

**Zebulon Animal Hospital
N. Arendell Ave. Zebulon, NC**

**STORMWATER
DESIGN CALCULATIONS**

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STORMWATER DESIGN CALCULATIONS

GENERAL SITE DESCRIPTION

The proposed project is for the construction of a warehouse to the back of the existing ABC building on Raleigh Rd Pkwy. Parking has been relocated to the Western side of the building to accommodate a truck ramp and dumpster pad on the Eastern side of the building. The existing property was developed prior to 2013 and only additional is to be treated.

PEAK RUNOFF

There is no existing stormwater infrastructure on site. In the R.O.W. along the Northern side of NC HWY 96 is a drainage ditch flowing South East to a culvert, which conveys water to the South side of the highway.

In accordance with the Town of Zebulon Master Plan; curb & gutter, sidewalk (located in the R.O.W.), and an additional lane on NC HWY 96 are included in the design of this project to convey offsite stormwater (shown in the post development calculations as the "OFF-SITE-NCDOT-DRAINAGE-SURVEY" subbasin) through the R.O.W. The Drainage and Hydrology & Hydraulics Report prepared by Volkert on behalf of NCDOT is included for reference in this report for the OFF-SITE-NCDOT-DRAINAGE SURVEY data.

CB-1-BYPASS, CB-2-BYPASS, and CB-3-BYPASS in the schematic and calculations are for gutter spread calculations only and not needed for construction. The time of concentration for the stormwater analysis was manually overridden to match the Wake County Stormwater Tool Tc values.

To meet Wake County peak flow requirements, two (2) bioretention cells will be constructed to manage the increase in runoff due to the addition of impervious area.

The Northern bioretention cell is designed to treat 0.465 AC of impervious area runoff. The proposed building will convey roof water runoff through a PVC downspout manifold.

The Southern bioretention cell is designed to treat 0.156 AC of impervious area runoff.

Both bioretention cell details are included in the plan set, and supplementary calculations are found in this report. This is a "Scenario B" for peak flow in accordance with the Wake County Stormwater Design Manual 4.2.1.

The existing condition and post construction peak runoff was modeled using the SCS method with coefficient numbers (CN) for B soils. The resulting post development peak runoff will be lesser than that of the existing condition for the 1-, 2-, 10-, and 25-year storm events.

DESIGN CRITERIA:

| <u>Storm Event</u> | <u>Peak Flow Requirement</u> |
|--------------------|--|
| 1-year, 24 hour | Not to exceed pre-development condition. |
| 2-year, 24 hour | Not to exceed pre-development condition. |
| 10-year, 24 hour | 10% Reduction |
| 25-year, 24 hour | 10% Reduction |

APPENDIX A

MAPS

- **USGS QUAD MAP**
- **USDA SOIL SURVEY MAPS**
- **PRE-DEVELOPMENT DRAINAGE AREAs AND T_c FLOW PATHS**
- **POST-DEVELOPMENT DRAINAGE AREAs AND T_c FLOW PATHS**
- **E&SC DRAINAGE AREA MAP**

