



East Coast Engineering & Surveying, P.C.
ENGINEERS • PLANNERS • SURVEYORS

Stormwater Outfall Emergency Repair Plan

at

308 North Shore Drive West

Sunset Beach, NC

**STORMWATER
INVESTIGATION REPORT**



October 2014

MAIN BRANCH

4918 Main Street
Shallotte, North Carolina 28470
910-754-8029 * 910-754-8049 fax

MAILING ADDRESS

Post Office Box 2469
Shallotte, North Carolina 28459
Firm License Number: C-3014 * www.eces.biz

WAKE FOREST BRANCH

3206 Heritage Trade Drive, Suite 108C
Wake Forest, NC 27587 (Engineering)
910-443-3484 * 910-754-8029

Stormwater Investigation Report
308 North Shore Drive West

1.0 Scope of Work

The purpose of this work is for East Coast Engineering and Surveying, PC (ECES) to provide professional services to prepare a stormwater outfall emergency repair plan for the existing failed 24” single wall corrugated plastic pipe outfalling at 308 North Shore Drive West, Sunset Beach, NC (subject property).

Additionally, the scope of work includes investigating the existing off-site Town storm drainage system located within the 308 North Shore Drive West outfall project drainage area. This work includes identifying our findings and providing recommendations for future repairs and replacements.



Our investigations are based upon aerial imagery, Brunswick County GIS records, Town of Sunset Beach records, as-built and topographic survey information, wetlands investigation data and maps by Land Management Group, Inc. (LMG), information in hand, and visual observations in the field.

Based on our investigations we have identified our findings and recommendations as stated below.

2.0 Existing Storm Drainage System Conditions

An as-built survey dated September 2014 including NC Grid location, storm drainage structures, rim elevations, invert elevations, and storm drainage pipe materials and sizes has been provided within the 308 North Shore Drive West outfall project drainage area. High point and low point locations within the roadways were also included as part of this work.

A CD containing an electronic copy of the As-Built Survey has been provided to the Town for record.

The existing storm drainage system contains pipes with reverse slopes, upstream pipes with inverts significantly lower (+/- 3 feet) than downstream pipes, an insufficient number of drainage inlets, inadequate grading, inadequate areas for storage, and a deficient outfall system.

With the existing outfall pipe elevation exceeding system inverts, the drainage system is acting as underground storage. All pipes that are below the outfall pipe invert of 4.0’ will be partially or fully submerged. Several drainage inlet rim elevations are only a few inches above the outfall pipe invert and flooding is imminent in these areas. Additionally, there are multiple pipes with inadequate cover that will result in premature failure.

Stormwater Investigation Report
308 North Shore Drive West

2.1 Project Area Soils

A Soils Report that includes the existing groundwater elevations and soil infiltration rates was not performed for this site. In accordance with the Soil Survey of Brunswick County, North Carolina and the Natural Resources Conservation Service Soils Data, the majority of the upland areas contain Newhan Fine Sands at 2-30% typical slopes. Newhan soils are defined as excessively drained soils with high permeability rates exceeding 20 in/hr. Significant surface wetness is not anticipated during construction.

2.2 Existing 308 North Shore Drive West Outfall Drainage Area

Based upon our investigations, a Drainage Area Map (DAM) has been created for each of the storm drainage structures within the 308 North Shore Drive West outfall drainage area.

The drainage areas identified on the DAM are theoretical and approximate due to the limited capacity within the existing system. Existing grading within the right of way as well as individual parcels does not provide a positive slope to all of the drainage inlets. This creates multiple low areas of ponding that cannot reach the inlets.

The theoretical drainage areas represent the probable area to each existing inlet with further improvements.



The actual drainage areas are significantly less than the theoretical drainage areas as the drainage inlet locations and elevations are not adequate to handle the volume of runoff, the storm system piping is under sized, and the system outfall is deficient. The combination of these items creates a head condition on the system that exceeds the structure rim elevations creating significant flooding, especially at the upstream portion of the system, including West Main Street. Additionally, a percentage of the drainage areas are infiltrating into the ground, weather planned or out of necessity. Sub-drainage areas identifying the areas of infiltration are not shown as part of this work. The stormwater runoff is finding alternative sources of outfall due to the limited capacity and conditions created by the existing system.

2.3 Existing Storm Drainage System Calculations

Based upon our findings, we know that utilizing the theoretical drainage areas to perform the existing closed conveyance drainage system calculations would create a false condition that would not represent an accurate model of the current 10 year storm rainfall event.

