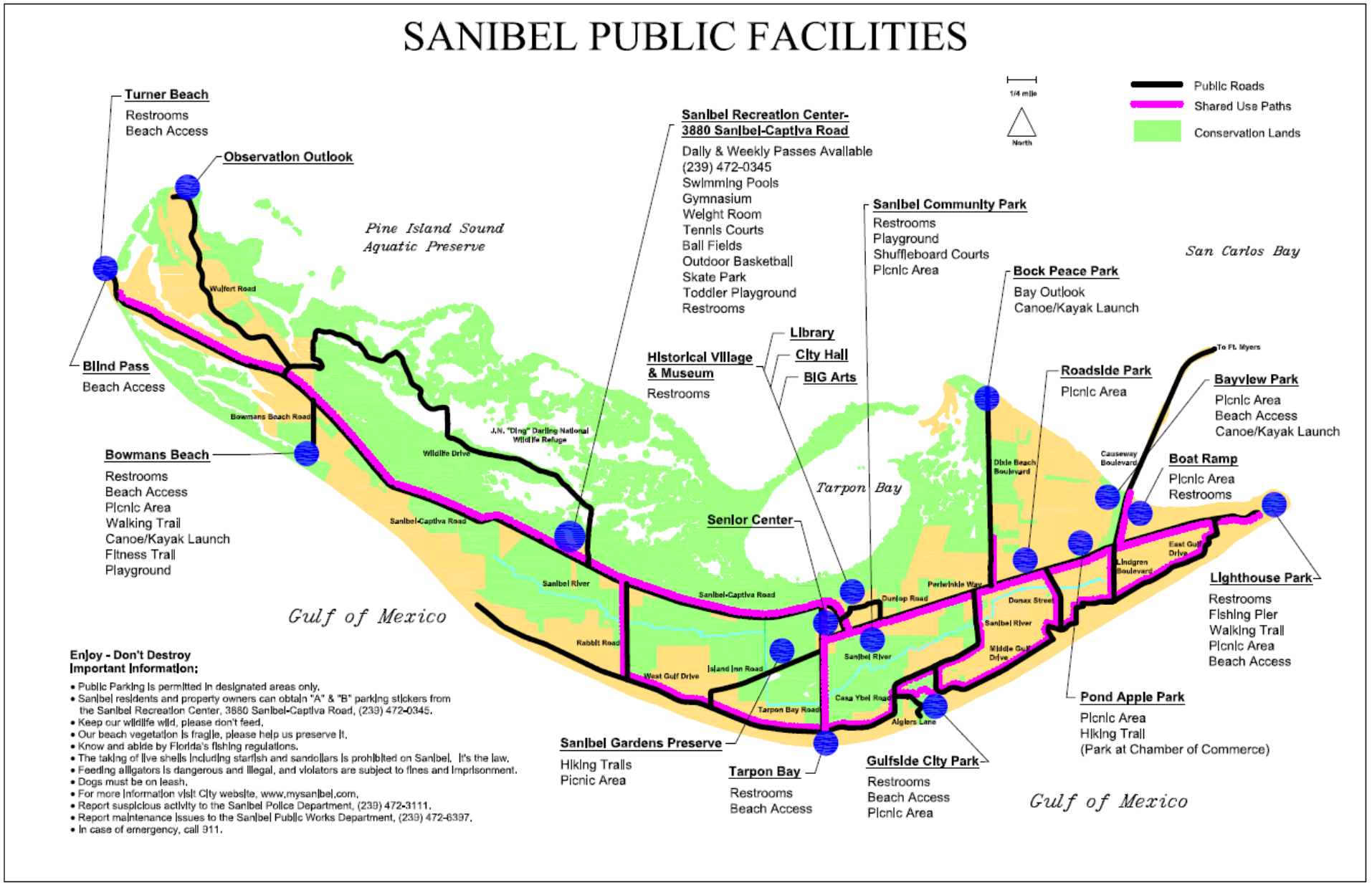


Figure 20. Existing Sanibel Shared-Use Paths and Public Facilities Map[2]

3 Recommendations

The following sections provide the recommendations for the audited locations at J.N. Ding Darling National Wildlife Refuge. The recommendations are organized in the order of priority location number, followed by a summary of trail connectivity and general recommendations. For recommended safety improvement cost estimates, see Appendix A.

3.1 Refuge Entrance and Parking Area

Refuge Entrance

The refuge entrance currently experiences near misses between vehicles entering the Refuge and users of the multi-use path. Based on the field inspection, visibility is limited from trees and shrubbery obstructing the view. Vegetation clearing is recommended to improve sight distance to allow both motorists and path users to see each other when approaching the crossing at the entrance. Another reason may be that the path users do not anticipate that they have to stop as it is currently signed. After looking into Sanibel Crosswalk Policy, the current signage does not seem to meet the city policy or Florida Statute 316. The policy states: "Motorists are to stop for pedestrians within a crosswalk at an intersection that has a traffic control signal or at any crosswalk where signage so indicates [FS 316.(7)(a), (b)] Elsewhere, motorists shall yield the right-of-way to pedestrians in crosswalks [FS316.(7)(c)]. On sidewalks and within crosswalks, state law grants cyclists the same rights and duties of pedestrians. A person propelling a vehicle by human power upon and along a sidewalk, or across a roadway upon and along a crosswalk, has all the rights and duties applicable to a pedestrian under the same circumstances [FS 316.2065(9)].[8]" With this in mind, it is recommended that the Refuge consider removing the stop signage from the crosswalk for the trail users at the Refuge entrance. It is also recommended that trail crossing warning signs be installed for drivers to be aware of the shared-use path users.

Other challenges encountered at the Refuge entrance are narrow road segments and pavement edge drop offs. At the narrowest sections, there is limited distance for both vehicles and cyclists, leaving cyclists to oftentimes move over to allow vehicles to pass. This maneuver is risky near steep pavement edge drop offs. One option could be to widen the road and use a safety edge. This would allow cyclists some more space to maneuver and provide a chamfered pavement edge that makes it easier to travel back to the roadway as shown in Figure 21. The downside is that there is limited space to widen the road due to wetlands and this option might move the edge rutting farther out. Another option would be to install concrete pavers. This option helps maintain the natural characteristic of the roadside with its lattice or grid-like shape that allows vegetation to grow in the openings, while maintaining a stable roadside. The downside of this option is that the pavers are not recommended for high traffic areas. Figure 22 is a detail drawing of the concrete pavers installed on sections of Blue Ridge Parkway to address road edge rutting.

