UniverCity Year

Better • Places • Together

2020-2021

Village of Egg Harbor STH 42 Reconstruct

Preliminary Engineering Report

CIVIL & ENVIRONMENTAL ENGINEERING 578: SENIOR CAPSTONE

UniverCity Alliance
UNIVERSITY OF WISCONSIN-MADISON

SELECT ENGINEERING SERVICES

October 15th, 2020

To: Jan Kucher, PE
Adjunct Professor
University of Wisconsin-Madison
Room 2346 Engineering Hall
Madison, Wisconsin 53706

RE: Preliminary Design Report _ Engineering Services for Highway 42 Corridor Improvements in the Village of Egg Harbor, Wisconsin

Dear Mr. Kucher,

Select Engineering Services has enclosed a preliminary design report looking at alternatives for the design of the State Trunk Highway 42 (STH 42) corridor in the Village of Egg Harbor. The site consists of approximately 7,000 ft between County Trunk Highway (CTH T) and Church Street. These design alternatives focus on improving multi-modal access and safety for vehicles, bicyclists, and pedestrians throughout the highway. Further design considerations, such as stormwater management and corridor aesthetics will be incorporated into the chosen design alternative.

In order to begin the preliminary design, our team visited the Village to gain insight on how the STH 42 currently services the community. We then collected data and started forming three potential alternatives to meet the needs of the Village. Our alternatives include two-way left turn lane, a mini roundabout, and signaling of an intersection. These were then put through a decision matrix to determine which option best meets the needs of the community. A preferred alternative was then chosen.

Select Engineering Services is grateful to work with the Village of Egg Harbor on the STH 42 corridor. Once approved by the Village of Egg Harbor, our team will move forward with the detailed design of the mutually agreed alternative. If you have any questions or concerns, please contact me.

Sincerely,

Student Liaison
Project Manager
Select Engineering
CEEstudent@wisc.edu

PRELIMINARY ENGINEERING REPORT

Village of Egg Harbor
STH 42 Reconstruct

Prepared by:

SELECT ENGINEERING SERVICES

Prepared for:
Jan Kucher, PE
Adjunct Professor
University of Wisconsin-Madison
Room 2346 Engineering Hall
Madison, Wisconsin 53706

Disclaimer

The concepts, drawings and written materials provided here were prepared by students in the Department of Civil & Environmental Engineering at the University of Wisconsin-Madison as an activity in the course Civ Engr 578 – Senior Capstone Design/GLE 479 – Geological Engineering Design. These do not represent the work products of licensed Professional Engineers. These are not for construction purposes.

Executive Summary

Project Background

Select Engineering Services was selected by the Village of Egg Harbor, Wisconsin to provide engineering services for the design and construction of improvements along a section of State Trunk Highway (STH) 42. Figure 1 shows the project limits. STH 42 is a two-lane highway classified as a minor arterial. During the tourism season, primarily the summer months, congestion occurs within the Village due to lack of turn lanes and pedestrian facilities. The Average Annual Daily Traffic (AADT) of the facility ranges from 12,000 to 14,000 during the summer tourism season. The primary needs for the project are congestion reduction, improving multimodal travel and connectivity within the Village, and maintaining the quaint feel of the community.

Figure 1: Overview of project location.

Design Challenges

The following challenges and constraints will be considered during the design and construction phases for the STH 42 reconstruction project.

Economic

The Village of Egg Harbor has provided a budget of $7,000,000 for this project. This includes the engineering work during the design phase, the cost of construction, and the cost of materials for construction. Over 40 local businesses are situated along the project site. Construction could hinder the income of these businesses. Steps will need to be taken to minimize this risk.

Environmental

The Village of Egg Harbor is bordered to the west by Green Bay, a part of Lake Michigan. It is important to maintain the cleanliness of the bay within the project limits. Because this project is located in an area of heavy snowfall, the onsite stormwater treatment facilities will be designed to remove deicing agents from the water before discharging into Green Bay.

Social

The Village of Egg Harbor is a regional hub for tourists, especially during the summer months. Staging construction to maintain flow and access to businesses along the corridor would be taken into consideration. Another strong consideration for the design phase is maintaining the quaint feel and aesthetic of the Village. Community members and Village officials have emphasized aesthetics as a top priority for this project.

Political

The right of way along the STH 42 corridor is limited. To provide a reconstruction that satisfies the desires of the Village, Right-of-Way acquisition will need to be limited. During certain phases of construction,

access to some properties may be closed, which could reduce revenues to businesses. Maintaining access to properties and businesses will be considered for the construction phase.

Ethical

The project will be completed by abiding by the National Society of Professional Engineers (NSPE) Code of Ethics for Engineering. The Village of Egg Harbor is a Green Tier Legacy community, our team will work to meet the expectations set by Green Tier Legacy for the Village of Egg Harbor to continue its enrollment in the program.

Health & Safety

Providing adequate bicycle and pedestrian facilities is important to help increase the wellbeing of the residents and tourists of the Village. Although remaining within the budget is important, safety is of utmost importance. The focus of the project will be on increasing safety for vehicles, pedestrians, and bicyclists along the corridor.

Constructability

There are businesses and residential properties close to the STH 42 corridor, so construction efforts will operate within the existing roadway footprint to limit adverse impacts to the neighboring properties. This may limit the design options along the corridor. If necessary, a detour route may be developed to reduce the number of vehicles traveling through the construction site. To the west side of STH 42, the slope approaching the bay waters is steep. This could provide challenges in constructing the west side of the highway to reduce erosion and the amount of fill material needed.

Sustainability

Economic, environmental, and social sustainability needs for this project will be evaluated. The alternative which has the highest level of sustainability was chosen. We will consider American Society of Civil Engineers Envision (ASCE Envision) guidelines for providing a green project. The materials needed for this reconstruction project will be locally sourced to reduce material transport costs. Public involvement will be used to assess community desires and views.

Alternatives

The intersection of STH 42 and Horseshoe Bay Road was focused on for the traffic designs, as congestion and other traffic conditions are of the greatest concern here. Each of the alternatives provide a unique traffic design at this intersection, with similarities at other locations and intersections.

Alternative 1 (Two-Way Left-Turn Lane (TWLTL) with Bike Lanes): A TWLTL will be implemented from Harbor School Road to Orchard Road. The TWLTL will replace the current left-turn lane at the Horseshoe Bay intersection for northbound movements along STH 42. Figure 2 shows the typical section for the planned design at the Horseshoe Bay intersection. From Orchard Road to Church Street, new parking stalls will be added along both sides of STH 42 where space is available. Bike lanes will be added along both sides of STH 42. All pedestrian facilities will be redesigned and reconstructed.

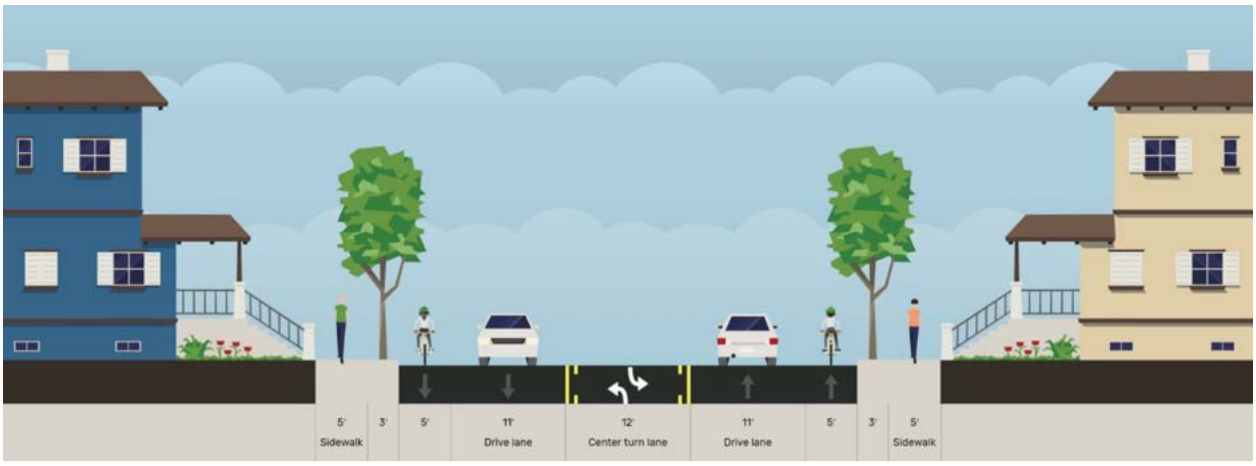


Figure 2: Proposed typical section including a TWLTL.

Alternative 2 (Mini Roundabout at Horseshoe Bay Road with TWLTL elsewhere): A mini roundabout will be constructed at the Horseshoe Bay intersection. The mini roundabout should reduce the number of sideswipe crashes near the intersection. A TWLTL will be implemented at applicable locations along the corridor where it is warranted. Bike lanes and pedestrian facilities will also be developed, similar to Alternative 1.

Alternative 3 (Signalized Intersection at Horseshoe Bay Road): A signalized intersection will be utilized at the Horseshoe Bay intersection. This design provides safe pedestrian movement with a pedestrian phase, which should improve safety for both vehicles and pedestrians. Figure 3 shows a typical section for the planned design at the Horseshoe Bay intersection. A TWLTL will be implemented where applicable, and both bike lanes and pedestrian facilities will be developed, similar to Alternative 1.

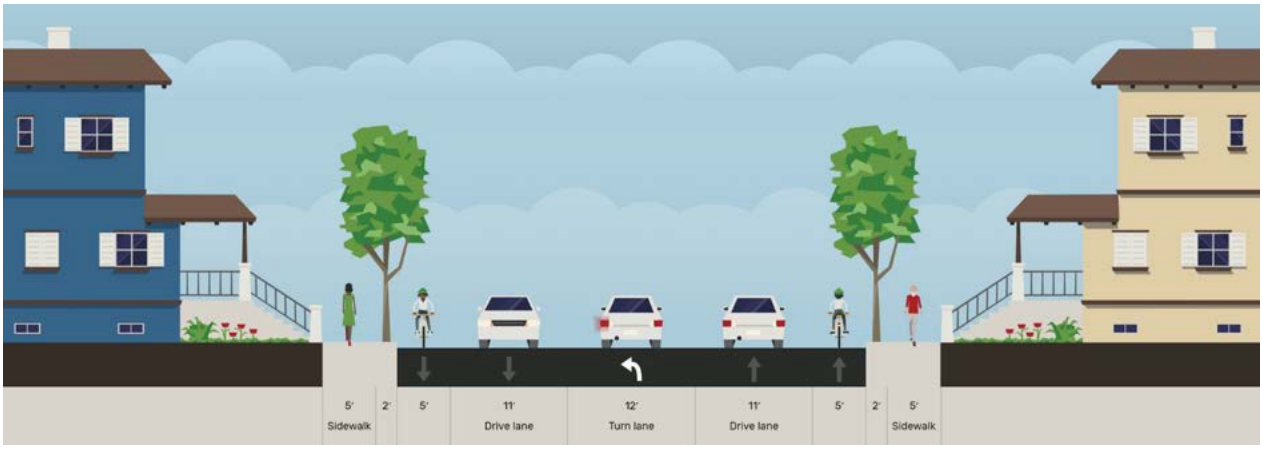


Figure 3: Proposed typical section for turn lane at Horseshoe Bay Road.

Alternative Comparison

A decision matrix was utilized to compare the design alternatives. In addition to this, the pros and cons for each alternative were compared relative to one another.

Decision Matrix

The results from the weighted decision matrix are shown in Table 1. Seven criteria were used to assess each alternative. The weighted values were assigned based on their relative importance compared to the other criteria. The most weighted criteria are public satisfaction and construction cost. This project is located in a community that is proud of the quaintness. Therefore, public satisfaction is the most heavily weighted criteria. Other criteria such as constructability, time to completion, and sustainability are considered. These seven criteria carry varying weights; however, all are important in selecting the preferred alternative.

Table 1: Weighted Decision Matrix.

Criteria	Weight	Alternative 1	Weighted Score	Alternative 2	Weighted Score	Alternative 3	Weighted Score
Public Satisfaction	25%	4	1.00	2	0.50	3	0.75
Construction Cost	15%	5	0.75	5	0.75	5	0.75
Constructability	15%	3	0.45	2	0.30	4	0.60
Environmental Impact	15%	4	0.60	3	0.45	4	0.60
Time to Completion	15%	4	0.60	3	0.45	3	0.45
Lifetime	10%	4	0.40	3	0.30	4	0.40
Sustainability	5%	4	0.20	2	0.10	3	0.15
Sum	100%		**4.00**		**2.85**		**3.70**

Opinion of Probable Construction Cost (OPCC)

A summary of the costs for the required items and quantities related to Alternative 1 can be found in Table 2. A 20 percent contingency was added to the total cost to account for uncertainty. At the moment, the chosen Alternative is well below the budget of $7,000,000. Currently, the projected cost for the selected Alternative is $2,832,000. The design of Alternative 1 will continue to develop as further research is gathered for the Village of Egg Harbor.

Final Recommendation

The decision matrix concludes that Alternative 1 (TWLTL with Bike Lanes) is the desired project to implement. This alternative consists of the lowest cost, time to completion, and environmental impact. It also has the highest public satisfaction, the best form of sustainability, and the longest lifetime. This alternative should improve multimodal travel within the Village and downtown area, as well as maintain the quaint feel of the community.

Project Schedule

The estimated timeline for the project is September 2020 to December 2023. Roughly 2 years will be spent on the planning and permitting phases. Construction is expected to begin in 2023. The Village would like to coordinate this project with the WisDOT milling and resurfacing project scheduled for 2023. Constructing these projects concurrently will maximize the return on investment for both the Village and WisDOT.

