



Federal Lands Highway Road Inventory Program

Road Inventory and Condition Assessment

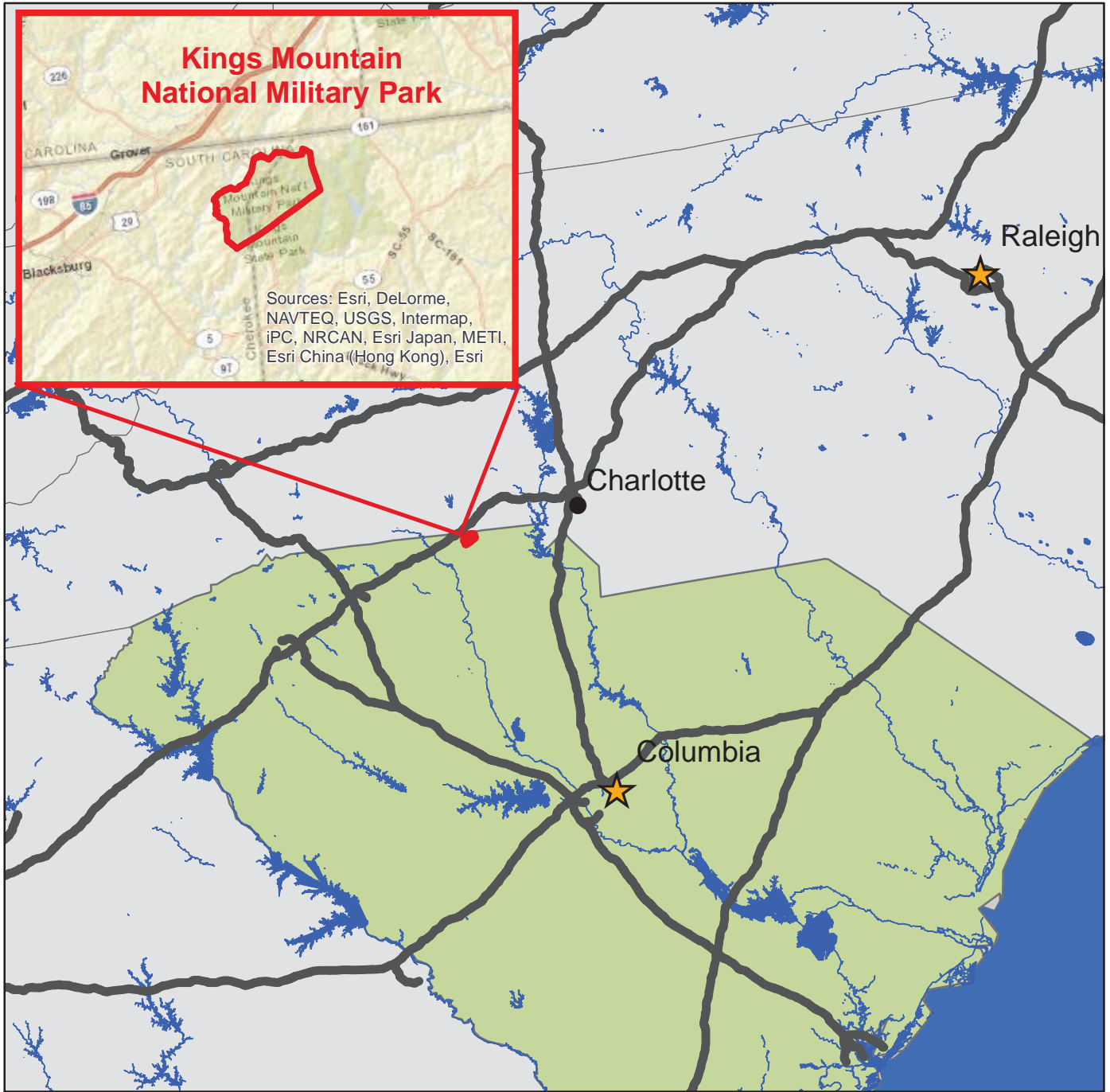


Kings Mountain National Military Park KIMO

Cycle 5 Report

Prepared By: Federal Highway Administration
Road Inventory Program (RIP)
Data Collected: 07/2013
Report Date: 02/2014

Kings Mountain National Military Park in South Carolina





DCV = Data Collection Vehicle

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Section 1

Introduction



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

INTRODUCTION

The Federal Highway Administration, (FHWA), in the mid 1970s, was charged with the task of identifying surface condition deficiencies and corrective priorities on National Park Service (NPS) roads and parkways. Additionally, FHWA was tasked with establishing an integrated maintenance features inventory, locating features such as culverts, guardrails, and signs, among others, along NPS roads and parkways. As a result, in 1976 the NPS and FHWA entered into an MOA (Memorandum Of Agreement) which established the RIP (Road Inventory Program). This MOA was terminated and revised in 1980 to establish a new MOA aiming to update RIP data and develop a long-range program to improve and maintain NPS roads to designated condition standards and establish a maintenance management program.

The FHWA completed this initial phase of the RIP in the early 1980s. As a result of this effort, each NPS site included in the study received a RIP Report known as the “Brown Book” which included the information collected during this first RIP phase.

In the 1990s, the effort was again renewed to update and maintain the RIP data. By this time the computer age was upon us and a process was employed that relied heavily on electronic data collection and computer technology. A cyclical program was developed and the RIP completed two cycles of data collection from 1994 to 2001. Cycle 1, starting in 1994, was conducted in 44 “large parks” (parks containing 10 or more paved route miles). Cycle 2 began in 1997 and comprised 79 large parks and 5 small parks totaling 4,874 paved route miles. Each of these parks received a RIP Report known as the “Blue Book”. Cycle 3, from 2001 to 2004, was conducted in all parks, large and small, that contained any paved routes, including parking areas and, again, each park received a RIP Report and associated electronic files.

Cycle 4 was initiated in the spring of 2006 covering 86 large parks and several associated small parks consisting of 5,553 paved route miles and 6,232 paved parking areas. Data collection has been completed for Cycle 4 and all data has been delivered to the NPS.

In 2005, the FHWA began implementing the use of a Pavement Management System (PMS) to assist the NPS in prioritizing Pavement Maintenance and Rehabilitation activities. The PMS used by FHWA is the Highway Pavement Management Application (HPMA) and this software has the ability to store inventory and condition data from RIP and forecast future performance using prediction models. Outputs include performance and condition reports at the National, Regional, Park, or Route level. A regional prioritized list and optimization have been produced for most regions and the Federal Highway Deferred Maintenance is calculated via the HPMA.

In an effort to improve the accuracy of treatment recommendations and pavement condition descriptions, an extensive study was completed throughout 2010 that has resulted in changes to the RIP condition reporting method, specifically the distresses and indexes that comprise the Pavement Condition Rating (PCR). It was determined that a better representation of PCR could

be achieved by modifying the relative impact certain distresses would have on the overall rating. The changes that were implemented were endorsed by management at both the FHWA and NPS in October 2010. These changes will allow greater use of RIP and HPMA data for not simply condition data reporting, but also as a reliable tool for project identification and selection. Because of these changes, the PCR Condition ratings reported in Cycle 5 do not directly relate to the condition ratings reported in previous cycle RIP Reports. For more detailed information about the changes, see Section 3 and Section 10 in this RIP Report.

Cycle 5 has launched in the summer of 2010 and will again comprise all parks, large and small, that are served by paved roads and/or parking areas. For Cycle 5, the decision was made to collect condition data in large parks on Functional Class 1, 2, and 7 paved routes only, as well as any new routes that were previously not collected. In small parks, all paved routes and parking areas will be collected. As a result, this will include 81 large parks with 4,459 paved route miles and 231 small parks with 529 paved route miles and associated paved parking areas.

Since 1984, the Road Inventory Program has been funded through the Federal Lands Highway Park Roads and Parkways (PRP) Program. Currently, coordination of the RIP with FLH is under the NPS Washington Headquarters Park Facility Management Division. The FLH Washington office coordinates policy and prepares national reports and needs assessment studies for Congress.

In 1998, the Transportation Equity Act for the 21st Century (TEA-21) amended Title 23 U.S.C., and inserted Section 204(a)(6) requiring the FHWA and NPS, to develop by rule, a Pavement Management System (PMS) applied to park roads and parkways serving the National Park System.

FLH is responsible for the accuracy of all data presented in this report. Any questions or comments concerning the contents of this report should be directed to the national RIP Coordinator located in Sterling, Virginia.

Respectfully,

FHWA RIP Team

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Section 2

Park Route Inventory



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

Cycle 5 NPS/RIP Route ID Report

Road Inventory Program 02/20/2014

(Numerical By Route #)

Page 1 of 4

Shading Color Key:

Red text denotes approx. mileage

White = Paved Routes, DCV Driven

Yellow = Unpaved Routes, DCV not Driven

Blue = All Paved Parking Areas

Green = All Unpaved Parking Areas

Grey = Paved Routes, DCV not Driven

Black = State, Local or Private non-NPS Routes

= Concession Route Flag ON

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

KIMO

KINGS MOUNTAIN NATIONAL MILITARY PARK

Rte. No.	Cycle Collected	FMSS No.	Concess Route	Route Name	Route Description From	To	Maint. District	Paved Miles	Un-Paved Miles	Total Route Length	Func. Class	Manual Rated SQ/FT	Surf. Type	Area Maps
0010	5	42951		MAIN PARK DRIVE	FROM WEST PARK BOUNDARY AT PAVEMENT CHANGE / END OF ROUTE 5216 (NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85)	TO EAST PARK BOUNDARY AT PAVEMENT CHANGE / BEGINNING OF ROUTE 5021 (PARK ROAD)	N/A	2.82	0.00	2.82	1		AS	1
0100	NC	54279		EAST YORK-SHELBYVILLE ROAD	FROM ROUTE 0010 (MAIN PARK DRIVE)	TO ROUTE 0102 (HUFFMAN ROAD) AND ROUTE 0103 (VAN DYKE ROAD)	N/A	0.00	0.92	0.92	6		NV	
0101	NC	54280		PIEDMONT ROAD	FROM ROUTE 0010 (MAIN PARK DRIVE)	TO PARK BOUNDARY	N/A	0.00	1.07	1.07	1		GR	
0102	NC	54281		HUFFMAN ROAD	FROM ROUTE 0100 (EAST YORK-SHELBYVILLE ROAD)	TO PARK BOUNDARY	N/A	0.00	0.24	0.24	6		NV	
0103	NC	54282		VAN DYKE ROAD	FROM ROUTE 0100 (EAST YORK-SHELBYVILLE ROAD)	TO PARK BOUNDARY	N/A	0.00	0.25	0.25	6		NV	
0400	NC	54283		WEST YORK-SHELBYVILLE ROAD	FROM ROUTE 0010 (MAIN PARK DRIVE)	TO PARK BOUNDARY	N/A	0.00	0.96	0.96	6		NV	
0401	NC	54285		DELLINGHAM ROAD	FROM ROUTE 0402 (HOWSER HOUSE ROAD)	TO LOOKOUT TOWER ROAD	N/A	0.00	0.96	0.96	6		NV	
0402	NC	54284		HOWSER HOUSE ROAD	FROM ROUTE 5000 (S-11-86 / ROCK HOUSE ROAD)	TO PARK BOUNDARY	N/A	0.00	0.50	0.50	6		NV	
0405	NC	54286		BROWNS MOUNTAIN ROAD	FROM LOOKOUT TOWER ROAD	TO BROWNS MOUNTAIN	N/A	0.00	0.79	0.79	6		NV	
0406	NC	54291		SEWER PLANT ROAD	FROM ROUTE 0900 (VISITOR CENTER PARKING)	TO SEWER PLANT	N/A	0.00	0.24	0.24	6		GR	
0407	NC	54292		WHITWORTH FIRE ROAD	FROM ROUTE 0010 (MAIN PARK DRIVE) AT MP 1.36 ON RIGHT	TO PARK BOUNDARY	N/A	0.00	0.66	0.66	6		NV	
0408	NC	54293		HORSE TRAIL ACCESS	FROM ROUTE 0010 (MAIN PARK DRIVE) AT MP 2.08 ON RIGHT	TO PARK BOUNDARY	N/A	0.00	0.82	0.82	6		NV	
0410	NC	54295		GORDON CEMETERY ROAD	FROM ROUTE 0101 (PIEDMONT ROAD)	TO END OF LOOP	N/A	0.00	0.09	0.09	6		NV	
0411	NC	54297		PUMP HOUSE ROAD	FROM ROUTE 0100 (EAST YORK-SHELBYVILLE ROAD)	TO PUMP HOUSE	N/A	0.00	0.22	0.22	6		OT	

Cycle 5 NPS/RIP Route ID Report

Road Inventory Program 02/20/2014

(Numerical By Route #)

Page 2 of 4

Shading Color Key:

Red text denotes approx. mileage

White = Paved Routes, DCV Driven
Grey = Paved Routes, DCV not Driven

Yellow = Unpaved Routes, DCV not Driven
Black = State, Local or Private non-NPS Routes

