

Chapter 3 Plan Preparation

3.1 Introduction

The development of roadway plans is the primary responsibility of the roadway designer. The completed roadway plans consist of the following basic information: a title sheet showing the general type of work planned and the project location, typical sections for roadways to be constructed, the horizontal and vertical alignments, the proposed drainage pipes, ditches, structures, and the proposed right of way necessary for roadway construction. Also included are basic summaries such as earthwork, guardrail, and pavement removal. A complete set of roadway plans typically consist of, but are not limited to, the following:

- Title sheet
- Index of sheets, general notes, and list of roadway standard drawings
- Symbolology sheet
- Typical sections
- Detail sheets
- Summary of quantities and parcel index sheets
- Plan and profile sheets
- Cross section sheets

Complete and accurate final roadway plans are necessary to ensure highway construction projects are contracted in an economical and efficient manner. The roadway plans need to be detailed enough to provide prospective contractors with the information to accurately bid and construct the project. Omissions and errors in the plans may lead to project delays and cost overruns; therefore, it is critical the roadway designer submit complete and accurate plans at all phases of plan development.

This chapter provides detailed information pertaining to the preparation of the various items which comprise a completed set of roadway plans. Guidelines and examples are provided to aid the designer in the preparation of the roadway plans during all phases of project development. Consult the plan development checklists when preparing the roadway plans at the various stages of project development. Unless noted within each individual section, the information specified refers to plans developed during and after Stage 2 (Alignment Defined) of the Project Delivery Network (PDN). Complete the appropriate quality assurance (QA) or quality control (QC) checklist for the activity being performed.

Detailed information regarding content of the various sheets that comprise the roadway plan package is listed in the [NCDOT Review List for Final Construction Plans](#). Templates for NCDOT sheeting are found in the NCDOT workspace.

Refer to [NCDOT Example Roadway Plan Set \(Title Sheet through Profile Sheets\)](#).

3.2 Title Sheet

The title sheet is the first sheet of the assembled roadway plan package and serves to identify the location and limits of the project to aid in locating the project in the field. This sheet describes the project, lists the project identification numbers, and provides information related to

the project location, project length, and type of work. Some of the components that comprise a completed title sheet are covered in detail below.

The information that is typically listed on a title sheet include:

- Project identification numbers
- County name(s)
- Location and type of work
- Vicinity map
- Project layout
- Scale
- Design data information
- Project length
- Roadway and hydraulics engineer's seals
- NCDOT contact (if applicable)
- Standard specifications for roads and structures.
- Right of way date
- Letting date
- Firm logo (if applicable)

3.2.1 Project Identification Numbers

The project identification number is a unique number used to identify each individual project within the NCDOT. This project identification number will typically be a Transportation Improvement Program (TIP) number, but other project identification numbers can also be specified.

Work Breakdown Structure) (WBS) elements are used to identify funding for the project. For NCDOT personnel, the WBS elements will be provided by the NCDOT Project Manager and can be found by accessing the TIP Project Information (ZPSR25) on the North Carolina Enterprise Business Services portal (link is accessible only with a valid NCID account). NCDOT partners at private engineering firms will need to obtain the WBS elements from the NCDOT Project Manager. Typically, there will be three WBS elements referenced on a title sheet.

- PE (Preliminary Engineering)
- RW, UTIL. (Right of Way and Utility Relocation)
- CONST. (Construction)

In some cases, there may be individual or more than one RW and UTIL WBS elements for a project.

When the project involves federal funds, reference the Federal Aid Number on the title sheet.

For centrally let projects, a contract number (or contract ID) will be assigned by the Estimating Management Section in the Contract Standards and Development Unit when the project is added to the 13-Month Let List. On Division managed projects, the contract number will be assigned by the Division project development staff. Include a contract number and TIP number

on the left-hand margin of the title sheet. Reference the contract number on the cover sheet of the proposal during advertisement for use by the Construction Unit and contractor to identify the project during construction.

3.2.2 Location and Type of Work

The location of the project and type of work is used repeatedly on various engineering documents throughout the project development process. In the preparation of various project documents, the space available for writing this information is limited. Keep the descriptions for the location and type of work to an absolute minimum.

In describing the location, limit the information to the county or counties, route (Interstate, US, NC, or SR), and the begin and end points of the mainline (-L-) project. Ensure the location and type of work information on the title sheet correspond to the description and type of work listed on the [NCDOT 12 Month Let List](#).

Limit the information listed in the type of work to the major types of construction. The major types of work include but are not limited to the following: grading, paving, drainage, structure (if the project has a bridge and culvert (if applicable)), culvert (if the only structure on the project is a culvert) and widening (if the project involves the widening of the mainline). Signals, signing, and pavement markings are not typically considered major types of work unless the project is only adding signals, signing, or pavement markings without improving other major types of construction.

3.2.3 Vicinity Map

A vicinity map is required to show sufficient identifying information so the project may be easily located on a county or state map. The vicinity map is not to scale. Clearly show the major transportation routes (Interstate, US, NC, SR) that can be used for transporting construction materials to the project site. Show the begin and end points of the project on the vicinity map except for bridge replacement projects. On bridge replacement projects a circle can be used to represent the project limits in lieu of labeling the begin and end points. Include a vicinity map with the following information when applicable:

- City and city limits
- Interstate, US, NC, and state routes
- North arrow (oriented towards the top of the title sheet)
- Beginning and end of project
- Vicinity map title block
- Offsite detours

3.2.4 Project Layout

The project layout is a small-scale drawing of each plan sheet that is displayed on the center of the title sheet. The sheet number is shown on each superimposed plan sheet on the project layout. This provides a quick reference to a specific location in the plans. Include on the project layout all interchanges, intersection, service roads, structures (bridges and culverts), railroads, outstanding geographical features, and any other major landmarks that may be used as a reference point. The project layout will include the following information when applicable:

- Shade areas to show proposed limits of construction (-L- lines, -Y- lines, service roads, detours, etc.)
- Existing roads to be affected by construction, but not a part of the project
- Route numbers (Interstate, US, NC, SR), survey line numbers, and street names.
- Symbols for proposed bridges and culverts (culverts 20 feet and greater in width) with begin and end stations
- Streams and rivers
- Railroads
- City limits.
- State and county limits
- Begin and end stations for each project
- Begin and end construction stations outside of the project limits
 - Begin or end construction labels are not required for minor -Y- line constructions on title sheet; however, it should be referenced on applicable plan sheet
- Destination points/arrows at the begin and end of the project
- North arrow (showing correct state plane grid coordinates)
- Existing and proposed traffic signals (Title Sheet and Plan Sheet)
 - Existing traffic signals denoted with a hollow star
 - Proposed traffic signals denoted with a solid star

The begin and end project stations represent the limits of the project determined at the early stages of plan development. The begin and end construction limits are needed if any work is being performed outside of the begin or end project limits. Reference the begin and end project stations and begin and end construction stations on the title sheet and applicable plan sheets.

3.2.5 Scale

Display the scale of the plan and profile sheets on the title sheet.

Refer to RDM Part II Chapter 2 Section 2.1 for additional information pertaining to scale.

3.2.6 Design Data

The design data or design controls are the criteria used to optimize or improve the design. The design data is a list of specific design criteria used in the design of the project.

Show information related to design as follows:

- | | | | |
|-----|----------|---|--|
| (1) | ADT 2021 | = | 25,000 (LET year) |
| (2) | ADT 2041 | = | 60,000 (Design year = LET year + 20 years) |
| (3) | K | = | 12% |
| (4) | D | = | 60% |
| (5) | T | = | 11% (5% TTST and 6% DUAL) |
| (6) | V | = | 60 MPH |

Where:

(1)	Average daily traffic (ADT)	Given for the year that the project is let to construction.
(2)	Average daily traffic (ADT)	Given for the design year. The design year should be twenty years from the letting date.
(3)	K	Give as a percentage for design hourly factor.
(4)	Peak hour directional split (D)	Percentage of DHV traveling in the direction of major flow.
(5)	Percent of ADT that is trucks	Truck, tractor, and semi-trailer (TTST) are multi-unit trucks including both single and twin-trailer rig. Duals are trucks with at least one dual tired axle.
(6)	V	Design speed

Reference the functional classification of the mainline and the hydraulic tier with the design data. Obtain the functional classification through the [GO!NC Portal](#). Obtain the hydraulic tier from the hydraulics engineer. The NCDOT hydraulic tiers are as follows:

- Statewide Tier: All interstate and US routes on strategic highway corridors.
- Regional Tier: US and NC routes not on strategic highway corridors.
- Sub-regional Tier: SR routes and local roads. SR routes classified as arterials will be classified as regional tier.