Table of Contents

List of Figures

List of Tables

Purpose and Scope

Project Background

Select Engineering Services was selected by the Village of Egg Harbor to provide engineering services pertinent to the reconstruct of STH 42 from County Trunk Highway T (CTH T) to Church Street (seen in Figure 1). STH 42, also known as Egg Harbor Road, is a minor arterial that runs through Door County and serves Egg Harbor as a primary access point to more than 40 local businesses. In the past decade, Egg Harbor has transitioned to a tourist destination while remaining a quaint harbor community. STH 42 experiences frequent congestion due to the number of tourists during the summer months. Because the downtown Egg Harbor area spans less than a mile, the downtown area is a prime location for walking and bicycling. With the increase in tourism, the Village of Egg Harbor desires to "maintain the quaint" while accommodating all modes of transportation to reduce congestion and pollution. Egg Harbor requires updated parking accommodations, the addition of bike lanes, and improved sidewalks and intersections to achieve this goal and help create a socially sustainable Village.

Figure 1: Overview of project location.

Client Background

The Village of Egg Harbor located in Door County, Wisconsin, is a vibrant resort community of about 250 year-round and 2,500 seasonal residents. Figure 2 shows the location of Egg Harbor within Door County. The Village of Egg Harbor is the first Green Tier Legacy Community in Door County. This voluntary program rewards environmental performance that exceeds legal requirements related to health and safety. The Village has also participated in multiple Sustainable Initiative Projects, including recycling, eliminating Styrofoam and plastic waste, and diverting waste from landfills.

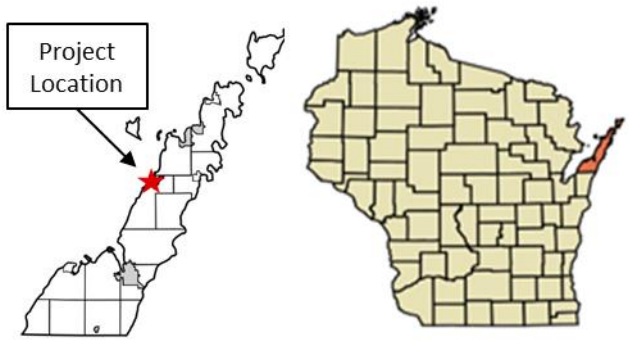


Figure 2: Village of Egg Harbor location map

Client Needs

The Village of Egg Harbor has listed various requests that shall be considered throughout the STH 42 corridor project. As a Green Tier Legacy member, the Village of Egg Harbor necessitates an improvement

in air quality by reducing congestion and the number of vehicle miles traveled. The Village has identified the lack of turn lanes as the primary cause of congestion, specifically during the tourist season. To reduce the number of vehicle miles traveled, the Village desires increased parking spaces to meet the parking demand and promote a "park once" mentality for community members and guests. The "park once" mentality will allow residents and tourists to park once before traversing the Village on foot and bicycle. The desired outcome is to allow for pedestrians and bicyclists to feel safe on foot throughout the downtown area.

The on-street parking spaces also need to be reconfigured to improve crosswalk visibility. Both pedestrians and drivers currently struggle to see one another because of the parked vehicles near the crosswalks. An example of this is shown in Figure 3. This creates situations where pedestrians either slowly move their way into the street to get a better view of oncoming traffic or quickly cross to try and avoid traffic. This is a safety concern and will be explored to improve safety for all modes of travel.

Figure 3: Example of the limited vision of oncoming traffic for pedestrians at a crosswalk

To further encourage the "park once" mentality and reduction of vehicle miles traveled, the Village needs adequate bike and pedestrian facilities for safe and effective multi-modal travel. On-street bike lanes and sidewalks compliant with the Americans with Disabilities Act (ADA) that provide links to the downtown area of Egg Harbor as well as other destinations within the Village are required. The Village desires either exclusive bike lanes on both sides of STH 42 or shared bicycle and vehicle parking lanes throughout STH 42. To improve safety and movement of pedestrians, enhanced crosswalk pavement markings and the addition of pedestrian flashing lights are desired.

Other anticipated improvements include streetscaping, stormwater revisions, and on-site stormwater treatment prior to discharge to Green Bay. New or repurposed streetlights will be selected to enhance lighting of the downtown area to improve safety for all modes of travel. All other overhead utilities are to be relocated underground to enhance the quaint feel of the Village. Currently, all stormwater from the highway leads to one outflow point near the Village Marina. A form of erosion control measure is recommended at an onsite treatment facility before discharging stormwater into Green Bay. Stormwater management that exceeds required standards may be desired by the Village.

Existing Conditions and Future Needs

STH 42 is designated as a 65' restricted route. Therefore, no vehicle larger than 65 feet in length may travel on STH 42 in Egg Harbor.

Traffic Volume

Average Annual Daily Traffic (AADT) and hourly volumes exist on STH 42 just north and south of Horseshoe Bay Road. AADT and hourly volumes were counted on Horseshoe Bay Road west of STH 42. These volumes were used to estimate the turning movements during the AM and PM peak hours at the intersection of STH 42 with Horseshoe Bay Road. Current AADT data shows that approximately 6800 vehicles travel on STH 42 north of Horseshoe Bay Road per day. Currently, no pedestrian information is available from the Wisconsin Department of Transportation, so the pedestrian volumes were not considered in the preliminary analysis. Without pedestrians, the control delay per vehicle is less than ten seconds. The existing Level of Service at the intersection of STH 42 with Horseshoe Bay Road is A, so this intersection flows vehicles through efficiently with the current stop control. The Level of Service values are the accepted values published by the Highway Capacity Manual (HCM). When the number of pedestrians is included in the traffic analysis, the delay per vehicle can be expected to increase along the entire corridor.

Table 1: Level of Service Table (HCM 2010)

Level of Service	Average Control Delay (seconds/vehicle)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

All intersections throughout the project limits are minor-street stop-controlled, so STH 42 runs freely throughout the corridor. The delay that STH 42 experiences is due to pedestrians crossing the roadway, bicyclists utilizing the full travel lane, and vehicles entering and exiting parallel parking stalls.

Pedestrian Facilities

Sidewalks exist on STH 42 on the east and west side of the highway from approximately 775 feet south of Harbor School Road to County Highway E. Painted crosswalks and curb ramps are provided at the intersections of STH 42 with Harbor School Road, Market Street, Horseshoe Bay Road, White Cliff Road, Orchard Road, and County Highway E. Several curb ramps are not ADA compliant and will require replacement.

Available On-Street Parking

On-street parallel parking stalls are located on the east and west sides of STH 42 from Harbor School Road to County Highway E. The stalls vary in length, mostly between 20 and 25 feet long. Several stalls are less than 10 feet in length. They consist of transverse white lines delineating each parking stall. There are approximately 70 stalls along the corridor. Approximately 50 stalls are located on the west side of STH 42, and approximately 20 stalls are located on the east side of STH 42.

Near intersections, parking stalls are located as little as 20 feet away. This poses safety concerns that adequate sight distance is not maintained for vehicles turning from minor streets onto STH 42. This is also a safety concern for vehicles on STH 42 traveling along the corridor and having inadequate sight of pedestrians and vehicles on minor streets.

Access Points

Driveways for homes and businesses increase points of conflict for highway facilities. Problems such as increased crash potential and congestion arise when there are an excessive number of access points along a corridor. Pedestrians struggle to find a safe area to cross the road and the overall community livability suffers. Table 2 shows the number of access points between intersections traveling along STH 42.

Table 2: Number of access points along STH 42.

Intersections	Traveling North	Traveling South
Ballpark Rd – Harbor School Rd	5	9
Harbor School Rd – Market St	5	3
Market St – Co Rd G	4	3
Co Rd G – Orchard Rd	7	7
Orchard Rd – Co Rd E	5	6
Co Rd E – Church St/Harbor Heights Rd	9	13

Some businesses along STH 42 have multiple access points. Removing the additional access points will limit the number of conflict points and will increase capacity for STH 42.

Sight Lines

A review of the existing sight lines was conducted along the STH 42 corridor. Overhead utilities travel along and across the corridor. There are trees located along STH 42, but there were no visibility issues seen due to trees.

Crosswalk visibility and sight lines from minor streets turning onto STH 42 is deficient. Because of the number and proximity of on-street parking stalls to intersections and crosswalks, the sight distance of vehicles and pedestrians is impaired. The limited sight poses safety concerns as pedestrians and vehicles may not be able to communicate with each other to share the roadway safely.

Future Needs

As the Village of Egg Harbor develops more, it is expected that the number of visitors will increase each year, making traffic more dense over time. The population has grown as much as 35% over ten years historically. In 2040, the population could grow up to 330 permanent residents and 3400 seasonal residents. By this time, traffic mitigation strategies will be needed throughout the corridor to reduce congestion in the downtown area because the delay per vehicle throughout the corridor will be higher.

Project Challenges

The following challenges were considered during the preliminary design phase for the STH 42 reconstruction project.

Economic

The Village of Egg Harbor has provided a budget of $7,000,000 for this project. This includes the engineering work during the design phase, the cost of construction, and the cost of materials for construction. Over 40 local businesses are situated along the project site. Construction can hinder the income of these businesses. Steps will need to be taken to minimize this risk.

Environmental

The Village of Egg Harbor is bordered to the west by Green Bay, a part of Lake Michigan. It is important to maintain the cleanliness of the bay within the project limits. Because this project is located in an area of heavy snowfall, the onsite stormwater treatment facilities will be designed to remove deicing agents from the water before discharging into Green Bay.

Social

The Village of Egg Harbor is a regional hub for tourists, especially during the summer months. Staging construction to maintain flow and access to businesses along the corridor will be taken into consideration. Community members and tourists enjoy the downtown area during the summer months and should not be inconvenienced during construction. Therefore, alternative routes to the downtown area will be offered for all modes of travel during the construction process.

Another strong emphasis is maintaining the quaint feel and aesthetic of the Village. Community members and Village officials have emphasized aesthetics as a top priority for this project.

The Egg Harbor Cemetery is located alongside a section of STH 42 within the project limits. STH 42 is the only access point for the cemetery. During the construction phase, a safe path will be provided for community members to visit the cemetery. The burial limits were determined, and the new roadway footprint will be designed to avoid those limits.

Political

The right of way along the STH 42 corridor is limited. To provide a reconstruction that satisfies the desires of the Village, Right-of-Way acquisition will need to be limited. During certain phases of construction, access to some properties may be closed, which could reduce revenues to businesses. Maintaining access to properties and businesses will be considered for the construction phase.

Ethical

The project will be completed by abiding by the National Society of Professional Engineers (NSPE) Code of Ethics for Engineering. The Village of Egg Harbor is a Green Tier Legacy community, our team will work to meet the expectations set by Green Tier Legacy for the Village of Egg Harbor to continue its enrollment in the program.

The project designs will adhere to the standards outlined in the Wisconsin Department of Transportation Facilities Design Manual and the Federal Highway Administration Manual on Uniform Traffic Control Devices. The designs included in this report are compliant with the state and federal guidelines for highway design.

Health and Safety

Providing adequate bicycle and pedestrian facilities is important to help increase the wellbeing of the residents and tourists of the Village. Although remaining within the budget is important, safety is of

utmost importance. The focus of the project will be on increasing safety for vehicles, pedestrians, and bicyclists along the corridor.

Constructability

There are businesses and residential properties close to the STH 42 corridor, so construction efforts will operate within the existing roadway profile to limit adverse impacts to the neighboring properties. This may limit the design options along the corridor. If necessary, a detour route may be developed to reduce the number of vehicles traveling through the construction site.

To the west side of STH 42, the slope approaching the bay waters is steep. This could provide challenges in constructing the west side of the highway to reduce erosion and the amount of fill material needed.

Sustainability

The economic, environmental, and social sustainability needs for this project have been evaluated. In order to provide economic sustainability, access to the local business need to be maintained both during and after the construction of the project to limit financial impact. Inlet protection and other forms of stormwater protection will be used throughout the construction phase to reduce erosion and pollution going into the harbor. Throughout the construction of the project and after, social sustainability will be met by trying to keep the small community feel while meeting traffic needs. This may include rerouting of traffic during construction as needed to reduce congestion in the downtown area. The alternative chosen will have the highest level of sustainability. We will consider the American Society of Civil Engineers Envision (ASCE Envision) guidelines for providing a green project. The materials needed for this reconstruction project will be locally sourced to reduce material transport costs.

A public involvement meeting was held on October 22nd, 2020 where both concerned business owners and residents expressed their concerns and feedback on the proposed alternative designs. Details of this meeting are described below after explaining the alternatives.

Alternatives

The following sections describe three alternatives to mitigate congestion along the STH 42 corridor. All alternatives include upgrading the sidewalks to 5-foot wide concrete sidewalks that comply with ADA requirements as well as upgrading curb ramps and updating pavement markings. Along with sidewalks, each alternative includes 5-foot wide on-street bike-lanes, which is within the allowable widths. Along with sidewalks, each alternative includes 5-foot wide on-street bike-lanes, which is within the allowable widths. The decision to close access points will be incorporated into the final design.

Stormwater Treatment: Urban Bioretention Basins

Each alternative is proposed to use urban bioretention basins for stormwater runoff along the curb line of the street. The basins will be spaced out and placed between the sidewalk and curb line of STH 42. The locations of these basins are determined on the distance between storm water inlets and the inlet locations. The approximate volume of the bio-retention basins are 60 cubic feet and incorporate native plants to area. With the inclusion of native

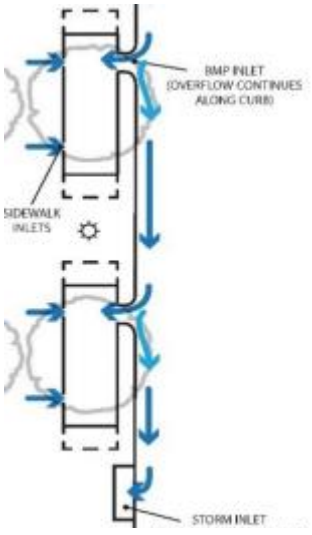


Figure 4: Stormwater flow guide for urban bioretention basins

plants, there will also be a ponding area, organic layer, and sand layer. The ponding area allows water to accumulate, infiltrate, and settle through the remaining layers.

