



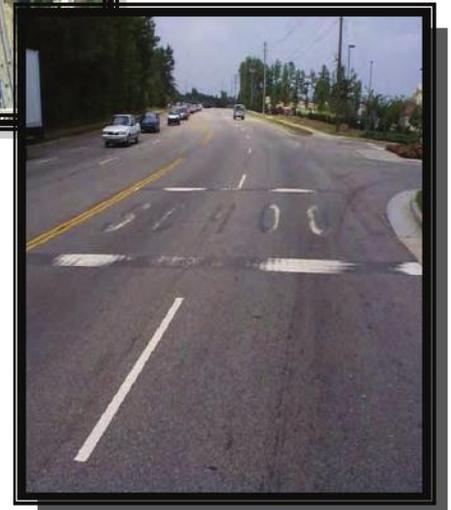
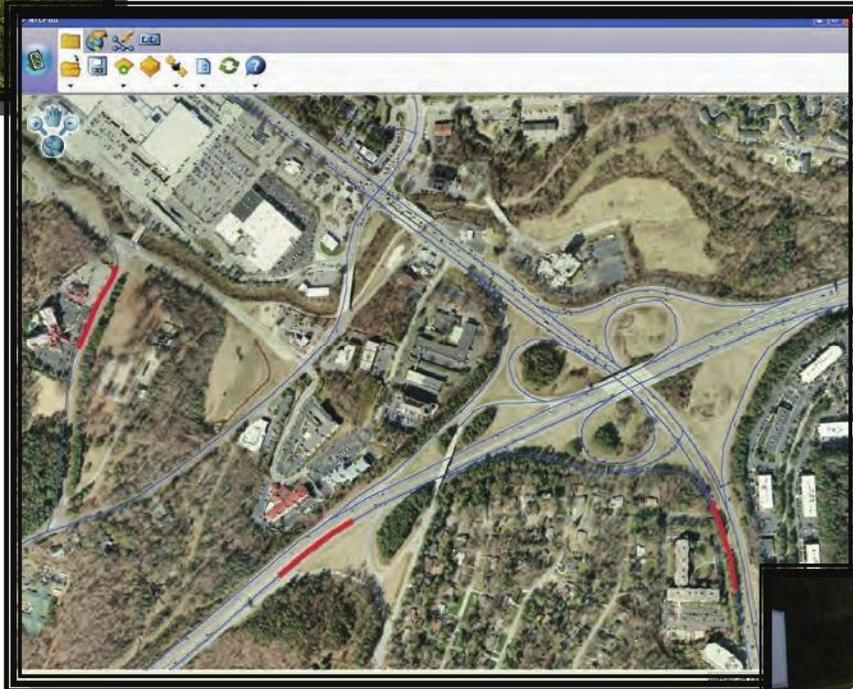
NCDOT

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Connecting people and places in North Carolina — safely and efficiently, with accountability and environmental sensitivity.

Maintenance Condition Assessment Program

Manual



srmu

State Road Maintenance Unit

Table of Contents

Preface	3
Introduction.....	4
Conducting the Assessment/Survey.....	5
Equipment Needed	5
Reporting Assessment Data	11
Random Segment Assessment Form in ArcPad	12
Element Features and Conditions	13
Shoulders and Ditches.....	15
Unpaved Shoulders (Low & High)	15
Lateral Ditches	17
Drainage.....	21
Crossline Pipes Blocked.....	21
Crossline Pipes Damaged.....	23
Gutters Blocked.....	25
Inlets (Drop Inlets, Catch Basins, Shoulder Drains, Funnel Drains, etc.).....	28
Roadside.....	32
Brush and Tree Control	32
Turf Condition	34
Traffic	36
Pavement Markings / Striping	36
Words and Symbols	38
Pavement Markers.....	40



Preface

Welcome to the Team!! Thanks to you, the North Carolina Department of Transportation continues to improve and enhance its maintenance management system.

The collection of data on the condition of state-maintained highways will provide an indication of the level of maintenance we are now providing. This information will enable us to address funding level needs and develop a strategy for prioritizing maintenance operations.

This manual presents the procedures of the maintenance condition survey. Instructions on the collection and reporting of survey data are provided, as well as detailed descriptions, examples, and illustrations of the features to be measured. In addition, a summary of these feature definitions is provided in the appendix.

It is imperative that the surveys be conducted in a timely manner, and that the data is uploaded as soon as practical. If you have any trouble or questions, contact:

Lonnie Watkins, P.E.
Maintenance Systems Engineer

Phone: (919) 733-3725
Fax: (919) 733-1838
Email: lwatkins@ncdot.gov

Matthew Whitley, P.E.
Maintenance Management Engineer

Phone: (919) 835-8446
Fax: (919) 733-1838
Email: mpwhitley@ncdot.gov

Joshua Vaughan
Assessments Engineer

Phone: (919) 835-8448
Fax: (919) 733-1838
Email: jlvaughan2@ncdot.gov



Introduction

Quality assurance in highway maintenance has been the subject of study and discourse for several years. It may best be described as the planned and systematic actions needed to provide adequate confidence that highway facilities meet specified requirements. Such requirements are usually defined by the highway agency but are intended to reflect the needs and expectations of the user.

First largely considered in the 1960s as part of the maintenance management system concept, the issue of quality assurance in highway maintenance has since remained an active topic due mainly to increased workloads, greater maintenance demands, limited maintenance funds, and public perceptions of maintenance departments. The need for better quality maintenance has increased significantly within the last few years in recognition of the change in focus from new highway construction to maintenance and rehabilitation of existing roadways.

Building off of the successes of current quality management programs and the National Cooperative Highway Research Program (NCHRP) project 14-12, Highway Maintenance Quality Assurance, a program is being developed to implement quality management practices for North Carolina Department of Transportation.

The program will accomplish the following objectives:

1. Determine the expectations of the traveling public.
2. Be able to assure the public that NCDOT is meeting those goals.
3. Develop the funding level needed to achieve a desired service level.
4. Develop a "priority strategy" to direct maintenance operations.
5. Achieve a uniform service level throughout the state by identifying excessively high or low areas of maintenance.
6. Identify areas requiring additional employee skills or equipment to accomplish assigned tasks.

Using various interactive components to fulfill these objectives will enable the NCDOT to shift from a "fixing" reactive mode to a "prevention" proactive mode, thereby incurring the benefits associated with repairs that do not have to be repeated. Eventually, this may lead the way to greater levels of customer satisfaction at unit costs below those currently experienced by the agency.

The purpose of this manual is to provide a method for collecting roadway maintenance information in order to determine the overall condition of highways in the state. With this data, a maintenance needs report can be generated addressing required funding levels, a strategy for prioritizing maintenance operations, and areas of excessively high or low maintenance. This maintenance condition survey is the first, and perhaps the most important, step of a maintenance management system for NCDOT. A quality management system must be based upon good data, and therefore it is imperative that the information collected is uniform and consistent.



Conducting the Assessment/Survey

The maintenance condition assessment program has been developed to assist the NCDOT to plan, schedule, budget, and report highway maintenance activities and needs. The agency has performance standards that describe how individual maintenance tasks are to be performed, the resources required to carry out the task, and the expected rate of production. The information from this maintenance condition survey will be used to evaluate the effectiveness of maintenance performance and identify opportunities for improvement. To maintain credibility of the program, the data must be collected accurately and completely.

Rating teams will be composed of two persons, and will be responsible for conducting the survey and reporting the findings. Each team will be assigned several segments for survey. The element features will be reviewed and assessed according to the criteria in the next chapter. To assure statewide uniformity of the maintenance inventory system, there should be no deviation from the criteria. Several passes through the survey segment may be required to adequately assess each feature.

Because the reviews will be made on foot, special precautions must be made for protection of the reviewers from traffic. The team's first responsibility is the safety of motorists, pedestrians, and themselves. Always be aware of traffic conditions. For the safety of the crew, it may be necessary to schedule the survey of those segments with high traffic volumes during off-peak traffic periods. The survey team should walk facing traffic as the segment is evaluated. This is for the protection of the team, and to assure that features will not be overlooked. A list of equipment and supplies that should be used by the survey team is shown below. While some of these are necessary for proper collection of the data, other items will make the survey safer and more efficient.

Equipment Needed

- Personal Protective Equipment (safety vest, foot protection, etc.)
- Roof-top revolving amber light
- Copy of the Maintenance Condition Survey manual
- Clipboard
- Pencils and erasers
- Vehicle-installed distance measuring instrument –Optional
- Measuring wheel or tape
- Small measuring ruler (6 in)
- Straightedge
- Insect repellent with Deet
- First aid kit
- Calculator
- Bush axe / Machete
- Gloves
- Tablet PC
- Binoculars
- Flashlight
- USB Flash Drive (Memory stick for Data)



Conducting the Assessment/Survey

Inventory Instructions

If there is a problem with the randomly-selected site, do not survey the section. Such problems could be but not limited to:

- the road is under construction
- more than half of the segment is affected by an at-grade intersection area
- more than half of the road segment is bridge structure
- the route is unpaved
- the route happens to be a Ferry Route, not a drivable road

On the Tablet form select “Section Skipped” and hit the “Ok” button. Then proceed to an alternate section to survey and make up for the section that was previously skipped.

If the majority of the section is NOT affected by the issues above, you may still assess it. However, you will need to assess ONLY the length up to where the interference comes in. Do not move the segment. You will then denote the new inventory distance on your form in the comments section, if it must be shortened.

When locating a sample in the field, use the GPS location information to locate one end of the sample section. Mark this end with paint and then measure the sample length either with the vehicle Distance Measuring Instrument (DMI) or with a measuring wheel. Once the end of the sample is reached, mark that point with paint as well. This practice clearly defines the boundaries of the sample along the roadway for both the assessment team and the QA team and should alleviate many issues of teams measuring different inventory and failure values.