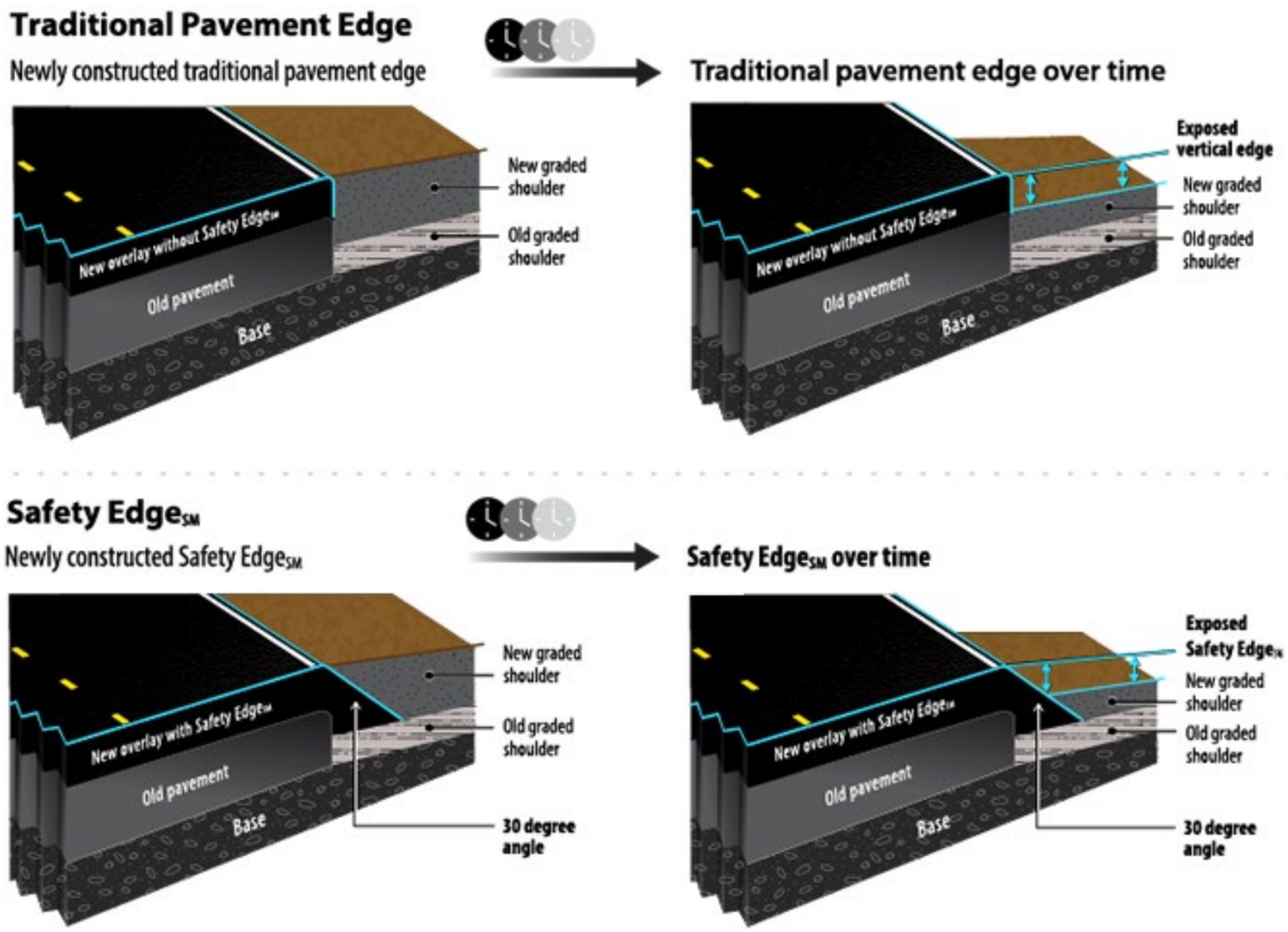


Figure 21. Comparison of Traditional Pavement Edge and Safety Edge

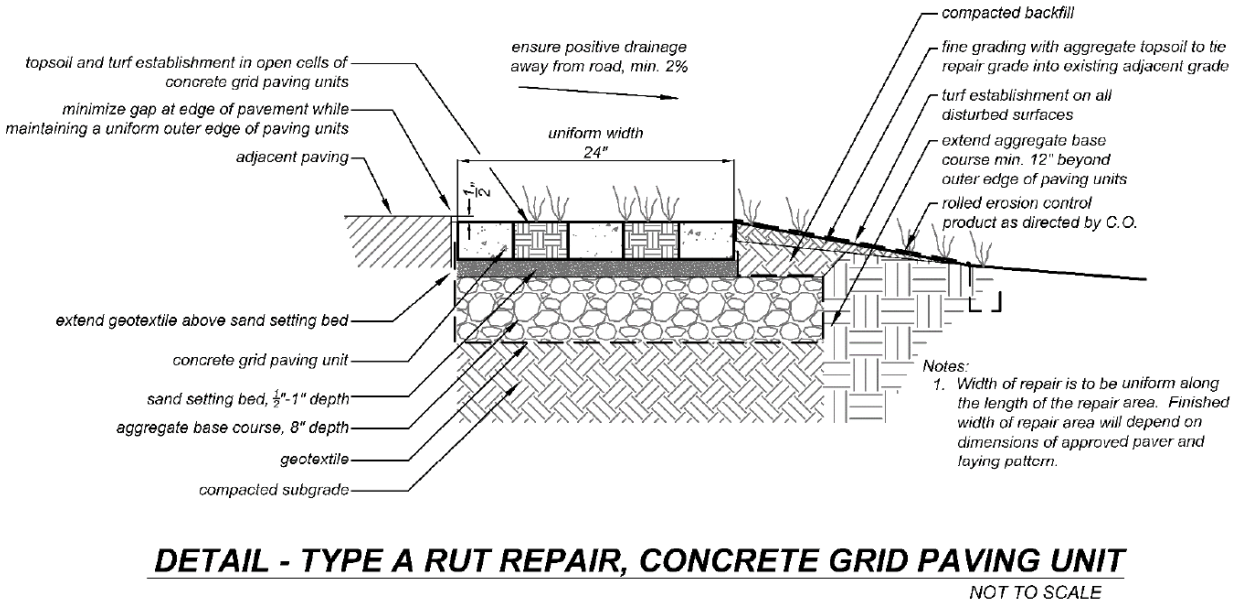


Figure 22. Concrete Paver Detail Example

Refuge Parking Area

The refuge parking currently has separate parking sections for visitors and employees. The current layout has a separate gravel driveway for Refuge employees, then further down the driveway there is a paved access for visitors. Some visitors have difficulty making the turn into the parking area, and as a result, create a bottleneck behind them as they try to adjust their vehicles. One solution is to reconfigure the layout of the parking lot. The following conceptual drawing shows both visitors and employees accessing the parking area using what is now the employee parking lot entrance. Employee parking will be signed, and other spots will be open to visitors. The reconfiguration provides wider turning radii for buses and RVs while maintaining a similar amount of parking spaces. The reconfigured parking area will stay one way like the existing one, so it is recommended that arrow pavement markings be installed to complement the one-way signage. The remaining portion of the entrance can be left for an additional egress or filled in with turf. It is also recommended that the existing signage be replaced with retroreflective signs at a minimum height of 7 feet since there are parking and pedestrian movements.

