

# Staffing Analysis Report for the North Carolina Department of Transportation Division of Highways

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**2014**

**By the North Carolina Department of Transportation for the NC General Assembly Joint Legislative  
Transportation Oversight Committee and Fiscal Research Staff**

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This document reports on the NC Department of Transportation's study of staffing for the  
Preconstruction units and Division of Highways, pursuant to S.L 2014-100, Section 34.16 (a) & (b)

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# NCDOT Staffing Analysis

## Executive Summary

In accordance with S.L. 2014-100, Section 34.16 (a) & (b), this report on the NC Department of Transportation's study of staffing for the Preconstruction units and Division of Highway is an initial staffing analysis. Reviewing and analyzing staffing must be put in context of other statewide, national and organizational directives. The Department is currently engaged in furthering its efforts on the following programs and initiatives that will greatly influence the Department's future staffing needs.

- State Transportation Improvement Program (STIP);
- The Department's Strategic Asset Management Focus and Organization;
- Highway Maintenance Improvement Program (HMIP);
- Transportation Asset Management Plan (TAMP);
- The Department's Comprehensive Cost and Staffing Analysis (including workflow and process assessment); and
- Needs Based Budgeting.

The Department's path forward takes into account these programs and initiatives. Through the course of the next several months there are legislative and self-imposed milestones that will inform the Department's efforts to optimize staffing. For instance, the Capital Program, better known as the STIP, will be released in Draft form for public comment for the next six months starting December 4, 2014. The STIP will provide project needs for the next 10 years.

Over the next year, the operation and maintenance program will meet three major legislative requirements that will result in further prioritization of our operations and maintenance needs and will help us mature as an Asset Management Organization.

- 1) On December 31, 2014, we are required to provide a "Report on the condition of the State highway system and maintenance funding needs" pursuant to G.S. 136-44.3. This will outlay the activity rates, staffing adjustments and begin to further define and analyze our direct and indirect costs. Prioritizing the activities and matching the appropriate staffing will be an outcome of this report.
- 2) On April 1, 2015, the Department will be submitting the first of the annual "Highway Maintenance Improvement Program" pursuant to G.S. 136-44.3A. The first HMIP will establish a 3-year pavement program. The Department plans to expand on this report in the future to include bridge and major maintenance activities.
- 3) As required by MAP-21, the Department will deliver a Transportation Asset Management Plan to the Federal Highway Administration by early 2016. This will include maintenance and operations needs for the next 20 plus years. The Department plans to define performance expectations and assess where our allocated budget should be applied through cross-asset optimization.

After the completion of these above items, the Department will have an enhanced view of the Department's staffing needs. This will deepen the Department's abilities to assess baseline in-house staffing needs and outsourcing opportunities.

## Preconstruction Units in Division of Highways

There are six units that comprise the Preconstruction area of the Division of Highways. These Units are: the Geotechnical Engineering Unit, the Hydraulics Unit, the Right of Way Unit, the Roadway Design Unit, the Project Development and Environmental Analysis Unit, and the Utilities Unit.

In accordance with S 744 and considering SL 2014-00, Outsourcing of Preconstruction Activity Legislation, each Unit within Preconstruction has reviewed their current organizational structure and has developed a future or “vision” organizational structure. Within Attachment s A-1 through F-2, each Unit’s current and future organizational charts are provided. Each Unit’s organizational chart also provides information regarding the major responsibilities/duties of each major area within the Unit. On the future organizational chart, changes from the existing organizational chart are highlighted in yellow. Also, changes that require new positions are shaded in green. Importantly, where new positions are noted on the future organizational charts, these will not be new Departmental positions. These positions will be obtained from other changes within the Preconstruction area. As further explanation, some of the organizational charts show the term “embedded” consultants or “embedded” private engineering firms. This term means that the Unit is using consultant(s) who are reporting directly to the Unit’s office for their work assignments rather than working directly from their consultant offices. This is why they are shown on the organizational charts.