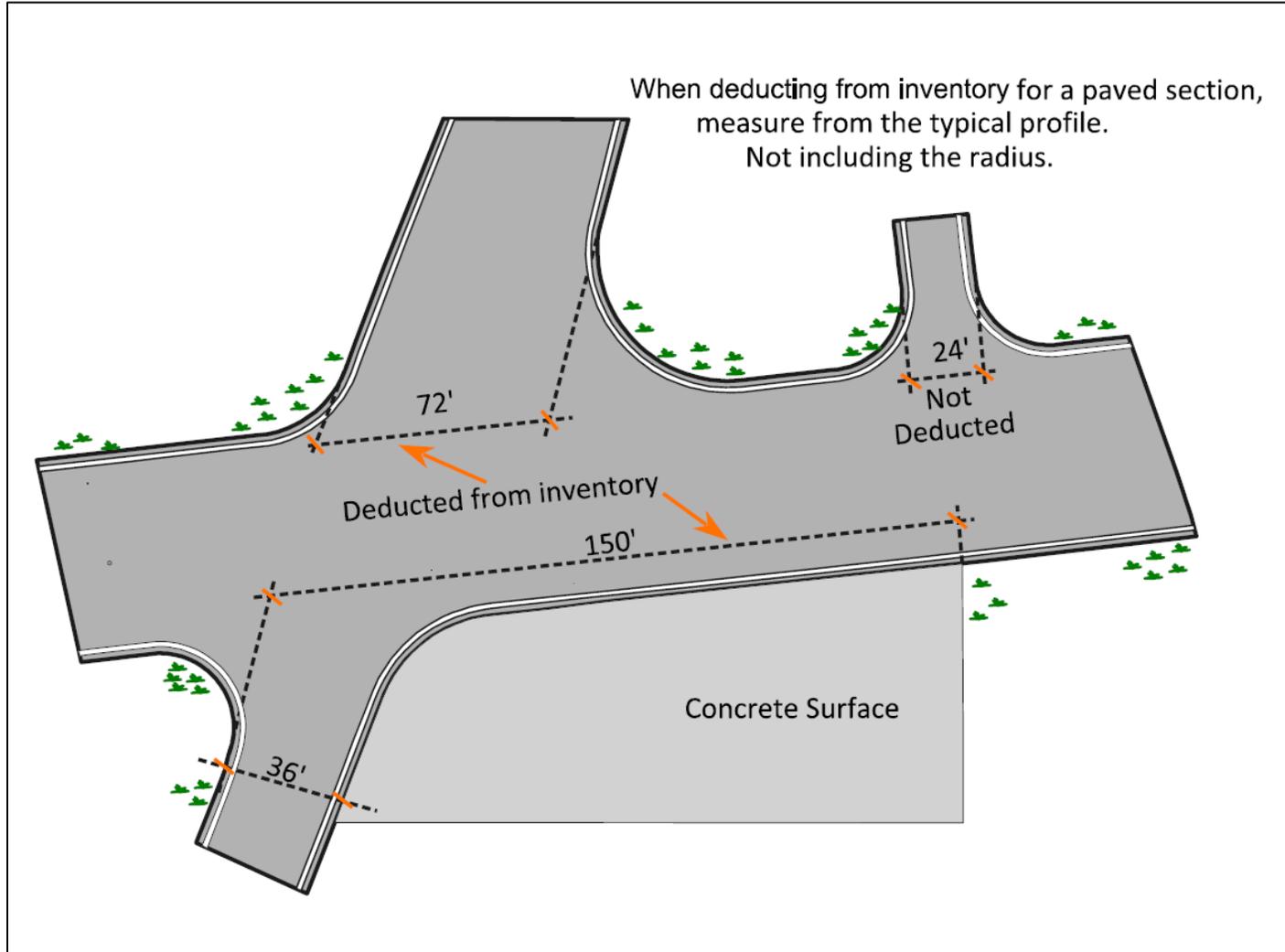
If an intersecting road or paved driveway is encountered inside a sample section, pertinent inventories will be removed if the typical paved section of the intersecting roadway is greater than 50'. For intersecting roads, the typical section pavement will be measured, not inside the radius. Pertinent inventories may include shoulder, curb and gutter, turf or brush and tree.

It is important for the inventories of samples beginning at intersecting roads to have a definite point of beginning. This line that separates the elements from intersecting roads may be “drawn” from the center of the curve to the midpoint of the curve, at each radius. This point on the curve will mark the beginning of the first sample on a road at a T intersection.

Samples on controlled access freeways that occur at on/exit ramps also require a definite line of inventory separation. Samples in these areas may occur on the ramp or along the mainline, so the lines that separate these two will divide the inventories consistently. These lines will begin at the physical gore point and bisect the ramp and the mainline, as well as run perpendicular to the mainline, across the ramp pavement. See the diagrams below.

