



Federal Lands Highway Road Inventory Program

Road Inventory and Condition Assessment

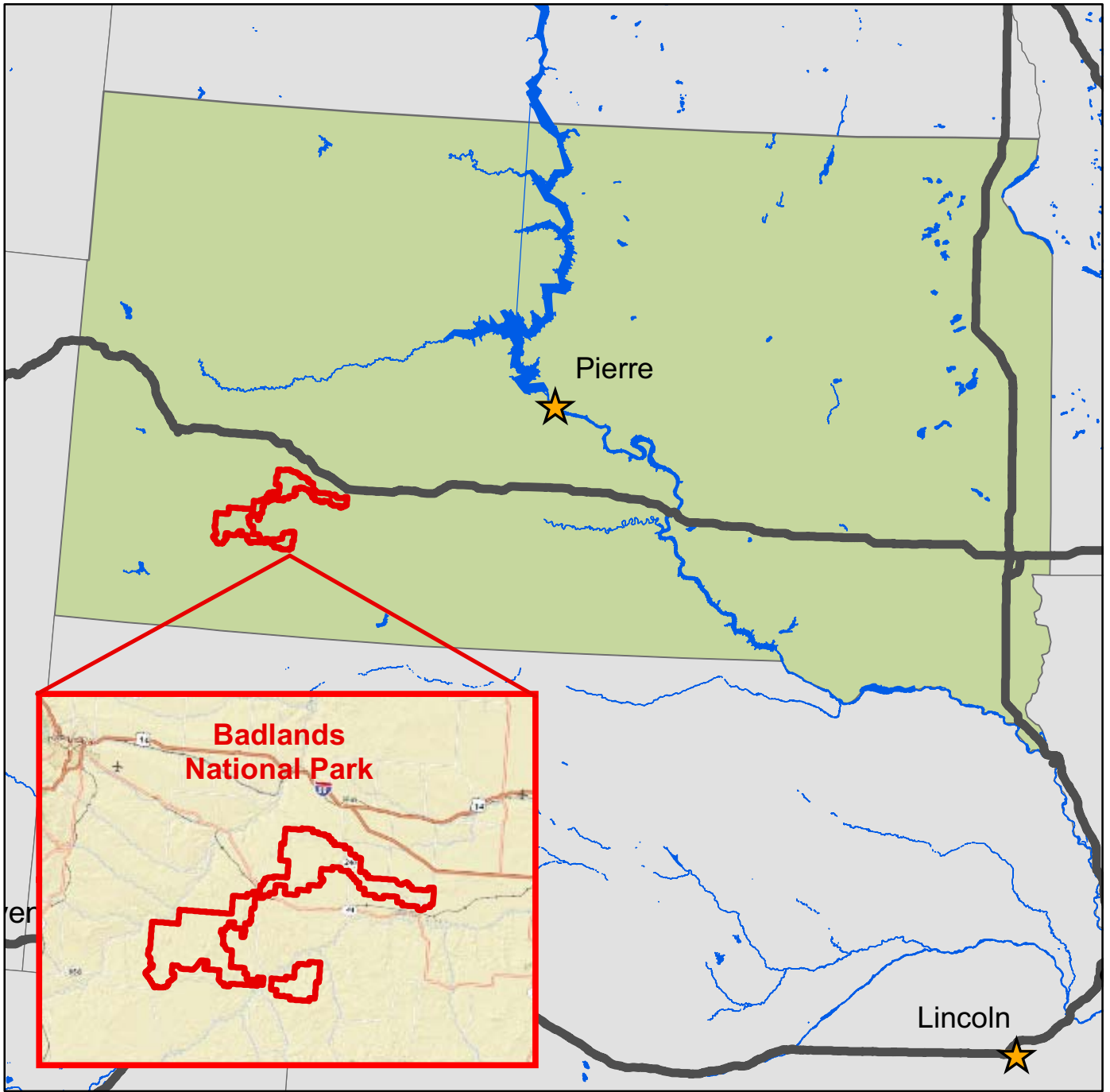


Badlands National Park
BADL - 1300

Cycle 5 Report

Prepared By: Federal Highway Administration
Road Inventory Program (RIP)
Data Collected: 11/2010
Report Date: 05/2012

Badlands National Park in South Dakota





DCV = Data Collection Vehicle

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Section 1 Introduction



Badlands National 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 168 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



Badlands National Park



Federal Lands Highway
Road Inventory Program

Cycle 5 NPS/RIP Route ID Report

Road Inventory Program 05/16/2012

(Numerical By Route #)

Page 1 of 7

Shading Color Key:

White = Paved Routes, DCV Driven

Yellow = Unpaved Routes, DCV not Driven

Blue = All Paved Parking Areas

Green = All Unpaved Parking Areas

Red text denotes approx. mileage

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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

*** Only Functional Class 1, 2, & 7 routes, and previously uncollected routes were collected in Cycle 5

BADL

BADLANDS NATIONAL 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
0010ZZ	5	43372		BADLANDS LOOP ROADS	FROM END OF ROUTE 5010 (STATE HIGHWAY 240 (NORTHEAST ENTRANCE ROAD)) TO PARK BOUNDARY AT NORTHWEST/PINNACLES ENTRANCE	NORTH UNIT	27.92	0.00	27.92	1	9,981	AS	1,2
0011	5	43370		ENTRANCE ROAD (HIGHWAY 377)	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) TO PARK BOUNDARY AT INTERIOR ENTRANCE	NORTH UNIT	0.69	0.00	0.69	1	0	AS	2
0200	NC	43362		SHEEP MOUNTAIN TABLE ROAD	FROM COUNTY ROUTE 589 (SOUTH) TO STONY PASS	SOUTH UNIT	0.00	7.26	7.26	3	0	GR	
0201	NC	43361		SAGE CREEK RIM ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 27.09 ON LEFT (WEST) TO HOCKING "Y"	NORTH UNIT	0.00	6.45	6.45	3	0	GR	
0202	NC	43359		SAGE CREEK CAMPGROUND ACCESS ROAD	FROM COUNTY ROUTE 590 TO CAMPGROUND	NORTH UNIT	0.00	1.42	1.42	3	0	GR	
0203ZZ	4	27756		CEDAR PASS CAMPGROUND ROADS	FROM ROUTE 0011 (ENTRANCE ROAD (HIGHWAY 377)) AT MP .1 ON LEFT THROUGH CAMPGROUND	NORTH UNIT	1.37	0.76	2.13	3	0	AS	2
0204	4	43352		CONATA ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 23.76 ON LEFT TO PARK BOUNDARY AT CATTLE GUARD/END OF PAVEMENT	NORTH UNIT	1.65	0.00	1.65	3	0	AS	1
0205	NC	27813		OLD NORTHEAST ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 3.41 ON RIGHT TO PARK BOUNDARY	NORTH UNIT	0.00	1.84	1.84	3	0	GR	
0206	NC	61753		CEDAR PASS CABINS LOOP	FROM CONCESSION PARKING AREA TO AROUND LOOP	NORTH UNIT	0.00	0.29	0.29	3	0	GR	
0207	NC	43357		WEST INTERIOR ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 8.44 ON LEFT TO PARK BOUNDARY	NORTH UNIT	0.00	0.76	0.76	3	0	GR	
0208	4	61759		CONATA PICNIC AREA ROAD	FROM ROUTE 0204 (CONATA ROAD) TO END OF PAVEMENT AT TRAILHEAD	NORTH UNIT	0.21	0.00	0.21	3	0	AS	1
0210	NC	92852		QUINN ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 19.76 ON RIGHT TO END	NORTH UNIT	0.00	0.59	0.59	3	0	GR	
0211	NC	92853		UPPER BIGFOOT ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 13.85 ON LEFT TO END	NORTH UNIT	0.00	0.37	0.37	3	0	GR	

Cycle 5 NPS/RIP Route ID Report

Road Inventory Program 05/16/2012

(Numerical By Route #)

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BADLANDS NATIONAL 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	
0212	NC	92854		COTTONWOOD PASS ROAD	FROM 7 MILES NORTH OF BADL SU STRONGHOLD VISITOR CENTER ON BIA ROAD 27, HEADS 8 MILES WEST TO BADL BOUNDARY	ROAD SPLITS TO THE NORTH 6 MILES IN AND GOES NORTH FOR 4 MILES TO PARK BOUNDARY	SOUTH UNIT	0.00	11.06	11.06	3	0	GR	
0213	NC	92855		BLINDMAN TABLE ROAD	FROM 1.5 MILES EAST OF RED SHIRT VILLAGE ON BIA ROAD 41, SOUTH SOUTHEAST	TO BLIND MAN TABLE	SOUTH UNIT	0.00	6.59	6.59	3	0	GR	
0400	4	53282		CEDAR PASS MAINTENANCE ACCESS ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 4.83 ON LEFT	TO COUNTY MAINTENANCE AT ROUTE 0906	NORTH UNIT	0.88	0.25	1.13	5	0	AS	2
0401	4	43353		RESIDENCE AREA ROAD AND PARKING	FROM ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.19 ON LEFT	TO END OF PAVEMENT	NORTH UNIT	0.30	0.00	0.30	6	0	AS	2
0403	NC	61755		WHITE RIVER PUMPHOUSE ROAD	FROM STATE HWY 44 (SOUTH)	TO END AT PUMPHOUSE	SOUTH UNIT	0.00	0.70	0.70	5	0	GR	
0404	NC	61760		BUFFALO CORRAL ROAD	FROM SAGE CREEK RIM ROAD	TO CORRAL	NORTH UNIT	0.00	0.47	0.47	5	0	GR	
0405	NC	61756		FIRING RANGE ROAD	FROM CEDAR PASS MAINTENANCE ACCESS ROAD	TO GATE AT FIRING RANGE	NORTH UNIT	0.00	2.26	2.26	5	0	GR	
0406	NC	61757		WHITE RIVER WELL FIELD ROAD	FROM LOST DOG ROAD	TO END AT WELL FIELD AND WATER WELLS	SOUTH UNIT	0.00	0.90	0.90	5	0	GR	
0407	4	53284		PINNACLES RANGER STATION SERVICE ACCESS ROAD	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 27.66 ON RIGHT	TO RANGER STATION UNPAVED PARKING	NORTH UNIT	0.10	0.00	0.10	6	0	AS	1
0408	NC	61754		CEDAR PASS LODGE SERVICE ROAD	FROM CEDAR PASS LODGE PARKING	TO END AT TRAILERS	NORTH UNIT	0.00	0.13	0.13	5	0	GR	
0901	4	53286		BIG BADLANDS PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.46 ON LEFT		NORTH UNIT	0.00	0.00	0.00		41,282	AS	2
0902	5	28222		DOORS AND WINDOWS PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 2.60 ON LEFT		NORTH UNIT	0.00	0.00	0.00		150,917	AS	2

Cycle 5 NPS/RIP Route ID Report

Road Inventory Program 05/16/2012

(Numerical By Route #)