3.2.7 Length of Project

The length of project is broken into roadway lengths and structure lengths of the mainline alignment. Compute separate lengths for the federal aid portion of any project. When a new box culvert or culvert extension is at least 20 feet wide, it is considered a structure when the length of the project is computed. Always show the length of project to three decimal places. When the fourth digit is five and above, round the third digit up. If equalities are present on the horizontal alignment, add the line ahead length to the line back length to determine the project length. This corresponds with the Structure Management Unit's method of computing structure lengths.

Examples of computing project lengths are shown below. When other conditions are experienced, discuss them with the [State Plans and Standards Engineer](#) in the Contract Standards and Development Unit.

3.2.7.1 Project (with structures)

- Length of Roadway TIP Project R-99A = 4.205 Miles
- Length of Structure TIP Project R-99A = 0.038 Mile
- Total Length TIP Project R-99A = 4.243 Miles

3.2.7.2 Project (without structures)

- Length of Roadway TIP Project R-99A = 4.205 Miles
- Total Length of TIP Project R-99A = 4.205 Miles

3.2.7.3 Combined Project (with structures)

- Length of Roadway TIP Project R-99A/R-99B = 7.708 Miles
- Length of Structure TIP Project R-99A/R-99B = 0.094 Mile
- Total Length TIP Project R-99A/R-99B = 7.802 Miles

3.2.7.4 Combined Project (without structures)

- Length of Roadway TIP Project R-99A/R-99B = 7.708 Miles
- Total Length TIP Project R-99A/R-99B = 7.708 Miles

3.2.7.5 Combined Federal-Aid and State Project (I-303 & U-83)

- Length of Roadway TIP Project I-303 = 3.210 Miles
- Length of Structure TIP Project I-303 = 0.044 Mile
- Total Length TIP Project I-303 = 3.254 Miles
- Length of Roadway TIP Project U-83 = 0.723 Miles
- Length of Structure TIP Project U-83 = 0.022 Mile
- Total Length TIP Project U-83 = 0.745 Mile
- Total Length TIP Project I-303/U-83 = 3.999 Miles

3.2.8 Roadway and Hydraulics Engineer's Seal

The roadway designer is responsible for obtaining the Roadway Design Engineer's seal and the Hydraulics Engineer's seal for the title sheet. Construction revisions may require additional professional engineering seals if the original roadway or hydraulics engineer are not available to perform the revisions.

3.2.9 Firm Logo and Contact Information

Reference the logo of the engineering firm and the names of the NCDOT and firm contacts on the title sheet.

3.2.10 Title Sheet Notes

Add the following notes to the title sheet of the Right of Way Plan Set or Contract Roadway Design Plans, as needed.

- Method of Clearing Note (Remove from Contract Roadway Design Plans)
- Municipal Boundaries Note (Remove from Contract Roadway Design Plans)
- Control of Access Note
- Design Exception Note
- PDN submittal name based on the deliverable at the stage of project development (Stage 1 (Project Initiation), Stage 2 (Alignment Defined), etc.)

3.2.10.1 Method of Clearing Note

Show the method of clearing note on the Right of Way Plan Set (3RD1 of the PDN) but remove from the Contract Roadway Design Plans (4RD1 of the PDN). The preferred method of clearing will be provided by the Division Construction Engineer at the Field Inspection. The location of the project is the driving factor for determining the appropriate method of clearing. Factors such as urban vs. rural, environmental conditions, and permitting play a role in determining which method of clearing will be specified.

Refer to [NCDOT Roadway Standard Drawings](#) Std. Nos. 200.02 and 200.03 for additional guidance on the methods of clearing.

The standard method of clearing notes are as follows:

“Clearing on this project shall be performed to the limits established by Method II.”

or

“Clearing on this project shall be performed to the limits established by Method III.”

It is possible that both methods of clearing can be specified on an individual project or combined project. In that case, modify the notes to specify which alignments will require the specific method of clearing. There are also instances where a hybrid approach (i.e., Type II modified) will be specified. In that case, modify the note accordingly and obtain a detail sheet of the modified method of clearing from the [State Plans and Standards Engineer](#).

3.2.10.2 Municipal Boundaries Note

Show one of the following notes on the Right of Way Plan Set when the project or a portion of the project is within the limits of a local government. Remove the municipal boundary notes from the Contract Roadway Design Plans (4RD1 of the PDN).

“This project is within the municipal boundaries of Town or City.”

or

“A portion of this project is within the municipal boundaries of Town or City.”

3.2.10.3 Control of Access Note

Add a note to the plans for projects that have control of access right of way. The applicable control of access note listed in the bullets below is required on the title sheet of the contract roadway design plans. There are three general types of control of access that may need to be referenced in the note.

- **Full Control of Access:** Connections to a facility provided only via ramps at interchanges. No private driveway connections allowed. For full control of access right of way, use the following note:

“This is a controlled access project with access being limited to interchanges.”

- **Limited Control of Access:** Connections to a facility provided only via ramps at interchanges (major crossings) and at-grade intersections (minor crossings and services roads). No private driveway connections allowed. For limited control of access right of way use the following note:

“This is a limited controlled access project with access being limited to interchanges and at-grade intersections.”

- **Partial Control of Access:** Connections to a facility provided via ramps at interchanges, at-grade intersections, and private driveways. Private driveway connections are normally

defined as a maximum of one connection per parcel. One connection is defined as one ingress and one egress point. The use of shared or consolidated connections is highly encouraged. For partial control of access right of way use the following note:

“This is a partial controlled access project with access being limited to points shown on the plans.”

Refer to RDM Part II Chapter 4 Section 4.2 for control of access definitions and additional guidance pertaining to control of access and right of way.

3.3 Index of Sheets, General Notes, and List of Roadway Standard Drawings

Reference the index of sheets, general notes, and list of roadway standard drawings on plan sheet 1A which is placed directly behind the title sheet. Include the roadway designer’s seal on sheet 1A.

3.3.1 Index of Sheets

The index of sheets acts as the table of contents of the construction plan package which includes the roadway and structure plans. The order of the plan sheets has been standardized to make it easier to locate individual plan sheets in the construction plans. The index of sheets should be placed on the left side of the 1A sheet. The final plan sheet arrangement for the index of sheets is listed in Table 3-1. Other discipline plan sets that may be unique to the project can be added to the list as needed.

Table 3-1 Final Plan Sheet Arrangement Index of Sheets

Sheet Number	Sheet Description
1	Title Sheet
1A	Index of Sheets, General Notes and List of Standard Drawings
1B	Conventional Symbols
2A-Series	Pavement Schedule and Typical Sections
2B-Series	Roadway Details (produced by roadway personnel)
2C-Series	Details not covered by roadway (special details produced by the State Plans and Standards Engineer)
2D-Series	Drainage Details
2G-Series	Geotechnical Details
2H-Series	Geoenvironmental Details
2N-Series	Noise Wall Envelopes
3B-Series	Roadway Summaries (earthwork, guardrail, etc.)
3D-Series	Drainage Summaries
3G-Series	Geotechnical Summaries
3P-Series	Parcel Index Sheets

Sheet Number	Sheet Description
4	The first plan sheet will always be number 4; all other plan and profile sheets shall be numbered to fit the project conditions.
RW-Series	Survey Control, existing centerlines, right of way, easement, and property ties
TMP-Series	Transportation Management Plans
PMP-Series	Pavement Marking Plans
E-Series	Electrical Plans
EC-Series	Erosion Control Plans
RF-Series	Reforestation Plans
NS-Series	Natural Stream Restoration Plans
LS-Series	Landscape Plans
SIGN-Series	Signing Plans
SIG-Series	Signal Plans
ITS-Series	ITS Plans
UC-Series	Utility Construction Plans
UO-Series	Utility by Others Plans
X-1	Cross Section Index (when there are more than two alignments)
X-1A, X-1B, etc.)	Cross Section Summary (number as X-1 if there is no Cross Section Index)
X-2, X-3, etc.	Cross Sections
W-Series	Wall Plans ³ (if placed in roadway plan set)
S-Series	Structure Plans
C-Series	Culvert Plans
W-Series	Wall Plans ³ (if placed in structure plan set)

Notes:

1. Do not show total sheet numbers on the plans.
2. For series sheets, example of sheet numbering is 2A-1, 2A-2, 2A-3, etc.
3. Wall plans are typically a part of the structure plan package, but if there are no structure plans (bridge or culvert), the retaining wall plans will be included as part of the roadway plan set.