Blue = All Paved Parking Areas
■ = Concession Route Flag ON

Green = All Unpaved Parking Areas

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

KIMO

KINGS MOUNTAIN NATIONAL MILITARY PARK

Rte. No.	Cycle Collected	FMSS No.	Concess Route	Route Name	Route Description From To	Maint. District	Paved Miles	Un-Paved Miles	Total Route Length	Func. Class	Manual Rated SQ/FT	Surf. Type	Area Maps
0412	NC	54296		HORSE TRAIL CONNECTOR A	FROM ROUTE 0101 (PIEDMONT ROAD) TO HORSE TRAIL	N/A	0.00	0.91	0.91	6		OT	
0413	NC	54298		LEAD LINE ROAD	FROM ROUTE 0101 (PIEDMONT ROAD) TO END	N/A	0.00	0.52	0.52	6		NV	
0415	NC	54299		RESERVOIR ROAD	FROM ROUTE 0010 (MAIN PARK DRIVE) AT MP 1.13 ON RIGHT TO RESERVOIR	N/A	0.00	0.19	0.19	6		GR	
0416	NC	54302		ESA ROAD	FROM ROUTE 0400 (WEST YORK-SHELBYVILLE ROAD) TO ROUTE 0402 (HOWSER HOUSE ROAD)	N/A	0.00	0.90	0.90	6		NV	
0417	NC	54303		BATTLEFIELD TRAIL ACCESS	FROM ROUTE 0411 (PUMP HOUSE ROAD) TO FIRE ROAD	N/A	0.00	0.30	0.30	6		NV	
0900	5	54287		VISITOR CENTER PARKING	FROM ROUTE 0010 (MAIN PARK DRIVE) TO ROUTE 0010 (MAIN PARK DRIVE)	N/A	0.00	0.00	0.00		46,293	AS	1
0901	5	54288		MAINTENANCE AREA	FROM ROUTE 0010 (MAIN PARK DRIVE) TO MAINTENANCE AREA	N/A	0.00	0.00	0.00		15,640	AS	1
0902	5	54289		RESIDENCE ROAD	FROM ROUTE 0901 (MAINTENANCE AREA) TO RESIDENCE	N/A	0.00	0.00	0.00		10,468	AS	1
0903	5	54290		HEADQUARTERS PARKING	FROM ROUTE 0010 (MAIN PARK DRIVE) TO PARKING	N/A	0.00	0.00	0.00		7,963	AS	1
5000	5			S-11-86 / ROCK HOUSE ROAD	FROM ROUTE 5216 (NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85) TO STATE ROAD S-11-21 (ANTIOCH ROAD)	N/A	1.99	0.00	1.99			AS	1
5021	5			PARK ROAD	FROM END OF ROUTE 0010 (MAIN PARK DRIVE) AT EAST PARK BOUNDARY TO SOUTH CAROLINA STATE ROUTE 161	N/A	2.87	0.00	2.87			AS	1
5216	5			NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85	FROM INTERSECTION OF NB INTERSTATE 85 RAMP AND NORTH CAROLINA 216 S (BATTLEGROUND ROAD) TO BEGIN ROUTE 0010 (MAIN PARK DRIVE) AT WEST PARK BOUNDARY	N/A	2.09	0.00	2.09			AS	1

Cycle 5 NPS/RIP Route ID Report

Shading Color Key:
Red text denotes approx. mileage

White = Paved Routes, DCV Driven
Grey = Paved Routes, DCV not Driven

Yellow = Unpaved Routes, DCV not Driven
Black = State, Local or Private non-NPS Routes

Blue = All Paved Parking Areas
■ = Concession Route Flag ON

Green = All Unpaved Parking Areas

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

CYCLE 5 SUMMARY TOTALS FOR KINGS MOUNTAIN NATIONAL MILITARY PARK

<u>CYCLE 5 ROUTE TOTALS</u>	
DCV Driven Route Miles	2.82
Manually Rated Route Miles	0.00
TOTAL PARK ROUTE MILES COLLECTED IN CYCLE 5	2.82
Manually Rated Routes (SQFT)	0
TOTAL UNPAVED PARK ROUTE MILES	10.53

<u>CYCLE 5 CONCESSION TOTALS</u>	
Concession Paved Route Miles	0.00
Concession Unpaved Route Miles	0.00
TOTAL CONCESSION ROUTE MILES	0.00
Concession Paved Parking Area SQFT	0
Concession Unpaved Parking Area SQFT	0
TOTAL CONCESSION PARKING AREA SQFT	0
Concession Manually Rated Routes SQFT	0

* <u>CYCLE 5 PARKING AREA TOTALS</u>	
Paved Parking (SQFT)	80,364
Unpaved Parking (SQFT)	0
TOTAL PARKING (SQFT)	80,364

<u>CYCLE 5 WEIGHTED AVERAGE PARK VALUES</u>	
DCV Driven PCR	99
**Manually Rated Routes PCR	N/A
**Parking PCR	71
***Total Equivalent Lane Miles	6.87

* - The Parking Area Totals SQFT value represents all parking areas collected in Cycle 5, both park and concessionaire.

** - Parking and Manually Rated Routes are assigned the following PCR values based on their observed condition: Construction=-1, Excellent=97, Good=90, Fair=73, and Poor=45.

*** - Equivalent Lane Miles are calculated by route using the following equations : DCV and Manually Rated Lines Routes=(PAVE_WIDTHxPAVED_MI)/11 foot lane. Parking Areas=SQ_FEET/5280/11. Manually Rated Polygons=SQ_FEET/5280/11.

Cycle 5 NPS/RIP Route ID Report

Shading Color Key:

Red text denotes approx. mileage

White = Paved Routes, DCV Driven	Yellow = Unpaved Routes, DCV not Driven	Blue = All Paved Parking Areas	Green = All Unpaved Parking Areas
Grey = Paved Routes, DCV not Driven	Black = State, Local or Private non-NPS Routes	■ = Concession Route Flag ON	

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

General Park Road Functional Classification Table

- Class 1** Principal Park Road/Rural Parkway (Public Roads) Roads which constitute the main access route, circulatory tour, or thoroughfare for park visitors. Route Numbers 1 - 99. Note: Rural parkways (e.g. Natchez Trace) are numbered 1 - 9. State Routes Inventoried for Park. Route Numbers 5000-5999
- Class 2** Connector Park Road (Public Roads) - Roads which provide access within a park to areas of scenic, scientific, recreational or cultural interest, such as overlooks, campgrounds, etc. Route Numbers 100-199.
- Class 3** Special Purpose Park Road (Public Roads) - Roads which provide circulation within public areas, such as campgrounds, picnic areas, visitor center complexes, concessionaire facilities, etc. These roads generally serve low-speed traffic and are often designed for one-way circulation. Route Numbers 200-299.
- Class 4** Primitive Park Roads (Public Roads) - Roads which provide circulation through remote areas and/or access to primitive campgrounds and undeveloped areas. These roads frequently have no minimum design standards and their use may be limited to specially equipped vehicles. Route Numbers 200-299. Note: Functional Classes 3 and 4 have the same route numbers because, historically, they were numbered similarly.
- Class 5** Administrative Access Road (Administrative Roads) - All public roads intended for access to administrative developments or structures such as park offices, employee quarters, or utility areas. Route Numbers 400-499.
- Class 6** Restricted Road (Administrative Roads) - All roads normally closed to the public, including patrol roads, truck trails, and other similar roads. Route Numbers 400-499. Note: Functional Classes 5 and 6 have the same route numbers because historically they were numbered similarly and often there is little distinction between these routes. For example, because utility areas and employee housing are often closed to the public, this restriction would result in classification of FC 6 rather than FC 5.
- Class 7** Urban Parkway (Urban Parkways and City Streets) - These facilities serve high volumes of park and non-park related traffic and are restricted, limited-access facilities in an urban area. This category of roads primarily encompasses the major parkways which serve as gateways to our nation's capital. Other major park roads or portions thereof, however, may be included in this category. Route Numbers 1-9.
- Class 8** City Streets (Urban Parkways and City Streets) - City streets are usually extensions of the adjoining street system that are owned and maintained by the National Park Service. The construction and/or reconstruction should conform with accepted local engineering practice and local conditions. Route Numbers 600-699.

A park road system contains those roads within or giving access to a park or other unit of the NPS which are administered by the NPS, or by the Service in cooperation with other agencies. The assignment of a functional classification (FC) to a park road is not based on traffic volumes or design speed, but on the intended use or function of that road or route.

The historic route numbering system also included a 300 number series for interpretive roads, and a 500 series for one-way roads. There are approximately 250 roads nationwide which are designated by the 300 and 500 series. The numbers for these roads will be maintained for reporting consistency. However, since these interpretive and one-way routes are not as clearly tied to a specific functional class, the 300 and 500 series will be discontinued for future use.

5000 route numbers are assigned to Non-NPS Routes that are State, County or City owned which border, traverse, or provide access to Park Facilities or Locations. 5000 Routes are driven for GPS and Video Log only.

Surface Type Abbreviations:

- AS - Asphaltic Concrete Pavement**
- CO - Portland Cement Concrete Pavement**
- BR - Brick or Pavers Road Bed**
- CB - Cobble Stone Road Bed**
- GR - Gravel Road Bed**
- SA - Sand Road Bed**
- NV - Native or Dirt Material Road Bed**
- OT - Other Materials Road Bed**

ROUTES ADDED FROM PREVIOUS INVENTORY:

Route #	Route Name	Reason for Addition	Comments
5000	S-11-86 / ROCK HOUSE ROAD	OTHER	NEW 5000 ROUTE ADDED DURING THE CYCLE 5 ROUTE ID MEETING.
5021	PARK ROAD	OTHER	NEW 5000 ROUTE ADDED DURING THE CYCLE 5 ROUTE ID MEETING.
5216	NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85	OTHER	NEW 5000 ROUTE ADDED DURING THE CYCLE 5 ROUTE ID MEETING.

OTHER CHANGES FROM PREVIOUS INVENTORY:

Route #	Route Name	Type of Change	Comments
0902	RESIDENCE ROAD	SQ FEET CHANGE	ROUTE AREA INCREASED DUE TO ROUTE SHAPE CHANGES SINCE CYCLE 3 DATA COLLECTION.

Section 3

Park Summary Information



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

KIMO: PAVED ROUTE MILES AND PERCENTAGES BY FUNCTIONAL CLASS AND PCR

F.C.	Pavement Condition Rating (PCR)								TOTAL MILES
	Poor (0-60)		Fair (61-84)		Good (85-94)		Excellent (95-100)		
	MILES	%	MILES	%	MILES	%	MILES	%	
1			0.06	2.13%	0.24	8.51%	2.52	89.36%	2.82
2									
3									
4									
5									
6									
7									
8									
Totals	0.00	0.00%	0.06	2.13%	0.24	8.51%	2.52	89.36%	2.82

Note: The information in this table is derived from the PMS_20 table in the Park database, which only contains processed data from routes collected with the Data Collection Vehicle (DCV). Information for Manually Rated Routes (MRR) and Parking Areas is not reported in this table. Only Functional Class 1, 2, & 7 routes, and any new routes not previously collected by RIP, are collected in Large Parks.

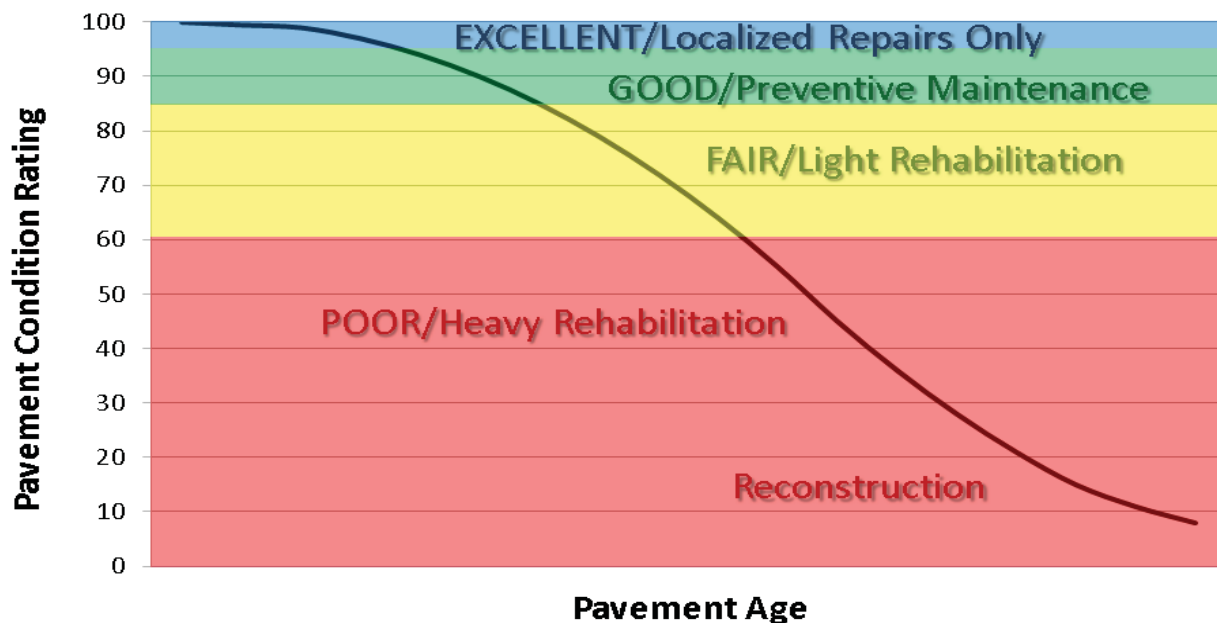
Explanation of the Excellent, Good, Fair and Poor Condition Descriptions

In addition to the RIP Index changes that have been implemented in Cycle 5, we will also aim to provide greater assistance in translating excellent/good/fair/poor categories into pavement needs categories. The PCR can be used to indicate the place in the Pavement Life Cycle and the types of treatments that should be considered now and into the future.