Stormwater Investigation Report
308 North Shore Drive West

Assumed areas of infiltration were simulated and subtracted from the theoretical drainage areas in order to produce an acceptable drainage area for the purposes of this work. We have found that drastically reducing the drainage areas in the hydraulic model obtains more accurate results of how the system is currently functioning. This further supports our findings that a significant portion of the stormwater runoff is finding alternative outfall points, is ponding in low points creating longer times of concentration on the system, and/or infiltrating into the sandy soils with rapid permeability rates.

In order to model the system, several additional assumptions were required. Rims and inverts for buried structures, including Structures 29-403 and 30-402, within the drainage area that could not be located without subsurface exploration were assumed for the purposes of this work. For pipe runs with more than one pipe material identified by the as-built survey, the highest manning ‘n’ value is used.



Random samples were taken within the drainage area to establish existing runoff coefficient “c” values based on the percentage of impervious areas as of September 2014 within the sample area and applied to similar drainage areas.

Time of concentration values within each drainage area were estimated using the Kirpich Method for Overland Flow.

A 10 year storm event tailwater of 4.00 was used in the system model. The surveyed contour elevation of 4.00 is in close proximity to the flagged 404 wetlands limits.

For the purposes of this work, adequate data was available and justifiable assumptions could be made in order to obtain reasonable results. However, ECES recommends a detailed drainage study with subsurface exploration of the storm drainage system, including video monitoring, be performed to obtain more accurate system results.

2.4 Existing Outfall

The existing 24” single wall corrugated plastic pipe currently has a reverse slope. The pipe extends from JBNSDW-308 in the North Shore Drive W right of way at invert 2.87’ for approximately 200 linear feet to outfall at elevation 4.00’. Rip rap stone has been placed at the outfall and extends into the 404 wetlands limits. Even though rip rap is currently used to reduce the stormwater pipe velocity, there is visible evidence of scour at the existing outfall location.

Stormwater Investigation Report
308 North Shore Drive West

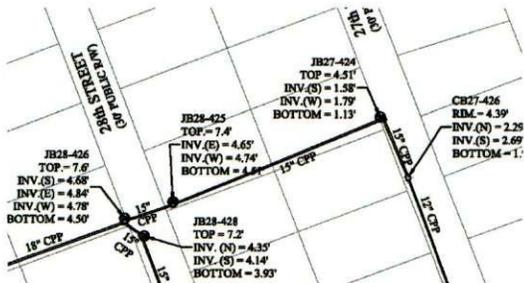
3.0 Proposed Storm Drainage System Conditions

Replacing the existing 24" pipe on the subject property at the existing outfall invert will not resolve the flooding conditions created as a result of the existing storm system. The Town of Sunset Beach must make a commitment to move forward with other improvements within the drainage area in order to reduce flooding.

3.1 Proposed 308 North Shore Drive West Outfall Drainage Area

No changes have been made to the existing 308 North Shore Drive West outfall drainage areas for the purposes of this work.

3.2 Proposed Storm Drainage System Calculations



No changes to the existing stormwater system model were made to the proposed stormwater system model apart from the two most downstream pipes as identified on the Emergency Stormwater Repair Plan for the subject property as part of this work discussed below.

While the Town of Sunset Beach will not see the immediate benefit of the proposed stormwater pipe and structure replacements, they are ultimately necessary if the Town is committed to further improvements within the system.

3.3 Emergency Stormwater Repair

The topographic survey dated September 2014 for the subject property delineates the existing boundary survey, high water line, coastal wetlands limits, 404 wetlands limits, 30' buffer, 75' area of environmental concern setback, grades, and physical features necessary to provide information for design purposes for this project.

A CD containing an electronic copy of the 308 North Shore Drive West Topographic Survey has been provided to the Town for record.

The subject parcel is bound to the north by the Intracoastal Waterway, south by North Shore Drive West, and to the east and west by built upon residential parcels. The privately owned site is currently vacant and contains areas of fill and minimal vegetation.

Stormwater Investigation Report
308 North Shore Drive West

Based upon our investigations, we have prepared a detailed construction plan showing the horizontal alignment of the proposed storm drainage outfall pipes and structures, grading, drainage, easements and all other data necessary to support the plan.