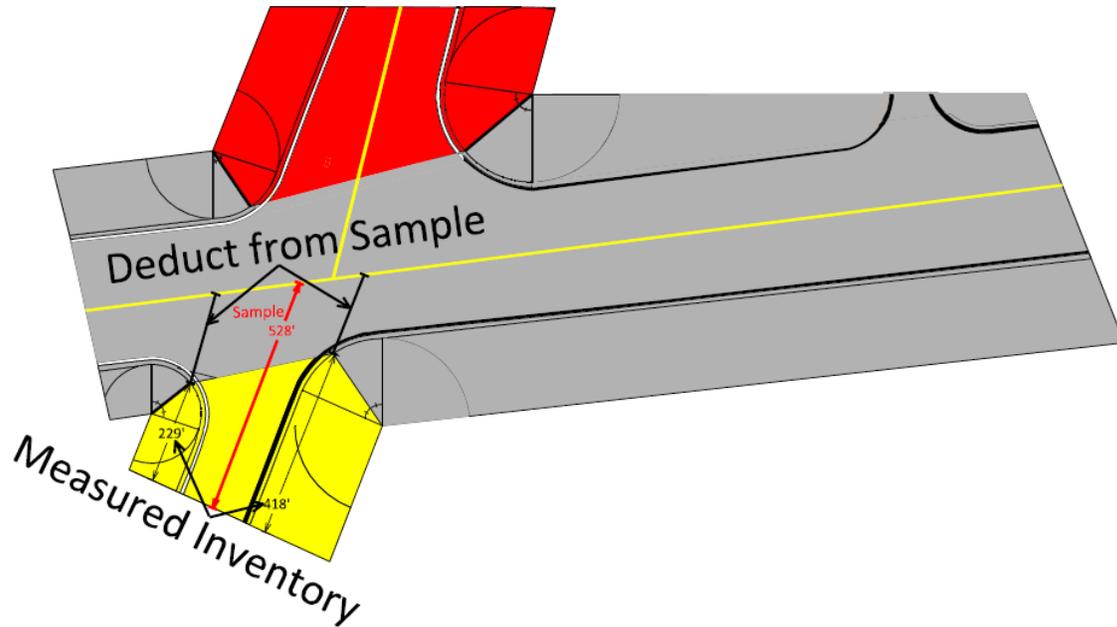


Conducting the Assessment/Survey





Conducting the Assessment/Survey

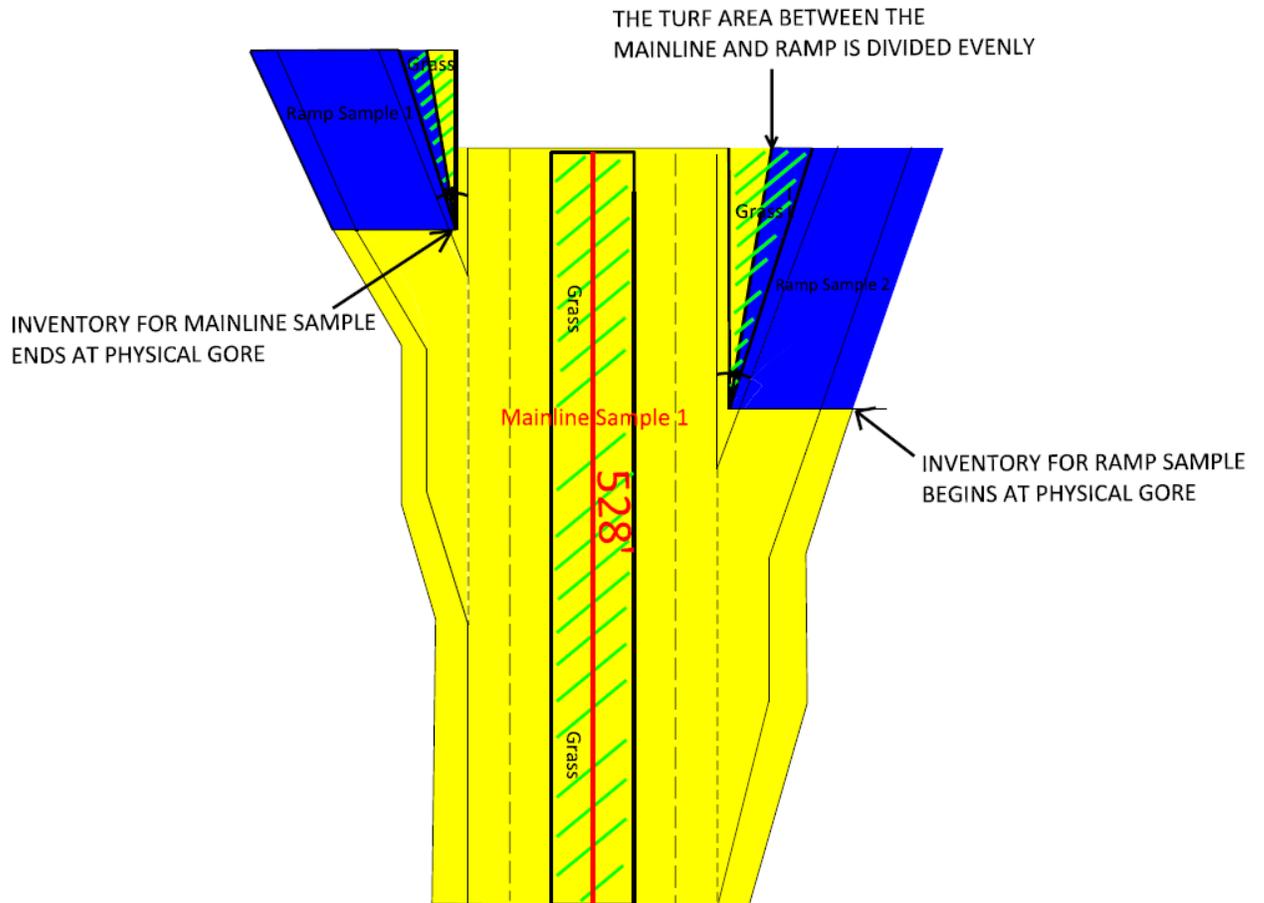


INTERSECTION INVENTORY PROCESS



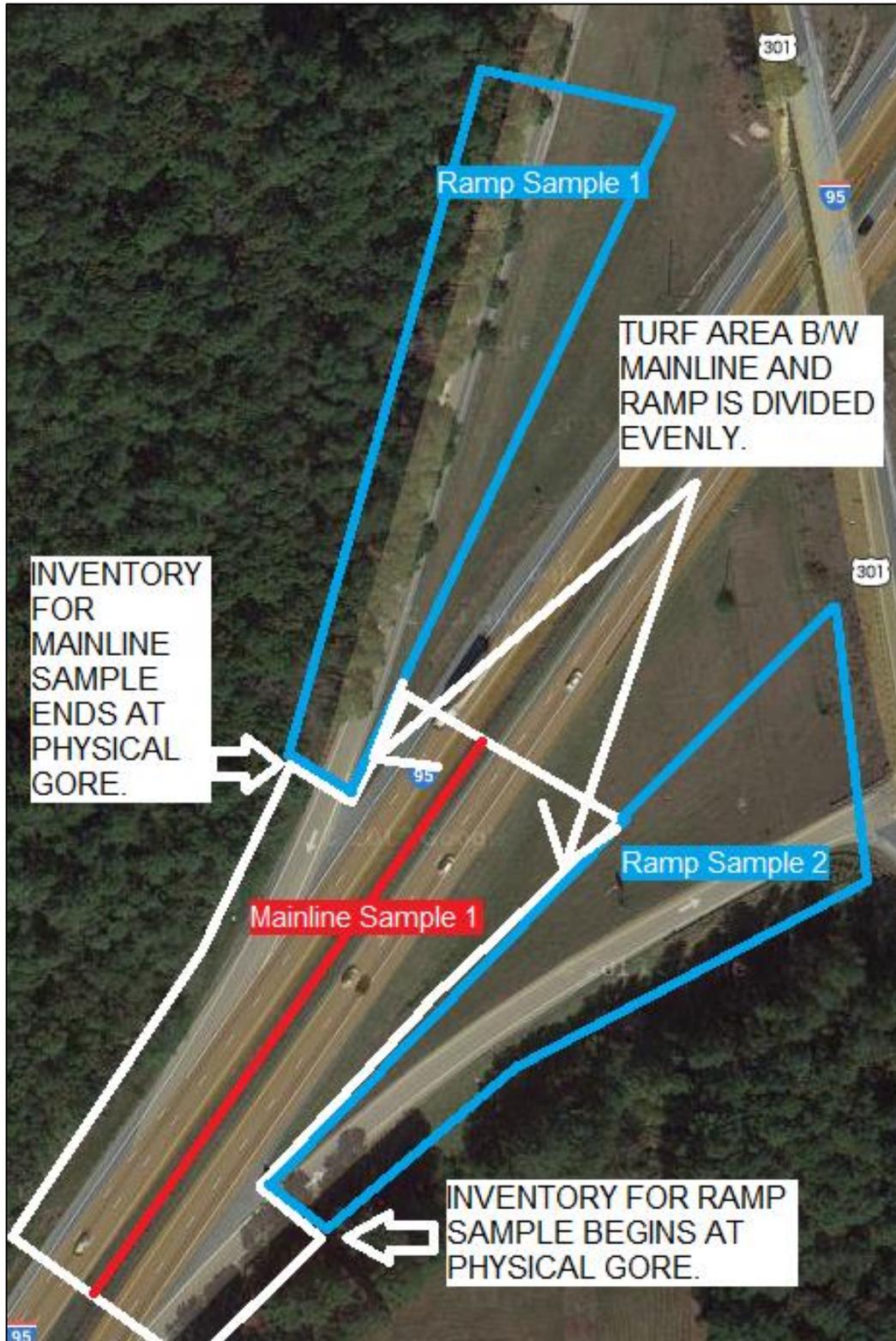
Conducting the Assessment/Survey

Ramp Assessment Process





Conducting the Assessment/Survey





Reporting Assessment Data

The information collected during the assessment will be recorded using tablet type PCs with ArcPad software. An example of the electronic form you will fill out for the random sections is shown on the next page. All pertinent information will be filled in by the assessor in the given blanks or by using drop down menus. The date of the survey and names of those conducting the survey must also be entered on the form. It is important that the inventory form be filled out completely. All information blocks on the form must be completed. If a segment cannot be assessed then make sure to select "Section Skipped" on the electronic form before moving on. If you need to skip a section, be sure to assess one of the back-up sections. If a feature does not exist in the segment (for example, there may be no unpaved shoulder), enter "0" in both the inventory and condition blocks.

Quality Assurance visits will be made by MSAU and QA personnel while the assessment is being conducted. This will assist the raters by clearing up questions and problems that may arise and ensures data quality and consistency. Any remarks about the assessment can also be made on the back sheet in this manual. If a concern needs to be addressed immediately, use the contact information on page 1.

It is recommended that each day's data will be backed up on the supplied USB memory devices and that each week's work be uploaded to the server via the MCAP Data Sync Application.



Reporting Assessment Data

Random Segment Assessment Form in ArcPad

Sample Sections

Page 1 | Page 2 | Symbology

Route ID Sample ID Year Quarter

Tier County Division

Beg_MP End_MP Sample Length

Unpaved Shoulder Inventory (ft)	<input type="text" value="0"/>	Unpaved Shoulder Failure (ft)	<input type="text" value="0"/>
Ditch Inventory (ft)	<input type="text" value="0"/>	Ditch Failure (ft)	<input type="text" value="0"/>
Curb and Gutter Inventory (ft)	<input type="text" value="0"/>	Curb and Gutter Failure (ft)	<input type="text" value="0"/>
Crossline Pipe Inventory (ea)	<input type="text" value="0"/>	Crossline Blocked (ea)	<input type="text" value="0"/>
		Crossline Damaged (ea)	<input type="text" value="0"/>
Drainage Box Inventory (ea)	<input type="text" value="0"/>	Drainage Box Failure (ea)	<input type="text" value="0"/>
Brush and Tree Inventory (ft)	<input type="text" value="0"/>	Brush and Tree Failure (ft)	<input type="text" value="0"/>
Turf Inventory (ft)	<input type="text" value="0"/>	Turf Failure (ft)	<input type="text" value="0"/>

Sample Sections

Page 1 | Page 2 | Symbology

Words and Symbols Inventory (ea)	<input type="text" value="0"/>	Words and Symbols Failure (ea)	<input type="text" value="0"/>
Pavement Markers Inventory (ea)	<input type="text" value="0"/>	Pavement Markers Failure (ea)	<input type="text" value="0"/>
Pavement Markings Inventory (ft)	<input type="text" value="0"/>	Pavement Markings Failure (ft)	<input type="text" value="0"/>

Survey Status

Survey Date

Rater Name

COMMENT

FOR QA TEAM ONLY

QA Date QA Pass/Fail

QA Comments



Element Features and Conditions

This chapter provides a procedure for collecting information in order to evaluate the condition of selected sections of roads maintained by NCDOT. The results from this survey will be used to estimate the overall condition of roadways throughout the state and determine highway maintenance needs.

Four maintenance elements will be rated for each survey segment: (1) unpaved shoulders and ditches, (2) drainage, (3) roadside, and (4) traffic control devices. Each element will consist of several features and characteristics that will be evaluated against certain threshold conditions. The elements and their features to be rated are shown on the following table.

An explanation of each feature follows in this chapter with a description of the feature, the threshold condition that will be rated, and photographs of the characteristics of each feature. The descriptions also provide methods of measuring the features and any special instructions to take into account during the survey.

Each team will be assigned several segments for survey. The element features will be reviewed and assessed according to the criteria on the following pages. To assure statewide uniformity of the maintenance inventory system, there should be no deviation from the criteria.

Several passes through the survey segment site may be required to adequately assess each feature. Because most of the reviews will be made on foot, special precautions must be taken for protection of the assessors from traffic. Always be aware of traffic conditions.

This survey is intended to be an assessment of the elements that DOT is responsible for maintaining. In the vast majority of cases this implies all elements within the right-of-way. In some cases a determination of where the right-of-way is will prove to be very difficult. For controlled access highways, it may be assumed that the right-of-way is at the controlled access fence. For many secondary roads, however, the following “rules of thumb” may be employed to determine NCDOT right-of-way:

- Right-of-way monuments or other property corner evidence such as iron pipes or rods.
- Utility locations, such as power poles, fiber optic, water meters, etc.
- Back of ditch.
- 30’ from centerline of road.
- Limits of maintenance.



