

GIP Report

NPS Guardwall/Rail Inventory Program Grand Canyon National Park

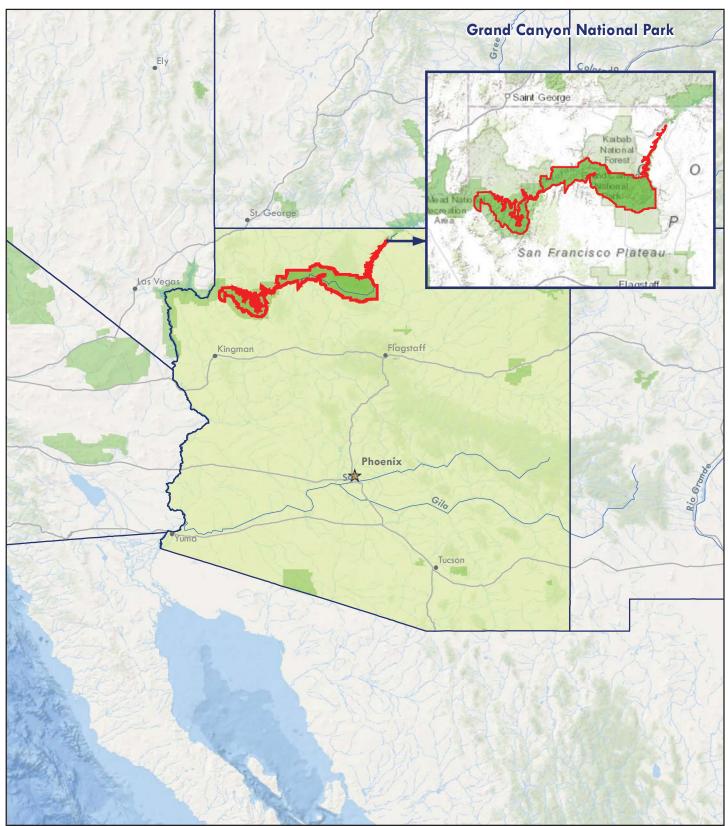




Federal Lands Highway Road Inventory Program Prepared By: Federal Highway Administration Eastern Federal Lands Highway Division Road Inventory Program (RIP)

Data Collection Date: October 2010 Report Date: November 2015

Grand Canyon National Park in Arizona



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 Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

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Introduction



Grand Canyon National Park



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.

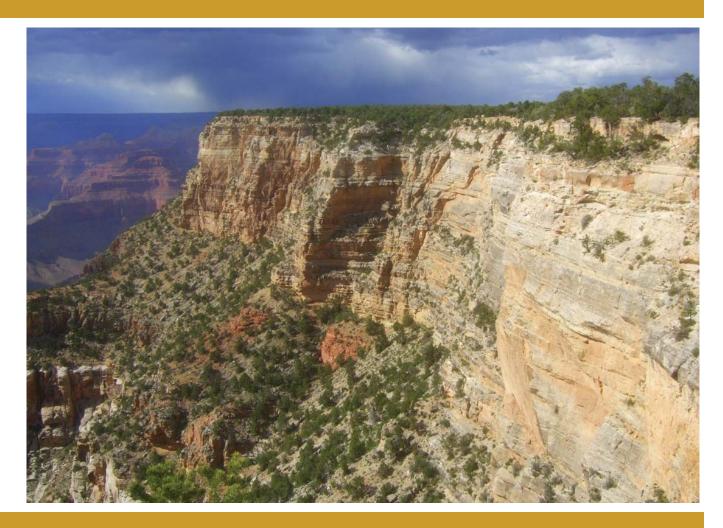
Drafted work orders have been classified as being either deferred maintenance or capital improvement. This classification is based on the type of work recommended, as defined below.

- *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 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

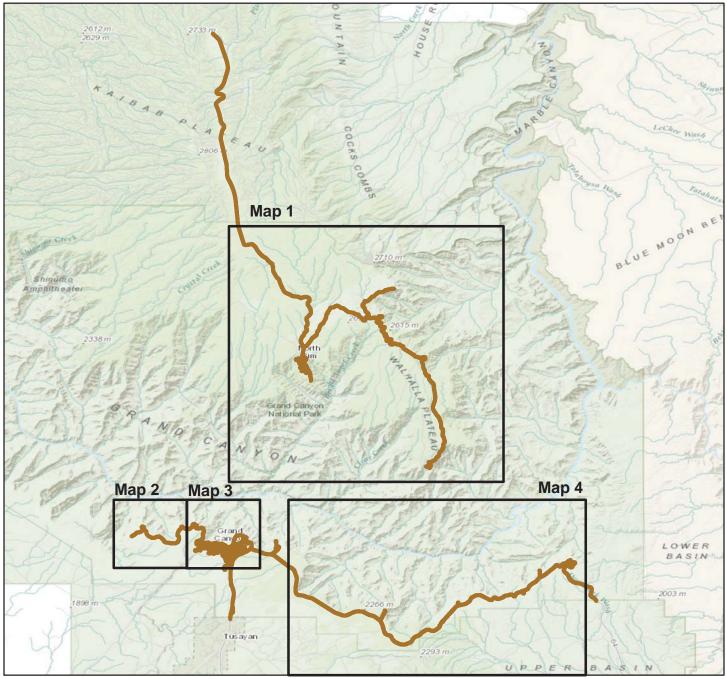


Grand Canyon National Park



BARRIER LOCATION MAP

Key Map



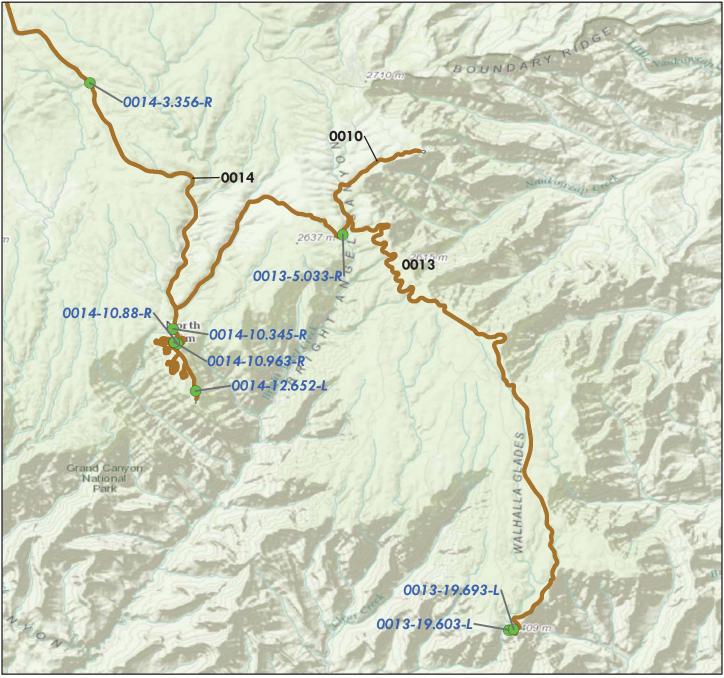
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

RIP Collected Routes



BARRIER LOCATION MAP

Map 1



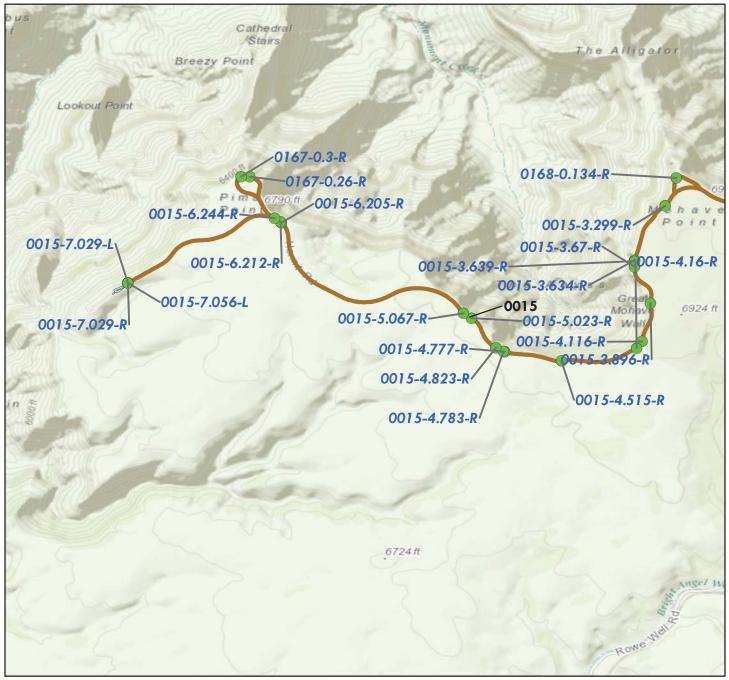
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations
 RIP Collected Routes



BARRIER LOCATION MAP

Map 2



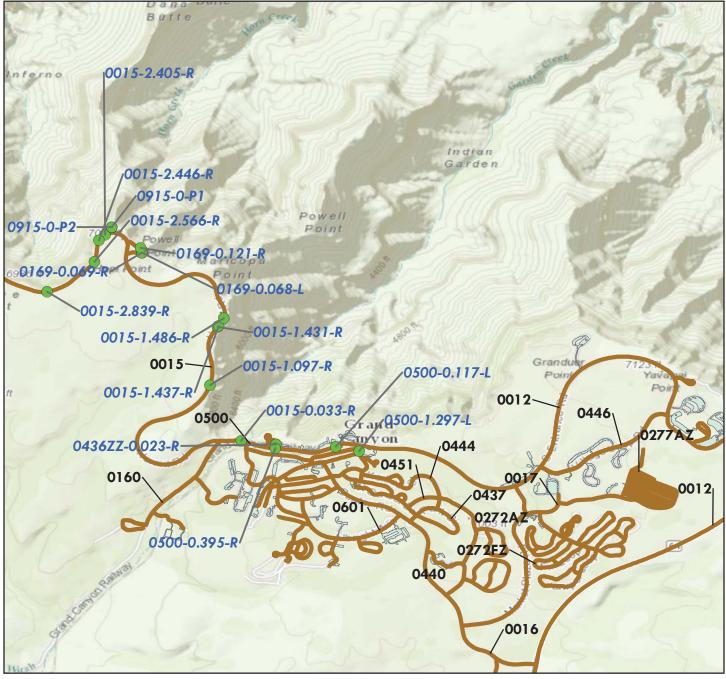
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community





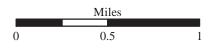
BARRIER LOCATION MAP

Map 3



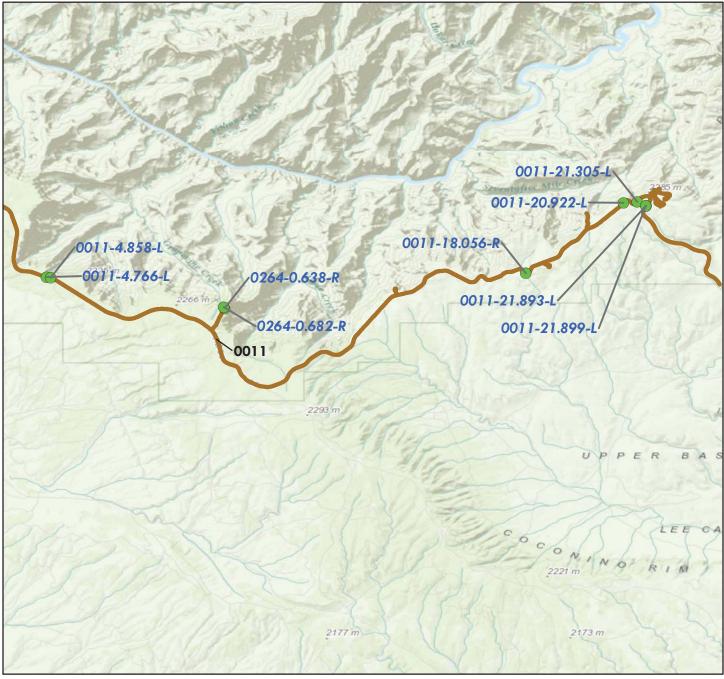
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations
 RIP Collected Routes



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





Tier 1 Park Barrier Overview



Grand Canyon National Park



Parkwide Summary: Grand Canyon National Park

Initial barrier inspections were conducted at Grand Canyon National Park in 2010, and encompassed all known barriers associated with Park roadways. In general, walls are not included in this assessment, but were inspected under a separate effort as part of the Retaining Wall Inventory Program (WIP).

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, 57 barriers were inventoried on the routes listed below.

Route Number	Route Name	No. of Barriers
0011	DESERT VIEW DRIVE	7
0013	CAPE ROYAL ROAD	3
0014	NORTH ENTRANCE ROAD (HWY 67)	5
0015	HERMIT REST ROAD	28
0167	PIMA POINT ROAD	2
0168	MOHAVE POINT ROAD	1
0169	POWELL MEMORIAL ROAD	3
0264	GRANDVIEW POINT ROAD	2
0436ZZ	BRIGHT ANGEL LOOP ROADS	1
0500	VILLAGE LOOP DRIVE	3
0915	HOPI POINT PARKING	2

Table 1: Number of Barriers by Route

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.

Barrier Function	No. of Barriers
TRAFFIC	45
NON-TRAFFIC	12

Table 2: Number of Barriers by Function

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

Primary Barrier Type	No. of Barriers
W-Beam Strong Post	8
Stone Masonry With Concrete Core Wall	2
Stone Masonry Without Concrete Core Wall	45
W-Beam Weak Post	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.

Recommended Action	Repair Costs*	No. of Barriers
No Action	\$0	10
Monitor	\$0	0
Repair	\$1,725,401	47
Replace	\$0	0
Totals	\$1,725,401	57

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

*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.

Cost Range*	No. of Barriers
\$0	10
\$1 - \$25,000	28
\$25,001 - \$50,000	9
\$50,001 - \$100,000	4
\$100,001 - \$250,000	6
\$250,001 - \$500,000	0
\$500,001 - \$1,000,000	0
\$1,000,001 - \$2,000,000	0
\$2,000,001 - \$3,000,000	0
\$3,000,001 - \$4,000,000	0
Total Number of Barriers	57

Table 5: Number of Barriers Grouped by Associated 2008 Cost

*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 16 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



Grand Canyon National Park



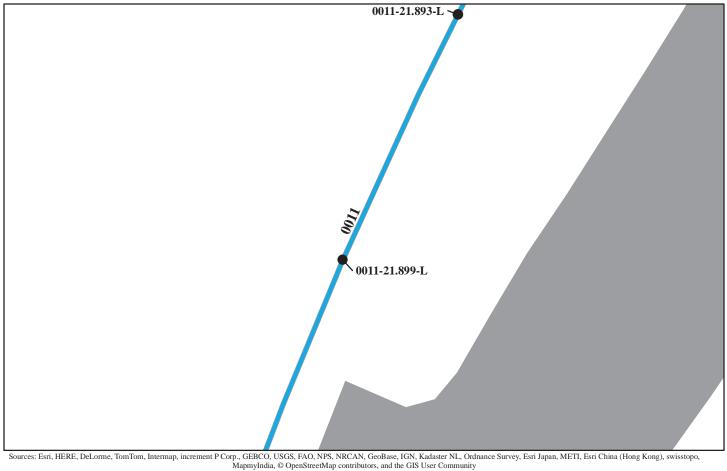
ROUTE 0011: DESERT VIEW DRIVE



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	Barrier Length	Barrier	Barrier End Treatment		*Repair	
Inspection Date	(Ft.)	Туре	Begin	End	Cost	
GRCA-0011-4.766-L 10/10/2010	172	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$6,848.00	
GRCA-0011-4.858-L 10/10/2010	102	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,931.00	
GRCA-0011-18.056-R 10/10/2010	490	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	\$1,755.00	
GRCA-0011-20.922-L 10/10/2010	446	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$1,755.00	
GRCA-0011-21.305-L 10/10/2010	532	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$1,789.00	
*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

ROUTE 0011: DESERT VIEW DRIVE



Barrier ID	Barrier Length	Barrier	Barrier En	Barrier End Treatment		
Inspection Date	(Ft.)	Туре	Begin	End	Cost	
GRCA-0011-21.893-L 10/10/2010	30	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00	
GRCA-0011-21.899-L 10/10/2010	30	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00	
*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

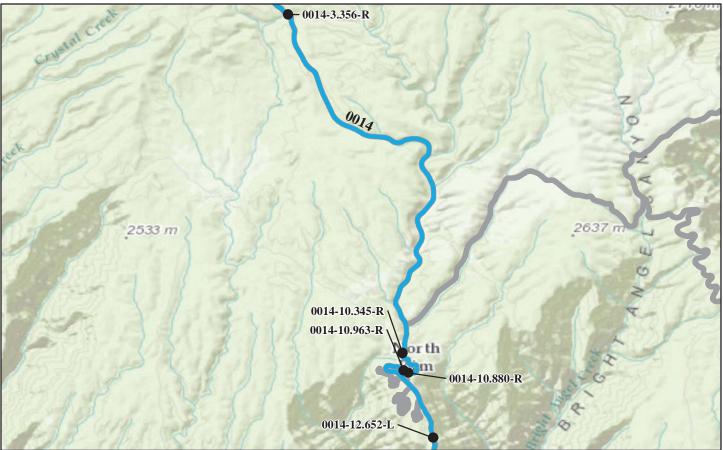
ROUTE 0013: CAPE ROYAL ROAD



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	Barrier Length	Barrier	Barrier End	Barrier End Treatment		
Inspection Date	(Ft.)	Туре	Begin	End	Cost	
GRCA-0013-5.033-R 10/11/2010	406	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$7,513.00	
GRCA-0013-19.603-L 10/11/2010	393	W-BEAM WEAK POST	NONE	NONE	\$12,045.00	
GRCA-0013-19.693-L 10/11/2010	243	W-BEAM WEAK POST	NONE	NONE	\$6,974.00	
*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

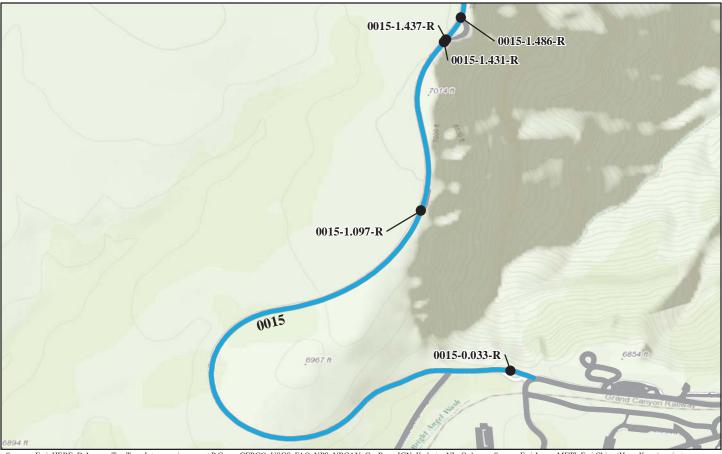
Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



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	Barrier Length	Barrier	Barrier End Treatment		*Repair	
Inspection Date	(Ft.)	Туре	Begin	End	Cost	
GRCA-0014-3.356-R 10/11/2010	382	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$5,022.00	
GRCA-0014-10.345-R 10/11/2010	502	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$2,349.00	
GRCA-0014-10.880-R 10/11/2010	311	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$3,351.00	
GRCA-0014-10.963-R 10/11/2010	760	W-BEAM STRONG POST	W-BEAM TANGENT 350 COMPLIANT	W-BEAM TANGENT 350 COMPLIANT	\$10,357.00	
GRCA-0014-12.652-L 10/11/2010	154	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$2,085.00	
*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

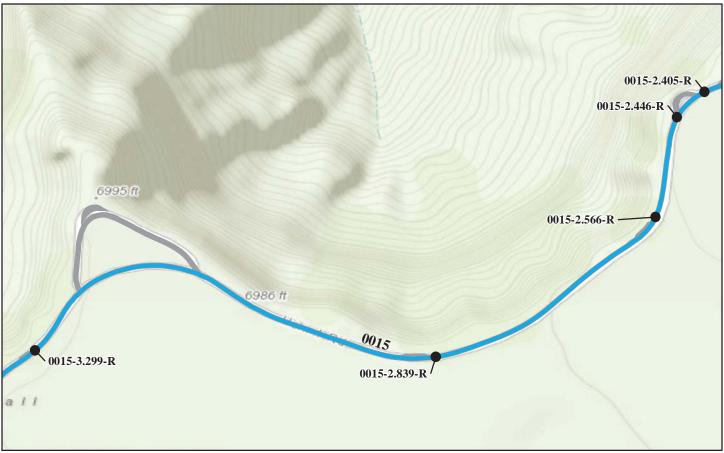
ROUTE 0015: HERMIT REST ROAD



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	Barrier Length	Barrier	Barrier End Treatment		*Repair	
Inspection Date	(Ft.)	Туре	Begin	End	Cost	
GRCA-0015-0.033-R 10/9/2010	32	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,777.00	
GRCA-0015-1.097-R 10/9/2010	73	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,777.00	
GRCA-0015-1.431-R 10/9/2010	157	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$30,690.00	
GRCA-0015-1.437-R 10/9/2010	178	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$35,090.00	
GRCA-0015-1.486-R 10/8/2010	111	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$29,590.00	
*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

ROUTE 0015: HERMIT REST 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	Barrier Length	Barrier	Barrier End	Treatment	*Repair
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0015-2.405-R 10/9/2010	85	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$32,769.00
GRCA-0015-2.446-R 10/9/2010	81	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$29,865.00
GRCA-0015-2.566-R 10/9/2010	188	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$36,465.00
GRCA-0015-2.839-R 10/9/2010	224	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$61,644.00
GRCA-0015-3.299-R 10/9/2010	121	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$58,108.00
	*2008 cost estimate (AS	STM Class D), preliminary for co	mparison to other repair cos	ts only.	

ROUTE 0015: HERMIT REST 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	Barrier Length	Barrier	Barrier End	l Treatment	*Repair			
Inspection Date	(Ft.)	Туре	Begin	End	Cost			
GRCA-0015-3.634-R 10/9/2010	36	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$18,618.00			
GRCA-0015-3.639-R 10/9/2010	177	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$2,723.00			
GRCA-0015-3.670-R 10/9/2010	37	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$19,443.00			
GRCA-0015-3.896-R 10/9/2010	190	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$44,413.00			
GRCA-0015-4.116-R 10/9/2010	63	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$3,097.00			
	*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.							

ROUTE 0015: HERMIT REST 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	Barrier Length	Barrier	Barrier End	Treatment	*Repair			
Inspection Date	(Ft.)	Туре	Begin	End	Cost			
GRCA-0015-4.160-R 10/9/2010	59	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$37,565.00			
GRCA-0015-4.515-R 10/9/2010	188	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$17,793.00			
GRCA-0015-4.777-R 10/8/2010	50	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$23,568.00			
GRCA-0015-4.783-R 10/8/2010	193	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00			
GRCA-0015-4.823-R 10/8/2010	45	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00			
	*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.							