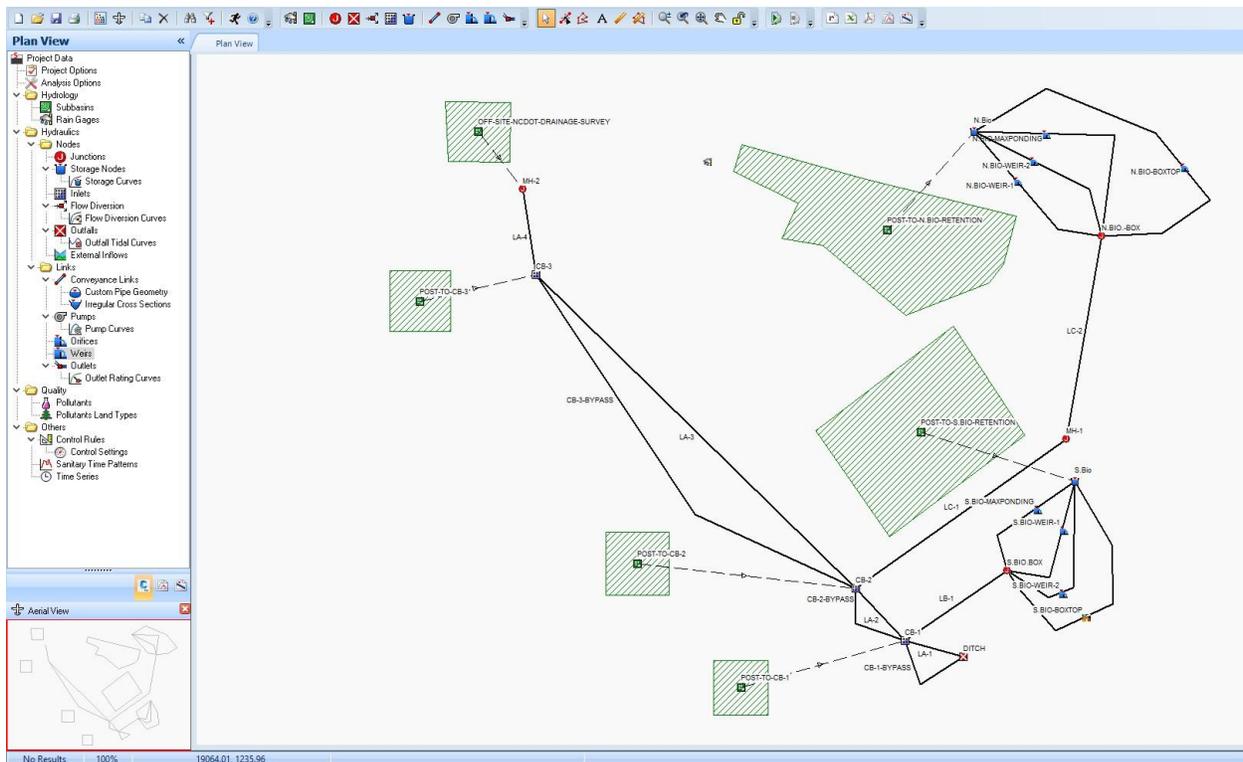
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STORM DRAIN SYSTEM CALCULATIONS

- **CALCULATION SCHEMATIC LAYOUT**
- **STORM DRAIN SCHEDULE**
- **DISSIPATOR PADS**



STORM DRAIN SCHEDULE (10-YEAR STORM)
n = 0.013

| FROM | TO | PIPE RUN | INLET AREA (SF) | INLET AREA (ACRES) | A TOTAL AREA (ACRES) | INLET TIME (MIN) | PIPE TIME (MIN) | tc TIME OF CONC (MIN) | I INTENSITY (IN/HR) | Cc RUNOFF COEFF | Cc RUNOFF COEFF | Q10 DSCHRG (CFS) | SLOPE (FT/FT) | Dtheo (INCHES) | SIZE (INCHES) | Vfull (FT/SEC) | Qfull (CFS) | LENGTH PIPE (FT) | SEGMENT TIME (MIN) | UPPER INVERT | LOWER INVERT |
|---------------|-------|----------|-----------------|--------------------|----------------------|------------------|-----------------|-----------------------|---------------------|-----------------|-----------------|------------------|---------------|----------------|---------------|----------------|-------------|------------------|--------------------|--------------|--------------|
| LINE A | | | | | | | | | | | | | | | | | | | | | |
| MH-2 | CB-3 | LA-4 | 110207 | 2.53 | 2.53 | 5.0 | 0.0 | 5.0 | 8.03 | 0.50 | 0.50 | 10.2 | 0.0102 | 17.7 | 24 | 7.3 | 22.8 | 24.5 | 0.1 | 339.50 | 339.25 |
| CB-3 | CB-2 | LA-3 | 3833 | 0.09 | 2.62 | 5.0 | 0.0 | 5.0 | 8.03 | 0.90 | 0.90 | 18.9 | 0.0171 | 20.3 | 24 | 9.4 | 29.6 | 117.0 | 0.2 | 339.25 | 337.25 |
| CB-2 | CB-1 | LA-2 | 3920 | 0.09 | 2.71 | 5.0 | 0.0 | 5.0 | 8.03 | 0.90 | 0.90 | 19.6 | 0.0048 | 26.1 | 30 | 5.8 | 28.4 | 42.0 | 0.1 | 335.60 | 335.40 |
| CB-1 | FES-1 | LA-1 | 1220 | 0.03 | 2.74 | 5.0 | 0.0 | 5.0 | 8.03 | 0.90 | 0.90 | 19.8 | 0.0080 | 23.8 | 24 | 6.4 | 20.2 | 25.0 | 0.1 | 335.40 | 335.20 |
| LINE B | | | | | | | | | | | | | | | | | | | | | |
| S. BIO | CB-1 | LB-1 | 14310 | 0.33 | 0.33 | 5.0 | 0.0 | 5.0 | 7.20 | 0.73 | 0.73 | 1.7 | 0.0129 | 8.7 | 18 | 6.7 | 11.9 | 31.0 | 0.1 | 335.50 | 335.10 |
| LINE C | | | | | | | | | | | | | | | | | | | | | |
| N. BIO | MH-1 | LC-2 | 33360 | 0.77 | 1.09 | 5.0 | 0.0 | 5.0 | 7.20 | 0.76 | 0.75 | 5.9 | 0.0044 | 16.9 | 18 | 3.9 | 7.0 | 91.0 | 0.4 | 336.51 | 336.11 |
| MH-1 | CB-2 | LC-1 | 0 | 0.00 | 1.09 | 5.0 | 0.0 | 5.0 | 7.20 | 0.90 | 0.75 | 5.9 | 0.0037 | 17.5 | 18 | 3.6 | 6.4 | 136.5 | 0.6 | 336.11 | 335.60 |