## Field Divisions in Division of Highways

### Division High Level Data Analysis

NCDOT has 14 local division offices under the Division of Highways located geographically throughout the state. These 14 local division offices are responsible for construction, maintenance, roadside environmental programs, traffic services and the fiscal and facility operations involved in administering these functions. The division boundaries were established to primarily provide roughly equivalent transportation infrastructure responsibility. Given that, there are some distinct differences in population, geographical area, construction workload, and exposure level to emergency events. See **Attachment G** (State Map) and **Attachment H** of a proposed organization chart for a typical field division. This chart aligns division operations into asset maintenance under the Division Maintenance Engineer, project development/program delivery support under the Division Construction Operations Engineer, and policy/data under the Division Engineer. Any new positions shown would come from the division’s existing complement of available positions. The chart also reflects the four year plan to outsource Division Bituminous (Chip Seal) operations to an 80% level.

**Attachment I** provides a high level breakdown by division of area, population, critical infrastructure elements such as road mileage and bridges, construction projects value, maintenance budget, and snow & ice response costs. This information is shown in Table 1 and is sorted from highest to lowest values with a relative rank provided to each division. As such, more highly urbanized areas tend to have higher rankings than rural divisions. Statewide averages for each category are also provided as a basis of comparison.

Table 2 uses the same data as Table 1 but divides each division value by the position complement in that particular division. This provides, for example, the number of paved lane miles in the division per permanent employee as an additional means of making division comparisons. These values are also sorted from highest to lowest with a relative rank provided for each division. It should be noted that the permanent position complement only is used for these computations and rankings which means that temporaries, vacancies, and outsourced construction staff are not considered at this point.

The various rankings for each division are given a weighted average in both tables with the relative weighting for each category provided by consensus of the 14 division engineers. These two numbers can be compared to determine if there is a significant increase or decrease in a particular division's average ranking once staffing complement is taken into account. For a given division, an equivalent or higher average rank in Table 2 as compared its average rank in Table 1 may indicate more efficient use of available positions. For example, the ranking for Division 9 increases from 8.5 to 5.5 which represents the most dramatic positive change. On the other hand the ranking for three divisions dropped by what would seem to be a significant amount so they are highlighted for additional evaluation regarding overall staffing level.

### County Road Maintenance Data Analysis

Given that the current 14 transportation divisions were originally established to provide roughly equivalent responsibility for transportation infrastructure, the number of counties in each division ranges from a low of 5 in 4 divisions to a high of 14 in Division One. County size and population varies greatly as well with some counties having just over 4000 residents and others at or approaching 1 million residents. Since county road maintenance employees represent the single largest group in each division, it makes sense to perform a comparative analysis regarding work load and staffing levels similar to the division level analysis.

**Attachment J (1-4)** provides a high level breakdown by county of area, population, critical infrastructure elements such as road mileage and bridges, maintenance budget, and snow & ice response costs. This information is shown in Table 1 and is sorted from highest to lowest values with a relative rank provided to each county. As such, larger and more highly urbanized counties tend to have higher rankings than smaller and rural counties. Averages for each category are also provided as a basis of comparison.

Table 2 uses the same data as Table 1 but divides each county value by the position complement for that particular county. This provides, for example, the number of pavement lane miles in the county per permanent employee as an additional means of making county comparisons. These values are also sorted from highest to lowest with a relative rank provided for each county. It should be noted that the permanent position complement is used for these computations and rankings which means that numbers of temporaries or vacancies are not considered.

The various rankings for each county are given a weighted average in both tables with the relative weighting for each category provided by consensus of the 14 division engineers. These two numbers can be compared to determine if there is a significant increase or decrease in a particular county's average ranking once staffing complement is taken into account. For a given county, an equivalent or higher average rank in Table 2 as compared its average rank in Table 1 may indicate efficient use of

available positions. For example, three counties had a net increase of 16 in their ranking. On the other hand, 15 counties had their ranking drop by 10 or more so they are highlighted in the attachment. While not extremely complicated this type of analysis appears may be an initial indicator of counties that should be evaluated more closely regarding overall staffing levels.

### Division Bridge Maintenance Data Analysis

There are a total of 54 Bridge Maintenance facilities across the state with a range of 3 to 5 crews geographically dispersed within each of the 14 transportation divisions. There are approximately 10 employees on average in each office led by a supervisor with higher level engineering support and guidance provided by the Division Bridge Maintenance Engineer. The primary responsibility of these bridge crews is to maintain bridges within their respective areas within the division. In general all bridges require maintenance at a fairly consistent return period depending on the structure type and material. In addition to this primary responsibility these crews also replace and repair large culverts and pipes, provide initial evaluations of bridges damaged by traffic, and sometimes raise bridges to create additional vehicle clearance at older bridges built to past standards.