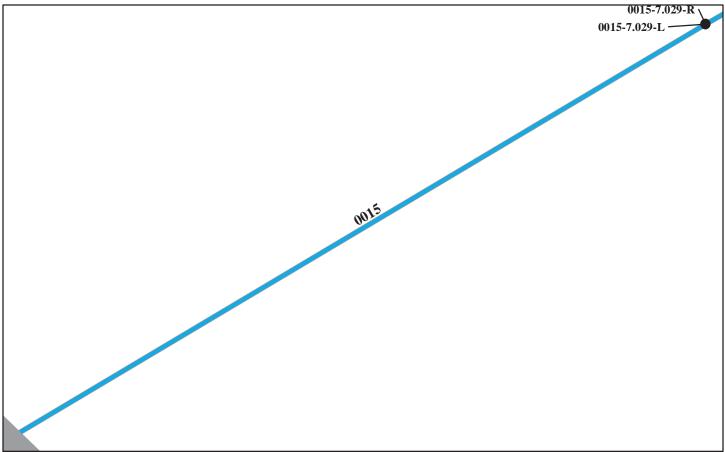
Grand Canyon National Park ROUTE 0015: HERMIT REST ROAD



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	er ID Barrier Length Barri		Barrier End Treatment		
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0015-5.023-R 10/8/2010	44	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$21,643.00
GRCA-0015-5.067-R 10/8/2010	41	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$20,818.00
GRCA-0015-6.205-R 10/8/2010	38	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$24,943.00
GRCA-0015-6.212-R 10/8/2010	187	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$112,750.00
GRCA-0015-6.244-R 10/8/2010	38	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$24,668.00
	*2008 cost estimate (AS	STM Class D), preliminary for comp	parison to other repair co	sts only.	1

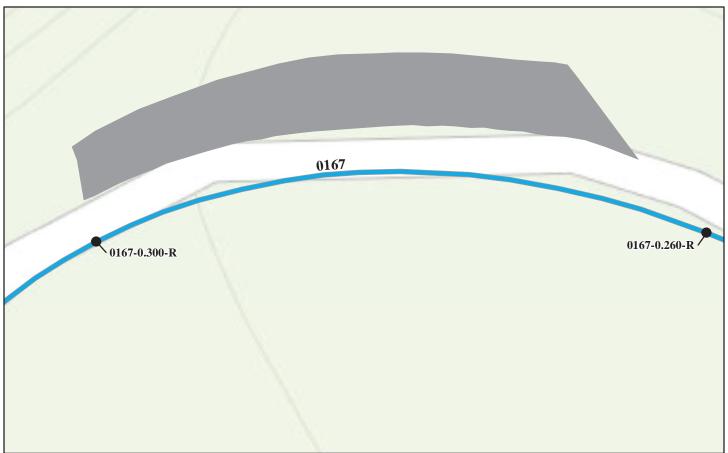
ROUTE 0015: HERMIT REST ROAD



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	Barrier Length	Barrier	Barrier End	Treatment	*Repair
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0015-7.029-L 10/8/2010	430	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$192,445.00
GRCA-0015-7.029-R 10/8/2010	144	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$52,333.00
GRCA-0015-7.056-L 10/8/2010	537	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$164,753.00
\$	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair cos	ts only.	

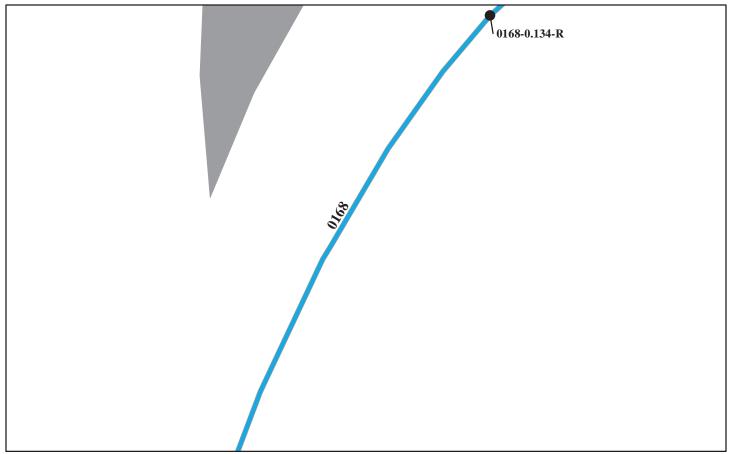
ROUTE 0167: PIMA POINT ROAD



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	Barrier Length	ngth Barrier Barrier End Treatment		*Repair	
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0167-0.260-R 10/8/2010	58	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$17,793.00
GRCA-0167-0.300-R 10/8/2010	33	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
;	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair cos	sts only.	

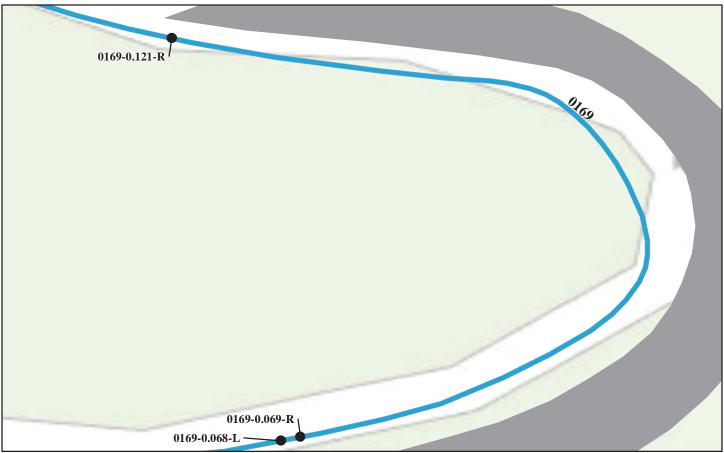
ROUTE 0168: MOHAVE POINT ROAD



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	Barrier Length	Barrier	Barrier En	d Treatment	*Repair
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0168-0.134-R 10/9/2010	72	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$46,943.00
;	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair co	sts only.	

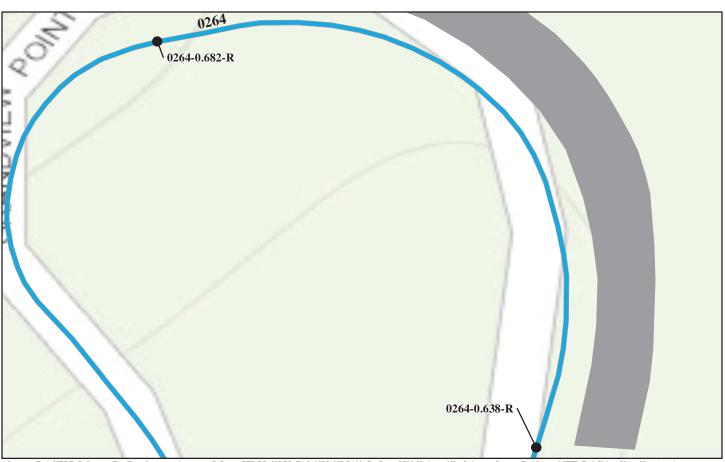
ROUTE 0169: POWELL MEMORIAL ROAD



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	Barrier Length Barrier Barrier End Treatment		*Repair		
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0169-0.068-L 10/9/2010	304	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
GRCA-0169-0.069-R 10/9/2010	53	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
GRCA-0169-0.121-R 10/9/2010	30	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair cos	sts only.	

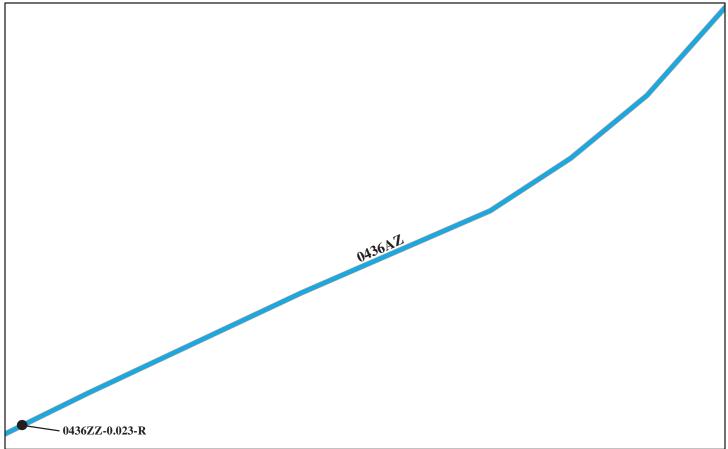
ROUTE 0264: GRANDVIEW POINT ROAD



Sources: Esri, HERE, DeLorme, TomTom, Internap, 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	Barrier Length	Barrier	Barrier En	d Treatment	*Repair
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0264-0.638-R 10/10/2010	13	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
GRCA-0264-0.682-R 10/10/2010	34	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$2,173.00
*	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair co	sts only.	

Grand Canyon National Park ROUTE 0436ZZ: BRIGHT ANGEL LOOP ROADS



Sources: Esri, HERE, DeLorme, TomTom, Internap, 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	Barrier Length	Barrier	Barrier En	d Treatment	*Repair				
Inspection Date	(Ft.)	Туре	Begin	End	Cost				
GRCA-0436ZZ-0.023-R 10/8/2010	85	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00				
*	*2008 cost estimate (AS	STM Class D), preliminary for co	*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.						

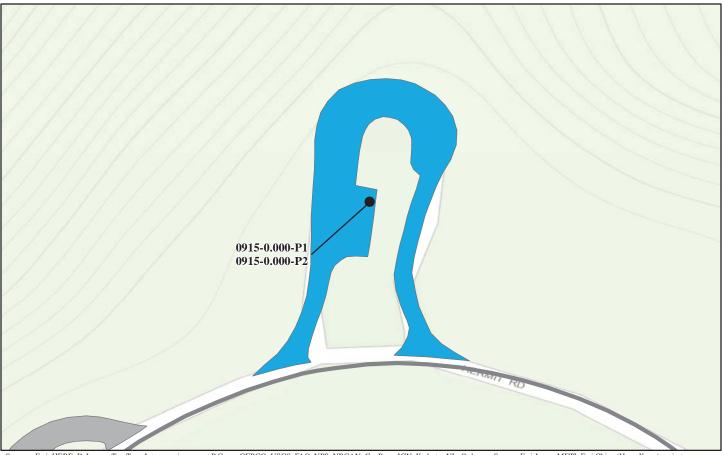
ROUTE 0500: VILLAGE LOOP DRIVE



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	8		Treatment	*Repair	
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0500-0.117-L 10/8/2010	960	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$177,557.00
GRCA-0500-0.395-R 10/8/2010	443	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$108,092.00
GRCA-0500-1.297-L 10/8/2010	157	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$11,924.00
	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair cos	ts only.	

Grand Canyon National Park ROUTE 0915: HOPI POINT PARKING



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	Barrier Length	Barrier			*Repair
Inspection Date	(Ft.)	Туре	Begin	End	Cost
GRCA-0915-0.000-P1 10/9/2010	0	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$134,613.00
GRCA-0915-0.000-P2 10/9/2010	0	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$63,184.00
,	*2008 cost estimate (AS	STM Class D), preliminary for co	omparison to other repair cos	sts only.	

Tier 3 Barrier Details



Grand Canyon National Park



Barrier ID:		GRCA-0011-4.766-L							
Route Name:		DESERT VIEW DRIVE							
Inspection Data		10/10/201	0	Barrier Rating:		58.70			
Inspection Date: 10		10/10/201	0	Darr	ier Kating:	38.70			
Barrier Description									
Туре:		STONE MASONRY WITHOUT CONCRETE CORE WALL		Barrier Function:		TRAFFIC			
Barrier Material:		STONE		Post Material:		N/A			
Blockout		N/A		Length (ft.):		172			
Вюской Туре:				Length (It.):		172			
Speed Limit (MPH):		45		Placement with Respect to Road:		TANGENT			
Hazard Behind	Hazard Behind Barrier:								
Barrier Crashwo	rth <u>iness</u>								
Appropriate Test Level:	TL-2		Barrier Test Level:	NCW		Is Barrier	NO		
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach	NONE		
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A		ion Type:			
Туре:			Crashhworthy?:						
Average Measure	ements								
Design Height (In.):	24		Width (In.):	26.7	Post Spa	cing (In.):	0.0		
Height (In.): 19.2			Lateral Offset (In.):	0.0	Road G	rade (%):	6.50		
Physical Condition	on								
	Align	Imment and Height:No deviation in barrier alignment was observed. Barrier was 4 to 6 in below 24 in design height for entire length of barrier.							
Barrier	Breaking and Cracking:		4 linear ft of barrier was destroyed by impact at beginning end. Grout was gone but stones remain stacked in place at end of barrier.						
	Missing Elements:		No missing elements were observed.						
		osion and eathering:	No corrosion or weathering was observed.						
	Align	ment and Height:							
End Treatments	Breaking and Cracking:								
	Missing 1	Elements:							
		osion and eathering:							

Barrier ID:		GRCA-0011-4.766-L									
Route Name:		DESERT VIEW DRIVE									
Inspection Date:		10/10/2010		Barrier Rating:		58.70					
Repair Recommendations											
Repair Action:	REPAIR			DEFERRED MAINTENANCE	Repair Cost:		\$6848				
Brief Workorder:	Remove and reset 4 linear feet of barrier to existing height.										
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 19 CF = 4750 . [(4ft)(2ft)(2.3ft)] = 18.4 CF. To repair damage at end of barrier. 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.											

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_4.766_L_1.JPG

Bar	rier ID:	GRCA-001	1-4.858-L					
	e Name:		VIEW DRIVE					
Inspectio	n Date:	10/10/201	0	Barri	er Rating:	41.40		
Barrier Description		10/10/2010		Daili	er Rating.	11.10		
	Type:		ASONRY WITHOUT E CORE WALL	Barrier	Function:	TRAFFIC		
Barrier M		STONE		Post	Material:	N/A		
В	Blockout Type:	N/A		L	ength (ft.):	102		
Speed Limit ((MPH):	45			ement with et to Road:			
Hazard Behind H	Barrier:	EXTREME						
Barrier Crashwort	thiness							
Appropriate Test T Level:	TL-2		Barrier Test Level:	NCW		Is Barrier worthy?:	NO	
Beg. End Trtmt N Type:	IONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE	
Ending End Trtmt N Type:	IONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measuren	nents							
	24		Width (In.):	25.0	Post Spa	cing (In.):	0.0	
Height (In.): 2	23.0		Lateral Offset (In.):	0.0	Road G	rade (%):	2.50	
Physical Condition	1							
	Align	ment and Height:						
Barrier		aking and Cracking:	2 ft of barrier had 1/2 in wi	de crack between rock and	mortar.			
I	Missing I	Elements:	No missing elements were	observed.				
		osion and eathering:	No corrosion or weathering	g was observed.				
	Align	ment and Height:						
End Treatments		aking and Cracking:						
Missing Elements:								
		osion and eathering:						

B	arrier ID:	GRCA-001	GRCA-0011-4.858-L							
Rou	ite Name:	DESERT	ESERT VIEW DRIVE							
Inspec	tion Date:	ate: 10/10/2010 Barrier Rating: 41.40								
Repair Recomme	endations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$19Work Type:MAINTENANCECost:							
Brief Workorder:	Repoint 2 sq	uare yards of 1	nortar.							
Workorder:Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 2 SY = \$280. $[(2ft)(2ft)(12ft)]/9 = 1.3$ SY. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	her repair co	sts only.				

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_4.858_L_1.JPG

Ba	rrier ID:	GRCA-001	1-18.056-R							
	te Name:		SERT VIEW DRIVE							
T (·	10/10/201	0		D ' D /'	27.00				
		10/10/201	0		Barrier Rating:	37.00				
Barrier Description	on									
	Туре:	W-BEAM S	STRONG POST		Barrier Function:	TRAFFIC				
Barrier I	Material:	WEATHER	RING	Post Material:		WOOD				
		STEEL/CO	RTEN							
	Blockout Type:	WOOD			Length (ft.):	490				
Speed Limi	t (MPH):	45			Placement with Respect to Road:	OUTSIDE	OF CURVE			
Hazard Behind	Barrier:	HIGH								
Barrier Crashwo	rthiness									
Appropriate Test Level:	TL-2		Barrier Test Level:	TL-3		Is Barrier worthy?:	YES			
Beg. End Trtmt Type:	W-BEAM I	BCT	Is Beg. End Trtmt Crashhworthy?:	NO		Approach ion Type:	NONE			
Ending End Trtmt Type:	W-BEAM I	ВСТ	Ending End Trtmt Crashhworthy?:	NO						
Average Measure	ements									
Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	74.3			
Height (In.):	28.7		Lateral Offset (In.):	28.2		rade (%):	4.10			
Physical Conditio	n									
	Align	ment and Height:	Two 10 ft sections had alig the 27 in design height.	nment less than 6	in off due to impact. He	eight was at or	up to 3 in above			
Barrier		aking and Cracking:	2 cracked blockouts were of	bserved.						
-	Missing	Elements:	2 missing blockouts were of	bserved.						
-		osion and eathering:	No corrosion or weathering	g was observed.						
	Align	ment and Height:	No deviation was observed design height.	l in alignment of e	end treatments and heigh	it was 0-3in. a	bove the 27-in			
End Treatments		aking and Cracking:	No breaking or cracking w	as observed.						
Missing Elements: No missing end treatment elements were observed.										
		osion and eathering:	No corrosion or weathering	g was observed.						

Ba	arrier ID:	GRCA-0011-18.056-R								
Rou	ite Name:	DESERT	DESERT VIEW DRIVE							
Inspect	spection Date: 10/10/2010 Barrier Rating: 37.00									
Repair Recomme	endations	;								
Repair Action:	REPAIR		FMSSDEFERREDRepairWork Type:MAINTENANCECost:							
Brief Workorder:	Replace 4 blo	eplace 4 blockouts.								
Workorder:	orkorder: Replace Block at \$30- per -Each for 4 Block(s) = \$120. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.									
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	her repair co	osts only.				

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_18.056_R_1.JPG

Ba	arrier ID:	GRCA-001	1-20.922-L					
	ite Name:	DESERT	VIEW DRIVE					
Inspace	ion Doto.	10/10/201	0		Barrier Rating:	38.70		
		10/10/2010	0		Darrier Katilig.	58.70		
Barrier Descripti		WDEAM	TRONC DOST	р		TRAFFIC		
	Туре:	W-BEAM S	STRONG POST	B POST Barrier Function :		TRAFFIC		
Barrier	Material:	WEATHER STEEL/CO			Post Material:	WOOD		
	Blockout Type:	WOOD			Length (ft.):	446		
Speed Limi	t (MPH):	45		R	Placement with Respect to Road:	OUTSIDE	OF CURVE	
Hazard Behind	Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-2		Barrier Test Level:	TL-3		Is Barrier worthy?:	YES	
Beg. End Trtmt Type:	W-BEAM TANGENT	350	Is Beg. End Trtmt YES Approach					
Ending End Trtmt Type:	W-BEAM TANGENT	350	Ending End Trtmt Crashhworthy?:	YES				
Average Measure	ements							
Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	74.6	
Height (In.):	28.0		Lateral Offset (In.):	39.7	Road G	rade (%):	2.50	
Physical Condition	n							
	Align	ment and Height:	No deviation was observed design height.	l in barrier alignmen	t. Height of barrier wa	as 1 in below t	to 3 in above 27 in	
Barrier		aking and Cracking:	No breaking or cracking w	as observed.				
	Missing 1	Elements:	Two tilted blocks and two	loose bolts were obs	served.			
		osion and eathering:	Minimal corrosion/weather was observed.	ring of barrier eleme	ents and no erosion to c	compromise st	ability of posts	
	Align	ment and Height:	No deviation was observed 27-in design height.	l in alignment of end	d treatments. End treat	tments were 0-	3in. above the	
End Treatments		aking and Cracking:	No cracked or broken end	treatment elements v	were observed.			
	Missing 1	Elements:	No missing end treatment e	No missing end treatment elements were observed.				
		osion and eathering:	Minimal corrosion/weather	ring of end treatmen	t elements was observe	ed.		

B	arrier ID:	GRCA-001	GRCA-0011-20.922-L							
Rou	ite Name:	DESERT	ESERT VIEW DRIVE							
Inspec	pection Date: 10/10/2010 Barrier Rating: 38.70									
Repair Recomme	endations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$Work Type:MAINTENANCECost:							
Brief Workorder:	Right tilted b	olocks and tigh	ten loose bolts.							
Workorder: Labor at \$60- per -Hour for 2 Hrs = \$120. Labor to right tilted blocks and tighten loose bolts. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to ot	her repair co	osts only.				

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_20.922_L_1.JPG

B	arrier ID:	GRCA-001	1-21.305-L					
	ite Name:		VIEW DRIVE					
Terrar	tion Data	10/10/201	0	D	ier Rating:	43.00		
	tion Date:	10/10/201	0	Bari	ier Rating:	43.00		
Barrier Descripti								
	Туре:	W-BEAM	STRONG POST	Barrie	r Function:	TRAFFIC		
Barrier	Material:	WEATHEF	RING	Pos	st Material:	WOOD		
Durrier		STEEL/CO		10.	, iviater iai.			
	Blockout	WOOD		I	Length (ft.):	532		
	Type:	4.5				OUTGIDE		
Speed Lim	it (MPH):	45			ement with ect to Road:	OUTSIDE	OF CURVE	
Hazard Behind	d Barrier:	EXTREME	2			I		
Barrier Crashwo	rthiness	1						
Appropriate Test	1		Barrier	TL-3		Is Barrier	YES	
Level:			Test Level:			worthy?:		
Beg. End Trtmt			Is Beg. End Trtmt	YES	NONE			
Type:	TANGENT	350	Crashhworthy?:		Transit	tion Type:		
Ending End Trtmt Type:	W-BEAM TANGENT	350	Ending End Trtmt Crashhworthy?:	YES				
Average Measure								
Design Height (In.):	27		Width (In.):	0.0	Post Sna	cing (In.):	75.3	
Height (In.):	27.2		Lateral Offset (In.):	44.0		rade (%):	4.60	
Physical Condition	on							
		ment and Height:	No deviation in barrier alig	nment was observed. Bar	rier was within	1 in of 27 in d	esign height.	
		aking and	1 block was broken in half					
Barrier		Cracking:						
	Missing	Elements:	4 blocks had loose bolts.					
	Corre	osion and	No corrosion or weathering	z was observed.				
		eathering:						
	A 12	montand	No deviation in aligneet (of and traction	amund Fund to a	0	2in above the	
	Align	ment and Height:	No deviation in alignment 27-in design height.	of end treatments was obs	erved. End treat	ments were 0-	3in. above the	
End Treatments		aking and Cracking:	No breaking or cracking was observed.					
	Missing	Elements:	No missing end treatment of	elements were observed.				
		osion and eathering:	No corrosion or weathering	g was observed.				

B	arrier ID:	GRCA-001	RCA-0011-21.305-L								
Rou	ite Name:	DESERT	DESERT VIEW DRIVE								
Inspection Date: 10/10/2010 Barrier Rating: 43.00											
Repair Recomme	endations										
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$1789				
Brief Workorder:	Replace one	broken block a	and tighten bolts for four blo	ocks.							
Workorder:	Workorder:Replace Block at \$30- per -Each for 1 Block(s) = \$30. Labor at \$60- per -Hour for 2 Hrs = \$120. Labor to tighten loose bolts. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	her repair co	osts only.					

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_21.305_L_1.JPG

B	arrier ID:	GRCA-001	1-21.893-L				
	ute Name:		VIEW DRIVE				
Ingree	tion Data:	10/10/201	0	Dat	rier Rating:	4.10	
		10/10/201	0	Dar	rier Kating:	4.10	
Barrier Descript							
	Туре:		ASONRY WITH E CORE WALL	Barri	er Function:	NON-TRA	FFIC
Barrier	Material:	CONCRET		Po	ost Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	30	
Speed Lim		25		Pla	cement with	NON-TRA	FFIC BARRIER
Speed Lini	n (1911 11).	23			ect to Road:		
Hazard Behind	d Barrier:	N/A					
Barrier Crashwo	orthiness						
Appropriate Test	TL-1		Barrier	N/A		Is Barrier	N/A
Level:			Test Level:		Crasl	worthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Type: Ending End Trtmt	NONE		Ending End Trtmt	N/A		ion Type:	
Type:	HOILE		Crashhworthy?:	11/11			
Average Measur	ements						
Design Height (In.):	27		Width (In.):	19.0	Post Spa	cing (In.):	0.0
Height (In.):	27.0		Lateral Offset (In.):	0.0		rade (%):	0.00
Physical Condition	on						
	Align	ment and Height:	No deviation in barrier alig which was assumed based		arrier was at the 2	7 in design he	ight throughout
		aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing	Elements:	No missing elements were	observed.			
	Corre	osion and	No corrosion or weathering	z was observed			
		eathering:					
	A 1:	montand					
	Align	ment and Height:					
End Treatments		aking and Cracking:					
End I cathlents		UI UUNIIIZI					
	Missing	Elements:					
	Corrr	osion and					
	We	eathering:					

Ba	arrier ID:	ID: GRCA-0011-21.893-L								
Rou	ite Name:	DESERT	DESERT VIEW DRIVE							
Inspect	Inspection Date: 10/10/2010 Barrier Rating: 4.10									
Repair Recomme	endations	;								
Repair Action:	NO ACTIC	DN	FMSS Work Type:	N/A		Repair Cost:	\$0			
Brief Workorder:	N/A									
Workorder:										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for compari	son to other repair co	osts only.				