3.3.2 General Notes

General notes are referenced on Sheet 1A and provide clarification to the plans. The general notes provide additional information that the roadway designer feels are necessary to correctly understand the intent of the design. The general notes apply to the contents of the roadway plans as a whole, as opposed to applying to individual plan sheets.

Refer to the [NCDOT Contract Standards and Development Unit website](#) to download a Microsoft Excel file containing the standard roadway general notes.

It is the responsibility of the roadway designer to denote the general notes pertinent to the project and include additional notes which do not appear in the standardized list of general notes when deemed appropriate. Many of the general notes reference standard drawings or are fill in the blank. Take care to ensure the correct information is referenced in the general notes.

Show only general notes relative to the project. Any questions pertaining to the general notes should be directed to the [State Plans and Standards Engineer](#) in the Contracts Standards and Development Unit.

3.3.3 List of Roadway Standard Drawings

Reference a list of roadway standard drawings that are applicable to the project on Sheet 1A. The standard drawings are intended to support the engineering processes for construction operations and ensure the application of uniform standards in design and construction. It is important that the roadway designer be familiar with the NCDOT Roadway Standard Drawings before selecting a standard drawing for inclusion in the list. The NCDOT Roadway Standard Drawings are updated periodically, and some standard drawings may be replaced by details in lieu of standards. When needed, insert the details in lieu of standards in the plan set as a 2C-Series detail sheet. When a detail in lieu of standards is added, the detail may replace the applicable roadway standard drawing in the list or apply to specific sheets in the standard drawing. If the detail in lieu of standard replaces all the sheets in the applicable roadway standard drawing, do not reference the standard drawing in the plans. Any questions pertaining to the List of Roadway Standard Drawings and details in lieu of standards should be directed to the [State Plans and Standards Engineer](#) in the Contracts Standards and Development Unit.

Refer to the most current [NCDOT Roadway Standard Drawings](#) website for additional information pertaining to the standard drawings and details in lieu of standards.

3.4 Conventional Symbols

On a set of roadway plans, the objects are depicted by symbols, not by names. The symbols are used to mark necessary objects and features on the plans. Conventional symbols include, but are not limited to, the following:

- Boundaries and property lines
- Buildings
- Drainage features
- Railroads
- Right of way
- Roads and related features
- Existing and proposed structures
- Utilities

Include the conventional plan sheet symbols in the roadway plans as sheet 1B. A standard conventional plan sheet symbols cell has been created to standardize the conventional symbols used when preparing NCDOT plans.

Add a legend to the applicable plan sheet for any new symbols that are not included in the standard conventional symbols.

3.5 Typical Sections and Pavement Schedule

3.5.1 Typical Sections

A typical section is a cross sectional representation of the proposed roadway showing grading and paving details. Include all elements necessary to construct the roadbed, typical ditches, and pavement structure in the typical sections.

Draw typical sections for each different pavement design and for major variations in the component widths. Use partial typical sections or insets with notes for minor variations to minimize the number of typical sections required. Make a conscious effort to minimize the number of typical sections. The use of a single typical section to represent multiple alignments is encouraged. Use tables to denote the variations in dimension widths and pavement codes.

Refer to the [Example Typical Section Sheets](#) provided by NCDOT.

- Typical sections or partial typical sections are not needed for auxiliary lanes or tapers. When typical sections cover a length of roadway that is typically of uniform width, do not put variable dimensions to cover turning lanes, tapers, etc. The plans will cover these variations
- Show a normal crown (0.02) as typical unless the project warrants a 0.025 pavement cross slope
- Typical sections are not needed to cover superelevation unless there are no normal crown conditions on the segment of the roadway for which the typical section applies.
- If all ramps have the same pavement design, use a single typical section to cover all ramps by labeling “reverse” on the individual ramp listing
- Ensure the stations shown on the typical sections agree with the stations shown on the title sheet and plan sheets
- Show monolithic islands, concrete barrier (single or double faced), and retaining walls when they comprise a significant portion of the typical section. Insets or partial typical sections may also be used to cover these features
- Narrow widening is any widening less than 6 feet in width. Note that narrow widening is also applicable to paved shoulders. When the pavement design references a narrow widening pavement design for any alignment, clearly denote on the typical sections all areas that will require the narrow widening pavement design. An inset may be used to denote and clarify the areas of narrow widening
- Typical sections should be organized or grouped on the typical section sheets in sequential order as they appear on the plan sheets
- Typical sections for bridges shall also be provided on plans up to the Field Inspection Plan Set.
- Typical sections should differentiate between sidewalk and sidepaths or shared-use paths. Sidepaths and shared-use paths may require a pavement design that differs from standard 4-inch-thick sidewalk.

3.5.1.1 Limits of Use

Include on each typical section, a listing of the locations where it applies. Designate these locations by a survey line and station limits. Break station to station limits at the begin and end of the bridge (not the approach slabs). Also break stations for equalities, when applicable.

3.5.1.2 Dimensions

Show dimensions for all typical section elements. Show horizontal dimensions in feet, tenths of a foot, or inches, typically to the nearest foot. Limit dimensions to those required to clearly explain the intent of the typical section.

Refer to RDM Part II Chapter 2 Section 2.1 for more detail on displaying information and data.

3.5.2 Pavement Schedule

For centrally managed projects, request and receive the Pavement Design from the [State Pavement Design Engineer](#) at the PDN Stage 2 (Alignment Defined). Incorporate the Pavement Design into the full and partial pavement schedules on the typical section sheets.

Refer to the [NCDOT Project Delivery Network](#) for when to request and incorporate the pavement designs. The Division Project Manager has the option to request a pavement design from the State Pavement Design Engineer or develop their own pavement design. The engineer who developed the pavement design will seal the typical sections.

Show a full pavement schedule on the first typical section sheet and include a code and a description for all elements of the various pavement designs applicable to the project. Show an abbreviated pavement schedule on the remaining typical section sheets for ease of reference. Use the code letters shown in Table 3-2 in pavement schedule.

Table 3-2 Code Letters for Pavement Schedule

Code Letter	Item
A	Portland cement concrete pavement
B	Open-graded asphalt friction course, Type FC
C	Asphalt concrete surface course, Type S
D	Asphalt concrete intermediate course, Type I
E	Asphalt concrete base course, Type B
F	Asphalt surface treatment
G	Cement treated base course
J	Aggregate base course
K	Stabilized subgrade
L	Stabilized Subgrade
M	Soil type base course
N	Geotextile
P	Prime coat

Code Letter	Item
R	Combination concrete curb and gutter Concrete curb 5" Monolithic concrete island Concrete island cover
S	Concrete sidewalk
S1	Sidepath or Shared-use path
T	Earth material
U	Existing pavement
V	Milling, incidental milling, or as needed
W	Variable depth asphalt pavement (See Standard Wedge Detail)
X	Permeable Asphalt Drainage Course, Type P
Y	Rumble Strips

Standardized typical section cells can be found in the roadway design cell library. Ensure the pavement design shown on the typical section and pavement schedules correspond to the approved Pavement Design. Delete or modify descriptions as needed based on the design of the project.

When developing a pavement schedule refer to the following examples of how the information is to be displayed in the pavement schedule.

3.5.2.1 Concrete Pavement and Friction Course

- A1 ___" Portland Cement Concrete Pavement
- A2 ___" Continuously Reinforced Concrete Pavement
- B Prop. Open-Graded Asphalt Friction Course, Type FC___, at an average rate of ___ lbs. per sq. yd.

3.5.2.2 Surface Course

- C1 Prop. Approx. " Asphalt Concrete Surface Course, Type S ___, at an average rate of ___ lbs. per sq. yard.
- C2 Prop. Approx. " Asphalt Concrete Surface Course, Type S ___, at an average rate of ___ lbs. per sq. yard in each of two layers.
- C3 Prop. Var. Depth Asphalt Concrete Surface Course, Type S ___, at an average rate of ___ lbs. per sq. yard per 1" depth to be placed in layers not to exceed ___" in depth.

3.5.2.3 Intermediate Course

- D1 Prop. Approx. " Asphalt Concrete Intermediate Course, Type I19.0___, at an average rate of ___ lbs. per sq. yard.
- D2 Prop. Approx. " Asphalt Concrete Intermediate Course, Type I19.0___, at an average rate of ___ lbs. per sq. yard in each of two layers.