The bioretention basins are designed to guide storm water from the curb line into the basin (Figure 4). Once in the basin, the water can start to infiltrate through the layers and treat the water. Water that overflows the ability of the basin will continue towards the storm water inlet. These basins can work as solely infiltration centers for groundwater, or can be combined with existing stormwater lines to go into the harbor. These two variations in design allow for the basins to be incorporated into areas that both do and do not have inlets and stormwater pipes.

Alternative 1: Two-Way Left-Turn Lane (TWLTL)

This alternative includes the addition of a Two-Way Left-Turn Lane (TWLTL) from Harbor School Road to Orchard Road.

A TWLTL is to be implemented from Harbor School Road to Orchard Road. The TWLTL will likely be 12 feet wide along the corridor instead of the typical 14 feet (*Figure 4*), as limited space is available. The TWLTL will allow for the execution of left-turns into the various residential and business driveways along the corridor, without disrupting traffic flow. The TWLTL will move all left-turning vehicles out of the way of the vehicles continuing a through movement. The locations of the TWLTL will not stretch the entire length, but will depend on space availability and access needs.

At the Horseshoe Bay Road intersection, a TWLTL of 12 feet will replace the current left-turn lane south of the intersection. North of the intersection will also include a TWLTL of 12 feet. In addition to the TWLTL, bike lanes of the standard width of 5 feet will be added to both sides of STH 42. Vehicle lanes for through movements and right turns will be 11 feet wide. Figure 5 shows the aerial view of the planned modifications to the Horseshoe Bay Road intersection.

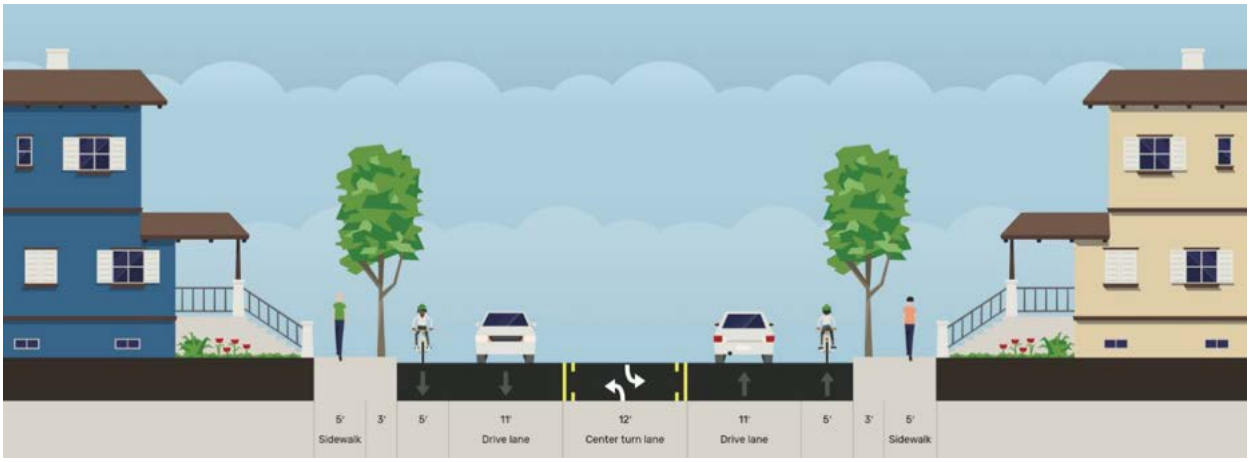


Figure 5: Proposed typical section including a TWLTL.

The TWLTL will continue until Orchard Road. From Orchard Road to the remaining project boundaries, additional on-street parking stalls will be installed as some may need to be relocated to make space for the TWLTL. The parking stalls will be 7 feet wide by 20 feet long. Some areas may consist of a shared bike and parking lane. The shared lanes will vary from 12 to 16 feet, depending upon available space. In order to accommodate the bike lanes, gutter pans may be shortened. Stormwater runoff may flow onto the

roadway because of the shortened gutter pan. This consideration will be incorporated into the final design if this alternative is chosen.

To the south of the Horseshoe Bay Road intersection, additional parking stalls will be installed where space is available. Results from our traffic study will be incorporated into our final design regarding the location of the TWLTL and the parking stalls along shorter segments of the corridor.

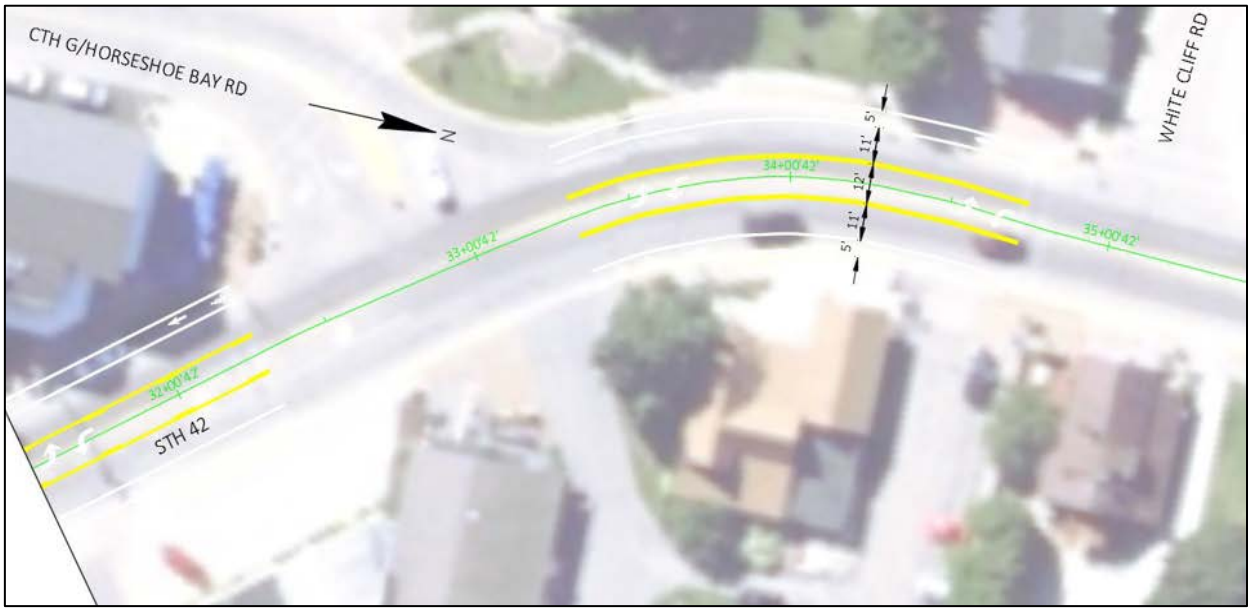


Figure 6: Aerial view of the lane configuration for the STH 42 & Horseshoe Bay Road intersection.

Alternative 2: Mini Roundabout at Horseshoe Bay, TWLTL elsewhere

A mini roundabout will be constructed at the intersection of STH 42 with Horseshoe Bay Rd/CTH G.

This design includes elements from a TWLTL design and an implementation of a mini roundabout. The traffic volumes of the corridor are low enough to have this option be effective in mitigating congestion. As the Village crash history shows sideswipe crashes from vehicles going north and south, a roundabout would also help to avoid future crashes. The mini roundabout is smaller than Wisconsin Department of Transportation standards in order to reduce the cost of right of way. Further consultation with the Wisconsin Department of Transportation for approval of the mini-roundabout geometry will be needed if this alternative is chosen. The inscribed circle diameter will be approximately 85 feet in order to account for a WB-40 truck. The mini roundabout would allow northbound movement to be seamless while other movements are slowed down by the curvature of the approaching lanes to the mini roundabout. To allow clear sight distance, the center for the mini roundabout will have no landscaping but rather a raised masonry circle with gradual sloping curbs for larger vehicles to travel over during their turning movement.

A TWLTL would be installed north and south of the intersection as well as additional parking and bike lanes. Leading up to the mini roundabout, bike lanes would merge into traffic and be able to safely utilize the full width of the lane until they are done with the turning movement. Similar details on parking, bike lanes, and TWLTL are described in Alternative 1. Figure 6 shows the aerial view of the proposed mini roundabout alternative.

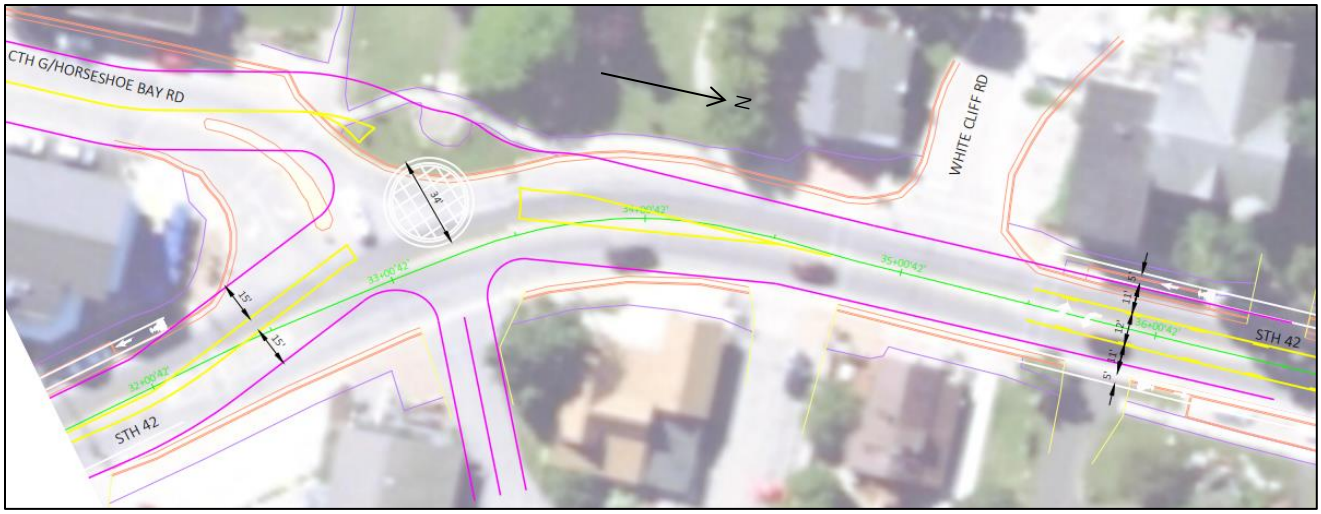


Figure 7: Aerial view of the roundabout and bike lanes for Horseshoe Bay Road.

Some concerns for the roundabout design include having enough room to construct the roundabout to allow traffic diversion and meet vehicle needs, as vehicles larger than 65 feet are not permitted. Design vehicle tracking paths will be incorporated into the final design if this alternative is chosen. There is also a considerable amount of earthwork required to make the mini-roundabout fit in the intersection because of the unique geometry and encroachment into Harbor View Park.

Alternative 3: Signalized Intersection at Horseshoe Bay Road

The intersection of STH 42 and Horseshoe Bay Road is the primary cause of congestion along the corridor. The implementation of a traffic signal at this intersection would improve overall traffic conditions for all modes of travel. An engineering study of the existing traffic conditions, pedestrian characteristics, and physical characteristics is required to warrant a traffic signal. Appendix A shows the successful completion of a traffic warrant analysis for this intersection. The signal will be semi-actuated to maximize the green time for STH 42 traffic. The cycle length for this intersection will vary, and the phases and approximate split times are shown in Table 3 and Figure 8, respectively. Signal timings with a left-turn phase and without a left-turn phase will be explored if this alternative is selected.

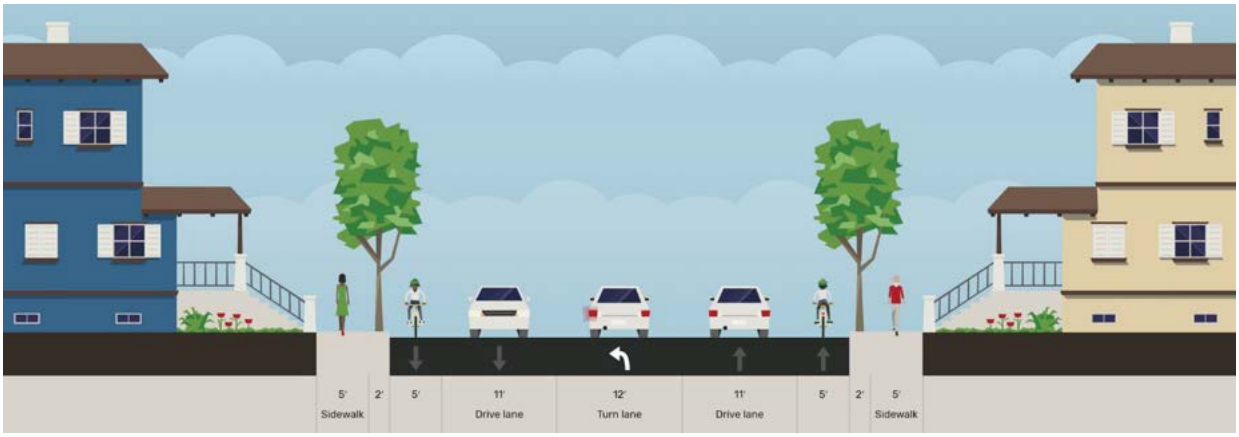


Figure 8: Proposed typical section for turn lane at Horseshoe Bay Road.