**Attachment K** provides a fairly high level breakdown by division of number of bridge offices, employee complement, number of bridges, culverts, and large pipes, average bridge age and traffic carried, bridge deck (surface) area, and an monetary estimate of bridge maintenance needs based on inspections, condition ratings, and recommended work suggested by the Department's bridge inspectors. This information is shown in Table 1 and is sorted from highest to lowest values with a relative rank provided for each division by category. Statewide averages for each category are also provided as a basis of comparison among the divisions.

Table 2 uses the same data as Table 1 but divides each division value by the "hands on" position complement for bridge maintenance in that particular division. This complement represents the combined total of the transportation workers, immediate supervisors, and the welder as those who are the boots on the ground caretakers of bridges. Table 2 provides, for example, the number of bridges and large culverts in the division per permanent "hands on" employee as an additional means of making comparisons among divisions. These values are also sorted from highest to lowest with a relative rank provided for each division in each category. It should be noted that the permanent position complement only is used for these computations and rankings which means that temporary employees and vacancies are not considered at this point.

The various rankings for each division are given a weighted average in both tables with the relative weighting for each category provided by consensus of the 14 division engineers. These two numbers can be compared to determine if there is a significant increase or decrease in a particular division's average ranking once staffing complement is taken into account. For a given division, an equivalent or higher average rank in Table 2 as compared to its average rank in Table 1 may indicate efficient use of available positions. For example, Division 9 had a 5+ point swing in its Table 2 weighted ranking. Four other divisions had relatively significant drops in ranking and are highlighted in the attachment for further evaluation of staffing levels.

## Equipment Shop Staffing Analysis

The Department maintains a vast fleet of pickup trucks and both on and off highway construction and maintenance equipment. Maintenance of this 21,000+ piece fleet is performed primarily by a complement of 557 equipment mechanics in the various equipment shops within each division.

**Attachment L (1-7)** represents an analysis of equipment repair and maintenance workload within each division down to the county shop level which provides a computed number of mechanics that represents either an appropriate balance of work for the available mechanics or an overstaffed/understaffed situation.

The analysis is based on methodology supported by the Association of Equipment Management Professionals and established government fleet best practices. It uses Vehicle Equivalency Units (VEUs) to more precisely take into account the size and composition of the fleet. Certain maintenance and repair unit requirements of a particular vehicle class can be indexed to the base vehicle class (passenger pickup for NCDOT). Through several computations, this process converts a mixed fleet size to its vehicle equivalent size which in turn can be used to estimate mechanic staffing requirements for the fleet operation.

The results of this analysis can be used by division management to either shift work or mechanics to different shops depending on the need. There are two divisions that are identified as being significantly overstaffed and appropriate rebalancing will be implemented over time through attrition. **Overall, this analysis indicates that the Department's mechanics are understaffed on a total positions basis (13 short) and certainly on a filled positions basis (59 short).** Still, our efficiency percentage is almost 62% which fits nicely in the 50% - 70% range considered acceptable by industry standards particularly given the size, diversity, and age of our fleet. Efficiency is the % of time spent directly on "wrench turning" activities on equipment which means that vacation, sick leave, holidays, and work on other extraneous activities such as fuel systems, or work on other agency vehicles is excluded.

## Traffic Services Data Analysis

Division Traffic Services is primarily a centralized work unit in each division with some sign erectors dispersed throughout the division for emergency response and more efficient operations. The average complement for this group is approximately 35 employees. This group is responsible for pavement markings, sign installation/repairs, setting up planned and emergency detours, and aiding with traffic control at times in response to significant wreck events affecting traffic on interstate and other primary routes. They are led by a supervisor who receives appropriate higher level engineering support from the Division Traffic Engineer and his staff. Information is also included for Electronic Signal Technicians who are primarily responsible for maintenance and installation of traffic signals in addition to work on some other electronic devices and assets.

