COLM
GIP Report

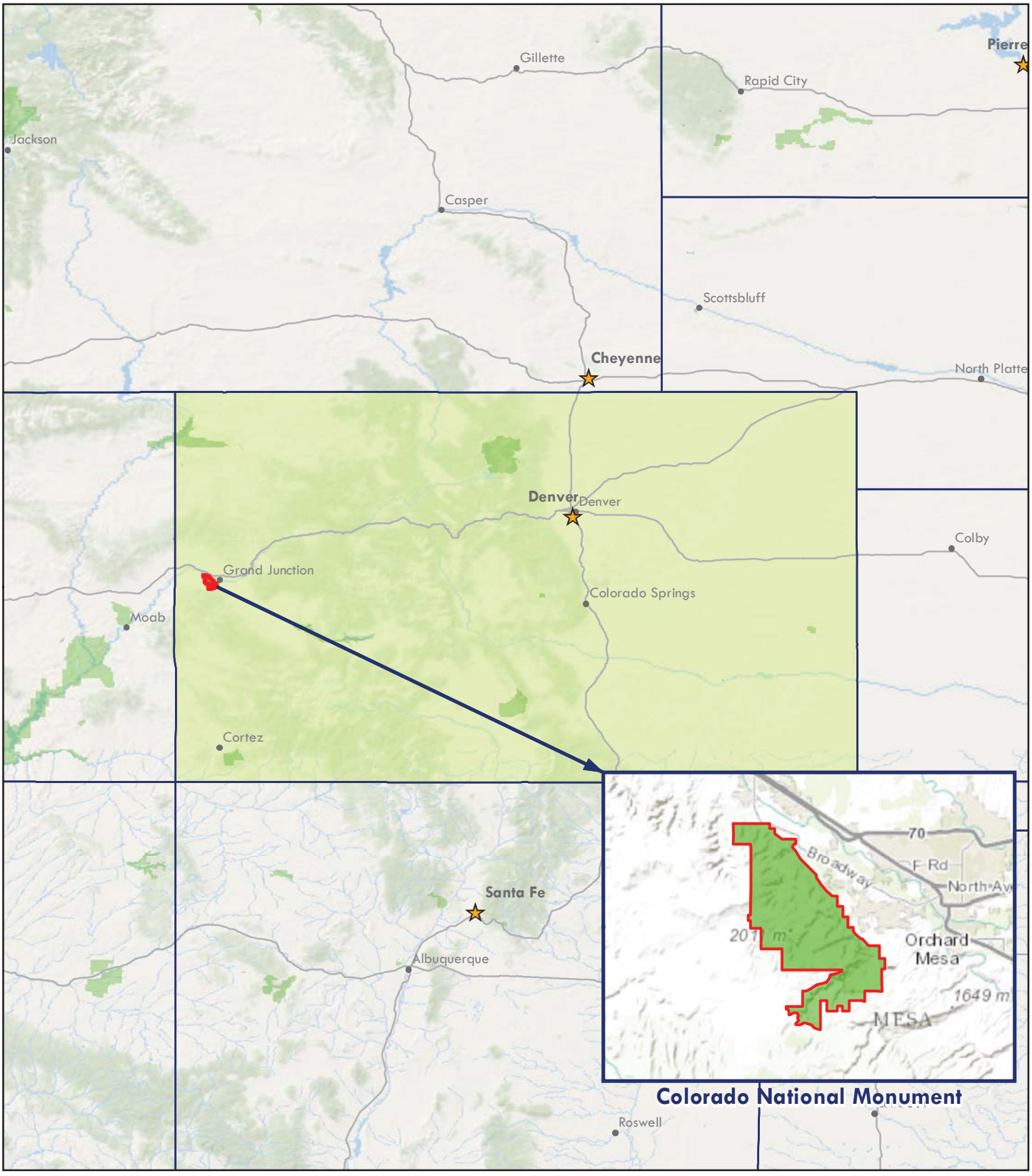
NPS Guardwall/Rail Inventory Program
Colorado National Monument

Federal Lands Highway
Road Inventory Program

Prepared By:
Federal Highway Administration
Eastern Federal Lands Highway Division
Road Inventory Program (RIP)

Data Collection Date: March 2011
Report Date: November 2015

Colorado National Monument
in
Colorado



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Introduction

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Introduction

In support of the NPS Facility Management Software System (FMSS) asset management program, FHWA- contracted staff completed the Guardwall/Rail Inventory Program (GIP) inspections within selected National Park Service (NPS) units between 2010 and 2011. This inventory provides static information to FMSS regarding barrier characteristics such as height, length and location, as well as dynamic information about the condition of the barrier. In addition, when barrier deficiencies were identified, repair recommendations and estimated costs, suitable for use as FMSS work orders, were generated to bring the barrier back to its "new" condition.

In over 30 parks, numerous crashworthy barriers inspected maybe in poor condition by simply applying a new overlay of asphalt without milling previous layers. In instances such as this, basically the critical element of barrier height decreased as the elevation of the roadway increased. Resulting work orders were drafted to raise w-beam barriers or to remove and reset stone masonry barriers to their original design height.

This inventory provides static information and a condition assessment of each barrier inventoried. In addition, when barrier deficiencies were identified, repair recommendations and estimated costs were drafted to bring the barrier back to its "new" condition.

Drafted work orders have been classified as being either deferred maintenance or capital improvement. This classification is based on the type of work recommended, as defined below.

- *Deferred Maintenance* can be classified as repair or replace in kind. Work done to the barrier does not include any upgrading.
- *Capital Improvement* can be classified as upgrading part of or the entire existing barrier. Typically the upgrade will be from a non-crashworthy to a crashworthy device. Other examples of capital improvements would be the addition of a curb to improve drainage.

Care was taken to maintain the cultural significance of historic barriers located in the NPS. While historic traffic barriers likely would not withstand current crashworthiness performance criteria, they are considered by the NPS to be important resources for the historic and/or cultural value. Historic barriers may be "character defining features" that contribute to the cultural significance of historic roadways. As such, these barriers have resource value in and of themselves which may be somewhat independent from their functionality as barriers as previously defined. The consideration of both the crashworthiness and resource value of historic barriers was a significant challenge for the NPS and the FHWA when designing the GIP, to the point that for historic stone masonry barriers, the barrier height had to be more than 6-in below its design height before any work would be considered to deal with height issues. To preserve historic stone masonry barriers, typical drafted work orders for historic barriers were to remove and reset the barrier to the barrier's original design height on a concrete footer, as compared to replacing it with a similar crashworthy barrier.

This report is organized in a tiered approach from the broad park overview perspective (Tier 1) to a route overview perspective (Tier 2), then down to the details of each barrier (Tier 3). Tier 1 presents park barrier location maps and an overall park-specific summary narrative of the results of the guardwall/rail inventory program. Tier 2 presents route overview maps with associated barrier summary information. Tier 3 presents individual barrier information in a one-page detailed format, including a photograph of each barrier. Appendix A provides a condensed summary of guardwall/rail inventory definitions and assessment categories to assist in reading this report.

Park Barrier Location Maps

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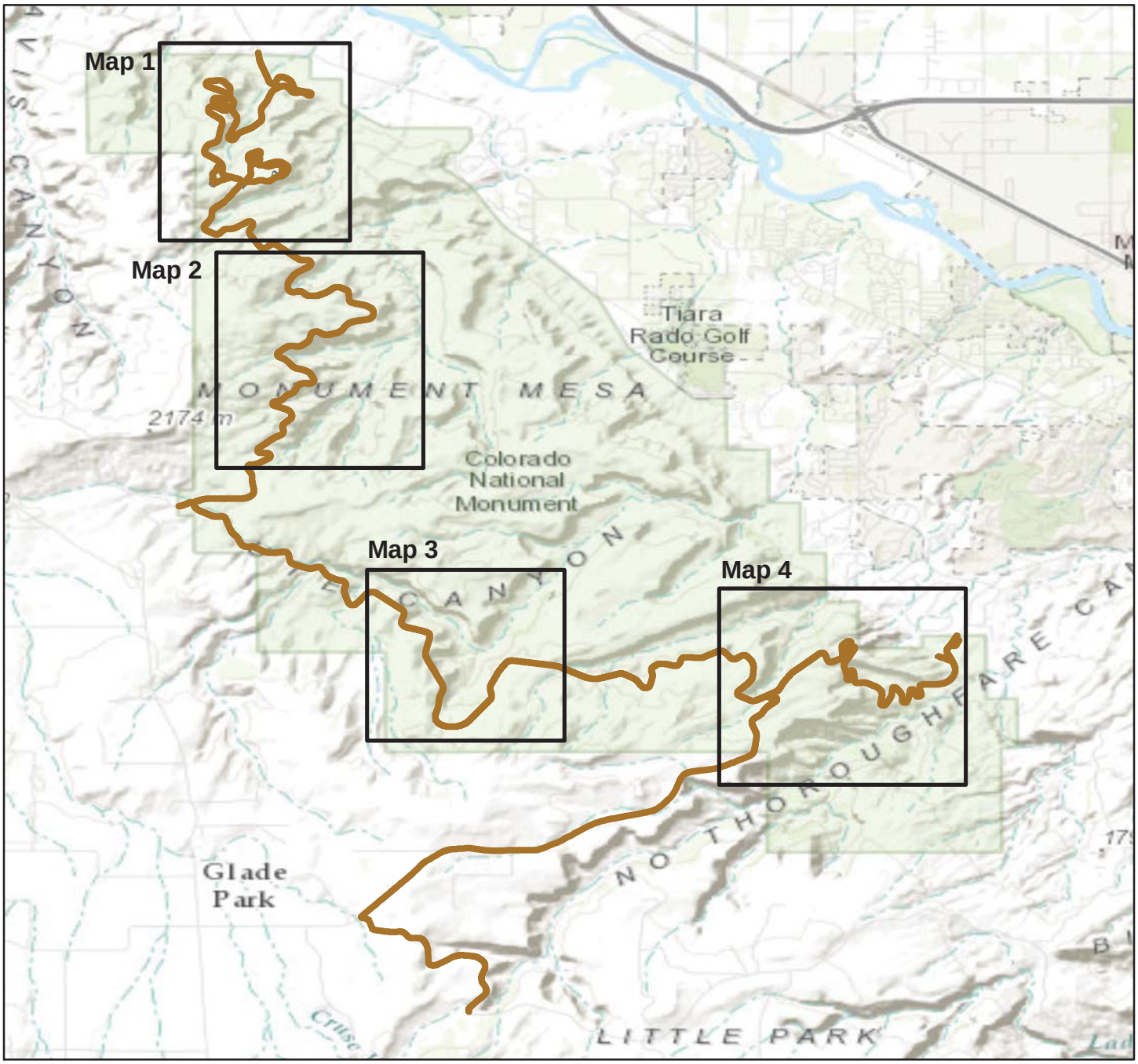
BARRIER LOCATION MAP

Key Map



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

RIP Collected Routes

Miles

0 1 2

N

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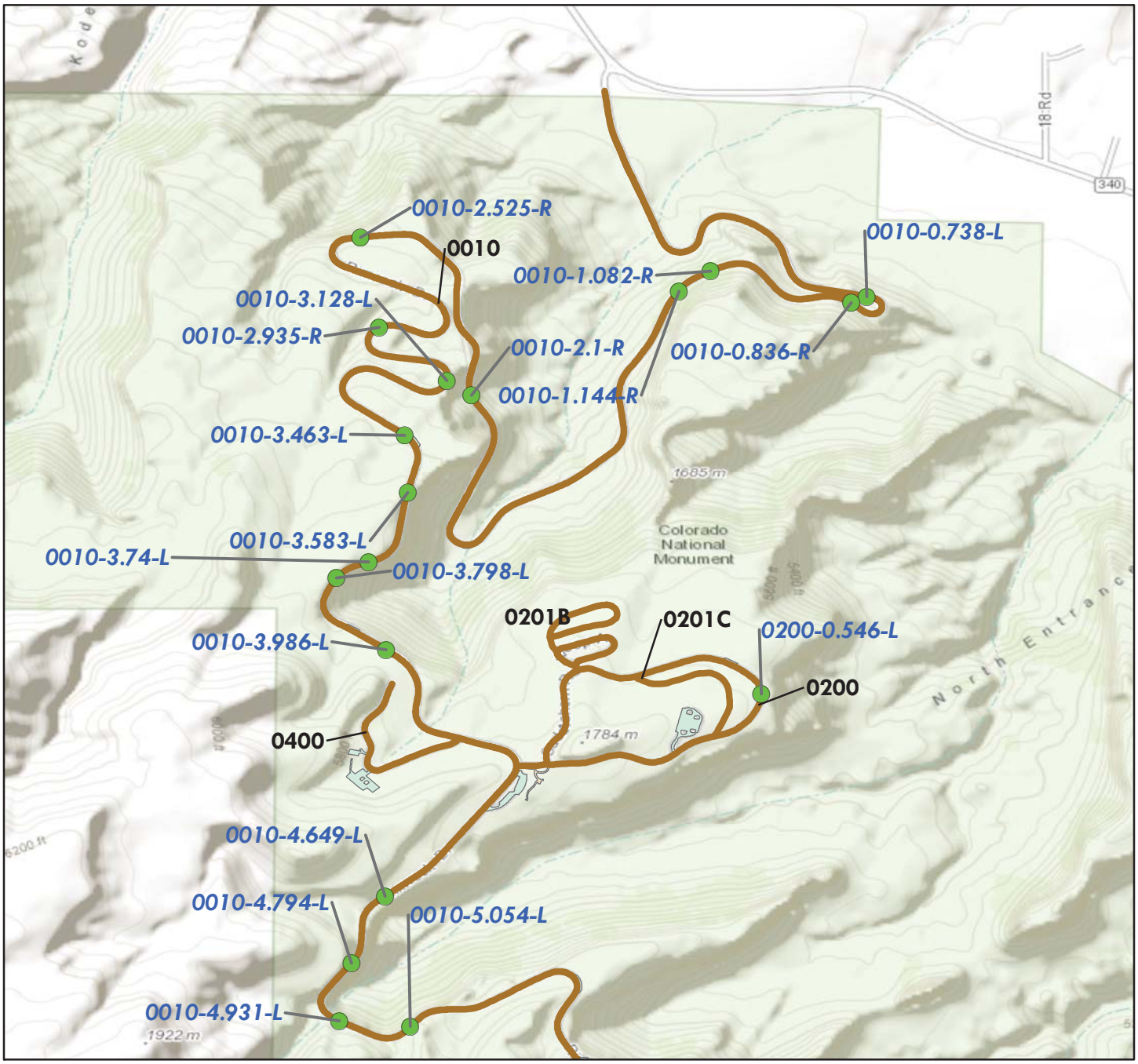
BARRIER LOCATION MAP

Map 1



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Barrier Locations

RIP Collected Routes

Miles

0 0.25 0.5

N

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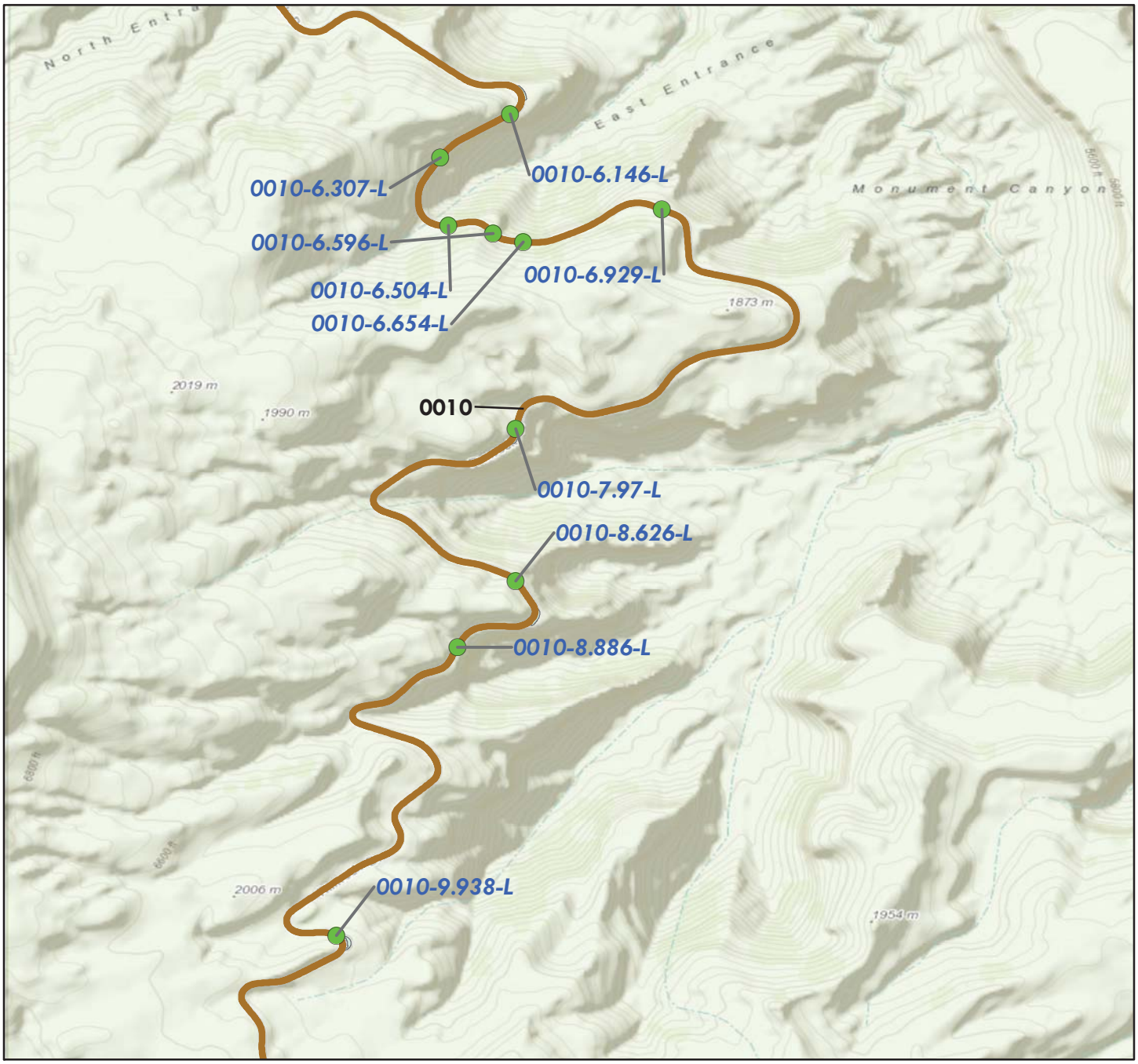
BARRIER LOCATION MAP