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BADLANDS NATIONAL 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
0903	4	43342		CLIFF SHELF NATURE TRAIL PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 4.19 ON LEFT	NORTH UNIT	0.00	0.00	0.00		21,038	AS	2
0904	4	53288		BEN REIFEL VISITOR CENTER PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AND ROUTE 0400	NORTH UNIT	0.00	0.00	0.00		23,003	AS	2
0905ZZ	4	53292		RV PARKING AND REAR VISITOR CENTER PARKING	ADJACENT TO ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.06 (ON RIGHT AND LEFT)	NORTH UNIT	0.00	0.00	0.00		66,499	AS	2
0906	4	53293		MAINTENANCE AREA PARKING	FROM ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.86 (ON RIGHT) TO PARKING	NORTH UNIT	0.00	0.00	0.00		32,495	AS	2
0908	4	53295		CEDAR PASS LODGE PARKING	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 4.97 (ON LEFT) TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 5.05 (ON LEFT)	NORTH UNIT	0.00	0.00	0.00		57,828	AS	2
0909	4	53296		AMPHITHEATER PARKING	FROM ROUTE 0203ZZ (CEDAR PASS CAMPGROUND ROADS) AT MP 0.01 (ON LEFT) TO PARKING	NORTH UNIT	0.00	0.00	0.00		18,023	AS	2
0910	4	92858		SADDLE PASS PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 6.85 ON RIGHT	NORTH UNIT	0.00	0.00	0.00		9,027	AS	2
0912	4	43187		FOSSIL TRAIL PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 9.72 ON LEFT	NORTH UNIT	0.00	0.00	0.00		58,744	AS	2
0913	4	53297		WHITE RIVER VALLEY OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 11.91 ON LEFT	NORTH UNIT	0.00	0.00	0.00		25,868	AS	2
0914	4	53298		BIGFOOT PASS PICNIC AREA	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 12.70 ON RIGHT	NORTH UNIT	0.00	0.00	0.00		33,077	AS	2

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BADLANDS NATIONAL 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
0915	4	53299		PANORAMA POINT OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 14.25 ON LEFT	NORTH UNIT	0.00	0.00	0.00		26,237	AS	2
0916	4	53300		PRAIRIE WINDS OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 15.71 ON RIGHT	NORTH UNIT	0.00	0.00	0.00		19,535	AS	1
0917	4	53301		BURNS BASIN OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 18.39 ON LEFT	NORTH UNIT	0.00	0.00	0.00		25,537	AS	1
0918	4	53302		HOMESTEAD OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 20.97 ON LEFT	NORTH UNIT	0.00	0.00	0.00		20,290	AS	1
0919	4	53303		CONATA BASIN OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 22.75 ON LEFT	NORTH UNIT	0.00	0.00	0.00		22,029	AS	1
0920	4	53304		YELLOW MOUNDS OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 23.45 ON LEFT	NORTH UNIT	0.00	0.00	0.00		11,592	AS	1
0921	4	53305		ANCIENT HUNTERS OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 26.06 ON RIGHT	NORTH UNIT	0.00	0.00	0.00		8,843	AS	1
0922	4	43338		PINNACLES OVERLOOK PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 26.64 ON LEFT	NORTH UNIT	0.00	0.00	0.00		33,396	AS	1
0923	NC	92856		HAY BUTTE OVERLOOK PARKING	FROM ROUTE 0201 (SAGE CREEK RIM ROAD) TO PARKING	NORTH UNIT	0.00	0.00	0.00		0	GR	
0924	NC	92857		PINNACLES ENTRANCE AND RANGER STATION PARKING	FROM ROUTE 0407 (PINNACLES RANGER STATION SERVICE ACCESS ROAD) (SOUTH) TO PARKING	NORTH UNIT	0.00	0.00	0.00		0	GR	
0925	NC	92859		ROBERTS PRAIRIE DOG TOWN	FROM ROUTE 0201 (SAGE CREEK RIM ROAD) AT MP 4.7 TO PARKING	NORTH UNIT	0.00	0.00	0.00		0	GR	

Cycle 5 NPS/RIP Route ID Report

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(Numerical By Route #)

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BADLANDS NATIONAL 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
0926	NC	92860		SAGE CREEK BASIN OVERLOOK	FROM ROUTE 0201 (SAGE CREEK RIM ROAD) AT MP 6.1 TO PARKING	NORTH UNIT	0.00	0.00	0.00		0	GR	
0927	NC	92861		GUNNERY RANGE OVERLOOK PARKING	FROM ROUTE 0200 (SHEEP MOUNTAIN TABLE ROAD) TO PARKING	SOUTH UNIT	0.00	0.00	0.00		0	GR	
0928	NC	92863		WHITE RIVER VISITOR CENTER PARKING	FROM STATE HIGHWAY 27 TO PARKING	SOUTH UNIT	0.00	0.00	0.00		0	GR	
0929	NC	99537		BADLANDS WILDERNESS OVERLOOK	FROM ROUTE 0201 (SAGE CREEK RIM ROAD) AT MP 1.7 TO PARKING	NORTH UNIT	0.00	0.00	0.00		0	GR	
0930	4	92865		NORTH ENTRANCE SUPPORT BUILDING PARKING	ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.30 (ON LEFT)	NORTH UNIT	0.00	0.00	0.00		4,220	AS	2
0933	4	115273		CEDAR PASS FIRE CACHE PARKING	FROM ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.41 (ON LEFT) TO PARKING	NORTH UNIT	0.00	0.00	0.00		24,565	AS	2
0934ZZ	4			RESIDENCE AREA PARKING LOTS	FROM ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.09 (ON LEFT) TO ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.29 (ON LEFT)	NORTH UNIT	0.00	0.00	0.00		8,106	AS	2
0935	4			ADMINISTRATIVE PARKING	FROM ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.16 (ON RIGHT) TO PARKING	NORTH UNIT	0.00	0.00	0.00		6,265	AS	2
0936	5	115627		INTERIOR ENTRANCE BOOTH PARKING LOT	ADJACENT TO ROUTE 0011 (ENTRANCE ROAD (HIGHWAY 377)) AT MP 0.56 (ON RIGHT)	NORTH UNIT	0.00	0.00	0.00		1,012	AS	2
5010	5			STATE HIGHWAY 240 (NORTHEAST ENTRANCE ROAD)	FROM NORTH END OF EXIT 131 BRIDGE OVER I-90 AT CACTUS FLAT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.00 (NORTHEAST PARK ENTRANCE)	NORTH UNIT	3.45	0.00	3.45		0	AS	2
5011	4			STATE HIGHWAY 44	FROM NORTHWEST BOUNDARY OF PARK TO SOUTHWEST BOUNDARY OF PARK	NORTH UNIT	2.25	0.00	2.25		0	AS	3
5012	4			COUNTY ROUTE 589/BIA ROUTE 27	FROM NORTHWEST PARK BOUNDARY TO SOUTHWEST PARK BOUNDARY	NORTH UNIT	1.55	0.00	1.55		0	AS	3

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CYCLE 5 COLLECTED SUMMARY TOTALS FOR BADLANDS NATIONAL PARK

CYCLE 5 COLLECTED ROUTE TOTALS

DCV Driven Route Miles	28.61
Manually Rated Route Miles	0.00
TOTAL PARK ROUTE MILES COLLECTED IN CYCLE 5	28.61
Manually Rated Routes (SQFT)	9,981

* CYCLE 5 COLLECTED PARKING AREA TOTALS

Paved Parking (SQFT)	151,929
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CYCLE 5 COLLECTED CONCESSION TOTALS

Concession Paved Route Miles	0.00
Concession Paved Parking Area SQFT	0
Concession Manually Rated Rotes SQFT	0

CYCLE 5 COLLECTED WEIGHTED AVERAGE PARK VALUES

DCV Driven PCR	96
**Manually Rated Routes PCR	90
**Parking PCR	90
***Total Equivalent Lane Miles	68.52

TOTAL PARK SUMMARY FOR BADLANDS NATIONAL PARK

ROUTE TOTALS

TOTAL PAVED PARK ROUTE MILES	33.12
TOTAL PAVED PARKING (SQFT)	824,033

* - 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

Road Inventory Program 05/16/2012

(Numerical By Route #)

Page 7 of 7

Shading Color Key:

White = Paved Routes, DCV Driven

Yellow = Unpaved Routes, DCV not Driven

Blue = All Paved Parking Areas

Green = All Unpaved Parking Areas

Red text denotes approx. mileage

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

*** Only Functional Class 1, 2, & 7 routes, and previously uncollected routes were collected in Cycle 5

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 Assets. 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**

NPS/RIP Subcomponent Details for BADL

Road Inventory Program 05/16/2012

(Numerical By Subcomponent #)

Page 1 of 3

Shading Color Key:

White = Paved Routes, DCV Driven

Yellow = Unpaved Routes, DCV not Driven

Blue = All Paved Parking Areas

Green = All Unpaved Parking Areas

Red text denotes approx. mileage

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).

BADL

BADLANDS NATIONAL PARK

Asset Entered in FMSS System

Rte. No.	FMSS No.	Cycle Collected	Route Name	From	To	Concess Route	Func. Class	Paved Miles	Un-Paved Miles	Total Route Length	Manual Rated SQ/FT
0010ZZ	43372	5	BADLANDS LOOP ROADS	FROM END OF ROUTE 5010 (STATE HIGHWAY 240 (NORTHEAST ENTRANCE ROAD))	TO PARK BOUNDARY AT NORTHWEST/PINNACLES ENTRANCE		1	27.92	0.00	27.92	9,981
0203ZZ	27756	4	CEDAR PASS CAMPGROUND ROADS	FROM ROUTE 0011 (ENTRANCE ROAD (HIGHWAY 377)) AT MP .1 ON LEFT	THROUGH CAMPGROUND		3	1.37	0.76	2.13	0
0905ZZ	53292	4	RV PARKING AND REAR VISITOR CENTER PARKING	ADJACENT TO ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.06 (ON RIGHT AND LEFT)				0.00	0.00	0.00	66,499
0934ZZ	N/A	4	RESIDENCE AREA PARKING LOTS	FROM ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.09 (ON LEFT)	TO ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.29 (ON LEFT)			0.00	0.00	0.00	8,106

Asset BADL-0010ZZ Subcomponent Breakdown

Rte. No.	FMSS No.	Cycle Collected	Route Name	From	To	Concess Route	Func. Class	Paved Miles	Un-Paved Miles	Total Route Length	Manual Rated SQ/FT
0010AZ	43372	5	BADLANDS LOOP (ROAD 240)	FROM END OF ROUTE 5010 (STATE HIGHWAY 240 (NORTHEAST ENTRANCE ROAD))	TO PARK BOUNDARY AT NORTHWEST/PINNACLES ENTRANCE		1	27.92	0.00	27.92	0
0010BZ	43372	5	NORTH EAST ENTRANCE TURNAROUND	FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.35	TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.38		1	0.00	0.00	0.00	9,981

NPS/RIP Subcomponent Details for BADL

Road Inventory Program 05/16/2012

(Numerical By Subcomponent #)

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Shading Color Key:

White = Paved Routes, DCV Driven

Yellow = Unpaved Routes, DCV not Driven

Blue = All Paved Parking Areas

Green = All Unpaved Parking Areas

Red text denotes approx. mileage

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).