D3 Prop. Var. Depth Asphalt Concrete Intermediate Course, Type I19.0__, at an average rate of 114 lbs. per sq. yard per 1" depth to be placed in layers not less than 2 1/2" or greater than 4" in depth.

3.5.2.4 Base Course

E1 Prop. Approx. __" Asphalt Concrete Base Course, Type B__, at an average rate of __ lbs. per sq. yard.

E2 Prop. Approx. __" Asphalt Concrete Base Course, Type B__, at an average rate of __ lbs. per sq. yard in each of two layers.

E3 Prop. Var. Depth Asphalt Concrete Base Course, Type B__, at an average rate of 114 lbs. per sq. yd. per 1" depth, to be placed in layers not greater than __" in depth or less than __" in depth.

F1 Asphalt Surface Treatment, Mat and Seal.

F2 Asphalt Surface Treatment, __

G Prop. Approx. __" Cement Treated Base Course (Plant Mixed), or
Prop. __" ABC with the top 7" to be Cement Treated (Road Mixed).

J1 Prop. __" Aggregate Base Course

J2 Prop. __" Aggregate Base Course

J3 Prop. Var. Depth Aggregate Base Course

K1 Prop. __" Chemical Stabilization (Soil-Cement Base/Lime-Treated Soil). Base treated with Cement at a Rate of 55 lbs. per sq. yard or Soil treated with Lime at a rate of 20 lbs. per sq. yard.

K2 Prop. __" Class IV Subgrade Stabilization

L Base to be stabilized with 200 to 400 lbs. per sq. yard of Stabilizer Aggregate mixed with the top 3" of subgrade soil at locations directed by the Engineer.

M1 Prop. __" Soil Type Base Course, Type A

M2 Prop. __" Soil Type Base Course, Type __

3.5.2.5 Others

N1 Geotextile for Pavement Stabilization

N2 Geotextile for Soil Stabilization

P1 Prime Coat at the rate of .35 gal. per sq. yard.

P2 Prime Coat at the rate of .50 gal. per sq. yard.

R3 8" x 6" Concrete Curb

R4 __" x __" Concrete Curb

R5 5" Monolithic Concrete Island (surface mounted)

R6 5" Monolithic Concrete Island (keyed in)

R7 3" Concrete Island Cover

R8 __" Concrete Island Cover

S	4" Concrete Sidewalk
S1	___' Sidepath or ___" Sidepath (See Special Provision) ___' Shared-use path or ___" Shared-use path (See Special Provision)
T	Earth Material
U	Existing Pavement
V	Milling
W	Variable Depth Asphalt Pavement (See Standard Wedging Detail Sheet No.)
X	Permeable Asphalt Drainage Course – Type P- ___
Y	Rumble Strips

Table 3-3 lists the minimum and maximum pavement thickness to ensure proper compaction and maintain pavement integrity.

Refer to the NCDOT Material and Tests Unit's [NCDOT Asphalt Quality Management System Manual](#) for detailed guidance.

Table 3-3 Minimum and Maximum Pavement Thickness

Mix Type	English (Inches)		
	<i>Minimum lift</i>	<i>Maximum lift</i>	<i>Normal total layer</i>
SA-1	0.5	1.0	2.0
S4.75	0.5	1.0	2.0
S9.5B	1.0	1.5	3.0
S9.5C, D	1.5	2.0	3.0
I19.0C	2.5	4.0	4.0
B25.0C	3.0*	5.5	-

Note: For B25.0C placed on unstabilized subgrade, minimum lift thickness is 4.0.

Table 3-4 lists the percent asphalt binder, asphalt binder grade, and the rate of application for each asphalt mix type. Use the percentage of asphalt binder and the rate of application in calculating the asphalt binder quantities. Use the asphalt binder grade to determine whether the asphalt binder for plant mix or polymer modified asphalt binder for plant mix pay items will be specified in the engineers estimate.

Table 3-4 Properties of Asphalt Mix Types

Mix Type	% Asphalt Binder	Asphalt Binder Grade	Rate (lbs./SY/in)
Friction			
OGAFC, Type FC-1 Modified	6.1	PG 76-22	70-90 lbs./SY
Surface			
SA-1	6.8	PG 64-22	100

Mix Type	% Asphalt Binder	Asphalt Binder Grade	Rate (lbs./SY/in)
S4.75A	7.0	PG 64-22	100
S9.5B	6.7	PG 64-22	110
S9.5C	6.0	PG 64-22	112
S9.5D	5.7	PG 76-22	112
Intermediate			
I19.0C	4.8	PG 64-22	114
Base			
B25.0C	4.5	PG 64-22	114
PADC, Type P-57	2.5	PG 64-22	90
PADC, Type P-78M	3.0	PG 64-22	90

Note: Group like pavement mixtures together in the pavement schedule.

3.5.3 Typical Details and Notes

The roadway designer is responsible for incorporating details into the typical sections to clarify the design for construction. The following details are commonly included with the typical sections:

- Wedging detail(s)
- Asphalt wearing surface on cored slab and box beam bridges
- Concrete barrier detail(s)
- Incidental milling detail
- Shoulder drain detail (obtained from Pavement Design)

The roadway designer may also decide whether to incorporate any note in the typical sections to clarify the design for construction. Make notes clear and concise.

Standard cells have been created for many of these typical details.

3.6 Detail Sheets

Provide details in the roadway plans for any construction details not included in the [NCDOT Roadway Standard Drawings](#). The roadway designer is responsible for preparing and/or acquiring all detail sheets to be incorporated into the roadway plans. Include the following typical types of details in the construction plans as needed:

- Roadway detail sheets (2B-Series)
- Special detail sheets (2C-Series)
- Drainage detail sheets (2D-Series)
- Geotechnical details (2G-Series)
- Geoenvironmental details (2H-Series)

- Noise wall envelopes (2N-Series)
- Miscellaneous details

Coordinate with the [State Plans and Standards Engineer](#) before special construction details are drawn for a project. The Plans and Standard Engineer has special drawings which can be adapted to fit most projects.

3.6.1 Roadway Detail Sheets (2B-Series)

All 2B-Series detail sheets are the responsibility of the roadway designer. Any roadway details the roadway designer feels would be helpful in clarifying the design and aiding in construction can be added as a 2B-Series detail. Where applicable, the 2B-Series details typically include but are not limited to the following:

- Intersection and monolithic island details
- Interchange details
- Temporary detour (if not a part of the roadway plan sheets)
- Cross section layout
- False cuts

3.6.1.1 Intersection and Monolithic Island Detail

If the plans are cluttered, the designer may choose to include a detail sheet for the intersections. Intersection details typically show such things as the radii, island configurations, layout of intersection, and dimensioning on a larger scale than shown on the plan sheets. It is the intent of the intersection details to provide specific guidance on how to construct the intersection in a level of detail not achievable on the plan view.

3.6.1.2 Interchange Detail

Include interchange detail sheets to help reduce clutter.

3.6.1.3 Temporary Detour

A separate detail sheet may be warranted for temporary detours to reduce plan sheet clutter. The 2B-Series detour detail sheet is intended to supplement the roadway plans.

