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FINAL DELIVERABLE

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Completed By	Jarod Erlandson, Patrick Maston, Nick Nelson
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Instructor	Christopher Stoakes
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RECREATIONAL RIVER ACCESS DESIGN REPORT KEOKUK, IA

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April 8th, 2020

Report Submitted to:
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EXECUTIVE SUMMARY

This document is the official design report created by JNP Consultants, a student design group at the University of Iowa, for the Recreational River Access project in Keokuk, IA. Our design team was tasked with designing a new marina for river access and storage for boats on water. It is expected that the additional boat ramps and boat docks will absolve ongoing issues of traffic congestion entering and leaving the Keokuk Yacht Club about a mile south of the project location. Our team has designed three boat ramps as well as nine boat docks. Both the ramps and the docks include two-way directional traffic flow. The project location is south of Prices Creek, running parallel with the BNSF Railroad and the Mississippi River. A visual representation of the site location, in reference to the city of Keokuk, can be found under Figure 2 in Appendix E. In addition to the boat ramps and boat docks, our team designed a parking lot to accommodate boat trailers and passengers along with a bathroom facility. Lastly, we investigated whether it would be possible to utilize existing sediment that has built up at the project location. Our team determined that due to the lack of soil information regarding the existing sediment, the material must be removed and replaced with engineering fill. Additionally, our group designed extensive green space, a concrete levee, landscaping, and exterior improvements for the marina.

The overall area of the designed marina covers roughly 4.3 acres of land. Roughly one acre of land is green space while the remaining land contains the other main design elements that define the project scope. The dimensions of the main design elements, which includes the access road, parking lot, boat launch, and levee, are roughly 10,900 square feet, 110,000 square feet, 7,200 square feet, and 7,000 square feet respectively. In addition, the Iowa DNR requires the project to be raised, at minimum, to the minor flood stage. In this case is an average elevation of 525 feet. This would require the installation, compaction, and testing of roughly 15 feet of engineering fill throughout the entire project.

Based on requests from the City of Keokuk, a cost estimation for the design work through the contract period has been created. For the purpose of simplifying phase recommendations and construction costs, categorical allocations were created. The project categories to determine the total construction cost include waterway and marine construction, earthwork, roadway and parking lot, concrete and masonry, boat docks, bathroom facility, exterior improvements, utilities, landscaping, and erosion control. Please view the Final Design Details section and the Cost Estimation section in the report below for information regarding the individual element by element selection, quantity, and cost breakdown. Our team has determined that the total estimated construction cost for the project will be roughly 17.7 million dollars. In addition to the construction cost, our team also included in the total project cost an engineering/administrative cost along with a contingency fund. The total engineering/administrative cost is estimated to be roughly 1.8 million dollars while the contingency fund (assuming 10%) should be roughly 1.8 million dollars. We have determined the total project cost will accrue to be roughly 21.3 million dollars.

Necessary attachments, including standards and guidelines, cost estimations, project workflows, figures, and drawing sets have been attached at the end of the design report in the Appendices section. We thank you for your time and consideration.

ORGANIZATION QUALIFICATIONS AND EXPERIENCE

We at JNP Consultants are a group of students, currently in our final semester capstone design course, with various experiences and backgrounds. Our core strength is that we work as efficiently and diligently as possible to provide you with the best possible product that will satisfy all your expectations and more. At JNP, we work as a team by recognizing everyone's strengths and applying those characteristics to the project work plan. We are a group of young and eager engineers looking to advance ourselves by creating the best possible product to assist in the advancement of the great city of Keokuk, IA.

Our current location is in the Seamans Center located on campus at The University of Iowa. Our address is 103 South Capitol Street. Iowa City, IA 52242. The project manager of our firm is Jarod Erlandson who can be reached by email at jarod-erlandson@uiowa.edu.

JNP is a team of three students at the University of Iowa in the senior capstone design class for the civil engineering department. Our team consists of Jarod Erlandson, Nick Nelson, and Patrick Maston. Jarod is currently a civil engineering student specializing in management who is currently an EIT. Nick is studying civil engineering specializing in structures. Patrick is also studying civil engineering specializing in transportation. For more information regarding our qualifications and job experience, please reference our resumes with the link located in the Proposal Attachments section located at the end of our proposal.

For the Recreational River Access project, Jarod lead the geotechnical and hydraulic work, Nick lead the structural work, and Patrick lead the design work. Jarod is qualified to lead the geotechnical work from his one year of experience working for Braun Intertec, a geotechnical firm out of Cedar Rapids. Jarod is also qualified to lead the hydraulic work based upon his successful work in a Water Resources design course offered by the civil engineering department at The University of Iowa. Nick is qualified to lead the structural work based on his success in Design of Concrete Structures and Design of Steel Structures; both of which are design courses provided by The University of Iowa. Nick also worked an internship for the Iowa Department of Transportation further expanding his knowledge on designing and analyzing structural elements. Patrick is qualified to lead the design aspect of the project based on experience in computer aided design work from working at HDR who is a large general engineering contractor out of Cedar Rapids.

DESIGN SERVICES

Through extensive background research, we were able to identify multiple examples of similar projects constructed throughout the state of Iowa that fit our project scope. One example that really stood out to us, and that served as the basis for our design, was the Guttenberg Marina located in Guttenberg, IA. The 5.6 acre Guttenberg Marina, which can be found under Figure 1 in Appendix E, includes most of the design items identified in our project scope. Combining some of our own ideas with some aspects of the Guttenberg Marina, our team designed a 4.3 acre marina located at the project location. All of the main elements entailed within the project scope, which included the parking lot, boat launch, boat docks, a bathroom facility, and two-way directional traffic flow, was included in the marina design. In addition to these elements, our team was also able to include additional green space, a concrete levee, landscaping, and exterior improvements to the project design. All of these elements can be viewed in Figure 4 located below and in Appendix E. The only design element our team was unable to include in the construction of the project was the utilization of existing sediment based on the lack of soil information regarding the sediment. The existing sediment at the project location can be viewed under Figure 3 in Appendix E.

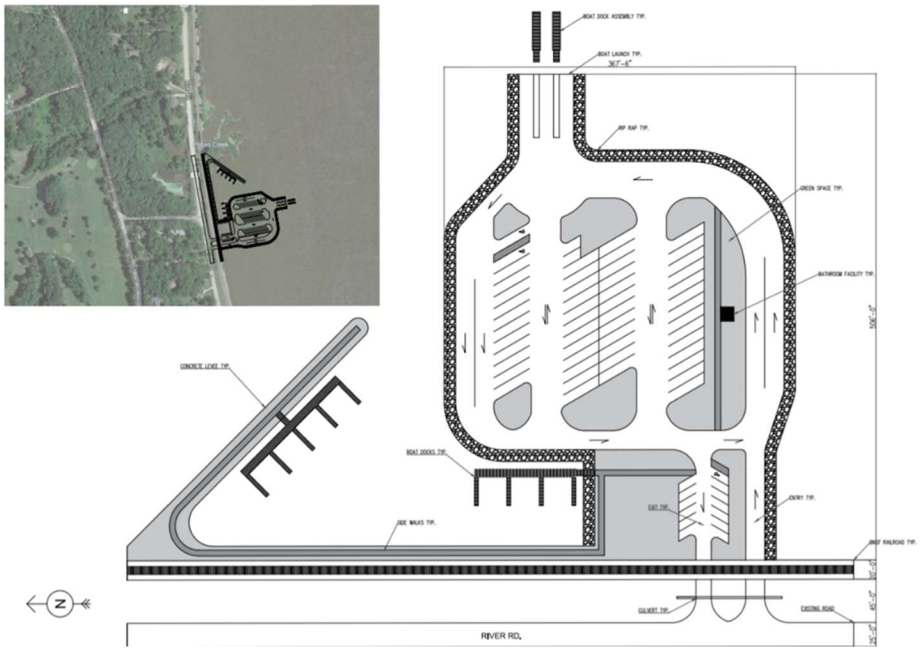


Figure 4: Proposed Site Plan and Design Elements

The access road, which can be viewed in Appendix E, consists of concrete pavement, two-way directional traffic flow, angled parking, and green space. The design of the 10,900 square foot access road, which crosses over the BNSF railroad, also required the addition of a culvert, which can be viewed in Appendix E. The parking lot design, which can be viewed in Appendix E, includes concrete pavement, green space, angled parking, two-way directional traffic flow, the bathroom facility, and the boat launch. Further details regarding the 110,000 square foot parking

lot can be accessed in Appendix E. Room has also been provided where the access road merges with the parking lot for addition of a fishing pier to be created on the south side of the site. The proposed site elevation, along with the drainage plan of the parking lot, can be found in Appendix E. A detail of the designed bioswale for storm water runoff can also be located in Appendix E.

As requested, our team was able to design three boat ramps for year around river access. Details of the 7,200 square foot boat ramp design are located in Appendix E. An example of the proposed boat ramp can be found in Figure 5 located in Appendix E along with an example of the proposed guardrail addition in Figure 6, also located in Appendix E. Our team also designed multiple boat docks located on the northwest side of the project site that can house up to nine boats. The boat docks were designed as floating boat docks in order to rise and fall with the water levels of the Mississippi River. The boat docks were designed to house private boats/marina similar to Guttenberg Marina. Access to the boat ramps was designed to be two-way access. Directional traffic on water between the boat docks was also designed to allow for two-way access. Details regarding the boat docks, along with the 7,000 square foot levee, can be found in located in Appendix E. An example of the designed docks can also be located in Figure 7 under Appendix E. Other elements designed by our team, which include the sheet pile design, soil design, bathroom facility, masonry of the bathroom facility, utility plans, and landscaping plans can all be located in Appendix E.

In addition to the design services, our team has also developed a five phase plan for the construction of the marina. The first phase of the construction process should include all of the mechanical dredging and site material excavation at the site. Our design and cost estimation for this process includes the removal of all existing sediment and material on site. Phase two entails a majority of the earthwork which includes the subgrade for all the major design elements. Phase three includes most of the remaining earthwork such as the subbase for all the main design elements and construction of the foundation for the bathroom facility. All of the concrete work, the creation of the bathroom facility, the construction of the boat launch, and the construction of the boat docks have been recommended to occur in phase four. Phase five, the final phase, consists of all the utility connections, landscaping, and exterior improvements for the marina. A visual representation of all five of the recommended project phases can be found under Appendix E in Figure 8, Figure 9, Figure 10, Figure 11, and Figure 12 respectively.

The work plan that was implemented for the design through the contract period can be accessed in Appendix D. The work plan is portrayed in Microsoft Excel using a Gantt chart. This document was used and referenced during our team's weekly meetings. The work plan was developed while keeping in mind important project deadlines. Specific tasks were assigned based on each individual's specialization in civil engineering and each member's respective assigned role for the duration of the contract period.

Throughout the design process, the Iowa Department of Transportation Design, Construction, and SUDAS Manuals was referenced for a majority of the design process. Also referenced was the US Army Corps of Engineers Manual No. 1110-1-400 specifically sections 5-9 through 5-12. The US Army Corps of Engineers Manual provides specifications for roadway and structural designs. These sections include material such as minimum boat launch dimensions, lane dimensions, vertical curve specifications, lighting, safety and bathroom facility specifications. Other codes for a courtesy fishing dock are included in the provided sections as well. Elevations were determined based upon contour lines that will be accessed through the Iowa Geodata website. Our team downloaded Lee County two-foot contour data and uploaded the results into Arc Maps for further analysis. Hydraulic analysis was completed based on data provided by the NOAA hydraulic prediction service as well as the Iowa DNR. With respect to the railroad, the 1D-20 Reviewing Railroad Crossings at Side Roads manual was used from the IDOT. For geotechnical work, the Soil Survey Field and Laboratory Methods Manual provided by the NRCS was referenced. Also, appropriate ASTM testing methods was referenced as well as the AASHTO Soils Classification Table for further analysis of the soils at the project location. For more information regarding the design specifications used throughout the design process, please see Appendix A.

CONSTRAINTS, CHALLENGES, AND IMPACTS

Our design team was able to identify several constraints based upon the chosen location for the Recreational River Access. One constraint is the existence of the BNSF Railroad located between River road and the Mississippi River at the chosen project location. The width of the Railroad, along with the right of way extending horizontally, forced the project to be designed further west of River Road into the Mississippi River. Due to the Railroad, almost none of the existing ground was eligible to be used resulting in an increase in engineering fill required for the project. The height of the existing railroad compared to the existing grade of a majority of the project location also served as a constraint. Specific slopes required by the DOT to connect existing roadway to the project site required the utilization of additional engineering fill to build the site vertically. The railroad also crossed over a nearby creek on site but the existing structure on which the railroad utilizes is too short to allow safe access under the bridge. Even if the height of the structure was adequate, consultation with the railroad and purchasing/accessing the right of way would be necessary. Another constraint our team identified are existing utilities located on site. USIC will have to be called out on site for utility locate which can complicate the design and construction process.

We have been able to identify a few challenges with the chosen project location in addition to the constraints mentioned above. As mentioned above, crossing the railroad track will be a problem because of both right of way access and times the train utilizes the track at the project location. Times to allow access over the Railroad will have to be consulted with BNSF at a later date.

Another challenge of constructing the site is the water level of the Mississippi River. Depending on the time of year when construction is taking place, certain precautions and measures may need to be taken into consideration to handle the rise and fall of the water level of the Mississippi River. This can lead to challenges for erosion control and landscaping for the project site. Also, based on changes in the water level, a temporary barge that can adjust to the changing water levels will be necessary for the completion of the project. Another challenge will be determining the appropriate amount of fill needed based on contour lines to meet roadway standards for trucks, boats and trailers to access. Based upon the lack of existing contours in the area, further analysis, through the use of borings, has been recommended. Another challenge is the preservation and utilization of the built-up sediment and wetland. Without any boring or soil samples, we have designed for most of the material to be removed. Another environmental challenge presented is the incorporation of the bathroom facility at the project location. It is essential that we design a system of sanitation that is environmentally friendly. The system must be designed to adapt in case of rising water levels and remain Iowa DNR compliant.