BADL

BADLANDS NATIONAL PARK

Asset BADL-0203ZZ Subcomponent Breakdown

Rte. No.	FMSS No.	Cycle Collected	Route Name	Route Description		Concess Route	Func. Class	Paved Miles	Un-Paved Miles	Total Route Length	Manual Rated SQ/FT
				From	To						
0203AAZ	27756	4	CEDAR PASS CAMPGROUND ROAD AA	FROM ROUTE 0203AZ (CEDAR PASS CAMPGROUND ROAD LOOP A) AT MP 0.20	TO ROUTE 0203AZ (CEDAR PASS CAMPGROUND ROAD LOOP A) AT MP 0.40		3	0.13	0.00	0.13	0
0203AZ	27756	4	CEDAR PASS CAMPGROUND ROAD LOOP A	FROM ROUTE 0011 (ENTRANCE ROAD (HIGHWAY 377)) AT MP .07 ON LEFT	TO END OF LOOP		3	0.54	0.00	0.54	0
0203BAZ	27756	4	CEDAR PASS CAMPGROUND ROAD BA	FROM ROUTE 0203BZ (CEDAR PASS CAMPGROUND ROAD LOOP B) AT MP 0.11	TO ROUTE 0203BZ (CEDAR PASS CAMPGROUND ROAD LOOP B) AT MP 0.30		3	0.07	0.00	0.07	0
0203BZ	27756	4	CEDAR PASS CAMPGROUND ROAD LOOP B	FROM ROUTE 0203AZ (CEDAR PASS CAMPGROUND ROAD LOOP A)	TO END OF LOOP		3	0.33	0.00	0.33	0
0209Z	27756	NC	CEDAR PASS AGATE LOOP	FROM CEDAR PASS CAMPGROUND ROAD (GRAVEL PORTION)	TO AGATE CAMPGROUND LOOP		3	0.00	0.76	0.76	0
0214Z	27756	4	CEDAR PASS CAMPGROUND GROUP LOOP ROAD	FROM ROUTE 0203AZ (CEDAR PASS CAMPGROUND ROAD LOOP A) AT MP 0.06	TO ROUTE 0203AZ (CEDAR PASS CAMPGROUND ROAD LOOP A) AT MP 0.03		3	0.30	0.00	0.30	0

Asset BADL-0905ZZ Subcomponent Breakdown

Rte. No.	FMSS No.	Cycle Collected	Route Name	Route Description		Concess Route	Func. Class	Paved Miles	Un-Paved Miles	Total Route Length	Manual Rated SQ/FT
				From	To						
0905AZ	53292	4	RV PARKING	ADJACENT TO ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.06 (ON RIGHT)				0.00	0.00	0.00	9,531
0905BZ	53292	4	REAR VISITOR CENTER PARKING	ADJACENT TO ROUTE 0400 (CEDAR PASS MAINTENANCE ACCESS ROAD) AT MP 0.09 (ON LEFT)				0.00	0.00	0.00	56,968

NPS/RIP Subcomponent Details for BADL

Road Inventory Program 05/16/2012

(Numerical By Subcomponent #)

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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).

BADL

BADLANDS NATIONAL PARK

Asset BADL-0934ZZ Subcomponent Breakdown

Rte. No.	FMSS No.	Cycle Collected	Route Name	From	To	Concess Route	Func. Class	Paved Miles	Un-Paved Miles	Total Route Length	Manual Rated SQ/FT
0934AZ	N/A	4	RESIDENCE AREA PARKING A	ADJACENT TO ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.09 (ON LEFT)				0.00	0.00	0.00	3,985
0934BZ	N/A	4	RESIDENCE AREA PARKING B	ADJACENT TO ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.25 (ON LEFT)				0.00	0.00	0.00	1,810
0934CZ	N/A	4	RESIDENCE AREA PARKING C	ADJACENT TO ROUTE 0401 (RESIDENCE AREA ROAD AND PARKING) AT MP 0.29 (ON LEFT)				0.00	0.00	0.00	2,311

ROUTE IDENTIFICATION CHANGES TO PAVED ROUTES FROM PREVIOUS CYCLE - BADL

ROUTES MODIFIED FROM PREVIOUS INVENTORY:			
Route #	Route Name	Type of Modification	Comments
0902	DOORS AND WINDOWS PARKING	SQ FEET CHANGE	AREA OF ROUTE HAS CHANGED SINCE CYCLE 4. LOT WAS RECOLLECTED.
0936	INTERIOR ENTRANCE BOOTH PARKING LOT	SQ FEET CHANGE	AREA OF ROUTE HAS CHANGED SINCE CYCLE 4. LOT WAS RECOLLECTED.
OTHER CHANGES FROM PREVIOUS INVENTORY:			
Route #	Route Name	Type of Change	Comments
0214Z	CEDAR PASS CAMPGROUND GROUP LOOP ROAD	ROUTES COMBINED	COMBINED INTO ROUTE 0203ZZ
0401	RESIDENCE AREA ROAD AND PARKING	FUNCTIONAL CLASS CHANGE	ROUTE CHANGED FROM FUNCTIONAL CLASS 5 TO FUNCTIONAL CLASS 6.
0407	PINNACLES RANGER STATION SERVICE ACCESS ROAD	FUNCTIONAL CLASS CHANGE	ROUTE CHANGED FROM FUNCTIONAL CLASS 5 TO FUNCTIONAL CLASS 6.
ROUTES REMOVED FROM PREVIOUS INVENTORY:			
Route #	Route Name	Reason for Removal	Comments
0931	VOLUNTEER RV PARKING	CLOSED/ABANDONED	PARK REMOVED THE PAVEMENT FROM THIS ASSET AND CONSIDERS IT LANDSCAPING.
0932	CEDAR PASS DUMP STATION PARKING	OTHER	REMOVED AS PER NPS REQUEST IN THE ROADS PORTAL ON 9/10/2010

Section 3

Park Summary Information



Badlands National Park



Federal Lands Highway
Road Inventory Program

BADL: 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	0.16	0.56%	3.19	11.15%	4.84	16.92%	20.42	71.37%	28.61
2									
3									
4									
5									
6									
7									
8									
Totals	0.16	0.56%	3.19	11.15%	4.84	16.92%	20.42	71.37%	28.61

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.

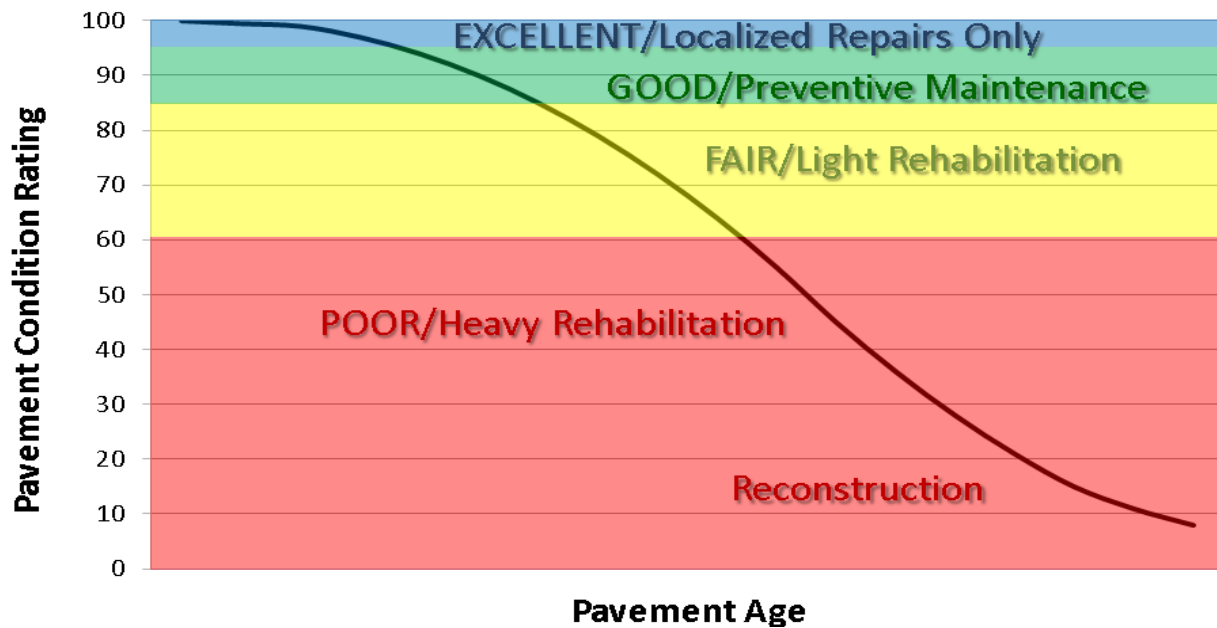
Explanation of the Excellent, Good, Fair and Poor Condition Descriptions

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.

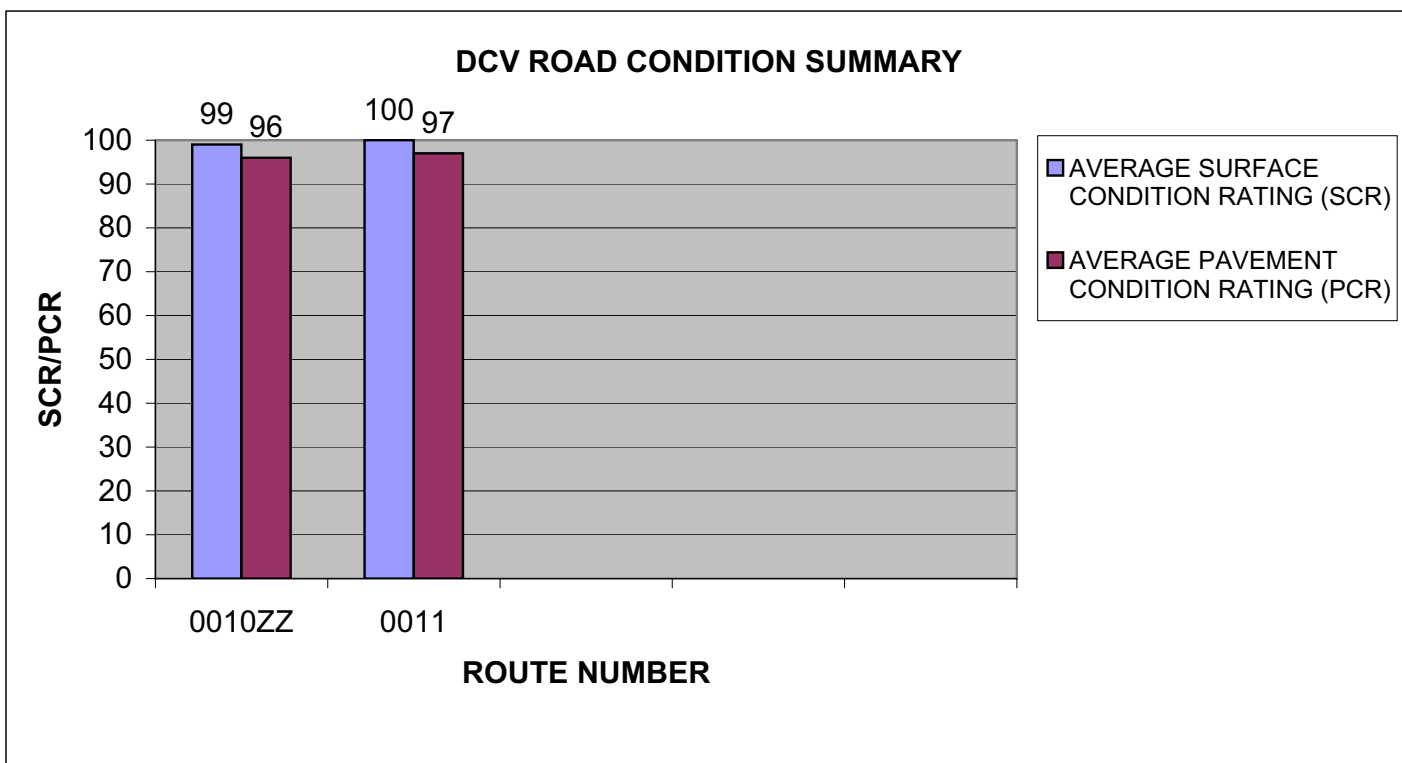
Condition Categories and Treatments



BADL: DCV ROAD CONDITION SUMMARY

DCV - Data Collection Vehicle

ROUTE NUMBER	ROUTE NAME	FUNCT CLASS	ROUTE LENGTH	SURFACE TYPE	AVERAGE SURFACE CONDITION RATING (SCR)	AVERAGE PAVEMENT CONDITION RATING (PCR)
0010ZZ	BADLANDS LOOP ROADS	1	27.92	ASPHALT	99	96
0011	ENTRANCE ROAD (HIGHWAY 377)	1	0.69	ASPHALT	100	97