Map 2



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations

RIP Collected Routes

Miles

0 0.25 0.5

N

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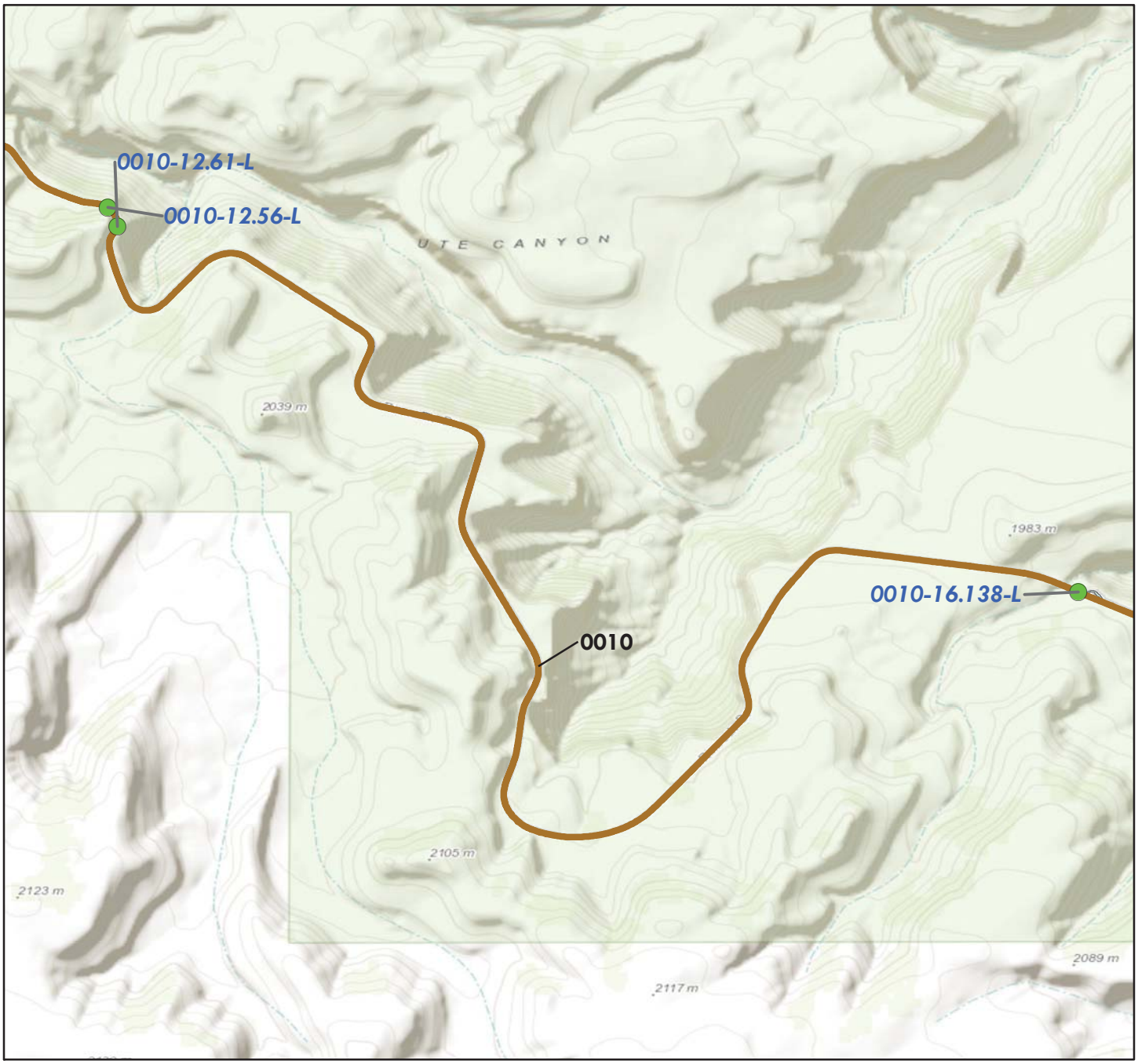
BARRIER LOCATION MAP

Map 3



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations

RIP Collected Routes

Miles

0 0.5 1

N

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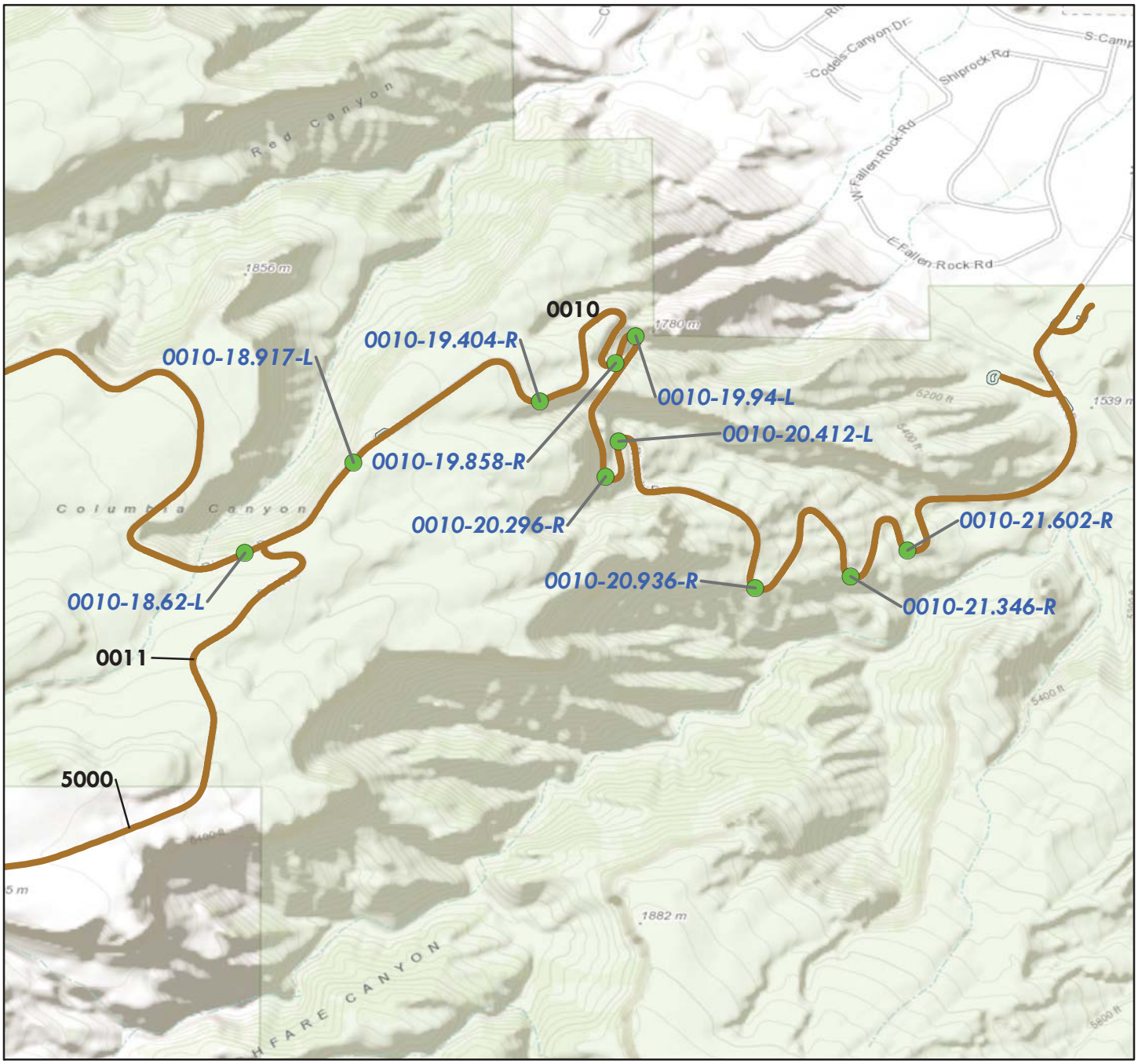
BARRIER LOCATION MAP

Map 4



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations

RIP Collected Routes

Miles

0 0.5 1

N

Tier 1
Park Barrier Overview

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Parkwide Summary: Colorado National Monument

Initial barrier inspections were conducted at Colorado National Monument in 2011, and encompassed all known barriers associated with Park roadways. In general, walls are not included in this assessment, but were inspected for Colorado National Monument in 2007 under a separate effort as part of the Retaining Wall Inventory Program (WIP). A report for WIP is available under separate cover.

All paved roadways and parking areas listed in the RIP Route Identification Report were inspected for barriers.

The following tables provide an overview of the findings of this inspection and assessment effort. In all, 41 barriers were inventoried on the routes listed below.

Table 1: Number of Barriers by Route

Route Number	Route Name	No. of Barriers
0010	RIMROCK DRIVE	40
0200	SADDLEHORN LOOP ROAD	1

Due to the different GIP assessment criteria of barriers based on their intended use, barriers were classified as being either traffic barriers or non-traffic barriers.

- *Traffic* barriers are physical devices intended to keep vehicles or people from straying into dangerous or off-limits areas. For the purpose of this inventory, a traffic barrier is categorized as roadside hardware placed longitudinally, excluding pedestrian railing and fencing.

- *Non-traffic* barriers provide a physical delineation between public access areas and restricted or protected areas in locations such as a parking lot, viewpoint or turnout. **Non-traffic barriers which inhibit access of vehicles are included in this report; non-traffic barriers which only inhibit access of pedestrians or bicyclists are not included. For the purpose of this inventory, non-traffic barriers are guidewalls and guiderails. Note: rocks, stones, boulders, fences or curbs were excluded from this inventory.**

There are instances in parks where a single barrier can switch between being classified as a traffic barrier and a non-traffic barrier. Such instances typically occur at pullouts, where a traffic barrier along the road will continue through the pullout without interruption. In such instances, the traffic barrier and non-traffic barrier were assessed using different criteria. Due to the different criteria, the GIP database was designed to record the traffic barrier and non-traffic barrier as multiple distinct barriers, even though to the eye, they appear as one barrier. Other instances where a single barrier is split into multiple barriers would be when the barrier is placed continuously along two legs of an intersection, so that one portion of the barrier may be on one road and the remaining portion of the barrier is on a different road.

Table 2: Number of Barriers by Function

Barrier Function	No. of Barriers
NON-TRAFFIC	5
TRAFFIC	36

The following table shows the barrier types that were inventoried and assessed.

Table 3: Number of Barriers by Type

Primary Barrier Type	No. of Barriers
Stone Masonry Without Concrete Core Wall	25
W-Beam Strong Post	14
Stone Masonry Crenellated Without Core Wall	2

The following table shows the number of barriers by one of four categories of recommended action along with associated work order costs and the number of barriers that are in each recommended action. All work order information is presented for individual barriers, even though some work orders were not accepted by the Park. Some work orders were later combined to simplify route deferred maintenance requests.

Table 4: Number of Barriers by Recommended Action and Associated 2008 Cost

Recommended Action	Repair Costs*	No. of Barriers
No Action	$0	6
Monitor	$0	0
Repair	$5,090,419	35
Replace	$0	0
Totals	**$5,090,419**	**41**

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

The following table categorizes the number of barriers that fall into one of ten cost ranges, based on the prepared work orders. The locations, work descriptions, and cost of the recommended repairs for these barriers are listed by individual barrier in Tier 3 of this report.

Table 5: Number of Barriers Grouped by Associated 2008 Cost

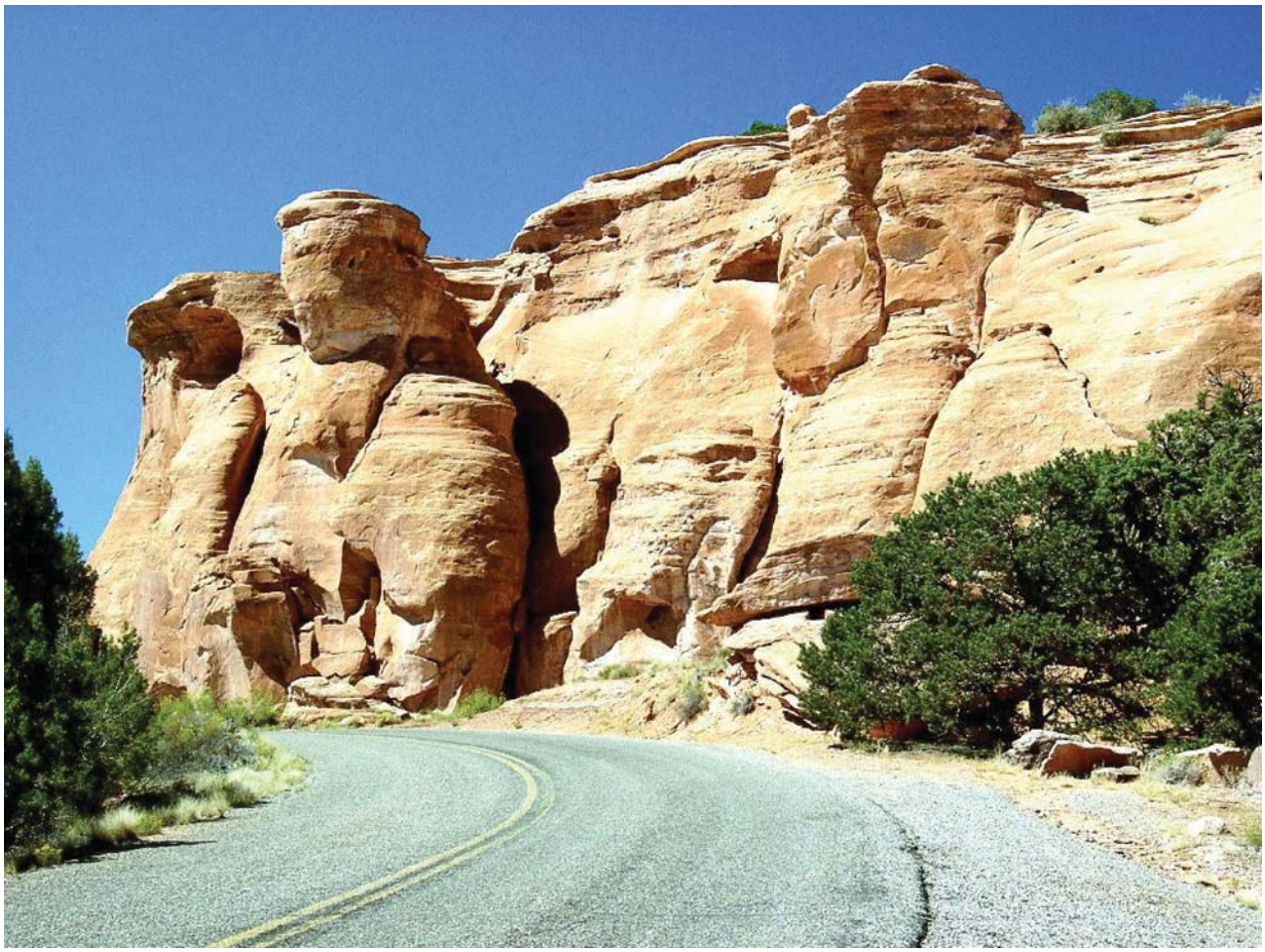
Cost Range*	No. of Barriers
$0	6
$1 - $25,000	12
$25,001 - $50,000	0
$50,001 - $100,000	6
$100,001 - $250,000	12
$250,001 - $500,000	4
$500,001 - $1,000,000	0
$1,000,001 - $2,000,000	1
$2,000,001 - $3,000,000	0
$3,000,001 - $4,000,000	0
Total Number of Barriers	**41**

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Data for end terminals was collected on the GIP data collection form and indicates if an end terminal meets current crashworthiness standards. End terminals are specially designed barrier ends that attenuate impacts to the ends of barriers. This is supplemental information that WASO designed into the inventory program.

A total of 28 end terminals were found on barriers at the Park. There are generally a greater number of end treatments than actual barriers because end treatments are located at both the beginning and end of each barrier.

Tier 2
Route Barrier Overview



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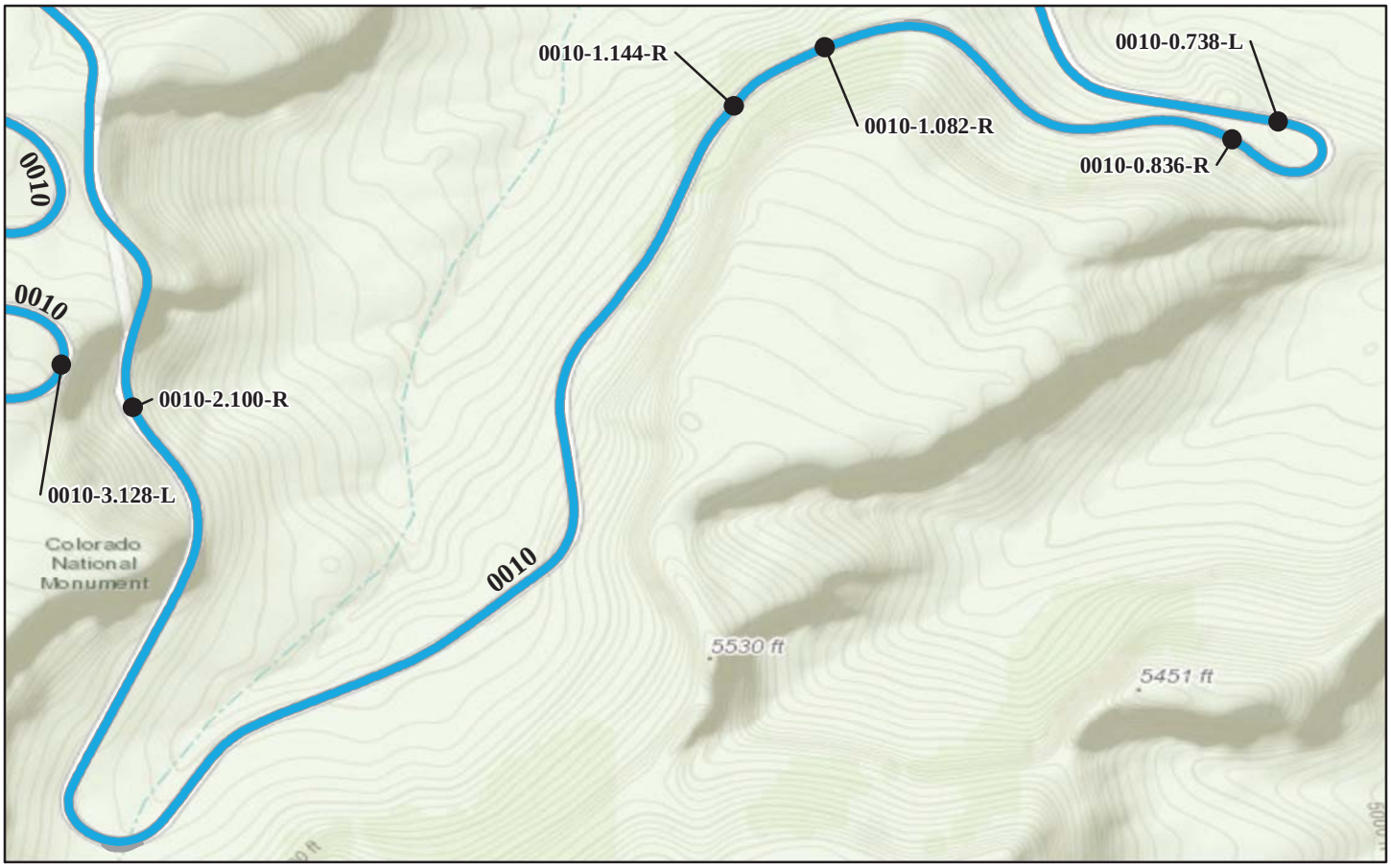
ROUTE 0010: RIMROCK DRIVE