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_21.893_L_1.JPG

B	arrier ID:	GRCA-001	1-21.899-L							
	ute Name:		SERT VIEW DRIVE							
Increase	tion Deter	10/10/201	/10/2010 Barrier Rating: 4.10							
		10/10/201	0	Da	rrier Kating:	4.10				
Barrier Descript										
	Туре:		ASONRY WITH E CORE WALL	Barr	ier Function:	NON-TRA	FFIC			
Barrier	Material:	CONCRET		Р	ost Material:	N/A				
	Blockout Type:	N/A			Length (ft.):	30				
Speed Lim		25		PI	acement with	NON-TRA	FFIC BARRIER			
Speed Lini	n (1911 11).	20			pect to Road:					
Hazard Behind	d Barrier:	N/A								
Barrier Crashwo	orthiness									
Appropriate Test	TL-1		Barrier	N/A		Is Barrier	N/A			
Level:			Test Level:		Crast	worthy?:				
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach ion Type:	NONE			
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A		ion Type:				
Type:	HOILE		Crashhworthy?:	11/21						
Average Measur	ements									
Design Height (In.):	27		Width (In.):	19.0	Post Spa	cing (In.):	0.0			
Height (In.):	27.0		Lateral Offset (In.):	0.0		rade (%):	0.00			
Physical Condition	on									
	Align	ment and Height:	No deviation in barrier alig which was assumed based		Barrier was at the 2	7 in design he	ight throughout			
		aking and	No breaking or cracking w	as observed.						
Barrier		Cracking:								
	Missing	Elements:	No missing elements was o	observed.						
	Corr	osion and	No corrosion or weathering	g was observed.						
		eathering:								
	Alian	ment and								
	Align	Height:								
End Treatments		aking and Cracking:								
		g.								
	Missing	Elements:								
	Corrr	osion and								
	We	eathering:								

B	arrier ID:	GRCA-0011-21.899-L								
Rou	ite Name:	DESERT	ESERT VIEW DRIVE							
Inspect	tion Date:	10/10/201	0		Barrier Rating:	4.10				
Repair Recomme	endations	5								
Repair Action:	NO ACTIC	DN	FMSS Work Type:	N/A		Repair Cost:	\$0			
Brief Workorder:	N/A									
Workorder:										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for compa	rison to other repair co	sts only.				

ROUTE 0011: DESERT VIEW DRIVE



GRCA_0011_21.899_L_1.JPG

Ba	arrier ID:	GRCA-001	3-5.033-R				
Rou	ite Name:	CAPE RO	YAL ROAD				
Inspect	tion Date:	11/10/201	0		Barrier Rating:	36.90	
Barrier Descripti		11/10/201			During		
	Туре:	W-BEAM	STRONG POST	В	arrier Function:	TRAFFIC	
Barrier	Material:	WEATHEF STEEL/CO			Post Material:	WOOD	
	Blockout Type:	WOOD			Length (ft.):	406	
Speed Limi	it (MPH):	35		I	Placement with Respect to Road:	BOTH INS	IDE AND OUTSIDE
Hazard Behind	Barrier:	HIGH					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-2		Barrier Test Level:	TL-3		Is Barrier worthy?:	YES
Beg. End Trtmt Type:	W-BEAM TANGENT	350	Is Beg. End Trtmt Crashhworthy?:	YES		Approach ion Type:	NONE
Ending End Trtmt Type:	W-BEAM TANGENT	350	Ending End Trtmt Crashhworthy?:	YES			
Average Measure	ements						
Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	75.6
Height (In.):	26.7		Lateral Offset (In.):	12.6	Road G	rade (%):	5.60
Physical Condition	on						
	Align	ment and Height:	No deviation was observed within 1 in of the 27 in des		nent. 1 post was over 1	2 in off alignr	nent. Height was
Barrier		aking and Cracking:	18 ft of a 24 ft rail section	was severely bent.			
	Missing 3	Elements:	4 missing blockouts were of	bserved.			
		osion and eathering:	Erosion greater than 8 in w asphalt shoulder.	as observed around	one post that has unde	rcut the post a	nd portion of
	Align	ment and Height:	No deviation was observed 27-in design height.	in alignment of end	d treatments. End treat	ments were w	ithin 1 in of the
End Treatments		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	No corrosion or weathering	g was observed.			

B	arrier ID:	GRCA-001	3-5.033-R						
Rou	ite Name:	CAPE RO	YAL ROAD						
Inspec	tion Date:	11/10/201	0	Barrie	r Rating:	36.90			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$75		
Brief Workorder:	<u>^</u>	*	ace 1 bent post replace 4 mis rrier to control erosion.	ssing blocks fill eroded section	on with 6 CY	of backfill and	l install 230 ft of		
Workorder:	Workorder: Replace Rail at \$25- per -Lin. Ft. for 24 LF = \$600. Replace 24 foot bent rail section. Replace Post at \$100- per -Each for 1 Post(s) = \$100. Replace one misaligned post. Replace Block at \$30- per -Each for 4 Block(s) = \$120. Structural Backfill at \$50- per -Cu. Yd. for 6 CY = \$300. Fill in eroded section. Asphalt Curb at \$12- per -Lin. Ft. for 230 LF = \$2760. Construct curb along barrier to divert water. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950. 1 day for rail elements 1 day for asphalt curb and backfill.								
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	her repair co	osts only.			

ROUTE 0013: CAPE ROYAL ROAD

Barrier Condition Photos



GRCA_0013_5.033_R_1.JPG



GRCA_0013_5.033_R_2.JPG

Ba	arrier ID:	GRCA-001	3-19.603-L					
Rou	te Name:	CAPE RO	YAL ROAD					
Inspect	ion Date.	11/10/201	0	I	Barrier Rating:	55.90		
Barrier Descripti		11/10/201		-	barrier Rating.	55.90		
	Туре:	W-BEAM	WEAK POST Barrier Function:		TRAFFIC			
Barrier	Material:	GALVANI	ZED STEEL		Post Material:	WOOD		
	Blockout Tvpe:				Length (ft.):	393		
Speed Limi	t (MPH):	35			Placement with espect to Road:	OUTSIDE	OF CURVE	
Hazard Behind	Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-2		Barrier Test Level:	TL-2		Is Barrier worthy?:	YES	
Beg. End Trtmt Type:			Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	27		Width (In.):	0.0		cing (In.):	150.6	
Height (In.):	23.0		Lateral Offset (In.):	20.2	Road G	rade (%):	6.90	
Physical Conditio		ment and Height:						
Barrier		aking and Cracking:	90 percent of one post was	burnt away.				
	Missing	Elements:	2 barrier reflectors were de	tached and near barri	er.			
		osion and eathering:	No corrosion or weathering front of barrier.	g was observed. Veg	etation was growing o	over barrier. I	Debris was piled in	
	Align	ment and Height:						
End Treatments		aking and Cracking:						
	Missing 1	Elements:						
		osion and eathering:						

Bar	rrier ID:	GRCA-001	3-19.603-L						
Route	e Name:	CAPE RO	YAL ROAD						
Inspectio	on Date:	11/10/201)	Barriei	r Rating:	55.90			
Repair Recommen	idations								
Repair R Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$12045		
	Raise 393-ft of	1	o 27-in design height replace	e 1 post reattach 2 barrier ref	lectors and rea	move vegetatio	n and debris		
R L L	Workorder:Adjust Guardrail at \$10- per -Lin. Ft. for 393 LF = \$3930. Raise 393-ft of barrier up to 27-in design height. Replace Post at \$100- per -Each for 1 Post(s) = \$100. Labor at \$60- per -Hour for 1 Hrs = \$60. Reattach 2 barrier reflectors. Labor at \$60- per -Hour for 16 Hrs = \$960. Remove vegetation and debris from in front of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 2 days to raise barrier 2 days for remaining work.								
				ary for comparison to oth					

Grand Canyon National Park ROUTE 0013: CAPE ROYAL ROAD



GRCA_0013_19.603_L_1.JPG

Ba	arrier ID:	GRCA-001	3-19.693-L					
Rou	ite Name:	CAPE RO	YAL ROAD					
Inspect	tion Date:	11/10/201	0	Ba	rrier Rating:	46.00		
Barrier Descripti		11/10/201			, in the second second			
	Туре:	W-BEAM	WEAK POST	Barr	ier Function:	TRAFFIC		
Barrier	Material:	GALVANI	ZED STEEL	F	ost Material:	WOOD		
	Blockout Type:	N/A			Length (ft.):	243		
Speed Lim	it (MPH):	35			acement with pect to Road:	OUTSIDE	OF CURVE	
Hazard Behind	l Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-2		Barrier Test Level:	TL-2		Is Barrier worthy?:	YES	
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	27		Width (In.):	0.0		cing (In.):	151.0	
Height (In.):	23.2		Lateral Offset (In.):	28.7	Road G	rade (%):	7.20	
Physical Condition		ment and Height:	No deviation was observed in barrier alignment. Height of barrier was 2 to 3 in below the 27 in design height for 118 ft and 3 to 6 in below for 125 ft. No evidence of impact was observed.					
Barrier		aking and Cracking:	No cracked or broken barri from the barrier face.	er elements were obser	ved. Some plastic	reflectors have	e come detached	
	Missing]	Elements:	No missing barrier elemen	ts were observed.				
		osion and eathering:	No corrosion of galvanized moderate weathering of wo		aint is peeling from	the rail in sor	ne locations with	
	Align	ment and Height:						
End Treatments		aking and Cracking:						
	Missing 1	Elements:						
		osion and eathering:						

B	arrier ID:	GRCA-001	3-19.693-L						
Rou	ite Name:	CAPE RO	YAL ROAD						
Inspec	tion Date:	11/10/201	0	Barrie	r Rating:	46.00			
Repair Recomme	endations	;							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$6974		
Brief Workorder:	Raise 243 fee	et of guardrail	to 27 inch design height ren	nove vegetation and debris fi	rom face of ba	arrier and reatta	ach reflectors.		
Workorder:	Workorder: Adjust Guardrail at \$10- per -Lin. Ft. for 243 LF = \$2430. Raise 243-ft of guardrail to 27 in design height. Labor at \$60- per -Hour for 16 Hrs = \$960. Remove vegetation and debris from face of barrier and re-attach reflectors. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950.								
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	her repair co	osts only.			

ROUTE 0013: CAPE ROYAL ROAD



GRCA_0013_19.693_L_1.JPG

Barrier ID:GRCA-0014-3.356-RRoute Name:NORTH ENTRANCE ROAD (HWY 67)Inspection Date:11/10/2010Barrier Rating:Barrier Description35.50W-BEAM STRONG POSTBarrier Function:TRAFFICBarrier Material:WEATHERING STEEL/CORTENPost Material:WOODBlockout Type:WOODLength (ft.):382	
Barrier Description Type: W-BEAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft.): 382	
Barrier Description Type: W-BEAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft.): 382	
Type:W-BEAM STRONG POSTBarrier Function:TRAFFICBarrier Material:WEATHERING STEEL/CORTENPost Material:WOODBlockoutWOODLength (ft.):382	
Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft.): 382	
STEEL/CORTEN Blockout WOOD Length (ft.): 382	
Speed Limit (MPH): 45 Placement with Respect to Road: INSIDE OF CURVE	
Hazard Behind Barrier: HIGH	
Barrier Crashworthiness	
Appropriate Test Level:TL-2Barrier Test Level:TL-3Is Barrier Crashworthy?:YES	
Beg. End TrtmtW-BEAMIs Beg. End TrtmtYESApproachNONEType:TANGENT 350Crashhworthy?:Transition Type:NONE	
Ending End TrtmtW-BEAMEnding End TrtmtYESType:TANGENT 350Crashhworthy?:	
Average Measurements	
Design Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 75.0	
Height (In.): 26.2 Lateral Offset (In.): 23.7 Road Grade (%): 2.10	
Physical Condition	
Alignment and Height:No deviation was observed in barrier alignment. Height was 1 to 3 in below 27 in design height 178 ft while the remaining height was within 1 in of the 27 in design height.	nt for
Barrier Breaking and Cracking: 5 blocks were cracked through.	
Missing Elements: 6 missing barrier reflectors and 1 missing post were observed.	
Corrrosion and Weathering: Concrete curb was eroded and missing for 12 linear ft.	
Alignment and Height: No deviation was observed in alignment of end treatments. The beginning end treatment was 1 below 27 in design height.	to 3 in
Breaking and Cracking: One broken post was observed on beginning end treatment.	
Missing Elements: No missing elements were observed.	
Corrosion and Weathering: No corrosion or weathering was observed.	

B	arrier ID:	GRCA-001	4-3.356-R						
Rou	ite Name:	NORTH E	ENTRANCE ROAD (H	IWY 67)					
						25.50			
Inspec	tion Date:	11/10/201	0	Barrie	er Rating:	35.50			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$5022		
Brief Workorder:	Raise 178 fee missing refle	1	to the 27 inch design heigh	t replace 5 cracked blocks 2	posts 12ft. of	eroded concre	te curb and 6		
Workorder:	Workorder: Adjust Guardrail at \$10- per -Lin. Ft. for 178 LF = \$1780. Raise 178 feet to 27 inch design height. Replace Block at \$30- per -Each for 5 Block(s) = \$150. Replace Post at \$100- per -Each for 2 Post(s) = \$200. Concrete Curb at \$20- per -Lin. Ft. for 12 LF = \$240. Replace eroded curb. Labor at \$60- per -Hour for 2 Hrs = \$120. Replace missing reflectors. Barrier Reflectors at \$100- per -Each for 6 Unit(s) = \$600. Install 6 reflectors to replace missing ones. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.								
				ary for comparison to oth	ier repair co	sts only.			

Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



GRCA_0014_3.356_R_1.JPG

Route Name: NORTH ENTRANCE ROAD (HWY 67) Inspection Date: 11/10/2010 Barrier Rating: 26.80 Barrier Description Type: W-BAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING Post Material: WOOD Bockout WEATHERING Post Material: WOOD Bockout WOOD Length (ft,): 592 Bockout WOOD Length (ft,): 592 Speed Limit (MPH): 35 Placement with Respect to Road: Barrier II-2 Barrier II-3 Is Beg.End Trunt Type: VES Approach NONE Level: Level: Transition Type: Transition Type: NONE Crashworthy?: Transition Type: Ending End Trunt Type: TANGENT 350 Crashworthy?: Transition Type: Post Spacing (In,): 74.6 Besign Height (ft,): 27 Width (In,): 0.0 Post Spacing (In,):	B	arrier ID:	GRCA-001	4-10.345-R						
Barrier Description Type: W-BEAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft.): 502 Speed Limit (MPH): 35 Placement with OUTSIDE OF CURVE Respect to Road: OUTSIDE OF CURVE Respect to Road: Barrier Crashworthiness TL-2 Test Level: Crashworthy?: Appropriate Test Level: TL-3 Is Barrier Test Level: Transition Type: Beg. End Trunt Type: TANGENT 350 Crashworthy?: Transition Type: Ending End Trunt Type: VES Approach NONF Type: Transition Type: Crashworthy?: Transition Type: Average Measurements Crashworthy?: Crashworthy?: 4.80 Physical Condition No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. No deviation in barrier alignment was observed. 4.80 Physical Condition Alignment and Height: S post mounted definations: 3 post mounted definations: 5.0 Corrrosion and Weathe					HWY 67)					
Barrier Description Type: W-BEAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft.): 502 Speed Limit (MPH): 35 Placement with OUTSIDE OF CURVE Respect to Road: OUTSIDE OF CURVE Respect to Road: Barrier Crashworthiness TL-2 Test Level: Crashworthy?: Appropriate Test Level: TL-3 Is Barrier Test Level: Transition Type: Beg. End Trunt Type: TANGENT 350 Crashworthy?: Transition Type: Ending End Trunt Type: VES Approach NONF Type: Transition Type: Crashworthy?: Transition Type: Average Measurements Crashworthy?: Crashworthy?: 4.80 Physical Condition No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. No deviation in barrier alignment was observed. 4.80 Physical Condition Alignment and Height: S post mounted definations: 3 post mounted definations: 5.0 Corrrosion and Weathe		tion Dotos	11/10/201	0		Douriou Doting	26.80			
Type: W-BEAM STRONG POST Barrier Function: TRAFFIC Barrier Material: WEATHERING STEEL/CORTEN Post Material: WOOD Blockout WOOD Length (ft,): 502 Speed Limit (MPH): 35 Placement with OUTSIDE OF CURVE Respect to Road: OUTSIDE OF CURVE Respect to Road: Barrier Crashworthiness Appropriate Test Level: TL-2 Barrier Test Level: Is Barrier Crashworthy?: YES Beg.End Trimt W-BEAM Type: TaxGENT 350 Ending End Trimt Crashworthy?: NONE Transition Type: Posign Height (In): 27 Width (In,): 0.0 Post Spacing (In,): 74.6 Height (In): 28.2 Lateral Offset (In,): 65.3 Road Grade (%): 4.80 Physical Condition Modivation in barrier algoment was observed. Barrier beight ranged from 0.3in, above the 27-in Height: design height. 4.80 Barrier Missing Elements: 3 post mounted defineators were observed. Barrier beight ranged from 0.3in, above the 27-in Height: design height. Breaking and Corrrosion and Weathering: No deviation in end restment alignment was observed. End treatments were 0-3in, above			11/10/201	0		Barrier Rating:	20.80			
Barrier Material: WEATHERING STEFL/CORTEN Post Material: WOOD Blockout WOOD Length (ft,): 502 Speed Limit (MPH): 35 Placement with Respect to Road: OUTSIDE OF CURVE. Hazard Behind Barrier: HIGH Barrier Tr-3 Is Barrier Frest. Beg. End Trimt U-2 Barrier Tr-3 Is Barrier YES Level: Test Level: Crashworthy?: Transition Type: NONE Type: TANGENT 350 Crashworthy?: Transition Type: NONE Fading End Trimt W-BEAM Is Beg. End Trimt YES Approach NONE Type: TANGENT 350 Crashworthy?: Transition Type: NONE Average Measurements Ending End Trimt YES Approach NONE Design Height (In.): 28.2 Lateral Offset (In.): 6.3 Road Grade (%): 4.80 Physical Condition Missing Elements: 3 post mounted delineators were observed. Barrier reflectors Cracking: Missing Elements: 3 post mounted delineators were observed. End treatments were 0-3in. above the 27-in Height: Alignment and Veathering: No corrosion or weathering was observed. End treatments were 0-3in. above the 27-in <th>Barrier Descript</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	Barrier Descript									
STEEL/CORTEN Length (ft.): 502 Blockout WOOD Length (ft.): 502 Speed Limit (MPH): 35 Placement with Respect to Road: OUTSIDE OF CURVE Barrier HIGH Barrier Ft.3 It.3 It.3 OUTSIDE OF CURVE Barrier East It.2 Barrier TL.3 It.8 Barrier YES Beg. End Trimit W-BEAM Is Beg. End Trimit YES Approach NONE Ending Ead Trimit W-BEAM Is Beg. End Trimit YES Approach NONE Transition Type: TANGENT 350 Crashbworthy?: Transition Type: NONE Average Measurements Ending Ead Trimit YES Associal (fn.): 74.6 Height (fn.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. Barrier Alignment and Cracking: No deviation in eatire ralignment was observed. Hourier reflectors		Туре:	W-BEAM S	BIRONG POST Barrier Function:		TRAFFIC				
Type: Type: Speed Limit (MPI): 35 Hazard Behind Barrie: HIGH Barrier Crashworthiness HIGH Barrier Crashworthiness Test Level: Appropriate Test Level: TL-2 Beg. End Trum Type: W-BEAM Transition Type: TL-3 Beg. End Trum Type: W-BEAM Transition Type: NONE TANGENT 350 Crashhworthy?: Transition Type: Poign Height (In): 27 Width (In): 0.0 Poign Height (In): 28.2 Lateral Offset (In): 65.3 Road Grade (%): 4.80 Physical Condition Alignment and Height: No deviation in hair's alignment was observed. Barrier height ranged from 0-3in, above the 27-in design height. Barrier Alignment and Weathering: No deviation in hair's alignment was observed. Barrier height ranged from 0-3in, above the 27-in design height. Barrier Alignment and Weathering: No deviation in hair's a minor dents were observed in w-beam railing. 4 barrier reflectors Missing Elements: No corrosion or weathering was observed. End treatments were 0-3in above the 27-in design height. Fand Treatments Breaking and Weathering: No deviation in end treatment alignment was observed. End treatments were 0-3in above the 27-in design height. End Treatments Breaking and Corrosion ard No deviation	Barrier	Material:			Post Material: WOOD					
Respect to Road: HIGH Barrier Crashworthiness TL-2 Barrier Test Level: Crashworthy: Beg. End Trintt W-BEAM Is Beg. End Trintt YES Approach NONE Type: TANGENT 350 Ending End Trintt YES Approach NONE Crashbworthy? Crashbworthy? Crashbworthy? Crashbworthy? Crashbworthy? NONE Ending End Trintt W-BEAM Ending End Trintt YES Approach NONE Crashbworth? Crashbworth?? O Post Spacing (In.): 74.6 Beign Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition Barrier Alignment and Height: No deviation in barrier alignment was observed. Barrier beight no.9-3in. above the 27-in design beight. Breaking and Cracking: No deviation in end treatment alignment was observed. Barrier beight no.9-3in. above the 27-in design beight. <th <="" colspan="2" th=""><th></th><th colspan="3"></th><th></th><th>Length (ft.):</th><th>502</th><th></th></th>	<th></th> <th colspan="3"></th> <th></th> <th>Length (ft.):</th> <th>502</th> <th></th>							Length (ft.):	502	
Barrier Crashworthiness Appropriate Test Level: TL-2 Barrier Test Level: TL-3 Is Barrier Crashworth?: YES Beg. End Trtmt Type: W.BEAM Is Beg. End Trtmt TANGENT 350 Is Beg. End Trtmt Crashhworth?: YES Approach Transition Type: NONE Ending End Trtmt Type: TANGENT 350 Ending End Trtmt Crashhworth?: YES Approach Transition Type: NONE Average Measurements Ending End Trtmt Crashhworth?: VES Aso 74.6 Design Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition No deviation in barrier alignment was observed. Barrier height ranged from 0-3in, above the 27-in Height: design height. Barrier Alignment and Vere bent and flattened. No deviation in end treatment alignment was observed. In webeam railing. 4 barrier reflectors Were bent and flattened. Corrrosion and Weathering: No corrosion or weathering was observed. End treatments were 0-3in, above the 27-in Height. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment illted.	Speed Lim	it (MPH):	35		F		OUTSIDE	OF CURVE		
Appropriate Test Level: TL-2 Barrier Test Level: TL-3 Is Barrier Crashworthy?: YES Beg. End Trtmt Type: TANGENT 350 Is Beg. End Trtmt Crashhworthy?: YES Approach Transition Type: NONE Ending End Trtmt Type: V=BEAM TANGENT 350 Ending End Trtmt Crashhworthy?: YES Transition Type: Average Measurements Ending End Trtmt Tangent (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. 6 blocks were broken in half: 3 minor dents were observed in w-beam railing. 4 barrier reflectors were ben and flattened. is post mounted delineators were broken off and missing. Barrier Missing Elements: 3 post mounted delineators were broken off and missing. is post mounted delineators were broken off and missing. End Treatments Alignment and Height: No deviation in end treatment alignment was observed. End treatments were 0-3in, above the 27-in design height. End Treatments Missing Elements: No deviation in end treatment alignment was observed. End treatments were 0-3in, above the 27-in	Hazard Behine	d Barrier:	HIGH							
Level: Test Level: Crashworthy?: Beg. End Trrmt W-BEAM Type: Is Beg. End Trrmt YES Approach Transition Type: NONE Ending End Trrmt W-BEAM Type: Ending End Trrmt YES Transition Type: NONE Average Measurements Crashhworthy?: YES Image: Crashworthy?: NONE Design Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition Modeviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were ber and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No deviation in end treatment alignment was observed. End treatments were 0-3in. above the 27-in design height. End Treatments Alignment and Height: No deviation in end treatment alignment was observed. Weathering: No deviation in end treatment alignment was observed. End treatment tilted. Missing Elements:	Barrier Crashwo	rthiness								
Type: TANGENT 350 Crashhworthy?: Transition Type: Ending End Tritmt Type: W-BEAM TANGENT 350 Ending End Tritmt Crashhworthy?: YES Average Measur====================================		TL-2			TL-3			YES		
Type: TANGENT 350 Crashhworthy?: Average Measurements Design Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition Alignment and Height: No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. Barrier Alignment and Cracking: were borken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No corrosion or weathering was observed. End Treatments Breaking and Cracking: Missing Elements: No deviation in end treatment alignment was observed. End treatment tilted. Corrrosion and No corrosion or weathering was observed. End treatment tilted. Missing Elements: No missing elements were observed. Missing Elements: No corrosion or weathering was observed.	e e e e e e e e e e e e e e e e e e e		350		YES			NONE		
Design Height (In.): 27 Width (In.): 0.0 Post Spacing (In.): 74.6 Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition Barrier Alignment and Height: No deviation in barrier alignment was observed. Barrier height ranged from 0-3in, above the 27-in design height. Breaking and Cracking: 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No deviation in end treatment alignment was observed. End treatments were 0-3in, above the 27-in design height. End Treatments Alignment and Height: No deviation in end treatment alignment was observed. End treatments titled. Gorrrosion and Weathering: No deviation in end treatment alignment was observed. End treatments were 0-3in, above the 27-in design height. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. In missing elements were observed.					YES					
Height (In.): 28.2 Lateral Offset (In.): 65.3 Road Grade (%): 4.80 Physical Condition Alignment and Height: No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. Barrier Breaking and Cracking: 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were ben and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No deviation in end treatment alignment was observed. End Treatments Breaking and Cracking: Missing Elements: No missing elements were observed. Missing Elements: No deviation in end treatment alignment was observed. End Treatments Breaking and Cracking: Missing Elements: No missing elements were observed. Missing Elements: No missing elements were observed.	Average Measur	ements								
Physical Condition Alignment and Height: No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. Barrier Breaking and Cracking: 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No deviation in end treatment alignment was observed. End Treatments Breaking and Cracking: Boreaking and Corrosion or weathering was observed. Bolt was pulled loose from post leaving beginning end treatment tilted. End Treatments Missing Elements: No missing elements were observed. Missing Elements: No missing elements were observed.	Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	74.6		
Alignment and Height: No deviation in barrier alignment was observed. Barrier height ranged from 0-3in. above the 27-in design height. Breaking and Cracking: 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No deviation in end treatment alignment was observed. Breaking and Cracking: No deviation in end treatment alignment was observed. End treatment silted. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. No missing elements were observed.	Height (In.):	28.2		Lateral Offset (In.):	65.3	Road G	rade (%):	4.80		
Barrier Height: design height. Breaking and Cracking: 6 blocks were broken in half. 3 minor dents were observed in w-beam railing. 4 barrier reflectors were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No deviation in end treatment alignment was observed. End treatments were 0-3in. above the 27-in design height. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements: were observed. No missing elements were observed.	Physical Condition	on								
Barrier Cracking: were bent and flattened. Missing Elements: 3 post mounted delineators were broken off and missing. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No deviation in end treatment alignment was observed. End treatments were 0-3in. above the 27-in design height. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. Mo orrosion or weathering was observed.		Align								
Informing Definition Informing Definition Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No deviation in end treatment alignment was observed. End treatments were 0-3in. above the 27-in design height. Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. Corrrosion and No corrosion or weathering was observed.	Barrier		0		lf. 3 minor dents w	ere observed in w-bear	m railing. 4 ba	arrier reflectors		
Weathering: Weathering: Alignment and Height: No deviation in end treatment alignment was observed. End treatments were 0-3in. above the 27-in design height. End Treatments Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. No missing elements were observed.		Missing]	Elements:	3 post mounted delineators	were broken off an	d missing.				
End Treatments Height: design height. Breaking and Cracking: Bolt was pulled loose from post leaving beginning end treatment tilted. Missing Elements: No missing elements were observed. Corrrosion and No corrosion or weathering was observed.				No corrosion or weathering	g was observed.					
End Treatments Cracking: Missing Elements: No missing elements were observed. Corrrosion and No corrosion or weathering was observed.		Align			ent alignment was o	bserved. End treatmen	nts were 0-3in	. above the 27-in		
Corrrosion and No corrosion or weathering was observed.	End Treatments			Bolt was pulled loose from	post leaving beginr	ning end treatment tilte	:d.			
		Missing	Elements:	No missing elements were observed.						
weathering:			osion and eathering:	No corrosion or weathering	g was observed.					

