

ZION

GIP Report

NPS Guardwall/Rail Inventory Program Zion National Park



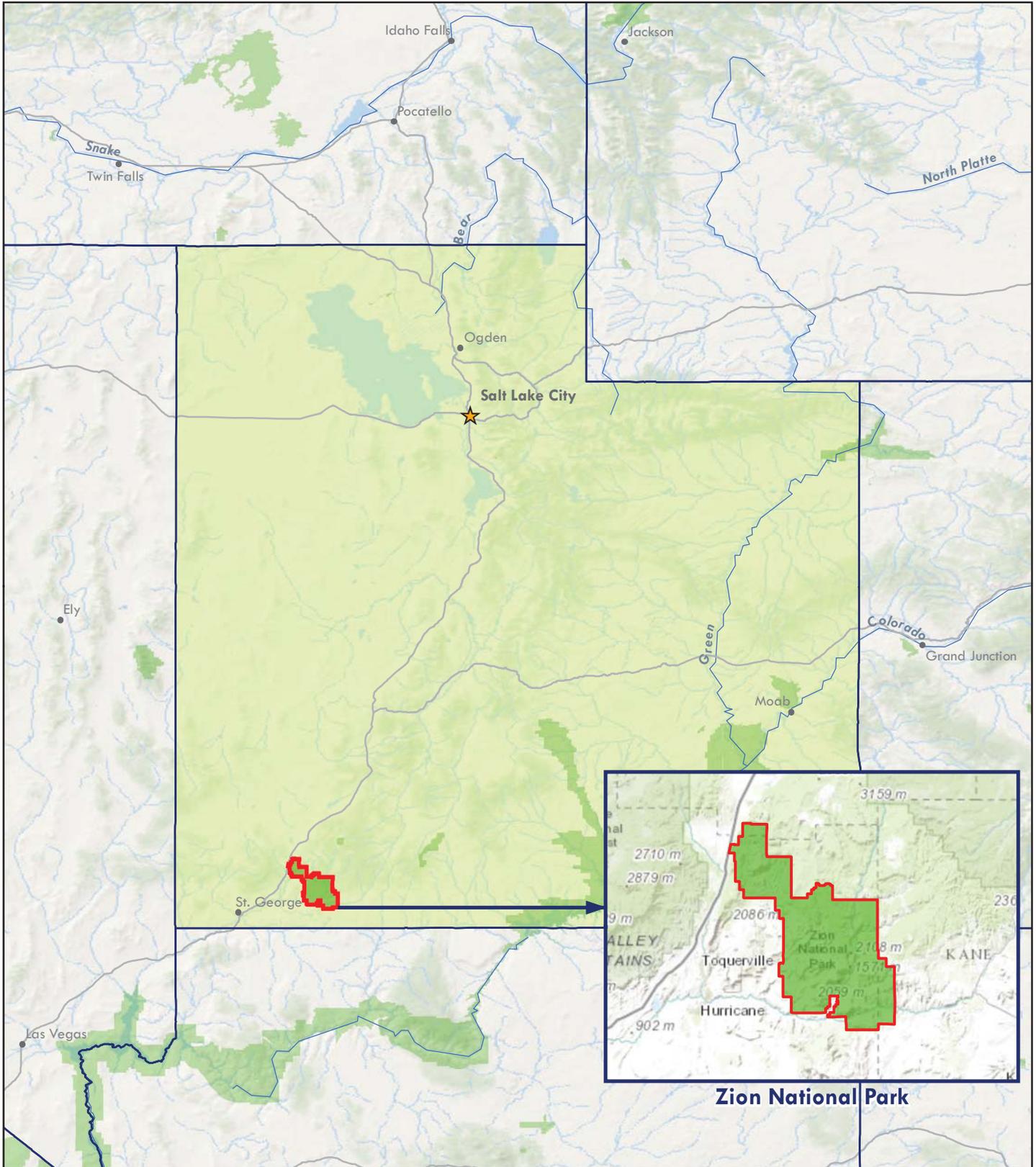
**Federal Lands Highway
Road Inventory Program**

Prepared By:

**Federal Highway Administration
Eastern Federal Lands Highway Division
Road Inventory Program (RIP)**

**Data Collection Date: April 2010
Report Date: November 2015**

Zion National Park in Utah



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



Zion National Park



**Federal Lands Highway
Road Inventory Program**

Introduction

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

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

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

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

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

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

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

Park Barrier Location Maps



Zion National Park

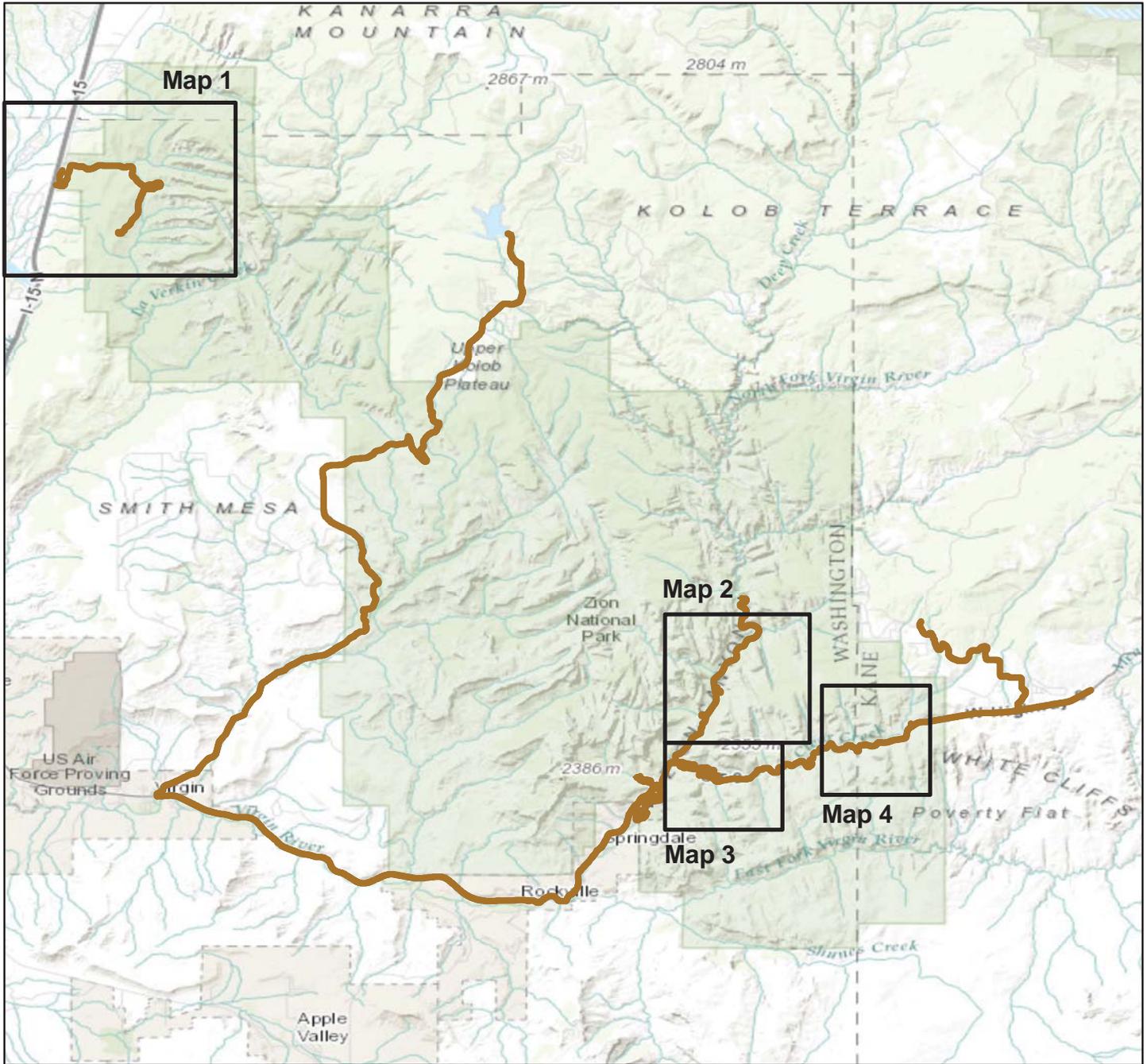


**Federal Lands Highway
Road Inventory Program**

Zion 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

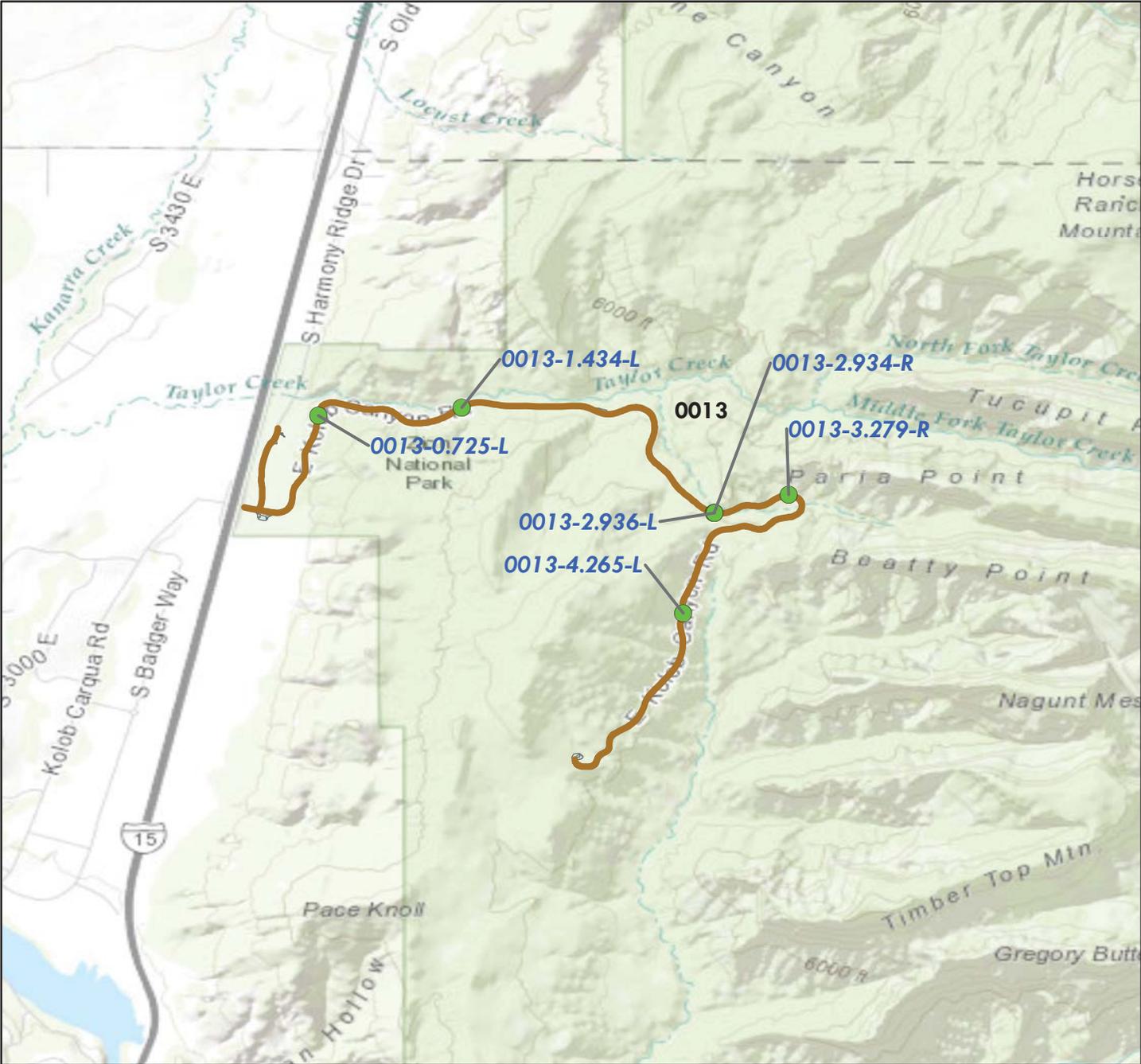
 RIP Collected Routes



Zion National Park

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



Zion National Park

BARRIER LOCATION MAP

Map 2



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

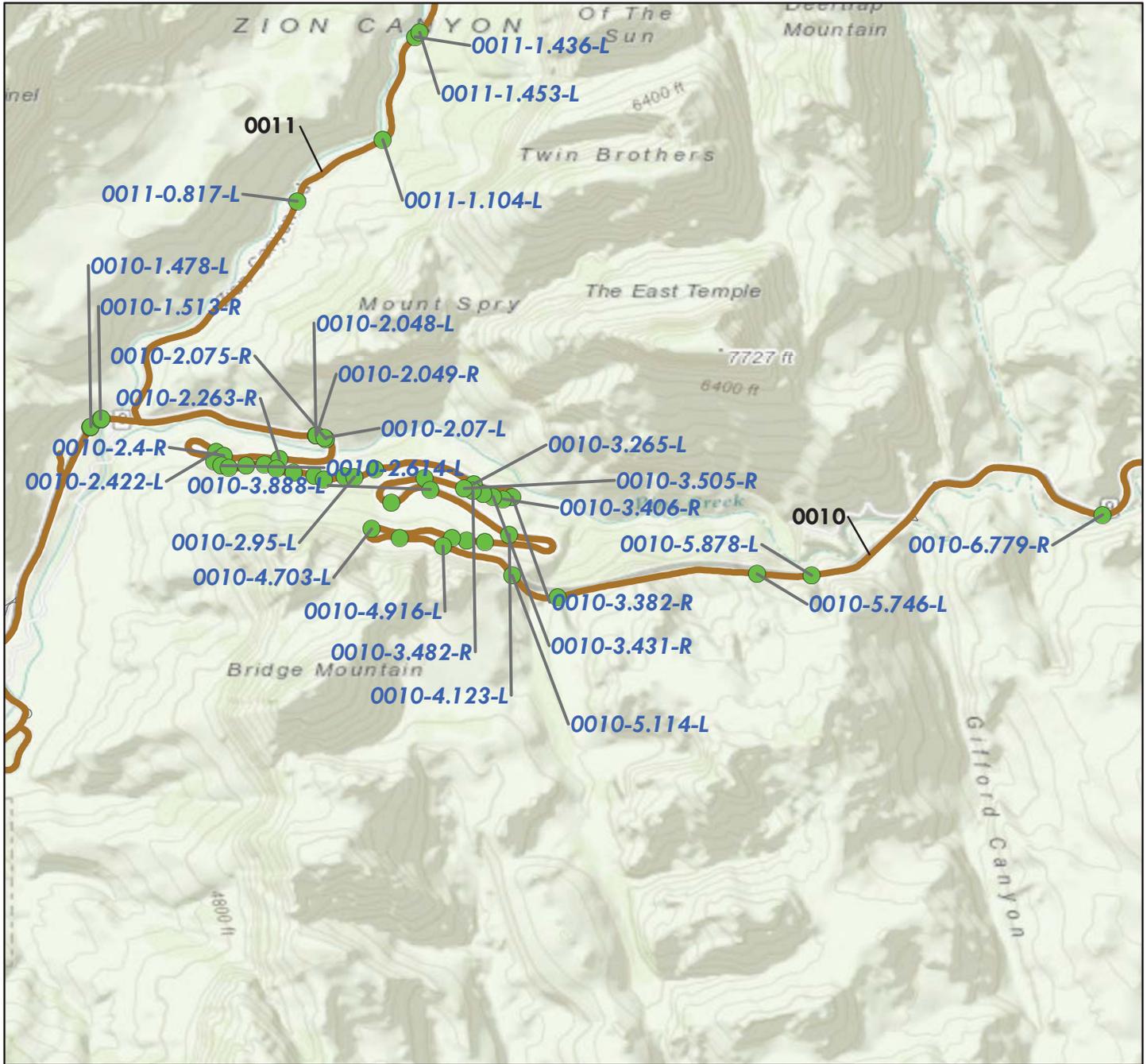
- **Barrier Locations**
- **RIP Collected Routes**