Element Features and Conditions

Element 1 – Unpaved Shoulders and Ditches

Shoulders
Lateral Ditches

Element 2 – Drainage

Crossline Pipes Blocked
Crossline Pipes Damaged
Gutters Blocked
Inlets (Blocked or Damaged)

Element 3 – Roadside

Brush & Tree Control
Turf Condition

Element 4 – Traffic Control Devices

Pavement Striping
Words & Symbols
Pavement Markers



Shoulders and Ditches

Within a sample section, you will need to assess the shoulders and ditches. Where there is unpaved shoulder, the section will be assessed for the presence of both low and high shoulder. For unpaved shoulders, two longitudinal measurements will be recorded: the total segment inventory of unpaved shoulders and the measured amount that the feature exceeds the threshold conditions.

Unpaved Shoulders (Low & High)

Feature description:

Low Shoulders occur when the elevation of the unpaved shoulder is lower than it was originally designed. A low shoulder can result in an unsafe recovery in the event a vehicle leaves the roadway. A low shoulder can also hold water that may eventually penetrate the base and subgrade and weaken the roadway.

High Shoulders occur when the elevation of the unpaved shoulder is higher than it was originally designed. A high shoulder can restrict water drainage and result in ponding at the edge of roadway. The standing water can cause vehicle hydroplaning, and may also infiltrate the base and subgrade and weaken the roadway. The relief of ponding caused by a high shoulder may also scour the shoulder and front slope.

Threshold Condition: A **Low Shoulder** should be noted where there is a drop-off greater than **3"** within the shoulder width or 10', whichever is less. A **High Shoulder** should be noted where the elevation difference is **2"** higher than the original design, within the shoulder width or 10', whichever is less.

Total Sample Section Inventory: The total shoulder length in the segment will be recorded. For example, if a typical two-lane, two-way roadway is being inspected, the total shoulder length will be 1,056 feet (0.1 mi. x 5,280 ft. x 2 shoulders). For the assessment of a four-lane roadway divided by a grass median, the total shoulder length may be 2,112 feet (0.1 mi. x 5,280 ft. x 4 shoulders). Do not inventory lengths of the sample section where an unpaved shoulder does not exist due to curb and gutter, valley gutter, median barrier, paved shoulder, paved shoulder to guardrail face, etc. Also, if a portion of the shoulder is paved and the width is 10' or greater, then the Total Sample Section Inventory must be reduced by that portion of the section length.

Measured Amount: Each shoulder in the segment is to be evaluated. The Measured Amount is the longitudinal length wherever a shoulder exceeds the given threshold condition listed above for both Low and High Shoulders within the sample section being assessed. On the ArcPad form, record the sum of the lengths, **in Feet**, that meet both conditions.

Special Instructions: Oftentimes, high and low shoulder conditions occur adjacent to the edge of pavement. In these cases, the 2" and 3" may be measured from the top of the edge of pavement. Also, if the high or low shoulder area is also poor turf the length may be counted as turf failure as well. It is necessary to rework shoulders after a road is resurfaced or widened. The expectation is that the shoulders blend into the original profile. If this is not accomplished so that the failure criteria is met, that amount will fail.



Shoulders and Ditches



Example 1 - Low Shoulder



Example 2 – Low Shoulder

Examples of Low Shoulders



Examples of High Shoulders



Shoulders and Ditches

Within a sample section that is being assessed only one ditch feature will be rated. When assessing lateral ditches, two longitudinal measurements will be recorded: the total segment inventory of the lateral ditch and the measured amount that the feature exceeds the threshold condition.

Lateral Ditches

Feature Description: Lateral ditches are trough-shaped channels oriented parallel to the roadway. Located along the roadside and in medians, these ditches are constructed to collect and disperse surface water in a controlled manner, and assist in the drawdown of groundwater from the road base to prevent saturation and loss of support. A blocked ditch can cause saturation of the base and subgrade, which may lead to pavement failure. The relief of ponding caused by a blocked ditch may also erode downstream slopes and ditches when the water is released. Because ditches are constructed to collect and disperse surface water in a controlled manner, they are often seeded and mulched to prevent erosion but may be lined with rip rap or even paved. A proper lining helps dissipate water flow velocities, and it prevents loss of roadbed support by stabilizing the soil. Ditch erosion can not only impact road stabilization and contaminate natural drainage areas, but it can also be a safety problem for errant motorists.

Threshold Condition: Lateral ditches that are 50% blocked or more and are not functioning properly should be noted. An eroded lateral ditch should be noted when there is a lining loss of 1 foot below the original ditch line, or lower. There should also be no joint separation, misalignment, or undermining in paved ditches.

Total Sample Section Inventory: The total lateral ditch length in the segment will be recorded. For example, if a typical two-lane, two-way roadway is being inspected, the total ditch length will be 1,056 feet (0.1 mi. x 5,280 ft. x 2 ditches). For the assessment of a four-lane roadway divided by a grass median that has a single median lateral ditch, the total ditch length will be 1,584 feet (0.1 mi. x 5,280 ft. x 3 ditches).

Measured Amount: Each lateral ditch in the segment is to be evaluated. Once the ditch's design shape is determined, check where blockage occurs that is 50% or higher from the ditch invert or where the ditch has eroded 1 foot or lower than the original ditch line. When noted, measure the longitudinal length of blocked ditches (that are not functioning properly) and eroded ditches. Record the sum of the lengths of blocked and eroded ditches.

Special Instructions: Outfall ditches will not be rated as part of this survey. Also, do not deduct ordinary driveway pipe; the length of the driveway pipe will be included in the lateral ditch inventory. While ordinary driveway pipe will not be assessed for damages or erosion, it will be assessed for blockage. If either inlet or outlet is 50% blocked or more, include the length of the driveway pipe in the sum of blocked and eroded ditches. Also if a lateral ditch is piped it will be treated the same as a driveway pipe, regardless of the length. Large canals will not be inventoried as ditches. **If ditch is filled in and there is no pipe, DO NOT inventory as ditch (however, high shoulder may still apply).**



Shoulders and Ditches



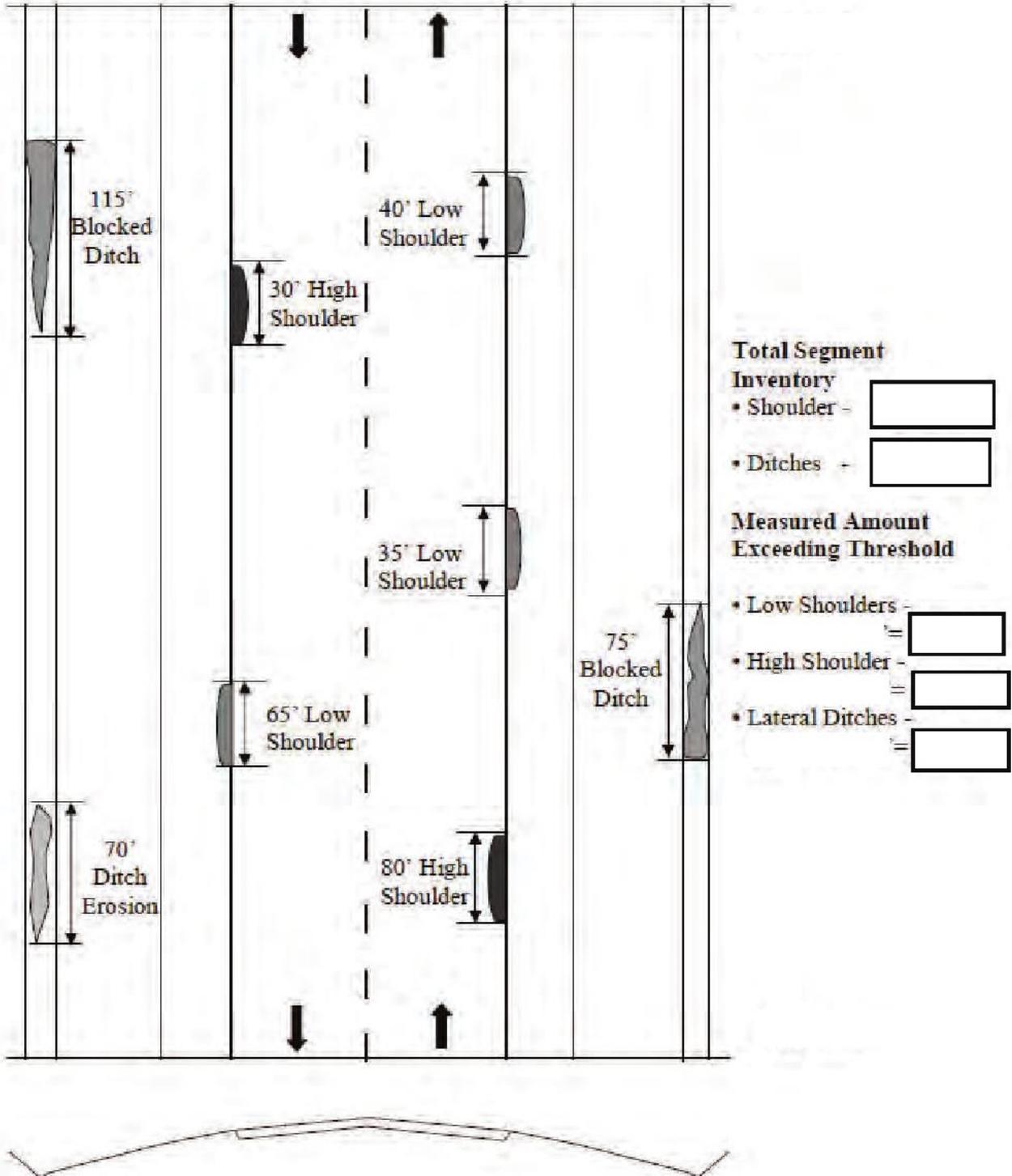
Examples of Lateral Ditches - Blocked



Example of Lateral Ditches - Eroded



Shoulders and Ditches





Drainage

Three drainage features will be rated: crossline pipes, gutters, and inlets. For each feature, two measurements will be recorded.