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
COLM-0010-0.738-L 4/5/2010	386	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$0.00
COLM-0010-0.836-R 4/5/2010	101	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$114,813.00
COLM-0010-1.082-R 4/5/2010	137	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$141,130.00
COLM-0010-1.144-R 4/5/2010	99	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$112,888.00
COLM-0010-2.100-R 4/5/2010	48	STONE MASONRY CRENELLATED WITHOUT CORE WALL	NONE	NONE	$1,777.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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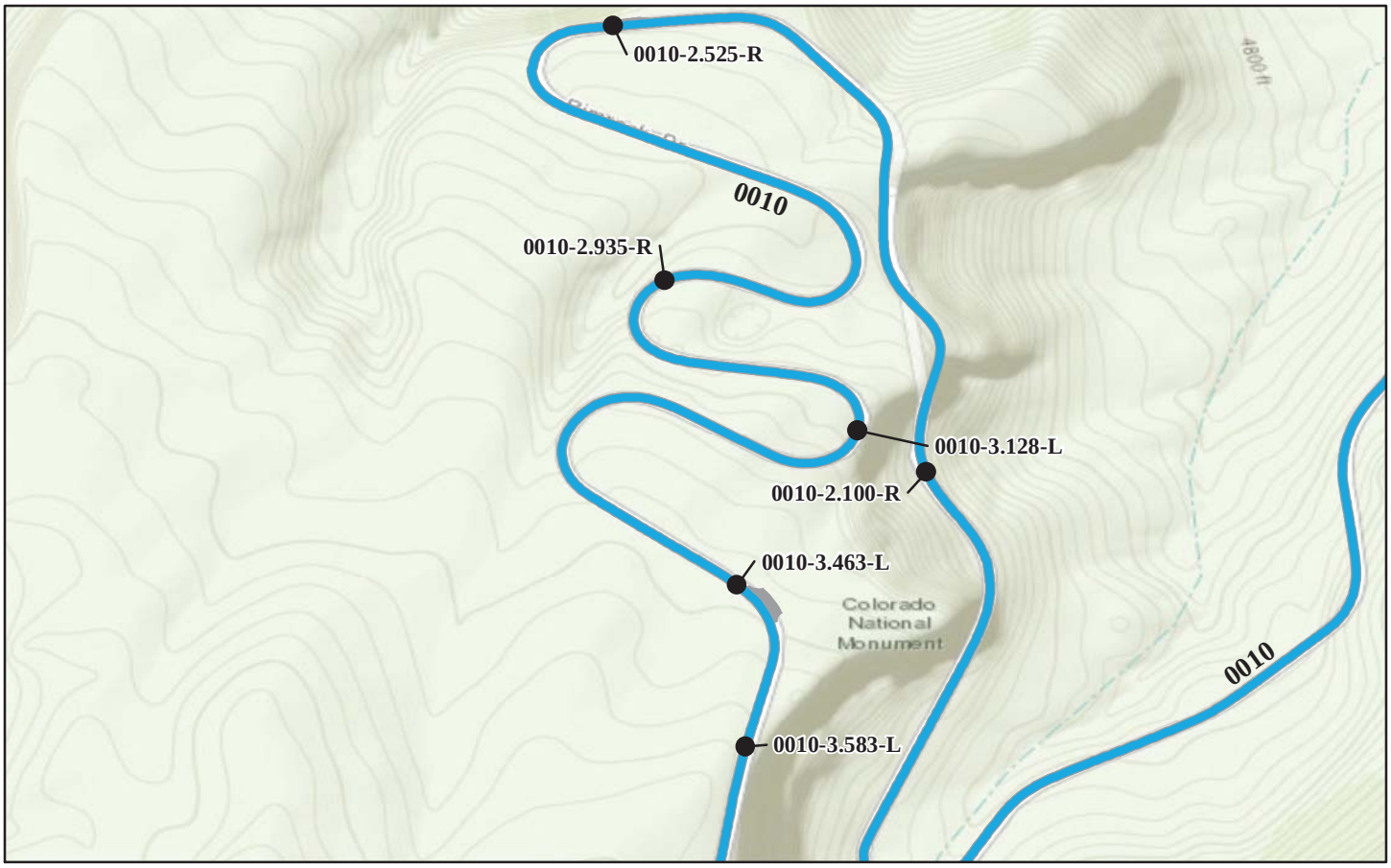
ROUTE 0010: RIMROCK DRIVE



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
COLM-0010-2.525-R 4/5/2010	208	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$204,848.00
COLM-0010-2.935-R 4/5/2010	162	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$93,913.00
COLM-0010-3.128-L 4/5/2010	66	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$53,268.00
COLM-0010-3.463-L 3/15/2011	245	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$207,268.00
COLM-0010-3.583-L 4/5/2010	356	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$262,405.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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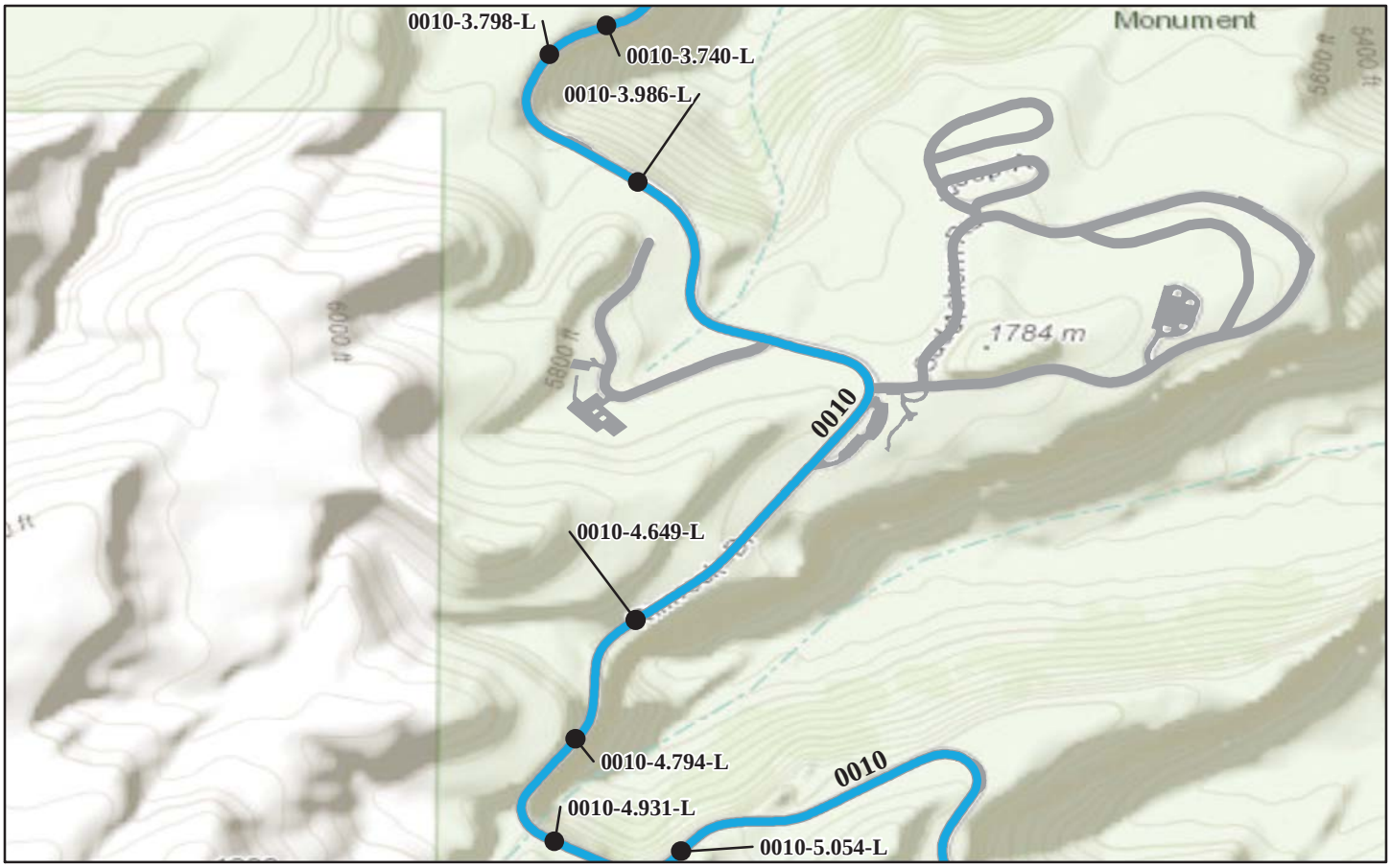
ROUTE 0010: RIMROCK DRIVE



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
COLM-0010-3.740-L 4/5/2010	111	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$85,140.00
COLM-0010-3.798-L 4/5/2010	231	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$175,780.00
COLM-0010-3.986-L 4/6/2010	295	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$312,263.00
COLM-0010-4.649-L 4/6/2010	456	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$0.00
COLM-0010-4.794-L 4/6/2010	697	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$1,887.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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ROUTE 0010: RIMROCK DRIVE

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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
COLM-0010-4.931-L 4/6/2010	540	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$494,368.00
COLM-0010-5.054-L 4/6/2010	281	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$156,530.00
COLM-0010-6.146-L 4/6/2010	656	STONE MASONRY CRENELLATED WITHOUT CORE WALL	NONE	NONE	$1,788.00
COLM-0010-6.307-L 4/6/2010	154	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$1,953.00
COLM-0010-6.504-L 4/6/2010	242	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$229,515.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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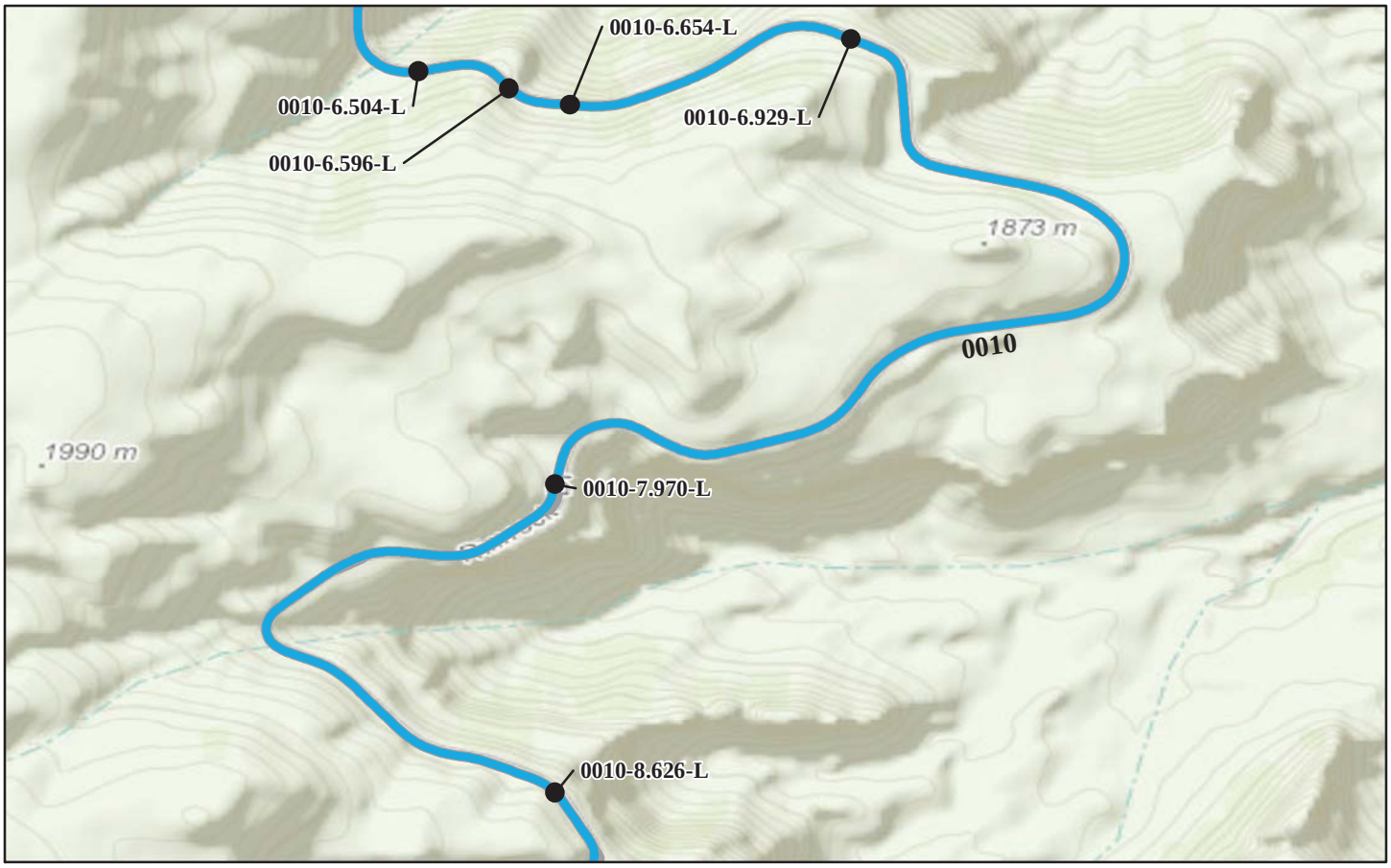
ROUTE 0010: RIMROCK DRIVE



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
COLM-0010-6.596-L 4/6/2010	151	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$165,385.00
COLM-0010-6.654-L 4/6/2010	880	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$1,126,125.00
COLM-0010-6.929-L 4/6/2010	164	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$218,378.00
COLM-0010-7.970-L 4/8/2010	230	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$98,340.00
COLM-0010-8.626-L 4/8/2010	409	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$366,025.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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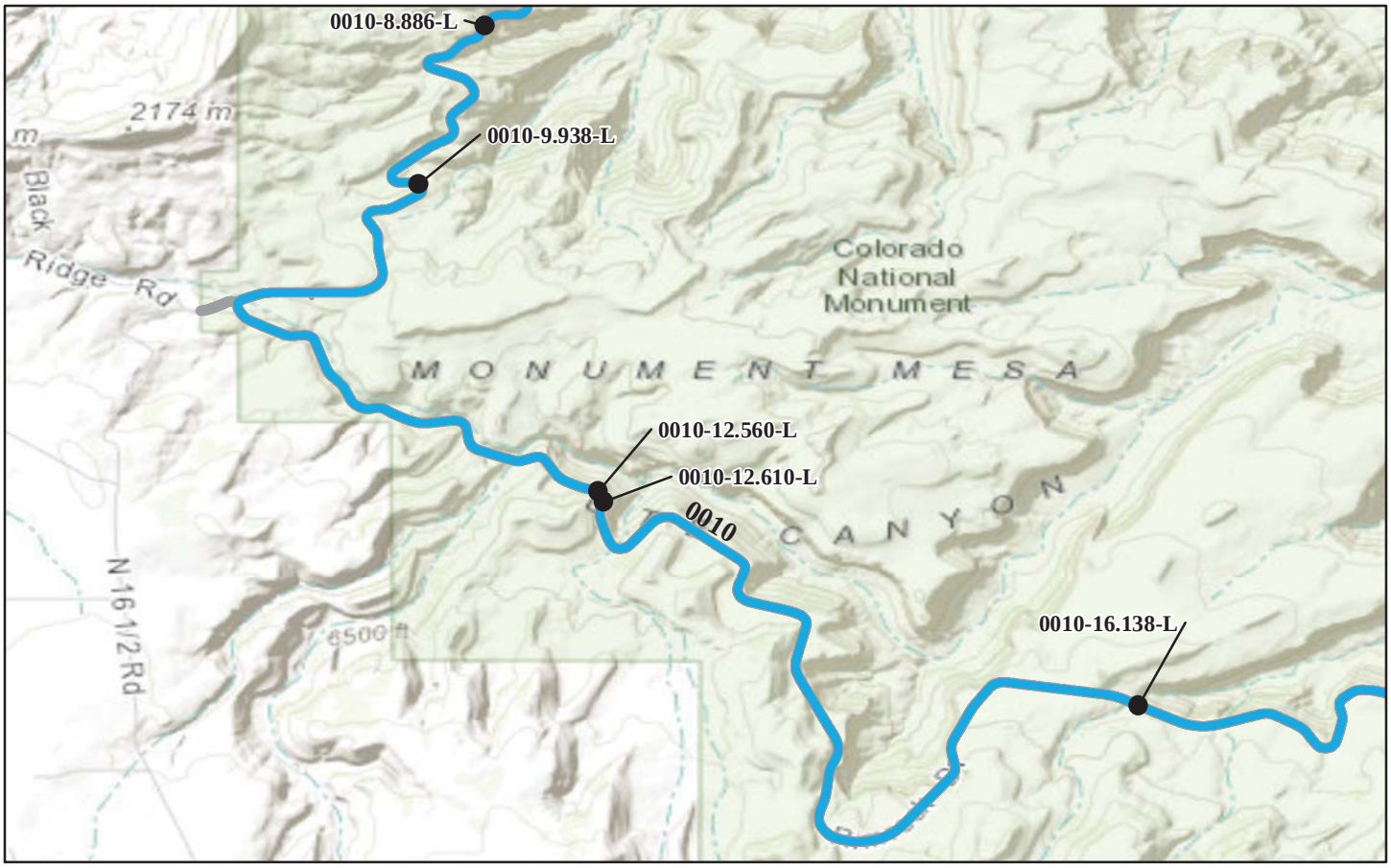
ROUTE 0010: RIMROCK DRIVE



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
COLM-0010-8.886-L 4/8/2010	242	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$0.00
COLM-0010-9.938-L 4/8/2010	250	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$20,845.00
COLM-0010-12.560-L 4/8/2010	165	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$136,890.00
COLM-0010-12.610-L 4/8/2010	108	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$119,185.00
COLM-0010-16.138-L 4/8/2010	223	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$74,140.00