Table 3: Phase plan for the intersection of STH 42 & Horseshoe Bay Road

Phase 1	STH 42: Northbound Through STH 42: Northbound Left-Turn Horseshoe Bay Road: Permissive Right Turn on Red Bicyclists: Northbound Through	9.5
Phase 2	STH 42: Northbound Through STH 42: Southbound Through Horseshoe Bay Road: Permissive Right Turn on Red Bicyclists: Northbound Through Bicyclists: Southbound Through	23
Phase 3	Horseshoe Bay Road: Left-Turn Horseshoe Bay Road: Right-Turn STH 42: Southbound Permissive Right Turn on Red	22.5

Figure 9: Splits and phases for the intersection of STH 42 & Horseshoe Bay Road

A pedestrian phase will be included to allow for a more regulated pedestrian crossing. A pedestrian signal must include the following requirements:

- Walking Phase: A minimum of 7 seconds of walk interval
- Flashing Hand Symbol: Time = Distance/Walking Speed (Use 3.5 ft/s for walking speed, curb to curb for distance)
- Steady Hand Symbol: A minimum of 3 seconds for the buffer interval
- Near the STH 42 and Horseshoe Bay Road intersection, lane widths of 11 feet will be used. Bike Lanes will be the standard width of 5 feet and will be located on both sides of STH 42. A TWLTL with a width of 12 feet will be located between the minor streets of Horseshoe Bay Road and White Cliff Road. Figure 9 shows the aerial view of the planned developments near Horseshoe Bay Road.

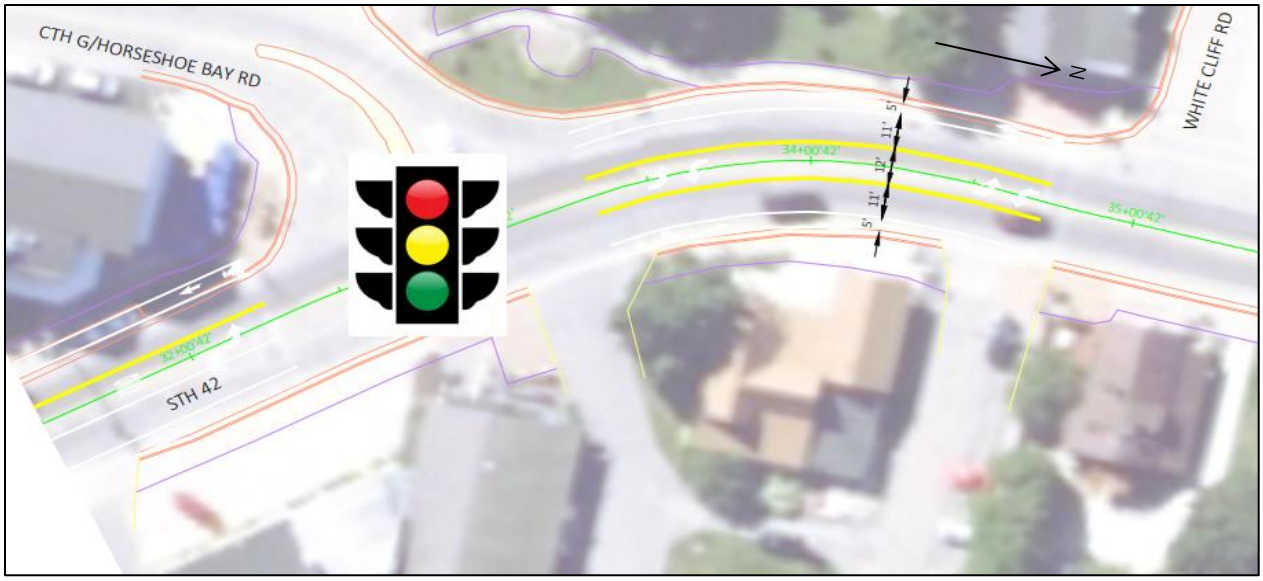


Figure 10: Aerial view for the intersection of STH 42 & Horseshoe Bay Road.

A TWLTL will begin at Harbor School Road and will continue until the STH 42 and Market Street intersection. The TWLTL will start again after the intersection and will continue until it converts into a taper that leads into the left-turn lane at the STH 42 and Horseshoe Bay Road intersection. The taper will consist of an 8:1 ratio (taper length to turn-lane width), as is the standard according to the Wisconsin Facilities Development Manual (FDM) 11-25, Attachment 2.3, Taper Length Criteria. The left-turn lane will be 175 feet long to allow for adequate vehicle storage leading up to the signalized intersection. Figure 10 shows the planned design.

Figure 11: Aerial view of the lane configuration for the intersection of STH 42 & Horseshoe Bay Road.

All additional parking stalls will be located to the north of Horseshoe Bay Road. The parking lanes will have a width of 7 feet and a length of 20 feet. The parking stalls will be located in areas where the TWLTL is deemed unwarranted. Results from a traffic study will be incorporated in the final design phase to confirm

the positioning of the TWLTL and the parking stalls. Bike lanes will be maintained along this section as well.

Alternative Comparison

There are many different benefits, challenges, and considerations that each alternative presents. An intuitive diagnosis for the proposed alternative solutions based off project cost, traffic mobility, right-of-way requirement, constructability, and safety will be provided.

Alternative 1: Two-Way Left-Turn Lane

A TWLTL throughout the corridor provides continuous flow of traffic without queuing behind a left-turning vehicle. As shown in Table 3, this is the least expensive option of the alternatives. Another advantage of the TWLTL is the continuous access to businesses and driveways without causing traffic congestion. For vehicles turning onto the corridor from minor approaches, this option provides a "refuge" to allow vehicles to perform a two-stage turn. The TWLTL also provides a "refuge" for pedestrians traveling across STH 42.

In order to work with the given right of way, this option requires removal of some existing parking stalls and a smaller than average TWLTL lane width.

Alternative 2: Mini Roundabout at Horseshoe Bay, TWLTL elsewhere

A mini roundabout at Horseshoe Bay Road can provide congestion mitigation of both STH 42 and Horseshoe Bay Road. This option provides easier access to the east driveway for larger vehicles or vehicles towing trailers. A mini roundabout can also help reduce sideswipe crashes because vehicles flow the same direction through the mini roundabout. The mini roundabout will also allow access to the business driveway to be maintained. The congestion reduction by the TWLTL is also provided in this option as well as other positive aspects stated in Alternative 1.

Along with the positives shared with Alternative 1, the mini roundabout alternative shares the same weaknesses of it as well as some other challenges. Constructability, right of way availability, project cost, pedestrian movement, and certain traffic situations are some of the challenges that this alternative provides. Roundabouts are known to deter pedestrian movement since the crossings are further away than a regular crossing. Large vehicle movement through the intersection would essentially negate any congestion mitigation done by the roundabout for normal cars due to the turning width of the vehicle. Right-of-way needs would also inhibit this design alternative since a large portion of the Harbor View Park and a small portion of the adjacent restaurant would need to be acquired. The right-of-way and size of this option also contribute to the large cost as this is the most expensive option as noted in Table 3.

Alternative 3: Signalized Intersection at Horseshoe Bay Road

A signalized intersection at Horseshoe Bay Road can increase traffic flow for the turning movements of both Horseshoe Bay Road and STH 42. It is also beneficial for pedestrians, as there will now be a pedestrian signal phase for the safe traversing across STH 42. This design allows for the current parking stalls to be maintained while increasing parking stalls in other areas where the TWLTL is not located.

A significant drawback of implementing a signal at this intersection is the reduced flow of through movements along STH 42. Currently, vehicles traveling through STH 42 can pass through this intersection without stopping. The implementation of a traffic signal here will create a stop-and-go traffic flow. Another drawback is that a few driveways to businesses near this intersection will need to be closed off,

which may not be desired by the Village. Adding an exclusive left-turn lane at the intersection of STH 42 with Horseshoe Bay Road will also limit the ability for southbound vehicles to turn south of the intersection.

Public Involvement Meeting

A public involvement meeting was held on October 22, 2020 to gain public input on the upcoming project. The meeting was well attended with a variety of business owners, residents, and other stakeholders. The following concerns were voiced, and the suggestions and concerns will be incorporated into the project design.

On-Street Parking

Attendees voiced concerns about the reduction of on-street parking stalls because of the Two-Way Left-Turn Lane along the corridor. This concern will be considered in the final design. Shorter segments along the STH 42 corridor will be examined to determine whether a TWLTL would be beneficial in the segment. If the TWLTL is deemed unnecessary, then the TWLTL will be removed and on-street parking stalls will be installed.

Mini-Roundabout

There were several concerns voiced regarding the location and space needed for the mini-roundabout at the intersection of STH 42 with Horseshoe Bay Road. The Shipwrecked restaurant owners voiced concern about losing their outdoor seating area because of the space needed for the mini roundabout. This concern has led the mini-roundabout alternative to be less desirable.

Crosswalks

One resident voiced concerns about the crosswalks at Horseshoe Bay Road. Both crosswalks are set back from the intersection which has caused safety issues. Because the crosswalks are set back, vehicles are less likely to yield to pedestrians, which can cause vehicle-pedestrian crashes. Different crosswalk pavement markings and treatments will be explored to increase visibility of crosswalks along the entire corridor.

Landscaping

Residents of the Village expressed concern about the highway upgrade destroying the quaintness throughout the downtown area. This project will include landscaping, local art, and plantings in order to maintain the quaintness of the downtown Village area.

Speed

Residents had voiced concern about vehicles speeding on STH 42 and causing safety issues. Several traffic calming features will be explored in the final design to address speeding along the corridor. Because STH 42 will be converted into a “complete street,” natural traffic calming is expected to occur because of the presence of bicyclists and pedestrians along the corridor.

Cost Estimate

The Village of Egg Harbor has requested to keep the project budget under $7 million. This has shown to be a conservative estimate and we believe that this project could be done on budget and within time constraints. A complex table of opinions of probable cost for each alternative utilizing bid items provided by WISDOT can be seen in Table 4. A detailed cost opinion for the selected alternative can be viewed in Table 4. The quantities were calculated by using GIS mapping for the corridor and obtaining accurate measurements from existing plan sets.

Table 4: Estimated bid item costs.

Bid Item Number	Bid Item	Unit	Unit Price	Quantity			Cost		
				Alternative 1	Alternative 2	Alternative 3	Alternative 1	Alternative 2	Alternative 3
460.5244	HMA Pavement 4 LT 58-34 S	TON	$80.00	8022.784	8726.144	8022.784	$642,000	$698,000	$642,000
601.0409	Concrete Curb & Gutter 30-Inch Type A	LF	$17.00	14175	14269	14175	$241,000	$243,000	$241,000
602.0410	Concrete Sidewalk 5-Inch	SF	$5.50	36958	39237	36958	$203,000	$216,000	$203,000
646.1020	Marking Line Epoxy 4-Inch (White)	LF	$1.10	24201.215	23585.215	24376.215	$27,000	$26,000	$27,000
646.1020	Marking Line Epoxy 4-Inch (Yellow)	LF	$1.10	16454	15622	16086	$18,000	$17,000	$18,000
646.7520	Marking Crosswalk Epoxy Block Style 24-Inch	LF	$26.00	527	527	527	$14,000	$14,000	$14,000
646.5020	Marking Arrow Epoxy	EACH	$300.00	28	28	26	$8,000	$8,000	$8,000
646.5120	Marking Word Epoxy	EACH	$300.00	0	0	2	$0	$0	$1,000
646.5220	Marking Symbol Epoxy	EACH	$200.00	18	18	18	$4,000	$4,000	$4,000
619.1000	Mobilization	LS	$500,000.00	1	1	1	$500,000	$500,000	$500,000
	Remove Existing Road	LS	$200,000.00	1	1	1	$200,000	$200,000	$200,000
204.0110	Bioretention Basin	CF	$5.30	600	600	600	$3,000	$3,000	$3,000
Subtotal							$1,860,000	$1,929,000	$1,861,000
Additional Items							$2,360,000	$2,629,000	$2,461,000
20% contingency							$2,832,000	$3,154,800	$2,953,200
Total							$2,832,000	$3,155,000	$2,953,000

Table 5: Cost opinion for the selected design alternative 1

Select Engineering Services

Reconstruct STH 42: CTH T to Church St.
Location:

By and Date: 1-Oct
Checked By and Date: 14-Oct

Item No.	Item	Units	Quantitiy	Unit Price	Total Cost	Cost Source Reference
1	HMA Pavement 4 LT 58-34 S	TON	8022.784	$80.00	642,000	WisDOT Bid Tabs
2	Concrete Curb & Gutter 30-Inch Type A	LF	14175	$17.00	241,000	WisDOT Bid Tabs
3	Concrete Sidewalk 5-Inch	SF	36958	$5.50	203,000	WisDOT Bid Tabs
5	Marking Line Epoxy 4-Inch (White)	LF	24201.215	$1.10	27,000	WisDOT Bid Tabs
6	Marking Line Epoxy 4-Inch (Yellow)	LF	16454	$1.10	18,000	WisDOT Bid Tabs
8	Marking Crosswalk Epoxy Block Style 24-Inch	LF	527	$26.00	14,000	WisDOT Bid Tabs
9	Marking Arrow Epoxy	EACH	28	$300.00	8,000	WisDOT Bid Tabs
10	Marking Symbol Epoxy	EACH	18	$200.00	4,000	WisDOT Bid Tabs
11	Mobilization	LS	1	$500,000.00	500,000	WisDOT Bid Tabs
12	Remove Existing Road	LS	1	$200,000.00	200,000	WisDOT Bid Tabs
13	Bioretention Basin	CF	600	$5.30	3,000	WisDOT Bid Tabs
	SUBTOTAL: SITE WORK				1,860,000	
14	Additional Items	-	1	$500,000.00	500,000	N/A
	SUBTOTAL: Additional items				500,000	

typ range 5% to 25%
LF = linear foot
LS = lump sum
EA = each
CY = cubic yard
AC = acre

SUBTOTAL: **2,360,000**

20% CONTINGENCY: **472,000**

TOTAL COST: **2,832,000**

Project Schedule

The estimated timeline of the project spans from September 2020 through December 2023. The engineering team will be selected by the end of 2020. Approximately 2 years will be spent on the planning and permitting phases. Upon finalizing plans and contracts, work is scheduled to begin early April 2023. An expected completion date is scheduled for the end of the October 2023 as landscaping adds the final touches. Final documentation and project design plans will be submitted by the end of 2023.