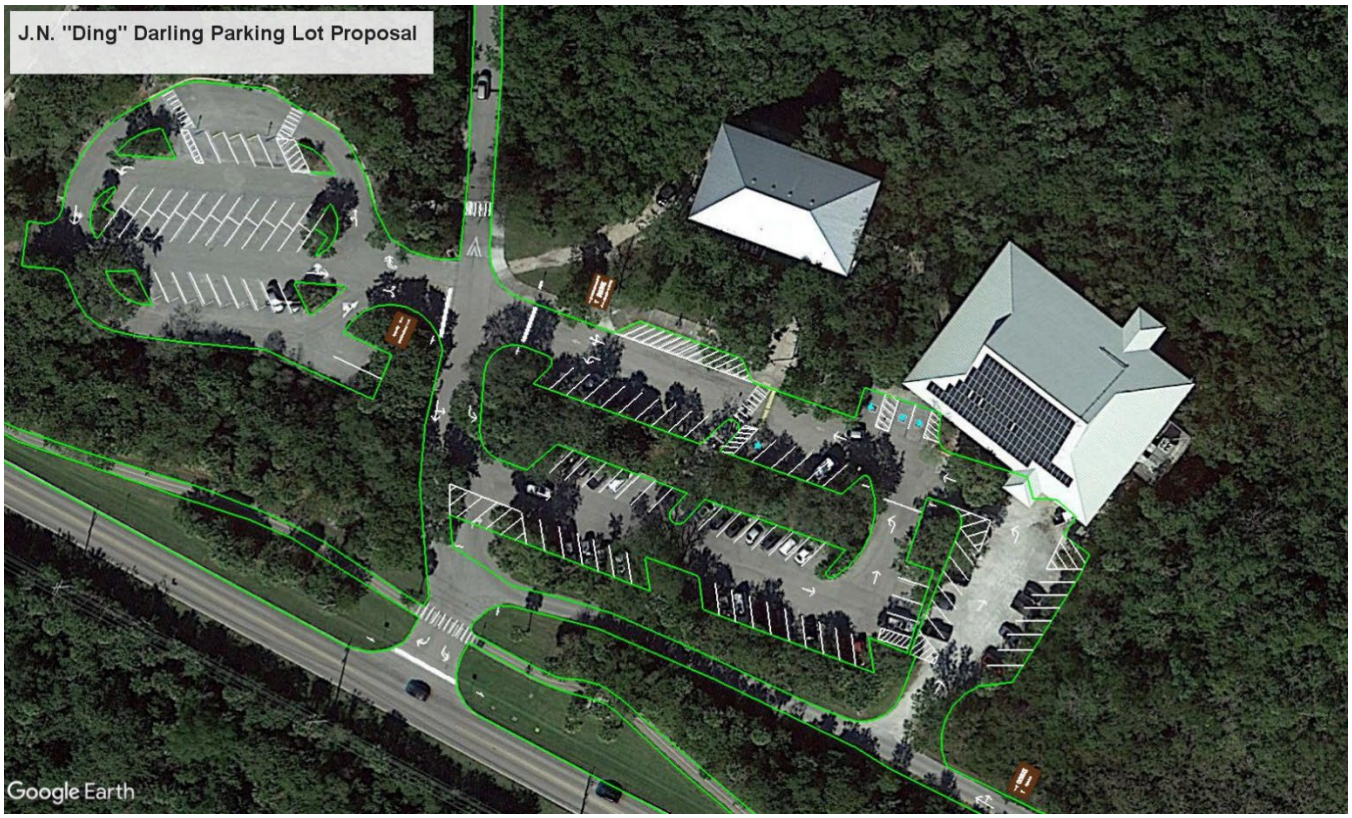


Figure 23. Parking Reconfiguration Concept

Parking Area Exit

On multiple occasions, the Refuge experiences tourists entering through the parking area exit. When this happens, the risk of near misses with vehicles and multi-use path users increases. The exit is currently signed with “Wrong Way” signs on both sides. It is recommended that an “Exit Only” sign be placed facing both sides of traffic along Sanibel Captiva Road. Another option could be to install a non-traversable channelizing island. The channelizing island would provide a visual and physical deterrent to

vehicles from entering, see Figure 24. This location also experiences near misses from exiting vehicles with trail users that do not stop as it currently is signed. Taking the Sanibel crosswalk policy into consideration, it is recommended that the stop signage be removed from this location and trail crossing warning signage be installed.

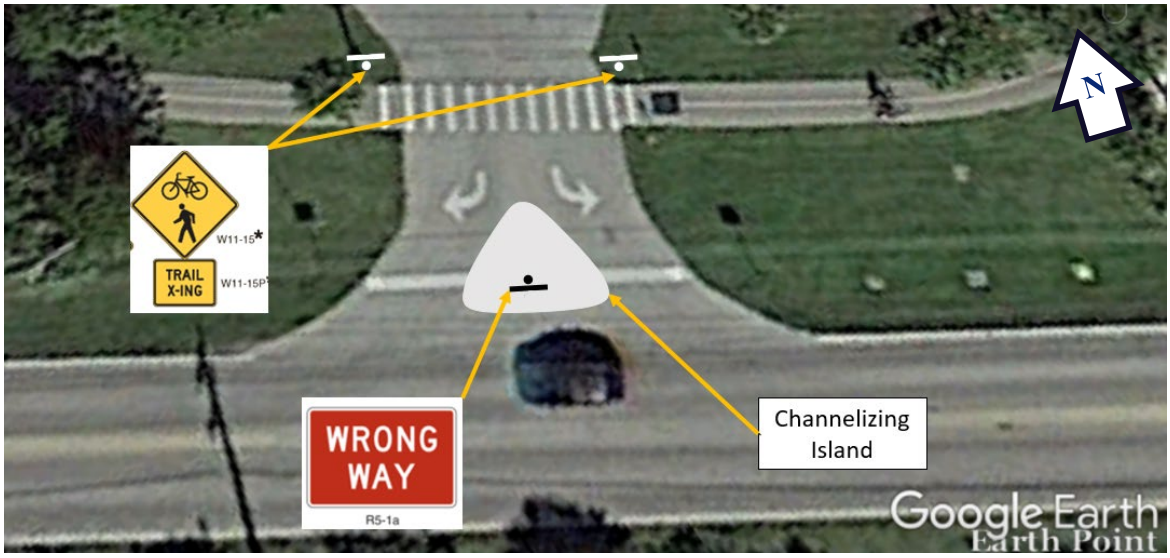


Figure 24. Conceptual Visual of Refuge Parking Exit Alternative, NTS

3.2 Wildlife Drive at Fee Booth

Currently the fee booth location experiences conflicts between all visitor types. There also seems to be confusion to visitors if the fee is applicable to all or only to motorists. One way to alleviate the conflict between cyclists and vehicles is by separating them. This can be achieved by providing a pay area for cyclists and hikers that is apart from vehicles. This will address the cyclists' concerns about breathing in vehicle exhaust while waiting in line. To keep the vehicle line and the cyclists and hikers fee lines moving, it is recommended to either install another toll booth on the right side of the road as depicted in Figure 25, or to have non-motorized visitors pay using a kiosk as depicted in Figure 26. It is also recommended that delineators separate the traffic, and that the crosswalk pavement markings be realigned for either option. This way it aligns towards the fee booth with another crosswalk going from fee booth to Indigo Trail to provide a visual indication for hikers and cyclists that they must also pay a fee.

Figure 25. Two Fee Booths Alternative

Source: GoogleEarth

Figure 26. Add Fee Kiosk Alternative

Source: GoogleEarth

3.3 Tarpon Bay Road

Tarpon Bay Road is currently the only road that connects bicycle rental customers of the Tarpon Bay Concessionaire and the multi-use path along Sanibel Captiva Road. Customers and motorists share the narrow road with no shoulder. There are generally two alternatives to separate vulnerable road users from motorists: add a trail along Tarpon Bay Road or provide a trail elsewhere that provides the customers access to and from the concessionaire and the existing multi-use path. Due to the natural resources encountered on the island, both options would require a field assessment of the wetlands boundaries. A preliminary desktop assessment was done on the Tarpon Bay roadside path option and it is estimated that 0.08 miles could pass through estuarine weltands and 0.04 miles may potentially pass through palustrine wetlands, see Appendix B for Preliminary Wetlands Assessment Memo. It is recommended that the path be installed along the east side of the road to avoid utility poles. It is also recommended that the portion of multi-use path that passes over wetlands be constructed as a boardwalk. The 1000-ft cut-through path option would cross over more wetlands than the Tarpon Bay Road option and would most likely be the more costly option due to wetlands mitigation, the path/boardwalk construction, and tree clearing. In addition to the path, it is recommended the installation of speed humps ahead of the curve and curve delineation as speed management countermeasures. Speed humps are gradual raised areas that have been shown to be effective at lowering speeds up to 10 mph.[5] Curve delineation can be done by providing chevron signs with reflective posts. This countermeasure can potentially reduce non-intersection type crashes of all severities by 27.5-percent. In addition to curve delineation, the curve should be analyzed to be a no passing zone. Per MUTCD standard, no passing zone markings shall be used at horizontal or vertical curves where the passing sight distance is less than minimum distance for it corresponding 85th-percentile or posted speed limit.