Zion National Park

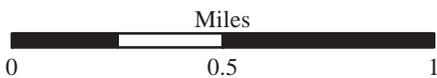
BARRIER LOCATION MAP

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

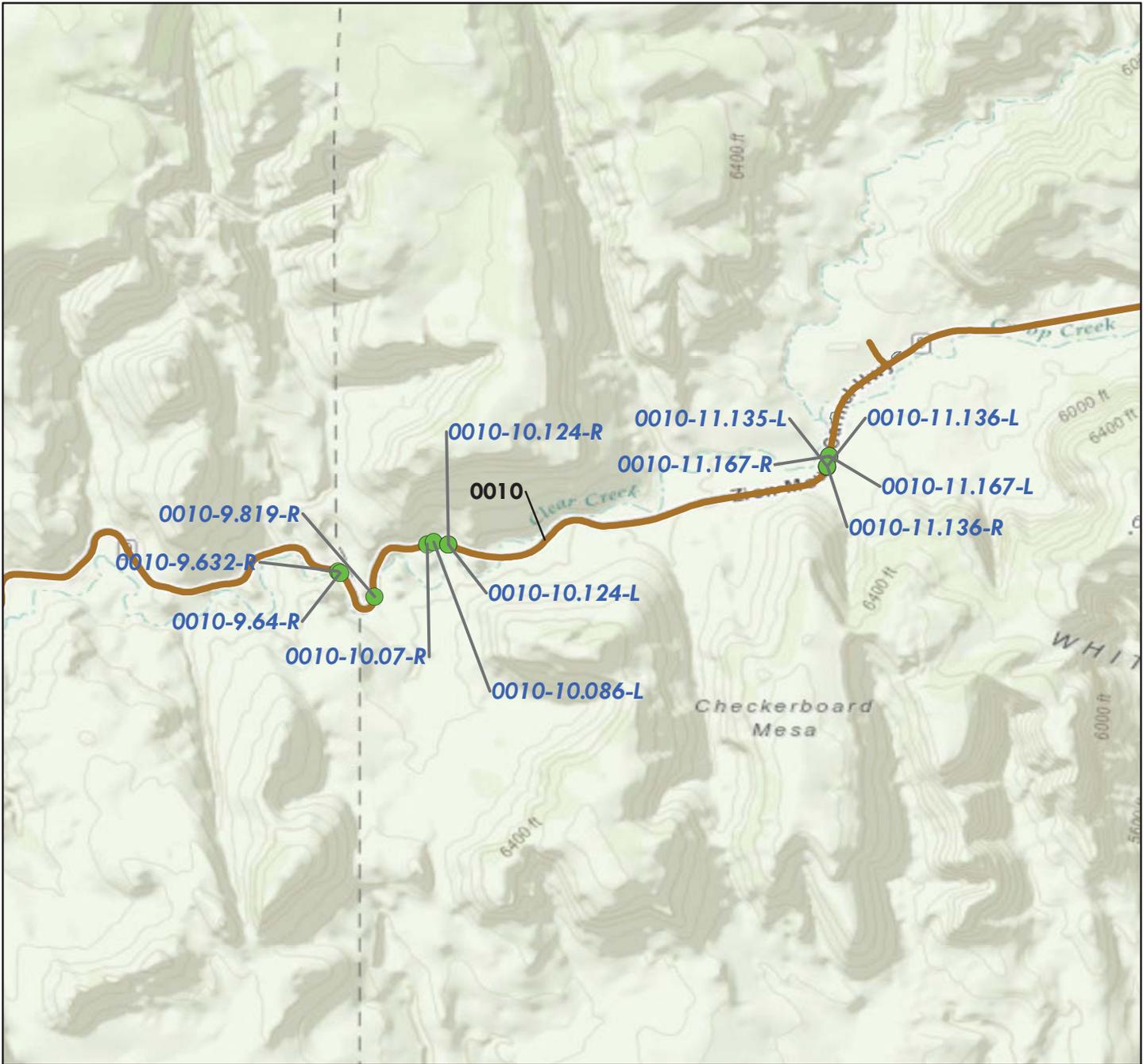
- Barrier Locations (Not all labeled)
- RIP Collected Routes



Zion National Park

BARRIER LOCATION MAP

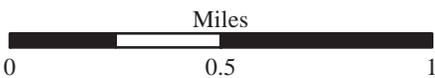
Map 4



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

 **Barrier Locations**

 **RIP Collected Routes**



Tier 1 Park Barrier Overview



Zion National Park



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Parkwide Summary: Zion National Park

Initial barrier inspections were conducted at Zion 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 for Zion National Park in 2006 under a separate effort as part of the Retaining Wall Inventory Program (WIP). A report for WIP is available under separate cover.

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

The following tables provide an overview of the findings of this inspection and assessment effort. In all, 72 barriers were inventoried on the routes listed below.

Table 1: Number of Barriers by Route

Route Number	Route Name	No. of Barriers
0010	ZION-MT CARMEL HIGHWAY	57
0011	ZION SCENIC CANYON DRIVE	9
0013	KOLOB CANYON ROAD	6

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

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

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

Table 2: Number of Barriers by Function

Barrier Function	No. of Barriers
NON-TRAFFIC	7
TRAFFIC	65

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

Table 3: Number of Barriers by Type

Primary Barrier Type	No. of Barriers
Stone Masonry With Concrete Core Wall	9
Stone Masonry Without Concrete Core Wall	58
W-Beam Weak Post	5

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

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

Recommended Action	Repair Costs*	No. of Barriers
No Action	\$0	30
Monitor	\$0	0
Repair	\$3,913,998	42
Replace	\$0	0
Totals	\$3,913,998	72

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

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

Table 5: Number of Barriers Grouped by Associated 2008 Cost

Cost Range*	No. of Barriers
\$0	30
\$1 - \$25,000	18
\$25,001 - \$50,000	2
\$50,001 - \$100,000	5
\$100,001 - \$250,000	15
\$250,001 - \$500,000	2
\$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	72

*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 0 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



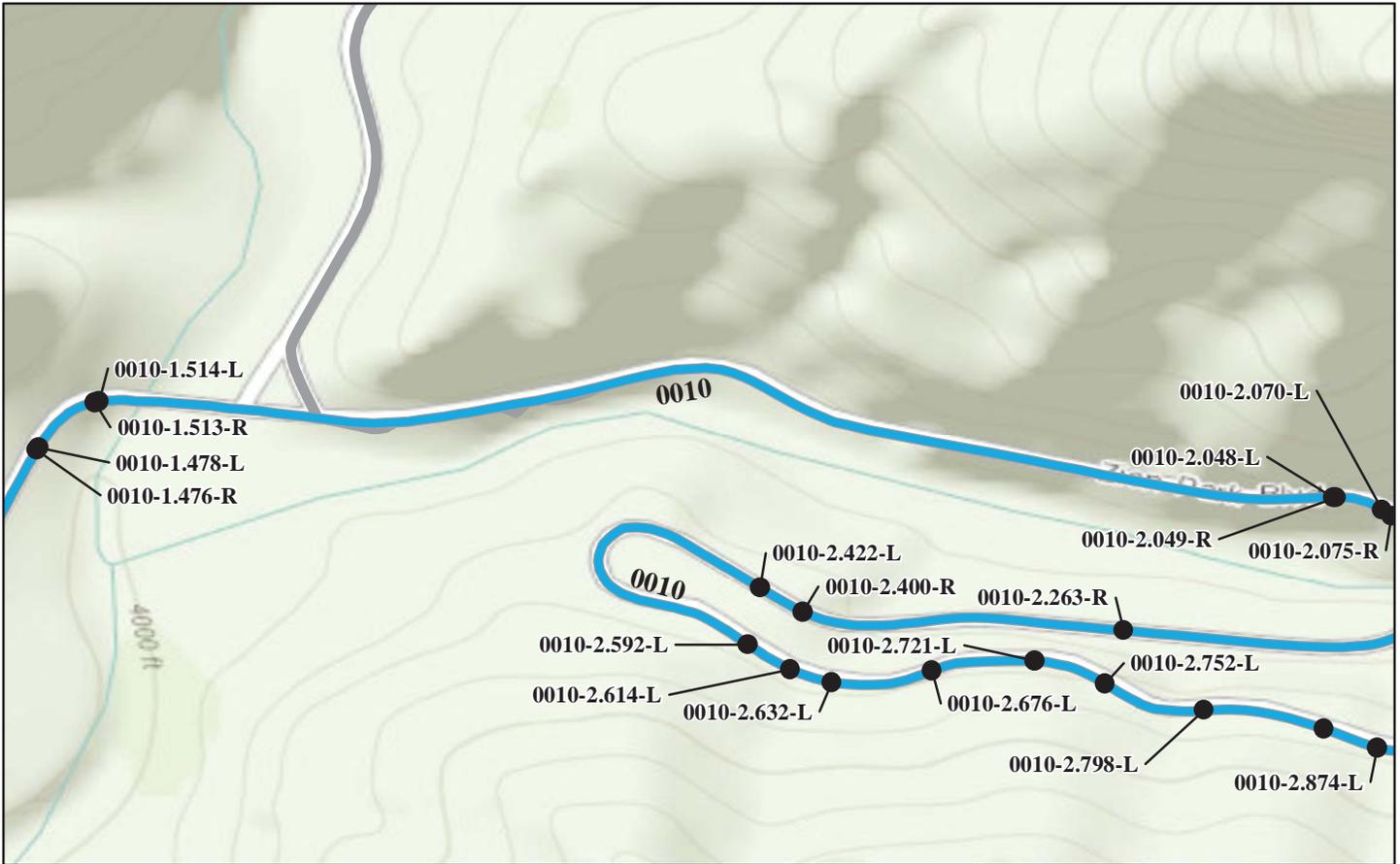
Zion National Park



Federal Lands Highway
Road Inventory Program

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



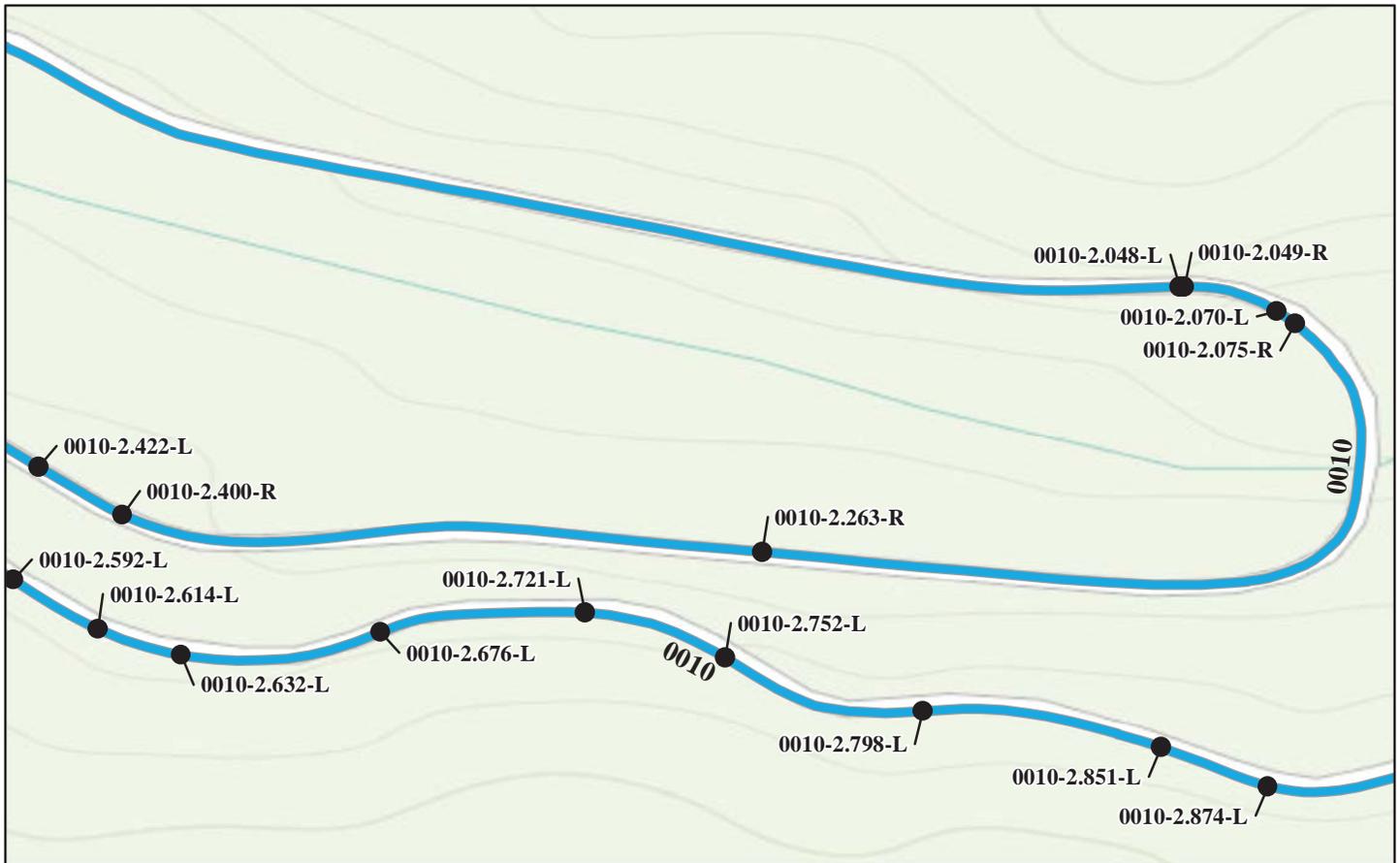
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-1.476-R 4/29/2010	10	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-1.478-L 4/29/2010	10	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-1.513-R 4/29/2010	11	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-1.514-L 4/29/2010	10	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-2.048-L 4/29/2010	53	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



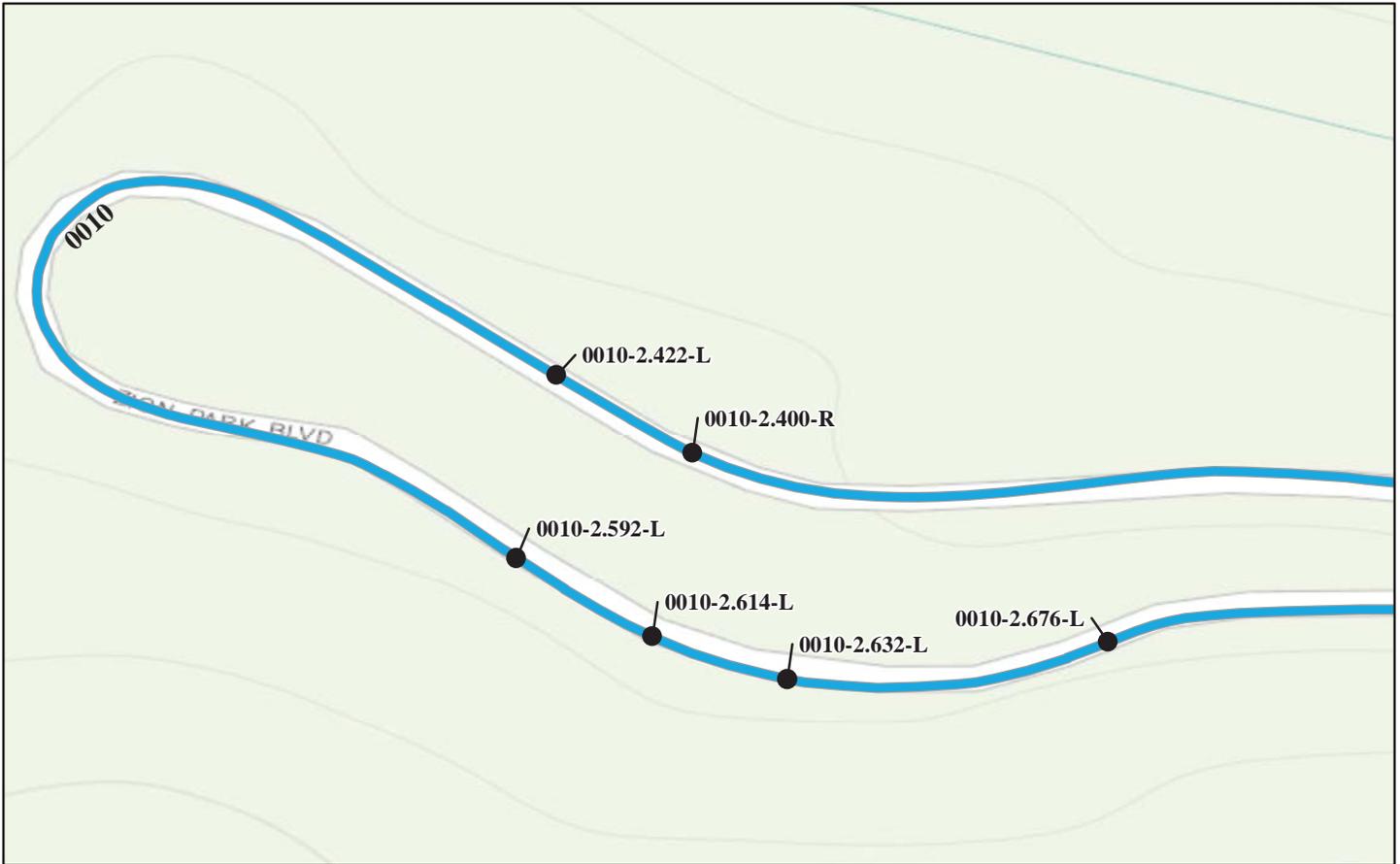
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-2.049-R 4/29/2010	36	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-2.070-L 4/29/2010	65	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,931.00
ZION-0010-2.075-R 4/29/2010	40	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-2.263-R 4/27/2010	151	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$156,090.00
ZION-0010-2.400-R 4/27/2010	313	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