Based upon analysis of related projects constructed in the state of Iowa, the overall societal impact with the community of Keokuk will be incredibly positive. The main factor driving the Recreational River Access project is the traffic density that builds up during the summer months near the Keokuk Yacht Club and B & H Marine due to the single boat ramp and small parking lot. The creation of the new boat ramps along with a larger parking lot will be able to decrease the amount of traffic buildup on River road. We predict that the decrease in traffic, and therefore frustration and time, will lead to an increase in tourism and activity for recreational purposes on the Mississippi River. There will also be the impact of jobs being created for both the design phase as well as the construction phase of the project.

ALTERNATIVE SOLUTIONS

Our group has been able to customize multiple alternatives for various features within the project design. One of the features includes the design of the parking spaces within the parking lot. The two alternatives we weighed with respect to the parking lot were angled parking vs. parallel parking. With angled parking, it will be easier to get vehicles with boats and trailers in and out causing the least amount of traffic congestion. A con to the angled parking solution is that it is not as space efficient. A parallel parking lot would be much more efficient for space, but it would be more difficult for a vehicle to pull in and out of the lot with a boat trailer. The option we decided to proceed with is the angled parking. Although it is less efficient in regards to space, the proper room for maneuverability and parking will lead to less traffic congestion which promotes the initial factor driving the existence of the project.

Another feature our team created alternatives for is the amount of green space located on site. We wanted to make sure to include green space for recreational activities and leisure to create a family atmosphere. The amount of green space however had a lot to do with the parking

arrangement and flow of traffic within the parking lot. By switching to angled parking, we had to eliminate some of the original green space that was located in original preliminary designs. The original green space area can be referenced in Appendix E. We did however provide additional ideas for green space that is not present in the current design drawing. The additional green space would provide more area for recreational and leisure activities but limit the amount of parking space available. Due to the original concern of traffic congestion for needing the project, we opted to go with the additional parking space instead of green space.

Related to the green space was the idea of adding a fishing pier. Although this would increase the family atmosphere of the finished product, we had to eliminate the fishing pier in order to include the additional space needed for parking. We do however include an alternative drawing located below in Appendix E that extends from the built-up site location. This alternative would be a viable option to add the pier without taking away parking space.

Another feature we developed alternatives for is the bathroom facility. We originally brainstormed two designs: one entails running water that would be connected through water mains and waste pipes while the other included water less bathrooms. We decided to proceed with the design for waterless bathrooms. The pros to installing a waterless bathroom is that it is easier to maintain and the process of connecting water and wastewater piping from existing utilities over/under the railroad can be discarded. Our team has also determined that the lack of pipes would ease concerns of waste overflow from flooding. This determination was made assuming proper upkeep of the facility including proper removal and sanitation of the water tank holding the discarded water. The cons are that there is limited water on site because the tank to hold the water is only so large. Other cons are that there is no running water and water can't be heated. Our team proceeded with the design of a connection-less facility in order to avoid pollution concerns and crossing the over/under the railroad.

Lastly, our group created alternatives for the roadway over the railroad crossing. One alternative included the installation of a right turn lane heading northbound on River Road into the marina. This alternative can be located in Appendix E below. The main incentive to this alternative would be less traffic build up heading northbound on River Road. However, creating the right turn lane would be a challenge considering the limited space available due to existing conditions and the railroad R.O.W. Another consideration would be the added cost and closure of the existing lane heading northbound within proximity of the project location. Our team decided to proceed with the design assuming no right-turn-lane would be installed due to the cons outweighing the pros.

FINAL DESIGN DETAILS

The final design details, item selection, and quantity determination/calculations were made in accordance with various design guide specifications and guidelines located in Appendix A. The item selection process was performed as follows:

1. Background research on possible design ideas for individual sub categories of the design and construction process.
2. Research design specifications and standards for individual sub categories of the design and construction process.
3. Select and record individual design and construction items with assistance from RS Means for each individual sub category of the design and construction process. Our team prioritized selecting items to keep costs as low as possible while meeting proper design standards and specifications.
4. Verify and correct item selection to meet design standards and specifications for each individual sub category of the design and construction process.
5. Quantify items based on design drawings for each individual sub category of the design and construction process.

The order of the design details and item selection listed below follows the general layout of the drawing set and recommended construction phases. The same order applies to the Engineer's Cost Estimate section of the report.

Waterway and Marine Design

Due to a majority of the project being located in the Mississippi River, mechanical dredging will be required to remove all of the existing sediment and debris from the bottom of the River. This will need to be completed in order to ensure adequate compaction and strength of the base layer below the engineering fill. Unfortunately, more material than originally planned will have to be removed because none of the existing sediment can be assumed to be an adequate replacement for engineering fill due to the lack of soil samples/testing. We have determined through computations that the total area needed to be dredged is roughly 180,566 bank cubic yards. This computation can be located in Appendix B under Computation 1. Also, in order to speed up the efficiency of the dredging process, our team has opted to go with two commonly used docks that provide the ability to hold a barge mounted dragline or clamshell. Each dock is a concrete pontoon that contains a wood frame and a deck. We opted to go with the medium sized option available through RS Means in order to ensure proper strength to hold the mechanical barge and so that the dock can withstand the elements year around.

In order to provide adequate protection and soil stabilization of the engineering fill, seawalls will be required around the perimeter of the entire marina. Our team has decided to install both concrete seawalls and steel sheet piling seawalls. We would have chosen the concrete seawall for

better visuals, however, the cost of concrete seawalls are almost three times the cost of steel sheet piling. Therefore, our team elected to go with the steel sheet piling for most of the marina except for the levee. We decided that only six foot tiebacks would be required for the levee therefore, it allowed our team the opportunity to install concrete seawall around the perimeter without the cost rising too high. Our team has determined through computations that the total required linear feet of concrete seawalls and steel sheet piling seawalls will by roughly 321 and 2020 respectively. The seawall computations can also be found under Computation 1.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the waterway and marine construction elements, please see the final drawing set. Information regarding design standards and specifications for the design of the waterway and marine elements can be found under Appendix A.

Earthwork Design

Before any earthwork is completed, it is important to consider that certain locations at the project site will require excavation to be completed. Due to the soil being heavily saturated, the base layer poses a high chance of being unsuitable. In addition, it must be expected that the rock removal will be required as well. After these items are taken care of, water from the Mississippi River must be kept away from the engineering fill that is being placed and compacted in order to maintain proper densities and moisture contents. It is required from the IDOT that soils have a minimum of 95% compaction. Therefore, to avoid any water from seeping in, drainage trenches for dewatering will be required. In addition to drainage trenches, pumping stations need to be set up as well. For earthwork excavation estimates, please view Computation 3 in Appendix B. For drainage trench, pumping quantities, and rock removal, please view Computation 4 in Appendix B. The hauling and cycle time for the excavated soil and engineering fill can be found under Computation 5.

Due to the need to raise the elevation of the project location, the incorporation of engineering fill will be required. In nearly every area of the project east of the BNSF Railroad, 15 feet of engineering fill will be required. To limit costs, it has been determined that only the top 5 feet of the subgrade will need to be type 1 fill. Type 1 fill is generally stronger than type 3 fill and it is also recommended by the IDOT Design Manual for the top five feet of any subgrade for a parking lot. For the remaining 10 feet below the 5 foot type 1 layer is type 3 fill. The type 3 fill is generally less expensive than type 1 fill and it meets the requirements from both the IDOT and Iowa DNR. For any concrete material and backfill of trenches, it is required by the IDOT that type 4 fill be used for the top foot as a subbase. It has been determined based on engineering computations that the required amount type 3, type 1, and type 4 fill required will be roughly 47,515 loose cubic yards, 28,468 loose cubic yards, and 43,110 square feet. Please see

Computation 5 and Computation 6 under Appendix B for the engineering design computations for engineering fill.

In addition to soil testing, proper grading and compaction of the engineering fill will be required. Our team has computed that there will be roughly 77,580 cubic yards of engineering fill that will be placed on site. IDOT specifications require roughly 124 soil density tests to be performed. For additional information regarding the computations for soil testing and grading, please see Appendix B, sub-section Earthwork.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the earthwork construction elements, please see the final drawing set. Information regarding design standards and specifications for the design of the earthwork elements can be found under Appendix A.

Roadway & Parking Lot Design

Our team first had to decide whether or not to install asphalt or concrete for the access road and parking lot. After much consideration, our team opted to lean on the side of longevity and common usage throughout the state. Therefore, concrete was the chosen pavement. Most of the concrete information can be found under the concrete and masonry sub-sections throughout the report. The only concrete computations under the roadway and parking lot sub-sections is for the cast-in-place concrete curbs and gutters. In order to assist in the directing of storm water runoff, our team designed the installation of curbs to direct the water to the south side of the site into the designed bioswales. The computation for the concrete curbs and gutters can be found under Computation 7 in Appendix B.

Throughout the design phase, our team also elected to go with angled parking. Although the angled parking takes up more space allowing less parking spots to be installed, it allows for safe and easy maneuvering of motorized vehicles with trailers. Even with the angled parking, our team was still able to include 70 parking spots, which includes three handicap spots.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the roadway and parking lot elements, please see the final drawing set. Information regarding design standards and specifications for the design of the roadway and parking lot elements can be found under Appendix A.

Concrete & Masonry Design

Design recommendations and standards from the IDOT require certain thicknesses of concrete for sidewalks and parking lots. Fortunately, for design purposes, any parking lot or roadway withstanding heavy weight from boats and trailers is recommended to be four to six inches thick. Our team wanted to error on the side of caution, so we opted to design for six inch thick

concrete. Due to the grading that is required, slab on grade concrete, which is cheaper than non-slab on grade, has been recommended. Also, due to the location of the parking lot relative to River Road and the BNSF Railroad, the only way to get the concrete placed is through the usage of a pump that extends from River Road over the Railroad. Our team has computed that roughly 34,478 cubic yards of pumped concrete will be required. This computation can be found under Appendix B, Computation 10. For sidewalk and pathways, it is required that three to four inch thick concrete be used. Our team again, went on the safe side and designed for four inches. Please view Computation 10 for quantity information for the sidewalk and pathways. Testing calculations for the concrete can also be located in Appendix B under Computation 9.

In order to give the bathroom facility a fresh, clean look, our team opted to build the exterior of the bathroom facility with masonry blocks. The masonry blocks we chose to design with are decorative, split-face CMU blocks that are 6 inches x 16 inches x 4 inches. Our engineering computations have indicated that 364 CMU blocks will be required for the construction of the bathroom facility. For computations regarding the masonry blocks, along with the masonry testing and rebar testing, please view Computation 8 and Computation 9 under Appendix B.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the concrete and masonry elements, please see the final drawing set. Information regarding design standards and specifications for the design of the concrete and masonry elements can be found under Appendix A.

Boat Dock Design

As discussed in the Design Services section of the report, our team wanted to design boat docks that could withstand the rise and fall of the water levels of the Mississippi River. Therefore, the best option for boat docks would be floating docks. A common technique of pile driving the structural elements for a typical boat dock would not suffice in this case because during several months of the year, the dock would be under water. With floating docks, the docks will adjust along with the water level providing easier boating access for recreational users. With safety and longevity in mind, our team has also designed for the installation of bumpers to be placed at the ends of each floating dock. Computations for the floating boat docks and bumpers can be found under Appendix B, Computation 11.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the boat dock elements, please see the final drawing set. Information regarding design standards and specifications for the design of the boat dock elements can be found under Appendix A.

Bathroom Facility Design

The Iowa DNR provided multiple links to commonly used bathroom designs for parks and recreational facilities. Most of the bathroom components, provided by RS Means, are in accordance with the Iowa Plumbing Code, Building Facility Code, and Department of Public Safety. Most of the design aspects created by our team were on the exterior of the building. The only specific element we designed on the interior of the bathroom facility that was not required by various building and safety codes were the waterless toilets. We chose to go with waterless toilets in order to avoid waste contamination from underground pipes to River Road in case there is a sudden rise of the water level from the Mississippi River. We instead are diverting waste to a septic tank located under the bathroom facility. The septic tank we chose was a 1500 gallon tank that should only need to be changed every few months. Water tanks however will have to be stored on site next to the bathroom facility to provide running water out of the handwashing station. Please see the final design drawing set for more information.

Some of the exterior designs include the fascia of the bathroom roofing, wood materials for the construction of the truss, and the steel roofing. We decided to go with wood material for the construction of the truss instead of steel because it significantly cheaper than welded steel. The fascia is a typical line item requirement for the creation of any bathroom facility. Therefore, only one line item was provided by RS Means. The typical roofing for an outdoor bathroom facility in the Midwest is steel roofing. Although the steel roofing is one of the more expensive options, it is the most durable material and provides the most longevity under the harsh conditions of the Midwest. Computations for the truss, fascia, and steel roofing can be found under Appendix B, Computation 12 and Computation 13.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the boat bathroom facility elements, please see the final drawing set. Information regarding design standards and specifications for the design of the bathroom facility elements can be found under Appendix A.

Exterior Improvement Design

Exterior improvements were not part of the project scope, however, we wanted to provide a rough estimate for what some of the more basic items would cost for the client's benefit. Our team only provided three basic design elements: park benches, picnic tables, and trash receptacles. We chose to go with a recycled plastic material for the park benches and picnic tables for two reasons in particular. First, the recycled plastic costs much less than metal or wood. Also, we wanted to provide another environmentally friendly design element to the marina. For the trash receptacle, we opted to go with the line item for a more expensive receptacle. We did this because our team estimates that the longevity of the nicer and heavier receptacle will last longer than a cheaper and lighter receptacle.

Utility Design

Many individual utility line items are requirements from the department of public health, such as the installation of fire and carbon dioxide alarms, fire hydrants, and utility septic tanks. The only slight deviation is that due to waterless toilets, we opted to go with a much larger septic tank than what is typically required. Other line items include individual fixture installation costs, general plumbing, and general electrical costs which are estimated based on the square footage of the bathroom facility. The two line items that required computations were the square footage of the bathroom facility and the public water distribution connection. Our team has computed that the square footage of the bathroom facility is roughly 202 feet (not including the concrete foundation). Our team has also computed that the piping required for public water connection will be roughly 350 feet of 4 inch diameter ductile iron piping. Our team opted to proceed with ductile iron piping because of the longevity concerns of PVC and concrete piping. Computations for the piping and square footage of the bathroom facility can be found under Appendix B, Computation 14. The public water connection is to supply water to drinking fountains and the sprinkler irrigation system that is described in the next sub-section. The water connection also provides the option to do away with the waterless toilets.