Section 4

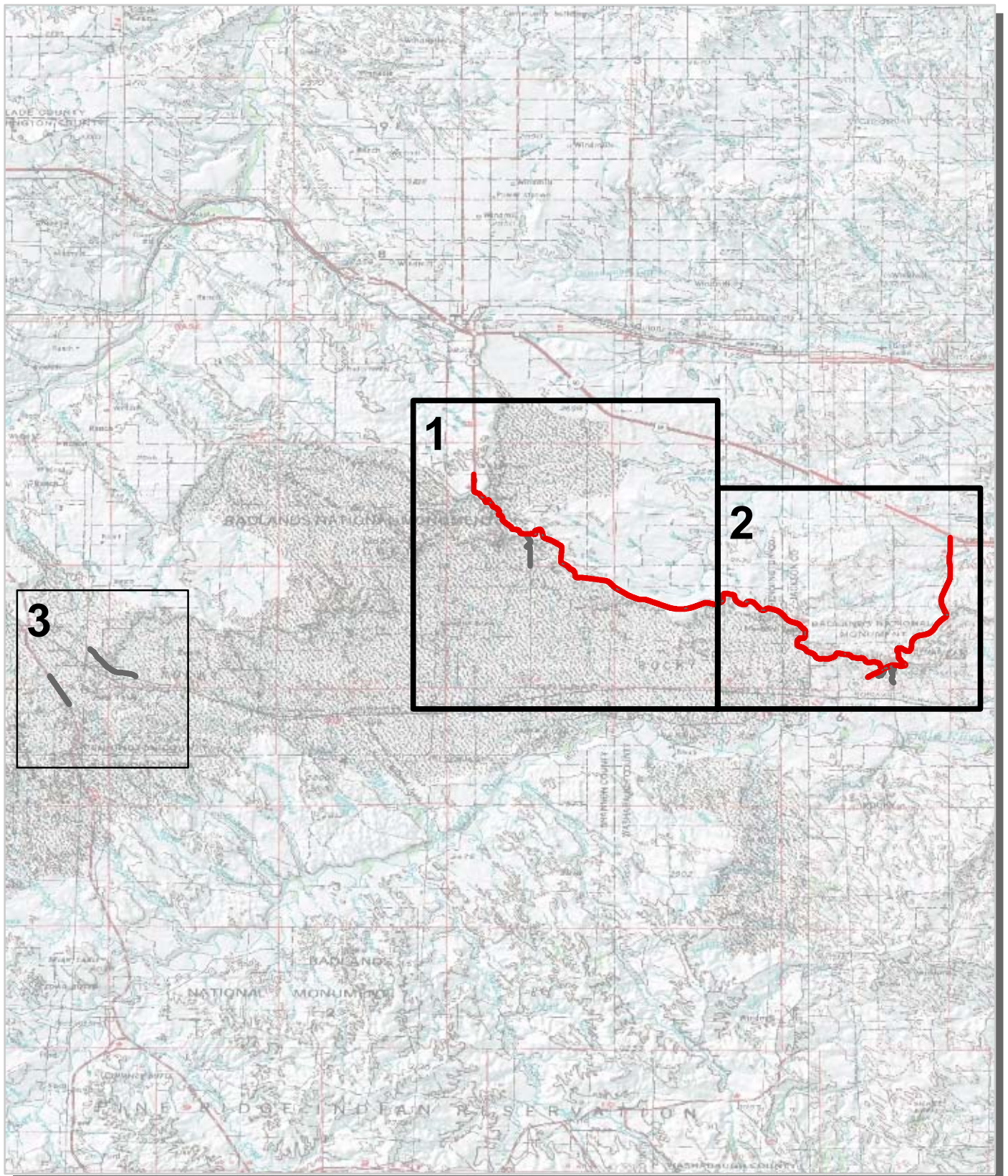
Park Route Location Maps




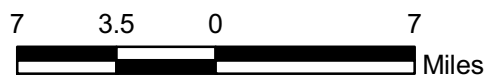
Badlands National Park



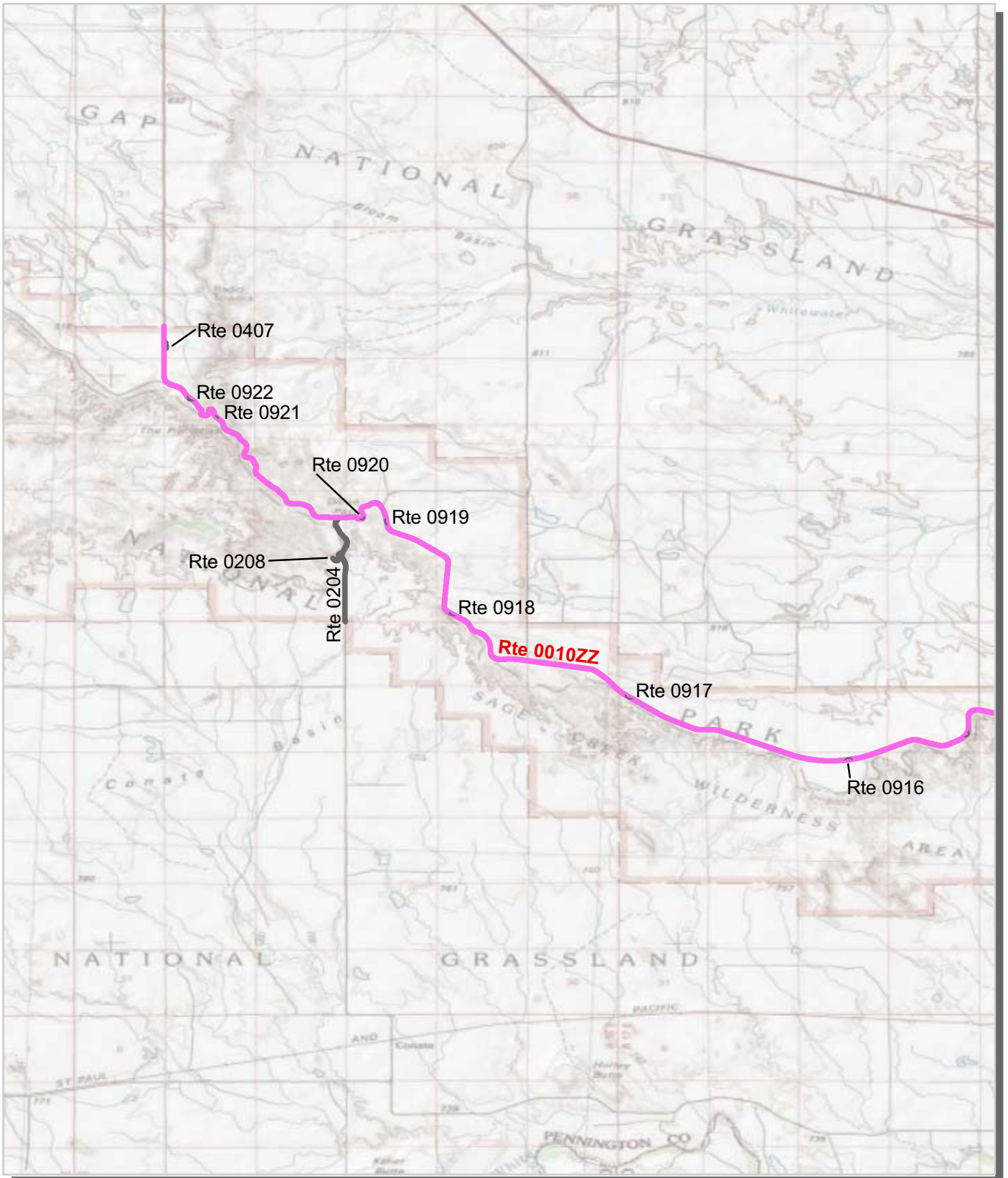
Badlands National Park Route Location Map Key Map