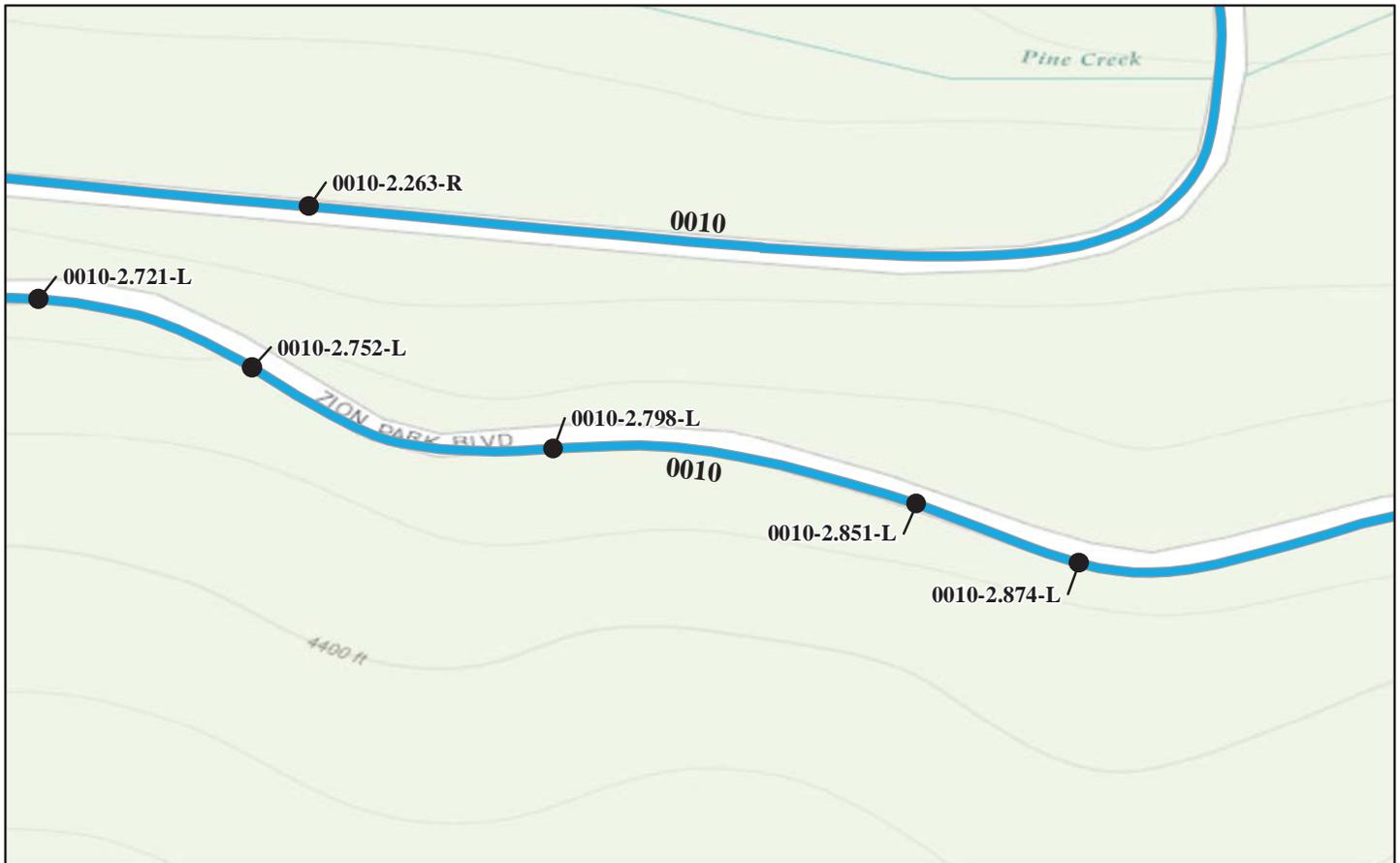
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-2.422-L 4/27/2010	220	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$233,970.00
ZION-0010-2.592-L 4/27/2010	107	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$15,703.00
ZION-0010-2.614-L 4/27/2010	29	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-2.632-L 4/27/2010	163	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,760.00
ZION-0010-2.676-L 4/27/2010	168	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$2,547.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



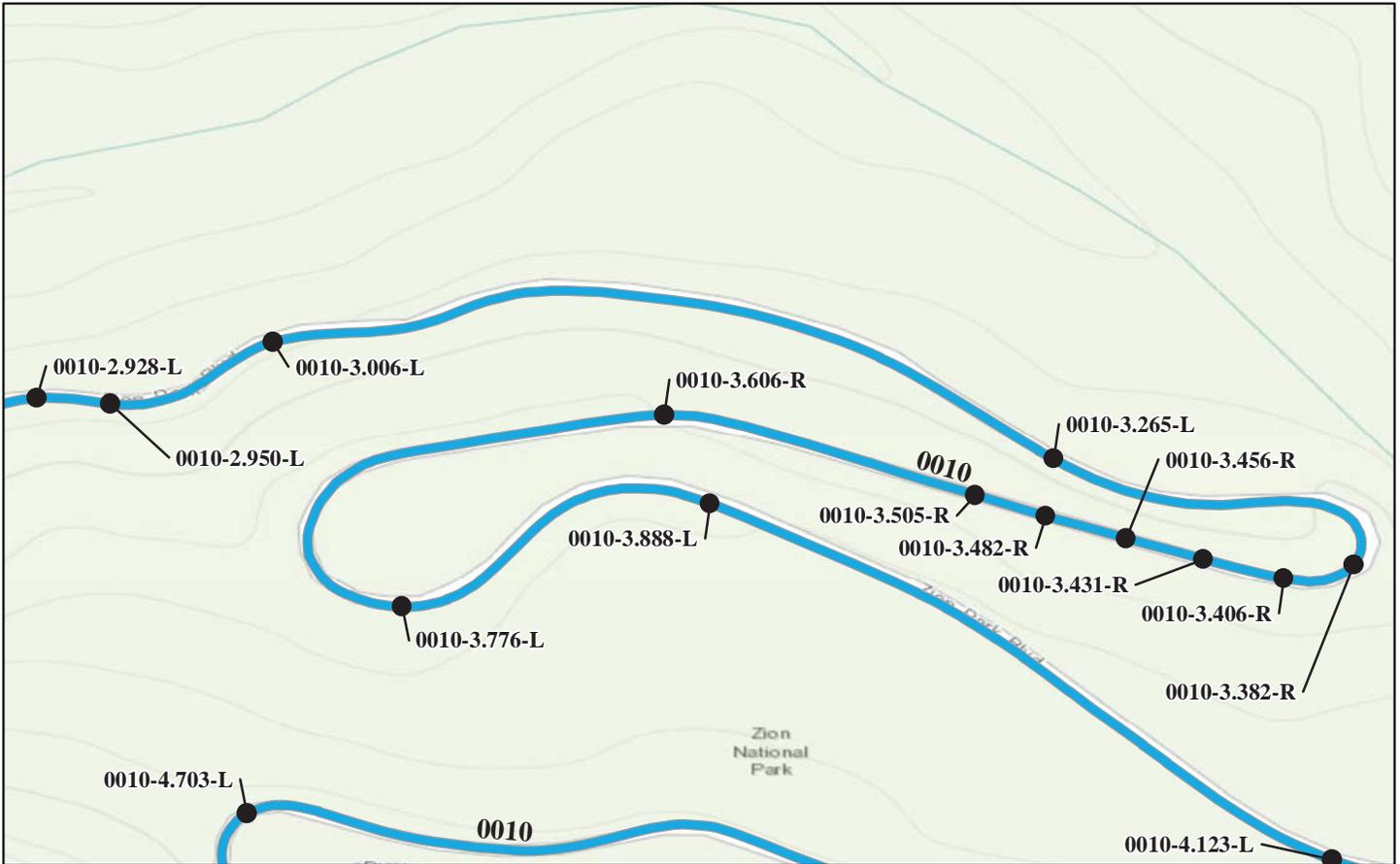
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-2.721-L 4/27/2010	89	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$48,538.00
ZION-0010-2.752-L 4/27/2010	157	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$2,822.00
ZION-0010-2.798-L 4/27/2010	191	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$207,075.00
ZION-0010-2.851-L 4/27/2010	35	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,931.00
ZION-0010-2.874-L 4/27/2010	207	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$212,905.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-2.928-L 4/27/2010	34	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-2.950-L 4/27/2010	245	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$249,893.00
ZION-0010-3.006-L 4/27/2010	726	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$409,668.00
ZION-0010-3.265-L 4/27/2010	282	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$167,888.00
ZION-0010-3.382-R 4/27/2010	35	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$12,320.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



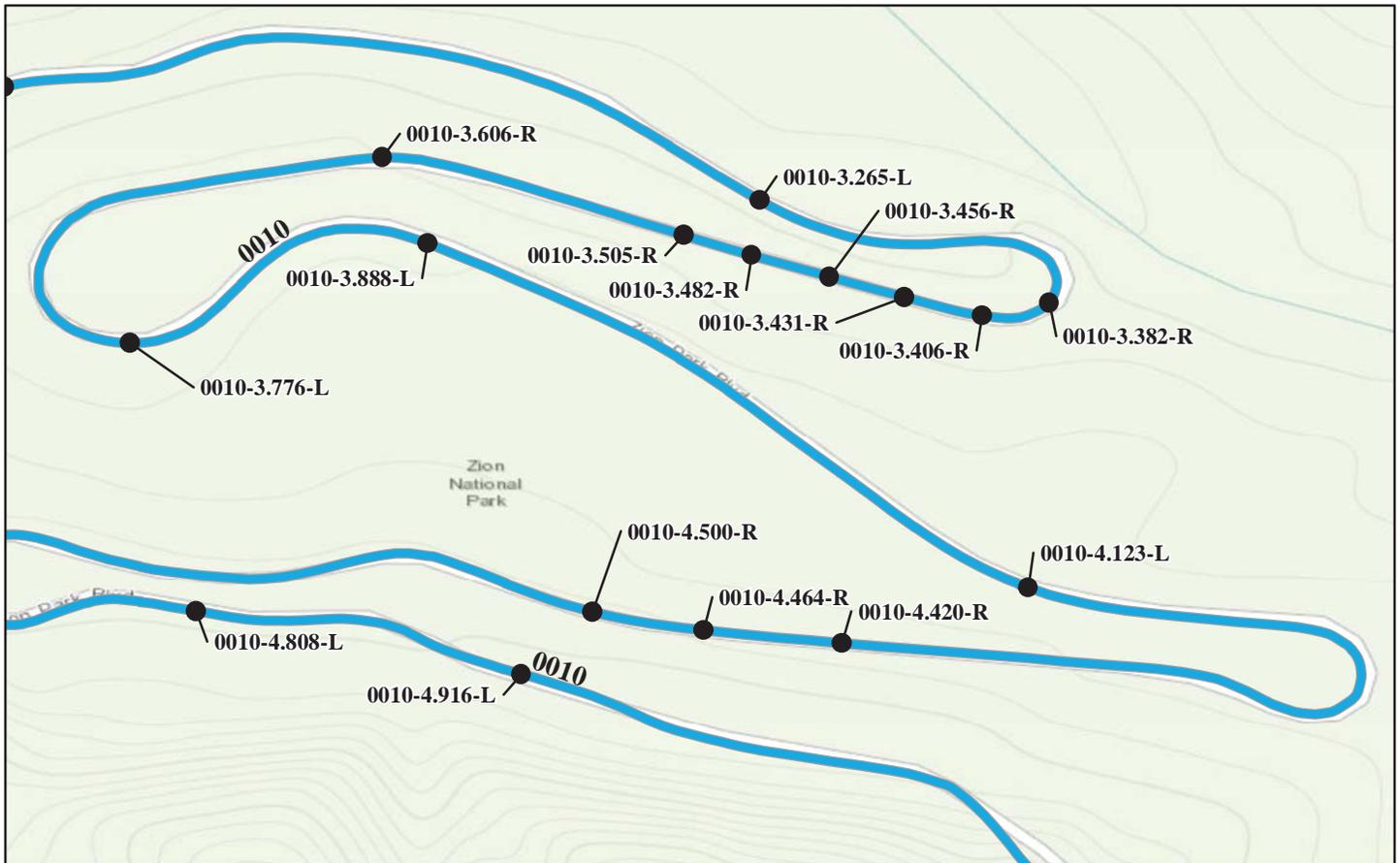
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-3.406-R 4/27/2010	35	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-3.431-R 4/27/2010	36	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-3.456-R 4/27/2010	36	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$4,939.00
ZION-0010-3.482-R 4/27/2010	35	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-3.505-R 4/27/2010	186	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$108,350.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-3.606-R 4/28/2010	417	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$171,050.00
ZION-0010-3.776-L 4/28/2010	174	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$101,063.00
ZION-0010-3.888-L 4/28/2010	112	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$116,683.00
ZION-0010-4.123-L 4/28/2010	354	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$201,328.00
ZION-0010-4.420-R 4/28/2010	153	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$88,880.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-4.464-R 4/28/2010	72	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$43,340.00
ZION-0010-4.500-R 4/28/2010	703	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$129,305.00
ZION-0010-4.703-L 4/28/2010	239	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$142,918.00
ZION-0010-4.808-L 4/28/2010	210	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$186,093.00
ZION-0010-4.916-L 4/28/2010	319	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$65,065.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-5.114-L 4/29/2010	85	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-5.254-L 4/29/2010	31	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-5.746-L 4/29/2010	35	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-5.878-L 4/29/2010	17	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-6.779-R 4/28/2010	86	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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			Begin	End	
ZION-0010-9.632-R 4/28/2010	21	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$19,470.00
ZION-0010-9.640-R 4/28/2010	181	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$100,925.00
ZION-0010-9.819-R 4/28/2010	122	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$85,333.00
ZION-0010-10.070-R 4/28/2010	162	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$2,173.00
ZION-0010-10.086-L 4/28/2010	64	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



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

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-10.124-L 4/28/2010	81	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$1,931.00
ZION-0010-10.124-R 4/28/2010	27	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-11.135-L 4/28/2010	39	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-11.136-L 4/28/2010	32	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-11.136-R 4/28/2010	31	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY



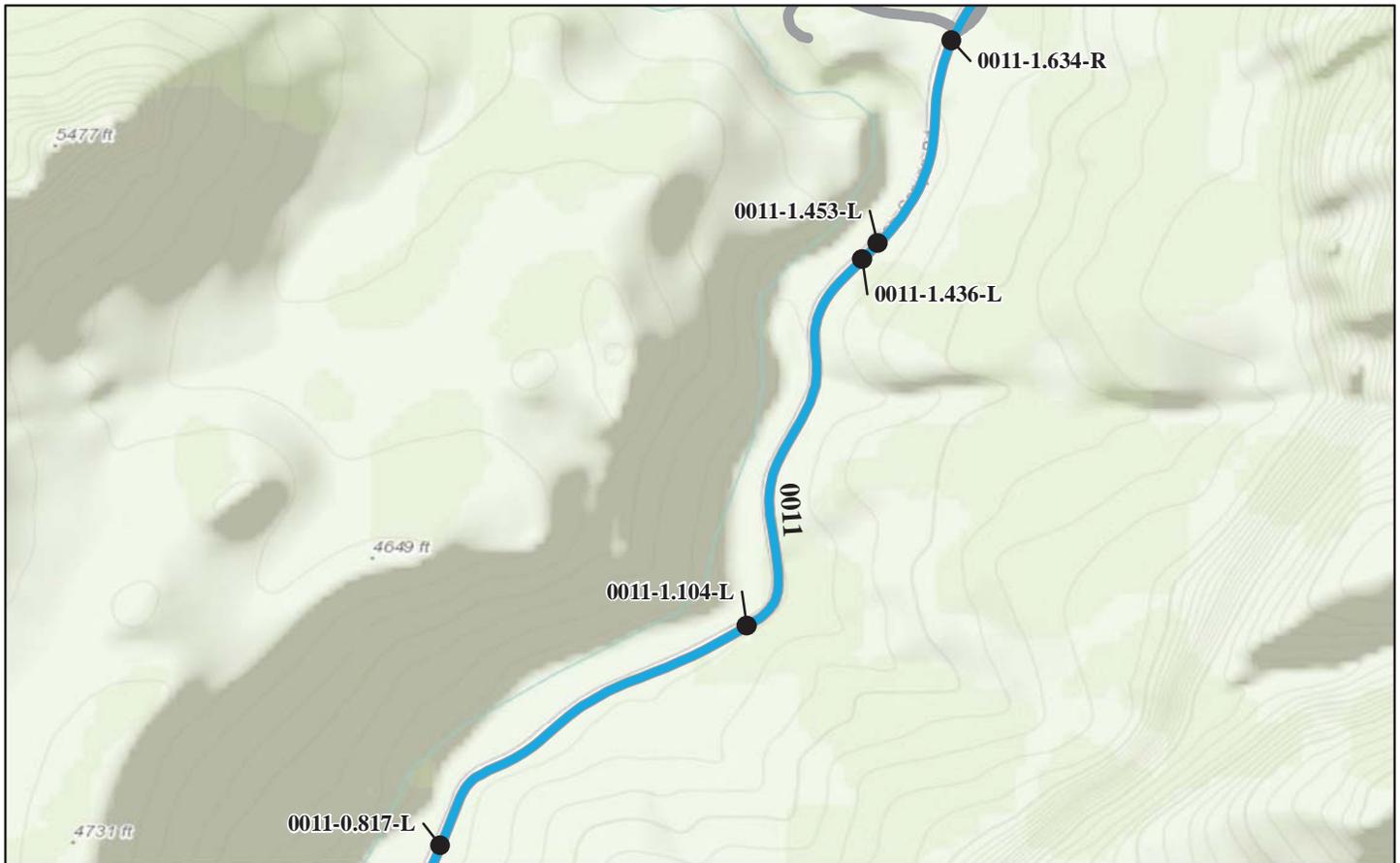
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0010-11.167-L 4/28/2010	60	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0010-11.167-R 4/28/2010	26	STONE MASONRY WITH CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE