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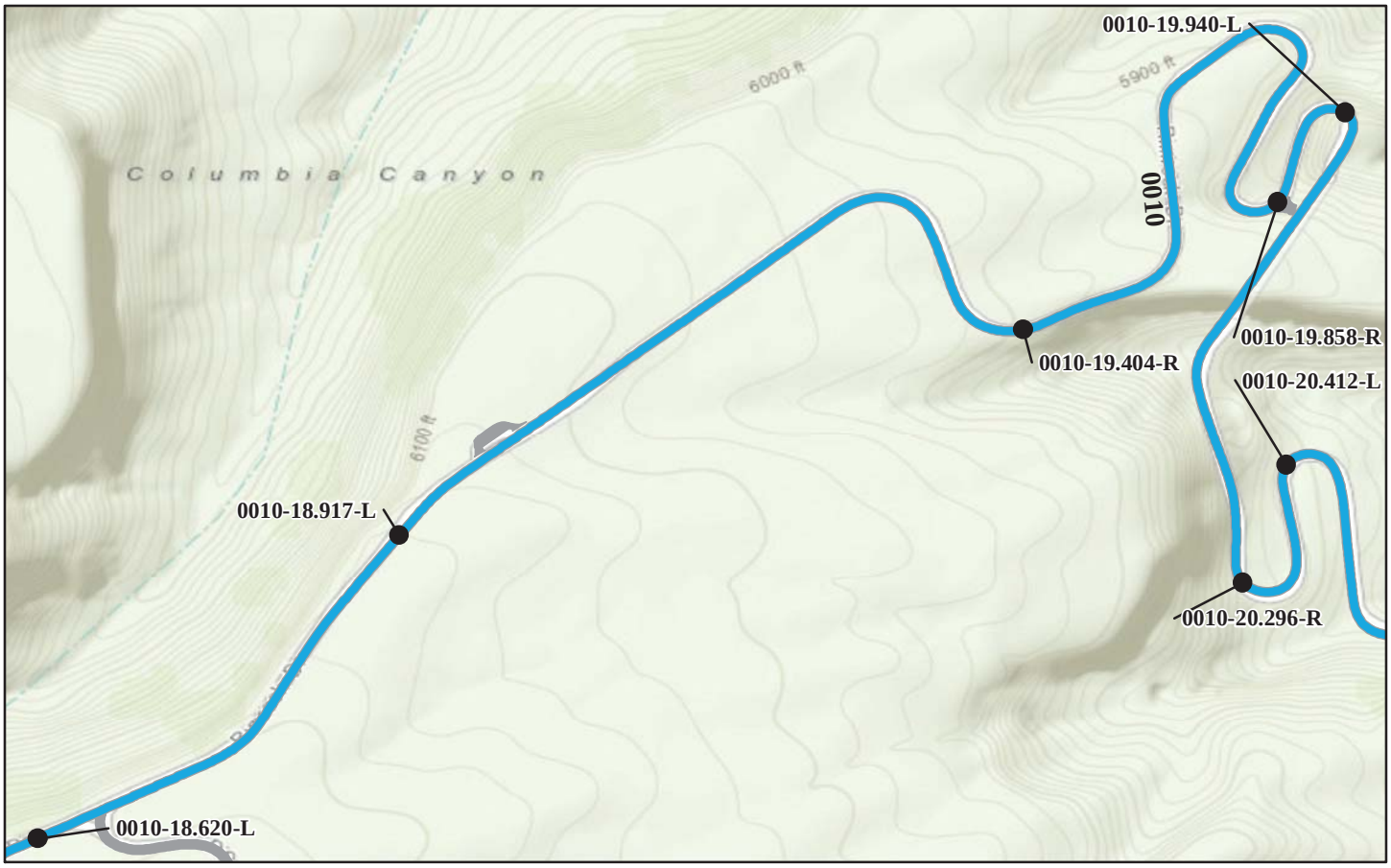
ROUTE 0010: RIMROCK DRIVE



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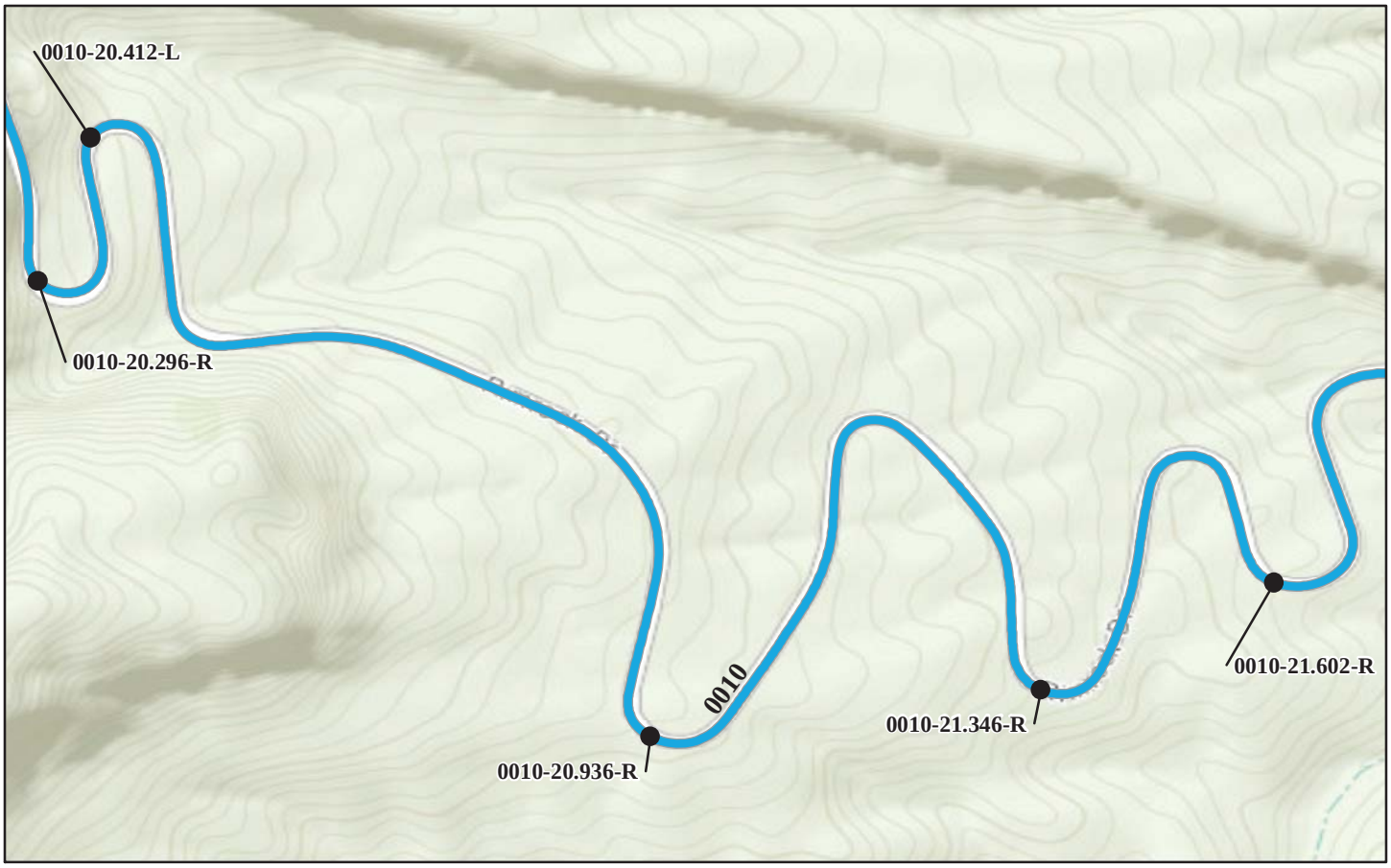
Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
COLM-0010-18.620-L 4/7/2010	404	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$8,580.00
COLM-0010-18.917-L 4/7/2010	178	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$0.00
COLM-0010-19.404-R 4/7/2010	497	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$81,912.00
COLM-0010-19.858-R 4/7/2010	247	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$4,224.00
COLM-0010-19.940-L 4/7/2010	226	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$1,733.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE



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COLM-0010-20.296-R 4/7/2010	421	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$5,924.00
COLM-0010-20.412-L 4/7/2010	325	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	$0.00
COLM-0010-20.936-R 4/7/2010	287	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$2,910.00
COLM-0010-21.346-R 4/7/2010	363	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$3,944.00
COLM-0010-21.602-R 4/7/2010	411	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$4,345.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

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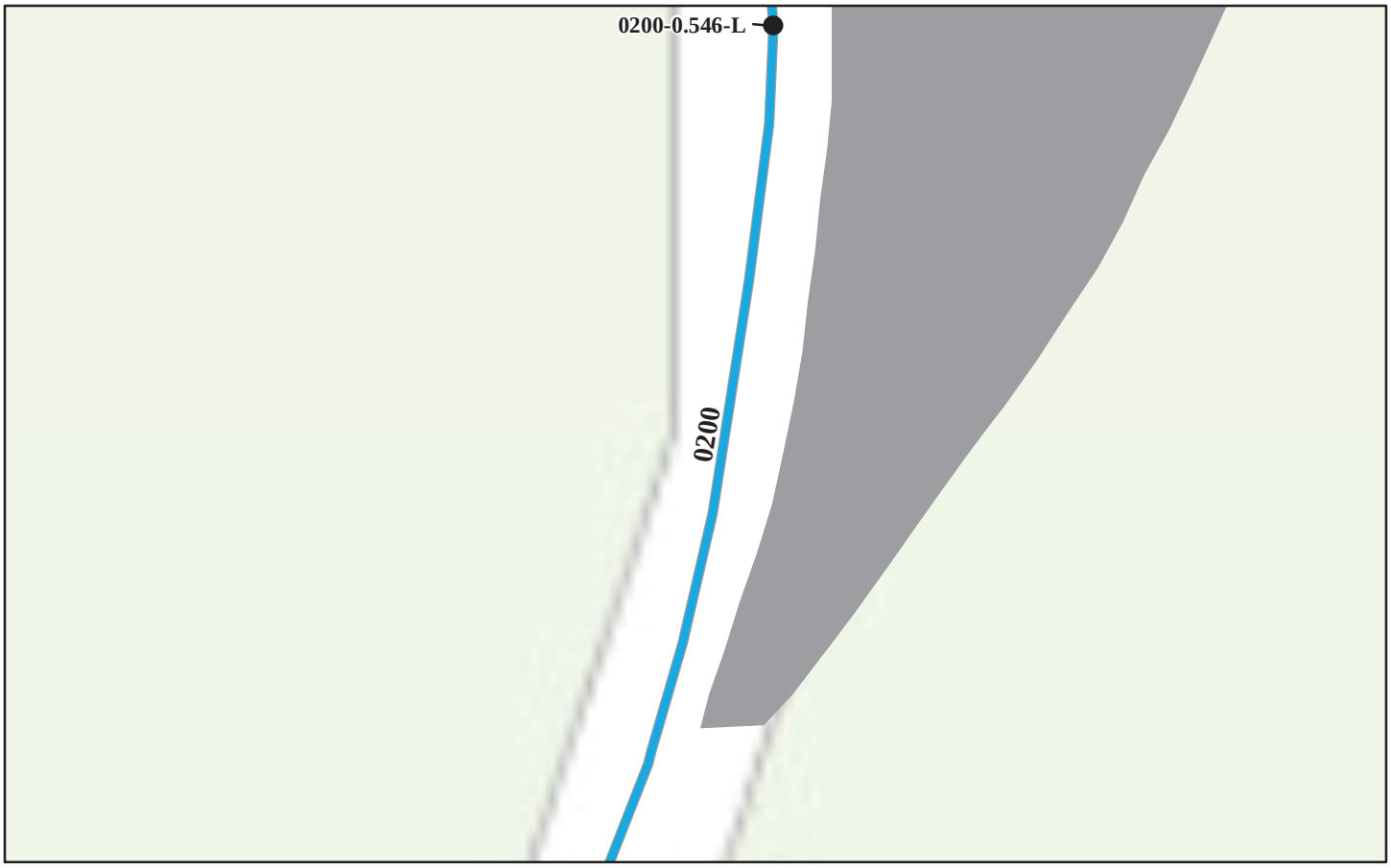
ROUTE 0200: SADDLEHORN LOOP ROAD



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
COLM-0200-0.546-L 4/8/2010	72	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	$0.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Tier 3
Barrier Details

Colorado National Monument

Federal Lands Highway
Road Inventory Program

Barrier ID:	**COLM-0010-0.738-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	34.40

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	386
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.6
Height (In.):	29.2	**Lateral Offset (In.):**	41.7	**Road Grade (%):**	4.20

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 2 to 3-in above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking of barrier elements.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No corrosion of barrier elements. No erosion along back of barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking of end treatments.
	Missing Elements:	No missing end treatment elements.
	Corrrosion and Weathering:	No corrosion/weathering of end treatment elements.

Barrier ID:	**COLM-0010-0.738-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	34.40

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_0.738_L_1.JPG

Barrier ID:	**COLM-0010-0.836-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	54.90

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	101
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	20.7	**Post Spacing (In.):**	0.0
Height (In.):	13.8	**Lateral Offset (In.):**	18.7	**Road Grade (%):**	5.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment accepatable. Height was 7 to 12-in below 24-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	1 square yard of missing grout in barrier
	Corrrosion and Weathering:	No weathering in barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-0.836-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	54.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$114813
Brief Workorder:	Raise guardwall 10-in. Remove and reset 101-ft of stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 364 CF = $91000. (2ft)(1.8ft)(101ft) = 364 CF Structural Concrete at $1000- per -Cu. Yd. for 6 CY = $6000. [(0.8ft)(1.8ft)(101ft)]/27 = 5.2 CY Low Speed Traffic Control at $1475- per -Day for 5 Day(s) = $7375. 1 day removal and 4 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_0.836_R_1.JPG

Barrier ID:	**COLM-0010-1.082-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	56.50

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	137
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.7	**Post Spacing (In.):**	0.0
Height (In.):	14.0	**Lateral Offset (In.):**	21.2	**Road Grade (%):**	4.90

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 7 to 13-in below 24-in design height.
	Breaking and Cracking:	Minor cracking of mortar (less than 1/4 in). No broken rocks in barrier.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No erosion along back of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-1.082-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	56.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$141130
Brief Workorder:	Raise guardwall 10-in. Remove and reset 137-ft of stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 438 CF = $109500. (1.6ft)(2ft)(137ft) = 438 CF Structural Concrete at $1000- per -Cu. Yd. for 7 CY = $7000. [(1.6ft)(0.8ft)(137ft)]/27 = 6.5 CY Low Speed Traffic Control at $1475- per -Day for 8 Day(s) = $11800. 2 days removal and 6 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_1.082_R_1.JPG

Barrier ID:	**COLM-0010-1.144-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	45.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	99
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	21.2	**Post Spacing (In.):**	0.0
Height (In.):	12.6	**Lateral Offset (In.):**	29.7	**Road Grade (%):**	4.50

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 8 to 14-in below 24-in design height.
	Breaking and Cracking:	Minor spalling of rocks and mortar within barrier.
	Missing Elements:	No missing rocks or mortar in barrier.
	Corrrosion and Weathering:	No erosion along back of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-1.144-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	45.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$112888
Brief Workorder:	Raise guardwall 11 inches. Remove and reset 99-ft stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 357 CF = $89250. (2ft)(1.8ft)(99ft) = 356.4 CF Structural Concrete at $1000- per -Cu. Yd. for 6 CY = $6000. [(1.8ft)(0.9ft)(99ft)]/27 = 5.9 CY Low Speed Traffic Control at $1475- per -Day for 5 Day(s) = $7375. 1 day removal and 4 days installation				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_1.144_R_1.JPG

Barrier ID:	**COLM-0010-2.100-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	34.20

Barrier Description

Type:	STONE MASONRY CRENELLATED WITHOUT	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	48
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	18	**Width (In.):**	19.0	**Post Spacing (In.):**	0.0
Height (In.):	19.2	**Lateral Offset (In.):**	47.2	**Road Grade (%):**	4.90

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was within 3-in of 18-in/24-in crenellated design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	Missing 2 square feet grout in barrier.
	Corrrosion and Weathering:	No weathering in barrier
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-2.100-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	34.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1777
Brief Workorder:	Repoint 1 SY of guardwall.				
Workorder:	Re-Point Masonry Barrier at $140- per -Sq. Yd. for 1 SY = $140. (2SF)/9 = 0.2 SY Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_2.100_R_1.JPG

Barrier ID:	**COLM-0010-2.525-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	60.00

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	208
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.0	**Post Spacing (In.):**	0.0
Height (In.):	10.3	**Lateral Offset (In.):**	25.7	**Road Grade (%):**	5.10

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 13 to 14-in below 24-in design height.
	Breaking and Cracking:	Minor cracking of mortar (less than1/4 in). All barrier stones intact.
	Missing Elements:	No missing mortar or stones in barrier.
	Corrrosion and Weathering:	No erosion along back of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-2.525-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	60.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$204848
Brief Workorder:	Raise guardwall 14-in. Remove and reset 208-ft of stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 624 CF = $156000. (2ft)(1.5ft)(208ft) = 624 CF Structural Concrete at $1000- per -Cu. Yd. for 14 CY = $14000. [(1.5ft)(1.2ft)(208ft)]/27 = 13.9 CY Low Speed Traffic Control at $1475- per -Day for 11 Day(s) = $16225. 2 days removal and 9 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_2.525_R_1.JPG

Barrier ID:	**COLM-0010-2.935-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	49.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	162
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.7	**Post Spacing (In.):**	0.0
Height (In.):	15.6	**Lateral Offset (In.):**	113.0	**Road Grade (%):**	4.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 67-ft was 3 to 6-in below the 24-in design height and 95-ft was 6 to 11-in below.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No weathering in barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-2.935-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	49.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$93913
Brief Workorder:	Raise guardwall 3-in. Remove and reset 95-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 304 CF = $76000. (2ft)(1.6ft)(95ft) = 304 CF Structural Concrete at $1000- per -Cu. Yd. for 2 CY = $2000. [(1.6ft)(0.5ft)(95ft)]/27 = 2.8 CY Low Speed Traffic Control at $1475- per -Day for 5 Day(s) = $7375. 1 day removal and 4 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_2.935_R_1.JPG

Barrier ID:	**COLM-0010-3.128-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	55.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	66
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	19.2	**Post Spacing (In.):**	0.0
Height (In.):	13.3	**Lateral Offset (In.):**	52.7	**Road Grade (%):**	4.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. 15-ft was 3 to 6-in below the 24-in design height and 51-ft was 6 to 12-in below.
	Breaking and Cracking:	1 crack about 20-in long that is greater than 1/2 in wide in area that is of below design height by more than 6-in.
	Missing Elements:	No missing mortar or stones in barrier.
	Corrrosion and Weathering:	No erosion on either side of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.128-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	55.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$53268
Brief Workorder:	Raise guardwall 5-in. Remove and reset 51-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 164 CF = $41000. (2ft)(1.6ft)(51ft) = 163.2 CF Structural Concrete at $1000- per -Cu. Yd. for 3 CY = $3000. [(1.6ft)(0.5ft)(51ft)]/27 = 1.5 CY Low Speed Traffic Control at $1475- per -Day for 3 Day(s) = $4425. 1 day removal and 2 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.128_L_1.JPG

Barrier ID:	**COLM-0010-3.463-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:** 0.00	