-  Cycle 5 Collected Routes
-  Routes Collected in Previous Cycle

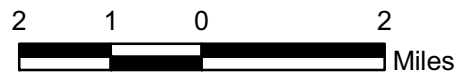


Badlands National Park Route Location Map Area 1

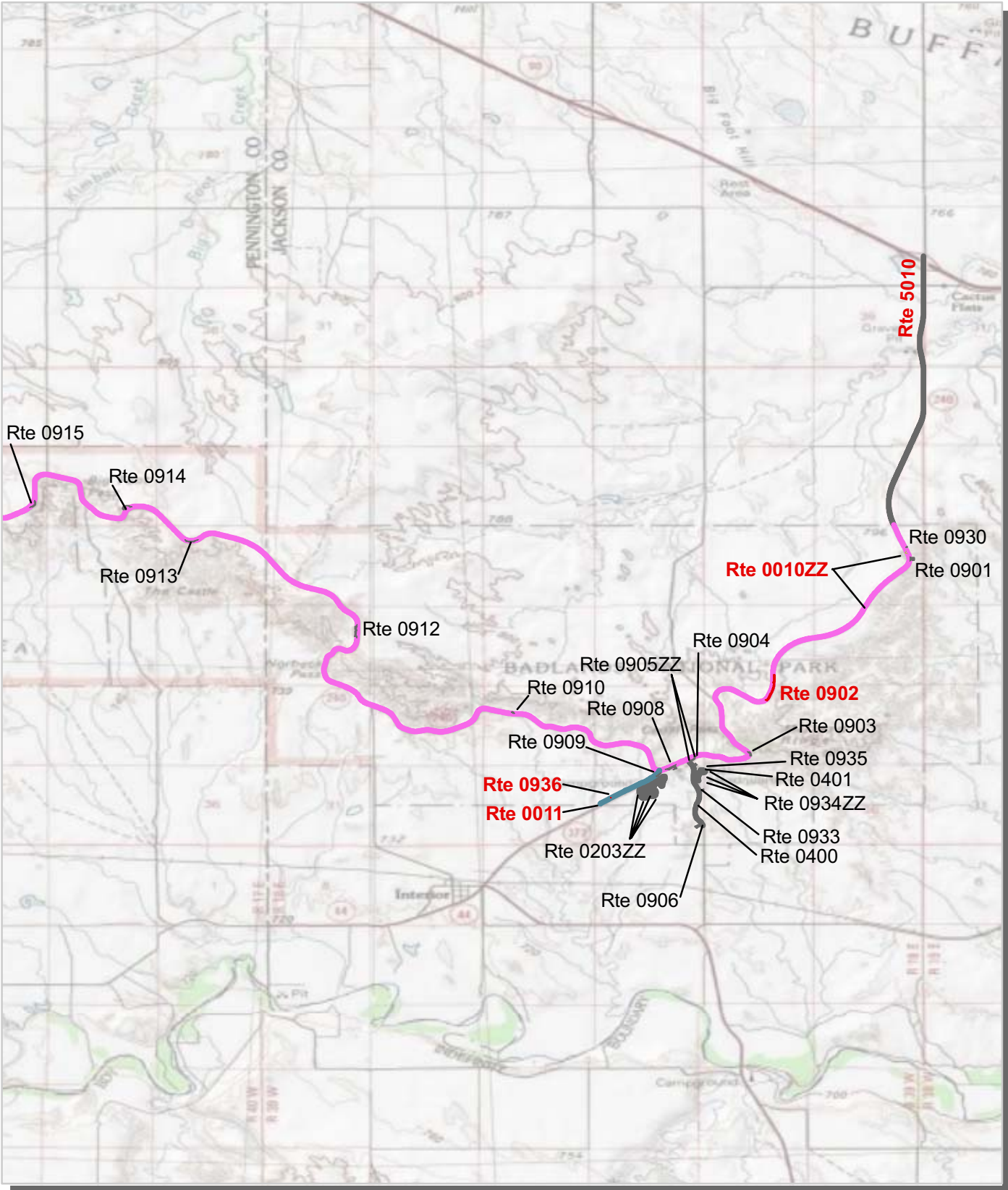


Unique colors used to differentiate routes

— Routes Collected in Previous Cycle

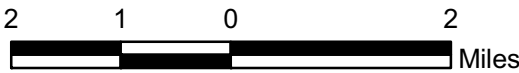


Badlands National Park Route Location Map Area 2

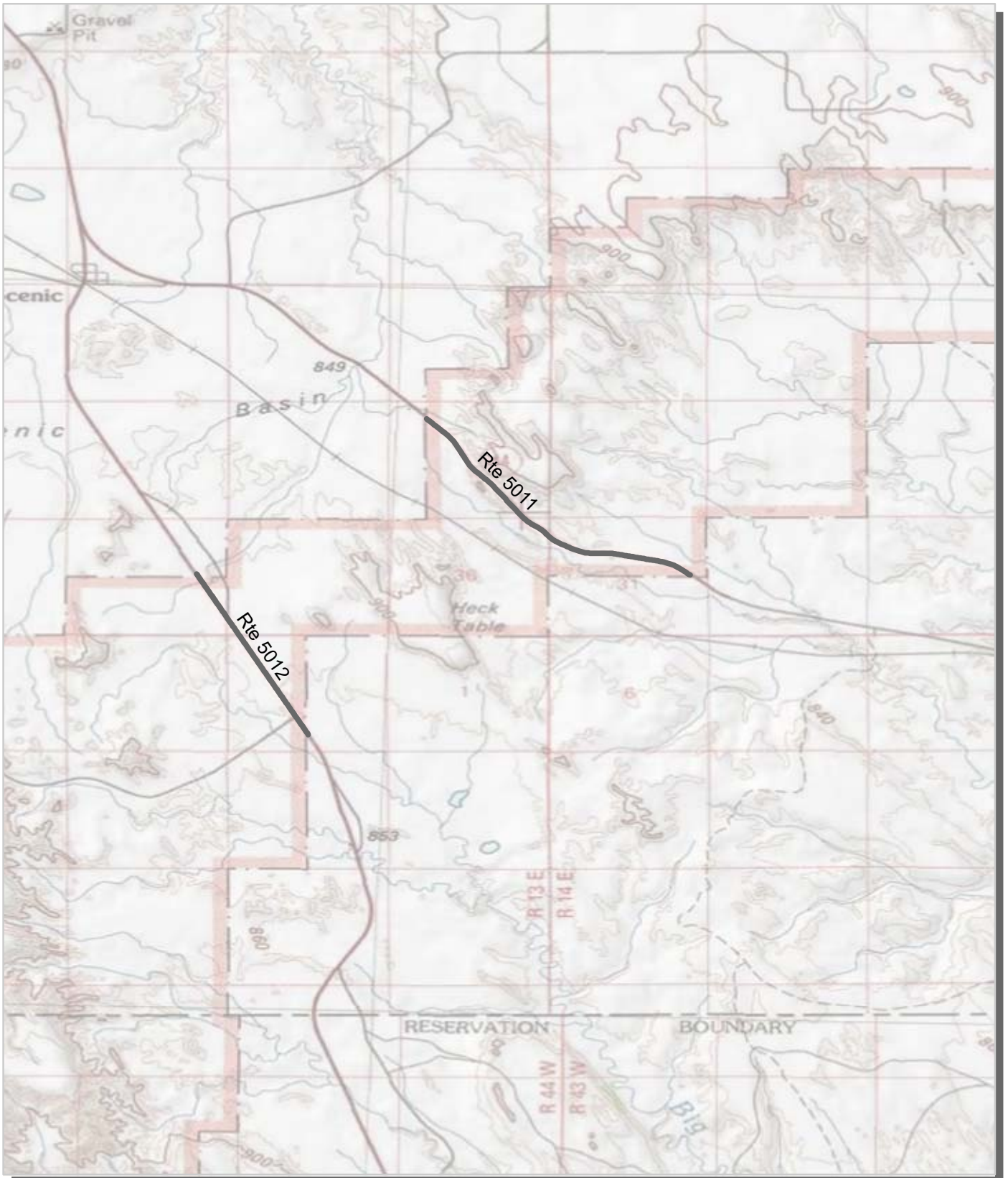


Unique colors used to differentiate routes

Routes Collected in Previous Cycle

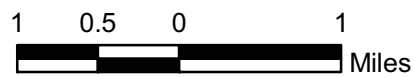


Badlands National Park Route Location Map Area 3

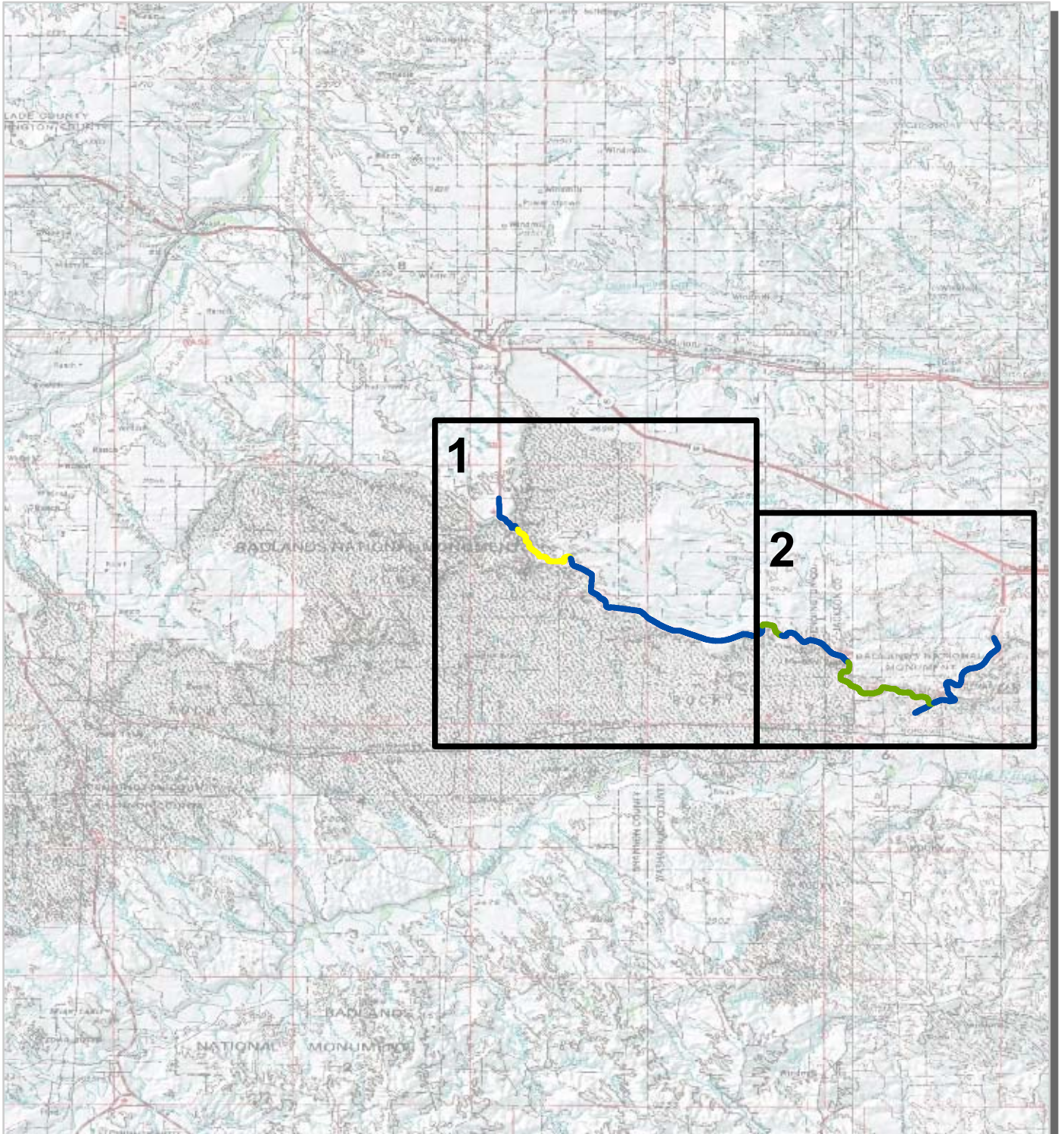


Unique colors used to differentiate routes

— Routes Collected in Previous Cycle



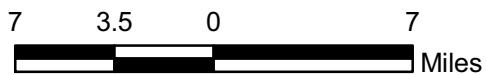
Badlands National Park Route Condition Map PCR - Mile by Mile Key Map



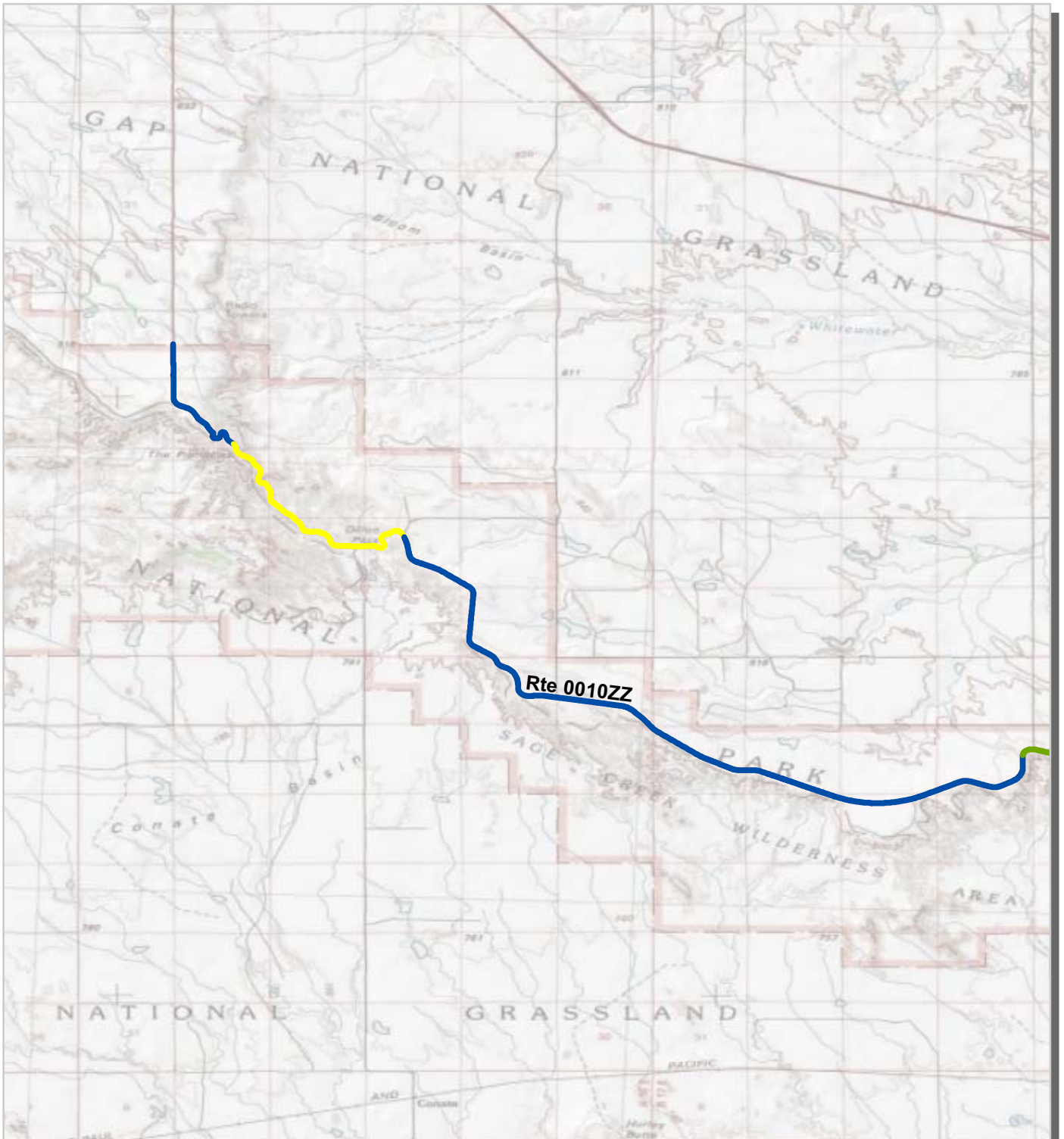
PCR	Poor ■	Fair ■	Good ■	Excellent ■	No Data ■
	(0 - 60)	(61 - 84)	(85 - 94)	(95 - 100)	