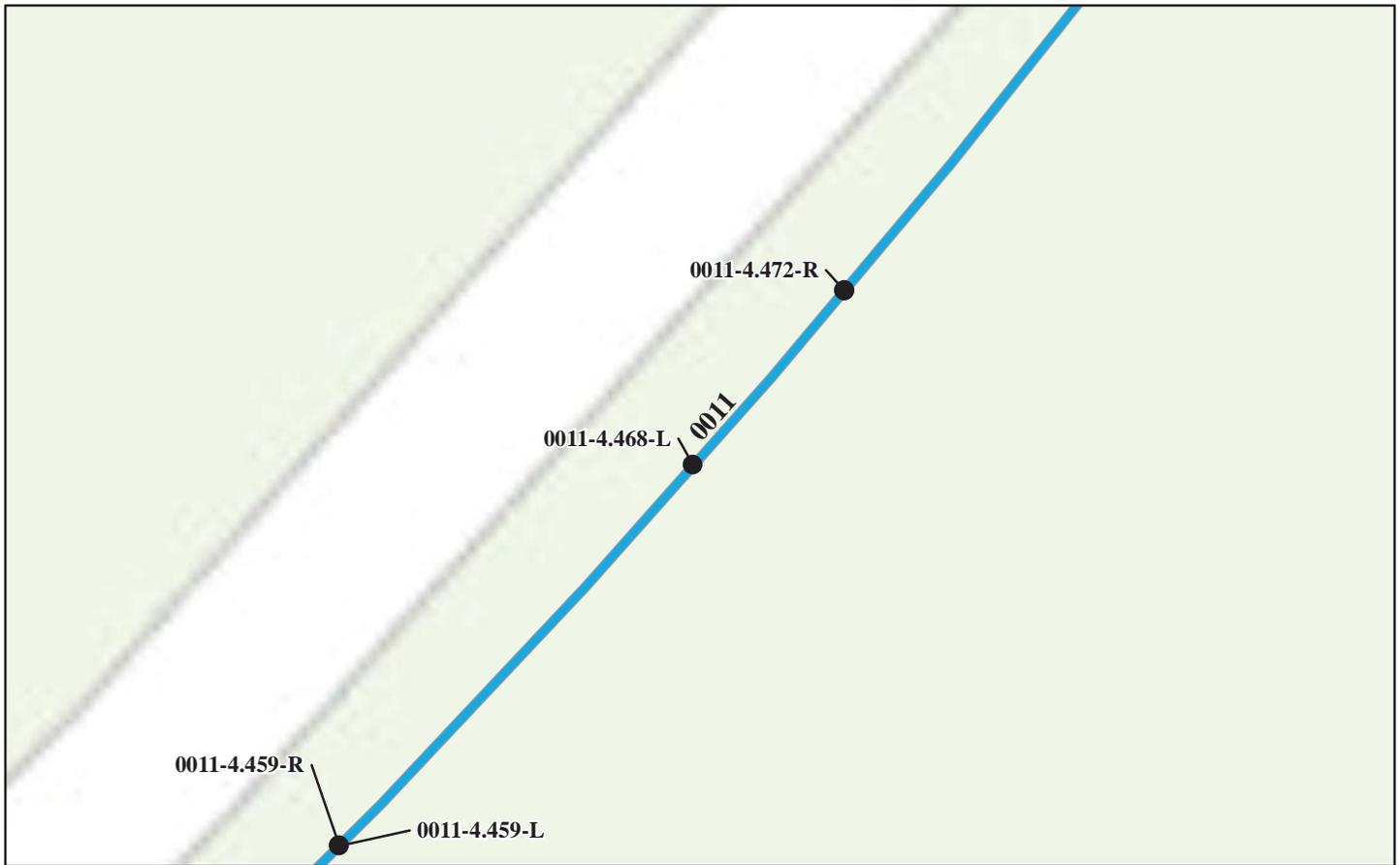
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0011-0.817-L 4/29/2010	761	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0011-1.104-L 4/29/2010	105	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$82,060.00
ZION-0011-1.436-L 4/29/2010	91	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$85,938.00
ZION-0011-1.453-L 4/29/2010	297	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$386,513.00
ZION-0011-1.634-R 4/29/2010	72	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE



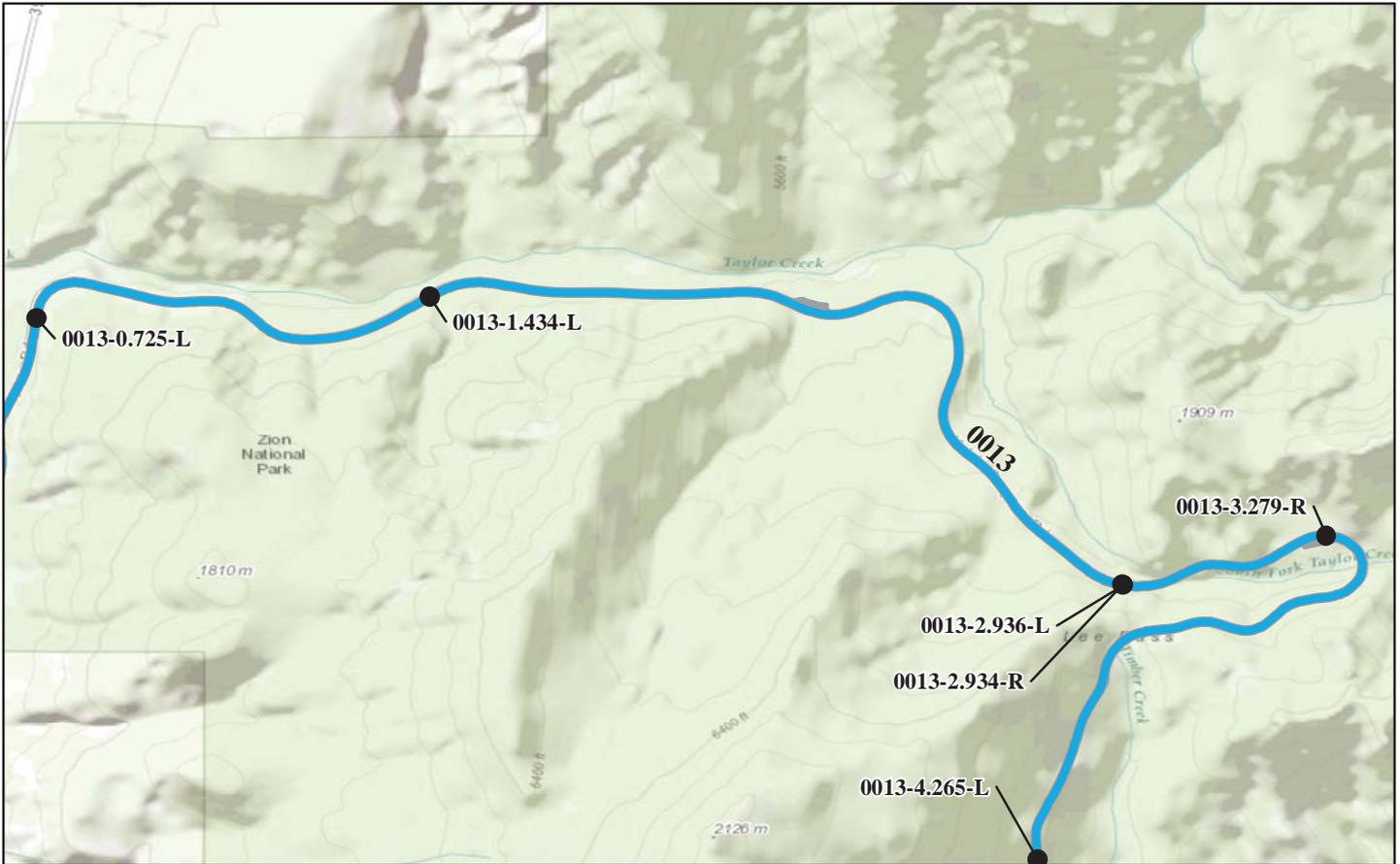
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0011-4.459-L 4/29/2010	19	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0011-4.459-R 4/29/2010	31	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$1,777.00
ZION-0011-4.468-L 4/29/2010	45	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00
ZION-0011-4.472-R 4/29/2010	32	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$0.00

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

Zion National Park

ROUTE 0013: KOLOB CANYON ROAD



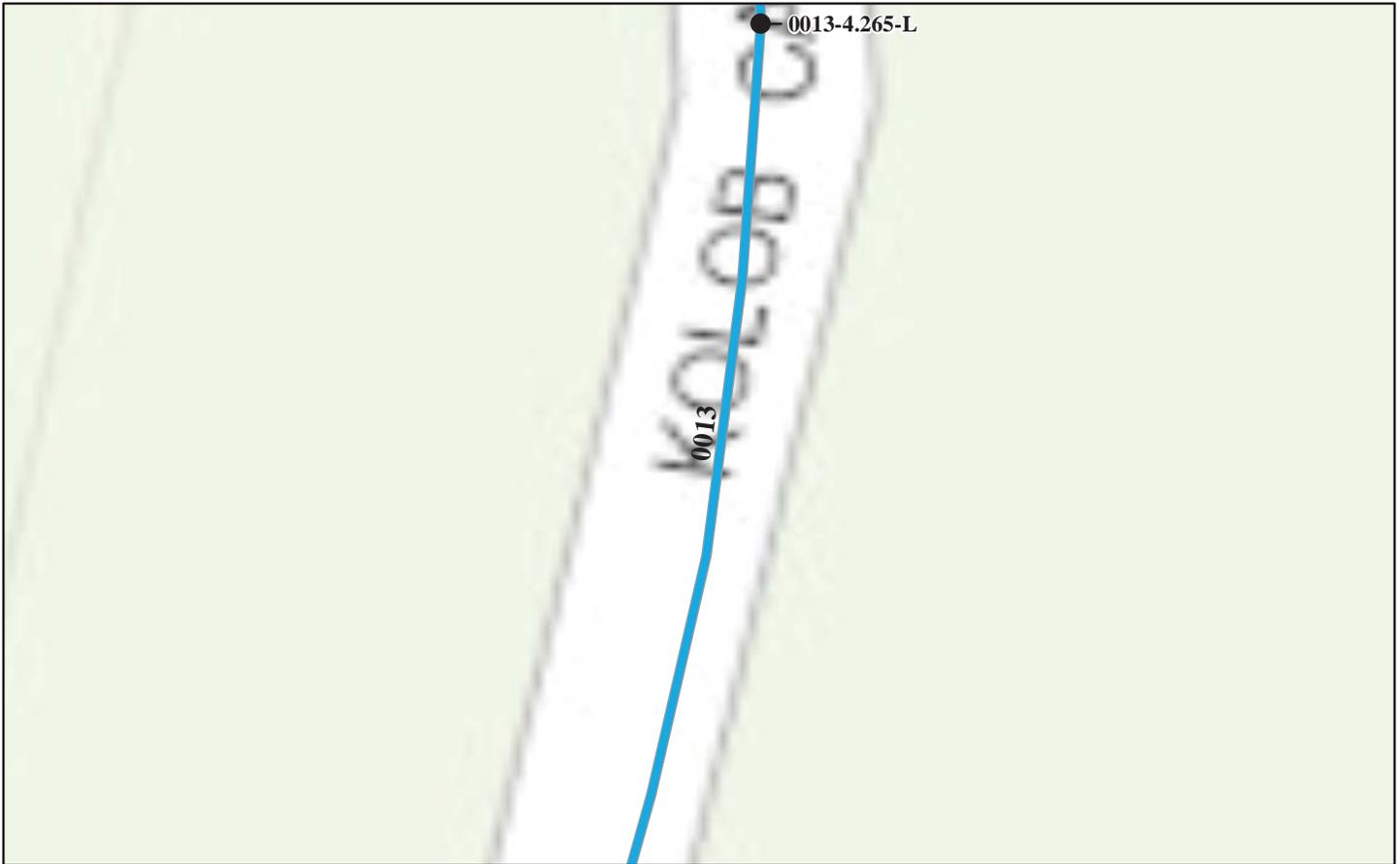
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0013-0.725-L 4/27/2010	269	W-BEAM WEAK POST	NONE	NONE	\$6,204.00
ZION-0013-1.434-L 4/27/2010	142	W-BEAM WEAK POST	NONE	NONE	\$9,922.00
ZION-0013-2.934-R 4/27/2010	140	W-BEAM WEAK POST	NONE	NONE	\$7,095.00
ZION-0013-2.936-L 4/27/2010	105	W-BEAM WEAK POST	NONE	NONE	\$7,893.00
ZION-0013-3.279-R 4/27/2010	397	W-BEAM WEAK POST	NONE	NONE	\$10,516.00

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

Zion National Park

ROUTE 0013: KOLOB CANYON ROAD



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

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
ZION-0013-4.265-L 4/27/2010	38	STONE MASONRY WITHOUT CONCRETE CORE WALL	NONE	NONE	\$22,193.00

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

Tier 3 Barrier Details



Zion National Park



**Federal Lands Highway
Road Inventory Program**

Barrier ID:	ZION-0010-1.476-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	25.10		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	10		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	27.0	Post Spacing (In.):	0.0
Height (In.):	42.0	Lateral Offset (In.):	57.5	Road Grade (%):	0.40
Physical Condition					
Barrier	Alignment and Height:	The alignment of abutment was correct. Height of abutment was 41 to 47 in.			
	Breaking and Cracking:	No breaking or cracking of abutment.			
	Missing Elements:	No missing elements in abutment.			
	Corrosion and Weathering:	No major weathering on abutment.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-1.476-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:		25.10	
Repair Recommendations					
Repair Action:	NO ACTION	FMSS Work Type:	N/A	Repair Cost:	\$0
Brief Workorder:	N/A				
Workorder:					

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_1.476_R_1.JPG

Barrier ID:	ZION-0010-1.478-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	33.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	10		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	25.2	Post Spacing (In.):	0.0
Height (In.):	42.0	Lateral Offset (In.):	34.5	Road Grade (%):	2.00
Physical Condition					
Barrier	Alignment and Height:	Abutment alignment was correct. Abutment height was 43 to 44 in high.			
	Breaking and Cracking:	No breaking or cracking of abutment.			
	Missing Elements:	No missing elements in the abutment.			
	Corrosion and Weathering:	No major weathering of the abutment.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-1.478-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	33.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_1.478_L_1.JPG

Barrier ID:	ZION-0010-1.513-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	24.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	11		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	26.0	Post Spacing (In.):	0.0
Height (In.):	42.0	Lateral Offset (In.):	50.2	Road Grade (%):	1.20
Physical Condition					
Barrier	Alignment and Height:	Barrier was in alignment and was greater than the 24-in design height by 21 in. Appeared to be bridge abutment.			
	Breaking and Cracking:	No breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-1.513-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:		24.00	
Repair Recommendations					
Repair Action:	NO ACTION	FMSS Work Type:	N/A	Repair Cost:	\$0
Brief Workorder:	N/A				
Workorder:					

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_1.513_R_1.JPG

Barrier ID:	ZION-0010-1.514-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	28.60		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	10		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	25.7	Post Spacing (In.):	0.0
Height (In.):	42.0	Lateral Offset (In.):	32.7	Road Grade (%):	0.30
Physical Condition					
Barrier	Alignment and Height:	Barrier was in alignment and was greater than 24 in design height by 20 in for entire length. Appeared to be bridge abutment.			
	Breaking and Cracking:	No breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-1.514-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	28.60

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_1.514_L_1.JPG

Barrier ID:	ZION-0010-2.048-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	33.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	53		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.0	Post Spacing (In.):	0.0
Height (In.):	32.0	Lateral Offset (In.):	36.2	Road Grade (%):	0.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 6-10in. above the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking of the barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No major weathering of barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.048-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	33.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos

Condition photos are not available for ZION-0010-2.048-L.

Barrier ID:	ZION-0010-2.049-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	30.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	36		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.2	Post Spacing (In.):	0.0
Height (In.):	29.0	Lateral Offset (In.):	12.3	Road Grade (%):	2.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 3-8in. above the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking of bridge abutment.			
	Missing Elements:	No missing elements in abutment.			
	Corrosion and Weathering:	No major weathering of the bridge abutment.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.049-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	30.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.049_R_1.JPG

Barrier ID:	ZION-0010-2.070-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	35.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	65		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.7	Post Spacing (In.):	0.0
Height (In.):	32.2	Lateral Offset (In.):	46.0	Road Grade (%):	1.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 6-11 in. above the 24-in. design height.			
	Breaking and Cracking:	Cracks greater than 1/2 in wide are apparent in various locations of the barrier totaling approximately 16s.f.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.070-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	35.50

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$1931
Brief Workorder:	Repoint 16 square feet of barrier.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 2 SY = \$280. Repoint masonry where grout has separated from rock. 165ft. / 9 = 1.8 SY.. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.070_L_1.JPG

Barrier ID:	ZION-0010-2.075-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	29.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	40		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.2	Post Spacing (In.):	0.0
Height (In.):	33.2	Lateral Offset (In.):	22.7	Road Grade (%):	0.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 8-11 in. above the 24-in. design height.			
	Breaking and Cracking:	1 chip in rock face.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.075-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	29.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.075_R_1.JPG

Barrier ID:	ZION-0010-2.263-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	57.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	151		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.7	Post Spacing (In.):	0.0
Height (In.):	12.1	Lateral Offset (In.):	20.0	Road Grade (%):	5.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 11-13in. below the 24-in. design height.			
	Breaking and Cracking:	20 square ft of grout area had cracks more than 1/2 in wide.			
	Missing Elements:	Round barrier reflector holder at approach end was empty.			
	Corrosion and Weathering:	Minor weathering to stones.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.263-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	57.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$156090
Brief Workorder:	Raise guardwall 12-in. Remove and reset 151-ft of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 484 CF = \$121000. [(1.6ft)(2ft)(151ft)] 483.2 CF. Structural Concrete at \$1000- per -Cu. Yd. for 9 CY = \$9000. [(1.6ft)(1ft)(151ft)] /27 = 8.9 CY. Barrier reflector replacement at \$100- per - for 1 = \$100. Replacement reflector includes labor. 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos

Condition photos are not available for ZION-0010-2.263-R.