Figure 27. Cut Through Shared-Use Path Connectivity Alternative

Source: GoogleEarth

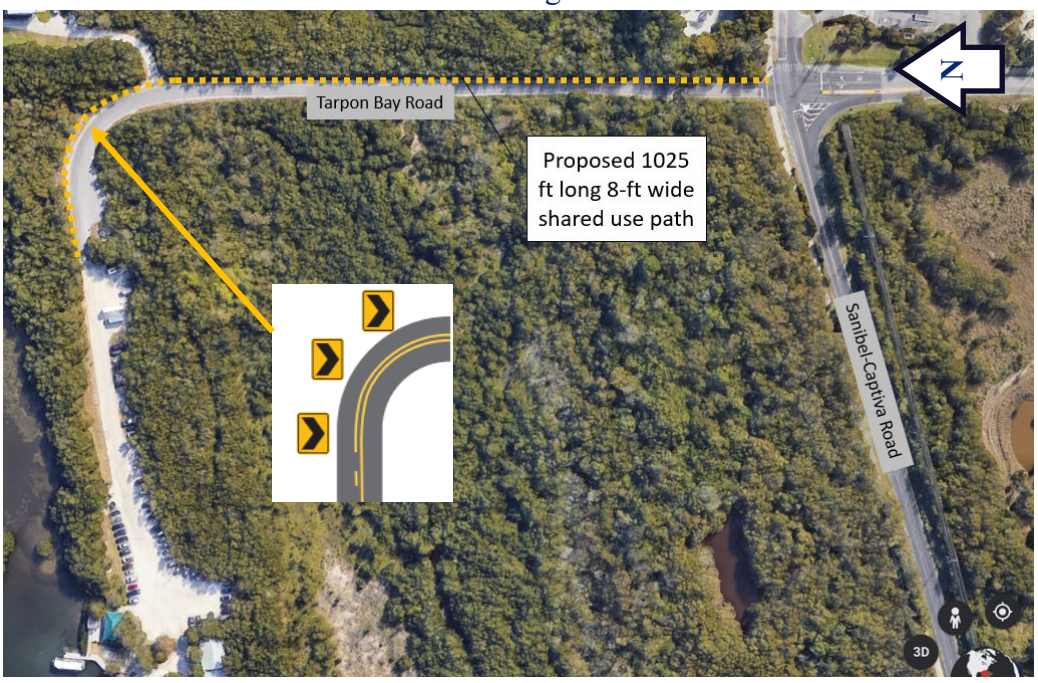


Figure 28. Shared-Use Path Alternative for Tarpon Bay Road Map and Cross Section

Source: GoogleEarth (top) Streetmix (bottom)

3.4 Wildlife Drive at Cross Dike Trail Crossing

At the crossing of Wildlife Drive with Cross Dike Trail there are instances of wrong way driving and biking. There are bathroom facilities at this location, and it seems that numerous visitors want to turn back towards the entrance instead of continuing along the one-way roadway. The roadway at this location is wide and vehicles have enough space to turn around. It is recommended that these movements be discouraged by installing delineators or pavement markings. When selecting delineators, it is recommended that the flexible type be installed in case one gets hit, the delineator bends downward from the bottom and is less likely to get damaged thus creating a maintenance issue. It is also recommended that the existing accessible signage (R7-8) be updated, and the one-way sign (R6-2) directed to cyclists be mounted at a minimum 7 feet height, replaced, and relocated closer to the roadway, see Figure 30. Approaching the first crosswalk, a speed hump is recommended to slow down motorists approaching the crossing, At the first crosswalk, a trail crossing sign (W11-15) and a special plaque that reads 2 XING are recommended to indicate to drivers that there are multiple crossings ahead.

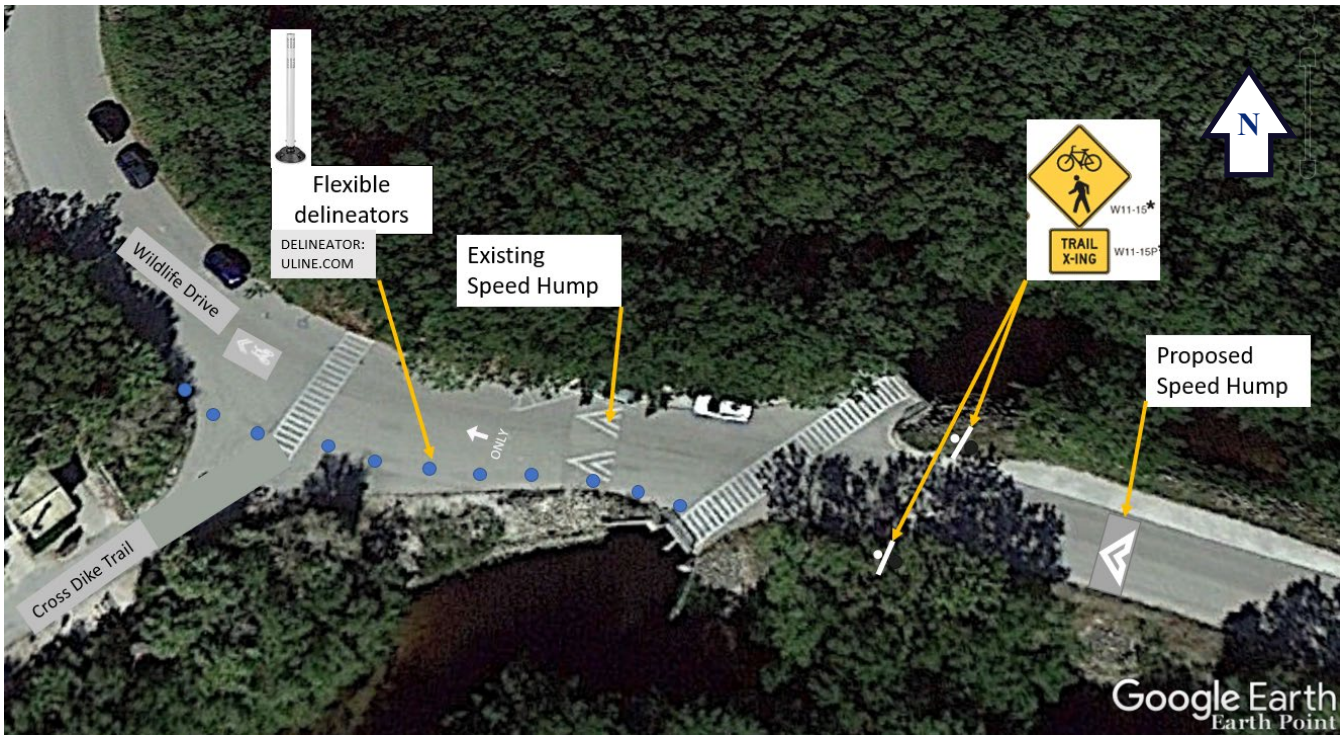


Figure 29. Delineator Delineation Option[3]