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

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

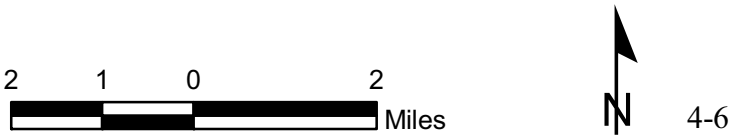


**Badlands National Park
Route Condition Map
PCR - Mile by Mile
Area 1**

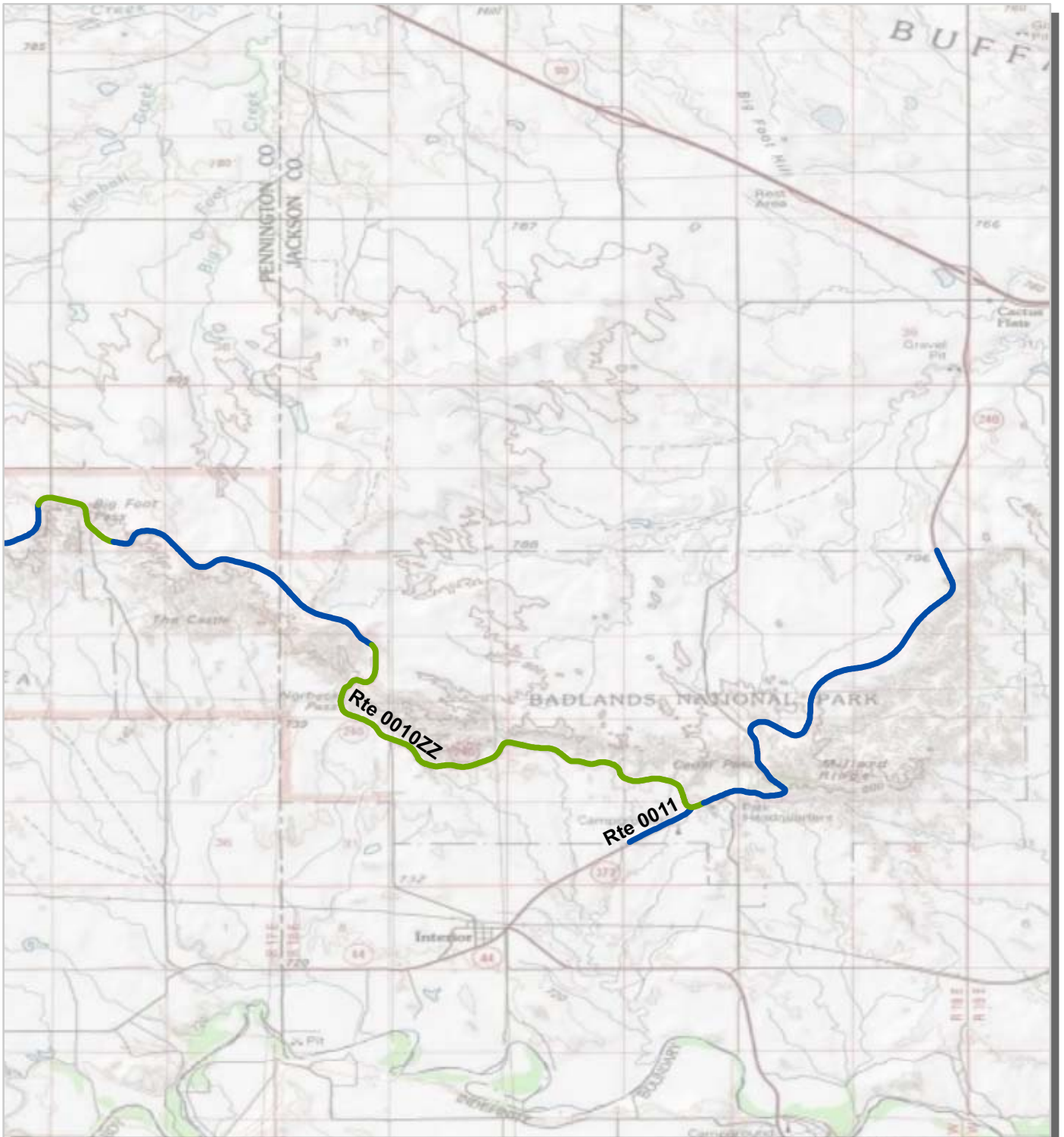


PCR	Poor	Fair	Good	Excellent	No Data
	(0 - 60)	(61 - 84)	(85 - 94)	(95 - 100)	

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



**Badlands National Park
Route Condition Map
PCR - Mile by Mile
Area 2**



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.



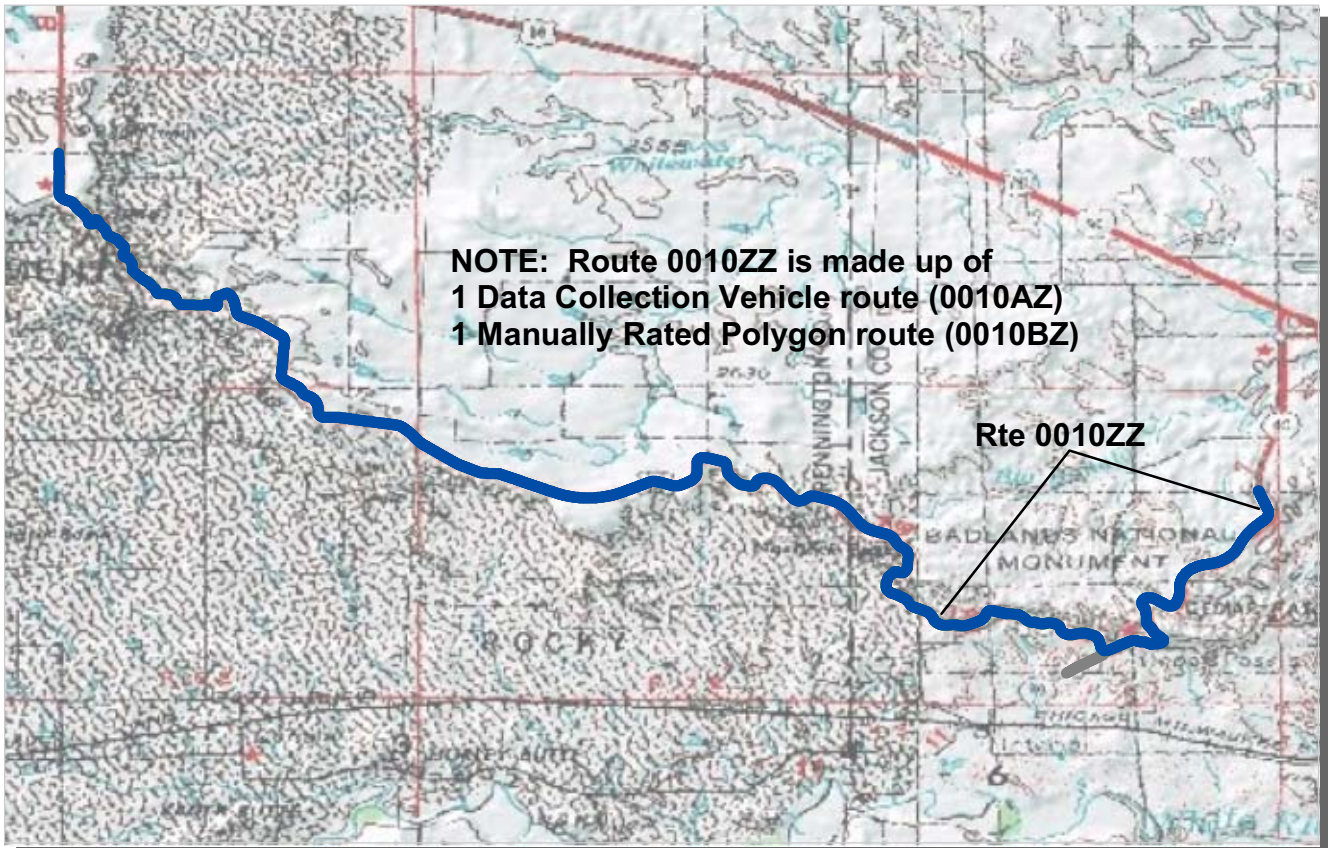
Section 5
Paved Route
Condition Rating Sheets



Badlands National 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: 0010ZZ BADLANDS LOOP ROADS
BADL : BADLANDS NATIONAL PARK

Summary Record COLLECTED: 11/20/2010
 MIDWEST REGION TOTAL LENGTH: 27.92 Miles

Section Number					
Section Length (mi)					
Cross Section Information					
Number of Lanes	N/A				
Paved Width (ft)	N/A				
Lane Width (ft)	N/A				
Roadway Condition Information					
SCR (Surface Condition Rating)	99				
PCR (Pavement Condition Rating)	96				
Distress Index Values					
Structural Crack Index	N/A				
Transverse Cracking Index	N/A				
Patching Index	N/A				
Rutting Index	N/A				
Roughness Condition Index (RCI)	N/A				

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 - Non Applicable

ROUTE: 0010ZZ BADLANDS LOOP ROADS



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

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

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)
BADL : BADLANDS NATIONAL PARK

Subcomponent Record
MIDWEST REGION

COLLECTED: 11/20/2010
TOTAL LENGTH: 27.92 Miles

<i>Section Number</i>	0	1	2	3	4
<i>Section Length (mi)</i>	1.00	1.00	1.00	1.00	1.00
<i>Cross Section Information</i>					
Number of Lanes	2	2	2	2	2
Paved Width (ft)	34	22	24	23	25
Lane Width (ft)	13	10	10	10	11
<i>Roadway Condition Information</i>					
SCR (Surface Condition Rating)	99	100	100	100	99
PCR (Pavement Condition Rating)	99	100	100	100	99
<i>Distress Index Values</i>					
Structural Crack Index	100	100	100	100	99
Transverse Cracking Index	100	100	100	100	99
Patching Index	100	100	100	100	100
Rutting Index	99	100	100	100	99
Roughness Condition Index (RCI)	100	100	100	100	100