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	NON-TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	245
Speed Limit (MPH):	25	**Placement with Respect to Road:**	NON-TRAFFIC BARRIER
Hazard Behind Barrier:	N/A		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	N/A	**Is Barrier Crashworthy?:**	N/A
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	15.0	**Post Spacing (In.):**	0.0
Height (In.):	7.0	**Lateral Offset (In.):**	0.0	**Road Grade (%):**	0.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 17-in below the 24-in design height.
	Breaking and Cracking:	Grout showing no cracks.
	Missing Elements:	No missing stones or gout.
	Corrrosion and Weathering:	Less than 5% of stones flaking.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.463-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	0.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$207268
Brief Workorder:	Raise guardwall 17-in. Remove and reset 245-ft of stone masonry guardwall on concrete footer to design height of 24-in.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 613 CF = $153250. (2ft)(1.25ft)(245ft) = 612.5 CF Structural Concrete at $1000- per -Cu. Yd. for 16 CY = $16000. [(1.25ft)(1.4ft)(245ft)]/27 = 15.9 CY Low Speed Traffic Control at $1475- per -Day for 13 Day(s) = $19175. 3 days removal and 10 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.463_L_1.jpg

Barrier ID:	**COLM-0010-3.583-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	62.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	356
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.7	**Post Spacing (In.):**	0.0
Height (In.):	14.5	**Lateral Offset (In.):**	16.7	**Road Grade (%):**	5.10

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 101-ft was 3 to 6-in below the 24-in design height and 255-ft was 6 to 12-in below.
	Breaking and Cracking:	1-in wide cracks for 10 ft of barrier
	Missing Elements:	3 square feet of missing grout and 1 square ft of missing stone in barrier
	Corrrosion and Weathering:	Rocks on face and top of wall have areas of spalling approximately 2-in deep for a total of 24 linear ft.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.583-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	62.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$262405
Brief Workorder:	Raise guardwall 5-in. Remove and reset 255-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 816 CF = $204000. (2ft)(1.6ft)(255ft) = 816 CF Structural Concrete at $1000- per -Cu. Yd. for 8 CY = $8000. [(1.6ft)(0.5ft)(255ft)]/27 = 7.6 CY Low Speed Traffic Control at $1475- per -Day for 14 Day(s) = $20650. 3 days removal and 11 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.583_L_1.JPG

Barrier ID:	**COLM-0010-3.740-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	49.50

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	111
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	22.2	**Post Spacing (In.):**	0.0
Height (In.):	16.2	**Lateral Offset (In.):**	24.0	**Road Grade (%):**	4.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 34-ft was 3 to 6-in below the 24-in design height and 76-ft was 6 to 9-in below.
	Breaking and Cracking:	Minor cracking of mortar (less than 1/4 in) in barrier in area where height is 18 to 21 in.
	Missing Elements:	12 square ines of mortar missing in area where wall height is less than 18-inches. No other elements missing from barrier.
	Corrrosion and Weathering:	Moderately weathered barrier - older construction. No erosion along back of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.740-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	49.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$85140
Brief Workorder:	Raise guardwall 2-in. Remove and reset 76-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 274 CF = $68500. (2ft)(1.8ft)(76ft) = 273.6 CF Structural Concrete at $1000- per -Cu. Yd. for 3 CY = $3000. [(1.8ft)(0.5ft)(76ft)]/27 = 2.5 CY Low Speed Traffic Control at $1475- per -Day for 4 Day(s) = $5900. 1 day removal and 3 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.740_L_1.JPG

Barrier ID:	**COLM-0010-3.798-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	45.90

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	231
Speed Limit (MPH):	25	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	23.7	**Post Spacing (In.):**	0.0
Height (In.):	18.2	**Lateral Offset (In.):**	33.7	**Road Grade (%):**	3.80

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 89-ft was 3 to 6-in below the 24-in design height and 142-ft was 6 to 10-in below.
	Breaking and Cracking:	2 SF of mortar was cracked and missing. One cracked stone 3 sq ft.
	Missing Elements:	No missing stones in barrier. Some missing mortar - mostly open cracks - see breaking/cracking above.
	Corrrosion and Weathering:	Minimal weathering of stones and mortar - even though it is older construction. No significant erosion along back of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.798-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	05/04/2010	**Barrier Rating:**	45.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$175780
Brief Workorder:	Raise guardwall 3-in. Remove and reset 142-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 568 CF = $142000. (2ft)(2ft)(142ft) = 568 CF Structural Concrete at $1000- per -Cu. Yd. for 6 CY = $6000. [(2ft)(0.5ft)(142ft)]/27 = 5.3 CY Low Speed Traffic Control at $1475- per -Day for 8 Day(s) = $11800. 2 days removal and 6 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.798_L_1.jpg

Barrier ID:	**COLM-0010-3.986-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	60.90

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	295
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	22.2	**Post Spacing (In.):**	0.0
Height (In.):	12.6	**Lateral Offset (In.):**	47.0	**Road Grade (%):**	2.80

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 16-ft was 3 to 6-in below the 24-in design height and 279-ft was 6 to 14-in below.
	Breaking and Cracking:	1-in crack spalling face of rock for 4 linear ft.
	Missing Elements:	12 cubic feet of missing rocks at approach end flare; 6 square feet of missing grout
	Corrrosion and Weathering:	Minor spalling of top of rocks for 8 linear ft.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-3.986-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	60.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$312263
Brief Workorder:	Raise guardwall 6-in. Remove and reset 279-ft of stone masonry guardwall on concrete footer to adjacent 18-in height. Replace 2 missing boulders.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 1005 CF = $251250. (2ft)(1.8ft)(279ft) = 1004.4 CF Structural Concrete at $1000- per -Cu. Yd. for 10 CY = $10000. [(1.8ft)(0.5ft)(279ft)]/27 = 9.3 CY Replace boulder at $250- per -Each for 2 = $500. Replace missing boulders. Low Speed Traffic Control at $1475- per -Day for 15 Day(s) = $22125. 3 days removal and 12 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_3.986_L_1.JPG

Barrier ID:	**COLM-0010-4.649-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	31.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	456
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.6
Height (In.):	27.7	**Lateral Offset (In.):**	18.2	**Road Grade (%):**	2.50

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion/weathering in barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in end treatments.
	Missing Elements:	No missing elements in end treatments.
	Corrrosion and Weathering:	No corrosion or weathering in end treatments.

Barrier ID:	**COLM-0010-4.649-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	31.50

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_4.649_L_1.JPG

Barrier ID:	**COLM-0010-4.794-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	28.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	697
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	29.0	**Lateral Offset (In.):**	25.5	**Road Grade (%):**	2.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 1 to 4-in above the 27-in design height.
	Breaking and Cracking:	One cracked block and two rotated blocks in barrier.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No corrosion of barrier elements. Minimal erosion along back of barrier.
End Treatments	**Alignment and Height:**	Approach end treatment (15 l.f.) is more than 2-in lower than 27-in design height. Alignment is acceptable.
	Breaking and Cracking:	No breaking or cracking of end treatments.
	Missing Elements:	No elements missing from end treatments.
	Corrrosion and Weathering:	No corrosion or erosion at end treatments.

Barrier ID:	**COLM-0010-4.794-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	28.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1887
Brief Workorder:	Raise 15-ft of barrier up to 27-in design height replace 1 block and adjust rotated blocks.				
Workorder:	Replace Block at $30- per -Each for 1 Block(s) = $30. Replace one cracked block. Adjust Guardrail at $10- per -Lin. Ft. for 15 LF = $150. Raise 15-ft of barrier up to 27-in design height. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475. Labor at $60- per -Hour for 1 Hrs = $60. Rotate and nail misaligned blocks.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_4.794_L_1.JPG

Barrier ID:	**COLM-0010-4.931-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	63.70

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	540
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	22.0	**Post Spacing (In.):**	0.0
Height (In.):	16.5	**Lateral Offset (In.):**	48.0	**Road Grade (%):**	1.50

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 95-ft was 3 to 6-in below the 24-in design height and 445-ft was 6 to 9-in below.
	Breaking and Cracking:	Minor cracking of mortar with cracks less than 1/4 in wide. One delaminating rock in barrier.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	Barrier has been undermined by erosion and shored up in the past. Seems stable currently. Minor weathering of barrier elements.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-4.931-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	63.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$494368
Brief Workorder:	Raise guardwall 2-in. Remove and reset 445-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 1602 CF = $400500. (2ft)(1.8ft)(445ft) = 1602 CF Structural Concrete at $1000- per -Cu. Yd. for 15 CY = $15000. [(1.8ft)(0.5ft)(445ft)]/27 = 14.8 CY Low Speed Traffic Control at $1475- per -Day for 23 Day(s) = $33925. 5 days removal and 18 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_4.931_L_1.jpg

Barrier ID:	**COLM-0010-5.054-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	54.50

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	281
Speed Limit (MPH):	35	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	22.7	**Post Spacing (In.):**	0.0
Height (In.):	17.7	**Lateral Offset (In.):**	38.2	**Road Grade (%):**	1.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 40-ft was within 3-in of the 24-in design height 109-ft was 3 to 6-in below and 132-ft was 6 to 9-in below.
	Breaking and Cracking:	No breaking and cracking in barrier
	Missing Elements:	No missing elements in barrier
	Corrrosion and Weathering:	No weathering in barrier
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-5.054-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	54.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$156530
Brief Workorder:	Raise guardwall 3-in. Remove and reset 132-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 502 CF = $125500. (2ft)(1.9ft)(132ft) = 501.6 CF Structural Concrete at $1000- per -Cu. Yd. for 5 CY = $5000. [(1.9ft)(0.5ft)(132ft)]27 = 4.6 CY Low Speed Traffic Control at $1475- per -Day for 8 Day(s) = $11800. 2 days removal and 6 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_5.054_L_1.JPG

Barrier ID:	**COLM-0010-6.146-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	60.00

Barrier Description

Type:	STONE MASONRY CRENELLATED WITHOUT	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	656
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	18	**Width (In.):**	18.0	**Post Spacing (In.):**	0.0
Height (In.):	13.0	**Lateral Offset (In.):**	16.7	**Road Grade (%):**	0.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 164-ft was within 3-in of the 18-in/24-in crenellated design height and 492-ft was 3 to 6-in below.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No elements missing from barrier.
	Corrrosion and Weathering:	1 CY of erosion at approach end of barrier. Minimal weathering of stones and mortar.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-6.146-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	60.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1788
Brief Workorder:	Repair 1 CY of erosion with fill and riprap.				
Workorder:	Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50. Fill for erosion repair. Riprap at $100- per -Cu. Yd. for 1 CY = $100. Riprap for erosion repair/control. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.146_L_1.JPG

Barrier ID:	**COLM-0010-6.307-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	32.90

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	154
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.6
Height (In.):	28.2	**Lateral Offset (In.):**	14.3	**Road Grade (%):**	3.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 0 to 2-in above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking of guardrail elements.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	Erosion at ends of retaining wall is compromising guardrail posts. No corrosion of barrier elements.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No braking or cracking of end treatments.
	Missing Elements:	No elements missing from end treatments.
	Corrrosion and Weathering:	No corrosion or weathering of end treatments.

Barrier ID:	**COLM-0010-6.307-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	32.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1953
Brief Workorder:	Repair 4 CY of erosion at ends of retaining wall.				
Workorder:	Structural Backfill at $50- per -Cu. Yd. for 2 CY = $100. Repair erosion at retaining wall ends. Riprap at $100- per -Cu. Yd. for 2 CY = $200. Repair erosion at retaining wall ends. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.307_L_1.JPG

Barrier ID:	**COLM-0010-6.504-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	49.50

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	242
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	28.0	**Post Spacing (In.):**	0.0
Height (In.):	15.0	**Lateral Offset (In.):**	44.7	**Road Grade (%):**	1.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 81-ft was 3 to 6-in below the 24-in design height and 161-ft was 6 to 12-in below.
	Breaking and Cracking:	Rock spalling in barrier for 10 linear ft has deteriorated approximately 1/2 of rock.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Erosional hole under approach end of barrier where water drains off roadway undermining end of wall.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-6.504-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	49.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$229515
Brief Workorder:	Raise guardwall 4-in. Remove and reset 161-ft of stone masonry guardwall on concrete footer to 24-in design height. Add 1CY backfill to repair erosion. Add 1 CY riprap for erosion control on approach end.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 741 CF = $185250. (2st)(2.3ft)(161ft) = 740.6 CF Structural Concrete at $1000- per -Cu. Yd. for 7 CY = $7000. [(2.3ft)(0.5ft)(161ft)]/27 = 6.9 CY Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50. Backfill to repair erosion Riprap at $100- per -Cu. Yd. for 1 CY = $100. Add riprap for erosion control New Boulders at $250- per -Each for 6 Day(s) = $1500. Low Speed Traffic Control at $1475- per -Day for 10 Day(s) = $14750. 2 days removal 7 days installation 1 day erosion control				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.504_L_1.JPG

Barrier ID:	**COLM-0010-6.596-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	57.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	151
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	20.7	**Post Spacing (In.):**	0.0
Height (In.):	11.3	**Lateral Offset (In.):**	19.0	**Road Grade (%):**	0.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 11 to 14-in below the 24-in design height.
	Breaking and Cracking:	1-in crack spalling rock face for 10 linear ft total in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Erosion on backside of barrier directly across the roadway from inlet is undermining wall for 10 linear ft.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-6.596-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	57.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$165385
Brief Workorder:	Raise guardwall 12-in. Remove and reset 151-ft of stone masonry guardwall on concrete footer to 24-in design height. Add 1 CY structural backfill for erosion control.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 514 CF = $128500. (2ft)(1.7ft)(151ft) = 513.4 CF Structural Concrete at $1000- per -Cu. Yd. for 10 CY = $10000. [(1.7ft)(1ft)(151ft)]/27 = 9.5 CY Low Speed Traffic Control at $1475- per -Day for 8 Day(s) = $11800. 2 days removal and 6 days installation. Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.596_L_1.JPG

Barrier ID:	**COLM-0010-6.654-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	80.00

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	880
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	24.3	**Post Spacing (In.):**	0.0
Height (In.):	10.8	**Lateral Offset (In.):**	19.2	**Road Grade (%):**	1.10

Physical Condition

Barrier	**Alignment and Height:**	80 to 100-ft of barrier leaning outward; misalignment greater than 6-in. Height was 11 to 14-in below the 24-in design height.
	Breaking and Cracking:	7 stones (about 24 linear ft) are highly weathered and broken. Mostly minor cracking less than 1/4 in wide of mortar.
	Missing Elements:	5 sq ft of mortar is missing from joints.
	Corrrosion and Weathering:	Two of three drain openings through guardwall have severe erosion along back side of barrier compromising stability. Some of the stones are weathered - mostly those placed with bedding plane vertical.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-6.654-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	80.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1126125
Brief Workorder:	Raise guardwall 13-in. Remove and reset 880-ft of stone masonry guardwall on concrete footer to 24-in design height. Replace 14 boulders and repair 6CY of erosion at 2 drain openings through guardwall.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 3520 CF = $880000. (2ft)(2ft)(880ft) = 3520 CF Structural Concrete at $1000- per -Cu. Yd. for 72 CY = $72000. [(2ft)(1.1ft)(880ft)]/27 = 71.7 CY Structural Backfill at $50- per -Cu. Yd. for 4 CY = $200. Backfill to repair erosion at drain openings. Riprap at $100- per -Cu. Yd. for 2 CY = $200. Erosion repair at drain openings. Low Speed Traffic Control at $1475- per -Day for 46 Day(s) = $67850. 9 days removal 36 days installation and 1 day erosion control New Boulders at $250- per -Each for 14 = $3500.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.654_L_1.JPG

Barrier ID:	**COLM-0010-6.929-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	54.40

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	164
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	25.0	**Post Spacing (In.):**	0.0
Height (In.):	11.0	**Lateral Offset (In.):**	16.0	**Road Grade (%):**	2.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 11 to 15-in below the 24-in design height.
	Breaking and Cracking:	1/2-in spalling cracks on back of wall rock for 7 linear ft total in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Minor spalling on back of rocks for 4 linear ft total.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-6.929-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	06/04/2010	**Barrier Rating:**	54.40

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$218378
Brief Workorder:	Raise guardwall 12-in. Remove and reset 164-ft of stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 689 CF = $172250. (2ft)(2.1ft)(164ft) = 689 CF Structural Concrete at $1000- per -Cu. Yd. for 13 CY = $13000. [(2.1ft)(1ft)(164ft)]/27 = 12.8 CY Low Speed Traffic Control at $1475- per -Day for 9 Day(s) = $13275. 2 days removal and 7 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_6.929_L_1.JPG

Barrier ID:	**COLM-0010-7.970-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	28.60

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	NON-TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	230
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	N/A		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	N/A	**Is Barrier Crashworthy?:**	N/A
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	27.0	**Post Spacing (In.):**	0.0
Height (In.):	18.7	**Lateral Offset (In.):**	0.0	**Road Grade (%):**	0.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 80-ft was within 3-in of the 24-in design height 80-ft was 3 to 6-in below and 70- ft was 6 to 10-in below.
	Breaking and Cracking:	No breaking or cracking of barrier elements. Barrier recently repointed. Mortar in excellent condition.
	Missing Elements:	No missing stones or mortar in barrier.
	Corrrosion and Weathering:	Minimal weathering of barrier. No erosion to compromise stability.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-7.970-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	28.60

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$98340
Brief Workorder:	Raise guardwall 2-in. Remove and reset 70-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 322 CF = $80500. (2ft)(2.3ft)(70ft) = 322 CF Structural Concrete at $1000- per -Cu. Yd. for 3 CY = $3000. [(2.3ft)(0.5ft)(70ft)]/27 = 2.9 CY Low Speed Traffic Control at $1475- per -Day for 4 Day(s) = $5900. 1 day removal and 3 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_7.970_L_1.JPG

Barrier ID:	**COLM-0010-8.626-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	69.50

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	409
Speed Limit (MPH):	35	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	17.0	**Post Spacing (In.):**	0.0
Height (In.):	14.0	**Lateral Offset (In.):**	26.7	**Road Grade (%):**	1.80

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 7 to 13-in below the 24-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	15 square feet of missing grout.
	Corrrosion and Weathering:	No weathering in barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-8.626-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	69.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$366025
Brief Workorder:	Raise guardwall 10-in. Remove and reset 409-ft of stone masonry guardwall on concrete footer to 24-in design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 1145 CF = $286250. (2ft)(1.4ft)(409ft) = 1145.2 CF Structural Concrete at $1000- per -Cu. Yd. for 17 CY = $17000. [(1.4ft)(0.8ft)(409ft)]/27 = 16.9 CY Low Speed Traffic Control at $1475- per -Day for 22 Day(s) = $32450. 5 days removal and 17 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_8.626_L_1.JPG

Barrier ID:	**COLM-0010-8.886-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	25.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	242
Speed Limit (MPH):	25	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	29.0	**Lateral Offset (In.):**	30.2	**Road Grade (%):**	5.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 1 to 3-in above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking of barrier elements.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No corrosion or weathering of barrier elements. No erosion compromising barrier posts.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking of end treatment elements.
	Missing Elements:	No missing end treatment elements.
	Corrrosion and Weathering:	No corrosion or weathering of end treatment elements.