- Excellent/New: PCR of 95-100. Pavements in this range will require only spot repairs
- Good: PCR of 85-94. Pavements in this range will likely be candidates for Preventive Maintenance. Examples include Chip and Slurry Seals, Micro Surfacing and Thin Overlays.
- Fair: PCR of 61-84. Pavements in this range will likely be candidates of Light Rehabilitation (L3R). Examples include single-lift overlays up to 2.5 inches in total thickness, milling and overlays.
- Poor: PCR of 0-60. Pavements in this range will likely be candidates of Heavy Rehabilitation or Reconstruction (H3R or 4R). Examples include Pulverization, Multiple Lift Overlays, and Reconstruction.

At this time, specific Maintenance and Rehabilitation activities should be evaluated and recommended at the project level. Site-specific conditions that influence treatment type should be determined based on performing a subsurface investigation and/or pavement condition survey, and not be based solely on RIP data. Additionally, RIP produces a snapshot of conditions the year in which the data was collected. For further information or to obtain additional Pavement Management System's data from our Highway Pavement Management Application (HPMA) please contact the Eastern Federal Lands pavement team.

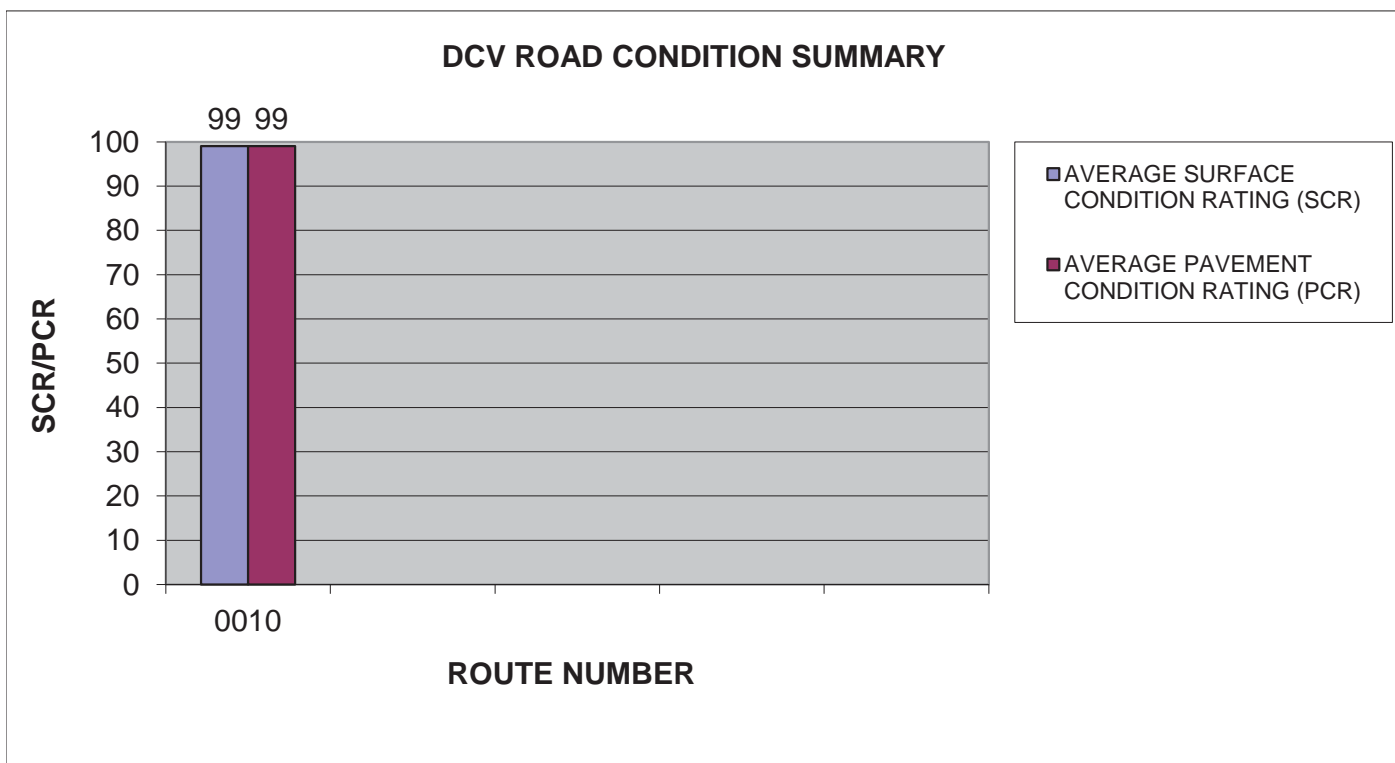
Condition Categories and Treatments



KIMO: DCV ROAD CONDITION SUMMARY

DCV - Data Collection Vehicle

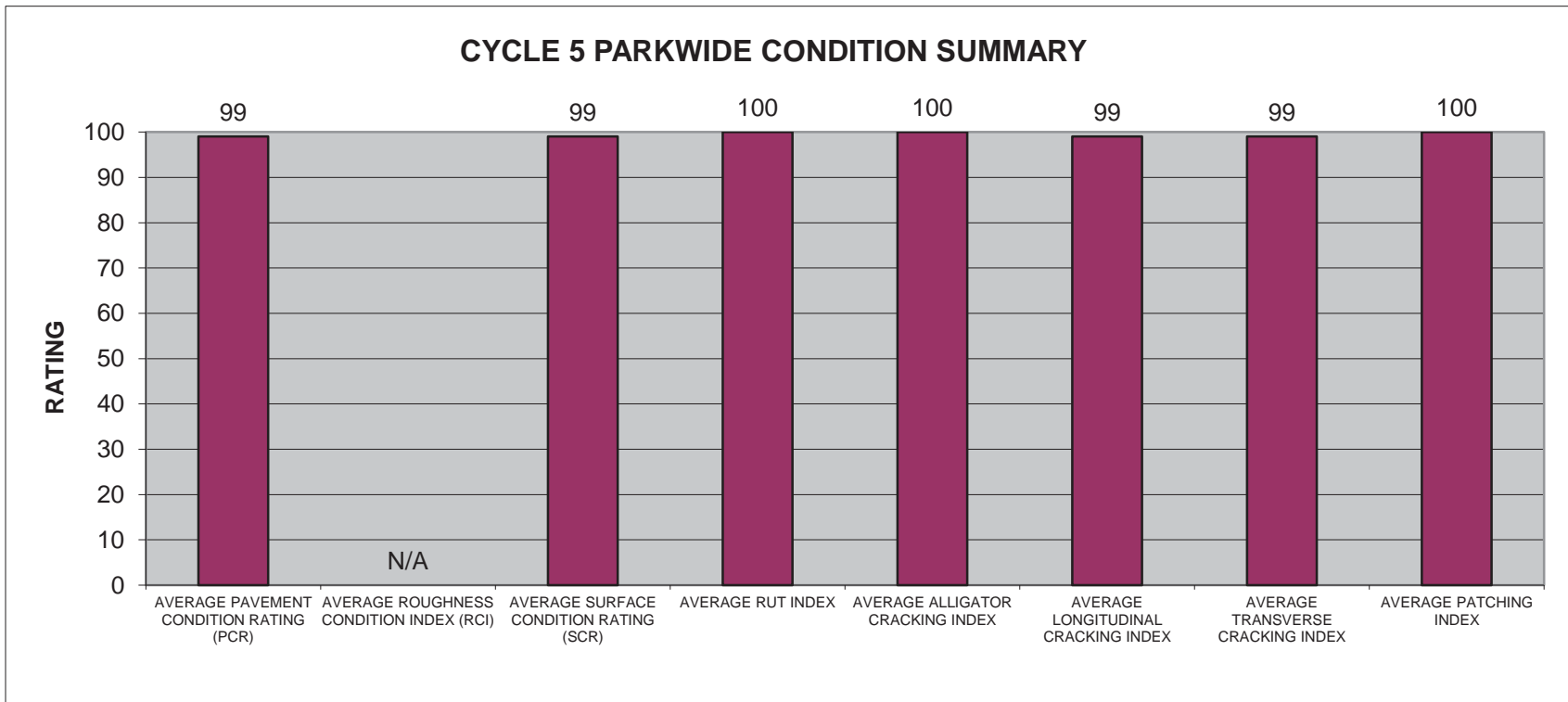
ROUTE NUMBER	ROUTE NAME	FUNCT CLASS	PAVED LENGTH	SURFACE TYPE	AVERAGE SURFACE CONDITION RATING (SCR)	AVERAGE PAVEMENT CONDITION RATING (PCR)
0010	MAIN PARK DRIVE	1	2.82	ASPHALT	99	99



KIMO: PARKWIDE DCV CONDITION SUMMARY

AVERAGE PAVEMENT CONDITION RATING (PCR)	AVERAGE ROUGHNESS CONDITION INDEX (RCI)	AVERAGE SURFACE CONDITION RATING (SCR)	AVERAGE RUT INDEX	AVERAGE ALLIGATOR CRACKING INDEX	AVERAGE LONGITUDINAL CRACKING INDEX	AVERAGE TRANSVERSE CRACKING INDEX	AVERAGE PATCHING INDEX
99	N/A	99	100	100	99	99	100

All Index values are based on Data Collection Vehicle (DCV) driven roads that were collected in Cycle-5.
 Roughness data is only collected on routes with lengths greater than 0.5 miles and a posted speed limit of 25 MPH or greater.