Our team has also designed for there to be an electrical connection near the same location of the water connection. The electrical connection will provide electricity to the various bathroom utilities along with the lights surrounding the perimeter of the marina. Please see the final drawing set for more information regarding the lights around the perimeter of the marina.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the utility elements, please see the final drawing set. Information regarding design standards and specifications for the design of the utility elements can be found under Appendix A.

Landscaping

Although not necessarily part of the project scope, our team chose to include the installation of green space throughout the marina. The green space helps provide an aesthetically pleasing look and allows room for recreational activity. Also, the grass acts as a buffer for storm water runoff and provided our team the option to install bioswales to properly filter the water in accordance with the Iowa DNR. We chose to go with seeded mechanical turf instead of sod or artificial turf due to cost limiting considerations. However, to ensure the green space reaches its full potential, we have called for seed testing to be performed roughly every 200 square feet. In addition to seed testing, we have also designed for the installation of a sprinkler irrigation system to keep the grass in perfect condition year around. Computations for the landscaping items can be located in Appendix B under Computation 15 and Computation 16.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the landscaping elements, please see the final drawing set. Information regarding design standards and specifications for the design of the landscaping elements can be found under Appendix A.

Erosion Control

Throughout the entirety of the construction process, the Iowa DNR along with the IDOT requires certain steps for erosion control to be implemented. The selection and duration of each erosion control element was chosen in accordance with the recommended construction phasing discussed earlier in the report. One erosion control element that will need to be installed is a fence around the perimeter of the area being constructed. Instead of having to deal with the hassle of probable delays and the taking down and putting up of a fence multiple times throughout the construction process, our team chose to go with a three foot high, polypropylene silt fence. The polypropylene material can survive adverse conditions and is the most durable material that makes the most sense financially. We have computed that roughly 2,000 feet fencing will be required throughout the phasing of the project. Please see Computation 17 in Appendix B for reference.

Other required erosion control measures include riprap, nylon geomatrix, and rolled erosion control blankets. The riprap will be placed for both erosion control of the engineering fill and for safety concerns along the perimeter of the marina wherever there are steel sheet piling seawalls or concrete seawalls. We have estimated that there will be roughly 658 cubic yards of riprap required for the project. This computation can be found under Computation 17. The nylon geomatrix is to be placed between the subgrade and subbase layer of engineering fill at the locations of the access road, parking lot, and boat launches. The geomatrix layer acts as a buffer and helps with soil stabilization measures over long periods of time. We have estimated that roughly 7,662 cubic yards of material will be required. This computation can be found under Computation 17. The green space will also require erosion control measures. For the seeding, we opted to go with the most common technique of applying erosion control blankets over the seeded area. Not only do the blankets help keep the seeds in one place, they also help with top soil consolidation and protection. The computation for the erosion control blankets can be found in Appendix B under Computation 17.

For specific line item listings and costs, please see the Engineer's Cost Estimate section below. For more information regarding the specific design of the erosion control elements, please see the final drawing set. Information regarding design standards and specifications for the design of the erosion control elements can be found under Appendix A.

ENGINEER'S COST ESTIMATE

Waterway and Marine

All line items and design of waterway and marine elements were created in accordance with Division 35 of the Iowa DNR which can be referenced in Appendix A. Due to site conditions, mechanical dredging will be required. We opted to go with a minimal cost approach which resulted in the selection of the barge mounted dragline/clamshell for mechanical dredging. This item is quantified based on bank cubic yard which we estimated will be roughly 180,566 B.C.Y. In order to expedite the dredging process, we designed for two of the barge mounted draglines to be operated at once. Our team selected the minimal mobilization and demobilization line item for the dragline/clamshell which is quantified per unit. In order to accommodate the barge mounted draglines/clamshells, two floating piers will be required for the duration of the project. Our team opted to go with two medium sized piers that are made of concrete and are durable to last through all months of the year.

Two other line items in relation to waterway and marine construction are the concrete seawalls and steel sheet piling seawalls. Due to the steel sheet piling seawalls costing three times the amount of concrete seawalls, our team made an effort to incorporate as much concrete seawall as possible while staying in accordance with Division 35 of the Iowa DNR. The specific selections for the concrete seawalls and steel sheet piles were limited due to design constraints. The most general line item for each respective seawall was used which are quantified in linear feet. Our team has estimated that the project will require roughly 321 linear feet of concrete seawall and 2020 linear feet of steel sheet piling seawall.

Please view Table 3 located in Appendix C for the individual item cost breakdown for the waterway and marine construction costs. It has been determined that the estimated waterway and marine construction costs for the project will total $7,379,334.00.

Earthwork

The first two line items included in the project cost estimate for earthwork construction contain quality control items of supervision of earthwork and quality control of earthwork. These line items, quantified in days, were the minimal prices selected from RS Means that meet design requirements presented in Section 3.02, Chapter 3 of the IDOT Construction Manual located in Appendix A. It was determined a total of 540 days would be required for both line items. The last quality control line item included for earthwork construction are soil density tests. It was determined from Section 3.09, Division 2 of the IDOT SUDAS Standard Specifications Manual that the nuclear method (ASTM D2922) would be required for this project. The line item is quantified each test and it has been determined that 124 tests will be needed throughout the duration of the project.

The next three line items for earthwork construction are related to grading of the material. Each line item selected is quantified by square yards. In order to be cost efficient, the line item of grading for subgrades of large parking lots was selected in accordance with Section 3.06, Section 3.07, and Section 3.08, Division 2 of the IDOT SUDAS Manual. It has been determined that roughly 7662 square yards will be the appropriate quantity. Additional grading for sidewalks and steep slopes will be needed for the project. Our team selected the two general line items provided by RS Means Data in accordance with Section 3.02 and Section 3.04, Division 2 of the IDOT SUDAS Manual. Our team has determined that 778 square yards and 3512 square yards of grading will be required for sidewalks and steep slopes respectively.

Due to the project location, dewatering of some material will be required. Section 3.04, Division 3 of the IDOT SUDAS Manual requires multiple drainage trenches to be installed throughout the site along with the pumping of water. Only a few line items were available for excavating trenches for dewatering, so our team decided to go with the medium size trench that is two feet wide by two feet deep. It has been determined by our team that the excavation trenches for dewatering, which is quantified by cubic yards, will be roughly 10,000 cubic yards. The general line item for pumping was selected which consists of eight hours of pumping which will be attended two hours per day. In order for proper efficiency to occur, a minimum of two pumps will have to be operated at one time. Our team has determined that the line item, which is quantified in days, will be roughly 540 days per pump totaling 1080 days in total.

Our group has determined three line items that pertain to the excavation and fill of the project. The first line item of the excavation category consists of rock removal. Rock removal, which is necessary under Section 3.01, Division 2 of the IDOT SUDAS Manual, is a line item provided by RS Means and quantified as linear feet. Our team has estimated that 424 linear feet of rock removal will be required. The next line item pertaining to excavation and fill is the structural excavation for minor structures such as small building foundations. This was determined by our team due to the need for a small foundation for the bathroom facility. Using Section 2.04, Division 2 of the IDOT SUDAS Manual, our team designed a small foundation plan that will require 126 bank cubic yards. RS Means Data provides an appropriate line item for small foundation work using bank cubic yards that we used for the construction cost of this line item. The final line item consists of excavation of utility trenches for water and electric utilities on site. The common line item for the excavation of utility trenches is quantified using linear feet. Our team has determined that roughly 700 linear feet will be required for this line item.

The excavation and fill section of the construction process requires the hauling of material, both fill and backfill, to be taken in consideration as well. Two line items were selected from RS Means that meet the design standards and specifications found in Section 3.03, Division 2 of the IDOT SUDAS Manual. One of these line items are for the excavation of large volume projects and the other includes the cycle time for hauling material away. Both items are quantified as

loose cubic yards and our team has determine the required amount of material to be hauled will be 90,000 loose cubic yards for both line items.

The use of excavation trenches will require backfill. Two line items, compaction of backfill and the transportation of the backfill material, were selected in accordance with Section 2.03, Division 3 of the IDOT SUDAS Manual. The compaction of backfill has been determined to be 7700 embankment cubic yards while the dozer material transportation was estimated at roughly 9625 loose cubic yards.

Another set of line items for the earthwork construction is the fill itself. Our team decided, in coordination with Section 2.01, Chapter 2 of the Iowa DNR, Section 3.06, and Section 3.08, Division 3 of the IDOT SUDAS Manual, that three types of fill will be needed. For a majority of the subgrade on site, type 3 fill could be used. For the top five feet of the subgrade, type 1 fill will be used. For the subbase and trench backfill, the gravel fill line item for type d soil will be used. All line items for the subgrade are measured in loose cubic yards which has been estimated by our team to be 47,515 and 28,468 for type 3 and type 1 material respectively. The gravel fill, which is type 4 material, is quantified in square feet and has been estimated to be roughly 43,110. The compaction of all fill materials is quantified under embankment cubic yards. Compaction of twelve inch lifts and three passes per lift is what we chose in accordance with Section 3.04 and Section 3.06 of the Iowa SUDAS Manual. Our team has estimated there will be roughly 77,580 embankment cubic yards of compaction.

Please view Table 4 located in Appendix C for the individual item cost breakdown for the earthwork costs. It has been determined that the estimated earthwork construction costs for the project will total $3,239,634.00.

Roadway & Parking Lot

The beginning of the design phase originally had us using asphalt for the parking lot and roadway. However, after more observation and background research on various construction and design codes, we opted to stick with concrete for the entirety of the project. Information pertaining to structural concrete for the bathroom facility, parking lot, and roadway can be found in the section below. In this section, we quantified the concrete curbs and gutters that will be needed for the parking lot and roadway. The concrete curbs and gutters are in this section because of the separation of line items by RS Means. The specific line item we selected is machine formed curbs and gutters in order to be as cost efficient as possible. Selection of the line item was made in accordance with Chapter 2 of IDOT Design Manual and Section 7010 of the IDOT SUDAS Manual. Our team has estimated that 240 linear feet of curb and gutter will be required.

Please view Table 5 located in Appendix C for the individual item cost breakdown for the roadway and parking lot construction costs. It has been determined that the estimated roadway and parking lot construction costs for the project will total $3,802.00.

Concrete & Masonry

Our team throughout the design phase and in accordance with various design guides and standards have determined that six line items will be necessary for the concrete and masonry construction of the project. Of the six line items, three of those items are quality control in particular quantified as each test performed and in accordance with Section 7A of the IDOT Design Manual and Section 7010 of the IDOT SUDAS Manual. Due to the amount of concrete we have estimated the project will require, concrete testing as described under ASTM C 131 will be required 1,266 times. For the bathroom facility walls, our team decided to go with masonry block. The masonry testing will need to be performed every five bricks per ASTM C 67 which can be located in Appendix A. Our team has estimated that a total of 73 tests will have to be performed. Rebar will also be required and is included in the individual masonry brick line item. However, the quality control of the rebar is a separate item and must be performed for every piece of rebar. Two pieces of rebar exist in each concrete/masonry block. This would require a total of 728 tests to be performed. This item is determined from the concrete unit masonry line item. This line item is measured in square feet and was chosen in accordance with Section 7A of the IDOT Design Manual. The specific concrete/masonry block that will be required for the design of the bathroom facility is decorative, split faced block that is six inches in height, sixteen inches in length, and four inches in thickness. Our team has estimated that a total of 364 square feet of masonry block will be required for the bathroom facility.

Additionally, two line items will be required in regards to structural concrete. One line item is structural concrete that is only used for sidewalk and bike paths. The other line item for structural concrete is for large slab on grade for the parking lot, roadway, boat launch, and bathroom facility. Both line items that were selected were chosen in accordance with Section 7010 and Section 7030, Division 7 of the IDOT SUDAS Manual. The line item for structural concrete of sidewalk and bike paths is quantified in square feet while the line item for slab on grade concrete is quantified in cubic yards. Due to the site location, the slab on grade will have to be pumped onto the project site. Our team has estimated that 6,998 square feet of concrete will be required for the sidewalks. The quantity for structural slab on grade concrete was estimated at roughly 34,478 cubic yards.

Please view Table 6 located in Appendix C for the individual item cost breakdown for the concrete and masonry construction costs. It has been determined that the estimated concrete and masonry construction costs for the project will total $6,398,249.00.

Boat Docks

Only two line items will be required for the boat docks. Our team has opted to go with floating docks in order to be as cost efficient as possible. The floating docks were chosen and designed in accordance with the Class 4 Commercial Dock section of the Iowa DNR. Multiple outside sources were used to estimate the price of a floating dock and can be located in Appendix A. The line item selected for the floating dock, quantified as square feet, includes the dock itself, the installation, and the deck of the dock. It has been determined that 4,044 square feet will be required. Each dock will also require a minimum of two bumpers at the end of the dock. We have quantified that thirty bumpers will be required.

Please view Table 7 located in Appendix C for the individual item cost breakdown for the boat docks construction costs. It has been determined that the estimated boat docks construction costs for the project will total $227,520.00.

Bathroom Facility

The bathroom facility is broken down into multiple line items that include structural components, exterior components, restroom components, and much more. The design of the bathroom was largely generated from common design plans used for parks and recreational facilities across the state of Iowa. The link to these plans can be found in Appendix A as well as Appendix E in the design drawing set. The facility designed had to meet multiple standards and specifications provided by the Iowa Plumbing Code, Building Facility Code, and Department of Pubic Safety Codes and Regulations. All codes and regulations can be referenced in Appendix A. The specific design of the facility was created keeping in mind cost but at the same time, our team wanted the facility to look modern and presentable. General line items were used from RS Means were used that fulfilled the minimal items needed for the bathroom facility.