B	arrier ID:	GRCA-001	4-10.345-R						
Rou	ite Name:	NORTH E	ENTRANCE ROAD (H	IWY 67)					
Inspect	tion Date:	11/10/201	0	Barrier	· Rating:	26.80			
Repair Recomme	endations	;							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$2349		
Brief Workorder:	Replace 6 blo	ocks straighter	a 4 bent barrier reflectors rep	place 3 post mounted delineat	ors and repla	ce bolt.			
Workorder:	Workorder: Replace Block at \$30- per -Each for 6 Block(s) = \$180. Labor at \$60- per -Hour for 1 Hrs = \$60. Labor to straighten barrier reflectors. Delineators on Curve and Tangent at \$100- per -Each for 3 Unit(s) = \$300. Replace 3 missing post mounted delineators. Labor at \$60- per -Hour for 2 Hrs = \$120. Replace bolt and adjust tilted end treatment. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.								
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	er repair co	osts only.			

Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



GRCA_0014_10.345_R_1.JPG

B	arrier ID:	GRCA-001	4-10.880-R					
	ite Name:		ENTRANCE ROAD (F	IWY 67)				
	(**** D *		×	,		27.00		
		11/10/201	0	Barı	ier Rating:	27.00		
Barrier Descripti	ion					l		
	Туре:	W-BEAM	STRONG POST	Barrier	· Function:	TRAFFIC		
Barrier	Material:	WEATHER STEEL/CO		Pos	t Material:	WOOD		
	Blockout WOOD Type:			L	ength (ft.):	311		
Speed Lim	it (MPH):	25			ement with ct to Road:	INSIDE OF	F CURVE	
Hazard Behind	d Barrier:	HIGH						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	TL-3		Is Barrier worthy?:	YES	
Beg. End Trtmt Type:	W-BEAM TANGENT	350	Is Beg. End Trtmt Crashhworthy?:	YES		Approach	NONE	
Ending End Trtmt	W-BEAM TANGENT	350	Ending End Trtmt Crashhworthy?:	YES				
Average Measur	ements							
Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	74.0	
Height (In.):	26.0		Lateral Offset (In.):	17.0		rade (%):	5.50	
Physical Condition	on							
	Align	ment and Height:	No deviation was observed for 257 ft and was 1 to 3 in	-	height was with	hin 1 in of the	27 in design height	
Barrier		aking and Cracking:	27 linear ft of rail was torn	. 13 linear ft of rail had mi	nor bending fro	om impact.		
	Missing	Elements:	No missing barrier elemen	er elements were observed.				
		osion and eathering:	Minimal corrosion/weather	ring of rails and posts obser	eved with 1 crac	eked blockout.		
	Align	ment and Height:	No deviation was observed design height.	in alignment of end treatm	nents and height	t was within 1	in of the 27 inch	
End Treatments		aking and Cracking:	No cracked or broken end	treatment elements were ob	oserved.			
	Missing 1	Elements:	No missing end treatment of	elements were observed.				
		osion and eathering:	Minimal corrosion/weather	ring of end treatment eleme	ents was observe	ed.		

B	arrier ID:	GRCA-001	4-10.880-R						
Rou	ite Name:	Name: NORTH ENTRANCE ROAD (HWY 67)							
Inspection Date: 11/10/2010				Barrier Rating: 27.00					
Repair Recomme	endations	;							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$3351		
Brief Workorder:	Replace 40 f	eet of rail raise	e 54 feet of guardrail up to th	e 27 inch design height and	replace one b	lock.			
Workorder:	Workorder: Replace Rail at \$25- per -Lin. Ft. for 40 LF = \$1000. Replace 40 feet of torn and bent rail. Adjust Guardrail at \$10- per -Lin. Ft. for 54 LF = \$540. Raise 54-ft of guardrail to 27 in design height. Replace Block at \$30- per -Each for 1 Block(s) = \$30. Replace one cracked block. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.								
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	her repair co	osts only.			

Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



GRCA_0014_10.880_R_1.JPG

B	arrier ID:	GRCA-001	4-10.963-R									
	ite Name:	NORTH E	GRCA-0014-10.963-R NORTH ENTRANCE ROAD (HWY 67)									
Tagara	tion Datas	11/10/2014	Barrier Rating: 30.80									
		11/10/201	0		barrier Kating:	30.80						
Barrier Descripti				_								
	Туре:	W-BEAM S	STRONG POST	B	arrier Function:	TRAFFIC						
Barrier	Material:	WEATHEF STEEL/CO			Post Material:	WOOD						
	Blockout Type:	WOOD		Length (ft.):		760						
Speed Lim	it (MPH):	25]	Placement with Respect to Road:	BOTH INS	IDE AND OUTSIDE					
Hazard Behine	d Barrier:	MEDIUM										
Barrier Crashwo	rthiness											
Appropriate Test Level:	TL-1		Barrier Test Level:	TL-3		Is Barrier worthy?:	YES					
Beg. End Trtmt Type:	W-BEAM TANGENT	350	Is Beg. End Trtmt Crashhworthy?:	YES		Approach ion Type:	NONE					
Ending End Trtmt Type:	W-BEAM TANGENT	350	Ending End Trtmt Crashhworthy?:	YES								
Average Measure	ements											
Design Height (In.):	27		Width (In.):	0.0	Post Spa	cing (In.):	75.0					
Height (In.):	26.0		Lateral Offset (In.):	24.0	Road G	rade (%):	4.90					
Physical Condition	on											
	Align	ment and Height:	Alignment was off by grea Height was 1 to 3 ines belo for the remaining length.		-	-						
Barrier		aking and Cracking:	4 separate rails were bent a alignment.	nd/or ripped for a t	otal of 91 linear ft of ra	il sections. O	ne post bent off					
	Missing	Elements:	Two missing blockouts and	16 missing barrier	reflectors/post delineato	ors were obser	ved.					
		osion and eathering:	No corrosion or weathering	g was observed.								
	Align	ment and Height:	No deviation was observed design height.	in alignment of en	d treatments and height	t was within 1	in of the 27 in					
End Treatments		aking and Cracking:	No breaking or cracking w	as observed.								
	Missing	Elements:	No missing elements were	observed.								
		osion and eathering:	No corrosion or weathering	g was observed.								

Ba	arrier ID:	rier ID: GRCA-0014-10.963-R							
Rou	ite Name:	NORTH E	NTRANCE ROAD (H	IWY 67)					
Inspect	tion Date:	11/10/201)	Barrie	r Rating:	30.80			
Repair Recomme	endations								
Repair	REPAIR		FMSS	DEFERRED		Repair	\$10357		
Action:			Work Type:	MAINTENANCE		Cost:			
Brief	Raise 305 fee	aise 305 feet of guardrail to 27-in design height adjust 38 feet of misaligned guardrail replace 91 feet of rail 1 post 2 blocks							
Workorder:	and 6 delinea	ators.							
Workorder:	Adjust Guard	drail at \$10- pe	er -Lin. Ft. for 343 LF = \$34	30. Raise 343 feet of barrier	to 27-in desig	n height.			
	Replace Rail	at \$25- per -L	in. Ft. for 91 LF = \$2275. R	eplace 91 feet of torn rail.					
	Replace Post	at \$100- per -	Each for 1 Post(s) = 100 . F	Replace 1 bent post.					
	Replace Bloc	eplace Block at \$30- per -Each for 2 Block(s) = \$60. Replace 2 missing blocks.							
	Delineators of	lineators on Curve and Tangent at \$100- per -Each for 6 Unit(s) = \$600. Replace 6 missing delineators.							
	Low Speed 7	Traffic Control	at \$1475- per -Day for 2 Da	ay(s) = \$2950.					
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	ier repair co	sts only.			

Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



GRCA_0014_10.963_R_1.JPG

Ba	arrier ID:	GRCA-001	4-12.652-L					
	te Name:	NORTH E	ENTRANCE ROAD (H	IWY 67)				
Inspect	tion Date:	11/10/201	0	Barrier Rating: 21.50				
Barrier Descripti								
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		NON-TRAFFIC		
Barrier	Material:	STONE		Post Material:		N/A		
	Blockout Type:	N/A			Length (ft.):	154		
Speed Limi	it (MPH):	15			lacement with spect to Road:	NON-TRA	FFIC BARRIER	
Hazard Behind	Barrier:	N/A						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A	
Туре:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	24		Width (In.):	23.0		cing (In.):	0.0	
Height (In.):	19.2		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00	
Physical Condition								
	Align	ment and Height:	No deviation in barrier alig design height.	nment was observed.	Barrier height was b	between 4 to 6	in below the 24 in	
Barrier		aking and Cracking:	No breaking or cracking w	as observed.				
	Missing	Elements:	No missing elements were	observed.				
		osion and eathering:	3 square yards of missing/o	leteriorated mortar wit	h stones displaced v	vas observed.		
	Align	ment and Height:						
End Treatments		aking and Cracking:						
	Missing	Elements:						
		osion and eathering:						

B	arrier ID:	ier ID: GRCA-0014-12.652-L								
Rou	ite Name:	Name: NORTH ENTRANCE ROAD (HWY 67)								
Inspec	tion Date:	11/10/201	0	Barrie	r Rating:	21.50				
Repair Recomme	endations	;								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$2085			
Brief Workorder:	Repoint 3 sq	uare yards of 1	nissing mortar to reset displ	aced stones.						
Workorder:		e-Point Masonry Barrier at \$140- per -Sq. Yd. for 3 SY = \$420. Repoint to reset displaced stones. bw Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.								
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ier repair co	osts only.				

Grand Canyon National Park ROUTE 0014: NORTH ENTRANCE ROAD (HWY 67)



GRCA_0014_12.652_L_1.JPG

Ba	rrier ID:	GRCA-001	5-0.033-R				
Rou	te Name:	HERMIT	REST ROAD				
Inspecti	ion Date:	09/10/201	0	Ba	rrier Rating:	28.20	
Barrier Description				-			
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC	
Barrier N	Material:	STONE		F	ost Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	32	
Speed Limit		15		Placement with Respect to Road:		OUTSIDE	OF CURVE
Hazard Behind	Barrier:	HIGH					
Barrier Crashwor	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:			Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ments						
	24		Width (In.):	23.0		cing (In.):	0.0
	26.0		Lateral Offset (In.):	34.7	Road G	rade (%):	1.50
Physical Conditio		ment and Height:	No deviation was observed design height.	in barrier alignment.	Γhe height ranged f	rom 0-3in. ab	ove the 27-in
Barrier		aking and Cracking:	One stone was displaced 1	to 3 in with broken mo	rtar.		
-	Missing 1	Elements:	No missing elements were	observed.			
-		osion and eathering:	One joint had missing/dete	riorated mortar.			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing l	Elements:					
		osion and eathering:					

B	arrier ID:	ier ID: GRCA-0015-0.033-R							
Rou	ite Name:	HERMIT REST ROAD							
Inspec	tion Date:	09/10/201	0	Barrie	r Rating:	28.20			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$1777		
Brief Workorder:	Repoint 1 SY	of barrier and	l realign one stone.						
Workorder:		e-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = 140 . [(1.9ft)(1ft) + (2.2ft)(1ft)(2ft)]/9 = 0.7 SY. ww Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.							
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ier repair co	osts only.			



GRCA_0015_0.033_R_1.JPG

Ba	arrier ID:	GRCA-001	5-1.097-R				
	ite Name:	HERMIT	REST ROAD				
Inspect	ion Data.	09/10/201	0	Rarr	ier Rating:	8.60	
Barrier Descripti		07/10/201	·		ici ixatilig.	3.00	
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		NON-TRAFFIC	
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A		I	length (ft.):	73	
Speed Limi	it (MPH):	25			ement with ct to Road:	NON-TRA	FFIC BARRIER
Hazard Behind	Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Beg. End Trtmt Type:			Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.2		cing (In.):	0.0
Height (In.):	20.0		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00
Physical Condition		ment and Height:	No deviation was observed height throughout.	in barrier alignment. The	barrier height v	vas 4 in below	the 24 in design
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	1 square ft of missing/deter observed including minor l compromising stability of	ess than 1/4 in wide cracks			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing	Elements:					
		osion and eathering:					

B	arrier ID:	ier ID: GRCA-0015-1.097-R							
Rou	ite Name:	HERMIT REST ROAD							
Inspect	tion Date:	09/10/201	0	Barrie	r Rating:	8.60			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$1777		
Brief Workorder:	Repoint 1 sq	uare yard of m	issing mortar.						
Workorder:		e-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = $140. [(1ft)(1ft)]/9 = 0.1$ SY. ow 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.								



GRCA_0015_1.097_R_1.JPG

B	arrier ID:	GRCA-001	15-1.431-R				
	ite Name:		REST ROAD				
Inspec	tion Date:	00/10/201	0	Da	rrier Rating:	50.00	
		09/10/201	0	Da	rrier Kating:	30.00	
Barrier Descripti							
	Туре:		ASONRY WITHOUT TE CORE WALL	Barr	ier Function:	TRAFFIC	
Barrier	Material:	STONE		P	ost Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	157	
Speed Lim		25		PI	acement with	OUTSIDE	OF CURVE
	n (1911 11).	20			pect to Road:	OUTSIDE	OF CORVE
Hazard Behind	d Barrier:	EXTREME	8				
Barrier Crashwo	rthiness						
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO
Level:			Test Level:		Crast	nworthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Type: Ending End Trtmt	NONE		Ending End Trtmt	N/A		ion Type.	
Type:	110112		Crashhworthy?:				
Average Measur	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0
Height (In.):	17.7		Lateral Offset (In.):	16.0		rade (%):	1.20
Physical Condition	on						
	Align	ment and Height:	No deviation in barrier alig linear ft and 3 to 6 in below		3arrier was 7 in bel	low 24 in desig	gn height for 63
	Bre	aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing	Elements:	No missing elements were	observed			
	wiissing	Elements.					
		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and					
		Height:					
	Bre	aking and					
End Treatments		Cracking:					
	Missing	Elements:					
		osion and eathering:					

B	arrier ID:	rier ID: GRCA-0015-1.431-R							
Rou	ite Name:	HERMIT	HERMIT REST ROAD						
Inspec	tion Date:	Date: 09/10/2010 Barrier Rating: 50.00							
Repair Recomme	endations	;							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$30690	
Brief Workorder:	Raise guardv 18-in height.		ove and reset 63-ft of stone	masonry guardwall on 1 row	of new stone	to raise barrie	er to the adjacent		
Workorder:	'korder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 56 CF = \$14000. [(.5ft)(1.75ft)(63ft)] = 55.2 CF. Remove top layer of stones in barrier for 63ft. New Stones at \$250- per -Each for 32 Unit(s) = \$8000. [(63ft) / (2ft/stone) x 1 row]= 32 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation.								
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ier repair co	sts only.			



GRCA_0015_1.431_R_1.JPG

Ba	arrier ID:	GRCA-001	5-1.437-R				
	ite Name:	HERMIT	REST ROAD				
Inspect	tion Date.	09/10/201	0	Rarri	ier Rating:	17.10	
Barrier Descripti		07,10,201	• 		ier manning.		
	Туре:		ASONRY WITHOUT Barrier E CORE WALL		Function:	NON-TRA	FFIC
Barrier	Material:	STONE		Pos	t Material:	N/A	
	Blockout Type:	N/A		L	ength (ft.):	178	
Speed Limi	it (MPH):	25			ement with et to Road:	NON-TRA	FFIC BARRIER
Hazard Behind	Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Beg. End Trtmt Type:			Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.7		cing (In.):	0.0
Height (In.):	18.0		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00
Physical Condition							
	Align	ment and Height:	No deviation was observed ft and 5 to 6 in below for 1	-	height was 7 in	below 24 in d	lesign height for 75
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing	Elements:					
		osion and eathering:					

B	arrier ID:	rier ID: GRCA-0015-1.437-R							
Rou	ite Name:	HERMIT	IERMIT REST ROAD						
Inspect	tion Date:	Den Date: 09/10/2010 Barrier Rating: 17.10							
Repair Recomme	endations	5							
Repair Action:	REPAIR	AIRFMSSDEFERREDRepair\$3509Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardv 18-in height.		ove and reset 75-ft of stone	masonry guardwall on 1 row	of new stone	to raise barrier	to the adjacent		
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 66 CF = 16500 . [(0.5ft)(1.75ft)(75ft)] = 65.6 CF. Remove top layer of stones in barrier for 75 feet. New Stones at \$250- per -Each for 38 Unit(s) = 9500 . [(75ft) / (2ft/stone) x 1 row]= 38 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation.								
				ary for comparison to oth					



GRCA_0015_1.437_R_1.JPG

Ba	arrier ID:	GRCA-001	5-1.486-R				
Rou	ite Name:	HERMIT	REST ROAD				
Inspect	ion Data.	08/10/201	0		Barrier Rating:	48.40	
Barrier Descripti		00/10/201	0		Darrier Rating.	10.10	
Darrier Descripti		GTONE M		п		TRAFFIC	
	Туре:		ASONRY WITHOUT TE CORE WALL	L R	Sarrier Function:	IKAFFIC	
Barrier	Material:	STONE			Post Material:	N/A	
	Blockout Type:	N/A		Length (ft.): 111			
Speed Limi	it (MPH):	25			Placement with Respect to Road:	OUTSIDE	OF CURVE
Hazard Behind	Barrier:	HIGH				1	
Barrier Crashwo	rthi <u>ness</u>						
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0
Height (In.):	17.0		Lateral Offset (In.):	16.0		rade (%):	0.50
Physical Condition	on						
	Align	ment and Height:	No deviation was observed height for 51 ft and 6 to 10	-	-	as 4 to 6 in bel	low the 24-in design
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing barrier elemen	ts were observed.			
		osion and eathering:	Minor cracking of mortar l stones. No erosion was ob			nimal weather	ring of mortar and
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing]	Elements:					
		osion and eathering:					

B	arrier ID:	GRCA-001	5-1.486-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	08/10/201	0	*Barrie	r Rating:	48.40				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$29590		
Brief Workorder:	Raise guardv 18-in height.		ove and reset 60-ft of stone	masonry guardwall on 1 row	of new stone	to raise barrier	to the adjacent			
Workorder:	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 54 CF = \$13500. [(0.5ft)(1.8ft)(60ft)] = 54 CF. Remove top layer of stones in barrier for 60 feet. New Stones at \$250- per -Each for 30 Unit(s) = \$7500. [(60ft) / (2ft/stone) x 1 row]= 30 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation. 									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									



GRCA_0015_1.486_R_1.JPG

Bar	rier ID:	GRCA-001	5-2.405-R						
Route	e Name:	HERMIT	REST ROAD						
Inspectio	on Date:	09/10/201	0	В	arrier Rating:	56.50			
Barrier Description					8				
	Type:		ASONRY WITHOUT E CORE WALL	Ba	rrier Function:	TRAFFIC			
Barrier M	laterial:	STONE		Post Material:		N/A			
B	Blockout Type:	N/A			Length (ft.):	85			
Speed Limit	(MPH):	25			Placement with espect to Road:	OUTSIDE	OF CURVE		
Hazard Behind I	Barrier:	EXTREME	;						
Barrier Crashwort	thiness								
Appropriate Test T Level:	ГL-1		Barrier Test Level:	NCW		ls Barrier worthy?:	NO		
Beg. End Trtmt N Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE		
Ending End Trtmt N Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A					
Average Measuren	nents								
	24		Width (In.):	21.7	Post Spa	cing (In.):	0.0		
Height (In.):	16.7		Lateral Offset (In.):	0.0	Road G	rade (%):	0.50		
Physical Condition	1								
	Align	ment and Height:	No deviation was observed height for 26 ft and 6 to 9 i						
Barrier		aking and Cracking:	No breaking or cracking w	No breaking or cracking was observed.					
	Missing I	Elements:	No missing elements were	observed.					
		osion and athering:	2 square ft total of missing cracking was observed wit compromise barrier.	-					
	Align	ment and Height:							
End Treatments		aking and Cracking:							
	Missing Elements:								
		osion and athering:							

B	arrier ID:	GRCA-001	5-2.405-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
	·	00/10/201/	2		D. (1	56.50				
Inspect	tion Date:	09/10/201)	Barrie	r Rating:	56.50				
Repair Recomme	endations	5								
Repair	REPAIR		FMSS	DEFERRED		Repair		\$32769		
Action:			Work Type:	MAINTENANCE		Cost:				
Brief		ardwall 3-in. Remove and reset 67-ft of stone masonry guardwall on 1 row of new stone to raise barrier to the adjacent								
Workorder:	18-in height	including the 8	foot end section with highe	er stone design to retain the d	lesign. Repoi	nt 2 sq. ft. of b	arrier.			
Workorder:			5	er -Cu. Ft. for $61 \text{ CF} = 152	50. [(0.5ft)(1.5	(67ft) = 60	0.3 CF. Remove			
	1 5	tones in barrie		$[(67ft)/(2ft/stope) \times 1 row]$	I= 34 stones I	neart new ston	e on retaining			
		New Stones at \$250- per -Each for 34 Unit(s) = 8500 . [(67ft) / (2ft/stone) x 1 row]= 34 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier.								
		Re-Point Masonry Barrier at \$140- per -Sq. Yd. for $1 \text{ SY} = $140. [(2sf.)(3)]/9 = .67 \text{ SY}.$								
	Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = $$5900. 1$ day removal 3 days installation.									
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	her repair co	osts only.				