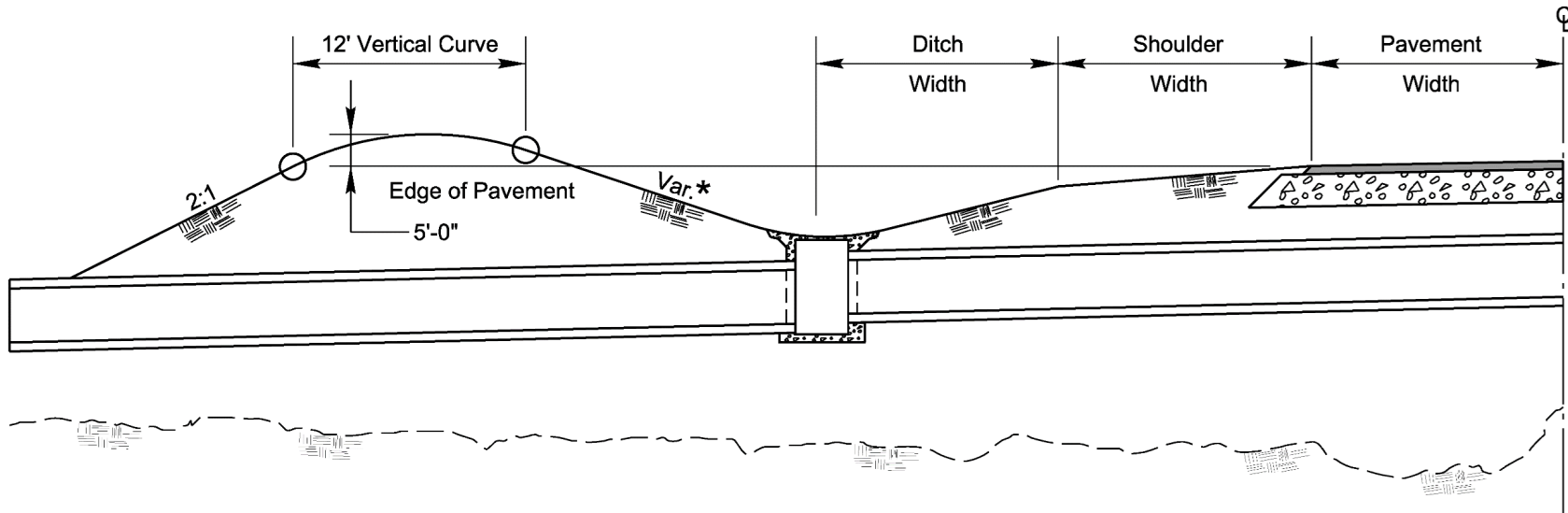
3.6.1.4 Cross Section Layout

Include cross section layout details, also referred to as shear point diagrams, in all final plans that have interchange designs more complex than a standard diamond. Include this detail in the 2B-Series sheets and show lines indicating where individual cross sections have been cut and where they intersect. Clearly label intersecting shear points in the detail and properly reference the corresponding cross section template.

3.6.1.5 False Cuts

False cuts are designed to eliminate or reduce hazards and may sometimes be used for noise abatement. Utilization of a false cut must be based on a project-by-project basis with strong considerations given to economics, aesthetics, safety, and engineering judgement. See Figures 3-1 and 3-2 for examples of false cuts.

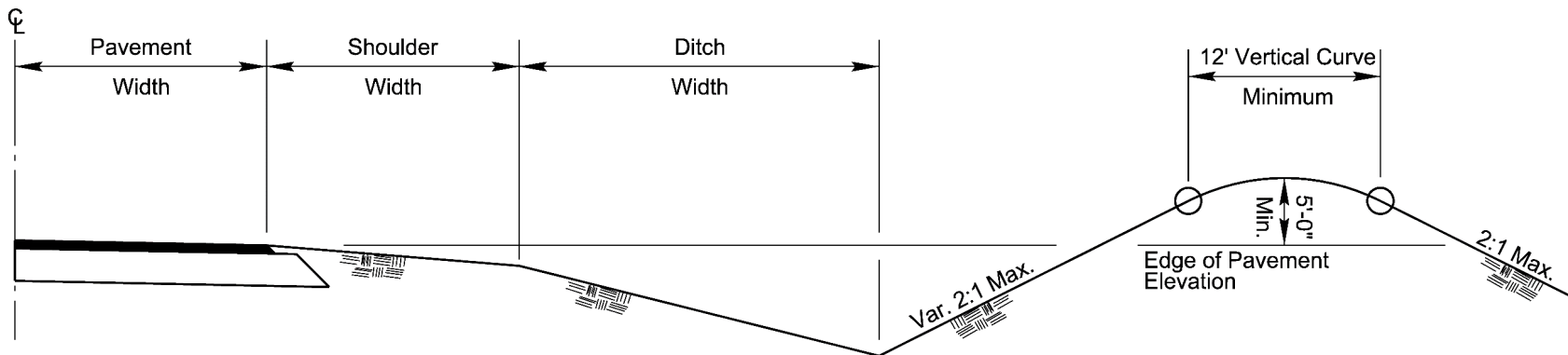
Figure 3-1 False Cut in Draw Between Cut Slopes



Notes:

1. For use in locations where it can be constructed without its costs exceeding approximately two times the cost of providing guardrail.
2. (*) Blend slope to match adjacent cut slope. No flatter than 3:1

Figure 3-2 False Cut to be Used on Waste Projects Where Fill Height Exceeds 30"



3.6.2 Special Detail Sheets not covered by Roadway (2C-Series)

Incorporate special details prepared by the State Plan and Standards Engineer into the plans as 2C-Series plan sheets. Special details are needed when a standard drawing needs to be modified or if a roadway detail needed for construction is not included in the [NCDOT Roadway Standard Drawings](#). The roadway designer is responsible for identifying whether a special detail is needed. Coordinate with the State Plans and Standards Engineer to obtain the necessary construction detail. To request a special detail, submit an email to the [State Plans and Standard Engineer](#) providing the following information:

- TIP number
- County
- WBS number
- Letting date
- Project turn in date to Contract Standards and Development
- Project Manager
- Description of detail(s)
- Attached plans or drawings, if needed, to clarify the needed detail

3.6.2.1 Details in Lieu of Standards

The NCDOT Roadway Standard Drawings are updated approximately every six years. During this timeframe, some standard drawings are revised to reflect changes in design practices. Refer to the details in lieu of standards referenced in the latest [NCDOT Roadway Standard Drawings](#) on the Contract Resources website. Insert any applicable detail in lieu of standards into the Contract Roadway Design Plans.

3.6.2.2 Special Details

Incorporate special details into a project as needed. These include, but are not limited to:

- Alternate curb ramp designs
- 25-foot clear span guardrail detail
- Double faced guardrail detail
- Updated guardrail and guiderail standard drawings
- Bridge approach fill details
- Modified method of clearing (when applicable)

Consult the [State Plans and Standards Engineer](#) or Plan Review Engineer before placing special details in the roadway plans.

3.6.3 Drainage Details (2D-Series)

Special drainage and ditch details may be included in the roadway plans as 2D-Series plan sheets rather than including these details on the roadway plan sheets. The drainage detail sheets are intended to consolidate all the drainage details in one location if needed to reduce

plan sheet clutter. The hydraulics engineer is responsible for preparing, sealing, and submitting the drainage detail sheets for inclusion in the roadway plans.

3.6.4 Geotechnical Details (2G-Series)

Special geotechnical detail sheets may be included in the roadway plans as 2G-Series plan sheets. [NCDOT Geotechnical Support Services](#) is responsible for preparing and submitting the geotechnical details. The geotechnical engineer will place the completed details on the preconstruction project team site on Connect NCDOT in the LET Preparation/Final Plans folder. Examples of geotechnical standard details include, but are not limited to:

- Retaining wall details
- Standard horizontal drain
- Standard temporary shoring
- Standard temporary wall
- Standard reinforced soil slope

3.6.5 Geoenvironmental Details (2H-Series)

Special geoenvironmental detail sheets may be included in the roadway plans as 2H-Series plan sheets when applicable. The geotechnical engineer will place the completed details on the preconstruction project team site on Connect NCDOT in the LET Preparation/Final Plans folder. The [GeoEnvironmental Engineering Supervisor](#) is responsible for preparing, sealing, and submitting the geoenvironmental details. The geoenvironmental details typically involve the handling of contaminated materials from sites of concern which include, but are not limited to, active and abandoned underground storage tank sites, hazardous waste sites, dry cleaners, maintenance facilities, regulated landfills, and unregulated dumpsites.

3.6.6 Noise Wall Envelopes (2N-Series)

The Traffic Noise and Air Quality specialist or consultant is responsible for developing the Design Noise Report. The Design Noise Report evaluates the selected alternative, considers mitigation for all impacted receptors, and creates the noise wall envelopes for any noise wall that is found to be feasible and reasonable. The Traffic Noise and Air Quality group is responsible for providing the noise wall envelopes to the roadway designer and coordinating with the Structures Management Unit to develop the noise wall plans. When barriers for noise abatement (also known as noise walls) are included in a project, place a noise wall envelope in the roadway plans as 2N-Series plan sheets. Coordinate with the [NCDOT Traffic Noise and Air Quality Group Leader](#) if there are questions pertaining to noise walls on the project.

Refer to RDM Part I Chapter 5 Section 5.4 for additional guidance.

3.7 Summary Sheets

The summary of quantity sheets document specific pay item quantities by location. Ensure the pay items shown in the summaries agree with the description, quantity, and unit listed on the [NCDOT Master Pay Item List](#).

Place the summary of quantity sheets in the roadway plans as 3-Series sheets. The most common summaries generated by the designer include, but are not limited to, earthwork summaries, guardrail/guiderail summaries, pavement removal/break-up summaries, shoulder

drain summaries, fence summaries, drainage summaries, geotechnical summaries, and parcel index sheets.