Barrier ID:	**COLM-0010-8.886-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	25.70

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_8.886_L_1.JPG

Barrier ID:	**COLM-0010-9.938-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	15.80

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	NON-TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	250
Speed Limit (MPH):	35	**Placement with Respect to Road:**	NON-TRAFFIC BARRIER
Hazard Behind Barrier:	N/A		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	N/A	**Is Barrier Crashworthy?:**	N/A
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.0	**Post Spacing (In.):**	0.0
Height (In.):	21.2	**Lateral Offset (In.):**	0.0	**Road Grade (%):**	0.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 80-ft was 3 to 5-in above the 24-in design height 100-ft was within 3-in 50-ft was 3 to 6-in below and 20-ft was 6 to 11-in below.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No weathering in barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-9.938-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	15.80

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$20845
Brief Workorder:	Raise guardwall 5 inches. Remove and reset 20-ft stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 60 CF = $15000. (2ft)(1.5ft)(20ft) = 60 CF Structural Concrete at $1000- per -Cu. Yd. for 1 CY = $1000. [(1.5ft)(0.5ft)(20ft)]/27 = 0.6 CY Low Speed Traffic Control at $1475- per -Day for 2 Day(s) = $2950. 1 day removal and 1 day installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_9.938_L_1.JPG

Barrier ID:	**COLM-0010-12.560-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	58.00

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	165
Speed Limit (MPH):	35	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	21.7	**Post Spacing (In.):**	0.0
Height (In.):	14.0	**Lateral Offset (In.):**	45.0	**Road Grade (%):**	2.20

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 45-ft was 3 to 6-in below the 24-in design height and 120-ft was 6 to 14-in below. Gravel built up in front of barrier.
	Breaking and Cracking:	Mostly minor cracking of mortar with some missing. No cracked or broken stones.
	Missing Elements:	15 SF of mortar missing. (5 SF from area where height is 18 to 21-in and 10 SF from areas where height is lower than 18-in.)
	Corrrosion and Weathering:	Barrier is older construction and therefore highly weathered.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-12.560-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	58.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$136890
Brief Workorder:	Raise guardwall 9-in. Remove and reset 120-ft of stone masonry guardwall on concrete footer to adjacent 18-in height. Remove gravel build up from 45 linear feet of barrier.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 432 CF = $108000. (2ft)(1.8ft)(120ft) = 432 CF Structural Concrete at $1000- per -Cu. Yd. for 6 CY = $6000. [(1.8ft)(0.75ft)(120ft)]/27 = 6 CY Labor at $60- per -Hour for 2 Hrs = $120. Remove gravel from front of barrier. Low Speed Traffic Control at $1475- per -Day for 7 Day(s) = $10325. 2 days removal and5 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_12.560_L_1.JPG

Barrier ID:	**COLM-0010-12.610-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	55.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	108
Speed Limit (MPH):	35	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	20.2	**Post Spacing (In.):**	0.0
Height (In.):	13.0	**Lateral Offset (In.):**	61.7	**Road Grade (%):**	1.90

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 9 to 12-in below the 24 in design height.
	Breaking and Cracking:	2 broken stones. Mortar is cracked and missing in many locations along barrier.
	Missing Elements:	9 SF of missing mortar. No stones missing from barrier.
	Corrrosion and Weathering:	Moderate weathering of barrier. Erosion does not compromise stability.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-12.610-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	55.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$119185
Brief Workorder:	Raise guardwall 11-in. Remove and reset 108-ft of stone masonry guardwall on concrete footer to 24-in design height. Replace 2 boulders.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 368 CF = $92000. (2ft)(1.7ft)(108ft) = 368 CF Structural Concrete at $1000- per -Cu. Yd. for 7 CY = $7000. [(1.7ft)(0.9ft)(108ft)]/27 = 6.2 CY New Boulders at $250- per -Each for 2 = $500. Low Speed Traffic Control at $1475- per -Day for 6 Day(s) = $8850. 2 days removal and 4 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_12.610_L_1.JPG

Barrier ID:	**COLM-0010-16.138-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	24.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	NON-TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	223
Speed Limit (MPH):	35	**Placement with Respect to Road:**	NON-TRAFFIC BARRIER
Hazard Behind Barrier:	N/A		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	N/A	**Is Barrier Crashworthy?:**	N/A
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.7	**Post Spacing (In.):**	0.0
Height (In.):	19.2	**Lateral Offset (In.):**	0.0	**Road Grade (%):**	0.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 75-ft was within 3-in of the 24-in design height 75-ft was 3 to 6-in below and 73-ft was 6 to 11-in below.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No weathering in barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-16.138-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	08/04/2010	**Barrier Rating:**	24.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$74140
Brief Workorder:	Raise guardwall 4 inches. Remove and reset 73-ft of stone masonry guardwall on concrete footer to adjacent 18-in height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 234 CF = $58500. (2ft)(1.6ft)(73ft) = 233.6 CY Structural Concrete at $1000- per -Cu. Yd. for 3 CY = $3000. [(1.6ft)(0.5ft)(73ft)]/27 = 2.2 CY Low Speed Traffic Control at $1475- per -Day for 4 Day(s) = $5900. 1 day removal and 3 days installation.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_16.138_L_1.jpg

Barrier ID:	**COLM-0010-18.620-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	48.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	404
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.6
Height (In.):	22.7	**Lateral Offset (In.):**	30.2	**Road Grade (%):**	2.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 4 to 5-in below the 27-in design height. Two areas of minor impact. Gravel is piled up in front of rail.
	Breaking and Cracking:	25-ft of damaged rail. Four damaged/bent reflectors.
	Missing Elements:	No missing rail elements.
	Corrrosion and Weathering:	Minimal corrosion or rail and weathering of blocks and posts.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height was 4-in below the 27-in design height.
	Breaking and Cracking:	Minor impact on ending end BCT. No cracking.
	Missing Elements:	No missing end treatment elements.
	Corrrosion and Weathering:	Minimal corrosion/weathering of end treatments.

Barrier ID:	**COLM-0010-18.620-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	48.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$8580
Brief Workorder:	Raise 404-ft of barrier up to 27-in design height replace 25-ft of bent rail bend reflectors back into place and remove gravel from in front of barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 404 LF = $4040. Raise 404-ft of barrier up to 27-in design height. Replace Rail at $25- per -Lin. Ft. for 25 LF = $625. Replace 25-ft of rail. Labor at $60- per -Hour for 1 Hrs = $60. Bend reflectors back into place. Grader at $125- per -Hour for 1 Hrs = $125. Remove gravel from in front of barrier. Low Speed Traffic Control at $1475- per -Day for 2 Day(s) = $2950.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_18.620_L_1.JPG

Barrier ID:	**COLM-0010-18.917-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	25.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	178
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.3
Height (In.):	28.0	**Lateral Offset (In.):**	14.3	**Road Grade (%):**	3.90

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion or weathering in barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in end treatments.
	Missing Elements:	No missing elements in end treatments
	Corrrosion and Weathering:	No corrosion or weathering in end treatments.

Barrier ID:	**COLM-0010-18.917-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	25.70

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_18.917_L_1.JPG

Barrier ID:	**COLM-0010-19.404-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	50.20

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	497
Speed Limit (MPH):	25	**Placement with Respect to Road:**	BOTH INSIDE AND OUTSIDE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	NCW	**Is Barrier Crashworthy?:**	NO
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	18.2	**Post Spacing (In.):**	0.0
Height (In.):	21.7	**Lateral Offset (In.):**	32.0	**Road Grade (%):**	6.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 227-ft was within 3-in of the 24-in design height 185-ft was 3 to 6-in below and 85-ft was 6 to 7-in below.
	Breaking and Cracking:	Minor cracking of mortar (less than 1/4-in wide) for most of guardwall. Two cracked stones.
	Missing Elements:	10 sq ft of missing mortar. No stones missing from barrier.
	Corrrosion and Weathering:	No erosion along back of guardwall. Stones and mortar are moderately weathered. Gravel piled in front of approach end of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0010-19.404-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	50.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$81912
Brief Workorder:	Raise guardwall 1-in. Remove and reset 85-ft of stone masonry guardwall on concrete footer to adjacent 18-in height. Remove gravel from in front of approach end of barrier and repoint 2 SY of barrier to remain in place.				
Workorder:	Labor at $60- per -Hour for 1 Hrs = $60. Remove gravel from in front of barrier at approach end. Remove & Reset Stone Masonry Guardwall at $250- per -Cu. Ft. for 255 CF = $63750. (2ft)(1.5ft)(85ft) = 255 CY Structural Concrete at $1000- per -Cu. Yd. for 3 CY = $3000. [(1.5ft)(0.5ft)(85ft)]/27 = 2.4 CY Re-Point Masonry Barrier at $140- per -Sq. Yd. for 2 SY = $280. Repoint masonry in areas to remain in place. (10SF)/9 = 1.1 SY Low Speed Traffic Control at $1475- per -Day for 5 Day(s) = $7375. 1 day removal 4 days installation and 1 day all other work.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_19.404_R_1.JPG

Barrier ID:	**COLM-0010-19.858-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	34.00

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	247
Speed Limit (MPH):	25	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	150.6
Height (In.):	26.7	**Lateral Offset (In.):**	30.7	**Road Grade (%):**	6.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	7-ft of rail near approach end of barrier bent more than 50%. 1 broken block.
	Missing Elements:	12 missing posts and 12 missing blocks in barrier.
	Corrrosion and Weathering:	Gullies have formed around uphill side of posts from approach end to halfway down guardrail where curb starts then curb to ending end.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in end treatments.
	Missing Elements:	No missing elements in end treatments.
	Corrrosion and Weathering:	No corrosion or weathering in end treatments.

Barrier ID:	**COLM-0010-19.858-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	34.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$4224
Brief Workorder:	Replace 25-ft of rail replace 1 block add 12 posts and 12 blocks to meet design specifications and add 1 CY backfill and 1 CY riprap to eroded areas around two posts.				
Workorder:	Replace Rail at $25- per -Lin. Ft. for 25 LF = $625. Replace damaged section of w-beam. Replace Block at $30- per -Each for 13 Block(s) = $390. Replace broken block and add 12 blocks to complete design specs. Replace Post at $100- per -Each for 12 Post(s) = $1200. Add 12 posts to complete design specs. Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50. Add backfill to erosion area near two posts. Riprap at $100- per -Cu. Yd. for 1 CY = $100. Add riprap for erosion control around two posts. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_19.858_R_1.JPG

Barrier ID:	**COLM-0010-19.940-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	30.00

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	226
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	76.0
Height (In.):	29.0	**Lateral Offset (In.):**	22.0	**Road Grade (%):**	7.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 1 to 3-in above the 27-in design height.
	Breaking and Cracking:	No cracked or broken elements in barrier.
	Missing Elements:	No elements missing from barrier.
	Corrrosion and Weathering:	Erosion evident around several posts about the middle of the barrier. No corrosion of the steel elements.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No cracked or broken elements on the end treatments.
	Missing Elements:	No elements missing from the end treatments.
	Corrrosion and Weathering:	No corrosion or weathering of the end treatments.

Barrier ID:	**COLM-0010-19.940-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	30.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1733
Brief Workorder:	Add 2 CY backfill to repair erosion.				
Workorder:	Structural Backfill at $50- per -Cu. Yd. for 2 CY = $100. Backfill for posts with erosion. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_19.940_L_1.JPG

Barrier ID:	**COLM-0010-20.296-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	421
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	100.3
Height (In.):	26.7	**Lateral Offset (In.):**	40.2	**Road Grade (%):**	8.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	13-ft of impacted rail and 6 bent reflectors.
	Missing Elements:	Eleven missing posts and eleven missing blocks in barrier.
	Corrrosion and Weathering:	Moderate corrosion and some weathering of posts in barrier. Gravel piled in front of barrier for the entire length.
End Treatments	**Alignment and Height:**	Alignment acceptable. 20-ft of beginning end treatment is 10-in below the 27-in design height.
	Breaking and Cracking:	No breaking or cracking of end treatment elements.
	Missing Elements:	No missing end treatment elements.
	Corrrosion and Weathering:	Minimal corrosion/weathering of end treatments.

Barrier ID:	**COLM-0010-20.296-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$5924
Brief Workorder:	Raise 20-ft of beginning end treatment up to 27-in design height replace 11 missing blocks and 11 missing posts. Bend reflectors back into position and remove gravel from in front of barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 20 LF = $500. Raise 20-ft of beginning end treatment up to 27-in design height. Replace Rail at $25- per -Lin. Ft. for 13 LF = $325. Replace 13-ft of rail. Replace Post at $100- per -Each for 11 Post(s) = $1100. Add missing posts. Replace Block at $30- per -Each for 11 Block(s) = $330. Add missing blocks. Labor at $60- per -Hour for 1 Hrs = $60. Bend reflectors back into position. Labor at $60- per -Hour for 2 Hrs = $120. Remove gravel from in front of barrier. Low Speed Traffic Control at $1475- per -Day for 2 Day(s) = $2950.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_20.296_R_1.JPG

Barrier ID:	**COLM-0010-20.412-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	28.30

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	325
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TANGENT 350	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TANGENT 350	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.3
Height (In.):	28.7	**Lateral Offset (In.):**	26.0	**Road Grade (%):**	6.80

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 1 to 2-in above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion or weathering in barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in end treatments.
	Missing Elements:	No missing elements in end treatments.
	Corrrosion and Weathering:	No corrosion or weathering in end treatments.

Barrier ID:	**COLM-0010-20.412-L**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	28.30

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_20.412_L_1.JPG

Barrier ID:	**COLM-0010-20.936-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	35.90

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	287
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	125.0
Height (In.):	27.2	**Lateral Offset (In.):**	30.2	**Road Grade (%):**	5.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	9 missing posts and 9 missing.
	Corrrosion and Weathering:	No corrosion or weathering in barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking in end treatments.
	Missing Elements:	No missing elements in end treatments.
	Corrrosion and Weathering:	No corrosion or weathering in end treatments.

Barrier ID:	**COLM-0010-20.936-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	35.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$2910
Brief Workorder:	Add 9 missing posts and 9 missing blocks to meet design specifications.				
Workorder:	Replace Post at $100- per -Each for 9 Post(s) = $900. Add 9 posts to bring to design specifications. Replace Block at $30- per -Each for 9 Block(s) = $270. Add 9 blocks to bring to design specifications. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_20.936_R_1.JPG

Barrier ID:	**COLM-0010-21.346-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	363
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	124.6
Height (In.):	27.2	**Lateral Offset (In.):**	33.7	**Road Grade (%):**	6.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	10-ft of bent rail (minor). One cracked block.
	Missing Elements:	16 missing posts and 16 missing blocks.
	Corrrosion and Weathering:	Moderate corrosion and weathering of rail elements. No erosion along back of barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height within 1-in of 27-in design height.
	Breaking and Cracking:	No breaking or cracking of end treatments.
	Missing Elements:	No elements missing from end treatments.
	Corrrosion and Weathering:	Moderate corrosion and weathering of end treatment elements.

Barrier ID:	**COLM-0010-21.346-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$3944
Brief Workorder:	Replace one cracked block 16 missing blocks and 16 missing posts to meet design specifications.				
Workorder:	Replace Block at $30- per -Each for 17 Block(s) = $510. Replace 1 cracked and 16 missing blocks. Replace Post at $100- per -Each for 16 Post(s) = $1600. Replace 16 missing posts. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_21.346_R_1.JPG

Barrier ID:	**COLM-0010-21.602-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	411
Speed Limit (MPH):	25	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	99.6
Height (In.):	27.7	**Lateral Offset (In.):**	29.0	**Road Grade (%):**	6.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 217-ft was 1 to 3-in above the 27-in design height and 194-ft was within 1-in.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	8 missing posts and 8 missing blocks.
	Corrrosion and Weathering:	No corrosion or weathering in barrier.
End Treatments	**Alignment and Height:**	24-ft of approach end is out of alignment by more than 6-in and height was 3-in above the 27-in design height. Ending end treatment is out of alignment by more than 6-in and was 3-in below the 27-in design height.
	Breaking and Cracking:	2 broken blocks and 1 broken post in ending end treatment
	Missing Elements:	No missing elements in end treatment
	Corrrosion and Weathering:	No corrosion or weathering in end treatment.

Barrier ID:	**COLM-0010-21.602-R**		
Route Name:	RIMROCK DRIVE		
Inspection Date:	07/04/2010	**Barrier Rating:**	40.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$4345
Brief Workorder:	Remove and reset 51-ft of rail to realign end treatments and raise height of ending end treatment up to 27-in design height. Replace 2 blocks and 1 post and add 8 posts and 8 blocks to meet design standards.				
Workorder:	Replace Block at $30- per -Each for 10 Block(s) = $300. Replace 2 broken blocks and add 8 new blocks to meet design design standards. Replace Post at $100- per -Each for 9 Post(s) = $900. Replace 1 broken post and add 8 new posts to meet design standards. Remove & Reset Guardrail at $25- per -Lin. Ft. for 51 LF = $1275. Reset end treatments to realign to upright and raise ending to 27-in design height. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0010: RIMROCK DRIVE

Barrier Condition Photos

COLM_0010_21.602_R_1.JPG

Barrier ID:	**COLM-0200-0.546-L**		
Route Name:	SADDLEHORN LOOP ROAD		
Inspection Date:	08/04/2010	**Barrier Rating:**	0.00

Barrier Description

Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	**Barrier Function:**	NON-TRAFFIC
Barrier Material:	STONE	**Post Material:**	N/A
Blockout Type:	N/A	**Length (ft.):**	72
Speed Limit (MPH):	15	**Placement with Respect to Road:**	NON-TRAFFIC BARRIER
Hazard Behind Barrier:	N/A		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	N/A	**Is Barrier Crashworthy?:**	N/A
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	24	**Width (In.):**	23.0	**Post Spacing (In.):**	0.0
Height (In.):	34.5	**Lateral Offset (In.):**	0.0	**Road Grade (%):**	0.00

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height was 2 to 19-in above the 24-in design height.
	Breaking and Cracking:	No breaking or cracking of barrier.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No weathering of barrier. Erosion has not compromised barrier stability.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**COLM-0200-0.546-L**		
Route Name:	SADDLEHORN LOOP ROAD		
Inspection Date:	08/04/2010	**Barrier Rating:**	0.00

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Colorado National Monument

ROUTE 0200: SADDLEHORN LOOP ROAD

Barrier Condition Photos

COLM_0200_0.546_L_1.JPG

Appendix A
Summary of GIP Definitions and Assessment

Colorado National Monument

Federal Lands Highway
Road Inventory Program

Appendix A:
Guardwall/Rail Inventory Program (GIP)
EXPLANATION OF REPORT TERMS

The Guardwall/rail Inventory Program (GIP) was commissioned by WASO to identify deferred maintenance related to barriers in National Parks that have more than one mile of guardwall or guardrail. GIP was designed jointly by the NPS and FHWA and the inventory process records both static characteristics of the barrier (e.g., length, height, etc.) as well as dynamic information about the condition of the barrier.

Barriers that traverse bridges are not included in this inventory, these barriers are covered in FHWA's Bridge Inventory Program (BIP); however, barriers that are approaches to bridges were part of this inventory.

The following discussion highlights each of the elements found in the reports.