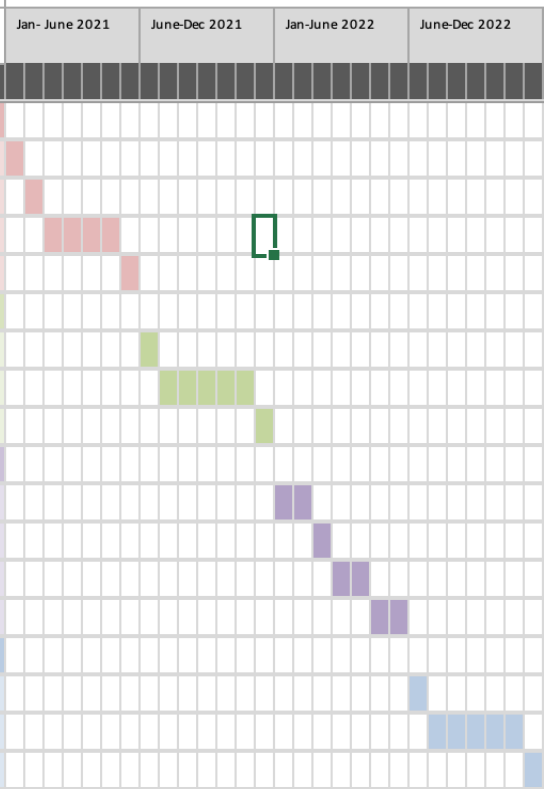
Figure 12: Project timeline

PROJECT TITLE

Selecting Engineering Services
Alexis Ford

Project Start: Sun, 1/3/2021
Display Week: 1

TASK	PROGRESS	START	END
Regulatory/ Funding Approval			
Submission to Regulatory Agencies		1/3/21	1/6/21
Submission to Funding Agencies		1/5/21	1/9/21
Feedback on Report/Drawings		4/19/21	4/22/21
Final Approval		5/30/21	6/2/21
Construction Permitting			
Permit Applications Filed		6/5/21	6/9/21
Pending Approval		6/10/21	12/6/21
Construction Permits Issued		12/9/21	12/14/21
Site Investigation Reports			
GIS/ Land Surveying		1/3/22	2/2/22
Environmental Reports		2/5/22	3/7/22
Geotechnical Report		3/10/22	4/9/22
Comprehensive Site Report		4/14/22	6/2/22
Easement Granting			
Apply for easements		6/12/22	6/15/22
Public Meetings		6/20/22	9/28/22
Easements Received		1/3/23	1/5/23



Decision Criteria

Seven criteria were used to evaluate each alternative. The cost of construction is important so that the chosen alternative has a lower cost relative to the other alternatives. The constructability is important because of the limited space surrounding STH 42. Alternative 1 and 2 are more desirable for constructability because they do not require excess space. The time to completion was used because the Village of Egg Harbor is a tourist destination, so having as little disruption during the main tourist season is important to the Village. The project lifetime is important because the alternative that has the longest lifetime will limit future costs by reducing the need for reconstruction. Because STH 42 is located along Green Bay, reducing the environmental impact is also important. Reducing impacts to the community and to the water is considered in each alternative. Keeping the public satisfied during construction and with the resulting highway will be important as well, as the residents and tourists will be using the highway on a daily basis. Sustainability was also considered during the design of this project. This project considers environmental, social, cultural, and economic sustainability.

Table 6: Weighted Decision Matrix.

Criteria	Weight	Alternative 1	Weighted Score	Alternative 2	Weighted Score	Alternative 3	Weighted Score
Public Satisfaction	25%	4	1.00	2	0.50	3	0.75
Construction Cost	15%	5	0.75	5	0.75	5	0.75
Constructability	15%	3	0.45	2	0.30	4	0.60
Environmental Impact	15%	4	0.60	3	0.45	4	0.60
Time to Completion	15%	4	0.60	3	0.45	3	0.45
Lifetime	10%	4	0.40	3	0.30	4	0.40
Sustainability	5%	4	0.20	2	0.10	3	0.15
Sum	100%		**4.00**		**2.85**		**3.70**

Each criterium was assigned a weight according to its relative importance in the decision-making process. The weights were applied to values calculated from each category and added together to get the final number. The highest final number corresponds to the most desirable alternative.

Conclusion and Recommendations

Based on the decision matrix, Alternative 1 would be the most desired alternative. This alternative consists of the lowest cost, lowest time to completion, the longest lifetime, the lowest environmental impact, the highest public satisfaction, and the best form of sustainability.

Alternative 1 consists of a Two-Way Left-Turn Lane throughout the STH 42 corridor. This alternative includes on-street bike lanes and sidewalks throughout the corridor. Alternative 1 also includes urban bioretention basins located along the corridor to treat stormwater runoff before discharging into Green Bay.

The current design for Alternative 1 also removes some on-street parking stalls. Before finalizing the design for Alternative 1, short segments of the corridor will be examined to determine whether a TWLTL is recommended. Where a TWLTL is not recommended, the highway will be restored to a two-lane facility with on-street parking stalls to maintain some of the existing on-street parking.

Uncertainties

There are a few uncertainties that can alter design factors of the Alternative 1 recommendation. Most of these are data-based and include traffic counts, ROW, and the number of stalls and locations for on-street parking. The traffic counts that were explored are based on one intersection at Horseshoe Bay Road and future estimates for the corridor were calculated off this intersection. The amount of ROW along the corridor is not currently known and can change the amount of available space that the Alternative is able to reside inside. Lastly, the numbers and locations of the on-street parking stalls are approximations based on ariel views and not GPS locations.

Appendix A: Signal Warrant for Horseshoe Bay Road

At least one of the following warrants must be satisfied to justify a signalized intersection:

- Warrant 1, Eight-Hour Vehicular Volume
- Warrant 2, Four-Hour Vehicular Volume
- Warrant 3, Peak Hour
- Warrant 4, Pedestrian Volume
- Warrant 5, School Crossing
- Warrant 6, Coordinated Signal System
- Warrant 7, Crash Experience
- Warrant 8, Roadway Network
- Warrant 9, Intersection Near a Grade Crossing

The analysis for Warrant 1 is shown below.

Standard: The need for a traffic control signal shall be considered if an engineering study finds that one of the following conditions exist for each of any 8 hours of an average day:

A. The vehicles per hour given in both of the 100 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; or

B. The vehicles per hour given in both of the 100 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

According to the Manual of Uniform Traffic Control Devices (MUTCD), "if the intersection lies within the built-up area of an

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

isolated community having a population of less than 10,000, the traffic volumes in the 70 percent columns in Table 4C-1 may be used in place of the 100 percent columns." The table is shown below.

Condition B: *Major Street (2 or more lanes), Minor Street (2 or more lanes)*

- Vehicles per hour (vph) on major street (total of both approaches): Must be > 630 vph
    - 9:00 – 10:00: 707 vph
    - 10:00 – 11:00: 874 vph
    - 11:00 – 12:00: 904 vph
    - 12:00 – 1:00: 891 vph
    - 1:00 – 2:00: 916 vph
    - 2:00 – 3:00: 954 vph
    - 3:00 – 4:00: 1004 vph
    - 4:00 – 5:00: 928 vph
- Vehicles per hour (vph) on minor street (one approach): Must be > 70 vph
    - 9:00 – 10:00: 86 vph
    - 10:00 – 11:00: 86 vph
    - 11:00 – 12:00: 79 vph
    - 12:00 – 1:00: 76 vph
    - 1:00 – 2:00: 74 vph
    - 2:00 – 3:00: 75 vph
    - 3:00 – 4:00: 90 vph
    - 4:00 – 5:00: 71 vph

Condition B is Satisfied

Appendix B: Design Drawings

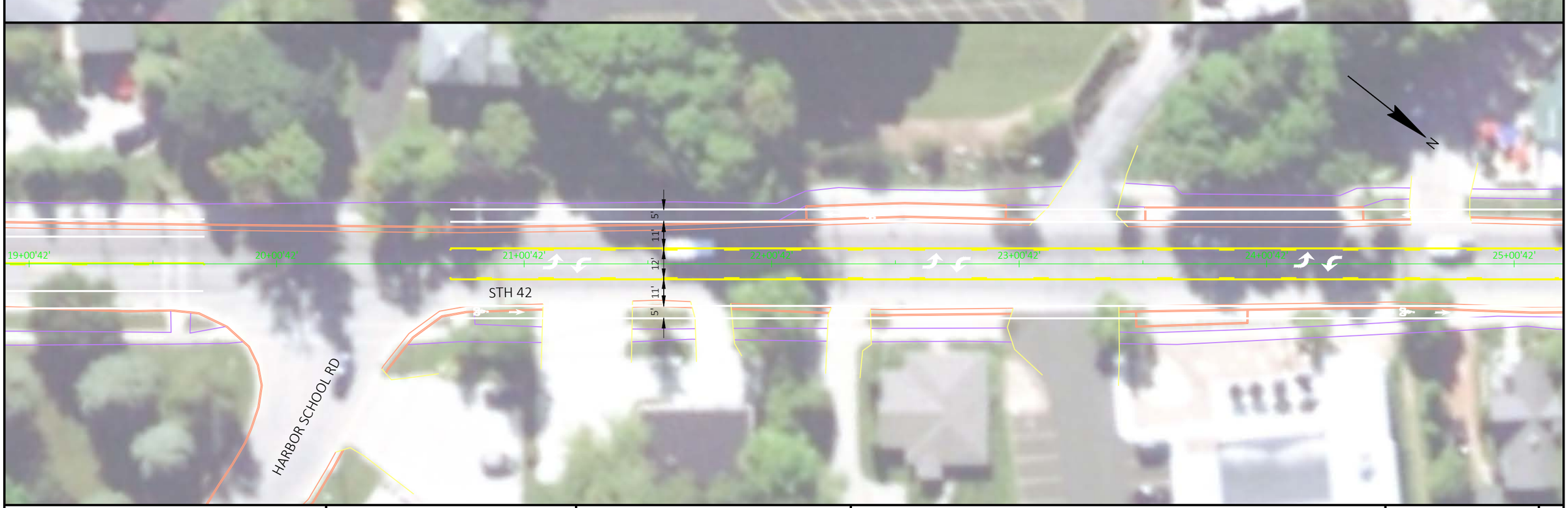
2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET E