3.7.1 Miscellaneous Roadway Summaries (3B-Series)

Show a separate summary for the items listed below when the associated pay items are applicable to the project:

- Earthwork Summary
- Guardrail and Temporary Guardrail Summaries
- Guiderail Summary
- Fence Summary (Typically for Urban Projects)
- Pavement Removal Summary
- Breaking of Existing Pavement Summary
- Shoulder Drains Summary

3.7.1.1 Earthwork Summary

The purpose of the earthwork summary is to provide the contractor with an overview of the location, type, and quantity of the proposed roadway excavation on the project and is derived from the information shown on the earthwork balance sheet. Providing the contractor with accurate earthwork information is extremely important, since earthwork pay items are a significant portion of the overall project cost.

Refer to RDM Part II Chapter 5 Section 5.4.1.1 for additional guidance on preparing the NCDOT Earthwork Balance Sheet.

Show the earthwork summary in the roadway plans as a 3B-Series plan sheet. Only the station to station, total unclassified, undercut excavation, embankment (+%), borrow, and total waste columns should be shown on the earthwork summary. Do not show the shrinkage factor in the embankment +% column on the earthwork summary.

Include the following note on all earthwork summary sheets:

“Note: Earthwork quantities are calculated by the roadway designer. These earthwork quantities are based in part on subsurface data provided by the Geotechnical Engineering Unit.”

When the lump sum grading pay item is included in the final construction estimate, include the following note on the earthwork summary sheet (3B-Series plan sheet). Remove any pay items that are not applicable to the project.

“Note: Approximate quantities only. Unclassified excavation, borrow excavation, shoulder borrow, fine grading, clearing and grubbing, breaking of existing pavement, and removal of existing pavement will be paid for at the contract lump sum price for grading.”

Earthwork summaries can be very complex. Factors such as select borrow, hard rock, degradable rock, rock swell, earth shrinkage, suitable unclassified excavation, and unsuitable unclassified excavation have an impact on earthwork quantities.

Refer to RDM Part II Chapter 5 Section 5.4 for detailed guidance on the development of the earthwork summary and associated pay items.

Refer to the [Example Earthwork Summary](#) provided by NCDOT.

3.7.1.2 Guardrail and Guiderail Summaries

The purpose of the guardrail and guiderail summaries is to provide the contractor with the location of all proposed guardrail and guiderail shown in the plans. It also provides more detailed information regarding the location and layout of the proposed guardrail/guiderail than can be derived from the plan sheets. Some of this information includes the location and type of guardrail, warrant points, the distance from the edge of lane to face of guardrail, the distance from edge of travel lane to shoulder break point, the flare length, and the total width of flare from the begin of the taper to the end of the guardrail.

The guardrail summary also provides information related to any guardrail removal, temporary guardrail, and type and number of impact attenuators required on the project. Do not combine temporary guardrail with the permanent guardrail in the summaries. Permanent and temporary guardrail have unique pay items which require them to be listed separately on the guardrail summary sheet. If the project has multiple traffic control phases, investigate whether relapping guardrail (Section 869 of the Standard Specifications) is needed.

To properly estimate the guardrail, pay items and provide the necessary information for the contractor to install the guardrail properly, it is critical to fill out the guardrail summary accurately and completely.

Refer to RDM Part I Chapter 6 for additional guidance on guardrail design.

A brief explanation of critical information is provided below.

- Warrant point: Typically represents a fill warrant or rigid obstacle warrant (bridge rail, interior bent, fixed hazards, etc.)
- “N” distance from edge of lane: Distance from the edge of lane to the face of guardrail
- Total shoulder width: Distance from the edge of travel lane to the shoulder break point. The total shoulder width should correspond to the widths shown on the typical section and cross section
- Flare length: Distance from the last section of parallel guardrail to the end of the guardrail
- W: Total width of the flare from the begin of the taper to the end of the guardrail

Refer to the [Example Guardrail Summary](#) provided by NCDOT.

Cable guiderail is typically installed on median divided highways with median widths of 46 feet and greater with 6:1 or flatter slopes. The guiderail summary will show station, location, length, and the number of cable guiderail anchors.

Refer to the [Example Cable Guiderail Summary](#) provided by NCDOT.

List all guardrail and guiderail related pay items in their respective summary.

3.7.1.3 Fence Summary

A fence summary is only required for chain link fence in urban areas, but the roadway designer has the option to include a summary for woven wire fence. Include chain link and woven wire fence summaries when both chain link and woven wire fence are included in the plans. At the engineer’s discretion, a fence summary may be added to help clarify the location and type of

fencing to be installed on the project. Refer to Example [Chain Link Fence and Woven Wire Fence Summaries](#) provided by NCDOT.

Refer to RDM Part II Chapter 4 Section 4.6 for additional guidance on control of access fencing.

3.7.1.4 Pavement Removal/Breaking of Existing Pavement Summaries

The purpose of the pavement removal/breakup summary is to provide the contractor with the locations and quantities for the removal of existing asphalt and concrete pavements and the breaking of existing asphalt and concrete pavements. Please note that there are separate pay items for “Removal of Existing Asphalt Pavement,” “Removal of Existing Concrete Pavement”, “Breaking of Existing Asphalt Pavement”, and “Breaking of Existing Concrete Pavement”. It may be difficult to determine the location and quantity of pavement removal/breakup from the plan view since pavement removal is only crosshatched on the plan view outside the slope stake lines. Include all quantities of pavement removal and breaking of existing pavement within the project limits in the summaries. Use cross sections to help determine the limits of pavement removal and breakup. The [NCDOT Standard Specifications for Roads and Structures](#) states that existing pavement should be broken up rather than removed when the existing pavement is located under the proposed embankment and the depth of the proposed embankment is greater than 1-foot exclusive of the base and pavement. Simply stated, the depth from the proposed subgrade to the top of the existing pavement should be greater than one foot for the pavement to be broken up and left in place.

3.7.1.5 Shoulder Drains Summary

Shoulder drains are typically installed on projects with high type Portland Cement concrete pavement designs. The information necessary to complete the shoulder drain summary will be provided by the State Pavement Design Engineer in the Materials and Tests Unit. The State Pavement Design Engineer will provide shoulder drain recommendations in the Pavement Design. The roadway designer is responsible for creating a shoulder drain summary based on these recommendations. A shoulder drain detail will also be placed with the typical sections. Refer to the [Example Shoulder Drain Drains Summary](#) provided by NCDOT.

3.7.2 Drainage Summaries (3D-Series)

Drainage items are summarized on standard drainage summary sheets, which outline detailed drainage information. The classification, size, and quantity of pipe by location are referenced on the drainage summary sheets. The hydraulics engineer is responsible for preparing and submitting the drainage summaries to the roadway designer for inclusion in the roadway plans as 3D-Series plan sheets.

The hydraulics engineer is responsible for the permanent numbering of things such as drainage structures, pipe system outlets, pipe collars, elbows, cross pipes, and side drainpipes, on the plans. Do not renumber the drainage structures on the plans.

There are two different drainage summary sheets, one for statewide tier facilities and one for regional/subregional tier facilities. The regional/subregional tier drainage summary sheets will have columns for drainage pipe and side drainpipe. The use of the drainage pipe pay items is limited to pipes located on regional and subregional tier facilities. Statewide tier facilities will have a statewide tier drainage summary sheet and will not use the drainage pipe pay items but will specify only the side drainpipe pay items. Separate drainage summaries are required for pipes greater than 54 inches in diameter and for pipes 48 inches and under.

For cross drain pipes under high type pavement and special situations, the hydraulics engineer will provide pipe classifications. High type pavement is defined as any Portland Cement concrete pavement or asphalt concrete pavement that is 2 inches or greater in thickness.

The hydraulics engineer may also submit a stormwater control measure summary table with the drainage summary. The summary will list stormwater control measures (bioretention basins, bioswales, hazardous spill basins, level spreaders, preformed scour holes, etc.) from the drainage design. The purpose of the stormwater control measure summary table is to provide a list of measures that will need to be inspected both during and after construction.

The following drainage summary content is intended to reside on the Hydraulics Unit website in the near future. This content will remain in the Roadway Design Manual until the Hydraulics Unit website is updated.

3.7.2.1 Masonry Drainage Structures

The height of the drainage structures is measured vertically to the nearest tenth of a foot from the top of the bottom slab to the top of the wall. Special design junction boxes or manholes will be required if the depth of fill does not fall within the range specified in the [NCDOT Roadway Standard Drawings](#). See Figure 3-3 for an example of computing quantities of masonry drainage structures.