Structural items include wood framing for the roofs, the truss for the roof, and steel roofing panels which were quantified at 100 linear feet, six units, and 211 square feet respectively. Exterior components include a louvers vinyl gable vent, fascia, one roof vent, and two entrance doors. The components have been quantified at two units, twenty-three square feet, one unit, and two units respectively. One bathroom fixture is included separately from the utilities section and that line item is for a bathroom vent fan, economy model. Two of these fans will be required.

A large number of restroom component line items were required for the bathroom facility. These components included a headrail, grab bars, hat & coat strip, mirror, mop holder strip, soap dispenser, soap tank, toilet tissue dispenser, towel dispenser, and waste receptacle. Each line item was quantified at two units besides the soap tank which would be located between the two bathrooms. For longevity concerns, stainless steel components for the toilet and sink station will be required. Our team selected a WT-2016 waterless toilet to help avoid the risk of contamination due to the risk of flooding from the Mississippi. To go along with the toilet, a

hinged white plastic seat was selected. The toilet and plastic seat were quantified at two units each. Two ES-1015 lavatory commercial exposed hand washed stations, which are handicap accessible, were selected to be installed in each bathroom. In addition, a line item for center set control level faucet was selected as well. Connection costs for both plumbing and electrical can be found in the utility section of the report.

Please view Table 8 located in Appendix C for the individual item cost breakdown for the bathroom facility construction costs. It has been determined that the bathroom facility construction costs for the project will total $29,979.00.

Exterior Improvements

Three exterior improvements were selected while keeping in mind cost/space efficiency while referencing the Iowa State Parks Design Guide provided by the Iowa DNR. The specific line items were provided by RS Means and are quantified per each item. The three line items include park benches, picnic tables, and trash receptacles. Our team has estimated the number of park benches will be two units, the number of picnic tables to be seven units, and the number of trash receptacles to be six units.

Please view Table 9 located in Appendix C for the individual item cost breakdown for the exterior improvements costs. It has been determined that the estimated exterior improvements cost for the project will total $23,358.00.

Utilities

The utility components needed for the project consist of electrical components, plumbing components, safety components, and public water distribution. Each line item selected was the general line item for each individual component necessitated by Department of Public Safety Electrical, Energy, Accessibility, and Fire Codes located in Appendix A. Electrical fixtures pertain directly to the bathroom facility and include one exterior wall mounted lighted, two interior vents, two timed switch devices, two heat lamps, and two fans mentioned in the bathroom facility section of the report. A line item is also provided for the installation and hook-up for all nine electrical fixtures. In addition, fire safety codes require the installation of two fire and carbon dioxide detectors for the bathroom facility. The line item for the detectors includes the installation and connection of the devices. The same fire codes also require the installation of the two hydrants for the bathroom facility which has also been included as a line item by our team.

Multiple plumbing fixtures will also be required for the bathroom facility. All plumbing related line items were the general line items provided by RS Means. Two of the fixtures include metal drainage piping. One of the pipes is an open drain that will be located in the middle of the bathroom floor while the other pipe is an open drain with a toilet auger. These drains are

quantified at two units a piece. A utility septic tank to store waste for the bathroom facility will need to be installed. Our team selected to use a 1500 gallon tank in order to provide longer durations between maintenance and pumping. Only one tank will be required. Line items for general plumbing and installation of individual fixtures are included as well into the utility cost estimation. General plumbing costs are quantified by square feet and our team estimated the square footage of the plumbing installation area to be 202 square feet. Each individual fixture installation also requires a separate line item which our team has quantified at a total of six units.

The last three line items included in the project cost estimation for utilities is in regards to the public water utility distribution. In addition to the Iowa Fire Code, Sections 5010, 5020, 5030, and 6010 of the IDOT SUDAS Manual were referenced in the component selection process. Unlike the electrical fee, the connection to water was not included in the past line items for general plumbing fixtures. Therefore, a general line item for a water service connection was included in the cost estimation for a four inch branch of water main connection into an existing 8 inch water main along the existing roadway of River Road. Our team is assuming that the existing water main is an eight inch diameter main. Fire Codes, which can be accessed in Appendix A, also required the installation of a fire hydrant on site. A line item was created for this component. Lastly, a line item for the piping of new four inch water main is required. We chose to error on the side of caution be selecting ductile iron instead of PVC and concrete piping, so durability won't be an issue. Also, the amount of piping being installed is so minute, choosing to go with the more durable and stable selection does not have a large price increase. Our team has estimated that roughly 350 linear feet of ductile piping will be required.

Please view Table 10 located in Appendix C for the individual item cost breakdown for the utilities costs. It has been determined that the estimated utilities costs for the project will total $57,259.00.

Landscaping

Our team has determined that three line items in regards to landscaping will be required for the project. These items include mechanical seeding, the quality control of the seeding, and the installation of a sprinkler irrigation system for the seeding. Line items were chosen in reference to Section 9020, Division 9 of the IDOT SUDAS Manual. Our design layout of green space will require about 1 acre of mechanical seeding which will also require 43,467 square feet of installation for the sprinkler irrigation system. Quality control of the seeding, quantified per test seed test, has been estimated to require a minimal 200 tests.

Please view Table 11 located in Appendix C for the individual item cost breakdown for the landscaping costs. It has been determined that the estimated landscaping costs for the project will total $102,059.00.

Erosion Control

The construction of the project will require four different line items. All items selected were general line items provided by RS Means and chosen in accordance with Section 9040 of the IDOT SUDAS Manual and the Iowa Construction Site Erosion Control Manual provided by the Iowa DNR. Rolled erosion control mats will be required for the mechanical seeding. Quantified in square yards, our team has determined based on mechanical seeding quantities that 4,830 square yards will be required. A geotechnical nylon fabric for parking lot and roadway will be required as well. Quantified in square yards, it has been determined that 7,662 square yards will be required. The cheapest and most efficient option for overall site and erosion control along the perimeter of the site would be to use a three foot high polypropylene silt fence that could withstand adverse conditions year around. Quantified as linear feet, our team has estimated that a minimal of 2000 linear feet will be required. Lastly, riprap and rock lining will be required for the sheet pile and concrete seawall. The rip rap, which will consist of a minimal eighteen inch thickness, has been estimated at roughly 658 square feet.

Please view Table 12 located in Appendix C for the individual item cost breakdown for the erosion control costs. It has been determined that the estimated erosion control costs for the project will total $259,059.00.

Engineering/Administrative Items

The design fees for the project has been broken down into five different categories that are commonly used according to RS Means Data: architectural fees, engineering fees, electrical design, landscaping and site development, and structural design. The architectural fees for any construction project is roughly 4.9% of the total construction cost of the project. Engineering fees on average for any construction project total 0.5% of the total construction cost of the project. The typical electrical design cost for any construction project is roughly 4.1% of the total construction cost. Landscaping and site development costs are generally 2.5% of the total construction cost. Lastly, the structural design fees are roughly 1.0% of the total construction cost.

Please view Table 1 located in Appendix C for the individual item cost breakdown for the design fees. It has been determined that the estimated engineering/administrative cost for the project will total $1,323,016.00.

General Construction Items

The general construction costs have been broken down into three line items for the project. The first two line items are similar to the design fees where the cost is taken from a percentage of the total construction cost of the project. Construction fees for any construction project, according to RS Means Data, is roughly 4.5% of the total construction cost of the project. The construction fees must be incorporated into any construction project according to Section 3.02, Chapter 3 of

the IDOT Construction Manual. Regulatory requirements specifically permit requests, account for roughly 0.5% of the total construction cost. Permit requests for construction are required by state law. Section 1D-3, Chapter 1 of the IDOT Design Manual requires specific surveys to be conducted before the design process ensues. For this project in particular, because of the lack of contour information available, a topographical survey of the entire site will be required. This line item is measured in acres and has been estimated to be one acre for the project location.

Please view Table 2 located in Appendix C for the individual item cost breakdown for the general construction costs. It has been determined that the estimated general construction cost for the project will total $509,795.00.

Contingencies

A typical rule of thumb is to have a contingency fund that account for 10% of the overall construction for change orders and other unplanned expenses. It has been determined that the estimated total contingency cost for the project should total $1,772,050.00

Total Project Cost

Please view Table 13 below for the individual project category breakdown for the construction cost. Our team has estimated that the total construction cost will be roughly $17,720,500.00. In addition, our team has estimated that the engineering/administrative costs, along with the general construction costs, will total roughly $1,833,000.00. For practicality, our team as also added a contingency cost to the total project cost of $1,772,050.00. It has been determined that the estimated total project cost, which includes all construction costs, engineering/administrative costs, and contingencies for the project, will total roughly $21,325,550.00.

Table 13: Breakdown of Project Category Cost and Total Project Cost

Keokuk, Iowa: Recreational River Access Total Cost	
Project Category	**Tabulated Cost**
Waterway and Marine Construction	$ 7,379,000
Earthwork Construction	$ 3,240,000
Roadway & Parking Lot	$ 3,800
Concrete & Masonry Construction	$ 6,398,000
Boat Docks	$ 227,500
Bathroom Facility	$ 30,000
Exterior Improvements	$ 23,500
Utilities	$ 57,500
Landscaping	$ 102,000
Erosion Control	$ 259,000
Total Construction Cost	$ 17,720,500
Contingency	$ 1,772,050
Engineering & Design Fees	$ 1,833,000
TOTAL PROJECT COST	**$ 21,325,550**

APPENDICES

There are five appendices containing information pertaining to the design report. Appendix A contains all design specifications, standards, and guidelines used in the design phase. Appendix B contains all of the supporting engineering design calculations. Appendix C contains all the cost related information, including the project cost and budget. Appendix D contains the project workflow scheduling that was implemented throughout our design phase of the project. Appendix E, the final Appendix, contains all referenced figures within the design report.

Appendix A: Design Specifications, Standards, and Guidelines

Engineering Cost Estimation Tool

- RS Means Construction Cost Estimating Software
    - What is RS Means data? (n.d.). Retrieved April 17, 2020, from https://www.rsmeans.com/

Design Specifications, Standards, and Guidelines

- US Army Corps of Engineers
    - U.S. Army Corps of Engineers (2004). Engineering and Design Recreating Facility and Customer Service Standards. Retrieved 2020, from https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-400.pdf

- NOAA/National Weather Service Hydrograph
    - US Department of Commerce, & Noaa. (2020). National Weather Service Advanced Hydrologic Prediction Service. Retrieved April 18, 2020, from https://water.weather.gov/ahps2/hydrograph.php?wfo=dvn

General Construction Specifications, Standards, and Guidelines

- Supervision By Subcontractor/Contractor
    - Iowa Department of Transportation Construction Manual (2020). Section 3.02, Chapter 3 General Inspection. Retrieved 2020, from https://iowadot.gov/erl/current/CM/content/CM%203.00.htm

- Survey Guidelines and Standards
    - Iowa Department of Transportation Design Manual (2000, September 22). Section 1D-3, Chapter 1 General Information. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Salvaged Project Materials Reporting
    - Iowa Department of Transportation Construction Manual (2020). Section 3.05 Chapter 3 General Inspection. Retrieved 2020, from https://iowadot.gov/erl/current/CM/content/CM%203.00.htm

Waterway and Marine Construction Specifications, Standards, and Guidelines

- Iowa DNR Marine Construction
    - Iowa DNR (2020). Division 35 - Waterway and Marine Construction. Retrieved 2020, from https://www.iowadnr.gov/About-DNR/dnr-staff-offices/conservation-law-enforcement

Earthwork Specifications, Standards, and Guidelines

- Fill Type Selection
    - Iowa DNR (2020). Section 2.01, Chapter 2 Materials. Retrieved 2020, from https://www.iowadnr.gov/Environmental-Protection/Land-Quality

- Earthwork Calculations Guidelines
    - Iowa Department of Transportation Design Manual. (2019). Section 5A-2, Chapter 5 Earthwork. Retrieved 2020, from https://iowadot.gov/design/dmanual/05a-02.pdf

- Suitable Embankment Materials
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2.03, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Foundation Materials

    Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2.04, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Clearing and Grubbing of Trees, Vegetation, Timber, and All Other Products
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.01, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Topsoil Spreading and Grade Finishing
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.02, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Excavation
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.03, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Site Preparation and Depositing of Embankment Material
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.04, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Type A Compaction for Earthwork
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.04, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Subgrade Preparation, Stability, and Compaction
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.06, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Subgrade Treatment
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.07, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Subbase Construction and Treatment
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.08, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Materials Excavated from a Trench
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2.01, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Bedding Material for Trench and Utilities
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2.02, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Appropriate Material for Trench Backfill
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2.03, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Trench Dewatering
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.04, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Roadway & Parking Lot Specifications, Standards, and Guidelines

- Iowa DOT - 1D-20 Reviewing Railroad Crossing at Side Roads
    - Iowa Department of Transportation Design Manual (2019). Section 1D-20, Chapter 1 General Information. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Intersection Right Turn Lane
    - Iowa Department of Transportation Design Manual (2016). Section 6A-8, Chapter 6 Geometric Design. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Right Turn Lengths DOT
    - Iowa Department of Transportation Design Manual (2004). Section 6A-1, Chapter 6 Geometric Design. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Crossing for Railroad Design Guide
    - Iowa Department of Transportation Design Manual (2019). Section 1D-20, Chapter 1 General Information. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Paving Information and Thickness
    - Iowa Department of Transportation Design Manual (2020). Chapter 2, Asphalt Design Guide. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Portland Cement Concrete Pavement
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 7010, Division 7 Streets and Related Work. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Sidewalks, Shared Use Paths, and Driveways
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 7030, Division 7 Streets and Related Work. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Pavement Markings for Parking Lot
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 8020, Division 8 Traffic Control. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Concrete & Masonry Specifications, Standards, and Guidelines

- Masonry Testing and Rebar
    - Iowa Department of Transportation Design Manual (2019). Section 7A, Chapter 7 Pavement. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