GRCA_0015_2.405_R_1.JPG

Ba	rrier ID:	GRCA-001	5-2.446-R				
Rout	te Name:	HERMIT	REST ROAD				
Inspecti	ion Date:	09/10/201	0	Bar	rier Rating:	56.50	
Barrier Description	on						
	Туре:		ASONRY WITHOUT E CORE WALL	Barri	er Function:	TRAFFIC	
Barrier N	Material:	STONE		Ро	ost Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	81	
Speed Limit	t (MPH):	25			cement with ect to Road:	OUTSIDE	OF CURVE
Hazard Behind	Barrier:	EXTREME					
Barrier Crashwor	thiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ments						
	24		Width (In.):	21.0		cing (In.):	0.0
Height (In.):	15.6		Lateral Offset (In.):	0.0	Road G	rade (%):	3.40
Physical Condition							
	Align	ment and Height:	No deviation in alignment for 61 linear and below by		Barrier was 7 to	12 in below 24	t in design height
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing l	Elements:	No missing elements were	observed.			
-		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing l	Elements:					
		osion and eathering:					

B	arrier ID:	GRCA-001	5-2.446-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	09/10/201	0	Barrier	· Rating:	56.50				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$29865		
Brief Workorder:	Raise guardv 18-in height.		ove and reset 61-ft of stone	masonry guardwall on 1 row	of new stone	e to raise barrier	r to the adjacent			
Workorder:	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 54 CF = \$13500. [(0.5ft)(1.75ft)(61ft)] = CF. Remove top layer of stones in barrier for 61 feet. New Stones at \$250- per -Each for 31 Unit(s) = \$7750. [(61ft) / (2ft/stone) x 1 row]= 31 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation. 									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									

Grand Canyon National Park

ROUTE 0015: HERMIT REST ROAD



GRCA_0015_2.446_R_1.JPG

B	arrier ID:	GRCA-001	15-2.566-R				
	ute Name:	HERMIT	REST ROAD				
Increa	tion Date:	00/10/201	0	D	rrier Rating:	30.20	
		09/10/201	0	Da	irrier Katilig:	30.20	
Barrier Descripti							
	Туре:		ASONRY WITHOUT TE CORE WALL	Barrier Function:		TRAFFIC	
Barrier	Material:	STONE		F	ost Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	188	
Speed Lim		25		PI	acement with	INSIDE OF	FCURVE
Speed Lini	n (1911 11).	20			pect to Road:	INSIDE OF	CORVE
Hazard Behind	d Barrier:	EXTREME	8				
Barrier Crashwo	orthiness						
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO
Level:			Test Level:		Crast	nworthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach tion Type:	NONE
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A		tion Type:	
Type:	NONE		Crashhworthy?:	1 1/2 1			
Average Measur	ements						
Design Height (In.):	24		Width (In.):	21.7	Post Spa	cing (In.):	0.0
Height (In.):	20.0		Lateral Offset (In.):	134.0		rade (%):	2.10
Physical Condition	on						
	Align	ment and Height:	No deviation was observed ft and was 6 to 11 in below	-	Height was 3 to 6 in	n below 24 in o	design height for 48
		aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing	Elements:	No missing elements were	observed.			
	Carry	osion and	No corrosion or weathering	was observed			
		eathering:		5 was 00501 vea.			
	Align	ment and Height:					
		8					
End Treatments		aking and					
Enu reatments	'	Cracking:					
	Missing	Elements:					
	Corrr	osion and					
		eathering:					

B	arrier ID:	GRCA-001	5-2.566-R						
Rou	ite Name:	HERMIT	ERMIT REST ROAD						
Inspec	tion Date:	09/10/201	0	Barrier	· Rating:	30.20			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$36465	
Brief Workorder:	Raise guardv 18-in height.		ove and reset 66-ft of stone	masonry guardwall on 1 row	of new stone	e to raise barrie	r to the adjacent		
Workorder:	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 76 CF = \$19000. [(0.5ft)(2.3ft)(66ft)] = 75.9 CF. Remove top layer of stones in barrier for 66 feet. New Stones at \$250- per -Each for 33 Unit(s) = \$8250. [(66ft) / (2ft/stone) x 1 row]= 33 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation. 								
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.								



GRCA_0015_2.566_R_1.JPG

Ba	arrier ID:	GRCA-001	5-2.839-R						
Rou	te Name:	HERMIT	REST ROAD						
Inspect	ion Date:	09/10/201	0		Barrier Rating:	38.70			
Barrier Descripti		0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							
	Туре:		ASONRY WITHOUT E CORE WALL	Ba	rrier Function:	TRAFFIC			
Barrier	Material:	STONE			Post Material:	N/A			
	Blockout Type:	N/A			Length (ft.):	224			
Speed Limi	t (MPH):	25			Placement with espect to Road:	INSIDE OF	FCURVE		
Hazard Behind	Barrier:	EXTREME							
Barrier Crashwo	rthiness								
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO		
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE		
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A					
Average Measure	ements								
Design Height (In.):	24		Width (In.):	21.7	Post Spa	cing (In.):	0.0		
Height (In.):	18.2		Lateral Offset (In.):	116.6	Road G	rade (%):	0.60		
Physical Condition	n								
	Align	ment and Height:	No deviation was observed for 163 ft and 6 to 8 in belo	-		n below the de	sign height of 24 in		
Barrier		aking and Cracking:	No breaking or cracking w	as observed.					
	Missing 1	Elements:	No missing elements were	observed.					
		osion and eathering:	1 square ft of missing/deter cracks were observed with compromise stability of the	minimal weathering					
	Align	ment and Height:							
End Treatments		aking and Cracking:							
	Missing	Elements:							
		osion and eathering:							

B	arrier ID:	GRCA-001	5-2.839-R						
Rou	ite Name:	HERMIT	ERMIT REST ROAD						
Inspec	tion Date:	09/10/201	0	Barrie	r Rating:	38.70			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$61644		
Brief Workorder:	Raise guardv	vall 2-in. Rem	nove and reset 53-ft of stone	masonry guardwall on conce	rete footer to a	adjacent 18-in	height.		
Workorder:	Re-Point Ma Structural Co	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 192 CF = \$48000. (53ft)(2ft)(1.8ft) = 192 CF. Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. 1sf. / 9sf/sy = 0.11 SY. Structural Concrete at \$1000- per -Cu. Yd. for 2 CY = \$2000. [(53ft)(.5ft)(1.8ft)] /27 = 1.77 CY. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation.							
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.								



GRCA_0015_2.839_R_1.JPG

Ba	arrier ID:	GRCA-001	5-3.299-R						
	ite Name:	HERMIT	REST ROAD						
Inspec	tion Data:	09/10/201	0	Da	rrier Rating:	49.50			
		09/10/201	0	Dariter Rating, 1980					
Barrier Descripti									
	Туре:		ASONRY WITHOUT TE CORE WALL	Barr	ier Function:	TRAFFIC			
Barrier	Material:	STONE		Р	ost Material:	N/A			
	Blockout Type:	N/A			Length (ft.):	121			
Speed Limi		30		DI	acement with	INSIDE OF	CURVE		
Speed Linn	III (IVIP II): 50				bect to Road:		CORVE		
Hazard Behind	l Barrier:	EXTREME	2						
Barrier Crashwo	rthiness								
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO		
Level:			Test Level:		Crasl	hworthy?:			
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach tion Type:	NONE		
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A	11781151	tion Type:			
Туре:	NONE		Crashhworthy?:	1 1/2 1					
Average Measure	ements								
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0		
Height (In.):	16.0		Lateral Offset (In.):	127.0		rade (%):	0.70		
Physical Condition	on								
	Align	ment and Height:	No deviation in alignment 105 ft.	was observed. The heig	ht was 7 to 9 in be	elow the 24 in	design height for		
Barrier		aking and Cracking:	No breaking or cracking w	as observed.					
	Missing]	Elements:	No missing elements were	observed.					
		osion and eathering:	No corrosion or weathering	g was observed.					
	Align	ment and Height:							
End Treatments		aking and Cracking:							
	Missing	Elements:							
		osion and eathering:							

B	arrier ID:	GRCA-001	5-3.299-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	09/10/201	0	Barrier	r Rating:	49.50				
Repair Recomme	endations	\$								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$58108			
Brief Workorder:	Ŭ Ŭ		ove and reset 121-ft stone n e higher ends to maintain th	nasonry guardwall on 1 row o e original design.	of new stone t	to raise barrier t	to the 24-in			
Workorder:	Remove top New Stones retaining wa	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 109 CF = 27250 . [(0.5ft)(1.8ft)(121ft)] = 108.9 CF. Remove top layer of stones in barrier for 121 feet. New Stones at \$250- per -Each for 61 Unit(s) = 15250 . [(121ft) / (2ft/stone) x 1 row]= 61 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 7 Day(s) = \$10325. 2 days removal 5 days installation.								
	-			ary for comparison to oth						



GRCA_0015_3.299_R_1.JPG

Ba	arrier ID:	GRCA-001	5-3.634-R							
Rou	te Name:	HERMIT	REST ROAD							
Inspect	ion Date:	09/10/201	/10/2010 Barrier Rating: 60.90							
Barrier Descripti					0					
	Туре:		ASONRY WITHOUT Barrier Function:		TRAFFIC					
Barrier	Material:	STONE			Post Material:	N/A				
	Blockout Type:	N/A			Length (ft.):	36				
Speed Limi	t (MPH):	30			Placement with espect to Road:	OF CURVE				
Hazard Behind	Barrier:	EXTREME								
Barrier Crashwo	rthiness									
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO			
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE			
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A						
Average Measure	ements									
Design Height (In.):	24		Width (In.):	21.0	Post Spa	cing (In.):	0.0			
Height (In.):	14.3		Lateral Offset (In.):	0.0	Road G	rade (%):	1.70			
Physical Conditio	n									
	Align	ment and Height:	No deviation in alignment 24 in for 28 linear ft.	was observed. Heigl	nt of barrier was 9 to 1	11 in below th	e design height of			
Barrier		aking and Cracking:	No breaking or cracking w	as observed.						
	Missing 1	Elements:	No missing elements were	observed.						
		osion and eathering:	Minor cracking of mortar l erosion was observed to co			ing of mortar	and stones. No			
	Align	ment and Height:								
End Treatments		aking and Cracking:								
	Missing 1	Elements:								
		osion and eathering:								

B	arrier ID:	GRCA-001	GRCA-0015-3.634-R						
Rou	ite Name:	HERMIT	IERMIT REST ROAD						
Inspec	tion Date:	09/10/201	0	Barrier Rating: 60.90					
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$18618	
Brief Workorder:	Raise guardv 18-in height.		ove and reset 36-ft of stone	masonry guardwall on 1 row	of new stone	e to raise barrier	r to the adjacent		
Workorder:	Workorder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 32 CF = \$8000. [(0.5ft)(1.75ft)(36ft)] = 31.5 CF. Remove top layer of stones in barrier for 36 feet. New Stones at \$250- per -Each for 18 Unit(s) = \$4500. [(36ft) / (2ft/stone) x 1 row]= 18 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.								
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.								



GRCA_0015_3.634_R_1.JPG

Ba	arrier ID:	GRCA-001	5-3.639-R					
Rou	ite Name:	HERMIT	REST ROAD					
Inspect	tion Date:	09/10/201	0	Barri	ier Rating:	25.70		
Barrier Descripti								
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		NON-TRAFFIC		
Barrier	Material:	STONE		Post Material:		N/A		
	Blockout Type:	N/A		Le	ength (ft.):	177		
Speed Limi	it (MPH):	30			ment with t to Road:	NON-TRA	FFIC BARRIER	
Hazard Behind	Barrier:	N/A						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A	
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	24		Width (In.):	21.2		cing (In.):	0.0	
Height (In.):	17.0		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00	
Physical Condition		ment and Height:	No deviation in barrier alig design height for 54 ft and	nment was observed. The h was 7 in below for 121 ft.	neight ranged f	from 3 to 6 in 1	below the 24 in	
Barrier		aking and Cracking:	2 linear ft of missing barrie	er was observed.				
	Missing	Elements:	No missing elements were	observed.				
		osion and eathering:	No corrosion or weathering	g was observed.				
	Align	ment and Height:						
End Treatments	ments Breaking and Cracking:							
	Missing 1	Elements:						
Corrosion and Weathering:								

B	arrier ID:	GRCA-001	GRCA-0015-3.639-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	09/10/201	0	Barrie	r Rating:	25.70				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$2723			
Brief Workorder:	Replace 2 fee	et of stone gua	rdwall to replace missing se	ction.						
Workorder:	ler: Stone Masonry w/o Concrete Core at \$500- per -Lin. Ft. for 2 LF = \$1000. Replace 2 ft of missing stone guardwall. 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.									



GRCA_0015_3.639_R_1.JPG

B	arrier ID:	GRCA-001	15-3.670-R								
	ute Name:	HERMIT	REST ROAD								
Increa	tion Deter	00/10/201	Barrier Rating: 59.20								
		09/10/201	0	Da	irrier Kating:	39.20					
Barrier Descripti											
	Туре:		ASONRY WITHOUT Barrier Function: E CORE WALL		TRAFFIC						
Barrier	Material:	STONE		P	ost Material:	N/A					
	Blockout Type:	N/A			Length (ft.):	37					
Speed Lim		30		PI	acement with	OUTSIDE	OF CURVE				
	n (1911 11).	50			pect to Road:	OUTSIDE	of conve				
Hazard Behind	d Barrier:	HIGH									
Barrier Crashwo	orthiness										
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO				
Level:			Test Level:		Crasl	nworthy?:					
Beg. End Trtmt	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE				
Type: Ending End Trtmt	NONE		Ending End Trtmt	N/A		ion Type:					
Type:	HOILE		Crashhworthy?:	11/21							
Average Measur	ements										
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0				
Height (In.):	14.6		Lateral Offset (In.):	0.0		rade (%):	0.70				
Physical Condition	on										
	Align	ment and Height:	No deviation in alignment ft on the end had an extra l			pelow the 24 in	n design height. 8				
		aking and	No breaking or cracking w	as observed							
Barrier		Cracking:									
	Missing	Elements:	No missing elements were	observed.							
	Com	osion and	No corrosion or weathering	was observed							
		eathering:	1.5 contosion or weathering	5							
	Align	ment and Height:									
End Treatments		aking and									
Enu Freatments	'	Cracking:									
	Missing	Elements:									
	Corrr	osion and									
		eathering:									

B	arrier ID:	GRCA-001	RCA-0015-3.670-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	te: 09/10/2010 Barrier Rating: 59.20								
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$19443		
Brief Workorder:	U U		ove and reset 37-ft of stone reset the end section to reta	masonry guardwall on 1 row in original design.	of new stone	to raise barrie	er to the 24-in			
Workorder:	Workorder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 34 CF = \$8500. [(0.5ft)(1.8ft)(37ft)] = 33.3 CF. Remove top layer of stones in barrier for 37 feet. New Stones at \$250- per -Each for 19 Unit(s) = \$4750. [(37ft) / (2ft/stone) x 1 row] = 19 stones. Insert new stone on retaining wall to increase barrier he Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ier repair co	osts only.				



GRCA_0015_3.670_R_1.JPG

B	arrier ID:	GRCA-001	15-3.896-R								
	ite Name:	HERMIT	ERMIT REST ROAD								
Inspec	tion Date:	09/10/201	10/2010 Barrier Rating: 54.40								
Barrier Descripti		09/10/201	0	D	arrier Katilig.	54.40					
Darrier Descripti		CTONE 1		D	·						
	Туре:		ASONRY WITHOUT TE CORE WALL	Barrier Function:		TRAFFIC					
Barrier	Material:	STONE			Post Material:	N/A					
	Blockout Type:	N/A			Length (ft.):	190					
Speed Lim		30		p	Placement with	OUTSIDE	OF CURVE				
Speed Lini		20			spect to Road:	00101012	01 001112				
Hazard Behind	l Barrier:	EXTREME									
Barrier Crashwo	rthiness										
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO				
Level:			Test Level:		Crash	nworthy?:					
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE				
Ending End Trtmt	NONE		Ending End Trtmt	N/A	11 ansie	ion Type.					
Туре:			Crashhworthy?:								
Average Measure	ements										
Design Height (In.):	24		Width (In.):	21.0	Post Spa	cing (In.):	0.0				
Height (In.):	17.7		Lateral Offset (In.):	0.0		rade (%):	2.50				
Physical Condition	on										
	Align	ment and Height:	No deviation in alignment for 79 linear ft and 6 to 8 in	•		6 in below the	24 in design height				
		aking and	No breaking or cracking was observed.								
Barrier		Cracking:									
	Missing	Elements:	No missing barrier element	s were observed.							
	Сонич	osion and	Minor cracking of mortar l	ess than 1/4 in wide w	ith minimal weather	ing of stones	and mortar. No				
		eathering:	erosion was observed comp								
	A 12 am	mont and									
	Align	ment and Height:									
End Treatments		aking and Cracking:									
		~·									
	Missing	Elements:									
	Corrr	osion and									
	We	eathering:									

B	arrier ID:	GRCA-001	5-3.896-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	te: 09/10/2010 Barrier Rating: 54.40								
Repair Recomme	endations	5								
Repair Action:	REPAIR	FMSSDEFERREDRepair\$44413Work Type:MAINTENANCECost:								
Brief Workorder:	Raise guardv 18-in height.		ove and reset 95-ft stone ma	asonry guardwall on 1 row of	new stone to	raise barrier to	the adjacent			
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 84 CF = \$21000. [(0.5ft)(1.75ft)(95ft)] = 83.1 CF. Remove top layer of stones in barrier for 95 feet. New Stones at \$250- per -Each for 48 Unit(s) = \$12000. [(95ft) / (2ft/stone) x 1 row]= 48 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 5 Day(s) = \$7375. 1 day removal 4 days installation.									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									

Grand Canyon National Park

ROUTE 0015: HERMIT REST ROAD



GRCA_0015_3.896_R_1.JPG

Ba	arrier ID:	GRCA-001	5-4.116-R								
	ite Name:	HERMIT	ERMIT REST ROAD								
Inspect	ion Dotor	09/10/201	/10/2010 Barrier Rating: 42.90								
		09/10/201	0	Dar	rier Kating:	42.90					
Barrier Descripti											
	Туре:		ASONRY WITHOUT TE CORE WALL	Barrier Function: TRAI							
Barrier	Material:	STONE		Po	st Material:	N/A					
	Blockout Type:	N/A		-	Length (ft.):	63					
Speed Limi		30		Pla	cement with	INSIDE OF	F CLIRVE				
Speed Linn	it (1911-11).	50			ect to Road:	INSIDE OF	CORVE				
Hazard Behind	Barrier:	EXTREME	2								
Barrier Crashwo	rthiness										
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO				
Level:			Test Level:			nworthy?:					
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach	NONE				
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A	I ransu	tion Type:					
Type:	NONE		Crashhworthy?:	IN/A							
Average Measure	ements										
Design Height (In.):	24		Width (In.):	20.7	Post Spa	cing (In.):	0.0				
Height (In.):	19.0		Lateral Offset (In.):	48.2		rade (%):	3.50				
Physical Condition	on										
	Align	ment and Height:	No deviation in barrier alig linear ft with an 8 ft section			n below 24 in	design height for 55				
Barrier		aking and Cracking:	6 square yards of missing g were 1/2 to 3 in wide.	grout and chipped rocks w	vere observed in i	impact area. N	Aissing grout cracks				
	Missing 3	Elements:	No missing elements were	observed.							
		osion and eathering:	1 linear ft of rock was miss	ing in area of deterioratin	ng grout.						
	Align	ment and Height:									
End Treatments		aking and Cracking:									
	Missing 1	Elements:									
		osion and eathering:									

B	arrier ID:	GRCA-001	RCA-0015-4.116-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	09/10/201	0	Barrier	r Rating:	42.90				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$3097			
Brief Workorder:	Repoint 6 sy	and replace a	1 foot missing section of sto	ne masonry guardwall.						
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 6 SY = \$840. Repoint 6 sy of stone masonry barrier. Stone Masonry w/o Concrete Core at \$500- per -Lin. Ft. for 1 LF = \$500. Replace 1 ft of missing stone barrier. 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.									