Except for gutters, the total number of drainage features in the segment will be noted as the total segment inventory. Then, the number of these features that do not meet the threshold condition will be recorded as the measured amount. For gutters, the total longitudinal length of gutter in the segment will be recorded as the total segment inventory. Next, the length of gutters exceeding the threshold conditions will be recorded as the measured amount.

Crossline Pipes Blocked

Feature Description: Crossline pipes are subsurface conduits that carry water under the roadway to the natural drainage area. Designed for each location, pipes come in a variety of materials, sizes, and shapes. If a blocked pipe causes ponding at the inlet and in the upstream ditch, the water can penetrate the subgrade and weaken the roadway. A restricted pipe can also result in scouring at the outlet due to the increased water flow.

Threshold Condition:

1. Crossline pipes shall have openings greater than 50% of diameter open.
2. No eroded area at the inlet or outlet that is wider or longer than 1.5 times the pipe diameter and greater than 6" deep.

Total Inventory: The total number of crossline pipes in the segment will be recorded.

Measured Amount: If at all possible, each crossline pipe in the segment is to be evaluated. If either inlet or outlet is 50% blocked or more, that pipe will be recorded as a single feature that does not meet the threshold condition. On the ArcPad form, record the number of crossline pipes that are blocked.

Special Instructions: Only Crossline Pipes maintained by Roadway Maintenance (48 inches or less) will be evaluated. Pipes and culverts maintained by Bridge Maintenance (larger than 48 inches) will not be rated as crosslines. Also, pipes along the lateral ditch that serve as a crossline pipe at an intersecting roadway will be evaluated. Drainage pipes that are part of a closed system will not be assessed.



Examples of Crossline Pipes Blocked



Drainage

Three drainage features will be rated: crossline pipes, gutters, and inlets. For each feature, two measurements will be recorded.

Except for gutters, the total number of drainage features in the segment will be noted as the Total Segment Inventory. Then, the number of these features that do not meet the threshold condition will be recorded as the Measured Amount. For gutters, the total longitudinal length of gutter in the segment will be recorded as the Total Segment Inventory. Next, the length of gutters exceeding the threshold conditions will be recorded as the Measured Amount.

Crossline Pipes Damaged

Feature Description: See feature description for crossline pipes blocked. If the pipe is damaged due to cracking, joint failures, or corrosion, water infiltration and exfiltration may result in loss of fines from the subgrade, causing roadway settlement and pavement failure.

Threshold Condition: Where a pipe is damaged so that it affects the functionality of the system, it should be noted.

1. No damage due to cracking, joint failures, or corrosion.
2. No water infiltration causing pavement failures, shoulder failures, or roadway settlement.

Total Inventory: The total number of crossline pipes in the segment will be recorded.

Measured Amount: If at all possible, each crossline pipe in the segment is to be evaluated. If the pipe is damaged, that pipe will be recorded as a single feature that does not meet the threshold condition. On the survey form, record the number of crossline pipes that are damaged.

Special Instructions: Only Crossline Pipes maintained by Roadway Maintenance (48 inches or less) will be evaluated. Pipes and culverts maintained by Bridge Maintenance (larger than 48 inches) will not be rated as crosslines. Also, pipes along the lateral ditch that serve as a crossline pipe at an intersecting roadway will be evaluated. Drainage Pipes that are part of a closed system will not be assessed.



Example of Crossline Pipes Damaged



Drainage

Three drainage features will be rated: crossline pipes, gutters, and inlets. For each feature, two measurements will be recorded.

Except for gutters, the total number of drainage features in the segment will be noted as the Total Segment Inventory. Then, the number of these features that do not meet the threshold condition will be recorded as the Measured Amount. For gutters, the total longitudinal length of gutter in the segment will be recorded as the Total Segment Inventory. Next, the length of gutters exceeding the threshold conditions will be recorded as the Measured Amount.

Gutters Blocked

Feature Description: Gutters are open drainage channels that direct the flow of water from the road surface and roadside area to a catch basin or other outlet. All gutters must tie into edge of pavement. Examples of open-channel gutters are curb and gutter, shoulder berm gutter, expressway gutter, and valley gutter. Also if Concrete Barrier is present, the base on each side serves as Curb & Gutter and is to be recorded as such. An obstruction in the gutter may divert water flow onto the travelway and cause vehicle hydroplaning.

Threshold Condition: Gutters that are not functioning as designed due to an obstruction 2 inches or greater in depth for at least 2 feet of gutter length should be noted.

Total Segment Inventory: The total gutter length in the segment will be recorded. For example, if a typical four-lane roadway is being inspected, and it has a raised median concrete barrier and Curb & Gutter on the outside, the total curb and gutter length will be 2,112 feet (0.1 mi. x 5,280 ft. x 4 gutters).

Measured Amount: Measure the longitudinal length wherever a gutter is not functioning as designed due to an obstruction 2 inches or greater for at least 2 feet of curb length. On the ArcPad form, record the sum of the lengths of gutter that meet or exceed this condition.

Special Instructions: Blockage will not be noted if it will not obstruct water flow (grass growing in a construction joint, trash that will be flushed clean in the next storm, etc.). At intersections, measure the gutter longitudinally through the intersection; do not measure around the corner radius. Short sections of monolithic barrier (such as a 4-foot wide by 50-foot long concrete median island) will not be included in this inventory. If resurfacing has been done in a curb and gutter section so that the new asphalt has been placed in the gutter, up to the face of the curb, then consider this blocked if it is more than one overlay. Valley curb located in an intersection 50' or wider will also be counted in Total Segment Inventory.



Examples of Gutters Blocked



Drainage





Drainage

Three drainage features will be rated: crossline pipes, gutters, and inlets. For each feature, two measurements will be recorded.

The total number of drainage features in the segment will be noted as the Total Segment Inventory. For questions about how to determine inlet inventory, refer to the diagram “Inlet Inventories at Intersections.” Then, the number of these features that do not meet the threshold condition will be recorded as the Measured Amount

Inlets (Drop Inlets, Catch Basins, Shoulder Drains, Funnel Drains, etc.)

Inlets Blocked:

Feature Description: Inlets are the openings through which water enters an underground drainage network. They can be found in curbs, ditches, valley gutter, and at other locations that are designed to collect water runoff. Examples of inlets are catch basins, drop inlets, shoulder drains, and slope flumes. If the inlet is blocked, water ponding may occur at the obstructed opening. This can result in scour and erosion at an off-road structure, or vehicle hydroplaning if adjacent to the travelway.

Threshold Condition: Grates, Outlet Pipes, and Inlets that are 50% blocked or more should be noted.

Inlets Damaged:

Feature Description: If the structure is damaged, water can penetrate the base and weaken the roadway. Also, a damaged or missing grate is a safety hazard to motorists, bicyclists, and pedestrians.

Threshold Condition: Inlets that are damaged or that have missing or broken grates should be noted.

1. No eroded area within 1' of the structure that is greater than 6" deep or below the base elevation of the concrete apron.
2. Inlets and Outlet Pipes are not damaged and are functioning properly.
3. Grates are present and not broken.

Total Inventory: The total number of inlets in the segment will be recorded.

Measured Amount: Each inlet in the segment is to be evaluated. On the ArcPad form, record the number that exceeds or meets the above listed criteria for both blocked and damaged.

Special Instructions: For the Inlets that are located along the shoulders or median, do NOT fail if the inlet is ONLY covered by a thin layer of grass/mowing clippings that will more than likely be blown off or washed away when the next rain occurs.