PLOT SCALE : 1 IN:40 FT

2

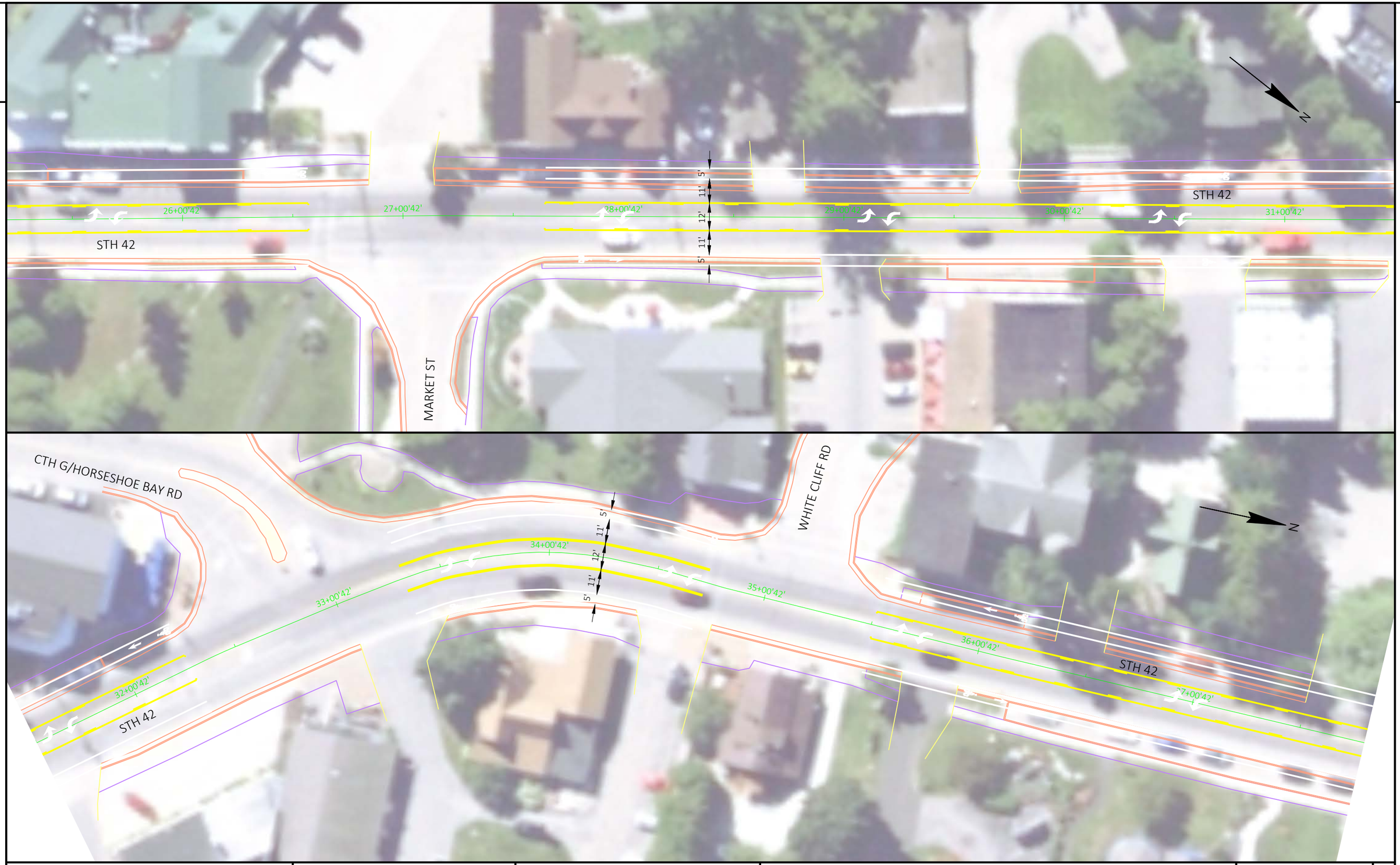


SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET E

PLOT SCALE : 1 IN:40 FT

2

2



SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET	E

PLOT SCALE : 1 IN:40 FT

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET E

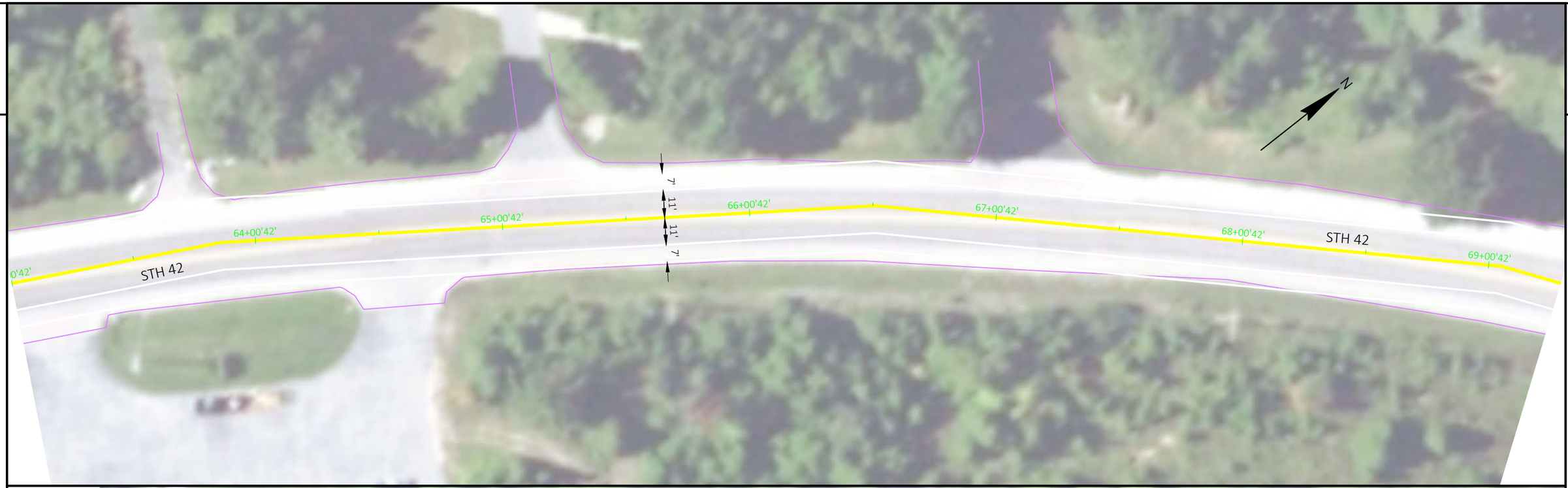
PLOT SCALE : 1 IN:40 FT

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET	E

PLOT SCALE : 1 IN:40 FT

2



SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 1	SHEET E

PLOT SCALE : 1 IN:40 FT

2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET	E

PLOT SCALE : 1 IN:40 FT

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET	E

PLOT SCALE : 1 IN:40 FT

2

2

STH 42

26+00'42'

27+00'42'

28+00'42'

29+00'42'

30+00'42'

31+00'42'

5'

17'

17'

5'

MARKET ST

N

CTH G/HORSESHOE BAY RD

WHITE CLIFF RD

34'

34+00'42'

33+00'42'

35+00'42'

15'

15'

32+00'42'

36+00'42'

37+00'42'

5'

11'

12'

11'

5'

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET E

PLOT SCALE : 1 IN:40 FT

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET E

PLOT SCALE : 1 IN:40 FT

2

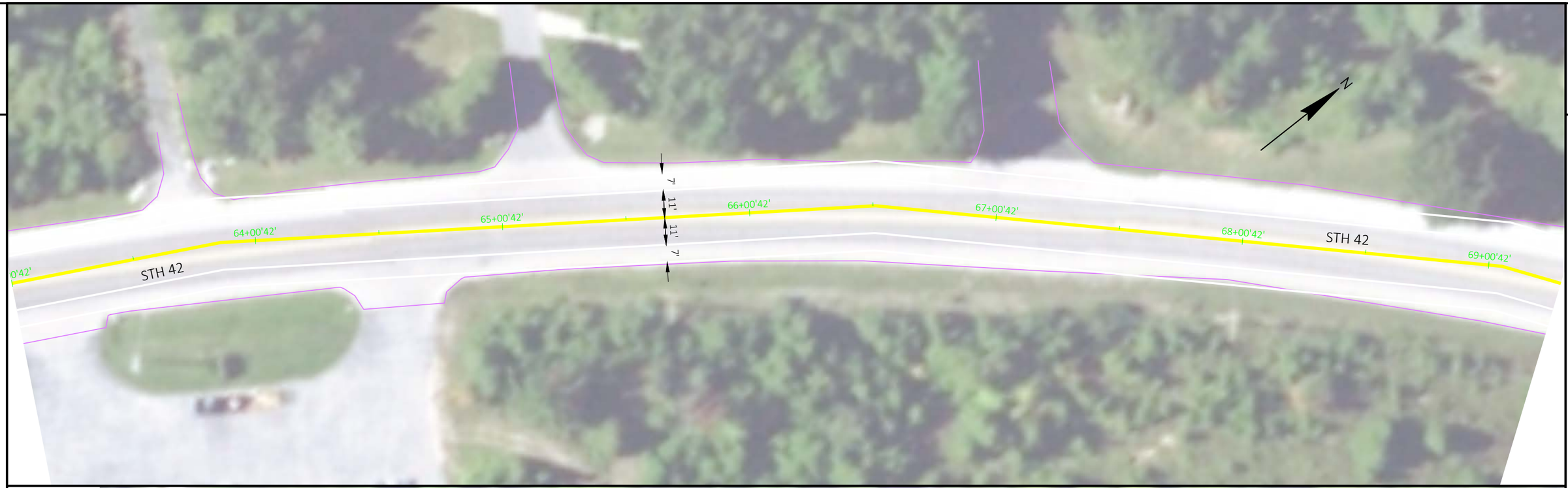
2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET E

PLOT SCALE : 1 IN:40 FT

2



SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 2	SHEET E

PLOT SCALE : 1 IN:40 FT

2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET	E

PLOT SCALE : 1 IN:40 FT

2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET E

PLOT SCALE : 1 IN:40 FT

2

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET	E

PLOT SCALE : 1 IN:40 FT

2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET E

PLOT SCALE : 1 IN:40 FT

2

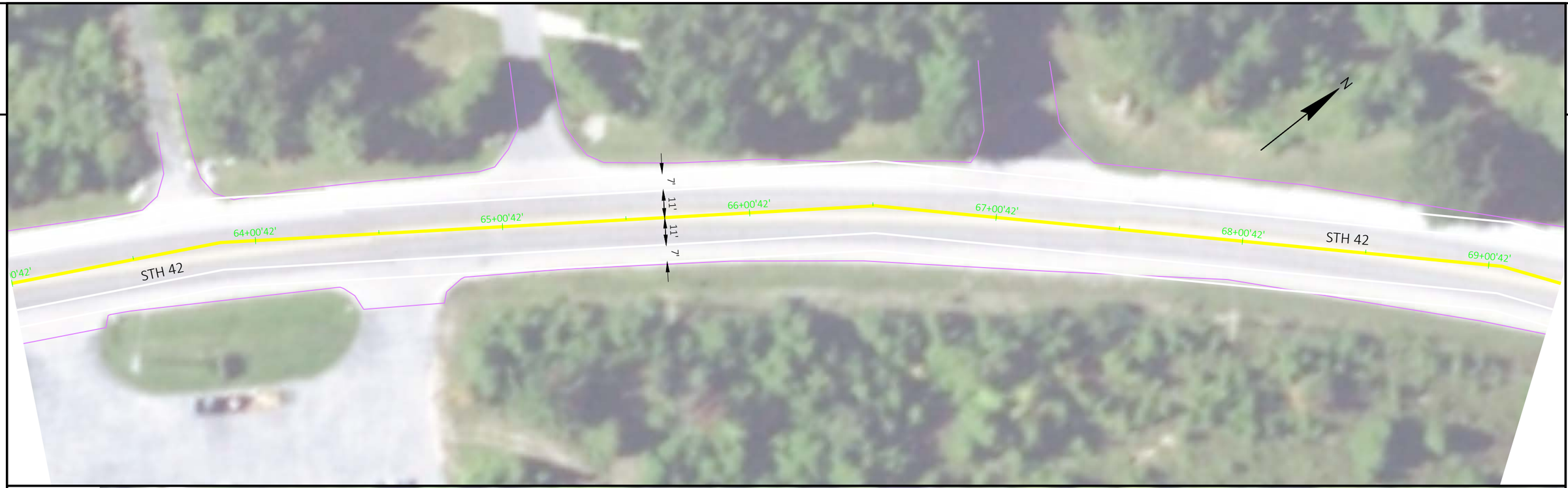
2

SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET E

PLOT SCALE : 1 IN:40 FT

2

2



SELECT ENGINEERING SERVICES	HWY: STH 42	COUNTY: DOOR	ALTERNATIVE 3	SHEET E

PLOT SCALE : 1 IN:40 FT

Appendix C: Geotechnical Report

SELECT ENGINEERING SERVICES

SELECT ENGINEERING SOLUTIONS
OCTOBER 15, 2020

Jan Kucher
2346 Engineering Hall
1415 Engineering Drive
Madison, WI 53706

Subject: Preliminary Geotechnical Report
Engineering Services for Highway 42 Corridor Improvements in the Village of Egg Harbor, Wisconsin

Dear Mr. Kucher,

As requested, Select Engineering Services, SES, has completed a geotechnical report for the Highway 42 Corridor Improvements in the Village of Egg Harbor, Wisconsin. The purpose of this report was to examine the subsurface geotechnical properties within and around the construction project limits. This report will provide key information for the storm water runoff plan, as well as the underground utility burial. SES performed soil borings on site in key areas. In addition, comprehensive soil surveys have been done on Door county by the USDA's Soil Conservation Service.

The Village of Egg Harbor's request for proposal calls for a redesigned downtown to add functional features to the infrastructure while maintaining the quaint of the historic town. This report includes results of field and laboratory testing, as well as both engineering and construction recommendations for the site design.

Respectfully Submitted,

Daniel Chyko
Geotechnical Engineer

Table of Contents

Project Description

The proposed project includes the redesign of State Trunk Highway 42 (STH 42) in the Village of Egg Harbor in Wisconsin. The design will include renovations to vital areas of the Village's infrastructure, aiming to improve functionality for pedestrians, vehicles and business owners. The project limits are defined as the intersection of STH 42 and Church Street as the northern limit, and the intersection of STH 42 and County Trunk Highway T as the southern limit, totaling approximately 7000 feet of roadway to be reconstructed. Within this stretch, existing above ground utilities will be relocated underground. These include telephone, electric and fiber optic cables. Additionally, a new onsite stormwater treatment method will be applied to the downtown's runoff that drains into the harbor.

Scope

This geotechnical report concerning the downtown Egg Harbor section of STH 42 provides information on the soil and geology of the area. Geotechnical recommendations will also be included in the report, using the knowledge of the region's subsurface characteristics. Soil maps of the town allow for approximations on the depth to bedrock. Due to the highway's close proximity to the shore, there always remains the possibility of bedrock being shallower than expected. It is essential that the team prepares for all of the possible geotechnical scenarios that may come into play. This will help SES make the best possible engineering and construction recommendations regarding the design and construction of the roadway, utility relocation and onsite stormwater treatment. However, soil is often unpredictable and always presents new scenarios. SES would be on constant notice to re-evaluate their recommendations and create new ones using all the information available as the project progresses.

Site Description

Downtown Egg Harbor is situated between the sandy beaches of Lake Michigan and tall Dolomite bluffs of the Door County peninsula. Shown below in **Figure 1** is the downtown district. The bluffs belong to a section of the Niagara Escarpment, a long continuous bluff that runs along Green Bay, reaching heights of 200 ft above the water in some locations. Over 75 percent of the soil in the county is moderately well-drained glacial till. The corridor currently consists of a two-lane highway with parking along both shoulders. The sidewalks are constructed with asphalt, concrete and brick pavers along the corridor. When there is a terrace present, it is made up of sections of grass with small trees and plantings. Along the sidewalk on both sides of the street there are a number of nodes, which consist of benches, waste baskets, and brick pavers. Almost all the buildings in this section of downtown are either restaurants or shops. The elevation of downtown Egg Harbor is approximately 630 feet, resting 50 feet above the elevation of the water. In the area around the shoreline, soil is approximately 3 feet deep before bedrock is reached. Slightly larger deposits of glacial till are found higher up the bluff, where the roadway sits, which is approximately 4-7 feet of soil. The dolomite bedrock has many natural fissures and crevices which leave it susceptible to sinkholes.

Figure 1: Aerial photograph of downtown Egg Harbor, WI

Soil Survey

Field Exploration

The SES team of subsurface drilling technicians completed a series of 7 soil borings (**Appendix D)** within the project limits. The drilling took place July 31st, 2020. Locations were carefully selected to characterize and identify as many different geologic settings along the 7000-foot stretch of highway. Found also in **Appendix D** is the map of the 7 locations where the soil borings were performed. The depths of the soil borings ranged from 4-7 feet. Six of the soil borings were done along the side of the highway. The other boring was done on the slope down to the water, halfway up from the shoreline. This location ended up being one of the two shortest borings, only going 4 feet before reaching bedrock. Five other borings struck bedrock at 5 feet of depth or greater.