GRCA_0015_4.116_R_1.JPG

	ier ID:	GRCA-001	5-4.160-R						
Route			REST ROAD						
Inspectior	n Date:	09/10/2010	/10/2010 Barrier Rating: 52.00						
Barrier Description		09/10/2010		Daim	i Kating.	52.00			
	Type:		ASONRY WITHOUT Barrier Function: TE CORE WALL		TRAFFIC				
Barrier Ma	aterial:	STONE		Post	Material:	N/A			
Bl	lockout Type:	N/A		Le	ngth (ft.):	59			
Speed Limit (I	MPH):	30			ment with t to Road:	INSIDE OF	FCURVE		
Hazard Behind Ba	arrier:	HIGH							
Barrier Crashworth	hiness								
Appropriate Test TL Level:	L-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO		
Beg. End Trtmt NC Type:	ONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE		
Ending End Trtmt NC Type:	ONE		Ending End Trtmt Crashhworthy?:	N/A					
Average Measurem	ients								
Design Height (In.): 24			Width (In.):	21.2	Post Spa	cing (In.):	0.0		
Height (In.): 14	4.0		Lateral Offset (In.):	64.3	Road G	rade (%):	4.20		
Physical Condition									
	Align	ment and Height:	No deviation in alignment	was observed. Height was 6	to 11 in below	w 24 in design	height for 58 ft.		
Barrier		iking and Cracking:	Broken mortar and rotated	blocks were observed in a 4	ft section of b	arrier at impa	ct location.		
N	Missing F	Elements:	No missing elements were	observed.					
		osion and athering:	No corrosion or weathering	was observed.					
	Align	ment and Height:							
End Treatments		king and Cracking:							
N	Missing F	Elements:							
		osion and athering:							

B	arrier ID:	GRCA-001	5-4.160-R						
Rou	ite Name:	HERMIT	ERMIT REST ROAD						
Inspec	tion Date:	: 09/10/2010 Barrier Rating: 52.00							
Repair Recomme	endations	5							
Repair Action:	REPAIR	FMSSDEFERREDRepair\$37565Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardv design heigh		move and reset 59-ft stone n	nasonry guardwall on 2 rows	of new stone	to raise barrier to	to the 24-in		
Workorder:	Workorder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 54 CF = \$13500. [(0.5ft)(1.8ft)(59ft)] = 53.1 CF. Remove top layer of stones in barrier for 59 feet. New Stones at \$250- per -Each for 59 Unit(s) = \$14750. [(59ft) / (2ft/stone) x 2 rows = 59 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900. 1 day removal 3 days installation.								
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.								



GRCA_0015_4.160_R_1.JPG

Ba	arrier ID:	GRCA-001	5-4.515-R						
Rou	te Name:	HERMIT	REST ROAD						
Inspect	ion Date:	ate: 09/10/2010 Barrier Rating: 44.40							
Barrier Descripti	on								
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC			
Barrier	Material:	STONE			Post Material:	N/A			
	Blockout Type:	N/A			Length (ft.):	188			
Speed Limi	t (MPH):	25		I	Placement with Respect to Road:	INSIDE OF	FCURVE		
Hazard Behind	Barrier:	EXTREME							
Barrier Crashwo	rthiness								
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO		
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE		
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A					
Average Measure	ements								
Design Height (In.):	24		Width (In.):	21.7	Post Spa	cing (In.):	0.0		
Height (In.):	17.2		Lateral Offset (In.):	0.0	Road G	rade (%):	1.60		
Physical Conditio									
	Align	ment and Height:	No deviation in alignment in for 81 ft and 6 to 8 ines		-	5 in below the	design height of 24		
Barrier		aking and Cracking:	No breaking or cracking w	as observed.					
	Missing	Elements:	No missing elements were	observed.					
		osion and eathering:	Approximately 6 square ft in wide of mortar with min compromising stability of	imal weathering of			-		
	Align	ment and Height:							
End Treatments		aking and Cracking:							
	Missing 1	Elements:							
		osion and eathering:							

B	arrier ID:	ier ID: GRCA-0015-4.515-R								
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspect	tion Date:	09/10/201	0	Barriei	r Rating:	44.40				
Repair Recomme	endations	5								
Repair Action:	REPAIR	PAIR FMSS DEFERRED Repair \$1779 Work Type: MAINTENANCE Cost:								
Brief Workorder:	Raise guardv 18-in height.		nove and reset 33-ft stone ma	asonry guardwall on 1 row of	f new stone to	raise barrier to	o the adjacent			
Workorder:	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 30 CF = \$7500. [(0.5ft)(1.8ft)(33ft)] = 29.7 CF. Remove top layer of stones in barrier for 33 feet. New Stones at \$250- per -Each for 17 Unit(s) = \$4250. [(33ft) / (2ft/stone) x 1 row] = 17 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation. 									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									



GRCA_0015_4.515_R_1.JPG

B	arrier ID:	GRCA-001	5-4.777-R					
	ute Name:	HERMIT	REST ROAD					
Inspec	tion Date:	08/10/201	0	Dom	ier Rating:	47.20		
		08/10/201	0	Dari	ier Kating:	47.20		
Barrier Descripti					B			
	Туре:		ASONRY WITHOUT Barrier Function: E CORE WALL		TRAFFIC			
Barrier	Material:	STONE		Pos	t Material:	N/A	N/A	
	Blockout Type:	N/A		I	length (ft.):	50		
Speed Lim		30		Plac	ement with	INSIDE OF	FCURVE	
Speed Lini	n (1911 11).	20			ct to Road:		001112	
Hazard Behind	d Barrier:	EXTREME]			•		
Barrier Crashwo	orthiness							
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO	
Level:			Test Level:		Crasl	hworthy?:		
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach tion Type:	NONE	
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A		tion Type:		
Type:	NONE		Crashhworthy?:	1 1/2 1				
Average Measur	ements							
Design Height (In.):	24		Width (In.):	20.7	Post Spa	cing (In.):	0.0	
Height (In.):	17.0		Lateral Offset (In.):	49.2		rade (%):	3.00	
Physical Condition	on							
	Align	ment and Height:	No deviation was observed	in barrier alignment. Bar	rier was 7 in bel	low 24 in desig	gn height for 50 ft.	
Barrier		aking and Cracking:	No breaking or cracking w	as observed.				
Darrier		cracking.						
	Missing	Elements:	No missing elements were	observed.				
		osion and	No corrosion or weathering	g was observed.				
	We	eathering:						
	Align	ment and						
		Height:						
	Bro	aking and						
End Treatments		Cracking:						
	Missing	Elements:						
	Corrr	osion and						
	We	eathering:						

B	arrier ID:	GRCA-001	5-4.777-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	08/10/201	0	Barrier	Rating:	47.20				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$23568			
Brief Workorder:	Raise guardy design heigh		ove and reset 50-ft stone ma	asonry guardwall on 1 row of	new stone to	raise barrier to	the 24-in			
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 43 CF = \$10750. [(0.5ft)(1.7ft)(50ft)] = 42.5 CF. Remove top layer of stones in barrier for 50 feet. New Stones at \$250- per -Each for 25 Unit(s) = \$6250. [(50ft) / (2ft/stone) x 1 row]= 25 stones Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
				ary for comparison to othe						



GRCA_0015_4.777_R_1.JPG

Ba	arrier ID:	GRCA-001	5-4.783-R				
Rou	te Name:	HERMIT	REST ROAD				
Inspect	ion Date:	08/10/201	0	Barrie	r Rating:	25.70	
Barrier Descripti							
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier	Function:	NON-TRA	FFIC
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A		Length (ft.):		193	
Speed Limi	t (MPH):	30			ment with t to Road:	NON-TRA	FFIC BARRIER
Hazard Behind	Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Туре:	NONE		Is Beg. End Trtmt Crashhworthy?:			Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.7		cing (In.):	0.0
Height (In.):	18.2		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00
Physical Conditio	n						
	Align	ment and Height:	No deviation was observed height for 147 ft and was 7	in barrier alignment. The h in below for 46 ft.	eight was 5 to	6 in below th	e 24 in design
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing 1	Elements:					
		osion and eathering:					

Barri	Barrier ID: GRCA-0015-4.783-R							
Route N	Name:	HERMIT						
Inspection	Date:	08/10/2010	0		Barrier Rating:	25.70		
Repair Recommend	ations							
RepairNOAction:) ACTIO	N	FMSS Work Type:	N/A		Repair Cost:	\$0	
Brief N/A Workorder:	A							
Workorder:								
<u>ь </u>	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparis	son to other repair co	osts only.		



GRCA_0015_4.783_R_1.JPG

Ba	arrier ID:	GRCA-001	5-4.823-R				
Rou	ite Name:	HERMIT	REST ROAD				
Inspect	tion Date:	08/10/201	0	E	Barrier Rating:	35.70	
Barrier Descripti					0		
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC	
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A	Length (ft.):		45		
Speed Limi	it (MPH):	30			Placement with espect to Road:	TANGENT	
Hazard Behind	l Barrier:	EXTREME					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0
Height (In.):	19.0		Lateral Offset (In.):	58.2	Road G	rade (%):	2.50
Physical Condition	on						
	Align	ment and Height:	No deviation in barrier alig height of 24 in for 37 ft. R		-		-
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	Minor cracking less than 1. erosion was observed comp			thering of mo	rtar and stones. No
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing 1	Elements:					
		osion and eathering:					

Barr	rier ID:	GRCA-001	5-4.823-R				
Route	Name:	HERMIT					
Inspection	n Date:	08/10/2010	0		Barrier Rating:	35.70	
Repair Recommend	dations						
RepairNOAction:	O ACTIO	N	FMSS Work Type:	N/A		Repair Cost:	\$0
Brief Workorder:	/A						
Workorder:							
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparis	on to other repair co	osts only.	



GRCA_0015_4.823_R_1.JPG

B	arrier ID:	GRCA-001	15-5.023-R				
	ite Name:	HERMIT	REST ROAD				
Increa	tion Date:	08/10/201	0	т	Barrier Rating:	55.20	
		08/10/201	0	1	barrier Katilig:	33.20	
Barrier Descripti							
	Туре:		ASONRY WITHOUT TE CORE WALL	Ba	rrier Function:	TRAFFIC	
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A			Length (ft.):	44	
Speed Lim		30			Placement with	OUTSIDE	OF CURVE
	n (1911 11).	50			espect to Road:	OUTSIDE	of conve
Hazard Behind	d Barrier:	EXTREME	8				
Barrier Crashwo	orthiness						
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO
Level:			Test Level:		Crasł	worthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach	NONE
Type:	NONE		Crashhworthy?:	N/A	1 ransu	ion Type:	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	IN/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.0	Post Sna	cing (In.):	0.0
Height (In.):	15.3		Lateral Offset (In.):	82.6		rade (%):	2.10
Physical Condition	on						
	Align	ment and Height:	No deviation was observed ft of higher design at end a	-	-	1 below 24 in o	design height for 8
	Bre	aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing		No missing elements were	observed			
	MISSING	Elements:	The missing clements were	observed.			
		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and					
		Height:					
	Rre	aking and					
End Treatments		Cracking:					
	Missing	Elements:					
	Corrr	osion and					
	We	eathering:					

B	arrier ID:	rier ID: GRCA-0015-5.023-R								
Rou	ite Name:	HERMIT	IERMIT REST ROAD							
Inspec	tion Date:	08/10/201	0	Barrie	er Rating:	55.20				
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$21643		
Brief Workorder:	Raise guardv 18-in height.		ove and reset 44-ft of stone	masonry guardwall on 1 row	of new stone	to raise barrier	to the adjacent			
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 39 CF = \$9750. [(0.5ft)(1.75ft)(44ft)] = 38.5 CF. Remove top layer of stones in barrier for 44 feet. New Stones at \$250- per -Each for 22 Unit(s) = \$5500. [(44ft) / (2ft/stone) x 1 row] = 22 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
				ary for comparison to oth						

Grand Canyon National Park

ROUTE 0015: HERMIT REST ROAD



GRCA_0015_5.023_R_1.JPG

Ba	arrier ID:	GRCA-001	5-5.067-R				
Rou	ite Name:	HERMIT	REST ROAD				
Inspect	tion Date:	08/10/201	0	Bari	rier Rating:	52.40	
Barrier Descripti					0	I	
	Type:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC	
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A	Length (ft.):		41		
Speed Limi		30			ement with ect to Road:	INSIDE OF	FCURVE
Hazard Behind	l Barrier:	EXTREME					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.7		cing (In.):	0.0
Height (In.):	16.7		Lateral Offset (In.):	44.7	Road G	rade (%):	2.90
Physical Condition		ment and Height:	No deviation was observed 24 in for 41 linear ft.	in barrier alignment. He	ight of barrier wa	as 6-7 in belov	v design height of
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing 1	Elements:	No missing elements were	observed.			
		osion and eathering:	Minor cracking less than 1. erosion was observed com			athering of mo	rtar and stones. No
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing 1	Elements:					
		osion and eathering:					

B	arrier ID:	ier ID: GRCA-0015-5.067-R								
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspect	tion Date:	08/10/201	0	Barrie	r Rating:	52.40				
Repair Recomme	endations	5								
Repair Action:	REPAIR	PAIR FMSS DEFERRED Repair \$2081 Work Type: MAINTENANCE Cost:								
Brief Workorder:	Raise guardv 18-in height.		ove and reset 41-ft of stone	masonry guardwall on 1 row	of new stone	e to raise barrie	er to the adjacent			
Workorder:	korder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 37 CF = \$9250. [(0.5ft)(1.8ft)(41ft)] = 36.9 CF. Remove top layer of stones in barrier for 41 feet. New Stones at \$250- per -Each for 21 Unit(s) = \$5250. [(41ft) / (2ft/stone) x 1 row] = 21 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ner repair co	osts only.				



GRCA_0015_5.067_R_1.JPG

Route Name: HERMIT REST ROAD Inspection Date: 08/10/2010 Barrier Rating: 53.50 Barrier Description Type: STONE MASONRY WITHOUT CONCRETE CORE WALL Barrier Function: TRAFFIC Barrier Material: STONE Post Material: N/A Blockout N/A Length (ft.): 38 OUTSIDE OF CURVE Blockout N/A Intervention of the state o	В	arrier ID:	GRCA-001	5-6.205-R				
Barrier Description Type: STONE MASONRY WITHOUT CONCRETE CORE WALL Barrier Function: TRAFFIC Barrier Material: NA Barrier Material: NA Barrier Material: NA Book Material: NA Book Material: NA Book Material: NA Book Material: NA Image: Colspan="2">Concents Barrier Crashworthiness Appropriate Test TL-1 Barrier NONE Crashworthy?: Transition Type: Crashworthy?: Transition Type: Crashworthy?: NONE Transition Type: Crashworthy?: No Average Measurements Not design neight (In.): 0.0 Meight (In.): 21.7 Post Spacing (In.): 0.0 Physical Condifion Misi	Rou	ite Name:	HERMIT	REST ROAD				
Barrier Description Type: STONE MASONRY WITHOUT CONCRETE CORE WALL Barrier Function: TRAFFIC Barrier Material: NA Barrier Material: NA Barrier Material: NA Book Material: NA Book Material: NA Book Material: NA Book Material: NA Image: Colspan="2">Concents Barrier Crashworthiness Appropriate Test TL-1 Barrier NONE Crashworthy?: Transition Type: Crashworthy?: Transition Type: Crashworthy?: NONE Transition Type: Crashworthy?: No Average Measurements Not design neight (In.): 0.0 Meight (In.): 21.7 Post Spacing (In.): 0.0 Physical Condifion Misi	Inspec	tion Date:	08/10/201	0	Barr	ier Rating:	53.50	
Type: STONE MASONRY WITHOUT CONCRETE CORE WALL. Barrier Function: TRAFFIC Barrier Material: STONE Post Material: N/A Barrier Material: STONE Post Material: N/A Bockout N/A Length (ft,): 38 Speed Limit (MPH): 30 Placement with OUTSIDE OF CURVE. Barrier Crashworthines Jappropriate Test Test Level: NOW IBGE and Trunt NONE Is Beg. End Trunt N/A Appropriate Test NONE Crashworthy: Transition Type: Crashworthy? Transition Type: Crashworthy? Transition Type: Crashworthy? Post Spacing (In.): 0.0 Read Trunt NONE Lateral Offset (In.): 21.7 Post Spacing (In.): 0.0 Physical Condition Alignment and Cracking: No deviation was observed. Missing Elements:							1	
Biokout N/A Length (ft.): 38 Speed Limit (MPR): 30 Placement with Respect to Road: OUTSIDE OF CURVE Barrier IIIGII Barrier Crashworthiness IIIGII Appropriate Test Tube: Tube: IS Beg. End Trunt NONE Beg. End Trunt NONE Is Beg. End Trunt NA Approach Type: Crashworthy?: Transition Type: NONE Ending End Trunt NONE Ending End Trunt N/A Average Measurements Ending End Trunt N/A Approach Design Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Physical Condition No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Alignment and Cracking: No breaking or eracking was observed. Missing Elements: No missing elements were observed. End Treatments Reaking and Cracking: No ecorrosion or weathering was observed. Missing Elements: Missing Elements: In design height Height: Breaking and Cracking: No secretion or weath					Barrier Function:		TRAFFIC	
Type: Design Cost Speed Limit (MPI): 30 Placement with Respect to Road: Hazard Behind Barrier: HIGH Barrier Crashworthiness Appropriate Test Level: Tt-1 Beg. End Tritt NONE Type: Transition Type: Crashworthy?: NONE Type: Crashworthy?: Peign Height (In): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition Missing Elements: No missing elements were observed. Barrier Corrosion and Height: Missing Elements: No missing elements were observed.	Barrier	Material:	STONE		Post Material:		N/A	
Respect to Road: Hazard Behind Barrier: IIIGH 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?: NA Approach Approach NONE Ending End Trtmt Type: NONE Ending End Trtmt Crashhworthy?: NA Approach Approach NONE Average Measurements Ending End Trtmt Crashhworth?: NA Approach Approach OO Design Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Physical Condition Modeviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 0 which was a higher stone design on the end and was 6 to 11 in below for 30 0. Barrier Breaking and Craeking: No missing elements: were observed. It is below for 30 0. Missing Elements: No missing elements were observed. Mo envestion or weathering was observed. It is below for 30 0. End Treatments Alignment and Ifeight: It is is below for 30 or reackin			N/A					
Barrier Crashworthiness Appropriate Test Level: TL-1 Barrier Test Level: NCW Is Barrier Crashworthy?: NO Beg. End Trtmt Type: NONE Is Beg. End Trtmt N/A Approach Transition Type: NONE Ending End Trtmt Type: NONE Ending End Trtmt N/A Approach Transition Type: NONE Average Measurements Ending End Trtmt Crashhworthy?: N/A 0.0 0.0 Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height Height: for 8 it which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Alignment and Keight: No breaking or cracking was observed. Missing Elements: No missing clements were observed. End Treatments Alignment and Height: No corrosion or weathering was observed. Missing Elements: Missing Elements: Missing Elements: Missing Elements: Corrrosion and Corrosion and Corrosion and Missi	Speed Lim	it (MPH):	30				OUTSIDE	OF CURVE
Appropriate Test Level: TL-1 Barrier Test Level: NCW Is Barrier Crashworthy?: NO Beg. End Trtmt Type: NONE Is Beg. End Trtmt Crashhworthy?: NA Approach Approach NONE Ending End Trtmt Type: NONE Ending End Trtmt Crashhworthy?: NA Approach NONE Average Measurements Ending End Trtmt Type: NA Post Spacing (In.): 0.0 Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height Height: For 8 it which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. In below for 30 ft. Missing Elements: No missing elements were observed. In below for 30 ft. In below for 30 ft. End Treatments Alignment and Height: No corrosion or weathering was observed. In below for 30 ft. In below for 30 ft. End Treatments Alignment and Cracking: No corrosion or weathering was observ	Hazard Behind	d Barrier:	HIGH					
Image: Problem in the image: proble	Barrier Crashwo	rthiness						
Type: Crashhworthy?: Transition Type: Ending End Trtmt Type: NONE Ending End Trtmt Crashhworthy?: N/A Average Measurements Cashhworthy?: N/A Design Height (In.): 24 Width (In.): 21.7 Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition Alignment and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing clements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No corrosion or weathering was observed. End Treatments Breaking and Cracking: Missing Elements:		TL-1			NCW			NO
Type: Crashhworthy?: Image: Crashhworthy?: Average Measurements Average Measurements Design Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition Image: Cracking and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Height: No corrosion or weathering was observed. Breaking and Cracking: No corrosion or weathering was observed. Missing Elements: Missing Elements: Image: Cracking: Cracking: Missing Elements: Image: Cracking:		NONE			N/A			NONE
Design Height (In.): 24 Width (In.): 21.7 Post Spacing (In.): 0.0 Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition Alignment and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Breaking and Cracking: No corrosion or weathering was observed. Missing Elements: No corrosion or weathering was observed. Missing Elements: No corrosion or weathering was observed. End Treatments Breaking and Cracking: Image: Corrosion and Cracking: Missing Elements: Corrosion and Cracking: Image: Corrosion and Cracking:		NONE			N/A			
Height (In.): 13.3 Lateral Offset (In.): 96.0 Road Grade (%): 0.30 Physical Condition Alignment and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Breaking and Cracking: Missing Elements: No corrosion or weathering was observed. Missing Elements: No corrosion or weathering was observed. Missing Elements: Missing Elements: Mo corrosion or weathering was observed. Missing Elements: Corrrosion and Cracking: Missing Elements: Missing Elements: Missing Elements: Missing Elements: Corrrosion and Cracking: Missing Elements: Missing Elements:	Average Measur	ements						
Physical Condition Alignment and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Barrier Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No corrosion or weathering was observed. Breaking and Cracking: No corrosion or weathering was observed. Missing Elements: Missing Elements: Missing Elements: Missing Elements: Missing Elements: Missing Elements: Missing Elements: Corrrosion and Corrrosion and Cracking:								
Alignment and Height: No deviation was observed in barrier alignment. The height was 3 to 6 in below 24 in design height for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: Height: Breaking and Cracking: No corrosion or weathering was observed. Missing Elements: No corrosion or weathering was observed. Missing Elements: Missing Elements: Missing Elements: Cracking: Missing Elements: Cracking: Corrrosion and Cracking: Missing Elements: Corrrosion and Missing Elements: Corrrosion and	Height (In.):	13.3		Lateral Offset (In.):	96.0	Road G	rade (%):	0.30
Height: for 8 ft which was a higher stone design on the end and was 6 to 11 in below for 30 ft. Breaking and Cracking: No breaking or cracking was observed. Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Breaking and Cracking: No corrosion or weathering was observed. Breaking and Cracking: No corrosion or weathering was observed. Missing Elements: No corrosion or weathering was observed. Missing Elements: Corrosion and Cracking: Missing Elements: Corrrosion and Corrosion and	Physical Condition							
Barrier Cracking: Missing Elements: No missing elements were observed. Corrrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: Breaking and Cracking: Breaking and Cracking: Missing Elements: Missing Elements: Missing Elements:		Align			_	-		
Corrosion and Weathering: No corrosion or weathering was observed. Alignment and Height: No corrosion or weathering was observed. End Treatments Breaking and Cracking: Missing Elements: Corrrosion and	Barrier			No breaking or cracking w	as observed.			
Weathering: Weathering: Alignment and Height: Breaking and Cracking: Missing Elements: Corrrosion and		Missing 3	Elements:	No missing elements were	observed.			
Height: End Treatments Breaking and Cracking: Missing Elements: Corrrosion and				No corrosion or weathering	g was observed.			
End Treatments Cracking: Missing Elements: Corrrosion and		Align						
Corrosion and	End Treatments							
		Missing]	Elements:					
Weathering:								

B	arrier ID:	GRCA-001	GRCA-0015-6.205-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	08/10/201)	Barrier	· Rating:	53.50				
Repair Recomme	endations	5								
Repair Action:	REPAIR	RFMSSDEFERREDRepair\$24943Work Type:MAINTENANCECost:								
Brief Workorder:	Raise guardy design heigh		nove and reset 38-ft of ston	e masonry guardwall on 2 rov	ws of new sto	ne to raise barr	tier to the 24-in			
Workorder:	rder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 35 CF = \$8750. [(0.5ft)(1.8ft)(38ft)] = 34.5 CF. Remove top layer of stones in barrier for 38 feet. New Stones at \$250- per -Each for 38 Unit(s) = \$9500. [(38ft) / (2ft/stone) x 2 rows] = 38 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									