Barrier ID:	ZION-0010-2.400-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	42.90		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	313		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.2	Post Spacing (In.):	0.0
Height (In.):	20.2	Lateral Offset (In.):	27.7	Road Grade (%):	6.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height between 3 and 6in. below the 24-in. design height.			
	Breaking and Cracking:	There was no breaking on the wall. All cracking was less than 1/4 in wide.			
	Missing Elements:	There were no missing elements on the wall.			
	Corrosion and Weathering:	There was no corrosion or weathering on wall. All cracking was less than 1/4 in wide.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.400-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	42.90

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.400_R_1.jpg

Barrier ID:	ZION-0010-2.422-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	60.90		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	220		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.7	Post Spacing (In.):	0.0
Height (In.):	7.3	Lateral Offset (In.):	21.2	Road Grade (%):	5.40
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 16-17in. below the 24-in. design height.			
	Breaking and Cracking:	The grouting between the stones at 4 locations was broken into pieces for sections where the stones were 2 ft wide and 8 in high.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor corrosion and weathering observed on the barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.422-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	60.90

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$233970
Brief Workorder:	Raise guardwall 17-in. Remove and reset 220-ft of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 704 CF = \$176000. [(1.6ft)(2ft)(220ft)] = 704 CF. Structural Concrete at \$1000- per -Cu. Yd. for 19 CY = \$19000. [(1.6ft)(1.4ft)(220ft)] /27 = 18.2 CY. Low Speed Traffic Control at \$1475- per -Day for 12 Day(s) = \$17700. 3 days removal 9 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.422_L_1.jpg

Barrier ID:	ZION-0010-2.592-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	48.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	107		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	19.2	Lateral Offset (In.):	32.7	Road Grade (%):	6.40
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Barrier was below 24-in design height by 3 to 6-in for 21 linear ft and was below by more than 6-in for 30 linear ft. The remainder of the wall is within 3 in of design height.			
	Breaking and Cracking:	7 square ft of missing grout in cracks greater than 1/2 in wide.			
	Missing Elements:	Round reflector missing from holder on approach end.			
	Corrosion and Weathering:	Minor weathering in stones.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.592-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	48.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$15703
Brief Workorder:	Raise guardwall 2in. Remove and reset 30ft. of stone masonry guardwall on 1 row of new stone to raise barrier to the adjacent 18in. height.				
Workorder:	<p>Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 24 CF = \$6000. [(1.6ft)(0.5ft)(30ft)] = 24 CF. Remove top layer of stones in barrier for 30ft.</p> <p>New Stones at \$250- per -Each for 15 Each = \$3750. [(30ft) / (2ft./stone)] x 1 row = 15 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier.</p> <p>Barrier reflector at \$100- per - for 1 = \$100. Replacement reflector includes labor.</p> <p>Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425. 1 day removal 2 days installation.</p>				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.592_L_1.jpg

Barrier ID:	ZION-0010-2.614-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	38.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	29		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.0	Post Spacing (In.):	0.0
Height (In.):	20.0	Lateral Offset (In.):	127.3	Road Grade (%):	5.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height between 3 and 6in. below the 24-in. design height.			
	Breaking and Cracking:	8 SF of grout was cracked or missing with cracks approximately 1/2 in wide and needed to be repointed. This is the same area where the guardwall is low.			
	Missing Elements:	No missing elements on the wall.			
	Corrosion and Weathering:	Minor weathering of the stone faces and all other cracks were less than 1/4 in wide.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.614-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	38.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.614_L_1.jpg



ZION_0010_2.614_L_2.jpg

Barrier ID:	ZION-0010-2.632-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	35.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	163		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	21.2	Lateral Offset (In.):	22.0	Road Grade (%):	3.20
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. 61ft was within 3in. of the 24in. design height and 102ft. was 3-6in. below the design height.			
	Breaking and Cracking:	There was no breaking or cracking observed on the barrier.			
	Missing Elements:	There were no missing elements observed for the barrier.			
	Corrosion and Weathering:	There was some sediment build-up in front of the guardwall. The approach end had soil eroding around the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.632-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	35.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$1760
Brief Workorder:	Remove sediment build-up next to the guardwall and monitor the erosion around the front of the approach end.				
Workorder:	Loader at \$125- per -Hour for 1 Hrs = \$125. Remove sediment build-up next to the wall. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475. Traffic control for the sediment removal.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.632_L_1.jpg

Barrier ID:	ZION-0010-2.676-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	37.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	168		
Speed Limit (MPH):	35	Placement with Respect to Road:	BOTH INSIDE AND OUTSIDE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	23.7	Lateral Offset (In.):	25.2	Road Grade (%):	3.40
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was within 3-in of 24-in design height.			
	Breaking and Cracking:	One chipped rock in wall. 48 square ft of grout missing in cracks greater than 1/2 in wide.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	Minor weathering of stones in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.676-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	37.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$2547
Brief Workorder:	Replace 48 square feet area of cracked grout. Monitor erosion at trailing end of wall.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 6 SY = \$840. Add grout to cracked areas. 48sf./9 = 5.3SY. 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.676_L_1.jpg

Barrier ID:	ZION-0010-2.721-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	58.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	89		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	15.3	Post Spacing (In.):	0.0
Height (In.):	12.1	Lateral Offset (In.):	49.2	Road Grade (%):	6.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 7-16in. below the 24-in. design height.			
	Breaking and Cracking:	There were partial stones broken at three locations along the wall.			
	Missing Elements:	There were stones missing at three locations along the wall.			
	Corrosion and Weathering:	There is minor weathering of the stone wall. There was sediment built up along the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.721-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	58.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$48538
Brief Workorder:	Raise guardwall 12-in. Remove and reset 89-ft stone masonry guardwall on 2 rows of new stone to raise barrier to the 24-in design height.				
Workorder:	<p>Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 58 CF = \$14500. [(1.3ft)(0.5ft)(89ft)] = 57.9 CF.</p> <p>Remove top layer of stones in barrier for 89ft.</p> <p>New Stones at \$250- per -Each for 89 Unit(s) = \$22250. [(89ft) / (2ft/stone)] x 2 rows = 89 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier.</p> <p>Low Speed Traffic Control at \$1475- per -Day for 5 Day(s) = \$7375. 1 day removal 4 days installation.</p>				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.721_L_1.jpg

Barrier ID:	ZION-0010-2.752-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	37.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	157		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	23.2	Lateral Offset (In.):	40.7	Road Grade (%):	4.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3-in of 24-in design height.			
	Breaking and Cracking:	There was a 4 sq.ft. piece of grout cracked at the approach end where there was a gap.			
	Missing Elements:	The barrier had 1 missing stone at the approach end that was 4 in tall 6 inches long and 18 inches wide.			
	Corrosion and Weathering:	There was only minor corrosion and weathering observed to the barrier. Monitor the sediment build-up next to the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.752-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	37.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$2822
Brief Workorder:	Repoint 1sy. of grout and replace one missing stone.				
Workorder:	<p>Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 6 SY = \$840. Repoint the 1SY. section of missing grout and 2 sq ft for the stone piece missing. 45sf./9 = 0.4SY.</p> <p>Replace Stones at \$250- per -Each for 1 Unit(s) = \$250. Replace missing stone.</p> <p>Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.</p>				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.752_L_1.jpg

Barrier ID:	ZION-0010-2.798-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	58.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	191		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.2	Post Spacing (In.):	0.0
Height (In.):	13.5	Lateral Offset (In.):	22.2	Road Grade (%):	4.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 9-13in. below the 24-in. design height.			
	Breaking and Cracking:	Grout had 1/4 to 1/2 in wide cracks in various locations in barrier for total of 10 square ft area and cracks wider than 1/2 inch wide for total of 12 square ft area.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	Minor weathering in stones and grout in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.798-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	58.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$207075
Brief Workorder:	Raise guardwall 11-in. Remove and reset 191-ft of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 650 CF = \$162500. [(1.7ft)(2ft)(191ft)] = 649.4 CF. Structural Concrete at \$1000- per -Cu. Yd. for 11 CY = \$11000. [(1.7ft)(0.9ft)(191ft)] /27 = 10.8 CY. 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.798_L_1.jpg

Barrier ID:	ZION-0010-2.851-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	38.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	35		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	21.0	Lateral Offset (In.):	60.0	Road Grade (%):	5.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3-in of 24-in design height.			
	Breaking and Cracking:	The grout had cracks in it approximately 1/2 in wide for 10sf.			
	Missing Elements:	There were no missing elements on the wall.			
	Corrosion and Weathering:	Minor weathering of the stone wall but all other cracks were less than 1/4 in wide and did not require attention.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.851-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	38.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$1931
Brief Workorder:	Repoint 2 square yards of grout on the wall.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 2 SY = \$280. 10sf./9 = 1.1SY. 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.851_L_1.jpg

Barrier ID:	ZION-0010-2.874-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	59.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	207		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	14.6	Lateral Offset (In.):	29.0	Road Grade (%):	3.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 14-15in. below the 24-in. design height.			
	Breaking and Cracking:	There was 12 sq.ft. of cracked or missing grout.			
	Missing Elements:	There was a round barrier reflector missing from the approach end.			
	Corrosion and Weathering:	There was only minor corrosion and weathering observed to the barrier. There was moss growing on the back side of the barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.874-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	59.50

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$212905
Brief Workorder:	Raise guardwall 9-in. Remove and reset 207-ft. of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 663 CF = \$165750. [(1.6ft)(2ft)(207ft)] = 662.3 CF. Structural Concrete at \$1000- per -Cu. Yd. for 10 CY = \$10000. [(1.6ft)(0.75ft)(207ft)] /27 = 9.2 CY. Install barrier reflector at \$100- per -Each for 1 Unit(s) = \$100. Replace missing barrier reflector. Low Speed Traffic Control at \$1475- per -Day for 12 Day(s) = \$17700. 3 days removal 9 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.874_L_1.jpg

Barrier ID:	ZION-0010-2.928-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	34.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	34		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.0	Post Spacing (In.):	0.0
Height (In.):	25.2	Lateral Offset (In.):	73.3	Road Grade (%):	4.60
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3-in of 24-in design height.			
	Breaking and Cracking:	No breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	Minor weathering in grout.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.928-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	34.20

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.928_L_1.jpg

Barrier ID:	ZION-0010-2.950-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	59.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	245		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	14.5	Lateral Offset (In.):	27.7	Road Grade (%):	6.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 13-16in. below the 24-in. design height.			
	Breaking and Cracking:	There was no noteworthy breaking. All cracks were less than 1/4 in in width.			
	Missing Elements:	There were no missing elements on the wall.			
	Corrosion and Weathering:	There was no noteworthy corrosion or weathering.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-2.950-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	59.50

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$249893
Brief Workorder:	Raise guardwall 10-in. Remove and reset 245-ft. of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 784 CF = \$196000. [(1.6ft)(2ft)(245ft)] = 784 CF. Structural Concrete at \$1000- per -Cu. Yd. for 12 CY = \$12000. [(1.6ft)(0.8ft)(245ft)] /27 = 11.6 CY. Low Speed Traffic Control at \$1475- per -Day for 13 Day(s) = \$19175. 3 days removal 10 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_2.950_L_1.jpg

Barrier ID:	ZION-0010-3.006-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	72.30		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	726		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	17.5	Post Spacing (In.):	0.0
Height (In.):	14.0	Lateral Offset (In.):	27.5	Road Grade (%):	2.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 7-12in. below the 24-in. design height.			
	Breaking and Cracking:	There was about 78 sq.ft. observed of stone with gaps in grouting.			
	Missing Elements:	There was 1 missing barrier reflector from the approach end.			
	Corrosion and Weathering:	There was only minor corrosion and weathering observed to the guardwall with moss growing on parts of it.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.006-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	72.30

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$409668
Brief Workorder:	Raise guardwall 10-in. Remove and reset 726-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height. Install barrier reflector.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 545 CF = \$136250. Remove top layer of stones in barrier for 726ft. New Stones at \$250- per -Each for 726 Unit(s) = \$181500. [(726ft)/(2ft/stone)] x 2 rows = 726 stones. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier. Install Barrier Reflector at \$100- per -Each for 1 Unit(s) = \$100. Replace missing barrier reflector. Low Speed Traffic Control at \$1475- per -Day for 37 Day(s) = \$54575. 8 days removal 29 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.006_L_1.jpg

Barrier ID:	ZION-0010-3.265-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	65.10		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	282		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-1	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.0	Post Spacing (In.):	0.0
Height (In.):	13.5	Lateral Offset (In.):	137.5	Road Grade (%):	5.20
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-11 in. below the 24-in. design height.			
	Breaking and Cracking:	Rock chipped at approach end of wall. 82 square ft area total of grout cracked more than 1/2-in in various areas of wall.			
	Missing Elements:	2 stones were missing in approach end of wall and 1 slab stone was missing near trailing end of wall.			
	Corrosion and Weathering:	Some erosion at trailing end of wall where broken pavement has dropped 7-in.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.265-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	65.10

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$167888
Brief Workorder:	Raise guardwall 11-in. Remove and reset 282-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height. Monitor erosion at trailing end of wall.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 240 CF = \$60000. $[(1.7ft)(0.5ft)(282ft)] = 239.7 CF$. Remove top layer of stones in barrier for 282ft. New Stones at \$250- per -Each for 282 Unit(s) = \$70500. $[(282ft)/(2ft/stone)] \times 2 \text{ rows} = 282 \text{ stones}$. 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 15 Day(s) = \$22125. 3 days removal 12 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.265_L_1.jpg

Barrier ID:	ZION-0010-3.382-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	46.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	35		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.7	Post Spacing (In.):	0.0
Height (In.):	17.0	Lateral Offset (In.):	27.0	Road Grade (%):	5.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 6-8in. below the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.382-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	46.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$12320
Brief Workorder:	Raise guardwall 2-in. Remove and reset 25-ft. of stone masonry guardwall on 1 row of new stone to raise barrier to the adjacent 18in. height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 20 CF = \$5000. [(1.6ft)(0.5ft)(25ft)] = 20 CF. Remove top layer of stones in barrier for 25ft. New Stones at \$250- per -Each for 13 Unit(s) = \$3250. [(25ft)/(2ft/stone)] x 1 row = 13 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 2 Day(s) = \$2950. 1 day removal 1 day installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.382_R_1.JPG

Barrier ID:	ZION-0010-3.406-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	44.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	35		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	18.0	Lateral Offset (In.):	14.6	Road Grade (%):	6.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. The height of the entire barrier was 6 in below the 24 in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.406-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	44.20

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.406_R_1.JPG

Barrier ID:	ZION-0010-3.431-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	41.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	36		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	18.2	Lateral Offset (In.):	39.2	Road Grade (%):	6.60
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable but the height of the barrier was between 5 and 6 in below the 24 in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.431-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	41.50

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.431_R_1.JPG

Barrier ID:	ZION-0010-3.456-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	26.80		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	36		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	24.0	Lateral Offset (In.):	48.0	Road Grade (%):	6.40
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of the 24-in design height.			
	Breaking and Cracking:	No breaking of barrier. 50% of the barrier grout was cracked.			
	Missing Elements:	No missing barrier elements.			
	Corrosion and Weathering:	Some weathering of barrier grout.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.456-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	26.80

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$4939
Brief Workorder:	Repoint weathered and cracked grout.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 11 SY = \$1540. Repoint 50% of the barrier. [(2ft+1.5ft+2ft)x(18ft)] /9 = 11 SY. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.456_R_1.JPG

Barrier ID:	ZION-0010-3.482-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	32.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	35		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	22.6	Lateral Offset (In.):	52.2	Road Grade (%):	6.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of the 24-in design height.			
	Breaking and Cracking:	No cracks in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No major weathering of barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.482-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	32.70

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.482_R_1.JPG

Barrier ID:	ZION-0010-3.505-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/27/2010	Barrier Rating:	63.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	186		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	9.3	Lateral Offset (In.):	32.0	Road Grade (%):	6.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 9-19in. below the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.505-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/27/2010	Barrier Rating:	63.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$108350
Brief Workorder:	Raise guardwall 15-in. Remove and reset 186-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 149 CF = \$37250. $[(1.6ft)(0.5ft)(186ft)] = 148.8$ cf New Stones at \$250- per -Each for 186 Unit(s) = \$46500. $[(186ft)/(2ft/stone)] \times 2$ rows = 186 stones. Insert new stone on retaining wall to increase 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.505_R_1.JPG