Drainage



Examples of Inlets Blocked

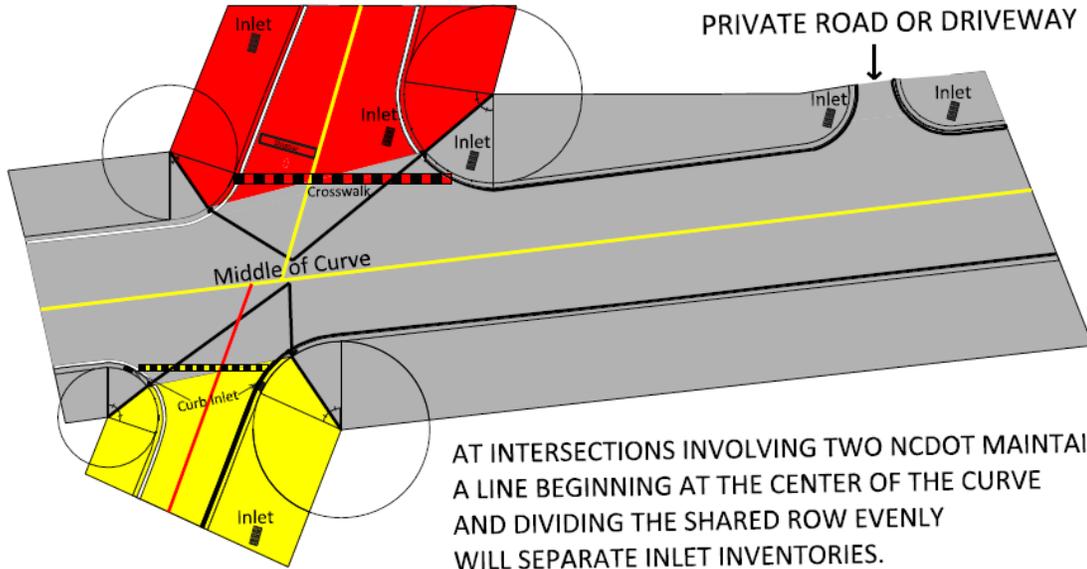


Examples of Inlets Damaged/Missing



Drainage

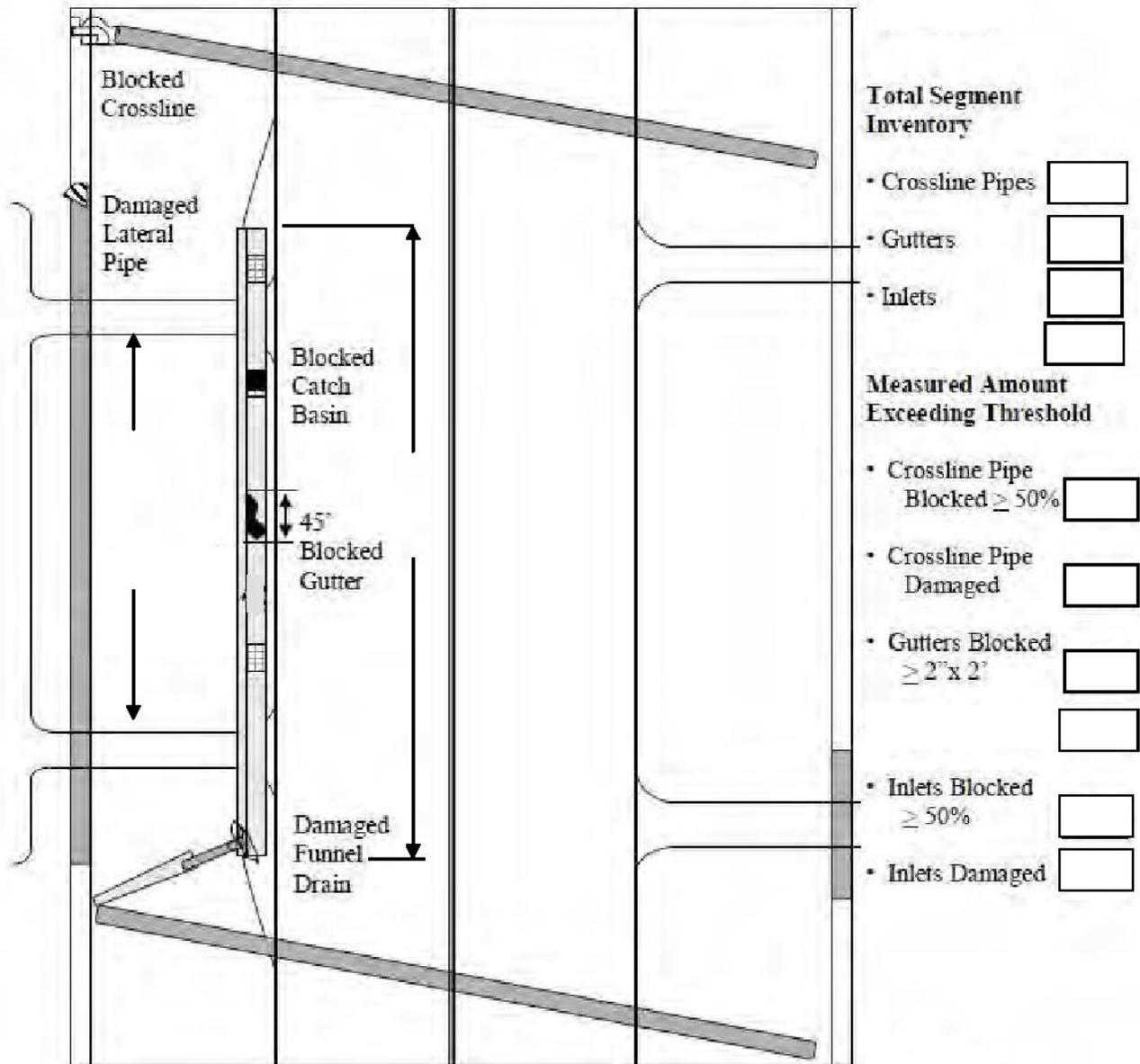
STOPBARS & CROSSWALKS: INVENTORY TO THE ROAD IT CROSSES



INLET INVENTORY AT INTERSECTIONS



Drainage





Roadside

Brush and Tree Control

Feature Description: Brush and tree control involves the removal of large vegetation for safety reasons, to maintain a roadway clear zone, and to provide adequate sight distance. Although trees are an appealing roadside feature, the presence of large trees in the recovery area can be a hazard to errant motorists. A tree canopy can also be a problem if it restricts the visibility of traffic control devices (traffic signals or signs), reduces the stopping sight distance of drivers travelling the road, or limits the sight distance of drivers entering the roadway.

Threshold Condition:

- Freeways: Freeways are defined as a route with a controlled access fence. 45' from travelway, 5' behind guardrail, not blocking signs.
- Primary: Vertical clearance of 15' over roadway and 10' back of ditch centerline or shoulder point. 5' behind guardrail.
- Secondary: Vertical clearance of 15' over roadway or 5' back of ditch centerline or shoulder point. 5' behind guardrail.

Total Segment Inventory: Brush and Tree will be inventoried on a per side basis. If there is any presence of brush and tree, failing or non-failing, on any side of the sample then that whole side (528') counts toward the inventory. For example, if a typical two-lane, two-way roadway is being inspected, with no presence of brush and tree on one side and approximately 200' on the other side, the total inventory will be 528.' Median vegetation will not be inventoried or assessed.

Measured Amount: Each forested / large vegetation piece in the segment is to be evaluated. The Measured amount is the longitudinal distances where the brush and tree exceeds or meets the above threshold conditions within the control zone. Enter the sum of these lengths on the assessment form.

Special Instructions: Brush and small trees within the control zone should not be counted as failure if they are less than 4' tall. All vegetation that is greater than 4' tall will be counted as failure, only be sure to measure the actual cumulative length of failure. An exception is brush and trees that will not be removed due to public sensitivity, such as growth in a residential area. If these "ornamentals" are causing a safety concern, they may be failed. If a tree is beyond the control zone but is a safety concern, it should be measured. Vertical clearance of 15' should be evaluated up to the shoulder point not just over the travelway.



Examples of Brush and Tree Control



Roadside

Within each sample section, Turf Condition will be evaluated where applicable. Two longitudinal measurements will be recorded: the Total Segment Inventory of the feature and the Measured Amount that the feature exceeds the threshold condition.

Turf Condition

Feature Description: Turf cover is essential to maintaining the stability of unpaved shoulders, slopes, and the ditch line. Without proper vegetation or other stabilizing material, soil erosion can lead to water infiltration and loss of roadbed support, and even contamination of natural drainage areas due to sediment loss.

Threshold Condition: Areas of Bare or Erodible turf will be recorded.

Total Sample Section Inventory: The total roadside length in the Sample Section will be recorded. For example, if a typical two-lane, two-way roadway is being inspected, the total roadside length will be 1,056 feet (0.1 mi. x 5,280 ft. x 2 shoulders). For the assessment of a four-lane roadway divided by a grass median, the total roadside length may be 2,112 feet (0.1 mi. x 5,280 ft. x 4 shoulders) where grass median is > 5 feet wide and 1,584 feet (0.1 mi. x 5,280 ft. x 3 shoulders) where median is less than 5 feet wide.