Geotechnical Specifications, Standards, and Guidelines

- Subgrade, Subbase, and Pavement Design
    - Iowa Department of Transportation Design Manual (2015). Section 200l-1, Chapter 200 Geotechnical Design. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual
    - Iowa Department of Transportation Design Manual (2019). Section 5A-2, Chapter 5 Earthwork. Retrieved April 18, 2020, from https://iowadot.gov/design/design-manual

- Field Quality Control for Earthwork
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.09, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- In Trench Compaction Testing
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.06, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Boat Docks Specifications, Standards, and Guidelines

- Boat Dock Specifications
    - Iowa DNR. (2020). Class 4 Commercial Dock. Retrieved 2020, from https://www.iowadnr.gov/boatdocks/index.php/ClassIVCommercialDock

Bathroom Facility Specifications, Standards, and Guidelines

- Iowa Plumbing Code
    - State of Iowa. (2010). Iowa State Plumbing Code. Retrieved 2020, from https://idph.iowa.gov/Portals/1/Files/PMSB/plumbing_code_booklet_2010.pdf

- Building Facility Code
    - Iowa Administrative Code. (2008). Chapter 302 State Building Code. Retrieved 2020, from https://www.legis.iowa.gov/docs/iac/chapter/07-08-2015.661.302.pdf

- Department of Public Safety Including Electrical, Energy, Accessibility, and Fire Codes
    - Iowa Department of Public Safety. (2020). Public Safety. Retrieved 2020, from https://dps.iowa.gov/

Exterior Improvements

- Iowa State Parks Design Guide
    - Iowa DNR, I. (2020). Iowa State Parks Design Guide. Retrieved 2020, from https://www.iowadnr.gov/Portals/idnr/uploads/parks/PDFs/parks_design_guide.pdf

Utilities Specifications, Standards, and Guidelines

- Utility Pipe Bedding and Backfill
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 3.05, Division 3 Trench and Trenchless Construction. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Pipe Fittings for Water Mains
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 5010, Division 5 Water Mains and Appurtenances. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Valves and Fire Hydrants
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 5020, Division 5 Water Mains and Appurtenances. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Testing and Disinfection of Water Mains
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 5030, Division 5 Water Mains and Appurtenances. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Sanitary and Storm Sewers (Septic Tank Included)
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 6010, Division 6 Structures for Sanitary and Strom Sewers. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Cleaning, Inspecting and Testing of Structures
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 6020, Division 6 Structures for Sanitary and Strom Sewers. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Landscaping Specifications, Standards, and Guidelines

- Seed and Plant Growth
    - ASTM D7322/D7322M-17 Standard Test Method for Determination of Erosion Control Product (ECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions

- Off-Site Topsoil
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 2010, Division 2 Earthwork. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Seeding Specifications
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9010, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Sodding Specifications
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9020, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Plant Material and Planting
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9030, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

- Segmental Block Retaining Wall
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9071, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

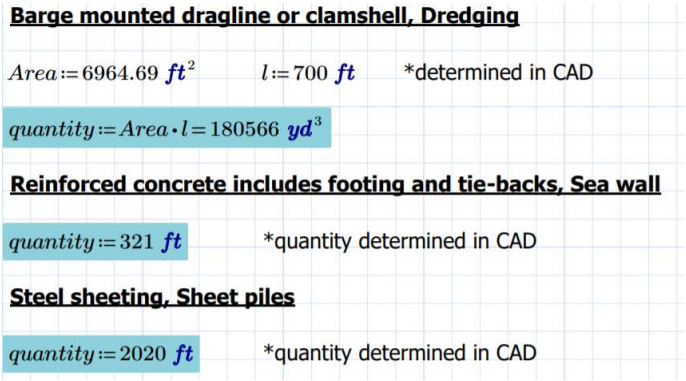
- Landscape Retaining Walls
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9070, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Erosion Control Specifications, Standards, and Guidelines

- Design and Specifcations
    - Iowa DNR. (2006). Iowa Construction Site Erosion Control Manual. Retrieved 2020, from https://www.iowadnr.gov/portals/idnr/uploads/water/stormwater/constructionmanual.pdf

- Erosion Control and Sediment Control
    - Iowa Department of Transportation SUDAS Standard Specifications Manual (2020). Section 9040, Division 9 Site Work and Landscaping. Retrieved 2020, from https://iowadot.gov/erl/current/US/Navigation/nav.htm

Appendix B: Engineering Design Computations
Waterway and Marine Computations



Computation 1: Material to be dredged, concrete seawalls, and steel sheet piles.

Earthwork Computations

Soil density, Nuclear method

$volume := 77580\ yd^3$

$$quantity := \frac{volume}{25\ yd \cdot 25\ yd \cdot 1\ yd} = 124$$

Computation 2: Soil Density (nuclear method) tests required.

Grading Subgrade for Base Course, Parking

$A := 68956\ yd^2$ *quantity determined in CAD

$$quantity := \frac{A}{9} = 7662\ yd^2$$

Fine Grade Granular Base, Sidewalks

$A := 6998\ yd^2$ *quantity determined in CAD

$$quantity := \frac{A}{9} = 778\ yd^2$$

Finish Grading steep slopes

$A := 321\ yd^2 + 2020\ yd^2$ *quantity determined in CAD

$quantity := A \cdot 1.5 = 3512\ yd^2$

Excavating, Earth work

$quantity := 90000\ yd^3$ *quantity determined in CAD

Computation 3: Grading calculations and total soil excavation.

Rock Removal, Earth work

$quantity := 72\ ft + 352\ ft = 424\ ft$ *quantity determined in CAD

Structural Excavation for minor structures

$quantity := 126\ ft$ *quantity determined in CAD

Excavating Utility Trench

$quantity := 350\ ft \cdot 2 = 700\ ft$ *quantity determined in CAD

Drainage Trench, Dewatering

$quantity := 2 \cdot (2\ yd \cdot 500\ yd \cdot 5\ yd) = 10000\ yd^3$ *quantity determined in CAD

Plumbing, Dewatering (days)

$quantity := 540 \cdot 2 = 1080$

Compacting Backfill, Backfill

$quantity := 7700\ yd^3$ *quantity determined in CAD

Computation 4: Rock removal, structural excavation, utility trench excavation, drainage trench, plumbing, and soil compaction of backfill.

Dozer Backfilling trench

$quantity := (700\ yd \cdot 5.5\ yd \cdot 2\ yd) \cdot 1.25 = 9625\ yd^3$ *quantity determined in CAD

General Fill, Dumped Material

$quantity := 47515\ yd^3$ *quantity determined in CAD

General Fill, Spread fill

$quantity := 28468\ yd^3$ *quantity determined in CAD

General Fill, Gravel Fill

$quantity := 36810\ ft^2 + 6300\ ft^2 = 43110\ ft^2$ *quantity determined in CAD

Excavated or Borrowed, Hauling

$quantity := 90000\ yd^3$ *quantity determined in CAD

Riding, Vibrating Roller

$quantity := \frac{43110}{27}\ yd^3 + 47515\ yd^3 + 28468\ yd^3 = 77580\ yd^3$

Computation 5: Dozer trench backfill, engineering fill, soil hauling, and vibrating roller.

Area	Type 1 (SF)	Type 3 (SF)	N-S length (ft)
1	1500	2739.54	360
2	454.5	909.99	80
3	280.49	399.99	340
4	299.51	149.99	180
5	45	4	720
6	400	2005	30
7	240.49	480	20
8	1050	2120	20

* All areas were taken from AutoCAD

Computation 6: Engineering fill.

Roadway & Parking Lot Computations

Cast-in-place concrete curbs and gutters

$L := 60\ ft$ $quantity := L \cdot 4 = 240\ ft$

Computation 7: Concrete totals for curb and gutters.

Concrete & Masonry Computations

$bb := 15\ in + \frac{5}{8}\ in$ $hb := 7\ in + \frac{5}{8}\ in$ $hw := 7\ ft$ $nh := \frac{hw}{hb} = 11.016$

$L1 := 10\ ft + 8\ in$ $n1 := \left(\frac{L1}{bb}\right) \cdot 2 = 16.384$

$L2 := 14\ ft + 8.5\ in$ $n2 := \frac{L2}{bb} = 11.296$

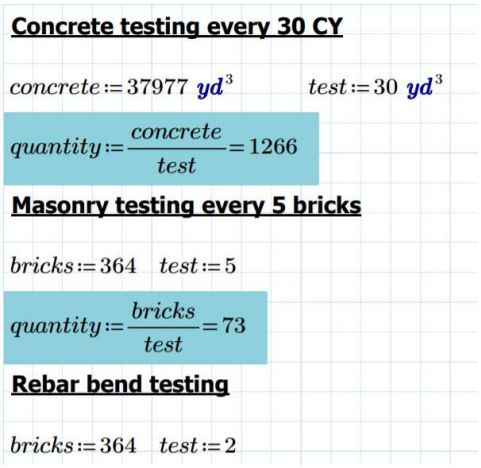
$L3 := 1\ ft + 7\ in$ $n3 := 2 \cdot \left(\frac{L3}{bb}\right) = 2.432$

$L4 := 3\ ft + 8.5\ in$ $n4 := \frac{L4}{bb} = 2.848$

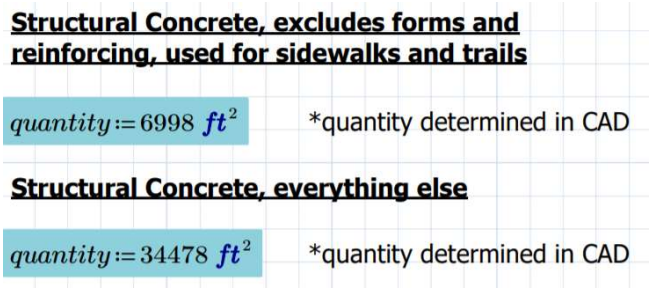
$tb := (n1 \cdot nh) + (n2 \cdot nh) + (n3 \cdot nh) + (n4 \cdot nh) = 363.1$ ---> 364 blocks

$price := 364 \cdot 3.29 = 1197.56$ ---> 1200 dollars

Computation 8: Masonry block quantity.

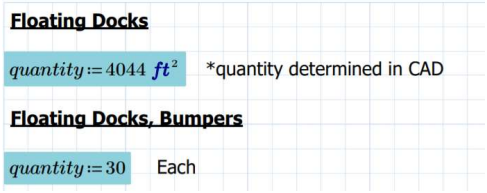


Computation 9: Concrete testing, masonry testing, and reinforcing steel bend tests



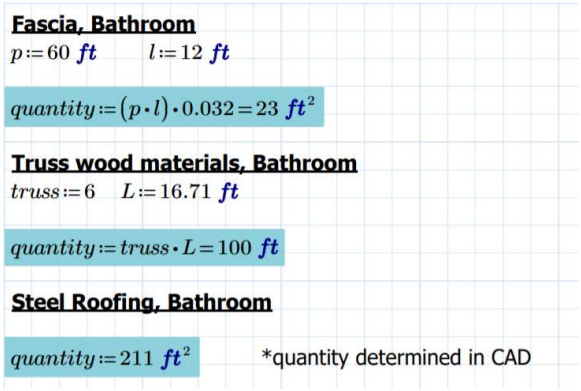
Computation 10: Concrete totals for sidewalk and all other design elements.

Boat Dock Computations

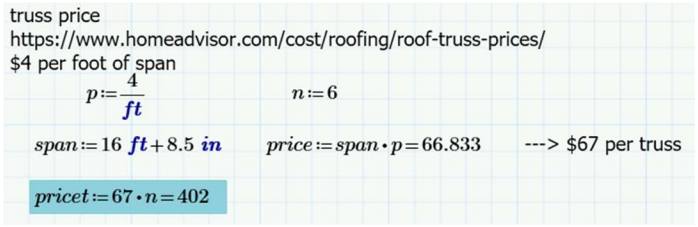


Computation 11: Floating dock and bumpers.

Bathroom Facility Computations

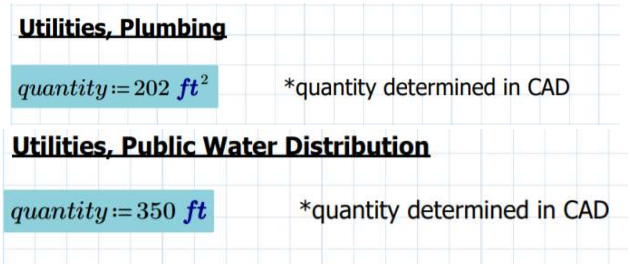


Computation 12: Fascia, truss wood materials, and steel roofing.



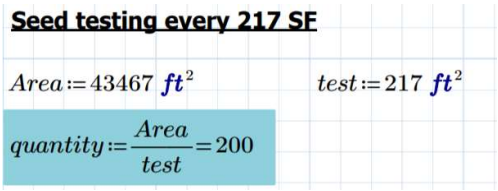
Computation 13: Truss quantity.

Utilities Computations



Computation 14: Plumbing and water distribution.

Landscaping Computations



Computation 15: Seed testing.

Area for sprinkler irrigation system

$quantity := 43467\ ft^2$ *quantity determined in CAD

Acres of green space for seeding

$quantity := \frac{Area}{43560\ ft^2} = 1$ Acre

Computation 16: Sprinkler irrigation system and seeding.

Erosion Control Computations

Rolled Erosion Control Mats and Blankets

$quantity := \frac{43467\ yd^3}{9} = 4830\ yd^3$ *quantity determined in CAD

Nylon, Erosion Control

$quantity := \frac{68956\ yd^3}{9} = 7662\ yd^3$ *quantity determined in CAD

Silt Fence, Erosion Control

$quantity := 2000\ ft$ *quantity determined in CAD

Riprap, and Rock Lining

$quantity := \frac{5925\ yd^2}{9} = 658\ yd^2$ *quantity determined in CAD

Computation 17: Erosion control items.