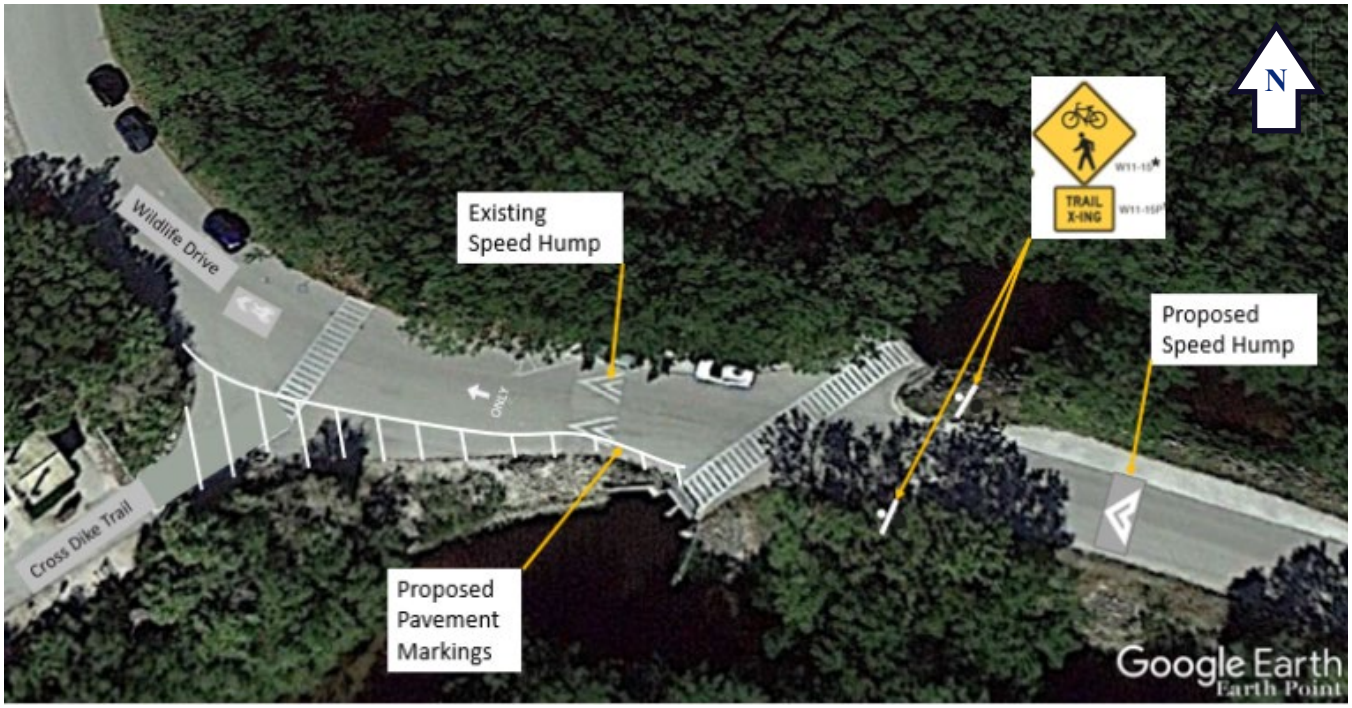


Figure 30. Pavement Marking Delineation Option[3]

Figure 31. Proposed Sign Improvements at Cross Dike Trail Location[3]

3.5 Wildlife Drive at Observation Tower

The observation tower site is a popular site for visitors and one of two tram stops. Due to the high activity at this site, there is congestion between the vehicles, visitors crossing the road, cyclists, wide vehicles such as buses and the tram, and parking maneuvers. To help direct visitor crossing, it is recommended that a crosswalk with crossing signage (W11-15) be placed in front of the observation tower ramp and a speed hump to slow down vehicles approaching this location.

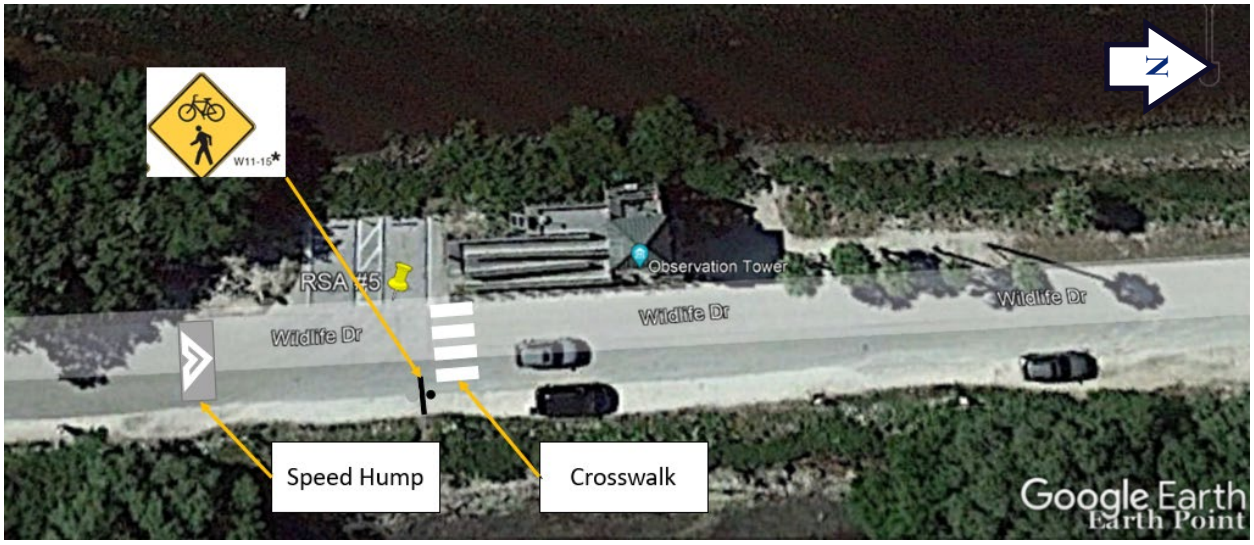


Figure 32. Observation Tower Site Safety Improvements[3]

3.6 Wildlife Drive at Alligator Bend

Wildlife Drive Approaching "Alligator Bend"

This site is the section of Wildlife Drive approaching "alligator bend". The section of Wildlife Road between Calusa Shell Mound Trail Parking and "alligator bend", see Figure 32, is very narrow, approximately 12 feet wide at its narrowest. It is recommended that this roadway section be widened to a minimum of 14 feet, but preferably 16 feet since extra space is needed for the tram and buses.[4]

Figure 33. Wildlife Drive at Alligator Bend

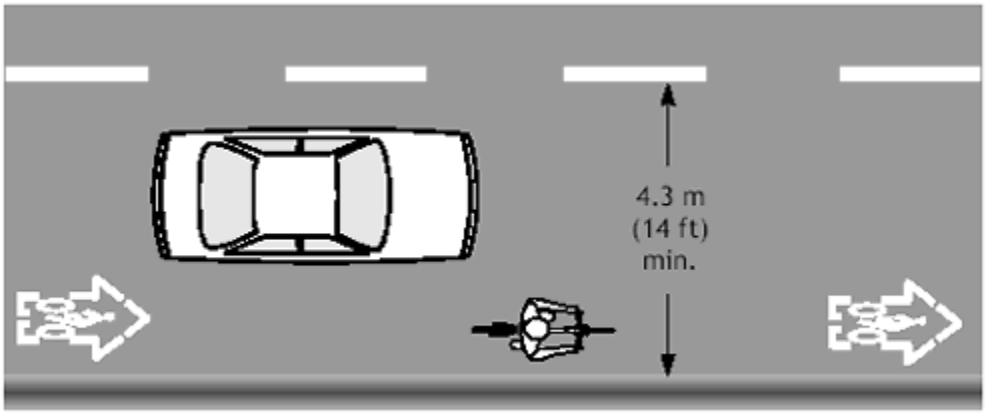


Figure 34. Typical Application of Shared-Use Lane[4]

Wildlife Drive Section between "Alligator Bend" and Sanibel-Captiva Road

At the section of Wildlife Drive between the Refuge's exit and Sanibel Captiva Road, the roadway turns from one way to two way. Currently there are many incidents of cyclists going against traffic on this section of roadway, resulting in near misses between vehicles and bikes. It is recommended that the shared-use path be extended from Sanibel Captiva Road to the Refuge exit and it be placed on the south side of the road to avoid the utility poles. Adding this path would require wetlands in field delineation. A preliminary desktop assessment estimates approximately 350 feet of the proposed shared-use path passes

through wetlands (see memo in Appendix B). Similar to the path for the Tarpon Bay Road site, it is recommended that the portion of multi-use path within wetlands be constructed as a boardwalk. It is also recommended to refresh centerline pavement markings. To address speeding along this segment, it is recommended that speed humps be installed on both sides ahead of the horizontal curve. Lastly, tree trimming to minimize the tree canopy over the road which creates shadows on the vehicles and cyclists.