*LA-1, LA-2, LA-3, AND LA-4 ARE CLASS V RCP. ALL OTHER PIPES CLASS III RCP.
 *LINE A SIZED FOR 25YR STORM.
 *UPSTREAM DRAINAGE AREAS FOR PIPE LA-4 PROVIDED BY VOLKERT ENGINEERING VIA "DRAINAGE AND HYDROLOGY & HYDRAULICS REPORT" PREPARED BY VOLKERT FOR N.C.D.O.T.
 *LINES B & C PIPES SIZED BY 'Q' VALUES OF BIORETENTION CELL OUTFLOWS. SEE STORMWATER REPORT FOR MORE DATA.

DISSIPATOR PAD/OUTLET PROTECTION SCHEDULE
(NYDOT METHOD)

| LOCATION | Qmax | Q10 | V10 | Vmax | PIPE DIA. ¹ | NUMBER OF PIPES | DISTANCE CENT-CENT | APRON LENGTH ² | APRON WIDTH ³ | CLASS | STONE DEPTH ⁴ | D50 STONE | | |
|----------|-------|-------|------|------|------------------------|-----------------|--------------------|---------------------------|--------------------------|-------|--------------------------|-----------|----|---|
| | CFS | CFS | FPS | FPS | INCHES | ZONE | FEET | (La) FEET | FEET | STONE | INCHES | SIZE | | |
| FES-1 | 17.54 | 12.34 | 6.04 | 6.31 | 24 | 2 | 6 | 1 | 1 | 12 | 9 | B | 22 | 8 |

¹ Pipes: Do = Pipe Diameter; Channels: Do = Square root of the cross sectional area of flow at channel outlet

| UNDERDRAIN CALCULATIONS | | | | | |
|-------------------------|-------|-------|--------|-------|----------|
| n=0.011 | | | | | |
| CELL | DRAIN | SLOPE | DESIGN | D | # OF |
| I.D. | DIA. | | FLOW | VALUE | DRAINS |
| | IN. | FT/FT | CFS | | REQUIRED |
| N. Bio | 6 | 0.01 | 0.28 | 4.338 | 2 |
| S. Bio | 6 | 0.01 | 0.08 | 2.712 | 2 |

APPENDIX D

BIORETENTION CELL DESIGN CALCULATIONS

- **1-YR, 2-YR, 10-YR, 25-YR DATA (GROUPED BY STORM EVENT):**
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