ROUTE 0015: HERMIT REST ROAD



GRCA_0015_6.205_R_1.JPG

Ba	arrier ID:	GRCA-001	5-6.212-R						
Rou	ite Name:	HERMIT	REST ROAD						
Inspect	tion Date:	08/10/201	0	-	Barrier Rating:	32.20			
Barrier Descripti	on								
	Туре:		ASONRY WITHOUT TE CORE WALL	Barrier Function:		NON-TRAFFIC			
Barrier	Material:	STONE	Post Material:		N/A				
	Blockout Type:	N/A			Length (ft.):	187			
Speed Limi	it (MPH):	30		Placement withNON-TRAFFIC BARRIRespect to Road:					
Hazard Behind	Barrier:	N/A							
Barrier Crashwo	rthiness								
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A		
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE		
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A					
Average Measure	ements								
Design Height (In.):	24		Width (In.):	21.0		cing (In.):	0.0		
Height (In.):	12.6		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00		
Physical Condition		ment and Height:	No deviation was observed height throughout.	l in barrier alignment	t. The height was 10 t	o 13 in below	the 24 in design		
Barrier		aking and Cracking:	No breaking cracking or ev	vidence of impact wa	s observed.				
	Missing]	Elements:	No missing elements were	observed.					
		osion and eathering:	Minor cracking of mortar l stones. No erosion was ob			nimal weather	ing of mortar and		
	Align	ment and Height:							
End Treatments		aking and Cracking:							
	Missing 1	Elements:							
		osion and eathering:							

B	arrier ID:	GRCA-001	GRCA-0015-6.212-R							
Rou	ite Name:	HERMIT	IERMIT REST ROAD							
Inspec	tion Date:	Date: 08/10/2010 Barrier Rating: 32.20								
Repair Recomme	endations	5								
Repair Action:	REPAIR	R FMSS DEFERRED Repair \$112750 Work Type: MAINTENANCE Cost:								
Brief Workorder:	Raise guardy design heigh		move and reset 187-ft of sto	ne masonry guardwall on 2 r	ows of new st	tone to raise ba	rrier to the 24-in			
Workorder:	Workorder:Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 164 CF = \$41000. [(0.5ft)(1.75ft)(187ft)] = 163.6 CF. Remove top layer of stones in barrier for 187 feet. New Stones at \$250- per -Each for 187 Unit(s) = \$46750. [(187ft) / (2ft/stone) x 2 rows] = 187 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 10 Day(s) = \$14750. 2 days removal 8 days installation.									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									



GRCA_0015_6.212_R_1.JPG

B	arrier ID:	GRCA-001	15-6.244-R								
	ite Name:	HERMIT	RMIT REST ROAD								
Increa	tion Date:	08/10/201	0	D	arrier Rating:	55.20					
		08/10/201	0	D	arrier Kating:	55.20					
Barrier Descripti				-							
	Туре:		ASONRY WITHOUT TE CORE WALL	Bar	rier Function:	TRAFFIC					
Barrier	Material:	STONE]	Post Material:	N/A					
	Blockout Type:	N/A			Length (ft.):	38					
Speed Lim		30		р	lacement with	OUTSIDE	OF CURVE				
	n (1911 11).	50			spect to Road:	OUTSIDE	of conve				
Hazard Behind	d Barrier:	EXTREME	8								
Barrier Crashwo	rthiness										
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO				
Level:			Test Level:		Crasl	nworthy?:					
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach tion Type:	NONE				
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A		tion Type:					
Type:	NONE		Crashhworthy?:	1 1/2 1							
Average Measur	ements										
Design Height (In.):	24		Width (In.):	21.0	Post Spa	cing (In.):	0.0				
Height (In.):	13.3		Lateral Offset (In.):	111.3		rade (%):	0.30				
Physical Condition	on										
	Align	ment and Height:	No deviation was observed for 30 linear ft and 4 to 6 in	•		2 in below des	ign height of 24 in				
		aking and	No breaking or cracking w	as observed.							
Barrier		Cracking:									
	Missing	Elements:	No missing elements were	observed.							
			-								
		• •	No corrosion or weathering	was observed							
		osion and eathering:		g was observed.							
	Align	ment and									
		Height:									
		1									
End Treatments		aking and Cracking:									
	Missing	Elements:									
	Com	ocion and									
		osion and eathering:									

B	arrier ID:	GRCA-001	GRCA-0015-6.244-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	08/10/201	0	Barrier	· Rating:	55.20				
Repair Recomme	endations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$24668Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardy design heigh		move and reset 38-ft of ston-	e masonry guardwall on 2 rov	ws of new sto	one to raise barr	tier to the 24-in			
Workorder:	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 34 CF = \$8500. [(0.5ft)(1.75ft)(35ft)] = 33.3 CF. Remove top layer of stones in barrier for 35 feet. New Stones at \$250- per -Each for 38 Unit(s) = \$9500. [(38ft) / (2ft/stone) x 2 rows] = 38 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation. 									
2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.										



GRCA_0015_6.244_R_1.JPG

Ba	arrier ID:	GRCA-001	5-7.029-L							
	te Name:	HERMIT	REST ROAD							
Inspect	ion Doto.	08/10/201	0	Rarr	ier Rating:	64.50				
Barrier Descripti		00/10/201	·		ici itatilig.					
	Туре:		ASONRY WITHOUT	Barrier Function:		TRAFFIC				
Barrier	Material:	STONE	E CORE WALL	Post Material: N/A		N/A				
	Blockout	N/A	Length (ft.):		430					
Speed Limi	Type: t (MPH):	30			ement with	BOTH INS	IDE AND OUTSIDE			
Hazard Behind	Barrier:	MEDIUM		Respect to Road:						
Barrier Crashwo										
Appropriate Test Level:			Barrier Test Level:	NCW		Is Barrier worthy?:	NO			
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach	NONE			
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A		51				
Average Measure	ements									
Design Height (In.):	24		Width (In.):	20.7	Post Spa	cing (In.):	0.0			
Height (In.):	16.2		Lateral Offset (In.):	2.7		rade (%):	1.30			
Physical Conditio	n									
		ment and Height:	No deviation was observed linear ft and below by 6 to	-	ier was 3 to 6 in	n below 24 in c	lesign height for 69			
Barrier		aking and Cracking:	No breaking or cracking w	as observed.						
	Missing	Elements:	No missing elements were	observed.						
		osion and eathering:	No corrosion or weathering	g was observed.						
	Align	ment and Height:								
End Treatments		aking and Cracking:								
	Missing	Elements:								
Corrrosion and Weathering:										

B	arrier ID:	GRCA-001	RCA-0015-7.029-L							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspec	tion Date:	08/10/201	0	Barrie	r Rating:	64.50				
Repair Recomme	endations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$192445Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardv design heigh		ove and reset 422-ft stone n	nasonry guardwall on 1 row o	of new stone t	to raise barrier	to the 24-in			
Workorder:	r: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 359 CF = \$89750. [(0.5ft)(1.7ft)(422ft)] = 358.7 CF. Remove top layer of stones in barrier for 422 feet. New Stones at \$250- per -Each for 211 Unit(s) = \$52750. [(422ft) / (2ft/stone) x 1 row] = 211 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 22 Day(s) = \$32450. 5 days removal 17 days installation.									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									

ROUTE 0015: HERMIT REST ROAD



GRCA_0015_7.029_L_1.JPG

Ba	arrier ID:	GRCA-001	5-7.029-R				
Rou	te Name:	HERMIT	REST ROAD				
Inspect	ion Date:	08/10/201	0	B	arrier Rating:	53.70	
Barrier Descripti		00,00,200					
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC	
Barrier	Material:	STONE			N/A		
	Blockout Type:	N/A	Length (ft.):		144		
Speed Limi		30			lacement with spect to Road:	TANGENT	,
Hazard Behind	Barrier:	EXTREME]				
Barrier Crashwo	rthiness						
Appropriate Test Level:			Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0
Height (In.):	16.0		Lateral Offset (In.):	40.0		rade (%):	3.10
Physical Condition	n						
	Align	ment and Height:	No deviation was observed height for 29 linear ft and 6				he 24 in design
Barrier		aking and Cracking:	No breaking cracking or ev	vidence of impact was o	observed.		
	Missing 1	Elements:	No missing elements were	observed.			
		osion and eathering:	Minor cracking of mortar l erosion was observed to co			nimal weather	ing of mortar. No
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing	Elements:					
	Corrrosion and Weathering:						

Ba	arrier ID:	GRCA-001	RCA-0015-7.029-R							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspect	ion Date:	Date: 08/10/2010 Barrier Rating: 53.70								
Repair Recomme	ndations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$52333Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardv adjacent 18-i		ove and reset 108-ft of ston-	e masonry guardwall on 1 ro	w of new ston	e to raise barri	er to the			
	 Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 95 CF = \$23750. [(0.5ft)(1.75ft)(108ft)] = 94.5 CF. Remove top layer of stones in barrier for 108 feet. New Stones at \$250- per -Each for 54 Unit(s) = \$13500. [(108ft) / (2ft/stone) x 1 row] = 54 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 7 Day(s) = \$10325. 2 days removal 5 days installation. 									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									



GRCA_0015_7.029_R_1.JPG

Ba	arrier ID:	GRCA-001	5-7.056-L							
Rou	ite Name:	HERMIT	REST ROAD							
Inspect	tion Date:	08/10/201	0	Barrie	er Rating:	42.00				
Barrier Descripti										
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		NON-TRAFFIC				
Barrier	Material:	STONE		Post Material:		N/A				
	Blockout Type:	N/A	Length (ft.):		537					
Speed Limi	it (MPH):	30			Placement with NON-TRAFFIC BARRIE espect to Road: Image: Comparison of the second					
Hazard Behind	Barrier:	LOW								
Barrier Crashwo	rthiness									
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A			
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:			Approach ion Type:	NONE			
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A						
Average Measure	ements									
Design Height (In.):	24		Width (In.):	21.0		cing (In.):	0.0			
Height (In.):	16.2		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00			
Physical Condition		ment and Height:	No deviation was observed for 183 ft and 6 to 12 in be	l in barrier alignment. The h low for 354 ft.	eight was 3 to	6 in below 24	in design height			
Barrier		aking and Cracking:	No breaking or cracking w	as observed.						
	Missing	Elements:	No missing elements were	observed.						
		osion and eathering:	No corrosion or weathering	g was observed.						
	Align	ment and Height:								
End Treatments		aking and Cracking:								
	Missing 1	Elements:								
		osion and eathering:								

Ba	arrier ID:	GRCA-001	GRCA-0015-7.056-L							
Rou	ite Name:	HERMIT	ERMIT REST ROAD							
Inspect	tion Date:	Den Date: 08/10/2010 Barrier Rating: 42.00								
Repair Recomme	endations	5								
Repair Action:	REPAIR		FMSSDEFERREDRepair\$164753Work Type:MAINTENANCECost:							
Brief Workorder:	Raise guardv adjacent 18-i		ove and reset 354-ft of stone	e masonry guardwall on 1 ro	w of new stor	ne to raise barri	er to the			
Workorder:	er: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 310 CF = \$77500. [(0.5ft)(1.75ft)(354ft)] = 309.8 CF. Remove top layer of stones in barrier for 354 feet. New Stones at \$250- per -Each for 177 Unit(s) = \$44250. [(354ft) / (2ft/stone) x 1 row]= 177 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 19 Day(s) = \$28025. 4 days removal 15 days installation.									
	2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.									



GRCA_0015_7.056_L_1.JPG

Ba	arrier ID:	GRCA-016	57-0.260-R					
Rou	ite Name:	PIMA PO	INT ROAD					
Inspect	tion Date:	08/10/201	0	Barri	er Rating:	65.10		
Barrier Descripti					0			
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier	Function:	TRAFFIC		
Barrier	Material:	STONE		Pos	t Material:	N/A		
	Blockout Type:	N/A		L	ength (ft.):	58		
Speed Limi	it (MPH):	15			ement with et to Road:	OUTSIDE OF CURVE		
Hazard Behind	l Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO	
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	24		Width (In.):	21.0	Post Spa	cing (In.):	0.0	
Height (In.):	14.6		Lateral Offset (In.):	0.0	Road G	rade (%):	8.50	
Physical Condition	on							
	Align	ment and Height:	No deviation was observed height for 5 linear ft and 6				below 24 in design	
Barrier		aking and Cracking:	No impact or breaking/crac	sking was observed.				
	Missing 1	Elements:	No missing elements were	observed.				
		osion and eathering:	Minor cracking less that 1/ erosion was observed com			thering of mor	tar and stones. No	
	Align	ment and Height:						
End Treatments		aking and Cracking:						
	Missing 1	Elements:						
		osion and eathering:						

Ba	arrier ID:	GRCA-016	7-0.260-R							
Rou	ite Name:	PIMA PO	IMA POINT ROAD							
Inspect	tion Date:	08/10/2010 Barrier Rating: 65.10								
Repair Recomme	endations	;								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$17793		
Brief Workorder:	Raise guardv 18-in height.		ove and reset 34-ft of stone	masonry guardwall on 1 row	of new stone	to raise barrie	er to the adjacent			
Workorder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 30 CF = \$7500. [(0.5ft)(1.75ft)(34ft)] = 29.8 CF. Remove top layer of stones in barrier for 34 feet. New Stones at \$250- per -Each for 17 Unit(s) = \$4250. [(34ft) / (2ft/stone) x 1 row]= 17 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.										
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ier repair co	sts only.				

ROUTE 0167: PIMA POINT ROAD



GRCA_0167_0.260_R_1.JPG

Ba	arrier ID:	GRCA-016	57-0.300-R					
Rou	ite Name:	PIMA PO	INT ROAD					
Inspect	tion Date:	08/10/201	0	Ba	rrier Rating:	50.00		
Barrier Descripti								
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC		
Barrier	Material:	STONE		Рс	ost Material:	N/A		
	Blockout Type:	N/A			Length (ft.):	33		
Speed Limi	it (MPH):	15			cement with ect to Road:	OUTSIDE	OF CURVE	
Hazard Behind	Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO	
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	24		Width (In.):	21.0		cing (In.):	0.0	
Height (In.):	18.2		Lateral Offset (In.):	0.0	Road G	rade (%):	4.70	
Physical Condition	on							
	Align	ment and Height:	No deviation in alignment ft with an 8 ft section of hi			24 in design	height for 25 linear	
Barrier		aking and Cracking:						
	Missing	Elements:	No missing elements were	observed.				
		osion and eathering:	No corrosion or weathering	g was observed.				
	Align	ment and Height:						
End Treatments		aking and Cracking:						
	Missing	Elements:						
		osion and eathering:						

Barrier	D: GRCA-01	67-0.300-R							
Route Nat	ne: PIMA PC	PIMA POINT ROAD							
Inspection Da	te: 08/10/201	0	Ba	arrier Rating:	50.00				
Repair Recommendati	ons								
RepairNO A0Action:	TION	FMSS Work Type:	N/A		Repair Cost:	\$0			
Brief Workorder:									
Workorder:									
200	8 cost estimate (ASTM Class D), prelimin	ary for comparison	to other repair co	osts only.				

ROUTE 0167: PIMA POINT ROAD



GRCA_0167_0.300_R_1.JPG

B	arrier ID:	GRCA-016	58-0.134-R				
	ite Name:	MOHAVE	E POINT ROAD				
Increa	tion Date:	00/10/201	0		Barrier Rating:	50.00	
		09/10/201	0		barrier Kating:	30.00	
Barrier Descript							
	Туре:		ASONRY WITHOUT Barrier Function:		TRAFFIC		
Barrier	Material:	STONE			Post Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	72	
Speed Lim		15			Placement with	OUTSIDE	OF CURVE
	n (1911 11).	10			Respect to Road:	OUTSIDE	of conve
Hazard Behind	d Barrier:	EXTREME	8				
Barrier Crashwo	rthiness						
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO
Level:			Test Level:		Crasl	nworthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt	N/A		Approach	NONE
Type: Ending End Trtmt	NONE		Crashhworthy?: Ending End Trtmt	N/A	I ransit	ion Type:	
Type:	NONE		Crashhworthy?:	11/21			
Average Measur	ements						
Design Height (In.):	24		Width (In.):	21.7	Post Spa	cing (In.):	0.0
Height (In.):	17.2		Lateral Offset (In.):	0.0		rade (%):	1.60
Physical Condition	Dn						
	Align	ment and Height:	No deviation in barrier alig linear ft and below by 3 to		d. Barrier was 7 to 9 in	n below 24 in	design height for 32
		aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing	Elements:	No missing elements were	observed.			
	Carry	osion and	No corrosion or weathering	was observed			
		eathering:		5 was observed.			
	Align	ment and Height:					
End Treatments		aking and					
Enu i reatments	'	Cracking:					
	Missing	Elements:					
	Corrr	osion and					
		eathering:					

B	arrier ID:	GRCA-016	GRCA-0168-0.134-R							
Rou	ite Name:	MOHAVE	IOHAVE POINT ROAD							
Inspec	tion Date:	Date: 09/10/2010 Barrier Rating: 50.00								
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$46943			
Brief Workorder:			ove and reset 40-ft of stone the higher stone design to re	masonry guardwall on concr tain the design.	rete footer to a	adjacent 18-in he	eight. Include			
Workorder:	r: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 145 CF = \$36250. 40 ft x (24/12) ft x (21.7/12) ft = 145 cf structural Concrete at \$1000- per -Cu. Yd. for 2 CY = \$2000. (40 ft x (6/12) ft x (21.7/12) ft) / 27 = 1.34 cy Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.									
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for comparison to oth	ner repair co	osts only.				

ROUTE 0168: MOHAVE POINT ROAD



GRCA_0168_0.134_R_1.JPG

Ba	rrier ID:	GRCA-016	69-0.068-L				
	te Name:		MEMORIAL ROAD				
					D - 4	11.50	
		09/10/201	U	Barrie	er Rating:	11.50	
Barrier Description	on						
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier	Function:	NON-TRAFFIC	
Barrier	Material:	STONE		Post	Material:	N/A	
	Blockout Type:	N/A		Le	ength (ft.):	304	
Speed Limi		15			Placement with NON-TRAFFIC BARF Respect to Road:		
Hazard Behind	Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A		51	
Average Measure	ments		Crushi worthy		<u> </u>		
Design Height (In.):	24		Width (In.):	22.0	De et Cere	· · · · (I · ·) ·	0.0
Height (In.):	20.7		Lateral Offset (In.):	0.0		cing (In.): rade (%):	0.00
Physical Conditio			Euterur Offset (III.).		Roud G	i uuo (70).	
		ment and Height:	No deviation was observed design height for 100 ft bet stone design.	in barrier alignment. The laween 1 to 3 in below for 18			
Barrier		aking and Cracking:					
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	No corrosion or weathering	g was observed.			
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing 1	Elements:					
		osion and eathering:					

Barrier I): GRCA-01	69-0.068-L				
Route Nan	e: POWELL	MEMORIAL ROAD				
Inspection Da	e: 09/10/201	0	Barri	ier Rating:	11.50	
Repair Recommendation	ns					
RepairNO ACAction:	TION	FMSS Work Type:	N/A		Repair Cost:	\$0
Brief N/A Workorder:						
Workorder:						
200	cost estimate (ASTM Class D), prelimin	ary for comparison to o	other repair co	osts only.	

Grand Canyon National Park ROUTE 0169: POWELL MEMORIAL ROAD



GRCA_0169_0.068_L_1.JPG

Route I Inspection Barrier Description	n Date: 0		MEMORIAL ROAD					
Barrier Description		9/10/2010						
Barrier Description)	Barria	er Rating:	50.00		
-		<i>9/10/2010</i>)	Dailie	ri Katilig.	50.00		
	T							
			ASONRY WITHOUT E CORE WALL	Barrier	Function:	TRAFFIC		
Barrier Ma	aterial: S	STONE		Post	Material:	N/A		
	ockout N Type:	J/A		Le	ngth (ft.):	53		
Speed Limit (N		15			ment with t to Road:	OUTSIDE	OF CURVE	
Hazard Behind Ba	arrier: E	EXTREME		Respec	to Road.			
Barrier Crashworth	I							
Appropriate Test TL Level:			Barrier Test Level:	NCW		Is Barrier	NO	
Beg. End Trtmt NC	ONE		Is Beg. End Trtmt	N/A		worthy?: Approach	NONE	
Type: Ending End Trtmt	ONE		Crashhworthy?: Ending End Trtmt	N/A	1 ransit	ion Type:		
Type:	JINE		Crashhworthy?:	IV/A				
Average Measurem	ents							
Design Height (In.): 24			Width (In.):	21.7	Post Spa	cing (In.):	0.0	
Height (In.): 19	9.2		Lateral Offset (In.):	16.0		rade (%):	3.10	
Physical Condition								
			•	nment was observed. Barrie on end of higher stone desi		n below 24 in	design height for 45	
Barrier		king and racking:						
M	Aissing El	ements:	No missing elements were	observed.				
	Corrros Weat	sion and thering:	No corrosion or weathering	was observed.				
		nent and Height:						
End Treatments		king and racking:						
M	Aissing El	ements:						
		sion and thering:						

Barı	rier ID:	GRCA-016	9-0.069-R				
Route	e Name:	POWELL	MEMORIAL ROAD				
Inspectio	n Date:	09/10/2010)]	Barrier Rating:	50.00	
Repair Recomment	dations						
Repair N Action:	IO ACTIO	N	FMSS Work Type:	N/A		Repair Cost:	\$0
Brief Workorder:	//A						
Workorder:							
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for compariso	on to other repair co	osts only.	

Grand Canyon National Park ROUTE 0169: POWELL MEMORIAL ROAD



GRCA_0169_0.069_R_1.JPG

Ba	arrier ID:	GRCA-016	69-0.121-R				
Rou	te Name:	POWELL	MEMORIAL ROAD				
Inspect	ion Date:	09/10/201	0		Barrier Rating:	40.00	
Barrier Description		09/10/201		-	barrier Rating.	10.00	
Darrier Descripti		STONE M					
	Туре:		ASONRY WITHOUT TE CORE WALL	Da	rrier Function:	TRAFFIC	
Barrier	Material:	STONE			Post Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	30	
Speed Limi		15			Placement with espect to Road:	INSIDE OF	F CURVE
Hazard Behind	Barrier:	EXTREME]			1	
Barrier Crashwo	rthiness						
Appropriate Test Level:			Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Sna	cing (In.):	0.0
Height (In.):	19.7		Lateral Offset (In.):	0.0		rade (%):	4.30
Physical Conditio	n						
	Align	ment and Height:	No deviation was observed height of 24 in for 22 linea				
Barrier		aking and Cracking:					
	Missing 1	Elements:	No missing elements were	observed.			
		osion and eathering:	Minor cracking of mortar l stones. No erosion was ob			nimal weather	ing of mortar and
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing 1	Elements:					
		osion and eathering:					

Barr	rier ID:	GRCA-016	69-0.121-R				
Route	Name:	POWELL	MEMORIAL ROAD				
Inspectior	n Date:	09/10/2010	0		Barrier Rating:	40.00	
Repair Recommend	dations						
RepairNOAction:	O ACTIO	N	FMSS Work Type:	N/A		Repair Cost:	\$0
Brief Workorder:	/A						
Workorder:							
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparise	on to other repair co	osts only.	