Barrier ID:	ZION-0010-3.606-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	65.10		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	417		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	15.6	Lateral Offset (In.):	73.3	Road Grade (%):	5.60
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. 30ft. was 3-6in. below the 24in. design height and 387ft. was 6-12in. below the design height.			
	Breaking and Cracking:	There was 30 square ft of cracks in grout.			
	Missing Elements:	There are no missing elements on the wall			
	Corrosion and Weathering:	Monitor erosion on the approach end of the barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.606-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	65.10

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$171050
Brief Workorder:	Raise guardwall 4-in. Remove and reset 387-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the adjacent 18in. height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 310 CF = \$77500. [(1.6ft)(0.5ft)(387ft)] = 309.6 CF. Remove top layer of stones in barrier for 387ft. New Stones at \$250- per -Each for 194 Unit(s) = \$48500. [(387ft)/(2ft/stone)] x 1 row = 194 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 20 Day(s) = \$29500. 4 days removal 16 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.606_R_1.jpg

Barrier ID:	ZION-0010-3.776-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	59.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	174		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	14.3	Lateral Offset (In.):	39.7	Road Grade (%):	1.20
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 14-15in. below the 24-in. design height.			
	Breaking and Cracking:	There was about 52 sq.ft. with gaps and large cracks in the grouting.			
	Missing Elements:	There was a barrier reflector missing from the front of the approach end.			
	Corrosion and Weathering:	There was sediment and gravel build-up next to the guardwall that needs to be monitored.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.776-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	59.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$101063
Brief Workorder:	Raise guardwall 10-in. Remove and reset 174-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height. Install barrier reflector.				
Workorder:	<p>Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 140 CF = \$35000. $[(1.6ft)(0.5ft)(174ft)] = 139.2 CF$.</p> <p>Remove top layer of stones in barrier for 174ft.</p> <p>New Stones at \$250- per -Each for 174 Unit(s) = \$43500. $[(174ft)/(2ft/stone)] \times 2 \text{ rows} = 174 \text{ stones}$. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier.</p> <p>Install Barrier Reflector at \$100- per -Each for 1 Unit(s) = \$100. Replace missing barrier reflector.</p> <p>Low Speed Traffic Control at \$1475- per -Day for 9 Day(s) = \$13275. 2 days removal 7 days installation.</p>				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.776_L_1.jpg

Barrier ID:	ZION-0010-3.888-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	52.40		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	112		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	13.3	Lateral Offset (In.):	28.7	Road Grade (%):	2.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-11 in. below the 24-in. design height.			
	Breaking and Cracking:	4 square ft of cracking in one area.			
	Missing Elements:	There were no missing wall elements.			
	Corrosion and Weathering:	There was no corrosion or weathering of the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-3.888-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	52.40

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$116683
Brief Workorder:	Raise guardwall 11-in. Remove and reset 112-ft of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 359 CF = \$89750. $[(1.6ft)(2ft)(112ft)] = 358.4 CF$. Structural Concrete at \$1000- per -Cu. Yd. for 6 CY = \$6000. $[(1.6ft)(0.9ft)(112ft)] / 27 = 5.9 CY$. 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_3.888_L_1.jpg

Barrier ID:	ZION-0010-4.123-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	69.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	354		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	13.8	Lateral Offset (In.):	168.0	Road Grade (%):	6.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 7-12in. below the 24-in. design height.			
	Breaking and Cracking:	There was approximately 72 sq.ft. with gaps and large cracks in the grouting.			
	Missing Elements:	There were no missing elements observed in the barrier.			
	Corrosion and Weathering:	There was only minor weathering to the barrier. There was sediment and gravel build-up next to the wall that needs to be monitored.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.123-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	69.50

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$201328
Brief Workorder:	Raise guardwall 11-in. Remove and reset 354-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 266 CF = \$66500. [(1.5ft)(0.5ft)(354ft)] = 265.5 CF. Remove top layer of stones in barrier for 354 ft. New Stones at \$250- per -Each for 354 Unit(s) = \$88500. [(354ft)/(2ft/stone)] x 2 rows = 354 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.

Zion National Park
ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.123_L_1.jpg



ZION_0010_4.123_L_2.jpg

Barrier ID:	ZION-0010-4.420-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	61.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	153		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	14.3	Lateral Offset (In.):	29.2	Road Grade (%):	6.90
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 9-10in. below the 24-in. design height.			
	Breaking and Cracking:	There was no breaking. Cracks were minor and are less than 1/4 in wide.			
	Missing Elements:	There were no missing wall elements.			
	Corrosion and Weathering:	There was no corrosion or weathering of the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.420-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	61.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$88880
Brief Workorder:	Raise guardwall 10-in. Remove and reset 153-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 123 CF = \$30750. $[(1.6ft)(0.5ft)(153ft)] = 122.4 CF$. Remove top layer of stones in barrier for 153ft. New Stones at \$250- per -Each for 153 Unit(s) = \$38250. $[(143ft)/(2ft/stone)] \times 2 \text{ rows} = 153 \text{ stones}$. 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 8 Day(s) = \$11800. 2 days removal 6 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.420_R_1.jpg

Barrier ID:	ZION-0010-4.464-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	56.40		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	72		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.2	Post Spacing (In.):	0.0
Height (In.):	13.0	Lateral Offset (In.):	96.3	Road Grade (%):	6.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 9-13in. below the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed on the barrier.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor weathering observed to the barrier. There was some sediment and gravel build-up next to the wall that needs to be monitored.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.464-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	56.40

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$43340
Brief Workorder:	Raise guardwall 11-in. Remove and reset 72-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 62 CF = \$15500. [(1.7ft)(0.5ft)(72ft)] = 61.2 CF. Remove top layer of stones in barrier for 62ft. New Stones at \$250- per -Each for 72 Unit(s) = \$18000. [(72ft)/(2ft/stone)] x 2 rows = 72 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.464_R_1.jpg

Barrier ID:	ZION-0010-4.500-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	65.10		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	703		
Speed Limit (MPH):	35	Placement with Respect to Road:	BOTH INSIDE AND OUTSIDE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	15.5	Post Spacing (In.):	0.0
Height (In.):	16.2	Lateral Offset (In.):	67.8	Road Grade (%):	4.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. 387ft. was 3-6in. below the 24in. design height and 316ft. was 6-13in. below the design height.			
	Breaking and Cracking:	The barrier had cracked/broken stones in 4 locations. 50 square ft of cracked mortar.			
	Missing Elements:	There were no missing elements on the wall.			
	Corrosion and Weathering:	Corrosion and weathering was a partial cause of the deterioration of the joints and mortar that resulted in cracks greater than 1/4 in wide.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.500-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	65.10

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$129305
Brief Workorder:	Raise guardwall 6-in. Remove and reset 316-ft. of stone masonry guardwall on 1 row of new stone to raise barrier to the adjacent 18in. height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 206 CF = \$51500. [(1.3)(.5)(316)] = 205.4 CF. Remove top layer of stones in barrier for 316ft. New Stones at \$250- per -Each for 158 Unit(s) = \$39500. [(316ft)/(2ft/stone)] x 1 row = 158 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 18 Day(s) = \$26550. 4 days removal 13 days installation 1 day repoint.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.500_R_1.jpg

Barrier ID:	ZION-0010-4.703-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	62.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	239		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.2	Post Spacing (In.):	0.0
Height (In.):	13.6	Lateral Offset (In.):	30.0	Road Grade (%):	3.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable except for about 10 linear ft that is deflecting between 6 and 12 in away from the road. Height was 7-14in. below the 24in. design height.			
	Breaking and Cracking:	There was about 58 sq.ft. of barrier that has gaps and large cracks in the grouting.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor weathering observed to the barrier. There was some sediment and gravel build-up next to the wall that needs to be monitored.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.703-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	62.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$142918
Brief Workorder:	Raise guardwall 10-in. Remove and reset 239-ft. of stone masonry guardwall on 2 rows of new stone to raise barrier to the 24in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 204 CF = \$51000. [(1.7ft)(0.5ft)(239ft)] = 203.2 CF. Remove top layer of stones in barrier for 239ft. New Stones at \$250- per -Each for 239 Unit(s) = \$59750. [(239ft)/(2ft/stone)] x 2 rows = 239 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 13 Day(s) = \$19175. 3 days removal 10 days installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.703_L_1.jpg

Barrier ID:	ZION-0010-4.808-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	65.90		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	210		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	15.3	Post Spacing (In.):	0.0
Height (In.):	10.3	Lateral Offset (In.):	26.2	Road Grade (%):	3.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 11-16in. below the 24-in. design height.			
	Breaking and Cracking:	There was no cracking or breaking.			
	Missing Elements:	There were no missing wall elements.			
	Corrosion and Weathering:	Minor rock/sediment built up in front of the barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.808-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	65.90

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$186093
Brief Workorder:	Raise guardwall 14-in. Remove and reset 210-ft. of stone masonry guardwall on concrete footer to design height of 24 inches. Remove rock and sediment buildup in front of barrier.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 546 CF = \$136500. [(1.3ft)(2ft)(210ft)] = 546 CF. Structural Concrete at \$1000- per -Cu. Yd. for 13 CY = \$13000. [(1.3ft)(1.2ft)(210ft)] /27 = 12.1 SY. Loader at \$125- per -Hour for 4 Hrs = \$500. Remove rock/sediment buildup in front of barrier. Low Speed Traffic Control at \$1475- per -Day for 13 Day(s) = \$19175. 3 days removal 9 days installation 1 day loader.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.808_L_1.jpg

Barrier ID:	ZION-0010-4.916-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	61.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	319		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	19.2	Lateral Offset (In.):	30.7	Road Grade (%):	4.40
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable except for 34 ft at the beginning end that was deflecting between 6 and 12 in. 255ft. was 3-6in. below the 24in. design height and 64ft. was 6-9in. below the design height.			
	Breaking and Cracking:	There was approximately 38 sq.ft. of guardwall with gaps and large cracks in the grouting.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor weathering observed to the barrier. There was gravel and sediment build-up next to the guardwall that needs to be monitored.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-4.916-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	61.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$65065
Brief Workorder:	Raise guardwall 2-in. Remove and reset 64-ft. of stone masonry guardwall on concrete footer to adjacent 18in. height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 205 CF = \$51250. $[(1.6ft)(2ft)(64ft)] = 204.8$ CF. Structural Concrete at \$1000- per -Cu. Yd. for 2 CY = \$2000. $[(1.6ft)(0.5ft)(64ft)] / 27 = 1.9$ 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_4.916_L_1.jpg

Barrier ID:	ZION-0010-5.114-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	85		
Speed Limit (MPH):	25	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	20.0	Post Spacing (In.):	0.0
Height (In.):	41.7	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 16-20in. above the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-5.114-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_5.114_L_1.JPG

Barrier ID:	ZION-0010-5.254-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	31		
Speed Limit (MPH):	25	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.6	Post Spacing (In.):	0.0
Height (In.):	41.2	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 17-18in. above the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking of barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No major weathering of barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-5.254-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_5.254_L_1.JPG

Barrier ID:	ZION-0010-5.746-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	35		
Speed Limit (MPH):	25	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	41.7	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 17-18in. above the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-5.746-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park
ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_5.746_L_1.jpg



ZION_0010_5.746_L_2.jpg

Barrier ID:	ZION-0010-5.878-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	17		
Speed Limit (MPH):	25	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	41.7	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 17-18in. above the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed on the barrier.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor weathering observed to the barrier with some moss growing in spots.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-5.878-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_5.878_L_1.jpg

Barrier ID:	ZION-0010-6.779-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	41.50		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	86		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	19.2	Lateral Offset (In.):	26.2	Road Grade (%):	0.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height between 3 and 6in. below the 24-in. design height.			
	Breaking and Cracking:	Minor chip in one rock; no other breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-6.779-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	41.50

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_6.779_R_1.JPG

Barrier ID:	ZION-0010-9.632-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	52.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	21		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	15.6	Post Spacing (In.):	0.0
Height (In.):	12.6	Lateral Offset (In.):	90.0	Road Grade (%):	2.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-11 in. below the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking of barrier.			
	Missing Elements:	No missing elements on barrier.			
	Corrosion and Weathering:	No weathering of barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-9.632-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	52.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$19470
Brief Workorder:	Raise guardwall 12-in. Remove and reset 21-ft. of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 55 CF = \$13750. [(1.3ft)(2ft)(21ft)] = 54.6 CF. Structural Concrete at \$1000- per -Cu. Yd. for 1 CY = \$1000. [(1.3ft)(1ft)(21ft)] /27 = 1 CY. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950. 1 day removal 1 day installation.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_9.632_R_1.JPG

Barrier ID:	ZION-0010-9.640-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	59.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	181		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	17.0	Post Spacing (In.):	0.0
Height (In.):	13.3	Lateral Offset (In.):	43.2	Road Grade (%):	1.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-11 in. below the 24-in. design height.			
	Breaking and Cracking:	6 broken cap rocks on top of barrier.			
	Missing Elements:	No missing elements on barrier.			
	Corrosion and Weathering:	10 % of the barrier cap rocks were weathered and falling apart.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-9.640-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	59.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$100925
Brief Workorder:	Raise guardwall 11-in. Remove and reset 18-ft. stone masonry guardwall on 2 rows of new stone to raise barrier to the 24-in. design height.				
Workorder:	<p>Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 127 CF = \$31750. $[(1.4ft)(0.5ft)(181ft)] = 126.7 CF$.</p> <p>Remove top layer of stones in barrier for 181ft.</p> <p>New Stones at \$250- per -Each for 181 Unit(s) = \$45250. $[(181ft) / (2ft/stone)] \times 2 \text{ rows} = 181 \text{ stones}$. Insert new stone on retaining wall to increase barrier height then reset top layer of barrier.</p> <p>Low Speed Traffic Control at \$1475- per -Day for 10 Day(s) = \$14750. 2 days removal 8 days installation.</p>				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_9.640_R_1.JPG

Barrier ID:	ZION-0010-9.819-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	53.90		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	122		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	17.0	Post Spacing (In.):	0.0
Height (In.):	5.3	Lateral Offset (In.):	32.0	Road Grade (%):	4.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 18-20in. below the 24-in. design height.			
	Breaking and Cracking:	No breaking or cracking of barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering of barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-9.819-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	53.90

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$85333
Brief Workorder:	Raise guardwall 18-in. Remove and reset 122-ft. stone masonry guardwall on 3 rows of new stone to raise barrier to the 24-in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 86 CF = \$21500. [(1.4ft)(.5ft)(122ft)] = 85.4 CF. New Stones at \$250- per -Each for 183 Unit(s) = \$45750. [(122ft) / (2ft/stone)] x 3 rows = 183 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_9.819_R_1.JPG

Barrier ID:	ZION-0010-10.070-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	19.30		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	162		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	27.2	Lateral Offset (In.):	25.0	Road Grade (%):	1.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	10 square ft of cracked mortar at loose slabs in barrier.			
	Missing Elements:	10 square feet of barrier had 2 slabs at top of barrier that were off the barrier from probable impact.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-10.070-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	19.30

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$2173
Brief Workorder:	Reset 2 slab rocks onto top of barrier and repoint 10 square feet area around replaced rocks.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. Repoint area around 2 rocks. 10sf./9 = 1 SY. Labor at \$60- per -Hour for 6 Hrs = \$360. Reset 2 slab rocks on top 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.

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_10.070_R_1.JPG

Barrier ID:	ZION-0010-10.086-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	16.50		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	64		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	26.7	Lateral Offset (In.):	83.6	Road Grade (%):	0.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	No breaking or cracking in barrier.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-10.086-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	16.50

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_10.086_L_1.JPG

Barrier ID:	ZION-0010-10.124-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	26.70		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	81		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	18.2	Post Spacing (In.):	0.0
Height (In.):	24.2	Lateral Offset (In.):	43.2	Road Grade (%):	1.20
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was 14sq.ft. of barrier that had stones that had been knocked off. The stones were still near the barrier and intact.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-10.124-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	26.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$1931
Brief Workorder:	Reset 2 stones and repoint 2sy. of barrier.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 2 SY = \$280. Repoint the area with missing stones to reattach them. 14sf./9 = 1.6 SY. Low Speed Traffic Control at \$1475- per -Day for 1 Day(s) = \$1475.				