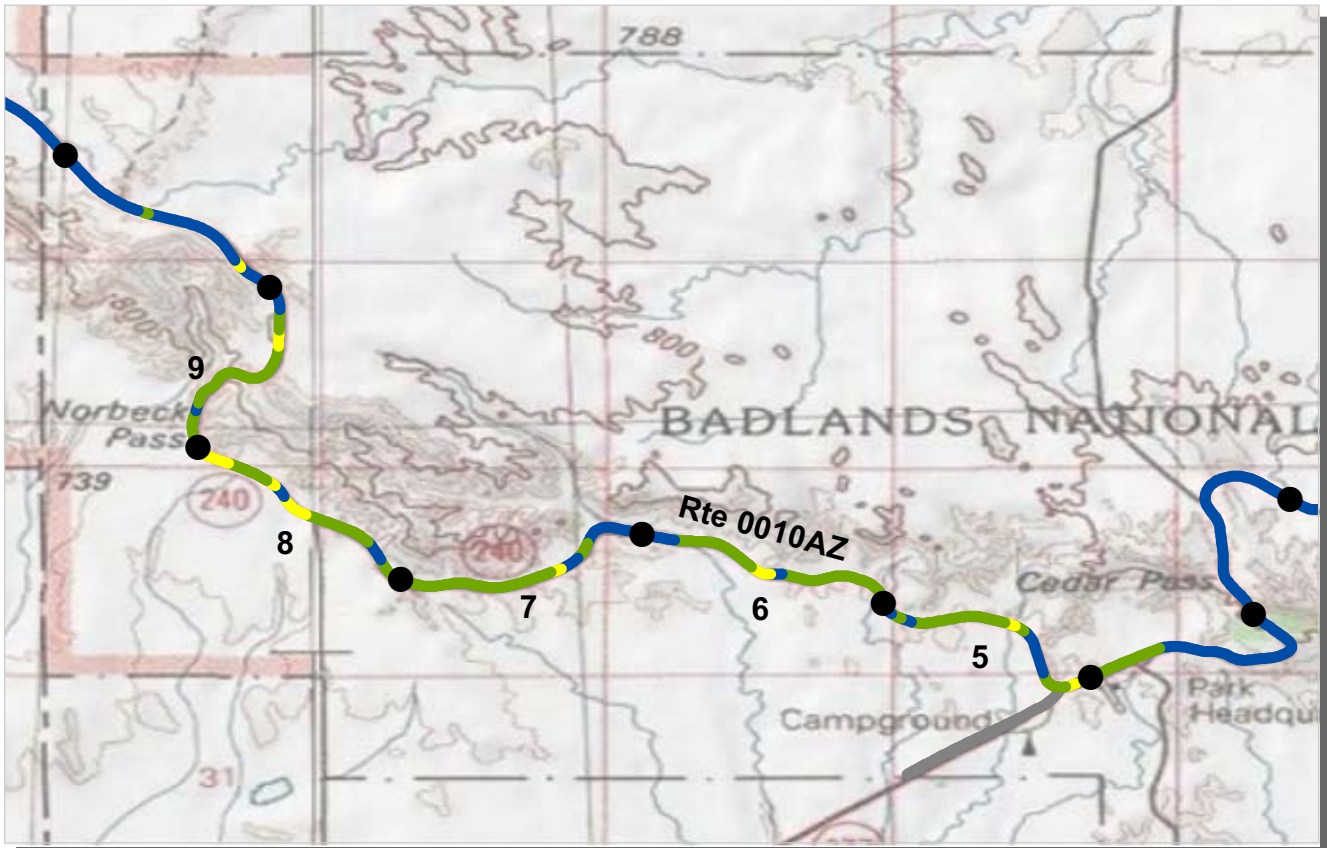
NOTES:

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 - Non Applicable

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)



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: 0010AZ BADLANDS LOOP (ROAD 240)
BADL : BADLANDS NATIONAL PARK

Subcomponent Record
 MIDWEST REGION

COLLECTED: 11/20/2010
TOTAL LENGTH: 27.92 Miles

<i>Section Number</i>	5	6	7	8	9
<i>Section Length (mi)</i>	1.00	1.00	1.00	1.00	1.00
<i>Cross Section Information</i>					
Number of Lanes	2	2	2	2	2
Paved Width (ft)	29	27	26	28	29
Lane Width (ft)	11	11	11	11	11
<i>Roadway Condition Information</i>					
SCR (Surface Condition Rating)	99	99	98	99	98
PCR (Pavement Condition Rating)	93	90	92	89	91
<i>Distress Index Values</i>					
Structural Crack Index	99	100	99	99	99
Transverse Cracking Index	99	99	98	99	99
Patching Index	100	100	100	100	100
Rutting Index	100	100	100	99	98
Roughness Condition Index (RCI)	85	77	82	74	81

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 - Non Applicable



ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)



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: 0010AZ BADLANDS LOOP (ROAD 240)
BADL : BADLANDS NATIONAL PARK

Subcomponent Record
 MIDWEST REGION

COLLECTED: 11/20/2010
 TOTAL LENGTH: 27.92 Miles

Section Number	10	11	12	13	14
Section Length (mi)	1.00	1.00	1.00	1.00	1.00
Cross Section Information					
Number of Lanes	2	2	2	2	2
Paved Width (ft)	26	25	28	28	23
Lane Width (ft)	11	11	11	11	10
Roadway Condition Information					
SCR (Surface Condition Rating)	100	99	99	98	100
PCR (Pavement Condition Rating)	100	99	99	92	100
Distress Index Values					
Structural Crack Index	100	100	100	98	100
Transverse Cracking Index	100	100	99	99	100
Patching Index	100	100	100	99	100
Rutting Index	100	99	100	98	100
Roughness Condition Index (RCI)	100	100	98	83	100

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 - Non Applicable

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)



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

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

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)
BADL : BADLANDS NATIONAL PARK

Subcomponent Record COLLECTED: 11/20/2010
 MIDWEST REGION TOTAL LENGTH: 27.92 Miles

Section Number	15	16	17	18	19
Section Length (mi)	1.00	1.00	1.00	1.00	1.00
Cross Section Information					
Number of Lanes	2	2	2	2	2
Paved Width (ft)	22	22	20	21	22
Lane Width (ft)	9	9	9	9	9
Roadway Condition Information					
SCR (Surface Condition Rating)	100	100	100	100	100
PCR (Pavement Condition Rating)	100	100	100	100	100
Distress Index Values					
Structural Crack Index	100	100	100	100	100
Transverse Cracking Index	100	100	100	100	100
Patching Index	100	100	100	100	100
Rutting Index	100	100	100	100	100
Roughness Condition Index (RCI)	100	100	100	100	100

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 - Non Applicable

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)



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: 0010AZ BADLANDS LOOP (ROAD 240)
BADL : BADLANDS NATIONAL PARK

Subcomponent Record
 MIDWEST REGION

COLLECTED: 11/20/2010
 TOTAL LENGTH: 27.92 Miles

Section Number	25	26	27		
Section Length (mi)	1.00	1.00	0.92		
Cross Section Information					
Number of Lanes	2	2	2		
Paved Width (ft)	28	27	33		
Lane Width (ft)	11	11	11		
Roadway Condition Information					
SCR (Surface Condition Rating)	97	97	99		
PCR (Pavement Condition Rating)	82	95	99		
Distress Index Values					
Structural Crack Index	97	97	99		
Transverse Cracking Index	99	99	99		
Patching Index	100	100	100		
Rutting Index	99	100	99		
Roughness Condition Index (RCI)	60	93	98		

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 - Non Applicable

ROUTE: 0010AZ BADLANDS LOOP (ROAD 240)



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: 0011 ENTRANCE ROAD (HIGHWAY 377)
BADL : BADLANDS NATIONAL PARK

COLLECTED: 11/20/2010
TOTAL LENGTH: 0.69 Miles

MIDWEST REGION

Section Number	0				
Section Length (mi)	0.69				
Cross Section Information					
Number of Lanes	2				
Paved Width (ft)	28				
Lane Width (ft)	11				
Roadway Condition Information					
SCR (Surface Condition Rating)	100				
PCR (Pavement Condition Rating)	97				
Distress Index Values					
Structural Crack Index	100				
Transverse Cracking Index	100				
Patching Index	100				
Rutting Index	100				
Roughness Condition Index (RCI)	93				

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 - Non Applicable



ROUTE: 0011 ENTRANCE ROAD (HIGHWAY 377)

Section 6
Manually Rated Paved Route
Condition Rating Sheets



Badlands National Park



Federal Lands Highway
Road Inventory Program

BADLANDS NATIONAL PARK

Route 0010ZZ

BADLANDS LOOP ROADS

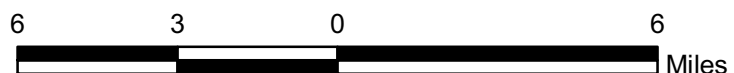
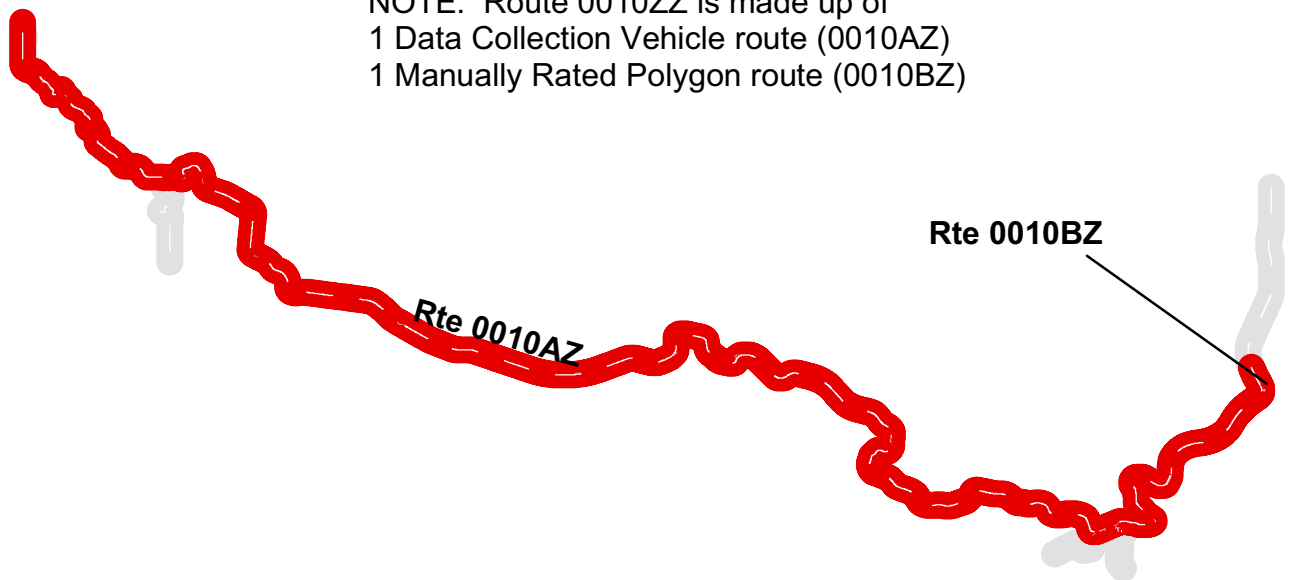
FROM END OF ROUTE 5010 (STATE HIGHWAY 240 (NORTHEAST ENTRANCE ROAD))
TO PARK BOUNDARY AT NORTHWEST/PINNACLES ENTRANCE

Summary Record

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0010ZZ	PUBLIC	11/20/2010	9,981	64.13	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
NC	NC	NC	N/A	N/A	SUMMARY/96

* Lane miles are based on 11' lane widths

NOTE: Route 0010ZZ is made up of
1 Data Collection Vehicle route (0010AZ)
1 Manually Rated Polygon route (0010BZ)



BADLANDS NATIONAL PARK

Route 0010BZ

NORTH EAST ENTRANCE TURNAROUND

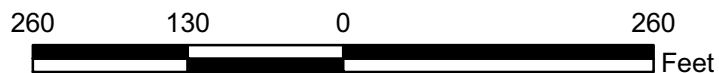
FROM ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.35

TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 0.38

Subcomponent Record

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0010BZ	PUBLIC	11/20/2010	9,981	0.17	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
0	0	0	CONCRETE CURB AND GUTTER	NO CURB	GOOD/90