Figure 35. Shared-Use Path Connectivity Alternative for Wildlife Drive Map and Cross Section

Source: GoogleEarth (top) Streetmix (bottom)

Signage:

A major concern common in all locations of the Refuge was wrong way driving by motorists and wrong way riding by cyclists. It is recommended that a combination of one-way signs (R6-2) and wrong way signs (R5-1a or R5-1b and R9-3cP) be installed at key locations where it has been observed this behavior exists, and throughout the refuge at every half mile or so. This sign spacing should be enough to convey the message to visitors without causing a maintenance issue during mowing and trimming operations.

Figure 36. One Way and Wrong Way Signage[3]

Pavement Markings:

In addition to signage, it is recommended that pavement markings be used to communicate one-way driving with an arrow with the text "ONLY". Also, bicycle shared-use lane markings, also referred to as sharrows, indicate the correct direction to drive and ride. It is recommended in MUTCD guidance that the shared-use lane markings be placed at least 11 feet from the edge of pavement on streets with parallel parking, and in locations where the street is less than 14 feet wide and in locations where there is no parallel parking, the markings should be at least 4 feet from the edge of pavement. It is also recommended that sharrows be placed immediately after an intersection and spaced out in intervals no greater than 250 feet. We recommend the same spacing, every 250 ft, be followed for the one way pavement markings.

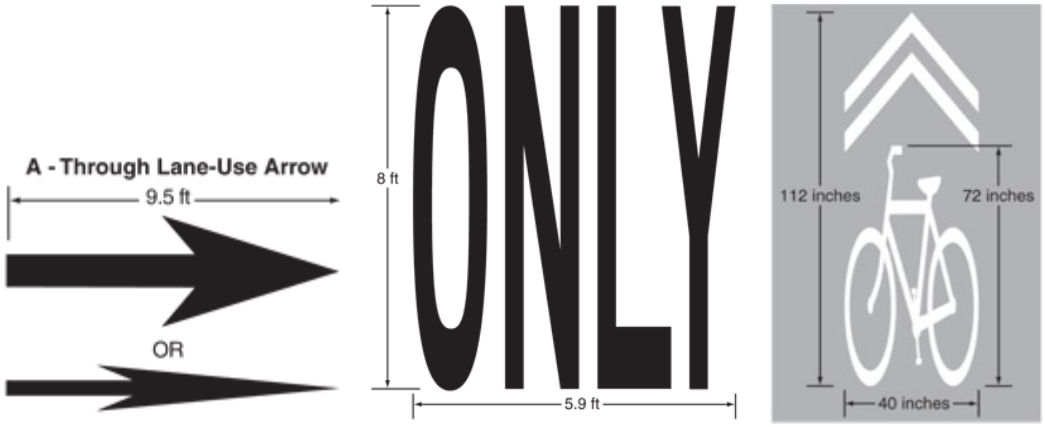


Figure 37. Suggested Pavement Markings for One Way Driving and Bicycle Shared-Use Lanes[3]

3.7 Funding Opportunities:

A project to provide trail connectivity from the Refuge to Sanibel Island's existing system can qualify for funding under the Federal Lands Access Program (FLAP). The FLAP was established in 23 U.S.C. 204 to improve transportation facilities that provide access to, are adjacent to, or are located within Federal lands. The Access Program supplements State and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on high-use recreation sites and economic generators. The Access Program is funded by contract authority from the Highway Trust Fund and subject to obligation limitation. Funds are allocated among the States using a statutory formula based on road mileage, number of bridges, land area, and visitation. Projects are selected by a Programming Decision Committee (PDC) established in each State. The PDCs request project applications through a call for projects. The frequency of the calls is established by the PDCs.

4 Conclusion

The J.N. Ding Darling National Wildlife Refuge identified six locations with the highest potential for safety improvements. These locations are:

- Site 1: Refuge Entrance and Parking Area
- Site 2: Wildlife Drive at Fee Booth
- Site 3: Tarpon Bay Drive
- Site 4: Wildlife Drive at Cross Dike Trail Crossing
- Site 5: Wildlife Drive at Observation Tower
- Site 6: Wildlife Drive before and after "Alligator Bend"

On July 27, 2022 a road safety audit was conducted that included a multi-disciplinary team to discuss safety concerns and possible countermeasures. Pavement edge drop offs were a concern on Site 1's

entrance driveway. This site also encountered near misses between vehicles and bicycles, small turning radii, and wrong way driving. Site 2 is where visitors pay the entrance fee and sometimes visitors walking or biking get confused on whether they have to pay as well, since there is one pay booth for motorized and non-motorized visitors. Site 3 is Tarpon Bay Drive and the main route for bike renters to get to and from the multi-use path on Sanibel Captiva Road where they currently have to share the road with vehicles that oftentimes speed along the roadway. There are bathrooms located at Site 4 and sometimes visitors both vehicular and cyclists go against traffic when they leave to try to avoid traveling the rest of Wildlife Drive causing near misses and congestion. The observation tower at Site 5 is a popular destination for wildlife watching and gets congested with visitors trying to park, bus or tram drop offs, cyclists, and visitors crossing the street. Lastly, Site 6 contains a narrow segment approaching “alligator bend” whose width does not allow a wide vehicle like a bus to pass a cyclist. The segment connecting the Refuge exit to Sanibel Captiva Road experiences near misses from cyclists that frequently are going against traffic and motorists.

Potential safety improvements per site were discussed in the report, including general improvements such as signage and pavement markings to help deter wrong way riding/ driving throughout the Refuge. The following table provides a summary of the recommendations discussed in this report and the following map provides a reference of where the recommendations can be implemented.