Static Barrier Characteristics

BARRIER TYPE

Refers to both the design and the construction materials used:

- W-Beam, Strong Post
- W-Beam, Weak Post
- Thrie Beam/Modified Thrie Beam
- Box Beam
- Steel-Backed Timber, w/ Blockout
- Steel-Backed Timber, w/o Blockout
- Steel-Backed Log Rail
- High Tension Cable
- Three-Strand Cable
- Stone Masonry, w/o Concrete Core Wall
- Stone Masonry, w/ Concrete Core Wall
- Random Rubble Cavity Wall
- Concrete Barrier
- Concrete, with Simulated Stone Face
- W-Beam (Double Face), Strong Post
- Steel-Backed Timber (Double Face)
- Other: *Completed by field crew*

BARRIER MATERIAL

The type of material of which the barrier is composed:

- Cable
- Concrete
- Galvanized Steel
- Log/Timber/Wood
- Steel-Backed Timber/Log
- Weathering Steel/Corten
- Stone
- Other: *Completed by field crew*

LENGTH

The longitudinal distance between the beginning and end of the barrier. It should include the length of end treatments in the overall length of the barrier. For roadside barriers, this can be calculated from the start and end locations.

BARRIER FUNCTION: Traffic or Non-Traffic Barrier.
Due to the different GIP assessment criteria of barriers based on their intended use, barriers were classified as being either traffic barriers or non-traffic barriers.

> *Traffic barriers* are physical devices intended to keep vehicles or people from straying into dangerous or off-limits areas. For the purpose of this inventory and assessment, a traffic barrier is categorized as roadside hardware placed longitudinally, excluding pedestrian railing and fencing.
>
> *Non-traffic barriers* provide a physical delineation between public access areas and restricted or protected areas in locations such as a parking lot, viewpoint or turnout. Non-traffic barriers which inhibit access of vehicles are included in this report; non-traffic barriers which only inhibit access of pedestrians or bicyclists are not included. For the purpose of this inventory, non-traffic barriers are guidewalls and guiderails. Note: rocks, stones, boulders, fences or curbs were excluded from this inventory.

There are instances in parks where a single barrier can switch between being classified as a traffic barrier and a non-traffic barrier. Such instances typically occur at pullouts, where a traffic barrier along the road will continue through the pullout without interruption. In such instances, the traffic barrier and non-traffic barrier were assessed using different criteria. Due to the different criteria, the GIP database was designed to record the traffic barrier and non-traffic barrier as two distinct barriers, even though to the eye, they appear as one barrier. Other instances where a single barrier is split into multiple barriers would be when the barrier is placed continuously along two legs of an intersection, so that one portion of the barrier may be on one road and the remaining portion of the barrier is on a different road.

POST MATERIAL
The type or material that the barrier's supporting posts are made of:

- Galvanized Steel
- Wood
- Corten
- Other: *Completed by field crew*
- N/A

BLOCKOUT TYPE

The type of blockout or of what it is comprised:

- Wood
- Plastic
- Steel
- N/A

BARRIER PLACEMENT WITH RESPECT TO ROADWAY
To identify the roadway alignment the barrier is located upon:

- Tangent
- Inside of Curve
- Both Inside and Outside of Curve
- Outside of Curve

POSTED SPEED LIMIT
The posted speed limit of the roadway section.

HAZARD BEHIND BARRIER

A qualitative description of the severity of the hazard behind the barrier:

- Low
- Medium
- High
- Extreme

APPROPRIATE TEST LEVEL (TL) FOR ROAD

Based on the posted speed limit, the NCHRP 350 Crashworthiness test level appropriate for the roadway.

- TL-1, 30 mph and lower
- TL-2, 35-45 mph
- TL-3, 50 mph and higher

BARRIER TEST LEVEL (TL)

A traffic barrier is crashworthy if it was successfully crash tested under *NCHRP Report 350* at speeds along the park road or parkway or if it was accepted through analysis by FHWA, based on similarity to other crashworthy critical design element features. Non-traffic barriers are classified at N/A.

- TL-1
- TL-2
- TL-3
- No
- N/A – Non-Traffic Barrier

IS BARRIER CRASHWORTHY

This compared the appropriate crashworthy test level required for the posted speed limit to the barrier's test level.

- Yes
- No

BEGINNING END TREATMENT TYPE

An end treatment is safety hardware that mitigates impacts to the ends of a barrier. Most common end treatments are for w-beam systems. Note that stonemasonry barriers typically do not have end treatments.

The beginning end treatment is based on the travel lane closest to the barrier. A vehicle traveling in the lane closest to the barrier will encounter the barrier's beginning end treatment first. It is not based on the RIP primary direction. Identifies the barrier's beginning end treatment type:

- W-Beam Flared 350 Compliant
- W-Beam Tangent 350 Complaint
- W-Beam Buried End
- W-Beam Trailing End/CRG
- W-Beam BCT, Flared
- W-Beam, Turn Down
- SBT/Log, Flared
- SBT/Log, Buried
- Median Treatments
- Box Beam
- Cable
- Crash Cushions/Attenuator
- Other: *Completed by field crew*
- None

IS BEGINNING END TREATMENT CRASHWORTHY

Identifies if the barrier's beginning end treatment (based on direction of travel for the travel lane closest to barrier) is crashworthy, based on NCHRP-350.

- Yes
- No
- N/A

APPROACH TRANSITION TYPE

A transition is safety hardware designed to be placed between two different types of barrier. Most common transition types are between bridge rail and w-beam systems.

This identifies the barrier's transition type:

- Bridge Rail, W-Beam
- Bridge Rail, SBT
- Rigid W-Beam, W-Beam
- Rigid SBT (Wall), SBT
- Concrete/Masonry, W-Beam
- Concrete/Masonry, SBT
- Concrete/Masonry, Thrie Beam
- Other: *Completed by field crew*
- None

ENDING END TREATMENT TYPE

The ending end treatment is based on the travel lane closest to the barrier. A vehicle traveling in the lane closest to the barrier will encounter the barrier's ending end treatment last, after passing the rest of the barrier. It is not based on the RIP primary direction. Identifies the barrier's ending end treatment type:

- W-Beam Flared 350 Compliant
- W-Beam Tangent 350 Complaint
- W-Beam Buried End
- W-Beam Trailing End/CRG
- W-Beam BCT, Flared
- W-Beam, Turn Down
- SBT/Log, Flared
- SBT/Log, Buried
- Median Treatments
- Box Beam
- Cable
- Crash Cushions/Attenuator
- Other: *Completed by field crew*
- None

IS ENDING END TREATMENT CRASHWORTHY

Identifies if the barrier's ending end treatment (based on direction of travel for the travel lane closest to barrier) is crashworthy, based on NCHRP-350.

- Yes
- No
- N/A

BARRIER DESIGN HEIGHT

Identifies the barrier's original "as-built" design height:

- 27-in, W-beam, Steel-Backed Timber, Stone Masonry w/ Concrete Core Wall
- 24-in, Stone Masonry w/o Concrete Core Wall, Log on Log
- 20-in, Timber on Wood Posts, Timber on Concrete Posts, Timber on Granite Posts
- 18/24-in, Crenellated Stone Masonry Barrier
- 18/24-in, Dry Stack Stone Wall
- 31-in, Steel-Backed Log
- 32-in, Jersey Barrier

AVERAGE MEASUREMENTS

Minimum of three measurements taken on each barrier.

First measurement approximately 50-ft from the beginning of the barrier, measured from the extreme ends of the barrier's end treatment/transition. Do not take a measurement along the end treatment
Measure and record measurement every 200-ft thereafter for the run of barrier

Last measurement approximately 50-ft from the end of the barrier. Do not take a measurement along the end treatment
If a barrier is less than 300-ft, even say 45-ft, a minimum of three measurements were still taken.

AVERAGE WIDTH

The width of the barrier. Only recorded for guardwalls; not guardrail.

AVERAGE POST SPACING

The spacing of the barrier's (not the end treatments') posts. Only recorded for guardrails; not guardwalls or non-traffic barriers.

AVERAGE BARRIER HEIGHT

The average barrier height. If the barrier has crenellations, the height is measured in the non-crenellated sections of the barrier. If the average lateral offset is less than or equal to 4-ft, average barrier height is measured from the roadway; if the average lateral offset is greater than 4-ft, average barrier height is measured at the barrier face.

AVERAGE LATERAL OFFSET

Determine the average distance between the barrier and the edge of roadway. If a white edgeline is present on the roadway, average lateral offset is measured from the outside edge of the white line to the barrier face. If no white edgeline is present, average lateral offset is measured from the edge of pavement to the barrier face.

AVERAGE ROAD GRADE and UPHILL OR DOWNHILL

Determine an average roadway grade at each barrier location, based on the direction of travel in the lane closest to the barrier.

DYNAMIC BARRIER CHARACTERISTICS – CONDITION ASSESSMENT NARRATIVES

Field crews were directed to write a narrative of the barrier's physical condition. To keep consistency between field crews, all narratives were based on severity and distress criteria, which were developed jointly by the NPS and FHWA. Condition assessments were based on barrier type and can be found directly after this description of report elements.

BARRIER ALIGNMENT/HEIGHT

Narrative completed by field crew describing the barrier's alignment and height. Height comments are based on the barrier's original "as-built" design height.

BARRIER BREAKING/CRACKING

Narrative completed by field crew describing any barrier breaking or cracking found during the inspection.

BARRIER MISSING ELEMENTS

Narrative completed by field crew describing any barrier missing elements encountered during the inspection.

BARRIER CORROSION/WEATHERING

Narrative completed by field crew describing and corrosion or weathering issues associated with the barrier.

END TREATMENTS ALIGNMENT/HEIGHT

Narrative completed by field crew describing the barrier end treatment's alignment and height, when present. Height comments are based on the end treatment's original "as-built" design height.

END TREATMENTS BREAKING/CRACKING

Narrative completed by field crew describing any barrier end treatment's breaking or cracking found during the inspection.

END TREATMENTS MISSING ELEMENTS

Narrative completed by field crew describing any barrier end treatment missing elements encountered during the inspection.

END TREATMENTS CORROSION/WEATHERING

Narrative completed by field crew describing and corrosion or weathering issues associated with the barrier's end treatments.

BARRIER PHOTOGRAPHS

During the inspection, the field crews photographed the beginning end (based on the closest lane's direction of travel) of each barrier. Additional photographs were taken of any unusual deficiencies encountered. Up to two photographs of the barrier are included in this report.

CONDITION AND SEVERITY DISTRESS TABLES

Due to the extreme number of possible conditions of the barrier, transition and end treatment, the following descriptions and matrices are guidelines created to help classify the condition of the element. While the distinction between good and fair is needed, the distinction between fair and poor is much more important since this is the threshold that defines if the element is slightly compromised or is not functional.

In all likelihood, according to these guidelines different portions of an element (most likely a barrier) may be classified differently; however, a single classification will need to be provided for the element. The survey team will use their professional judgment to determine this single classification. The single classification of each element should be considered an index value that provides a general indicator of overall performance, but not necessarily indicate that a specific treatment is warranted. The specific work order that is prepared based on the observed deficiencies will be a much more definitive indicator of the appropriate treatment based on existing distresses. The overall condition will be used as part of the risk assessment tool to evaluate the risk to driver safety associated with the physical condition of the barrier.

GOOD

The barrier performs as intended. The barrier is in fairly straight alignment but may have some small amount that is slightly out of alignment. While the height of the barrier may vary over its run, the height is relatively consistent and is close to its original "as-built" design height. Minor cracks may be visually observed on some the posts, though these cracks are neither long nor deep and the only hardware missing are isolated nuts and bolts. Minor surface corrosion on small portions of the surface is visible but there is no decay associated with connections.

The end treatment performs as intended. The end treatment is in good alignment and tension is acceptable. While the end treatment may exhibit some dents, there are no cracked rails, posts, blocks or any missing elements. Corrosion and erosion, while present, are at a minimum.

In general, all distresses observed, either in isolation or in combination, do not seriously affect the ability of the element to serve the intended functions of protecting drivers from a roadside hazard and/or contributing to the cultural value of the roadway corridor. Keep in mind that "intended function" is a relative term. In many cases, older designs were "intended" to protect drivers but would not be considered fully functional in that regard by today's standards.

FAIR

The barrier is slightly compromised. The barrier is noticeably out of alignment and the height along the run of barrier varies considerably. Cracks and broken elements are visible from the roadside. The barrier may be missing elements, such as nuts, bolts, blockouts or even a post. Surface corrosion is visible on a fair amount of the barrier but connections will still provide element interlock. Decay and minor erosion, while not always visible, may begin to reduce element strength and individual post stability.

The end treatment is slightly compromised. The end treatment may be somewhat out of alignment, have low cable anchor tension or isolated broken or cracked rail, posts or blocks. Corrosion and erosion are evident.

In general, the distresses observed, either in isolation or combination, may generate unpredictable outcomes related to the functions of the element stated above.

POOR

The barrier is not functional. The barrier will not function as intended. Any of the following could mean that the barrier is in poor condition: The barrier has fallen out of alignment or its height varies greatly from the designed height. Cracks and broken elements are visible from the roadside. The barrier is missing several elements, such as nuts, bolts, blockouts or consecutive posts. Corrosion, causing structural compromise is significant and obvious. Erosion around posts will reduce the barrier's strength and capacity.

The end treatment is not functional. The end treatment does not function as intended. There is no tension in the cable anchor. A significant portion of the end treatment has broken, cracked or dented elements. Elements are missing and corrosion or erosion is significant.

In general, the distresses observed clearly illustrate the inability of the element to perform the intended functions.

CONDITION AND SEVERITY DISTRESS TABLES – BARRIERS

Condition and Severity Distress Table for Semi-Rigid Barriers (including barriers with posts, rail elements and blocks).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment off by less than 6”	• Alignment off by 6”-12”	• Alignment off by more than 12”
	• Within 1” of ***design height***	• Less than 3” lower than ***design height***	• Greater than 3” lower than ***design height***
Breaking/Cracking, an member, post or rail – due to impact loading			
	• Metal – no twisting/bending, tears or cracking	• Metal – no cracking or tearing (but minor twisting/bending is ok)	• Metal – any cracks or tears
	• Wood – no impact related cracking	• Wood – maybe cracked but retains original cross section	• Wood – cracks or tears that deform original section
	• Isolated broken blocks	• Two Consecutive broken blocks	• Consecutive broken blocks (three or more consecutive)
Missing Elements			
	• No bolts and nuts missing	• One or two bolt/nut missing at one rail/rail connection	• Three or more bolts/nuts missing at one rail/rail connection
	• n/a	• Two consecutive missing blocks	• Three or more consecutive missing blocks
	• n/a	• n/a	• One missing rail element or post
Corrosion/Decay/Weathering, all posts, rails and blocks – due to aging			
	• Loss of 5% or less of cross section	• Loss of 5% to 50% of cross section	• Loss of 50% or more of cross section
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around posts (8” or more of post exposed below original groundline) for one	• Erosion around consecutive posts (more than 8” of post exposed below original groundline)

Condition and Severity Distress Table for Rigid Concrete Barriers (including pre-cast).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment off by less than 6”	• Alignment off by 6”-12”	• Alignment off by more than 12”
	• Within 1” of *design height*	• Less than 3” lower than *design height*	• Greater than 3” lower than *design height*
Breaking/Cracking– due to impact loading			
	• Minor cracks (less than ¼”) present	• Cracking present ¼” or greater but no displacement or discontinuity in face	• Barrier displaced and/or discontinuous
	• n/a	• Pieces broken from barrier 3” deep or less without exposing rebar	• Cracking exposes rebar
	• n/a	• n/a	• Pieces broken from face greater than 3” deep
Missing Elements			
	• n/a	• n/a	• n/a
Corrosion/Decay/Weathering – due to aging			
	• Surface corrosion on less than 5% of the run	• Surface corrosion on between 5-25% of the run	• Surface corrosion on more than 25% of the run
	• n/a	• Spalling 3” deep or less without exposing rebar	• Spalling greater than 3” deep
	• Erosion (less than 8” below groundline) around base	• Erosion (8” or more below groundline) around base	• Erosion (8” or more below groundline)
	• n/a	• Less than 50% undermined (less than half barrier width)	• 50% or more undermined (less than half barrier width)

Condition and Severity Distress Table for Rigid Stone/Masonry Barriers (including all types of stone or masonry barriers).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment (off by less than 6”)	• Alignment (off by 6”-12”)	• Alignment (off by more than 12”)
	• Within 3” of *design height*	• Between 3.1 - 6” lower than *design height*	• Greater than 6.1” lower than *design height*
Breaking/Cracking – due to impact loading			
	• Minor cracks (less than ¼”) present	• Cracks, less than ½” present	• Cracks greater than ½” present
		• Stones broken/displaced extending less than 1/3 of width of barrier	• Stones broken/displaced extending 1/3 width or more through the barrier
Missing Elements			
	• n/a	• n/a	• n/a
Corrosion/Decay/Weathering – due to aging			
	• Cracks in mortar joints 1/4” or less and/or single loose or missing stones	• Mortar joints deteriorated resulting in two - three loose or missing adjacent stones (without impact)	• Mortar joints deteriorated resulting in more than three continuous/adjacent loose or missing stones (without impact)
	• Erosion (less than 8” below groundline) around base	• Erosion (8” or more below groundline) around base	• Erosion (8” or more below groundline)
	• n/a	• Less than 50% undermined (less than half barrier width)	• 50% or more undermined (less than half barrier width)

Condition and Severity Distress Table for Flexible Barriers, (including cable barriers and weak-post systems designed without blocks).

	GOOD	FAIR	POOR
Alignment/Tension/Design Height			
	• No bent posts	• Bent posts; one to three consecutive posts	• Bent posts; four or more consecutive posts
	• Cable has tension	• Cable under-tensioned/sagging	• No cable tension
	• Less than 1” too low	• 1-3” too low	• Greater than 3” too low
Breaking/Cracking			
	• No cracked or broken posts	• One to three isolated broken posts	• Four or more consecutive broken posts
	• n/a	• Cable frayed	• Cable broken or severed
Missing Elements			
	• No bolts and nuts missing at anchors	• n/a	• Bolts and nuts missing or loose at anchors
	• n/a	• n/a	• Any missing posts or cable for any length of run
Corrosion/Decay/Weathering – due to aging			
	• Loss of 5% or less of cable cross section	• Loss of 5% to 15% of cable cross section	• Loss of 15% or more of cross section
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around one post (8” or more of post exposed below original groundline)	• Erosion around consecutive posts (more than 8” of post exposed below original groundline)

CONDITION AND SEVERITY DISTRESS TABLES – END TREATMENTS

Condition and Severity Distress Table for Flexible End Treatments, (including cable end terminals).