* Lane miles are based on 11' lane widths



Section 7
Parking Area
Condition Rating Sheets



Badlands National Park



Federal Lands Highway
Road Inventory Program

BADLANDS NATIONAL PARK

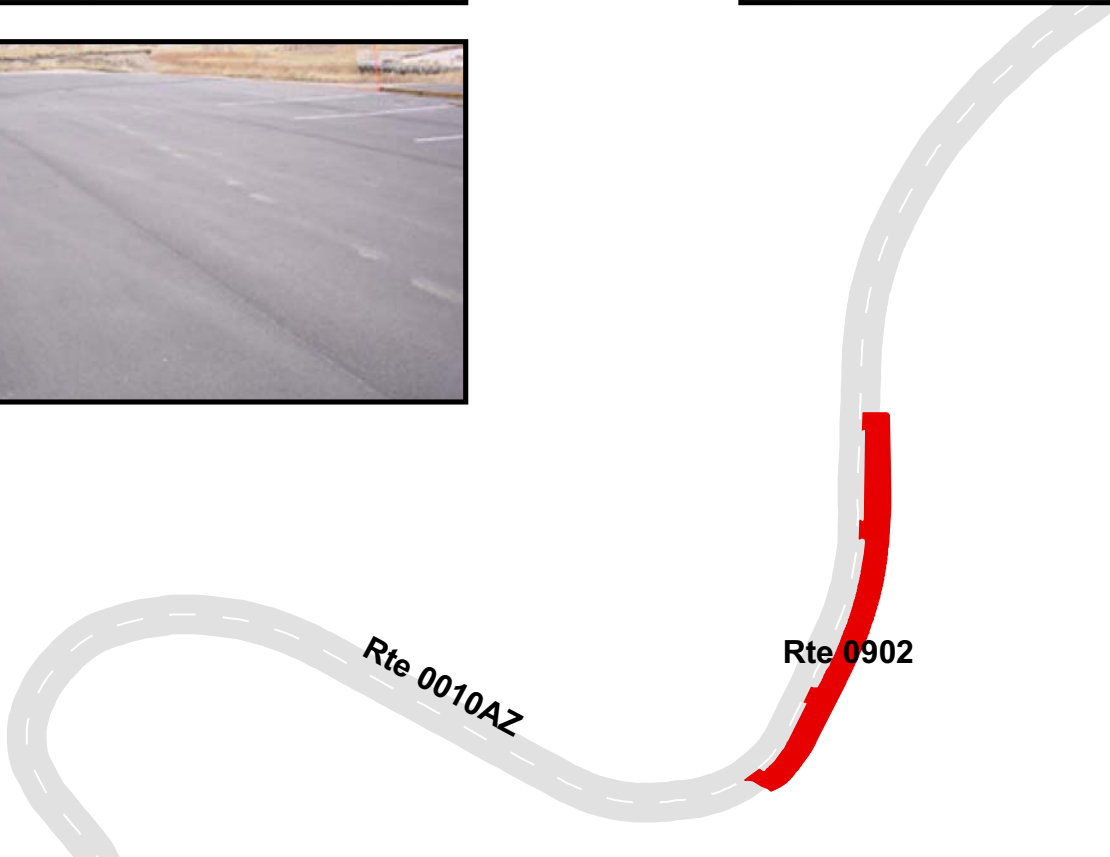
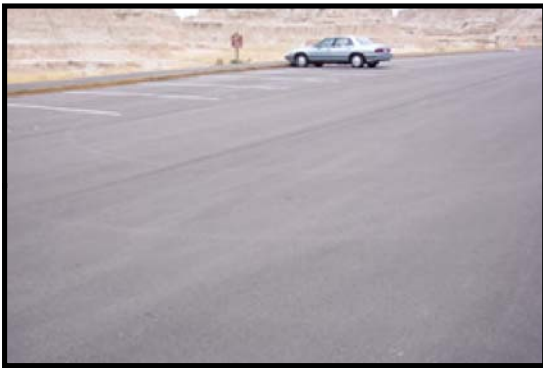
Route 0902

DOORS AND WINDOWS PARKING

ADJACENT TO ROUTE 0010AZ (BADLANDS LOOP (ROAD 240)) AT MP 2.60 ON LEFT

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0902	PUBLIC	11/20/2010	150,917	2.60	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
0	5	0	NO CURB AND GUTTER	WOOD CURB	GOOD/90

* Lane miles are based on 11' lane widths



BADLANDS NATIONAL PARK

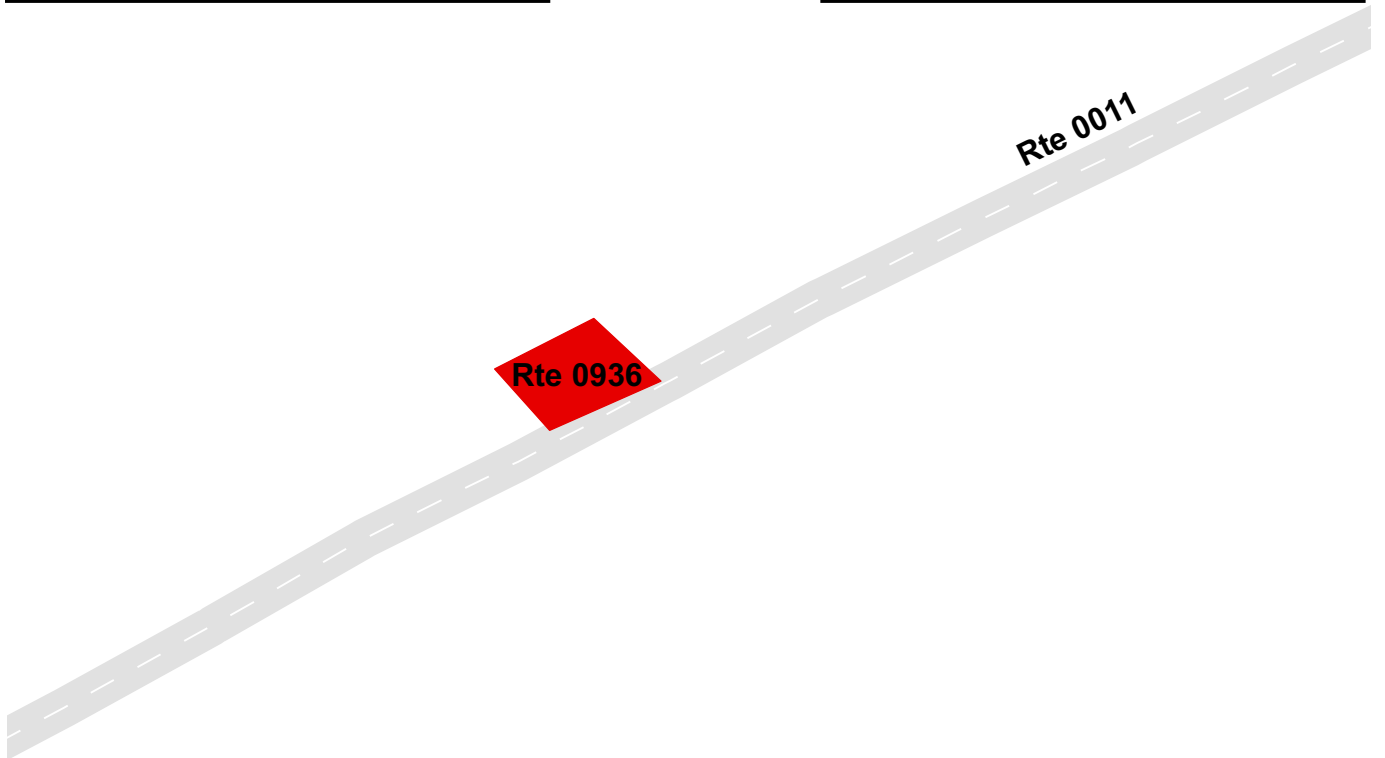
Route 0936

INTERIOR ENTRANCE BOOTH PARKING LOT

ADJACENT TO ROUTE 0011 (ENTRANCE ROAD (HIGHWAY 377)) AT MP 0.56 (ON RIGHT)

Route Number	Public / NonPublic	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0936	PUBLIC	11/20/2010	1,012	0.02	AS
Culverts	Drop Inlets	Gates	Curb & Gutter	Curb	PCR
0	0	0	NO CURB AND GUTTER	NO CURB	GOOD/90

* Lane miles are based on 11' lane widths



Section 8
Route Maintenance
Features Summaries



Badlands National Park



**Federal Lands Highway
Road Inventory Program**

DCV ROUTE MAINTENANCE FEATURES SUMMARY

This park is classified as a Large Park. DCV Route Maintenance Features are only collected in Cycle 5 on routes that were not collected in a previous cycle or routes that have had a significant change in alignment since the previous collection. For this park unit no DCV Route Maintenance Features were collected in Cycle-5, there are no DCV Route Maintenance Features to report for Cycle-5.

Section 9
Route Maintenance Features
Road Logs



Badlands National Park



ROUTE MAINTENANCE FEATURES ROAD LOGS

This park is classified as a Large Park. Therefore, in Cycle 5, no features asset inventory was conducted unless the route was modified or previously uncollected by RIP.

Section 10 Appendix



Badlands National Park



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 vis a vis the distresses and indexes that comprise the Pavement Condition Rating (PCR), an extensive study was completed throughout 2010 that has 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. The 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.

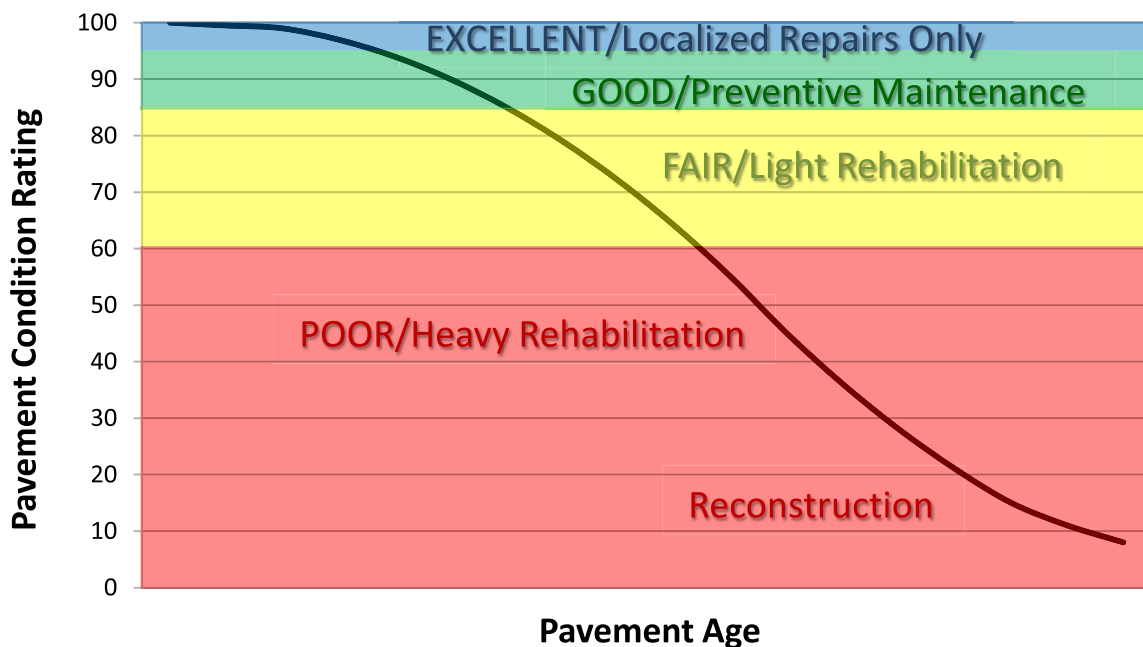
Explanation of the Excellent, Good, Fair and Poor Condition Descriptions

In addition to the RIP Index changes that will be implemented in Cycle 5, we will also aim to 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.

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



DESCRIPTION OF RATING SYSTEM

The Federal Highway Administration (FHWA), Road Inventory Program (RIP) for the National Park Service (NPS), collects roadway condition data on paved surfaces (asphalt, concrete, brick, and cobblestone) on roads, parkways, and parking areas in national parks nationwide. The road surface condition data is collected using an automated Data Collection Vehicle (DCV). Roads having brick or cobblestone surfacing are not normally surveyed with the DCV, but are manually rated for condition rating.

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 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. In truth, the FHWA RIP distress types are similar to those described in the LTPP manual with some modifications. This 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 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, 168 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 23.

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 patch may not exceed 0.30 mi. (0.48 km). (Any full-lane patch exceeding 0.30 mi. in length is considered a pavement change). 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 Inertial Measuring Unit (IMU) to provide accurate positioning data 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	+ - 0.1 degrees
Grade	+ - 0.1 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.

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 tables 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.

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