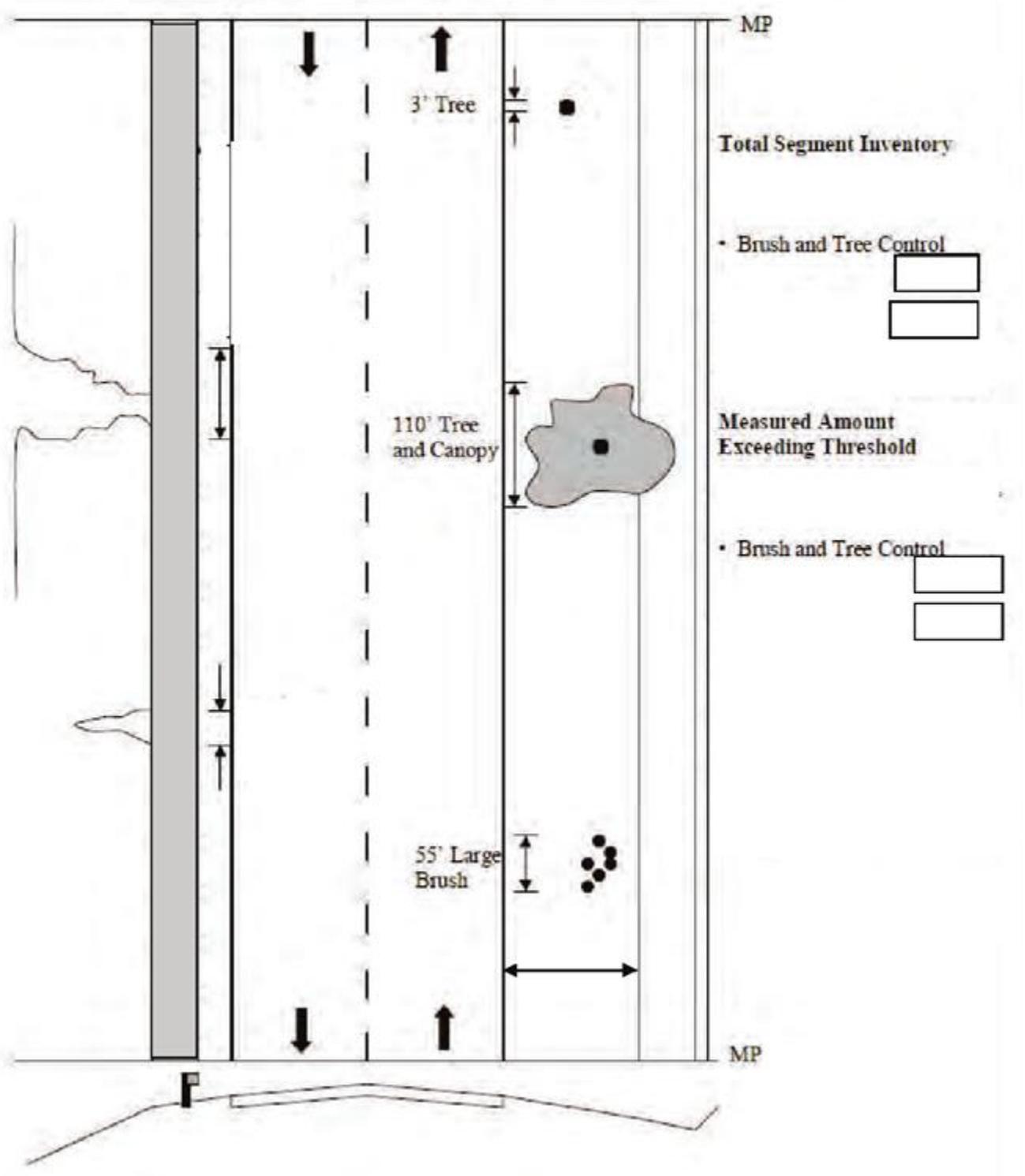
Measured Amount: Each shoulder, slope, and ditch is to be evaluated. The Measured Amount is the longitudinal length (parallel to the roadway) of any area that has bare or erodible turf. These areas must be significantly erodible with little to no grass sprigs present. Also, areas that have been stabilized with gravel will not be considered poor turf. Furthermore, anywhere there are signs of current erosion, this area may be considered poor turf. On the ArcPad form, record the sum of the lengths of poor turf growth.



Examples of Failing Turf



Roadside





Traffic

Pavement Markings / Striping

Feature Description: Pavement Markings are applied to the road surface to convey warnings or information without diverting the driver's attention from the roadway. They consist of center lines that separate traffic traveling in opposite directions, edge lines that provide an edge of pavement guide for drivers, and lane lines that separate traffic traveling in the same direction. When pavement striping is worn or missing, this important traffic control device does not guide and direct motorists as intended, may cause driver confusion, and could even direct motorists into the wrong path.

Threshold Condition: Markings / Striping that have significant portions that are worn, missing, obliterated, or non-retroreflective should be noted.

Total Segment Inventory: All Markings / Striping within a section will be collected as Inventory. You will be given a handout with some precalculated inventory amounts for general sections. Use this only as a base amount then add or subtract any other necessary markings. The exact footage is not critical, but should be reasonably close.

See handout for Inventory details.

Measured Amount: The measured amount is the longitudinal length where center lines, edge lines, or lane lines do not meet the Threshold Conditions. On the ArcPad form, record the sum of the poor pavement striping.

Special Instructions: Only the marking is to be measured. When recording broken lane lines or center lines, measure the painted marking and not the unpainted gap. For example, if rating a normal broken lane line, measure the 10 foot marking and not the 30 foot gap. This inspection will be done during the day. If the cross section of a marking is missing more than 50% of its original width, that portion may be considered failure.



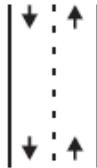
Examples of Markings Failure



Traffic

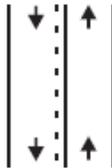
Pavement Marking Inventory for Various Roadway Segments

Road 1



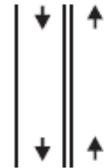
Inv. 1188
 Inv. C&G 1 side 660
 Inv. C&G both sides 132

Road 2



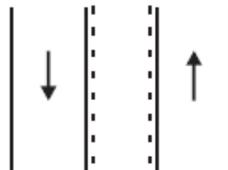
Inv. 1716
 Inv. C&G 1 side 1188
 Inv. C&G both sides 660

Road 3



Inv. 2112
 Inv. C&G 1 side 1584
 Inv. C&G both sides 1056

Road 4



	C&G 1 side	C&G both sides
3 lane <u>2376</u>	3 lane <u>1848</u>	3 lane <u>1320</u>
5 lane <u>2640</u>	5 lane <u>2112</u>	5 lane <u>1584</u>
7 lane <u>2904</u>	7 lane <u>2376</u>	7 lane <u>1848</u>

Road 5
 Divided Facilities



	C&G 1 edge	C&G 2 edges	C&G 3 edges	C&G4 edges
2 lanes <u>2376</u>	<u>1848</u>	<u>1320</u>	<u>792</u>	<u>264</u>
3 lanes <u>2640</u>	<u>2112</u>	<u>1584</u>	<u>1056</u>	<u>528</u>
4 lanes <u>2904</u>	<u>2376</u>	<u>1848</u>	<u>1320</u>	<u>792</u>
5 lanes <u>3168</u>	<u>2640</u>	<u>2112</u>	<u>1584</u>	<u>1056</u>



Traffic

Words and Symbols

Feature Description: Words and symbols on the pavement may be used for the purpose of guiding, warning, or regulating traffic. Some examples are Right Turn Arrows, Merge Arrows, Stop Bars, Lane Ends, Crosswalks, School Area Markings, and Railroad Crossing Markings, etc. **Threshold Condition:** Word or symbol markings that have significant portions that are worn, missing, obliterated, or non-retroreflective should be noted.

Total Segment Inventory: The total number of word and symbol markings in the segment will be recorded.

Measured Amount: Count the number of words or symbols that are either worn, missing, obliterated, or non-retroreflective, and record on the ArcPad form.

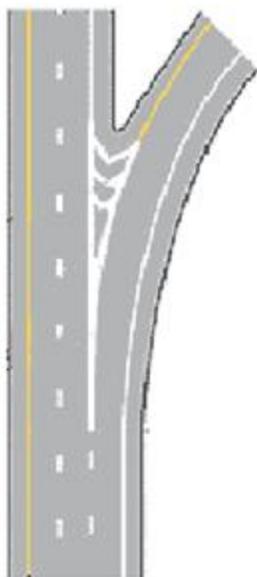
Special Instructions: For two-way left turn lane paired arrows, count as two symbols. Even though individual pavement marking patterns will make up a word (such as an ONLY, a RXR, or a SCHOOL), count the entire pattern as one word. All types of crosswalks (hi-visibility and standard) will count as one symbol. When a transverse rumble strip (e.g. approaching a stop sign) is painted, each group will count as one symbol. This inspection will be done during the day.



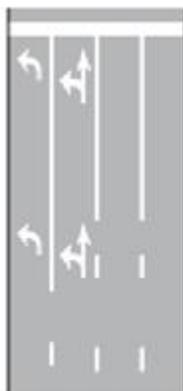
Examples of Failed Words and Symbols



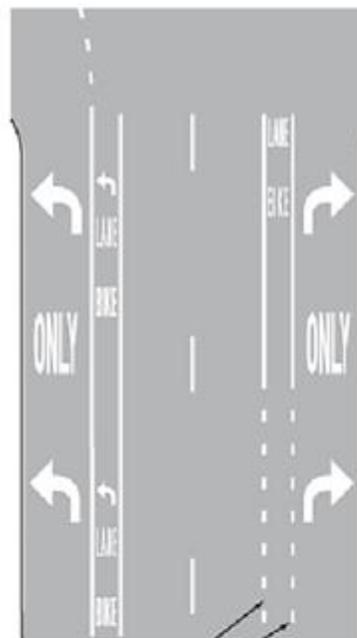
Traffic



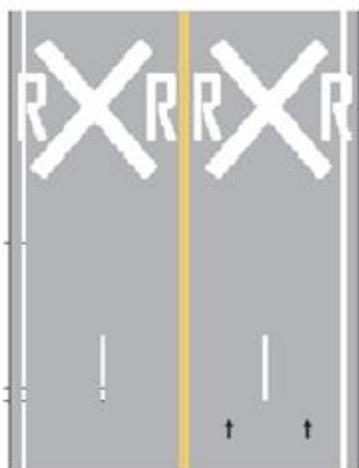
Symbols: 0



Symbols: 5



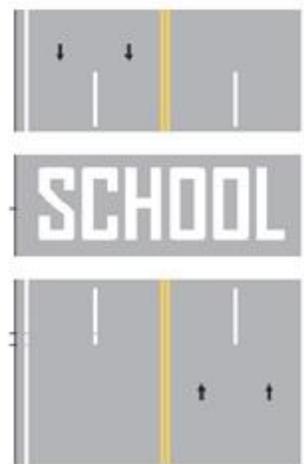
Symbols: 14



Symbols: 2



Symbols: 0



Symbols: 1



Traffic

Pavement Markers

Feature Description: Pavement markers may be used as positioning guides or to supplement pavement markings. These may be surface-mounted, recessed, or snow plowable. Pavement markers are normally spaced every 80 feet, except in areas of severe road curvature (horizontal curves $> 6^\circ$) where the spacing is 40 feet. A spacing chart for pavement markers is provided in the NCDOT Roadway Standard Drawings on standard 1250.01, sheet 1 of 3.

Threshold Condition: Pavement markers that are damaged or missing should be noted.