**Attachment M** provides a relatively simple high level breakdown by division of division land area, population, pavement lane miles, and critical infrastructure items such as overhead signs and signals. The Department has just recently started to collect asset management data on ground mounted signs on highway shoulders but it is not yet complete and verified. As such, paved lane mileage is probably the best indicator of signing and pavement marking assets with some additional volume of signing in more highly urbanized areas. This attachment is not as detailed as the previously referenced attachments but, as before, the data in each category is sorted in highest to lowest order with a relative rank provided for each division. Statewide averages for each category are also computed to provide a basis of comparison among the divisions.

Two categories worth noting are the number of paved lane miles per each Traffic Services employee and the number of traffic signals per each Electronic Signal Technician. An overall weighted average of the various rankings is provided as a final basis of comparison. The relative weights of each category were provided by consensus of the division engineers. One observation that the number of traffic services employees in Division 3 is the highest of all the divisions, followed closely by Division 5, but a category by category comparison of the rankings for these two divisions seems to indicate that they may be a surplus of positions in Division 3. Additional evaluation will be necessary before a final determination is made.

### Roadside Environmental Data Analysis

The Division Roadside Environment Unit, originally named the Landscape Department, was established in the 1940's to address erosion control stabilization needs along state roads. Over the years, the Division Roadside Environmental Unit responsibilities have grown substantially and now encompass multiple asset management, environmental, and aesthetic program areas. Average position complement in the divisions is currently 24 employees with staffing both at a central location in the division and locally in some of the other division counties. This group is led by an engineer and is responsible for a number of specific activities including turf management, wildflower beds, landscape beds, seeding and mulching, rest areas, storm water management, and brush/tree control among other functions.

**Attachment N** provides a fairly detailed list of categories by division that are specific to this particular work group. Examples include Roadside positions in each division, turf acreage, rest areas, plant beds, storm water devices, brush/tree managed acreages, etc. These categories are shown specifically in Table 1 and have been sorted from high to low values with a relative rank provided for each division in each category. Statewide averages for each category are also provided as a basis of comparison among the divisions.



Table 2 uses the same data as Table 1 but divides each division value by the Roadside position complement in that particular division. Table 2 provides, for example, the maintained plant bed acreage per position as an additional means of making comparisons among divisions. These values are also sorted from highest to lowest with a relative rank provided for each division in each category. It should be noted that the permanent position complement only is used for these computations and rankings which means that temporary employees and vacancies are not considered.

The various rankings for each division are given a weighted average in both tables with the relative weighting for each category provided by consensus of the 14 division engineers. These two numbers can be compared to determine if there is a significant increase or decrease in a particular division's average ranking once staffing complement is taken into account. For a given division, an equivalent or higher average rank in Table 2 as compared to its average rank in Table 1 should indicate efficient use of available positions. However, it should be noted for this particular group that lower numbers of employees which yield better rankings in Table 2 could mean that the asset quantities shown in tables 1 and 2 are most likely not being maintained consistently across the state which would contribute to varying levels of service in the divisions. A number of factors may be contributing to this situation but the two primary reasons are available budget for these activities at any given time and a 24% loss in Roadside positions since 2002. Although several divisions are highlighted in the attachment for additional evaluation, it may be that others that are not highlighted may need to be considered as well regarding overall performance.

### Construction Project Staffing

The Department's construction program reached \$1.6 billion in 2013 and has already exceeded \$1.8 billion in newly let projects during 2014. Oversight of transportation projects is provided by a combination of in-house engineering/technical staff and consultant contract engineering and inspection (CEI) firms and specifically involves contract administration and engineering control. The Department began using CEI firms in earnest in the 90's to address insufficient in-house staff during peaks in construction work load. The use of these firms has grown substantially over time. One reason for that is the continuation of a relatively robust construction program and the other reason is related to attrition of in-house technical staff over time. Given that the Department has eliminated 305 division technician positions in the past six years, outsourcing to address subsequent personnel shortages has been critical to successful management of the Department's construction work load.