Section 4

Park Route Location Maps

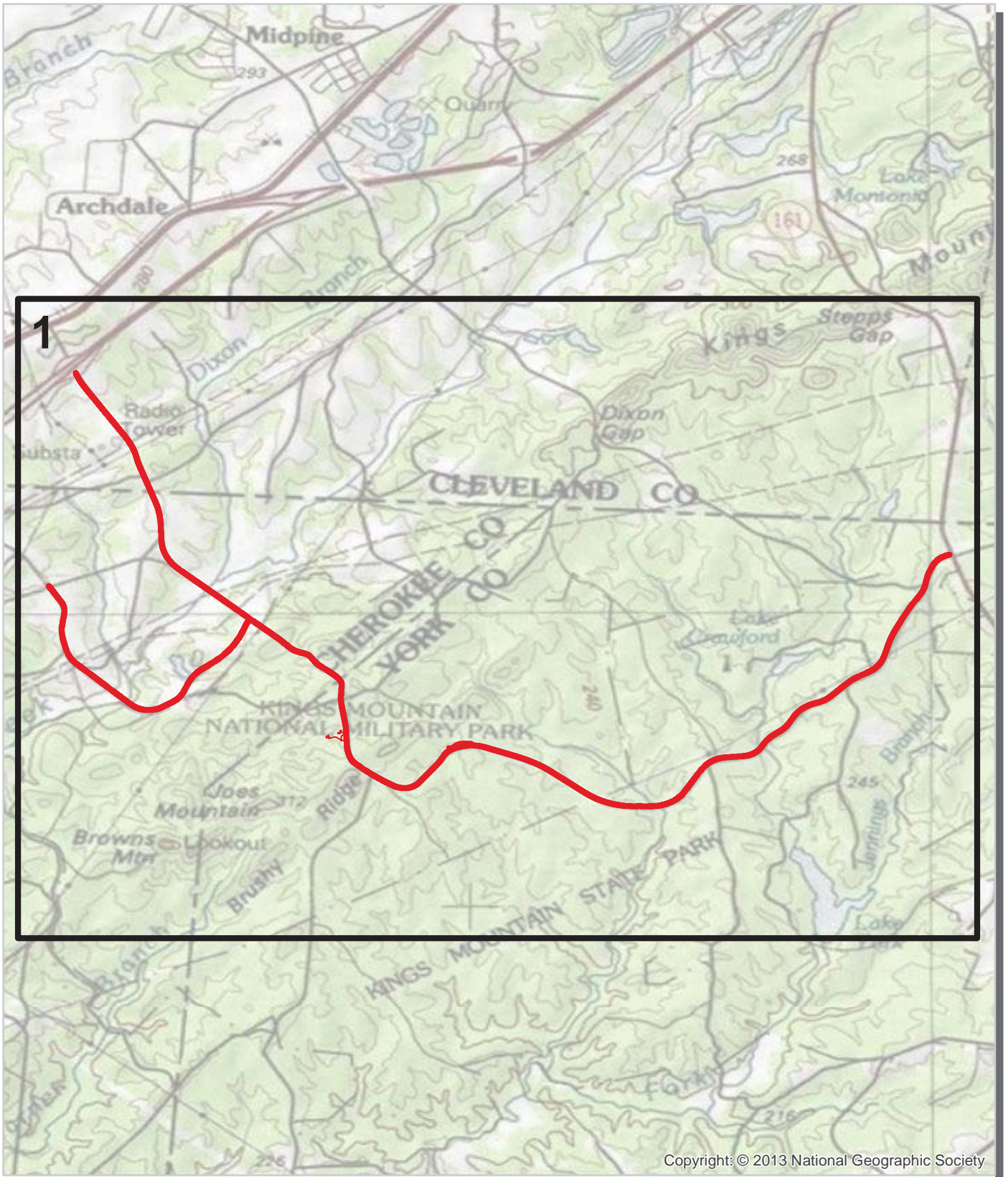



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

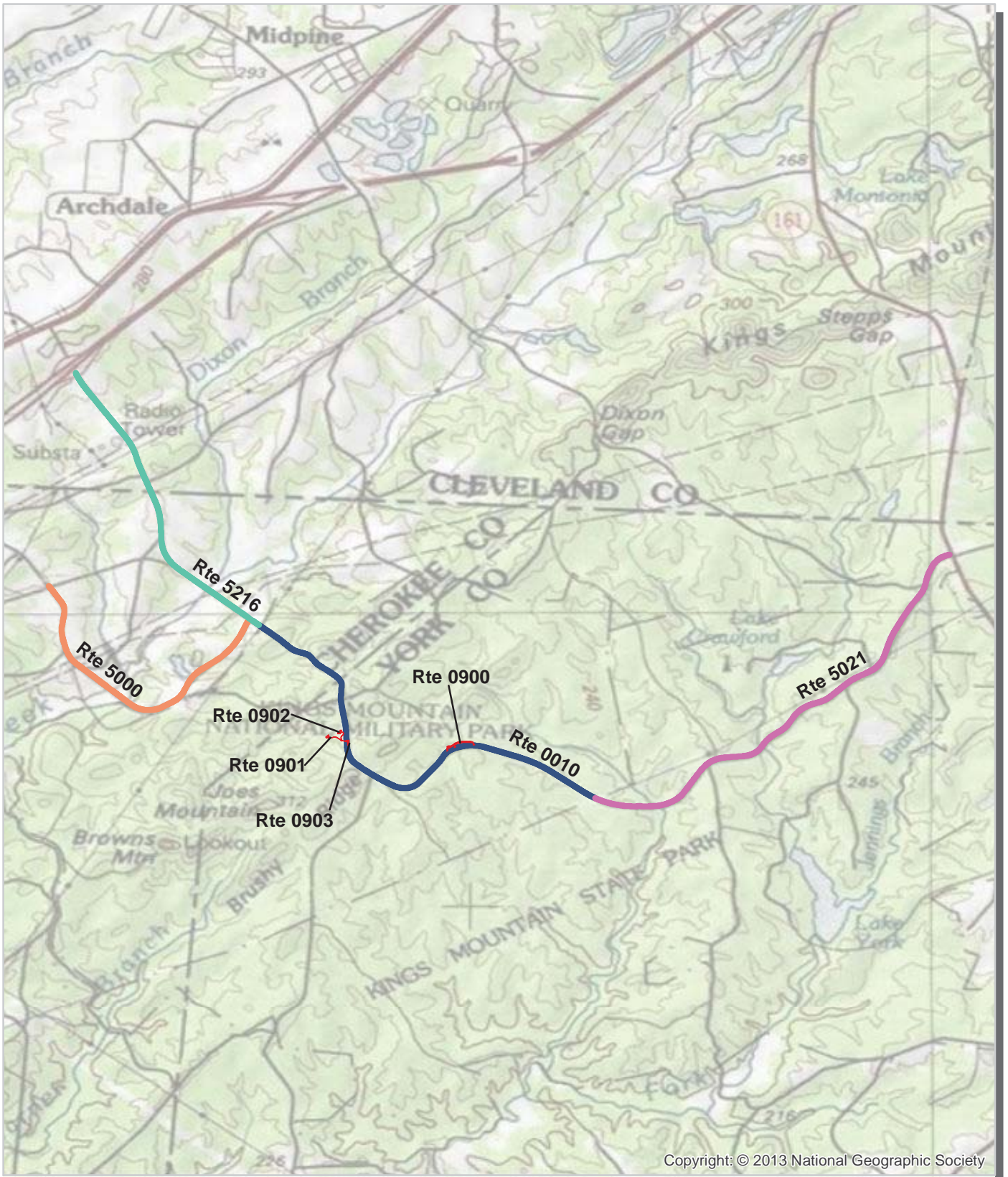
Kings Mountain National Military Park Route Location Map Key Map



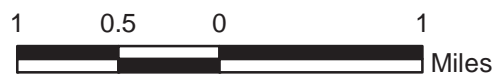
 Cycle 5 Collected Routes



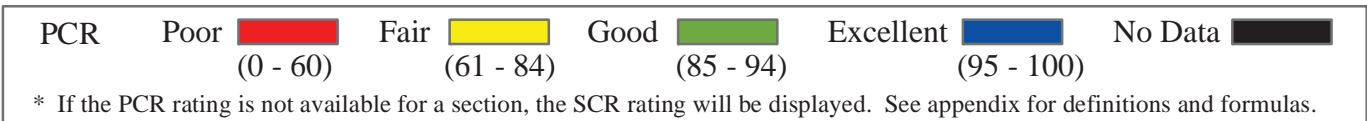
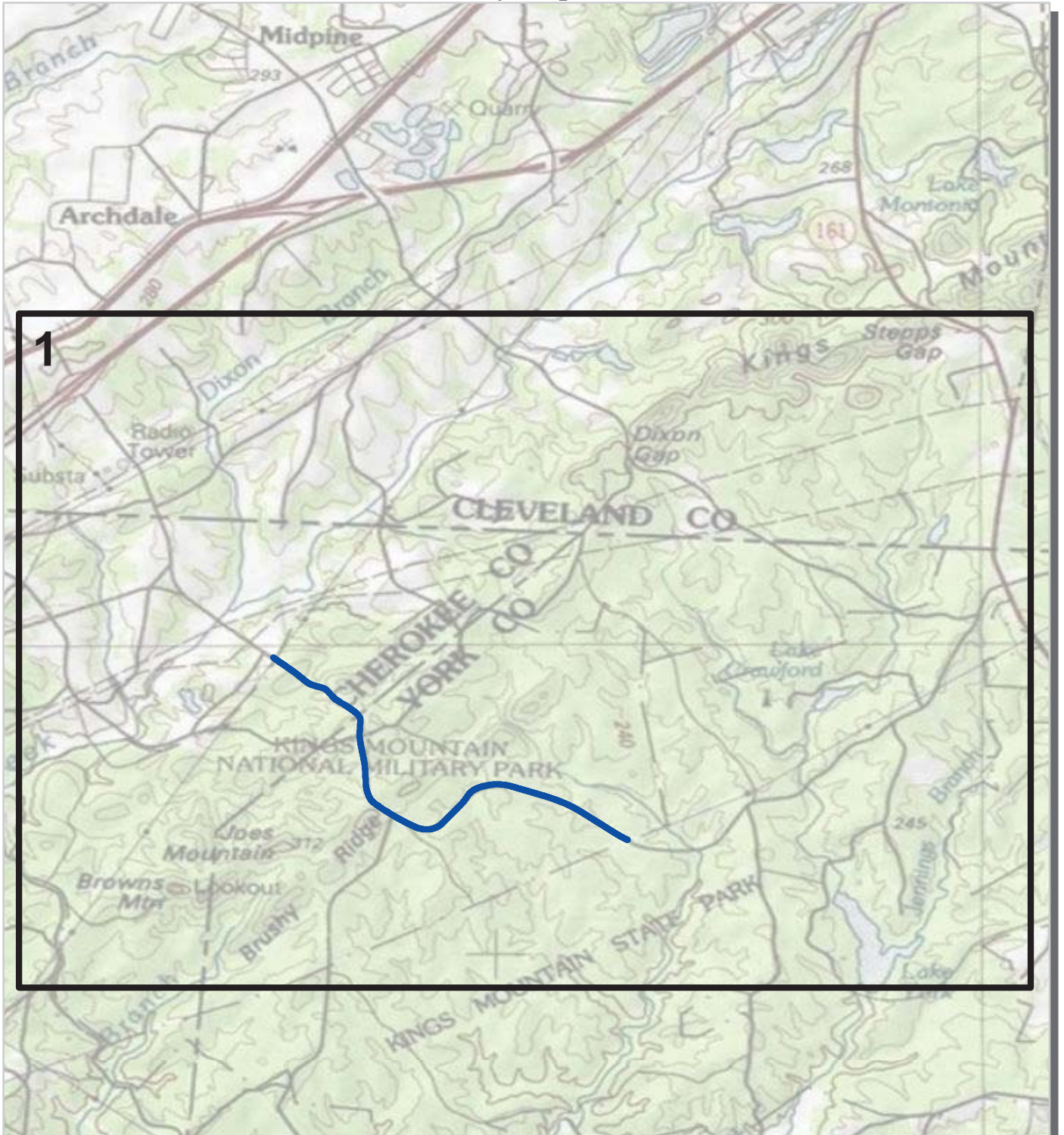
Kings Mountain National Military Park Route Location Map Area 1



Unique colors used to differentiate routes



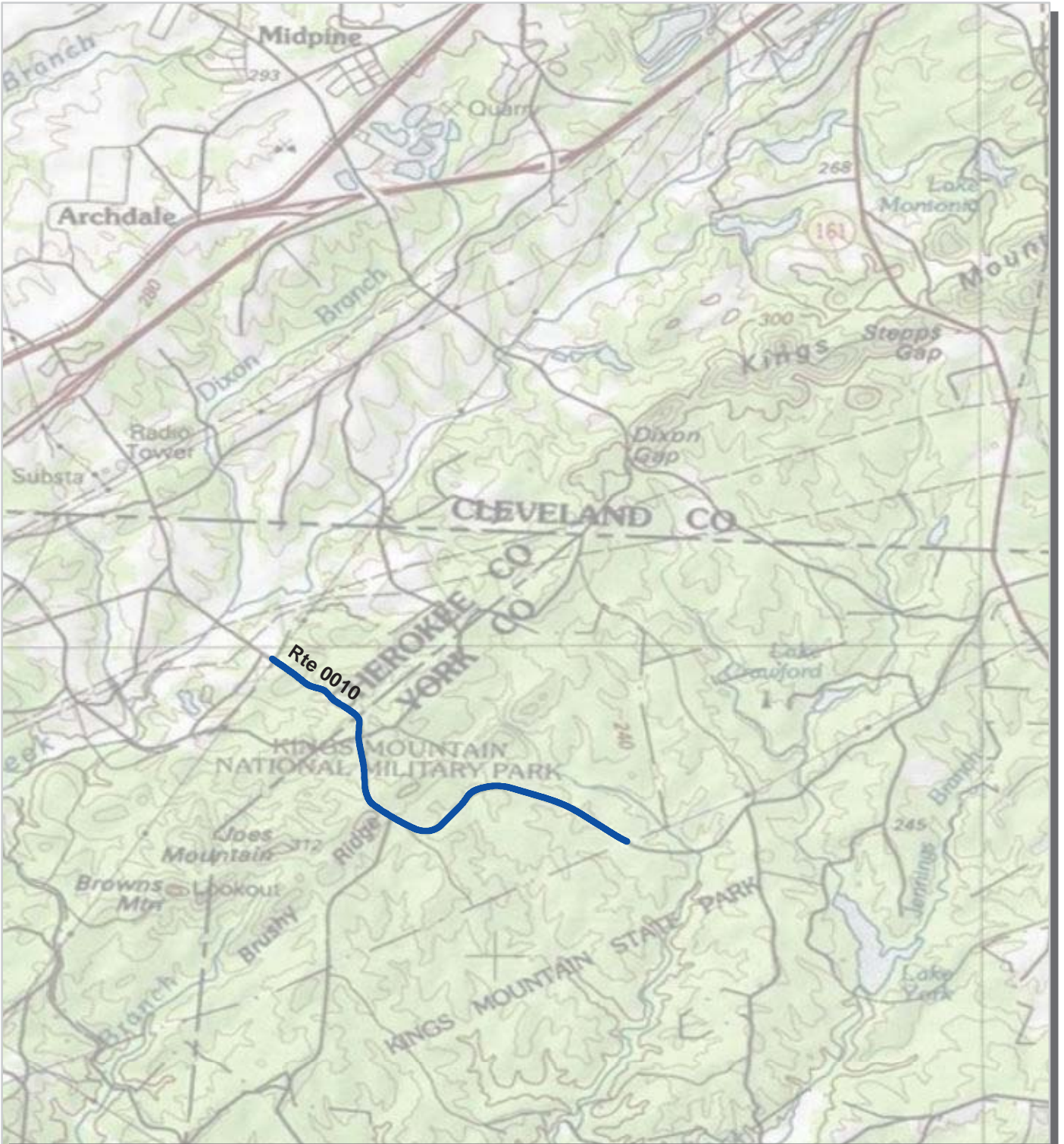
Kings Mountain National Military Park Route Condition Map PCR - Mile by Mile Key Map



Note: Only routes collected by the DCV in Cycle-5 are displayed.