Boring Number	Location	Elevation (ft)	Depth to bedrock (ft)
1	Sidewalk Terrace	635	5.5
2	Sidewalk Terrace	630	5,75
3	Sidewalk Terrace	605	4
4	Village Park Grass	630	6.3
5	Sidewalk Terrace	635	6.8
6	Sidewalk Terrace	640	7
7	Sidewalk Terrace	645	4

Laboratory Testing

No Standard Penetration Tests were performed directly on the soil, as there is not a great depth of soil present. Generic values for the type of soil present in the top few feet will be used instead of acquiring it

from a test. Foundational compressive strength values for the soil are not available because any foundation deeper than 5-7 feet will be drilled into the dolomite bedrock.

Soil Information

The general soil conditions of the Egg Harbor area are found on a soil map, located in **Appendix E.** Upon shallow soil sampling performed by SES, NRCS soil surveys were also cross-checked to approximate a list of the five most common soils within our site. They are listed below, with the first soil as the most abundant. Included on the list are the slope grades, description and additional geology. The predominantly loamy soil has a range of friction angles from 30-34.

1. Longrie loam (LoB) : 2-6 percent slopes
    a. Gently sloping soil on glacial till plains, underlain by dolomite bedrock
    b. Runoff is medium, erosion is moderate and the only limitation of this soil
    c. Bedrock is at a depth of 40-60 inches. Exposed in some areas
2. Namur loam (NaB) : 0-6 percent slopes
    a. Gently sloping soil on glacial till plains, underlain by dolomite bedrock
    b. Runoff is medium, erosion is moderate and the only limitation of this soil
    c. Not ideal for farming
3. Summerville loam C (SvC): 2-6 percent slopes
    a. Gently sloping soil on glacial till plains, underlain by dolomite bedrock
    b. More surface stones, dolomite outcrops common and more susceptible to erosion
4. Alpena gravelly sandy loam (ApC): 0-12 percent slopes
    a. Nearly level to sloping soil is on old glacial lake beach ridges
    b. Runoff slow, hazard of erosion is slight
    c. Dryness is main limitation of soil
5. Summerville Loam B (SvB): 6-12 percent slopes
    a. Gently sloping soil on glacial till plains, underlain by dolomite bedrock
    b. Runoff is medium, erosion is moderate and the only limitation of this soil

Soil Factors

<u>Passive Earth Pressure Coefficient:</u>

*Longrie loam friction angle = 32°

$K_P = \tan^2(45° + \frac{f}{2})$

$K_P = \tan^2(45° + \frac{32°}{2})$

$K_P = \tan^2(61°)$

$K_P = 3.2545$

<u>Active Earth Pressure Coefficient</u>

$K_A = \tan^2(45° - \frac{f}{2})$

$K_A = \tan^2(45° - \frac{32}{2})$

$K_A = \tan^2(29°)$

$K_A = 0.3073$

The active earth pressure coefficient is 0 .307, while the passive is 3.255. The estimated settlement is not calculated, as no deep foundation is being constructed. The roadway will rest atop of bedrock and thin layers of soil; thus, settlement is not expected.

Geologic Setting

Geologic History

The geology of the Door County Peninsula is dominated by the Silurian age Niagara Dolomite, which is visible in the numerous bluffs throughout the region. The dolomite was once laid down as the floor in a marine climate during the Ordovician-Silurian tropical about 425 million years ago. During the Silurian, magnesium replaced some of the calcium carbonates, forming a harder dolomite layer. As the layers of sandstone eroded away, the dolomite resisted weather much better, which is why it remains today. Below that is the Maquoketa shale, which can be visible outcropping along the shoreline of southern Green Bay. Underlying that is the Platteville dolomite, a stratum visible in many places throughout Wisconsin. Sitting atop the bedrock lies loamy till, resulting from years of dolomite being weathered through glaciation. During the Pleistocene, the Laurentide ice sheet advanced and retreated over the state many times. This is evident across the landscape in the county. In most locations the dolomite is close to the surface or outcropping. The exceptions are the glacial drumlins or end moraines, where till can be as deep as 100 feet.

Karst topography is a defining feature of the region. As the dolomite dissolves away, underground streams can form and lead to a variety of formations. Dolomite is common for incurring fissures in both horizontal and vertical directions. As water percolates through the ground, it fills these cracks, eventually expanding when frozen. The result is dolomite fracturing and dissolving away, leaving caves and sinkholes scattered across the county. The dolomite is also quarried in many sites around the county, as the crushed rock serves well for road construction or forming the breakwater on a shoreline.

Geotechnical Encounters

The geotechnical conditions along downtown Egg Harbor are expected to be approximately 4-7 feet of soil before hitting the Niagara Dolomite bedrock. The unpredictability of some glacial deposits could lead to greater depths of soil. However, due to STH 42's proximity to the shoreline, deeper deposits are less likely. Of the 7 soil borings taken on site, the 6 along the roadway averaged a soil depth of 4-7 feet before striking bedrock. The lone boring done along the slope had a soil depth of 4 feet to bedrock. Both areas have relatively small deposits of soil, restricting the utility relocation. At most there will be no more than 7 feet of soil. As many utilities as possible must be fit into this range to limit the amount of bedrock that needs to be extracted, as this is time consuming and an expensive addition to the project.

Layer 1: 0-1 feet below ground surface: Brown to fine medium sand (SP) with trace of clay and gravel. Topsoil/sand

Layer 2: 1-3 feet below ground surface: Brown sand (SM) w/ trace of gravel – moist- medium dense to dense. Within in this range some areas have a black organic peat (PT) later.

Layer 3: 3-7 feet below the ground surface: Grayish brown fine to coarse sand (SP) – with a travel silt, gravel, and organics - Moist to wet- very loose. Black coarse sand, present.

Layer 4: 7+ feet below ground surface: Niagara Dolomite Bedrock.

Groundwater Conditions

While no groundwater data for the site was provided to SES, it is assumed to be similar across the county. The groundwater table is at an elevation of 580 feet near the shorelines of Lake Michigan, which serves as the drainage basin for Door county. Away from the shoreline, locating the water table has been complicated by large deposits of glacial till. This has altered the hydrologic activity and blocked drainage patterns. The result is swamplands on the shore and inland.

Gravel seams in the dolomite approximately 30-40 feet thick also hold considerable amounts of water. Many of the rural residents drill into these as their source of drinking water for their homes. The layer below the dolomite, the Maquoketa shale, is impermeable, thus many natural springs are found near the shoreline, where this layer outcrops. No groundwater was encountered by the team while performing the soil borings.

Contamination

Water is also present in the many crevices of the dolomite bedrock. This presents a problem of groundwater pollution if any toxic or hazardous material moves through the openings in the rock. Sources of pollution could be an unfiltered septic tank or material from a business. Egg Harbor lacks any businesses that pose a threat to groundwater contamination, especially in the downtown area. Most buildings are homes and vacation properties which run on septic systems. In the case of a leak or improper filtration, rather than flowing and dispersing into the lake, there is a chance of it collecting in a pocket of dolomite. However, this is not a densely populated area, and the water quality is assumed to be acceptable.

Engineering Recommendations

Using current information and data found in this report, SES is making the following recommendations to the project, listed in the ensuing sections. Any geological variation onsite from the given site information will require SES to reanalyze the conditions and propose a new or modified recommendation.

Overview

Based on the data and field observations of the soil conditions in the area, the glacial loam exists for only a few feet before bedrock is hit. As no deep foundations are required as a part of this project, this should not cause an issue for construction. The shallow bedrock may be encountered earlier than expected, which will require it to be excavated with proper equipment. The more bedrock encountered that needs to be excavated, the more costly the underground work will become.

Site Preparation

The foreseeable underground work on the project that will deal with the presence of bedrock is the utility relocation, the stormwater treatment, and possible lighting or signal bases. Drilling the large bases required for the streetlights and traffic signals will most likely be done into bedrock. Vertical drilling into bedrock will not be as complicated or costly as any horizontal drilling required for the utility burial, thus the importance of fitting utilities into the top 3-5 feet below the surface. The roadway should be proof rolled according to Wisconsin Department of Transportation highway standards. The site's topography does require any special underdrain conditions, as runoff naturally travels down the slope away from the site.

Utility Burial

Relocating the utilities underground is a key part of the plan that will enhance the glow of downtown Egg Harbor. Electric, telephone and fiber optic cables currently run overhead along wood poles. They will need to navigate around existing storm sewer, sanitary sewer, and gas services buried below the streets and sidewalks. Burial of these should happen within the first 5 feet below the surface. This will prevent from having to dig through continuous bedrock, slowing production and inflating the cost.

Stormwater Treatment

The current stormwater runoff from the village of Egg Harbors STH 42 drainage basins also includes CTH G. This is a large surface area of land that empties into Green Bay at the concrete culvert shown below in **Figure 2.** Currently, storm water simply flows into catch basins through a series of manholes and exits via a pipe. SES proposes a possible method of stormwater treatment that utilizes the shallow bedrock of the area. Upon falling to the ground, water begins its descent into Green Bay at an elevation about 50 feet higher than the water level. Thus, it can be easily directed down the slope into an area where it may be temporarily held for infiltration. These holding areas will be bioretention basins. These basins are essentially depressions in the ground where water is held and filtered via vegetation and layers of material. The basins will be located in the terrace between the sidewalk and the roadway, with the possibility of a basin being placed in the village park as well. The layers in the basin consist of a native grass buffer strip on top, followed by the ponding area, organic layer and eventual stone chips where the pipe outflow will be located. When water fills up in the basin, gravity forces the water to percolate and filter through the layers of vegetation, and earth before ending up in Green Bay. Special overflow capabilities would be added to accommodate for special water levels. This proposed method would fulfill the request for stormwater to be treated while also adding another nice feature to the waterfront area.

Figure 2: Stormwater drainage entering Green Bay at the Egg Harbor Marina.

Construction Recommendations

Roadway

The current construction planned for the roadway is a mill and overlay for the duration of the STH 42 corridor through downtown Egg Harbor. In locations where utility burial must cross or travel beneath the roadway, the roadway will need to be replaced. This includes removing the pavement and reconstructing the roadway. The highway will be constructed according to Wisconsin Department of Transportation State Highway Standards. **Figure 3** roughly illustrates a cross section of this detail. This includes steps and procedure in the following lifts:

Layer 1: Surface
Layer 2: Binder
Layer 3: Base
Layer 4: 1/4" Aggregate
Layer 5: Breaker run
Layer 6: Subgrade

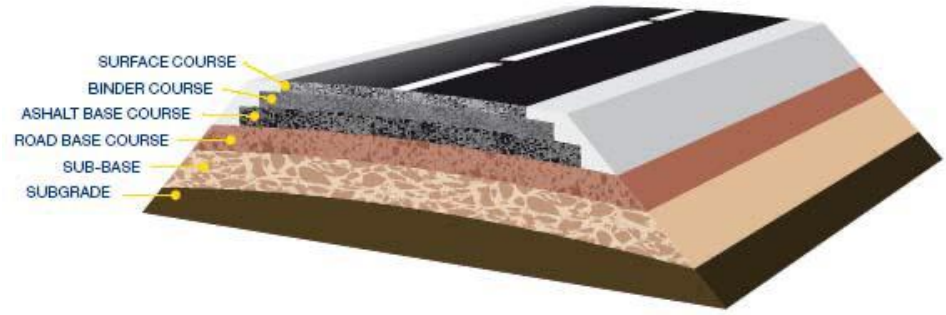


Figure 3: Expected roadway cross section

Erosion Control

The Erosion Control and Implementation Plan (ECIP) for this project will require vigilant inspection to ensure that it is functioning properly and not filling the harbor with sediment. As shown earlier, the storm water empties into the marina, the main waterfront location of the Village. Even during the heavy construction phases, people will still expect to see clear blue water in the harbor, not a sandy brown plume. This will require multiple layers of silt fence and ditch checks running parallel to the slope, inhibiting sediment from leaving the site. All existing catch basins must be fitted with proper inlet protection bags. It is also recommended that rock bags be placed in the flowlines of any culverts in proximity to the site. Water will easily flow down the slope of the hillside, which means sediment will likely be transported easily with the water. The purity of the harbor water will serve as a constant check of erosion control throughout the project.

Timeline

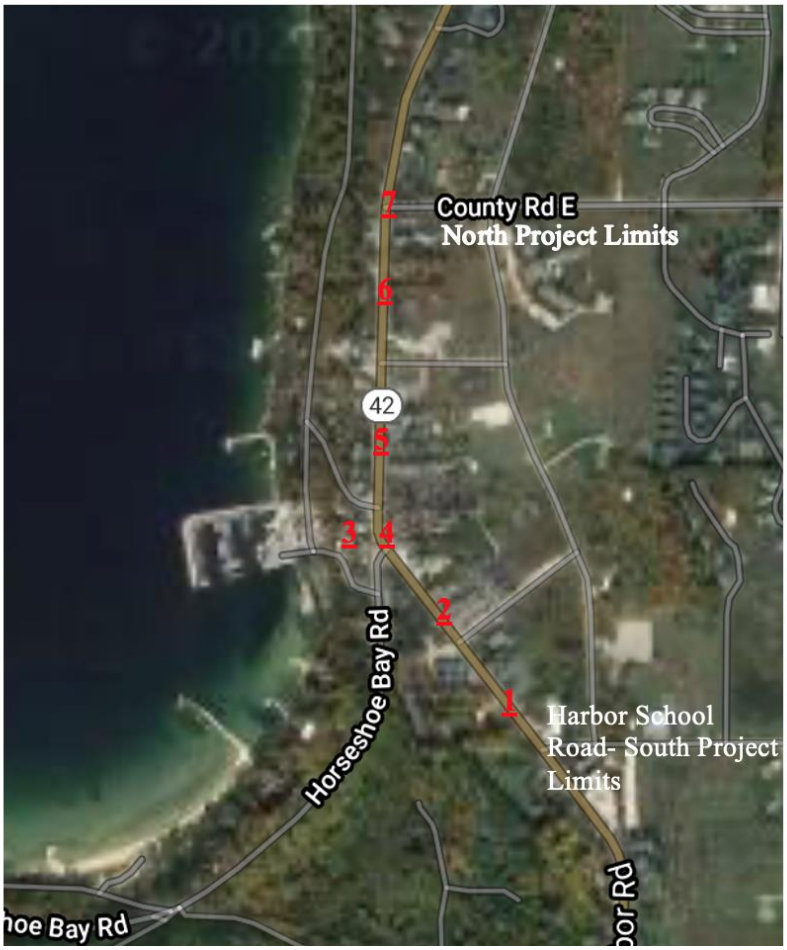
The advised construction start date would need to be after the spring thaw. Digging is essential on numerous parts of the project. Excavating through frozen ground would not be recommended, thus the advised construction start date is April 1st, 2023.