Total Segment Inventory: The total number of pavement markers that should be in the segment will be recorded. For a typical two-lane, two-way roadway, the number of pavement markers will be 7 (0.1 mi. x 5,280 ft / 80ft). If assessing a five lane road (two throughlanes each direction with a two way left turn lane), the number of pavement markers will be 26 (4 lane lines x 0.1 mi. x 5,280 ft. / 80 ft.)

Measured Amount: Count the number of pavement markers that are either damaged or missing and record on the ArcPad form.

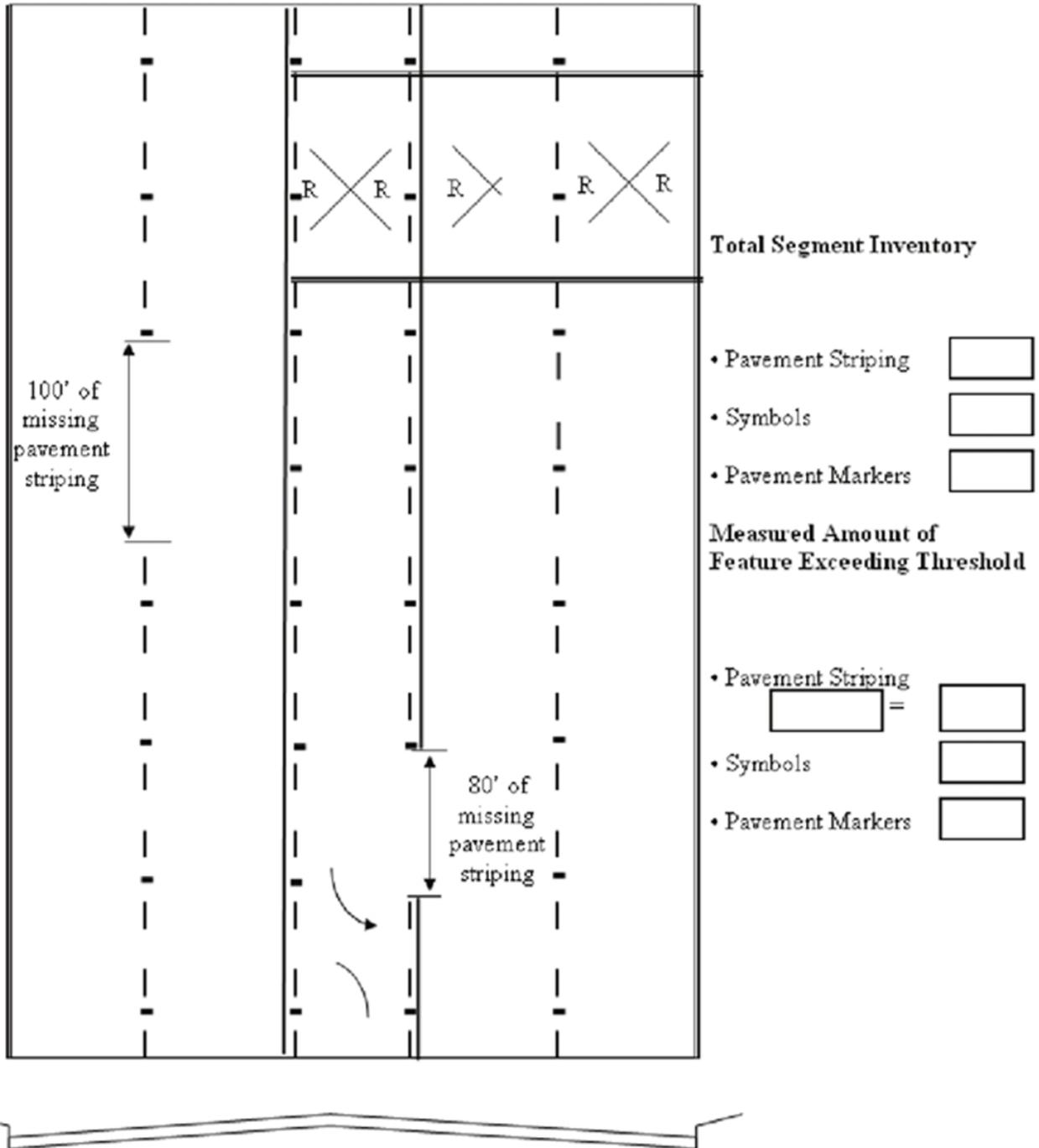
Special Instructions: Pavement markers will only be assessed on the Interstate and Primary System. Secondary roads will always get a "0" inventory for markers. On Primary routes, if there is no evidence of pavement markers ever having been installed in the segment being rated, both the Total Segment Inventory and the Measured Amount will be "0". This inspection will be done during the DAY. If there is confusion about how many markers to inventory, please refer to the Standard Drawings Manual for questions about typical spacing of markers. See section 1250.01.



Examples of Pavement Markers



Traffic



NOTES



Shoulders and Ditches

Component Element	Performance Standard	Special Instructions	Measurements to be Recorded
Shoulders	<ol style="list-style-type: none"> 1. No dropoffs greater than 3" within 10' of the edge of Travelway 2. No shoulders higher than 2" within 10' of the edge of Travelway. 3. No shoulders that cause water to drain back within the Travelway. 	If paved portion is greater than 10' wide or, if concrete gutter is present, then inventory is 0.	<ul style="list-style-type: none"> • Total shoulder length • Length that does not meet performance standard
Lateral Ditches (Includes Rip Rap and Paved)	<ol style="list-style-type: none"> 1. No more than 50% blocked 2. No erosion greater than 1' below original ditch line 	None	<ul style="list-style-type: none"> • Total ditch • Length that does not meet performance standard



Drainage

Component Element	Performance Standard	Special Instructions	Measurements to be Recorded
<p>Crossline Pipes (< 48") (Blocked)</p>	<ol style="list-style-type: none"> 1. Greater than 50% diameter open. 2. No eroded area at the inlet or outlet that is wider or longer than 1.5 times the pipe diameter and greater than 6" deep. 	<ul style="list-style-type: none"> • Driveway Pipe does not count as a Crossline Pipe. • Pipe running under side streets do count as Crossline. 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount Failed within Section
<p>Crossline Pipes (<48") (Damaged)</p>	<ol style="list-style-type: none"> 1. No damage due to cracking, joint failures, or corrosion that affects performance/functionality. 2. No water infiltration causing pavement failures, shoulder failures, or roadway settlement. 	<ul style="list-style-type: none"> • Driveway Pipe does not count as a Crossline Pipe. • Pipe running under side streets do count as Crossline. 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount Failed within Section
<p>Drop Inlets/Catch Basins/ Shoulder Drains/ Funnel Drains/etc. (Blocked)</p>	<ol style="list-style-type: none"> 1. Grates, Box, Outlets, and Inlets that are 50% blocked or more should be noted. 	<ul style="list-style-type: none"> • Record: Pass/Fail 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount Failed within Section



Drainage Continued

Component Element	Performance Standard	Special Instructions	Measurements to be Recorded
<p>Drop Inlets/Catch Basins/ Shoulder Drains/ Funnel Drains/etc. (Damaged)</p>	<ol style="list-style-type: none"> 1. Inlets that are damaged or have missing or broken grates should be noted. 2. No eroded area within 1' of the structure that is greater than 6" deep or below the base elevation of the concrete apron. 3. Inlets and Outlets are not damaged and are functioning properly 4. Grates are present and not broken. 	<ul style="list-style-type: none"> • Record: Pass/Fail 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount Failed within Section
<p>Curb & Gutter/ Valley Gutter/ Median Barrier (Blocked)</p>	<ol style="list-style-type: none"> 1. No obstruction greater than 2" deep for a length of 2' 	<ul style="list-style-type: none"> • Would not be counted if it would not obstruct flow, such as grass growing in a expansion joint 	<ul style="list-style-type: none"> • Total Inventory within Section • Length that does not meet performance standard



Roadside

Component Element	Performance Standard	Special Instructions	Measurements to be Recorded
Brush & Trees	<ol style="list-style-type: none"> 1. Freeways: No Trees or woody growth within 45' of travel way, measured along surface of ground (excluding ornamental plantings and guardrail). A clear distance of 5' behind guardrail or concrete barrier (excluding ornamental plantings). Ramps to be cleared 10' behind ditch. 2. Non-Freeways: Vertical clearance of 15' over roadway, including paved shoulders. 10' back of ditch centerline or shoulder point. 3. No dead trees, or leaning trees that present a hazard. 	None	<ul style="list-style-type: none"> • Total length of brush and tree that is present within the Control Zone • Length that does not meet performance standard • Brush & Small trees within the Control Zone should NOT be noted if they would be mowed in normal mowing operations. • Median Vegetation will NOT be inventoried or assessed.
Turf Condition	<ol style="list-style-type: none"> 1. No "Brown Out" or bare or eroded areas 	None	<ul style="list-style-type: none"> • Total length of turf condition • Length that does not meet performance



Traffic

Component Element	Performance Standard	Special Instructions	Measurements to be Recorded
Pavement Striping/Markings	1. Edgelines, centerlines, or skip lines within a section that have significant portions that are worn, missing, obliterated, or non-retroreflective should be noted.	<ul style="list-style-type: none"> • Record: Pass/Fail 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount failed (in feet) within Section.
Words & Symbols	1. Words or Symbols that have portions that are worn, missing, obliterated, or non-retro reflective should be noted as Failed.	<ul style="list-style-type: none"> • A word is counted as one symbol. • Record: Pass/Fail 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount failed within Section.
Pavement Markers	1. Either Damaged or Missing count as failure.	<ul style="list-style-type: none"> • Record: Pass/Fail • Only on Interstate or Primary System 	<ul style="list-style-type: none"> • Total Inventory within Section • Amount failed within Section.