**Kings Mountain National Military Park
Route Condition Map
PCR - Mile by Mile
Area 1**



PCR	Poor	Fair	Good	Excellent	No Data
	(0 - 60)	(61 - 84)	(85 - 94)	(95 - 100)	

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.



Section 5
Paved Route
Condition Rating Sheets



Kings Mountain National Military Park



**Federal Lands Highway
Road Inventory Program**



PCR Poor ■ Fair ■ Good ■ Excellent ■ No Data ■
 (0 - 60) (61 - 84) (85 - 94) (95 - 100)

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

ROUTE: 0010 MAIN PARK DRIVE
KIMO : KINGS MOUNTAIN NATIONAL MILITARY PARK

COLLECTED: 7/22/2013

TOTAL LENGTH: 2.82 Miles

SOUTHEAST REGION

<i>Section Number</i>	0	1	2		
<i>Section Length (mi)</i>	1.00	1.00	0.82		
<i>Cross Section Information</i>					
Number of Lanes	2	2	2		
Paved Width (ft)	21	22	21		
Lane Width (ft)	10	10	10		
<i>Roadway Condition Information</i>					
SCR (Surface Condition Rating)	99	99	98		
PCR (Pavement Condition Rating)	99	99	98		
<i>Distress Index Values</i>					
Structural Crack Index	99	99	98		
Transverse Cracking Index	100	99	99		
Patching Index	100	100	100		
Rutting Index	100	100	100		
Roughness Condition Index (RCI)	NC	NC	NC		

NOTES:

Structural Crack Index is a combination of the Longitudinal Cracking Index and Alligator Cracking Index.

See Section 10 for explanation of SCR, PCR, & all Distress Index Values.

NC - Not Collected N/A - Not Applicable



ROUTE: 0010 MAIN PARK DRIVE

Section 6
Manually Rated Paved Route
Condition Rating Sheets



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

MANUALLY RATED ROUTE CONDITION RATING SHEETS

No data available for this section.

Section 7
Parking Area
Condition Rating Sheets



Kings Mountain National Military Park



**Federal Lands Highway
Road Inventory Program**

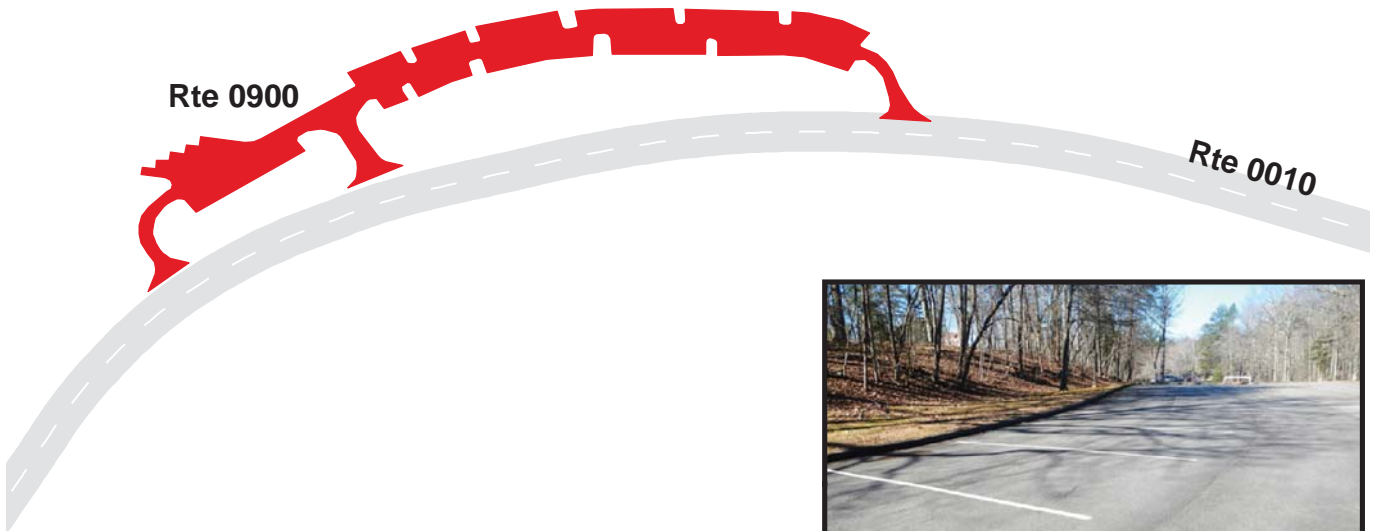
KINGS MOUNTAIN NATIONAL MILITARY PARK

Route 0900

VISITOR CENTER PARKING
 FROM ROUTE 0010 (MAIN PARK DRIVE)
 TO ROUTE 0010 (MAIN PARK DRIVE)

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0900	PUBLIC	2/21/2013	46,293	0.80	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
1	11	3	CONCRETE CURB AND GUTTER	NO CURB	GOOD/90

* Lane miles are based on 11' lane widths



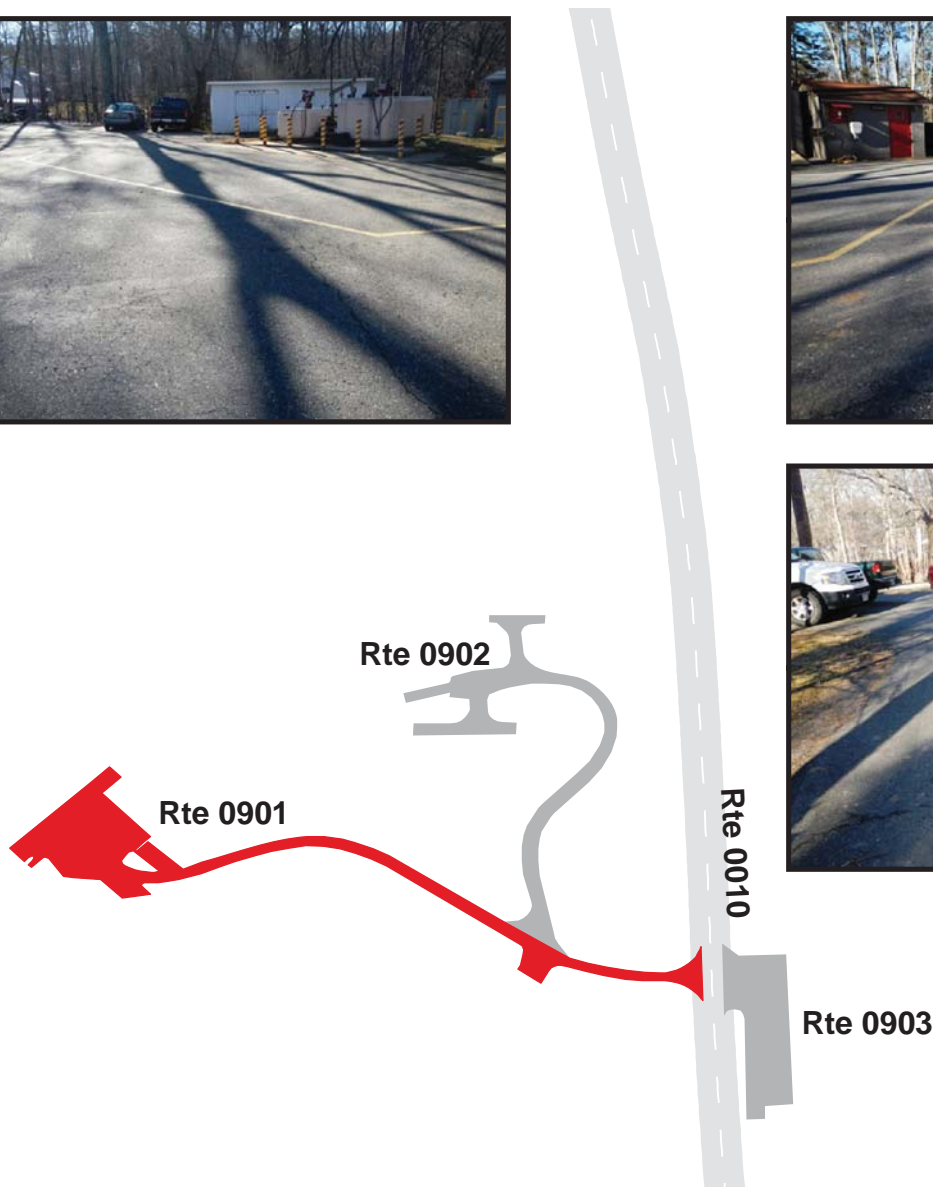
KINGS MOUNTAIN NATIONAL MILITARY PARK

Route 0901

MAINTENANCE AREA
FROM ROUTE 0010 (MAIN PARK DRIVE)
TO MAINTENANCE AREA

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0901	NONPUBLIC	2/21/2013	15,640	0.27	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
3	2	1	NO CURB AND GUTTER	NO CURB	POOR/45

* Lane miles are based on 11' lane widths



KINGS MOUNTAIN NATIONAL MILITARY PARK

Route 0902

RESIDENCE ROAD
FROM ROUTE 0901 (MAINTENANCE AREA)
TO RESIDENCE

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0902	NONPUBLIC	2/21/2013	10,468	0.18	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
1	0	0	NO CURB AND GUTTER	NO CURB	POOR/45

* Lane miles are based on 11' lane widths



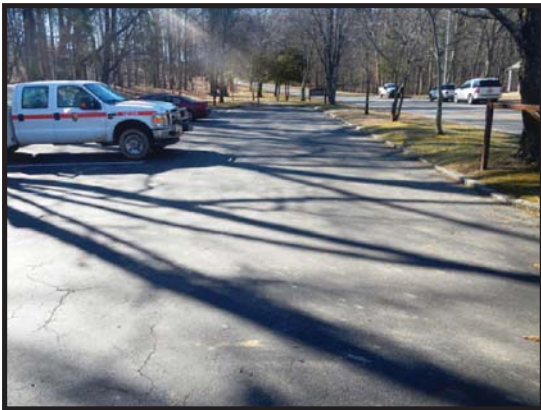
KINGS MOUNTAIN NATIONAL MILITARY PARK

Route 0903

HEADQUARTERS PARKING
FROM ROUTE 0010 (MAIN PARK DRIVE)
TO PARKING

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0903	PUBLIC	2/21/2013	7,963	0.14	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
0	1	1	NO CURB AND GUTTER	STONE CURB	POOR/45

* Lane miles are based on 11' lane widths



Section 8
Parkwide/Route
Maintenance Features Summaries



Kings Mountain National Military Park



**Federal Lands Highway
Road Inventory Program**

KIMO: PARKWIDE MAINTENANCE FEATURES SUMMARY
Includes DCV, MRL, MRP & PKG routes collected in Cycle-5

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all DCV driven routes. Culverts, drop inlets, and gates were also collected on all Manually Rated Routes and Paved Parking areas. Those totals are reflected below.

FEATURE	LINEAR FEET	COUNT
BRIDGE	--	0
CATTLE GUARD	--	0
CULVERT	--	13
CURB	275	--
DROP INLET	--	17
GATE	--	5
GUARD/GUIDE RAIL	0	--
CABLE	0	--
NON-CABLE	0	--
GUARD/GUIDE WALL	0	--
BOLLARD	0	--
TEMPORARY BARRIER	0	--
NON TEMP/BOLLARD	0	--
INTERSECTION	--	13
LOW WATER CROSSING	0	0
MILE MARKER	--	0
OVERPASS	--	0
PARK BOUNDARY	--	2
PAVED DITCH	675	--
PULLOUT	307	2
RAILROAD CROSSING	--	0
RETAINING WALL	0	0
SIGN	--	54
STATE BOUNDARY	--	0
TRAFFIC LIGHT	--	0
TUNNEL	0	0

KIMO: DCV ROUTE MAINTENANCE FEATURES SUMMARY

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5.