Limitations

The recommendations in the report are based on the available subsurface information obtained by SES via soil borings and regional research. If changes or variations are made to the site design, the geotechnical team must be notified to correctly update the report. As construction progresses, site conditions may change and another report may be required.

Appendix D: Site Soil Borings

Site Soil Boring Map: STH 42/ Downtown Egg Harbor



SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project: STH 42
Location: Egg Harbor, WI

Boring No. HA-1
Surface Elevation 635 ft.
Job No.
Sheet 1 of 1

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)		DCP	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						Brown Lean CLAY (CL)					
					5	Brown Silty SAND, Some Gravel (SM)					
						Auger Refusal & End Boring at 5.5 ft					
					10						

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/31/2020
Driller Chief
Logger Editor
Equip. Used: Hand Auger

SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project: STH 42
Location: Egg Harbor, WI

Boring No. HA-2
Surface Elevation 630 ft.
Job No.
Sheet 1 of 1

SAMPLE No.	Type	Rec (in.)	DCP	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
				0	Brown Silty SAND, Some Gravel (SM) (Upper Portions are Probable Fill)					
					Bottom of Footing at 32 in. Depth					
				5	SANDSTONE BEDROCK at 5'9" and End Boring/Pit - Auger Refusal Drilled adjacent to Test Pit A.					
				10						

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

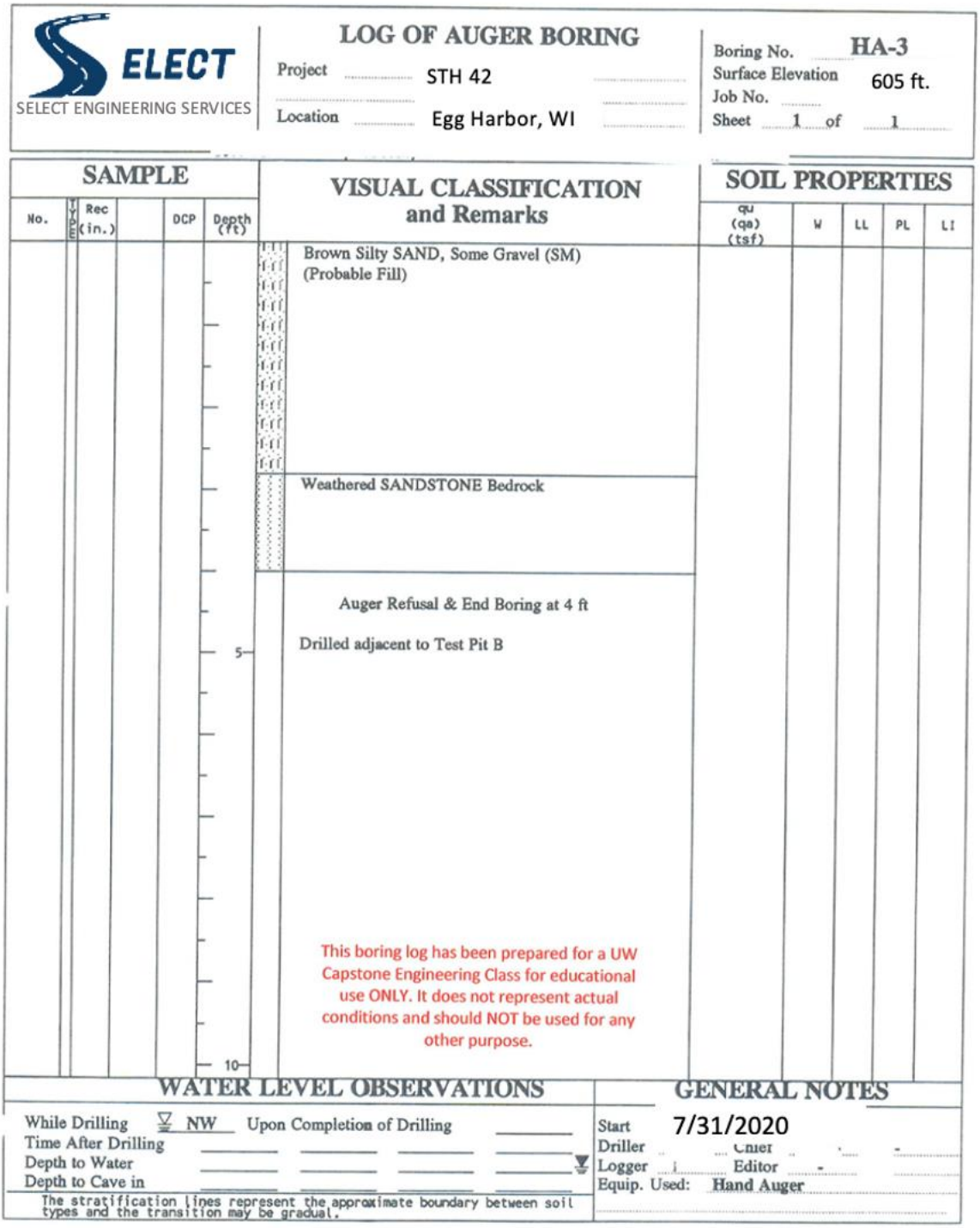
WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling
Depth to Water ▽
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/31/2020
Driller
Logger Editor
Equip. Used: Hand Auger



SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project STH 42
Location Egg Harbor, WI

Boring No. HA-3
Surface Elevation 605 ft.
Job No.
Sheet 1 of 1

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	DCP	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					Brown Silty SAND, Some Gravel (SM) (Probable Fill)					
					Weathered SANDSTONE Bedrock					
				5	Auger Refusal & End Boring at 4 ft Drilled adjacent to Test Pit B					
				10						

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling
Depth to Water ▽
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/31/2020
Driller Chief
Logger Editor
Equip. Used: Hand Auger

SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project: STH 42
Location: Egg Harbor, WI

Boring No. HA-4
Surface Elevation 630 ft.
Job No.
Sheet 1 of 1

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	DCP	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
				0	Brown Lean CLAY (CL)					
				5	Brown Silty SAND, Some Gravel (SM)					
					End Boring at 6.3 ft (No Bedrock Encountered)					
				10						

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling
Depth to Water ▽
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/31/2020
Driller
Logger Editor
Equip. Used: Hand Auger

SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project STH 42

Location Egg Harbor, WI

Boring No. HA-5
Surface Elevation 635 ft.
Job No.
Sheet 1 of 1

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	DCP	Depth (ft)		qu (qe) (tsf)	W	LL	PL	LI
				0	TOPSOIL (OL)					
				5	Brown Lean CLAY (CL)					
					Brown to Greenish Brown Silty SAND, Some Gravel (SM) (Weathered Bedrock)					
				10	Auger Refusal & End Boring at 6.8 ft					

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 1 7/31/2020
Driller Chief
Logger Editor
Equip. Used: Hand Auger

SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project STH 42

Location Egg Harbor, WI

Boring No. HA-6

Surface Elevation 640 ft.

Job No.

Sheet 1 of 1

SAMPLE No.	SAMPLE TYPE	SAMPLE Rec (in.)	DCP	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
					FILL: Mix of Topsoil, Sand, Gravel & Cobbles					
				5	Yellow to Greenish Brown SAND & GRAVEL, Some Silt (SM/GM) (Probable Weathered Bedrock)					
					Auger Refusal & End Boring at 7 ft+/-					
				10	This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.					

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling

Time After Drilling

Depth to Water ▼

Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

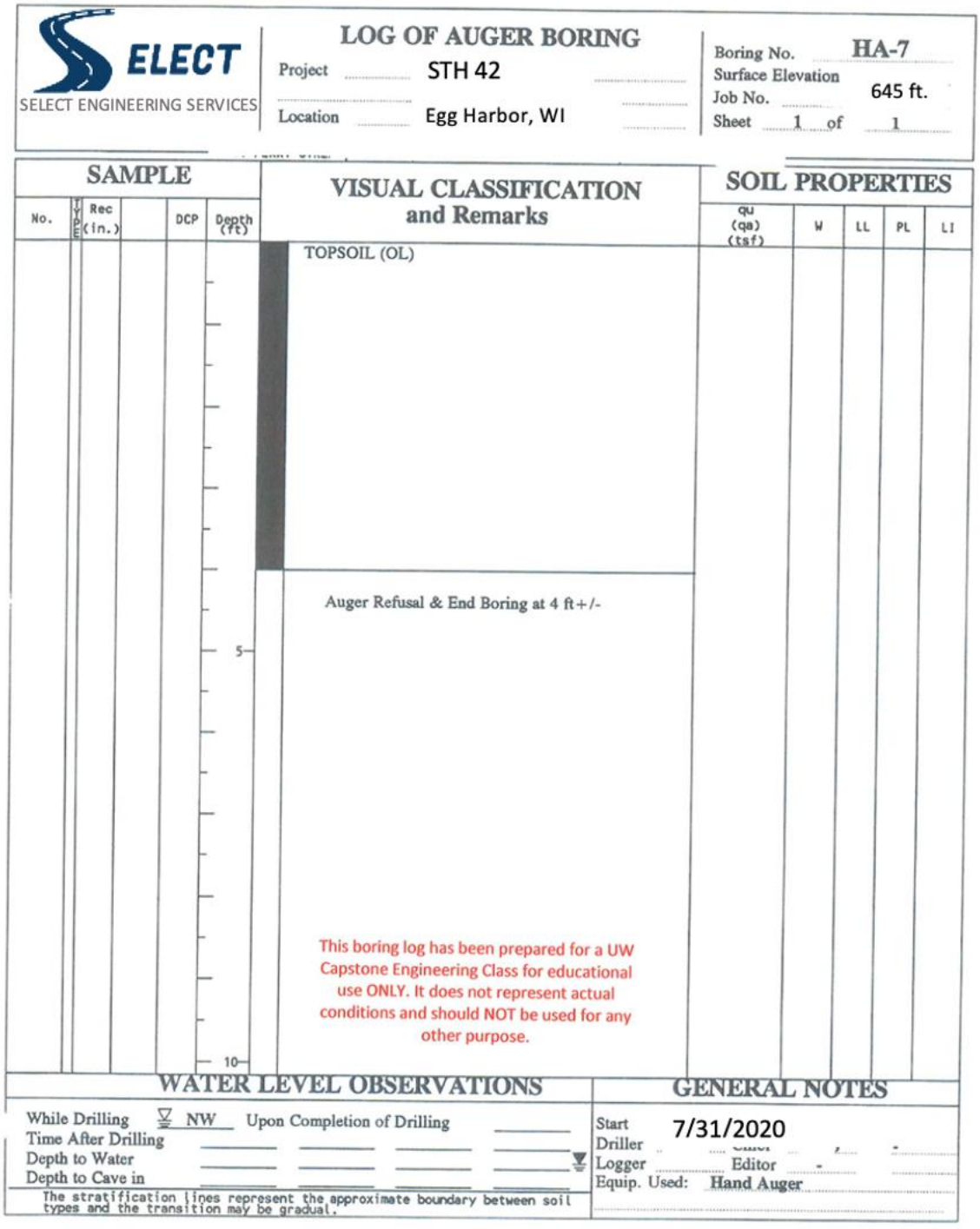
GENERAL NOTES

Start 7/31/2020

Driller [illegible]

Logger S Editor

Equip. Used: Hand Auger



SELECT ENGINEERING SERVICES

LOG OF AUGER BORING

Project STH 42

Location Egg Harbor, WI

Boring No. HA-7

Surface Elevation 645 ft.

Job No.

Sheet 1 of 1

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	DCP	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					TOPSOIL (OL)					
				5	Auger Refusal & End Boring at 4 ft+/-					
				10						

This boring log has been prepared for a UW Capstone Engineering Class for educational use ONLY. It does not represent actual conditions and should NOT be used for any other purpose.

WATER LEVEL OBSERVATIONS

While Drilling NW Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 7/31/2020

Driller Other

Logger Editor

Equip. Used: Hand Auger

Appendix E: Egg Harbor Area Soil Map


*STH 42's path
shown in yellow

UniverCity Alliance
UNIVERSITY OF WISCONSIN–MADISON

About UniverCity Year

UniverCity Year is a three-phase partnership between UW-Madison and one community in Wisconsin. The concept is simple. The community partner identifies projects that would benefit from UW-Madison expertise. Faculty from across the university incorporate these projects into their courses, and UniverCity Year staff provide administrative support to ensure the collaboration's success. The results are powerful. Partners receive big ideas and feasible recommendations that spark momentum towards a more sustainable, livable, and resilient future. Join us as we create better places together.

univercityalliance@wisc.edu • 608-261-1141 • univercity.wisc.edu • @UWUniverCity