Grand Canyon National Park ROUTE 0169: POWELL MEMORIAL ROAD



GRCA_0169_0.121_R_1.JPG

Ba	arrier ID:	GRCA-026	64-0.638-R				
	ite Name:		TEW POINT ROAD				
Inspect	ion Date:	10/10/201	0	Barri	er Rating:	4.10	
Barrier Descripti		10/10/2010	0	Darri	er Rating.	1.10	
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier	Function:	NON-TRA	FFIC
Barrier	Material:	STONE		Post	Material:	N/A	
	Blockout Type:	N/A		L	ength (ft.):	13	
Speed Limi	it (MPH):	25			ment with t to Road:	NON-TRA	FFIC BARRIER
Hazard Behind	Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	23.0	Post Spa	cing (In.):	0.0
Height (In.):	23.2		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00
Physical Condition	on						
	Align	ment and Height:	No deviation was observed height to 3 in below.	in barrier alignment. Barri	er height range	ed from 1 in al	pove 24 in design
Barrier		aking and Cracking:	No cracked or broken barri	er elements were observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	Minimal weathering of mo	rtar and stones was observe	d.		
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing	Elements:					
		osion and eathering:					

Barrier II	GRCA-02	64-0.638-R				
Route Nam	GRAND	/IEW POINT ROAD				
Inspection Dat	: 10/10/201	0	B	Barrier Rating:	4.10	
Repair Recommendation	ns					
Repair NO ACT Action: NO ACT	ION	FMSS Work Type:			Repair Cost:	\$0
Brief N/A Workorder:						
Workorder:						
2008	cost estimate (ASTM Class D), prelimin	ary for compariso	n to other repair co	osts only.	

Grand Canyon National Park ROUTE 0264: GRANDVIEW POINT ROAD



GRCA_0264_0.638_R_1.JPG

Ba	arrier ID:	GRCA-026	64-0.682-R				
Rou	ite Name:	GRANDV	TEW POINT ROAD				
Inspect	ion Date.	10/10/201	0		Barrier Rating:	32.70	
Barrier Descripti		10/10/201			Darrier Rating.	52.70	
		STONE M				TRAFFIC	
	Туре:		ASONRY WITHOUT TE CORE WALL	Da	rrier Function:	TRAFFIC	
Barrier	Material:	STONE			Post Material:	N/A	
	Blockout Type:	N/A			Length (ft.):	34	
Speed Limi		25			Placement with espect to Road:	OUTSIDE	OF CURVE
Hazard Behind	Barrier:	EXTREME]				
Barrier Crashwo	rth <u>iness</u>						
Appropriate Test Level:			Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A		JI	
Average Measure	ements						
Design Height (In.):	24		Width (In.):	22.2	Post Sna	cing (In.):	0.0
Height (In.):	25.0		Lateral Offset (In.):	0.0		rade (%):	1.50
Physical Condition	on						
	Align	ment and Height:	No deviation in barrier alig in.	nment was observed	. Barrier is at or abov	ve 24 in design	height by up to 2
Barrier		aking and Cracking:	No breaking or cracking w	as observed.			
	Missing	Elements:	No missing elements were	observed.			
		osion and eathering:	1/2 cubic ft stone was miss	ing from end of barr	ier in small area of de	teriorated grou	ıt.
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing]	Elements:					
		osion and eathering:					

B	arrier ID:	rier ID: GRCA-0264-0.682-R							
Rou	ite Name:	GRANDV	TEW POINT ROAD						
Inspec	tion Date:	10/10/201	0	Barrie	r Rating:	32.70			
Repair Recomme	endations	5							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$2173		
Brief Workorder:	Replace 1/2 of	cubic feet of n	issing stone in barrier.						
Workorder:		Stone Masonry w/o Concrete Core at \$500- per -Lin. Ft. for 1 LF = $$500$. Replace 1/2 cubic feet of missing stone and mortar. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.							
	2008 cos	st estimate (A	ASTM Class D), prelimin	ary for comparison to otl	her repair co	sts only.			

Grand Canyon National Park ROUTE 0264: GRANDVIEW POINT ROAD



GRCA_0264_0.682_R_1.JPG

			6ZZ-0.023-R				
1	Name:	BRIGHT A	ANGEL LOOP ROAD	S			
T	n Datas	00/10/2014	0	D	n Datin a	16.80	
		08/10/2010	0	Barrie	r Rating:	10.80	
Barrier Description							
			ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC	
Barrier Ma	aterial:	STONE	Post Material:		N/A		
BI	lockout Type:	N/A		Le	ngth (ft.):	85	
Speed Limit ((MPH):	15			ment with t to Road:	OUTSIDE	OF CURVE
Hazard Behind B	Barrier:	LOW					
Barrier Crashwort	hiness						
Appropriate Test TI Level:	L-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO
Beg. End Trtmt No Type:	ONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Ending End Trtmt No Type:	ONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measurem	nents						
Design Height (In.): 24			Width (In.):	16.2	Post Spa	cing (In.):	0.0
Height (In.): 22	.3.7		Lateral Offset (In.):	100.6		rade (%):	6.10
Physical Condition							
	Align	ment and Height:	No deviation was observed design height to 2 in below	in barrier alignment. The h	eight ranged b	etween 1 in al	pove the 24 in
Barrier		iking and Cracking:	No breaking or cracking wa	as observed.			
N	Missing F	Elements:	No missing elements were	observed.			
		osion and athering:	No corrosion or weathering	was observed.			
	Align	ment and Height:					
End Treatments		king and Cracking:					
N	Missing F	Elements:					
		osion and athering:					

Ba	arrier ID:	GRCA-043	6ZZ-0.023-R				
Rou	ite Name:	BRIGHT A	ANGEL LOOP ROAD	S			
Inspect	tion Date:	08/10/201	0]	Barrier Rating: 16.80		
Repair Recomme	endations	;					
Repair Action:	NO ACTIC	DN	FMSS Work Type:	N/A		Repair Cost:	\$0
Brief Workorder:	N/A						
Workorder:							
	2008 co	st estimate (A	ASTM Class D), prelimin	ary for compariso	on to other repair co	osts only.	

Grand Canyon National Park ROUTE 0436ZZ: BRIGHT ANGEL LOOP ROADS



GRCA_0436ZZ_0.023_R_1.JPG

Ba	arrier ID:	GRCA-050	00-0.117-L								
Rou	ite Name:	VILLAGE	AGE LOOP DRIVE								
Inspect	tion Date:	08/10/201	0	Ba	rrier Rating:	52.20					
Barrier Descripti	on										
	Type:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC					
Barrier	Material:	STONE	Post Material:		N/A						
	Blockout Type:	N/A			Length (ft.):	960					
Speed Limi	it (MPH):	20			acement with bect to Road:	TANGENI					
Hazard Behind	Barrier:	MEDIUM									
Barrier Crashwo	rthiness										
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO				
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE				
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A							
Average Measure	ements										
Design Height (In.):	24		Width (In.):	21.6		cing (In.):	0.0				
Height (In.):	18.6		Lateral Offset (In.):	0.0	Road G	rade (%):	0.50				
Physical Condition		ment and Height:									
Barrier		aking and Cracking:	No breaking/cracking was	observed.							
	Missing	Elements:	There were 2 missing store 10 inches high.	es one was 3.5 feet long	by 15 ines high an	d the other wa	as 1.6 feet long by				
		osion and eathering:	Occasional deteriorated mo	ortar which caused the m	iissing stones a tot	al of 1 sq yd.					
	Align	ment and Height:									
End Treatments		aking and Cracking:									
	Missing	Elements:									
		osion and eathering:									

B	arrier ID:	er ID: GRCA-0500-0.117-L								
Rou	ite Name:	VILLAGE	E LOOP DRIVE							
Inspec	tion Date:	Date: 08/10/2010 Barrier Rating: 52.20								
Repair Recomme	endations	5								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$177557			
Brief Workorder:		aise guardwall 2-in. Remove and reset 373-ft of stone masonry guardwall on 1 row of new stone to raise barrier to the jacent 18-in height. Replace 5 feet of missing stone guardwall and repoint 1 sq yd of barrier.								
Workorder:	rder: Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 336 CF = \$84000. [(0.5ft)(1.8ft)(373ft)] = 335.7 CF. Remove top layer of stones in barrier for 373 feet. New Stones at \$250- per -Each for 187 Unit(s) = \$46750. [(373ft) / (2ft/stone) x 1 row] = 187 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Stone Masonry w/o Concrete Core at \$500- per -Lin. Ft. for 5 LF = \$2500. Replace 5 feet of missing stone guardwall. Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. Re-point missing mortar sections. Low Speed Traffic Control at \$1475- per -Day for 19 Day(s) = \$28025. 4 days removal 15 days installation.									
				ary for comparison to oth						

ROUTE 0500: VILLAGE LOOP DRIVE



GRCA_0500_0.117_L_1.JPG

Ba	rrier ID:	GRCA-050	00-0.395-R								
	te Name:	VILLAGE	LAGE LOOP DRIVE								
Inspect	ion Date:	08/10/201	0		Barrier Rating:	37.00					
Barrier Description	on										
	Туре:		ASONRY WITHOUT E CORE WALL	Barrier Function:		TRAFFIC					
Barrier I	Material:	STONE			Post Material:	N/A					
	Blockout Type:	N/A			Length (ft.):	443					
Speed Limit	t (MPH):	20			Placement with espect to Road:	TANGENT	,				
Hazard Behind	Barrier:	LOW									
Barrier Crashwor	rthiness										
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO				
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE				
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A							
Average Measure	ements										
Design Height (In.):	24		Width (In.):	22.0	Post Spa	cing (In.):	0.0				
Height (In.):	19.0		Lateral Offset (In.):	147.6	Road G	rade (%):	4.30				
Physical Conditio											
	Align	ment and Height:	No deviation was observed height for 201 linear ft. Ba	-	-		ow 24 in design				
Barrier		aking and Cracking:	No breaking cracking or ev	idence of impact wa	s observed.						
-	Missing	Elements:	There were 36 missing stor	nes and 1 sq. ft. of m	issing grout observed.						
-		osion and eathering:	Some grout was deteriorati tree was growing under ba			t. No erosion	was observed. A				
	Align	ment and Height:									
End Treatments		aking and Cracking:									
	Missing 1	Elements:									
-		osion and eathering:									

B	arrier ID:	er ID: GRCA-0500-0.395-R							
Rou	ite Name:	VILLAGE	E LOOP DRIVE						
Inspec	tion Date:	08/10/201	08/10/2010 Barrier Rating: 37.00						
Repair Recomme	endations								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:	\$108092		
Brief Workorder:	Ŭ		ove and reset 93-ft of stone ace 1 sq. ft. of grout.	masonry guardwall on conc	rete footer to a	adjacent 18-in	height. Replace		
Workorder:	Structural Co Stone Mason 3 total linear Re-Point Ma	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 341 CF = \$85250. (93ft)(2ft)(1.8ft) = 341 CF. Structural Concrete at \$1000- per -Cu. Yd. for 4 CY = \$4000. (93ft)(.5ft)(1.8ft) / 27 = 3.15 CY. Stone Masonry w/o Concrete Core at \$500- per -Lin. Ft. for 3 LF = \$1500. Replace 36 missing stones approximately equaling total linear feet. Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. Replace missing mortar. Low Speed Traffic Control at \$1475- per -Day for 5 Day(s) = \$7375. 1 day to remove 4 days to reset.							
	-			ary for comparison to otl					

ROUTE 0500: VILLAGE LOOP DRIVE



GRCA_0500_0.395_R_1.JPG

B	arrier ID:	GRCA-050	00-1.297-L				
	ite Name:	VILLAGE	E LOOP DRIVE				
Inspec	tion Date:	08/10/201	0	T	Barrier Rating:	26.70	
Barrier Descripti		08/10/201	0	1	Darrier Katilig.	20.70	
Darrier Descripti		GTONE M					
	Type:		ASONRY WITHOUT Barrier Function: TE CORE WALL		TRAFFIC		
Barrier	Material:	STONE		Post Material:		N/A	
	Blockout Type:	N/A			Length (ft.):	157	
Speed Lim		20			Placement with	INSIDE OF	FCURVE
		-			espect to Road:		
Hazard Behind	d Barrier:	MEDIUM					
Barrier Crashwo	rthiness						
Appropriate Test	TL-1		Barrier	NCW		Is Barrier	NO
Level:			Test Level:		Crast	worthy?:	
Beg. End Trtmt	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE
Type: Ending End Trtmt	NONE		Ending End Trtmt	N/A		ion Type:	
Type:	TIONE		Crashhworthy?:	11/21			
Average Measur	ements						
Design Height (In.):	24		Width (In.):	21.2	Post Spa	cing (In.):	0.0
Height (In.):	20.0		Lateral Offset (In.):	63.2		rade (%):	0.50
Physical Condition	on						
	Align	ment and Height:	No deviation was observed linear ft and below by 6 to	-	. Barrier was 3 to 6 in	n below 24 in	design height for 68
		aking and	No breaking or cracking w	as observed.			
Barrier		Cracking:					
	Missing	Elements:	Barrier was missing one se	ction of 2 square feet	of grout.		
				*			
			No corrosion or weathering				
		osion and eathering:	no corrosion or weathering	g was observed.			
	Align	ment and					
		Height:					
	Bre	aking and					
End Treatments		Cracking:					
	Missing	Elements:					
		osion and					
	We	eathering:					

B	arrier ID:	ID: GRCA-0500-1.297-L								
Rou	ite Name:	VILLAGE	LLAGE LOOP DRIVE							
Inspec	tion Date:	08/10/2010 Barrier Rating: 26.70								
Repair Recomme	endations	}								
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$11924		
Brief Workorder:	0	vall 2-in. Rem Repoint 2 sq.		masonry guardwall on 1 rov	v of new stone	to raise barrie	er to the adjacent			
Workorder:	top layer of s New Stones wall to increa Re-Point Ma	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 20 CF = \$5000. [(0.5ft)(1.8ft)(22ft)] = 19.8 CF. Remove top layer of stones in barrier for 22 feet. New Stones at \$250- per -Each for 11 Unit(s) = \$2750. [(22ft) / (2ft/stone) x 1 row] = 11 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950. 1 day removal 1 day installation.								
	-			ary for comparison to otl						

ROUTE 0500: VILLAGE LOOP DRIVE



GRCA_0500_1.297_L_1.JPG

Ba	arrier ID:	GRCA-091)915-0.000-P1				
Rou	ite Name:	HOPI POI	NT PARKING				
Inspection Date: 09/10/20		09/10/2010		Barrier Rating:		24.30	
Barrier Descripti							
Type: STONE N			ASONRY WITHOUT E CORE WALL	Barrier Function:		NON-TRAFFIC	
		STONE		Post Material:		N/A	
Blockout Type:		N/A		Length (ft.):		0	
Speed Limit (MPH):		15		Placement with Respect to Road:		NON-TRAFFIC BARRIER	
Hazard Behind	l Barrier:	N/A					
Barrier Crashwo	rthiness						
Appropriate Test Level:	TL-1		Barrier Test Level:	N/A		Is Barrier worthy?:	N/A
Beg. End Trtmt Type:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach tion Type:	NONE
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A			
Average Measure	ements						
Design Height (In.):	24		Width (In.):	21.0		cing (In.):	0.0
Height (In.):	17.0		Lateral Offset (In.):	0.0	Road G	rade (%):	0.00
Physical Condition		ment and Height:	No deviation was observed throughout.	l in barrier alignment. The	height was 7 in	below the 24	in design height
Barrier		aking and Cracking:	No breaking or cracking was observed.				
	Missing	Elements:	No missing elements were observed.				
		rosion and Mortar was completely deteriorated for 9 linear ft total in 2 sections. Rocks remained stacked. eathering:					ed stacked.
	Align	ment and Height:					
End Treatments		aking and Cracking:					
	Missing	Elements:					
		osion and eathering:					

Ba	arrier ID:	GRCA-0915-0.000-P1						
Route Name:		HOPI POINT PARKING						
Inspection Date:		09/10/2010		Barrier Rating:		24.30		
Repair Recomme	Repair Recommendations							
Repair Action:	REPAIR			DEFERRED MAINTENANCE		Repair Cost:		\$134613
Brief Workorder:	Raise guardwall 7-in. Remove and reset 291-ft of stone masonry guardwall on 1 row of new stone to raise barrier to the 24-in design height.							
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 255 CF = \$63750. [(0.5ft)(1.75ft)(291ft)] = 254.6 CF. Remove top layer of stones in barrier for 291 feet. New Stones at \$250- per -Each for 146 Unit(s) = \$36500. [(291ft) / (2ft/stone) x 1 row] = 146 stones. Insert new stone on retaining wall to increase barrier Low Speed Traffic Control at \$1475- per -Day for 15 Day(s) = \$22125. 3 days removal 12 days installation.							
2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.								

ROUTE 0915: HOPI POINT PARKING



GRCA_0915_0.000_P1_1.JPG

Barrier ID: GRC			GRCA-0915-0.000-P2					
Rou	te Name:	HOPI POI	INT PARKING					
Inspection Date: 0		09/10/2010		Barrier Rating:		48.70		
Barrier Descripti				·				
Type: STC		STONE MASONRY WITHOUT CONCRETE CORE WALL		Barrier Function:		TRAFFIC		
		STONE		Post Material:		N/A		
Blockout Type:		N/A		Length (ft.):		0		
Speed Limit (MPH):		15		Placement with Respect to Road:		OUTSIDE OF CURVE		
Hazard Behind	Barrier:	EXTREME						
Barrier Crashwo	rthiness							
Appropriate Test Level:	TL-1		Barrier Test Level:	NCW		Is Barrier worthy?:	NO	
Туре:	NONE		Is Beg. End Trtmt Crashhworthy?:	N/A		Approach ion Type:	NONE	
Ending End Trtmt Type:	NONE		Ending End Trtmt Crashhworthy?:	N/A				
Average Measure	ements							
Design Height (In.):	24		Width (In.):	21.7		cing (In.):	0.0	
Height (In.):	18.0		Lateral Offset (In.):	0.0	Road G	rade (%):	1.80	
Physical Conditio								
	Align	ment and Height:						
Barrier		aking and Cracking:						
	Missing 1	Elements:	No missing elements were observed.					
		osion and eathering:	No corrosion or weathering	g was observed.				
	Align	ment and Height:						
End Treatments	Breaking and Cracking:							
	Missing 1	Elements:						
		osion and eathering:						

B	arrier ID:	GRCA-0915-0.000-P2					
Route Name:		HOPI POINT PARKING					
Inspection Date:		09/10/2010		Barrier Rating:		48.70	
Repair Recomme	endations	5					
Repair	REPAIR		FMSS	DEFERRED		Repair	\$63184
Action:			Work Type:	MAINTENANCE		Cost:	
Brief	Raise guardwall 3-in. Remove and reset 129-ft of stone masonry guardwall on 1 row of new stone to raise barrier to the						
Workorder:	adjacent 18-i	jacent 18-in height. Repoint 1 sq. yd. of guardwall with cracked or missing grout.					
Workorder:		Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 117 CF = \$29250. [(0.5ft)(1.8ft)(129ft)] = 116.1 CF.					
	Remove top layer of stones in barrier for 129 feet.						
	New Stones at \$250- per -Each for 65 Unit(s) = 129 [(129ft) / (2ft/stone) x 1 row] = 65 stones. Insert new stone on						
	U U	taining wall to increase barrier height then reset top layer of barrier.					
		Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. Repoint 1 SY. of guardwall.					
Low Speed Traffic Control at \$1475- per -Day for 8 Day(s) = \$11800. 2 days removal 6 days installation							
2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.							

Grand Canyon National Park ROUTE 0915: HOPI POINT PARKING



GRCA_0915_0.000_P2_1.JPG

Appendix A Summary of GIP Definitions and Assessment



Grand Canyon National Park



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

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

• Stone Masonry, w/o Concrete Core Wall

• Stone Masonry, w/ Concrete Core Wall

• Concrete, with Simulated Stone Face

• W-Beam (Double Face), Strong Post

• Steel-Backed Timber (Double Face)

• Other: *Completed by field crew*

Random Rubble Cavity Wall

• Concrete Barrier

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.

A-1

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

BLOCKOUT TYPE

The type of blockout or of what it is comprised:

- Wood
- Plastic

Steel

N/A

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

Other: *Completed by field crew*

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

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 •

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 •

IS BARRIER CRASHWORTHY

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

• Yes

No

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

TL-3, 50 mph and higher •

N/A – Non-Traffic Barrier

High

Extreme

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

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

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

N/A

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

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

- Concrete/Masonry, Thrie Beam

Concrete/Masonry, SBT

- Other: *Completed by field crew*
- None

•

N/A

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

<u>The barrier performs as intended.</u> 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.

<u>The end treatment performs as intended.</u> 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

<u>The barrier is slightly compromised.</u> 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. <u>The end treatment is slightly compromised.</u> 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

<u>The barrier is not functional.</u> 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.

<u>The end treatment is not functional.</u> 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).

and blocks).	GOOD	FAIR	POOR
Alignment/Design H	eight		
	• Alignment off by less than 6"	• Alignment off by 6"-12"	• Alignment off by more than 12"
	Within 1" of <u>design</u> <u>height</u>	• Less than 3" lower than <u>design height</u>	• Greater than 3" lower than <u>design height</u>
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/We	eathering, all posts, rails ar	nd blocks – due to aging	Â
	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).

Condition and Severity	y Distress Table for Rigid Concrete Barriers (including pre-cast).							
	GOOD	FAIR	POOR					
Alignment/Design H	leight							
	• Alignment off by less than 6"	• Alignment off by 6"-12"	• Alignment off by more than 12"					
	Within 1" of <i>design</i> <u>height</u>	• Less than 3" lower than <u>design height</u>	• Greater than 3" lower than <u>design height</u>					
Breaking/Cracking-	- due to impact loading							
	• Minor cracks (less than 1/4") 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/W	eathering – 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).

masonry barriers).	GOOD	FAIR	POOR
Alignment/Design H	leight		
	• Alignment (off by less than 6")	• Alignment (off by 6"- 12")	• Alignment (off by more than 12")
	• Within 3" of <u>design</u> <u>height</u>	• Between 3.1 - 6" lower than <i>design height</i>	• Greater than 6.1" lower than <u>design height</u>
Breaking/Cracking -	– due to impact loading		
	• Minor cracks (less than ¹ / ₄ ") present	• Cracks, less than ¹ / ₂ " present	• Cracks greater than ¹ /2" 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/We	eathering – 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).

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/We	eathering – 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

, i i i i i i i i i i i i i i i i i i i	GOOD	FAIR	nd terminals). 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	e 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/Weathe	ering – 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 Flexible End Treatments, (including cable end terminals).

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

Condition and Severity	Distress Table for Semi-Rigid		
	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 <u>design</u> height	• Less than 3" lower than <u>design height</u>	• Greater than 3" lower than <u>design height</u>
For <i>Aesthetic Barriers</i> (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/We	eathering – 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	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	Tangent	0.0
Roadway Geometry	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	4.1 – ft and greater	0.0
Traveled Way	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	0 – 1-in lower	0.0
test level height)	1.1 - 4-in lower	4.4
test level height)	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	0-25	0.0
(based on design height)	26 - 200	4.4
(oused on design height)	201 - 400	8.6
	401 - 600	12.9
	601 - 800	17.1
	801 and above	21.5
Barrier Conformance with Current		0.0
Barrier Conformance with Current Crashworthiness Criteria	Yes No	0.0 5.7

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
А	90-100	 Identify measures other than barrier replacement that could be taken to reduce risk (including engineering countermeasures). Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 90.
	Below 90	 Identify measures that could be taken to reduce risk (including engineered countermeasures). Identify repairs needed to improve physical condition/maintain historic integrity. When condition is good and risk is acceptable, no action is necessary.
В	70-100	 Identify measures that could be taken to reduce risk (including engineered countermeasures). Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 70.
	Below 70	 Identify measures that could be taken to reduce risk (including engineered countermeasures). Identify repairs needed to improve physical condition/maintain historic integrity. When condition is good and risk is acceptable, no action is necessary.
С	50-100	 Identify measures that could be taken to reduce risk (including engineered countermeasures). Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 50.
	Below 50	 Identify measures that could be taken to reduce risk (including engineered countermeasures). Identify repairs needed to improve physical condition/maintain historic integrity. 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.