FEATURE	ROUTE 0010 MAIN PARK DRIVE	UNIT
BRIDGE	0	EACH
CATTLE GUARD	0	EACH
CULVERT	8	EACH
CURB	275	LINEAR FEET
DROP INLET	3	EACH
GATE	0	EACH
GUARD/GUIDE RAIL	0	LINEAR FEET
CABLE	0	LINEAR FEET
NON-CABLE	0	LINEAR FEET
GUARD/GUIDE WALL	0	LINEAR FEET
BOLLARD	0	LINEAR FEET
TEMPORARY BARRIER	0	LINEAR FEET
NON TEMP/BOLLARD	0	LINEAR FEET
INTERSECTION	13	EACH
LOW WATER CROSSING	0	EACH
LOW WATER CROSSING	0	LINEAR FEET
MILE MARKER	0	EACH
OVERPASS	0	EACH
PARK BOUNDARY	2	EACH
PAVED DITCH	675	LINEAR FEET
PULLOUT	2	EACH
PULLOUT	307	LINEAR FEET
RAILROAD CROSSING	0	EACH
RETAINING WALL	0	EACH
RETAINING WALL	0	LINEAR FEET
SIGN	54	EACH
STATE BOUNDARY	0	EACH
TRAFFIC LIGHT	0	EACH
TUNNEL	0	EACH
TUNNEL	0	LINEAR FEET

STRUCTURE LIST

No data available for this section.

Section 9

Route Maintenance Features

Road Logs



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

KIMO: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0010: MAIN PARK DRIVE

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.000	0.000	ROUTE BEGIN	N/A	FROM WEST PARK BOUNDARY AT PAVEMENT CHANGE / END OF ROUTE 5216 (NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85)
0.000	0.000	PARK BOUNDARY	N/A	N/A
0.000	0.000	INTERSECTION	N/A	ROUTE 5216 (NORTH CAROLINA 216 S / SOUTH CAROLINA S-11-85)
0.004	0.004	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.004	0.004	SIGN	RIGHT	WARNING, SHARE THE ROAD
0.007	0.031	CURB-AND-GUTTER	RIGHT	N/A
0.007	0.031	PULLOUT	RIGHT	N/A
0.009	0.009	SIGN	LEFT	GUIDE, CHEROKEE COUNTY
0.031	0.031	SIGN	RIGHT	GUIDE, KINGS MOUNTAIN NATIONAL MILITARY PARK VISITOR CENTER 2 MILES
0.040	0.040	SIGN	RIGHT	REGULATORY, COMMERCIAL VEHICLES EXCLUDED
0.048	0.048	SIGN	LEFT	GUIDE, WE HOPE YOU VISIT US AGAIN
0.078	0.078	SIGN	RIGHT	REGULATORY, RADAR ENFORCED
0.078	0.078	SIGN	RIGHT	REGULATORY, SPEED LIMIT 35
0.099	0.099	SIGN	RIGHT	GUIDE, WELCOME ENJOY YOUR VISIT
0.187	0.187	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.295	0.295	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
0.322	0.322	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.404	0.404	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.441	0.441	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
0.443	0.443	CULVERT	N/A	N/A
0.461	0.461	SIGN	LEFT	REGULATORY, UNABLE TO READ FROM VIDEO
0.463	0.463	SIGN	LEFT	GUIDE, UNABLE TO READ FROM VIDEO
0.482	0.496	PAVED DITCH	RIGHT	N/A
0.483	0.483	DROP INLET	RIGHT	N/A
0.536	0.536	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.651	0.651	DROP INLET	RIGHT	N/A
0.651	0.656	PAVED DITCH	RIGHT	N/A

KIMO: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0010: MAIN PARK DRIVE

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.676	0.676	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
0.720	0.720	INTERSECTION	LEFT	ROUTE 0100 (EAST YORK-SHELBYVILLE ROAD)
0.722	0.722	INTERSECTION	RIGHT	ROUTE 0400 (WEST YORK-SHELBYVILLE ROAD)
0.790	0.790	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
0.790	0.790	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.854	0.854	SIGN	RIGHT	GUIDE, UNABLE TO READ FROM VIDEO
0.968	0.968	SIGN	LEFT	REGULATORY, UNABLE TO READ FROM VIDEO
0.995	0.995	SIGN	RIGHT	GUIDE, VISITOR CENTER 1 MILE CAMPING PICNICKING 5 MILES
1.003	1.003	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
1.020	1.020	INTERSECTION	LEFT	ROUTE 0903 (HEADQUARTERS PARKING)
1.020	1.020	INTERSECTION	RIGHT	ROUTE 0901 (MAINTENANCE AREA)
1.038	1.072	PULLOUT	RIGHT	N/A
1.041	1.055	CURB	RIGHT	N/A
1.058	1.072	CURB	RIGHT	N/A
1.060	1.060	SIGN	LEFT	GUIDE, KINGS MOUNTAIN NATIONAL MILITARY PARK
1.083	1.083	CULVERT	N/A	N/A
1.135	1.135	INTERSECTION	RIGHT	ROUTE 0415 (RESERVOIR ROAD)
1.185	1.185	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
1.216	1.216	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
1.222	1.245	PAVED DITCH	LEFT	N/A
1.254	1.267	PAVED DITCH	RIGHT	N/A
1.288	1.288	INTERSECTION	RIGHT	ROUTE 0101 (PIEDMONT ROAD)
1.296	1.296	SIGN	RIGHT	GUIDE, PIEDMONT RD
1.342	1.342	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
1.368	1.368	INTERSECTION	RIGHT	ROUTE 0407 (WHITWORTH FIRE ROAD)
1.390	1.390	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
1.444	1.444	CULVERT	N/A	N/A
1.600	1.600	CULVERT	N/A	N/A
1.633	1.633	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT

KIMO: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0010: MAIN PARK DRIVE

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
1.686	1.759	PAVED DITCH	LEFT	N/A
1.715	1.715	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
1.739	1.739	DROP INLET	LEFT	N/A
1.771	1.771	SIGN	LEFT	REGULATORY, SPEED LIMIT 35
1.771	1.771	SIGN	RIGHT	REGULATORY, SPEED LIMIT 25
1.870	1.870	SIGN	LEFT	GUIDE, GRAPHIC SIGN NO TEXT
1.875	1.875	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
1.880	1.880	INTERSECTION	LEFT	ROUTE 0900 (VISITOR CENTER PARKING)
1.885	1.885	SIGN	LEFT	REGULATORY, DO NOT ENTER
1.900	1.900	SIGN	RIGHT	GUIDE, KINGS MOUNTAIN NATIONAL MILITARY PARK VISITOR CENTER
1.907	1.907	SIGN	LEFT	GUIDE, GRAPHIC SIGN NO TEXT
1.922	1.922	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
1.930	1.930	INTERSECTION	LEFT	ROUTE 0900 (VISITOR CENTER PARKING)
1.988	1.988	SIGN	LEFT	GUIDE, KINGS MOUNTAIN NATIONAL MILITARY PARK VISITOR CENTER
2.029	2.029	SIGN	LEFT	REGULATORY, DO NOT ENTER
2.030	2.030	INTERSECTION	LEFT	ROUTE 0900 (VISITOR CENTER PARKING)
2.071	2.071	CULVERT	N/A	N/A
2.082	2.082	INTERSECTION	RIGHT	ROUTE 0408 (HORSE TRAIL ACCESS)
2.180	2.180	SIGN	LEFT	REGULATORY, SPEED LIMIT 25
2.181	2.181	SIGN	RIGHT	REGULATORY, SPEED LIMIT 35
2.288	2.288	CULVERT	N/A	N/A
2.434	2.434	CULVERT	N/A	N/A
2.678	2.678	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
2.703	2.703	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
2.703	2.703	SIGN	LEFT	WARNING, SHARE THE ROAD
2.721	2.721	CULVERT	N/A	N/A
2.740	2.740	SIGN	LEFT	GUIDE, WELCOME ENJOY YOUR VISIT
2.762	2.762	SIGN	LEFT	REGULATORY, SPEED LIMIT 35
2.762	2.762	SIGN	LEFT	REGULATORY, UNABLE TO READ FROM VIDEO

KIMO: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0010: MAIN PARK DRIVE

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
2.771	2.771	SIGN	RIGHT	GUIDE, WE HOPE YOU VISIT US AGAIN
2.785	2.785	SIGN	LEFT	REGULATORY, COMMERCIAL VEHICLES EXCLUDED
2.789	2.789	SIGN	LEFT	GUIDE, KINGS MOUNTAIN NATIONAL MILITARY PARK VISITOR CENTER 1 MILE
2.817	2.817	SIGN	RIGHT	GUIDE, KINGS MOUNTAIN STATE PARK
2.820	2.820	INTERSECTION	N/A	ROUTE 5021 (PARK ROAD)
2.820	2.820	PARK BOUNDARY	N/A	N/A
2.820	2.820	ROUTE END	N/A	TO EAST PARK BOUNDARY AT PAVEMENT CHANGE / BEGINNING OF ROUTE 5021 (PARK ROAD)

Section 10 Appendix



Kings Mountain National Military Park



Federal Lands Highway
Road Inventory Program

Explanation of Changes to the RIP Index Equations and Determination of PCR

In 2005, the FHWA began implementing the use of a Pavement Management System to assist the National Park Service in prioritizing Pavement Maintenance and Rehabilitation activities. The PMS used by FHWA is the Highway Pavement Management Application (HPMA) and this software has the ability to store inventory and condition data from RIP and forecast future performance using prediction models. Outputs include performance and condition reports at the National, Region, Park, or Route level. A regional prioritized list and optimization have been produced for most regions and the Federal Highway Deferred Maintenance is calculated via the HPMA as well.

In an effort to improve the accuracy of treatment recommendations and pavement condition descriptions in relation to the distresses and indexes that comprise the Pavement Condition Rating (PCR), an extensive study was completed throughout 2010 that resulted in changes to the Road Inventory Program condition reporting method and specifically, the calculation of PCR. It was determined that a better representation of PCR could be achieved by modifying the relative impact certain distresses would have on the overall rating.

Through the use of HPMA data, it was noted that false failure indicators existed with the existing PCR model, and that it would be necessary to reduce their impact. The distresses affected in this way were Rutting and Roughness. Conversely, experience showed that roadways with extensive cracking present were often shown to have a high PCR. Therefore, the crack index models were adjusted to be more sensitive to changes in crack severity or quantity. It was also determined that these issues were not due to a problem with data acquisition (i.e. the RIP “van”), but with the way the collected data was processed. The final change was to provide guidance on when to use the Roughness Condition Index (RCI) in the PCR calculation. Roughness data is of little value to determining overall condition on routes that, due to their length or geometrics, have lower vehicle operating speeds. Therefore, in Cycle 5, only routes that have lengths of one half mile or greater and posted speed limits of 25 mph or greater will have RCI reported and included in the PCR calculations.

The changes that were implemented were endorsed by management at both the FHWA and NPS. In order to show the effectiveness of these changes, several sites were ground truth tested to ensure that an improvement was achieved between the relationship of PCR and the actual Maintenance and Rehabilitation needs that were represented. These changes will allow greater use of RIP and HPMA data for not simply condition data reporting, but also as a reliable tool for project identification and selection.

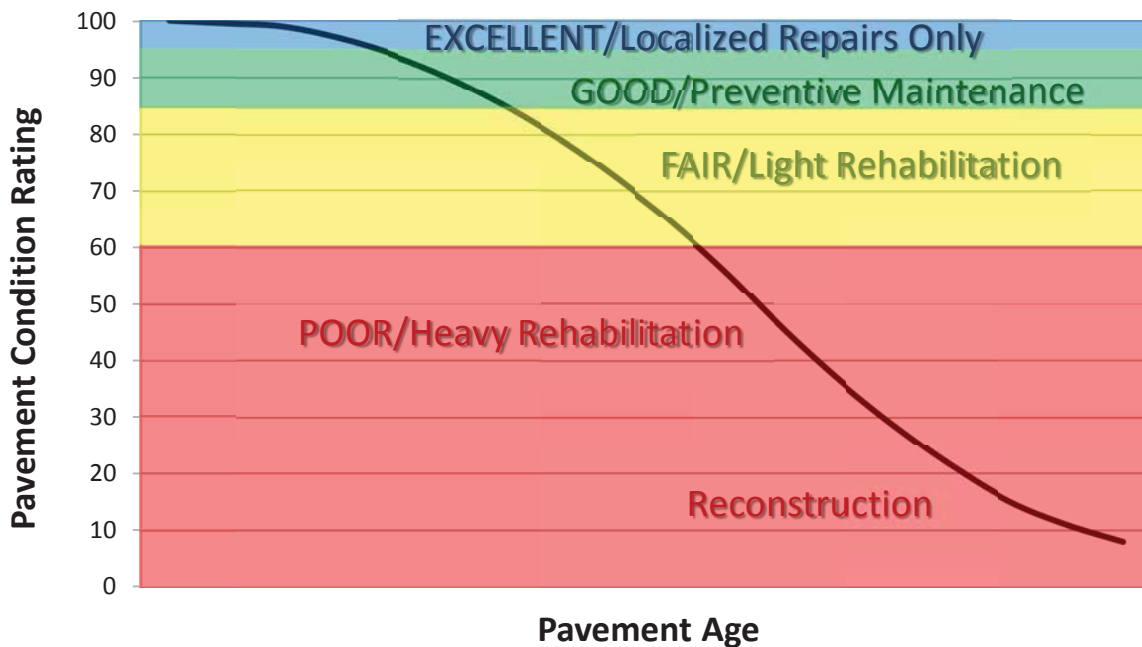
Explanation of the Excellent, Good, Fair and Poor Condition Descriptions

In addition to the RIP Index changes that were implemented in Cycle 5, we will provide greater assistance in translating good/fair/poor categories into pavement needs categories. The PCR can be used to indicate the place in the Pavement Life Cycle and the types of treatments that should be considered now and into the future.