Drainage Structures 5 Feet and Under in Height

A drainage structure which incorporates an opening for circular pipe not exceeding 48 inches in diameter is measured and paid for on a per each basis up to a height of 5 feet at the contract price per each for Masonry Drainage Structures.

Drainage Structures Over 5 Feet and Up to 10 Feet in Height

The portion of a drainage structure from 5.1 feet up to and including 10 feet is figured and paid for at the contract unit price per linear foot for Masonry Drainage Structures.

Drainage Structures Over 10 Feet in Height

The portion of the drainage structure above 10 feet is measured and paid for at 1.3 times the contract unit price per linear foot for Masonry Drainage Structures.

Drainage Structures for Circular Pipe Over 48 Inches in Diameter or Pipe Arch of Any Size

Any masonry drainage structure which incorporates an opening for circular pipe exceeding 48 inches in diameter, or for pipe arch of any size, is measured and paid for on a volume basis. The quantity of masonry to be paid for is the number of cubic yards of cast-in-place concrete, brick, or precast masonry which has been incorporated into the structure. These quantities are provided in the [NCDOT Roadway Standard Drawings](#).

Median Drop Inlets (2GI)

Median drop inlets are typically used in roadway ditches and along shoulder and expressway gutters. The grates used are separate pay items and depend on the type of facility.

- Narrow Slot Grates ([NCDOT Roadway Standard Drawings](#), Std. Nos. 840.24 and 840.29):
 - Use on non-controlled access projects and projects with heavy pedestrian traffic.

- Use on controlled access projects at locations where pedestrian traffic is anticipated.
- Wide Slot Grates ([NCDOT Roadway Standard Drawings](#), Std. Nos. 840.20 and 840.22):
 - Use on controlled access projects where pedestrian traffic is not anticipated.

Traffic Bearing Drop Inlets

Use traffic bearing drop inlets within 4 feet of travel lanes since there is potential for vehicular traffic over them. If the inlets are located entirely within a concrete traffic island, they do not need to be traffic bearing.

Refer to [NCDOT Roadway Standard Drawings](#), Std. Nos. 840.35 or 840.36.

Use steel frame and flat steel grates ([NCDOT Roadway Standard Drawings](#), Std. No. 840.37) with traffic bearing drop inlet ([NCDOT Roadway Standard Drawings](#), Std. No. 840.36) on controlled access projects where traffic bearing drop inlets are needed, and pedestrian traffic is not anticipated. The NCDOT Traffic Safety Unit or the hydraulics engineer may specify other locations where steel frame and grates must be used due to other special considerations such as in a travel lane. Bicycle safe frame and grates are required when pedestrian and bicycles need to be accommodated. Obtain the necessary special detail from the [State Plans and Standards Engineer](#).

Standard Catch Basins

Refer to [NCDOT Roadway Standard Drawings](#), Std. Nos. 840.01 or 840.02.

- Use type “E”, “F”, or “G” grates ([NCDOT Roadway Standard Drawings](#), Std. No. 840.03) on standard catch basins unless specified otherwise by the Hydraulics Unit and discussed on field inspection with Division personnel.
- Standard catch basins are suitable for use adjacent to travel lanes when placed in 2-foot 6-inch curb and gutter.

Example for Computing Quantity of Masonry Drainage Structure

For further information on drainage structure depths please refer to the [NCDOT Drainage Box Depths](#) document. See Figure 3-3 for an example of calculating the “per each” and “per linear foot” pay items for masonry drainage structures.

Figure 3-3 Example for Computing Quantity of Masonry Drainage Structure

* TOTAL LIN. FT. FOR PAY QUANTITY SHALL BE COL. "A" + (1.3 X COL. B)

HEIGHT OF STRUCTURES	QUANTITIES FOR DRAINAGE STRUCTURES		
	PER EACH (0' THRU 5.0')	*LIN. FT.	
		A	B
		5.1' THRU 10.0'	10.1' AND ABOVE
4.5'	1	-	-
8.0'	1	3	-
15.2'	1	5	5.2
9.0'	1	4	-
18.0'	1	5	8
TOTAL	5	17	13.2
*GRAND TOTAL	5**	35***	

* 17 + (1.3 X 13.2) = 34.2 LIN.FT.
SAY 35 LIN.FT.

PAY ITEMS:
 MASONRY DRAINAGE STRUCTURE 5 EACH **
 MASONRY DRAINAGE STRUCTURE 35 LIN. FT. ***

Allowed Construction Types

Optional types of construction are allowed for catch basins, drop inlets, junction boxes, and manholes. See Table 3-5 for allowed construction types.

Table 3-5 Permitted Construction Type

PERMITTED CONSTRUCTION TYPE				
	BRICK	CONCRETE	PRECAST	SOLID BLOCK
Brick Catch Basin Std. 840.01	✓			✓
Conc. Catch Basin Std. 840.02		✓	✓	
Conc. Open Throat Catch Basin Std. 840.04		✓	✓	
Brick Open Throat Catch Basin Std. 840.05	✓			✓
Conc. Bridge Approach Drop Inlet Std. 840.13		✓		
Conc. Drop Inlet Std. 840.14		✓	✓	
Brick Drop Inlet Std. 840.15	✓			✓
Conc. Grated D.I., Type A Std. 840.17		✓	✓	
Brick Grated D.I., Type A Std. 840.26	✓			✓
Conc. Grated D.I., Type B Std. 840.18		✓	✓	
Brick Grated D.I., Type B Std. 840.27	✓			✓
Conc. Grated D.I., Type D Std. 840.19		✓	✓	
Brick Grated D.I., Type D Std. 840.28	✓			✓
Driveway Drop Inlet Std. 840.3		✓		
*Conc. Junction Box Std. 840.31		✓	✓	
*Brick Junction Box Std. 840.32	✓			✓
Traffic Bearing Junction Box Std. 840.34	✓		✓	✓
Traffic Bearing Grated Drop Inlet Std. 840.35	✓	✓	✓	✓
Traffic Bearing Grated Drop Inlet Std. 840.36		✓		
Spring Box Std. 840.41	✓	✓	✓	✓
Manhole Std. 840.51, 840.52, or 840.53	✓		✓	✓

3.7.2.2 Drainage Pipes

Different pipe materials can be used depending on the road classification (interstate, primary, secondary), and specific site conditions such as abrasion, environmental factors, soil resistivity, pH, high ground water, and special loading conditions.

Refer to the Hydraulic Unit's [NCDOT Pipe Material Selection Guide](#) document for further information.

Where specific site conditions such as low cover over pipe or other topographical constraints exist, the hydraulics engineer may specify pipe shapes not listed in the NCDOT Pipe Material Selection Guide. These include corrugated steel or corrugated aluminum pipe arches, structural plate steel pipes, and elliptical and arched concrete pipes.

3.7.2.3 Other quantities

The hydraulics engineer quantifies and specifies the class of rip rap used for drainage. Note that the hydraulics engineer labels rip rap for drainage, geotextile for drainage, and drainage ditch excavation quantities for channels and pipes on the plan sheets. The roadway designer is responsible for quantifying and adding these pay items to the final estimate.

Refer to the [NCDOT Standard Specifications for Roads and Structures](#) and the [NCDOT Roadway Standard Drawings](#) for further information on other drainage pay item quantities such as elbows, endwalls, pipe removal, junction boxes, manholes, sluice gates, preformed scour holes, energy dissipators, and riser pipes.

3.7.3 Geotechnical Summaries (3G-Series)

The geotechnical engineer is responsible for completing the geotechnical summary tables and placing a Microsoft Excel spreadsheet of the summary with the geotechnical project files. If there is more than one geotechnical product pavement design investigation, subsurface investigation, subsurface investigation addendum, etc.), there may be more than one geotechnical summary table (Excel file) provided. Confirm all geotechnical summary tables are included in the roadway plans. The Excel file(s) can be found on the projects preconstruction team site in the geotechnical disciplines folder. Consolidate all geotechnical tables onto a single geotechnical summary sheet. The roadway designer is responsible for creating the geotechnical summary (3G-Series sheet) based on the completed tables found in the Excel file(s) provided by the Geotechnical Engineering Unit. The roadway designer may need to remove any unused (blank) summary tables and reformat the tables in the sheet for inclusion in the roadway plans. Common geotechnical summary tables include:

- Subsurface drainage (subsurface drains, underdrains and/or blind drains)
- Rock plating
- Reinforced soil slopes
- Bridge waiting periods
- Embankment waiting periods
- Geotextile for pavement stabilization
- Settlement gauges
- Horizontal drains
- Surcharge and surcharge waiting periods

- Aggregate subgrade/stabilization

3.7.4 Parcel Index Sheet (3P-Series)

A parcel index sheet references the parcel numbers, property owner names, and plan sheet numbers where the parcels are located. Parcel index sheets are required on all projects with two or more plan sheets. Refer to the [Example Parcel Index Sheet](#) provided by NCDOT.