The Construction Unit forecasts upcoming work based on a 5 year plan and reviews available staffing in conjunction with the projected need for additional staffing. CEI firms can be used on a project specific basis or on an as-needed (on-call) basis. **Attachment O, Construction Data**, provides a current overview of Department and CEI firm technicians along with contract value of active projects, the value of the current 5 year projected work plan, and proposed funding levels for the statewide tier portion (40%) of the STI 10 year program. **It will be critical for the Department to reassess our work load projections once the full 10 year STI program is known in December to determine if in-house technician positions need to be redistributed across the state.** It will also be important to advise our CEI firm partners of the projected volume of work they can anticipate in the coming years. The Department's Chief Engineer has

a stated goal of outsourcing 50% of the engineering and inspection work to private firms. This business plan ensures a baseline complement of NCDOT technicians to manage construction workloads while also providing availability of well-trained experienced consultant inspectors for construction peaks. It should be noted that there is value in maintaining a significant complement of in house technicians for general stability of operations, favorable costs for engineering, inspection, and contract administration, and a ready pool of employees to provide administrative assistance during larger natural disasters.

### Division Bituminous (Road Oil) Crews

Over the past decade, North Carolina's chip sealing program was primarily implemented by state forces. Based on the defined outsourcing requirements (shown below) of Session Law 2014 - 100, Section 34.11(h), the Department will systematically reduce its use of personnel in placing chip seals as required.

#### Outsourcing Schedule

- 20% 2014-15
- 30% 2015-16
- 55% 2016-17
- 80% 2017-18

The Department plans to utilize 10 of the 14 Division Bituminous crews during the 2015 paving season. The Department recognizes that a new contract industry will need assistance in building their programs. Therefore, the Department plans to utilize leadership from experienced NCDOT Bituminous staff to assist in the development and inspection of contracts. All Divisions anticipate contracting a portion of their work this fiscal year with an approximate total of 45-50 contracts in FY 14-15.

**It is anticipated that over 100 positions will eventually be eliminated through attrition during this transition period.** Some of these employees will be shifted to technical oversight roles for outsourced pavement preservation activities and others will transfer to vacant Transportation Worker positions in other units to assist with maintenance duties such as road and bridge maintenance. These employees currently play vital roles in all divisions for snow and ice removal and response to other natural disasters.

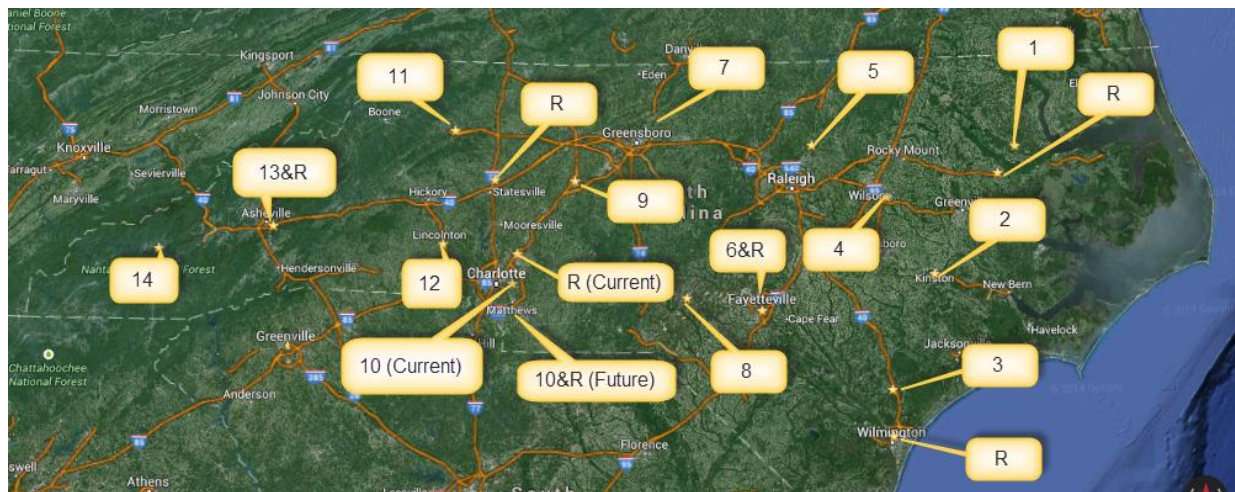
### Division Asphalt Quality Assurance (QA) Personnel

Currently, employees in Division Quality Assurance (QA) laboratories conduct testing and evaluations to determine and verify the quality of asphalt mix materials. These labs fall under the supervision of each of the 14 Division Construction Engineers. Each lab is staffed with 2-5 employees depending on workload. A core tenet of the Department's Materials and Tests Unit's (M&T) mission is to ensure quality materials are used in all NCDOT construction and maintenance projects. The asphalt testing conducted by the current Division QA Labs aligns perfectly with that mission. M&T currently supports these division labs by providing guidance, training, and expertise plus additional resources in equipment purchasing and maintenance without any direct authority over the labs.