- Excellent/New: PCR of 95-100. Pavements in this range will require only spot repairs.
- Good: PCR of 85-94. Pavements in this range will likely be candidates for Preventive Maintenance. Examples include Chip and Slurry Seals, Micro Surfacing and Thin Overlays.
- Fair: PCR of 61-84. Pavements in this range will likely be candidates of Light Rehabilitation (L3R). Examples include single-lift overlays up to 2.5 inches in total thickness, milling and overlays.
- Poor: PCR of 60 or below. Pavements in this range will likely be candidates of Heavy Rehabilitation or Reconstruction (H3R or 4R). Examples include Pulverization, Multiple Lift Overlays, and Reconstruction.

Specific Maintenance and Rehabilitation activities should be evaluated and recommended at the project level. Site-specific conditions that influence treatment type should be determined based on performing a subsurface investigation and/or pavement condition survey, and not be based solely on RIP data. Additionally, RIP produces a snapshot of conditions the year in which the data was collected. For further information or to obtain additional Pavement Management System’s data from our Highway Pavement Management Application (HPMA) please contact the Eastern Federal Lands pavement team.

Condition Categories and Treatments



DESCRIPTION OF RATING SYSTEM

The Federal Highway Administration (FHWA), National Park Service Road Inventory Program (NPS-RIP), collects condition data on paved roads, parkways, and parking areas in park units nationwide. Road surface condition data is collected using an automated Data Collection Vehicle (DCV). Roads having brick, cobblestone, or wood surfaces are not normally surveyed with the DCV, but are manually rated for the purpose of assigning a condition rating. Unpaved roads, parkways, and parking areas are not currently being evaluated for condition. Paved campground pads and driveways are also not currently being evaluated for condition.

The FHWA RIP is implemented based on the premise that an accurate pavement surface condition assessment can be accomplished using automated crack detection technology as applied to digital images. Various methods of pavement condition assessment have been developed over the years with varying degrees of accuracy and acceptance. The use of digital photography to record pavement images and subsequent crack detection and classification has undergone continuous improvements over the past decade. Digital cameras with increasingly superior resolution and high definition have become more affordable, and the proprietary programming code and algorithms have been improved in crack detection software.

With the use of high quality digital photography and automated crack detection software, FHWA RIP is tasked with executing a pavement condition assessment on about 5000 miles of National Park Service roads and parkways. Foremost in setting up the basis of pavement distress identification is employing the distress identification protocols used by FHWA. There is no single distress identification system that is universal among entities conducting a program of distress identification. For the purpose of the NPS-RIP, FHWA employs distress identification protocols that are specific to this program.

FHWA has referenced the “*Distress Identification Manual for the Long-Term Pavement Performance Program*”, *Publication No. FHWA-RD 03-031, June 2003*, as the point-of-reference for distress types on NPS pavement. The FHWA RIP distress types are similar to those described in the LTPP manual with some modifications. The document, “*Distress Identification Manual for the NPS Road Inventory Program, Cycle 5, 2010-2013*” was developed using the “*Distress Identification Manual for the Long-Term Pavement Performance Program*” as a guideline. Definitions of severity levels based on crack width contained in this document adhere to the LTPP Distress ID Manual. Modifications have been made to the definition of Alligator and Longitudinal Cracking and determination of Alligator Cracking severity. This manual also addresses Rutting and Roughness and its application to NPS-RIP.

In 2010, FHWA RIP began the fifth cycle of data collection in national parks. For Cycle 5, data will be collected in approximately 81 large parks (10 or more paved route miles) on Functional Class 1, 2, and 7 routes plus any new routes or parking areas previously not collected, totaling an estimated 4,459 paved route miles. Additionally, 231 small parks will be collected comprising approximately 529 paved route miles and associated paved parking areas. The data is used to support the National Park Service road maintenance program and Pavement Management System (PMS) developed and maintained by FHWA.

This “*Distress Identification Manual for the NPS Road Inventory Program, Cycle 5, 2010-2013*” will be used as a reference resource in crack detection and classification, determination of distress severity and extent, and in the calculation of distress index values for the FHWA RIP Cycle 5.

SURFACE DISTRESSES

Surface Condition Rating - SCR

Surface distresses are measured in the primary lane only. In the classification and measurement of all paved surface condition data, results will be reported in the database in record intervals of 0.02 miles (105.6 feet) (smallest granularity) along the route.

Surface distresses determined from digital images

- Transverse Cracks
- Longitudinal Cracks
- Alligator Cracks
- Patching/Potholes

Surface distress measured by DCV (Data Collection Vehicle) LRMS (Laser Rut Measuring System)

- Rutting

Each of the five surface distresses is assigned a computed surface distress index

- Transverse Crack Index
- Longitudinal Crack Index
- Alligator Crack Index
- Patching/Pothole Index
- Rutting Index

Surface distress data are classified as listed above, measured for severity, and quantified for extent. Classification, severity, and extent of these five surface distresses comprise the three main elements for calculation of SCR (Surface Condition Rating).

In addition to the five surface distresses, a **Structural Crack Index** is computed, which is a combination of the Longitudinal Crack Index and the Alligator Crack Index. The Structural Crack Index is then used in lieu of the LC and AC indices to compute SCR.

Roughness Condition Index - RCI

Additional condition data measured by DCV (lasers and accelerometers)

- Roughness (IRI)

Roughness is measured by FHWA's DCV and reported as International Roughness Index (IRI) in inches/mile. Using IRI, the Roughness Condition Index (RCI) is computed.

Pavement Condition Rating - PCR

Using the SCR (computed from the five surface distresses) and the RCI, an overall Pavement Condition Rating (PCR) is computed. The formula for PCR is:

$$\text{Asphalt PCR} = (0.60 * \text{SCR}) + (0.40 * \text{RCI})$$

$$\text{Concrete PCR} = \text{RCI}$$

A detailed description of each distress index formula, roughness index formula, SCR and PCR is provided in this document beginning on page 8.

Each classified surface distress will fall into one or more *severity*...LOW, MEDIUM, or HIGH based on criteria listed. For each severity, an *extent* is established based on the measured quantity of the distress within that severity. Within each *severity* individual distresses are assigned a *Maximum Allowable Extent* (MAE). For example, LOW severity transverse cracking may be allowed up to 21.1 cracks within a 0.02 interval before it reaches MAE and fails.

The index formulas are based on a scale of 0-100. A PCR index value of 100 would indicate a “new” road with no measurable distresses or rough ride. A PCR value of 60 is determined to be *terminable serviceability* and the road is considered failed. The range of index values with condition descriptors is:

POOR (<=60), FAIR (61 - 84), GOOD (85 - 94), EXCELLENT (95 - 100)

Index values are generally computed based on cumulative deducts of the measured severities. As shown in the index formulas below, as any single severity reaches or exceeds MAE, the index computes to a value of 60 or less, and the road fails for that 0.02 interval.

Note: As a result of a unique combination of measured surface distresses and IRI, index values occasionally compute to less than 0 or greater than 100. In this instance, an index value < 0 defaults to 0. Index values > 100 default to 100. For all indices, a higher value indicates a better road condition, and a lower value indicates a poorer road condition.

On the following page, Table 1 summarizes the different types of distresses measured.

TABLE 1: Distress Summary

ASPHALT-SURFACED PAVEMENT DISTRESS TYPES with RUTTING and ROUGHNESS				
DISTRESS TYPE	UNIT OF MEASURE...	...CONVERTED TO	DEFINED SEVERITY LEVELS?	MEASURED BY
Alligator Cracking	Square Feet	Percent of Lane Per 0.02 Mile	Yes	Digital Image Crack Detection Software
Transverse Cracking	Linear Feet	Number of Cracks Per 0.02 Mile	Yes	Digital Image Crack Detection Software
Longitudinal Cracking	Linear feet	Percent of Lane Length Per 0.02 Mile	Yes	Digital Image Crack Detection Software
Patching/Potholes	Square Feet	Percent of Lane Per 0.02 Mile	No	Digital Image Crack Detection Software
Rutting	Inches	Rut Depth Per 0.02 Mile	Yes	DCV – Laser Rut Measuring System (LRMS)
Roughness	IRI	*RCI Per 0.02 Mile	No	DCV – Lasers /Accelerometers

***Note: Roughness is measured on concrete roadways, but surface distresses and rutting are not measured. For concrete, PCR = RCI**

ALLIGATOR CRACKING

Description

Alligator cracking is considered a combination of fatigue and block cracking. It is a series of interconnected cracks in various stages of development. Alligator cracking develops into a many-sided pattern that resembles chicken wire or alligator skin. It can occur anywhere in the road lane. Alligator cracking must have a quantifiable area.

Severity Levels

LOW

An area of cracks with no or very few interconnecting cracks and the cracks are not spalled. Cracks are ≤ 0.25 in (6mm) in mean width. Cracks in the pattern are no further apart than 1 foot (0.328 m). May be sealed cracks with sealant in good condition and a crack width that cannot be determined.

MEDIUM

An area of interconnected cracks that form a complete pattern. Cracks may be slightly spalled. Cracks are >0.25 in. (6 mm) and ≤ 0.75 in. (19 mm) or any crack with a mean width ≤ 19 mm and adjacent low severity cracking. Cracks in the pattern are no further apart than 6 in. (150 mm).

HIGH

An area of interconnected cracks forming a complete pattern. Cracks are moderately or severely spalled. Cracks are >0.75 in (19mm) or any crack with a mean width ≤ 0.75 in (19mm) and adjacent medium to high severity random cracking.

A combination of observed crack width and crack pattern is used to determine overall severity of alligator cracking. Based on above description of each severity, the highest level of crack width and crack pattern determines overall severity. Table 2 illustrates this.

TABLE 2: Alligator Crack Severity Levels

ALLIGATOR CRACKING SEVERITY LEVELS		Crack Pattern		
		LOW	MED	HIGH
Crack Width	LOW	L	M	H
	MED	M	M	H
	HI	H	H	H

LONGITUDINAL CRACKING

Description

Longitudinal cracking occurs predominantly parallel to the pavement centerline. It can occur anywhere within the lane. Longitudinal cracks occurring in the wheelpath may be noteworthy.

Severity Levels

LOW

Cracks with a mean width of < 0.25 in. (6 mm). Sealed cracks with sealant in good condition and a width that cannot be determined.

MED

Cracks with a mean width > 0.25 in. (6 mm) and ≤ 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random low severity cracking.

HIGH

Cracks with a mean width > 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random medium to high severity cracking.

TRANSVERSE CRACKING

Description

Transverse cracking occurs predominantly perpendicular to the pavement centerline. It can occur anywhere within the lane.

Severity Levels

LOW

Cracks with a mean width of < 0.25 in. (6 mm). Sealed cracks with sealant in good condition and a width that cannot be determined.

MED

Cracks with a mean width > 0.25 in. (6 mm) and ≤ 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random low severity cracking.

HIGH

Cracks with a mean width > 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random medium to high severity cracking.

PATCHING AND POTHOLES

Description

Patching is an area of pavement surface that has been removed and replaced with patching material or an area of pavement surface that has had additional patching material applied. Patching may encompass partial-lane or full-lane width. On full-lane width patching; the total, contiguous length of a patch may not exceed 0.30 mi. (0.48 km). Any full-lane width patch exceeding 0.30 mi. in length is considered a pavement change, not a patch for the purposes of distress analysis. Patching must have a quantifiable area.

Potholes are bowl-shaped holes of various sizes occurring in the pavement surface.

Severity Levels

There are no stratified severities for Patching/Potholes. They either are present or they are not.

RUTTING

Description

Rutting is a longitudinal surface depression in the wheelpath.

Severity Levels

LOW

Ruts with a measured depth $\geq 0.20''$ and $\leq 0.49''$

MED

Ruts with a measured depth $\geq 0.50''$ and $\leq 0.99''$

HIGH

Ruts with a measured depth $\geq 1.00''$

Ruts $< 0.20''$ are not included in the distress calculations.

ROUGHNESS

Description

Roughness is the measurement of the unevenness of the pavement in the direction of travel. It is measured in units of IRI (International Roughness Index), inches per mile, and is indicative of ride comfort.

Severity Levels

There are no stratified severity levels for roughness. The roughness (or smoothness) of a road surface can be defined by IRI in the following table.

TABLE 3: IRI

IRI Descriptions	
Type of Road	Typical IRI (in/mile)
New Road, no noticeable roughness	<90
Small level of roughness	90 – 126
Road of average roughness	126 – 190
Road with above average roughness	190 – 253
Road with severe roughness	253 – 380
Nearly impassable	>380

INDEX FORMULAS

Note: All index formulas listed below contain MAE applicable to 0.02 mile (105.6 feet) interval.