Appendix C: Project and Item Cost Tables

Design Fees

Table 1: Design Fees Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
1	Design	Architectural Fees	Architectural fees for new construction minimum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 498,675.25	$ 498,675.25
1	Design	Engineering Fees	Engineering fees minimum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 50,885.23	$ 50,885.23
1	Design	Electrical Design	Electrical design minimum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 417,258.88	$ 417,258.88
1	Design	Landscaping and Site Development	Landscaping & site development minimum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 254,426.15	$ 254,426.15
1	Design	Structural Design	Structural design minimum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 101,770.46	$ 101,770.46
Total											**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,323,015.96**	**$ 1,323,015.96**

TOTAL PROJECT COST	$ 1,323,000

General Construction

Table 2: General Construction Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
1	General Construction	Construction Fees	Construction management fees $1,000,000 job mininmum cost				Project				$ -	$ -	$ -	$ -	$ -	$ 457,967.06	$ 457,967.06
5	General Construction	Regulatory Requirements	Permit requests				Project				$ -	$ -	$ -	$ -	$ -	$ 50,885.23	$ 50,885.23
1	General Construction	Surveys	Site survey: topographical survey	A7	3.3	7.273	Acre	$ 18.20	$ 340.00	$ 21.00	$ 379.20	$ 18.20	$ 340.00	$ 21.00	$ 379.20	$ 563.00	$ 563.00
Total											**$ 379.20**	**$ 18.20**	**$ 340.00**	**$ 21.00**	**$ 379.20**	**$ 509,415.29**	**$ 509,415.29**

TOTAL PROJECT COST	**$ 510,000**

Waterway and Marine Construction

Table 3: Waterway and Marine Construction Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
180566	Waterway and Marine Construction	Mechanical Dredging	Barge mounted dragline or clamshell, hopper dumped, pumped 1000' to shore dump, minimum	B57	340	0.141	B.C.Y.	$ -	$ 5.55	$ 4.71	$ 10.26	$ -	$ 1,002,141.51	$ 850,466.03	$ 1,852,607.54	$ 13.60	$ 2,455,698.10
2	Waterway and Marine Construction	Mechanical Dredging	Dredging mobilization and demobilization minimum	B8	0.53	120	Total	$ -	$ 4,600.00	$ 5,225.00	$ 9,825.00	$ -	$ 9,200.00	$ 10,450.00	$ 19,650.00	$ 12,725.00	$ 25,450.00
321	Waterway and Marine Construction	Concrete Seawalls	Reinforced concrete includes footing and tie-backs up to 6' miniumum	C17C	28	2.964	L.F	$ 49.50	$ 133.00	$ 22.50	$ 205.00	$ 15,889.50	$ 42,693.00	$ 7,222.50	$ 65,805.00	$ 283.50	$ 91,003.50
2020	Waterway and Marine Construction	Steel sheet piling seawalls	Steel sheeting, with 4' x 4' x 8" concrete deadmen, @ 10' O.C 12' high, barge driven	B76	15	4.8	L.F	$ 155.00	$ 207.00	$ 216.00	$ 578.00	$ 313,100.00	$ 418,140.00	$ 436,320.00	$ 1,167,560.00	$ 734.00	$ 1,482,680.00
2	Waterway and Marine Construction	Floating Piers	Jetties, Docks, floating inlcuding anchors, concrete pontoons, treated wood frame and deck: breakwater, concrete pontoon, 50' L x 8' W x 6.5' D	F4	4	12	Each	$ 51,000.00	$ 520.00	$ 300.00	$ 51,820.00	$ 102,000.00	$ 1,040.00	$ 600.00	$ 103,640.00	$ 57,620.00	$ 115,240.00
Total											**$ 62,438.26**	**$ 430,989.50**	**$ 1,473,214.51**	**$ 1,305,058.53**	**$ 3,209,262.54**	**$ 71,376.10**	**$ 4,170,071.60**

TOTAL PROJECT COST	**$ 7,379,000.00**

Earthwork Construction

Table 4: Earthwork Construction Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
540	Earthwork	Quality Control	Supervision of earthwork per day	1 Skwk	1	8	Day	$ -	$ 355.00	$ -	$ 355.00	$ -	$ 191,700.00	$ -	$ 191,700.00	$ 545.00	$ 294,300.00
540	Earthwork	Quality Control	Quality control of earthwork	1 Clab	1	8	Day		$ 275.00		$ 275.00	$ -	$ 148,500.00	$ -	$ 148,500.00	$ 420.00	$ 226,800.00
124	Earthwork	Quality Control	Soil density, nuclear method, ASTM D2922				Each				$ 35.00	$ -	$ -	$ -	$ 4,344.46	$ 38.50	$ 4,778.91
7662	Earthwork	Grading	Grade subgrade for base course, roadways: for large parking lots	B32C	5000	0.01	S.Y	$ -	$ 0.39	$ 0.36	$ 0.75	$ -	$ 2,988.09	$ 2,758.24	$ 5,746.33	$ 0.98	$ 7,508.54
778	Earthwork	Grading	Fine grade granular base for sidewalks and bikeways	B62	1200	0.02	S.Y	$ -	$ 0.75	$ 0.13	$ 0.88	$ -	$ 583.17	$ 101.08	$ 684.25	$ 1.28	$ 995.27
3512	Earthwork	Grading	Finish grading steep slopes	B11L	7100	0.002	S.Y	$ -	$ 0.09	$ 0.08	$ 0.17	$ -	$ 316.04	$ 280.92	$ 596.96	$ 0.22	$ 772.53
90000	Earthwork	Hauling	Excavating, Large Volume Project, various materials, restricted loading trucks, 8 C.Y. bucket, 100% fill factor	B14J	4000	0.003	L.C.Y	$ -	$ 0.13	$ 0.45	$ 0.58	$ -	$ 11,700.00	$ 40,500.00	$ 52,200.00	$ 0.69	$ 62,100.00
424	Earthwork	Excavation and Fill	Rock Removal	B47	316	0.076	L.F.	$ -	$ 2.89	$ 4.13	$ 7.02	$ -	$ 1,225.36	$ 1,751.12	$ 2,976.48	$ 8.94	$ 3,790.56
126	Earthwork	Excavation and Fill	Structural Excavation for minor structures, machine excavation, for spread and mat footings, elevator pits, and small building foundations, clay, till, or blasted rock, 3/4 C.Y. bucket	B12F	80	0.2	B.C.Y.	$ -	$ 8.10	$ 8.00	$ 16.10	$ -	$ 1,022.63	$ 1,010.00	$ 2,032.63	$ 21.00	$ 2,651.25
700	Earthwork	Excavation and Fill	Excavating, utility trench, excavation utility trench, rock material	B54D	400	0.04	L.F.	$ 17.15	$ 1.59	$ 0.83	$ 19.57	$ 12,005.00	$ 1,113.00	$ 581.00	$ 13,699.00	$ 22.18	$ 15,526.00
10000	Earthwork	Dewatering	Excavate drainage trench, 2' wide, 2' deep	B11C	90	0.178	C.Y	$ -	$ 7.10	$ 3.56	$ 10.66	$ -	$ 71,000.00	$ 35,600.00	$ 106,600.00	$ 14.62	$ 146,200.00
1080	Earthwork	Dewatering	Pumping 8 hr., attended 2 hrs. per day, including 20 L.F. of suction hose & 100 L.F. discharge hose: 2" diaphragm pump used for 8 hrs	B10H	4	3	Day	$ -	$ 125.00	$ 17.60	$ 142.60	$ -	$ 135,000.00	$ 19,008.00	$ 154,008.00	$ 207.35	$ 223,938.00
7700	Earthwork	Backfill	Compacting backfill, 6" to 12" lifts, vibrating roller	B10C	800	0.015	E.C.Y.	$ -	$ 0.63	$ 1.81	$ 2.44	$ -	$ 4,851.00	$ 13,937.00	$ 18,788.00	$ 2.93	$ 22,561.00
9625	Earthwork	Backfill	Dozer backfilling, trench, up to 300' haul, no compaction	B10B	900	0.013	L.C.Y	$ -	$ 0.56	$ 1.17	$ 1.73	$ -	$ 5,390.00	$ 11,261.25	$ 16,651.25	$ 2.12	$ 20,405.00
47515	Earthwork	Fill	General Fill: spread dumped material, no compaction, type 3	B10B	1000	0.012	L.C.Y	$ -	$ 0.50	$ 1.05	$ 1.55	$ -	$ 23,757.50	$ 49,890.75	$ 73,648.25	$ 1.91	$ 90,753.65
28468	Earthwork	Fill	General Fill: spread fill, from stockpile with 2-1/2 C.Y. F.E. loader, type 1	B10P	600	0.02	L.C.Y	$ -	$ 0.83	$ 1.68	$ 2.51	$ -	$ 23,628.44	$ 47,826.24	$ 71,454.68	$ 3.10	$ 88,250.80
43110	Earthwork	Fill	General Fill: gravel fill, compacted, 12" deep, type D	B37	6000	0.008	S.F.	$ 1.40	$ 0.29	$ 0.02	$ 1.71	$ 60,354.00	$ 12,501.90	$ 862.20	$ 73,718.10	$ 2.01	$ 86,651.10
90000	Earthwork	Hauling	Excavated or borrow, loose cubic yards, no loading equipment, including hauling, waiting, loading/dumping, time per cycle: 25MPH ave, cycle 4 mile, 20 min wait	B34A	128	0.063	L.C.Y	$ -	$ 2.15	$ 2.46	$ 4.61	$ -	$ 193,500.00	$ 221,400.00	$ 414,900.00	$ 5.98	$ 538,200.00
77580	Earthwork	Compaction	Riding, vibrating roller, 12" lifts, 3 passes	B10Y	3500	0.003	E.C.Y.	$ -	$ 0.14	$ 0.14	$ 0.28	$ -	$ 10,861.15	$ 10,861.15	$ 21,722.31	$ 0.38	$ 29,480.27
Total											**$ 878.16**	**$ 72,359.00**	**$ 839,638.28**	**$ 457,628.95**	**$ 1,373,970.70**	**$ 1,299.19**	**$ 1,865,662.88**

TOTAL PROJECT COST	$ 3,240,000.00

Roadway & Parking Lot

Table 5: Roadway & Parking lot Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
240	Roadway and Parking Lot	Curbs and Gutters	Cast-in-place concrete curbs and gutters: machine formed, 6" x 18", straight	B69A	2000	0.024	L.F	$ 6.10	$ 0.90	$ 0.37	$ 7.37	$ 1,464.00	$ 216.00	$ 88.80	$ 1,768.80	$ 8.47	$ 2,032.80
Total											**$ 7.37**	**$ 1,464.00**	**$ 216.00**	**$ 88.80**	**$ 1,768.80**	**$ 8.47**	**$ 2,032.80**

TOTAL PROJECT COST	$ 4,000.00

Concrete & Masonry

Table 6: Concrete & Masonry Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
1266	Concrete & Masonry	Quality Control	Concrete testing, aggregates, abrasion, ASTM C 131				Each				$ 136.00	$ -	$ -	$ -	$ 172,162.40	$ 150.00	$ 189,885.00
73	Concrete & Masonry	Quality Control	Masonry testing, absorption, per 5 brick, ASTM C 67				Each				$ 45.00	$ -	$ -	$ -	$ 3,276.00	$ 50.00	$ 3,640.00
728	Concrete & Masonry	Quality Control	Reinforcing steel, bend test				Each				$ 55.00	$ -	$ -	$ -	$ 40,040.00	$ 61.00	$ 44,408.00
6998	Concrete & Masonry	Structural Concrete	Structural concrete, in place, slab on grade (3500 psi), over 10000 S.F., 4" thick includes concrete, placing and finishing	C14F	3350	0.021	S.F.	$ 1.89	$ 0.84	$ 0.01	$ 2.74	$ 13,226.22	$ 5,878.32	$ 69.98	$ 19,174.52	$ 3.33	$ 23,303.34
34478	Concrete & Masonry	Structural Concrete	Structural concrete, placing, slab on grade, pumped, over 6" thick, iincludes strikeoff and consolidation	C20	185	0.346	C.Y	$ 130.00	$ 12.75	$ 4.26	$ 147.01	$ 4,482,140.00	$ 439,594.50	$ 146,876.28	$ 5,068,610.78	$ 23.98	$ 826,782.44
364	Concrete & Masonry	Concrete Unit Masonry	Concrete block, decorative, split face 6"x16"x4" thick	D8	350	0.114	S.F.	$ 3.28	$ 4.90	$ -	$ 8.18	$ 1,193.92	$ 1,783.60	$ -	$ 2,977.52	$ 10.96	$ 3,989.44
Total											**$ 393.93**	**$ 4,496,560.14**	**$ 447,256.42**	**$ 146,946.26**	**$ 5,306,241.22**	**$ 299.27**	**$ 1,092,008.22**

TOTAL PROJECT COST	$ 6,398,000.00

Boat Docks

Table 7: Boat Docks Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
4044	Boat Docks	Water	Floating Dock and boat launch docks	NA	NA	NA	S.F.	$ -	$ -	$ -	$ 20.00	$ -	$ -	$ -	$ 80,880.00	$ 35.00	$ 141,540.00
30	Boat Docks	Water	Bumpers for floating dock	NA	NA	NA	Each	$ -	$ -	$ -	$ 75.00	$ -	$ -	$ -	$ 2,250.00	$ 95.00	$ 2,850.00
Total											**$ 95.00**	**$ -**	**$ -**	**$ -**	**$ 83,130.00**	**$ 130.00**	**$ 144,390.00**