The Department is giving serious consideration as an efficiency improvement to move the Division QA Labs under the M&T Unit with an interest in achieving the following goals:

- Immediate reduction of the overall number of employees and facilities
- Reduction of the quantity of test equipment (replacement, maintenance, and calibration costs).
- Regionalization of other testing and sampling (IA assessment samples, emulsions, etc.)
- Future potential to reduce employees, facilities, and equipment to a level of one M&T Lab per 2 divisions

The map below shows locations of each QA Lab and each Regional Lab.



**Long term reductions in personnel are anticipated to range from 15 – 17 positions which will occur by attrition over time.** Significant savings in facilities costs and reduction in expensive testing equipment are expected as well.

### Span of Control for Key Supervisors in the Field Divisions

Section 34.16.(a) of the staffing related legislation specifically indicates that the Department should look for “variations in the number of employees reporting to persons identified as supervisors.” There are a wide array of supervisors within the Department’s Division of Highways with a few being at a very high level such as the Division Engineer and a far greater number at a lower level. The Department’s lowest level transportation supervisor is considered a supervisor who is directly involved and engaged in the work at hand by physically operating equipment and directly guiding transportation workers in the work area. Information will be provided for a broad cross section of supervisors within the divisions.

**Attachment P** “Span of Control for Key Supervisory Staff” provides a list of 14 key supervisory classifications in the divisions including the division engineers and the positions that directly report to them. This attachment lists the numbers of employees supervised by these 14 supervisory

classifications by each division. The 14 supervisory classifications represent 417 positions while a total of almost 2500 positions are shown to be assigned to these supervisors. In addition, the ratio of supervised positions to supervisory position is computed for each classification on a statewide basis. In general the numbers are somewhat consistent with a few exceptions here and there. It is worth noting that the ratios for Division Engineers and Division Maintenance Engineers are the highest for these 14 classifications. A number of Division Engineers have indicated recently to the Department's Chief Engineer that Division Maintenance Engineers have been extremely consumed with supervisory responsibilities since being assigned the County Maintenance Engineers a few years ago. Consideration is being given to provide the appropriate level of support to allow them sufficient time to manage each division's infrastructure assets.

The lowest three levels of supervisors in the divisions are Transportation Supervisors at contributing, journey, and advanced levels. These supervisors are primarily located in the road maintenance, bridge, traffic services, and roadside environmental units. There are currently 950 positions within these three levels. One method to evaluate the span of control for these 3 supervisory levels is to take an overarching look at the total number of positions assigned at these three levels and compare it to the total number of transportation worker positions assigned to those positions. This approach will yield slightly lower supervisor to worker ratios because the highest of these three supervisor levels will not have the lower level supervisors included in their total of direct reports. However, this approach is relatively simple and is the quickest method to evaluate supervisory responsibilities at this level in the organization.

When the permanent transportation worker complement including temporary positions and inmate labor is divided by the total number of supervisors, a ratio of 4.7 to one is computed. However, the lowest level supervisor (contributing level) has always been a "boots on the ground" working supervisor who maintains a commercial driver's license, operates equipment, and has a much lower supervisory burden regarding performance management, human resources activities, etc. than the higher two levels of supervisor. In addition, the number of employees who work directly with this level supervisor varies greatly day to day based on the type of work activity so establishing a specifically assigned number of employees to them is not practical. Excluding the contributing level supervisors from the computation leads to a ratio of 11.3 to one.

### **Implementation Timeframe**

The proposed staffing changes shown in the body of this report and in the various attachments will begin immediately in most instances. The department proposes to have all changes scheduled for full implementation over a three year period, at worst, with many occurring well before that period of time. Additional analysis of staffing criteria for the divisions, counties, and other units within Division of Highways will continue and may lead to further staffing recommendations within the next year.