Alligator Crack Index

$$AC_INDEX = 100 - 40 * [(\%LOW / 35) + (\%MED / 15) + (\%HI / 5)]$$

Where:

The values *%LOW*, *%MED* and *%HI* report the percentage of the observed pavement (0.02 mile, primary lane) that contains alligator cracking within the respective severities. These values range from 0 to 100.

%LOW = Percent of total area (primary lane, 0.02 in length), low severity

%MED = Percent of total area (primary lane, 0.02 in length), medium severity

%HI = Percent of total area (primary lane, 0.02 in length), high severity

Percent of total area is computed as:

$$\frac{\text{square foot area of alligator crack severity}}{0.02 \text{ mile} * \text{lane width}}$$

In AC_INDEX, the denominators 35, 15, and 5 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 35% of low severity alligator cracking for a 0.02 interval before failure, 15% for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Longitudinal Crack Index

$$LC_INDEX = 100 - 40 * [(\%LOW / 175) + (\%MED / 75) + (\%HI / 25)]$$

Where:

The values *%LOW*, *%MED*, and *%HI* report the length of longitudinal cracking within each severity as a percent of the section length (0.02 mile, primary lane).

These values are ≥ 0 and can exceed 100.

%LOW = Percent of interval length (primary lane, 0.02 in length), low severity

%MED = Percent of interval length (primary lane, 0.02 in length), medium severity

%HI = Percent of interval length (primary lane, 0.02 in length), high severity

Percent of interval length is computed as:

$$\frac{\text{length of respective longitudinal cracking}}{0.02 \text{ mile (105.6 feet)}}$$

In LC_INDEX, the denominators 175, 75, and 25 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 175% of low severity alligator cracking for a 0.02 interval before failure, 75% for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Structural Crack Index

$$SC_INDEX = [100 - ((100 - AC_INDEX) + (100 - LC_INDEX))]$$

Structural Crack Index is a combination of Alligator Cracking and Longitudinal Cracking, and is used in the SCR formula in lieu of AC and LC separately.

Transverse Crack Index

$$TC_INDEX = 100 - 40 * [(LOW / 21.1) + (MED / 4.4) + (HI / 2.6)]$$

Where:

The values *LOW*, *MED* and *HI* report a count of the total number of transverse cracks (reported to three decimals) within each severity level, where one transverse crack is equal to the lane width. These values are ≥ 0 .

LOW = Number of cracks in interval (primary lane, 0.02 in length), low severity

MED = Number of cracks in interval (primary lane, 0.02 in length), medium severity

HI = Number of cracks in interval (primary lane, 0.02 in length), high severity

Number of cracks is computed as:

$$\frac{\text{Total length of transverse cracks}}{\text{Lane width}}$$

In TC_INDEX, the denominators 21.1, 4.4, and 2.6 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 21.1 low severity transverse cracks for a 0.02 interval before failure, 4.4 cracks for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Patching Index

$$\text{PATCH_INDEX} = 100 - 40 * (\% \text{PATCHING} / 80)$$

Where:

The value *%PATCHING* reports the percentage of the observed pavement (0.02 mile, primary lane) that contains patching/potholes. This value ranges from 0 to 100.

%PATCHING = Percent of total area (primary lane, 0.02 in length)

Percent of total area is computed as:

$$\frac{\text{square foot area of patching/potholes}}{0.02 \text{ mile} * \text{lane width}}$$

There are no severity levels for patching. It either exists or does not.

In *PATCH_INDEX*, the denominator 80 is the Maximum Allowable Extent (MAE) for each severity. In other words, we will allow up to 80% patching for a 0.02 interval before failure. As you can see, if patching/potholes reaches MAE the resulting index value is 60, or failure.

Rutting Index

$$\text{RUT_INDEX} = 100 - 40 * [(\% \text{LOW} / 535) + (\% \text{MED} / 205) + (\% \text{HI} / 40)]$$

Where:

20 rut depth measurements are taken per 0.02 interval for each of 2 wheel paths (left and right), resulting in a total of 40 measurements taken for both wheel paths. *Each wheelpath is analyzed independently for rut severities.* The values *%LOW*, *%MED* and *%HI* are a *total percentage* of left wheelpath percentage and right wheelpath percentage added together for the respective severity. These values range from 0 to 200.

%LOW = Percent of LOW ruts in left wheelpath based on 20 ruts, plus percent of LOW ruts in right wheelpath based on 20 ruts.

%MED = Percent of MED ruts in left wheelpath based on 20 ruts, plus percent of MED ruts in right wheelpath based on 20 ruts.

%HI = Percent of HI ruts in left wheelpath based on 20 ruts, plus percent of HI ruts in right wheelpath based on 20 ruts.

Percent of rut measurements within each severity can also be computed as:

$$\frac{\text{total number of ruts within each severity in both wheelpaths}}{20} * 100$$

In *RUT_INDEX*, the denominators 535, 205, and 40 are the Maximum Allowable Extents for each severity. In other words, the formula allows up to 535% low severity

ruts for a 0.02 interval before. However, since 200 is the highest measurable percentage allowed, 535% is unattainable and therefore, no amount of LOW severity rutting will cause the RUT_INDEX to fail a road. Similarly, since the MAE for MED severity rutting is 205, no amount of MED severity rutting will cause the RUT_INDEX to reach 60 and fail the road. As you can see, LOW severity rutting reaches MAE the resulting index value is 60, or failure. This formula was intentionally designed to minimize the impact of LOW and MED severity rutting on RUT_INDEX.

Roughness Condition Index (Asphalt)

$$RCI = 32 * [5 * (2.718282 ^ {(-0.0041 * AVG IRI)})]$$

Where:

The value *AVG IRI* reports the average value of the Left IRI and Right IRI measurements for the interval (0.02 mile, primary lane). This value can range from approximately 40 to 999.0.

Average IRI is computed as:

$$\frac{\text{Left wheelpath IRI} + \text{Right wheelpath IRI}}{2}$$

There is no applicable threshold for failure for this index.

Roughness Condition Index (Concrete)

$$RCI = -0.0012(IRI^2) + 0.0499(IRI) + 99.542$$

For concrete, PCR = RCI

Surface Condition Rating Index

SCR = *Lowest* Index Value Of: [SC_INDEX, TC_INDEX, PATCH_INDEX, RUT_INDEX]

Note: The modified SCR equation above combines AC_INDEX and LC_INDEX, and considers that a single AC/LC index value of the Structural Crack Index (SC_INDEX). The lowest of the four computed index values (SC_INDEX, TC_INDEX, PATCH_INDEX, or RUT_INDEX) becomes the SCR.

Where:

See above for determinations of SC_INDEX, TC_INDEX, PATCH_INDEX and RUT_INDEX.

The threshold for failure for this index is SCR = 60.

Data Collection Vehicle Subsystems

Data on paved roads in Cycle 5 is collected by FHWA using a Pathway Services Inc. Data Collection Vehicle (DCV), called PathRunner. The DCV is driven in the primary-direction lane at posted speed limits and less.

CAMERAS

Forward-facing and rear-facing video is collected as .jpg digital imagery at a frequency of 26.4 feet.

Two forward-facing cameras are mounted above the vehicle cab, one pointed straight ahead and the other to the right shoulder providing seamless 120 degree viewing.

CAMERA SPECIFICATIONS Two Forward/ One Rear Facing	
Camera lens/type	FUJINON CCTV LENS H16x10B-Y41
Focal length	10 mm – 160 mm
Image size	8.8 mm x 6.6mm
Image format	*.jpg
Image resolution	HD 2000 X 1200
Image pixel size	depends on distance
Zoom ratio	16x
Max Relative Aperture	1:2.5
Iris range	F25-T800 (Equivalent to F800)

Pavement images are created using a Laser Scan Imaging System. This system is composed of a single high resolution line-scan camera and two lasers configured to image an approximate 11-foot wide lane with 1 mm resolution.

CAMERA SPECIFICATIONS Pavement Line Scan	
Image size	4280 pixels/line
Image width	4 meters (3950 mm nominal)
Laser class	3B
Power	250W
Vehicle speed limitations	62 mph
Environment	Dry pavement, day or night
Sensor size (approx)	300 mm(H) x 375 mm(L) x 200 mm(D)
Image frame length	26.4 feet

DMI (Distance Measuring Instrument)

The DMI (Distance Measuring Instrument) obtains road length measurements that are accurate to 0.1% for speeds up to 60 mph. The DMI is connected to the hub of the rear wheel on the driver's side, and is calibrated to the revolutions of the rear vehicle axle on a regular basis.

ROUGHNESS (IRI)

The collection system includes a South Dakota type laser profiler manufactured based on active Class 1 ASTM E950 standards. The dynamic profile of the pavement surface is collected from which the IRI roughness data is computed. The sensors include one accelerometer on each wheelpath, one height sensor (laser) on each wheelpath, and a distance transducer.

IRI SPECIFICATIONS	
Reported IRI units	Inches/mile
Vehicle speed limitations	12-62 mph
IRI equipment certification	Texas Transportation Institute (TTI)
Wavelengths accommodated	6 in. – 300 feet
IRI computed & reported	World Bank Technical Paper Number 46
Environment	Dry pavement, day or night, above 32 degrees F
Adherence to specifications	ASTM E950-98 (2004), ASTM E 1926-08, AASHTO MP 11-08, AASHTO PP 49-08

RUTTING

Rutting depths are measured using an INO Laser Rut Measurement System (LRMS). This system is a transverse profiling device that detects and characterizes pavement rutting. The LRMS can acquire full 4 meter width profiles of a pavement lane at normal traffic speeds and uses two laser profilers that digitize transverse sections of the pavement.

RUTTING SPECIFICATIONS	
Reported rut depth units	Inches
Vehicle speed limitations	Up to 62 mph
Sampling rate	30-150 profiles/second
Transverse resolution	1280 points/profile
Transverse field-of-view	4 m
Depth accuracy (nominal)	+/- 1 mm
Environment	Dry pavement, day or night, above 32 degrees F
Adherence to specifications	ASTM E1703M-95 (reapproved 2005)

GPS & INERTIAL SYSTEMS

GPS is collected by an onboard system employing OmniSTAR real-time correction and a gyroscope (spin-type) to provide accurate positioning data (pitch/roll/heading) in instances of satellite obstruction. All GPS coordinates are tied to image and linear distance measurements.

GPS SPECIFICATIONS	
Static accuracy	Sub-meter
Dynamic accuracy	2-3 meters
Receiver	12 satellite tracking
Coordinate system	Lat Lon WGS 84
Environment	Day or night
Cross-slope	+ - 0.5 degrees
Grade	+ - 0.5 degrees

GPS on Manually Rated Roads (MRR)

Parking areas, some roads, and other paved areas that are not fully drivable with the DCV are collected manually by field technicians. GPS is collected for these routes using portable Trimble GPS backpack units. Paved campground pads and driveways are not typically included in the inventory or GPS.

Geodatabase – Background and Metadata

In addition to this park report, a *geodatabase* containing both tabular and spatial data specific to this park has been provided. All data disseminated in the preceding report has been obtained from the tables and fields within said geodatabase. The geodatabase can be referenced for tabular data via Microsoft Access or for both tabular and spatial data via ESRI's ArcGIS Suite of software which consists of; ArcMap, ArcCatalog and ArcExplorer. Consolidating the RIP data into one database creates a seamless relationship of tabular and geographic data. It will allow RIP to facilitate easier updates and enhancements in the future.

A geodatabase can be thought of as simply a database containing spatial data. Many different tables are contained with the park's geodatabase. A complete and thorough description of the tables and fields contained within this geodatabase can be found in the *metadata*. The metadata is attached directly within the geodatabase and can be accessed via ESRI's ArcCatalog. The metadata portion of the geodatabase also includes data dictionary report functionality that formats the metadata into an easy to read report.

GLOSSARY OF TERMS AND ABBREVIATIONS

<u>TERM OR ABBREVIATION</u>	<u>DESCRIPTION OR DEFINITION</u>
AC	Alligator Cracking
CRS	Condition Rating Sheets (Section 5)
DCV	Data Collection Vehicle
Excellent	Excellent rating with an index value of 95 to 100
Fair	Fair rating with an index value from 61 to 84
FUNCT_CLASS	Functional Classification (see Route ID, Section 2)
Good	Good rating with an index value from 85 to 94
IRI	International Roughness Index
Lane Width	Width from road centerline to fogline, or from centerline to edge-of-pavement when no fogline exists
LC	Longitudinal Cracking
MRR	Manually Rated Route
MRL	Manually Rated Line
MRP	Manually Rated Polygon
N/A	Not Applicable
NC	Not Collected
PATCH	Patching and Potholes
Paved Width	Width from edge-of-pavement to edge-of-pavement
PCR	Pavement Condition Rating
PKG	Parking Area
Poor	Poor rating with an index value of 0 to 60
RCI	Roughness Condition Index
SC	Structural Cracking
SCR	Surface Condition Rating
TC	Transverse Cracking