TOTAL PROJECT COST	$ 228,000.00

Bathroom Facility

Table 8: Bathroom Facility Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
2	Bathroom Facility	Bathroom fixture	Bathroom vent fan, resi, hook-up, economy model	1 Elec	15	0.533	Each	$ 25.00	$ 27.00	$ -	$ 52.00	$ 50.00	$ 54.00	$ -	$ 104.00	$ 67.00	$ 134.00
2	Bathroom Facility	Entrance Door	Aluminum, narrow stile including standard hardware, clear finish, no glass, 3'-6" x 7'-0" opening	2 Swk	2	8	Each	$ 740.00	$ 390.00	$ -	$ 1,130.00	$ 1,480.00	$ 780.00	$ -	$ 2,260.00	$ 1,520.00	$ 3,040.00
2	Bathroom Facility	Restroom Component	Toilet compartment component, headrail, for stainless steel, 62" long	2 Carp	65	0.246	Each	$ 24.00	$ 10.60	$ -	$ 34.60	$ 48.00	$ 21.20	$ -	$ 69.20	$ 42.75	$ 85.50
2	Bathroom Facility	Restroom Component	Toilet Accessories, grab bars, stainless steel, 1-1/4" diameter x 18" long	1 Carp	24	0.333	Each	$ 29.00	$ 14.35	$ -	$ 43.35	$ 58.00	$ 28.70	$ -	$ 86.70	$ 54.00	$ 108.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, hat & coat strip, stainless steel, 4 hook, 36" long	1 Carp	24	0.333	Each	$ 71.00	$ 14.35	$ -	$ 85.35	$ 142.00	$ 28.70	$ -	$ 170.70	$ 100.50	$ 201.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, mirror, 36" x 24", with stainless steel 3'4" square frame	1 Carp	15	0.533	Each	$ 101.00	$ 23.00	$ -	$ 124.00	$ 202.00	$ 46.00	$ -	$ 248.00	$ 146.00	$ 292.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, mop holder strip, stainless steel, 5 holders, 48" long	1 Carp	20	0.4	Each	$ 78.00	$ 17.20	$ -	$ 95.20	$ 156.00	$ 34.40	$ -	$ 190.40	$ 112.50	$ 225.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, soap dispenser, stainless steel, recessed, liquid	1 Carp	10	0.8	Each	$ 123.00	$ 34.50	$ -	$ 157.50	$ 246.00	$ 69.00	$ -	$ 315.00	$ 188.00	$ 376.00
1	Bathroom Facility	Restroom Component	Toilet Accessories, soap tank, stainless steel, 5 gallon	1 Carp	5	1.6	Each	$ 275.00	$ 69.00	$ -	$ 344.00	$ 275.00	$ 69.00	$ -	$ 344.00	$ 406.00	$ 406.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, toilet tissue dispenser, stainless steel, surface mounted, double roll	1 Carp	24	0.333	Each	$ 22.50	$ 14.35	$ -	$ 36.85	$ 45.00	$ 28.70	$ -	$ 73.70	$ 47.00	$ 94.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, towel dispenser, stainless steel, surface mounted	1 Carp	16	0.5	Each	$ 33.50	$ 21.50	$ -	$ 55.00	$ 67.00	$ 43.00	$ -	$ 110.00	$ 69.50	$ 139.00
2	Bathroom Facility	Restroom Component	Toilet Accessories, waste receptacle, stainless steel, w/top, 36 gallon	1 Carp	8	1	Each	$ 325.00	$ 43.00	$ -	$ 368.00	$ 650.00	$ 86.00	$ -	$ 736.00	$ 426.00	$ 852.00
2	Bathroom Facility	Restroom Component	Faucets/fittings, lavatory faucet, center set with single control lever handle polished chrome, with pop up drain	1 Plum	6.66	1.201	Each	$ 172.00	$ 64.50	$ -	$ 236.50	$ 344.00	$ 129.00	$ -	$ 473.00	$ 285.00	$ 570.00
2	Bathroom Facility	Restroom Component	WT-2016 Waterless Toilet	1 Plum	NA	NA	Each	$ 1,171.00	$ 200.00	$ -	$ 1,371.00	$ 2,342.00	$ 400.00	$ -	$ 2,742.00	$ 2,913.00	$ 5,826.00
2	Bathroom Facility	Restroom Component	Hinged White Plastic Seat	1 Plum	NA	NA	Each	$ 78.00	$ 20.00	$ -	$ 98.00	$ 156.00	$ 40.00	$ -	$ 196.00	$ 110.00	$ 220.00
2	Bathroom Facility	Restroom Component	ES-1015-HC Handicap Lavatory-Commercial Exposed Trap	1 Plum	NA	NA	Each	$ 310.00	$ 200.00	$ -	$ 510.00	$ 620.00	$ 400.00	$ -	$ 1,020.00	$ 1,191.00	$ 2,382.00
23	Bathroom Facility	Exterior	Fascia: Fascia, aluminun, reverse board & battern, colored, 0.032" thick, excl. furring	1 Shee	145	0.055	S.F.	$ 5.95	$ 2.85	$ -	$ 8.80	$ 137.09	$ 65.66	$ -	$ 202.75	$ 10.86	$ 250.21
1	Bathroom Facility	Exterior	Roof vent, muschroom for built-up roofs, aluminum	1 Rofc	30	0.267	Each	$ 88.50	$ 9.75	$ -	$ 98.25	$ 88.50	$ 9.75	$ -	$ 98.25	$ 113.25	$ 113.25
6	Bathroom Facility	Exterior	Roof truss, using galv LB metal studs, fink (W) or king post type, 4:12 to 8:12 pitch, 18 ga x 4" chords, 16' span, excl erectio, bridging & bracing, fabrication only of trusses on-site	2 Carp	7	2.286	Each	$ 127.00	$ 98.50	$ -	$ 225.50	$ 762.00	$ 591.00	$ -	$ 1,353.00	$ 290.00	$ 1,740.00
100	Bathroom Facility	Exterior	Wood framing, roofs, composite rafter, 9-1/2" deep	2 carp	575	0.028	L.F	$ 1.54	$ 1.20	$ -	$ 2.74	$ 154.40	$ 120.31	$ -	$ 274.71	$ 3.53	$ 353.92
2	Bathroom Facility	Exterior	Louvers, vinyl gable vent, 8" x 8"	1 Carp	38	0.211	Each	$ 11.55	$ 9.05	$ -	$ 20.60	$ 23.10	$ 18.10	$ -	$ 41.20	$ 26.60	$ 53.20
211	Bathroom Facility	Exterior	Steel roofing Panels	G3	1100	0.029	S.F.	$ 1.68	$ 1.25	$ -	$ 2.93	$ 354.48	$ 263.75	$ -	$ 618.23	$ 3.75	$ 791.25
Total											**$ 5,100.17**	**$ 8,400.57**	**$ 3,326.27**	**$ -**	**$ 11,726.84**	**$ 8,126.24**	**$ 18,252.33**

TOTAL PROJECT COST	**$ 30,000.00**

Exterior Improvements

Table 9: Exterior Improvements Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
2	Exterior Improvements	Site Seating	Classic park bench, recycled plastic, various colors, 6' long	2 clab	5	3.2	Each	$ 890.00	$ 110.00	$ -	$ 1,000.00	$ 1,780.00	$ 220.00	$ -	$ 2,000.00	$ 1,144.00	$ 2,288.00
7	Exterior Improvements	Site Seating	Picnic tables, recycled plastic, various colors, 6'	2 clab	5	3.2	Each	$ 640.00	$ 110.00	$ -	$ 750.00	$ 4,480.00	$ 770.00	$ -	$ 5,250.00	$ 869.00	$ 6,083.00
6	Exterior Improvements	Site Furnishings	Trash Receptacle Alum. Frame, hardboard panels, steel drum base: 50 gal. capacity, silk screen on plastic finish	2 Clab	20	0.8	Each	$ 580.00	$ 27.50	$ -	$ 607.50	$ 3,480.00	$ 165.00	$ -	$ 3,645.00	$ 682.00	$ 4,092.00
Total											**$ 2,357.50**	**$ 9,740.00**	**$ 1,155.00**	**$ -**	**$ 10,895.00**	**$ 2,695.00**	**$ 12,463.00**

TOTAL PROJECT COST	**$ 23,000.00**

Utilities

Table 10: Utilities Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
9	Utilities	Electrical Fixture	Individual fixture cost	1 Elec	NA	NA	Each	$ -	$ 150.00	$ -	$ 150.00	$ -	$ 1,350.00	$ -	$ 1,350.00	$ 1,410.00	$ 12,690.00
1	Utilities	Exterior Wall Mount Light	Light Fixtures, resi, outdoor, wall mounted, economy grade	1 Elec	30	0.267	Each	$ 32.50	$ 13.40	$ -	$ 45.90	$ 32.50	$ 13.40	$ -	$ 45.90	$ 55.85	$ 55.85
2	Utilities	Interior Vent	Louvers, inyl gable vent, 8" x 8"	1 Carp	38	0.211	Each	$ 11.55	$ 9.05	$ -	$ 20.60	$ 23.10	$ 18.10	$ -	$ 41.20	$ 26.60	$ 53.20
2	Utilities	Light Fixture	Swithc devices, resi, interval timer wall switch, 1-30 min.	1 Elec	14.55	0.55	Each	$ 52.00	$ 27.50	$ -	$ 79.50	$ 104.00	$ 55.00	$ -	$ 159.00	$ 99.50	$ 199.00
2	Utilities	Light Fixture	Light Fixture, resi, bathroom heat lamp, 1-250 W lamp	1 Elec	28	0.286	Each	$ 47.50	$ 14.35	$ -	$ 61.85	$ 95.00	$ 28.70	$ -	$ 123.70	$ 74.00	$ 148.00
9	Utilities	Metal Drainage Piping	Plumbing fixtures, open drain with snake	1 Plum	13	0.615	Each	$ -	$ 33.00	$ -	$ 33.00	$ -	$ 297.00	$ -	$ 297.00	$ 49.00	$ 441.00
2	Utilities	Metal Drainage Piping	Plumbing fixtures, open drain with toilet auger	1 Plum	16	0.5	Each	$ -	$ 27.00	$ -	$ 27.00	$ -	$ 54.00	$ -	$ 54.00	$ 40.00	$ 80.00
2	Utilities	Hydrant	Hydrant, wall type, moderate climate, bronze, anti-siphon, encased, 3/4" I.P.S connection	1 Plum	16	0.5	Each	$ 600.00	$ 27.00	$ -	$ 627.00	$ 1,200.00	$ 54.00	$ -	$ 1,254.00	$ 700.00	$ 1,400.00
6	Utilities	Plumbing Components	Fixture (sink, toilet, etc.)	1 Plum	NA	NA	Each	$ 500.00	$ 300.00	$ -	$ 800.00	$ 3,000.00	$ 1,800.00	$ -	$ 4,800.00	$ 1,000.00	$ 6,000.00
1	Utilities	Plumbing Components	Utility Septic tank and Effluent Wet Wells, septic tanks high density polyethylene, 1500 gallon, excluding piping and excavation	B21	4	7	Each	$ 1,375.00	$ 277.00	$ 32.00	$ 1,684.00	$ 1,375.00	$ 277.00	$ 32.00	$ 1,684.00	$ 1,985.00	$ 1,985.00
202	Utilities	Plumbing Components	General Plumbing	1 Plum	NA	NA	S.F.	$ -	$ -	$ -	$ 3.50	$ -	$ -	$ -	$ 707.00	$ 4.50	$ 909.00
2	Utilities	Operational	Installation of Fire and carbon dioxide alarms	1 Elec	5.33	1.501	Each	$ -	$ 75.50	$ -	$ 75.50	$ -	$ 151.00	$ -	$ 151.00	$ 112.00	$ 224.00
350	Utilities	Public Water Utility Distribution	Ductile Iron Pipe, cement lined, not including excavation or backfill, pipe, class 50 water piping, 18' lengths, mechanical joint, 4" diameter	B21A	200	0.2	L.F	$ 12.50	$ 8.55	$ 2.17	$ 23.22	$ 4,375.00	$ 2,992.50	$ 759.50	$ 8,127.00	$ 29.04	$ 10,164.00
1	Utilities	Public Water Utility Distribution	Water Service Connection: Tapping, crosses and sleeves, tap and insert gate valve 8" main, 4" branch	B21	3.2	8.75	Each	$ -	$ 345.00	$ 40.50	$ 385.50	$ -	$ 345.00	$ 40.50	$ 385.50	$ 574.00	$ 574.00
1	Utilities	Public Water Utility Distribution	Fire hydrant, two way; excavation and backfill not included. 4-1/2" valve size, depth 2'	B21	10	2.8	Each	$ 1,350.00	$ 111.00	$ 12.90	$ 1,473.90	$ 1,350.00	$ 111.00	$ 12.90	$ 1,473.90	$ 1,683.15	$ 1,683.15
Total											**$ 5,490.47**	**$ 11,554.60**	**$ 7,546.70**	**$ 844.90**	**$ 20,653.20**	**$ 7,842.64**	**$ 36,606.20**

TOTAL PROJECT COST	**$ 57,000.00**

Landscaping

Table 11: Landscaping Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
200	Landscaping	Quality Control	Seed testing, complete test				Each				$ 45.00	$ -	$ -	$ -	$ 9,000.00	$ 55.00	$ 11,000.00
43467	Landscaping	Sprinkler Irrigation System	Residential system, custom, 1" supply	B20	2000	0.012	S.F.	$ 0.32	$ 0.46	$ -	$ 0.78	$ 13,909.44	$ 19,994.82	$ -	$ 33,904.26	$ 1.06	$ 46,075.02
1	Landscaping	Turf and Grasses	Mechanical Seeding, 215lb./acre	B66	1.5	5.333	Acre	$ 570.00	$ 233.00	$ 149.00	$ 952.00	$ 568.29	$ 232.30	$ 148.55	$ 949.14	$ 1,134.00	$ 1,130.60
Total											**$ 997.78**	**$ 14,477.73**	**$ 20,227.12**	**$ 148.55**	**$ 43,853.40**	**$ 1,190.06**	**$ 58,205.62**