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_10.124_L_1.JPG

Barrier ID:	ZION-0010-10.124-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	28.00		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	27		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	27.0	Lateral Offset (In.):	31.7	Road Grade (%):	0.70
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-10.124-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:		28.00	
Repair Recommendations					
Repair Action:	NO ACTION	FMSS Work Type:	N/A	Repair Cost:	\$0
Brief Workorder:	N/A				
Workorder:					

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_10.124_R_1.JPG

Barrier ID:	ZION-0010-11.135-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	39		
Speed Limit (MPH):	35	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	18.2	Post Spacing (In.):	0.0
Height (In.):	30.7	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 2in. below to 17in. above the 27in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-11.135-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_11.135_L_1.JPG

Barrier ID:	ZION-0010-11.136-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	14.00		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	32		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	LOW				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	26.2	Lateral Offset (In.):	81.0	Road Grade (%):	1.10
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-11.136-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	14.00

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_11.136_L_1.JPG

Barrier ID:	ZION-0010-11.136-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	16.80		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	31		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	LOW				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	26.6	Lateral Offset (In.):	37.2	Road Grade (%):	1.20
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	No missing elements in barrier.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-11.136-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	16.80

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_11.136_R_1.JPG

Barrier ID:	ZION-0010-11.167-L				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	16.50		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	60		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	26.2	Lateral Offset (In.):	54.0	Road Grade (%):	1.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-11.167-L		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	16.50

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_11.167_L_1.JPG

Barrier ID:	ZION-0010-11.167-R				
Route Name:	ZION-MT CARMEL HIGHWAY				
Inspection Date:	04/28/2010	Barrier Rating:	26.60		
Barrier Description					
Type:	STONE MASONRY WITH CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	CONCRETE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	26		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-3	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	18.2	Post Spacing (In.):	0.0
Height (In.):	24.0	Lateral Offset (In.):	21.2	Road Grade (%):	1.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0010-11.167-R		
Route Name:	ZION-MT CARMEL HIGHWAY		
Inspection Date:	04/28/2010	Barrier Rating:	26.60

Repair Recommendations

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

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

Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

Barrier Condition Photos



ZION_0010_11.167_R_1.JPG

Barrier ID:	ZION-0011-0.817-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	35.40		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	761		
Speed Limit (MPH):	35	Placement with Respect to Road:	BOTH INSIDE AND OUTSIDE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	21.0	Post Spacing (In.):	0.0
Height (In.):	30.0	Lateral Offset (In.):	52.7	Road Grade (%):	1.90
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of 27-in design height.			
	Breaking and Cracking:	There was no breaking or cracking on the wall or joints. All cracks were hairline and were less than 1/4 in wide.			
	Missing Elements:	There were no missing wall elements.			
	Corrosion and Weathering:	There was no corrosion or weathering of the wall.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-0.817-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	35.40

Repair Recommendations

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

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

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_0.817_L_1.jpg

Barrier ID:	ZION-0011-1.104-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	55.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	105		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	24.0	Post Spacing (In.):	0.0
Height (In.):	7.3	Lateral Offset (In.):	35.7	Road Grade (%):	2.90
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 16-18in. below the 24-in. design height.			
	Breaking and Cracking:	Three (3) joints were cracked. 10sq.ft. of cracks are greater than 1/2 in wide.			
	Missing Elements:	There were no missing wall elements			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-1.104-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	55.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$82060
Brief Workorder:	Raise guardwall 17-in. Remove and reset 105-ft. stone masonry guardwall on 3 rows of new stone to raise barrier to the 24-in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 105 CF = \$26250. [(2ft)(.5ft)(105ft)] = 105 CF. Remove top layer of stones in barrier for 105ft. New Stones at \$250- per -Each for 158 Unit(s) = \$39500. [(105ft) / (2ft/stone)] x 3 rows = 158 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 6 Day(s) = \$8850. 1 day removal 5 days installation.				

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

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_1.104_L_1.jpg

Barrier ID:	ZION-0011-1.436-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	91		
Speed Limit (MPH):	35	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	16.2	Post Spacing (In.):	0.0
Height (In.):	9.0	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 12-18in. below the 24-in. design height.			
	Breaking and Cracking:	6 square ft area total of 1/4 to 1/2 in wide cracks in grout in barrier.			
	Missing Elements:	There were no missing wall elements			
	Corrosion and Weathering:	Minor weathering of stones in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-1.436-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$85938
Brief Workorder:	Raise guardwall 15-in. Remove and reset 91-ft. of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 255 CF = \$63750. [(1.4ft)(2ft)(91ft)] = 254.8 CF. Structural Concrete at \$1000- per -Cu. Yd. for 7 CY = \$7000. [(1.4ft)(1.3ft)(91ft)] /27 = 6.1 CY. 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.

Zion National Park
ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_1.436_L_1.JPG

Barrier ID:	ZION-0011-1.453-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	58.70		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	297		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	EXTREME				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	24.0	Post Spacing (In.):	0.0
Height (In.):	7.3	Lateral Offset (In.):	86.6	Road Grade (%):	5.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 13-24in. below the 24-in. design height.			
	Breaking and Cracking:	1 rock slab 2 ft by 3 ft by 1/2 ft was broken off more than 50%.			
	Missing Elements:	There were 4 missing rock slabs 2 ft by 2 ft by 1/2 ft each and 23 square feet area total of missing or separated grout in cracks wider than 1/2 in.			
	Corrosion and Weathering:	Minor weathering in stones.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-1.453-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	58.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$386513
Brief Workorder:	Raise guardwall 17-in. Remove and reset 297-ft. of stone masonry guardwall on concrete footer to design height of 24 inches.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 1188 CF = \$297000. [(2ft)(2ft)(297ft)] = 1188 CF. Structural Concrete at \$1000- per -Cu. Yd. for 31 CY = \$31000. [(2ft)(1.4ft)(297ft)] /27 = 30.8 CY. New Stones at \$250- per -Each for 5 Unit(s) = \$1250. 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.

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_1.453_L_1.JPG

Barrier ID:	ZION-0011-1.634-R				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	0.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	NON-TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	72		
Speed Limit (MPH):	35	Placement with Respect to Road:	NON-TRAFFIC BARRIER		
Hazard Behind Barrier:	N/A				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	N/A	Is Barrier Crashworthy?:	N/A
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.0	Post Spacing (In.):	0.0
Height (In.):	24.2	Lateral Offset (In.):	0.0	Road Grade (%):	0.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height within 3in. of the 24-in design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-1.634-R		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	0.00

Repair Recommendations

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

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

Zion National Park
ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_1.634_R_1.jpg

Barrier ID:	ZION-0011-4.459-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	19.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	19		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	37.0	Lateral Offset (In.):	59.7	Road Grade (%):	1.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-15in. above the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking on the barrier.			
	Missing Elements:	There were no missing wall elements.			
	Corrosion and Weathering:	There was no corrosion or weathering on the barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-4.459-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	19.20

Repair Recommendations

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

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

Zion National Park
ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_4.459_L_1.jpg

Barrier ID:	ZION-0011-4.459-R				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	22.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	31		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	19.2	Post Spacing (In.):	0.0
Height (In.):	34.7	Lateral Offset (In.):	47.7	Road Grade (%):	0.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 10-11 in. above the 24-in. design height.			
	Breaking and Cracking:	There was 6 sq.ft. at the approach end that has cracks in grout more than 1/2 in wide.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was minor weathering observed on the wall with some moss growing in parts.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-4.459-R		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	22.20

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$1777
Brief Workorder:	Repoint 6 sq ft of barrier that has large cracks in grouting.				
Workorder:	Re-Point Masonry Barrier at \$140- per -Sq. Yd. for 1 SY = \$140. 6sf./9 = 0.7SY. 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.

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_4.459_R_1.jpg

Barrier ID:	ZION-0011-4.468-L				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	19.20		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	45		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.7	Post Spacing (In.):	0.0
Height (In.):	36.7	Lateral Offset (In.):	49.7	Road Grade (%):	1.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 12-14in. above the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed on the barrier.			
	Missing Elements:	There were no missing elements observed on the barrier.			
	Corrosion and Weathering:	There was only minor weathering observed on the barrier with moss growing in spots.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-4.468-L		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	19.20

Repair Recommendations

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

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

Zion National Park

ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_4.468_L_1.jpg

Barrier ID:	ZION-0011-4.472-R				
Route Name:	ZION SCENIC CANYON DRIVE				
Inspection Date:	04/29/2010	Barrier Rating:	24.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	32		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	18.0	Post Spacing (In.):	0.0
Height (In.):	37.2	Lateral Offset (In.):	43.0	Road Grade (%):	0.30
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 13-15in. above the 24-in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0011-4.472-R		
Route Name:	ZION SCENIC CANYON DRIVE		
Inspection Date:	04/29/2010	Barrier Rating:	24.00

Repair Recommendations

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

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

Zion National Park
ROUTE 0011: ZION SCENIC CANYON DRIVE

Barrier Condition Photos



ZION_0011_4.472_R_1.jpg

Barrier ID:	ZION-0013-0.725-L				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	58.00		
Barrier Description					
Type:	W-BEAM WEAK POST	Barrier Function:	TRAFFIC		
Barrier Material:	OTHER: PAINTED STEEL	Post Material:	WOOD		
Blockout Type:	N/A	Length (ft.):	269		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	0.0	Post Spacing (In.):	150.3
Height (In.):	20.2	Lateral Offset (In.):	35.0	Road Grade (%):	7.60
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 5-8in. below the 27in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-0.725-L		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	58.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$6204
Brief Workorder:	Raise 269ft. of barrier up to 27-in design height.				
Workorder:	Adjust Guardrail at \$10- per -Lin. Ft. for 269 LF = \$2690. Raise 269ft. of barrier up to 27-in design height. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950.				

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

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_0.725_L_1.JPG

Barrier ID:	ZION-0013-1.434-L				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	50.70		
Barrier Description					
Type:	W-BEAM WEAK POST	Barrier Function:	TRAFFIC		
Barrier Material:	OTHER: PAINTED STEEL	Post Material:	WOOD		
Blockout Type:	N/A	Length (ft.):	142		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	0.0	Post Spacing (In.):	149.6
Height (In.):	19.6	Lateral Offset (In.):	30.0	Road Grade (%):	1.00
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 3-13in. below the 27in. design height.			
	Breaking and Cracking:	No major cracking of barrier posts.			
	Missing Elements:	No missing barrier elements.			
	Corrosion and Weathering:	Paint was chipped and peeling on barrier and posts.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-1.434-L		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	50.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$9922
Brief Workorder:	Raise 142-ft of barrier up to 27-in design height reposition trailing end spoon and paint barrier.				
Workorder:	Adjust Guardrail at \$10- per -Lin. Ft. for 142 LF = \$1420. Raise 142-ft. of barrier up to 27-in. design height. Labor at \$60- per -Hour for 4 Hrs = \$240. Remove and reset beginning end spoon to inside of rail W/traffic direction. Labor at \$60- per -Hour for 16 Hrs = \$960. 16 hours labor to paint the barrier. Lump Sum = \$500.00 for paint for the barrier. Low Speed Traffic Control at \$1475- per -Day for 4 Day(s) = \$5900.				

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

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_1.434_L_1.JPG

Barrier ID:	ZION-0013-2.934-R				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	47.00		
Barrier Description					
Type:	W-BEAM WEAK POST	Barrier Function:	TRAFFIC		
Barrier Material:	OTHER: PAINTED STEEL	Post Material:	WOOD		
Blockout Type:	N/A	Length (ft.):	140		
Speed Limit (MPH):	35	Placement with Respect to Road:	OUTSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	0.0	Post Spacing (In.):	150.0
Height (In.):	21.7	Lateral Offset (In.):	13.0	Road Grade (%):	6.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 4-6in. below the 27in. design height.			
	Breaking and Cracking:	There was no breaking or cracking observed.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-2.934-R		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	47.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$7095
Brief Workorder:	Raise 140-ft. of barrier up to 27-in design height.				
Workorder:	Remove & Reset Guardrail at \$25- per -Lin. Ft. for 140 LF = \$3500. Raise 140-ft of barrier up to 27-in design height. Low Speed Traffic Control at \$1475- per -Day for 2 Day(s) = \$2950.				

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

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_2.934_R_1.JPG

Barrier ID:	ZION-0013-2.936-L				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	48.00		
Barrier Description					
Type:	W-BEAM WEAK POST	Barrier Function:	TRAFFIC		
Barrier Material:	OTHER: PAINTED STEEL	Post Material:	WOOD		
Blockout Type:	N/A	Length (ft.):	105		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	0.0	Post Spacing (In.):	150.0
Height (In.):	20.2	Lateral Offset (In.):	19.0	Road Grade (%):	6.80
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 7-8in. below the 27in. design height.			
	Breaking and Cracking:	No major cracking of barrier posts. Bent spoon on trailing end of W-beam.			
	Missing Elements:	Missing washer on approach end post.			
	Corrosion and Weathering:	Paint was chipped and peeling on W-beam.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-2.936-L		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	48.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$7893
Brief Workorder:	Raise 105-ft. of barrier up to 27-in design height straighten bent spoon end and paint barrier.				
Workorder:	Adjust Guardrail at \$10- per -Lin. Ft. for 105 LF = \$1050. Raise 105-ft. of barrier up to 27-in design height. Labor at \$60- per -Hour for 4 Hrs = \$240. Replace hardware and straighten bent spoon end. Labor at \$60- per -Hour for 16 Hrs = \$960. Paint the barrier. Lump Sum = \$500. Paint for the barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425.				

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

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_2.936_L_1.JPG

Barrier ID:	ZION-0013-3.279-R				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	42.70		
Barrier Description					
Type:	W-BEAM WEAK POST	Barrier Function:	TRAFFIC		
Barrier Material:	OTHER: PAINTED STEEL	Post Material:	WOOD		
Blockout Type:	N/A	Length (ft.):	397		
Speed Limit (MPH):	35	Placement with Respect to Road:	INSIDE OF CURVE		
Hazard Behind Barrier:	HIGH				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	TL-2	Is Barrier Crashworthy?:	YES
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	27	Width (In.):	0.0	Post Spacing (In.):	149.6
Height (In.):	20.2	Lateral Offset (In.):	71.3	Road Grade (%):	2.50
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Entire barrier is between 5-9in. below the 27in. design height.			
	Breaking and Cracking:	There were 3 badly cracked posts along with 25 linear ft of badly bent rail.			
	Missing Elements:	There were no missing elements observed.			
	Corrosion and Weathering:	There was no corrosion or weathering observed.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-3.279-R		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	42.70

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$10516
Brief Workorder:	Raise 397-ft of barrier up to 27-in design height replace 3 posts and 25 feet of rail.				
Workorder:	Adjust Guardrail at \$10- per -Lin. Ft. for 397 LF = \$3970. Raise 397-ft of barrier up to 27-in design height. Replace Rail at \$25- per -Lin. Ft. for 25 LF = \$625. Replace the badly bent rail sections. Replace Post at \$100- per -Each for 3 Post(s) = \$300. Replace the badly cracked posts. Labor at \$60- per -Hour for 4 Hrs = \$240. Remove the material build-up at the base of the barrier. Low Speed Traffic Control at \$1475- per -Day for 3 Day(s) = \$4425.				

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

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_3.279_R_1.JPG

Barrier ID:	ZION-0013-4.265-L				
Route Name:	KOLOB CANYON ROAD				
Inspection Date:	04/27/2010	Barrier Rating:	43.00		
Barrier Description					
Type:	STONE MASONRY WITHOUT CONCRETE CORE WALL	Barrier Function:	TRAFFIC		
Barrier Material:	STONE	Post Material:	N/A		
Blockout Type:	N/A	Length (ft.):	38		
Speed Limit (MPH):	35	Placement with Respect to Road:	TANGENT		
Hazard Behind Barrier:	MEDIUM				
Barrier Crashworthiness					
Appropriate Test Level:	TL-2	Barrier Test Level:	NCW	Is Barrier Crashworthy?:	NO
Beg. End Trtmt Type:	NONE	Is Beg. End Trtmt Crashworthy?:	N/A	Approach Transition Type:	NONE
Ending End Trtmt Type:	NONE	Ending End Trtmt Crashworthy?:	N/A		
Average Measurements					
Design Height (In.):	24	Width (In.):	16.0	Post Spacing (In.):	0.0
Height (In.):	14.3	Lateral Offset (In.):	59.0	Road Grade (%):	7.60
Physical Condition					
Barrier	Alignment and Height:	Alignment acceptable. Height was 7-12in. below the 24-in. design height.			
	Breaking and Cracking:	No major cracking of wall.			
	Missing Elements:	No missing wall elements.			
	Corrosion and Weathering:	No weathering observed in barrier.			
End Treatments	Alignment and Height:	N/A			
	Breaking and Cracking:	N/A			
	Missing Elements:	N/A			
	Corrosion and Weathering:	N/A			

Barrier ID:	ZION-0013-4.265-L		
Route Name:	KOLOB CANYON ROAD		
Inspection Date:	04/27/2010	Barrier Rating:	43.00

Repair Recommendations

Repair Action:	REPAIR	FMSS Work Type:	DEFERRED MAINTENANCE	Repair Cost:	\$22193
Brief Workorder:	Raise guardwall 10-in. Remove and reset 38-ft. stone masonry guardwall on 2 rows of new stone to raise barrier to the 24-in. design height.				
Workorder:	Remove & Reset Stone Masonry Guardwall at \$250- per -Cu. Ft. for 25 CF = \$6250. [(1.3ft)(.5ft)(38ft)] = 24.7 CF. Remove top layer of stones in barrier for 38ft. 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.

Zion National Park
ROUTE 0013: KOLOB CANYON ROAD

Barrier Condition Photos



ZION_0013_4.265_L_1.JPG

Appendix A

Summary of GIP Definitions and Assessment



Zion National Park



Federal Lands Highway
Road Inventory Program

Appendix A:

Guardwall/Rail Inventory Program (GIP)

EXPLANATION OF REPORT TERMS

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

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

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

Static Barrier Characteristics

BARRIER TYPE

Refers to both the design and the construction materials used:

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

BARRIER MATERIAL

The type of material of which the barrier is composed:

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

LENGTH

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

BARRIER FUNCTION: Traffic or Non-Traffic Barrier.