Countermeasure	Potential Crash Reduction[7]	Countermeasure Implementation Applicable to:						Implementation Term*
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	
Widen pavement (1' widening)	3% injury crashes	X						long
Safety Edge	11% total crashes	X						long
Concrete Pavers (2' wide)	N/A	X				X		medium
Arrow/ ONLY Pavement Markings	N/A	X	X	X	X	X	X	medium
High Visibility Crosswalks[6] with trail crossing sign	40% veh/ ped crashes	X	X	X	X	X	X	medium
Speed hump	50% all crash types/ all injury severities			X	X	X	X	long
Chevrons with reflective post	27.5% non-intersection type crashes, all severities			X				short
Shared-Use Path Pavement Markings	N/A	X	X	X	X	X	X	medium
One Way/ Wrong Way Sign Assembly	N/A	X	X	X	X	X	X	short
Shared-Use Path (8 ft wide)	25% veh/ bicycle crashes			X			X	long
Reconfigure Parking Lot	N/A	X						long
Install additional fee booth	N/A		X					long
Fee booth kiosk	N/A		X					long
delineators	N/A		X		X			short
Upgrade existing signage (retroreflectivity)	15% injury crashes	X	X	X	X	X	X	short
Tree and Shrub maintenance	N/A	X					X	short
Channelizing Island	N/A	X						long
Wetlands Mitigation	N/A			X			X	long
*Implementation Terms:								
short term <6 months								
mid-term >6 months to 1 year								
long term >1 year								


Wulfert Keys Trail
Shell Mound Trail
Site 6
Site 5 (Observation Tower)
Site 4
Cross Dike Trail
Wildlife Dr
Sanibel- Captiva Conservation Foundation Marine Lab
Tarpon Bay
Site 2
Indigo Trail
Site 1
Tarpon Bay Explorers
Site 3
Visitor's Center
Sanibel Island
Sanibel Captiva Rd
Tarpon Bay Rd
Legend:
Shared Use Path
Trail
Google Earth

1. Florida Traffic Online, available online at https://tdaappsprod.dot.state.fl.us/fto/, accessed July19, 2022.

2. *Sanibel Public Facilities,* available online at https://finnimores.com/pick-a-path/, accessed July19, 2022.

3. MUTCD, 2009 Edition, published by FHWA at https://mutcd.fhwa.dot.gov/pdfs/2009/pdf_index.htm

4. *Federal Highway Administration University Course on Bicycle and Pedestrian Transportation, Lesson 14: Shared Roadways,* Publication No. FHWA-HRT-05-111, Federal Highway Administration, July 2006, available online at https://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/pdf/lesson14lo.pdf, accessed October 24, 2022.

5. *Speed Management Countermeasures: More than Just Speed Humps,* Publication No. FHWA-SA-16-077, Federal Highway Administration, available online at https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa16077/fhwasa16077.pdf, accessed October 25, 2022.

6. *Crosswalk Visibility Enhancements Safe Transportation for Every Pedestrian Countermeasure Tech Sheet*, Publication No. FHWA-SA-18-061, June 2018, available online at https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheet_VizEnhancemt2018.pdf, accessed October 25, 2022.

7. *Crash Modification Factors Clearinghouse,* Federal Highway Administration, available online at https://www.cmfclearinghouse.org/, accessed October 25, 2022.

8. *Sanibel Crosswalk Policy*, City of Sanibel, Resolution No.13-081, available online at http://www.mysanibel.us/admin/04%2013-081%20Crosswalk%20Policy%20and%20Document%20(002).pdf, accessed October 24, 2022.

Appendix A

Cost Estimates

Countermeasure	Cost	Unit	Quantity	Quantity Breakdown							Total
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Refuge	
Concrete Pavers (2' wide)	$400.00	SY	300	300							$120,000.00
Straight Arrow Pavement Markings	$150.00	EA	93				1	1		91	$13,950.00
ONLY Pavement Markings	$150.00	EA	93				1	1		91	$13,950.00
High Visibility Crosswalks, Thermoplastic (ladder)	$3.00	LF	2300	300	1500			500			$6,900.00
Trail Crossing Warning Sign Assembly	$150.00	SF	46.25	18.5			18.5	9.25			$6,940.00
Speed hump	$4,000.00	EA	5			1	1	1	2		$20,000.00
Chevrons with reflective post	$150.00	SF	24			24					$3,600.00
Shared Use Path Pavement Markings	$150.00	EA	93				1	1		91	$13,950.00
One Way/ Wrong Way Sign Assembly (bike)	$150.00	SF	16				8	8			$2,400.00
One Way/ Wrong Way Sign Assembly	$150.00	SF	88							88	$13,200.00
Shared Use Path (8 ft wide boardwalk)	$2,500.00	LF	990			640			350		$2,475,000.00
Shared Use Path (8 ft wide paved)	$125.00	SY	1250			350			900		$156,250.00
Reconfigure Parking Lot (new paved areas)	$500.00	TON	3120	3120							$1,560,000.00
Reconfigure Parking Lot (pavement markings)	$3.00	LF	4400	4400							$13,200.00
Reconfigure Parking Lot (curb)	$65.00	LF	240	240							$15,600.00
Install additional fee booth (option)	$30,000.00	LPSM	1		1						$30,000.00
Fee booth kiosk (option)	$25,000.00	LPSM	1		1						$25,000.00
delineators, flexible	$200.00	EA	12		4		8				$2,400.00
tree removal	$750.00	EA	3	3							$2,250.00
Channelizing Island	$200.00	SY	20	20							$4,000.00
Wetlands Mitigation	$150,000.00	AC	0.23			0.15			0.08		$34,500.00
										Subtotal	$4,533,090.00
										Mobilization, Testing, and Other Contingencies (35%)	$6,119,671.50
										Rounded Total	$6,200,000.00

Appendix B

Desktop Wetlands Assessment Memo

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **Preliminary Wetland Assessment of two potential trail improvement locations**, JN "Ding" Darling National Wildlife Refuge, Sanibel Island, FL

Date: 10/20/2022

From: Ryan Kimberley
Environmental Protection Specialist

To: Yanira Rivera
Civil Engineer, Safety

General information: The refuge is located on the north side of Sanibel Island, a barrier island in the Gulf of Mexico along Florida's west coast. The 5,200 acre refuge contains extensive natural resources including one of the largest mangrove ecosystems in the United States. Much of the refuge contains the following wetland habitats:

- marine deepwater: these are the open waters of the ocean overlying the continental shelf
- estuarine: this includes tidal wetlands, intertidal areas, and transitional areas between the marine deepwater and the shore.
- Palustrine: All nontidal wetlands dominated by tree, shrubs, and other freshwater-tolerant species. These are inland freshwater wetlands.
- Developed portions of the refuge, including roadways, parking lots, trails, etc. are located in upland (non-wetland) areas to the extent possible.

Wetlands are ecologically important, especially those in coastal/estuarine areas. Projects should be designed to avoid and minimize impacts to wetlands. Unavoidable impacts may be subject to compensatory mitigation. Mitigation involves the preservation and/or restoration of wetlands, usually within the same drainage basin, to compensate for wetlands impacted by construction. Wetland mitigation usually requires compensation at greater than a 1:1 ratio, especially for highly-sensitive coastal wetlands.

Preliminary Wetland Identification: The National Wetlands Inventory (NWI) contains information about wetlands throughout the United States. The data is typically photo interpreted from satellite imagery, meaning the data has not been confirmed in the field or reviewed/approved by the US Army Corp of Engineers. Information obtained from NWI is for planning purposes only. A wetland delineation should be conducted, and a jurisdictional determination should be obtained from the US Army Corp of Engineers prior to finalizing mitigation plans or applying for permits.
https://www.fws.gov/program/national-wetlands-inventory

SITE 1: Sanctuary Road: This design would include the construction of an approximately 0.25 mile long pedestrian walkway along the south/east side of Sanctuary Road from Sanibel Captiva Road to the refuge boundary near Caloosa Drive. Most of this trail would be located in upland areas adjacent to a row of houses (SEE ATTACHED NWI MAP). The easternmost segment of

trail, approximately 0.07 miles (350 feet), would pass through land identified as potentially estuarine and marine wetland (E2FO3N, see description below). If a ten foot wide trail were constructed through this area, the resulting impacts would be less than 1/10 acre. Wetland Impacts greater then 1/10 acre typically require mitigation to obtain an Army Corp/Section 404 permit. State and local mitigation requirements for lower thresholds may also apply. As mentioned above, field verification of the actual wetland boundaries is needed.