TOTAL PROJECT COST	**$ 102,000.00**

Erosion Control

Table 12: Erosion Control Item Breakdown and Cost

Quantity	Category	Sub Category	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Quantified Material	Quantified Labor	Quantified Equipment	Quantified Total	Total Overhead and Profit	Quantified Overhead and Profit
4830	Erosion Control	Erosion control	Rolled Erosion control mats and blankets: jute mesh, 100 S.Y. per roll, 4' wide, stapled	B80A	2400	0.01	S.Y	$ 0.76	$ 0.34	$ 0.09	$ 1.19	$ 3,670.55	$ 1,642.09	$ 434.67	$ 5,747.30	$ 1.47	$ 7,099.61
7662	Erosion Control	Erosion control	Nylon, 3 dimensional geomatrix, 12 mil thick	B80A	515	0.047	S.Y	$ 5.70	$ 1.60	$ 0.42	$ 7.72	$ 43,672.13	$ 12,258.84	$ 3,217.95	$ 59,148.92	$ 9.17	$ 70,258.50
2000	Erosion Control	Erosion control	Silt fence, polypropylene, 3' high, adverse conditions	2 clab	950	0.017	L.F.	$ 0.41	$ 0.58	$ -	$ 0.99	$ 820.00	$ 1,160.00	$ -	$ 1,980.00	$ 1.34	$ 2,680.00
658	Erosion Control	Erosion control	Riprap and rock lining: random broken stone, machine placed for slope protection, 18" minimum thickness, not grouted	B13	53	1.057	S.Y.	$ 19.70	$ 39.50	$ 14.15	$ 73.35	$ 12,969.17	$ 26,004.17	$ 9,315.42	$ 48,288.75	$ 97.05	$ 63,891.25
Total											$ 83.25	$ 61,131.85	$ 41,065.10	$ 12,968.04	$ 115,164.97	$ 109.03	$ 143,929.36

TOTAL PROJECT COST	$ 259,000.00

Table 13: Breakdown of Project Category Cost and Total Project Cost

Keokuk, Iowa: Recreational River Access Total Cost	
Project Category	**Tabulated Cost**
Waterway and Marine Construction	$ 7,379,000
Earthwork Construction	$ 3,240,000
Roadway & Parking Lot	$ 3,800
Concrete & Masonry Construction	$ 6,398,000
Boat Docks	$ 227,500
Bathroom Facility	$ 30,000
Exterior Improvements	$ 23,500
Utilities	$ 57,500
Landscaping	$ 102,000
Erosion Control	$ 259,000
Total Construction Cost	$ 17,720,500
Contingency	$ 1,772,050
Engineering & Design Fees	$ 1,833,000
TOTAL PROJECT COST	$ 21,325,550

Appendix D: Project Workflow for Design Process

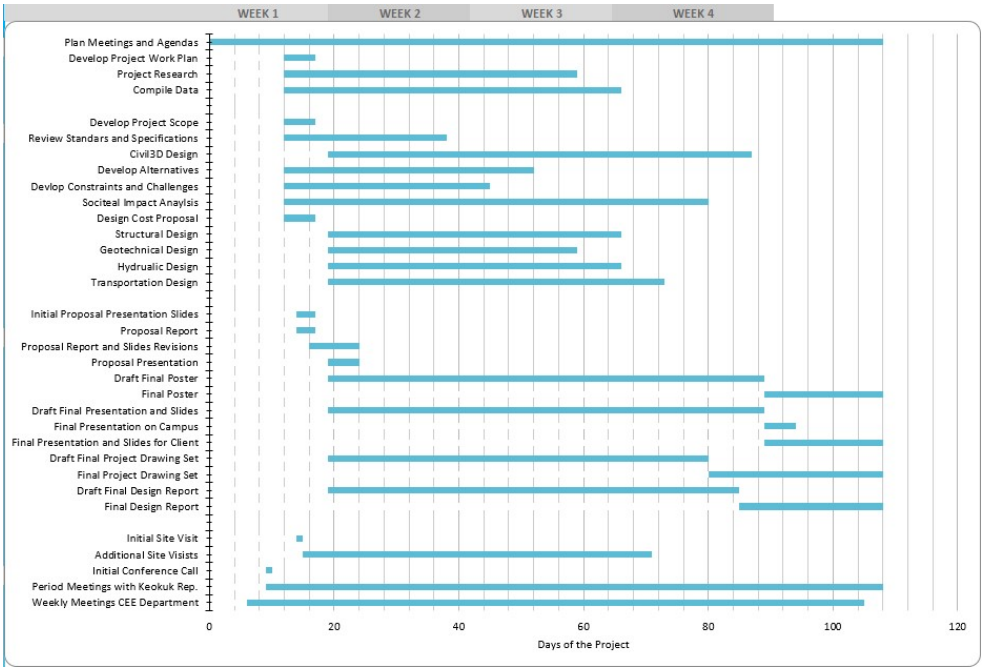
Table 14: Gantt Chart Task Breakdown

GANTT CHART RECREATIONAL RIVER ACCESS

* = an automatically calculated cell

TASK NAME	START DATE	END DATE	START ON DAY*	DURATION* (WORK DAYS)	TEAM MEMBER	PERCENT COMPLETE
Planning and Data Collection						
Plan Meetings and Agendas	1/22	5/8	0	108	JNP	100%
Develop Project Work Plan	2/3	2/7	12	5	JNP	100%
Project Research	2/3	3/20	12	47	JNP	100%
Compile Data	2/3	3/27	12	54	JNP	100%
Concept Design						
Develop Project Scope	2/3	2/7	12	5	JNP	100%
Review Standars and Specifications	2/3	2/28	12	26	JNP	100%
Civil3D Design	2/10	4/17	19	68	JNP	100%
Develop Alternatives	2/3	3/13	12	40	JNP	100%
Devlop Constraints and Challenges	2/3	3/6	12	33	JNP	100%
Sociteal Impact Anaylsis	2/3	4/10	12	68	JNP	100%
Design Cost Proposal	2/3	2/7	12	5	JNP	100%
Structural Design	2/10	3/27	19	47	JNP	100%
Geotechnical Design	2/10	3/20	19	40	JNP	100%
Hydrualic Design	2/10	3/27	19	47	JNP	100%
Transportation Design	2/10	4/3	19	54	JNP	100%
Report and Presentation Production						
Initial Proposal Presentation Slides	2/5	2/7	14	3	JNP	100%
Proposal Report	2/5	2/7	14	3	JNP	100%
Proposal Report and Slides Revisions	2/7	2/14	16	8	JNP	100%
Proposal Presentation	2/10	2/14	19	5	JNP	100%
Draft Final Poster	2/10	4/19	19	70	JNP	100%
Final Poster	4/20	5/8	89	19	JNP	100%
Draft Final Presentation and Slides	2/10	4/19	19	70	JNP	100%
Final Presentation on Campus	4/20	4/24	89	5	JNP	100%
Final Presentation and Slides for	4/20	5/8	89	19	JNP	100%
Draft Final Project Drawing Set	2/10	4/10	19	61	JNP	100%
Final Project Drawing Set	4/11	5/8	80	28	JNP	100%
Draft Final Design Report	2/10	4/15	19	66	JNP	100%
Final Design Report	4/16	5/8	85	23	JNP	100%
Meetings						
Initial Site Visit	2/5	2/5	14	1	JNP	100%
Additional Site Visists	2/6	4/1	15	56	JNP	100%
Initial Conference Call	1/31	1/31	9	1	JNP	100%
Period Meetings with Keokuk Rep.	1/31	5/8	9	99	JNP	100%
Weekly Meetings CEE Department	1/28	5/5	6	99	JNP	100%

Table 15: Visual Representation of Task Breakdown



Appendix E: Figures

Figure 1: Example of Boat Ramp Design in Guttenberg, Iowa

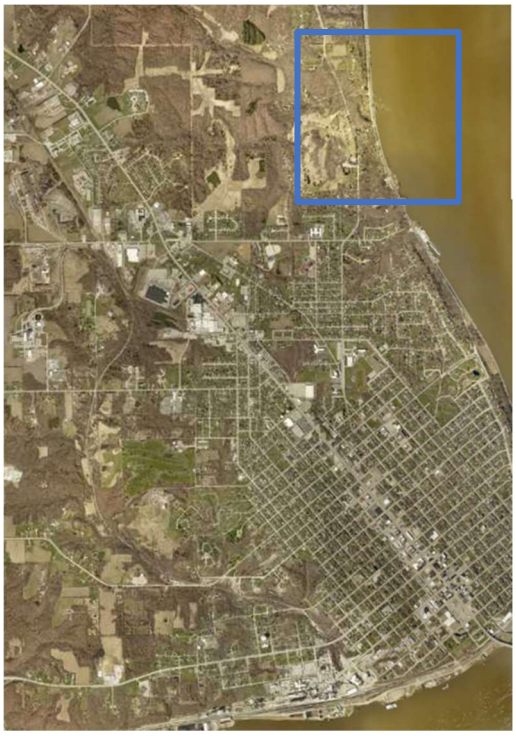


Figure 2: Expanded View of Site Location

Figure 3: Existing Sediment at Project Location

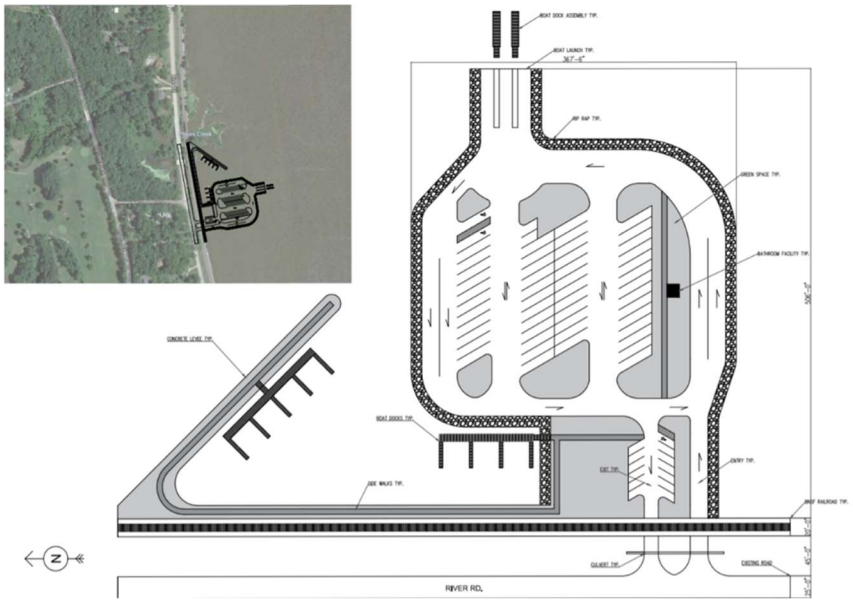


Figure 4: Proposed Site Plan and Design Elements

Figure 5: Example of Proposed Boat Launch

Figure 6: Example of Proposed Guardrails for Boat Launch and Boat Docks

Figure 7: Example of Proposed Floating Dock and Staircase

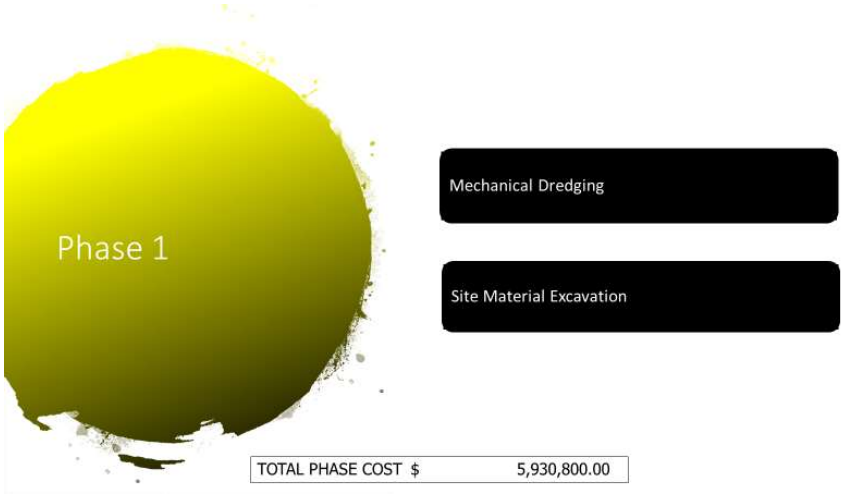


Figure 8: Recommended Phase 1 of the Construction Process

Figure 9: Recommended Phase 2 of the Construction Process

Figure 10: Recommended Phase 3 of the Construction Process

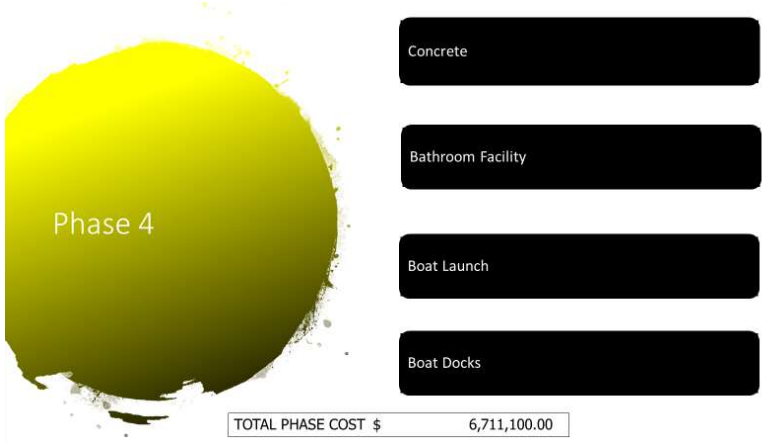


Figure11: Recommended Phase 4 of the Construction Process

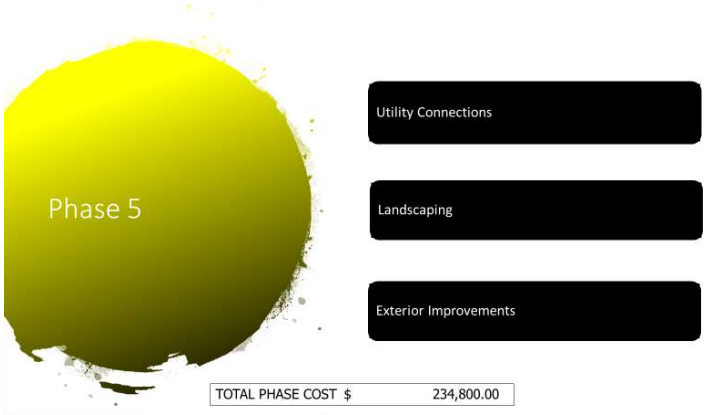


Figure 12: Recommended Phase 5 of the Construction Process

For any additional references to Appendix E not displayed in the above images, please see the final project drawing set for more information.