	GOOD	FAIR	POOR
Alignment/Tension			
	• Alignment off by less than 4”	• Alignment off by 4”-8”	• Alignment off by more than 8”
	• Adequate cable tension	• Low cable anchor tension	• No cable anchor tension
Breaking/Cracking – due to impact loading			
	• No broken or cracked elements	• Minor cable fraying but still with adequate tension	• Broken or cracked cables or posts
	• No damage to posts, cable or anchor	• Slight damage to posts without cracking or tearing (*but minor twisting/bending on isolated posts is OK)*	• Cable broken or severed on any cable
Missing Elements			
	• No bolts and nuts missing at anchors; No missing cables	• n/a	• Any missing element (post, cable, bolts, nuts, or anchor)
Corrosion/Decay/Weathering – due to aging			
	• Loss of 5% or less of cable cross section	• Loss of 5% to 15% of cable cross section	• Loss of 15% or more of cross section
	• Connections weathered but still provide element interlock on less than 5% of the end treatment	• Connections weathered but still provide element interlock on between 5% to 15% of the end treatment	• Connections weathered but still provide element interlock on more than 15% of the end treatment

Condition and Severity Distress Table for Semi-Rigid End Treatments, including Flared and Tangent

	GOOD	FAIR	POOR
Alignment/Tension			
	• Alignment of flares and offsets off by less than 4”	• Alignment of flares and offsets off by 4”-8”	• Alignment of flares and offsets off by more than 8”
	• Within 1” of ***design height***	• Less than 3” lower than ***design height***	• Greater than 3” lower than ***design height***
For *Aesthetic Barriers* (i.e. – SBT and SBL guardrail) that do not have crashworthy terminals:	• Approach barrier terminals are buried, anchored, and flared away from the travel lane	• Approach barrier terminals are buried, anchored, and flared away from the travel lane	• Approach barrier ends are NOT buried, anchored, nor flared away from the travel lane
Breaking/Cracking – due to impact loading			
	• Metal – no twisting/bending, tears or cracking	• Metal – no cracking or tearing (but minor twisting or bending is ok)	• Metal – any cracks or tears
	• Wood – no impact related cracking	• Wood – maybe cracked but retains original cross section	• Wood – cracks or tears that deform original section
	• No broken blocks	• One broken block	• Two consecutive broken blocks
Missing Elements			
	• No missing elements, including breakaway cables and struts	• Isolated bolts, nuts, or blocks loose on non-consecutive posts	• Any missing element, including blocks, rails, posts cables, or struts
	• No bolts, nuts, or blocks missing or loose	• Breakaway strut present but vertical height off by more than 2”	• Missing nuts / bolts on consecutive posts
Corrosion/Decay/Weathering – due to aging			
	• Surface corrosion / decay / connections weathered with a loss of 5% or less of cross section of interlocking elements	• Surface corrosion / decay / connections weathered with between 5-25% loss of cross section along transition interlocking elements	• Surface corrosion / decay / connections weathered with more than 25% loss of cross section along transition interlocking elements
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around 1 post (8” or more of post exposed below original groundline)	• Erosion around consecutive posts (8” or more of post exposed below original groundline)

SPECIFIC RISK ELEMENTS

The potential risk to a motorist after a vehicle impacts a traffic barrier depends on the crashworthiness of the traffic barrier as well as traffic exposure factors. Variables relating to the roadside, the traffic barrier's crashworthiness and traffic data include the following:

ADT. The number of vehicles (in both directions) that travel the roadway on which the traffic barrier is located.

Barrier Crashworthy. A traffic barrier is crashworthy if it was successfully crash tested under NCHRP Report 350 at speeds along the park road or parkway or if it was accepted through analysis by FHWA, based on similarity to other crashworthy critical design element features. If crashworthy, the appropriate test level also needs to be recorded. For crashworthy barriers, the barrier test level will be compared to the test level appropriate for the roadway (based solely on posted speed limit). The intent is to record situations in which a crashworthy barrier of a lower test level is installed on a roadway which should have a barrier of a higher test level.

Barrier Height. Determined from barrier height as collected in the physical condition assessment. The database will compare this value to the NCHRP test level height that is appropriate for the posted speed of the road and barrier type.

End Treatment Crashworthy. An end treatment is crashworthy if it has been successfully crash tested. This is for the approach end treatment, which is defined as the end treatment which a vehicle will first pass when traveling on the same side of the road as the barrier.

Existing Roadway Features. The list of roadway features is limited to the following, all of which have a documented history of reducing the number of crashes, and are found later in the GIP as possible countermeasures.

Centerline pavement markings	Grooved pavement surface
Edgeline pavement markings	Delineators on curve and tangent
Wider centerline	Chevrons
Wider edgeline	Warning sign
Centerline rumble strips	Flashing beacon on warning sign
Shoulder rumble strips	Lighting
Barrier reflectors	Speed feedback sign

Factored Crash Rate. The average annual number of crashes (on the overall road and by barrier segment), over the last 5 years. If the road has an ADT of less than 1000, evaluate a minimum of
7 to 10 years of crash data, if available.

Lateral Offset of Barrier from Edge of Traveled Way. The distance from the edge of traveled way to the face of the barrier is useful for determining impact to asset during different types of construction. Two or three measurements will be taken – beginning, middle and end of barrier run (not including the end treatments) – and the average will be used.

Posted Speed Limit. The posted speed limit(s) of the roadway section.

Roadway Grade and Uphill or Downhill. Is refers to the grade of the roadway, in the direction of travel closest to the barrier.

Severity of the Hazard behind Barrier. A rating system based on photos will be used to rate the severity of the hazard behind the barrier. Choices include:

- Low
- Medium
- High
- Extreme

RISK ASSESSMENT AND RISK SCORE

The following table shows the variables relating to the overall roadway safety in the vicinity of barriers. In addition, the table illustrates the range of values considered for each variable and associated levels of risk. For categorization purposes, variables have been placed into one of three categories: segment, site or barrier variables. The "Associated Risk" column identifies the relative risk posed by each variable. This looks at the relative risk of the each variable itself and is only a cursory evaluation.

A Risk Score or Rating ("Barrier Rating" on Tier 3 Barrier page) was created for each barrier based on the table values. The level of risk tolerated is dependent on the category of road, which will be discussed in subsequent pages.

Once the inventory has been conducted, a total risk value can be assigned to each barrier. A comparison of the relative risk to an acceptable risk threshold will be performed in order to analyze the overall risk of a given barrier.

Variable and Associated Levels of Risk

VARIABLE	RANGE	ASSOCIATED RISK
SEGMENT VARIABLES		
ADT	0 – 1000	0.0
	1001 – 4000	2.9
	4001 – 8000	5.7
	8001 – 20,000	7.1
	20,001 and greater	8.6
Crash Factor	0	0.0
	0.1 – 5.0	4.2
	5.1 – 20.0	8.7
	20.1 – 30.0	17.1
	30.1 – 75.0	25.8
	75.1 and greater	34.2
Posted Speed Limit	15 – 25 mph	0.0
	30 – 40 mph	4.3
	45 and higher	8.6
SITE VARIABLES		
Barrier Placement w/ Respect to Roadway Geometry	Tangent	0.0
	Inside of curve	2.9
	Both inside and outside of curve	8.6
	Outside of curve	8.6
Severity of Hazard behind the Barrier	Low severity	2.6
	Medium severity	5.1
	High severity	6.9
	Extreme severity	8.6
Longitudinal Length of Barrier	1 – 250-ft	0.0
	251 – 750-ft	2.9
	751 – ft and greater	5.7
Lateral Offset of Barrier from Edge of Traveled Way	4.1 – ft and greater	0.0
	2 – 4-ft	2.9
	less than 2-ft	5.7
Roadway Grade	Uphill/level/downgrade less than 3%	0.0
	Mild downgrade (3 – 6%)	4.3
	Steep downgrade (greater than 6%)	8.6
BARRIER VARIABLES		
Actual Barrier Height (compared to test level height)	0 – 1-in lower	0.0
	1.1 – 4-in lower	4.4
	4.1 – 7-in lower	12.9
	7.1 – 12-in lower	19.4
	12.1-in and greater lower	21.5
Dynamic Barrier Condition Rating (based on design height)	0 – 25	0.0
	26 – 200	4.4
	201 – 400	8.6
	401 – 600	12.9
	601 – 800	17.1
	801 and above	21.5
Barrier Conformance with Current Crashworthiness Criteria	Yes	0.0
	No	5.7
	Maximum Total Possible Risk Score	**100**

REPLACEMENT/REPAIR STRATEGIES

Information is integrated by combining static data on barrier type, materials, dimensions, etc. with the condition and risk assessments, and the asset management roadway categories (which include cultural and historic resource considerations) to come up with actionable repair strategies for barriers. In addition, repair costs are accounted for so that estimates can be made for repair actions identified. Costed repair estimates, or work orders, then form the basis for estimating deferred maintenance associated with roadside barriers.
Repair recommendations generated by this assessment are intended to provide an estimated cost of deferred maintenance of barriers. As such, the evaluation is not rigorous and may be changed when a more detailed review and assessment at a project level is completed. In addition, any repairs or replacements that are recommended by this inventory and assessment process must be vetted through a project selection, planning and design process, including compliance with the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA).

Many park barriers are located in harsh environments where freeze-thaw cycles, avalanche impacts, surface erosion, rockfall and vehicle impacts damage them; consequently, they are showing signs of fatigue, at times serious. Whenever possible, historic barriers are repaired or rehabilitated in place so that the historic significance can be preserved; however, removal or reconstruction, which is typically the least preferred alternative, is at times necessary.

Barrier deficiencies can generally be categorized into one of two categories:

- Barriers that pose an unacceptable risk to the traveling public (as determined by the risk assessment methods described in Chapter Seven and including standards found in NCHRP Report 350), or
- Damaged barriers, due to either crash impacts, other loadings (e.g., snow / avalanche, etc) or deteriorated parts (from age / weathering).

Outside of the national park system, barriers that do not meet NCHRP Report 350 crashworthiness standards are typically removed and a barrier of a crashworthy design is constructed in its place. However given the sensitive natural and cultural environments found within the national park system, deficient barriers not meeting national crashworthiness standards may warrant no action, particularly where risk is low.

The type of repair strategy is often dependent on the barrier deficiency and its cultural context. Typically barriers that do not meet current crashworthiness criteria may be replaced while damaged or deteriorated barriers can be repaired. However, under unique situations found in certain national parks and as evaluated using the risk assessment and asset management roadway categories, some barriers that do not meet current crashworthiness criteria may warrant no action being taken for their replacement or repair.

Risk assessment and asset management roadway categories are integrated in the following table, which establishes different risk thresholds within each roadway category. In essence, a higher level of risk will be tolerated in Asset Management Roadway Category A, as demonstrated by the higher risk threshold (90), while less risk will be tolerated in Roadway Category B (70) and even less risk in Roadway Category C (50).

Asset Management Roadway Categories, Risk Thresholds and Treatment Recommendations.

ASSET MANAGEMENT ROADWAY CATEGORY	RISK THRESHOLD	PROGRAM-LEVEL TREATMENT RECOMMENDATION
A	90-100	1. Identify measures other than barrier replacement that could be taken to reduce risk (including engineering countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 90.
	Below 90	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.
B	70-100	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 70.
	Below 70	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.
C	50-100	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 50.
	Below 50	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.

Fourteen engineering countermeasures have been specifically selected for use with the GIP risk assessment tool, and are show in the next table. This is an all-inclusive list of available countermeasures for the risk assessment toll; countermeasures not on the list should not be considered.

The concept of employing countermeasures is evident with barriers that have a risk score just above the risk threshold. For such barriers, installing countermeasures should reduce the future number of crashes by a given amount, based on the countermeasure. Depending on the factored crash rate, reducing the number of crashes will lower the overall risk score. Thus, barriers that were classified as “reconstruct/replace” may be able to be reclassified as “repair”.

The decision to include any of the engineering countermeasures can be done only when the risk score is over the risk threshold by three points or less. When countermeasures are employed to reduce the risk score, they must be based on engineering judgment. The GIP database will allow the user to select up to three countermeasures to reduce the risk score under the threshold, based on crash reduction factors from the FHWA publication “Desktop Reference for Crash Reduction Factors” FHWA-SA-07-015.

Proposed Countermeasures.

COUNTERMEASURE	CRASH REDUCTION FACTOR
Speed Feedback Signs	0.46
Flashing Beacons On Warning Signs	0.30
Centerline Pavement Marking	0.30
Lighting	0.25
Chevrons	0.20
Warning Signs	0.20
Barrier Reflectors	0.16
Grooved Pavement Surface	0.15
Edgeline Pavement Marking	0.12
Shoulder Rumble Strips	0.12
Delineators on Curve and Tangent	0.05
Centerline Rumble Strips	0.04
Wider Edgeline	0.02
Wider Centerline	0.02

Maintaining Barriers As Is

Individual barrier elements and roadside conditions are interrelated. Sometimes, barrier deficiencies will be obvious and the best course of action is apparent; however, in context sensitive environments barrier deficiencies may be marginal and a decision will be based on judgment.

If risk is low (as determined by the assessment of variables such as traffic speeds, volumes), it may be acceptable for an historical or culturally significant barrier that does not meet current crashworthiness standards to remain until changes in risk factors would require an upgrading.

If the maintaining barrier as is alternative is the preferred choice through this approach, low cost mitigation measures may be considered to improve safety, such as improving roadside delineation (e.g., pavement markings / rumble strip(e)s, etc.), improving visibility (e.g., advance warning signs, increased sign size, etc.), upgrading the roadway shoulder, or improving skid resistance of the road surface. Although these measures will not reduce crash severity of an errant vehicle impact, these improvements have been tried or proven to reduce the frequency or probability of a vehicle striking the barrier.

Barrier Repair

If a barrier has been damaged due to a crash or there are parts that have deteriorated due to age or weathering but the majority of the barrier meets current crashworthiness standards and is functionally sound, repairing the system can be considered a viable option. Examples of these improvements include replacing damaged timber rail, removing a corroded, weathered steel post and replacing with new, upgraded guardrail blockouts to meet standards on high speed facilities or repointing, resetting or replacing loose or missing stones on the concrete corewalls of stone masonry guardwalls. Pursuing a repair approach should be the first consideration for Roadway Category A and B road assets.

For barriers that do not meet crashworthiness criteria but are functionally sound and have been determined good candidates to be maintained as-is based on the risk assessment and application of asset management roadway categories, repair could include measures such as repointing deteriorated masonry, re-setting or replacing loose, broken or missing stones, restoring walls to their original height (by adding a concrete footing, for example), restoring or improving drainage through or under walls or restoring wall foundations. Alterations to improve safety may also be considered, such as adding or changing end treatments or other mitigation measures as mentioned above.

For historic, stone masonry barriers that have a risk score below the threshold, it is possible that portions of the barrier need to be removed and reset in order increase the height of the barrier. The following guidelines are provided to assist in determining when this should be done and to what height the barrier should be rebuilt:

1. If all or a portion of stone masonry guardwall has a deficient height based upon the Severity Description Charts, that is, at worst, within the fair category, do not raise it. (Other work besides raising the barrier can be specified.)

2. If a portion of a stone masonry guardwall has a deficiency in height based upon the Severity Description Charts, considered "poor" (assumed typically to be less than 18-in) write a work order to raise the poor segment to the height of the adjacent barrier with a non-poor height.

3. If the entire stone masonry guardwall is in poor condition due to height based upon the Severity Description Charts– write a work order to raise the entire segment to its design height (assumed typically to be 24-in).

For aesthetic barrier systems used on many park roads and parkways, there is not a sufficient bid history database for estimating costs to repair or replace individual elements of the system, such as posts or rail. Usually repair of an aesthetic barrier system, such as steel-backed timber guardrail consists of removing and resetting the post or rail section or raising the guardrail to meet standard height requirements.

Barrier Replacement/Reconstruction

If the risk analysis, including the application of asset management roadway categories, indicates the barrier poses an unacceptable safety risk, the first step should be an analysis to determine if there are mitigating measures that can be applied to reduce the risk to an acceptable level without the need to reconstruct the barrier. A second step is to determine if the barrier is needed. If it is practical to eliminate the shielded hazard (by removal, relocation or redesign) removal of the barrier should be considered. However, if the shielded hazard cannot be eliminated or if it is determined inappropriate to remove the barrier (e.g., it is historically significant and/or contributes to the historical or aesthetic significance of the associated road, district or landscape), reconstruction or replacement of the barrier to meet current criteria for crashworthiness may be the appropriate recommended treatment.

The typical reconstruction option used by the NPS for stone masonry guardwalls is to document then dismantle the existing barrier, construct a concrete core and build a stone masonry veneer around the concrete core using the original wall materials and using stone masonry designs that are compatible with the historic road, district or landscape. A number of concrete core stone masonry barrier types have been designed for use in national parks, including 18-in, 22-in, 24-in and 27-in barriers; however, not all have been crash tested or otherwise determined to meet current criteria for crashworthiness.

WORK ORDERS

Work order preparation is essentially determining and documenting the repair actions needed to correct the deficiencies observed during the condition assessment. Barriers are relatively simple structures so this determination can be made by trained inspectors. Keep in mind that this is not a design environment and that more rigorous analysis (if needed) may change the work that is actually performed. The intent of this effort is to prepare a credible estimate of deferred maintenance that may or may not be directly actionable. Simple repairs and/or those that require no compliance with environmental policies (which may be a large percentage of the work orders) can probably be executed without modification.

Once a repair strategy is determined, a cost must be developed for the proposed action. Work orders will be classified as being either deferred maintenance or capital improvement. This classification is based on the type of work recommended, as defined below.

Definition: *Deferred Maintenance* can be classified as repair or replace in kind. Work done to the barrier does not include any upgrading.

Definition: *Capital Improvement* can be classified as upgrading existing barrier. Typically the upgrade will be from a non-crashworthy to a crashworthy device. Other examples of capital improvements would be the addition of a curb to improve drainage or the inclusion of any countermeasure.

There are four types of work:

- No Action
- Monitor
- Repair
- Replace

"No Action" – if risk is low (based on the GIP risk score), a barrier that does not meet current crashworthy performance standards may be acceptable to remain until changes in risk factors would require upgrading.

"Monitor" – if risk is low (based on the GIP risk score), a barrier that does not meet current crashworthy performance standards may be acceptable to remain until changes in risk factors would require upgrading, however, if conditions exist that the park should monitor (e.g., erosion), then "monitor" can be selected as a recommended action.

"Repair" – considered when a barrier damaged by impact deteriorated due to age/weathering and the barrier is functionally sound in a low risk environment. The goal is to bring the barrier back to its "new" condition.

"Replacement/Reconstruction" – when a barrier poses an unacceptable safety risk:

1. If the risk score is less than 3 points above the risk threshold, determine if countermeasures can reduce risk so the barrier can be repaired.
2. Determine if the barrier is warranted and either shielded hazard or barrier itself can be removed (only when barrier NOT considered historically/culturally significant)

For all barrier repair/replace/reconstruction recommendations, the NPS will vet the recommendations through a project selection, planning and design process, including compliance with:

National Historic Preservation Act (NHPA)
National Environmental Policy Act (NEPA)

Aesthetic barriers are commensurate with an approved crashworthy design for the specific conditions at the barrier site as the basis for selecting a crashworthy structure. Types of barriers are generally selected based on emulating the existing types of barriers in the park.