Classification code: E2FO3N

System **Estuarine (E)** : The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines, there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (Rhizophora mangle) and eastern oysters (Crassostrea virginica), are also included in the Estuarine System.
Subsystem **Intertidal (2)** : The substrate in these habitats is flooded and exposed by tides; includes the associated splash zone.
Class **Forested (FO)** : Characterized by woody vegetation that is 6 m tall or taller.
Subclass **Broad-Leaved Evergreen (3)** : Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g. red mangrove (Rhizophora mangle).
Water Regime **Regularly Flooded (N)** : Tides alternately flood and expose the substrate at least once daily.

Site 2: Tarpon Bay Road (SEE ATTACHED NWI MAP). A pedestrian access trail is proposed along Tarpon Bay Road to connect the Sanibel Captiva Road with the Tarpon Bay Kayak launching site, a distance of 0.3 miles. Tarpon Bay Road is constructed on natural and/or manmade uplands surrounded by wetlands. It is possible that a pedestrian trail located immediately adjacent to the vehicular road could avoid/minimize the need for additional wetland fill. A wetland delineation would help identify the exact wetland/upland boundaries and help guide the project design. A preliminary assessment of suggests that the proposed route could pass through 0.08 miles of potential estuarian (E2SS3/EM1Pd, see description below) and 0.04 miles of palustrine wetlands (PSS3A , see below). If a ten foot wide trail is constructed, it is possible that the impacts could exceed 1/10 acre and require wetland mitigation.

Classification code: E2SS3/EM1Pd

System **Estuarine (E)** : The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines, there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (Rhizophora mangle) and eastern oysters (Crassostrea virginica), are also included in the Estuarine System.
Subsystem **Intertidal (2)** : The substrate in these habitats is flooded and exposed by tides; includes the associated splash zone.
Class **Scrub-Shrub (SS)** : Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.

Subclass **Broad-Leaved Evergreen (3)** : Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g. red mangrove (Rhizophora mangle).
Split Class **Emergent (EM)** : Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
Split Subclass **Persistent (1)** : Dominated by species that normally remain standing at least until the beginning of the next growing season. This subclass is found only in the Estuarine and Palustrine systems.
Water Regime **Irregularly Flooded (P)** : Tides flood the substrate less often than daily.
Special Modifier **Partially Drained/Ditched (d)** : A partly drained wetland has been altered hydrologically, but soil moisture is still sufficient to support hydrophytes. Drained areas that can no longer support hydrophytes are not considered wetland. This Modifier is also used to identify wetlands containing, or connected to, ditches. The Partly Drained/Ditched Modifier can be applied even if the ditches are too small to delineate. The Excavated Modifier should be used to identify ditches that are large enough to delineate as separate features; however, the Partly Drained/Ditched Modifier also should be applied to the wetland area affected by the ditching.

Classification code: PSS3A

System **Palustrine (P)** : The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 ft) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt.
Class **Scrub-Shrub (SS)** : Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.
Subclass **Broad-Leaved Evergreen (3)** : Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g. red mangrove (Rhizophora mangle).
Water Regime **Temporary Flooded (A)** : Surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.

SUMMARY: The two trail proposals have the potential to impact wetlands. Site 1 would likely impact less than 1/10 acre. Site two could impact more than 1/10 acre, depending on the exact upland boundaries of the existing roadways. If the two projects are designed together, it is likely that the combined wetland impacts would exceed 1/10. A wetland delineation is recommended to confirm the wetland/upland boundaries. This will help designers avoid and minimize impacts by utilizing upland areas. Embankment/fill can be minimized by using steeper slopes, MSE walls, etc. Boardwalks may be preferable in wetland portions of the trail.

U.S. Fish and Wildlife Service

National Wetlands Inventory

Sanctuary Road

October 20, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

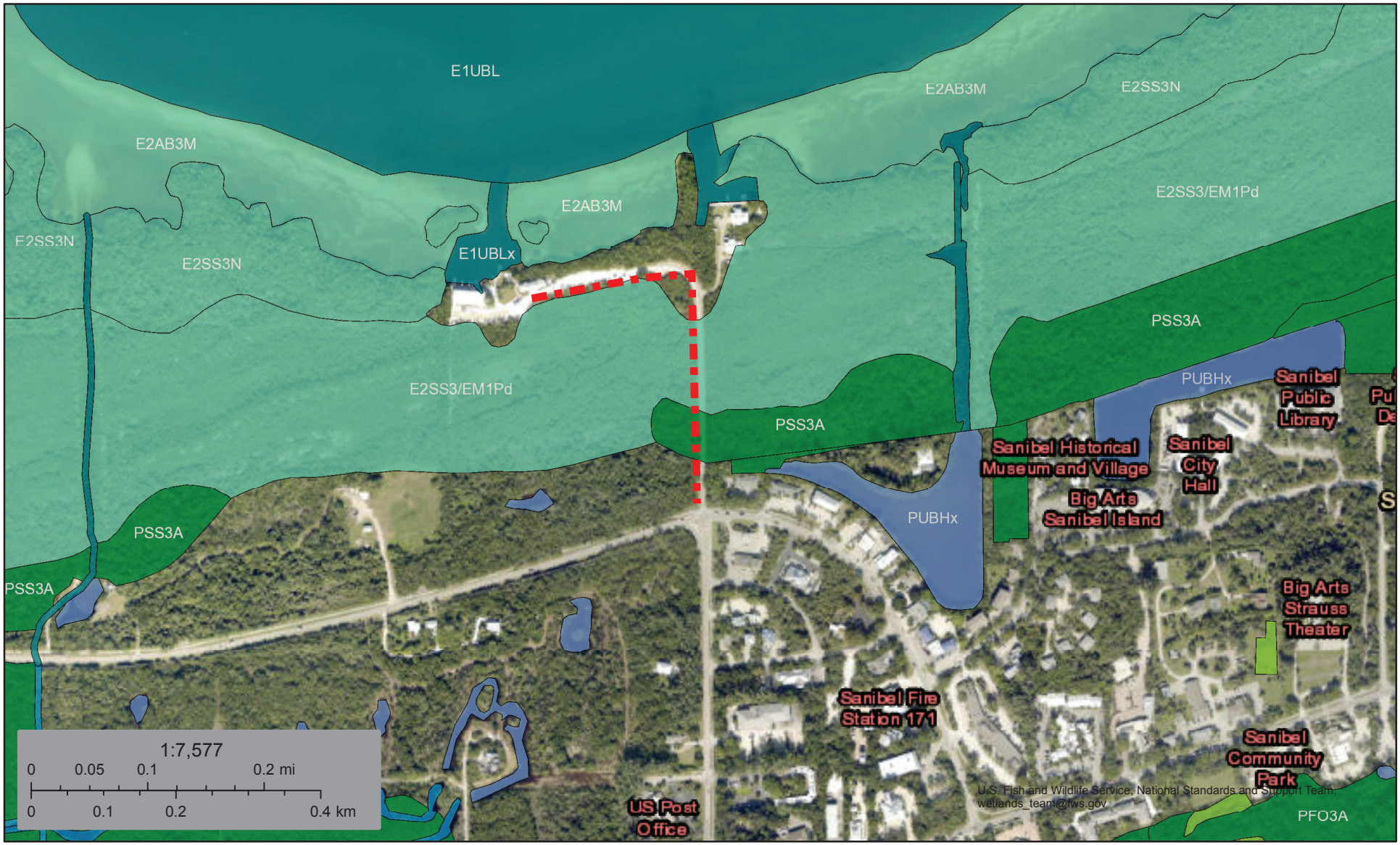
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Pedestrian Path

U.S. Fish and Wildlife Service

National Wetlands Inventory

Tarpon Bay Road



October 20, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

Pedestrian Trail