The proposed work includes removing and replacing the existing 24" single wall corrugated plastic pipe within the North Shore Drive West right of way with a 36" reinforced concrete pipe. It also includes removing and replacing the 24" reinforced concrete stormwater pipe running through the subject property with a 36" reinforced concrete pipe. This requires removing existing catch basin CBNSDW-402 and replacing the structure with NCDOT standard 4.0' diameter manhole with grate top STM C and abandoning Junction Box NSDW-308. Due to the extensive underground utilities in this area, the proposed pipe is to extend from STM C, angle into the property, and tie to proposed NCDOT

standard 5.0' diameter manhole STM B. The contractor should take extra precautions when performing work in this area. From STM B, the proposed 36" pipe will continue parallel to the 306 North Shore Drive West (306) property line five feet (5.00') inside the property to proposed NCDOT junction box (modified) STM A which serves as the storm system outfall structure.

The proposed work will require the removal of existing vegetation within the subject property limits. No vegetation should be removed on the 306 or 402 North Shore Drive West properties.

Erosion and sediment control practices, including but not limited to, silt fence, inlet protection, erosion control stone, construction entrance, temporary seeding, and permanent seeding, that are required for the proposed work are included as part of this plan.

3.4 Proposed Outfall

The proposed outfall is in the general location of the existing outfall. Our calculations have found that increasing the two most downstream pipe sizes from 24" to 36" will reduce the outfall velocity and lower the head condition on the system. A rectangular weir placed at the outfall structure above half pipe diameter (0.5D) of the 36" pipe will further reduce the outfall velocity as it will act as a level spreader.

The proposed weir elevation is located at the same elevation as the existing 24" outfall pipe and 404 wetlands limits in order to proceed with a Minor CAMA Permit. Lowering the outfall elevation will require a Major CAMA Permit and should be considered with future work in order to alleviate the existing system.

Stormwater Investigation Report
308 North Shore Drive West

Although there is rip rap outlet protection at the existing outfall, the existing rip rap appears inadequate as there is visible evidence of scour. The existing drainage system was constructed prior to current State and Federal stormwater regulations and does not represent an adequate stormwater management system. ECES is proposing a more substantial rip rap section downstream of the proposed weir. It is to be designed in accordance with NCDOT standards and terminate at the 30' buffer.

We are requesting that the environmental regulatory agencies allow the existing rip rap to remain within and around the 404 wetlands for the continued use of velocity control and to limit the disturbance within the environmentally sensitive areas.

3.5 Drainage Easement

No drainage easement currently exists for the public stormwater system on the subject property. Considering future development and restrictions of this parcel, ECES is proposing a 10.0' and variable width public drainage easement along the front of the parcel and along the 306 North Shore Drive West property line. Generally, a wider easement would be preferred for a pipe of this size and depth. The 308 North Shore Drive West property owner should be made fully aware of all future construction restrictions.

The proposed drainage easement will not accommodate the minimum 1:1 side slopes necessary for typical underground infrastructure installations and/or repairs. A trench box will be required for future work. ECES recommends that the Town of Sunset Beach enforce a minimum 5.0' side yard setback for all future building construction from the drainage easement on the parcel in order to protect the integrity of the drainage system.

A 5.0' temporary construction easement should be obtained from the 306 property owner to complete the construction. A temporary construction easement within the limits of construction should be obtained from the 308 North Shore Drive West property owner on the subject property for the proposed work by the Town of Sunset Beach.

All temporary and permanent easements proposed as part of this plan should be secured by the Town of Sunset Beach prior to construction. ECES recommends that the Town obtain written permission from both the 306 and 308 North Shore Drive West property owners for record.



The metes and bounds and area of the proposed 10.0' and variable width public drainage easement have been provided on the Construction Plans for the Town of Sunset Beach's use in the preparation of the legal documents needed to secure the easement.

Stormwater Investigation Report
308 North Shore Drive West

4.0 Summary of Findings

Due to the extensive inadequacies of the existing stormwater system, ECES recommends a detailed drainage study of the entire barrier island identifying all of the system deficiencies and providing recommendations for phased construction of stormwater infrastructure repairs, replacements, and additions.

The Town should also consider utilizing undeveloped parcels or areas within the right of way for storage and/or infiltration to alleviate the existing storm system. Isolated areas could strategically be placed throughout the island to mitigate flooding and effectively treat the stormwater runoff prior to outfalling into the waterways.

In order to expedite the review process and installation for the emergency stormwater repair, ECES recommends that the Town of Sunset Beach proceed with the proposed outfall and obtain a Minor CAMA Permit for the work.

Once the Minor CAMA Permit has been issued and construction is complete, the Town should proceed with the design of a modified outfall system to lower the outfall elevation to relieve the existing stormwater system. This will require a Major CAMA Permit which takes approximately 75 days to review, the application fee is \$400, and the request must be submitted to multiple local and federal review agencies for review and approval.