3.8 Plan and Profile Sheets

The design information shown on the plan and profile sheets should provide the contractor and Resident Engineer with all the basic information needed to construct the project. Plan and profile sheets generally convey the following information: horizontal and vertical alignments, existing and proposed roadways, proposed slope stake lines, proposed drainage pipes, ditches, structures, existing topographic information, and proposed right of way necessary for the roadway construction.

Plan and profile sheets are normally shown on separate sheets but may be shown on the same sheet when conditions allow. It is important that the horizontal and vertical alignments tie to the final survey alignments. Standard plan and profile sheet cells have been created to automate and standardize the preparation of the roadway plans.

3.8.1 Plan Sheets

Plan sheets show existing features and proposed design elements as shown from an aerial view (or plan view). The purpose of the plan sheet is to show the horizontal alignments and use text and symbols to describe the work to be performed. Note that the level of detail provided varies depending on the stage of project development with more detail being provided in the final construction plans.

Refer to the applicable QA/QC checklists and the [NCDOT Review List for Final Construction Plans](#) for additional information.

The following basic information is typically included on a plan sheet:

- TIP number
- Sheet number
- Roadway and hydraulics engineer seals
- Begin and end project stations
- Begin and end construction stations
- Existing pavement width and type
- Proposed construction elements
- Horizontal alignment and horizontal curve data
- Centerline stationing and tangent bearings
- Superelevation
- Intersecting roads and driveways
- Proposed drainage

- Location features (north arrow, right of way lines, easements, county lines, municipal boundaries, etc.)
- Final survey

3.8.2 Profile Sheets

A profile illustrates the grade of the existing and/or proposed roadway alignment. The following basic information is typically included on a profile sheet:

- Begin and end stations
- Vertical alignment and vertical curve data
- Elevation and station references
- Scale
- Existing groundline along the horizontal alignment
- Hydraulic data for bridges, culverts, and cross pipe (information to be provided by the Hydraulics Unit)

Denote any structural excavation as a “Str. Pay Item” on the profile sheet and do not include when calculating the unclassified excavation.

3.9 Cross Sections

The cross section sheets depict the existing ground cross sections and the proposed templates of the roadway to be constructed. Individual cross sections are typically cut at 50-foot intervals. The primary purpose of the cross section sheets is to aid the designer in estimating the earthwork quantities, but they are also used by the contractor and the resident engineer as a reference during the construction of the project. Follow the cross section listing in the [NCDOT Review List for Final Construction Plans](#) when preparing the cross sections to ensure that all required information is shown on the plans.

Include a cross section index as a cover sheet to the cross sections when there are more than two alignments that require cross sections.

In addition to the cross section templates and cross section index, create a cross section summary sheet. Place the cross section summary after the cross section index sheet or as a cover sheet to the cross section templates if there is no index sheet. The cross section summary displays the earthwork volumes broken down for each cross section interval. Refer to the Excel file entitled “Earthwork XSC Volume Summary” found on the NCDOT Roadway Design Technical Resources Website at [NCDOT Roadway Design - CADD](#). Earthwork volumes (unclassified excavation, undercut, and embankment) by station range are shown on the cross section summary sheet. Do not apply the shrinkage factor to the embankment volumes.

Add the following notes to the cross sections, as needed.

3.9.1 Cross Section Note for Lump Sum Grading

When the lump sum grading pay item is included in the final construction estimate, add the following note on the cross section summary sheet or first cross section template plan sheet and with the Earthwork Summary (3B-Series plan sheet). Both notes should be identical.

“Note: Approximate quantities only. unclassified excavation, borrow excavation, shoulder borrow, fine grading, clearing and grubbing, breaking of existing pavement, and removal of existing pavement will be paid for at the contract lump sum price for Grading.”

Revise the note to remove pay items that are not applicable to the project. If the cost of any one of the items listed on the lump sum grading note (excluding clearing and grubbing and fine grading) exceeds 50 percent of the total cost of the lump sum grading, remove that item from the note and include it as an individual pay item in the contract.

Refer to RDM Part II Chapter 5 Section 5.4.4 and the NCDOT Grading Lump Sum Calculation of Quantities Sheet.

3.9.2 Cross Section Note for Projects that do not Specify Lump Sum Grading

When the lump sum grading pay item is not included in the final construction estimate, add the following note on the cross section summary sheet or first cross section template plan sheet and with the Earthwork Summary (3B-Series plan sheet)

“Note: Quantities are approximate only. The Resident Engineer will re-cross section the work accurately when the project is staked out. These cross section notes will be used in computing the final quantities for which the contractor will be paid.”

3.9.3 Backfill for Undercut Note

Include a backfill for undercut note on the cross section summary sheet. At the discretion of the roadway designer, the embankment column may include the material needed to backfill any undercut specified by station range. This note is needed to clarify whether the embankment column includes or does not include backfill for undercut. Show one of the following notes.

“Note: Embankment column does not include backfill for undercut.”

Or

“Note: Embankment column includes backfill for undercut.”

The note Embankment column does not include backfill for undercut is more commonly used and ensures that the earthwork quantities needed to backfill any undercut areas are clearly represented on the earthwork balance sheet. Adjust embankment quantities on the cross section summary when the embankment column includes backfill for undercut. Common errors in the cross sections encountered during plan review include:

- Not labeling the cut and fill slopes on the cross section templates
- Not comparing the total earthwork volumes shown on the cross section summary to the volumes shown on the earthwork balance sheet and earthwork summary
- Not listing the undercut volumes by station range on the cross sections summary when specified in the geotechnical recommendations
- Not labeling undercut and/or shallow undercut when specified by station range in the geotechnical recommendations
- Showing subsurface information (existing rock lines or unsuitable unclassified excavation) on the cross sections
- Not referencing the correct backfill for undercut note on the cross section summary sheet(s)

- Not listing the appropriate grading note on the cross section summary sheet or cross section sheet
- Not showing the existing grade elevation

3.10 Roadway Supporting Documentation

Store all project documentation on the individual projects SharePoint team site. It is critical that the key RDY property be used to identify all documents that should be permanently preserved. The information found in the key supporting documents are essential for preparing a complete set of roadway construction plans.

Refer to RDM Part II Chapter 2 Section 2.4 for additional guidance on Preconstruction Best Practices when accessing the project team sites on Connect NCDOT.

Typical roadway key documents that should have the key RDY value set include, but are not limited to, the following:

- All approvals and denials
- Construction cost estimate
- Information related to any pending legal actions
- Correspondence providing historical or background information on controversial matters
- Justification studies for special or unusual matters
- Design exception approval
- Design decisions
- Location and design approval (LADA)
- Any other item that, in the judgment of the project manager or roadway designer, should be retained

Typical roadway supporting documents that should be placed in the Roadway Supporting Documents Document Set include, but are not limited to, the following:

- Calculation of quantity package
- Cost based estimate quantity breakdown sheet
- Earthwork Balance Sheet (PDF)
- Index of Sheets (8" x 11" PDF)
- List of Roadway Standard Drawings and General Notes (EXCEL)
- Checklist for Coordination of Roadway and Structure Plans
- Completed Review List for Final Construction Plans

The roadway designer is responsible for placing the earthwork balance sheet and other supporting documents in the LET Preparation/Final Plans/Roadway Supporting Documentation folder on the project's Preconstruction Team site.

Typical key documents and supporting documentation from other disciplines that the roadway designer may need to reference include, but are not limited to, the following:

- Field Inspection correspondence (may be placed in the team collaboration library)

- Pavement design
- Memoranda on demolition and removal (Section 200 Letter from the Right of Way Unit)
- Geotechnical reports
 - Geotechnical Recommendations for Design and Construction
 - Geotechnical Recommendations for Pavement and Subgrade
 - Roadway Subsurface Inventory
 - Pavement and Subgrade Investigation Report
- Foundation recommendations
- Bridge and culvert survey reports
- Traffic reports and forecasts
- Municipal agreements and betterments
- Planning document
- Agency coordination
- Right of Way letter sent to Right of Way Unit (Letter of Authorization if federally funded)
- 200 Series right of way memo
- Consultations
- Natural Resource Technical Report (NRTR)

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