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

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

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

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

POST MATERIAL

The type or material that the barrier’s supporting posts are made of:

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

BLOCKOUT TYPE

The type of blockout or of what it is comprised:

- Wood
- Plastic
- Steel
- N/A

BARRIER PLACEMENT WITH RESPECT TO ROADWAY

To identify the roadway alignment the barrier is located upon:

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

POSTED SPEED LIMIT

The posted speed limit of the roadway section.

HAZARD BEHIND BARRIER

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

- Low
- Medium
- High
- Extreme

APPROPRIATE TEST LEVEL (TL) FOR ROAD

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

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

BARRIER TEST LEVEL (TL)

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

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

IS BARRIER CRASHWORTHY

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

- Yes
- No

BEGINNING END TREATMENT TYPE

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

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

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

IS BEGINNING END TREATMENT CRASHWORTHY

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

- Yes
- No
- N/A

APPROACH TRANSITION TYPE

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

This identifies the barrier's transition type:

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

ENDING END TREATMENT TYPE

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

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

IS ENDING END TREATMENT CRASHWORTHY

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

- Yes
- No
- N/A

BARRIER DESIGN HEIGHT

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

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

AVERAGE MEASUREMENTS

Minimum of three measurements taken on each barrier.

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

Last measurement approximately 50-ft from the end of the barrier. Do not take a measurement along the end treatment

If a barrier is less than 300-ft, even say 45-ft, a minimum of three measurements were still taken.

AVERAGE WIDTH

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

AVERAGE POST SPACING

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

AVERAGE BARRIER HEIGHT

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

AVERAGE LATERAL OFFSET

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

AVERAGE ROAD GRADE and UPHILL OR DOWNHILL

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

DYNAMIC BARRIER CHARACTERISTICS – CONDITION ASSESSMENT NARRATIVES

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

BARRIER ALIGNMENT/HEIGHT

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

BARRIER BREAKING/CRACKING

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

BARRIER MISSING ELEMENTS

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

BARRIER CORROSION/WEATHERING

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

END TREATMENTS ALIGNMENT/HEIGHT

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

END TREATMENTS BREAKING/CRACKING

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

END TREATMENTS MISSING ELEMENTS

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

END TREATMENTS CORROSION/WEATHERING

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

BARRIER PHOTOGRAPHS

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

CONDITION AND SEVERITY DISTRESS TABLES

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

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

GOOD

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

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

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

FAIR

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

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

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

POOR

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

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

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

CONDITION AND SEVERITY DISTRESS TABLES – BARRIERS

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

	GOOD	FAIR	POOR
Alignment/Design Height			
	<ul style="list-style-type: none"> Alignment off by less than 6" 	<ul style="list-style-type: none"> Alignment off by 6"-12" 	<ul style="list-style-type: none"> Alignment off by more than 12"
	<ul style="list-style-type: none"> Within 1" of <i>design height</i> 	<ul style="list-style-type: none"> Less than 3" lower than <i>design height</i> 	<ul style="list-style-type: none"> Greater than 3" lower than <i>design height</i>
Breaking/Cracking, an member, post or rail – due to impact loading			
	<ul style="list-style-type: none"> Metal – no twisting/bending, tears or cracking 	<ul style="list-style-type: none"> Metal – no cracking or tearing (but minor twisting/bending is ok) 	<ul style="list-style-type: none"> Metal – any cracks or tears
	<ul style="list-style-type: none"> Wood – no impact related cracking 	<ul style="list-style-type: none"> Wood – maybe cracked but retains original cross section 	<ul style="list-style-type: none"> Wood – cracks or tears that deform original section
	<ul style="list-style-type: none"> Isolated broken blocks 	<ul style="list-style-type: none"> Two Consecutive broken blocks 	<ul style="list-style-type: none"> Consecutive broken blocks (three or more consecutive)
Missing Elements			
	<ul style="list-style-type: none"> No bolts and nuts missing 	<ul style="list-style-type: none"> One or two bolt/nut missing at one rail/rail connection 	<ul style="list-style-type: none"> Three or more bolts/nuts missing at one rail/rail connection
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Two consecutive missing blocks 	<ul style="list-style-type: none"> Three or more consecutive missing blocks
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> One missing rail element or post
Corrosion/Decay/Weathering, all posts, rails and blocks – due to aging			
	<ul style="list-style-type: none"> Loss of 5% or less of cross section 	<ul style="list-style-type: none"> Loss of 5% to 50% of cross section 	<ul style="list-style-type: none"> Loss of 50% or more of cross section
	<ul style="list-style-type: none"> Erosion (less than 8" of post exposed below original groundline) 	<ul style="list-style-type: none"> Erosion around posts (8" or more of post exposed below original groundline) for one 	<ul style="list-style-type: none"> Erosion around consecutive posts (more than 8" of post exposed below original groundline)

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

GOOD				FAIR				POOR							
Alignment/Design Height															
				<ul style="list-style-type: none"> Alignment off by less than 6" 				<ul style="list-style-type: none"> Alignment off by 6"-12" 				<ul style="list-style-type: none"> Alignment off by more than 12" 			
				<ul style="list-style-type: none"> Within 1" of <i>design height</i> 				<ul style="list-style-type: none"> Less than 3" lower than <i>design height</i> 				<ul style="list-style-type: none"> Greater than 3" lower than <i>design height</i> 			
Breaking/Cracking– due to impact loading															
				<ul style="list-style-type: none"> Minor cracks (less than ¼") present 				<ul style="list-style-type: none"> Cracking present ¼" or greater but no displacement or discontinuity in face 				<ul style="list-style-type: none"> Barrier displaced and/or discontinuous 			
				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> Pieces broken from barrier 3" deep or less without exposing rebar 				<ul style="list-style-type: none"> Cracking exposes rebar 			
				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> Pieces broken from face greater than 3" deep 			
Missing Elements															
				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> n/a 			
Corrosion/Decay/Weathering – due to aging															
				<ul style="list-style-type: none"> Surface corrosion on less than 5% of the run 				<ul style="list-style-type: none"> Surface corrosion on between 5-25% of the run 				<ul style="list-style-type: none"> Surface corrosion on more than 25% of the run 			
				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> Spalling 3" deep or less without exposing rebar 				<ul style="list-style-type: none"> Spalling greater than 3" deep 			
				<ul style="list-style-type: none"> Erosion (less than 8" below groundline) around base 				<ul style="list-style-type: none"> Erosion (8" or more below groundline) around base 				<ul style="list-style-type: none"> Erosion (8" or more below groundline) 			
				<ul style="list-style-type: none"> n/a 				<ul style="list-style-type: none"> Less than 50% undermined (less than half barrier width) 				<ul style="list-style-type: none"> 50% or more undermined (less than half barrier width) 			

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

	GOOD	FAIR	POOR
Alignment/Design Height			
	<ul style="list-style-type: none"> Alignment (off by less than 6") 	<ul style="list-style-type: none"> Alignment (off by 6"-12") 	<ul style="list-style-type: none"> Alignment (off by more than 12")
	<ul style="list-style-type: none"> Within 3" of <i>design height</i> 	<ul style="list-style-type: none"> Between 3.1 - 6" lower than <i>design height</i> 	<ul style="list-style-type: none"> Greater than 6.1" lower than <i>design height</i>
Breaking/Cracking – due to impact loading			
	<ul style="list-style-type: none"> Minor cracks (less than ¼") present 	<ul style="list-style-type: none"> Cracks, less than ½" present 	<ul style="list-style-type: none"> Cracks greater than ½" present
		<ul style="list-style-type: none"> Stones broken/displaced extending less than 1/3 of width of barrier 	<ul style="list-style-type: none"> Stones broken/displaced extending 1/3 width or more through the barrier
Missing Elements			
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a
Corrosion/Decay/Weathering – due to aging			
	<ul style="list-style-type: none"> Cracks in mortar joints 1/4" or less and/or single loose or missing stones 	<ul style="list-style-type: none"> Mortar joints deteriorated resulting in two - three loose or missing adjacent stones (without impact) 	<ul style="list-style-type: none"> Mortar joints deteriorated resulting in more than three continuous/adjacent loose or missing stones (without impact)
	<ul style="list-style-type: none"> Erosion (less than 8" below groundline) around base 	<ul style="list-style-type: none"> Erosion (8" or more below groundline) around base 	<ul style="list-style-type: none"> Erosion (8" or more below groundline)
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Less than 50% undermined (less than half barrier width) 	<ul style="list-style-type: none"> 50% or more undermined (less than half barrier width)

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

	GOOD	FAIR	POOR
Alignment/Tension/Design Height			
	<ul style="list-style-type: none"> No bent posts 	<ul style="list-style-type: none"> Bent posts; one to three consecutive posts 	<ul style="list-style-type: none"> Bent posts; four or more consecutive posts
	<ul style="list-style-type: none"> Cable has tension 	<ul style="list-style-type: none"> Cable under-tensioned/sagging 	<ul style="list-style-type: none"> No cable tension
	<ul style="list-style-type: none"> Less than 1" too low 	<ul style="list-style-type: none"> 1-3" too low 	<ul style="list-style-type: none"> Greater than 3" too low
Breaking/Cracking			
	<ul style="list-style-type: none"> No cracked or broken posts 	<ul style="list-style-type: none"> One to three isolated broken posts 	<ul style="list-style-type: none"> Four or more consecutive broken posts
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Cable frayed 	<ul style="list-style-type: none"> Cable broken or severed
Missing Elements			
	<ul style="list-style-type: none"> No bolts and nuts missing at anchors 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Bolts and nuts missing or loose at anchors
	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Any missing posts or cable for any length of run
Corrosion/Decay/Weathering – due to aging			
	<ul style="list-style-type: none"> Loss of 5% or less of cable cross section 	<ul style="list-style-type: none"> Loss of 5% to 15% of cable cross section 	<ul style="list-style-type: none"> Loss of 15% or more of cross section
	<ul style="list-style-type: none"> Erosion (less than 8" of post exposed below original groundline) 	<ul style="list-style-type: none"> Erosion around one post (8" or more of post exposed below original groundline) 	<ul style="list-style-type: none"> Erosion around consecutive posts (more than 8" of post exposed below original groundline)

CONDITION AND SEVERITY DISTRESS TABLES – END TREATMENTS

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

	GOOD	FAIR	POOR
Alignment/Tension			
	<ul style="list-style-type: none"> Alignment off by less than 4" 	<ul style="list-style-type: none"> Alignment off by 4"-8" 	<ul style="list-style-type: none"> Alignment off by more than 8"
	<ul style="list-style-type: none"> Adequate cable tension 	<ul style="list-style-type: none"> Low cable anchor tension 	<ul style="list-style-type: none"> No cable anchor tension
Breaking/Cracking – due to impact loading			
	<ul style="list-style-type: none"> No broken or cracked elements 	<ul style="list-style-type: none"> Minor cable fraying but still with adequate tension 	<ul style="list-style-type: none"> Broken or cracked cables or posts
	<ul style="list-style-type: none"> No damage to posts, cable or anchor 	<ul style="list-style-type: none"> Slight damage to posts without cracking or tearing (<i>but minor twisting/bending on isolated posts is OK</i>) 	<ul style="list-style-type: none"> Cable broken or severed on any cable
Missing Elements			
	<ul style="list-style-type: none"> No bolts and nuts missing at anchors; No missing cables 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Any missing element (post, cable, bolts, nuts, or anchor)
Corrosion/Decay/Weathering – due to aging			
	<ul style="list-style-type: none"> Loss of 5% or less of cable cross section 	<ul style="list-style-type: none"> Loss of 5% to 15% of cable cross section 	<ul style="list-style-type: none"> Loss of 15% or more of cross section
	<ul style="list-style-type: none"> Connections weathered but still provide element interlock on less than 5% of the end treatment 	<ul style="list-style-type: none"> Connections weathered but still provide element interlock on between 5% to 15% of the end treatment 	<ul style="list-style-type: none"> Connections weathered but still provide element interlock on more than 15% of the end treatment

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

				GOOD	FAIR	POOR
Alignment/Tension						
	<ul style="list-style-type: none"> Alignment of flares and offsets off by less than 4” 	<ul style="list-style-type: none"> Alignment of flares and offsets off by 4”-8” 	<ul style="list-style-type: none"> Alignment of flares and offsets off by more than 8” 			
	<ul style="list-style-type: none"> Within 1” of <i>design height</i> 	<ul style="list-style-type: none"> Less than 3” lower than <i>design height</i> 	<ul style="list-style-type: none"> Greater than 3” lower than <i>design height</i> 			
For <i>Aesthetic Barriers</i> (i.e. – SBT and SBL guardrail) that do not have crashworthy terminals:	<ul style="list-style-type: none"> Approach barrier terminals are buried, anchored, and flared away from the travel lane 	<ul style="list-style-type: none"> Approach barrier terminals are buried, anchored, and flared away from the travel lane 	<ul style="list-style-type: none"> Approach barrier ends are NOT buried, anchored, nor flared away from the travel lane 			
Breaking/Cracking – due to impact loading						
	<ul style="list-style-type: none"> Metal – no twisting/bending, tears or cracking 	<ul style="list-style-type: none"> Metal – no cracking or tearing (but minor twisting or bending is ok) 	<ul style="list-style-type: none"> Metal – any cracks or tears 			
	<ul style="list-style-type: none"> Wood – no impact related cracking 	<ul style="list-style-type: none"> Wood – maybe cracked but retains original cross section 	<ul style="list-style-type: none"> Wood – cracks or tears that deform original section 			
	<ul style="list-style-type: none"> No broken blocks 	<ul style="list-style-type: none"> One broken block 	<ul style="list-style-type: none"> Two consecutive broken blocks 			
Missing Elements						
	<ul style="list-style-type: none"> No missing elements, including breakaway cables and struts 	<ul style="list-style-type: none"> Isolated bolts, nuts, or blocks loose on non-consecutive posts 	<ul style="list-style-type: none"> Any missing element, including blocks, rails, posts cables, or struts 			
	<ul style="list-style-type: none"> No bolts, nuts, or blocks missing or loose 	<ul style="list-style-type: none"> Breakaway strut present but vertical height off by more than 2” 	<ul style="list-style-type: none"> Missing nuts / bolts on consecutive posts 			
Corrosion/Decay/Weathering – due to aging						
	<ul style="list-style-type: none"> Surface corrosion / decay / connections weathered with a loss of 5% or less of cross section of interlocking elements 	<ul style="list-style-type: none"> Surface corrosion / decay / connections weathered with between 5-25% loss of cross section along transition interlocking elements 	<ul style="list-style-type: none"> Surface corrosion / decay / connections weathered with more than 25% loss of cross section along transition interlocking elements 			
	<ul style="list-style-type: none"> Erosion (less than 8” of post exposed below original groundline) 	<ul style="list-style-type: none"> Erosion around 1 post (8” or more of post exposed below original groundline) 	<ul style="list-style-type: none"> Erosion around consecutive posts (8” or more of post exposed below original groundline) 			

SPECIFIC RISK ELEMENTS

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

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

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

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

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

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

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

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

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

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

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

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

- Low
- Medium
- High
- Extreme

RISK ASSESSMENT AND RISK SCORE

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

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

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

Variable and Associated Levels of Risk

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

REPLACEMENT/REPAIR STRATEGIES

Information is integrated by combining static data on barrier type, materials, dimensions, etc. with the condition and risk assessments, and the asset management roadway categories (which include cultural and historic resource considerations) to come up with actionable repair strategies for barriers. In addition, repair costs are accounted for so that estimates can be made for repair actions identified. Costed repair estimates, or work orders, then form the basis for estimating deferred maintenance associated with roadside barriers.

Repair recommendations generated by this assessment are intended to provide an estimated cost of deferred maintenance of barriers. As such, the evaluation is not rigorous and may be changed when a more detailed review and assessment at a project level is completed. In addition, any repairs or replacements that are recommended by this inventory and assessment process must be vetted through a project selection, planning and design process, including compliance with the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA).

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

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

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

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

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

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

Asset Management Roadway Categories, Risk Thresholds and Treatment Recommendations.

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

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

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

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

Proposed Countermeasures.

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

Maintaining Barriers As Is

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

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

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

Barrier Repair

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

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

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

1. If all or a portion of stone masonry guardwall has a deficient height based upon the Severity Description Charts, that is, at worst, within the fair category, do not raise it. (Other work besides raising the barrier can be specified.)
2. If a portion of a stone masonry guardwall has a deficiency in height based upon the Severity Description Charts, considered “poor” (assumed typically to be less than 18-in) write a work order to raise the poor segment to the height of the adjacent barrier with a non-poor height.
3. If the entire stone masonry guardwall is in poor condition due to height based upon the Severity Description Charts– write a work order to raise the entire segment to its design height (assumed typically to be 24-in).

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

Barrier Replacement/Reconstruction

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

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

WORK ORDERS

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

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

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

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

There are four types of work:

- No Action
- Monitor
- Repair
- Replace

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

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

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

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

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

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

National Historic Preservation Act (NHPA)

National Environmental Policy Act (NEPA)

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